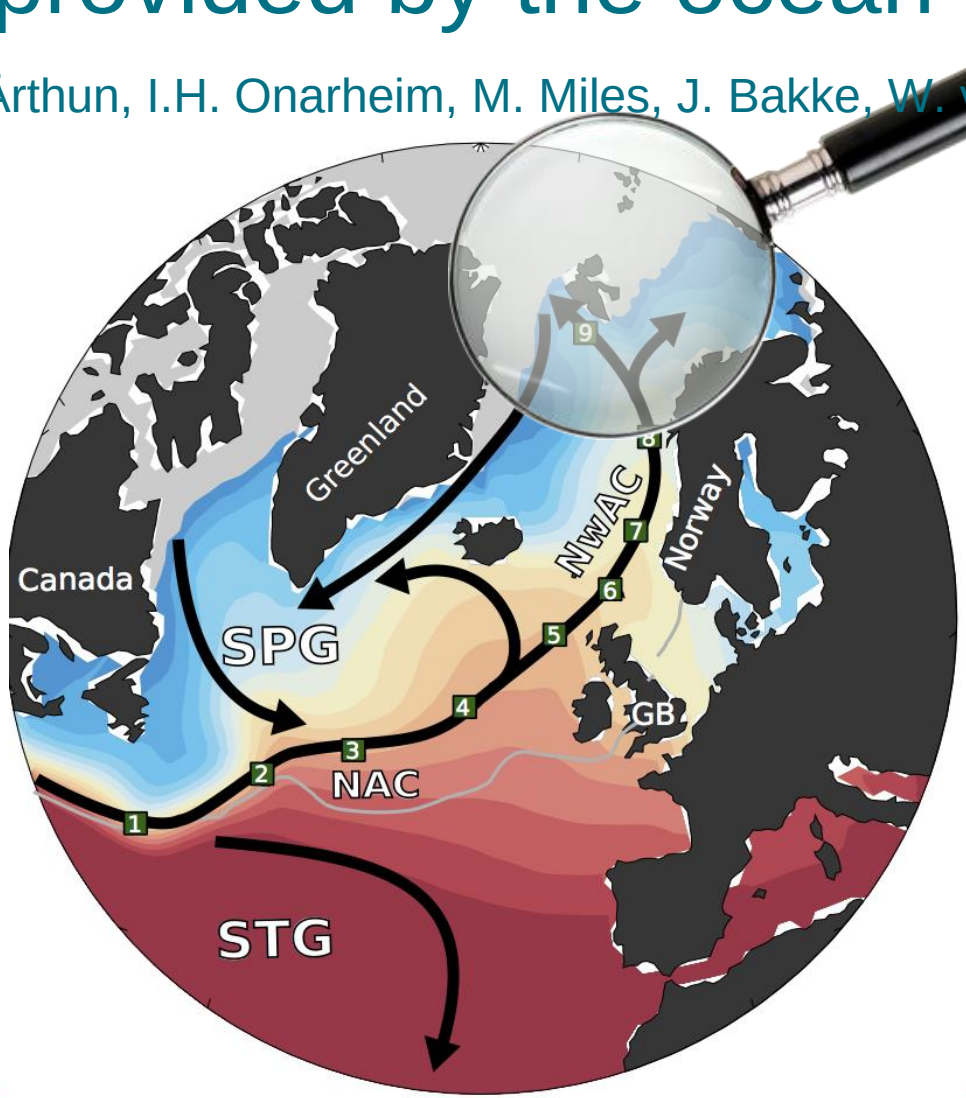
Skillful prediction of northern climate provided by the ocean

Tor Eldevik, M. Årthun, I.H. Onarheim, M. Miles, J. Bakke, W. van der Bilt, et al.

Willem van der Bilt



Marius Årthun

Martin Miles

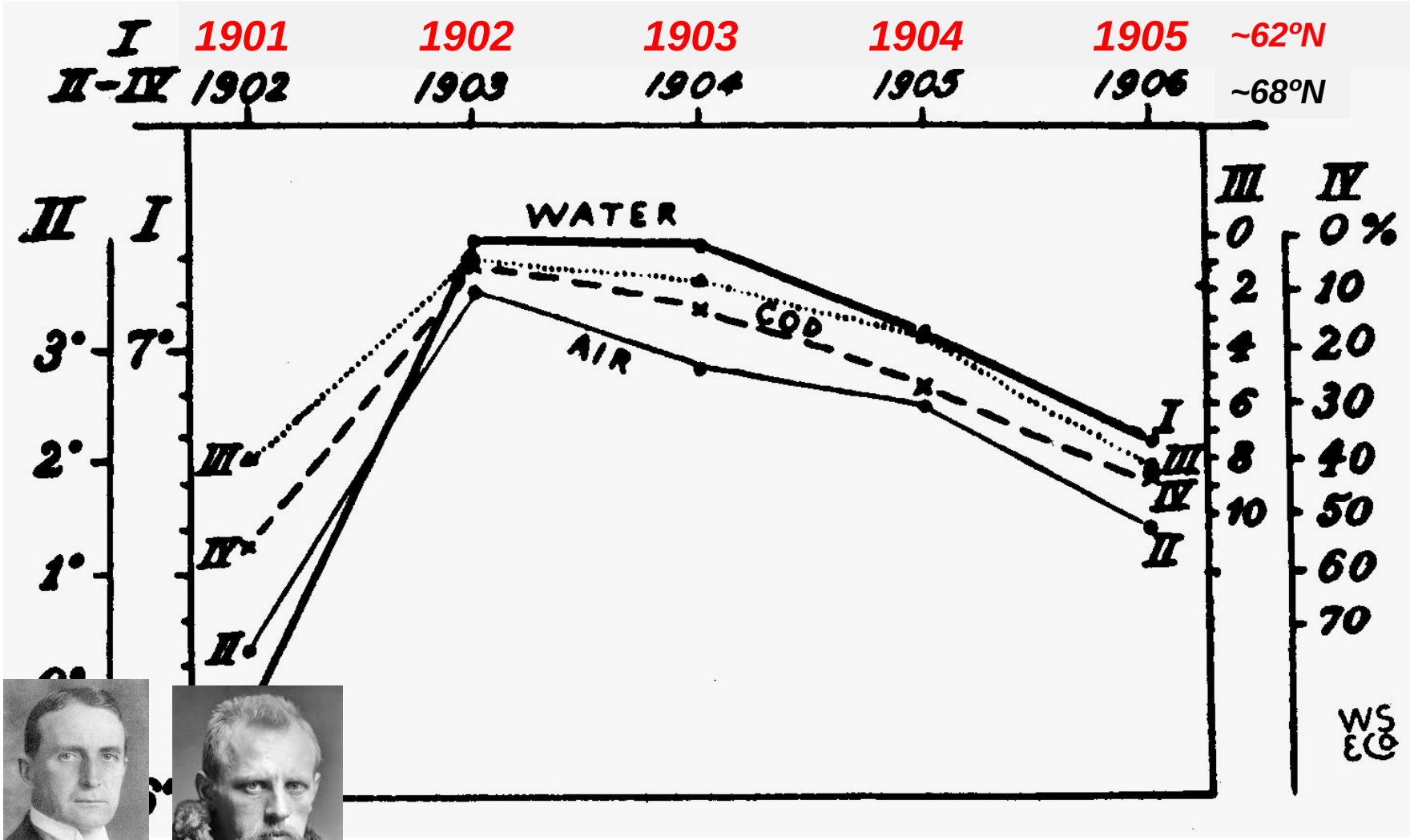
Ingrid H. Onarheim

funding includes

- Research Council of Norway
  - NORTH, PATHWAY, EPOCASA, SHIFTS, ULTRAMAR

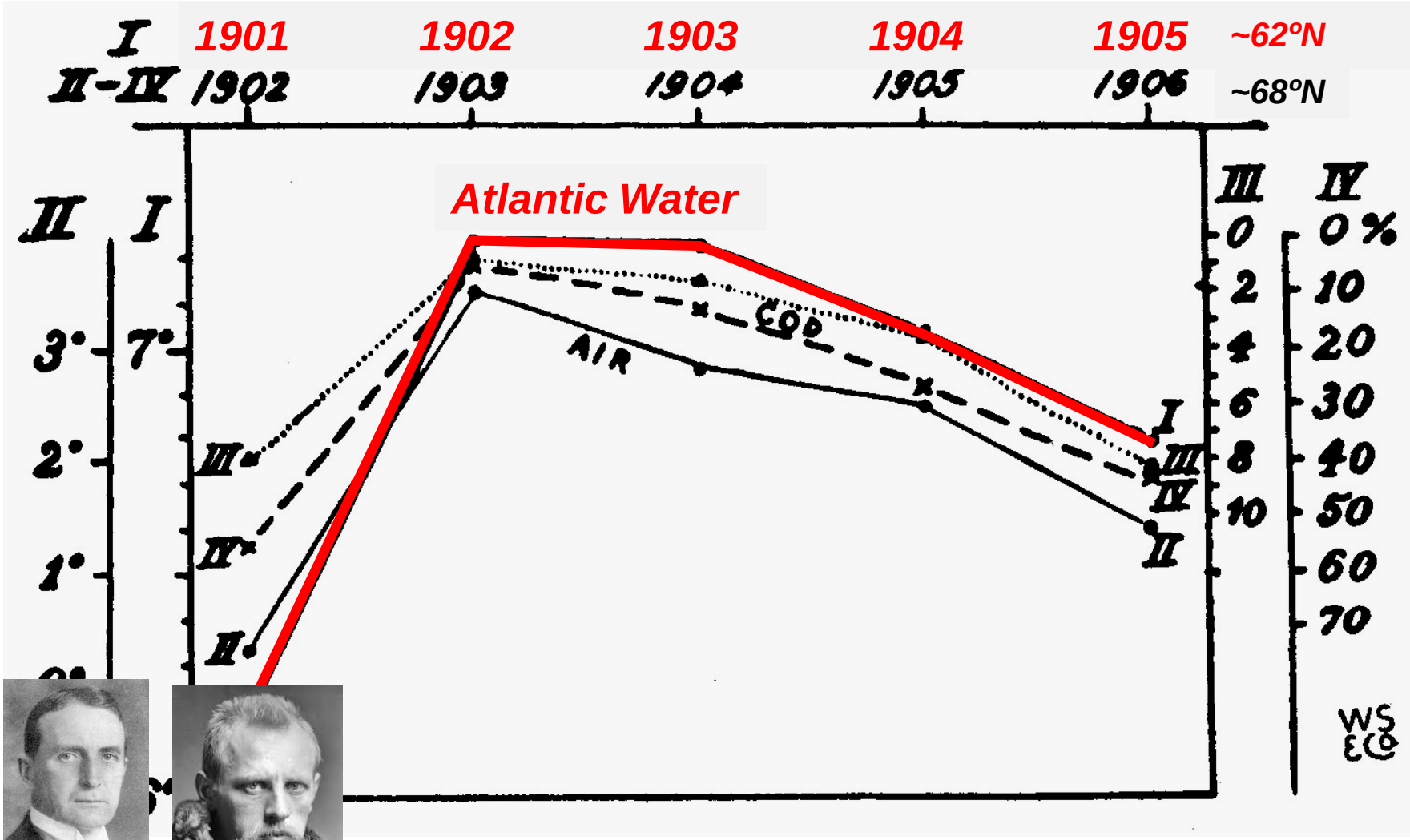
- EU H2020
  - Blue-Action *Arctic Impact on Weather and Climate*

