A role of storm activity in formation of high air pollution

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Spatial and temporal variability of gas impurities at different scales was analyzed using measurements at IAP RAS stations and the data of TROICA expeditions (TRanscontinental Observations Into the Chemistry of the Atmosphere). The experiments were conducted annually from 1995 to 2001 and from 2004 to 2012. Two specialized railway cars (a mobile laboratory) were created with the goal to perform continuous measurements of gas and aerosol content in the atmosphere as well as of radiation and meteorological parameters (Pankratova et al., 2011). Thirteen experiments have been made since 1995, including eleven ones when measurements were held along the Trans-Siberian Railway (Moscow-Vladivostok). This paper analyzes large-scale spatial and temporal variations of ground-level concentrations of O_3, NO and NO_2 obtained during observations made between Moscow and Vladivostok. The results of the first experiments have been already published in (Pankratova et al., 2011; Gurjar et al., 2008), subsequent observations gave an opportunity to clarify and supplement the earlier conclusions.

Long-term series of observations enable correct assessment of linear trends in statistical analysis of temporal variability of gas components. Synoptic information and modern reanalysis data were used to take into account the effect of photochemical and dynamic atmospheric processes on the chemical composition of surface air. An automated method of identification of extratropical cyclones and anticyclones was developed to explore and systematize synoptic conditions. Characteristics of extratropical cyclones and anticyclones, including the number, size and intensity were investigated. The relation between the characteristics of storm-track activity and the surface air composition in Central Russia (IAP RAS stations) and in Central Siberia (Zotino) was analyzed. The contribution of various synoptic processes in terms of accumulation and dispersion admixtures was studied. This work helps to clarify the previously developed methods for forecasting extreme ecological situations.

For example, the accumulation of impurities in the surface layer of the atmosphere was observed during extremely hot summer of 2010 in the central regions of Russia. Because of this the concentration of many pollutants significantly exceeded the MAC (maximum allowable concentration) (Fig. 1).

A similar situation was observed in Siberia during the summer of 2012, when catastrophic fires were observed in the region. In both cases, the reason for such strong fires was quasi-stationary anticyclones, which contributed to the establishment of hot dry weather. It is obvious that the storm activity in the atmosphere played a key role in the formation of extreme situations.

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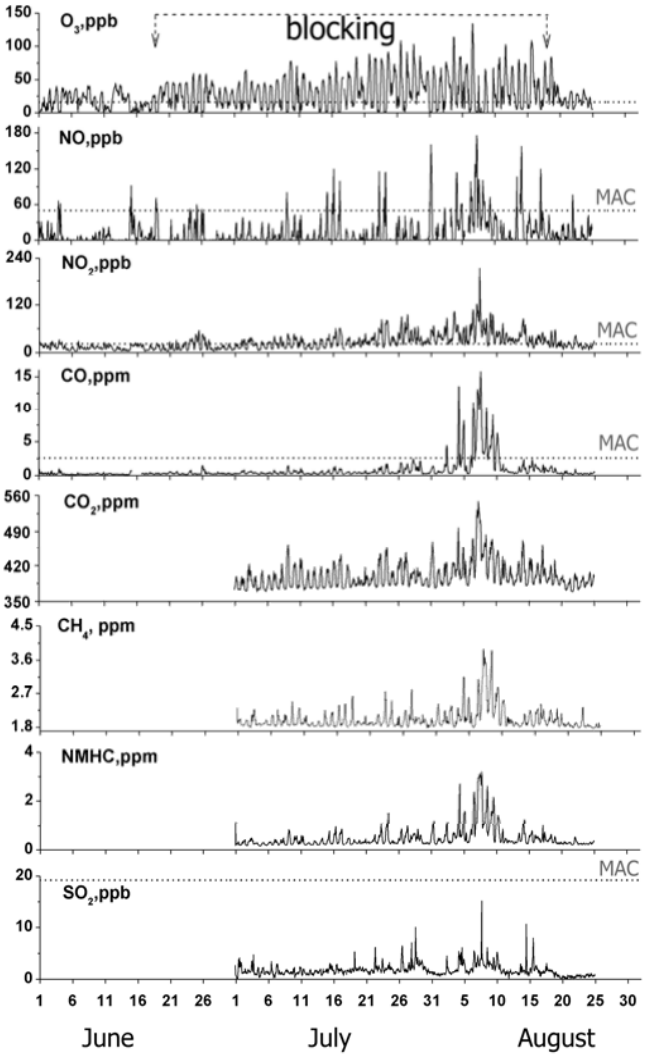

Figure 1. Hourly average concentration of ozone, NO, NO_2, CO, CO_2, CH_4, NMHC, and SO_2 at the Moscow IAP RAS station during the extremely hot summer of 2010. The dotted line shows MAC.

References

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