Geophysical Research Abstracts
Vol. 13, EGU2011-8015, 2011
EGU General Assembly 2011

A High Resolution Flash Flood Event Simulation in Istanbul Using the WRF Model

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Quantitative precipitation forecasting (QPF) is still a well-known problem of mesoscale models. Although the precipitation intensity and its spatial distribution can be estimated with some reasonable errors, estimation of the storm hitting can mostly be shifted a few hours in time by these models. Thus, intensive precipitation occurrences, which can cause flash floods, can hardly be simulated accurately, especially for the smaller scales. An improvement in the QPF especially for flash flood events is necessary, since they can cause significant economic loss and injuries even fatalities. As cities developed, the probability of flash flood occurrences increase, since infiltration is reduced and eventually the amount of runoff is increased due to the urbanized areas. Thus, even a moderate flash flood can be hazardous especially in metropolitan districts.

A flash flood was occurred on the 23th of June in 2010 in Istanbul. Location is very close to the main campus of Istanbul Technical University. Closeness of the flood event to our Faculty is also one of the motivations of the selection of this case. In this study, precipitation forecast skills of the WRF-ARW model are tested for this event by using combination of different global datasets: ECMWF, GFS, and NNRP; five microphysics schemes: Kessler, Purdue Lin, WSM6, Morrison, and Thompson; and two different terrain datasets USGS and MODIS. A three-nested domain configuration of the WRF is used. The coarsest resolution domain covers Marmara region, which lies between Greek and Bulgarian political border in the Northwest and extends through Anatolia in the Southeast. The finest, 450m, resolution domain is located just over the Bosphorus where the event takes place. Since the flash food was occurred during the warm season, relatively a small domain is selected by assuming that convective activities are more dominant than the synoptic scale events in order to decrease the computation time of the simulations. MODIS terrain data is used at 30' resolution to show the impact of terrain data resolution on the model output.

In this study, the forecast skills of the WRF for different boundary conditions, microphysics options, and terrain data are evaluated. The results will be compared in terms of spatial, temporal, and quantitative accuracy. The best physical option configuration will be determined for the case study. Our preliminary results show that ECMWF dataset is more reliable in timing of QPF than other datasets, whereas ECWMF, GFS, and NNRP are produced similar amount of precipitation. Moreover, high-resolution simulations significantly improve the QPF for the complex topography of Istanbul especially with including MODIS terrain data effect, which minimizes errors caused by the model topography.