

## Arctic Climate Change –

Perhaps the most visible consequence of Global Warming

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# Arctic Climate Stability and Change

ECRA General Assembly 2017 - “Climate Change and Vulnerable Regions”

*March 7-8, 2017, Square Brussels Meeting Centre*

### Co-chairs:

**Lars H. Smedsrud, Bjerknes Centre, Norway**

Thomas Jung, AWI, Germany (On the way out)

Richard Bintanja, KNMI, Netherland (On the way in)

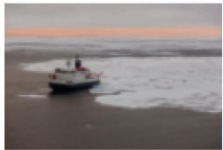


# Arctic ECRA - since 2012

**A number of workshops resulted in recommending that the EU fund collaborative research aiming to answers these questions:**



[More information](#)



[More information](#)



[More information](#)

**Why is Arctic sea ice disappearing so rapidly?**

**What are the local and global impacts of Arctic climate change?**

**How to advance environmental prediction capabilities for the Arctic and beyond?**

# Milestone in 2014:

## Arctic ECRA Strategy and Work Plan

**30 pages**

“Advancing European Arctic climate research for the benefit of society”



[www.ecra-climate.eu](http://www.ecra-climate.eu)

# Resent achievements:

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- **Recomendations played a role for Horizon 2020 call**
- **Coordination for applications:**
  - **Resulted in «the Big 3» projects:**  
**INTAROS, Blue-Action & APPLICATE**
- **Response and input to EU-Polar Net**  
**Dedicated workshop in February 2016**

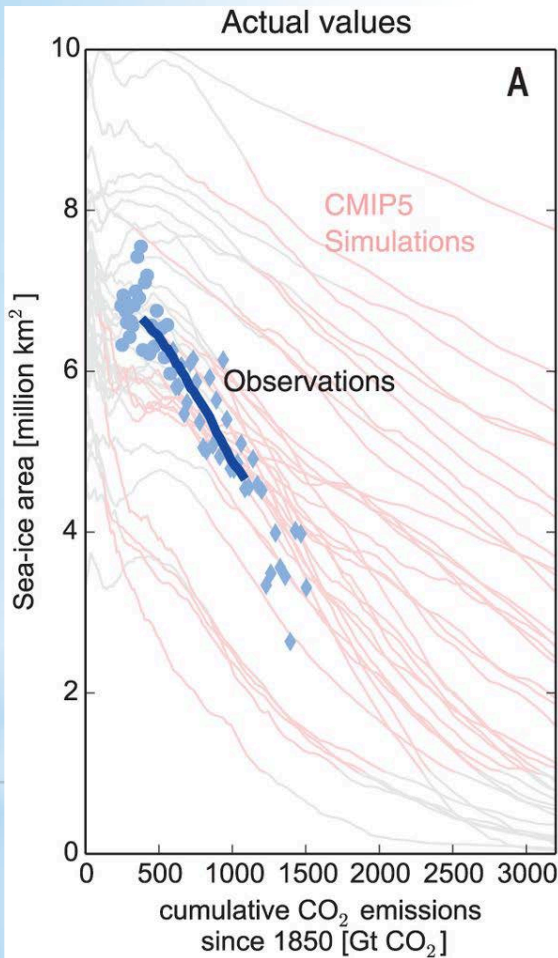


# Google: Arctic Climate Change

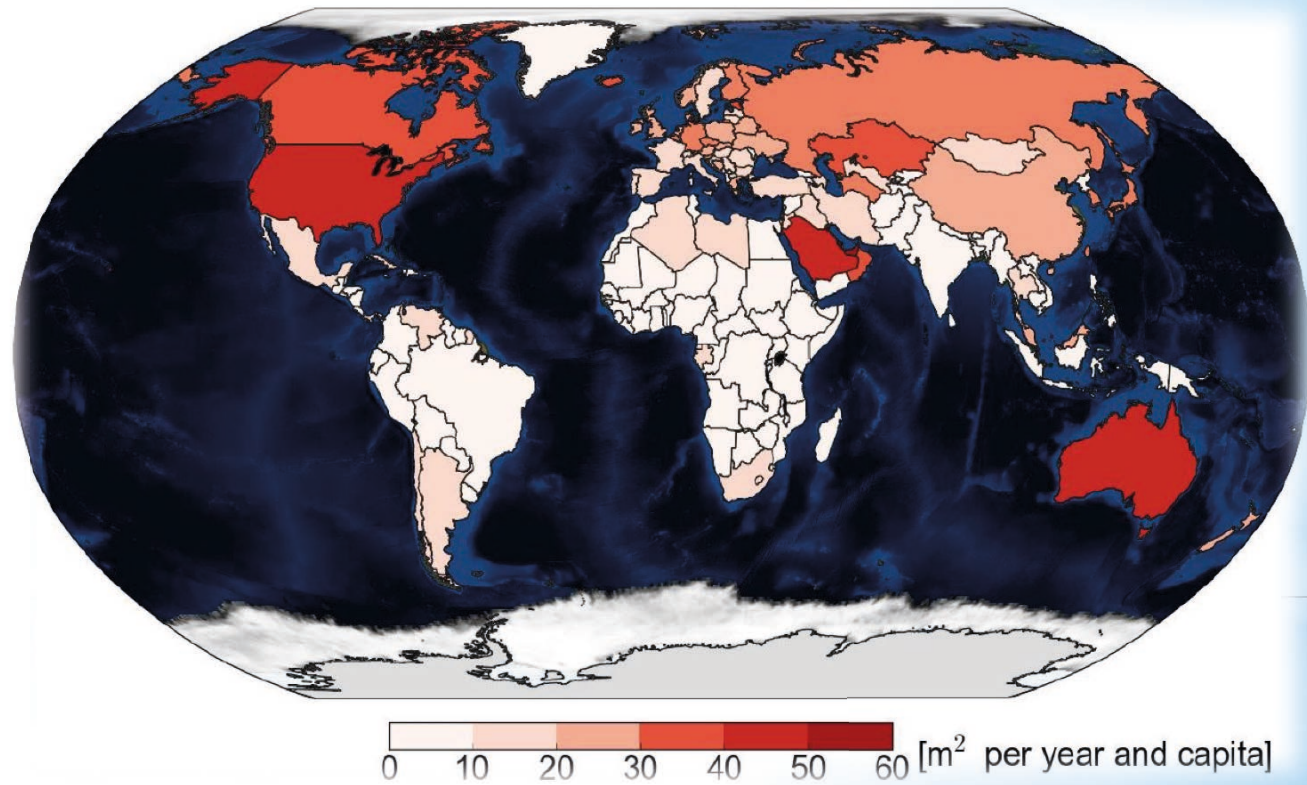
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# Arctic sea ice decline is caused by you and me ...



