Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07703, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07703
EGU General Assembly 2008

Sensitivity analysis of regional climate model (RegCM3) over Turkey

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Turkey and its neighborhood present many challenging scientific problems due to geographic and climatic characteristics of the region. In this study, sensitivity of the regional climate model, RegCM3, to the domain size, resolution and cumulus and convective closure scheme has been tested. Then, climate simulation of RegCM3 using the NCEP-NCAR reanalysis data as initial and boundary conditions between 1971 and 2000 is evaluated.

Model sensitivity depending on the choice of model domain can be affected by various internal and external forcings. Evaluation of meso-scale features for regional climate is very important and these regional scale forcings should be considered while determining model domain. In this study, basically two different sizes of domain have been tested in order to decide on the model domain for further analysis. In both simulations, same physical packages and resolution (30km) have been used. Spring season is selected for comparison since the large and meso-scale features are active at the same time in the interested domain. The large domain covers the area from 5^oE to 60^oE in the east-west direction and from 26^oN to 55^oN in the north-south direction. The small domain just focuses on the Eastern Mediterranean region (28^oN-50^oN and 10^oE-50^oE). Excluding Zagros and Alpine Mountains causes precipitation differences in the domain. Significant precipitation differences occur over the mid-Black Sea region. In the large domain case, exaggerated precipitations around 2500 mm in spring are obtained at Kackar (Pontic) Mountains. However, precipitation pattern and intensity are very similar in both domains. Therefore, by considering the computational coast, small domain has been selected for further analysis.

Secondly, the model has been tested for 60km, 30km and 15km resolutions. Model results were significantly improved between 30km and 60 km resolutions. 60 km resolution produces very crude precipitation distribution compared to 30 km, especially over the mountainous regions. In the 15 km resolution, the results are more detailed than the 30 km simulation. Comparison with the CRU dataset reveals that there is a positive precipitation bias in the model. It might be due to the location of land observations such as lack of mountainous stations in CRU dataset. The general precipitation pattern of 30km and 15km simulations are quite similar and bias in 30km simulation is less than the 15km simulation. Therefore, 30km resolution has been selected for the climate simulation of the region.

Performance of cumulus and convective closure schemes (Grell and Emanuel schemes) have been tested on the small domain with 30 km resolution for all seasons of 1995. It has been found that contribution of convective precipitation to total precipitation is less than 50% even in spring and summer seasons since the large scale precipitation scheme is very dominant in every seasons. Comparisons show that both Grell and Emanuel schemes generate excessive precipitation over mountainous regions. Arakawa-Schubert scheme has better agreement with the observations. However, largest bias has been produced over Caucasus and Eastern Black Sea mountains, in all schemes. RegCM3 has a general problem producing precipitation over eastern Black Sea, Caucasus and Kackar mountains. The model cannot handle the very steep coastal topography and produces excess precipitation.