2. Greenhouse gas emissions from a Siberian Alas ecosystem near Yakutsk, Russia

Fumiaki Takakai[1], Alexey R. Desyatkin[2] Larry Lopez[3], Ryusuke Hatano[1,4], Alexander N. Fedorov[5] and Roman V. Desyatkin[2]

[1] Graduate School of Agriculture, Hokkaido University
[2] Institute for Biological Problems of Cryolithozone, SB, RAS
[3] Institute of Low Temperature Science, Hokkaido University
[4] Field Science Center for Northern Biosphere, Hokkaido University,
[5] Permafrost institute, SB RAS

Abstract

Alas is a circular grassland area with a pond at the center, formed by subsidence associated with permafrost thawing in Taiga forests in the eastern Siberia. Temporal measurements of GHG (CO_2, CH_4 and N_2O) were carried out in the Alas ecosystem near Yakutsk, Russia (62°N, 129°E) from June to September 2004. A transect line was set up from the forest to the pond through the grassland. Six sampling sites were set up for various vegetation type along the transect: Larch forest (F), dry grassland (G-1 and G-2), wet grassland (G-3 and P-1; the temporarily flooded grassland) and pond (P-2; continuous flooded). GHG fluxes were measured by a closed chamber method, for two treatments (with and without plants) in each site except for forest and pond site (F and P-2 were only measured without plant). In dry and wet grassland sites, relationships between soil temperature and total ecosystem respiration, PAR and gross photosynthesis were made. Net ecosystem exchange of CO_2 (NEE) was estimated by the continuous measurements of soil temperature and PAR. Cumulative CH_4 and N_2O emissions during the measurement period were also calculated.

The cumulative NEE in dry grassland site showed a emission (1159 to 2037 kg C ha^{-1}, positive value indicates emission to the atmosphere) and in wet grassland showed both emission and uptake (-931 to 156 kg C ha^{-1}). CH_4 (cumulative value, Unit: kg C ha^{-1}) uptake constantly occurred in the forest (-0.13). Both CH_4 uptake and emission occurred in individual measurements, however, cumulative flux was the low uptake (-0.1 to -0.04) in dry grassland. CH_4 emission from the water surface of the pond (238) showed a maximum value in the beginning of July, and then decreased gradually. In wet grassland (17 to 174), high CH_4 emissions were found during the flooding period. In this period, CH_4 emissions via plant body accounted for 52 to 78% of the total emission. After flooded water disappeared, CH_4 emission decreased immediately. A positive relationship between flooding period and total CH_4 emission were found in wet area (temporal or consistently flooding zone). Both uptake and emission of N_2O (cumulative value, Unit: kg N ha^{-1}) occurred in individual measurements, however, cumulative flux was the low emission (0.01) in the forest. A low N_2O emission was found (0.04 to 0.05) in dry grassland. While, N_2O uptake (-0.02) constantly occurred on the water surface of the pond. In wet grassland (0.16 to 1.7), N_2O emission didn't occur as same as in the pond. However, after the flooded water disappeared, a peak of N_2O emission was found. Our results showed that the vegetation zone around the pond was the important sources of CH_4 and N_2O, and was possibly the sink of CO_2. These results also indicated that the soil moisture condition, especially water flooding, could be an important controlling factor of GHG dynamics in the Alas ecosystem.