



## Felixstowe Directional Waverider Buoy

|  |   |  |   |
|--|---|--|---|
| <b>Location</b>                          |   |  |  |
| OS                                       | 633378 E 232069 N                                 |  |   |
| WGS84                                    | Latitude: 51° 56.29' N<br>Longitude: 01° 23.63' E |  |   |
| <b>Instrument type</b>                   |   |  |   |
| Datawell<br>Directional Waverider Mk III |   |  |   |
| <b>Water depth</b>                       | ~8m CD  | Example buoy in situ.<br>Photo courtesy of Fugro Marine<br>GB Limited              | Location of buoy (Google<br>mapping, image ©2019<br>Landsat / Copernicus)           |

## Data Quality

|                          |                        |
|--------------------------|------------------------|
| <b>Recovery rate (%)</b> | <b>Sample interval</b> |
| 100                      | 30 minutes             |

## Monthly Averages - 2015

All times are GMT

| Month     | H <sub>s</sub><br>(m) | T <sub>p</sub><br>(s) | T <sub>z</sub><br>(s) | Dir.<br>(°) | SST<br>(°C) | Bimodal<br>seas (%) | No. of<br>days |
|-----------|-----------------------|-----------------------|-----------------------|-------------|-------------|---------------------|----------------|
| January   | 0.56                  | 4.5                   | 3.2                   | 162         | 5.5         | -                   | 31             |
| February  | 0.57                  | 5.1                   | 3.6                   | 125         | 4.5         | -                   | 28             |
| March     | 0.57                  | 4.6                   | 3.3                   | 136         | 6.1         | -                   | 31             |
| April     | 0.47                  | 4.3                   | 3.2                   | 120         | 8.8         | -                   | 30             |
| May       | 0.51                  | 4.0                   | 3.1                   | 150         | 12.3        | -                   | 31             |
| June      | 0.51                  | 4.3                   | 3.2                   | 133         | 15.0        | -                   | 30             |
| July      | 0.50                  | 4.4                   | 3.2                   | 144         | 18.1        | -                   | 31             |
| August    | 0.52                  | 4.1                   | 3.1                   | 130         | 18.6        | -                   | 31             |
| September | 0.59                  | 5.4                   | 3.6                   | 110         | 16.3        | -                   | 30             |
| October   | 0.64                  | 5.2                   | 3.6                   | 107         | 13.9        | -                   | 31             |
| November  | 0.62                  | 4.4                   | 3.3                   | 166         | 11.4        | -                   | 30             |
| December  | 0.72                  | 4.0                   | 3.2                   | 171         | 9.3         | -                   | 31             |

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

| Month     | H <sub>s</sub><br>(m) | T <sub>p</sub><br>(s) | T <sub>z</sub><br>(s) | Dir.<br>(°) | SST<br>(°C) | Bimodal<br>seas (%) |
|-----------|-----------------------|-----------------------|-----------------------|-------------|-------------|---------------------|
| January   | 0.62                  | 4.9                   | 3.5                   | 143         | 6.2         | -                   |
| February  | 0.66                  | 4.9                   | 3.5                   | 135         | 5.4         | -                   |
| March     | 0.63                  | 5.0                   | 3.5                   | 128         | 6.8         | -                   |
| April     | 0.54                  | 4.7                   | 3.3                   | 117         | 9.2         | -                   |
| May       | 0.51                  | 4.6                   | 3.3                   | 120         | 12.5        | -                   |
| June      | 0.52                  | 4.4                   | 3.2                   | 127         | 15.9        | -                   |
| July      | 0.44                  | 4.3                   | 3.1                   | 131         | 18.7        | -                   |
| August    | 0.47                  | 4.1                   | 3.1                   | 145         | 19.3        | -                   |
| September | 0.50                  | 4.6                   | 3.3                   | 131         | 17.6        | -                   |
| October   | 0.64                  | 5.0                   | 3.5                   | 127         | 14.3        | -                   |
| November  | 0.67                  | 5.0                   | 3.5                   | 133         | 10.4        | -                   |
| December  | 0.61                  | 4.7                   | 3.4                   | 150         | 7.7         | -                   |

