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Oceanographic Investigations off West Greenland 2005

by

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Abstract

Results of the summer 2005 standard section cruise along the west coast of Greenland are presented together with CTD data gathered during trawl surveys.

The NAO index was slightly negative and the westerlies was weakened, i.e. anomaly easterlies.

West of Fylla Bank (st. 4) at intermediate depths (150-400 m) the salinities and temperatures were among the highest observed yet in June. The time series of mid-June temperatures on top of Fylla Bank (st. 2) was record high 2°C above average conditions, while the salinity was slightly higher than normal. The mean (400-600 m) salinity west of Fylla Bank (st. 4) was 0.1 above normal and the temperature 0.4°C above normal. This indicates above normal inflow of Irminger Water in 2005 but far from the high inflow observed in 2004.

The temperature of the Polar Water was high compared to normal years, the front between Polar Water and Irminger Water was week and the multi-year-ice ("Storis") was absent, indicating a reduced inflow of Polar Water to the West Greenland area in 2005. Pure Irminger Water was observed at the Cape Farewell and Cape Desolation sections, and Modified Irminger Water could be traced north to the Fylla Bank section. The inflow of Irminger Water to West Greenland waters seems to be above normal.

1. Introduction

The North Atlantic marine climate is largely controlled by the so-called North Atlantic Oscillation (NAO), which is driven by the pressure difference between the Azores High and the Iceland Low pressure cells. We use wintertime (December-March) sea level pressure (SLP) difference between Ponta Delgada, Azores, and Reykjavik, Iceland, and subtract the mean SLP difference for the period 1961-1990 to construct the NAO anomaly. The winter NAO index during winter 2004/2005 was slightly negative[1] as last year (Fig. 1). The Icelandic Low during the winter months (December-March) was deflected northward with center in the middle of Nordic Seas (Fig. 2) and the Azores High was also deflected north (Fig. 3).

The pressure difference has the effect that the center of the westerlies was shifted towards north resulting in weaker than normal westerlies over the North Atlantic from Portugal to Cape Farewell. Thereby the wind anomaly (difference from normal conditions) was towards west (Fig. 4). Contrary, north of about 55°N from Cape Farewell towards Ireland the westerlies were increased. Over the Denmark Strait area, the average wind condition was towards east. In the

[1] The NAO index using December-February was positive. This means that in March the NAO index was negative.

western part of the Nordic Seas, the wind anomaly was towards south across the Fram Strait, but deflected towards east north of Iceland.

West Greenland lies within the area which normally experiences warm conditions when the NAO index is negative. As can be seen from Fig. 5 the annual mean air temperature for 2005 in Nuuk was 0.2°C which is about 1.5°C above average, reflecting well the negative NAO value. The mean annual air temperature for 2005 was above normal for almost the entire North Atlantic region with anomalies above 2°C West of Greenland and above 3°C over the Davis Strait region (Fig. 6).

Changes in the ocean climate in the waters off West Greenland generally follow those of the air temperatures, exceptions are years with great salinity anomalies i.e. years with extraordinary inflow of Polar Water or water of Atlantic origin. In 2005 the mean temperature on top of Fylla Bank in the middle of June was 3.78°C which is 2°C above the average value for the whole 55-year period and the highest value observed, whereas the mean salinity value, 33.51, was about equal to the average value for the entire period (Fig. 7).

2. **Measurements**

The 2005 cruise was carried out according to the agreement between the Greenland Institute for Natural Resources and Danish Meteorological Institute during the period June 20-29, 2005 onboard the Danish naval ship "TULUGAQ"**.** Observations were performed on the following stations (Fig. 8):

Offshore Labrador Sea/Davis Strait:

- Cape Farewell St. 1–5
- Cape Desolation St. 1–5
- Paamiut St. 1
- Fylla Bank St. 1–5
- Maniitsoq St. 1–5
- Sisimiut St. 1–5

Fjords around Sisimiut:

- Amerdloq St. 1–2, 4
- Ikertoq St. 1, 4
- Kangerdluarssuk St. 1–3
- Itivdleq St. 1–4

On each station the vertical distributions of temperature and salinity was measured from surface to bottom, except on stations with depths greater than 750 m, where approximately 750 m was the maximum depth of observation.

The cruise was blessed with favourable ice conditions. Both "Storis"[2] (Fig. 10) and "Vestice"[3] was not present at all. The absent of "Storis" is very seldom for the area at that time of the year. However, several days of stormy weather conditions prohibited us to carry out Paamiut St. 2-5.

During the period July 5-27, 2005 the Greenland Institute of Natural Resources carried out trawl surveys from Sisimiut to the Disko Bay area and further North onboard "R/V PAAMIUT". During these surveys CTD measurements were carried out on national oceanographic standard stations (Fig. 8):

Offshore Davis Strait/Baffin Bay:

- Sisimiut St. 1-5
- Aasiaat (Egdesminde) St. 1–7
- Kangerluk (Disko fjord) St. 1–4
- Nugssuag St. 1–4
- Upernavik St. 1–5

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2 "Storis" is multi year ice transported from the Arctic Ocean through Fram Strait by the East Greenland Current to Cape Farewell, where it continues northward by the West Greenland Current.

3 "Vestice" is one year ice formed in the Baffin Bay, Davis Strait, and western part of the Labrador Sea during winter.

Disko Bay:

- Qeqertarsuaq–Aasiaat (Godhavn–Egdesminde) St. 1, 3−4
- Akunaq–Skansen St. 1–4
- Ilulissat (Skansen–Jakobshavn) St. 1–4
- Appat (Arveprinsens Ejlande) St. 1–3

3. Data handling

Measurements of the vertical distribution of temperature and salinity were carried out using a SEABIRD SBE 9-01 CTD. For the purpose of calibration of the conductivity sensor of the CTD, water samples were taken at great depth on stations with depths greater than 500 m. The water samples were after the cruise analysed on a Guildline Portosal 8410 salinometer.

The CTD data were analysed using SBE Data Processing version 5.37d software provided by SEABIRD (www.seabird.com). Onboard the data was uploaded using term17 in SEASOFT version 4.249 (for DOS) also provided by SEABIRD.

CTD data collected by the Greenland Institute of Natural Resources during cruises with R/V Paamiut using the same instrumentation have gone through the same calibration and quality check.

All quality-controlled data are stored in the Marine Database at the Danish Meteorological Institute from where copies have been sent to ICES and MEDS.

4. Oceanographic conditions off West Greenland in 2005

The surface temperatures and salinities observed during the 2005 cruise are shown in Fig. 11. The cold and low salinity conditions observed close to the coast off Southwest Greenland reflect the inflow of Polar Water carried to the area by the East Greenland Current. Water of Atlantic origin ($T>3^oC$; $S>34.5$) is found at the surface at the three outermost stations on the Cape Farewell and Cape Desolation sections.

In the Baffin Bay the very low surface salinities, generally below 33, is caused by melting of sea-ice during summer and fresh water runoff from land. The salinities around 34 reflect the core of the West Greenland Current, which is slightly modified by Atlantic Water. The warm surface waters in and around the Disko Bay is caused by solar heating of the 20-30 m thin low-saline surface layer.

A vertical section of salinity, temperature and density over the shelf break from Cape Farewell to Sisimiut is shown in Fig. 14 and over the shelf in Fig. 15. The vertical distribution of temperature, salinity and density at sections along the West Greenland coastline is given in Fig.16-Fig. 26 and within the Disko Bay in Fig. 27-Fig. 30. In addition to data from the five standard sections obtained during the TULUGAQ cruise in late June, standard sections further north from Sisimiut up to Upernavik, including section within the Disko Bay, was measured during the R/V PAAMIUT cruise in July.

At intermediate depths Pure Irminger Water ($T \sim 4.5^oC$; $S > 34.95$) was traced north to the Cape Desolation section. Unfortunately, it is unknown if Pure Irminger Water is also present at the Paamiut section, as stormy weather prohibited measurement on the four outermost stations. Modified Irminger Water ($T > 3.5^oC$; $34.95 > S > 34.88$) was observed all the way north to Fylla Bank section. The northward extension of Modified Irminger Water indicates medium to high inflow of water of Atlantic origin to the West Greenland area.

As usual, parts of the Irminger Water recirculates in a cell from just north of Paamiut[4] to the south of Cape Farewell (see e.g. Jakobsen *et at.*, 2003) which is seen as a slightly doming up of isolines.

The average salinity and temperature at 400-600 m depth west of Fylla Bank (st. 4), which is where the core of the Irminger Water is normally found, supports, that the inflow of Irminger Water was higher than normal in 2005 (red

[4] Not observed at the Paamiut section this year, but it is a persistent phenomenon observed almost every year.

curves in Fig. 12). The temperature of this layer is 4.58°C which is 0.43°C higher than normal and the average salinity of 34.90 is 0.09 higher than normal. This is the 6^{th} highest value for salinity and 9^{th} highest for temperature out of 49 measurements.

Noticeably, the temperature seems to be relative warm and stable since the mid-1990s in all layers - and even increasing in the early 2000s. Likewise, the mean salinity in the 400-600 m layer have increased in the early 2000s indicating increased strength of the Irminger Current as pointed out by Ribergaard (2004). Since the early 2000s, not only the strength of the Irminger Current, but also the air temperatures has increased considerable and it is now comparable with the air temperatures for the period mid-1920s to the late 1960s (Fig. 5). It will be interesting to observe, if the climate conditions will remain in this state or "regime" the coming years. According to Stein (2004), warming over time, not just interannual variations, seems to be important for the abundance of juvenile cod and haddock in Greenland waters.

The surface salinity seems in general to be higher than normal and the multi-year-ice "Storis" was absent at West Greenland and only in small concentration on the Southeast coast in the Irminger Basin (Fig. 10), which is seldom observed in June. In the surface layer (0-100 m) week gradients between the cold, low-saline Polar Water and the warm, high-saline water of Atlantic origin was observed. Normally there is a very pronounced core of Polar Water, revealed by its low temperatures, just west of Fylla Bank at depth of 50-100 m, but in 2005 this core was hardly recognizable which is a sign of a reduced inflow of Polar Water in 2005. The core was even more absent than in 2003 and 2004 (see Ribergaard and Buch, 2004; Ribergaard and Buch, 2005). This indicates a very low intensity in the East Greenland Current component. One explanation could be that more than normal Polar Water was drifting eastward north of Iceland, caused by the southeastward wind anomaly north of the Denmark Strait (Fig. 4). At the same time the transport through Denmark Strait was reduced caused by the wind anomaly towards east within the strait and northeastward wind anomalies just south of the strait (Fig. 4).

Measurements west of Fylla Bank (st.4) support reduced inflow of Polar Water and above normal inflow of Atlantic Water (Fig. 12). The surface temperature (0-50 m) was the fifth highest observed more than 1°C above average and the surface salinity was the second highest more than 0.6 above average. At intermediate depths at 50-150 m and 150-400 m the temperatures was respectively the second highest and highest observed about 1.9°C and 1.3°C above average conditions. The salinities were the highest observed about 0.5 and 0.3 above average conditions.

The weak Polar Water core observed at the Sisimiut section in June (Fig. 21) has almost disappeared one month later in July (Fig. 22), whereas the water of Atlantic origin is found in larger quantities in July. This shows part of the annual cycle of the strength of the inflow of Polar Water and Irminger Water to the area, which is not in phase. The strength of the inflow of Irminger Water peaks during autumn and winter whereas the inflow of Polar Water peaks in spring and early summer.

