The Great Salinity Anomaly: A View from The Barents Sea

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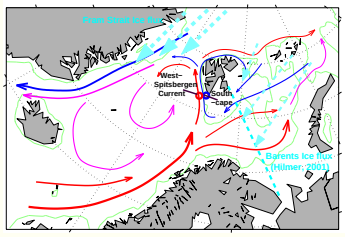
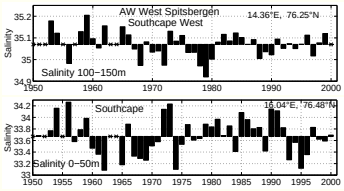
1 West of Spitsbergen

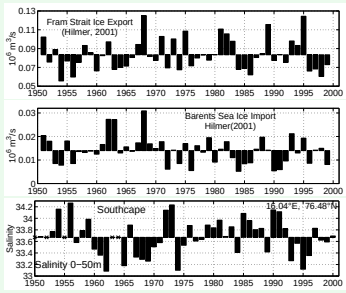




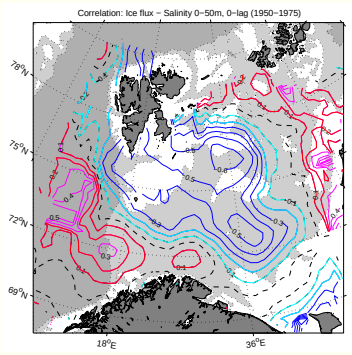
When considering the timing of the Great Salinity Anomaly (GSA, Dickson etal., 1988) in the Nordic Seas the waters west of Spitsbergen are especially interesting. Here a sharp front seperates the fresh coastal waters from the warm saline Atlantic Water. Longterm series that have been derived from a large database highlight the difference between the upper 0-50 m salinity from Southcape, and the 100-150 m salinity in the Atlantic Core 50 km to the west. The Southcape salinity shows a minimum in the early 1960s, while the Atlantic Core shows the most prominent minimum in 1978/79,which has been interpreted as the return of the GSA from the North Atlantic.

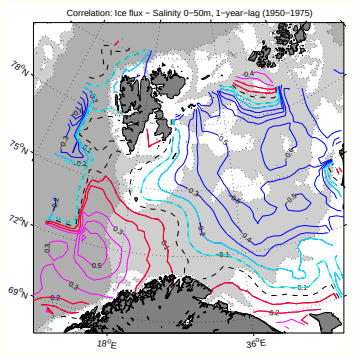
3 GSA Initiation and Barents Sea Ice Flux

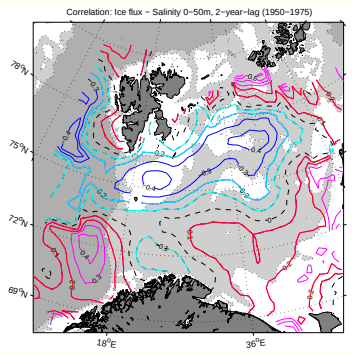
Hilmer(2001) has pointed out that during the 1960s the extreme southwestward ice flux from the Arctic Ocean to the Barents Sea was comparable to the ice export through Fram Strait. The correspondence of the extreme fresh water fluxes 1962/63 with the upper salinity timeseries from Southcape is not singular, the correlation coefficient of the series being -0.52.



5 Correlation for 1950-1975



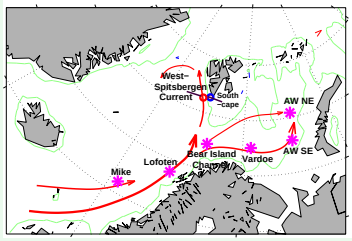


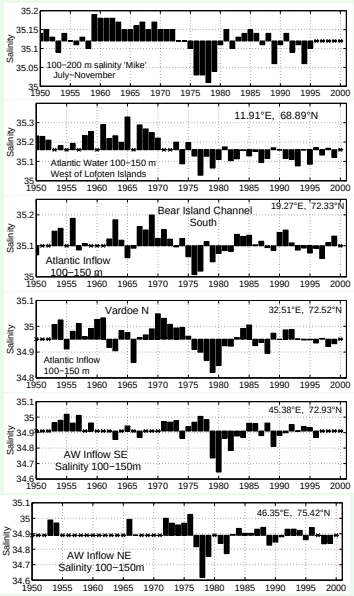


When correlating the upper salinity fields with the ice flux for the period 1950-1975 the response of the surface salinity is stronger indicating the dominance of the signal from the 1960s. A further remarkable feature is that the fresh water fluxes in the Northwestern Barents Sea during this period occured, when the West Spitsbergen Current and Norwegian Sea was much more saline, confirming on a larger scale the finding from the timeseries west of Spitsbergen.

