EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-70, 2009
9th EMS / 9th ECAM

Elevated Ozone Levels in Denmark: Analysis Employing Trajectory and Chemical Transport Modelling

A. Mahura (1), A. Gross (1), and I. Petrova (2)

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

In our study, among 9 Danish measurement sites, 3 sites having long-term ozone measurement (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. After pre-screening of the time series (covering almost 15 year period and including almost 543 thousand valid observations), the measurements with high ozone level (using threshold as 150 μg/m3) were selected accounting in total for 508 cases for these 3 locations. 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 total 508, 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.

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 (CAC) model 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 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.