Understanding the societal and climatic influences of arctic sea ice loss

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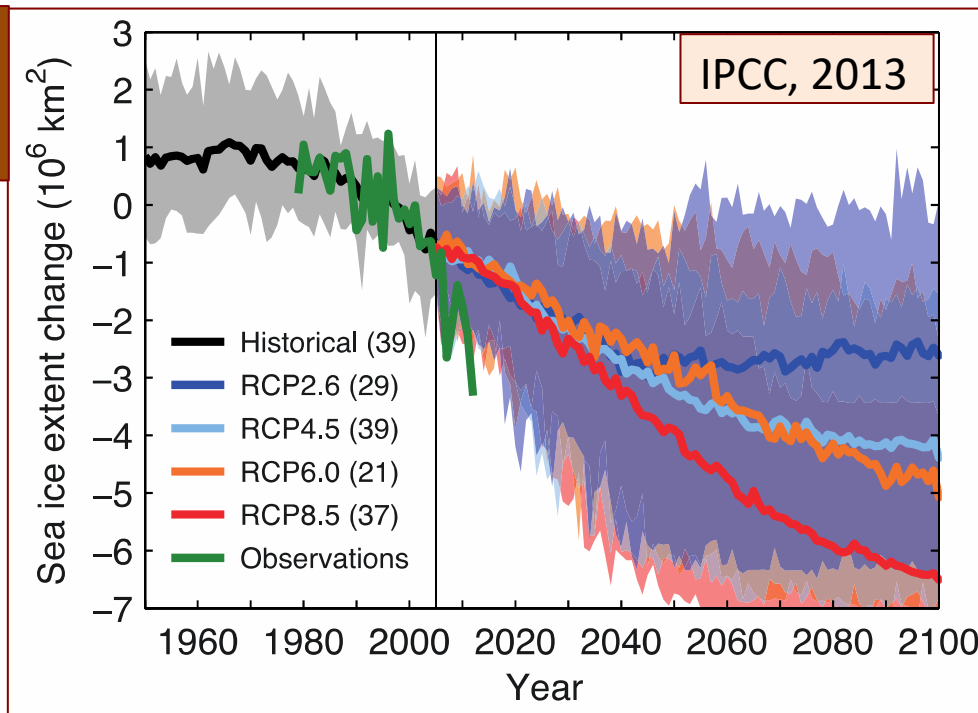1. University of Bergen; 2. Stefansson Arctic Institute

Grímsey

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Global warming is causing a long-term decline of Arctic sea ice

Arctic sea ice cover: observations and model projections

IPCC, 2013

What are the affects on climate and society? We focus on the

1. Socio-economic impacts on two Arctic communities
2. Northern hemisphere atmospheric circulation

Societal Context

➢ The Arctic is no longer a place of isolation and local livelihoods and global processes are closely interlinked.

➢ Numerous complex developments must be considered, not just with regard to climate change.

➢ Small Arctic communities reflect the interplay between local and global change.

TWO ARCTIC COMMUNITIES

ITTOQORTOORMIITT

➢ Current community established in 1925
➢ Population ~400
➢ This hunting is still a significant cultural-economical factor in the area
➢ Sea ice has so far prevented exploitation of rich fishing grounds
➢ Tourism is growing in importance, but is problematic
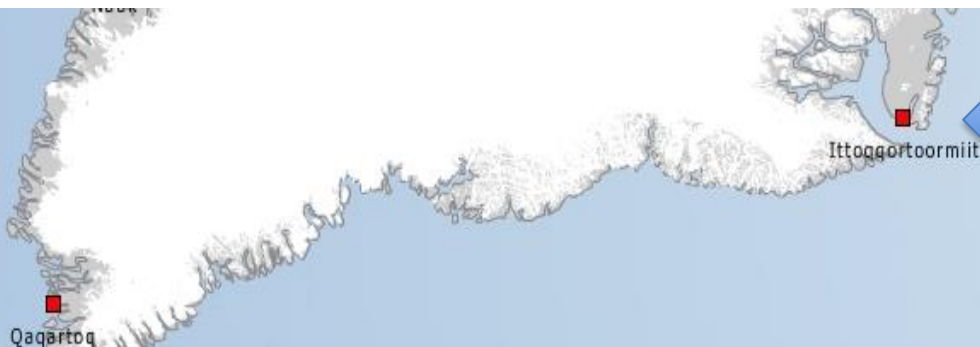
ITTOQORTOORMIITT

