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Antarctic Snow Algae: Monitoring Blooms Using Optical Remote Sensing Combined with Field Spectroscopy

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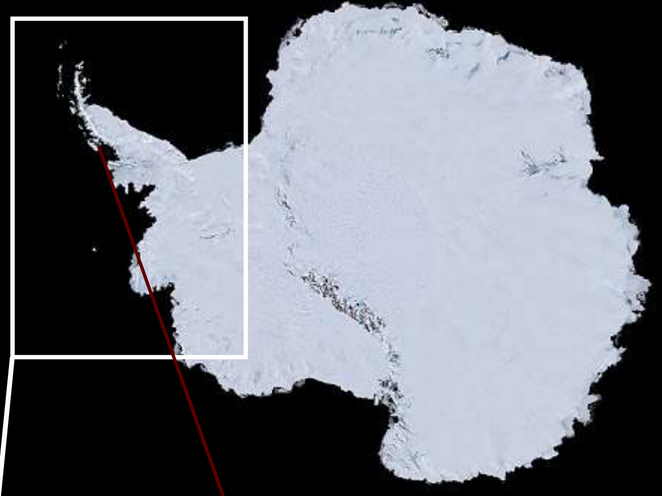
ABSTRACT Summer in Antarctica sees coastal snow fields turning green and then red with blooming snow algae (see right). Due to the inaccessibility of coastal Antarctica, little is known about the size, distribution, or seasonal development of this ecosystem. This poster presents the remote sensing work package of a project attempting to answer these important ecological questions. Field spectroscopy was used in combination with biophysical measurements, to define the spectral reflectance characteristics of snow algae in different growth phases. This information is used to supervise classification models using WorldView and Sentinel 2 imagery above our validation site. A citizen science survey was utilised to target areas for imagery acquisition based on documented presence of snow algal blooms.

INTRODUCTION In Antarctica, terrestrial life is able to flourish only in areas that are ice-free for at least part of the year, an estimated 0.18% of the continent's surface. Even here, estimates are that 1.34% of ice free land is covered by vegetation. This may be a gross underestimate of the true area, however, as ground-validation of satellite imagery has revealed that in many places the vegetation comprises not just patches of land plants on exposed ground, but also snow algae, which are often well developed in coastal regions. Little is known about these snow algae ecosystems, so we propose a remote sensing approach to constrain their area and seasonal development across the Antarctic Peninsula. This will help us to better understand their importance within tightly coupled Polar food chains, the global carbon cycle and in influencing snow and ice melt rates, as well as their importance as an Antarctic plant species.

AIMS AND OBJECTIVES Our project aims to determine the coverage and seasonal development of algal blooms across the Antarctica Peninsula. Our initial observations indicate that snow algae could be the largest terrestrial photosynthetic ecosystem in Antarctica.

SNOW ALGAE in its green phase, blooming on Adelaide Island, Antarctica. Biophysical Sampling

