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# Report on hydrographic conditions off West Greenland June 2023

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## Abstract

Hydrographic conditions were monitored along 6 hydrographic standard sections in June 2023 across the continental shelf off West Greenland. Three offshore stations have been chosen to document changes in hydrographic conditions off the southern part of West Greenland. Salinity of the coastal and offshore waters showed the same trend with marked decrease. After a year with above its long-term mean salinity the Subpolar Mode Water mass continued to freshen.

## 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. 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 2023 standard hydrographic cruises were carried out by the Greenland Institute of Natural Resources (GINR) onboard TARAJOQ during the period 29 May to 18 June and onboard the Royal Danish Navy vessel HDMS KNUD RASMUSSEN during the period 23 June to 29 June. Observations were carried out on the following standard stations (Figure 1):

TARAJOQ sections:

Sisimiut (Holsteinsborg) St. 1–5

HDMS KNUD RASMUSSEN sections:

Cape Desolation St. 1-5
Paamiut St. 1-5
Fyllas Banke St. 1-5

Maniitsoq St. 1-5
Sisimiut St. 0-3

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 2022, the winter NAO (JFM) index was slightly positive[1]. The annual mean air temperature at the Nuuk weather station in 2023 was -0.2°C, which was 0.8°C above the long-term normal (1991-2020; -1.0°C), and 1.1°C higher than the year before (2022; -1,3°C) (DMI, 2024).

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 low temperatures in the period 2018-20, the temperatures in 2022 experienced an increase to levels characteristic of the long-term mean, with temperatures -0.04°C lower than the long-term mean (1981-2010, $T_{mean}$=1.69°C) for a July observation. Conversely, the salinity of the CW broke its positive trend, which started around 1970. In 2023 salinity was -0.39 below 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 to 2015 and in the period 2016 to 2017, the temperature in 2023 reverse to a positive temperature trend with levels close to the long-term mean, with temperatures 0.37°C higher than the long-term mean (1981-2010, $T_{mean}$=1.90°C). The salinity of the sea surface layer resumed the negative trend which started around 1970. In 2023, salinity was -0.35 below 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 July 2022 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., 0.46°C above and -0.18 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 only observed at the Paamiut section on the Greenland west coast in June 2023 (Figure 5). Waters with salinities in the range 34.88 to 34.95 could be followed from the Cape Desolation section in the south (61°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 June 2023 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) 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 June 2022 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.

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

**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.

Jensen, CD (ed.), 2024: Greenland - DMI Historical Climate Data Collection 1784-2023, DMI Report No. 24-??.


