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Spatial distribution of carbon dioxide and methane concentrations across West Siberia: a case study using the Picarro G4301 mobile gas concentration analyzer

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Due to a huge area of Siberia, most places of which are hard-to-reach, undertaking a large-scale investigation of the atmospheric composition in this key region of the Northern Hemisphere remains challenging. By mid 2000s, the National Institute for Environmental Studies (NIES) under the international collaboration with V.E. Zuev Institute of Atmospheric Optics SB RAS (IAO SB RAS) had established a network for greenhouse gas monitoring in Siberia (Japan-Russia Siberian Tall Tower Inland Observation Network – JR-STATION; Sasakawa et. al, 2010).

The above network covers a significant part of the West Siberian Plain extending between 54.5˚ and 63.2˚ north latitude and between 62.3˚ and 85.0˚ east longitude. Its stations are spaced 300 to 900 kilometres apart. Despite operating in a fully automated mode, they need to be maintained several times per year. We usually drive to the sites most remote from IAO SB RAS about 4 times a year, covering a distance of about 7,000 km during one trip.

When the Picarro G4301 mobile gas concentration analyzer became available, we decided to use it during the regular trips to obtain the data on the GHG distribution across West Siberia with a more detailed spatial resolution. The G4301 was installed in an off-road vehicle. A gas inlet has been mounted behind a radiator cover. Before supplying to the analyzer, ambient air passes through a three-stage drying unit to avoid a possible liquid water penetration into the cavity, as well as to reduce interference from water vapor on accurate measurements of CO_2 and CH_4. Prior to and just after the trip, the Picarro G4301 was calibrated against three standard gas mixtures of known concentrations.

Here, we present data of the first mobile survey undertaken across West Siberia in late October through early November 2018. It is evident that when driving on the heavy traffic motorways, measurements, especially of CO_2 concentrations, are highly affected by vehicle emissions. Therefore, when analyzing the data we used a baseline approach to derive "background" values. This allowed the anthropogenic (transportation) and natural spatial distribution pattern of CO_2 and CH_4 to be obtained during the survey. In 2019, we plan to undertake four more surveys in March, June, August, and late October to explore seasonal changes of the GHG distribution taking place in different ecoregions of West Siberia.

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