

Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms (AC)³

From Bergen via Cologne to the Arctic

Erlend Moster Knudsen,
University of Cologne (Germany)

BCCR/GFI Seminar, Bergen
May 16th, 2017

www.ac3-tr.de

TRANSREGIO TR 172 | LEIPZIG | BREMEN | KÖLN

UNIVERSITÄT LEIPZIG

 Universität Bremen

University
of Cologne



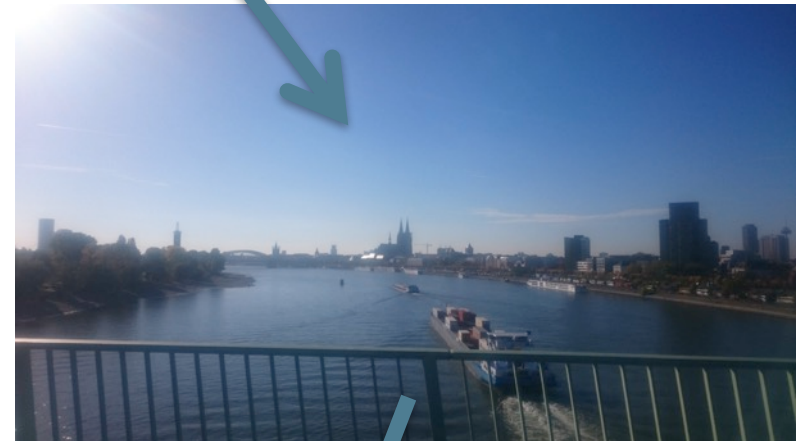
TROPOS
Leibniz Institute for
Tropospheric Research

 AWI



Outline

1. Background for presentation and research
2. The research center $(AC)^3$ and field campaign ACLOUD
3. Personal climate research and communication
4. Summary



Introduction

$(AC)^3$

Own work

Summary

Why?

Introduction

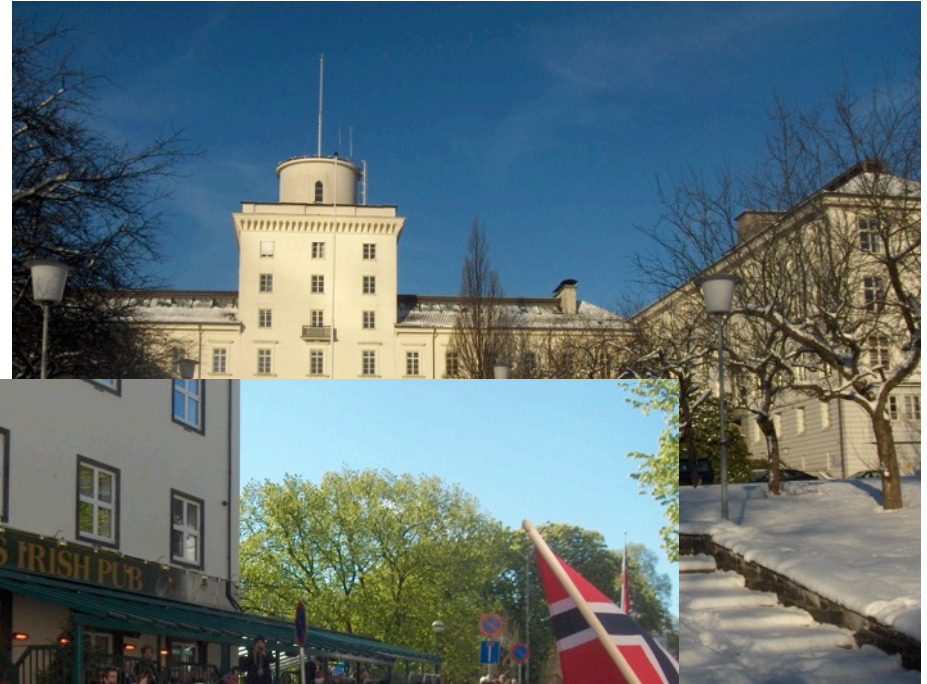
$(AC)^3$

Own work

Summary

Motivation for talk

- Personal background from GFI/BCCR and the Arctic
- Relevance for research at BCCR
- May 17th in Bergen



Introduction

(AC)³

Own work

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Arctic amplification

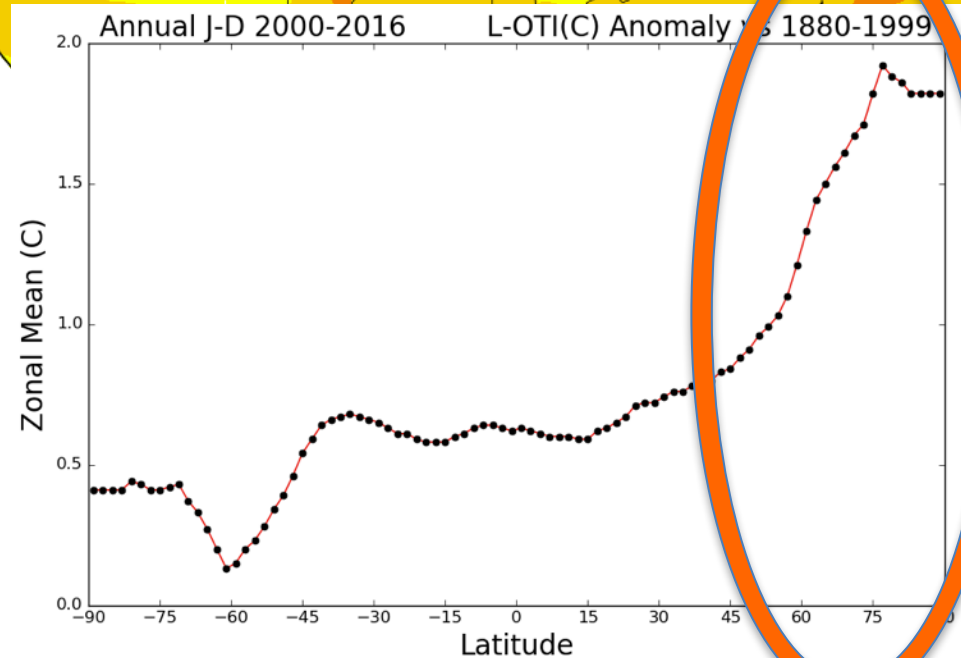
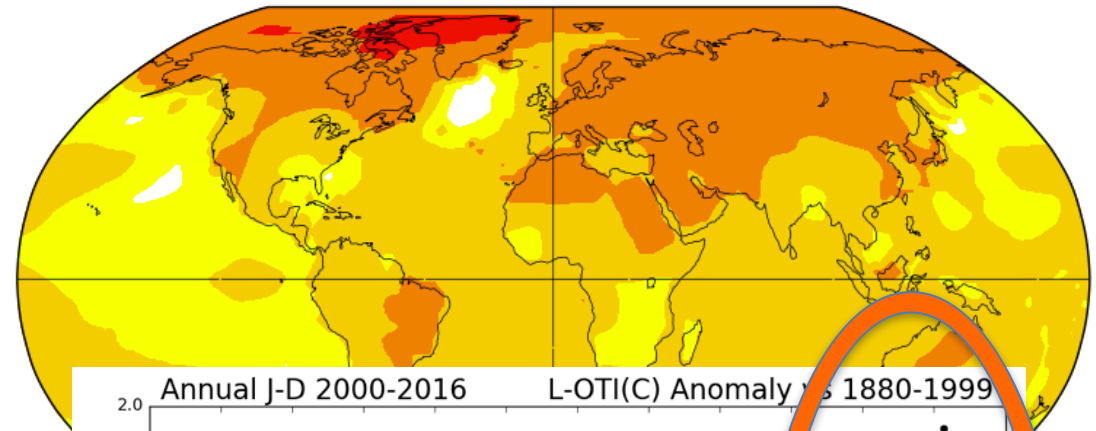
Data from NASA Goddard Institute for Space Studies (2017).