GRÍMSEY

➢ Community established in AD 871 onwards
➢ Population ~90
➢ The most important economic activity is fishing and fish processing.
➢ Tourism is growing in importance, but is also problematic

GRÍMSEY

2061.5 km

An interesting example of sea ice impacts

Locals comment on stronger winds in recent times, and say that when these interact with local currents, these can cause conditions that prevent fishing, and also become hazardous for small-boat activities.
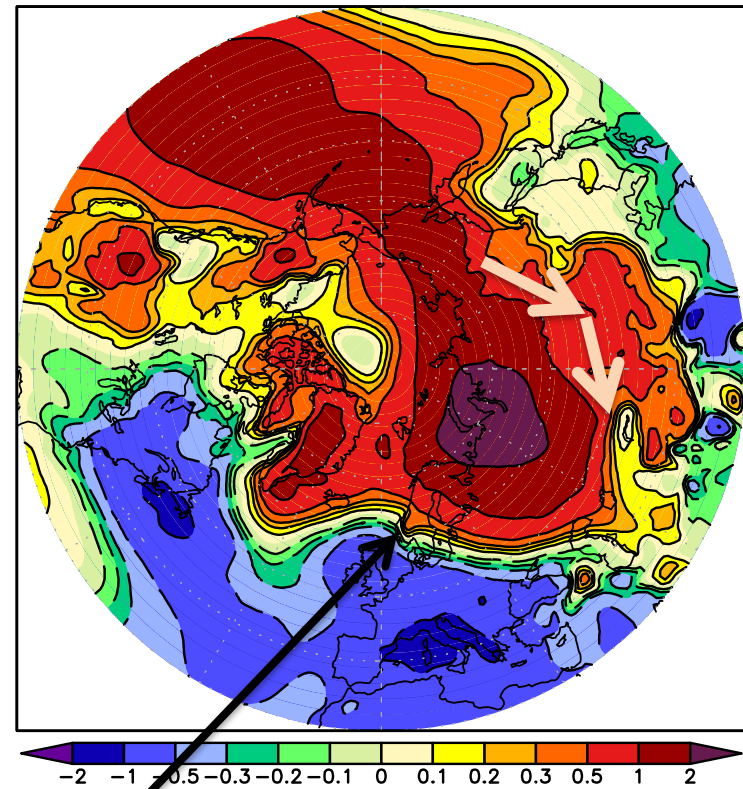
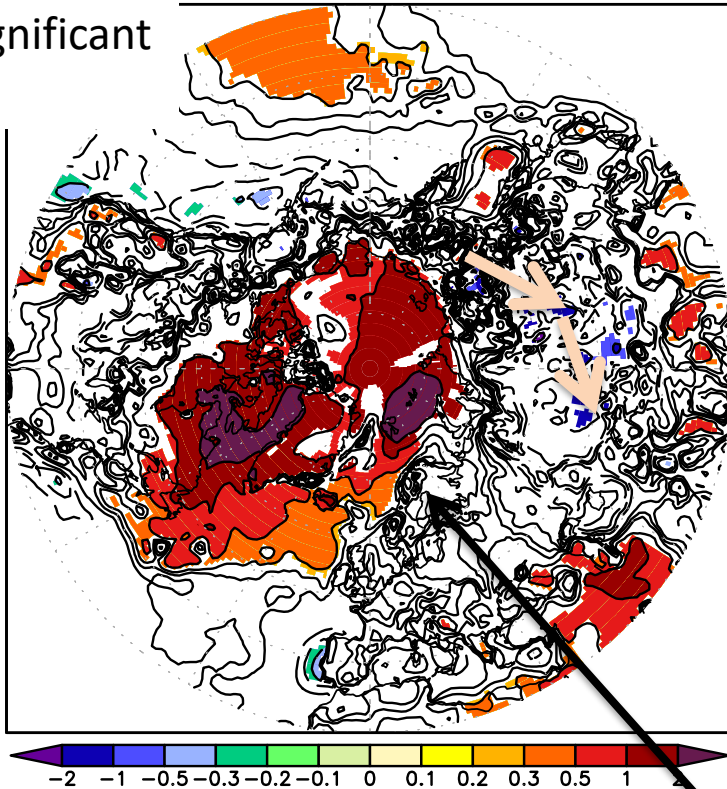# How has sea ice decline impacted climate?

