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Effects of long-term and short-term warming on VOC emissions from a Subarctic heath

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It is predicted that the temperature increase during the next 100 years will be highest in the high latitudes. Temperature is also the main factor affecting the volatile organic compound (VOC) emissions by plants. In the Subarctic, the VOC emissions appear to be even more sensitive to temperature changes than in temperate systems, probably because the plant species are adapted to colder climate. The arctic ecosystems are very sensitive to any disturbances, and therefore it is important to study climate change effects and predict future responses in these areas.

Long-term climate change experiment with elevated temperature and litter addition treatments has been running on a subarctic heath in Abisko, North Sweden since 1999. Five treatments (1. unmanipulated control, 2. long-term warming, 3. short-term warming, 4. litter addition and 5. litter addition + warming) are replicated in six blocks. In 2010, eight vegetation-soil-chamber-based VOC collection campaigns were made. VOCs were collected into adsorbent cartridges, which were analyzed by thermal desorption and gas chromatography-mass spectrometry. Point quadrant analysis was used to investigate the species composition in the different treatments, and the vegetation data was used as an explaining factor for the different VOC emission profiles between treatments.

Elevated temperature significantly increased the total VOC emission from the subarctic heath. Most significant effects were found for the emissions of isoprene and sesquiterpenes. The short-term and long-term temperature treatments differed for the emissions of total terpenoids.

According to these results, elevated temperature has both long- and short term effects on VOC-emissions. In the short term, direct temperature effect increases VOC-emissions. In the long term, indirect effects via vegetation changes dominate. After the release into the atmosphere, the lifetime of VOCs is from seconds to days. They participate in secondary organic aerosol formation and affect the lifetime of methane in the atmosphere. Because of this important role in the atmosphere, the increased VOC emissions due to warming may have consequences for the future climate.