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Supplement of

Storm Daria: Societal and energy impacts in northwest Europe on 25–26 January 1990

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SUMMARY OF SECTIONS IN THE SUPPLEMENT

SECTION S1. STORM TRAJECTORY FROM PRIMAVERA DATASET

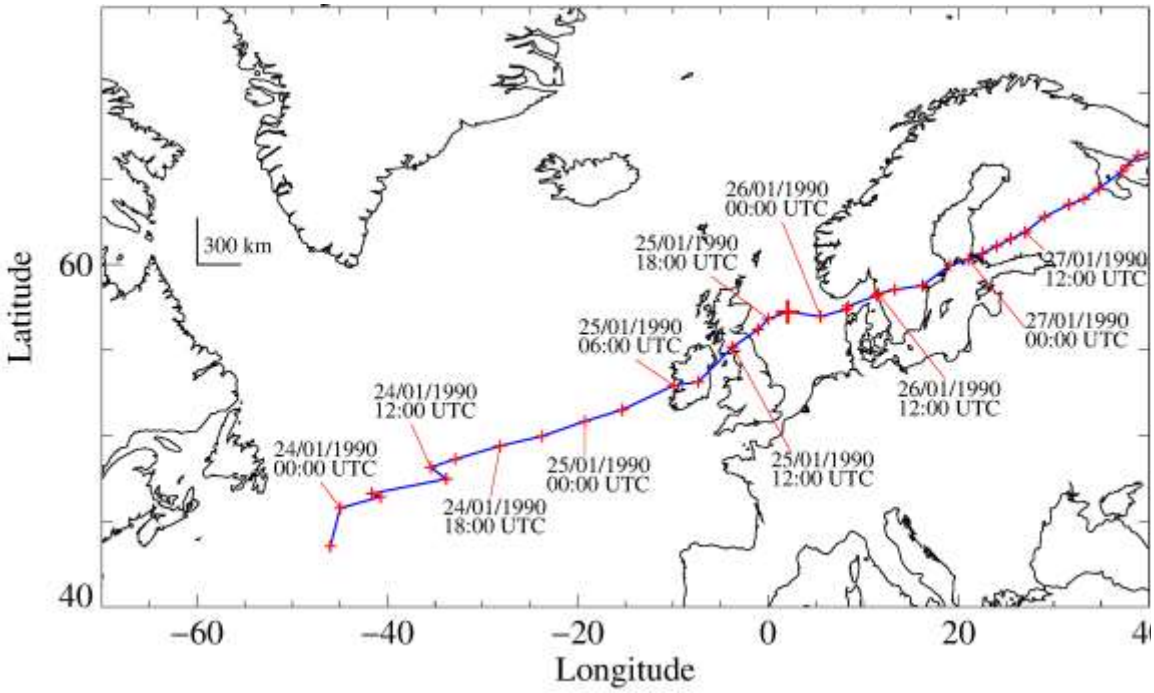


Figure S1.1. Map of the trajectory of the low pressure centre of Storm Daria from the PRIMAVERA dataset of Lockwood et al. (2022). The lowest pressure of Storm Daria is shown with a large cross in the central North Sea.

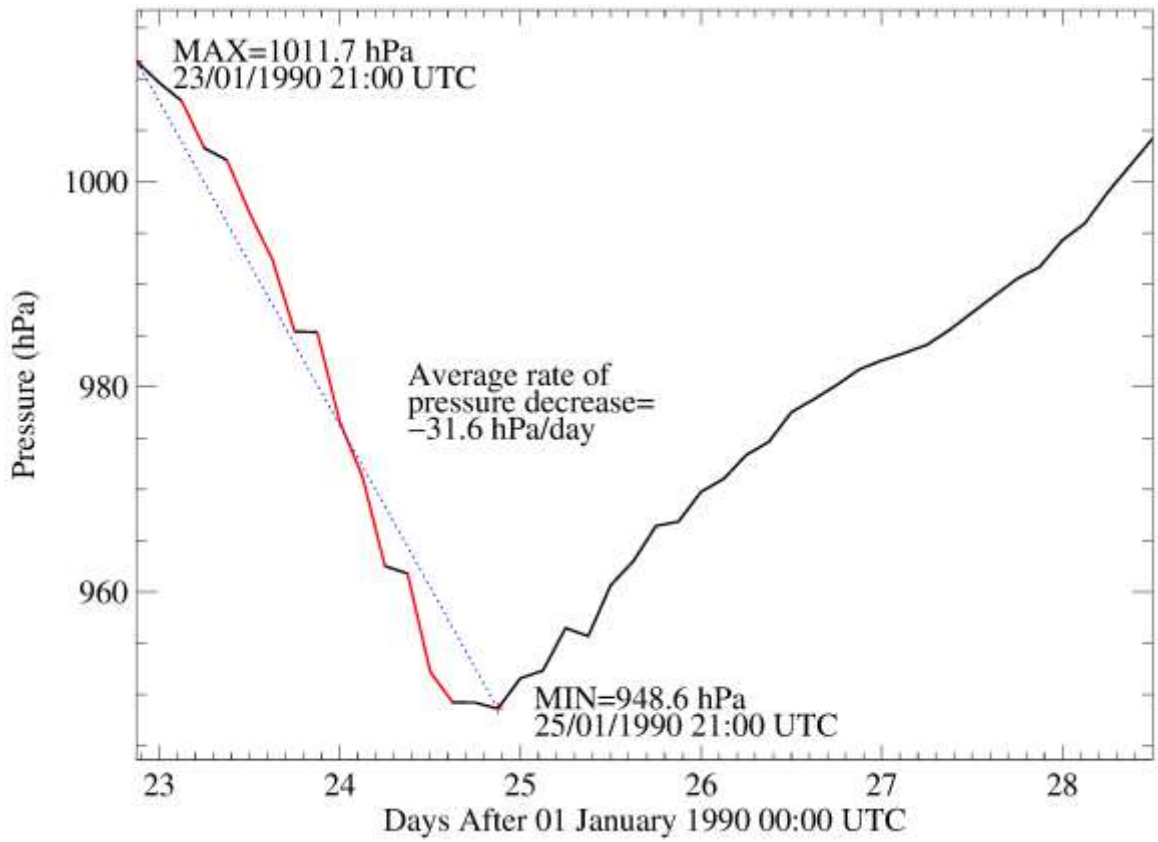


Figure S1.2. Time series of the central pressure of Storm Daria from the PRIMAVERA dataset of Lockwood et al. (2022). Red lines indicate time intervals of rapid pressure decreases, exceeding the threshold for an atmospheric bomb or explosive cyclogenesis (1 hPa/hour).

SECTION S2. WIND MEASUREMENTS ACROSS THE PERIOD OF THE STORM

The following text is reproduced from the Supplement of Kettle (2023b) as background information to understand the maps produced from the USAF data.

The USAF data set is described in the website 'U.S.A.F. DATSAV3 Surface observations, 1901–continuing' at https://rda.ucar.edu/datasets/ds463.2/. Data from the WMO, ICAO, and AFWA networks within the larger dataset forms an element of the Copernicus Climate Data Store product 'Global land surface atmospheric variables from 1755 to 2020 from comprehensive in-situ observations' at https://cds.climate.copernicus.eu/cdsapp#!/dataset/insitu-observations-surface-land?tab=overview'. The wind data from the WMO, ICAO, and AFWA networks have been used to compose the diagrams in this section. According to WMO reporting requirements, the wind speed report is a 10 minute average value and corrected for a 10 m standard height (CIMO guide, Chapter 5. Measurement of surface wind https://library.wmo.int/doc_num.php?explnum_id=3177/CIMO_Guide_2014_en_I_5.pdf).

Problems have been noted with some of the wind speed data passing into the international weather networks, which is most likely associated with a unit conversion error between knots and m/s (Gatey and Miller, 2007). The problem makes it difficult to trust the infrequent occurrence of high wind speed values in the raw data set. For this reason, a basic data buddy check was implemented for rejecting potentially bad data when drawing up the maps of this section. For a given reporting time, a wind speed value was compared with the nearest other reporting station and rejected if it was more than four times greater.

Reference:

Gatey, D.A. and Miller, C.A.: An investigation into 50-year return period wind speed differences for Europe, J Wind Engineering and Industrial Aerodynamics, 95, 1040–1052, 2007.

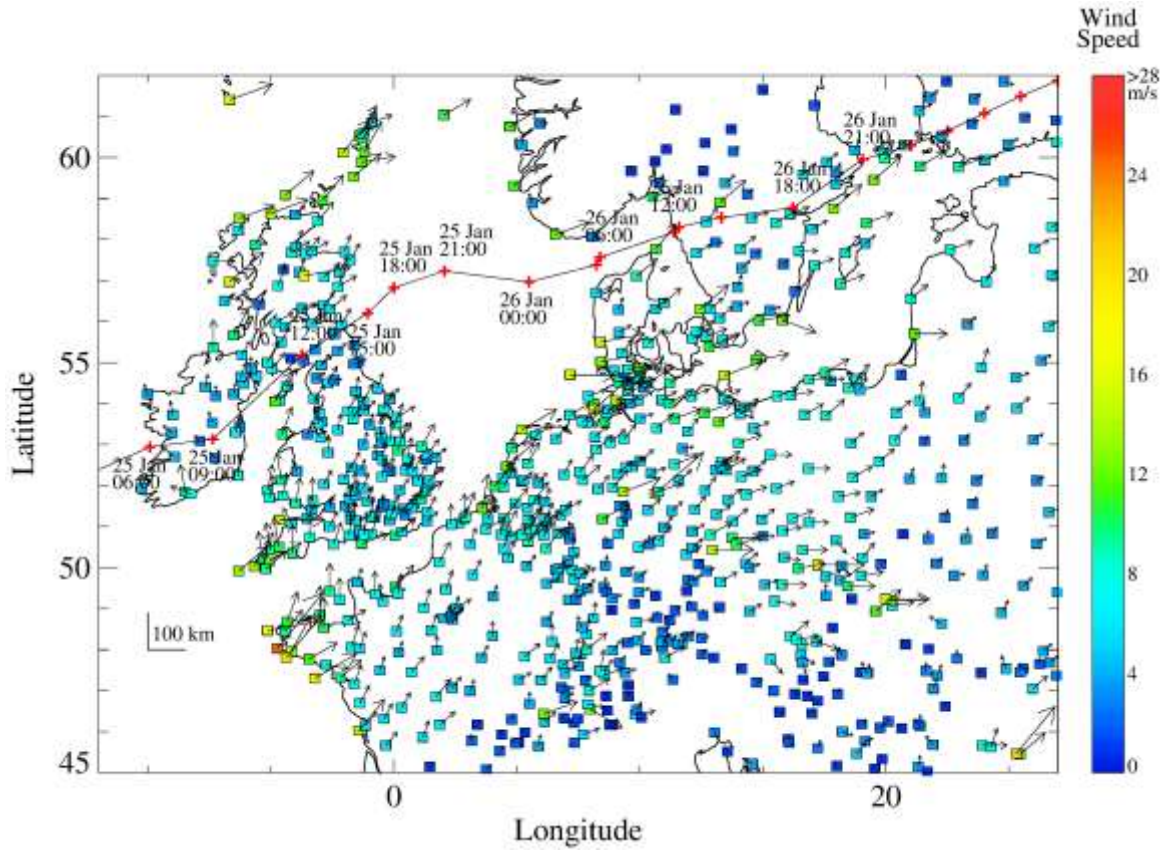


Figure S2.1. Wind speed and direction within 5 minutes of 00:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is off the left hand side of the map.

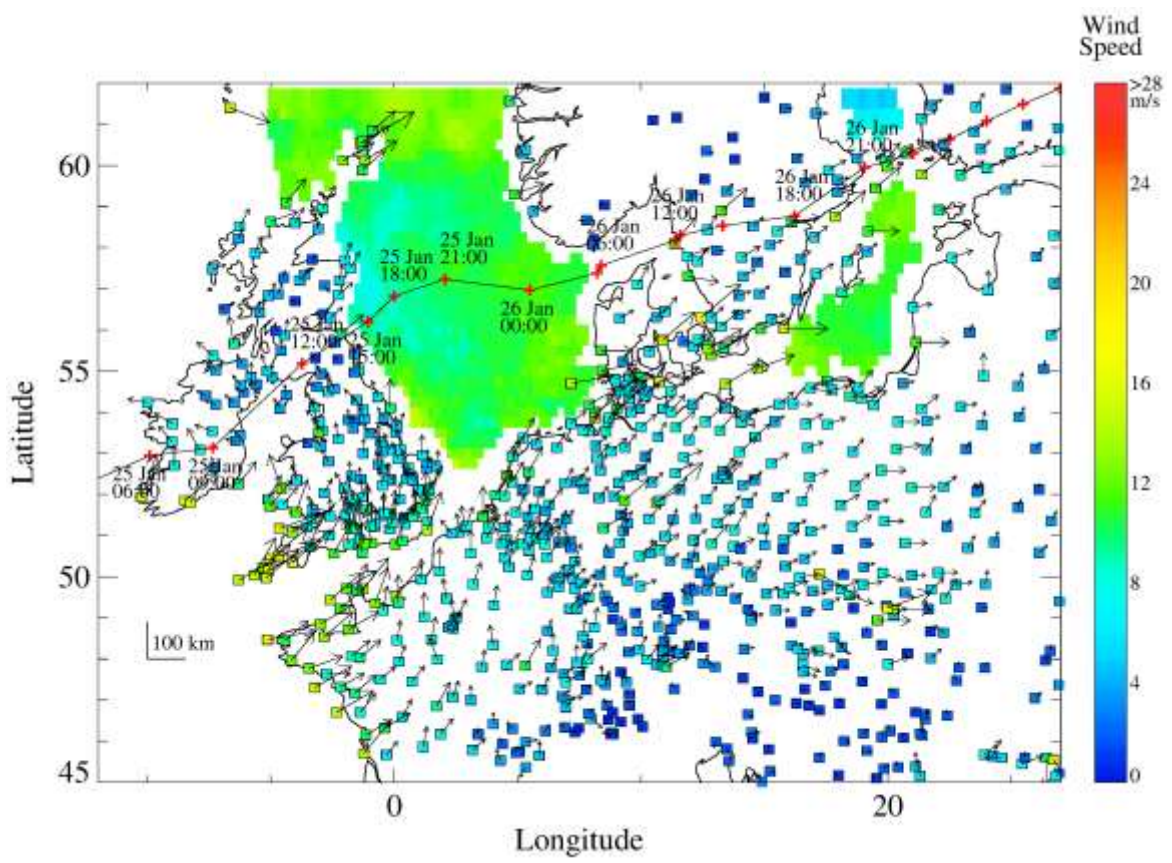


Figure S2.2. Wind speed and direction within 5 minutes of 03:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is off the left hand side of the map. SSM/I sea surface wind speeds are shown for a satellite overpass at ~04:42 UTC or ~102 minutes after the synoptic station reports.

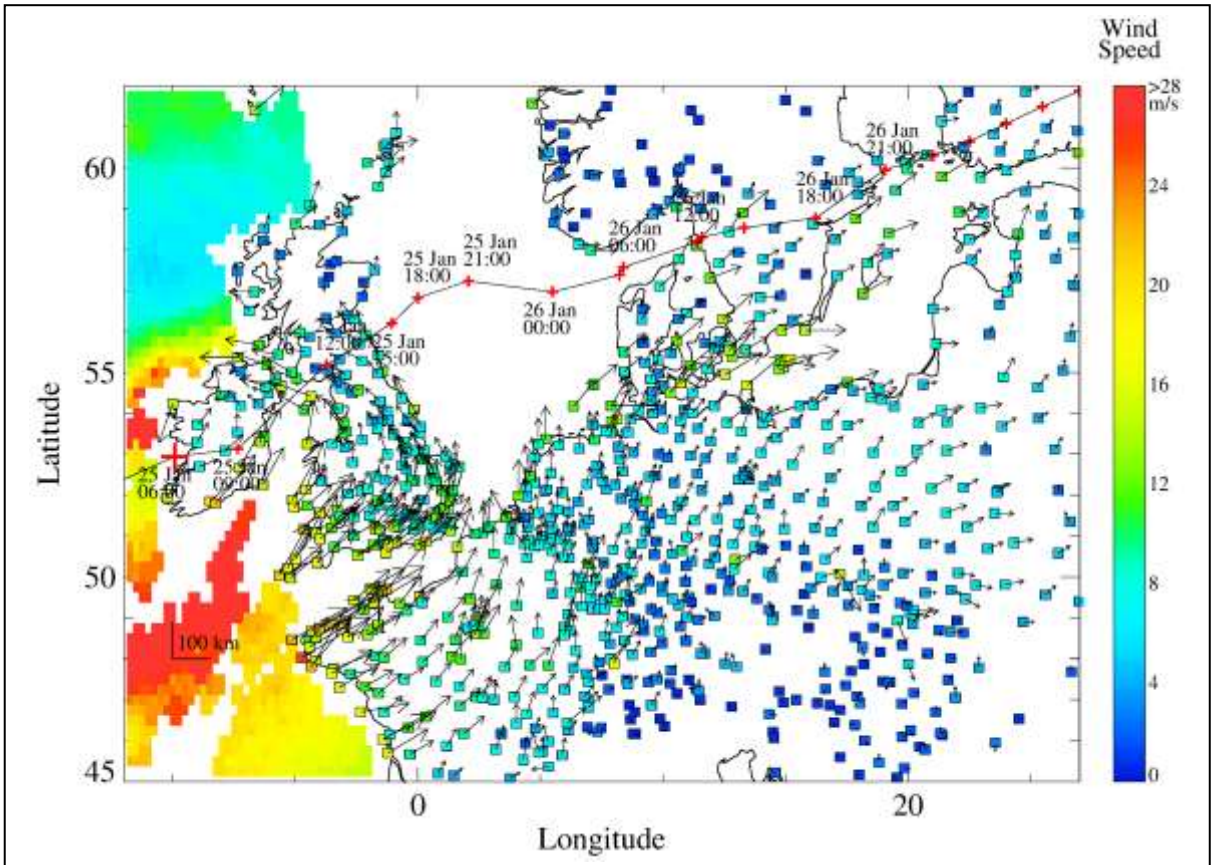


Figure S2.3. Wind speed and direction within 5 minutes of 06:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Lockwood et al., 2022). The location of the pressure centre at the time of wind field is shown by a larger cross. SSM/I sea surface wind speeds are shown for a satellite overpass at ~06:24 UTC or ~24 minutes after the synoptic station reports.

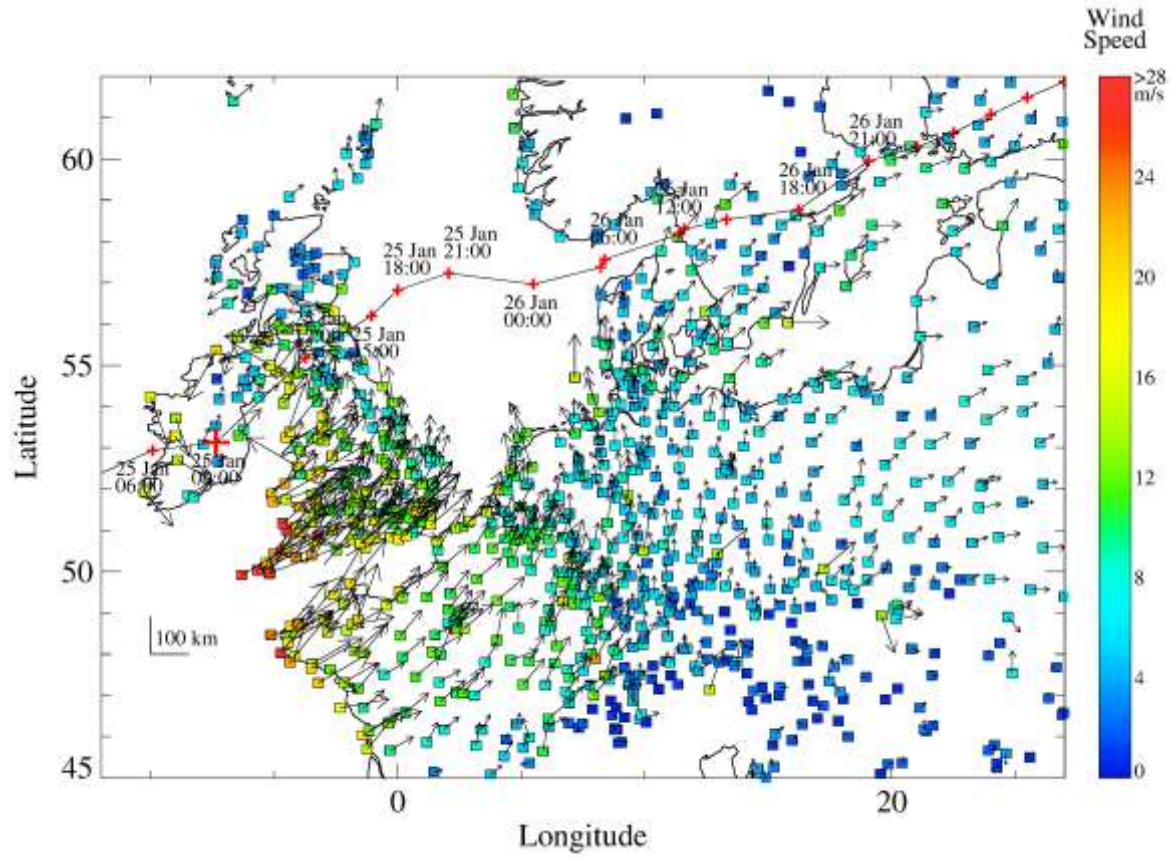


Figure S2.4. Wind speed and direction within 5 minutes of 09:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

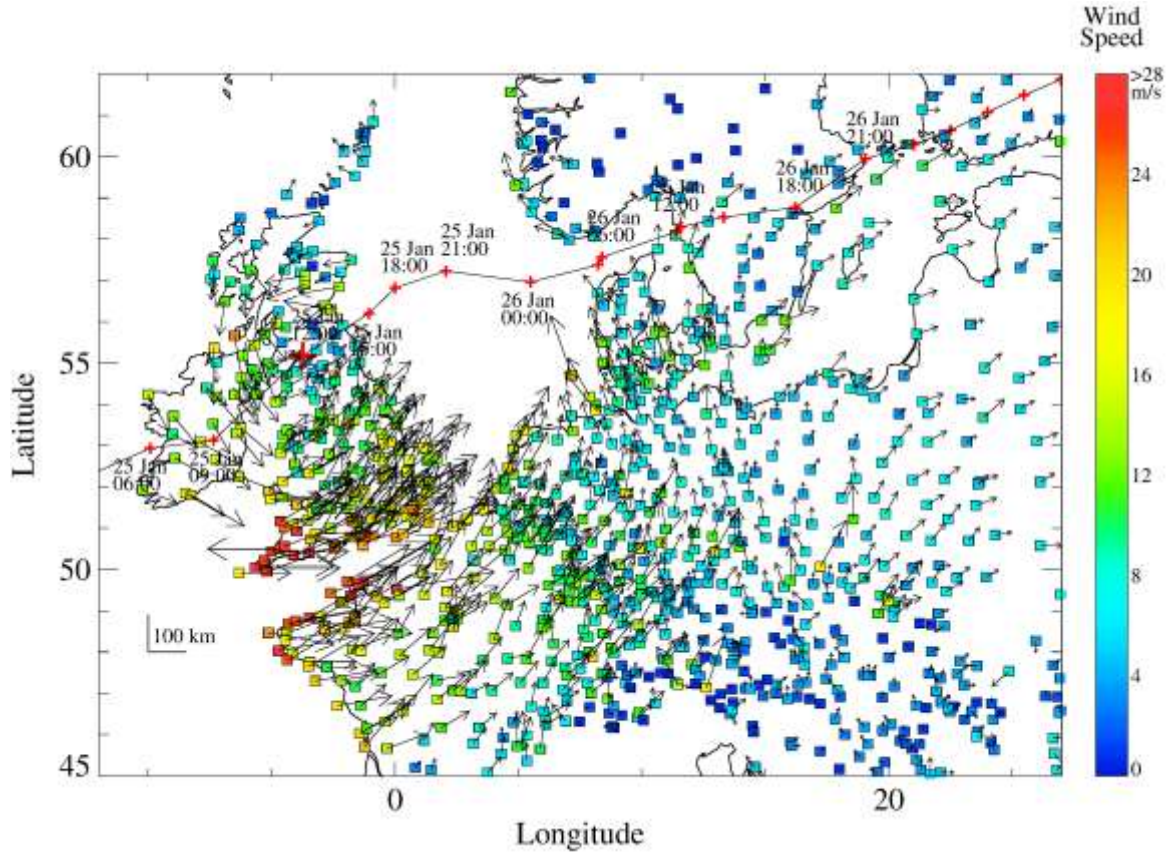


Figure S2.5. Wind speed and direction within 5 minutes of 12:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

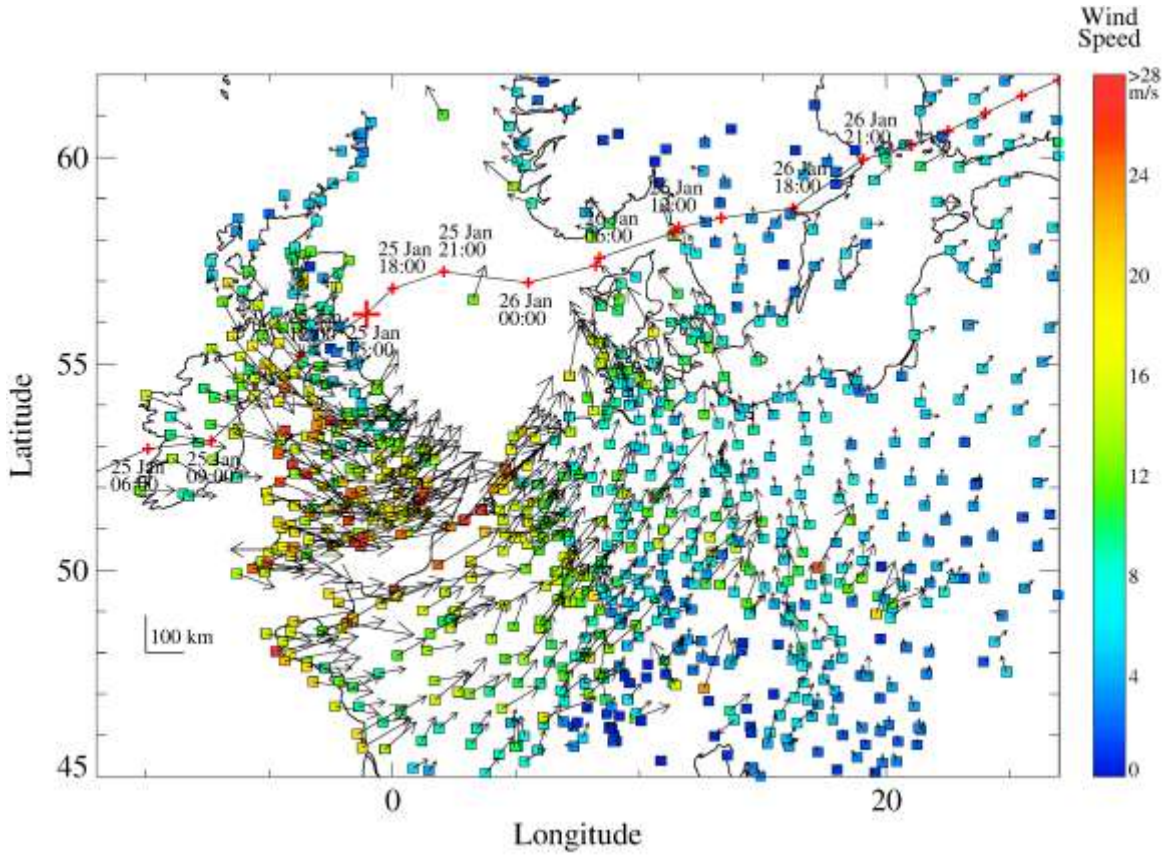


Figure S2.6. Wind speed and direction within 5 minutes of 15:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

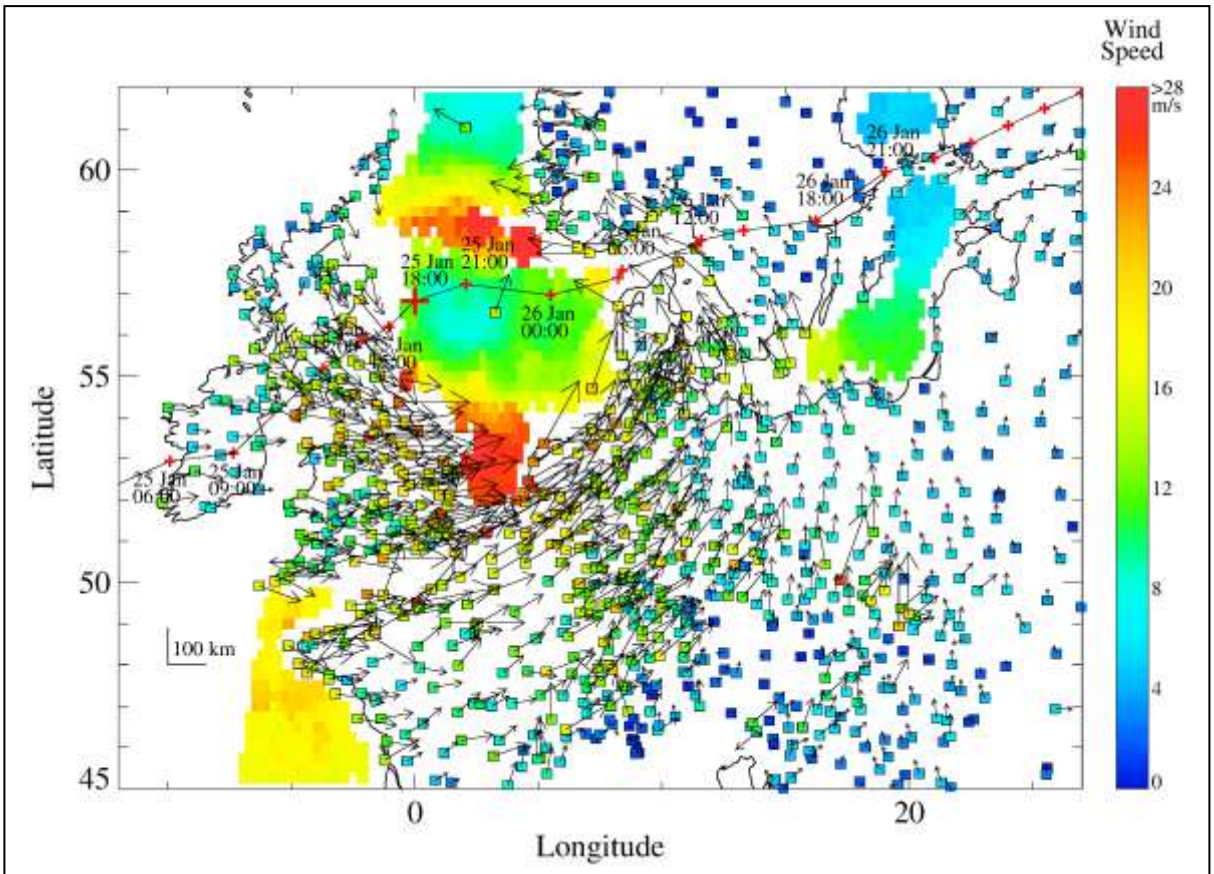
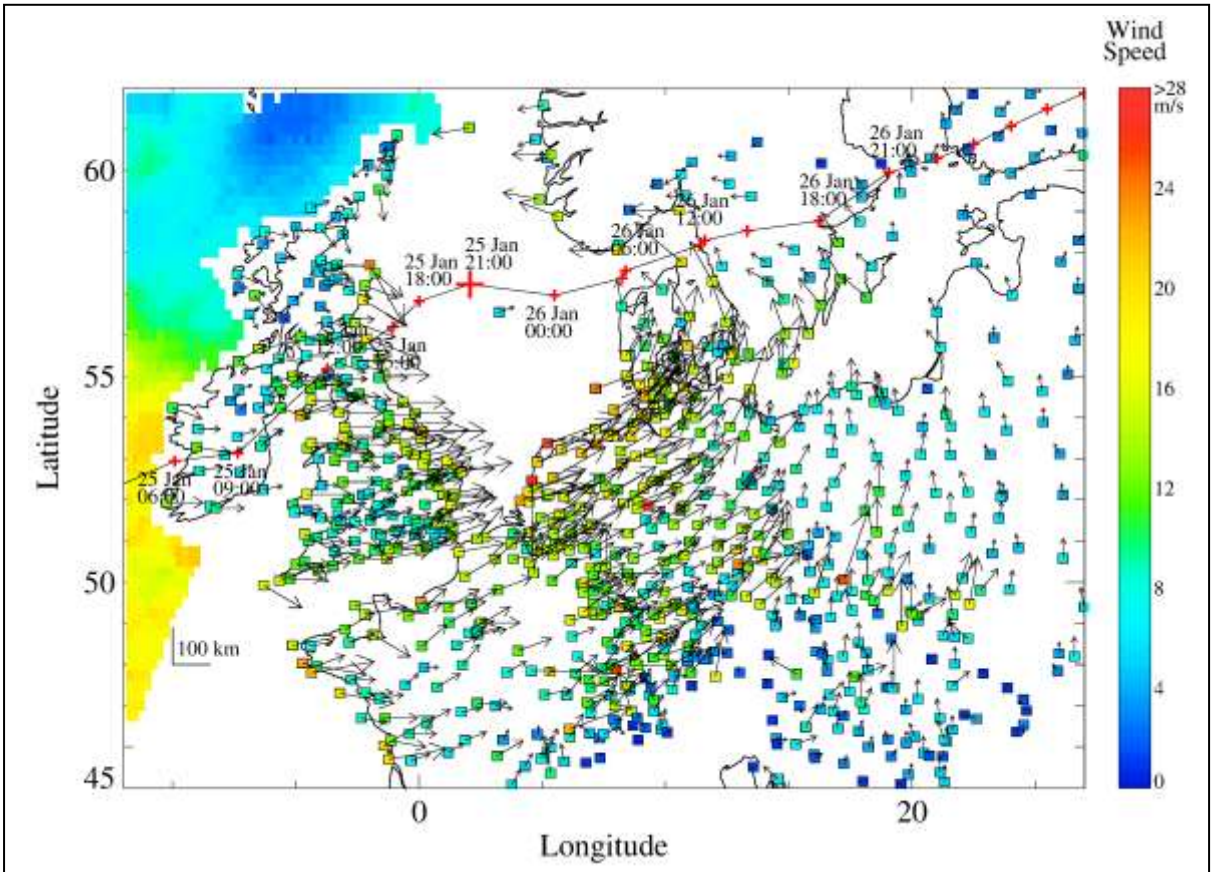


Figure S2.7. Wind speed and direction within 5 minutes of 18:00 UTC 25 January 2007 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross. SSM/I sea surface wind speeds are shown for a satellite overpass at about 18:36 UTC or ~36 minutes after the synoptic station reports.



S2.8. Wind speed and direction within 5 minutes of 21:00 UTC 25 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross. SSMI sea surface wind speeds are shown for a satellite overpass at about 20:18 UTC or ~42 minutes before the synoptic station reports.

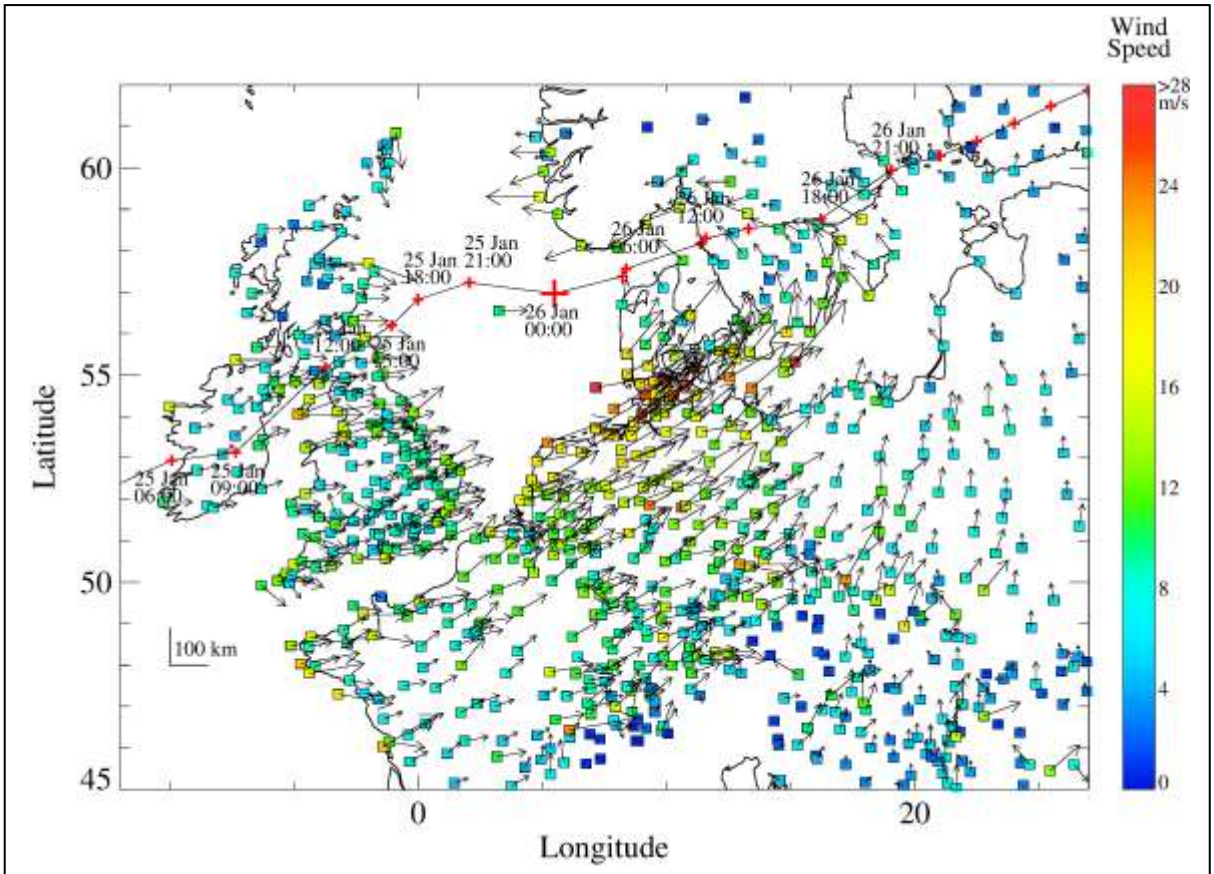


Figure S2.9. Wind speed and direction within 5 minutes of 00:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

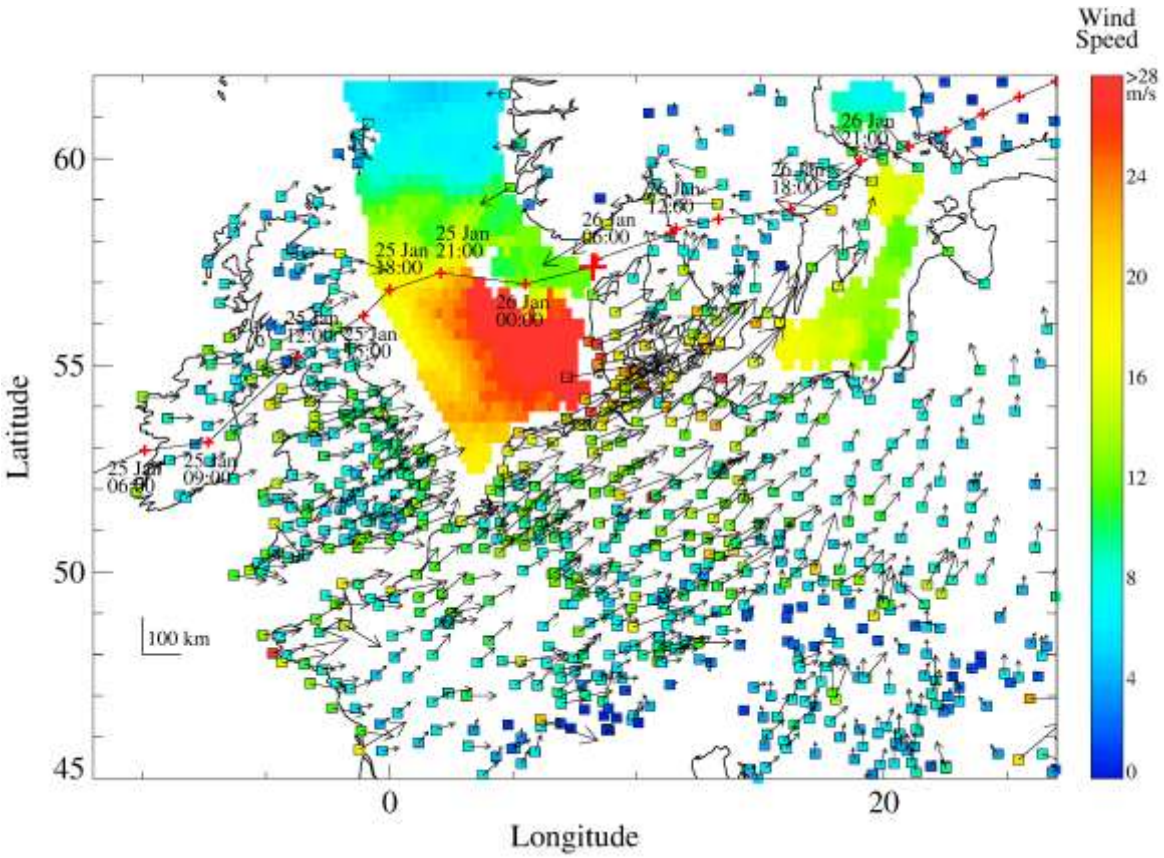


Figure S2.10. Wind speed and direction within 5 minutes of 03:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross. SSM/I sea surface wind speeds are shown for a satellite overpass at about 04:30 UTC or ~90 minutes after the synoptic station reports.

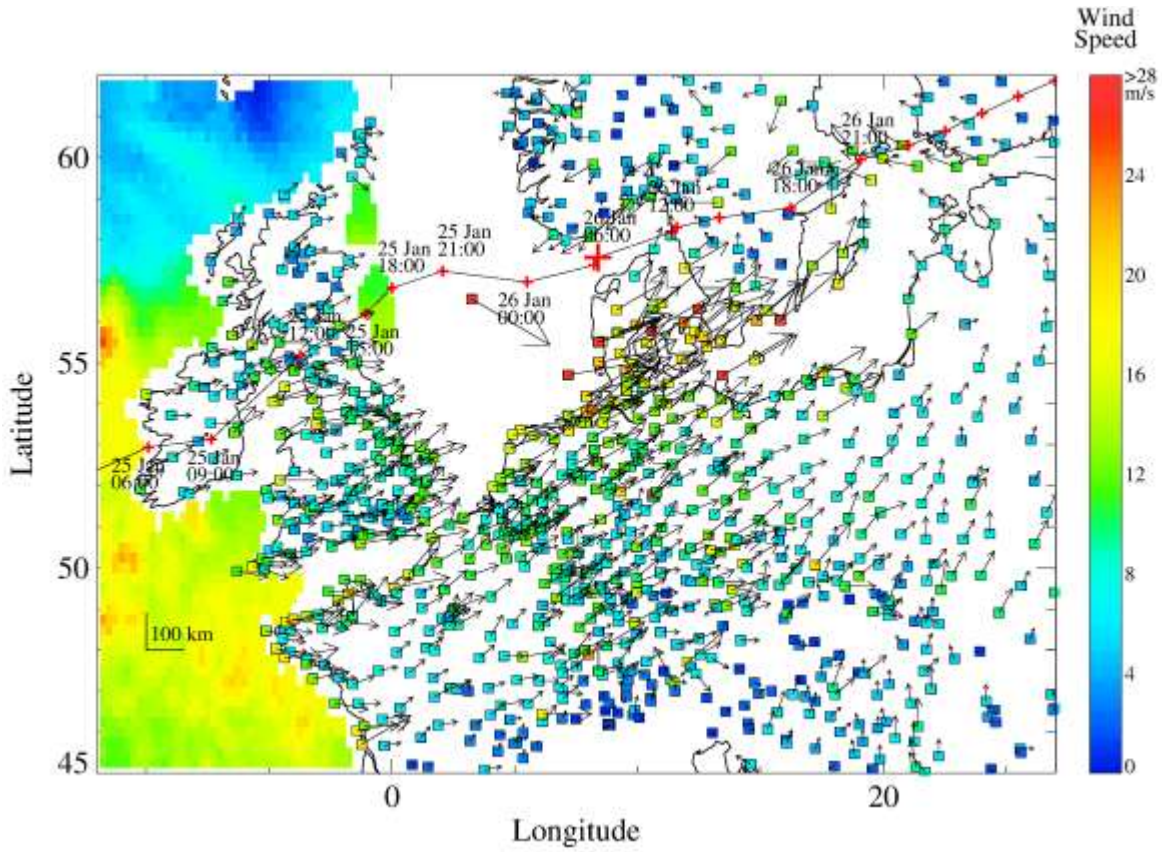


Figure S2.11. Wind speed and direction within 5 minutes of 06:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross. SSM/I sea surface wind speeds are shown for a satellite overpass at about 06:05 UTC or ~5 minutes after the synoptic station reports.

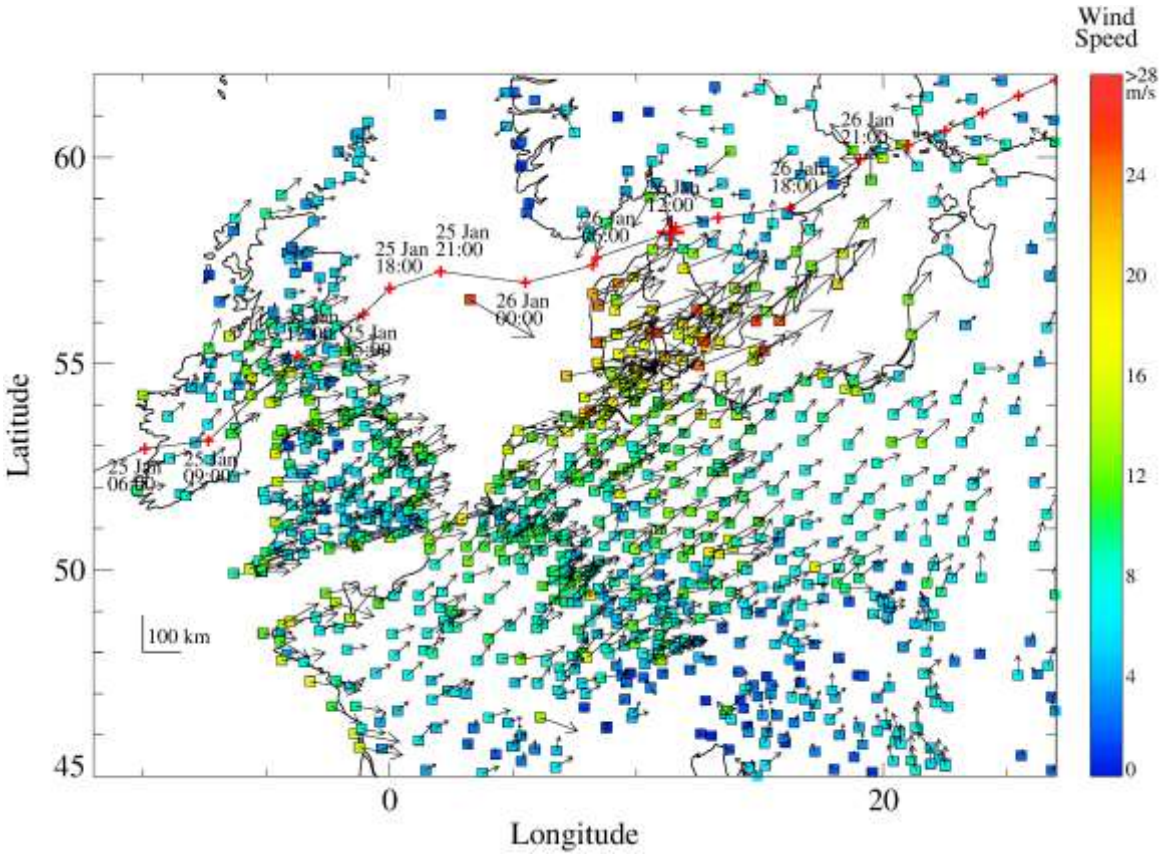


Figure S2.12. Wind speed and direction within 5 minutes of 09:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

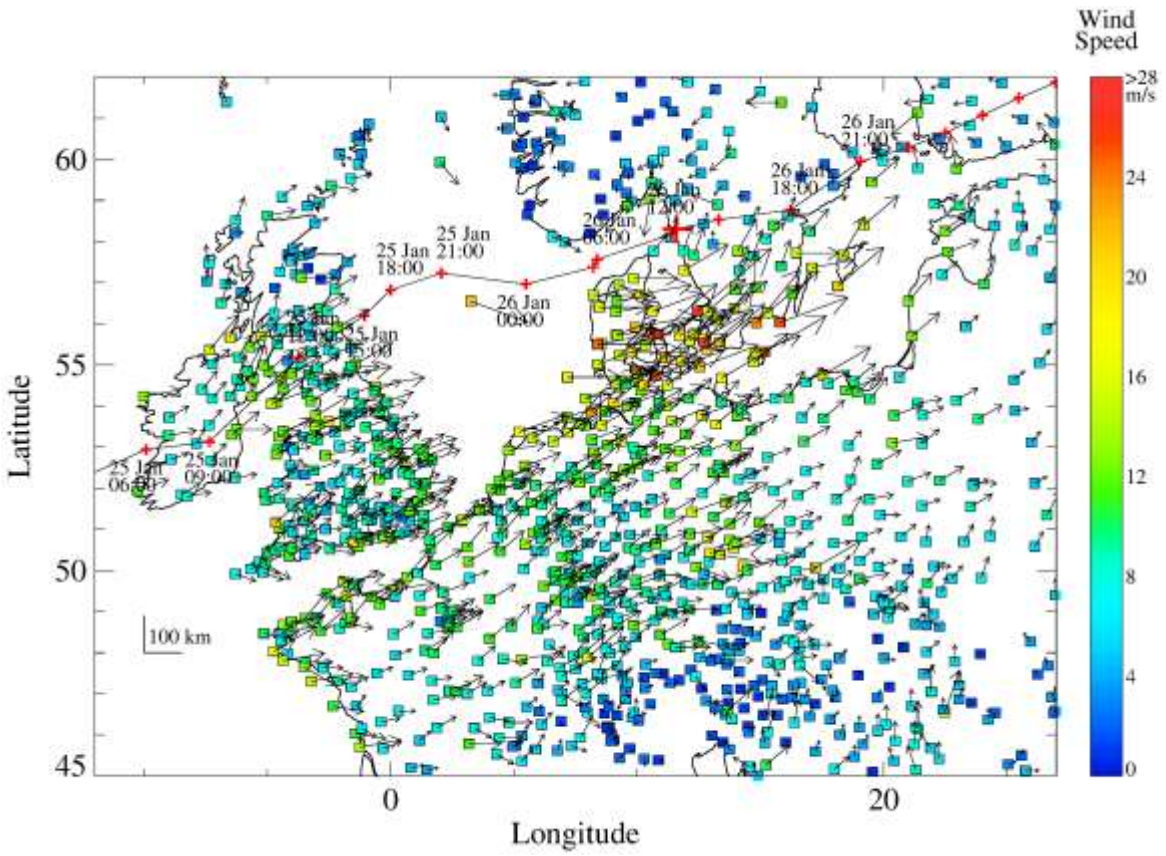


Figure S2.13. Wind speed and direction within 5 minutes of 12:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

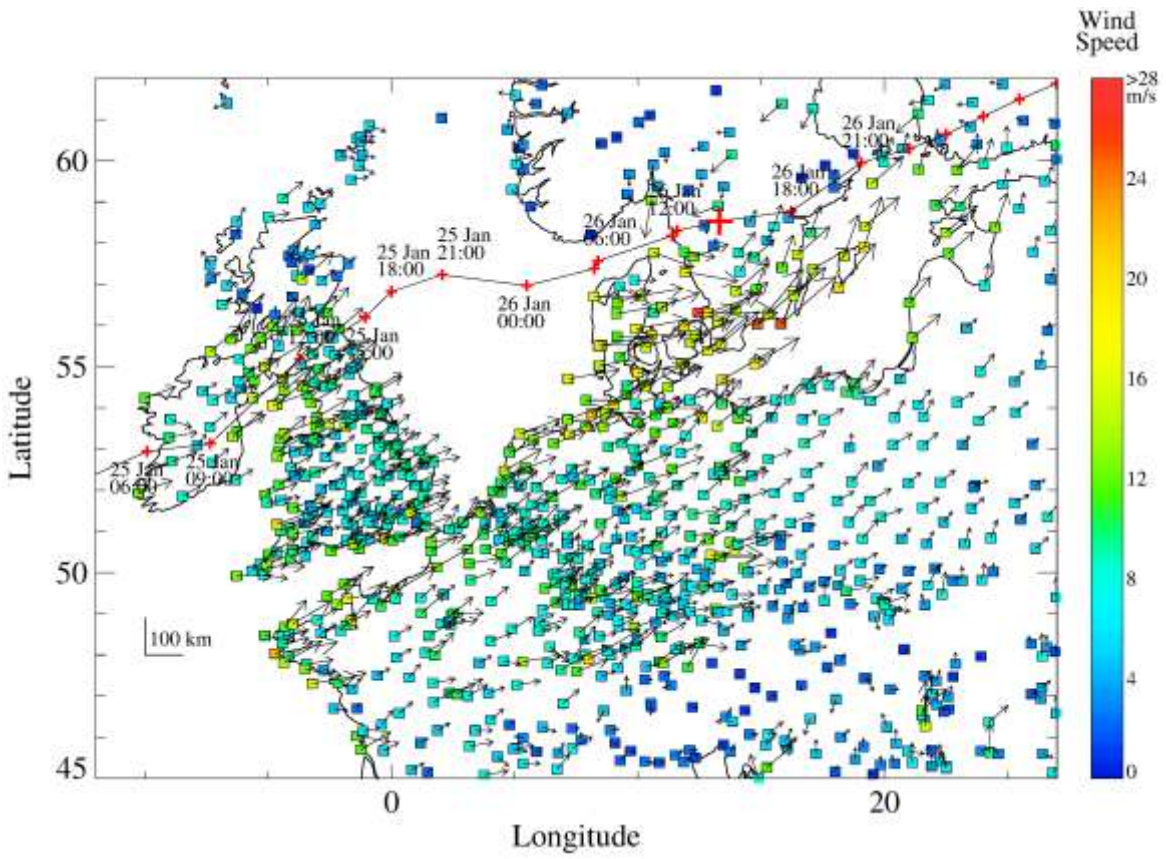


Figure S2.14. Wind speed and direction within 5 minutes of 15:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross.

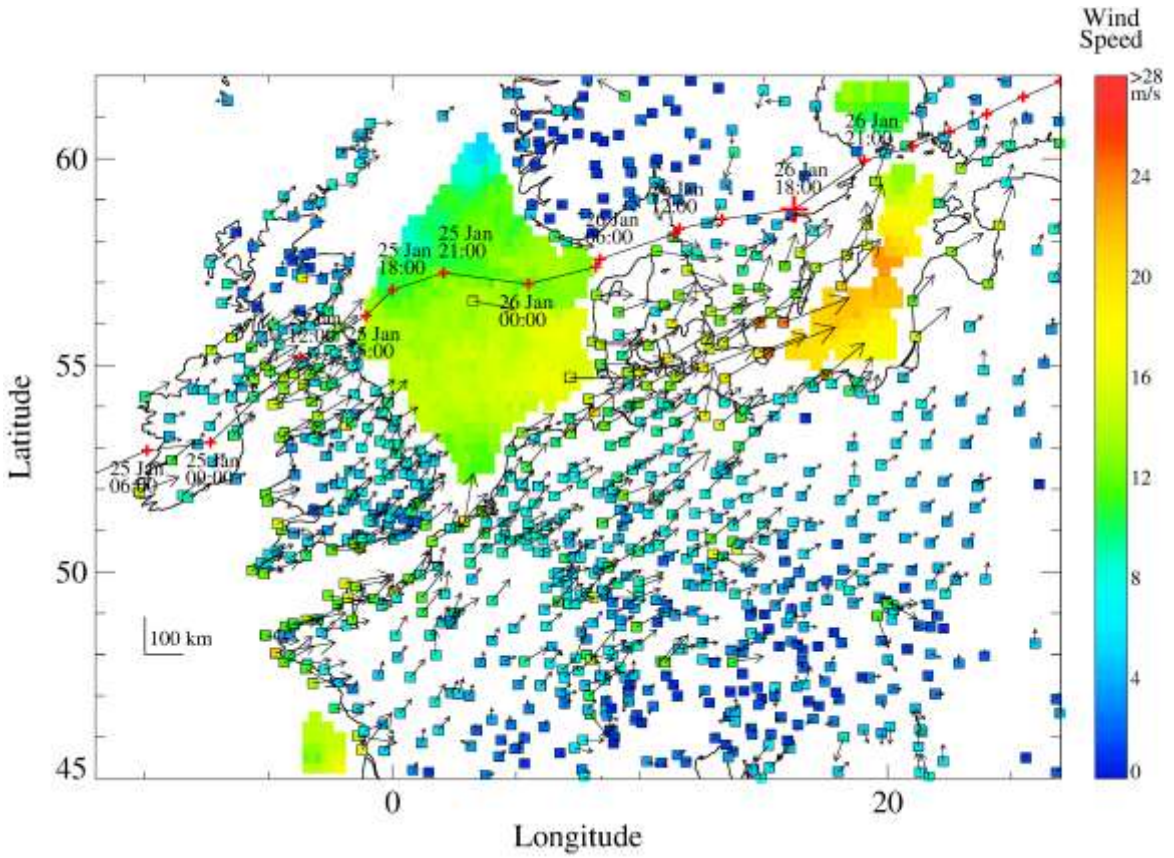


Figure S2.15. Wind speed and direction within 5 minutes of 18:00 UTC 26 January 1990 from selected stations of the USAF data set. The trajectory of low pressure centre is indicated by the black line with red crosses at 3 hour intervals (Roberts et al., 2014). The location of the pressure centre at the time of wind field is shown by a larger cross. SSM/I sea surface wind speeds are shown for a satellite overpass at about 18:23 UTC or ~23 minutes after the synoptic station reports.

SECTION S3. RADIOSONDE ANALYSIS ACROSS THE PERIOD OF THE STORM

The following description has been reproduced and modified from Kettle (2023b).

Radiosonde data for Europe were downloaded from the University of Wyoming archival website at http://weather.uwyo.edu/upperair/sounding.html. The locations of the stations chosen for the analysis are shown in Fig. S3.1. The data for the time period 1–31 January 1990 were selected for analysis. Most of the stations had radiosonde ascents at 12 h intervals, although some had data at 6 h intervals. The original data sets included primary profile measurements (pressure, height, temperature, dew point temperature, wind speed, and wind direction), derived profile measurements (relative humidity, mixing ratio, and potential temperature) and a number of diagnostic values including convective available potential energy (CAPE) , level of free convection, equilibrium level, and SWEAT index. Although the archival website does not present metadata or instrument specifications, information about the radiosonde instruments that have used by the different national meteorological services is given in Gaffen (1993).

A subset of information for height and wind speed is presented in this section. Time series of vertical profiles of wind speed are shown in Fig. S3.2 and S3.3 for two stations at Crawley and Camborne in the UK. These show high upper tropospheric wind speeds at the time of Storm Daria on 25–26 January 2007. These stations were in the region of high surface wind speeds across north-western Europe. The upper tropospheric wind speeds of approximately 80 m/s for one station would have marked this storm as a category 5 hurricane if the wind speeds had been registered as a 10 minute sustained average at 10 m height above the ground surface. The selected stations also register high upper tropospheric winds for others storms on 16 January, 28 January, and 30 January.

Latitude-height profiles of wind speed are shown for stations in western Europe at 25 January 1990 at 12:00 UTC (Fig. S3.4), 26 January 1990 at 00:00 UTC (Fig. S3.5), and 26 January 1990 at 12:00 UTC (Fig. S3.6). The figures emphasize that the highest tropospheric winds occurred at latitudes of about 47–52 N, south of the trajectory of the low pressure centre. The high winds penetrated down into the troposphere below 5 km.

The spatial distribution of positive CAPE data calculated from the radiosonde profiles is shown in maps in Fig. S3.7 (25 January 1990 12:00 UTC), S3.8 (26 January 1990 00:00 UTC), and S3.9 (26 January 1990 12:00 UTC). The maps also show the level of free convection and equilibrium for positive CAPE data, revealing that the convection systems were mainly shallow and close to the surface. The spatial distribution of positive SWEAT index data calculated from radiosonde profiles is shown in maps in Fig. S3.10 (25 January 1990 12:00 UTC), S3.11 (26 January 1990 00:00 UTC), and S3.12 (26 January 1990 12:00 UTC). The SWEAT index takes account of vertical wind shear and stability, and the important message from these plots is that the tornado potential in north-western Europe near the North Sea coast was comparable to a bad summertime convection system in the mid-western United States.

References:

Gaffen, Dian J.: Historical changes in radiosonde instruments and practices, World Meteorological Organization, Instruments and Observing Methods, Report No. 50. WMO/TD-No.541, 1993

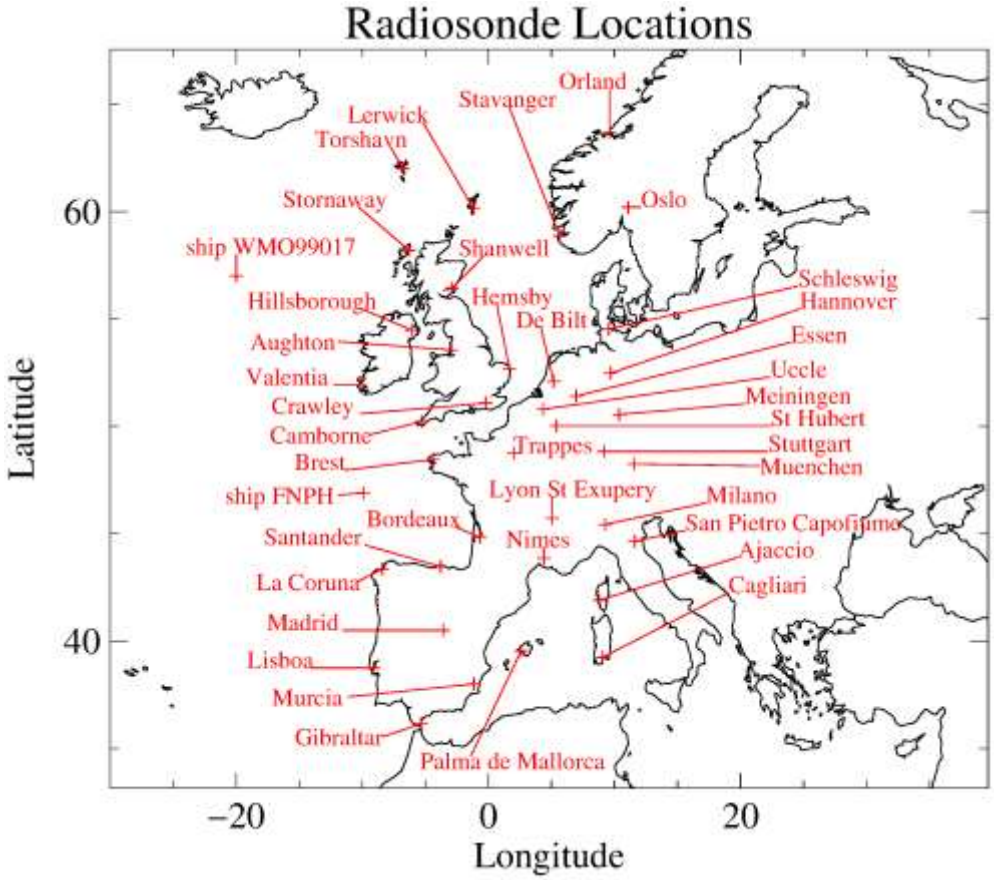


Figure S3.1. Map of radiosonde stations with data during the time period 1–31 January 1990.

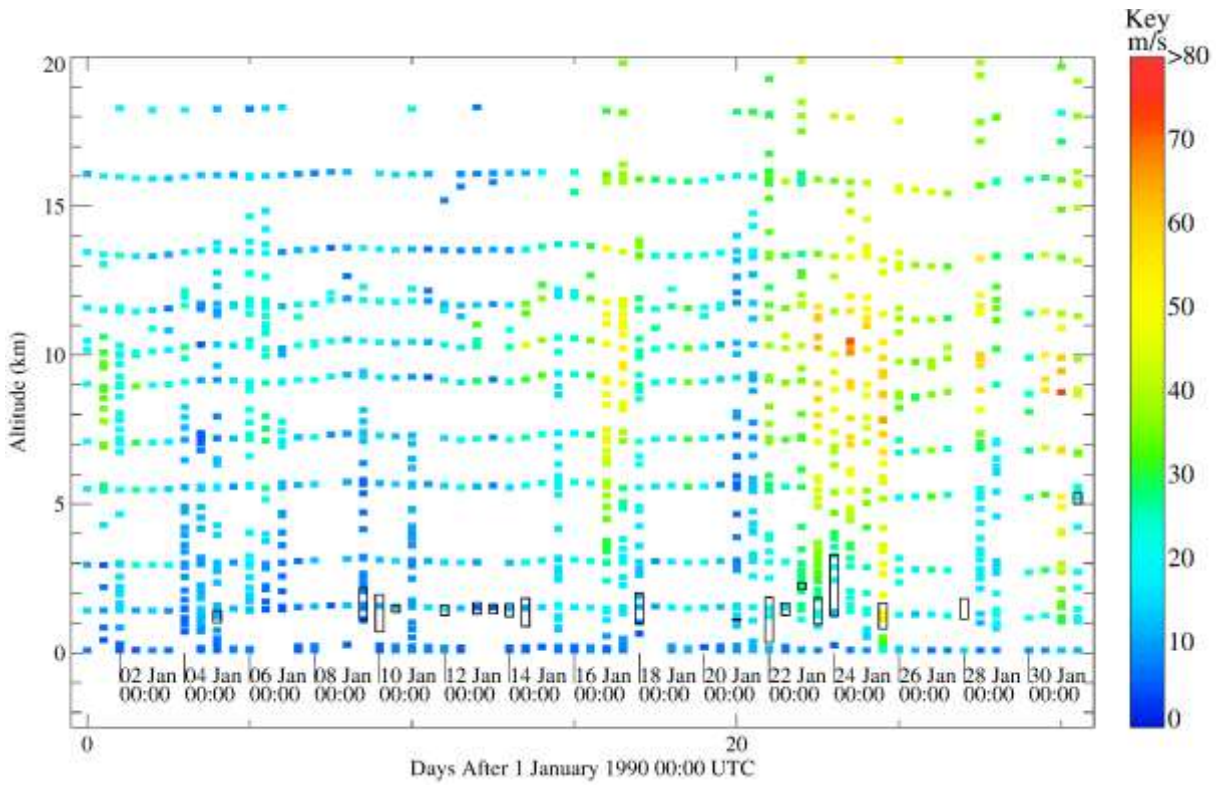


Figure S3.2. Time series of vertical profiles of wind speed for the radiosonde station at Cambourne in the UK for the period 1–31 January 1990. Open boxes near the bottom of the figure (lower troposphere) indicate the vertical range between the level of free convection and the equilibium level for profiles showing positive values of convective available potential energy (CAPE).

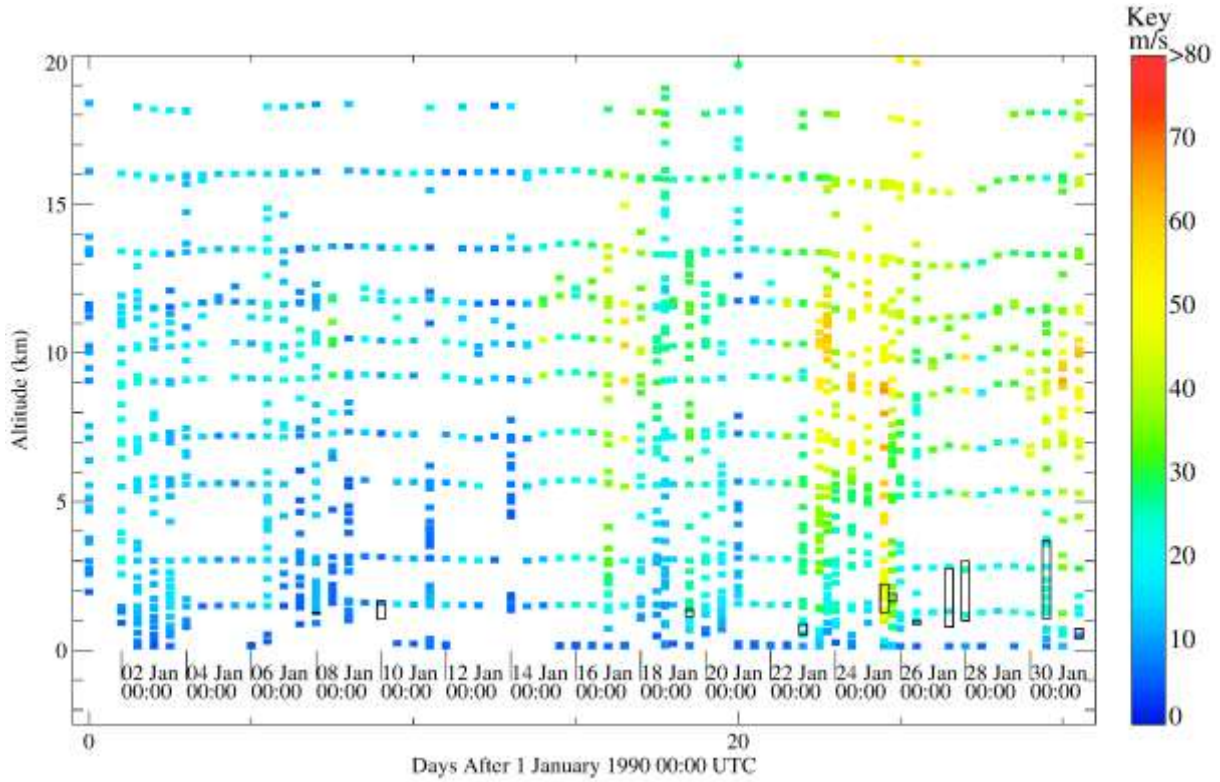


Figure S3.3. Time series of vertical profiles of wind speed for the radiosonde station at Crawley in the UK for the period 1–31 January 1990. Open boxes near the bottom of the figure (lower troposphere) indicate the vertical range between the level of free convection and the equilibium level for profiles showing positive values of convective available potential energy (CAPE).

