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The performance of the parameterisations of vertical turbulence in the 3D modelling of hydrodynamics in the Baltic Sea

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This paper is devoted to a study on the effects of different parameterisations of vertical turbulence - with a 3D hydrodynamic model COHERENS - on the accuracy of calculated temperature and salinity fields in the Baltic Sea, Gulf of Finland. Two algebraic parameterisations and k-ε and kl models were used. For k-ε both one- and two-equation models were used. For kl two different sets of stability functions were used. Calculated vertical profiles of temperature and salinity were compared against CTD-profiles collected during a measurement campaign in the Gulf of Finland in summer 1996. The dataset has outstanding spatial and temporal coverage including over 300 measured CTD profiles. The thermocline depth was underestimated throughout summer by all the vertical turbulence schemes. The selection of stability functions had significant effect on the accuracy of the kl model. Generally k-ε and kl models performed better when the limiting conditions for mixing length were not applied. Kl model with stability functions based on the Munk-Andersson relation without limiting condition for mixing length showed best accuracy in the calculated profiles of temperature and in the thermocline depth. Calculated salinity was overestimated in the surface layer and underestimated in the bottom layers. Algebraic parameterisations had highest accuracy in the vertical salinity profiles. In the eastern Gulf of Finland the calculated values of salinity were overestimated. The accuracy of initial conditions, river runoff and bathymetry had significant effect on the accuracy of calculated salinity fields.