



EUROPEAN POLAR BOARD

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Photo: Alfred Wegener Institute for Polar and Marine Research

EGU2017
Vienna, 27th April 2017



Polar Change and Implications for Mid-Latitude Weather – Science and Policy for Society in Europe

@EuPolarBoard





Panellists

- **Peter Gibbs** (Chair) – meteorologist and broadcaster
- **Hilppa Gregow** – Finnish Meteorological Institute
- **Len Shaffrey** – University of Reading/National Centre for Atmospheric Science
- **Julienne Stroeve** – University College London (UCL)
- **Tina Swierczynski** – European Climate Research Alliance (ECRA)





Polar Change and Implications for Mid-Latitude Weather – Science and Policy for Society in Europe





National Snow and Ice Data Center
Supporting Cryospheric Research Since 1976



Rapid transformation of the polar regions

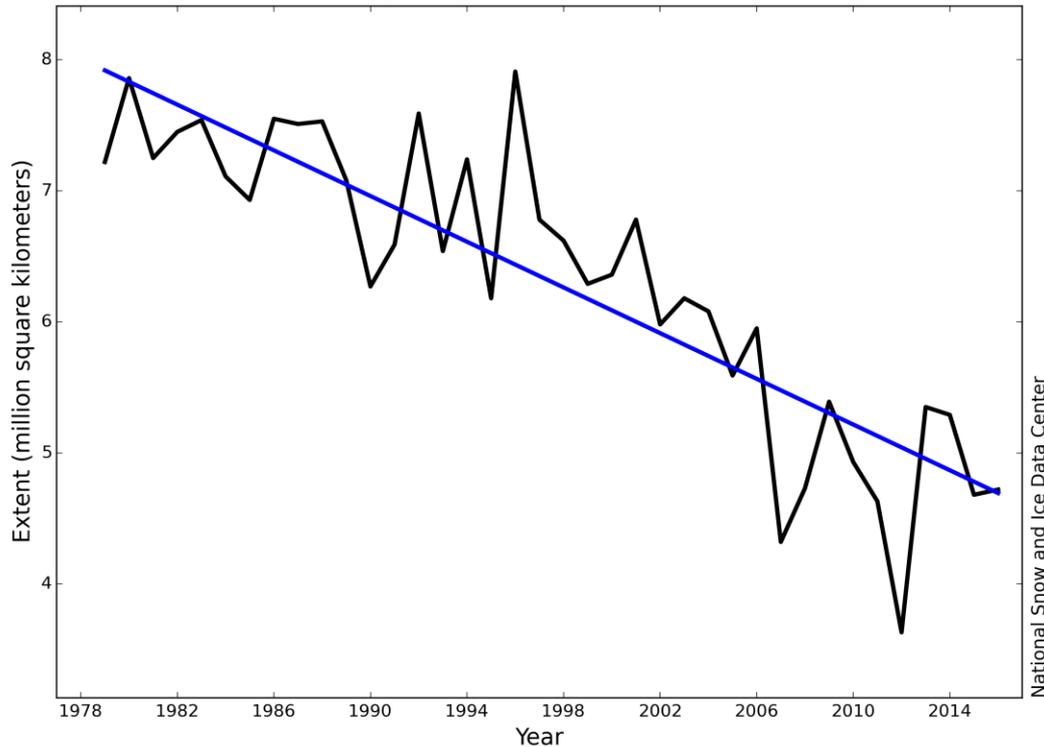
Julienne Stroeve



The shrinking summer sea ice cover

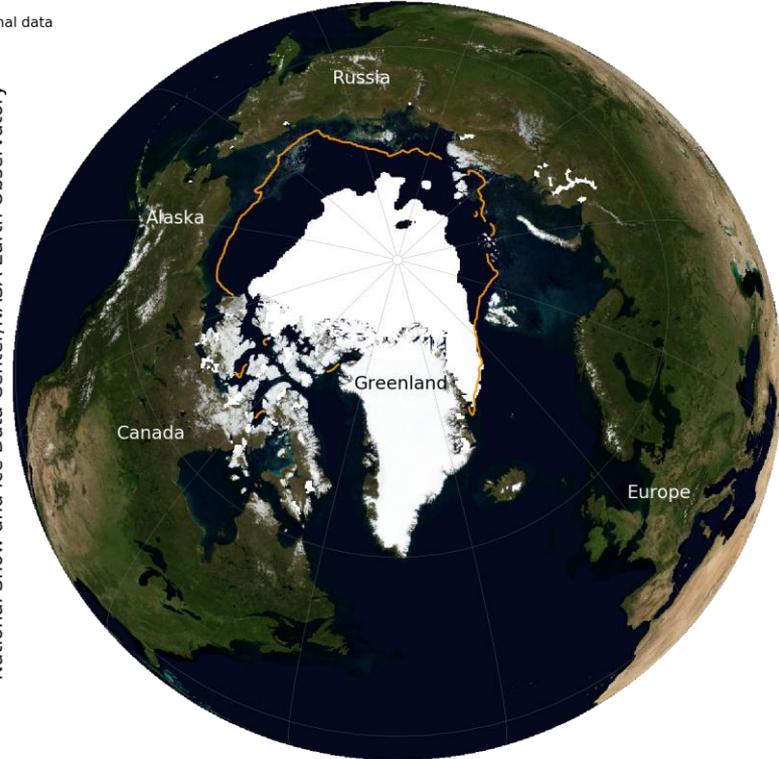
September 16 2012

Average Monthly Arctic Sea Ice Extent
September 1979 - 2016



final data

National Snow and Ice Data Center/
National Snow and Ice Data Center/NASA Earth Observatory



16 September 2012

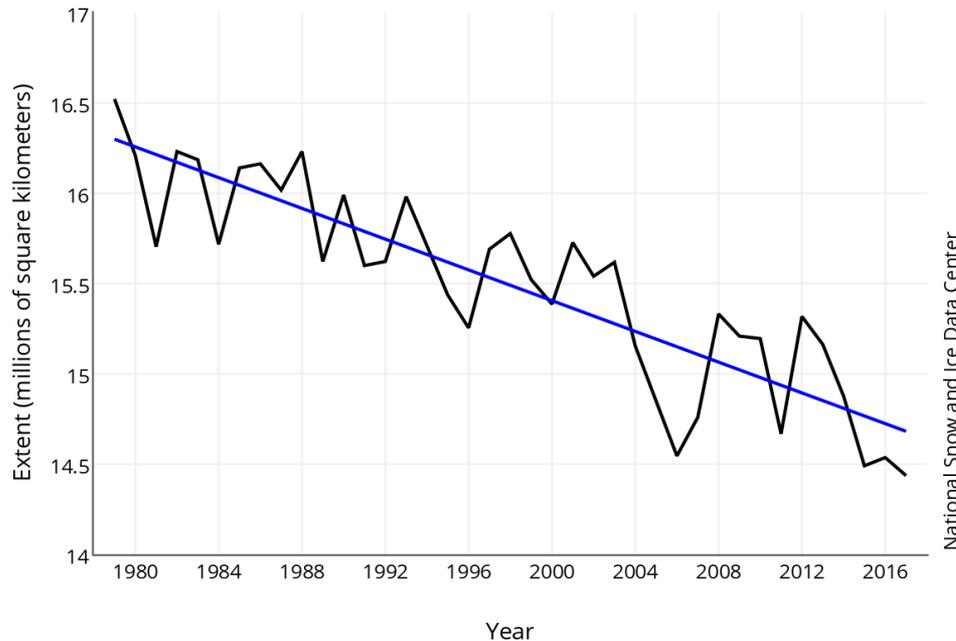
■ median ice edge 1981-2010

- Rate of summer decline is $-87,000 \text{ km}^2/\text{yr}$ in September ($-13.8\%/\text{decade}$).

Ice loss in winter is less, but remains significant

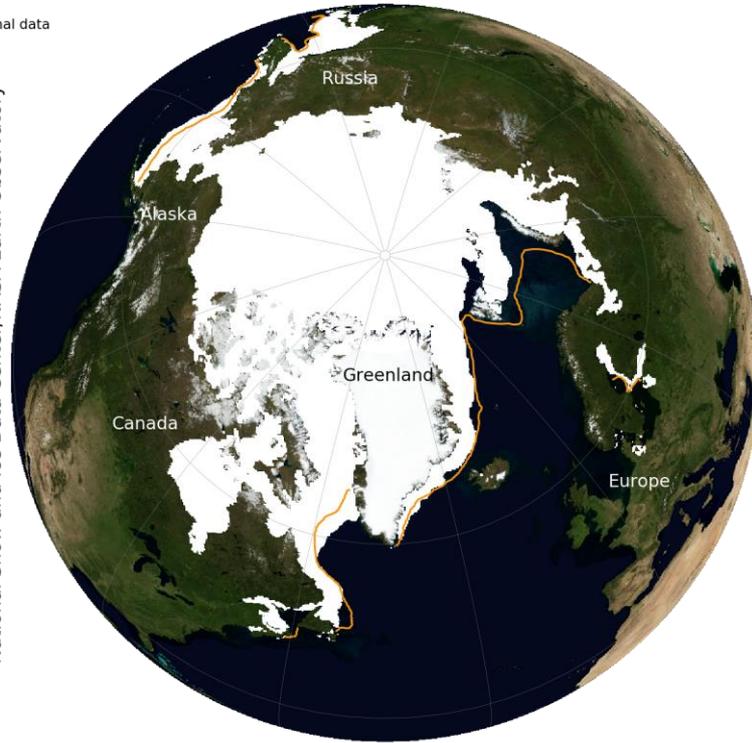
March 7 2017

Average Monthly Arctic Sea Ice Extent
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National Snow and Ice Data Center/NASA Earth Observatory



