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Uncertainty of global hydrologic simulations: associated with data and physics including groundwater capillary flux

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Numerical simulation has three major sources of uncertainty: 1) boundary conditions, 2) model physics, and 3) physical parameters. In this study, we introduce a few examples of uncertainty estimations from those aspects. First, it was shown how the uncertainty in forcing data translates into evapotranspiration and runoff calculations. To quantify the uncertainty, ensemble simulation was carried out using five different observational precipitation datasets, and the uncertainty was estimated based on Omega index which quantifies relative similarity of ensemble members. The uncertainty in the boundary condition was relatively amplified and damped in runoff and evapotranspiration calculations, respectively. Second, as an example to estimate the uncertainty associated with model physics, the simulation sensitivity due to parameterizations of the GW capillary flux and depth of interaction interface were tested. It has been found that the capillary flux parameterization affects the magnitude of GW-supported ET and GW recharge significantly, and the biggest sensitivities were related with the dependency of the capillary flux simulation on water table depth. Third, we tested the effect of soil texture classification on the partitioning of the water balance components. The sensitivity test concluded that the uncertainty associated with soil parameters mainly affects partitioning of sub-components rather than the first order water balance. In other words, the balance between transpiration-evaporation and surface-subsurface runoff were changed significantly, while the changes in the balance between evapotranspiration and runoff were negligible.

Keywords: Global Hydrologic Simulation, Simulation Uncertainty, Groundwater Capillary Flux