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An integrated model for the assessment of global water resources – Part 1: Model description and input meteorological forcing

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Abstract. To assess global water availability and use at a subannual timescale, an integrated global water resources model was developed consisting of six modules: land surface hydrology, river routing, crop growth, reservoir operation, environmental flow requirement estimation, and anthropogenic water withdrawal. The model simulates both natural and anthropogenic water flow globally (excluding Antarctica) on a daily basis at a spatial resolution of 1°×1° (longitude and latitude). This first part of the two-feature report describes the six modules and the input meteorological forcing. The input meteorological forcing was provided by the second Global Soil Wetness Project (GSWP2), an international land surface modeling project. Several reported shortcomings of the forcing component were improved. The land surface hydrology module was developed based on a bucket type model that simulates energy and water balance on land surfaces. The crop growth module is a relatively simple model based on concepts of heat unit theory, potential biomass, and a harvest index. In the reservoir operation module, 452 major reservoirs with >1 km^3 each of storage capacity store and release water according to their own rules of operation. Operating rules were determined for each reservoir by an algorithm that used currently available global data such as reservoir storage capacity, intended purposes, simulated inflow, and water demand in the lower reaches. The environmental flow requirement module was newly developed based on case studies from around the world. Simulated runoff was compared and validated with observation-based global runoff data sets and observed streamflow records at 32 major river gauging stations around the world. Mean annual runoff agreed well with earlier studies at global and continental scales, and in individual basins, the mean bias was less than ±20% in 14 of the 32 river basins and less than ±50% in 24 basins. The error in the peak was less than ±1 mo in 19 of the 27 basins and less than ±2 mo in 25 basins. The performance was similar to the best available precedent studies with closure of energy and water. The input meteorological forcing component and the integrated model provide a framework with which to assess global water resources,

with the potential application to investigate the subannual variability in water resources.

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