EGU23-13220, updated on 23 Apr 2024
https://doi.org/10.5194/egusphere-egu23-13220
EGU General Assembly 2023

Submarine melting of glaciers in Greenland amplified by atmospheric warming

Donald Slater[1] and Fiamma Straneo[2]
[1]University of Edinburgh, School of Geosciences, United Kingdom of Great Britain – England, Scotland, Wales (donald.slater@ed.ac.uk)
[2]Scripps Institution of Oceanography, University of California San Diego

The retreat and acceleration of Greenland's marine-terminating glaciers since the 1990s is responsible for approximately half of Greenland's sea level contribution over the same period. A warming ocean, and the associated increase in submarine melting of calving fronts, is understood to be the most likely driver of this retreat. Yet atmospheric variability can also affect submarine melting by modulating subglacial discharge, which plays a role in driving fjord circulation and enhancing the transfer of heat from ocean to ice. The relative importance of atmospheric and oceanic sources of variability in submarine melting have, however, not been quantified.

We use atmospheric and oceanic reanalyses to estimate submarine melt rate at Greenland's marine-terminating glaciers since 1979, finding that in southeast Greenland the ocean has driven the majority of variability in submarine melt, while in northwest Greenland it is the atmosphere that has played the greater role. A simple two-stage glacier model is then used to map submarine melting onto dynamic mass loss, suggesting that although submarine melting is intuitively an ocean process, a warming atmosphere has amplified the impact of the ocean on the Greenland ice sheet.