- Arctic warming > 2 x global warming

Annual J-D 2000-2016

L-OTI(°C) Anomaly vs 1880-1999

0.70



Introduction

(AC)³

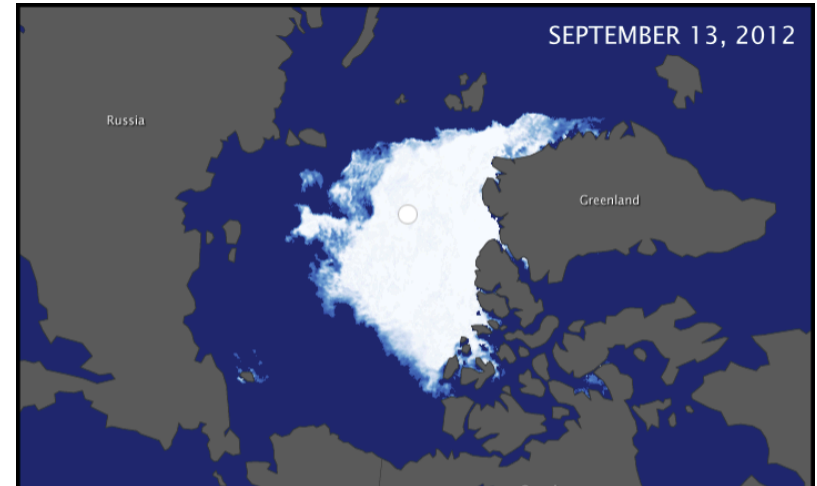
Own work

Summary

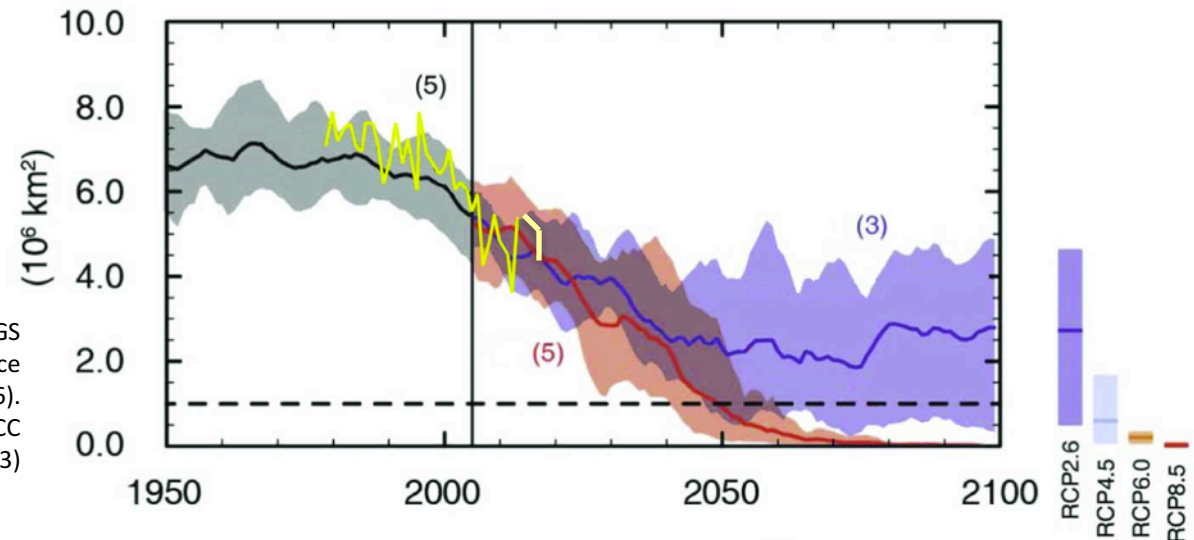
Arctic amplification

- Arctic warming > 2 x global warming
- Toward a blue Arctic Ocean

From NASA Earth Observatory (2012).



Northern Hemisphere September sea ice extent

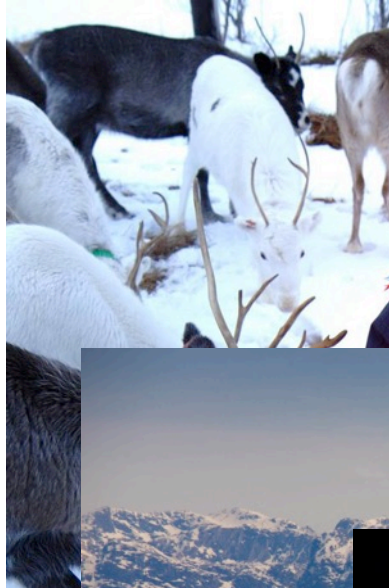


From USGS Alaska Science Center (2016).
Based on IPCC (2013)

Arctic amplification

- Arctic warming > 2 x global warming
- Toward a blue Arctic Ocean
- Opening up challenges and opportunities

