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Impact of Uncertainties in Meteorological Forcing Data and Land Surface Parameters on Global Estimates of Terrestrial Water Balance Components

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Global estimates of the components of terrestrial water balance depend on a technique of estimation and on the global observational data sets used for this purpose. Land surface modelling is an up-to-date and powerful tool for such estimates. However, the results of modelling are affected by the quality of both a model and input information (including meteorological forcing data and model parameters). The latter is based on available global data sets containing meteorological data, land-use information, and soil and vegetation characteristics. Now there are a lot of global data sets, which differ in spatial and temporal resolution, as well as in accuracy and reliability. Evidently, uncertainties in global data sets will influence the results of model simulations, but to which extent? The present work is an attempt to investigate this issue.

The work is based on the land surface model SWAP (Soil Water – Atmosphere – Plants) and global 1-degree data sets on meteorological forcing data and the land surface parameters, provided within the framework of the Second Global Soil Wetness Project (GSWP-2). The 3-hourly near-surface meteorological data (for the period from 1 July 1982 to 31 December 1995) are based on reanalyses and gridded observational data used in the International Satellite Land-Surface Climatology Project (ISLSCP) Initiative II. Following the GSWP-2 strategy, we used a number of alternative global forcing data sets to perform different sensitivity experiments (with six alternative versions of precipitation, four versions of radiation, two pure reanalysis products and two fully hybridized products of meteorological data). To reveal the influence of model parameters on simulations, in addition to GSWP-2 parameter data sets, we produced two alternative global data sets with soil parameters on the basis of their relationships with the content of clay and sand in a soil. After this the sensitivity experiments with three different sets of parameters were performed. As a result, 16 variants of global annual estimates of water balance components were obtained. Application of alternative data sets on radiation, precipitation, and soil parameters allowed us to reveal the influence of uncertainties in input data on global estimates of water balance components.