Past and present carbon dynamics in the Scheldt estuary as traced by changes in the isotopic composition of dissolved inorganic and particulate organic carbon

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The freshwater Scheldt estuary, located in Belgium, is known as one of the most populated and most industrialized estuaries in Europe. The historical emission of a variety of pollutants by the agriculture, domestic and industrial activity in the watershed decreased its water quality. Wastewater treatment (WWTP) efforts since the nineties allowed the system to recover from hyper-eutrophication around 2006. Although the water quality of the Scheldt estuary has since impressively been improved, the situation needs continuous monitoring data to understand the complex interactions between the anthropogenic (WWTP, dredging, dumping and channel deepening) and natural influences. Since 1996, a systematic, long-term multidisciplinary monitoring program called OMES (Onderzoek Milieu-Effecten Sigmaplan, Van Damme *et al.* (2005)) monitors monthly the water quality of the Scheldt estuary by measuring variable parameters at representative sampling stations. Results presented are part of this OMES project.

Particulate organic carbon concentrations (POC) are monitored since the beginning of the project, and since 2006, the stable carbon isotopic composition ($d^{13}C$) of POC, but also of dissolved inorganic carbon (DIC), are analyzed. $d^{13}C$-POC and -DIC are influenced by the inputs and origin of organic carbon and by the balance between primary production and respiration.

In this study, the isotopic composition of POC and DIC were combined with an isotopic mixing model to estimate the fraction of allochthonous and autochthonous (phytoplankton) carbon in the POC pool. This composition of POC is a crucial factor in estuarine ecology as it defines the biodegradability of the POC, and so, its biological oxygen demand, but also its "quality" as a food source for higher trophic levels. Indeed, allochthonous carbon sources (POC_{ALL}) are general composed of old, already highly mineralized material with a low biodegradability and low nutritional value, while freshly produced phytoplankton biomass carbon (POC_{PHY}) is highly respirable and has a high nutritional value.

Our study focusses on the evolution over the last 17 years of the POC composition, combined with other variables, such as turbidity, biological oxygen demand, chlorophyll a and carbon to nitrogen ratio to highlight long-term changes in the estuary. Recent studies highlighted that this period is characterized by an increased turbidity in the freshwater part of the estuary combined with a reduced chlorophyll a. The contribution of allochthonous material and phytoplankton biomass to suspended particulate matter (SPM) was investigated. The evolution of these fractions over the last two decades will provide insights in the main sources that drive the food web and the quality of the ecosystem.

Reference

Van Damme, S.; Struyf, E.; Maris, T.; Ysebaert, T.J.; Dehairs, F.A.; Tackx, M.; Heip, C.H.R.; Meire, P. (2005). Spatial and temporal patterns of water quality along the estuarine salinity gradient of the Scheldt estuary (Belgium and The Netherlands): results of an integrated monitoring approach. Hydrobiologia 540(1-3): 29-45. https://dx.doi.org/10.1007/s10750-004-7102-2

Keywords

Scheldt Estuary; Dissolved Inorganic Carbon; Phytoplankton Biomass Carbon; Allochthonous Carbon; Suspended Particulate Matter