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Report on hydrographic conditions off Southwest Greenland May/June 2020

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Abstract

Hydrographic conditions were monitored at 10 hydrographic standard sections in June 2020 across the continental shelf off West Greenland. 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 2020 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard HELGA MARIA during the period 6 June to 26 June and onboard the Royal Danish Navy vessel HDMS LAUGE KOCH during the period 29 May to 2 June. Observations were carried out on the following standard stations (Figure 1):

HELGA MARIA 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



HDMS LAUGE KOCH section:

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

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 2020, the winter NAO (JFM) index was positive¹. This was reflected in below normal temperatures in January and February. The annual mean air temperature at the Nuuk weather station in 2020 was -0,8°C, which was 0,6°C above the long-term normal (1981-2010; -1,4°C), and 1,2°C lower than the year before (2019; +0,4°C) (Cappelen, 2021).

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 2020 experienced a decrease to levels characteristic of the lower end of the decade, with temperatures 0.41°C lower than the long-term mean (1981-2010, $T_{\text{mean}}=1.69^{\circ}\text{C}$). Conversely, the salinity of the CW resumed its positive trend, which started around 1970. In 2020 salinity was 0.22 above its long-term mean (1981-2010, $S_{\text{mean}}=33.27$).

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 2020 resumed the negative trend attaining levels similar to those observed before the 2000's, with temperatures 0.26°C lower than the long-term mean (1981-2010, $T_{\text{mean}}=1.90^{\circ}\text{C}$). The salinity of the sea surface layer experienced a slight positive trend, setting the negative trend which started around 1970 on a halt. In 2020, salinity was 0.24 above its long-term mean (1981-2010, $S_{\text{mean}}=33.42$).

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 2020, water temperature in the 75-200 m layer at Cape Desolation Station 3 (KD3) was 3.88°C and salinity was 34.77, i.e. 1.23°C and 0.11 below the long-term mean (1992-2010: $T_{\text{mean}}=4.65^{\circ}\text{C}$; $S_{\text{mean}}=34.88$).

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 2020 (Figure 5). Waters with salinities in the range 34.88 to 34.95 could be followed from the Cape Farewell section in the south (60°N) to the Paamiut section in the north at 62°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 May/June 2020 was at the Cape Farewell 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.

¹ <https://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/season.JFM.nao.gif>

The lowest temperature observed on the Greenland west coast during the measuring campaigns in June 2020 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 LAUGE KOCH.

Reference:

Cappelen, J (ed.), 2021: Greenland - DMI Historical Climate Data Collection 1784-2020, DMI Report No. 21-04.

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).

