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Contribution of long-range transport to the ozone levels recorded in the Northeast of Portugal

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In the past four years (2004-2007), measurements carried out at Lamas de Olo, the only air quality monitoring background station in the Northeast of Portugal, showed high ozone concentrations (97,7±29,7 μg.m^{-3}). This remote site, located in the middle of Alvão Natural Park, in Portugal, 1086 m asl, plays a significant role on the total amount of exceedances registered in the national air quality network.

The analysis of the data recorded at this monitoring station revealed an annual cycle of ozone concentrations similar to the ones observed in other background sites of the Northern Hemisphere (Monks, 2000; Vingarzan and Taylor, 2003). This common feature comprises a distinct maximum during spring (peaking during the month of April). Nevertheless it is during the summer that the hourly concentrations are higher, due to the typical atmospheric and meteorological conditions that promote photochemical pollution episodes. Photochemical pollution episodes can be related with production of ozone in a local scale or in a global scale due to the transportation of polluted air masses. For this reason analysing these events is crucial to fully understand the behaviour of ozone in the Northeast of Portugal, in order to adopt the correct long-term policies.

With the purpose of studying the influence of long-range transport on the ozone levels recorded at Lamas de Olo, a cluster analysis was performed on 96-hour back trajectories air masses. Different trajectory clusters represent air masses with different source regions of atmospheric pollutants and the influence of these regions on the atmospheric composition at the arrival point (receptor) of the trajectories can therefore be assessed (EMPA, 2008).

The back trajectories were simulated 4 times per day, using HYSPLIT model. A “bottom-up” cluster methodology was used to group trajectories into clusters according to their characteristics, for several time periods with similar ozone levels and/or distributions. Ozone average levels were calculated for each cluster and the differences between the groups were validated using the Kruskal-Wallis statistical test.

The results have shown a significant influence of the transport path on ozone concentrations, which is more noticeable when the probability of occurring photochemical pollution phenomena is higher. Air masses from Europe (Spain, France, United Kingdom, etc.) generally originate higher ozone levels than the ones arriving from the Atlantic Ocean. This feature shows the role of photochemical production along long-range transport phenomena, and the input of pollutants into air masses, along their path.

A more detailed analysis at local/regional scale, supported mainly by an intensive field campaign performed during spring/summer of 2006 in the vicinity of Alvão Natural Park (FOTONET Project), at different altitudes, together with pollutant measurements from rural air quality stations in the north of Portugal and one from Spain (Peñausende) was carried out in order to evaluate the extension of photochemical pollution in the Northeast of Portugal. Ozone concentrations measurements in the region showed a noticeable decrease with altitude, mainly at night.

In resume back trajectories based analysis has demonstrated that other countries, mainly Spain, contribute decisively to the ozone levels registered in the station used for this study. Backed on this knowledge we point out towards the need of considering common international policies when dealing with controlling ozone levels in the environment.

References:

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