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Response of the global water availability and use model WaterGAP to different climatic forcings and human impacts within the late 20th century

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Global-scale hydrological modeling faces multiple sources of uncertainty resulting from e.g. input data, model structure and model parameters, and it is of particular interest to investigate the sensitivity of a model to these influences. In the last years, a number of climate forcing data sets were developed for the global modelling community, and variable fields were found to differ significantly between the data-sets in certain regions. On the other side, human activity has a significant impact on the global hydrological cycle, e.g. through the construction of dams and the abstraction of water for irrigation purposes. In a global-scale hydrological modelling approach, human impact can be represented in various ways. It can be neglected (i.e. naturalized conditions without human impacts on river flow are simulated), kept at a constant level (e.g. present day conditions), or it can be simulated time-variant hence mimicking historical development of reservoirs and irrigation demand. Both uncertainties (forcing data, human impact) are influencing the response (i.e. output) of a water model, and it is assumed that the sensitivity of model outputs increases when combining the uncertainties of both input data.

In this study we applied the WaterGAP global water availability and use model for 12 simulation setups resulting from four climate forcings (PGMFD v.2 (Princeton), GSWP3 (Global Soil Wetness Project 3), WATCH (WATCH Forcing Data, WFD), WATCH+WFD/ERAInterim) and three settings for human impact (naturalized, constant human impacts, time-varying human impacts). We assess the modeled water balance components for the late 20th century and evaluate the relative response to climate forcing as compared to human impact. Results are presented for selected large river basins as well as for the global scale.