
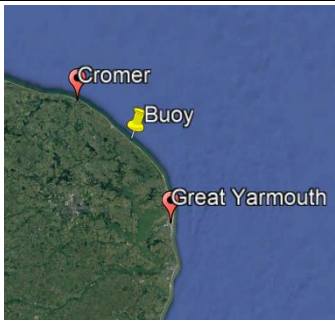


Happisburgh Directional Waverider Buoy

Location			
OS	639248 E 331307 N		
WGS84	Latitude: 52° 49.58' N Longitude: 01° 32.97' E		
Instrument type			
Datawell Directional Waverider Mk III			
Water depth	~10m CD	Example buoy in situ. Photo courtesy of Fugro Marine GB Limited	Location of buoy (Google mapping, image ©2019 Landsat / Copernicus)

Data Quality

Recovery rate (%)	Sample interval
58	30 minutes

Monthly Averages - 2016

All times are GMT

Month	H _s (m)	T _p (s)	T _z (s)	Dir. (°)	SST (°C)	Bimodal seas (%)	No. of days
January	0.82	6.9	4.6	94	6.7	-	31
February	0.81	7.6	4.6	88	6.0	-	29
March	0.73	6.4	4.2	76	6.4	-	31
April	0.77	6.3	4.3	82	8.8	-	30
May	0.74	6.1	4.1	60	11.8	-	31
June	0.59	6.2	4.2	67	14.8	-	30
July	0.37	5.0	3.7	100	18.2	-	31
August	0.41	5.0	3.7	168	19.2	-	0
September	-	-	-	-	-	-	0
October	-	-	-	-	-	-	0
November	-	-	-	-	-	-	0
December	-	-	-	-	-	-	0

Monthly Averages - All Years (May 2012 – December 2019)

Month	H _s (m)	T _p (s)	T _z (s)	Dir. (°)	SST (°C)	Bimodal seas (%)
January	0.77	7.1	4.5	101	5.8	-
February	0.72	7.1	4.3	86	4.9	-
March	0.80	7.0	4.3	93	6.1	-
April	0.69	6.4	4.0	83	8.8	-
May	0.67	6.2	4.1	82	12.0	-
June	0.59	5.9	4.0	76	15.0	-
July	0.50	5.4	3.8	90	18.0	-
August	0.48	5.4	3.8	104	18.4	-
September	0.65	6.3	4.1	92	16.4	-
October	0.75	6.6	4.3	83	13.4	-
November	0.77	6.8	4.4	90	9.8	-
December	0.67	7.2	4.4	102	7.1	-

Storm Analysis

Date/Time	H _s (m)	T _p (s)	T _z (s)	Dir. (°)	Water level elevation* (OD)	Tidal stage (hours re. HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
14-Jan-2016 20:30:00	3.60	9.1	6.0	6	2.15	HW -1	4.00	-	-
31-May-2016 05:30:00	2.96	7.7	5.7	18	0.36	HW +3	2.21	0.49	0.49
02-Jun-2016 03:30:00	2.82	8.3	5.5	17	1.45	HW -1	3.40	-	-
26-Apr-2016 07:00:00	2.68	6.7	5.5	353	0.25	HW -3	3.60	-	-

* Tidal information is obtained from the National Network gauge at Cromer and/or estimated from the predicted tide levels (Admiralty Total Tide). The surge shown is the residual at the time of the highest H_s. The maximum tidal surge is the large surge during the storm event.

Annual Statistics

Year	Annual H _s exceedance** (m)						Annual Maximum H _s	
	0.05%	0.5%	1%	2%	5%	10%	Date	A _{max} (m)
2012	2.89	2.52	2.25	1.95	1.48	1.16	27-Oct-2012 03:00:00	3.16
2013	3.53	2.85	2.65	2.36	1.89	1.48	10-Oct-2013 21:00:00	4.06
2014	2.68	2.22	1.95	1.67	1.37	1.14	09-Jul-2014 14:30:00	3.00
2015	3.03	2.25	2.03	1.79	1.42	1.16	21-Nov-2015 11:00:00	3.84
2016	3.36	2.51	2.35	2.08	1.70	1.35	14-Jan-2016 20:30:00	3.60
2017	2.68	2.35	2.24	2.04	1.76	1.48	28-Jun-2017 13:00:00	2.68
2018	2.88	2.47	2.19	1.93	1.53	1.18	20-Nov-2018 04:00:00	3.00
2019	3.21	2.56	2.33	2.06	1.61	1.27	27-Jan-2019 22:30:00	3.62

** i.e. 5 % of the H_s values measured in 2012 exceeded 1.48 m

Significant wave height return periods

Return periods for significant wave height can be calculated since the buoy has been deployed for more than 5 years. The return periods are based on 0.5 hourly records and are calculated for periods up to 10 times the record length using a peaks-over-threshold method and Generalised Pareto Distribution (GPD).

