Application of PCA and FA models for source apportionment of PM10 in Sofia

Blagorodka Veleva (1), Elena Hristova (1), Maria Kolarova (1), Emilia Nikolova (2), and Raliza Valcheva (2)

(1) NationNational Institute of Meteorology and Hydrology, NIMH-BAS, Tsarigradsko sh. 66, Sofia, Bulgaria (elena.hristova@meteo.bg), (2) Institute of Nuclear Research and Nuclear Engineering, INRNE-BAS, Tsarigradsko sh. 72, Sofia

Air particulate PM10 mass concentration and more than 20 elements, measured by EDXRF technique, in the daily quartz filter samples are obtained during winter and summer experimental campaigns (2012 and 2013) at NIMH observatory in Sofia. These data and SO_2 and NO_2 concentrations from air quality urban background stations are used to perform source apportionment study. Multivariate techniques as Factor analyses (FA) and Principle Components Analyses (PCA) by STATISTICA.6 software are applied to identify sources of PM10.

The whole data set (85 daily values) is divided in summer and winter subsets. The contribution of 5 factors for each group with different elemental components is derived. 85% of the PM10 concentration in summer is due to the impact of K, Ca, Ti, Fe source. In separate group with no significant contribution are Zn and Cu.

Sulfur content in PM10 is not explained by any of the 5 factors in winter and do not correlate significantly with NO_2. Hysplit Trajectory Model is applied in cases with high sulfur concentration to trace back the origin of air masses. Hysplit dispersion model is run in case when back trajectories indicate the regional transport from major industrial SO_2 sources.

When we use the entire data set, 51% of the contribution to PM10 is from sources related to the traffic and road dust resuspension (NO_2, Zn, Sr, Ti). The source of S and Mn (grouped in one factor) contribute with 18% to the PM10 and the crustal elements source (K, Ca, Fe) with about 4.5%.

Stagnant weather conditions and inversions are the major factor for the high PM10 values, registered during the cold period. Higher PM10 daily concentrations correlate with higher concentrations of the S, K, Ti, Sr. The connections with the meteorological parameters and mixing height determined from 12 UTC aerological soundings is discussed.