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Evaluation of the diurnal cycle of summertime convection in kilometer-scale climate simulations

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Diurnal moist convection is an important part of precipitation over Central Europe and the Alps, in particular in summer when the synoptic forcing is weak. This convection is poorly represented in current models using parameterized convection often leading to large biases and a too early onset and peak of precipitation. These biases raise questions regarding the robustness of important aspects of European climate change scenarios for the summer season. Preliminary experience with cloud-resolving models have shown promising results. Here we use the COSMO-CLM in a cloud-resolving setup to investigate the diurnal cycle of moist convection and validate the model simulations using a variety of observations with a focus on satellite data. The satellite data used comes from the SEVIRI and GERB sensors onboard the Meteosat Second Generation geostationary satellites. SEVIRI provides high temporal and a quite high spatial resolution information on fast developing convective cells. GERB provides information about the top-of-the-atmosphere energy budget which is of course strongly influenced by clouds. We investigate the influence of model setup, lateral boundary and initial conditions on the diurnal cycle of moist convection over the European Alps and adjacent regions. Large differences in cloud amounts are found for different model configurations, while the timing of convection onset is, however, quite similar. It is found that the lateral boundary conditions have the largest influence on the simulated diurnal cycle, even though the period investigated was dominated by weak synoptic forcing. The mean energy flux over the whole domain in the model is quite similar to the energy flux measured by GERB, although larger differences exist at smaller scales. The results are used to define an optimized model configuration.