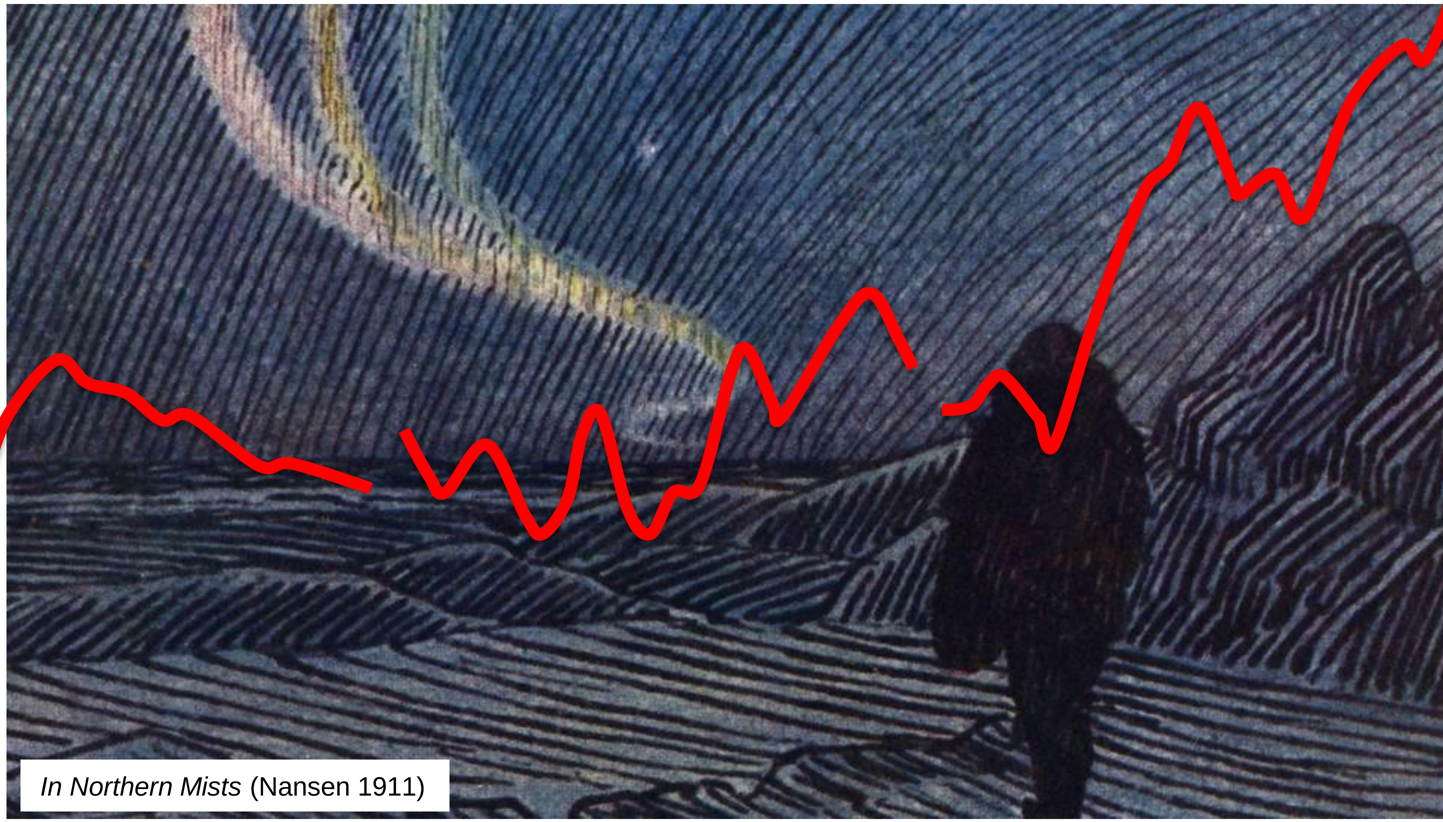
The Nansen Legacy

a digression and the project



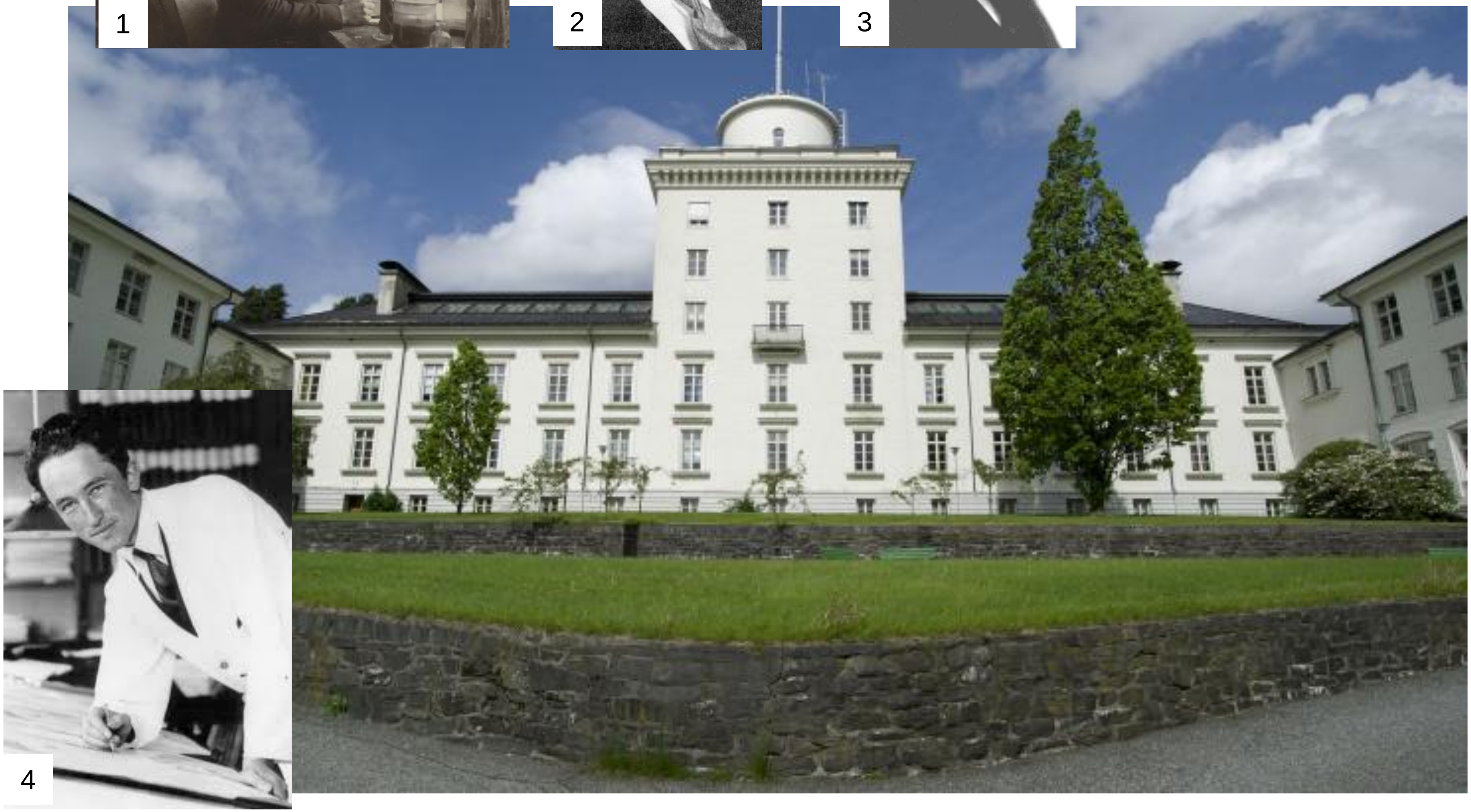
In Northern Mists (Nansen 1911)

”A brief history of climate”
(Eldevik et al. 2014)

Tor Eldevik

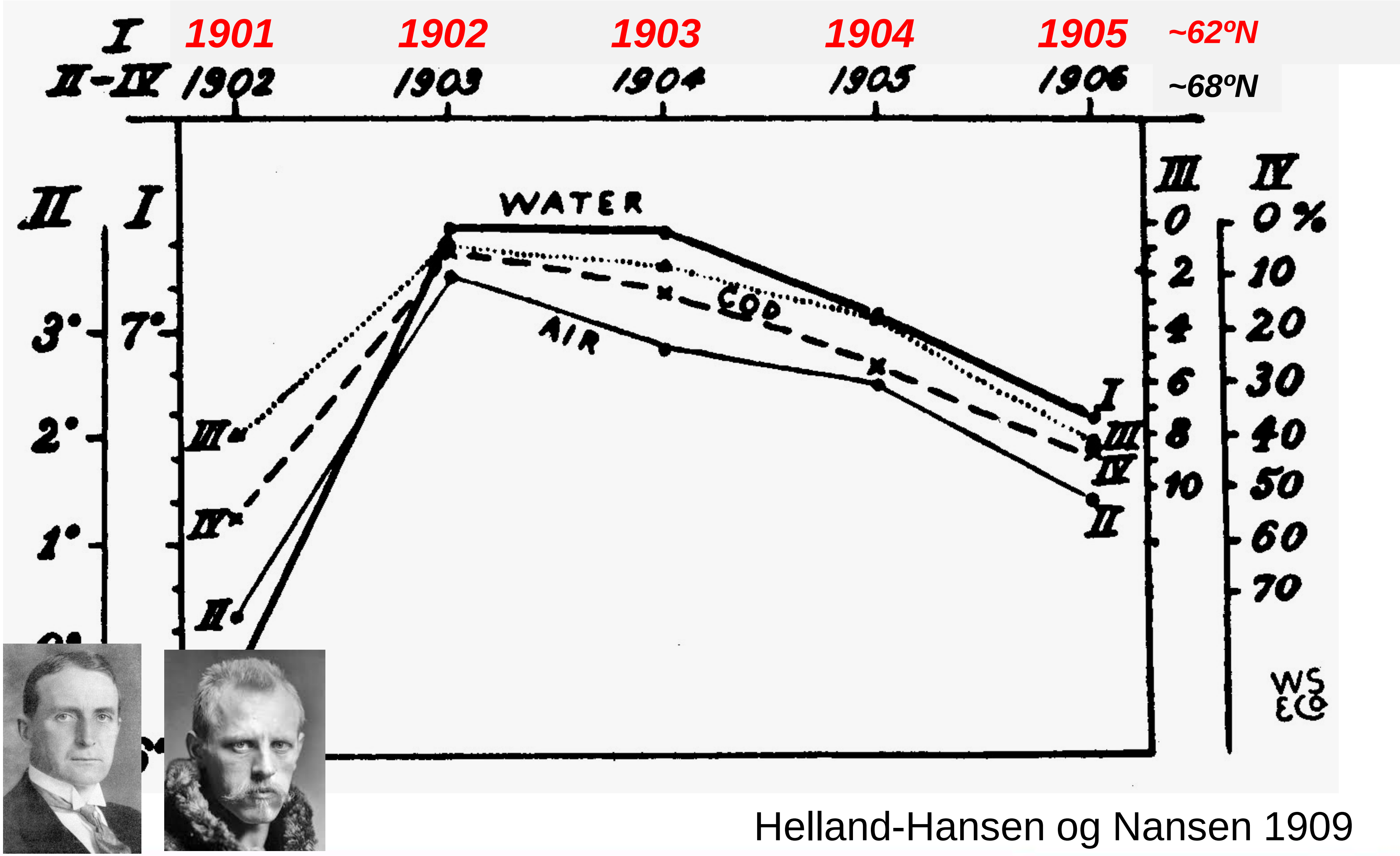
Geophysical Insitute UiB / Bjerknes Centre for Climate Research