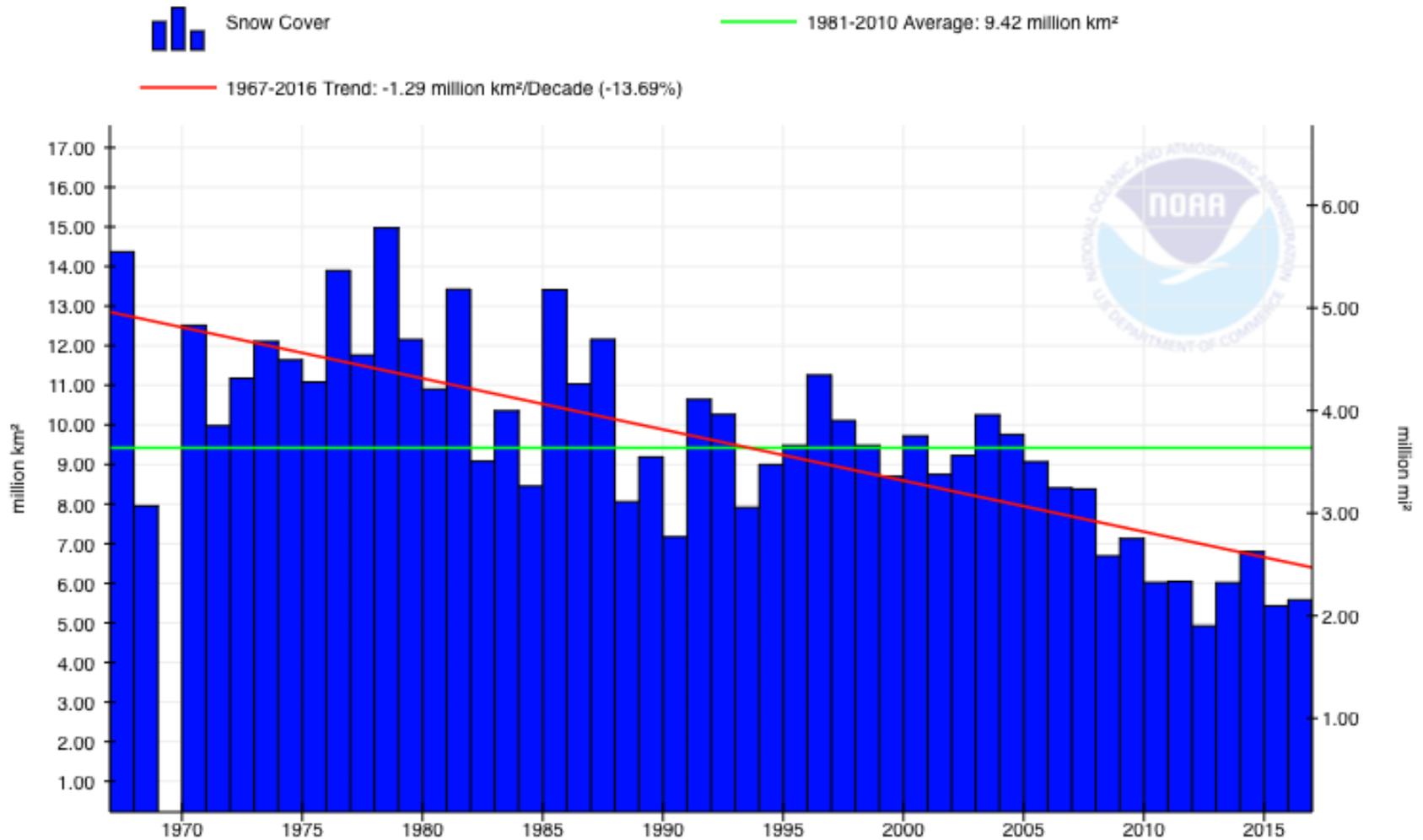
07 March 2012

median ice edge 1981-2010

- Rate of winter decline is $-43,000 \text{ km}^2/\text{yr}$ or $-2.8\%/\text{decade}$.
- 2017 is the lowest winter maximum on record, followed previous record lowest maximum in 2015 and 2016.

Snow cover is also declining

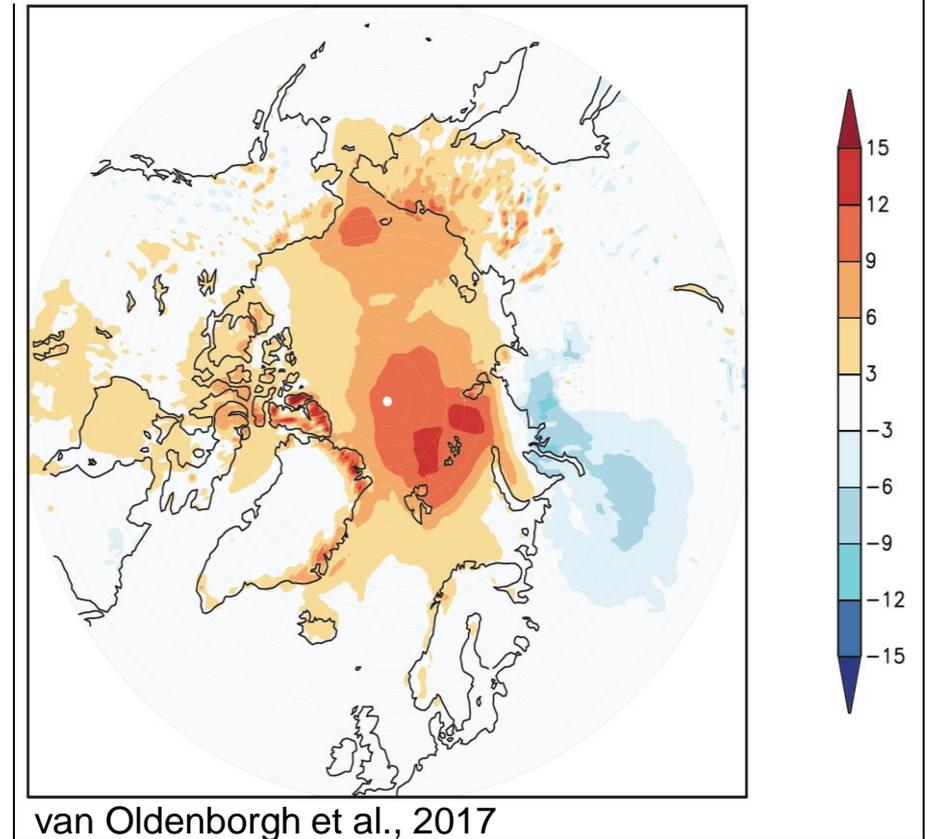
June Northern Hemisphere Snow Cover Extent (1967-2016)



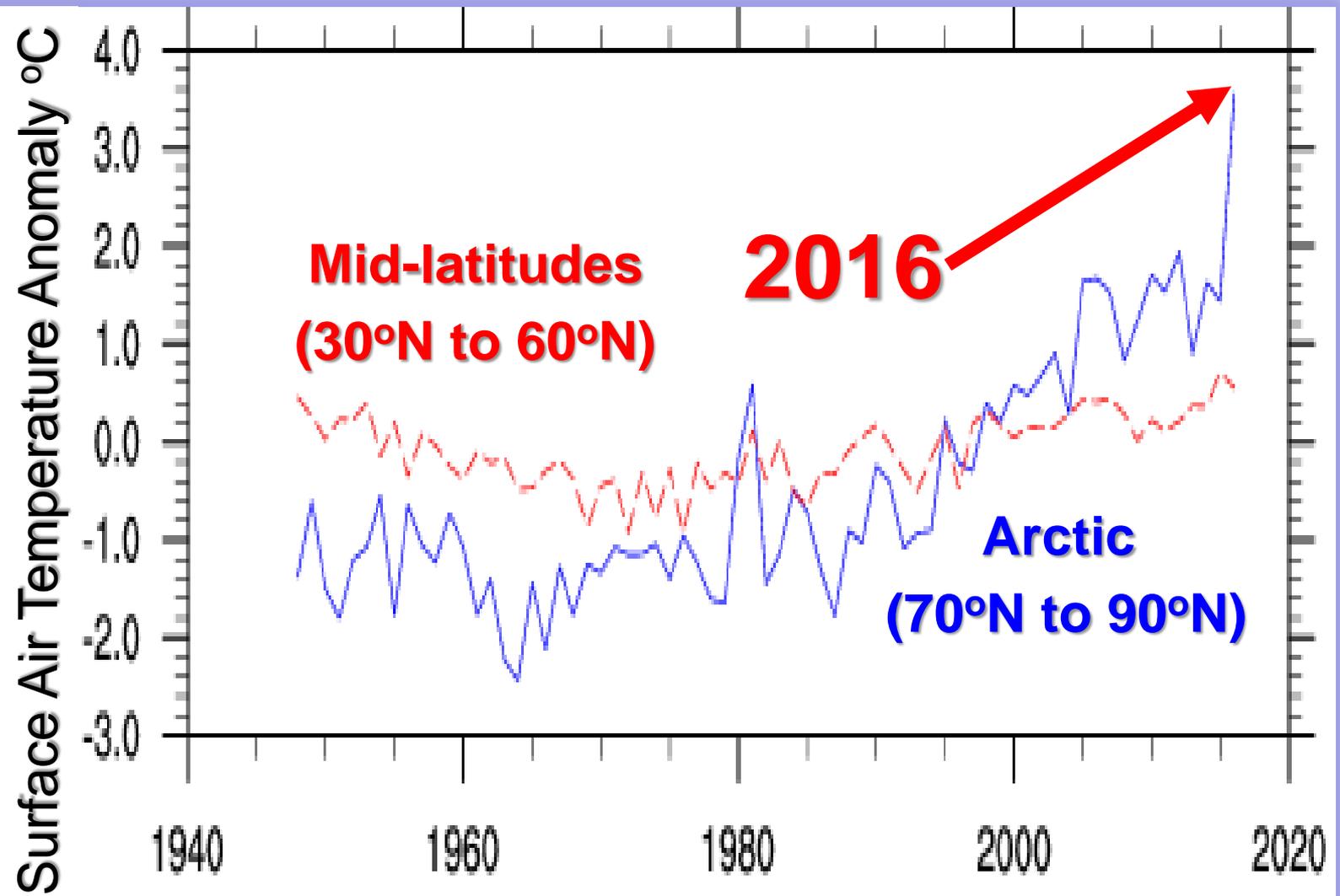
Importance of the ice-albedo feedback

- Snow and ice have high albedos, reflecting much of the incoming solar radiation back out to space.
- A loss of snow and sea ice translates into more surface warming that can feedback on atmospheric warming and changes in atmospheric circulation.

