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Value of additional discharge information for tuning a global hydrological model

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In hydrological modelling it is general practice to tune model parameters with observed river discharge data. Tuning serves to compensate for uncertainties of model structure, model parameters and input data. Measured discharge can provide models with additional integral information on local hydrological characteristics. Little is known about which density and distribution of discharge observations is adequate to tune macro-scale hydrological models. This contribution discusses the value of densifying the discharge information for tuning the spatially distributed global water model WaterGAP 2.

WaterGAP 2 was developed to assess and predict water availability and water use in drainage basins worldwide. It combines a global hydrological model with several global water use models. WaterGAP computes time series of surface runoff, groundwater recharge and river discharge with a resolution of 0.5˚ latitude by 0.5˚ longitude, taking into account discharge reduction by human water use. The calculations are based on spatially distributed physiographic characteristics and on time series of climatic data. The last model version - WaterGAP 2.1e – was tuned with time series of annual river discharge at stations in 724 catchments around the world by adjusting one model parameter individually for each basin. Meanwhile updates for several input datasets are available and a new sub-version of the model – WaterGAP 2.1f – was developed. The new version includes extended climate and water use time series reaching from 1901 to 2002, an improved irrigation database and an advanced algorithm for snow accumulation and melt. WaterGAP 2.1f is tuned, in one case using the former discharge dataset (724 catchments), and in the other case using a new densified dataset comprising 1235 catchments. The output of the two resulting model variants is compared and evaluated based on goodness-of-fit and error measures, the focus being on the models' ability to simulate the annual and inter-annual variability of discharge as well as the 90% reliable monthly discharge Q90. The benefits of including additional discharge information for tuning are discussed in detail and conclusions for further improvements of WaterGAP are drawn.