

Supplement of Adv. Geosci., 45, 273–279, 2018  
<https://doi.org/10.5194/adgeo-45-273-2018-supplement>  
© Author(s) 2018. This work is distributed under  
the Creative Commons Attribution 4.0 License.



*Supplement of*

## **The North Sea surge of 31 October–1 November 2006 during Storm Britta**

**Anthony James Kettle**

*Correspondence to:* Anthony James Kettle ([ake3358@gmail.com](mailto:ake3358@gmail.com))

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.

## Supplementary Material

Table S1. Tide gauge information for 60 sites in the United Kingdom, the Netherlands, Germany, and Denmark.

The sites have been ordered on a counter-clockwise path around the North Sea with distances from Aberdeen.

N	Abbreviation	Name	Country (Note E)	Distance (km)	Longitude	Latitude	Time Interval (min)	Sea Level (m)	Notes
1	AB	Aberdeen	UK	0	-2.07	57.14	15	2.735	A
2	LE	Leith	UK	153	-3.18	55.99	15	3.350	A
3	NS	North Shields	UK	307	-1.44	55.01	15	3.109	A
4	WH	Whitby	UK	385	-0.61	54.49	15	3.603	A
5	IM	Immingham	UK	475	-0.19	53.63	15	4.353	A
6	CR	Cromer	UK	594	1.30	52.93	15	3.085	A
7	LT	Lowestoft	UK	646	1.75	52.47	15	1.789	A
8	HW	Harwich	UK	701	1.29	51.95	15	2.298	A
9	SH	Sheerness	UK	762	0.74	51.45	15	3.168	A
10	DV	Dover	UK	791	1.32	51.11	15	3.913	A
11	VL	Vlissingen	NE	951	3.60	51.44	10	0	B
12	RM	Roompot buiten	NE	971	3.68	51.62	10	0	B
13	EU	Euro Platform	NE	995	3.28	51.99	10	0	B
14	LG	Lichteiland Goeree	NE	1000	3.67	51.93	10	0	B
15	HH	Hoek van Holland	NE	1020	4.12	51.98	10	0	B
16	SV	Scheveningen	NE	1036	4.26	52.10	10	0	B
17	IJ	IJmuiden buitenhaven	NE	1081	4.55	52.46	10	0	B
18	DH	Den Helder	NE	1133	4.74	52.96	10	0	B
19	TX	Texel Nordzee	NE	1145	4.73	53.12	10	0	B
20	VH	Vlieland haven	NE	1173	5.09	53.30	10	0	B
21	HL	Harlingen	NE	1180	5.41	53.18	10	0	B
22	TL	West-Terschelling	NE	1183	5.22	53.36	10	0	B
23	TN	Terschelling Nordzee	NE	1194	5.33	53.44	10	0	B
24	WG	Wierumergronden	NE	1230	5.96	53.52	10	0	B
25	LW	Lauwersoog	NE	1243	6.20	53.41	10	0	B
26	SM	Schiermonnikoog	NE	1245	6.20	53.47	10	0	B
27	HG	Huibertgat	NE	1259	6.40	53.57	10	0	B
28	BO	Borkum-Sudstrand	DE	1276	6.66	53.58	10	5	C
29	BF	Borkum-Fischerbalje	DE	1281	6.75	53.56	10	5	C
30	EE	Eemshaven	NE	1284	6.83	53.45	10	0	B

Table S1 (continued)

