

# Multi-decadal link between Arctic Ocean and subpolar North Atlantic freshwater anomalies

Horn, M., Schauer, U., and Rabe, B. (in prep.)

# Why do we care about freshwater?

Ocean's salinity changes only due to the addition or removal of freshwater by

- Precipitation/evaporation
- Continental run-off
- Sea ice melting/formation

## **Arctic Ocean**

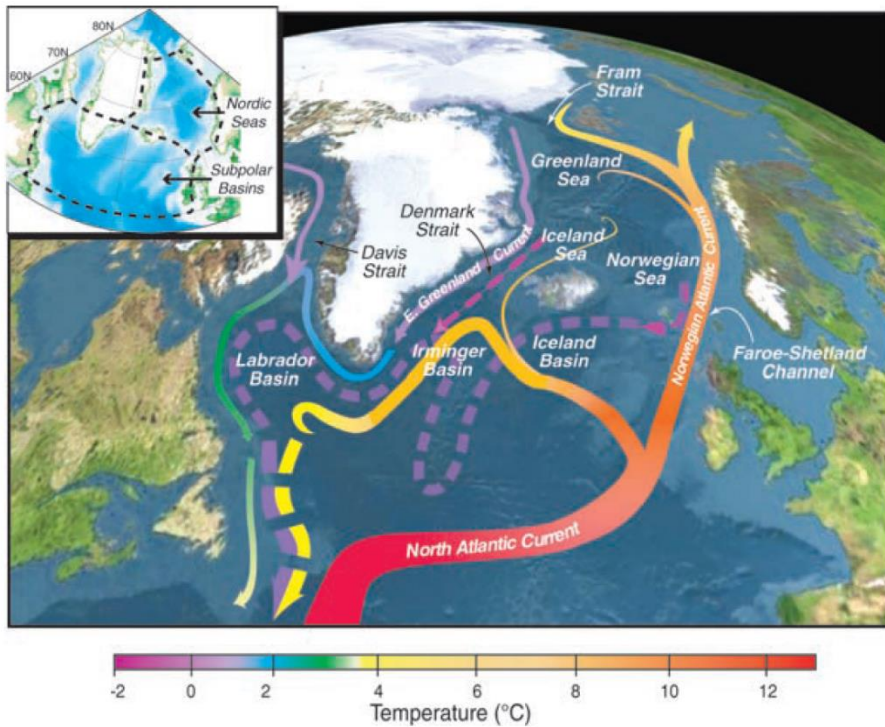
- Insulation effect of the fresh surface layer

## **Subpolar North Atlantic and Nordic Seas**

- Deep water formation (Meridional Overturning Circulation)

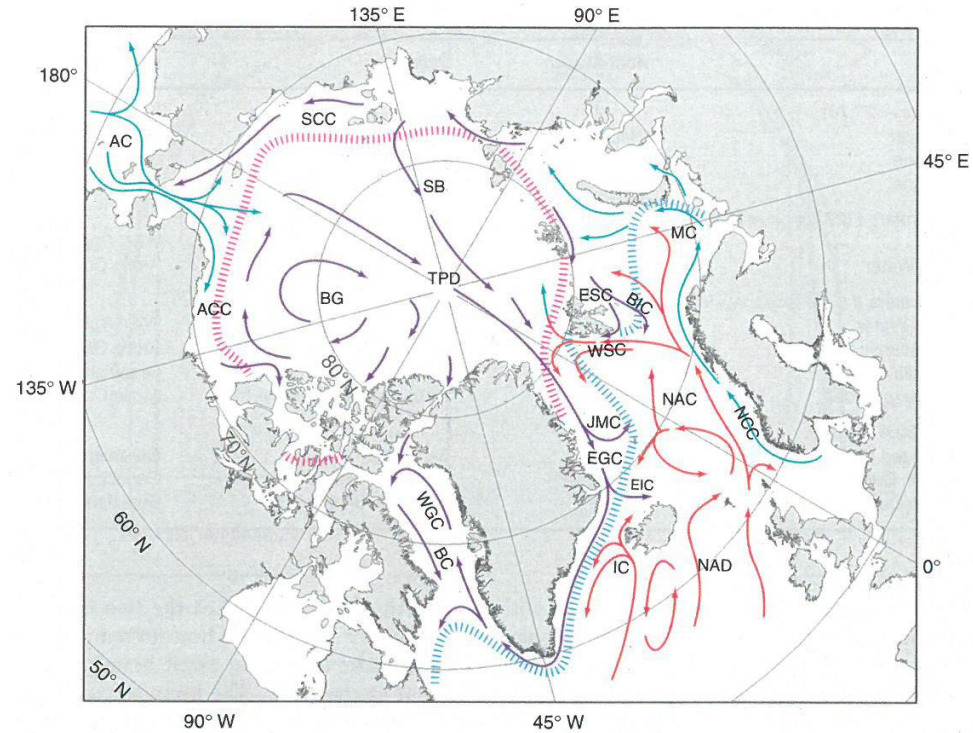
# Circulation

## Subpolar North Atlantic and Nordic Seas



Curry and Mauritzen (2005)