1. Fridtjof Nansen (1861–1930)
2. Bjørn Helland-Hansen (1877–1957)
3. Vilhelm Bjerknes (1862–1951)
4. Jacob Bjerknes (1897–1975)



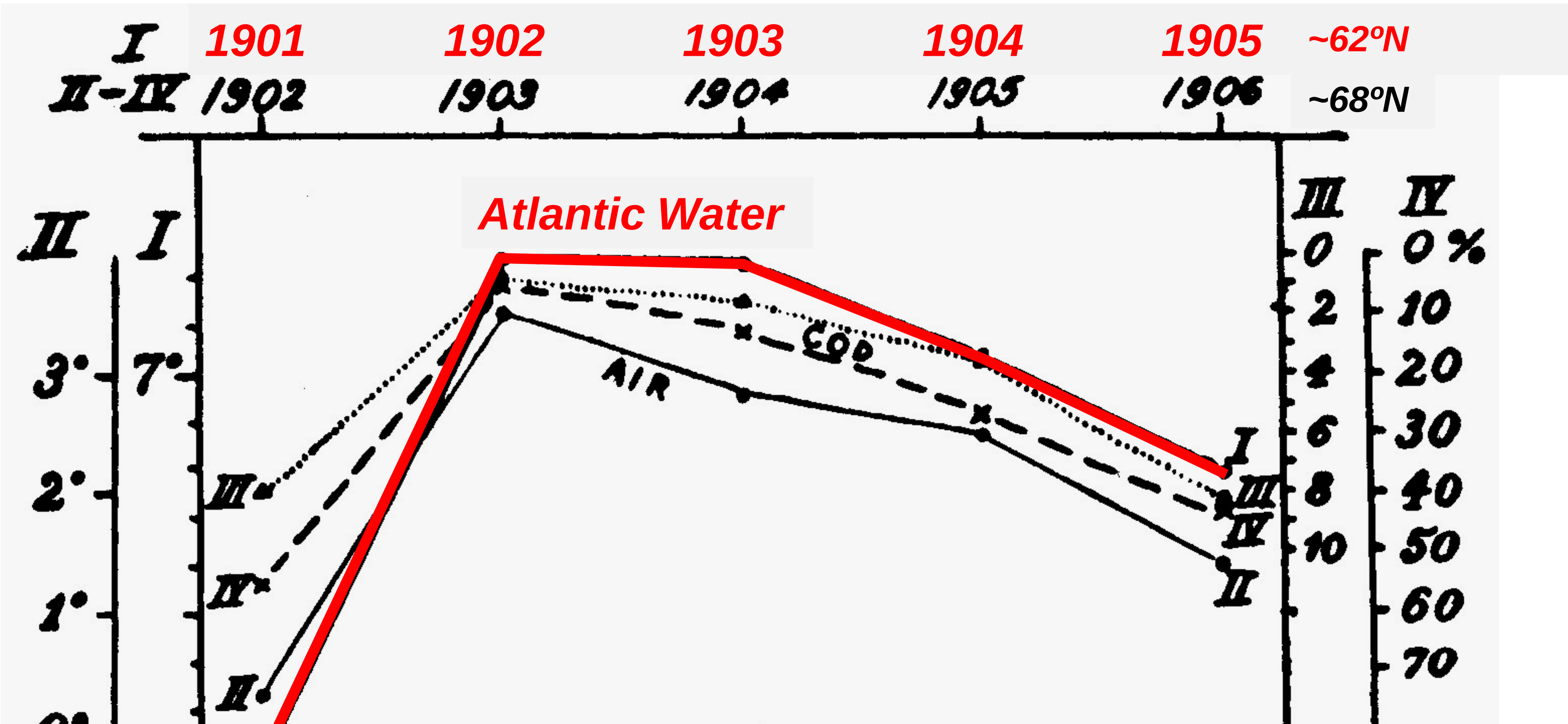
GFI established 1917 [building from 1928]

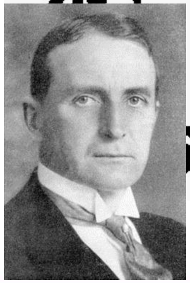
An early vision of a predictable climate



Helland-Hansen og Nansen 1909

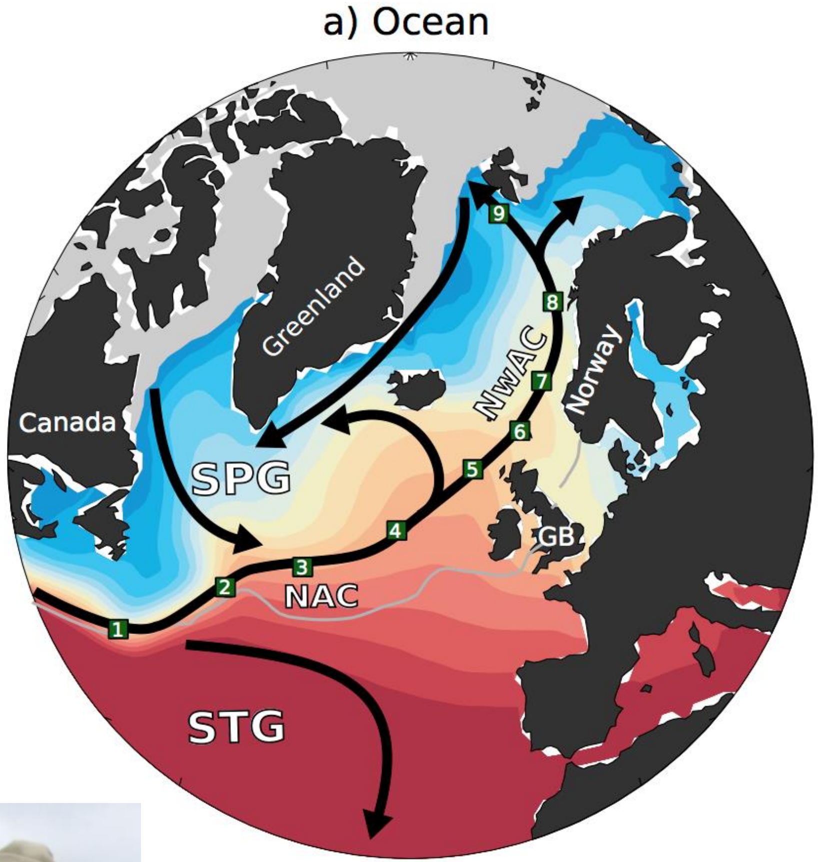
An early vision of a predictable climate

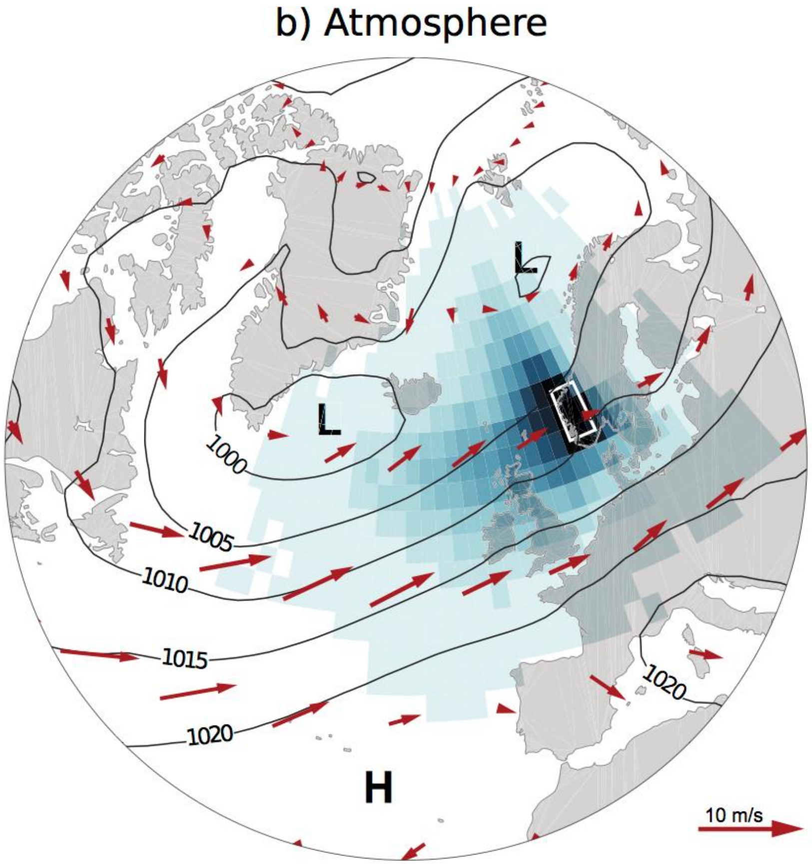




Helland-Hansen og Nansen 1909

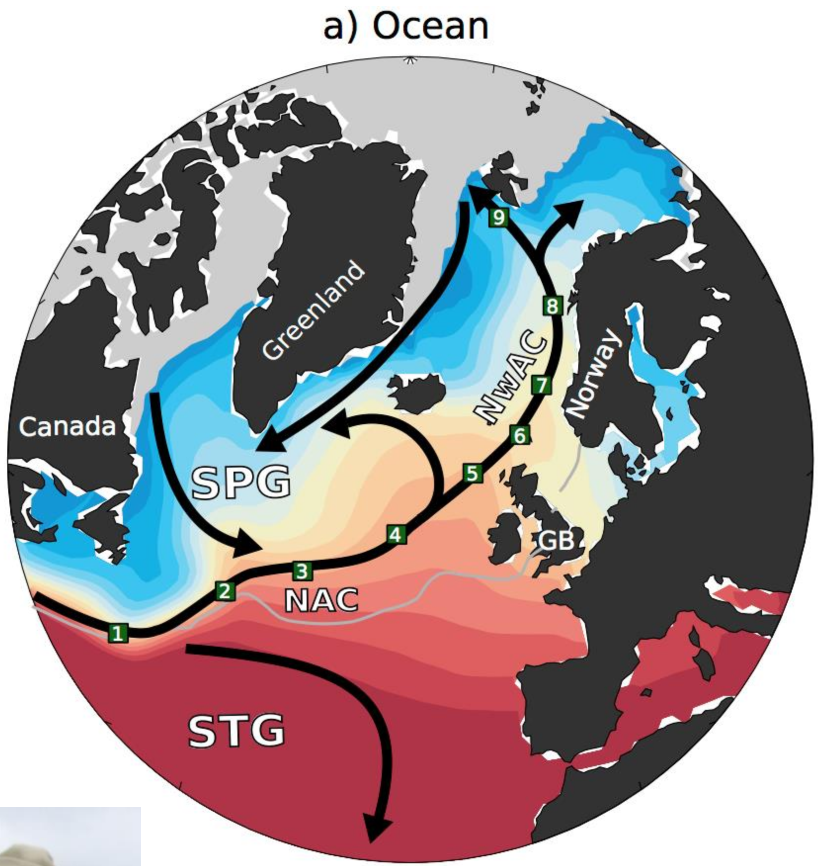
The “Gulf Stream” and the westerly winds