From the Aasiaat section up to the Upernavik section, a very cold subsurface layer is found with temperatures below -1°C (below 0°C at Aasiaat) with cores at depth at about 75 m. This layer is most likely formed during winter by convection. Brine rejection increases the low surface (0.50 m) salinities, so it can overcome the strong surface gradients which are created during summer by melting of sea-ice and run-off of fresh water from land. Below the cold subsurface layer, a relative warm (>1°C) watermass is found with a core around 400–500 m (for the core depth see e.g. Ribergaard and Buch, 2005). This water is the extension of the Irminger Water component of the West Greenland Current.

5. **Fjords around Sisimiut**

The hydrography in fjords is to a large extent determined by the land runoff of fresh water in the surface and at the inflow near the bottom at the mouth of the fjord (see Fig. 13). Often fjords have a sill at the opening to the open ocean and it is the depth of this sill that determinate which watermass is allowed to enter near the bottom. Above sill depth water can freely flow either in or out of the fjord. At the surface the current are often directed out of the fjord caused by the runoff of fresh water, which will increase the sea level in the fjord. Thereby a pressure gradient is established and surface water will flow out of the fjord. Normally this surface water will entrain water from below. To compensate for this entrainment, inflow is taking place at the bottom as sketched in Fig. 13.

In the West Greenlandic fjord basically three different kinds of waters exists:

- Relative warm and saline waters of Atlantic origin (mixed Irminger Water).

- Cold and relative fresh water of polar origin (mixed Polar Water).
- Fresh surface water from land, either as melting of the Greenland Ice Sheet or from precipitation (surface water). The amount of this water is highly variable depending on the time of the year. The water is mixed with the surrounding surface waters, which is Polar Water. This mixing is continues going on along the coast, and the watermass keeps close to the coast. In the following it is named Coastal Polar Water.

Four fjords around Sisimiut were investigated (Fig. 31-Fig. 34). They represent two very different types of fjords: two with deep sills (Amerdloq, Ikertoq), one with shallow sills (Kangerdluarssuk). Itivdleq[5] fjord has an intermediate sill depth, which categorizes it as a fjord with a shallow sill, which occasionally has properties as a fjord with a deep sill depth. None of the fjords are directly connected to the Greenland ice sheet, and so the fresh water supply added are limited to runoff from land. For all fjords, the fresh water added is of minor importance as can be seen directly from a topographic map, but also by the fact, that only a shallow fresh water cap is measured at the surface.

In the deep sill fjords, Amerdloq and Ikertoq fjord (Fig. 31 and Fig. 32), the sill depth is about 150-180 m. These sill depths allow relative warm and saline waters of Atlantic origin to enter the fjords close to the bottom. The density is higher than the Coastal Polar Water above, even at the freezing point of the Coastal Polar Water. Thereby winter convection to the bottom is prevented. The bottom water up to about sill depth remain saline and "warm" (1-3°C). Above sill depth the salinities are almost homogenous whereas the temperature is coldest just above the interface between the diluted Irminger Water and the Coastal Polar Water. This cold water could be a result of winter convection of Coastal Polar Water, or it is just the core of the Polar Water. This water is actually also seen outside the fjord just above 200 m depth. Close to the surface a thin warm layer (~15 m for Amerdloq, ~50 m for Ikertoq) is found caused by the sun heating of runoff water from land. Compared to the observations in 2003 (see Ribergaard and Buch, 2004) the salinity has increased by 0.09/0.17 and the temperature decreased by 0.50°C/0.06°C for Amerdloq/Ikertoq fjord. Amerdloq is slightly more saline and warmer than Ikertoq reflecting deeper sill depth of Amerdloq, but the salinities has become more similar.

Kangerdluarssuk fjord (Fig. 33) can be considered as a fjord with shallow sill. Kangerdluarssuk fjord have a sill depth of about 50 m. The whole bottom layer below sill depth is filled with Coastal Polar Water and the salinity is very homogeneous. During winter the Coastal Polar Water are cooled and undergoes convection. As the water inside the fjord have homogenous salinities the whole water column are gradually cooled by winter convection and the water become totally homogenous (neutral stability). Therefore cold temperatures are measured below sill depth. The bottom temperature is below 0°C and the bottom salinity is just above 33.6. The low salinity at depth indicates, that the winter cooled water is actually Coastal Polar Water. At the surface relative warm water is found in both fjords caused by the solar radiation during spring and summer. In the top a thin (~15 m) warm solar heated fresh water cap is found caused by runoff from land. The hydrographic measurements below sill depth is very similar to what observed in 2003 (Ribergaard and Buch, 2004).

Itivdleq fjord (Fig. 34) may be considered as a fjord with properties of a fjord with both a shallow and deep sill. The sill depth is about 100 m which most of the year prohibit the relative "warm" and saline water of Atlantic origin to enter. However, occasionally, the deep water is influenced by water from outside the fjord, which is denser and more saline than the water found in the fjord above sill depths. The bottom salinities are about 34 and temperatures below 1°C. A gradient in salinity with depth below sill depth shows, that winter convection to the bottom has not taken place in the last few years, despite of fairly constant temperatures just below 1°C below sill depth. The density of the water below sill depth is marginally higher than the surface water above, even at the freezing point of the water above sill depth. This exclude winter convection to the bottom, but only small changes in the properties of the Coastal Polar Water could change this statement. It is therefore believed, that winter convection occasionally takes place depending on the salinity of the Coastal Polar Water during winter. Part of the water at intermediate depths below sill depth could be Coastal Polar Water from outside earlier of the year, when it was colder. In the top near the mouth of the fjord a thin (~10 m) warm solar heated fresh water cap is found caused by runoff from land.

[5] The picture on the front page is taken towards south near the mouth of the Itivdleq fjord in June 2005.

Conclusions

The oceanographic conditions off West Greenland during the summer 2005 was characterised by:

- NAO index was slightly negative.
- The center of action of the westerlies was shifted towards north caused by a northward displacement of both the Icelandic low and the Azores high.
- The westerlies over the North Atlantic are decreased south of a line between Portugal and Cape Farewell, i.e. anomaly easterlies.
- The westerlies has increased north of about 55°N.
- Anomaly warm air over most of the North Atlantic sector with highest anomalies over the Davis Strait.
- Weak East Greenland Current. The local windstress north of Iceland most likely forced higher than normal fraction of the Polar Water to turn eastward just north of Denmark Strait and further north of Iceland. South of the strait the wind anomalies was northeastward, which reduced the southward transport of Polar Water through the Denmark Strait.
- Nuuk air temperature was about 1.5°C higher than normal.
- Medio June water temperature on top of Fylla Bank was about 2°C above average while the salinity were close to average. The water temperature was the highest observed.
- Week inflow of Polar Water and above normal inflow of Irminger Water reflected by the facts that:
  - The concentration of "Storis" was very low.
  - Polar Water temperature above 0°C everywhere.
  - Cold core of Polar Water could hardly be distinguished at Fylla Bank.
  - Pure Irminger Water could be traced up to the Cape Desolation section (and maybe at the Paamiut section) and Modified Irminger Water could be traced up to the Fylla Bank section.
  - West of Fylla Bank (st. 4) the surface temperature (0-50 m) was the fifth highest observed, more than 1°C above average. The surface salinity was the second highest more than 0.6 above average.
  - West of Fylla Bank (st. 4) at intermediate depths at 50-150 m and 150-400 m the temperatures and salinities were among the highest observed.
  - West of Fylla Bank (st. 4) the mean temperature and salinity in 400-600 m depth was about 0.4°C and 0.08 above average conditions respectively. These are high values among the 6-9 highest observed, but not as high as e.g. in 2004.
  - Weak gradient between Polar Water and Irminger Water.

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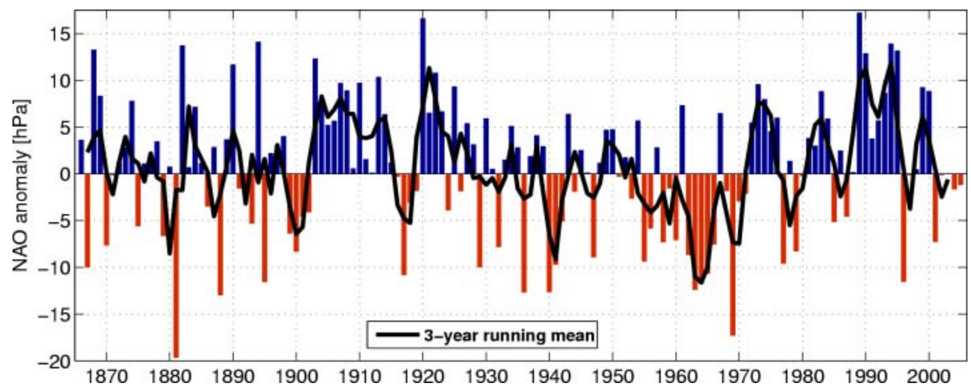

Fig. 1. Time series of winter (December–March) index of the NAO from 1865–2005. The heavy solid line represents the meridional pressure gradient smoothed with a 3-year running mean filter to remove fluctuations with periods less than 3 years. (Data updated, as described in Buch *et al.*, 2004, from http://ww.cru.uea.ac.uk/cru/data/nao.htm).

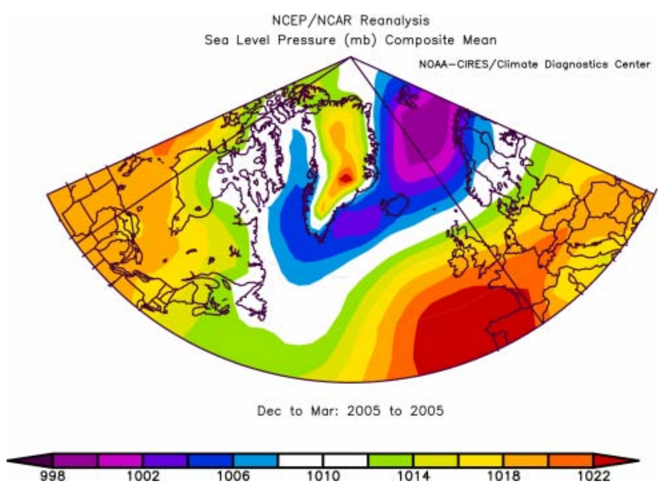

Fig. 2. Winter (DJFM) sea level pressure for 2004/2005 in the North Atlantic region. NCEP/NCAR re-analysis (taken from http://www.cdc.noaa.gov).

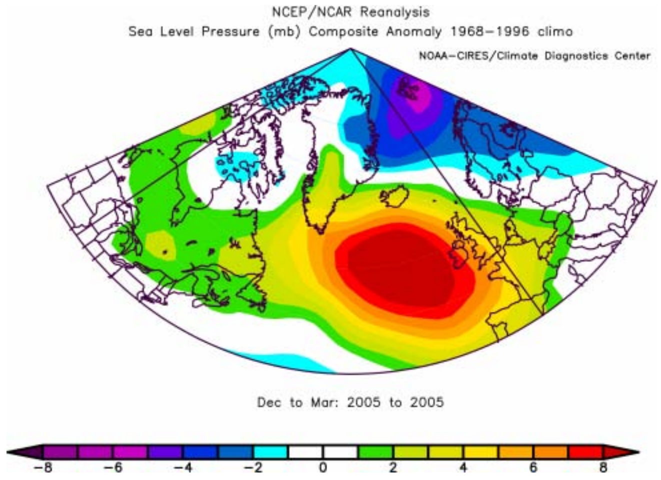

Fig. 3. Winter (DJFM) sea level pressure anomaly for 2004/2005 in the North Atlantic region. NCEP/NCAR re-analysis (taken from http://www. cdc.noaa.gov).

