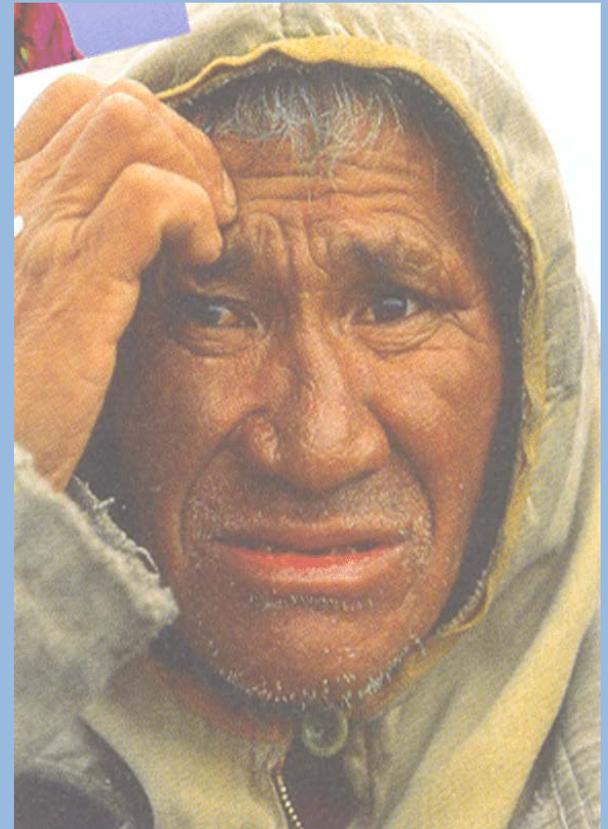


# AMAP

*Arctic Monitoring and Assessment Programme*

## Arctic Council Arctic Monitoring and Assessment Programme – Tasks and Products

Lars-Otto Reiersen  
AMAP Executive Secretary

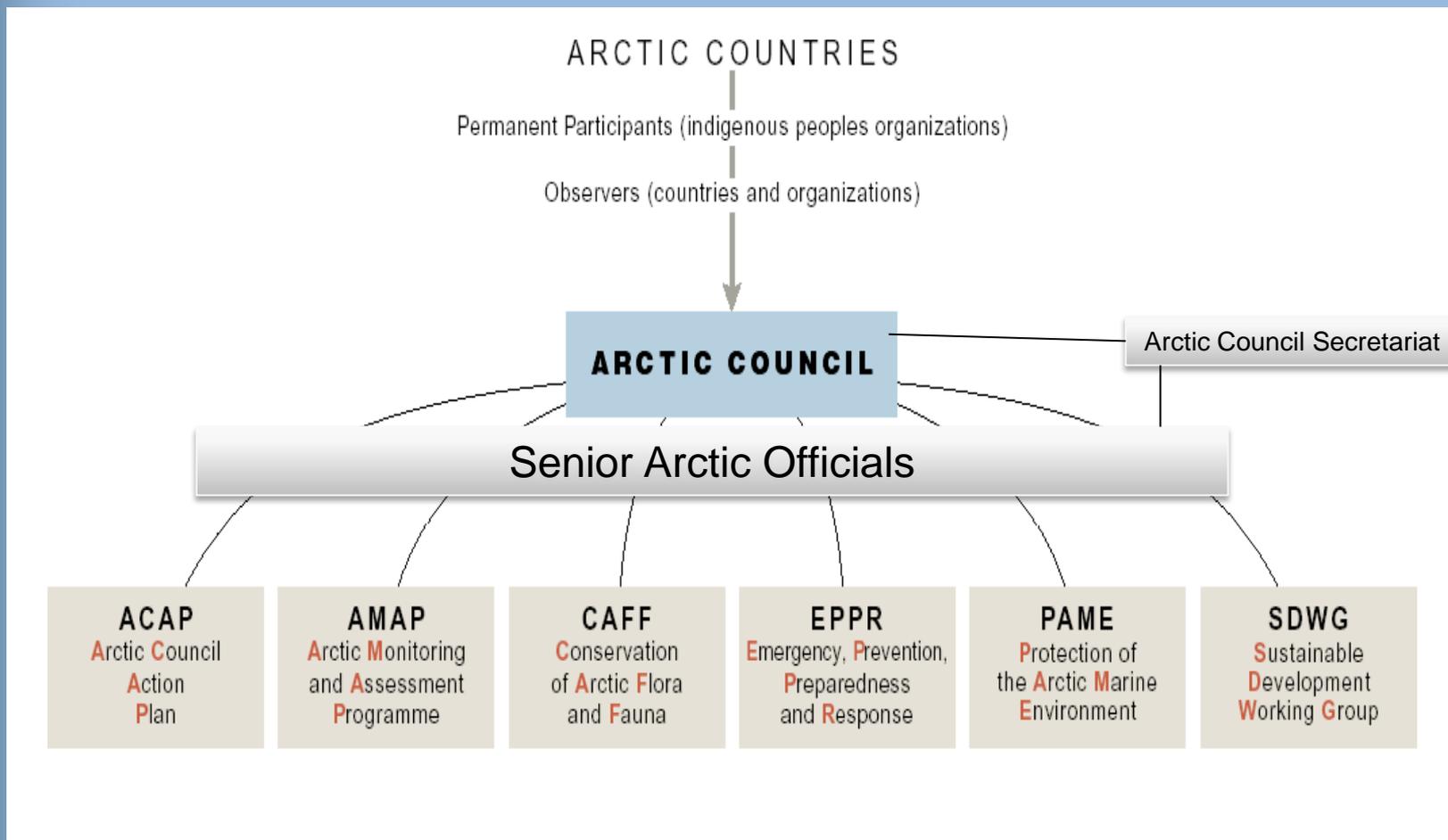


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## Thawing of the Cold war







ARCTIC COUNCIL

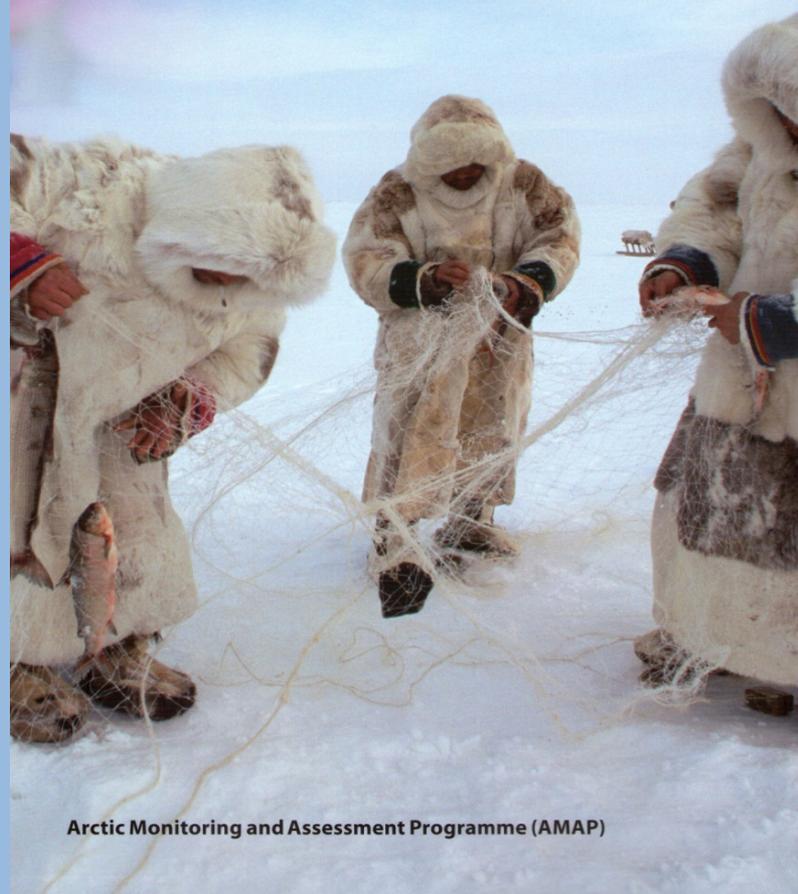
# AMAP

## Arctic Monitoring and Assessment Programme

### Permanent Participants (6 Arctic Indigenous Orgs):

- Aleut International Association
- Arctic Athabaskan Council
- Gwich'in Council International
- Inuit Circumpolar Council
- Saami Council
- Russian Arctic Indigenous Peoples of the North (RAIPON)

