



## Cleveleys Directional Waverider Buoy

<b>Location</b>			
OS	321475 E 444975 N		
WGS84	Latitude: 53° 53.70' N Longitude: 03° 11.78' W		
<b>Instrument type</b>			
Datawell Directional Waverider Mk III			
<b>Water depth</b>	~10 m CD	Example buoy in situ. Photo courtesy of Fugro Marine GB Limited	Location of buoy (Google mapping, image ©2016 TerraMetrics)

## Data Quality

<b>Recovery rate (%)</b>	<b>Sample interval</b>
49	30 minutes

## Monthly Averages - 2011

All times are GMT

Month	H <sub>s</sub> (m)	T <sub>p</sub> (s)	T <sub>z</sub> (s)	Dir. (°)	SST (°C)	Bimodal seas (%)	No. of days
January	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-
June	0.85	4.3	3.4	277	16.0	-	1
July	0.60	4.1	3.2	254	16.6	-	31
August	0.77	4.4	3.4	262	16.9	-	30
September	1.19	5.3	3.9	247	15.2	-	30
October	1.24	5.3	4.0	245	13.6	0	31
November	0.96	5.2	3.6	221	11.1	0	30
December	1.78	6.4	4.7	271	7.6	0	29

## Monthly Averages - All Years (June 2011 – December 2019)

Month	H <sub>s</sub> (m)	T <sub>p</sub> (s)	T <sub>z</sub> (s)	Dir. (°)	SST (°C)	Bimodal seas (%)
January	1.22	5.5	4.0	242	5.9	0
February	1.01	5.2	3.7	239	5.1	1
March	0.81	4.9	3.5	224	6.1	0
April	0.67	4.6	3.3	222	8.0	0
May	0.63	4.2	3.2	223	11.2	0
June	0.64	4.2	3.2	243	14.8	0
July	0.64	4.1	3.2	251	17.1	0
August	0.84	4.5	3.5	249	17.4	0
September	0.91	4.7	3.6	246	15.8	0
October	0.96	4.8	3.6	222	13.3	0
November	1.01	4.9	3.6	232	10.2	0
December	1.34	5.7	4.1	252	7.3	1

## Storm Analysis

Date/Time	H <sub>s</sub> (m)	T <sub>p</sub> (s)	T <sub>z</sub> (s)	Dir. (°)	Water level elevation* (OD)	Tidal stage (hours re. HW)	Tidal range (m)	Tidal surge (m)	Max. surge (m)
09-Dec-2011 00:30:00	4.32	10.0	7.4	271	1.36	HW +3	6.91	0.02	0.58
13-Dec-2011 18:30:00	4.25	10.0	7.4	273	-1.55	HW +5	6.83	1.32	1.34
28-Dec-2011 18:00:00	4.14	10.0	7.4	280	-1.08	HW +4	8.35	0.72	0.72
07-Dec-2011 11:00:00	3.97	9.1	6.8	280	2.14	HW +2	5.92	0.17	0.63
06-Oct-2011 18:00:00	3.96	8.3	6.3	278	1.40	HW -2	4.30	-	-

\* Tidal information is obtained from the National Network gauge at Heysham and/or estimated from the predicted tide levels (Admiralty Total Tide). The surge shown is the residual at the time of the highest H<sub>s</sub>. The maximum tidal surge is the largest surge during the storm event.

## Annual Statistics

Year	Annual H <sub>s</sub> exceedance** (m)						Annual Maximum H <sub>s</sub>	
	0.05%	0.5%	1%	2%	5%	10%	Date	A <sub>max</sub> (m)
2011	4.14	3.51	3.29	3.07	2.64	2.24	09-Dec-2011 00:30:00	4.32
2012	3.99	2.96	2.71	2.45	2.03	1.66	05-Jan-2012 00:00:00	5.03
2013	4.18	3.46	3.12	2.75	2.20	1.75	05-Dec-2013 13:00:00	4.71
2014	4.53	3.41	2.99	2.70	2.27	1.82	12-Feb-2014 19:00:00	4.84
2015	3.99	3.50	3.28	3.02	2.55	2.09	29-Nov-2015 18:30:00	4.52
2016	4.10	3.23	2.98	2.63	2.14	1.71	02-Feb-2016 02:30:00	4.60
2017	4.09	3.16	2.89	2.63	2.19	1.81	16-Oct-2017 20:30:00	4.53
2018	4.02	3.27	2.93	2.53	1.99	1.66	03-Jan-2018 03:30:00	4.63
2019	4.20	3.31	3.04	2.68	2.11	1.72	13-Mar-2019 01:00:00	5.01