N	Abbreviation	Name	Country (Note E)	Distance (km)	Longitude	Latitude	Time Interval (min)	Sea Level (m)	Notes
31	DZ	Delfzijl	NE	1287	6.93	53.33	10	0	B
32	NZ	Nieuwe Statenzijl	NE	1301	7.21	53.23	10	0	B
33	NO	Norderney-Riffgat	DE	1311	7.16	53.70	1	5	C
34	LA	Langeoog	DE	1334	7.52	53.72	1	5	C
35	SP	Spiekeroog	DE	1346	7.68	53.75	1	5	C
36	WW	Wangerooge-West	DE	1358	7.87	53.78	1	5	C
37	WN	Wangerooge-Nord	DE	1363	7.93	53.81	1	5	C
38	AW	Leuchtturm Alte Weser	DE	1377	8.13	53.86	1	5	C
39	HE	Helgoland Binnenhafen	DE	1382	7.89	54.18	1	5	C
40	BK	Bake-Z	DE	1397	8.31	54.01	1	5	C
41	SC	Scharhörn	DE	1401	8.47	53.97	1	5	C
42	ZE	Zehnerloch	DE	1408	8.66	53.96	1	5	C
43	BU	Busum	DE	1424	8.86	54.12	1	5	C
44	HU	Husum	DE	1451	9.03	54.47	1	5	C
45	WI	Wittdün	DE	1473	8.39	54.63	1	5	C
46	HR	Hörnum	DE	1487	8.30	54.76	1	5	C
47	HO	Højer	DK	1514	8.66	54.96	10	0	D
48	LS	List	DE	1522	8.44	55.02	1	5	C
49	HB	Havneby Havn	DK	1529	8.57	55.09	10	0	D
50	BA	Ballum Sluse	DK	1532	8.69	55.13	10	0	D
51	RI	Ribe Kammersluse	DK	1554	8.68	55.34	10	0	D
52	EJ	Esbjerg Havn	DK	1573	8.42	55.47	10	0	D
53	HS	Hvide Sand Havn	DK	1634	8.13	56.00	10	0	D
54	HV	Hvide Sand Havet	DK	1634	8.11	56.00	10	0	D
55	TS	Thorsminde Havn	DK	1675	8.12	56.37	10	0	D
56	TM	Thorsminde Havet	DK	1675	8.11	56.37	10	0	D
57	FE	Ferring Havet	DK	1692	8.12	56.52	10	0	D
58	TH	Thyborøn Havn	DK	1713	8.22	56.71	10	0	D
59	HI	Hirtshals Havn	DK	1866	9.96	57.60	10	0	D
60	SK	Skagen Havn	DK	1909	10.60	57.72	10	0	D

Notes: <sup>A</sup> the data were downloaded from [https://www.bodc.ac.uk/data/hosted\\_data\\_systems/sea\\_level/uk\\_tide\\_gauge\\_network/](https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/uk_tide_gauge_network/) with sea levels for Oct. 2006 from Bradshaw (2006) and site locations from the Internet document [http://www.bsh.de/de/Meeresdaten/Vorhersagen/Gezeiten/MHWI\\_MNWI\\_Daten.pdf](http://www.bsh.de/de/Meeresdaten/Vorhersagen/Gezeiten/MHWI_MNWI_Daten.pdf) attributed to Jan Siebert on Dec. 16, 2015;

<sup>B</sup> the data were downloaded from <http://live.waterbase.nl/>; <sup>C</sup> the data were provided by Wilfried Wiechmann of the Federal Institute of Hydrology of Germany with the sea level ('Pegel Null') convention from Annutsch (1977); the one minute data provided were averaged on a 10 minute grid for the spectral analysis; <sup>D</sup> the data were provided by Søren Bjerre Knudsen of Kystdirektoratet of Denmark with the sea level convention from Ditlevsen et al. (2018); <sup>E</sup> the country abbreviations are UK for the United Kingdom, NE for the Netherlands, DE for Germany, and DK for Denmark.

Table S2. Large wave reports and accidents in the North Sea during Storm Britta Oct. 31–Nov. 1, 2006 (to support the Figure 1 and Figure 4 of the manuscript).