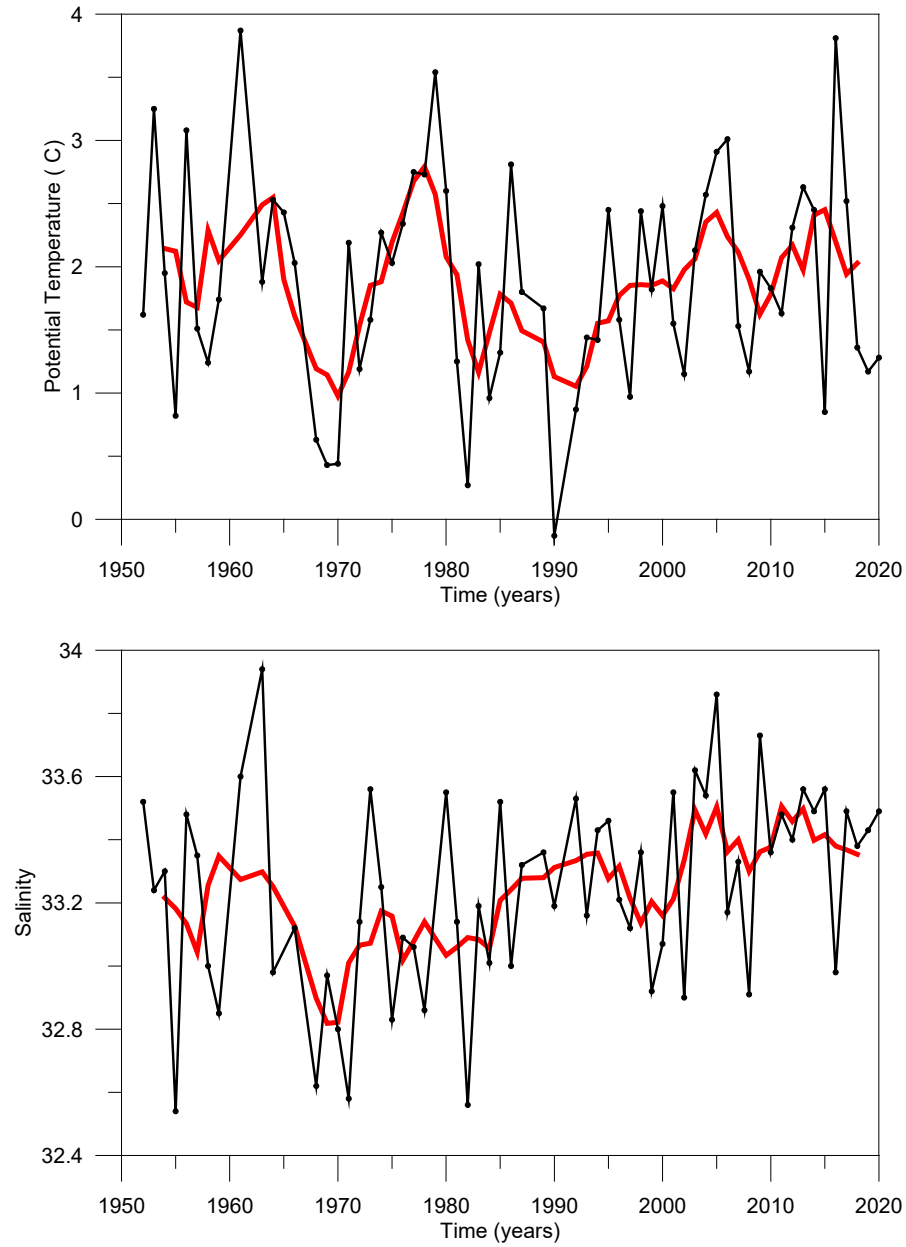


Figure 2. Time series of mean potential temperature ($^{\circ}\text{C}$, top) and salinity (bottom) from the Fyllas Banke continental slope (station 4, 0-50 m) with measurements in June/July for the period 1952-2020. The red curve shows the 5 year running mean.

