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Global-scale multi-model assessment of river flow regimes indicates an accelerating shift towards intermittent rivers with increasing global warming levels

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It is well known that river flow regime shifts (FRS) from perennial (streamflow of sufficient amount nearly the whole year) to intermittent (a river that flows not permanently), have a strong impact on river and associated wetland ecosystems and potentially to biodiversity conditions. In addition, FRS affect direct human goods like water supply and navigation. Climate change will lead to FRS, but global-scale studies on FRS due to climate change are rare. Up to now, there have not been any studies applying more than one global hydrological model (GHM). In this study, we quantify simulated FRS for different global warming levels (GWL) (in the range of 0.5 to 3.0°C warming compared to pre-industrial) using the Inter-Sectoral Impact Model Comparison Project phase 2b (ISIMIP2b) simulation output from seven GHMs (spatial resolution 0.5°). The GHMs are forced with bias-corrected outputs from four general circulation models (GCMs) that implement the Representative Concentration Pathways (RPC) scenarios RCP2.6 and RCP6.0, respectively. FRS are calculated using a threshold-based methodology, which counts the number of months m of 31 year time spans (maximum #m = 372) with river discharge above a river flow minimum (Q = 0.04 m3 s-1) and defines the categories perennial P (Q in more than 361 m), intermittent I (Q in less than 330 m) and transitional T (Q between 330 and 361 m). We evaluate FRS for the global land area, the continents, the 42 largest river basins across the globe as well as for biodiversity hotspots. Preliminary results indicate that averaged over all GCM-GHM model combinations, the global land share projected to experience FRS increases from 3.6% at 0.5°C GWL to 8.9% at 3.0°C GWL. Global land area with FRS in drying direction (from P to I or T as well as from T to I) increases with rising GWL (2.4/3.1/3.4/4.0/5.2/5.7 % at 0.5/1.0/1.5/2.0/2.5/3.0 °C GWL, respectively) while less areas (1.3/1.7/2.2/2.5/2.6/3.2 %) are projected to become wetter (T or P). Australia/Oceania in particular experiences stronger FRS (predominantly towards I and T) with increasing GWL. Some river basins are simulated to respond strongly to increasing GWL. In the Euphrates/Tigris basin, for example, 13% of the area become drier and thus I or T at 0.5 and 1.0°C GWL, 19% at 2.0°C GWL and 23% at 3.0°C GWL. Next steps are to elaborate the impact on biodiversity hotspots and to elaborate the uncertainties of the model chain as well as the applied thresholds to provide a reasonable data basis for climate change assessments like those of IPCC.