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Investigation of saline water intrusions into the Curonian Lagoon (Lithuania) and two-layer flow in the Klaipe[U+0097]da Strait using finite element hydrodynamic model

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This work is focused on the application of a modelling system to simulate 3-D interaction between the Curonian Lagoon and the Baltic Sea coastal waters and to reflect spatio-temporal dynamics of marine waters in the Curonian Lagoon. The model system is based on the finite element program package SHYFEM which can be used to resolve the hydrodynamic equations in lagoons, coastal seas, estuaries and lakes. The results of a one year 3-D model simulation with real weather and hydrological forcing show that the saline water intrusions from the sea through Klaipeda Strait are gradually decreasing with distance from the sea and become negligible (average annual salinity about 0.5 psu) at a distance of about 20 km to the south of Kiaules Nugara island. Analyses of the simulation results also show this area being highly heterogeneous according to the vertical salinity distribution. While in the deeper Klaipeda Strait (harbour waterway) differences in average salinity between near bottom and surface layers varies in the range 2-2.5 psu, in the rest of the Curonian Lagoon it is less than 0.1 psu. Analyses of the simulation results confirmed the presence of a two-directional flow that from time to time changes to either saline water one-directional flow to the Curonian Lagoon or fresh water one-directional flow to the sea. Two-directional flow duration decreases with a distance from sea entrance in Klaipeda Strait from around 180 days year-1 close to the sea entrance to 50 days year-1 just behind Kiaules Nugara island. One-directional outflow duration is increasing with a distance from the sea entrance from 100 to 225 days year-1. One-directional inflow duration occurs in the range 85-100 days year-1. The analysis of the ratio of buoyancy layer thickness and water depth (hb/H), and the Wedderburn number showed three main flow regimes in the strait identifying the main importance of wind action in the along-strait direction. Absence of wind or cross-strait wind regimes allow the maintenance of a two-layer flow typical of estuarine dynamics.