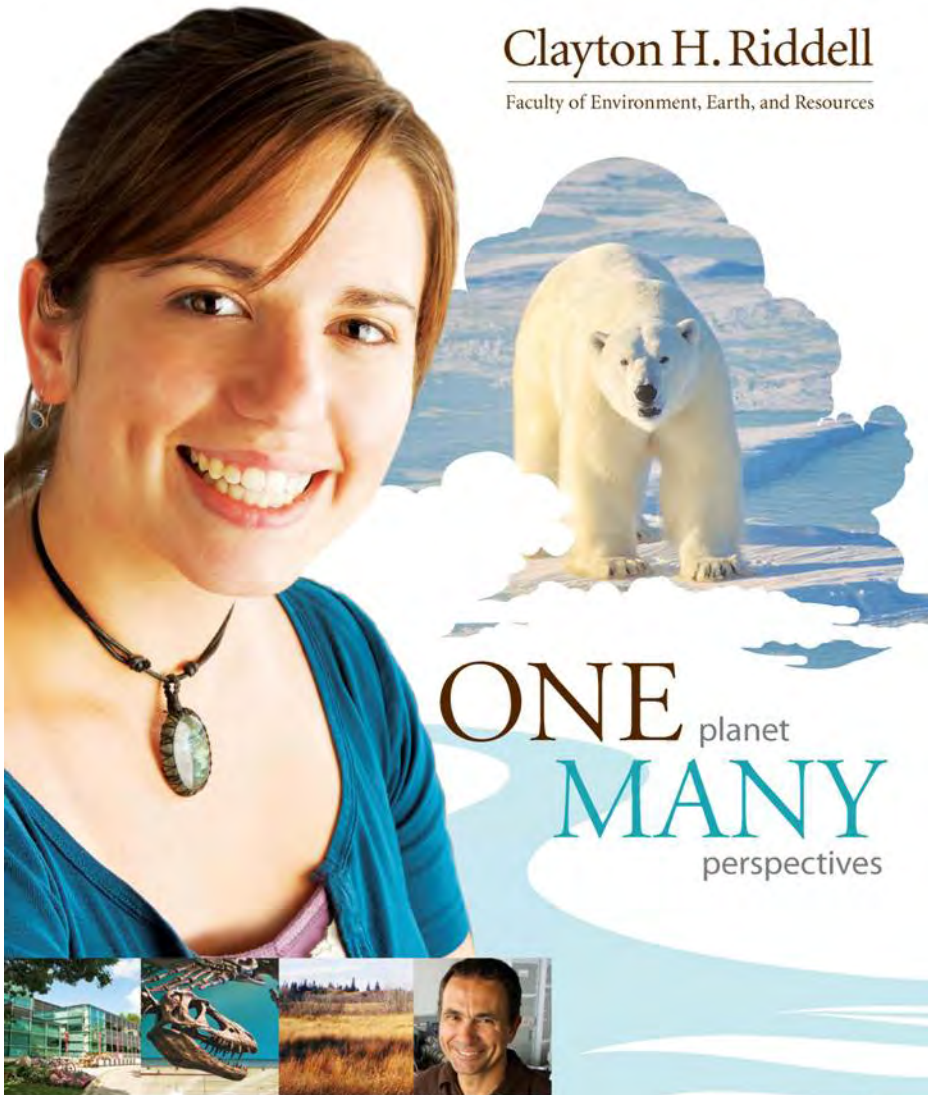


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Faculty of Environment, Earth, and Resources



ONE planet
MANY
perspectives

Climate Change

Prof. David G. Barber *CRC, DP*
Centre for Earth Observation Science
Faculty of Environment



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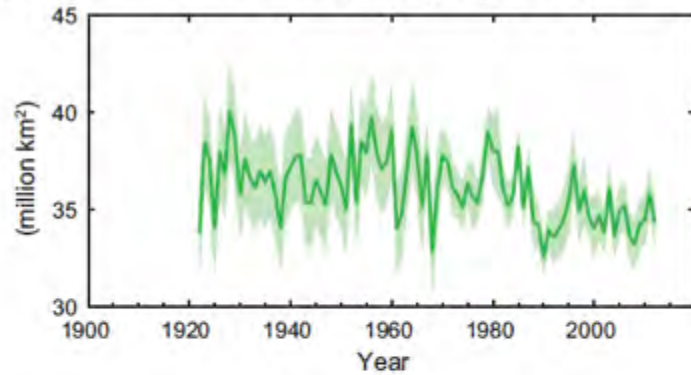


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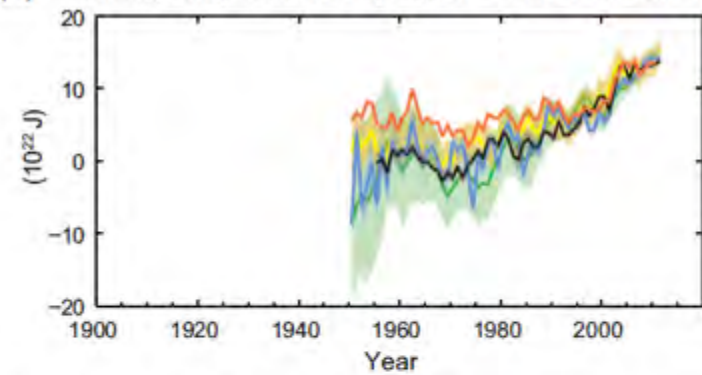
One university. Many futures.

Fifth Assessment Report

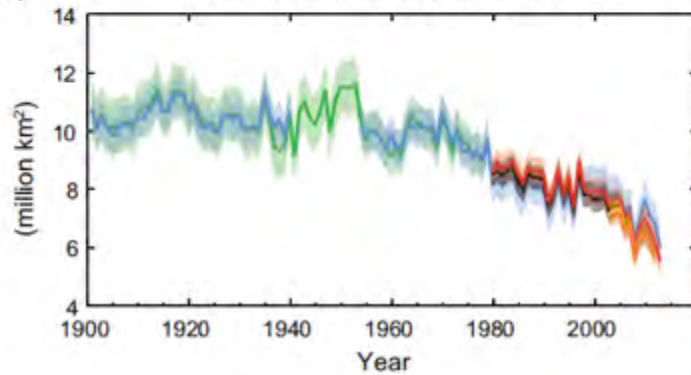
(a) Northern Hemisphere spring snow cover



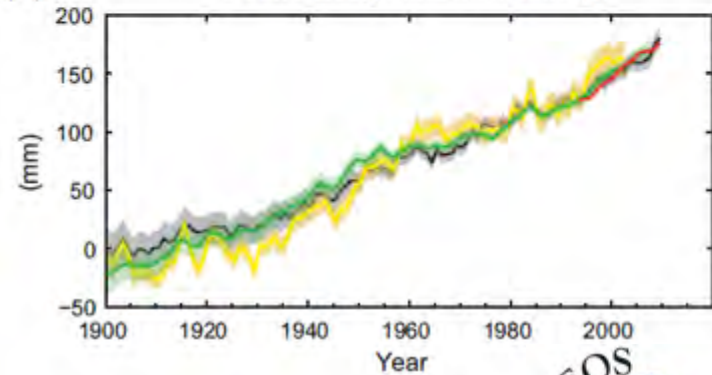
(c) Change in global average upper ocean heat content



(b) Arctic summer sea ice extent



(d) Global average sea level change





Tenure Track Faculty (13)