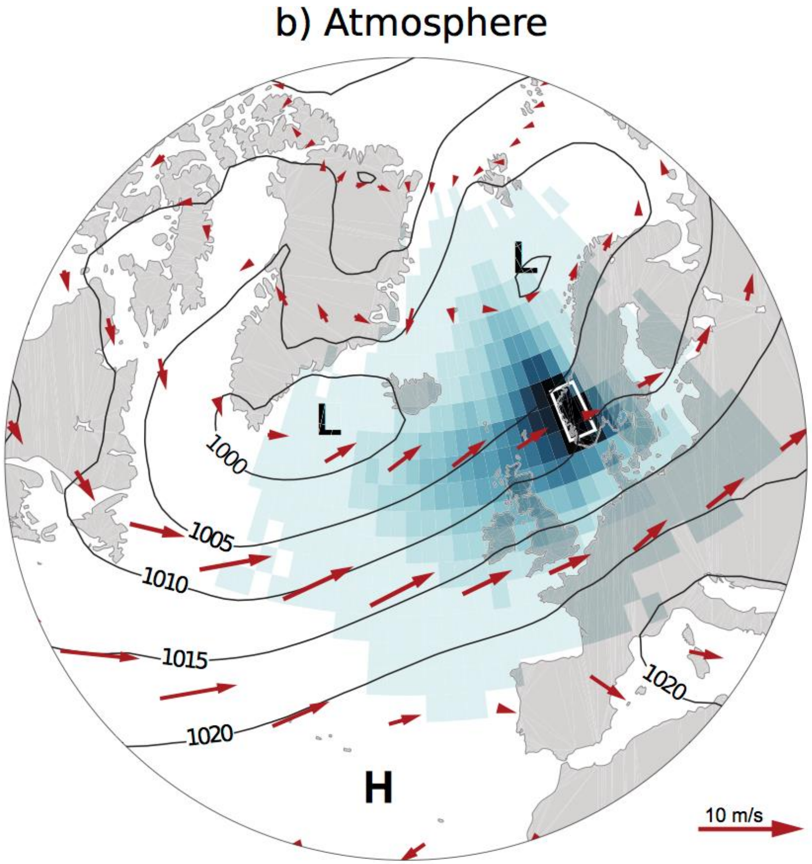




Årthun et al. 2017:
Skillful prediction of northern climate provided by the ocean.
Nature Comm.

The “Gulf Stream” and the westerly winds

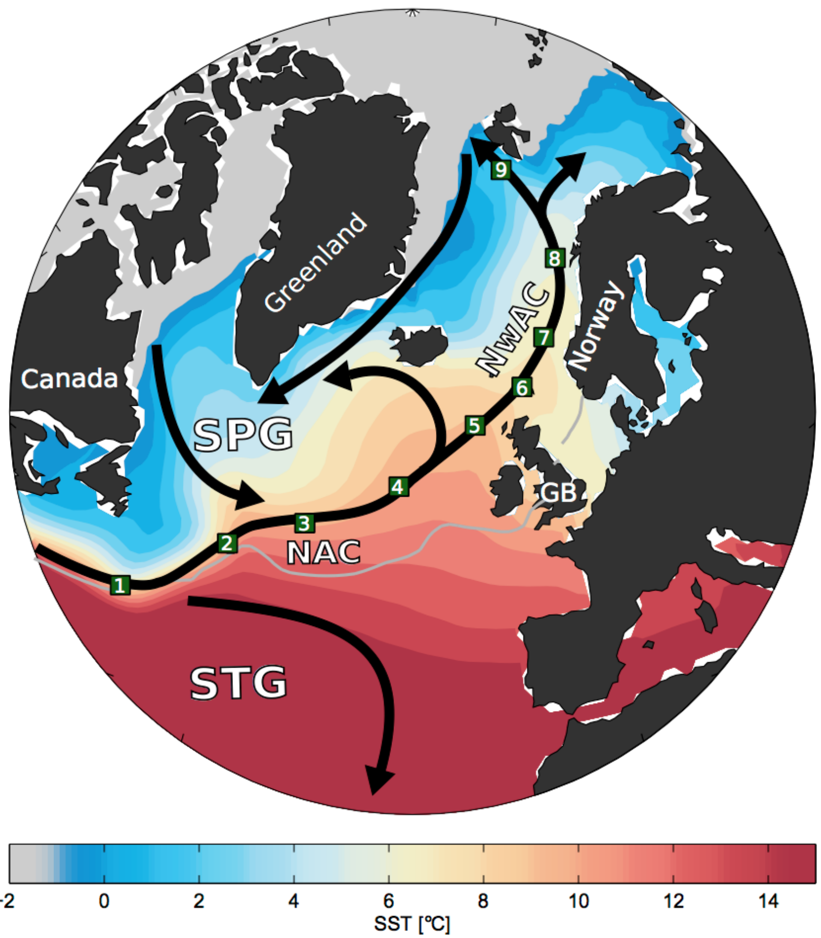


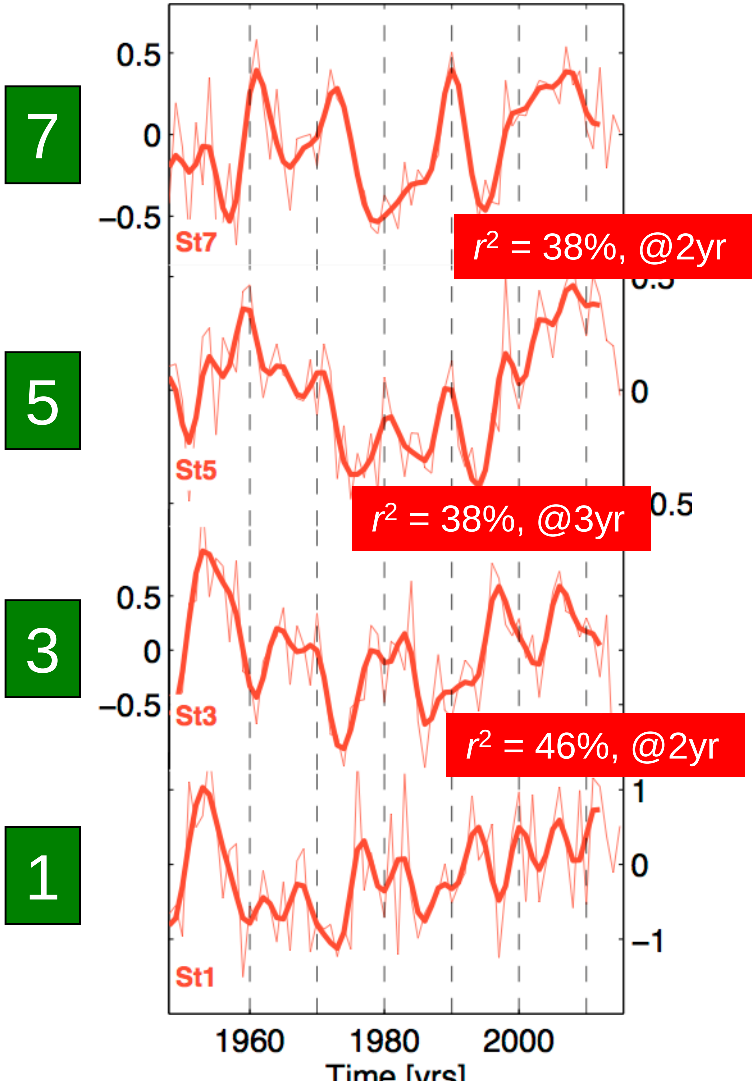


NAO + mean temperate ocean => *diagnostic*

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

Observed SST propagation (HadISST)

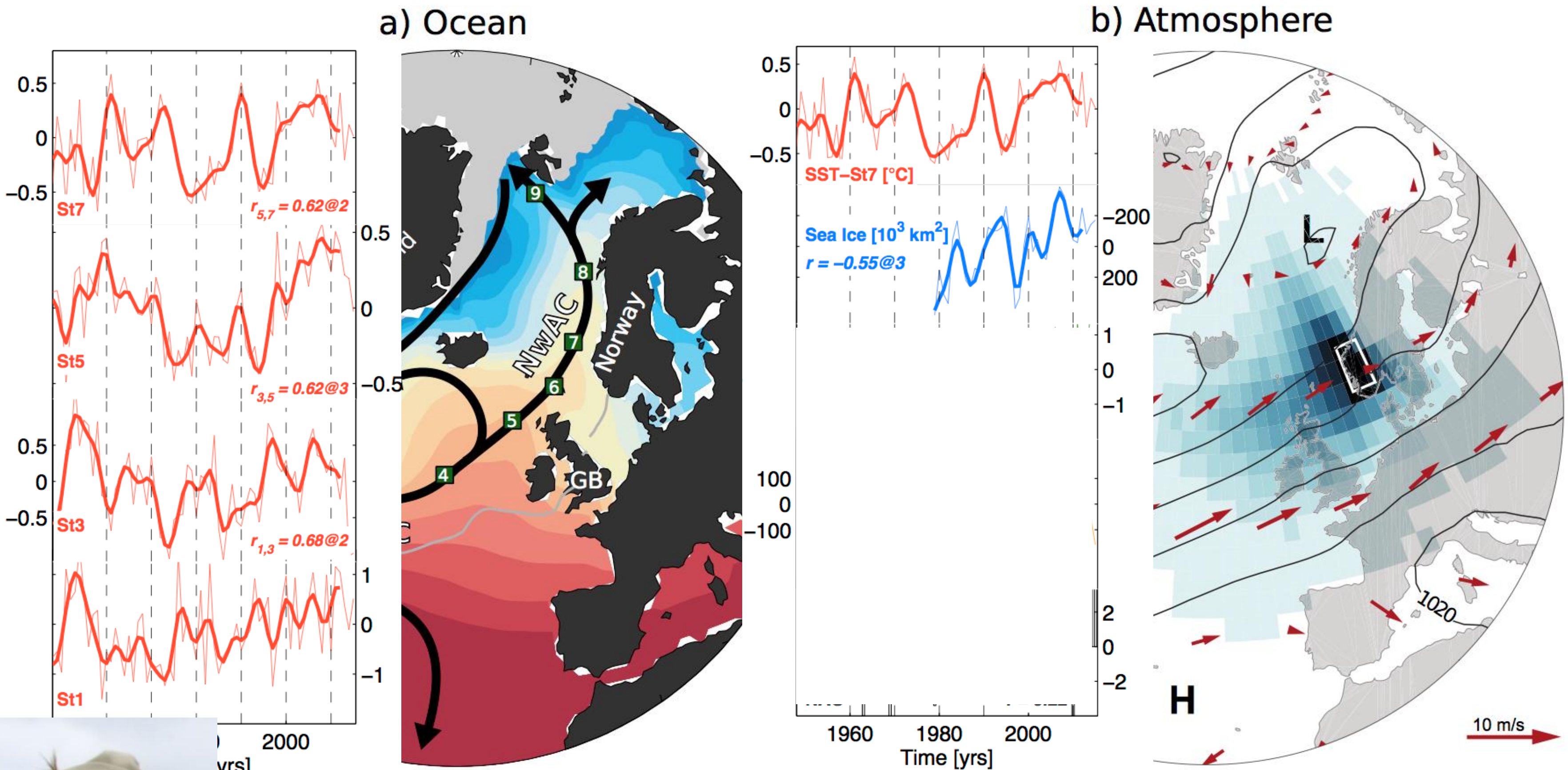




Propagating thermohaline anomalies, e.g., Sutton and Allen 1997, Holliday et al. 2008, Årthun and Eldevik 2016, +++

Årthun et al. 2017

How to get predictability beyond the ocean?