Abbreviation	Ship/Platform/Instrument Description	Latitude	Longitude	Date and Time (dd/mm/yyyy hh:mm GMT)	Source
SCA	Scarborough Shoreline	54.288	-0.385	01/11/2006 09:45	Scarborough News (2006); Nikolkina and Didenkulova (2012)
KES	Kessingland Beach	52.414	1.730	01/11/2006 06:55	Nikolkina and Didenkulova (2012)
SLO	Slotergracht Ship	53.095	3.383	01/11/2006 01:00	Lloyd's Casualty Week (2006a,b)
HAN	Hanseatic Sea Ship	53.753	5.087	01/11/2006 05:03	Lloyd's Casualty Week (2006a,b)
SMG-1	Schiermonnikoog buoy: wave 1	53.592	6.162	01/11/2006 01:23	Original data (see also RWS, 2007; KNRM, 2007)
SMG-2	Schiermonnikoog buoy: wave 2	53.592	6.162	01/11/2006 06:22	Original data (see also RWS, 2007; KNRM, 2007)
SMG-3	Schiermonnikoog buoy: wave 3	53.592	6.162	01/11/2006 09:19	Original data (see also RWS, 2007; KNRM, 2007)
FIN-1	FINO1 buoy: wave 1	54.014	6.588	31/10/2006 20:16	Hessner and Reichert (2007)
FIN-2	FINO1 buoy: wave 2	54.014	6.588	01/11/2006 03:46	Herklotz (2007), Hessner and Reichert (2007), Neumann and Nolopp (2007), Pleskachevsky et al. (2012), Rosenthal and Lehner (2007)
ELB	Elbe2: ADCP station	54.017	8.114	01/11/2006 05:11	Rosenthal and Lehner (2007)
HIR-1	Hirtshals-W buoy: wave 1	57.515	9.613	01/11/2006 03:00	Original data, Knudsen (2016)
HIR-2	Hirtshals-W buoy: wave 2	57.515	9.613	01/11/2006 05:00	Original data, Knudsen (2016)
BRE	Bredford Dolphin platform	58.067	3.083	31/10/2006 15:21	Solberg (2014)
BID	Bideford Dolphin platform	60.353	2.900	31/01/2006 16:22	Solberg (2014)
THO	Thor Sentry ship	59.150	2.283	31/01/2006 16:00	Arnoldson (2014)

Table S3. Britta storm surge level from publications (to support Figure 3 of the manuscript).

Country	Source	Station	Skew Surge (m)	Notes
UK	NTLSF (2013)	Leith	0.735	A
UK	NTLSF (2013)	Whitby	0.976	A
UK	NTLSF (2013)	Cromer	1.192	A
UK	NTLSF (2013)	Felixstowe	1.269	A
UK	NTLSF (2013)	Harwich	1.296	A
UK	NTLSF (2013)	Sheerness	1.150	A
Belgium	MVG (2011)	Nieuwpoort	1.1	B
Belgium	MVG (2011)	Oostende	1.1	B
Belgium	MVG (2011)	Zeebrugge	1.0	B
Netherlands	RWS (2006a)	Vlissingen	1.34	A
Netherlands	RWS (2006a)	Roompos Buiten	1.39	A
Netherlands	RWS (2006a)	Hoek van Holland	1.39	A
Netherlands	RWS (2006a)	Dordrecht	0.87	A
Netherlands	RWS (2006a)	Den Helder	1.60	A
Netherlands	RWS (2006a)	Harlingen	2.21	A
Netherlands	RWS (2006a)	Delfzijl	3.45	A
Netherlands	RWS (2006a)	Huibertgat	2.20	A
Netherlands	RWS (2006b)	Huibertgat	2.25	A
Netherlands	Terlouw (2013)	Wierumergronden	1.7	D
Germany	Gonnert and Buß (2009)	Cuxhaven	2.58	A
Germany	Herklotz (2007)	FINO1	2.20	A
Germany	Herrling et al (2010)	Borkum	2.46	C
Germany	Herrling et al (2010)	Emden	3.93	C
Germany	Herrling et al (2010)	Borkum	2.46	C
Germany	Herrling et al (2010)	Eemshaven	-999	C
Germany	Herrling et al (2010)	Emshoern	-999	C
Netherlands	Herrling et al (2010)	Delfzijl	3.45	C
Germany	Herrling et al (2010)	Knock	3.56	C
Germany	Herrling et al (2010)	Emden	3.72	C
Germany	Herrling et al (2010)	Emssperrwerk	3.96	C
Germany	Heyken (2007)	Knock	3.60	A
Germany	Heyken (2007)	Emssperrwerk	3.90	A
Germany	Heyken (2007)	Borkum	2.70	A
Germany	Heyken (2007)	Bensersiel	2.91	A
Germany	Heyken (2007)	Wilhelmshaven	3.15	A
Germany	Heyken (2007)	Vareler Schleuse	3.49	A
Germany	Heyken (2008)	Norderney	2.55	A
Germany	Heyken (2014)	Knock	3.60	A
Germany	Heyken (2014)	Emssperrwerk	3.90	A
Germany	Heyken (2014)	Borkum	2.70	A
Germany	Heyken (2014)	Bensersiel	2.91	A
Germany	KIT (2006)	Emden	3.59	A
Germany	KIT (2006)	Hamburg	-999	A
Germany	Kristandt et al. (2007)	Norderney	2.55	A
Germany	Lefebvre (2007)	Knock	3.60	A
Germany	Lefebvre (2007)	Emssperrwerk	3.90	A
Germany	Lefebvre (2007)	Wilhelmshaven	3.15	A
Germany	Lefebvre (2007)	Vareler Schleuse	3.49	A

