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Report on hydrographic conditions off Southwest Greenland June 2015

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Abstract

Hydrographic conditions were monitored at 8 of 10 hydrographic standard sections in June 2015 across the continental shelf off West Greenland. The two southernmost standard sections were not occupied due to a string of low-pressure systems passing through the Cape Farewell area. Two of three offshore stations have been chosen to document changes in hydrographic conditions off Southwest Greenland. The coastal water showed temperatures below the long-term mean in the area south of the Sisimiut section. The lack of the Cape Desolation stations makes it difficult to state if the same tendency was observed in the subpolar mode water mass, though neighboring sections showed temperatures below those observed in 2014.

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). Three offshore stations have been chosen to document changes in hydrographic conditions off Southwest Greenland.

Materials and Methods

The 2015 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard RV Paamiut during the period 3 June to 25 June and onboard the Danish naval ship Tulugaq during the period 10 June to 23 June 2015. Observations were carried out on the following standard stations (Figure 1):

RV Paamiut sections:

Sisimiut (Holsteinsborg) St. 1–5
Aasiaat (Egedesminde) St. 1–5
Kangerluk (Disko fjord) St. 1–3
Nuussuaq St. 1–4
Upernavik St. 1–4

Tulugaq sections:

Paamiut St. 1-4
Fyllas Banke St. 1-4
Maniitsoq St. 1-5
Sisimiut St. 0-5

This year, station occupations were hampered by sea ice to the north and a string of low-pressure systems passing the Cape Farewell area to the south.

Hydrographic data were collected by a SBE 25plus onboard RV Paamiut, whereas it was collected by a SBE 19plus 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 averaged to 1 m vertical bins. 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.

Results and Discussion

West Greenland usually experiences warmer than typical conditions when the North Atlantic Oscillation (NAO) index is negative. The highest annual mean air temperature ever reported for Nuuk occurred in 2010 with a strongly negative NAO. In 2015, the winter NAO (DJFM) index was strongly positive (3.56). This was reflected in the annual mean air temperature at the Nuuk weather station in 2015 (-2.8°C), which was 1.4°C below the long-term mean (1981-2010), and colder than the previous 4 years (Cappelen, 2016).

Average water properties between 0 and 50 m depth 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 2014, the temperature in 2015 experienced a significant drop to levels which have not been observed since the early 1990´s; with temperatures 0.84°C lower than the long-term mean (1981–2010, T_{mean}=1.69°C). Conversely, the salinity of the CW continued its positive trend, which started around 1970. In 2015 salinity was 0.29 above its long-term mean (S_{mean}=33.27).

Average water properties between a depth of 0 and 40 m at Fyllas Banke Station 2 (FB2) in June/July have previously been used to monitor the variability of the sea surface off West Greenland (Figure 3). Though the two stations (FB2 and FB4) should tell the same story, they do not. After a negative temperature trend between 2005 and 2014, the temperature in 2015 experienced a significant drop to levels which have not been observed since the early 1990´s; with temperatures 0.80°C lower than the long-term mean (1981–2010, T_{mean}=1.90°C). The salinity of the sea surface continued its slightly negative trend, which started around 1970. In 2015, salinity was 0.15 above its long-term mean (S_{mean}=33.42).

Temperature and salinity of the SPMW component of the West Greenland Current started to increase towards the end of the 1990s (Figure 4), 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 Cape 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) respectively. Note that KD3 was not occupied in 2015 due to weather.

Subpolar Mode Water (SPMW referred to by others as Atlantic Water or Irminger Sea Water and with salinity greater than 34.95, was observed at a single station on the Paamiut section off the west coast off Greenland in June 2015 (Figure 5). Waters with salinities in the range 34.88 to 34.95 could be followed from the Paamiut section in the south (62°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 section (~73°N) could not be established 2015 due to the lack of the deep station Upernavik 5. Instead, at 264 m depth at Upernavik station 4, potential temperature and salinity were 2.86°C and 34.36 in 2015; compared with 2.57°C and 34.33 in 2014 respectively.

The highest temperature observed off the west coast off Greenland during the measuring campaigns in June 2015 was at the Sisimiut section in the subsurface SPMW mass. This water mass is associated with the subduction processes which occur in the area around Cape Farwell when SPMW leaves the Irminger Sea and enters the Labrador Sea.

The lowest temperature observed off the west coast off Greenland during the measuring campaigns in June 2015 was north of the Sisimiut section and was associated with Baffin Bay Polar Water (BBPW).