The lagged correlation also shows that the signal does not decay after one and two years, yet the freshening extends to the Norwegian and Greenland Seas. There seems to be a stronger interaction of the Barents Sea and the GIN Sea upper layers under these conditions. If this interaction takes place via the ygre eddy ion the northern Greenland Sea or via a smallscale eddy west of Bear Island that is apparent from surface drifter data, is an interesting question concerning the timescale of signal propagation.

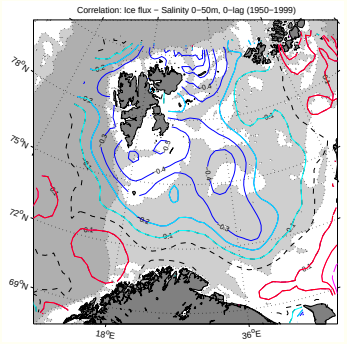
2 GSA Return: Advection from the North Atlantic

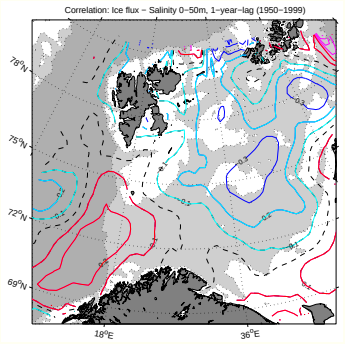




Looking at the advective signal the high quality data from weathership 'Mike' show a broad minimum in the 100-200 m averaged salinity from 1976 to 1979. The timing of the signal in the Atlantic inflow to the Barents Sea shows its arrival 1976/77 in Bear Island Channel, and from there two modes of signal propagation: a fast one along the northern inflow branch that appears in the Northeast one year later, and a slow one that reaches the eastern Barents Sea along the southern branch in 1980. The signal is the striking salinity anomaly in the Atlantic Water of the Barents Sea during the past 50 years.

4 Correlation of Upper Salinity and Barents Ice flux 1950-1999

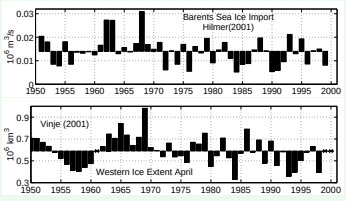




Correlation fields of upper salinity series and the southwestward iceflux show high correlations in the Northwestern Barents Sea for the period 1950-1999. West of Svalbard the signals appear to be limited to the coastal regime and with a lag of 1 year the salinity signal has decayed in the west.

6 Ice cover

The ice coverage in the Western Arctic sector (Vinje,2001) rises simultaneously with the maximum ice fluxes to the Barents Sea. Fram Strait ice fluxes, see section 3 above, do not show such a relationare to the ice cover increase.



If the unique Barents fresh water fluxes from 1962/63 were responsible for the formation of a high stability surface layer in the GIN Seas, promoting an ice cover advance and the later GSA in 1968, this might explain why in recent years of large Fram Strait fluxes no second GSA evolved.

References: 1.*Dickson, R., Meincke, J., Malmberg, S. and Lee, A. J.* (1988): The "Great Salinity Anomaly" in the northern North Atlantic 1968-1982. Progr. Oceanog. 20, 103-151. 2.*Golubev, V. A. and Zuyev, A. N.* 1999: Barents and Kara Seas Oceanographic Data Base (BarKode). ACSYS IACPO Report No. 5, ed. C. Oelke, Tromsø, Norway. 3.*Hilmer, M.* (2001): A model study of Arctic sea ice variability. Ph. d. thesis, Institut fr Meereskunde, Universitat Kiel. 4.*Vinje, T.* (2001): Anomalies and trends of sea-ice extent and atmospheric circulation in the Nordic Seas during the period 1864-1998. J. Climate 14, 255-267.

Aknowledgements: The database utilized was compiled from BarKode (Golubev and Zuyev 1999) enhanced by 43,000 profiles provided by the Institute of Marine Research Norway (IMR) and about 3,000 profiles from VEINS (Variability and Exchange in the Nordic Seas) and the initial phase of NOClim (Norwegian Ocean Climate program). I thank Torgny Vinje for providing the ice extent data.