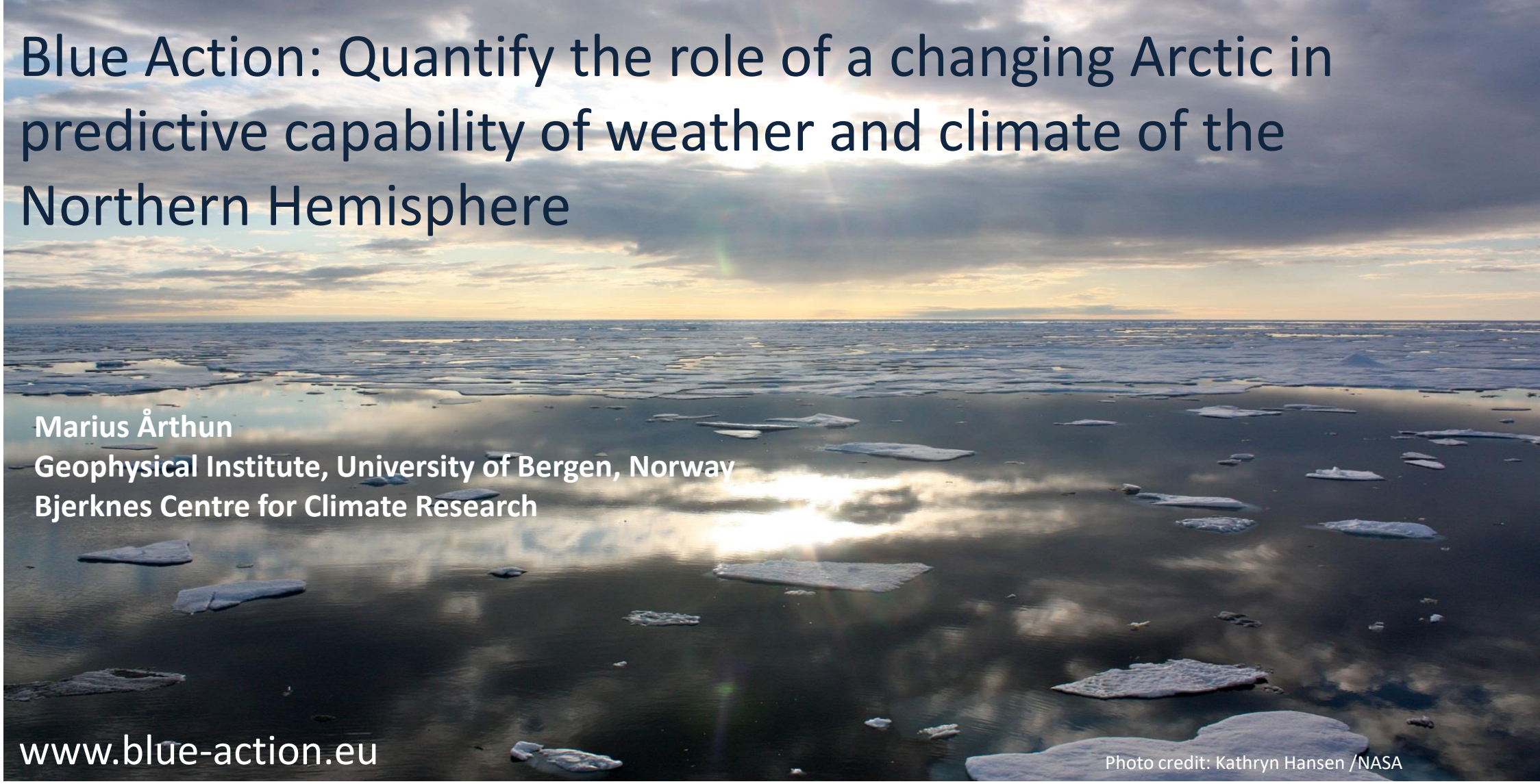
Blue Action: Quantify the role of a changing Arctic in predictive capability of weather and climate of the Northern Hemisphere



Marius Årthun
Geophysical Institute, University of Bergen, Norway
Bjerknes Centre for Climate Research

www.blue-action.eu

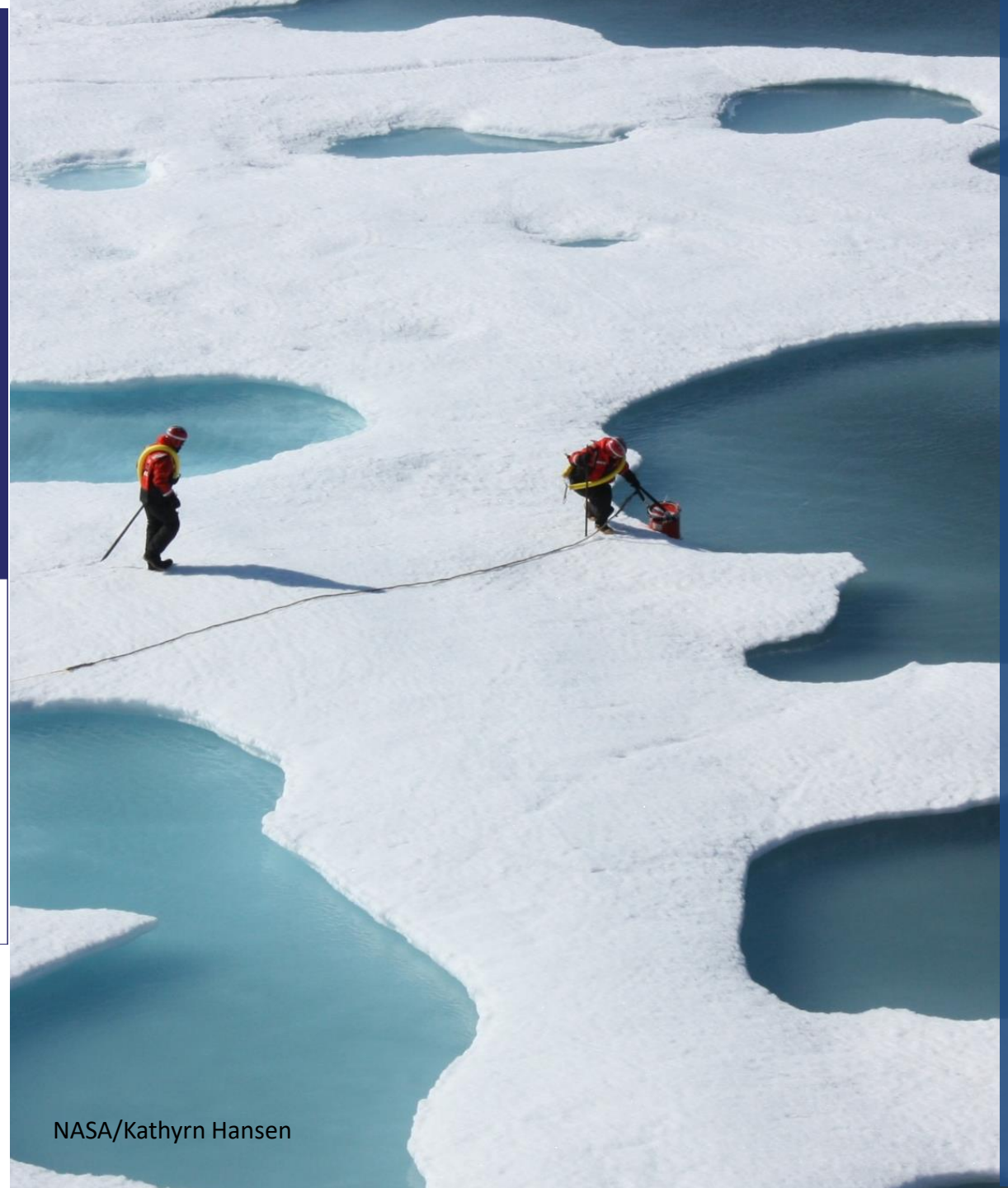
Photo credit: Kathryn Hansen /NASA

BLUE ACTION

WHY BLUE-ACTION?

Faced with a changing climate, businesses, policymakers, and local communities need to access reliable weather and climate information to safeguard human health, wellbeing, economic growth, and environmental sustainability.

