Downtime Assessment for Facilities Offshore of Ireland

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Aim

To develop a validated methodology for the assessment of facilities' downtime, applicable to oil and gas fields Offshore Ireland.
Objectives are:

- To collect point source and satellite wave data from different sources for sites off the west of Ireland.
- Data pre-processing –gap identification, spike detection and treatment with preparation of a data archive.
- Extreme Values analysis, spectral analysis of data & investigation of teleconnections.
- To develop an interpolation model that uses information from the wave connects to point source data.

Buoy Network Description

The Irish Marine Weather Buoy Network is operated by the Marine Institute, through collaboration between the Marine Institute, Met Eireann and the UK Met Office. The network consists of six WaveRider M-Buoys located in the offshore waters, with two more WaveRider buoys at the Atlantic Marine Energy Test site at Belmullet and another at Galway Bay. The buoys record ocean wave parameters including significant wave height. The buoys are deployed at Inner and Outer Belmullet in County Mayo, and at Spiddal in Galway Bay.
Figure 1 shows the locations of the M-buoys with the location of AMETS inset. Berth A refers to the Outer Belmullet site at 100m mean water depth and Berth B refers to the Inner Belmullet site at 50m mean water depth. The buoys in Figure 2 acquire continuous data on free surface elevation at a sampling rate of 1.28 Hz.

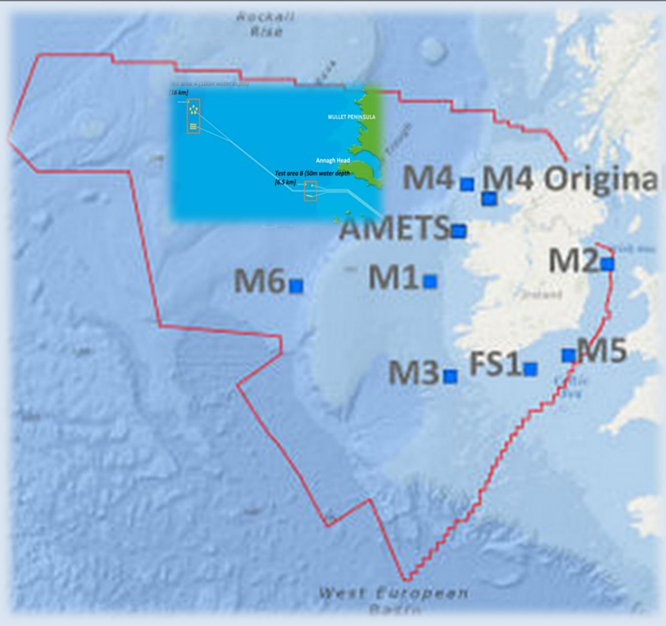

Figure 1. Depicts the Irish territorial waters with a zoom in providing a close-up view of the Atlantic Marine Energy Test Site off Belmullet, County Mayo.

Figure 2. Datawell WaveRider and Wavescan buoys at the quarter scale test site in Galway Bay. Image courtesy of the Marine Institute and SEAI.

Data Pre-Processing

It is clear that numerous false peaks were detected despite applying the Chen[1] filter with a multiplier of 1.15. Post-processing the H_{max} values can eliminate some of these spurious values. Various quantities to control the quality of the H_{max} values have been examined including:
-The standard deviation of FSE for each half-hour interval
-The median value of the FSE for each interval
-The ratio of the median FSE to H_{max} for each interval.
The ratio of the median FSE to H_{max} for each interval has been selected as the filter used to identify and clean the raw data. The filter also identifies spikes and removes values either side of a spurious spike. This has been set to 27 values either side of the spikes which was calculated to be approximately 1 wave length[2]. An example of the filter can be seen in Figure 3 and 4.

