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Natural banks

Waterways serve for several functions besides transporting goods and people. The ecological importance of navigable rivers has taken much attention during recent decades bringing efforts to improve these natural corridors for fauna and flora (Boeters et al., 1997).

Following the policy of the European Water Framework Directive (WFD), many Dutch river reaches have been recently restored through the removal of bank protections in search for better riparian habitats (Florsheim et al., 2009), but they also result exposed to erosive forces. Large uncertainties generally surround the prediction of erosion rates (e.g. Samadi et al., 2009) due to complex flow characteristics in the near-bank region, variable soil properties, etc. A better understanding of bank erosion processes is then of interest to predict erosion rates and improve the design of future interventions.

Case study: Meuse River

The recent natural banks of a reach in the Meuse River are being monitored and analysed to have insights on the morphological and hydrodynamic processes that result in different erosion patterns. A first objective of this study is to identify the main drivers of erosion. Various mechanisms were considered as potentially active ones, namely fluvial erosion triggered during floods, piping and ship-induced erosion.

Observations

Two distinct patterns are identified after six years of their restoration: uniform (Fig. 1) and bay-shaped (Fig. 2). The uniform pattern has low or zero erosion rates at present, hypothetically due to the toe protection of a gravel layers, whereas the embayments are hit by ship waves, especially in areas where the base level is low enough to allow them reach the banks virtually without energy dissipation. The primary ship waves also induce shear stresses onto the banks, in particular over terraces where the wave energy dissipation occurs. It is noticeable the presence of trees along the banks that delays the erosion rates in some cases, but not in others.

Monitoring

The morphology of banks is regularly being surveyed with an UAV (unmanned aerial vehicle) in order to monitor the vegetation development and quantify erosion rates. Near-bank velocities, suspended sediment concentrations and soil properties will be measured to characterize loads and bank resistances.

Figure 1. Uniform erosion pattern characterized by short grass-covered banks with gravel at the toe.

Figure 2. Bay-shaped erosion pattern characterized by high banks and contrasting erosion rates.

Initial conclusions

This case study evidences during summer time that the primary driver of erosion are ship-induced waves. There is not clear proof of piping and the role of floods will be analysed the next high-flow season. The patterns of erosion differ presumably after different soil strengths and the presence of gravel, trees and bushes seem to reduce rates by modifying erosion processes of the erosion cycle.

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