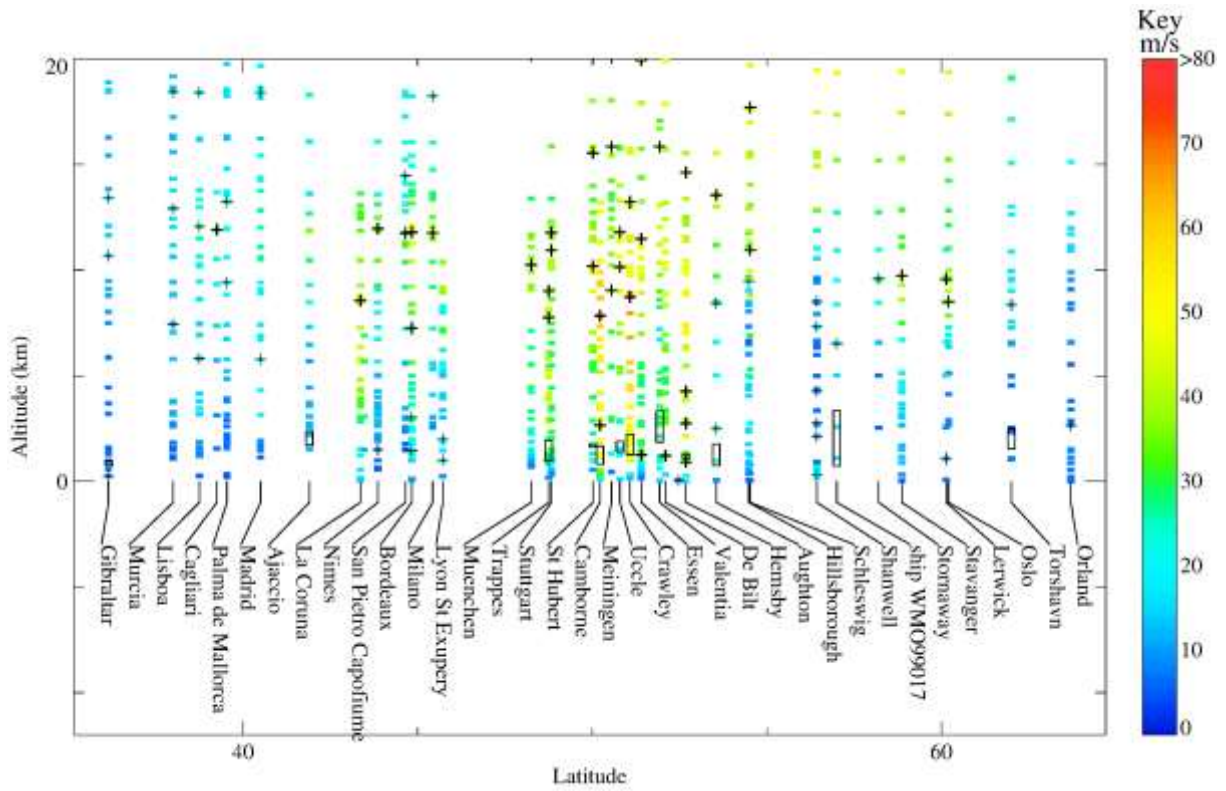


Figure S3.4. Latitude-height section of radiosonde wind speeds for stations in Europe on 25 January 1990 at 12:00 UTC. Crosses mark local maxima in the wind speed profiles, and bold crosses indicate local maximum wind speeds exceeding 32 m/s. Open boxes near the bottom of the figure (lower troposphere) indicate the vertical range between the level of free convection and the equilibium level for profiles showing positive values of convective available potential energy (CAPE).

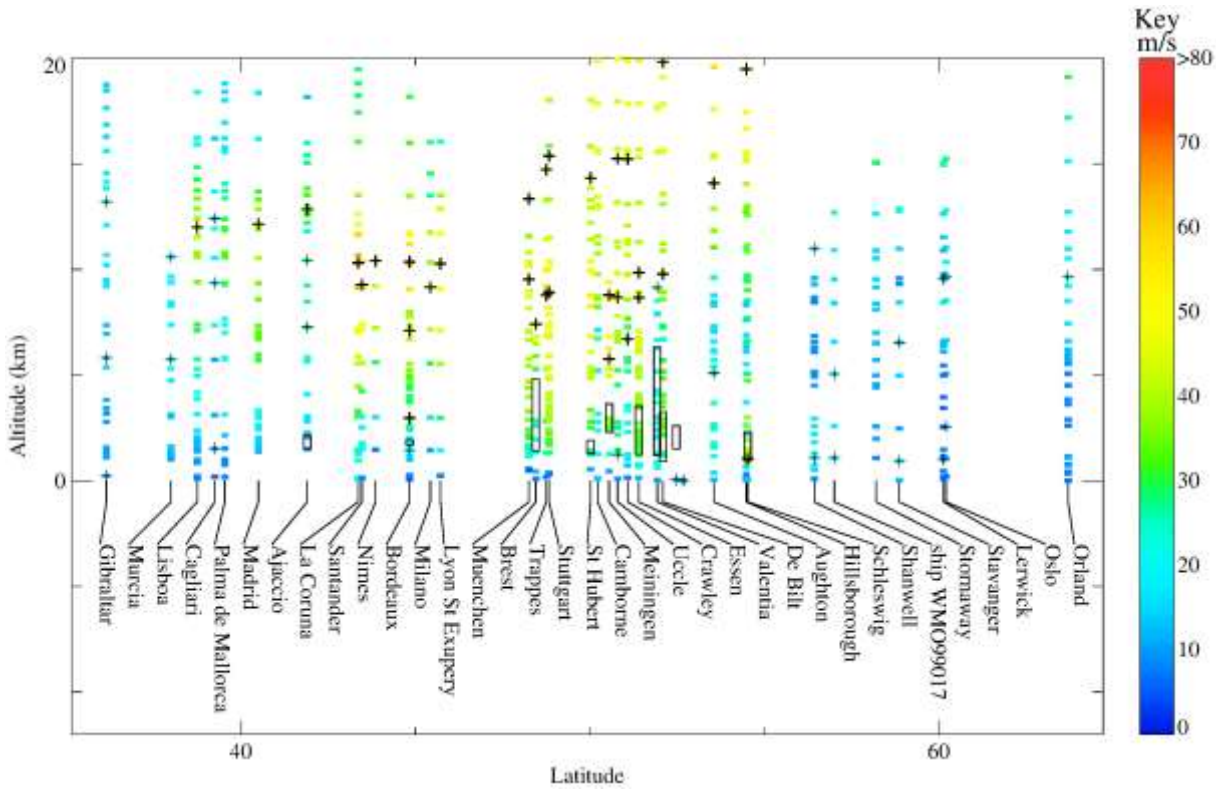


Figure S3.5. Latitude-height section of radiosonde wind speeds for stations in Europe on 26 January 1990 at 00:00 UTC. Crosses mark local maxima in the wind speed profiles, and bold crosses indicate local maximum wind speeds exceeding 32 m/s. Open boxes near the bottom of the figure (lower troposphere) indicate the vertical range between the level of free convection and the equilibium level for profiles showing positive values of convective available potential energy (CAPE).

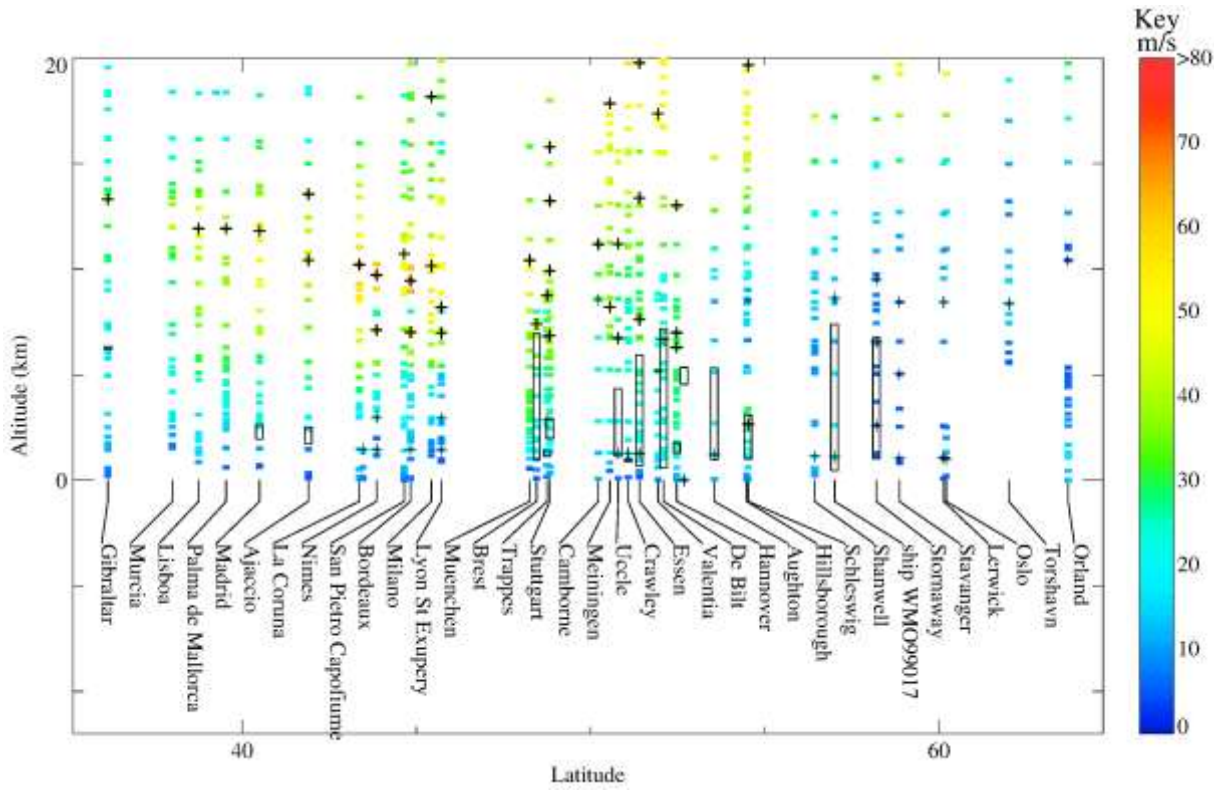


Figure S3.6. Latitude-height section of radiosonde wind speeds for stations in Europe on 26 January 1990 at 12:00 UTC. Crosses mark local maxima in the wind speed profiles, and bold crosses indicate local maximum wind speeds exceeding 32 m/s. Open boxes near the bottom of the figure (lower troposphere) indicate the vertical range between the level of free convection and the equilibium level for profiles showing positive values of convective available potential energy (CAPE).

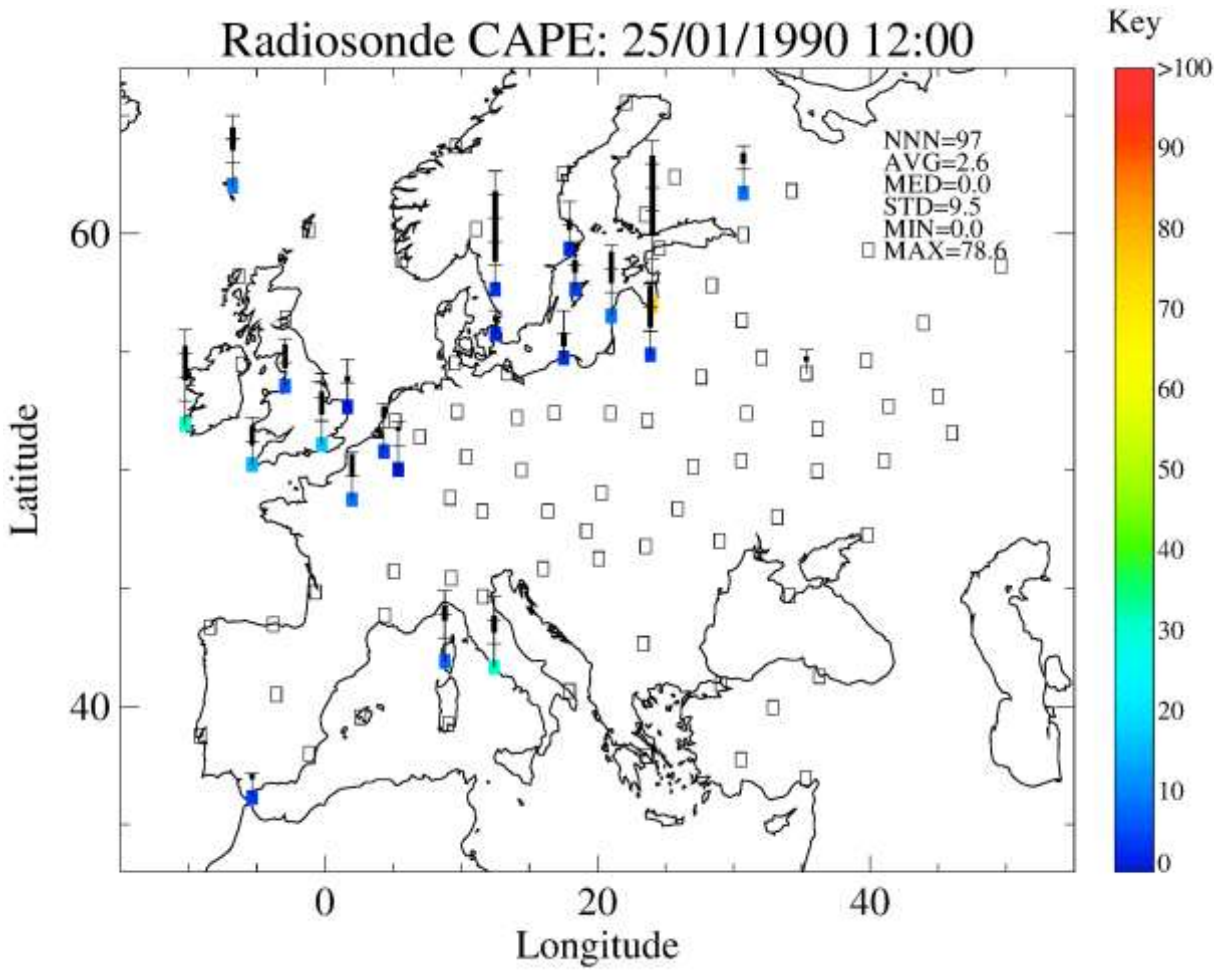


Figure S3.7. Map of convective available potential energy (CAPE, J/kg) for stations in Europe on 25 January 1990 at 12:00 UTC. The black vertical bars give the heights of the level of free convection and the equilibrium level for radiosonde profiles showing positive CAPE values, with horizontal tick marks at 1000 m intervals starting at the surface.

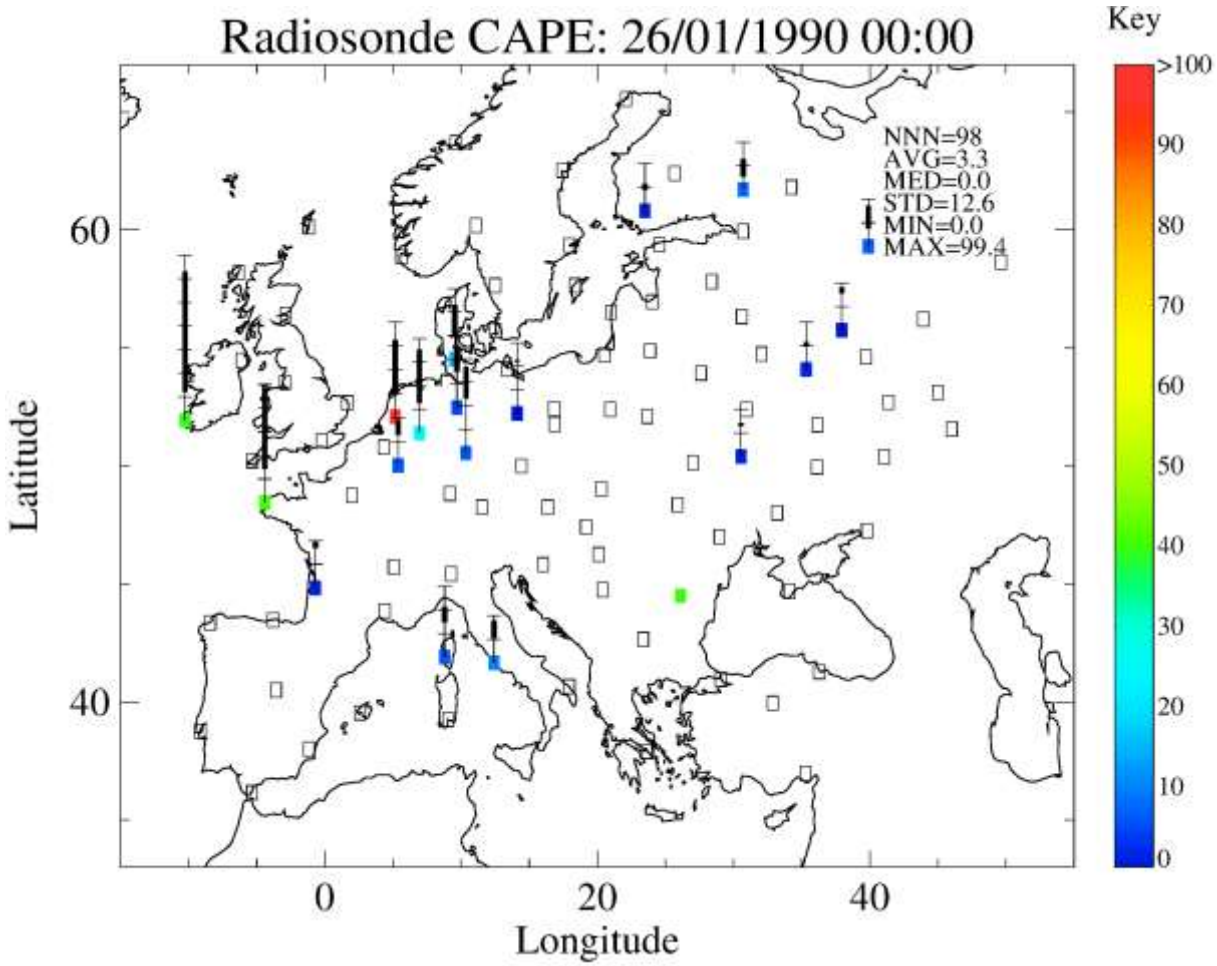


Figure S3.8. Map of convective available potential energy (CAPE, J/kg) for stations in Europe on 26 January 1990 at 00:00 UTC. The black vertical bars give the heights of the level of free convection and the equilibrium level for radiosonde profiles showing positive CAPE values, with horizontal tick marks at 1000 m intervals starting at the surface.

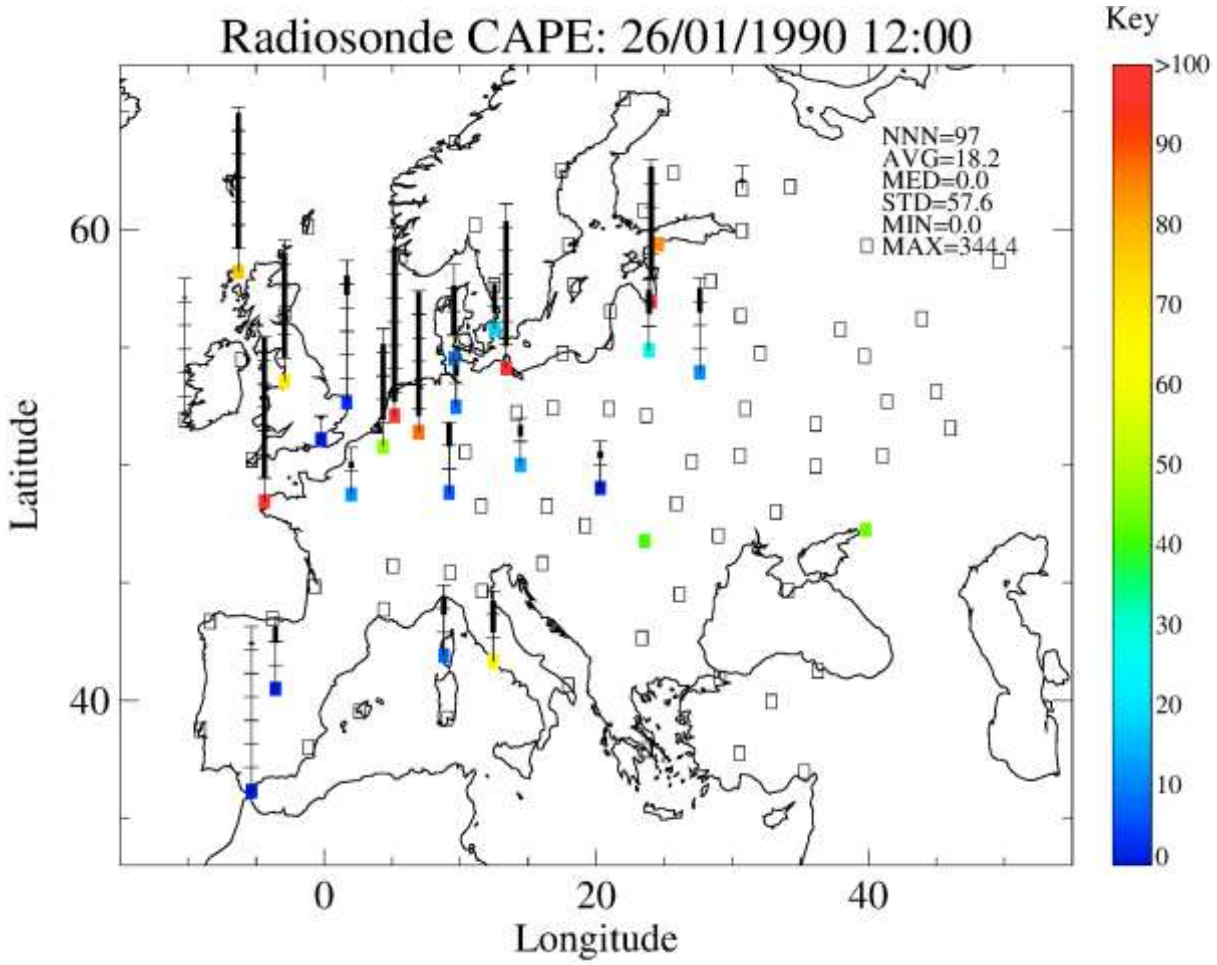


Figure S3.9. Map of convective available potential energy (CAPE, J/kg) for stations in Europe on 26 January 1990 at 12:00 UTC. The black vertical bars give the heights of the level of free convection and the equilibrium level for radiosonde profiles showing positive CAPE values, with horizontal tick marks at 1000 m intervals starting at the surface.

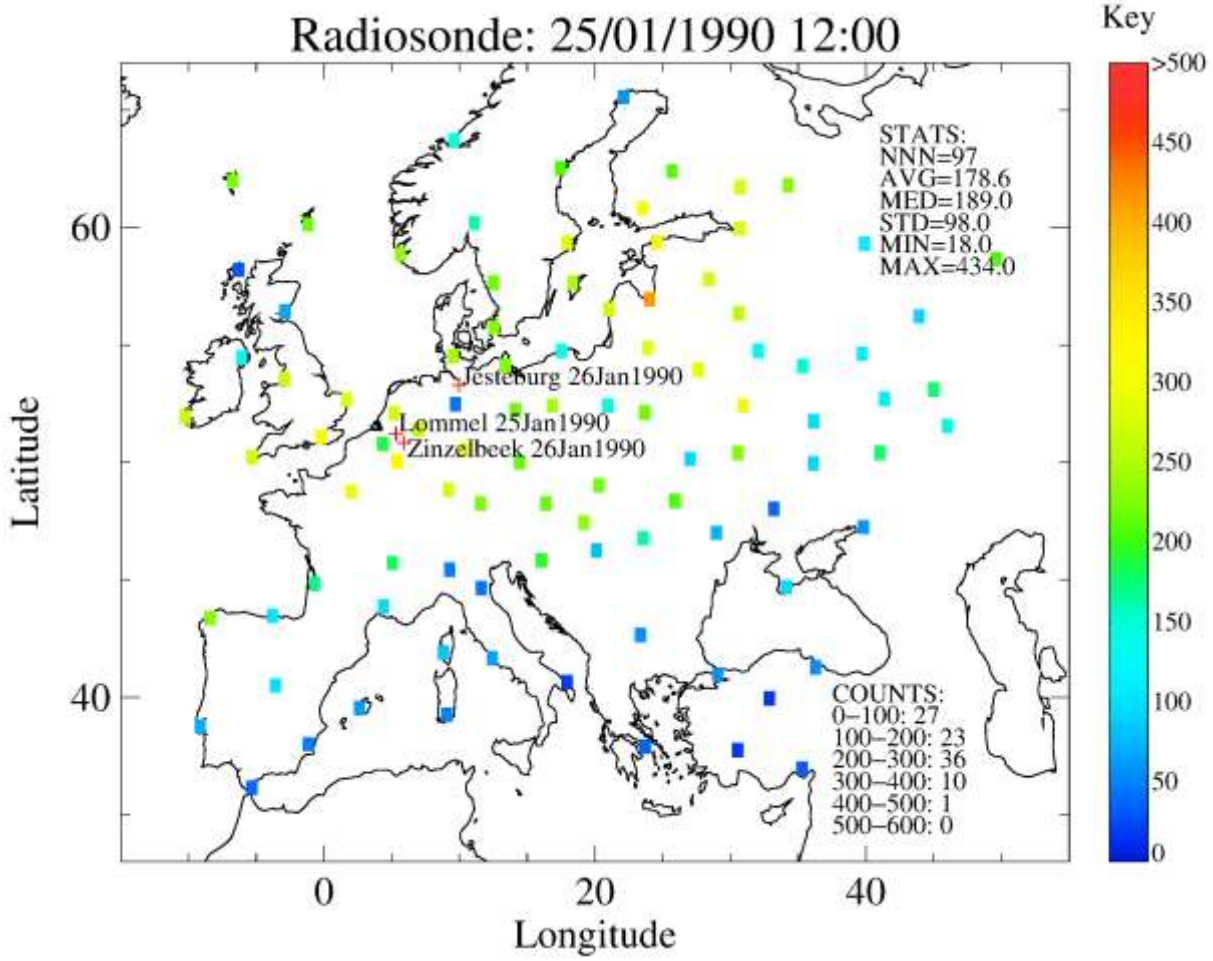


Figure S3.10. Map of SWEAT index for stations in Europe on 25 January 1990 at 12:00 UTC. Crosses mark the locations of tornadoes. The statistics of the displayed stations are printed on the map, along with a tabulated histogram distribution of values.

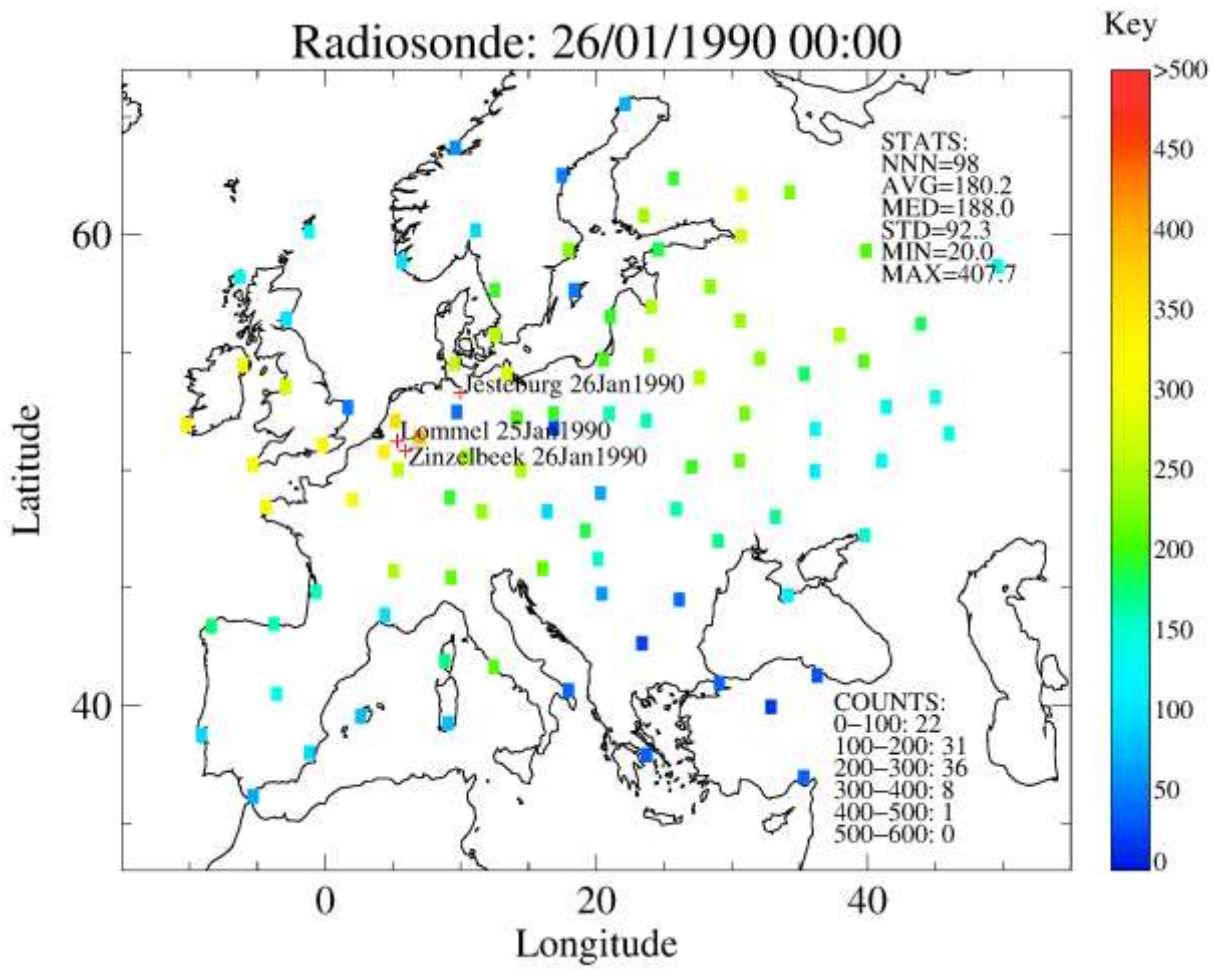


Figure S3.11. Map of SWEAT index for stations in Europe on 26 January 1990 at 00:00 UTC. Crosses mark the locations of tornadoes. The statistics of the displayed stations are printed on the map, along with a tabulated histogram distribution of values.

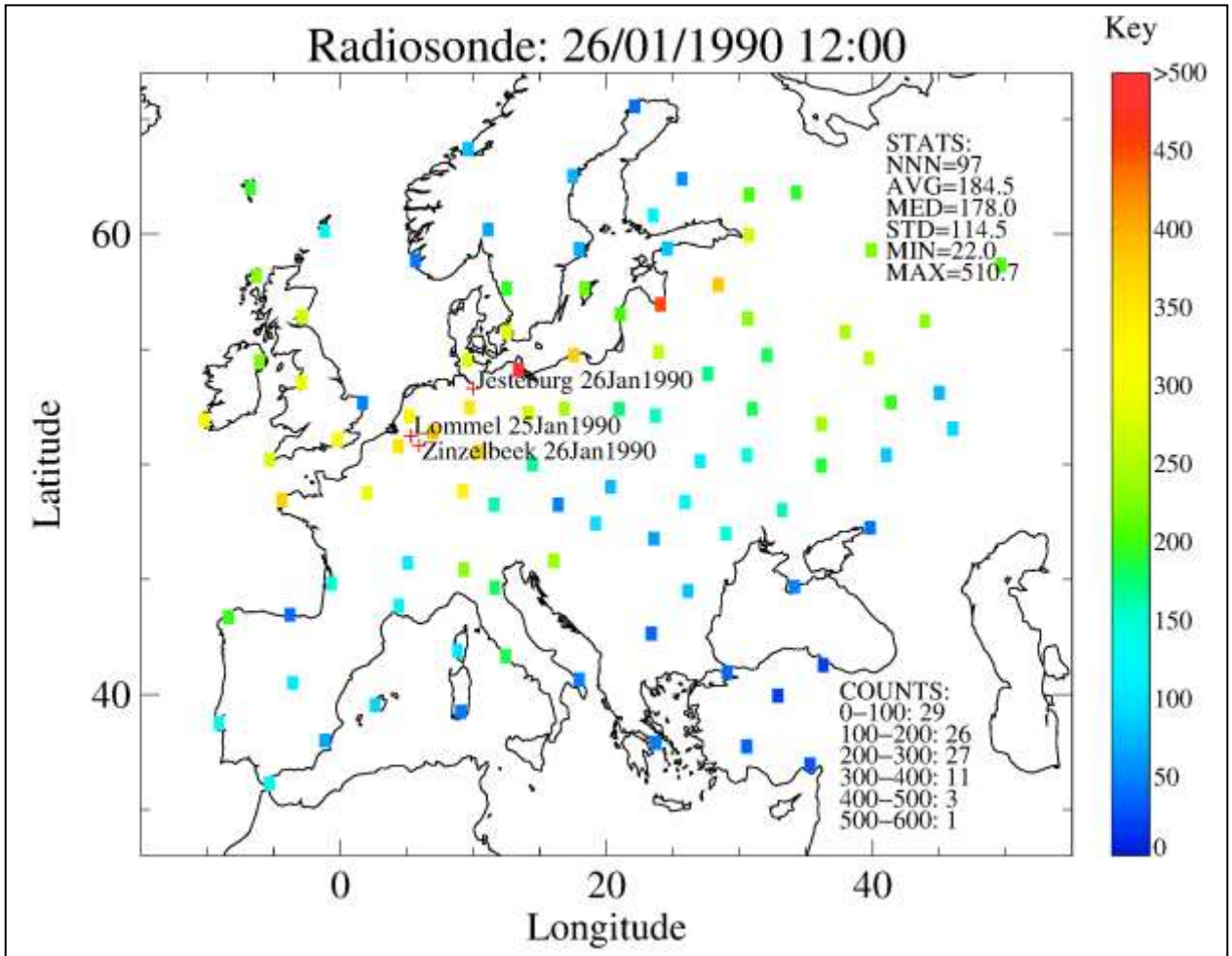


Figure S3.12. Map of SWEAT index for stations in Europe on 26 January 1990 at 12:00 UTC. Crosses mark the locations of tornadoes. The statistics of the displayed stations are printed on the map, along with a tabulated histogram distribution of values.

SECTION S4. STATION MEASUREMENTS FROM THE FORSCHUNGSPLATTFORM NORDSEE

The Forchungsplattfom Nordsee was a manned offshore platform in operation in the German Bight in the period 1976–1993. It was funded by the German government authority for research and technology, and the military authority for research into water acoustics and geophysics (RF, 1976; Dolezalek, 1992). Research papers based on data from the platform appeared in mainstream scientific journals, usually on the subject of wave research and radar remote sensing of waves. The platform had a regular meteorological measurement program whose data were sent to the German meteorological office DWD and to international weather networks.

Met-ocean observations from the platform across the period of Storm Daria have been collated from different sources (BSH, 2002, Keitz, 20240419, USAF data set) and are shown in the figure below. The air temperature and pressure measurement sensors failed during the storm. The data set obtained from the DWD has gaps where no measurements were taken during night time. However, the time series gives insight into the offshore conditions in the region of the strongest winds in the southern North Sea. Offshore met-ocean platform measurements in the North Sea were not common in 1990. At least one petroleum platform (Ekofisk) was also recording met-ocean data in the northern North Sea, just to the north of the trajectory track of the storm.

References:

RF (Reedereigemeinschaft Forschungsschiffahrt GmbH), Forshungsplattform Nordsee, 4 pp, 1976

BSH, Beobachungen auf den deutschen Messstationen der Nord- und Ostsee im Jahre 1990, Meereskundliche Beobachtungen und Ergebnisse, Nr. 70, Bundesamt fuer Seeschiffahrt und Hydrographie, Hamburg, 1992

Dolezalek, H., Oceanographic research towers in Europe, ONR Europe Reports, AD-A264 795, Dec. 1992

Keitz, P., DWD data file of met-ocean data from the Forschungsplattform Nordsee for the period 1988-1992, 19 April 2024

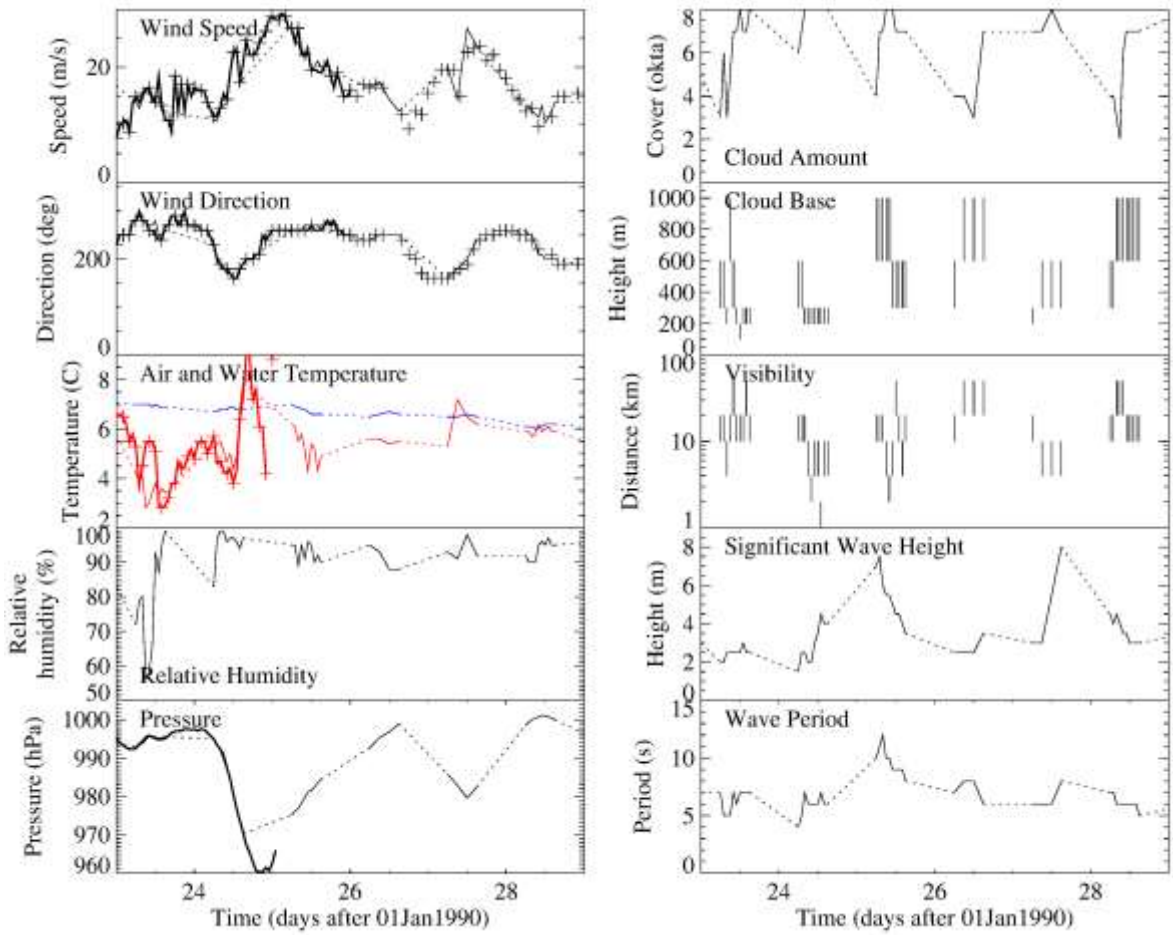


Figure S4.1. Time series of meteorological and wave data from the offshore platform FP Nordsee in the southern North Sea off the coast of Sylt. Data have been compiled from three different sources: USAF data set (wind speed, wind direction, air temperature, pressure; thick lines), BSH (1992) (wind speed, wind direction, and air temperature), and Keitz (2024) (all data fields; thin solid lines with night time tie lines given by dotted lines.) Measured offshore wind speeds reached 28 m/s. The water temperature was warmer than air temperatures over most of the period, creating and unstable boundary layer situation. The storm period was characterized by extended periods of the low-altitude broken clouds.

SECTION S5. WAVE MEASUREMENTS IN THE NORTH SEA

Measurements of significant wave height are presented for stations in the Norwegian Sea and North Sea. The data originate from different sources, which are given in Tables S5.1 and S5.2. The data providers are mostly governmental authorities, except CMEMS, which is a European Commission organization and has provided data from different sources. The quality control and data cleaning procedures for the different providers is not known. Referring to wave instrumental records from late 1990s and 2000s, Magnusson (2009) indicated that the data cleaning may be too vigorous in some instances and may remove valid wave data in extreme sea states.

Reference:

Magnusson, A.K.: What is true sea state? Proceedings of the 11th International Workshop on Wave Hindcasting and Forecasting and Coastal Hazard Symposium, JCOMM Halifax, Canada, Oct 18–23, 2009, Technical Report No 52, WMO/TD-No. 1533, IOC Workshop Report No. 232, 2009b.

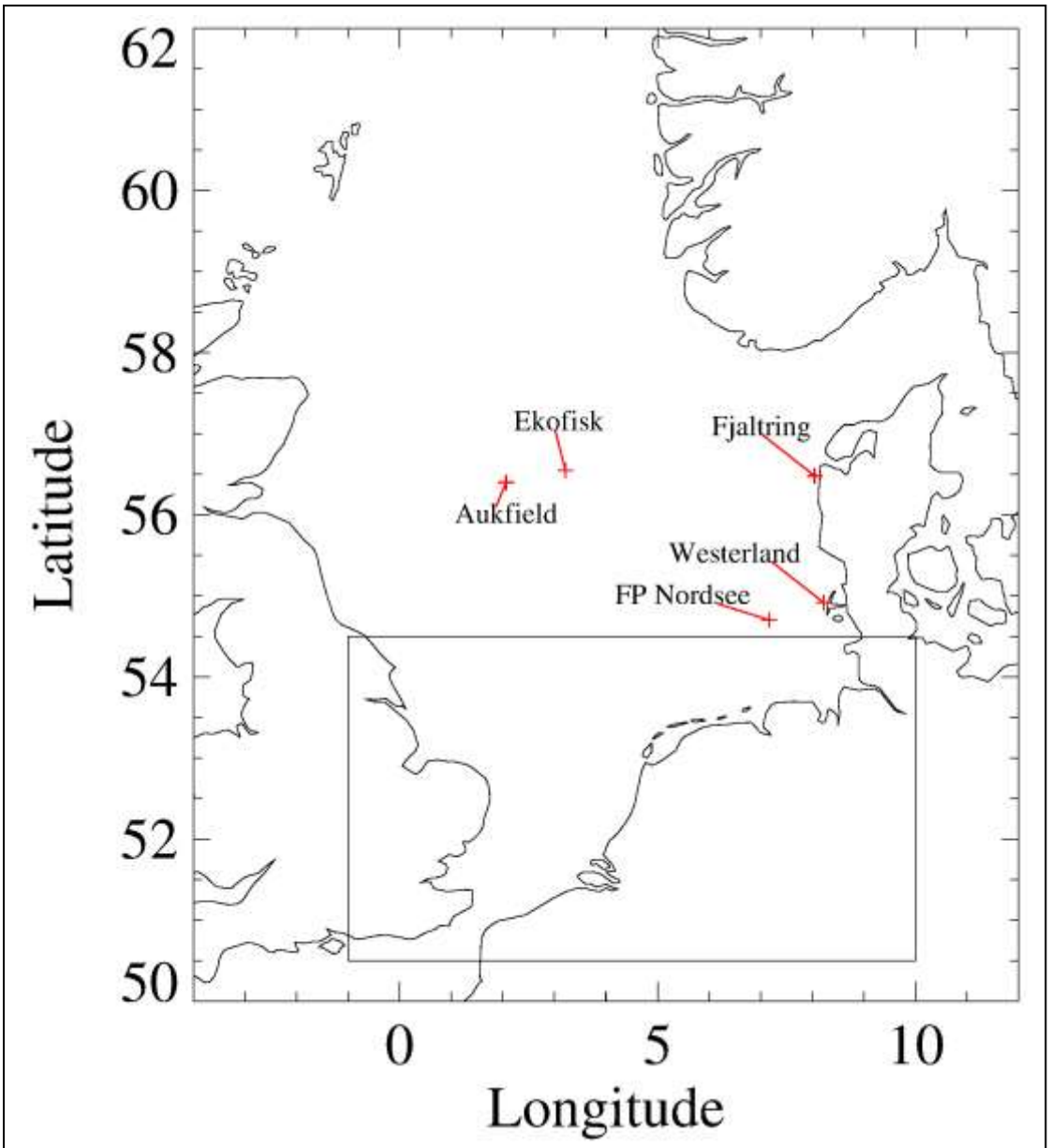


Figure S5.1. Location of wave measurement stations. Wave recorders in the box in the southern North Sea are shown in Figure S5.2 for clarity.

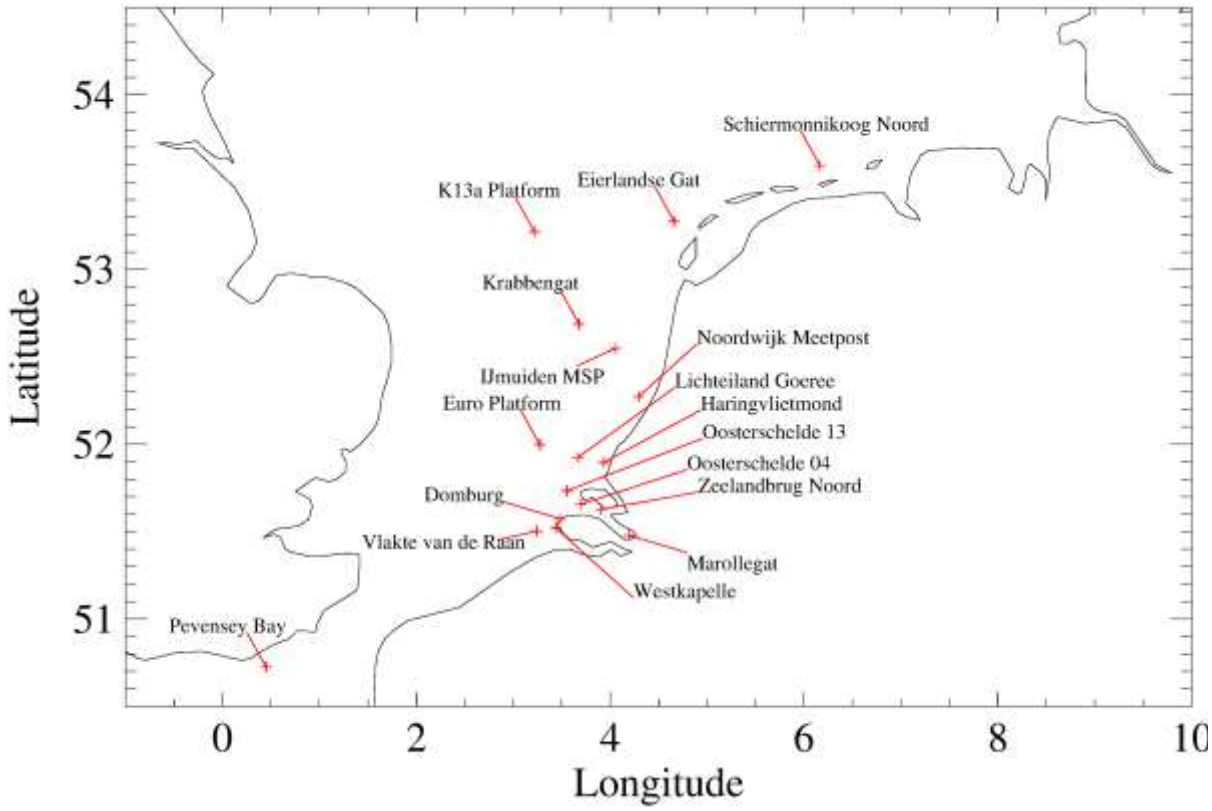


Figure S5.2. Location of wave measurement stations in the southern North Sea.

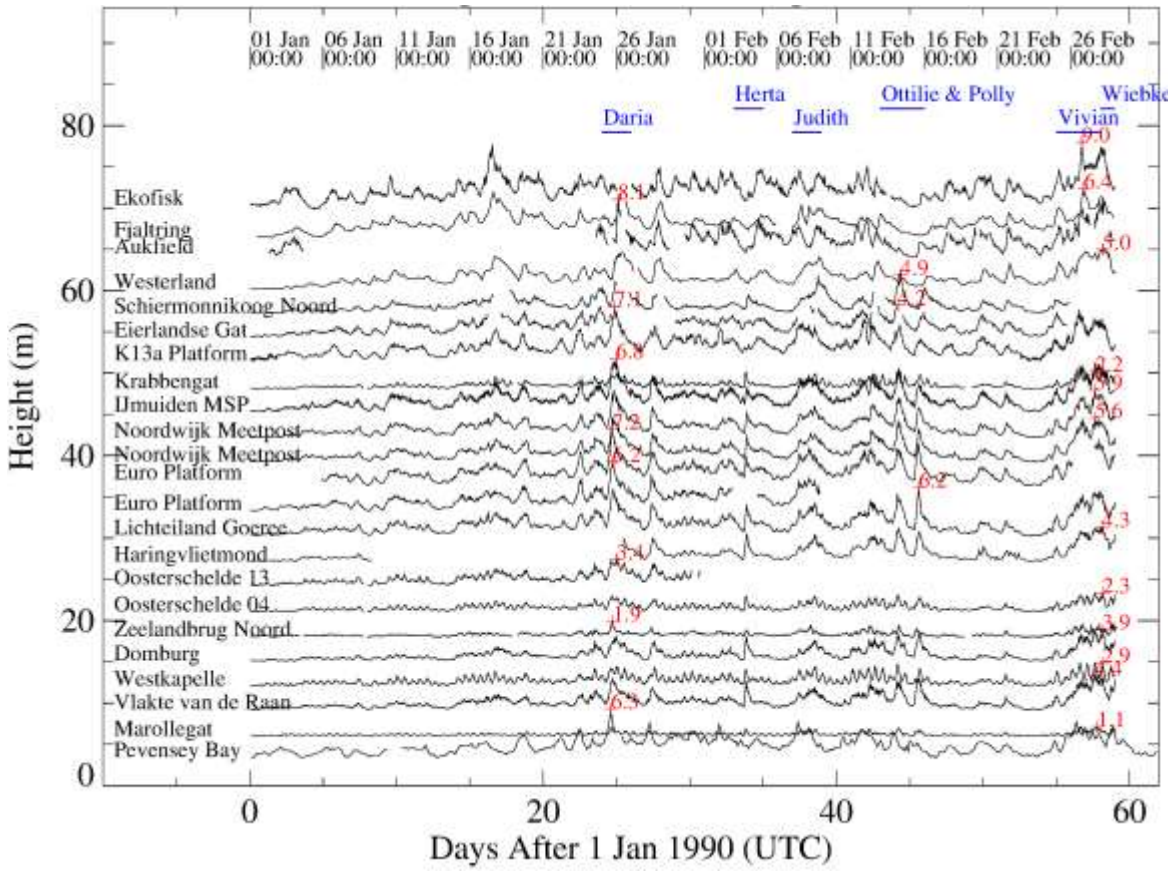


Figure S5.3. Time series of significant wave height for selected stations in the Norwegian Sea and North Sea for the period January and February 1990. The time series have been vertically offset for clarity, and the stations in each panel have been arranged according to latitude. The highest value of each series is indicated by a red cross with the significant wave height printed in red font. Important storms of the period are written in blue text at the top of the figure.

Table S5.1. Significant wave height information from the North Sea area for the period January to February 1990. Information is presented for the highest significant wave height over the full period and for the two day period of the storm 25–26 January 1990.

Station name [1]	Land [2]	NNN [3]	Date & time series start [4]	Date & time series end [5]	Median Δt (min) [6]	Date/time peak full series [7]	Peak (m) [8]	Date/time peak 25–26Jan1990 [9]	Peak (m) [10]
Pevensey Bay	CEFAS	1420	28/09/1989 17:53	29/03/1990 12:21	179.0	25/01/1990 14:51	6.3	25/01/1990 14:51	6.3
Marollegat	RWS	2810	01/01/1990 01:30	01/03/1990 00:00	30.0	27/02/1990 19:00	1.1	25/01/1990 17:00	1.0
Vlakte van de Raan	RWS	2803	01/01/1990 01:00	01/03/1990 00:00	30.0	27/02/1990 14:30	4.4	25/01/1990 17:30	3.9
Westkapelle	RWS	2797	01/01/1990 01:00	01/03/1990 00:00	30.0	28/02/1990 03:30	2.9	26/01/1990 01:00	2.4
Domburg	RWS	2809	01/01/1990 01:00	01/03/1990 00:00	30.0	28/02/1990 03:00	3.9	25/01/1990 23:30	3.0
Zeelandbrug Noord	RWS	2517	01/01/1990 01:00	01/03/1990 00:00	30.0	25/01/1990 18:00	1.9	25/01/1990 18:00	1.9
Oosterschelde 04	RWS	2802	01/01/1990 01:30	01/03/1990 00:00	30.0	28/02/1990 03:30	2.3	25/01/1990 17:30	2.0
Oosterschelde 13	RWS	1304	01/01/1990 01:30	31/01/1990 16:30	30.0	25/01/1990 23:30	3.4	25/01/1990 23:30	3.4
Haringvlietmond	RWS	729	01/01/1990 01:00	01/03/1990 00:00	60.0	28/02/1990 03:00	4.3	26/01/1990 13:00	2.9
Lichteiland Goeree	RWS	1396	01/01/1990 01:00	01/03/1990 00:00	60.0	15/02/1990 15:00	6.2	25/01/1990 19:00	5.9
Euro Platform	RWS	889	01/01/1990 01:00	08/02/1990 21:00	60.0	25/01/1990 18:00	6.2	25/01/1990 18:00	6.2
Euro Platform	RWS	1261	05/01/1990 21:00	01/03/1990 00:00	60.0	25/01/1990 17:00	7.2	25/01/1990 17:00	7.2
Noordwijk Meetpost	RWS	1412	01/01/1990 01:00	01/03/1990 00:00	60.0	27/02/1990 15:00	5.9	25/01/1990 20:00	5.8
Noordwijk Meetpost	RWS	1413	01/01/1990 01:00	01/03/1990 00:00	60.0	27/02/1990 15:00	5.6	25/01/1990 19:00	5.5
IJmuiden MSP	RWS	2736	01/01/1990 01:00	28/02/1990 23:00	59.9	25/01/1990 23:00	6.8	25/01/1990 23:00	6.8
Krabbengat	RWS	2738	01/01/1990 01:00	01/03/1990 00:00	30.0	27/02/1990 15:30	2.2	26/01/1990 00:30	2.0
K13a Platform	RWS	1595	01/01/1990 01:00	01/03/1990 00:00	60.0	25/01/1990 21:00	7.1	25/01/1990 21:00	7.1
Eierlandse Gat	RWS	1104	01/01/1990 01:00	28/02/1990 17:00	60.0	14/02/1990 05:00	4.2	25/01/1990 01:00	3.3
Schiermonnikoog Noord	RWS	1254	01/01/1990 01:00	25/02/1990 20:00	60.0	14/02/1990 09:00	4.9	25/01/1990 22:00	4.0
FP Nordsee	DWD	447	03/01/1990 13:00	28/02/1990 15:00	60.0	26/02/1990 15:00	9.5	26/01/1990 07:00	7.5
Westerland	LSH	417	01/01/1990 00:00	01/03/1990 00:00	240.0	28/02/1990 04:00	5.0	26/01/1990 08:30	4.6
Aukfield	RWS	725	02/01/1990 07:00	01/03/1990 00:00	60.0	26/01/1990 02:00	8.1	26/01/1990 02:00	8.1
Fjaltring	DK	461	01/01/1990 12:00	28/02/1990 21:00	180.0	26/02/1990 21:00	6.4	26/01/1990 06:00	5.7
Ekofisk	NO	1375	01/01/1990 01:00	28/02/1990 23:00	60.0	26/02/1990 18:00	9.0	25/01/1990 00:00	4.8

Notes:
[1] Wave measuring station name
[2] Sources of wave data:
CEFAS: digital files from Wavenet website hosted by CEFAS,
DK: digital files for Denmark from https://kyst.dk/soeterritoriet/maalinger-og-data/vandstandsmaalinger/
DWD: digital file of met-ocean data from Forschungsplattform Nordsee provided by Peter Keitz,
LSH: digital data files emailed by Maria Bluemel
NO: digital data from Norwegian offshore platforms downloaded from https://seklima.met.no,
RWS: digital data file downloaded from Waterinfo website https://waterinfo.rws.nl/#!/nav/expert/alle-groepen/,
[3] Number of data points in time series
[4] Start date and time of time series (GMT)
[5] End date and time of time series (GMT)
[6] Median time interval
[7] Date and time of peak of full time series (GMT)
[8] Peak significant wave height of full time series.
[9] Date and time of peak of 2 d time series during Storm Daria 25–26 January 1990.
[10] Peak significant wave height of 2 d time series during Storm Daria 25–26 January 1990.

SECTION S6. COASTAL RETREAT/ADVANCE ON SYLT DURING 1989/1990

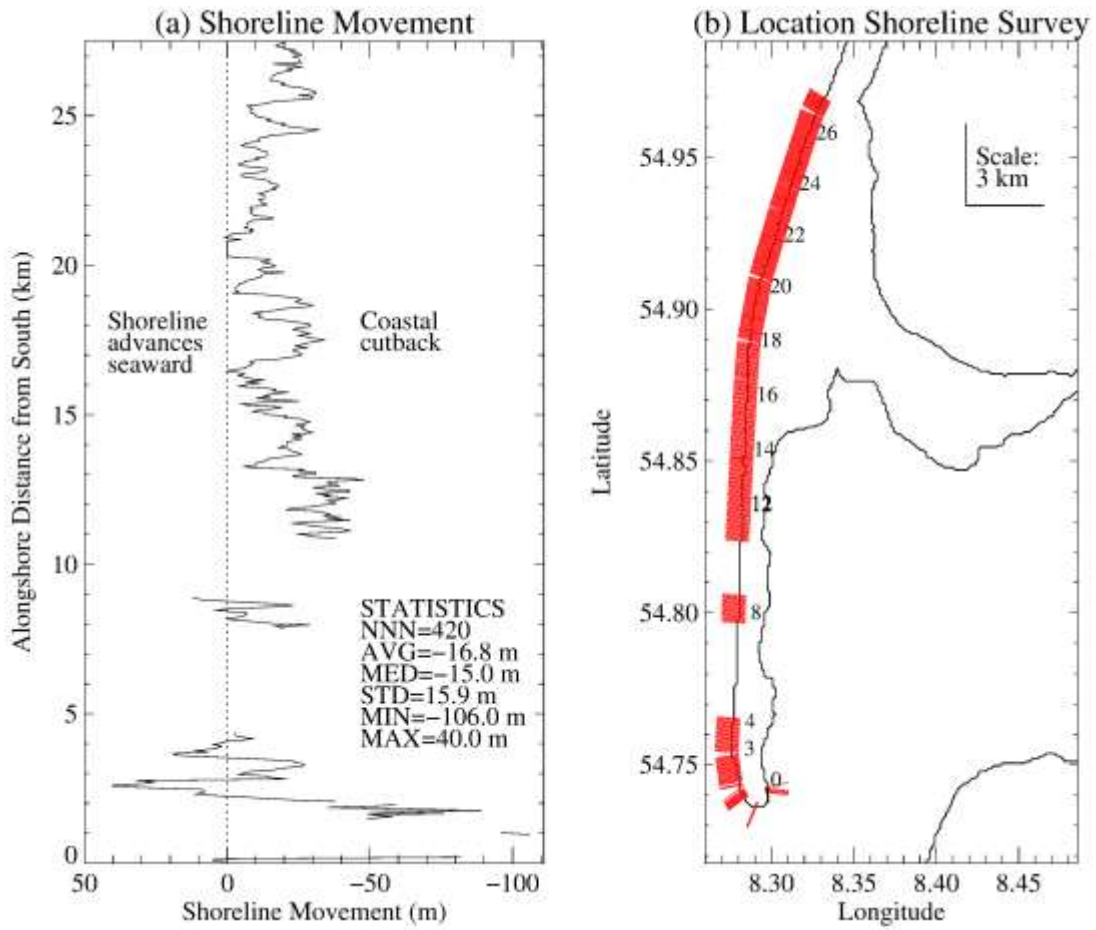


Figure S6.1. (a) Coastal retreat and advance (at the level +3.75 m above mean sea level) on the west coast of Sylt across the winter of 1989–1990. The profiles were measured on different dates in 1989 (ranging from 15 June to 15 December) and 1990 (ranging from 15 May to 15 June). (b) Map of location of location of survey profiles from which coastal advance and retreat were calculated. The numbers give the alongshore distance in kilometres from the first profile in the south. The data for this plot were sent by Theide-Erk Woeffler of the Landesbetrieb für Küstenschutz, Nationalpark, und Meereschutz Schleswig-Holstein, Germany.

SECTION S7. LOCATIONS OF MARITIME CASUALTIES DURING STORM DARIA

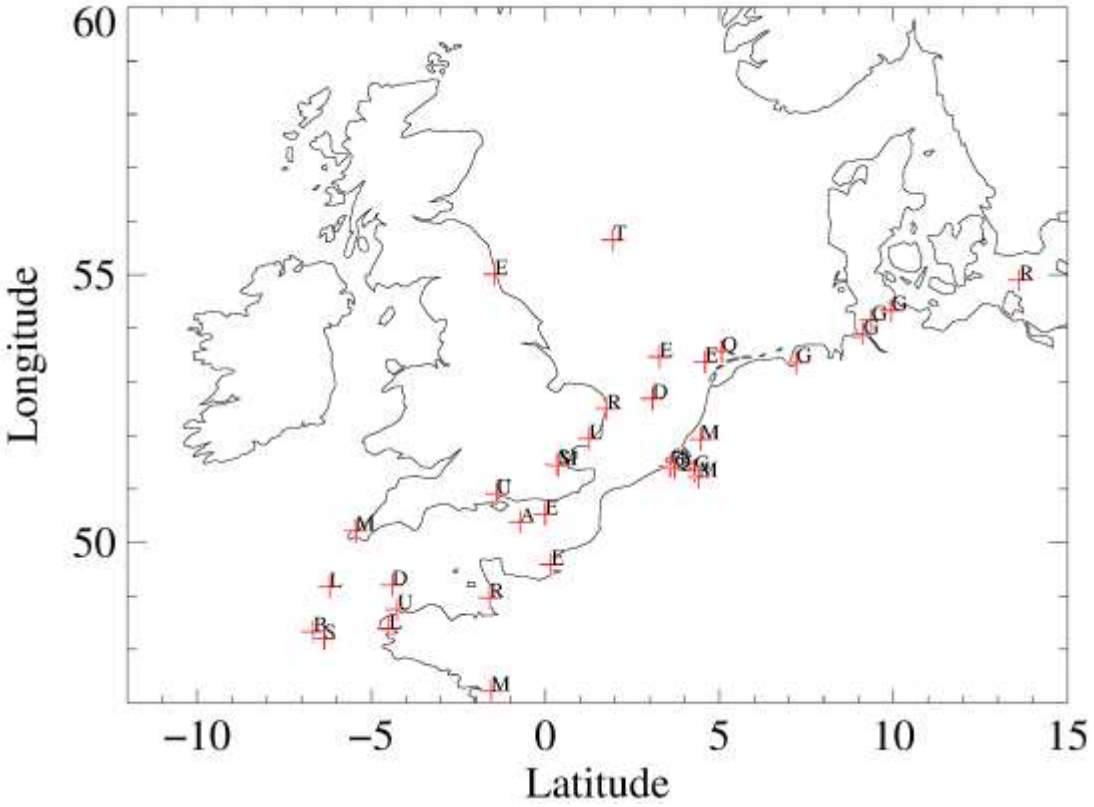


Figure S7.1. Locations of maritime casualties during Storm Daria 25–26 January 1990. The information is mostly from Lloyds Weekly Casualty Returns (19900206, 19900213) with additional information in Mariners Weather Log (1990). Serious offshore accidents occurred in the area of the English Channel, Celtic Sea, and Bay of Biscay, including two independent fatal accidents. A further fatal accident occurred in the western Baltic Sea. Several offshore accidents occurred in the North Sea, and there were many reported harbour incidents, mostly involving broken moorings.

SECTION S8. THEMATIC MAPS OF STORM IMPACTS

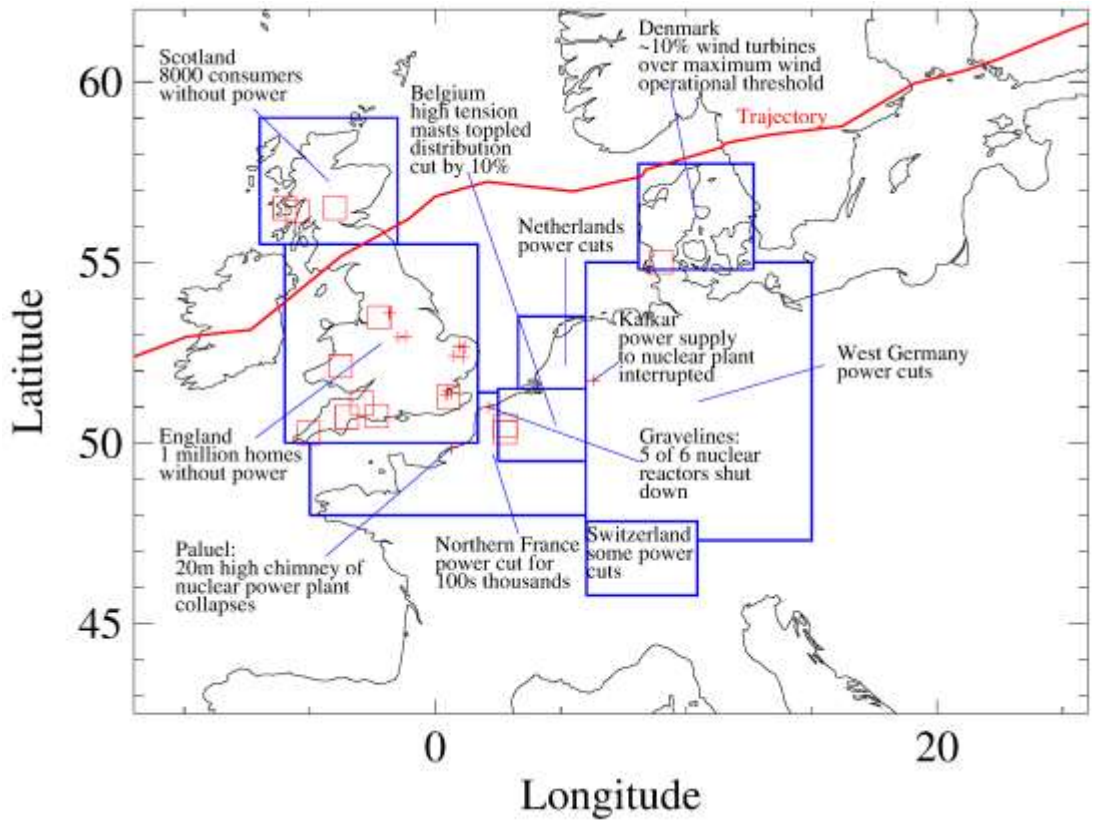


Figure S8.1. Thematic map of power outages, energy infrastructure damage, and wind turbine incidents that were reported in the literature for Storm Daria 25–26 January 1990. The trajectory of the low pressure centre is given by the thick red line. Blue boxes delimit countries and larger regions with a summary of energy impacts in black font. Red boxes smaller regions (English counties, French departements, etc.) with energy impacts. Three cases of problems at nuclear power plants are also indicated.

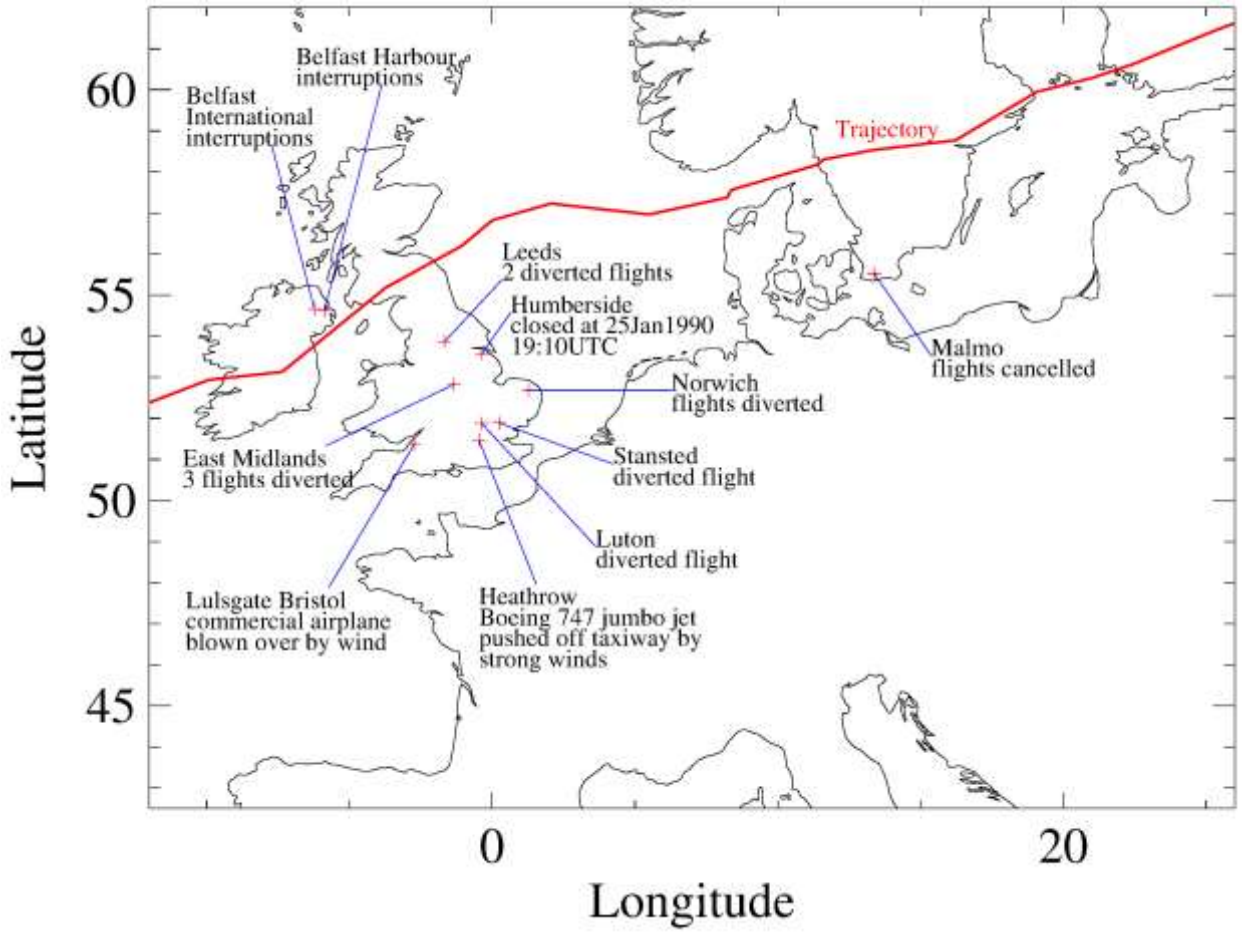


Figure S8.2. Thematic map of flight cancellations and air transport incidents that were reported in the literature for Storm Daria 25–26 January 1990. The trajectory of the low pressure centre is given by the thick red line.

