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Simulating floods and droughts in European river basins using very high resolution climate model data and a spatially distributed rainfall-runoff model

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As a consequence of climate change, the future climate in Europe may well become wetter in the northern regions of the continent, and dryer in the Mediterranean, and extreme precipitation events may become more frequent and more intense. As a result, hydrological extremes such as floods and droughts will likely become more frequent and severe as well. Due to their coarse horizontal resolution, climate models are usually not able to capture these extreme events. Therefore, hydrological impact studies commonly rely on statistical downscaling techniques or sensitivity studies of hydrological models. In recent years, the spatial resolution of regional climate model experiments has increased considerably and approaches a level that allows a realistic simulation of the amount and intensity of precipitation at the scale of river basins and small catchments. In the present study we use data of an experiment with the regional climate model HIRHAM using a grid size of approximately 12 km. The climate data are used to drive a spatially distributed, physically-based rainfall-runoff model (LISFLOOD) that typically runs at a resolution of 1 - 5 km, with the aim of assessing the impact of climate change on the risk of floods and droughts in river basins across Europe. A pilot study in the Meuse Basin demonstrates that, without further downscaling, the HIRHAM model represents the climate conditions fairly well and results in a realistic simulation of the water balance and the average discharge regime of the Meuse River.