Warm Arctic-Cold Continents

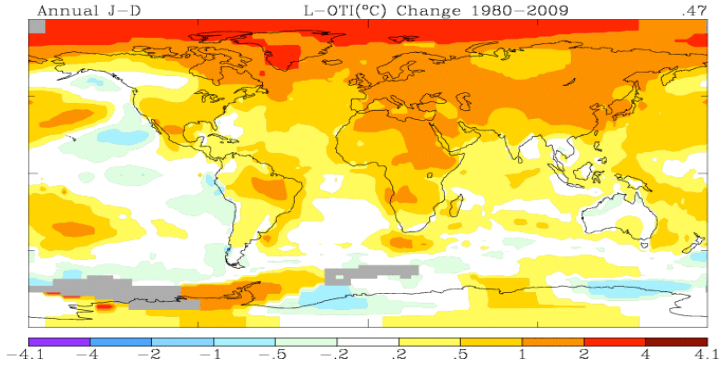
James Overland – NOAA/PMEL Seattle USA

Chukchi Sea
September 30, 2009


Negative Feedback- thin Ice grows fast

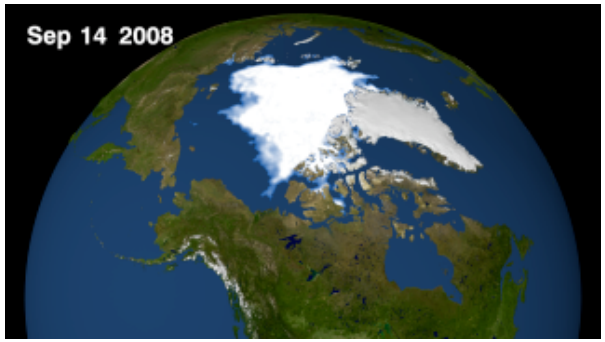
MULTIPLE Feedbacks

Global Warming



Arctic amplification

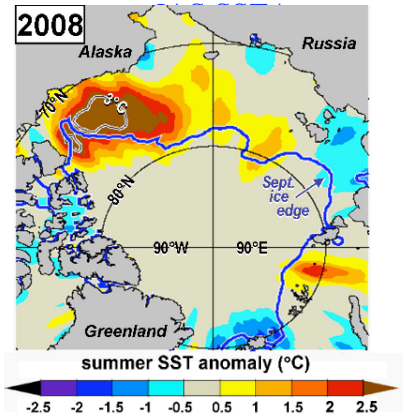
Reduction of Arctic sea Ice



Sept Sea Ice Extent

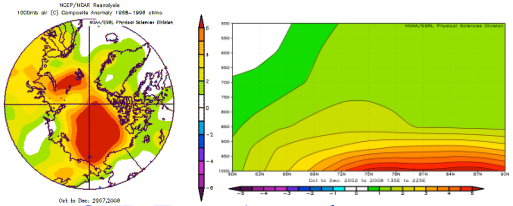
Surface albedo decrease

Ocean absorbs more heat



Heat releases to atmosphere in the fall.