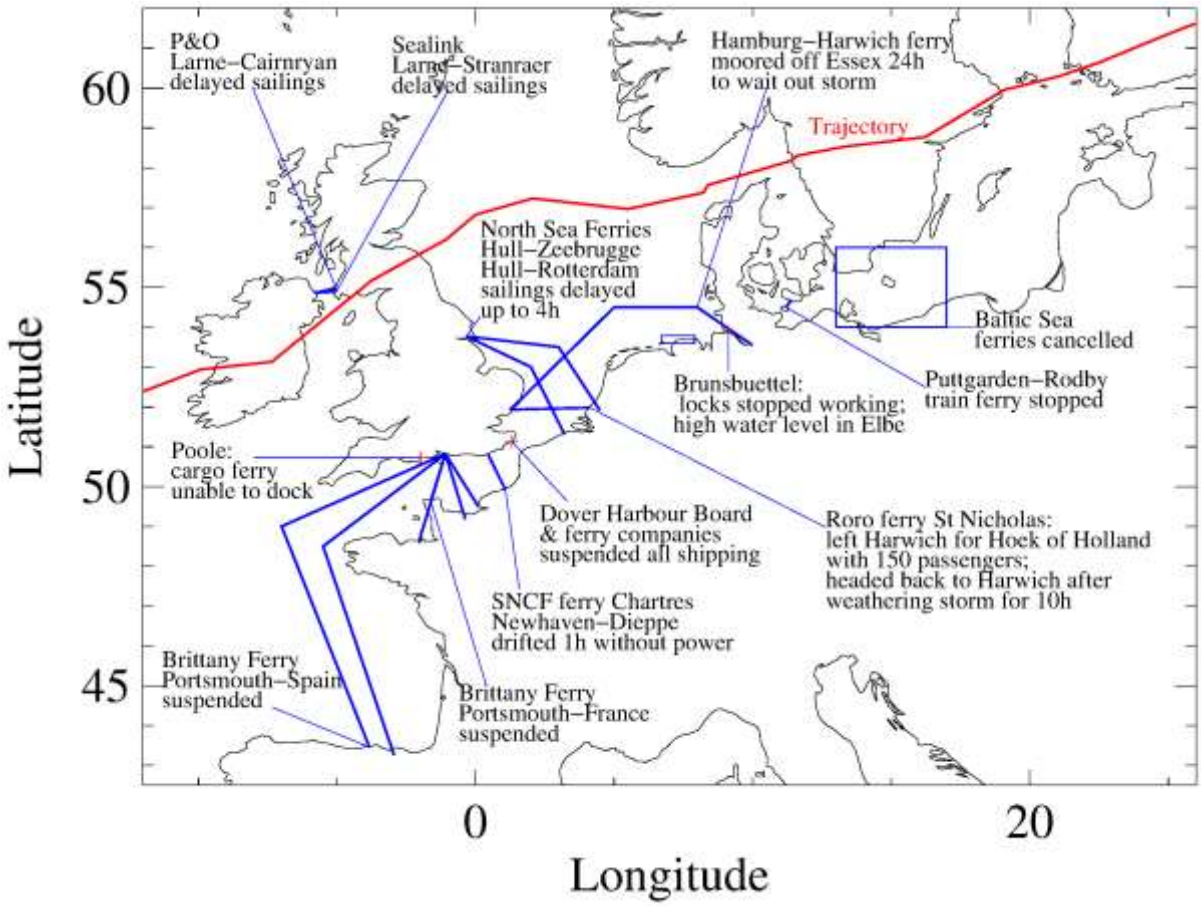


Figure S8.3. Thematic map of ferry and port interruptions that were reported in the literature for Storm Daria 25–26 January 1990. The trajectory of the low pressure centre is given by the thick red line.

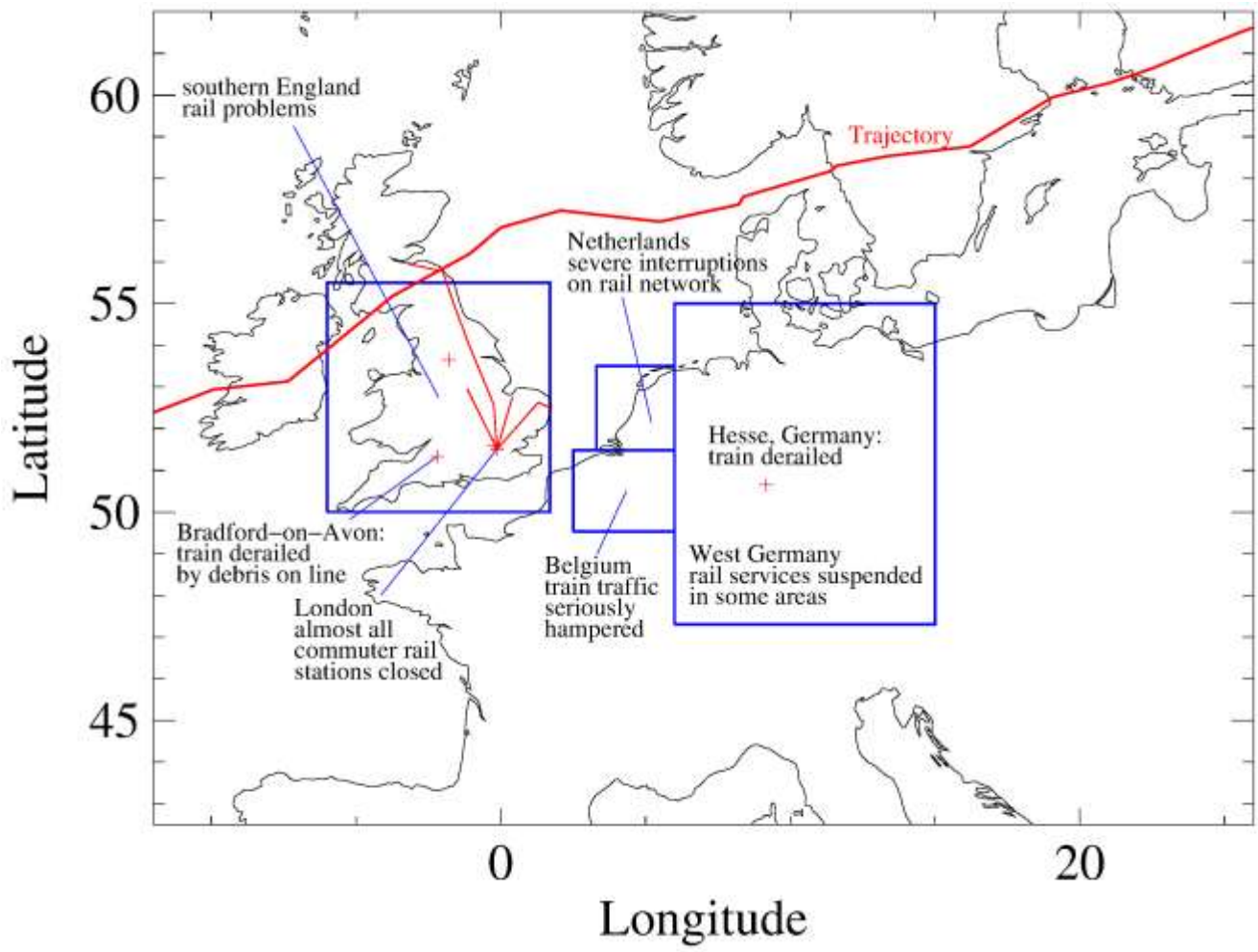


Figure S8.4. Thematic map of rail transport interruptions that were reported in the literature for Storm Daria 25–26 January 1990.

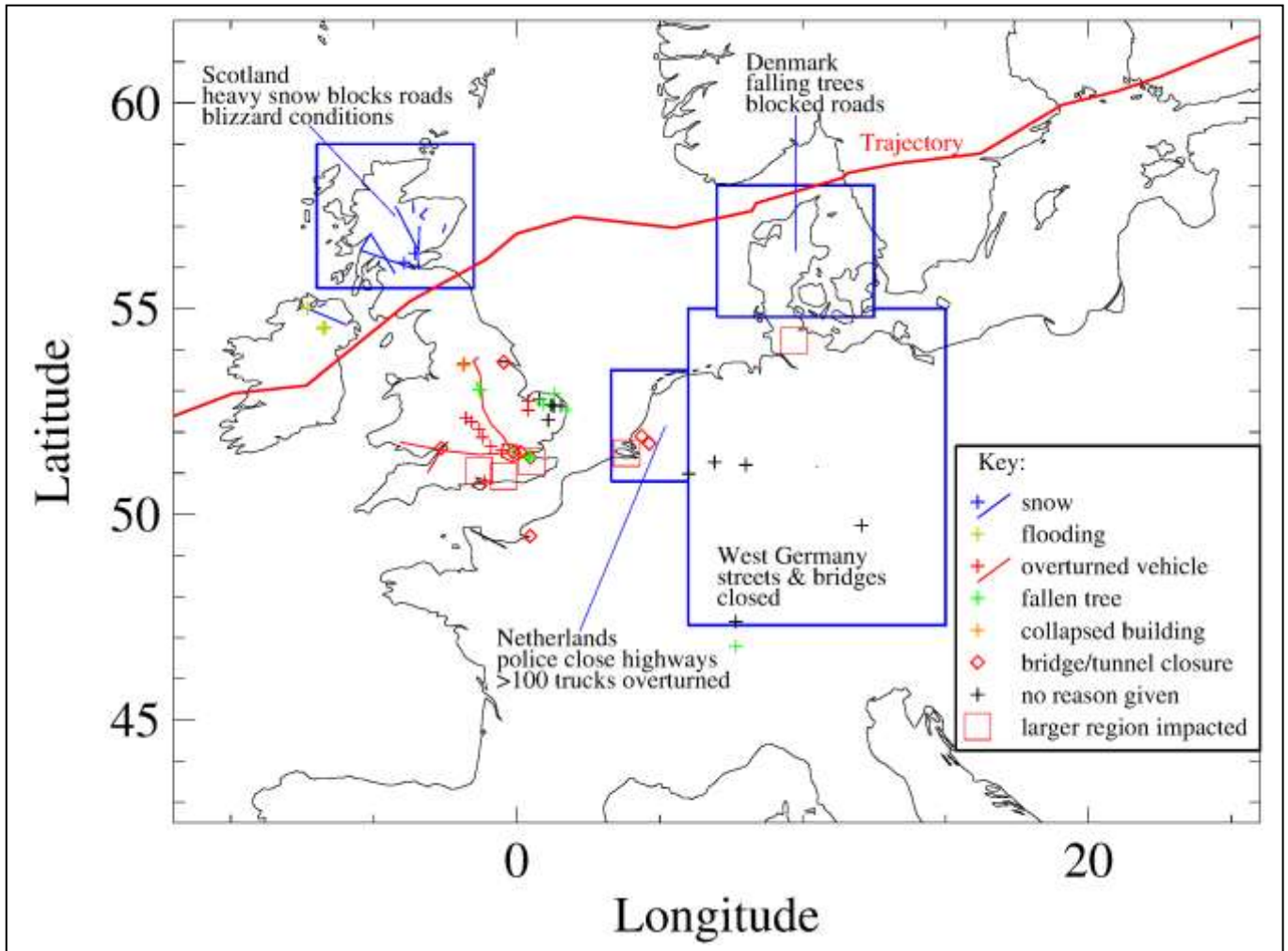


Figure S8.5. Thematic map of road transport interruptions that were reported in the literature for Storm Daria 25–26 January 1990. The trajectory of the low pressure centre is given by the thick red line.

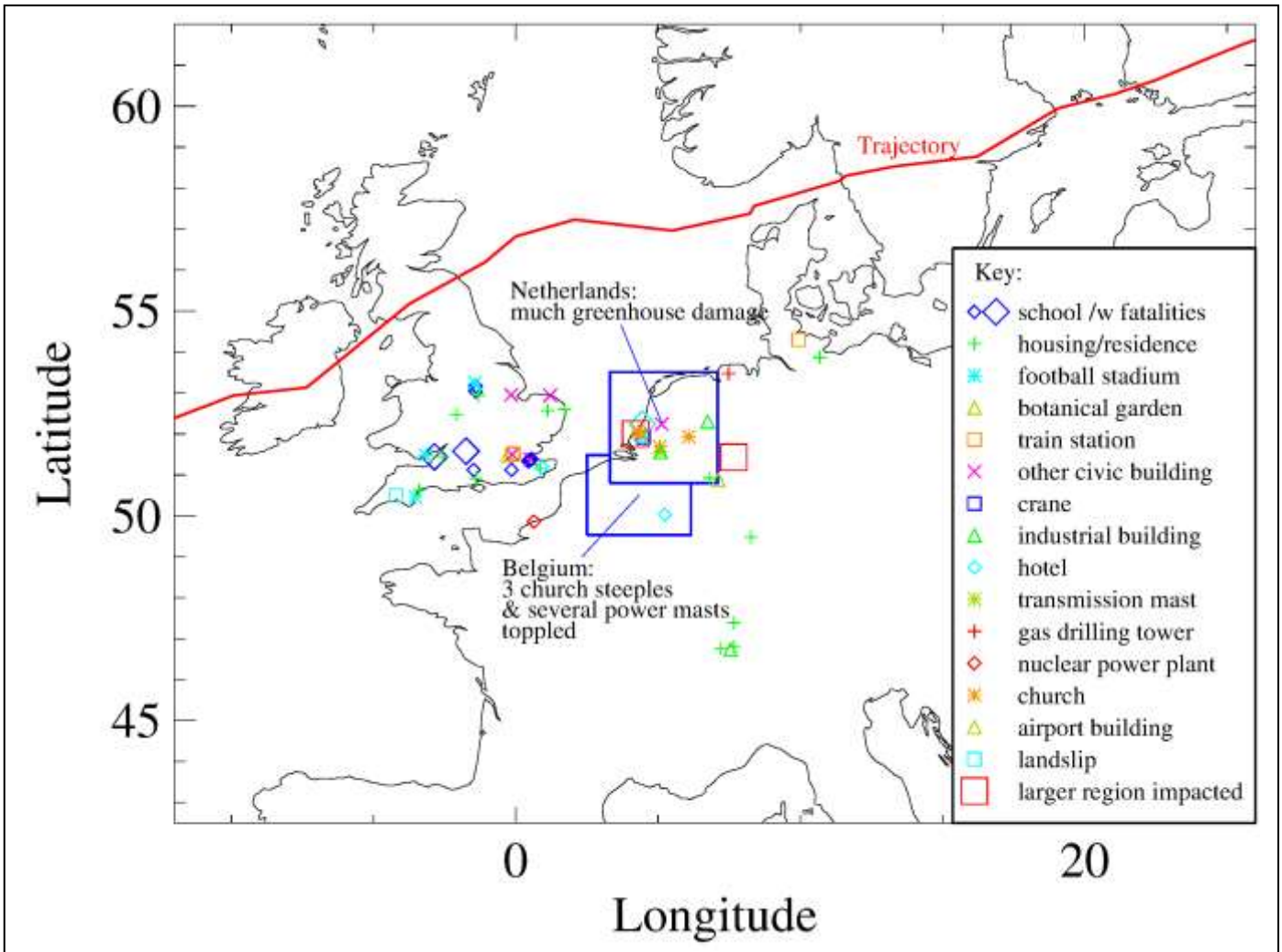


Figure S8.6. Thematic map of damage to buildings and monuments that were reported in the literature for Storm Daria 25–26 January 1990. The trajectory of the low pressure centre is given by the thick red line.

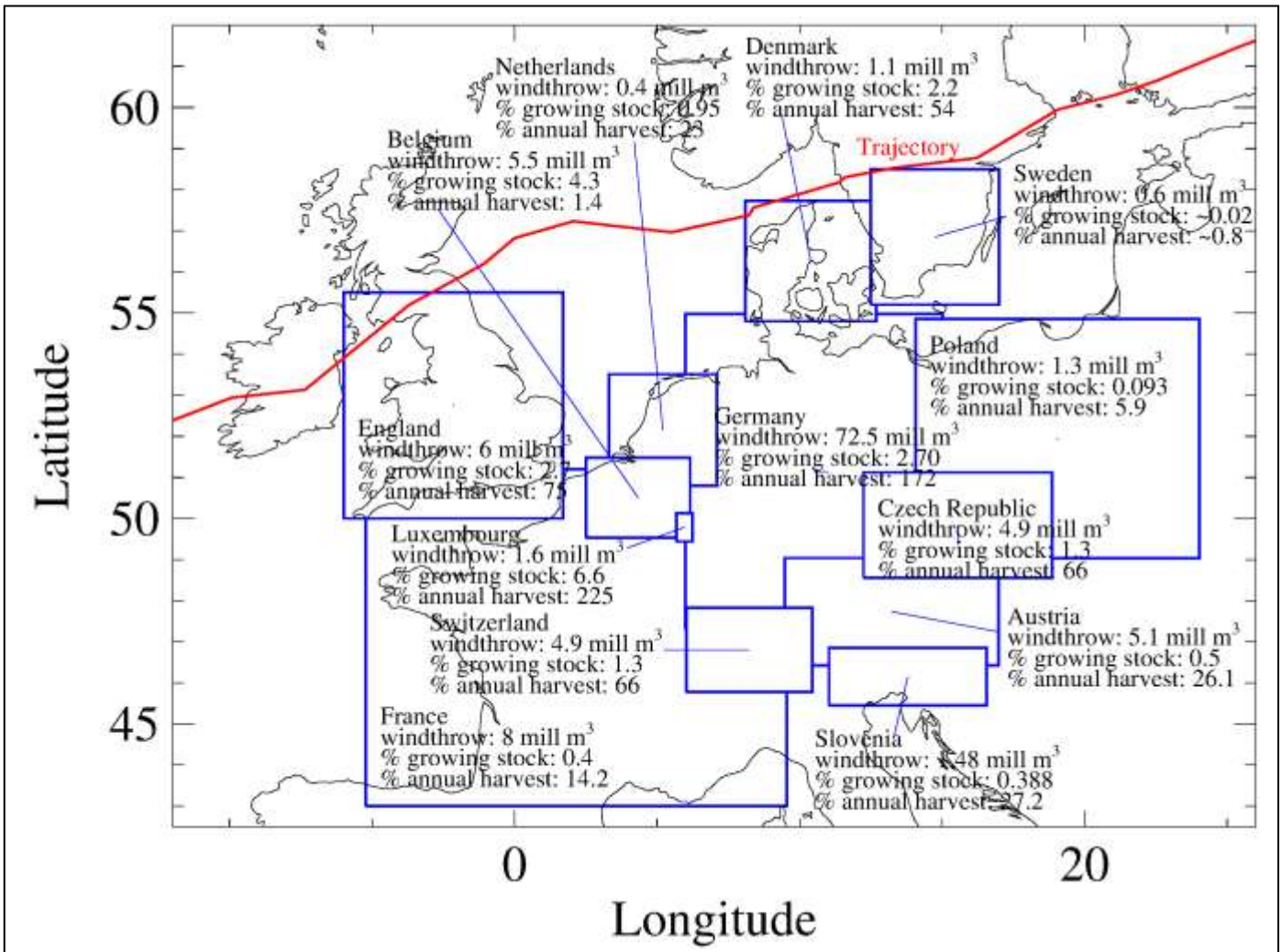


Figure S8.7. Thematic map of forest damage that was reported by Gardiner (2010) for the first three months of 1990. The trajectory of the low pressure centre is given by the thick red line. Most of the forest damage in the UK, the Netherlands, and Denmark would have been due to Storm Daria 25–26 January 1990.

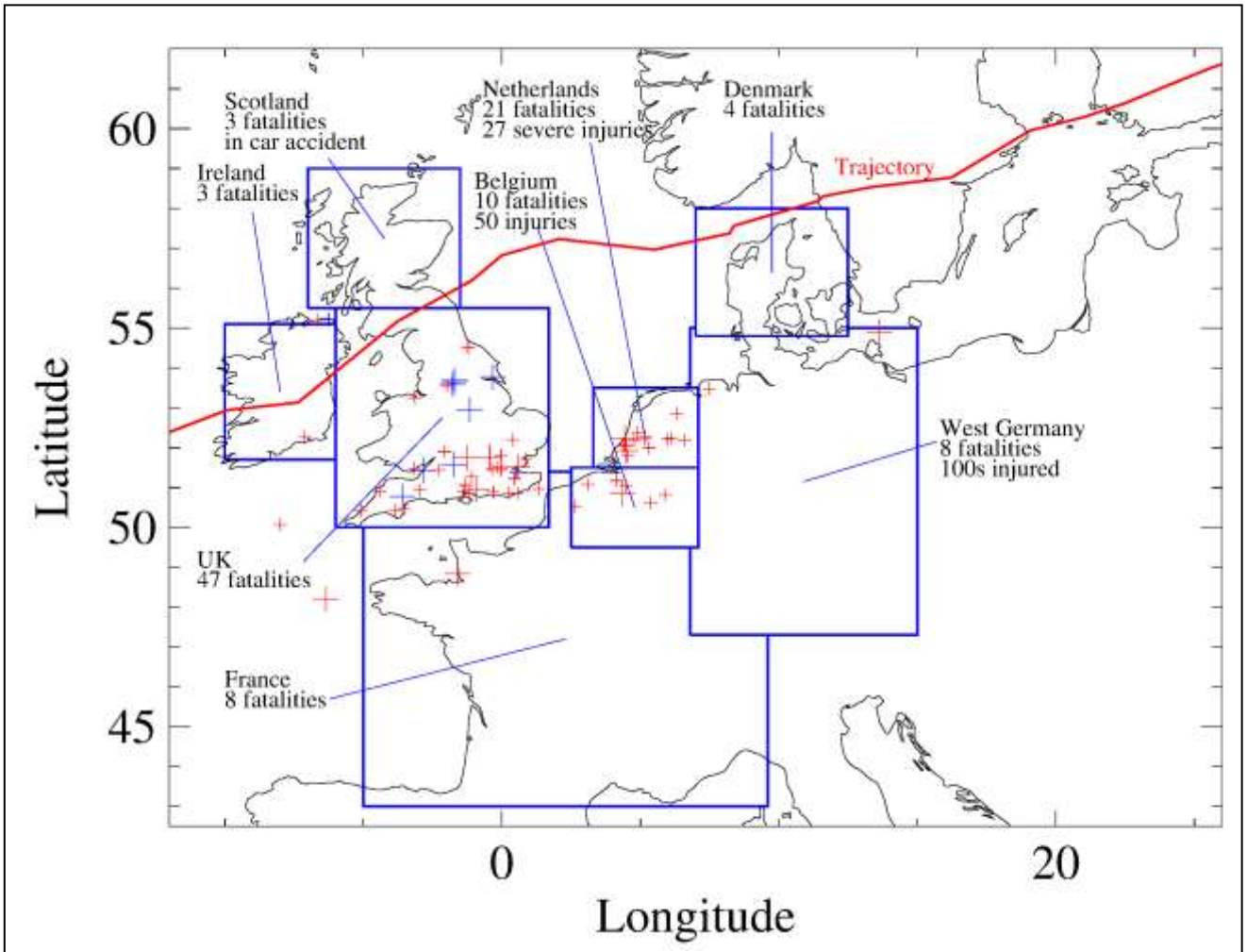


Figure S8.8. Thematic map of fatalities(red crosses) and injuries (blue crosses) that were reported in the literature for Storm Daria 25–26 January 1990. The smaller symbol size denotes a single fatality or injury; the larger symbol denotes multiple casualties. Most of the fatalities of this storm occur in a band across southern England, Belgium, and the Netherlands. The storm trajectory is plotted as a red line.

SECTION S9. WIND TURBINE IMPACTS IN DENMARK DURING STORM DARIA

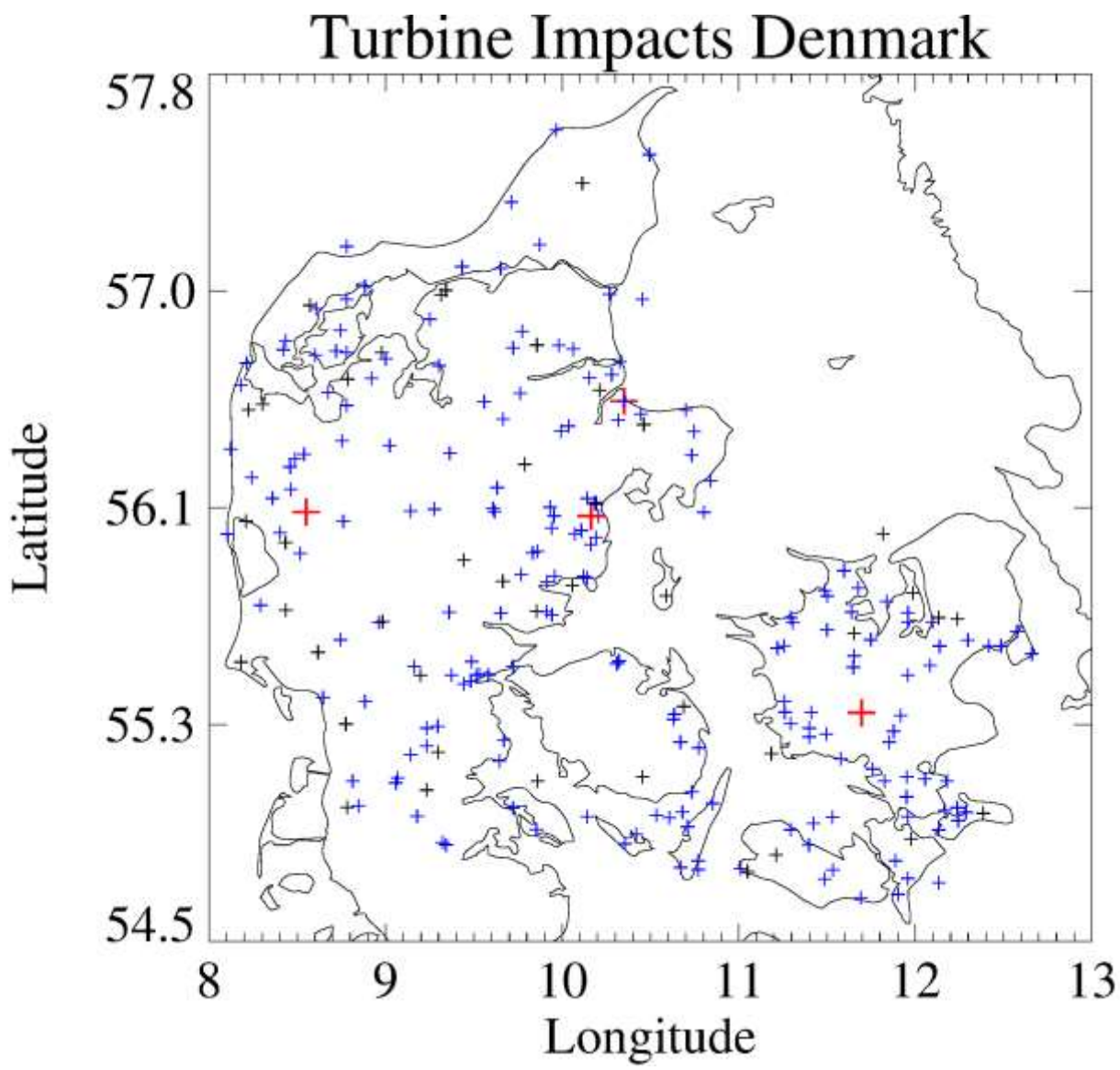


Figure S9.1. Map of turbine impacts in Denmark during Storm Daria. The map has been compiled from the remarks in the tabulated wind turbine operations data of Naturlig Energi (1990). Wind speeds exceeded the maximum operation threshold (~25 m/s) for turbine operation in many parts of Denmark, leading to turbine shut downs for different periods. This was registered as 'out of operation' keyword in the list of remarks (blue cross). Red crosses denote cases where a 'total destruction' keyword appears in the list of remarks, usually in relation to some mechanical subsystem of the turbine. There were a couple of cases of complete turbine collapse.

SECTION S10. TABLE OF TIDE GAUGE STATIONS USED IN THE INVESTIGATION

The following text is modified from the Supplement of Kettle (2023)

Table S10.1. Information on tide gauge data used in this study with source.

N	Station Name	Abb	Country	Latitude (degree)	Longitude (degree)	Δt orig (min)	Δt use (min)	Source
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1	Lerwick	LW	UK	60.15	−1.14	60	60	BODC
2	Wick	WK	UK	58.44	−3.09	60	60	BODC
3	Aberdeen	AB	UK	57.14	−2.07	60	60	BODC
4	Leith	LE	UK	55.99	−3.18	60	60	BODC
5	North Shields	NS	UK	55.01	−1.44	60	60	BODC
6	Whitby	WH	UK	54.49	−0.61	60	60	BODC
7	Immingham	IM	UK	53.63	−0.19	60	60	BODC
8	Cromer	CR	UK	52.93	1.30	60	60	BODC
9	Lowestoft	LT	UK	52.47	1.75	60	60	BODC
10	Felixstowe	FE	UK	51.96	1.35	60	60	BODC
11	Sheerness	SH	UK	51.44	0.74	60	60	BODC
12	Dover	DV	UK	51.12	1.32	60	60	BODC
13	Nieuwpoort	NI	BE	51.15	2.73	322	322	VLIZ
14	Ostend	OE	BE	51.23	2.92	334	334	VLIZ
15	Zeebrugge	ZB	BE	51.35	3.20	346	346	VLIZ
16	Cadzand	CZ	NE	51.38	3.38	10	10	RWS
17	Westkapelle	WL	NE	51.52	3.44	10	10	RWS
18	Vlissingen	VL	NE	51.44	3.60	10	10	RWS
19	Terneuzen	TE	NE	51.34	3.82	10	10	RWS
20	Hansweert	HS	NE	51.45	4.01	10	10	RWS
21	Roompot buiten	RM	NE	51.62	3.68	10	10	RWS
22	Bath	BA	NE	51.40	4.21	10	10	RWS
23	Bergse Diepsluis west	BD	NE	51.51	4.17	10	10	RWS
24	Stavenisse	SE	NE	51.60	4.01	10	10	RWS
25	Brouwershavensche Gat 08	BH	NE	51.75	3.83	10	10	RWS
26	Krammersluizen west	KM	NE	51.66	4.14	10	10	RWS
27	Stellendam buiten	SB	NE	51.83	4.03	10	10	RWS
28	Spijkenisse	SJ	NE	51.86	4.33	10	10	RWS
29	Maassluis	MA	NE	51.92	4.25	10	10	RWS
30	Hoek van Holland	HH	NE	51.98	4.12	10	10	RWS
31	Vlaardingen	VD	NE	51.90	4.35	10	10	RWS
32	Dordrecht	DD	NE	51.82	4.67	10	10	RWS
33	Krimpen a/d Lek	KL	NE	51.89	4.63	10	10	RWS
34	Krimpen a/d IJssel	KI	NE	51.92	4.58	10	10	RWS
35	Scheveningen	SC	NE	52.10	4.26	10	10	RWS
36	Schoonhoven	SO	NE	51.94	4.85	10	10	RWS
37	Noordwijk meetpost	NO	NE	52.27	4.29	10	10	RWS
38	IJmuiden buitenhaven	IJ	NE	52.46	4.55	10	10	RWS
39	Petten zuid	PZ	NE	52.77	4.65	10	10	RWS
40	Den Helder	DH	NE	52.96	4.74	10	10	RWS

Table S10.1 (continued).

N [1]	Station Name [2]	Abb [3]	Country [4]	Latitude (degree) [5]	Longitude (degree) [6]	Δt orig (min) [7]	Δt use (min) [8]	Source [9]
41	Den Oever buiten	DO	NE	52.93	5.05	10	10	RWS
42	Oudeschild	OS	NE	53.04	4.85	10	10	RWS
43	Texel Noordzee	TX	NE	53.12	4.73	10	10	RWS
44	Kornwerderzand buiten	KW	NE	53.07	5.34	10	10	RWS
45	Vlieland haven	VH	NE	53.30	5.09	10	10	RWS
46	Harlingen	HL	NE	53.18	5.41	10	10	RWS
47	West–Terschelling	TL	NE	53.36	5.22	10	10	RWS
48	Terschelling Noordzee	TN	NE	53.44	5.33	10	10	RWS
49	Nes	NE	NE	53.43	5.76	10	10	RWS
50	Holwerd	HD	NE	53.40	5.88	10	10	RWS
51	Wierumergronden	WG	NE	53.52	5.96	10	10	RWS
52	Lauwersoog	LR	NE	53.41	6.20	10	10	RWS
53	Schiermonnikoog	SM	NE	53.47	6.20	10	10	RWS
54	Huibertgat	HG	NE	53.57	6.40	10	10	RWS
55	Eemshaven	EE	NE	53.45	6.83	10	10	RWS
56	Delfzijl	DF	NE	53.33	6.93	10	10	RWS
57	Nieuwe Statenzijl	NZ	NE	53.23	7.21	10	10	RWS
58	K13a platform	KP	NE	53.22	3.22	10	10	RWS2
59	Euro platform	EU	NE	52.00	3.28	10	10	RWS2
60	Lichteiland Goeree	LG	NE	51.92	3.67	10	10	RWS2
61	Bremen–Grosse–Weserbruecke	BW	DE	53.07	8.80	300	300	BAFG
62	Knock	KN	DE	53.33	7.04	400	400	BAFG
63	Emden	EM	DE	53.34	7.20	397	397	BAFG
64	Borkum–Fischerbalje	BF	DE	53.56	6.75	400	400	BAFG
65	Zollenspieker	ZO	DE	53.40	10.19	261	261	BAFG
66	WHV–Alter_Vorhafen	WV	DE	53.51	8.14	373	373	BAFG
67	Hamburg–St. Pauli	HB	DE	53.55	9.97	306	306	BAFG
68	Norderney–Riffgat	ND	DE	53.70	7.16	394	394	BAFG
69	Hetlingen	HE	DE	53.61	9.54	318	318	BAFG
70	Stadersand	SD	DE	53.63	9.53	319	319	BAFG
71	Langeoog	LA	DE	53.73	7.51	386	386	BAFG
72	Spiekeroog	SP	DE	53.75	7.68	397	397	BAFG
73	Wangerooge–West	WW	DE	53.78	7.86	395	395	BAFG
74	Mellumplate	MP	DE	53.77	8.09	403	403	BAFG
75	Wangerooge–Nord	WN	DE	53.81	7.93	408	408	BAFG
76	Kollmar	KO	DE	53.73	9.46	330	330	BAFG
77	Glueckstadt	GL	DE	53.78	9.41	335	335	BAFG
78	LT Alte Weser	AW	DE	53.86	8.13	400	400	BAFG
79	Cuxhaven–Steubenhoeft	CU	DE	53.87	8.72	415	415	BAFG
80	Brunsbuettel	BR	DE	53.89	9.14	436	436	BAFG

Table S10.1 (continued).

N	Station Name	Abb	Country	Latitude (degree)	Longitude (degree)	Δt orig (min)	Δt use (min)	Source
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
81	Mittelgrund	MG	DE	53.94	8.63	420	420	BAFG
82	Zehnerloch	ZE	DE	53.95	8.66	417	417	BAFG
83	Scharhoern	SN	DE	53.97	8.46	409	409	BAFG
84	Buesum	BU	DE	54.12	8.86	382	382	BAFG
85	Helgoland–Binnenhafen	HF	DE	54.18	7.90	425	425	BAFG
86	Eider Sperrwerk	EI	DE	54.26	8.84	447	447	BAFG
87	Husum	HU	DE	54.47	9.02	409	409	BAFG
88	Pellworm	PW	DE	54.50	8.70	373	373	BAFG
89	Wittduen	WI	DE	54.63	8.39	409	409	BAFG
90	Dagebuell	DA	DE	54.73	8.69	407	407	BAFG
91	Hoernum	HR	DE	54.76	8.31	375	375	BAFG
92	List	LS	DE	55.02	8.45	380	380	BAFG
93	Hojer	HO	DK	54.96	8.66	30	30	KDI
94	Havneby	HY	DK	55.09	8.57	30	30	KDI
95	Ballum	BM	DK	55.13	8.69	30	30	KDI
96	Hvide Sande (Havn)	HV	DK	56.00	8.12	30	30	KDI
97	Thorsminde (Havn)	TS	DK	56.37	8.12	30	30	KDI
98	Thyboron (Havn)	TH	DK	56.71	8.22	30	30	KDI
99	Hirtshals	HI	DK	57.60	9.96	15	15	KDI2
100	Hanstholm	HA	DK	57.12	8.60	15	15	KDI2
101	Stavanger	SV	NO	58.97	5.73	10	10	Kartv
102	Bergen	BG	NO	60.39	5.33	10	10	Kartv
103	Maloy	MY	NO	61.94	5.11	10	10	Kartv

Notes:
[1] Station running index
[2] Station name
[3] Station abbreviation used in figures of the main manuscript
[4] Country
[5] Latitude
[6] Longitude
[7] Data reporting interval in minutes
[8] Data time interval used in analysis
[9] Source:
BODC: (British Oceanographic Data Centre; water level data from the primary tide gauge packed with the residual water level after subtraction of the BODC model tide): https://bodc.ac.uk/data/hosted_data_systems/sea_level/uk_tide_gauge_network/
VLIZ: (Vlaams Instituut voor de Zee) Ellen Lenaers of the Vlaams Ministerie van Mobiliteit en Openbare Werken (MOW) emailed time series records of high water and low water values for Nieuwpoort, Ostend, and Zeebrugge for 1990
RWS: (Rijkswatersaat Waterinfo) https://waterinfo.rws.nl/#/ (levels with respect common level reference of country)
RWS2: (Rijkswatersaat Waterinfo) https://waterinfo.rws.nl/#/ (offshore stations whose levels have a local reference)
BAFG: (Bundesanstalt fuer Gewaesserkunde) email communication with Wilfried Wiechmann at Datenstelle-M1@bafg.de
KDI: (Kystdirektoratet) https://kyst.dk/hav-og-anlaeg/maalinger-og-data/vandstandsmaalinger
KDI2: (Kystdirektoratet; data from gauges operated by Danish harbour authorities) email communication with Bjørn Frederiksen bfr@kyst.dk
Kartv: (Kartverket) https://www.kartverket.no/til-sjos/se-havniva

Table S10.2. Summary of Rejected Stations

Station	Country	Reason
Brouwershavensche gat punt 02	Netherlands	Model data absent
Haringvliet 10	Netherlands	Model data absent
Keizersveer	Netherlands	Entire measurement series bad
Oosterschelde 11	Netherlands	Model data absent
Vlakte van de Raan	Netherlands	Model data absent
Yerseke	Netherlands	Model data absent
Zeelandbrug noord	Netherlands	Model data absent
Pinnau Sperrwerk BP	Germany	Measurement series bad
Toenning	Germany	Measurement series bad
Esbjerg	Denmark	Data gaps >1 day
Ribe	Denmark	Data gaps >1day
Thorsminde (havet)	Denmark	Data gaps >2 h
Hvide Sand (Fjord)	Denmark	Measurement series bad
Tregde	Norway	Data gaps >1 day

SECTION S11. SAMPLE POWER SPECTRUM OF TIDE GAUGE WATER LEVEL DATA

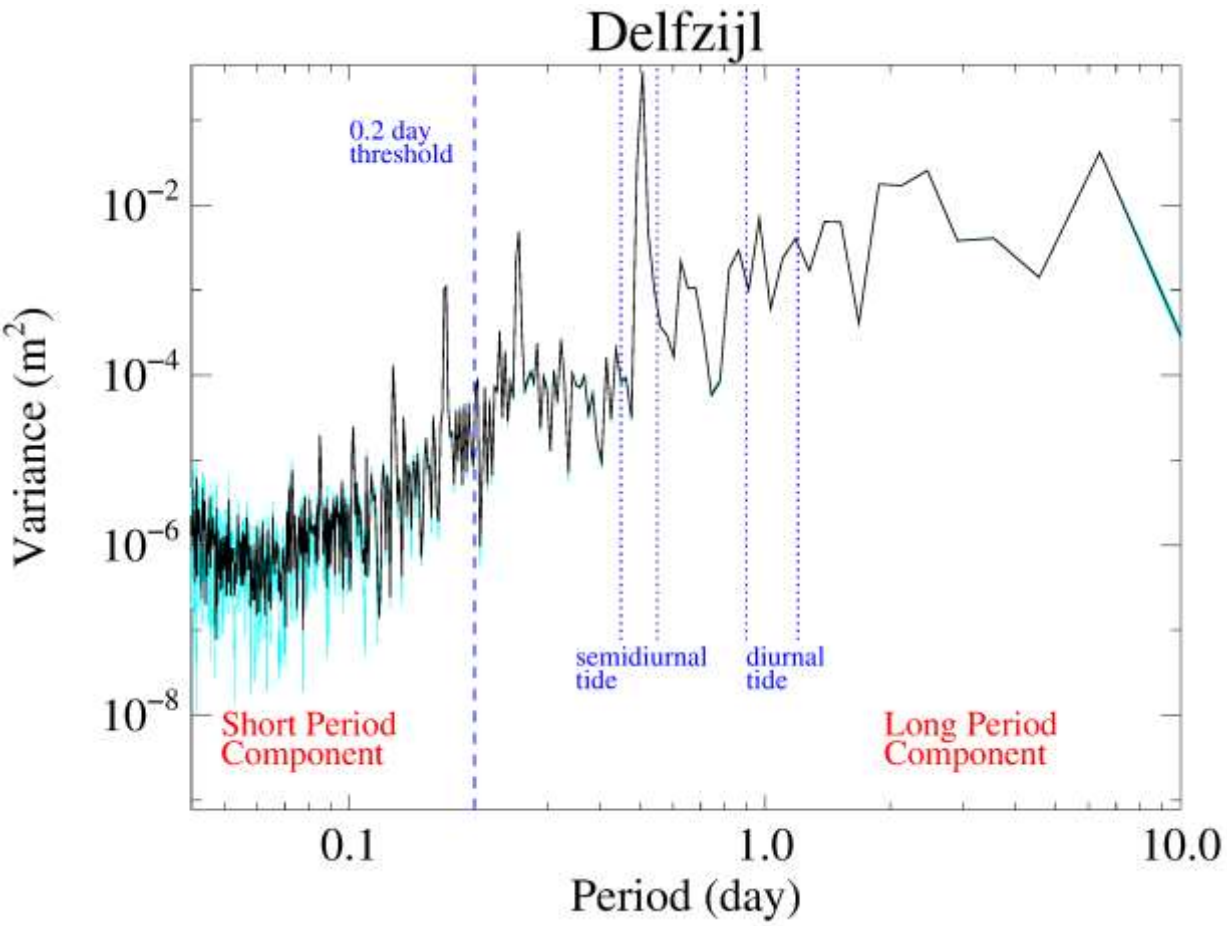


Figure S11.1. Sample spectrum of water level for Delfzijl in the Netherlands across the 16 day period 14–29 January 1990 (inclusive). The 0.2 day threshold separating the short period and long period components of the time series reconstructions is shown, as well as the thresholds defining the diurnal and semidiurnal components that were used to de-tide the time series. The uncertainty in the spectrum (light blue line) calculated as the standard deviation of three spectra derived from re-sampling the time series at every third point.

SECTION S12. TIDE GAUGE LEVELLING DIFFERENCES AND SURGE CORRECTIONS

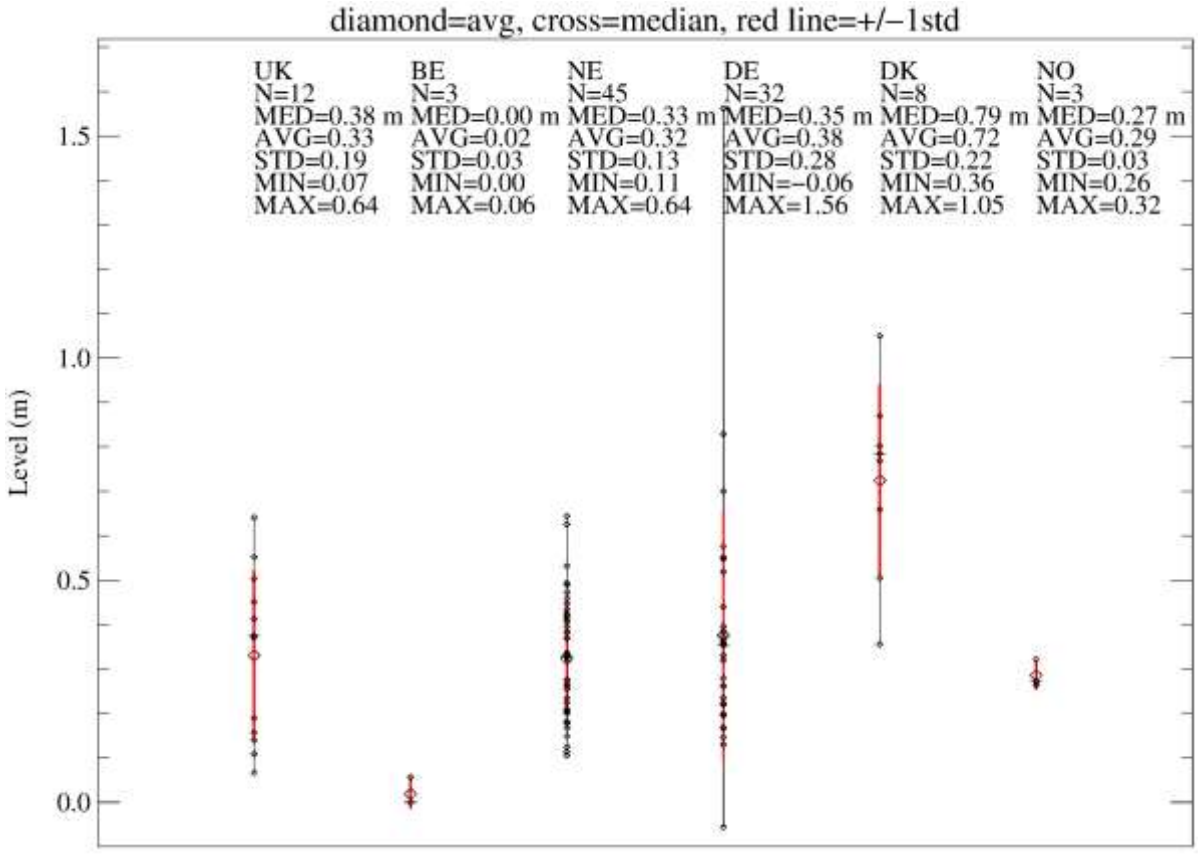


Figure S12.1. Difference of the reported mean sea level and the 16 day median level calculated from the tide gauge data for the period 14–29 January 1990. The station differences have been separated by country, and statistics from the country collections have been calculated. The reason for the apparent bias is not clear.

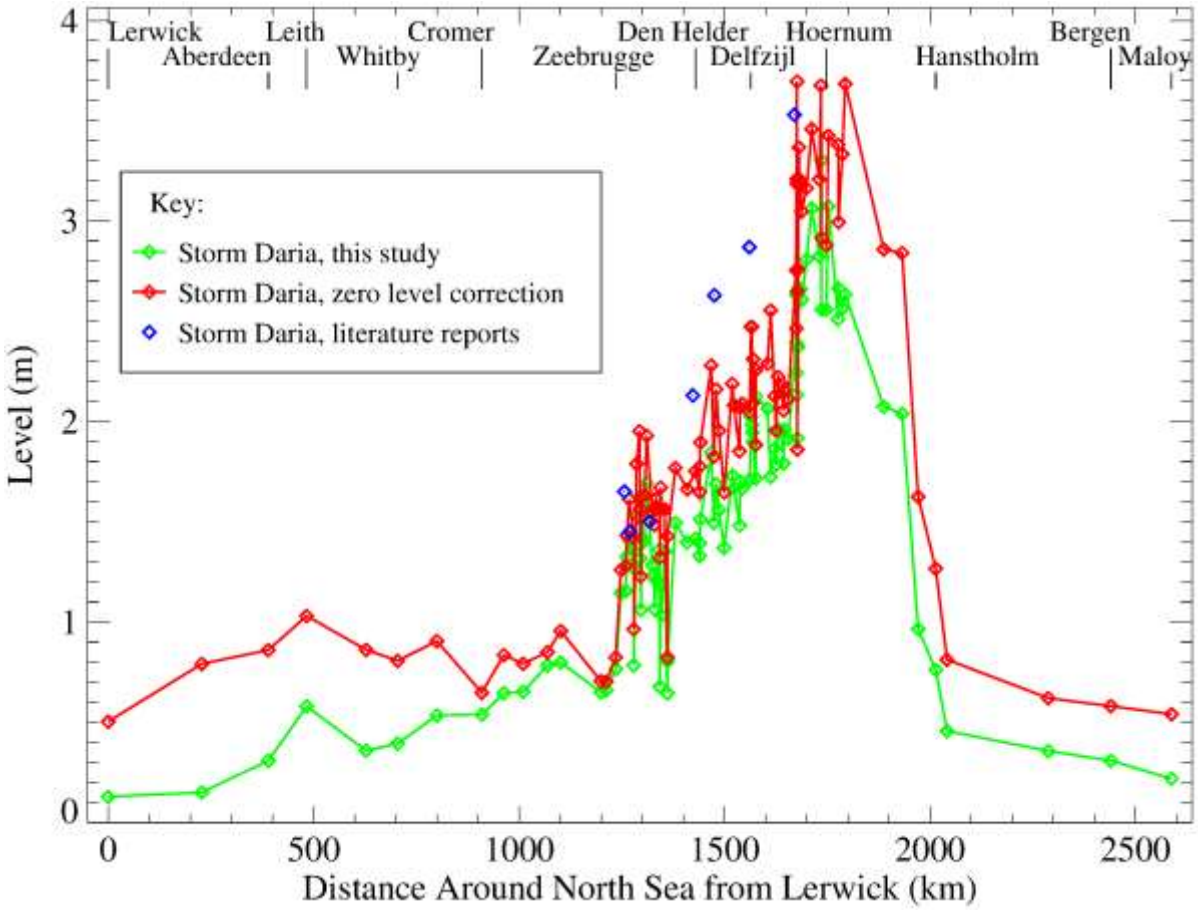


Figure S12.2. Maximum surge height for stations around the North Sea during Storm Daria on 25–26 January 1990 (green line). This is calculated as the detrended maximum water level minus the diurnal and semidiurnal. The red line shows the results when a zero level correction is applied between the reported mean sea level of the tide gauge and median of the trend line fitted to the 16 day time series. Blue diamonds show literature reports of surge levels. Better agreement between the surge levels in the present survey with literature values is obtained when the zero-level correction is applied.

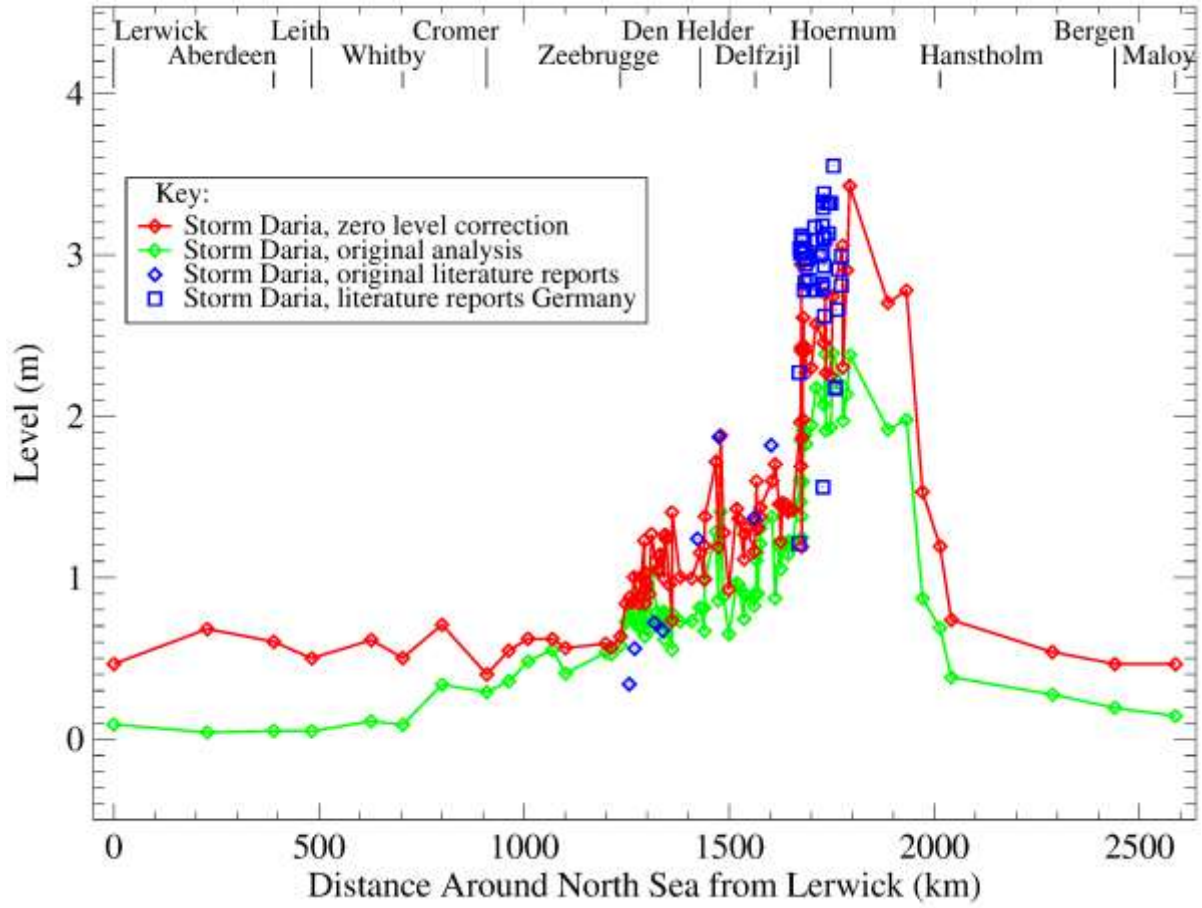


Figure S12.3. Maximum skew surge height for stations around the North Sea during Storm Daria on 25–26 January 1990 (green line). This has been calculated as the detrended maximum water level minus the nearest modelled high tide level. The red line shows the results when a zero level correction is applied between the reported mean sea level of the tide gauge and median of the trend line fitted to the 16 day time series. Blue diamonds show literature reports of surge levels (blue squares for the literature reports of Germany). Better agreement between the skew surge results in the present survey with literature values is obtained when the zero-level correction is applied.

SECTION S13. TABLE OF MARITIME ACCIDENTS AND INCIDENTS 25–26 JANUARY 1990

Table S13.1. Information for the maritime accidents and offshore events in the North Sea for 25–26 January 1990.

N [1]	Ship/Platform Name or Incident [2]	Abb [3]	Lati–tude (deg) [4]	Longi–tude (deg) [5]	Date (UTC) dd/mm/yyyy [6]	Time UTC hh:mm [7]	Uncer tainty (h) [8]	Source [9]
1	Dover Star	DOV	53.47	3.28	25/01/1990	20:29	0.0	LWCR_19900206
2	White Stone	WHI	51.43	3.58	25/01/1990	19:00	0.0	LWCR_19900206
3	Briz	BRZ	53.38	4.59	25/01/1990	19:17	0.0	LWCR_19900206
4	Impulsion	IMP	52.49	1.77	26/01/1990	00:38	0.0	LWCR_19900206
5	Hunter	HUN	55.65	1.95	26/01/1990	00:42	0.0	LWCR_19900206
6	Sea Girl	SEA	55.01	−1.45	26/01/1990	01:41	0.0	LWCR_19900206
7	Faust	FAU	51.35	4.28	25/01/1990	16:15	0.0	LWCR_19900206
8	Feederman	FEE	54.33	9.94	25/01/1990	12:00	12.0	LWCR_19900206
9	Arcturus	ARC	54.15	9.37	26/01/1990	12:00	12.0	LWCR_19900206
10	Weston	WES	53.90	9.13	26/01/1990	12:00	12.0	LWCR_19900206
11	Trans Fennia	TRA	51.44	0.37	25/01/1990	13:00	0.0	LWCR_19900206
12	Baltic Eagle	BAL	52.69	3.08	25/01/1990	17:14	0.0	LWCR_19900213
13	Corsham	COR	51.46	0.34	25/01/1990	17:50	0.0	LWCR_19900213
14	crane barge	CRA	51.44	0.40	26/01/1990	08:00	0.0	LWCR_19900213
15	Linde II	LIN	53.36	7.21	25/01/1990	12:00	12.0	LWCR_19900213
16	Allegra	ALL	51.94	1.26	26/01/1990	20:25	0.0	LWCR_19900213
17	Dilos	DIL	51.93	4.46	25/01/1990	12:00	12.0	LWCR_19900213
18	Rollon	ROL	51.93	4.46	25/01/1990	12:00	12.0	LWCR_19900213
19	Ebo	EBO	51.43	3.58	25/01/1990	12:00	12.0	LWCR_19900213
20	Funchal	FUN	53.58	5.07	26/01/1990	06:00	6.0	LWCR_19900213
21	Auto Atlas	AUT	51.40	3.72	26/01/1990	12:00	12.0	LWCR_19900213
22	Brightlingsea	BRI	51.94	1.26	25/01/1990	12:00	12.0	LWCR_19900213
23	River Asab	RIV	51.22	4.41	25/01/1990	12:00	12.0	LWCR_19900213

Notes:
[1] Running index of event
[2] Ship/platform name or wave measuring instrument with incident number
[3] Abbreviation used in figures of main manuscript
[4] Latitude
[5] Longitude
[6] Date of incident
[7] Time of incident
[8] Source:
LWCR_19900206: Lloyd's Weekly Casualty Returns: Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990
LWCR_19900213: Lloyd's Weekly Casualty Returns: Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990

SECTION S14. MAXIMUM SURGE RESIDUAL

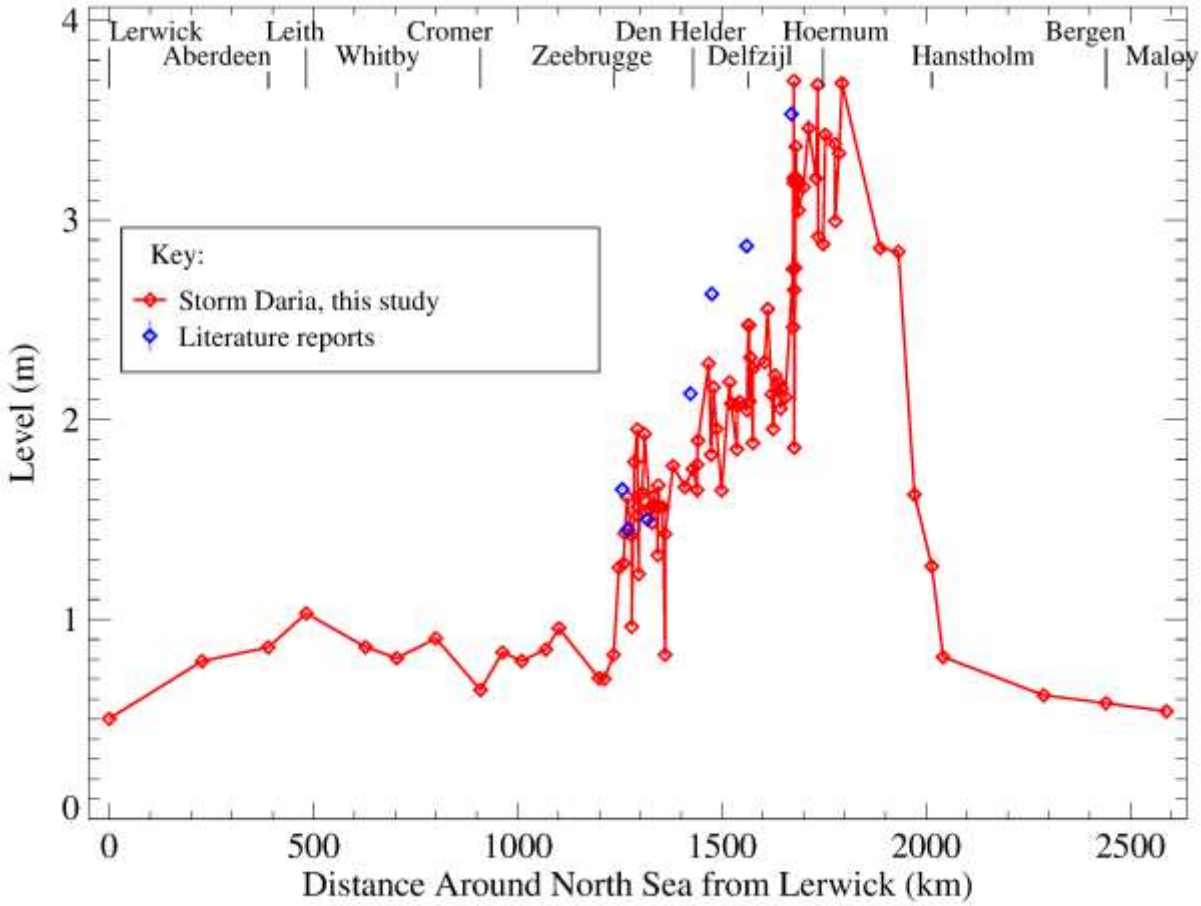


Figure S14.1. Maximum surge residual during Storm Daria on 25–26 January 1990 versus coastal distance around the North Sea starting from Lerwick in Scotland. The values of this study have been adjusted to compare with literature values (blue) by adding the difference in the calculated average sea level of the ~2 week data segment and official sea level presented with the data.

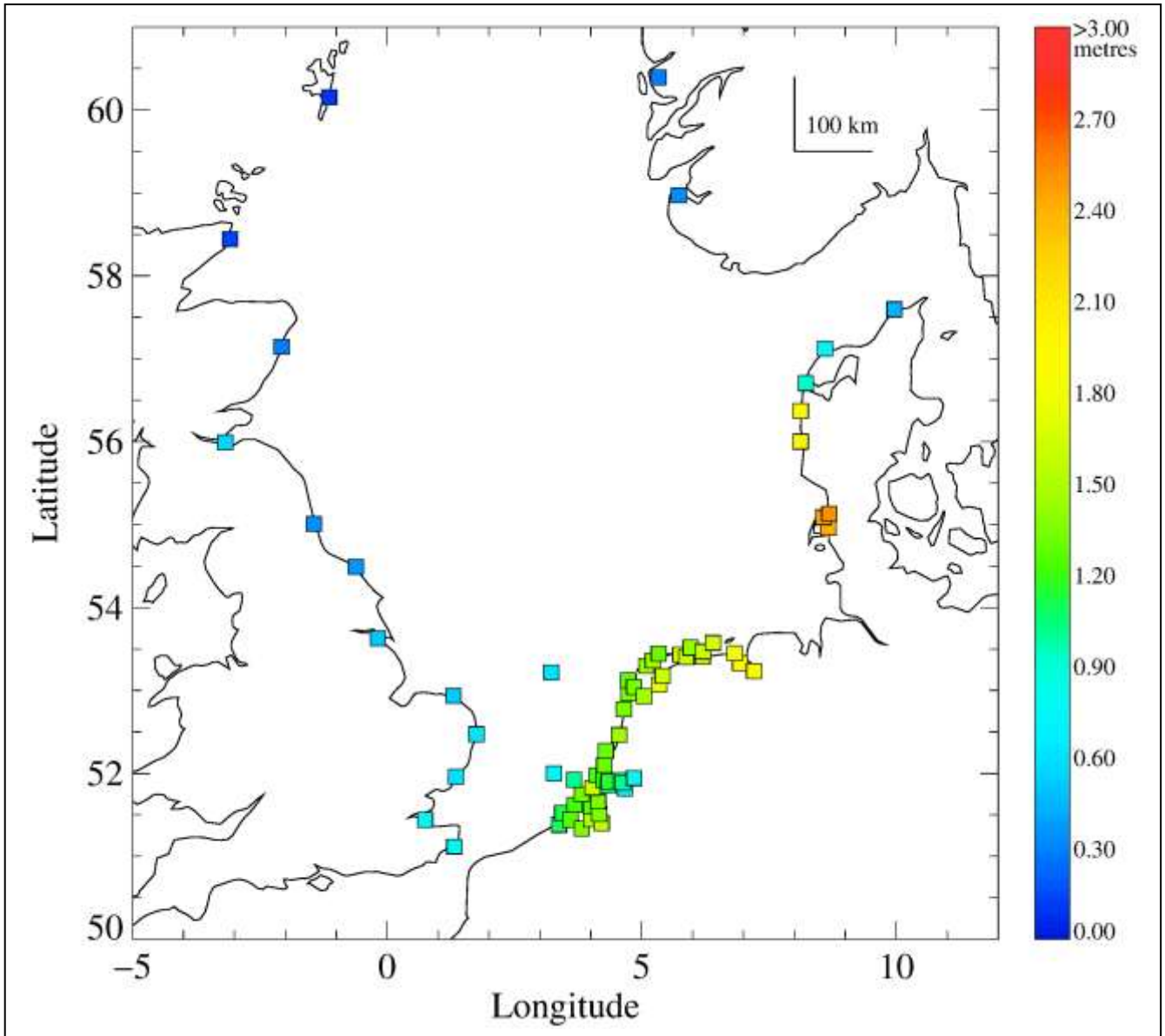


Figure 14.2. Map of maximum surge residual for tide gauge stations around the North Sea during Storm Daria on 25–26 January 1990.

SECTION S15. RETURN PERIOD OF WATER LEVELS FROM THE LITERATURE

Table S15.1. Sorted list of return periods of highest water levels during Storm Daria on 25–26 January 1990.

N	Location	Country	Latitude (degree)	Longitude (degree)	Return Period (year)	Case
[1]	[2]	[3]	[4]	[5]	[6]	[7]
1	Hvide Sande Havn	DK	56.00	8.10	92	7:NTSLF13
2	Esbjerg	DK	55.50	8.40	74	5:kdi18
3	Hvide Sand Havn	DK	56.00	8.10	55	5:kdi18
4	Thorsminde Havn	DK	56.40	8.10	50	5:kdi18
5	Ribe Kammersluse	DK	55.30	8.70	35	5:kdi18
6	Ballum	DK	55.10	8.70	33	5:kdi18
7	List–Hafen	DE	55.02	8.44	20	1:RP
8	Hojer	DK	55.00	8.70	18	5:kdi18
9	Havneby	DK	55.10	8.60	18	5:kdi18
10	Thorsminde Havn	DK	56.40	8.10	17	7:NTSLF13
11	Thyboron Havn	DK	56.70	8.20	13	5:kdi18
12	Esbjerg	DK	55.50	8.40	7.0	7:NTSLF13
13	Holyhead	UK	53.31	–4.62	6.9	7:NTSLF13
14	Thorsminde Hav	DK	56.40	8.10	5.2	5:kdi18
15	Ringkobing	DK	56.10	8.20	4.5	5:kdi18
16	Logstor	DK	57.00	9.20	3.8	5:kdi18
17	Cuxhaven	DE	53.87	8.72	2.6	1:RP
18	Ribe Kammersluse	DK	55.30	8.70	2.5	7:NTSLF13
19	Hanstholm	DK	57.10	8.60	2.3	5:kdi18
20	Harlingen	NE	53.17	5.42	2.0	2:FREQ
21	Norderney	NE	53.70	7.15	1.8	1:RP
22	Hojer	DK	55.00	8.70	1.4	7:NTSLF13
23	Den Helder	NE	52.97	4.75	0.83	2:FREQ
24	Delfzijl	NE	53.33	6.93	0.42	2:FREQ
25	Dordrecht	NE	51.82	4.67	0.16	2:FREQ
26	Hoek van Holland	NE	51.98	4.12	0.08	2:FREQ
27	Roompot buiten	NE	51.62	3.67	0.04	2:FREQ
28	Vlissingen	NE	51.45	3.60	0.01	2:FREQ

Notes:

[1] Running index of data
[2] Station name
[3] Country
[4] Latitude
[5] Longitude
[6] Calculated return period in years
[7] Water level, if presented in the source; the return period for the NTLSF13 source is based on a ranked series of skew surge values.
[8] Description of calculation:
RP: return period presented in source
FREQ: source presents number of exceedances within a time interval; return period is taken as reciprocal

RANK: source presents rank of water level across a date range; return period is calculated as the number of years represented divided by the rank.

kdi18: Ditlevsen et al (2018) present the maximum water levels for the storm and tabulated values of standardized return periods versus water level that were interpolated to derive the return periods [Ditlevsen C, MM Ramos, C Sørensen, UR Ciocan, T Pionkowitz, Højvandsstatistikker 2017, Miljo- og Fødevareministeriet, Kystdirektoratet Lemvig, Februar, 2018]

NTLSF13: The National Tide and Sea Level Facility NTSLF presents web pages with ranked lists of the top 10 skew surge levels for selected tide gauges around the UK across specified date ranges up to 2013. The return period was calculated as the number of years of data divided by the rank of Storm Kyrill, if it was present [https://ntslf.org/storm-surges/skew-surges/scotland, https://ntslf.org/storm-surges/skew-surges/england-east, https://ntslf.org/storm-surges/skew-surges/england-south, https://ntslf.org/storm-surges/skew-surges/england-wales, https://ntslf.org/storm-surges/skew-surges/england_west, https://ntslf.org/storm-surges/skew-surges/isle-of-man, https://ntslf.org/storm-surges/skew-surges/northern-ireland, https://ntslf.org/storm-surges/skew-surges/channel-islands (accessed 10Nov2021)]

SECTION S16. MAXIMUM RANGE AND AMPLITUDE OF SHORT PERIOD OSCILLATIONS

Table S16.1. List of maximum range (in descending order) of down-crossing oscillations derived from the short period time series reconstructions for each North Sea tide gauge station.

N	Station Name	Range (cm)	Midpoint of Oscillation (h after 25 Jan 1990 00:00 UTC)	Duration of Oscillation (h)
1	Stellendam buiten	74.3	13.92	2.83
2	Bath	48.3	37.00	3.67
3	Terneuzen	42.6	35.67	3.67
4	Texel Noordzee	41.4	38.17	3.33
5	Roompot buiten	40.9	35.08	3.50
6	Hansweert	40.7	36.33	4.00
7	Nieuwe Statenzijl	40.0	5.67	4.00
8	Westkapelle	39.1	35.00	3.67
9	Brouwershavensche Gat 08	39.0	10.50	3.33
10	Cadzand	37.3	43.42	3.83
11	Vlissingen	37.0	35.33	3.67
12	Petten zuid	37.0	37.58	3.50
13	Hanstholm	36.6	25.38	2.25
14	Holwerd	36.4	15.67	3.67
15	IJmuiden buitenhaven	35.3	37.17	3.00
16	Hvide Sande (Havn)	34.3	25.50	3.00
17	Hoek van Holland	33.7	14.58	3.83
18	Scheveningen	32.6	14.67	3.67
19	Den Helder	31.3	37.92	3.50
20	Thorsminde (Havn)	30.2	35.50	3.00
21	Noordwijk meetpost	30.1	14.75	3.50
22	Delfzijl	29.6	42.33	3.33
23	Bergse Diepsluis west	28.9	45.67	4.00
24	Krammersluizen west	28.2	36.25	3.17
25	Terschelling Noordzee	27.5	14.33	3.33
26	Den Oever buiten	26.2	39.08	3.50
27	Harlingen	25.7	15.50	3.33
28	Dover	25.6	33.00	4.00
29	Lichteiland Goeree	24.9	10.58	3.50
30	K13a platform	24.3	20.17	3.00
31	Huibertgat	24.0	15.75	3.17
32	Felixstowe	23.8	18.00	4.00
33	Thyboron (Havn)	23.6	33.75	1.50
34	Kornwerderzand buiten	23.6	40.08	3.50

Table S16.1 (continued).

