# Global Impacts of Climate Change on Freshwater

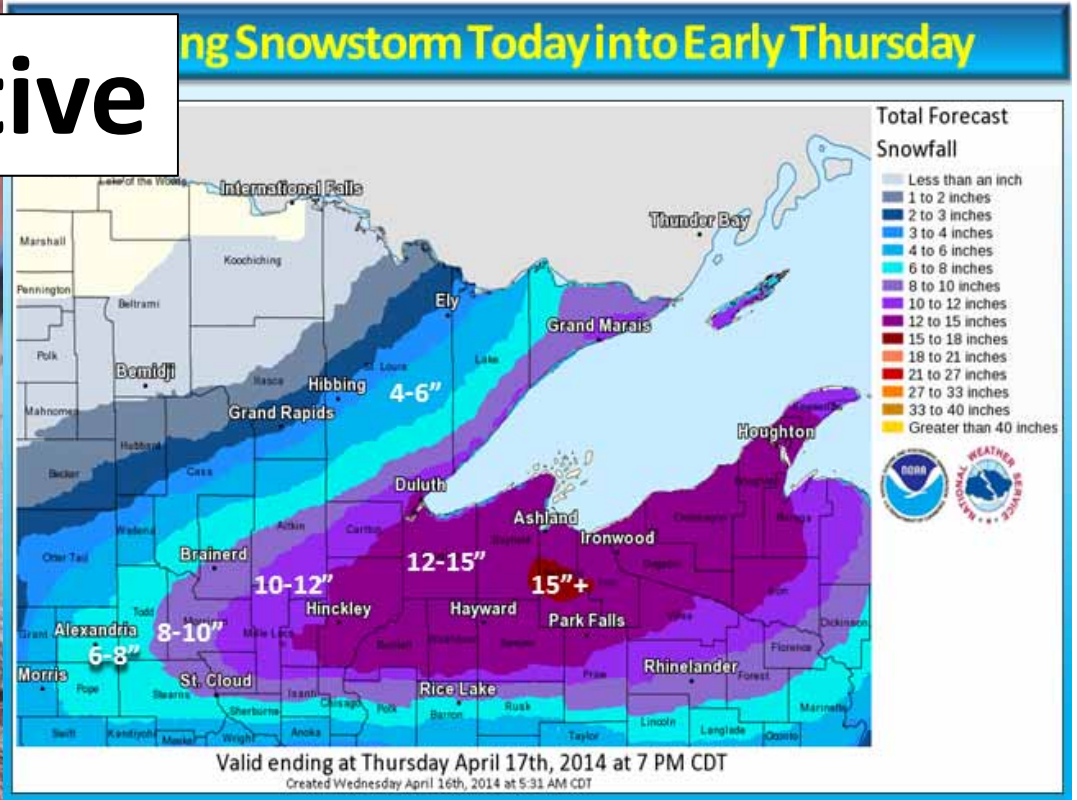
Katie Hein

Wisconsin Department of Natural Resources

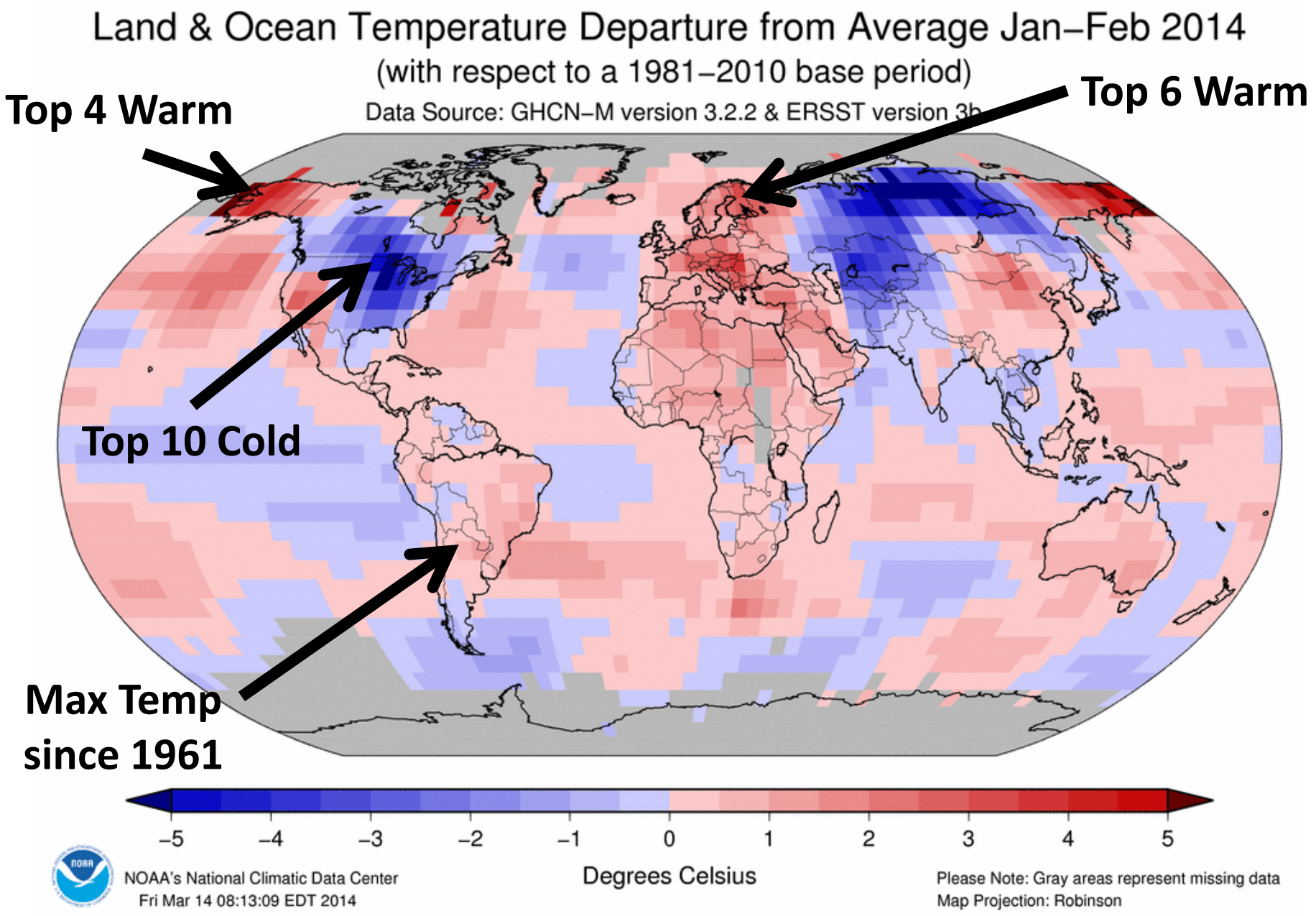
ESA's Rosetta spacecraft in 2009

# Wisconsin was COLD this winter!

# Broader Perspective




John Hart




NOAA National Climatic Data Center, State of the Climate: Global Analysis for February 2014

# A hot start to 2014 for Anchorage weather

Craig Medred | January 21, 2014



Alaska's largest city is off to a hot start in the new year. Temperatures along the Anchorage Hillside pushed into the upper 40s on Tuesday, with some locations threatening 50 on Tuesday as yet another warm gush of