### AMAP Assessment 2009: Human Health in the Arctic



Arctic Monitoring and Assessment Programme (AMAP)

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## Task Forces and agreements

Task Force on Scientific Cooperation

Task Force on Telecommunication infrastructure

Task Force on Arctic Marine Cooperation

Expert group on SLCP – the Framework

### Agreements:

Search & Rescue

Marine Oil Pollution Preparedness and Response

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## AMAP Climate Assessments - leads

Status, Feedbacks & Forecast: Russia & USA

Land ice: Canada, Denmark/Greenland,  
Russia & USA

Sea ice: Canada, Norway & USA

Permafrost: Russia & USA

Snow: Canada

Arctic Freshwater Synthesis: Canada

Ocean Acidification: Norway & USA

SLCF: - BC & Ozone: Norway & USA

- Methane: Canada & USA

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## AMAP Assessment - leads

Persistent Organic Pollutants (POPs)	Canada & Sweden
Radionuclides	Norway & Russia
Mercury	Canada & Denmark
Oil	Norway & USA
Human health	Canada & Norway

Adaptation Action for a Changing Arctic Norway & USA

1. Barents: Finland, Norway, Russia & Sweden
2. Bering/Chukchi: Canada, Russia & USA
3. Baffin/Davis Strait: Canada & Denmark/Greenland

## Cooperation related to Climate

WMO/CliC

IASC

IPA

ICES

National institutes e.g. Met. Offices, NSIDS,  
Universities,

UNECE/LRTAP/HTAP (SLCP)

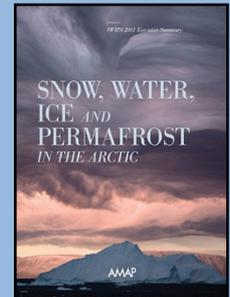
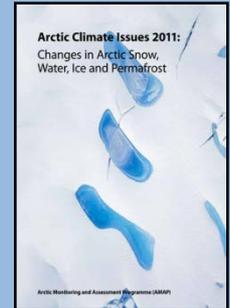
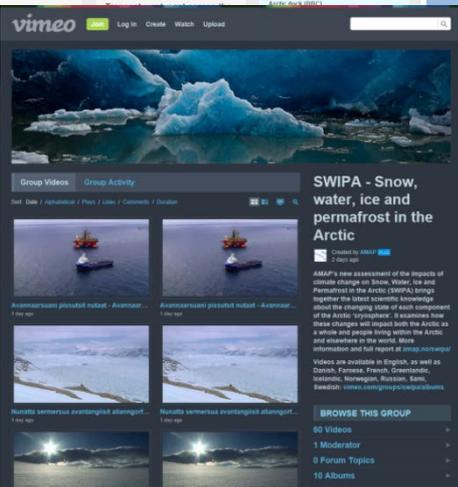
IIASA

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## Arctic Monitoring and Assessment Programme

# Robust derivative products

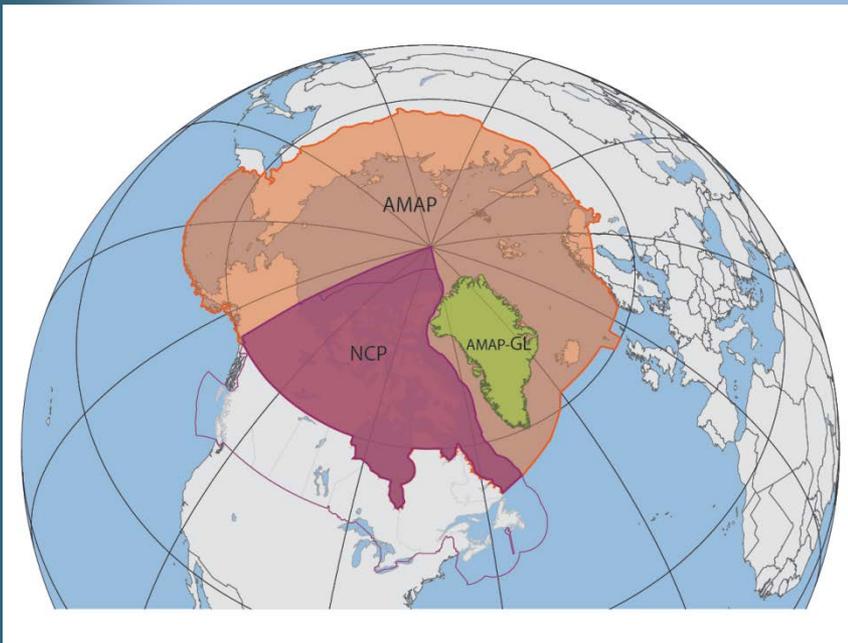
- Layman's overviews
- Summaries for policy-makers
- Video (web, DVD)
- Educational outreach
- Technical/data products
- Web dissemination
- Social media



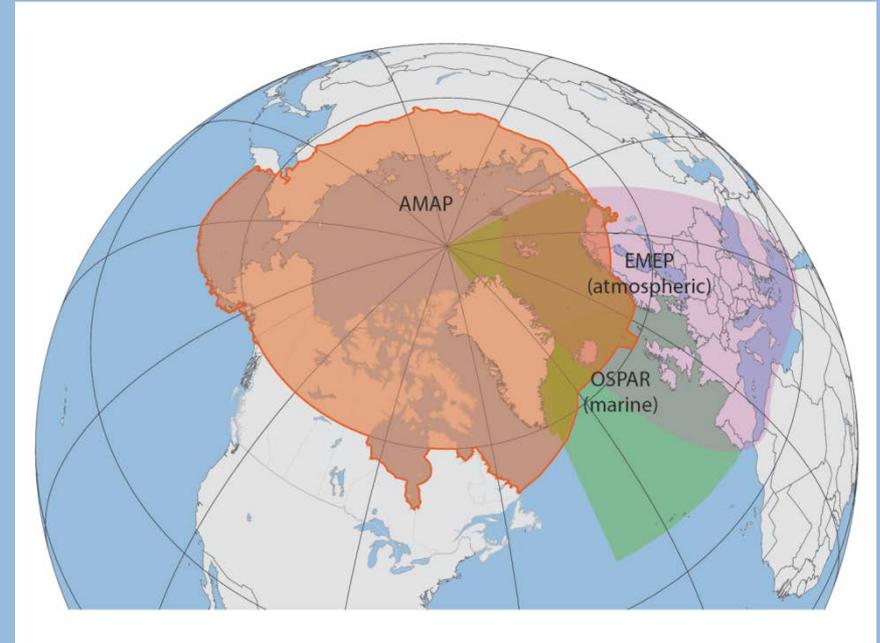
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### National implementation - Regional coordination



Based on national activities (e.g. Canada NCP, Greenlandic AMAP MP);  
Harmonization where necessary