An early vision of a predictable climate



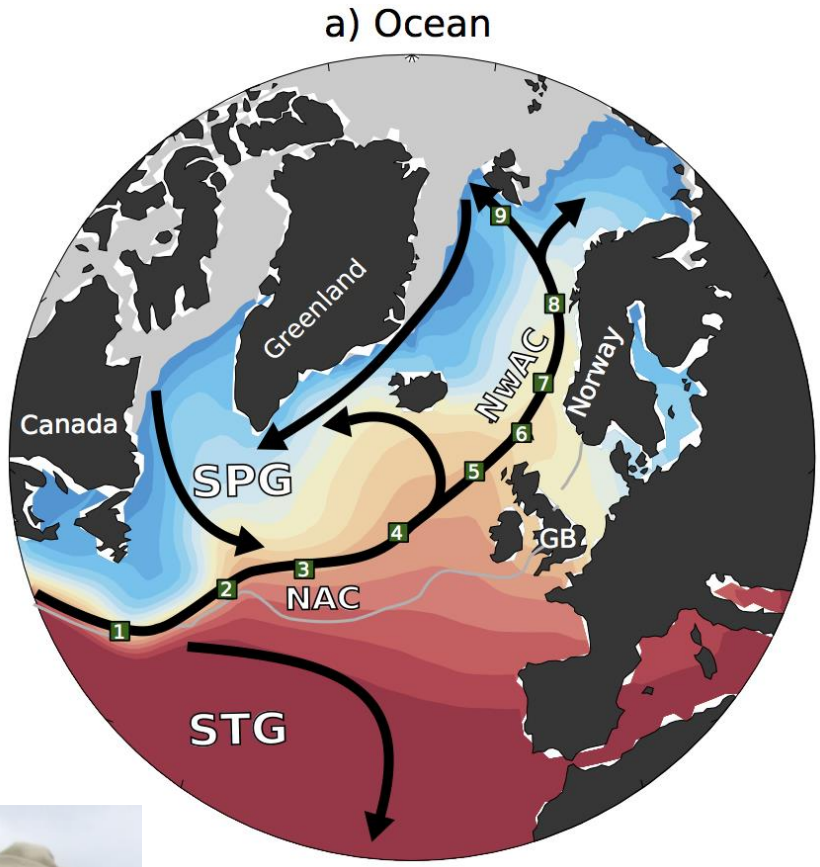
Helland-Hansen og Nansen 1909

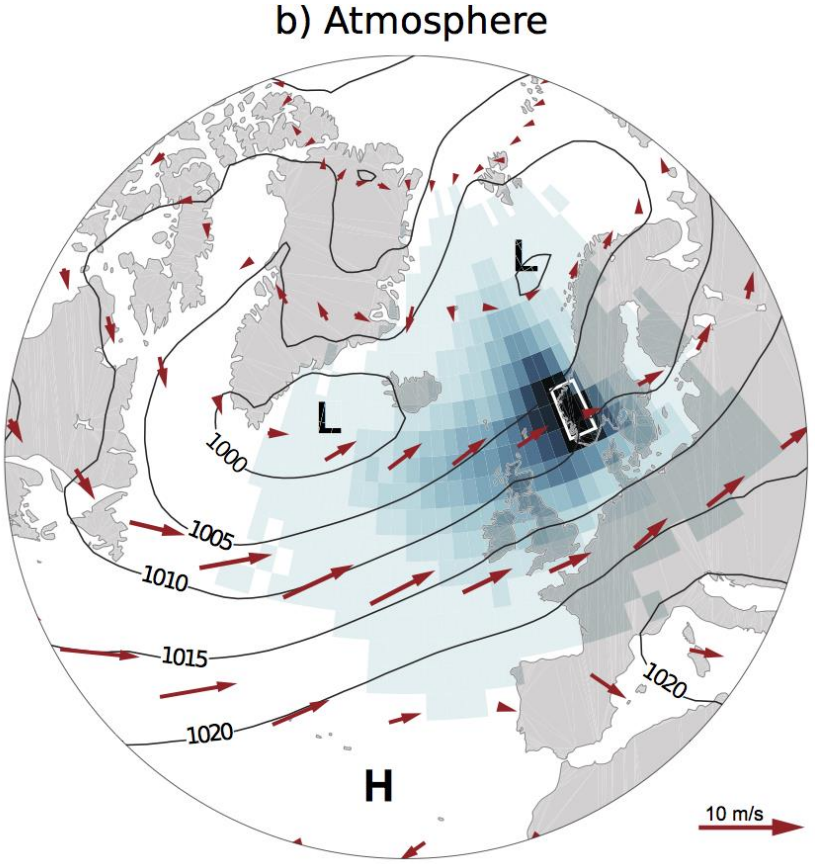
An early vision of a predictable climate



Helland-Hansen og Nansen 1909

The “Gulf Stream” and the westerly winds





Årthun et al. 2017: Skillful prediction of northern climate provided by the ocean. ***Nature Comm.***

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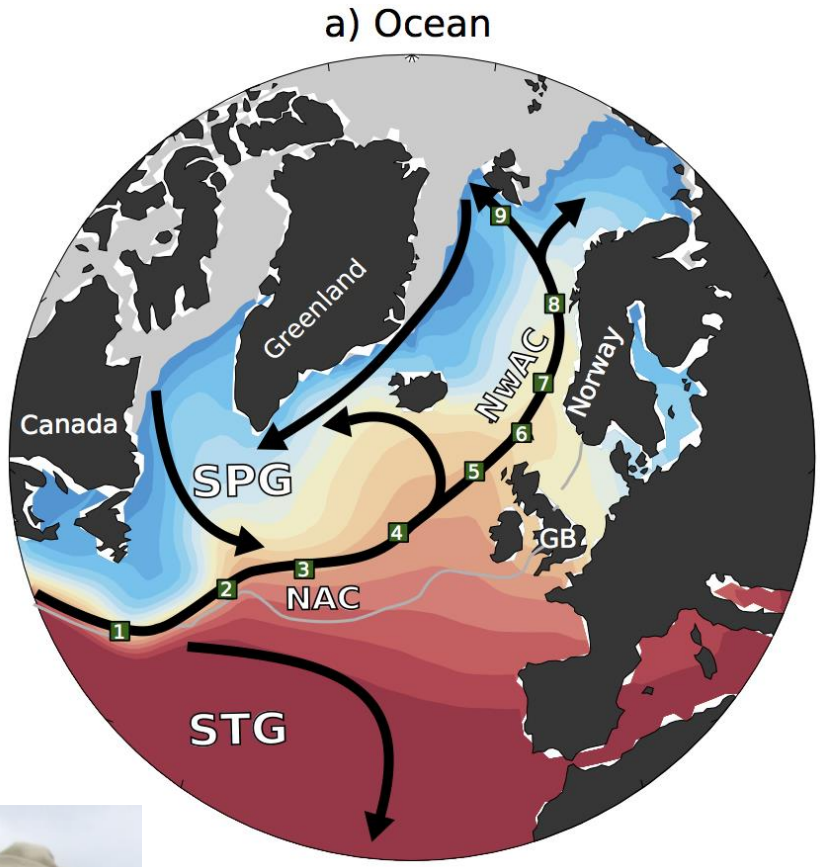
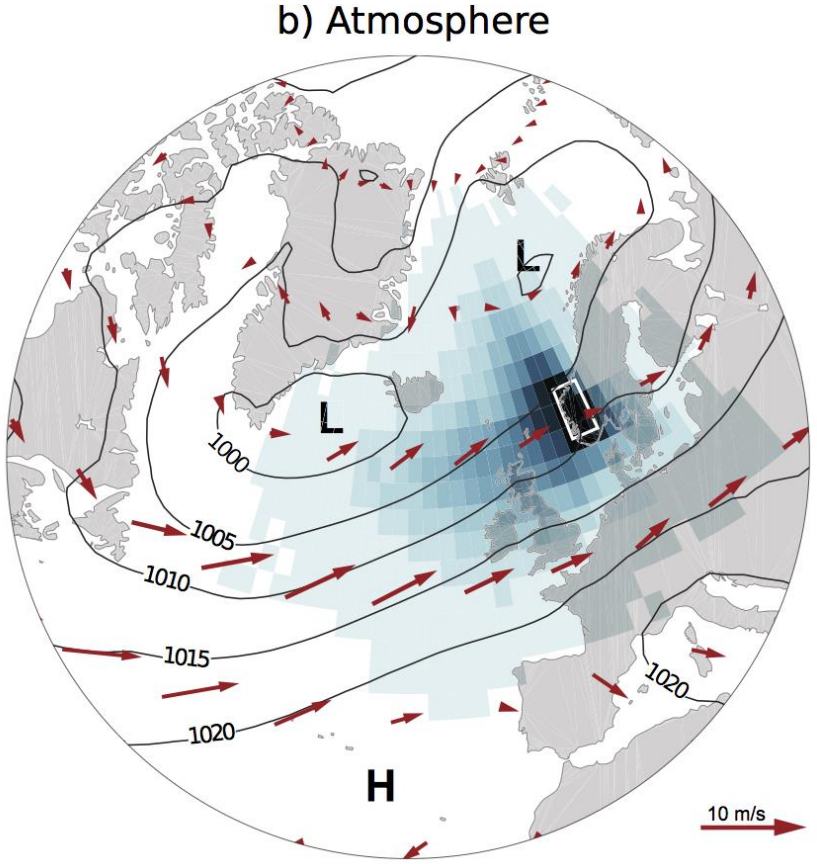
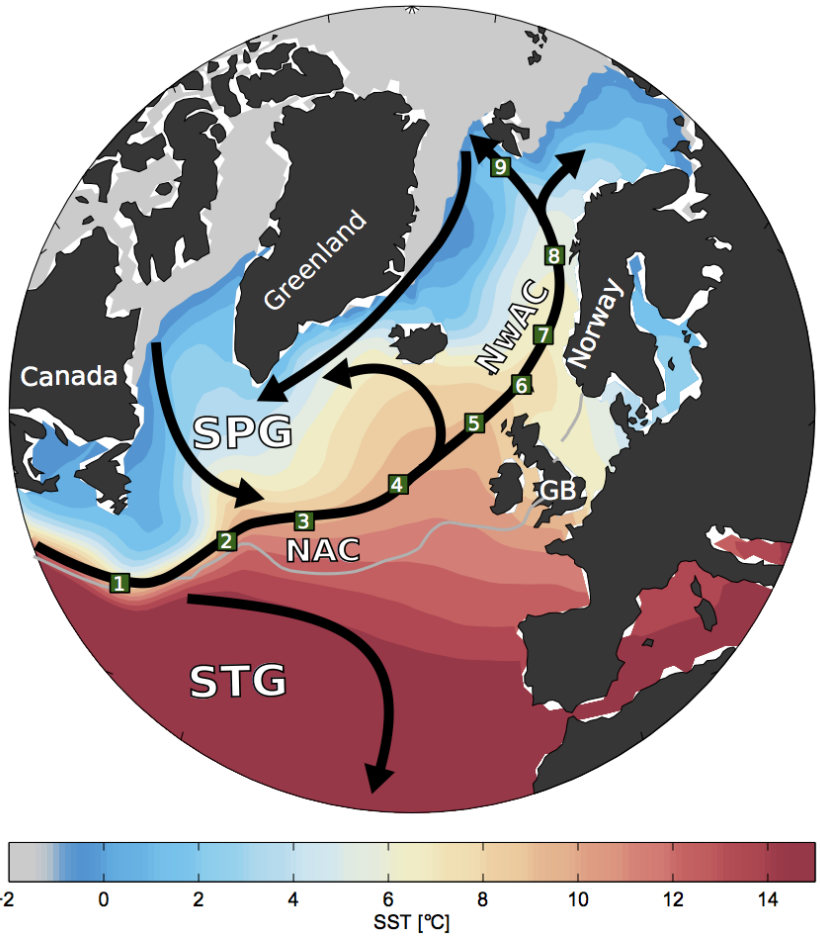




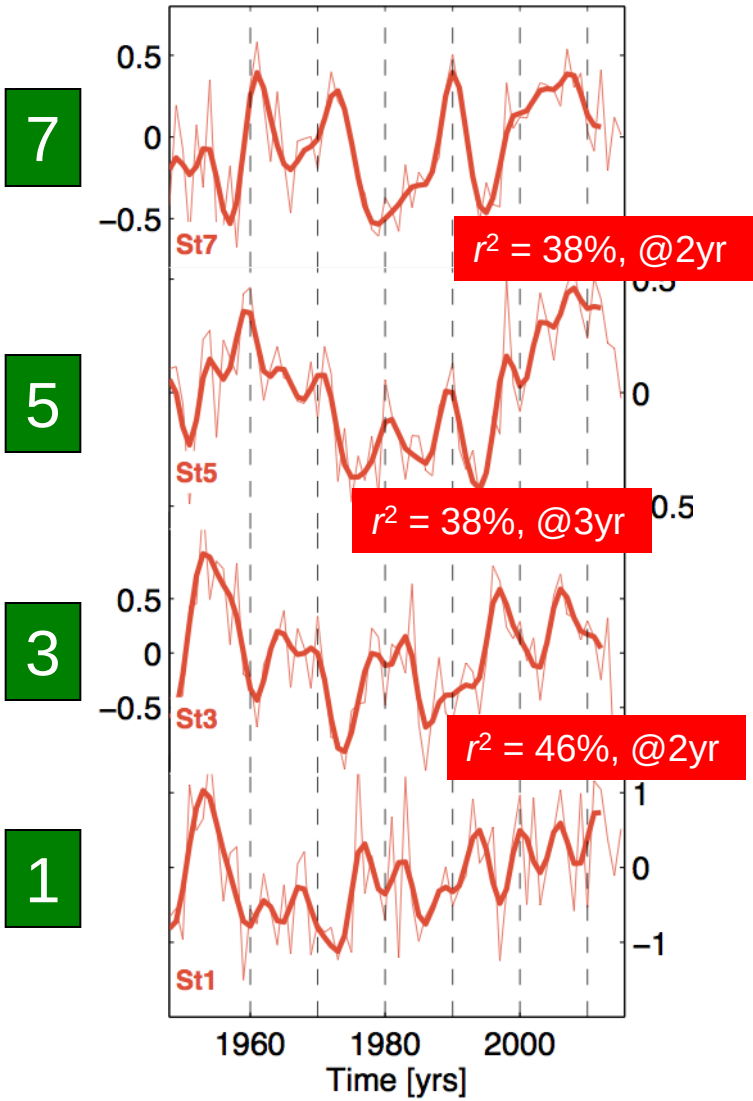
NAO + mean temperate ocean => *diagnostic*

