



Narrowing the range of water availability projections in China using the Budyko framework

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There is a growing demand for reliable 21st-century projections of water availability at the regional scale. Used alone, global climate models (GCMs) are unsuitable for generating such projections at catchment scales in the presence of simulated aridity biases. This is because the Budyko framework dictates that the partitioning of precipitation into runoff and evapotranspiration scales as a non-linear function of aridity. Therefore, GCMs are typically used in tandem with global hydrological models (GHMs), but this process is computationally expensive. Here, considering a Chinese case study, we utilise the Budyko framework to make use of plentiful GCM output, without the need for GHMs. We first apply the framework to 20th-century observations to show that the significant declines in Yellow river discharge between 1951 and 2000 cannot be accounted for by modelled climate change alone, with human activities playing a larger but poorly quantified role. We further show that the Budyko framework can be used to narrow the range of water availability projections in the Yangtze and Yellow river catchments by 33% and 72%, respectively, in the 21st-century RCP8.5 business-as-usual emission scenario. In the Yellow catchment the best-guess end-of-21st-century change in runoff decreases from an increase of 0.09 mm/d in raw multi-model mean output to an increase of 0.04 mm/d in Budyko corrected multi-model mean output. While this is a valuable finding, we stress that these changes could be dwarfed by changes due to human activity in the 21st century, unless strict water management policies are implemented.