Wave Forecast For Short Term Power Prediction

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Work stream 7: Advanced control of devices and network integration

Introduction

The ability to provide accurate short-term wave forecasts for shallow water would have 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 also facilitate network management, to minimise fluctuations in power transmission.

The principle aim of the work presented here is the examination of wave field evolution - analysis of wave group propagation and the statistical characteristics which describe sea-state - for the purpose of prediction.

Approach

Time-series of sea-surface elevation and wave direction from two Waverider buoys separated by a distance of 1.6 km have been acquired for the month of 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 analysis.

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.

Successful representation of the wave climate by this method will facilitate quantification of available power and the approach of quiescent intervals.

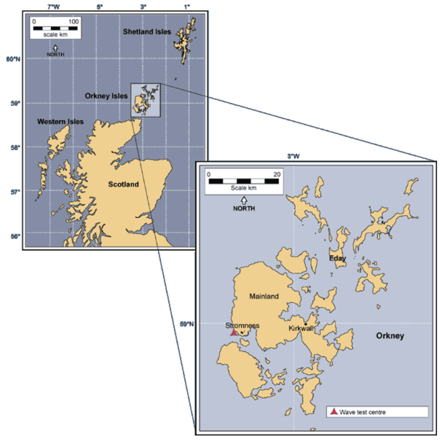

Figure 1: Location of EMEC wave test site
(Image courtesy of www.greentechnology.com)

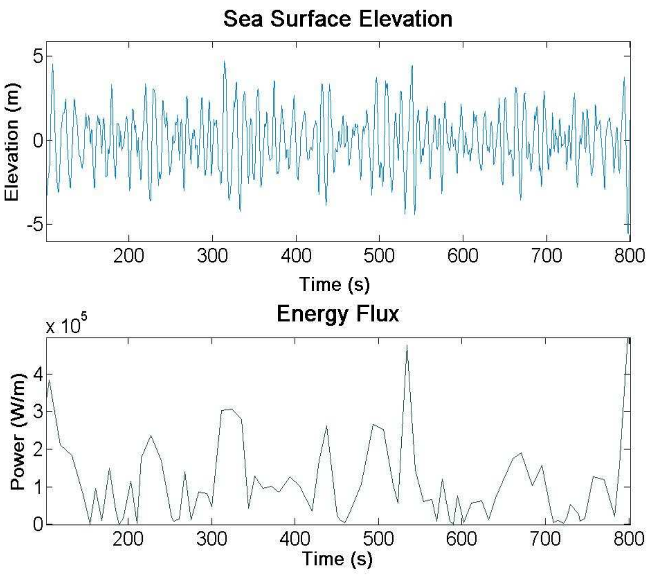

Figure 2: Sea surface elevation and corresponding energy flux.

As an example of preliminary analysis and to provide visual representation of the power available for extraction from ocean waves, 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 recorded on the 12th November 2005 at the location of the first buoy. The lower image shows the corresponding wave energy flux calculated on a wave-by-wave basis.

Building on this simplistic representation, the comparative robustness of different forecasting models of the time-varying statistics of this process will be evaluated.

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