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Structured and unstructured grid model performance in the Irish Sea

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Long-term resilience to future climate conditions is crucial for the power generation and supply industry. The nuclear power sector, in particular, has coastal sites with operational life-spans in excess of 100 years. Assessment of future changes to the shoreline and to coastal circulation patterns is essential for planning appropriate defences for these sites.

The ARCoES (Adaptation and Resilience of Coastal Energy Supply) project aims to identify the challenges facing the future security of the UK nuclear energy sector resulting from changing patterns of flooding, coastal erosion and coastal sedimentation. To this end, two numerical models, the Finite-Volume Coastal Ocean Model (FVCOM) and the Proudman Oceanographic Laboratory Coastal Ocean Modelling System (POLCOMS), are compared to determine their suitability for assessing the future risk to key coastal power-generation locations posed by changes to sedimentation, erosion and flood risk in the nearshore, and changes to the supply of cooling water.

FVCOM is an unstructured-grid, finite-volume model with fully coupled waves and currents using the SWAVE wave model. POLCOMS is a well-established structured-grid model, coupled with the WAM wave model. The modelled area (the Irish Sea) was chosen to focus on a localised study area (a nuclear fuel reprocessing site) and to assess the full regional north-west (Carlisle – Anglesey) energy network resilience. Model performance at simulating waves and currents will be evaluated through comparison with data collected by the Irish Sea Observatory, data from the UK National Tide Gauge Network, and available wave buoy observations within the model domain. A 12-month simulation (1 January 2008 to 31 December 2008) from each model will be compared, following a three month spin up period of the baroclinic fields.

We will demonstrate the importance of high resolution in the nearshore region. While both models validate well close to the coast, the flexibility offered by FVCOM's unstructured grid results in a considerable improvement in its ability to simulate tidal elevation and circulation. Additionally, FVCOM's unstructured grid can properly resolve ROFIs (Regions Of Freshwater Influence) and estuarine systems without the need for further nesting; these features are essential for predicting 3D circulation in the nearshore region. Simulated turbulence also compares well between the two models.