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# The interplay between estuarine transport and biogeochemical processes in determining the nutrient conditions in bottom layers of non-tidal Gulf of Finland

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In coastal areas, especially estuaries, spatial distribution and seasonal cycling of chemical and biological variables is largely determined by local biogeochemical processes and water transport of different properties. In tidal estuaries, however, biogeochemical processes are affected by tides as frequent water exchange alters nutrient and oxygen concentrations. In wide and deep non-tidal estuary-type marginal seas spatial distribution and seasonal cycling are determined by the mixture of water transport and local biogeochemistry.
The Baltic Sea is a stratified water basin where halocline divides the water column into two parts: upper layer, which is horizontally uniform in terms of distribution of chemical and biological parameters, and has clear seasonal cycle; and bottom part, where nutrient and oxygen dynamics is more complex. There water transport and sediment-water interface fluxes play a major role.
Our prime focus is the Gulf of Finland in the Baltic Sea. It is a wide, non-tidal and stratified sub-basin known for its high nutrient concentrations and severe oxygen deficiency in summer. We modelled the Baltic Sea (including Gulf of Finland) using ERGOM, a biogeochemical model coupled with circulation model GETM. Seasonal cycling and water circulation were observed with a 40-year simulation from 1966 to 2006. Our results show that in shallow areas above halocline the seasonal cycle of phytoplankton, nutrients and oxygen concentrations is uniform in space. Water circulation does not create inhomogeneous distribution pattern of biogeochemical parameters and their seasonal cycle. The circulation in the Gulf of Finland is strongly modulated by the seasonality of estuarine transport. Below the halocline
saline low-oxygen and nutrient-rich water is transported from the open Baltic Proper to the Gulf of Finland in spring and early summer. This results in the highest nutrient concentrations and the poorest oxygen conditions by the end of August. In the shallow area nutrients have high concentrations in March-April before the spring bloom of diatoms starts. Low oxygen and nutrient concentrations are observed at the end of August. There is a qualitative difference of nutrient dynamics between shallow and deep layers but quantification of the role of transport and local biogeochemical processes is still challenging.