6.032 Variations of atmospheric methane and its carbon and hydrogen isotopic ratios at Churchill, Canada.

Early Career Scientist

Presenting Author:
RYO FUJITA, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University, Sendai, Japan, ryo.fujita.t6@dc.tohoku.ac.jp

Co-Authors:
SHINJI MORIMOTO, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University, Sendai, Japan
TAKU UMEZAWA, National Institute for Environmental Studies, Tsukuba, Japan
KENTARO ISHIJIMA, Research Institute for Global Change, JAMSTEC, Yokohama, Japan
PRABIR PATRA, Research Institute for Global Change, JAMSTEC, Yokohama, Japan
DOUG WORTHY, Environment Canada, Toronto, Ontario, Canada
DAISUKE GOTO, National Institute of Polar Research, Tokyo, Japan
SHUJI AOKI, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University, Sendai, Japan
TAKAKIYO NAKAZAWA, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University, Sendai, Japan

Abstract:

We measured the concentration, $\delta^{13}C$ and δD of atmospheric CH_4 at Churchill (58°44'N, 93°50'W) in the northern part of Hudson Bay Lowlands (HBL), Canada during 2007–2014. Compared to the observational results at northern high-latitude background station, Ny-Ålesund, Svalbard (78°55'N, 11°56'E), the CH_4 concentration is generally higher and $\delta^{13}C$ and δD are lower, reflecting the influence of regional biogenic CH_4 sources. A clear seasonal cycle is observable for both the CH_4 concentration and $\delta^{13}C$, with the respective maximum (minimum) values in January–February (June) and May (October). δD also shows the seasonal cycle, but it is not so clear as those for the CH_4 concentration and $\delta^{13}C$. The seasonal phases of the three variables are earlier at Churchill than at Ny-Ålesund by up to one month, due to the difference in seasonally dependent CH_4 emissions from wetlands between the two sites, which is deduced by analyzing their seasonal cycles with a 1-box model. Short-term CH_4 variations are observed throughout the year, showing an enhancement especially in summer. The relationships between the concentration and isotopic ratios for the short-term CH_4 variations yield the respective source signatures of $\delta^{13}C$ and δD to be -63.4 ± 2.8 and -316 ± 24‰ for summer (May–October), and -47.7 ± 4.5 and -244 ± 52‰ for winter (November–April). These values suggest that the summertime and wintertime short-term CH_4 variations are produced by CH_4 emitted from wetlands and fossil fuel, respectively. The results simulated using an atmospheric chemistry transport model (ACTM) reproduce well the CH_4 variations observed at Ny-Ålesund, but much exceed the summertime CH_4

concentrations at Churchill. Tagged tracer experiments by the ACTM indicate that such high values are due to CH_4 emissions from the boreal zone in North America, suggesting that wetland fluxes calculated by a process-based ecosystem model (VISIT) to incorporate into the ACTM are overestimated for HBL.