Geophysical Research Abstracts
Vol. 17, EGU2015-4004-3, 2015
EGU General Assembly 2015

Statistical approach for assessing the influence of synoptic and meteorological conditions on ozone concentrations over Europe

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Air pollution has become a serious problem in many industrialized and densely-populated urban areas due to its negative effects on human health, damages agricultural crops and ecosystems. The concentration of air pollutants is the result of several factors, including emission sources, lifetime and spatial distribution of the pollutants, atmospheric properties and interactions, wind speed and direction, and topographic features. Episodes of air pollution are often associated with stationary or slowly migrating anticyclonic (high-pressure) systems that reduce advection, diffusion, and deposition of atmospheric pollutants. Certain weather conditions facilitate the concentration of pollutants, such as the incidence of light winds that contributes to the increasing of stagnation episodes affecting air quality. Therefore, the atmospheric circulation plays an important role in air quality conditions that are affected by both, synoptic and local scale processes.
This study assesses the influence of the large-scale circulation along with meteorological conditions on tropospheric ozone in Europe. The frequency of weather types (WTs) is examined under a novel approach, which is based on an automated version of the Lamb Weather Types catalog (Jenkinson and Collison, 1977). Here, we present an implementation of such classification point-by-point over the European domain. Moreover, the analysis uses a new grid-averaged climatology (1ºx1º) of daily surface ozone concentrations from observations of individual sites that matches the resolution of global models (Schnell,et al., 2014).
Daily frequency of WTs and meteorological conditions are combined in a multiple regression approach for investigating the influence on ozone concentrations. Different subsets of predictors are examined within multiple linear regression models (MLRs) for each grid cell in order to identify the best regression model. Several statistical metrics are applied for estimating the robustness of the regression models, specifically the R-adjusted, and the mean square skill score (MSSS, Murphy, 1988) are computed. In addition, the relative importance of the chosen predictors is determined for each regression model. The MLRs are driven by using two reanalysis data sets: ERA-Interim and NCEP2. The skill of the regression models exhibits distinct variations between regions, in particular in the coastal regions. Furthermore, atmospheric chemistry model simulations will be used in order to evaluate their performance in comparison to the reanalysis data sets. The presented work will contribute to a better understanding of synoptic conditions and meteorological parameters that affect ozone concentrations.