Bjerknes Centre for Climate Research

A PRESENTATION OF THE

The Bjerknes Centre for Climate Research: an overview

"The aim of the Bjerknes Centre is to understand and quantify the climate system for the benefit of society"
Tore Furevik, Ph.D. – Director (presented by Stefan Sobolowski)

Bjerknes Centre for Climate Research

An umbrella organisation gathering the four major institutions in climate research in Bergen:

University of Bergen

UNI Research AS

Nansen Environmental and Remote Sensing Center

Institute of Marine Research

Co-located with the Geophysical Institute, UiB the historical building that since housed the *Bergen School of Meteorology* since 1928

Vilhelm F. K. Bjerknes

(1862-1951)

- The father of modern Meteorology
- Founder of the *Bergen School of Meteorology* (1917-1926)

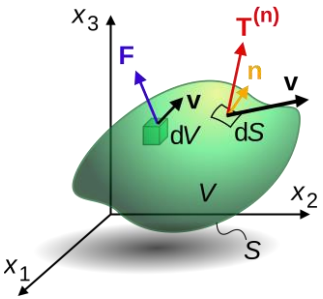
Jacob A. B. Bjerknes

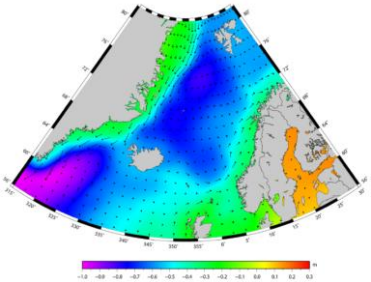
(1897-1975)

- Norwegian Cyclone Model (1917)
- Atlantic air – sea interaction (1964)
- *El Nino – Southern Oscillation* (1969)

- Started as a Norwegian *Centre of Excellence* 2003-2012. Now funded directly by the government until 2021
- Basic research on past, present and future climates
- Unique expertise and interdisciplinarity: Meteorology, physical and chemical oceanography, mathematics, biogeochemistry, palaeoclimates, paleobotany, marine biology & modelling

……. combining observations, theory and modeling

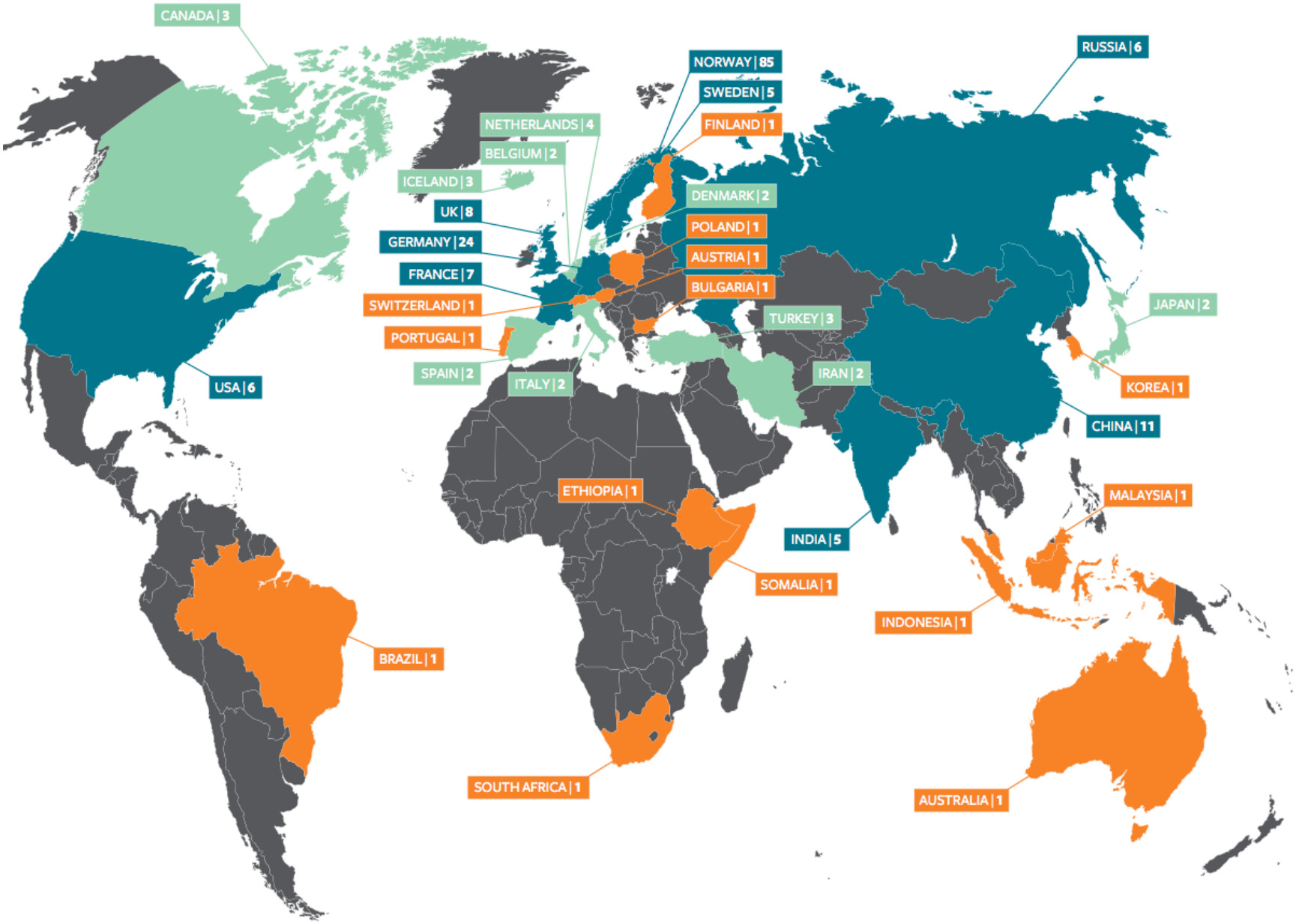




- Coordination: the national effort on the building and maintenance of the *Norwegian Earth System Model*
- Education: national research training of future generation of scientists in climate dynamics in Norway
- Internationalization: 190 scientists from 32 nationalities. Recruits from top institutions. Largest Nordic climate research centre, among the top-five in Europe