**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).

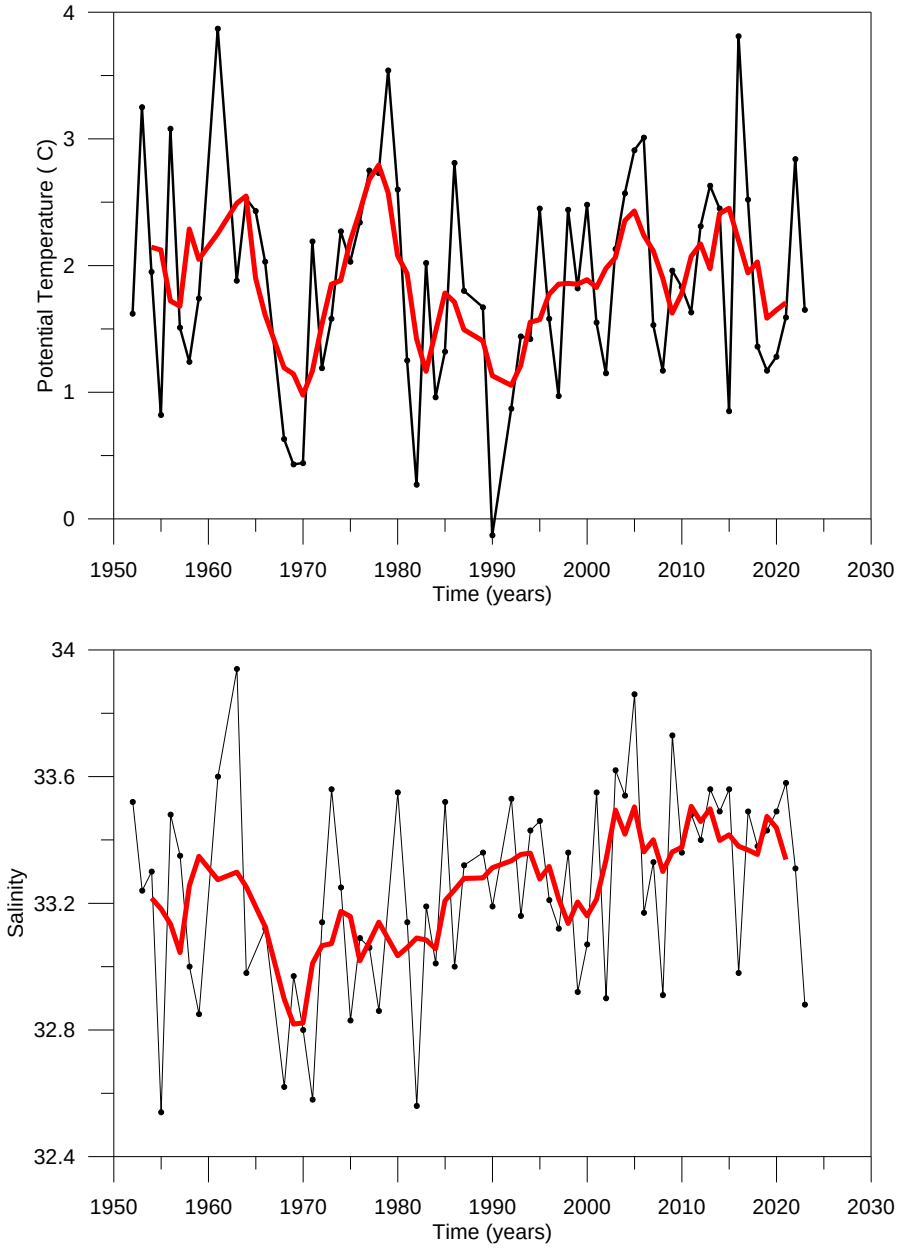


**Figure 2.** Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental slope (station 4, 0-50 m) with measurements in June/July for the period 1952-2023. The red curve shows the 5 year running mean.