**Annual mean loss of Arctic September sea-ice area caused by average emissions of each citizen**



**Talk tomorrow 15:30  
Julienne Stroeve**

**3 m<sup>2</sup> Arctic September sea ice loss = 1 ton anthropogenic CO<sub>2</sub> emission  
Notz & Stroeve (2016)**

# Arctic talks tomorrow: 15:30

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- Julienne Stroeve (CPOM, UK)

**Arctic sea ice loss and the response from CO<sub>2</sub>**

- Richard Bintanja (KNMI, NE)

**Observed Arctic sea ice loss and Arctic amplification**

- Ralph Döscher (SMHI, SE)

**Arctic climate change scenarios and consequences**

- Lis L. Jørgensen (IMR, NO)

**Effects of multiple stressors on the benthic ecosystem  
in the Barents Sea**



# INTAROS (2016 – 2021) € 15.5 mill

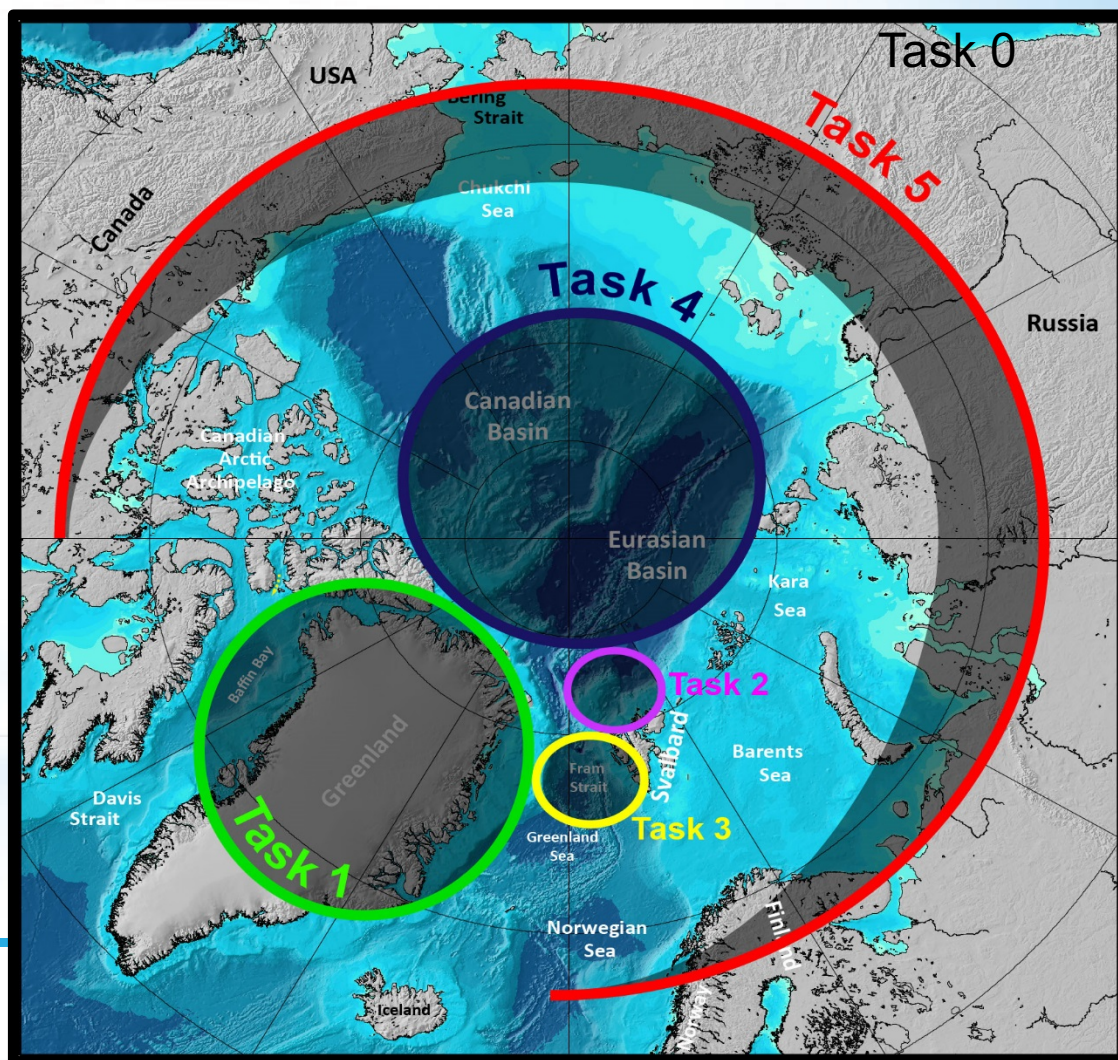
**Main goal: Improving and unifying existing Arctic Observation systems**