Ove Aalo



Conrad



WWF



The Arctic Journal



RTR / AP

Сегодня
СЕВЕРНЫЙ
ПОЛЮС

Introduction

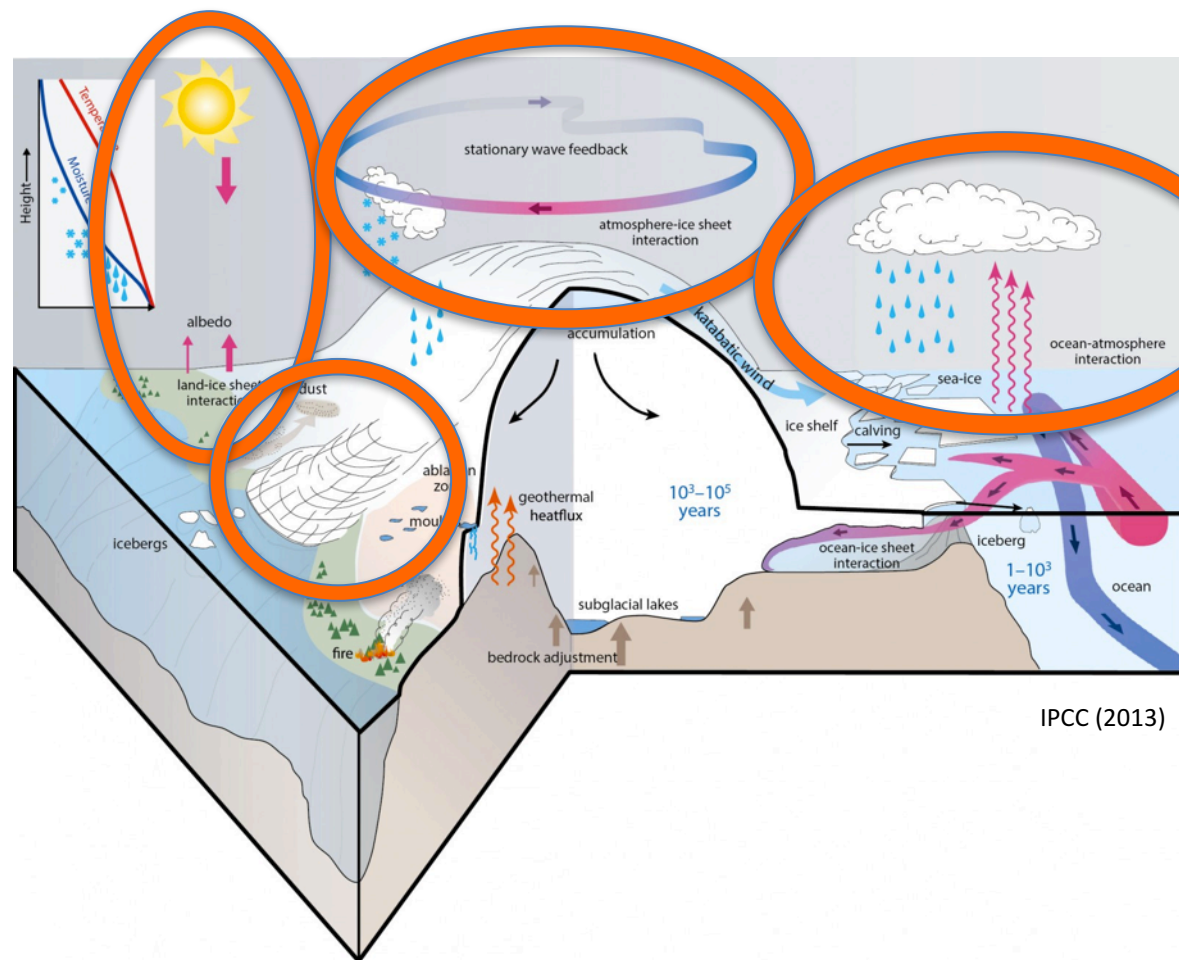
(AC)³

Own work

Summary

Arctic amplification

- Arctic warming > 2 x global warming
- Toward a blue Arctic Ocean
- Opening up challenges and opportunities
- Impact on the climate system



What is $(AC)^3$?

Introduction

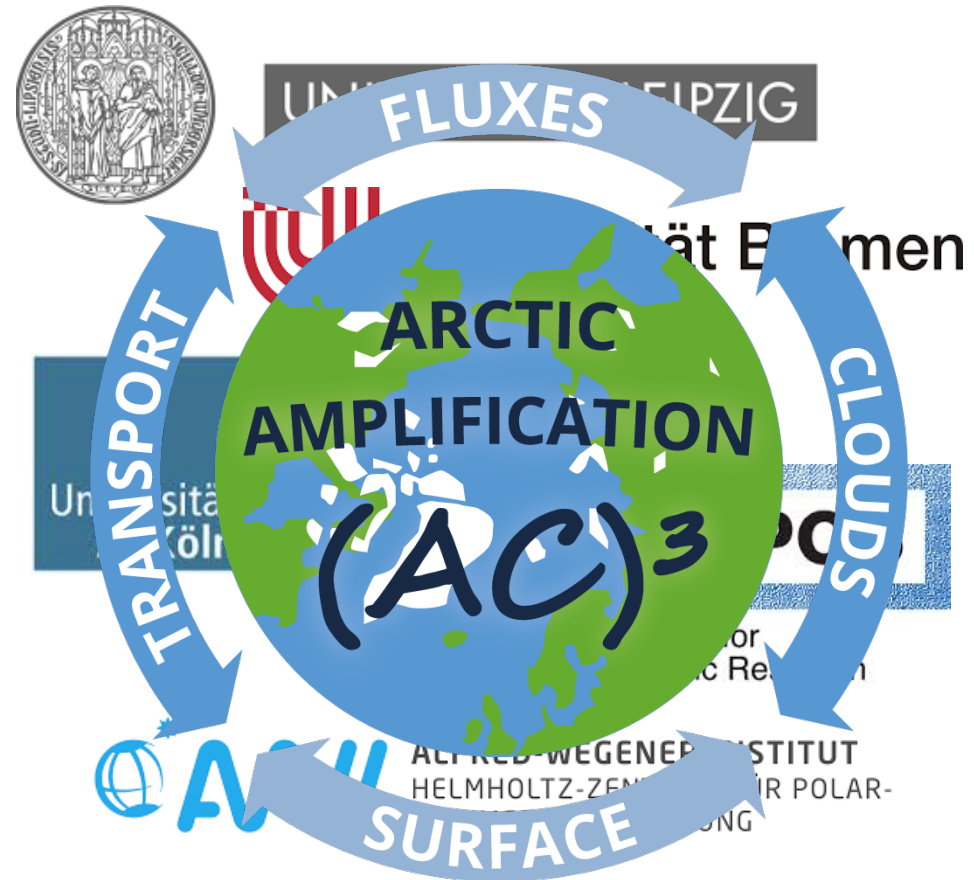
$(AC)^3$

Own work

Summary

Research center $(AC)^3$

- 5 German research institutions + international collaboration



ArctiC Amplification:
Climate Relevant **A**tmospheric and Surfa**C**e Processes
 and Feedback Mechanisms $(AC)^3$

