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Report on hydrographic conditions off Southwest Greenland June/July 2014

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Abstract

Hydrographic conditions were monitored at 10 hydrographic standard sections in June/July 2014 across the continental shelf off West Greenland. Two offshore stations have been chosen to document changes in hydrographic conditions off Southwest Greenland. Both the coastal water and subpolar mode water showed properties above the long-term mean in the area south of the Sisimiut section.

Introduction

The West Greenland Current carries water northward along the West Greenland continental slope and consists of three components: a cold, fresh and surface near inshore surface component referred to as Coastal Water (CW), a saltier, warmer and deeper offshore component referred to as Subpolar Mode Water (SPMW) and freshwater runoff from Greenland. The West Greenland Current is part of the cyclonic Subpolar Gyre and thus subject to hydrographic variations at different time-scales associated with variability of the gyre, local and regional atmospheric conditions. Hydrographic conditions are monitored at 10 hydrographic sections in June/July across the continental shelf off West Greenland (Figure 1). Two offshore stations have been chosen to document changes in hydrographic conditions off Southwest Greenland.

Materials and Methods

The 2014 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard RV Paamiut during the period 11 June to 3 July and onboard the Danish naval ship Tulugaq during the period 26 June to 7 July 2014. Observations were carried out on the following standard stations (Figure 1):

RV Paamiut sections:

Sisimiut (Holsteinsborg) St. 1–5

Aasiaat (Egedesminde) St. 1–7

Kangerluk (Disko fjord) St. 1–4

Nuussuaq St. 1–5

Upernavik St. 1–5

Tulugaq sections:

Cape Farwell St. 2-3
 Cape Desolation St. 1-5
 Paamiut St. 1-5
 Fyllas Banke St. 1-4
 Maniitsoq St. 1-5
 Sisimiut St. 0-5

Hydrographic data were collected by a SBE25plus onboard RV Paamiut whereas it was collect by a SBE19plus onboard Tulugaq. During the Tulugaq survey measurements were limited to the upper 600 m due to winch limitations. The instruments were respectively pre and post cruise calibrated by the manufacturer. The collected data were interpolated to a 1 m grid in the vertical. If data were missing at the top of a profile, we assumed constant properties from the first measurement (normally 2 m) up to the surface. Due to weather and ice conditions only 2 of 5 standard stations were occupied on the Cape Farwell section.

Results and Discussion

West Greenland usually experiences warmer-than typical conditions when the North Atlantic Oscillation (NAO) index is negative and the highest annual mean air temperature ever reported for Nuuk occurred in 2010. In 2014, the winter NAO (DJFM) index was strongly positive (3.10), yet the annual mean air temperature at the Nuuk weather station was -0.6°C in 2014, 0.8°C above the long-term mean (1981-2010), which is similar to the previous 3 years.

Average water properties between a depth of 0 and 50 m at Fyllas Banke Station 4 (FB4) in June/July are used to monitor the variability of the Coastal Water (CW) component of the West Greenland Current (Figure 2). After a positive temperature trend between 2009 and 2013 the temperature in 2014 experienced a smaller drop; however, the temperature of this water mass was still 0.76°C higher than the long-term mean (1981–2010). The salinity of the Coastal Water continued its positive trend which started around 1970. In 2014 salinity was 0.22 above its long-term mean.

Temperature and salinity of the SPMW component of the West Greenland Current started to increase towards the end of the 1990s (Figure 3), coinciding with changes in the Subpolar Gyre where warm and saline water from the Subtropical Gyre entered the Subpolar Gyre. In the beginning of July 2014, water temperature in the 75–200 m layer at Kap Desolation Station 3 (KD3) was 5.41°C and salinity was 34.89, i.e. 0.76°C and 0.01 above the long-term mean (1992-2010)

Subpolar Mode Water (SPMW), by other referred to as Atlantic Water or Irminger Sea Water, with salinity greater than 34.95 was not present at the west coast off Greenland in June/July 2014 (Figure 4). Waters with salinities in the range 34.88 to 34.95 could be followed from the Cape Farwell section in the south (60°N) to the Sisimiut section in the north at 67°N . North of the Sisimiut section the SPMW core becomes gradually colder and fresher with distance. Core properties of the SPMW at Upernavik ($\sim 73^{\circ}\text{N}$) were 3.17°C and 34.57 for potential temperature and salinity respectively.

