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Simulations of Local Circulations in Istanbul Using MM5V3

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Urban ozone is a major pollutant produced by various sources as well as urban traffic through photochemical transformation of nitrogen oxides, carbon monoxide, and volatile organic compounds. Ozone pollution in urban areas is a complex problem involving both atmospheric diffusion processes and chemical reactions and the transport. The superimposition of chemical production and physical processes leads to episodic level of photochemical air pollution under favorable meteorological conditions and abundance of precursors. In this study, the levels of NOx emissions which is the principal ozone precursor and ozone concentrations covering the urban areas of the city were investigated based on measurements and both wind and temperature fields in the area for a best photochemical period (June 2003).
In this study, the wind field and subsequently the dispersion of NO, NO_2 and O_3 concentrations in Istanbul and Izmit KOCAEL_ bay were simulated by the non-hydrostatic mesoscale model, MM5 v3.5. MM5 is a mesoscale meteorological model developed by PSU/NCAR. The MM5 meteorological pre-processor was run to obtain three dimensional meteorological fields. The area where MM5 was used was larger than the area where concentrations were evaluated. The model rebuilds three-dimensional wind and potential temperature fields. In this model, we have used MRF for boundary layer, Schultz microphysics for moisture scheme, KF2 for cloud scheme and NOAA Land-surface scheme for the soil respectively. MM5 is configured with four two way interactive nested grids. Three domains are used. The outmost domain covers the most of the Europe to account the pressure gradients and frontal passages. The first domain has 148 x 170 grid points with a horizontal grid distance of 27km. The second domain has 88 x 94 grid points with a horizontal resolution of 9km. The innermost domain encompasses the whole Marmara region and has a 91 x 139 grid points with a horizontal resolution of 3.0km. In the vertical direction 30 sigma levels were defined unequally from ground to top of the model 100 mb. The first ten layers are included in the atmospheric boundary layer. The episode simulated by the photochemical model occurred in June 19-21, 2003, during a period characterized by clear sky condition and light wind speed in the morning hours. The modeling system is run in a box on the Istanbul urban area. Meteorological input is obtained by MM5 meteorological pre-processor. The initial and boundary concentrations of species are obtained from the default values. The wind field simulation shows the major feature of the sea/land breeze circulations. The simulation ere performed for a 48 hours period.