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Modeling the nitrogen retention in the river-estuary continuum of the Scheldt: Seasonal evolution and response to pollution abatement within the catchment

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A fully coupled, two-dimensional hydrodynamic and reactive-transport model of organic carbon, nutrients and oxygen along the river-estuarine-coastal zone continuum of the Scheldt (B-NL) has been developed to quantify the nitrogen filtering capacity of this system.

Simulation results reveal that the tidal river and the estuary contribute almost equally to the overall biogeochemical transformation of elements, despite the very different water volumes involved. A pronounced seasonal variability in total nitrogen (TN) cycling results from the combined effect of these transformations and nutrient flux imbalances, which arise from the time-lagged response of the scalar fields to hydrological perturbations. Due to the complex interplay between reaction and transport, the dynamics of the estuarine TN filtering capacity cannot be constrained by the freshwater residence alone. In addition, simulations reveal that the filtering capacity, which ignores the effect of transient mass storage in the estuary, does not allow constraining the nutrient export fluxes to the coastal zone at the seasonal scale.

The influence of secondary and tertiary wastewater treatment plants in the catchments, both in operation and projected, has also been assessed by establishing TN mass budgets at the decadal timescale. Results show that a significant decrease of organic matter and ammonium concentrations may be expected by 2010. It will lead to a partial restoration of oxygen levels, and thus, to a reduction in denitrifying activity. Therefore, a significant decrease of the TN export to the coastal zone during the summer

period should not be expected.