Acknowledgements

We would like to thank the crew of Tulugaq and RV Paamiut.

Reference:

Cappelen, J. (2016): Vejret og klimaet i 2015. Vejret nr. 147, maj 2016

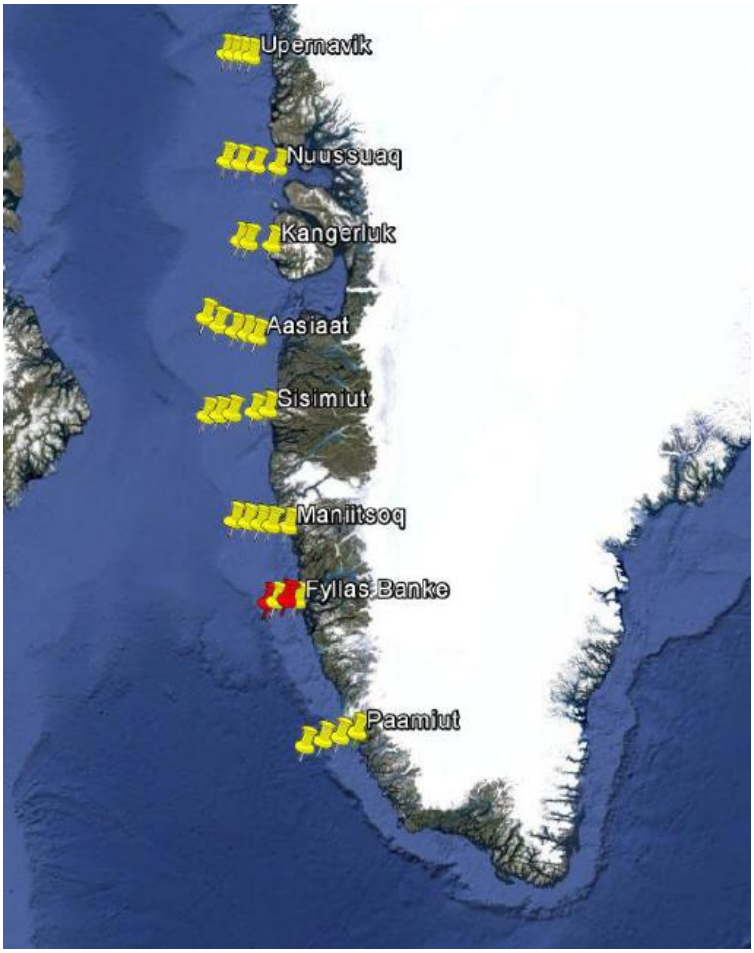

Fig. 1. Position of the hydrographic stations occupied off West Greenland during two cruises in June 2015. FB4 (located at the continental slope) and FB2 (located over the continental shelf) discussed in the text are indicated by red.

