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How well can a convection-permitting climate model reproduce decadal statistics of precipitation, temperature and cloud characteristics?

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Convection-permitting climate model are promising tools for improved representation of extremes, but the number of regions for which these models have been evaluated are still rather limited to make robust conclusions. In addition, an integrated interpretation of near-surface characteristics (typically temperature and precipitation) together with cloud properties is limited. The objective of this presentation is to comprehensively evaluate the performance of a 'state-of-the-art' regional convection-permitting climate model for a mid-latitude coastal region with little orographic forcing. For this purpose, an 11-year integration with the COSMO-CLM model at Convection-Permitting Scale (CPS) using a grid spacing of 2.8 km was compared with in-situ and satellite-based observations of precipitation, temperature, cloud properties and radiation (both at the surface and the top of the atmosphere). CPS clearly improves the representation of precipitation, in especially the diurnal cycle, intensity and spatial distribution of hourly precipitation. Improvements in the representation of temperature are less obvious. In fact the CPS integration overestimates both low and high temperature extremes. The underlying cause for the overestimation of high temperature extremes was attributed to deficiencies in the cloud properties: The modelled cloud fraction is only 46 % whereas a cloud fraction of 65 % was observed. Surprisingly, the effect of this deficiency was less pronounced at the radiation balance at the top of the atmosphere due to a compensating error, in particular an overestimation of the reflectivity of clouds when they are present. Overall, a better representation of convective precipitation and a very good representation of the daily cycle in different cloud types were demonstrated. However, to overcome remaining deficiencies, additional efforts are necessary to improve cloud characteristics in CPS. This will be a challenging task due to compensating deficiencies that currently exist in 'state-of-the-art' models, yielding a good representation of average climate conditions. In the light of using the CPS models to study climate change it is necessary that these deficiencies are addressed in future research.