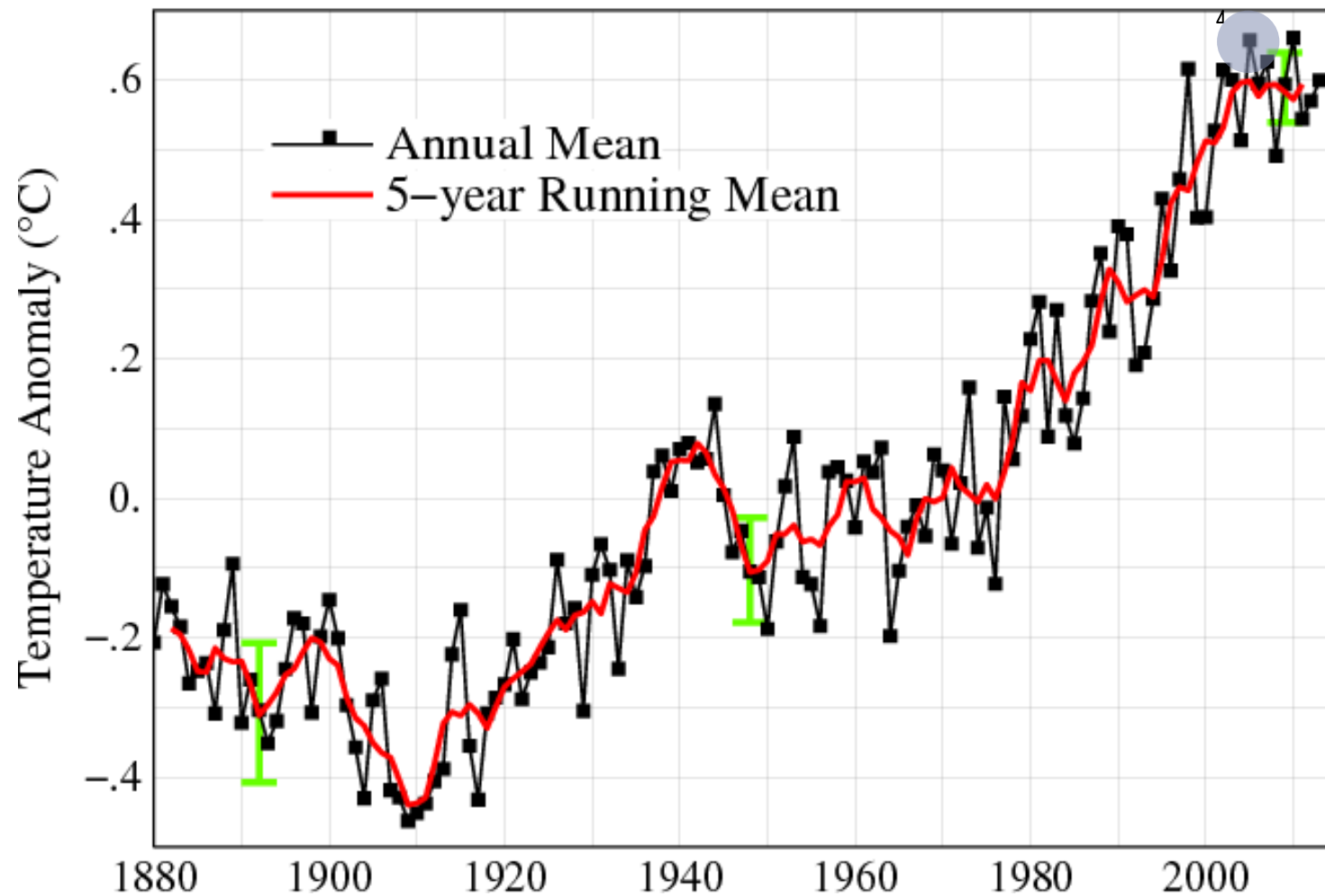
Research Faculty (8)

Adjunct Faculty (8)



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Global Land–Ocean Temperature Index

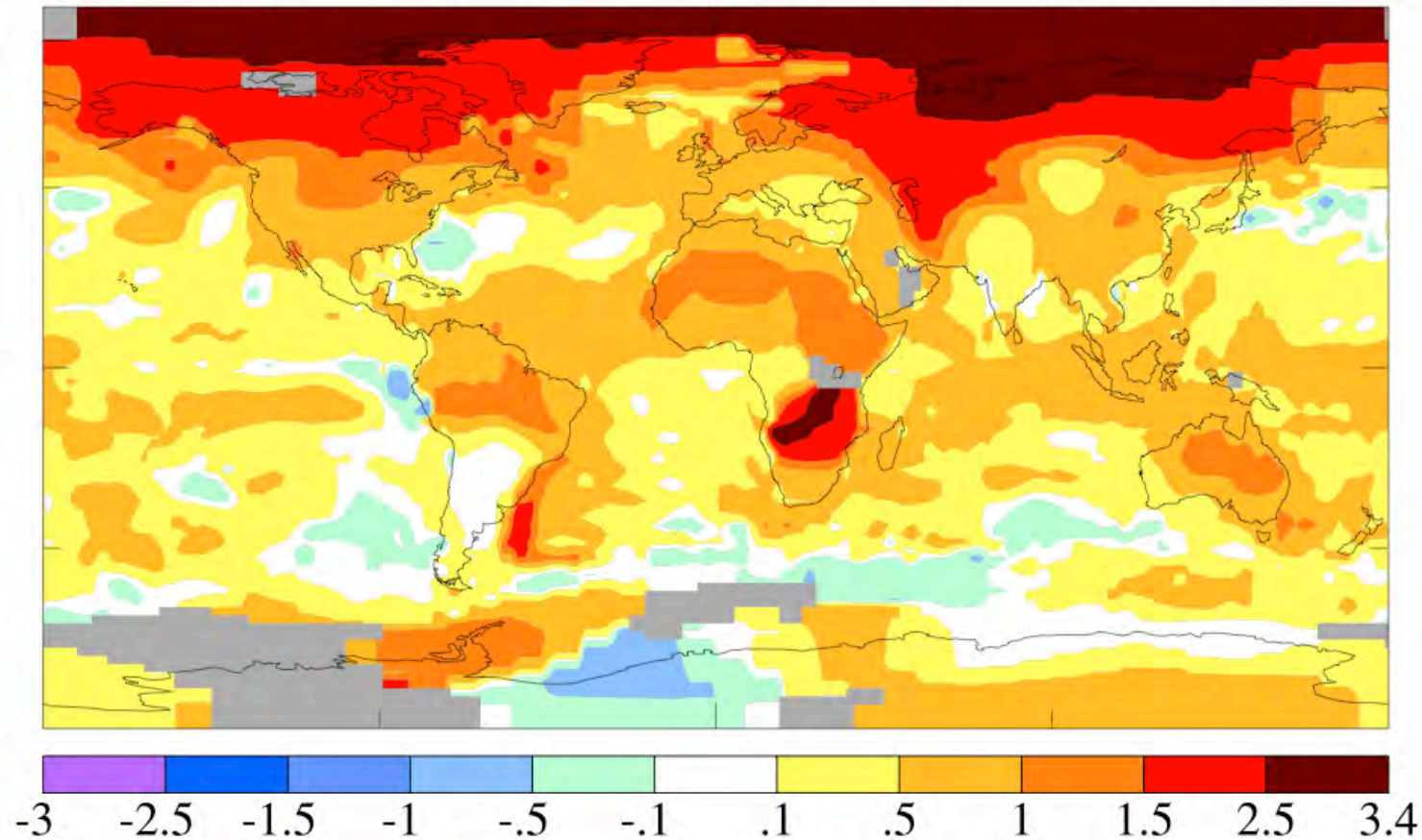


The Observational Record - Global mean surface temperature anomalies relative to the 1951-1980 climatology



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(b) 2005 Surface Temperature Anomaly ($^{\circ}\text{C}$)



Global mean surface temperature anomalies relative to the
1951-1980 climatology

Hansen et al. 2006



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Our addiction to fossil fuels:

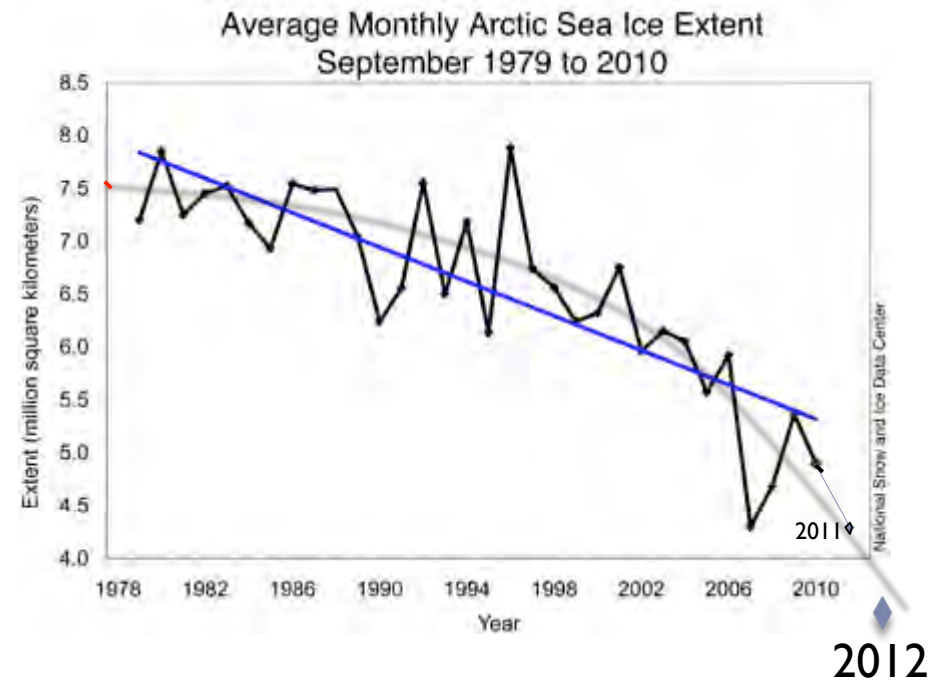
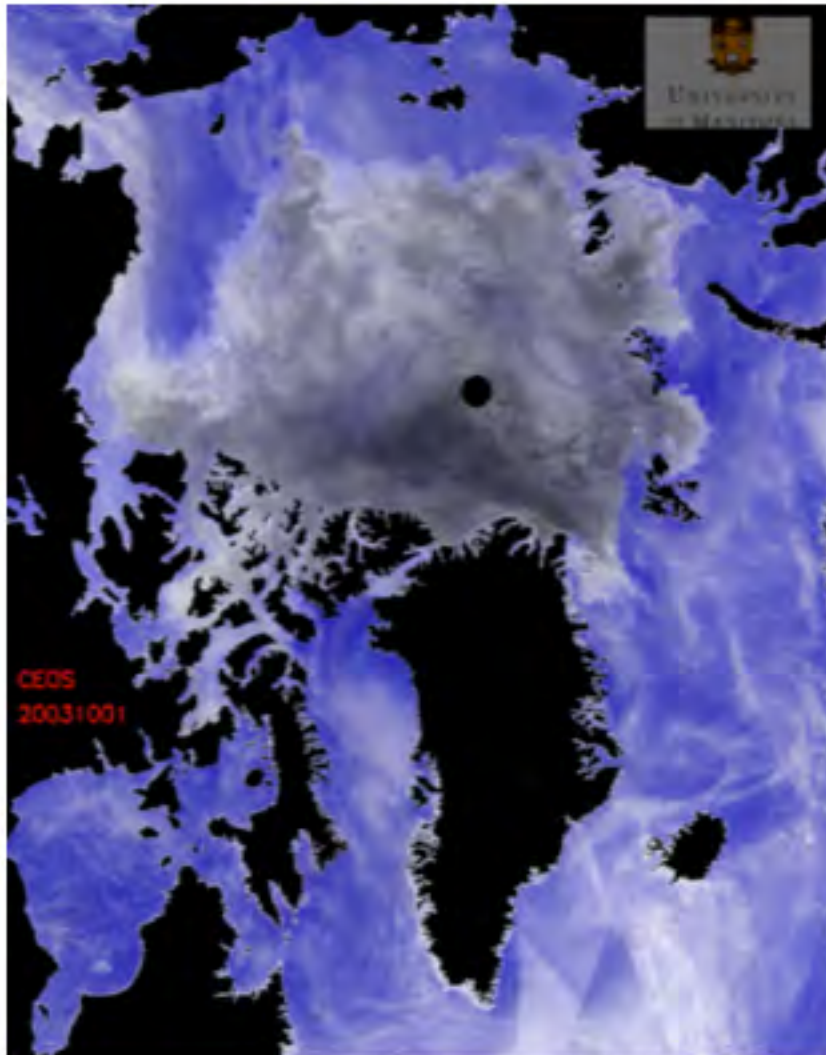
- 1990 emission = 20 billion tons
- 2013 emission = 32 billion tons
- Natural rate of increase = 0.0001 ppm/yr
- 2000 rate of increase = 2.5ppm/yr
- 2030 rate expectation = 5ppm/yr



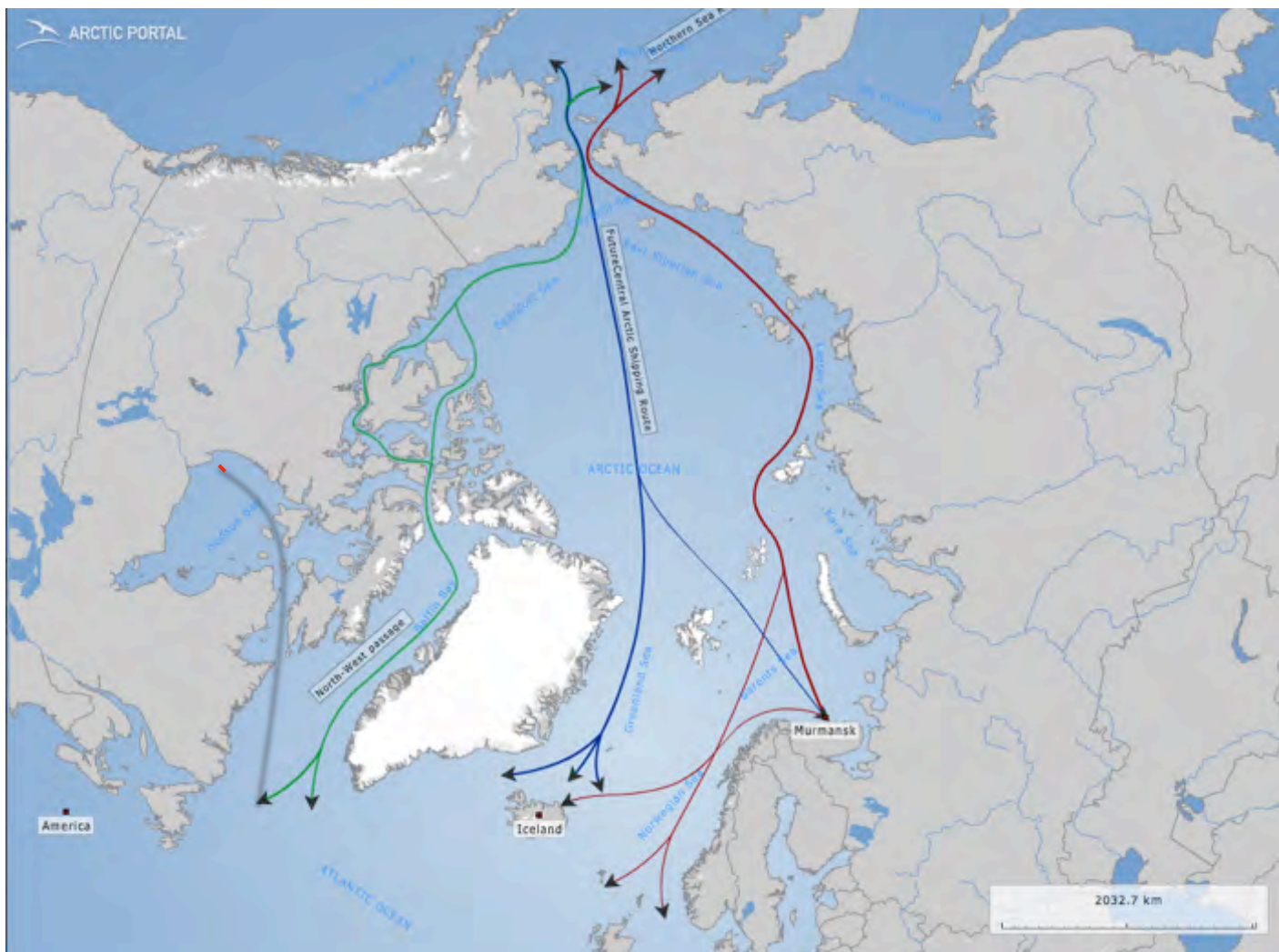
Our warming planet:

