

Lessons Learnt from Quality-Checking Observed and Simulated River Flow Data Worldwide



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Data and Methods

Global hydrological model

* World-Wide HYPE 1.3.3 (Arheimer et al., 2020)

Meteorological forcing

* Hydro-GFD v2 Corrected reanalysis of precipitation and temperature based on ERA-Interim (Berg et al. 2018, HESS)

River flow observations

* >14,000 time-series from 13 data providers (mainly GRDC, USGS, WSC, R-ArcticNet, NCAR-UCAR)

* 5338 gauges including at least 10 years of data were used in the evaluation of Worldwide-HYPE

More details on the quality check of flow data

Crochemore, L., Isberg, K., Pimentel, R., Pineda, L., Hasan, A. and Arheimer, B.: Lessons learnt from checking the quality of openly accessible river flow data worldwide, Hydrological Sciences Journal, 65(5), 699–711, doi:[10.1080/02626667.2019.1659509](https://doi.org/10.1080/02626667.2019.1659509), 2020.

More details on the global modelling

Arheimer, B., Pimentel, R., Isberg, K., Crochemore, L., Andersson, J. C. M., Hasan, A. and Pineda, L.: Global catchment modelling using World-Wide HYPE (WWH), open data, and stepwise parameter estimation, Hydrology and Earth System Sciences, 24(2), 535–559, doi:[10.5194/hess-24-535-2020](https://doi.org/10.5194/hess-24-535-2020), 2020.

Open dataset

“Quality check of river flow data worldwide”: the quality characteristics presented in Crochemore et al. (2020) are openly available doi:[10.5281/zenodo.2611858](https://doi.org/10.5281/zenodo.2611858)

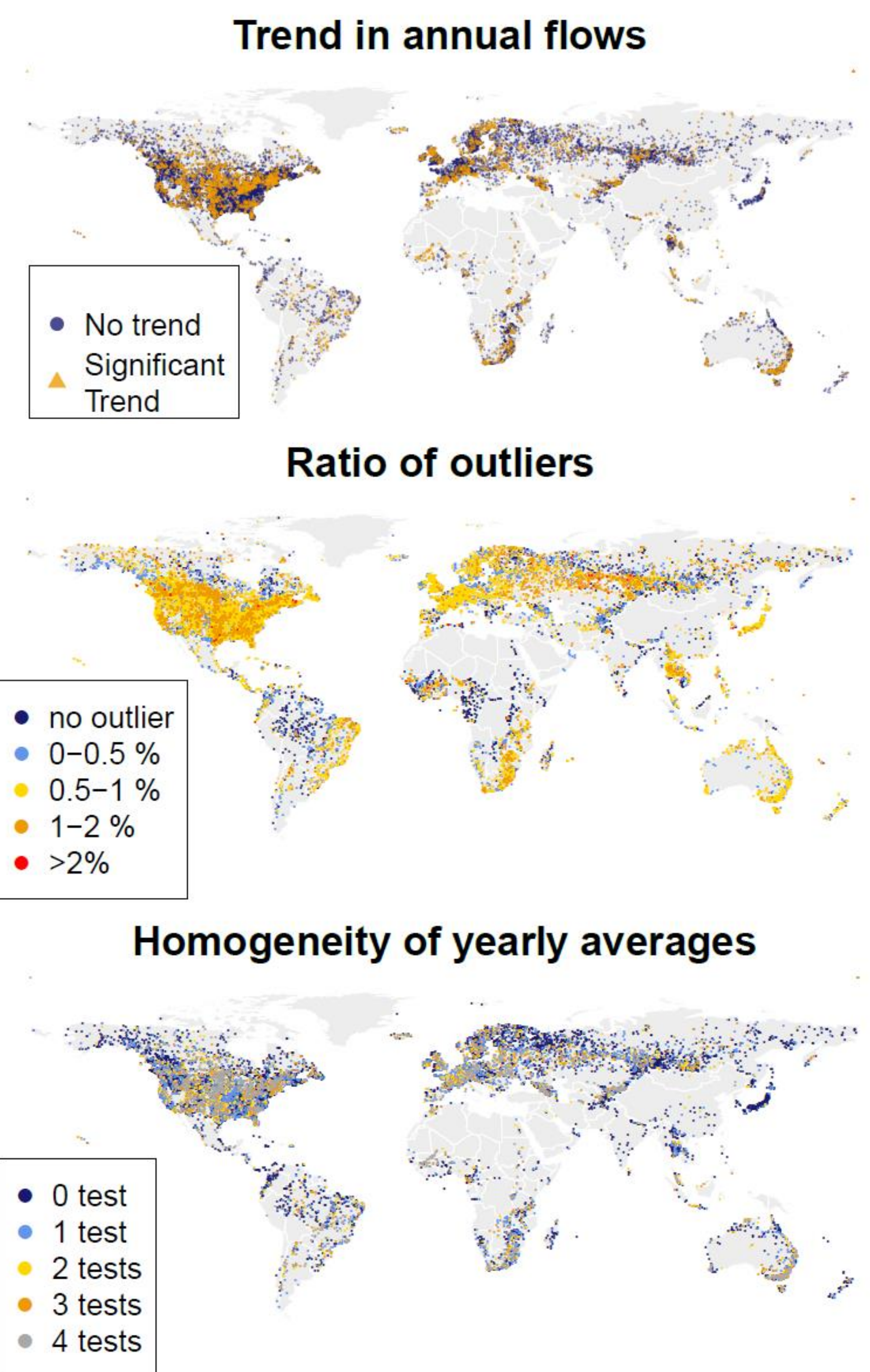
World-Wide HYPE model data, model performance and applications in forecasts and climate-change impacts can be explored at: <https://hypeweb.smhi.se/>