High degree of coordination with relevant regional monitoring programmes

# AMAP

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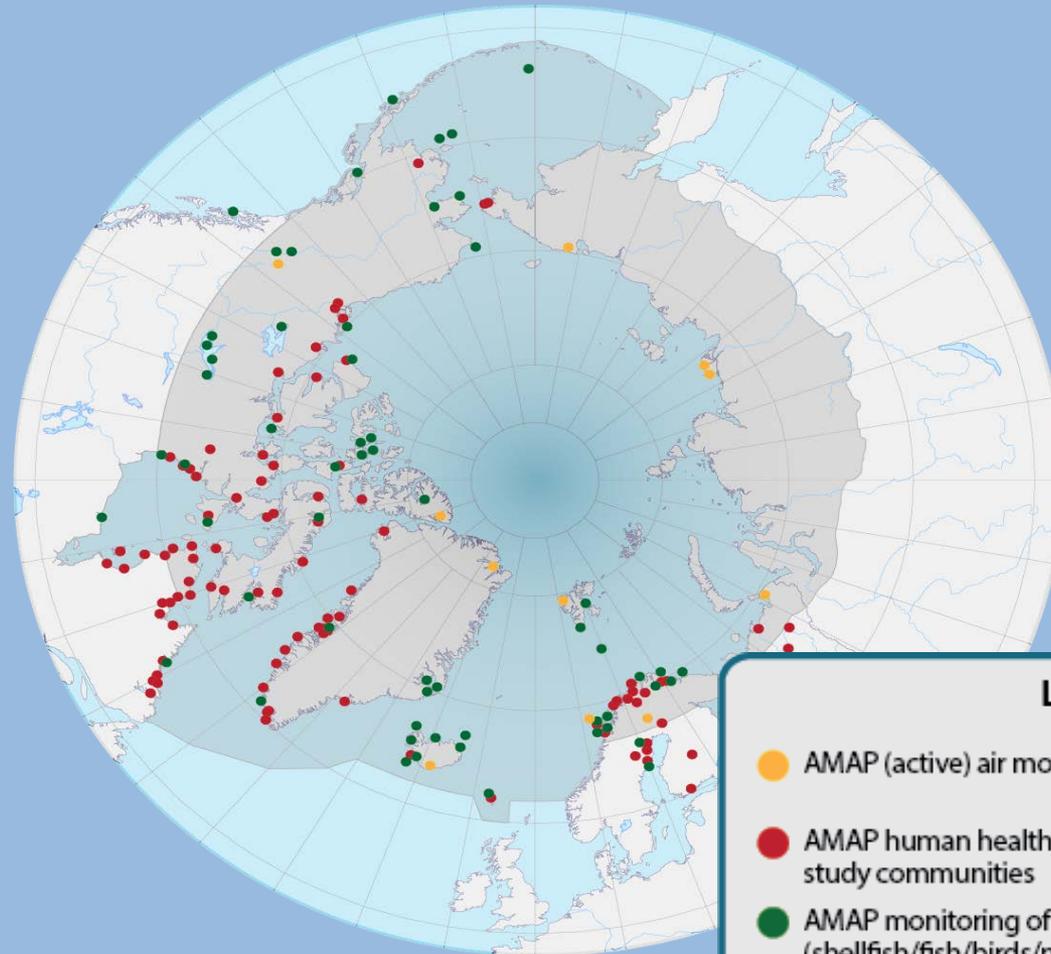
## AMAP's geographical coverage



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## AMAP monitoring network



### Legend

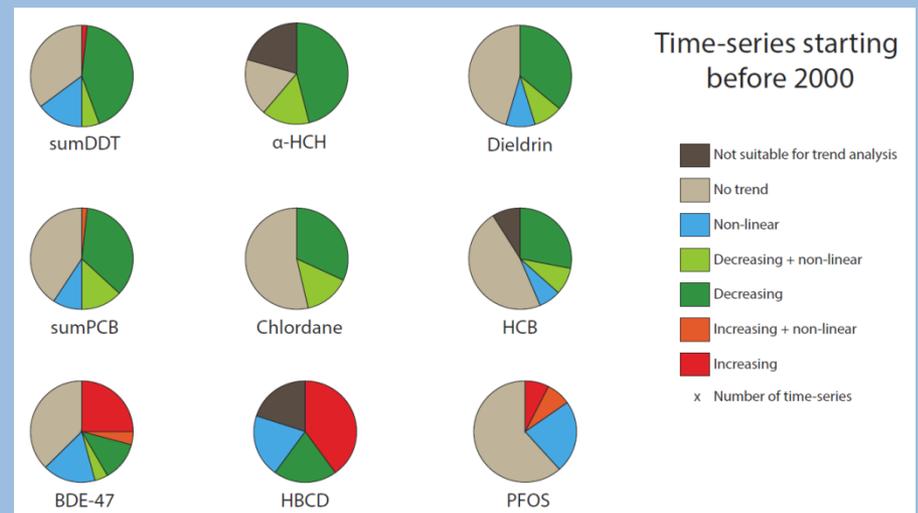
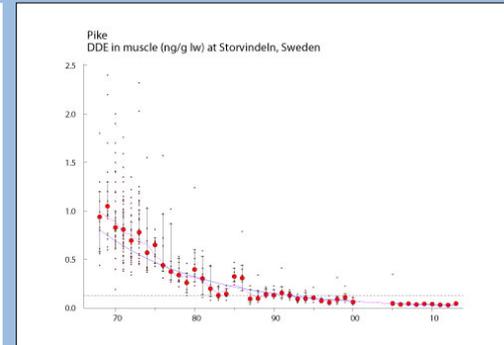
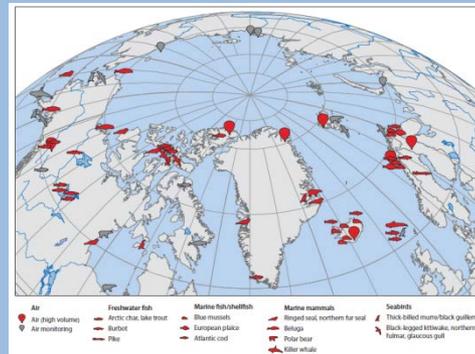
- AMAP (active) air monitoring network
- AMAP human health and blood bio-monitoring study communities
- AMAP monitoring of POPs (temporal trends) in biota (shellfish/fish/birds/mammals)

# POPs Trends in the Arctic (AMAP 2015)

‘Traditional’ POPs consistently declining in Arctic air and biota

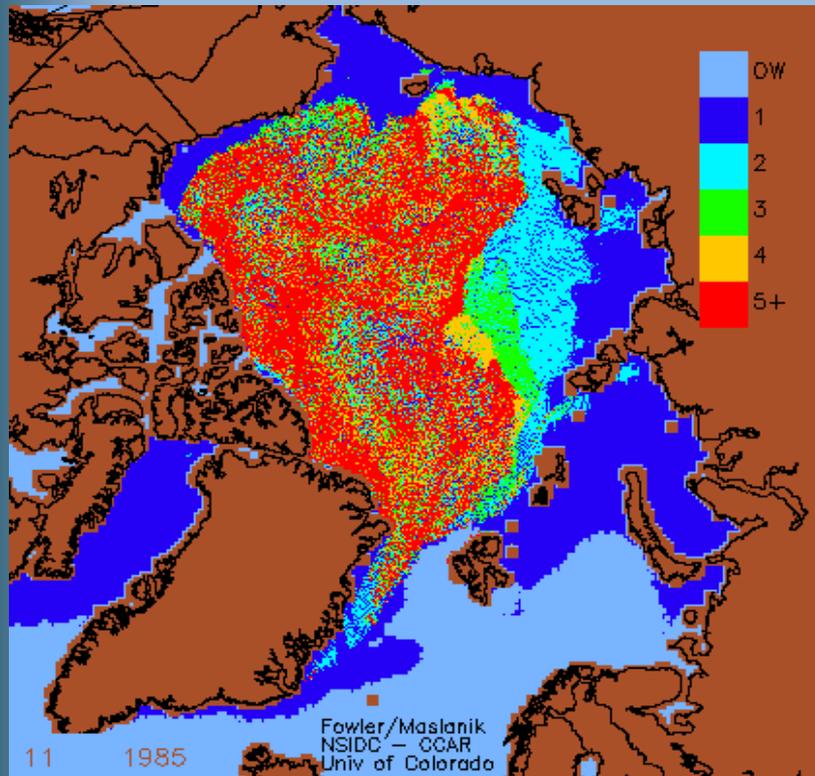
A more mixed picture for newer POPs

Arctic data are important in establishing, developing and implementing international agreements

