Nutrient Factories under the Ice (*NuttI*): Quantifying the subglacial biogeochemical reactor and its response to climate change

1. Promotors

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2. Summary and scientific objectives

Climate change is amplified in polar regions. As a consequence, ice sheets and glaciers (and in particular the Greenland Ice Sheet) are currently experiencing record melting, resulting in a significant increase of already substantial summer freshwater fluxes to the ocean. While the physical consequences of this freshwater input, as well as its alarming increase have been intensively studied, its biogeochemical dimension remains poorly understood.

Once thought to be devoid of life, mounting evidence suggests that subglacial environments are incredibly active biogeochemical reactors that supply globally significant fluxes of labile, bio-essential nutrients including iron, phosphorus, nitrogen, silica and carbon magnitude and timing of these export fluxes and, as a consequence, their response to projected climate change are poorly understood. This knowledge gap is critical because it not only limits our ability to fully evaluate the role of ice sheets and glaciers in the evolution of global biogeochemical cycles and climate, to key ocean regions. Yet, the controls on the nature, but also to assess the full socio-economic impact of alarming ice retreat.

Therefore, the **overarching objective of *NuttI* is to make a step change in our ability to quantitatively understand and predict the subglacial process interplay and associated nutrient export from subglacial environments by developing the very first, mechanistic, hydrological-biogeochemical model framework for subglacial environments**. The development of these critical analytic and predictive capabilities will be informed by decades of subglacial biogeochemical research. The new model will not only serve as an analytic and predictive tool, but will represent a platform for interdisciplinary knowledge synthesis, a tool for hypothesis testing and a guide for designing efficient research strategies and field campaigns. Here, it will be tested and applied to investigate the subglacial process interplay at the well-studied subglacial system of the Leverett Glacier (West-Greenland).

The specific objectives of *NuttI* are to:

1) to develop and test the very first, mechanistic, hydrological-biogeochemical model framework for subglacial environments and, thus, provide novel analytic and predictive capabilities for assessing the consequences of ice sheet retreat

2) use the newly developed model to quantitatively identify the main hydrological and biogeochemical controls on subglacial carbon and nutrient export under different environmental conditions and over a melt season.