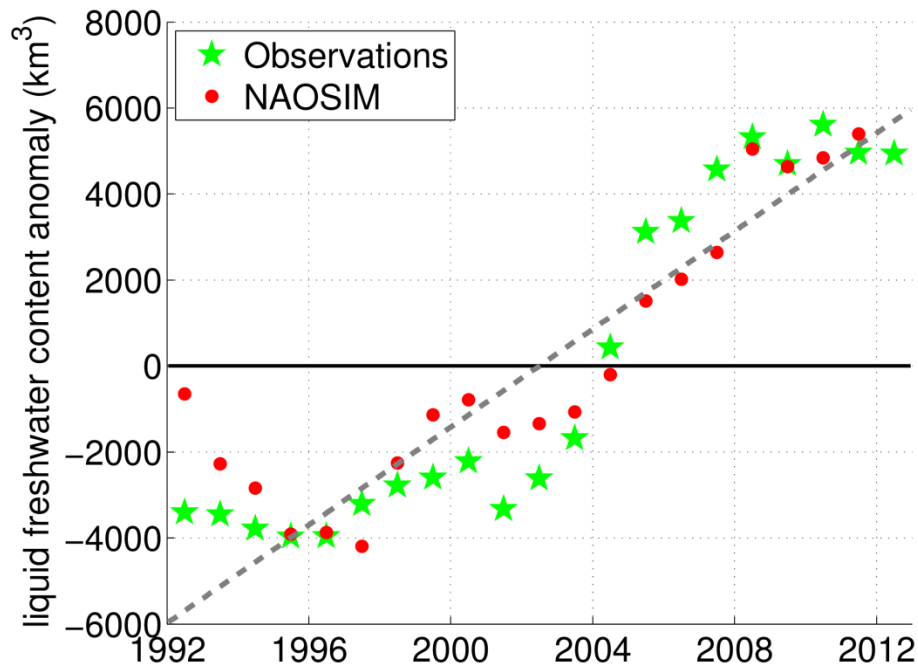
## Arctic Ocean



Rudels (2009)

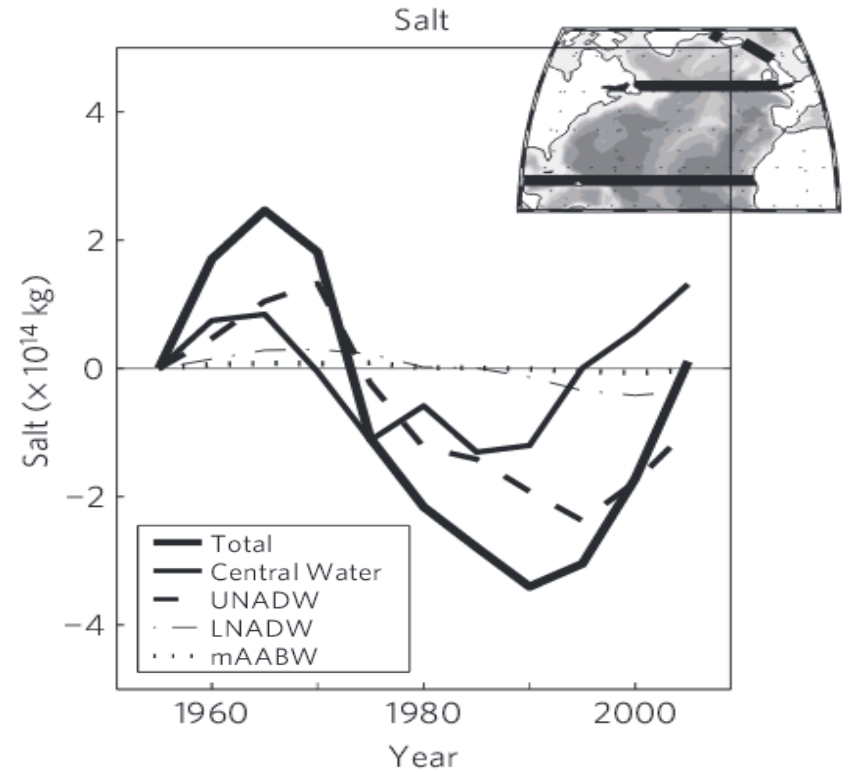
# Recent freshwater changes

## Arctic Ocean



Rabe et al. (2014)