The highest temperature observed at the west coast off Greenland during the measuring campaigns in June/July 2014 was observed at the Cape Desolation section in the subsurface upper SPMW (uSPMW) mass. This water mass is associated with the subduction processes which happens in the area around Cape Farwell when SPMW leaves the Irminger Sea and enters the Labrador Sea.

The lowest temperature observed at the west coast off Greenland during the measuring campaigns in June/July 2014 was observed north of the Sisimiut section and was associated with Baffin Bay Polar Water (BBPW).

Acknowledgements

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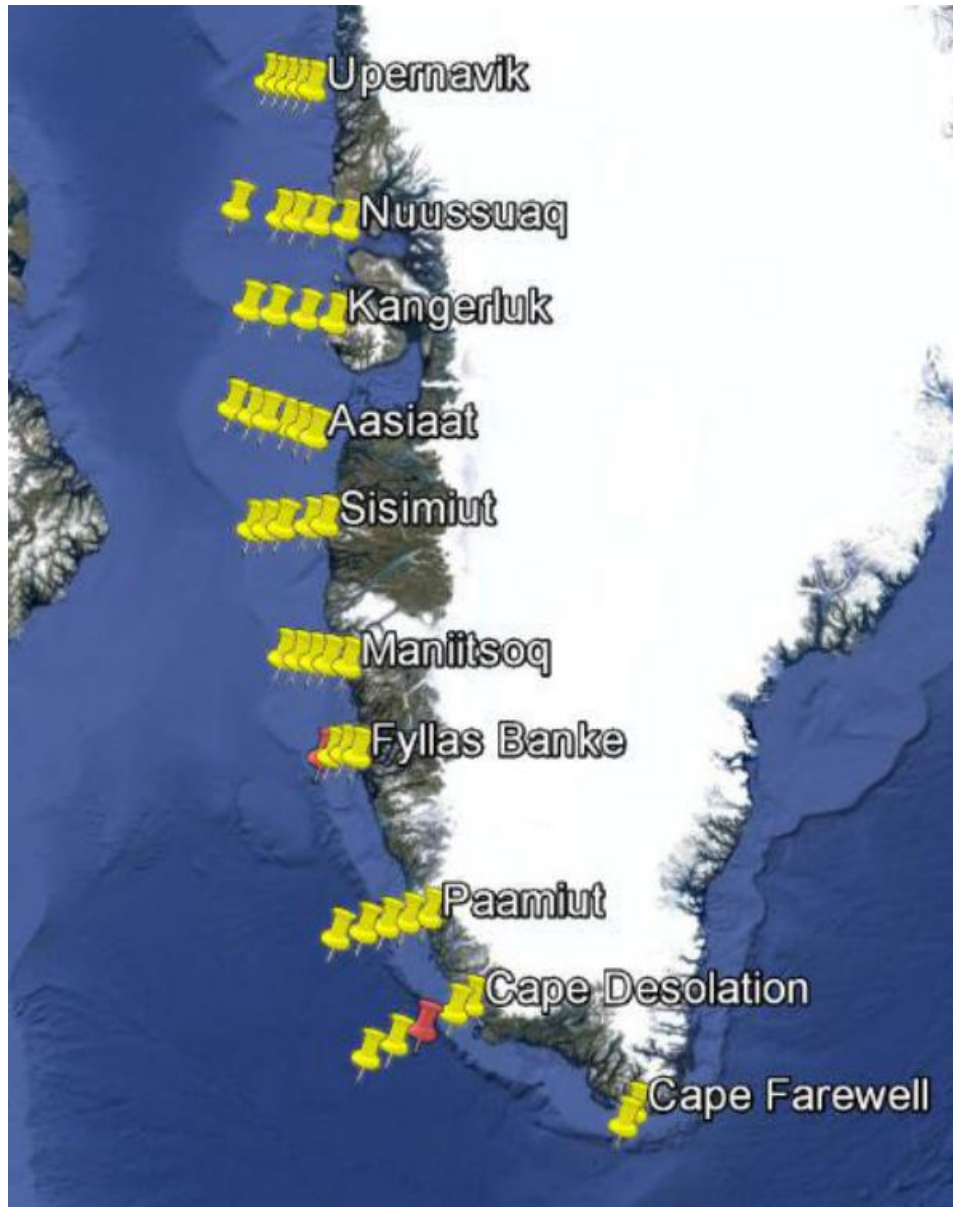