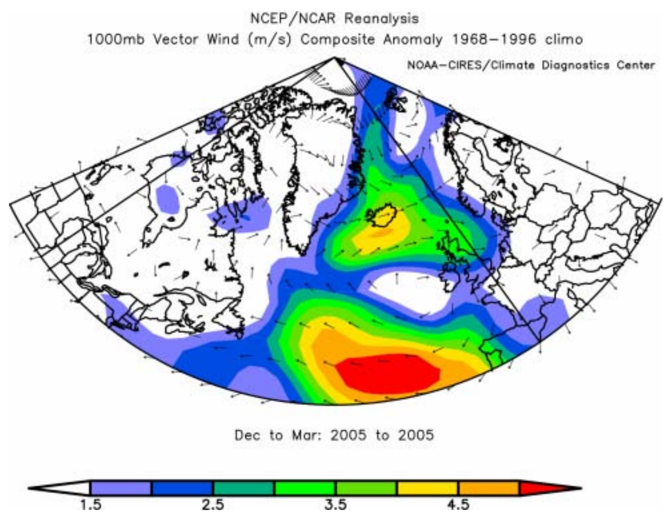

Fig. 4. Winter (DJFM) wind anomaly for 2004/2005 in the North Atlantic region. NCEP/NCAR re-analysis (taken from http://www.cdc.noaa.gov).

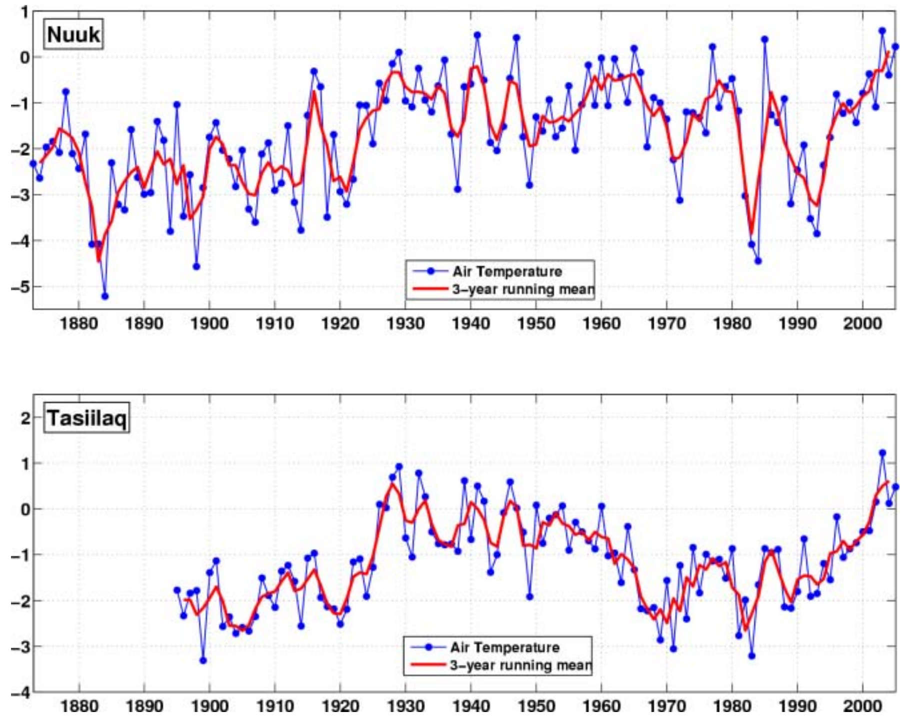

Fig. 5. Annual mean air temperature observed at Nuuk and Tasiilaq for the period 1873-2005. The mean and standard deviation is -1.32 ± 1.19°C for Nuuk and -1.25 ± 0.92°C for Tasiilaq.

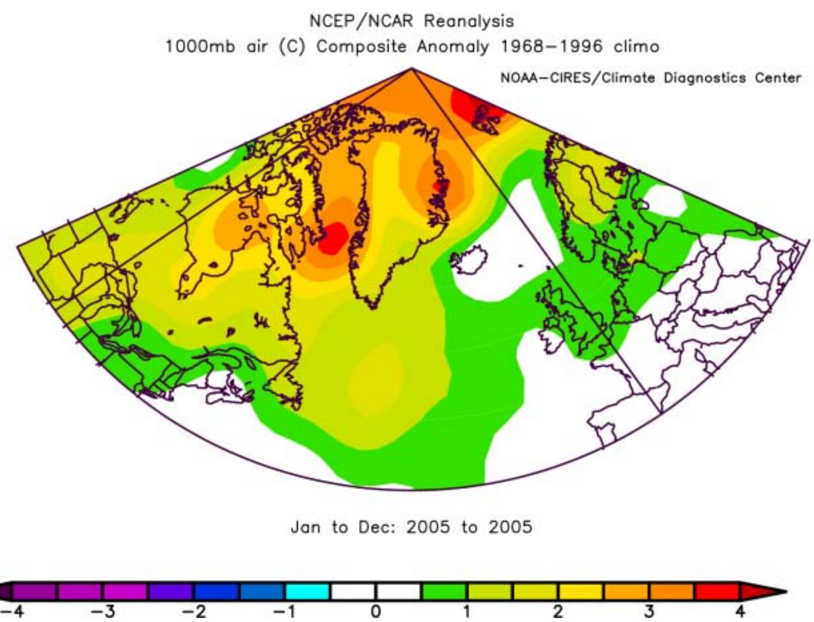

Fig. 6. Anomalies of the mean air temperature for 2005 in the North Atlantic region. NCEP/NCAR re-analysis (taken from http://www.cdc.noaa.gov).

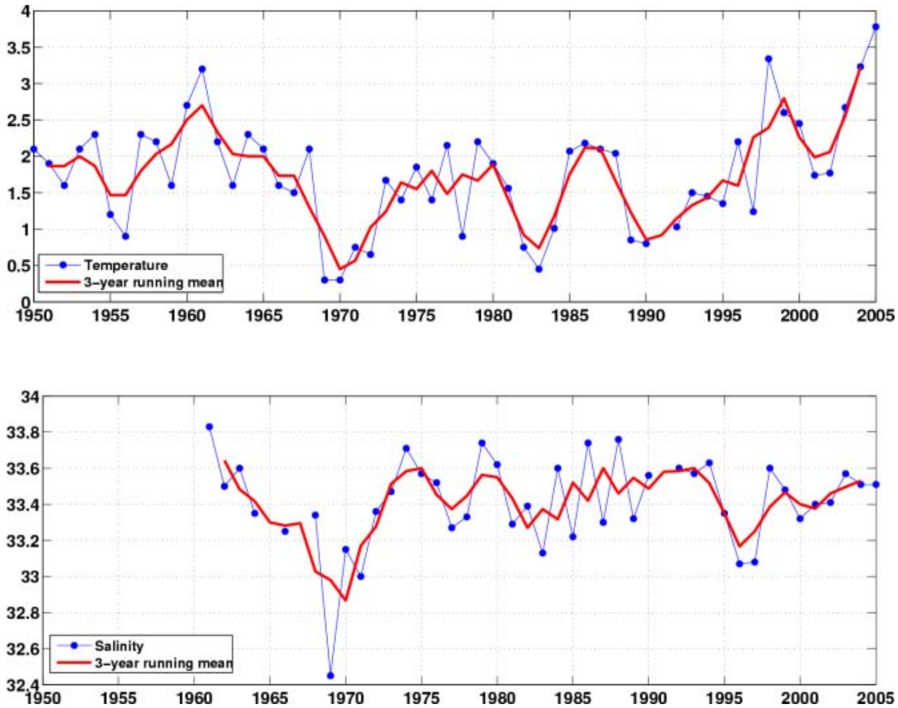

Fig. 7. Time series of mean temperature (top) and mean salinity (bottom) on top of Fylla Bank (0-40 m) in the middle of June for the period 1950-2005. The mean and standard deviation is 1.75±0.76°C for temperature and 33.42±0.25 for salinity. The red curve is the 3 year running mean value.

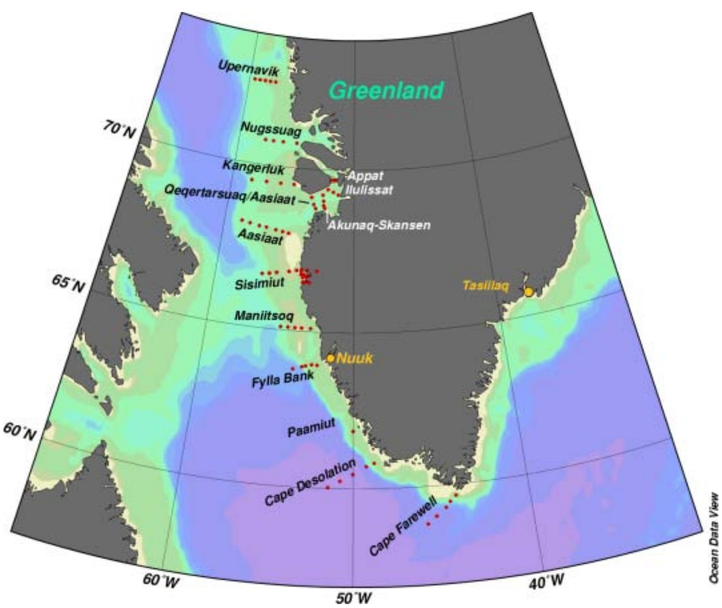

Fig. 8. Position of the oceanographic sections off West Greenland where measurements were preformed in 2005. The fjord sections at Sisimiut are *not* standard sections, but sections are measured this year (see Fig. 9). Due to stormy weather, only one station was taken on the Paamiut section. Map produced using Ocean Data View (Schlitzer, 2005).

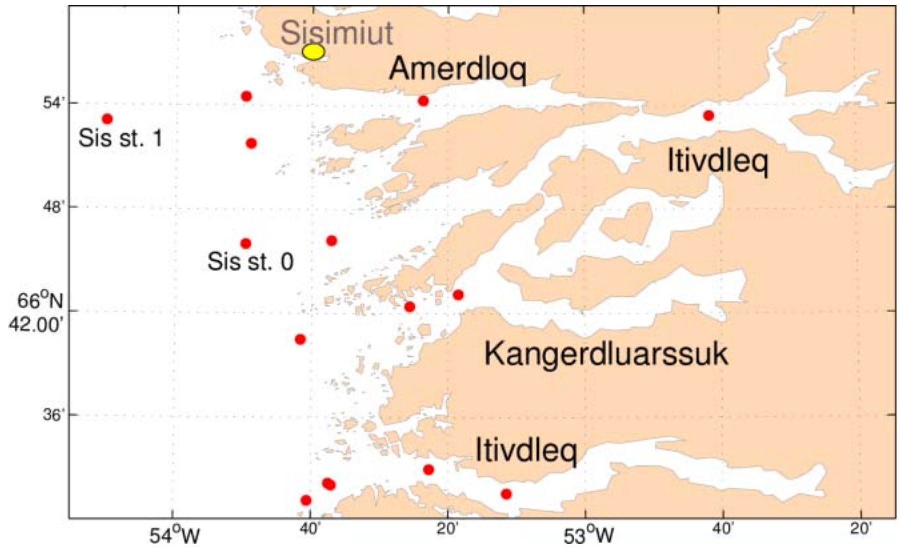

Fig. 9. Position of the oceanographic fjord sections around Sisimiut where measurements were preformed in 2005. See Fig. 8 for position of all sections measured in 2005.

