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Source identification of the aerosol from a suburban area of Lisbon, Portugal

A. Caseiro (1), C. Pio (1), M.C. Freitas (2), H. Manh Dung (2) and C. Repolho (2)

(1) CESAM and Environment and Planning Department, University of Aveiro, Portugal, (2) Nuclear Technical Institute, Sacavém, Portugal

Experimental

Aerosol samples (PM_{10}) were collected on Teflon filters using a low volume sampler, at a suburban location north of the city of Lisbon for three winter months (from January to March). The time resolution of the sampling procedure was one day.

The filters were weighed for gravimetrical determination of mass concentration, using a 0.1 μg balance. Each filter then was divided in two equal parts. One half was submitted to extraction, the other half was submitted to elemental analysis. The halves were weighed again.

After extraction of the soluble material from the half filters in ultra pure water with the help of sonication, the extracts were analysed by anionic and cationic chromatography. The species determined were the inorganic ions Cl^-, NO_3^-, SO_4^{2-}, Na^+, NH_4^+, K^+, Mg^{2+} and Ca^{2+}.

For elemental analysis, the halves were rolled up and neutron irradiated (short and long irradiations) in ultra pure polyethylene containers, measured to obtain gamma radiation spectra after a few minutes for short-lived nuclides, after 4 days and 4 weeks for medium and long-lived nuclides. Both normal and Compton modes were used for measurement. The used technique was $k_0$standardized neutron activation analysis. Total contents of up to 30 chemical elements could be determined. Contents of sodium, potassium, magnesium and calcium obtained by extraction and elemental analysis could be compared.

From the daily chemical aerosol characterization, source apportionment could be carried on using receptor modelling techniques (factor analysis and positive matrix factorization). Those have been applied to the collected data in order to quantify the number of sources contributing to the aerosol load in the city of Lisbon.

Also, backward trajectories were calculated using the READY HYSPLIT model from NOAA, and fire maps were obtained from the Web Fire Mapper using NASA MODIS data.

Results and discussion

The determined species were analysed and explained in function of variables such as emission, atmospheric chemistry, transport and dilution.

Isolated events could be explained with the backward trajectories and wildfire occurrences.

Source apportionment techniques were useful in determining the principal contributors to the PM_{10} in the area. Those were identified through their chemical characteristics when compared with known emission profiles.

Results from both receptor modelling techniques used were compared.

The results show that both anthropogenic and biogenic sources considerably contribute to the PM_{10} concentrations observed. Biogenic sources, such as sea salt, have a stronger seasonal variation than anthropogenic ones.

For some more severe events, when the PM_{10} concentrations were higher, one single source (e.g. Saharan dust inflow), or the combination of source strengths with other factors (e.g. traffic with stagnant meteorological conditions) were preponderant.