Observation period	May 2012 to December 2019	
Return period (years)	Significant wave height (m)	Comments
0.25	2.66	No depth limitation
1	3.26	
2	3.49	
5	3.74	
10	3.89	
20	4.02	Depth-limited at MLWS
50	4.16	

Distribution plots

The distribution of wave parameters are shown in the accompanying graphs/tables of:

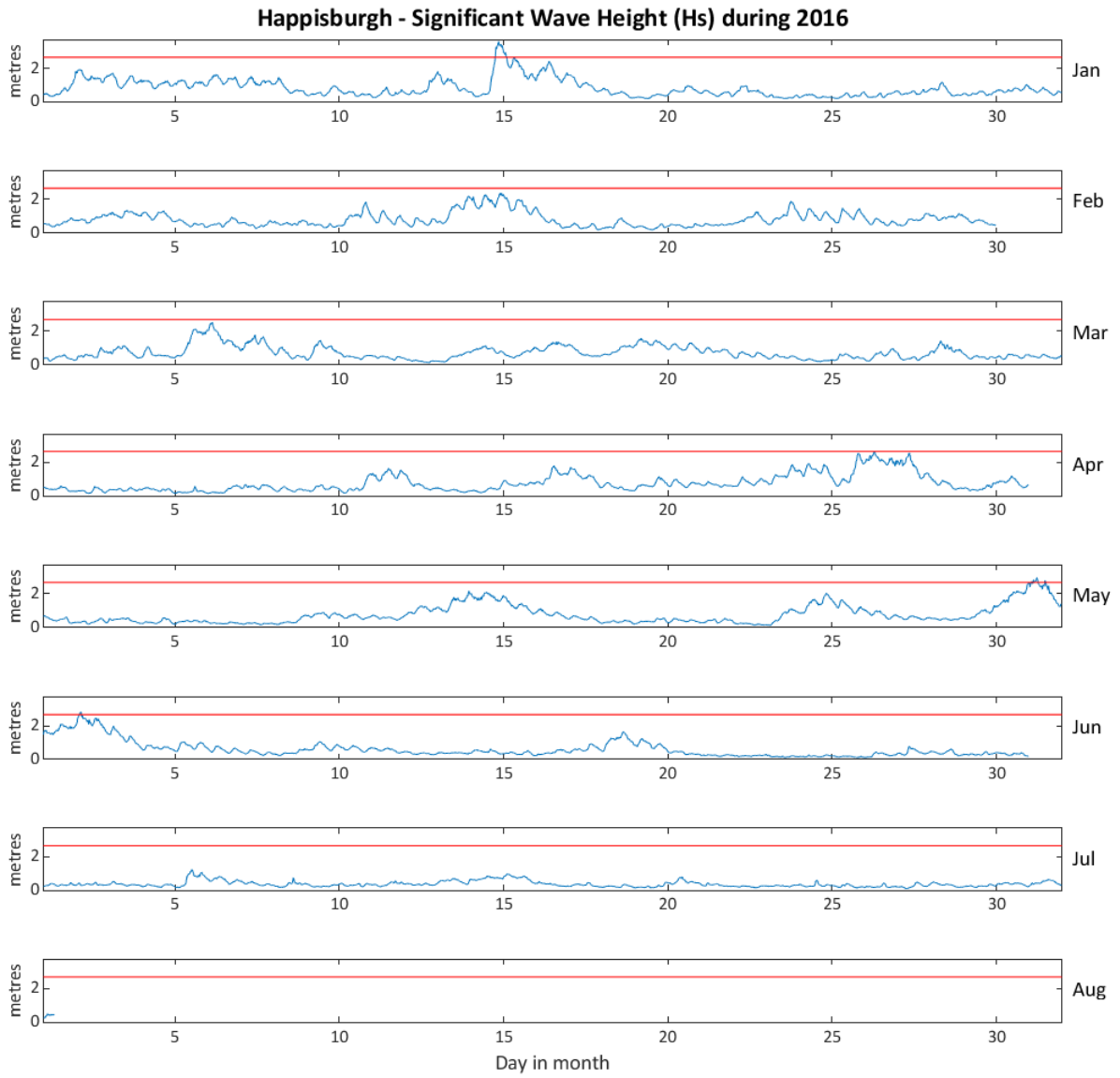
- Annual time series of H_s (red line is 2.66 m storm threshold)
- Incidence of storm waves for 2016. Storm events are defined using the Peaks-over-Threshold method. The highest H_s of each storm event is shown
- Wave height exceedance each year since deployment
- Percentage of occurrence of H_s , T_p , T_z and Direction for 2016
- Wave rose (percentage of occurrence of direction vs. H_s) for all measured data
- Joint distribution of all parameters for all measured data, given as percentage of occurrence