## Storm Analysis

| Date/Time            | H <sub>s</sub><br>(m) | T <sub>p</sub><br>(s) | T <sub>z</sub><br>(s) | Dir.<br>(°) | Water level<br>elevation*<br>(OD) | Tidal stage<br>(hours re.<br>HW) | Tidal<br>range<br>(m) | Tidal<br>surge*<br>(m) | Max.<br>surge*<br>(m) |
|----------------------|-----------------------|-----------------------|-----------------------|-------------|-----------------------------------|----------------------------------|-----------------------|------------------------|-----------------------|
| 06-Feb-2015 09:30:00 | 2.09                  | 6.7                   | 4.6                   | 87          | -0.34                             | HW -4                            | 3.38                  | 0.01                   | 0.09                  |
| 13-Oct-2015 09:00:00 | 1.94                  | 6.3                   | 4.4                   | 82          | 0.61                              | HW -3                            | 3.14                  | 0.10                   | 0.23                  |

\* Tidal information is obtained from the National Network gauge at Harwich. 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) |
| 2012 | 1.95                                   | 1.64 | 1.52 | 1.38 | 1.14 | 0.94 | 23-Sep-2012 23:30:00          | 2.07                 |
| 2013 | 2.59                                   | 2.27 | 2.12 | 1.91 | 1.45 | 1.15 | 11-Oct-2013 15:30:00          | 2.77                 |
| 2014 | 2.18                                   | 1.72 | 1.58 | 1.43 | 1.20 | 1.00 | 28-Dec-2014 04:00:00          | 2.54                 |
| 2015 | 1.86                                   | 1.51 | 1.37 | 1.28 | 1.12 | 0.98 | 06-Feb-2015 09:30:00          | 2.09                 |
| 2016 | 2.26                                   | 1.87 | 1.70 | 1.51 | 1.24 | 1.00 | 07-Nov-2016 02:00:00          | 2.58                 |
| 2017 | 1.79                                   | 1.61 | 1.44 | 1.27 | 1.08 | 0.92 | 13-Feb-2017 23:30:00          | 1.88                 |
| 2018 | 2.52                                   | 1.90 | 1.67 | 1.43 | 1.15 | 0.94 | 19-Nov-2018 18:00:00          | 2.62                 |
| 2019 | 1.94                                   | 1.60 | 1.48 | 1.32 | 1.12 | 0.97 | 02-Nov-2019 14:30:00          | 2.13                 |

\*\* i.e. 5 % of the H<sub>s</sub> values measured in 2012 exceeded 1.14 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                  | 1.90                        | No depth limitation |
| 1                     | 2.32                        |                     |
| 2                     | 2.48                        |                     |
| 5                     | 2.64                        |                     |
| 10                    | 2.74                        |                     |
| 20                    | 2.82                        |                     |
| 50                    | 2.90                        |                     |

## Distribution plots

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

- Annual time series of  $H_s$  (red line is 1.90 m storm threshold)
- Incidence of storm waves for 2015. 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 2015
- 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