Germany	Lefebvre (2007)	Borkum	2.70	A
Germany	Liste et al. (2012)	Station Watt	2.0	D
Germany	Loewe (2013)	Cuxhaven	2.39	A
Germany	NLWKN (2006)	Knock	3.60	A
Germany	NLWKN (2006)	Emssperrwerk	3.90	A
Germany	NLWKN (2006)	Borkum	2.70	A
Germany	NLWKN (2006)	Bensersiel	2.91	A
Germany	NLWKN (2006)	Wilhelmshaven	3.15	A
Germany	NLWKN (2006)	Vareler Schleuse	3.49	A
Germany	NLWKN (2007)	Norderney	2.55	A
Germany	NLWKN (2007)	Emden	3.73	A
Germany	NLWKN (2016)	Vareler Schleuse	3.46	A
Germany	RWS (2006b)	Borkum	2.9	A
Germany	RWS (2006b)	Emden	3.75	D
Germany	Schrader (2013)	Emden	3.6	A
Germany	Schrader (2013)	Wilhelmshaven	3.1	A
Germany	Spazierer et al (2006)	Hamburg	2.58	A
Germany	Stanev et al. (2009)	Emden	3.59	A
Germany	Stanev et al (2009)	Station Watt	1.7	D
Germany	Wetteronline (2006)	Hamburg	2.58	A

---

Notes: A: the skew surge value is presented in the reference; B: skew surge is estimated from the maximum water levels and average high tide levels in the reference; C: the skew surge is calculated from the maximum water level plotted in the reference figure and the high tide value from Herrling and Niemeyer (2008); D: the skew surge is estimated from the time series water level graph.