Nov-Dec T2m anomaly ECMWF analyses – ERA-I (1981-2010)

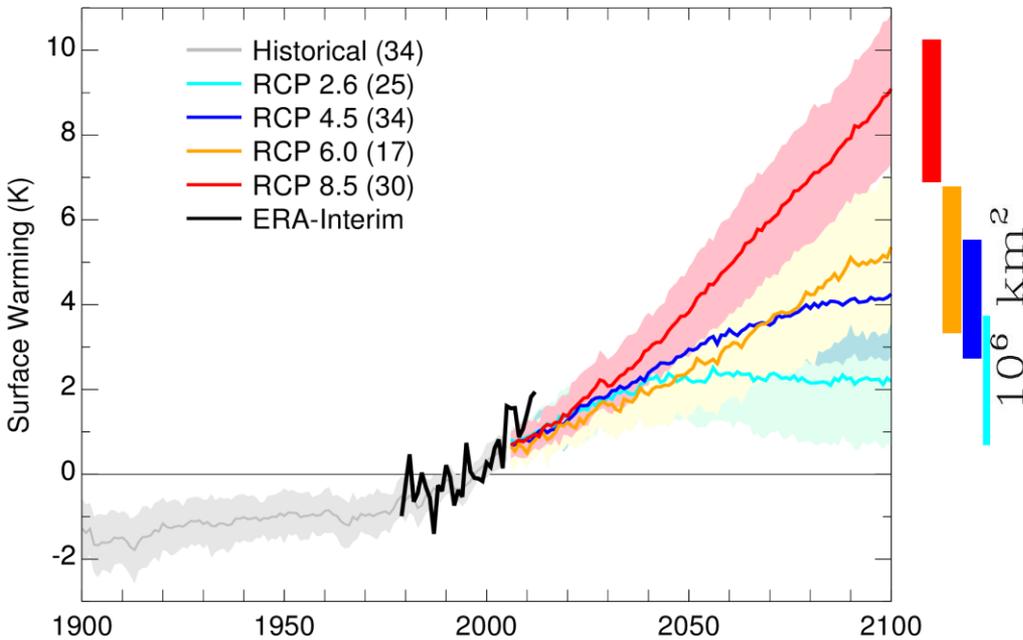


Amplified Arctic warming

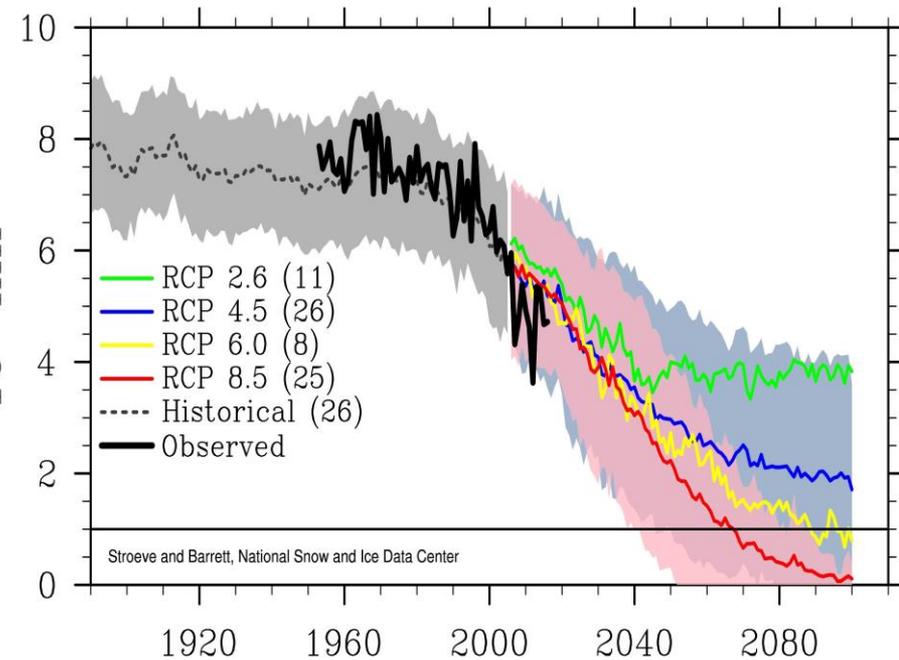


Sea ice will continue to decline as the planet warms

Arctic Surface Warming



Arctic September Sea Ice Extent



Impacts for Europe?

- Sea ice loss and associated Arctic warming contribute to:
 - Ice sheet/glacial melt and therefore sea level rise;
 - Fisheries/marine food-web;
 - Shipping and resource extraction;
 - Increased global warming through feedbacks;
 - Changes in large-scale ocean and atmospheric circulation with impacts on precipitation, frequency of extreme weather events.



Polar Mid-Latitude Links

A modelling perspective

Len Shaffrey
National Centre for Atmospheric Science
Department of Meteorology
University of Reading



Why do we need models?

Understanding – Is the recent loss of Arctic sea ice loss having an impact on the mid-latitude atmospheric and extreme events?

Prediction – When will the Arctic become sea ice free in summer? Will the large uncertainty in Arctic projections affect projections of mid-latitude weather?



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Hierarchy of models:

- Coupled climate models
- Atmosphere-only models
- Intermediate complexity models
- Idealised models
- Theories and mechanisms

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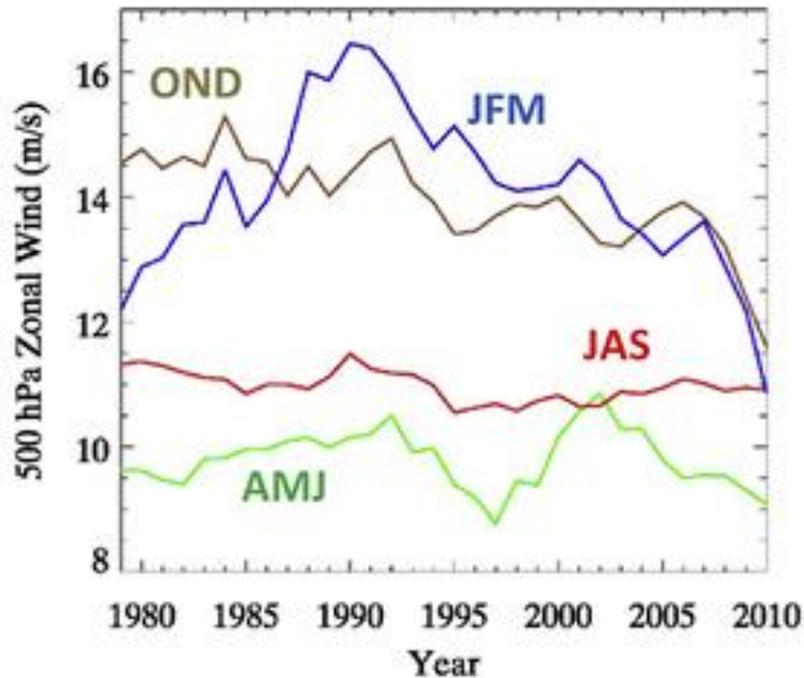
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Arctic sea ice loss: observations

Is the recent loss of Arctic sea ice loss having an impact on the mid-latitude atmosphere and extreme events?

Some observational evidence that *there is an impact...*



Time series of 500hPa zonal winds averaged over 140W-0, 60-40N, Francis and Vavrus (2012)

Weakening of 500hPa zonal winds in OND (October to December)

Also Liu et al (2012), Tang et al (2013),...

Arctic sea ice loss: observations

Is the recent loss of Arctic sea ice loss having an impact on the mid-latitude atmosphere and extreme events?

Some observational evidence that *there is an impact*...and some observational evidence that *there isn't an impact*.

Geophysical Research Letters

RESEARCH LETTER

10.1002/2013GL058745

Exploring recent trends in Northern Hemisphere blocking

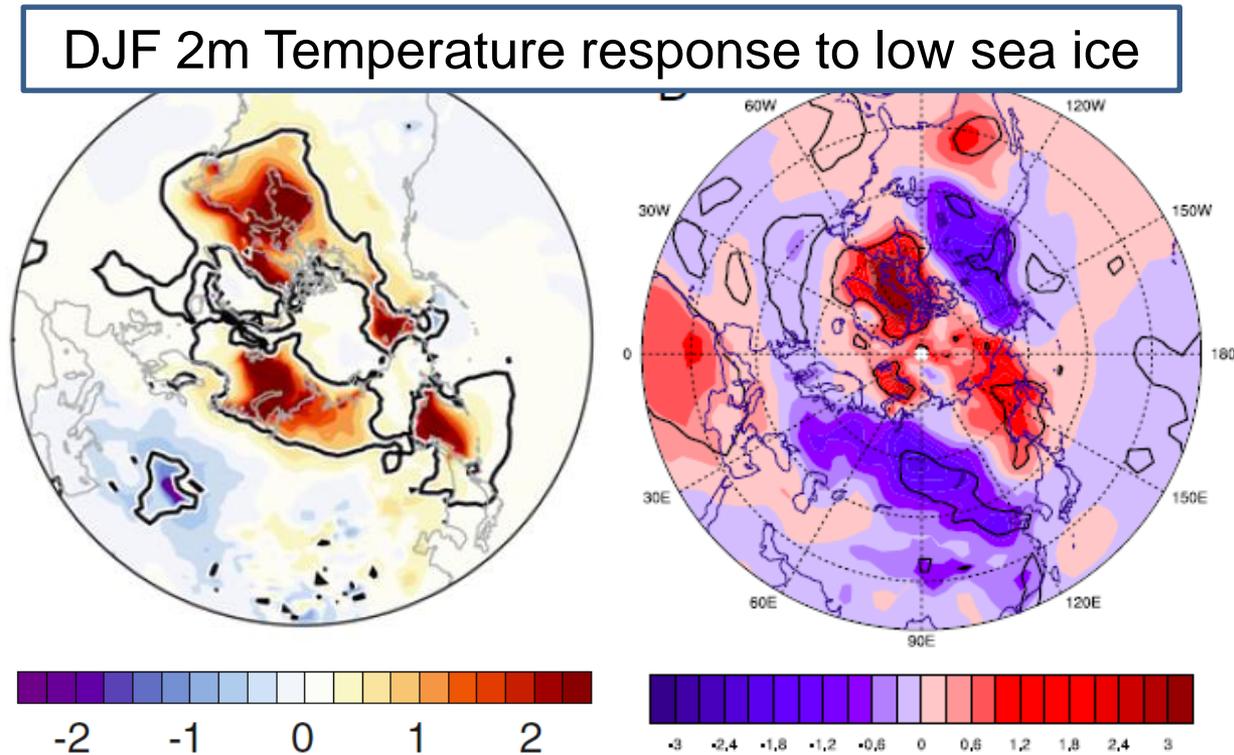
Elizabeth A. Barnes¹, Etienne Dunn-Sigouin², Giacomo Masato³, and Tim Woollings⁴

See also Barnes (2013), Screen and Simmonds (2013)...

Issues: Short observational records; different metrics; large variability in mid-latitudes; correlation is not causation; etc.

