Human impacts and responses to hydrological extremes: Large scale modeling over Europe to unravel the role of reservoir operations

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In the past century, the number and the total storage capacity of large dams and reservoirs have consistently increased. Reservoirs are typically built to satisfy a wide diversity of uses from domestic to industrial purposes. They have (deliberately or not) altered the frequency, the magnitude and the spatial distribution of hydrological extremes, i.e. floods and droughts. Moreover, as their scope can be the mitigation of droughts and/or floods, the coexistence of competing objectives in the management strategy may lead to unintended consequences, as seen for example in the 2011 flooding in Brisbane (Australia), and in the 2018 flooding in Kerala (India). In this work, we investigate the interplay between hydrological extremes and society with a focus on changes in reservoir operation rules. We explore how drought and flood can influence the human impacts on hydrological extremes, and investigate upstream-downstream cascade effects. To this end, the large-scale hydrological model PCR-GLOBWB is implemented to simulate the hydrological response of European catchments. The model also simulate, for the first time, the dynamic interaction between hydrological extremes and changes in reservoirs' operation rules. This work is a first attempt to unravel the feedback mechanisms between society and hydrological extremes throughout the time at large scale. Results provide insights that can be interesting for the interpretation of the role of reservoirs in a wide variety of case studies.