Inter- and intra-annual variability of NDVI and correlations to large-scale circulation patterns, sea ice, snow and cloud cover

Tundra, Subzone A, Franz Josef Land
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Fairbanks, Alaska,
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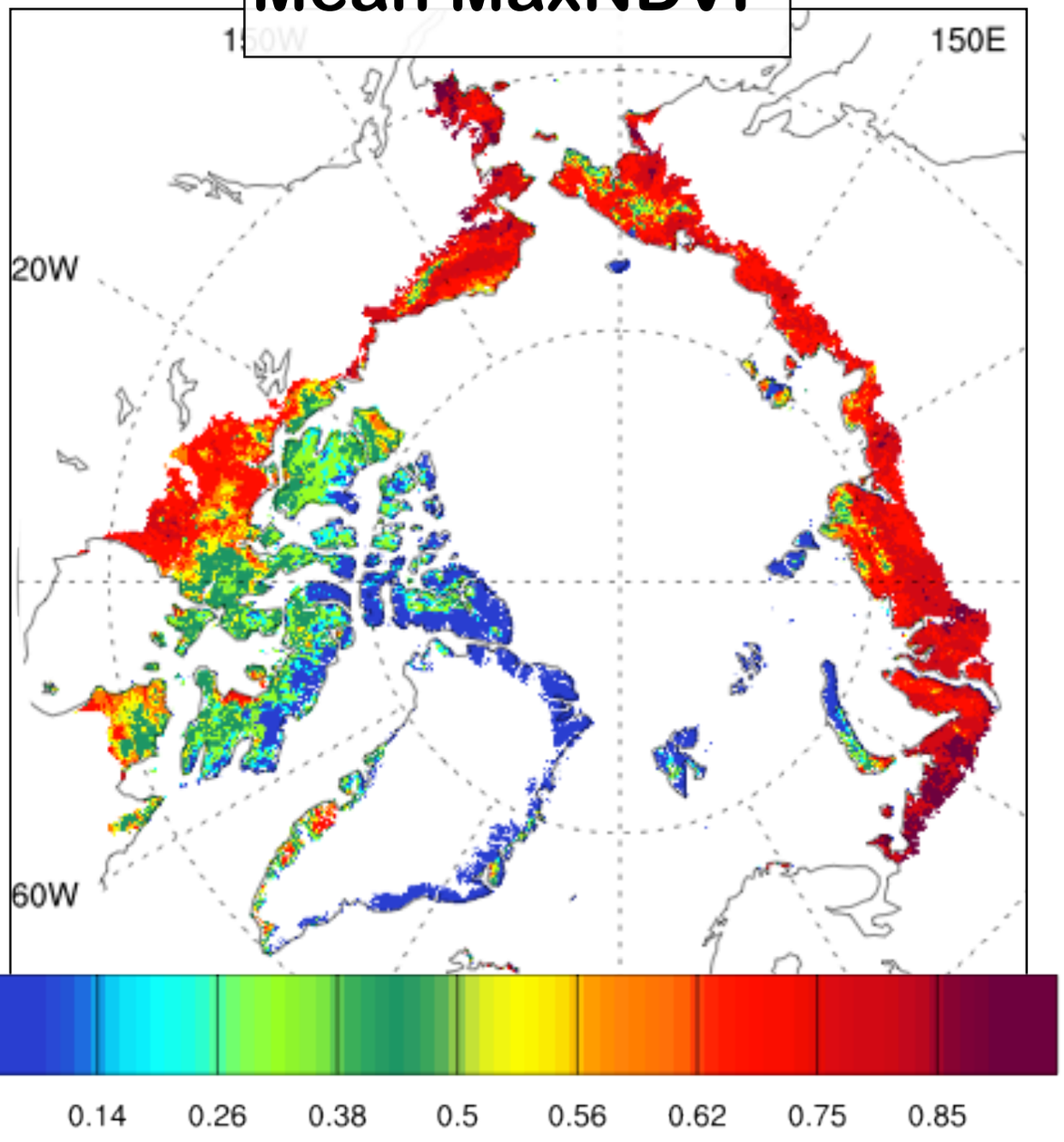
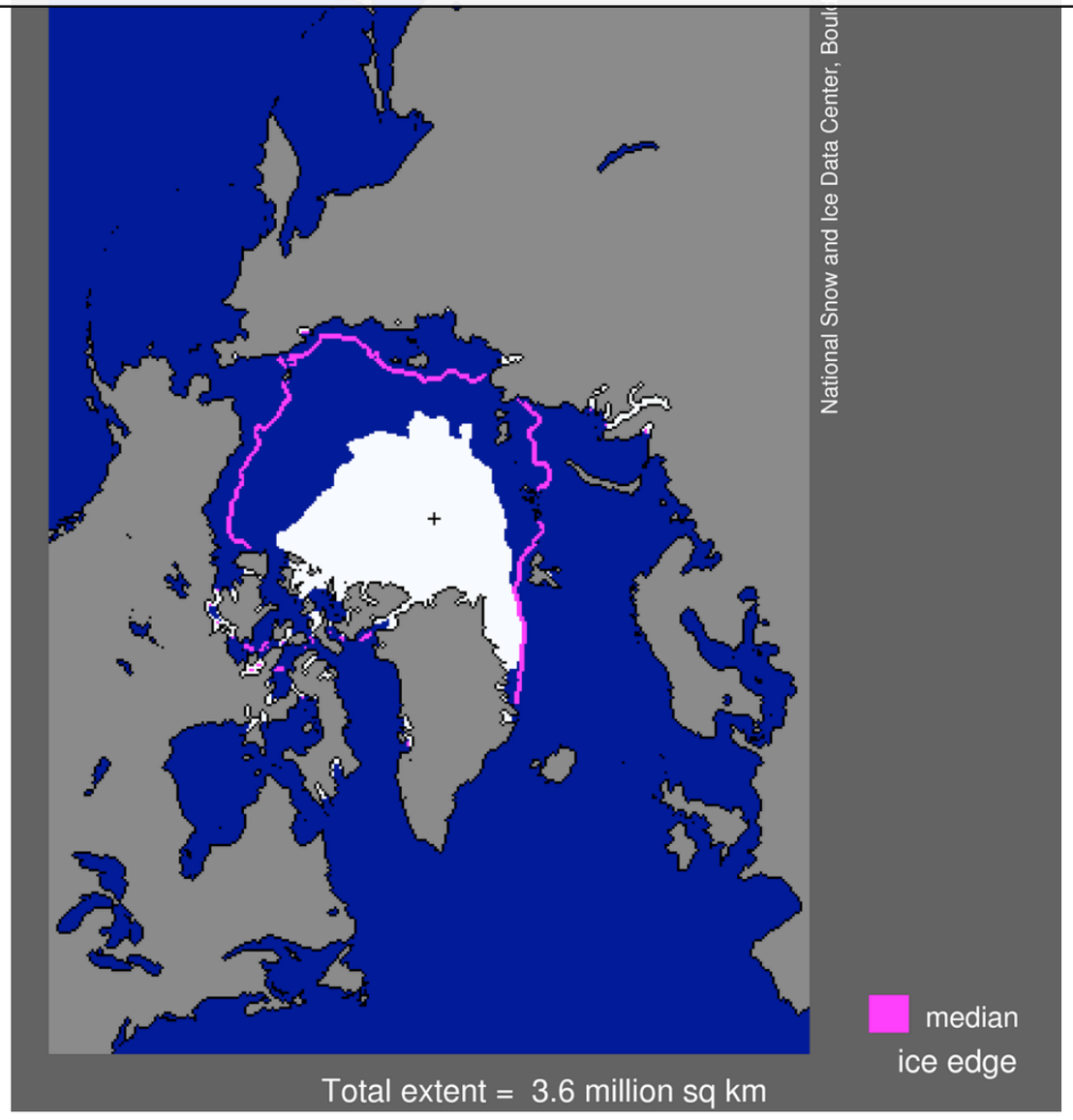
- Warming has flattened out and NDVI is declining in spring and fall.

Mean MaxNDVI (82-10) linked to Mean Sea Ice

Mean MaxNDVI



80% of the Arctic tundra (3.2 million km^2) < 100km from ocean



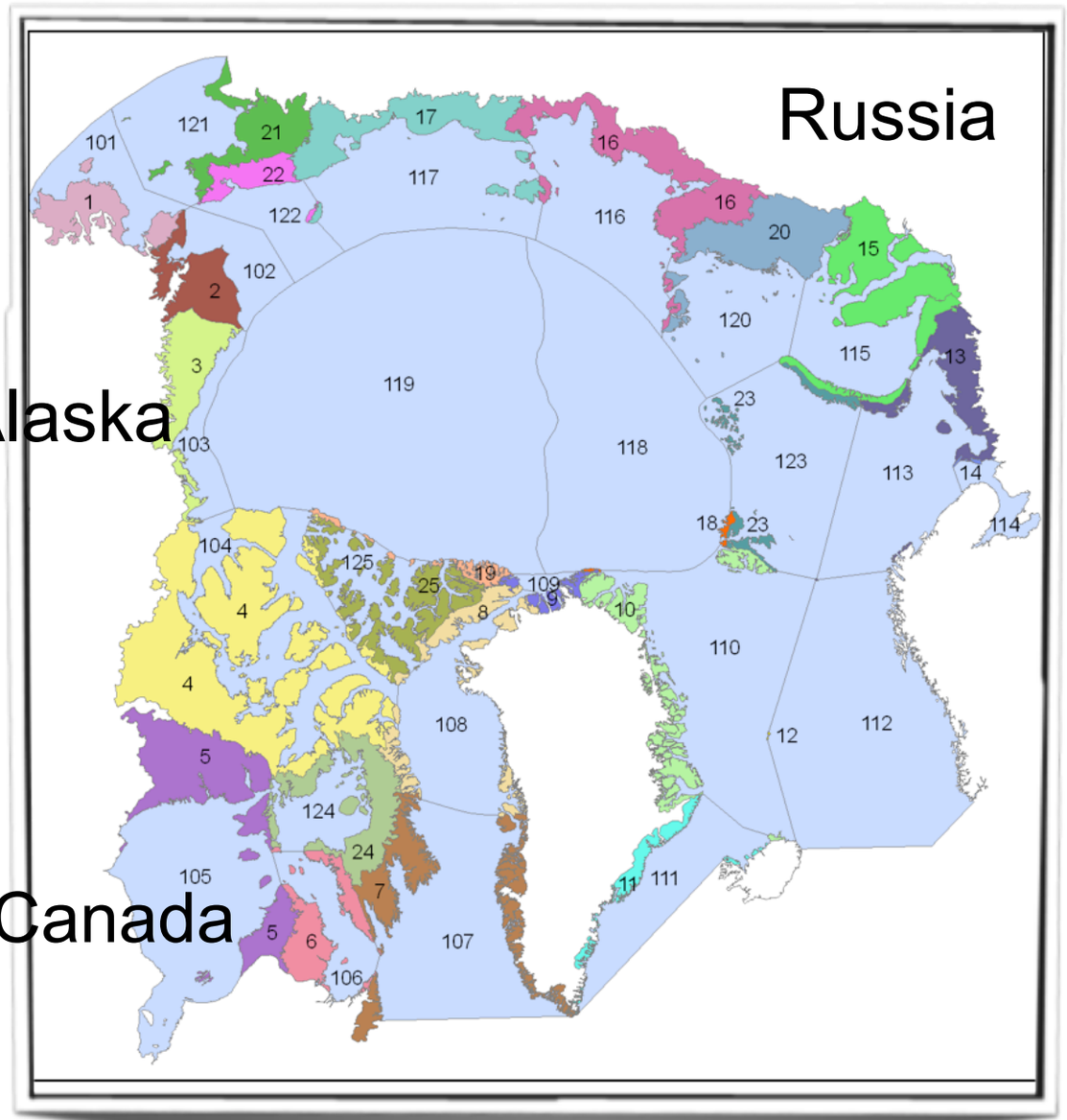
Main PanArctic hypothesis:

Periods of reduced sea ice should correspond to warmer land temperatures and more rapid greening.

