ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Change of heat in the intermediate and deep Eurasian Basin of the Arctic Ocean – up to 2008

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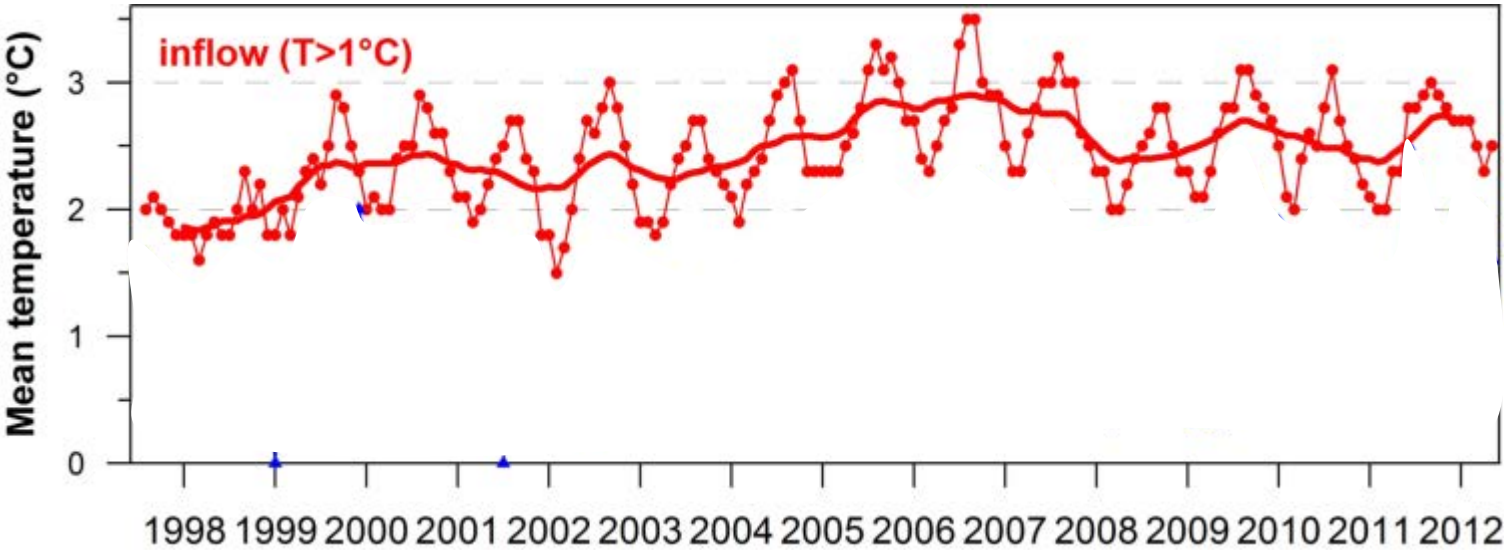
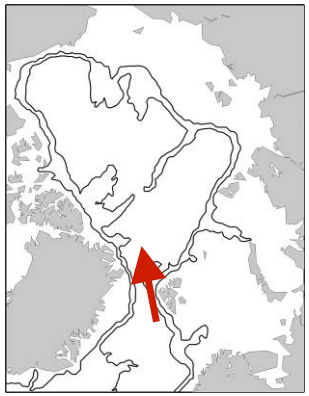
Agnieszka Beszczynska-Möller (AWI/IOPAS)

Data from the Arctic oceanography community

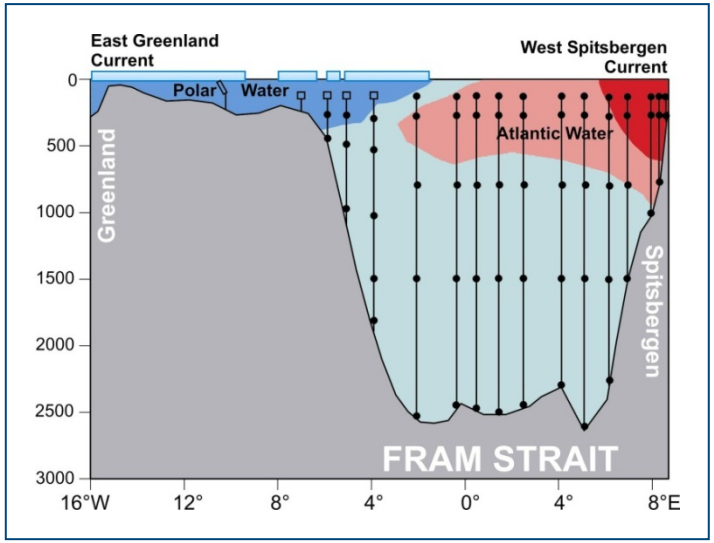
HELMHOLTZ
GEMEINSCHAFT

Temperature of northward flow in Fram Strait
(update by Agnieszka after Schauer and Beszczynska-Möller, 2009)



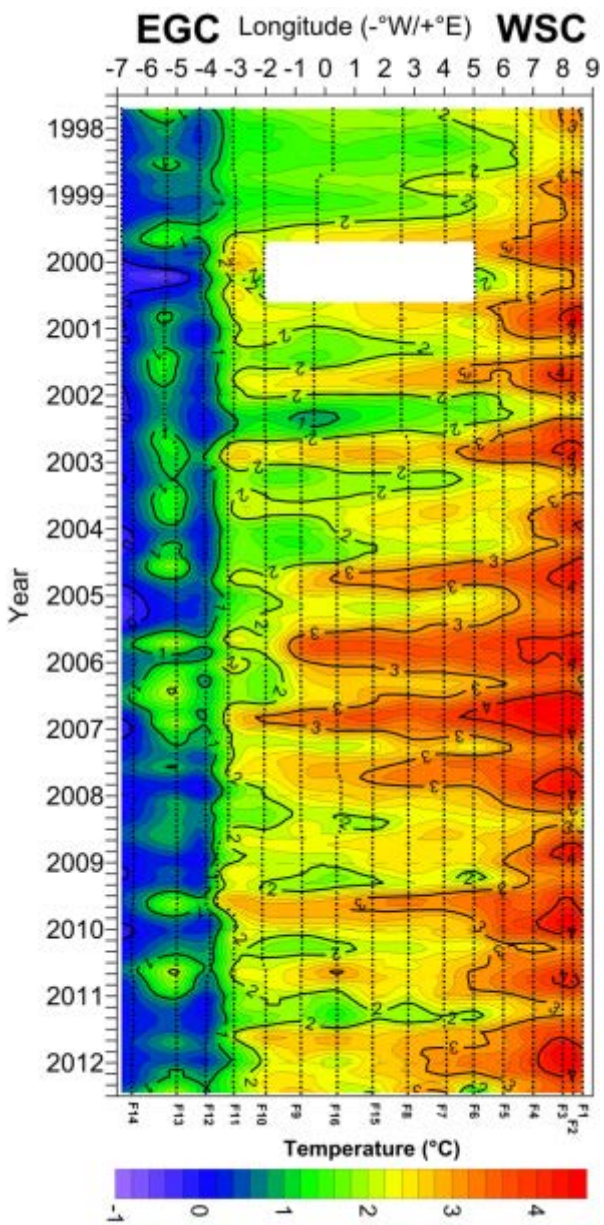


Since 1997 measurements of oceanic fluxes through the Fram Strait

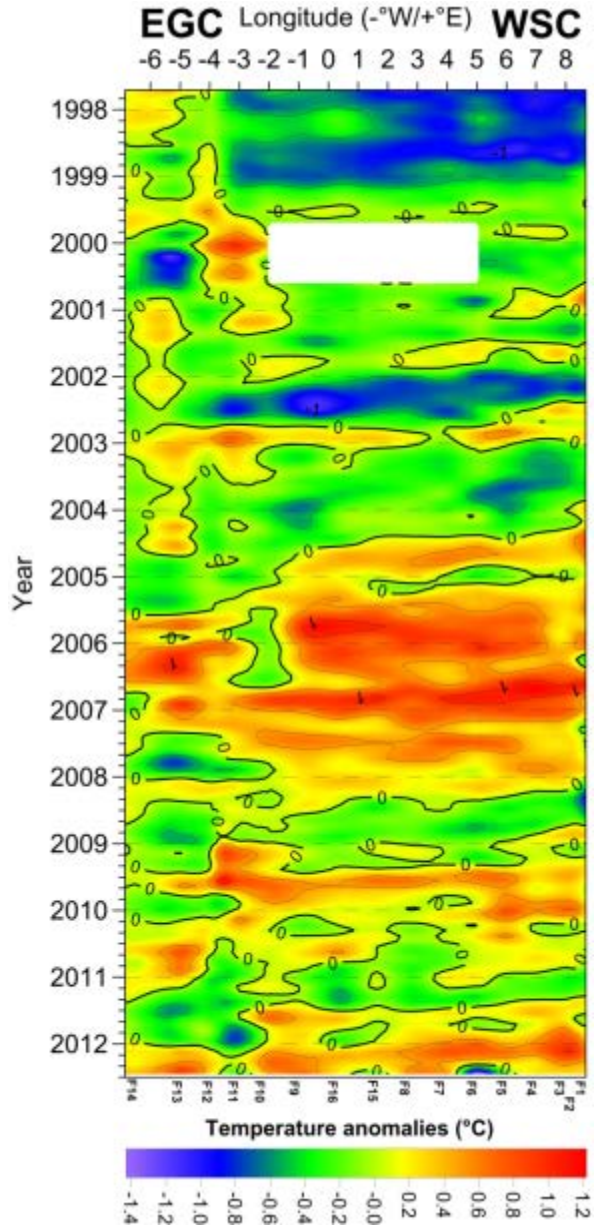


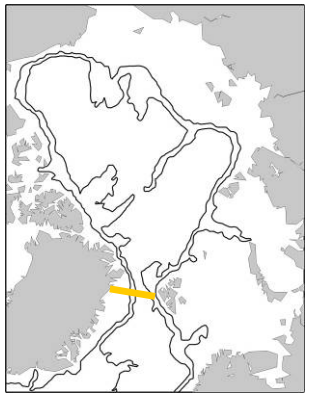
Spatio-temporal variability of temperature @ ca. 230 m