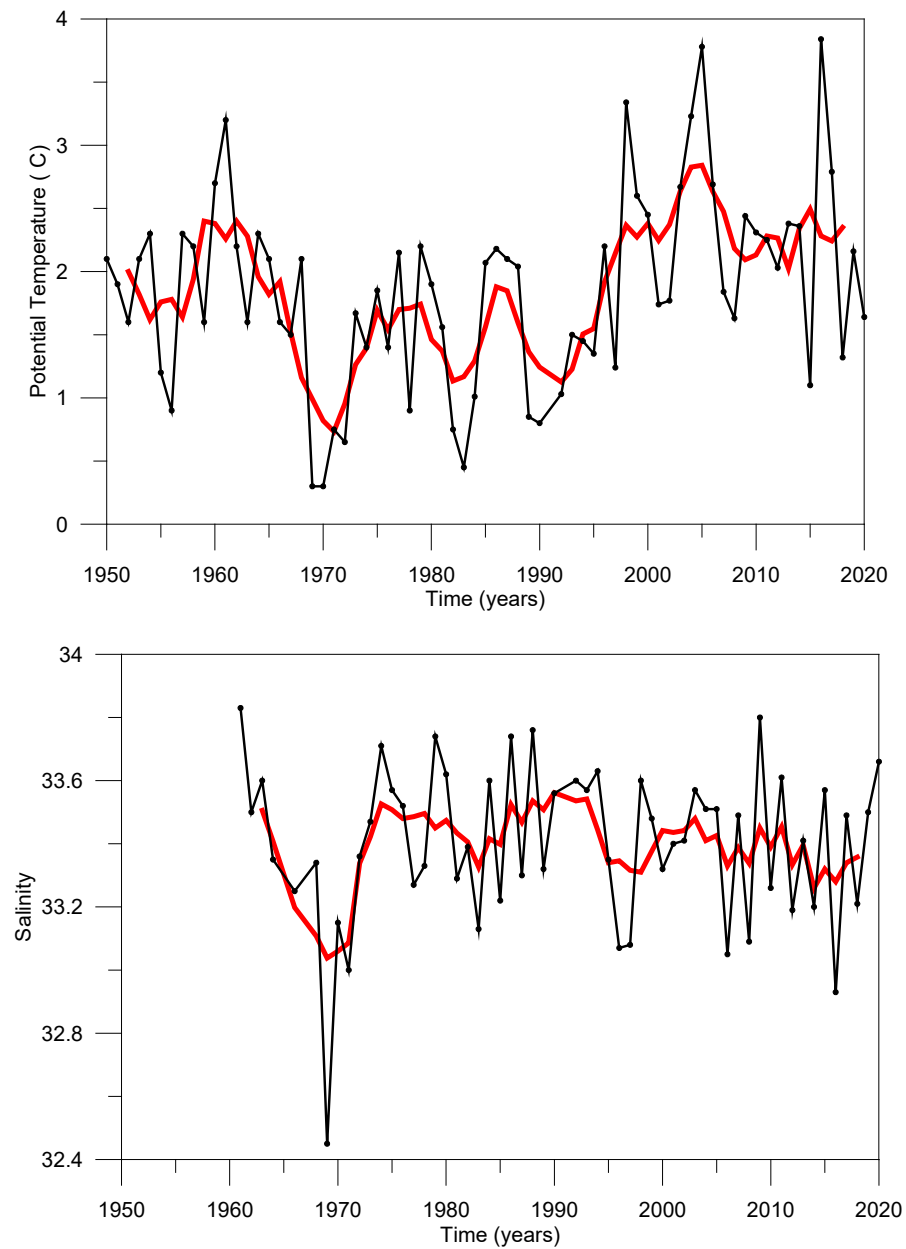


Figure 3. Time series of mean potential temperature ($^{\circ}\text{C}$, top) and salinity (bottom) from the Fyllas Banke continental shelf (station 2, 0-40 m) with measurements in June/July for the period 1950-2020. The red curve shows the 5 year running mean.

