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European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP)

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In this study, we evaluate a set of high-resolution (25–50 km horizontal grid spacing) global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP), developed as part of the EU-funded PRIMAVERA (Process-based climate simulation: Advances in high resolution modelling and European climate risk assessment) project, and from the EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment) regional climate models (RCMs) (12–50 km horizontal grid spacing) over a European domain. It is the first time that an assessment of regional climate information using ensembles of both GCMs and RCMs at similar horizontal resolutions has been possible. The focus of the evaluation is on the distribution of daily precipitation at a 50 km scale under current climate conditions. Both the GCM and RCM ensembles are evaluated against high-quality gridded observations in terms of spatial resolution and station density. We show that both ensembles outperform GCMs from the 5th Coupled Model Intercomparison Project (CMIP5), which cannot capture the regional-scale precipitation distribution properly because of their coarse resolutions. PRIMAVERA GCMs generally simulate precipitation distributions within the range of EURO-CORDEX RCMs. Both ensembles perform better in summer and autumn in most European regions but tend to overestimate precipitation in winter and spring. PRIMAVERA shows improvements in the latter by reducing moderate-precipitation rate biases over central and western Europe. The spatial distribution of mean precipitation is also improved in PRIMAVERA. Finally, heavy precipitation simulated by PRIMAVERA agrees better with observations in most regions and seasons, while CORDEX overestimates precipitation extremes. However, uncertainty exists in the observations due to a potential undercatch error, especially during heavy-precipitation events.

The analyses also confirm previous findings that, although the spatial representation of precipitation is improved, the effect of increasing resolution from 50 to 12 km horizontal grid spacing in EURO-CORDEX daily precipitation distributions is, in comparison, small in most regions and seasons outside mountainous regions and coastal regions. Our results show that both high-resolution GCMs and CORDEX RCMs provide adequate information to end users at a 50 km scale.

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