N	Station Name	Range (cm)	Midpoint of Oscillation (h after 25 Jan 1990 00:00 UTC)	Duration of Oscillation (h)
35	Hojer	23.2	20.00	2.00
36	Krimpen a/d Lek	21.9	12.67	3.00
37	Wierumergronden	21.9	15.25	3.17
38	Nes	21.5	18.67	0.67
39	Maassluis	21.4	14.83	4.00
40	Lauwersoog	21.2	15.92	2.83
41	Spijkenisse	21.1	12.00	2.67
42	Hirtshals	21.1	27.25	1.50
43	Krimpen a/d IJssel	20.5	37.25	3.83
44	Sheerness	20.2	20.50	3.00
45	Oudeschild	20.0	38.42	3.50
46	Schiermonnikoog	19.7	16.08	3.17
47	Dordrecht	19.5	12.92	2.83
48	Vlaardingen	18.8	15.25	3.83
49	Ballum	18.8	45.50	3.00
50	West–Terschelling	18.4	2.42	4.17
51	Leith	18.2	34.50	3.00
52	Stavenisse	18.1	36.42	3.50
53	Vlieland haven	18.1	2.25	3.83
54	Eemshaven	17.5	17.33	1.33
55	Euro platform	16.7	35.42	3.50
56	Lowestoft	16.0	41.00	4.00
57	Havneby	15.7	34.75	3.50
58	Stavanger	15.6	26.92	3.17
59	Schoonhoven	15.1	37.92	3.17
60	Immingham	13.8	20.50	3.00
61	Cromer	10.1	8.00	4.00
62	Bergen	9.6	27.92	3.17
63	Whitby	7.6	11.50	5.00
64	North Shields	6.3	11.00	4.00
65	Maloy	5.8	27.92	1.50
66	Lerwick	5.1	6.00	4.00
67	Aberdeen	4.9	9.00	4.00
68	Wick	3.3	34.00	4.00

Table S16.2. List of maximum amplitude (in descending order) of down-crossing oscillations derived from the short period time series reconstructions for each North Sea tide gauge station.

N	Station Name	Max (cm)	Midpoint of Oscillation (h after 25 Jan 1990 00:00 UTC)	Duration of Oscillation (h)
1	Stellendam buiten	33.5	13.92	2.83
2	Bath	28.0	45.42	4.17
3	Roompot buiten	26.8	35.08	3.50
4	Terneuzen	24.0	35.67	3.67
5	Cadzand	23.1	43.42	3.83
6	Nieuwe Statenzijl	23.0	19.42	1.50
7	Westkapelle	22.9	35.00	3.67
8	Hansweert	22.1	32.33	4.00
9	Brouwershavensche Gat 08	21.7	10.50	3.33
10	Holwerd	20.1	15.67	3.67
11	Vlissingen	20.1	13.58	3.50
12	Texel Noordzee	19.8	38.17	3.33
13	Hoek van Holland	19.4	35.67	3.67
14	Petten zuid	19.4	37.58	3.50
15	Hvide Sande (Havn)	18.9	25.50	3.00
16	Hanstholm	18.6	25.38	2.25
17	Thorsminde (Havn)	18.3	22.75	3.50
18	IJmuiden buitenhaven	16.7	37.17	3.00
19	Bergse Diepsluis west	16.2	45.67	4.00
20	Terschelling Noordzee	15.7	3.17	1.67
21	Scheveningen	15.6	11.17	3.33
22	Den Helder	15.5	37.92	3.50
23	Noordwijk meetpost	15.2	36.58	3.17
24	Krammersluizen west	15.1	33.08	3.17
25	Nes	14.7	18.67	0.67
26	Delfzijl	14.3	42.33	3.33
27	Lichteiland Goeree	14.0	35.50	3.67
28	K13a platform	14.0	16.00	3.33
29	Dover	13.5	33.00	4.00
30	Felixstowe	13.0	18.00	4.00
31	Hirtshals	12.7	27.25	1.50
32	Krimpen a/d IJssel	12.5	37.25	3.83
33	Den Oever buiten	12.3	39.08	3.50
34	Krimpen a/d Lek	12.1	12.67	3.00

Table S16.2 (continued).

N	Station Name	Max (cm)	Midpoint of Oscillation (h after 25 Jan 1990 00:00 UTC)	Duration of Oscillation (h)
35	Maassluis	11.9	11.25	3.17
36	Dordrecht	11.9	12.92	2.83
37	Spijkenisse	11.9	12.00	2.67
38	Eemshaven	11.8	17.33	1.33
39	Harlingen	11.8	15.50	3.33
40	Thyboron (Havn)	11.4	33.75	1.50
41	Huibertgat	11.4	15.75	3.17
42	Vlaardingen	11.0	11.67	3.33
43	Kornwerderzand buiten	11.0	18.92	2.17
44	Schiermonnikoog	11.0	16.08	3.17
45	Hojer	10.9	1.50	1.00
46	Wierumergronden	10.4	40.08	3.50
47	Ballum	10.4	31.00	4.00
48	West–Terschelling	10.3	2.42	4.17
49	Lauwersoog	10.0	15.92	2.83
50	Vlieland haven	9.8	2.25	3.83
51	Stavanger	9.7	23.58	3.50
52	Oudeschild	9.7	38.42	3.50
53	Leith	9.5	43.50	3.00
54	Sheerness	9.2	44.00	4.00
55	Euro platform	9.0	22.50	4.00
56	Havneby	8.4	34.75	3.50
57	Schoonhoven	8.1	37.92	3.17
58	Stavenisse	7.8	32.58	4.17
59	Lowestoft	7.5	41.00	4.00
60	Immingham	7.4	20.50	3.00
61	Cromer	5.1	8.00	4.00
62	Bergen	4.3	25.58	1.50
63	Whitby	3.3	11.50	5.00
64	North Shields	3.2	11.00	4.00
65	Aberdeen	2.9	29.50	3.00
66	Maloy	2.8	19.92	0.83
67	Lerwick	2.4	6.00	4.00
68	Wick	1.7	34.00	4.00

SECTION S17. TIMING OF TIDE, SURGE, AND INCIDENTS AROUND NORTH SEA COAST

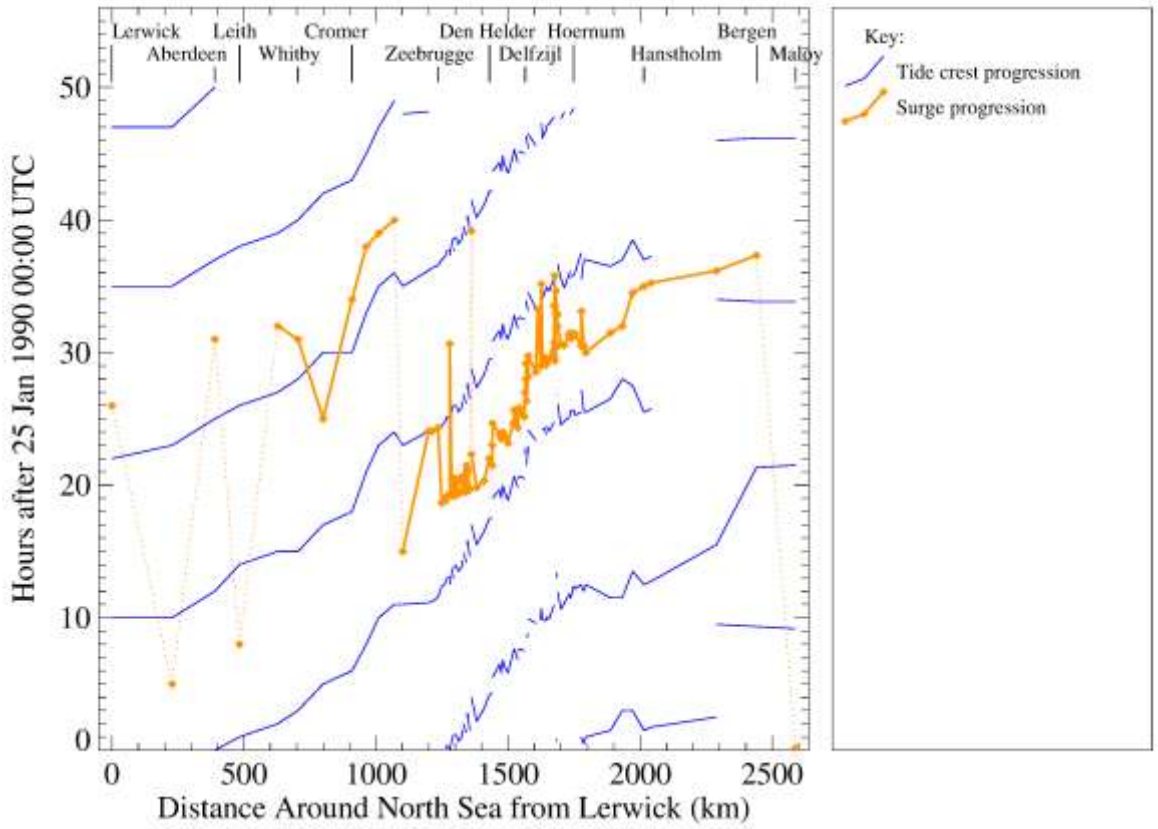


Figure S17.1. Summary of the progression of the tidal crests and storm surge peak around the North Sea on 25–26 January 1990. The data are plotted on axes of time versus counter-clockwise distance around the North Sea starting from Lerwick in Scotland.

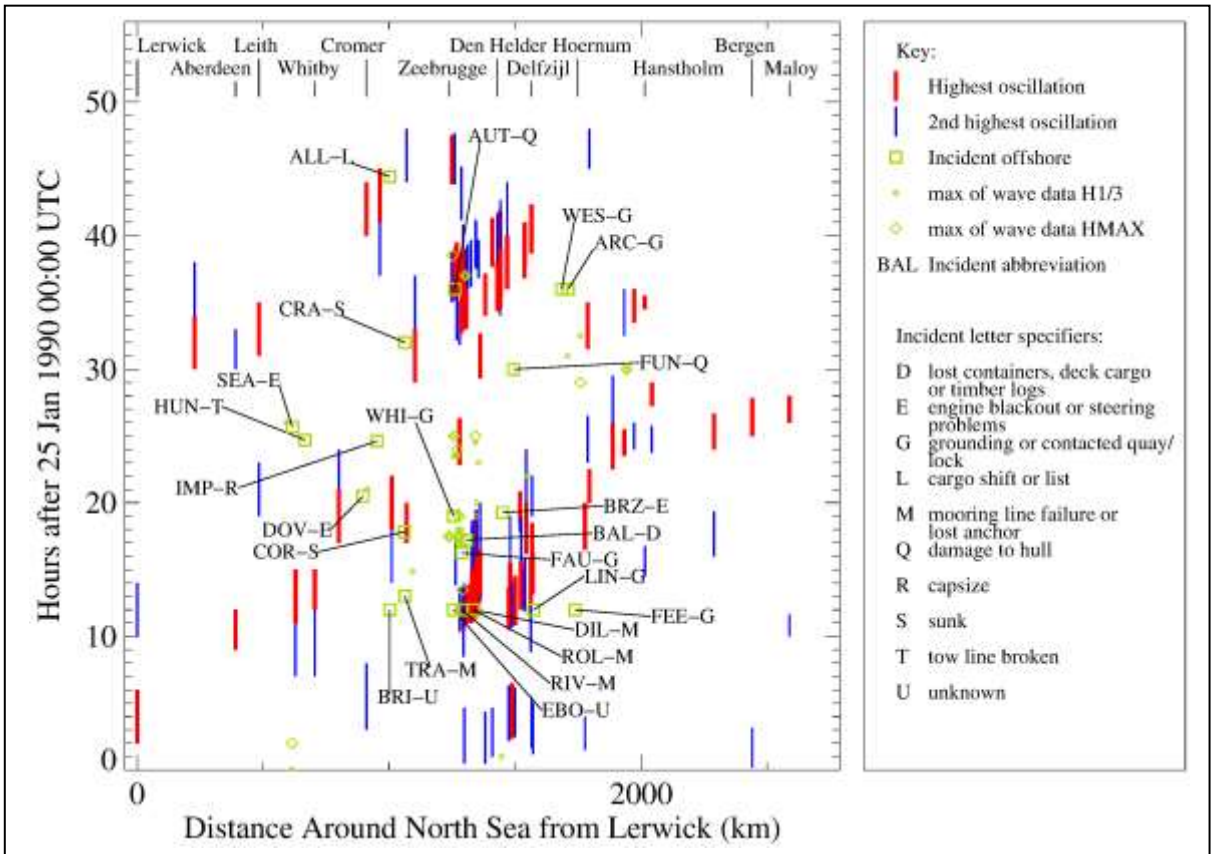


Figure S17.2. Summary of the spatial-temporal relationship of peak-to-trough range of the highest up-crossing short period oscillations in the tide gauge record, maritime incidents/accidents, and significant/maximum wave height across the two day storm period. The data are plotted on axes of time versus counter-clockwise distance around the North Sea starting from Lerwick in Scotland.

SECTION S18. THEMATIC TABLES OF STORM DESCRIPTION AND IMPACTS

Table SL0. Master list of tables in working notes

Content

Table SL1. List of sources reviewed for project (arranged by year and then alphabetically)

Source	Type[1]	Full Reference and Notes
Miller (1972)	4	Miller, R.C., Notes on analysis and severe-storm forecasting procedures of the Air Force Global Weather Central, Technical Report 200 (Rev), Air Weather Service (MAC) United States Air Force, May 1972
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Belfast Telegraph (19900125b)	1	Belfast Telegraph, Ulster awash as snow and floods cause road chaos, p.1, 25Jan1990b.
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Belfast Telegraph (19900126d)	1	Belfast Telegraph, Dozens die as winds hit continent, p.4, 26Jan1990d
Belfast Telegraph (19900126e)	1	Belfast Telegraph, Minister pledges financial help to local councils, p.4, 26Jan1990e
Dannevig (1990)	1	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990.
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Derby Evening Telegraph (1990a)	1	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a.
Derby Evening Telegraph (1990b)	1	Derby Evening Telegraph, Winds havoc round-up, p1, 26Jan1990b.
Derby Evening Telegraph (1990c)	1	Derby Evening Telegraph, Thousands of homes blacked out (contributor Lana Montgomery), p.3, 26/01/1990c
Derby Evening Telegraph (1990d)	1	Derby Evening Telegraph, Insurance chiefs set up hit squad (contributor: Graham Smith), p.3, 26Jan1990d
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Eastern Daily Press (19900126b)	1	Eastern Daily Press, Weathermen got it right this time, p.2, 26Jan1990b.
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Eastern Daily Press (19900126d)	1	Eastern Daily Press, Europe lashed, p.2, 26Jan1990d.

Eastern Daily Press (19900126e)	1	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e.
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Eastern Daily Press (19900126l)	1	Eastern Daily Press, Fishing boat alert, p.3, 26/01/1990l
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NRC Handelsblad (19900126f)	1	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f
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Notes:
[1] Type: 1=storm is main focus (or used as key example in general discussion); 2=1-4 case studies including the storm; 3=the storm is one of many case studies or mentioned only; 4=storm not mentioned; reference is included for background information

Table SL2. List of sources that could not be obtained (arranged by year and then alphabetically)

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Table SL3. List of photos of event (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. FIG. [PHOTO] Hurricane-force winds toppled lorries and left roads and rail in chaos.
Belfast Telegraph	Belfast Telegraph, Diana flies in to Ulster blizzard. Weather grounds helicopter (contributor Charles Haslett), p.1,

(19900125a)	25Jan1990 FIG. Princess Diana - given insight into bomb disposal work
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. FIG. [PHOTO] Mother of four Anne Baliey had a lucky escape when this tree fell on the side of her home in Victoria Avenue, Ockbrook. Workmen pictured trying to remove the tree at the height of last night's storm FIG. [PHOTO] Miracle escape. Peter Warwick's wrecked car
Eastern Daily Press (19900126c)	Eastern Daily Press, Rescue death PC is praised, p.1, 26Jan1990c. FIG. [PHOTO] Primary school at Swindon where a child died and (inset) a parent comforts his child
Eastern Daily Press (19900126g)	Eastern Daily Press, Rail chaos as trains are halted for hours, p.3, 26Jan1990g FIG. [PHOTO] Free tea and coffee in the buffet bar at Norwich Thorpe station last night for passengers who had to wait hours for trains to London
Eastern Daily Press (19900126h)	Eastern Daily Press, Falling roof hits workman, p.3, 26Jan1990h FIG. [PHOTO] Firemen move the roof that injured a man at J and G Autos, Yarmouth, yesterday
Eastern Daily Press (19900127d)	Eastern Daily Press, Brave skipper praised for rescue of tug crew, p.3, 27Jan1990d FIG. [PHOTO] Bert Coleman (left) and Bob Mountney with the roap that wrapped around the pilot boat's propeller during rescue operation.
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7 (contributors L Curry, K Cooper, C Smith, S Harvey), 26Jan1990a -FIG. [PHOTO] A Rover car crushed by a fallen tree on Clipstone Road East, at Forest Town, near Mansfield. Driver Lynette Quimby suffered whiplash injuries
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c FIG. [PHOTO] A school roof blown off at Stockbridge buries a teacher's car FIG. [PHOTO] Family had lucky escape when a tree flattened car minutes after they got out ... sales representative Andreww Bird had a near miss when the roof blew off two industrial units at Brookside Road, Ruddington and narrowly missed hitting him FIG. [PHOTO] Winds topple helicopter at Weston-super-Mare Helicopter Museum FIG. [PHOTO] Rupert Soar, a contractor at the Park Yacht and Country Club in Nottingham, found his car crushed by a tree FIG. [PHOTO] Crumbling walls at house in Southampton leave rooms exposed to the elements
Evening Post Nottingham (19900126f)	Evening Post (Nottingham), Chaos as gales hit capital, p.8, 26/01/1990f FIG. [PHOTO] tree uprooted and blown over the Victoria embankment in Westminster
Evening Post Nottingham (19900126h)	Evening Post (Nottingham), Britain takes a battering, p.8-9, 26/01/1990h FIG. [PHOTO] This huge tree was plucked out of the ground by the gale-force winds and crashed into Tadstone House, near Exmouth, Devon FIG. [PHOTO] The scene on the Severn Bridge, which was closed to traffic when a lorry overturned FIG. [PHOTO] Crashed lorries litter the M2 at Rochester, Kent. The motorway was closed bringing traffic chaos to motorists FIG. [PHOTO] A lorry which jackknifed on a roundabout crossing the M4 near Bristol FIG. [PHOTO] A gust took off the roof of this building in Bristol FIG. [PHOTO] A blown-over lorry blocks Waterloo Bridge in central London FIG. [PHOTO] The main stand at Torquay's soccer ground - left without a roof
Evening Post Nottingham (19900126j)	Evening Post (Nottingham), Pupil dies as roof blown off, p.8, 26/01/1990j -FIG. [PHOTO] A parent takes his child away from the Grange Drive Community Centre in Sindon after the roof was blown off -FIG. [PHOTO] Grange Junior School in Swindon, Wiltshire where a girl, aged 10, died and 4 others were hurt when the roof blew off.
Evening Post Nottingham (19900126l)	Evening Post (Nottingham), Thatcher's Storm Horror, p.1 and 19, 26/01/1990l FIG. [PHOTO] Mrs. Marjorie Hunt, or Wigman Road, Bilborough inspects the remains of her greenhouse destroyed in the storm.
Financial Times (19900126b)	Financial Times, Violent storm cuts road and railway links (contributors Richard Evans & Jimmy Burns), p.6, 26 January 1990b FIG. [PHOTO] Channel storm: A trawler washed ashore at Kerroch, France
Freiburger Nachrichten (19900127)	Freiburger Nachrichten, Vor allem Daecher erlitten Schaden, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) FIG. [PHOTO] storm damage in Huberli Quartier in Giffers: storm winds took off roof of family house [credit: G. Bielman]
Huddersfield Daily Examiner (19900126b)	Huddersfield Daily Examiner, Falling trees bring chaos to nightmare journeys, p1, 26Jan1990b. (Friday) FIG. [PHOTO] A couple had a miraculous escape from this Austin Maestro in Eastgate, Honley
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) FIG. [PHOTO] A 10-year-old girl died and four children were hurt when the roof of this junior school in Swindon, Wiltshire was ripped off in the gale
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -FIG [PHOTO] This double decker bus was blown off the road in Bridlington -FIG [PHOTO] An overturned lorry blocks Humber Bridge last night
Lund and Lund (1990)	Lund, Maj-Britt and Steffen Lund, Der Blaest en Storm, Naturlig Energi, 12, 6, Marts 1990 FIG. [PHOTO] wreckage from destroyed windmill
Milwauki Journal	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns

(19900126)	Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -FIG. [PHOTO] Tugboats helped the ferry Pride of Calais into a dock Thursday in Dover, England, shortly before the dock was closed due to high winds. A storm packing winds of up to 110 mph, killed at least 79 people in S England and 5 wesern European nations
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. FIG [PHOTO] After the storm, Co Wexford (credit: Joe Lyons); fallen trees on road
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) FIG. [PHOTO] This was the scene of devastation on the M2 bridge as heavy vehicles toppled like toys; one in background dangerously close to crashing through the parapet. FIG. [PHOTO] Mr. Craig Patching views his wrecked car after the wall collapsed under Rochester Bridge FIG. [PHOTO] A tree which blew over, blocking Borstad Road, Rochester, is cleared away FIG. [PHOTO] The gable end of this roof in William Road, Cuxton, was ripped away by the storm
The News Chatham-Rochester-Gillingham (19900126b)	The News Chatham-Rochester-Gillingham, Since 1987 hurricane bring havoc, p.11, 26Jan1990b (Friday) FIG. [PHOTO] Motorway chaos, with crashed lorries in the foreground and lorries on their sides further up the M2
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) FIG. [PHOTO] Headmaster Mr. Ian Gliddon surveys the damage FIG. [PHOTO] Hoardings throught Medway were blown down during the high winds. This one was on Chapel Hill
NRC Handelsblad (19900126d)	NRC Handelsblad, Miljoenenschade in Rotterdamse haven, p.2, 26/01/1990d FIG2. [PHOTO] at the Fruitterminal Rotterdam FTR two mobile cranes collapsed during the storm
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f FIG. [PHOTO] The stadium from Sparta (football club) after the storm. A goal is tipped over and roofing over the spectator stands is destroyed. Because of the destruction the game Ajax-Sparta due to be played Sunday at het Kasteel will not go ahead [credit: NRC Handleblad, Freddie Rikken] FIG. [PHOTO] The inland tanker Dagmar wedged against bank on the Waal at Haaften. [creidt: ANP]
Perthshire Advertiser (19900126)	Perthshire Advertiser, Snow Chaos Hits Roads (contributor Graeme Giles), p.1, 26/01/1990 FIG. [PHOTO] No through road: traffic attempting the road up Cairnie Braes yesterday grinds to halt
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday FIG. [PHOTO] Gordon Kaye
Press and Journal (19900126b)	Press and Journal, Blizzards cause road chaos (contributor Steve Stewart and David Steele), p11, 26Jan1990b. FIG. [PHOTO] Heavy snowfall was bad news for some but contestants in the 1990 Spillers Siberian Husky Club Snow Rally, to be held at the weekend at Aviemore. They took advantage of yesterday's blizzard conditions to get in some practice
SWEB News (1990)	SWEB News, February, 1990. FIG_p2: [TIMESERIES] Customers off supply between 25-31Jan1990 FIG_p2: [PHOTO] Northern Ireland Electricity staffland at St. Mawgans during gales FIG_p3: [PHOTO] Crew neutralize line on broken pole at South Molton FIG_p4: [PHOTO] Broken pole at Hayle FIG_p5: [PHOTO] North of Scotland Hydro Electric Board staff at Coleton Raleigh
Thuner Tagblatt (19900127a)	Thuner Tagblatt, Sturm fegte ueber die Region: Hauser abgedeckt, 27Jan1990a (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG1. [PHOTO] this industrial building in Gemeinde Uebeschi was damaged twice by storm winds; first on the outside and later in the area of the entrance; in front of the building the wind hurled building pieces. (credit: Werner Hostettler)
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG1. [PHOTO] at this house in Schwrazenegg a part of the roof (on the ground in the middle of the picture) was blown away. An emergency roof was placed during the night -FIG2. [PHOTO] this house at Rachholtern destroyed by fir tree -FIG3. [PHOTO] in the forest at Schwarzenegg -FIG4. [PHOTO] situation at 01:00 on Jungfraustrasse in Thun -FIG5. [PHOTO] man of protection service Steffisburg on night mission during storm -FIG6. [PHOTO] at Aaresteg in Steffisburg -FIG7. [PHOTO] Hombergstrasse closed in Steffisburg [credit Bruno Stuedle] -FIG8. [PHOTO] in Schwarzenegg there was hardly a building that was spared from storm winds -FIG9. [PHOTO] wind in the night: huge root place of the fallen fir tree.
Thuner Tagblatt (19900131a)	Thuner Tagblatt, Sturmschaeden im Thuner Ostamt weit schlimmer als angenommen, 31Jan1990a (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG. [PHOTO] Hurricane storm winds that blew over Thuner Ostamt in the night 25-26Jan left far greater damage than initially throught. Alone in Staatswald area Honegg-Sued above Eriz an area of 150 ha was impacted. Yesterday at midday (30Jan) 8000 m3 of windthrown timber counted. Our picture (with state forester Peter Salzmann) gives an impression of the devastation caused by the the storm winds in the state forest area the ob Eriz [credit: Werner Hostettler]

Thuner Tagblatt (19900131b)	Thuner Tagblatt, Ob Eriz wurden 150 Hektaren Wald von Sturmwinden heimgesucht (contributer Werner Hostettler), 31Jan1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG. [PHOTO] special mission at 1300m above sea level. Two foresters during clearing work on a forest road over the Eriz -FIG. [PHOTO] tracks of a stormy night. In state forest the Honegg-Sued dozens of tall coniferous trees were uprooted or snapped like matchsticks -FIG. [PHOTO] Hurricane storm winds rip several paths in the forest and flattened the large and heavy coniferous trees in rows in the same direction [credit: Werner Hostettler]
The Times (19900126b)	The Times, Britain at bay in the eye of 'hurricane', p.3, 26/01/1990b -FIG1. [PHOTO] Damage in Prince Regent Lane, Canning Town, east London, after strong gales brought down scaffolding, crushing parked cars -FIG2. [PHOTO] A woman protects a child from the severe winds at Waterloo, central London
The Times (19900126c)	The Times, Heavy weather sweeps coast, 26/01/1990c (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -FIG1. [PHOTO] A crushed lorry which spilt its load onto the A38 below, near Plymton in the South-west
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. FIG. [PHOTO] A swathe of ravaged trees at Stonor Park, near Henley-on-Thames from Daria Thursday
The Times (19900127b)	The Times, Insurance claims likely to exceed 1987s 2 bn GBP total (contributor Melinde Wittstock), p2, 27Jan1990b FIG: [PHOTO] Workmen clearing up a site at Islington, northeast London yesterday where three cars were crushed by scaffolding and splattered by industrial paint
The Times (19900127e)	The Times, Kew curator surveys the devastation (contributor Adrian Brooks), p.3, 27Jan1990e FIG. [PHOTO] Mr. Charles Erskine, curator a Kew Gardens, stopping during his inspection tour to survey the uprooted remains of a rare Eastern Mediterranean tree
The Times (19900127g)	The Times, Marines clear debris in Devon (contributor Guy Newman), p.3, 27Jan1990g FIG. [PHOTO] Two Royal Marines helping Mr. Geoffrey Moger, a line man, clear trees and restore power at Exton, near Exeter, Devon
The Times (19900129b)	The Times, Met Office examines storm warning media links (contributor Michael McCarthy), 29Jan1990b. FIG. [PHOTO] Royal Navy barge aground on promenade Southsea, Hampshire after it broke adrift during gale force winds while being towed
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -FIG. [PHOTO] Hurricane gusts to 150km/h destroyed the roof London Waterloo tube station. Daria raged over Great Britain and central Europe & took dozens of lives
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 FIG001. [007-01: NRC 26/01] Bij de Fruitterminal Rotterdam (FTR) zijn gisteren twee rijdende kranen onder de storm bezweken (Foto: ANP) (2 cranes destroyed Rotterdam port) FIG002. [008-01: NRC 29/01] In het Kralingse Bos werd door de storm van donderdag en gisteren een groot aantal bomen geveld (Foto NRC Handelsblad/Vincent Mentzel) (fallen trees in Kralingse wood) FIG003. [008-02: NRC 29/01] In en nieuwbouwwijk in Uithoorn richtte de storm van gisteren nog meer schade aan (Foto NRC Handelsblad/Maurice Boyer) (roofs with missing tiles in Uithoorn) FIG004. [009-01: de Volkskrant, van Zaterdag 27Jan] Vooral vrijstaande bomen en bomen langs wegen werden het slachtoffer van de storm. Deze twee sneuvelden in s' Graveland (two fallen trees in 's Gravenland) FIG005. [009-02: de Volkskrant, van Zaterdag 27Jan] Door de storm verdween een kenmerkend beeld van Amsterdam-Noord. De grote portaalkraan opt de de oude NDSM-werf, het symbool van de dedrijvigheid de er ooit heerste, veranderde in een hoop schroot. (collapsed crane at old NDSM wharf in Amsterdam Noord) FIG006. [009-03: de Volkskrant, van Zaterdag 27Jan] Vridagmorgen (26Jan) een trieste klus voor veel tuinders: glasscherven rapen in de vernielde kas (destroyed greenhouse) FIG007. [011-02: NRC 27-1] ...pectie van de schade bij de kassen in Naaldwijk (Foto NRC Handelsblad/ Chris de Jongh) (damage to greenhouses in Naaldwijk) FIG008. [015-01: unknown media] Paraguayaanse vrachtschip Boqueron dreigde gisteren in tweeen te breken nadat het door het zware weer bij kaap Quintres in de Golf van Biscay ... de rotsen was geslagen. Het schip, dat hout verwoerde voor een Spaans bedrijft, lekt olie. De bemanning van het schip is inmiddels in veilig-... bracht (Foto Reuter) FIG009. [017-01: NRC 27-1] ...eur Rudolf Spoor (links) en eindredacteur Fred Verhakel van het programma Het Capitool bekijken hun voormalige uitzendlokatie in 's-Gra... die tijdens de storm grotendeels door een omvallende boom werd vernield (Foto ANP) FIG010. [020-02: unknown media] ... vier pilaren van het portaal bleven over van het taehuise 'Het Capitool' in 's Graveland, bekend van het gelijknamige tv-programma. Een ... beuk verpletterde de rest van het gebouw (Foto: Marcel Mode) FIG011. [021-01: unknown media] ... politieagent probeert een vrouw te helpen met het tegen

	de wind in oversteken van de De Boelelaan in Amsterdam FIG012. [021-03: VIK 26-1] Straatbeeld in Amsterdam: door omgewaaide boomgevelde auto (Foto AP) FIG013. [021-03: VIK 26-1] Op de Waal ter hoogte van Haaften werd de binnenvaarttanker Dagmar tegen de wal geuwd (Foto ANP) FIG014. [021-03: VIK 26-1] Voetgangers in Zandvoort kunnen zich met moeite staande houden FIG015. [021-04: unknown media] ... in het Sparta-stadion (het 'Kasteel'), waar het dak van de hoofdtribune vloog (Foto ANP) FIG016. [021-04: unknown media] Gestrande passagiers op het Amstel Station in Amsterdam FIG017. [025-01: NRC 26Jan1990] ... Jaarbeursgebouw in Utrecht brachen gestrande treinreizigers de nacht door op veldbedden (Foto NRC Handelsblad/Rien Zilvold) FIG018. [026-02: NRC 26-1?, NRC Handelsblad] De binnenvaarttanker Dagmar werd gisteren op de Waal ter hoogte van Haaften door de storm tegen de wal geduwd. Het schip kvam muurvast te zitten (Foto ANP). FIG019. [026-03: NRC 26-1?, NRC Handelsblad] Het stadion van Sparta na de storm. Een doel is omgewaaid en de overkappingen van de overdekte tribunes zijn vernield. Alleen de kleinste staantribune bleef ongeschonen. Door de verwoestingen kan de competitiewedstrijd Sparta-Ajax van zondag op het Kasteel niet worden gespeeld. (Foto NRC Handelsblad/ Freddy Rikken) FIG020. [027-01: NRC 26-1] Map of Netherlands rail network with wind gusts labelled and and train lines still down on secon day of storms FIG021. [028-02: NRC 26-1?] ...der Andre van de Harder uit 's Gravezande neemt de schade aan zijn kassen op, aangericht door de storm van gisternacht. Zijn plan om gera... te planten kon niet doorgan (Foto: ANP) (collapsed greenhouse) -> 800 pages of Netherlands newspaper clippings mostly of building damage and fallen trees
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 FIG. [PHOTO] The storm of 1990 provided many spectacular sights including the surprise visit of a fin whale whose navigational ability was undermined by the churning seas. It came ashore at New Romney
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 FIG1. [PHOTO] storm centre Daria uprooted numerous trees, deroofed houses, and caused power outages FIG2. [PHOTO] with winds over 130 km/h hurricane Daria cracked trees like matches
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 FIG. [PHOTO] in London, the roof of Waterloo tube station was completely destroyed by Cyclone Daria FIG. [PHOTO] at Kew Gardens, London this 100 year old Black Pine was among hundreds of trees felled by the storm FIG. [PHOTO] in Hesse, West Germany the strong winds caused debris to line train tracks, leading to derailments

Table SL4. Ranking of storm among events; assessing importance of storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. - worst weather to hit England and Wales since 1987 storm
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -Oct1987 storm winds higher than Daria but Daria area larger
Derby Evening Telegraph (19900126d)	Derby Evening Telegraph, Insurance chiefs set up hit squad (contributor: Graham Smith), p.3, 26Jan1990d -insurance payout for Storm Daria expected to be less than Oct1987 storm
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -Daria assessed not to be century storm for Germany, but it did belong to the category cause a North Sea storm surge
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -more fatalities than 1987 storm
Eastern Daily Press (19900126n)	Eastern Daily Press, Insurance companies braced for claims, p.3, 26Jan1990n. -UK insurance payouts for Daria not expected to be of sam magnitude as 1987 hurricane with its 1.3 bill GBP payout -Daria insurance payout expected to be more like similar storm of Jan 1984 with 200 mill GBP bill
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -assessed as 20y wind speed event for Sweden
Evening Post Nottingham (1990c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c -London Weather Centre: Daria gales worst of century; not as strong as Oct1987 but larger area
Evening Post Nottingham (19900126g)	Evening Post (Nottingham), Winds whip up to the 100 mph, p.8, 26/01/1990g -London Weather Centre: storm among worst of this century; lower winds than Oct1987 but larger area -higher number of fatalities compared to Oct1987 storm due to larger area and fact that it took place during working day
Financial Times	Financial Times, Violent storm cuts road and railway links (contributors Richard Evans & Jimmy Burns), p.6, 26

(19900126b)	January 1990b -Daria comparable with Oct 1987 storm when there were 30 fatalities and 15million uprooted trees
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -4 hurricane centres over W and central Europe within 14 days had never happened before -they are the product of an unsually strong WSW circulation, which was already observed in both previous very mild winters.
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -Daria described in newspapers as worst storm in 300 years -Daria peak winds less than 1987 storm, but covered a larger area
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -FIG1. [MAP] Return period (years) for maximum gusts recorded on 25Jan1990 NOTE: RETURN PERIOD FORM LONDON AREA >200y -many stns reported highest gust on record; e.g., Boscombe Down 79kn highest since meas start 1933
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -insurance losses for Daria expected to be similar to Oct1987 storm
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -Britain counting tragic cost of one of most ferocious storms this century; 45 dead, hundreds injured -insurance companies prepared for avalanche of claims; payouts expected to be well below great storm of 1987; government promised emergency cash for for local authorities
Jensen and Winther-Jensen (1990)	Jensen, P.H. and M. Winther-Jensen, 99% af moellerne velbeholdne igennem stormen 25. januar, Naturlig Energi, 12, 6, Marts 1990 -storm 25Jan1990 strongest in Denmark for many years -significant damage to many houses, power lines and wind mills -Daria not as powerful as Nov1981 but still comparable -in Nov1981 there were 400 propeller windmills in Denmark connected to network -1% completely collapsed & 4% seriously damaged with cracked off blades, axel bearing rearrangment including hub -to compare, damage from 25Jan1990 included 3 totally destroyed turbines or 1 permille of total standing turbines with another 2 permille seriously damaged -wind turbines performed 10 time better than in 1981 -can't be certain that all seriously damaged turbines included
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -Dutch meteorologists said Daria was worst to hit Netherlands in 10years -insurers association Verbond van Verzekeraars: Dutch insurers face 100s millions of florins in claims after worst storm to hit country in decade
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -UK: wind records across country were shattered -Dutch meteorologists: worst storm for 10 years
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -wind speed records broken at Aberporth, Benson, Boscombe Down, Brawdy, Farnborough, London/Heathrow, Hurn, Larkhill, Plymouth, Stanstead airport, St. Mawgan,
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -Daria had lowest pressure for Iceland low since record start in 1873 (>30mb below normal) -many sites in England recorded highest ever max winds Jan and Feb; -eg Heathrow gust 76kt on 25Jan compared with 66kt Oct1987
Milwauki Journal (19900125)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -death toll in England higher than Oct1987 when 17 people killed -Royal Botanic Garden at Kew lost 100 old trees compared with 1000s during Oct1987
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -Daria worst storm since Oct 1987 when 19 people died in worst storm in 3 centuries
Neue Zuercher Nachrichtung (19900127)	Neue Zuercher Nachrichten, Sturm forderte Menschenleben, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -Great Britain had been hit by one ofthe worst storms of the century with at least 40 fatalities
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) -worst storm havoc since great hurricane of 1987 hit Medway 25Jan1990 (Thursday)
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -weathermen surprised by ferocity of storm; warning issued last week; winds stronger than feared -London Weather Centre spokeman: winds are strongest we have seen since great storm 2 years ago
NRC Handelsblad (19900126b)	NRC Handelsblad, Zeker 65 doden in buitenland, p.1, 26/01/1990b -UK: 45 fatalities reported; reported as hurricane of the century
NRC Handelsblad (19900126e)	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e -the storm that hit the Netherlands yesterday was one of the worst of the last decades

	-higher wind gusts were measured in the Netherlands 7Sep1944 -in Vlissingen wind gusts up to 175km/h -wind speeds topped previous seerious storms: Jan1976, Apr1973, Nov1972, 1Feb1953, 12May1983 (Hemelvaartsdagstorm), Nov1983, Dec1979
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -in terms of forest damage, Daria thought not to be as bad as the storms of 1972-1973 -Hoek of Holland-Harwich ferry cancelled; this happened previously only 1 or 2 times over 20 years
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -London Weather Centre: gales among worst of century; not as strong as Oct 1987 but wider area -Oct1987 deaths: 19 on night, 11 related deaths over next few days -Oct1987 damage: 1.5 billion GBP; Daria expected to be less -Severn Bridge closed for only 3rd time in 23 year history
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -Peter Salzmann from Schwarzenegg, vice-commander of the area protection service, doesn't like to remember the last time comparable large damage took place in the area: 1967 in Gluetschbachtal
Thuner Tagblatt (19900131b)	Thuner Tagblatt, Ob Eriz wurden 150 Hektaren Wald von Sturmwinden heimgesucht (contributer Werner Hostettler), 31Jan1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -in the area Chnubel above Eriz at 1300 m above sea level TT met state highways authority Daniel Haefliger in clearing work in spite of his 75y. He has been 52 years in the forest, but he has never experienced such an event.
The Times (19900126)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Met Office: weather not as bad as Oct1987 storm -more injuries from Daria because it occurred daytime -Severn Bridge closed for 3rd time in history
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -insurance companies bracing claims totalling a record 2 bill GBP -death toll at least twice as great as Oct1987; Daria damage to property on greater area than Oct1987
The Times (19900127b)	The Times, Insurance claims likely to exceed 1987s 2 bn GBP total (contributor Melinde Wittstock), p2, 27Jan1990b -insurance claims for Thursday storm damages could exceed 2bn GBP of Oct1987 great storm -David Hudson: we would not be surprised if losses greatly exceed 1987 -total insured loss will likely be more than 2 bn GBP in total -most of the big composite insurers increased their reinsurance cover after 1987 hurricane
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -FIG. [MAP] weather map with surface pressure isobars for 25Jan1990 1200; maximum gusts for 15 locations for Oct1987 storm and Daria, -MetOffice: destructive power of Daria did not match Oct1987 storm -London Weather Centre: much larger area of Britain affected by Daria than Oct1987 -Oct1987 storm affected mainly Essex, Kent, Sussex -death toll 1987 storm at 19; less than half of Daria; Oct 1987 storm in early morning -Keith Willey, Mullion resident, said fiercest wind in 38 years; many buildings lost roofs -100mph winds recorded in Shoreham Sussex where highest winds occurred Oct1987 -relatively few trees blown down SE England; Oct1987 felled 15 mill of most vulnerable trees
The Times (19900127i)	The Times, Taxing the Elements, p.11, 27Jan1990i. -previous compable storm to Oct1987 and Daria was 300 years before -difficult to assess if climate change would make similar storms happen every 4 years
Wieringa (1990)	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990 FIG3. [MAP] Storms 1972, 1973, 1976, 1990; which was the worst locally?
Wubs and Waldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source info: 027. NRC26-1: Zwaarste windstoten na 1944) -worse wind gusts measured 7Sep1944 -comparable storms Jan1976, Apr1973, Nov1972 -1Feb1953 wspd to 10Bft -storms 12May1983, Nov1983, Dec1979 all less than Daria
Zwarte (1990)	Zwart, B.: Zware stormen vanaf 1910, boven land (uurgemiddelden), Weerspiegel 17, 3: 211, 1990. -list of Netherlands wind storms in 20C; Daria in second rank with Bft11 compared with Bft 12 hurricane in 1944 -Daria gust in first rank with 43m/s gust tied for first place with 02Apr1973 storm
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -during month of Feb1990 weather more disturbed; weather did not exceed 1020 hPa for 8d. -most tempestuous weather of the region since 1979 (since 1946 at Abbeville for the number of days of wind speed >16m/s) -no wind speed record broken except for Dunkerque
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -end Jan-start Mar 1990 Europe hit by 8 storms reaching hurricane level

	-storms Daria, Herta, Judith, Nana, Ottilie, Polly, Vivian, Wiebke -total damage 25 billion DM, of which 17.3 billion DM insured (1990 values) -highest ever damage in Europe; designated a 'neue Dimension' -next most damaging storms: Capella Hurricane 1976 had insured damage 2.7 billion DM (1990) Oct1987 Hurricane for UK & France damage 5.2 billion DM (1990)
Berz (1998)	Berz, G.L., Global warming and the insurance industry, in F.L. Toch (ed), Cost-Benefit Analysis of Climate Change: The Broader Perspective, Birkhauser Verlag, Basel, Switzerland, pp. 41-56, 1998. -in 1990 Daria was the worst insurance loss of all decades but rank 2 in terms of total economic damage after hurrican Hugo in 1989 -Daria rank1 place for insurance loss was lost to Typhoon Mireille (1992) in Japan and Hurricane Andrew (1992) -in 1992 Daria was a rank3 insurance loss event and also a rank 3 total loss event
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. -Daria at rank 4 of insurance losses for all natural diasters (earthquakes included). -Among European winter storms Daria is rank1 of sequence -Daria-Herta-Vivian-Wiebke-Great Storm 1987. -No Europe winter storms exceeded 1 billion USD loss threshold before 1987
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -late 1980s & early 1990s western Europe hit by series of windstorms with unprecedented impact -Munichre show dramatic increase in costs of severe storms from 1960s onwards -insurance industry taken by surprise; wind storm losses of few bill USD unlikely (Berz, 1993) -Oct1987 storm 3.7bill USD1992 & 1990 storm sequence 15bill USD1992 -Daria storms damage 6.8 bill USD1992 of which 5.2 bill USD insured -peak gust intensities during storm event 27Aug1921 highest of century -peak gust intensities of Daria 25-26Jan1990 second highest -series of storm Jan-Mar 1990 exceptional exception for the Netherlands -only 1928 sequence had >2 separate storms following each other in short space of time
Swiss Re (2002)	Swiss Re, Natural catastrophes and man-made disasters in 2001: man-made losses take on a new dimension (authors: Aurelia Zanetti, Rudolf Erz, Werner Schaad), Sigma, No.1, Published by Swiss Reinsurance Company, Economic Research and Consulting, PO Box CH-8022 Zurich 28January2002 -rank 5 insurance loss after Hurricane Andrew - WTC attack - Northridge earthquake - Typhoon Mireille -European winter storms in global list: Daria-Lothar-Vivian-Anatol
Berz (2005)	Berz G, Windstorm and storm surges in Europe: Loss trends and possible counter-actions from the viewpoint of an international reinsurer, (Phil Trans R Soc) Philosophical Transactions: Mathematical, physical and engineering sciences, 363, 1431-140, 2005. -Daria rank 2 after Lothar 1999 for European storm insurance loss and economic loss
BBC (20070220)	BBC, UK storm payout 'may hit GBP 350m', 20Feb2007 http://news.bbc.co.uk/2/hi/business/6380123.stm -for UK insurance losses: Daria Jan1990 rank1, Great Storm Oct1987 rank2, Kyrill Jan2007 rank8
Sorensen et al (2007)	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007. -storm reached rank2 status on west coast Jutland
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -Daria among most serious damage impacts to western economies and ranks with Katrina-Andrew-Lothar
Goennert and Buss (2009)	Goennert, Gabriele & Thomas Buss, Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser Nr.2/2009, Freie und Hansestadt Hamburg, Landesbetrieb Strassen, Bruecken und Gewaesser, Hamburg, ISSN 1867-7959. -Daria produced rank 41 storm surge water level (8.76m) at Cuxhaven in time period 1901-2008
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -gales 25Jan1990 left more dead in Britain than any single weather event since East Coast flood 1953; 47 dead with 36 direct result of storm -high deaths attributed to storm occurrence in week day -if 1987 storm had occurred during daylight hours, fatalities would have been higher -1990 storm affected greater area of country
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -storm Daria was UK most expensive insurance weather event -for Germany: gust field of Daria in many cases worse than Lothar in1999 -Daria had the highest insured & noninsured damage in Europe at time of occurence -Muenchener Ruck insured damage assessement 4.4bill EUR (Muenchener Ruck, 2007); Swiss Re (2002) damage assessment >6 bill USD * -FIG6.4. The most important historic storm events in Europe from 1976 to 1999 with insured damage 1990 storm series>1999 storm series>87J * -storm represent most expensive storm catastrophes in Europe
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European

	Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] * -storm series Jan-Mar1990 one of most devastating for Europe * -total cost almost 13 bill EUR; most expensive storm series ever recorded (Munich Re,2001) * -120Mm3 damaged timber in 9 countries; 4 times more previous worst storm 1972
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -Daria rank4 insurance loss for Germany after Kyrill(2007)-Quimburga(1972)-Capella(1976) -for long period, Daria rank1 for highest insured damage; Kyrill overtook Daria in 2007
Munich Re (2013)	Munich RE, Natural catastrophes in Germany 1970-2012, Muenchener Rueckversicherung-Gesellschaft, Geo Risks Research, NatCatSERVICE - as of January 2013 -Daria: rank5 for overall loss; rank3 for insured loss; rank11 for fatalities
Kristandt et al (2014)	Kristandt, J, B Brecht, H Frank, H Knaack, Optimization of empirical storm surge forecast – modelling of high resolution wind fields, Die Kuste, 18, 301-308, 2014 -Daria had rank 19 skew surge of 39 storm surges at Norderney 1962-2011
Rohman (2014)	Rohman, James, European Extratropical Cyclones. Implications for local insurers, TransRe, May 2014 -damage cost rankingof storms: 1953>Daria>Lothar>Kyrill>Great storm>Vivian>Klaus>Martin>Xynthia>Anatol>St. Jude>Wiebke>Capella
Danish Energy Agency (2015)	Danish Energy Agency, Security of Electricity Supply in Denmark, 1st edition 2015, translated 2016, Danish Energy Agency, Amaliegade 44, 1256 Copenhagen K, ISBN 978-87-93180-15-4 -storm Daria 1990 does no rank as major threat to Denmarks'energy supply -Anatal1999 and Gudrun2005 led to major blackouts; Allan2013 almost resullted in blackout -Xaver2013 was as strong as Anatol1999 and Gudrun2005 but did not lead blackouts because power lines had been put underground
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -Daria rank 7 of 29 storm sin IMILAST storm database in terms of rate of deepening duing cyclogenesis
Met Office (20160415)	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019] -return period max gusts estimated > 100y from Dorset to London -data table shows Daria wind speed records still valid as of 2009
Gao (2017)	Gao, C., Analysis of storm surge and tidal resonance in the Bristol Channel, M.Sc., Oxford University, 2017. -rank1 surge for avonmouth and Ilfracombe
Cappelen (2018b)	Cappelen, John, Bodil og det beskidte dusin, https://www.dmi.dk/nyheder/2013/bodil-og-det-beskidte-dusin 11Dec2013, updated 2Oct2018b -regional category 4 storm in DMI Denmark list; one of 12 measured since end 19C.
Air Worldwide (20191219)	Air Worldwide: Three severe storms together were a wake-up call, Air Worldwide, Boston, Massachusetts, available at: https://www.air-worldwide.com/blog/posts/2019/12/three-severe-european-winter-storms-together-were-a-wake-up-call/ (last access: 21 November 2021), 19 December 2019. -maximum wind speeds of the storms in 1999 greater than first quarter storms of 1990; insurance companies companies did not take out re-insurance policies after 1990s; it created solvency problems after 1999 storms, particularly with Anatol in Denmark
Koks and Haer (2020)	Koks EE, and T Haer, A high resolution wind damage mdoel for Europe, Scientific Reports, Nature Research, 10:6866, https://doi.org/10.1038/s41598-020-63580-w, 2020 -Daria most damaging European winter storm, followed by Lothar 1999
Danhostel-Ribe (2021)	Danhostel-Ribe, Sturmfluten, https://web.archive.org/web/20131215125955/http://www.danhostel-ribe.dk/de/sturmfluten, accessed 25Apr2021 -Daria had rank 6 surge water level at Ribe since 1634
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -Daria in 1990 remains one of most devastating & expensive storms of world -Daria remains one of the most power storm since record began; also amongst most expensive -Welton: Daria drove local companies and markets to limits of existing financial capabilities -(no subsequent storm cmparable with Daria)
Lockwood et al (2022)	Lockwood, J.F, Guentchev, G.S., Alabaster, A., Brown, S.B., Palin, E.J., Roberts, M.J., and Thornton, H.E.: Using high-resolution global climate models from the Primavera project to create a European winter windstorm event set, Nat. Hazards Earth Syst. Sci., 22, 3585-3606, https://doi.org/10.5194/nhess-22-3585-2022, 2022 -Daria rank 1 insurance loss of European winter storms in period 1970-2018 -full ranked list: Daria 1990 > Lothar 1999 > Kyrill 2007 > 87J 1987 > Vivian 1990
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -storm caused millions in damage & is one of the most expensive winter storms of recent decades -Daria is in category as hurricanes Lothar 1999 & Kyrill 2007 as the most financially damaging natural catastrophes of the last 50y
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia -rated as worst stormin decades -wind gusts to hurricane strength -Schipol airport wind gust of 161km/h close to Netherlands record of 162km/h for Hoek van Holland on 6Nov1921 -in Utrecht it was highest wind since 1970s (Capella storm?)
Kystdirektoratet (2023)	Kystdirektoratet, De 10 hojest maalte vandstande langs Vestkysten, https://kyst.dk/kyster-og-klima/stormflod-og-beredskab/historiske-stormfloder-paa-vestkysten/ -Storm Daria: rank 5 in Thorsminde, rank 1 in Hvide Sand, rank7 in Hojer, rank2 in Esbjerg, rank4 in Ribe -only storm 24Nov1981 appears worse with top 10 rank in all 5 places.
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990,

	https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -storm is among the most destructive (highest fatalities) of 1990s across Europe -storm had most fatalities in Europe since the storm of Oct1987
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -1990 year of great expense for insurers and re-insurers: Daria 25Jan1990, then Wiebke & Vivian -Daria 95 people died in northern and central Europe -1990 storm cluster brought several companies or entire markets to limits of financial capabilities
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan2023 -storm remains most expensive weather event on record for UK insurers at 3.37 bill GBP
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -storm series among most serious in recent history of country (Belgium)

Table SL5. Severe forecast (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -weather forecasters insist storm forecast several days in advance
Belfast Telegraph (19900125b)	Belfast Telegraph, Ulster awash as snow and floods cause road chaos, p.1, 25Jan1990b. -after a short lull even worse weather expected with storm force winds at coast -70mph gusts expected on north and east coasts; strong winds in province 25-26Jan1990 -rain 25Jan1990 would turn to sleet and snow tonight & tomorrow
Belfast Telegraph (19900126a)	Belfast Telegraph, Weathermen warn of new freeze on the way (contributor Janet Devlin), p.1, 26Jan1990a. -another cold snap on the way; Northern Ireland cleaning up after snow and flood chaos -most of province bathed in crisp sunshine
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -Daria known to be catastrophic event 4 days ahead; explosive development 1987 in nearer to UK
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -tightly bounded area of very low pressure went further eastward and storm/hurricane winds were expected for Germany; wind speeds to 76kt were reported for N France & UK -with the approach of the cold front of the low P similar wind speeds were expected inland -warnings of hurricane and storm force winds given -at the North Sea coast there was a danger of a storm surge -Deutsche Hydrographische Institut gave storm surge warning on afternoon 25Jan of water levels 2-3.5m over normal high water in the night 25-26Jan
Eastern Daily Press (19900126b)	Eastern Daily Press, Weathermen got it right this time, p.2, 26Jan1990b. -Bob Pritchard, London Weather Centre: first forecast bad weather from Sunday 21Jan1990
ECMWF (1990)	ECMWF, ECMWF Report 1989.90, European Centre for Medium Range Weather Forecasts, 52pp, pdf datestamp 19/01/2010, 1990 -particularly challenging to make accurate and useful medium range forecasts for rapidly developing storms when development begins 2-3 days after start of forecast -such extreme events potentially predictable provided adequate data & most powerful computers available FIG. Medium-range forecast of the storm of 25 January 1990. The depression started to form about three days into the forecast (which is from the analysis of 20January). The graph shows the model's prediction of the timing, rapid deepening and subsequent filling of the low FIG. [MAP] Four-day forecasts of the storm of 25Jan1990 made with the Eulerian and semi-Lagrangian versios of the Centre's model (with 31 levels in the vertical). The forecasts were made with a 7.5 minute (Eulerian) and 30 minute semi-Lagrangian time steps
Evening Post Nottingham (19900126e)	Evening Post (Nottingham), We gave you warning this time, p.7, 26/01/1990e -forecasters insisted gales predicted well in advance with adequate warnings -Bob Pritchard, London Weather Centre: first forecast of bad weather as early a Sunday -Wednesday forecast spoke of storm force winds
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -24h hour forecast on 24Jan1990 12UTC did not indicate serious storm for UK
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -UK operational global model provided good guidance beyond 4days ahead for development of Great Storm Oct1987 (Gadd and Morris, 1988) -for Daria: global model gave guidanace 5 days ahead -108h forecast from 0000UTC on 21Jan verifying at 1200UTC on 25Jan; used to warn of stormy conditions on 25Jan in television farming forecast Sunday 21Jan; 50kt forecast for SW Ireland -earliest fine-mesh forecast valid for 1200UTC 25Jan was 36h forecast from 24Jan 0000UTC -depth of depression and strength of surface winds greatly underpredicted -in addition to sfc and upper air data from ships; data also from aircraft, drifting buoys,

	land stations; no satellite sounding data received by 1355UTC cutoff -operationally, forecast supplied with very good guidance from fine mesh model on afternoon 24Jan -warnings issued to military and civilian population in good time -advantages of fine mesh model to result tight gradients compromised by sparsity Natl observations -problems made worse by early data cutoff -lack of observations in area of explosive cyclogenesis contributed to poor forecast Oct1987 storm -on 24Jan1990 observations from 2 ships in low P area that was set to deepen explosively
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -system cam to life E of New Jersey on 21Jan2023 -moved east-northeastward; weaker than Icelandic storm (storm 3) -early on 25Jan 973mb center crossed 20W near 51N -merged with system to north; entered England with 952mb centre by 1200
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -depression started life 23Jan as ill-defined & shallow area of low pressure off eastern seaboard Namer -by 0000GMT on 24Jan1990 portion of depression lying under powerful jet stream 180kn started to develop -midday on 24Jan central pressure fallen to 992mb; pressure set to deepen explosively -UKMO gave excellent warning of the Burns Day storm -FIG8 shows T+108 forecast from UKMO global model -guidance from ECMWF also predicted marked cyclogenesis for 25Jan but with centre much deep and further north -guidance of severe gales for southern half of UK issued on Sunday farming forecast 21Jan1990 -more precise forecasts issued on 24Jan based on 24h forecast from fine-mesh regional model -predicted mean surface winds 50kn -event appeared extreme enough to warrant press release of storm and possible structural damage -warning to Ministry of Defence at 1830GMT Wednesday 24Jan that military assistance to civilian population might be required due to severity of winds
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -current generation of operational NWP model have skill for major cyclogenesis events; UKMO 15 level model leader in field -global (coarse mesh) version useful for advance warning up to 6d ahead -accurate notice of Burns Day storm on 25Jan1990 Thursday first given in TV farming forecast on previous Sunday -fine detail up to 36h ahead from fine mesh model; framing warnings for media -fine mesh model gives poor deepening forecasts for 25Jan and 26Feb -handling of 2 lows highlighted crucial role of forecaster to overcome occasional major deficiencies in numerical guidance -deficiencies in Burns Day case example of rogue run where model lapses into weak or nondevelopmental mode after clear signal for large cyclogenesis -other storm examples noted by Woodroffe (1990) and Reed et al (1988) -DARIA: FIG10a shows a nondevelopmental mode in 36h forecast in contrast to better 24h forecast -forecasters alert to problem; warnings issued on basis of solution ensemble -forecast greatly improved by observations from 2 ships near low centre -second problem: tendency to nudge towards correct solution from run to run rather than sudden change to explosive cyclogenesis -particularly true for 26Feb storm
Anonymous (1990)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -Atlantic depression deepened explosively from east coast North America -Met Office gave adequate warning on TV
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -Glasgow Met Office: more snow was on the way; cold snap expected to last few more days
The Times (19900129b)	The Times, Met Office examines storm warning media links (contributor Michael McCarthy), 29Jan1990b. -Colin Flood: Met Office to carry out internal investigation into Thursday great storm -concentration on how warnings of storm were publicized -enquiry likely to be chaired by John Houghton, Director General -storm predicted as far back as Sunday; extreme warning on Wednesday evening -Met Office satified with storm prediction in comparison with Oct 1987 storm -MetOffice between 2 computers; Cyber forecasting computer installed 1981 -Cray computer deliered last month
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -KNMI warned of storm on evening 24Jan -storm warning not broadcast in Dutch news until early morning 25Jan; at wnd of weather report

Table SL6. Storm not as bad as expected; not as bad as it could have been (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -fewer trees damaged by Daria; in 1987 15 million trees blew down because still had leaves

	-Insurance companies: at least 750 mill GBP damage; in 1987 it was 1.2 bill GBP in claims
Belfast Telegraph (19900126a)	Belfast Telegraph, Weathermen warn of new freeze on the way (contributor Janet Devlin), p.1, 26Jan1990a. -Belfast International and Harbour airports reported all flights back to normal -ferry companies P&O Larne-Cairnryan and Sealink Larne-Stranraer said some sailings running an hour late -should be on schedule tonight -Northern Ireland Electricity: supplies back to normal -RUC: spate of minor traffic bumps throughout city due to skidding -Department of Environment: crews out 25Jan unblocking drains and clearing flood damage -England suffered much more severely than we did -Housing Executive spokesman: there had been some severe flooding in greater Belfast area -Charlie Browne of Association of British Insurers: doubts whether Northern Ireland would be in line for special gov compensation -'... we have after all suffered hurricanes and very bad weather here in the past'
Belfast Telegraph (19900126d)	Belfast Telegraph, Dozens die as winds hit continent, p.4, 26Jan1990d -Dutch Transport Ministry: sea defences not jeapardized
Derby Evening Telegraph (19900126b)	Derby Evening Telegraph, Winds havoc round-up, p1, 26Jan1990b. -insurance companies preparing for flood of claims; storm payouts expected to be considerabley less than 1.3 bill GBP from Oct1987 storm -Sun Alliance UK, biggest home insurer, received 5000 claims by late yesterday (2000 more than avg)
Derby Evening Telegraph (19900126d)	Derby Evening Telegraph, Insurance chiefs set up hit squad (contributor: Graham Smith), p.3, 26Jan1990d -insurance payout for Storm Daria expected to be less than Oct1987 storm with 1.3 bill GBP payout
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -London Weather Centre: gales among worst of century; not as strong as Oct1987 but wider area
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -Norwich Weather Centre: wind speeds not far short of 1987 storm; worst winds since then -Met men: the wind would be 'near gale force, it will be nothing as horrendous - just very blowy'
Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -no fatalities or serious injuries in Norfolk (in spite of high fatalities in other placed UK)
Eastern Daily Press (19900126n)	Eastern Daily Press, Insurance companies braced for claims, p.3, 26Jan1990n. -insurance payout for Daria expected to be an order of magnitude lower than Oct1987 hurricane and more like Jan1984 storm
Eastern Daily Press (19900127d)	Eastern Daily Press, Brave skipper praised for rescue of tug crew, p.3, 27Jan1990d -Waveney district services manager Graham Jermyn: damage significantly less than 1987; only minor nuisance
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -rail: still problems at Hendon but Midlands bound commuters lightly hit compared with southern England where trains cancelled altogether
Evening Post Nottingham (19900126g)	Evening Post (Nottingham), Winds whip up to the 100 mph, p.8, 26/01/1990g -higher number of fatalities compared to Oct1987 storm due to larger area and fact that it took place during working day -Daria worst hit are in southwest, which escaped impact in Oct1987 -Daria highest winds 100 mph in parts of Cornwall; Oct1987 highest wind 112mph at Shoreham, West Sussex -Daria wind speeds not so unusual for north of Scotland
Evening Post Nottingham (19900126i)	Evening Post (Nottingham), Insurance companies ready for the worst', p.8, 26/01/1990i -Association of British Insurers: total claims could be considerably less than Oct1987 -Tony Baker, Association of British Insurers: structural damage not as bad as Oct1987 -storm much worse for fatalities
Freiburger Nachrichten (19900127)	Freiburger Nachrichten, Vor allem Daecher erlitten Schaden, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -side-runners of hurricane storm in night 25-26Jan over west and central Europe caused damage in Kanton Freiburg -kanton building insurance authority the received 100 mostly small damage claims by midday 26Jan -Pierre Ecoffey satisfied that storm did not cause more damage -in the past year summerstorms had caused damage especially in Glanebezirk
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -no deaths reported in West Yorkshire
Huddersfield Daily Examiner (19900126c)	Huddersfield Daily Examiner, Fierce gales cause chaos, p7, 26Jan1990c. (Friday) -motorways around Huddersfield remained open despite 15 toppled lorries
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -insurance companies prepared for avalanche of claims; payouts expected to be well below great storm of 1987; government promised emergency cash for for local authorities
Jensen and Winther-Jensen (1990)	Jensen, P.H. and M. Winther-Jensen, 99% af moellerne velbeholdne igennem stormen 25. januar, Naturlig Energi, 12, 6, Marts 1990 -in Nov1981 there were 400 propeller windmills in Denmark connected to network -1% completely collapsed & 4% seriously damaged with cracked off blades, axel bearing rearrangment including hub -to compare, damage from 25Jan1990 included 3 totally destroyed turbines or 1 permille of

	total standing turbines with another 2 permille seriously damaged -wind turbines performed 10 time better than in 1981 -can't be certain that all seriously damaged turbines included
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Royal Botanic Garden at Kew lost 100 old trees compared with 1000s during Oct1987
Neue Zuercher Nachrichten (19990127)	Neue Zuercher Nachrichten, Sturm forderte Menschenleben, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -in spite of wind speeds of 120km/h, Basel fire department did not receive a single call related to storm damage -to the astonishment of Appenzel Innerbodens Kantons police the emergency response unit had a quiet time in spite of wind speeds to 170km/h
NRC Handelsblad (19900126b)	NRC Handelsblad, Zeker 65 doden in buitenland, p.1, 26/01/1990b -UK damage estimates lower than the 2 billion GBP? of Great Storm of 1987
NRC Handelsblad (19900126e)	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e -higher wind gusts were measured in the Netherlands 7Sep1944 -in Vlissingen wind gusts up to 175km/h
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -the damage to forests and nature areas not yet known but generally believed to be less than in 1972-73 when there were 2 storms that blew down 1/2 million cubic meters of wood
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -London Weather Centre: gales among worst of century; not as strong as Oct 1987 but wider area -Oct1987 deaths: 19 on night, 11 related deaths over next few days -Oct1987 damage: 1.5 billion GBP; Daria expected to be less
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -assessment of recurrence period for basis stations indicates for worst station (Harlingen) water levels occur at Daria level every 2 years.
The Times (19900126)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Met Office: weather not as bad as Oct1987 storm
The Times (19900127f)	The Times, Airline pilots fly in face of 'hurricane' (contributor Harvey Elliott), p3, 27Jan1990f -25Jan1990: total of 447 aircraft landed at Heathrow; passengers sick in turbulence -Captain Bill Lawrence landed Boeing 757 at Heathrow twice -plane could have landed in winds 50% higher
Borgesius and de Vries (1991)	Borgesius, J.J. and S.M.G. de Vries, De januariestorm van 1990, Nederlands Bosbouw Tijdsschift, pp. 308-311, 1991. -Netherlands had bad forest damage but damage was worse in Belgium, Luxemburg, large parts of Germany, France and UK
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -storm very strong on 25Jan with high wind gusts in France & Belgium: Koksijde: 46m/s Munte, Boulogne, Dunkerque: 43m/s Radinghem: 42m/s Middelkerke: 41m/s Abbeville, Vron, Oostende: 40m/s -for all stations in departements of Aisne, Nort, Pas-de-Calais, Somme max gust > 28m/s -no wind speed record broken except for Dunkerque -record wind speeds since 1946: Boulogne 60m/s, Lesquin 45m/s, 40m/s Epinoy and Touquet
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -analysis of worst case scenario storms based on 1990 storm sequence -presentation of extreme 1953 surge-type storm
Doreland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -Munich Re model showed if track had been slightly diff, damage could have been 2-3X (Berz,1993)
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -hurricane and storm storm damage reaches only 0.5-1% GDP in western countries and can be handled by governments
Cusack (2013)	Cusack, Stephen, A 101 year record of windstorms in the Netherlands, Climate Change, 116, 693-704, 2013. -Daria 1990 ranks with Lothar (1999) as worst European winter storm for fatalitieis
Met Office (20160415)	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019] -loss of trees less than 1987 since strongest winds in less wooded areas; deciduous trees bare of leaves

Table SL7. Storm worse than expected; unusual damage or emergency services actions (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -police describe situation as chaotic -ambulance crews abandoned strike at height of storm -Home Secretary David Waddington: government announces special funds to councils in worst-hit areas
Belfast Telegraph (19900125a)	Belfast Telegraph, Diana flies in to Ulster blizzard. Weather grounds helicopter (contributor Charles Haslett), p.1, 25Jan1990 -visit of Princess Diana to Northern Ireland changed because of severe blizzard
Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -mopping up operations underway and troops called to help -people made homeless moved into barracks -6 specialist 2 man teams from 40 Commando Royal Marines standing by to help South West Electricity Board engineers removing trees and helping with fallen power lines -helicopters brought in to spot damaged lines ->200 people spent night in emergency accommodation after storm damaged roofs of 75 flats Cradley Heath near Birmingham -Birmingham: 5 weeks before all traces of blown over trees removed
Belfast Telegraph (19900126e)	Belfast Telegraph, Minister pledges financial help to local councils, p.4, 26Jan1990e -Mr Hunt rejected Labour claims that the Government had not acted quickly enough and had failed to implement civil defence preprations as the storm approached -David Blunkett: The Government would seem to have learned nothing from the 1987 storms nor to have any plan of action to deal with a recurrence
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -Kew Garden lost 100 trees at the same time in passage of squall line
Derby Evening Telegraph (19900126)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -police dealt with 500 calls, a record
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -army called in for assistance in many areas; ambulancement came off picket lines
Eastern Daily Press (19900126f)	Eastern Daily Press, Worse happening at sea (contributor: Anthony Wenham), p.3, 26Jan1990f. -UK mild winter so far; winds tracking north & missed us -jet stream undulations caused Norfolk to be hit -cause of fluctuations unknown; Norfolk storm event rare -north of Scotland, comparable storms 2-3 times per year
Eastern Daily Press (19900127a)	Eastern Daily Press, Storm death toll 46 as Britain clears up, p.1, 27/01/1990a. -electricity spokesman: some gale hit areas will be without power for several days -marines deployed to restore electricity supplied in West Country where 150000 without power night 26Jan1990 -RAF flew engineers from Scotland; workers from Irish Republic & North of England repaired cables
Evening Post Notthingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -northbound M1 closed for 4h as 19 vehicles blown over between junctions 28 and 30
Evening Post Notthingham (19900126i)	Evening Post (Nottingham), Insurance companies ready for the worst', p.8, 26/01/1990i -Association of British Insurers: total claims could be considerably less than Oct1987 -Tony Baker, Association of British Insurers: structural damage not as bad as Oct1987 -storm much worse for fatalities
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -24h hour forecast on 24Jan1990 12UTC did not indicate serious storm for UK -weak storm expected
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -unusual wind speeds in northern England and coast of Wales not well predicted in UKMO operational models
Herald (19900129)	The Herald, Army goes on gales stand-by, 29 January 1990 https://www.heraldscotland.com/news/11979862.army-goes-on-gales-stand-by/ -The Army and emergency services throughout the south were on stand-by to deal with potential damage to buildings already weakened by last Thursday's storm, in which 46 people died.
Herald Express (19900126a)	Herald Express, Clean-up will cost millions, p.1, Friday, 26January1990a -Torbay Council staff opened emergency control room for first time in many years
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -in Randstad, 20000 cars in 300km queue -on motorways 130 trucks and caravans blown over -train travel in this part of the country impossible (Rotterdam)
Het Vrije Volk (19900126b)	Het Vrije Volk, Schade is groter dan door aardbeving, p.5, 26/01/1990b -insurance estimate at 5 bill gulden; more material damage than SF earthquake from previous year
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -fire crews in county answered more than 200 calls between 4PM and 0830PM compared with 100 calls normal day
Huddersfield Daily Examiner (19900126c)	Huddersfield Daily Examiner, Fierce gales cause chaos, p7, 26Jan1990c. (Friday) -AA dealt with 4863 calls in northern region; normal day about 3000 calls

Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -military services placed at disposal of civil authorities; clearing damage -many people made homeless housed for the night by the army -six specialist 2man teams from 40 Commando Royal Marines standing by to help South West Electricity Board engineers by removing trees & helping with fallen power lines
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -UK: troops drafted to help restore electricity
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 Brussels, 30Jan United Press International -European Community to grant 2.6 million ECU in emergency aid to victims of last week's severe windstorm in western Europe -nearly 1/3 of aid 900000 ECU to go to UK with 47 of 96 fatalities from last Thursday storm 25Jan -Netherlands to receive 500000 ECU, France 400000, Belgium 300000, W Germany 300000, Denmark 200000 -spokesman for EC said most property loss from storm covered by insurance; emergency aid to help families who could not wait for insurance payments
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -80 died & 100s injured by storm in Britain & N Europe -damaged estimated in 100s millions dollars -Britain worst affected with 45 casualties
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -event appeared extreme enough to warrant press release of storm and possible structural damage -warning to Ministry of Defence at 1830GMT Wednesday 24Jan that military assistance to civilian population might be required due to severity of winds
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) -storm in S England so severe that police warned people to stay in their homes
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -operators at Medway exchange dealing with 300 emergency calls per hour; 50/day usual -weathermen surprised by ferocity of storm; warning issued last week; winds stronger than feared -London Weather Centre spokeman: winds are strongest we have seen since great storm 2 years ago -police inundated by calls for help -problems with people using operations room lines for road reports -Insp Mervyn Williams: people advised to stay home last night unless absolutely necessary
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -2 girls killed at separate incidents at their schools -roof came off 3 classrooms at Grange Junior School, Lower Stratton, Swindon, Wilts; falling debris killed 1 girl, injured 4 others -St Brandon's girls school, Clevedon, Near Bristol; 1 16y killed & 9 injured by masonry through conservatory at lunchtime -Gordon Kaye, TV series Allo Allo critically injured by plank through windscreen W London -London traffic stopped when road & rail bridges over Thames closed
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -sheer severity of snowfall this morning incredible -Collander: police used landrover to ferry nurses to patients needing daily visits -schools in Killin, Collander, Belfron closed as soon as they opened -Bill Rose, coordinator Killin Mountain Rescue Team: risk of avalanches
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -national news did not warn public of storm event before early morning 25Jan -many gov institutions and economic sectors vulnerable to storm not aware of threat -storm turned out to be much more severe than forecast -government bodies lack disaster plans & have little interest in storm impacts -railway system blocked completely from many broken wires and fallen trees -4500 train travellers stranded for night -road traffic brought to virtual standstill at height of storm
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -gales 25Jan1990 left more dead in Britain than any single weather event since East Coast flood 1953; 47 dead with 36 direct result of storm -high deaths attributed to storm occurrence in week day -if 1987 storm had occurred during daylight hours, fatalities would have been higher -1990 storm affected greater area of country
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -German Federal government started Federation-State auxiliary program; 30 mill DM to Baden-Wuerttenburg

	-Switzerland: 370 mill Swiss Franc made available by Federal government and cantons for extraordinary felling; military and foreign contractors to assist in salvage logging
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia -thousands of commuters stranded overnight when rail network stopped
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -1990 storm cluster brought several companies or entire markets to limits of financial capabilities

Table SL8. Storm duration; extended period bad weather (arranged by year and then alphabetically)

Source	Full Reference and Notes
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -by mid-evening worst of storm blown over as gales swept across North Sea towards Scandinavia -London Weather Centre: forecast bright, breezy day with blustery showers & strong winds
Eastern Daily Press (19900126g)	Eastern Daily Press, Rail chaos as trains are halted for hours, p.3, 26Jan1990g -frustrated commuters waited for more than 5h for trains to leave Norfolk for London last night -trains for London began running again around 8PM -BR said trains running several hours late; hoped services back to normal this morning.
Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -most damage in 3h burst
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -fire brigade attended 40 incidents between 1700-2100 -Notts police inspector: extra staff drafted to copy with number of emergency calls -Allen Linley, inspector: problems started 1600 ->100 calls about fallen trees blocking roads
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -mid-evening worst of storm over; storm heading to Scandinavia (worst school fatalities at lunch time)
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -wind damage only described for afternoon & evening of 25Jan1990
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -short duration storm? -engineers worked all night to clear trees from lines -British Rail said most main line services working again this morning; rolling stock in wrong places; storm damage to power supplies causing disruption
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -storm abated during the night but 55 mph gales still lashed North Sea this morning (report 26Jan1990)
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -short duration storm?: number of trains cancelled at height of storm in afternoon due to power faults
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -rapid passage across British Isles; strong winds in late morning & early evening 25Jan1990 -rapid passage across Atlantic? first appearance 23Jan1990 -max winds from rapid movement of system and sudden surge of pressure behind low
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -Jim Brown, deputy directory of roads: all equipment out since early Wednesday morning (24Jan1990) -Glasgow Met Office: more snow was on the way; cold snap expected to last few more days
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -storm damage over short period: the 20 man protection service picket group Schwarzenegg was called out on series of missions 00:30-06:00 26Jan
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -high winds lasted for 8h over most areas of England and Wales
Wieringa (1990)	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990 -short duration storm lasting <12 hours -Netherlands: cold front of depression passed at 14:00 with intense gust line -deep trough passed over country between 15:00 to 20:00 -in the trough avg wind force at storm level Bf10 -strongest winds in provinces of Zeeland, Zuid-Holland, Utrecht -over open land Bf11 encountered or 28.5m/s -gusts in the trough at 40m/s -after midnight wind speeds decreased
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -difficult to evaluate duration of storm; with 15m/s 10min avg as criteria, storm lasted 10h at Lesquin 12:00 to 22:00 -GRA2. 10min avg wind speed for stations KOK and LES
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -cold front 14:00-15:00; wind intensity increased and direction changed; 19:00 from SW & W

	-2nd depression area in northern part of Netherlands at 18:00 with high -after 20:00 storm subsided and it started to rain periodically -peak gusts to 28m/s until midnight
Goennert and Buss (2009)	Goennert, Gabriele & Thomas Buss, Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser Nr.2/2009, Freie und Hansestadt Hamburg, Landesbetrieb Strassen, Bruecken und Gewaesser, Hamburg, ISSN 1867-7959. -Daria storm surge lasted for 3 tidal cycles at Cuxhaven
Gao (2017)	Gao, C., Analysis of storm surge and tidal resonance in the Bristol Channel, M.Sc., Oxford University, 2017. -surge at Avonmouth and Ilfracombe lasted 7 h
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -date of event start: 25Jan1990 11:00 local -date of event end: 26Jan1990 00:00 local -duration: 14h

Table SL9. Names of the storm1 - Daria (arranged by year and then alphabetically)

Name	Full Reference and Notes
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023)
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html

Table SL10. Names of the storm2 - Burns Day Storm (arranged by year and then alphabetically)

Name	Full Reference and Notes
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990.
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html

Table SL11. Satellite pictures (arranged by year and then alphabetically)

Source	Full Reference and Notes
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -FIG2. [IR PHOTO] Storm No.4 centered just west of Ireland early on 25Jan, wreaks havoc across entire British Isles FIG.A1. visible satellite image 1515UTC 24Jan1990 Univ Dundee FIG.A2. NOAA IR at 0330 UTC on 25Jan1990 FIG.A3. NOAA-11 IR at 1325 UTC on 25Jan1990 FIG.A4. 25Jan1990 1200UTC; analysis of surface pressure and 850mb wet bulb potential temperature 1300UTC region of strongest winds.
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. FIG1. (a) [MAP] Surface analysis (mbar) for 0000GMT on 24Jan1990 (b) [SATELLITE] Meteosat infrared image for 0000GMT on 24 January 1990 FIG2. (a) [MAP] Surface analysis (mbar) for 1200GMT on 24Jan1990 (b) [SATELLITE] NOAA-11 visible image for 1518GMT on 24 January 1990 (Dundee) FIG3. [MAP] 500mbar (solid lines) and total (1000-500mbar) thickness (dahsed lines) analysis for 1200GMT 24Jan1990. units are decametres FIG4. (a) [MAP] Surface analysis (mbar) for 0000GMT on 25Jan1990 (b) [SATELLITE] NOAA-11 visible image for 0329GMT on 25 January 1990 (Dundee) Satellite image analysis -between 2 main cloud areas, a cloud-free or dry wedge formed -baroclinic leaf -cloud head: cloud signature with 2 cloud areas and dry wedge -first appearance of cloud head is reliable precursor of explosively deepening cyclone with Bf10 storm wind
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -FIG7. [SATELLITE MAP] NOAA-11 infra-red image for 1518UTC on 24Jan1990
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) FIG2. [ANIMATION] Animation of cloud patterns

Table SL12. Weather radar, radar reflectivity (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL13. Meteorological data maps or surface analysis (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 FIG. surface weather map with annotated observations 26Jan1990 00UTC
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 ABB3. [MAP] Maximale Boen in Norddeutschland 21-22Feb1990 [error: should be 25-26Jan1990]
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -FIG1. [MAP] simplified weather map for Wed 24Jan1990 12UTC -FIG3. [MAP] simplified weather map Thu 25Jan1990 12UTC -FIG4. [MAP] simplified weather map Fri 26Jan1990 12UTC
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -FIG5. [MAP] Distribution of surface and upper-air marine observations at 1200 UTC on 24Jan1990 marked by circles and stars, respectively -FIG12.[MAP] Observed 10-minute wind speeds (traditonal wind arrows) and maximum gusts if over 25kt within the previous hour at 1500 UTC on 25Jan1990.
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. FIG.A4. 25Jan1990 1200UTC; analysis of surface pressure and 850mb wet bulb potential temperature 1300UTC region of strongest winds.
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. FIG1. (a) [MAP] Surface analysis (mbar) for 0000GMT on 24Jan1990 FIG2. (a) [MAP] Surface analysis (mbar) for 1200GMT on 24Jan1990 FIG4. (a) [MAP] Surface analysis (mbar) for 0000GMT on 25Jan1990 FIG6. [MAP] Analysis of maximum winds (kn) for 25Jan1990 FIG7. [MAP] Analysis of maximum winds (kn) for 16Oct1987
NRC Handelsblad (19900126e)	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e -FIG. [MAP] map shows max wind gusts (1 minute average) that were measured yesterday; hurricane threshold is 117km/h
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -FIG. [MAP] weather map with surface pressure isobars for 25Jan1990 1200; maximum gusts for 15 locations for Oct1987 storm and Daria,
Wireinga (1990)	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990 FIG1. [MAP] Highest potential hourly-average wind speed 25/01/1990 (m/s)
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -MAP1. Location of anemometer posts -MAP2. Instantaneous max wind for 25Jan1990 in m/s
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -FIG2. [MAP] Wind field map of DWD from 25Jan1990 1200 (hurricane Daria/Cat 90A). Wind speed in knots
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. FIG10.3. [MAP] 10min V_max in the Netherlands on 25Jan1990 (Wieringa, 1990)
Met Office (20160415)	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019] -FIG. [MAP] Highest gusts of over 60kt (69mph) recorded on 25Jan1990 -FIG. [MAP] Highest hourly mean wind speed (kt) for >30kt 25Jan1990
SSWD (20210109)	Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021 -FIG. [MAP] NOAA reanalysis map of surface pressure and 850hPa temperature at 25Jan1990 00Z -FIG. [MAP] NOAA 850 hPa streamlines the wind speed in knots 25Jan1990 00Z
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) FIG5. [MAP] Surface analysis 25Jan1990 1300 local time FIG6. [MAP] a. daily maximum wind speed France 25Jan1990 (10min avg wind speed?); b. estimation of maximum gusts NOTE: storm winds from WSW; gusts in streaks along cloud lines

Table SL14. Model fields (arranged by year and then alphabetically)

Source	Full Reference and Notes
ECMWF (1990)	ECMWF, ECMWF Report 1989.90, European Centre for Medium Range Weather Forecasts, 52pp, pdf datestamp 19/01/2010, 1990

	FIG (cover): surface pressure map for Daria probably 25Jan1990 00:00 FIG. Medium-range forecast of the storm of 25 January 1990. The depression started to form about three days into the forecast (which is from the analysis of 20January). The graph shows the model's prediction of the timing, rapid deepening and subsequent filling of the low FIG. [MAP] Four-day forecasts of the storm of 25Jan1990 made with the Eulerian and semi-Lagrangian versios of the Centre's model (with 31 levels in the vertical). The forecasts were made with a 7.5 minute (Eulerian) and 30 minute semi-Lagrangian time steps
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -FIG2. [MAP] simplified 24h forecast issued on 24Jan1990 12UTC (for following day)
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -FIG1. [MAP] Analysis of obseved mean sea level pressure for 12:00UTC on 25Jan1990 -FIG2. [MAP] T+108 global model forecast for mslp. Data time 0000UTC on 21Jan1990 -FIG3. [MAP] T+36 operational fine mesh model of mslp. Data time 0000UTC on 24Jan1990 -FIG4. [MAP] T+30 operational fine mesh forecast of mslp. Data time 0600UTC 24Jan1990 -FIG6. [MAP] T+00 operational fine-mesh analysis for 1200UTC on 24Jan1990, (a) mean sea level pressure and (b) 500 mb height (full lines) and 1000-500mb thickness -FIG7. [MAP] Difference between fine-mesh operational analysis and analysis without OWS C and ONDA for 1200UTC on 24Jan1990 (a) mean sea level pressure, (b) 500mb height, (c) 1000-500mb thickness Positions of the two ships marked -FIG8. [MAP] T+24 fine mesh forecast of MSLP. Data time 1200UTC on 24Jan1990, (a) operational run, (b) rerun without OWS-C and ONDA -FIG9. [MAP] T+24 fine mesh forecast of 500mb height (full lines) and 1000-500mb thickness (dashed lines). Data time 1200UTC on 24Jan1990 (a) operational run, (b) rerun without OWS C and ONDA, and (c) verifying analysis for 1200UTC on 25Jan1990 -FIG10.T+24 fine-mesh forecast of mean sea level ressure. Data time 1200UTC on 24Jan1990, (a) rerun without OWS C only, and (b) rerun without ONDA only -FIG11.[MAP] Operational fine-mesh forecast of surface (10m) wind speed. Data time 1200 UTC on 24Jan1990, (a) T+24, (b) T+27, (c) T+30. Hatched areas highlight the progression of maximum winds -FIG12.[MAP] Observed 10-minute wind speeds (traditonal wind arrows) and maximum gusts if over 25kt within the previous hour at 1500 UTC on 25Jan1990. -FIG13.[MAP] Fine-mesh forecast of surface (10m) wind speed from analysis without OWS C and ONDA. Data time 1200UTC on 24Jan1990 (a) T+24, (b) T+27, (c) T+30
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. FIG8. [MAP] T+108 forecast of mean sea level pressure (mbar) and precipitation from the Met Office global model, data tiime 0000GMT on 21Jan1990 FIG9. [MAP] T+24 forecast of mean sea level pressure (mbar) and precipitation from the Met Office global model, data time 1200GMT on 25Jan1990
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -FIG1. [MAP] Anomalies of normalized 1000-500mb thickness (standard deviations, January 1990) (solid lines) and sea surface temperatures (dec C, 1-25January) (dashed lines) for the period preceeding the stormy period -FIG4. [MAP] Schematic of low development ahead of a broad, mobile, confluent 250mb trough. Disposition of centre of surface relative to 250mb pattern (a) at time of onset of rapid deepening, and (b) 24h later. Main cloud bands stippled NOTE: pattern for Daria -FIG10.Fine-mesh model output from consecutive runs, both verifying at 1200UTC on 25Jan1990. (a) T+36 forecast from data time 0001 UTC on 24Jan1990, (b) T+24 forecast from data time 1200 UTC on 24Jan1990
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. FIG [MAP] Chart shows the situation at 1200 on 25Jan with depression centre over North Sea
Pinto et al (1999)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -FIG2. [MAP] Case study for storm Daria 25Jan1990 06UTC a. Eady growth rate 400hPa (1/day) as 3 day running mean b. Jet Stream 250hPa (m/s) c. horizontal divergence 250hPa (1/s) d. equivalent potential temperature 850hPa (K) Exceedance of the long term 95th and 99th percentile denoted in color

Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -FIG6.2. [MAP] Wind field of the hurricane Daria (MunchenerRueck 1999) NOTE: TRAJECTORY ALSO -Annex1.2. [MAP] soil pressure dispersion (? sea level pressure) for February a month with a highly positive NAO index (Wernli etal, 2003) -Annex1.3. [MAP] Modelled maximum wind speeds occurring during storm 'Daria' in Jan1990 (Keller) -Annex1.4. [MAP] Windfield of a possible hurricane (Daria) scenario (MunchnerRuck 2001) -Annex1.5. [MAP] 500 hPa geopotential (gpdm) and surface pressure on 24Jan1990 (Daria) (Lowinski, 2006)
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -FIG_p34. map of max gust for Daria 26Jan1990
Westiedad (20131118)	westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/ FIG1. [MAP] NW Europe sea level pressure map 25Jan1990 18UTC
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -FIG4. Maximum wind gusts (kt) observed during the passage of the three ISD cyclones (TAB1): Daria in (a), Oratia in (b), and renate in (c). Letters denote the assigned cause of the max gust in different regions (W for warm jet, S for sting jet, and C for cold jet). Orange and yellow rings on (a) and (b) respectively denote the locations of Camborne and Crawley; soundings from these sites for windstorms are shown in FIG2c and 2a respectively.
Met Office (20160415)	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019] -FIG. [MAP] Synoptic chart for 1200GMT 25Jan1990
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia FIG. [MAP] Weather map of 25Jan1990 (source: ECMWF). ECMWF analysis Thursday 25Jan1990 1800UTC NOTE: low pressure center in North Sea east of Scotland with isobars bunched S England and Netherlands; central pressure at 950hPa
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) FIG6. [MAP] a. daily maximum wind speed France 25Jan1990 (10min avg wind speed?); b. estimation of maximum gusts NOTE: storm winds from WSW; gusts in streaks along cloud lines

Table SL15. Satellite altimeter strip maps (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL16. List meteorological data (arranged by year and then alphabetically)

Data type	Location	Time Interval	Full Reference and Notes
[MAP] highest wind gusts	Stations in northern Germany, Netherlands, Denmark	25-26Jan1990	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990
[TEXT] highest gust	Boscombe Down	25Jan1990	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990
[MAP] 10 minute wind speeds and maximum gusts	Stations in UK and Ireland	25Jan1990 15:00	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990.
[TEXT] maximum wind speed	Humberside airport	25-26Jan1990	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday)
[TEXT] maximum average wind speed and gust	Aberporth airport	25-26Jan1990	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990.
[TABLE] Daily rainfall	Belmullet, Clones, Malin Head, Mullingar, Roche's Point	25Jan1990	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990.
[TABLE] highest gusts of month	Belmullet, Birr, Cahirciveen, Casement, Claremorris, Clones, Cork AIrport, Dublin AIrport, Galway, Kilkenny, Malin Head, Mullingar, Roche's Point, Rosslare, Shannon Airport	Jan1990	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990.
[MAP] highest 1 min avg gusts	Stations in the Netherlands	25Jan1990	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e
[FIGURE] wind speed and direction	Hoek van Holland	25-26Jan1990	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX

			's-Gravenhage, 's-Gravenhage, april 1990 Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990
[MAP] maximum gust	Stations in the UK	25Jan1990	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d
[TEXT] maximum gust in UK	Aberporth, Wales	25Jan1990	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d
[MAP] highest potential hourly average wind speed	Stations in the Netherlands	25Jan1990	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990
[FIGURE] hour average wind speed	Leeuwarden, Schipol, Deelen	25Jan1990 12:00 - 26Jan1990 03:00	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990
[FIGURE] 10 min (?) average and max in 6 h intervals	De Koy, Eelde, De Bilt, Vlissingen, Z. Limburg LH	Jan and Feb 1990	Borgesius, J.J. and S.M.G. de Vries, De januariestorm van 1990, Nederlands Bosbouw Tijdsschift, pp. 308-311, 1991.
[FIGURE] maximum instantaneous wind speed	Stations in northern France	25Jan1990	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991.
[TABLE] wind speed and direction and air temperature at 1h intervals; daily average sea temperature	Forschungsplattform Nordsee	Jan. 1990	BSH, Beobachungen auf den deutschen Messstationen der Nord- und Ostsee im Jahre 1990, Meereskundliche Beobachtungen und Ergebnisse, Nr. 70, Bundesamt fuer Seeschiffahrt und Hydrographie, Hamburg, 1992
[FIGURE] highest 1 hour average wind speed	Netherlands stations	25Jan1990	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999.
[FIGURE] hour average wind speed	Schipol, Leeuwarden	25Jan1990 12:00-24:00	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999.
[FIGURE] wind speed	Ekofisk	16-30Jan1990	Ramboll, Kortlaegning af bolgeenergiforhold i den Dansk del af Nordsoen, Ramboll, Dansk Hydraulisk Institut, Danmarks Meteorologiske Institut, 04Juni1999, Energistyrelsen J.No. 51191/97-0014
[FIGURE] 10 min wind speed and direction	Scharhoern	25-27Jan1990	Goennert, Gabriele & Thomas Buss, Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser Nr.2/2009, Freie und Hansestadt Hamburg, Landesbetrieb Strassen, Bruecken und Gewaesser, Hamburg, ISSN 1867-7959.
[TABLE, FIGURE] highest gusts and hourly wind speeds	UK stations	25Jan1990	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019]
[TABLE] maximum gust	Feldberg (D), Saentis, Pilatus, La Dole, Ruenenberg, Schaffhausen, Basel Binningen, Friedrichshafen (D), Freiburg (D), Eschbach (D), Neuenburg, Konstanz (D), Dogern (D)	25-26Jan1990	Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021
[TEXT] maximum gust	Schipol airport	25Jan1990	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia
[TABLE] maximumm gust speed	Pointe du Raz, Cap de la Heve, Cap de la Hague, Dunkerque, Boulogne-sur-Mer, Quimper, Abbeville, Roissy, Nancy-Ochey, Saint-Gatien-des-Bois, Langres	25Jan1990	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023)
[FIGURE] maximum gust speed and direction	Stations in France	25Jan1990	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023)
[TEXT] maximum gust	Beauvechain, Coxyde, Saint	25Jan1990	belgorage, 25/01/1990 – Violentes lignes de grains et

	Hubert, Middelkerke, Ostende, Bierset		possibles tornades associées à la tempête Daria, https://belgorage.be/almanach/base-de-donnees-breves-et-articles-1990-01-25-orages/, access date 15Mar2024

Table SL17. Significant wave height and sea state (arranged by year and then alphabetically)

Data type	Location	Time Interval	Full Reference and Notes
[TEXT] significant wave height	Bay of Biscay	?	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990
[FIGURE] significant wave height	Westerland ODAS buoy in Southern North Sea	?	BSH, Seegangsmessungen in der Deutschen Bucht im Jahre 1990, Meereskundliche Beobachtungen und Ergebnisse Nr. 71, Bundesamt fuer Seeschiffahrt und Hydrographie, Nr. 2149/43, Hamburg, 1991, https://digitale-bibliothek.bsh.de/viewer/fullscreen/29682/1/

Table SL18. Wave period and other wave data (arranged by year and then alphabetically)

Data type	Location	Time Interval	Full Reference and Notes

Table SL19. Surge reports and quantitative water levels (arranged by year and then alphabetically)

Data type	Location	Time Interval	Full Reference and Notes
[TEXT] skew surge	Southern Jutland	Instantaneous	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b.
[TABLE] water level, astronomical tide, storm surge	Vlissingen, Roompot buiten, Hoek van Holland, Doredrecht, Den Helder, Harlingen, Delfzijl	Instantaneous	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990
[TEXT] qualitative skew surge information	Dutch coast	Instantaneous	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990
[TABLE] maximum water level	Hojer, Havneby, Ballum, Ribe Kammersluse, Esbjerg, Hvide Sand Havn, Thorsminde Havn, Tohorsminde Hav, Thoyboron Havn, Hanstholm, Ringkobing, Logstor	Instantaneous	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007.
[FIGURE] water level, modelled astronomical tide, calculated true surge by difference	Cuxhaven	Unknown, digitized record	Goennert, Gabriele & Thomas Buss, Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser Nr.2/2009, Freie und Hansestadt Hamburg, Landesbetrieb Strassen, Bruecken und Gewaesser, Hamburg, ISSN 1867-7959.
[TABLE] true surge?	Avonmuth, Ilfracombe	Instantaneous	Gao, C., Analysis of storm surge and tidal resonance in the Bristol Channel, M.Sc., Oxford University, 2017.
[TABLE] water level	Ribe	Instantaneous	Danhostel-Ribe, Sturmfluten, https://web.archive.org/web/20131215125955/http://www.danhostel-ribe.dk/de/sturmfluten, accessed 25Apr2021
[TABLE] skew surge	Holyhead	Instantaneous	NTSLF, Skew surge history, https://ntslf.org/storm-surges/skew-surges/england-wales (accessed 10Nov2021)
[TABLE] water level	Thorsminde, Hvide Sand, Hojer, Esbjerg, Ribe	Instantaneous	Kystdirektoratet, De 10 hojest maalte vandstande langs Vestkysten, https://kyst.dk/kyster-og-klima/stormflod-og-beredskab/historiske-stormfloder-paa-vestkysten/ (2023)
[TEXT] maximum skew surge?	Boulogne, Havre	Instantaneous	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023)
[TABLE] maximum water level	List-Sylt	Instantaneous	Thiesen, H., Email from Hauke Thiessen of Land SH with list of surges at Sylt in 20C. 05Dec2023

Table SL20. Water current information (arranged by year and then alphabetically)

Data type	Location	Time Interval	Full Reference and Notes

Table SL21. Return period of water level; ranking of water level (arranged by year and then alphabetically)

Source	Full Reference and Notes
Sorensen et al (2007)	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007. -ranked list of water levels on west coast of Jutland -Hojer Sluse, rank=6, data period 87.2 year -Havneby, rank=4, data period 46 year -Ballum, rank=3, data period 72.2 year

	-Ribe, rank=4, data period 87.7 year -Esbjerg, rank=2, data period 133.8 year -Hvide Sand Havn, rank=2, data period =75.2 year -Thorminde Havn, rank=3, data period=58.1 year -Thorsminde Hav, rank=8, data period =22.1 year -Thyboron, rank=11, data period=72.1 year -Hanstholm, rank=21, data period=37.2 year -Ringkobing, rank=11, data period=36.2 year -Logstor, rank=20, data period=76.1 year
Goennert and Buss (2009)	Goennert, Gabriele & Thomas Buss, Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser Nr.2/2009, Freie und Hansestadt Hamburg, Landesbetrieb Strassen, Bruecken und Gewaesser, Hamburg, ISSN 1867-7959. -Cuxhaven water level of 8.76 m was rank 41 vent in time period 1901 to 2008, giving average return period 2.61 y
Gao (2017)	Gao, C., Analysis of storm surge and tidal resonance in the Bristol Channel, M.Sc., Oxford University, 2017. -surge for Avonmouth and Ilfracombe identified as rank 1 events; not enough information to calculate a return period
Thiesen (20231205)	Thiesen, H., Email from Hauke Thiessen of Land SH with list of surges at Sylt in 20C. 05Dec2023 -water level at Sylt/List during Storm Daria reached 858 cm ueber NN; rank 6 event with 20.4year return period

Table SL22. Return period of wind speed; ranking of wind speed (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -Daria was assessed not to be a century storm for Germany
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -20y wind speed event evaluated for Sweden
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -FIG1. [MAP] Return period (years) for maximum gusts recorded on 25Jan1990 NOTE: RETURN PERIOD FORM LONDON AREA >200y
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -Dutch meteorologists said Daria was worst to hit Netherlands in 10years -insurers association Verbond van Verzekeraars: Dutch insurers face 100s millions of florins in claims after worst storm to hit country in decade
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -Dutch meteorologists: worst storm for 10 years
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -records broken at Aberporth, Benson, Boscombe Down, Brawdy, Farnborough, London/Heathrow, Hurn, Larkhill, Plymouth, Stanstead airport, St. Mawgan
Van Mouric (1990)	van Mourik, B.: De uitzonderlijkheid van de zware storm van 25 Januari 1990, (The rarity of the heavy January 25 1990 storm), Weerspiegel 17, 3: 207-211, 1990. return period based on Weibull-Rijkoort model with parenthesis showing return period based on Gumbell model Location Time Dir Wspd Cf. Up HERH MET Meas (m/s) TIJD (m/s) ---------- IJmuiden 19 W 30.4 0.86 26.1 15y De Kooy 20 W 23.7 0.99 23.5 5 y Tersch 22 W 28.3 0.85 24.1 5 y Schipol 19 SW 27.3 1.02 27.9 50y (45) Soesterb 19 W 22.1 1.19 25.2 70y (95) Houtrib 18 SW 26.8 0.89 23.9 10y Leeuward 18 SW 22.6 1.13 25.5 25y (20) Deelen 20 SW 21.1 1.01 21.3 5 y (5) Eelde 21 SW 22.1 0.96 21.2 5 y (7) Vliss 17 SW 28.3 0.84 23.8 10y (25) Rotterdam 19 SW 23.7 1.01 23.9 10y (25) Gilze-R 19 SW 19.0 1.27 24.1 50y (50) Eindhoven 19 SW 20.6 1.11 22.9 15y (15) Beek 17 Sw 19.5 1.00 19.5 5 y (8)
Wieringa (1990)	Wieringa J, Zware storm op 25 Januari 1990, In: Proceedings 5e Nationale Windenergieconferentie (Lunteren, Feb, 1990): Windenergie: een winnende realiteit, pp. 4-7, Uitgave can: ECN te Petten, VeWin, KNMI te De Bilt, 1990 FIG4. [MAP] Average return period of the highest hourly-average wind during 25/01/1990 NOTE: Schipol 50y return period; highest in Netherlands 70y
Borgesius and de Vries (1991)	Borgesius, J.J. and S.M.G. de Vries, De januariestorm van 1990, Nederlands Bosbouw Tijdsschift, pp. 308-311, 1991. FIG4. [MAP] storms 1972, 1973, 1976, and 1990 which locality was the worst (after Wieringa 1990)

	FIG5. [MAP] Return period (in years) of highest 1h average wind from 25Jan1990 (after Wieringa, 1990)
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -no wind speed record broken except for Dunkerque -record wind speeds since 1946: Boulogne 60m/s, Lesquin 45m/s, 40m/s Epinoy and Touquet
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -KNMI records: return period of Daria storm is 7-40 years in absenece of any climate change -Daria was worst storm Netherlands since hurricane 1944
Met Office (20160415)	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019] -return period max gusts estimated > 100y from Dorset to London

Table SL23. Return period of insurance loss; ranking of insurance loss (arranged by year and then alphabetically)

Source	Full Reference and Notes
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -TAB9. Return period of monetary loss in storm Belgium: Daria RP 10-20y; storm series 1990 RP 30-40y Germany: Daria RP 4-8y; storm series 1990 RP 30-40y France: storm series 1990 RP 15-20y UK: Daria RP 12-25y; storm series 1990 RP 30-40y Netherlands: Daria RP 10-25y
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. -Daria rank 4 insurance loss of 16 natural catastrophes to exceed 1 bill UDS threshold -Daria first among 5 European winter storms in the list: Great storm1987, Daria, Herta, Vivian, Wiebke
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 TAB. Ranking of storms by insured damage in Germany Storm / Date / Insured damage Germany mill Euro wrt 2012 1 Kyrill 18-19Jan2007 2800 2 Niedersachsen-Orkan 12-13Nov1972 2500 3 Capella 03Jan1976 2000 4 Daria 26Jan1990 1500 5 Vivian 26Feb1990 1500 6 Wiebke 01Mar1990 1500 7 Lothar 26Dec1999 1200 8 Jeanett 27-28Oct2002 1200 9 Herta 03Feb1990 770 10 Lore 27Jan1994 580 11 Xynthia 28Feb2010 530 12 Emma 01Mar2008 450 13 Anna 26-28Feb2002 340 14 Jennifer 26-29Jan2002 330 15 Anatol 03Dec1999 290 16 Xylia 27-28Oct1998 270 17 Elvira/Farah 04-05Mar1998 240 18 Sonja 27-28Mar1997 230 19 Oralie 20-21Mar2004 210 20 Dorian 16Dec2005 200 21 Andrea 05Jan2012 130
Cusack (2013)	Cusack, Stephen, A 101 year record of windstorms in the Netherlands, Climate Change, 116, 693-704, 2013. -100 year loss index for Netherlands based on 98th percentile of wind speed raised to third paper -1990 and 1984 events worst of series
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -storm caused millions in damage & is one of the most expensive winter storms of recent decades -Matthias Habel: hurricane damage in N,W,middle Europe; 4.4 billion EUR damage -Daria is in category as hurricanes Lothar 1999 & Kyrill 2007 as the most financially damaging natural catastrophes of the last 50y
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -storm is among the most destructive (highest fatalities) of 1990s across Europe

Table SL24. Storm trajectory map and translational speed (arranged by year and then alphabetically)

Source	Full Reference and Notes

Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 ABB2. [MAP] Die Zugbahnen der vier Tiefs 1. Orkantief von 23-27Jan1990 2. Stormtief von 26-30Jan1990 3. Stormtief von 1-4Feb1990 4. Stormtief von 4-9Feb1990
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -FIG2. [MAP] Tracks of the 15 lows. Positions of centres shown at 6h intervals, marked by identifying letter. Bold dots mark the start of period of maximum 24h deepening NOTE: DARIA trajectory; start max deepening in western central Atlantic
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -FIG. [MAP] Low pressure trajectory 24Jan1990 12:00GMT to 27Jan1990 00:00GMT NOTE: explosive cyclogenesis 24Jan1990 12:00 to 25Jan1990 00:00 with 24mb drop in 12 hours NOTE: storm culmination point 25Jan1990 18:00 NE of Aberdeen with 950mb
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -TAB5. Displacement & development of central pressure of storm 25Jan1990 [map drawn Aug1991] NOTE: explosive cyclogenesis 24Jan 12:00 to 25Jan 12:00 NOTE: rapid pressure increase in 2nd half of 26Jan -FIG1. Trajectory storms 25Jan and 3Feb1990
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -FIG1. [MAP] Temporal sequence and trajectory of storm series 1990 storm Daria 25-26Jan1990 storm Herta 3-4 Feb1990 storm Judith 7-8 Feb1990 storm Nana 11-12Feb1990 storm Ottilie 13-14Feb1990 storm Polly 14-15Feb1990 storm Vivian 25-27Feb1990 storm Wiebke 28Feb-1Mar1990
Dorland (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. FIG10.1. [MAP] Tracks of the eight storms between 25Jan and 02Mar1990 over Europe (Munich Re, 1993)
Pinto et al (2009)	Pinto, JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -TAB1. Life cycle of storm Daria -FIG2. [MAP] Case study for storm Daria 25Jan1990 06UTC a. Eady growth rate 400hPa (1/day) as 3 day running mean b. Jet Stream 250hPa (m/s) c. horizontal divergence 250hPa (1/s) d. equivalent potential temperature 850hPa (K) Exceedance of the long term 95th and 99th percentile denoted in color -storm trajectory linked with NAO pressure configuration
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -FIG6.1. [MAP] Schematic illustion of the tracks of cyclones. White paths are normal while grey describe the direction of the 1990 cyclones. Noticeable are the shift of the branching point from the eastern Atlantic Ocean to western Europe as well as the absence of the track toward the Mediterranean Sea -FIG6.2. [MAP] Wind field of the hurricane Daria (MunchenerRueck 1999) NOTE: TRAJECTORY ALSO
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] FIG3a. [MAP] Paths of low pressure centres for selected storms. (Most tracks are derived from the NASA re-analysis of extratropical storms 1953 storm, Feb1967 storm, Sep1969 storm, Nov1972 storm, Oct1987 storm, Daria 1990, Vivian 1990, Lothar 1999, Martin 1999, Gudrun 2005, Kyrill 2007, Klaus 2009
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -Daria had high translational speed
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) FIG3. [MAP] Trajectory of Storm Daria 25Jan1990 from 25Jan 0000UTC (977hPa) to 27Jan 0600UTC (957hPa). Minimum central pressure 25Jan 18:00UTC (949hPa)

Table SL25. Unusual pressure drop; time series central pressure; explosive characteristics; bomb; unusually low central pressure (arranged by year and then alphabetically)

Source	Full Reference and Notes
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -minimum pressure in both cases fell to ca 950hPa
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -at 18UTC low located at 45N44W; over next 24h it developed explosively from cold high air Greenland
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -weather maps indicate cetral pressure drop near 24mb in 24 h
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -Wed 24Jan depression centre deepened by 37mb in 24h moved rapidly east on powerful west jet
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -system cam to life E of New Jersey on 21Jan2023 -early on 25Jan 973mb center crossed 20W near 51N -merged with system to north; entered England with 952mb centre by 1200
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -midday on 24Jan central pressure fallen to 992mb; pressure set to deepen explosively -between 2 main cloud areas, a cloud-free or dry wedge formed -baroclinic leaf -cloud head: cloud signature with 2 cloud areas and dry wedge -first appearance of cloud head is reliable precursor of explosively deepening cyclone with Bf10 storm wind -upper trough at 500mb showed characteristics of rapid cyclogenesis -as low approached Ireland early hours 25Jan most rapid phase cyclogenesis taking place with central pressure down to 968mb -on passage across Nireland pressure fell 16mb in 3h and by midday was centred over Ayrshire at 952mb -lowest central pressure 949mb est at 1600GMT to east of Edinburgh as low continued to Denmark
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -most of 15 orth Atlantic storms Jan-Feb1990 had explosive cyclogenesis -TAB1. Relationship of surface low centres to certain features of flow patterns at 250mb. (a) at start of period of maximum 24h deepening, and (b) 24h later (table shows 24h pressure drop for all storms including Daria) -Sanders and Gyakum (1980) coined the term bomb for lows where the central pressure falls 18-24mb in 24h; 11/15 depressions classified as bombs -each bomb developed over or north of Grand Banks of Nfld
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -Low pressure trajectory map indicates explosive cyclogenesis, but this is not noted in text
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -explosive depression; normal for Scotland -Brian Hoskins (Reading) -explosive depressions were rare event on this side of Atlantic -72h forecast 23Jan showed pressure drop to 968mb for Wednesday night & 949 mb for Thursday; accurate
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -Atlantic depression deepened explosively from east coast North America
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -TAB5. Displacement & development of central pressure of storm 25Jan1990 [map drawn Aug1991] NOTE: explosive cyclogenesis 24Jan 12:00 to 25Jan 12:00 NOTE: rapid pressure increase in 2nd half of 26Jan -propagation speed of Daria slowed down alot after its culmination point in the North Sea
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -air pressure dropped; temperature increased 5.6 to 15.9C in a few hours
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -TAB1. Life cycle of storm Daria (table shows central pressure decreases about 10 hPa per 6h for a day)
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -maximum observed pressure deepening for Daria 14hPa in 6h
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023)

	-under the influence of strong high altitude winds, amplification started on the approach to Ireland & became explosive during passage across British Isles on night 24-25Jan -during 25Jan1990 central pressure decreased from 978 to 950hPa in only 15h

Table SL26. Rapid increase of surface pressure after passage of low (arranged by year and then alphabetically)

Source	Full Reference and Notes
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -confluent nature of upper trough caused pressure to rise rapidly behind low (20.2mb rise in 3h at Valentia) -max winds from rapid movement of system and sudden surge of pressure behind low
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -pressure rise behind system of same order as those ahead; most compared with Burns Day storm -Burns Day storm had pressure rise >20mb in 3h
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 - after the trough air pressure climbed rapidly over southern England -consequence of increased air pressure was sharp decrease in pressure gradient in south Netherland and also wind
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -central pressure of Daria increases rapidly after culmination point
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -temperature fell again after 19:00 & air pressure began to rise
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -TAB1. Life cycle of storm Daria (table shows rapid increase central pressure first half 26Jan1990)

Table SL27. Horizontal pressure gradient (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -tightly bounded area of very low pressure went further eastward and storm/hurricane winds were expected for Germany; wind speeds to 76kt were reported for N France & UK
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -investigations of the forecast depth of low pressure centre in the UKMO fine mesh model and how this was affected by the 2 ship launched radiosondes in the central North Atlantic
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -TAB5. Displacement & development of central pressure of storm 25Jan1990 [map drawn Aug1991] NOTE: explosive cyclogenesis 24Jan 12:00 to 25Jan 12:00 NOTE: rapid pressure increase in 2nd half of 26Jan -mention of horizontal pressure gradient in storm analysis
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -cyclone intensity defined by maximum in Laplacian of pressure field

Table SL28. Low level jet (arranged by year and then alphabetically)

Source	Full Reference and Notes
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -lower tropospheric jets from strom database: warm jet, sting jet, cold jet
Belgorage (20240315)	belgorage, 25/01/1990 – Violentes lignes de grains et possibles tornades associées à la tempête Daria, https://belgorage.be/almanach/base-de-donnees-breves-et-articles-1990-01-25-orages/, access date 15Mar2024 -reference to gusts in storm warm sector

Table SL29. Sting Jet (arranged by year and then alphabetically)

Source	Full Reference and Notes
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -sting jet phenomenon introduced by Browning (2004)

Table SL30. Radiosonde analysis (arranged by year and then alphabetically)

Source	Full Reference and Notes
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -investigations of the forecast depth of low pressure centre in the UKMO fine mesh model and how this was affected by the 2 ship launched radiosondes in the central North Atlantic -radiosondes from the OWS-C and merchant ship ONDA -model QC routine initially rejected the one radiosonde report

McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -deficiencies in Burns Day case example of rogue run where model lapses into weak or nondevelopmental mode after clear signal for large cyclogenesis -other storm examples noted by Woodroffe (1990) and Reed et al (1988) -DARIA: FIG10a shows a nondevelopmental mode in 36h forecast in contrast to better 24h forecast -forecasters alert to problem; warnings issued on basis of solution ensemble -forecast greatly improved by observations from 2 ships near low centre
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -forecast information: satellite; T/RH/P from weather ships, commercial aircraft, radiosondes; rain radar
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -FIG2. [TEPHIGRAM] Example of UK-area lower tropospheric soundings for the WJ, SJ, CJ phenomena, in (a), (b), and (c), respectively, with winds in alphanumeric format (kt). Pressure in hPa is shown in left, while temperature in C is shown below. (a) is for Camborne at 00UTC on 30Oct2000 (Oratia), while (c) is for Crawley at 18UTC on 25Jan1990 (Daria). To denote the SJ (b) shows two soundings from ECMWF HRES 6h forecast fields valid at 06UTC on 3Jan2012 (Ulli). These nominally the SJ surface impact zone at this time; mauve to the west, blue to the east. Sounding locations are shown by colored rings on FIG4b for the WJ in a, on FIG10b for the SJ in (b), and on FIG4a for the CJ in c.

Table SL31. Stable/unstable atmospheric boundary layer (arranged by year and then alphabetically)

Source	Full Reference and Notes
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -storm Daria marked by cold jet gusts only; downward advection of momentum linked to convection from cold air pasing over the warm sea surface; high gust field mainly offshore and in coastal areas

Table SL32. Problems with drag coefficient & forecasting wind setup at high wind speeds > 25m/s (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL33. Strong jet stream & Rossby wave breaking (arranged by year and then alphabetically)

Source	Full Reference and Notes
Eastern Daily Press (19900126f)	Eastern Daily Press, Worse happening at sea (contributor: Anthony Wenham), p.3, 26Jan1990f. -Pete Gibbs, Norwich Weather Centre: jet stream at 30000 ft -UK mild winter so far; winds tracking north & missed us -jet stream undulations caused Norfolk to be hit -cause of fluctuations unknown; Norfolk storm event rare -north of Scotland, comparable storms 2-3 times per year
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -comment on strong west wind at height -polar front at 50N
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -radiosonde from OWS-C launched into strong upper air jet
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -cloud pattern on NOAA-11 visible image 1515UTC 24Jan1990 suggest 2 distinct frontal zones -F associated with main jet stream & P as secondary front forming in cold air mass -NOTE: identification of jet stream along southern edge of developing low pressure center
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -depression started life 23Jan as ill-defined & shallow area of low pressure off eastern seaboard Namer -by 0000GMT on 24Jan1990 portion of depression lying under powerful jet stream 180kn started to develop
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -early winter Nov-Dec1989, much of Europe with stormy interludes -Atlantic jet stream unusually strong; displaced further south than normal in Dec -table emphasizes the strong winds at jet levels above each centre -jet is indication of marked baroclinicity & reason for rapid movement of each system -standard textbook idea: baroclinic disturbances begin as right entrance features of jet or embedded in jet & end deepening phase in left exit region; pattern of 13/15 depressions -Daria pattern -short wave trigger or jet streak that moved around flat, confluent upper trough -characteristic feature was surge in pressure that followed in wake of centre due to the marked subsidence -except for warm front wave (K) all of group exhibited cyclogenetic features on satellite imagery; baroclinic leaf and dry slot -precise timing and location of cyclogenesis will depend on trigger, small perturbation or jet streak; movie loop of satellite imagery

Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -FIG2. [MAP] Case study for storm Daria 25Jan1990 06UTC a. Eady growth rate 400hPa (1/day) as 3 day running mean b. Jet Stream 250hPa (m/s) c. horizontal divergence 250hPa (1/s) d. equivalent potential temperature 850hPa (K) Exceedance of the long term 95th and 99th percentile denoted in color -NOTE: jet stream shown to be up to 70/m/s in eastern North Atlantic at Bay of Biscay but 50m/s over England , North Sea and northern Germany.
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -storms formed in strong westward circulation from USA to Europe
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -under the influence of strong high altitude winds, amplification started on the approach to Ireland & became explosive during passage across British Isles on night 24-25Jan

Table SL34. Storm clustering; upstream/downstream cyclogenesis; secondary cyclone formation over North Sea (arranged by year and then alphabetically)

Source	Full Reference and Notes
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -comment on strong low pressure activity in North Atlantic in last week January
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -Feb1990 was windiest on record
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. FIG1. [MAP] An Icelandic Low, the likes of which have never been seen before in the history of the publication, combined with a potent Azore High to created a memorable month for North Atlantic Mariners -Azores High of 1028mb more reminiscient of July than January; 982mb Icelandic Low was -18mb anomaly -the steering levels (500mb) indicated a general flow toward the east northeast so that, in an ideal pattern, a storm would move from New York to the English Channel
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -passage of 15 lows with week of anticyclonic regime in middle of Feb -most lows deepened rapidly as they approached Europe; all result from baroclinic instability -no 2 lows behaved in the same way; classification into archtypes -FIG2. [MAP] Tracks of the 15 lows. Positions of centres shown at 6h intervals, marked by identifying letter. Bold dots mark the start of period of maximum 24h deepening NOTE: DARIA trajectory; start max deepening in western central Atlantic -TAB1. Relationship of surface low centres to certain features of flow patterns at 250mb. (a) at start of period of maximum 24h deepening, and (b) 24h later
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -The month began with a southerly airflow due to a complex low pressure area to the west and high far to the east. -The high slipped south and joined the semi-permanent Azores high in the South Atlantic, causing a succession of vigorous depressions from the Atlantic to track well to the N of country
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -a chain of storm and hurricane lows crossed central Europe in quick succession
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -mention of the storm series in Jan-Feb1990
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -series of storm Jan-Mar 1990 exceptional exception for the Netherlands -only 1928 sequence had >2 separate storms following each other in short space of time -to south of depression center (949 at time) small secondary depression formed and hit northern Netherlands -2nd depression area in northern part of Netherlands at 18:00 with high winds in Leeuwarden area, middle-western-sothern part of country
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010

	-in Jan at least 6 depressions reached low reading 950mb over Atlantic -caused by below avg temperatures Greenland & Iceland & above avg in northern Europe
Zuba and Simic (2010)	Zuba, Gerhard and Milan Simic, European Windstorms: Implications of storm clustering on definitions of occurrence losses, Air Currents, https://www.air-worldwide.com/publications/air-currents/2010/European-Windstorms--Implications-of-Storm-Clustering-on-Definitions-of-Occurrence-Losses/, 20Sep2010.
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -between 25Jan-1Mar1990 8 severe storms crossed Europe over wide area -most damaging storms were Daria 25-26Jan1990 & Vivian and Wiebke between 25Feb-1Mar
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -Daria on 25-26Jan was start of a storm series that lasted until first week of Mar1990 -storms formed in strong westward circulation from USA to Europe -storm series started with Daria, followed by 2 small hurricane centres (Herta & Judith) at start of February, followed by large-area destructive storms at the end of the month (Vivian and Wiebke) with similar material damage as Daria
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -storm clustering Jan-Mar 1990 causes insurance company solvency problems

Table SL35. Squall line, convective thunderstorms, tornadoes (arranged by year and then alphabetically)

Source	Full Reference and Notes
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -squall line with high winds passed London 14:10-14:15 25Jan1990 and resulted loss of 100 trees at Kew Garden and collapsed chimney in Chingford
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -at some locations there was lightning with the convection storms along the cold front
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -J.M Heighes of Sandhurst recorded W gust of 80kt at 1349 on 25Jan2023
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -Except for Rosslare and Cahirciveen, all stations had snow during the last 9 days of month -number of thunderstorms occurred between 25-31Jan -greatest daily rainfall 32.2 mm measured at Belmullet on 25Jan; new record for highest rain in Janaury for that station
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -cold front passed coast 13:00-14:00UTC
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -times of maximum instantaneous winds given for several stations in northern France; general eastward propagation of wind pattern
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -cold front reached Dutch coast 1400-1500, after speed of movement reduced, rain started -cold front 14:00-15:00; wind intensity increased and direction changed; 19:00 from SW & W -wind speeds BF9-10 with gusts to Bf11 -temperature fell again after 19:00 & air pressure began to rise -after 20:00 storm subsided and it started to rain periodically
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) TORNADO Location LA Latitud Longitu Date Day Time Uncertainty ND --- Jesteburg Niedersachsen DE 53.30 N 9.97 E 26-01-1990 fri 11:00 UTC (+/- 12 hrs.) tornado over land Zinzelbeek NE 50.82 N 5.92 E 26-01-1990 fri 11:00 UTC (+/- 12 hrs.) tornado over land
Belgorage (20240315)	belgorage, 25/01/1990 – Violentes lignes de grains et possibles tornades associées à la tempête Daria, https://belgorage.be/almanach/base-de-donnees-breves-et-articles-1990-01-25-orages/, access date 15Mar2024 -reference to tornado in Lommel in Limberg provice -damage corridors indicate tornadoes of downgusts

Table SL36. Derecho (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL37. Cold air outbreak (arranged by year and then alphabetically)

Source	Full Reference and Notes
LWCR (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP,

	06/02/1990 -Scotland: heavy snow blocked roads in near blizzard conditions; 3 people killed in car accident
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -late in day: heavy rain spread into S Ireland turning to sleet over Midlands; heavy wet snow over Donegal
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -center of depression moved across Ayrshire, home of Robbie Burns, on anniversary of birth, heavy snow Scotland
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -Except for Rosslare and Cahirciveen, all stations had snow during the last 9 days of month -number of thunderstorms occurred between 25-31Jan
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -London Weather Centre: temperature expected to fall during night to 2-3C
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -Stirling thrown into chaos yesterday (Thursday); first winter blizzards caused town to stop -in north, all routes beyond Stirling blocked
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -temperature fell again after 19:00 & air pressure began to rise -after 20:00 storm subsided and it started to rain periodically
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -storm Daria characterized by cold jet field; cold air passing over warm sea surface with attendant convective clod field

Table SL38. Unusual warm air temperature (arranged by year and then alphabetically)

Source	Full Reference and Notes
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -'at one stage it looked as though we were going to equal last January's record high mean temperatures, but a cooler spell later in the month put paid to that possibility' -The month began with a southerly airflow due to a complex low pressure area to the west and high far to the east.
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -rain commenced from S/SE on 25Jan at 06:00 -air pressure dropped; temperature increased 5.6 to 15.9C in a few hours
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -warm temperatures across Europe & Russia meant that much of forest soils unfrozen
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -unusually warm conditions preceded passage of depression -max temperatures 10-14C in northern half of France; 14-18C in southern half with points of >20C at foot of Pyrenees under a fohn effect -these temperatures are 5-10C above the normal for the end of January -FIG7. Excess of diurnal temperature 25Jan1990. Map of daily avg temperature for 25Jan1990 referenced to 1981-2010 of maximum temperature
Belgorage (20240315)	belgorage, 25/01/1990 – Violentes lignes de grains et possibles tornades associées à la tempête Daria, https://belgorage.be/almanach/base-de-donnees-breves-et-articles-1990-01-25-orages/, access date 15Mar2024 -there was a large warm sector with strong gusts from S and SW causing temperatures to increase 13-14C across all lower and middle Belgium (up to 14.6C at Grammont in province of Flandre Orientale); unusually high for season

Table SL39. Lightning (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -at some locations there was lightning with the convection storms along the cold front
Naturlig Energi (1990)	Naturlig Energi, Vindproduceret El (contributed by B. Groning, M. Koch, W. Canter, T. Moller), pp. 16-32, Mar, 1990. -4 cases of lightning strikes on Denmark wind turbines leading to serious damage in some cases: total destruction of sterring system, blade destruction

Table SL40. Meso-vortex (arranged by year and then alphabetically)

Source	Full Reference and Notes
Dorland et al (1990)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -reference to secondary cyclone feature that formed at culmination time 15:00 25Jan1990 and caused damage northern Netherlands
NRC Handelsblad (19900126e)	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e -storm started with passage of cold front over Zeeland shortly before 14:00 -with cold front there were extreme wind gusts across country -in many places highest wind speeds with passage of trough in early evening 17:00-20:00 -in the northern provinces the worst storm was later in the evening
Bissoli et al (2001)	Bissoli P., L. Goering, Ch. Lefebvre, Extreme Wetter- und Witterungsereignesse im 20. Jahrhundert, pp. 20-31, Klimastatusbericht 2001 -outrunners crossed Germany

Table SL41. Meteotsunami and unusual surges (arranged by year and then alphabetically)

Source	Full Reference and Notes
Sorensen et al (2007)	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007. -mention of meteotsunamis and single waves as causal agents of coastal flooding for Denmark -full list of storm surge causal agents for Denmark: -wind pushing water on coast -low pressure: 1cm rise per hectopascal drop -wave setup -long-period single waves; caused by storm in ocean further away or sea floor earthquake, or 'tilbageskvulp'. At Slipshavn (Nyborg) & Korsor extreme water levels in 1993 caused by meeting of 2 such waves from north & south -tilbageskvulp often seen along easter Jutland coast when powerful west wind blows water away from coast; when the wind weakens or turns, the water flows (skvulper) back to the coast resulting in heightened water levels. Phenomenon also seen in other areas of indre danske kyster -special low and high pressure configurations: 1872 storm & surge in indre danske farvande 1-2Nov2006

Table SL42. Maximum surface gusts noted (arranged by year and then alphabetically)

Source	Full Reference and Notes
Anonymous (1990)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -Dover: gusts reached hurricane force 104mph
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -emergency services at full stretch as winds reached 84mph in county
Deutschen Wetterdienst (1990)	Deutschen Wetterdienst, Monatlicher Witterungsbericht, 38, pp. 1-2, January 1990. -on 25-26Jan hurricane center created wind field with hurricane gusts over Germany -wind speeds on the coast reached 161 km/h (Cuxhaven on 25Jan); inland windspeeds to 150km/h (Aachen on 25Jan); wide field with wind speeds 130-148km/h; mountain areas registered wind speed to 172km/h (Feldberg/Schwiez on 25Jan) -on North Sea coast hurricane gusts reached 161km/h (Cuxhaven, 25Jan) -in inland west Germany gust speeds to 150km/h (Aachen, 25Jan) and 172km/h at Zugspitze
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -the strongest wind speeds were measured around midnight -over N Germany wind was blowing at 40kt with gusts to 60kt (Nordseeplattform) -higher winds measured at Zugspitze: peak gusts to 93 kt -hurricane gusts around 60 kt over most of Mittelgebirge -only in the Niederung were wind speeds of 50kt measured
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -winds gusting over 100mph
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -wind Norfolk mean speed 60mph with gusts to 70mph -Felixstowe in Suffolk: gust of 80mph
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -hurricane force winds caused destruction east Midlands -damage 100s thousands pounds by winds gusting up to 79 mph
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c -Storm winds hit 79 mph in Notts -vicious winds well into hurricane force blew across Notts at height of storm
Evening Post Nottingham (19900126f)	Evening Post (Nottingham), Chaos as gales hit capital, p.8, 26/01/1990f -howling winds up to 70mph reduced London to virtual standstill; chaos to commuters
Evening Post Nottingham	Evening Post (Nottingham), Winds whip up to the 100 mph, p.8, 26/01/1990g -Daria highest winds 100 mph in parts of Cornwall;

(19900126g)	Oct1987 highest wind 112mph at Shoreham, West Sussex
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -Forschungsplattform Nordsee reported repeated gusts >80kt 26Jan1990 00-06Uhr (Windmesser am Anschlag) -FIG3. Brocken in Harz registered a gust of even 128kt
Freiburger Nachtrichten (19900127)	Freiburger Nachrichten, Vor allem Daecher erlitten Schaden, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -in Freiburg region storm winds reached 100km/h
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -comment that -newspapers reported gusts over 90kt
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -FIG1. [MAP] Return period (years) for maximum gusts recorded on 25Jan1990 NOTE: RETURN PERIOD FORM LONDON AREA >200y -many stns reported highest gust on record; e.g., Boscombe Down 79kn highest since meas start 1933 -most exceptional gusts conc in densely populated band Dorset NE to London -2nd bout strong winds 7-8Feb; highest gusts S parts of UK; 50-70kn gutsts -'as it is maximum gusts that usually cause the most damage within one storm event, they are often appropriate to use in assessing the changing frequency of extreme winds, and in compariing severity of individual storm events' -Boscombe Down example: wind spells 1967, 1974/75, 1982/83 did not contain extreme gust conditions, so had less damaging impact at time -other central and southern stations look like Boscombe Down -more northern stations: recent peak gusts not so unusual
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -some of the strongest winds UK on 25Jan at Aberporth SW Wales 1400-1500UTC with mean 65kt & max gust 93kn -FIG12.[MAP] Observed 10-minute wind speeds (traditional wind arrows) and maximum gusts if over 25kt within the previous hour at 1500 UTC on 25Jan1990.
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -wind speeds >160km/h raged at hurricane strength over large parts of country
Lloyd's Weekly Casualty Returns (1990/02/13)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -winds strongest in coastal areas, reaching force 12 (hurricane) at Ymuiden
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -gusts to 78kt in Bristol -0600 on 25Jan, 959mb low W of Ireland; 3h later in Kintyre in SW Scotland with gusts 60kt to west and south of Erie -central Britain gusts reached 100kt
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 -period 24Jan-28Feb1990 notable for succession of storms -Burns Day storm winds comparable with Oct1987 storm -many sites in England recorded highest ever max winds Jan and Feb; -eg Heathrow gust 76kt on 25Jan compared with 66kt Oct1987 -gusts caused 80 deaths & lots of damage
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -Winds gusting to 86kt (99mph) along the S coast caused damage to Munster and South Leinster -table of highest January gusts in Ireland
Neue Zuercher Nachrichten (19900127)	Neue Zuercher Nachrichten, Sturm forderte Menschenleben, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -hurricane raged with wind speeds to 170km/h and caused severe damage. Switzerland with similar wind speeds did not have severe damage
The News Chatham-Rochester-Gillingham (19900126)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990 (Friday) -treacherous gusts 88-90mph brought chaos to towns
NRC Handelsblad (19900126e)	NRC Handelsblad, Zwaarste windstoten na 1944, p.3, 26/01/1990e -the storm that hit the Netherlands yesterday was one of the worst of the last decades -in coastal areas wind speeds reached Bf 11, while in IJmuiden avg wspd 120km/h reached -wind gusts everywhere in the Netherlands reached hurricane strength -the highest gust of approx 150km/h was in the western part of the country -FIG. [MAP] map shows max wind gusts (1 minute average) that were measured yesterday; hurricane threshold is 117km/h
Thuner Tagblatt (19900127a)	Thuner Tagblatt, Sturm fegte ueber die Region: Hauser abgedeckt, 27Jan1990a (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -hurricane storm winds with wind speeds to 90km/h -outside Switzerland, about 100 fatalities; England, France, Germany, Denmark, Sweden storm wind speeds to 175km/h

The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -FIG. [MAP] weather map with surface pressure isobars for 25Jan1990 1200; maximum gusts for 15 locations for Oct1987 storm and Daria,
Walliser Bot (19900127)	Walliser Bot, Schweiz von groesseren Sturmschaeden weitgehend verschont mit 170 km/h, 27Jan1990 (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -hurricane level storm with peak winds of 170km/h blew through Switzerland during night to Friday 26Jan -with wind speeds between 130-170km/h wind blew over Jura highland and Voralpen, said speaker of SMA Schweizer Meteorologische Anstalt in Zurich -peak gusts in Flachland 75-90km/s -in Basel, Schaffhausen, Bodensee wind speeds 100-120km/h -highest wind speeds measured on the Pilatus and Saentis
Borgesius and de Vries (1991)	Borgesius, J.J. and S.M.G. de Vries, De januariestorm van 1990, Nederlands Bosbouw Tijdsschift, pp. 308-311, 1991. -surface wind gusts reported for De Koy, Eelde, De Bilt, Vlissingen, Z. Limburg LH
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -MAP1. Location of anemometer posts -MAP2. Instantaneous max wind for 25Jan1990 in m/s -maximum instaneous gusts noted for stations in northern France -storm very strong on 25Jan with high wind gusts in France & Belgium: Koksijde: 46m/s Munte, Boulogne, Dunkerque: 43m/s Radinghem: 42m/s Middelkerke: 41m/s Abbeville, Vron, Oostende: 40m/s -for all stations in departements of Aisne, Nort, Pas-de-Calais, Somme max gust > 28m/s -no wind speed record broken except for Dunkerque -record wind speeds since 1946: Boulogne 60m/s, Lesquin 45m/s, 40m/s Epinoy and Touque
Buller (1993)	Buller PJS, The gales of January and February 1990: damage to buildings and structures, Building Research Establishment Report, Building Research Establishment, Garston, Watford, WD2 7JR, 24 pp, 1993 -cold front moved quickly eastward across England & Wales followed by low P trough -0900 GMT Wales & most parts of England with gusts >20m/s; isolated gusts to 40m/s -mid-afternoon high winds began to abate from SW; in extreme east winds died down evening
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -on 25-26Jan record wind gusts across whole of NW Europe -wind speeds BF9-10 with gusts to Bf11 -whole W part of Netherlands Bf10 measured -highest wind speeds Zealand, South Holland, Utrecht -2nd depression area in northern part of Netherlands at 18:00 with high winds in Leeuwarden area, middle-western-sothern part of country -highest wind gusts (44m/s Schipol; 38m/s Huizen) in middle of country -peak gusts 2nd highest measured in the Netherlands this century -temperature fell again after 19:00 & air pressure began to rise -after 20:00 storm subsided and it started to rain periodically -peak gusts to 28m/s until midnight -highest mean potential gusts in Tab10.3
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -FIG6.2. [MAP] Wind field of the hurricane Daria (MunchenerRueck 1999) with max squalls NOTE: TRAJECTORY ALSO -some regions western Germany gusts to 180km/h; wind speeds 120-130 km/h over large areas
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -Daria wind speeds 33-36m/s recorded over large area with highest wind gust 50m/s
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -25Jan1990 low pressure centre <950hPa appeared over Scotland -Germany peaks gusts at huricane strength 172km/h; 120-130km/h in low-lying areas -FIG_p34. map of max gust for Daria 26Jan1990
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -FIG4. Maximum wind gusts (kt) observed during the passage of the three ISD cyclones (TAB1): Daria in (a), Oratia in (b), and renate in (c). Letters denote the assigned cause of the max gust in different regions (W for warm jet, S for sting jet, and C for cold jet). Orange and yellow rings on (a) and (b) respectively denote the locations of Camborne and Crawley; soundings from these sites for windstorms are shown in FIG2c and 2a respectively.
Met Office	Met Office, Burn's Day Storm - 25 January 1990, Last updated 15 April 2016 [pdf datestamp: 11/01/2019]

(20160415)	-strongest winds late morning & afternoon; hourly mean wspd 40kn across S England & Wales -gusts > 80kn along coast west Wales & Cornwall to Kent -highest gust 93kn at Aberporth west Wales & Gwennap Head, Cornwall -return period max gusts estimated > 100y from Dorset to London -FIG. [MAP] Highest gusts of over 60kt (69mph) recorded on 25Jan1990 -FIG. [MAP] Highest hourly mean wind speed (kt) for >30kt 25Jan1990 -TAB. A selection of the highest gusts and mean hourly wind speeds on 25Jan1990. Many records were set which still stand
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -Daria cut numerous trees in Germany with wind speeds 130km/h over extensive area & extreme gusts 230km/h on the Brocken im Harz -in part of N France & GB peak gusts over 160km/h
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) SEVERE WIND Location LA Latitud Longitu Date Day Time Uncertainty ND --- Birkenheide Rheinland-Pfalz DE 49.48 N 8.26 E 26-01-1990 fri 12:00 UTC (+/- 12 hrs.) severe wind Lauwil Basel-Landschaft CH 47.39 N 7.67 E 25-01-1990 thu 21:00 UTC (+/- 6 hrs.) severe wind Germany DE 52.70 N 8.00 E 25-01-1990 thu 18:00 UTC (+/- 12 hrs.) severe wind Hubbelrath Nordrhein-Westfalen DE 51.27 N 6.92 E 25-01-1990 thu 16:30 UTC (+/- 15 min.) severe wind United Kingdom UK 51.75 N 1.30 W 25-01-1990 thu 12:00 UTC (+/- 12 hrs.) severe wind Ostentrop Nordrhein-Westfalen DE 51.20 N 8.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) severe wind Frechen Nordrhein-Westfalen DE 50.92 N 6.82 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) severe wind Stahe Nordrhein-Westfalen DE 50.98 N 6.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) severe wind Ketzin Brandenburg DE 52.47 N 12.85 E 25-01-1990 thu 11:00 UTC (+/- 6 hrs.) severe wind Parkstein Bayern DE 49.73 N 12.07 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) severe wind
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia -highest measured wind gust 161 km/h at Schipol airport comparable with worst on record: 162km/h at Hoek van Holland on 6Nov2021 -extreme wind gusts of 150km/h in different places -remarkable wind strength inland in the Netherlands
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -southwest wind continued increasing morning 25Jan in all northern France attaining paroxyms at start of the afternoon on all Britanny coasts to north Pas de Calais with gusts 150-170km/h -average wind speed equally remarkable, often exceeding 100km/h on coast of English Channel with max of 148 km/h at Cap de la Hague (5); record for this station in measurement time series that started n 1981) -in the interior, north of line Lorient-Paris, gusts reached 110-130km/h, locally 120km/h -further south, from the Pays-de-la-Loire to from Poitou-Charente to the central region, gusts were on the order of 100-110 km/h, locally 120km/h -at the end of the afternoon & start of the evening storm shifted on Champagne-Ardenne, Lorraine & Alsace with gusts of 110-120km/s and locally greater than 130km/h -storm also touched Bourgogne and north of Franche-Comte in more attenuated manner before moving to the Germany in course of evening -following day, winds not blowing hurricane strangths; gusts associated with thunderstorms still reached 100km/h FIG6. [MAP] a. daily maximum wind speed France 25Jan1990 (10min avg wind speed?); b. estimation of maximum gusts NOTE: storm winds from WSW; gusts in streaks along cloud lines TAB. Remarkable gust measurements on 25Jan1990
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -importance of gusts causing extensive damage
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan2023 -worst of storm in central and southern England and Wales -buildings damaged by sustained winds 70-75mph with gusts to 104mph
Belgorage (20240315)	belgorage, 25/01/1990 – Violentes lignes de grains et possibles tornades associées à la tempête Daria, https://belgorage.be/almanach/base-de-donnees-breves-et-articles-1990-01-25-orages/, access date 15Mar2024 -recorded gusts: -Beauvechain 169 km/h -Coxyde 167 km/h -Saint Hubert 152 km/h -Middelkerke 148 km/h -Ostende 145 km/h -Bierset 139 km/h

	-these enormous gusts probably of convective origin because the most violent among them liees a une ligne de grains extremement dynamique, accompanying a cold front and succeeding occluded front
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -gusts for Belgium and northern France noted

Table SL43. Hurricane gusts only on south (right) side of pressure center (arranged by year and then alphabetically)

Source	Full Reference and Notes
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -as in 1987 the rapid speed of movement of the system was an important addition to surface wind -surface wind is function of gradient wind at 1km; less than geostrophic flow due to curvature effects -because of rapid movement of system, actual trajectory of gradient flow much flatter than curvature implied from contour pattern; obs winds greater than standard gradient calculations
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -extreme storm scenario map of 1953 surge pattern with max winds on right hand side
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -highest winds always measured south of depression centre
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -map of Daria trajectory and max gust field shows max gusts 100-200 km on right hand side of storm track.
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 '...This brings system velocity into play. The faster a cyclone moves the greater will be the cyclonic curvature of low-level trajectories left of track, and, critically, the less will be the cyclonic curvature of trajectories right of track. So for a given isobaric spacing/gradient wind the faster a low is moving the stronger will be the near-surface winds to the right of the track (in the CJ zone). This may help explain why many high impact CJ cases are associated with cyclones that continue to move quite rapidly around phase 6 on Fig. 1a and b; Daria (Fig. 4a) is a case in point, as highlighted by McCallum (1990)...."

