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Seasonality of flood events in a changing climate - An uncertainty assessment for Europe through the combination of different climate projections

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Global climate models (GCMs) project an increasing intensity and frequency of heavy rainfall events due to climate change. As a result, the frequency and magnitude of severe flood events is expected to increase in many regions. Furthermore, a change in the seasonality of flood events can be anticipated. In regions that regularly experience snowmelt floods, for instance, temperature increase will lead to a decreased snow accumulation and to a shortened duration of the snowpack. Thus, the risk of spring floods may be reduced.

This study aims to estimate the impact of the projected climate change on the seasonality of flood events in the European region. For this purpose large scale river discharge simulations were carried out with the integrated, global model WaterGAP3 (Water - Global Assessment and Prognosis) with a spatial resolution of the grid cells of 5'. WaterGAP3 couples a hydrological model for the simulation of the terrestrial water cycle with a water use model that computes withdrawal and consumptive water use of the sectors manufacturing, electricity production, agriculture and private households. Thus, on the basis of daily climate input parameters with a spatial resolution of 0.5° and downscaled to the 5' grid scale level daily stream flow was simulated and analyzed.

First, the seasonality of flood events of defined recurrence periods was determined for the reference period 1961-1990 and validated against measured river discharge data. Subsequently, WaterGAP3 was forced with bias corrected time series originating from simulation runs of different GCMs for the scenario period 2071-2100. To asses the uncertainty that arises from the GCM output used as input forcing to the hydrological model, the calculations were carried out for three different GCMs (Echam5, CNRM, ISLP) and two emission scenarios (A2 and B1 of the IPCC SRES scenarios), respectively.

The study demonstrates that the selection of a particular GCM is a major source of uncertainty in assessing future trends in flood seasonality. I.e. modeling results in river discharge differ more significantly between the applied GCMs than simulation results for the two selected emission scenarios.