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Overlooked volatile production from Arctic permafrost triggered by global warming

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Permafrost thaw, as a consequence of climate warming, liberates large quantities of frozen organic carbon in the Arctic regions. The response of gaseous carbon release upon permafrost thaw might play a crucial role in the future evolution of atmosphere-land fluxes of biogenic gases such as volatile organic compounds (VOCs), a group of reactive gases and the dominant modulator of tropospheric oxidation capacities. Here, we examine the response of volatile release from Finnish Lapland permafrost soils to temperature increase in a series of laboratory incubation experiments. The experiments show that when the temperature rises from 0 °C to 15 °C, various VOC species are significantly emitted from the gradually thawing soils. The VOC fluxes from thawing permafrost are on average four times as high as those from active layer. Acetic acid and acetone dominate the total volatile emissions from both permafrost and active layer, with significant amounts of aromatics and terpenes detected as well. The emission rate and the composition of volatile release from thawing soils are highly responsive to temperature variations. As temperature increases, more less volatile compounds are released, i.e., sesquiterpenes and diterpenes. Collectively, these results demonstrate the highly overlooked volatile production from thawing permafrost, which will create a stronger permafrost carbon-climate feedback.