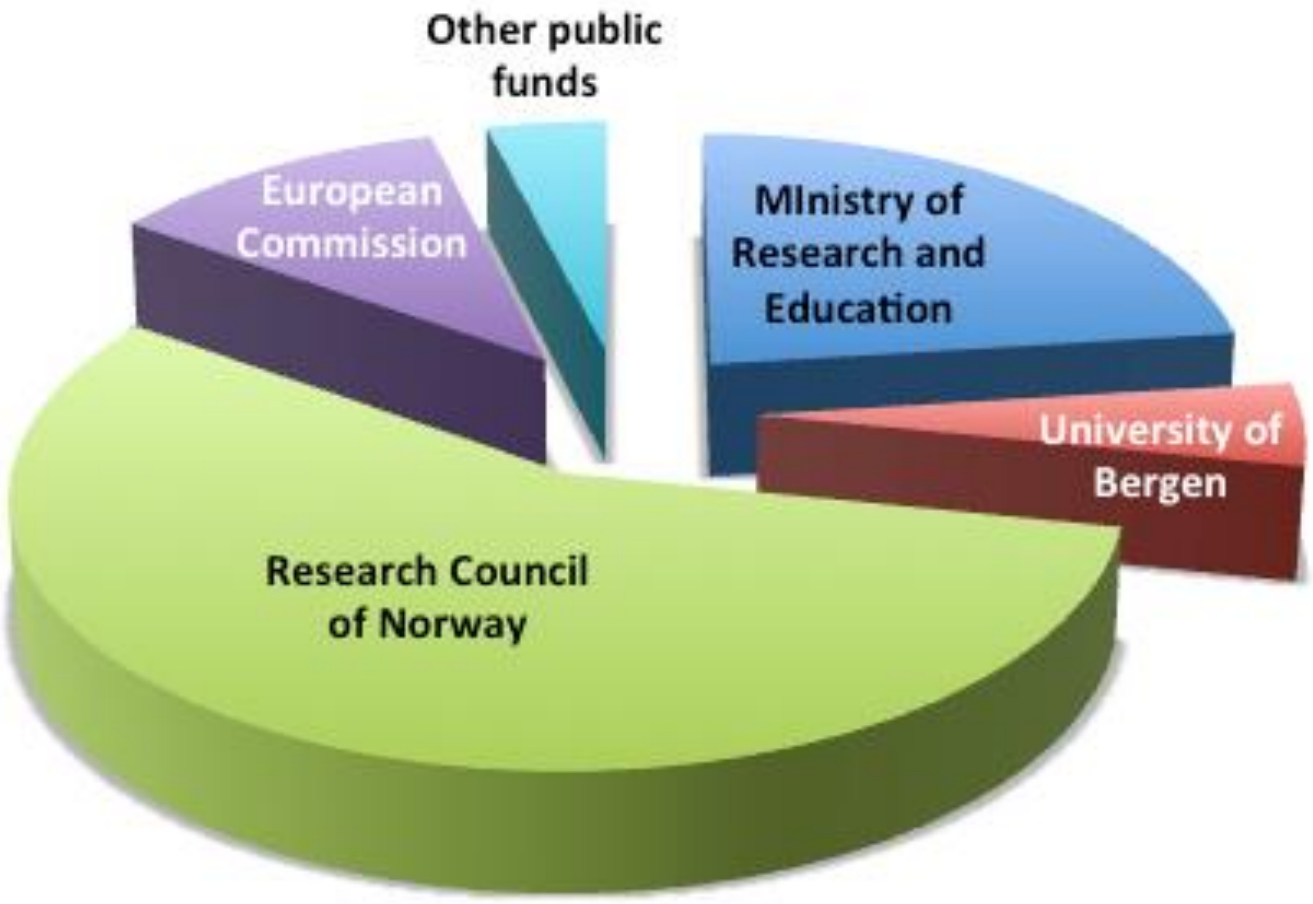
Bjerknes Centre for Climate Research

Scientists from 32 countries

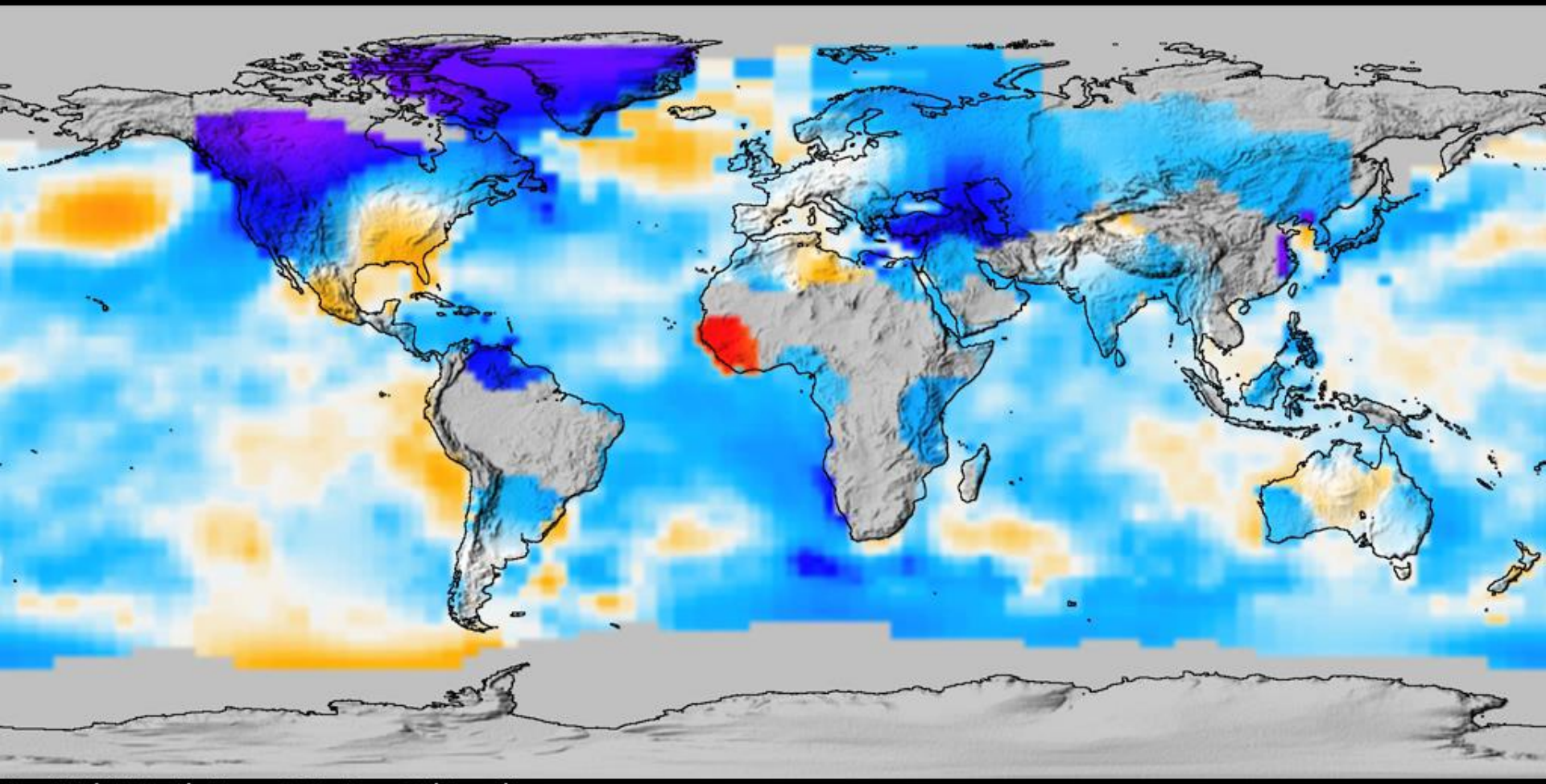


Basic funding + Project income

Total income 2014: 118 MNOK (14 M€)



1880

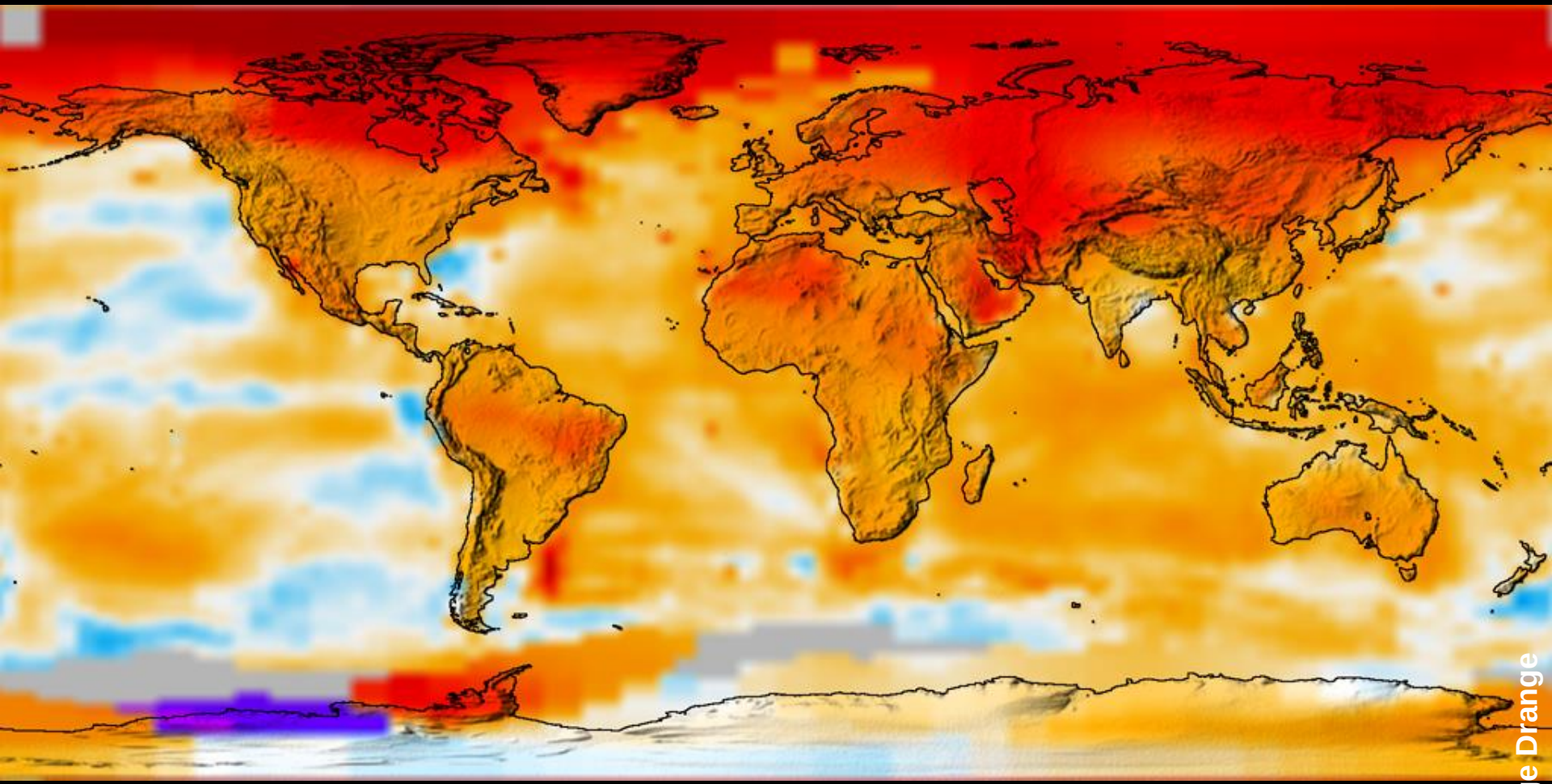


Data: NASA/GISS. Graphics: Bentsen, Bethke, Drange @ bjerknes.uib.no

3 yr averages (°C) relative to 1951-1980

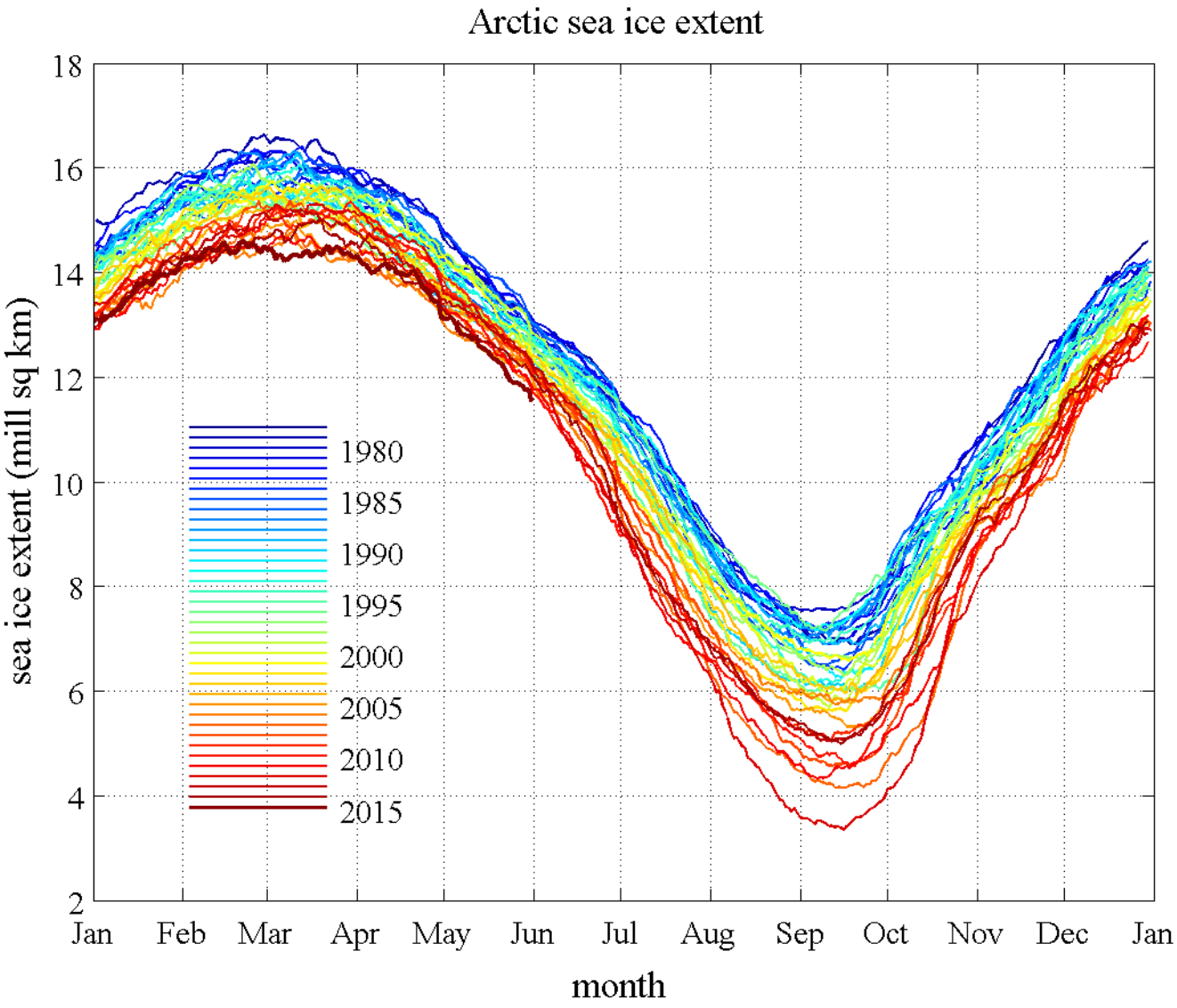
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0

