Global BROOK90: validation, uncertainties, current progress and future outline.

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'Just drop a catchment and receive reasonable model output' – still stays as motto and main idea of the 'Global BROOK90' project. The open-source R-package is build-up on global land cover, soil, topographical, meteorological datasets and the lumped hydrological model as a core to simulate water balance components on HRU scale all over the world in an automatic mode. First introduced in EGU2020 and followed by GitHub code release including an publication of methodology with few examples we want to continue with the insights on the current state and highlight the future steps of the project.

A global validation of discharge and evapotranspiration components of the model showed promising results. We used 190 small (median size of 64 km²) catchments and FLUXNET data which represent a wide range of relief, vegetation and soil types within various climate zones. The model performance was evaluated with NSE, KGE, KGESS and MAE. In more than 75 % of the cases the framework performed better than the mean of the observed discharge. On a temporal scale the performance is significantly better on a monthly vs daily scale. Cluster analysis revealed that some of the site characteristics have a significant influence on the performance. Additionally, it was found that Global BROOK90 outperforms GloFAS ERA5 discharge reanalysis (for the category with smallest catchments).

A cross-combination of three different BROOK90 setups and three forcing datasets was set up to reveal uncertainties of the Global BROOK90 package using a small catchment in Germany as a case study. Going from local to regional and finally global scale we compared mixtures of model parameterization schemes (original calibrated BROOK90, EXTRUSO and Global BROOK90) and meteorological datasets (local gauges, RaKlida and ERA5). Besides high model performances for a local dataset plus a calibrated model and weaker results for ERA5 and the Global BROOK90, it was found that the ERA5 dataset is still able to provide good results when combined with a regional and local parameterization. On the other side, the combination of a global parameterization with local and regional forcings gives still adequate, but much worse results. Furthermore, a hydrograph separation revealed that the Global BROOK90 parameterization as well as ERA5 discharge data perform weaker especially within low flow periods.

Currently, some new features are added to the original package. First, with the recent release of the ERA5 extension, historical simulations with the package now are expanded to 1950-2021
period. Additionally, an alternative climate reanalysis dataset is included in the framework (Merra-2, 0.5x0.625-degree spatial resolution, starting from 1980). A preliminary validation shows insignificant differences between both meteorological datasets with respect to the discharge based model performance.

Further upgrades of the framework will include the following core milestones: recognition of forecast and climate projections and parameter optimization features. In the nearest future we plan to utilize full power of the Climate Data Store for easy access to seasonal forecasts (i.e. ECMWF, DWD, NCEP) as well as climate projections (CMIP5) to extend the package's scope to predict near and far future water balance components.