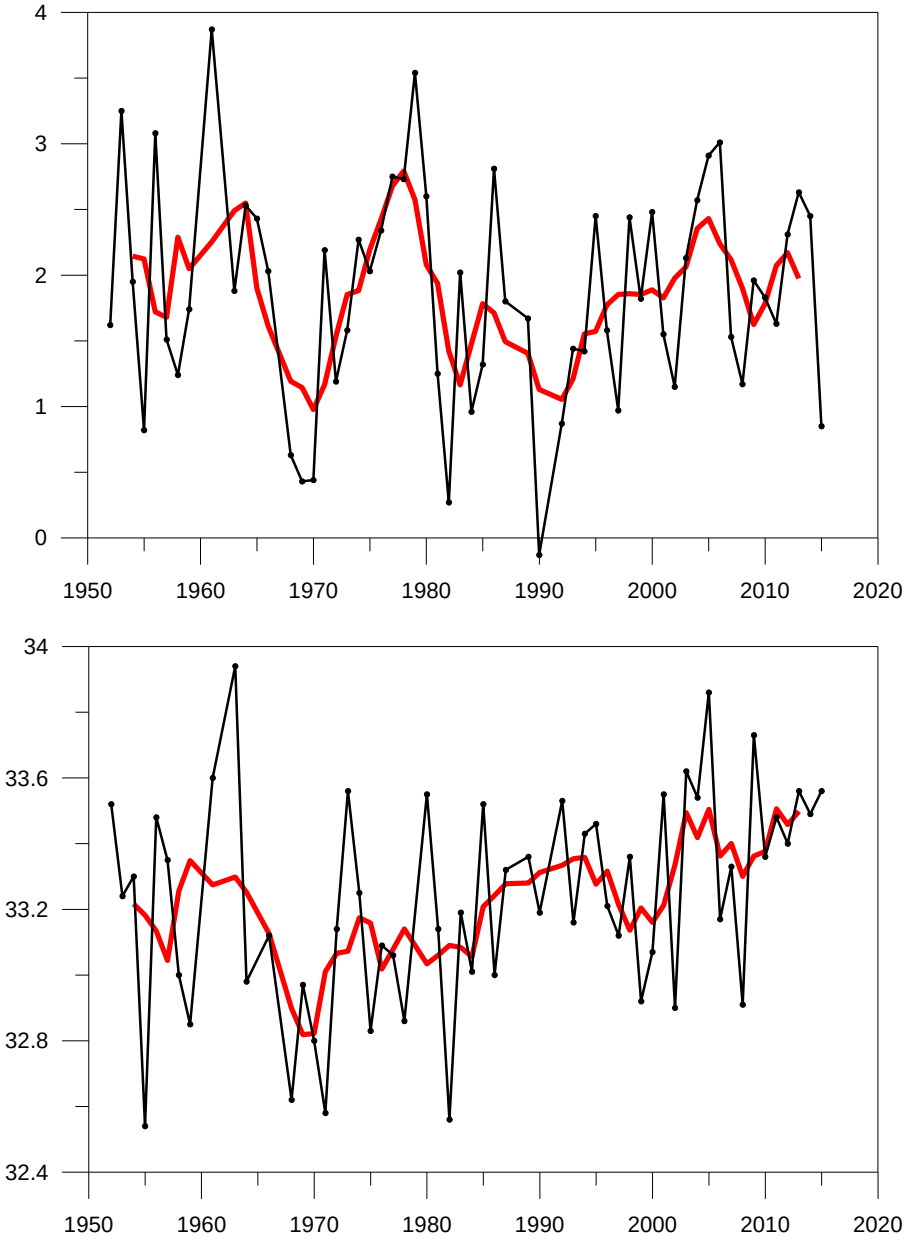

Fig. 2. Time series of mean potential temperature (top) and salinity (bottom) from the Fyllas Banke continental slope (station 4, 0–50 m) with measurements in June/July for the period 1952–2015. The red curves are 5 year running mean.