\*\* i.e. 5 % of the H<sub>s</sub> values measured in 2011 exceeded 2.64 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	June 2011 to December 2019	
Return period (years)	Significant wave height (m)	Comments
0.25	3.74	No depth limitation
1	4.43	
2	4.66	Depth-limited at MLWS
5	4.87	
10	4.99	
20	5.08	
50	5.16	

## Distribution plots

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

- Annual time series of  $H_s$  (red line is 3.74 m storm threshold)
- Incidence of storm waves for 2011. 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 2011
- Joint distribution of all parameters for all measured data, given as percentage of occurrence
- Wave rose (percentage of occurrence of direction vs.  $H_s$ ) for all measured data

## General

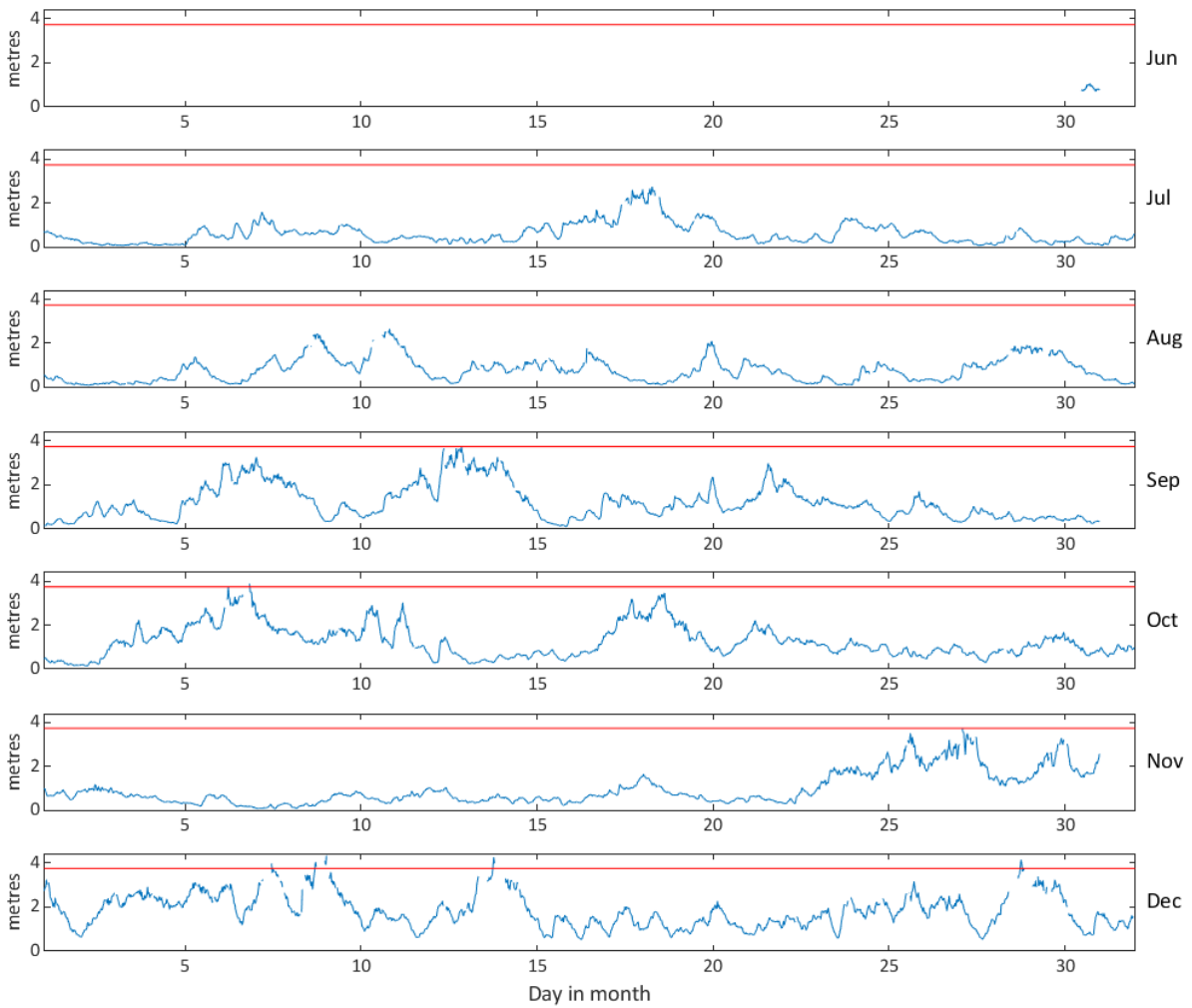
The wave buoy at Cleveleys, owned by Sefton Council, was deployed on 30 June 2011, at which time the magnetic declination at the site was 3.0° west, changing by 0.16° east per year.

