



Observations of atmospheric methane and its stable isotope ratio ($\delta^{13}\text{C}$) over the Arctic seas from ship cruises in the summer and autumn of 2015

Andrey Skorokhod (1), Igor Belikov (1), Natalia Pankratova (1), Alexander Novigatsky (2), and Rona Thompson (3)

(1) A.M.Obukhov Institute of atmospheric physics, Atmospheric chemistry, Moscow, Russian Federation (n_pankratova@list.ru), (2) Shirshov Institute of Oceanology RAS, Moscow, Russian Federation, (3) Norwegian Institute for Air Research, Kjeller, Norway

Atmospheric methane (CH_4) is the second most important long-lived greenhouse gas. The Arctic has significant sources of CH_4 , such as from wetlands and possibly also from methane hydrates, which may act as a positive feedback on the climate system. Despite significant efforts in establishing a network of ground-based CH_4 observations in the Arctic zone, there is still a lack of measurements over the Arctic Ocean and sub-polar seas.

From 21 July to 9 October 2015, concentrations of CH_4 and CO_2 , as well as of the $^{13}\text{C}:^{12}\text{C}$ isotopic ratio in CH_4 , i.e. $\delta^{13}\text{C}$, were measured in the marine boundary layer from aboard the Research Vessel "Akademik Mstislav Keldysh" by the Shirshov Institute of Oceanology. Measurements were made using a Cavity Ring Down Spectroscopy instrument from PicarroTM (model G2132-i). The cruises covered a vast area including the North Atlantic up to 70°N , the Baltic, North, Norwegian, Greenland, Barents, White, Kara and Laptev Seas. To the best of our knowledge, these are the first measurements of their type made in these regions. Concentrations of CH_4 typically had low variations (in the range of a few ppb) in the open sea but relatively large variations (of the order of 100 ppb) were recorded near and during stops in ports. High variability of atmospheric CH_4 was also registered near the delta of the Lena River in the Laptev Sea, which has been suggested to be a large CH_4 reservoir and where bubbles rising through the water column have been observed.

The obtained set of $\delta^{13}\text{CCH}_4$ is characterized by significant range of the measured values varying from open Atlantic to polluted regions near large sea ports. The Keeling plot analyses were implemented to study possible CH_4 sources according to its isotopic signature. Footprint analyses are presented for the shipboard observations, as well as comparisons to simulated CH_4 concentrations and $\delta^{13}\text{C}$ using the Lagrangian transport model, FLEXPART.

This work has been carried-out with the financial support of RFBR (Project #14-05-93089) and RSF (Project #14-47-00049).