



Modelling of hydrodynamics, sediment and radionuclide transport in ice covered estuaries

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Many estuaries are covered by seasonal ice sheet that results in strong changes in thermo-hydrodynamics and contamination transport. To simulate radionuclide transport in the ice covered estuaries the 3D model THREEETOX/ICE model was developed. It includes a set of sub-models: a hydrodynamics sub-model, ice dynamics-thermodynamics sub-model, sediment and radionuclide transport sub-models. The hydrodynamics is simulated on the basis of the three-dimensional, time-dependent, free surface, primitive equation model with two-equation $k - \epsilon$ model. The dynamic-thermodynamic ice and snow model is based on the modified Hibler approach. The sediment transport sub-model simulates transport of non-cohesive, cohesive sediments and mixture of fractions of different size of cohesive/no-cohesive sediments. The processes of erosion are interrelated when clay content is above a critical (Van Ledden, 2001). The water column and bottom are divided into a set of layers: water layer, active layer and the bed layer. The thickness of bed layer is governed by the equation of the bottom deformation. The bed composition changes are calculated by solving an advection-diffusion equation (Armanini, 1995). The equations of the radionuclide transport describe the concentration of the radionuclide in solute, ice, in the suspended sediments and the concentration in the bottom deposition. Adsorption and desorption of radionuclide between liquid and solid phases are described by the radionuclide exchange rates between suspended sediment and water, bottom sediment and by the distribution coefficients. The circulation, temperature and salinity in 1986-1988 and caused by Chernobyl accident fluxes of ^{137}Cs and ^{90}Sr through the Dnipro-Buh estuary were simulated and compared with field data. In the frame of EU INCO project RADARC the model coupled with 1D river model RIVTOX was applied to the Ob' and Yenisey estuaries to simulate radionuclide flux in the Kara Sea from activities of nuclear reprocessing plants placed in these river basins.