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Effect of grid size in RCMs on the representation of floods in small and medium sized catchments in Austria: added value of convection-permitting simulations

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This paper presents a small multi-model ensemble study of coupling two different ERA-Interim driven RCMs (WRF and COSMO-CLM) using different grid sizes (0.44°, 0.11°, 0.03°) with a hydrological model for representing floods in small to medium sized catchments in South-eastern Austria. The aim is to evaluate the benefit of grid size reduction and in particular, the added value of convection-permitting simulations with 0.03° ($\sim$ 3 km) resolution. The hydrological model is a spatially distributed model (1 km^2 grid), which was previously developed for operational flood forecasting and calibrated against data of more than 20 stream gauges with corresponding catchment sizes between 30 and 1000 km^2. The hindcast simulations (1989-2010) are evaluated in terms of accurately representing flood frequency, seasonality, as well as other flood event characteristics, such as weather type, antecedent soil moisture, etc. The results show, that for small catchments (< 200 km^2) a resolution of 3 km is essential to accurately simulate the magnitude of flood events. Flood frequency and seasonality is represented well in all catchments. In the larger catchments a resolution of 0.11° ($\sim$ 12.5 km) already yields statistically satisfying results. Also, due to the short response times in the small sub-catchments a time step of 1 hour is required. However, in all setups a bias still exists in precipitation and temperature, which sometimes leads to unrealistic hydrological conditions. Ongoing work comprises the test a of novel statistical error correction method, which is expected to improve results particularly for higher quantiles. Also, a future run ("time-slice" experiment) is planned with the coupled model setup using the RCP8.5 emission scenario, the GCM of the Max-Planck-Institute Hamburg (MPI-ESM-LR), dynamically downscaled to 3 km by COSMO-CLM, and the novel error correction method.

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