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Impacts of high resolution model downscaling in coastal regions

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With model development and cheaper computational resources ocean forecasts are becoming readily available, high resolution coastal forecasting is now a reality. This can only be achieved, however, by downscaling global or basin-scale products such as the MyOcean reanalyses and forecasts. These model products have resolution ranging from 1/16th - 1/4 degree, which are often insufficient for coastal scales, but can provide initialisation and boundary data. We present applications of downscaling the MyOcean products for use in shelf-seas and the nearshore. We will address the question 'Do coastal predictions improve with higher resolution modelling?' with a few focused examples, while also discussing what is meant by an improved result.

Increasing resolution appears to be an obvious route for getting more accurate forecasts in operational coastal models. However, when models resolve finer scales, this may lead to the introduction of high-frequency variability which is not necessarily deterministic. Thus a flow may appear more realistic by generating eddies but the simple statistics like rms error and correlation may become less good because the model variability is not exactly in phase with the observations (Hoffman et al., 1995).

By deciding on a specific process to simulate (rather than concentrating on reducing rms error) we can better assess the improvements gained by downscaling. In this work we will select two processes which are dominant in our case-study site: Liverpool Bay. Firstly we consider the magnitude and timing of a peak in tide-surge elevations, by separating out the event into timing (or displacement) and intensity (or amplitude) errors. The model can thus be evaluated on how well it predicts the timing and magnitude of the surge. The second important characteristic of Liverpool Bay is the position of the freshwater front. To evaluate model performance in this case, the location, sharpness, and temperature difference across the front will be considered. We will show that by using intelligent metrics designed with a physical process in mind, we can learn more about model performance than by considering 'bulk' statistics alone.

R. M. Hoffman and Z. Liu and J-F. Louic and C. Grassotti (1995) 'Distortion Representation of Forecast Errors' Monthly Weather Review 123: 2758–2770