Impacts on trends, variability, and extremes remain controversial

Observed winter time (DJF) linear trend from 1982-2014 (ERA-interim)

2-meter temperature (K/decade)

Sea level pressure (hPa/decade)

95% significant trends

Norway

Coordinated atmospheric model experiments

To achieve robust understanding of sea ice impacts in recent decades

Seven different atmospheric models (currently five)
- CAM4, WACCM, IFS, LMDZOR, AFES, ECHAM5, IAP

Two experiments to separate impacts of sea ice and sea surface temperature (SST) during 1982-2014
1. Observed daily varying sea ice and SST
2. Observed daily varying sea ice, but climatological SST

Large 20 member ensembles to better account for internal atmospheric dynamics

I will present results on the linear trend

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Models capture autumn 2m temperature trends

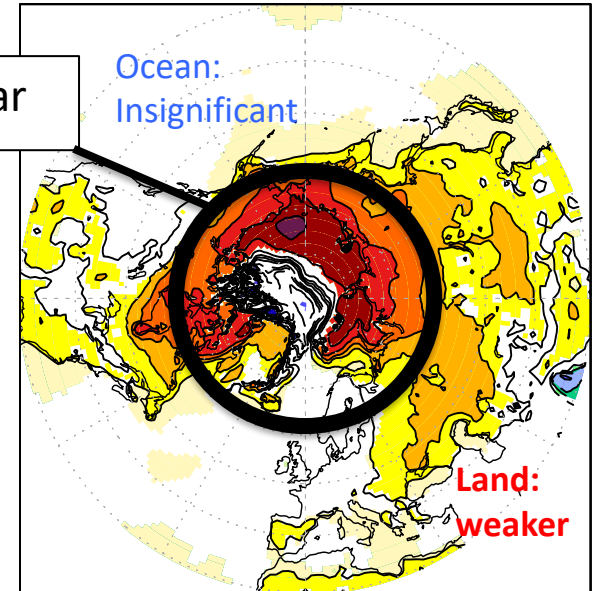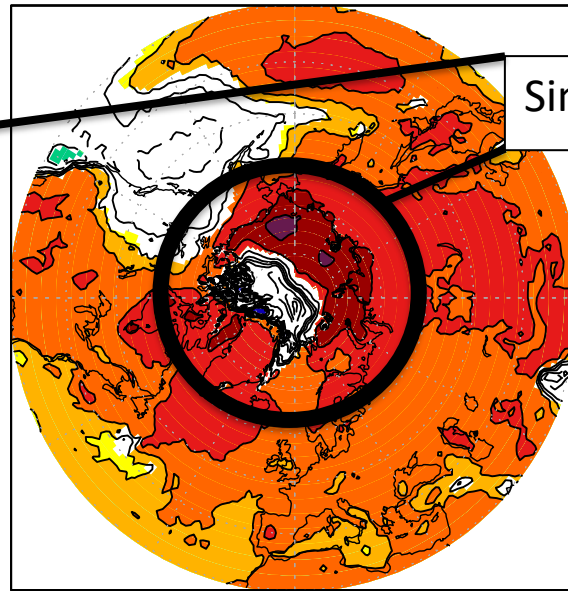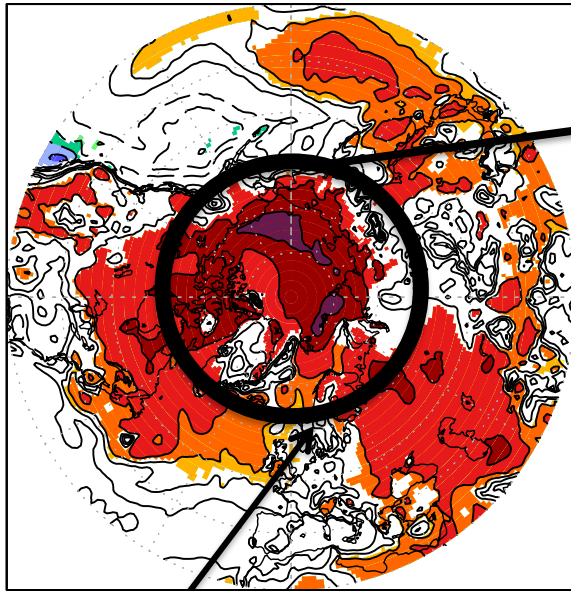SON linear trend from 1982-2014 (K/decade)

