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シベリア域におけるタワーネットワークを用いた大気メタンの連続観測

Continuous methane measurement using 9-tower network over Siberia

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Continuous measurements of CH_4 mixing ratio have been carried out with a tower network in Siberia in order to study the spatial and temporal variations of CH_4 in the forest, steppe, and wetland regions and estimate the distribution of the flux over this huge area where only few atmospheric investigations were made. The network consists of 9 towers located at Berezorechka (BRZ; 56°09'N, 84°20'E) since 2002, at Karasevoe (KRS; 58°15'N, 82°25'E) and Igrim (IGR; 63°11'N, 64°25'E) since 2004, at Demyanskoe (DEM; 59°47'N, 70°52'E), Noyabrsk (NOY; 63°26'N, 75°47'E) and Yakutsuk (YAK; 62°50'N, 129°21'E) since 2005, at Savvushka (SVV; 51°20'N, 82°08'E) since 2006, at Azovo (AZV; 54°42'N, 73°02'E) since 2007, and at Vaganovo (VGN; 54°30'N, 62°19'E) since 2008. Air samples taken at two heights (5-85 m) on each tower are analyzed with a SnO_2 semiconductor sensor after passing through a line with a glass water trap, a Nafion membrane drier and a magnesium perchlorate.
Clear diurnal CH_4 variations were observed particularly during summer (from June to August) due to height change of mixed layer. Daytime CH_4 concentrations (13:00-17:00GLT) exhibited rise in summer and winter at almost all sites and higher concentrations and bigger deviations at the northern sites surrounded by extensive wetland regions. Daytime CH_4 mean of over 2000 ppb was observed at some tower sites at the same periods of several days in winter, which was associated with weather condition. High atmospheric pressure making low boundary layer caused the CH_4 accumulation in sub-continental scale during winter. The number of high daytime mean (> 2000 ppb) was the most in the summer of 2007 when temperature and precipitation rate were the highest in the five years (2004-2008) over West Siberia, which suggests that high CH_4 events observed in 2007 were mainly attributed to the emission from wetlands. However, influence of biomass burning also should be considered since many hot spots were detected over West Siberia by MODIS on satellites in the summer of 2007. Daytime mean CH_4 concentrations over Siberia generally displayed higher than CH_4 values reported from flask sampling at NOAA coastal sites located in the same latitude. Our coupled Eulerian-Lagrangian transport model reproduced this difference and seasonal variation with double maxima. In summer, it also reproduced day-to-day variations and clarified that CH_4 emitted from wetlands predominantly contributed to CH_4 variation. Source category calculations revealed that the major contributor to day-to-day variation changed from wetlands during summer to fossil fuel during winter.

Extremely high CH_4plume of several ppm orders in several hours were sometimes observed from specific directions at towers of NOY and DEM where natural gas pipelines exist in several km. These results suggest that the tower network detected CH_4leakage from the pipelines.

Reference

Sasakawa, M., K. Shimoyama, T. Machida, N. Tsuda, H. Suto, M. Arshinov, D. Davidov, A. Fofonov, O. Krasnov, T. Saeki, Y. Koyama, and S. Maksyutov (2010) Continuous Measurement of Methane Concentration using 9-tower Network over Siberia, submitted to Tellus B.

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