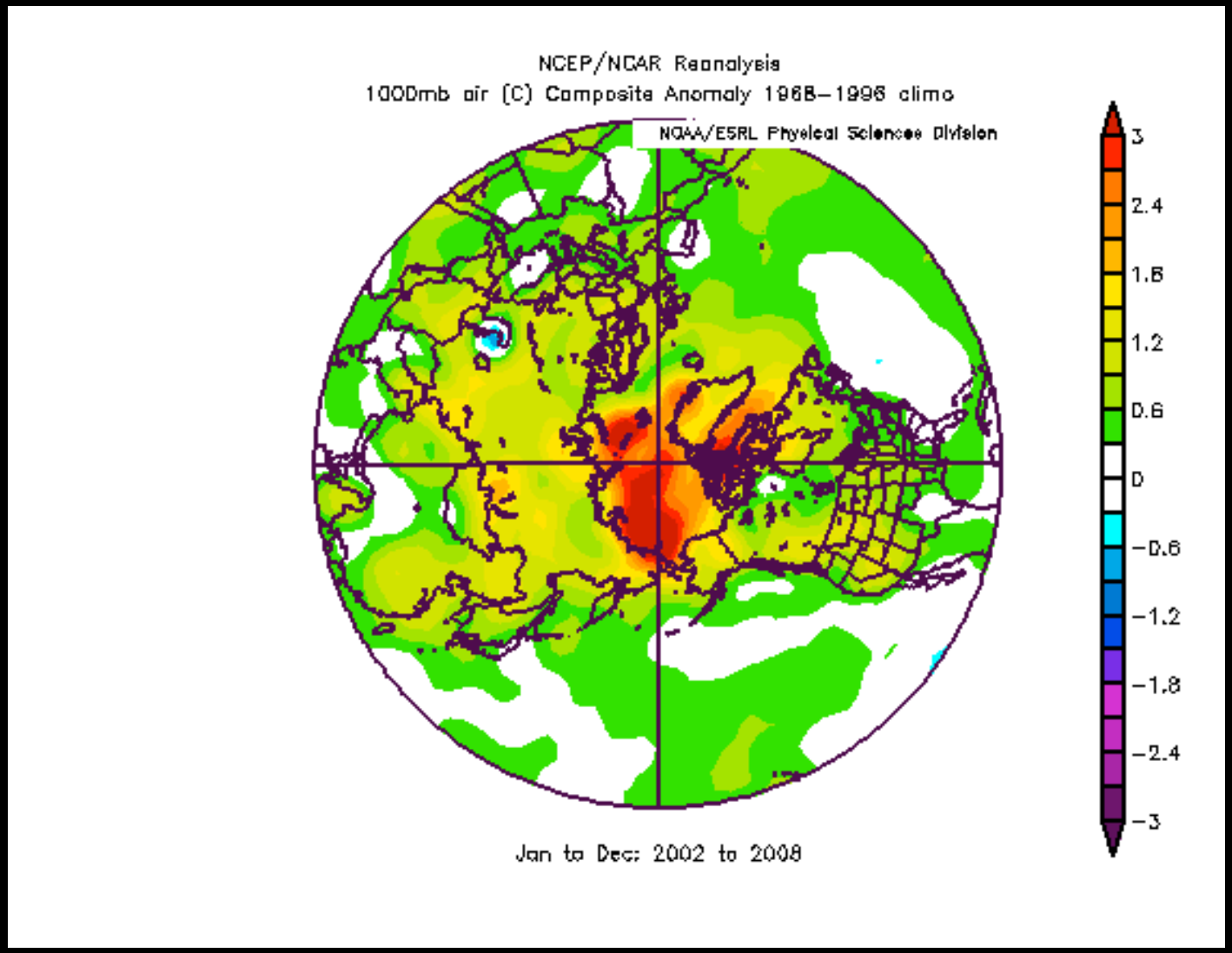
Atmosphere warming



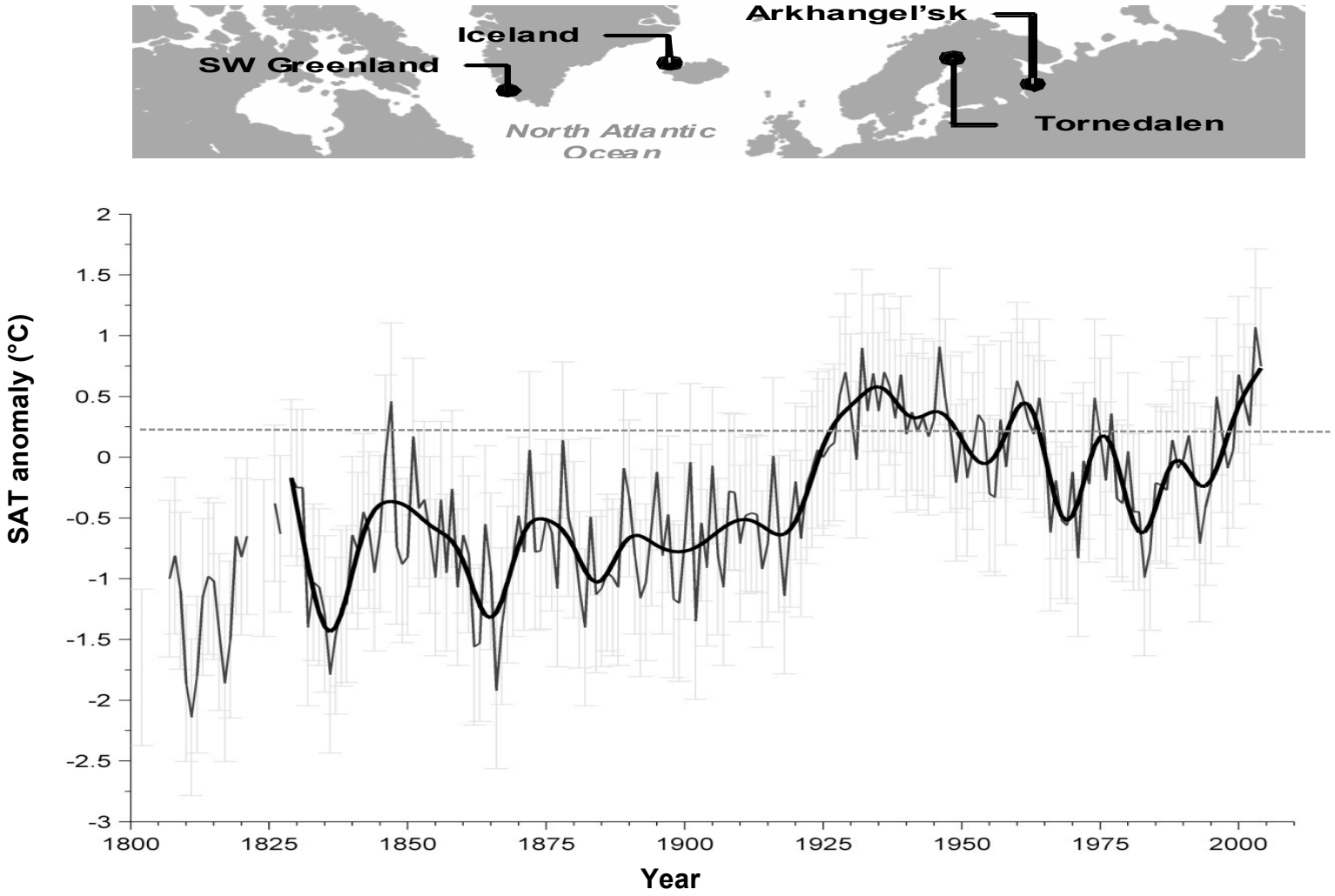
OND Temp Anomaly

Teleconnection and circulation pattern change

ARCTIC AMPLIFICATION:
The Arctic is Earth's fastest-warming region



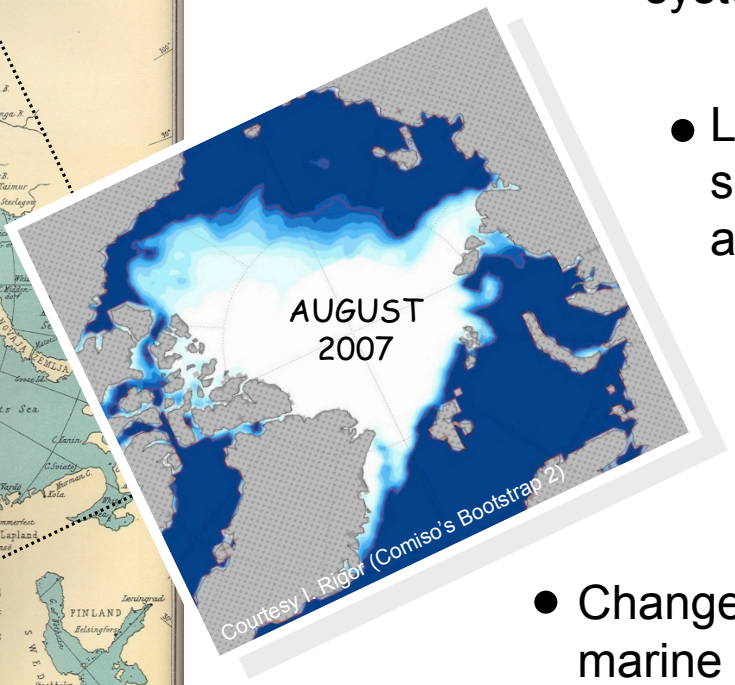
2002-2008 Air Temperature Anomalies Relative to 1968-1996



Extended annual mean SAT record for the northern North Atlantic region (T_{NA}). (Wood, et al. 2010). NO 60-80 Year Oscillations.

