Operational modelling of Baltic Sea - port of Liepaja - Liepaja lake system

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Operational oceanography of coastal system Baltic sea - Liepaja port - Liepaja lake is considered. The goal of the modelling is to provide correct forecast of currents in the Liepaja port. The currents in Liepaja port entrances are essentially dependent on currents and change in water level in surrounding Baltic sea and inflow/outflow from Liepaja lake. Therefore, we need multi-scale and multi-resolution model to simulate currents in port and port entrances. Characteristic horizontal resolution of the Baltic sea in operational setups is 1 nm, whereas channel connecting Liepaja port and Liepaja lake must have at least 30 m horizontal resolution. Moreover, the model has to be 3-dimensional because of water stratification in the port. The multi-scale coastal modelling is accomplished with 3-dimensional HIROMB BOOS model (HBM), where two way nesting is allowed. The operational model for the system Baltic sea - Liepaja port - Liepaja lake involves 3 nesting areas: 1) coarse resolution (1 nm) area of the Baltic proper, 2) fine resolution (30 m) area of Liepaja port and entrance to Liepaja lake, 3) average resolution (60 m) area of shallow Liepaja lake. The outer boundary conditions of the first area are obtained from CMEMS Baltic sea operational model HBM. Weather forcing is provided by DMI Harmonie model with 2 km horizontal resolution. Rivers running in to the lake are provided with temperature and run-off according to actual data in observation stations. Validation of the model is performed by comparing model to observation data of water level, temperature and salinity in port of Liepaja, Liepaja lake and Baltic sea. Moreover, flow rate in channel connecting Liepaja port and Liepaja lake is used for model validation, too. Liepaja port has 3 entrances connecting it to the Baltic sea. The model showed that currents in the port entrances depend significantly on large scale currents in the Baltic sea. The flow regime in the port, port entrances and channel connecting port with the lake can be both as two level flow or single level flow. Usually, Liepaja lake acts as a fresh water source in the port. However, during storm surge and periods with little precipitation large amount of salty water enters the lake. As the lagoon type Liepaja lake is relatively shallow with average depth of 1 m then the bottom friction of the lake is strongly important. However, it has to be altered seasonally because of varying vegetation. Long period with high precipitation (autumn 2017) suggested that inclusion of wetland in the model is highly important as the effective area of the lake strongly increases during flooding. In case of storms, there are strong currents in the port and port entrances. According to monitoring results, strong vorticity of currents leads to notable redistribution of sediments near the port structures.