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Integrating river bathymetry data with Digital Terrain Models for improved river flow simulations

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An important element in floodplain inundation modelling, and more general in hydraulic modeling of river flows, is the detailed knowledge of the river bed and the related floodplain topography. The latter can be obtained directly from Digital Terrain Models (DTM), but the measurement of the river bed bathymetry is not straightforward, since in the DTM only the water surface elevation is recorded. Although available, methods for integrating river bathymetry data to a DTM often depend on the specific case of application. Moreover, their implementation requires a lot of data preparation and is computationally demanding. Here we propose a method that can easily be applied to different river bed geometries and runs in a semi automatic fashion. This makes it particularly appealing if adjustments to the DTM have to be made frequently due to major morphological changes, which characterize, for instance, active river channels.

The channel topography can be obtained from cross section profiles, but these cannot be integrated directly in the DTM because of the different and irregular spatial resolution. While the DTM contains regularly spaced data points, the resolution of the cross section profiles is much higher in the lateral than in the longitudinal direction of the river. In order to integrate cross section data in a DTM, interpolation techniques are needed. Therefore an algorithm which combines lateral river profiles with a DTM was developed to produce a grid that can be used for flow modeling. The cross section data are interpolated to the grid points of the DTM that are part of the channel in two

steps, first in the lateral and then in the longitudinal direction of the river. The latter is computed from the breaklines, which can be obtained from the river cross section profiles. Additionally the algorithm can be adapted so that only the submerged part of the river bed is considered for interpolation. In that case the elevation recorded in the DTM is kept for the exposed part of the gravel bars.

The algorithm was applied to a restored reach of the river Thur in Switzerland, for which a 2D shallow water model was used for flow simulations. The corrected DTM represents well the complex morphological features of the river such as gravel bars, islands and local widenings. The accuracy of the algorithm was tested by comparing the elevation of the exposed part of the gravel bar to measurements obtained from the aerial survey, as well as by comparing the simulated inundation pattern with the corresponding aerial image.