Geophysical Research Abstracts
Vol. 20, EGU2018-13194-1, 2018
EGU General Assembly 2018

Biogenic volatile organic compound emissions from forest floor along a fire chronosequence on permafrost in Central Siberia, Russia

Huizhong Zhang-Turpeinen (1), Minna Kivimäenpää (1), Anatoly Prokushikin (3), Frank Berninger (2), Kajar Köster (2), and Jukka Pumpanen (2)

(1) University of Eastern Finland, Department of environmental and biological sciences, Kuopio, Finland (huizhong.zhang@uef.fi), (3) V.N.Sukachev Institute of forest SB RAS, Russia, (2) University of Helsinki, Department of forest sciences

While the boreal terrestrial ecosystems and the underlying permafrost are experiencing pronounced climate warming, boreal forests may also face to more occurrences of wild fires and longer fire seasons. Fire event has long-term effects on ecosystems and biological processes of boreal forest. Thawing permafrost soils and increase in the active layer depth after a fire event could induce substantial BVOC emissions, because of the large amount of available decomposing litter and soil organic matter in boreal forest. Biogenic volatile organic compounds (BVOCs) indirectly affect climate by acting as precursors to tropospheric O_3 and longer lifetime methane, and are associated with the formation of secondary organic aerosols, which further effect on cloud condensation nuclei formation. The aim of this study was to investigate the quality and quantity of BVOC emissions from arctic permafrost soil in boreal forest. We also aimed to assess how the combination of fire disturbance, vegetation communities shifting and environmental factors would affect the emissions. The study was executed in July of 2016 in Tura of Central Siberia, Russia. BVOCs were sampled from Siberian larch forest floor with a fire chronosequence that encompassed three age classes since the last fire occurred: (i) in 2 years ago, (ii) 23 years ago, and (iii) at least 100 (> 100) year ago. A total of 83 BVOC compounds were detected, composing of isoprene, 40 monoterpenes, 27 sesquiterpenes and 15 other VOCs from all the samples. The emissions of BVOC in sum and in compound species varied in large ranges through ages and forest areas. There were significant differences in isoprene emissions between areas. There was no difference in monoterpene fluxes between the areas. A significant difference in sesquiterpene fluxes was observed between the > 100-year-old and 2-year-old areas. The emissions of other VOCs were significantly higher in the control areas than those in the other areas. The highest BVOC emissions from the forest floor were measured in the 23-year-old stand, while the forest floor was acted as a source of BVOC emissions in all forest age classes. The bare soil from the most recently burnt stand and the lichen from the control stand were identified as a sink of isoprene. The shrubs and decomposing litter material were contributing large amount of monoterpenes and sesquiterpenes, while the new vegetated ground plants in the 2-year-old forest areas were sinks of BVOCs. We confirm that vegetation on the forest floor was the most dominating source and controlling factor for BVOC emissions. We observed that the forest succession over time in post fire years was playing a significant affecting factor to BVOC sources. We suggest that wild fire and consequent permafrost thawing have both direct and indirect effects on the BVOC emissions within a century time perspective. The longer period field observation and systematic samplings in the central Siberian larch forest are highly recommended for better understanding the relations of fire disturbance, forest succession and BVOC exchanges with the global warming scheme.