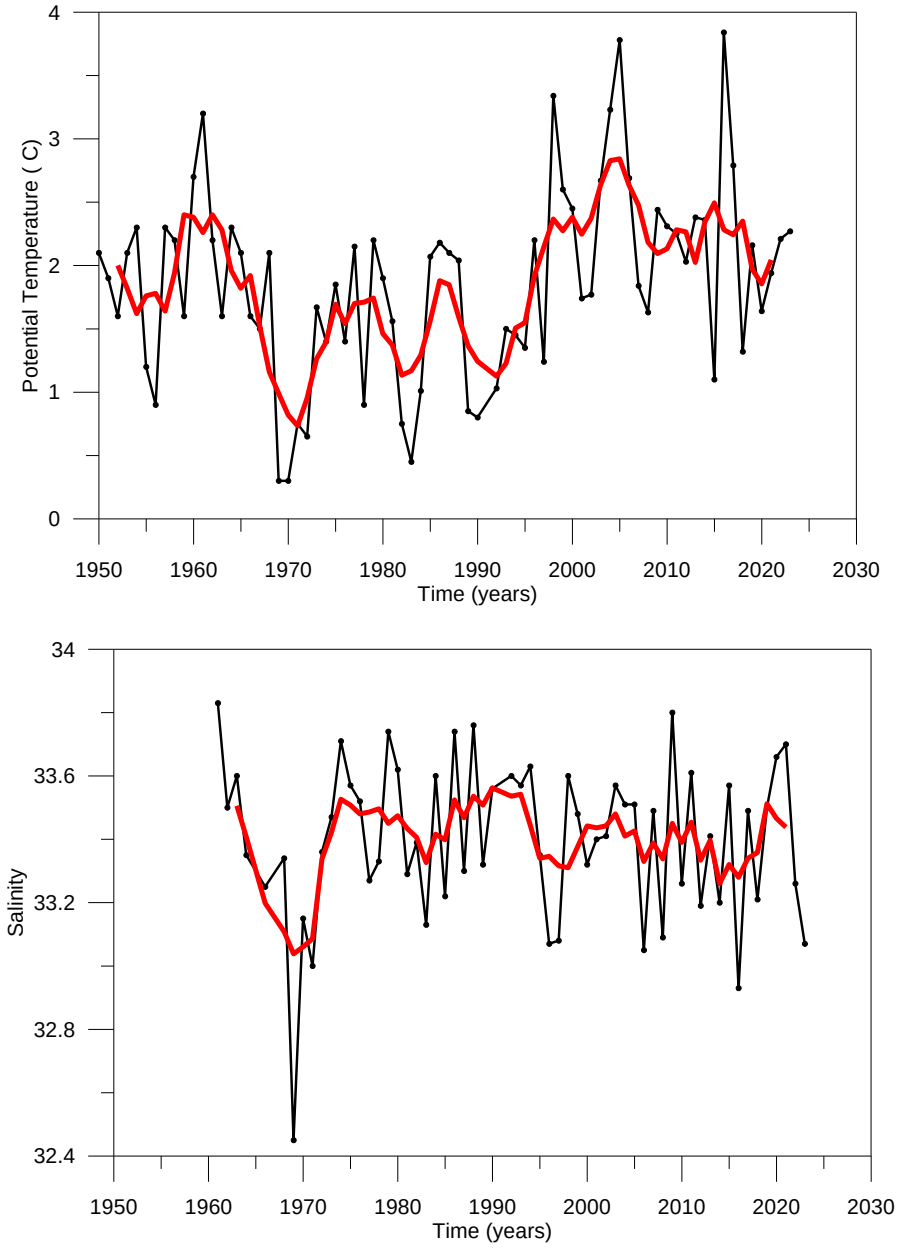


**Figure 3.** Time series of mean potential temperature (°C, top) and salinity (bottom) from the Fyllas Banke continental shelf (station 2, 0-40 m) with measurements in June/July for the period 1950-2023. The red curve shows the 5 year running mean.