## Acknowledgements

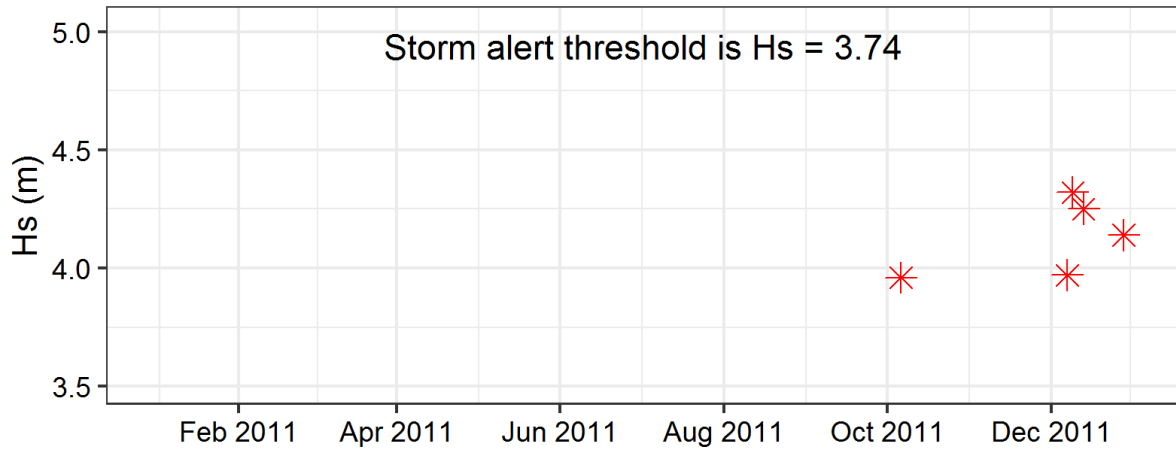
The shore station is kindly hosted by Café Cove, Cleveleys.

Tidal data at Heysham were provided by the British Oceanographic Data Centre from the UK national tide gauge network, owned and operated by the Environment Agency.

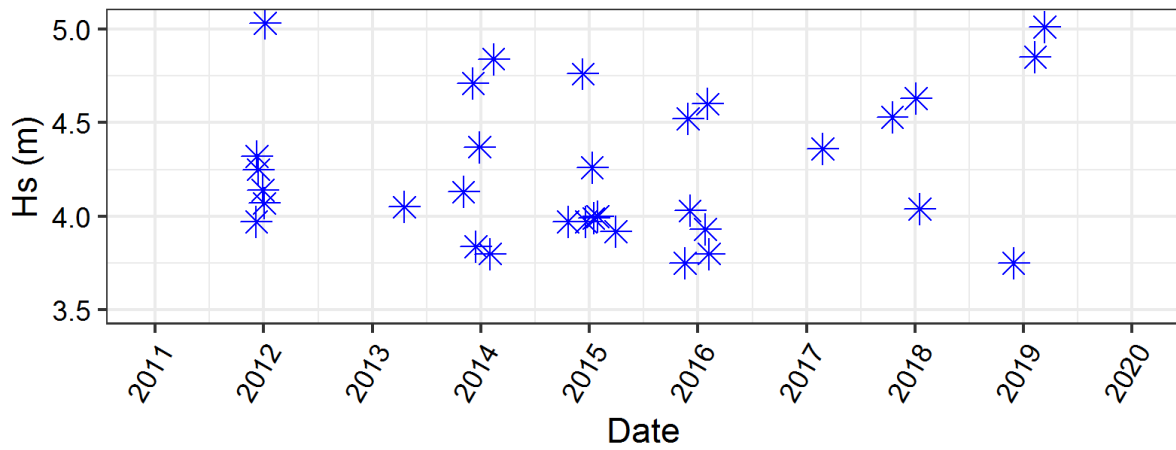
### Cleveleys – Significant Wave Height (Hs) during 2011



