



## Can reservoirs and dams effectively reduce flood runoff in river basins? A case study of the Rhine basin

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Flood retention basins constitute a pivotal component of flood protection measures. Local studies have unequivocally demonstrated their efficacy in significantly mitigating flood discharges, thereby minimizing potential downstream damage. However, the impact of these retention basins on the reduction of flood discharges at the large river basin scale remains ambiguous.

This study delves into the assessment of the influence wielded by reservoirs and dams on the reduction of flood discharges within the Rhine basin. Employing a spatially distributed version of the HBV model and Nash-cascade routing, daily discharges from 912 sub-catchments spanning the period 1951-2020 were simulated. The modeling approach comprehensively incorporates the influence of 192 reservoirs in the Rhine catchment on daily runoff volumes. Calibration at 200 gauging stations, facilitates a regional parameterization of the model, based on the PASS method.

Through various scenarios, the study explores how large-scale flood discharges would evolve in the absence of reserves for flood protection or if there were alterations to the storage capacity and function of individual reservoirs. Beyond merely assessing the reduction of runoff peaks, the research scrutinizes alterations in the duration of individual flood events and their spatial expansion, taking into account the intricate network of the 192 reservoirs.

In essence, this study not only contributes to the ongoing discourse on the efficacy of flood retention basins but also sheds light on the nuanced dynamics of reservoirs and dams in shaping the hydrological landscape of the Rhine basin. The findings provide valuable insights for optimizing flood protection strategies, encompassing considerations of storage capacities, operational functions, and the broader spatial and temporal dimensions of flood events.