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‘Drop a catchment and receive model output’: introduction to an open-source R-Package to model the water balance wherever you want

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‘Just drop a catchment and receive reasonable model output’ – is a pretty bold motto and idea of a new open-source R-package ‘Global BROOK90’.

The package is build-up on a basement of lumped physical hydrological model BROOK90 (Federer, C.A. 2002) which focuses on the detailed description of the vertical water movement and evapotranspiration.

Our primary goal is to broaden the BROOK90-user’s community by binding an open-source model with open-source global forcing datasets in order to get a rough estimations of the water balance components. Therefore, the presented framework enables the user to apply the model for any possible location by automatic download, extraction and processing of meteorological (Copernicus ERA-5¹ hourly reanalysis, from 1979 to 2019), topographical (Amazon Web Services²), soil (SoilGrids³) and land cover (Copernicus Global Land Service: Land Cover⁴) data.

The package framework routine consists of following steps. At first, all necessary data to run the model is downloaded according to the georeferenced shape file of the catchment of interest. In a next step, a regular grid of 100x100 m is setup to construct hydrotops in the catchment. Afterwards, BROOK90 is applied for each of the unique hydrotops. Finally, all queried hydrological variables (i.e. soil moisture, discharge, transpiration fluxes) for unique hydrotops as well as catchment averages (using an area-weighted mean) and stored together with time-series plots in the output folder.

Due to significant computational time requirements (especially for the retrieval of meteorological data and the number of necessary model runs), scope and limitations of BROOK90 itself the main applicability of the framework is expected to be limited to small catchments (<500 km²) or single sites.

Currently, a validation of the package and the global parameterization is being conducted using discharge data from small catchments with at least 5-year-length time-series (Global Runoff

Database⁵) and evapotranspiration data from meteorological towers measured by eddy covariance (FLUXNET⁶ network) which are located in various climatic zones all over the globe.

¹<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels?tab=overview>

²<https://registry.opendata.aws/terrain-tiles>

³<https://soilgrids.org>

⁴<https://land.copernicus.eu/global/products/lc>

⁵https://www.bafg.de/GRDC/EN/Home/homepage_node.html

⁶<https://fluxnet.fluxdata.org/data/fluxnet2015-dataset>