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Long term terrestrial water budget record from hydrological modeling

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Water is essential to life, and it is central to society's welfare and sustainable economic growth. Consistent documentation of the water cycle and its changes over time is needed by the users of water cycle data – water managers, and those involved in related socio-economic sectors. However, observation-based records are often insufficient (especially over data sparse regions) to develop a comprehensive understanding of long-term variations and trends in water cycle variables. Large scale land surface models, when forced by reliable meteorological fields, can be used as surrogates for observations. Such models produce consistent long term records of the terrestrial water budget terms, and achieve closure of the water balance by construct. To this end, we choose the well-developed Variable Infiltration Capacity (VIC) model including recently developed parameterizations for water management effects to create a global data record from 1950 to 2008. The model is run using a 3-hour time step at one-quarter degree spatial resolution, with forcings from a global one-quarter degree global data set developed at Princeton University. A global river network (also at one-quarter degree) is used to estimate the routed streamflows. Reservoir information (such as locations and operating rules) and irrigated areas are from the Global Reservoir and Dams Database produced by Lehner at McGill University and from the Global Map of Irrigation Area produced by Siebert at University of Frankfurt, respectively. Key water budget terms from the simulations include precipitation (from forcings), evapotranspiration, surface runoff, base flow, reservoir storage, and irrigation water usage. Model parameters are calibrated to observed streamflow where available. In this presentation, we focus on results for the Mississippi River basin, where the model-based estimates can be compared with direct and indirect observations of most of the water budget terms.