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Air quality in Moscow megacity: basic level and extreme cases

N. Pankratova, A. Skorokhod, and K. Moiseenko

A.M.Obukhov Institute of atmospheric physics, Atmospheric chemistry, Moscow, Russian Federation (n_pankratova@list.ru)

Moscow is one of the largest megacities in the world. Total annual emissions of polluting substances into the atmosphere in Moscow is likely to be about 2,0 mln. t. More than 90% of pollutants are emitted by traffic. Problem of air quality assessment is very urgent for Moscow both to alarm population and to compare with other world megacities.

To study contemporary structure of atmospheric pollution over Moscow megacity data on air composition (including CO, NO, NO_2, O_3, CH4, CO_2, SO_2, NMHC, aerosol) obtained since 2002 has been analyzed. The monitoring site is located at Moscow State University meteorological observatory on South-West of Moscow. All observations are provided by A.M. Obukhov Institute of Atmospheric Physics RAS. Due to these continuous measurements typical (basic) level of pollution as well as extreme cases have been studied. The relationship between O_3, NO_x and VOCs were analyzed as well.

Due to weather conditions (cyclonic regime is dominated) concentrations of pollutants usually do not reach dangerous levels but sometimes they are high.

The case of abnormal hot and dry weather in the summer of 2010 was investigated. Many Russians were suffering from the record-breaking heat and the worst drought in 40 years. The heat was caused by very intensive and stable blocking anticyclone that established in Moscow since June, 18 till August, 18. Anticyclone of such strength has been never observed before. During 33 days in succession surface air temperature exceeded 30ºC. During these 2 months troposphere over ETR was almost closed for western winds. Hot weather led to numerous forest and peat fires (about 29,000 cases) with total covered area about 12,000 km2. One of aftermaths was significant change of atmospheric composition. Many cities and settlements were covered by dense haze from fires. Evident presence of high amount of aerosol in the ambient air caused anxiety and application of safeguards. Meanwhile, less obvious increase of concentrations of trace gases (including toxic CO, NO, NO_2, O_3, VOCs) was very high as well and made great contribution to air quality deterioration. The strongest haze was registered on August, 6-10 when concentrations of almost all trace gases jumped far above maximum permissible thresholds. Thus, daily average concentrations for O_3 reached 50.8 ppb, for CO – 9.8 ppm, for CO_2 – 492.8 ppm.

The heat wave in central Russia has shown a necessity of warning of population. It can be possible due to the Air Pollution Index (API). In this work the new methodology of air quality estimation was made. A proper method to calculate API, considering specific situation and sources of pollution in Moscow and other Russian cities, has been developed. Methodology is tested on data from maximum air pollution episodes in Moscow in summer 2010. The methodology contains 5 levels of pollution and uses 6 regularly measured components (PM10, NO_2, CO, O_3, SO_2, total non-methane hydrocarbons). The methodology allows taking into account an adverse effect of high temperature and oxygen deficiency.

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