Temperature



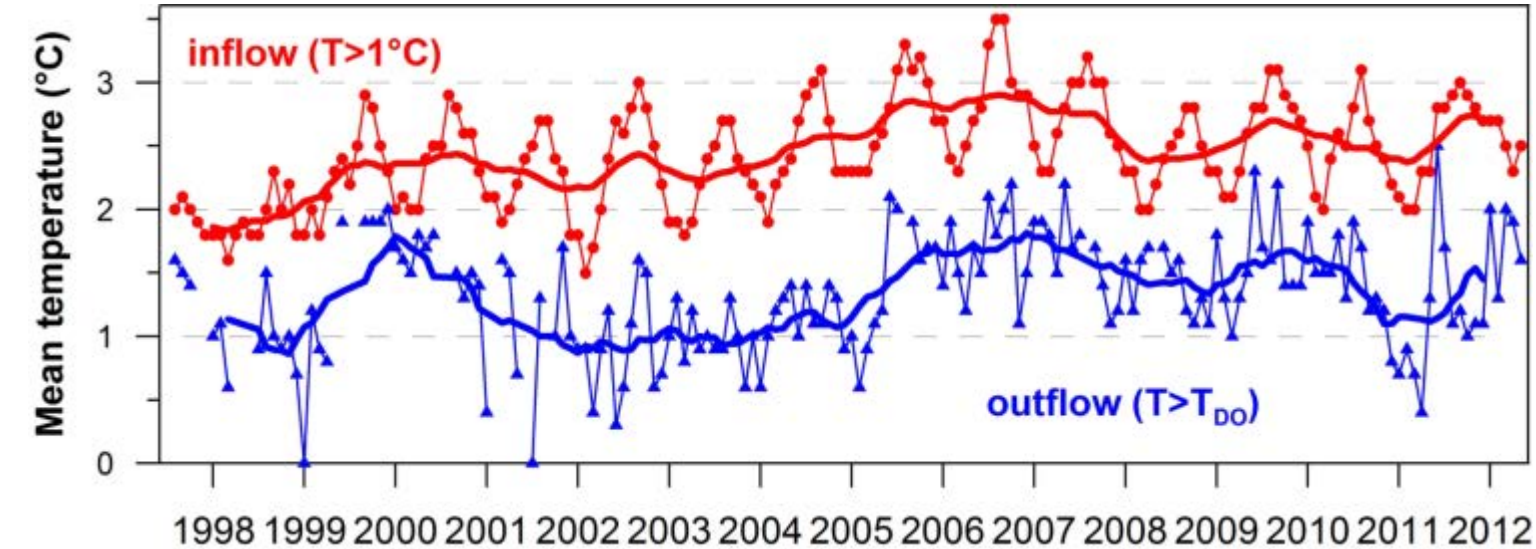
Temperature anomaly

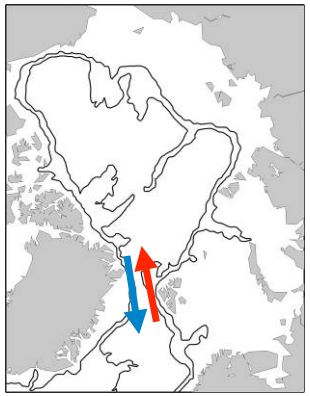


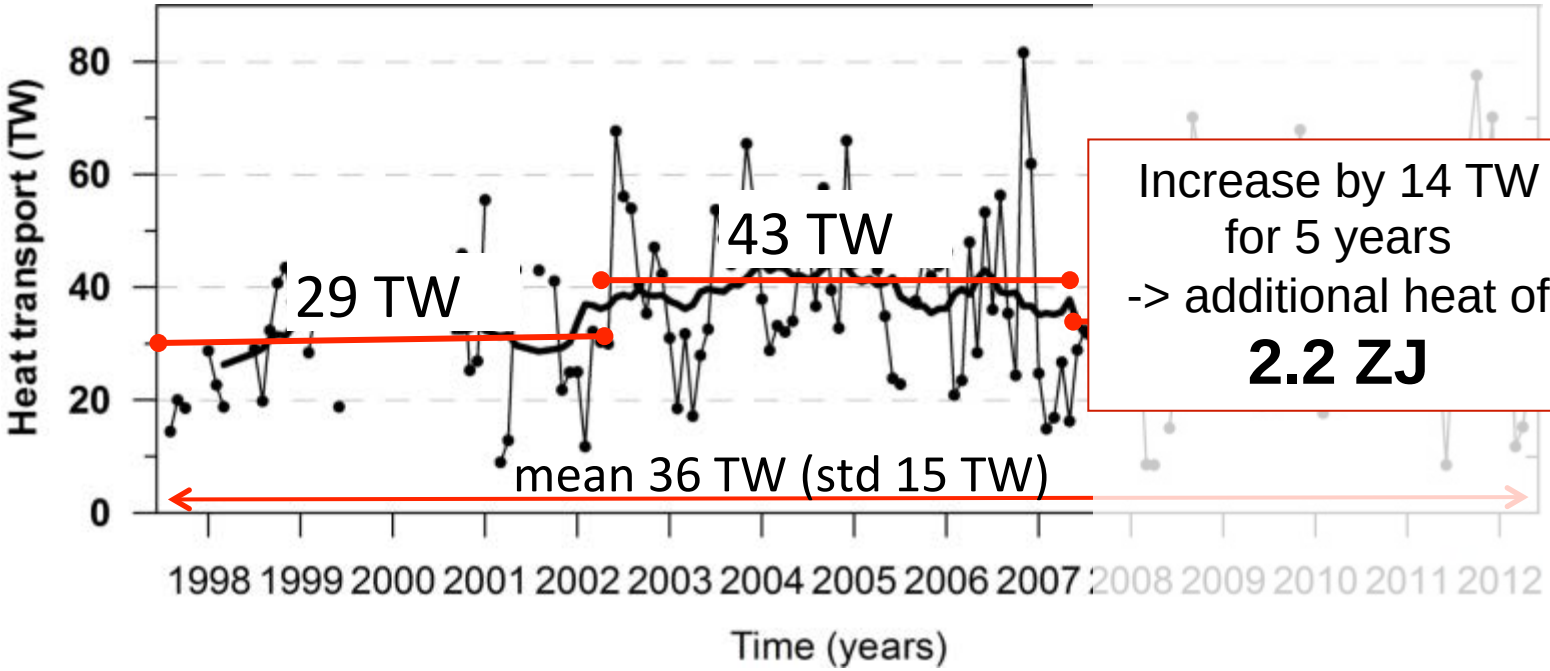


(Agnieszka Beszczynska-Möller)

Heat flux through Fram Strait
(update by Agnieszka after Schauer and Beszczynska-Möller, 2009)

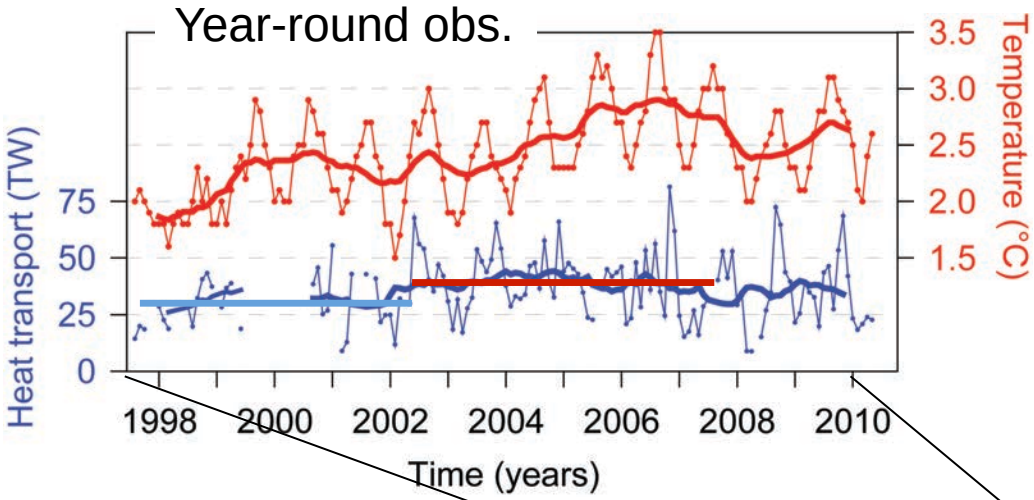






Increase by 14 TW
for 5 years
-> additional heat of
2.2 ZJ

Atlantic Water temperature in the eastern Fram Strait and heat transport



Increase by 14 TW
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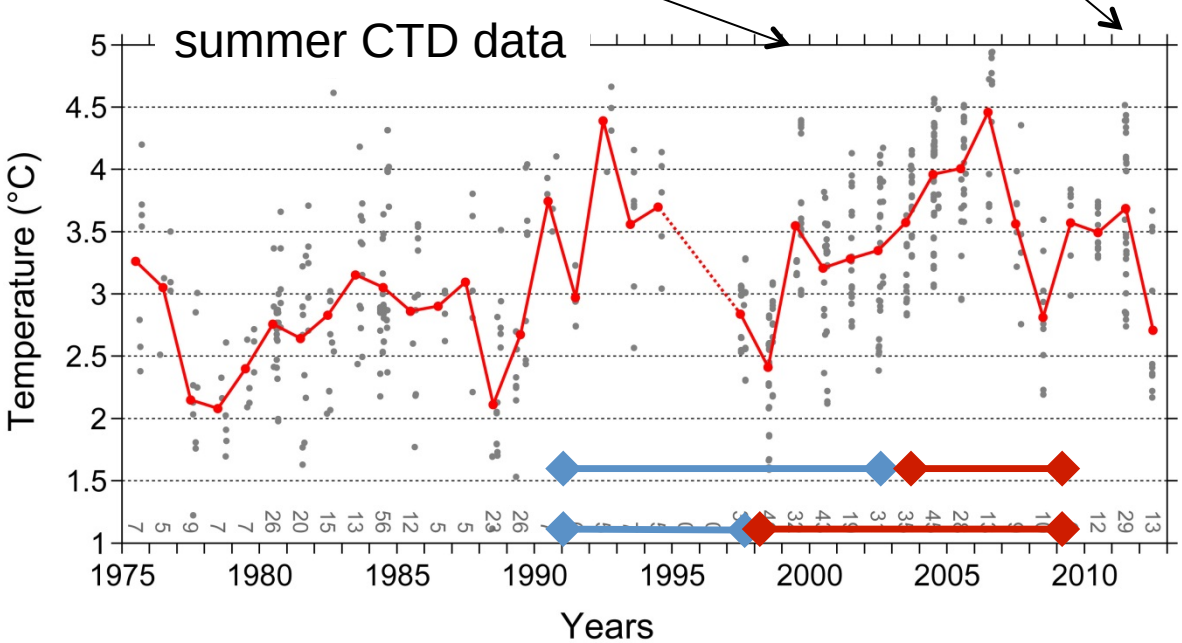
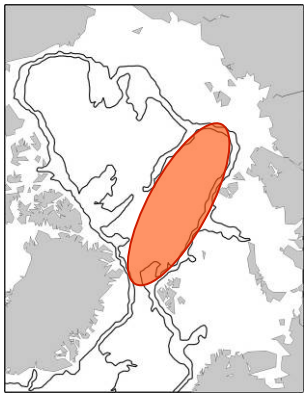
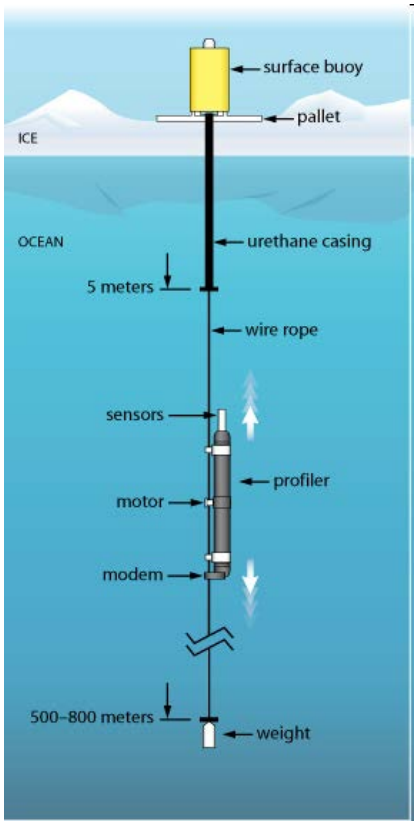
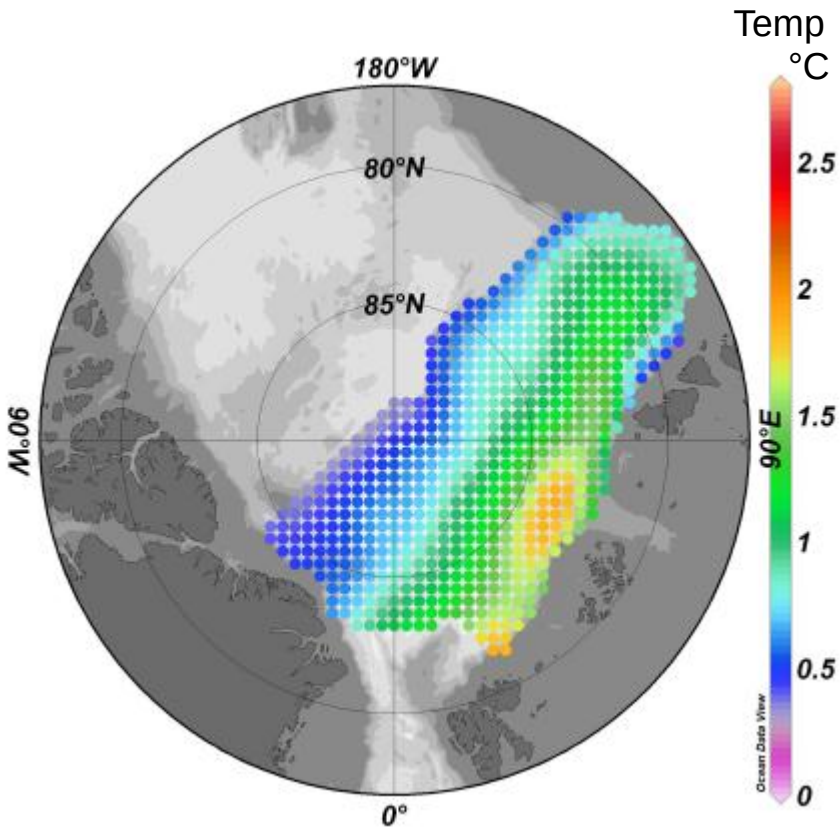




Ship-borne CTD obs and since 2007 autonomous drifting profilers (ITPs)



