Isoprene concentrations over Russia: ground-based measurements and chemistry-transport modeling

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Near-surface isoprene concentration was measured over Russia using the proton mass spectrometry method (PTR-MS) in TROICA (TRanscontinental Observations Into the Chemistry of the Atmosphere) experiments along the Trans-Siberian railway from 21.06.08 to 04.08.08 (TROICA-12) and from 08.10.09 to 23.10.09 (TROICA-13). The highest isoprene concentration is observed in the Far East (up to 3 ppb) due to the emissions from the major isoprene source - deciduous forests. The TROICA measurements were compared to the corresponding simulations performed with the CHIMERE chemistry transport model (CTM) using the MEGAN biogenic emission inventory. Simulated and measured isoprene concentrations are highly correlated (r = 0.8), but the simulated isoprene concentration is about 4-6 times higher than the measured one. The selection of daytime and background (from isoprene/benzene ratios) isoprene concentrations don't significantly increase the experimental values; moreover, even the isoprene concentration corrected for atmospheric photochemical losses (that is, the near-source concentration) is found to be 1.5 times lower than the simulated data. Therefore, the systematic discrepancy between the measurements and simulations could not be unambiguously attributed to the representativity error. The weak exponential dependence of summer isoprene concentration on temperature both for the model ($R2 = 0.3$) and for the experimental data ($R2 = 0.4$) is observed. However, a much stronger linear correlation ($r \sim 0.9$) is found between the isoprene concentration and temperature in Russian regions separated according to the type of vegetation. The differences between the simulated and experimental dependences of isoprene concentration on temperature are not statistically significant. The above results prompt the conclusion that the parameterization of isoprene emissions in the CHIMERE CTM is qualitatively adequate, but the isoprene emission factors applicable for Russian forest are likely overestimated in the MEGAN inventory .