[Bhatt et al. 2010]

Remote sensing data & methods

- Data: 1982-2013 (32 yrs, weekly)
- Passive Microwave Sea Ice Concentration (25km)
- AVHRR Land Surface Temp. (25-km) SWI, [Comiso 2003]
- Gimms NDVI 3g+ (Max and Integrated) (14-km) Version that is corrected for Arctic, TI-NDVI [Pinzon et al. 2014]

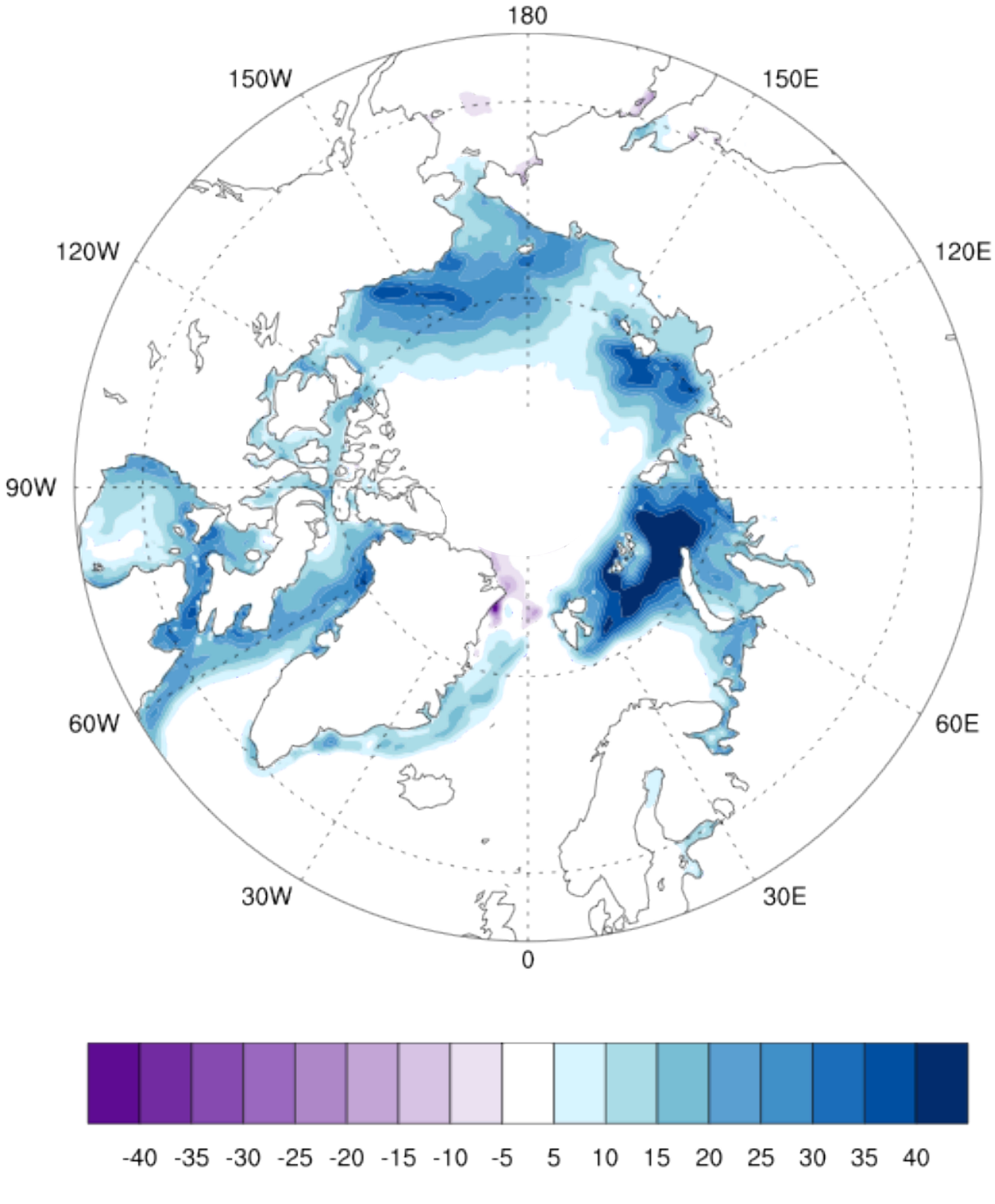


- Divided Arctic Ocean (Treshnikov, 1985) to examine trends and variability in full tundra land domains
- Reanalysis Sea Level Pressure
- Globsnow

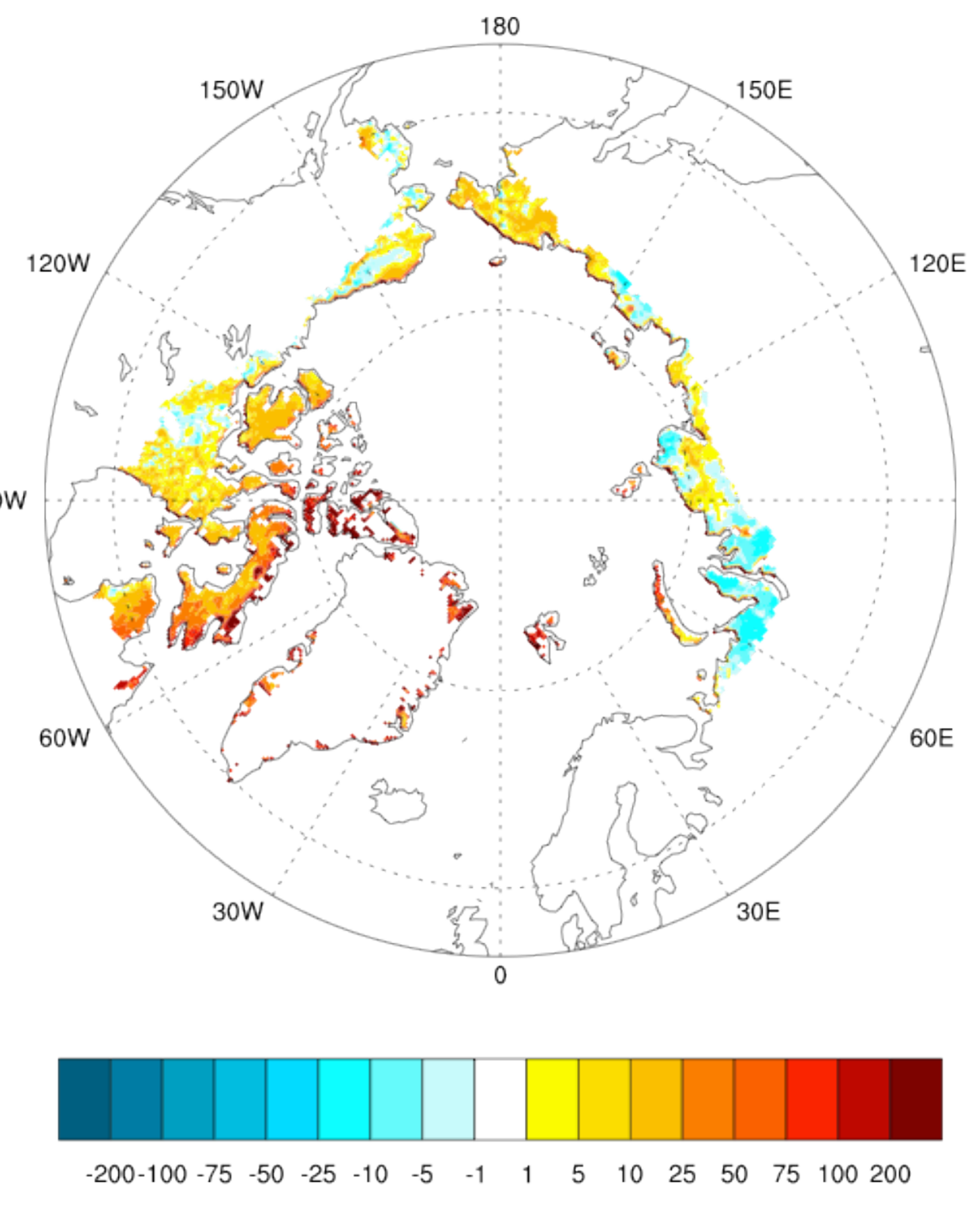
More Open Water & Nearby Land Warms

Trends 1982-2013

Open Water (May-Aug) magnitude change (%)



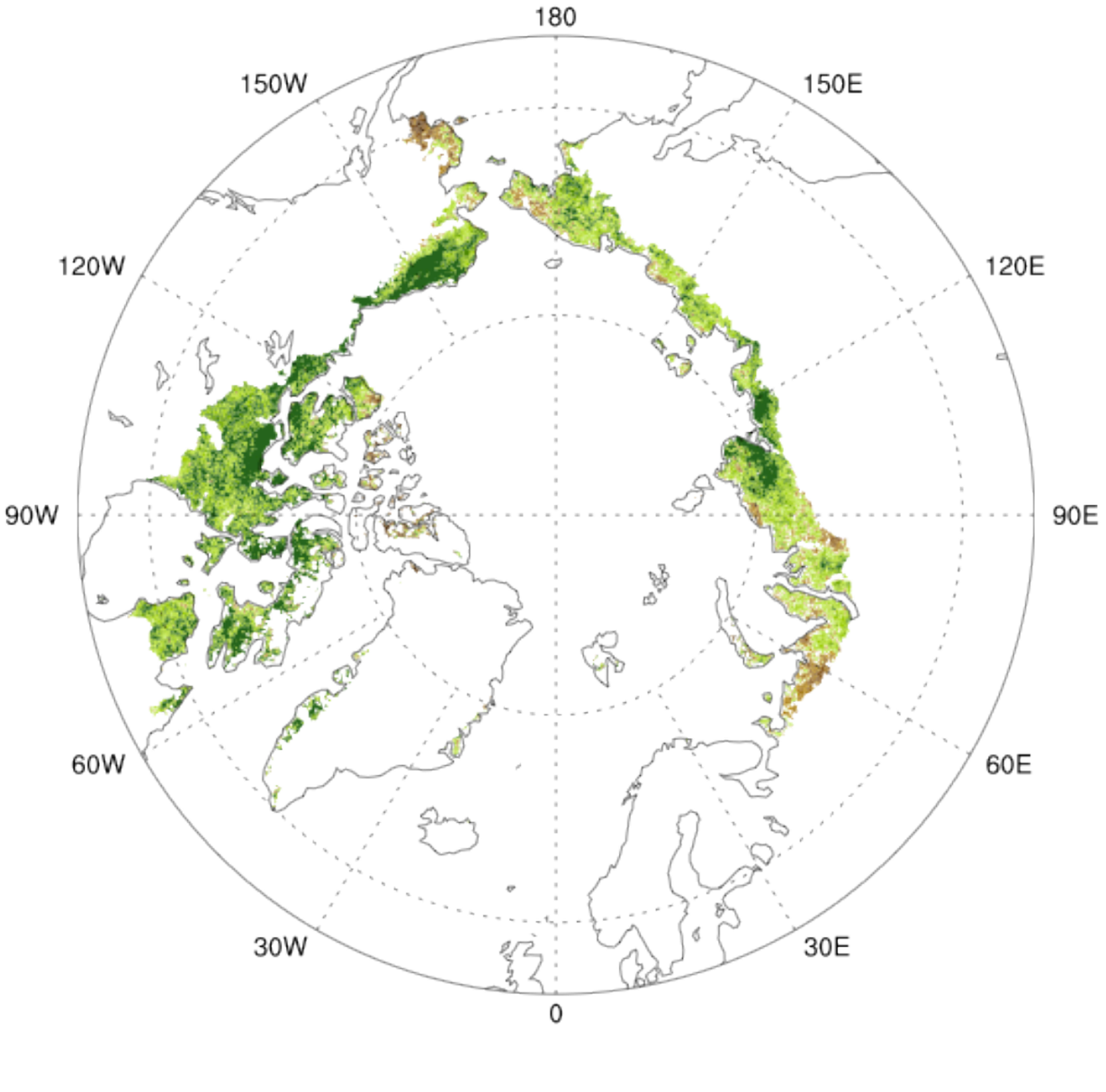
Summer Warmth Index percent change (%)