Stein Sandven (leader),  
Nansen Centre, Bergen, Norway  
+ 49 partners in 20 countries

INTAROS will work in:

- Coastal Greenland
- North of Svalbard
- Fram Strait
- The central Arctic Ocean
- Selected sites across the Arctic land areas

<http://www.intaros.eu/>

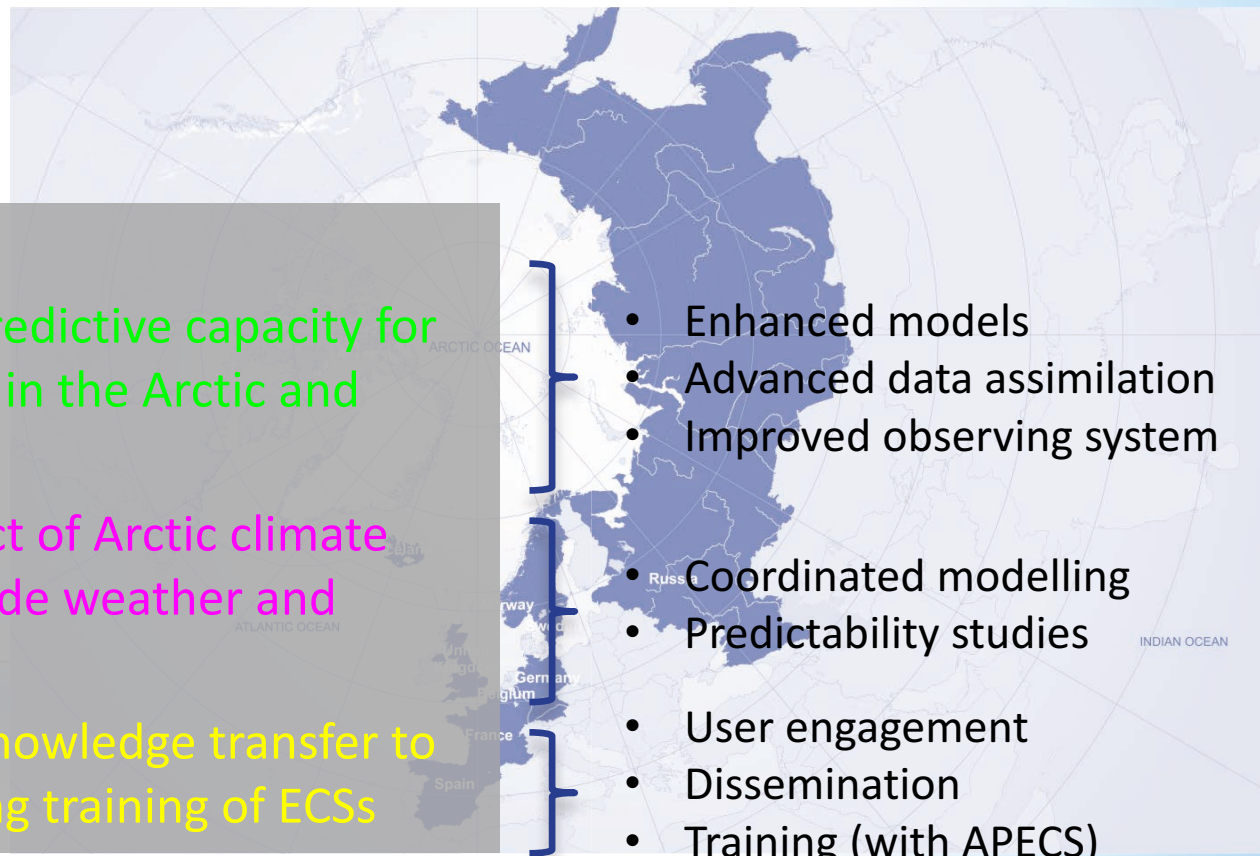




# APPLICATE (2016 – 2020) € 8 mill

**Advanced Prediction in Polar regions and beyond: modelling, observing system design and Linkages associated with a Changing Arctic climaTE**

Thomas Jung (leader),  
AWI, Germany  
+ 16 partners in 9 countries



APPLICATE will:

- Develop advanced predictive capacity for weather and climate in the Arctic and beyond
  - Determine the impact of Arctic climate change on mid-latitude weather and climate
  - Carry out effective knowledge transfer to stakeholders including training of ECSs
- Enhanced models
  - Advanced data assimilation
  - Improved observing system
  - Coordinated modelling
  - Predictability studies
  - User engagement
  - Dissemination
  - Training (with APECS)

