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Report on hydrographic conditions off West Greenland May-June 2024

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Abstract

Hydrographic conditions were monitored along 9 hydrographic standard sections in May-June 2024 across the West Greenland continental shelf. Three offshore stations have been chosen to document changes in hydrographic conditions off the southern part of West Greenland. The salinity of the coastal and offshore surface waters was much lower than average and continued the recent ongoing freshening. The temperature in 2024 was much lower than average but likely linked to the early timing of the survey this year. Unfortunately, the offshore station Cape Desolation 3 was not occupied in 2024, so the state of the Subpolar Mode Water is unknown. Data from the remaining survey suggests a minor decrease in salinity and temperature in Subpolar Mode Water compared to June 2023.

Introduction

The West Greenland Current that carries water northward along the West Greenland continental slope consists of three components: a cold, fresh, inshore near 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. To the north of Davis Strait, the West Greenland Current is met by Baffin Bay Polar Water (BBPW), a surface near water mass with Baffin Bay origin. 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 in the southern part of West Greenland.

Materials and Methods

The 2024 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard TARAJOQ during the period 29 May to 24 June 2024 and onboard the Royal Danish Navy vessel HDMS EJNAR MIKKELSEN during the period 19 to 23 May 2024. Observations were carried out on the following standard stations (Figure 1):

TARAJOQ sections:

Sisimiut St. 1–5
Aasiaat St. 1–7
Kangerluk St. 1–4
Nuussuaq St. 1–3(5)
Upernavik St. 1–2(5)

HDMS KNUD RASMUSSEN sections:

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 and Practical Salinity Scale – 1978 (PSS-78) is used throughout the text.

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 2024, the winter NAO (JFM) index was slightly positive[1]. The annual mean air temperature at the Nuuk weather station in 2024 was -0.8°C, which was 0.2°C above the long-term normal (1991-2020; -1.0°C), and -0.6°C lower than the year before (2023; -0,2°C) (personal communication, DMI, 2025).

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 low temperatures in the period 2018-20, the temperatures in 2024 again experienced low levels, with temperatures -1.52°C lower than the long-term mean (1992-2020, T_{mean}=1.91°C) for a May observation. Conversely, the salinity of the CW broke its positive trend, which started around 1970. In 2024 salinity was -0.54 below its long-term mean (1992-2020, S_{mean}=33.36).

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 short break in the negative temperature trend which started in 2005, the temperature in 2024 reversed to a negative temperature trend, with temperatures -1.32°C lower than the long-term mean (1992-2020, T_{mean}=2.18°C). The salinity of the sea surface layer resumed the negative trend which started around 1970. In 2024, salinity was -0.48 below its long-term mean (1992-2020, S_{mean}=33.40).

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 June 2023 the water temperature in the 75-200 m layer at Cape Desolation Station 3 (KD3) was 5.11°C and salinity was 34.7, i.e., 0.42°C above and -0.17 below the long-term mean (1992-2020: T_{mean}=4.69°C; S_{mean}=34.87). KD3 was not occupied in 2024.

[1] https://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/season.JFM.nao.png

SPMW referred to by others as Atlantic Water or Irminger Sea Water with salinity greater than 34.95 was only observed at the Paamiut section on the Greenland west coast in May 2024 (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 Maniitsoq section in the north at 65°N.

The highest temperature observed on the Greenland west coast during the measuring campaigns in May/June 2024 was at the Paamiut section at the subsurface SPMW core (Rysgaard et al., 2020). Only deep SPMW is observed to enter Baffin Bay. See Rysgaard et al. (2020) and Mortensen et al. (2022) 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 May-June 2024 was at the Sisimiut section and was associated with Baffin Bay Polar Water (BBPW).

Acknowledgements

I/we would like to thank the crew of HDMS EJNAR MIKKELSEN.

Reference:

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.

Mortensen J, Rysgaard S, Winding MHS, Juul-Pedersen T, Arendt KE, Lund H, Stuart-Lee AE, Meire L (2022) Multidecadal Water Mass Dynamics on the West Greenland Shelf, J. Geophys. Res. Oceans, 127, e2022JC018724. doi:10.1029/2022JC018724.

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).