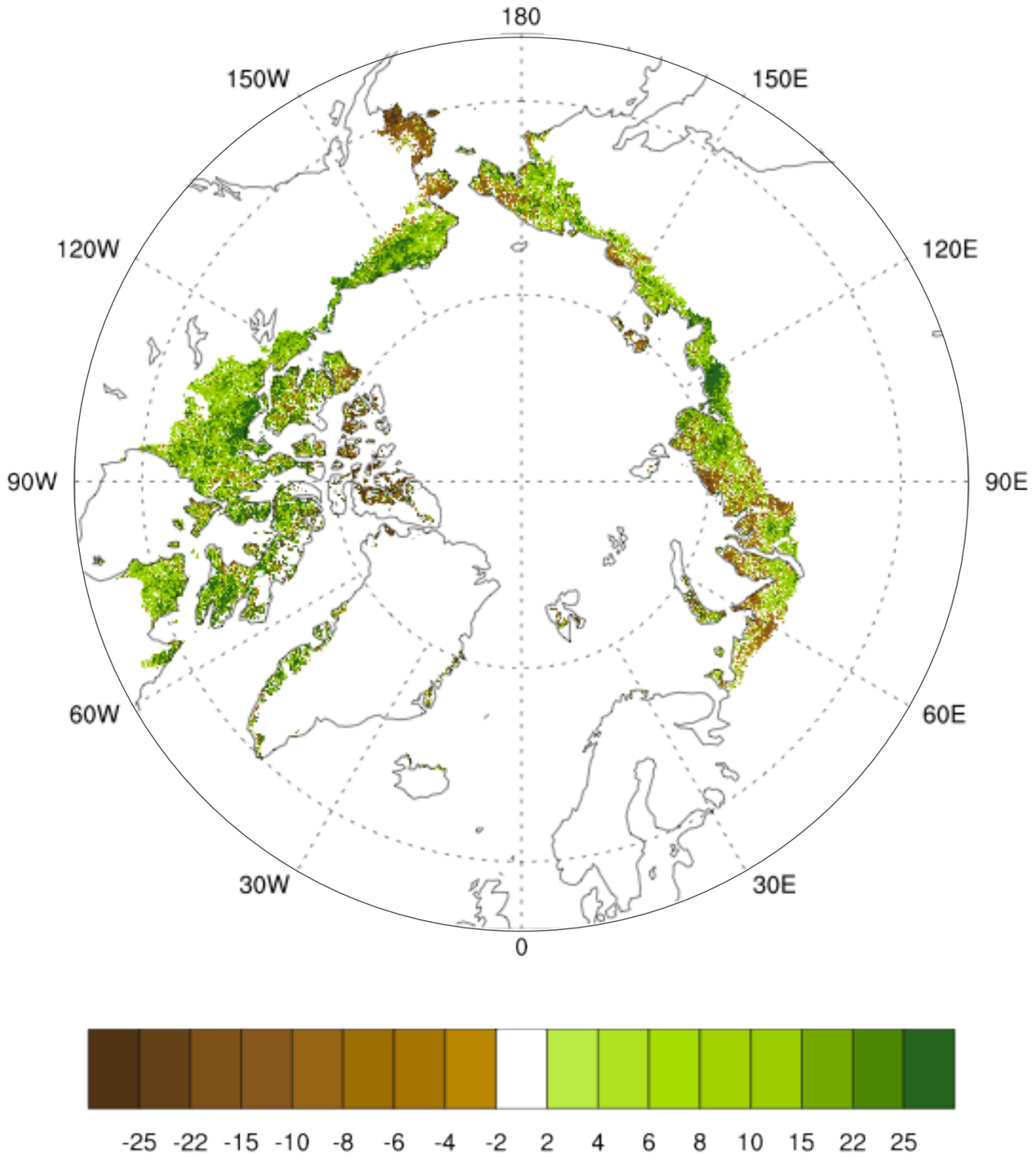
More warmth ==> Greener Arctic Tundra

Trends 1982-2013

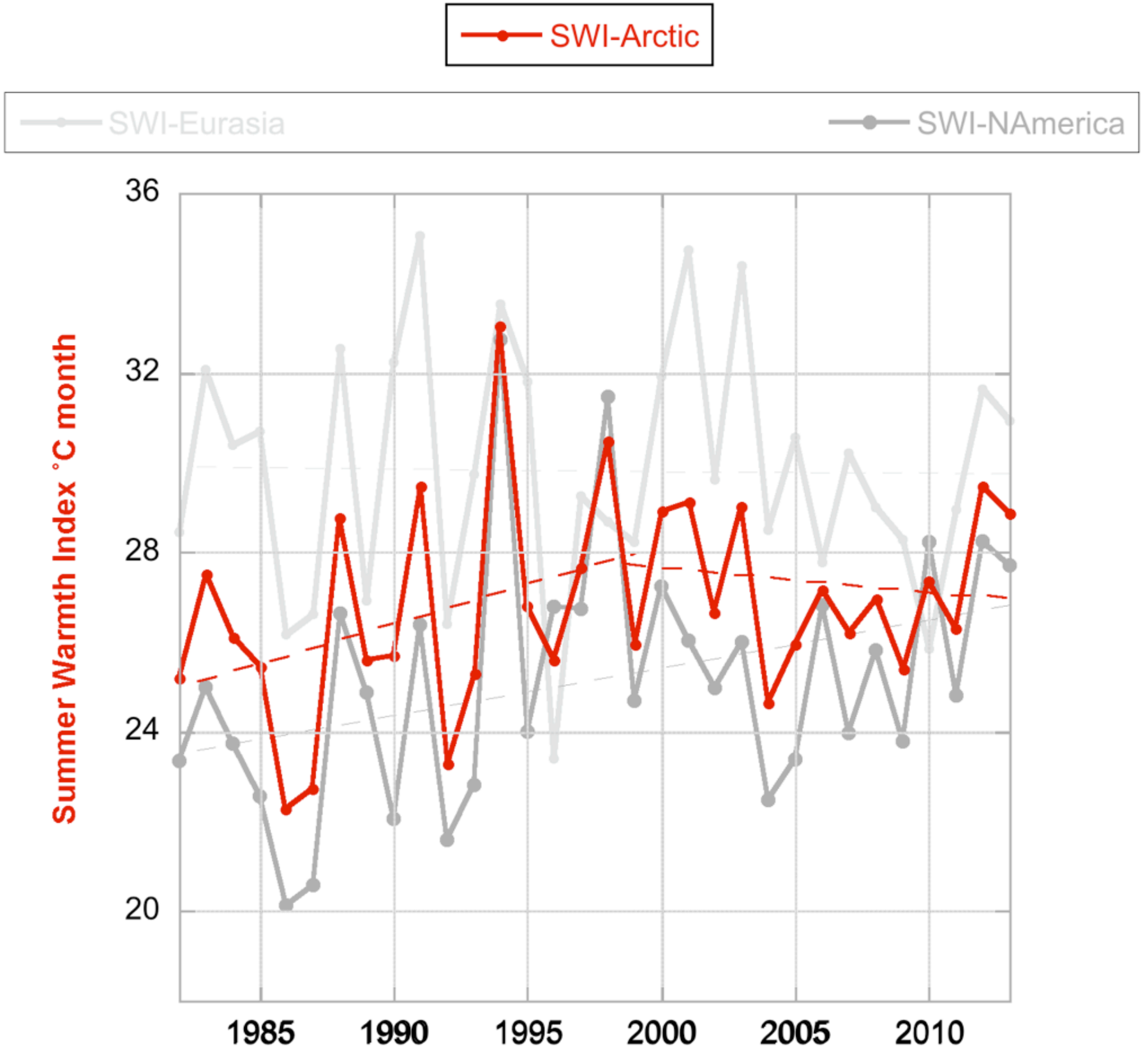
MaxNDVI percent change (%)



TI-NDVI percent change (%)



Summer Warmth increases have slowed!