BLUE ACTION



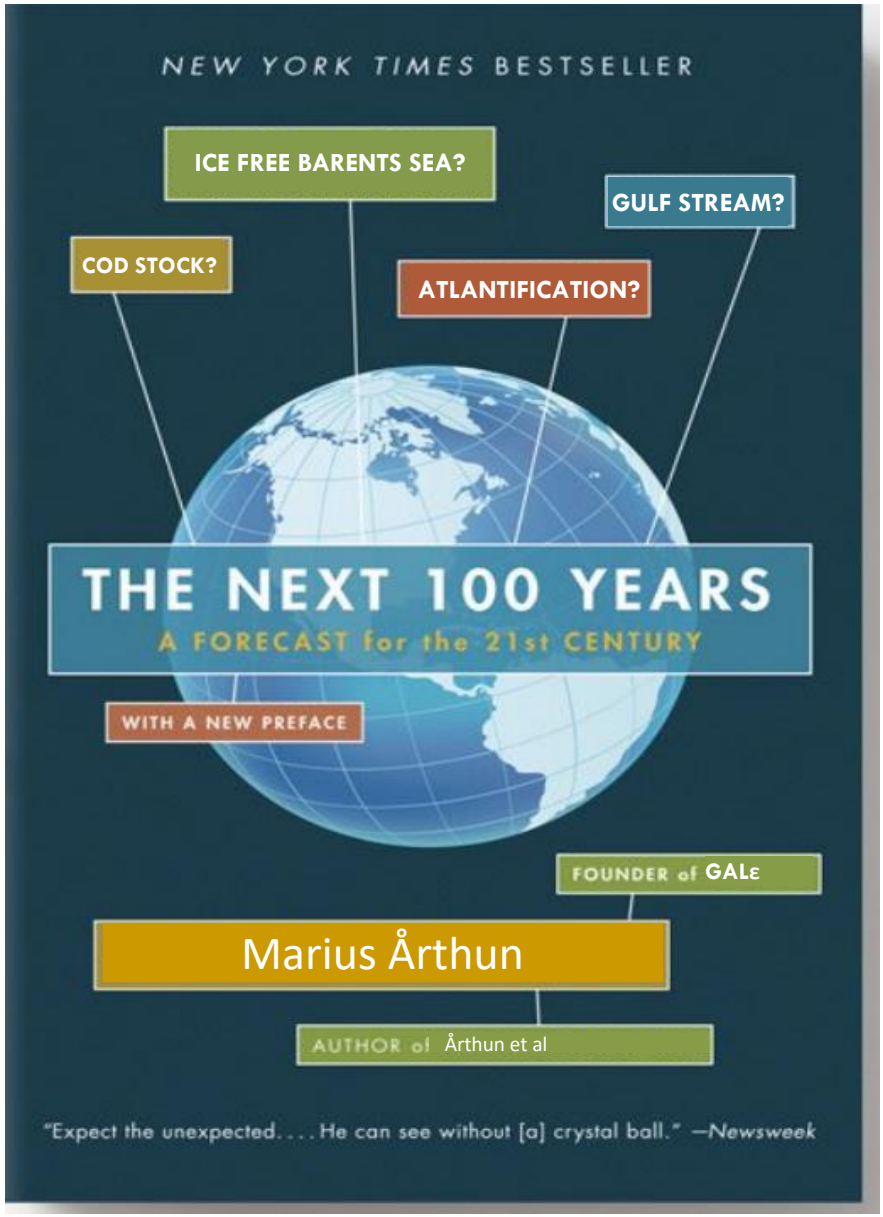
NASA/Kathyrn Hansen

Blue-Action brings together experts from over 40 organisations in 17 countries across 3 continents to:

- Develop new methods to characterise climate conditions where hazardous weather system forms across the Northern Hemisphere and establish their link to Arctic climate change.
- Deliver an improved representation of Arctic warming and its impact on atmosphere and ocean circulation.
- Enable robust and reliable forecasting to deliver better predictions at sub-seasonal to decadal scales.

WP2: Lower latitude drivers of Arctic changes

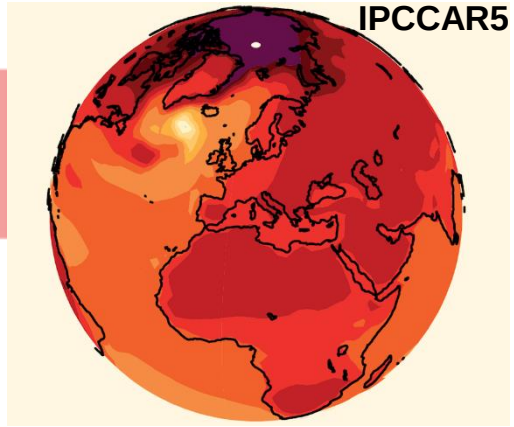
- How can we predict Arctic-Atlantic climate?
- Can we predict Arctic fish stock changes?



*adapted from George Friedman (2009)

What is climate prediction?

Climate prediction



Climate projection 2081-2100

day week month season year decade century

Meehl et al. 2009

Courtesy of H.R. Langehaug

What is climate prediction?

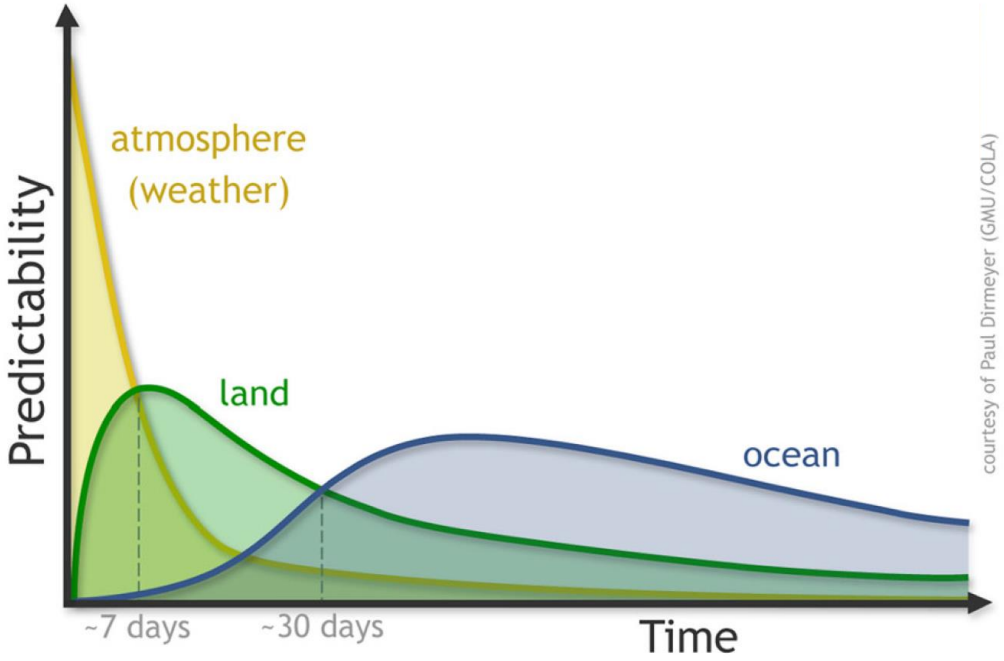
Will there be more cod in the Barents Sea in 2025?

Climate prediction

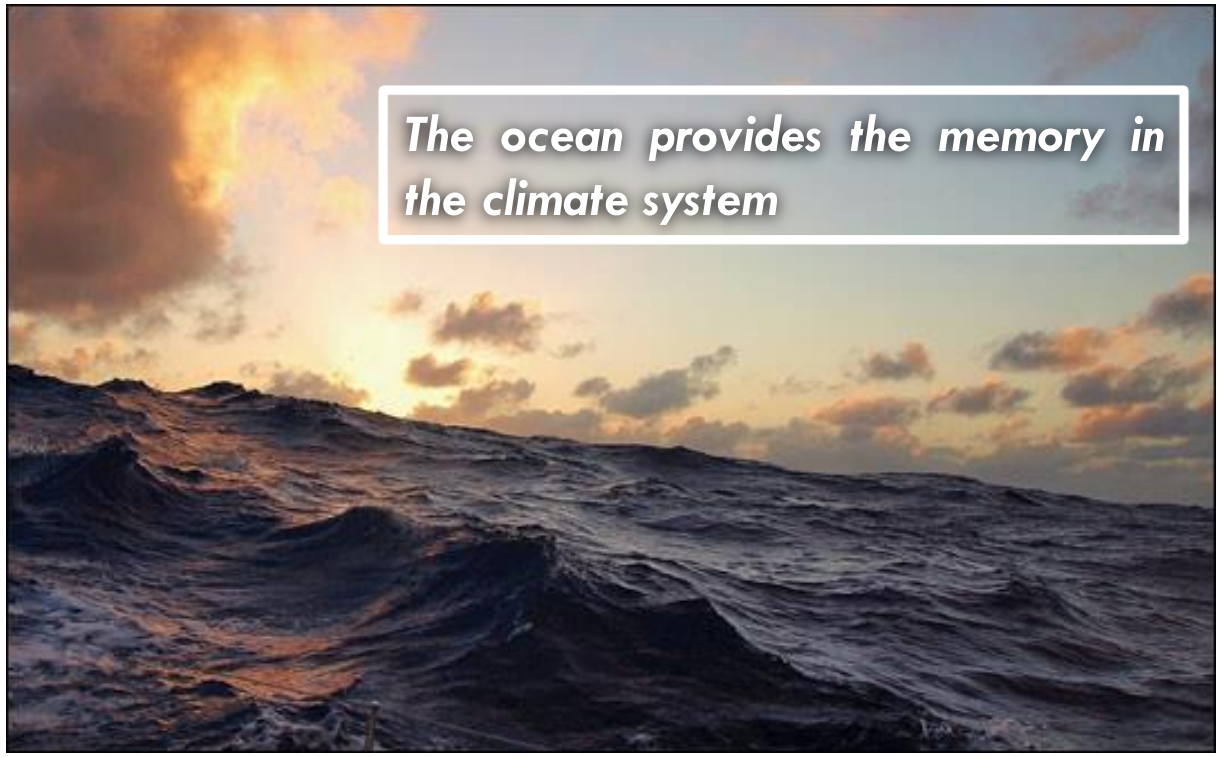
How will the snow conditions be next year?