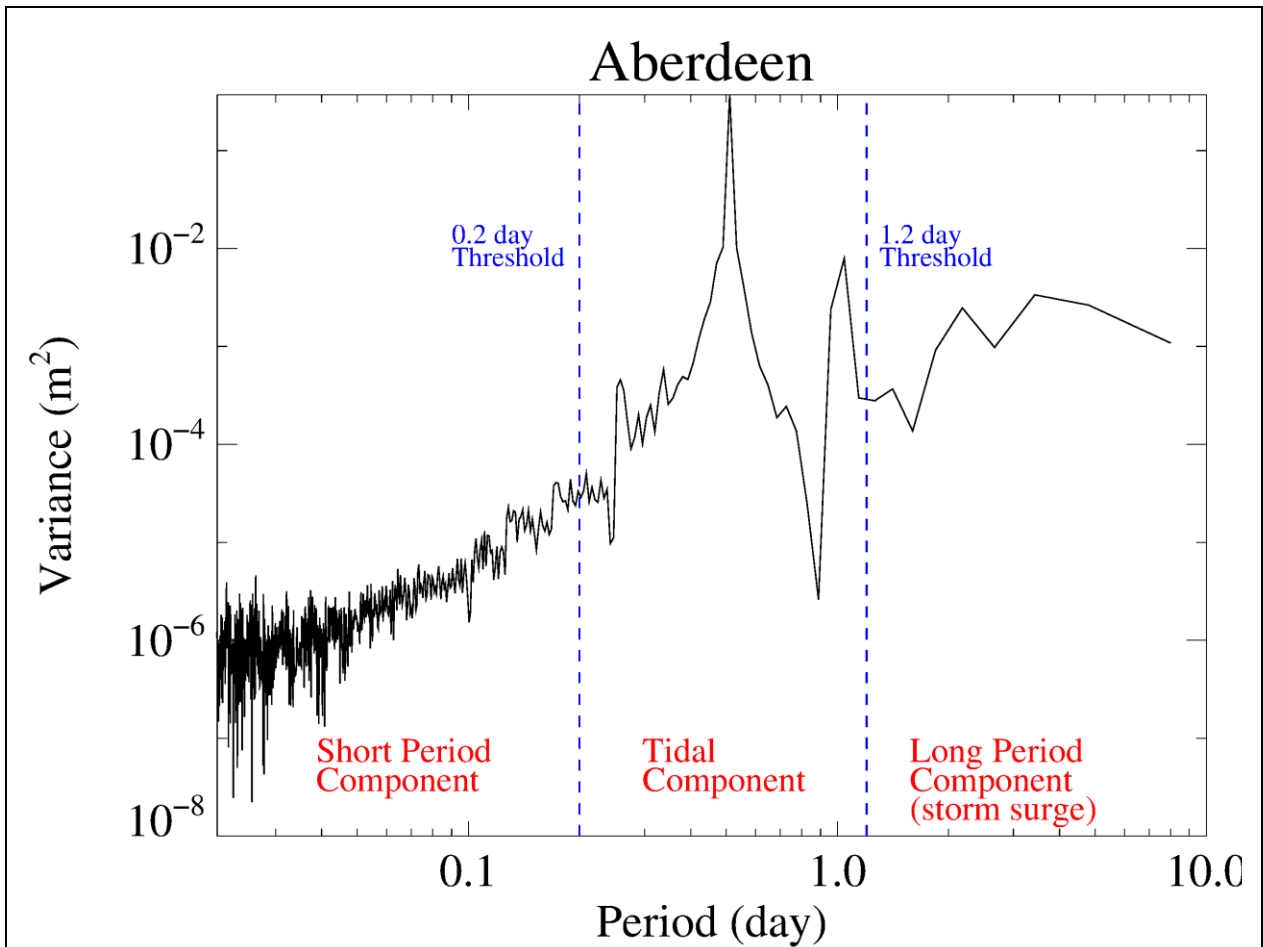


Figure S1. Energy spectrum for the detrended tide gauge time series (Oct. 24–Nov. 5, 2006, inclusive) for Aberdeen. The spectrum shows the thresholds used in the time series reconstruction of the long period (storm surge), tidal, and short period components from the original data set. The procedure for carrying out the discrete Fourier transform is given in Stull (1988), and the period of the x-axis is the inverse frequency.