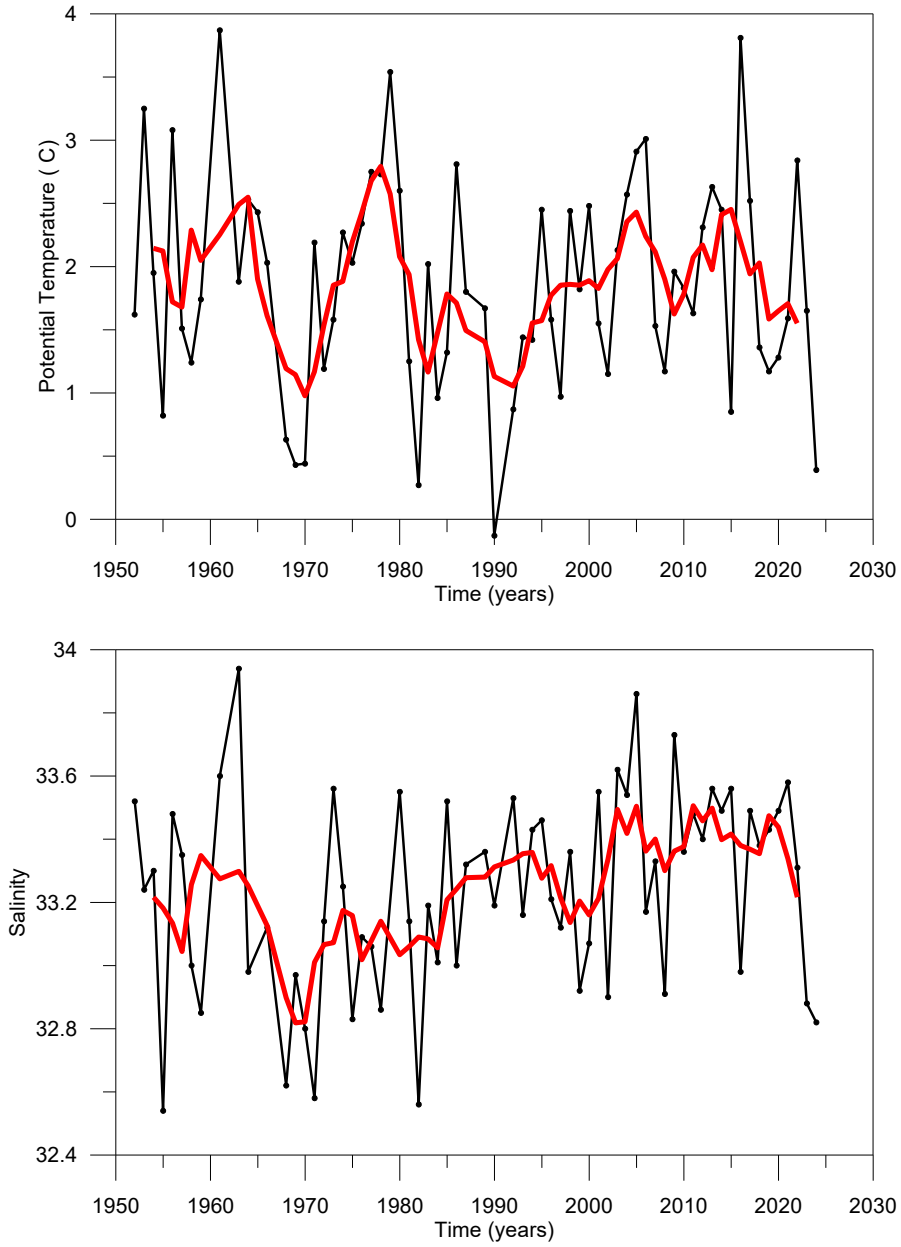

Figure 2. Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental slope (station FB4, 0-50 m) with measurements in June/July for the period 1952-2024. The red curve shows the 5 year running mean.