Will summers in Norway become wetter the next few years?

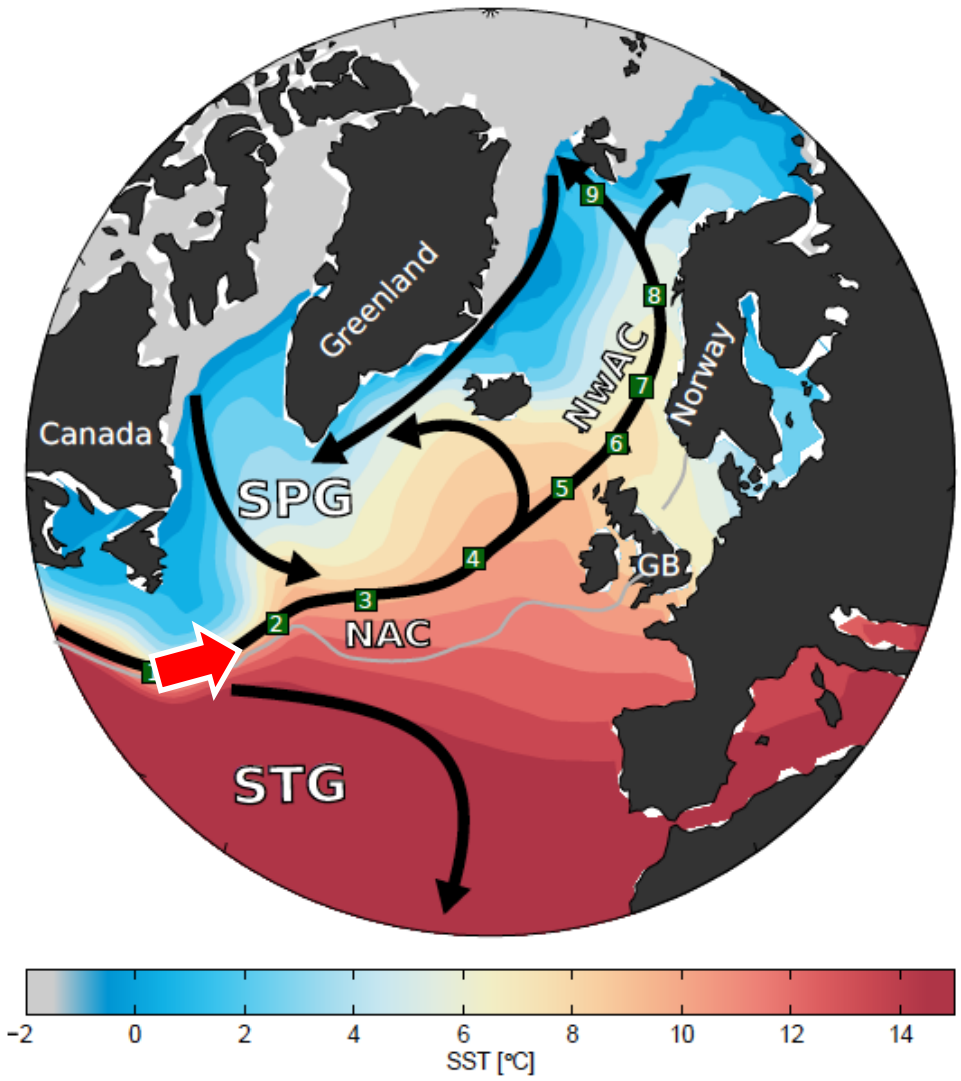
Climate predictability provided by the ocean

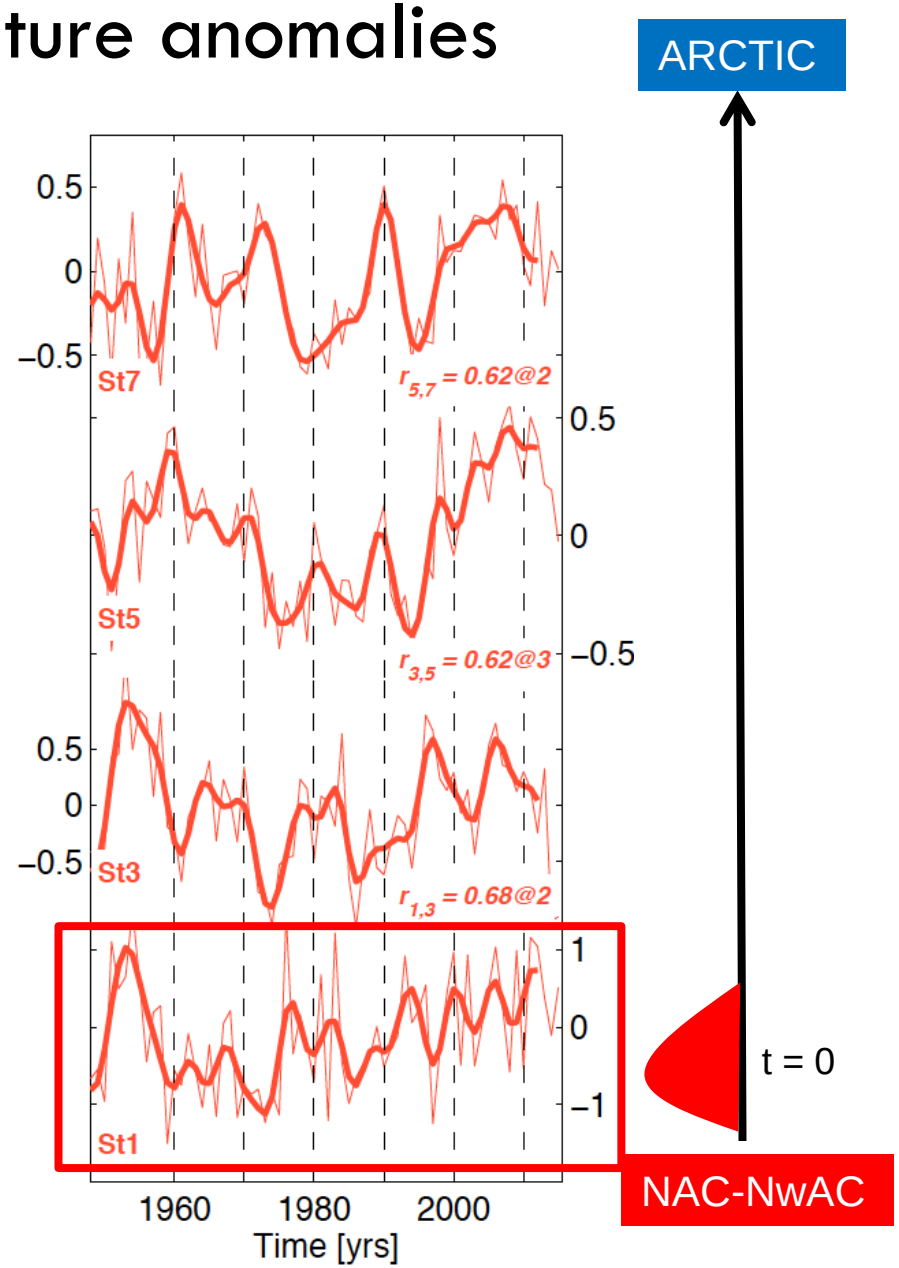


Mariotti et al. 2018



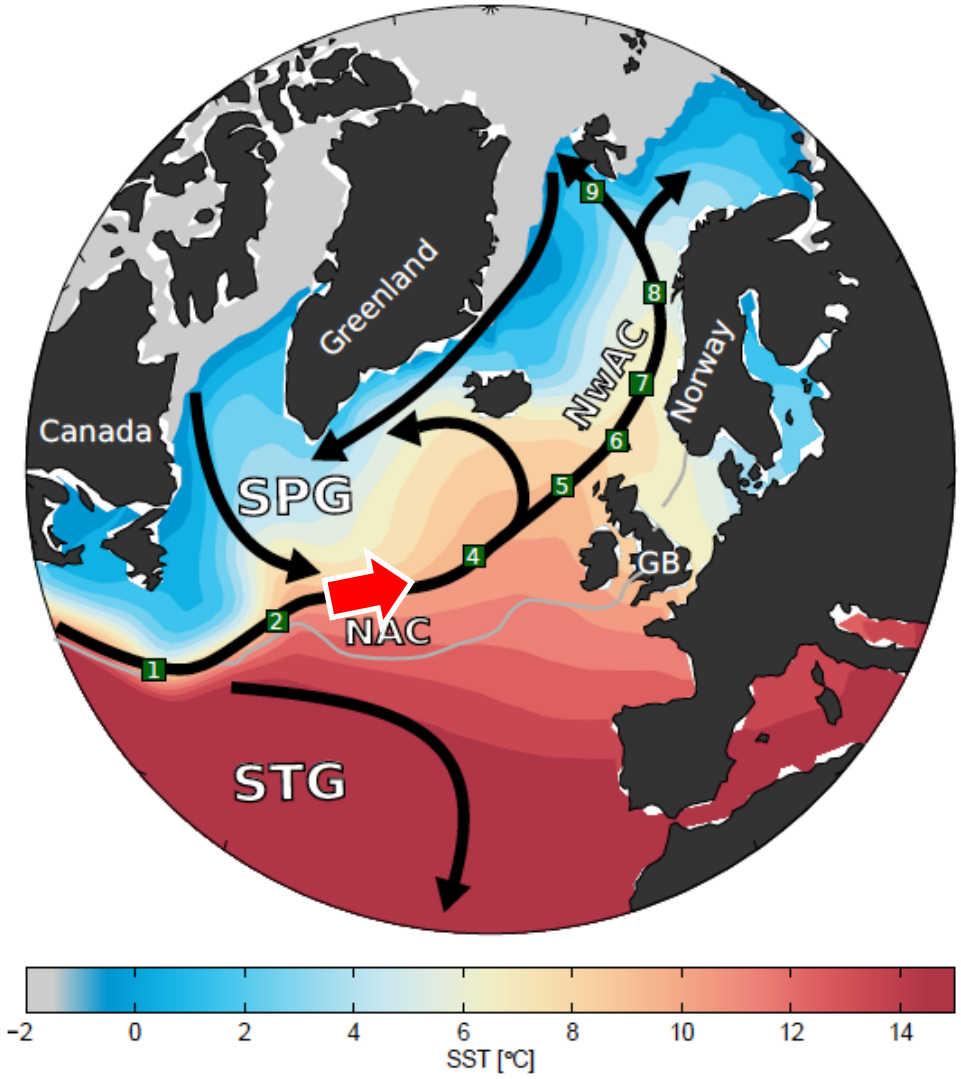
Circulation of ocean temperature anomalies