Arctic sea ice loss: models

Large spread in atmospheric responses to Arctic sea ice in models

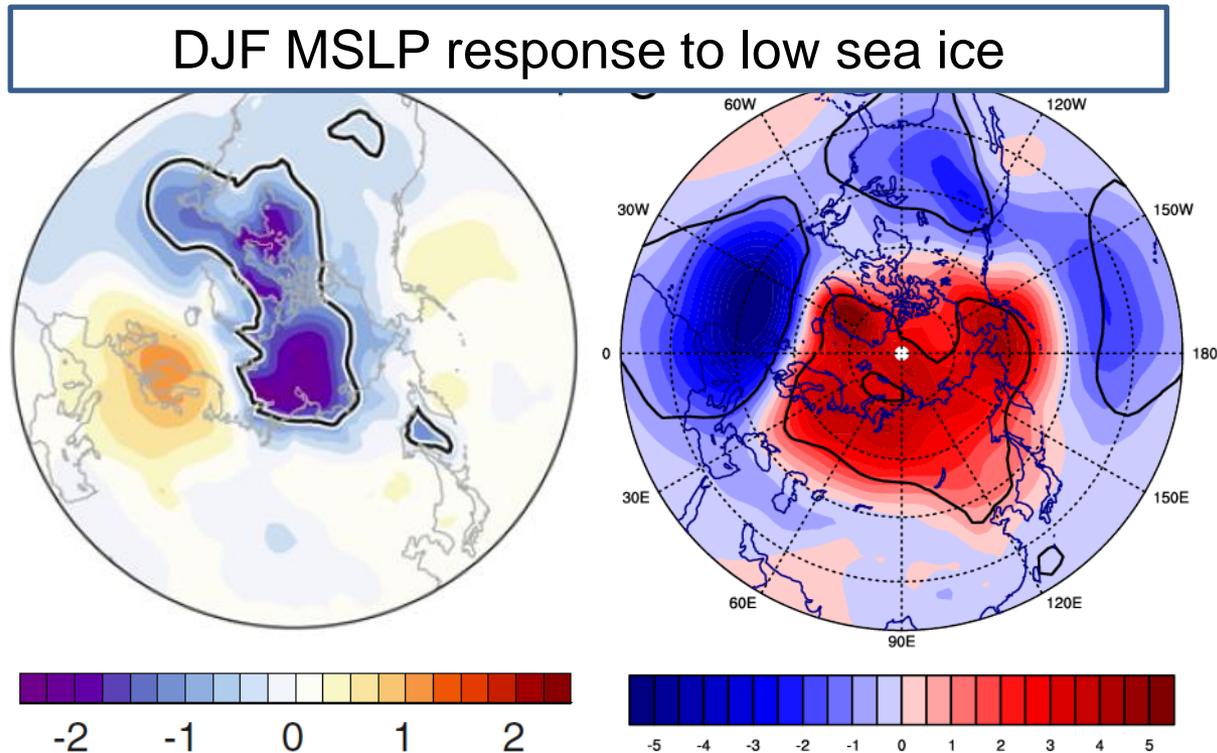


HadGEM2 Screen et al. (2014) **CAM3.1** Liu et al. (2012)

See Cohen et al. (2014) review

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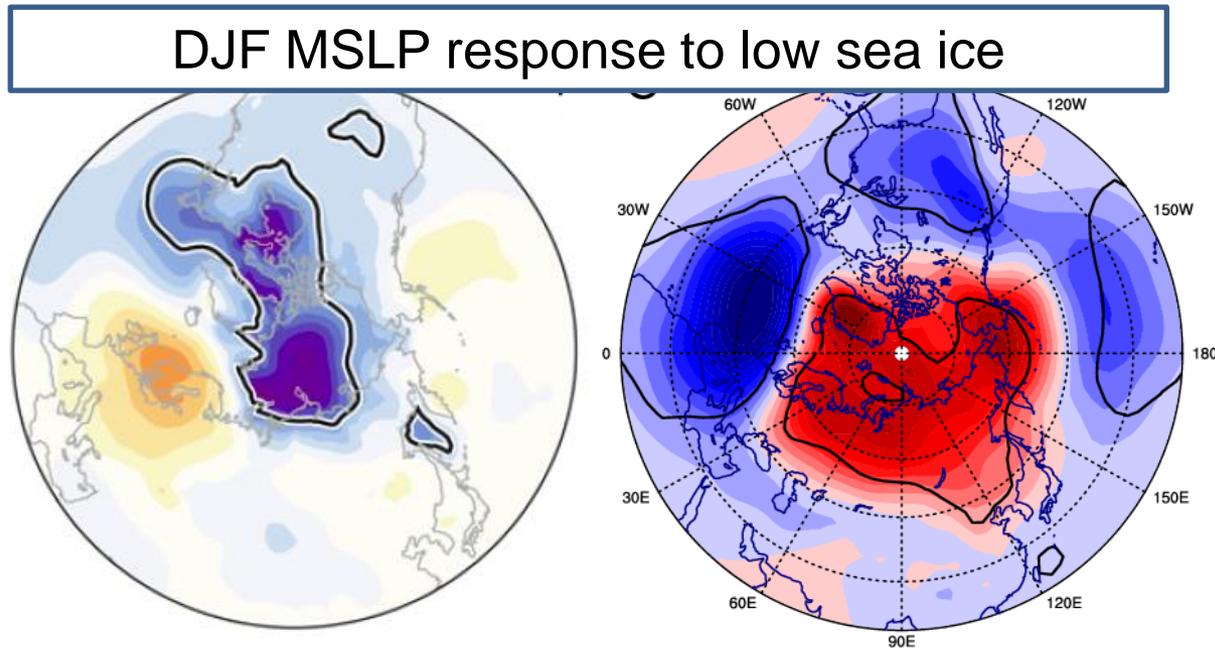


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Arctic sea ice loss: models

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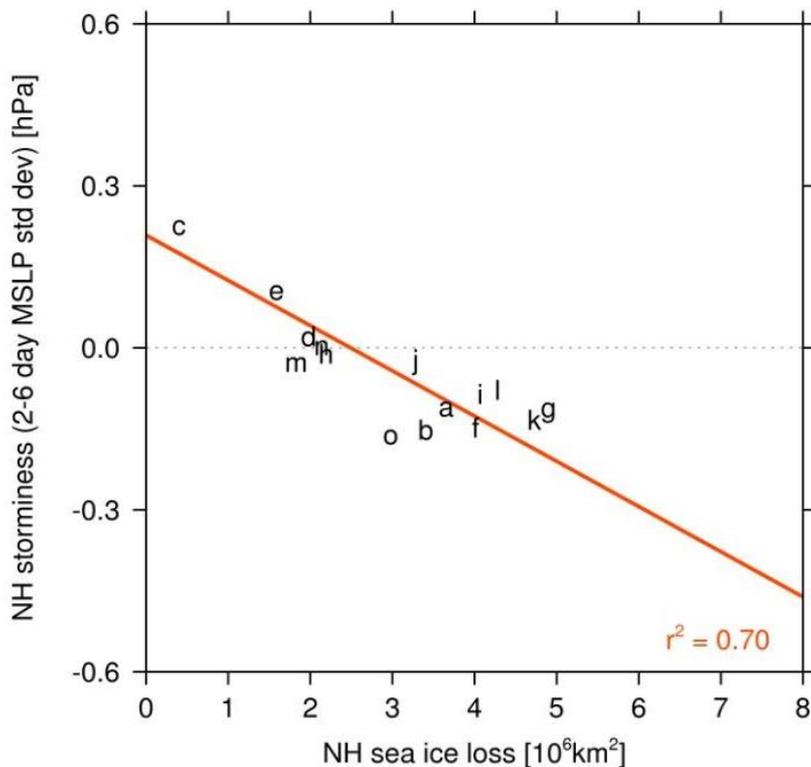


Issues: Different experimental designs, nonlinear responses to ice loss, model biases, etc...

See Cohen et al. (2014) review

Climate change and sea ice loss

Large spread in projected CMIP5 Arctic sea ice loss can lead to the large spread in projections of some mid-latitude circulation metrics.



CMIP5 (RPC8.5-HIST) DJF NH storm track response against DJF Arctic sea ice, Harvey et al. (2014)

More sea ice lost and warmer poles leads to reduced equator-to-pole temperature gradient and weaker NH storminess.

Also Cattiaux et al. (2013), Harvey et al (2015), Barnes & Polvani (2015), Kennedy et al. (2016)

Making progress

Horizon 2020 projects

- APPLICATE, Blue Action, INTAROS

Improved climate models:

- New observations (e.g. YOPP, MOSAiC, satellites, etc.)
- Improved climate model components (new sea ice models, higher resolution ocean models, etc.)

Renewed focus on mechanisms

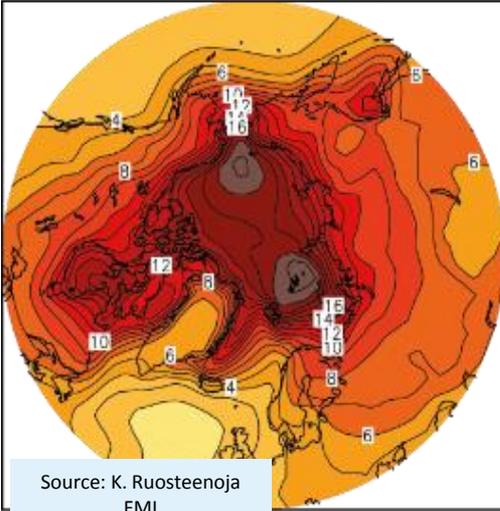
- Thermal wind balance, planetary waves, strat-tropospheric interactions and quasi-resonance, etc.
- Bridging the gap in the model hierarchy

New co-ordinated model experiments

- Proposed Polar Amplification Model Intercomparison

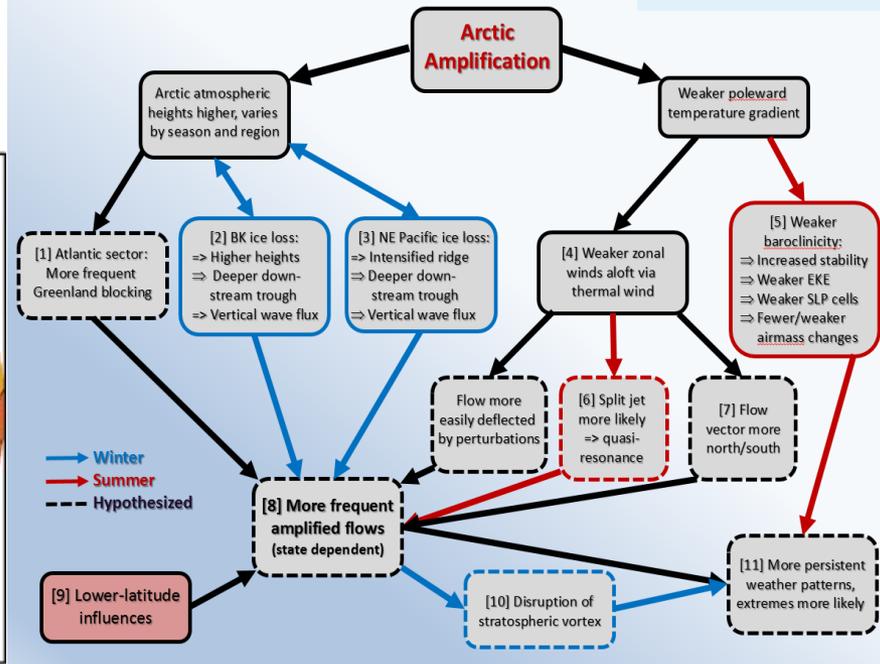


Tmean, Dec-Feb, RCP8.5, 2070-2099

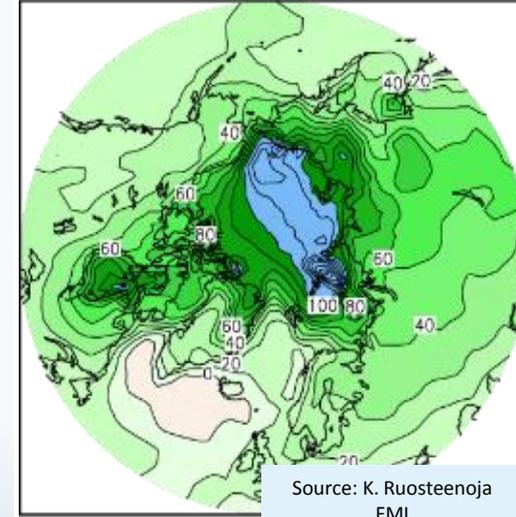


Source: K. Ruosteenoja
FMI

Source: T. Vihma FMI



Prec, Dec-Feb, RCP8.5, 2070-2099



Source: K. Ruosteenoja
FMI

Understanding climate and weather risks associated with polar change

EGU 27.4.2017
Hilppa Gregow et al.

