

Case study of the winter 2013/2014 extreme wave events off the west coast of Ireland

Jelena Janjić, Sarah Gallagher, and Frédéric Dias









Wave Energy Extraction

- Wave Energy Converters
- Extreme waves off the west coast of Ireland
- Survivability











Winter 2013/2014 (Dec, Jan, and Feb)







Deric Ó h'Artagáin * * @deric_hartigan · Feb 12 #TV3Weather "@andrewcareylk: Probably the scariest picture you will see from #limerick in the wake of #StormDarwin pic.twitter.com/Jswe85olfB"

WAVEWATCH III (version 4.18)



Hindcast

- Unstructured grid around Ireland (see Gallagher et al., 2016a)
- Varying resolution from 10 km to 225 meters
- ERA-Interim 2D wave spectra

MÉRA 10 m winds



Methodology

- M4, Killard, and Kinsale (blue pins) locations of wave measurements
- Malin Head, Mace Head, and Sherkin Island (red pins) – Met Éireann Synoptic (TUSCON) stations
- Three storms
- Atmospheric conditions
- Wave conditions





Dec 5th 2013 ("Xaver") storm

MET éireann

- First storm
- Wreaked havoc over parts of northern Europe
- Low pressure in the north-west (967 hPa)





Dec 5th 2013 ("Xaver") storm



Tucson Graphs for Malin Head (TUCSONID = 17)



Tucson Graphs for Mace Head (TUCSONID = 2)



Wind Speeds and Gusts

Horizontal lines show mean boundaries.

Speed (kt) ---Gust (kt) ---

Strong (22kt)

Gale (34kt) ---Storm (48kt) ---





Ω

Jan 26th 2014 storm

- Heavy rain caused flooding
- Low pressure system of 947 hPa
- M4 record (highest wave ever recorded at an M-buoy) 23.4 m wave



The Irish Meteorological Service Online

Castle Point, Kilkee, Co Clare



Jan 26th 2014 storm

8

2:00

Tucson Graphs for Mace Head (TUCSONID = 2)



Mace Head: Wind Speeds and Gusts for 26-jan-2014 (0 maxgust missing) Mace Head: Wind Speeds and Gusts for 27-jan-2014 65.0 64.0 60.0 60.0 56.0 55.0 52. 50.0 48.0 45.0 44.0 £ 40.01 40 ₩ 36. 35.0 32. ŝ 28.0 Pin 25.0 Pin 24. 20.0 20.0 15.0 16.0 12.0 10.0 8.0 5.0 4.0 0:00 0.0 01:00 12:00 3:0 24:00 4:0 2:0 3:0 0:6 0:0 ю, 0:00 ä ġ. Mace Head: Wind Direction for 26-jan-2014 (0 maxgust missing) 360 330 300 270 360 330 300 270 240 240 210 Dir (deg) (deg) 210 180 180 150 150 120 Dir 120 Hind 90 90 60 60

Hour

23:00 24:00

Tucson Graphs for Mace Head (TUCSONID = 2)



Jan 26th 2014 storm Hs(m) 25-01-2014 00:00:00 57 *→→→→→→→→→→→→→→→→→→→→* 56 777 777777 55 7-7-7 XXXXXXXX **プラブラファ**



1 1 1

7 1 1

8

6

4

2



Feb 12th 2014 ("Darwin") storm

- Hurricane force winds with up to 159 km/h gusts
- Fallen trees, structural damage, land and air transport disruption, and power losses
- Mean Sea Level Pressure of 952 hPa
- 25 m wave recorded at Kinsale Gas Platform





Feb 12th 2014 ("Darwin") storm



- Wind direction south to southwest
- Mace Head wind of 72 kt (133 km/h) with gusts of 84 kt (156 km/h)



Feb 12th 2014 ("Darwin") storm

Hs(m) 11-02-2014 00:00:00 57 * * * * * 56 ***** ->-> XXXXXXXX ********** 55 54 + + E FE FE FE FE FE KKKKK 53 KKKKKKKKKKKKKK 52 THE CERKER FREERER *********************** 51 1 1 1 1 1 1 20 m/s → 50 -14 -12 -10 -8 -6



Feb 1st and 12th 2014 storms

• Wave height depends of the wind speed, how long the wind blows and the distance over which the wind blows





Conclusions & Future plans

- 12 major storms
- Coastal destruction, flooding, transport disruptions, and fatalities
- Underestimation of maximum values of wave events
- Phenomenal waves (above 14 m of Hs) recorded at M4 and Kinsale Gas Platform
- The advantages of hindcast data
- ECMWF Operational archive 2D wave spectra
- Extend the hindcast to the present day to include storms Emma and Ophelia





Bibliography

[1] S. Gallagher, E. Gleeson, R. Tiron, R. Mcgrath, and F. Dias, "Wave climate projections for Ireland for the end of the 21st century including analysis of EC-earth winds over the North Atlantic ocean", international journal of climatology, vol. 36, no. 14, pp. 4592–4607, 2016a.

[2] S. Gallagher, E. Gleeson, R. Tiron, R. Mcgrath, and F. Dias, "Twenty-first century wave climate projections for Ireland and surface winds in the North Atlantic ocean," Advances in Science and Research, vol. 13, pp. 75–80, 2016b.

[3] Janjic, J., Gallagher, S., and Dias, F., 2017. "Case study of the winter 2013/2014 extreme wave events off the west coast of Ireland". Advances in Science and Research, Special Issue: 17th EMS Annual Meeting: European Conference for Applied Meteorology and Climatology 2017 (in review).











Thank you for listening!

This work is supported by Science Foundation Ireland (SFI) through Marine Renewable Energy Ireland (MaREI), the SFI Centre for Marine Renewable Energy Research-(12/RC/2302). Authors wish to thank the Irish Centre for High-End Computing (ICHEC) for the provision of computational facilities.

