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# High resolution modelling and observation of wind-driven surface currents in a semi-enclosed estuary

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Hydrodynamic circulation in estuaries is primarily driven by tides, river inflows and surface winds. While tidal and river data can be quite easily obtained for input to hydrodynamic models, sourcing accurate surface wind data is problematic. Firstly, the wind data used in hydrodynamic models is usually measured on land and can be quite different in magnitude and direction from offshore winds. Secondly, surface winds are spatially-varying but due to a lack of data it is common practice to specify a non-varying wind speed and direction across the full extents of a model domain. These problems can lead to inaccuracies in the surface currents computed by three-dimensional hydrodynamic models. In the present research, a wind forecast model is coupled with a three-dimensional numerical model of Galway Bay, a semi-enclosed estuary on the west coast of Ireland, to investigate the effect of surface wind data resolution on model accuracy. High resolution and low resolution wind fields are specified to the model and the computed surface currents are compared with high resolution surface current measurements obtained from two high frequency SeaSonde–type Coastal Ocean Dynamics Applications Radars (CODAR).

The wind forecast models used for the research are Harmonie cy361.3, running on 2.5 and 0.5km spatial grids for the low resolution and high resolution models respectively. The low-resolution model runs over an Irish domain on 540x500 grid points with 60 vertical levels and a 60s timestep and is driven by ECMWF boundary conditions. The nested high-resolution model uses 300x300 grid points on 60 vertical levels and a 12s timestep. EFDC (Environmental Fluid Dynamics Code) is used for the hydrodynamic model. The Galway Bay model has ten vertical layers and is resolved spatially and temporally at 150m and 4 sec respectively. The hydrodynamic model is run for selected hindcast dates when wind fields were highly energetic. Spatially- and temporally-varying wind data is provided by offline coupling with the wind forecast models. Modelled surface currents show good correlation with CODAR observed currents and the resolution of the surface wind data is shown to be important for model accuracy.