Geophysical Research Abstracts
Vol. 13, EGU2011-12062, 2011
EGU General Assembly 2011

Climate change impact on future air quality in Europe: A two-way approach

Konstantinos V. Varotsos (1,2), Christos Giannakopoulos (1), and Maria Tombrou (2)

(1) National Observatory of Athens, Institute for Environmental Research and Sustainable, Developmen, Greece (kvarotso@phys.uoa.gr), (2) Division of Environmental Physics and Meteorology, National and Kapodistrian University of Athens, Greece

It has become widely recognized that climate change could affect air pollution concentrations, through the assumption that air quality is strongly dependent on meteorological conditions and therefore sensitive to climate change. Changes in climate affect air quality by perturbing ventilation rates (wind speed, mixing depth, convection, frontal passages) precipitation scavenging, dry deposition, chemical production and loss rates, natural emissions, and background concentrations. This study describes a two way approach to examine the synergistic effects of climate change on air quality.

Firstly, we study the development, evaluation and application of an empirical-statistical model based on the concept that temperature is a capable predictor for the ozone concentrations. More specifically, the model is used to investigate the potential impact of increasing future temperatures due to climate change on ozone exceedance days in Europe. In our study we have used available gridded daily maximum temperatures and hourly ozone observations from different non-urban stations within the aforementioned area as well as daily maximum temperatures for two different future time periods 2021-2050 and 2071-2100 from the RACMO2 regional climate model with a horizontal resolution of 25 x 25km, based on the IPCC SRES A1B scenario. Statistically significant correlations between daily maximum temperatures and maximum 8-h average ozone concentrations are determined. Subsequently, calculated probability distributions of maximum 8-h average ozone concentration with daily maximum temperature are applied in two ways: firstly, to evaluate the performance of the empirical-statistical model and secondly to provide estimates of the future ozone exceedance days for the periods 2021-2050 and 2071-2100. The evaluation analysis reveals that the empirical-statistical model exhibits skill in capturing temporal patterns of ozone probability distributions with temperature and therefore it can be used as a quick indicator of ozone sensitivity to climate change.

For the second approach we conducted simulations with the global chemical transport model GEOS-CHEM driven from the GISS – 3 general circulation model in order to isolate the effect of potentially increasing temperatures due to climate change on future ozone exceedance days for two cases: (1) 2000 climate and emissions (2) 2050 climate following the IPCC SRES A1B scenario and 2000 anthropogenic emissions of ozone and aerosols precursors.

The comparison between the two approaches indicate that the potential increase of daily maximum temperatures for the 2050 period may imply changes that could lead to an increase of ozone exccedance due to favorable ozone pollution conditions such as increase in stagnation and biogenic emissions and faster chemical reactions rates. Differences in magnitude and in regionality are attributed to the different horizontal resolution of each approach.