“Gulf Stream” + mean westerlies => *prognostic?*

Observed SST propagation (HadISST)



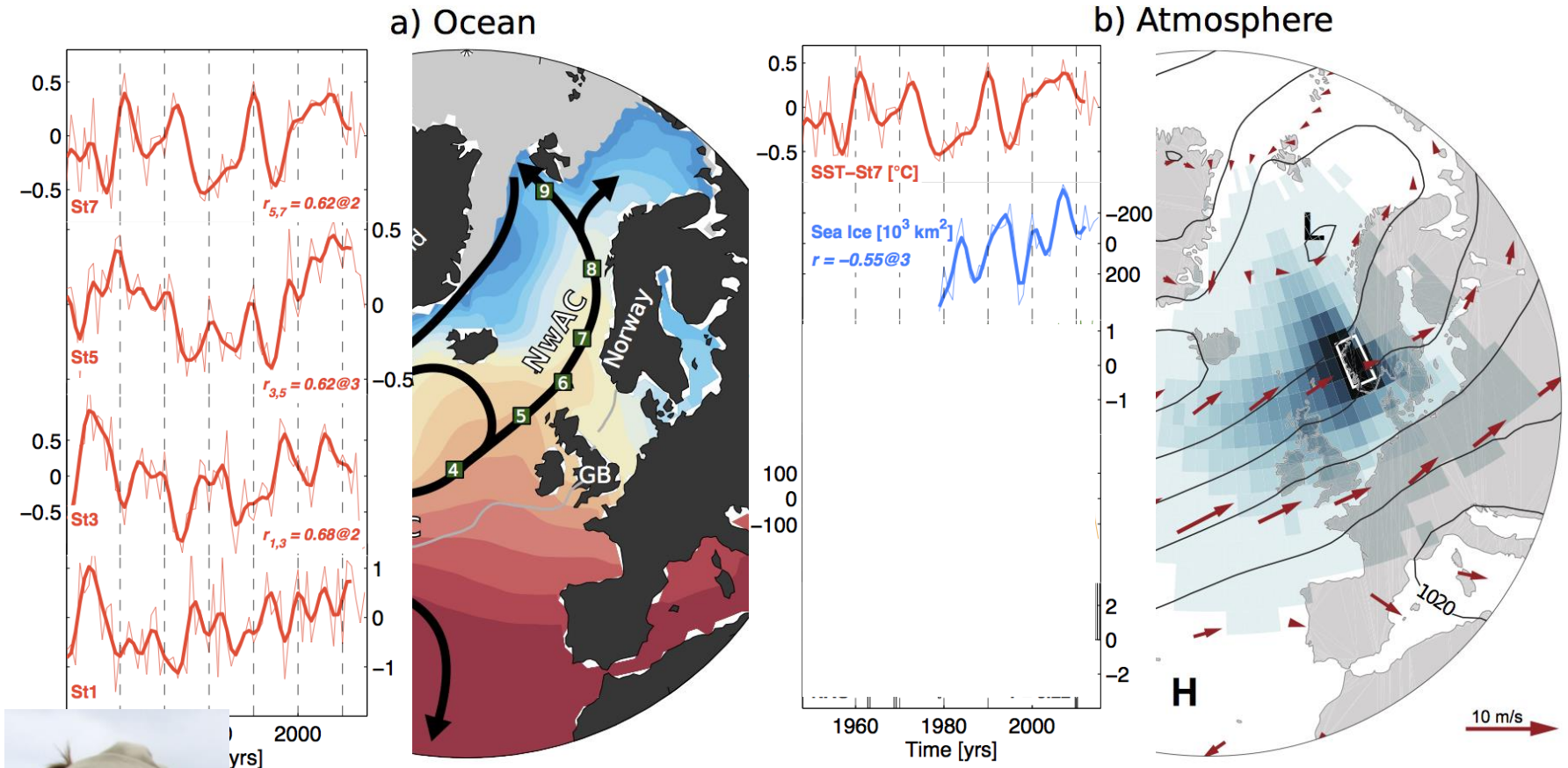
Propagating thermohaline anomalies, e.g., Sutton and Allen 1997, Holliday et al. 2008, Årthun and Eldevik 2016, +++



Årthun et al. 2017

Bjerknes Centre for Climate Research

How to get predictability beyond the ocean?



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Norwegian Sea heat (SST) is reflected in

+ Arctic winter sea ice cover (30% @3yr) – see also Yeager et al. (2016, GRL)

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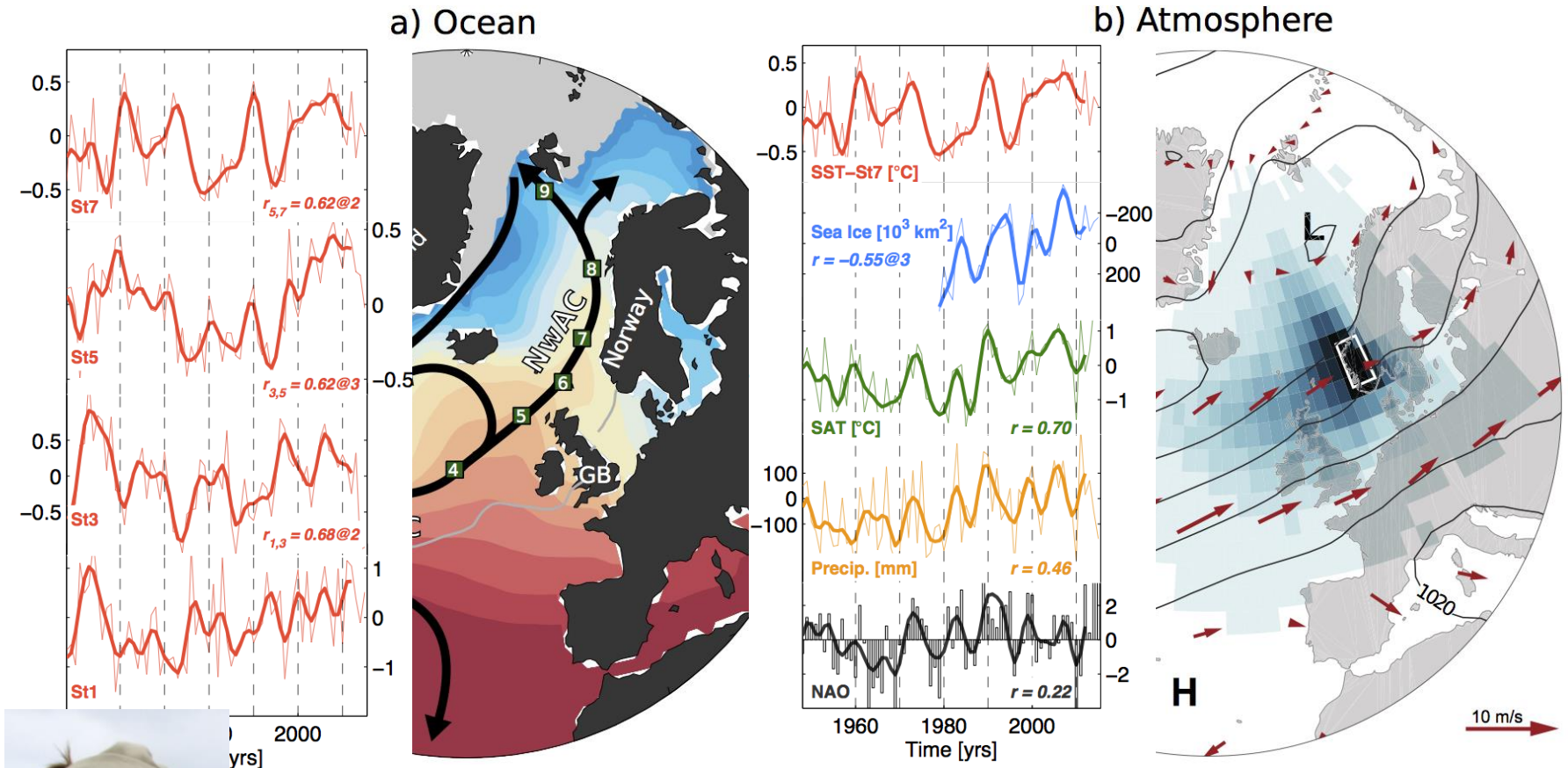

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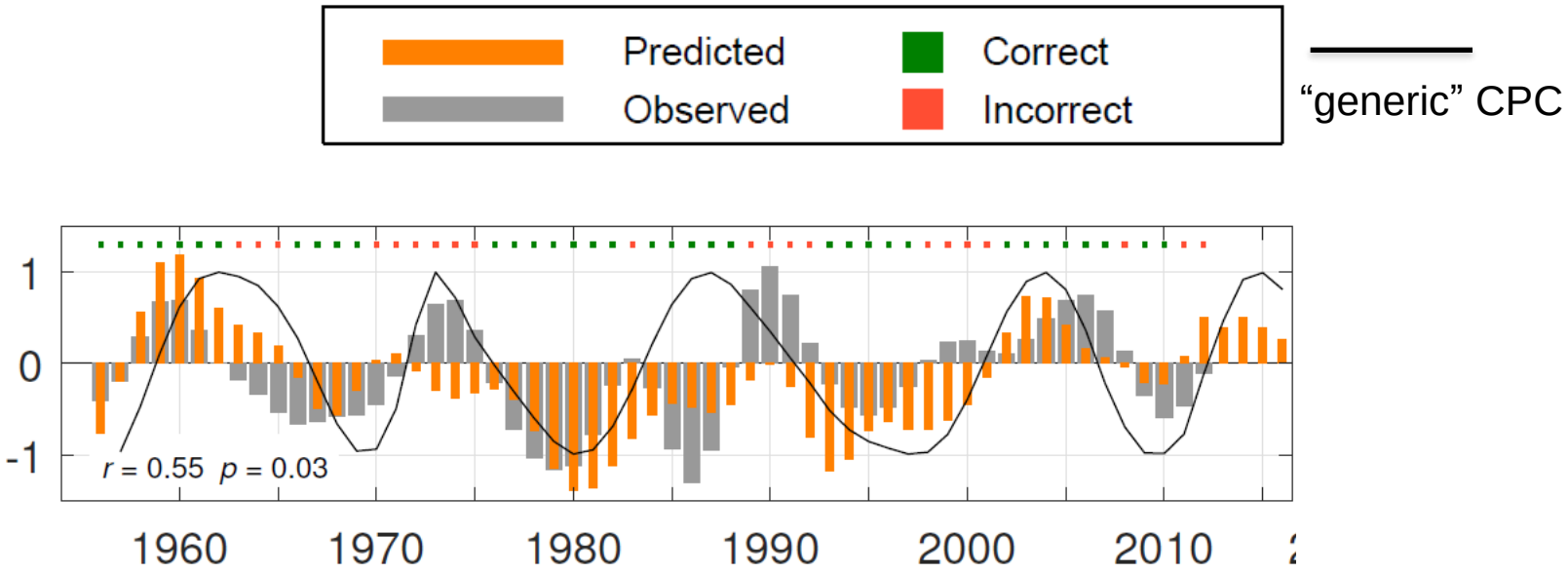
Norwegian Sea heat (SST) is reflected in

+ Arctic winter sea ice cover (30% @3yr) – see also Yeager et al. (2016, GRL)
+ Norwegian SAT (49%) and precipitation (21%) over land
+ practically *independent* from NAO (5%)

