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Modelling discrete and diffuse pollution sources within the Gulf of Bothnia using passive tracers and NEMO

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High levels of hazardous substances such as persistent organic pollutants (POP) and heavy metals in the environment imply health risks for humans and animals. Such substances have been found in residues, such as cellulose fibers, originating from discharged pulp and chemicals from old pulp and paper mills in Västernorrland. These residues were transported with the rivers and accumulated forming large banks of fibers in calm waters and now cover large areas of lakes and the sea in the vicinity of these old factories. The fiber banks and fiber rich sediment distribution has been mapped in previous projects. These projects also studied the release, bioaccumulation and dispersal of pollutants from the banks and sediment on a small scale. It was found that the banks contain large amounts of heavy metals such as lead, mercury, cadmium, chrome and zink, as well as POP such as polychlorinated biphenals (OCBs), dichlorodiphenyltrichloroethane (DDT) and hexachlorobenzene (HCB). The aim of this project is to study the dispersion of these substances on a larger scale using two different complementing types of models: 1) a multi-basin one-dimensional coastal zone model with high vertical resolution to study the dispersion of pollutants in the coastal zone, and; 2) a three-dimensional open ocean model, based on NEMO 3.6, with relatively high spatial resolution to study the dispersion in the open Bothnian Sea.

Here the pollution dispersion variability in the second model is studied. This study will then be used to set the appropriate methodology once the model 1 study has been performed. The pollution is modeled using passive tracers added at different temporal and vertical distribution. The temporal cases comprise two single discrete occasions during; 1) a high flow spring, 2) a low flow occasion, respectively, and 3) a diffuse constant source or 4) a source varying with to the river flow. The spatial distribution cases comprise cases where the source is evenly distributed over the water column, or is placed in the bottom- or the surface-most cells or according to NEMO mixed river inflow, respectively. The spatial cases mimic well-mixed or stratified conditions, respectively. The variability of the pollution dispersion is studied for these in total 8 cases during 10 years of simulation time.