Satellite altimetry and numerical wave modelling for Marine Renewable Energy

Nicolas Barré, Jenny Hanafin, Jarek Dobrzanski, Ann Fitzpatrick and Charlotte O’Kelly

TechWorks Marine Ltd., Ireland

To assess the potential of a wave energy site, the wave climate must be established from historical data over a period of several years. With their 20-year long time-series, satellite altimeter measurements have increasingly become one of the most important sources of information on the sea state. The record of the wave conditions over a representative period builds up a picture of the wave climate, such as its variation with the seasons and from year to year. The same analysis can be done for the tidal energy sites.

Wave climate data combined with numerical model outputs give the electrical power response over time and from that, its average level and its variability can be derived. These in turn will help determine the revenue stream from the sale of that electricity for a wave farm at that location, and therefore its commercial attractiveness. As more empirical data becomes available from operational machines, the power capture can be defined directly from measurements, although a role will remain for modelling tools in adapting this to improved energy converter designs and upgrades to control algorithms.

For marine energy resource assessment, TechWorks Marine Ltd. is assimilating altimetry data into the numerical wave model: WAVEWATCH III. In the light of RESGrow (collaborative project funded by ESA and managed by TechWorks Marine), two types of products are being developed for ocean energy resource assessments and marine operational services. One is a Marine Climatology Information (MCI) product for design and operational planning and feasibility studies whereas the other is a Nowcast Operational Service (NOS) for feasibility studies based on a near-real time basis (shipping and offshore operations).

Chawla A., A. D. Spindler, H. L. Tolman, "Validation of a thirty year wave hindcast using the Climate Forecast System Reanalysis winds", Ocean Modell., 2012.


Synthesis of numerical wave outputs for a specific energy site.

**Background:** Scatter table summarizing a wave climate in terms of Significant Wave Height ($H_{\text{m0}}$) and Wave Energy Period ($T_e$).

**Top left panel:** Wave Power Rose showing the wave power in function of the wave directions.

**Bottom left panel:** example plot illustrating a monthly distribution of wave power.