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TITLE: Recent variation of Siberian CH4 fluxes estimated from atmospheric observations of CH4

ABSTRACT BODY: Siberia is an area of choice for observing the effects of global warming sooner than in other regions. Perceivable changes in ecosystem and cryosphere environment have been reported such as damage to the forest or frequent flood. In this study, we use atmospheric methane observations in Siberia to estimate Siberian CH4 fluxes during 2006-2010 using an inverse model of atmospheric transport and investigate the recent variation of the estimated fluxes. Interseasonally varying CH4 emissions developed in TransCom-CH4 project are used in forward CH4 tracer simulations with NIES transport model including chemical sink rates: wetland and rice paddy emissions simulated with a process-based biogeochemical model (VISIT), biomass burning emissions of GFED v3.1, aseasonal anthropogenic emissions of EDGAR v4.2, and interseasonally repeating termite emissions of GISS. We use flask sampling and continuous measurement data of atmospheric CH4 archived at WDCGG in flux estimates. In addition, atmospheric CH4 observed in Siberia by aircrafts and a tall tower network (JR-STATION: Japan–Russia Siberian Tall Tower Inland Observation Network) are used to optimize Siberian CH4 flux: 1) monthly vertical profiles at Surgut, Novosibirsk and Yakutsk, and 2) continuous measurements at the JR–STATION in Berezorechka, Demyanskoe, Karasevoe, Igrim, Noyabrsk, Sawushka, Vaganovo, and Yakutsk.
Annual mean Siberian CH4 flux is estimated to be 21.63 ± 5.25 Tg/yr in 2006-2010, which is 4.3 % to the global total (505.40 Tg/yr). Our Siberian flux estimates present a positive flux anomaly since 2007 and the flux anomaly is defined as the departure from the 2006 flux estimates. In 2007, increased wetland flux is estimated in the north-western Siberia with large wetland area and high summer CH4 concentrations observed at Demyanskoe, Karasevoe and Igrim near extensive wetlands can be explained by the enhanced wetland flux under hot and wet summer. This result is consistent with other studies which mentioned enhanced CH4 flux from West Siberian wetlands as the main contributors to the 2007 increase of atmospheric CH4 observed in northern high latitudes. The estimated flux from biomass burning flux is highest in 2008 during the recent five years and the enhanced flux is centered in the south-eastern Siberia, where the biomass burning flux in 2008 is more than double the annual mean in 2006-2010. The large emission in 2008 is also seen in GFED v3.1, but with lower values than our estimates. The 2009 and 2010 positive flux anomalies are mainly contributed by increasing anthropogenic fluxes in south-western Siberia. We plan to investigate potential contributors to the recent variation of Siberian fluxes, through various data analysis: meteorological data such as temperature and precipitation, and satellite data detecting forest fires, droughts and floods.

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