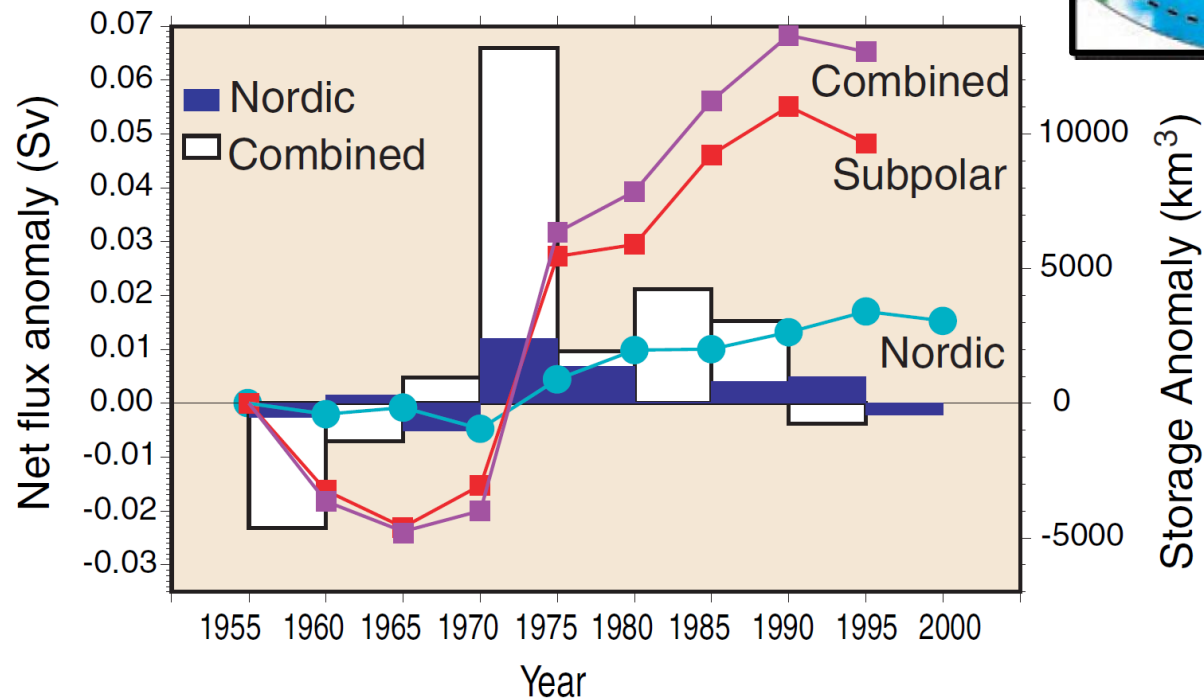
## Subpolar North Atlantic



Mauritzen et al. (2012)

# Recent freshwater changes II

## Subpolar North Atlantic and Nordic Seas



Curry and Mauritzen (2005)