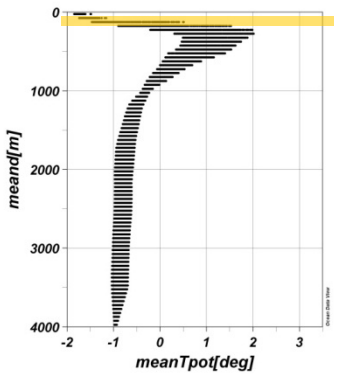
To avoid spatial bias …



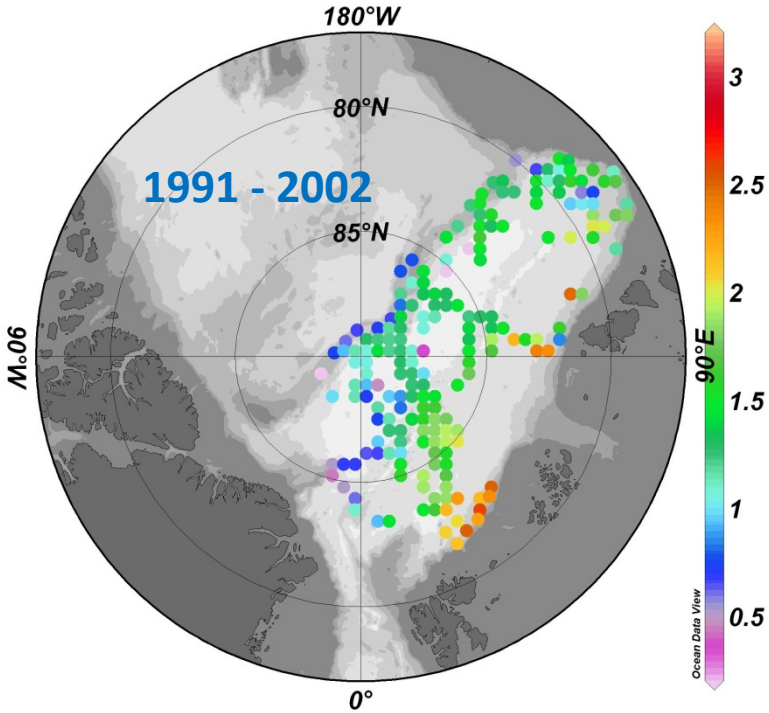
Mean (1950 – 1990) winter temperature between 150 and 400 m (EWG 1998)

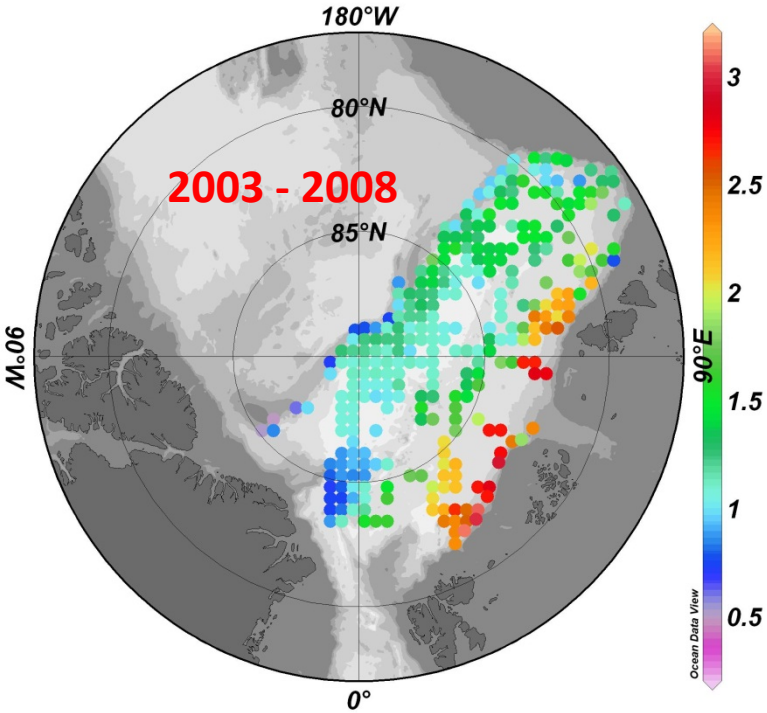
- All data referred to the mean temperature between 1950 and 1990 (EWG 1998)
- grid cells of 55 *55 km^2

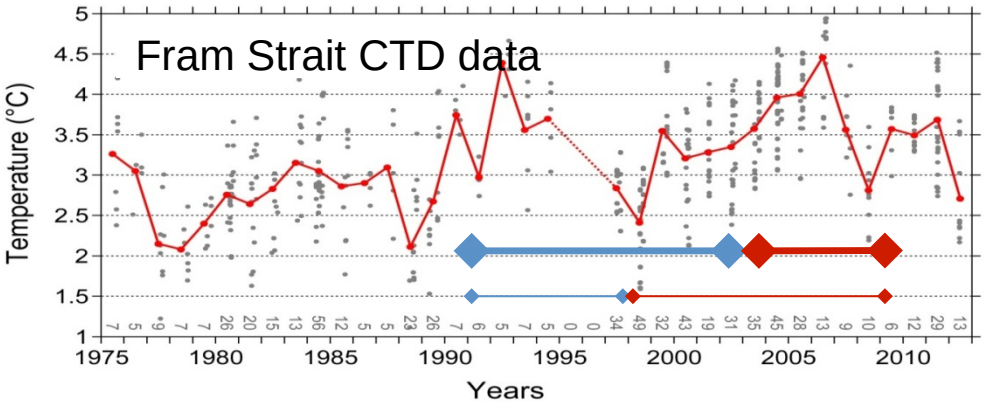
- Only depths below 150 m considered



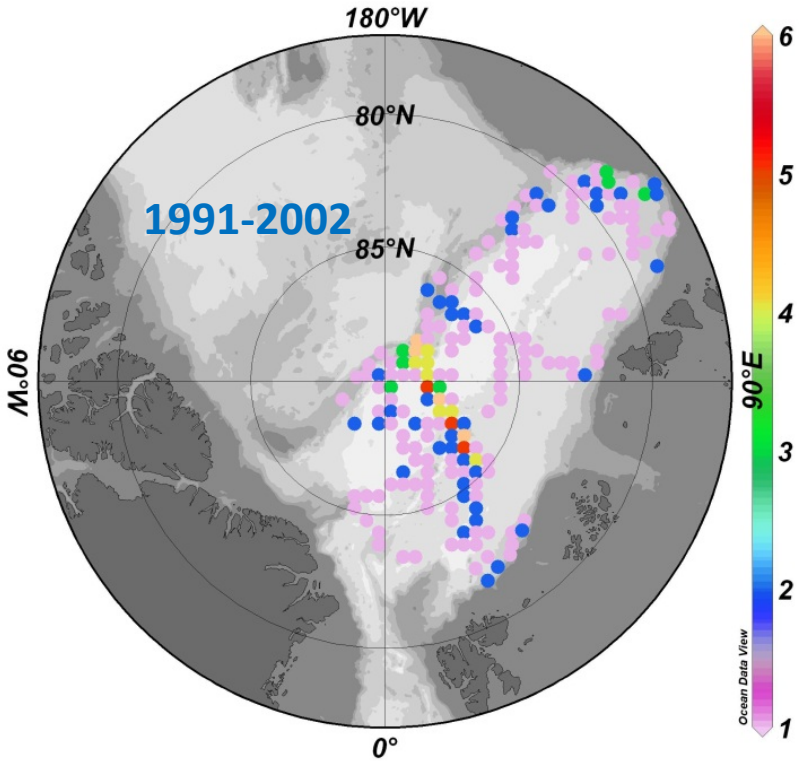
Mean temperature between 150 and 400 m in the Eurasian Basin

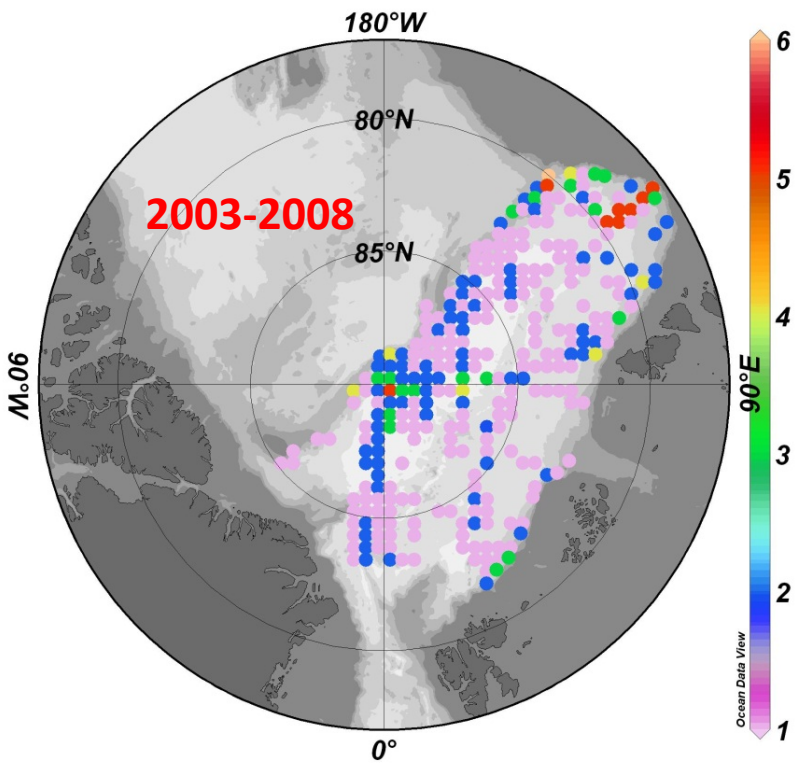


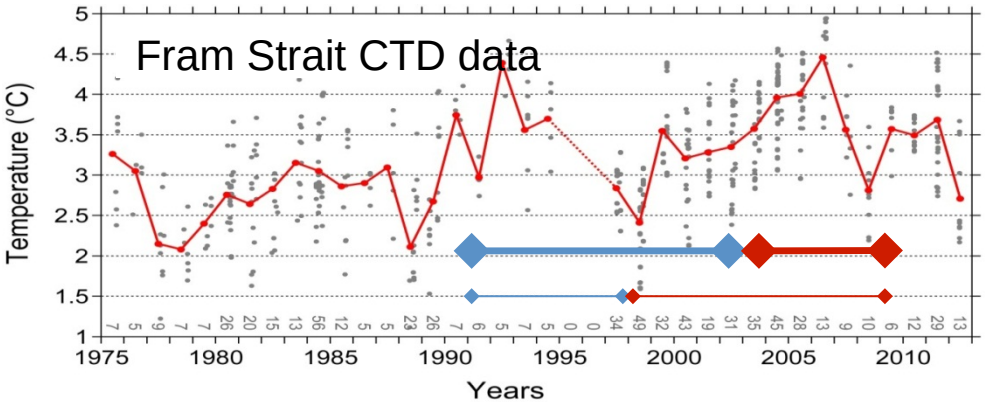




Number of years during which observations were made in a grid cell of 55 *55 km^2