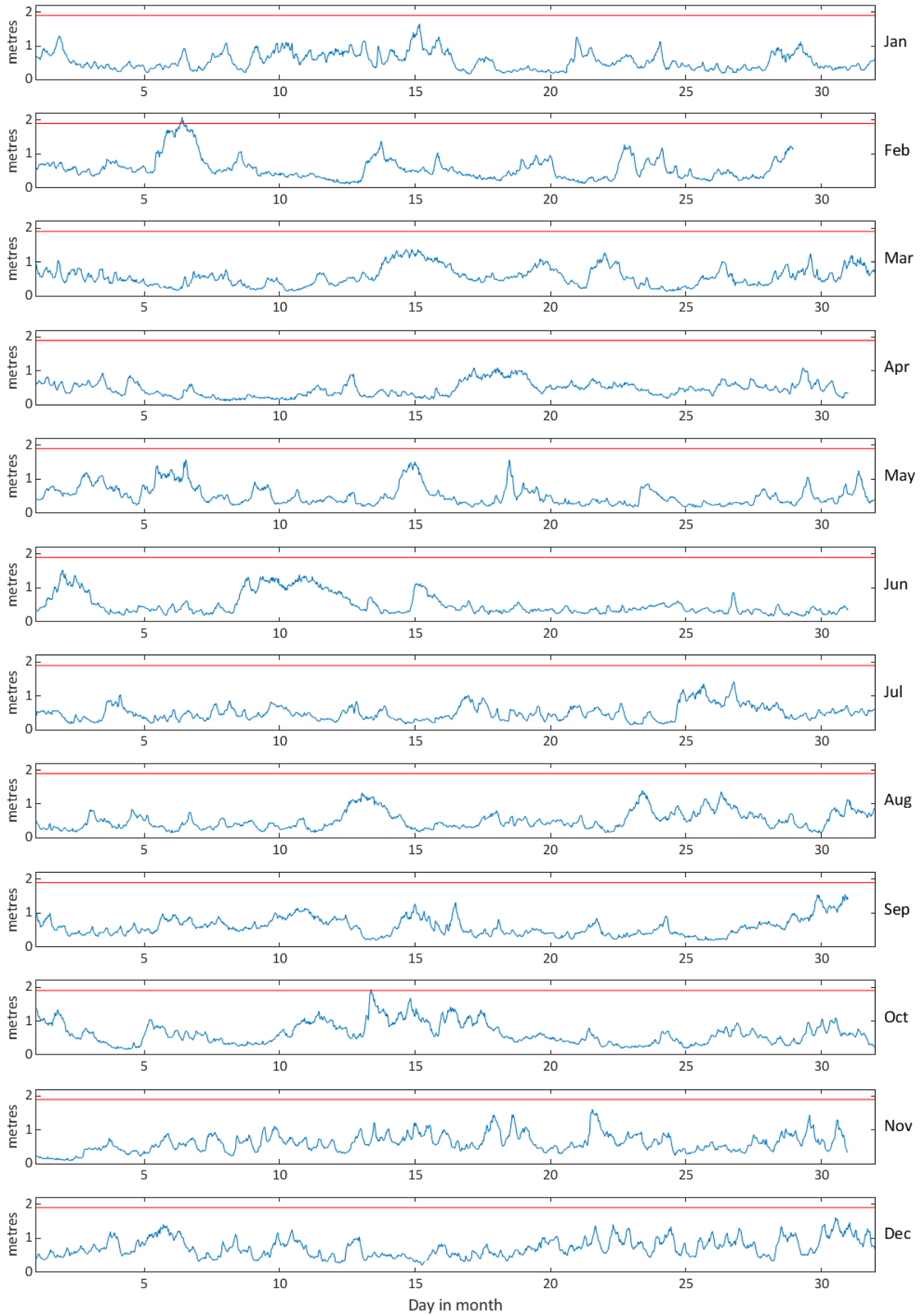
## General

The buoy, owned by the Environment Agency, was first deployed on 13 May 2012, at which time the magnetic declination at the site was  $0.89^\circ$  west, changing by  $0.17^\circ$  east per year.