Basic prediction

Surface Air Temperature - Norway



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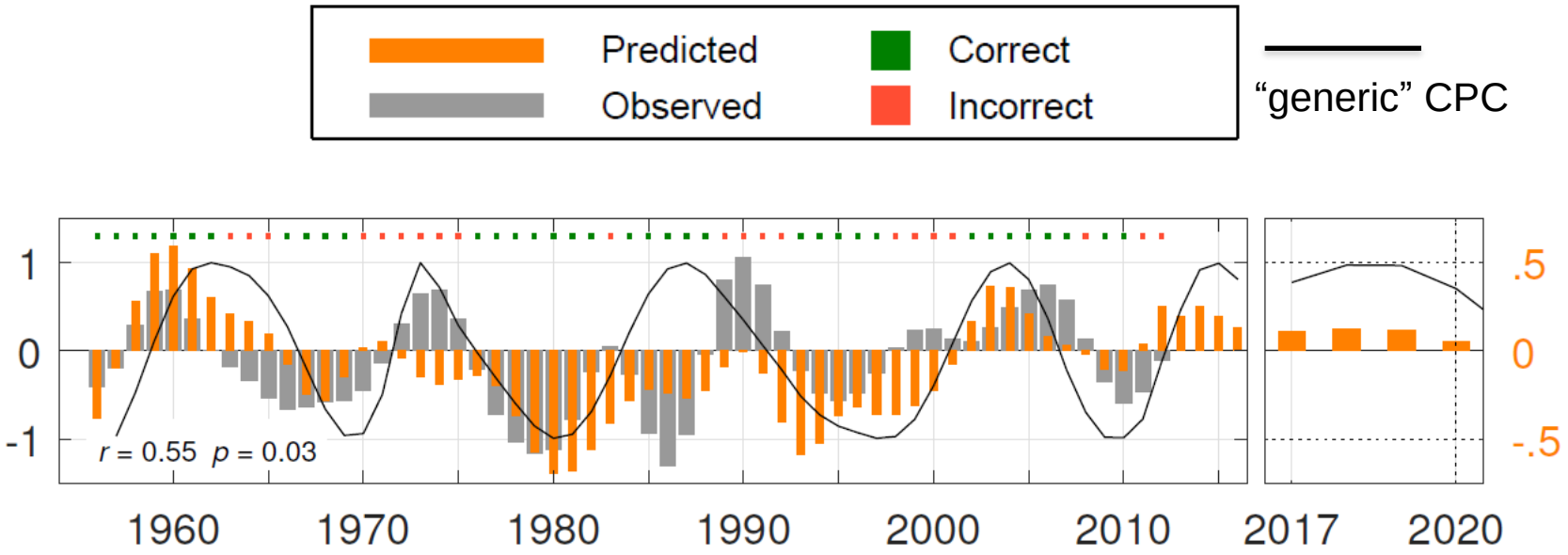
- Sign of prediction correct 67% of the time
- More skilful than random chance and climatology predictions

Basic prediction 2017–2020

Surface Air Temperature - Norway



- Sign of prediction correct 67% of the time
- More skilful than random chance and climatology predictions
- Slight temperature decrease toward 2020 (above long-term average)

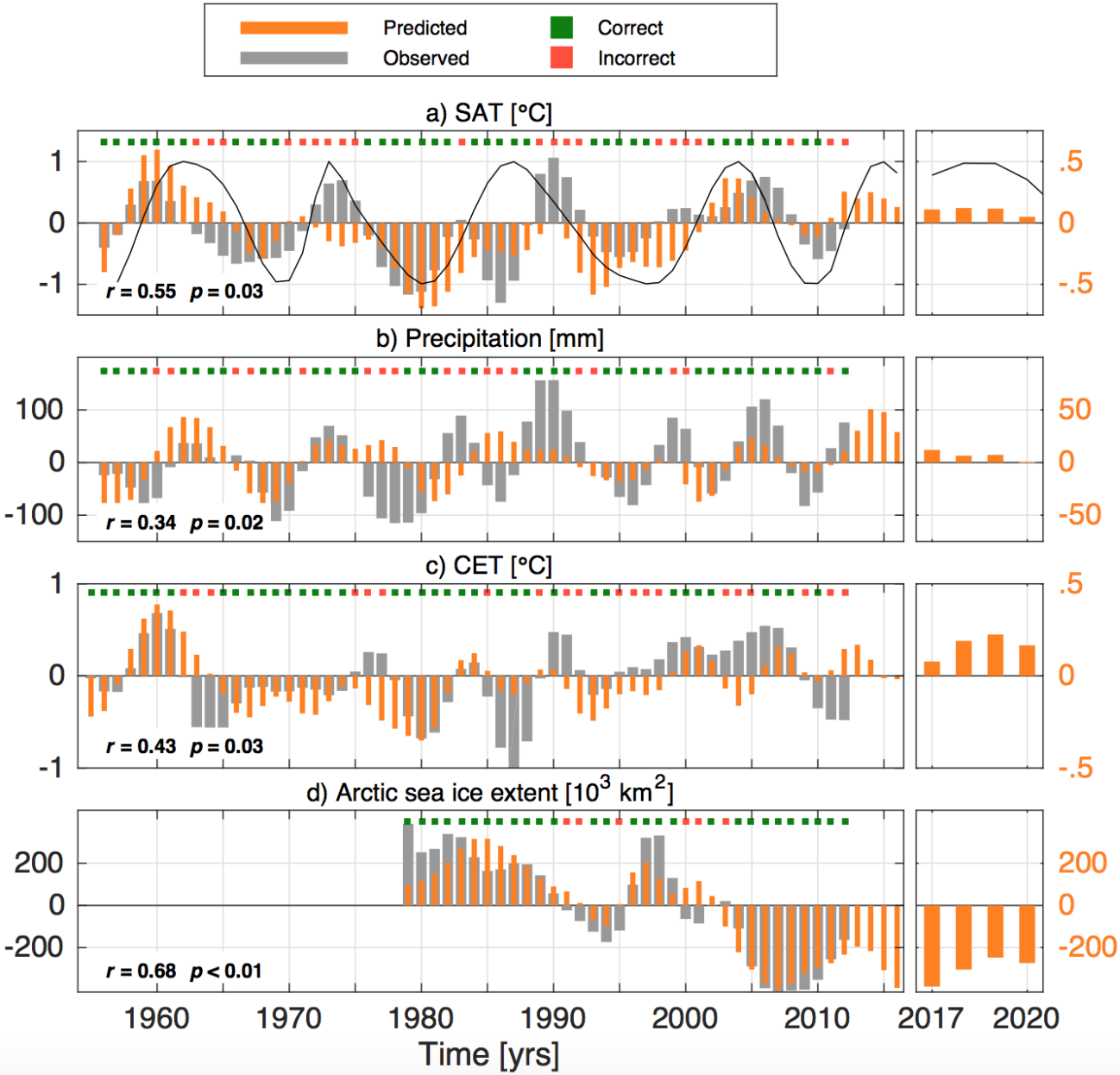
Årthun et al. 2017: *Nature Comm.*

Norway SAT

Norway precip

CET

Arctic sea ice



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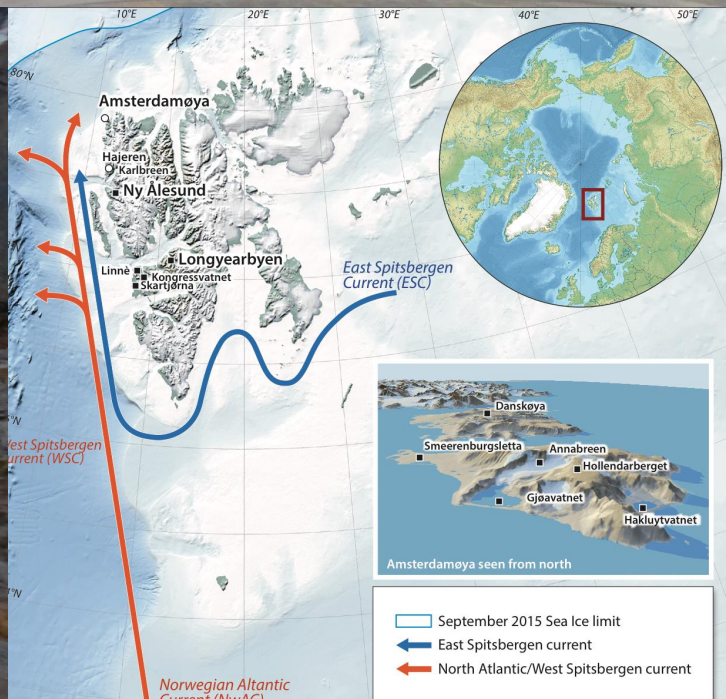
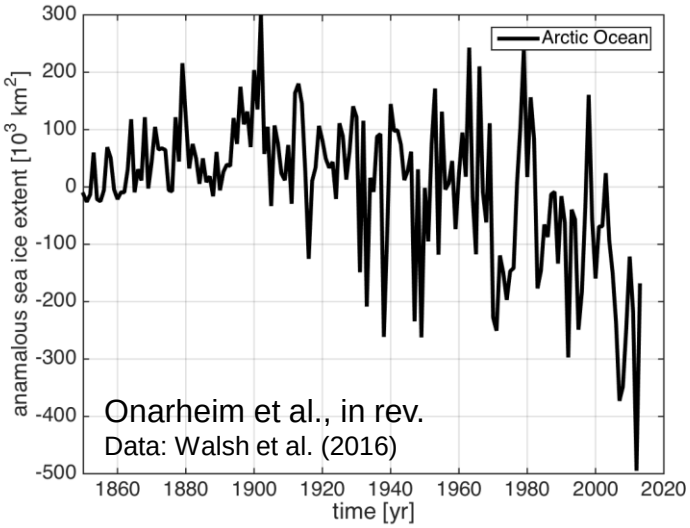
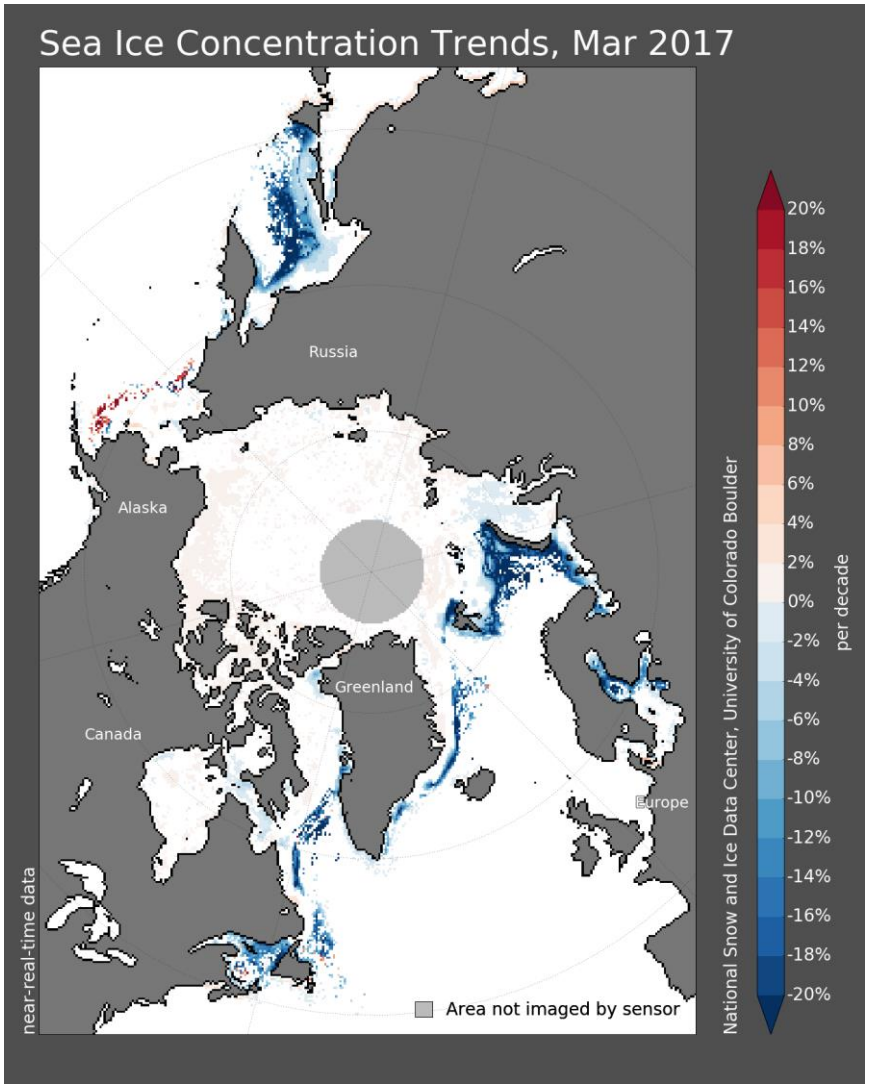
anomalies wrt 1981–2010 climatology

Longyearbyen, Svalbard - Bergen weather in the Arctic



Sea ice, marginal climates, Svalbard





Cf. also Førland et al. 2011

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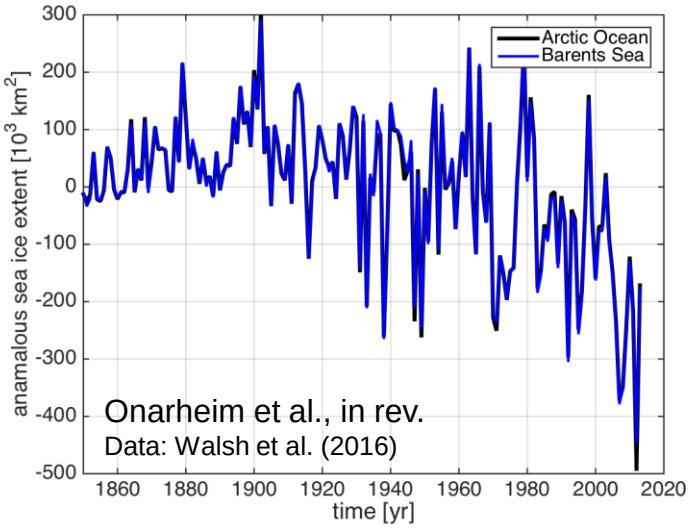

