# Black carbon in Arctic snow and sea ice: The big picture through the details

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## Overview

Model studies have indicated that black carbon (BC) in snow and sea ice may be producing significant warming in the Arctic and contributing to accelerated sea ice loss. All of these studies indicate that even small concentrations of BC may lead to large climate forcing because positive feedbacks, such as the snow albedo feedback, amplify the initial forcing. However, the magnitude of the forcing reported by different studies varies.

This talk will review our current state of knowledge regarding climate forcing by BC in Arctic snow and sea ice. The range of modeled estimates to date will be presented and reasons for differences between them explored. A recent Arctic-wide measurement study of snow and ice (BC) concentrations and sources will also be presented. This data set can be used to test modeled transport, deposition and in-snow concentration changes. However, the climate impact of BC in the cryosphere also depends strongly other factors such as snow cover, baseline snowpack radiative properties, cloud cover, in-snow redistribution of black carbon, and the presence of other light absorbing constituents. I will review what we know and what we still need to explore in order to understand whether black carbon is making a significant contribution to recent Arctic warming.

# Benthic $\delta^{18}O$ signature of dense brine from sea ice formation in the North Atlantic

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## Abstract

Sea ice is thought to be an important factor for explaining abrupt North Atlantic climate changes during the last ice age. Reconstructing past variations in sea ice cover remains a challenge, in large part because of the complicated and indirect relationships between sea ice proxy indicators and actual sea ice conditions. One approach is to use the idea that the isotopic signature of dense brines produced via salt rejection during the formation of sea ice may be detected in benthic foraminifera records [1]. Brine formation is an active process in the Arctic and Antarctic shelf regions today [2], [3], [4]. In the Southern Ocean in particular, large quantities of dense brines are generated in polynyas and contribute an isotopically light $d^{18}O$ signature to Antarctic Bottom Water [5]. To date, it has been unclear whether North Atlantic and Arctic brines formed from isotopically light surface waters can become dense enough to penetrate to the depth habitats of benthic foraminifera. Storfjorden, located in the southeastern Svalbard Archipelago, is a site of active winter brine formation due to a recurrent polynya. Each winter, dense, brine-enriched waters fill the depressions of the fjord to its sill level and subsequently descend as a gravity current following the bathymetry towards the shelf break [6]. Observations from a September 2000 cruise reveal the presence of cold, salty, brine-enriched seawater sitting in the deepest channels (> 100 m depths) of Storfjorden, with isotopically light $d^{18}O$ values corresponding to the $d^{18}O$ values of the surface water in the region. These results are useful in better characterizing the signature of brine-enriched seawater and brine formation processes, and suggest a way forward for reconstructing sea ice variability from paleoclimate records.

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