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Multiscale behavior of the ALARO-0 model for simulating extreme summer precipitation climatology

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Daily summer precipitation over Belgium from the ALADIN model and a new version of the model including a new parameterization of deep convection and microphysics, ALARO-0, are compared with respect to station observations for the period 1961-1990. ERA-40 reanalyses are dynamically downscaled using both models on a horizontal resolution of 40 km, followed by a one-way nesting on high spatial resolutions of 10 and 4 km. This set-up allows us to explore the relative importance of spatial resolution versus parameterization formulation on the model skill to simulate correctly extreme daily precipitation. In order to put our simulations into a larger context of the state-of-the-art regional climate modeling, the ALADIN-Climate model is added to the evaluation. Model performances are assessed through standard statistical errors, density-, frequency-, and quantile distributions as well as extreme value analysis, using the peak-over-threshold method and Generalized Pareto Distribution. Results for the 40 km simulations show a similar behavior for ALADIN and ALARO-0, both reproducing the observations reasonably well. For the high resolution simulations, ALARO-0 at both 10 and 4 km are in better agreement with the observations than ALADIN. The ALADIN model consistently produces too high precipitation rates. Our findings demonstrate that the new parameterization within ALARO-0 is responsible for a correct simulation of extreme summer precipitation at various horizontal resolutions. Moreover, this study shows that ALARO-0 and the used model set-up can compete with other state-of-the-art models used for regional climate modeling.