Loren Holmes

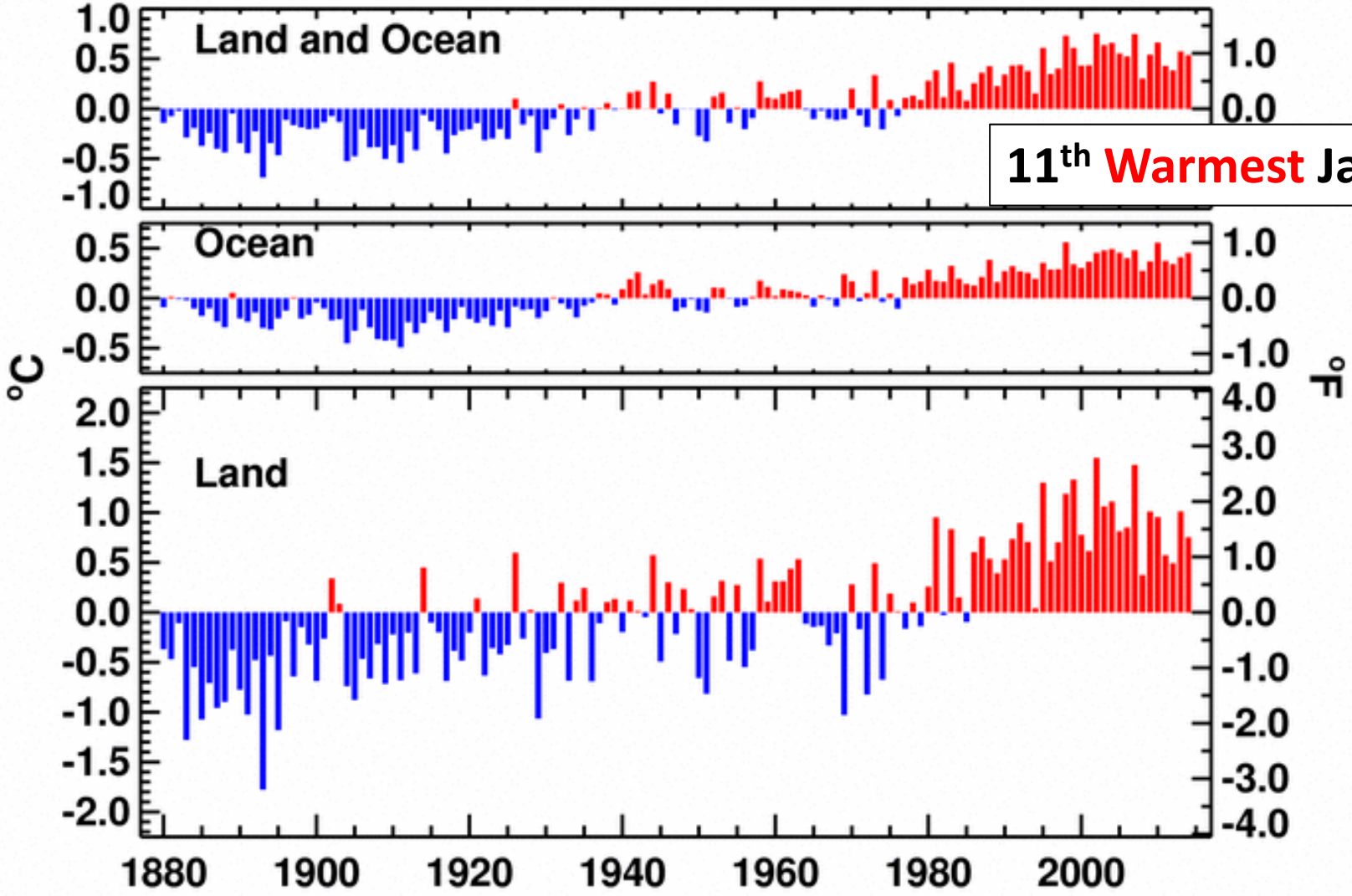

Nate Atwood - Anchorage

Alaska DOT&PF

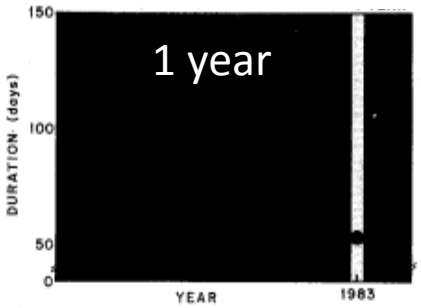
# Jan-Feb Global Surface Mean Temp Anomalies

## NCDC/NESDIS/NOAA

Analysis is based upon Smith et al. (2008) methodology.




