Project acronym: N2 Fix 2

Project title: In-situ Nitrogen Fixation Measurements of Lichens and Mosses in a Rapidly Changing Arctic Environment

Project leader: Nicolas Cassar, Duke University, United States

Discipline: Earth Sciences & Environment: Ecosystems & Biodiversity

Station(s): UK Arctic Research Station (NERC Arctic Station) (Svalbard/UK)

We propose collecting lichen and moss (cryptogams) samples from field sites near the Greenland Institute of Natural Resources and the UK Arctic Research Station. After our preliminary field work, we will perform a series of laboratory experiments conducted in the Cassar Lab at Duke University to determine the drivers of terrestrial BNF. We will use Acetylene Reduction Assays by Cavity ring down laser Absorption Spectroscopy (ARACAS), a state-of-the-art instrument developed in our laboratory, to measure biological nitrogen fixation (BNF) rates of nitrogen-fixing bacteria and archaea (diazotrophs). ARACAS has a higher temporal resolution than traditional acetylene reduction assays (ARAs), which all previous polar nitrogen fixation studies have used. We first will characterize the microbial community of each moss and lichen sample using metagenomics and then identify the diazotrophs by the expression of the nifH genes (responsible for BNF) using metatranscriptomics with the help of the Lutzoni Lab at Duke University. We then will use the ARACAS to perform a sensitivity analysis by looking at their short-term kinetic response to environmental forcings such as temperature, moisture and light levels, as well as additions of phosphorus, vanadium, and molybdenum. For each diazotroph-cryptogam relationship, we will compare the effect on BNF and the response time for each forcing to samples collected from the same location, as well other field sites. We hope to identify complex, non-linear relationships among drivers of BNF using machine learning that have previously only been analyzed using linear regressions.