# Liquid freshwater content

Inventory of liquid freshwater

$$LFWI = \int_{z=0m}^h \frac{S_{ref}-S}{S_{ref}} dz \quad [m]$$



Arctic Ocean

$$S_{ref} = 35$$

$h$  = depth of 34 isohaline



Subpolar North Atlantic

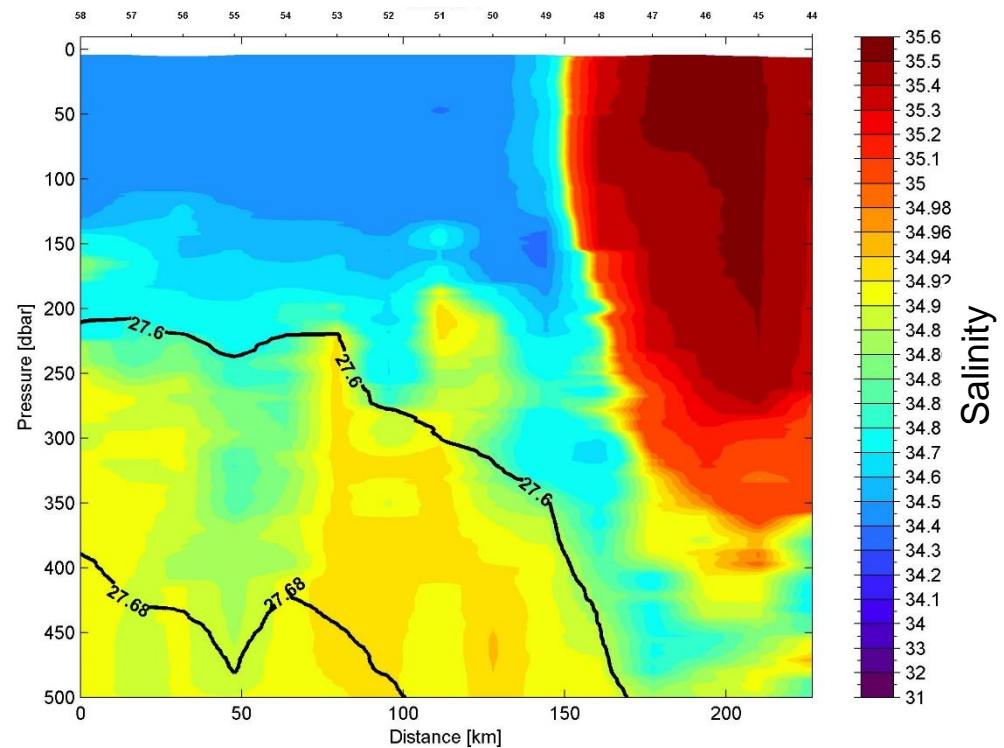
$$S_{ref} = 35$$

$h$  = 2000 m

Liquid freshwater content

$$LFWC = \oint LFWI dA \quad [km^3]$$

CTD section in the subpolar North Atlantic



# Objective

**How do the liquid freshwater contents of the Arctic Ocean and the North Atlantic covary over the past two decades?**

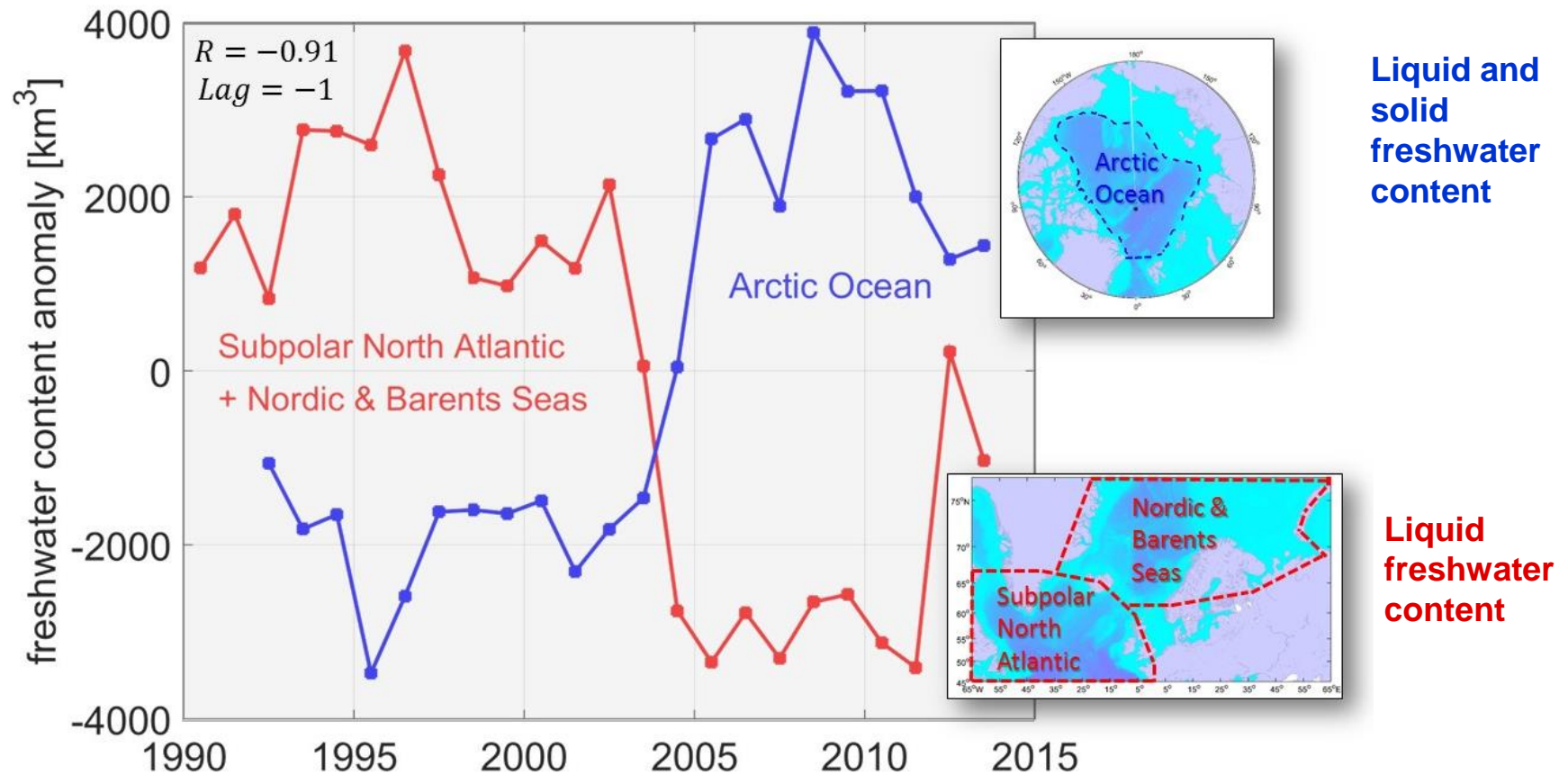


- Total freshwater content of the Arctic Ocean
  - including liquid and solid freshwater contents



