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Volatile organic compound emissions from arctic vegetation highly responsive to experimental warming

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Arctic areas are experiencing amplified climate warming that proceeds twice as fast as the global temperature increase. The increasing temperature is already causing evident alterations, e.g. changes in the vegetation cover as well as thawing of permafrost. Climate warming and the concomitant biotic and abiotic changes are likely to have strong direct and indirect effects on emission of volatile organic compounds (VOCs) from arctic vegetation.

We used long-term field manipulation experiments in the Subarctic, Low Arctic and High Arctic to assess effects of climate change on VOC emissions from vegetation communities. In these experiments, we applied passive warming with open-top chambers alone and in combination with other experimental treatments in well-replicated experimental designs. Volatile emissions were sampled in situ by drawing air from plant enclosures and custom-built chambers into adsorbent cartridges, which were analyzed by thermal desorption and gas chromatography-mass spectrometry in laboratory.

Emission increases by a factor of 2-5 were observed under experimental warming by only a few degrees, and the strong response seems universal for dry, mesic and wet ecosystems. In some cases, these vegetation community level responses were partly due to warming-induced increases in the VOC-emitting plant biomass, changes in species composition and the following increase in the amount of leaf litter (Valolahti et al. 2015). In other cases, the responses appeared before any vegetation changes took place (Lindwall et al. 2016) or even despite a decrease in plant biomass (Kramshøj et al. 2016). VOC emissions from arctic ecosystems seem more responsive to experimental warming than other ecosystem processes. We can thus expect large increases in future VOC emissions from this area due to the direct effects of temperature increase, and due to increasing plant biomass and a longer growing season.

References

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