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Megacity and Air Pollution in the Eastern Mediterranean: Istanbul Case Study

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Turkey, with a population of 75 million, is located at the confluence of Europe and Asia. Istanbul is at the hearth of Turkey's fast economic growth. The city has an annual growth of 3.7% and, according to a study conducted by OECD, is ranked 12th among 45 OECD metro-regions. Istanbul generates 27% of Turkey's Gross Domestic Product (GDP); 40% of tax revenues; and 38% of total industrial output (OECD, 2008). As a result, Istanbul is facing a variety of challenging environmental problems affecting more than 15 million people. Observations show that the number of days exceeding the 24-hour limit value of 50 $\mu gm-3$ reached 157 in 2008, with a significant increase from previous years. The city is also a hot spot of pollutant emissions for the surrounding Eastern Mediterranean area. As part of the CityZEN project, in order to quantify the contribution of this megacity as a source of air pollution in the Eastern Mediterranean, a climatological trajectory analysis using a regional climate model output (RegCM3) and a high resolution regional modeling study were performed using the Models-3 WRF meteorological and CMAQ air quality models. Trajectory approach was used to identify the effects of Istanbul emissions on other cities in regional scale. A 30-year (1961-1990) period RegCM3 simulations were used to get a meaningful evaluation. The trajectories were computed according to a method described by Pettersen (1956) as a forward trajectory approach in a 27-km grid resolution. An air parcel was released once every 6h and a total of 42,368 air parcels (trajectories) were released during these 30 years. Long-term meteorological observations in Istanbul show northeasterly and southwesterly prevailing winds over the city. According to these prevailing winds, the distributions of trajectories were mainly observed from the north and south directions of the city. In order to run an air quality model, anthropogenic emission inventory was compiled from a number of different sources including high resolution emission inventories developed for Istanbul at 2km resolution and at 10 km resolution emission inventory of INERIS covering Europe. MOSESS model was used to process emissions data to provide CMAQ ready data (i.e., speciated and vertically and temporally distributed). Regional biogenic and dust emissions are calculated at each time step using the online MEGAN and GOCART modules of WRF-CHEM model. This paper focuses on the climatological and air quality model outputs to analyze the possible impacts of Istanbul emissions on regional air quality.