- Liquid freshwater content of the subpolar North Atlantic

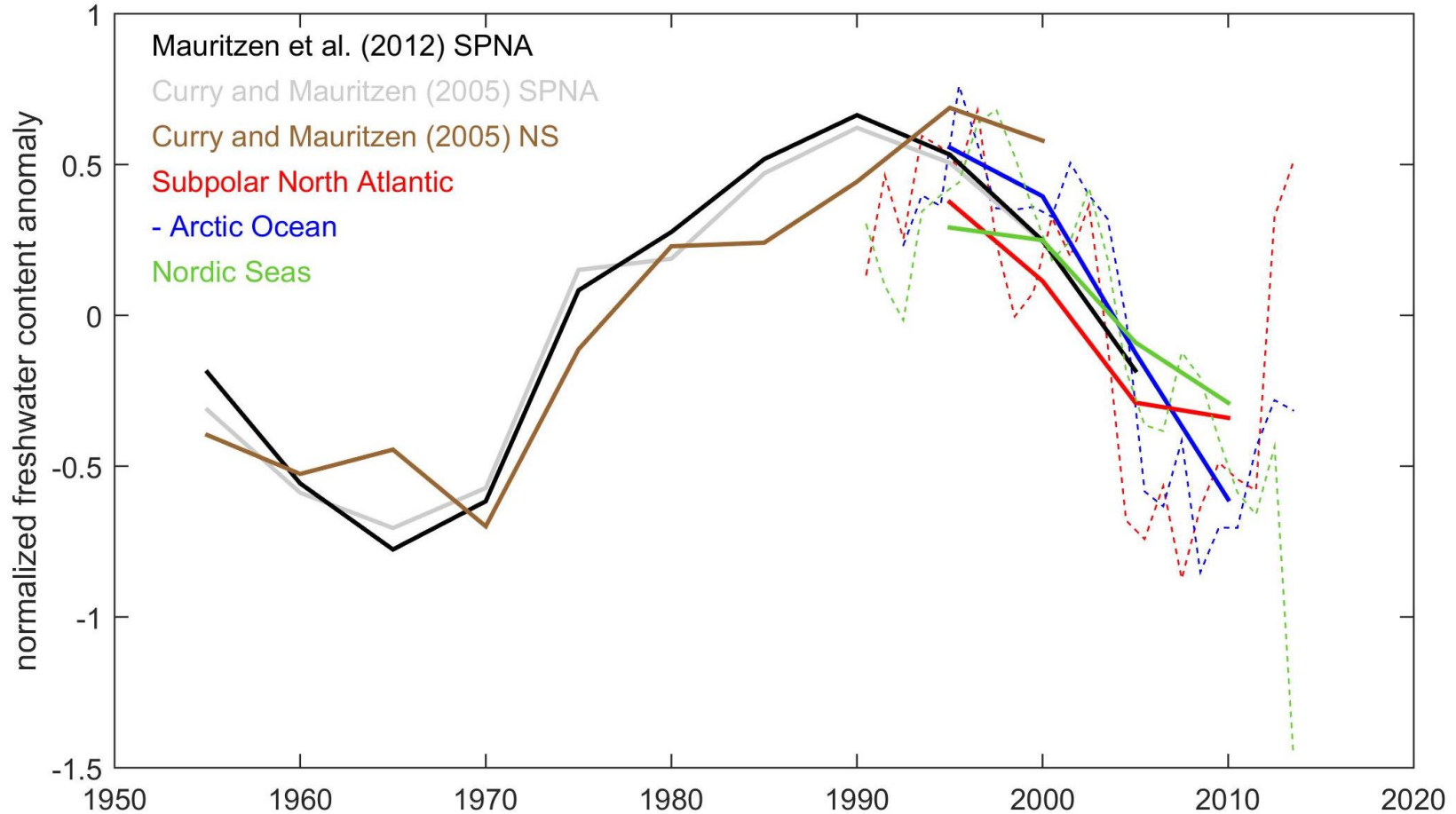
# Freshwater variability



- The freshwater contents are **significantly anti-correlated**.
- The amount of the **anomalies** are of the **same size**.
- Freshwater anomalies suggest an **oscillation**.



# Freshwater variability

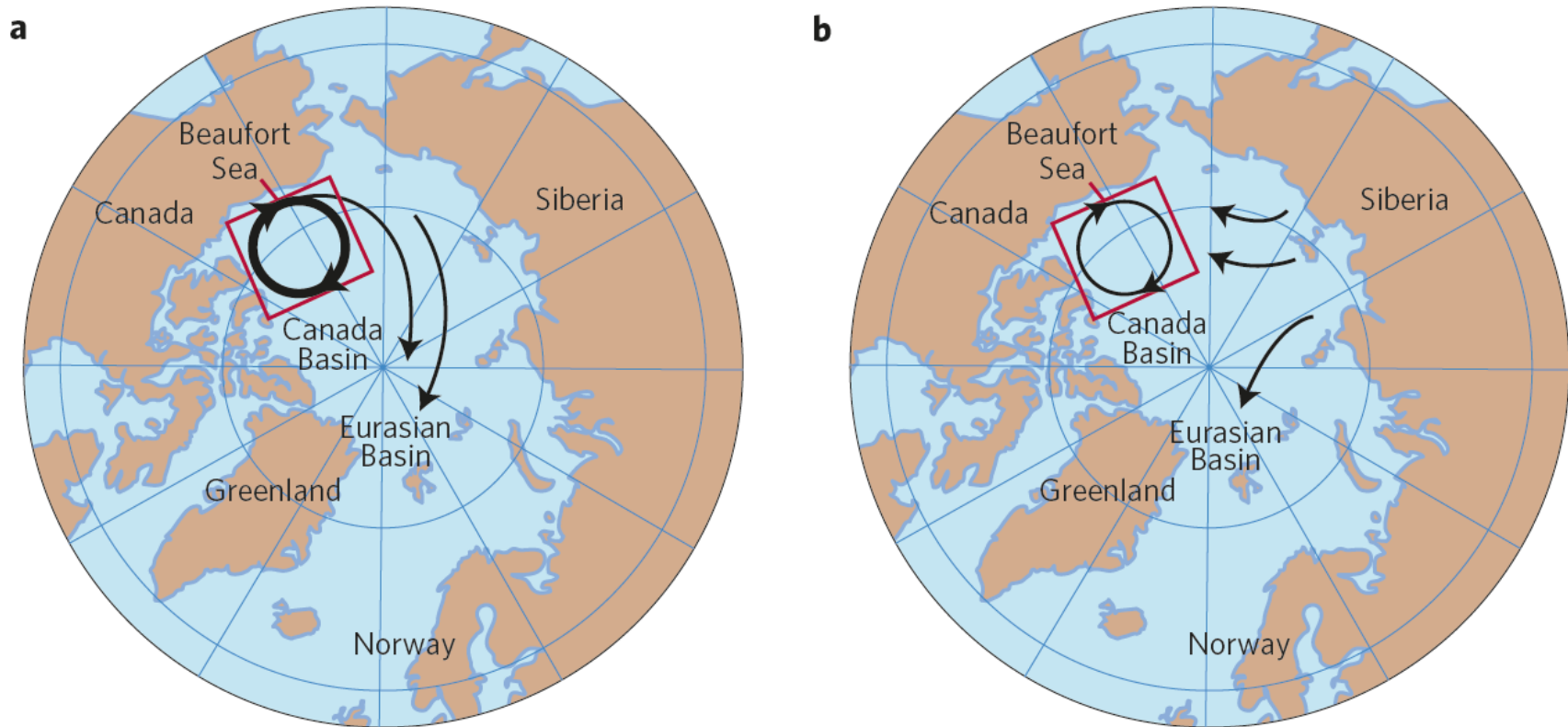


The anomalies have been normalised by twice their standard deviation

➤ Time series hint at **multidecadal oscillations**.

