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## North Atlantic soon flooded by Arctic fresh water?

### Introduction

A rapid increase in liquid freshwater content has been observed in the Arctic Ocean in the past two decades (e.g. Rabe et al., 2014). At the same time a significant part of Arctic sea ice volume has been lost to



Atlantic

lorth



Data & Method

Liquid freshwater content

 $LFWC = \oint \int_{z=0m}^{h} \frac{S_{ref} - S}{S_{ref}} dz dA [km^3]$ 

- Arctic Ocean (1992-2013):
- Upper ocean liquid freshwater content of the deep basins (z>500m) from Rabe et al. (2014) extended to 2013 (Sref=35, h=depth of 34 isohaline)
- solid freshwater content from Haine et al. (2015) derived from PIOMAS Assim. Product

### Subpolar North Atlantic & Nordic Seas (1990-2013):

- Liquid freshwater content calculated from CORA 4.1 salinity fields (Sref=35, h=2000 m) **Transport time series**
- AWI's global finite-element sea ice-ocean model FESOM with increased mesh resolution in the Arctic Ocean and Nordic Seas (Wekerle et al., 2017).

Atmospheric data

- Oscillation indices from NOAA/National Weather Service
- Sea level pressure from Core 2 forcing

# How do the freshwater contents compare?



### Arctic freshwater export



Significant anti-correlation (95 % confidence) of the subarctic North Atlantic liquid freshwater content anomalies and the Arctic Ocean total freshwater content anomalies.

Simulated net liquid, solid and total (liquid + solid) freshwater transport anomaly through the Arctic passages towards the North Atlantic (Fram Strait, Nares Strait, Hellgate & Lancaster Sound) calculated with a reference Salinity of Sref = 35.

## The atmosphere as the driver?



Atmospheric blocking linked to decreased sea ice export through Fram Strait (Ionita et al., 2016) may have caused the abrupt change in Arctic and North Atlantic freshwater content in the early 2000s.

DJF SLP Anomaly: 2004:2012 - 1990:2002

## Conclusions

Freshwater changes in the Arctic Ocean and the subarctic North Atlantic have been anti-correlated the last 20 years.

Arctic freshwater accumulation and release may respond to

<sup>5</sup> <sup>1950</sup> <sup>1960</sup> <sup>1970</sup> <sup>1980</sup> <sup>1990</sup> <sup>2000</sup> <sup>2010</sup> <sup>2020</sup> <sup>72</sup> Significant correlation (95 % confidence) of the Subpolar North Atlantic liquid <sup>60</sup> freshwater content from Mauritzen et al. (2012), the cumulative Arctic Oscillation <sup>48</sup> Index, and the cumulative North Atlantic <sup>36</sup> Oscillation Index. All time series have been normalized by twice their standard deviation, detrended, and demeaned.



multidecadal alternations of the dominant large-scale atmospheric variability.

We suggest changing freshwater export from the Arctic Ocean resulting from the atmospheric conditions to be responsible for the anti-correlation.

#### References

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