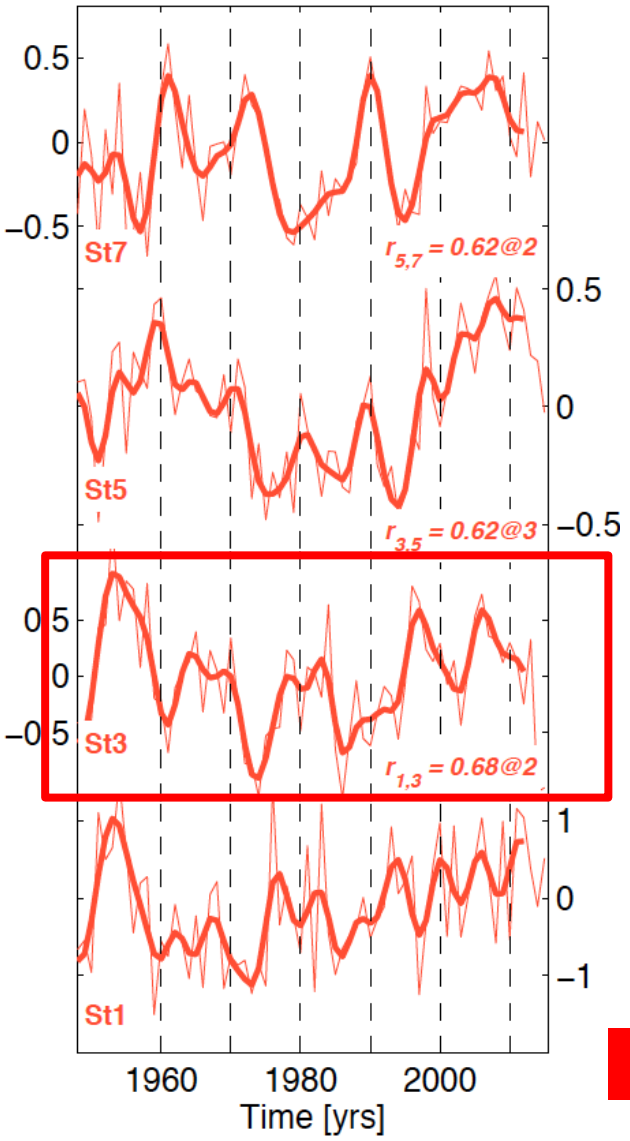


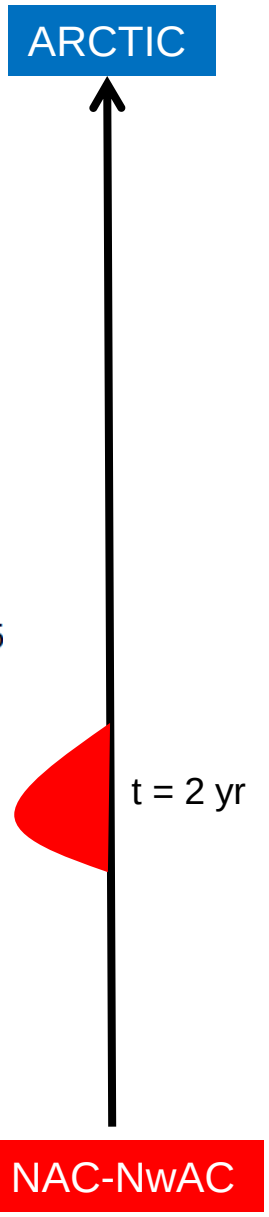


Årthun et al. 2017. *Nat. Commun.*

Circulation of ocean temperature anomalies







