

Land-Coast-Ocean Interaction in the melting cryosphere

The following factsheet presents the joint results, research gaps and priorities identified by the H2020-funded ECOTIP, FACE-IT, and CHARTER projects on Arctic biodiversity changes on land, coasts and in the ocean.

The thawing cryosphere is projected to have cascading consequences across the interlinked Arctic inland-coast-sea continuum. As sea ice is lost, physical interfaces shift, exposing previously sheltered coastal areas to more wave action and erosion. When glaciers retreat and terminate on land instead of at sea, the amount of meltwater increases, affecting turbidity, nutrient fluxes, salinity, and light availability. Climate change impacts in these landscapes also deeply affect local Arctic communities whose livelihoods depend upon this habitat continuum.

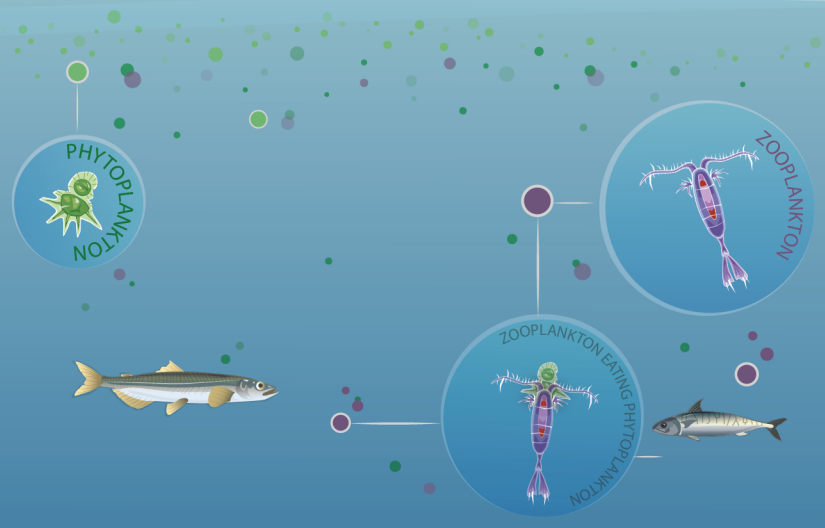
Rain on snow

Greening

- Created the Holocene Arctic Biodiversity Indicators Database (HABID) - a comprehensive, open-access resource with over 1,000 sites which defines the processes of Arctic change over centuries.
- Satellite imagery and AI were used to develop a new Rain-On-Snow dataset - makes studying the impacts of winter rains easier
- Drone monitoring was used to assess vegetation sensitivity and the magnitude of the effects of reindeer on vegetation and soil processes was assessed.
- Due to high trampling, lichens have declined the most in areas where reindeer graze during the summer.
- Warmer summers mean trees and shrubs are growing taller in situ (adding biomass), as well as expanding northward, a phenomenon known as "Arctic greening".
- More "icing events" (Rain-on-Snow and freeze-thaw events) in late autumn/early spring prevent reindeer from accessing forage, sometimes with fatal results.
- Retreat and loss of marine-terminating glaciers reduces the beneficial upwelling of nutrients in the sea.
- Terrestrial meltwater run-off intensifies sediment discharge and may introduce pollutants such as heavy metals or microplastics into adjacent fjord systems, which bioaccumulate in aquatic species, posing risks to fisheries and human health.

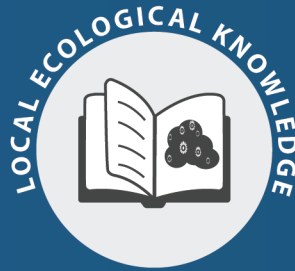
- Loss of tidewater glaciers threatens the exchange of bottom water in the fjords, which serves as an important heat source in winter for the open ocean, helping to regulate ocean temperatures and circulation patterns.

- Freshwater runoff stratifies the water column, impacting phytoplankton community composition and magnitude of the spring bloom.
- Sediments from SW Greenland/Kaalallit Nunaat indicate marine productivity in the study fjord is the highest it has been in over a century, and ongoing mass loss may continue to promote high productivity at sites close to other marine terminating glaciers.



- A well-dated marine sediment record from NE Greenland/Kalaallit Nunaat showed that >70–84% of the organic carbon preserved in the study fjord originates from land.

RESEARCH GAPS



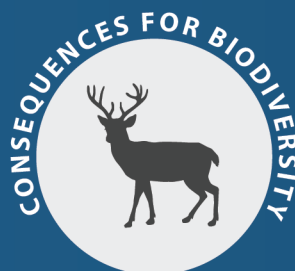
How can we integrate Local Ecological Knowledge and establish meaningful interactions between local communities and climate modelers? How do we incorporate end-user wants and needs during the planning phase? How do we facilitate mapping and weather predictions at locally-relevant spatial and temporal scales?



What are the effects of glaciers changing from marine- to land-terminating, on plankton productivity and community structure at the landscape level? What are the cascading effects to higher trophic levels?



What are the qualitative and quantitative aspects of pollutant transfer from land to sea? And what is the bioaccumulation along food web cascades?



What are the climate change consequences for biodiversity beyond the few emblematic (e.g., polar bear) and commercially harvested (e.g., Atlantic cod) species?



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CHARTER