Climate impact of 1930s in Atlantic - Arctic

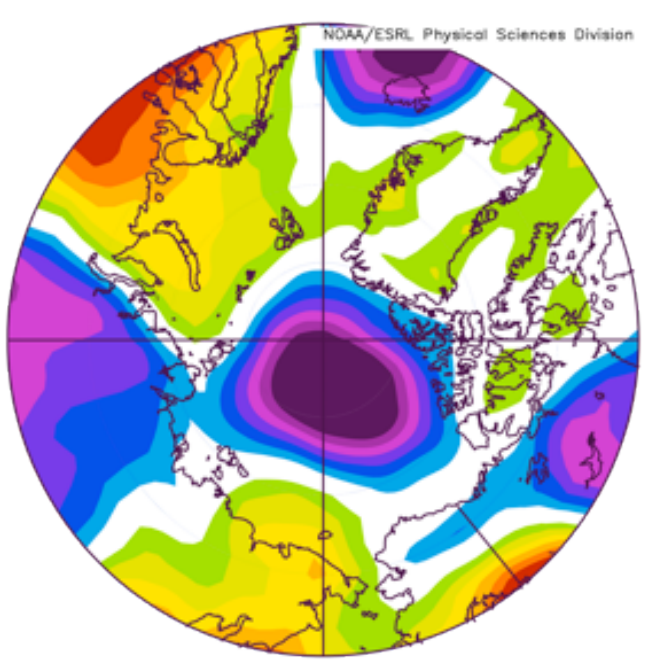
Danske Nautisk-Meteorologisk Årbog (Nautical-Meteorological Yearbook) DMI



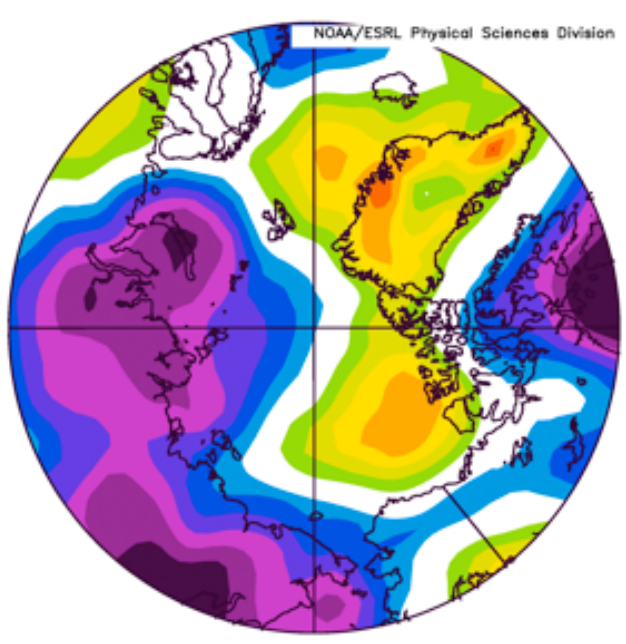
- *Parallel warming* from West Greenland to Northern Russia
- SST anomalies in Gulf Stream system, Nordic seas...
- Large declines in sea ice, glaciers, and tundra
- Increase in southerly winds & cyclones
- Changes in terrestrial & marine biogeography