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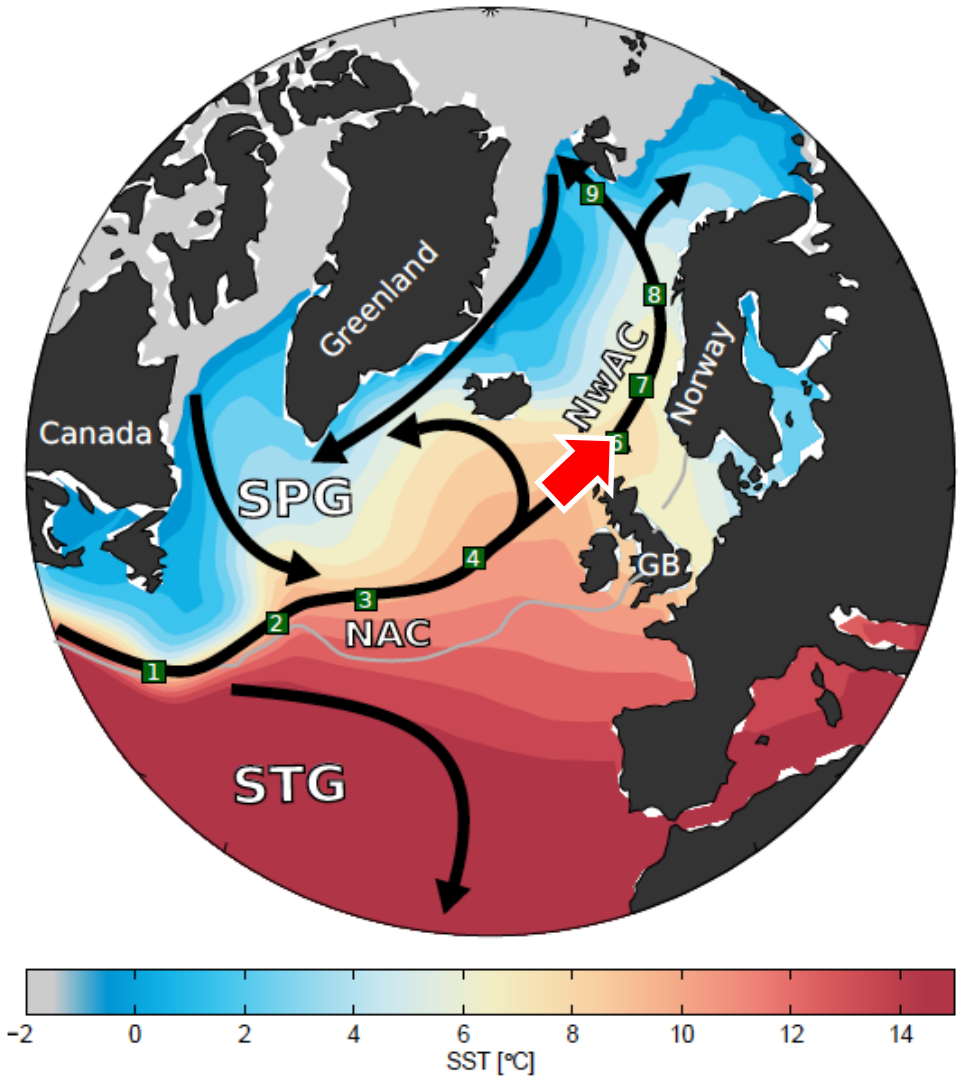
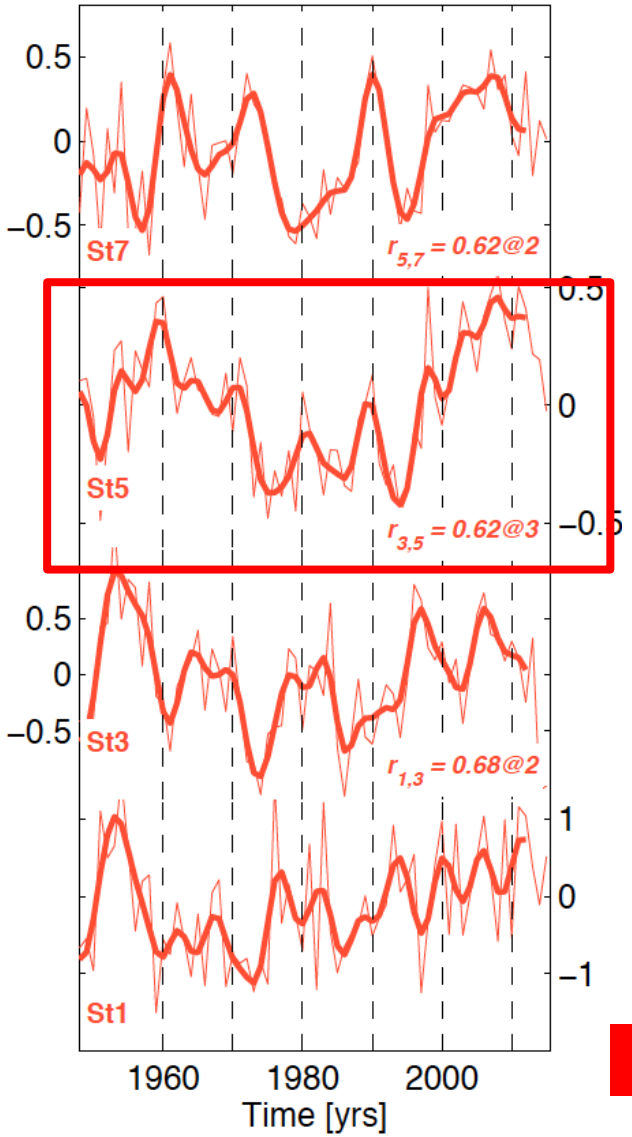
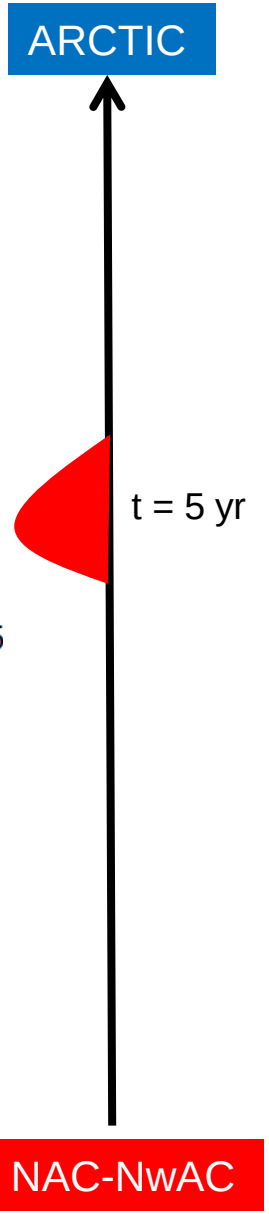
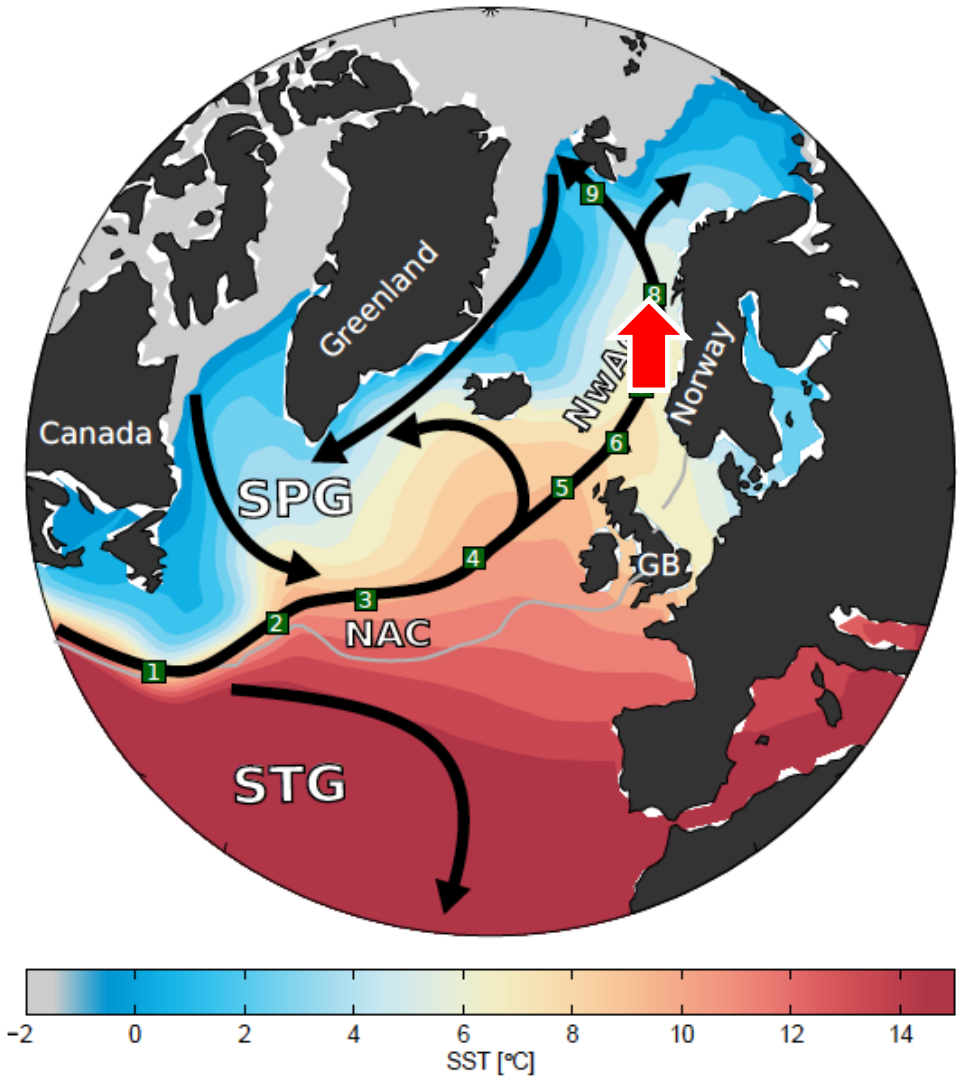