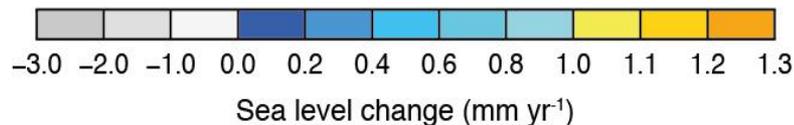
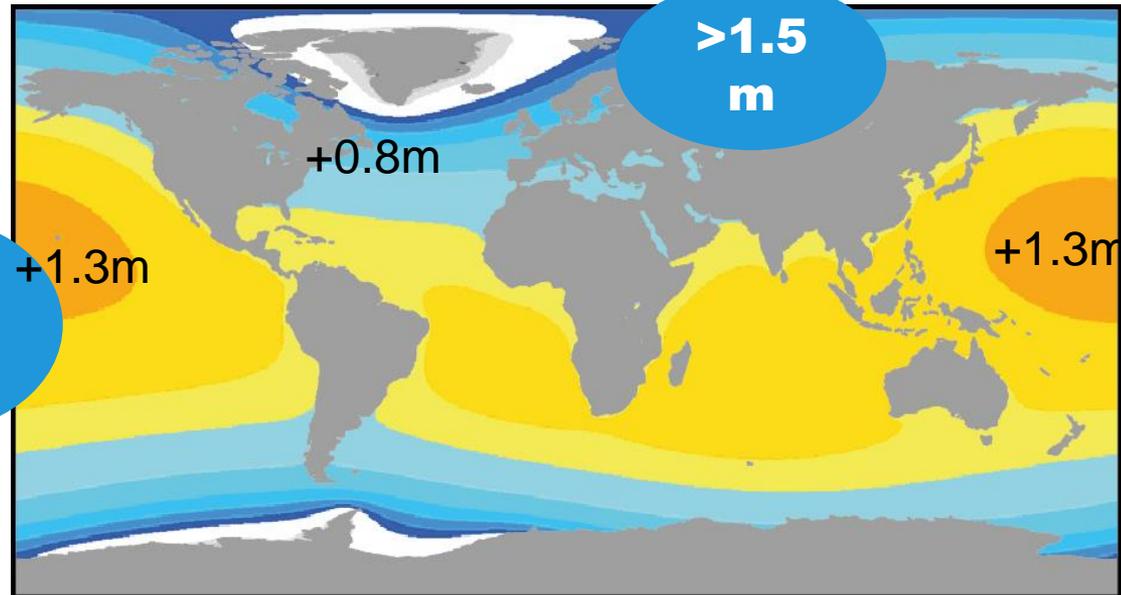


Antarctic sea ice melt lifts especially Northern Hemispheric sea surfaces

- According to DeConto et al. 2016 Antarctic ice shelves can break faster than earlier projected => **+1 meter more by 2100**

Tropics would have a dramatic impact. The sea level rise could be

>2.5 m

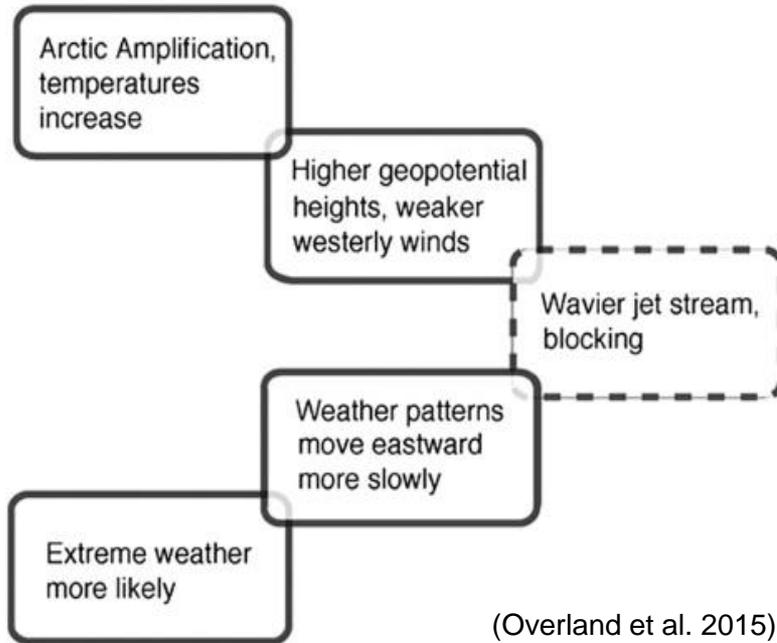


*) DeConto, R.M. and D. Pollard, 2016. Contribution of Antarctica to past and future sea-level rise. *Nature* 531 (7596), 591–597.

OLDER KNOWLEDGE IPCC AR5, Fig. FAQ13.1-2: expected sea level rise if the poles melt 0.5mm/year



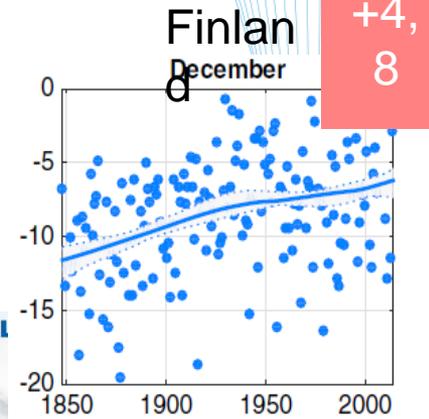
Arctic amplification means faster impacts of climate change



(Overland et al. 2015)

FIG. 2. Hypothesized steps linking Arctic amplification with extreme weather events in Northern Hemisphere midlatitudes.

DOI: <http://dx.doi.org/10.1175/JCLI-D-14-00822.1>

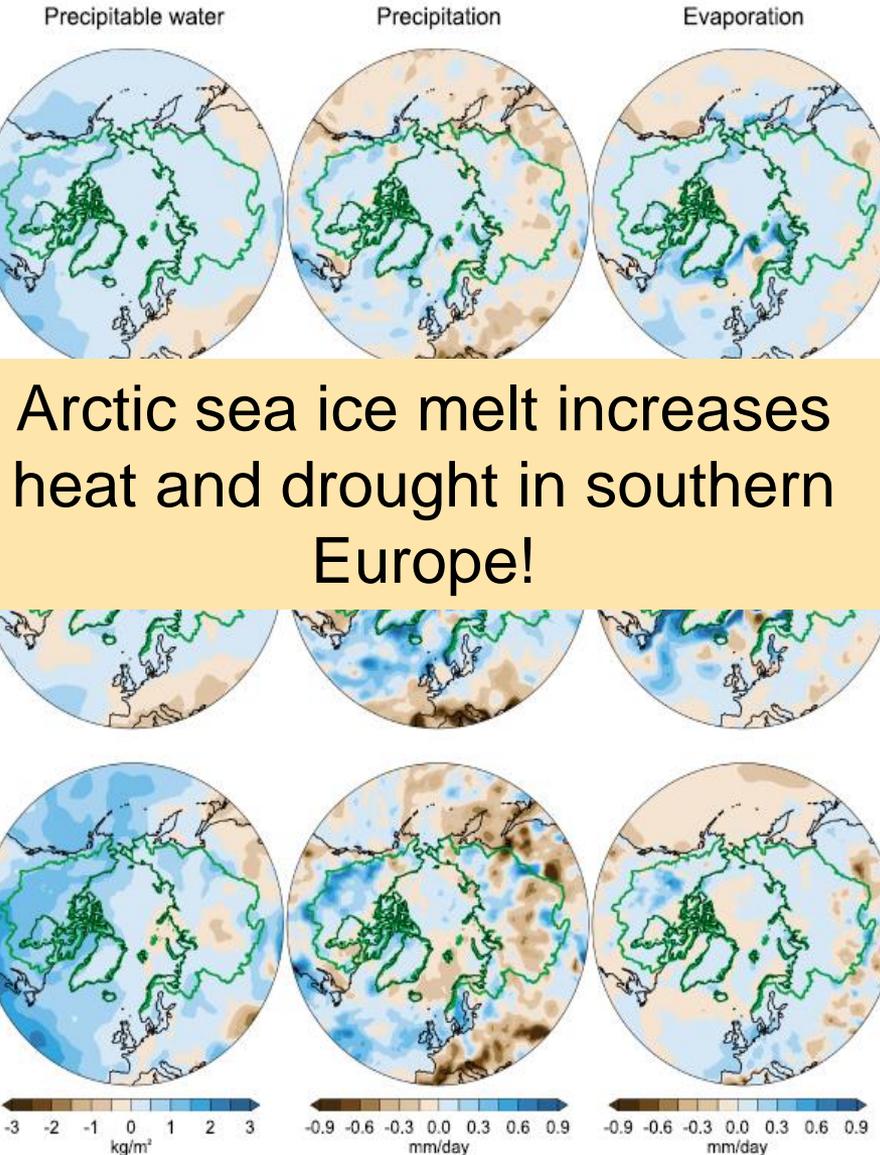


(Mikkonen et al. 2015)

DOI: [10.1007/s00477-014-0992-2](https://doi.org/10.1007/s00477-014-0992-2)

• According to Overland et al. 2015: “Warming causes loss of sea ice in the Arctic but the potential connections to Europe are less clear.”

