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Report on hydrographic conditions off Southwest Greenland June 2019

John Mortensen

Greenland Institute of Natural Resources
Kivioq 2, Box 570
3900 Nuuk, Greenland

Abstract

Hydrographic conditions were monitored at 8 hydrographic standard sections in June 2019 across the continental shelf off West Greenland. The northernmost section was not occupied due to technical problems. 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 south of the Sisimiut section. After some years with a relative saline Subpolar Mode Water mass, salinity dropped below its long-term mean.

Introduction

The West Greenland Current that carries water northward along the West Greenland continental slope consists of three components: a cold, fresh, 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 a freshwater component consisting of runoff from Greenland. The West Greenland Current is part of the cyclonic Subpolar Gyre and thus subject to hydrographic variations at different timescales associated with variability of the gyre and 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 2019 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard HELGA MARIA during the period 19 June to 3 July and onboard the Royal Danish Navy vessel HDMS KNUD RASMUSSEN during the period 3 June to 9 June. Observations were carried out on the following standard stations (Figure 1):

HELGA MARIA sections:

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

HDMS KNUD RASMUSSEN section:

Cape Desolation St. 1-5
Paamiut St. 1-5
Fyllas Banke St. 1-5
Maniitsoq St. 1-5
Sisimiut St. 0-5

Hydrographic data were collected with SBE 19plusV2 instruments. The instruments were pre- and post-cruise calibrated by the manufacturer. The collected data were averaged to 1 m vertical bins.

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 index. In 2019, Hurrell station-based winter NAO (DJFM) index was positive (1.47). This was not reflected in the annual mean air temperature at the Nuuk weather station in 2019 (0.4°C), which was 1.8°C above the long-term mean (1981-2010; -1.4°C), and 2.2°C higher than the year before (2018; -1.8°C) (Cappelen, 2020).

Average water properties between 0 and 50 m depth at Fyllas Banke Station 4 (FB4) in June are used to monitor the variability of the Coastal Water (CW) component of the West Greenland Current (Figure 2). After high temperatures in 2016, the temperatures in 2019 experienced a decrease to levels characteristic of the lower end of the decade, with temperatures 0.52°C lower than the long-term mean (1981-2010, T_{mean}=1.69°C). Conversely, the salinity of the CW resumed its positive trend, which started around 1970. In 2019 salinity was 0.16 above its long-term mean (1981-2010, S_{mean}=33.27).

Average water properties between 0 and 40 m depth at Fyllas Banke Station 2 (FB2) in June/July were previously used to monitor the variability of the sea surface waters off West Greenland (Figure 3). Though the two stations (FB2 and FB4) should tell the same story, they do not. After a break in the negative temperature trend between 2005 and 2015 in the period 2016 to 2017, the temperature in 2019 resumed the negative trend attaining levels similar to those observed before the 2000´s, with temperatures 0.26°C higher than the long-term mean (1981-2010, T_{mean}=1.90°C). The salinity of the sea surface layer continued its slightly negative trend, which started around 1970. In 2019, salinity was 0.08 above its long-term mean (1981-2010, 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 early June 2019, water temperature in the 75-200 m layer at Cape Desolation Station 3 (KD3) was 4.35°C and salinity was 34.83, i.e. 0.30°C and 0.05 below the long-term mean (1992-2010: T_{mean}=4.65°C; S_{mean}=34.88).

SPMW referred to by others as Atlantic Water or Irminger Sea Water with salinity greater than 34.95 was not observed on the Greenland west coast in June 2019 (Figure 5). Waters with salinities in the range 34.88 to 34.95 could be followed from the Cape Desolation section in the south (60°N) to the Maniitsoq section in the north at 65°N. North of the Sisimiut section, the SPMW core became gradually colder and fresher with distance.

The highest temperature observed on the Greenland west coast during the measuring campaigns in June 2019 was at the Cape Desolation section at the surface in the upper SPMW core (Rysgaard et al., 2020). Only deep SPMW is observed to enter Baffin Bay. See Rysgaard et al. (2020) for an updated view of water masses on the West Greenland continental shelf.