# Blue-Action (2016 – 2020) € 7.5 mill

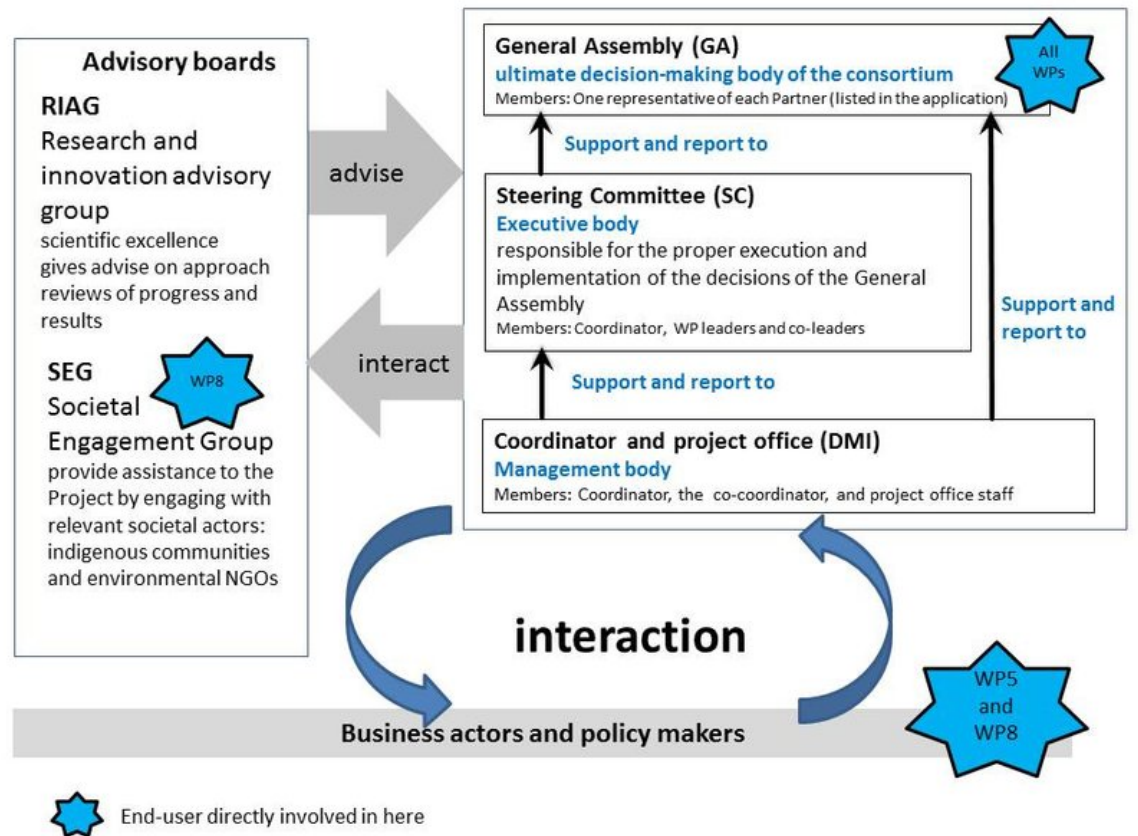
**Main goal: Quantify the role of a changing Arctic in predictive capability of weather and climate of the Northern Hemisphere**

Steffen M. Olsen (leader)  
Danish Met Office (DMI)  
+ 40 partners in 17 countries

Will cover:

- Extreme Events
- Model Improvements
- Coordinated Experiments
- Climate Service

<http://www.blueaction.eu/>



- Sustain an **on-going dialogue** with the European Commission on Polar topics
- Develop an integrated **European polar research programme** co-designed with all relevant stakeholders

**Report on prioritised objectives finalized in July 2016**

**Example “Key Question”:**

**What are the key ocean-atmosphere-ice-land interactions?**

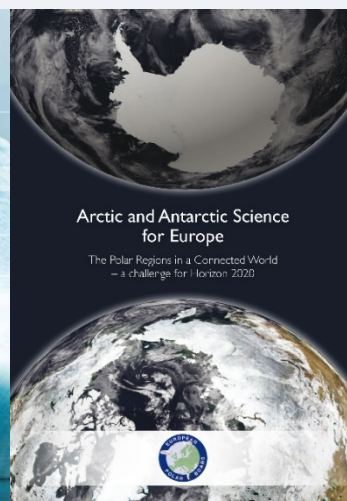
- Design a resource-oriented European **infrastructure access and usage plan**
- Improve and strengthen **international cooperation** and implement the **Transatlantic Research Alliance**





## White Papers by selected experts:

- **Formulate** urgent polar research questions for:  
**1) People 2) Climate and cryosphere 3) Sustainable management 4) Polar Biodiversity 5) New technologies**
- **Co-created** by stakeholders and scientific experts during a five day **Workshop in Madrid - October 2017.**
- **Nomination of experts** is ongoing.



# Key Arctic topics for the future:

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- *How rapidly will Arctic sea ice decline in the future?*
- *What long-term observations are essential for future predictions?*
- *What are the impacts of Arctic climate change – both locally and globally?*
- *How can we best advance environmental prediction capabilities?*

- Arctic ECRA is a network of leading climate research institutions and operational centres in Europe
- Arctic ECRA has been very active since 2012  
(documents, meetings, applications, ....)
- Arctic ECRA has attained a high level of visibility
- A new phase => 2020
  - work is happening in EU-PolarNet and in the three main projects (INTAROS, APPLICATE & Blue-Action).