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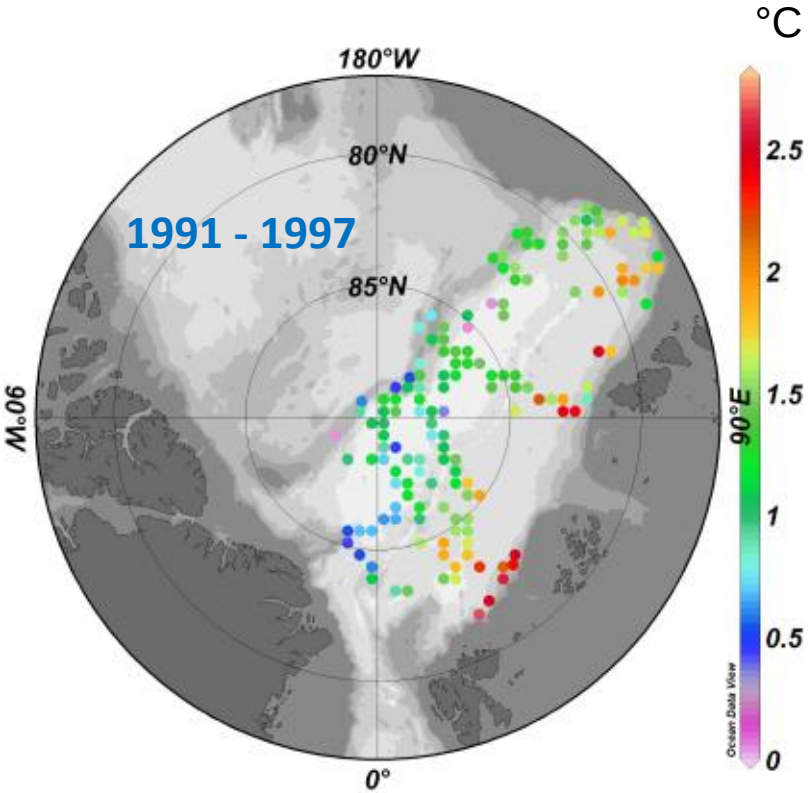
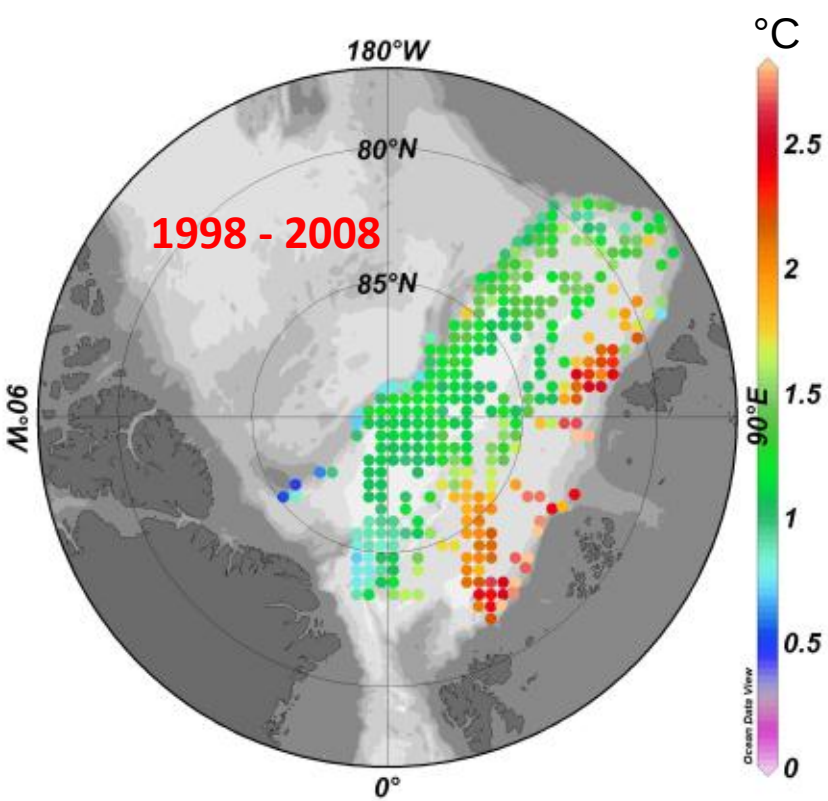
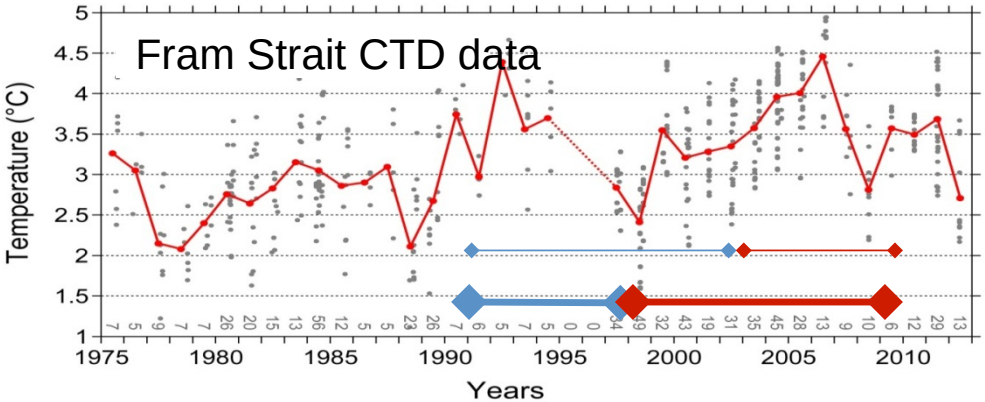
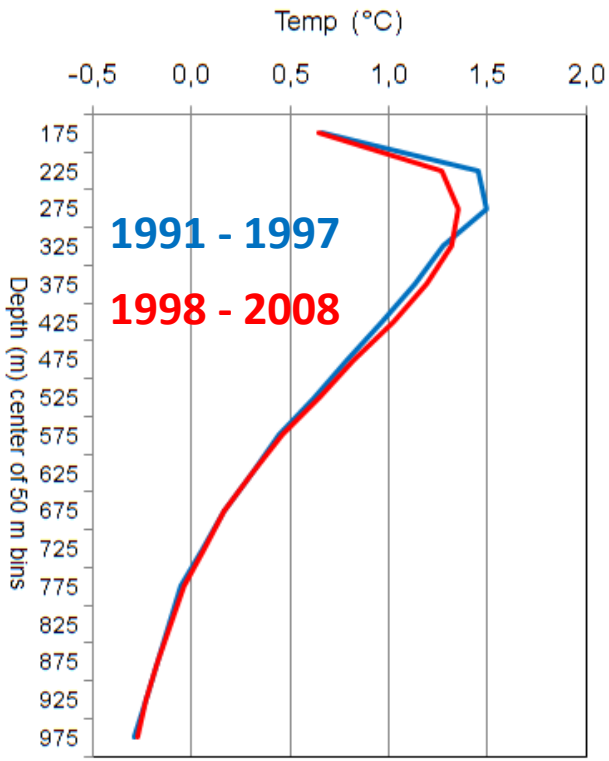
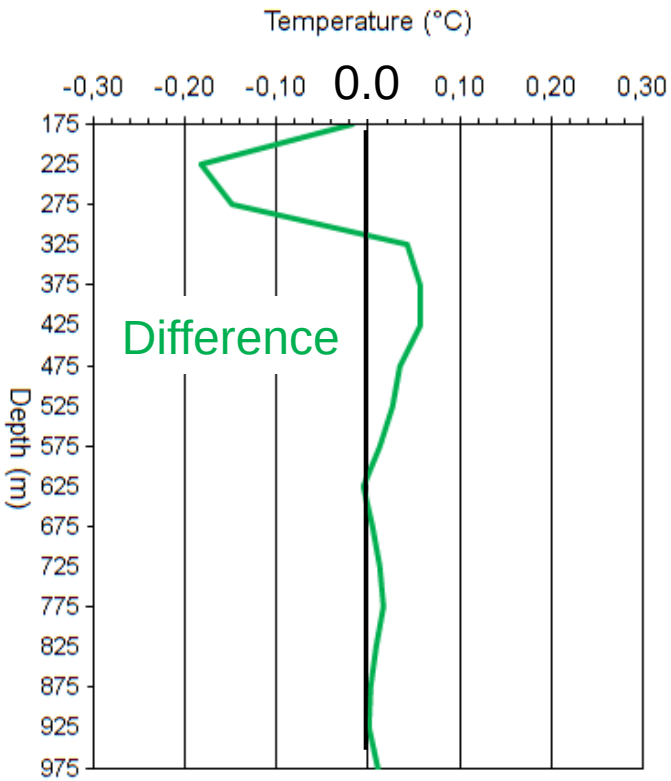


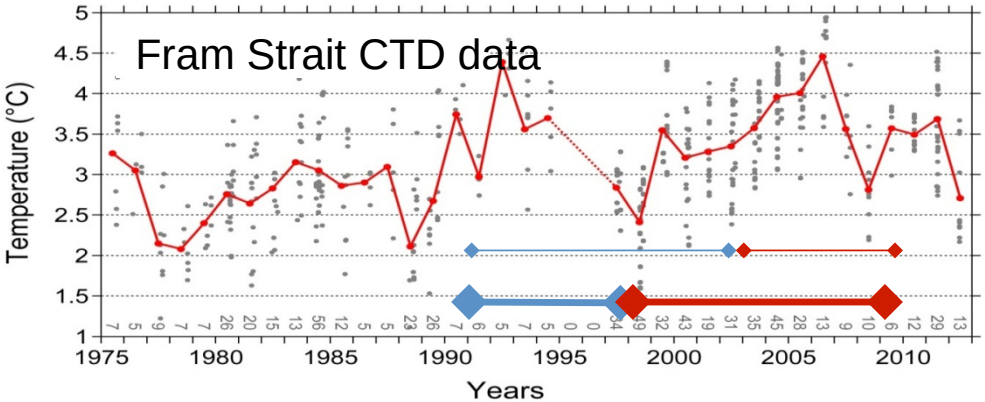




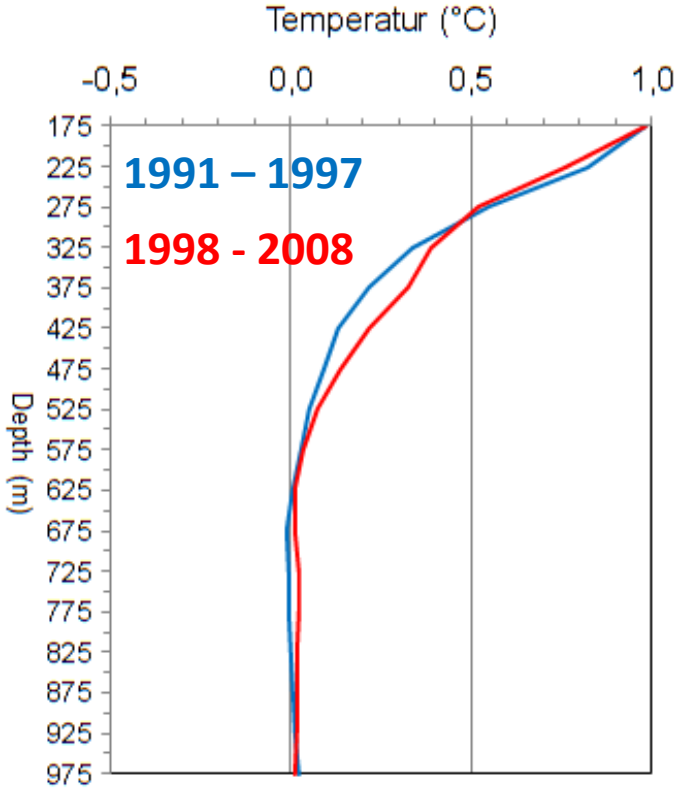
Eurasian Basin mean potential temperature profiles 1991-1997 and 1998-2008