Figure 1. Position of the hydrographic stations occupied off West Greenland during two cruises in June/July 2014. FB4 and KD3 discussed in the text are indicated by red.

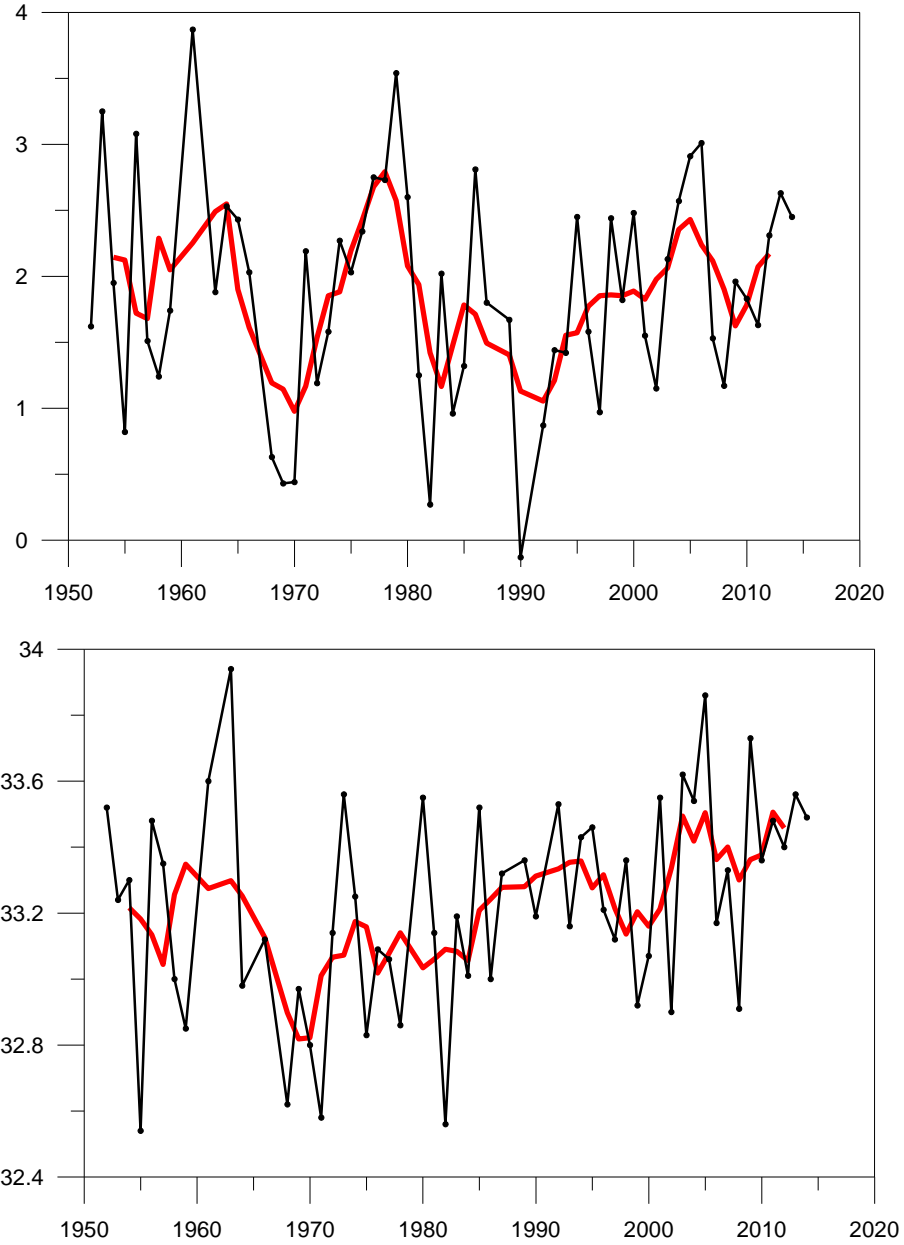


Figure 2. Time series of mean potential temperature (top) and salinity (bottom) from the Fyllas Banke continental slope (station 4, 0–50 m) with measurements in June/July for the period 1952–2014. The red curves are 5 year running mean.

