MORPHODYNAMIC MODELLING OF MIGRATING MID-CHANNEL BARS IN RIVERS USING DYNAMIC VEGETATION

A CASE STUDY ON THE AYEYARWADY RIVER

Braided rivers are highly dynamic river systems which are characterized by multiple, unstable channels and mid-channel bars. Numerical modelling of braided rivers is increasingly used by river managers to get insight in the complex interactions between the flow, sediment transport and alluvial vegetation controlling the morphological development of these rivers. Present morphodynamic models can produce many of the large-scale morphodynamics of braided rivers. However, these models often neglect the dynamic behaviour of vegetation on bars and floodplains which does affect the morphological development of rivers in nature significantly. At present, sophisticated dynamic vegetation methodologies exist which simulate small-scale ecological processes. However, these are not easy-to-use for engineering purposes when the large-scale morphodynamic development of mid-channel bars is mainly of interest. Therefore, the objective is to model and explore the effect of incorporating vegetation dynamics on the large-scale morphodynamics of vegetated migrating mid-channel bars in dynamic rivers.

The highly dynamic, monsoonal Ayeyarwady river in Myanmar is used as a case study. A procedure was developed to mimic the development of natural vegetation patterns on mid-channel bars in a morphodynamic model (Delft3D-Flexible Mesh). The procedure reads: vegetation is removed from areas where the flow velocity exceeds a certain *critical flow velocity* in the high-flow season and vegetation returns to areas which are dry during the low-flow season. The *vegetation update interval* determines how often we check whether vegetation should be removed. The procedure was coupled to the morphodynamic model using a Basic Model Interface which has a direct control over model time steps and variables during a simulation.

Next, the procedure was tested on a schematized and realistic model setup of the Ayeyarwady River. The use of the *dynamic vegetation procedure* increased our ability to model the large-scale morphodynamic behaviour of a vegetated, migrating mid-channel bar. Instead of being static over space and time, the mid-channel bar was exposed to upstream erosion and downstream deposition of sediments resulting in the migration of the bar as a whole, see figure. Vegetation removal at the upstream side of the bar induced higher flow velocities which led to higher bed shear stresses and erosion of the bar. Vegetation returned to the downstream side of the bar. It was found that the two settings of the procedure (*critical flow velocity* and *vegetation update interval*) are strongly interconnected and that a slight change in one of these settings can result in a significantly different, potentially unrealistic, development of the river. Yet, a trial-and-error procedure is required to obtain suitable settings for the *dynamic vegetation procedure*. General patterns were identified which can be used to steer this selection process as well as it is recommended to use calibration data, e.g. satellite imagery, to end up with natural behaviour of the vegetation patterns and bar morphology.

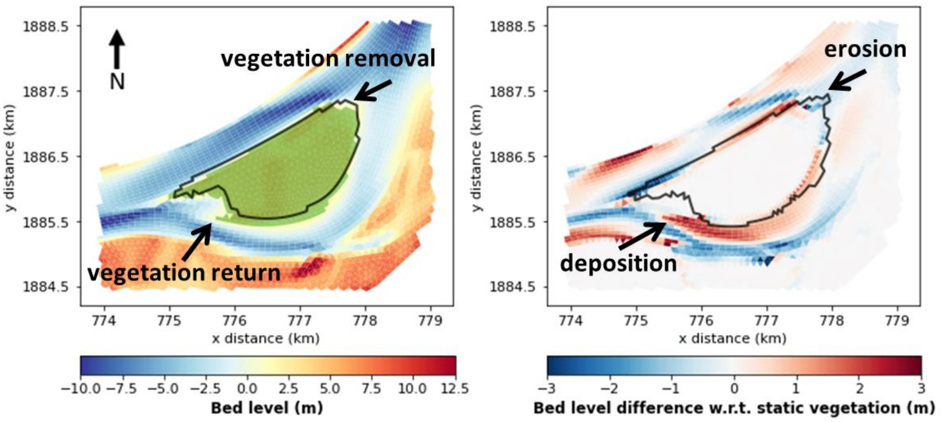

Figure 1: Development of the river bed after one year (left). Bed level difference w.r.t. static vegetation after one year (right). Black lines in left and right panels show the initial location of respectively the vegetation and the mid-channel bar. Green area shows the new location of vegetation after one year.

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