3.068 Measurements of carbon and hydrogen isotope ratios of atmospheric methane in the northern North Pacific and the Arctic Ocean and interpretation of Arctic methane sources.

Early Career Scientist

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Abstract:

There are large and important natural CH_4 sources in northern high latitudes, but their emissions and spatial distribution are not well understood yet. Simultaneous measurements of carbon and hydrogen isotope ratios ($\delta^{13}C$ and δD) of atmospheric CH_4 would help us to separate contributions from different types of sources (e.g., biogenic or thermogenic) to atmospheric CH_4; however, the isotope data are still sparse, especially in boreal North America and Siberia. In this study, we measured atmospheric CH_4, $\delta^{13}C$, and δD on board the research vessel MIRAI in the northern North Pacific and the Arctic Ocean in summer to autumn in 2012–2016. We also estimated the representative CH_4 isotope source signatures in their surrounding areas. A clear latitudinal gradient is observed for atmospheric CH_4, $\delta^{13}C$, and δD from 36°N to 76°N; northward increase of CH_4 and decrease of $\delta^{13}C$ and δD are evident. This suggests that biogenic CH_4 sources are dominant in northern high latitudes in the summertime. By applying a single mixing equation to the data observed at latitudes higher than 55°N, the average isotope signatures over 2012–2016 are estimated to be -65.6 ± 1.6‰ for $\delta^{13}C$ and -361 ± 45‰ for δD. The results are similar to the values reported previously for boreal wetland CH_4 sources. A five-day backward trajectory analysis shows that air parcels with high CH_4 come mainly from land areas of Alaska and Northern Canada and partially from Siberia. CH_4 emissions from surface water in the Arctic Ocean would not be prominent in summer to autumn in 2012–2016.