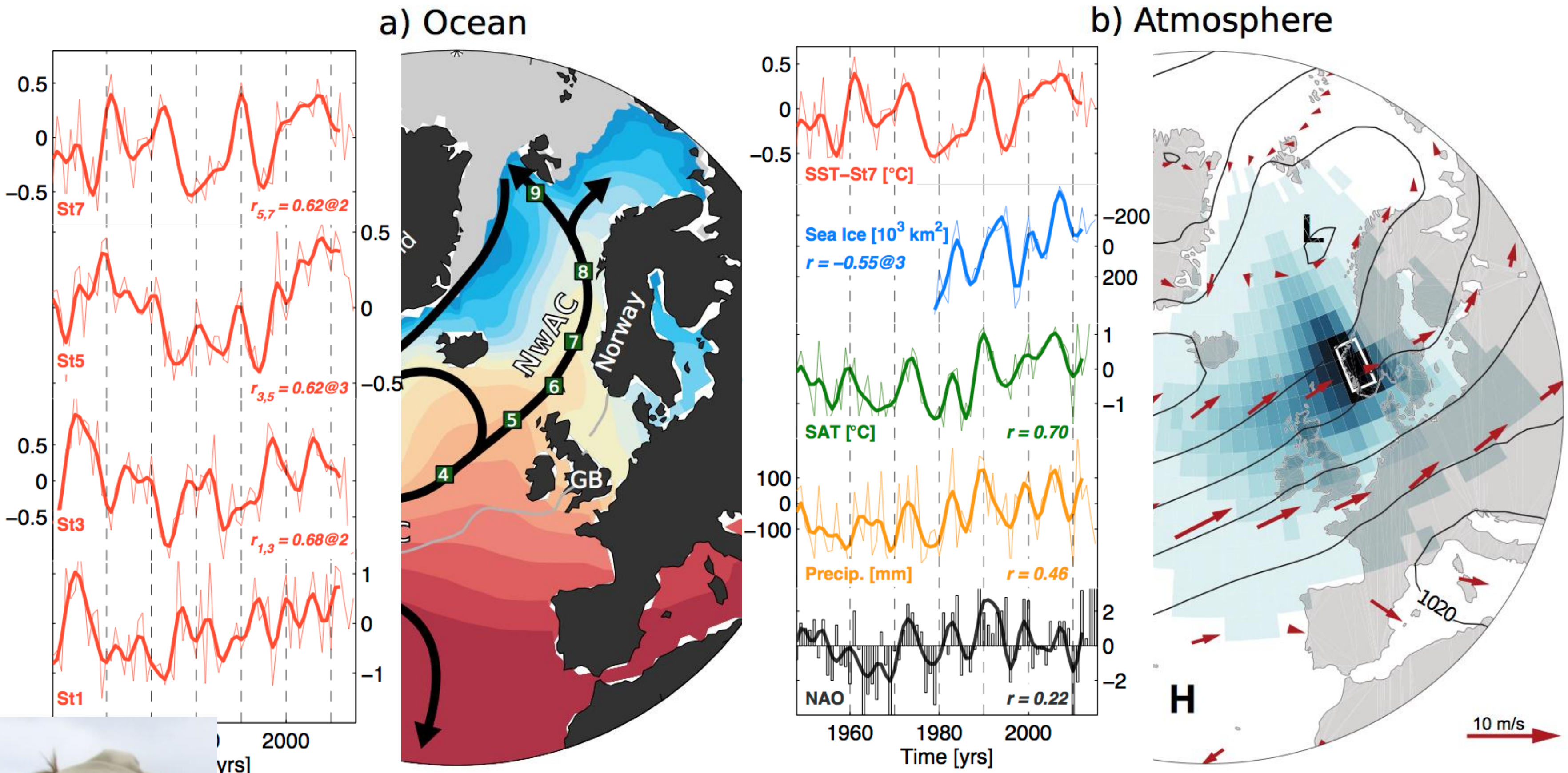


Århun et al. 2017: *Nature Comm.*

Norwegian Sea heat (SST) is reflected in

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

How to get predictability beyond the ocean?