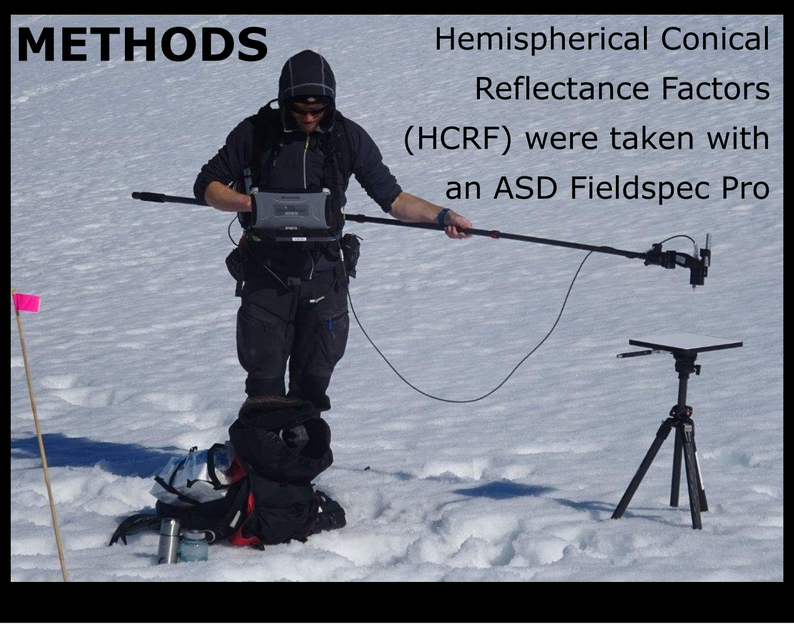
ANTARCTICA



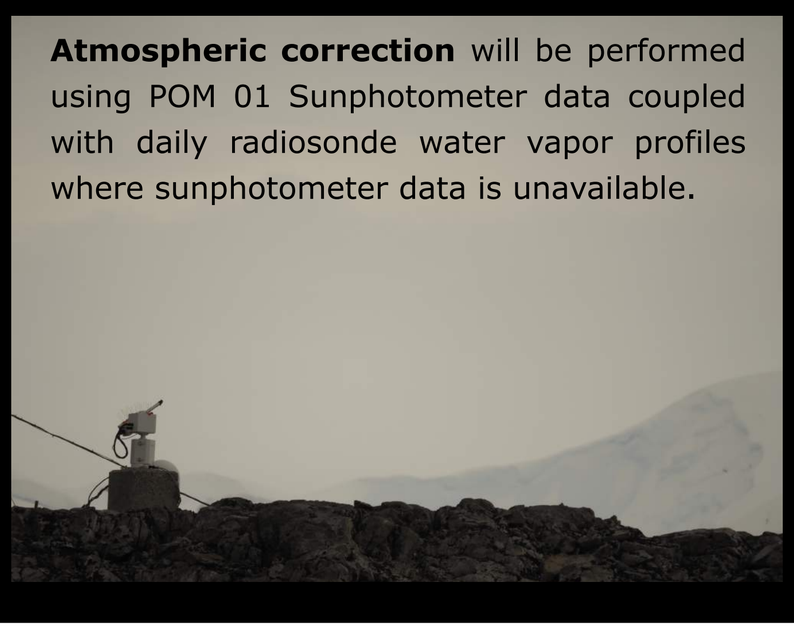
Adelaide Island, our ground validation site and home to Rothera Research Base

This box denotes the Antarctic Peninsula, which unlike the rest of Antarctica experiences large amounts of summer snow melt; potential habitat for snow algae. It is also the region undergoing the most rapid warming. Warmer temperatures could lead to a greening of inland snow and ice masses, lowering its albedo and accelerating melt.

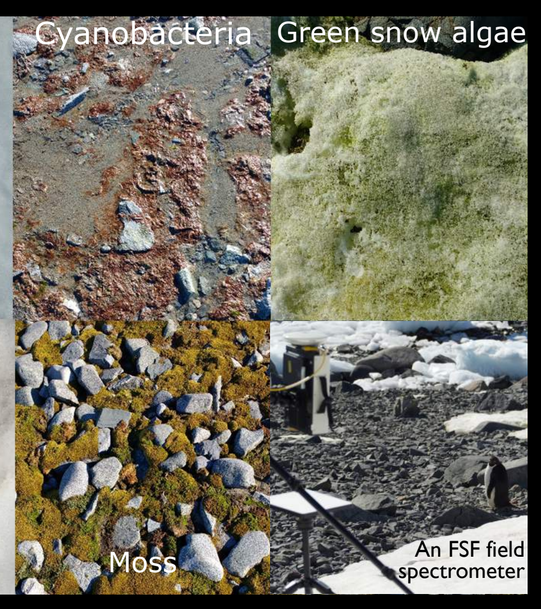
METHODS Hemispherical Conical Reflectance Factors (HCRF) were taken with an ASD Fieldspec Pro