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Introduction

$(AC)^3$

Own work

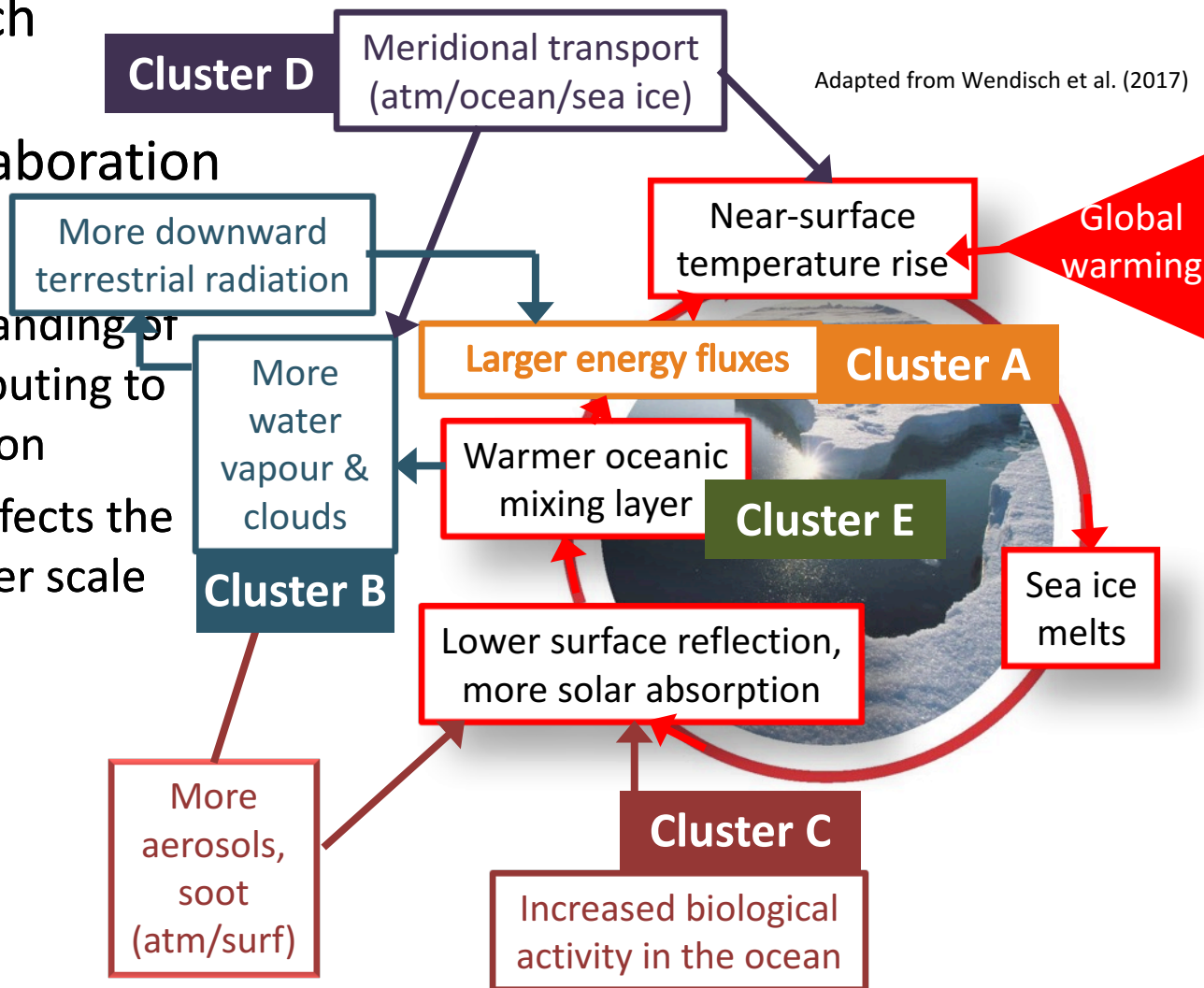
Summary

Research center $(AC)^3$

- 5 German research institutions + international collaboration

- Aim:

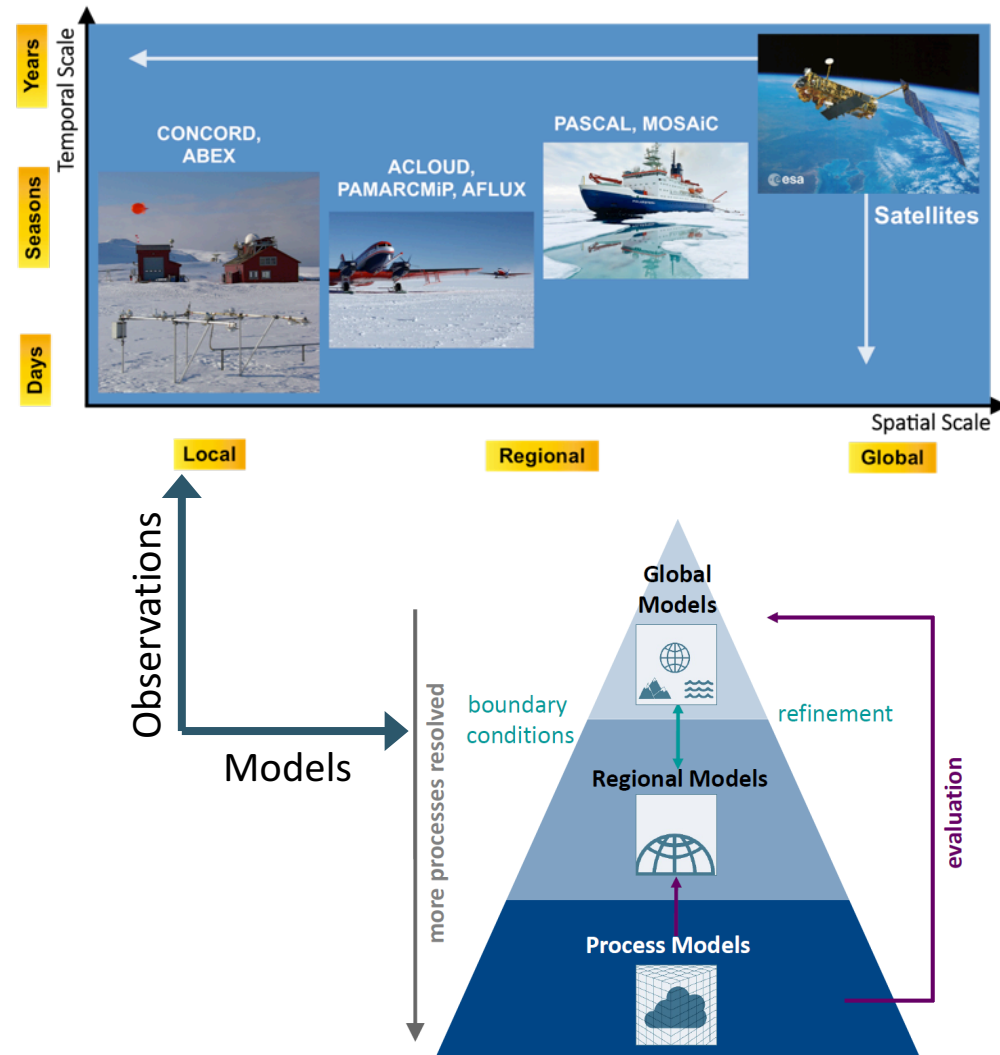
- Improve understanding of processes contributing to Arctic amplification
- ...and how this affects the regional and larger scale climate



Research center $(AC)^3$

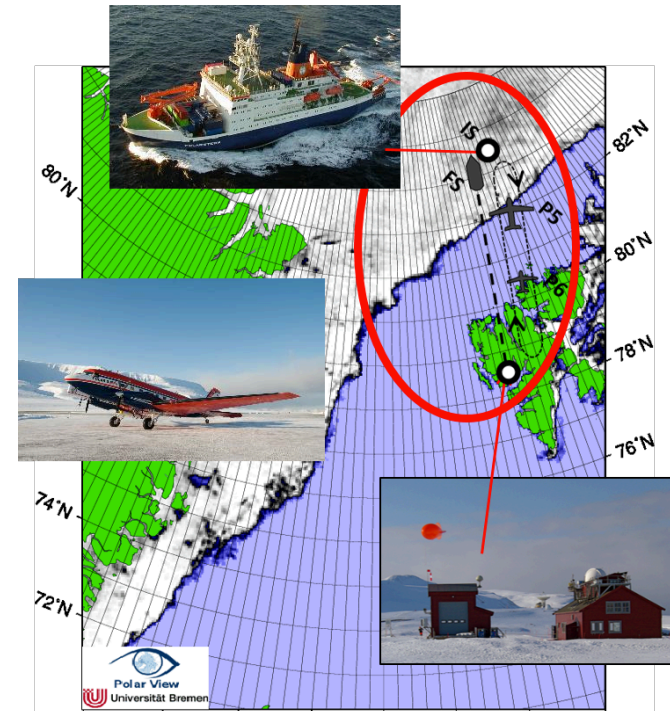
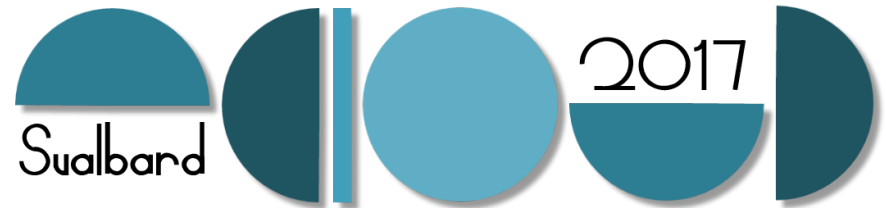
- 5 German research institutions + international collaboration
- Aim:
 - Improve understanding of processes contributing to Arctic amplification
 - ...and how this affects the regional and larger scale climate
- Combining observations and modeling, surface and atmospheric measurements

