

Adapting NEMO for use as the UK operational storm surge forecasting model

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The United Kingdom is an area vulnerable to damage due to storm surges, particularly the East Coast which suffered losses estimated at over £1 billion during the North Sea surge event of the 5th and 6th December 2013. Accurate forecasting of storm surge events for this region is crucial to enable government agencies to assess the risk of overtopping of coastal defences so they can respond appropriately, minimising risk to life and infrastructure. There has been an operational storm surge forecast service for this region since 1978, using a numerical model developed by the National Oceanography Centre (NOC) and run at the UK Met Office. This is also implemented as part of an ensemble prediction system, using perturbed atmospheric forcing to produce an ensemble surge forecast.

In order to ensure efficient use of future supercomputer developments and to create synergy with existing operational coastal ocean models the Met Office and NOC have begun a joint project transitioning the storm surge forecast system from the current CS3X code base to a configuration based on the Nucleus for European Modelling of the Ocean (NEMO). This work involves both adapting NEMO to add functionality, such as allowing the drying out of ocean cells and changes allowing NEMO to run efficiently as a two-dimensional, barotropic model. As the ensemble surge forecast system is run with 12 members 4 times a day computational efficiency is of high importance.

Upon completion this project will enable interesting scientific comparisons to be made between a NEMO based surge model and the full three-dimensional baroclinic NEMO based models currently run within the Met Office, facilitating assessment of the impact of baroclinic processes, and vertical resolution on sea surface height forecasts. Moving to a NEMO code base will also allow many future developments to be more easily used within the storm surge model due to the wide range of options which currently exist within NEMO or are planned for future NEMO releases, such as data assimilation, and surge-wave coupling.

Assessment of tidal performance of the NEMO-surge configuration and comparison to the existing operational CS3X model has been carried out. Evaluation of the models focus on performance relative to the UK Class A tide gauge network, a dataset which was established following the devastating flood of 1953 and which is managed by the British Oceanographic Data Service (BODC) based at NOC. Trials of the NEMO model in tide-only mode have illustrated the importance of having a well specified bathymetry and, for the 7km scaled model, a secondary sensitivity to bed friction coefficient and the specification of the coastline. Preliminary results will also be presented from model runs with atmospheric (wind stress and pressure at mean sea-level) forcing.