General

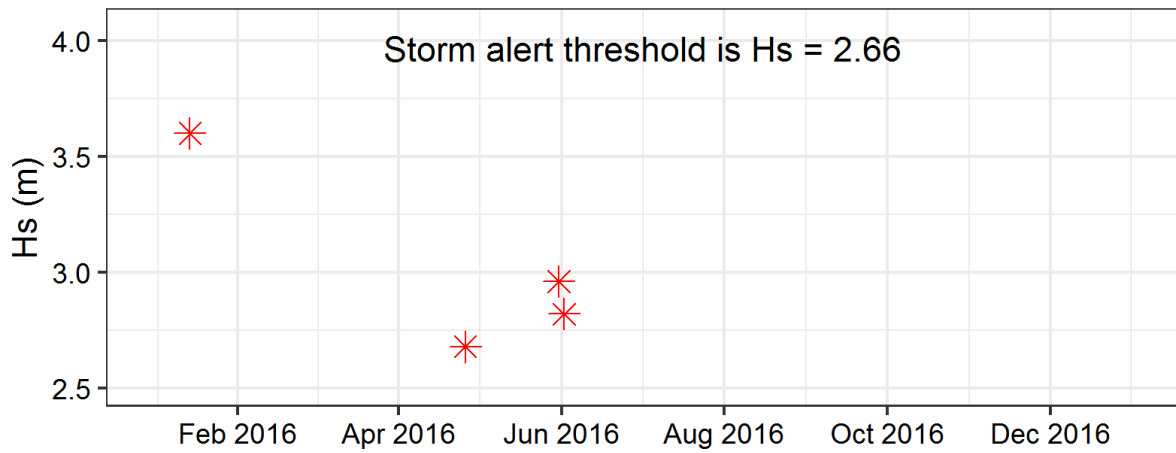
The buoy, owned by the Environment Agency, was first deployed on 09 May 2012, at which time the magnetic declination at the site was 1.04° west, changing by 0.17° east per year.

Acknowledgements

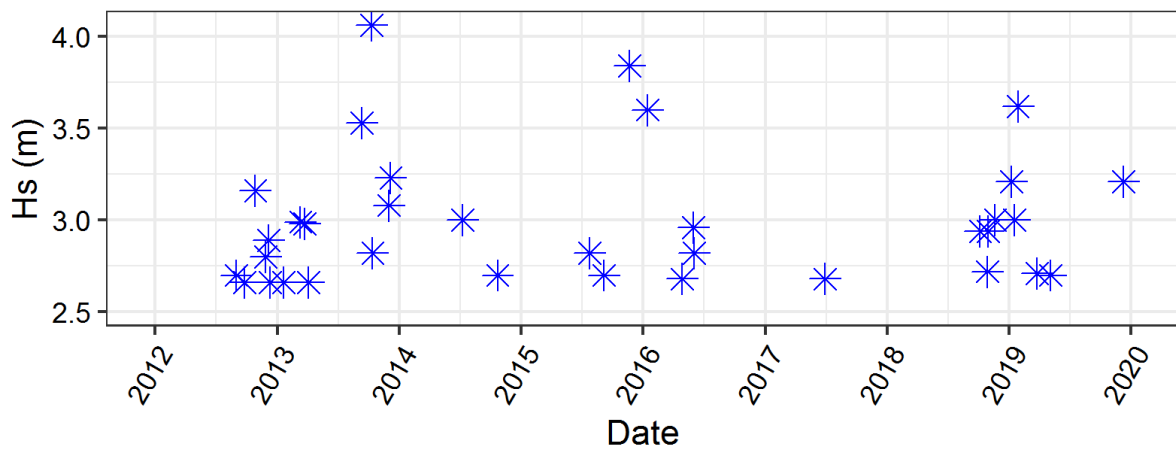
The shore station is kindly hosted by Happisburgh RNLI Lifeboat Station.