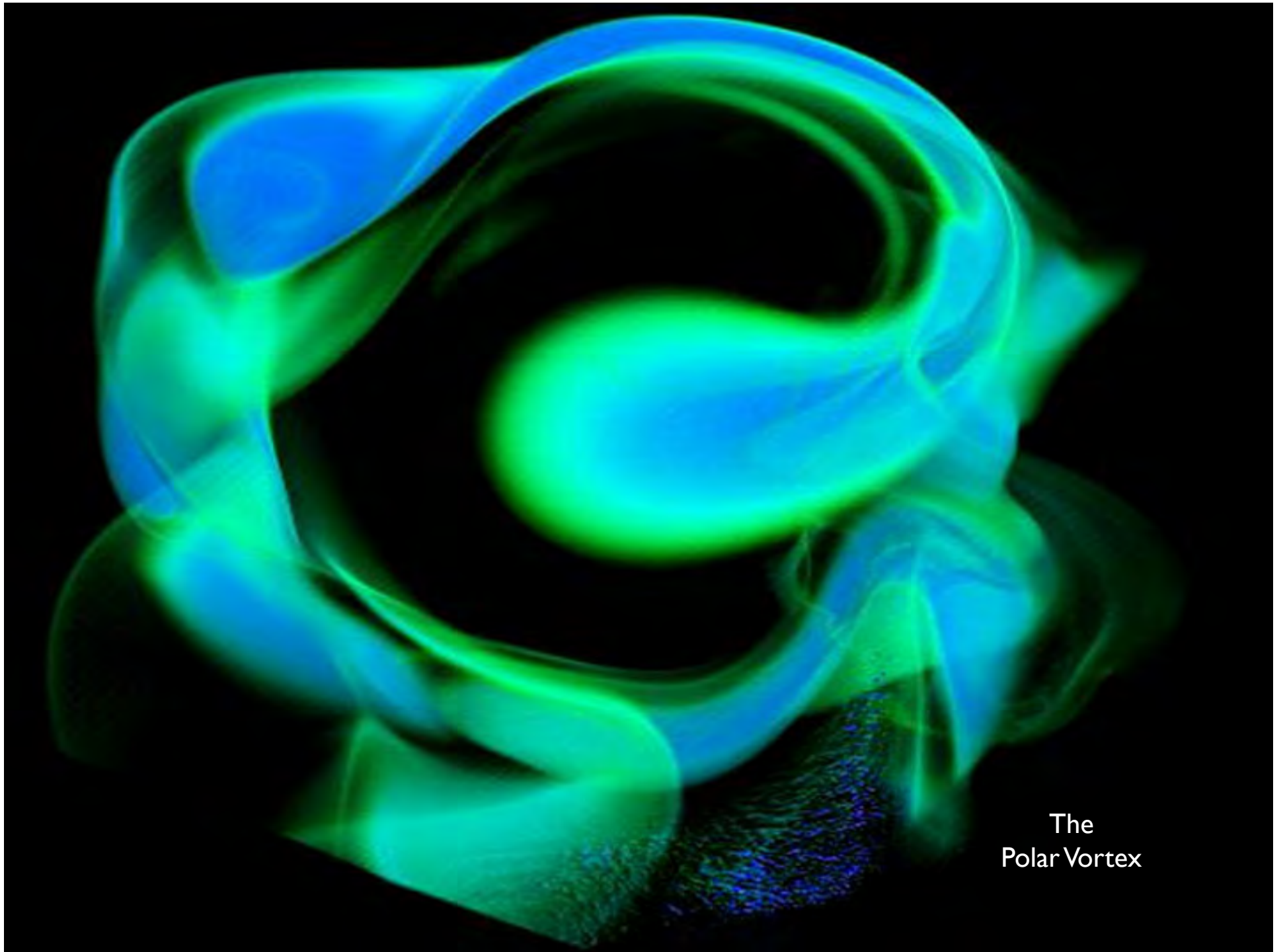
- 2013 tied with 2009 and 2006 for the seventh warmest year since 1880.
- With the exception of 1998, the 10 warmest years in the 134-year record all have occurred since 2000, with 2010 and 2005 ranking as the warmest years on record

Sea Ice – dynamic over many scales



Industrialization of the Arctic

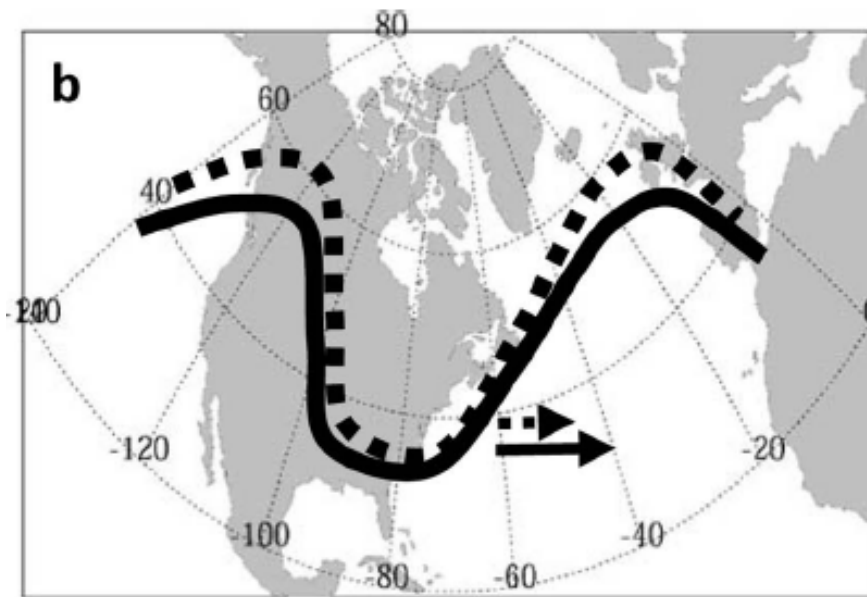




The
Polar Vortex

Effect on our climate?

Warm ocean cold continent hypothesis



- Decrease in gradient between the tropics and pole
- Slows eastward progression of Rossby waves
- Leads to persistence at mid latitudes
- Increase potential for extreme weather (droughts, floods, heatwaves, coldspells)

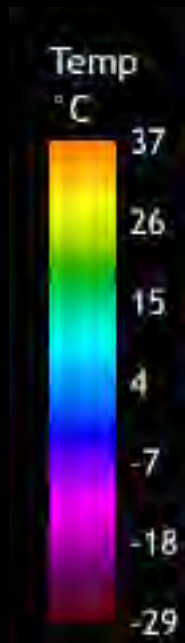


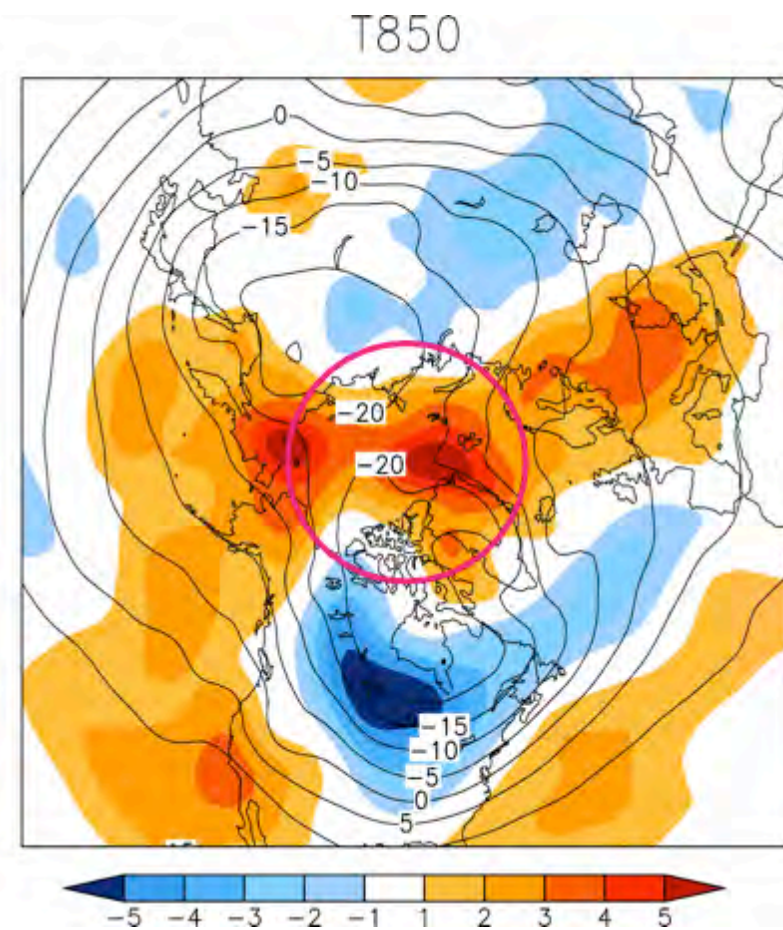
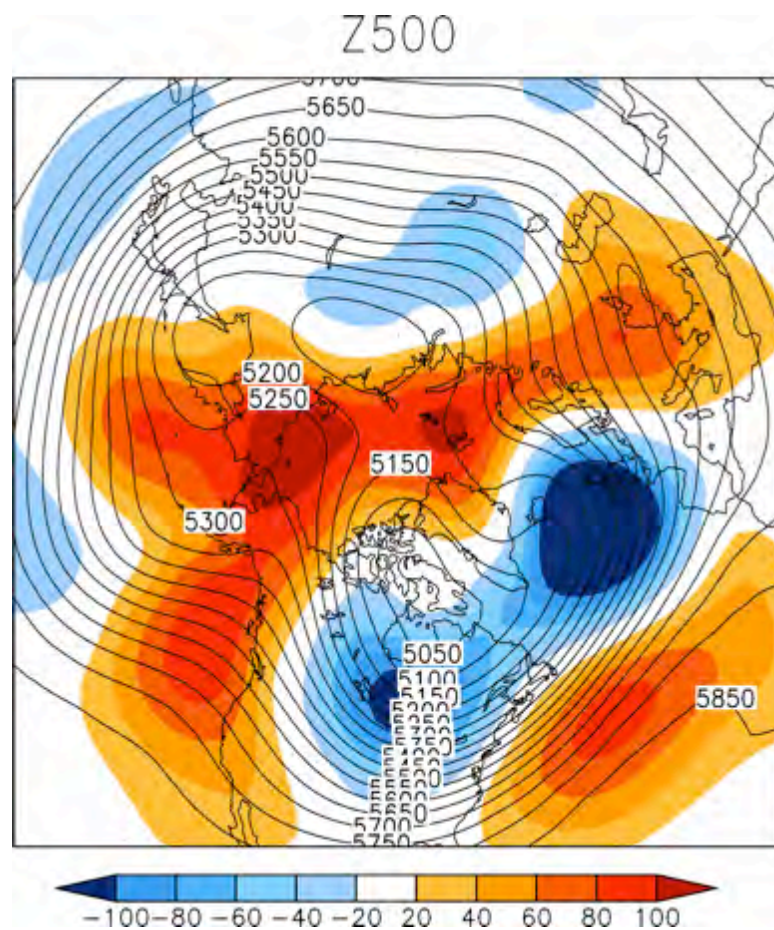
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Francis and Vavrus, 2012