Table SL44. Wind direction, fetch and wave size in German Bight (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL45. Culmination time and location determines damage properties of storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -storm Daria lowest pressure 950mb near Scotland
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -rapid movement across Ireland & Scotland to North Sea, deepening to 949mb
Pinto et al (19901219)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -focus on time of maximum intensification and rate of pressure decrease of Daria rather than culmination point
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -travelling at high speed; central pressure 968mb -cold front reached Dutch coast 1400-1500, after speed of movement reduced, rain started -severe storm Netherlands started 1500 -to south of depression center (949 at time) small secondary depression formed and hit northern Netherlands
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -extraordinary low pressure 950hPa measured near Edinburgh 16:00
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -trajectory map shows storm culminated 25/01/1990 18:00UTC with central pressure 949hPa in North Sea east of Scotland

Table SL46. Blocking high pressure system (arranged by year and then alphabetically)

Source	Full Reference and Notes
ECMWF (1990)	ECMWF, ECMWF Report 1989.90, European Centre for Medium Range Weather Forecasts, 52pp, pdf datestamp 19/01/2010, 1990 -blocking patterns of atmospheric flow major importance in determining large scale weather in mid-latitudes of NH; figure shows Centers operational

	model increased ability to predict blocking in recent past 1988/90 compared to earlier forecasts 1980/87
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -The month began with a southerly airflow due to a complex low pressure area to the west and high far to the east.
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -description of Daria pressure pattern -24Jan 12:00 deep depression D1 950hPa centred on Iceland with second mobile depression D2 -high pressure 1030-1035 hPa located over the Azores and Russia
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -comment that North Atlantic winter storms can penetrate into central Europe because of absence of high pressure in eastern Europe from snow cover.
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -FIG6.1. [MAP] Schematic illustion of the tracks of cyclones. White paths are normal while grey describe the direction of the 1990 cyclones. Noticeable are the shift of the branching point from the eastern Atlantic Ocean to western Europe as well as the absence of the track toward the Mediterranean Sea

Table SL47. Infragravity wave, rogue wave, green water incidents (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL48. Seismic signature of storm; microseism (arranged by year and then alphabetically)

Source	Full Reference and Notes
Darbyshire (1999)	Darbyshire J, Microseisms and weather, Weather, 1999 -microseism signature of Storm Daria at Maenai Bridge station in north Wales weaker than expected.
British Geological Society (2024)	British Geological Survey: BGS earthquake database search, https://www.earthquakes.bgs.ac.uk, last access 21 June 2024. -list of earthquakes with latitude, longitude, depth, magnitude from UK seismic network

Table SL49. Wave dynamics and dike breaches; wave runup studies (arranged by year and then alphabetically)

Source	Full Reference and Notes
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, 06/02/1990 -West German authorities decided to evacuated a small village in the northern coastal region after a tidal wave damaged a dike
Landesregierung Schleswig-Holstein (2023)	Landesregierung Schleswig-Holstein, Stormfloot und Hochwadder, dat geiht uns al wat an, Wasserstark.SH, https://www.schleswig-holstein.de/DE/landesregierung/themen/kueste-wasser-meer/wasserstarkSH/_documents/__geschichten/jensen.html, last change 27/08/2023 -Dagebuell evacuated after damage to dike

Table SL50. Precipitation/rain/snow, river level, river dike breaches (arranged by year and then alphabetically)

Source	Full Reference and Notes
Belfast Telegraph (19900125a)	Belfast Telegraph, Diana flies in to Ulster blizzard. Weather grounds helicopter (contributor Charles Haslett), p.1, 25Jan1990a -visit of Princess Diana to Northern Irealnd curtailed because of blizzard
Belfast Telegraph (19900125b)	Belfast Telegraph, Ulster awash as snow and floods cause road chaos, p.1, 25Jan1990b. -blizzards persisted in northewest; widespread flooding; dozens of residents evacuating homes -Tyrone river burst banks; woman motorist rescued from car in Coalisland; rescued by Ulster bus driver -reports of flooding in Springvale Park-Northland Road area of Londonderry -main Cookstown road out of Coalisland closed -river burst banks at Bush Road, Dungannon; roads in area flooded to 18 inches -severe flooding at Carpendale's crossroads near Carland village -homes flooded at Monkstown in Newtownabbey; blocked culvert -in north Belfast, Alliance Drive pensioners forced to abandon flooded homes
Belfast Telegraph (19900126a)	Belfast Telegraph, Weathermen warn of new freeze on the way (contributor Janet Devlin), p.1, 26Jan1990a. -Department of Environment: crews out 25Jan unblocking drains and clearing flood damage -Housing Executive spokesman: there had been some severe flooding in greater Belfast area
Deutschen Wetterdienst (1990)	Deutschen Wetterdienst, Monatlicher Witterungsbericht, 38, pp. 1-2, January 1990. -with strong changing cloudiness there was extensive rain, rain-snow and hail (Freudenstadt 26mm on 25Jan) -on 24-25Jan (frequent) and 26-27Jan (local) there were thunderstorms, localized road icing and much snow in high areas -precipitation higher than longterm average on 24Jan and significantly on 25Jan
Huddersfield Daily Examiner (19900126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -yesterday's winds of up to 110mph & torrential rain killed 71 people in western Europe
Lloyds Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -flood reports published on 29Jan1990; unclear if linked to Storm Daria -authorities issued flood warnings to people living near 3 rivers N Wales: Conwy, Dovey, Mawddach that have

	been swollen by rain, melting snow, unusually high tides -Severn had risen 12ft & waters breached banks of all 4 rivers -Herefordshire & Worcestershire had worst floods in 20y
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -late in day: heavy rain spread into S Ireland turning to sleet over Midlands; heavy wet snow over Donegal
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -Except for Rosslare and Cahirciveen, all stations had snow during the last 9 days of month -number of thunderstorms occurred between 25-31Jan -greatest daily rainfall 32.2 mm measured at Belmullet on 25Jan; new record for highest rain in Janaury for that station -Ireland highest 25Jan1990 rain: Belmullet, Clones, Malin Head, Mullingar, Roche's Point
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -howling wind & torrential rain battered Britain yesterday 25Jan1990
Press and Journal (19900126b)	Press and Journal, Blizzards cause road chaos (contributor Steve Stewart and David Steele), p11, 26Jan1990b. -18:00 26cm snow at Aviemore; 11cm snow Glenlivet -new Aonach Mor ski resort open 25Jan2023 -Central Highlands: blizzard conditions & strong winds, causing drifting; NW gusts up to 40mph -Northeast coastal areas: sleet fell, particularly Aberdeen, Elgin, Inverness -nearly 1 inch rain Aberdeen & Dundee -best weather N and W Isles: Stornaway clear day with a couple of wintry showers
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -Stirling thrown into chaos yesterday (Thursday); first winter blizzards caused town to stop -in north, all routes beyond Stirling blocked -schools throughout region closed -Jim Brown, deputy directory of roads: all equipment out since early Wednesday morning -sheer severity of snowfall this morning incredible -Bill Rose, coordinator Killin Mountain Rescue Team: risk of avalanches -Glasgow Met Office: more snow was on the way; cold snap expected to last few more days
Times (19900129a)	The Times, Floods and new gales ahead (contributor Ray Clancy), The Times, 29Jan1990a. -severe gales & rain affected most of country yesterday; serious flooding from swollen rivers and melting snow -London Weather Centre: Scotland could have severe flooding with temperature increase melting snow -heavy snow blocked many roads yesterday & gusts to 60mph in coastal areas -problems with damage repair including power lines -snow brought down several electricity pylons & blocked roads N Wales, Cumbria, Derbyshire -several inches snow Snowdonia; scouts found safe by mountain rescue team -Devon & Cornwall: flood alerts; hundreds acres farmland under water
Times (19900130)	The Times, Floods and gales bring more chaos (contributor John Young), 30 Jan 1990. -gales & heavy rain flooded parts of Britain yesterday -engineers struggled to repair power lines of last week's storm -flood warnings in Wales & West Country; River Severn Worcester highest level 20y -newly formed National Rivers Association issued warning possible flood coastal areas -warnings for several rivers Devon & Cornwall -some roads blocked by fallen trees & landslips -danger water levels for Rivers Wye and Monnow in Wales around Monmouth, Gwent -in north Wales, the Rivers Dovey, Mawddach, Conwy threatening to flood with melting weekend snow -Haverfordwest, Dyfed: 120 sheep drowned when overflowing water engulfed field -Worcester: number of roads flooded and impassable; local house flooding -Severn 14ft above normal; could rise by another 2ft -also flooding in Hereford area whereWye rose during weekend storm -drought orders still in force in parts of South-east, which rely on groundwater supplies; levels still well below need for unrestricted supply next summer -West Kent Water Company: drought order imposed 6 months ago still in force -Mid-Sussex Water Company: similar ban imposed 2 weeks ago
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -ppt in northern France 3-12 mm
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -cold front reached Dutch coast 1400-1500, after speed of movement reduced, rain started -27-28Jan widespread flooding UK caused by heavy rainfall during 25Jan storm -Netherlands: rain commenced from S/SE on 25Jan at 06:00 -Netherlands: after 20:00 storm subsided and it started to rain periodically
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -rivers burst banks and several dykes breached

Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -Daria accompanied by heavy rain; flooding in some regions -Daria: soils in most affected areas saturated following wet winter -Daria, UK: extensive flooding and erosion
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -floods in UK and W Germany
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -storm accompanied by moderate local ppt in 3/4 of NW of country -showers were sporadic with rain accumulations 7-15mm, locally 20mm
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -severe floods UK and western Germany
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 -flooding also in Britain -severe flooding West Germany

Table SL51. Unusual peak of significant wave height in northern North Sea (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL52. Very low coastal water levels (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL53. Modelled turbulence kinetic energy in ocean wave model (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL54. Classification of storm surges/storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 3.2. Classification into archetypes -FIG3. Tentative classification of lows into archetypes, based on relation to major trough at 250mb
Jensen et al (2006)	Jensen J, C Mudersbach, SH Mueller-Navarra, I Bork, C Koziar, V Renner, Modellgestuetzte Untersuchungen zu Sturmfluten mit sehr geringen Eintrittswahrscheinlichkeiten an der deutschen Nordseekueste, Die Kueste, 71, 123-167, 2006. -literature survey of atmospheric circulation types that give rise to North Sea storm surges
Sorensen et al (2007)	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007. -storm surges have different causal mechanisms (eg. storm trajectory path) that is not analyzed in the report -might have an impact on irregularities in extreme value analysis
Kristandt et al (2014)	Kristandt, J, B Brecht, H Frank, H Knaack, Optimization of empirical storm surge forecast – modelling of high resolution wind fields, Die Kuste, 18, 301-308, 2014 -Norderney storm surges classified as Scandinavian, Skaggerak, Jutland types -storm Capella 1976 was a Jutland type (comparatively uncommon); record skew surge for most stations in German Bight except for Norderney (1962)
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -type of event: Atlantic depression of type WD (classification Dreveton)

Table SL55. Fatalities & injuries (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -at least 39 people, some children have died in worst weather to hit England and Wales since 1987 storm -severe weather affected other parts of Europe killing at least 21 people France-Netherlands-Belgium -debris from falling roof Swindon kills 11y old girl, injures 2 others seriously -Bristol school: block of stone falls onto dinner hall, kills 1 girl, injures 5 -Ware Hertfordshire: 15y old girl killed by falling tree near school -Newhaven Sussex: children evacuated from 3 story building as cracks appeared in walls -Pounds Hill in Sussex: teacher led children to safety minutes before building toppled over -Cardiff: 28y old woman killed in car by falling tree; 2 month old baby survived -Uppark House in Sussex: 2 men died when scaffold collapsed -Winchester: police chief John Smith killed when tree fell on car -Gordon Kaye injured in W London

Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -dozens of families bereaved; 44 dead, 100s injured
Belfast Telegraph (19900126d)	Belfast Telegraph, Dozens die as winds hit continent, p.4, 26Jan1990d -winds up to 110mph and torrential rains killed dozens of people in western Europe 25Jan1990 -police: 11 people died Holland, 6 France, 6 Belgium, 3 West Germany -Bethune France: 12y old girl died when courtyard wall toppled in high winds
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -most deaths by impact from debris, trees, scaffolding, chimney parts. Cars hit by toppled trees were sometimes crushed, sometimes out of control -some cars blown from road in some places
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -father and 3 teenage sons lucky to be alive after a miracle escape as last night's storms swept across Derbyshire; injuries -30 foot tree smashed through roof of car as they drove along A6 near Matlock Bath
Derby Evening Telegraph (19900126b)	Derby Evening Telegraph, Winds havoc round-up, p1, 26Jan1990b. -winds up to 110 mph & torrential rains killed at least 22 people western Europe on 25Jan -Holland 11, France 6, Belgium 4, Western Germany 1 -moorland search for 16y old feared drowned after being in blown into stream during gales on Saddleworth moors above Manchester
Derby Evening Telegraph (19900126c)	Derby Evening Telegraph, Thousands of homes blacked out (contributor Lana Montgomery), p.3, 26/01/1990c -farmer John Kaylor injured by flying debris from blown down barn
Deutschen Wetterdienst (1990)	Deutschen Wetterdienst, Monatlicher Witterungsbericht, 38, pp. 1-2, January 1990. -8 people died, mostly from toppled trees or building pieces, sometimes inside cars -large number of severly injured people
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -Gordon Kaye severe head injury; 5h surgery -2 girls killed in separate accidents at schools: -Grange Junior School, Lower Stratton, Swindon, Wilts: 1 girl killed, 4 injured -St Brandon's girls school, Clevedon, near Bristol: 1X16y girl, 9 injured; masonry in conservatory -trees biggest killers during storm; possibly weakened in 1987 -14 deaths from trees falling on cars/vans/lorries -Cardiff suburb of Lakeside: 2month old baby recovered from car wrecked by fallen pine
Eastern Daily Press (19900126c)	Eastern Daily Press, Rescue death PC is praised, p.1, 26Jan1990c. -little girl died & 4 others injured when roof blown off school in gale-force winds -Grange Junior School, Lower Stratton, Swindon, Wiltshire -school at Clevedon near Bristol; conservatory collapsed; girl aged 15 died
Eastern Daily Press (19900126d)	Eastern Daily Press, Europe lashed, p.2, 26Jan1990d. -at least 5 killed & 40 injured in storm that swept Belgium & all Europe -near Brussels: woman and child killed in car by falling tree -Torhout, western Belgium: cyclist killed under truck -Sint Niklaas, near Antwerp: man blown from his roof while estimating damage -West Germany: at least 1 person killed
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -Norfolk Ambulance Service: no serious storm-related accidents -lorry driver slightly injured outside Yarmouth; overturned into ditch on Acle Strait
Eastern Daily Press (19900126h)	Eastern Daily Press, Falling roof hits workman, p.3, 26Jan1990h -Yarmouth: man taken to hospital after roof of portable building blown off & hit him -Station Officer Peter Harris: firemen lashed roof to enable ambulance crew to move him -man taken to James Paget hospital -driver of lorry carrying Dunlop tyres taken to hospital earlier yesterday when it was blown into a dyke on the Acle Strait
Eastern Daily Press (19900126i)	Eastern Daily Press, Lucky escape for driver, p.3, 26Jan1990i -driver narrowly escaped serious injury Sheringham -large section roof at Sheringham Ex-Servicemen's Club, Holway Road blown off -John Warrington, driver, trapped briefly after Sierra car roof partly crushed -light injury
Eastern Daily Press (19900126l)	Eastern Daily Press, Fishing boat alert, p.3, 26/01/1990l -train driver slightly injured when telegraph pole fell & hit train on Norwich-Lowestoft line -driver had injury to hand
Eastern Daily Press (19900127a)	Eastern Daily Press, Storm death toll 46 as Britain clears up, p.1, 27/01/1990a. -7 children among 46 victims of storm; youngest 11 months by collapsed chimney Colerne, Wiltshire -2 girls killed in separate roof collapse incidents -former Education Secretary Kenneth Baker spent 20 min touring school, Grange Lower School Swindon -girl killed, 9 injured in conservatory collapse, St. Brandon's school, Clevedon -Canvey Island, Essex, 3y old boy & 1y old girl killed bedroom blaze started by candle -15y old girl killed by falling tree as she left school -16y old boy drowned after falling into stream in Saddle Moor, near Oldham, Manchester
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -greater than 40 die & 100s injured on continent -at least 19 killed Netherlands -1 man crushed in gears of dutch windmill -France: 10 people killed

	-Belgium: cyclist blown under truck & killed -Belgium: at least 10 killed; 53 injured, 13 seriously -West Germany: at least killed including 17 y old girl at bus stop by falling pine tree -Danish freighter listing in high seas off eastern Germany; 6 crew but 2 saved
Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -no fatalities or serious injuries in Norfolk
Evening Post Notthingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -9 people injured when trees blew on cars & vehicles blown over -Stapleford man had head trapped in door -Whitegates Pub near Clipstone Colliery: woman injured by tree on car -Annesley Woodhouse: woman knocked down by gales -Nottingham City Hospital: person blown over in winds
Evening Post Notthingham (19900126b)	Evening Post (Nottingham), Europe - the grim toll grows, p.7, 26Jan1990b (Friday) -at least 22 people killed in mainland Europe by storms -Belgium: 6 killed & 40 injured by high winds -woman and child killed near Brussels by tree falling on car -bicycle rider swept under truck in Torhout, western Belgium -72y old man blown from his roof while estimating damage in Sint Niklaas near Antwerp -56y old man died from heart attack on his roof in Horion-Hozemont near Liege -Interior Ministry reported 11 seriously injured & 30 less seriously around country
Evening Post Notthingham (19900126d)	Evening Post (Nottingham), Traffic chaos in Germany, p.7, 26/01/1990d -53y old man swept off bicycle near Aurich in Niedersachsen; rushed to hospital but died
Evening Post Notthingham (19900126g)	Evening Post (Nottingham), Winds whip up to the 100 mph, p.8, 26/01/1990g -higher number of fatalities compared to Oct1987 storm due to larger area and fact that it took place during working day
Evening Post Notthingham (19900126j)	Evening Post (Nottingham), Pupil dies as roof blown off, p.8, 26/01/1990j -Grange Junior School, Swindon, Wiltshire: 10y old died and 4 pupils injured when gale winds ripped roof off school -St Brendan's girls school, Clevedon, near Bristol: girl died when conservatory collapsed, 4injured
Evening Post Notthingham (19900126k)	Evening Post (Nottingham), Falling trees biggest killer. Most victims from south, p.9, 26/01/1990k -Hampshire, Morestead, near Winchester: 51y old Chief Inspector John Smith killed by tree on car -Cardiff: 28y old woman died when 100 foot tree fell on car -Grange Lower School, Swindon, Wiltshire: 16y old girl died & 4 injured by roof caving in -St Brandon's School, Clevedon, near Bristol: 16y old girl died & 9 injured in conservatory collapse -Colerne, Wiltshire: 11 month girl killed by chimney collapse at barracks -Uppark House, near Chichester, Sussex: 2 workmen died in scaffolding collapse -Hemel Hempstead, Hampshire: 2 men killed when tree hit cab of truck -South Brent, Devon: person killed -Newquay, Cornwall: motorist died -Hailsham, Sussex: man killed under falling tree -Horton Cross, near Yeovil: 20y old woman killed after being hit by part of a chimney -man lost overboard from Liberian registered bulk carrier Serica 200 nm off Land's End -Torquay, Devon: man died after being hit by falling tree -Diaworthy, Devon: 42y old lieutenant commander died by a tree -Baskingstoke, Hampshire: young woman died when tree fell on her car -Portrush, Northern Ireland: 60y old man died when vehicle ran off road -Ballycastle, Northern Ireland: passenger killed & driver injured when vehicle went off road -A420 south of Oxford: 2 killed in road accident -near Hastings, Sussex: man killed when lorry overturned on A259 road -Flint, Clwyd, north Wales: man died when tree fell on car -Cheltenham, Gloucestershire: 25y old woman died when tree fell on soft top MG sports car -Southampton: 70y old man killed when wall collapsed -Crofton Park, SE London: woman killed by falling wall -Fareham, Hampshire: woman crushed by wall -Hunton, Kent: 43y old woman died when tree blown onto van -Twickanham, west London: 80y old an killed tree fell on car -Bledlow, Buckinghamshire: man killed when tree hit car -Bishopstoke, Hampshire: 72y old killed when part of a tree fell on him -Coulby Newham, Cleveland: man killed by tree on car -Steyning, West Sussex: 30y old man killed after being blown off moped -Ware, near Hartford: 15y old girl killed by falling tree -Victoria, London: 62y old man kill by falling chimney -Canvey Island, Essex: 3y old boy & 1y old girl killed fire during power outage -Saddleworth Moor, near Greater Manchester: 18y old feared drowned in stream -Stetchworth, near Newmarket: man killed by falling tree
Financial Times (19900126a)	Financial Times, 27 dead as gale winds sweep across the Channel, 26 January 1990a -at least 27 people killed & scores injured from gales in Britain & across English Channel -Netherlands: several people injured,
Financial Times (19900126b)	Financial Times, Violent storm cuts road and railway links (contributors Richard Evans & Jimmy Burns), p.6, 26 January 1990b -high death toll mainly by falling trees (particularly on cars) and falling masonry/collapsed walls -Swindon school roof collapse kills 11y old girl; Bristol school conservatory collapse kills another girl
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990

	-according to newspapers 60-70 people killed in storm & large material damage -many deaths due to trees falling on vehicles
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -gusts 70-90kt comparable to Great Storm Oct 1987 -Daria occurred in during day and with greater area; greater fatalities
Herald (19900129)	The Herald, Army goes on gales stand-by, 29 January 1990 https://www.heraldscotland.com/news/11979862.army-goes-on-gales-stand-by/ -The Army and emergency services throughout the south were on stand-by to deal with potential damage to buildings already weakened by last Thursday's storm, in which 46 people died.
Herald Express (19900126a)	Herald Express, Clean-up will cost millions, p.1, Friday, 26January1990a -Torquay nightclub owner Jurgen Etheridge (49) one of storm victims (crushed by tree at home in Torquay) -Adrian Bombach died under fallen tree 200 yds from house at Didworthy near South Brent
Herald Express (19900126b)	Herald Express, Trail of death nationwide, p.1, 26Jan1990b -at least 40 killed in some of worst storms to hit country this century -death toll > 1987 hurricane but winds lower -100s injured -deaths: senior police officer Hampshire when tree fell on car
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -Haag: at least 19 dead (2 in Rotterdam), 100s injured; 100s mill guildens damage -Rotterdam police received dozens calls -G van Bergen found dead by pier II in Waalhaven -MTM de Oude from Geervliet died when tree on car in Deelftweg -30-35 taken to hospitals; 10 serious injuries
Het Vrije Volk (19900126b)	Het Vrije Volk, Schade is groter dan door aardbeving, p.5, 26/01/1990b -UK with 40 dead including many children -10 dead along French channel coast -6 fatalities Belgium -1 fatality W Germany -4 fatalities Scandinavia -Gordon Kaye injury with 5 h emergency surgery
Het Vrije Volk (19900126c)	Het Vrije Volk, Storm-doden vielen vooral in 't verkeer, p.5, 26/01/1990c -19 fatalities in the storm, mostly in traffic -Nootdorp, Apeldoorn, Hilversum, Wierden people killed by trees falling on cars -person from Gelderse Garderen killed by falling tree on sidewalk in Bussum -17y old moped rider killed by fallig tree in Diever -Man killed in road accident in Stroe op de Veluwe -Utrechse Cothen: man killed when his border (wall?) collapsed -Binnenmaas: man trapped in in rotating parts if windmill machinery -Zoetermeer: man from Alkmaar hit container -Amsterdam: pedestrian blown into path of car and died -Belgische Mechelen: 20y old automobilist died with car blown off road and into tree -Zevenhovel: truck driver died when blown into oncoming traffic
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -no deaths reported in West Yorkshire
Huddersfield Daily Examiner (19900126b)	Huddersfield Daily Examiner, Falling trees bring chaos to nightmare journeys, p1, 26Jan1990b. (Friday) -Two people in hospital as fire crews stretched -6 people cheated death last night as trees crashed down on their cars in the storm -Mirfield: man and woman cut free from Lada that was crushed under massive tree -Thongsbridge: man and daughter rescued by fire crews when 100ft tree fell on Ford Granada -Eastgate, Honley: tree wrecked car but only slight injuries -fire crew from Holmfirth blocked by falling tree on Huddersfield Road at Thongsbridge
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) FIG. [PHOTO] A 10-year-old girl died and four children were hurt when the roof of this junior school in Swindon, Wiltshire was ripped off in the gale -Britain counting tragic cost of one of most ferocious storms this century; 45 dead, hundreds injured
Huddersfield Daily Examiner (19900126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -yesterday's winds of up to 110mph & torrential rain killed 71 people in western Europe -Britain worst hit with 45 dead -Holland 11, France 6, Belgium 6, West Germany 3 -northern France: 6 died & power cut to 100's of homes -Belgium: 6 deaths; mother and child died near brussels when tree fell on car -West Germany: 3 died, severe coast damage Schleswig-Holstein; inland areas like Frankfurt also hit
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -36 reported killed across UK -Hull Royal Infirmary: 46 people people treated 1800-2100
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -UK: Newquay Cornwall: man died when high winds toppled tree on his car -UK: Newton St Cyres: tree fell on school bus causing minor injuries; another tree fell on lorry -UK: South Brent, South Devon: 1 person feared dead when tree crashed on car -UK: Britain: at least 8 people killed & scores injured in gales -UK: Scotland: heavy snow blocked roads in near blizzard conditions; 3 people killed in car accident

	-UK: many people died as hurricane force winds wrecked buildings, tore up trees, and knocked out power supplies across Britain & continental Europe -UK: motorists killed by trees crashing on cars -UK: hundreds of people injured by flying debris -NETHERLANDS: hurricane across Netherlands flat lowlands 25Jan, causing several deaths -NETHERLANDS: hundreds of people injured by uprooted trees, toppling chimneys & flying roof tiles -GERMANY: hurricane winds lashed Germany, killing at least 5 people, injuring 100s -FRANCE: at least 8 people killed in France in storm with winds gusting to 108mph across N region Brittany, Pas de Calais, Ile de France -FRANCE: 3 fishermen listed as missing after catamaran sloop Revolution overturned while being towed off the coast at Granville -BELGIUM: crisis centre set up at Interior Ministry reported 10 people died and dozens injured in Belgium during storm 25Jan -BELGIUM: 13 people seriously injured; 50 people with lesser injuries -BELGIUM: injuries mainly caused by flying debris & uprooted trees -more than 80 people killed & 100s injured by storm in Britain & N Europe -UK: police & ambulance services say at least 45 people killed -UK: 2 schoolgirls killed & several children injured when school roofs collapsed
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -NETHERLANDS: storm sparked fire at luxury hotel in Noordwijk; 3 firemen died in blaze -NETHERLANDS: at least 20 people known to have died in storm -NETHERLANDS, Rotterdam: man crushed by 2000kg container when trying to seek shelter behind wall of boxes at Multi Terminals -EUROPE: killed at least 80 people -EUROPE: weather related accidents caused 10 deaths Belgium, 8 in France, 8 in West Germany -EUROPE: storm 25Jan1990 killed > 80 people -BRITAIN: 45 killed in Britain -BRITAIN: nearly 1/3 of aid 900000 ECU to go to UK with 47 of 96 fatalities from last Thursday storm 25Jan
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -80 died & 100s injured by storm in Britain & N Europe -Britain worst affected with 45 casualties
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -47 people killed because winds during day over wider area
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -storm with winds up to 110mph tore across S England & W Europe, killing at least 97 in 6 nations -Britain with 45 dead was the worst hit on Thursday -Belgium -Brussels: woman and child killed by tree on car -Torhout: man on bike swept under truck in western Belgium -Sint Niklaas: 72y old man blown off roof while surveying damage -Horion-Hozemont: 56y old man died of heart attack after he climbed on his roof -West Germany -53y old man swept off bike near Aurich in Niedersachsen and run over by car -death toll in England higher than Oct1987 when 17 people killed -several people killed when tree limbs crashed onto them or their cars
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -man killed in Waterford by falling tree; 2 other people died in weather relative accid N Ireland -Storm affected N France, Belgium, Netherlands, but Britain hardest hit with 46 killed, many crushed by falling trees
Neue Zuercher Nachrichten (19900127)	Neue Zuercher Nachrichten, Sturm forderte Menschenleben, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -hurricane in west and central Europe on Thurs 25Jan an yesterday 26Jan had caused 80 fatalities by noon 26Jan -Great Britain had been hit by one ofthe worst storms of the century with at least 40 fatalities -fatalities also in other countries: Belgium 6, Netherlands at least 14, Denmark 4.
NRC Handelsblad (19900126a)	NRC Handelsblad, Negentien doden door zware storm, p.3, 26/01/1990a. -Rotterdam, 26Jan. 19 fatalies after yesterdays storm: -Bussum (52.274, 5.166): 41y old man from Garderen killed by falling tree -Rotterdam (51.924, 4.478): 46y old worker killed under fallen container -Rotterdam (51.924, 4.478): 30y old man hit by a tree -Nootdorp (52.044, 4.391): 66y old man killed tree falling on top of car -Cothen (51.998, 5.308): 38 y old man died by het instorten van de schuur -Binnenmaas (51.796, 4.548): man killed in windmill machinery -Hilversum (52.229, 5.167): 13y old girl killed by tree falling on car -Apeldoorn (52.211, 5.970): 27y old man from Terwolde hit by falling tree -Amsterdam (52.368, 4.904): 33y old woman blown under moving car by wind gust -Wierden (52.358, 6.594): 23y old man killed by falling tree -Mechelen (51.026, 4.478): 20y old man dies after wind gust blows car off road into tree -Zevenhoven (52.180, 4.782): 42y old truck driver dies when wind blows truck into oncoming traffic

	-Twello (52.238, 6.098): 27y old man killed under falling tree -Gulpen (50.816, 5.891): 20y old auto driver dies after hitting tree during storm -Diever (52.855, 6.318): 17y old dies from tree fall -Zoetermeer (52.061,4.494): 26y old had fatal injury by falling container -Noordwijk (52.240, 4.450): 3 fire fighters die in fire in hotel Huis ter Duin
NRC Handelsblad (19900126b)	NRC Handelsblad, Zeker 65 doden in buitenland, p.1, 26/01/1990b -at 65 fatalities in storm 25Jan1990 outside Netherlands -UK: 45 fatalities reported; reported as hurricane of the century -northern France: 6 fatalities; 4 missing -Belgium: 6 fatalities -Germany: 5 fatalities
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -severe storm over past 24h resulted in 19 fatalities; 10s people injured under falling trees, roof tiles, construction material -among fatalities was man caught in the gears of windmill -in Zoetermeer and Rotterdam, 2 men crushed under falling containers -many fatalities by falling trees or traffic accidents linked to extreme gusts
NRC Handelsblad (19900126d)	NRC Handelsblad, Miljoenenschade in Rotterdamse haven, p.2, 26/01/1990d -in the area at Multi-terminals, 46y old G van Bergen killed under toppled containers
Perthshire Advertiser (19900126b)	Perthshire Advertiser, Family killed in A85 crash, p.1, 26/01/1990b -father, mother, child died late Wednesday 24Jan1990 when vehicle skidded out of control on A85 Perth-Dundee dual cariageway at Rait junction -wintry weather
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -39 people known to have died -flying debris caused 100s injuries -2 girls killed at separate incidents at their schools -roof came off 3 classrooms at Grange Junior School, Lower Stratton, Swindon, Wilts; falling debris killed 1 girl, injured 4 others -St Brandon's girls school, Clevedon, Near Bristol; 1 16y killed & 9 injured by masonry through conservatory at lunchtime -Gordon Kaye, TV series Allo Allo critically injured by plank through windscreen W London -trees biggest killers; many weakened after Oct1987 storm -14 deaths from trees falling on cars/vans/lorries -30y man from Steyring West Sussex died after being blown off moped at nearby Bramber -2 month old baby girl recovered alive from car crushed by 100 foot pine; mother killed -28y woman killed in collision with fallen tree in Volkswagen Golf at Lakeside Cardiff
The Times (19900126)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -at least 33 died in S Britain in winds gusting to 110mph -Grange Junior School, Swindon: 11y old girl killed, 2 injured -St Brandons School, Clevedon, near Bristol: 16y old killed & 4 injured -Gordon Kaye injured -many deaths & injuries caused by falling trees -Cardiff: woman killed by tree on car; 2 month old girl survived -Cheltonham, Gloucestershire: 25y old woman killed by tree on MG -at least 10 others killed by trees -John Smith, Chief Inspector killed by tree on car at Morestead, near Winchester
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -severe gales expected to hit Britain on Monday in wake of storms that left 46 dead -at least 40 killed on continent; 19 in Netherlands, 10 in France,7 in Belgium, 3 W Germany
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -death toll 1987 storm at 19; less than half of Daria; Oct 1987 storm in early morning -46 deaths and damage from Cornwall to Cleveland & Ulster to SE England -largest number of deaths from trees that killed people in cars
The Times (19900127i)	The Times, Taxing the Elements, p.11, 27Jan1990i. -Daria took many more lives than 1987 storm because people were up and about
Times (19900130)	The Times, Floods and gales bring more chaos (contributor John Young), 30 Jan 1990. -search for 2 men climbing Cobbler Peak near Arrochar Strathclyde on Sunday -Mrs. Valerie Howard, 82, found dead in home after fall during Daria -skeleton found under 1500 year old yew tree blown down in storm
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -94 people died; 8 in Germany
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 002. NRC26/1: Zeker 65 doden in buitenland) -at least 65 foreign deaths -45 deaths reported Great Britain; damage not as bad as Oct1987 storm; SW England worst affected; almost 1 million people without electricity at midday; snowstorm in north

	-6 deaths N France; 20m chimney collapses of Paleul nuclear station near Paris -6 deaths Belgium -5 deaths W Germany (source: 005. NRC 26-1: Drie leden bradweer omgekomen) -3 firefighter deaths in hotel blaze Huis der Tuin in Noordwijk (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -UK worst hit with 10s of fatalities -Bruxelles: woman and child killed by falling tree on car -Sint Niklaas: 72 year old man dies after being blown from roof of house -17y old girl killed by falling tree at bus stand -4 crew drowned at DDR coast (source: 022. VLK26-1: Tientallen doden door noodweer in West-Europa) -3 people died Scotland in snow accident -number of deaths significantly higher than 1987 storm (17) -4 deaths Belgium; single church tower collpased; government crisis centre -6 deaths N France; damage Calais-Boulogne-Dunkerk man overboard from Liberian ship Serica 300km SW of Cornwall; loss of 3 crew of fish-cutter Revolution in front of English coast (source: 029. Reformatorisch Dagblad 27Jan1990: EG geeft noodhulp aan slachtoffers orkaan) -94 fatalities; UK 45, NE 20, FR 8, BE 10, DK 4, DE 7
Buller (1993)	Buller PJS, The gales of January and February 1990: damage to buildings and structures, Building Research Establishment Report, Building Research Establishment, Garston, Watford, WD2 7JR, 24 pp, 1993 -media reports of many deaths & injuries, following collapse of buildings -number of incidents accentuated because highest winds did not occur until people at work
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -winter storm sequence: Belgium 15, Germany 33, Europe 225, France 66, UK 83, Netherlands 21, Austria 3, Switzerland 4
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -21 fatalities in the Netherlands; 26 severely injured
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -close to 100 casualties
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -gales 25Jan1990 left more dead in Britain than any single weather event since East Coast flood 1953; 47 dead with 36 direct result of storm -high deaths attributed to storm occurrence in week day -if 1987 storm had occurred during daylight hours, fatalities would have been higher -Kent: woman died when tree toppled onto florist's van in East Street, Hunton, nr Maidstone
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -Germany: 64 fatalities in storm Daria, Herta, Vivian, Wiebke; Wiebke with 24 fatalities -Netherlands: 17 fatalities from Daria -Germany: 8 deaths; deaths also in Belgium and Denmark(?) -most deaths from collapsing buildings, falling debris & trees, and traffic accidents -Sussex, S England: class of school children evacuated before building collapsed -Country data (Munchener Ruck, 2001) -Belgium: 1990 storms caused 0.87 bill EUR damage; 15 deaths -Denmark: 0.16 bill EUR -Germany: 3.8 bill EUR 64 -France: 1.65 bill EUR 66 -UK: 4.1 bill EUR 85 -Luxembourg: 0.3 bill EUR -Netherlands: 1.5 bill EUR 21 -Switzerland: 0.16 bill EUR 4 -Austria: 0.2 bill EUR 3 -Germany: Jan-Sep 1990 numerous working accidents processing fallen timber in SW Germany -private and community forests: 3544 accidents, 10 fatal -state forests: 1032 accidents, 3 fatal
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -272 people killed in storm sequence (Munchener Ruck, 2001); large percentage during Daria because because it reached peak intensity during daytime -despite lessons 1972, still numerous accidents clearing up wind damage -SW Germany 3544 accidents of which 10 fatal in private & community woodlands;

	in state forests 1032 accidents of which 3 fatal (Kuehnel, 1994)
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -94 fatalities in UK, Belgium, France, Netherlands, Germany (8)
Cusack (2013)	Cusack, Stephen, A 101 year record of windstorms in the Netherlands, Climate Change, 116, 693-704, 2013. -Daria 1990 and Lothar 1999 had about 100 fatailities
Munich Re (2013)	Munich RE, Natural catastrophes in Germany 1970-2012, Muenchener Rueckversicherung-Gesellschaft, Geo Risks Research, NatCatSERVICE - as of January 2013 -8 fatalities in Germany during storm Daria
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -95 died in Daria in northern & central Europe
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -hurricane Daria led to 94 fatalities, 8 in Germany
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) FATALITIES Location LA ND Latitud Longitu Date Day Time Uncertainty --- Germany DE 52.70 N 8.00 E 25-01-1990 thu 18:00 UTC (+/- 12 hrs.) Number of people dead: 8. United Kingdom UK 51.75 N 1.30 W 25-01-1990 thu 12:00 UTC (+/- 12 hrs.) 47 people dead
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia -17 people killed Netherlands
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -storm is among the most destructive (highest fatalities) of 1990s across Europe -le bilan of storm Daria was extremely heavy with 95 deaths and several 100 injured across north-west Europe -casualties from fallen trees, pylons, walls, and grues, or led to traffic accidents -storm had most fatalities in Europe since the storm of Oct1987
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -Daria 95 people died in northern and central Europe
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 -47 fatalities UK
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -Daria 25Jan1990 had at least 93 fatalities: 45 UK, 19 Netherlands, 10 Belgium, 7 Germany, 4 Denmark

Table SL56. Coastal flooding, dike breaks, and evacuations (arranged by year and then alphabetically)

Source	Full Reference and Notes
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -southern Jutland: sea level 9 feet higher than normal; dykes withstood battering
Hudderfield Daily Examiner (199001126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -Dutch Transport Ministry: defences against sea not jeapardized
Evening Post Nottingham (19900126d)	Evening Post (Nottingham), Traffic chaos in Germany, p.7, 26/01/1990d -Hamburg Harbour braced for possible flooding
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -parts of the harbour area of Hamburg flooded -West German authorities decided to evacuated a small village in the northern coastal region after a tidal wave damaged a dike -southern Jutland: coastal water levels up to 9 feet above normal; dykes protecting farmland withstood battering
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -West German authorities evacuated 1 coastal village threatened by floods from broken dyke -Danish authorities fought to block several breaches in nation's dyke network; threat controlled; many sheep lost by floodwaters in low-lying pastures -storm swept across Denmark; extensive damage to property, serious flooding, but no loss of life on land -considerable physical damage especially in southern areas Jutland & islands -several ports west coast of Jutland flooded after dykes washed away
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -southern Jutland in Denmark had sea level 9ft above normal; dykes withstood battering
Rosenorn (1990)	Rosenorn, Stig, Vintervejret 1989, Vejret, 43, 21-23, 1990 -coastal flooding west coast of Jutland, especially Varde-Esbjerg area
Wubs and Waaldijk	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor

(1990)	Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -Hamburg, W Germany: number of streets in harbour area flooded
Landesregierung Schleswig-Holstein (2023)	Landesregierung Schleswig-Holstein, Stormfloot und Hochwadder, dat geiht uns al wat an, Wasserstark.SH, https://www.schleswig-holstein.de/DE/landesregierung/themen/kueste-wasser-meer/wasserstarkSH/_documents/__geschichten/jensen.html, last change 27/08/2023 -Dagebuell evacuated after dike damage during Daria

Table SL57. Coastal dike heights and protection levels (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL58. Surge barrier closures (arranged by year and then alphabetically)

Source	Full Reference and Notes
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -along coast limited dike monitoring started -RWS: water level 1.25m higher than normal -it was not necessary to close the surge barrier at Oosterschelde

Table SL59. Beach damage and coastal issues; salt water contamination of groundwater; sewer systems (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (1990)	Deutschen Wetterdienst, Monatlicher Witterungsbericht, 38, pp. 1-2, January 1990. -there was significant loss of land from southern tip of Sylt island
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -severe storm surge against Sylt Island with 20000 m2 land lost
Huddersfield Daily Examiner (19900126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -West Germany: 3 died, severe coast damage Schleswig-Holstein; inland areas like Frankfurt also hit
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -tables and map showing dune cutback up to a few metres (max of 25m for one location in Terschelling)
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -dunes, natural part of Dutch coastal defense system, suffered severely in some places -repair of dunes 15mill Dfl
Bissoli et al (2001)	Bissoli P., L. Goering, Ch. Lefebvre, Extreme Wetter- und Witterungsereignesse im 20. Jahrhundert, pp. 20-31, Klimastatusbericht 2001 -land loss southern tip of Sylt
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -southern tip of Germany North Sea island Sylt lost stretches of coastline due to high tides
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -on island of Sylt, part of southernmost part carried away

Table SL60. Power interruptions; telephone poles/lines down; oil pipeline flow stopped due to electricity loss (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -at least half million homes without electricity
Belfast Telegraph (19900126a)	Belfast Telegraph, Weathermen warn of new freeze on the way (contributor Janet Devlin), p.1, 26Jan1990a. -Northern Ireland Electricity: supplies back to normal
Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -thousands of households over wide area without electricity after 100mph winds brought down power lines -engineers worked through night to restore power -6 specialist 2 man teams from 40 Commando Royal Marines standing by to help South West Electricity Board engineers removing trees and helping with fallen power lines -1000s of households still without power -100s schools closed throughout country because of wind damage or lack of heating -many villagers in Cornwall and east Devon advised to boil drinking water; power failure at treatment works -across rural mid and north Wales wind gusts topped 100mph; engineers worked to restore power to 100s homes -helicopters brought in to spot damaged lines
Belfast Telegraph (19900126d)	Belfast Telegraph, Dozens die as winds hit continent, p.4, 26Jan1990d -northern France: power was cut to 100s thousands of people
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -1000s of people left without power

Derby Evening Telegraph (19900126b)	Derby Evening Telegraph, Winds havoc round-up, p1, 26Jan1990b. -1000s homes Derbyshire had electricity outage when overhead power lines blown down -so many lines blown down that some homes without power until late 26Jan
Derby Evening Telegraph (19900126c)	Derby Evening Telegraph, Thousands of homes blacked out (contributor Lana Montgomery), p.3, 26/01/1990c -1000s of homes throughout Derbyshire had electricity cut off when overhead power lines blown down -first power cuts reported early afternoon 25Jan1990 Thur; some still without power Fri -extent of damage so great that it will be late 26Jan1990 before power restored -about 4000 homes in Derby area cut off with >10000 affected throughout east midlands -Les Sykes, district engineer for Derby area: about 100 homes still without power 26Jan; some people would have been without power 24h -telephone connections cut for scores of homes and businesses -villagers in north Derbyshire without water when gales cut off electricity to [umping stations -homes in Crich and Plaistow affected; pumping stations at Wingerworth, Riddings, Eckington
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -1000s homes without electricity night 25-26Jan1990 -British Telecom: request people not to call into city because call volume increased 100% -700000 homes without electricity night 25-26Jan: Greater Manchester, Somerset, Kent, Dorset, Wales; most of Devon & Cornwall suffered grid failure -Southern Electric spokesman: could be several days before electricity restored -large sections of country without TV or radio when winds knocked transmitters over
Eastern Daily Press (19900126d)	Eastern Daily Press, Europe lashed, p.2, 26Jan1990d. -West Germany: toppled cars, telephone poles, trees
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -Len Bacon, Eastern Electricity: 50 field staff working to fix to 1000 blacked out homes -homes in Diss without electricity for part of afternoon -Easton without power in evening -Thetford: blackout hit school, houses, wildife park
Eastern Daily Press (19900126i)	Eastern Daily Press, Lucky escape for driver, p.3, 26Jan1990i -Fakenham-Swaffham road impassable after tree fell on power cables -numerous trees fell around Dereham blocking side roads -electricity failed at Cranworth just outside Dereham
Eastern Daily Press (19900127a)	Eastern Daily Press, Storm death toll 46 as Britain clears up, p.1, 27/01/1990a. -engineers worked to restore power to 100s thousands homes with power loss by 120mph gales -electricity spokesman: some gale hit areas will be without power for several days -marines deployed to restore electricity supplied in West Country where 150000 without power night 26Jan1990 -RAF flew engineers from Scotland; workers from Irish Republic & North of England repaired cables
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -France: 10s thousands without electricity -Belgium: winds up to 105mph caused collapse of radio & television towers
Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -Norfolk: >100 trees fell, power lines brought down, dozens of roads blocked -engineers worked to restore electricity & telephone services to 500homes in east of county; at peak of storm 4000 houses without power
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -20000 homes in Nottingham & Mansfield without electricity last night -40 telephone lines brought down -power: 'at height of the problem we had 20000 customers cut off in Nottingham and Mansfield areas; half reconnected overnight and we are working on the other 10000 today and hope that most will be cleared by midday' ... There will be a small number of homes still without power until tomorrow -power: British Telecom spokesman Bob Flower: 40-50 overhead lines brought down in Nottingham
Evening Post Nottingham (19900126b)	Evening Post (Nottingham), Europe - the grim toll grows, p.7, 26Jan1990b (Friday) -telephone & electricity cut in some areas
Evening Post Nottingham (19900126f)	Evening Post (Nottingham), Chaos as gales hit capital, p.8, 26/01/1990f -British Telecom urged people not to telephone in or out of London; 100% increase jammed network
Evening Post Nottingham (19900126l)	Evening Post (Nottingham), Thatcher's Storm Horror, p.1 and 19, 26/01/1990l -6 specialist 2-man teams from 40 Commando RM standing ready to help SW electricity engineersby removing trees and helping with falled power lines -100s schools closed throughout country because wind made them dangerous or lack of heating -villagers in east Cornwall & East Devon advised to boil drinking water; electricity lost to water treatment plants -mid Wales and North Wales: engineers worked to restore electricity to 1000s homes -helicopters used to spot damaged lines -East Midlands electricity spent day repairing damaged pylons that left 30 homes without power -there have been 80 live faults on lines in Nottingham
Financial Times (19900126a)	Financial Times, 27 dead as gale winds sweep across the Channel, 26 January 1990a -ferry traffic impacted; 100s thousands people without power in UK and northern France
Financial Times (19900126b)	Financial Times, Violent storm cuts road and railway links (contributors Richard Evans & Jimmy Burns), p.6, 26 January 1990b -severe disruption of motorways throughout country -engineers seeking to restore power to >1 mill homes in SW, SE, Midlands after severe disruption supplies

	-water supplies also affected -telephone services badly hit with fallen lines & people calling
Herald Express (19900126b)	Herald Express, Trail of death nationwide, p.1, 26Jan1990b -at height of storm 1 million people without electricity after power lines brought down -some people could be without electricity for several days
Het Vjije Volk (19900126b)	Het Vrije Volk, Schade is groter dan door aardbeving, p.5, 26/01/1990b -W England with 250000 houses without power
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -electricity cut for Kirklees -power lines brought down in many areas; Yorkshire Electricity worked through night to restore suplied -only parts of Meltham without power morning 26Jan1990 -phone lines brought down; in Huddersfield 140 lines brought down -British Telecom: engineers would work throguh weekend to repair faults
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -thousands of households without electricity when 100mph winds brought down power lines -six specialist 2man teams from 40 Commando Royal Marines standing by to help South West Electricity Board engineers by removing trees & helping with fallen power lines -hundreds of schools throughout country because because wind damage made them dangerous or lack of heat
Huddersfield Daily Examiner (19900126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -northern France: 6 died & power cut to 100's of homes
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, . 279, No. 4, 06/02/1990 -Wales: damaged power lines leave thousands of homes without electricity -British Telecom marine radio staton at Land's End hit badly as its power lines were severed & emergency generator failed in strong winds -station continuing to monitor distress calls but unable to broadcast to shipping -French radio station transmitting all radio messages, including navigation warnings -southwest England: 300000 homes lost electricity with 120mph winds brought down electric cables -troops drafted to help restore electricity -Britain & N France: 900000 homes without electricity -British Rail said most main line services working again this morning; rolling stock in wrong places; storm damage to power supplies causing disruption -a gas drilling tower collapsed in northern Germany causing 1.5DM damage but injuring no one -southern Jutland: several coastal districts were without electricity after power lines snapped by winds gusting at 85mph -Belgium: winds gusting up to 100mph yesterday toppled at least 3 church steeples & several high tension masts -Belgium: electricity companies said normal distribution was cut by at least 10% because of broken power lines -100s thousands of people in S England still without electricity
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -EDF (electricity company) reported 60000 homes remained without power in Nord Pas-de-Calais area & 40000 in region of Arras -in Britain & N France nearly million homes without electricity -BRITAIN: 100s millions dollars damage; disrupted transport, communications, electricity across nation -BRITAIN: SW hardest hit; storm 29Jan frustrating efforts of workers to restore essential services to region -BRITAIN: BBC report 100000 households remained without electricity -BRITAIN: winds reaching 70mph preventing workmen from climbing utility poles for broken lines -BRITAIN: farmers thrown out 1000s gallons milk spoiled because frigs not working
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -England: damage to trees, power lines, windows
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -reactor chimney blown down at Paluel nuclear power plant in France -Electricite de France said plant was shut down immediately & monitored for hazards -about 250000 people in western England without electricity
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -transport, communications, electricity distribution severely disrupted
Naturlig Energi (1990)	Naturlig Energi, Vindproduceret El (contributed by B. Groning, M. Koch, W. Canter, T. Moller), pp. 16-32, Mar, 1990. -list of power production loss from turbines in Denmark for Jan1990
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) -150000 homes in villages near Rochester blacked out at midday; worst affected Snodland, Cliffe, Upchurch, Shorne -electricity board spokesman: hit villages had power supplies from overhead lines; towns had underground power cables -difficult for workmen to get to affected areas because of blocked roads & M2 closure
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -British Telecom engineers working flat out to repair lines blown down in storm -number of trains cancelled at height of storm in afternoon due to power faults (Southern Region)

NRC Handelsblad (19900126b)	NRC Handelsblad, Zeker 65 doden in buitenland, p.1, 26/01/1990b -UK: million people without electricity in middle of day -France: at nuclear power plant Paluel (49.86, 0.636) near Paris 20m high chimney collapsed
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -storm destroyed overhead train power lines in 41 places
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -Amsterdam: Central Station lost electricity
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -1000s homes without electricity; chaos on road & rail
Press and Journal (19900126b)	Press and Journal, Blizzards cause road chaos (contributor Steve Stewart and David Steele), p11, 26Jan1990b. -8000 consumers left without electricity: Perthshire, Argyll, Inner Hebrides heaviest hit
SWEB News (1990)	SWEB News, February, 1990. keywords: 8 days to fix electricity faults in southwest, marines helped, staff from other boards called in, 400kV supergrid goes down, max 400000 customers off grid (30% SWEB customers) -helicopters used to identify faults
The Times (19900126)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -half million homes in West Country without electricity -British Telecom appealed to Londoners not to use telephone because of 100% increase of calls blocked lines for emergency services
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -attempts to restore power & telephones to 10s thousands homes intensified yesterday -22 electricians from Scotland & 70 from NE England traveling to SW -many homes unlikely to have power until Sunday or Monday -British Telecom: working through weekend to restore services to homes West Country and Kent -everywhere 100s Royal Marines clearing trees & replacing power lines
The Times (19900127g)	The Times, Marines clear debris in Devon (contributor Guy Newman), p.3, 27Jan1990g FIG. [PHOTO] Two Royal Marines helping Mr. Geoffrey Moger, a line man, clear trees and restore power at Exton, near Exeter, Devon
Times (19900129a)	The Times, Floods and new gales ahead (contributor Ray Clancy), The Times, 29Jan1990a. -heavy snow blocked many roads yesterday & gusts to 60mph in coastal areas -problems with damage repair including power lines -snow brought down several electricity pylons & blocked roads N Wales, Cumbria, Derbyshire
Times (19900130)	The Times, Floods and gales bring more chaos (contributor John Young), 30 Jan 1990. -gales & heavy rain flooded parts of Britain yesterday -engineers struggled to repair power lines of last week's storm -100000 householders told power supplied might not be reconnected until later in week -South Western Eletricity Board -Devon: 13000 homes without electricity for 4th day; 20 schools closed -Cornwall: 15000 homes without power; dozen schools closed -4 spotter helicopters & extra engineers from Midlands working to restore power 3000 homes in west Wales (report from South Wales Electricity)
Walliser Bot (19900127)	Walliser Bot, Schweiz von groesseren Sturmschaeden weitgehend verschont mit 170 km/h, 27Jan1990 (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -toppled trees led to power loss in different places some streets closed
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 002. NRC26/1: Zeker 65 doden in buitenland) -SW England worst affected; almost 1 million people without electricity at midday (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -about million people in west England without power -north France 100000 people without power -Paleul nuclear reactor 20m chimney collapses (source: 022. VLK26-1: Tientallen doden door noodweer in West-Europa) -electricity masts collapsed S England; -N France: 380 000 houses without electricity because of fallen high voltage lines from Gravelines (source: 026. NRC26-1 vrijdag 26 januari 1990 (NRC Handelsblad): Vrachtverkeer reed door ondanks oproep) -Tilburg: broadcasting mast toppled
Heipertz and Nickel (2008)	\Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -nuclear power plant in France collapsed; several others shut down -natural gas production impaired -power supply impaired
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-

	1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -1000s trees felled in Kent & countless roads blocked -homes blacked out & phone lines severed -British Telecom workers struggled day & night to repair 6500 faults in Mid Kent & Weald
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -Germany: 2 trains derailed & power lines disrupted -Great Britain: 1 million households power cut; 320000 power cut lasting several days -France: wind gusts toppled chimney of nuclear power plant
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -significant damage to buildings & enormous damage to infrastructure-transport-electricity supply (Zou et al, 2008) -UK: >1 mill homes without power initially; 300000 without power for a few days
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -half a million households lost power
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -most importantly: power supply to nuclear power plant in Kalkar interrupted when lightning & storm toppled 2 power masts -Ostfriesland: several power masts toppled; power loss in several locations -different regions Germany, Great Britain, N France, Netherlands power cuts & massive storm damage; power loss for 100s thousands -nuclear power plant in Gravilines in Bretagne: 5 of 6 reactors shut down -in GB approx 1 million households without power
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -many cases of power outages; 10000 emergency callouts of fire-fighters -reference to fallen pylons
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -half a million households lost electricity
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 -Europe: 500 000 properties with power loss

Table SL61. List bridge closures, cancelled ferry crossings, port closures, airport cancel, rail interruptions, traffic accidents (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -hurricane force winds from SW forced closure many railway stns, roads, ports -flights to major airports in England diverted
Belfast Telegraph (19900125b)	Belfast Telegraph, Ulster awash as snow and floods cause road chaos, p.1, 25Jan1990b. -blizzards persisted in northwest; widespread flooding; dozens of residents evacuating homes -mountain road Coleraine to Limavady closed by heavy snowfall during night -police: Glenshane Pass on main Londonderry-Belfast road passable with care
Belfast Telegraph (19900126a)	Belfast Telegraph, Weathermen warn of new freeze on the way (contributor Janet Devlin), p.1, 26Jan1990a. -AA spokeman: many reports of motorists skidding on black ice; route to Londonderry tricky -Belfast International and Harbour airports reported all flights back to normal -ferry companies P&O Larne-Cairnryan and Sealink Larne-Stranraer said some sailings running an hour late -should be on schedule tonight -RUC: spate of minor traffic bumps throughout city due to skidding
Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -Hamburg ferry due to sail into Harwich Essex after nearly 24h moored offshore because of high winds -services improving on British Rail and London Underground & busses -commuters took their own cars into the city & brought London to standstill -appalling congestion made worse by many streets closed by fallen trees, unsafe buildings, scaffolding -parts of motorway closed esp M25 by abandoned vehicles -Police in Hampshire & Sussex: most major roads open; some country lanes closed by fallen trees; avoid exposed coast roads
Belfast Telegraph (19900126d)	Belfast Telegraph, Dozens die as winds hit continent, p.4, 26Jan1990d -Holland: disrupted rail, air, road traffic
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990.

	-100ton jumbo jet pushed off taxiway by winds -Heathrow airport closed because winds were so bad -flying debris at airport was threat to passengers -at another airport; air traffic services broke down completely when window of control tower shattered by flying debris
De Telegraaf (19900126a)	De Telegraaf, Schipol legt alle vliegverkeer stil, p.1, 26/01/1990a -Schipol airport -from 19:30-21:00 all flight traffic suspended -40 incoming and 45 outgoing flights suspended -KLM, NLM, Netherlines stopped all services in the afternoon -60 kt is operational limit for flights -KLM Jumbo jet suffered damage from a toppled container -also other toestellen (airplanes?) in Schipol and Eindhoven lightly damaged by flying objects -buildings suffered significant damage by flying objects from activities around the airport -10s of cars wrecked by toppled fences -planes were parked with nose to the wind to prevent them from drifting
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -30 vehicles overturned; 20 other road accidents -M1: another 19 vehicles overturned & road closed for 5h -3 flights to East Midlands International Airport diverted because of high winds
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -hurricane force winds at Dover end of channel -French SNCF ferry Chartres (Newhaven to Dieppe) spent hour drifting without power -London commuter rail stations closed -dozens roads closed in London -road transport -whole length of M4 impacted -Severn bridge closed for 3rd time in 23 year history -50miles of M5 between Avonmouth and Taunton Somerset closed after articulated lorries blown over
Eastern Daily Press (19900126d)	Eastern Daily Press, Europe lashed, p.2, 26Jan1990d. -West Germany: traffic chaos
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -more than 100 trees fell in county, blocking dozens of roads -trains arrived up to 6h late at Norwich; London service reduced to snail pace -Norwich airport: planes diverted, cars parked in front of light aircraft to prevent them blowing away -blocked roads: -A47 at Costessy -Acle Strait -Norwich ring road at North Walsham roundabout -A140 Ipswich Road at Stoke Ash -A1065 at East Raynham -fears of electric wires on railway reduced speed to 20mph -London Liverpool Station: roof blew off; Intercity trains from Norwich stopped at Colchester -one train from London reached Norwich 6h late -British Rail offered free accommodation for night in Norwich for stranded travellers -rail lines affected by trees on track -Kings Lynn service stopped at Cambridge -Lowestoft cut off from Norwich after power failure on line to Ipswich
Eastern Daily Press (19900126g)	Eastern Daily Press, Rail chaos as trains are halted for hours, p.3, 26Jan1990g -frustrated commuters waited for more than 5h for trains to leave Norfolk for London last night -trees & debris littered track from Norwich to London -buses taking passengers between several stations left isolated on line -in London, only major station open was Euston -passengers in Norwich put in hotels -trains for London began running again around 8PM -BR said trains running several hours late; hoped services back to normal this morning.
Eastern Daily Press (19900126h)	Eastern Daily Press, Falling roof hits workman, p.3, 26Jan1990h -driver of lorry carrying Dunlop tyres taken to hospital earlier yesterday when it was blown into a dyke on the Acle Strait -Lowestoft to Yarmouth road blocked by fallen tree at Hopton -police closed A47 Acle Strait & Breydon Bridge to lorries as winds increased to force 9
Eastern Daily Press (19900126i)	Eastern Daily Press, Lucky escape for driver, p.3, 26Jan1990i -many fallen trees reported temporarily blocking several minor roads Sheringham -Hall Road, Cromer, completely blocked by 2 fallen trees -Tunstead: level crossing gates over over Sheringham-Norwich line jammed -Fakenham-Swaffham road impassable after tree fell on power cables -numerous trees fell around Dereham blocking side roads
Eastern Daily Press (19900126l)	Eastern Daily Press, Fishing boat alert, p.3, 26/01/1990l -train driver slightly injured when telegraph pole fell & hit train on Norwich-Lowestoft line -driver had injury to hand
Eastern Daily Press (19900126m)	Eastern Daily Press, Lorries in trouble, p.3, 26Jan1990m. -at A10 at Southery near Downham Market, lorry had roof blown off, another went off road -3 other lorries overturned in west Norfolk; one on bridge of Kings Lynn southern bypass
Eastern Daily Press	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c

(19900127c)	-Norfolk: >100 trees fell, power lines brought down, dozens of roads blocked, rail & air links severely disrupted -major roads clear on Friday -122 emergency calls to Norfolk police: 76 trees on roads, 34 damaged buildings, 12 road accidents, 6 vehicles blown over
Eastern Daily Press (19900127d)	Eastern Daily Press, Brave skipper praised for rescue of tug crew, p.3, 27Jan1990d -cars damaged by fallen trees: Normanston Drive, Lowestoft and Durban Road -A12 partially blocked between Lowestoft and Yarmouth
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -number of flights into East Midlands International Airport EMIA cancelled or delayed because of conditions at other airports -4 flights diverted to EMIA from Luton, Stansted, Leeds (2) after planes unable to land there -commuters from Nottingham and Newark trapped in London stations -rail: East Coast Main Line: stopped 25Jan, blocked at Sandy in Bedfordshire -rail: Midland line to Nottingham, overhead power lines came down at Hendon & halted trains -rail: backlog of trains out of St Pancras meant severe delays for Nottingham bound passengers -rail: East Coast Main Line closed in London to Peterborough section -power has not been restored to the line; no electric trains will run -extended delays: likely to be modified train service all day (26Jan); things not being back to normal until 27Jan at earliest -rail: still problems at Hendon but Midlands bound commuters lightly hit compared with southern England where trains cancelled altogether -Allen Linley, inspector: problems started 1600 ->100 calls about fallen trees blocking roads -long delays on A61 Alfreton to Chesterfield road after police set up diversions after M1 closed -northbound M1 closed for 4h as 19 vehicles blown over between junctions 28 and 30 -Nottinghamshire: 3 vehicles overturned between junctions 24 and 27 -M1 reopened at midnight -earlier police had to close carriageway after farmer's shed blew across -Derbyshire police reported 193 uprooted trees & 19 vehicles overturned -tiles blown off Albert Hall in Nottingham -Eastwood, Nottingham Road: police closed road when slates came off building -trees blocked Mansfield Road in Brinsley and Moor Green -road: traffic along A608 at Nether Green, Eastwood delayed when winds toppled tree on road -road: tree fell on road at Moorgreen blocking access to M1
Evening Post Nottingham (19900126b)	Evening Post (Nottingham), Europe - the grim toll grows, p.7, 26Jan1990b (Friday) -Belgium: sea, train, road traffic stopped or seriously hampered
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c FIG. [PHOTO] Winds topple helicopter at Weston-super-Mare Helicopter Museum
Evening Post Nottingham (19900126d)	Evening Post (Nottingham), Traffic chaos in Germany, p.7, 26/01/1990d -storm with violent winds struck W Germany, killing 1 person, overturning cars, telephone poles and trees, blowing off roofs, creating traffic chaos
Evening Post Nottingham (19900126f)	Evening Post (Nottingham), Chaos as gales hit capital, p.8, 26/01/1990f -all mainline rail stns closed except Victoria with limited service; Underground disrupted -police closed Waterloo Bridge after bus overturned -British Rail urged commuters not travel but stay in London
Evening Post Nottingham (19900126h)	Evening Post (Nottingham), Britain takes a battering, p.8-9, 26/01/1990h FIG. [PHOTO] The scene on the Severn Bridge, which was closed to traffic when a lorry overturned FIG. [PHOTO] Crashed lorries litter the M2 at Rochester, Kent. The motorway was closed bringing traffic chaos to motorists FIG. [PHOTO] A lorry which jackknifed on a roundabout crossing the M4 near Bristol FIG. [PHOTO] A blown-over lorry blocks Waterloo Bridge in central London
Evening Post Nottingham (19900126l)	Evening Post (Nottingham), Thatcher's Storm Horror, p.1 and 19, 26/01/1990l -ports returning to normal after stopping all sailings while storms raged -commuters brought cars to London on 26Jan causing traffic jams; many streets already closed fom falling trees, unsafe buildings, scaffolding -sections of motorway, particularly M25 closed because of abandoned vehicles
Financial Times (19900126a)	Financial Times, 27 dead as gale winds sweep across the Channel, 26 January 1990a -ferry traffic impacted; 100s thousands people without power in UK and northern France -Netherlands: several people injured, most outgoing flights from Schipol cancelled
Financial Times (19900126b)	Financial Times, Violent storm cuts road and railway links (contributors Richard Evans & Jimmy Burns), p.6, 26 January 1990b -all ferry services suspended at Dover and other Channel ports -planes diverted from 3 London airports (Heathrow, Gatwick, Stansted); Bristol airport closed -UK trains at standstill in many parts of country; London commuters hard hit -central London stations closed completely: Waterloo, Euston, Marylebone, Fenchurch Street -no suburban rail services -London Transport bus services suspended after bus blown on side on Waterloo Bridge -some underground services suspended temporarily -some major roads in City and West End closed by Met Police

	-ambulance workers suspended industrial action -severe disruption of motorways throughout country
Herald Express (19900126a)	Herald Express, Clean-up will cost millions, p.1, Friday, 26January1990a -Devon county council to pay 50-300k GBP for clearing 130 roads that had to be closed
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -trucks blown over, -in Randstad, 20000 cars in 300km queue -most highways driveable at 0400 -on motorways 130 trucks and caravans blown over -Moerdijkbrug and Beneluxtunnel closed until late in night from towing work -Dutch railways register 40 broken overhead wires in Randstad -train travel in this part of the country impossible -between Utrecht and Amsterdam, 100s meters overhead line brought down -this morning still 3 sections of track closed; back to normal in course of day -everywhere in country roads and motorways cordoned off -commuters delayed for hours -bridges closed -boats stayed in harbour, ferries did not run
Het Vrije Volk (19900126b)	Het Vrije Volk, Schade is groter dan door aardbeving, p.5, 26/01/1990b -London public transport stopped -buses, metro, trains stopped; flights stopped -ambulance service with 300 calls per hour
Het Vrije Volk (19900126c)	Het Vrije Volk, Storm-doden vielen vooral in 't verkeer, p.5, 26/01/1990c -Moerdijkbrug: impassable -Zeeland: all bridges, dams, viaducts, dikes closed for all traffic
Huddersfield Daily Examiner (19900126a)	Huddersfield Daily Examiner, Insurers fear 1 billion GBP storm chaos claims (contributor Neil Atkinson and Chris Lever), p1, 26Jan1990a. (Friday) -train services delayed & cancelled last night; Huddersfield services should be back to normal 26Jan1990 -police warned blizzards & high winds affecting M62 above Huddersfield; no restrictions were in force
Huddersfield Daily Examiner (19900126c)	Huddersfield Daily Examiner, Fierce gales cause chaos, p7, 26Jan1990c. (Friday) -box lorry parked at Lindley Moor Road blown across road into trees -vehicles blown over on M62 at Clifton and near Windy Hill; by 19:00 at least 15 lorries toppled -Huddersfield fire fighters on road for hours dealing with incidents -Chain Road at Slaithwaite: blocked for hours when large shed destroyed and blown into road -several minor roads were blocked by fallen trees -motorway signs on M62 & M1 put out of action; motorways remained open -AA dealt with 4863 calls in northern region; normal day about 3000 calls -many drivers reported electrical problems because of rain and snow
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -ports returning to normal after stopping all sailing while storms raged -Hamburg ferry due into Harwich/Essex this morning after nearly 24h moored offshore in high winds -road chaotic situation; rail services improving -many commuters expected disrupted services following delays home evening 25Jan and took cars to work morning 26Jan and brought London to virtual standstill -appalling congestion made worse by streets closed by fallen trees, unsafe buildings, scaffolding -many sections of motorway closed because of abandoned vehicles; particularly M25
Huddersfield Daily Examiner (19900126e)	Huddersfield Daily Examiner, Storm death toll rises to 71, p7, 26Jan1990e. (Friday) -Holland: disrupted rail, air, and road traffic
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -Humberside airport shut at 1910 25Jan for rest of night; wind speeds of 98mph -Humber Bridge closed to high-sided vehicles; 2 vans blown on side -east coast main line: debris on tracks between Doncaster and Kings Lynn
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -Wales: damaged power lines leave thousands of homes without electricity & fallen trees closing some roads -Britain: roofs ripped off homes, trees toppled, aircraft blown off runway -London Heathrow: empty Boeing 747 veered off taxiway & became stuck in mud as it was being towed to maintenance area -Scotland: heavy snow blocked roads in near blizzard conditions; 3 people killed in car accident -high winds disrupted shipping in English Channel -cargo ferry unable to dock at Poole -helicopters unable to take off to help Celtic Navigator in Scilly Isles; ship listing when timber cargo shifted -Dover Harbour Board & ferry companies operating from port suspended all shipping movement -Dept of Transport reports: Shorts 360 G-OLGW, operated by Capital Airlines Ltd; passengers disembarked and plane blew over by wind at Lulsgate airport Bristol; no injuries to crew on 3 still on board -lorries overturned in wind -Cornwall to Wales, Midlands, NE England transport in chaos; railway stations closed, roads blocked by trees -Roro ferry St Nicholas: left Harwich for Hoek of Holland with 150 passengers; headed back to Harwich after weathering storm for 10h -London: many commuters in capital stranded when all but one of main rail stations closed -rail commuters in southern England faced more delays and disruption after yesterday's gales -engineers worked all night to clear trees from lines -British Rail said most main line services working again this morning; rolling stock in wrong places; storm

	damage to power supplies causing disruption -Waterloo worst hit of mainline London stations; 5 of 21 platforms open; checks carried out on damaged glass roof -Netherlands: record winds caused millions of dollars of property damage across country, halted trains & overturned trucks -Netherlands: state police closed off highways where at least 100 trucks had been blown over -Germany: shipping disrupted -Germany: streets & bridges had to be closed -West German railroad company forced to suspend operations in some areas -Denmark: falling trees blocked roads -channel ferry services returning to normal & airports resumed operations after day of chaos -Schleswig-Holstein: several roads closed due to fallen trees, roofs of houses damaged - Schleswig-Holstein: smaller inner ferry services stopped - Schlewig-Holstein: Puttgarden-Rodby train ferry stopped - Schleswig-Holstein: Brunsbuettel locks stopped working due to high water level in Elbe
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -ferry services around Britain returning to normal after near hurricane force winds brought them to standstill -no French Sealink service between Newhaven & Dieppe; Chartres broke down mid-Channel, regained engine power, but hit ramp as it entered French port; other vessels could not operate service -Brittany Ferries services to France & Spain from Portsmouth back to normal after being suspended -North Sea Ferries services from Hull to Rotterdam & Zeebrugge 2 hours late in reaction to yesterday evening when vessels delayed by up to 4h to allow weather to abate -flights cancelled at Sweden Malmo airport -ferry services cancelled across Baltic sea as storm approached S Scandinava -BBC: fresh winds toppled trees & blocked roads in several places in Devon
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -Bradford-on-Avon: train derailed by debris on line -from Cornwall to Scotland, transport in chaos; airports & rail stations closed; trees block roads -many London commuters stranded when all but one main rail stations closed
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -London at virtual standstill as air, bus, subway, and train services halted -British Airways suspended flights from Heathrow airport -ferry services suspended across English Channel -ferry services disrupted between Scotland and Northern Ireland -Friday: commuters faced long delays getting to London; many trains cancelled & delayed -major highways open; some routes still blocked by trees -Belgium: sea, train, road traffic halted or seriously hampered -some highways like M25 around London blocked by overturned trucks
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -storm lifted off building roofs, blew over trucks -transport, communications, electricity distribution severely disrupted
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) -workman taken to hospital after 20ft wall crashed on car beneath Rochester bridge -M2 bridge closed after 8 lorries blown over by the gale yesterday morning -one driver slightly injured; police warned it would take 12h to clear wreckage -traffic at standstill most of the day as drivers sought alternate routes -Maidstone and District bus company took double decker buses off route -train services disrupted
The News Chatham-Rochester-Gillingham (19900126b)	The News Chatham-Rochester-Gillingham, Since 1987 hurricane bring havoc, p.11, 26Jan1990b (Friday) FIG. [PHOTO] Motorway chaos, with crashed lorries in the foreground and lorries on their sides further up the M2
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -fallen trees blocked roads in villages: Bowsden Lane in Shorne and Borstal Road in Wouldham\ -long delays for commuters in Southern Region -Victoria and Charing Cross stations kept open; trains to Medway towns running slower -British Rail staff worked throughout day clearing lines blocked by trees & rubbish -number of trains cancelled at height of storm in afternoon due to power faults -Southern Region advised passengers to avoid catching trains; risk of stranding between stations
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -public transport completely closed last evening restarted in the morning -Nederlandse Spoorwegen that trains will be back to normal -3 rail lines still closed -storm destroyed overhead train power lines in 41 places -air transport: Schipol functioning normally in morning 26Jan -approx 80 flights cancelled 25Jan -regional transport functioning normally in morning -buses had been recovering train passengers deep into night -dozens of passengers spent night in special centers near stations in Amsterdam, Rotterdam, Utrecht -different motorways in SW part of the country closed to all traffic
NRC Handelsblad	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f