Normal

Arctic Dipole Pattern

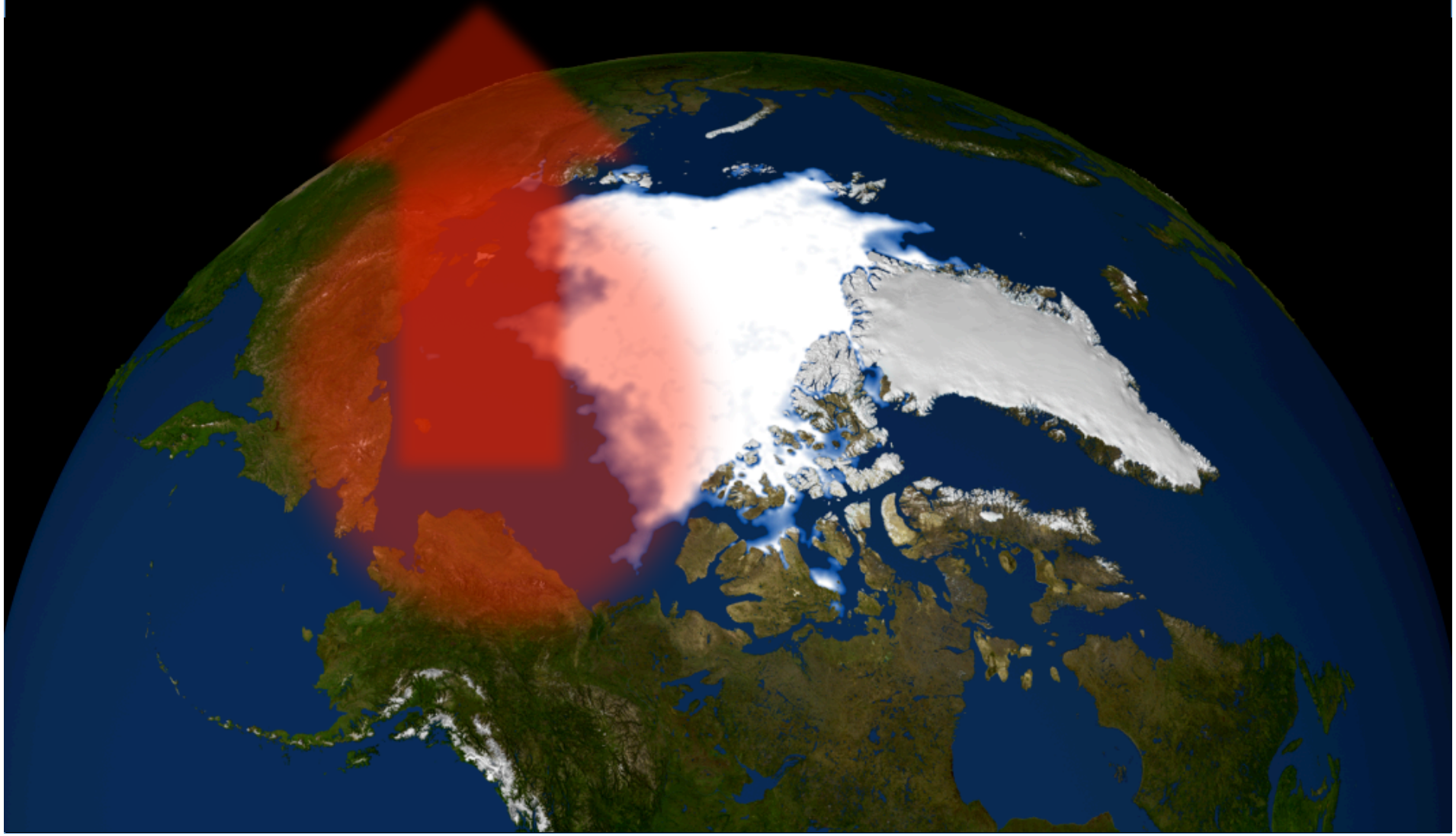


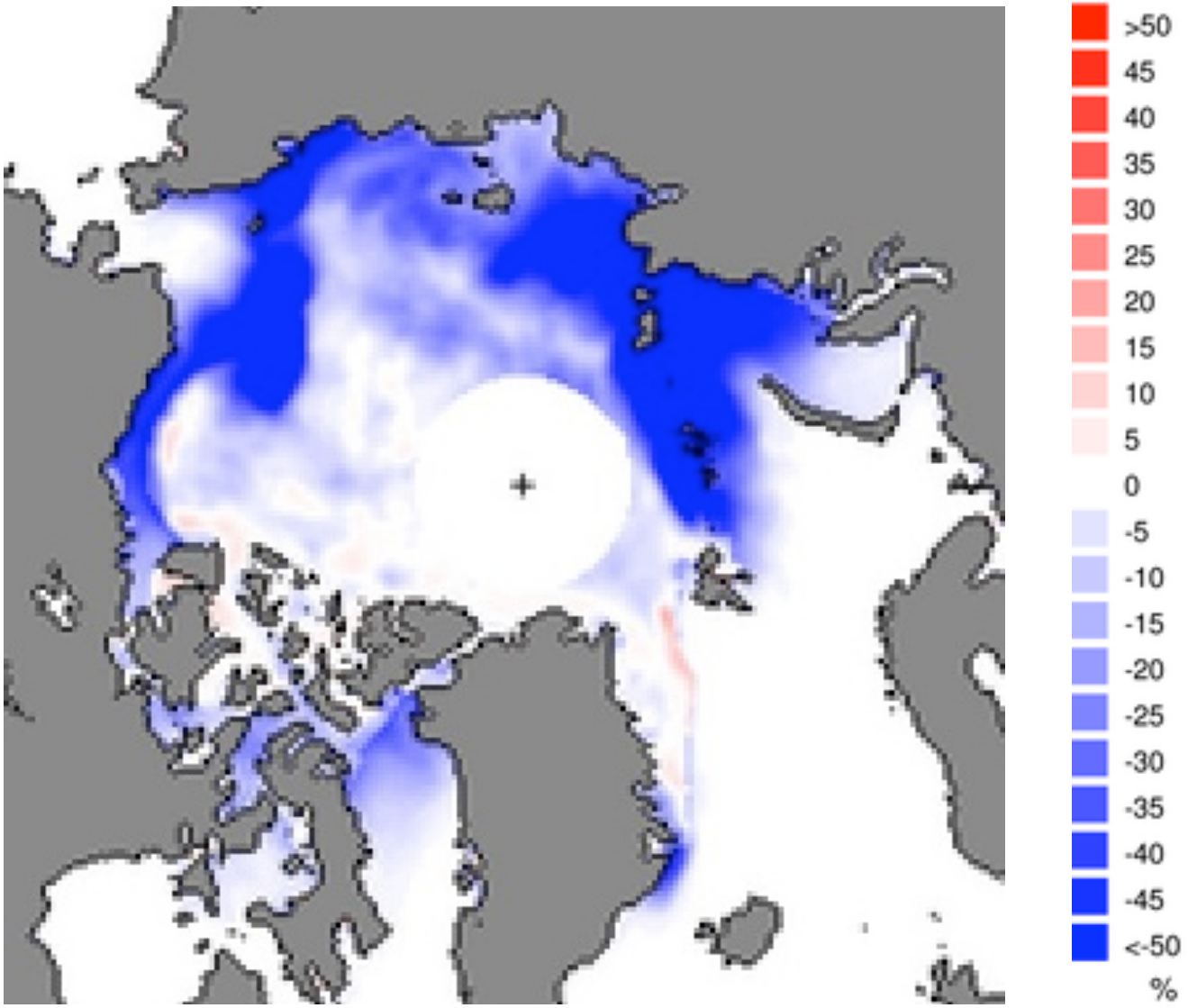
Sea Level Pressure (mb) Composite Mean
7/1/10 to 7/20/10
NCEP/NCAR Reanalysis