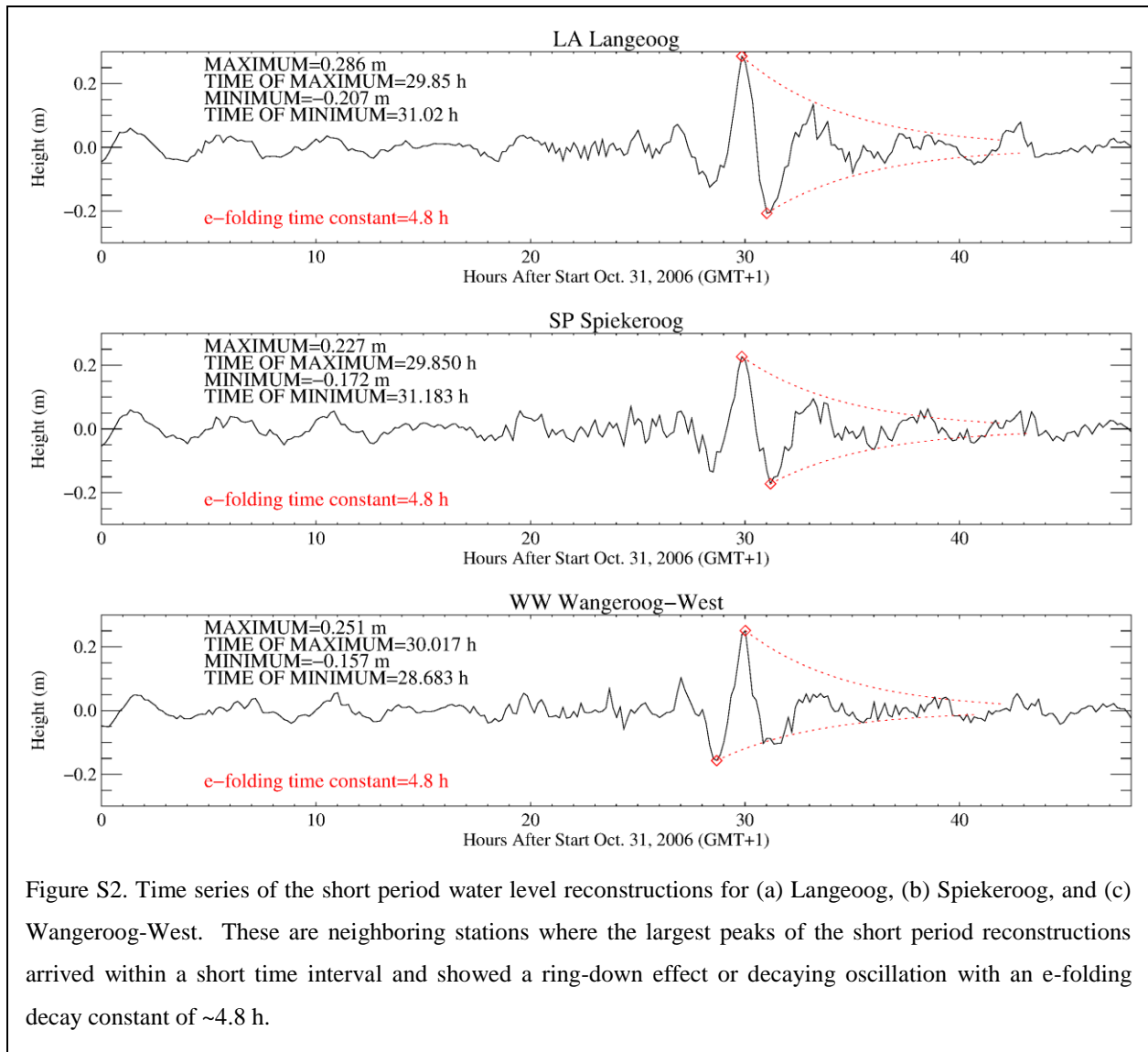


Figure S2. Time series of the short period water level reconstructions for (a) Langeoog, (b) Spiekeroog, and (c) Wangeroog-West. These are neighboring stations where the largest peaks of the short period reconstructions arrived within a short time interval and showed a ring-down effect or decaying oscillation with an e-folding decay constant of  $\sim 4.8$  h.

### References for Table S1

- Annusch, R.: Wasserstandsvorhersage und Sturmflutwarnung, *Der Seewart*, 38.Jg., H.5, pp. 185–204, 1977.
- Bradshaw, E.: Annual Report for 2006 for the UK National Tide Gauge Network and Related Sea Level Science, National Tidal and Sea Level Facility, NERC, 2006.
- Ditlevsen, C., Ramos, M.M., Sørensen, C., Ciocan, U.R., and Pionkowitz, T.: *Højvandstatistikker 2017*, Kystdirektoratet, Miljø- og Fødevareministeriet, February, 2018.
- Siebert, J.: [http://www.bsh.de/de/Meeresdaten/Vorhersagen/Gezeiten/MHWI\\_MNWI\\_Daten.pdf](http://www.bsh.de/de/Meeresdaten/Vorhersagen/Gezeiten/MHWI_MNWI_Daten.pdf), BSH, pdf document date stamp Dec. 16, 2015.



