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Isotopic evidence for sources of methane to the Arctic atmosphere in 2008 and 2009

Rebecca Fisher, David Lowry, Srimathy Sriskantharajah, Mathias Lanoisellé, Mary Fowler, and Euan Nisbet
Dept. of Earth Sciences, Royal Holloway, University of London, Egham, United Kingdom (r.fisher@es.rhul.ac.uk)

The Arctic contributes significant inputs to the global methane budget. Arctic methane comes from a wide variety of sources, most of which are vulnerable to global warming, with strong feedbacks such that the warming feeds the warming. The carbon isotopic signatures of some major Arctic and sub-Arctic methane sources have been characterised at a variety of spatial resolutions, from chambers at source, on-site atmospheric collection and downwind of source. These include Finnish and Siberian wetland, Canadian fires, Russian gas and submarine clathrate. Isotopic analysis of methane in ambient air samples collected throughout the summer months of 2008 and 2009 at high Arctic locations showed that the bulk Arctic methane increment had a $\delta^{13}C_{CH4}$signature of around -65‰ indicating a dominant wetland source. The bulk Arctic source signature calculated from spring 2009 samples, -53‰ was significantly more enriched than during the summer months, suggesting that the dominant Arctic sources prior to the thawing of wetland in late spring are gas emissions from source regions or pipeline networks. Emissions from submarine methane clathrates are occurring but at present the amounts reaching the atmosphere are not of global significance**.** Future high frequency monitoring of methane $\delta^{13}C_{CH4}$ from a number of Arctic sites will be important to identify sudden or anomalous changes in emissions from specific Arctic sources.