Sea Level Pressure (mb) Composite Mean
8/1/10 to 8/24/10
NCEP/NCAR Reanalysis

Warm Arctic-Cold Continents

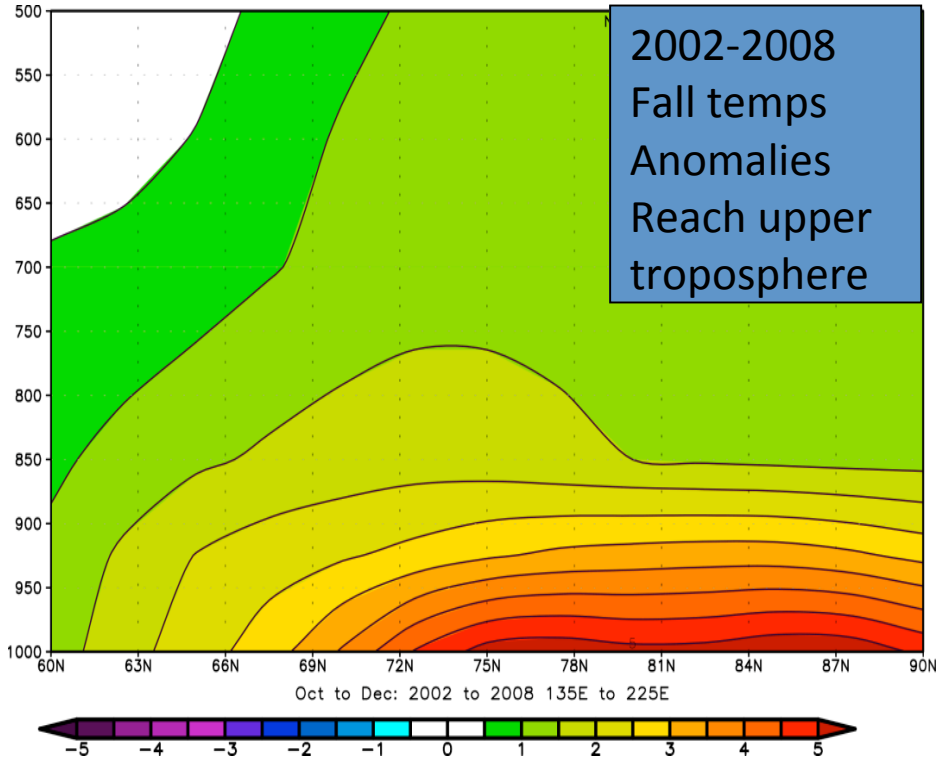




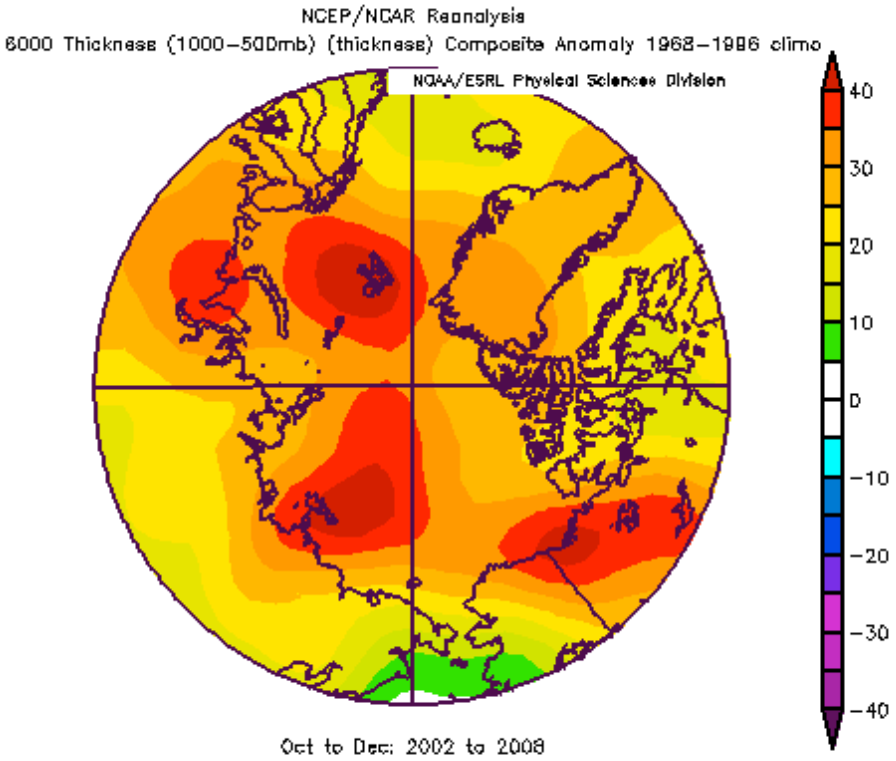
Sea ice concentration anomalies for October 2009
http://nsidc.org/data/seaice_index/archives/index.html.

Loss of Sea Ice Impacts Larger Atmospheric Climate

Pacific Arctic



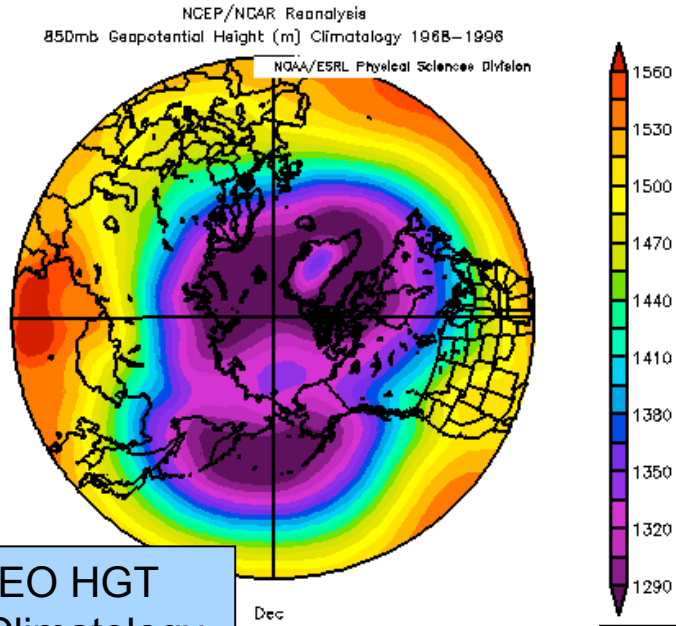
2002-2008
Fall temps
Anomalies
Reach upper
troposphere



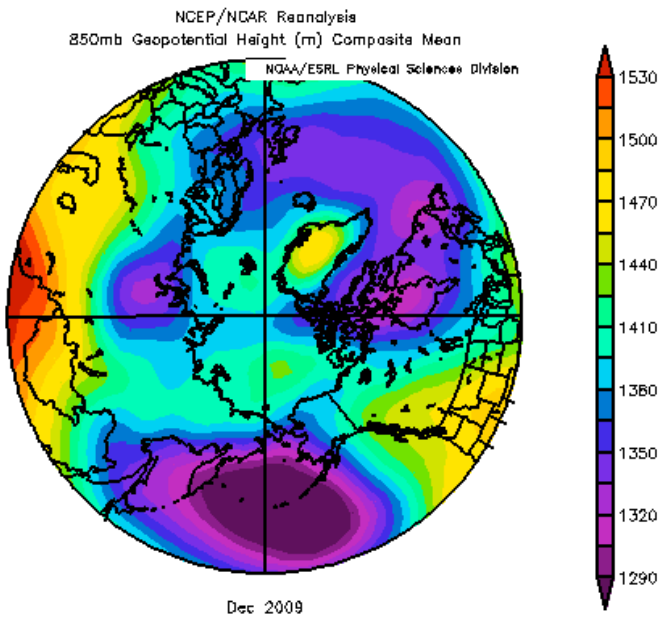
2002-2008 Fall 500-1000 mb
Thickness Anomaly