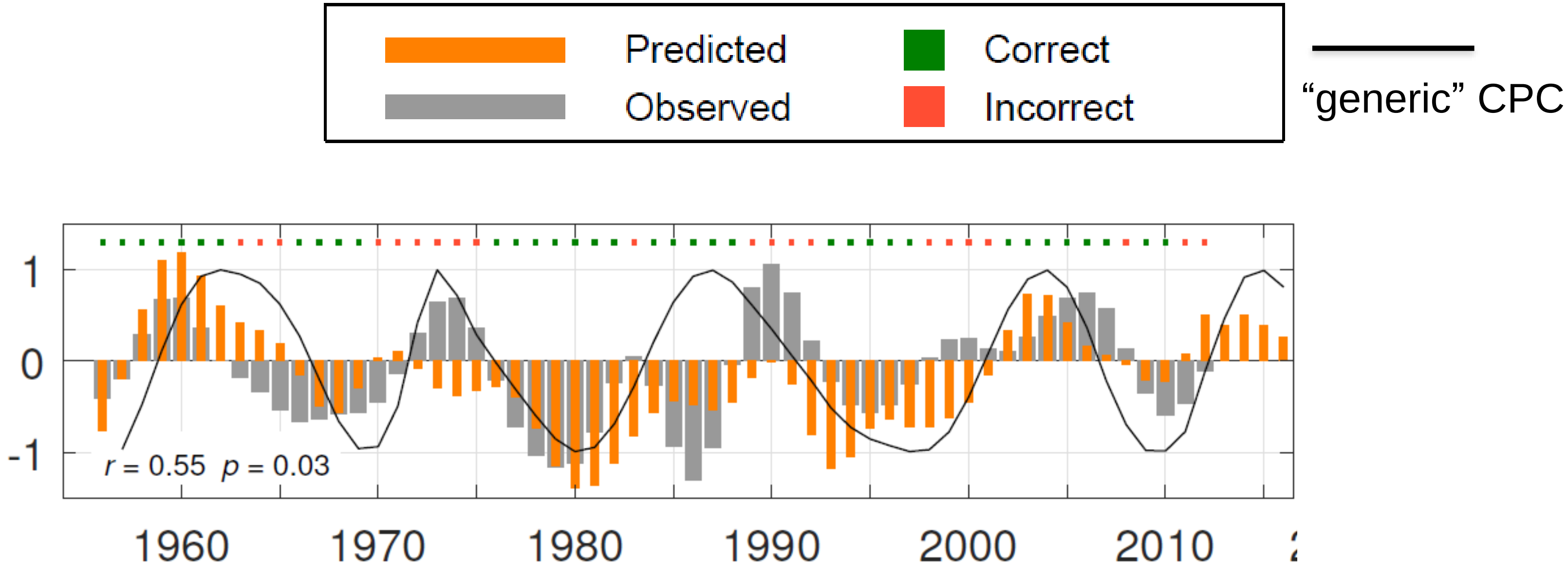
Årthun et al. 2017: *Nature Comm.*

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

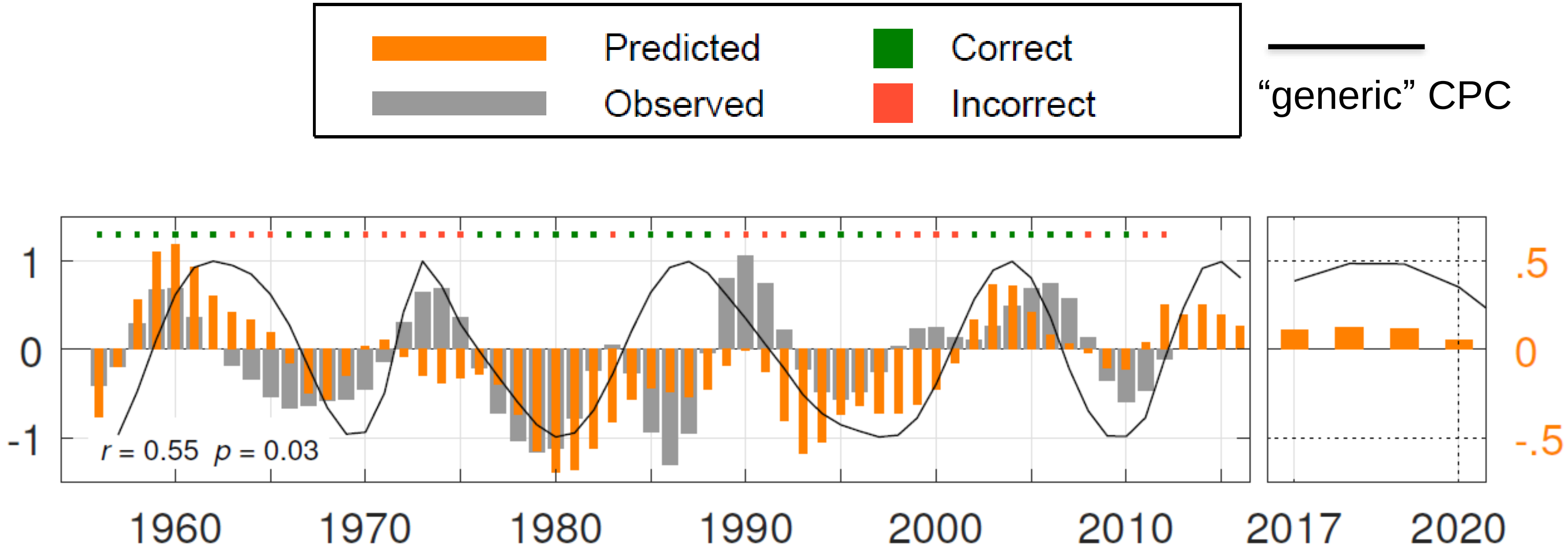


Årthun et al. 2017: *Nature Comm.*

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

Basic prediction 2017–2020

Surface Air Temperature - Norway



Årthun et al. 2017: *Nature Comm.*

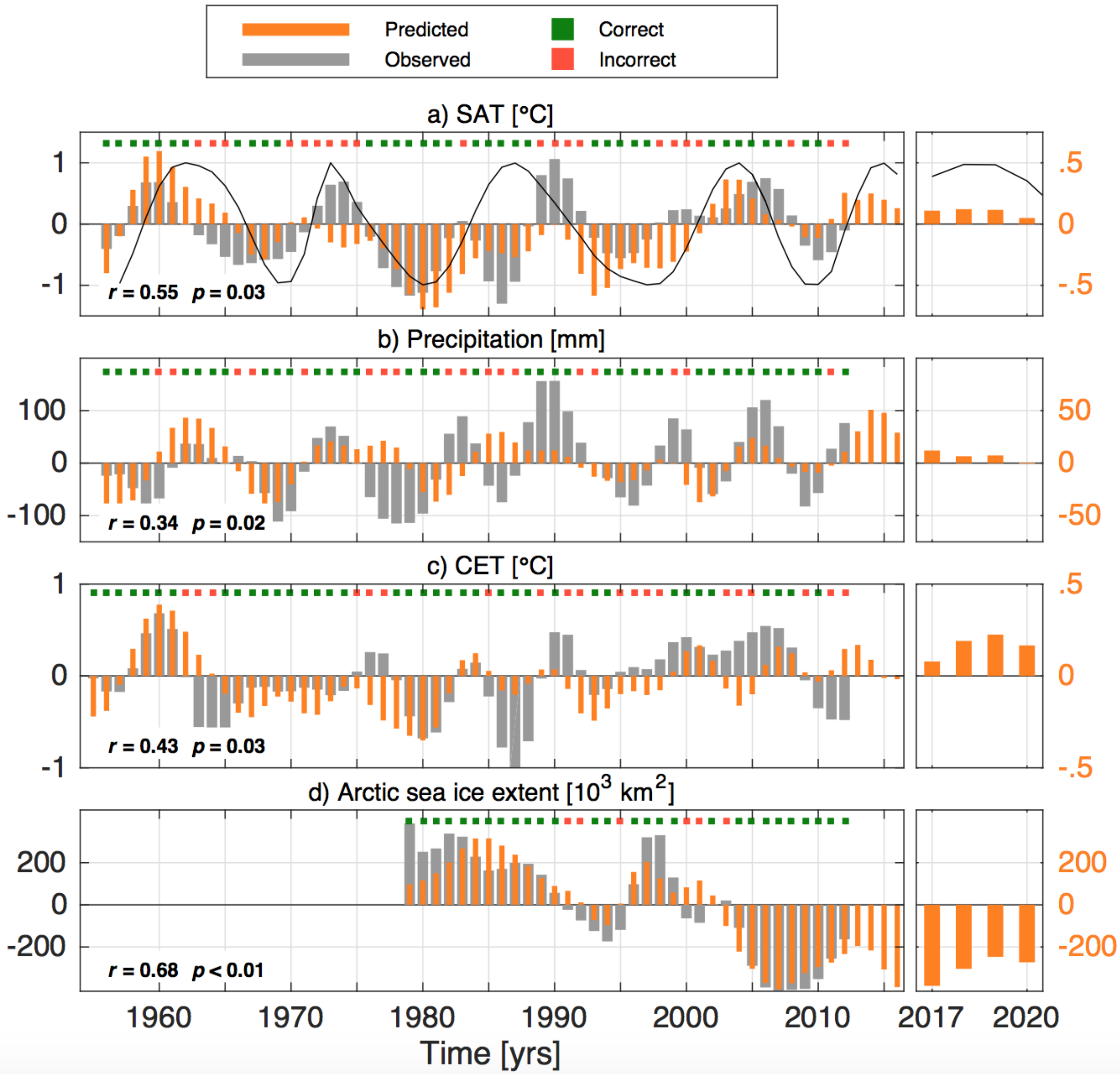
- Sign of prediction correct 67% of the time
- More skilful than random chance and climatology predictions
- Slight temperature decrease toward 2020 (above long-term average)

Norway SAT

Norway precip

CET

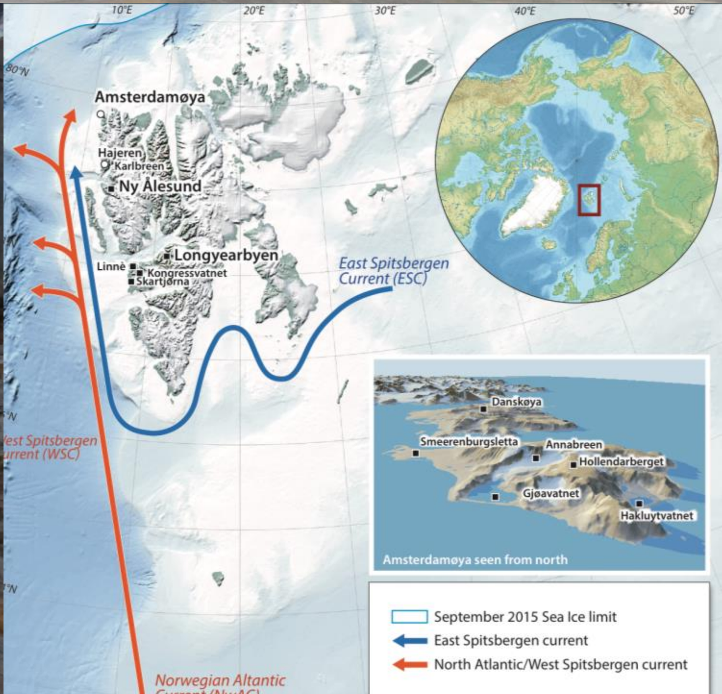
Arctic sea ice



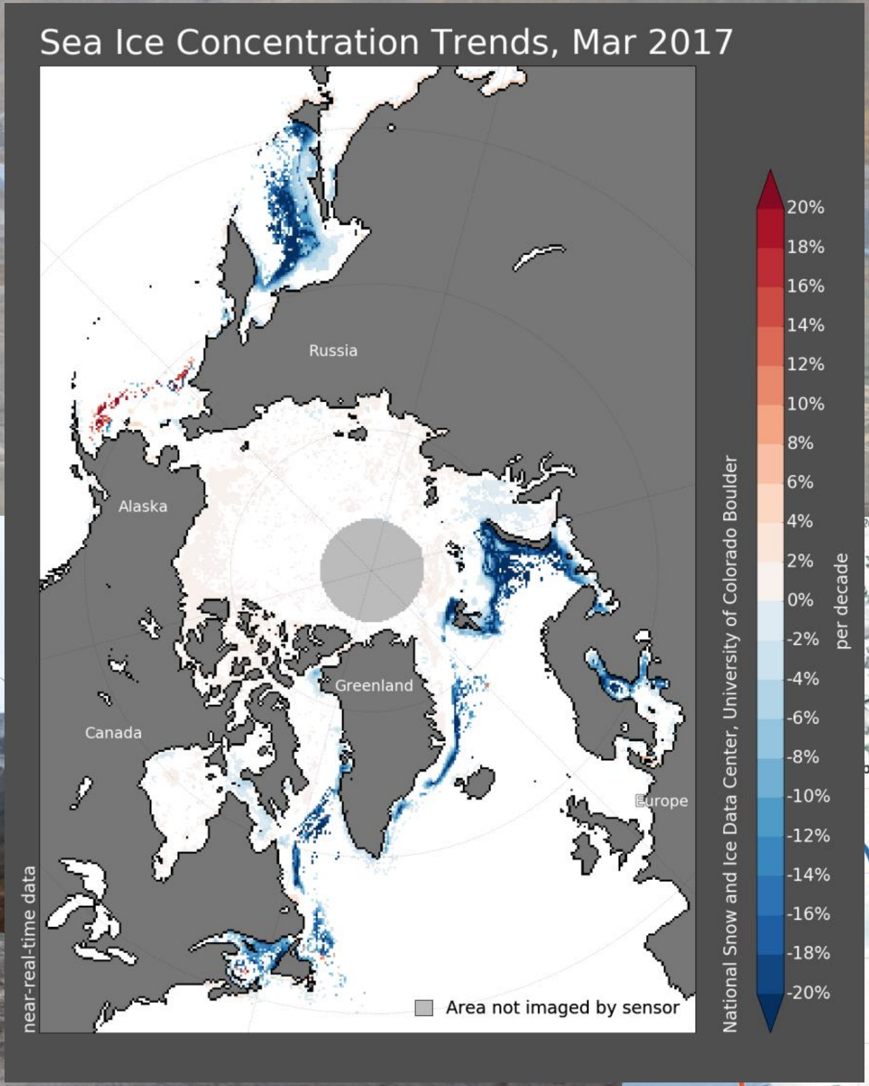
Årthun et al. 2017: *Nature Comm.*

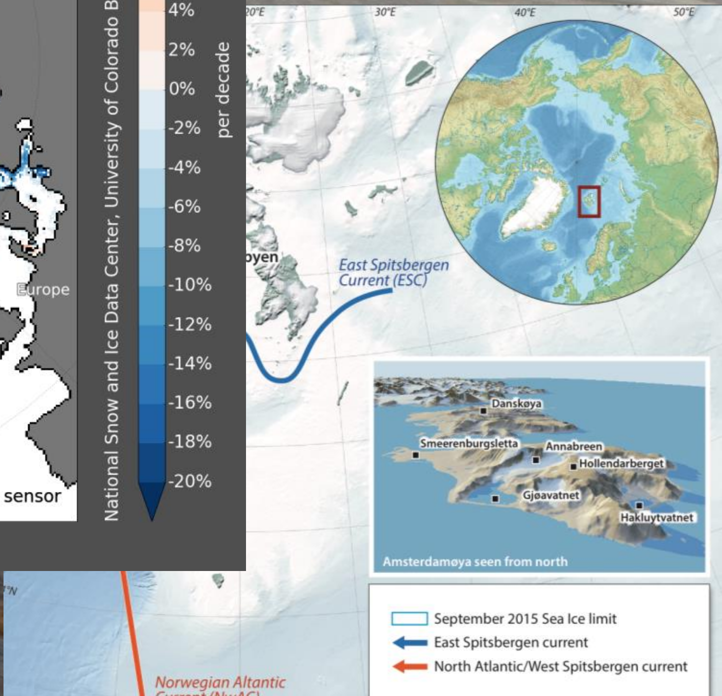
anomalies wrt 1981–2010 climatology

Longyearbyen, Svalbard - Bergen weather in the Arctic



Longyearbyen, Svalbard - Bergen weather in the Arctic





the Nansen LEGACY

A new Norwegian research project and structure

PI **Marit Reigstad** (UiT), Co-PIs Tor Eldevik (UiB), Sebastian Gerland (NPI)