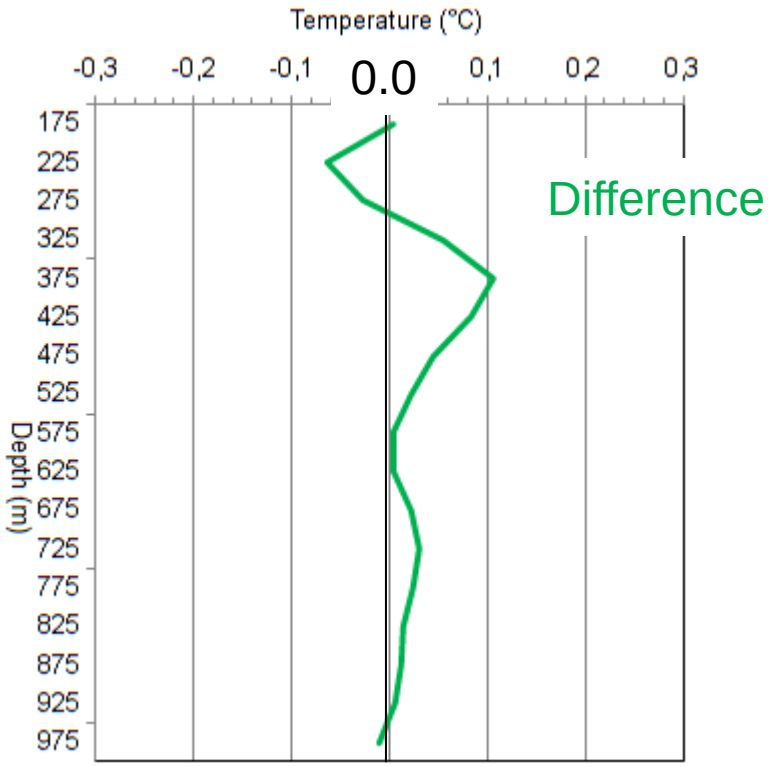


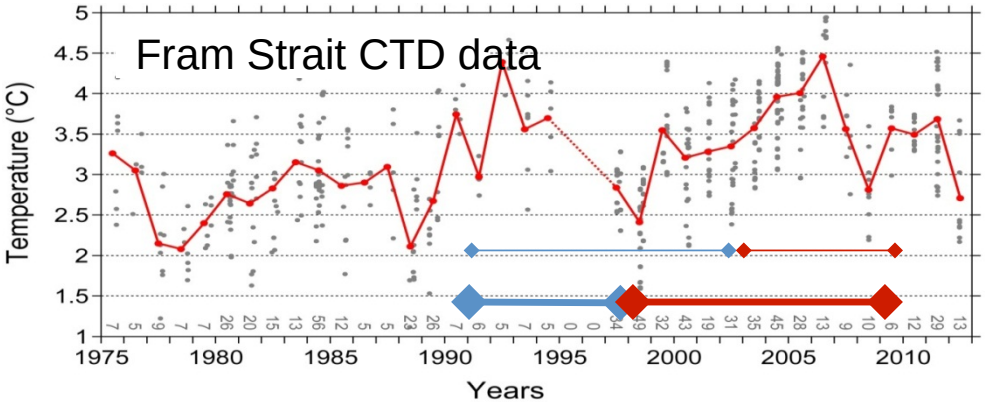




Temperature anomalies to EWG climatology 1950-1990







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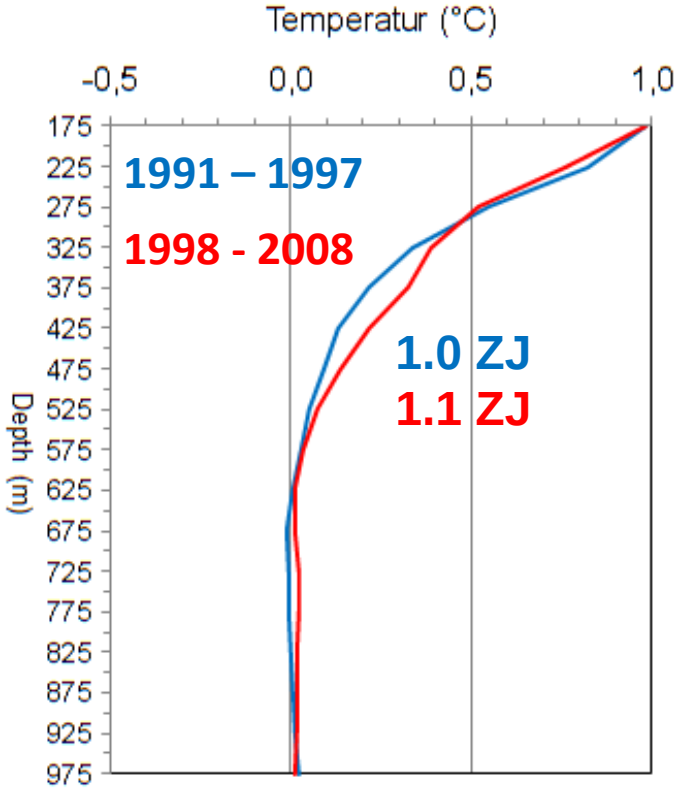
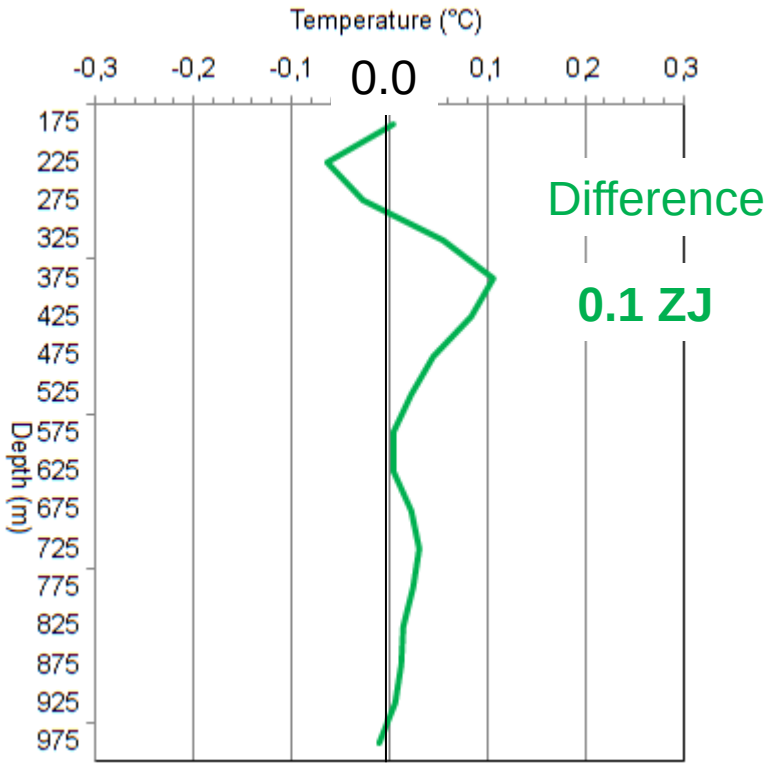
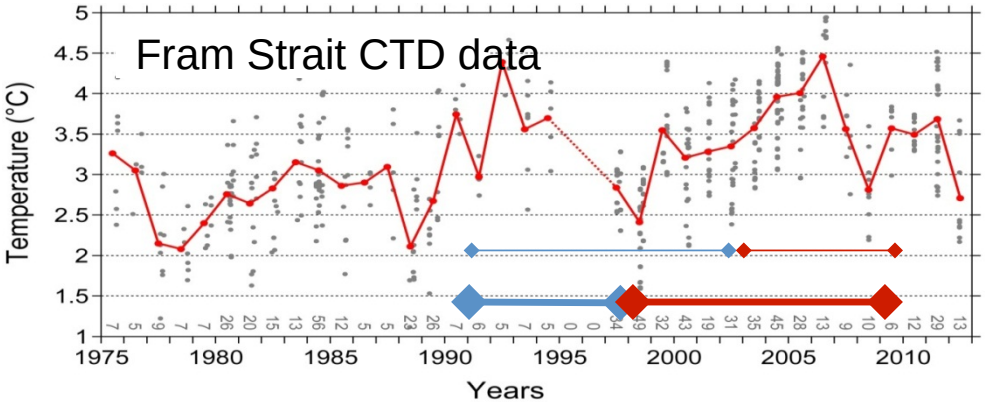
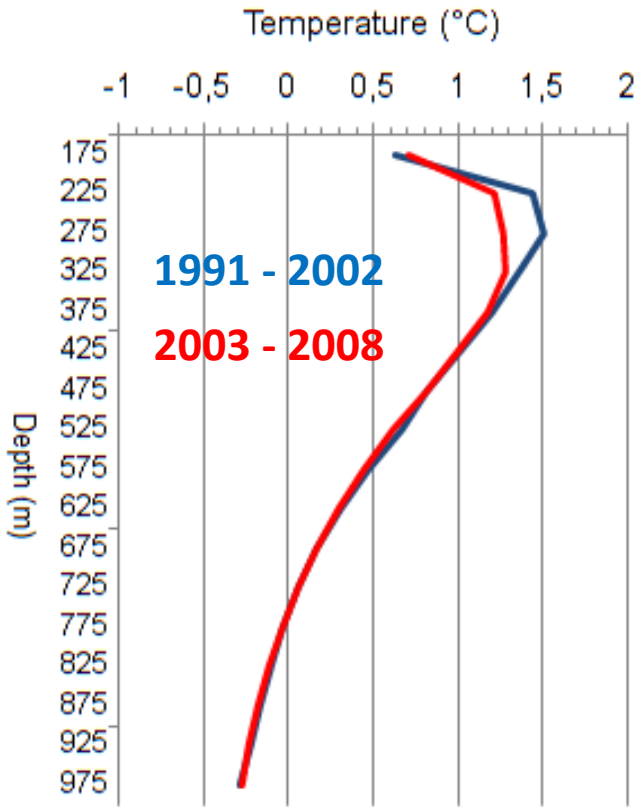
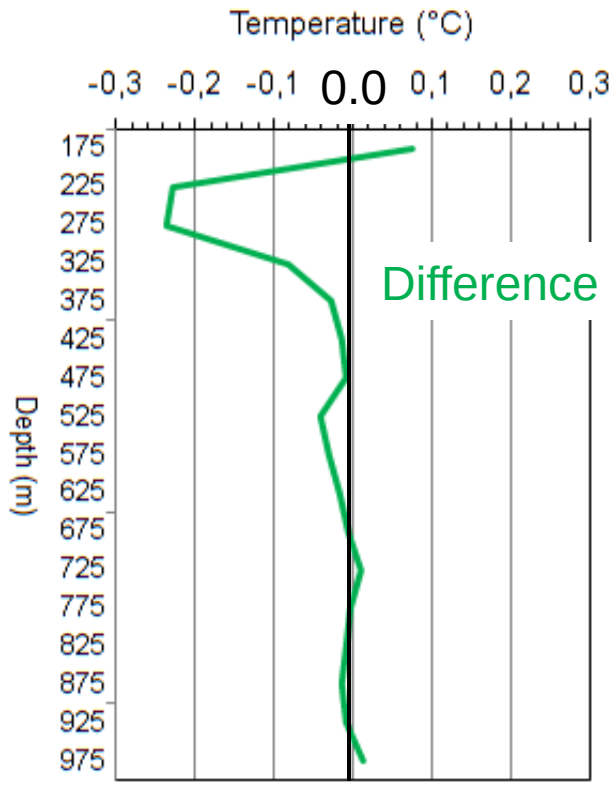


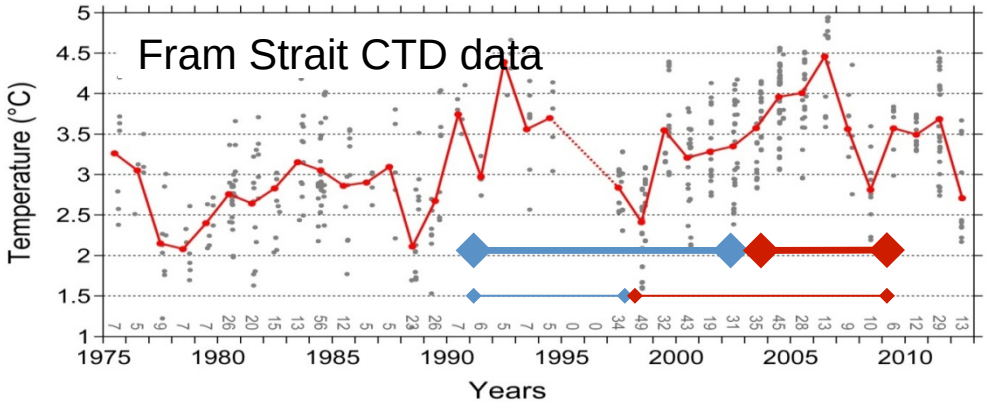




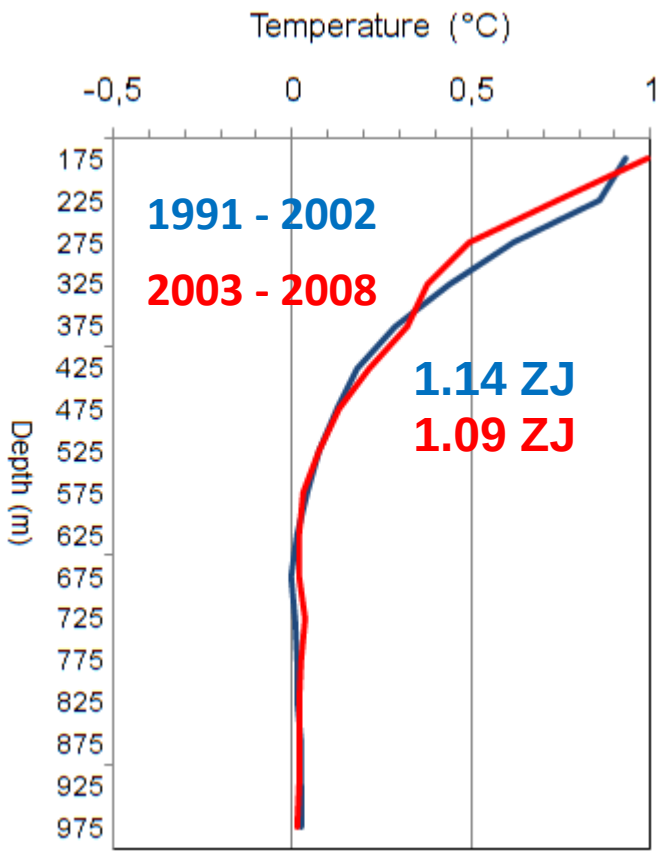
Eurasian Basin mean potential temperature profiles 1991-2002 and 2003-2008