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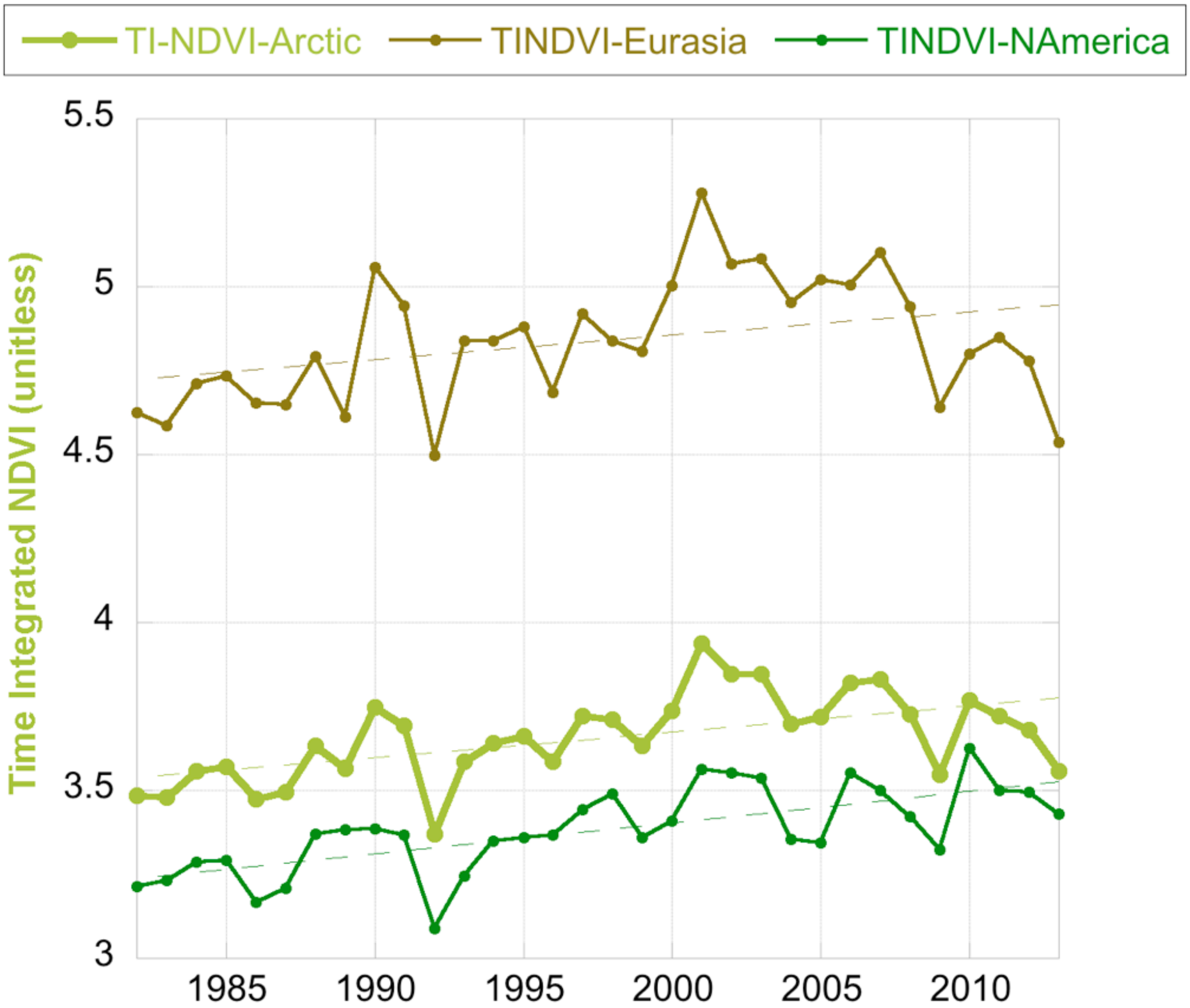
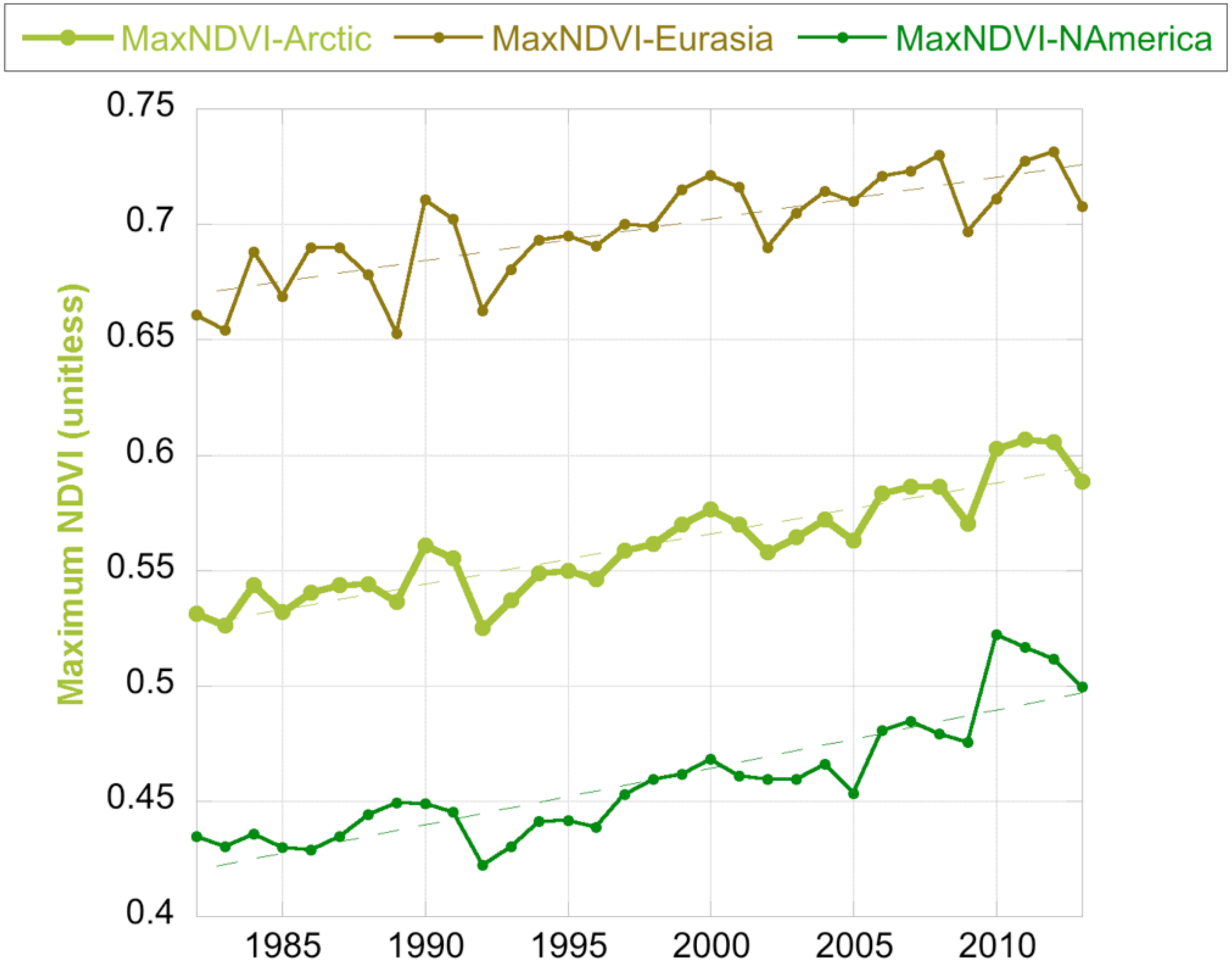
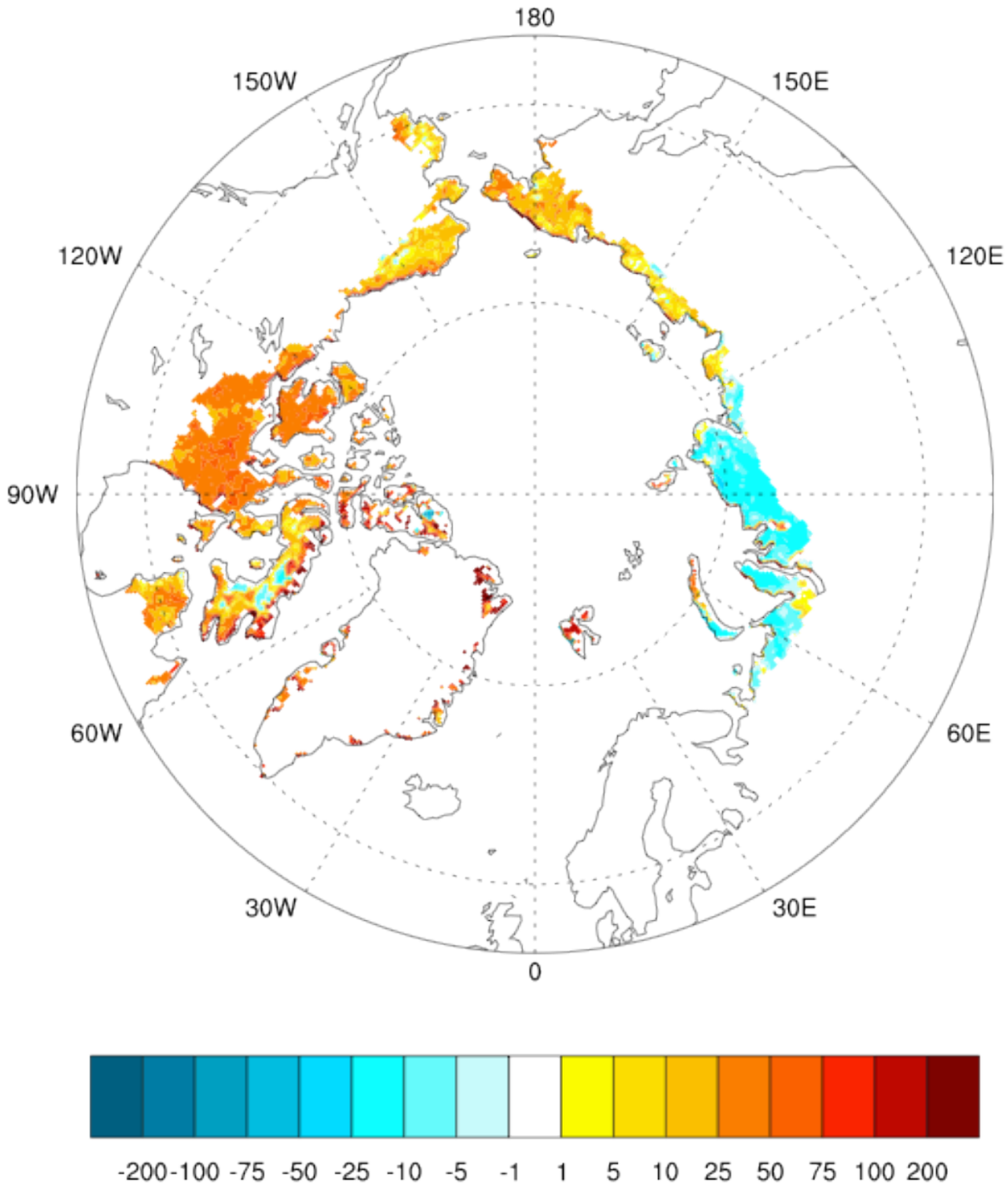


MaxNDVI increases continue!

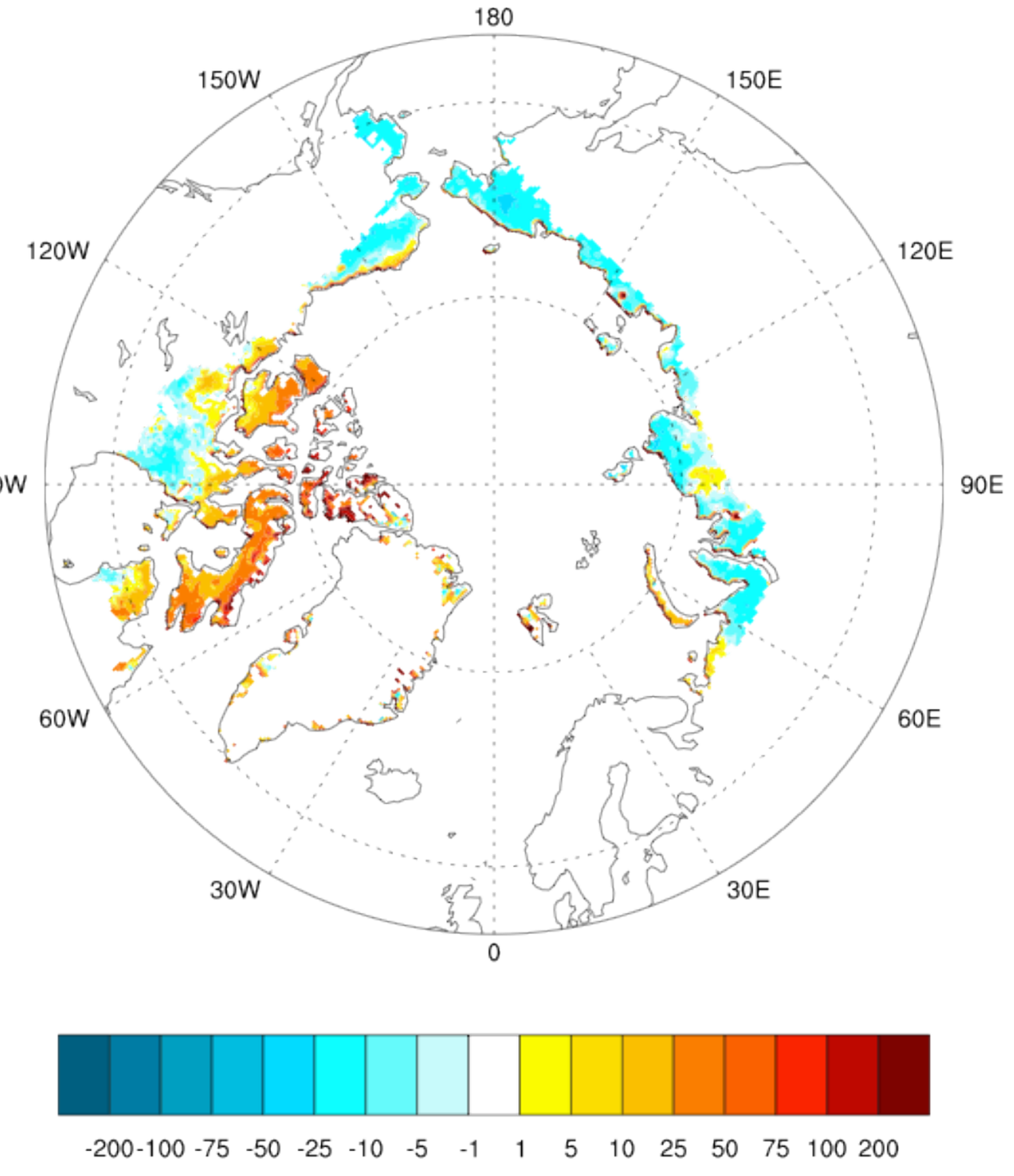


SWI declining over recent period!

