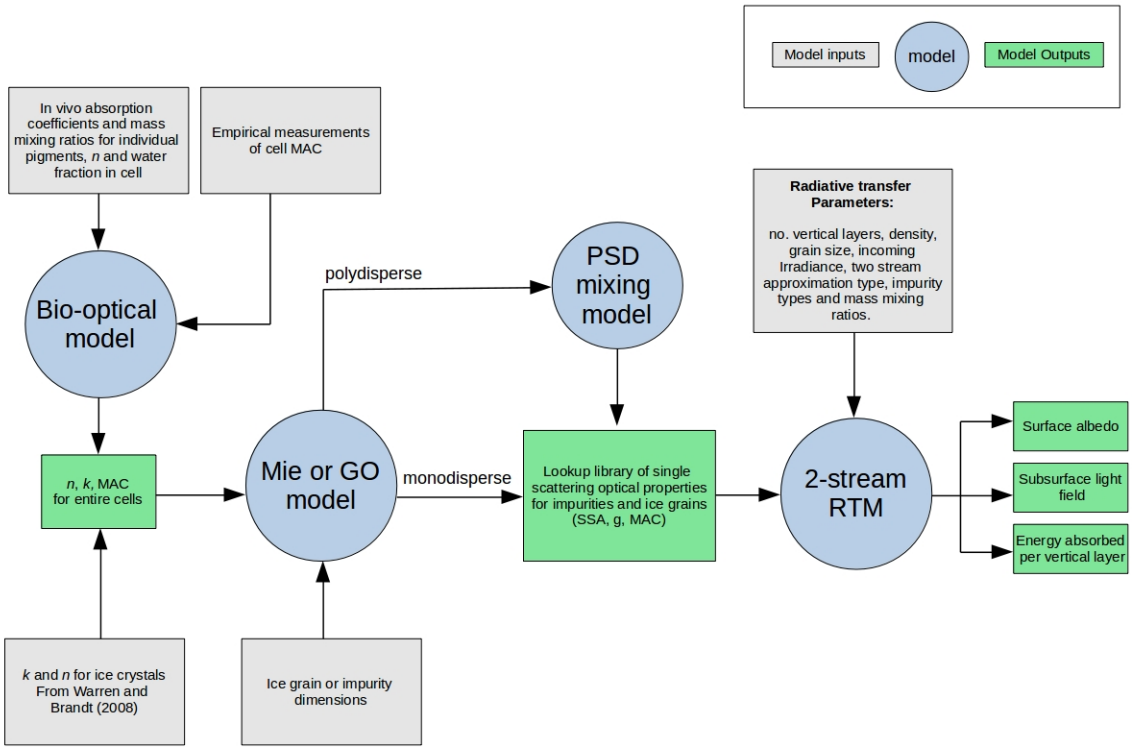
The Cryosphere

Cook et al. (2019): Glacier Algae accelerate melt rates on the south-western Greenland Ice Sheet