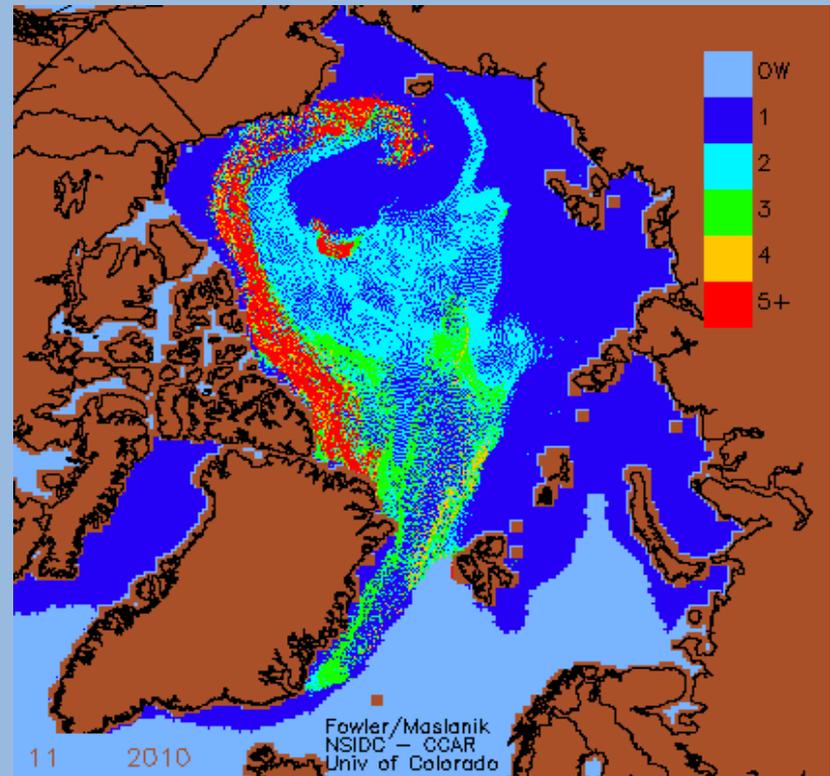


### Sea ice is getting younger and thinner

Mar 1985 – Mar 1986



Mar 2010 – Mar 2011



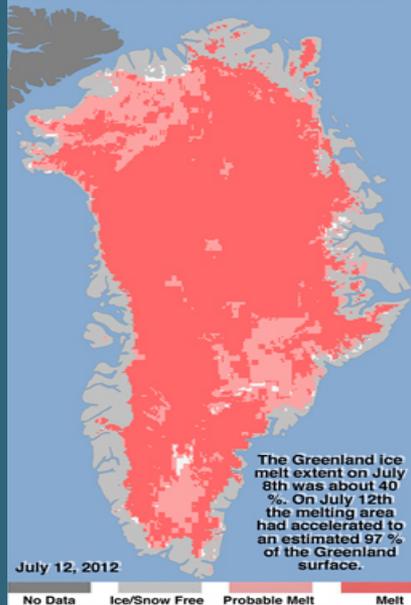
Much of older, thicker ice north of Alaska now melting away during summer

# AMAP

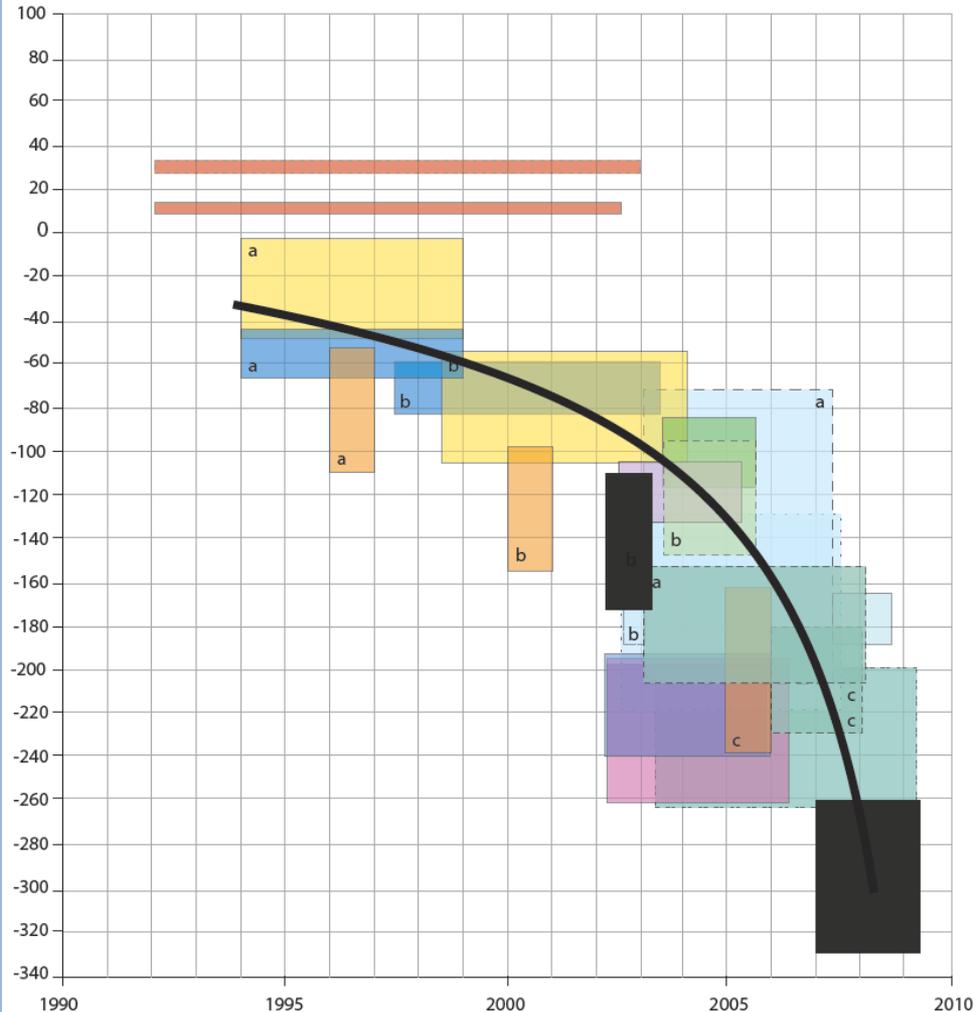
## Arctic Monitoring and Assessment Programme

# Greenland Mass Balance

### Extent of Surface Melt Greenland's Ice Sheet



Net balance, Gt/y



#### Radar Altimetry

- Johannessen et al., 2005
- Zwally et al., 2005 [SRALT]

