Climate change projections for the Middle East-North Africa domain with COSMO-CLM at different spatial resolutions

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As CORDEX-MENA is one of the last domains that have been defined in the frame of the CORDEX initiative, the number of literature works available is still limited. In this study, projected changes in the future climate conditions for this domain over the 21st century have been investigated with COSMO-CLM. Two simulations have been performed respectively at 0.44° and 0.22° spatial resolution, over the period 1979–2100. The historical period 1979–2005 has been simulated according with the IPCC 20C3M protocol, while the period 2006–2100 has been forced by the RCP4.5 scenario. Initial and boundary conditions are provided by the GCM CMCC-CM, which is a coupled atmosphere–ocean general circulation model. Analyses have been performed for average values of two-meter temperature (T2m) and total precipitation. Moreover, a subset of the standard ETCCDI indices based on precipitation has been selected, in order to evaluate the skill of COSMO-CLM to simulate extreme events and to assess future changes.

Climate projections have been analyzed considering the period 2071–2100 as representative of the end of the 21st century. Both global and regional simulations suggest a general increase of temperature in the four seasons, but the finer resolution projects a slight lower warming. These differences can be related to local processes linked to land processes and parameterization, a better representation of topography and the location of land and sea at higher resolution.

Both GCM and RCM suggest significant percentage decreases in winter in the western part of domain. However, this area is characterized by very low precipitation values in the reference period, leading to high percentage variations even if absolute changes are small. A band of increase on the coast along the Gulf of Guinea is visible in CMCC-CM and not projected by COSMO-CLM. This structure could be related to a change in the West African Monsoon system, which is very difficult to be modeled. It has been shown that precipitation projections on this area, both in terms of average values and of extreme events indicators, largely depend on the horizontal resolution, suggesting the need for additional simulations at higher resolution.