Multi-year response of CH_4 efflux to wetting at Indigirka Lowland in Northeastern Siberia

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Under the amplified Arctic warming climatic response of CH_4 emission from the wetlands needs to be understood and predicted because of possible influence to the global climate. Indigirka Lowland in Northeastern Siberia has wetlands in a taiga-tundra boundary on permafrost, whose ecosystem are possibly sensitive to the climate change. Though environmental controls on CH_4 efflux have been found such as water level (soil moisture), soil temperature and vegetation, the quantitative relationship between the controls and CH_4 efflux are still unclear, which depends on region and timescale (Olefeldt et al., 2013, Global Change Biol.; Treat et al., 2007, JGR). One difficulty is that CH_4 emission is composed of 3 processes, i.e. CH_4 production, oxidation and transport; they can respond to environmental controls and affect CH_4 efflux in different ways. These processes are reflected by stable isotope ratios of CH_4 (delta-^{13}C-CH_4, delta-D-CH_4), which can associate field observation and knowledge from laboratory incubation experiments on CH_4 production and on oxidation.
In this study we assessed interannual variation in chamber CH_4 efflux and in delta-^{13}C-, delta-D-CH_4 near Chokurdakh (70.62 N, 147.90 E) over summers of 2009-2013 to understand relationship between CH_4 efflux and environmental factors based on the 3 processes of CH_4.
CH_4 efflux was around the detection limit at dry tree mounds through the observation period, while large interannual variation was observed at wet areas of sphagnum moss and sedges. Wet event concurrent with the highest precipitation occurred in 2011 and CH_4 efflux increased at wet areas in the same year. Although water level decreased from 2011 to 2013, large CH_4 emission continued. Moreover, dissolved CH_4 concentration in soil pore water (at 10-15 cm depth) increased by 1 order of magnitude from 2011 to 2012 and kept high till 2013. CH_4 isotopes implies that CH_4 oxidation was depressed in 2012 after the wetting in 2011, suggesting soil reduction induced by the wetting proceeded over multiple years, which may have affected dissolved CH_4 concentration and CH_4 efflux. Such variation in CH_4 efflux and in dissolved CH_4 concentration will be discussed in relation to the 3 processes in this presentation.

Keywords: methane flux, interannual variation, isotope ratio, taiga-tundra boundary

