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Observations of Reactive Gases in the Central Siberia in 2007-2009

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There is a considerable shortage of direct observations of atmospheric trace gases in low-populated regions of Siberia. Since March, 2007 till now continuous measurements of O3, NOx, NO and NO2 concentrations have been performed at ZOTTO station in the middle of Krasnoyarsky Krai (60 N, 90 E) with 10 sec timing. Observations are completely automated and are part of scientific program on atmospheric chemistry measurements of ZOTTO Consortium headed by Max Planck Institute for Biogeochemistry, Jena.

Variations of ozone concentration reveal vivid seasonal and daily features which have been analyzed and compared to other mid-latitude background stations as well as to data of TROICA train-based observations. These variations are likely to be typical for the Northern Eurasia boreal zone. Seasonal spring maximum (40-50 ppbv) is caused by stratospheric ozone intrusions that are only considerable ozone source. Smaller variations can be induced both by local factors and long-range transport of ozone precursors from pollution sources. The largest ozone formation rate has been observed in summer time from 9 a.m. till 3 p.m. of local time and made up 1-2 ppbv/hour. Such value points out on quite low photochemical activity and ambient air oxidizing ability.

NOx concentration does not exceed 1 ppb that is typical for background areas but may vary by order and some more in few hours. Higher surface NOx(=NO+NO2) concentrations during day time generally correspond to higher ozone when NO/NO2 ratio indicates on clean or slightly polluted conditions.

Analysis on base of Lagrangian model for evaluation of air parcel trajectories basing on NCEP final analysis meteorological fields and Russian Federation Hydrometeocenter reanalysis fields and residence time statistics has shown that most probable sources of man-made emissions influencing the Central Siberia air are located on south of Siberia (Kemerovo, Novokuznetsk, Krasnoyarsk, Tomsk, Novosibirsk). These results have been verified by CO data provided Max Planck Institute for Chemistry, Mainz, and agreement was very good.

Data of TROICA-11, 12, 13 campaigns which occurred correspondingly in summer of 2007, 2008 and 2009 have been used to analyze pollution sources located along the Trans-Siberian Railroad. Measurements of volatile organic compounds by proton mass-spectrometry (PTR-MS) in 2008 and 2009 have been also considered to assess concentrations of biogenic VOCs (isoprene and monoterpenes) for dark-coniferous forests zone. Some of man-made VOCs (aromatic hydrocarbons and formaldehyde) were measured at ZOTTO in 2008 and in 2009 and are also presented in this study.

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