Geophysical Research Abstracts
Vol. 19, EGU2017-2201, 2017
EGU General Assembly 2017

Increasing process integrity in global scale water balance models

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Hydrological models on a global or continental scale are often used to model human impact on the water balance in data scarce regions. Therefore, they are not validated for a time series of runoff measured at gauges but for long term estimates. The simplistic model GlobWat was introduced by the FAO to predict irrigation water demand based on open source data for continental catchments. Originally, the model was not designed to process time series, but to estimate the water demand on long-time averages of precipitation and evapotranspiration. Therefore the emphasis of detail of GlobWat was focused on crop evapotranspiration and water availability in agricultural regions.

In our study we wanted to enhance the modelling in detail to forest evapotranspiration on the one hand and to time series simulation on the other hand. Meanwhile, we tried to keep the amount of input data as small as possible or at least limit it to open source data. Our objectives derived from case studies in the forest dominated catchments of Danube and Mississippi. With the use of Penman-Montheith equation as fundamental equation within the original GlobWat model, evapotranspiration losses in these regions could not be simulated adequately. As this being the fact, the water availability of downstream regions dominated by agriculture might be overestimated and hence estimation of irrigation demands biased. Therefore, we implemented a Shuttleworth & Calder as well as a Priestly-Taylor approach for evapotranspiration calculation of forested areas. Both models are compared and evaluated based on monthly time series validation of the model with runoff series provided by GRDC (Global Runoff Data Center). For an additional extension of the model we added a simple one-parameter snow-routine. In our presentation we compare the different stages of modelling to demonstrate the options to extent and validate these models with observed data on an appropriate scale.