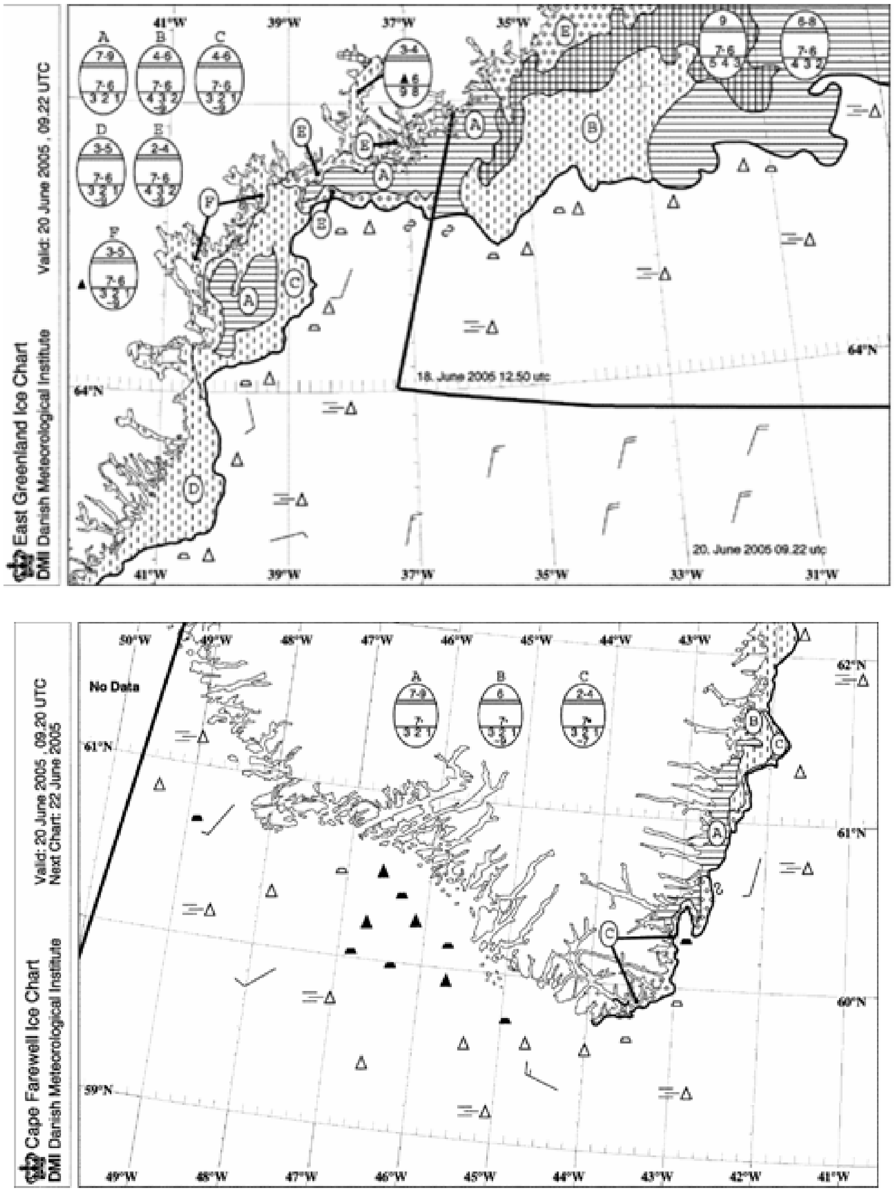

Fig. 10. Distribution of sea ice in the Amerssalik region valid at 19–20. June 2005 (top) and in the Cape Farewell region valid at 20. June 2005 (bottom).

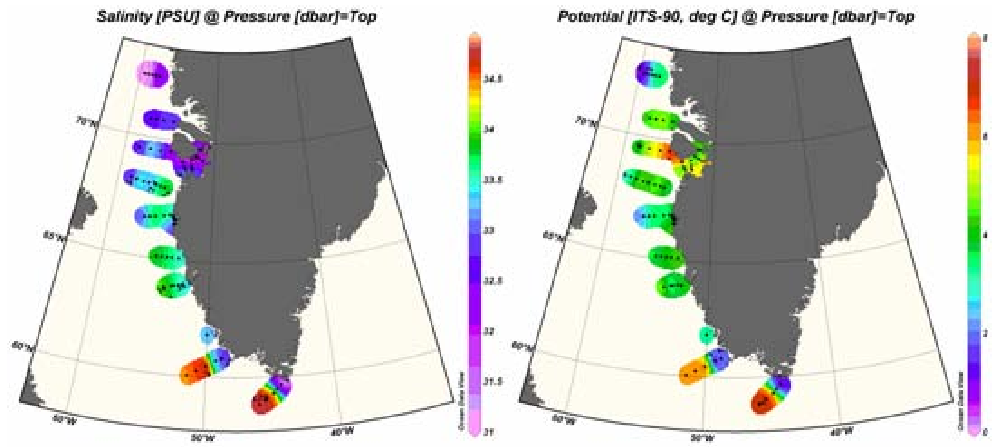

Fig. 11. Salinity (left) and temperature (right) observed in 2005 at the surface. The data are from late June south of Sisimiut, and from July north of Sisimiut (section about 67°N). The Sisimiut section was measured both in June and July. Contour lines shown for 33.0, 33.4, 33.7, 34.0, 34.4, 34.75, 34.85, 34.95 for salinity and from -2°C to 7°C for temperature with an interval of one degree.

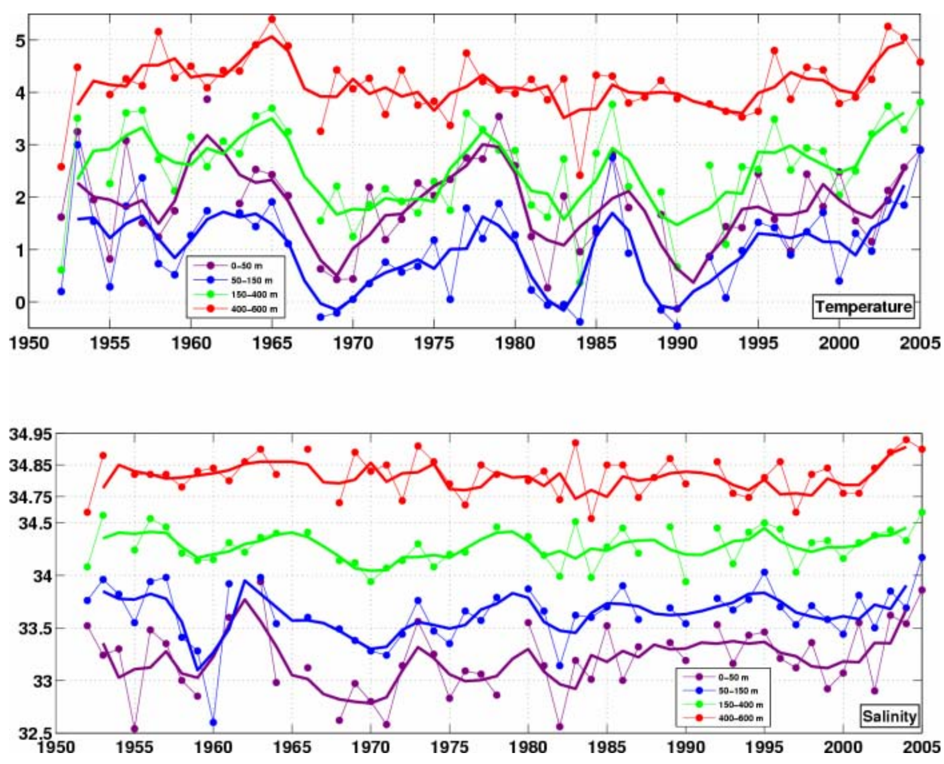

Fig. 12. Time series of mean temperature (top) and mean salinity (bottom) for the period 1950-2005 in four different depth intervals west of Fylla Bank (st.4) over the continental slope. The thick curves are the 3 year running mean values. Note the change in scales at 34.75 for salinity.

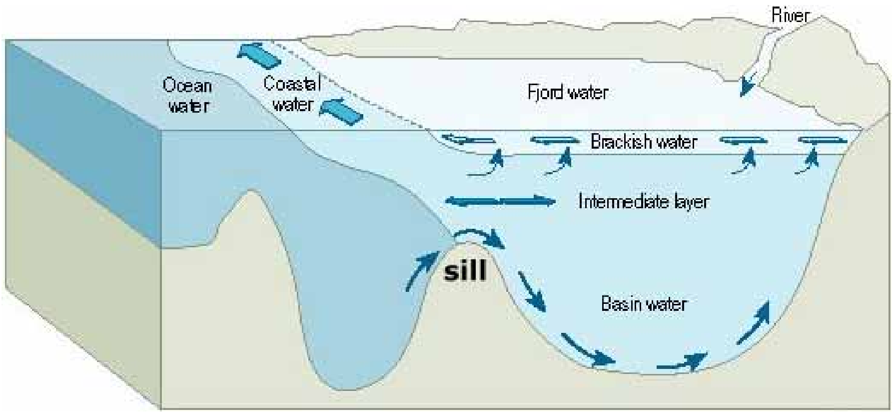

Fig. 13. Sketch of the circulation in a fjord (modified from http://www.amap.no/maps-gra/show.cfm?figureId=58).

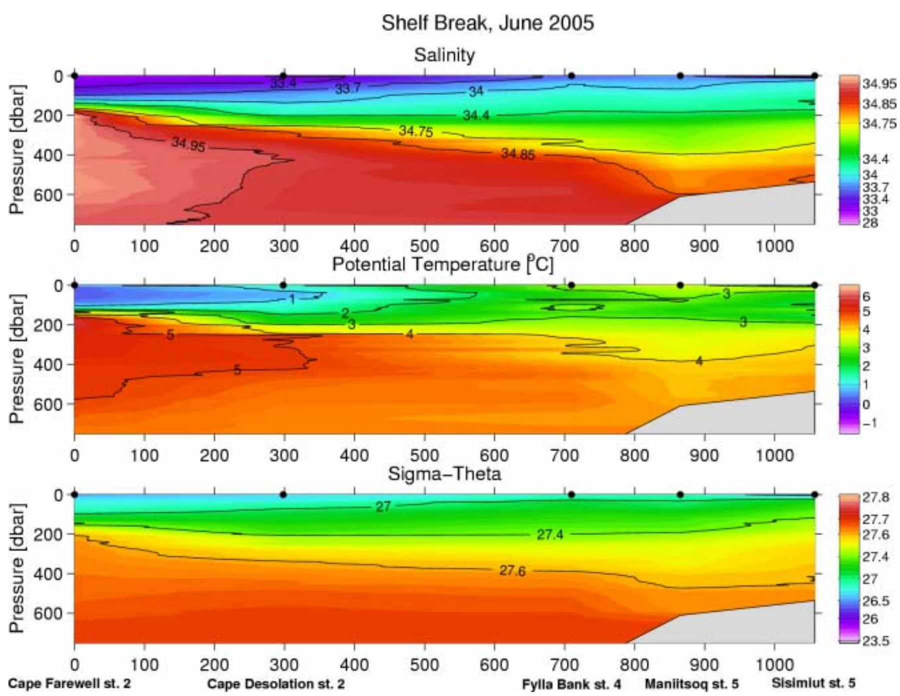

Fig. 14. Vertical distribution of temperature, salinity and density over the continental shelf break from Cape Farewell to Sisimiut, June 20-27, 2005.