SWI 82-98



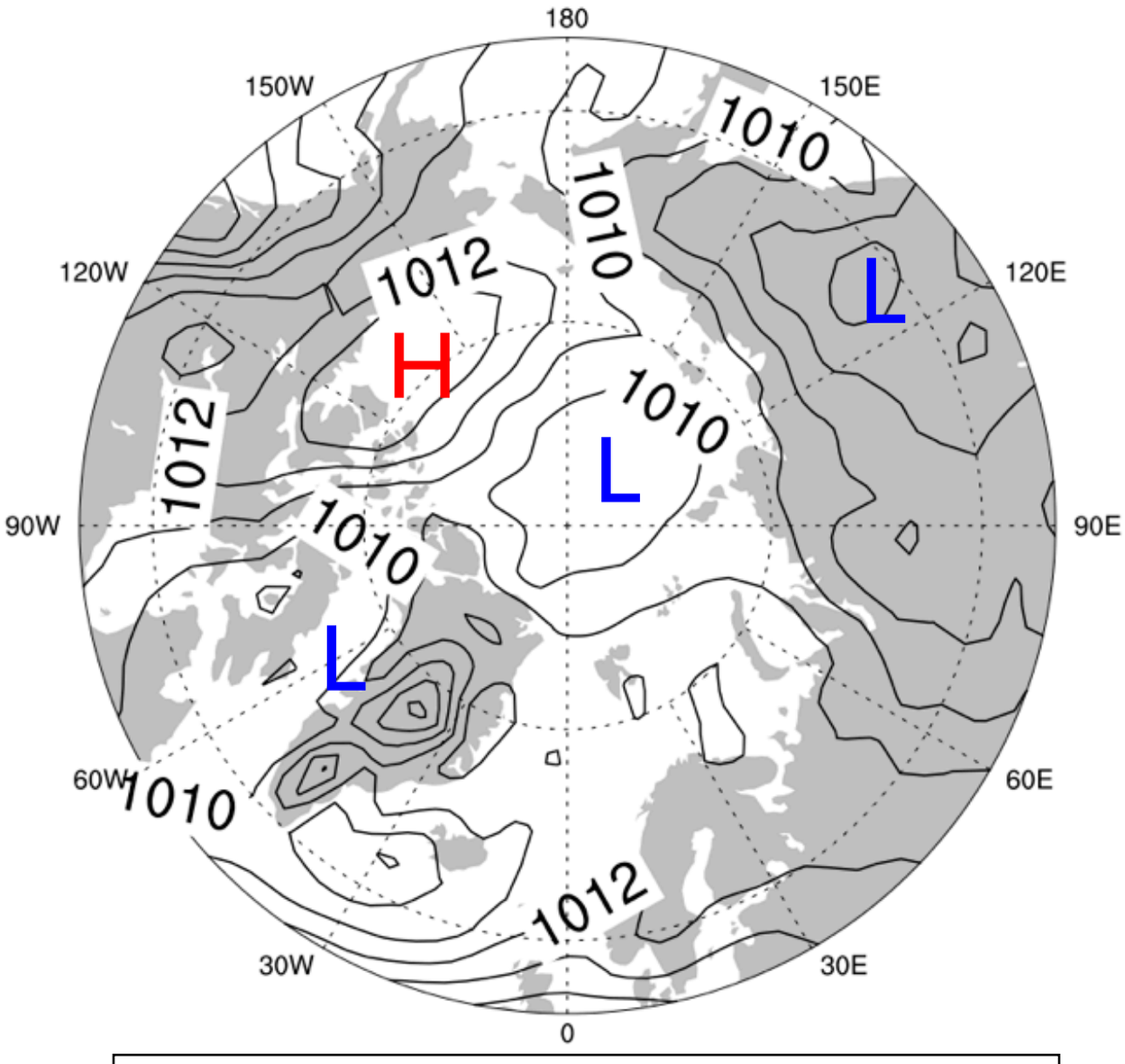
SWI 99-13



Summer Sea Level Pressure (SLP)

Long term average

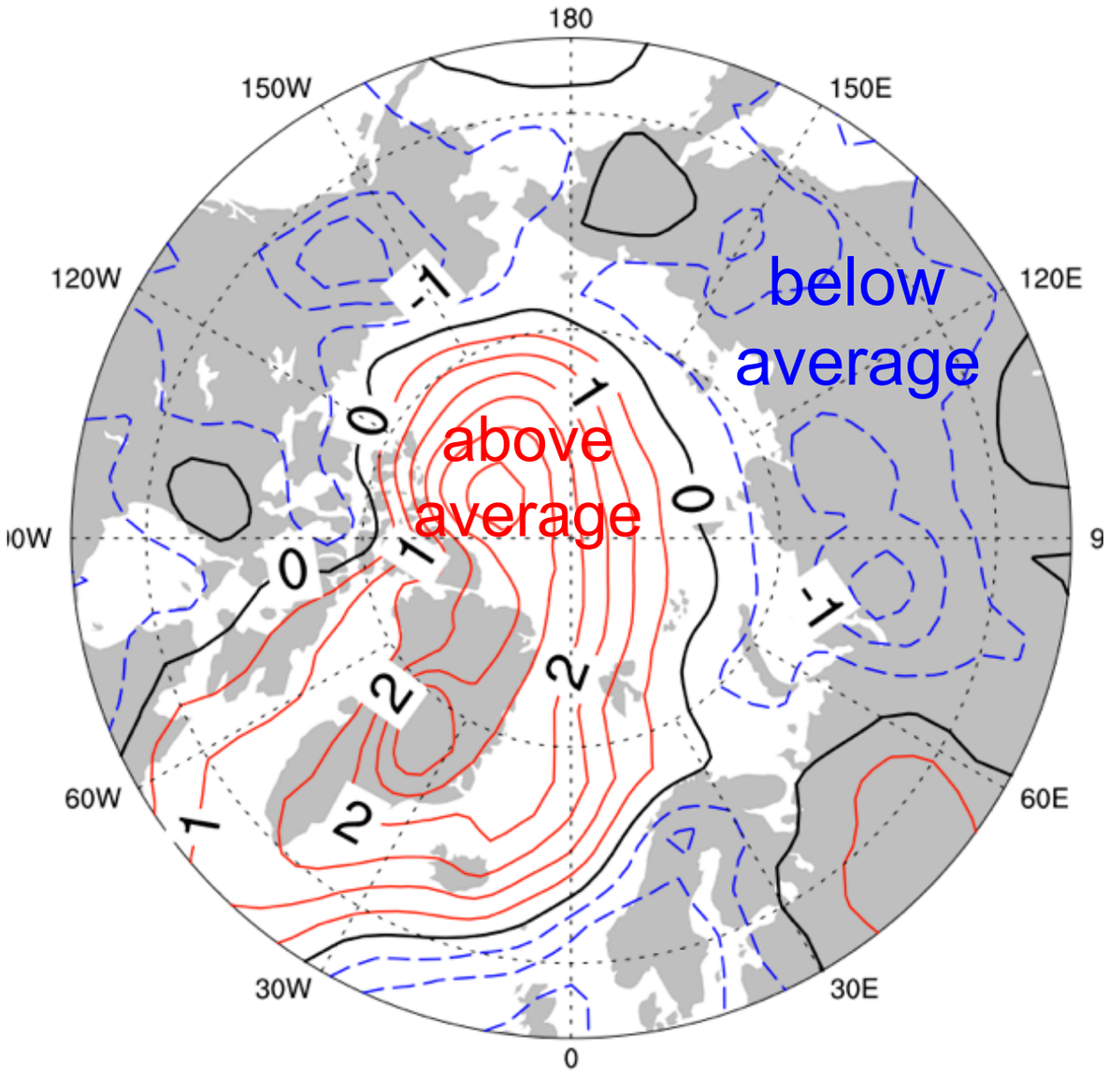
1982-2011



Climatology

SLP change

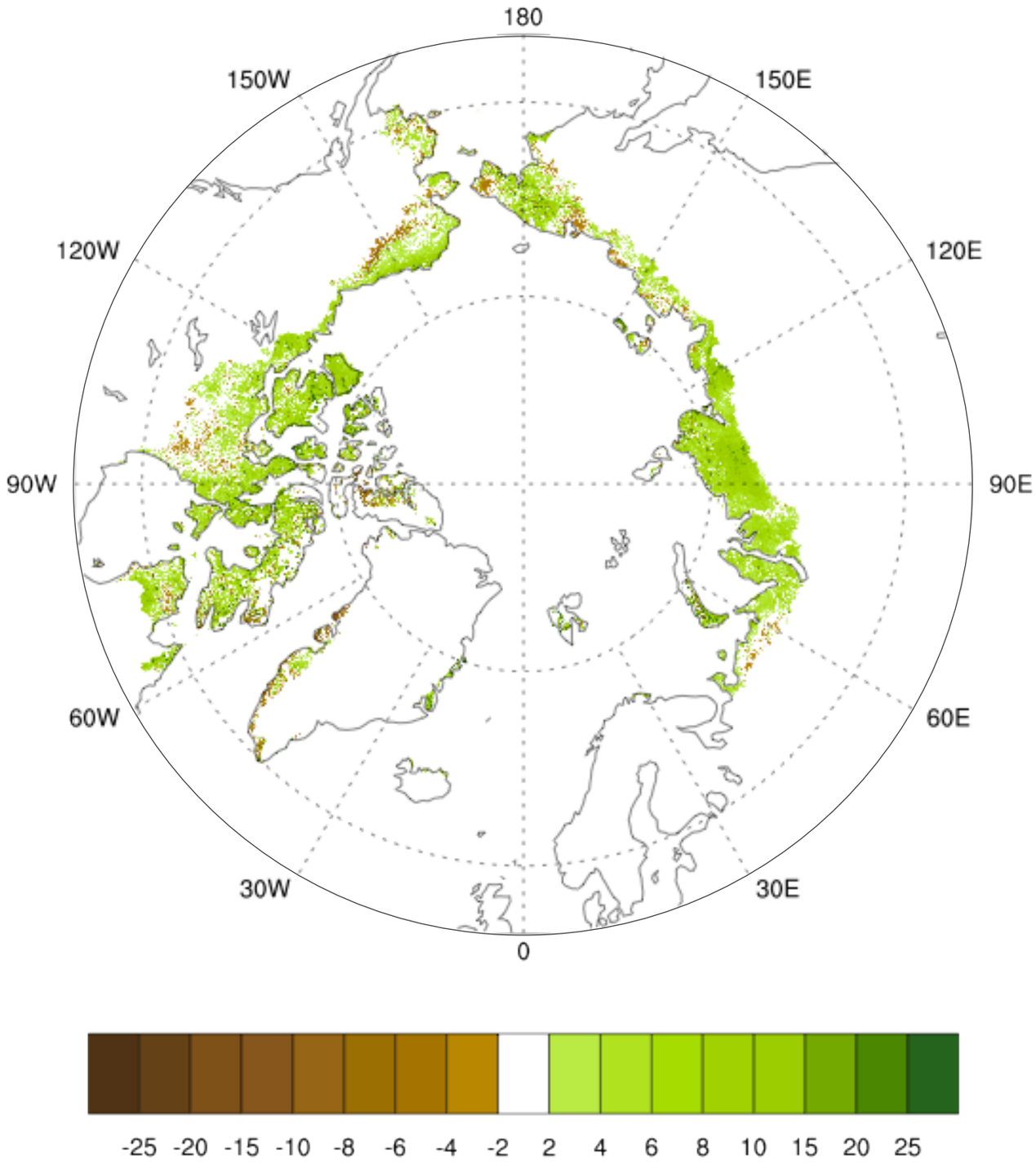
1999-2011 vs 1982-1998



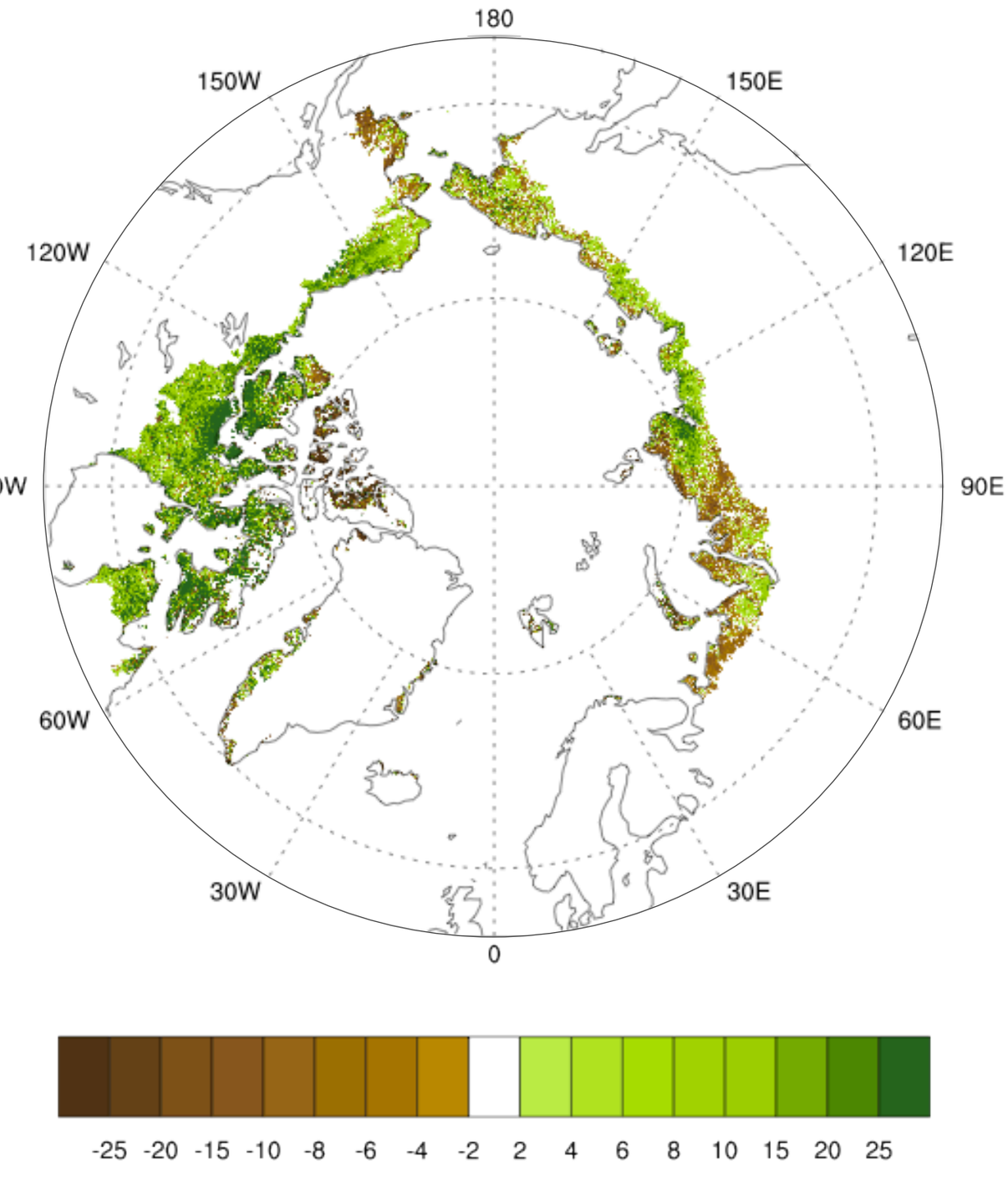
[Bhatt et al. 2013]

MaxNDVI trends stronger over recent period!

