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Dynamic relationship between discharge and river morphology in the braided sub-arctic lower Tana River: 2D-morphology modelling as a tool for river channel change detection

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Recent development of numerical hydraulic and morphological models has made them computationally efficient, stable and capable of representing fluvial systems better than previously. Transportation algorithms have been normally developed in flume studies, and therefore, equations may only be valid over a limited range. Simulating the evolution of braided rivers is highly challenging and demands lots of field measurements, due to variable channel conditions within a single river section.

The morphodynamics of braided rivers has been studied without modelling in a variety of environments, although mostly in small-scale rivers such as pro-glacial sand- or gravel-bed river reaches. Only a few studies using morphological modelling have been conducted in larger braided rivers, such as the sub-arctic lower Tana River. The aims of this study are, therefore, to (1) quantify the short time scale changes in river geometry caused by a single spring snowmelt flood and the subsequent discharge over the following year, (2) model the changes using the TUFLOW 2D morphology model (TUFLOW MORPH) and analyze the modelling results against the measured geometries of 2008 and 2009, and (3) evaluate the potential of the model for simulating large sand-bed braided sub-arctic river channels.

The results indicate that although spring flood dominates as the sediment transport event, a significant amount of bed load transport occurs throughout the year. The downstream movement of linguoid dunes and thalwegs during 2008–2009 was 70–188 m based on the echo-sounded geometries. Use of the Van Rijn sediment transport method gave more realistic results than the Meyer-Peter and Müller method. TUFLOW MORPH was able to run the whole year's simulation and with the Van Rijn algorithm, the bed form shapes and deepest channel locations resembled the echo-sounded geometry. Further model improvements are proposed, but the results are promising for future usage of this model in braided rivers.