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Modelling and prediction of channel morphology evolution in a large braided river (Tagliamento River, Italy)

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Prediction requires use of models (e.g. conceptual, physical, analytical or numerical models). Uncertainty associated with any kind of model and complexity of fluvial systems, specifically of braided rivers, are major issues to be taken into account. This means that we should be aware that prediction of channel morphology has inherent limitations since results of any model are affected by a degree of uncertainty and braided rivers are very complex systems that exhibit self-organized critical behaviour.
In this work a long braided reach (33 km in length) of the Tagliamento River (north-eastern Italy) is analysed. This large gravel-bed river (average channel width was 760 m in 2009) underwent notable channel adjustments due to human interventions (i.e. sediment mining and channelization) in the past. Our aim is to explore future channel evolution taking into account different scenarios of flow regime and sediment supply at catchment and reach scale. Two different modelling approaches were combined: (i) a conceptual model based on a historical analysis of channel changes over the last 200 years and controlling factors and (ii) numerical modelling, using a reduced complexity model (CAESAR).
According to the conceptual model channel widening will take place in the future, though the evolutionary trajectory will depend on magnitude and frequency of formative discharges. For instance assuming that flow regime in the next years will be similar to that in the period 1993-2009, channel width will increase up to 1020 m in 2080 (in this case an average widening rate of 3.7 m/yr is assumed). From this conceptual model different future trajectories could be derived, for instance more intense channel widening is predicted if an increase in magnitude and frequency of formative discharges is assumed. The numerical modelling, using constant conditions for flow regime and different conditions for sediment supply (i.e. scenarios), showed that channel widening will continue in the next decades, independently from sediment management strategies. As expected, widening turned out to be more intense in the scenario where bank protections were removed (w = 1230 m) compared to the scenario where upstream sediment input was reduced (w = 1130 m).
This work should be taken as an attempt to predict channel morphology evolution over long spatial and temporal scales (i.e. tens of km and tens of years) that are rarely considered in river modelling. Such scales are very relevant for river management. Because uncertainty can be very high in modelling long river reaches over several decades, it is worth using different models to reduce uncertainty. The results of the two models used in this study turned to be very coherent, thus increasing reliability of the predictions.