Thermal Wind Reduces Polar West Winds

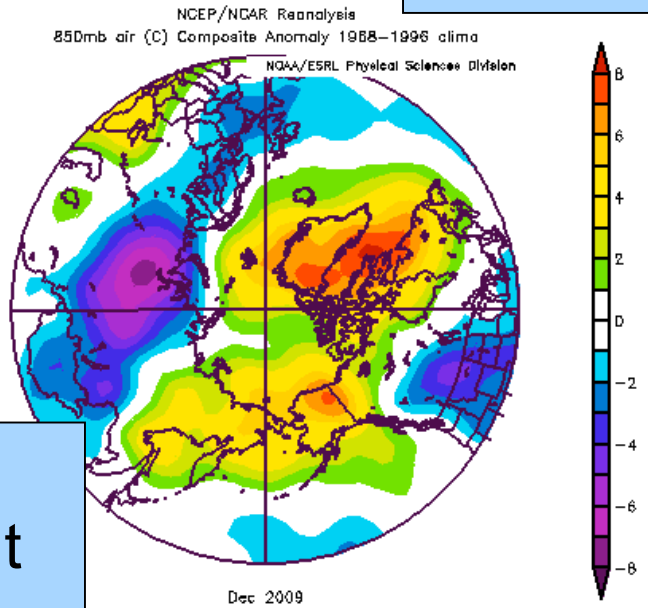
Overland and Wang,
Tellus, 2010



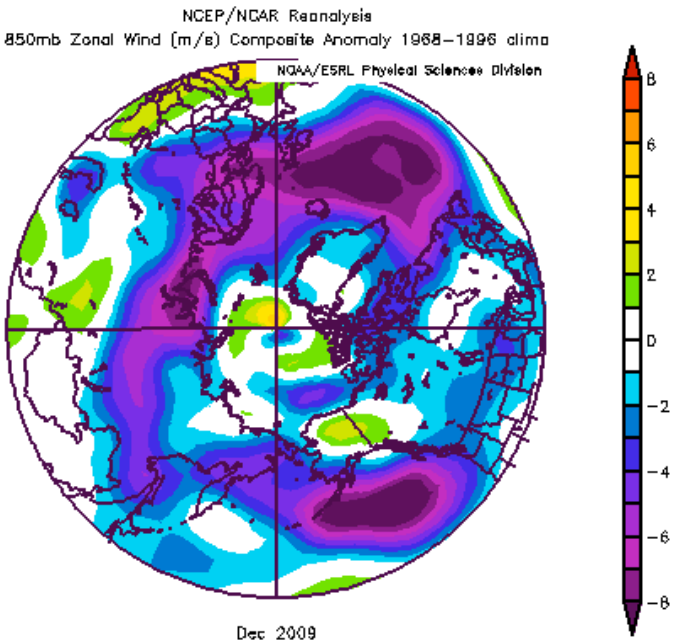
850 GEO HGT
DEC Climatology



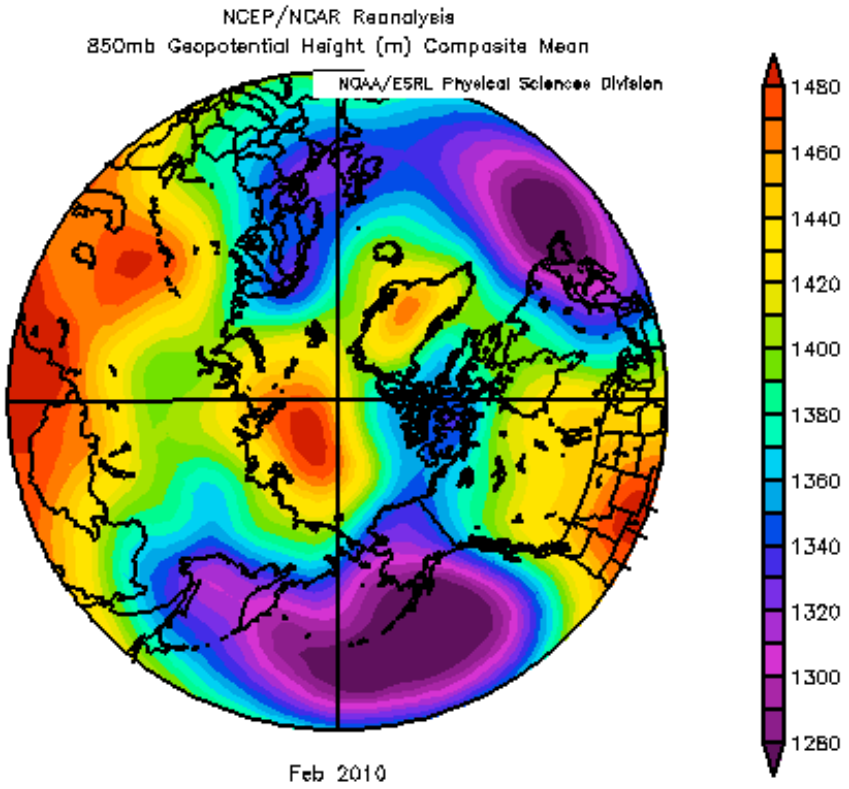
DEC 2009