The lowest temperature observed on the Greenland west coast during the measuring campaigns in June 2019 was north of the Sisimiut section and was associated with Baffin Bay Polar Water (BBPW).

Acknowledgements

I/we would like to thank the crew of HDMS KNUD RASMUSSEN.

Reference:

Cappelen, J (ed.), 2020: Greenland - DMI Historical Climate Data Collection 1784-2019, DMI Report No. 20-04.

https://www.dmi.dk/fileadmin/Rapporter/2020/DMIRep20-04.pdf Læs rapporten / Read the report

https://www.dmi.dk/fileadmin/user_upload/Rapporter/TR/2020/DMIRep20-04.zip Hent data / Get data

Rysgaard S, Boone W, Carlson D, Sejr MK, Bendtsen J, Juul-Pedersen T, Lund H, Meire L, Mortensen J (2020), An updated view on water masses on the pan-West Greenland continental shelf and their link to proglacial fjords, J. Geophys. Res. Oceans, 125, e2019JC015564. doi:10.1029/2019JC015564.

Figure 1. Position of the hydrographic standard stations and sections off West Greenland. FB4 (located on the continental slope) and FB2 (located over the continental shelf).

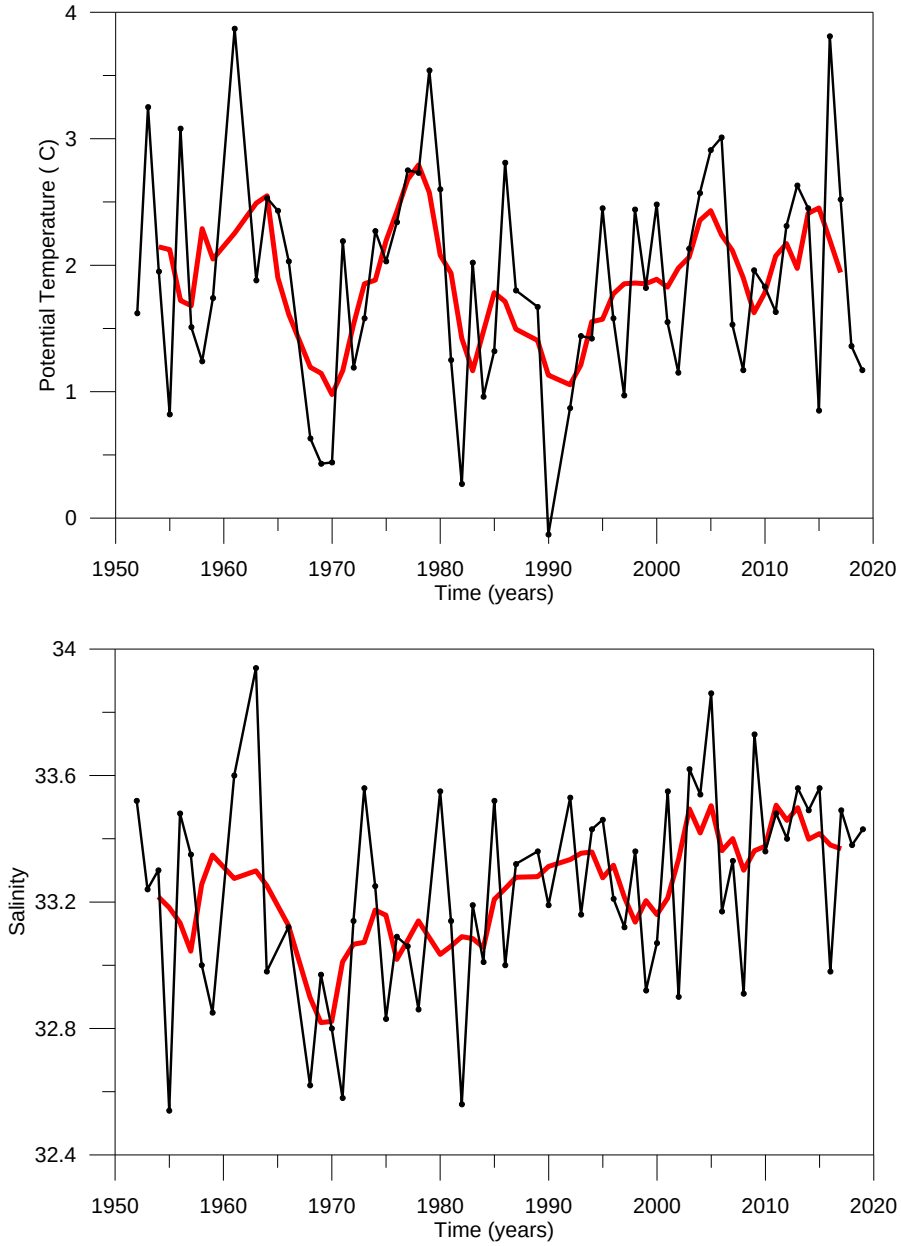

Figure 2. Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental slope (station 4, 0-50 m) with measurements in June/July for the period 1952-2019. The red curve shows the 5 year running mean.