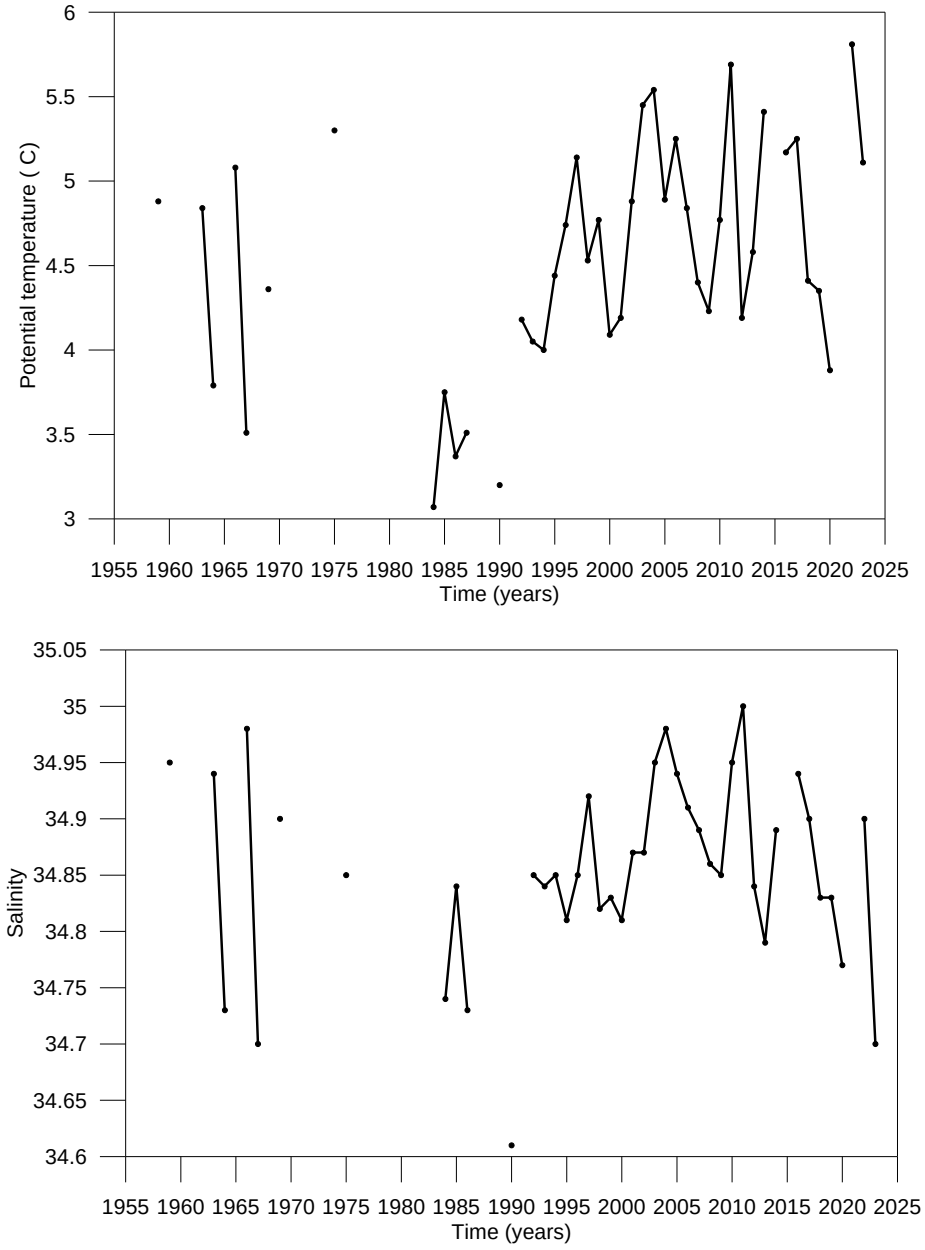


**Figure 4.** Mean potential temperature (°C, top) and salinity (bottom) for the depth range 75-200 m at Cape Desolation 3 (60.47°N, 50°W) June/July 1959-2023. Blue lines indicate observations obtained early in April.

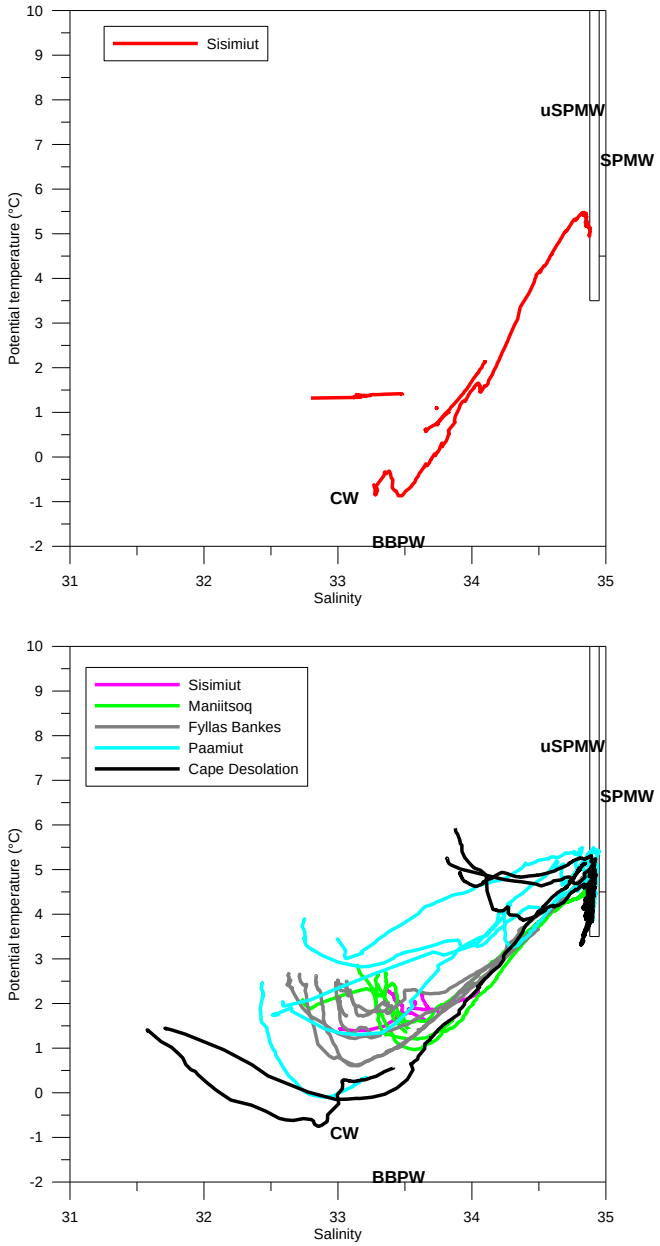


**Figure 5.** Potential temperature – salinity diagram showing every station occupied along the West Greenland continental shelf and slope during the June-July GINR surveys in 2023. Stations are color coded with respect to sections (see Figure legends and Figure 1). Also indicated are water masses that meet in the region: Coastal Water (CW), Subpolar Mode Water (SPMW), upper Subpolar Mode Water (upper SPMW), and Baffin Bay Polar Water (BBPW).