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Metabolic profiles of glacial ice algal-dominated habitats across the western Greenland ice sheet.

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The microbiologically-driven darkening of bare ice surfaces on the western Greenland Ice Sheet is significantly enhancing melting, contributing to sea level rise. Among microorganisms, purple-brown pigmented glacial ice algae (mainly members of *Ancylonema alaskanum* and *Ancylonema nordenskiöldi*) are key contributors to the ice surface darkening and the associated surface albedo reduction. It is known that the glacial ice algae actively replicate and spread across vast ice surface areas during the summer melt season. However, the metabolic pathways driving the glacial ice algal bloom development are still poorly understood. To address this knowledge gap, we used an untargeted endometabolomics approach to explore the dynamics and metabolic potential of glacier ice algal blooms and the role of the environment on their metabolic responses. We analyzed glacial ice algae-dominated surface ice samples from various locations across the western Greenland Ice Sheet using high-resolution mass spectrometry to annotate the metabolome of the algae-dominated samples. Combined with physical and chemical environmental data describing their constantly changing habitat (e.g., temperature, light response, cell numbers) we derived novel insights into the metabolic activity of the glacial ice algae and their biochemical adaptations to glacier conditions. Our data contribute to improving our understanding of the link between ice darkening and microbial activity.