Quality-checking observed river flow data

► From the data collection step, we learned that:

- Access to readily available river flow data is not equal across the globe, southern Asia, the Middle East and North and Central Africa having the lowest availability
- All continents display a **decreasing trend in data availability**, starting around the 1980s for most regions.

► From the data quality check, we learned that:



► **Trends: towards a change in river flow distribution;** more than 1% slope in yearly-averaged streamflow in 4% of the time series, while 60% of time series show no significant trends in river flow.

Large significant trends in Africa, Australia, southwest Europe and Southeast Asia.

Left: Presence of significant trends

► **Outliers: a distinction between numerical outliers and high-flow peaks is necessary;** 80% of the stations have outliers that could not be explained in a straightforward manner by low recurring high flows.

Left: Frequency of outliers

► **Homogeneity: a robust detection requires consensus;** half of the stations are homogenous

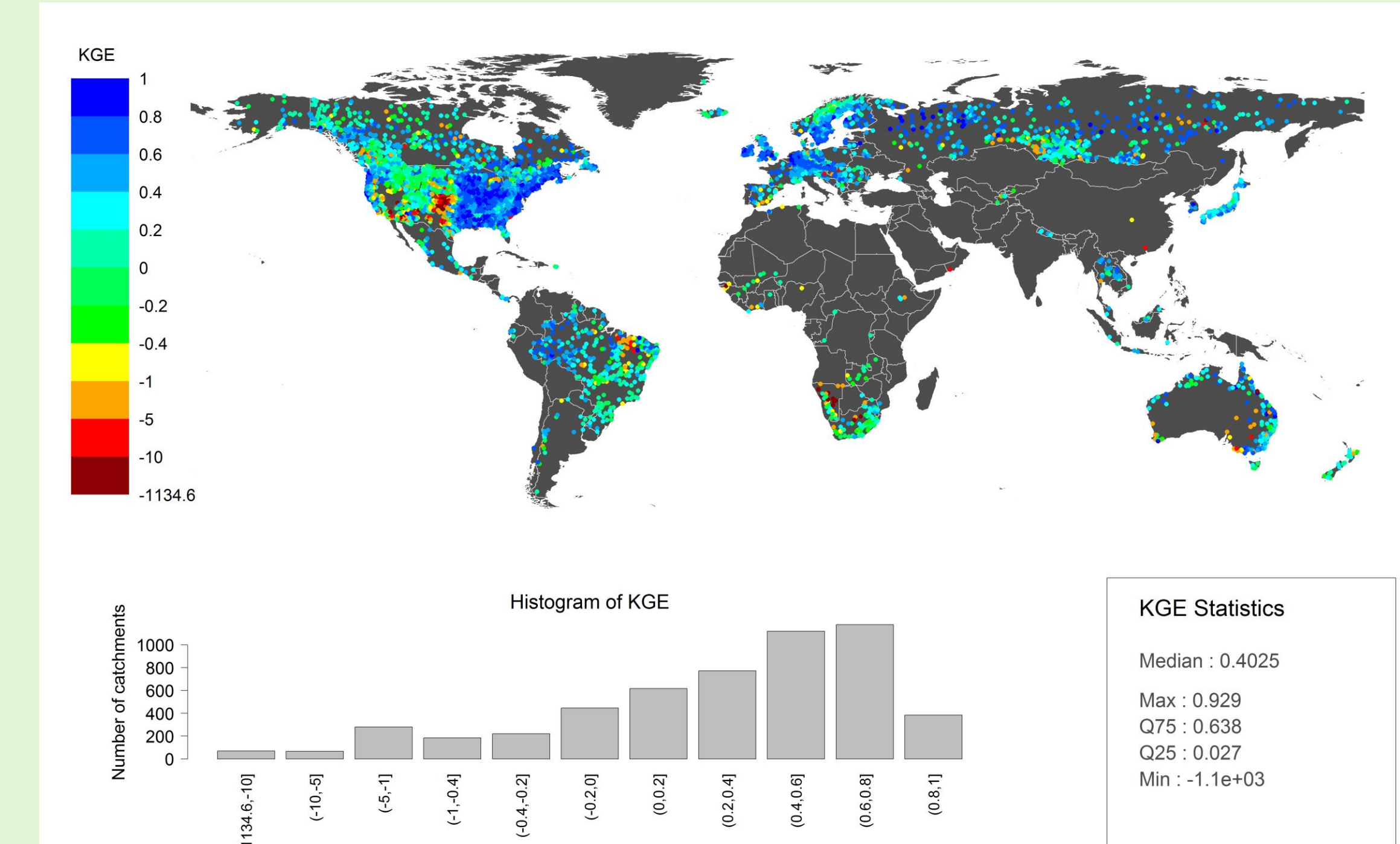
Left: Number of statistical tests detecting inhomogeneity

► **Composite quality indicator:** integrating all investigated quality characteristics (see open dataset)

Quality-checking simulated river flow data

► Spatial evaluation

- Median monthly KGE of 0.4 world-wide
- Performance varies widely spatially and with the target flow signature
- The model performs best in Eastern USA, Europe, South-East Asia, and Japan, as well as in parts of Russia, Canada, and South America.
- The model needs improvement in Africa, Western USA and South America



Above: Spatial evaluation of simulated monthly flows based on the Kling-Gupta Efficiency