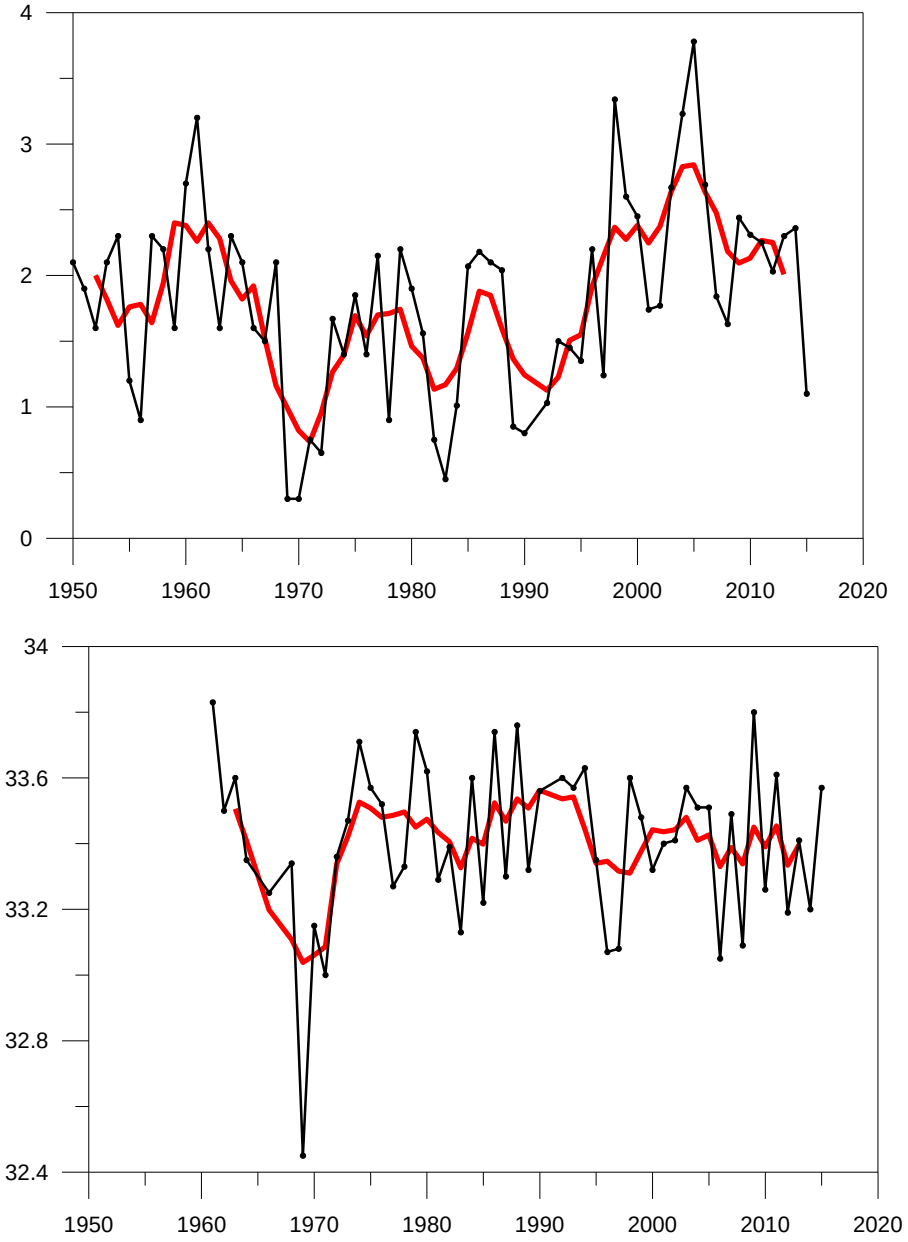

Fig. 3. Time series of mean potential temperature (top) and salinity (bottom) from the Fyllas Banke continental shelf (station 2, 0–40 m) with measurements in June/July for the period 1952–2015. The red curves are 5 year running mean.