According to
Vihma
et al. 2016:



Timo Vihma, James Screen, Michael Tjernström, Brandi Newton, Xiangdong Zhang, Valeria Popova, Clara Deser, Marika Holland, and Terry Prowse. 2016 The atmospheric role in the Arctic water cycle: A review on processes, past and future changes, and their impacts

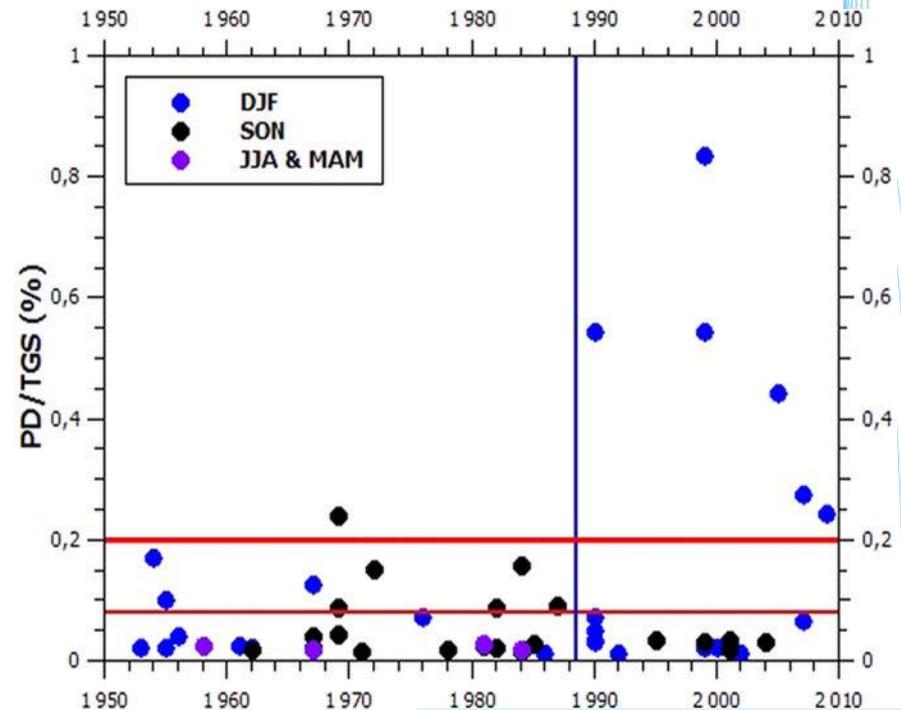
Figure 3. Epoch differences between 1986–2013 and 1958–1985 for precipitable water, precipitation, and evaporation on the basis of JRA-55 reanalysis for annual means, winter (DJF), and summer (JJA). The green lines indicate the boundaries of the Arctic river catchment.



Recent finding: Storm intensity of the catastrophic storms in Europe has increased by a factor of 3.5 (1951-2010)

Gregow et al. 2017* conclude:

1. **A change point in storm intensities has happened already in 1990**
2. NAO is not driving the change in storm intensities.
3. **Arctic amplification can be driver**
4. Research with climate models is needed to understand more.



PD= Forest damage obs

TGS= Total growing stock

Gregow et al. 2017.

<https://www.nature.com/articles/srep46397>

Follow us:

<https://climate.copernicus.eu/data-evaluation-climate-models>

Looking for information on climate change?

Have your say on the development of an easy to use service that offers scientifically sound climate change information!

DECM project is launching a very User-friendly survey by 15.5.2017

Aim of the survey

On behalf of the European Commission, the Copernicus Climate Change Service (C3S, see <https://climate.copernicus.eu>) is developing a Climate Data Store where climate information will become available free of charge for everyone who wants or needs to use state-of-the-art climate model data or climate information products based on this data. *Now it is for you to decide how this service should look like.*

The survey is part of the C3S project "Data Evaluation for Climate Models" (DECM), led by the Finnish Meteorological Institute. We are looking for your opinion, your expertise, and your needs regarding climate model data and information products that are based on this data.

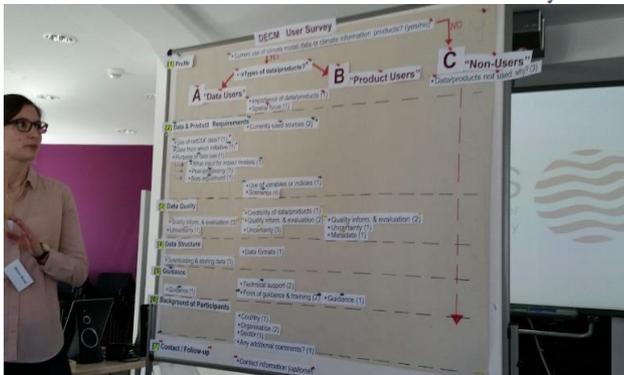
Data protection

The responses to the survey are confidential. The collected data will be stored and processed in accordance with data protection laws and retained by the European Centre for Medium-range Weather Forecasts (ECMWF) on behalf of the Copernicus Climate Change Service.

Completing the survey

This survey takes approximately 15 minutes to complete. Throughout the survey, please respond to all questions with respect to *climate model data and information products related to climate change*. Please answer on behalf of your individual role within your organisation or company. Proceed through the survey by using the arrows at the bottom of each page. Please work through the survey in one session as there is no opportunity to interrupt the survey and continue at a later date.

Thank you for taking the time to share your thoughts on the requirements applicable to the Climate Data Store.





Polar change speeds up the occurrence of extremes

1. Along the storm tracks – the "bad weather happens"
2. Along the blockings – the "heat and drought happens"
3. Along the storm tracks and blockings – some of the worst extremes are occurring

Seattle record of
cumulative precipitation
44.7 inches
ONDJFMA 2017



Just current
extremes in 2014
in England
(Fig. Courtesy of MetOffice)



Just the current drought
in Somalia in 2017



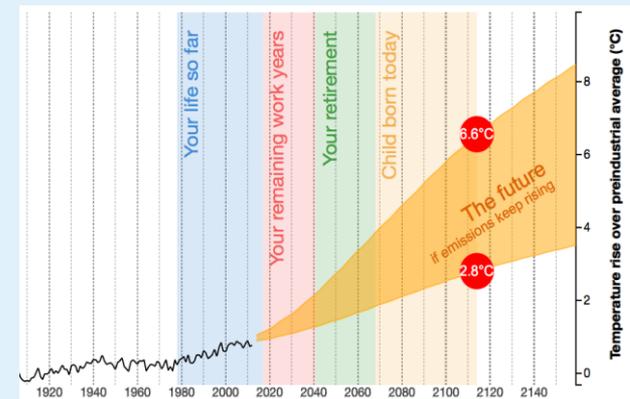
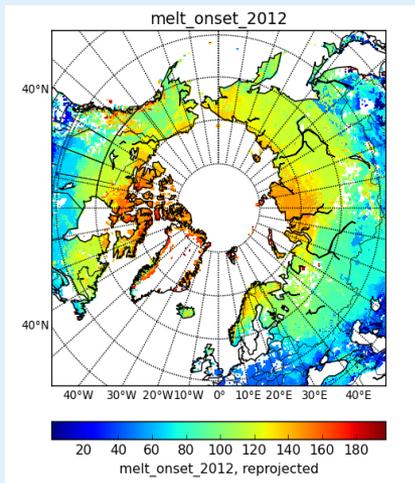
Just a flood in Vietnam
in 2017



Thank you for listening!

Key points of the talk are:

- 1) Climate of the two poles, Antarctic and Arctic, changes fast due to global warming
- 2) Critical climate change impacts are already occurring and adaptation is urgently needed
- 3) Mitigation must continue, new monitoring services and evaluation of climate models developed