Adapted from Wendisch et al. (2017)



Field campaign ACLOUD

- Arctic Cloud Observations Using airborne measurements during polar Day (ACLOUD):
 - May 22 – June 28, 2017
 - Based in Longyearbyen
 - Includes an icebreaker, two aircrafts and several surface-based observations



Field campaign ACLOUD

- Set-up:
 - May 22 – June 28, 2017
 - Based in Longyearbyen
 - Includes an icebreaker, two aircrafts and several surface-based observations
- Aim:
 - Understand and quantify specific physical parameters in, above and below Arctic clouds
- Outreach:
 - Open ship and aircrafts
 - Drawings and photos
 - Media and video clips



And what do I do?

Introduction

$(AC)^3$

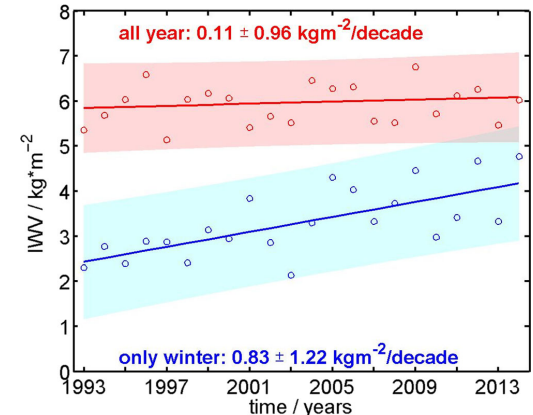
Own work

Summary

Own climate research

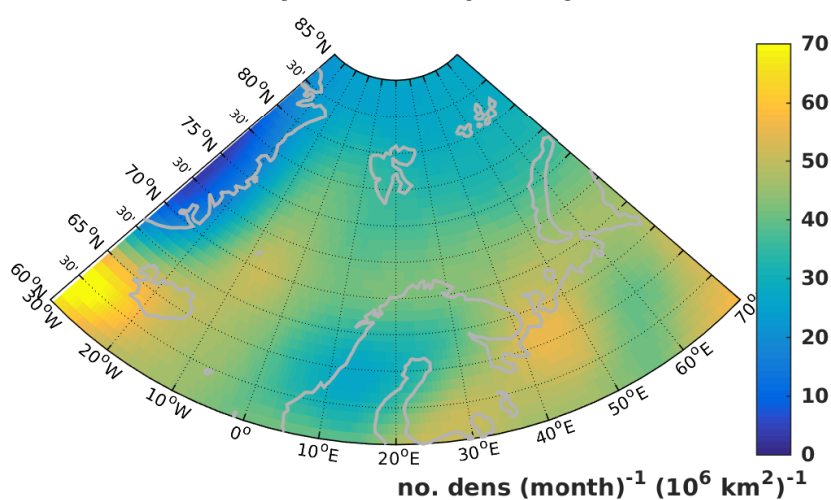
- Role of intense cyclones for precipitation, snow cover and sea ice in the Nordic Seas:
 - ERA-Interim reanalysis OND 1979–2014
 - 6-hourly cyclone tracking and statistics (TRACK)
 - Cyclone-associated precipitation in 5° radius

Integrated water vapor (IWV)

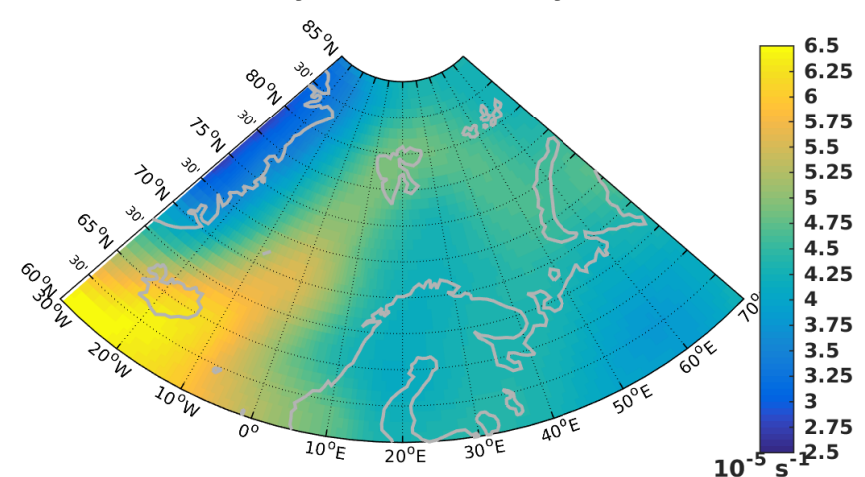


From Maturilli & Kayser. (2016)

Cyclone frequency



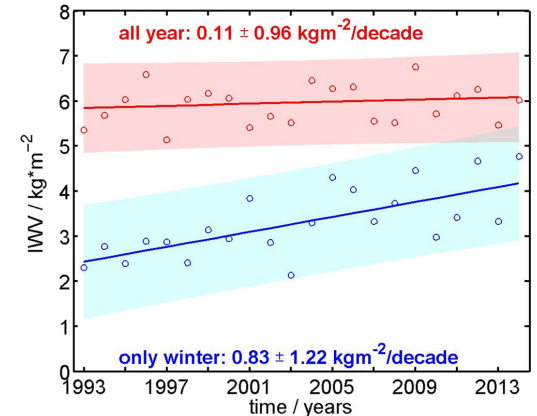
Cyclone intensity



Own climate research

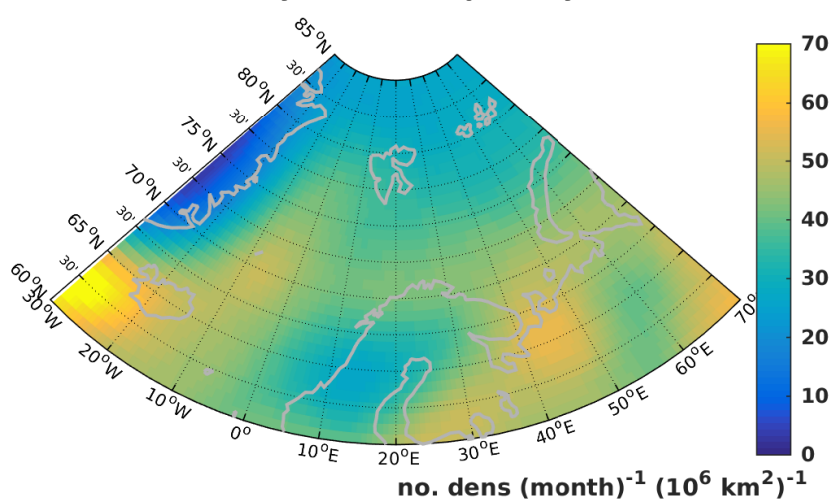
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Integrated water vapor (IWV)

