Geophysical Research Abstracts,
Vol. 11, EGU2009-11360, 2009
EGU General Assembly 2009


# A 3D finite-element operational model for a part of the Baltic Sea

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The growing demand and diverse needs for high-resolution sea state forecasts motivated the development of coastal and regional sea (ocean) models in maritime European countries. Here, we present the FiMar model designed in Latvia and applied for an adjacent subregion of the Baltic Sea including the Gulf of Riga. The model is routinely run in operational mode delivering prognostic fields of fine detail (less than about 1 nm) to a number of end-users. FiMar receives the atmospheric forcing and open-boundary conditions from wider-scale coarser-resolution models of a partner institution – the Centre for Ocean and Ice of the Danish Meteorological Institute. (This nesting technique can also be regarded as "dynamical downscaling".)

In this report, the focus is on the dynamical core of the system that deals with the physical state of the sea. FiMar is a finite-element, sigma-coordinate, three-dimensional shallow-water model. An unstructured fixed mesh is used in order to capture the detailed bathymetry and coastline, the elementary volume being a triangular prism. The spatial finite-element discretization is of the continuous Petrov–Galerkin, stabilized P1–P1 type. The temporal accuracy is of the first order, and the fractional-step approach is followed. Certain pieces of the algorithm are implemented in a discretely compatible way. The horizontal eddy diffusivity is constant, while the Mellor–Yamada turbulence closure model is employed for the vertical diffusion.

The application experience with the model is discussed, and some case studies are presented.