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Discovery of a new emission pathway of subglacial methane to the atmosphere from below the Greenland Ice Sheet

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Recent findings from the Greenland Ice Sheet (GrIS) and a glacier in Iceland[1-3] show that subglacial environments should be considered as active components of the Earth's methane (CH4) cycle. The studies[1,3] show that large quantities of dissolved CH4 are exported with the meltwater from interior parts of the GrIS to the margin, where it is emitted to the atmosphere. However, the climatic importance of subglacial methane export for the mixing ratio of CH4 in the atmosphere remains unknown and is dependent on the phenomena's global distribution, the source of subglacial methane as well as the climatic sensitivity of the release mechanisms.
Here we present results from a field campaign at the GrIS in the summer of 2018, where our main aims were to 1) confirm a known source of subglacial CH4 to document the temporal variation in direct subglacial CH4 emission between different melt seasons 2) investigate how the meltwater export and direct emission of subglacial CH4 vary over the melt season and 3) investigate the likely origin of the subglacial CH4.
In the presentation we will elaborate on the newly discovered emission pathway and results including:
1) Export and direct emission of subglacial CH4 over different seasons
2) Degassing of subglacial CH4 from the meltwater close to the ice margin.
3) Isotopic composition of subglacial CH4 indicating microbial turnover of organic carbon.
4) Linkages between variations in seasonal meltwater discharge and CH4 emissions.
Coupling of the glacial drainage dynamics to the subglacial carbon cycle is central in understanding the present emission of subglacial CH4 as well as future predictions under increased melting. With this contribution, we would like to present a future research area with mutually beneficial collaborations between the biogeochemical and glaciological research communities calling for increased collaboration across the glaciological and biogeochemical disciplines.
[1] Christiansen & Jørgensen (2018) First observation of direct methane emission to the atmosphere from the subglacial domain of the Greenland Ice Sheet, Scientific Reports 8
[2] Burns et al. (2018) Direct isotopic evidence of biogenic methane production and efflux from beneath a temperate glacier, Scientific Reports 8
[3] Lamarche-Gagnon et al. (2019) Greenland melt drives continuous export of methane from the ice-sheet bed Nature 565