ERA-Interim Obs. reanalysis

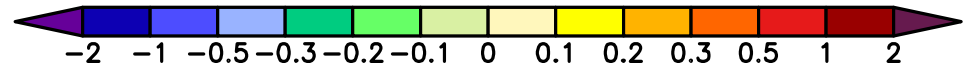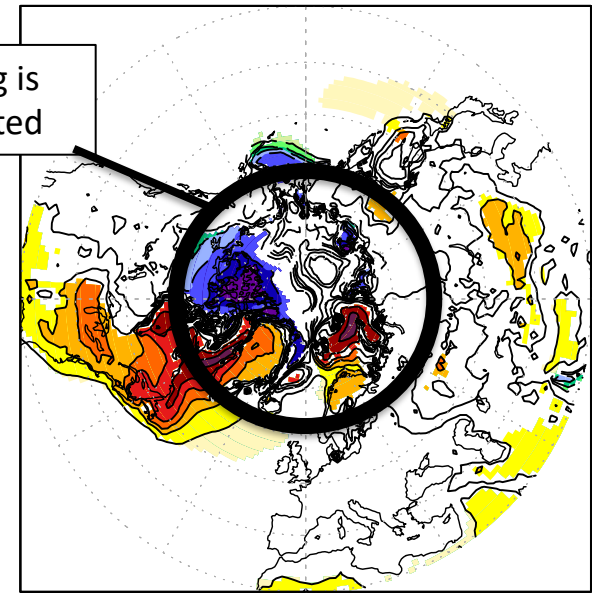Simulated with CAM4 atmospheric model

Sea ice and SST impact

Only Sea ice impact

Similar

Ocean: Insignificant

Land: weaker

Shaded for 95% confidence.

