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Analysis of Regional Climate of Turkey with WRF-ARW Model

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Global Climate Models are useful tools for predicting future climates. However their spatial and temporal resolutions are too coarse for regional climate studies. Therefore higher resolution regional climate models should be used to examine the regional climate changes.

Eastern Mediterranean Region is a very interesting area for testing the performance of climate models due to its complex topography and variable climate conditions. In this study, NCAR's next generation non-hydrostatic mesoscale model, Advanced Research WRF (WRF-ARW) was used to analyze the regional climate of Turkey and its neighbourhood for the period of 1961-1990 and the results are compared with RegCM outputs and observations. A similar study had been performed successfully with hydrostatic ICTP-RegCM3 model that is based on MM5, the predecessor of WRF. WRF on the other hand, is superior to RegCM and MM5 in both physics, dynamics and numerics, but computationally more expensive accordingly. However, WRF is still under development and requires more performance analyses for its validation in regional climate modelling. Therefore the result of this study is important for the validation of WRF in long term regional climate studies.

The WRF Model was used to downscale NCEP-NCAR Reanalysis data over a domain that spans from 13E - 55E and 28N - 51N. The grid resolution is 27 km in both directions and there are 144 by 100 grid points in east-west and south-north directions respectively. In the vertical direction 35 levels are used and that happens to be the twice the vertical resolution of RegCM3 run. The time step is 60 seconds and the model outputs are saved every 3 hours. Physics and dynamics options are especially chosen for long term regional climate runs and GISST data is used as the additional SST input. In order to handle the steep topography of the domain, MODIS dataset with 30 arcsecond resolution and gravity wave drag (GWD) was used.

Monthly means of the model outputs show that WRF is superior to RegCM over complex topography. WRF can simulate regional features better than RegCM. Generally WRF has a negative bias in surface temperatures but it can solve the temperature distribution better than RegCM that has a positive temperature bias. Especially in Mediterranean shores the difference is very clear. Moreover GWD enabled WRF runs can solve the temperature field better over steep topography. Boundary conditions are also handled better in WRF than in RegCM. RegCM generates superfluous distributions in southern and eastern boundaries whereas such problems are not seen in WRF results.