► Evaluation based on flow signatures

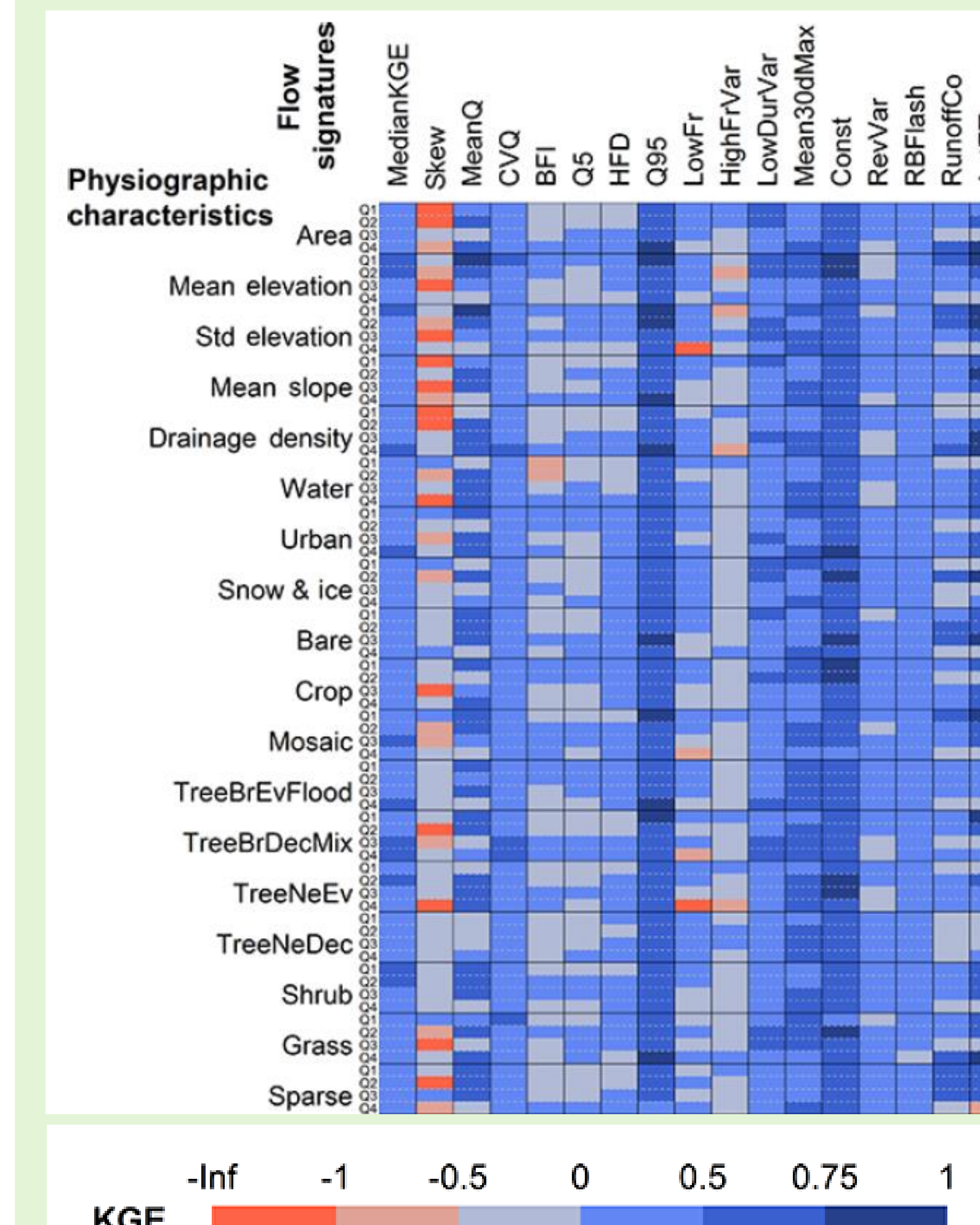
Overall potential to capture flow signatures of monthly high flows, spatial variability of high flows, duration of low flows and constancy of daily flow.

► Continuous model improvements

Large potential for model improvements remain for the next version, e.g. ongoing work on parameter estimation and reconsidering parts of the model structure.

► Model sharing to include local knowledge

Global models needs local knowledge to be really useful for water management – WWH is therefore shared under an open license: <https://hypeweb.smhi.se/model-water/> for regional/local evaluation and adjustments.



Left: Relation between model capacity to capture flow signatures and catchment physiography