



Reactive hydrocarbon emissions from thawing permafrost

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Thawing permafrost has been identified as a potentially large source of greenhouse gases, CO₂ and methane. However, some of the carbon from the vast deposits in permafrost may also be released as other climate-relevant gases such as volatile organic compounds (VOC). It is known that soils act both as sources and sinks of VOCs, and that these compounds can be biologically produced and slip out as side products of fermentation. Once in the atmosphere, VOCs participate in oxidation reactions with potential impacts on the lifetime of methane, and they also contribute to formation of secondary organic aerosol, with cooling impact on climate.

We conducted a laboratory experiment using proton transfer reaction-time of flight-mass spectrometry (PTR-TOF-MS) to measure VOCs in real time while letting permafrost samples thaw. We also incubated permafrost samples together with active layer soils sharing the flask headspace but no direct contact to assess whether this would impact the amount or composition of the compounds released. We observed that thawing permafrost soils are a significant source of a large range of VOCs. However, the active layer soils showed a strong capacity for VOC uptake. With mineralization assays using ¹⁴C-labelled VOCs, we identified that the VOC uptake was largely due to microbial mineralization of the compounds to CO₂. The environmental controls and the climatic relevance of the studied processes will be discussed.