MaxNDVI 82-98

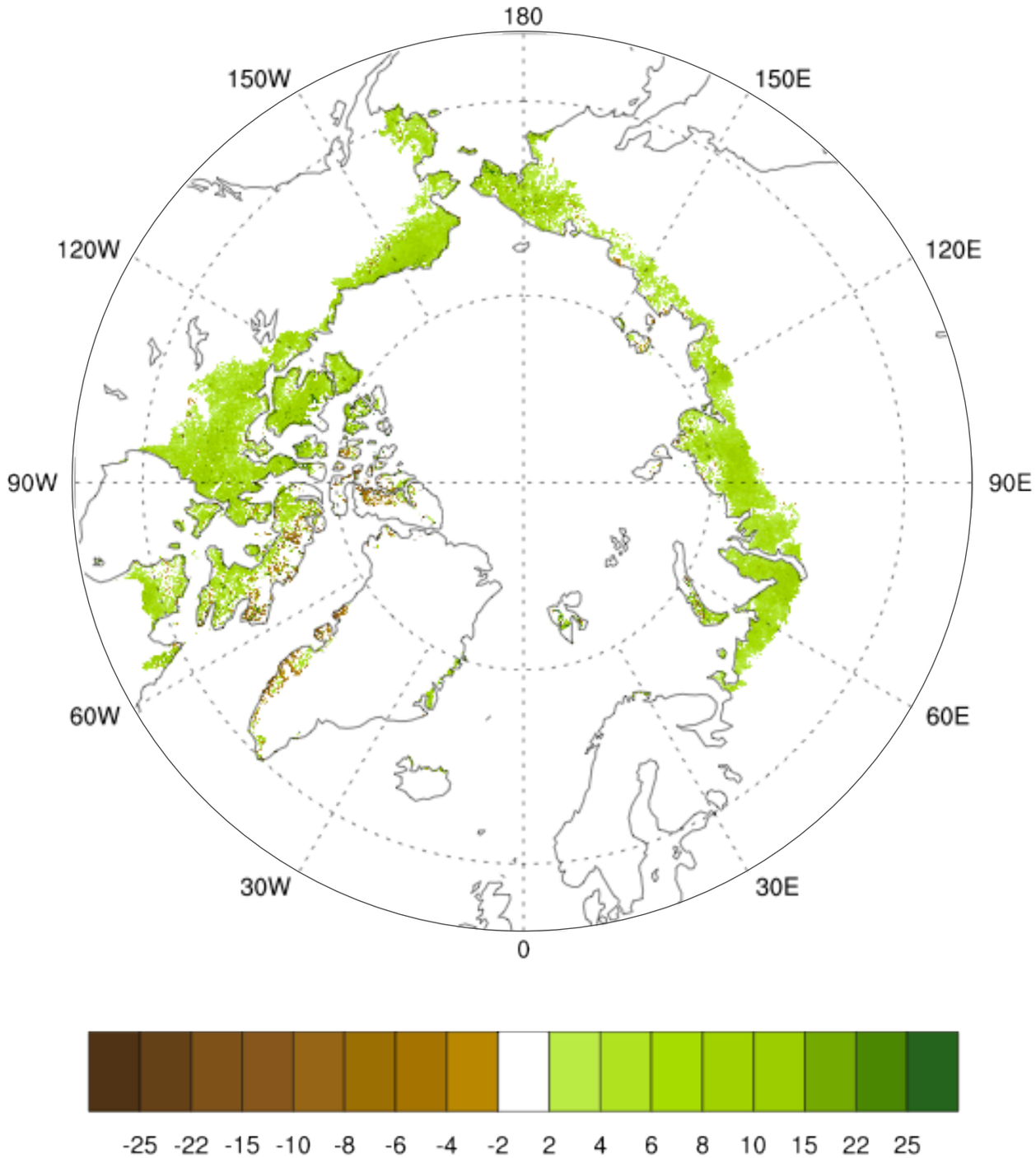


MaxNDVI 99-13

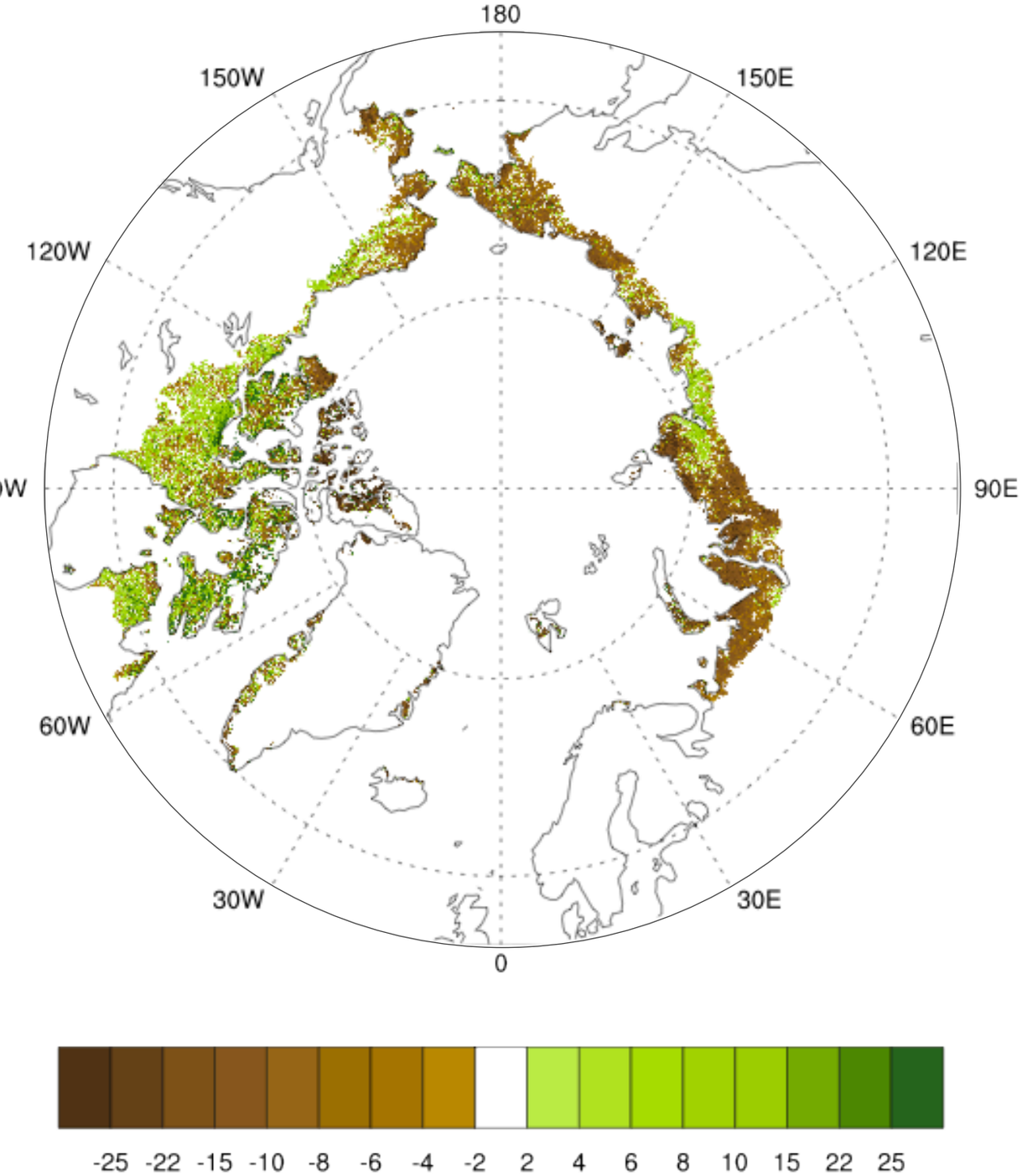


TI-NDVI declining over recent period!