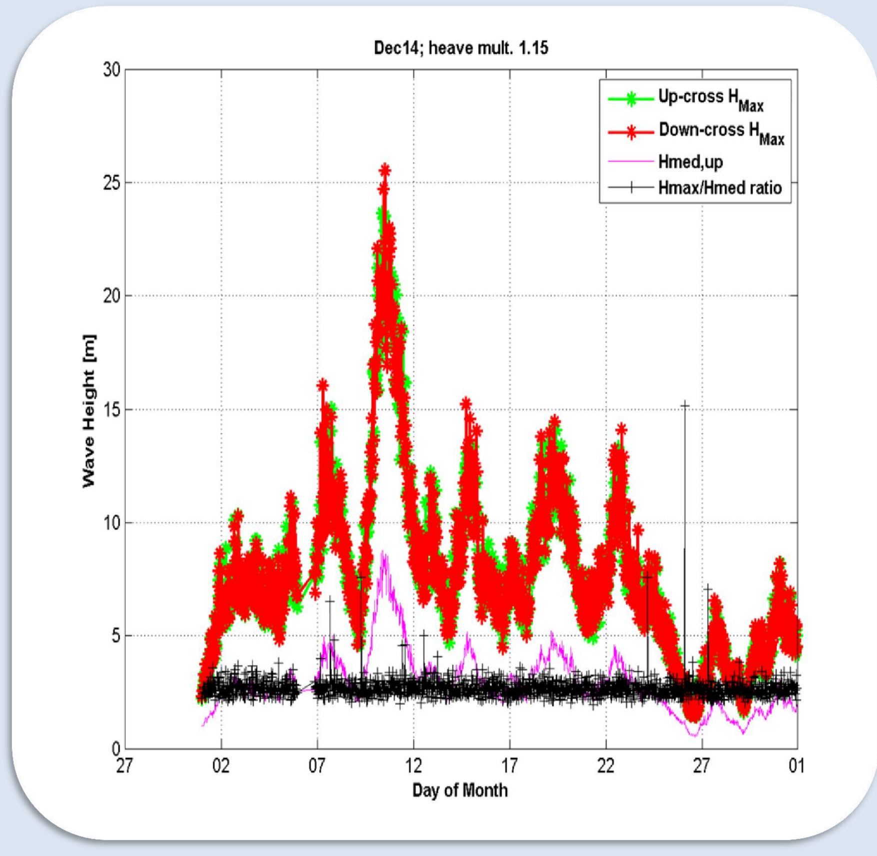

Figure 3. High Frequency Wave Data which has been filtered using a combination of Chen's filter and the ratio of the median FSE to Hmax for each interval

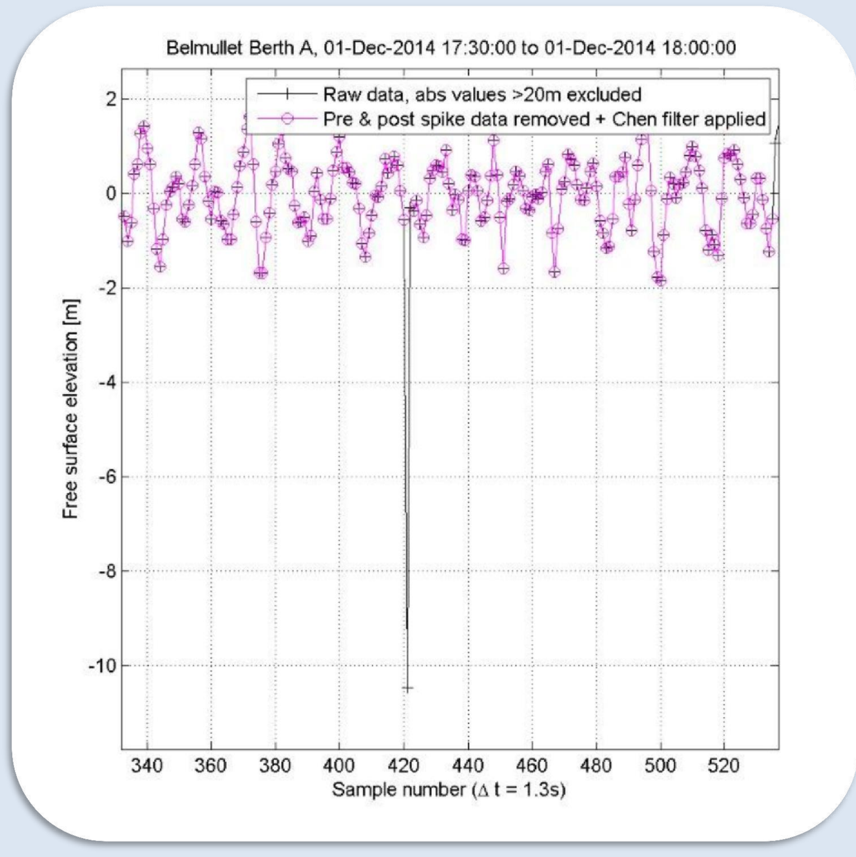

Figure 4. A series of data which shows how the filter identifies error values and filters them out of the dataset. These points are filled using a linear fit.

Future Work

Waves similar to NW Atlantic conditions will be simulated by an irregular sea simulation F95 program from Alistair Borthwick. The Fast Fourier Transform (fft) function in Matlab will be used to verify the simulated wave spectrum from the f95 program. This exercise will provide the data necessary for generating waves in subsequent tank tests.
After tank calibration in the Beaufort Building, unidirectional and multidirectional waves will be generated for an input spectrum. The process in which this work will be carried out is represented schematically in Figure 5.