### References for Table S2

- Arnoldson, S.J.: Nov 4, 2006 four page Accident Reporting Sheet for Thor Sentry wave strike accident on Oct. 31, 2006; email from S.J. Arnoldson of P/F Thor on July 23, 2014.
- Herklotz, K.: Oceanographic results of two years operation of the first offshore wind research platform in the German Bight, FINO1, DEWI Magazin Nr. 30, February, 2007.
- Hessner, K. and Reichert, K.: Sea surface elevation maps obtained with a nautical X-band radar – Examples from WaMoS II stations, 10<sup>th</sup> International Workshop on Wave Hindcasting and Forecasting and Coastal Hazard Symposium, North Shore, Oahu, Hawaii, November 11–16, 2007.
- KNRM: Capsize and survival. Report on lifeboat Anna Margaretha's capsizes November 1<sup>st</sup> 2006, Koninklijke Nederlandse Redding Maatschappij, Ijmuiden, 2007.
- Knudsen, S.B.: half-hour statistics of the Kystdirektoratet waverider buoy were provided by email communication, 2016.
- Lloyd's Casualty Week: Marine, Lloyd's Casualty Week, Nov.10, 2006a.
- Lloyd's Casualty Week: Marine, Lloyd's Casualty Week, Nov.17, 2006b.
- Neumann, T. and Nolopp, K.: Three years operation of far offshore measurements at FINO1, DEWI Magazin, Nr. 30, Februar, 2007.
- Nikolkina, I. and Didenkulova, I.: Catalogue of rogue waves reported in the media in 2006-2010, Nat. Hazards, 61, 989-1006, doi: 10.1007/s11069-011-9945-y, 2011.
- Pleskachevsky, A.L., Lehner, S., and Rosenthal, W.: Storm observations by remote sensing and influences of gustiness on ocean waves and on generation of rogue waves, Ocean Dynamics, 62, 1335–1351, doi 10.1007/s10236-012-0567-z, 2012.
- Rosenthal, W. and Lehner, S.: Extreme sea state conditions at offshore platforms, in 52<sup>nd</sup> IEA Topical Expert Meeting. Wind and Wave Measurements at Offshore Locations, Berlin, Germany, February, 2007, organized by TU Berlin and Germanischer Lloyd.
- RWS: Allerheiligenvloed 2006. Achtergrondverslag van de stormvloed van 1 november 2006, Rijkswaterstaat Rijksinstituut voor Kust en Zee (RIKZ), 30 juni, 2007.
- Scarborough News: Car spun around by freak wave, The Scarborough News, Nov. 2, 2006.
- Solberg, S.: list of maritime incidents registered at JRCC Stavanger on Oct.31–Nov. 1, 2006; email from S. Solberg, Chief Operations, JRCC Southern Norway, Stavanger, dated Nov. 4, 2014.

### References for Table S3

- Gönnert, G. and Buß, T.: Sturmfluten zur Bemessung von Hochwasserschutzanlagen, Berichte des Landesbetriebes Strassen, Bruecken und Gewaesser, Nr.2, 1999.
- Herklotz, H.: Oceanographic results of two years of operation of the first offshore wind research platform in the German Bight - FINO1, DEWI Magazin, Nr. 30, pp.47–51, Feb, 2007.
- Herrling, G., Knaack, H., Kaiser, R., and Niemayer, H.D.: Evaluation of design water levels at the Ems-Dollard estuary considering the effect of a storm surge barrier, Coastal Engineering Proceedings, International

