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Evaluation of agricultural-related extreme events in hindcast COSMO-CLM simulations over Central Europe

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Convection-permitting regional climate model simulations may serve as driving data for crop and dynamic vegetation models. It is thus possible to generate physically consistent scenarios for the future-concerning effects of climate change on crop yields and pollinators. Here, we performed convection-permitting hindcast simulations with the regional climate model COSMO5.0-CLM16 (CCLM) from 1980 to 2015 with a spin-up starting at 1979. The model was driven with hourly ERA5 data, which is the latest climate reanalysis product by ECMWF and directly downscaled to 3 km horizontal resolution over central Europe. The land-use classes are described by ECOCLIMAP, and the soil type and depth by HWSD. The evaluation is carried out in terms of temperature, precipitation, and extreme weather indices, comparing CCLM output with the gridded observational dataset HYRAS from the German Weather Service. While CCLM inherits a warm/cold and dry/wet summer/winter bias found in its parent model, it reproduces the main features of the present climate of the study domain, including the distribution, the seasonal mean climate patterns, and probability density distributions. The bias for precipitation ranges between ±20 % and the bias for temperature between ±1 °C compared to the observations over most of the regions. This is in the range of the bias between observational data. Furthermore, the model catches extreme weather events related to droughts, floods, heat/cold waves, and agriculture-specific events. The results highlight the possibility to directly downscale ERA5 data with regional climate models avoiding the multiple nesting approach and high computational costs. This study adds confidence to convection-permitting climate simulations of future changes in agricultural extreme events.