#### Laser Altimetry

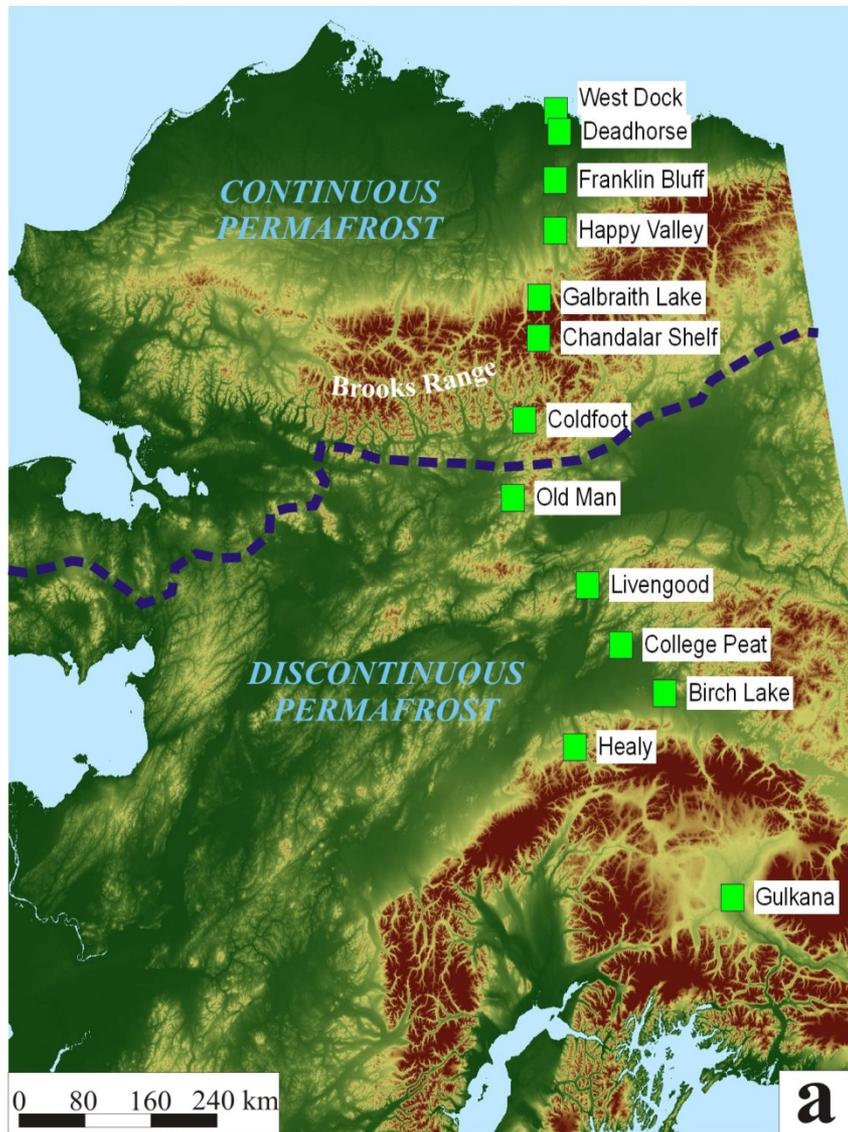
- ab Krabill et al., 2004 [ATM]
- ab Thomas et al., 2006 [ATM + GLAS]
- a Slobbe et al., 2009 [GLAS, density range  $\pm 300 \text{ kg/m}^3$ ]

#### Mass Budget

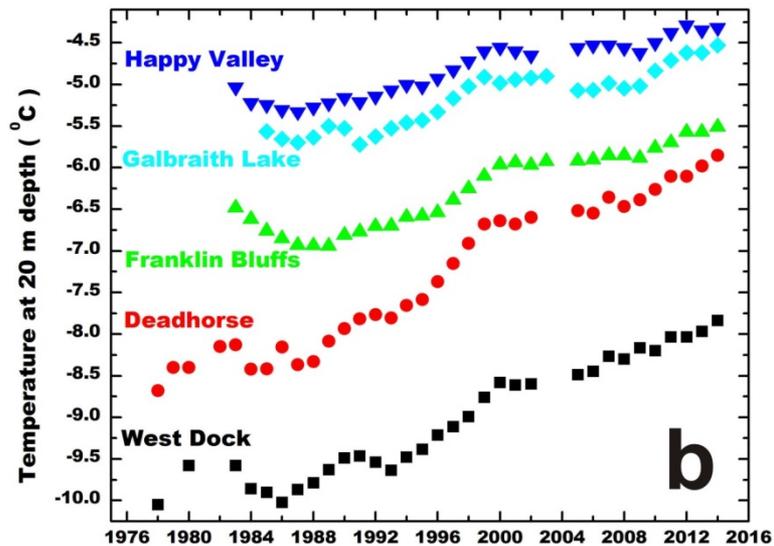
- abc Rignot and Kanagaratnam, 2006 [InSAR + SMB]
- van den Broeke et al., 2009 [SMB + InSAR]

#### Satellite Gravity (GRACE)

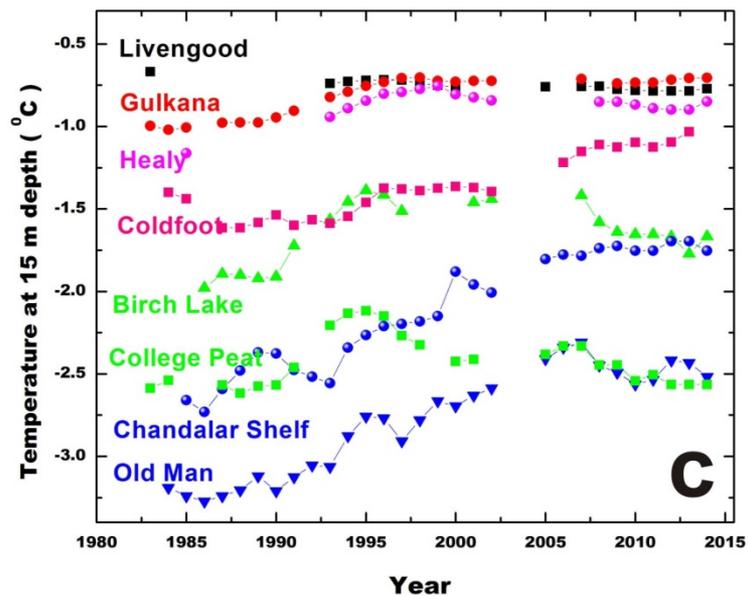
- Luthke et al., 2006 [GRACE/MASCON]
- Chen et al., 2006 [GRACE]
- Velcogna and Wahr, 2006 [GRACE]
- Velcogna, 2009 [GRACE]
- Ramillien et al., 2006 [GRACE]
- Wouters et al., 2008 [GRACE/EOFfilter]
- abc
- b Slobbe et al., 2009 [GRACE, CNES/CSR/DEOS/GFZ range]
- Baur et al., 2009 [GRACE, CSR/GFZ/JPL products, see Table 8.4 for range]
- Velcogna, GRL, 2009

