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Evaluating the role of Atlantic Water advection to the Arctic Ocean on geological, historical, and observational timescales

Recent observations of enhanced oceanic heat transfer into the Arctic concomitant with the rapid sea-ice decrease temptingly suggest a direct relationship between both features. However, except for marginal areas of the Arctic Ocean where warm and saline Atlantic Water (AW) reaches the surface, the majority of AW heat is presently isolated from the sea-ice cover by a cold and fresh halocline layer. No evidence has been found to suggest a weakening of the halocline across the central Arctic basins that would enhance the AW heat transfer to the surface. A more direct link between sea-ice reduction and AW inflow is, however, seen in the inflowing Barents Sea branch in both historical and observational time series. In this presentation the AW advection into the Arctic Ocean and its influence on sea-ice variability will be reviewed from a geological point of view. Records from the geologic past are of great value as the time span of modern observations and historical data is often too short to comprehend long-term trends and causes of AW variability, changes in the marginal ice zone, and the vertical structure of the Arctic water column. Paleoceanographic studies from the recent interglacial indirectly suggest that the strength of AW advection and its propagation into the Arctic interior is effective in melting sea ice in combination with other factors such as insolation, sea level, freshwater input, and upper water mass stratification. However, to date, very little paleoceanographic work in the Arctic has focused on how the strength and position of the halocline has changed during previous interglacial periods. More direct reconstructions of the Arctic's vertical stratification in the geologic past are needed to provide a longer-term view on the stability of the halocline, and more generally, the role of Atlantic Water inflow on the stability of sea ice in the interior basins.