Global Surface T°
Friday, April 25, 2014
7:32 am





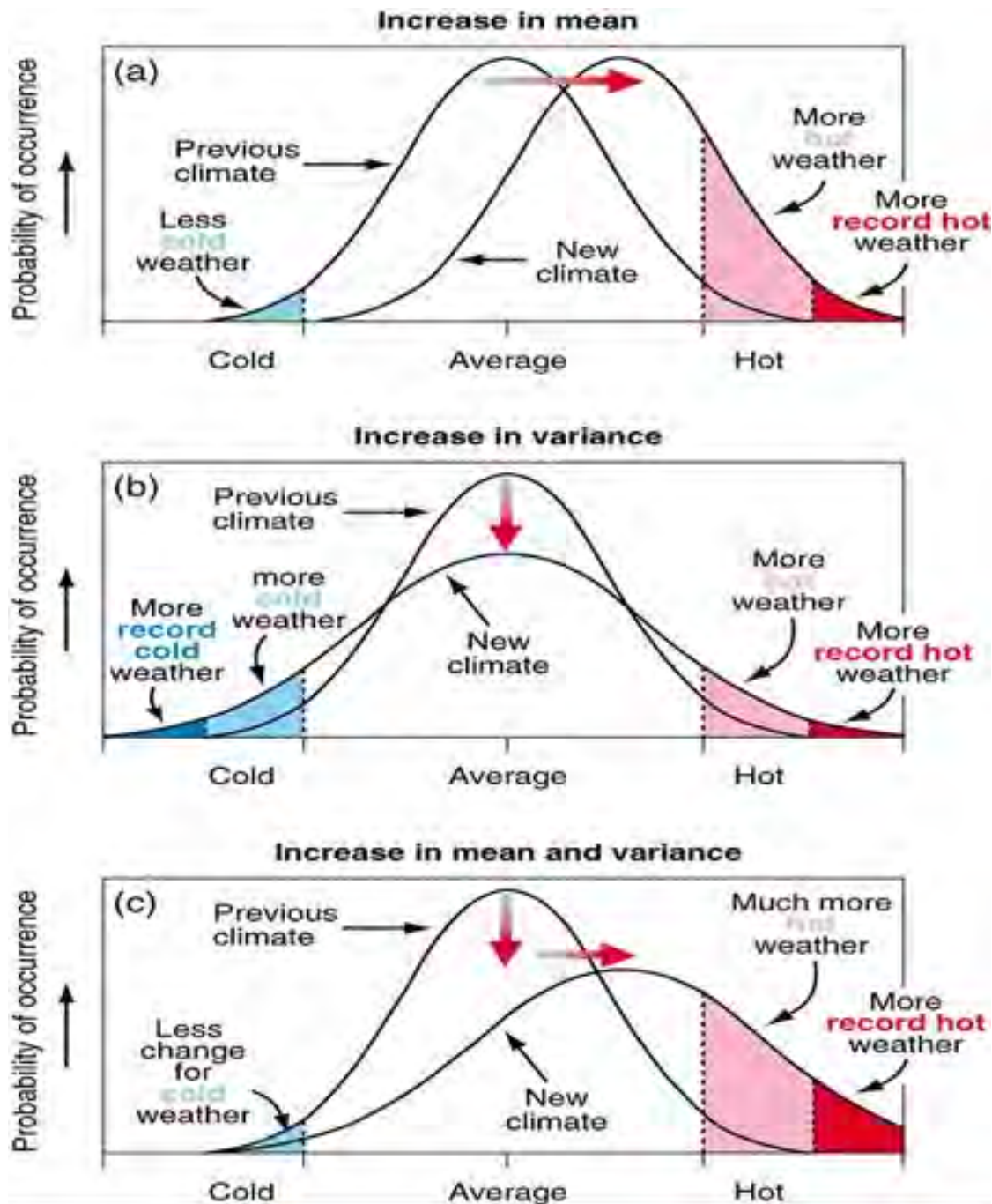
Our Cold Winter

(Ogi et al. 2014)



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Climate:

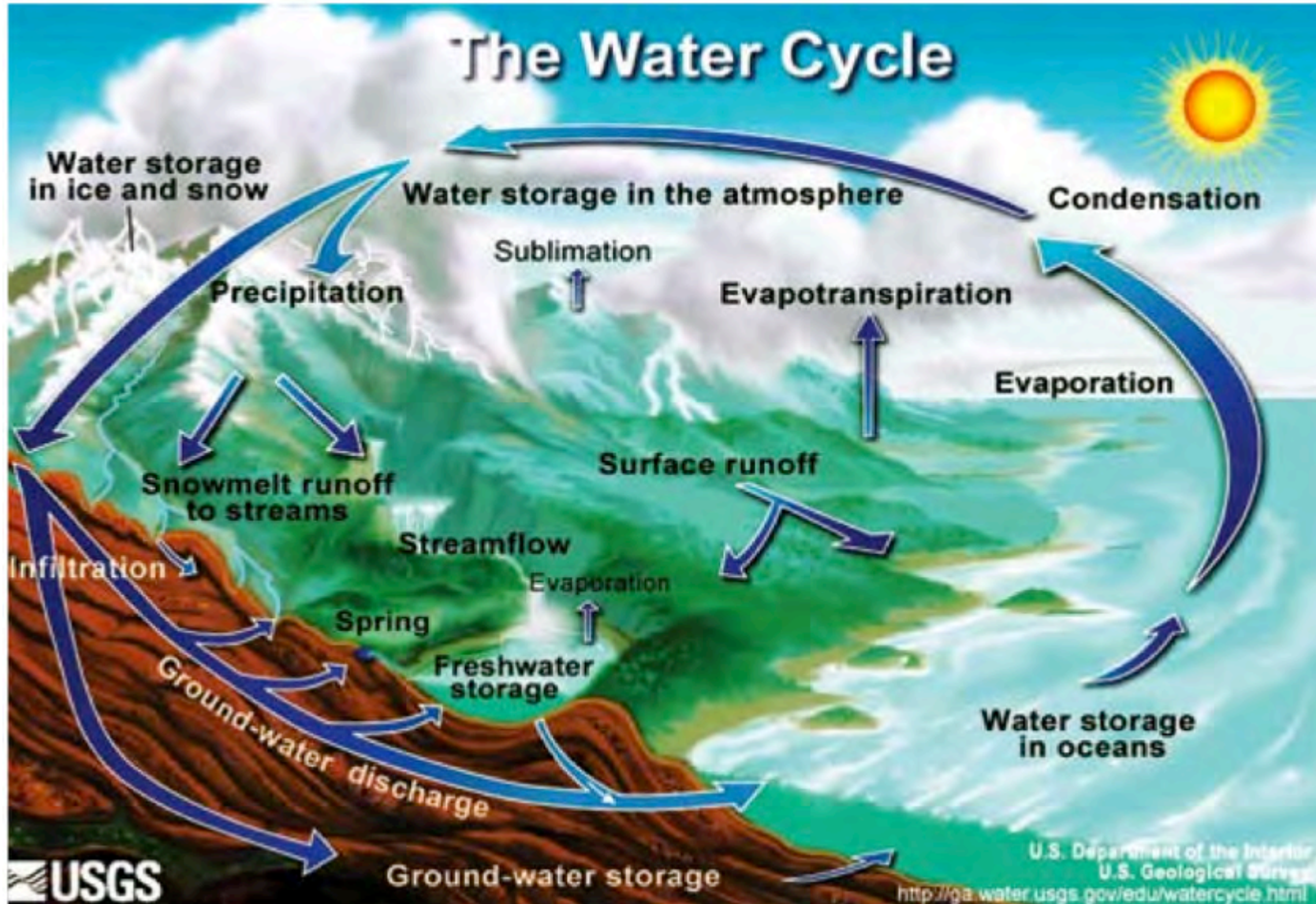
- Change
- Variability

Manitoba effects:

1. Rising Permafrost Temperatures
2. Thinning Ice
3. Forest Fires
4. Ecological Changes
5. Extreme Weather
6. Less Soil Moisture
7. Flooding



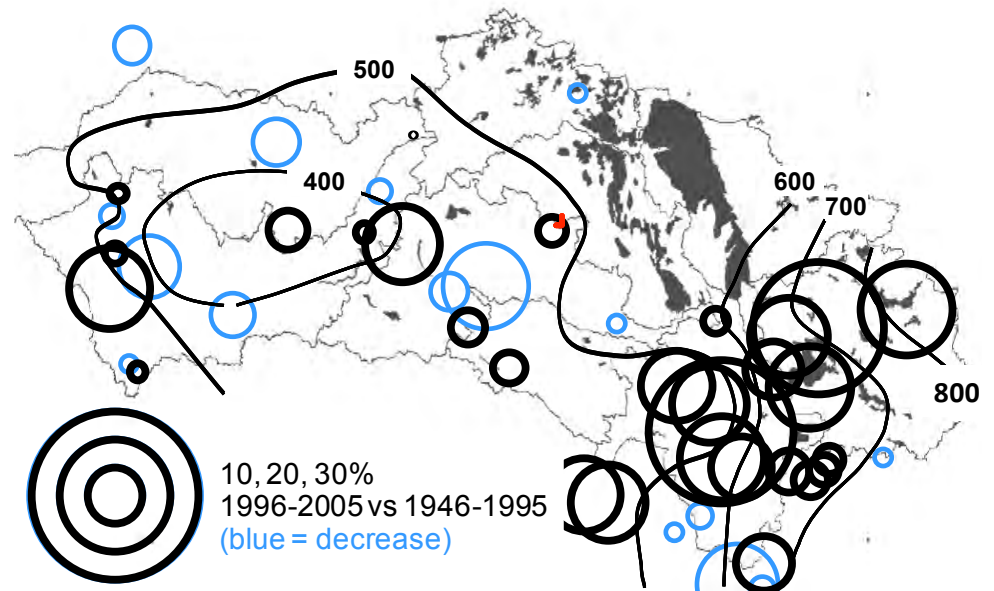
Increased Hydrological Cycle (now underway)



Source: IPCC, SPM05

Moderate increases in precipitation since the mid-1990s have doubled average runoff and caused more frequent flooding in the Red River valley.

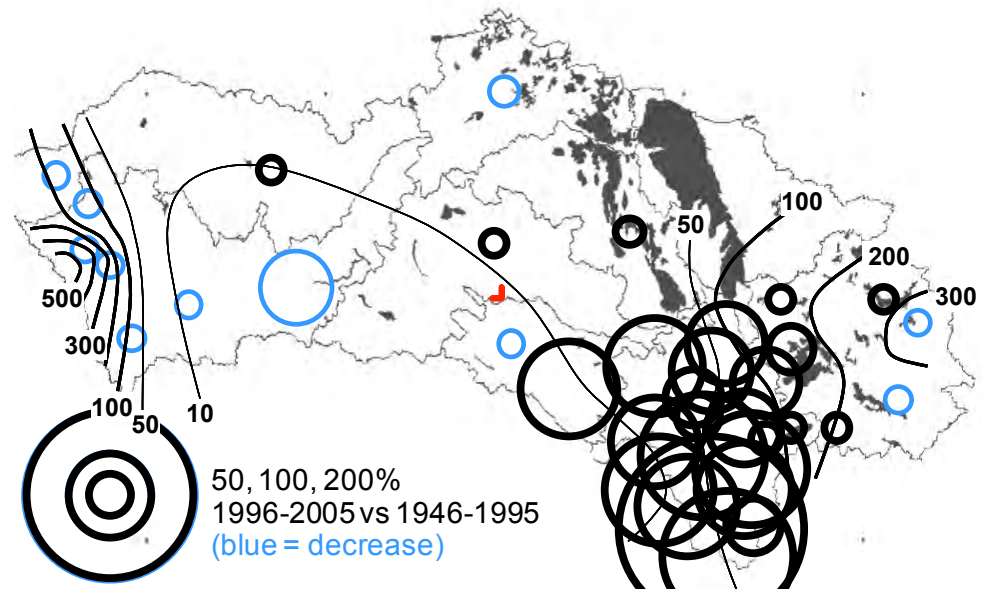
Precipitation



Hydrological forcing of a recent trophic surge in Lake Winnipeg

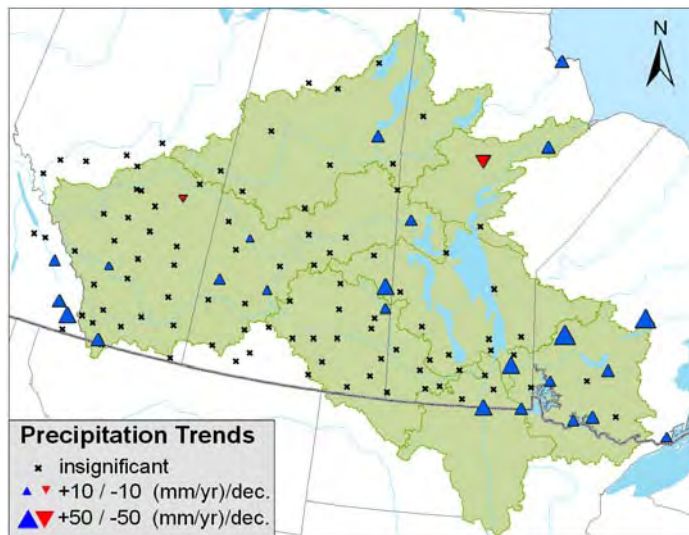
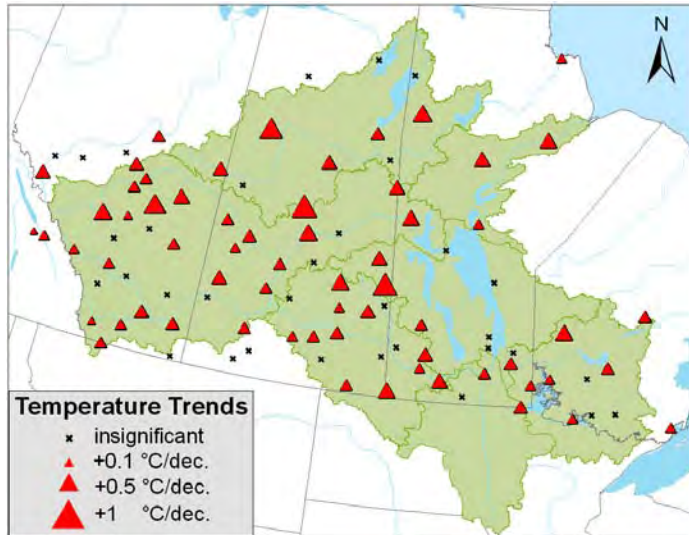
G.K. McCullough, et. al. 2012.