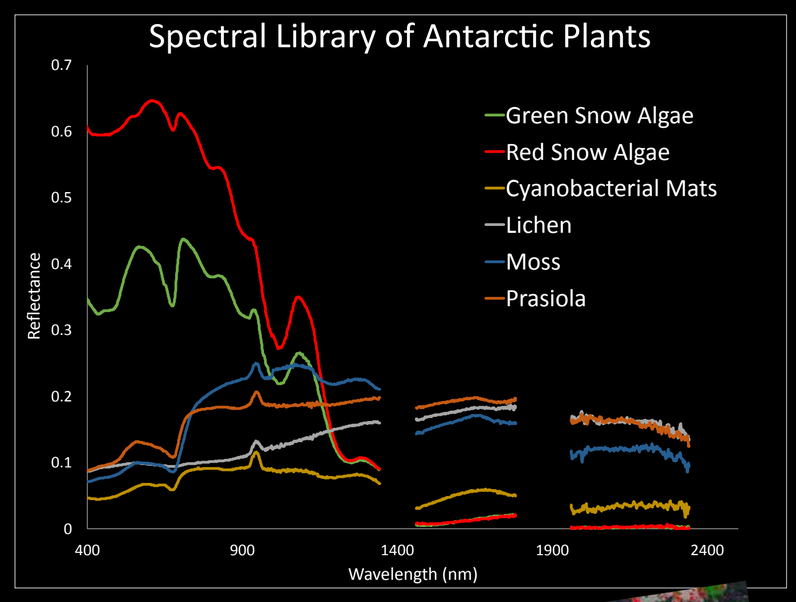


Atmospheric correction will be performed using POM 01 Sunphotometer data coupled with daily radiosonde water vapor profiles where sunphotometer data is unavailable.



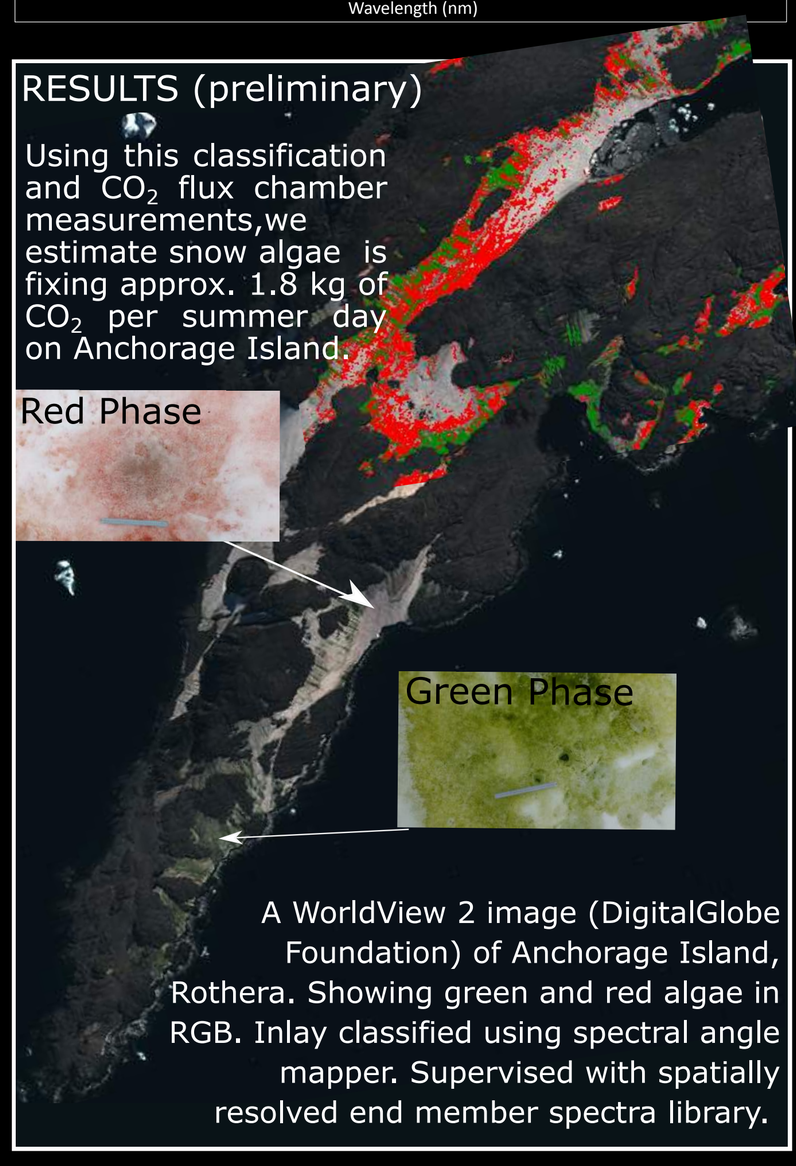
HCRF of each Antarctic plant species, white snow and local geology were used to create a spectral library





RESULTS (preliminary)

Using this classification and CO_2 flux chamber measurements,we estimate snow algae is fixing approx. 1.8 kg of CO_2 per summer day on Anchorage Island.



A WorldView 2 image (DigitalGlobe Foundation) of Anchorage Island, Rothera. Showing green and red algae in RGB. Inlay classified using spectral angle mapper. Supervised with spatially resolved end member spectra library.

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