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Temporal relationship between meltwater discharge and CH$_4$ and CO$_2$ emissions from the Greenland Ice Sheet.

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Emission of CH$_4$ and CO$_2$ was recently discovered at the western margin of the Greenlandic Ice Sheet (GrIS) $^{1,2}$. While knowledge on both carbon sources, extent and magnitude of these emissions are still very limited, the previous studies indicate that a primary driver for emission is degassing of dissolved and pressurized gases in the meltwater as it reaches the glacial margin. In this way we suggest that glacial hydrology plays a key role in regulating emission on both temporal and spatial scale.

In our studies of subglacial CH$_4$ and CO$_2$ emissions we have so far observed that the seasonal variations in meltwater discharge is correlated to both the magnitude of gas concentrations as well as timing of emissions$^{3,4}$. We propose that the seasonal variations in the connectivity of subglacial channels to both 1) pockets of sediment with CH$_4$ and CO$_2$ production from both anaerobic and aerobic biological processes and 2) supraglacial meltwater via englacial conduits could be a mechanism, which could explain the overall temporal and seasonal patterns of gas concentrations observed at the glacial margin.

We hypothesize that by observing hydrological and geochemical processes at the margin together with CH$_4$ and CO$_2$ in high frequency over the melt season it can be inferred how subglacial hydrological processes regulate biogeochemical and carbon turnover processes. Knowledge on these mechanism and processes are important for future upscaling CH$_4$ and CO$_2$ emission to seasonal periods and larger spatial scales through modeling as well as the assessment of the potential importance of subglacial carbon emissions to the climate system.

Here, we will present data that couples meltwater discharge to measurements of dissolved CH$_4$ and gaseous CH$_4$ and CO$_2$ as well as campaign measurements of water geochemistry and its isotopic composition. Preliminary data shows that CH$_4$ and CO$_2$ export display a clear diurnal signal in response to variations in the composition of melt water discharge. EC measurements and isotopic composition of melt water show a dominance of surface meltwater to subglacial meltwater, but clear diurnal trends in the mixing between these two water sources can be deduced from both isotope and elemental geochemistry of the meltwater.

