Assessment of the functional performance of lowland river systems subjected to climate change and large-scale morphological trends

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Abstract

Worldwide, rivers provide important socio-economic and environmental functions and are essential to human well-being. The growing demand of user-functions and the change in river conditions due to large-scale morphology and climate change, increase the pressure on lowland river systems (e.g. Rhine, Meuse, Danube and Mississippi). To ensure a multi-functional river system, challenges related to uncertain exogenous trends should be tackled. This asks for an integrated approach that accounts for large-scale system behaviour rather than a sectorial approach. This paper proposes a framework that provides support to the river management decision-making process by assessing policy-options against uncertain exogenous processes based on the quantified performance of river functions. Hence, a case study of the Dutch Rhine was carried out, proposing a set of models to simulate river conditions and quantify the performance of the river functions navigation, nature and flood protection. The framework quantifies and monetized the impact of climate change and morphology on the user-functions in 2050. The application of the framework reveals a reduction of shipping efficiency, reduction of floodplain inundation and an increase in flood level. The monetization of river functions allowed an optimization of the policy-options, while dealing with uncertain processes as climate change and morphological changes. We demonstrated the merits of the assessment framework with a case study for the Dutch Rhine, as it provides useful quantitative information to support to decision-making in integrated river management.

Keywords

Climate change; river morphodynamics; integrated river management; river's functional performance

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