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Morphodynamic investigation of the Danube River by a novel sediment transport modelling method

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The reliable quantitative calculation of sediment transport in large rivers is still a challenge, especially in case of non-uniform bed material. Although plenty of sediment transport formulas can be found in the literature, none of them works well for any general case. Because of this, a novel sediment transport calculation method was carried out and presented in Török et al. (2017). The principal core of the method is the combined use of the van Rijn formula (1984) and the Wilcock and Crowe model (2003); in a given place the sediment transport is calculated by the formula, which is supposed to be the more reliable, at given morphodynamic conditions. Thus, the morphological processes can be calculated more reliably at river reaches where strong spatial and temporal variation of the flow and sediment features is typical.
The upper-Hungarian Danube reach shows diverse planform characteristics; the bed material is spatially varied gravel-sand mixture and the flow conditions are also complex. The sediment transport calculation is quite challenging for such river sections. This research presents an application of the novel sediment transport method to reveal morphological changes of a shorter section in the upper-Hungarian Danube. A 3D CFD model was set up based on field measurements and the goal was to analyse the expected local- and reach-scale morphodynamic processes. The model results show that complex morphodynamic processes can be calculated by the novel method with a higher reliability compared to the already existing sediment transport formulas (e.g. van Rijn, or Wilcock and Crowe). As a unique morphodynamic investigation possibility, the characteristic daily bed change maps were calculated for different flow discharge ranges. Based on these maps the local- and reach-scale morphodynamic processes and the expected bed changes become explored.