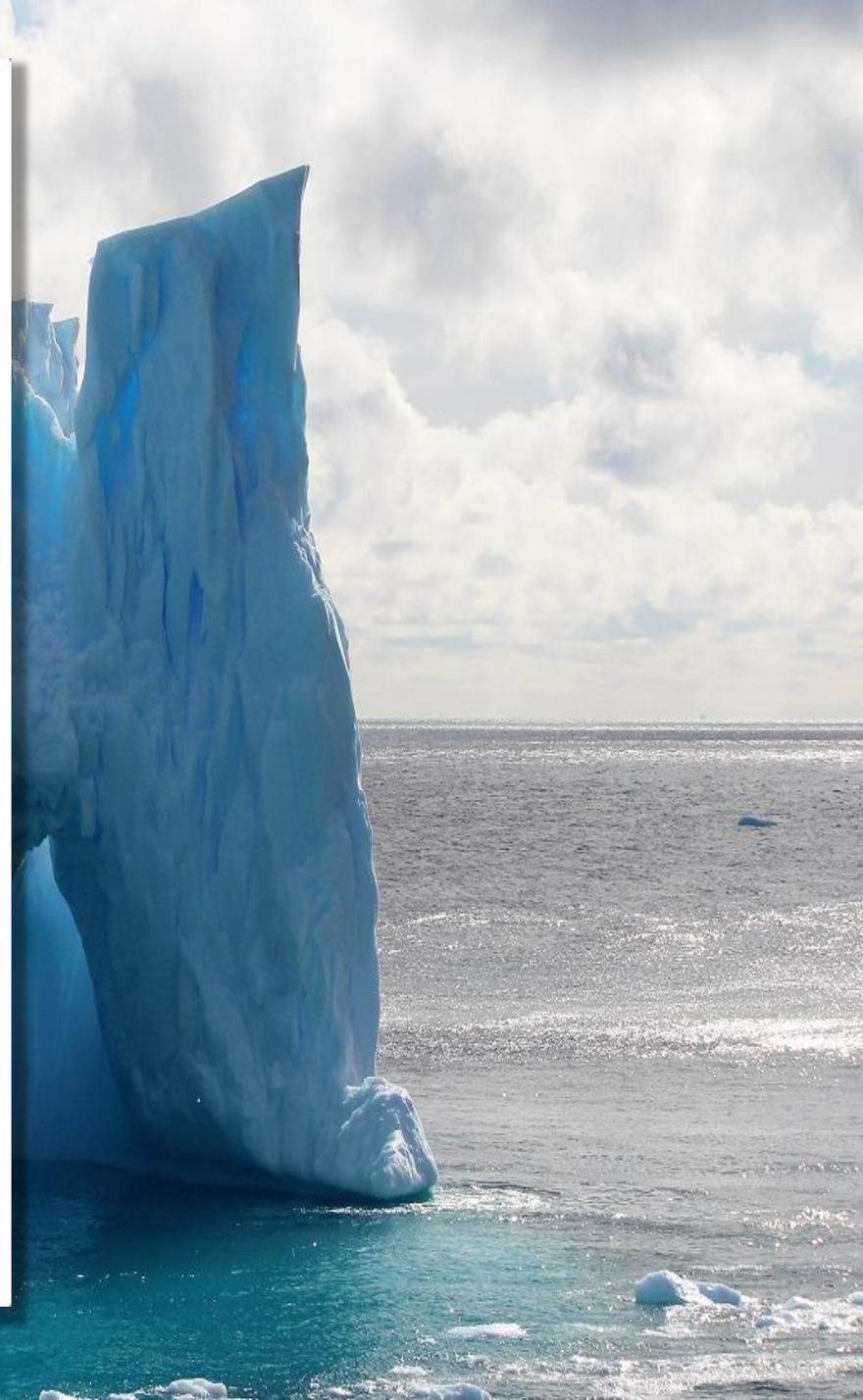
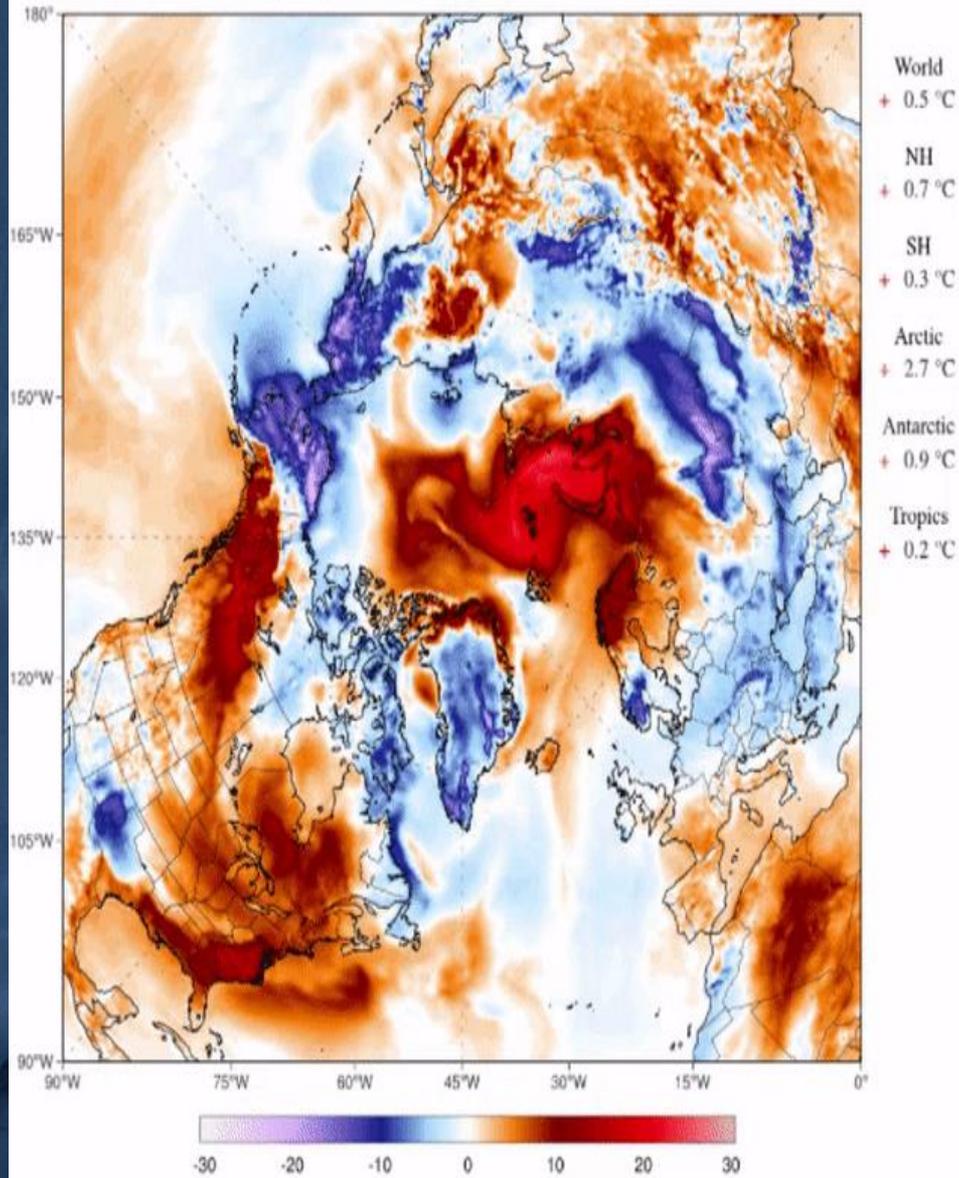


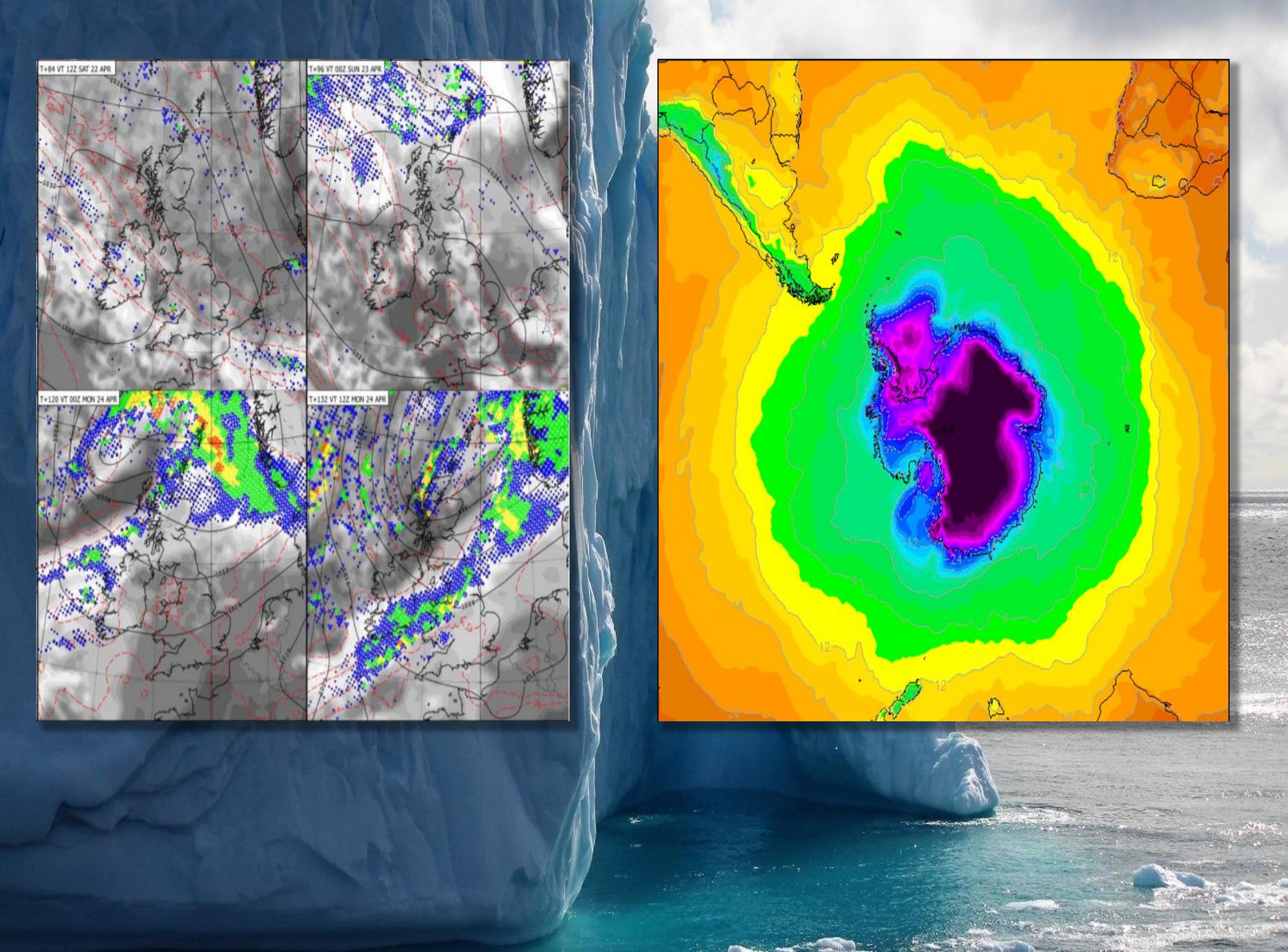
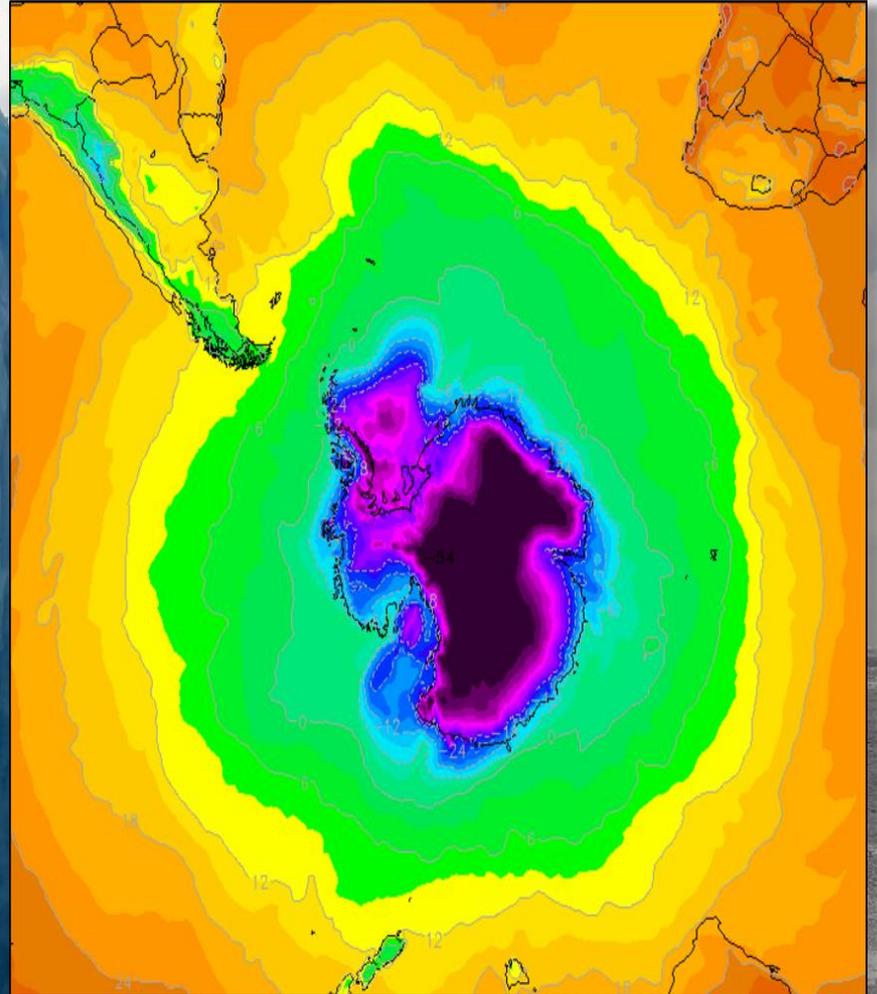
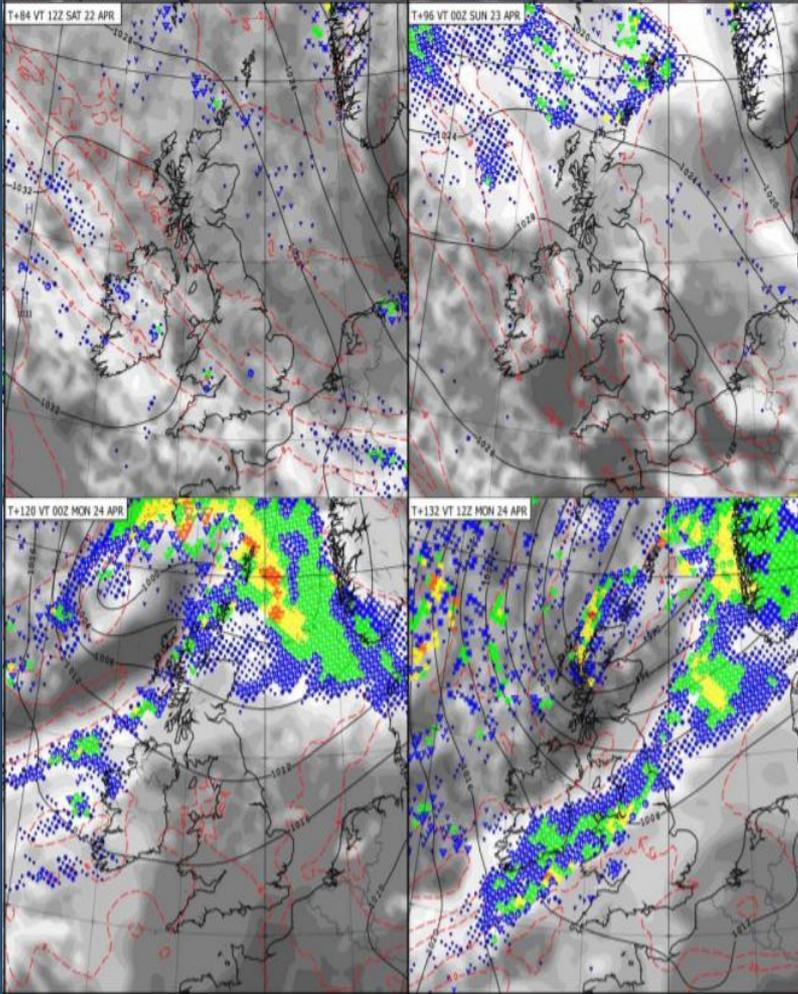
GFS T 2m Anomaly (°C) [1979-2000 base]