Norway

In autumn results consistent among models

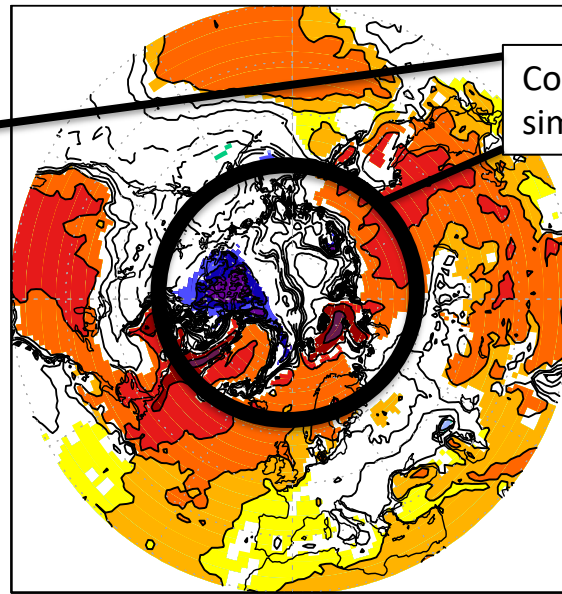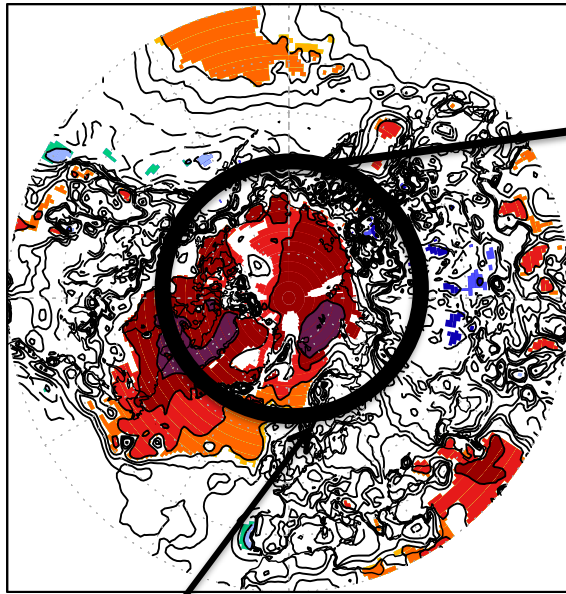# Models <u>do not</u> capture winter time trends

DJF linear trend from 1982-2014 (K/decade)