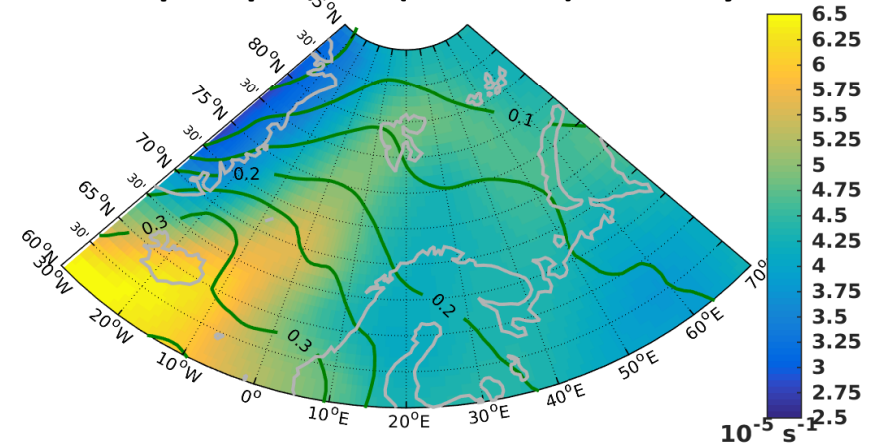


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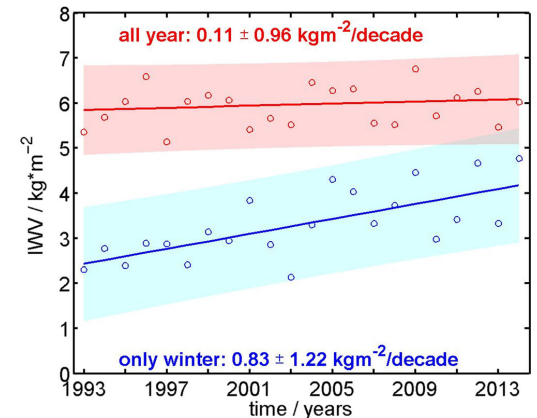
Cyclone (shading) and cyclone-associated precipitation (contours) intensity



Own climate research

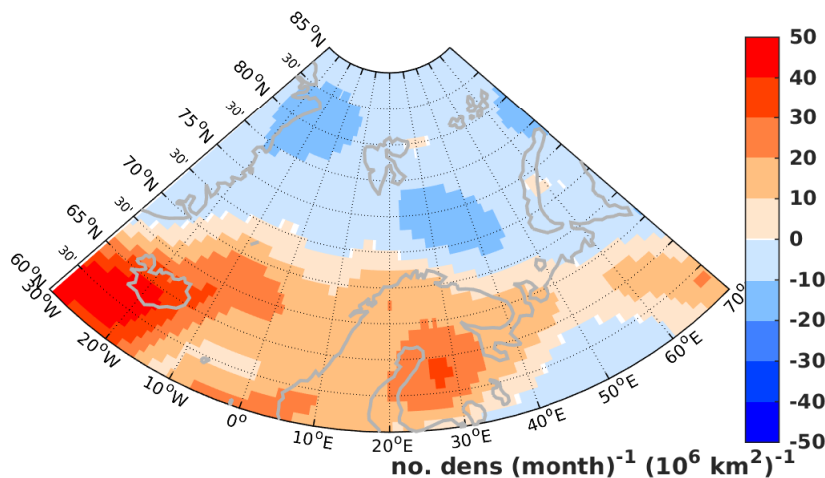
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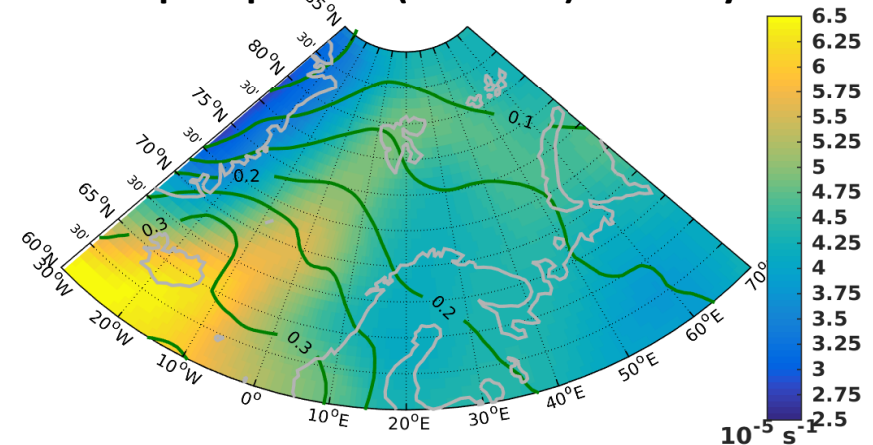


From Maturilli & Kayser. (2016)

Cyclone frequency (wet – dry)



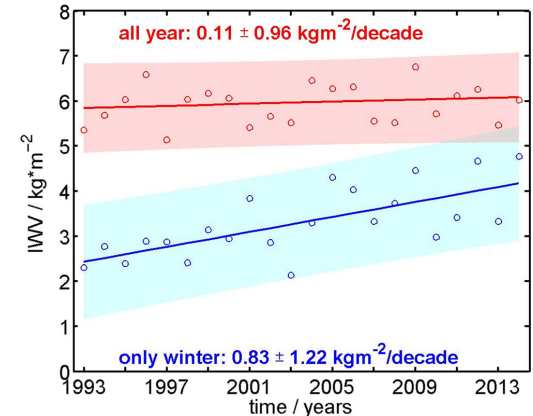
Cyclone (shading) and cyclone-associated precipitation (contours) intensity



