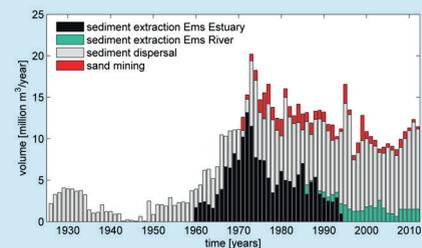


Quantifying the long-term effects of human interventions on estuarine sediment concentrations

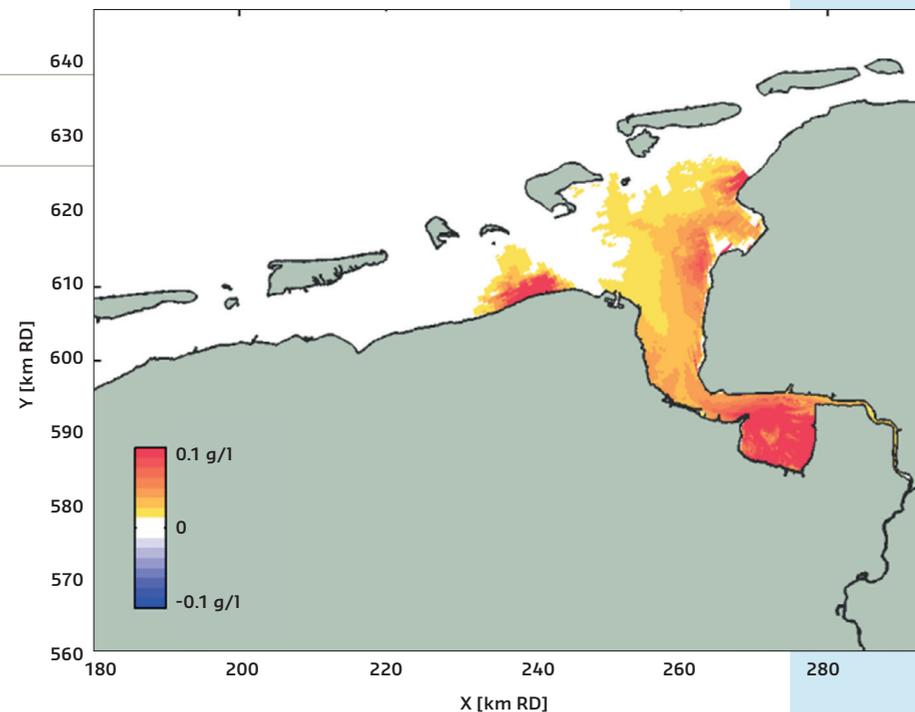


Volumes of dredged sediment dispersed in, and extracted from, the Ems estuary

Many estuaries worldwide have been modified in recent decades and centuries, for example through land reclamation or to allow ever larger ships to access inland waterways. These human interventions often lead to higher suspended sediment concentrations (SSC), which reduce visibility and lead to a decline in primary production at the base of the ecological food chain. One estuary affected in this way is the Ems Estuary on the Dutch-German border. Deltares has quantified historical changes in SSC associated with human interventions and advised on mitigating measures.

Historical data are available for four observation stations in the estuary. The statistical analysis of these data revealed that SSC has increased by 0.5% to 3% annually. In order to explain these changes, a numerical model was constructed to systematically test the impact of human interventions in the past. The implementation of ports in combination with a dredging and dumping tool was essential in the model set-up. A bed module was also used to model the buffering of fines in the seabed.

Detailed model analyses produced a surprising result. It was previously thought that the deepening of access channels and the disposal of sediment dredged from ports and waterways would have most impact on SSC. However, the largest human impact resulted from changes in sediment sinks. Over the course of several decades, large amounts of fine-grained sediment were dredged and deposited on land. When this practice ended in the 1990s, SSC increased substantially. Similarly, large amounts of sediment were deposited naturally on intertidal areas for centuries. This process of accumulation accelerated during land reclamation. Without land reclamation, there were few net sediment sinks in the estuary, with increasing SSC as a result.



Computed increase in SSC after stopping sediment extraction from ports

During several decades, this effect was obscured by large-scale sediment extraction from ports and waterways.

The results of this study of the role of sediment sinks are the basis for restoration measures implemented by local and national governments with the aim of reducing SSC by extracting sediment. The extraction strategies target the beneficial use of sediment in an environmental-friendly and cost-neutral way. Several pilot projects have been conducted in which suspended sediments are converted into building material for dike upgrades. This process involves the on-land ripening of clay and the creation of new intertidal areas where fine sediment accumulates.

Further reading:

van Maren et al. (2016). The effect of land reclamations and sediment extraction on the suspended sediment concentration in the Ems Estuary. *Marine Geology*, 376, 147-157.