(19900126f)	-during period of storm Algemene Verkeersdienst of Rijkpolitie in Driebergen 130 freight trucks, caravans, trailers were toppled -from the service 121 accidents were reports and by the alarm service there were 300 requests to recover wrecks -toppled trees and lightpoles cut national highways in 116 places -Stena Line ferry service from Hoek van Holland to Harwich suspended sailing of St Nicolaas from Hoek of Holland -over 20 years there were only 1 or 2 times when the ferry was cancelled -from Harwich the boat was delayed from 02:15 to 5 -earlier in the day the mid-day ferry sailed across channel but returne to port of origin; it was was not safe to cross the channel -Northsea Ferries and Olau Line suspended their services yesterday evening but presently on schedule, explained Van de Marel
Perthshire Advertiser (19900126)	Perthshire Advertiser, Snow Chaos Hits Roads (contributor Graeme Giles), p.1, 26/01/1990 -Perth almost cut off 25/01/1990 with blizzard conditions across Tayside -mid-morning M90 motorway & A9 north impassable -stranded trucks littered approaches to Cairnie Braes -police advised motorists to stay clear of A85 Perth-Dundee dual carriageway; jack-knifed lorries
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -1000s homes without electricity; chaos on road & rail -huge seas English Channel -80 passengers + 50 crew of French SNCF ferry Chartres (Newhaven-Dieppe) spent hour drifting without power until engines restarted -London traffic stopped when road & rail bridges over Thames closed -British Telecom: London telephone network jammed by 100% increase in calls -dozens roads sealed off in London -at height of storm, London Ambulance Service receiving 300 calls/h -closed roads -whole length of M4 hit -Severn Bridge closed for only 3rd time in 23 year history -M5: 50 miles of motorway Avonmouth-Taunton Somerset closed by blown over lorries
Press and Journal (19900126b)	Press and Journal, Blizzards cause road chaos (contributor Steve Stewart and David Steele), p11, 26Jan1990b. -scores of roads in North and Central Scotland blocked yesterday 25Jan1990 and dozens of schools forced to close early when blizzards covered the country -closed roads -A9 Perth-Inverness road closed at Drumochter -A82 Glasgow-Fort William road closed at Glencoe -A828 Fort William-Oban road open -A85 Oban-Tyndrum road passable -Grampian roads -A939 Cockbridge-Tomintoul road closed -A940 Forres-Grantown road closed -B977 Banchory-Fettercairn road closed -B9009 Dufftown-Tomintoul route not advised -other major Highland roads closed -A93 Perth-Braemar route at Glenshee -number of minor routes closed -rail services Scotland mainly unaffected; slow services Drumochter because of snow -all cross border overnight trains cancelled last night
Stirling Observer (19900126)	Stirling Observer, Blizzard chaos hits motorists (contributor: Fiona Wilson), p.1., 26Jan1990 -Stirling thrown into chaos yesterday (Thursday); first winter blizzards caused town to stop -in north, all routes beyond Stirling blocked -Jim Brown, deputy directory of roads: all equipment out since early Wednesday morning -sheer severity of snowfall this morning incredible -Collander: police used landrover to ferry nurses to patients needing daily visits -Belfron: almost cut off from rest of district as minor roads became impassable -West Stirlingshire: schools amongst 1st to close -AA in Glasgow: gave info all roads in Stirling area badly affected by snow; A9 blocked north of Dunblane -roads in Dunbartonshire particularly badly affected
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -Protection service Steffisburg also on mission: they had to clear cracked off trees from roads to Fahrni and Rachholtern and in the area Brandlisberg
The Times (19900126a)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990a (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -cross channel ferry with 130 people drifted helplessly -all of London's mainline termini closed at some stage afternoon 25Jan for roof safety check -even when reopened there were no or limited services because of damage to power lines -Motorways M4, M40, M5 closed mainly as result of lorries overturning -Severn Bridge closed for 3rd time in history -M27 near Gosport in Hampshire 4 lorries on sides -northbound carriageway of M1 in Bedfordshire & Buckinghamshire had to be cleared repeatedly

	-M25 closed near Heathrow -SNCF ferry Chartres from Newhaven to Dieppe lost power mid-channel for 1 hour -ferry sailing & hovercraft services suspended; some ships riding out storm at sea
The Times (19900126c)	The Times, Heavy weather sweeps coast, 26/01/1990c (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -FIG1. [PHOTO] A crushed lorry which spilt its load onto the A38 below, near Plymton in the South-west
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -Daria blizzards caused road problems in Scotland -AA: many roads Scotland affected by blizzards & drifting snow -Dumfries to Edinburgh road: snow 5 feet deep -Sanquhar to Wanlockhead road at Dalveen Pass blocked -Highlands: 300 men and 150 lorries with ploughs & blowers battled to keep roads clear -police closed snow gates -Cockbridge to Tomintoul road blocked -roads elsewhere in Scotland cleared as thaw set in -major routes in England cleared of storm damage; chaos in London yesterday with Embankment blocked because of a dangerous building -snow in Bristol area yesterday morning; driver problems compounded by motorway tel not working -rail services slowly returning to normal -many cancellations and delays in Southeast and East Anglia because of power failures -all London stations fully operational except Waterloo
The Times (19900127c)	The Times, Commuters fighting against all odds on the morning after (contributor Kevin Eason), p.3, 27Jan1990c -1000s commuters took their cars into London in belief that train services not running -trains & drivers stranded in rong direction; train schedules greatly disrupted -lane closures on motorway with abandoned vehicles; many on side -London roads jammed from 0800 to noon -people arriving at offices 2-3h late -Embankment and Upper Thames Street closed as workers tried to shore up dangerous buildings/tree -most train services back to normal last night -BR: only East Coast main line to northern England still had problems with tree on line near Sandy, Bedfordshire -some line subject ot speed reductions -Waterloo worst hit of main London stations; only 5/21 platforms open while checks done on glass roof.
The Times (19900127f)	The Times, Airline pilots fly in face of 'hurricane' (contributor Harvey Elliott), p3, 27Jan1990f -25Jan1990: total of 447 aircraft landed at Heathrow; passengers sick in turbulence -Captain Bill Lawrence landed Boeing 757 at Heathrow twice -plane could have landed in winds 50% higher -more fuel taken on plane for holding pattern above destination or diversion -wind 23000ft above Lydd Kent steady at 130kt -as aircraft descended through 11000ft wind dropped suddenly, causing turbulence -at 7000ft wind dropped again; constant wspd <90kt with sudden higher gusts -autopilot disengaged at 2000ft; autothrottles at 1500ft; relative smooth landing -we would not have attempted a landing with any hint of danger
Times (19900129a)	The Times, Floods and new gales ahead (contributor Ray Clancy), The Times, 29Jan1990a. -heavy snow blocked many roads yesterday & gusts to 60mph in coastal areas -problems with damage repair including power lines -snow brought down several electricity pylons & blocked roads N Wales, Cumbria, Derbyshire
Walliser Bot (19900127)	Walliser Bot, Schweiz von groesseren Sturmschaeden weitgehend verschont mit 170 km/h, 27Jan1990 (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -toppled trees led to power loss in different places some streets closed
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -London: no buses, trains, metro, all flights shut -ferry Chartres without power with 130 people (source: 022. VLK26-1: Tientallen doden door noodweer in West-Europa) -6-lane M25 blacked by toppled trucks -damage to London parliament building roof -mid-sized passenger aircraft at Lulsgate Bristol flipped; Heathrow Boeing 747 pushed off taxiway -Chartres ferry lost power in channel; returns to Dieppe (source: 026. NRC26-1 vrijdag 26 januari 1990 (NRC Handelsblad): Vrachtverkeer reed door ondanks oproep) -Stena Line ferry St. Nicolas between Hoek van Holland and Harwich cancelled; 1 of 2 times in 20y -Northsea Ferries and Olau Line cancelled services yesterday evening -Tilburg: broadcasting mast toppled (source: 027. NRC26-1: Zwaarste windstoten na 1944) -map of rail network disruptions
Buller (1993)	Buller PJS, The gales of January and February 1990: damage to buildings and structures, Building Research Establishment Report, Building Research Establishment, Garston, Watford, WD2 7JR, 24 pp, 1993

	-fallen trees & overturned vehicles blocked roads & made motorways hazardous -disruption of electricity supplies brought railways to standstill
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -peak of Daria when many people on way home from work -railway system blocked completely from many broken wires and fallen trees -4500 train travellers stranded for night -road traffic brought to virtual standstill at height of storm -few reacted to Public Traffic Service to stop all traffic -shipping sector reacted adequately to weather forecasts and impacts very small -damage to airplanes and buildings at Schipol 5mill Dfl
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -1000s trees felled in Kent & countless roads blocked -razor sharp roof panels danger on A20 at Bearsted when they became airborne
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -roads, tracks, motorways blocked -2 trains derailed & power lines disrupted
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -significant damage to buildings & enormous damage to infrastructure-transport-electricity supply (Zou et al, 2008)
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -train derailed in Hessen -damage to terminal of Koln-Bonn airport; apron had to be closed -snow storm in N part of country with massive traffic blockage -on the coast several ships in emergency -ferry traffic in English channel & Scotland-N Ireland routes suspended
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) BLOCKED ROAD Location LA Latitud Longitu Date Day Time Uncertainty ND --- Lauwil Basel-Landschaft CH 47.39 N 7.67 E 25-01-1990 thu 21:00 UTC (+/- 6 hrs.) Road(s) impassable or closed Hubbelrath Nordrhein-Westfalen DE 51.27 N 6.92 E 25-01-1990 thu 16:30 UTC (+/- 15 min.) roads blocked Ostentrop Nordrhein-Westfalen DE 51.20 N 8.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) road blocked Stahe Nordrhein-Westfalen DE 50.98 N 6.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) road blocked Parkstein Bayern DE 49.73 N 12.07 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) roads impassable
KNMI (2023)	KNMI, Zwaarste storm in decennia, undated internet page, last access 30Aug2023 https://www.knmi.nl/kennis-en-datacentrum/uitleg/zwaarste-storm-in-decennia -Schipol airport was prepared early -road and train traffic fully stopped from fallen trees -thousands commuters spent night at places where trains stopped
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -traffic cut in many places: N13, Tancarville bridge -ferries suspended across English Channel -number of ships in difficulty across Bretagne and in English Channel
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 -UK: trees covered roads making them impassable -UK: transports like trains and ships rendered unusable FIG. [PHOTO] in Hesse, West Germany the strong winds caused debris to line train tracks, leading to derailments

Table SL62. Structural damage to wind farms and wind energy impacts (arranged by year and then alphabetically)

Source	Full Reference and Notes
Jensen and Winther-Jensen (1990)	Jensen, P.H. and M. Winther-Jensen, 99% af moellerne velbeholdne igennem stormen 25. januar, Naturlig Energi, 12, 6, Marts 1990 -Test station received reports of 8 damaged mills from 25Jan; 3 totally destroyed, 5 with less damage -descriptions below -no reports of human or animals hurt

	-total loss at 1 permille of total mills in Denmark in operation for 1989-90 or 2700-2800 -in addition there were following operational irrgularities (1) cracks in back edge of LM-17 meter blades of Bonus 300 kW and Bonus 450 kW mills (2) blade brakes on front edge thrown off 150kW Vindsyssel windmill at Klinteby (3) a KL-13 meter blade cracked on on Nordex 150 kW at Veijle and hit the tower (4) a Vestas 55 kW at Skjern running free with air breaks fully activated/half-activated/ not activated; turbine lost nacelle cover (5) Bonus 95 kW lost turbine cover under normal operation
Lund and Lund (1990)	Lund, Maj-Britt and Steffen Lund, Der Blaest en Storm, Naturlig Energi, 12, 6, Marts 1990 keywords: Storm Daria 25-26Jan1990, turbine collapse description
Naturlig Energi (1990)	Naturlig Energi, Vindproduceret El (contributed by B. Groning, M. Koch, W. Canter, T. Moller), pp. 16-32, Mar, 1990. -tabulated summary of operations information for 1700 turbine sin Denamrk for Jan 1990 with remarks section giving storm impacts, related mostly to Storm Daria

Table SL63. Hydropower impacts (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL64. Structural damage to buildings, piers, and cultural monuments (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -buildings collapsing -Newhaven Sussex: children evacuated from 3 story building as cracks appeared in walls -Pounds Hill in Sussex: teacher led children to safety minutes before building toppled over
Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -100s schools closed throughout country because of wind damage or lack of heating ->200 people spent night in emergency accommodation after storm damaged roofs of 75 flats Cradley Heath near Birmingham
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -Buildings had roofs blown off -at another airport; air traffic services broke down completely when window of control tower shattered by flying debris
Derby Evening Telegraph (19900126a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -Derbyshire fire service had 230 storm-related calls; 161 incidents involving damaged buildings
Derby Evening Telegraph (19900126b)	Derby Evening Telegraph, Winds havoc round-up, p1, 26Jan1990b. -massive beech tree falls on Tupton Hall school near Clay Cross 30 min after pupils left
Derby Evening Telegraph (19900126c)	Derby Evening Telegraph, Thousands of homes blacked out (contributor Lana Montgomery), p.3, 26/01/1990c -Tupton Hall School near Clay Cross damaged by massive beech tree falling -large sections of roof torn off Ripley Junior School by gale -Chesterfield Football Club Saltergate ground damaged; part of rood of main stand blew off
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -2 girls killed in separate accidents at schools: -Grange Junior School, Lower Stratton, Swindon, Wilts: 1 girl killed, 4 injured -St Brandon's girls school, Clevedon, near Bristol: 1X16y girl, 9 injured; masonry in conservatory -roof blown off Torquay United Plainmoor Ground -football stands damaged in Ninian Park (Cardiff?) -Chesterfield Saltergate football ground damaged -Royal Botanic Gardens at Kew lost 100s panes of glass in 80mph gusts; lost at least 100 trees
Eastern Daily Press (19900126c)	Eastern Daily Press, Rescue death PC is praised, p.1, 26Jan1990c. -little girl died & 4 others injured when roof blown off school in gale-force winds -Grange Junior School, Lower Stratton, Swindon, Wiltshire -school at Clevedon near Bristol; conservatory collapsed; girl aged 15 died
Eastern Daily Press (19900126d)	Eastern Daily Press, Europe lashed, p.2, 26Jan1990d. -West Germany: roofs blown off
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -London Liverpool Station: roof blew off; Intercity trains from Norwich stopped at Colchester -Magdalen Street: shop front torn from two stores at lunchtime
Eastern Daily Press (19900126i)	Eastern Daily Press, Lucky escape for driver, p.3, 26Jan1990i -driver narrowly escaped serious injury Sheringham -large section roof at Sheringham Ex-Servicemen's Club, Holway Road blown off -John Warrington, driver, trapped briefly after Sierra car roof partly crushed -light injury -section of destroyed roof also damaged a number of cars opposite on Sheringham Garage forecourt
Eastern Daily Press (19900126j)	Eastern Daily Press, Woman trapped by roof collapse, p.3, 26Jan1990j -woman trapped for 3h when roof caved in on her top-storm flat -Kimberley Terrace, Yarmouth
Eastern Daily Press (19900127b)	Eastern Daily Press, At least 40 die in North Europe, p.1, 27/01/1990b. -Sweden: roofs ripped off houses & trees snapped

Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -122 emergency calls to Norfolk police: 76 trees on roads, 34 damaged buildings, 12 road accidents, 6 vehicles blown over -100y old cedar fell through roof of hostel for young offenders Bridewell building, Wymondham
Evening Post Nottingham (19900126a)	Evening Post (Nottingham), Havoc in Notts, p1 and p7, 26Jan1990a -tiles blown off Albert Hall in Nottingham -Stanton-by-Dale: tree crashed onto a house
Evening Post Nottingham (19900126b)	Evening Post (Nottingham), Europe - the grim toll grows, p.7, 26Jan1990b (Friday) -number of buildings damaged, some completely destroyed; houses, schools, sport stadia, plants, farms -wind reached peak 105 mph toppled roofs, church & power towers, power lines, walls, billboards, chimneys, Fences
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c FIG. [PHOTO] A school roof blown off at Stockbridge buries a teacher's car FIG. [PHOTO] Family had lucky escape when a tree flattened car minutes after they got out ... sales representative Andrew Bird had a near miss when the roof blew off two industrial units at Brookside Road, Ruddington and narrowly missed hitting him FIG. [PHOTO] Crumbling walls at house in Southampton leave rooms exposed to the elements
Evening Post Nottingham (19900126d)	Evening Post (Nottingham), Traffic chaos in Germany, p.7, 26/01/1990d -high winds tore off roof from Felde train station, near Luebeck -roofs stripped from several homes in Luebeck
Evening Post Nottingham (19900126h)	Evening Post (Nottingham), Britain takes a battering, p.8-9, 26/01/1990h FIG. [PHOTO] This huge tree was plucked out of the ground by the gale-force winds and crashed into Tadstone House, near Exmouth, Devon (residence) FIG. [PHOTO] A gust took off the roof of this building in Bristol (residence) FIG. [PHOTO] The main stand at Torquay's soccer ground - left without a roof
Evening Post Nottingham (19900126j)	Evening Post (Nottingham), Pupil dies as roof blown off, p.8, 26/01/1990j -Grange Junior School, Swindon, Wiltshire: 10y old died and 4 pupils injured when gale winds ripped roof off school -St Brendan's girls school, Clevedon, near Bristol: girl died when conservatory collapsed, 4injured
Evening Post Nottingham (19900126l)	Evening Post (Nottingham), Thatcher's Storm Horror, p.1 and 19, 26/01/1990l -many people made homeless housed for the night by the Army -Cavalry barracks in Hounslow, West London, 31 local residents accommodated -200 people spent night in emergency accom after storm damaged roofs of 75 flats at Cragley Heath, near Birmingham
Freiburger Nachrichten (19900127)	Freiburger Nachrichten, Vor allem Daecher erlitten Schaden, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG. [PHOTO] storm damage in Huberli Quartier in Giffers: storm winds took off roof of family house [credit: G. Bielman] -the quarter Huebeli in Giffers wind took off roof and framing from a family house and blew it several meters away near high point of storm around midnight
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -roofs taken off houses, church towers damaged, -greenhouse damage at millions of guildens damage cost -Weena in Rotterdam: brand new 150m office building of Nationale Nederlanden RVS; fear that building would collapse -central part of city encompassing Weena, Coolsingel, Hofplein, Pompenburg closed until 21:15
Het Vrije Volk (19900126c)	Het Vrije Volk, Storm-doden vielen vooral in 't verkeer, p.5, 26/01/1990c -glass installations (greenhouses) appear to be the hardest hit -Hagelunie, largest company for agricultural insurance, assessed damaged at several 10s mill guldens -postal services in Rotterdam shut down by storm -people in the Europoint building at Marconiplein in Rotterdam evacuated -pieces of stone fulled from walls -cyclists far from the building wounded by glass shards -workers in the highest floors of the WTC building on the Coolsingel sent home earlier after becoming nauseous in the swaying building -complete chaos at the Hofplein at rush hour -building material flew over Weena; all traffic diverted -passeersby watching the swaying construction cranes on the Weena -they turned like sind cocks on church steeples but remained standing -one construction crane collapsed -Graan Elevatoren Maatschappij (GEM): two grain elevators collapsed
Huddersfield Daily Examiner (19900126c)	Huddersfield Daily Examiner, Fierce gales cause chaos, p7, 26Jan1990c. (Friday) -shop windows blown out in town centre and Aspley; scaffolding had to be taken down -roof yarn shed lifted off at William Oddy's mill at Lockwood -Quarry Road, Crosland Hill: garage blown across road -Chain Road at Slaithwaite: blocked for hours when large shed destroyed and blown into road -Kirkheaton, Waterloo Road: new building being built by British Gas badly damaged
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -damage ran into 100s millions of pounds; trees on buildings and cars; walls/roofs demolished -appalling congestion made worse by streets closed by fallen trees, unsafe buildings, scaffolding (London) -many people made homeless housed for the night by the army

	-hundreds of schools throughout country because because wind damage made them dangerous or lack of heat -more than 200 people spent night in emergency accommodation after storm damaged roofs of 75 flats at Cradley Heath near Birmingham
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -Orchard Park Estate, Hull: corrugated iron ripped of garage roofs -North Hull: pigeon loft lifted off blocks into Barmston Drain -fallen trees, crashed chimney stacks, flattened walls
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -Mullion, Lizard Peninsula, Cornwall: roof blown off Polurrian Hotel & 8 people trapped -Devon: roofs blown off 3 county schools -Britain: roofs ripped off homes, trees toppled, aircraft blown off runway -Waterloo worst hit of mainline London stations; 5 of 21 platforms open; checks carried out on damaged glass roof -Netherlands: hundreds of people injured by uprooted trees, toppling chimneys & flying roof tiles -northern Germany: strong winds caused extensive damage to buildings -a gas drilling tower collapsed in northern Germany causing 1.5DM damage but injuring no one -Belgium: winds gusting up to 100mph yesterday toppled at least 3 church steeples & several high tension masts -UK: storm wrecked buildings & tore down power lines -UK: 200 people spent night in emergency shelters after roofs blown off houses -UK: 2 schoolgirls killed & several children injured when school roofs collapsed -storm hit Sweden during the night, ripping roofs from houses & snapping trees -Schleswig-Holstein: several roads closed due to fallen trees, roofs of houses damaged
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -NETHERLANDS: storm sparked fire at luxury hotel in Noordwijk; 3 firemen died in blaze -NETHERLANDS: much damage to Holland's extensive horticulture industry; many greenhouses reduced to metal skeletons & shattered glass -Belgium: at least 3 church steeples blown down -Hago-Unie (80% of market) said 40-50% of growers affected and some total losses -Manager Kees Geertsma: across country glass damage could reach 1250 mill florins -market gardeners fear crucial indirect losses with millions of seedling and bulbs at risk from cold weather -Rotterdam: 2 cranes collapsed in Mervehaven -storm swept across Denmark; extensive damage to property, serious flooding, but no loss of life on land -considerable physical damage especially in southern areas Jutland & islands -storm 25Jan1990 caused most damage to Britain -gusts > 100mph blew down rows of trees, deroofed buildings, swept vehicles from roads -pictures broadcast from Constock village in Cornwall; large landslide caused wall to collapse; 25 residents evacuated
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -by 1200 on 26Jan 960mb low moved across Sweden; roofs taken off houses & trees snapped
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -UK: rain came through wind damaged roof of parliament -reactor chimney blown down at Paluel nuclear power plant in France -Electricite de France said plant was shut down immediately & monitored for hazards
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -storm lifted off building roofs,
The News Chatham-Rochester-Gillingham (19900126a)	The News Chatham-Rochester-Gillingham, Storm Terror, p.1 and p.10, 26Jan1990a (Friday) -workman taken to hospital after 20ft wall crashed on car beneath Rochester bridge -several schools closed as wind ripped away roof tiles; children throughout Medway sent home early -Firemen dealt with 100s calls; most problems from fallen trees & tile and debris flying off buildings -an empty house in William Road, Cuxton, lost the whole gable end of roof; no one injured -Rochester High Street closed to traffic because lead cladding from British Gas building in danger of falling -schools with damaged roofs: Twydall Junior, Holmsdale High in Snodland (barn also destroyed), St Mathews Borstal
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -pupils evacuated from Upbury Manor School, Gillingham, when windows blown out in gale -Headmaster Ian Gliddon made decision to get children out of top classrooms shortly before windows shattered, showering tables and chairs with shards of glass -gusts buckled internal walls of school, in Marlborough Road & ripped down aluminum sheets -Ropery building in Chatham Historic Dockyard: pieces of leead blown off
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -reports of serious damage to houses, greenhouses, churches, businesses across country -in some places in Westland all greenhouses destroyed
NRC Handelsblad (19900126d)	NRC Handelsblad, Miljoenenschade in Rotterdamse haven, p.2, 26/01/1990d -at the Fruitterminal Rotterdam FTR, 40m crane collapsed; crane ran over rails in direction of our office when it ran 50m, it hit a second crane and both fell -FTR estimates damage at least 1.5 million guldens -in Europoort grain elevator ov Grainwave fell on an elevator of competing company Graan Elevator Mattschappij GEM. GEM elevator completely unusable. New cost price 10-12 million guldens; spokesman said elevator insured

NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -in flatland the storm caused a lot of damage -'s-Graveland: fallen beech destroyed historic building that was being used by NOS for a Sunday discussion program Het Capitool -Tilburg: collapse of transmission mast of local broadcaster -Rotterdam: Spangen stadium of Sparta football club was destroyed -Delft, Den Haag, Waalwijk, Zevenaart: church roofs damaged -Borne and Tilburg: sheds in which caravans were stored collapsed
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -2 girls killed at separate incidents at their schools -roof came off 3 classrooms at Grange Junior School, Lower Stratton, Swindon, Wilts; falling debris killed 1 girl, injured 4 others -St Brandon's girls school, Clevedon, Near Bristol; 1 16y killed & 9 injured by masonry through conservatory at lunchtime
Thuner Tagblatt (19900127a)	Thuner Tagblatt, Sturm fegte ueber die Region: Hauser abgedeckt, 27Jan1990a (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -in the community Schwarzenegg roofs of several houses were ripped away or strongly damaged -FIG1. [PHOTO] this industrial building in Gemeinde Uebeschi was damaged twice by storm winds; first on the outside and later in the area of the entrance; in front of the building the wind hurled building pieces. (credit: Werner Hostettler)
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG1. [PHOTO] at this house in Schwrazenegg a part of the roof (on the ground in the middle of the picture) was blown away. An emergency roof was placed during the night -FIG2. [PHOTO] this house at Rachholtern destroyed by fir tree -schulhouse Brucheren roof had to be covered; an emergency roof had to be placed on a house near the church -industrial building of the council Haeberli in Gwerdi in Gemeinde Ubeschi damaged twice by wind -Peter Haberli to TT: storm wind from west took off part of the roof, then wind turned and hit from Oberland
The Times (19900126a)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990a(clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Parliament: rain came through roof & masonry in central lobby -Grange Junior School, Swindon: 11y old girl killed, 2 injured -St Brandons School, Clevedon, near Bristol: 16y old killed & 4 injured
The Times (19900126b)	The Times, Britain at bay in the eye of 'hurricane', p.3, 26/01/1990b -FIG1. [PHOTO] Damage in Prince Regent Lane, Canning Town, east London, after strong gales brought down scaffolding, crushing parked cars
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -major routes in England cleared of storm damage; chaos in London yesterday with Embankment blocked because of a dangerous building
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -Polorrian Hotel in Mullion one of first properties in Britain to be damaged; 8 people trapped in hotel which was deroofed -Keith Willey, Mullion resident, said fiercest wind in 38 years; many buildings lost roofs -Building Employers Confederation: many millions GBP damage to buildings under construction -suspended construction work during Daria at Canary Whar, Olympia & Yorks's multi-million-pound project on Isle of Dogs in London Docklands
The Times (19900130)	The Times, Floods and gales bring more chaos (contributor John Young), 30 Jan 1990. -landslip: Cornwall at Higher Kelly near Calstock caused by falled garden wall
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 001. NRC26/1: Zware storm kost 19 mensenlevens) -greenhouse damage at 50-100 mill gulden cost (source: 005. NRC 26-1: Drie leden bradweer omgekomen) -3 firefighter deaths in hotel blaze Huis der Tuin in Noordwijk (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -Paleul nuclear reactor 20m chimney collapses -Charleroi Belgium: tower of 18th century church collapses -Hannover: 3 wolves escape from zoo (source: 022. VLK26-1: Tientallen doden door noodweer in West-Europa) -electricity masts collapsed S England; houses deroofed; damage compared to 1940 Blitz -damage to London parliament building roof (source: 024. VLK26-1: Duizenden Nederlanders blijven steken op wegvan werk naar huis) -collapse of construction crane as Schipol (source: 026. NRC26-1 vrijdag 26 januari 1990 (NRC Handelsblad): Vrachtverkeer reed door ondanks oproep) -Tilburg: broadcasting mast toppled -Spangan footbal stadium roof collapse, Rotterdam

	-church roof damage: Delft, Den Haag, Waalwijk, Zevenaar -Borne & Tilberg: caravan warehouse collapse
Buller (1993)	Buller PJS, The gales of January and February 1990: damage to buildings and structures, Building Research Establishment Report, Building Research Establishment, Garston, Watford, WD2 7JR, 24 pp, 1993 -reports of building damage over southern half of England and Wales -media reports of many deaths & injuries, following collapse of buildings
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -industrial capital goods and glasshouses damaged by storm -private house damage at top of storm bill (1.03 bill Dfl), followed by commercial buildings 0.38 bill Dfl
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -damage to greenhouse growers 65mill USD
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -North Kent: Fort Luton worst affected school; closed for several weeks -Rochester: Foster family living opposite St. Margaret's church, house damaged by slates -Ashford: >1400 buildings owned by local council damaged -Wye: large chimney toppled at Kings Head Hotel; in 1987 chimney came down completely -Kent County Nursery at Challock devastated. -tallest building Maidstone (9 storey Colman House in King Street) evacuated after occupants claimed it was swaying -wind so strong pedestrian had to cling on to lamposts to stay upright
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -house damage: chimneys and roofs -house flooding: England & western Germany -damage to office buildings, cars, gas pipelines -UK: extensive structural damage across UK -most deaths from collapsing buildings, falling debris & trees, and traffic accidents -Sussex, S England: class of school children evacuated before building collapsed
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -significant damage to buildings & enormous damage to infrastructure-transport-electricity supply (Zou et al, 2008)
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -Nordrhein-Westfalen: numerous houses deroofed -damage to terminal of Koln-Bonn airport; apron had to be closed -damage of lower house of parliament in London damaged & rain came in
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) BUILDING DAMAGE Location LA Latitud Longitu Date Day Time Uncertainty ND --- Birkenheide Rheinland-Pfalz DE 49.48 N 8.26 E 26-01-1990 fri 12:00 UTC (+/- 12 hrs.) damage to property Lauwil Basel-Landschaft CH 47.39 N 7.67 E 25-01-1990 thu 21:00 UTC (+/- 6 hrs.) Damage to roof or chimney Germany DE 52.70 N 8.00 E 25-01-1990 thu 18:00 UTC (+/- 12 hrs.) severe damage to property United Kingdom UK 51.75 N 1.30 W 25-01-1990 thu 12:00 UTC (+/- 12 hrs.) houses damaged and partly destroyed Frechen Nordrhein-Westfalen DE 50.92 N 6.82 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) houses damaged
Waetherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 FIG. [PHOTO] in London, the roof of Waterloo tube station was completely destroyed by Cyclone Daria -UK: buildings damaged by sustained winds 70-75mph with gusts to 104mph

Table SL65. Forest damage and tree falls (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -fewer trees damaged by Daria; in 1987 15 million trees blew down because still had leaves

Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -appalling congestion made worse by many streets closed by fallen trees, unsafe buildings, scaffolding -6 specialist 2 man teams from 40 Commando Royal Marines standing by to help South West Electricity Board engineers removing trees and helping with fallen power lines -Birmingham: 5 weeks before all traces of blown over trees removed
Dannevig (1990)	Dannevig, Petter, Januarstormen 1990 sett i forhold til oktoberstormen 1987, Vaeret, Aargang 14, Nr.1, p.25-26, 1990. -trees uprooted during passage of squall line at Kew Garden -Oct1987 had much more tree damage because leaves were still on the trees.
Derby Evening Telegraph (26Jan1990a)	Derby Evening Telegraph, Storm Devastation, p1, 26Jan1990a. -190 trees toppled
Derby Evening Telegraph (26Jan1990c)	Derby Evening Telegraph, Thousands of homes blacked out (contributor Lana Montgomery), p.3, 26/01/1990c -Tupton Hall School near Clay Cross damaged by massive beech tree falling -large tree blown onto wall in Ripley
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -trees biggest killers during storm; possibly weakened in 1987 -14 deaths from trees falling on cars/vans/lorries -Cardiff suburb of Lakeside: 2month old baby recovered from car wrecked by fallen pine -Royal Botanic Gardens at Kew lost 100s panes of glass in 80mph gusts; lost at least 100 trees
Eastern Daily Press (19900126e)	Eastern Daily Press, Devastation as force 10 gale strikes, p.3, 26Jan1990e. -more than 100 trees fell in county, blocking dozens of roads
Eastern Daily Press (19900126i)	Eastern Daily Press, Lucky escape for driver, p.3, 26Jan1990i -many fallen trees reported temporarily blocking several minor roads Sheringham -numerous trees fell around Dereham blocking side roads
Eastern Daily Press (19900127a)	Eastern Daily Press, Storm death toll 46 as Britain clears up, p.1, 27/01/1990a. -Forestry Commission: at least 3 million trees fell on Thursday -worst affected areas in southwest, but Wales and eastern England also affected
Eastern Daily Press (19900127c)	Eastern Daily Press, Norfolk counts the cost as clean-up starts, p.3, 27/01/1990c -Norfolk: >100 trees fell, power lines brought down, dozens of roads blocked -122 emergency calls to Norfolk police: 76 trees on roads -100y old cedar fell through roof of hostel for young offenders Bridewell building, Wymondham
Eastern Daily Press (19900127d)	Eastern Daily Press, Brave skipper praised for rescue of tug crew, p.3, 27Jan1990d -in Waveney area about 45 trees felled by winds
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c FIG. [PHOTO] Family had lucky escape when a tree flattened car minutes after they got out ... sales representative Andrew Bird had a near miss when the roof blew off two industrial units at Brookside Road, Ruddington and narrowly missed hitting him FIG. [PHOTO] Rupert Soar, a contractor at the Park Yacht and Country Club in Nottingham, found his car crushed by a tree
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -Hamburg 3000 trees toppled, UK 3 mill trees toppled -wind strength to Bf12 in hamburg
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a - 100s trees toppled
Het Vrije Volk (19900126c)	Het Vrije Volk, Storm-doden vielen vooral in 't verkeer, p.5, 26/01/1990c -forest damage not yet clear in the morning
Huddersfield Daily Examiner (19900126b)	Huddersfield Daily Examiner, Falling trees bring chaos to nightmare journeys, p1, 26Jan1990b. (Friday) -Mirfield: man and woman cut free from Lada that was crushed under massive tree -Thongsbridge: man and daughter rescued by fire crews when 100ft tree fell on Ford Granada -Eastgate, Honley: tree wrecked car but only slight injuries -fire crew from Holmfirth blocked by falling tree on Huddersfield Road at Thongsbridge
Hudderfield Daily Examiner (19900126c)	Huddersfield Daily Examiner, Fierce gales cause chaos, p7, 26Jan1990c. (Friday) -several minor roads were blocked by fallen trees -numerous trees fell around Dereham blocking side roads
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, . 279, No. 4, 06/02/1990 -parts of S England hit by winds gusting to 110mph; tore down trees and cables & caused a lot of accidents -Newton St Cyres: tree fell on school bus causing minor injuries; another tree fell on lorry -gales swept across country, tearing down trees and cables -South Brent, South Devon: 1 person feared dead when tree crashed on car -Britain: roofs ripped off homes, trees toppled, aircraft blown off runway -many people died as hurricane force winds wrecked buildings, tore up trees, and knocked out power supplies across Britain & continental Europe -motorists killed by trees crashing on cars -Cornwall to Wales, Midlands, NE England transport in chaos; railway stations closed, roads blocked by trees -engineers worked all night to clear trees from lines -southern Jutland: falling trees blocked roads -Belgium: injuries mainly caused by flying debris & uprooted trees -storm hit Sweden during the night, ripping roofs from houses & snapping trees -Schleswig-Holstein: several roads closed due to fallen trees, roofs of houses damaged

Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -storm 25Jan1990 caused most damage to Britain -gusts > 100mph blew down rows of trees, deroofed buildings, swept vehicles from roads -Britain's Forestry Commission: at least 3 million trees uprooted in England & Wales -BBC: fresh winds toppled trees & blocked roads in several places in Devon (29Jan1990 report) London, 30Jan, Press Association -at least 3 million trees blown down during last weeks storms, according to Forestry Commission -winds wrecked woodlands across S England & Wales -Somerset, Cornwall, Avon, Wiltshire worst hit -5% of trees on Dartmoor lost or damaged -substantial losses in Dorset, Shropshire, Wales & eastern Counties
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -England: damage to trees, power lines, windows -from Cornwall to Scotland, transport in chaos; airports & rail stations closed; trees block roads -by 1200 on 26Jan 960mb low moved across Sweden; roofs taken off houses & trees snapped
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Royal Botanic Garden at Kew lost 100 old trees compared with 1000s during Oct1987
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -man killed in Waterford by falling tree -Britain hardest hit with 46 killed, many crushed by falling trees
The News Chatham-Rochester-Gillingham (19900126c)	The News Chatham-Rochester-Gillingham, Classes evacuated as wind shatters school's windows, p.11, 26Jan1990c (Friday) -fallen trees blocked roads in villages: Bowsden Lane in Shorne and Borstal Road in Wouldham -British Rail staff worked throughout day clearing lines blocked by trees & rubbish (Southern Region)
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -the forests had a hard time -Natuurmonumenten reported on toppled trees and blown off roofs -KF Fiechter, spokesman for Natuurmonumenten... -the damage to forests and nature areas not yet known but generally believed to be less than in 1972-73 when there were 2 storms that blew down 1/2 million cubic meters of wood -according to Staatsbosbeheer more damage to needle tree than deciduous and more damage to young forests than older 150y stands -western part of country hit worst but also in the Utrechte ridge and polders
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -trees biggest killers; many weakened after Oct1987 storm -14 deaths from trees falling on cars/vans/lorries -30y man from Steyring West Sussex died after being blown off moped at nearby Bramber -2 month old baby girl recovered alive from car crushed by 100 foot pine; mother killed -28y woman killed in collision with fallen tree in Volkswagen Golf at Lakeside Cardiff
Thuner Tagblatt (19900127a)	Thuner Tagblatt, Sturm fegte ueber die Region: Hauser abgedeckt, 27Jan1990a (clipping shown in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -just in the Staatswald Honegg-Nord 3000 m3 of fallen coniferous trees were counted -in the forest around Schwarzenegg 100s pine trees broken or uprooted -Eriz, above the Restaurante Linde a large part of the forest was completely flattened
Thuner Tagblatt (19900127b)	Thuner Tagblatt, Region Thun: Die Sturmnacht-Wunden verheilen nicht so schnell (contributor Werner Hostettler), p.13, Samstag, 27Januar1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -hurricane storm left a picture of distruction in the area of Schwarzenegg during night 25-26Jan -100s of toppled pine trees in the forests and heavy damage to houses in the whole commune -Heinz Zimmer, forest engineer: 3000 m3 wood counted from fallen trees in Staatswald Honeg-Nord -5 hectares of forest hit; huge damage to private forests -Ob Eriz a larger area of forest was practically mown down
Thuner Tagblatt (19900131a)	Thuner Tagblatt, Sturmschaeden im Thuner Ostamt weit schlimmer als angenommen, 31Jan1990a (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG. [PHOTO] Hurricane storm winds that blew over Thuner Ostamt in the night 25-26Jan left far greater damage than initially throught. Alone in Staatswald area Honegg-Sued above Eriz an area of 150 ha was impacted. Yesterday at midday (30Jan) 8000 m3 of windthrown timber counted. Our picture (with state forester Peter Salzmann) gives an impression of the devastation caused by the the storm winds in the state forest area the ob Eriz [credit: Werner Hostettler]
Thuner Tagblatt (19900131b)	Thuner Tagblatt, Ob Eriz wurden 150 Hektaren Wald von Sturmwinden heimgesucht (contributer Werner Hostettler), 31Jan1990b (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -FIG. [PHOTO] Hurricane storm winds rip several paths in the forest and flattened the large and heavy coniferous trees in rows in the same direction [credit: Werner Hostettler] -in the state forest Honegg-Sued above Eriz offers singular picture of destruction: dozens of uprooted coniferous trees lay flattened in random directions or all in the same direction

	-state forester Peter Salzmann led TT through the devastated forest above Eriz: here above there is 200 ha of state forest of which 150 ha have been impacted by windthrow, of which 10 ha has big damage -on different places storm winds ripped long paths in the forest and in the area Farneggli have left a huge tooth gap in the Gratwald -alone in state forest area Honegg-Sued above Eriz 3500 m3 of windthrown timber was counted; in addition TT reported 3000m3 of windthrown timber in the state forest above Schwarzenegg and 1000m3 windthrow in private forests. These numbers will increase as surveys come in private forests
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -Forestry Commission: estimated 3.5 million trees blown down -Royal Botanical Gardens at Kew closed for > week with more than 100 trees blown down
The Times (19900127d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -100mph winds recorded in Shoreham Sussex where highest winds occurred Oct1987 -relatively few trees blown down SE England; Oct1987 felled 15 mill of most vulnerable trees
The Times (19900127e)	The Times, Kew curator surveys the devastation (contributor Adrian Brooks), p.3, 27Jan1990e FIG. [PHOTO] Mr. Charles Erskine, curator a Kew Gardens, stopping during his inspection tour to survey the uprooted remains of a rare Eastern Mediterranean tree
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -in Germany most of tree fall was fore hurricane Wiebke -damage costs in Germany for Wiebke were similar to Vivian -60-70 million m3 timber felled in German forests during storm; approx twice normal harvest. -FIG. [PHOTO] The forest of Ortschaft Grafenort im Kanton Obwalden is totally destroyed after storm (WIEBKE?) -forest owners and managers were busy for months aafter the storm chaos; fear of a plague of Borkenkafer in spring -storm caused a rethink of forestry practices. -instead of a monoculture of Fichten in Mittelgebirgen, mixed tree stands used to stabilize forest -the clear cut resulting from the storms had largely disappeared 20 years later.
Borgesius and de Vries (1991)	Borgesius, J.J. and S.M.G. de Vries, De januariestorm van 1990, Nederlands Bosbouw Tijdsschift, pp. 308-311, 1991. -analysis of forest damage in Netherlands -worst forest damage in Belgium, Luxemburg, large parts of Germany, France and UK -comment that wind pressure higher for lower temperatures
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -forests were severely damaged; lack of disaster plans led to chaos in the forests and domestic timber market -forests closed to public for several weeks -Bosschap, forestry organization in Netherlands, had a contingency plan to prevent chaos on timber markets after event
Bissoli et al (2001)	Bissoli P., L. Goering, Ch. Lefebvre, Extreme Wetter- und Witterungsereignesse im 20. Jahrhundert, pp. 20-31, Klimastatusbericht 2001 -ca 3000 trees uprooted Schlewig-Holstein
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -4 million trees uprooted across Britain vs 15 million in SE England in Oct1987
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -extensive damage to forests -Schleswig-Holstein: >3000 trees broken -Germany heavily hit by Vivian & Wiebke with 65 mill m3 damaged timber; other sources give 72.4 mill m3 damaged timber -Baden-Wuerttemburg: 15mill m3 storm damaged timber equal to 1.8 times annual harvest -Rheinland-falz, Hessen, Bavaria, Baden-Wuerttemburg: 66 mill m3 or 91% annual harvest -France: damaged timber 8.5 mill m3 -Belgium: 4 mill m3 -Britain: 4 mill m3 -Switzerland: 4.3 mill m3 -Austria: 4.8 mill m3 -Europe: 100 mill m3 or 30% annual harvest -Netherlands: 0.4 mill m3 or 1/3 to 1/2 annual harvest -Vivian/Wiebke: time damage as % annual harvest: -Germany 67% -France 18%

	-Switzerland 110% -intensive prevention activities 1990, beetle outbreak 1991 with damage Baden-Wuerttemburg -outbreak lasted several years (Kuehnel, 1994) -1992-2000 bark beetles killed high numbero Norway spruce Bavarian Forest national park; 3700 ha -most regions of bark beetle outbreak were affected by storm -Switzerland: max bark beetle outbreak 1992 & 1993 -Switzerland harvested 500000 m3 timber in addition to felling targets -FIG6.5. Graph shows a noticeable increase in harvesting as compared to the planned harvesting levels due to storm damages in m3 in 1991 and 1992. An increase of bark beetle infested timber is obvious in 1992. -FIG6.6. Amount of damaged timber due to storm, snow and beetle attack in Austria
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] * -120Mm3 damaged timber in 9 countries; 4 times more previous worst storm 1972 -Forest Condition -warm temperatures across Europe & Russia meant that much of forest soils unfrozen -Daria: soils in most affected areas saturated following wet winter -Daria: most damage to coniferous species with spruce & silver fir affected in Germany (Schmid-Haas and Bachofen, 1991), and for UK: spruce, Douglas fir, larch (also beech, deciduous) -In UK stands that had been thinned following 1987 storm particularly prone to damage -despite lessons 1972, still numerous accidents clearing up wind damage -SW Germany 3544 accidents of which 10 fatal in private & community woodlands; in state forests 1032 accidents of which 3 fatal (Kuehnel, 1994) -noticeable beetle outbreaks S Germany lasting several years (Kuehnel, 1994) -1992-2000 area of 3700 ha of Norway spruce killed by bark beetles in Bavarian Forests National Park (Wermelinger, 2004) -Switzerland: bark beetle max 1992-1993 leading to extra 500000 m3 harvested timber (BUWAL,2000) -beetle outbreaks corresponded to area affected by wind damage 1990 (Engesser,1998) -Response to Storm -in Germany, federal states responsible for dealing with natural event damage -because of severity of events, German government initiated auxiliary fund -German states received 0.85 mill EUR for processing storm damaged timber (Kronauer, 1990) -additional funds made available by states for removal wood from community woodlands and processing/storage of damged timber as precaution against beetle attack -Switzerland: 370 mill Swiss FR made available by federal government & cantons for dealing with storm aftermath -government provided military personnel & engaged foreign contractors for salvage logging -government helped by acquiring & maintaining harvesting machinery, constructing timber yards, transporting timber & purchasing storm-damaged timber -UK: Forest Windblow Action Committee (FWAC) reformed for advice & guidance; much less financial aid than 1987.
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -3 million trees felled when Daria travelled from Ireland to Denmark
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -Schleswig-Holstein 3000 trees toppled
ESWD (20231106)	European Severe Weather Database, 25-26Jan1990, https://eswd.eu (last access 06Nov2023) TREE DAMAGE OR UPROOTED Location LA Latitud Longitu Date Day Time Uncertainty ND --- Birkenheide Rheinland-Pfalz DE 49.48 N 8.26 E 26-01-1990 fri 12:00 UTC (+/- 12 hrs.) damage to crops and forests: damage Lauwil Basel-Landschaft CH 47.39 N 7.67 E 25-01-1990 thu 21:00 UTC (+/- 6 hrs.) Large tree branch(es) broken, Tree(s) uprooted or snapped Germany DE 52.70 N 8.00 E 25-01-1990 thu 18:00 UTC (+/- 12 hrs.) trees downed Hubbelrath Nordrhein-Westfalen DE 51.27 N 6.92 E 25-01-1990 thu 16:30 UTC (+/- 15 min.) trees downed United Kingdom UK 51.75 N 1.30 W 25-01-1990 thu 12:00 UTC (+/- 12 hrs.) trees downed Ostentrop Nordrhein-Westfalen DE 51.20 N 8.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) trees downed Frechen Nordrhein-Westfalen DE 50.92 N 6.82 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) forests damaged Stahe Nordrhein-Westfalen DE 50.98 N 6.02 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) trees downed Parkstein Bayern DE 49.73 N 12.07 E 25-01-1990 thu 11:00 UTC (+/- 12 hrs.) trees uprooted or snapped
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -number of trees lost was equivalent to Fontainebleu forest

Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -Daria travelled Ireland to Denmark; 3 million trees felled
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan1990 FIG. [PHOTO] at Kew Gardens, London this 100 year old Black Pine was among hundreds of trees felled by the storm -almost 3 million trees felled across Europe
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -large quantity of windthrown wood caused market exceedance, notably in Germany, that took a long time to re-absorb. Wood harvest in Europe strongly reduced in 1991

Table SL66. General ship/rig emergency reports/offshore incidents/platform evacuations (arranged by year and then alphabetically)

Source	Full Reference and Notes
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -hurricane force winds at Dover end of channel -French SNCF ferry Chartres (Newhaven to Dieppe) spent hour drifting without power
Eastern Daily Press (19900126l)	Eastern Daily Press, Fishing boat alert, p.3, 26/01/1990l -rescue helicopters standing by night 25Jan1990 after Dover Star fishing vessel from Grimsby reported taking on water 80nm NE Yarmouth -Humber CG said lifeboat already in that sector of the North Sea
Eastern Daily Press (19900127d)	Eastern Daily Press, Brave skipper praised for rescue of tug crew, p.3, 27Jan1990d -2 rescuers praised for bravery in saving 3 man crew of sinking tug early yesterday -Impulsion owned by Imperial Tugs of Hoxne near Diss got into difficulties after it was called out (with pilot boat) to assist 800 ton coaster (Oakham) that had engine filure shortly after midnight
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -at the same time there were reports in the Bay of Biscay of numerous ships in emergency in conditions of 12m wave height
Herald (19900126)	The Herald, Soviet cargo ship adrift in high winds, 26Jan1990 https://www.heraldscotland.com/news/11980484.soviet-cargo-ship-adrift-in-high-winds/ -large Soviet cargo ship Briz with 56 crew sent mayday last night 10pm 25Jan1990 for immediate help -position close to Dutch coast off Den Helder -drifting in storm force winds without power -Dutch dispatched 3 rescue helicopters; forced back to bases by wind -2 Dutch warships attempted to take off survivors; defeated by high winds -captain reported that ship taking water & snapped anchor chain -ship drifting toward Fleland Island in Dutch Friesen group
Het Vrije Volk (19900126a)	Het Vrije Volk, Grote chaos en 19 doden door zware storm, p.1, 26/01/1990a -8 ocean ships and 30 inland ships broke free in Rotterdam Harbour -56 member crew of sinking Russian ship brought from North Sea during night
Het Vrije Volk (19900126c)	Het Vrije Volk, Storm-doden vielen vooral in 't verkeer, p.5, 26/01/1990c -ECT-Europoort: containership lost anchors
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -no French Sealink service between Newhaven & Dieppe; Chartres broke down mid-Channel, regained engine power, but hit ramp as it entered French port; other vessels could not operate service -East German officials: dispatched rescue teams to assist foreign vessels -NETHERLANDS, Rotterdam: freighter broke from moorings and in contact with several Rhine barges -NETHERLANDS: Waalhaven: drifting dock damaged quays.
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -Irving Forest sent a Mayday on 11Jan when taking water off Azores; 4 containers washed overboard -Charlie: bulk carrier, Cyprus-registered, 20246 tons, 27 complement, vanished in violent weather 20Jan -England Daria storm -Rio Santa Rosa: lost propeller resulting in damage to deck and hull -Funchal Pass: lost propeller resulting in damage to deck and hull -River Asab: contact damage in Antwerp during high winds -Auto Atlas: heavy weather damage on 20Jn -Brightingsea: passenger ferry suffered damage on 25Jan -Sea Mother: damage on 25Jan -Jotun: capsized on26Jan in Baltic -Briz: ran into trouble on 26Jan; 56 crew rescued -Impulsion: 60 foot harbour tug with 3 people capsized in force 9-10 winds in North Sea -White Stone: ran into trouble 25Jan -Cottic Navigator: ran into trouble 25Jan -Faust: ran into trouble 25Jan -barge Cusham No 18936: sank in Gravesend Reach with 29 loaded refuse containers on 25Jan while in tow -La Fayatte: missing with 5 seamen after reporting smashed portholes off Brittany on 25Jan -Reefer Star: encountered hurricane force winds 25-26Jan with hatch cover damage & flooding -Zorro: sank on 25Jan in Antwerp

	-hurricane wind Netherlands 25Jan: several dead & 100s injured -West Germany: extensive damage to buildings, parts of Hamburg Harbour flooded; at least 5 killed -France: at least 8 deathes; 94kt gusts across N Brittany -3 fishermen missing after catamaran sloop Revolution overturned while being towed -Belgium: 10 died and dozens injured, mainly be falling debris & uprooted trees; gusts to 55kt
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Soviet ship with 56 people in trouble off Dutch coast; 3 navy helicopters & 2 lifeboats in rescue
NRC Handelsblad (19900126c)	NRC Handelsblad, Zware storm kost 19 mensenlevens, p.1, 26/01/1990c. -near the coast at Vlieland a Soviet cargo ship is adrift; 56 crew rescued by rescue ship Carlo
NRC Handelsblad (19900126d)	NRC Handelsblad, Miljoenenschade in Rotterdamse haven, p.2, 26/01/1990d -pier 2 of Waalhaven containers toppled over -at ship wharf and machine manufacturer Duivendijk in Waalhaven; floating dock broke free from moorings and drifting on its own to the other side; no damage to dock -in Maashaven large 120m ship broke loose and rammed 10 inland ships and a speeding boat from the Gemeentelijk haven Bedrift. The ocean ship Heemskerk went out of control in the Petroleumhaven and hit a tugboat -at ECT-Europoort, container ship broke loose and lost a couple of containers -Rotterdam harbour police: 12 ocean ships and about 30 inland ships damaged; a number of barges broke free -spokesman from Gemeentelijk Havenbedrijft reported this morning 12 ships could not enter harbour -Gemeentelijk Havenbedrijft could not make an estimate of total damage.
NRC Handelsblad (19900126f)	NRC Handelsblad, Vrachtverkeer reed door ondanks oproep, p.3, 26/01/1990f -in Rotterdam and Amsterdam harbours the storm caused great damage -problems with Russian freight ship near Vlieland
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -huge seas English Channel -80 passengers + 50 crew of French SNCF ferry Chartres (Newhaven-Dieppe) spent hour drifting without power until engines restarted
The Times (19900129b)	The Times, Met Office examines storm warning media links (contributor Michael McCarthy), 29Jan1990b. FIG. [PHOTO] Royal Navy barge aground on promenade Southsea, Hampshire after it broke adrift during gale force winds while being towed
The Times (19900130)	The Times, Floods and gales bring more chaos (contributor John Young), 30 Jan 1990. -several ships sheltering from 60mph winds in Falmouth Bay -Royal Air Force long range SAR aircraft from Kinloss to join international search for 20000 ton MV Charlie (Cyprus) last reported 20Jan1990 with 27 crew; sailed Montreal 14Jan; feared lost in hurricane winds -Canadian, American, Portuguese aircraft also in search N of Azores & SW of Ireland
Wubs and Waaldijk (1990)	Wubs AJ and A Waaldijk, Krantelknipsels storm 25 january 1990, Deel 1: Knipsels 1 t/m 200, Instituut TNO voor Bouwmaterialen en Bouwconstructies (IBBC) BI-90-105 (Projectnaam: Storm 25-1-90; Projectnummer: 62.8.3903) Juni 1990 (source: 001. NRC26/1: Zware storm kost 19 mensenlevens) -56 crew of Briz rescued by lifeboat Carlot during night (source: 010. VLK27-1: Delen van Engeland en Frankrijk zonder storm) -ferry Chartres without power with 130 people -4 crew drowned at DDR coast (source: 022. VLK26-1: Tientallen doden door noodweer in West-Europa) -Chartres ferry lost power in channel; returns to Dieppe -2 ships in channel had problems with cargo shift; 2 others lost power; man overboard from Liberian ship Serica 300km SW of Cornwall; loss of 3 crew of fish-cutter Revolution in front of English coast
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -shipping sector reacted adequately to weather forecasts and impacts very small
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -number so ships in difficulty across Bretagne and in English Channel

Table SL67. Instrument failures during storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -Forschungsplattform Nordsee reported repeated gusts >80kt 26Jan1990 00-06Uhr (Windmesser am Anschlag)
RWS (199004)	RWS, Verslag van de Stormvloed can 25 en 26 januari 1990 (SR62), Rijkswaterstaat, Die nst Getijdewateren Stormvloedwaarschuwingsdienst, postbus 20920907, 2500 EX 's-Gravenhage, 's-Gravenhage, april 1990 -tide gauge malfunctioned at IJmuiden
BSH (1991)	BSH, Seegangsmessungen in der Deutschen Bucht im Jahre 1990, Meereskundliche Beobachtungen und Ergebnisse Nr. 71, Bundesamt fuer Seeschiffahrt und Hydrographie, Nr. 2149/43, Hamburg, 1991, https://digitale-bibliothek.bsh.de/viewer/fullscreen/29682/1/ -Westerland ODAS buoy stops working during Storm Daria on 26Jan1990
BSH (1992)	BSH, Beobachungen auf den deutschen Messstationen der Nord- und Ostsee im Jahre 1990, Meereskundliche Beobachtungen und Ergebnisse, Nr. 70, Bundesamt fuer Seeschiffahrt und Hydrographie, Hamburg, 1992

	-gaps in the wind speed record from Forschungsplattform Nordsee on 26, 27, 29 January 1990 -gap in air temperature record from Forschungsplattform Nordsee from 26-30 January 1990
Ramboll (1999)	Ramboll, Kortlaegning af bolgeenergiforhold i den Dansk del af Nordsoen, Ramboll, Dansk Hydraulisk Institut, Danmarks Meteorologiske Institut, 04Juni1999, Energistyrelsen J.No. 51191/97-0014 -Ekofisk wave sensor shows no data on 25Jan1990

Table SL68. Nonhomogeneous data sets (arranged by year and then alphabetically)

Source	Full Reference and Notes
Cusack (2013)	Cusack, Stephen, A 101 year record of windstorms in the Netherlands, Climate Change, 116, 693-704, 2013. -storm loss index for Netherlands based on 101 years of measured station winds -loss index based on 98th percentile of wind raised to third power -some time series corrected for inhomogeneities overperiod -mention of WASA project using surface pressure records instead of wind speed

Table SL69. Climatological background of storm; unusual preceding weather events (arranged by year and then alphabetically)

Source	Full Reference and Notes
Deutschen Wetterdienst (1990)	Deutschen Wetterdienst, Monatlicher Witterungsbericht, 38, pp. 1-2, January 1990. -from 15-23 an extensive low pressure system (extending from Iceland to North Atlantic with a high pressure zone from the Azores to the Balkans) moved quickly across central Europe to the NE -23Jan Bremen received record rainfall, overtopping previous record of 6.9mm by 5.5mm -average temperature warmer than multi-year average -only on 18Jan polar air penetrated into central Bunderepublik & temperatures dropped to 60th percentile -Hohenpeissenburg temperature broke previous record of 6.6C by 0.4C on 23Jan -from 24-31 extensive low pressure sytem developed S of Iceland with a series of associated storm and hurricane lows across Nsea and into Scandinavia
Deutschen Wetterdienst (19900202)	Deutschen Wetterdienst, Der Orkan am 25./26. Januar 1990; Ein Jahrhundertorkan?, Beilage zur Wetterkarte, D 7311A, 10/1990, 02.Feb.1990 -reference to low pressure area around Iceland that steering Daria into Europe
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990 -very large temperature difference across frontal zone that stretches from Scotland to W Russia -at 500hPa level at 24/01/1990 00:00 it was -13C WSW of the Azores & -38C at OWS L (57.5N20W) -series of powerful cyclones travelling from NFLD over Iceland and Norwegian Sea toward Scandinavia -from 20/01/1990 travelling cyclones along trajectory significantly further south -4 hurricane centres over W and central Europe within 14 days had never happened before -they are the product of an unsually strong WSW circulation, which was already observed in both previous very mild winters.
Eastern Daily Press (19900126f)	Eastern Daily Press, Worse happening at sea (contributor: Anthony Wenham), p.3, 26Jan1990f. -UK mild winter so far; winds tracking north & missed us -jet stream undulations caused Norfolk to be hit -cause of fluctuations unknown; Norfolk storm event rare -north of Scotland, comparable storms 2-3 times per year
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c -Frank Barnes, former senior lecturer at Nottingham Univeristy: tenuous link between this month's gales and greenhouse effect -Britain experiencing very unusual weather patterns -in last 1 or 2 week we had two depressions between Britain and Iceland that were lowest I've ever seen -unusual number of depressions heading further and further south -Daria on 25Jan stretched across N Britain; normally between Iceland & Britain
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -last week of Jan1990 characterized by powerful low pressure activity North Atlantic -Tue 23Jan the Polar Front was along 50N; small low P center at Nfld
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. FIG1. [MAP] An Icelandic Low, the likes of which have never been seen before in the history of the publication, combined with a potent Azore High to created a memorable month for North Atlantic Mariners -Azores High of 1028mb more reminiscient of July than January; 982mb Icelandic Low was -18mb anomaly -the steering levels (500mb) indicated a general flow toward the east northeast so that, in an ideal pattern, a storm would move from New York to the English Channel
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 2. Setting the scene - early winter in the North Atlantic -early winter Nov-Dec1989, much of Europe with stormy interludes -Atlantic jet stream unusually strong; displaced further south than normal in Dec -area of exceptional cold 1000-500mb thickness (thickness anomaly) across NE US, eastern Canada, and Newfoundland -early Jan transition to more zonal regime; still anomalously cold Labrador & NE of NFLD -exceptionally strong baroclinic zone S of normal latitude

	-SST abnormally cold E of NFLD; further south values above normal; strong SST gradient across GS -past studies indicated distrib of SST signif influence on development of depressions -explosive cyclogenesis where cold air moved rapidly across strong SST gradient towards warmer water -latent heat important for intense cyclogenesis -Namias (1987,1989) drew attention to concurrence warm SST S of Nfld with negative geopotential anomalies furthern north during record Atlantic low Dec 1986 and Great storm Oct1987 -continued cyclogenesis during Feb continued to amplify pre-existing temperature anomalies -mid-Atlantic negative thickness anomaly for Jan and pressure of mean Iceland low >30mb below normal; for values largest recorded anomalies since record start 1873 -FIG1. [MAP] Anomalies of normalized 1000-500mb thickness (standard deviations, January 1990) (solid lines) and sea surface temperatures (dec C, 1-25January) (dashed lines) for the period preceeding the stormy period
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. p.1. Mainly mild, but stormy at times -'at one stage it looked as though we were going to equal last January's record high mean temperatures, but a cooler spell later in the month put paid to that possibility' -The month began with a southerly airflow due to a complex low pressure area to the west and high far to the east. -The high slipped south and joined the semi-permanent Azores high in the South Atlantic, causing a succession of vigorous depressions from the Atlantic to track well to the N of country
Rosenorn (1990)	Rosenorn, Stig, Vintervejret 1989, Vejret, 43, 21-23, 1990 -mild winter 1989-1990, winter 1989-1990 rank2 temperature, climate normal 1931-1960, Feb1990 rank1 precipitation, Feb1990 rank1 temperature -Denmark met record start 1874 -Jan/Feb1990 monthly average temperature 4C over climate normal 1931-1990
Paul (1991)	Paul, F, Les tempetes des mois janvier et fevrier 1990 dans le Nord de la France, Hommes et Terres du Nord, pp.208-212, 1991. -temperatures higher than normal for season with max 12-13C in northern France with 2-15mm ppt
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -area of Natl & North Sea in Jan1990 up to 3C warmer than normal -extension of Nalt cyclone track significantly further toward European than normal -extension of cyclone track into western Europe mainland because of absence of blocking action of winter high P over snow-covered eastern Europe that would other deflect cyclones north & south -1990 was warmest year in 130y; beginning of worldwide measurements -further 6y of last decade had measurements over all previous measured values -Pinatubo eruption 1991 led to light cooling of atmosphere -in central Europe, there has not been a similar series of mild & low ppt winters compared to the 3 years between 1987/88 to 1989/90 for 700 years
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. (3) milder winters more common in Europe leading to shrinkage snow cover & protective blocking high P systems. Series of gales like 1990 no longer exceptional. No confirmation of increase in frequency & severity of low P & wind storm activity. (NOTE: Schinke 1993). Controversial and contradictory connection between global warming and tropical cyclone activity.
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -severe storms like Daria associated with extreme positive phase NAO -NOTE: Calculation of special daily NAO index for Oct 1989-Mar1990 with prolonged positive phase from mid Dec1989. Daria & Vivian occur during height of positive oscillations -FIG1. NAO definition for NCEP a. [MAP] leading MSLP EOF for North Atlantic/Europe using latitude weighting for NCEP data (1958-1998); explained variance is 36.14%, period is Oct-Mar b. [TIMESERIES] monthly NAO indices, first PC (black); Jones et al 1997 (grey) c. [TIMESERIES] example for daily NAO index for the winter 1989-1990, including the period of occurrence of extratropical storms over central Europe. The gray areas correspond to the periods of occurrence of Storm Daria and Vivian. The day of maximum intensification is shaded dark gray
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -in Jan at least 6 depressions reached low reading 950mb over Atlantic -caused by below avg temperatures Greenland & Iceland & above avg in northern Europe
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -met situation winter 1989-90 showed peculiarities -western Natl & Canada had cooler than avg airt Feb; N & E Europe had higher airt -storm cyclones could develop but not following usual winter course (Kuehnel, 1994)

	-European winter 1989-90 abnormally power cyclones in Natl region -windstorm areas hit Europe repeatedly -airt reached record highs; winter 1989-90 one of mildest of 20C -16Dec: +20C temperatures meas in several regions Germany; +10C in northern Russia -soils not frozen & thawing resulted in high plasticity -25Jan-01Mar eight severe storms hit Europe with great damage: -Daria 25-26Jan1990 -Herta 03-04Feb1990 -Judith 07-08Feb1990 -Nana -Ottilie & Polly 13-15Feb1990 -Vivian 25-27Feb1990 -Wiebke 28Feb-01Mar1990
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -Unusual met conditions winter 1989/90; cold over Canada & W Atlantic & warm over Northern & Central Europe -winter 1989-90 one of mildest in 100years in Europe; temperatures >20C in several regions of Germany & >10C in northern Russia -synoptic situation led to cyclones taking abnormal routes with many passing across UK-NorthSea-Baltic (Kuehnel, 1994) -warm temperatures across Europe & Russia meant that much of forest soils unfrozen -Daria: soils in most affected areas saturated following wet winter
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -Daria occurred during exceptionally mild winter 1989-90; one of mildest of 20C -on 16Dec1989 station in Germany registered 21.7C
Rohman (2014)	Rohman, James, European Extratropical Cyclones. Implications for local insurers, TransRe, May 2014 -most damaging ETC in Europe linked NAO & AO -when NAO & AO are positive, jet stream set up across North Atlantic and greater tendency for cluster storms -1953 would have exceeded damage of Daria
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -after 31 years, Daria remains powerful example of risk attendant on rising temperature -Daria preceded by unusually warm winter -with temperatures rising around globe & 2020 confirmed as Europe's hottest year, high-severity weather events like Daria are increasingly likely -only matter of time before another major windstorm rewrites weather books
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -one of the mildest winters of 20C;
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -unusually warm conditions preceded passage of depression -max temperatures 10-14C in northern half of France; 14-18C in southern half with points of >20C at foot of Pyrenees under a fohn effect -these temperatures are 5-10C above the normal for the end of January
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -Daria preceded by considerably warm winter -Germany temperatures 20C just before Christmas

Table SL70. Storm timing compared with spring tide; phase of surge and tide (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL71. Tide analysis (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL72. Data filtering and discretization issues (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL73. Difficulties in meteorological model of storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
ECMWF (1990)	ECMWF, ECMWF Report 1989.90, European Centre for Medium Range Weather Forecasts, 52pp, pdf datestamp 19/01/2010, 1990 -Thur 25Jan1990 NW Europe struck by major storm; trees uprooted, buildings damaged, fatalities -particularly challenging to make accurate and useful medium range forecasts for rapidly developing storms when development begins 2-3 days after start of forecast -such extreme events potentially predictable provided adequate data & most powerful computers available FIG. Medium-range forecast of the storm of 25 January 1990. The depression

	started to form about three days into the forecast (which is from the analysis of 20January). The graph shows the model's prediction of the timing, rapid deepening and subsequent filling of the low -NOTE: model successfully predicted Daria 5 days in advance
Fremming (1990)	Fremming, Ornulf, Den verste stormen paa 300 aar, Vaeret, No. 1, Aargang 14, pp. 22-24, 1990 -24h forecast made on 24Jan12UTC for 25Jan12UTC indicates much weaker low pressure centre in S England compared to what was actually observed
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -UKMO fine mesh model designed to capture tight gradients from intense storms but forecast compromised by sparse data set set over North Atlantic
McCallum (1990)	McCallum E, The Burn's Day storm, 25 January 1990, Weather, 45, 166-173, 1990. -UKMO gave excellent warning of the Burns Day storm -FIG8 shows T+108 forecast from UKMO global model -guidance from ECMWF also predicted marked cyclogenesis for 25Jan but with centre much deep and further north -guidance of severe gales for southern half of UK issued on Sunday farming forecast 21Jan1990 -more precise forecasts issued on 24Jan based on 24h forecast from fine-mesh regional model -predicted mean surface winds 50kn
McCallum and Norris (1990)	McCallum E and WJT Norris, The storms of January and February 1990, Meteorological Magazine, 119, 201-220, 1990 5. How well were the cyclogenesis events forecast? -current generation of operational NWP model have skill for major cyclogenesis events; UKMO 15 level model leader in field -global (coarse mesh) version useful for advance warning up to 6d ahead -accurate notice of Burns Day storm on 25Jan1990 Thursday first given in TV farming forecast on previous Sunday -fine detail up to 36h ahead from fine mesh model; framing warnings for media -fine mesh model gives poor deepening forecasts for 25Jan and 26Feb -handling of 2 lows highlighted crucial role of forecaster to overcome occasional major deficiencies in numerical guidance -deficiencies in Burns Day case example of rogue run where model lapses into weak or nondevelopmental mode after clear signal for large cyclogenesis -other storm examples noted by Woodroffe (1990) and Reed et al (1988) -DARIA: FIG10a shows a nondevelopmental mode in 36h forecast in contrast to better 24h forecast -forecasters alert to problem; warnings issued on basis of solution ensemble -forecast greatly improved by observations from 2 ships near low centre -second problem: tendency to nudge towards correct solution from run to run rather than sudden change to explosive cyclogenesis -particularly true for 26Feb storm -FIG9. Observed 24h change in central pressure (mb) of rapidly deepening lows in the North Atlantic compared with values forecast by the find-mesh model during period 22Jan-28Feb 1990. Only cases were observed or forecast change exceeded 24mb are shown NOTE: poor forecast for DARIA and VIVIAN
The Times (19900129d)	The Times, Day of destruction and death that left Britain battered (contributor David Sapsted), p.3, 27Jan1990d -Brian Hoskins (Reading) -explosive depressions were rare event on this side of Atlantic -72h forecast 23Jan showed pressure drop to 968mb for Wednesday night & 949 mb for Thursday; accurate -forecast information: satellite; T/RH/P from weather ships, commercial aircraft, radiosondes; rain radar
The Times (19900129b)	The Times, Met Office examines storm warning media links (contributor Michael McCarthy), 29Jan1990b. -Colin Flood: Met Office to carry out internal investigation into Thursday great storm -concentration on how warnings of storm were publicized -enquiry likely to be chaired by John Houghton, Director General -storm predicted as far back as Sunday; extreme warning on Wednesday evening -Met Office satified with storm prediction in comparison with Oct 1987 storm -MetOffice between 2 computers; Cyber forecasting computer installed 1981 -Cray computer deliered last month
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -ERA-Interim data set does not capture observed maximum 6h central pressure rate of deepening