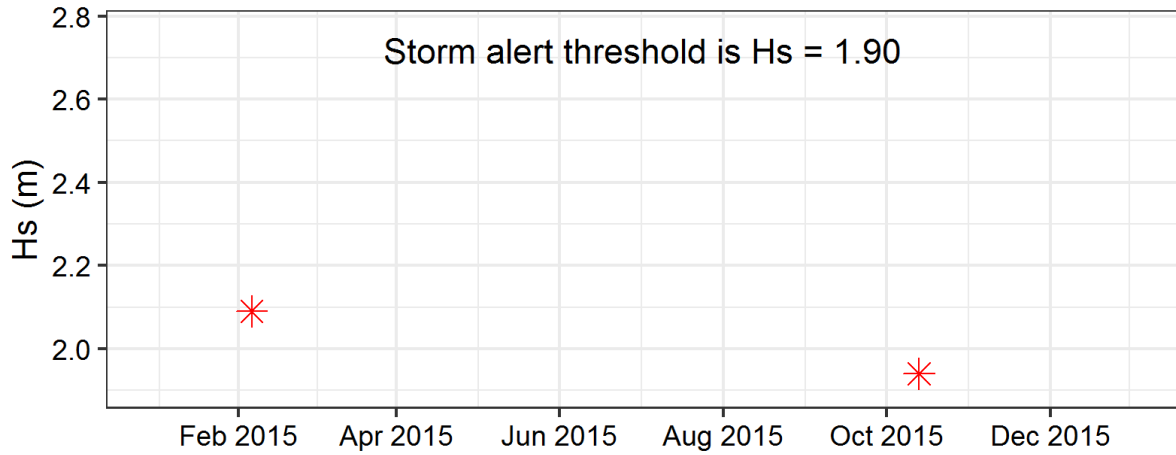
## Acknowledgements

The shore station is kindly hosted by Clacton-on-the-Sea RNLI Lifeboat Station.

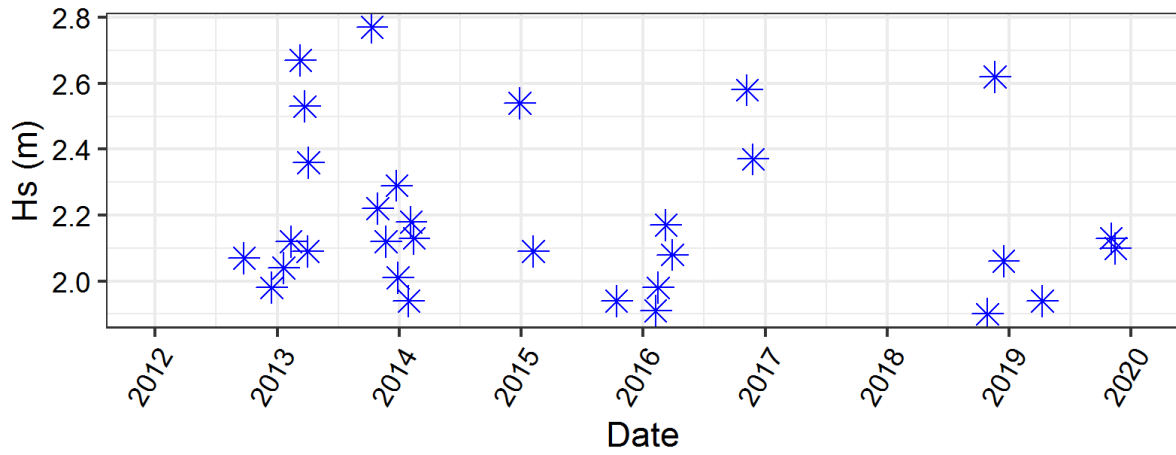
### Felixstowe - Significant Wave Height (Hs) during 2015