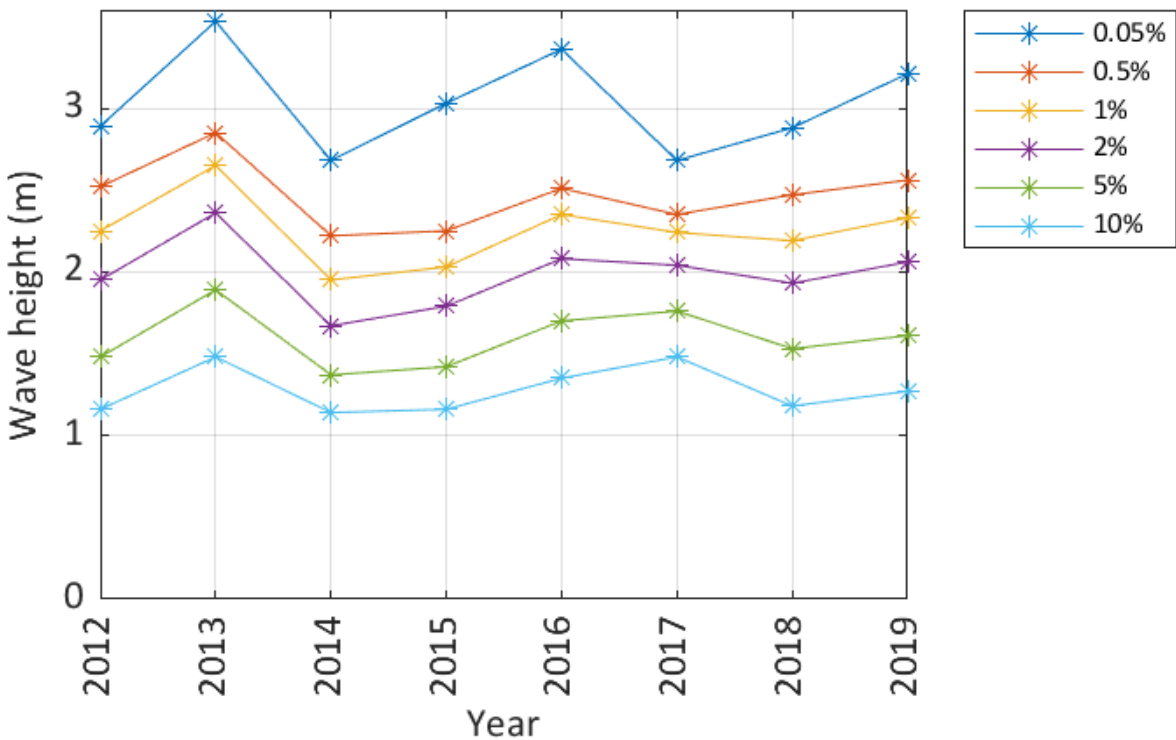
Storms at Happisburgh during 2016



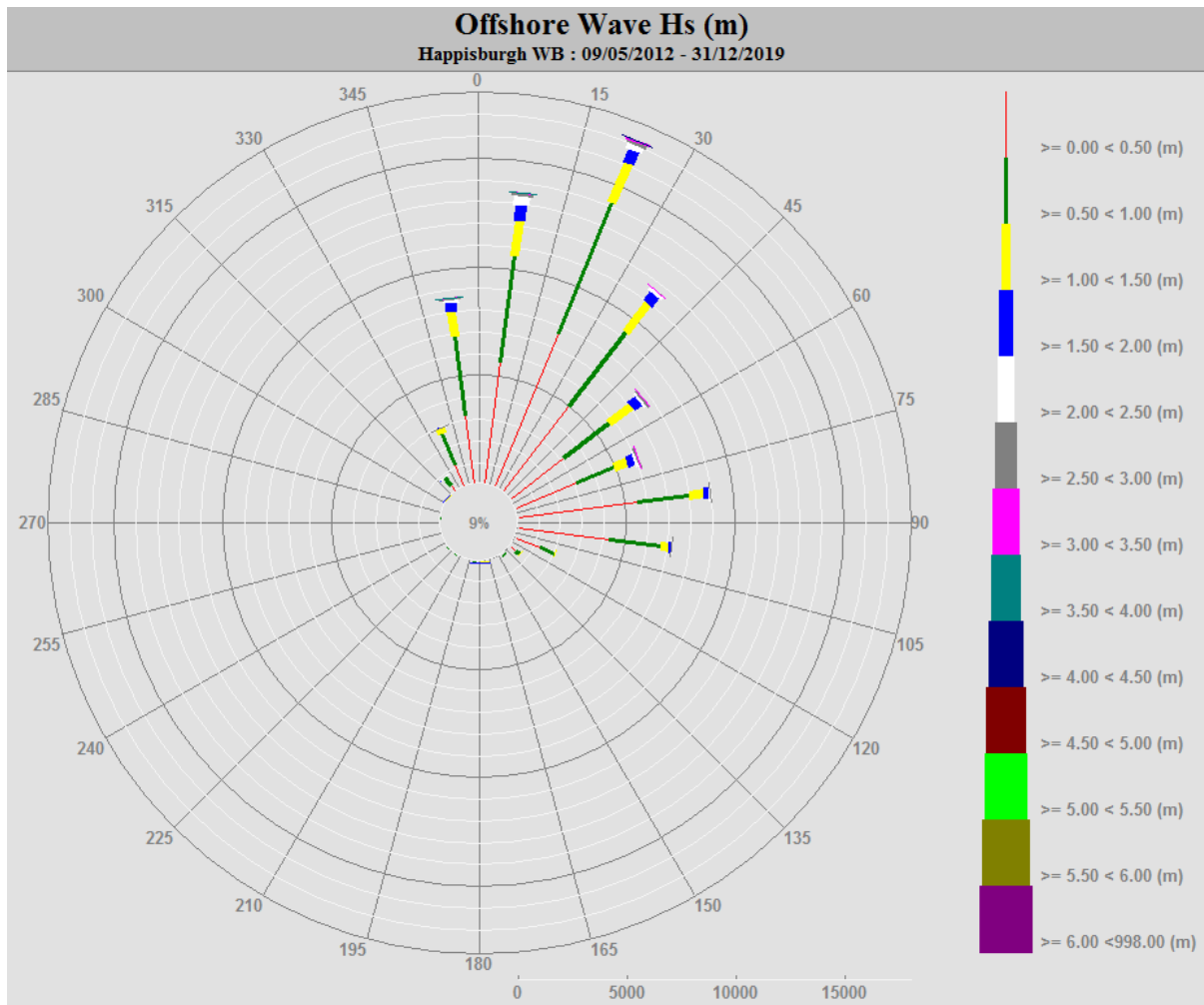
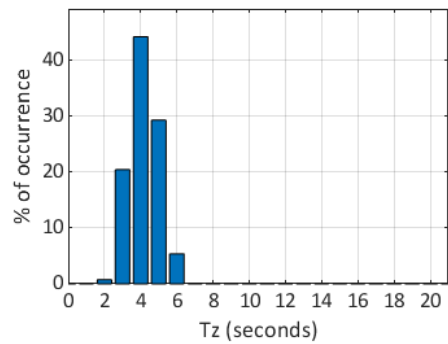
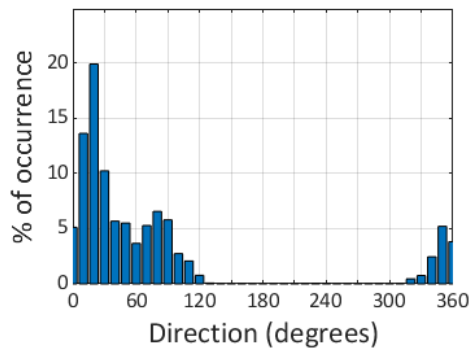
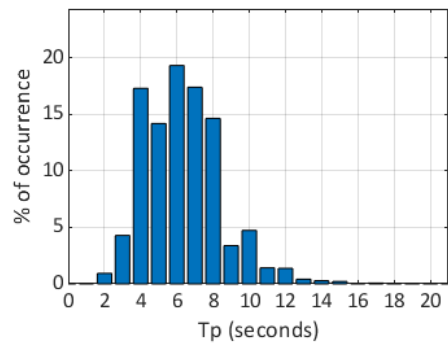
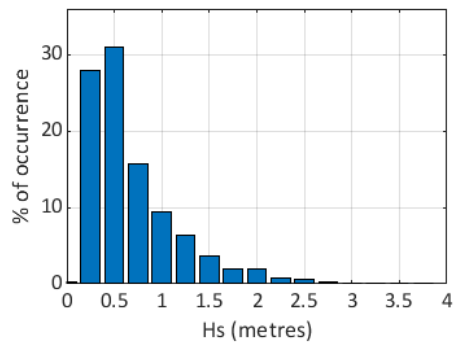
Storms at Blakeney Overfalls - all years



Happisburgh - Wave height exceedance (Hs)



Happisburgh 2016



Happisburgh 2012 to 2019 - Joint distribution (% of occurrence)