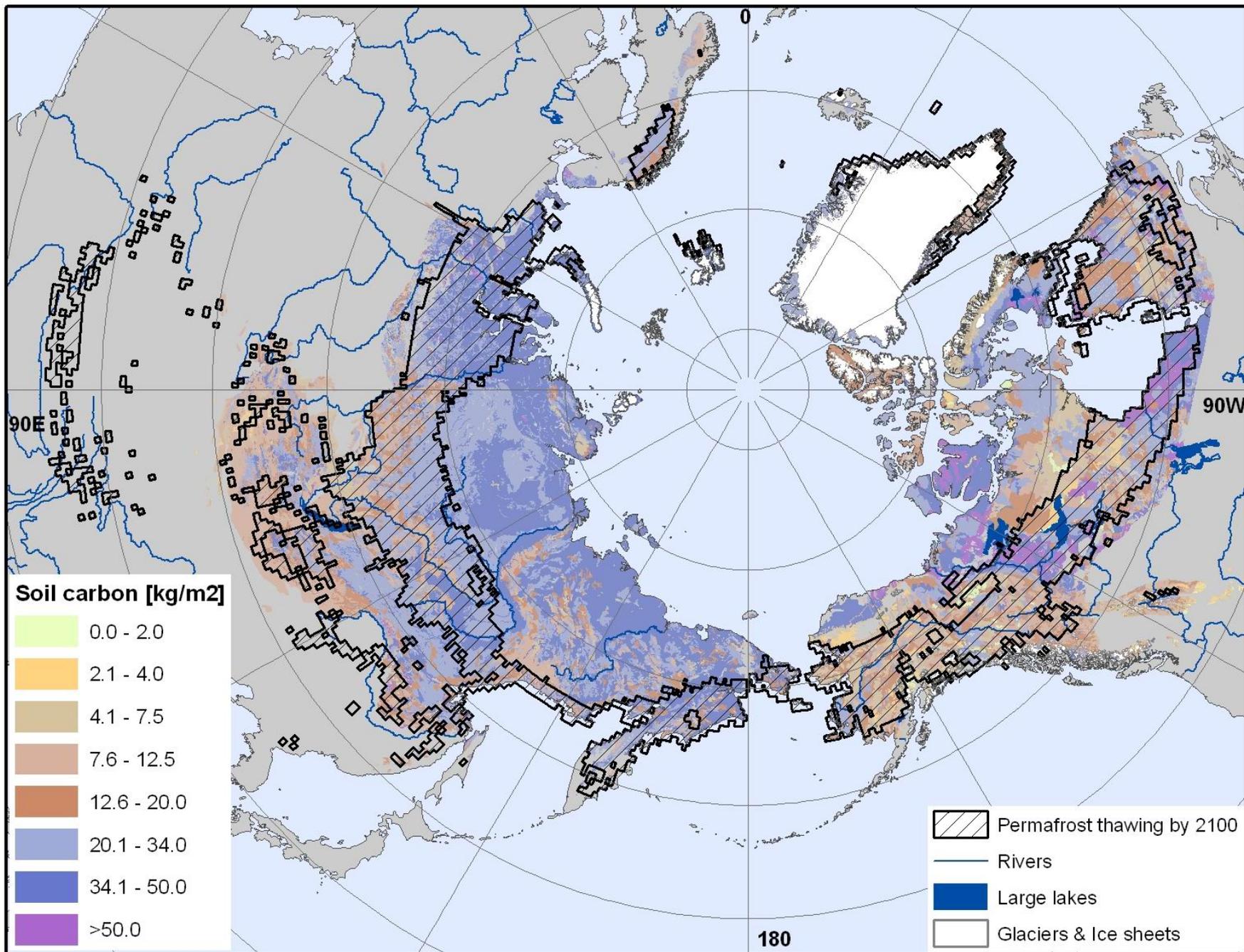


## Northern Alaska



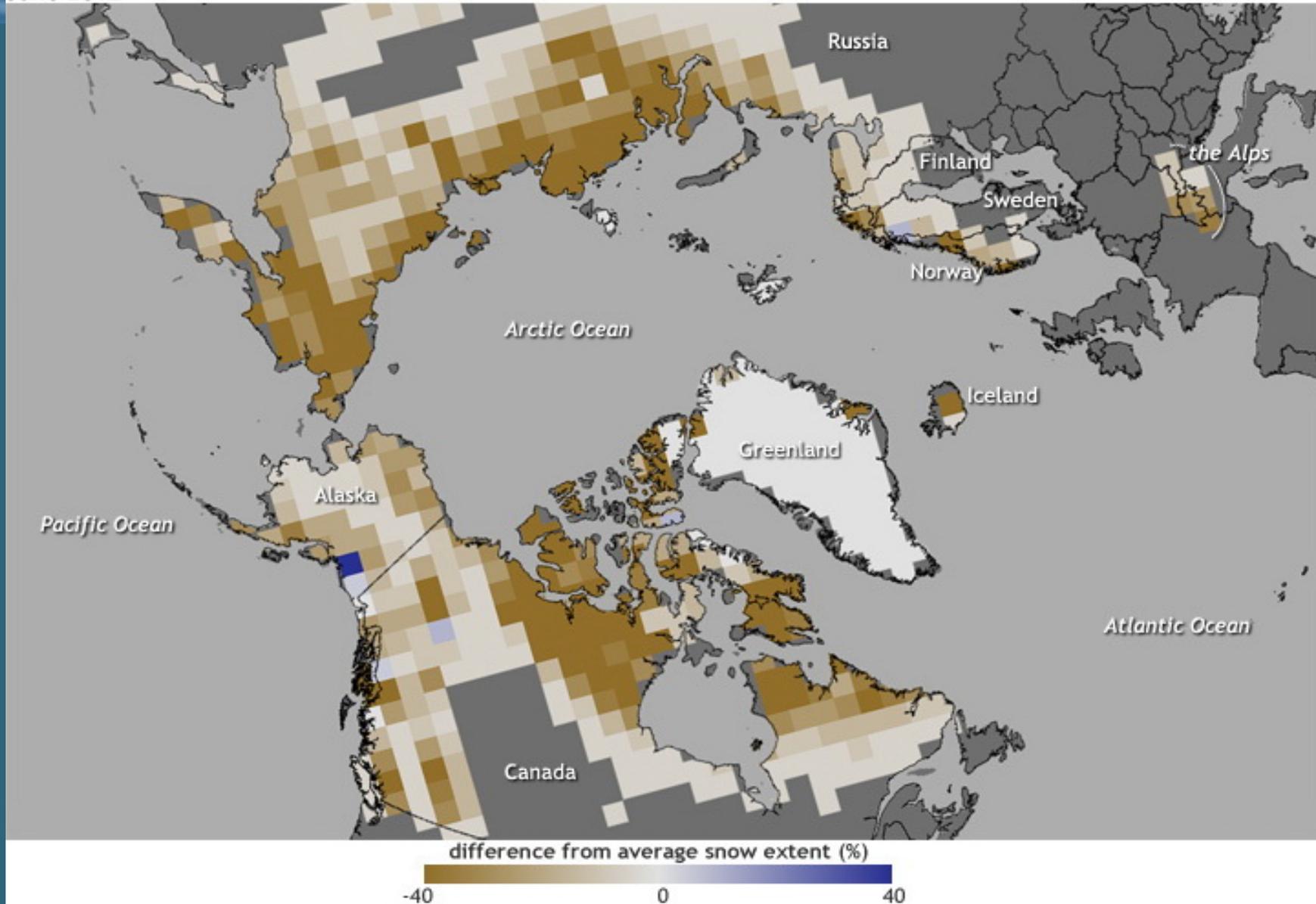
## Interior Alaska





## June Snow Cover 2012 relative to 1971-2000

June 2012



## River transport into the Arctic Ocean



Carmack/Winsor/Williams\_2015

# Arctic Temperature

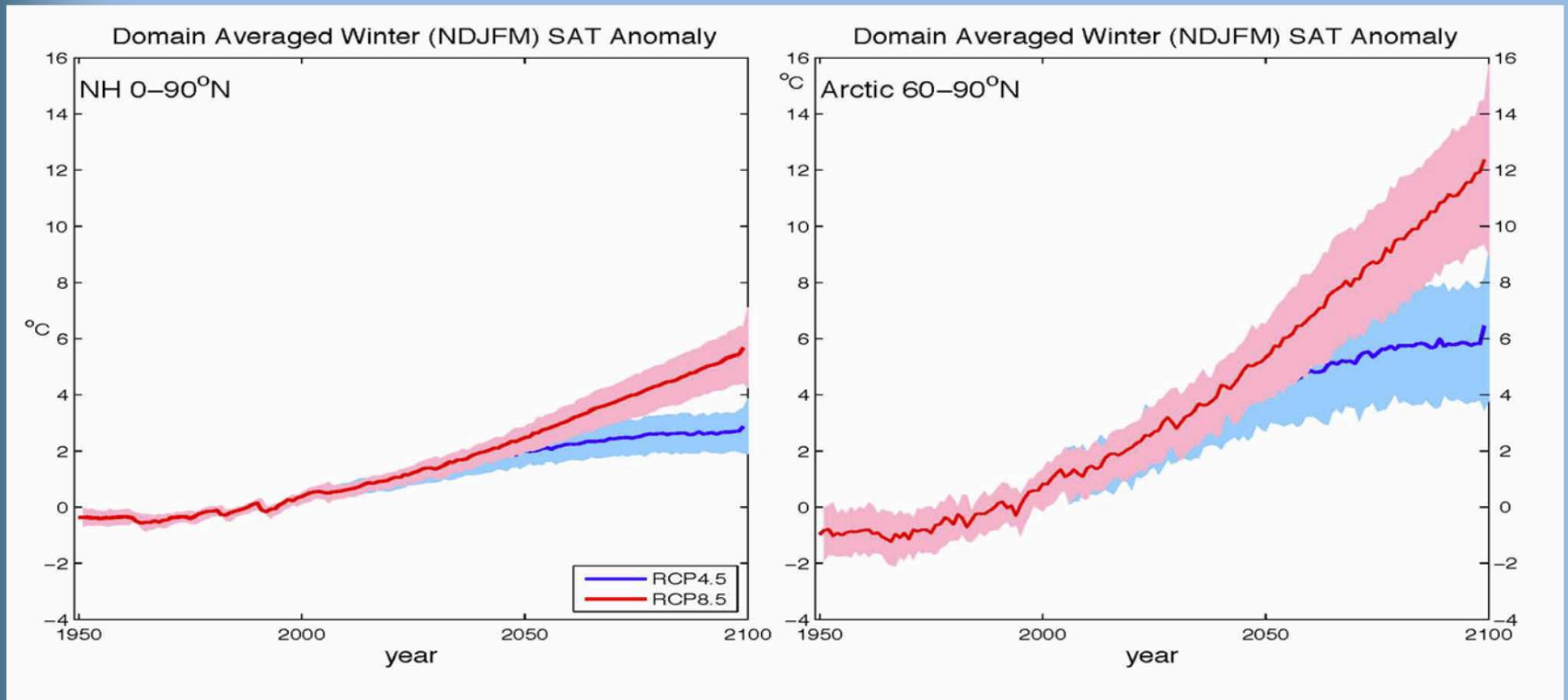
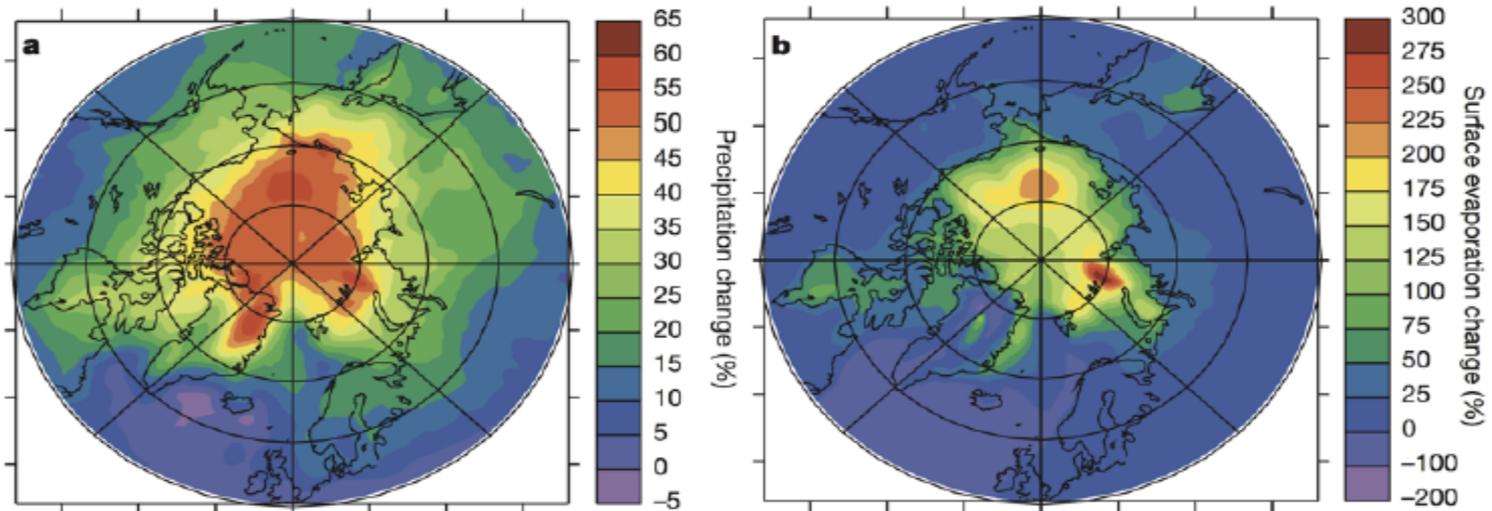