# Our strengths...

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- Breadth of expertise including observations, modelling, theory and logistics
- Leading role in various national and international committees
- Flexible and responsive to new ideas
- Access to large-scale infrastructures (research icebreaker, polar stations, aircraft, HPC facilities ...)
- Availability of some of the most advanced regional and global earth system models

# Our mission...

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## **Mission statement:**

*Advancing Arctic climate research in Europe for the benefit of society...*

... through

- international cooperation (e.g. shared infrastructure),
- Identification of key topics (research priorities), and
- providing advice (policy makers, funding agencies...)



# Selected activities...

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- Arctic ECRA workshops (4 since 2012)
- Arctic ECRA documents
  - Briefing documents
  - Strategy and Work Plan
- High-level side events
- Parliamentary lunchtime events
- General Assemblies
- Organisation and co-sponsoring of conferences and meetings

# Who we are...

25 participating institutions from 10 European countries

Denmark			Finland		FINNISH METEOROLOGICAL INSTITUTE			
France			EUROPEAN POLAR BOARD					
Germany			KIT Karlsruher Institut für Technologie	Italy		National Research Council of Italy		Italian National Agency for New Technologies, Energy and Sustainable Economic Development
Norway			HAVFORSKNINGSINSTITUTTET INSTITUTE OF MARINE RESEARCH			NORSK-POLARINSTITUTT		UNIVERSITÄT BERGEN
Sweden		The Netherlands			Royal Netherlands Meteorological Institute Ministry of Infrastructure and the Environment			
United Kingdom		British Antarctic Survey		UNIVERSITY OF CAMBRIDGE		National Centre for Atmospheric Science NATURAL ENVIRONMENT RESEARCH COUNCIL		University of Reading



International workshop on *Polar-lower latitude linkages and their role in weather and climate prediction*. 10-12 December 2014, Barcelona; Spain



# What we do...

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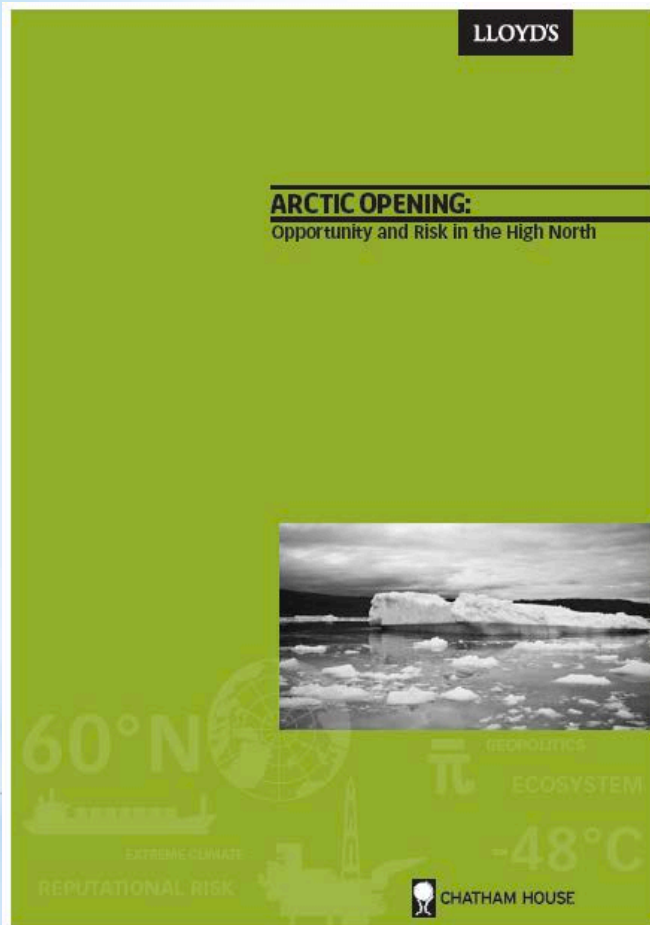
- Arctic ECRA workshops (4 since 2012)
- Arctic ECRA documents
  - Briefing documents
  - Strategy and Work Plan
- High-level side events
- Parliamentary lunchtime events
- Organisation and co-sponsoring of conferences and meetings
- Contribution to the implementation of the Galyway statement ➔ Coordination of the theme *Arctic-Atlantic interplay*

# Scientific key-questions

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- Why is Arctic sea ice declining so rapidly?
- What are the local and global consequences of Arctic climate change?
- How can polar prediction capabilities be improved?

# Local consequences



18	<b>2. Opportunity and uncertainty: Charting the Arctic's economic and political future</b>
19	2.1 Arctic mineral resources
19	2.1.1 Arctic oil and gas
26	2.1.2 Mining
27	2.2 Fisheries
29	2.3 Shipping and logistics
31	2.4 Arctic tourism
32	2.5 Arctic politics
32	2.5.1 Who owns what? Who controls what?
33	2.5.2 The geopolitics of Arctic energy
34	2.5.3 Arctic governance

# Traditional knowledge

D-29

## Contributions from TK

- Loss of predictive power of TK for weather forecasting
  - Reported since the 1990s by various indigenous communities across the Arctic (Krupnik and Jolly, 2002)

Even if we try to predict what it is going to be like tomorrow ( ) the environmental indication isn't what the Elders said it would be. Sometimes, it is still true but sometimes it isn't. In the past, when they said, "it's going to be like this tomorrow," it was. But our weather and environment are changing so our knowledge isn't true all the time now.

