Wave Sensor Observations during a severe Storm event at a Marine Energy Development Site

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I. Keywords

Datawell Wave buoy, Nortek AWAC, wave shoaling, shallow water, storm.

II. Abstract

This study describes wave measurements taken during a severe storm event by a sensor network consisting of two Datawell Mk3 Waverider buoys and two 1MHz Nortek AWAC wave enabled acoustic Doppler current profilers. The buoys were moored some 16km offshore parallel to the coastline with 13.5km spacing between buoys in 60m depth, which for the data period described here constitutes intermediate water depth. Both AWACs were bolted to the seabed to the east of the buoys at shallow water at a depth of 13.5m mean water level (MWL), approximately 600m offshore with 500m spacing between sensors [1,2]. The study area features the best wave resource in the UK, is home to the world's largest fully consented wave power development, and is targeted for energy extraction projects by a number of developers [3, 4]. Wave measurements available for the study area were very limited prior to the recent sensor campaign, and these are summarised and referenced in [5].

In winter 2013, on 04 February, the combination of a high pressure system centred to the north east of the Azores and a deep low pressure system with a pressure of 965mbar only to the south of Iceland resulted in strong to storm force westerly winds across a large fetch area extending from south of Greenland to the Outer Hebrides and the sensor network.

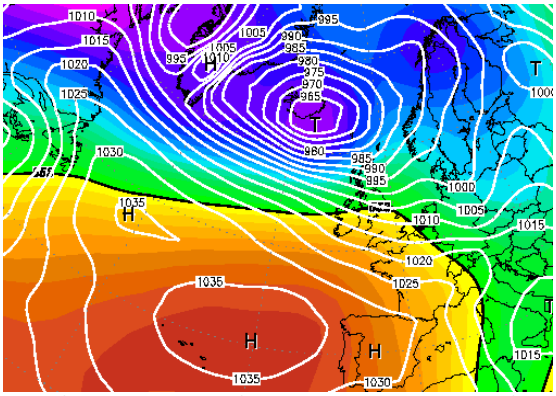

Fig. 1 Surface Pressure Chart for 04 February 2013; adapted from [6].

During the storm event the study area experienced significant wave heights of around 14m at the buoy locations and waves in excess of 24m were measured and confirmed as true readings during a quality control process. Wave heights of more than 8m were recorded at the shallow water locations and data returns were successful throughout the period across the sensor network. Some limitations to signal quality of the acoustic beams were observed, and these were likely to be caused by both high turbulence and aeration in the water column, evident during the observed conditions.

This paper compares data from the individual locations across the sensor network, and describes the sea state transition from intermediate to shallow water. Considerable differences were observed between the individual shallow water sensors, only distanced at 500m from each other, and these are also detailed and analysed in this study. A comparison of sensor data with the output of a high resolution spectral wave model is also included.

Findings described in this study are relevant not only to wave energy developers, but also to coastal protection agencies, as an enhanced understanding of extreme wave situations and wave height distributions under the observed conditions will inform project design, construction, maintenance and operations of energy converters. It will also help to identify appropriate erosion alleviation measures to protect the shoreline against a predicted intensified storminess in future years.

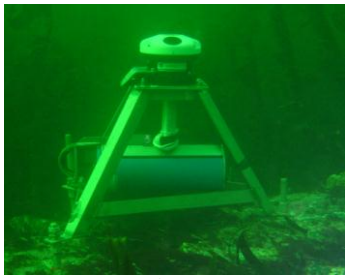

Fig. 2 Acoustic Sensor bolted to seafloor in 13.5m MWL off the Isle of Lewis.

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