Largest temperature increase in the north



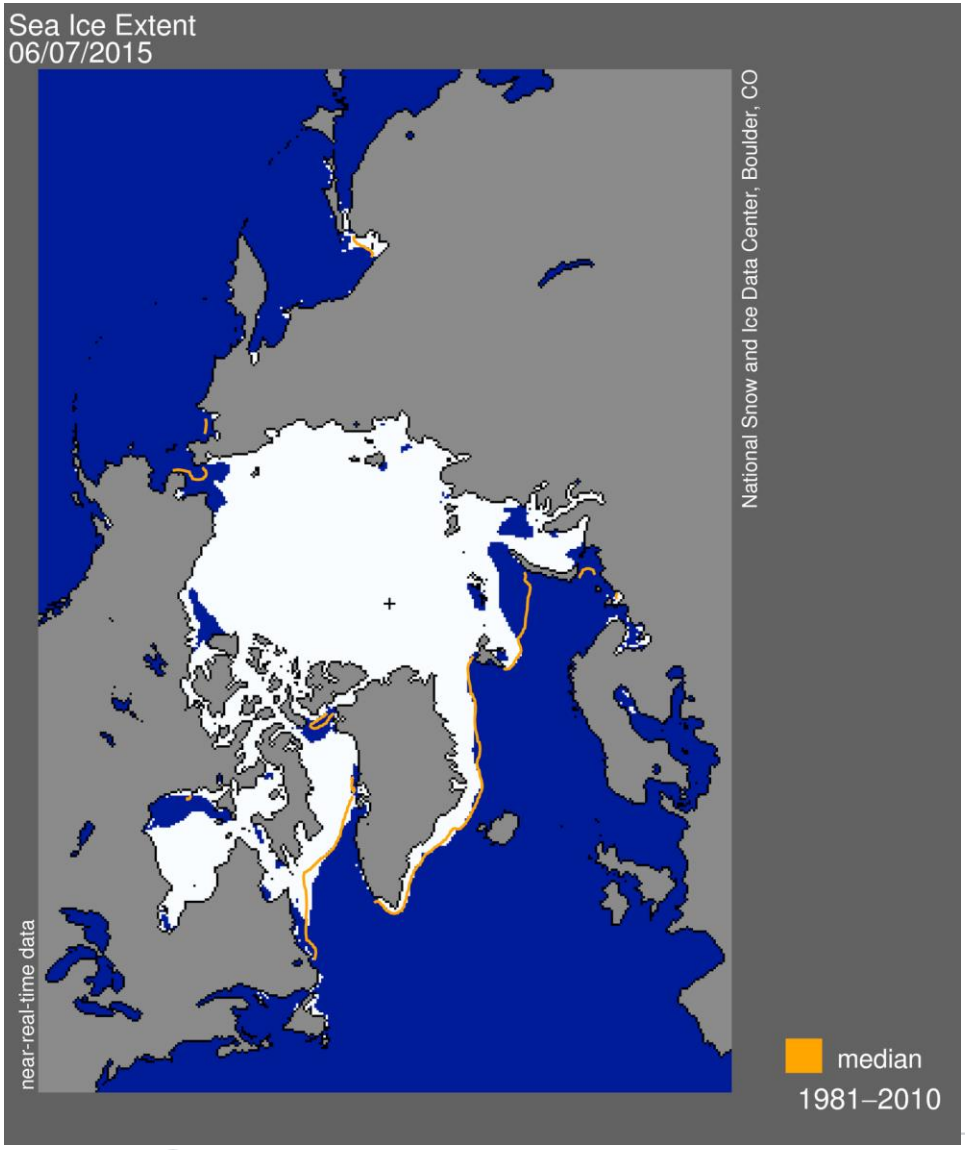
Courtesy Helge Drange

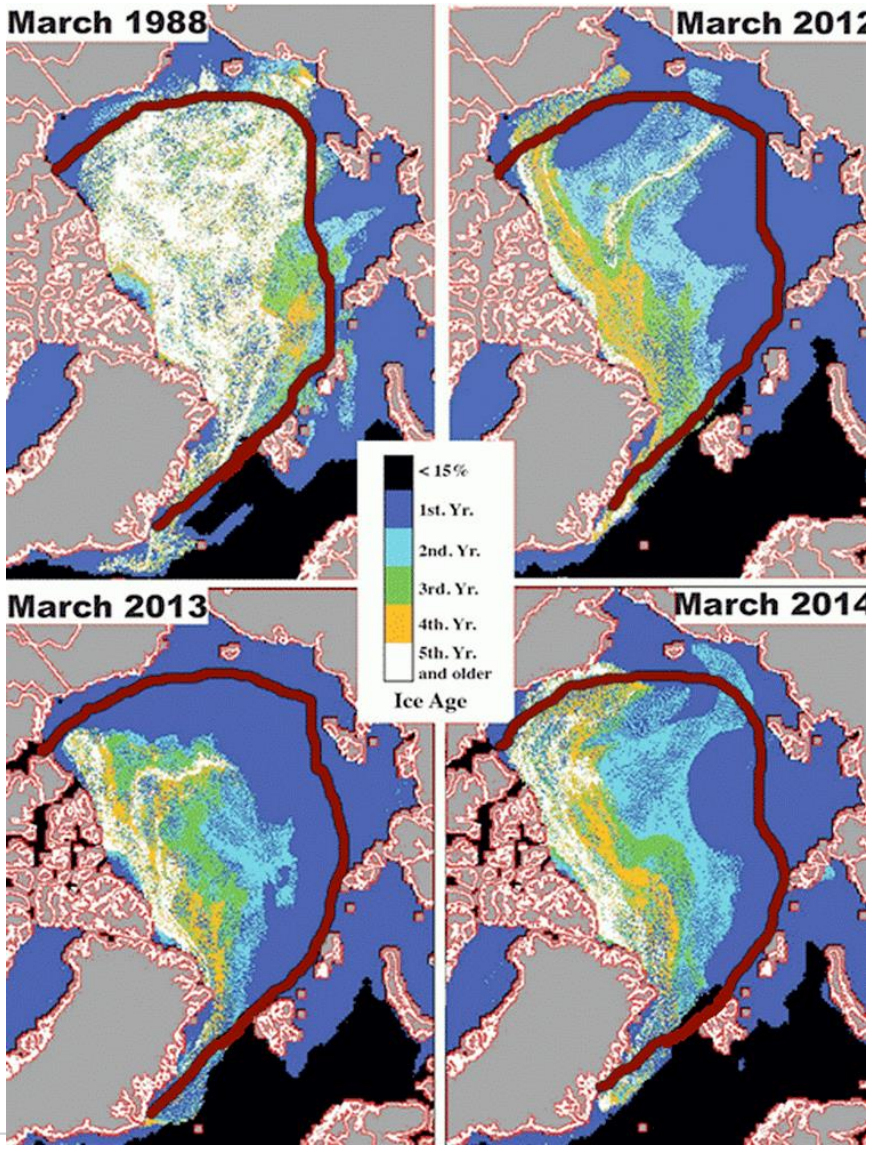
Arctic sea ice 1978 to present



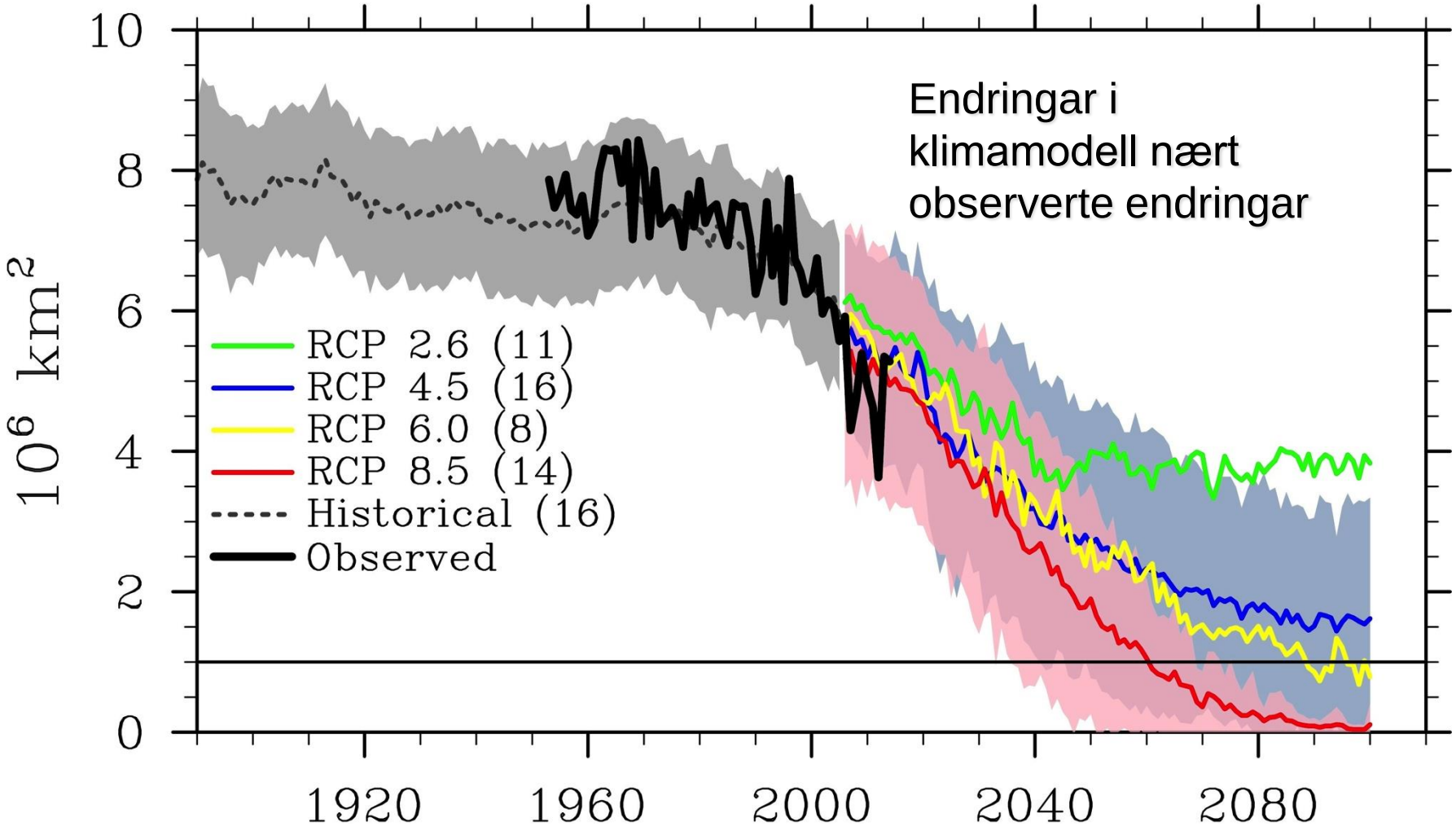
T Furevik, Bjerknessenteret

Sea ice extent – sea ice age





Arctic sea ice toward 2100



Julienne Stroeve, NSIDC

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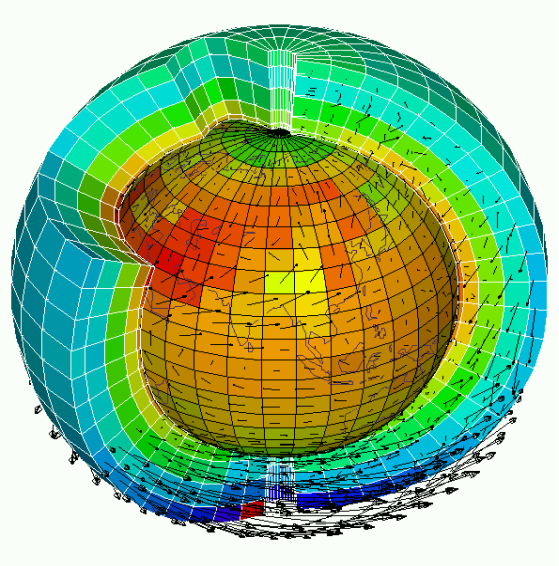
Regional climate research and climate services at the Bjerknes Centre

Stefan Sobolowski, Ph.D. Head – Regional Climate & Climate Services, Uni Research Klima

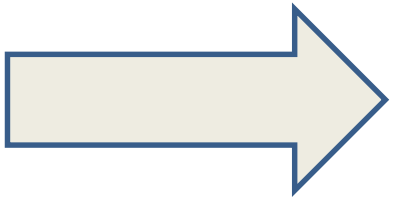
UNIVERSITY OF BERGEN uni Research NERSC Nansen Center, Bergen HAVFORSKNINGSINSTITUTTET INSTITUTE OF MARINE RESEARCH

Regional Climate Change