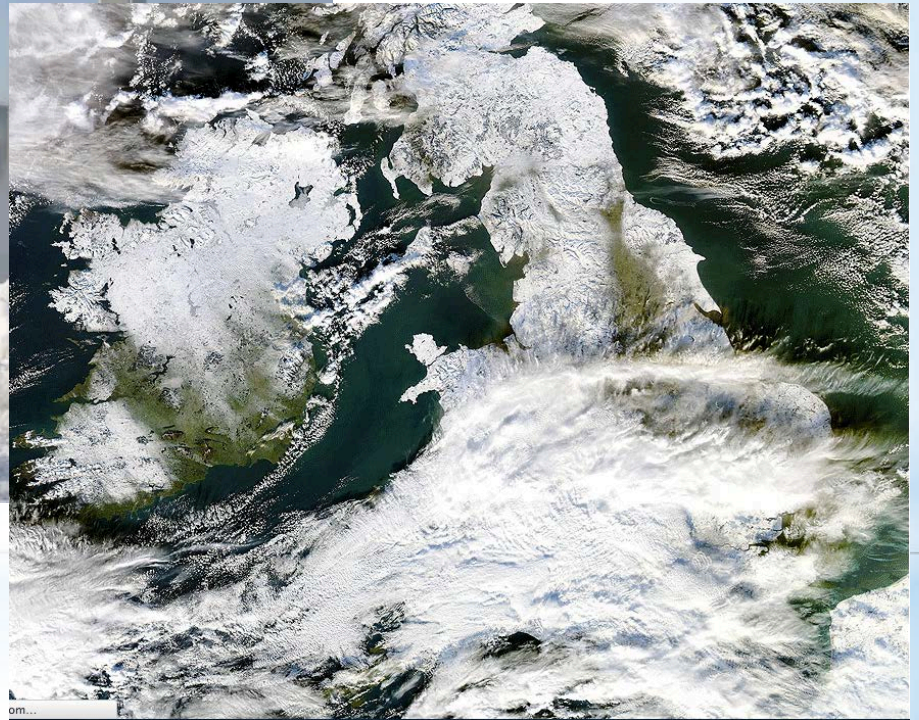
– Lucassie Arrangutainaq, Sanikiluaq, Canada, cited in MacDonald, 1998
  - Is this due to changing weather patterns or the erosion of indigenous forecasting skills?
  - TK observations consistent with recent scientific findings
    - Spring (June) as time of year most frequently cited by Inuit as increasingly unpredictable
    - Over the last 20 years, temperature persistence has dropped during spring in Baker Lake, Canada, implying more chaotic daily variability (Weatherhead et al., 2010)
  - Some indigenous experts becoming reluctant to use their prediction skills + take additional precautions

