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Multimodel assessment of flood characteristics in four large river basins at global warming of 1.5, 2, 3K above the pre-industrial level

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The Paris agreement requires climate impact assessments of global warming above the pre-industrial levels, however, such studies are still limited, especially for extremes. This study assesses the pure climate change impacts on floods at the warming levels of 1.5, 2.0 and 3.0 K above pre-industrial levels for four large basins (the Rhine, Upper Mississippi, Upper Niger and Upper Yellow) using three hydrological models. For that, outputs of four GCMs from the CMIP5 archive, including simulations for the pre-industrial, historical and future period until 2100, are used within the framework of the Inter-Sectoral Impact Model Intercomparison Project. The natural variability of flood characteristics (timing, magnitude and frequency) is analysed in the pre-industrial and historical periods, and the mean values are compared to the ensemble means under future scenarios. In general, the natural variability of floods is strong in the pre-industrial period, but there are some extreme events in the historical or future periods, which overshot the highest flood magnitude record in the pre-industrial period in all basins. There is a clear shift towards late flood timing for the Upper Niger under all scenarios while there is a shift towards early flooding in the Rhine under the 1.5 K and 2.0 K scenarios and in the Upper Mississippi under the 3.0 K scenario. The flood magnitudes show an increase in the Rhine, Upper Yellow and Mississippi under the 3.0 K scenario. The floods would occur more frequently in the Rhine and Upper Niger under the 1.5 K and 2.0 K scenarios, while less frequently in the Upper Mississippi under all warming scenarios.