IMPACT2C



Global model

Zoom & Downscaling



Regional model

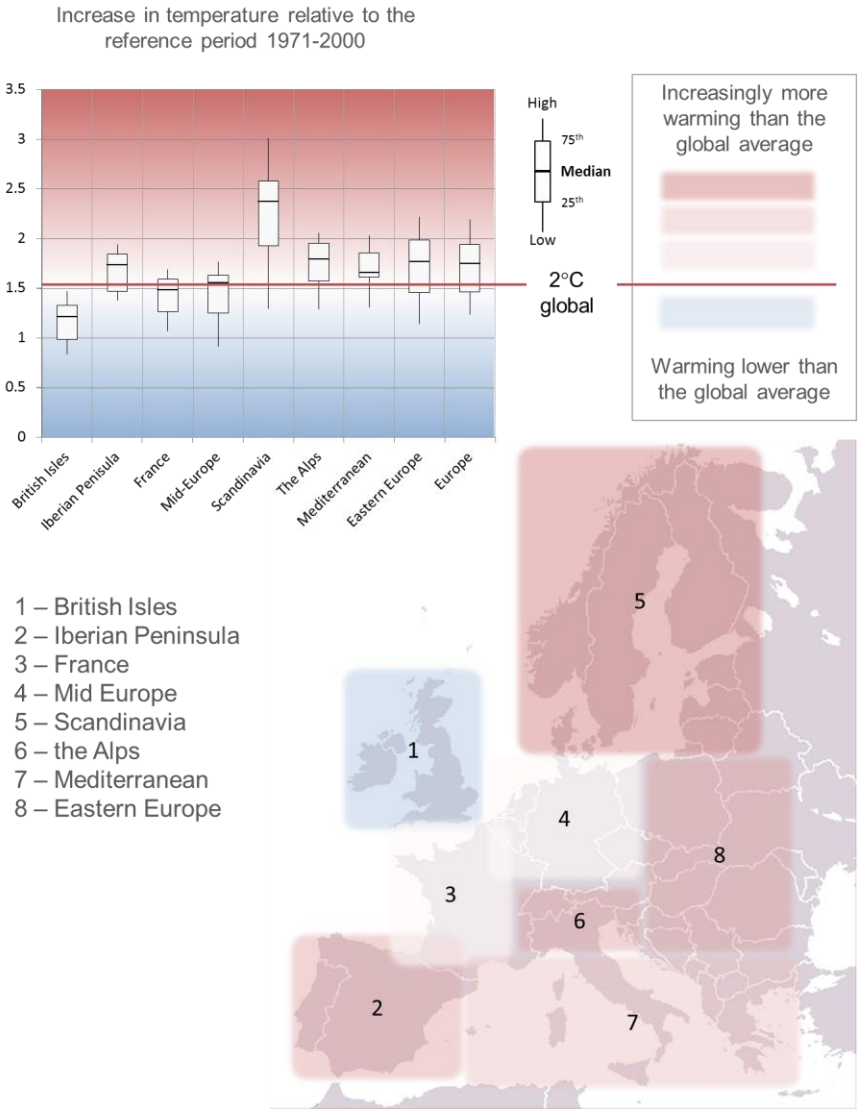
Why regional modeling?

- Higher resolution for impact studies, better description of extremes

Europe at the +2C Threshold

How much does Europe warm compared to the global average?

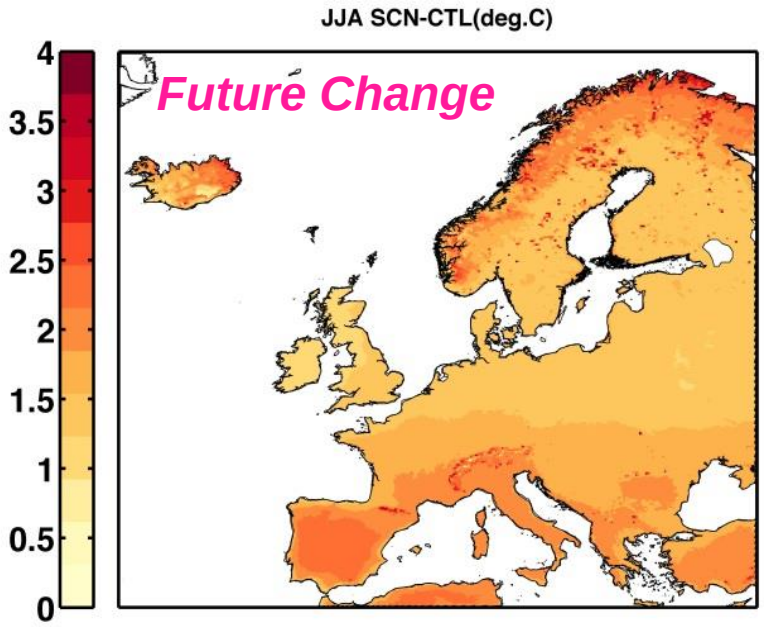
- Most regions in Europe warm more than global average
- Exceptions are British Isles, France, Germany and surrounding area



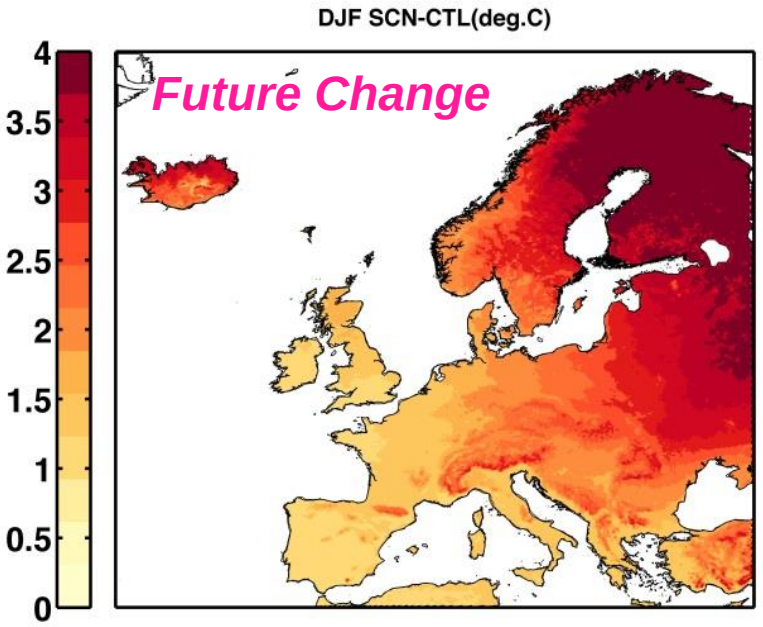
Source: Cathrine Fox Maule and Ole Bøssing Christensen, 2014.

Daily maximum(summer) and minimum(winter) at +2°C global warming:

- Daily max. temp. (3-4˚ C) over S, S-E Europe increase heat related impacts
- Daily min temp. (3 – 6°C) in North, Alps affect ecosystems and winter tourism.