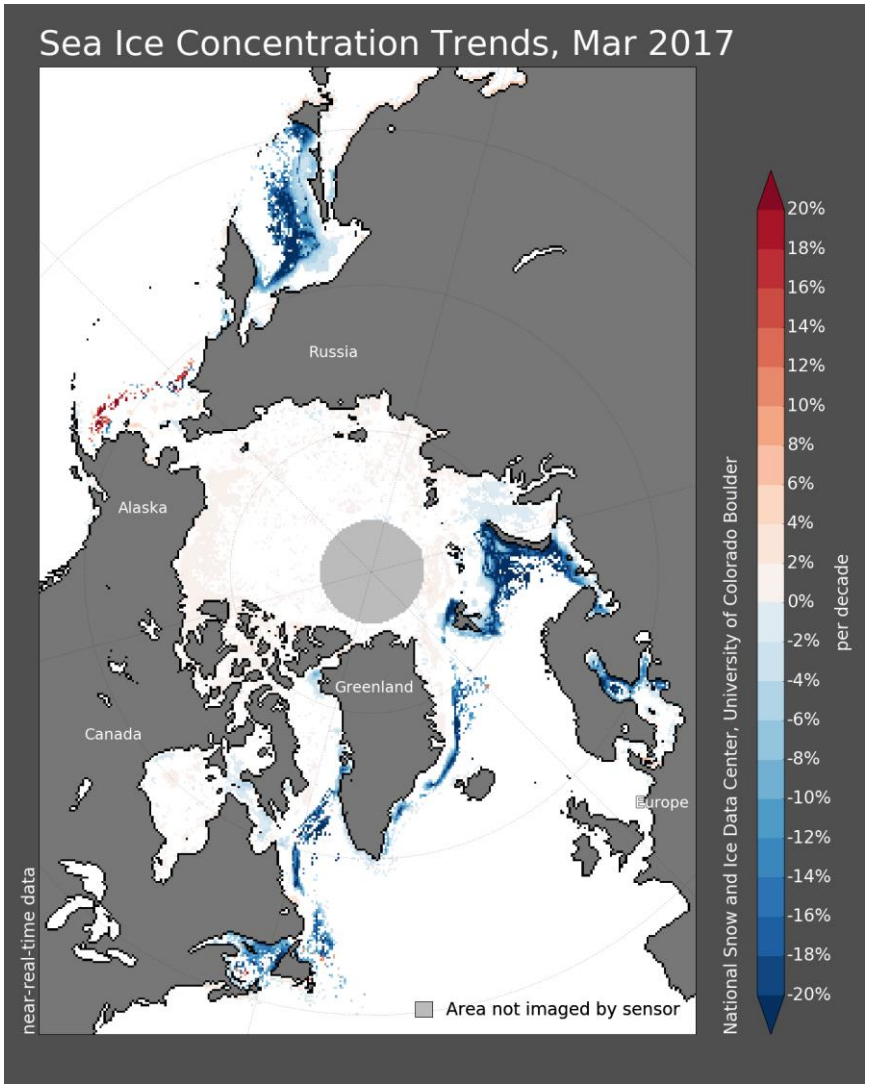

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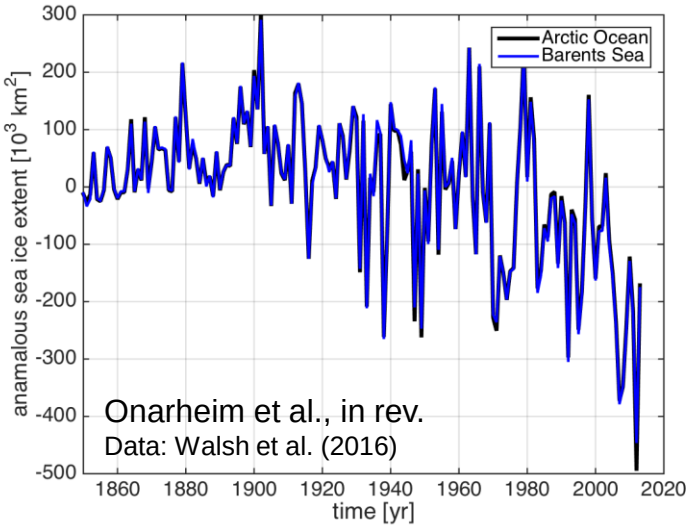

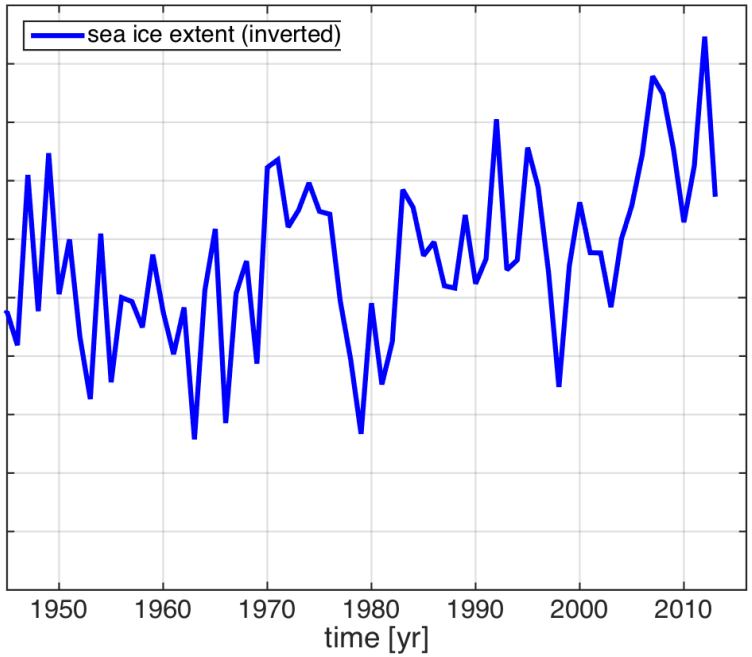

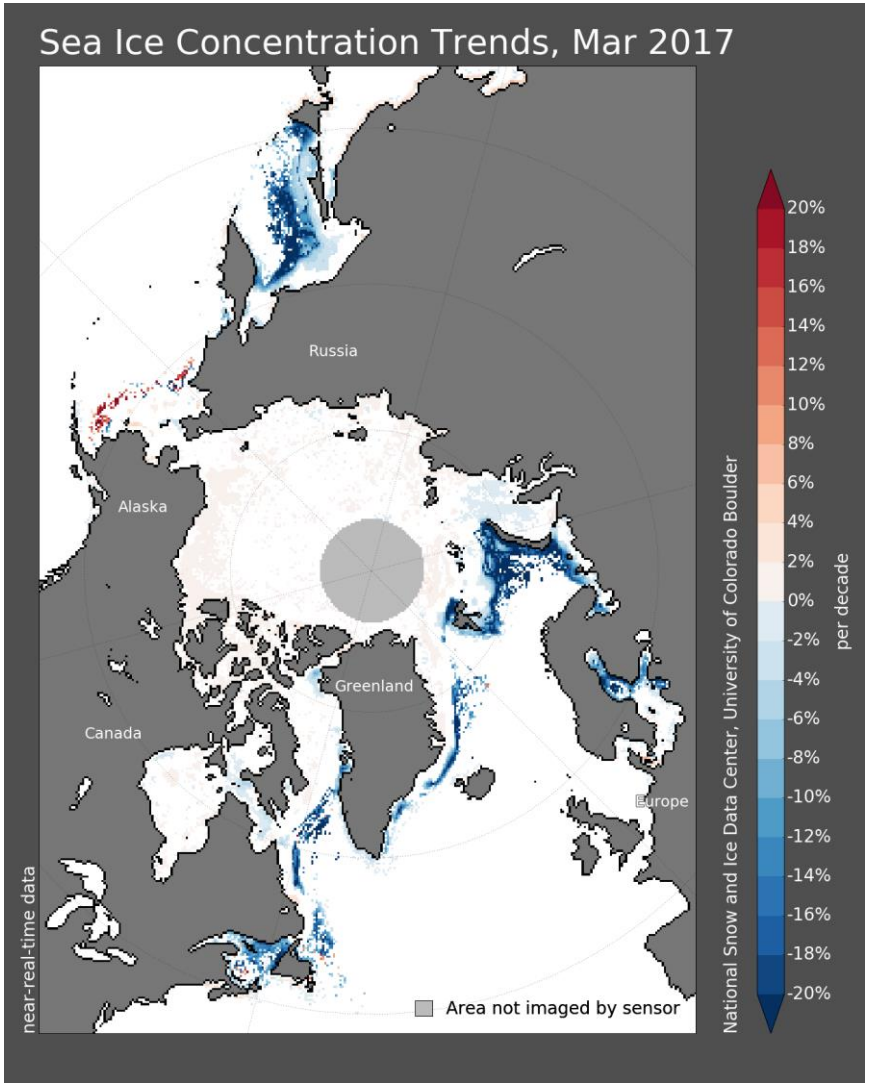

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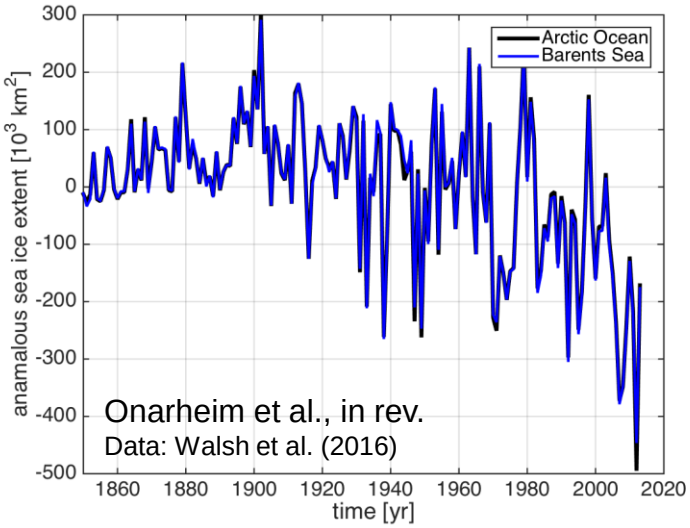