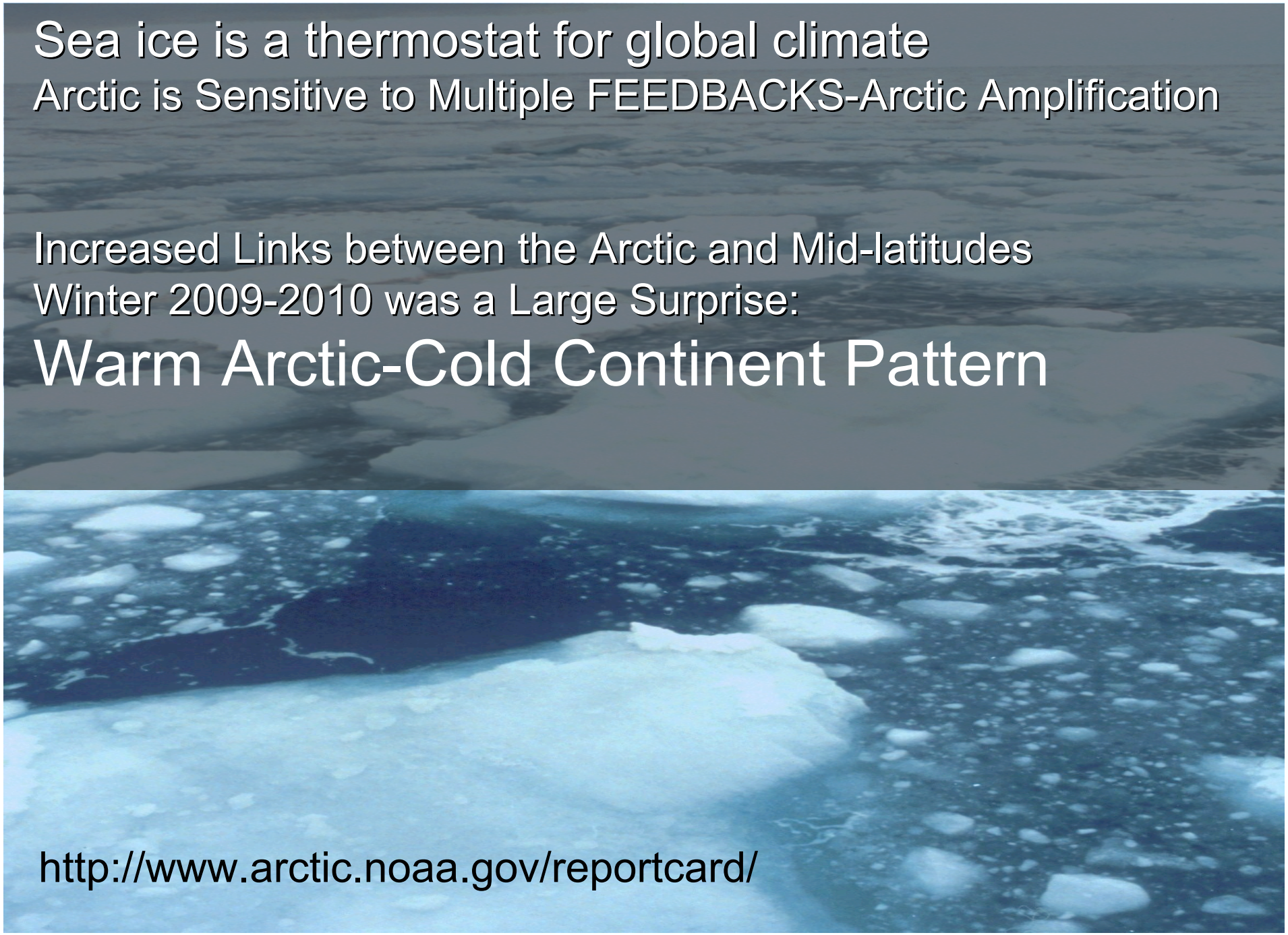
Warm Arctic
Cold Continent
Pattern

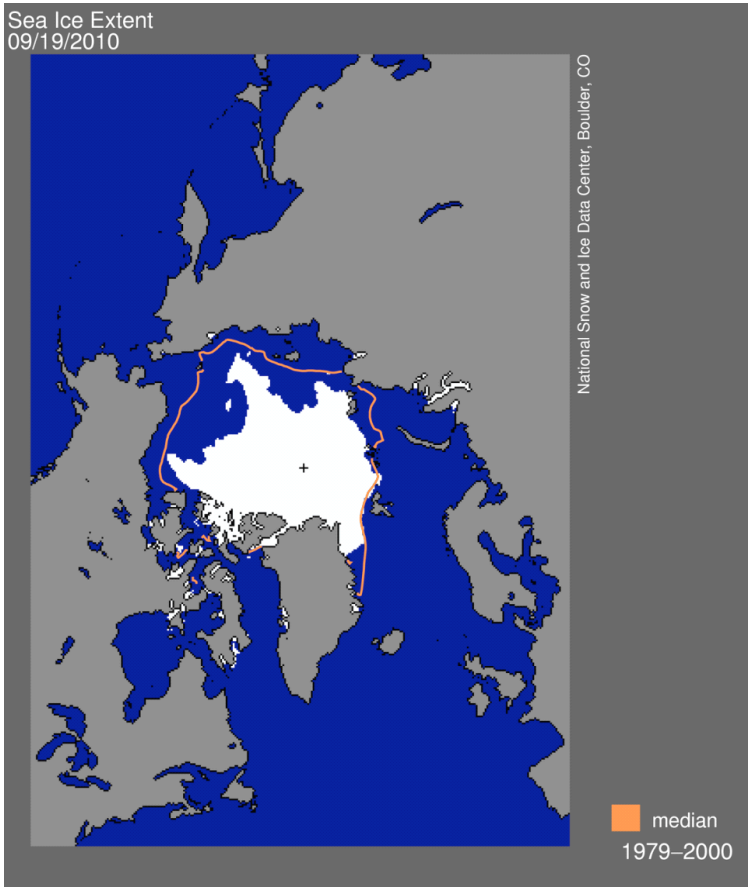


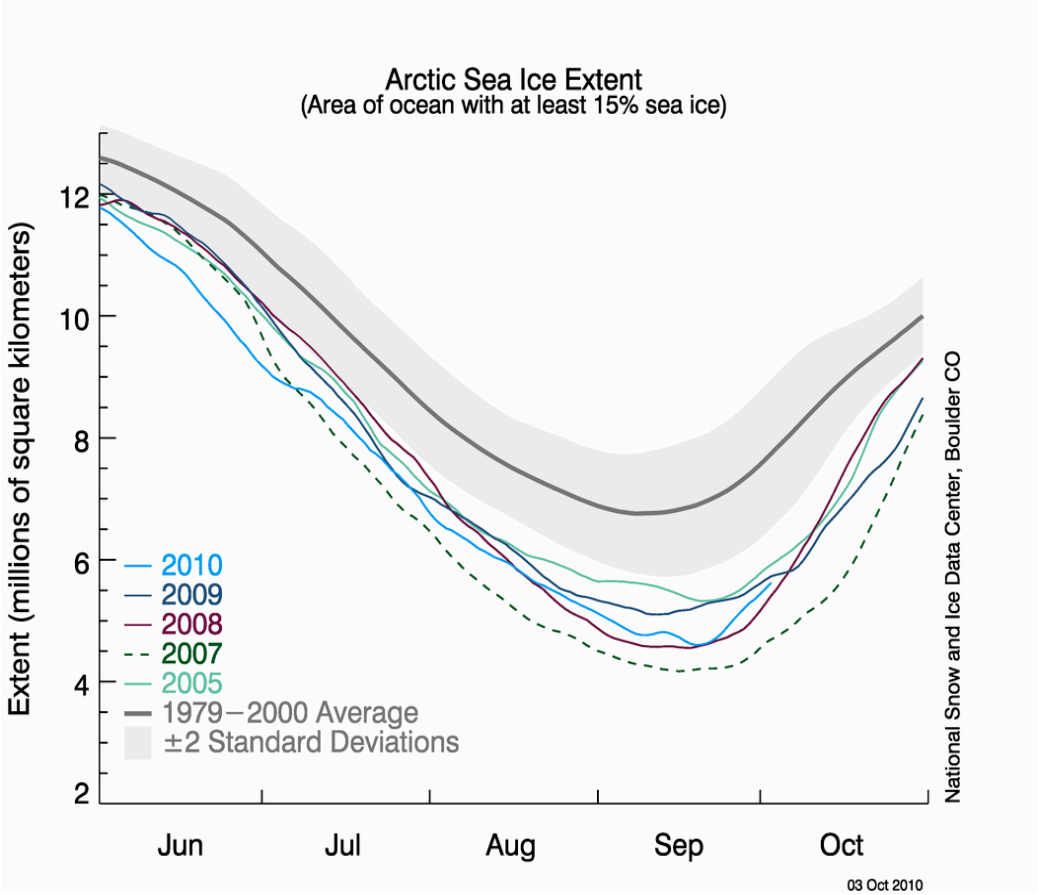
Polar Research in review



More Negative NAO than El Nino (Seager et al. 2010)
Only 3 times in last 160 years