Runoff

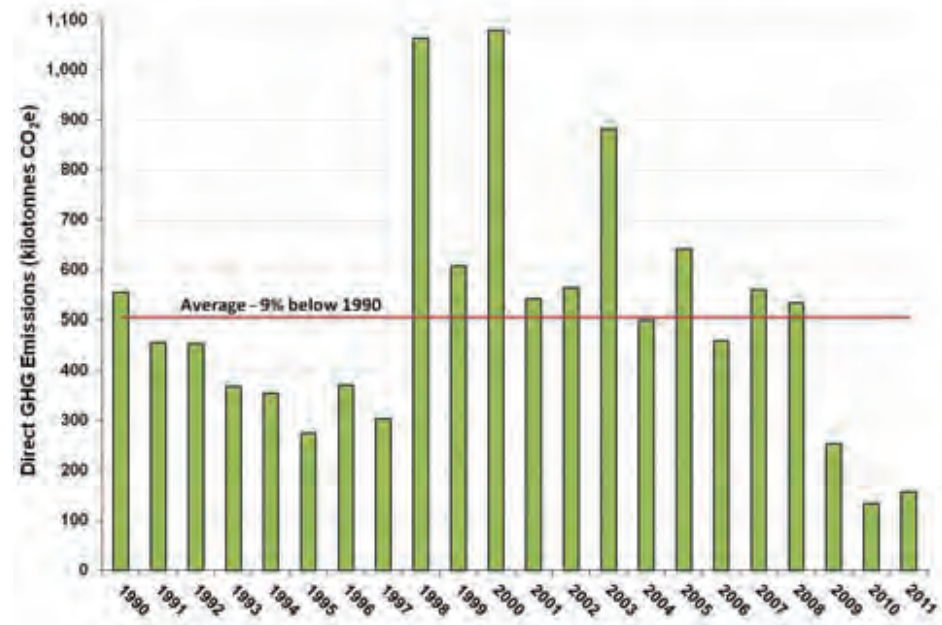


Manitoba's Infrastructure and Energy demands are influenced by

- Changes in temperature
- Precipitation patterns
- Rising sea levels
- Extreme weather events

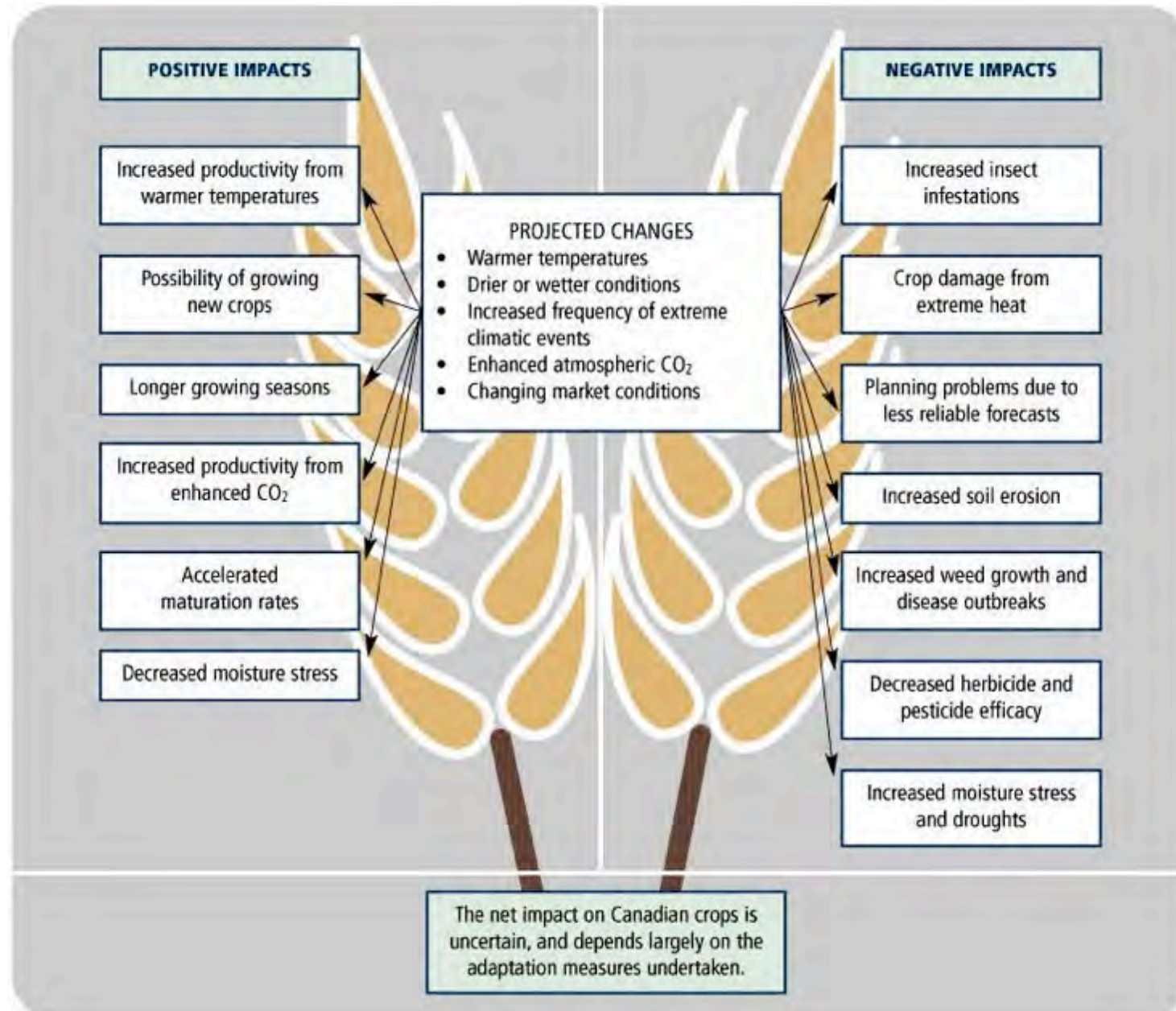


Manitoba Hydro Direct GHG Emissions Reduction



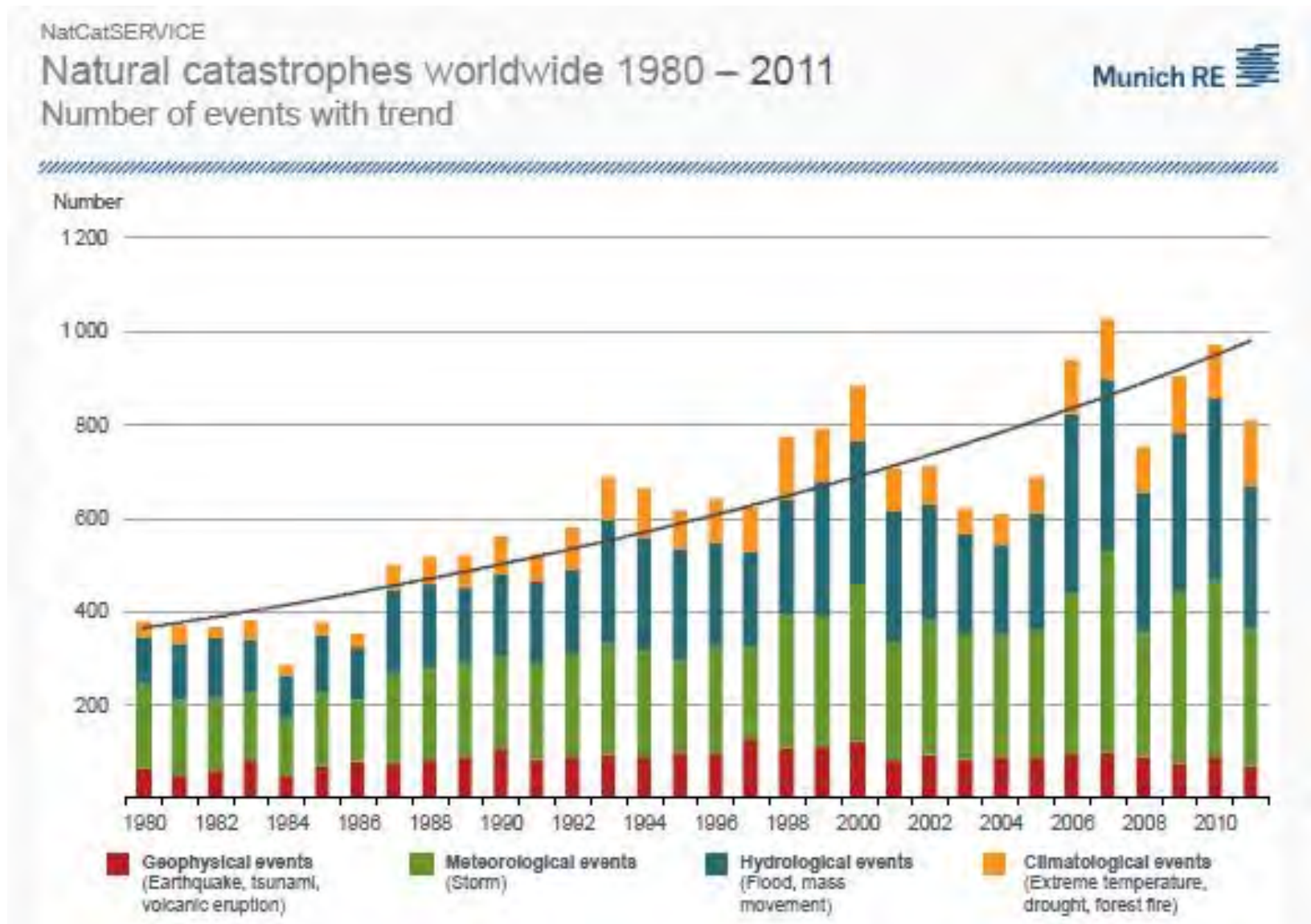
Source: Manitoba Hydro Climate Change Report, 2012-13

