

The comparative influence of organic and inorganic precursors on tropospheric ozone formation in Russian cities

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Ground-based concentrations of some important anthropogenic (benzene, toluene, phenol, styrene, xylene, and propylbenzene) and biogenic (isoprene, monoterpenes) VOCs together with NO_x , CO and O_3 measured simultaneously along the Trans-Siberian railway (TSR) on a mobile laboratory in TROICA-12 campaign in summer 2008 have been analyzed to determine their contribution to surface ozone formation. Maximum levels of aromatic VOCs (up to 1.5–2 ppb), CO (up to 0.6 ppm) and NO_x (> 20 ppb) were observed in large cities (with population size of 0.25 – 1 million people). To evaluate the relative importance of the studied compounds in ground-level ozone formation in differently populated cities along the Trans-Siberian railway, daytime ozone-forming potential (OFP) was calculated. Taking into account that all VOCs studied can have significant chemical losses during their transport from sources to the measurement point, especially isoprene, calculated initial concentrations of VOCs were used for OFPs evaluation. The largest ozone generation was found under enhanced NO_x level (10-20 ppbv) along with high daytime temperatures ($> 25^\circ\text{C}$). The significant relationship between OFPs by aromatic VOCs (OFPAR) and by CO (OFCO) in Russian cities is established. It was shown that in all cities along the Trans-Siberian railway, regardless their population, CO and biogenic VOCs (isoprene and monoterpenes) had the main contribution to ground-based ozone formation. This contribution is evaluated to be 25-56% and up to 30-40% for CO and biogenic VOCs, respectively. A very significant contribution to ozone production is made by monoterpenes (up to 30%), especially in the cities located in the areas with significant part of coniferous vegetation: Tumen, Ulan-Ude, Taishet. Isoprene contribution to ozone formation in the observed cities is also very significant, up to 42%, in the cities of the Far East region (Birobidjan, Khabarovsk) where a large part of deciduous forests is located. The impact of aromatic VOCs in all cities did not usually exceed 15%.