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The benefit of convection permitting horizontal resolution in a climate model for the representation of summer precipitation in the Alp region.

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Accurate model projections of precipitation distribution, especially the frequency and intensity of wet extremes, still remains one of the largest challenges in the climate model community. To investigate possible improvements and limitations in simulated precipitation using convection permitting resolution, in this study we have run the HARMONIE regional climate model at 2 km resolution over the Alp region in Europe. The model is configured with model physics based on the research MESO-NH non-hydrostatic model with explicitly resolved convection. The question we seek to answer is how well summer precipitation characteristics, with focus on convective events, on sub-daily time scales are captured by HARMONIE in an area with complex terrain. Our means to answer this question involves the evaluation of diurnal timing and the intensities, durations and frequencies of precipitation spells. The model results are evaluated against high-resolution gridded observations, based on synoptic as well as radar measurements, and also against two other HARMONIE runs at the coarser 6.25 and 15 km resolutions to investigate the sensitivity to horizontal resolution. In these double nested experiments, the 6.25 and 15 km runs have been simulated on the CORDEX Europe domain forced by ERA-Interim on the boundaries, and in turn provide the boundary conditions to the 2 km simulation. In contrast to the 2 km run these model simulations uses a hydrostatic dynamical core and with convection parametrisation. Our results show a significantly improved realism of the sub-daily temporal characteristics of precipitation at convection permitting resolution, especially concerning duration and frequency as well as the atmospheric conditions leading to the events. The diurnal timing of precipitation is also better represented at the highest resolution in areas of flatter terrain whereas in connection with steep orography all simulations deviates significantly from observations.
These results indicate a clear benefit of using convection permitting scales with explicit convection and a means to increase our confidence in possible changes in precipitation and its extremes induced by a perturbed climate system.