ERA-Interim Obs. reanalysis

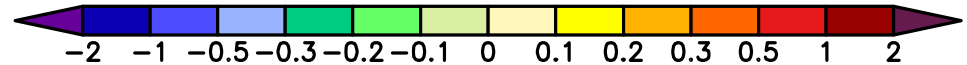Simulated with CAM4 atmospheric model

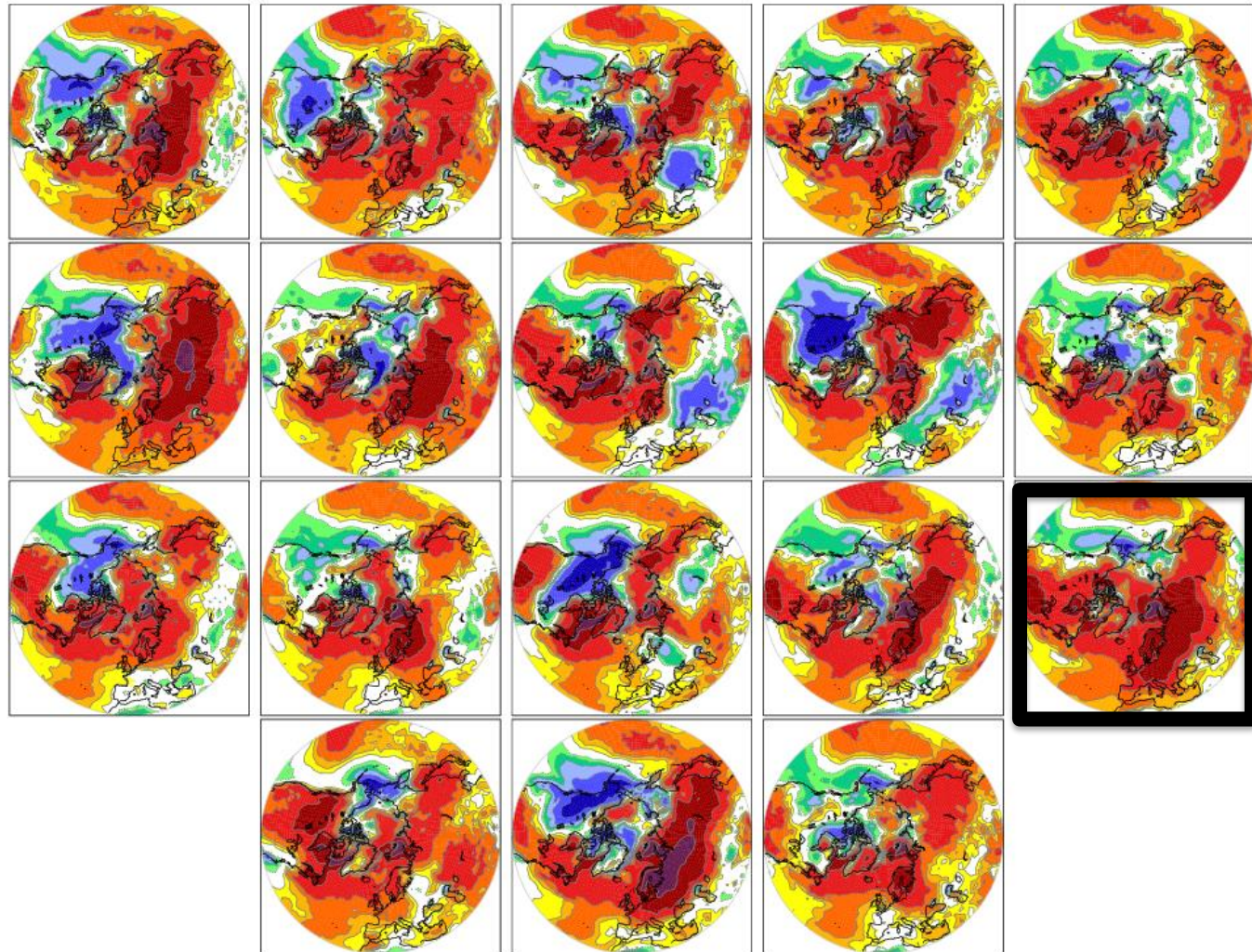Sea ice and SST impact
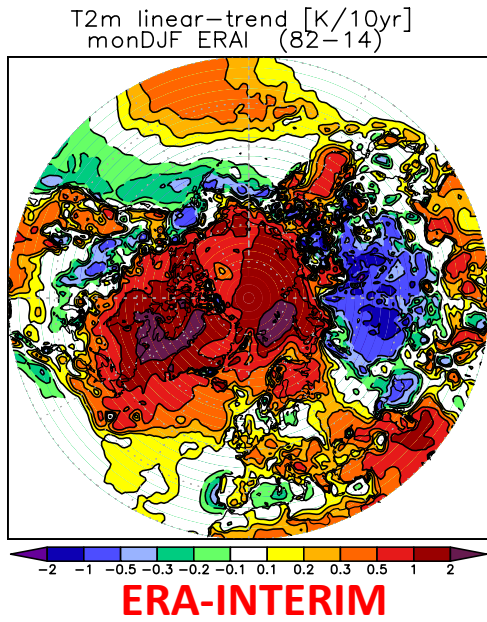
Only Sea ice impact

Cooling is simulated

Shaded for 95% confidence.

Norway

−2 −1 −0.5 −0.3 −0.2 −0.1 0 0.1 0.2 0.3 0.5 1 2

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LMDZOR, Sea ice and SST forcing

T2m linear-trend [K/10yr]
monDJF ERAI (82-14)

ERA-INTERIM

-Observation is one realization.

Shows surface polar warmings. (But SLP pattern is not negative AO-like.)

GREENICE is leading to significant insights

- Into the viability and adaptability of Arctic communities with regard to rapid climatic and other global changes.

- Into the extent to which sea ice decline has and will affect climate.

- Current results an important impact in boreal autumn, but little impact over the northern hemisphere in winter

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