EGU24-5846, updated on 09 Dec 2024
https://doi.org/10.5194/egusphere-egu24-5846
EGU General Assembly 2024


# Nonlinear 21st century increase of Greenland Ice Sheet runoff into Disko Bay surface water recorded by long-lived coralline algae

**Steffen Hetzinger**[1], Jochen Halfar[2], and Alexandra Tsay[3]

[1]Institut für Geowissenschaften, CAU Kiel, Kiel, Germany (steffen.hetzinger@ifg.uni-kiel.de)
[2]Chemical and Physical Sciences Department, University of Toronto Mississauga, Mississauga, Canada (jochen.halfar@utoronto.ca)
[3]Department of Earth Sciences, University of Geneva, Geneva, Switzerland (Alexandra.Tsay@unige.ch)

Greenland is particularly vulnerable to ongoing anthropogenic climate change and observational data document recent rapid mass loss of many of the Greenland Ice Sheet (GIS) glaciers. Mass loss of the GIS represents a major contributor to global sea level rise, but uncertainties in future projections are large. A recent acceleration in mass loss has been observed, with 2012 and 2018/19 record years documented by direct observations. However, estimates of melt variability and glacier runoff remain uncertain before the satellite era and the influence on surface ocean waters is unclear. In general, available observational records from high latitudes are sparse and short. Models require high-resolution data of past variability to resolve how fast the GIS reacts to warming.

Past climate can be reconstructed from natural proxy archives. In high latitudes, however, most proxy time series utilised to date come from indirect land-based proxies. Calcified coralline algae are important shallow-marine calcifiers that grow attached to the seafloor and have emerged as subannual-resolution climate recorders for the extratropics. By analyzing long-lived coralline algae from Disko Bay, West-Greenland, in close proximity to Jakobshavn Glacier, we address this data gap. Jakobshavn Glacier is one of the largest glaciers in Greenland and the single largest source of mass loss from the GIS over the last 20 years. Sclerochronological analysis and ultra-high-resolution laser ablation ICP-MS data from calcified coralline algae (*Clathromorphum compactum*) provide seasonally-resolved records that capture the impact of surface temperature warming and glacier runoff on coastal Arctic environments. Algal Ba/Ca ratios track past glacier-derived meltwater input to the ocean surface layer and we report an unprecedented nonlinear increase in Jakobshavn glacier runoff into Disko Bay in the last 20 years. Our chronology from southern Disko Bay sites shows a distinct increasing trend from the early 2000s, recording the acceleration of GIS glacier mass loss and matching recent years of record amounts of ice loss in satellite data. The rate of increase in Ba/Ca (a runoff proxy) is unprecedented over at least the last 100 years, highlighting the rising influence of global warming on Arctic coastal ecosystems. The new algal chronology provides a long-term perspective on high-resolution variability in Jakobshavn Glacier runoff into Disko Bay, extending before observations, and confirming model data.