Geophysical Research Abstracts
Vol. 19, EGU2017-8852, 2017
EGU General Assembly 2017

Year-round methane emissions from permafrost in a North-east Siberian region

Karel Castro-Morales (1), Sonja Kaiser (1), Thomas Kleinen (2), Min Jung Kwon (1), Fanny Kittler (1), Sönke Zaehle (1), Christian Beer (3), and Mathias Göckede (1)

(1) Max Planck Institute for Biogeochemistry, Germany (kcastro@bgc-jena.mpg.de), (2) Max Planck Institute for Meteorology, Germany, (3) Stockholm University, Stockholm

In recent decades, permafrost regions in northern latitudes are thawing as a response of climate warming. Soils in permafrost areas contain vast amounts of organic material that is released into the environment after thaw, providing new labile material for bacterial decomposition. As a result, higher production of methane in the anoxic soil layers and within anaerobic wetlands is anticipated, and this will be further released to the atmosphere. In order to assess the current large-scale methane emissions from a wetland permafrost-thaw affected area, we present results of year-round simulated methane emissions at regional scale for a section at the Russian far Northeast in Siberia, located in the low Arctic tundra and characterized by continuous permafrost. For this we use a newly developed process-based methane model built in the framework of the land surface model JSBACH. The model contains explicit permafrost processes and an improved representation of the horizontal extent of wetlands with a hydrological model (TOPMODEL). Model simulated distribution and horizontal extent of wetlands is evaluated against high-resolution remote sensing data. Total and individual regional methane emissions by ebullition, molecular diffusion, plant-mediated and emissions through snow are presented for 2014 and 2015. The model shows a reasonable seasonal transition between the individual methane emission paths. Most of the methane emissions to the atmosphere occur in summer (July, August, September), with the peak of the emissions during August. In this month, plant-mediated transport is the dominant emission path with about 15 mg CH4 m-2 d-1 in 2014, followed by ebullition (7 mg CH4 m-2 d-1) accounting for about half of the emissions thorough plants. Molecular diffusion is a minor contributor with only 0.006 mg CH4 m-2 d-1 at the peak of the summer emissions. Methane emissions through snow occur only during spring, fall and winter months, with higher emissions in spring and autumn (max. 2 mg CH4 m-2 d-1) when the thickness of the snow layer starts to melt or accumulate, respectively. The performance of the model was evaluated by comparing the modeled total methane emissions from a section of the Kolyma river floodplain near Chersky, against methane fluxes obtained from eddy covariance (for 2014 and 2015) and chambers (for June – August 2014) measured in the same area. Model results agree well with observations, with the highest emissions during August each year with 92.3 mg CH4 m-2 d-1 from eddy fluxes, 72.5 mg CH4 m-2 d-1 from chambers and 79.0 mg CH4 m-2 d-1 from the model in 2014, while 64.4 mg CH4 m-2 d-1 from eddy and 66.3 mg CH4 m-2 d-1 from the model in August 2015. The model underestimates winter emissions by up to 15 mg CH4 m-2 d-1, however a better agreement is observed in April 2014. To understand the shortcomings of the model against observations, the heterogeneity between model grid cells will be discussed.