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The link between water quality and tidal marshes in a highly impacted estuary.

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The Schelde estuary is one of the most heavily impacted estuaries in Europe. During several decades, untreated waste water from large cities (e.g. Brussels, Antwerp, Valenciennes, Lille) and industries was discharged in the river. As a result, the Schelde estuary has the reputation of being one of the most polluted estuaries in Europe. For a long time (approx. 1950 – 1995) all forms of higher life (macro-invertebrates and fish) were absent in the fresh and brackish parts of the estuary. Due to European legislation, a large part of the sewage water is now treated resulting in a significant recovery of water quality in the estuary. However, next to water quality, the estuary also suffered serious habitat losses during the last decades, mostly due to economic development and changing hydrological conditions causing more erosion.

Over the last fifteen years, the management of the estuary has changed fundamentally. It is now more and more focused on the restoration of ecosystem services. In this presentation we will document the changes in water quality over the last 50 years and summarize recent work on the role of tidal marshes on water quality within the freshwater part of the Schelde estuary. Our results stress the important of taking into account ecosystem services and habitat restoration for long-term estuarine management.

.After decades of high inorganic nutrient concentrations and recurring anoxia and hypoxia, we observed a paradoxical increase in chlorophyll-a concentrations with decreasing nutrient inputs, indicating a regime shift. Our results indicate that the recovery of a hypereutrophied systems towards a classical eutrophied state, needs the reduction of waste loads below certain thresholds. Paradoxically, phytoplankton production was inhibited by high ammonia or low oxygen concentrations. The system state change is accompanied by large fluctuations in oxygen concentrations. The improved water quality resulted in a remarkable recovery of different groups of higher organisms, especially fish populations. It is clear that the improved water quality is to a large part due to improved waste water treatment. However detailed studies of the exchange between tidal marshes and the estuary clearly proved also the importance of these habitats for water quality. A whole ecosystem labeling experiment gave evidence on the sink function of these marshes for nitrogen. Detailed mass balance studies show also the importance of mashes in the silica cycle. Amorphous biogenic silica is imported into marshes were it accumulates in the soil, while dissolved silica is exported again to the pelagic. At times when the concentrations of dissolved silica in the estuary are limiting (during plankton blooms), the export of DSi from the marshes is highest. These results clearly indicate the crucial role tidal marshes play in the estuarine biogeochemical cycles and in their resilience against imbalanced nutrient inputs. Based on these insights new tidal marshes have been developed along the Schelde, their design being so that the delivery of ecosystems services (eg impact on water quality) is maximal.