New Norwegian infrastructure

provides new opportunities for Arctic marine research from 2018

Length: 100 meter
Width: 21 meter
Price: 1,4 billion NOK
At sea: 2017

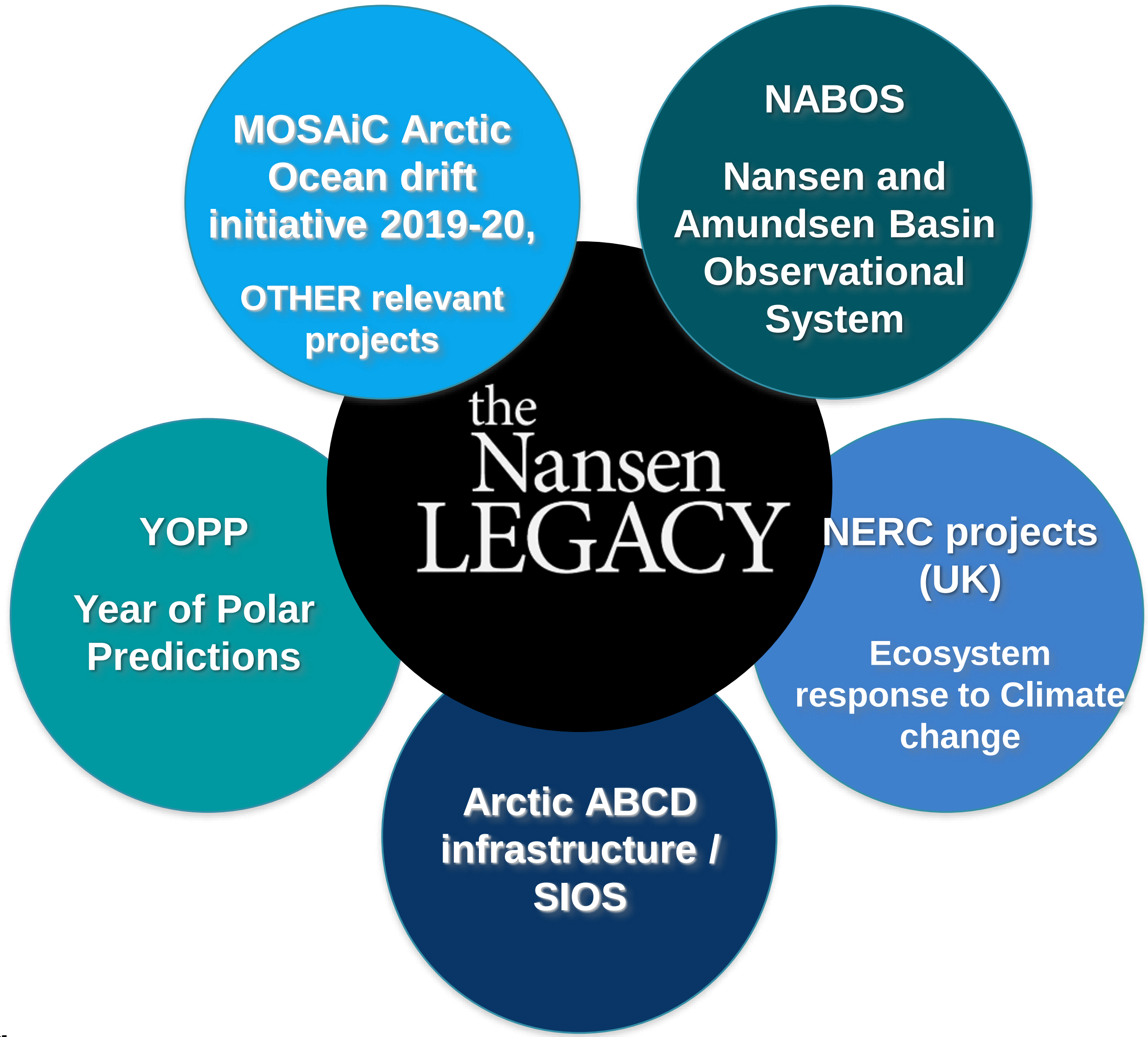
- Designed by Rolls Roys Marine
- Finnishing in Italy

- Capacity: 35-39 scientists
- Performance: 1.5 m ice
- Moonpool and helicopter

the Nansen LEGACY

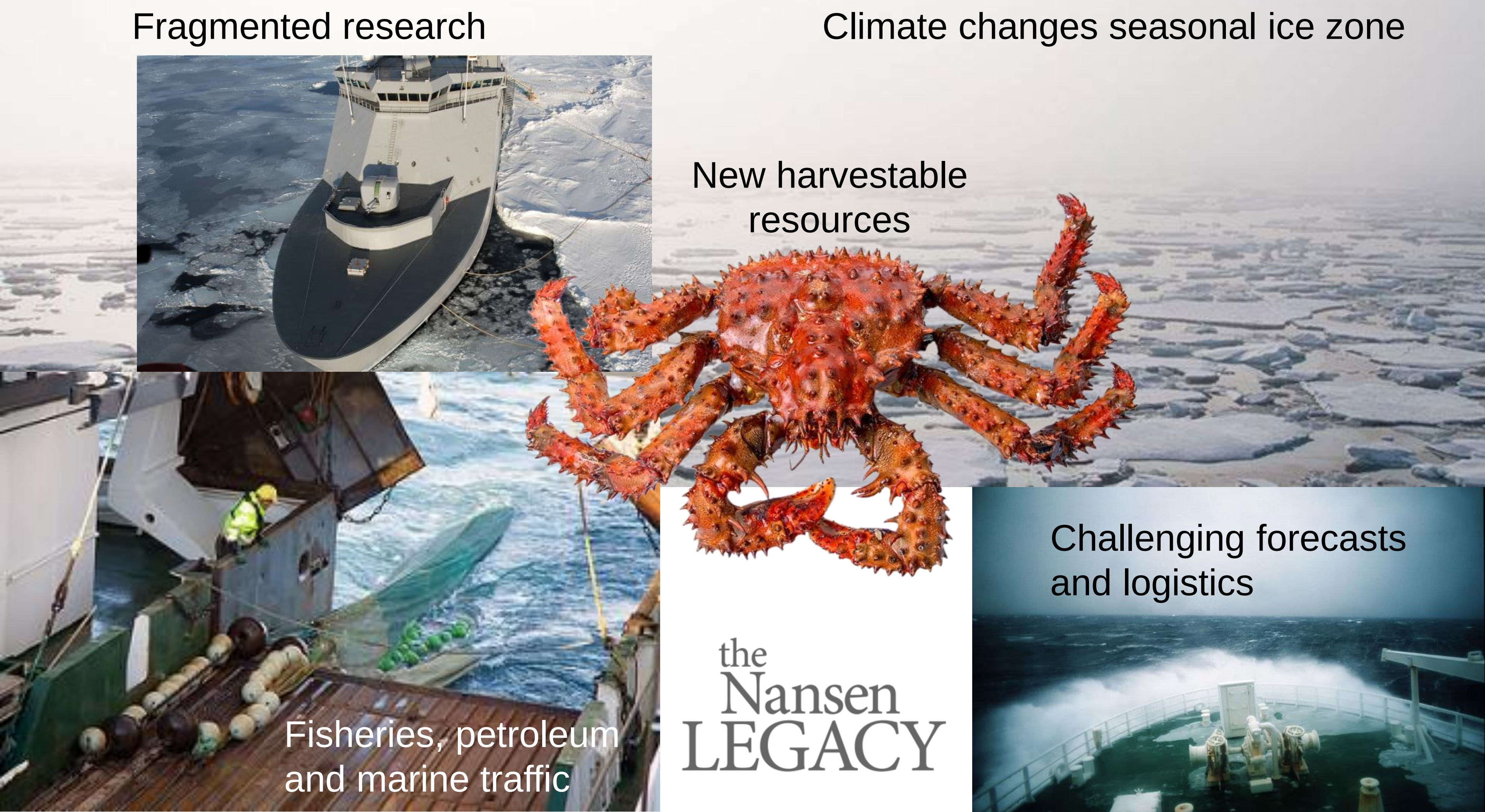
The science landscape

with some relevant project and initiatives for potential synergy and cooperation

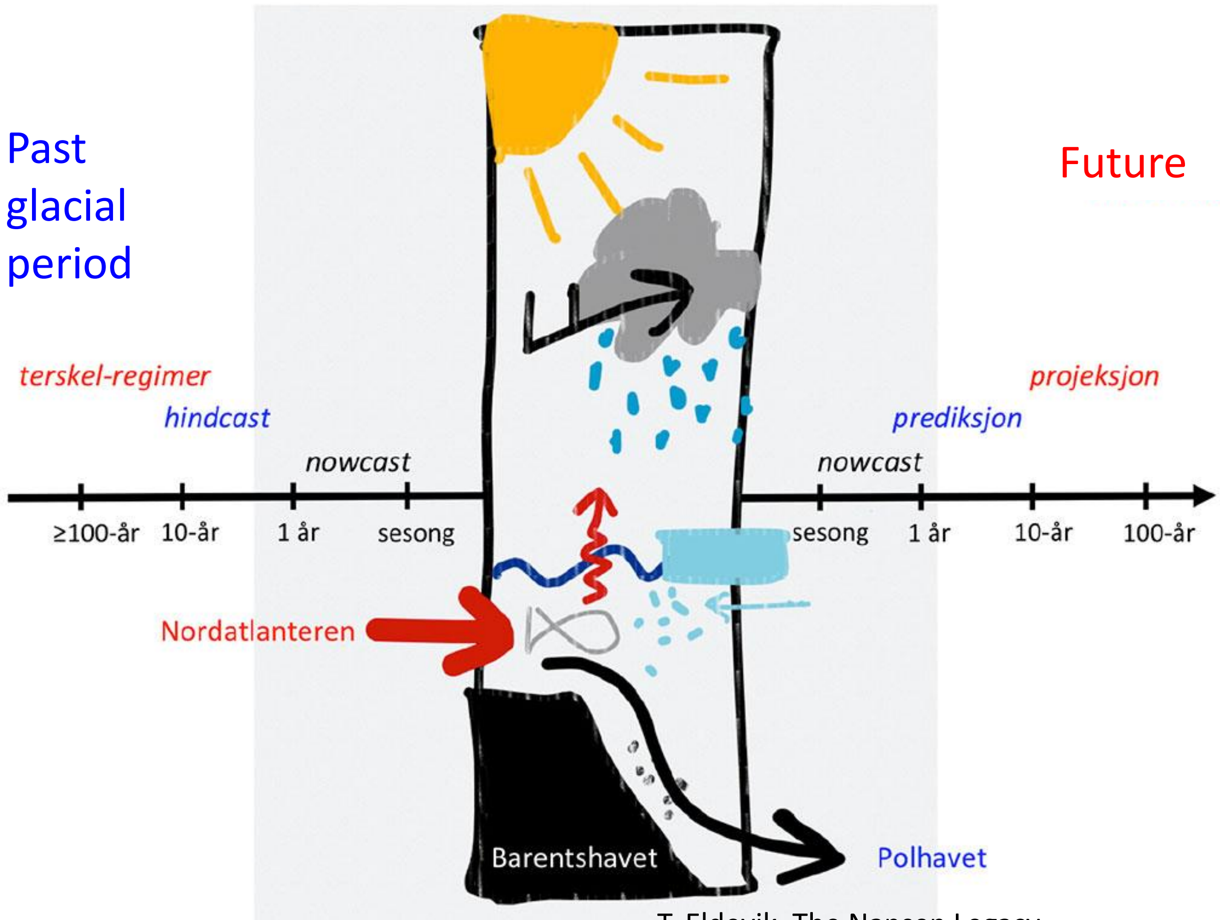


The Nansen LEGACY 2017-23

answers the need for knowledge beyond the ice edge



Towards a holistic understanding of a changing climate and ecosystem



T. Eldevik, The Nansen Legacy

The Nansen LEGACY objectives

1. **Improve scientific basis for sustainable management of natural resources beyond the present ice edge**

2. **Characterize main human and natural impact and ecosystem responses – past, present, future**