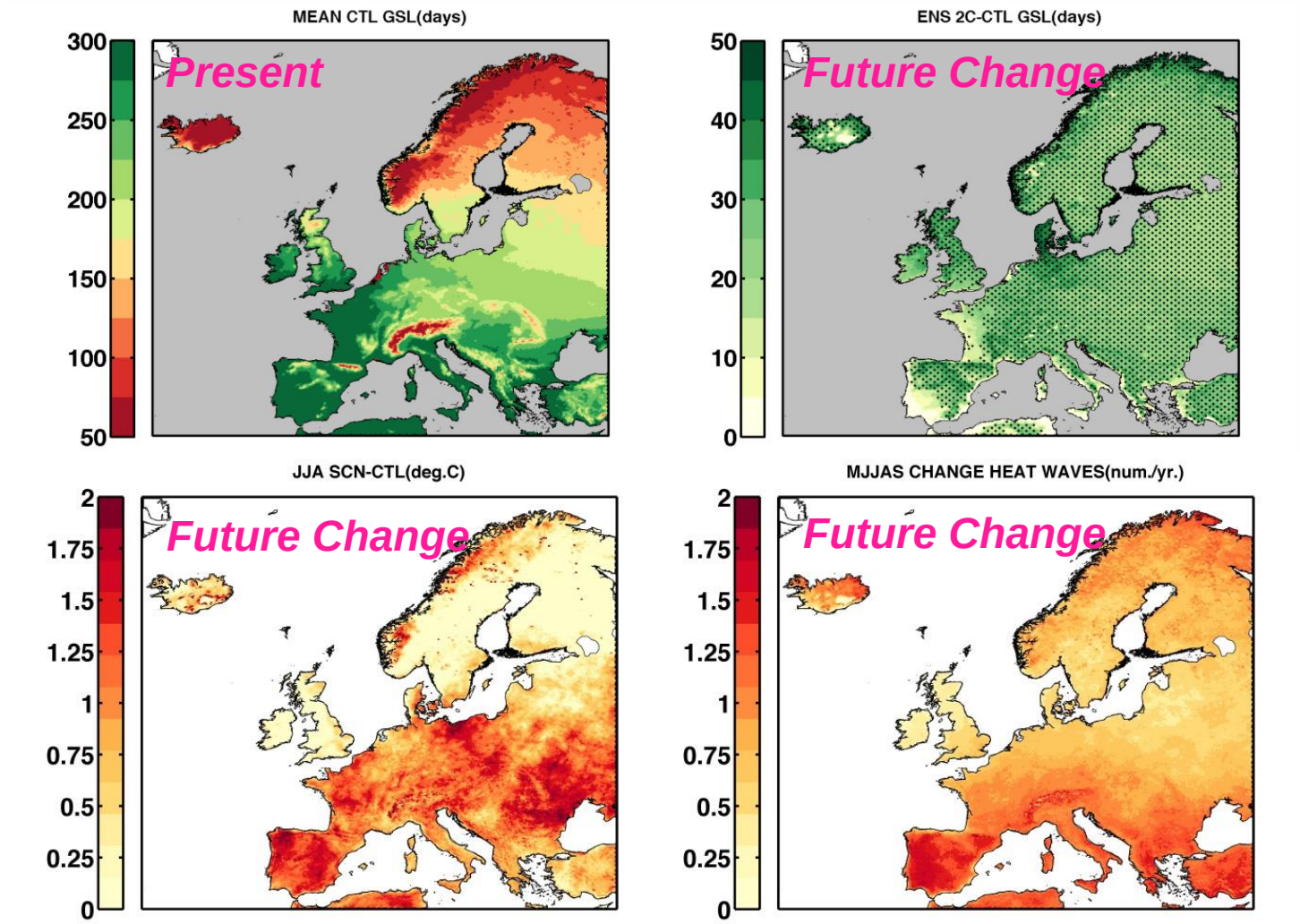


Tmax summer



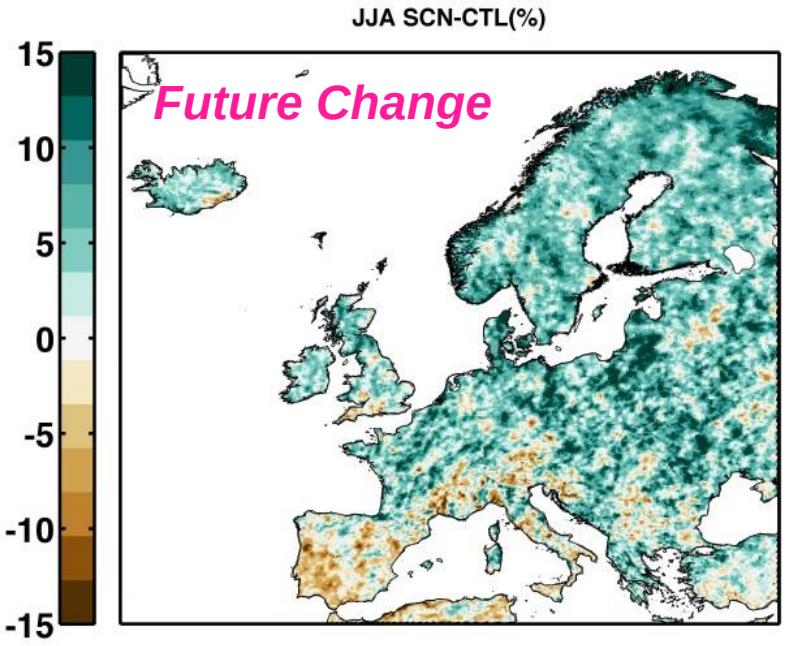
Tmin winter

Thermal Growing Season Length (top) increases, but... Must be interpreted with caution! Extreme heat can wipe out gains (bottom)

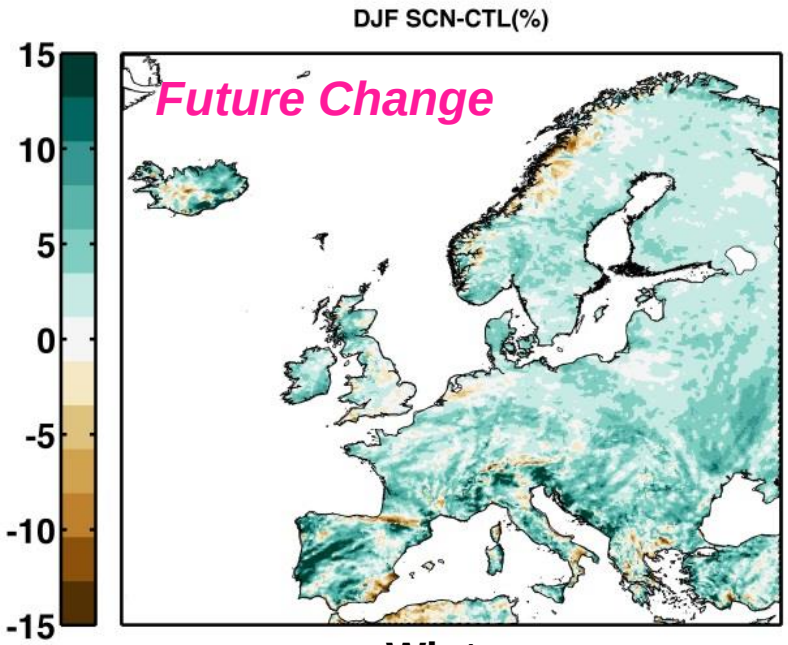


Heavy precipitation events (20 year return period) at +2°C: Increases across much of Europe but with N-S and seasonal differences

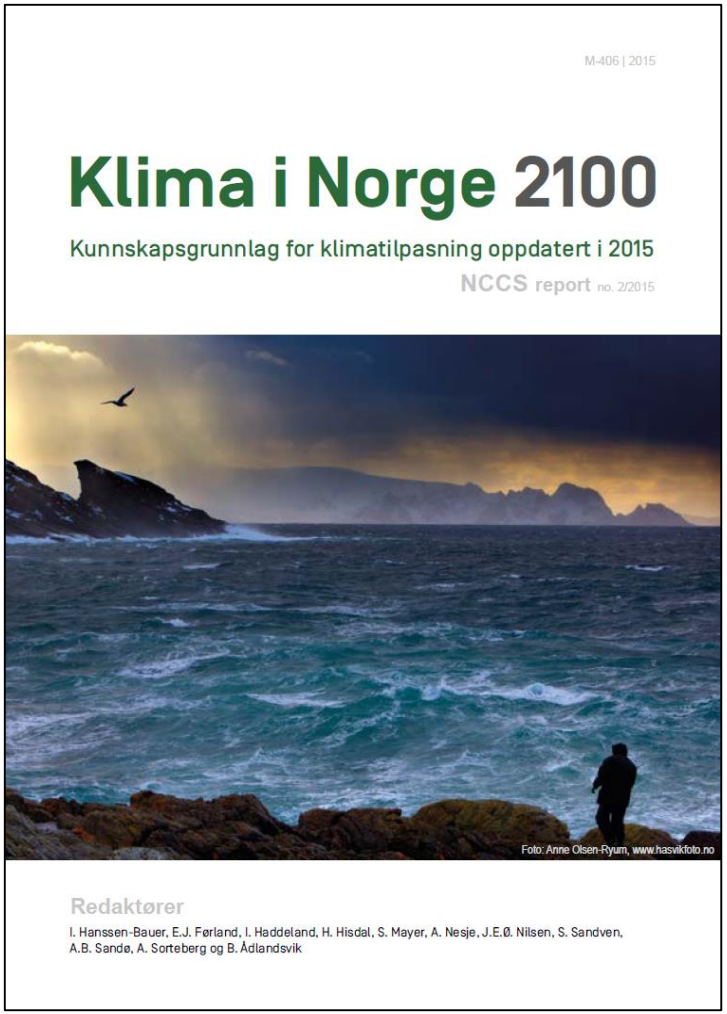
- Intensity increasing by +5% to +15%



Summer



Winter



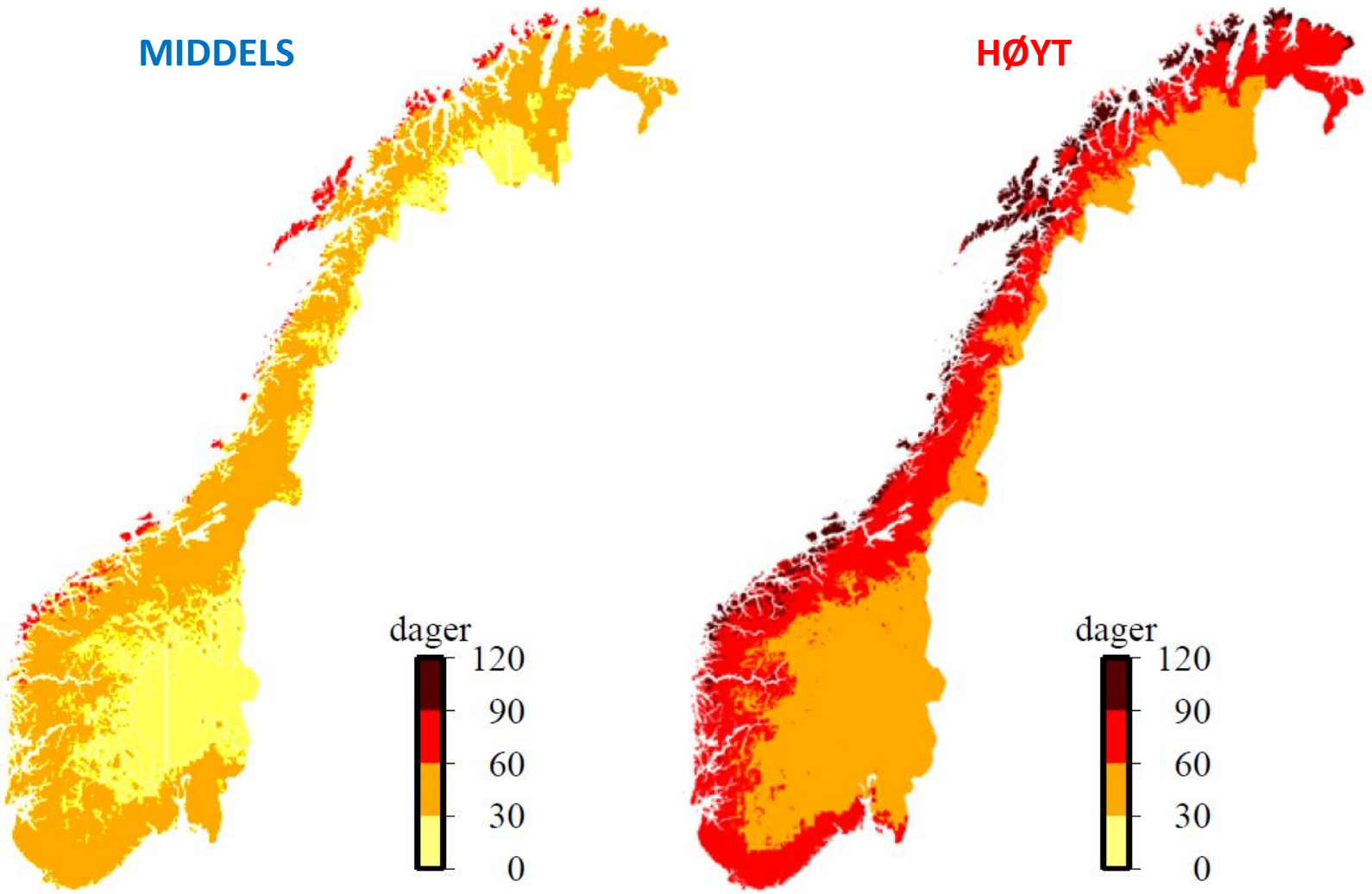
Norsk klimaservicesenter er et samarbeidsprosjekt mellom:

Meteorologisk institutt

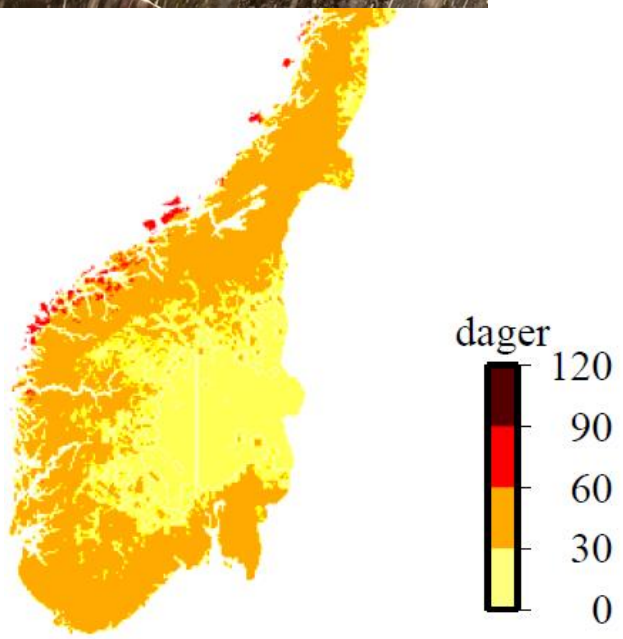
uniResearch

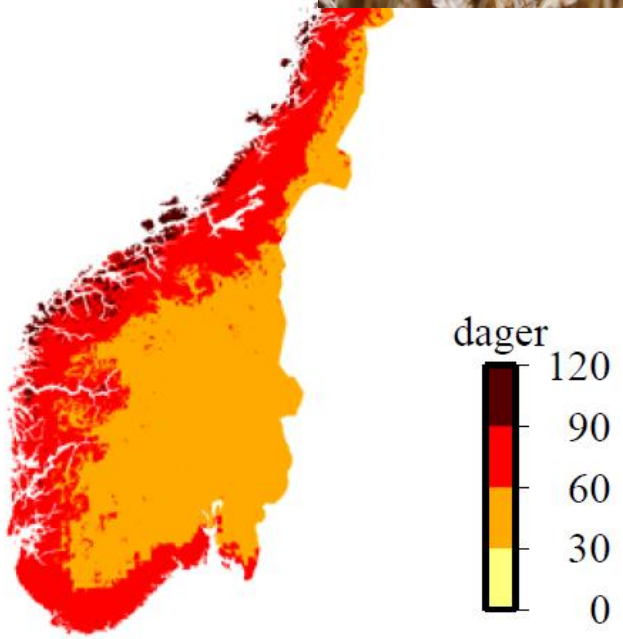
Norges vassdrags- og energidirektorat

Growing season lengthens



Growing season lengthens





New results: 3-hourly rainfall

- Short-duration high-intensity rainfall causes significant problems

- KiN has evaluated 3-hourly rainfall from 6 simulations (Euro-CORDEX)

- Under high emissions scenario
  - «2 x pr. år» median: + 20%
  - «5-årsverdi» med. : + 28%
  - «200-årsverdi» med.: + 38%

Disappearing glaciers

1996 (Foto: Stefan Winkler)

2014 (Foto: Erling Briksdal)

2100: Fewer glaciers. Those that remain will be much reduced.

Snowseason shortens

2100: In low-lying areas snow will be absent in some years while high altitudes could see much deeper snow packs but shorter seasons