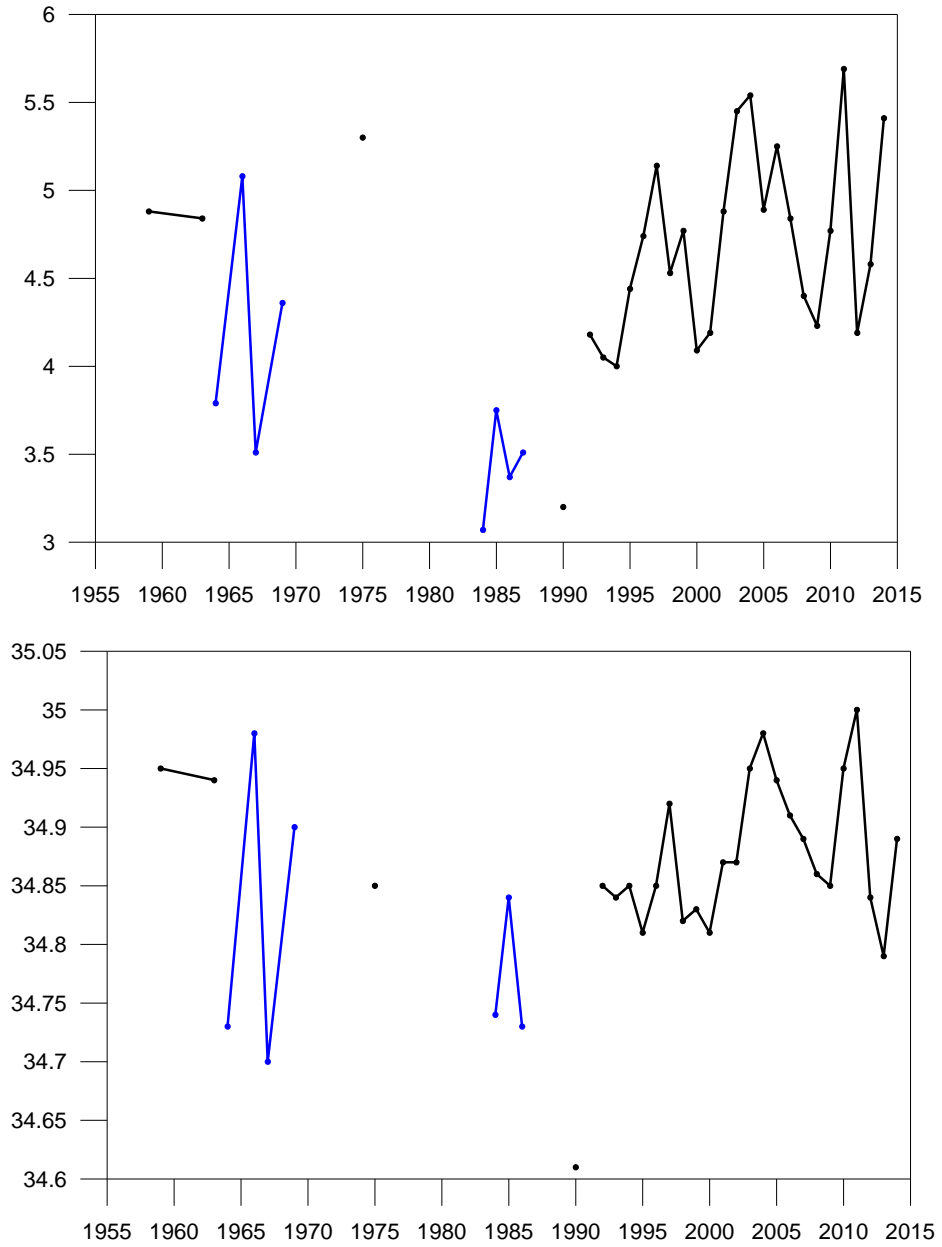


Figure 3. Mean potential temperature (upper) and salinity (lower) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2014. Blue colors indicate observations obtained early in April.

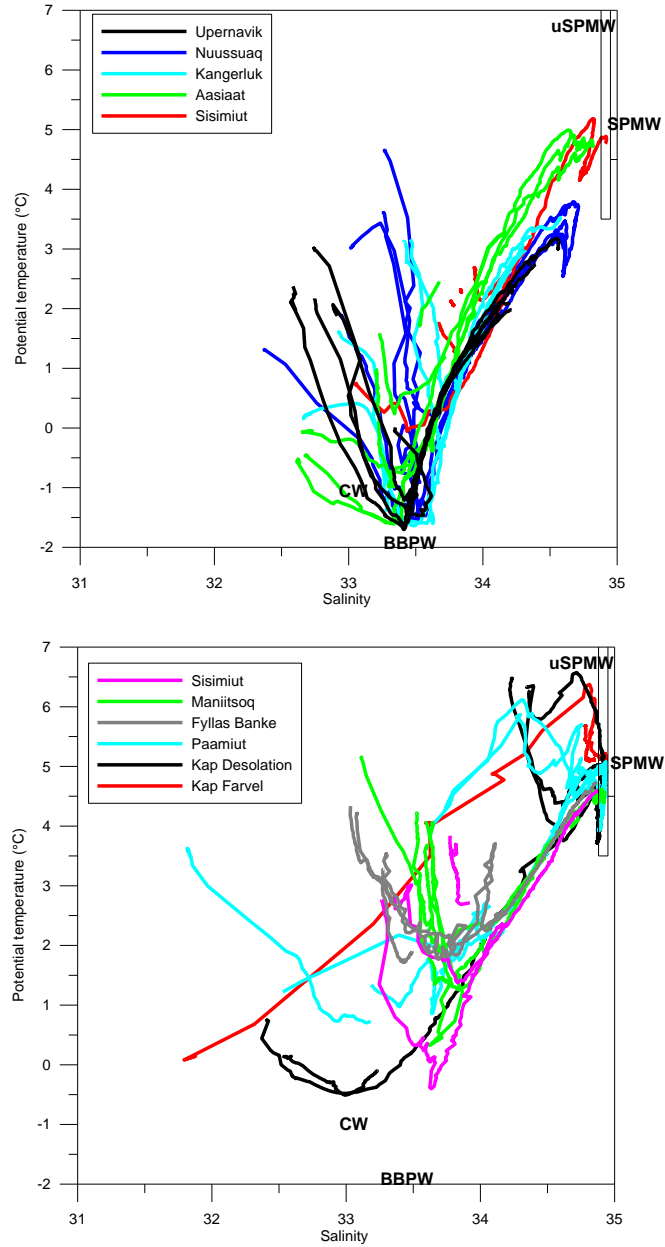


Figure 4. Potential temperature - salinity diagrams showing every station occupied along the West Greenland continental shelf and slope during the June/July GINR surveys in 2014. Stations are color coded with respect sections (see Figure legends and Figure 1). Also indicated are water masses meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).