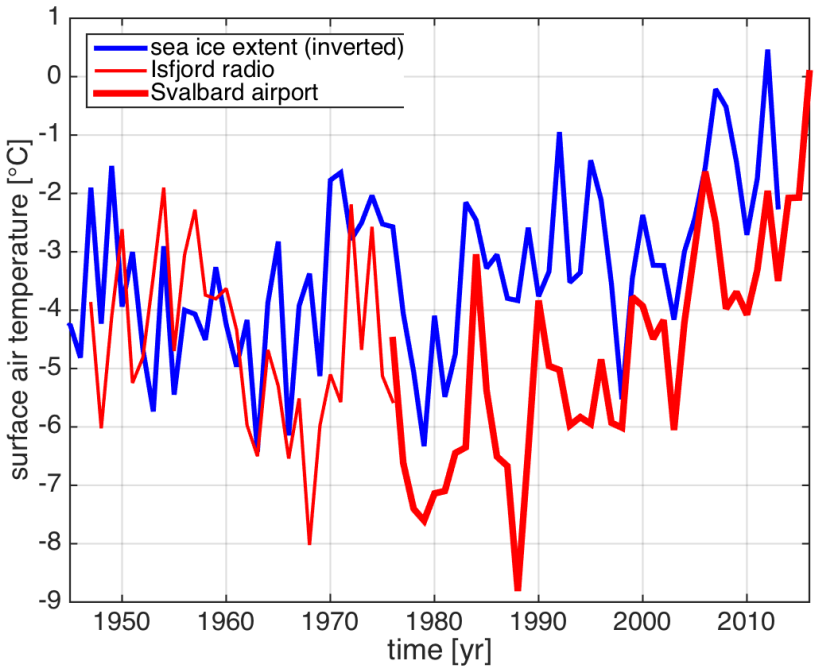

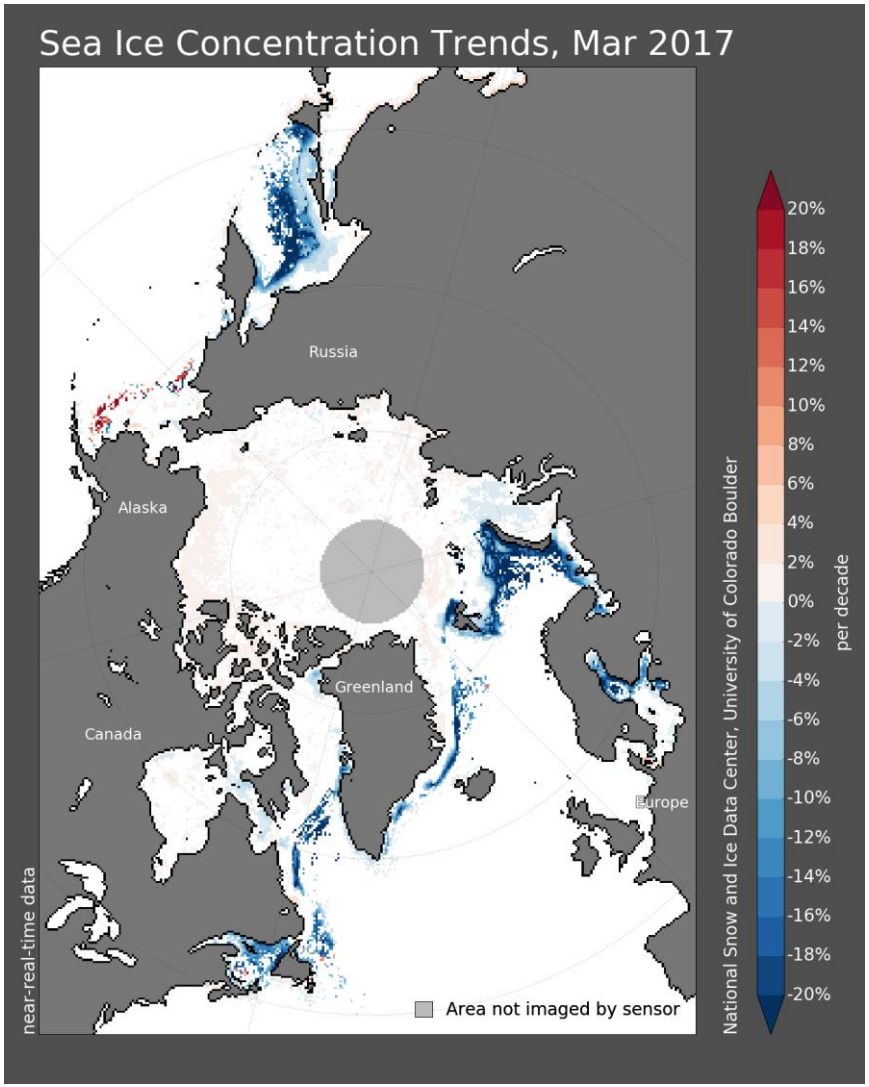

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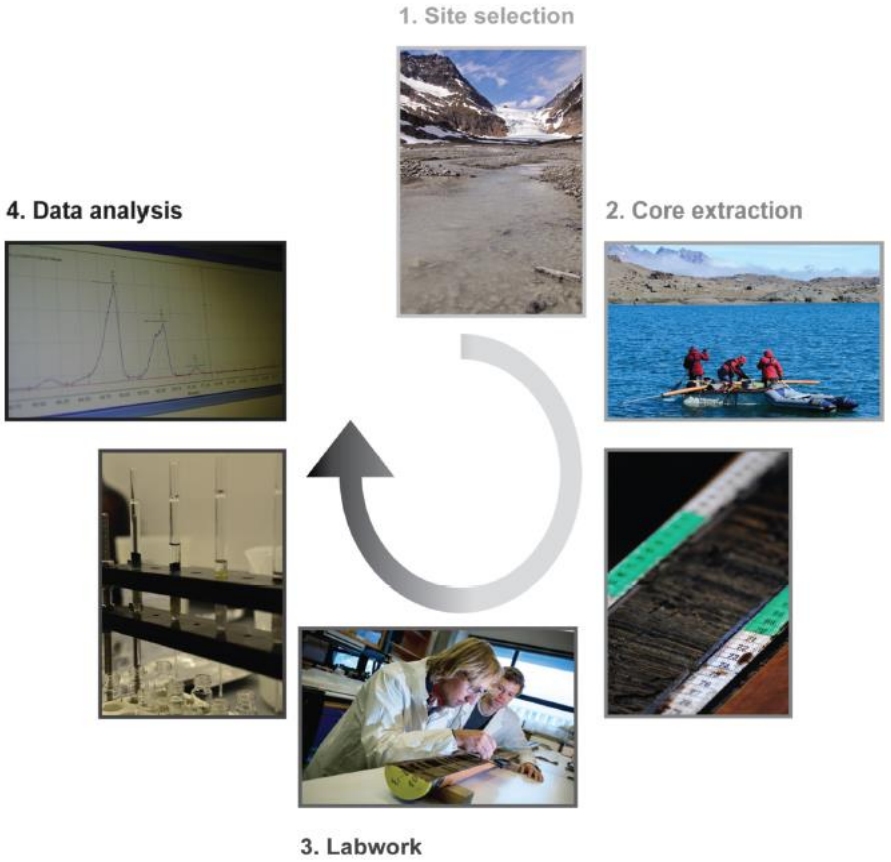
The paleo perspective – using accessible Svalbard / Amsterdamøya

How can we assess the effect of global warming in the Arctic?

Bakke et al., 2017



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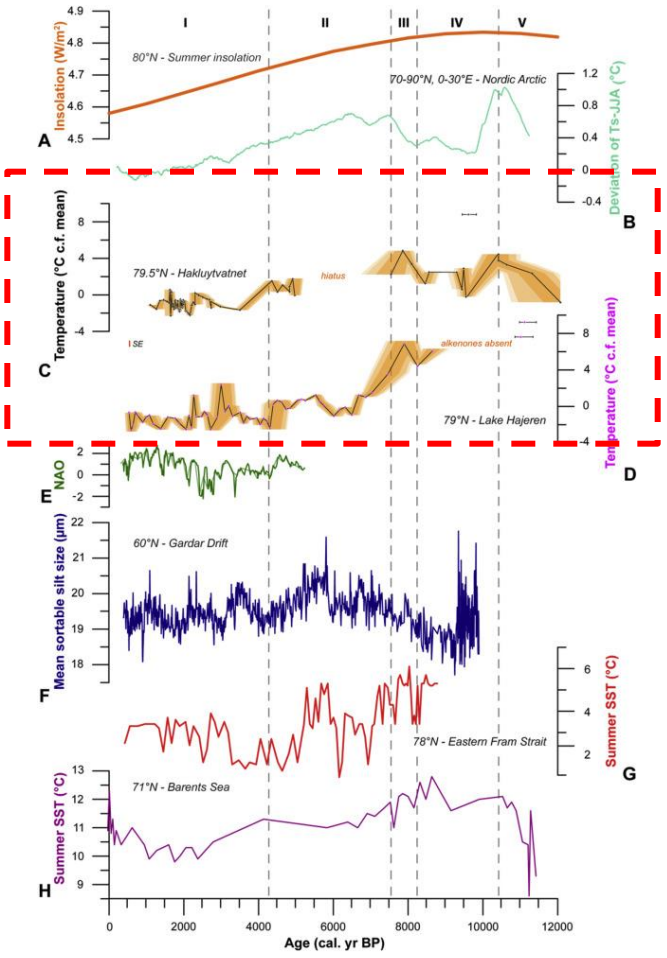

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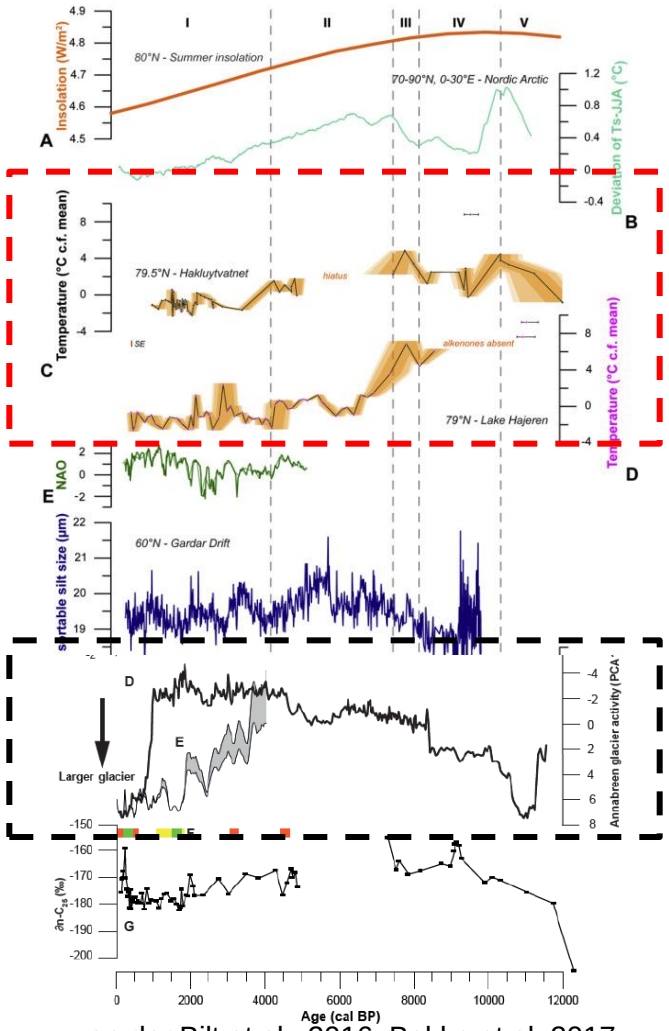
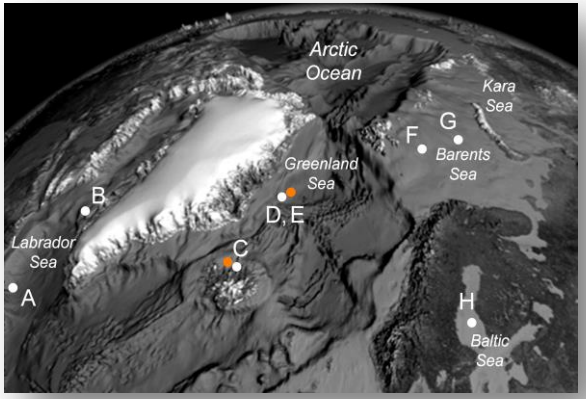


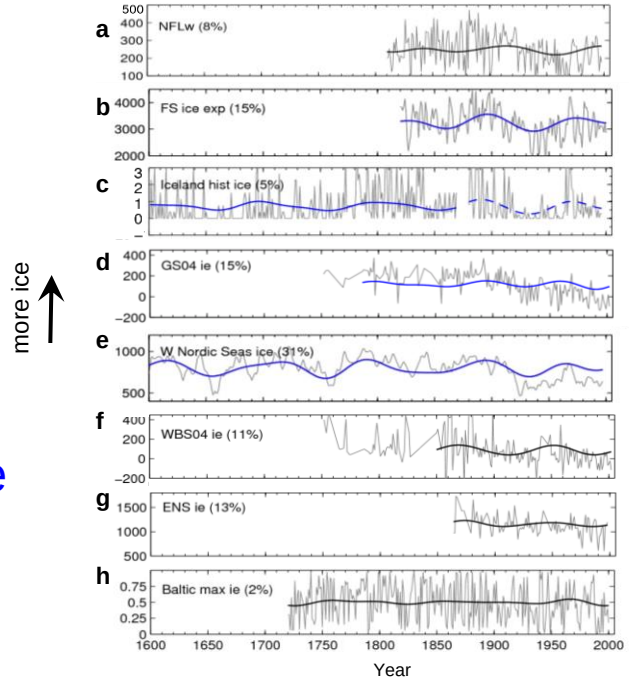
van der Bilt et al., 2016; Bakke et al. 2017

Multidecadal variability in Arctic and sub-Arctic sea ice



Historical sea ice records:

Multidecadal variability strongest in the Fram Strait sea-ice export (b), Iceland (c) and Greenland Sea records (d,e)