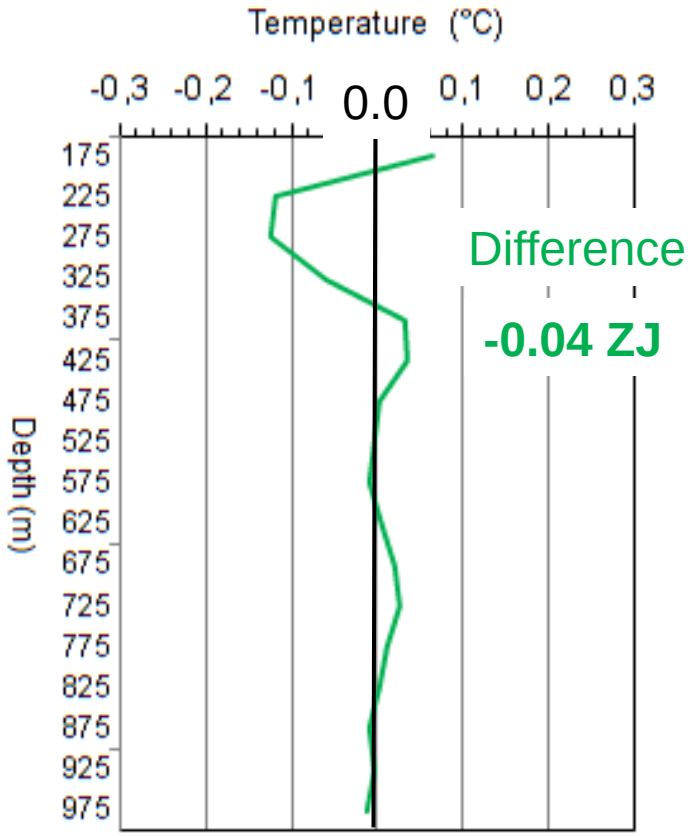


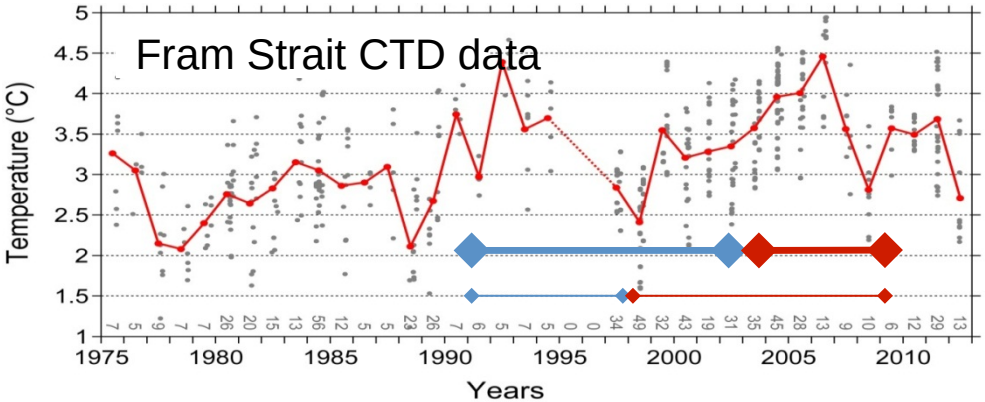




Temperature anomalies to EWG climatology (1950-1990)







Summary

- Multiannual heat transport through Fram Strait after 1997
  between 29 and 43 TW,
  difference over 5 years makes additional supply of **2.2 ZJ**

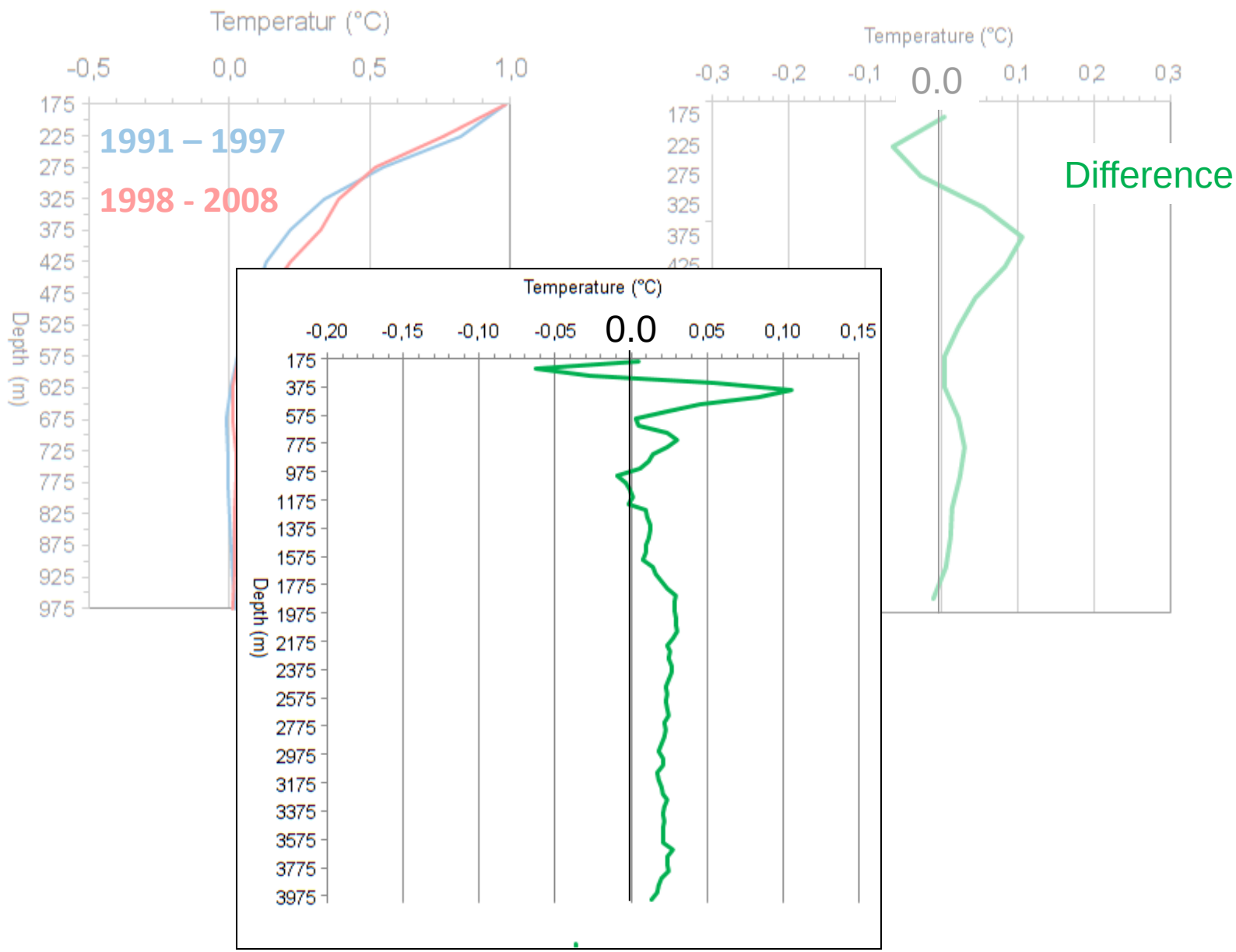
- Heat changes in European Basin northeast of Yermak Plateau
  between 150 and 1000 m depth
  from EWG to last two decades **1 – 1.14 ZJ**

- Multiannual heat changes in Eurasian Basin within the last two decades
  -0.04 – 0.1 ZJ

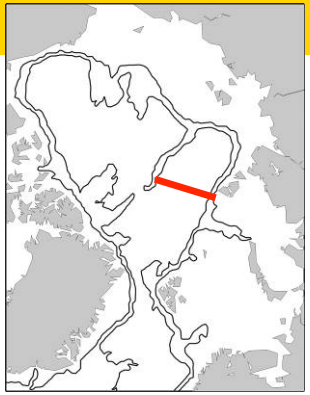
- „Imbalance“ of **O(1 ZJ**)
  - Released to atmosphere immediately north of Fram Strait?
  - Transfered to Canadian Basin?
  - Released to atmosphere/sea ice in Eurasian Basin?
  - Balanced within error limits of heat transport estimates (FS) and temperature changes (EB), and taking into account the temporal mismatch?

  Probably a mixture of all.

Temperature anomalies to EWG climatology 1950-1990



Warming of deep water temperature



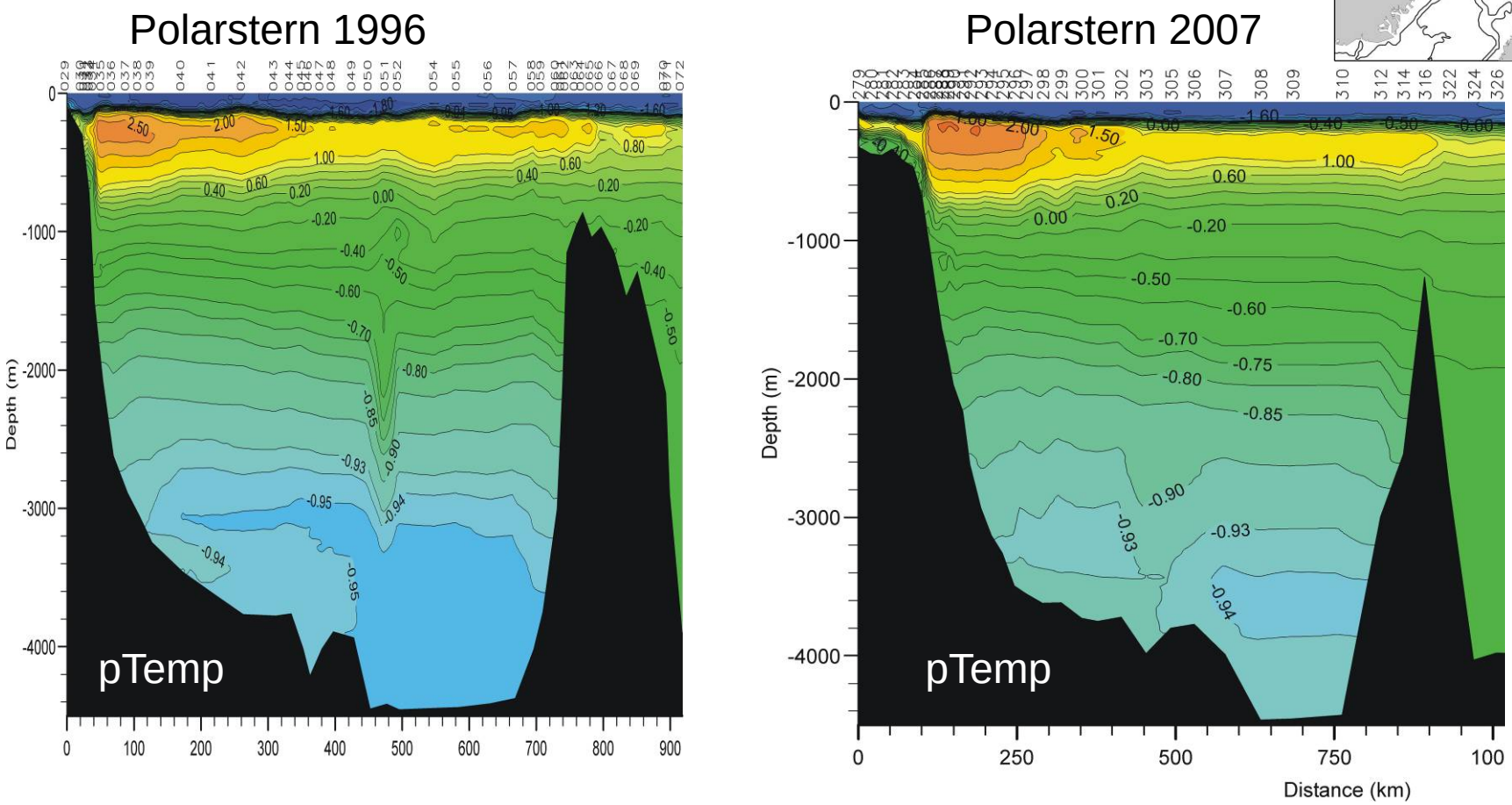
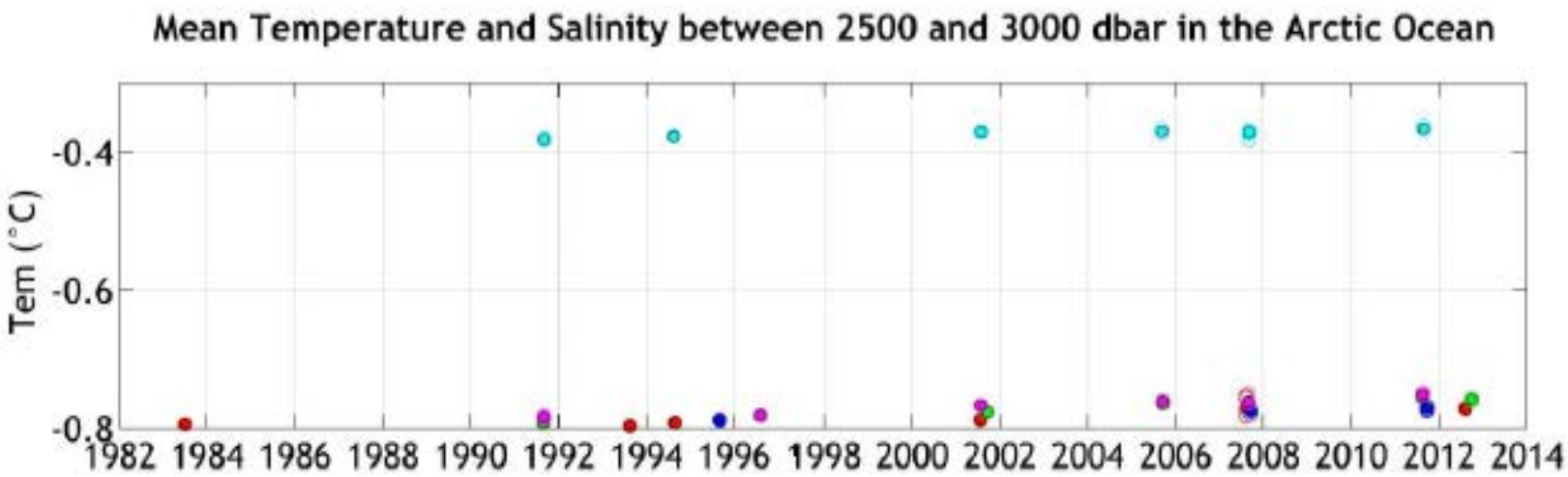