- Conference on Coastal Engineering (ICCE), ([https://icce-ojs-tamu.tdl.org/icce/index.php/icce/article/view/1258/pdf\\_292](https://icce-ojs-tamu.tdl.org/icce/index.php/icce/article/view/1258/pdf_292)), 2010.
- Heyken, H.: Kuestenschutz: Sturmflutenwaren Belastungsprobe fuer Festland und Inseln, in H. Heyken (ed), Jahresbericht 2007, NLWKN, Niedersachsischer Landesbetrieb fuer Wasserwirtschaft, Kuesten- und Naturschutz, Norden, pp. 10–11, March, 2007.
- Heyken, H.: 15 Sturmfluten sind keine Boten des Klimawandels, in H Heyken (ed), Jahresbericht 2007, NLWKN, Niedersachsischer Landesbetrieb fuer Wasserwirtschaft, Kuesten- und Naturschutz, Norden, pp.14–15, April, 2008.
- Heyken, H.: Bilder der Sturmflut von 1. November 2006. Die Sturmflut zählt zu den schwersten der letzten 100 Jahre an der niedersächsischen Nordseeküste, NLWKN, June 11, 2014; internet site: [http://www.nlwkn.niedersachsen.de/hochwasser\\_kuestenschutz/sturmflutbilder\\_2006/41467.html](http://www.nlwkn.niedersachsen.de/hochwasser_kuestenschutz/sturmflutbilder_2006/41467.html) (last access Apr.8, 2016)
- KIT: Orkantief "Britta". Mittel, -Nordeuropa 31.10./1.11/2006, Institut fuer Meteorologie und Klimaforschung, Karlsruhe Institute of Technology, Nov.5, 2006.
- Kristandt, J., Brecht, B., Frank, H., and Knaack, K.: Optimization of empirical storm surge forecast - modelling of high resolution wind fields, Die Küste, 81, 301–318, 2014.
- Lefebvre, C.: Orkan BRITTA am 31.10 und 01.11.2006 une seine Auswirkung, DWD Deutsche Wetterdienst, created Jan.2, 2007.
- Liste, M., Monbaliu, J., Grifoll, M., Keupers, I., Toorman, E., Bi, Q., Soret, A., Fernandez, J., Carniel, S., Benetazzo, A., Staneva, J., Wahle, K., Bricheno, L., Wolf, J., Lepesqueur, J., and Arduin, F.: Impact assessment for the improved four boundary conditions (at bed, free surface, land-boundary and offshore-boundary) on coastal hydrodynamics and particulate transport, Report\_D3\_3, Field AC Contract No: FP7-SPACE-2009-1-242284, Dec., 2012.
- Loewe, P.: 2. Atmosphärenphysik, in P Loewe, H Klein, S Weigelt-Krenz (ed), System Nordsee, 2006 & 2007: Zustand und Entwicklungen, Berichte des Bundesamtes für Seeschifffahrt und Hydrographie, Nr. 49/2013. pp 37–113.
- MVG: Overzicht van de tijwaarnemingen langs de Belgische kust. Periode 2001-2010 voor NIEUWPOORT, OOSTENDE EN ZEEBRUGGE, Ministerie va de Vlaamse Gemeenschap, Agentschap Maritieme Dienstverlening en Kust, Afdeling Kust, Vlaamse Hydrografie, OOSTENDE, 38pp, 2011(?).
- NLWKN: Schwere Sturmflut an niedersachsischer Nordseeküste, Historische höchstwerte in der Emsmündung, 01/11/2006; internet site: [http://www.nlwkn.de/portal/live.php?navigation\\_id=7903&article\\_id=41464&psmand=26](http://www.nlwkn.de/portal/live.php?navigation_id=7903&article_id=41464&psmand=26) (accessed Oct.5, 2015)
- NLWKN: Information zur Sicherung und Verstärkung der Schutzdüne auf Juist, Niedersachsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, Norden, assumed publication year 2007.
- NLWKN: internet site for gauge Vareler Schleuse: <https://www.pegelonline.nlwkn.niedersachsen.de/Karte> (accessed Apr.8, 2016).

NTSLF2013: websites: <http://www.ntslf.org/storm-surges/storm-surge-climatology/england-east>;  
<http://www.ntslf.org/storm-surges/storm-surge-climatology/scotland>

RWS: Verslag van de Stormvloed van 31 oktober en 1 november 2006 (SR84), Allerheiligenvloed 2006, Ministerie van Verkeer en Waterstaat, Rijkswaterstaat, Stormvloedwaarschuwingsdienst/SVSD, 's-Gravenhage, november 2006a.

RWS: Evaluatie Allerheiligenvloed 2006. Analyse van de voorspelling van de hoogwaterstand voor Delfzijl, Nov.24, 2006b.

Schrader, D.: 3.3. Seegang, in P. Loewe, H. Klein, S. Weigelt-Krenz (ed), System Nordsee, 2006 & 2007: Zustand und Entwicklungen, Berichte des Bundesamtes für Seeschifffahrt und Hydrographie, pp. 131–136, Nr. 49/2013.

Spatzierer, M., Laps, S., and Saevert, T.: Orkantief BRITTA - 30.10. bis 01.11.2006 (Tief Nr. 8), Unwetterzentralen Deutschland & Österreich, (<http://www.unwetterzentrale.de/uwz/341.html>; accessed Oct.7, 2015), Nov., 2006.

Stanev, E.V., Grayek, S., and Staneva, J.: Temporal and spatial circulation patterns in the East Frisian Wadden Sea, *Ocean Dynamics*, 59, 167–181, 2009.

Terlouw, A.: Predicting morphological storm impact on coastal dunes at Ameland, M.Sc Thesis, Deltares, 2013.

### **References for Figure S1**

Stull, R.B.: *An Introduction to Boundary Layer Meteorology*, Kluwer Academic Publishers, Dordrecht, 1988.

(Document generated by A.J. Kettle on 14 August 2018 as Supplementary Material for Advances in Geosciences manuscript ‘The North Sea surge of Oct 31-Nov 1, 2006 during Storm Britta’, presented at the EGU General Assembly 2018, Vienna, Austria, 8–13 April 2018.)