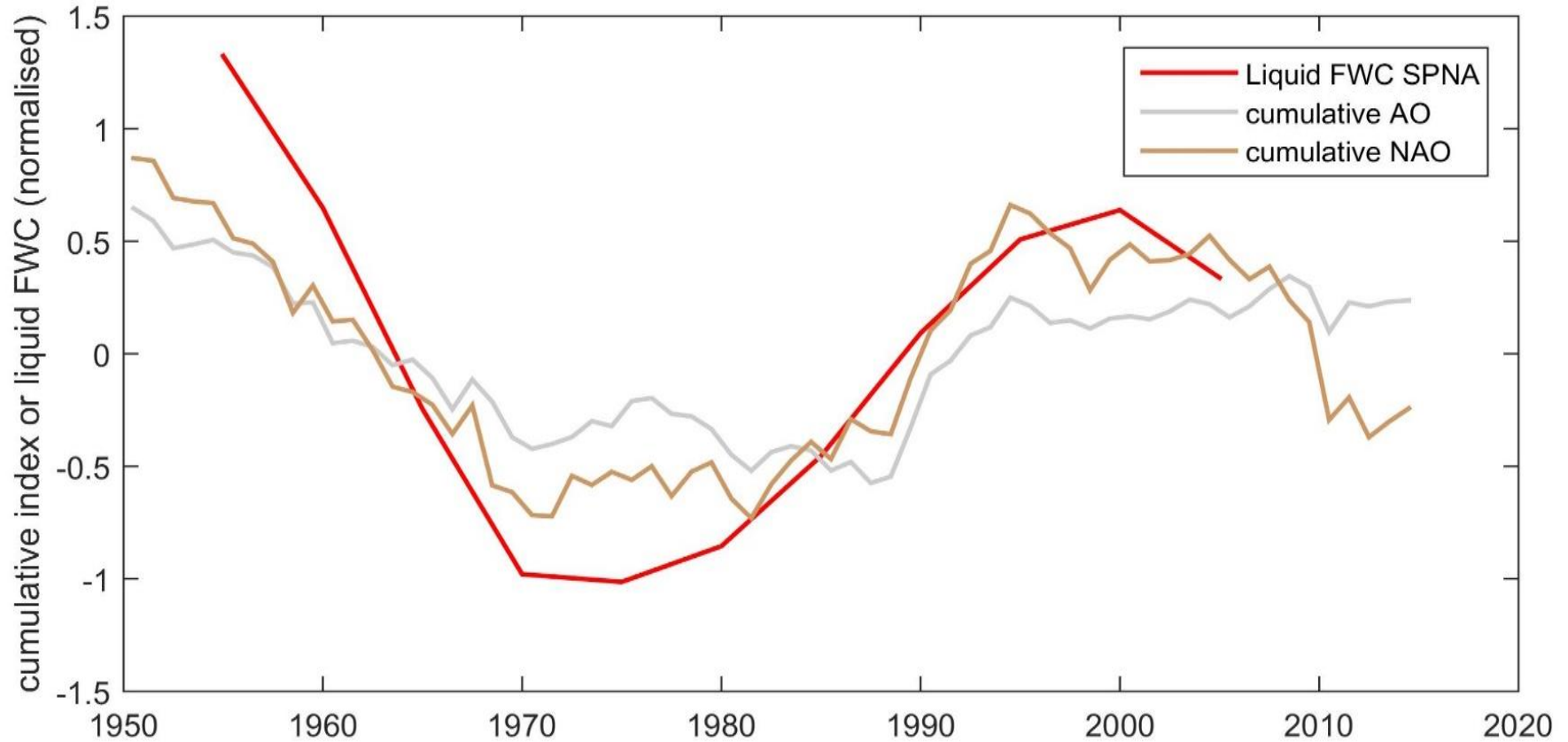
# Possible mechanisms underlying

The freshwater might be redistributed as a response to frequent changes in atmospheric pressure patterns



Mauritzen (2012)

# North Atlantic and Arctic Oscillation Index



The time series have been normalised by twice their standard deviation, detrended and demeaned.

- The cumulative oscillation indices and the liquid freshwater content of the subpolar North Atlantic are **significantly correlated**.

# Conclusions

Freshwater changes of the Arctic Ocean and of the subpolar North Atlantic and the Nordic & Barents Seas has been anti-correlated during the last 20 years.

Decadal scale changes of the freshwater content in the subpolar Seas are likely to originate in the Arctic Ocean.

An aerial photograph of a vast, frozen sea under a dramatic, cloudy sky at sunset. The sun is low on the horizon, casting a bright, shimmering reflection across a narrow, winding channel of open water known as a lead. The surrounding ice is broken into numerous small, irregular floes of varying sizes, creating a textured, mosaic-like appearance. The overall color palette is dominated by the warm, golden tones of the setting sun, contrasted with the cool blues and greys of the ice and the overcast sky.

**Thank you for your  
attention**



# References

Curry, R. & Mauritzen C. Dilution of the Northern North Atlantic Ocean in Recent Decades. *Science* **308**, 1772-1774 (2005).

