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Late 20th century increase in northern Svalbard glacier-derived runoff tracked by encrusting coralline algae

Steffen Hetzinger[1,2], Jochen Halfar[3], Zoltan Zajacz[4], Marco Möller[5,6], and Max Wisshak[7]

[1]Institut für Geologie, Universität Hamburg, Hamburg, Germany (steffen.hetzinger@uni-hamburg.de)
[2]GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Kiel, Germany
[3]CPS-Department, University of Toronto Mississauga, Mississauga, Canada
[4]Department of Earth Sciences, University of Geneva, Geneva, Switzerland
[5]Institute of Geography, University of Bremen, Bremen, Germany
[6]Geography Department, Humboldt-Universität zu Berlin, Berlin, Germany
[7]Senckenberg am Meer, Marine Research Department, Wilhelmshaven, Germany

The Arctic cryosphere is changing at a rapid pace due to global warming and the large-scale changes observed in the Arctic during the past decades exert a strong influence throughout the global climate system. The warming of Arctic surface air temperatures is more than twice as large as the global average over the last two decades and recent events indicate new extremes in the Arctic climate system, e.g. for the last five years Arctic annual surface air temperature exceeded that of any year since 1900 AD. Northern Spitsbergen, Svalbard, located in the High Arctic at 80°N, is a warming hotspot with an observed temperature rise of ~6°C over the last three decades indicating major global warming impacts. However, even the longest available datasets on Svalbard climatic conditions do not extend beyond the 1950s, inhibiting the study of long-term natural variability before anthropogenic influence. Ongoing climate trends strongly affect the state of both glaciers and seasonal snow in Svalbard. Modeled data suggest a marked increase in glacier runoff during recent decades in northern Svalbard. However, observational data are sparse and short and the potential effects on the surface ocean are unclear.
This study focuses on the ultra-high-resolution analysis of calcified coralline algal buildups growing attached to the shallow seafloor along Arctic coastlines. Analysis of these new annually-layered climate archives is based on the long-lived encrusting coralline algae *Clathromorphum compactum*, providing a historic perspective on recently observed changes. Here, we present a 200-year record of past surface ocean variability from Mosselbukta, Spitsbergen, northern Svalbard. By using algal Ba/Ca ratios as a proxy for past glacier-derived meltwater input, we investigate past multi-decadal-scale fluctuations in land-based freshwater contributions to the ocean surface layer. Our records, based on multiple coralline algal specimens, show a strong and statistically significant increasing trend in algal Ba/Ca ratios from the 1990s onwards, suggesting a drastic increase in land-based runoff at Mosselbukta. The drastic rate of increase is unprecedented during the last two centuries, directly capturing the impact of amplified surface air temperature warming on coastal high Arctic surface ocean environments.