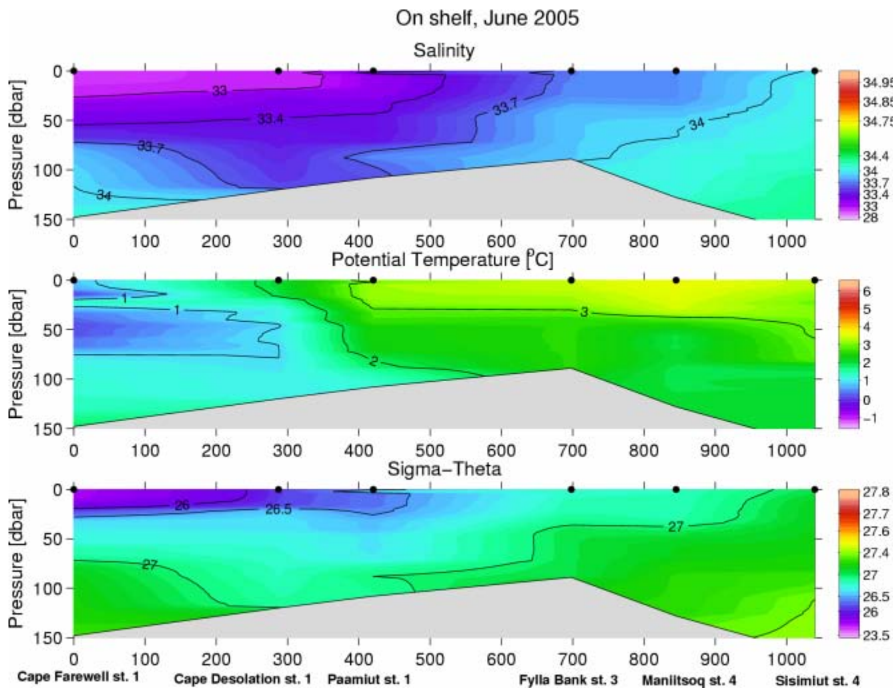

Fig. 15. Vertical distribution of temperature, salinity and density over the shelf banks from Cape Farewell to Sisimiut, June 20-27, 2005.

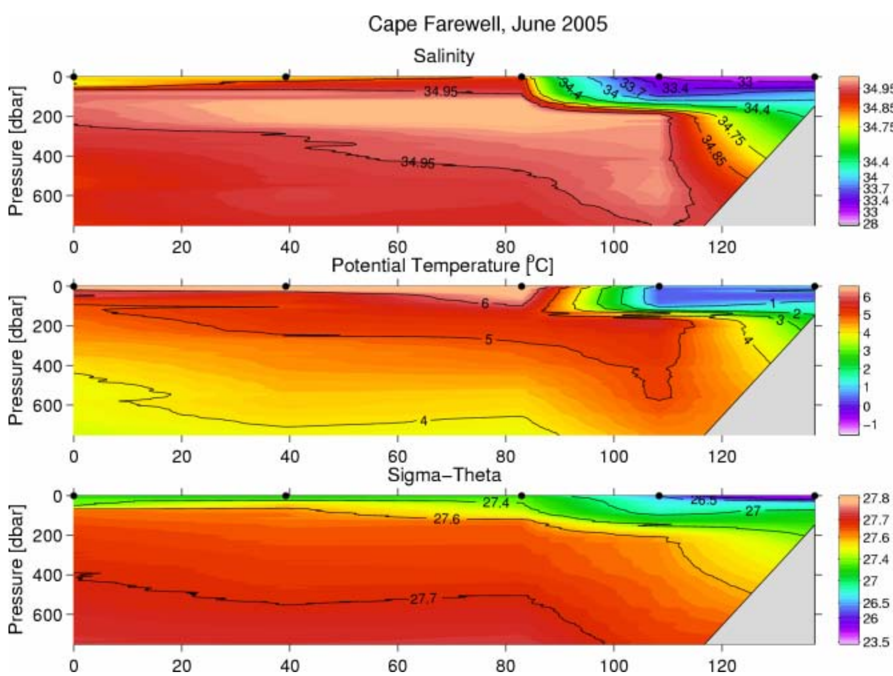

Fig. 16. Vertical distribution of temperature, salinity and density at the Cape Farewell section, June 20, 2005.

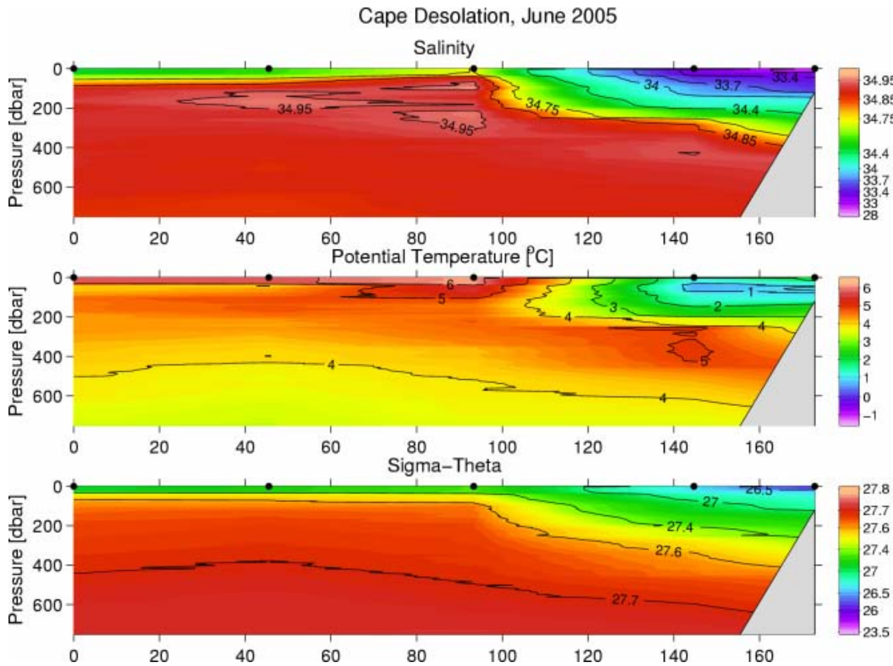

Fig. 17. Vertical distribution of temperature, salinity and density at the Cape Desolation section, June 21-22, 2005.

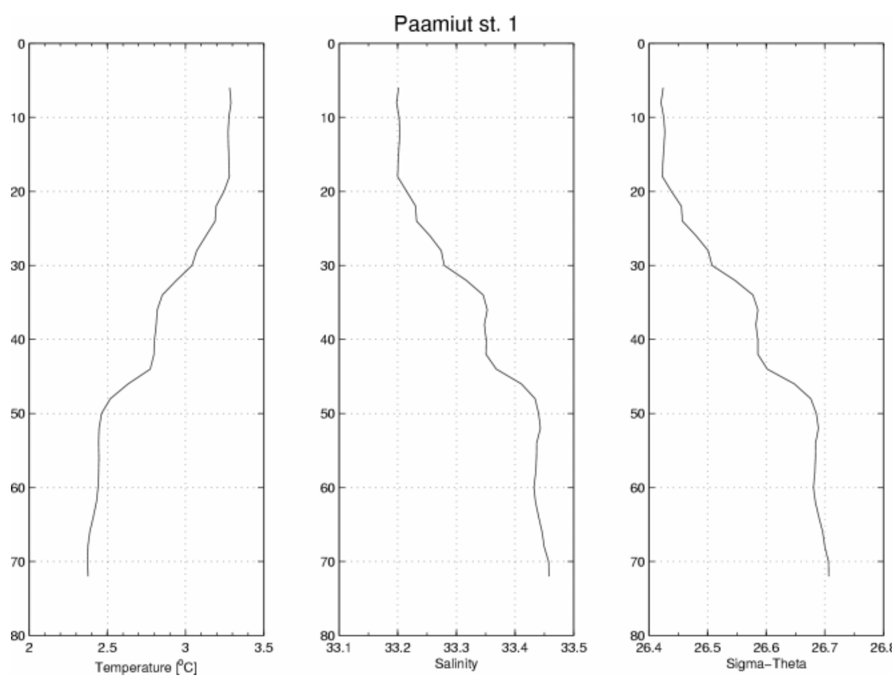

Fig. 18. Vertical distribution of temperature, salinity and density at the Paamiut (Frederikshaab) section 1, June 23, 2005.

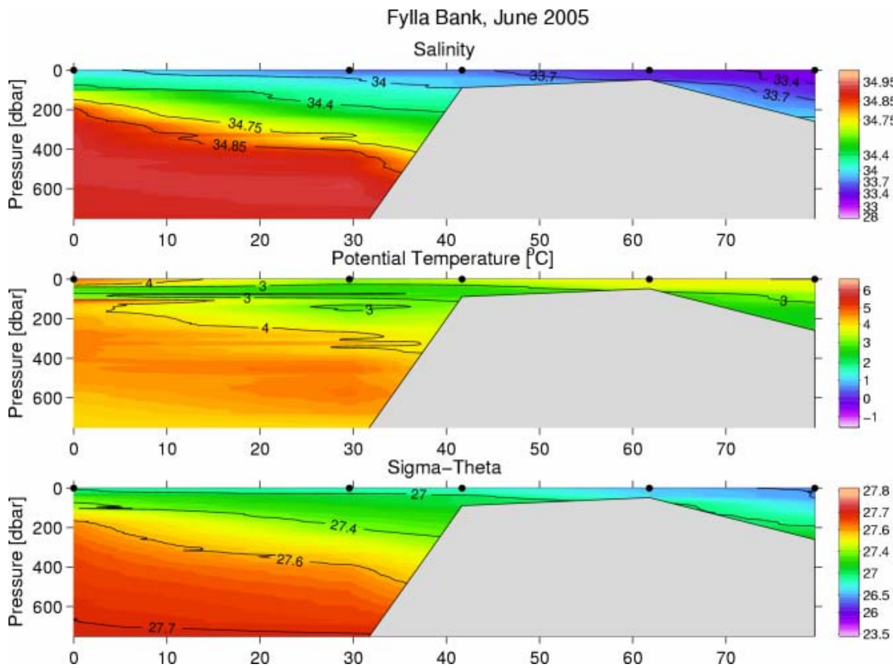

Fig. 19. Vertical distribution of temperature, salinity and density at the Fylla Bank section, June 25-26, 2005.

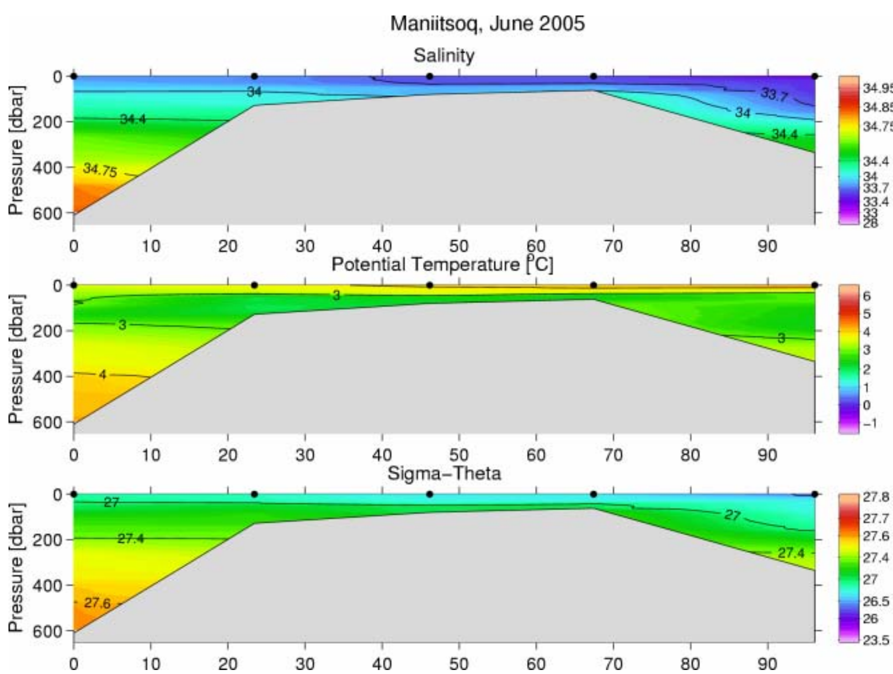

Fig. 20. Vertical distribution of temperature, salinity and density at the Maniitsoq (Sukkertoppen) section, June 26, 2005.