Init Mon 1200Z, Feb 06, 2017 | 174h | Valid Mon 1800Z, Feb 13, 2017

ClimateReanalyzer.org

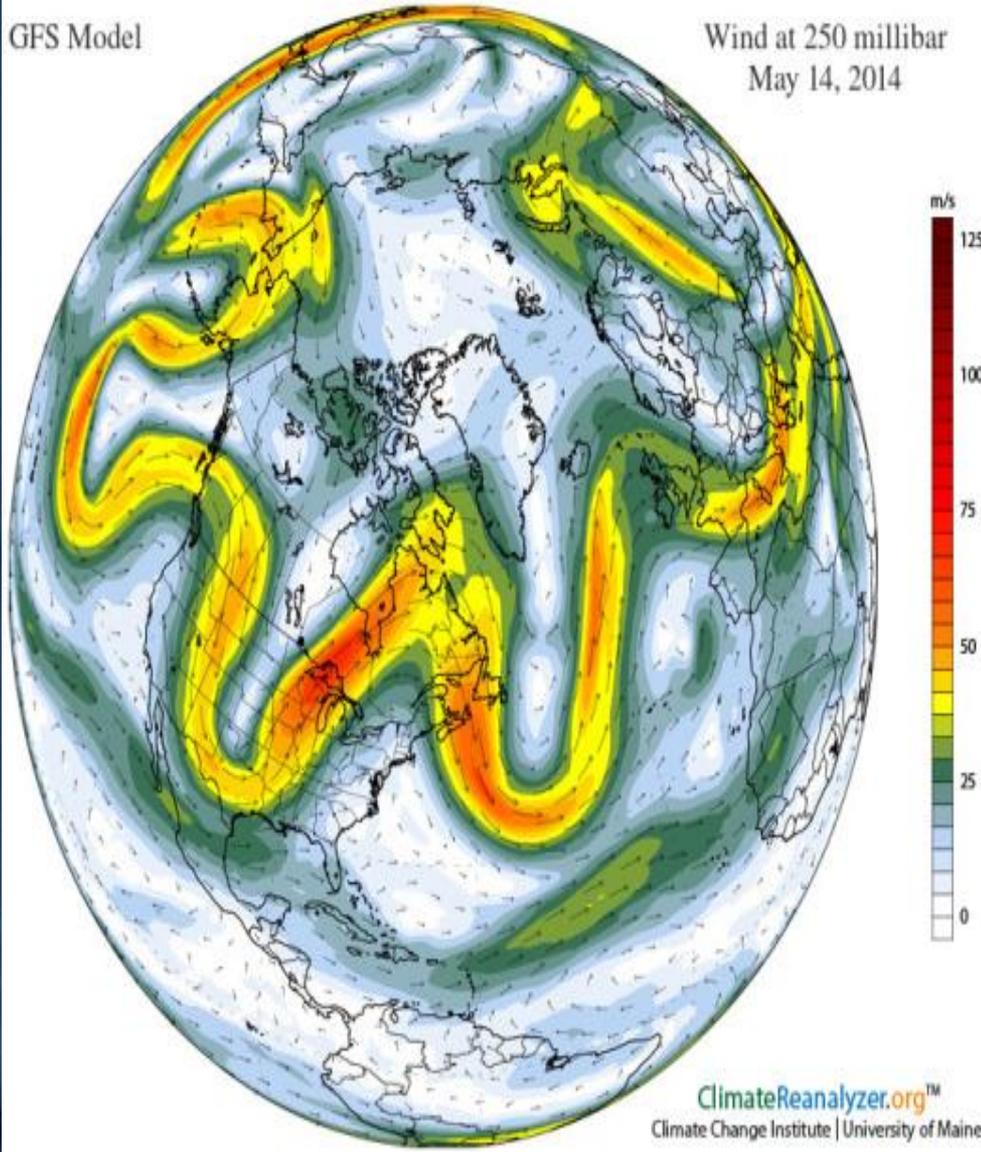
University of Maine | Climate Change Institute





GFS Model

Wind at 250 millibar
May 14, 2014







Strengthening European Climate Research

Tina Swierczynski
European Climate Research Alliance



Home

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Activi
Event

Strengthening Climate Research in Europe

search...

The European Climate Research Alliance (ECRA) is an association of [23 leading European research institutions](#). ECRA's objective is to bring together, expand and optimise expertise in climate research through a bottom-up approach. The initiative is a platform for joint research planning by sharing existing national research capacities and infrastructures.

ECRA acts as a unified voice for climate research in Europe. [Read more »](#)

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ECRA

ECRA_Climate The latest
Read about climate sci
upcoming events at bit
13 Apr 09:01AM



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12 Apr 08:34AM



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[climate.eu/images/doc](#)
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12 Apr 08:31AM

Collaborative Programmes

ECRA's core activities are represented in four Collaborative Programmes. [Read more »](#)



Members

ECRA's member institutions are from 10 European countries. [Read more »](#)



- Bjerknes Centre
- Nansen Centre
- University of Bergen



Bolin Centre for
Climate Research



NEWS

ECRA – Tasks

1. Work in **ECRA Collaborative Programmes** (*participation is open to all*): *Develop White Paper/Strategy*
2. Develop **training, education and outreach activities** (*particularly for young researchers*): *Organize ECRA Side events, support EU research proposal (e.g. COST action) etc.*
3. Provide **advice to policy and public** in respect to climate change: *Stakeholder consultations for HORIZON 2020, briefing documents in European Parliament etc.*
4. Develop **links to other climate initiatives and sustained partnerships with industry** to strengthen the interplay between research outcomes and innovation and to foster the early take-up of promising results: *Partnerships with industry in progress*

Past ECRA Workshops

1st Circular



ECRA/BCCR Workshop

Sea Level Change and Coastal Impacts *Towards adaptation strategies*

21-22 June 2016, Bergen

Bjerknes Centre for Climate Research (BCCR)



Goals of the Workshop:

- **Assessment of the most immediate research** that can and should be done to improve knowledge of regional sea level changes in Europe
- **Learn from novel approaches** Interdisciplinary research and cross-topical issues, co-designed projects
- **Link communities** of ECRA, Future Earth and JPI Climate (improve impact research by learning from social scientists)
- **Advance ECRA Strategy** for Collaborative Programme Sea level change and coastal impacts (in particular exchange about research gaps in sea level change research)

Agenda

- Day 1**
14:00 - 18:00
Keynotes and Plenary
- Day 2**
9:00-16:00
Scientific presentations

ECRA workshops are open (no workshop fees), but registration is required (max. 40 participants)

- Expected participants:*
- ECRA/Bjerknes Centre researchers
 - Social scientists
 - JPI Climate
 - Future Earth
 - Stakeholders

Registration and further practical information:

www.ecra-climate.eu

Joint ECRA – ADSIMNOR Workshop on
Arctic Climate Change and Processes

13 – 15 November 2013
Norrköping, Sweden

Workshop

SCENARIOS OF REGIONAL AND THEIR UNCERTAINTIES

Workshop of the
'Biological Cycle'

Biological Cycle

Impacts on the

multiple scales

Effects on eco-

hydrology

Workshop is aimed at advancing the above mentioned research findings in the workshop. The workshop is meant as a platform for discussion, shaping and

Presentations:

(ny) Buslacchi:
for the World Climate
Change: Grand Challenges for
the Future Ahead"

Latif:
of regional centennial
level trends"



NOVEMBER 2013

UNIVERSITY OF HAMBURG



07/06/2017



“Added Value” for European Research

- **Bottom-up approach** for research strategy based on scientists and participating scientific institutions
- **Platform for joint research planning and activities** in European climate research (national/European)
 - Common strategy to tackle research questions
 - Exchange of information (science, funding)
 - Exchange of personnel (within CPs)
 - Optimised use of existing infrastructure (e.g. data centres)

>>> A unified voice for climate research in Europe

Further efforts of ECRA

Square Brussels Meeting Centre
Coudenberg 3
1000 Brussels



*European Climate Research Alliance
General Assembly, 7-8 March 2017*

Climate Change and Vulnerable Regions



Further efforts of ECRA

- **Research focus on vulnerable regions and improving impact assessments:** The Arctic, Hydrological cycle, Sea level change and coastal impacts, High impact events are key priorities
- **Integration of natural and social sciences in research projects**
- **Bottom-up initiatives and stakeholder involvement**
- **Outreach and communication**
- **Open science – Sharing data**

>>> *See also conference documentation: www.ecra-climate.eu*

Thank you for your attention



Polar Change and Implications for Mid-Latitude Weather – Science and Policy for Society in Europe