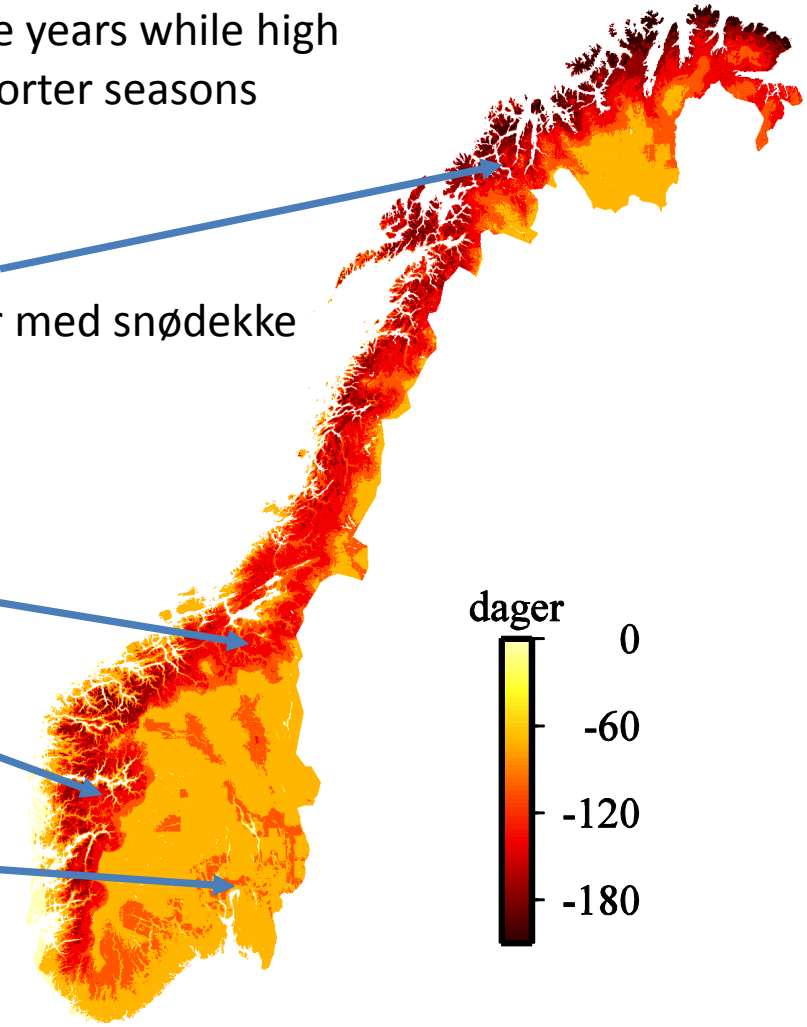
oto: Ingjerd Haddeland

– 4 færre måneder med snødekke

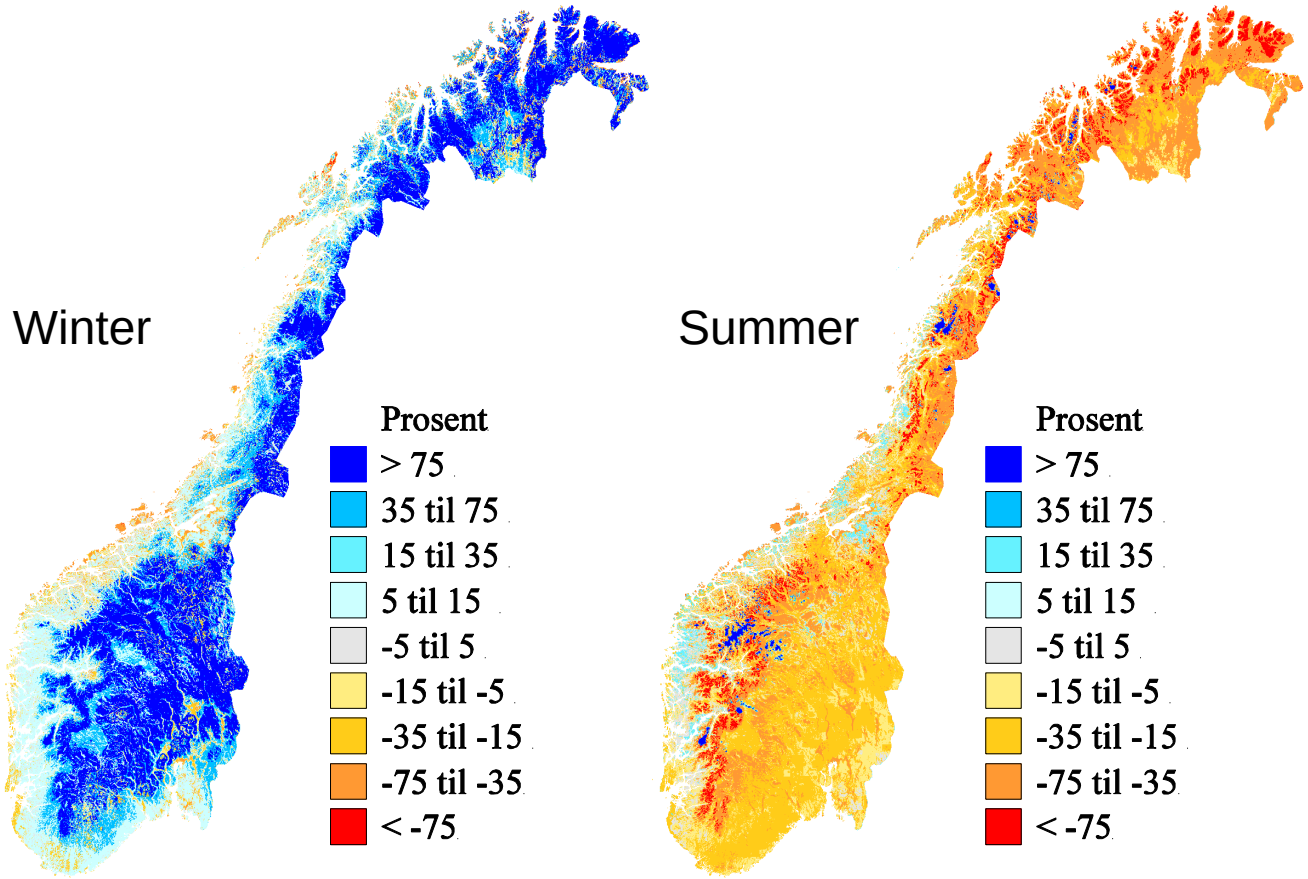
2 – 3 måneder

2 – 4 måneder

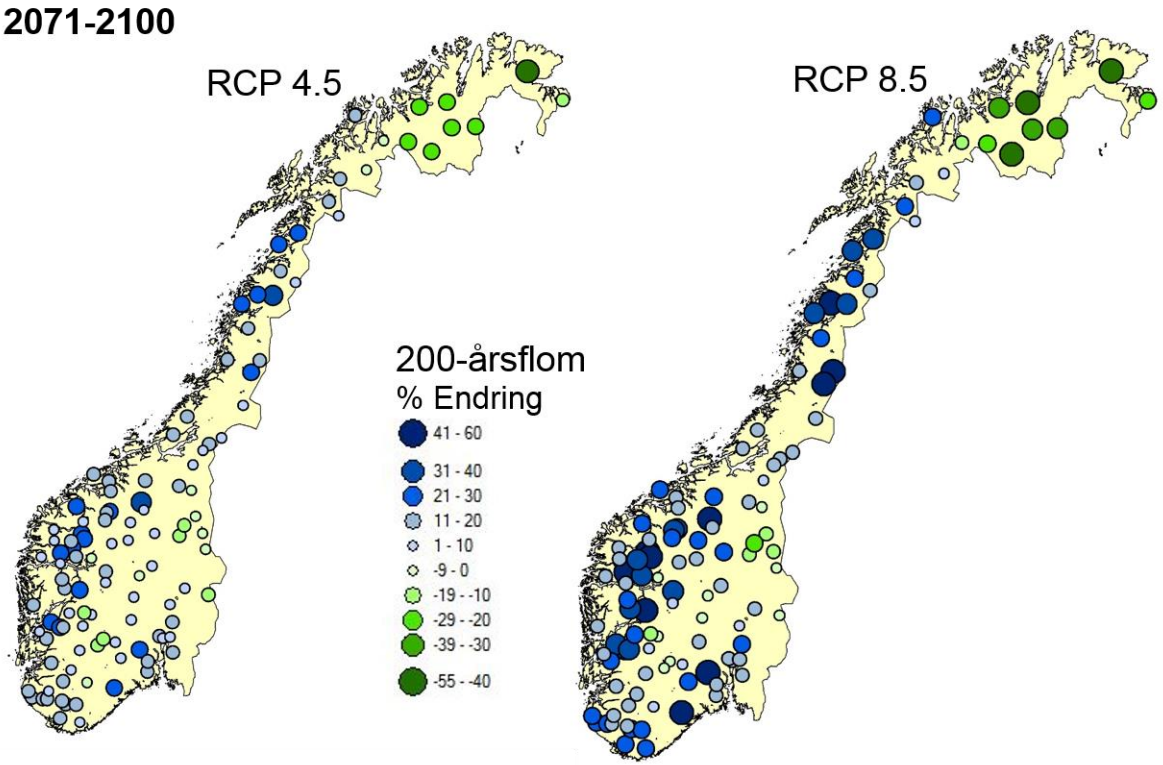
1 – 2 måneder



More water in the rivers in winter, less in summer



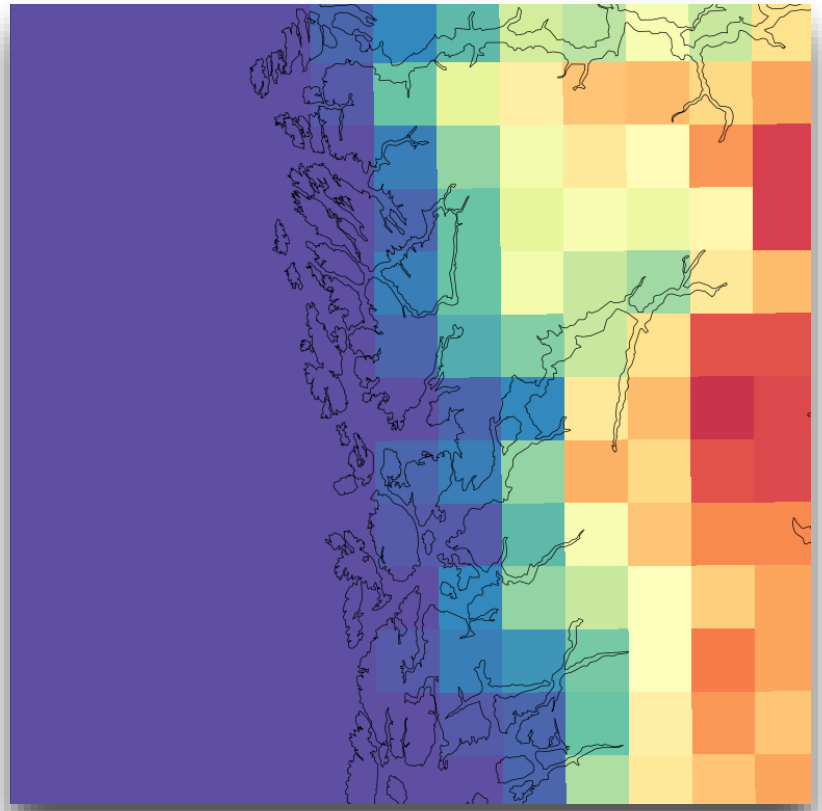
Flooding increases in magnitude and frequency