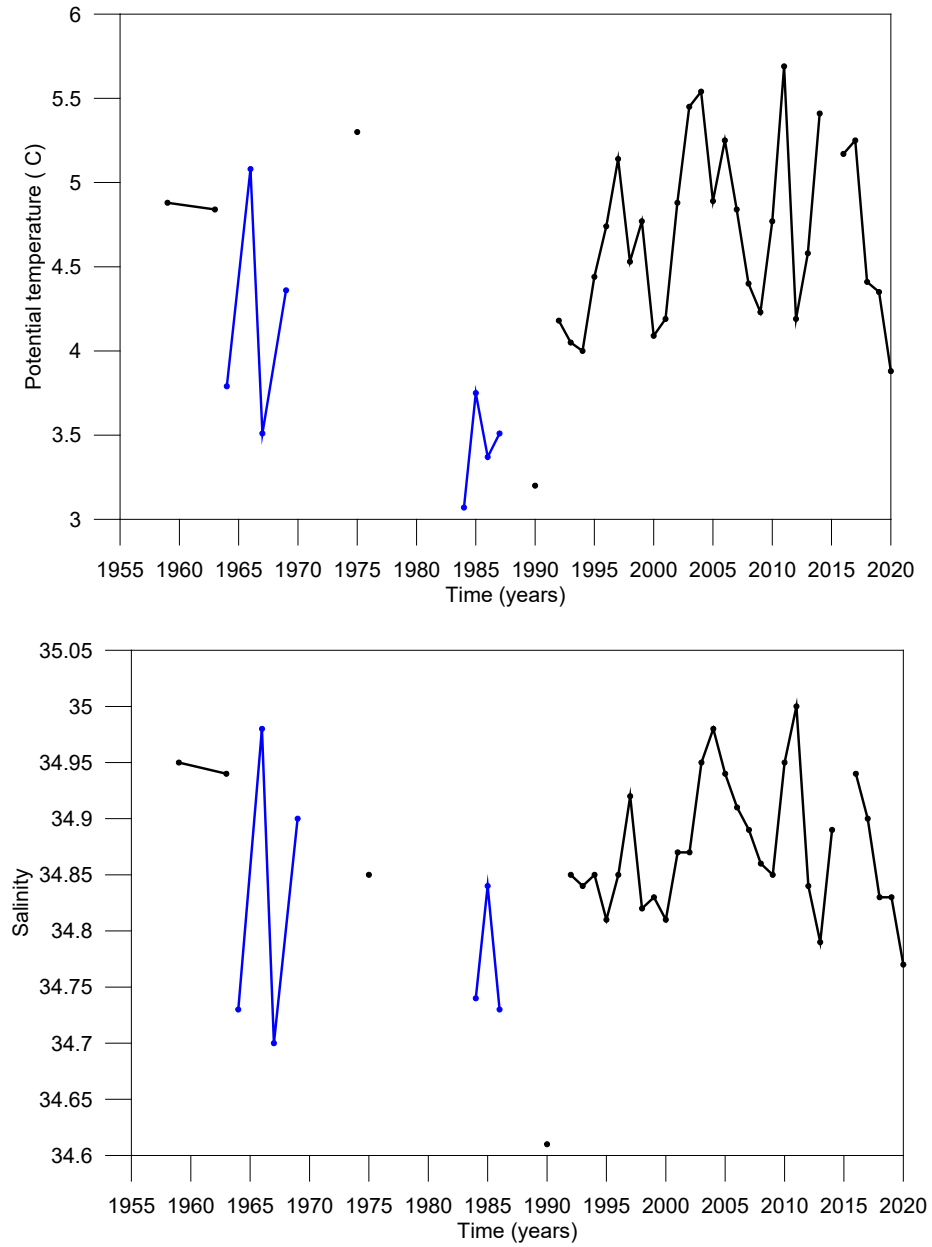


Figure 4. Mean potential temperature (°C, top) and salinity (bottom) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2020. Blue lines indicate observations obtained early in April.

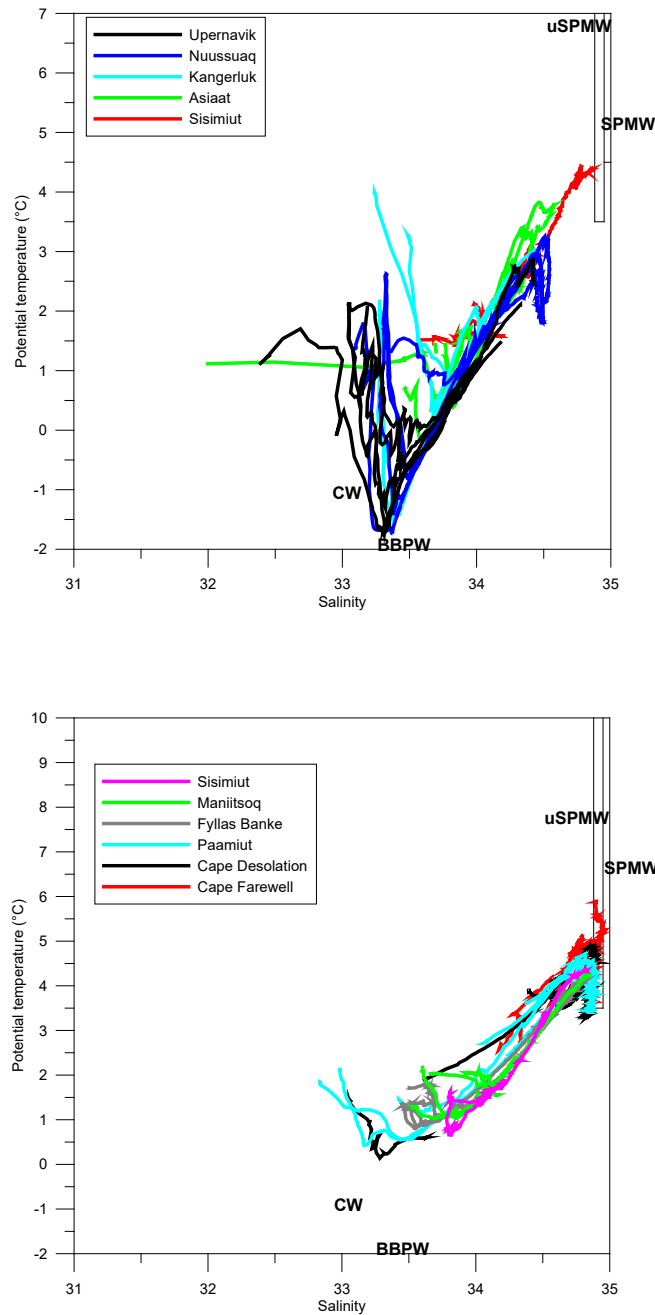


Figure 5. Potential temperature – salinity diagram showing every station occupied along the West Greenland continental shelf and slope during the May/June GINR surveys in 2020. Stations are color coded with respect to sections (see Figure legends and Figure 1). Also indicated are water masses that meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).