



TROICA experiments 1995-2010: Atmospheric species spatial distribution and temporal variations over Eurasia

Nikolai Elansky, Igor Belikov, Elena Berezina, Alexander Elokhov, Olga Lavrova, Natalya Pankratova, Alexey Rakin, Alexander Safronov, Andrey Skorokhod, and Roman Shumsky

A.M. Obukhov Institute of Atmospheric Physics RAS, Department of Atmospheric Composition, Moscow, Russian Federation (n.f.elansky@mail.ru)

TROICA experiments (Transcontinental Observations Into the Chemistry of the Atmosphere) started in 1995. The mobile railroad laboratory was used for the atmospheric gases, aerosol, solar radiation, and meteorological parameters measurements. Fifteen experiments were carried out during 1995-2010: eleven of them – along the Trans-Siberian railroad from Moscow to Vladivostok, two experiments were made in meridian direction between Murmansk and Kislovodsk, and two ones – around and across the Moscow megacity. The main goal of the experiments was collecting of information about transport, distribution, emission, and chemical transformation of key atmospheric constituents that determine the atmospheric chemistry and air quality. Continuous measurements allowed to obtain information on spatial distribution of atmospheric constituents from continental scale to local one (hundreds meters). Industrial heavily polluted regions, moderately polluted rural territories, and remote areas with background level of concentrations were separated using air quality criteria.

For each group of data the spatial distribution characteristics, their seasonal and daily variations were analyzed. One of the features of the species distribution over the continent was the longitudinal gradient of O₃, CO, and some other compounds. The surface concentrations of O₃, CO, biogenic VOC were growing in eastern direction, whereas nitrogen oxides, anthropogenic CO₂, and VOC were decreasing.

Using ²²²Rn concentration and temperature vertical profile data the fluxes of ²²²Rn from the soil as well as nocturnal CO₂, CH₄, and CO fluxes from the soil and vegetation were calculated. The biogenic fluxes of CO₂ and CH₄ were more intensive compared with anthropogenic ones. The similar approach was used for estimation of ozone dry deposition along the way between Moscow and Vladivostok.

The multiple cross-sections of the cities allowed determining the peculiarities of temperature island formation over cities with different size and pollution and the distribution of the key gases and aerosols over their territory. The observations done around and crossing Moscow megacity let us to estimate the up wind and down wind fluxes of pollutants. The coming to Moscow pollutants consist for some compounds one quarter of their quantity in outgoing plume.

For an estimation of long and regional transport of gases and aerosol different models were used. In combination with isotope analyses it was shown that anthropogenic CO₂ and some VOC from Western Europe really reach the Central and Eastern Siberia. Multiple crossing of air pollution plumes from cities and large enterprises gave the possibility to verify the transport photochemical models.