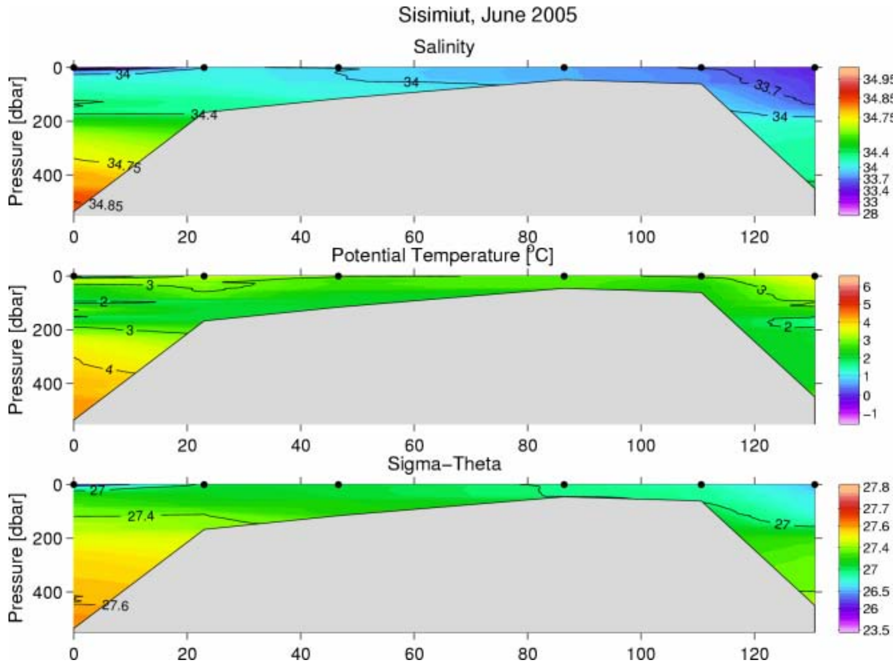

Fig. 21. Vertical distribution of temperature, salinity and density at the Sisimiut (Holsteinsborg) section, June 27-28, 2005. Sisimiut st. 0 right.

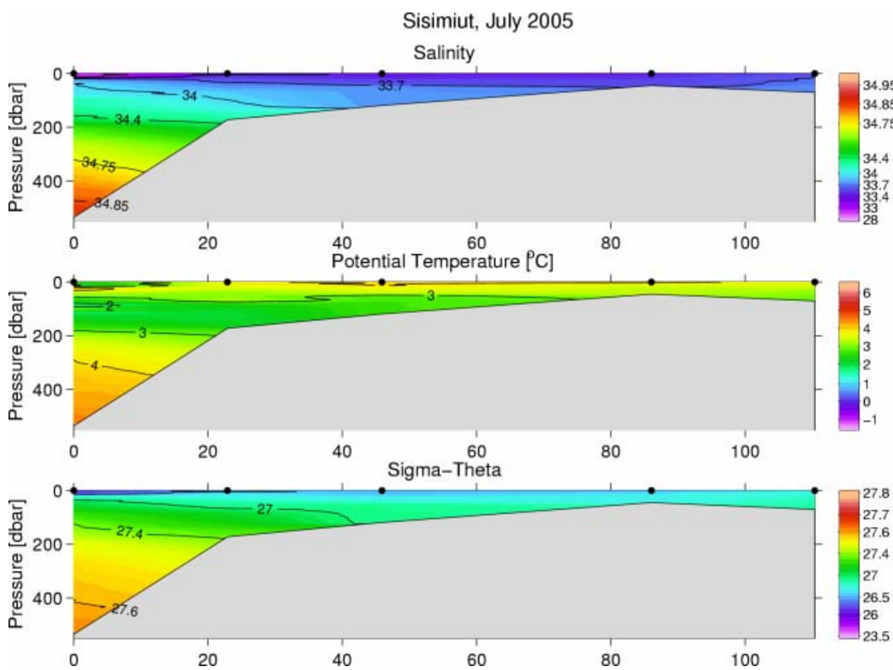

Fig. 22. Vertical distribution of temperature, salinity and density at the Sisimiut (Holsteinsborg) section, July 4-6, 2005.

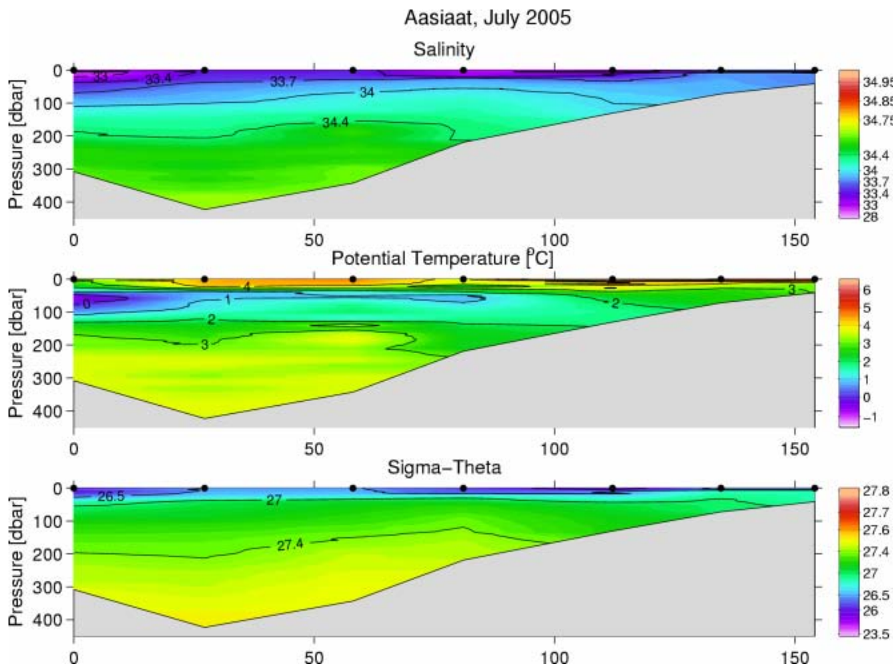

Fig. 23. Vertical distribution of temperature, salinity and density at the Aasiaat section, July 8-11, 2005.

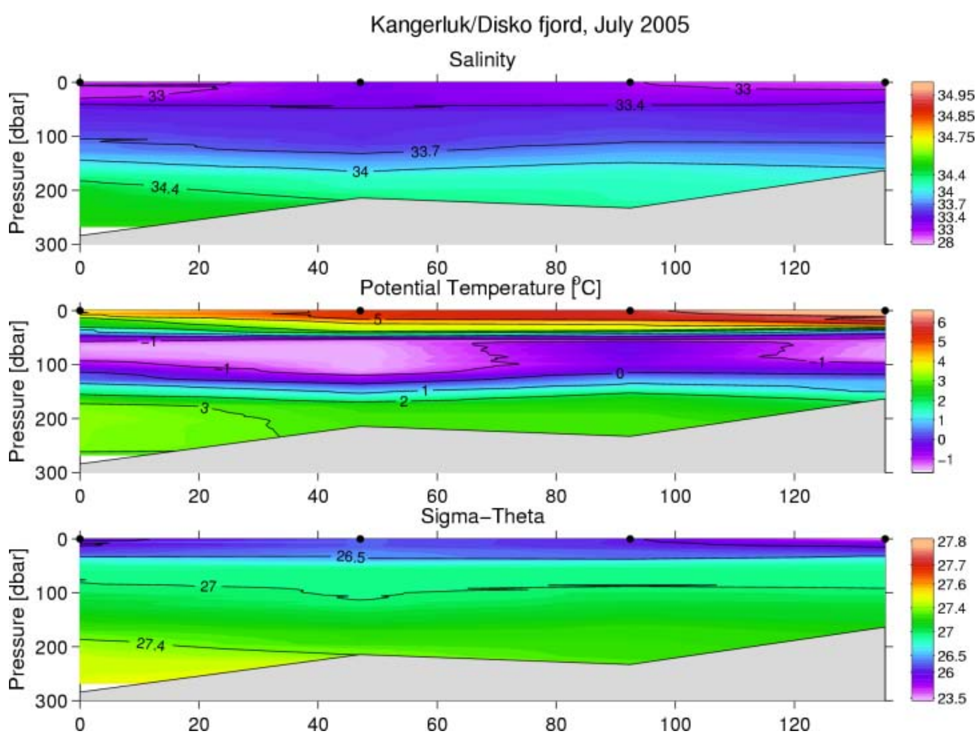

Fig. 24. Vertical distribution of temperature, salinity and density at the Kangerluk (Disko Fjord) section, July 26-27, 2005.

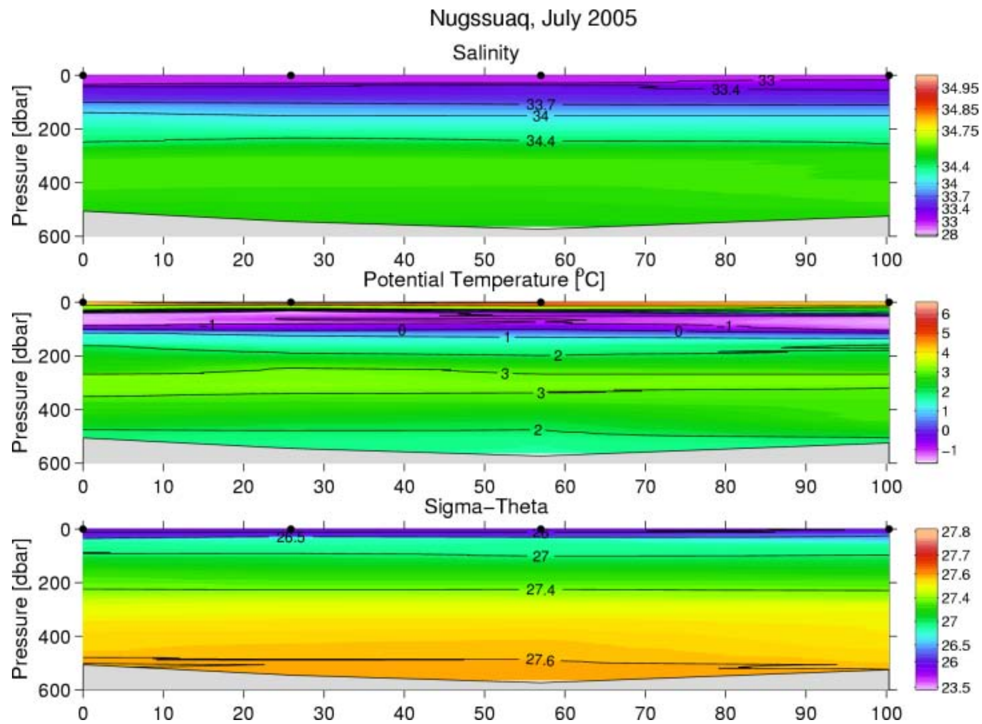

Fig. 25. Vertical distribution of temperature, salinity and density at the Nugssuaq section, July 24–25, 2005.

