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Water and sediment transport in the Biesbosch Freshwater Tidal Wetland

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The creation of new wetlands and re-activation of sedimentation in wetlands are potentially effective measures of delta restoration. Diversion of water and sediment into drowning delta wetlands aims at renewed sediment accumulation to provide a platform for ecosystem regeneration and to compensate sea-level rise and soil subsidence. The success of such measures, however, requires sound understanding of the flow pathways and deposition patterns within the wetlands and their feeding channels.
Here we study pathways of water and sediment in the Biesbosch, a small inland delta within the lower Rhine and Meuse delta in the southwest of the Netherlands. The area currently forms a network of channels that connect recently partially de-poldered freshwater tidal wetlands, which divert excess water during peak discharges of the Rivers Rhine and Meuse, but at the same time function as a dynamic ecosystem and trap of fluvial sediment.
Specific objectives are to: (a) determine the major flow paths within the system; (b) quantify sediment fluxes to, within, and out of the system, and (c) determine the relative contribution of the Rivers Rhine and Meuse to the water and sediment budget.
Moving boat campaigns were conducted to acquire suspended sediment concentrations (SSC), electrical conductivity and measurements of channel discharge. Electrical conductivity measurements were used to distinguish the distribution and mixing of Rhine and Meuse water through the area. Flow velocities and SSC were combined to calculate changes in suspended sediment concentration and load along different channel sections in the study area. Existing bathymetric data, collected by Rijkswaterstaat was used to determine rates and patterns of sedimentation in the channels.
Most channels have a southwest orientation, with flow to the southwest during ebb tide, and to the northeast during flood tide. The flow direction also changes in the north-south oriented channels, except for a side channel in the very east of the study area. Rhine water penetrates into the northern part of the study area, while the Meuse water feeds the southwestern channels. Within the central part of the area almost no mixing of Rhine and Meuse water occurs, in spite of the tide-driven changing flow direction in most channels.
The results show the major part of the study area functions as a local sink for sediment both during flood and during ebb tide. Some small channels function as a local source of sediment. Channel bed sedimentation was on average 12.8 mm yr-1 over the period 2007 – 2013, with highest values up to 0.97 m yr-1 in the newly de-poldered wetlands. Sedimentation primarily occurred in the large and deep channels, while the small and shallow channels experienced erosion.