Geophysical Research Abstracts
Vol. 12, EGU2010-11374, 2010
EGU General Assembly 2010

Potential Source Regions for Elevated Ozone Events in Denmark

Alexander Mahura (1), Roman Nuterman (), and Irina Petrova (2)

(1) Danish Meteorological Institute, DMI, Research Department, DK-2100, Copenhagen, Denmark (ama@dmi.dk, +45-3915-7400), (2) Russian State Hydrometeorological University, RSHU, 195196, St. Petersburg, Russia

In our study, three Danish measurement sites having the longest time-series of ozone measurements (with a time resolution of 1 hour and starting in early 1990s) records were selected – Ulborg (DK31; 56.28°N, 8.43°E) and Frederiksborg (DK32; 55.97°N, 12.33°E) and Lille Valby (DK41; 55.69°N, 12.13°E) located on Jutland Peninsula and Zealand Island of Denmark, respectively. The measurements with high ozone level (threshold as 150 μg/m3) were selected accounting in total for more than 500 cases for these 3 locations. Note, that among these, 42 (for DK41) and 59 (for DK31 and DK32) cases showed very high ozone concentrations (i.e. above 180 μg/m3).
For all these cases, at first, the trajectory modelling approach was applied in order to estimate atmospheric transport pathway of air mass arrival at the measurement sites and potential source regions from where the elevated ozone level can be associated. In our study the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) model using REANALYSIS meteorological dataset (global, 1948-present) was run to calculate a set of backward trajectories (in with duration of 5 day backward in time and arriving at altitude of 100 m) and divide into groups with respect to potential source regions and dominating atmospheric transport pathways using cluster analysis technique. Analyzing distribution of trajectories (associated with elevated ozone concentrations measured at the Danish sites) as a function of the sector and pathway for the atmospheric transport, the percentage of trajectories had varied among 3 locations and ranged between 11-18% (from the eastern sector), 6-13% (from SW), 10-22% (S), 7-22% (SE), 25-39% (NW), 7-13% (N); with some trajectories having no clear identification. Among trajectories there are those passing through inland (i.e. through the Baltic States, Russia, Poland, Germany, France, Benelux and Scandinavian countries) as well water areas (i.e. transport from the Atlantic Ocean, Baltic and North Seas).
Several relatively long-term episodes with continuous elevated ozone were identified in the analyzed time series; in particular, for DK31 – 7 episodes (having longest duration and observed in Jun 1996 and Jun 2000), DK32 – 5 (Jul 1992 and Jun 2000), and DK41 – 4 (Jul 1992 and Jun 2000). For selected episodes the off-line Eulerian Chemistry-Aerosol-Cloud modeling system was run over the European domain. As meteorological driver, the High Resolution Limited Area Model (HIRLAM) generated output with 3D meteorological fields was used. The applied HIRLAM modelling system consists of the pre-processing, climate file generation, data-assimilation and analysis, initialization, forecast, postprocessing, and verification. A forecast integration starts by assimilation of meteorological observations whereby a 3D state of the atmosphere is produced, which as well as possible is in accordance with the observations. The simulation was used to evaluate in details patterns of atmospheric transport, dispersion, deposition, and transformation of ozone over Denmark and compare with results of trajectory modelling for source regions identification.