Geophysical Research Abstracts
Vol. 20, EGU2018-6251, 2018
EGU General Assembly 2018

Improving streamflow predictions in groundwater-dominated catchments using JULES

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Groundwater is of paramount importance for water management and flood predictions, as it can be an important component in groundwater-dominated catchments. However, the representation of groundwater in Land Surface Models (LSM) is still limited. As a result, most LSMs are moving from the typical use of shallow soil column depth with free drainage boundary condition to a better representation of the surface-subsurface processes by including an explicit groundwater component. The Joint UK Land Environment Simulator (JULES) is a widely-used LSM in the UK, but still lacks the representation of groundwater process, which can be significantly important for flooding predictions in the UK.

In this study, we evaluate the impact of a newly-developed groundwater representation in JULES (JULES-GW) in comparison to its default version. The groundwater representation assumes pressure and flux continuity between the soil-aquifer interface, consequently allowing for a simple extrapolation of the pressure head from the bottom soil layer to identify the water table depth. The aquifer model solves a 2D groundwater model and provides a two-way interaction with the soil domain in JULES-GW. We hypothesize that JULES-GW can represent the baseflow component more accurately than the JULES default. We evaluate the relative impact of our new parameterization using both a set of synthetic experiments as well as against daily runoff observations (from the National River Flow Archive) obtained at a number of groundwater-dominated catchments in UK. In this case, simulations are forced with the CHESS (Climate, Hydrological and Ecological research Support System) meteorological data at 1 km2 resolution.