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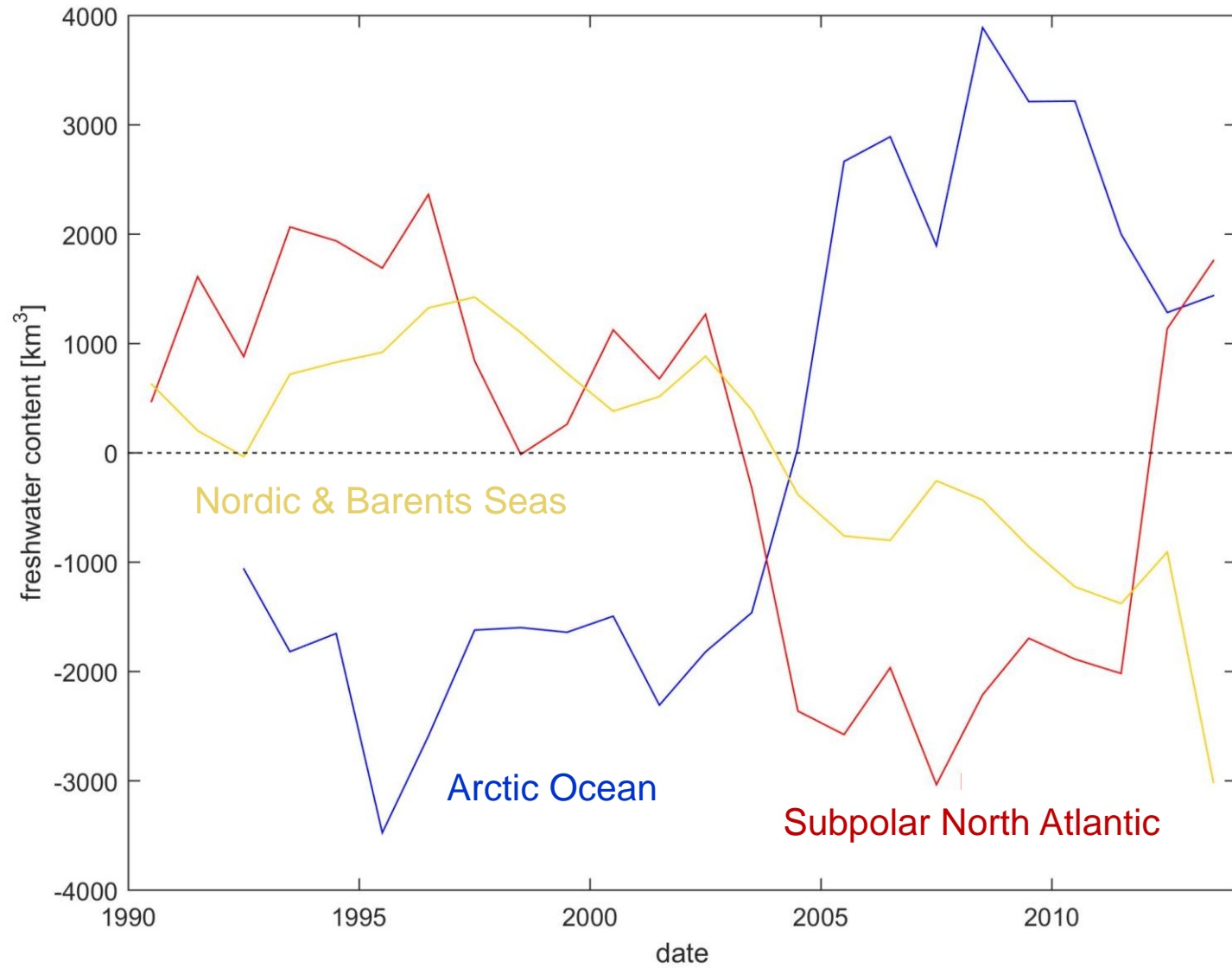
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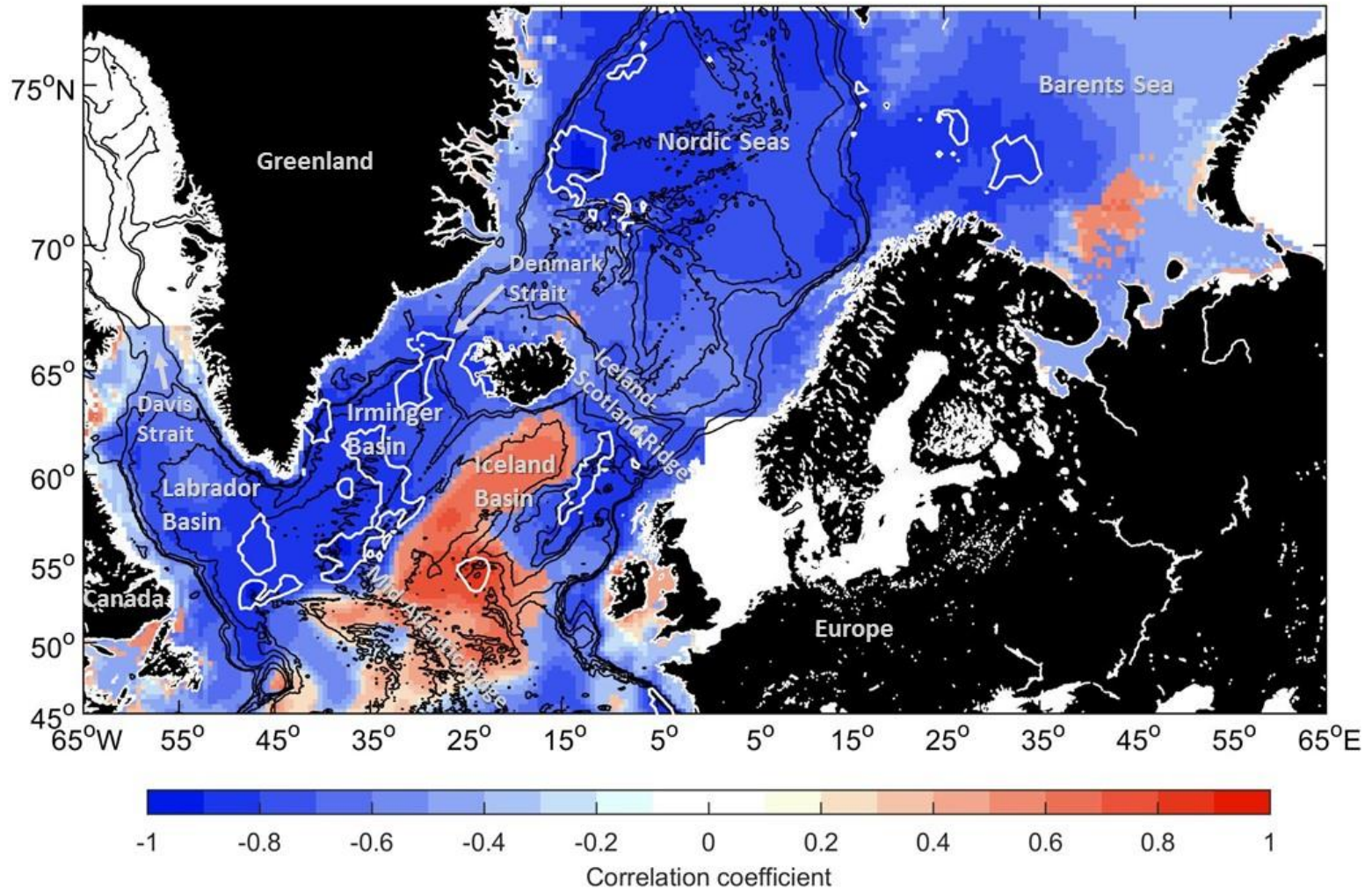
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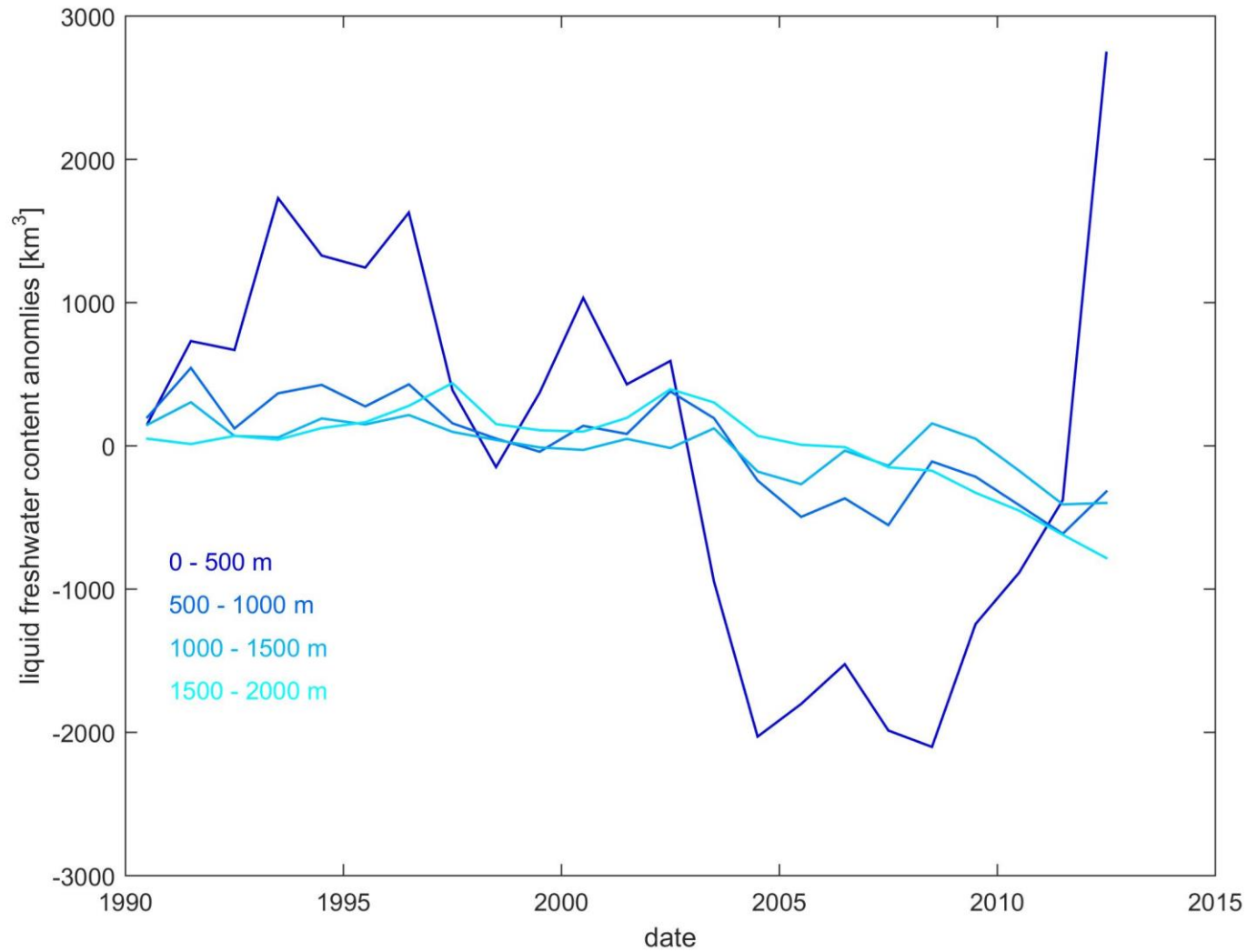
# Freshwater variability



# Correlation with the freshwater content of the Arctic Ocean



# Freshwater variability of the subpolar North Atlantic



# Freshwater variability of the subpolar North Atlantic