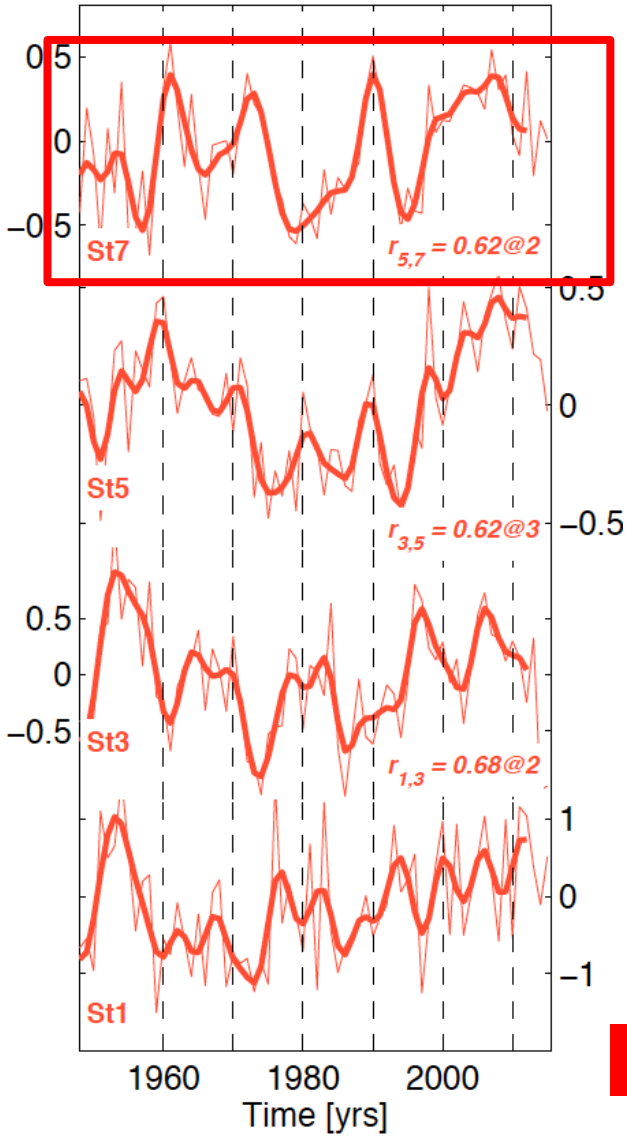


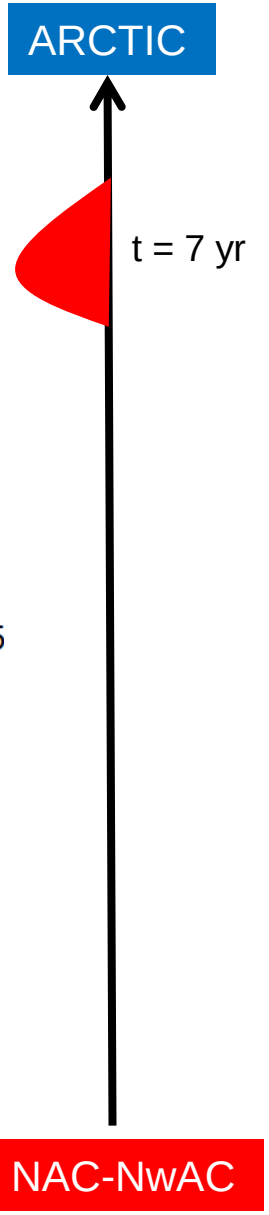


Årthun et al. 2017. *Nat. Commun.*

Circulation of ocean temperature anomalies

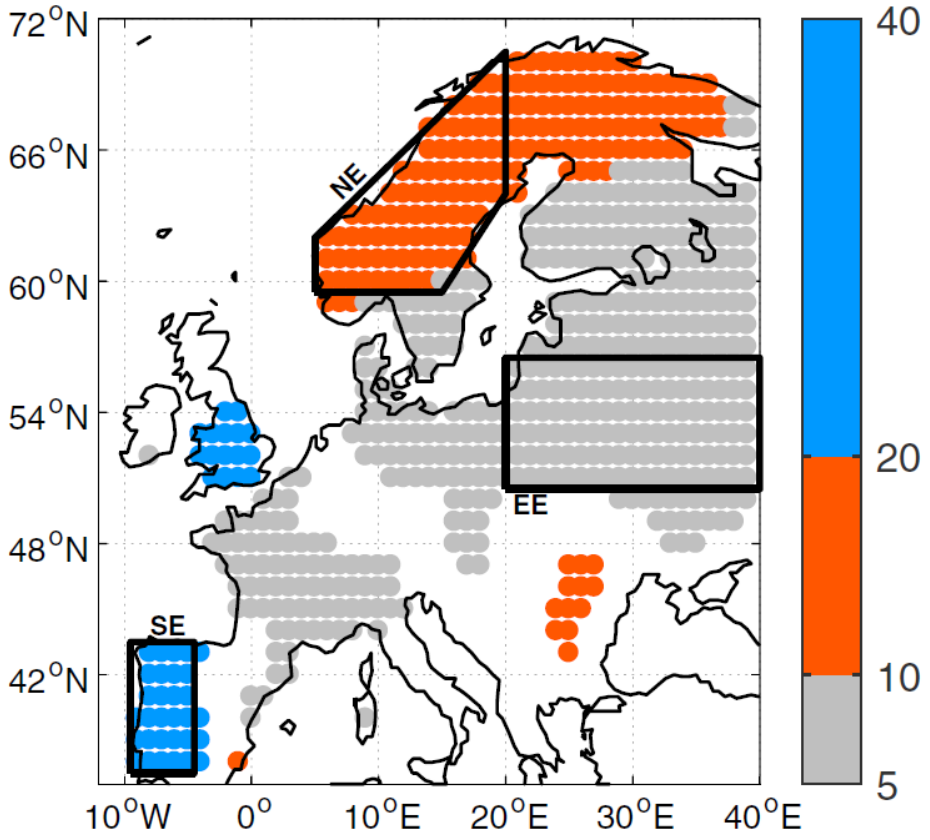




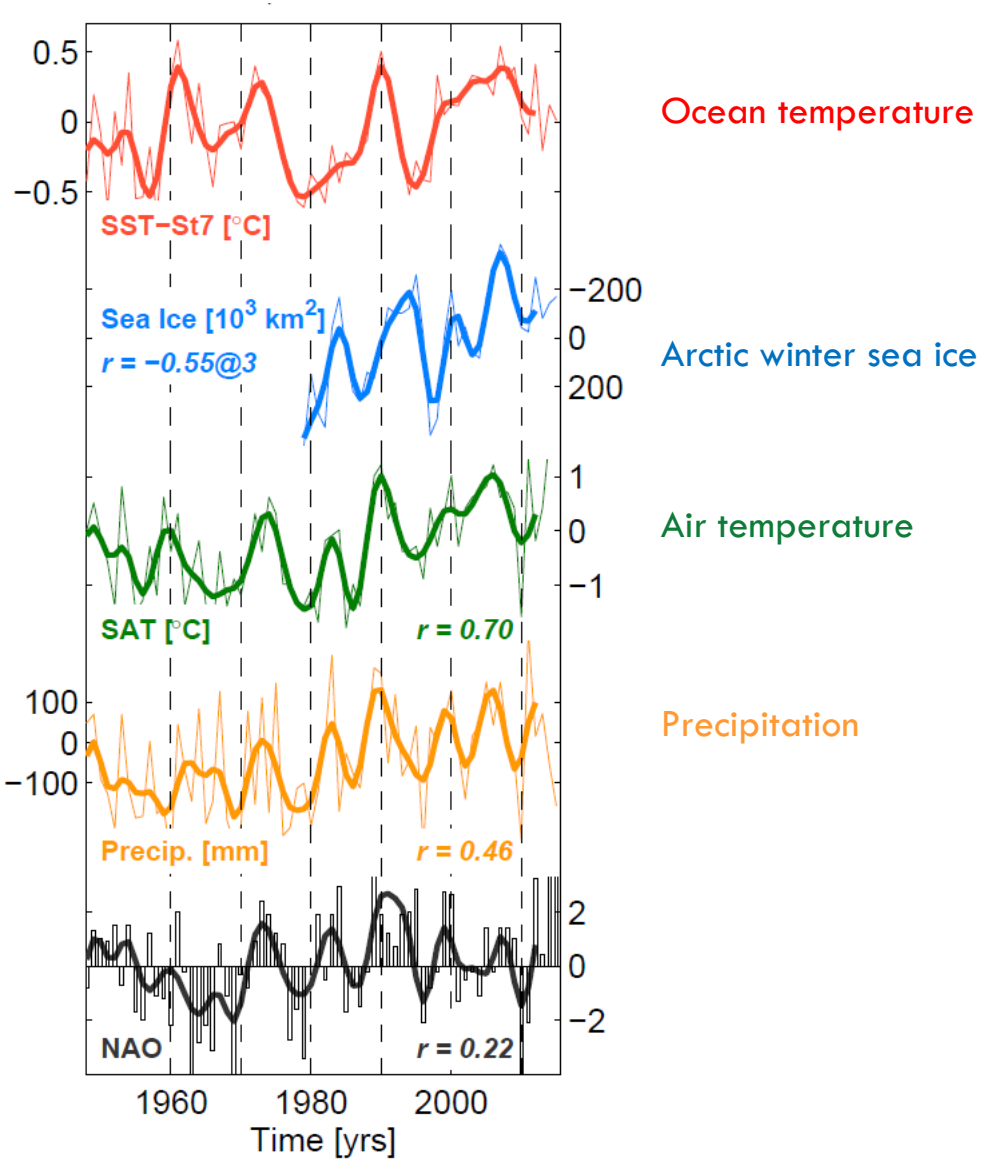


Årthun et al. 2017. *Nat. Commun.*

Oceanic influence on Arctic-Atlantic climate



Colours: The leading time scale (in years) of air temperature variability



Årthun et al. 2017. *Nat. Commun.*

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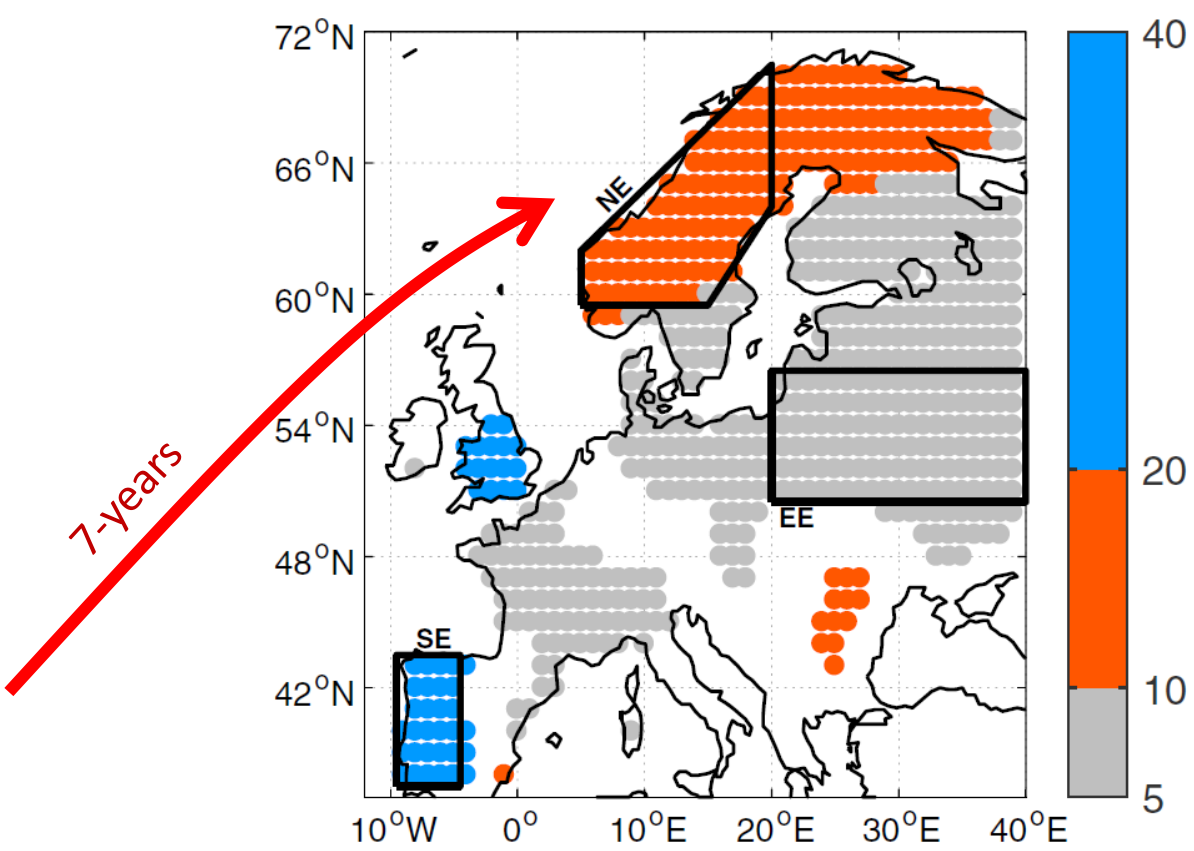