TI-NDVI 82-98

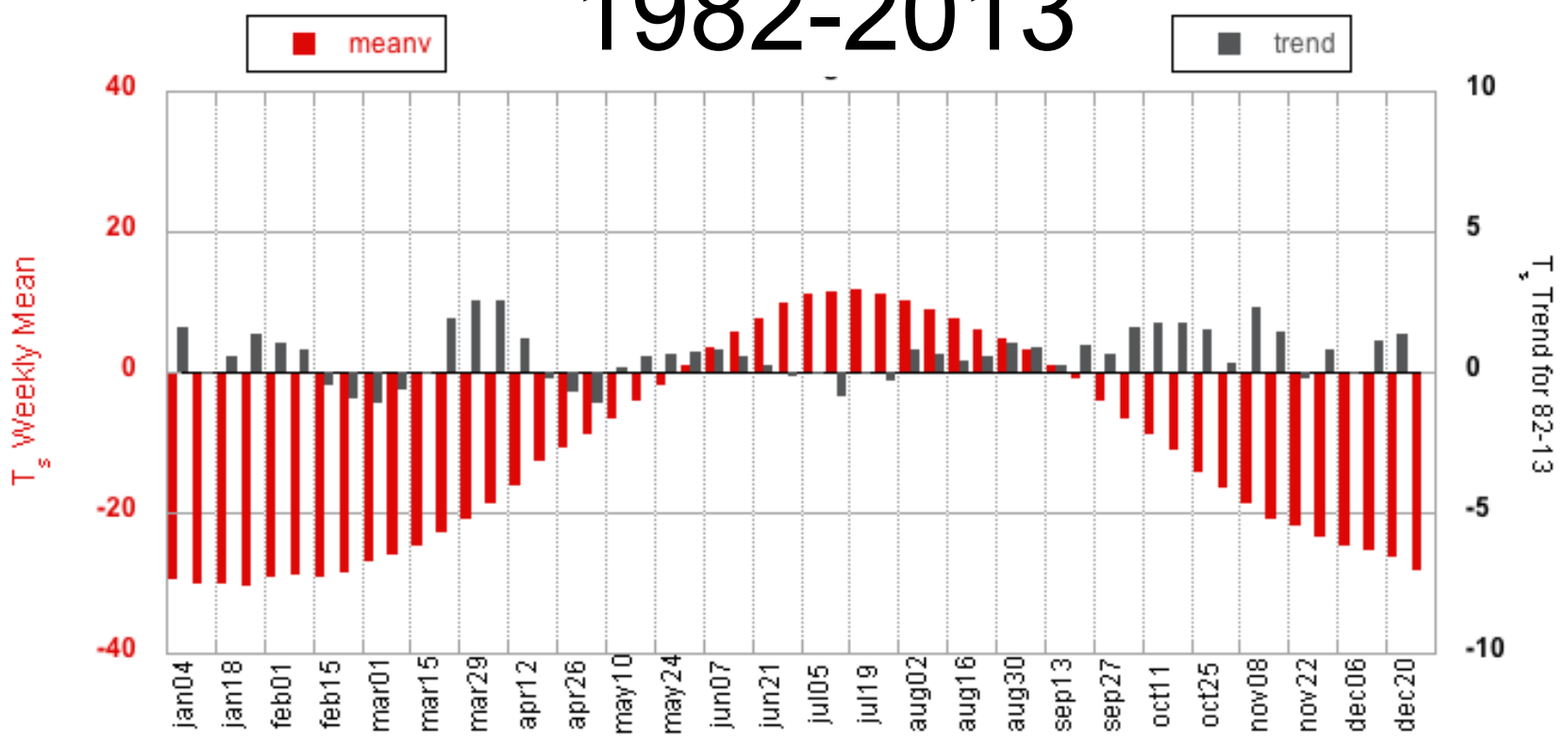


TI-NDVI 99-13

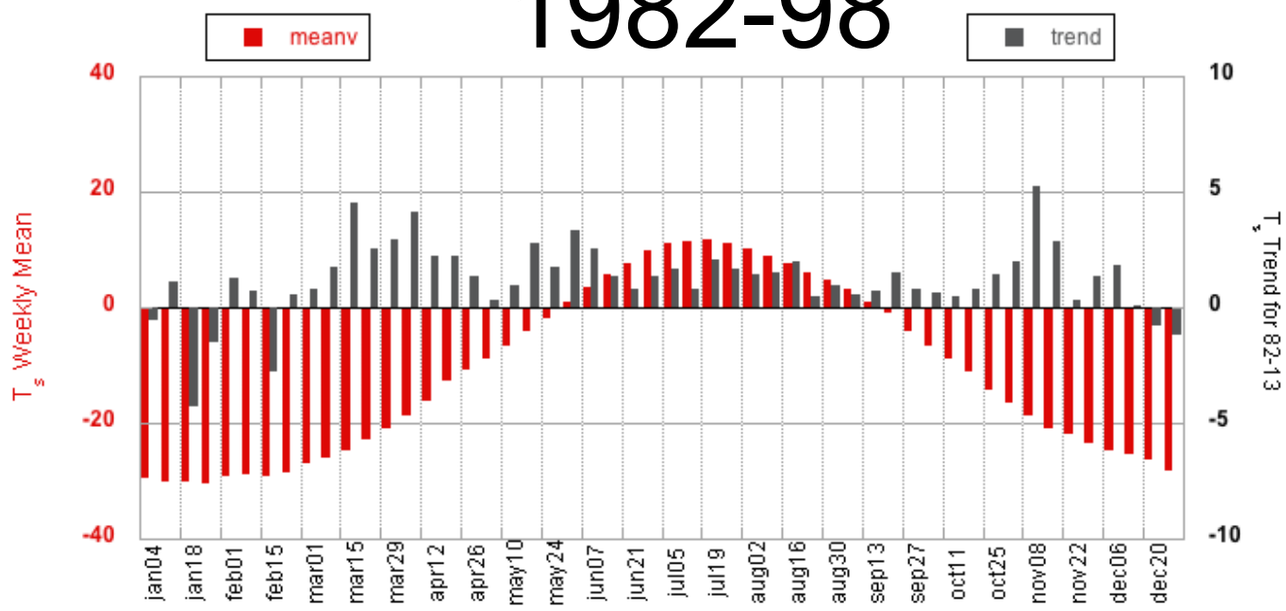


Ts Spring/Fall warming & Mid-summer cooling

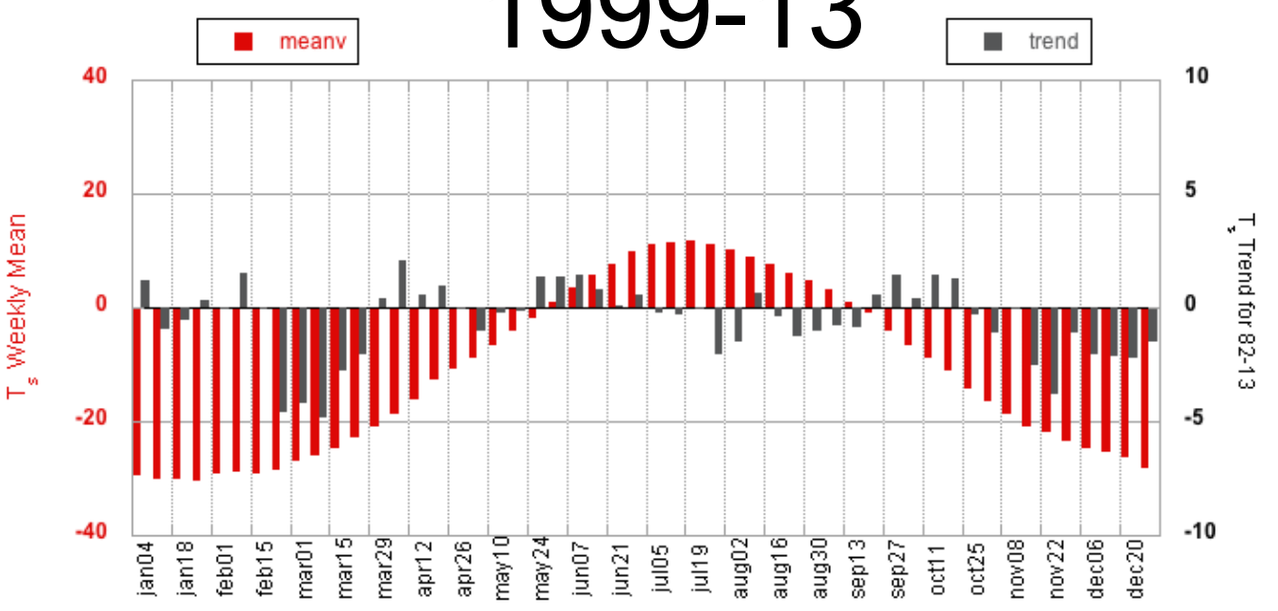
1982-2013



1982-98

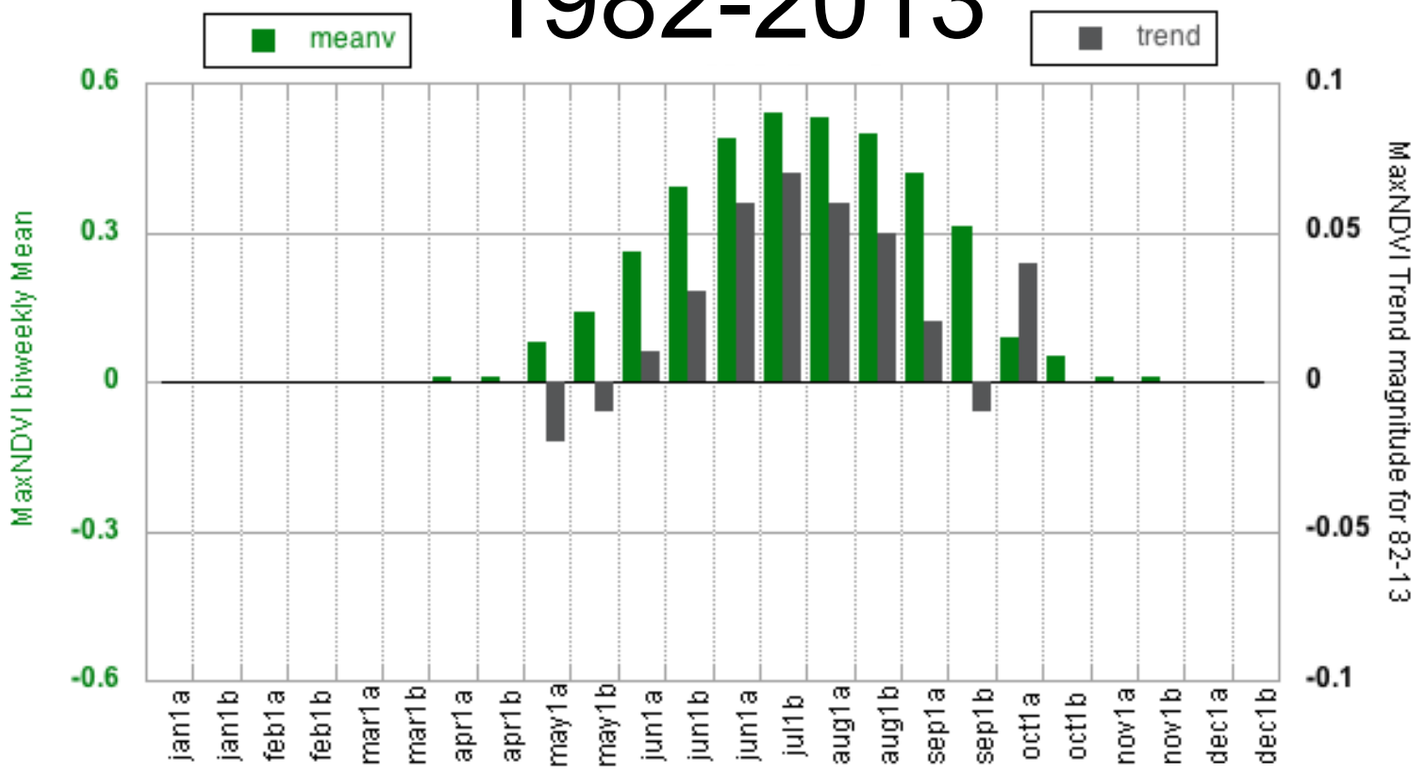


1999-13

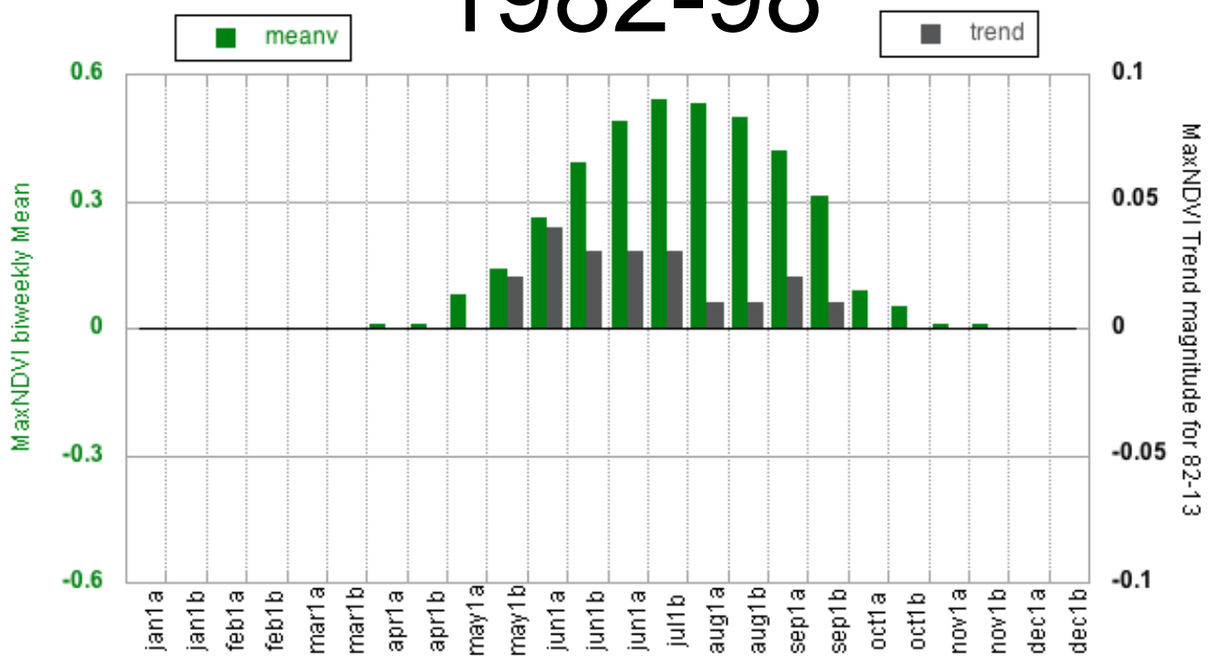


MaxNDVI Spring/Fall decline & Peak increase

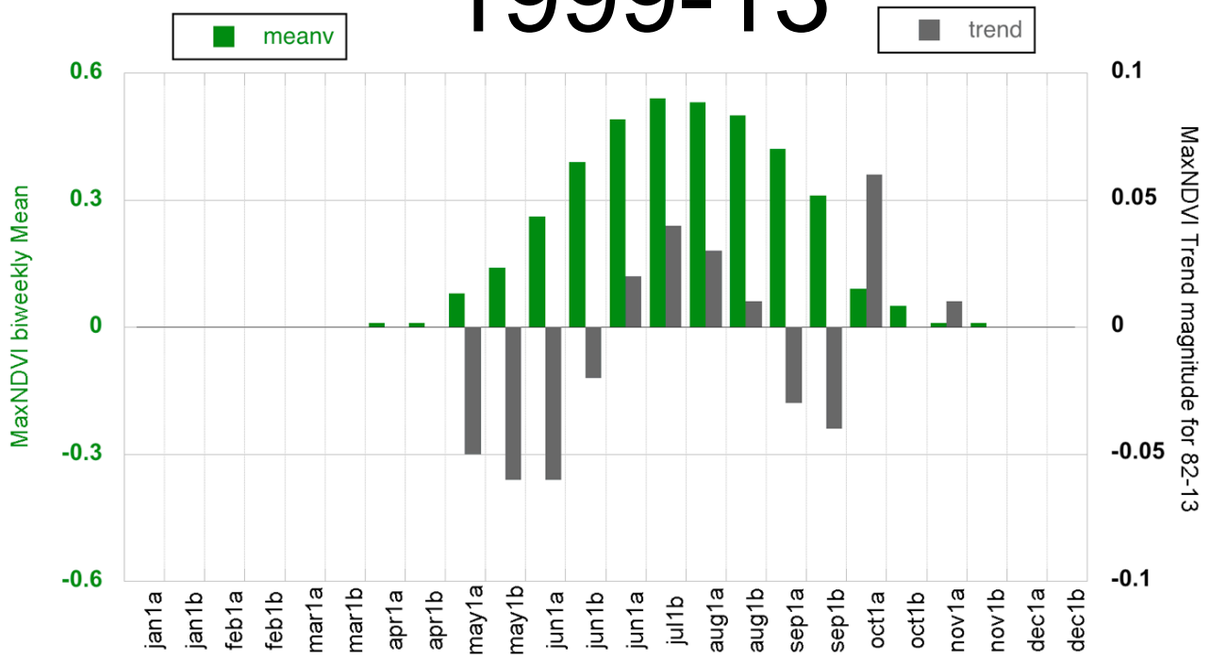
1982-2013



1982-98



1999-13



1982-1998

1999-2013

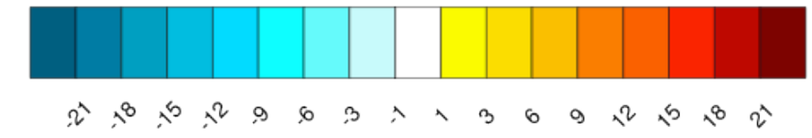
Jun

Jul

Aug

SWI changing trends within season

- Alaska
- Taymyr
- Canadian Arch.
- July-August consistent with SLP trends



1982-1998

1999-2013

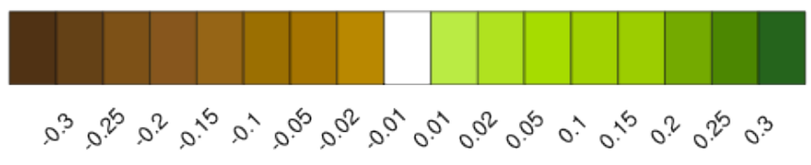
Jun

Jul

Aug

TI-NDVI changing trends within season

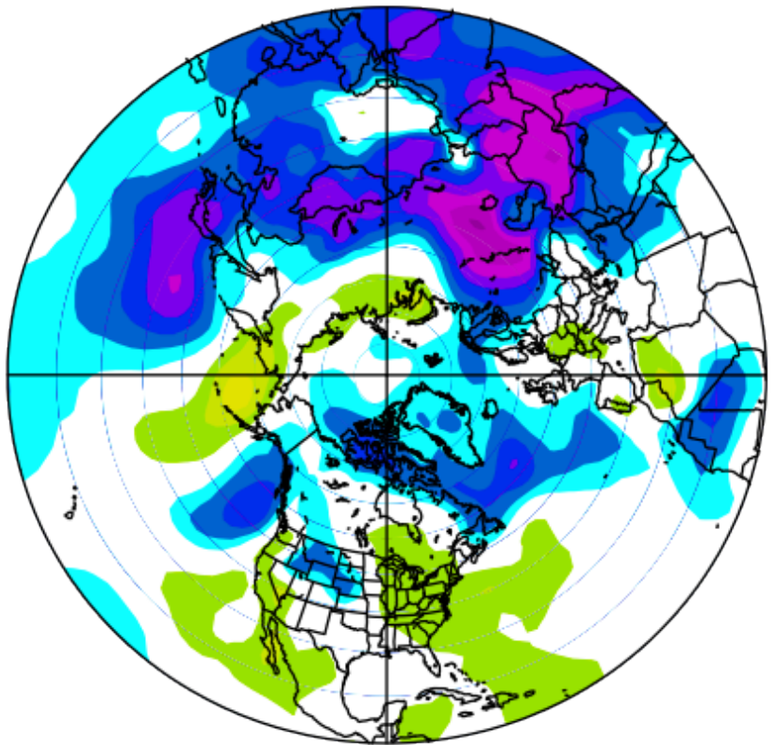
