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Modelling phytoplankton successions and nutrient transfers along the Scheldt estuary (Belgium, The Netherlands)

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The freshwater (RIVE) and the marine (MIRO) biogeochemical models were coupled to a 1D hydro-sedimentary model to describe contemporary phytoplankton successions and nutrient transfers in the macrotidal Scheldt estuary (BE/NL) affected by anthropogenic nutrient loads. The 1D-RIVE-MIRO model simulations are performed between Ghent and Vlissingen and the longitudinal estuarine profiles are validated with physico-chemical and phytoplankton observations available for the year 2006. Results show the occurrence of two distinct phytoplankton blooms in the upper and lower estuary, suggesting that neither the freshwater nor the marine phytoplankton is crossing the maximum turbidity zone (MTZ) at the saline transition. Sensitivity tests performed to understand how changing conditions (salinity, turbidity and nutrients) along the estuary are controlling this bimodal spatial phytoplankton distribution point salinity and light availability as key drivers while the grazing pressure and nutrient limitations are negligible. In the absence of species-specific salinity control or in low light limitation, freshwater phytoplankton is able to cross the MTZ and grow in the lower estuary where they compete with marine phytoplankton for nutrients. Additional tests with varying salinity-resistant (euryhaline) species in the freshwater assemblage conclude that the presence (or absence) of euryhalines determines the magnitude and the extension of freshwater and marine phytoplankton blooms in the estuary. Annual nutrient budgets estimated from 1D-RIVE-MIRO simulations show that biological activities have a negligible impact on nutrient export but modify the speciation of nutrients exported to the coastal zone towards inorganic forms.