OCEAN

OCEAN

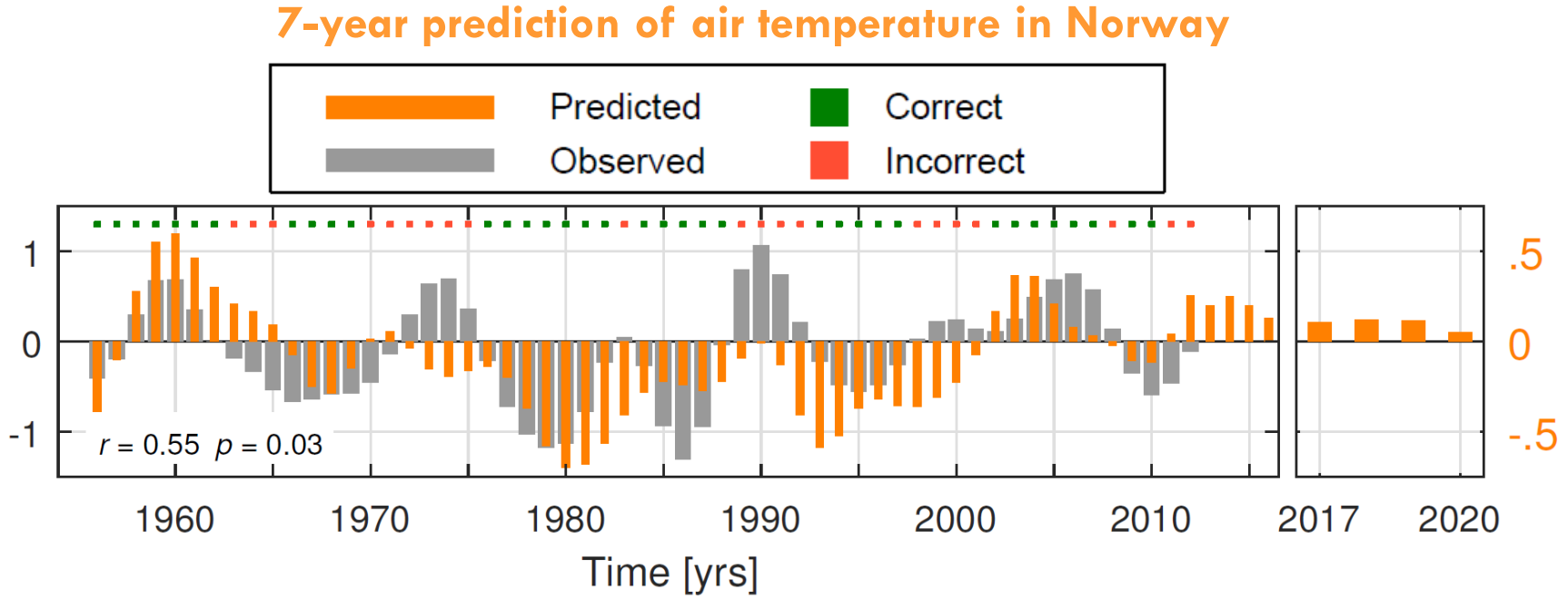
ATMOSPHERE

The ocean controls slow variations in European temperature

Colours: The leading time scale (in years) of air temperature variability

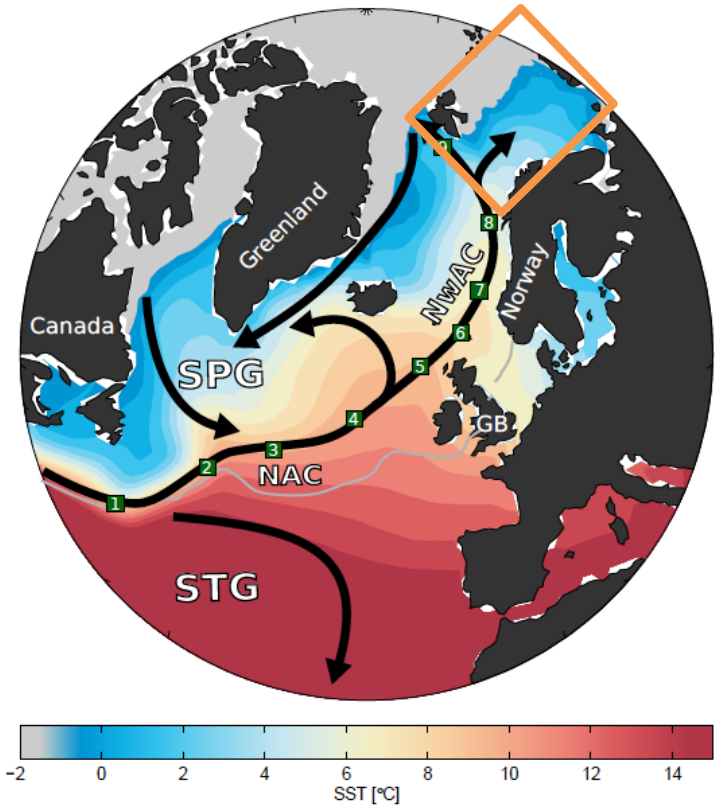
Årthun et al. 2018. *Geophys. Res. Lett.*

Oceanic influence on Arctic-Atlantic climate



Årthun et al. 2017. *Nat. Commun.*

Can Barents Sea cod stock changes be predicted?



The Barents Sea is an economically important fisheries area

Major commercial species: Barents Sea cod (*Gadus morhua*)

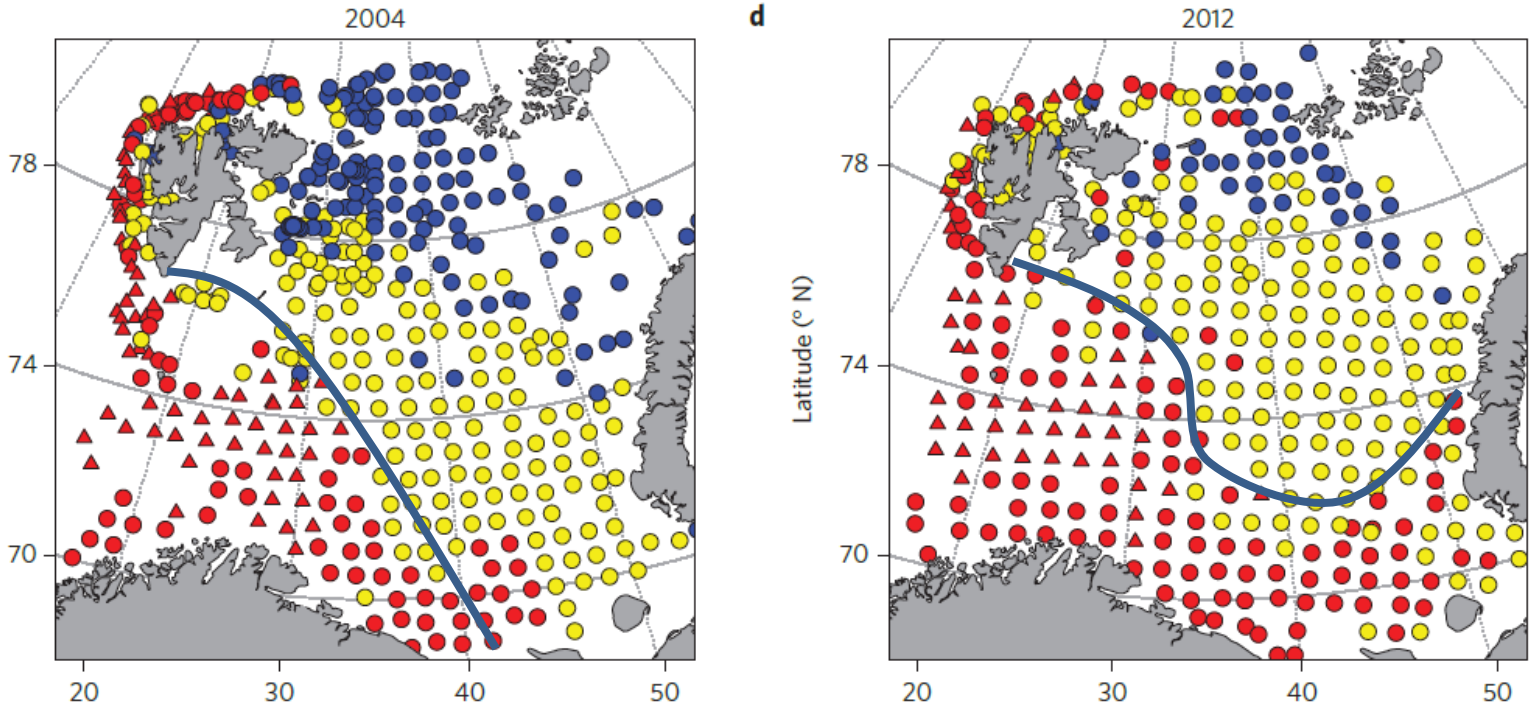
"..exploiting this predictive skill [of the ocean] to aid in resource management is emerging as one of the new challenges in marine science.."
ICES

Can Barents Sea cod stock changes be predicted?