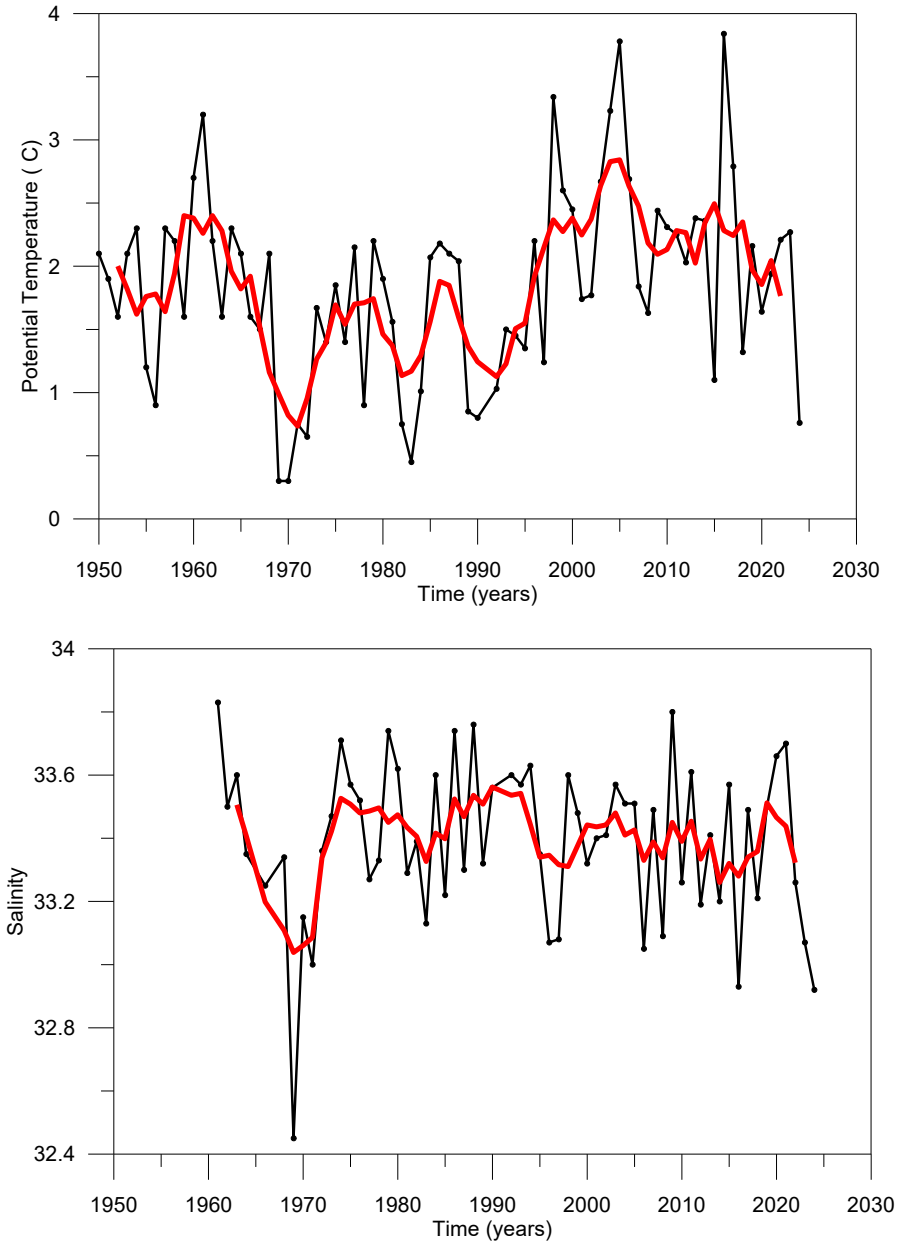

Figure 3. Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental shelf (station FB2, 0-40 m) with measurements in June/July for the period 1950-2024. The red curve shows the 5 year running mean.

