

# ARCTIC 2023 – PROJECTS SELECTED FOR IMPLEMENTATION

## NFIX: Response of Nitrogen Fixation Liches and Mosses to a Rapidly- Changing Arctic Environment

### PI, LEAD INSTITUTION

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### ABSTRACT

Arctic climate change is particularly alarming owing to the vulnerability of the wildlife and inhabitants that are dependent on a stable and predictable environment for their life and livelihoods. The IPCC suggested the terrestrial biosphere could store anywhere between 22-57% of expected carbon emissions by 2100, however this would require additional bioavailable nitrogen (N). We aim to characterize the main drivers of biological nitrogen fixation (BNF) and how they respond to environmental forcings to refine current climate models that forecast how climate change will affect Arctic ecosystems.

Our work aboard Le Commandant Charcot in the summer of 2023 will be part of a larger study to **address some of the outstanding questions that have hindered projections of how the Arctic environment will respond and adapt to climate change** by making the first measurements of Arctic terrestrial BNF with ARACAS, a state-of-the-art instrument developed in the Cassar Lab. Compared to traditional methods, ARACAS has 1000 times the sensitivity and a higher temporal resolution that allows continuous BNF measurements with time intervals on the order of seconds as opposed to hours or days.

We will build on our work from this coming summer and autumn (2022), which will collect and analyze in the laboratory lichens and bryophytes (cryptogams) from Arctic tundra habitats in Alaska, Canada, Greenland, Iceland and Norway. We will use the relationships we identify in the laboratory to guide our work aboard Le Commandant Charcot in 2023. We will take a Zodiac or helicopter to the shoreline of southeast Greenland and north Svalbard to collect cryptogam samples then measure their BNF rates using ARACAS in the Dry Lab aboard Le Commandant Charcot.

We will pair these measurements with other in-situ BNF measurements to test how the drivers of BNF express in natural environments. We then will upscale our measurements to develop new Arctic-wide BNF estimates, which will include **building a comprehensive BNF budget for the sites visited by Le Commandant Charcot during our cruise**. We will incorporate these estimates into new climate models to enhance our predictive ability about how Arctic environments will respond to climate change, which we will use to address the following **hypotheses: 1)** the effect on BNF from changing drivers of BNF varies as a function of specific cryptogam-associated diazotrophs, **2)**

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lichens and mosses are bioindicators of heavy metal pollution in both urban and industrial environments and **3)** drivers of BNF exhibit complex, nonlinear coupling.

We will write about our work in a format that is accessible to everyone. It is a privilege to work in Arctic environments, and we want to ensure the knowledge we learn from the fieldwork will benefit the scientific community and the inhabitants/stewards of these areas. Additionally, **we welcome the opportunity to teach guests aboard Le Commandant Charcot about our work through lectures in the onboard theater and demonstrations of ARACAS in the Dry Lab.** Furthermore, if there is interest, during some of the stops, guests could **participate in the sample collection to engage directly with hands-on research.**