3-D modelling of ^{137}Cs and ^{90}Sr transport in Dnieper-Boog Estuary

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The developed recently 3-D numerical model of hydrodynamics, sediment transport and pollutant dispersion (THREETOX) is applied to simulate radionuclide fate in stratified water bodies. Hydrodynamics of THREETOX is similar to Blumberg-Mellor model, also known as Princeton Ocean Model. Suspended sediment transport is described by advection- diffusion equations. Transport of the radionuclides is calculated separately for the liquid and solid phases. The paper presents the methodology and results of the model implementation to Dnieper –Boog Estuary (Dnieper River, Ukraine), that is the largest estuary of the Black Sea with a surface area of 1006.3 km^2, and a volume of 4.24 km^3. The regime of this drowned-river water body varies from stratified to partially mixed. The sources of fresh water discharge are the Dnieper and Southern Boog rivers. Dnieper-Boog Estuary (DBE) is the end of Chernobyl radionuclide's riverine pathway from Chernobyl into the Black Sea. The simulation of the ^{137}Cs and ^{90}Sr distribution in the DBE and calculation of the relevant radionuclide fluxes to\from Black Sea were done on the basis of the measured radionuclide influxes into the DBE from the Dniper River in 1986-1989. The simulated radionuclide concentrations on sediments and in dilute where compared with the measured data. It was shown that the spatial correlation between ^{137}Cs and salinity in DBE is strongly nonlinear due to sorption of the radionuclides on the fine sediment particles. The water stratification, compared with the wind action, has minor effect on the sediment and radionuclide fluxes in major part of the estuary except the ship channel, where the salt wage is formed.