Table SL74. Difficulties in modelling water levels and surge (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL75. Future sea level rise and flooding effects; future climate and storm return period (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL76. Isostatic rebound and tide gauge record corrections (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL77. Storm event as manifestation of climate change (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -climatologists say storms of recent years caused by Greenhouse effect
Eastern Daily Press (19900126f)	Eastern Daily Press, Worse happening at sea (contributor: Anthony Wenham), p.3, 26Jan1990f. -Gibbs: no evidence of Norfolk becoming a windier county, despite notorious 1987 gales
Evening Post Nottingham (19900126c)	Evening Post (Nottingham), Storm winds hit 79 mph in Notts, p.7, 26/01/1990c -London Weather Centre: Daria gales worst of century; not as strong as Oct1987 but larger area -meteorologists skeptical that strong winds another manisfestation of greenhouse effect -global warming should reduce temperature differences between equator and poles resulting in lower wind speeds -Frank Barnes, former senior lecturer at Nottingham Univeristy: tenuous link between this month's gales and greenhouse effect
Evening Post Nottingham (19900126e)	Evening Post (Nottingham), We gave you warning this time, p.7, 26/01/1990e -meteorologists skeptical about strong winds being another manifestation of Greenhouse Effect
Franke (1990)	Franke, R., Eine Serie von Orkantiefs ueber der Nord- und Ostsee im Januar/Februar 1990, Wetterlotse, 518, pp.30-37, Feb, 1990
Hammond (1990)	Hammond, JM, The strong winds experienced during the late winter of 1989/90 over the United Kingdom: Historical perspectives, Meteorological Magazine, 119, 211-219, 1990 -Boscombe Down example: wind spells 1967, 1974/75, 1982/83 did not contain extreme gust conditions, so had less damaging impact at time -long-term analysis of ann max gusts show no sign of sustained upward trend -35-day mean winds 24Jan-27Feb almost unprecedented in recent decades over central & southern districts; however it is known in other parts of UK -for Feb data, last 3 years show increasing tendency to higher mean winds -Smiths (1990) windiness index indicated Feb1990 most windy nationally since before 1881 -using windiness indices avg over year, general trend in recent decades for wind anomalies to decline since early 1950s -any changes in wind climate of UK are wonderings in long term wind speed'; no long term trend -'Yet we should be vigilant, because if rises either in long-term mean winds or in the frequency of short term extreme events should start to accelerate, the resilience of modern soceal and industrial activities to a nonstationary climate will be tested.'
Monthly Weather Bulletin (199001)	Monthly Weather Bulletin, Meteorological Service, Glasnevin Hill, Dublin 9, No. 45, Jan 1990. -review of weather in 1990s -Decadal temperatures -on a global scale: 1980s had 6 of warmest years of century; Ireland 1940s warmest decade -graphs of decade mean temperatures 1900-1980 for Cahirciveen, Roche's Point, Phoenix Park, Malin Head showing peak temperature 1940s with upward trend for Phoenix Park & Malin Head
The Times (19900127i)	The Times, Taxing the Elements, p.11, 27Jan1990i. -in 1987 defensible to treat impact of Oct storm as something far out of regular pattern of met events that it could be treated as unique -last comparable storm 300y previous -some specialists suggested 1987 storm may be consequence of long term changes in weather pattern. fitting in with predictions of rising temperatures associated with greenhouse effect that might cause fiercer Natl storm -two storms of anomalous ferocity do not make greenhouse effect -two pieces of evidence that must be added to growing bulk of indications that significant change underway -5 warmest years of present century occurred 1980s -some scientists argue that changes part of natural self-reversing 100y cycle
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -1990 was warmest year in 130y; beginning of worldwide measurements -further 6y of last decade had measurements over all previous measured values -Pinatubo eruption 1991 led to light cooling of atmosphere -in central Europe, there has not been a similar series of mild & low ppt winters compared to the 3 years between 1987/88 to 1989/90 for 700 years -according to present scientific info expected temperature increase at 2100 1.5-4.5C -this would be the highest global temperature ever experienced by humanity -expected impacts on storm damage from future climate change -change in number & intensity of atmospheric events; increased water vapour leads to stronger ppt and flooding -climate models predict temperature increase for Europe; loss of winter snow cover; weaker cold high P pushing further Europe -sea level increase 30-100cm in 100y by melting of inland glaciers
Berz (1998)	Berz, G.L., Global warming and the insurance industry, in F.L. Toch (ed), Cost-Benefit Analysis of Climate Change: The Broader Perspective, Birkhauser Verlag, Basel, Switzerland, pp. 41-56, 1998. -present problems will be dramatically aggravated if greenhouse predictions come true -increasing intensity of all convective processes will force up freq and intensity of all cyclones -TAB1: billion dollar insurance losses -before 1987: one bill USD event (hurricane Alicia 1983); after 1987 16 such events with 14 since 1990

	-hurricane Andrew leads losses with insured loss 20 bill USD; Andrew was double miss event -loss trend since 1960 (FIG1) shows dramatic incr in catastr losses in last few years -avg annual loss burdens from great disasters could rise to 30-50 bill USD by end of decade -1980s loss factor of (3 econic losses/5 insur losses) higher than 1960s
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. -insurance loss from natural catastrophes show clear upward trends that have been fitted to exponential time series -scientific proof of link still to be presented, no doubt about plausibility -precautionary principle: cost of adopting effectual preentative strategies
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -late 1980s & early 1990s western Europe hit by series of windstorms with unprecedented impact -Munichre show dramatic increase in costs of severe storms from 1960s onwards -insurance industry taken by surprise; wind storm losses of few bill USD unlikely (Berz, 1993) -Oct1987 storm 3.7bill USD1992 & 1990 storm sequence 15bill USD1992 -Daria storms damage 6.8 bill USD1992 of which 5.2 bill USD insured -similar storm & tropical cyclone events in USA -concerns if early signals of climate change
Pinto et al (2009)	Pinto. JG, S Zacharias, AH Fink, GC Leckebusch, U Ulbrich, Factors contributing to the development of extreme North Atlantic cyclones and their relationship with the NAO, Clim. Dyn., 32, 711-737, 2009 -Future greenhouse gas climate change to result in more extreme cycles near British Isles and extension of storm track into Europe
Cusack (2023)	Cusack, Stephen, A 101 year record of windstorms in the Netherlands, Climate Change, 116, 693-704, 2013. -analysis of loss index based on Netherlands measured wnd speed -50year storm loss cycle with minimum in 2010 and max in 1980s -phase lags in storm SOND compared with JFMA
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -after 31 years, Daria remains powerful example of risk attendant on rising temperature

Table SL78. Baltic Sea events (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL79. Irish Sea events (arranged by year and then alphabetically)

Source	Full Reference and Notes

Table SL80. Bristol Channel/English Channel/Celtic Sea events (arranged by year and then alphabetically)

Source	Full Reference and Notes
Gao (2017)	Gao, C., Analysis of storm surge and tidal resonance in the Bristol Channel, M.Sc., Oxford University, 2017. -extreme surge in Bristol Channel during Storm Daria

Table SL81. Aftermath: new defenses; new design criteria; assessment of climate change; model problems (arranged by year and then alphabetically)

Source	Full Reference and Notes
Hull Daily Mail (19900126)	Hull Daily Mail. Dozens hurt as storm lashes county, 26Jan1990 (Friday) -emergency meeting of Government Ministers last night to review storm effects; 36 killed -Home Office confirmed that financial assistance available to local authorities in affected areas -Bellwyn Scheme: mechanism for compensating local authorities -Home Secretary: David Waddington
Eastern Daily Press (19900127a)	Eastern Daily Press, Storm death toll 46 as Britain clears up, p.1, 27/01/1990a. -David Hunt, local government minister: government would meet 75% if local authority damage
Heming (1990)	Heming, JT, The impact of surface and radiosonde observations from two Atlantic ships on a numerical weather prediction model forecast for the storm of 25 January 1990, Meteorological Magazine, 119, 249-259, Dec 1990. -investigation of UKMO fine mesh model and impact of two mid-Atlantic radiosonde reports.
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -London: emergency meeting of ministers; Home Office to provide financial aid to affected areas
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -British government pledged to pay local councils 75% of storm damage costs Brussels, 30Jan United Press International -European Community to grant 2.6 million ECU in emergency aid to victims of last week's severe windstorm in western Europe -nearly 1/3 of aid 900000 ECU to go to UK with 47 of 96 fatalities from last Thursday storm 25Jan -Netherlands to receive 500000 ECU, France 400000, Belgium 300000, W Germany 300000, Denmark 200000 -spokesman for EC said most property loss from storm covered by insurance; emergency aid to help families who could not wait for insurance payments
The Times (19900127h)	The Times, Call for improved warnings (contributor Richard Ford), p.3, 27Jan1990h -government under pressure to improve public warnings after devastating storm in just over 2y -opposition MPs attacked government for failure to provide public warnings, after failing to learn lessons from Oct1987 storm

	-Labour MPs said some of deaths/damage might have been avoided with US-style storm warnings -Labour MPs called for improved coordination between dept on providing advance information -David Hunt, Minister for Local Government and Inner Cities, supported relief scheme of several million GBP; local authorities should not be hindered from actions to ensure swift response
The Times (19900127i)	The Times, Taxing the Elements, p.11, 27Jan1990i. -all precautions against extreme natural events based on calculated risk -possible to reduce dangers of disruption by investing massively in underground cables & higher structural standards for construction & motorway penalties & proactive tree felling near motorways & rails; policy would result in loss of more trees than storm -making calculated risk means balancing effects of possible disaster against cost of safeguards -society could ride out storm like Daria every 300y at acceptable cost -if such storms expected every 3-4 years, case stronger for elaborate & costly framework like US hurricane -if 1987/1990 storms represent new climate change trend, then risks represent one of gravest challenges to mankind
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -detailed analysis of insurance loss to assess relationship with wind speed & predict insurance loss profile of more severe storms
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. -over past 2 decades, insurance industry increasingly concerned about rapid increase in losses from natural catastrophes -as large percentage of losses derived from extreme atmospheric events (windstorms, floods, droughts, hail) suspicion that trend influenced by environmental & climatic change worldwide -scientific proof of link still to be presented, no doubt about plausibility -precautionary principle: cost of adopting effectual preventative strategies -economic losses in last 10y factor of 8 greater than 1960s; insured losses by factor 14 -losses due to mounting economic values and insured liabilities in heavily exposed metropolitan areas -susceptibility of buildings and infrastructure has increased rather than decreased in spite of tighter building codes and technological advances -2nd IPCC report: no proof of connection between global warming & incr freq/intensity extr atmos events -analysis of statistical series and computer models produced numerous indications that there has been or will be a change in probability of extreme events. Examples: (1) heat waves. 1995 heatwave was 75y event in 1961-1990 climate normal will be 3y event in 2050, 39C event will be 9 times more frequent in 2100 (2) in recent decades, Europe's winters have become wetter & summers drier. Runoff of rain rather than snow so river discharges increases. Repeated Rhine floods Dec 1993 & Jan 1995. Torrential rainfall events responsible for majority of flooding losses (3) milder winters more common in Europe leading to shrinkage snow cover & protective blocking high P systems. Series of gales like 1990 no longer exceptional. No confirmation of increase in frequency & severity of low P & wind storm activity. (NOTE: Schinke 1993). Controversial and contradictory connection between global warming and tropical cyclone activity. *-question not if & when having definite proof of man-made climate change but whether available data & models can provide reliable estimate of future changes so adaptive & preventative strategies can be taken -Not all effects are inevitably negative -positive effect: greater crop yield & heating cost reduction in moderate & subpolar regions -risk of frost greatly diminished -negative effect: heat waves, droughts, air conditioning -attempts have recently been made to estimate global cost of man-made climate change and compare it to long-term stabilization measures -cost of climate change will be 1% of GNP for most countries; 10% for small island states -gov indecision & opposition at follow-up conferences in Berlin1995, Geneva1996, Kyoto1997
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -some effects lasted minutes or hours: electricity cuts, travel delays -other effects days or weeks: house/infrastructure damage -effects on forests/dunes/morbidity/mortality more long-lasting -forests closed to public for several weeks -payments by Dutch Red Cross to victims -building codes updated 1993 so buildings would withstand higher winds -insurance companies slightly increased insurance premiums -5 years after event hardly any traces left in Dutch society; only change in building code -highly developed society not vulnerable; interest in disaster preparedness is low -re-insurance companies seeing increases losses -Dutch railway company criticized for providing inadequate info to stranded travellers -Bosschap, forestry organization in Netherlands, had a contingency plan to prevent

	chaos on timber markets after event
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -German Federal government started Federation-State auxiliary program; 30 mill DM to Baden-Wuerttenburg -Switzerland: 370 mill Swiss Franc made available by Federal government and cantons for extraordinary felling; military and foreign contractors to assist in salvage logging
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] -Current and future trends -increase of growing stock & avg forest age across Europe in last 60y contributed to incr damage -if total growing stock & avg age increases, there will be proportial increase in volume damage -some evidence that storm intensity increasing & storm tracks penetrating further into Europe along wider swath; risk to forests in Eastern Europe -climate change: higher temp leads to longer periods of unfrozen soils; damage in Fennoscandia -storms will tend to have heavier rainfall leading to more saturated soils & wind damage -if growing stock increases with predicted changed in climate, damage levels 2-4X by2100 -storm damage give annual reduction of 2% in carbon sequestration by forests -ABSTRACT -storm intensity increasing; storm tracks penetrating further into mainland Europe and along a wider swath -higher temperatures will lead to longer periods unfrozen soils in winter, leading to increased damage particularly in Fennoscandia -storms will be accompanied by heavier rainfall; more saturated soils & increased wind risk -expect forest damage to double by 2100 from weather trends & ageing forest stock -no consistent recording and reporting system of forest damage across Europe -storm damage to European forests results in annual reduction of 2% in carbon sequestion; could exceed 5% by end of century
Koks and Haer (2020)	Koks EE, and T Haer, A high resolution wind damage mdoel for Europe, Scientific Reports, Nature Research, 10:6866, https://doi.org/10.1038/s41598-020-63580-w, 2020 -new storm damage model based on Corine map and Open Street Map; openly available outside insurance industry -insurance industry normally conducts storm damage models; insurance damage not open access
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -after 31 years, Daria remains powerful example of risk attendant on rising temperature
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -new insurance procedures to account for storm clustering and prevent solvency problems
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -in Netherlands after Daria, a research team for the crisis (Crisis Onderzoeksteam) created to evaluate the reactions of the authorities, transport companies and media. It concluded that the storm information was heterogeneous, late, inadapted and that the public often did not take account of the recommendations. The news of the storm, given by the media at the end of bulletin without emphasis, was often ignored. The study cited the counterexample of Belgium and UK where members of the government and queen were interviewed TV to talk about the crisis. No crisis plans at all levels of government. Dutch railways was able to use buses connect cancelled trains but the information to passengers was deficient, and more often it was the municipalities and Red Cross who provided food and shelter. Rail company devised emergency plan several months afterwords. The Dutch forest administration had a plan for the case of emergency but it was poorly known to the to the public services and forest owners

Table SL82. Worst case storm surge/storm situation (arranged by year and then alphabetically)

Source	Full Reference and Notes
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -consideration of insurance loss for super Daria storm andextreme version of 1953 pattern storm.
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -Munich Re model showed if track had been slightly diff, damage could have been 2-3X (Berz,1993) -damage scenarios based on analysis of impacts of recent storms & future storm risks
Jensen et al (2006)	Jensen J, C Mudersbach, SH Mueller-Navarra, I Bork, C Koziar, V Renner, Modellgestuetzte Untersuchungen zu Sturmfluten mit sehr geringen Eintrittswahrscheinlichkeiten an der deutschen Nordseekueste, Die Kueste, 71, 123-167, 2006. -MUSE project: maximum storm surge water levels that can be expected in Germany Bight -highest theoretical surges greater than 1 m higher than highest measurement over last 100y and higher than

	predicted 10000 y surge.

Table SL83. Damage costs; insurance losses (arranged by year and then alphabetically)

Source	Full Reference and Notes
BBC (19900125)	BBC, On this day 1950-2005, 25 January 1990: Children killed in devastating storm, (file created 5 December 2022) http://news.bbc.co.uk/onthisday/hi/dates/stories/january/25/newsid_3420000/3420797.stm, 25 January 1990. -Home Secretary David Waddington: government announces special funds to councils in worst-hit areas -Insurance companies: at least 750 mill GBP damage; in 1987 it was 1.2 bill GBP in claims
Belfast Telegraph (19900126c)	Belfast Telegraph, Death toll 44 as Britain counts the cost of storms, p4, 26Jan1990c. -insurance companies prepared for avalanche of claims; payouts expected to be well below great storm Oct1987
Belfast Telegraph (19900126e)	Belfast Telegraph, Minister pledges financial help to local councils, p.4, 26Jan1990e -local authorities facing massive storm damage clear-up operations can expect large scale financial help from government -government activating emergency scheme to pay for 75% of damage above certain level -cash paid under Bellwyn scheme -decision followed emergency meeting of Ministers last night in Cabinet Office, presided over by Home Secretary Waddington
Derby Evening Telegraph (19900126d)	Derby Evening Telegraph, Insurance chiefs set up hit squad (contributor: Graham Smith), p.3, 26Jan1990d -insurance companies nationwide preparing for flood of claims; storm damage payouts expected to be considerably less than 1.3bill GBP damage from Oct1987 hurricane -Sun Alliance UK, biggest home insurer had already received 5000 claims (2000 more than avg) by late yesterday -Bill Sciare, director of Sun Alliance UK: preparing for worst but not expected to be as bad as 1987 -Sun insures 1 in 5 homes in Britain -Association of British Insurers: total claims would be considerable less than 3 years ago -Tony Baker, ABI public affairs manager: not as severe as 1987
Eastern Daily Press (19900126a)	Eastern Daily Press, Storm leaves trail of death, p.1-2, 26Jan1990a. -Sun Alliance: 5000 calls for claims on 25Jan
Eastern Daily Press (19900126n)	Eastern Daily Press, Insurance companies braced for claims, p.3, 26Jan1990n. -insurance payouts expected to be much less than 1.3bill GBP of 1987 hurricane -Norwich Union reported 1000s of calls during afternoon at Norwich HQ -Sun Alliance UK, biggest home insurer, received 5000 calls by early evening 25/01/1990, 3000 more than average -Bill Sciare, Sun Alliance director: preparing for worst but do not expect magnitude of 1987 -telling people to get damage repaired as quickly as possible & send bill -Ken Hurst, spokesman Norwich Union: quick decision to be made today whether special claims unit needs to be set up like Oct1987 storm, which cost the company 54 mill GBP in claims -not quite the same devastation as 1987; immediately investigating interim payments so that people can fix things quickly -spokeman for Association of British Insurers: industry's final bill likely to be nearer 200 mill GBP bill for similar storm Jan1984
Evening Post Nottingham (19900126i)	Evening Post (Nottingham), Insurance companies ready for the worst', p.8, 26/01/1990i -insurance companies today preparing for flood of claims; fear damage could >1.3bill GBP for Oct 1987 hurricane -Sun Alliance UK, biggest home insurer: received 5000 claims by early evening 25Jan; 2000 more than average -Bill Sciare, Sun Alliance director: not known if Daria same magnitude as Oct1987 storm -Sun Alliance insures 1 in 5 homes in Britain -Association of British Insurers: total claims could be considerably less than Oct1987 -Tony Baker, Association of British Insurers: structural damage not as bad as Oct1987 -time delay in insurance totals for Oct1987 storm -4 days after Oct1987, damage at 200 mill GBP -1 month later, 400 mill GBP -Jan1988, 1.3 bill GBP -Oct1987 storm: 3/4 of claims settled within 3 months
Freiburger Nachrichten (19900127)	Freiburger Nachrichten, Vor allem Daecher erlitten Schaden, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -side-runners of hurricane storm in night 25-26Jan over west and central Europe caused damage in Kanton Freiburg -kanton building insurance authority the received 100 mostly small damage claims by midday 26Jan -Pierre Ecoffey, director of kanton insurance agency KGVA: small damage report by yesterday midday -mostly damage roofs or roof parts -100 damage reports come to about 300000 Franken -Pierre Ecoffey satisfied that storm did not cause more damage -in the past year summerstorms had caused damage especially in Glanebezirk
Herald Express (19900126a)	Herald Express, Clean-up will cost millions, p.1, Friday, 26January1990a -insurance companies & builders flooded with calls as clean-up began; 2 dead S Devon -local tax payers could end up paying part of repair bill -Dave Berridge, Association of British Insurers: receiving 100s claims -advising people to get damage repaired -Devon county council to pay 50-300k GBP for clearing 130 roads that had to be closed

Herald Express (19900126b)	Herald Express, Trail of death nationwide, p.1, 26Jan1990b -Home Secretary David Waddington summoned to review effects of storm -financial assistance made available to local authorities
Huddersfield Daily Examiner (19900126d)	Huddersfield Daily Examiner, Tragic cost of 100mph winds, p7, 26Jan1990d. (Friday) -damage ran into 100s millions of pounds; trees on buildings and cars; walls/roofs demolished -insurance companies prepared for avalanche of claims; payouts expected to be well below great storm of 1987; government promised emergency cash for for local authorities
Lloyd's Weekly Casualty Returns (19900206)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 4, 06/02/1990 -Netherlands: record winds caused millions of dollars of property damage across country, halted trains & overturned trucks
Lloyd's Weekly Casualty Returns (19900213)	Lloyd's Weekly Casualty Returns, Lloyd's of London Press Ltd., Sheepen Place, Colchester, Essex, CO3 3LP, vol. 279, No. 5, 13/02/1990 -NETHERLANDS: National Insurance Information Office spokeswoman: it will take weeks to appraise, damage probably in 100s millions dollars -NETHERLANDS: insurers association Verbond van Verzekeraars: Dutch insurers face 100s millions of florins in claims after worst storm to hit country in decade -NETHERLANDS: total damage could reach billions of florins, but a proportion, particularly cars, were not covered -Dutch new agency ANP: claims in The Hague and Amsterdam reached 3300 -Denmark's insurance society estimated insured damage around 150 mill DKR; figure will probably rise -100s millions dollars damage in Britain, France, Belgium, Netherlands -provisional figures from Belgium's Group AG suggest bill Fr3billion -British insurance damage estimated damage up to 1 billion GBP
Mariners Weather Log (1990)	Mariners Weather Log, North Atlantic Weather Log January, February and March 1990, Marine Weather Review, Mariners Weather Log, pp.50-63, summer, 1990. -damaged estimated in 100s millions dollars
Milwauki Journal (19900126)	Milwauki Journal, Fierce storm claims 93 lives in Europe, 26/01/1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -Independent newspaper: early estimate of property damage Britain 1.3 bill USD
Neue Zuercher Nachrichten (19900127)	Neue Zuercher Nachrichten, Sturm forderte Menschenleben, 27Jan1990 (clipping in Swiss Severe Storm Database SSWD, 19900125 01 Storm Daria, https://www.sturmarchiv.ch/index.php?title=19900125_01_Storm_Daria, last edit 09Jan2021) -by contrast Basellandschaftelische Gebaudeversicherung received 100s damage reports
Press and Journal (19900126a)	Press and Journal, 39 killed as storms batter Britain, p.1,11, 26Jan1990a Friday -damage estimated at millions of GBP -emergency meeting of ministers to review effects of storm -financial assistance through Bellwin scheme -David Waddington, Home Secretary -Oct1987 damage: 1.5 billion GBP; Daria expected to be less -Sunn Alliance, Britains's biggest insurance company; 5000 calls
The Times (19900126)	The Times, Motorways blocked, London halted (contributors David Cross and David Sapsted), p.1, 26Jan1990 (clipping in westiedad, Weathering the Burns Day Storm: 25-26 January 1990, 18/11/2013 https://onlylivingboyintitirangi.wordpress.com/2013/11/18/weathering-the-burns-day-storm-25-26-january-1990/) -emergency meeting government ministers: government support to pay for damage
The Times (19900127a)	The Times, More fierce gales coming; Blizzards bring road chaos to Scotland in wake of storm (contributor David Sapstead), p.1, 27Jan1990a. -insurance companies bracing claims totalling a record 2 bill GBP
The Times (19900127b)	The Times, Insurance claims likely to exceed 1987s 2 bn GBP total (contributor Melinde Wittstock), p2, 27Jan1990b -insurance claims for Thursday storm damages could exceed 2bn GBP of Oct1987 great storm -David Hudson: we would not be surprised if losses greatly exceed 1987 -total insured loss will likely be more than 2 bn GBP in total -most of the big composite insurers increased their reinsurance cover after 1987 hurricane
Wetteronline (19900228)	Wetteronline, Schwere Orkanserie im Spaetwinter. Vivian, Wiebke, und Co, 28Feb1990 https://www.wetteronline.de/wetterticker/schwere-orkanserie-im-spaetwinter-vivian-wiebke-und-co--3GGPXoiQ0zeGK6WfdXJvns -large chaos resulted from the hurricane in north and central Europe; damage at 4.4billion EUR
Munich Re (1993)	Munich Re, Winterstuerme in Europa, Schadenanalyse 1990 Schadenpotentiale, Muenchener Rueckversicherungs-Gesellschaft, Konigenstrasse 107, D-80802 Muenchen, Bestellnummer 2041-E-d, 56pp, 1993 -end Jan-start Mar 1990 Europe hit by 8 storms reaching hurricane level -storms Daria, Herta, Judith, Nana, Ottilie, Polly, Vivian, Wiebke -total damage 25 billion DM, of which 17.3 billion DM insured (1990 values) -highest ever damage in Europe; designated a 'neue Dimension' -next most damaging storms: Capella Hurricane 1976 had insured damage 2.7 billion DM (1990) Oct1987 Hurricane for UK & France damage 5.2 billion DM (1990)
Berz (1998)	Berz, G.L., Global warming and the insurance industry, in F.L. Toch (ed), Cost-Benefit Analysis of Climate Change: The Broader Perspective, Birkhauser Verlag, Basel, Switzerland, pp. 41-56, 1998. -TAB1. The billion dollar insurance losses from natural disasters as of 11/95 Rank Year Event Area Insur_loss Econ_loss

	insu bill_USD bill_USD --- 15 1983 hurricane Alicia USA 1.275 1.650 6 1987 winter storm W Europe 3.100 3.700 5 1989 hurricane Hugo Carib, USA 4.5 9.0 4 1990 winterstorm Daria Europe 5.1 6.8
Berz (1999)	Berz, Gerhard A., Catastrophes and climate change: concerns and possible countermeasures of the insurance industry, IPCC Workshop, Costa Rica, April 1998, Proceedings. Mitigation and adaptation strategies for the global change, 4, 283-293, 1999, Kluwer Academic Publishers, 1999. -Daria with 5.1 bill USD of insured loss & 6.8 bill USD of total loss (info not given of reference year)
Dorland et al (1999)	Dorland C, RSJ Tol, AA Olsthoorn, JP Palutikof, Impacts of windstorms in the Netherlands: Present risk and prospects for climate change, in Climate, Change and Risk, ed by TE Downing, AA Olsthoorn, RSJ Tol, Routledge, London and New York, pp.245-278, 1999. -total damage 2.6 bill Dfl1990 of which 1.5bill Dfl covered by insurance industry -repair of dunes 15mill Dfl -damage to forests 13-15mill Dfl -damage to airplanes and buildings at Schipol 5mill Dfl -economic losses from transport delays 10mill Dfl -private house damage at top of storm bill (1.03 bill Dfl), followed by commercial buildings 0.38 bill Dfl -of total losses, 38% not insured
BBC (20070220)	BBC, UK storm payout 'may hit GBP 350m', 20Feb2007 http://news.bbc.co.uk/2/hi/business/6380123.stm -insurers could face a 350 million GBP bill for damage for UK January storms -storm Kyrill hit UK 18Jan and resulted in 13 UK deaths -Association of British Insurers ABI: Kyrill was only rank 8 expensive weather event -high winds in first weeks 1990 cost insurers 3.37 billion GBP; most expensive for insurers -great storm of 1987 cost insurers 2 billion GBP rank 2 most expensive -last month Swiss Re estimated Kyrill damage cost across Europe could be as high as 2.3 billion GBP
Heipertz and Nickel (2008)	Heipertz, Martin and Christiane Nickel, Climate change brings stormy days: Case studies on the impact of extreme weather events on public finances, SSRN Electronic Journal, pp. 613-630, DOI: 10.2139/ssrn.1997256, April 2008 (In Fiscal Sustainability, Analytical Developments and Emerging Policy Issues, 3-5April2008) -TAB4. Estimated indirect fiscal impact of Winter storm Daria -insured damage: UK 2402 mill EUR, Netherlands 630 mill EUR, W Germany 472.6 mill EUR, France 236 mill EUR, Belgium 196.9 mill EUR -economic damage as %GDP: Luxembourg 0.71, Netherlands 0.41, UK0.34, Belgium 0.17, Poland 0.13, Denmark 0.09, west Germany 0.07, France 0.03 -indirect fiscal impact
Anonymous (2010)	Anonymous, And it happened again! 25th January 1990, p.153, https://www.google.com/imgres?imgurl=https://content-eu.invisioncic.com/d321955/monthly_01_2010/post-1989-12643409089528.jpg&imgrefurl=https://community.netweather.tv/topic/27190-the-great-storm-of-25th-january-1990/&h=1424&w=1008&tbnid=p2nU7mIDvNusXM&tbnh=267&tbnw=189&usg=AI4_-kRiUmGPQ4jCA2OrtnS8qnb12lN52Q&vet=1&docid=wxEVezsB6bUF3M, 2010 -nationally, Daria (plus other storm February) cost insurance companies 2.081 bill GBP vs 1.227 billion GBP after 1987 hurricane -big freeze Jan1987 cost 0.332 bill GBP -cold spell 1981-82 cost 0.383 bill
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -storm was UK most expensive insurance weather event -estimates of economic loss potential based on insurance data -Muenchener Ruck (1999): Daria, Vivian, Wiebke caused 2bill DM in Germany -50% of these damages insured -damage for all Europe at 25 bill DM (12.5bill EUR), of which 17.3 bill EUR insured (1990 val) -Daria had the highest insured & noninsured damage in Europe at time of occurence -Muenchener Ruck insured damage assessement 4.4bill EUR (Muenchener Ruck, 2007); Swiss Re (2002) damage assessment >6 bill USD -Muenchener Ruck: UK insured damage highest at 2.6 billon EUR; Neth 0.7 bill EUR, DE 0.5 bill EUR; for FR-BE-LU-DK together damage 0.6 bill EUR -TAB6.1. Insured storm damage of the storm series 1990 (Munchner Rueck 2001) NOTE: Europe damage: Daria>Vivian>Wiebke>Herta NOTE: Daria: UK>Netherlands>Germany>France>Belgium * -FIG6.4. The most important historic storm events in Europe from 1976 to 1999 with insured damage 1990 storm series>1999 storm series>87J -total economic loss for storm sequence 12.8bill EUR (Munchener Ruck, 2001) -8.5bill EUR insurance payment for Daria-Herta-Vivian-Wiebke -Goyette et al (2001) gives estim for storm damage Daria-Vivia-Wiebke 10bill USD * -storm represent most expensive storm catastrophes in Europe -Country data (Munchener Ruck, 2001) -Belgium: 1990 storms caused 0.87 bill EUR damage; 15 deaths -Denmark: 0.16 bill EUR -Germany: 3.8 bill EUR 64 -France: 1.65 bill EUR 66

	-UK: 4.1 bill EUR 85 -Luxembourg: 0.3 bill EUR -Netherlands: 1.5 bill EUR 21 -Switzerland: 0.16 bill EUR 4 -Austria: 0.2 bill EUR 3
Gardiner et al (2012)	Gardiner B, K Blennow, J-M Carnus, P Fleischer, F Ingemarson, G Landmann, M Lindner, M Marzano, B Nicoll, C Orazio, J-L Peyron, M-P Reviron, M-J Schelhaas, A Schuck, M Spielmann, T Usbeck, Destructive storm in European Forests: Past and Forthcoming Impacts, European Forest Institute, Atlantic European Regional Office - EFIAtlantic [pdf document properties: author=Barry Gardiner, datestamp=09Mar2012] * -storm series Jan-Mar1990 one of most devastating for Europe * -total cost almost 13 bill EUR; most expensive storm series ever recorded (Munich Re,2001)
AON Benfield (2013)	AON Benfield, Historie von 1703 bis 2012: Winterstuerme in Europea, Stand: Januar 2013 -for long period, Daria rank1 for highest insured damage; Kyrill overtook Daria in 2007 -insured damage from Daria for Germany was 1.5 bill EUR2012
Munich Re (2013)	Munich RE, Natural catastrophes in Germany 1970-2012, Muenchener Rueckversicherung-Gesellschaft, Geo Risks Research, NatCatSERVICE - as of January 2013 - Daria: rank5 for overall loss; rank3 for insured loss; rank11 for fatalities
Air Worldwide (20191219)	Air Worldwide: Three severe storms together were a wake-up call, Air Worldwide, Boston, Massachusetts, available at: https://www.air-worldwide.com/blog/posts/2019/12/three-severe-european-winter-storms-together-were-a-wake-up-call/ (last access: 21 November 2021), 19 December 2019. -maximum wind speeds of the storms in 1999 greater than first quarter storms of 1990; insurance companies companies did not take out re-insurance policies after 1990s; it created solvency problems after 1999 storms, particularly with Anatol in Denmark
Koks and Haer (2020)	Koks EE, and T Haer, A high resolution wind damage mdoel for Europe, Scientific Reports, Nature Research, 10:6866, https://doi.org/10.1038/s41598-020-63580-w, 2020 -Daria most damaging European winter storm, followed by Lothar 1999
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -Swiss Re estimated total property damage at 6 billion EUR -UK insurers paid out 3.37 billion GBP -Welton: Daria drove local companies and markets to limits of existing financial capabilities -oversight in insurers policies: claims inflation, clustering, unexpected aggregation from multiple events
Lockwood et al (2022)	Lockwood, J.F, Guentchev, G.S., Alabaster, A., Brown, S.B., Palin, E.J., Roberts, M.J., and Thornton, H.E.: Using high-resolution global climate models from the Primavera project to create a European winter windstorm event set, Nat. Hazards Earth Syst. Sci., 22, 3585-3606, https://doi.org/10.5194/nhess-22-3585-2022, 2022 -Daria insurance loss 8.7 billion USD (2017)
Wetteronline (20220122)	Wetteronline, Vor 30 Jahren: Orkantief Daria wuetet - Tote und Milliardenschaeden, contributor Matthias Habel, 22/01/2022. https://www.presseportal.de/pm/12322/4499208 -storm caused millions in damage & is one of the most expensive winter storms of recent decades -Matthias Habel: hurricane damage in N,W,middle Europe; 4.4 billion EUR damage -Daria is in category as hurricanes Lothar 1999 & Kyrill 2007 as the most financially damaging natural catastrophes of the last 50y
Emerging risks (2021)	Emerging risks, Daria anniversary a wake-up call to be prepared, https://www.emergingrisks.co.uk/daria-anniversary-a-wake-up-call-to-be-prepared/, (accessed 09Dec2023), 2021 -Swiss Re estimated total property damage at 6 billion EUR -UK insurers paid out 3.37 billion GBP -Welton: Daria drove local companies and markets to limits of existing financial capabilities -oversight in insurers policies: claims inflation, clustering, unexpected aggregation from multiple events
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) -cost of damage up to 1.5billion EUR
Swiss Re (2023)	Swiss Re, Cyclone Daria, or the Burns' Day Storm, last access 23Aug2023 https://www.swissre.com/risk-knowledge/mitigating-climate-risk/winter-storms-in-europe/cyclone-daria-burns-day-storm.html -Swiss Re estimated total cost property damage 6 billion EUR -UK insurance companies paid out 3.37 billion GBP -1990 storm cluster brought several companies or entire markets to limits of financial capabilities -several areas critical -unexpected aggregation can take place via the specific event definition in a reinsurance contract (72h clause) ... -clustering generates large losses and therefore has a substantial impact on solvency considerations -claims inflation can lead to substantial loss amplification -processes become overwhelmed with the vast number of claims
Weatherandradar (2023)	Weatherandradar, On this day in 1990. The great Burns Day cyclone (contributor Ryan Hathaway),https://www.weatherandradar.co.uk/weather-news/on-this-day-in-1990-the-great-burns-day-cyclone--a73e8ce9-ff3e-41c2-ac05-db47b25fe829, 25Jan2023 -storm remains most expensive weather event on record for UK insurers at 3.37 bill GBP
Wikipedia (20240111)	Wikipedia, Tempetes de l'hiver 1990 en Europe, https://fr.wikipedia.org/wiki/Temp%C3%AAtes_de_l%27hiver_1990_en_Europe, accessed 11/01/2024. -Damage from the 25Jan storm in Europe estimated at 6.8bill USD of which 5.2 bill USD insured -Netherlands: storm damage for 1990 events at 2.5 bill florins of which 1.5 bill insured

	-extra 15 mill florins for dune restoration, 13-15 mill florins for forests, 5 mill florins for damage to Schipol airplanes and buildings, and 10 mill florins for late transport

Table SL84. Online data sets (alphabetically)

Source	Full Reference and Notes
Belgium VLIZ	Belgium tide gauge and wave information with some associated meteorology: https://meetnetvlaamsebanken.de
Caithness Wind Farm	Caithness wind farm list of wind energy accidents: https://scotlandagainstspin.org/turbine-accident-statistics/ https://scotlandagainstspin.org/wp-content/uploads/2023/04/Detailed-incidents-to-31-Mar2023.pdf https://sctlandagainstspin.org/turbine-accident-statistics/
CMEMS	European Copernicus wave information http://www.marineinsitu.eu/dashboard/
Danish Energy Agency (20230719)	Danish Energy Agency, Overview of the Energy Sector, last access 19Jul2023 https://ens.dk/en/our-services/statistics-data-key-figures-and-energy-maps/overview-energy-sector -excel files of operating and decommissioned turbines in Denmark -monthly wind energy production in Denmark from 2002
Denmark tide gauge data	https://kyst.dk/soeterritoriet/maalinger-og-data/vandstandsmaalinger/
DWD (2022)	DWD archive of weather maps: www2.wetter3.de/Archiv/archiv_dwd.html
ESWD (20220501)	European Severe Weather Database, https://eswd.eu (last access 01May2022)
Extreme Wind Storms Catalog	http://www.europeanwindstorms.org
Fink et al (2007)	Fink AH, T Brucher, V Ermert, A Kruger, JG Pinto, The European storm Kyrill in Jan 2007: synoptic evolution, meteorological impacts and some considerations with repect to climate change, Natural Hazards and Earth System Sciences, 9, 405-423, 2009. -'weather charts over North America were obtained from the California Regional Weather Server and Unisys Weather Information Services'
Gatzen et al (2020)	Gatzen CP, AH Fink, DM Schultz, JG Pinto, An 18-year climatology of derechos in Germany, Nat Hazards Earth Syst. Sci., 20, 1335-1351, 2020 -lightning used to identify and track European derechos 1997-2014 -'We used data from the Arrival Time Difference (ATD) system operated by the Met Office (Lee, 1986) available at wetterzentrale.de (2016) until the year 2000 and from the Siemens Blids lightning network (Siemens, 2019) for events after the year 2000'
Karlsruhe Institute of Technology KIT	KIT extreme weather descriptions: http://www.wettergefahren-fruehwarnung.de/Ereignis/archiv_sturm.html
Karlsruhe Institute of Tecnology KIT	KIT FDA reports: https://www.cedim.kit.edu/english/2850.php
Land-SH	http://www.umweltdaten.landsh.de/public/hsi/pegelsuche.html -information on the Land-SH tide gauges
Norway Kartverket (20220301)	Kartverket website https://api.sehavniva.no/tideapi_en.html (last access 1Mar2022)
Norway SEklima	Norway wave information https://seklima.met.no
Netherlands RWS Waterinfo	RWS: (Rijkswatersaat Waterinfo) https://waterinfo.rws.nl/#!/nav/expert/alle-groepen/
Primavera	PRIMAVERA European winter windstorm event https://zenodo.org/record/6492182#.YzRjCqTMJPY
Quikscat	qscat data product information site https://podaac.jpl.nasa.gov/dataset/QSCAT_LEVEL_2B_OWV_COMP_12 qscact ftp download site https://podaac-tools.jpl.nasa.gov/drive/files/allData/quikscat/L2B12/v3/2007/011
UK BODC tide gauge	https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/uk_tide_gauge_network/processed/
UK CEFAS Wavenet	https://wavenet.cefas.co.uk/
UKMO (2021) Daily Weather Summary	UKMO, personal communication with Catherine Ross, UKMO, 2 Mar 2021. UKMO daily weather summaries at Digital Library and archive: https://digital.nmla.metoffice.gov.uk/collection_86058de1-8d55-4bc5-8305-5698d0bd7e13/
UKMO (2022) Marine Observer	Back issues of Marine Observer, https://digitial.nmla.metoffice.gov.uk/SO_Oafb8f96-434b-42c3-8082-056623702322/
UKMO Meteorological Magazine	Back issues of Meteorological Magazine https://digital.nmla.metoffice.gov.uk/SO_31c4215d-460a-4ce3-bdac-12c775f5c92d/
University of Wyoming radiosonde archive	https://weather.uwyo.edu/upperair/sounding.html

Table SL85. Storm animations (alphabetically)

Source	Full Reference and Notes
Extreme Wind Storms (XWS) Catalog	
Meteofrance (2023)	Meteofrance, Daria le 25 janvier 1990, https://web.archive.org/web/20171107022827/http://tempetes.meteofrance.fr/Daria-le-25-janvier-1990.html (accessed 26Mar2023) FIG2. [ANIMATION] Animation of cloud patterns

Table SL86. Onshore/offshore wind energy policy and historical development

Source	Full Reference and Notes

Rand (1991)	Rand, Marcus, Wind energy in the UK and the role of local authorities, Wind Energy, 2, 68-79, 1991 -NFFO Non Fossil Fuel Obligation, environmental implications of Greenhouse Effect, renewable energy R&D from energy crisis 1970s & environmental crisis like acid deposition, Denmark and California installed wind energy, US wind energy program peak 1981, US National Energy Act, Elsam & Elkraft utilities install wind capacity 1991 & 1993, Denmark private and collective wind energy ownership, Denmark exported 7000 turbines to California, emphasis UK government policy to determine resource potential & demonstrate technology, UK wind developments Burgar Hill in Orkneys & CEGB turbine test centre Carmarthen Bay at Dyfed, UK institutional factors preventing wind energy development
Price et al (1996)	Price T, J Bunn, D Probert, R Hales, Wind-energy harnessing: Global, national and local considerations, Applied Energy, 54, 103-179, 1996 -wind energy in Europe and UK at very early stage of development -history wind energy -oil/nuclear hamper wind energy 1960s, -oil crisis 1973, -beginning 1980s only Deanmark/California with significan commercial developments, -early 1990s popularity grown wind energy Europe, -1989 UK Electricity Act, -British government policy 1995 to develop renewable energy for objectives; secure/sustainable energy source & reduce pollution emissions, -UK 1.5GW renewable energy target 2000, -advantages of wind power, -FIG2 European wind turbine capaicity installed 1991-1993, -FIG3 UK onshore net capacity 1989-1993, -TAB3 displaced emissions
Auken (2002)	Auken, S., Answers in the wind: How Denmark became a world pioneer in wind power, Fletcher Forum of World Affairs, 26, 149-157, 2002 -history of development of wind energy in Denmark -Denmark R&D favors small turbine versus large turbine of other countries -Denmark wind market from interest in alternative energy sources-nuclear opposition-1970 oil crisis -California wind energy explosion early 1980s (Great California Wind Rush); 50% CA turbines Danish -Energy21 policy, 50% electricity from wind power by 2030, -Danish energy planning to accommodate intermittent power sources -1994-2000 Danish wind industry grew by 40% per year; 2000-2010 growth anticipated at 20%/year, comparable with cell phone/computer growth rate -Denmark 6200 turbines with total capacity 2350MW since eaerly 1980s, >80% of 6200 turbines owned by energy cooperatives or individual farmers, -government directives for utilities to install large scale onshore wind farms starts from 1986 -Denmark to have first large scale offshore wind farm
Pasqualetti et al (2004)	Pasqualetti M, R Righter, P Gipe, History of Wind Energy, in Encyclopedia of Energy, vol.6, pp.419-433, 2004 -history of wind energy -California and Denmark main countries with wind turbines 1990 -Denmark government policy form 1981 -German government law for renewable energy from 1990 -UK & NE had development programs from early 1980s -UK: misdirected R&D funds to electric utilities; wind industry near collapse late 1990s -by 2002 installed capacity in UK/NE only 5% DE
Price (2006)	Price, T.J., UK large-scale wind power programme from 1970 to 1990: The Carmarthen Bay experiments and the Musgrove vertical-axis turbine, Wind Engineering, 30, 225-242, 2006 keywords: Musgrove Vertical Axis WInd Turbine VAWT, UK Carmarthen Bay test programme, Burgar Hill in Orkneys, contemporary policy for Danish/German turbines, 3 100kW test turbines 1950-1960, wind power funding terminated 1960s, oil crisis 1973, WEG 3MW HAWT Burgar Hill Orkney, UK government wind program starts 1979, feasibility studies 1980s & demonstration projects 1990s, DOE objectives and programmes, CEGB 1980s 80 coal/oil/nucleaer power stations, first turbine Carmarthen test site 1982 US 200kW, offshore not to be developed before 1990s success of Denmark-Germany-Spain to manufacture & install own networks due to policy of feed-laws rather than grants to specific companies
Wilson (2012)	Wilson, JC, A history of the UK renewable energy programme, 1974-88: some social, political, and economic aspects, Ph.D. thesis, University of Glasgow, Sept, 2010, 2012. renewable energy insurance technology, first postwar energy crisis 1956, massive expansion nuclear energy program 1950s for energy security, renewable energy programme token gesture uncertain landscape 1970s, 1972 book The Club of Rome's: The limits to Growth UK wave energy program 1975-1982, 1988 doc Renewable Energy in the UK: The Way Forward, renewables cannot replace fossil fuels, fossil fuels from 18C solve problem of intermittency, UK paradigm centralized energy supply, UK grid network prevents integration renewable energy 1970s 1980s, electricity Supply Act 1926, National Grid built 1927-1933, UK net importer of coal 1936, British Electrical Authority 1948 believed coal would contniue to be dominant fuel, UKAEA established 1953, Harold Macmillan 1957 orders trebling of nuclear program,

	isolated attempt by CEGB to experiment with wind energy Lleyn Peninsula Wales 1950s 1970s energy issues-1973 oil crisis-political upheaval- repeated industrial unrest in coal industry-discovery North Sea oil & gas- decision over nuclear reactor-emergence of new environmentalism, 1970 oil overtakes coal, oil price shock 16Oct1973 10d after outbreak of Yom Kippur War, British Advanced Gas-Cooled Reactor (AGR) vs American Light Water Reactor (LWR) Heathrow Wave Energy Conference Nov1978, Hawker Siddeley Dynamics proposal 1977 3.7MW turbine, UK change stance wind energy 1978 with US decision to develop wind power & job opport for UK, Jan1981 Sec State for Energy David Howell announced gov plan to build 60m diam blade 3MW at Burgar Hill in Orkneys, Carter plan to have 20% US electricity from solar by 2000, Scottish islands relied mainly on diesel oil for electricity generation-suffered 1970s, California wind rush, US wind subsidies stopped Dec1985, Danish turbine manufacturers demon any immediat potential in smaller machines than 3MW WEG, 3MW WEG machine became elegant white elephant, Howden bad experience US withdraw from wind industry, Howden Richborugh turbine, UK made late start compared to Denmark-Germany-Sweden, commercial advantage of <1MW machines not recognized by DoEn-opted for 3MW Orkney machine 5y, Feb1988 Walter Marshal plan to build 3 wind farms in UK-only 1 farm Cold Northcott Cornwall built, wind energy and renewables would have disappeared at end of 1980s except for climate change, after 1974 drivers were rising oil prices-supply security-dwindling fossil fuel reserves, after 1989 new incentive of reducing carbon emissions
Beurskens (2014)	Beurskens, J, The History of Wind Energy, Understanding Wind Power Technology: Theory, Deployment and Optimisation, First Edition, ed by A Schaffarczyk, John Wiley and Sons, 2014 -history of wind energy Enlargement trend of modern wind turbines, Growth of the world market for wind turbines, WEGA I 1989 & WEGA II European programs, wind energy development Denmark 1970s versus others, Limits to Growth 1971/1972 by Club of Rome, oil crisis 1973, offshore Vindby-Tuno Knob-Horns Rev, 10y lead time for extension of grids, wind turbine product life 6y, nuclear & fossil fuels 1970s -FIG1.34.[SCHEMATIC] Overview of the large wind turbines developed in Europe. Reproduced with permission of Keesing Media Group -FIG1.35.[SCHEMATIC] Enlargement trend of modern wind turbines -FIG1.36.[TIMESERIES] Growth of the world market for wind turbines

Table SL87. Context and background information where storm not mentioned (arranged by year and then alphabetically)

Source	Full Reference and Notes
Miller (1972)	Miller, R.C., Notes on analysis and severe-storm forecasting procedures of the Air Force Global Weather Central, Technical Report 200 (Rev), Air Weather Service (MAC) United States Air Force, May 1972 -explanation of SWEAT index for tornado and severe thunderstorm forecasting
Hayden (1970)	Hayden, BP, Storm wave climates at Cape Hatteras, North Carolina: Recent secular variations, Science, 190, 981-983, 1975. -trend toward increasing number of storms generating wave height >11 feet in Cape Hatteras area in period 1942-1973; storm have longer duration -modal month of highest storm incidence changed over time -storm trend explains increased coastal erosion -sea level increase trend notes -world wide climate change publications from early period; Hayden, BP, Storm wave climates at Cape Hatteras, North Carolina: Recent secular variations, Science, 190, 981-983, 1975.
RF (1976)	RF (Reedereigemeinschaft Forschungsschiffahrt GmbH), Forshungsplattform Nordsee, 4 pp, 1976 -background information for Forschungsplattform Nordsee
Neu (1984)	Neu HJA, Interannual variations and longer-term changes in sea state of the North Atlantic from 1970 to 1982, JGR, 89, 6397-6402, 1984. -increase in North Atlantic sea state during 1970s
Groning et al (1990)	Groning, B., M. Koch, W. Canter, T. Moller, Sa stor forurening sparede vindkraft os for i januar, Vindproduceret El, Naturlig Energi, 12, p.17, March 1990. -pollution saved from burning coal by using wind energy
Houghton et al (1990)	Houghton, J.T., Jenkins, G.J., and Ephraums, J.J., Climate Change. The IPCC Scientific Assessment, Cambridge University Press, Cambridge, 1990. -IPCC first assessment report
Bacon and Carter (1991)	Bacon S and DJT Carter, Wave climate changesin the North Atlantic and North Sea, International Journal of Climatology, 11, 545-558, 1991. -literature review showing long term increase in annual mean significant wave height in North Atlantic from 1950-1990 -North Sea does not show long term trend but rough conditions in period 1979-1980
Hamre et al (1991)	Hamre R, A Kvitrud, K Tesdal, In service experience of fixed offshore structured in Norway, OMAE-91-512/AQ-305-90/24.9.1990 http://kvitrud.no/1991%20OMAE%20In%20service%20experience%20of%20fixed%20offshore%20structures.pdf -Norwegian platform storm damage in period 1980-1989
Van Cauwenburghe	van Cauwenberghe, C., Overzicht van de tijwaarnemingen langs de Belgische kust. Periode 1981-1990 voor Nieuwpoort, Oostende en Zeebrugge, Infrastructuur in het Leefmilieu 6/93, 421-440, 1992. VLIZ, Vlaams Institut voor de

(1992)	Zee/Flanders Marine Institute, Oostende, Belgium, No. 66536. -Storm Daria did not generate a significant storm surge in Belgium
Johns et al (1993)	Johns, Robert H., Jonathan M. Davies, Preston W. Leftwich: Some wind and instability parameters associated with strong and violent tornadoes. 2. Variations in the combinations of wind and instability parameters, Proceedings Tornado Symposium III, C. Church (ed), Amer. Geophys Union, pp.583-590, The Tornado: Its Structure, Dynamics, Prediction, and Hazards, Geophysical Monograph 79, American Geophysical Union, 1993 keywords: positive wind shear PWS, convective available postential energy CAPE, surface parcel lifted index SPLI, warm season derechoes, helicity, bulk Richardson number, tornado, supercell, downdraft
Schinke (1993)	Schinke, H., On the occurrence of deep cyclones over Europe and the North Atlantic in the period 1930-1991, Beitr. Phys. Atmosph., 66, 223-237, 1993. -statistical analysis of spatial and temproal distribution of low pressure centres on daily weather maps over North Atlantic and Europe -increase of storms starting in 1970s -extreme low pressure centers migrated south into Europe during 1980s
Hogben (1994)	Hogben, N, Increases in wave heights over the North Atlantic: A review of the evidence and some implications for the naval architect, Transacations of The Royal Institution of Naval Architects, W5, 93-101, 1994. -evidence for increasing trend of North Atlantic and North Sea wave height in recent decades -increasing wave height has implications of increased fatigue damage to offshore structures; not directly addressed -long term wind speeds Sevenstones light vessel do not show long-term trend -changing relation between significant wave height and wind speed based on increasing swell -speculation that increasing swell from increasing frequency of storms -key publications: Waldon (1970), Rodewald (1972), Neu (1984), Carter and Draper (1988), Bacon and Carter (1991) -using JONSWAP model to illustrate how the relation between mean wave height and wind speed varies as function of duration and/or fetch
Eden (1995)	Eden, Philip, The North Sea Floods of 1953, in Weatherwise. The Sunday Telegraph Companion to the British Weather, pp.42-45, MacMillan Reference Books, 1995. -information on UK storm surges including insurance loss from 1953 North Sea storm surge
Bouws et al (1996)	Bouws E, D Jannink, GJ Komen, The increasing wave height in North Atlantic Ocean, Bulletin of the American Meteorological Society BAMS, 77, 2275-2276, 1996 -secular trend of increasing wave heights on both sides of the North Atlantic based on analysis of 20000 wave charts 1960-1985 -agreement with wave trend analysis of Neu (1984) and Bacon and Carter (1991) -wave trend agrees with trend in North Atlantic Oscillation -wind speeds from Seven Stones Light Vessel Lands End do not show secular trend; wave climate reflects swell which is not directly linked with local wind speed.
Gallett et al (1997)	Gallett, I.N.L., D. Thomas, A.J. Fyfe, An assessment of the impact of changing meteorological and oceanographic (Metocean) conditions on offshore activities. Report on the SUT Colloquium, held 18 April 1996 in London, UK, Journal of the Society for Underwater Technology, vol.22, no.2, pp.75-78, 1997 -change in North Sea wave climate especially since early 1990s -Leggett et al: data from Shell's northern North Sea platform from mid-1970s -peak values Hs since 1988 signif higher than 1973-1987 -autumn conditions calmer & late winter conditions more severe -Smith and Owrid: 1990s SWH peaked at values higher than previously recorded for the North Sea, but no evidence of mean SWH for each year -unclear if annual max Hs increase 1975-1993 part of trend or due to short term cyclic behavior peaking early 1990s -100y wave for design criteria; 10000y wave for air gap -NESS data set -older structures over-designed with larger air gaps than necessary -satellite altimeter for significant wave height -North Sea northerly storm -El Nino predictor -several incidents where waves covered full air gap
WASA Group (1998)	The WASA group, Changing waves and storms in the Northeast Atlantic, BAMS, 79, 741-760, 1998 -much recent discussion on increases in storm and climate climate over North Atlantic Ocean -problems identifying long term changes in wave climate in North Atlantic and North Sea -most data sets have inhomogeneities; data quality issues on time scales > 10 years -best data sets for maritime storminess trends are mercury barometers (for grestrophic wind trinagles, lowest pressure and pressure tendency) and tide gauges -two storminess peaks: recent decades and at end of 19th century -wave height trends linked with North Atlantic Oscillation
Lefebvre (2000)	Lefebvre Ch., Haufigkeit von Stuermen im Nordatlantik, report from 01/06/2000b pdf timestamp: 28/05/2002. https://www.dwd.de/DE/leistungen/besondereereignisse/stuerme/20000601_haeufigkeit_stuerme.pdf?__blob=publicationFile&v=4 -literature review summary in wake of storms Anatol-Lothar-Ginger in 1999-2000 -emphasis on scientific results from Heiner Schmidt and Hans von Storch -number of days per year with gust at Bf8+storms show decreasing trend from 1951-1999 for Bremerhaven & List/Sylt -annual number of low pressure areas with core pressure < 950hPa over North Atlantic shows step change at 1989 onward -result is supported by number of ship reports of pressure <= 970hPa -Schmidt/von Storch geostrophic wind speed triangle analysis show peaks 1880s-1950s-1990s -climate change link can not be proven; only periodic fluctuations.

Goennert et al (2001)	Goennert G, SK Dube, T Murthy, W Siefert (2001): 7. Storm surges generated by extratropical cyclones - case studies. In: Die Kueste 63 Sonderheft. Heide, Holstein: Boyens. pp 455-546 -improvements in coastal infrastructure after 1953 floods that prevented a comparable disaster during the surge 31Jan-1Feb1983 -Gust bump (meteotsunami) -Timmerman (1971): cold fronts over S part of North Sea can produce 'gust bumps' -water level increases only occur for cold front propagation speed 29-36kt (54-67 km/h) -suggests resonance between traveling atmospheric disturbance & long surface gravity waves -numerical simulation of event 13Dec1956 -FIG7.18.Sudden water level changes (gust bumps) during Mar27 1966 at several locations on the Netherlands coast (Timmerman, 1971) maximum amplitude 1m -FIG7.20.Sudden water level changes (gust bumps) at several locations on the Netherlands coast on 13Dec1956 (Timmerman 1971) maximum amplitude 56cm at Katwuk aan Zee -case study for storm Vivian -during 20C German Bight surges have not increased in level , but surges have become longer duration -FIG7.10. Progression of storm surge and diurnal tide around the North Sea (Charnock and Crease, 1957)
Deutschen Wetterdienst (2002)	Deutschen Wetterdienst, Klimatologische Bewertung der juensten Stark-Windereignisse (Anatol und Lothar) aus der Sicht der Klimatologie der freien Atmosphaere, [pdf document properties: 28/05/2002] -winters 1994-1998 (especially 1995-1998) have very high number of cases of wind speeds > 80m/s
Haver (2004)	Haver, S. (2004), A possible freak wave event measured at the Draupner jacket January 1 1995, in Rogue Waves Workshop, pp. 1–8, Brest, France. [Available at www.ifremer.fr/web-com/stw2004/rw/fullpapers/walk_on_Haver.pdf.] -background information for Draupner wave 1 January 2005
Jensen et al (2006)	Jensen J, C Mudersbach, SH Mueller-Navarra, I Bork, C Koziar, V Renner, Modellgestuetzte Untersuchungen zu Sturmfluten mit sehr geringen Eintrittswahrscheinlichkeiten an der deutschen Nordseekueste, Die Kueste, 71, 123-167, 2006. -MUSE project: water storm surge water levels that can be expected for stations in German Bight -atmospheric circulation types that cause North Sea storm surges
Liu and MacHutchon (2006)	Liu PC and KR MacHutchon, Are there different kinds of rogue wave? Proceedings of OMAE2006, 25th International Conference on Offshore Mechanics and Arctic Engineering, June 4-9, 2006, Hamburg, Germany -presentation of a raw and uncontrolled data set with rogue waves from FA platform Mossel Bay, South Africa -proposal of 2 kinds of rogue waves -difficult of Marex radar and it tendency to register virtual rogue waves -Muller et al (2005): Our understanding of rogue waves greatly hampered by lack of comprehensive observations in space and time -one instrument cannot conclusively show the presence of a rogue wave
Windpower Monthly (2006)	Windpower Monthly, Definition of a wind index, https://www.windpowermonthly.com/article/956842/definition-wind-index, 01/01/2006 -wind index started by Denmark wind energy as early as 1979 -normal month defined as 100%, Denmark summer month as low as 50%, winter month as high as 180% -only in Denmark, Germany, Sweden, Netherlands -based on reference wind turbine -arose in situation where no local wind measurement to assess performance of wind turbine.
Hasager et al. (2007a)	Hasager CB, P. Astrup, P Nielsen, QuikSCAT and SSM/I ocean surface winds for wind energy, IEEE International Geoscience and Remote Sensing Symposium, 2007. IGARSS 2007 (pp. 3507-3512) IEEE https://doi.org/10.1109/IGARSS.2007.4423602, 2007a -info on QuikSCAT and SSMI satellite data for wind energy applications
Hasager et al (2007b)	Hasager CB, P Astrup, M Nielsen, MB Christiansen, J Badger, P Nielsen, PB Soorensen, RJ Barthelmie, SC Pryor, H Bergstroom, SAT-WIND project Final Report, Riso-R-1586(EN), Riso National Laboratory, Technical University of Denmark, Roskilde, Denmark, April, 2007b. -wind satellite products: scatterometer, passive microwave, polarized passive microwave, altimeter, SAR
Liu (2007)	Liu, Paul C., A chronology of freaque wave encounters, Geofizika, 24, 57-70, 2007 -media reports of rogue waves
Sorensen et al (2007)	Sorensen C, SM Ingvardsen, I Andersen, BB Kloster, KDI, Hojvandsstatistikker 2007, Extreme sea level statistics for Denmark, 2007, Kystdirektoratet, Dec, 2007. -description of functional forms for extrapolating extreme surge water levels for Denmark
Simon (2008)	Simon, B., Les niveaux marins extremes le long des cotes de France et leur evolution, Service hydrographique et oceanographique de la Marine, SHOM, 139 pp, June 2008 -return period of extreme coastal sea levels at French ports
Gemmrich et al (2009)	Gemmrich J, C Garrett, K Thompson, Extreme waves in Canadian coastal waters, 11 th International Workshop on Wave Hindcasting and Forecasting and Coastal Hazard Symposium, JCOMM Technical Report 62, WMO/TD-No. 1533, IOC Workshop Report 232, Halifax, Canada, October 18-23, 2009. http://www.waveworkshop.org/11thWaves/ -rogue waves on Canada west coast more frequent in shallow water onshore than offshore -depending on location, rogue waves more frequent when wave and current direction are the same -theory predicts increase in roge wave frequency when wave and current directions are opposite
Jensen et al (2010)	Jensen J, T Wahl, T Frank, Improved estimates of mean sea level changes in the south-eastern North Sea since 1843, Coastal Engineering 2010 -sea level rise acceleration in period late 19C and 1970s to 2000s -high resolution tide gauge data back to late 1990s -certain stations have longer high resolution records; e.g. Cuxhaven, Heligoland -recent digitization exercies for Hoernum (1951,1965,1976,1987) & Wyk (1951,1952) -tide gauge problems: -Schluettsiel & Bensersiel (impact inland drainage) -Toenning (barrages)

	-Buesum (significant coastal engineering measures) -Borkum (suspicious data)
Ardhuin et al. (2012)	Ardhuin F, A Balanche, E Stutzmann, M Obrebski, From seismic noise to ocean wave parameters: General methods and validation, Journal of Geophysicial Research, 117, C05002, doi:10.1029/2011JC007449, 2012. -history of using seismic information to assess ocean storm wave field go back to 1900 -ocean wave buoys only came online in 1980s;before then seismic main method to assess nearby storm wave field. -mixed information how to interpret seismic 3D signal to assess storm azimuth direction.
Nikolkina and Didenkulova (2012)	Nikolkina, I. and I. Didenkulova, Catalogue of rogue waves reported in media 2006-2010, Nat. Hazards, 61, 989-1006, 2012 -database of media reports of of rogue wave strikes on beaches and ships worldwide; mostly with fatalities
Joosten (2013)	Joosten, H.P., Datawell 1961-2011, Drukkerij Grave, Heemstede, 2013 -history of Datawell company
CH2MHill Halcrow (2014)	CH2MHill Halcrow, Cell 1 Regional Coastal Monitoring Programme, Wave Data Analysis Report 2: 2013-2014, Final Report, March 2014 [document properties: author=Andy.Parson@ch2m.com; datestamp; 04/04/2014] -highest significant wave height during high water periods for Storm Xaver 5-6Dec2013 -high sea state sufficient to change beach profiles
Christou and Ewans (2014)	Christou M, and K Ewans, Field measurements of rogue water waves, Journal of Physical Oceanography, 44, 2317-2335, 2014 -presentation rogue wave database based on high frequency recordings; most platforms in North Sea with about 24 years of contnuous data among 20+ platforms -severe quality control remove >80% of the identified rogue data -accepted rogue wave data have parameter range: significant wave height 0.12-15.4m, period from 1 to 24.7s, max crest height 18.5m, max recorded wave height 25.5m,
Danish Energy Agency (2015)	Danish Energy Agency, Security of Electricity Supply in Denmark, 1st edition 2015, translated 2016, Danish Energy Agency, Amaliegade 44, 1256 Copenhagen K, ISBN 978-87-93180-15-4 -FIG5. blackouts in Denmark 2010-2014 lower than period 1990-2008 -overhead power lines placed underground -two major power blackout storms: Anatol1999 and Gudrun2005 -Daria and the other storms of Jan-Feb1990 did not lead to major blackouts in Denmark
Hewson and Neu (2015)	Hewson TD and U Neu, Cyclones, windstorms and the IMILAST project, Tellus A, 67, 27128, http://dx.doi.org/10.3402/tellusa.v67.27128, 2015 -Schematic of development of European winter storm with life cycle stages
Spencer et al (2015)	Spencer, T., Brooks, S.M., Evans, B.R., Tempest, J.A., and Möller, I.: Southern North Sea storm surge event of Dec.5, 2013: Water levels, waves, and coastal impacts, Earth Science Reviews, 146, 120–145, http://dx.doi.org/10.1016/j.earscirev.2015.04.002, 2015. -for Storm Daria, Lincolnshire & North Norfolk high water and max Hs at same time -for storm Daria, Blakeney Overfalls, Hs 1.5-2.5 h earlier than maximum water level at Wells -for storm Daria, Sizewell on Suffolk coast, peak Hs was 10h before max water level
Franta (2018)	Franta, B., Shell and Exxon's secret 1980s climate change warnings, The Guardian, https://www.theguardian.com/environment/climate-consensus-97-per-cent/2018/sep/19/shell-and-exxons-secret-1980s-climate-change-warning, 19Sep2018 keywords: Shell (1988), Exxon (1982), climate change predictions, American Midwest desertification, Daniel Ellsberg, West Antarctic Ice Sheet, Pentagon papers, CO2 threshold 560ppt by 2060, climate changes greatest in recorded history
Sallee et al (2021)	Sallee J-B, V Pellichero, C Akhoudas, E Pauthenet, L Vignes, S Schmidtko, A Naveira Garabato, P Sutherland, M Kuusela, Summertime increases in upper ocean stratification and mixed layer depth, Nature, 591, 592-598, 10.1038/s41586-021-03303-x. hal-03184114, 2021 - keywords: North Atlantic winter mixed layer depth trend from 1970
BBC (20230112)	BBC, Hinckley Point C: Giant vessels arrive for nuclear power station station build (contributor Steve Mellen), 11Apr2023 https://www.bbc.com/news/uk-england-somerset-65237474 -ExxonMobil research program from late 1970s reveals climate warming trend in advance of NASA James Hansen in 1988
EIOPA (2023)	EIOPA, Impact of inflation on the insurance sector, European Insurance and Occupational Pensions Authority, EIOPA-BoS-23/360, 05 October 2023 https://www.eiopa.europa.eu/system/files/2023-10/Report%20on%20the%20impact%20of%20inflation%20on%20the%20insurance%20sector.pdf -keywords: World Bank Inflation and consumer prices 1960-2022
Guardian (20230803)	Guardian, Attack on energy network a major risk, UK register says for first time (contributor Rowena Mason), 03Aug2023, https://www.theguardian.com/uk-news/2023/aug/03/attack-on-energy-network-a-major-risk-uk-register-says-for-first-time -UK risk register: Russian attack on UK energy network -chronic risk: climate change
Kystdirektoratet (20230811)	Kystdirektoratet, Stormflodsberedskabet paa Vestkysten (accessed 11Aug2023) https://kyst.dk/kyster-og-klima/stormflod-og-beredskab/kystdirektoratets-stormflodsberedskaber/beredskab-paa-vestkysten/ -threshold water levels for evacuation from towns on Jutland west coast =emergency procedures implemented after Nov1981 surge when there was hinterland flooding.
Supran et al (2023)	Supran G, S Rahmstorf, N Oreskes, Assess ExxonMobil's global warming projections, Science, 379, eabk0063, 9pp, 2023 -investigative journalists uncovered ExxonMobil internal reports 2015 showing company climate research program from 1977 -fossil fuel industry climate assessments starting from 1950s -'ten internal reports and one peer-reviewed publication spanning 1979-1985 offered quantitative estimates, with a median year of 2000pm5' -this is consistent with what in fact occurred -in 1995 the IPCC declared that a human effect on global temperatures had been detected -5 ExxonMobil studies published 1982-2005 conclude to that to stabilized CO2 conc

	below 550 ppm and limit warming to 2C would impose a carbon budget of 251-716 GT -'body of literature documenting the history of climate lobbying and propaganda by fossil fuel interests has been described as a vast blind spot' of major climate assessments

Table SL88. Errors/typos in source reports for storm (arranged by year and then alphabetically)

Source	Full Reference and Notes
Gardiner (2010)	Gardiner, Barry, Appendix 3: Background information on 11 storms selected for detailed analysis, European Forest Institute, Atlantic European Regional Office - EFIAtlantic, 161 pp. [PDF properties: author=Barry Gardiner, datestamp=23Jul2010] https://ec.europa.eu/environment/forests/pdf/Final_Report_Appendix_3.pdf -mention of signficant coastal damage and erosion along England south coast but this is not supported by the source referenced and surge flooding during Daria is not supported by the Surgewatch catalog.

Table SL89. Abbreviations used in manuscript (alphabetical)

Abbreviation	Full name
CAPE	Convective Available Potential Energy
ESWD	European Severe Weather Database
FINO1	Forschungsplattformen in Nord- und Ostsee
IPCC	Intergovernmental Panel on Climate Change
KNMI	Koninklijk Nederlands Meteorologisch Instituut
MISELA	Minute Sea-Level Analysis
NAO	North Atlantic Oscillation
NOAA	National Oceanic and Atmospheric Administration
QuikSCAT	Quick Scatterometer
PRIMAVERA	Process-based climate simulation: advances in high-resolution modelling and European climate risk assessments
RWS	Rijkswaterstaat
SSM/I	Special Sensor Microwave Imager
SWEAT	Severe Weather Threat
UTC	Coordinated Universal Time
WASA	Waves and Storms in the North Atlantic

Table SL90. People contacted for information about storm (alphabetical)

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