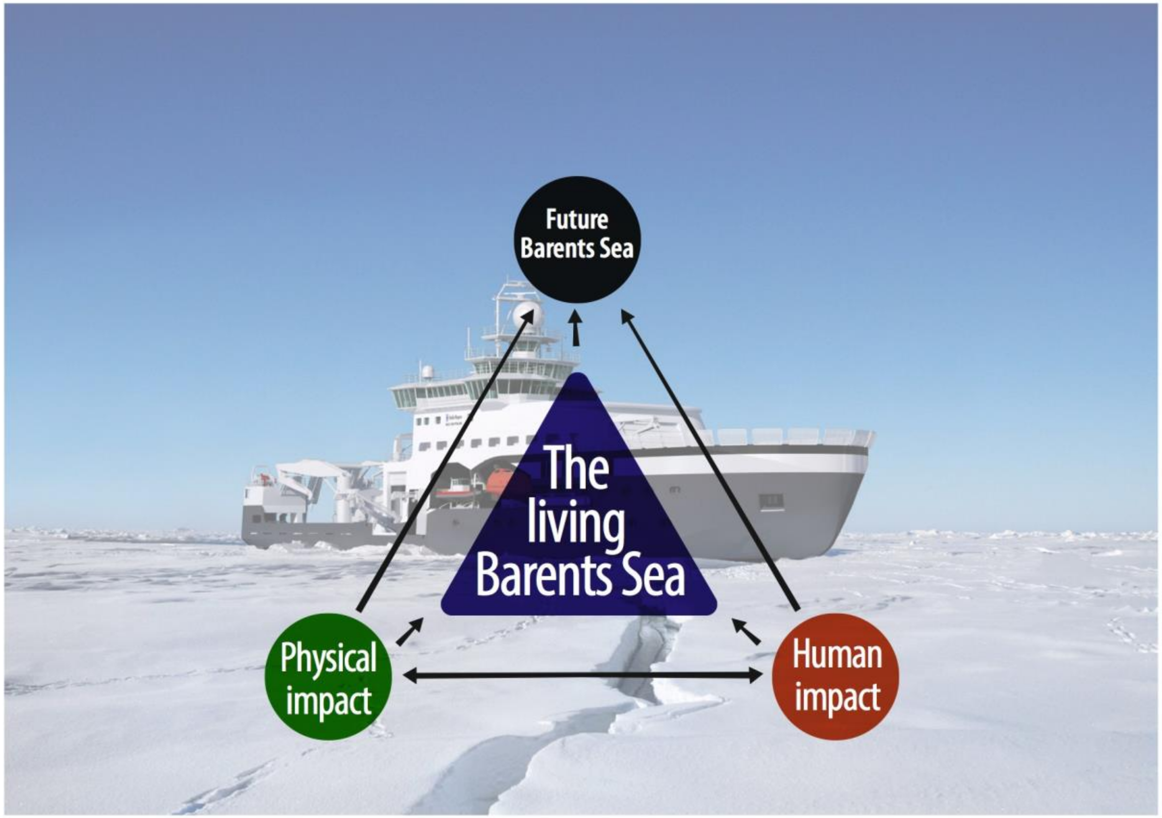
1. **Resolve mechanisms governing Barents Sea ice cover and climate state – and the predictive capability**

1. **Optimize use of emerging technologies, infrastructure, recruitment and stakeholder dialogs to explore and manage the emerging Arctic**

the Nansen LEGACY

The Nansen LEGACY

investigate how physical and humans impact the living present and future Barents Sea



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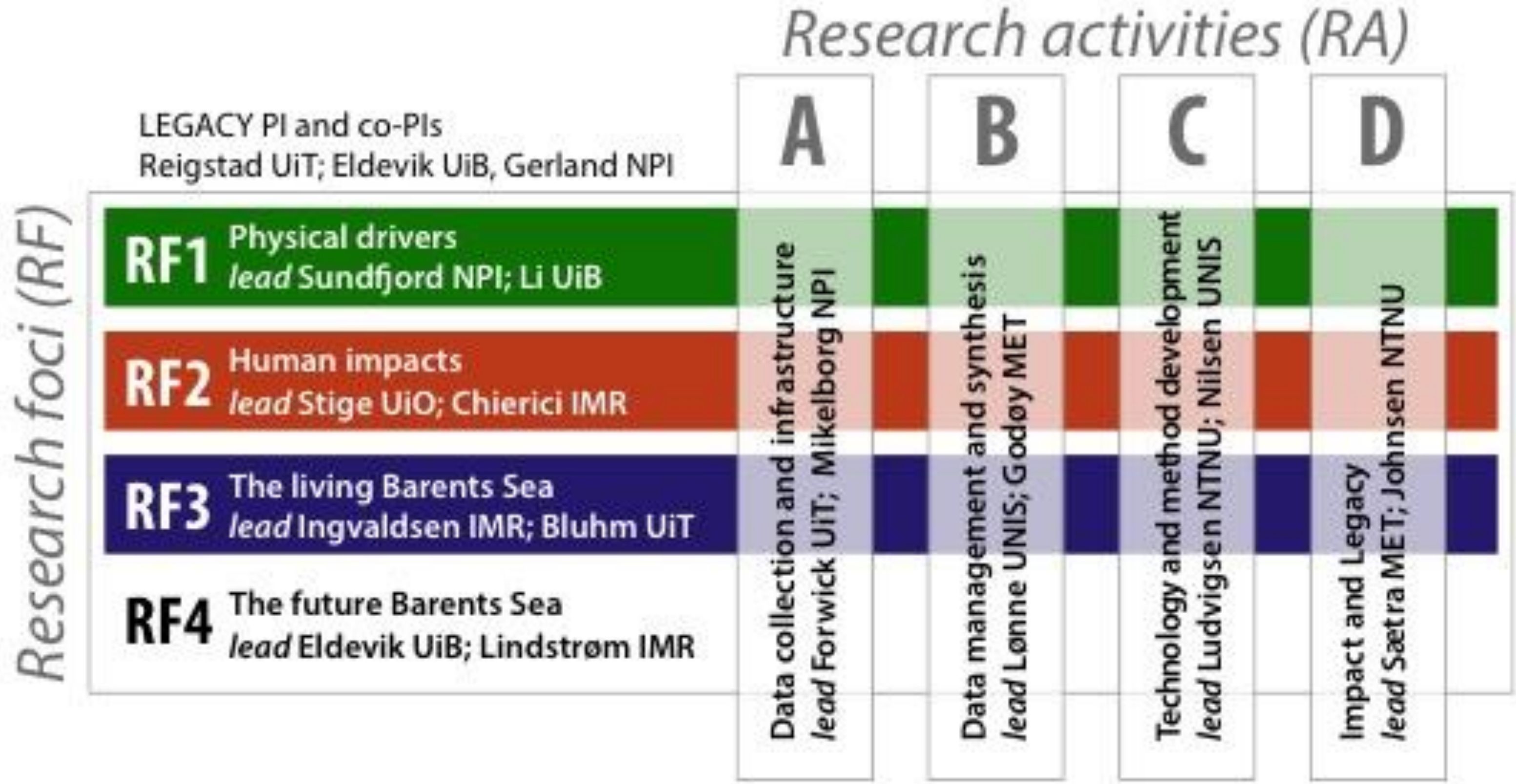
The Nansen LEGACY

project organisation facilitates integration

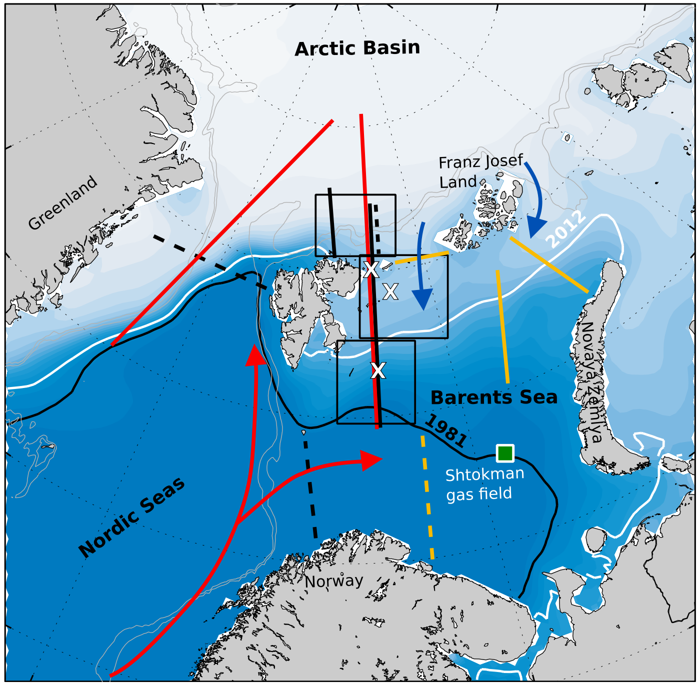


the Nansen LEGACY

The Nansen LEGACY 2017-23

collect data and improve predictions to build knowledge for future management

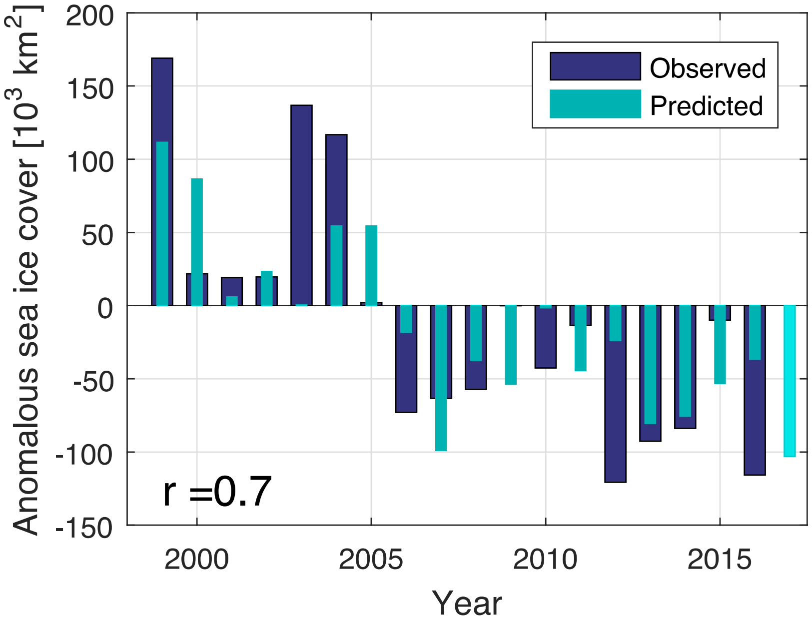
Data collection



5 years with ≈360 days in field (2018-2022), incl. seasonal study, moorings and autonomous vehicles

