Geophysical Research Abstracts
Vol. 19, EGU2017-14949-1, 2017
EGU General Assembly 2017

Stable carbon isotopic signature of methane from high-emitting wetland sites in discontinuous permafrost landscape

Maija Marushchak, Maarit Liimatainen, Saara Lind, Christina Biasi, and Pertti Martikainen
University of Eastern Finland, Department of Environmental and Biological Sciences, Kuopio, Finland
(maija.marushchak@uef.fi)

The rising methane concentration in the atmosphere during the past years has been associated with a concurrent change in the carbon isotopic signature: The atmospheric methane is getting more and more depleted in the heavy carbon isotope. The decreasing $^{13}C/^{12}C$ ratio indicates an increasing contribution of methane from biogenic sources, most importantly wetlands and inland waters, whose global emissions are still poorly constrained. From the climate change perspective, arctic and subarctic wetlands are particularly interesting due to the strong warming and permafrost thaw predicted for these regions that will cause changes in the methane dynamics. Coupling methane flux inventories with determination of the stable isotopic signature can provide useful information about the pathways of methane production, consumption and transport in these ecosystems.

Here, we present data on the emissions and carbon isotopic composition of methane from subarctic tundra wetlands at the Seida study site, Northeast European Russia. In this landscape, underlain by discontinuous permafrost, waterlogged fens represent sites of high carbon turnover and high methane release. Despite they cover less than 15% of the region, their methane emissions comprise 98% of the regional mean (± SD) release of 6.7 (± 1.8) g CH_4 m^{-2} y^{-1} (Marushchak et al. 2016).

The methane emission from the studied fens was clearly depleted in ^{13}C compared to the pore water methane. The bulk mean $\delta^{13}CH_4$ (± SD) over the growing season was -68.2 (± 2.0) ‰ which is similar to the relatively few values previously reported from tundra wetlands. We explain the depleted methane emissions by the high importance of passive transport via aerenchymous plants, a process that discriminates against the heavier isotopes. This idea is supported by the strong positive correlation observed between the methane emission and the vascular leaf area index (LAI), and the inverse relationship between the $\delta^{13}CH_4$ of emitted methane and LAI. The latter cannot be explained by greater dominance of acetoclastic methanogenesis on densely vegetated sites, since this would lead to the opposite: more enriched methane with higher LAI.

While the spatial variability of methane emission was related to the differences in the vascular plant cover, the seasonal dynamics followed closely the local temperatures. Height of the water table level was an unimportant regulator of methane emissions in these fens, where floating peat surface follows the water table fluctuations. This implies that these fens have high potential for increased methane release in the future warmer climate, due to enhanced microbial methane production and vascular plant growth.