Cold ocean
More sea ice
Less cod

Warm ocean
Less sea ice
More cod

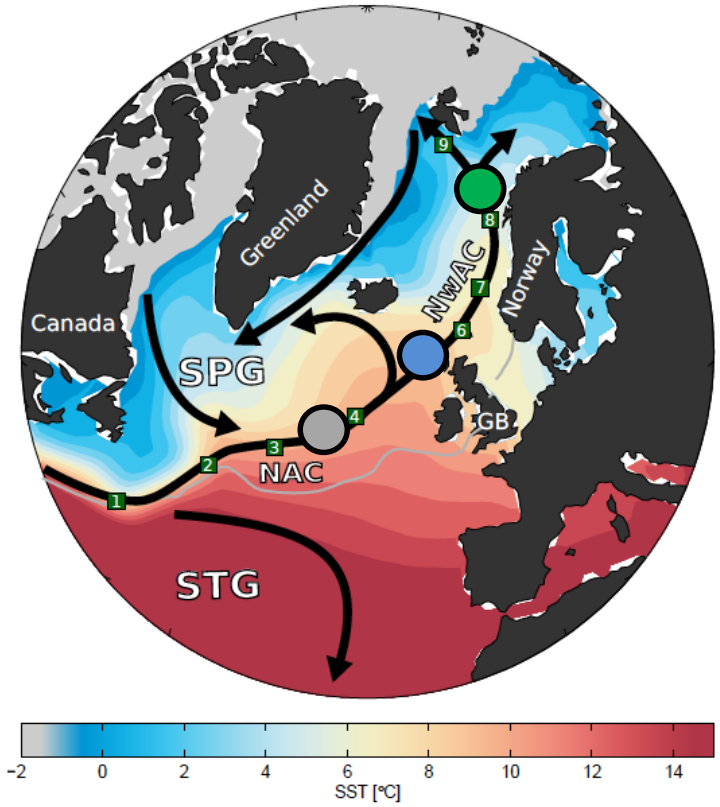
- Atlantic (cod)
- Central
- Arctic

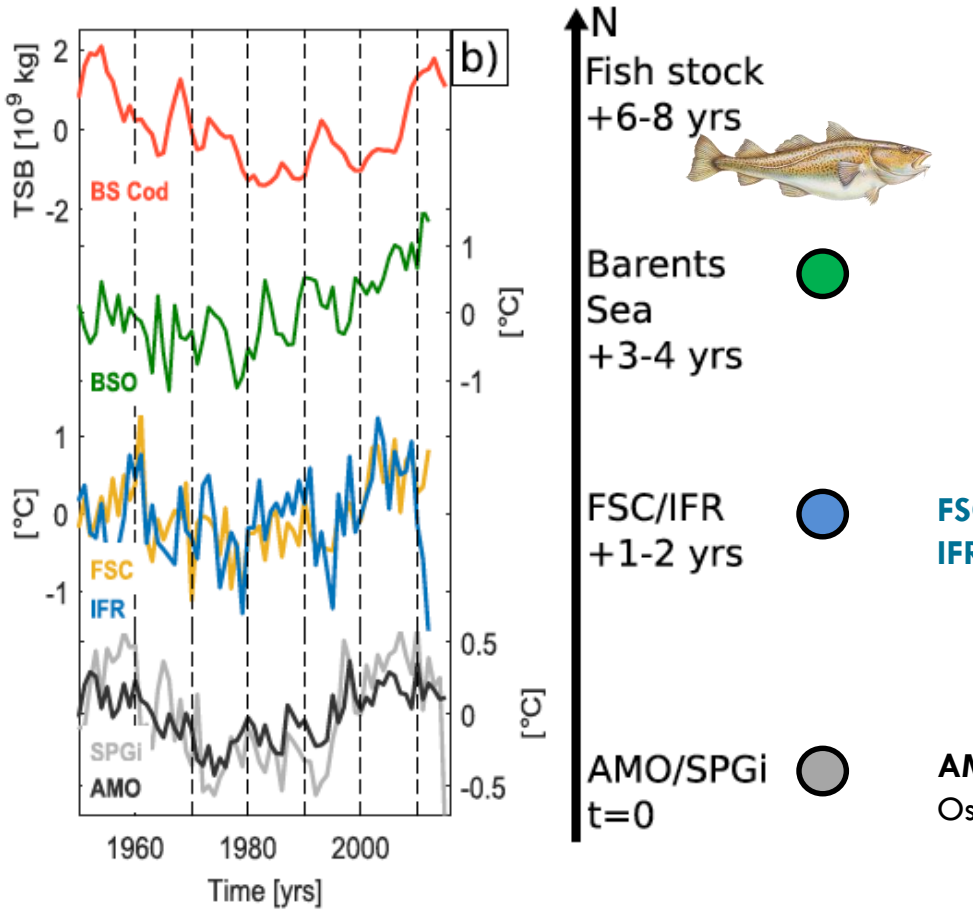


Fish stocks respond to variations in ocean temperature.
Ocean temperature in the Barents Sea is predictable from upstream conditions.

Fossheim et al. 2015. *Nat. Clim. Change*

Can Barents Sea cod stock changes be predicted?





N

Fish stock
+6-8 yrs

Barents Sea
+3-4 yrs

FSC/IFR
+1-2 yrs

AMO/SPGi
t=0

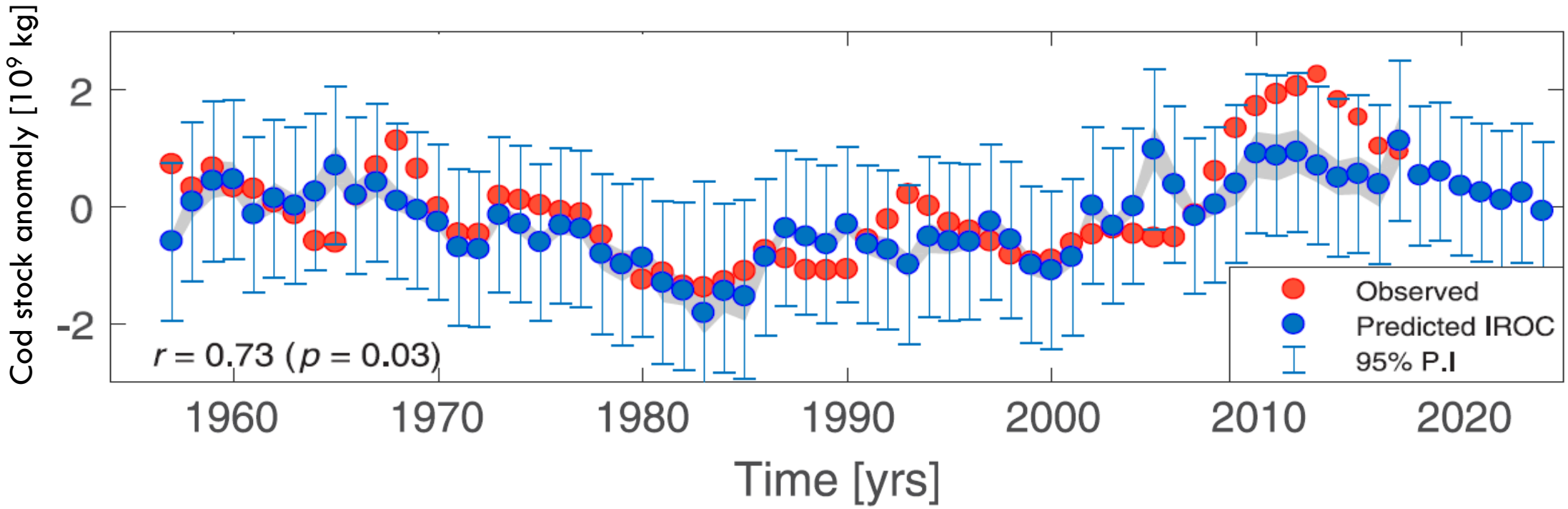
Data:
ICES
Nordic Seas Atlas
NOAA
HadISST

FSC: Faroe-Shetland Channel
IFR: Iceland-Faroe Ridge

AMO: Atlantic Multidecadal Oscillation (unfiltered)

Årthun et al. 2018. *Plos One*.

Climate based multi-year predictions of the Barents Sea cod stock



Årthun et al. 2018. *Plos One*.

CONCLUSIONS

- Ocean temperature in the North Atlantic provides predictability of northern European SAT and commercially valuable fish stocks.

- Multi-year predictions fill the gap between short-term predictions and century-scale climate change projections → could enable strategic planning on longer time scales than today.

- Major challenges remain: The mechanisms underlying prediction are incompletely understood and poorly represented in models.

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