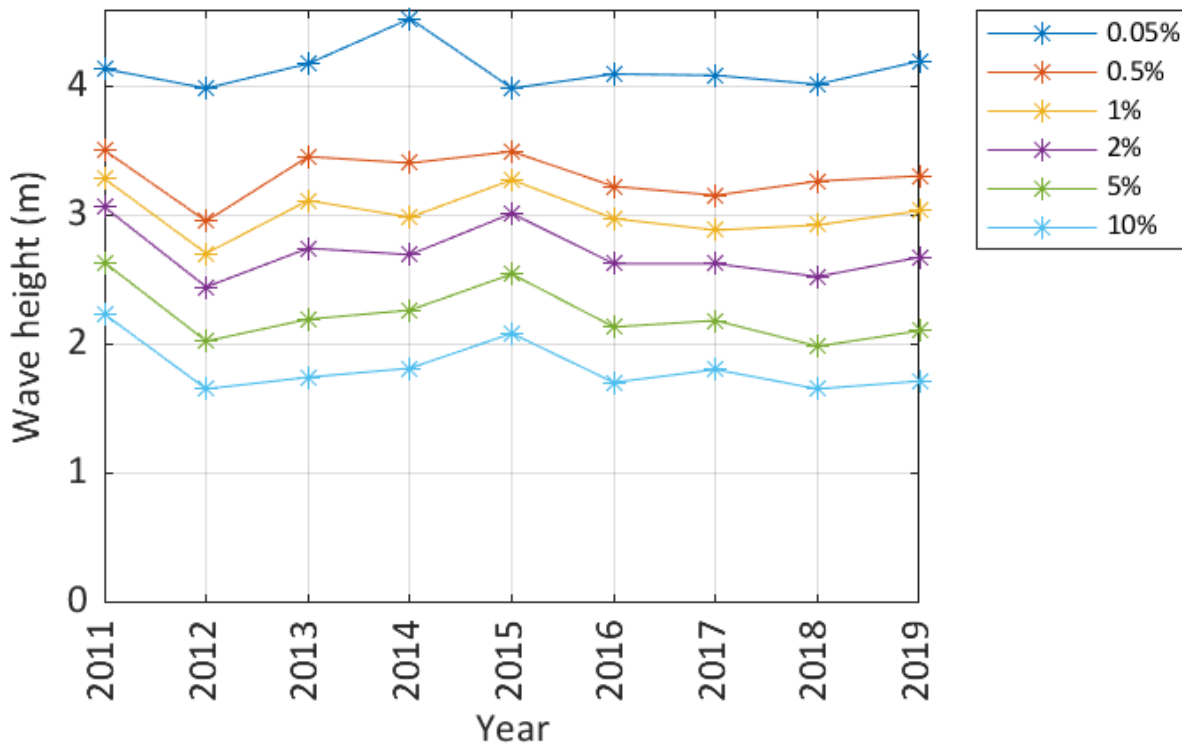
### Storms at Cleveleys during 2011



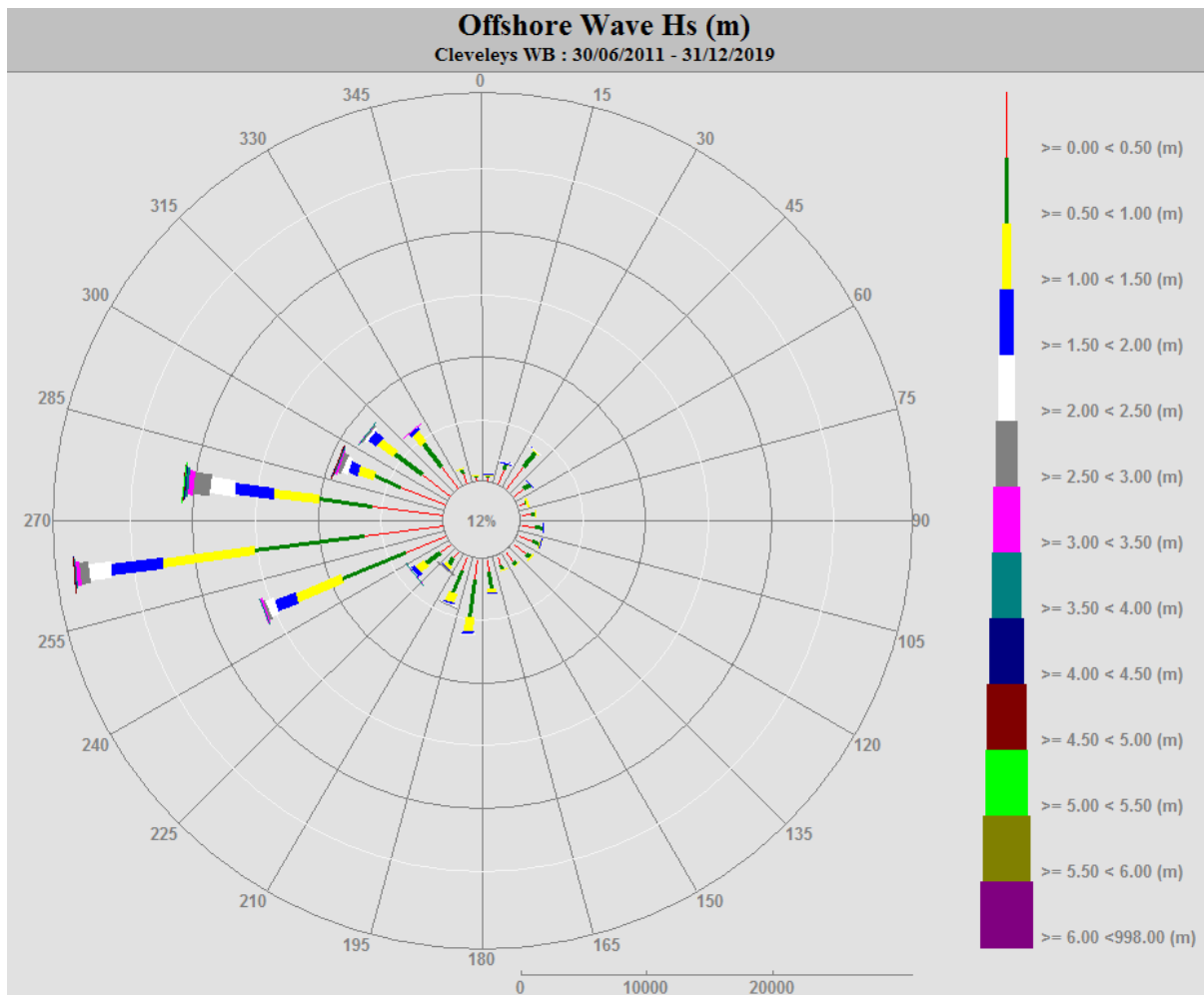
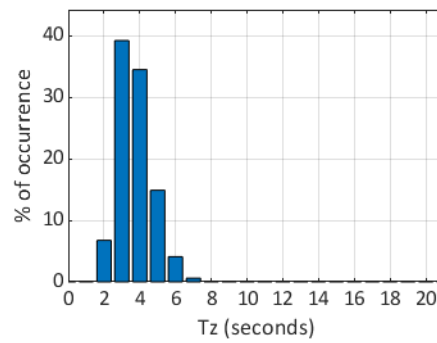
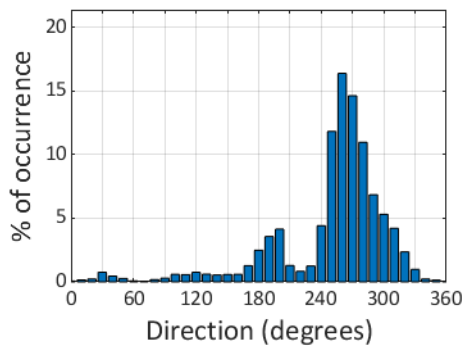
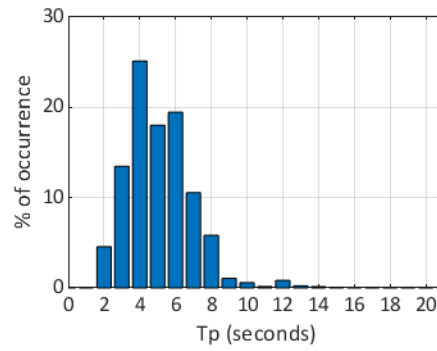
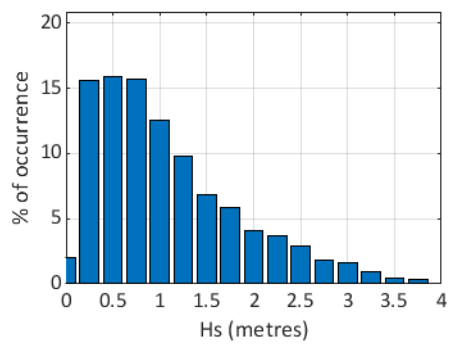
### Storms at Cleveleys - all years



### Cleveleys - Wave height exceedence (Hs)



Cleveleys 2011



Cleveleys 2011 to 2019 - Joint distribution (% of occurrence)

