On the behavior of reservoir operation in a global hydrological model under multiple meteorological forcing

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We performed an intercomparison of simulated river discharge using the H08 hydrological model with four meteorological forcing datasets to investigate regulatory dam functions on river flow. An intensive case-study was performed at Fort Peck Dam on the Missouri River. Results demonstrated that dam-regulated river flow reduces the temporal variability for large time periods (smoothing effects). Consequently, this dampened the natural variability present within the meteorological forcing data. We also observed that during wet years, occasional floods pass through the dam control. This was attributed to simulated dam overflow and resulted in a distinctive hydrograph shape downstream of the dam (pulsing effects), which created divergences between simulated peak flow discharges for the different meteorological datasets. To confirm whether the pulsing effects were commonly seen globally, we evaluated other major dam sites. The results showed that the differences in the magnitude of simulated peak flow between the meteorological forcing datasets increased downstream at 37 of 47 global major dam sites for wet years. Depending upon the meteorological forcing data, dams act as a selective filter against peak flow events. That is, dams nonlinearly magnified differences in meteorological data and produced large uncertainties in regulated river discharge primarily downstream of dams.

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