Possible Impacts of Climate Change on Agricultural Crops in Manitoba

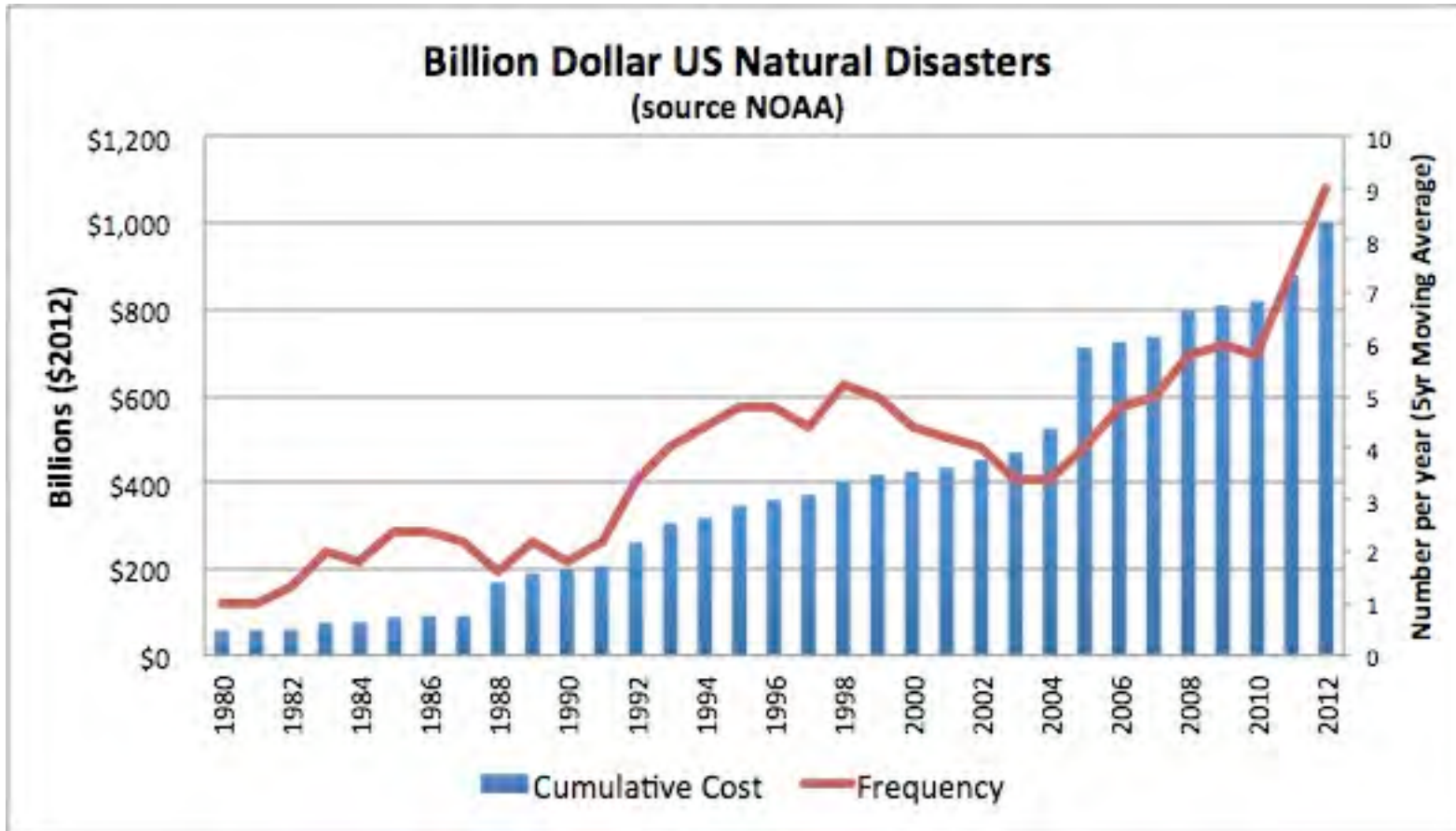


Source: Natural Resources Canada, Climate Change Impacts and Adaptation: A Canadian Perspective.

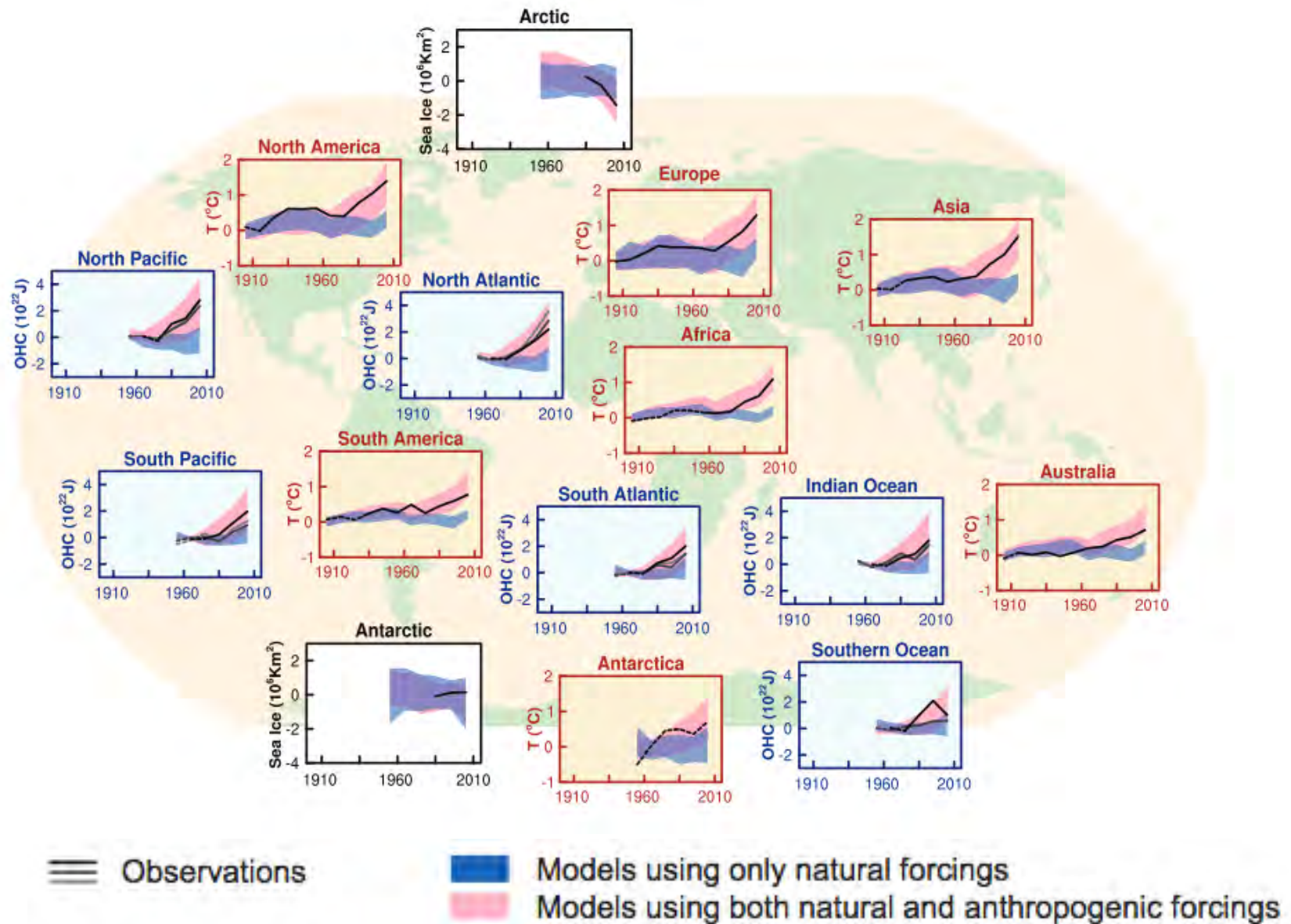
Cost of Natural Disasters is already a key impact to our economies



Cost of Natural Disasters is already a key impact to our economies



Overwhelming evidence - yet.....



Source: IPCC, SPM05

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MANY perspectives

Climate change is here and
we need to plan for it!



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