Continuous measurement of CO_2 and CH_4 concentration from a tower network (JR-STATION) over Siberia

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Continuous measurements of CO_2 and CH_4 concentration have been carried out with a tower network in Siberia (JR-STATION: Japan-Russia Siberian Tall Tower Inland Observation Network) in order to study the spatial and temporal variations of CO_2 and CH_4 in the forest, steppe, and wetland regions and estimate the distribution of the flux over this huge area (Sasakawa et al., 2010) where only a few atmospheric investigations were made.

The JR-STATION consists of 6 towers (Figure) located at Berezorechka (BRZ) since 2002, at Karasevoe (KRS) since 2004, at Demyanskoe (DEM) and Noyabrsk (NOY) since 2005, at Azovo (AZV) since 2007, and at Vaganovo (VGN) since 2008. Air samples taken at two heights (~85 m) on each tower were analyzed with an NDIR (LI-COR, LI-820) for CO_2 and a SnO_2 semiconductor sensor (Suto et al., 2010) for CH_4 after passing through the line with a glass water trap, a Nafion membrane dryer (PERMA PURE, MD-050-72F-2), and a magnesium perchlorate. Measurement precision was ±0.3 ppm for CO_2 and ±5 ppb for CH_4.

Both CO_2 and CH_4 concentration showed clear diurnal variation during summer mainly due to the diurnal variation of the PBL height (Sasakawa et al., 2012), which is pronounced in inland continental locations such as Siberia. Sasakawa et al. (2013) reported that daytime (13:00-17:00 LST) mean data observed at the towers can capture the characteristic of CO_2 concentration in the PBL well during dormant season, and growing season (June-August) with a negative bias of -2.4±0.8 ppm (80 m inlet). This bias is characteristic of close ground observation at high source/sink region. Using the daytime mean, spatial and temporal variations in annual and decadal scale were obtained for Siberia; e.g. the CO_2 drawdown in the summer of 2010 in West Siberia was much shallower than in 2009. This result is consistent with the report that carbon uptake at Eurasia in the summer of 2010 was reduced because of the heat wave in Eurasia driving biospheric fluxes and fire emissions (Guerlet et al., 2013).

We have started to install a Cavity Ring-Down Spectroscopy (CRDS; Picarro inc., G2401) to renew the antiquated system. Branching before the magnesium perchlorate, sample air flowed into the CRDS through a Nafion dryer (PERMA PURE, MD-050-72S-1). The flow rate was controlled at the same value for the original path (35 ml/min) with a mass flow controller. The water vapor was kept at <0.01 % in this condition, which value is good enough for water correction of the CRDS (Nara et al., 2012). The CO_2 concentration in compressed dry natural air measured with the CRDS (391.85±0.04 ppm) showed good agreement with that measured with the NDIR (391.72±0.18 ppm). We will present preliminary atmospheric data observed with this modified system at KRS in the presentation.

References

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