Water and sediment transport in the Biesbosch Freshwater Tidal Wetland

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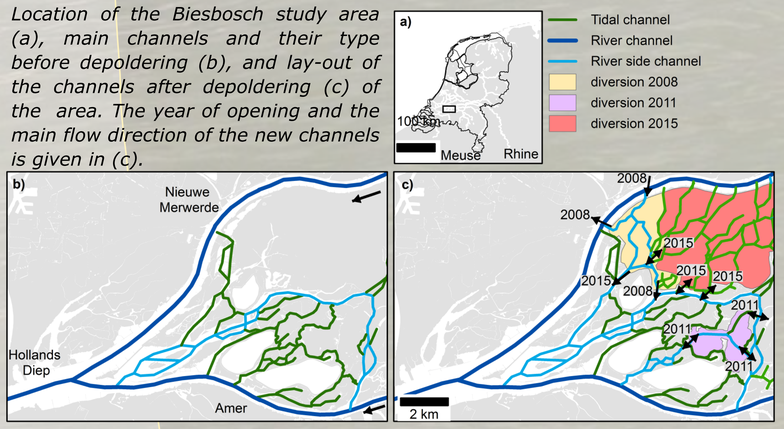
Enabling new technology

1. Introduction

Successful delta restoration by measures such as the creation of new wetlands and re-activation of sedimentation through river diversions requires a sound understanding of water flow pathways and sediment deposition patterns within wetlands and their feeding channels.

This study aims to determine **flow pathways**, **sediment fluxes** and **sediment deposition** in the Biesbosch, a small inland delta within the lower Rhine and Meuse delta - the Netherlands. This is a former polder area that has recently been converted to a freshwater tidal wetland and in which water and sediment have been reintroduced.



Location of the Biesbosch study area (a), main channels and their type before depoldering (b), and lay-out of the channels after depoldering (c) of the area. The year of opening and the main flow direction of the new channels is given in (c).

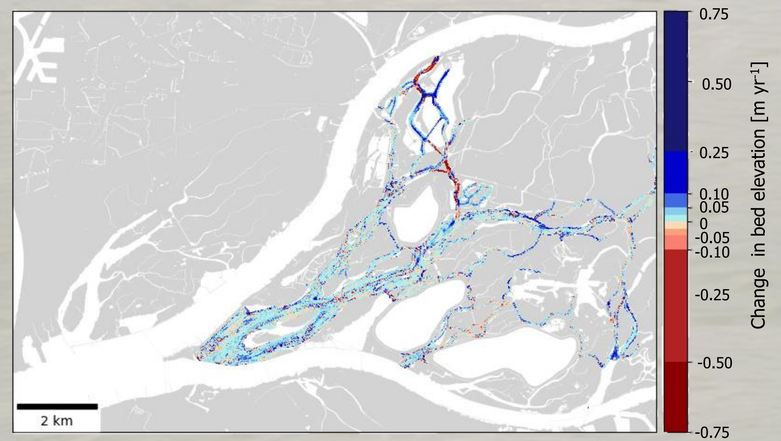
2. Methods

- Bathymetry of main channels (Multibeam echosounder data from Rijkswaterstaat)
- Synoptic measurements during 13 field surveys from a small boat:
  - Suspended sediment concentration (STM + water samples)
  - Flow velocities (VADCP)
  - Electrical conductivity (EGV)

3. Results

3.1. Bathymetry

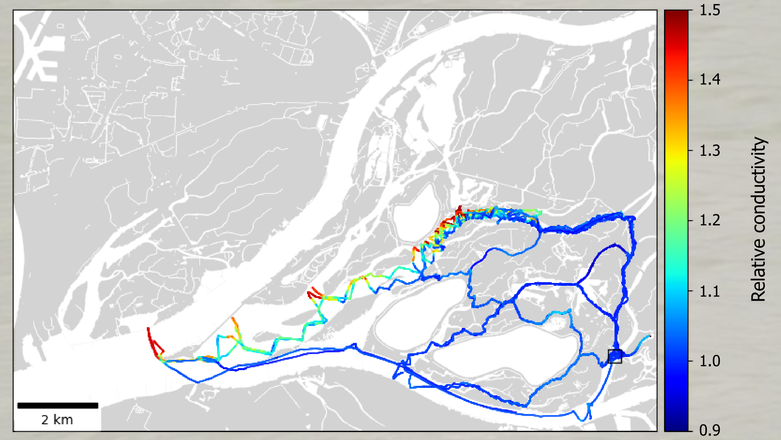
Sedimentation primarily occurred in the large and deep channels, while small and shallow channels experienced erosion. Channel bed sedimentation was on average 12.8 mm yr^{-1} over the period 2007–2013, with highest values in the newly de-poldered wetlands.



Change in bed elevation [m yr^{-1}] over the period 2007 – 2013

3.2. Rhine versus Meuse water

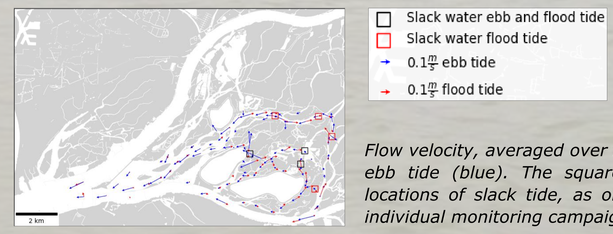
Rhine water (high EC) penetrates into the north of the area (orange/red), while the Meuse water (low EC) feeds the south (blue). There is little mixing of flows.



Electrical conductivity (EC) of all field campaigns, relative to the EC as measured across the side channel of the River Rhine.

3.3. Water flow

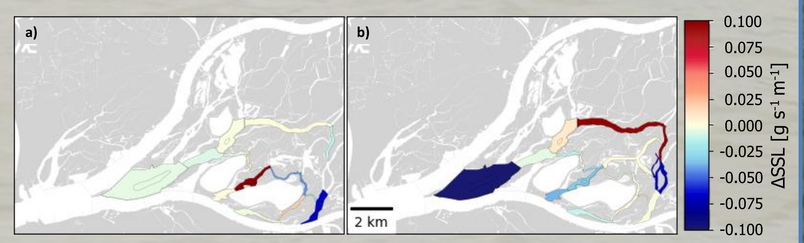
Most channels experience a change in flow direction due to the tide. In tidal channels, the average velocities are larger for ebb then for flood tide. In the river side channels, the magnitude of the flow velocities is slightly larger.



Flow velocity, averaged over flood tide (red) and ebb tide (blue). The square boxes mark the locations of slack tide, as observed during the individual monitoring campaigns.

3.4. Sediment deposition

The major part of the study area functions as a local sink (blue) for sediment both during flood and during ebb tide, but the magnitude is larger during ebb tide.



Change in suspended sediment load (SSL) during flood (a), and ebb (b) tides measured during synoptic surveys

4. Conclusions

- Sedimentation takes mainly place in the northern half of the study area, which receives a relatively large input of sediment from the River Rhine, compared to the south of the study area, fed by the River Meuse;
- Sedimentation was on average of 12.8 mm yr^{-1} , with highest rates in the depoldered areas, where morphodynamic equilibrium sets in;
- Sediment supply and flow path are the major factors determining the sediment budget of a wetland compartment;
- Synoptic measurements of water flow, EC and SSC are efficient means to document water flow and sediment budgets in wetland systems.

Acknowledgements

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