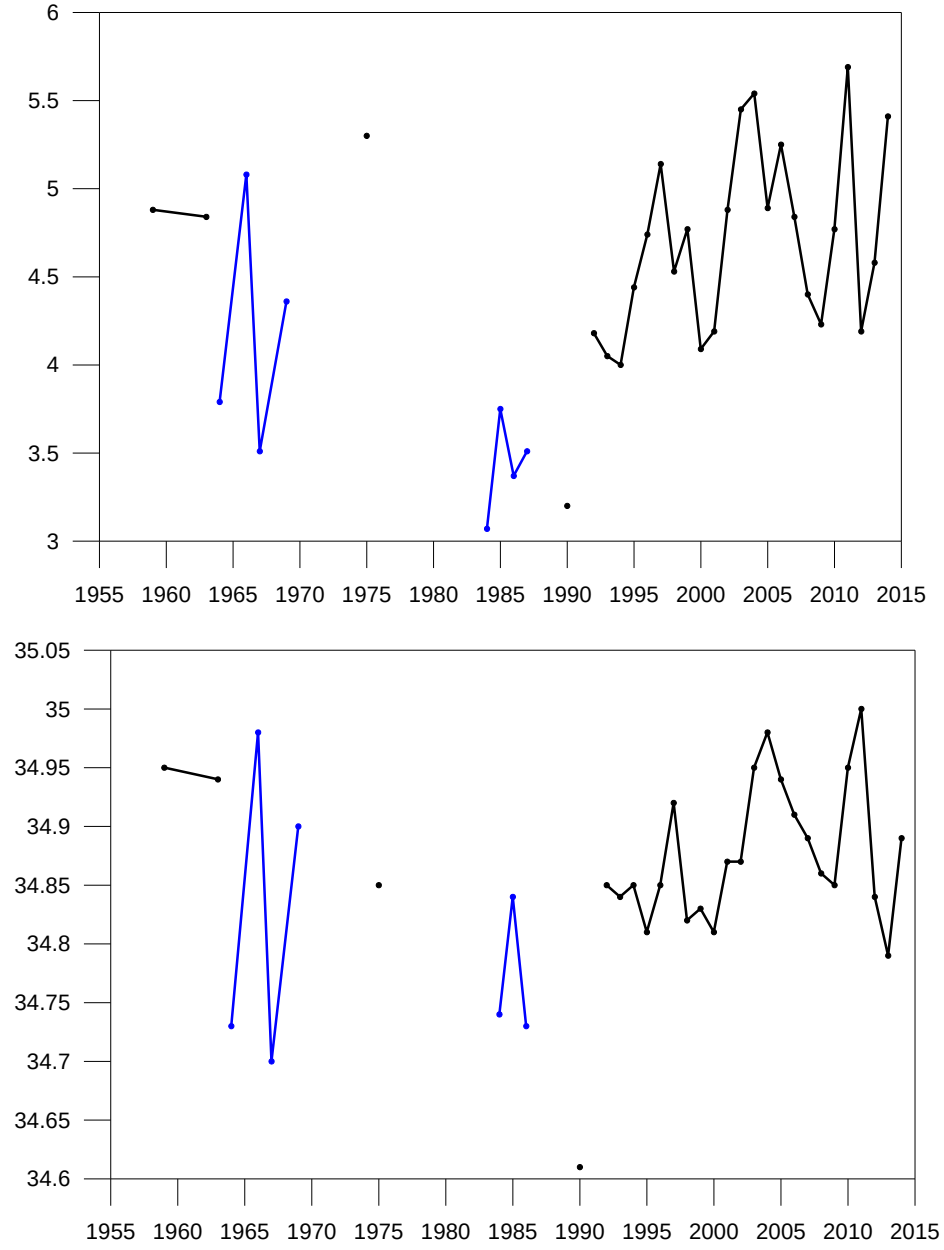

Fig. 4. Mean potential temperature (top) and salinity (bottom) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2014. Blue colors indicate observations obtained early in April. Note that no data were collected at this station in 2015

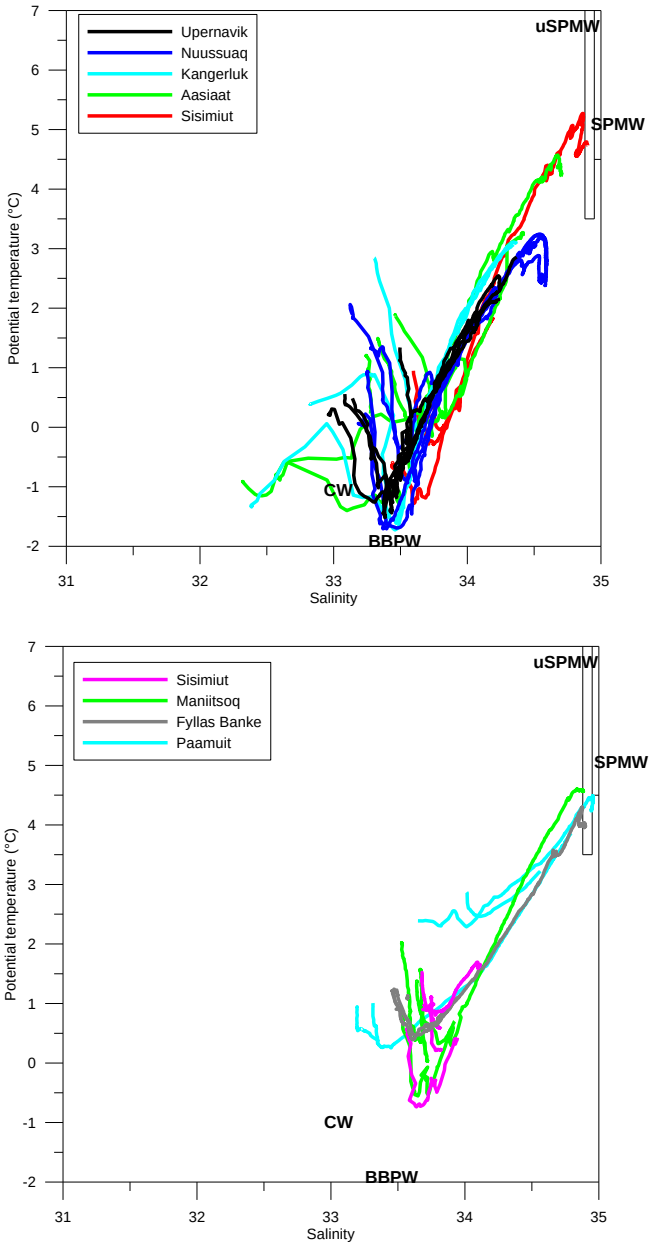

Fig. 5. Potential temperature - salinity diagrams showing every station occupied along the West Greenland continental shelf and slope during the June GINR surveys in 2015. Stations are color coded with respect sections (see Figure legends and Figure 1). Also indicated are water masses meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).