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Analysis of temporal variability of horizontal water exchange in the East and South-East Baltic due to probable climate changes

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Temporal variability of horizontal water exchange within the Baltic Sea was investigated using three-dimensional not hydrostatic hydrodynamic model MIKE3-FlowModel (DHI Water & Environment, http://www.dhi.dk) during annual cycle under mean-annual, real (2004) and predicted external conditions. Bathymetry of the Baltic Sea is based on data from http://www.io-warnemuende.de. Numerical regular rectangular grid had 152 $\times$ 306 meshes in horizontal (5 km $\times$ 5 km) and 92 layers in vertical (4 m each). Time step of integration was 90 s. The conditions of solar radiation (including day/night variations) are calculated in the model automatically on the base of latitude/longitude of every particular place. External forcing included solar radiation, turbulent heat exchange with the atmosphere, wind, rivers and the Earth rotation. As initial conditions, mean-annual salinity and temperature fields T,S (x,y,z) were taken for the whole Baltic Sea in February. Open boundary was placed in the Northern Kattegat, where mean-annual salinity and temperature profiles varied monthly. The whole Baltic Sea river runoff was distributed between 21 individual river and varied monthly. Mean-monthly values for cloudiness were used, averaged over the Baltic Sea area. The volumetric flow-rate values through arbitrary cross-sections for coastal zones of East and South-East Baltic were researched. Horizontal exchange between coastal and off-shore regions through (curvilinear) cross-sections, put along 30-m and 50-m iso-baths, was estimated. The simulations were carried out for three scenarios of external atmospheric conditions: (i) monthly mean-annual variations of the air temperature (2 m above sea level), variable over the sea area, and the wind data only set taken from real measurements in Visby (in the central part of the Baltic Sea, 1/day, year 2007); (ii) real air temperature and wind data (1/day, year 2003), variable over the sea area; (iii) increase in the monthly mean-annual variations air temperature by 2.6ºC (wind data as in (i)).
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