**11th Warmest Jan-Feb**




# Long-term data give context

## Days of ice cover on Lake Mendota



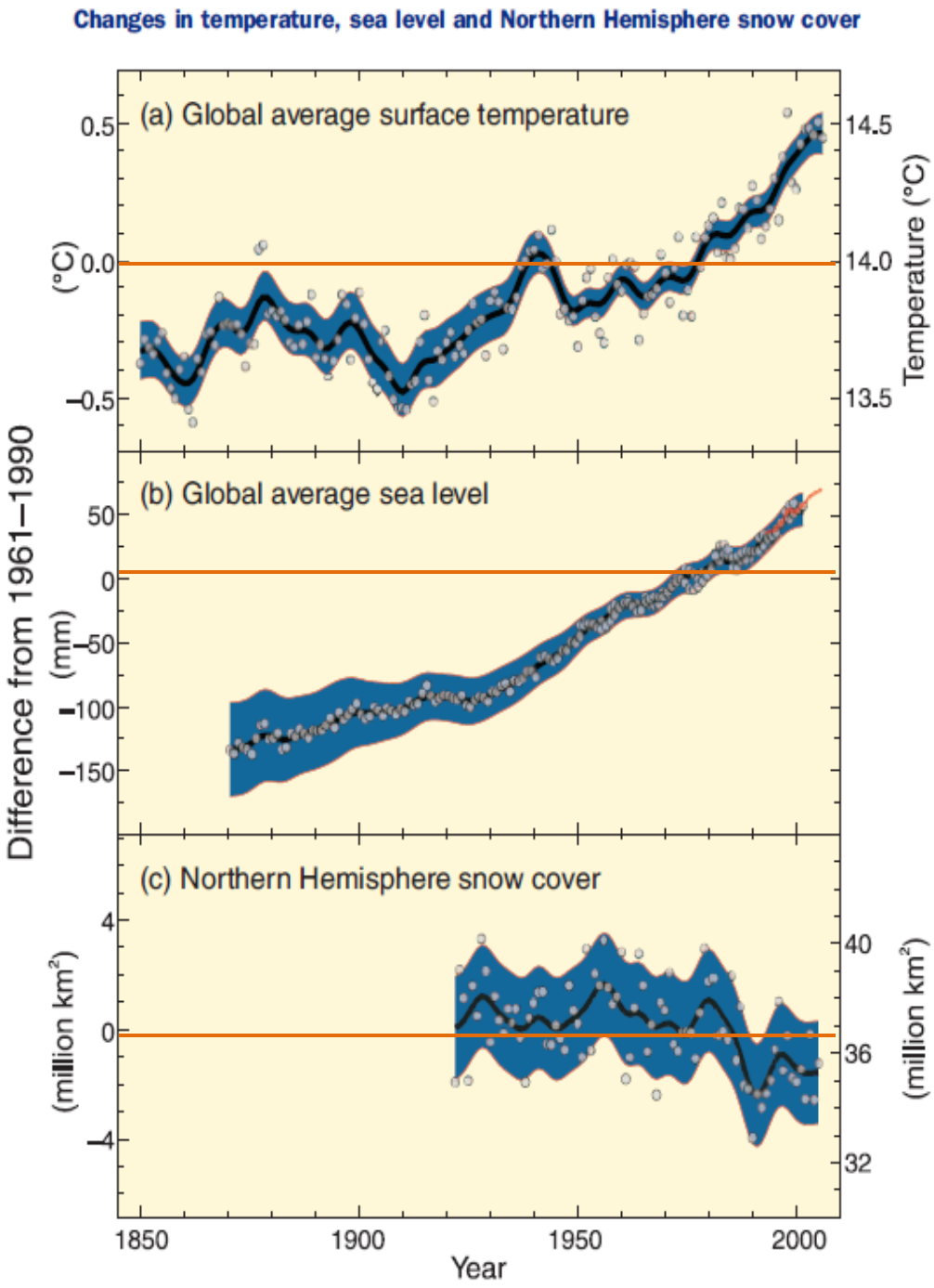
John Magnuson

Photo: Peter Essick

NATIONAL GEOGRAPHIC



YEAR


Changes in temperature, sea level and Northern Hemisphere snow cover
(a) Global average surface temperature
(b) Global average sea level
(c) Northern Hemisphere snow cover
Difference from 1961–1990
(°C)
(mm)
(million km²)
Temperature (°C)
(million km²)
0.5
0.0
−0.5
14.5
14.0
13.5
50
0
−50
−100
−150
4
0
−4
40
36
32
1850
1900
1950
2000
Year