Slide from Dominique Henri, Environnement and Climate Change Canada

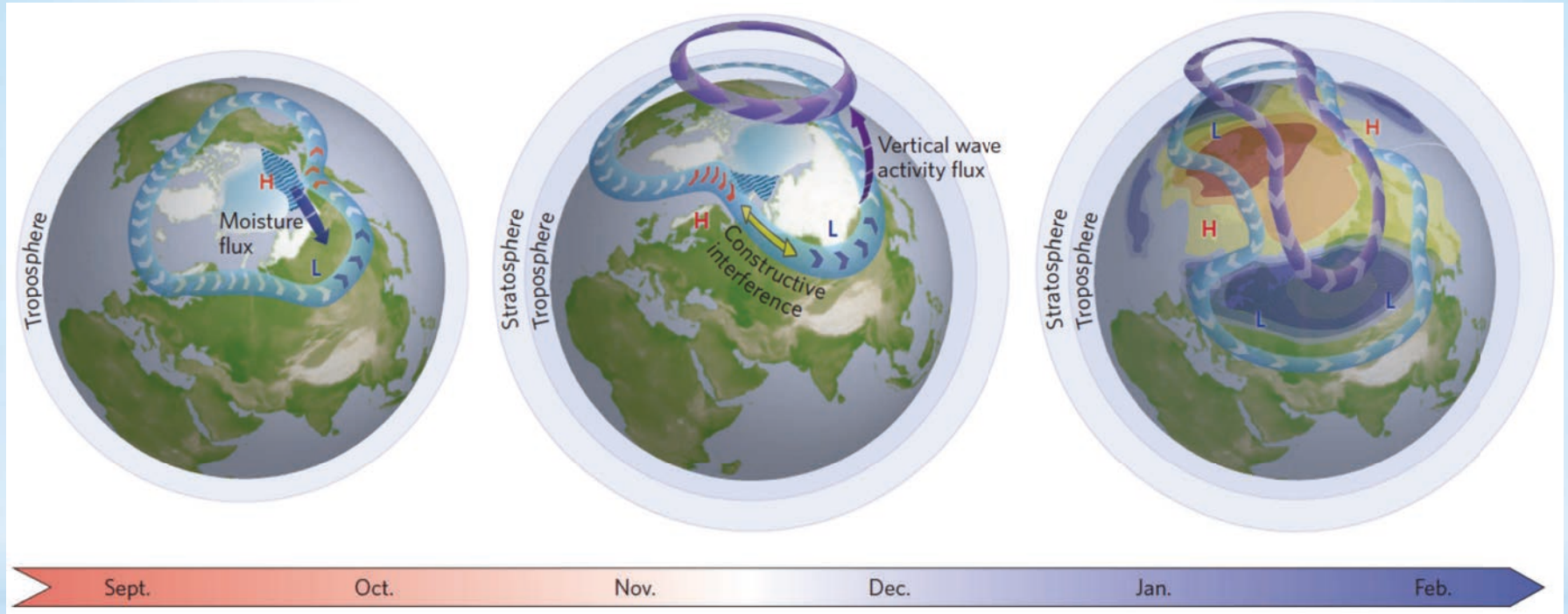


# Remote consequences

„What happens at the poles does not stay at the poles...”



