



## **Validation of three-dimensional hydrodynamic models of the Gulf of Finland based on a statistical analysis of a six-model ensemble**

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A model-intercomparison study was conducted, the first of its kind in the Baltic Sea, in which the aim was to systematically simulate the basic three-dimensional hydrographic properties (including their spatio-temporal variability) of a realistic, complex basin. The level of accuracy of different models in reproducing the properties of the marine environment was investigated in a transparent and fair way, thus providing an assessment of the current state-of-the art of hydrodynamic modeling of the Gulf of Finland. Six three-dimensional hydrodynamic models of the Baltic Sea were compared in their simulations of the hydrographic features of the Gulf of Finland in the summer-autumn period of 1996. Validation was undertaken using more than 300 vertical hydrographic profiles of salinity and temperature. The analysis of model performance, including ensemble averaging of the results, was undertaken with a view to assessing the potential suitability of the models in reproducing the physics of the Baltic Sea accurately enough to serve as a basis for accurate simulations of biogeochemistry once ecosystem models are incorporated. The performance of the models was generally satisfactory. Nevertheless, all the models had some difficulties in correctly simulating vertical profiles of temperature and salinity, and hence mixed layer dynamics, particularly in the eastern Gulf of Finland. Results emphasized the need for high resolution in both vertical and horizontal directions in order to resolve the complex dynamics and bathymetry of the Baltic Sea. Future work needs to consider the choice of mixing and advection schemes, moving to higher resolution, high-frequency forcing, and the accurate representation of river discharges and boundary conditions.