

Identifying the controlling factors of sedimentation in a recently restored tidal freshwater wetland

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Sediment deposition is one of the key mechanisms to counteract the impact of sea level rise in tidal freshwater wetlands (TFWs). In a study to identify the factors controlling sedimentation in a recently restored tidal freshwater wetland in the Biesbosch National Park in the Rhine-Meuse delta – The Netherlands, we adopted both a modelling and a field measurement approach. This approximately 700 ha large tidal freshwater wetland is characterised by two openings with the main inlet connected to the Nieuwe Merwede river, a tributary of the River Rhine, two artificial channels connecting the in- and outlet of the area, and tidal flats.

We quantified the sediment budgets of the TFW using 10-minute interval measurement of water level, discharge and suspended sediment concentration at the in- and outlet of the area for several events including a river discharge event and several windstorm events, and for different tidal ranges. In addition, we conducted 14 numerical experiments using a combined hydrodynamic and sediment transport model to simulate sedimentation rates and patterns for different river discharges, windstorm magnitudes, and tidal conditions.

Both the results from the field measurements and the modelling results show that the overall sediment budget is positive in the area and increases with river discharge due to the associated higher water inflow and suspended sediment concentrations at the main inlet of the study area. The short-term sediment budget is generally positive during flood and negative during ebb, but the net sediment budget during a tidal cycle is not influenced by the tidal range. The sedimentation rates decrease with increasing windstorm magnitude, as wind waves cause sediment resuspension on the tidal flats and transport of the resuspended sediment towards the channels. Sediment trapping efficiencies are in the order of 45% of the incoming sediment load, but decrease with increasing river discharge and wind magnitude. The effect of wind on the trapping efficiency becomes low during periods of high river discharge. In the long term, river discharge is the principal factor controlling the sedimentation in the area.