Potential sources of aerosol pollution of the Moscow region

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In 2011-2012 regular measurements of PM1.0, PM2.5, PM5.0 and PM10 were carried out at the Zvenigorod Scientific Station (ZSS) of A.M. Obukhov Institute of atmospheric physics RAS using Russian photoelectric particle counter AZ-10-03. In the period there were 298 measurements of the mass concentration of aerosol in all seasons and at different air masses and meteorological conditions. The measurements were conducted at 10:00 UTS at minimal relative air humidity and therefore when aerosol particles are dry maximally. For analysis of potential sources of aerosols PM1.0 was used as it consists of small (less then 1 mcm) aerosol particles that can fly in atmosphere for a longer time (several days) and can be transported for a longer distances than particles of fractions PM2.5-PM1.0.

Using the trajectory model HYSPLIT [1,2] ensemble of 5-days backward trajectories of air masses was calculated for the heights 10 m and 200 m above ground level for all days of measurements. Using special software the distributions of probability of backward trajectories were mapped for the two different types of aerosol weather at ZSS: a) when local minimal values of PM1.0 were observed (Fig.1a) and b) when local maximum values of PM1.0 were observed (Fig.1b).

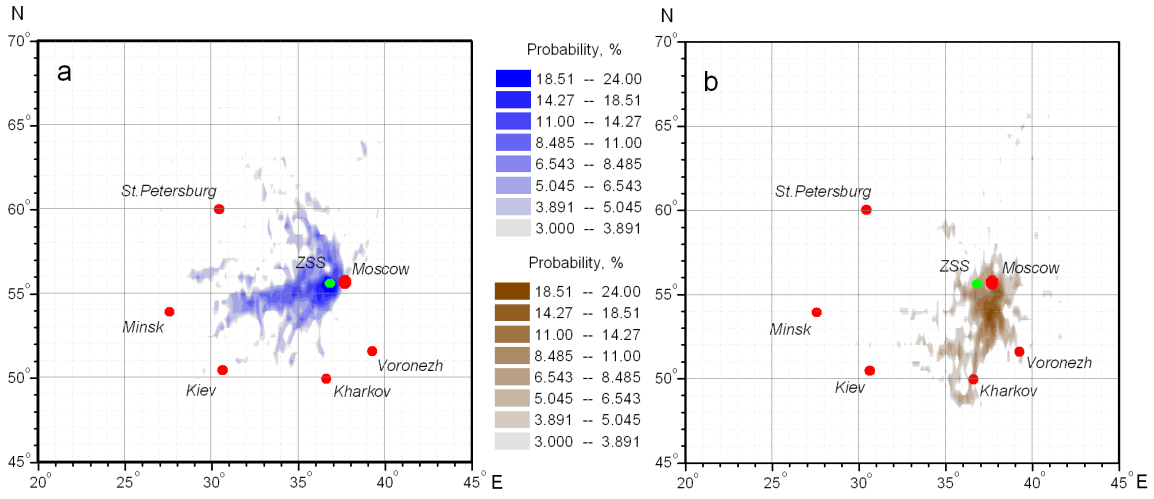

Figure 1. Spatial distribution of the probabilities of 5-day backward trajectories for ZSS calculated for a) events of local minima of aerosol upload at ZSS, b) events of local maxima of aerosol upload at ZSS.

As it seen from Fig.1 the regions of localization of the backward trajectories related to the local aerosol minima as well as to the local aerosol maxima: a) are distributed asymmetrically in wide space around the ZSS and b) practically are not superposed if probability of backward trajectory is above 9-11%. Some superposition of the regions at low probabilities of backward trajectories may be caused by: a) variation of local aerosol maxima in wide range of concentration and b) relatively short datasets of local aerosol maxima and local aerosol

minima used for the analysis. Moreover the superposition may be caused by potential seasonal variation of localization of trajectories of air masses with high aerosol upload.

Nevertheless the dividing of the regions of backward trajectories of air masses with and without high aerosol upload may give opportunity to reveal the region polluting with aerosols the Moscow region. As it seen from Fig.1b the region of potential aerosol sources polluting the Moscow region is situated to south and southwest from the Moscow region. Contrariwise the region wherefrom air masses with low aerosol upload come to the Moscow region is situated to west and northwest from the Moscow region (see Fig.1a).

For more reliable and accurate localization of the regions of potential sources of aerosol polluting the air in the Moscow region it is necessary: a) to extend datasets of local aerosol minima and local aerosol maxima and b) to localize the regions of potential sources of aerosols using similar clasterization of backward trajectories by other markers as Haenel parameter, presence/absence of sulphates, nitrates, organics in aerosols and so on.

For mapping the localizations in a wider space it is necessary: a) to calculate backward trajectories of air masses longer in time and space, b) to extend ensemble of backward trajectories and c) to extend aerosol datasets as well as to extend the number of parameters of aerosols to be analyzed including PM2.5-PM10, Haenel parameter, chemical composition and so on.

References

1. Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php). NOAA Air Resources Laboratory, Silver Spring, MD.

2. Rolph, G.D., 2012. Real-time Environmental Applications and Display sYstem (READY) Website (http://ready.arl.noaa.gov). NOAA Air Resources Laboratory, Silver Spring, MD.