Figure reproduced from Redone figures from the Pithan feedback paper and the Arctic temperature plot from our Earth's Future paper (Overland et. al. 2014)

# A future, wetter Arctic

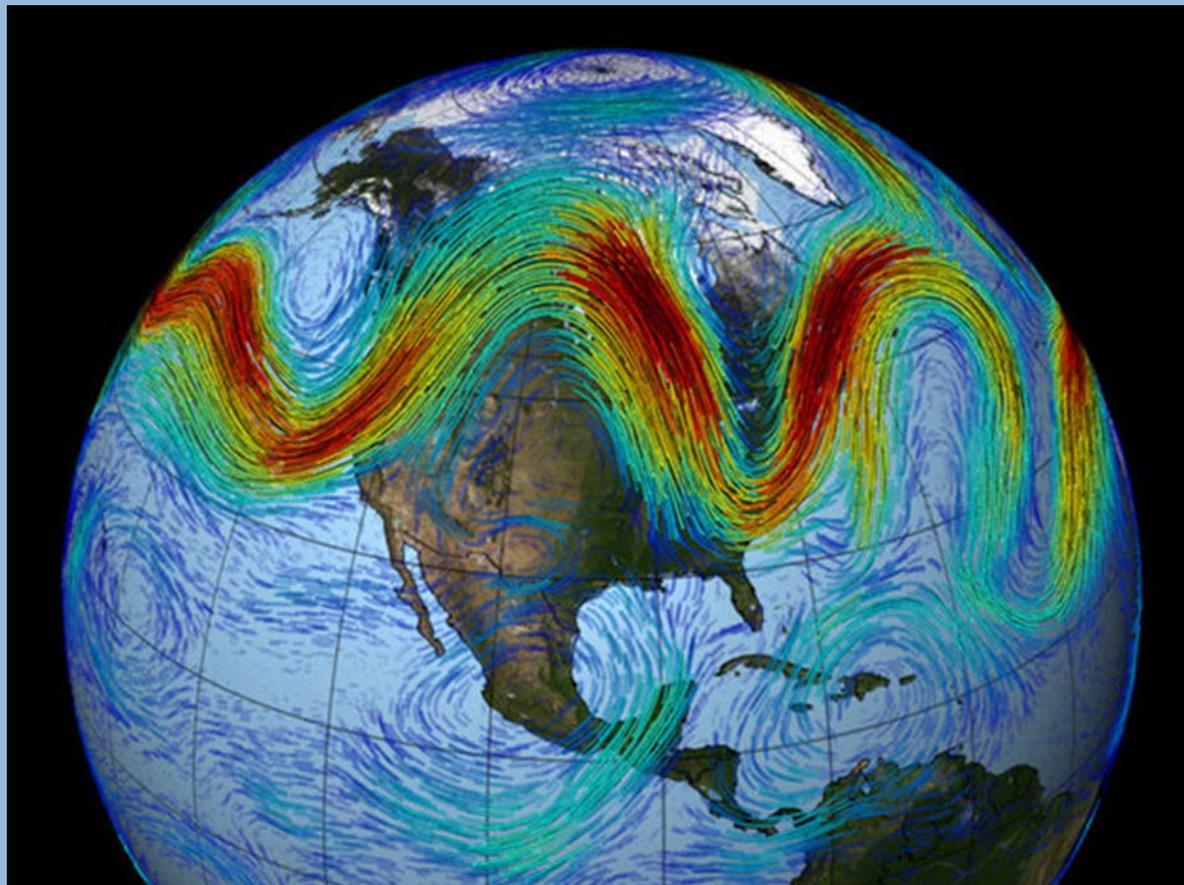


In general, CMIP5 models predict that sea ice loss will lead to more precipitation (left), caused by more evaporation (right).

