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WAVE FORECAST FOR SHORT TERM POWER PREDICTION

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Introduction

The ability to provide accurate short-term wave forecasts for shallow water has numerous benefits for the marine energy sector. Forecasts are a requisite for the tuning of wave energy converters to an incoming sea-state to optimise energy capture. Wave climate predictions would also facilitate network control when managing fluctuations in power transmission.

Objectives

This study aspires to ensure that the nonlinear and non-stationary effects of the wave resource are well understood. Critical questions within the investigation include:

1. Is it possible to describe the evolution of wave groups and quiescent periods using time domain modelling techniques? Over what scale is this approach viable?

2. To what extent does including the effect of nonlinearities within a numerical model improve the accuracy of predictions?

3. Could such a system enable accurate forecast of the available wave energy?

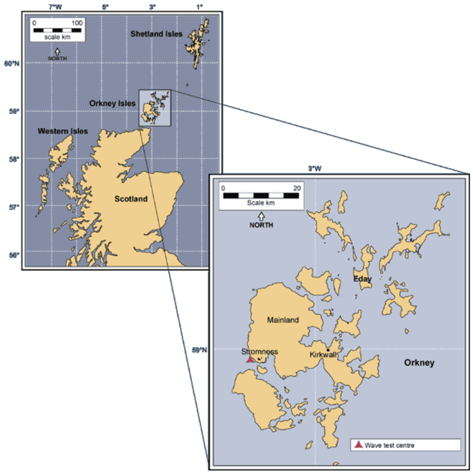

Figure 1: Location of EMEC wave test site
(Image courtesy of www.greentechnology.com)

Progress

- Sea-surface elevation and wave direction from two Waverider buoys separated by 1.6 km have been acquired for November 2005 from the EMEC wave test site off Billia Croo, situated on the western edge of Orkney (Figure 1). The exposed North Sea location means this is an area with one of the highest wave energy potentials in Europe and an excellent site for analyis.

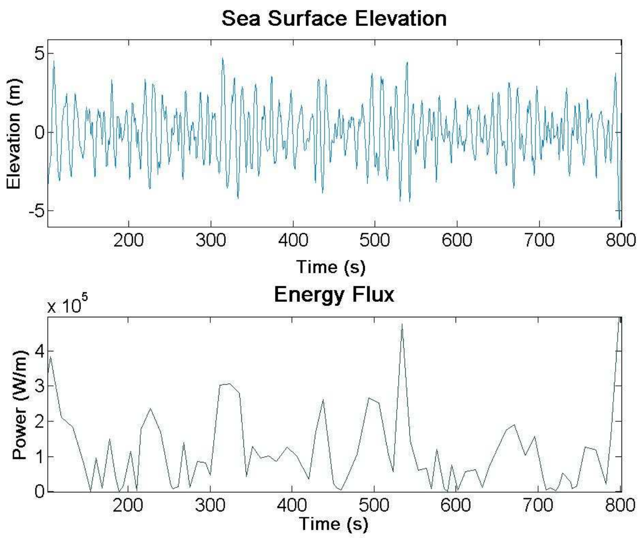

Figure 2: Sea surface elevation and corresponding wave energy flux.

- The possession of two data sets recorded in close spatial proximity enables wave characteristics from the first buoy to be used to build a probabilistic model of the waves which will later arrive at the second buoy, with data from the second buoy used as forecast validation.

- As an example of preliminary analysis a proxy for available power the *wave energy flux* is considered;

$$P_t = \left(\frac{g^2\rho}{64\pi}\right) H_t^2 T_t$$

Where, P denotes the power, in watts per metre (Wm^{-1}) of crest length, g is the acceleration due to gravity (9.81 ms^{-2}), ρ denotes the density of seawater (1025 kgm^{-3}), H is the wave height (m) and T the wave period (s).

Figure 2 illustrates a time-series of sea surface elevation (upper) and the corresponding wave energy flux calculated on a wave-by-wave basis using this mehod (lower).

- Building on this simplistic representation, the comparative capability of different forecasting methods will be evaluated.

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