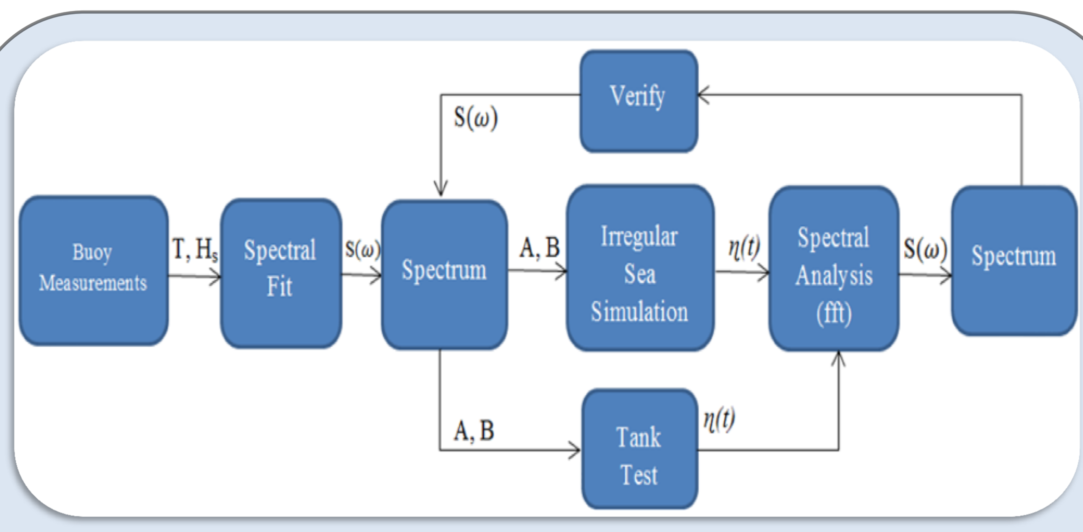

Figure 5. The process in which this work will be carried out is represented this schematic.

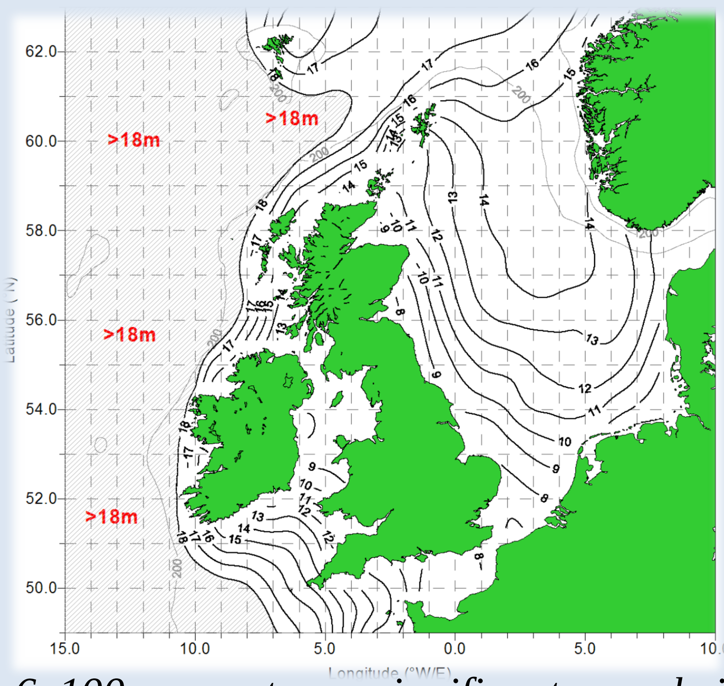

Figure 6. 100 year extreme significant wave height (m) contour map for the North Sea.[3]

A spatial map of the Atlantic Ocean around Ireland will be created using the hourly wave height data from wave buoys in the Atlantic such as the K-Buoys and M-Buoys. These will be used to tie the spatial map together. Geospatial techniques (e.g. Kriging) will be used to interpolate the data. Kriging is a recognised contouring algorithm, widely used in geostatistics. Figure 6 shows a 100 year extreme wave height contour map for the North Sea[3], a similar approach will be taken to develop a contour map for the Atlantic Ocean offshore of Ireland

This project is funded by the Irish Shelf Petroleum Studies Group (ISPSG) of the Irish Petroleum Infrastructure Programme (PIP) Group 4. The ISPSG comprises: Atlantic Petroleum (Ireland) Ltd, Cairn Energy Plc, Chrysaor E&P Ireland Ltd, Chevron North Sea Limited, ENI Ireland BV, Europa Oil & Gas (Holdings) plc, ExxonMobil E&P Ireland (Offshore) Ltd., Kosmos Energy LLC, Maersk Oil North Sea UK Ltd, Petroleum Affairs Division of the Department of Communications, Energy and Natural Resources, Providence Resources plc, Repsol Exploración SA, San Leon Energy Plc, Serica Energy Plc, Shell E&P Ireland Ltd, Sosina Exploration Ltd, Statoil (UK) Ltd, Tullow Oil Plc and Woodside Energy (Ireland) Pty Ltd.

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[1]*Chen, J. M. 2008. Wave Statistics in Directional Spread Sea-States and Wave-Wave Interactions. MSc Thesis, University of Oxford, U.K.*
[2]*Cahill, B. 2011. Characteristics of the Wave Energy Resource at the Atlantic Marine Energy Test Site. PhD Thesis, University College Cork, Ireland.*
[3]*O Williams, Martin. 2005. Wave Mapping in UK Waters, Health & Safety Executive publication, UK.*

The author would like to thank Providence Resources Ltd. for their mentorship whilst undertaking this research.