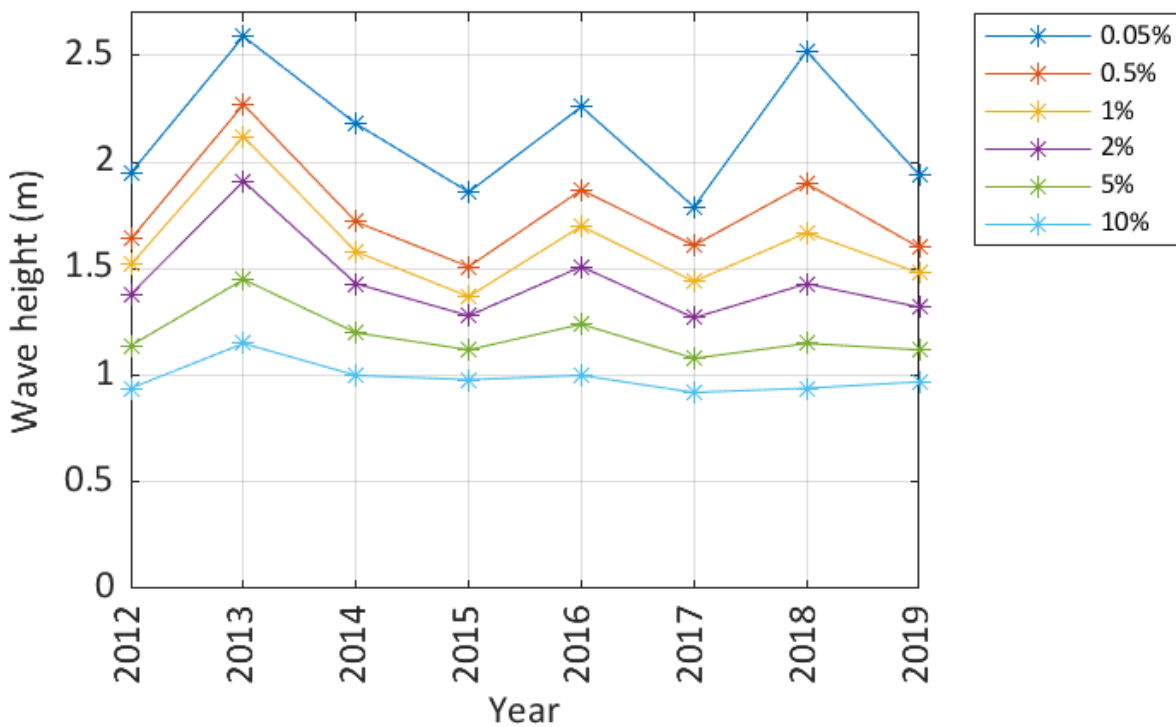
### Storms at Felixstowe during 2015



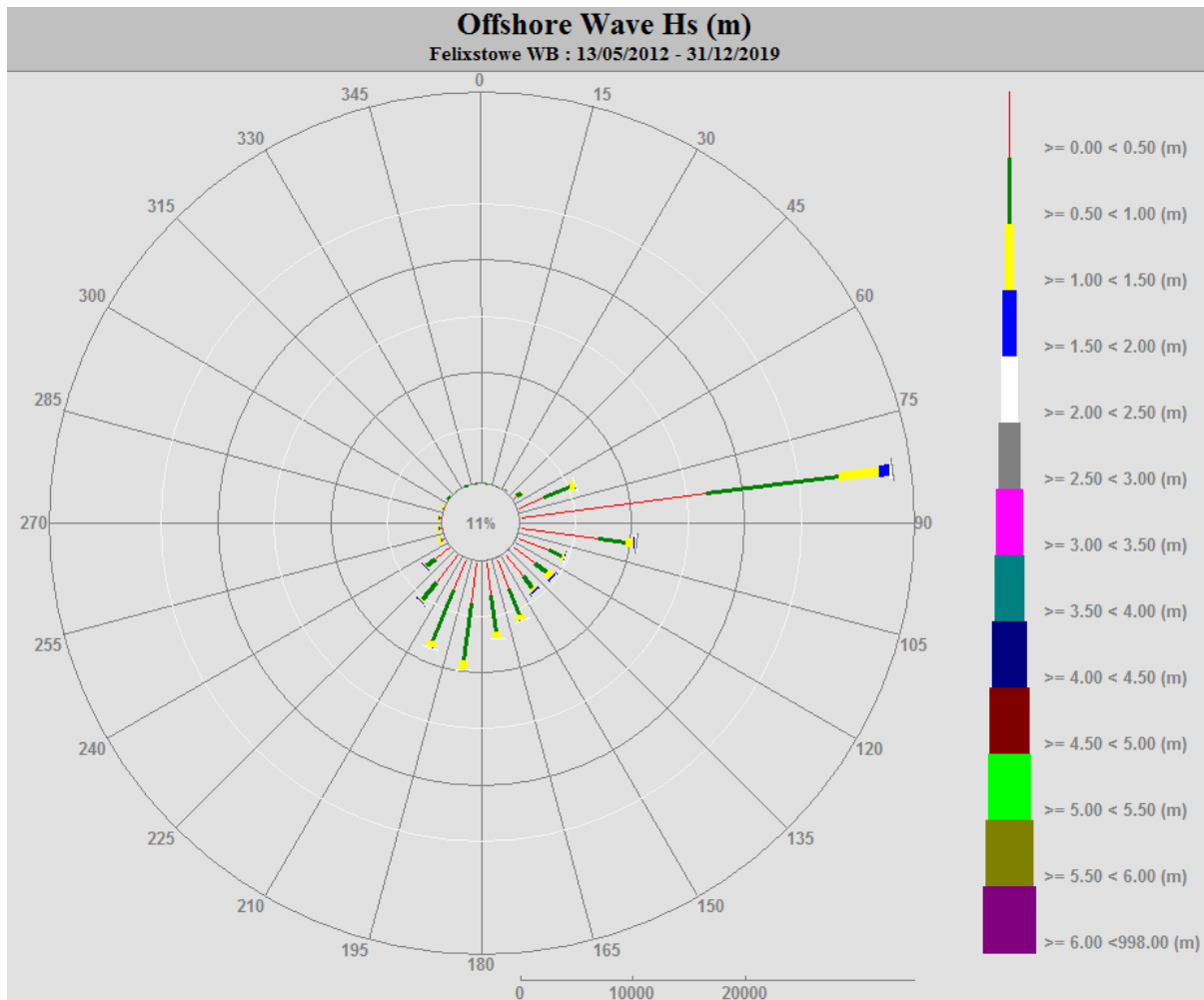
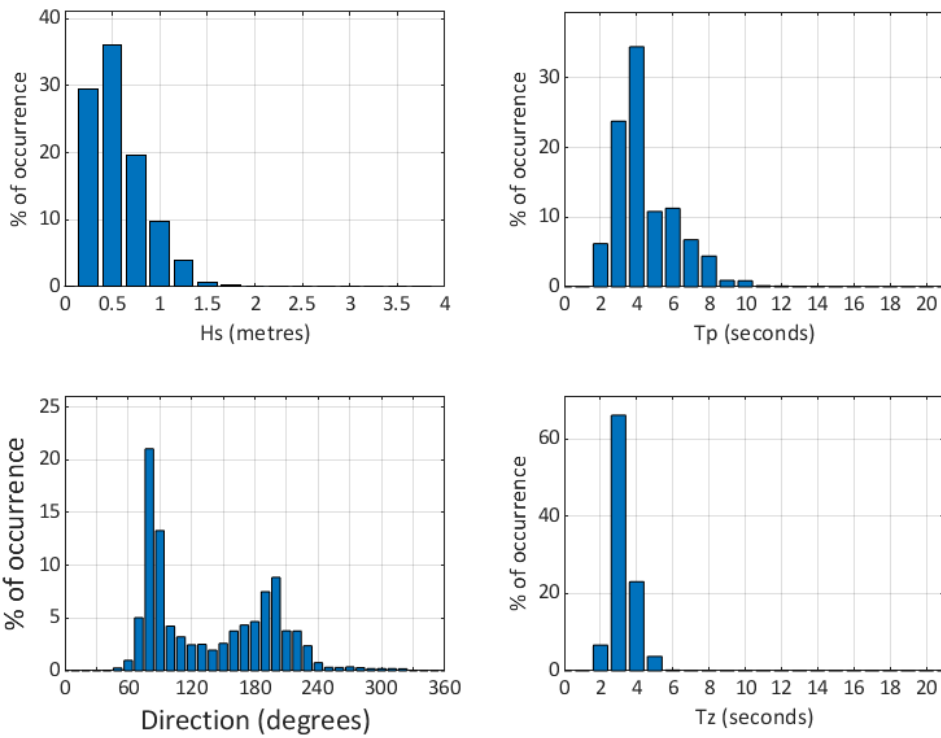
### Storms at Felixstowe - all years



### Felixstowe - Wave height exceedance ( $H_s$ )



Felixstowe 2015



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