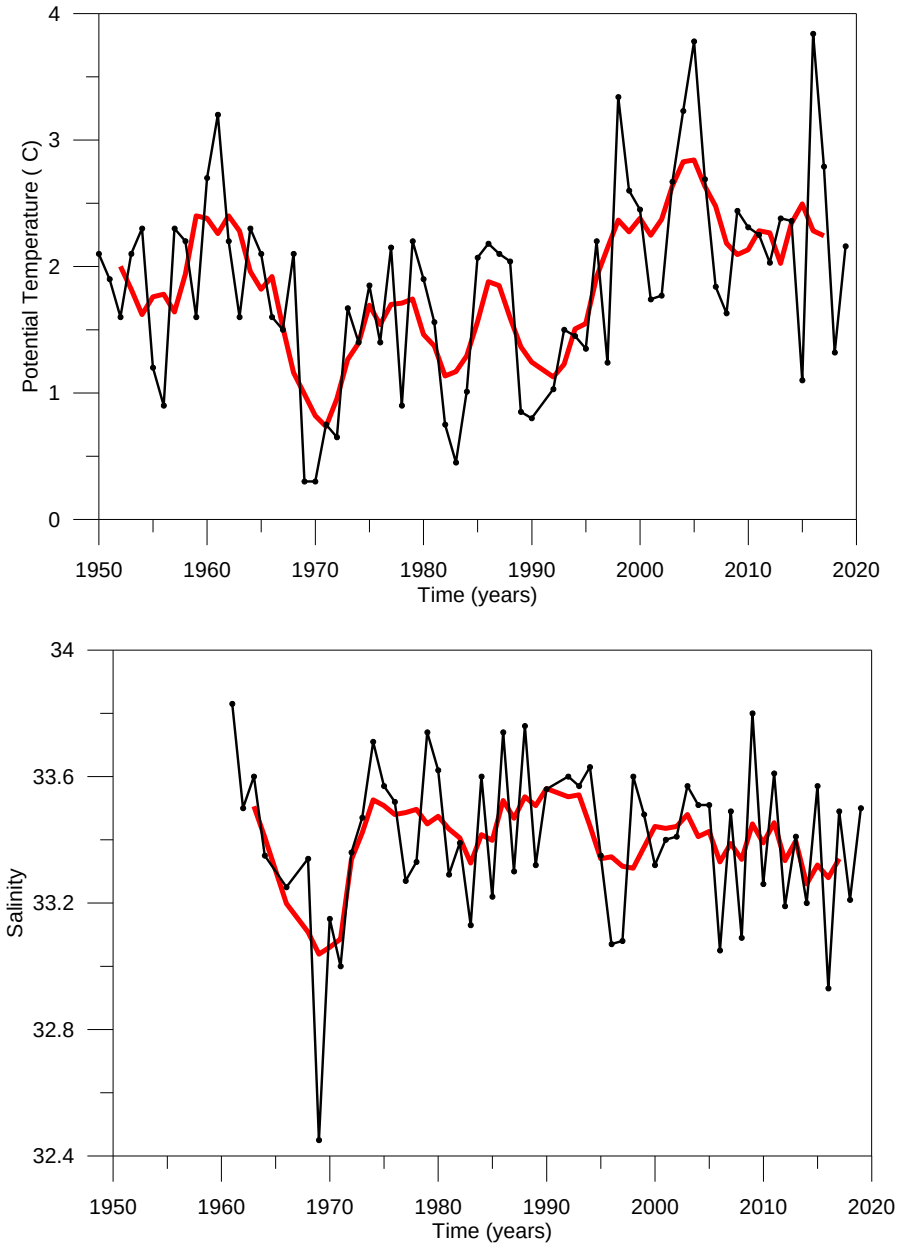

Figure 3. Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental shelf (station 2, 0-40 m) with measurements in June/July for the period 1950-2019. The red curve shows the 5 year running mean.

