Geophysical Research Abstracts
Vol. 19, EGU2017-2921, 2017
EGU General Assembly 2017

Assessment of the terrestrial water balance using the global water availability and use model WaterGAP – status and challenges

Hannes Müller Schmied (1,2) and Petra Döll (1)

(1) Institute of Physical Geography, Goethe-University Frankfurt, Frankfurt, Germany, (2) Senckenberg Biodiversity and Climate Research Centre (BiK-F), Frankfurt, Germany

The estimation of the World's water resources has a long tradition and numerous methods for quantification exists. The resulting numbers vary significantly, leaving room for improvement. Since some decades, global hydrological models (GHMs) are being used for large scale water budget assessments. GHMs are designed to represent the macro-scale hydrological processes and many of those models include human water management, e.g. irrigation or reservoir operation, making them currently the first choice for global scale assessments of the terrestrial water balance within the Anthropocene. The Water – Global Assessment and Prognosis (WaterGAP) is a model framework that comprises both the natural and human water dimension and is in development and application since the 1990s. In recent years, efforts were made to assess the sensitivity of water balance components to alternative climate forcing input data and, e.g., how this sensitivity is affected by WaterGAP's calibration scheme. This presentation shows the current best estimate of terrestrial water balance components as simulated with WaterGAP by 1) assessing global and continental water balance components for the climate period 1971-2000 and the IPCC reference period 1986-2005 for the most current WaterGAP version using a homogenized climate forcing data, 2) investigating variations of water balance components for a number of state-of-the-art climate forcing data and 3) discussing the benefit of the calibration approach for a better observation-data constrained global water budget.

For the most current WaterGAP version 2.2b and a homogenized combination of the two WATCH Forcing Datasets, global scale (excluding Antarctica and Greenland) river discharge into oceans and inland sinks (Q) is assessed to be 40 000 km3 yr-1 for 1971-2000 and 39 200 km3 yr-1 for 1986-2005. Actual evapotranspiration (AET) is close to each other with around 70 600 (70 700) km3 yr-1 as well as water consumption with 1000 (1100) km3 yr-1. The main reason for differing Q is varying precipitation (P, 111 600 km3 yr-1 vs. 110 900 km3 yr-1).

The sensitivity of water balance components to alternative climate forcing data is high. Applying 5 state-of-the-art climate forcing data sets, long term average P differs globally by 8000 km3 yr-1, mainly due to different handling of precipitation undercatch correction (or neglecting it). AET differs by 5500 km3 yr-1 whereas Q varies by 3000 km3 yr-1. The sensitivity of human water consumption to alternative climate input data is only about 5%.

WaterGAP's calibration approach forces simulated long-term river discharge to be approximately equal to observed values at 1319 gauging stations during the time period selected for calibration. This scheme greatly reduces the impact of uncertain climate input on simulated Q data in these upstream drainage basins (as well as downstream). In calibration areas, the Q variation among the climate input data is much lower (1.6%) than in non-calibrated areas (18.5%). However, variation of Q at the grid cell-level is still high (an average of 37% for Q in grid cells in calibration areas vs. 74% outside). Due to the closed water balance, variation of AET is higher in calibrated areas than in non-calibrated areas.

Main challenges in assessing the world's water resources by GHMs like WaterGAP are 1) the need of consistent long-term climate forcing input data sets, especial considering a suitable handling of P undercatch, 2) the accessibility of in-situ data for river discharge or alternative calibration data for currently non-calibrated areas, and 3) an improved simulation in semi-arid and arid river basins. As an outlook, a multi-model, multi-forcing study of global water balance components within the frame of the Inter-Sectoral Impact Model Intercomparison Project is proposed.