Fig. G: Section of potential temperature across the Eurasian basins in (a) 1996 and (b) 2007.

Eurasian deep water temperature up to 2012

Raquel Somavilla:

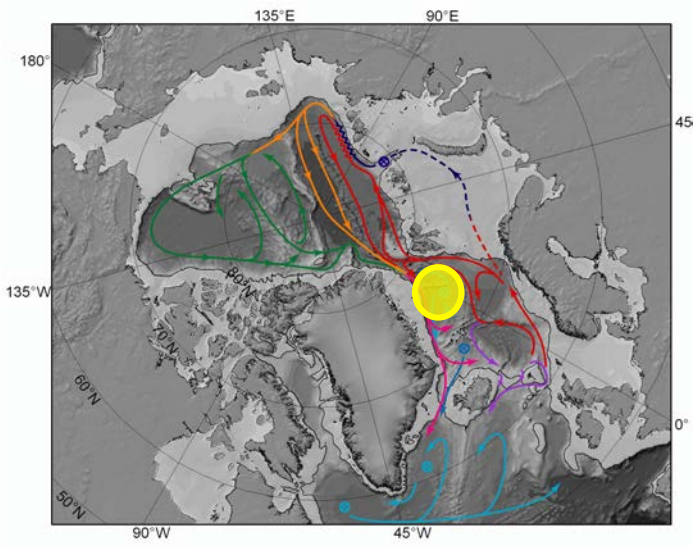


Makarov Basin
Eastern Gakkel Ridge
Western Gakkel Ridge
Amundsen Basin

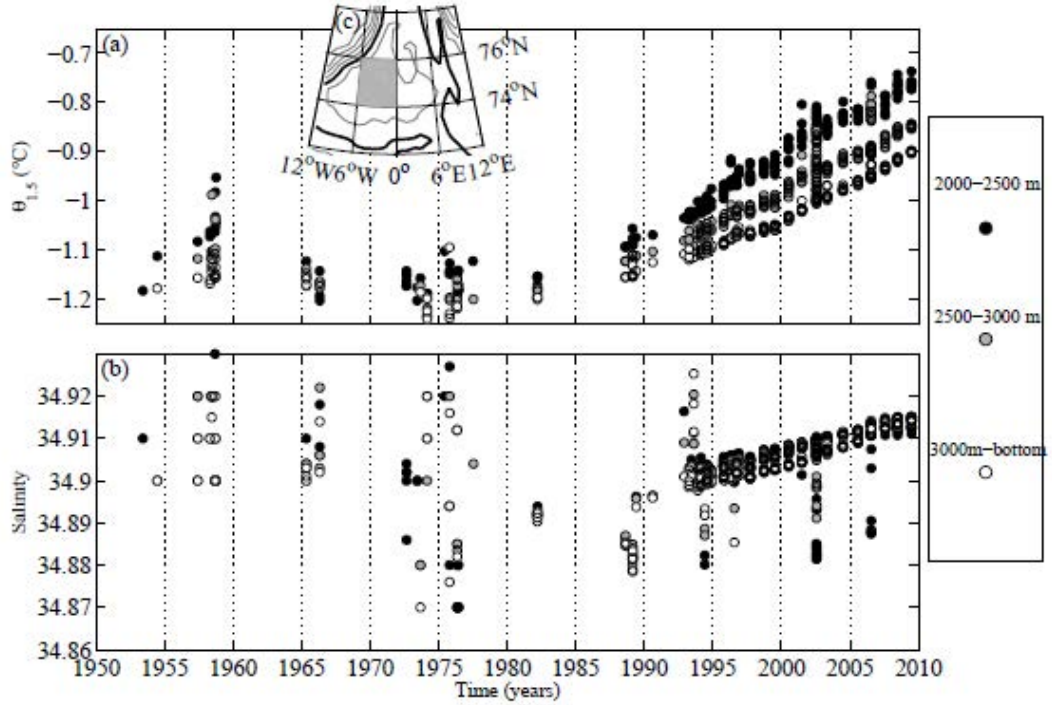
Warming by ca. 0.02-0.03°C

„Dear Raquel, please chose a different

Greenland Sea deep water warming



Karstensen et al., 2005
Budeus et al., 2009
Rudels et al., 2012

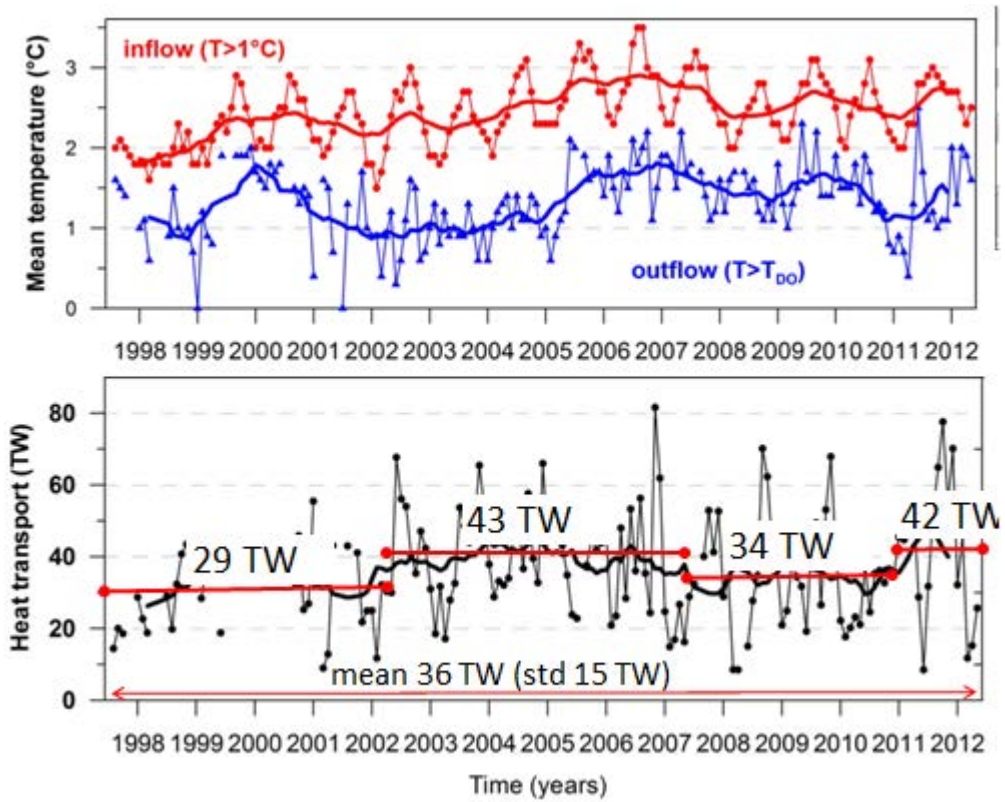


Somavilla et al., 2013

- Greenland Sea warming due to inflow of warm Eurasian Basin deep water and **no more cooling** through deep convection
- Eurasian Basin warming due to **less cooling** through Greenland Sea deep water inflow? I.e. ongoing warming through shelf-slope convection & entrainment?
- Geothermal influence?

Ceterum censeo …

Ocean heat transport can only be derived along sections closing a volume …



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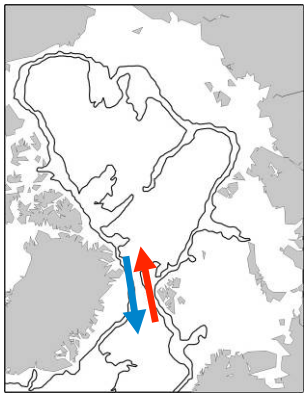
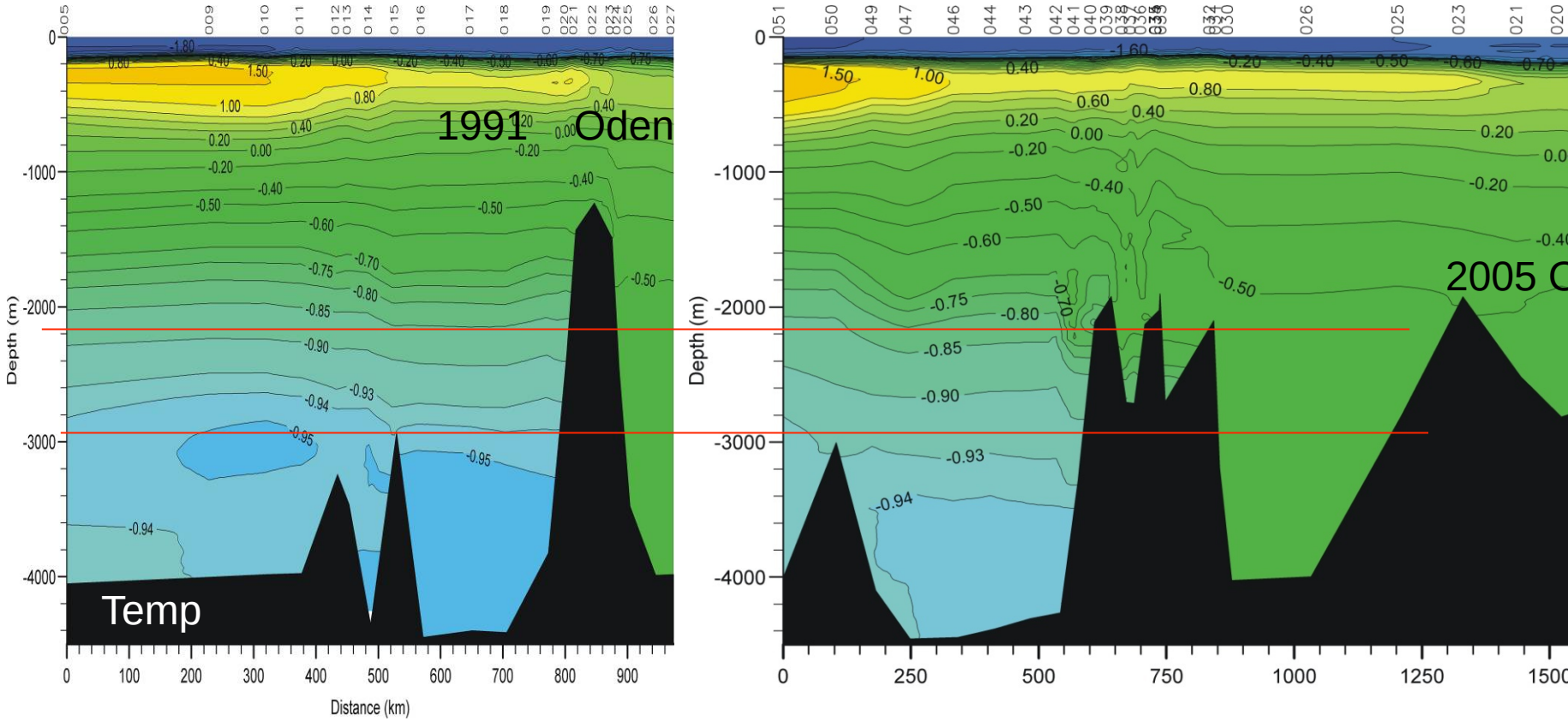