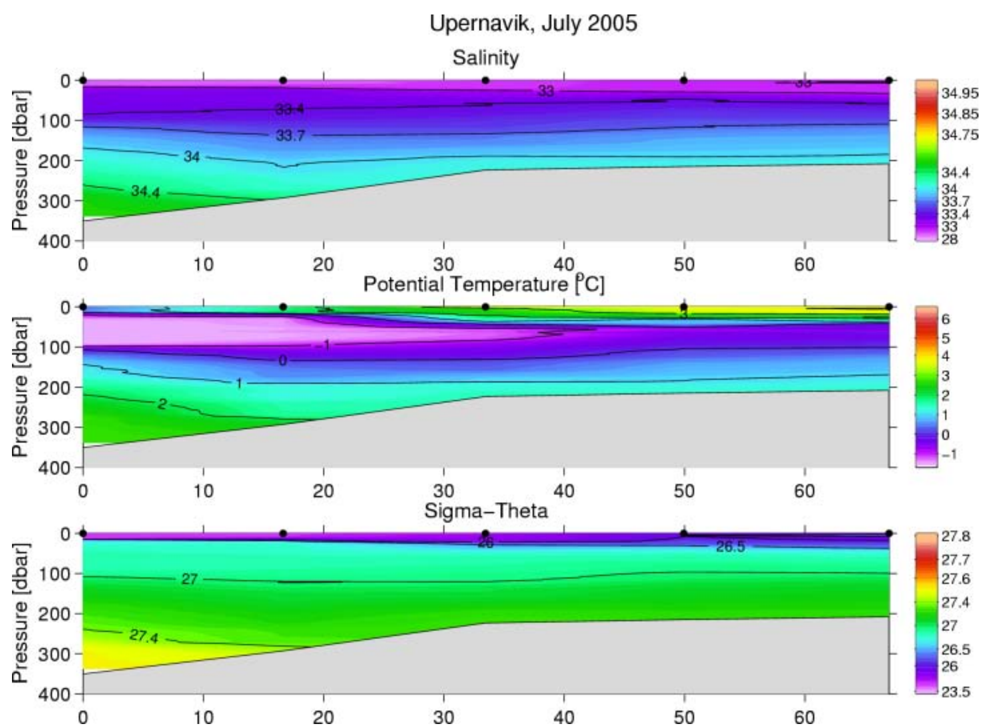

Fig. 26. Vertical distribution of temperature, salinity and density at the Upernavik section, July 22–23, 2005.

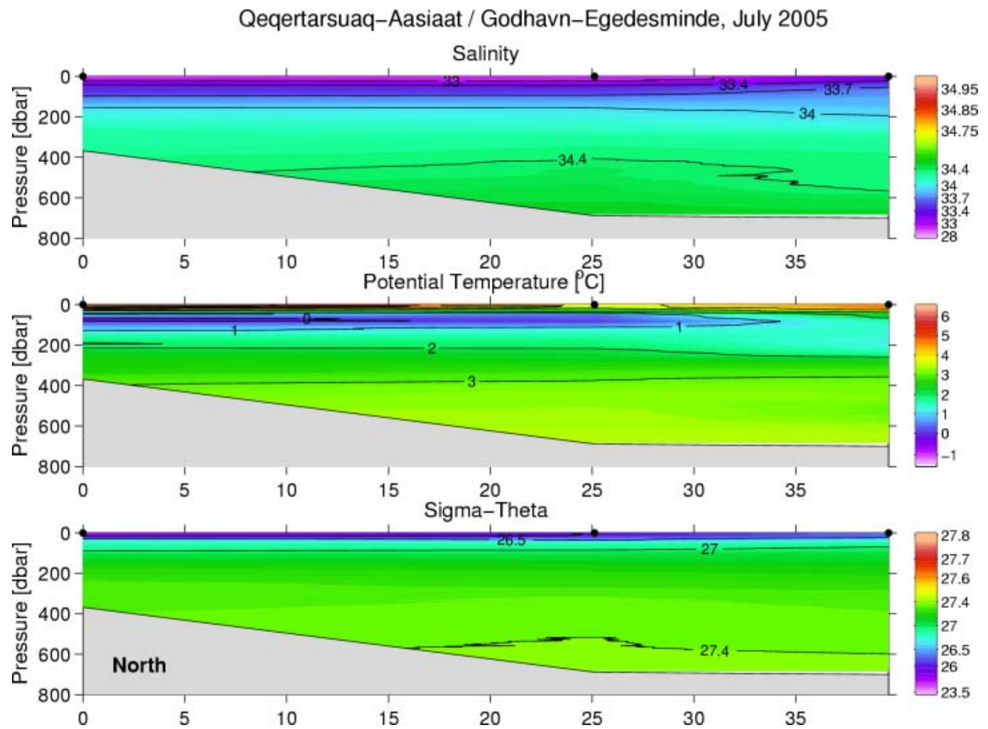

Fig. 27. Vertical distribution of temperature, salinity and density at the Aasiaat–Qeqertarsuaq (Egedesminde–Godhavn) section, July 12, 2005.

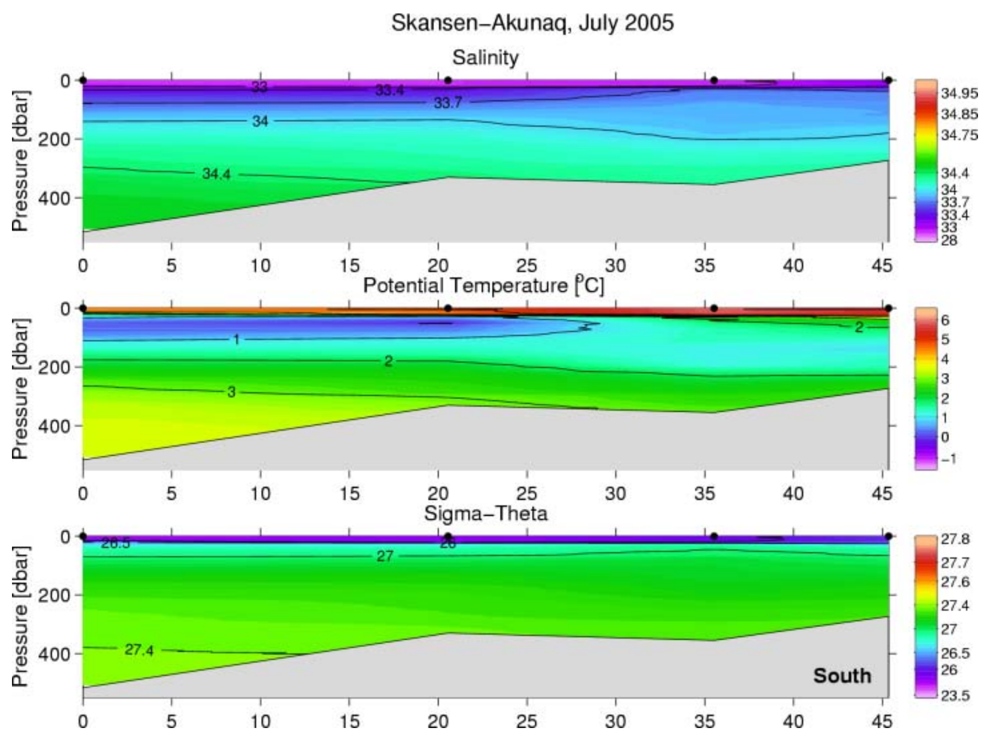

Fig. 28. Vertical distribution of temperature, salinity and density at the Skansen–Akunaq section, July 12-13, 2005.

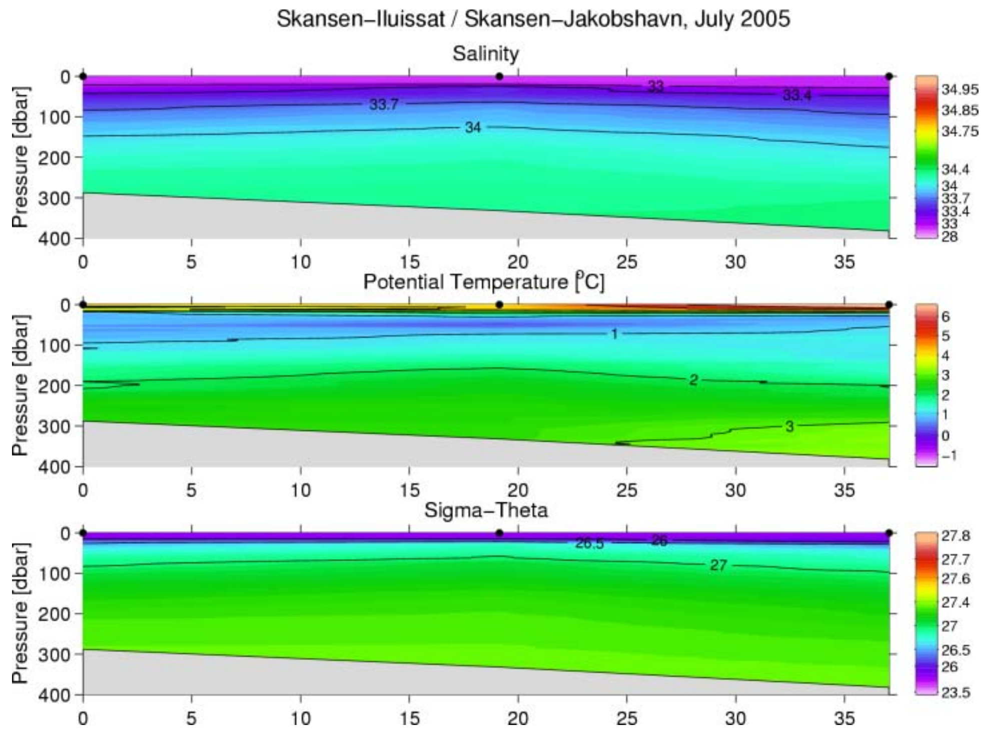

Fig. 29. Vertical distribution of temperature, salinity and density at the Skansen–Iluissat (Skansen–Jakobshavn) section, July 13, 2005.