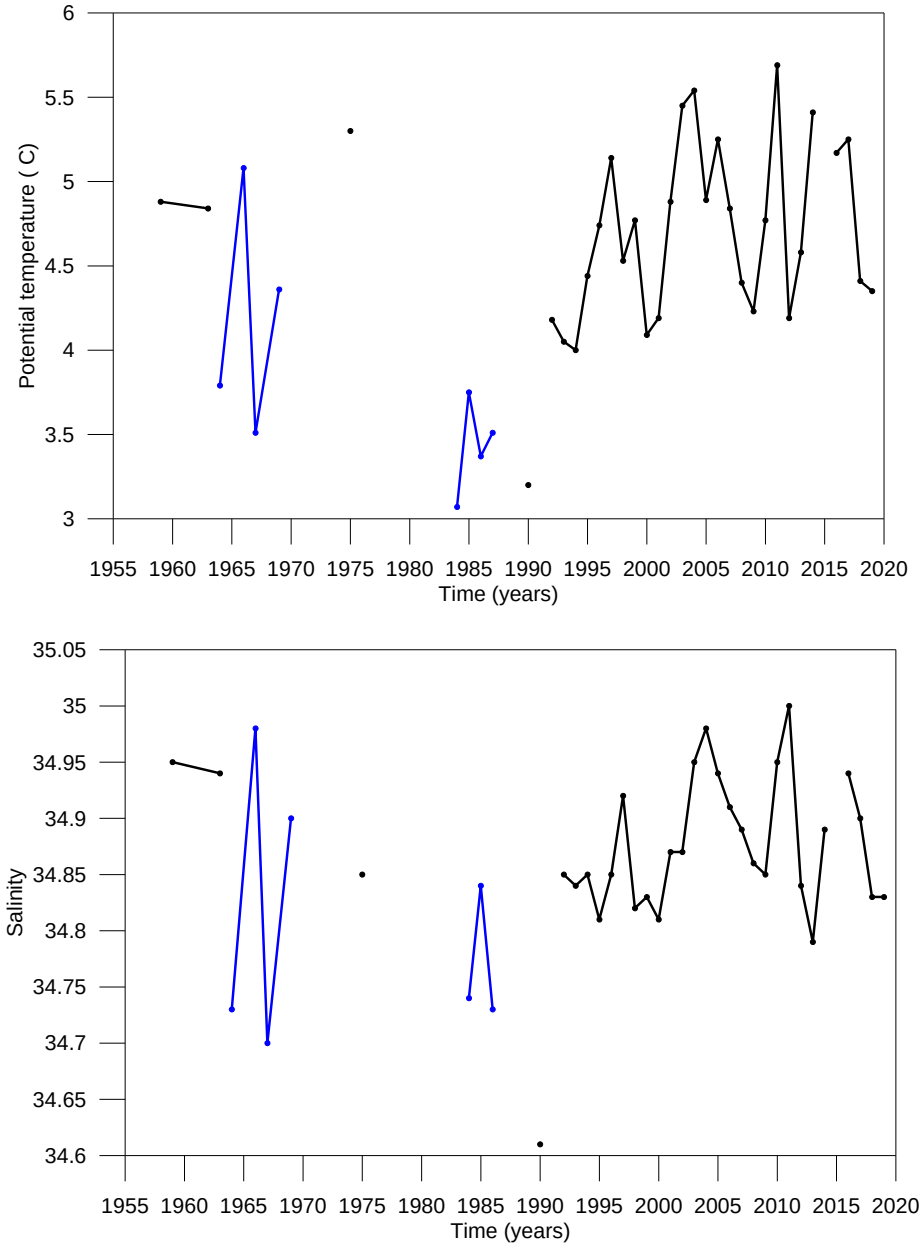

Figure 4. Mean potential temperature (°C, top) and salinity (bottom) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2019. Blue lines indicate observations obtained early in April.

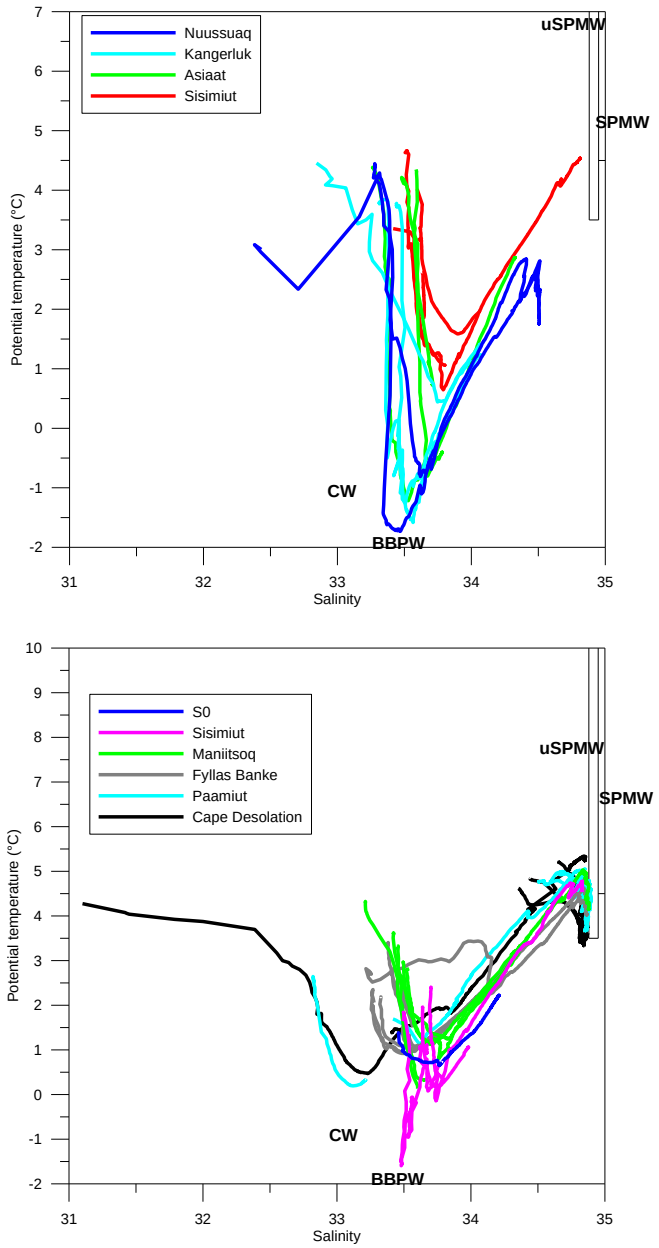

Figure 5. Potential temperature – salinity diagram showing every station occupied along the West Greenland continental shelf and slope during the June GINR surveys in 2019. Stations are color coded with respect to sections (see Figure legends and Figure 1). Also indicated are water masses that meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).