The importance of understanding sediment dynamics to achieve a good chemical status in harbor environments.

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Introduction: The European Water Framework Directive aims at achieving a good ecological status for aquatic systems. All water bodies, including heavily modified systems such as harbors should not exceed the environmental quality standards for priority pollutants set by the European Commission in order to achieve a good chemical status [1].
Historical and current industry and shipping are resulting in contamination of surface water and sediments of the Port of Antwerp. As many large harbors worldwide, the port is located near a turbid river (Scheldt estuary), has a high depth with low flow velocities and is enclosed by locks, which makes it a sink for sediments and associated contaminants. The high influx of sediments from the estuary into the docks, dredging to allow navigation and the shipping itself have a large impact on spatial distribution as well as on the ecotoxicological risk of present contaminants.
In order to achieve a good chemical status in harbors it is important to understand pollutant sources, sinks and dynamics. Within the project ECODOCKS a dynamic risk model for the Port of Antwerp is made. With an integrated approach ECODOCKS supports and is supported by all port stakeholders (port environmental department, authorities, companies) in order to implement appropriate management.
Methods: Based on extensive datasets, pollutant fluxes and the impact of dredging and navigation on pollutant dynamics were calculated. An exposure model allows calculation of changes in water and sediment concentrations (Fig. 1).

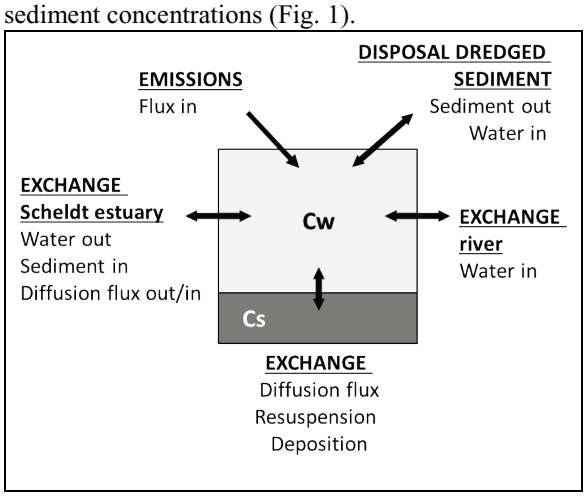

Fig. 1: Calculated fluxes within the exposure model.

Results: The large effect of sediment fluxes on the dynamics of contaminants is displayed in Fig. 2. The influx of sediment bound zinc from the Scheldt estuary and the disposal of zinc contaminated dredged sediments are an order of magnitude larger than the fluxes related to water or emissions to the surface water (sum of all diffuse and point sources).

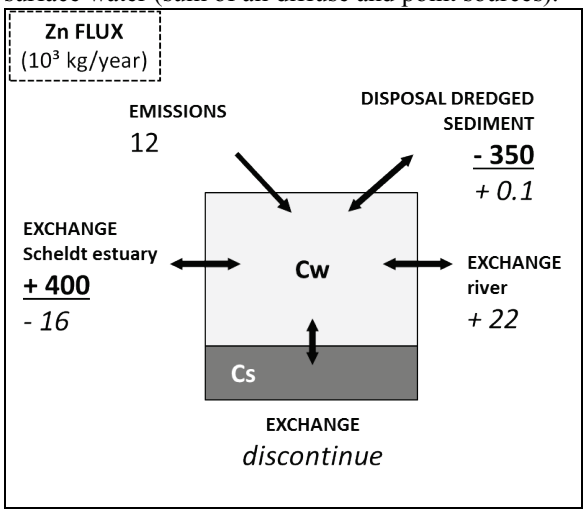

Fig. 2: Zinc fluxes in ton per year in (+) and out (-) the Antwerp harbor docks for **sediment** and *water.*

Discussion: Contaminants are often adsorbed to particulate matter [2]. Consequently, sediment fluxes are found to be the main route of contaminant transport within the harbor docks. Influx from the estuary is found to be the main source of zinc in the port of Antwerp. Also in the surface water high contaminant concentrations are frequently related to high suspended solid concentrations caused by navigation of large vessels or dredging activities. Knowledge on the spatial and temporal fluxes of bottom and suspended sediments is essential to understand contaminant dynamics and establish appropriate management in order to achieve a good chemical status without coming into conflict with the economic and navigation obligations of large harbors. The ECODOCKS risk model supports in decision making when ecotoxicological risks are involved. Use of the model might be extended to the adjacent Scheldt estuary or other harbors.

References: [1] Eur. Com. 2013/39/EU. [2] Eggleton et al. (2004) Environ. Int. **30**:973-980.