



## **Human impacts on sediment dynamics within the Rhine delta, the Netherlands**

Noortje Hobo (1,2), Hans Middelkoop (1), and Bart Makaske (2)

(1) Utrecht University, Faculty of Geosciences, Physical Geography, Utrecht, Netherlands (h.middelkoop@uu.nl), (2) WUR-Alterra, Wageningen, The Netherlands

The Rhine delta in the Netherlands has a long history of human impacts, of which large-scale land reclamation, drainage, embankment and river channelization have been the most prominent. On-going plans for river and floodplain restoration will lead to renewed – but yet unknown – sediment dynamics along the lower Rhine branches in the coming century. Here we address the consequences of human impacts for the sediment dynamics in the Rhine delta during three major phases in the past: 1) the pristine high-stand delta before land reclamation and embankment (~4000 BP - 1300 AD), 2) the period of embanked rivers (~1350-1850 AD), and 3) the period after the river channels were normalized to a fixed standard width by arrays of groynes and riprap (~1870 AD-present). For each of these periods we quantitatively reconstructed the amounts of sediment deposited within the delta, internal sediment reworking, and associated sediment residence times. The results show that sediment trapping varied across the delta during the pre-embankment period, and demonstrate how avulsions caused small sediment pulses within the system. Estimated average residence times of overbank fines were in the order of 10 ka. Embankment has dramatically reduced the spatial extent where sediment deposition occurred, while internal sediment reworking along the embanked rivers remained locally very active. Channel normalization not only ceased re-erosion of previously deposited floodplain sediment along the channel banks, but implied an ultimate shift of the depo-centre of both overbank and channel sediments from the floodplain to the lower river channels and the estuary. To date, the Rhine sediment has to be dredged from its lower reaches, while the old floodplain surface presently protected by embankments suffers from increasing soil subsidence.