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Downscaling CESM1 climate change projections for the MENA-CORDEX domain using WRF

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According to analysis of observations and global climate model projections, the broader Middle East, North Africa and Mediterranean region is found to be a climate change hotspot. Substantial changes in precipitation amounts and patterns and strong summer warming (including an intensification of heat extremes) is a likely future scenario for the region, but a recent uncertainty analysis indicated good model agreement for temperature but much less for precipitation. Although the horizontal resolution of global models has increased over the last years, it is still not adequate for impact and adaptation assessments of regional or national level and further downscaling of the climate information is required. The region is now studied within the CORDEX initiative (Coordinated Regional Climate Downscaling Experiment) with the establishment of a domain covering the Middle East – North Africa (MENA-CORDEX) region (http://mena-cordex.cyi.ac.cy/). In this study, we present the first climate change projections for the MENA produced by dynamically downscaling a bias-corrected output of the CESM1 global earth system model. For the downscaling, we use a climate configuration of the Weather, Research and Forecasting model (WRF). Our simulations use a standard CORDEX Phase I 50-km grid in three simulations, a historical (1950-2005) and two scenario runs (2006-2100) with the greenhouse gas forcing following the RCP 4.5 and 8.5. We evaluate precipitation, temperature and other surface meteorological variables from the historical using gridded and station observational datasets. Maps of projected changes are constructed for different periods in the future as differences of the two scenarios model output against the data from the historical run. The main spatial and temporal patterns of change are discussed, especially in the context of the United Nations Framework Convention on Climate Change agreement in Paris to limit the global average temperature increase to 1.5 degrees above pre-industrial levels.