Own climate research

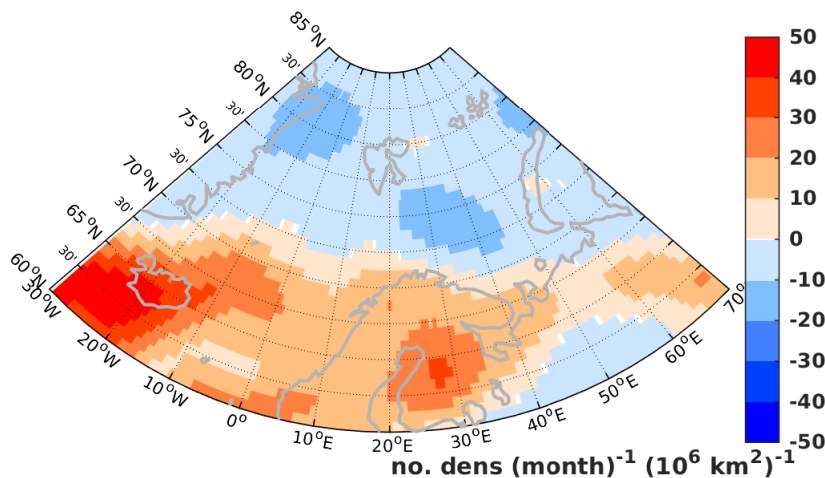
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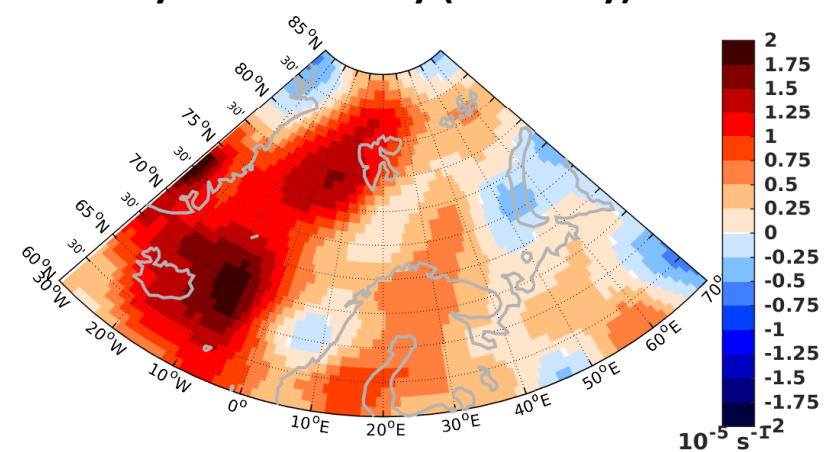


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Cyclone frequency (wet – dry)



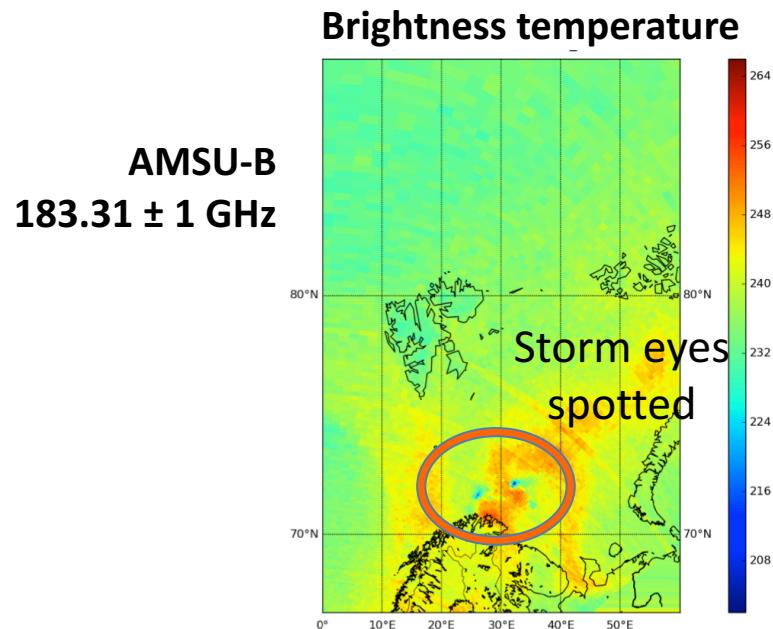
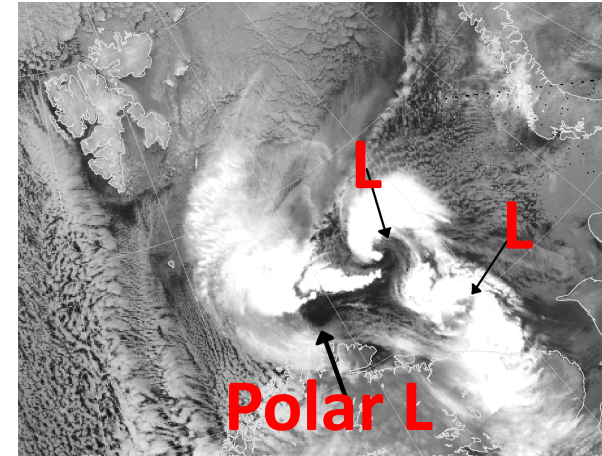
Cyclone intensity (wet – dry)



Own climate research

- Role of polar lows and atmospheric rivers for water vapor variability in the Arctic:
 - AMSU-B satellite, ASR reanalysis and HIRHAM5 regional climate model
 - Case study from January 7, 2009