- June declines throughout domain
- July increases stronger & declines stronger



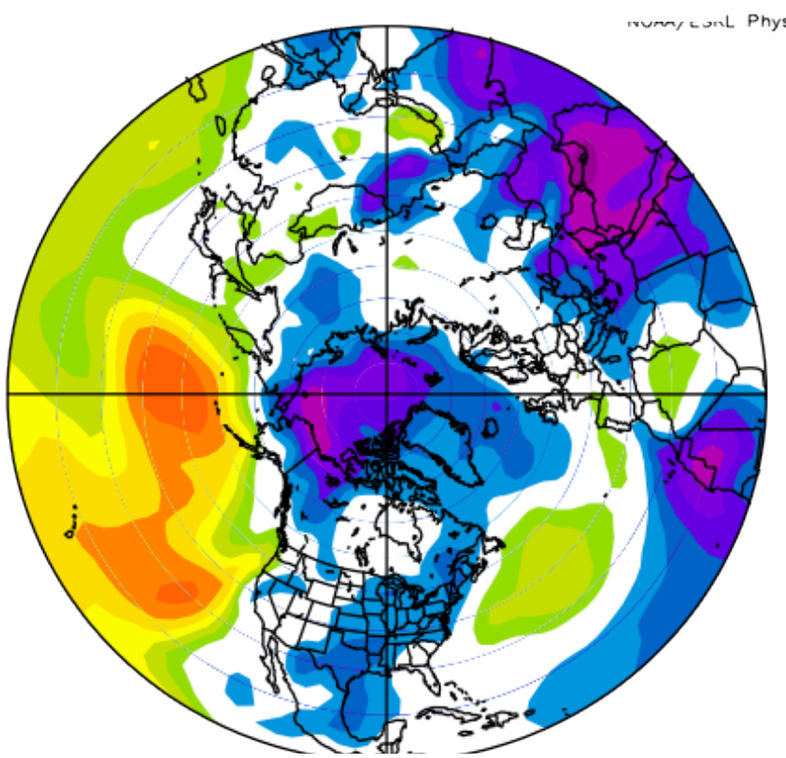
What could be affecting the trends?

- Cooling in summer?
  - Clouds
  - More clouds due to more moisture
- Declines of Biweekly MaxNDVI in spring & fall
  - Delayed growing season start
  - Snow!

SWI-SLP correlations Jun-Aug:Large-scale

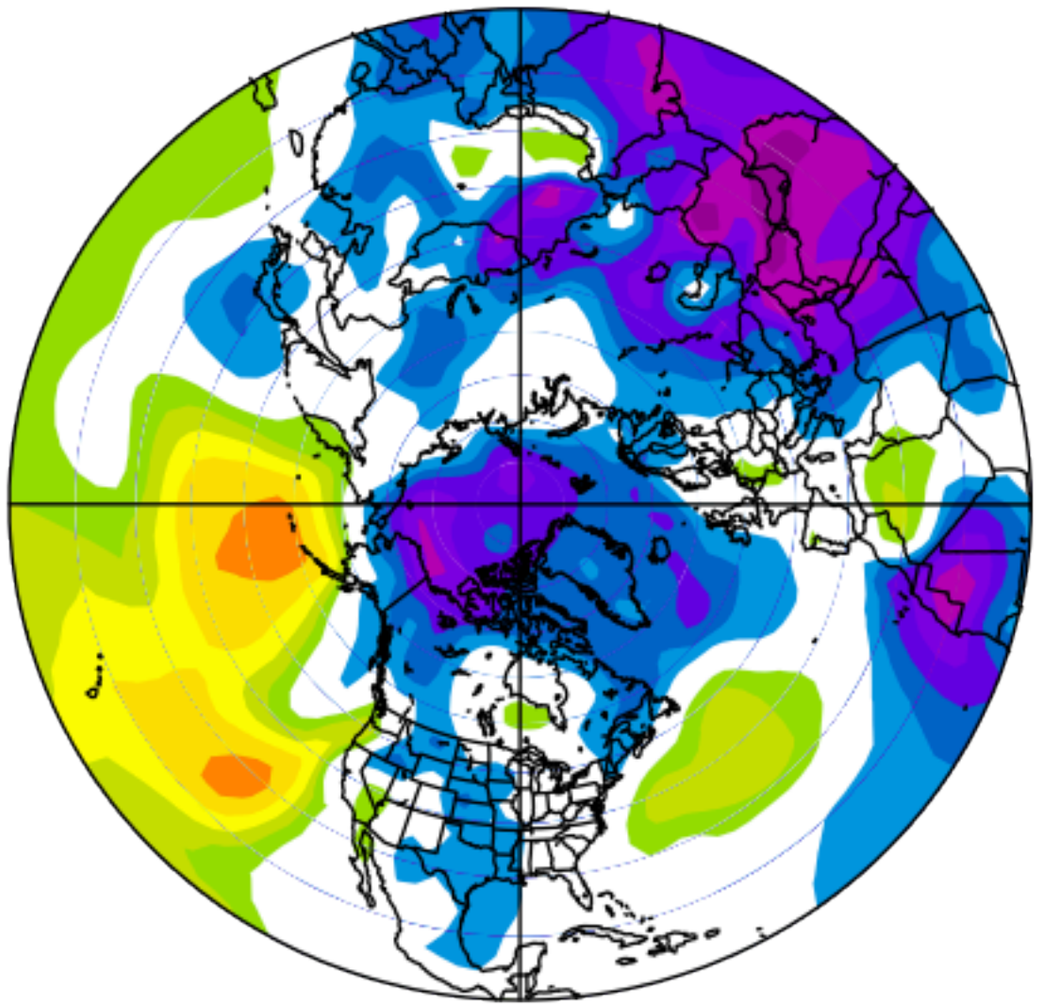


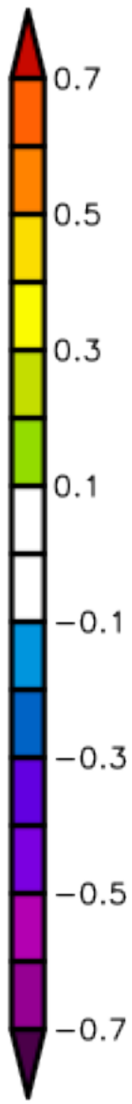
Eurasia



N.Hemisphere

Arctic SWI 82-13





Jun to Aug: 1982 to 2013: Surface Sea Level Pressure
Seasonal Correlation w/ Jun to Aug swinhemic.txt

NCEP/NCAR Reanalysis

NOAA/ESRL Physical Sciences Division

Summary

- Moisture is likely important in this changing NDVI story.
- Need good snow data
- Large-scale climate

NH JJA SLP trends
82-13