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## **Change of the Arctic Dome & Jet Stream is affecting the Global Climate**



---

## 4. Permafrost-related processes, coastal erosion, thermokarst and recent changes in thaw lake development

Marina Leibman, Alexandr Kizyakov, Guido Grosse, Benjamin M. Jones, Torre Jorgenson, Mikhail Kanevskiy

????????????



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## Effects due to Action on SLCP by 2050

Arctic warming due to all climate forcers of approximately 2 C.

Mitigation of SLCP are actions that complement (not replace) CO<sub>2</sub> reductions.

Reducing BC and co-emitters globally may slow warming by 0.25 C.

Global mitigation of all SLCPs (methane, BC and co-emitters) could reduce warming by roughly 0.5 C.

Arctic warming is partly a result of SLCPs emitted outside the Arctic countries;

Fully effective mitigation efforts require engagement of non-Arctic countries.

# Ocean Acidification

Arctic marine waters are experiencing widespread and **rapid ocean acidification**

The **primary driver** of ocean acidification is uptake of CO<sub>2</sub> emitted to the atmosphere by **human activities**

The Arctic Ocean is especially **vulnerable** to ocean acidification

Acidification is **not uniform** across the Arctic Ocean

pH	H <sup>+</sup> (moles per liter)	change in acidity
7.2	$6.3 \times 10^{-8}$	+900%
7.3	$5.0 \times 10^{-8}$	+694%
7.4	$4.0 \times 10^{-8}$	+531%
7.5	$3.2 \times 10^{-8}$	+401%
7.6	$2.5 \times 10^{-8}$	+298%
7.7	$2.0 \times 10^{-8}$	+216%
7.8	$1.6 \times 10^{-8}$	+151%
7.9	$1.3 \times 10^{-8}$	+100%
8.0	$1.0 \times 10^{-8}$	+58%
8.1	$7.9 \times 10^{-9}$	+26%
8.2	$6.3 \times 10^{-9}$	

*Average global surface ocean pH has fallen from a pre-industrial value of 8.21 to 8.10, corresponding to an increase in acidity of 28.8%. Values of 7.8–7.9 are expected by 2100, representing a 100–150% increase in acidity (NOAA/PMEL)*

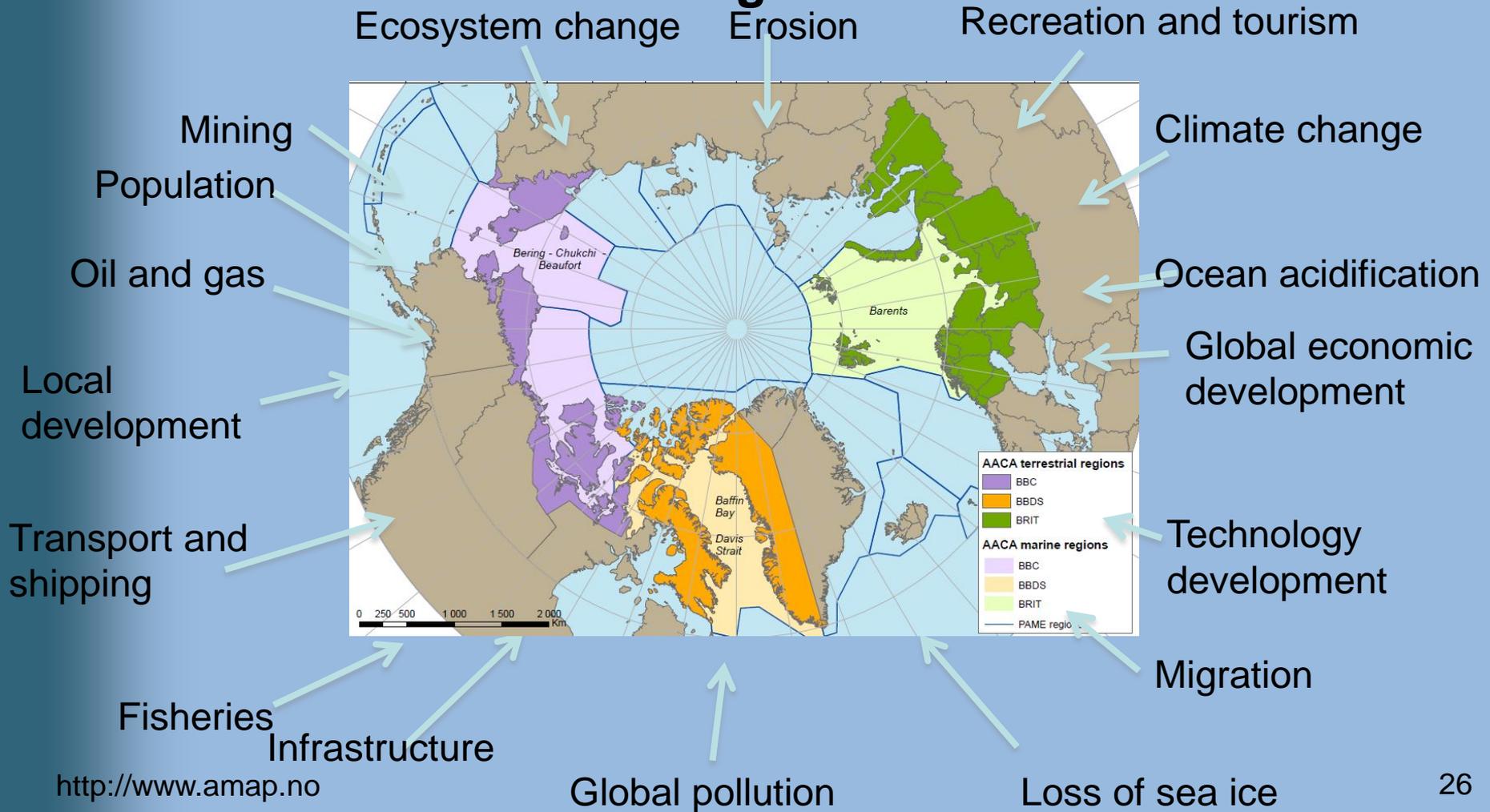


# AMAP

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### Adaptation Action to a Changing Arctic (AACCA)

#### Drivers of Arctic Change



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## The charismatic losers: Walrus: Calves get separated from their mothers; Haul-outs are on land



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### From Science to Policy:

- Reduced radioactivity risks (1996 – 2014)
- Food advice to Arctic peoples
- UNECE Århus Protocols (1998)
- UNEP Stockholm Convention on POPs (2001 > entry into force 2004)
- UNFCCC COP & IPCC (2004 - 2014)
- UNEP Minamata Convention on Hg (2013 > entry into force ?)

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Shaken not stirred!

