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Controls of alluvial aquifers on continental drainage

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Continental-scale hydrological research is becoming more important as climate variability and change, and anthropogenic impacts on groundwater, are increasing over large spatial and temporal scales. Groundwater quantities and flows are usually difficult to observe due to sparse or spatially limited monitoring networks. Thus, large-scale hydrological models are needed to provide continuous predictions of hydrological states and fluxes for water resource management. A large part of groundwater consumed comes from alluvial aquifers, which constitute valley fills of continental catchments. While the role of alluvial aquifers as a significant water store has been subject of many previous studies, the importance of the spatial extent and continuity of alluvial aquifers in the drainage characteristics of freshwater from the continental interior to the oceans is unclear. We present a high resolution (3km) hydrological model of continental Europe using ParFlow, a 3D, parallel groundwater and surface water flow model, which uses detailed hydrofacies information as input. We discuss the effect of spatial continuity and extent of alluvial aquifers on continental lateral groundwater flow and discharge to the oceans, water table depth, streamflow, and surface and subsurface storage. The results suggest that the alluvial valleys act as conduits that manage the drainage and retention of continental freshwater in sync with the atmospheric forcing. This dynamic equilibrium may be significantly disturbed by human interventions such as pumping and irrigation leading to a new equilibrium in terms of continental water quantity and also quality.