Revised Supplementary Information

S1: Schematic diagram of the BioSNICAR_GO model structure

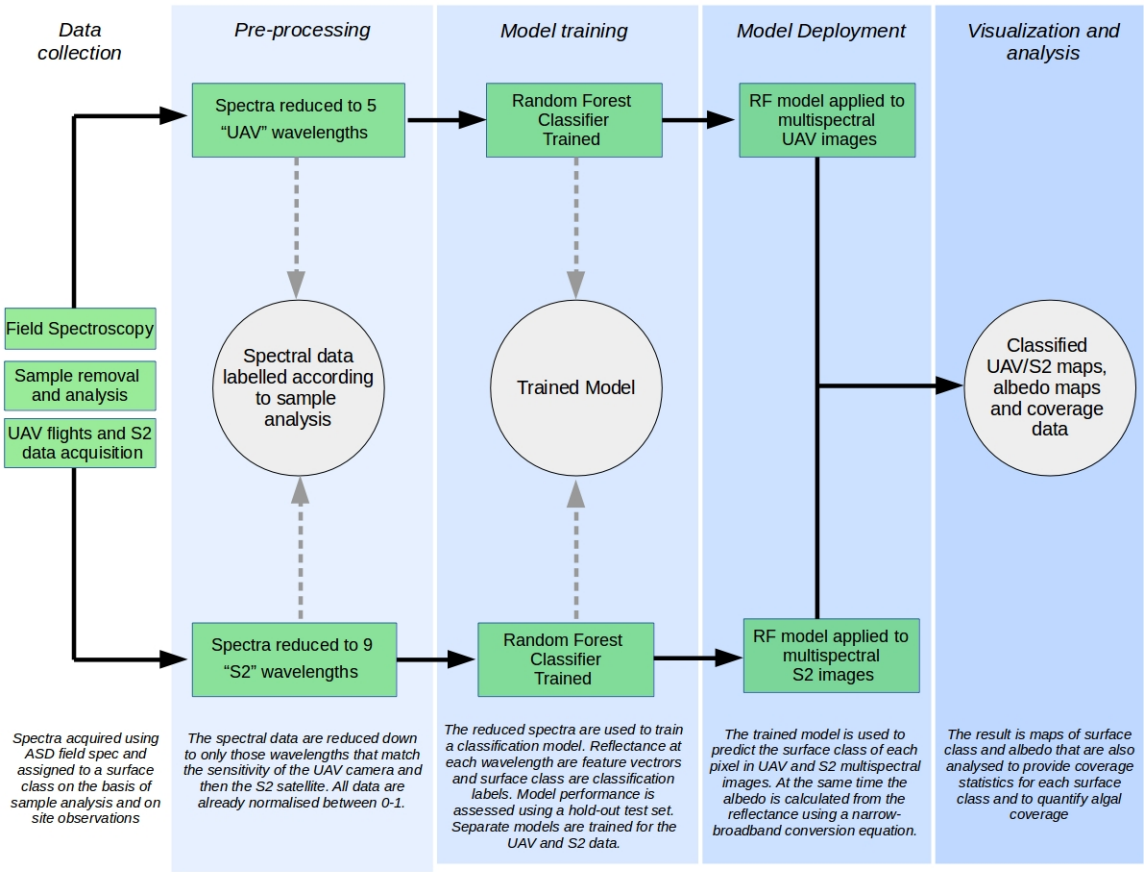


Supp Info 2: Mineral dust sampling and particle size distribution (PSD).

High algal biomass ice samples were collected in sterile sample bags and melted at ambient temperatures (5-10 °C). The thawed samples were filtered onto glass fiber filters (0.7 µm pore size), from which the solids were removed into a glass jar using a stainless steel spatula. In 50 mL centrifuge tubes, the samples were treated using 30% H_2O_2 (w/w) (Honeywell Fluka™) to remove the organic fraction. The samples (1-2 g) were sonicated (VWR ultrasonic cleaner) in 45 mL of the H_2O_2 treatment for 10 min to disaggregate the material. The samples were left in the H_2O_2 treatment for 48 h, after which they were centrifuged for 10 min at 4000 rpm (Eppendorf centrifuge 5810). The supernatant was removed, and the H_2O_2 solution was replaced. This process was repeated up to ten times until no more organic oxidation was observed. The remaining mineral fraction was washed three times in water (Sartorius arium® pro ultrapure water), with centrifugation after each wash.

A 5 mg of H_2O_2-treated sample was suspended in 10 mL of ultrapure water. The sample was sonicated to disaggregate the grains. The suspension was dispersed onto a 0.2 µm polycarbonate filter (Sartorius Track-Etch Membrane, 0.2 µm). Once dry, a section of each filter was adhered to a stainless steel SEM stub using an adhesive carbon tab. The sample was coated with 8 nm of Ir (Agar high resolution sputter coater). The PSD was determined using a Zeiss Ultra Plus field emission scanning electron microscope (FE-SEM) operated at 20 kV. Automated particle counting software was used to determine the PSD in an area of approximately 1 mm^2.

Supp Info 3: Schematic diagram of the classification method



Supp Info 4: A) Performance metrics for supervised classification algorithms on training data using five bands coincident with MicaSense Red-Edge multispectral imagery, plus the final model performance on the test set; B) Performance metrics for supervised classification algorithms on training data using eight bands coincident with Sentinel-2 multispectral imagery, plus the final model performance on the test set.