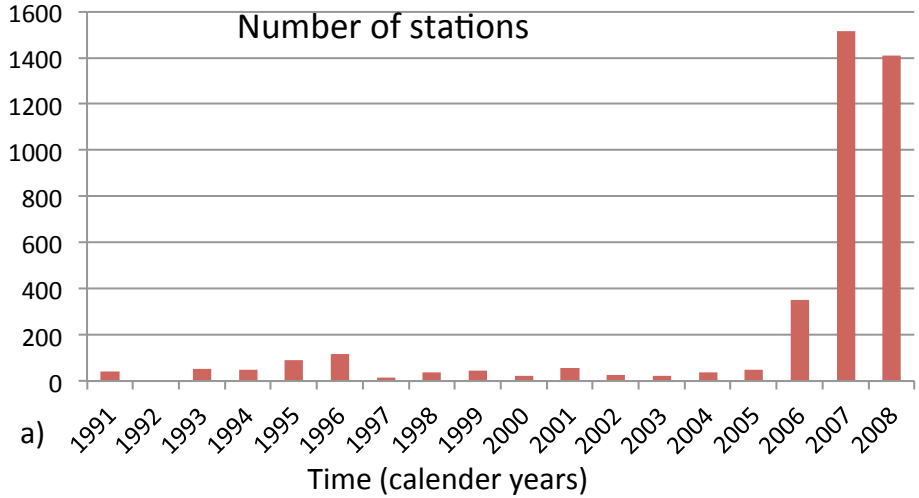
Fram Strait:

- Uncertainty of volume flux due to insufficient spatial resolution
- Also outflow of cold Barents Sea – if mixed with Fram Strait return flow
- heat transport is overestimated.
- Part of warm inflow returns as ice – leads to underestimation of heat transport.

Continue mooring array?

Fig. G: Section of potential temperature across the Eurasian basins in (a) 1991 and (b) 2005.





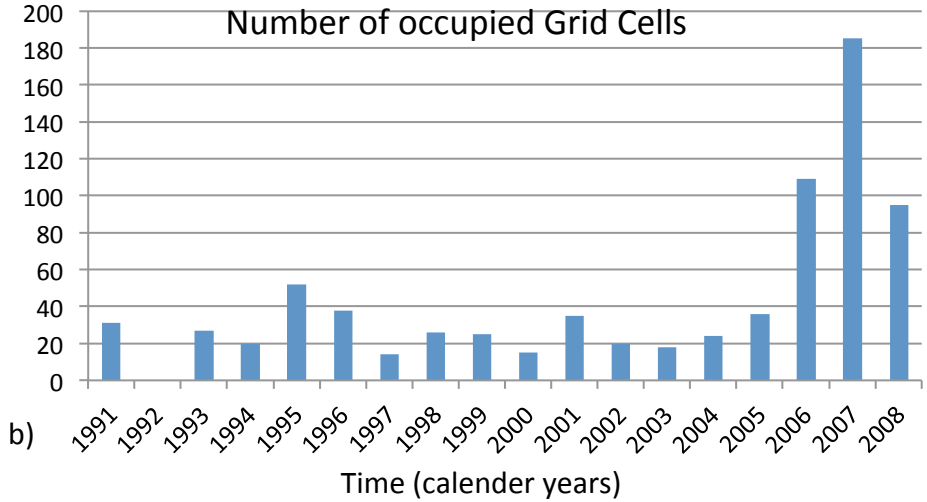
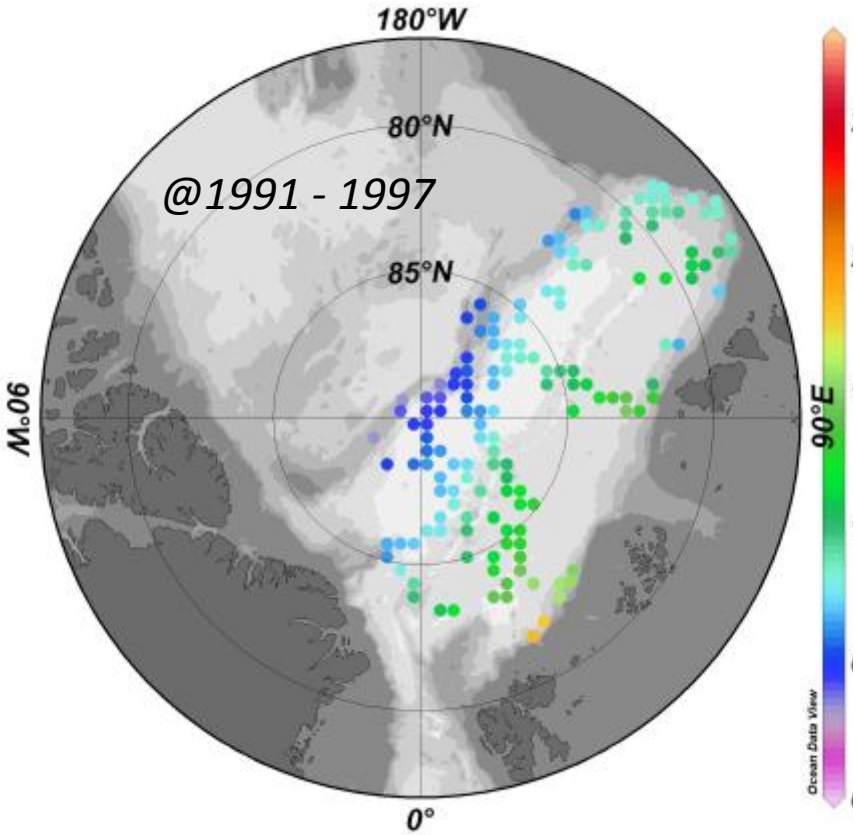
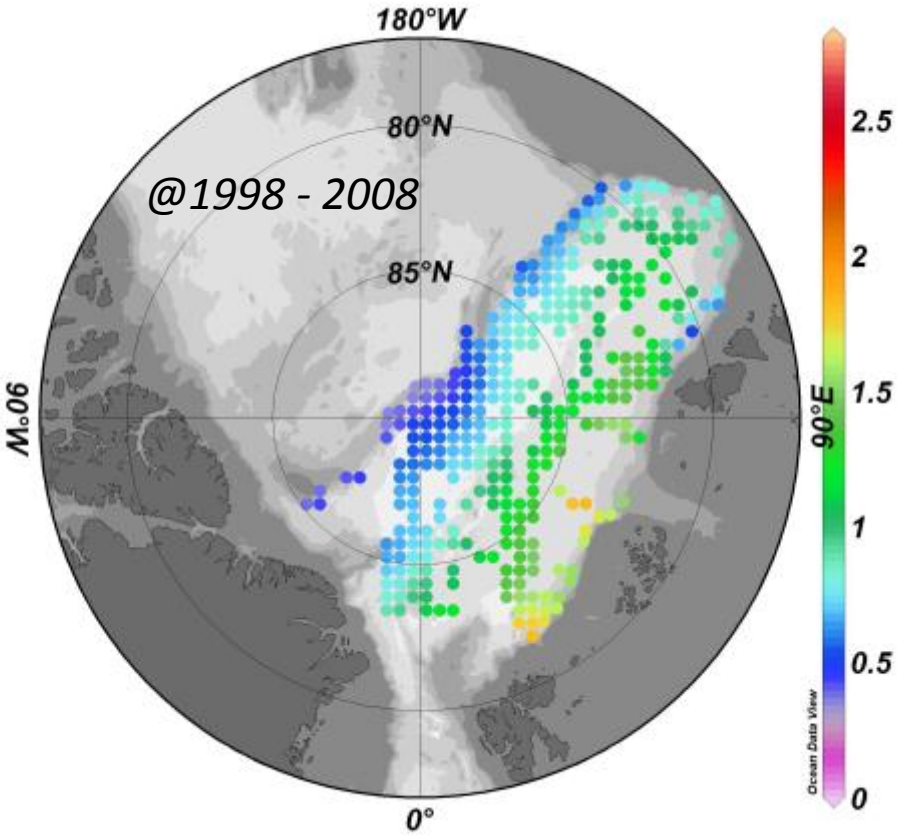


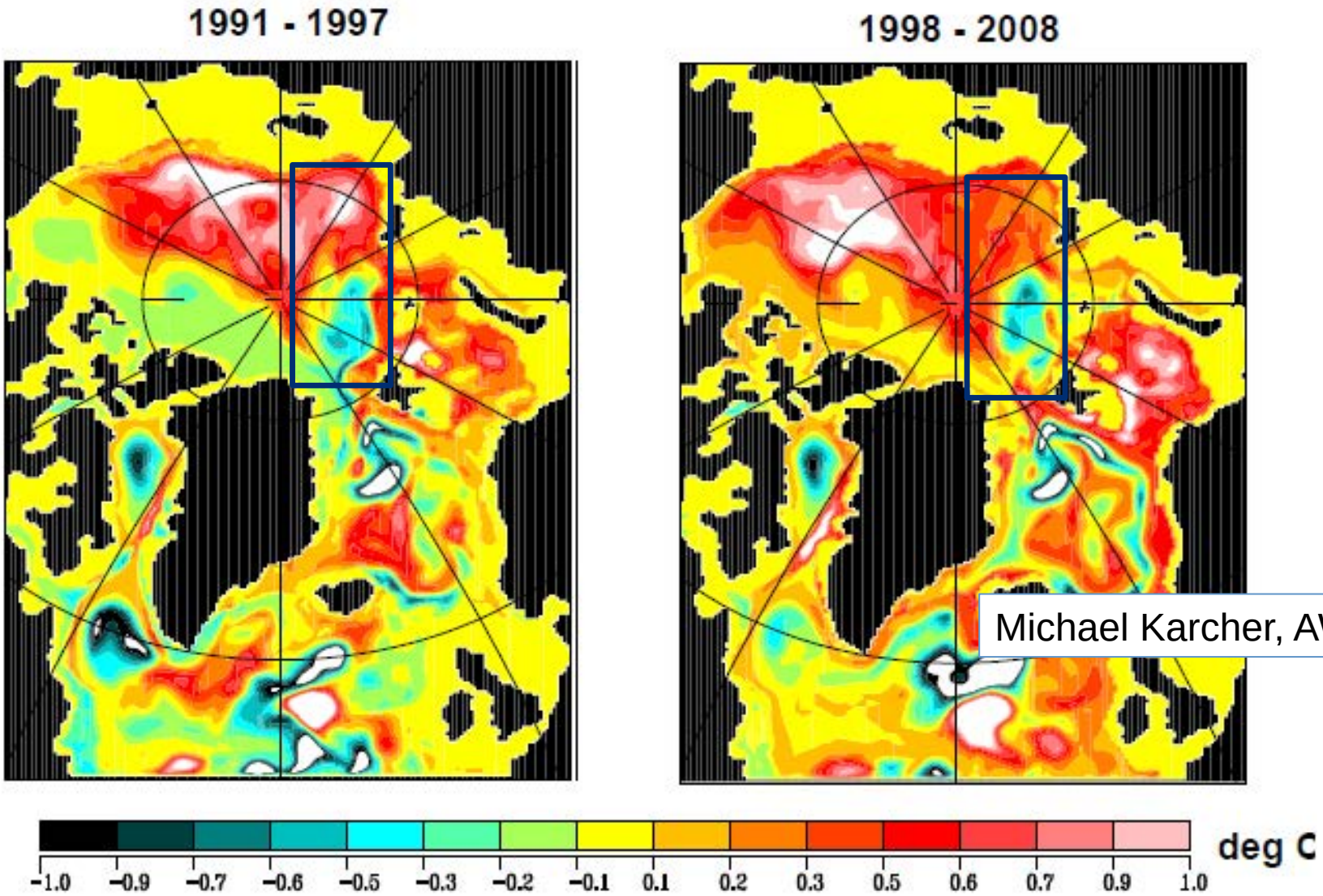
Fig. A:
Number of the original stations (a) and of the occupied EWG grid cells (b) per year in the study area between 1991 and 2008.
Note the strong increase in the IPY 2007/2008

Mean (1950 – 1990) winter temperature between 150 and 400 m (EWG 1998)





150-400 m T-anomalies (rel to 1960-1989 mean)
NAOSIM



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