Source: Bjerknes Centre
Miles et al., 2014, *Geophys. Res. Lett.*

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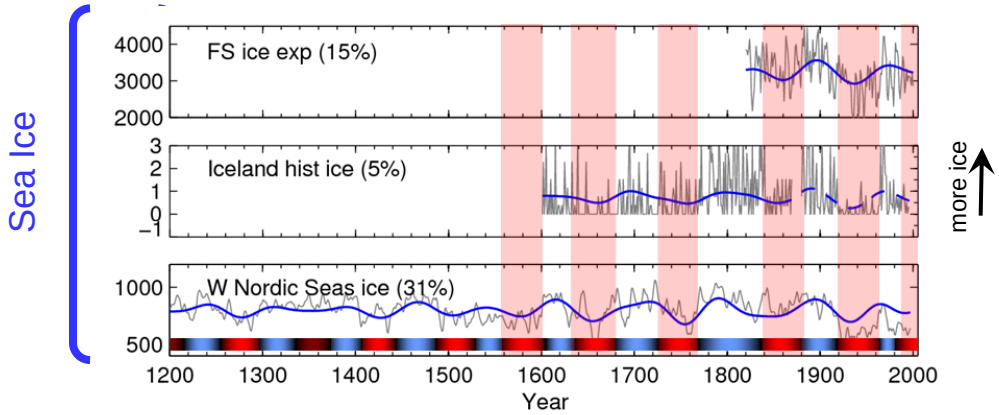
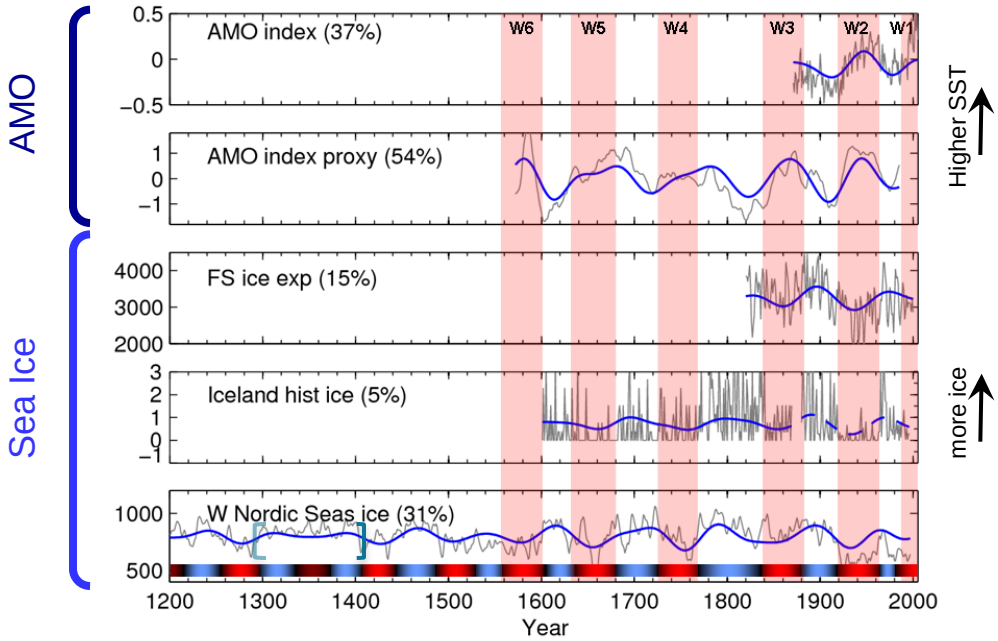


Sea ice records: Consistent and persistent signal

Source: Bjerknes Centre
Miles et al., 2014, *Geophys. Res. Lett.*

AMO and sea ice covariability



AMO and sea ice records: AMO^{+} linked to less ice and warm periods

Source: Bjerknes Centre
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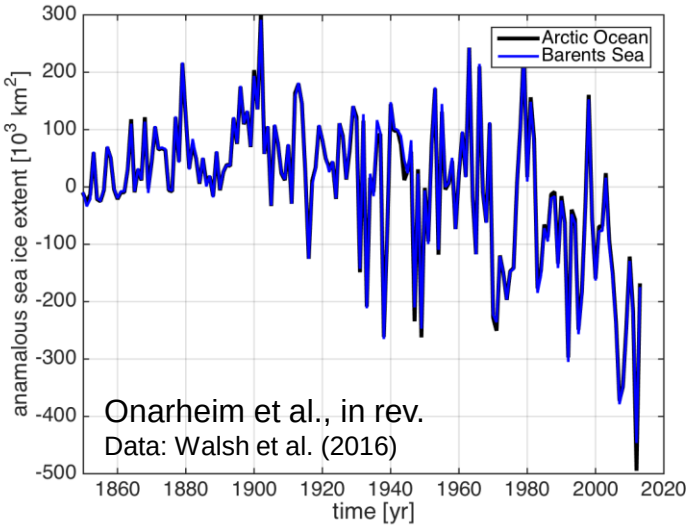
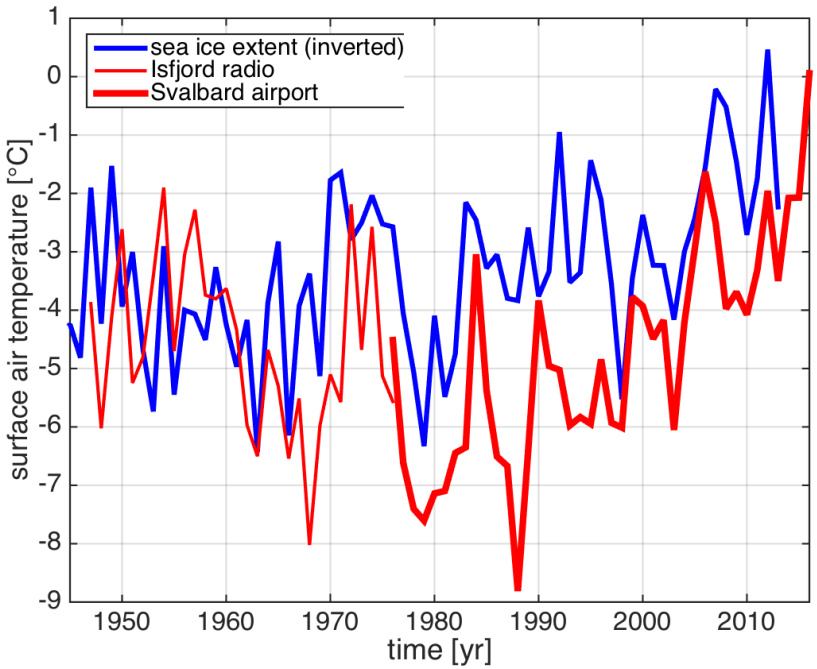
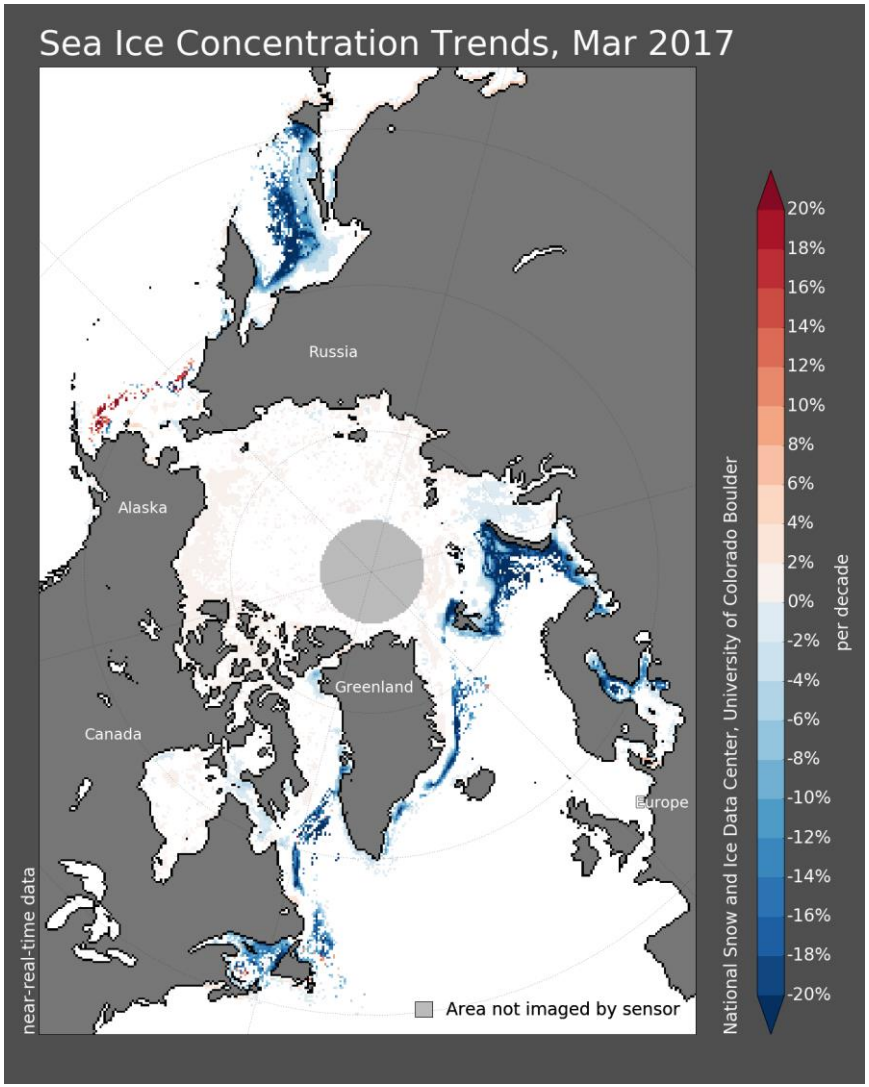
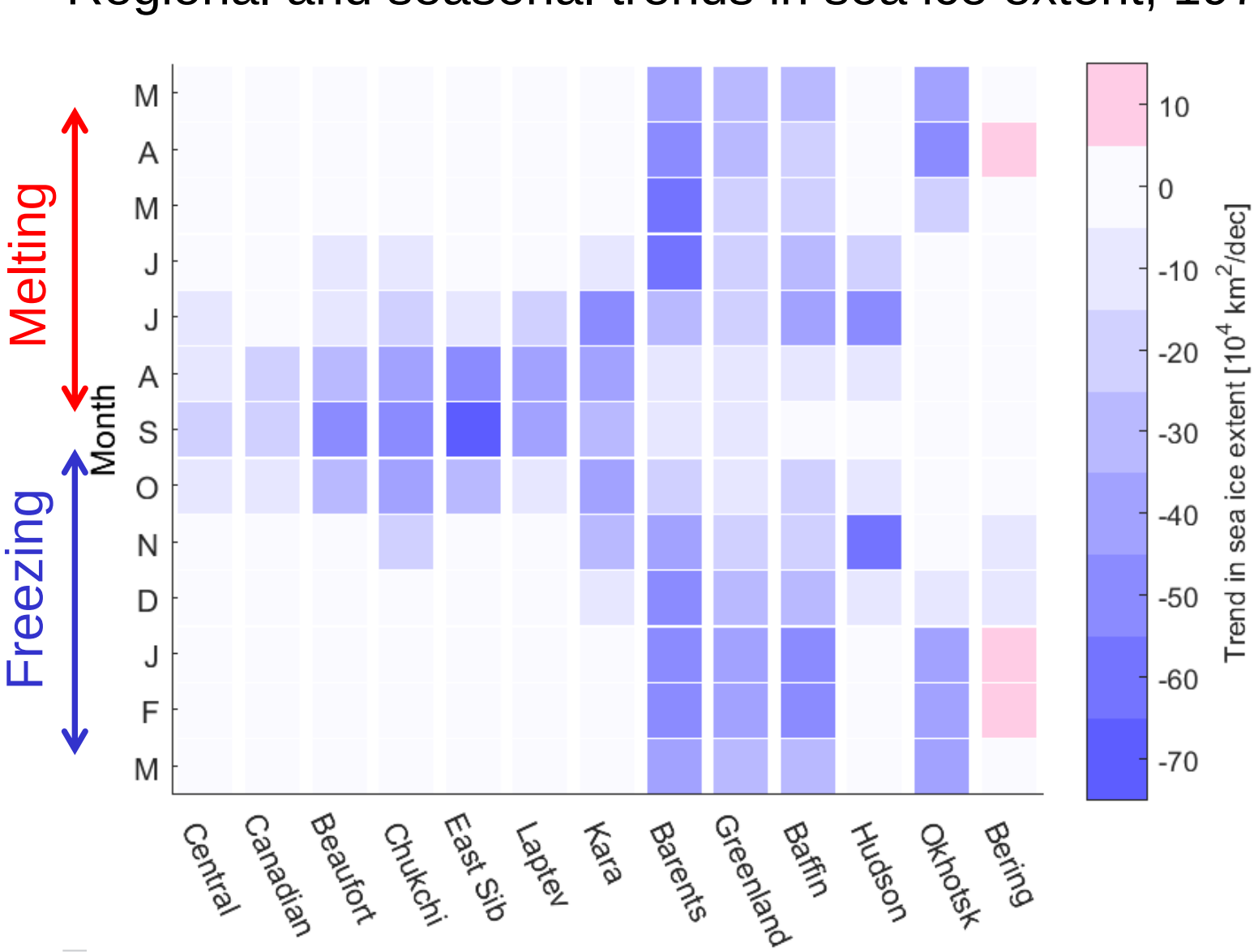


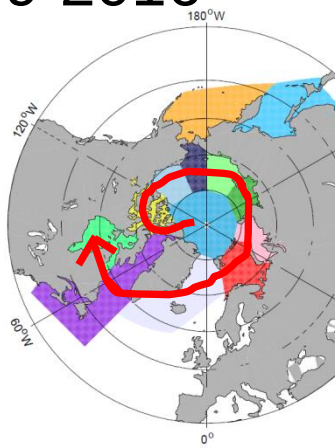




Cf. also Førland et al. 2011

Regional and seasonal trends in sea ice extent, 1979-2016





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Onarheim et al., *J. Clim.*, in revision