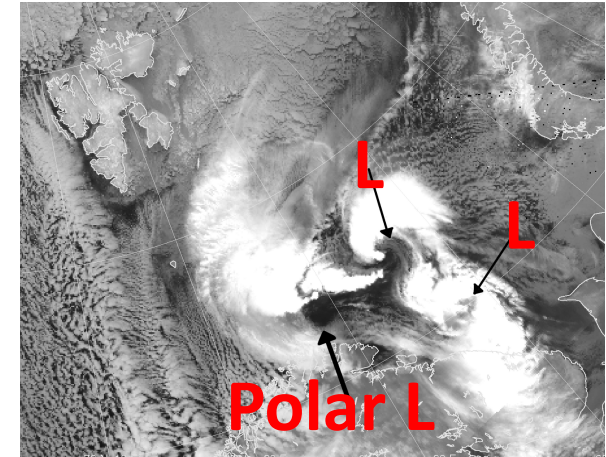
AVHRR satellite image



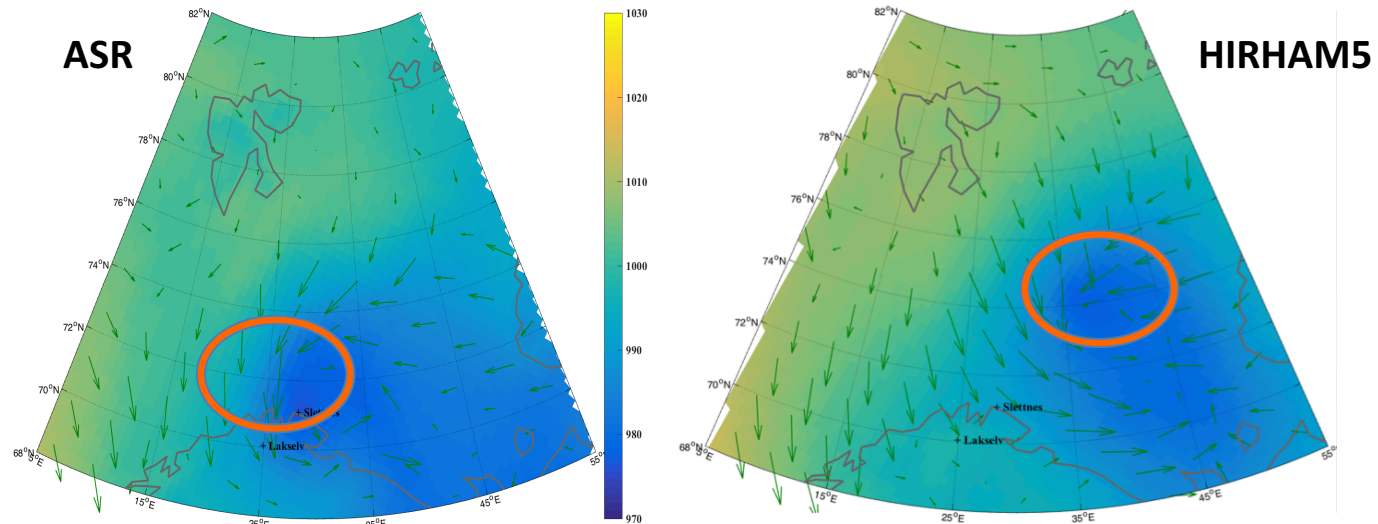
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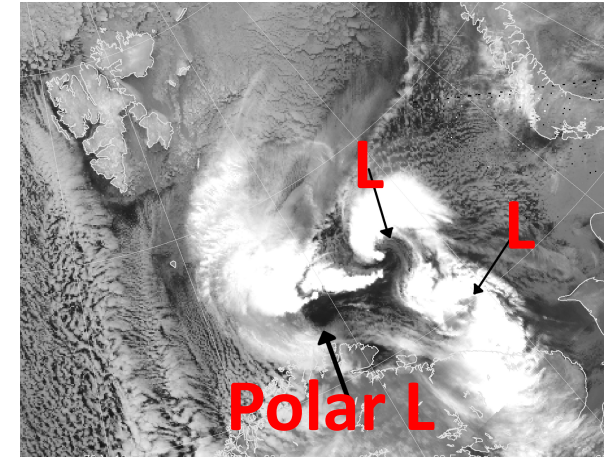
Sea level pressure (shading; hPa) and 10-m horizontal wind (arrows)



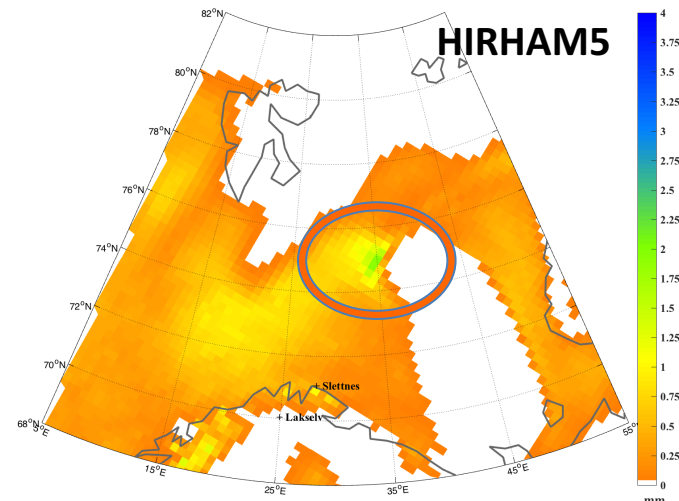
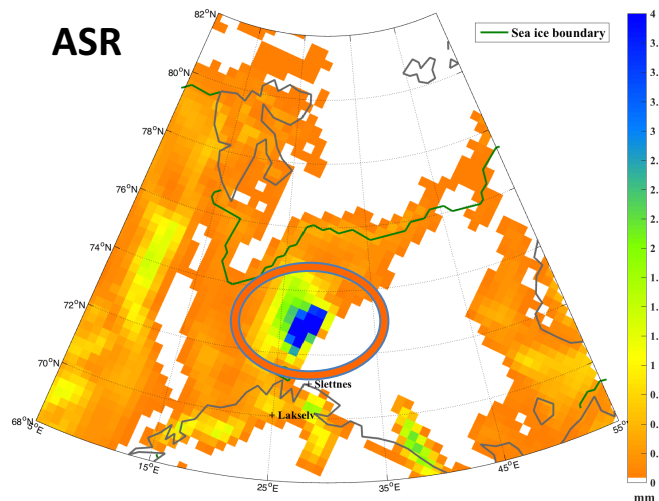
Own climate research

- Role of polar lows and atmospheric rivers for water vapor variability in the Arctic:
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 - Case study from January 7, 2009
 - Association between polar lows and atmospheric rivers

AVHRR satellite image



Precipitation

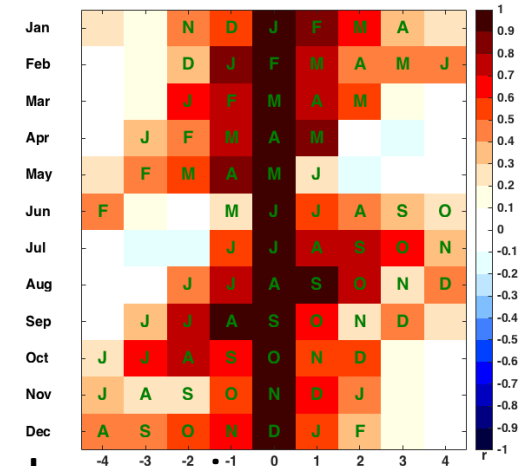


Own climate research

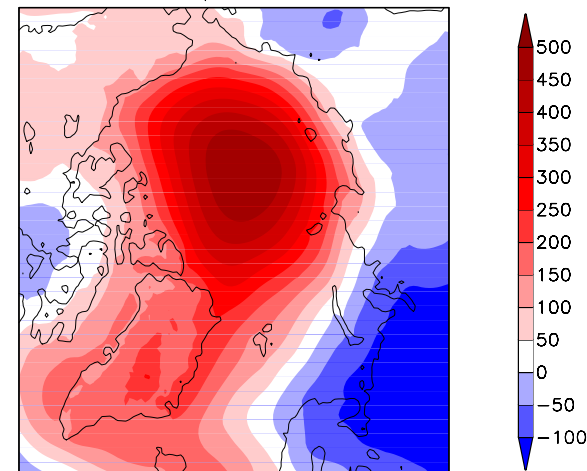
- Arctic sea ice persistence and teleconnections:
 - NSIDC satellite and ERA-Interim reanalysis 1979–2015
 - Lead/lag correlations and regressions

- Anomalous Arctic summer sea ice melt in ECHAM5:
 - Follow-up of Knudsen et al. (2015)
 - Anomalous atmospheric patterns in summers of high vs. low Arctic sea ice melt

Sea ice extent autocorrelation



Mean sea level pressure in high – low sea ice melt summers



Own climate research

- Role of polar lows and atmospheric rivers for water vapor variability in the Arctic
- Role of polar lows and atmospheric rivers for water vapor variability in the Arctic
- Arctic sea ice persistence and teleconnections
- Anomalous Arctic summer sea ice melt in ECHAM5

Own climate communication



Introduction

(AC)³

Own work

Summary

Summary

Introduction

$(AC)^3$

Own work

Summary

Summary

1. The Arctic is
“hot”, not cold
temperatures



2. $(AC)^3$ aims to improve understanding of reasons for and impacts of Arctic amplification
3. Collaboration very welcome based on common interests



ArctiC Amplification:
Climate Relevant **A**tmospheric and Surfa**C**e Processes
and Feedback Mechanisms $(AC)^3$

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