# Can it? Has it? Will it?



Cohen et al. (2014), Nature Geoscience



# Sea ice prediction



Tactical use

Operation planning

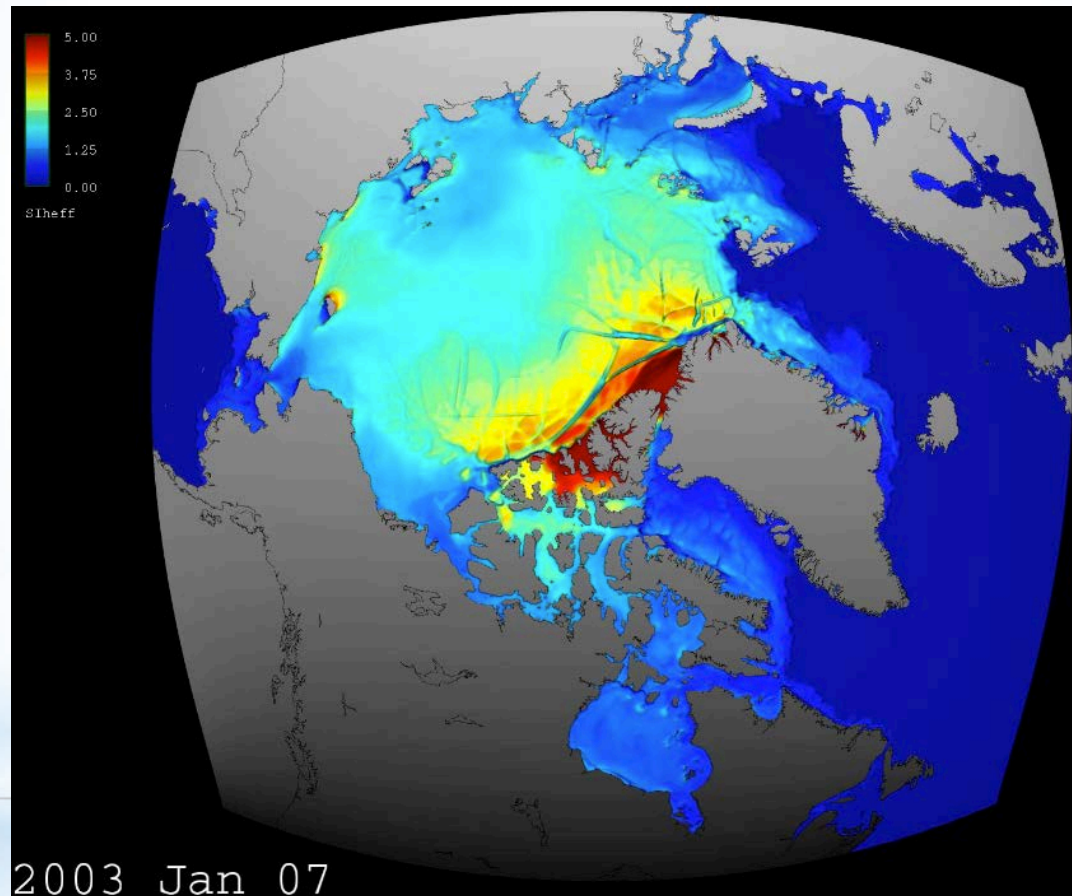
Strategic planning

Hours to 2 weeks

subseasonal to interannual

decades

# Sea ice prediction

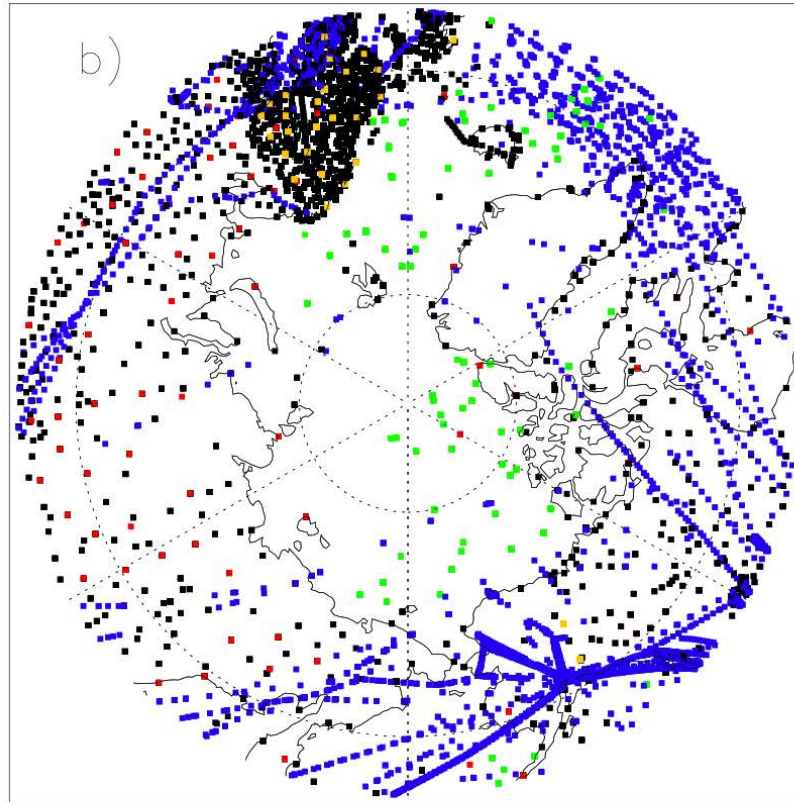


MITgcm @ 4 km resolution, Nguyen et al. (2012)



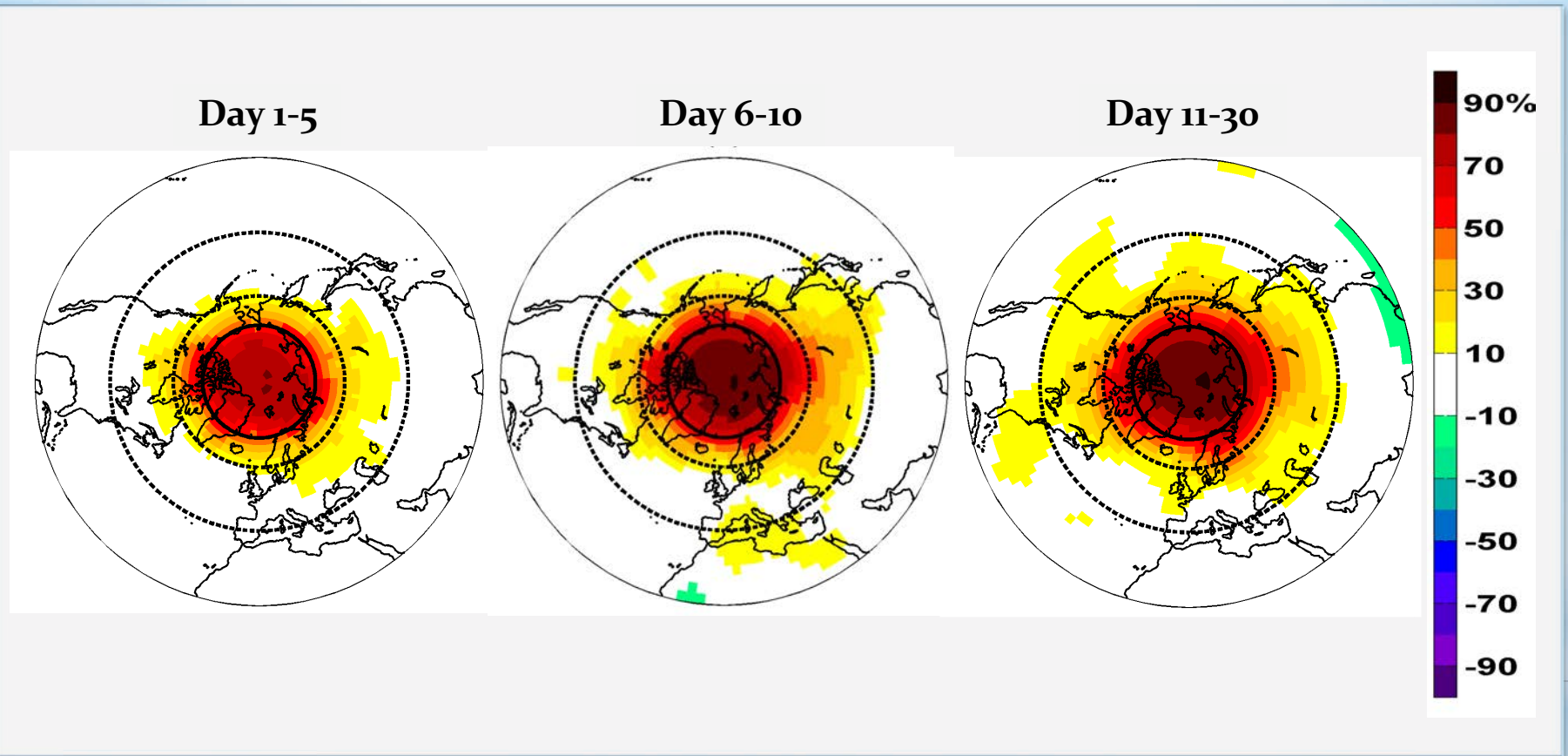
# Global observing system

Synop  
AIREP  
DRIBU  
TEMP  
PILOT



Peter Bauer (ECMWF)

# Arctic-lower latitude linkages



Jung et al. (2014)

# Questions for the Arctic discussion

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- Julianne: Why is this response from CO<sub>2</sub> so linear, when we also see an increased variability?
- Richard: Do you think that Arctic Amplification will continue with the same magnitude in the future? (What about when all the sea ice is gone?)