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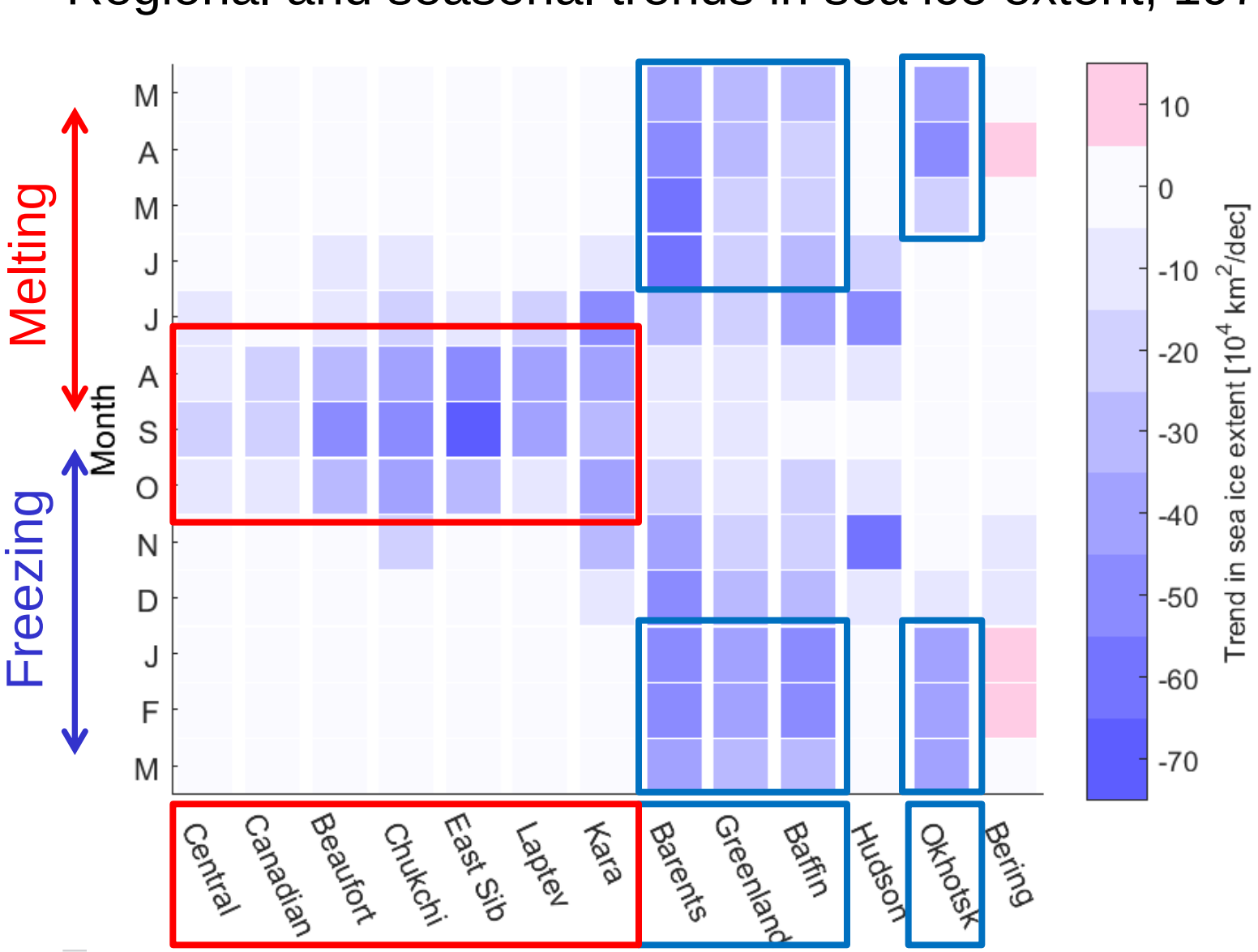

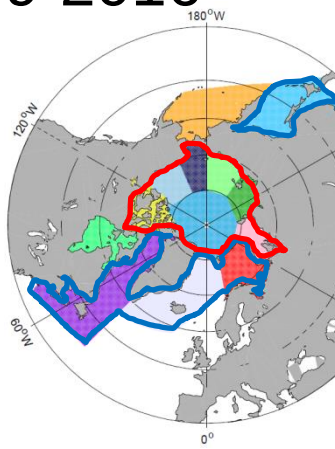

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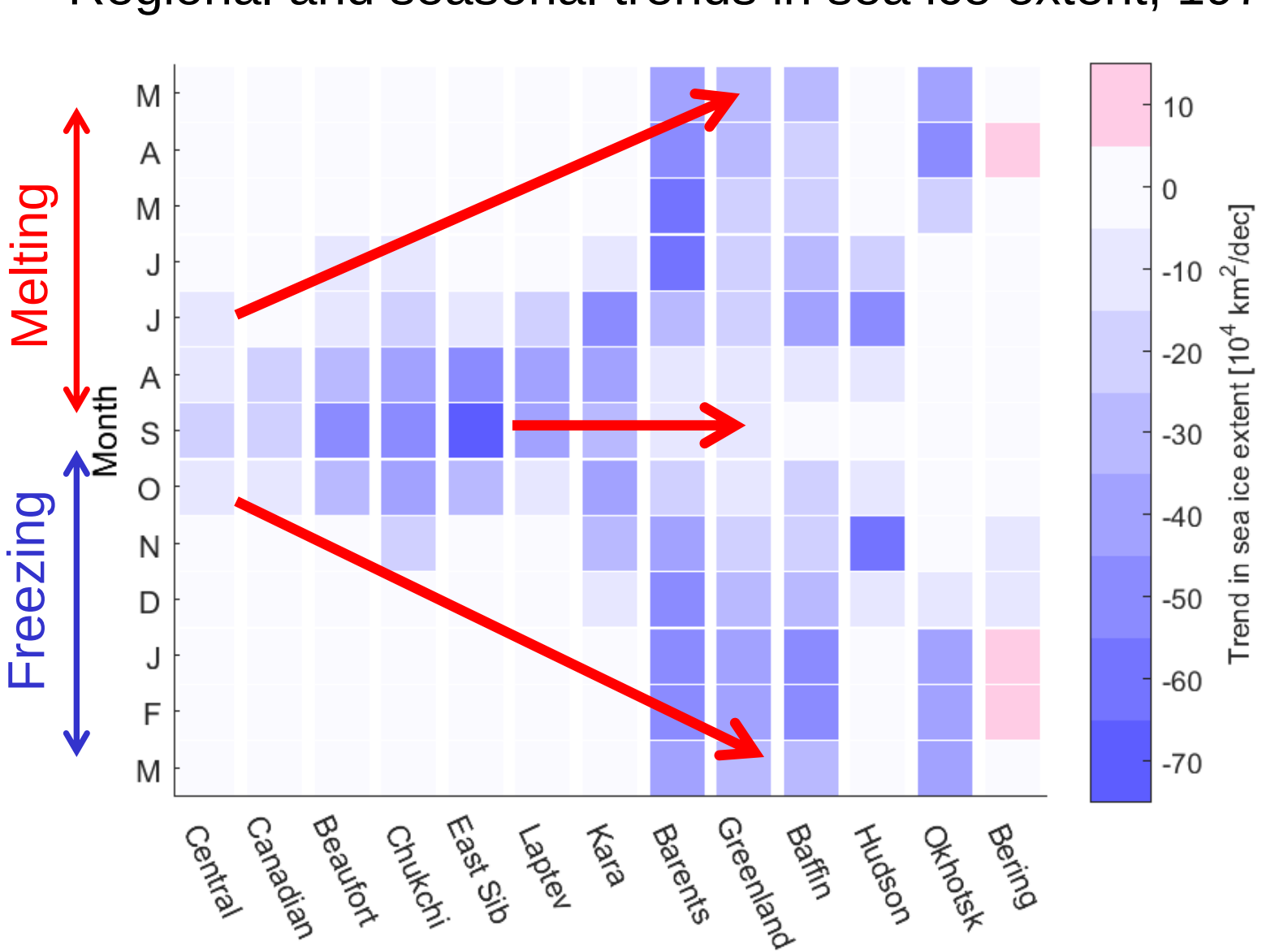

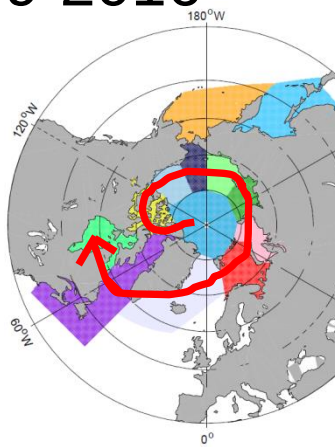

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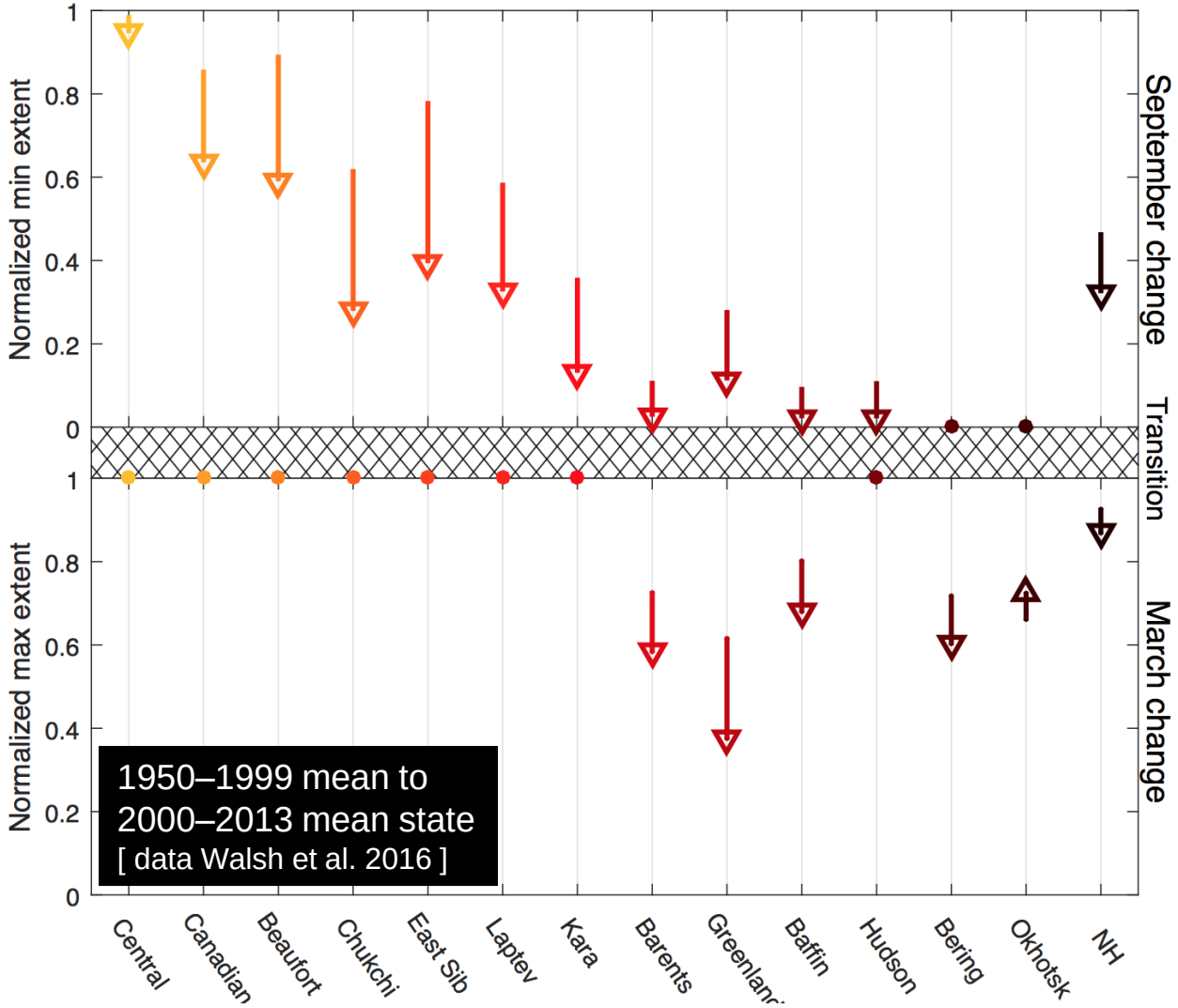
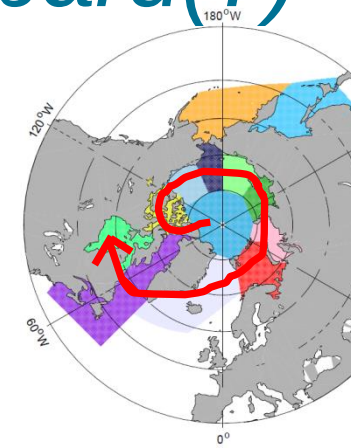
The future Arctic is the present Svalbard(?)

summer change

winter change





Onarheim et al., *J. Clim.*, in revision

perspectives

- Svalbard as the **prototype** marginal Arctic climate
- remote influences are evident, incl year-to-year **predictability**
- Arctic ➔ global climate remains a **topic of debate**