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Simulation of recent past and 21st century climate in the eastern Mediterranean and the Middle East with the PRECIS regional climate model

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We present results from multi-decadal simulations with the PRECIS regional climate model (RCM) over the eastern Mediterranean and the Middle East (EMME) and analyse late 20th and 21th century climate change. PRECIS is based on UK Met. Office Hadley Centre's HadRM3P RCM and was used to dynamically downscale global output from a HadCM3's coupled atmosphere-ocean integration driven by the A1B SRES emissions scenario. The RCM was applied in a 25 km x 25 km horizontal resolution and was run from 1950 to 2099 over a domain covering the EMME region. The 20th century surface climatology (mean temperature, precipitation) produced by the RCM is compared with several gridded (i.e. CRU, WorldClim, GHCN, APHRODITE) and station (ECAD) observational datasets. PRECIS tends to underestimate temperature during winter and overestimating it for summer, while it produces more rainfall over higher elevation. These biases are within the known range of RCM performance of the recent past climate. Modelled trends in temperature indicate a warming for the second half of the 20th century but are smaller than the observed. The RCM's main atmospheric dynamics features agree well with the ECMWF ERA-40 climatology. We present projected changes (derived as differences from the reference 1951-2000) of temperature and precipitation for the 50-year periods 2001-2050 (first half of century) and 2051-2100 (end of century). The simulated warming in the 21st century is larger for the summer and varies spatially, with larger temperature increase over continental and mountainous areas. Rainfall is projected to decrease in the eastern Mediterranean and the Near East (by 10-15% until 2050 and by 30-40% at the end of the century), while the northern parts of the Balkans, Turkey and parts of Iran and the Persian Gulf appear to become wetter. We also apply statistical tests for difference for the projections, which are uniform and significant for temperature while vary spatially (and are less significant) for precipitation. These changes are diagnosed with other atmospheric variables and their connection with shifts in atmospheric circulation is assessed, for example the intensity and location of the mid-latitude storm-track. Statistical distributions of the projected temperature derived for representative locations around the EMME area, indicate that by the end of the 21st century summer daily temperatures will increase twice as the winter ones and anomalous summertime conditions could be 6 degrees Celsius (seasonally averaged) warmer compared to those during the 20th century.