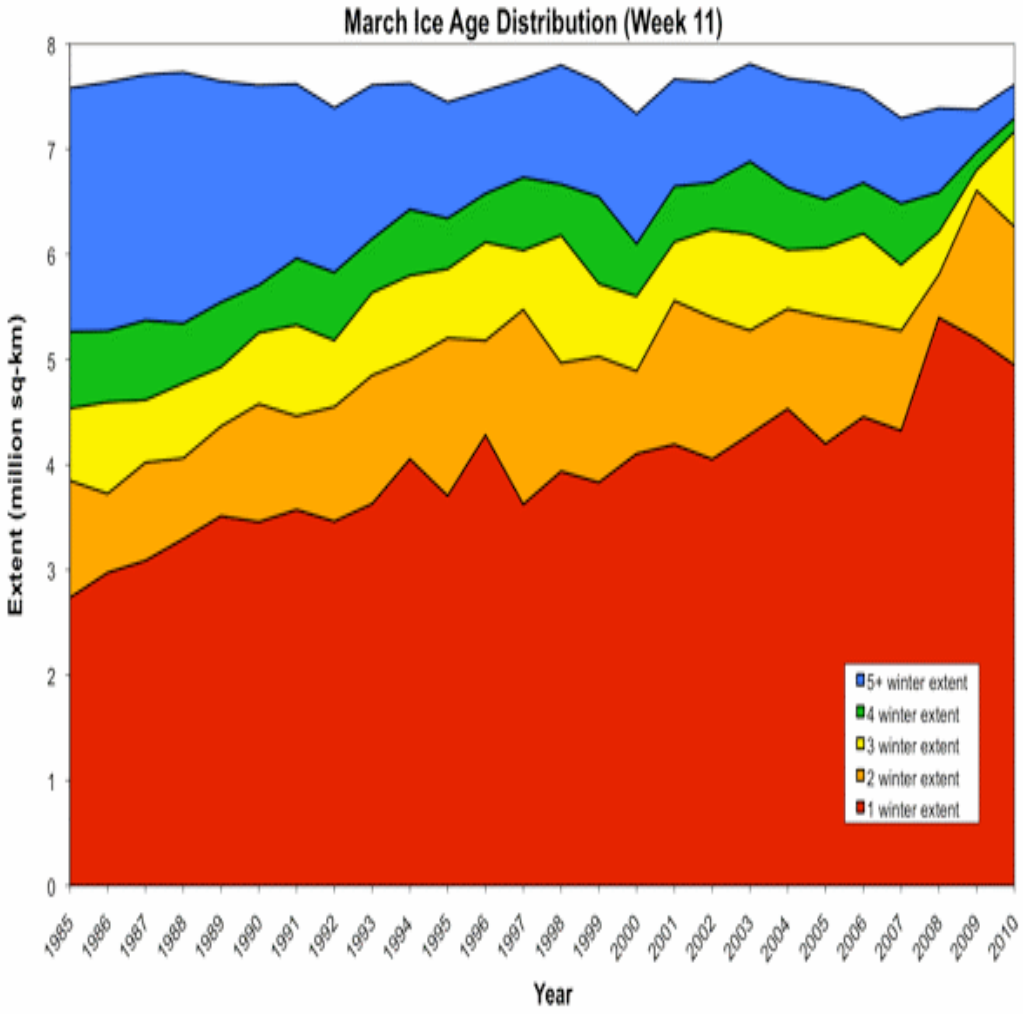

Sea ice is a thermostat for global climate
Arctic is Sensitive to Multiple FEEDBACKS-Arctic Amplification
Increased Links between the Arctic and Mid-latitudes
Winter 2009-2010 was a Large Surprise:
Warm Arctic-Cold Continent Pattern
http://www.arctic.noaa.gov/reportcard/


Sea Ice Extent
09/19/2010
National Snow and Ice Data Center, Boulder, CO
median
1979–2000

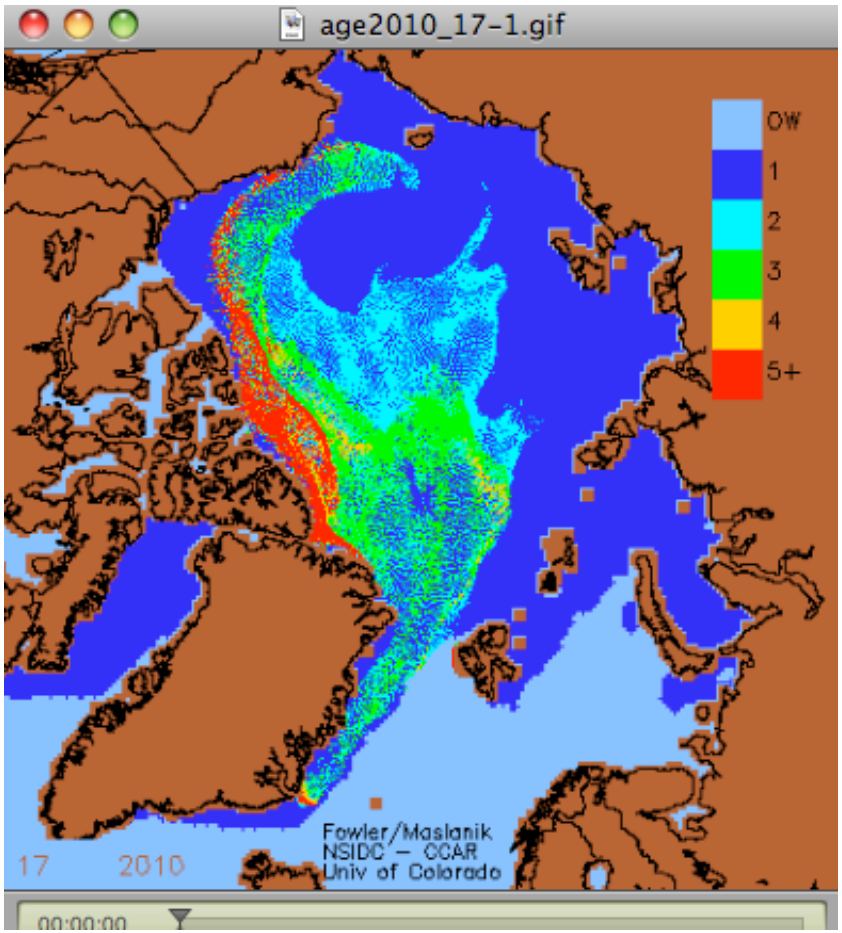

Arctic Sea Ice Extent
(Area of ocean with at least 15% sea ice)
Extent (millions of square kilometers)
12
10
8
6
4
2
2010
2009
2008
2007
2005
1979–2000 Average
±2 Standard Deviations
Jun
Jul
Aug
Sep
Oct
03 Oct 2010
National Snow and Ice Data Center, Boulder CO

STEADY AS SHE FLOWS

In 1896, Fram became the first vessel to have ridden the Transpolar Drift Stream – one of the Arctic's ice currents. This year, Tara was the second, making the journey in less than half the time. The Transpolar Drift Stream is pushed along by westerly winds, while the other major ice current in the Arctic is the clockwise-circulating Beaufort Gyre, generated by the rotating winds created by a high-pressure atmospheric system



End of April, 2010



Stroeve , et al. in press