Geophysical Research Abstracts
Vol. 19, EGU2017-7508, 2017
EGU General Assembly 2017

Annual fluxes of nitrous oxide (N2O) in boreal trees

Katerina Machacova (1), Elisa Halmeenmäki (2), Otmar Urban (1), and Mari Pihlatie (2)

(1) Global Change Research Institute CAS, Brno, Czech Republic (machacova.k@czechglobe.cz), (2) Department of Physics, Division of Atmospheric Sciences, University of Helsinki, Finland

Boreal forests covering almost one-third of the global forest area are considered to be a natural source of nitrous oxide (N_2O), an important greenhouse gas produced in soils. The forest ecosystems exchange of N_2O has so far been calculated based on N_2O flux measurements at the soil-atmosphere interface excluding other possible natural sources of N_2O. Scarce studies revealed that trees can emit N_2O; however, only under conditions with high N_2O production in the soil due to e.g. fertilisation or flooding treatment. Unfortunately, information about the N_2O exchange of mature trees under natural field conditions is almost non-existent.

We determined N_2O fluxes from common boreal tree species: Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), and downy and silver birch (*Betula pubescens*, *B. pendula*). We aimed to investigate (1) whether these tree species exchange N_2O with the atmosphere, (2) whether these fluxes show seasonal cycle, (3) how the tree N_2O fluxes contribute to the forest floor N_2O exchange, and (4) whether soil water content affects the N_2O exchange of trees.

The measurements were performed on mature trees in the boreal forest around the SMEAR II station at Hyytiälä in southern Finland. Fluxes of N_2O at stem and forest floor level were simultaneously measured from June 2014 until May 2015 using static chamber systems and quantified by gas chromatography.

All trees studied emitted N_2O from their stems during the vegetation season. The emission rates of all tree species decreased from October onwards. In winter, the tree fluxes remained low (mostly weak uptake by birch and pine, weak uptake or emission by spruce) and increased again in March. The forest floor mostly emitted N_2O during the whole year without significant seasonal variation.

At the annual scale, all species studied were sources of N_2O. Spruce was the strongest emitter of N_2O with total emission of 0.91 mg N_2O m^{-2} stem area and 2.4 g N_2O ha^{-1} ground area per year, followed by pine (0.41 mg m^{-2} and 1.9 g ha^{-1} per year) and birch (total emission of both sub-species was 0.38 mg m^{-2} and 0.71 g ha^{-1} per year). The forest floor emitted in total 7.1 mg N_2O m^{-2} soil area and 70.7 g ha^{-1} per year. These emissions were not significantly modulated by soil water content.

Boreal tree species, as newly identified emitters of N_2O, considerably contribute to total N_2O emissions of boreal forests and their emission potential has to be included in the forest N_2O emission inventories.

Acknowledgement

This research was supported by the Czech Science Foundation (17-18112Y), the National Programme for Sustainability I (LO1415), EU FP7 project ExpeER (Grant Agreement 262060), Emil Aaltonen Foundation, Academy of Finland Research Fellow projects (292699, 263858, 288494), The Academy of Finland Centre of Excellence (projects 1118615, 272041), and ICOS-Finland (281255).We thank Marian Pavelka, Jiří Dušek, Stanislav Stellner, Jiří Mikula and Marek Jakubík for technical support.