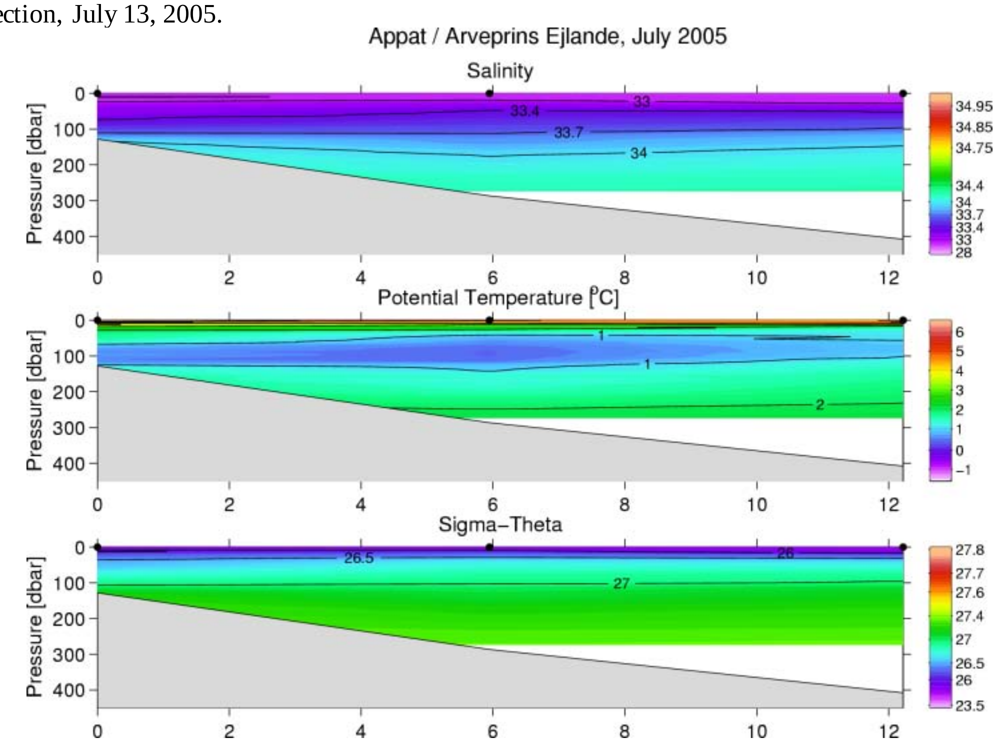

Fig. 30. Vertical distribution of temperature, salinity and density at the Appat (Arveprins Ejlande) section, July 25, 2005.

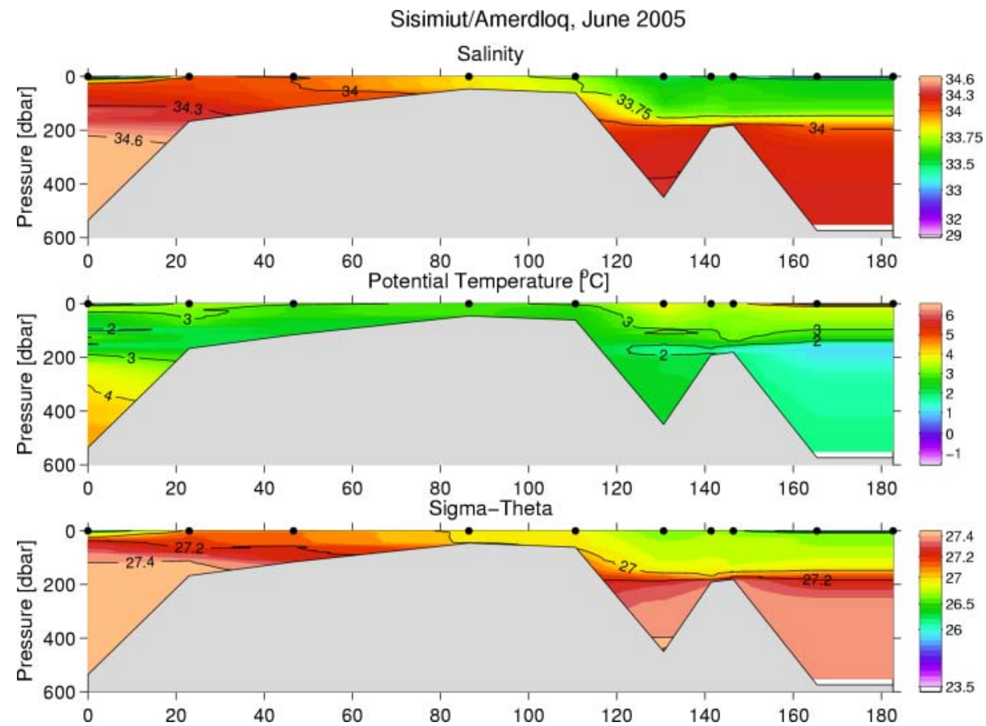

Fig. 31**.** Vertical distribution of temperature, salinity and density at the Amerdloq fjord, June 27-28, 2005. St.1 (#4 from right) south of the fjord. Sisimiut section left (identical to Fig. 19). Note, the innermost fjord station has been repeated.

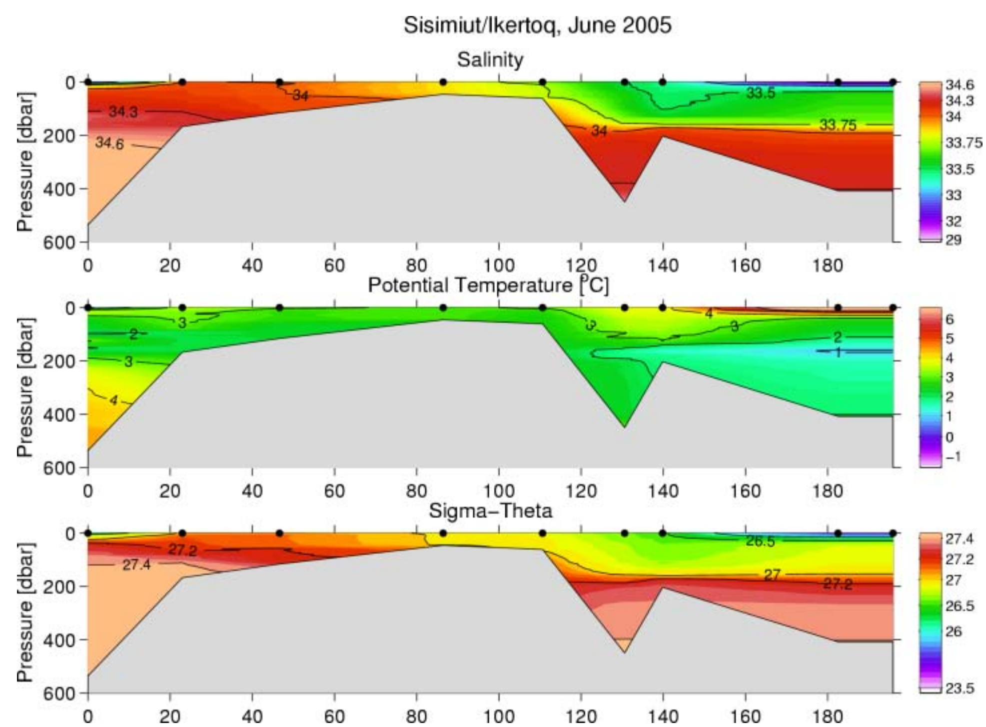

Fig. 32**.** Vertical distribution of temperature, salinity and density at the Ikertoq fjord, June 27-28, 2005. Sisimiut section left (identical to Fig. 19). Note, the innermost fjord station has been repeated

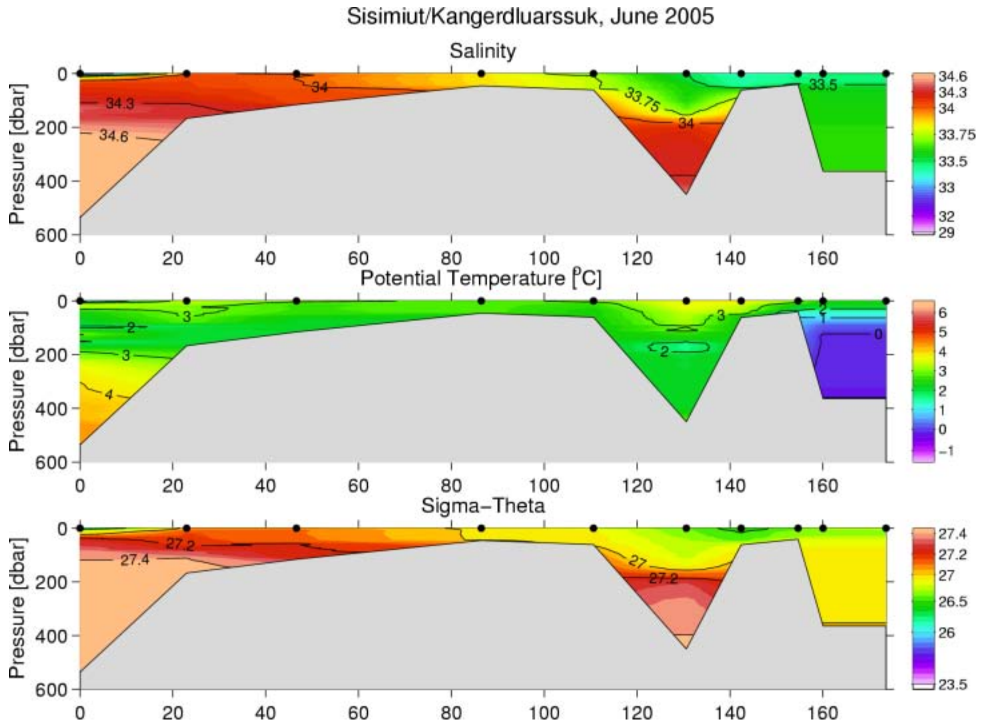

Fig. 33. Vertical distribution of temperature, salinity and density at the Kangerdluarssuk fjord, June 27-28, 2005. Sisimiut section left (identical to Fig. 19). Note, the innermost fjord station has been repeated

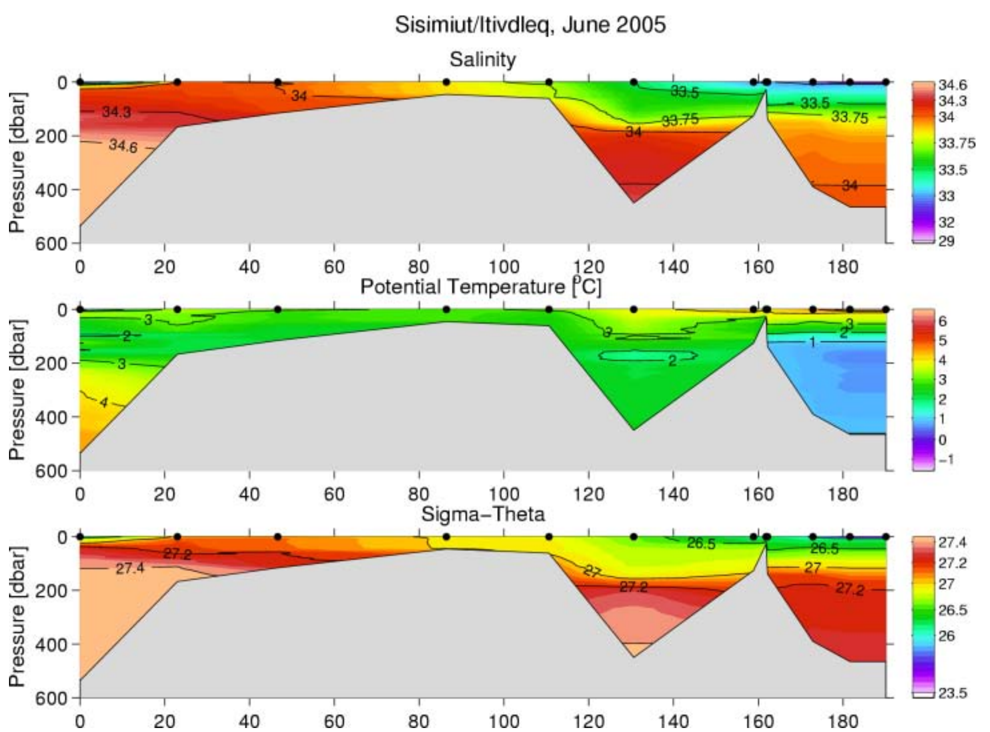

Fig. 34. Vertical distribution of temperature, salinity and density at the Itivdleq fjord, June 27-29, 2005. Sisimiut section left (identical to Fig. 19). Note, the innermost fjord station has been repeated