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Comparison of Dynamic Topography Bias in HIROMB and NEMO-Nordic Model by Utilizing Marine Geoid

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Hydrodynamic models (HDM) provide a reasonable estimate of the sea conditions. Thus making them a vital tool for climate change, engineering, and marine ecosystems. One of the parameters often derived from HDM is the Sea Surface Height (SSH). There exists however a very important hidden characteristic with respect to SSH derived from HDM. For instance, the modelled sea level may have a bias relative to a geodetic reference system datum. In many cases, this bias can change both spatially and temporally. This study now examines this bias by comparison of HDM modelled SSH with tide gauges derived SSH that are geodetically referenced to a more stable vertical reference frame such as the marine geoid (equipotential surface of the earth i.e. is the shape of the ocean surface under the influence of the gravity and rotation of Earth alone).

In this study, the performance of two HDM is analysed for the period 2014–2015: the Nemo-Nordic (utilised for the Baltic and the North Sea) and the HIROMB-BOOS (used for operational sea forecast in Estonia). In these models, the derived SSH is compared to the fourteen tide gauges (TG) located along the Estonian coastal zone of the Baltic Sea. The vertical reference frame for these tide gauges is fitted to that of a regional high-resolution geoid model, thus deriving the Dynamic Topography. The methodology consisted of: (i) determining the offshore points that are closest to the tide gauge location, (ii) filtering and averaging of the data sets to remove outliers and high-frequency fluctuations (iii) calculation of the SSH bias between TG and HDM (iv) calculation of the standard deviation and root mean square error (RMSE).

In general, results show that both models conform to a similar trend as tide gauge. The bias however between tide gauge and models varied randomly in magnitude (both spatially and temporally) between both models. The maximum bias for the HIROMB was calculated to be an overestimation of 57 cm and for the Nemo an underestimation of 64 cm. These results hint of possible improvement that can be made in HDM by utilizing a high resolution geoid model that can assist in accurate engineering and scientific studies.