EMS Annual Meeting Abstracts
Vol. 12, EMS2015-595, 2015
15th EMS / 12th ECAM

Added value of regional climate modeling over areas characterized by complex terrain- Precipitation over the Alps

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We present an analysis of the added value (AV) of downscaling via regional climate model (RCM) nesting with respect to the driving global climate models (GCMs). We analyse ensembles of driving GCM and nested RCM (two resolutions, 0.44° and 0.11°) simulations for the late 20th and late 21st century from the CMIP5, EURO-CORDEX and MED-CORDEX experiments, with a focus on the Alpine region. Different metrics of AV are investigated, measuring aspects of precipitation where substantial AV can be expected in mountainous terrains: spatial pattern of mean precipitation, daily precipitation intensity distribution and daily precipitation extremes tails. Comparison with a high quality, fine scale (5 km) gridded observational dataset shows substantial AV of RCM downscaling for all metrics selected, and results are mostly improved compared to the driving GCMs also when the RCM fields are upscaled at the scale of the GCM resolution. We also find consistent improvements in the high resolution (0.11°) vs. the medium resolution (0.44°) RCM simulations. Finally, we find that the RCM downscaling substantially modulates the GCM-produced precipitation change signal in future climate projections, particularly in terms of fine scale spatial pattern associated with the complex topography of the region. Our results thus point to the important role that high resolution nested RCMs can play in the study of climate change over areas characterized by complex topographical features.