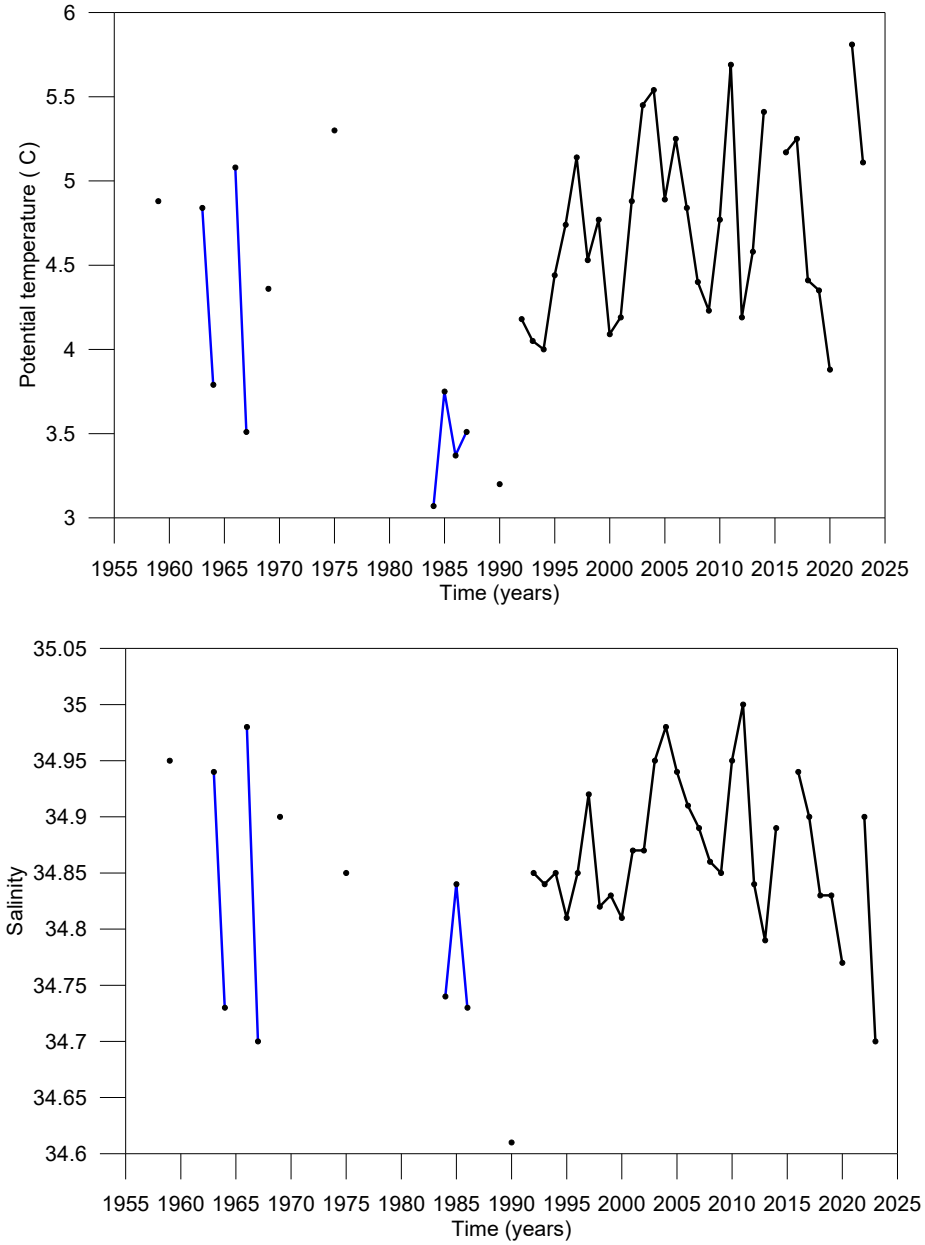

Figure 4. Mean potential temperature (°C, top) and salinity (bottom) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2023. Blue lines indicate observations obtained early in April. No observations in 2024.

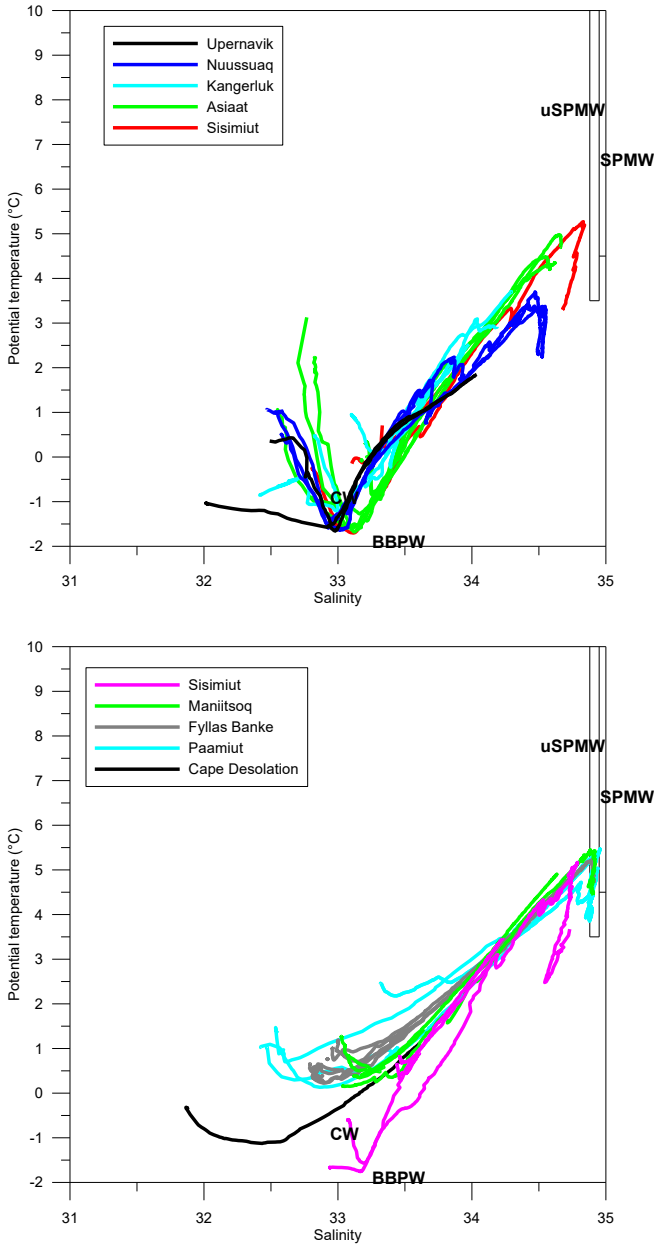

Figure 5. Potential temperature – salinity diagram showing every station occupied along the West Greenland continental shelf and slope during the May-June GINR surveys in 2024. Stations are color coded with respect to sections (see Figure Legends and Figure 1). Also indicated are water masses that meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).