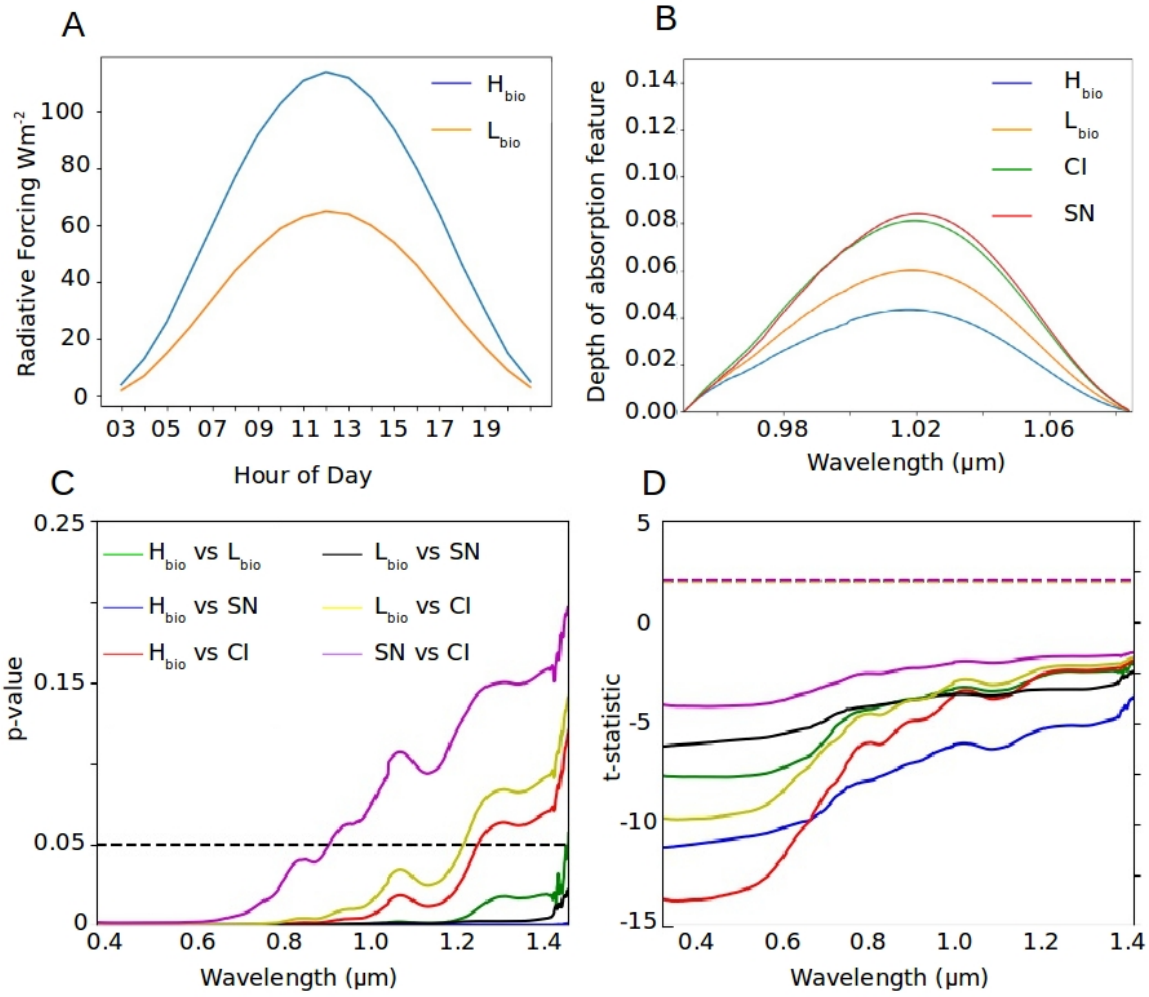
A:

Model	Accuracy	Precision	Recall	F1 Score
K-Nearest Neighbours	0.90	0.74	0.78	0.76
Naive-bayes	0.90	0.80	0.81	0.80
Support Vector Machine	0.94	0.89	0.87	0.88
Random Forest	0.99	0.99	0.95	0.97
Ensemble	0.92	0.76	0.81	0.78
RF performance on test set	**0.90**	**0.91**	**0.90**	**0.90**

B:

Model	Accuracy	Precision	Recall	F1 Score
K-Nearest Neighbours	0.89	0.90	0.89	0.87
Naive-bayes	0.89	0.89	0.89	0.89
Support Vector Machine	0.96	0.96	0.96	0.96
Random Forest	0.99	0.99	0.99	0.99
Ensemble	0.93	0.93	0.93	0.93
RF performance on test set	**0.92**	**0.93**	**0.92**	**0.93**

Supp Info 5: A) Hourly radiative forcing for H_{bio} and L_{bio} ice; B) Mea depth of absorption feature for H_{bio}, $L_{bio,}$ CI and SN sites; C) p-values for spectral Bonferroni-corrected t-tests for albedo between each surface class; D) t-statistics for spectral Bonferroni-corrected t-tests for albedo between each surface class.



Supp Info 6: Confusion matrices and normalised confusion matrices for the final RF model applied to UAV (A,B) and Sentinel-2 (C,D) multispectral data. Confusion matrices show predicted class on the y-axis and actual class on the x-axis. The score at the intersections shows the frequency of instances – i.e. higher scores along the top-left to bottom-right diagonal indicate a more accurate classifier.