Predictive tools

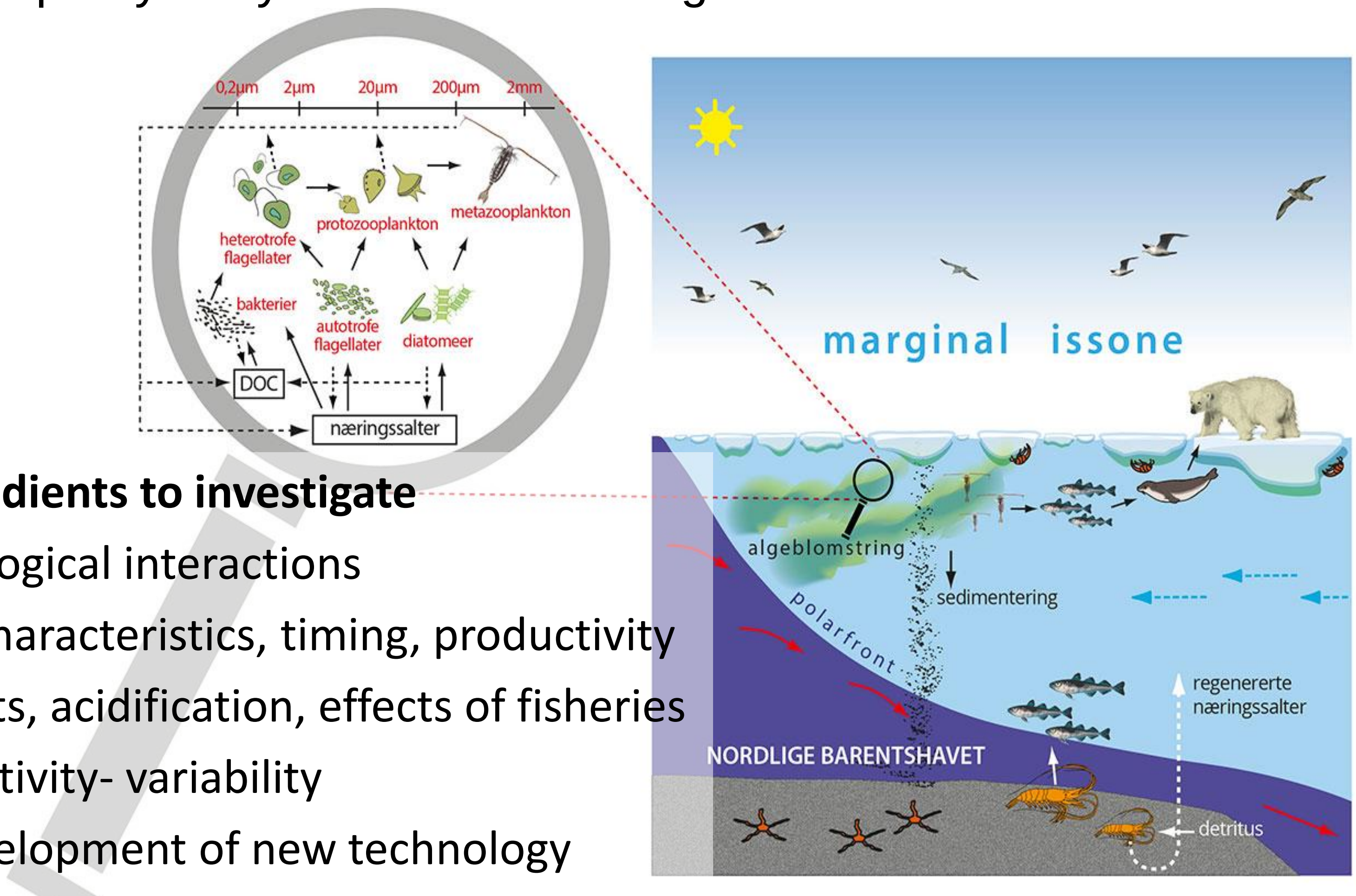
Onarheim et al. 2015, updated for input data through to 4/2016 (Onarheim, UiB/Bjerknes Center & Ingvaldsen, IMR)



the Nansen LEGACY

The Nansen LEGACY

has an interdisciplinary ecosystem focus on the living Barents Sea



Use climatic gradients to investigate

- Physical-biological interactions
- Ecosystem characteristics, timing, productivity
- Contaminants, acidification, effects of fisheries
- Paleoproductivity- variability
- Use and development of new technology
- Observations for improved prediction
- Data legacy

Physical drivers

RF1 Objective: Improve understanding **of how environmental conditions and internal regulating mechanisms** in the northern Barents Sea **respond to changing external forcing**

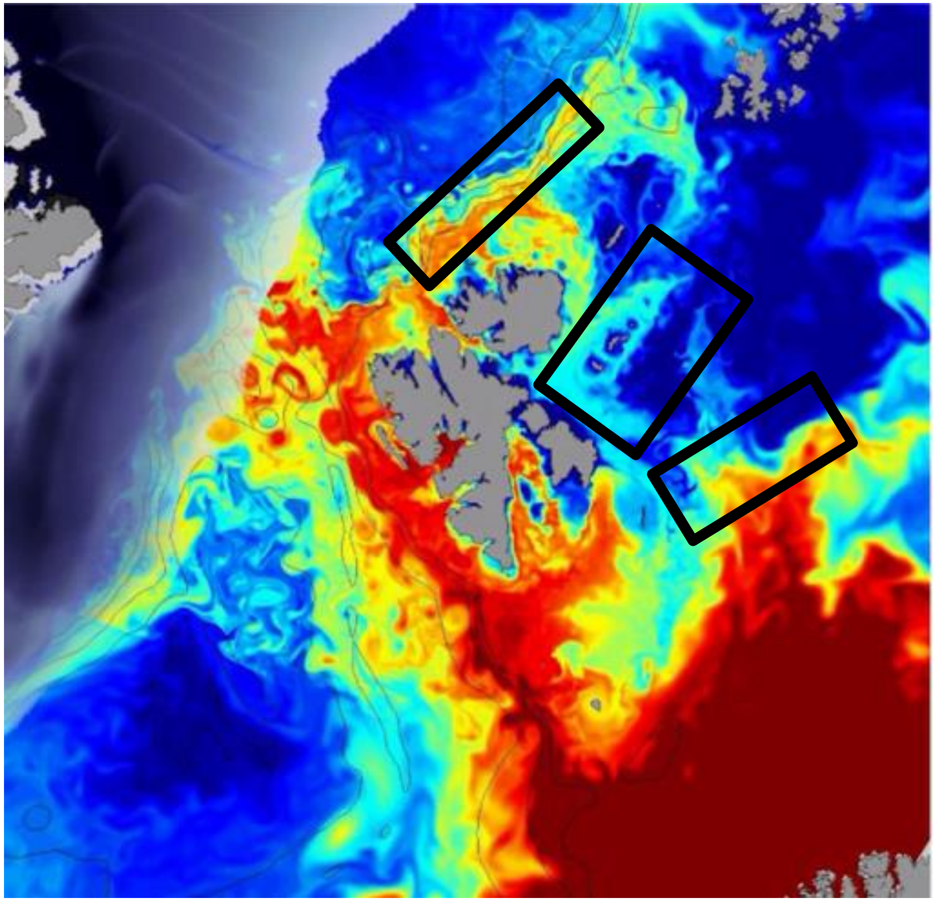
RF1 tasks:

T1-1 **External forcing:** fluxes of sea ice, water masses, momentum and heat

T1-2 **Internal forcing** on the distribution of sea ice and stratification

T1-3 Climate history to develop high-resolution **time series of sea ice and ocean climate** properties.

T1-4 **Global and regional climate simulations** with sensitivity experiments, 1D modelling and analysis of long data series to quantify the relative influence of large-scale forcings and local processes on the ice-ocean-atmosphere system.



Human impact

RF2 objective: Improve our understanding of
human activities influence the
Sea ecosystem

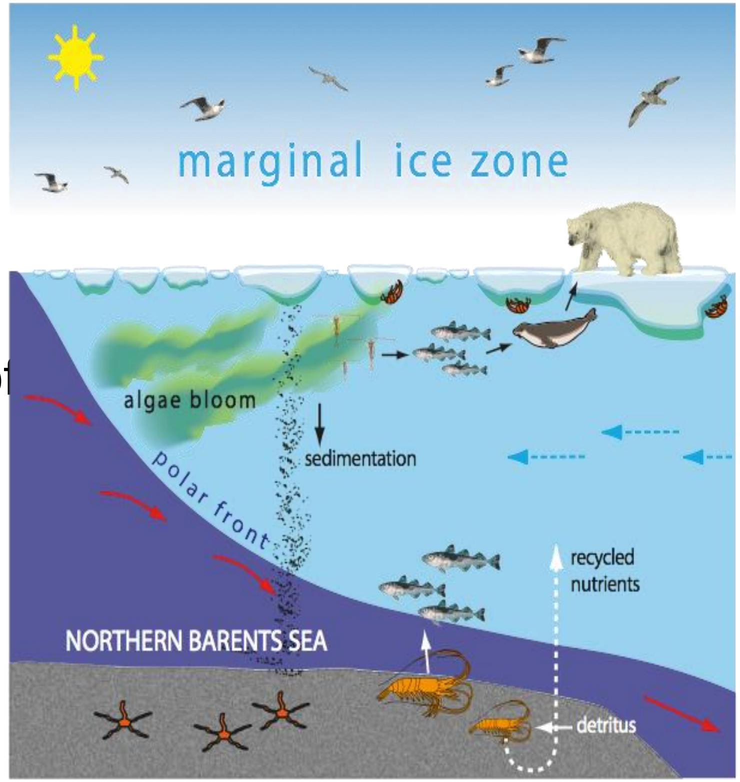
RF2 tasks:

T2-1 **Ocean acidification**: Variability and drivers, effect on bio-availability of essential nutrients and metals, consequences for key ecosystem species

T2-2 **Pollution:** Drivers of food web biomagnification, effects of contaminants in the marine food web, including the effects of changes in species composition, energy allocation, and food availability

T2-3 **Harvesting:** Incorporate new knowledge about climate-driven ecological and genetic changes in fish communities in ice-covered areas, into ecosystem models that quantify the combined effects of climate and harvesting

The living Barents Sea



RF3 objective: To build critical understanding of how organisms in the northern Barents Sea ecosystem respond to current and changing environmental conditions on the species and community levels.

RF3 tasks:

T3-1 **Characterize and quantify biota** along the climate gradient of the seasonal ice zone

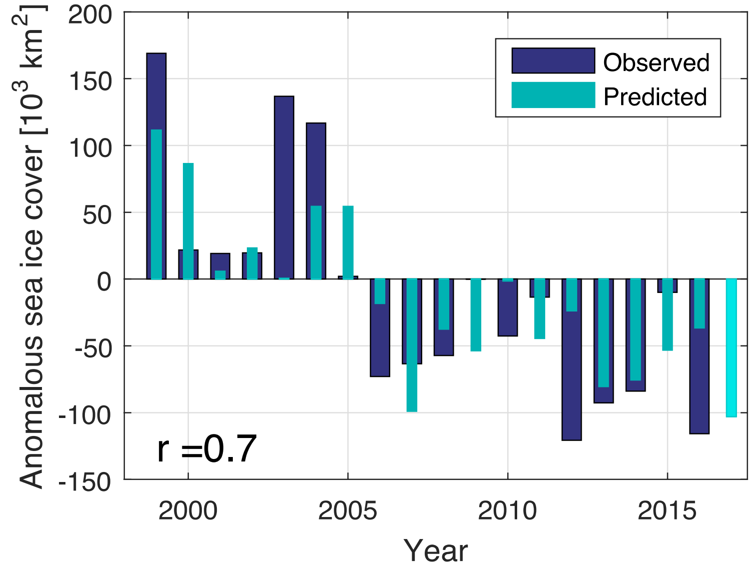
T3-2 Investigate **the timing of key biological processes** including production, phenology of life cycles across several trophic levels using in situ observations, experiments and satellite observations.

T3-3 Total annual **production across several trophic levels** along latitudinal and environmental gradients using in situ observations and modeling.

T3-4 Characterize **food web structure, carbon cycling and biological interactions**, and investigate **selected key regulating factors** using in situ observations, field experiments and models.

Onarheim et al. 2015, updated for input data through to 4/2016 (Onarheim, UiB/Bjerknes Center & Ingvaldsen, IMR)

The future Barents Sea



RF4 objective: To assess state, predictability, and associated uncertainties of Barents Sea weather, climate and ecosystem.

RF4 tasks:

T4-1 Tailor an ensemble **weather**–ice–ocean **forecast** model system for the Barents Sea and Polar region

T4-2 Climate predictions and climate **projection** scenarios for the Barents Sea and regions influenced thereof

T4-3 Constrain **biogeochemical variability** spatially and temporally

T4-4 Develop and use **dynamic ecosystem models** to simulate key ecosystem properties of the **future** living Barents Sea

T4-5 Identify ecosystem indicators that might reveal **early warning of significant systemic state change**, and evaluate possible ecosystem indicators for their scientific, management, and communication potential