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Regional climate modeling on European scales: A joint standard evaluation of the EURO-CORDEX RCM ensemble

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EURO-CORDEX is an international climate downscaling initiative that aims to provide high-resolution climate scenarios for Europe. Here an evaluation of the ERA-Interim-driven EURO-CORDEX regional climate model (RCM) ensemble is presented. The study documents the performance of the individual models in representing the basic spatio-temporal patterns of the European climate for the period 1989-2008. Model evaluation focuses on near-surface air temperature and precipitation, and uses the E-OBS dataset as observational reference. The ensemble consists of 17 simulations carried out by seven different models at grid resolutions of 12 km (nine experiments) and 50 km (eight experiments). Several performance metrics computed from monthly and seasonal mean values are used to assess model performance over eight sub-domains of the European continent. Results are compared to those for the ERA40-driven ENSEMBLES simulations.

The analysis confirms the ability of RCMs to capture the basic features of the European climate, including its variability in space and time. But it also identifies non-negligible deficiencies of the simulations for selected metrics, regions and seasons. Seasonally and regionally averaged temperature biases are mostly smaller than 1.5 °C, while precipitation biases are typically located in the +/- 40% range. Some bias characteristics, such as a predominant cold and wet bias in most seasons and over most parts of Europe and a warm and dry summer bias over southern and south-eastern Europe reflect common model biases. For seasonal mean quantities averaged over large European sub-domains, no clear benefit of an increased spatial resolution (12 km vs. 50 km) can be identified. The bias ranges of the EURO-CORDEX ensemble mostly correspond to those of the ENSEMBLES simulations, but some improvements in model performance can be identified (e.g., a less pronounced southern European warm summer bias). The temperature bias spread across different configurations of one individual model can be of a similar magnitude as the spread across different models, demonstrating a strong influence of the specific choices in physical parameterizations and experimental setup on model performance. Based on a number of simply reproducible metrics, the present study quantifies the currently achievable accuracy of RCMs used for regional climate simulations over Europe and provides a quality standard for future model developments.