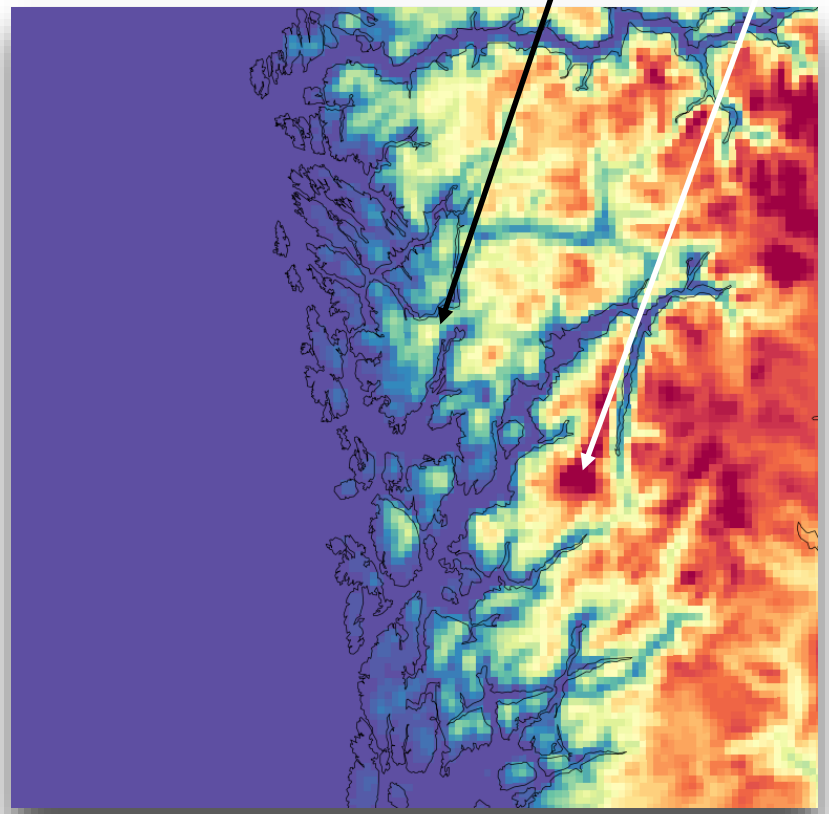
Climate Services @ Uni Research & BCCR

HORDAKLIM

Resolution matters for local change

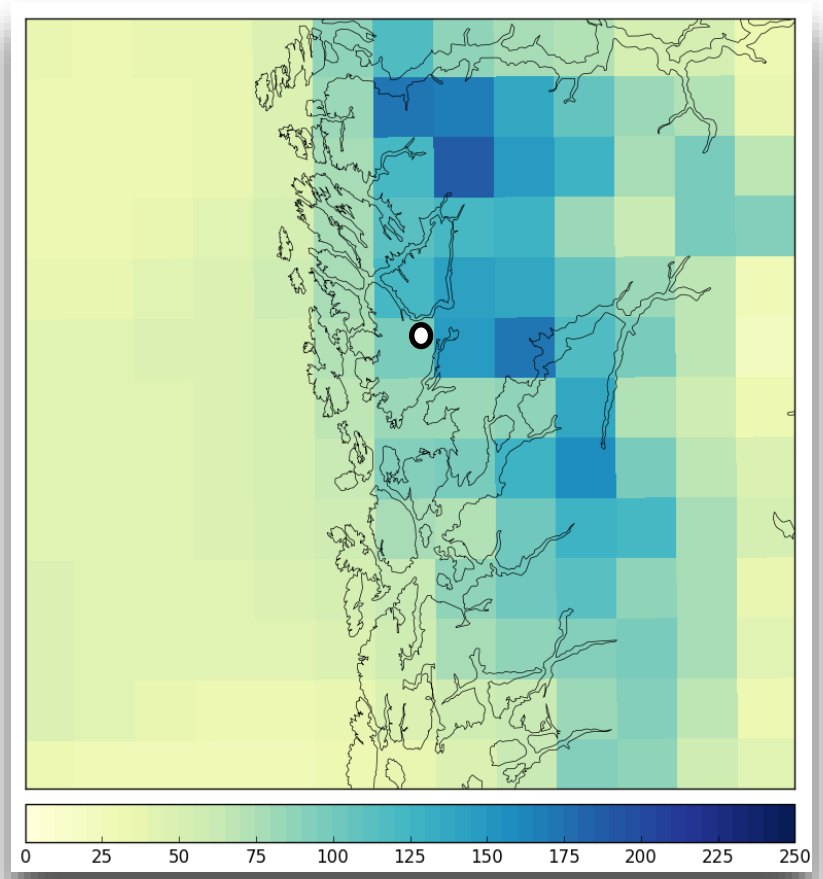


18 km

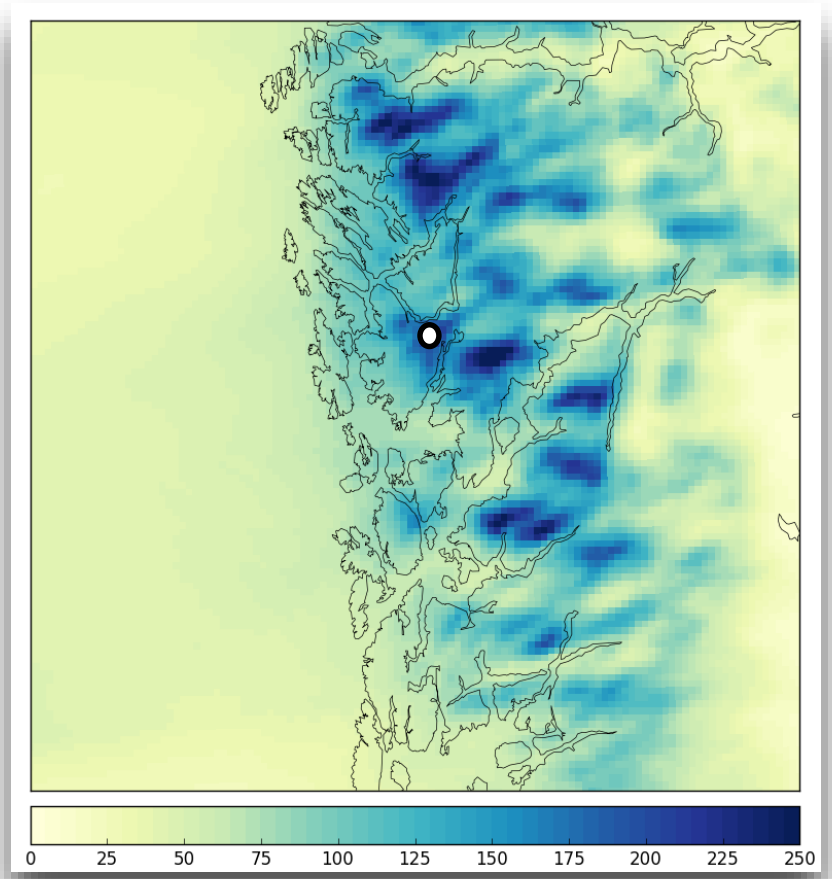


2 km

Need cloud resolving scales for extremes

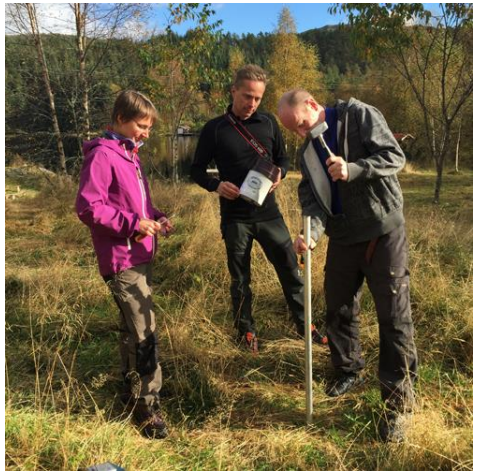


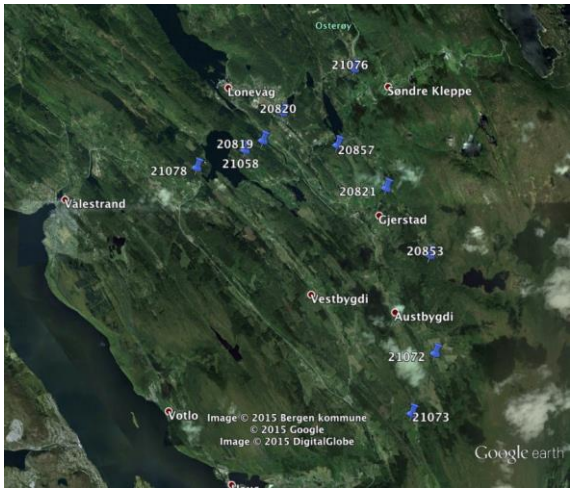
18 km



2 km

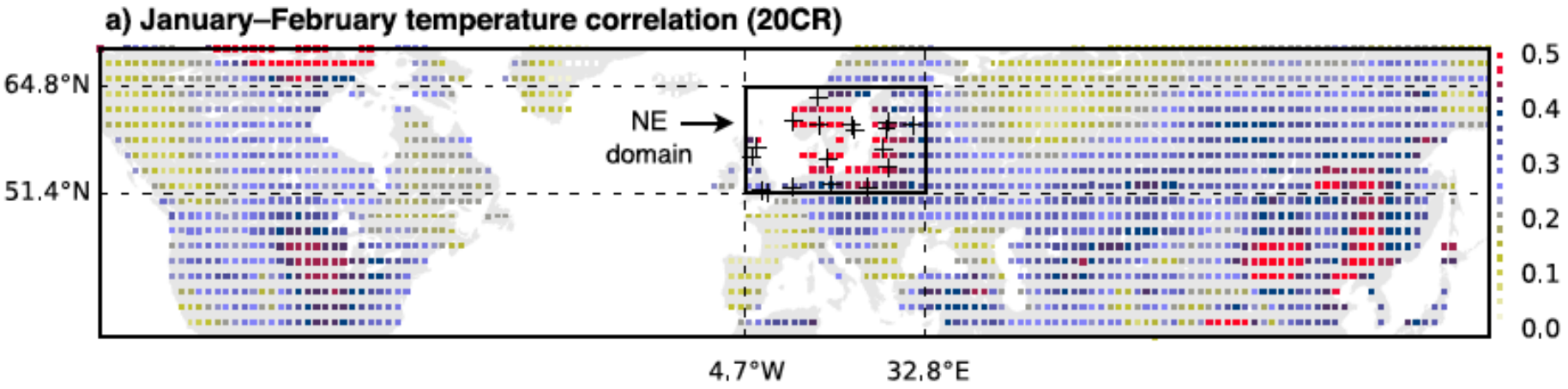
Engagement and cooperation in HORDAKLIM: Climate Services in action





- Need: information about intense preciptation changes and
- Need: highly localized information for local capacity building
- Lack of present-day data
- Uncertainty in interpreting and integrating available CC information into local adaptation strategies

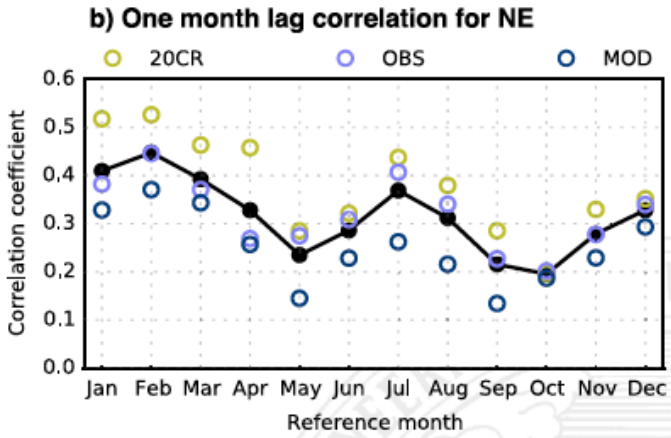
Persistence in anomalous month to month surface temperatures (Kolstad et al. 2015)

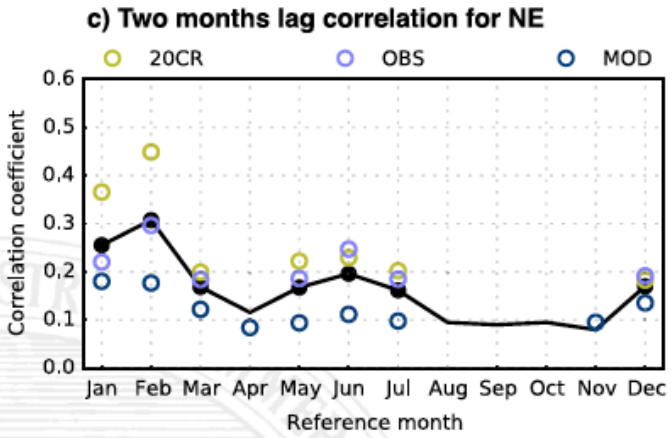


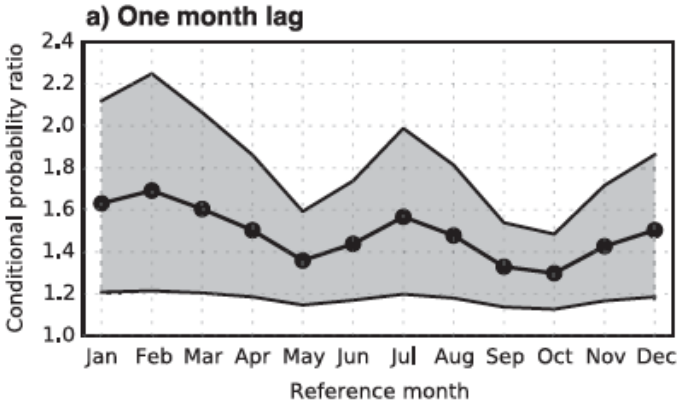
- Persistence of anomalous cold/warm surface temperatures seen to last beyond time periods explained by NAO, blocking, serial dependence, etc.
- But is this feature robust?
- Evaluated pre-industrial CMIP5 runs, observations (HCDN) and 20th Century reanalysis products
- Answer: yes

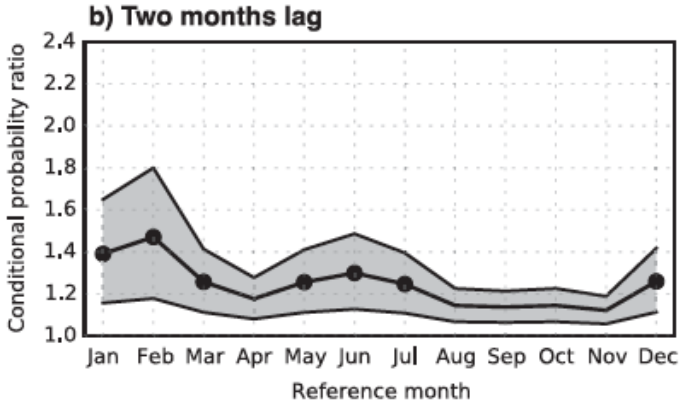
Persistent anomalous temp. cont.

- lagged auto-correlations significantly, higher than climatological persistence (~.17)
- Developed a linear conditional probability ratio
- Shows, for example, that cold/warm April is 60% more likely than not if March was cold/warm









Persistent anomalous temp. cont.

- But what drives this persistence?
- Checked the usual suspects: NAM, Temperature itself, NAO and varous linear combination of same
- As far as predictors go, previous monthly temperature is a better predictor than NAM or NAO