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Variations of atmospheric contaminants in Moscow and their dependence on season and meteorological parameters

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PM 2.5 aerosol fraction and volatile organic compounds (VOCs) significantly imply air quality being associated with human health problems and mortality. In Russia these characteristics of pollution are not widely implemented. In this study we analize data of sinchronous PM2.5 and some VOCs (benzene, toluene, acetic acid, ethanol, acetone, phenol, isoprene) continious observations performed in 2011-2013 by Obukhov Institute of Atmospheric Physics RAS on Meteorological observatory of Moscow State University. PM2.5 was measured by TEOM-1400ab instrument (Thermo Scientific Inc., USA) and VOCs – by proton mass-spectrometer PTR-MS (Ionicon, Austria). PM2.5 data were also compared to atmospheric optical depth (AOD) measured at 500 nm (AOD500) by sun photometer CIMEL CE 31 (Aeronet network) and to global chemical-transport model (CTM) GEOS-Chem simulations.

A pronounced seasonal course of the average monthly mass concentration of some VOCs (ethanol, acetone and acetic acid) and PM2.5 aerosols was established. The average monthly values of the concentration of aromatic hydrocarbons and isoprene do not have a clear trend to change, which indicates the independence of the sources and sinks of these substances in the atmosphere of Moscow megacity from the season.

The ambiguous nature of changes in average annual concentrations of VOCs and PM2.5 aerosols caused by different meteorological conditions and dynamically changing anthropogenic factors was revealed. The average annual concentration of the studied VOCs and PM2.5 aerosols in the surface air of Moscow do not exceed maximum permissible concentration

The significant influence of meteorological parameters (air temperature, horizontal wind speed) on the mass concentration of some VOCs (acetic acid, ethanol, acetone) and PM2.5 aerosols was shown: the mass concentration of organic contaminants and aerosols generally grows with increase of air temperature, and falls with increase of wind speed. For isoprene and aromatic hydrocarbons, a weak tendency to decrease the values of their mass concentration with increasing temperature, which indirectly indicates favorable conditions for the formation of secondary fine aerosols at high temperatures observed in the warm period of the year, was revealed.

The analysis of correlations between 2.5 concentration and AOD500 revealed that correlation coefficients strongly vary with season, indicating that both local aerosol sources and long-range transport have a complex effect, and that convective mixing in Moscow proceeds in a complex regime. Overall, a stably high correlation is characteristic for warm months with a more active convective mixing. The 2.5 concentration and AOD500 are found to depend significantly on horizontal wind speed and temperature, and to not depend on air humidity.

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