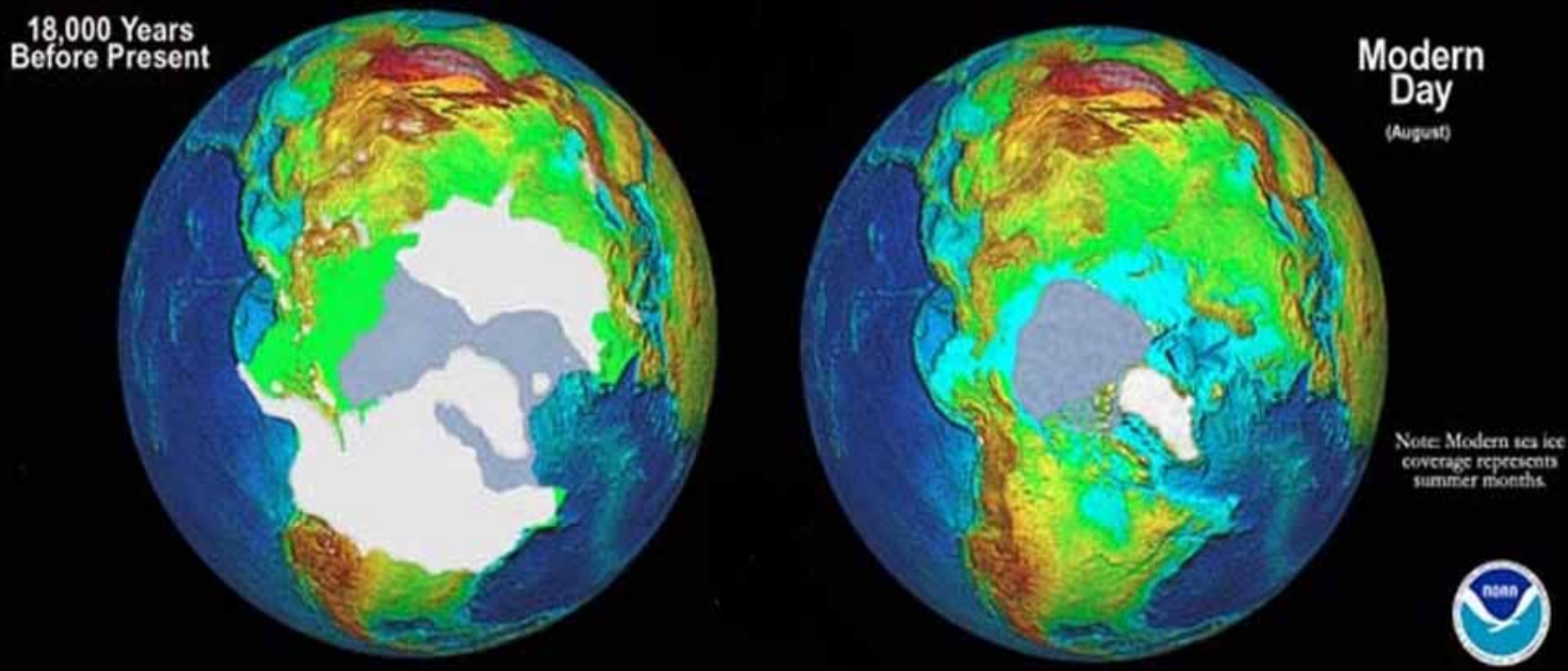
IPCC

# Glaciers Retreating

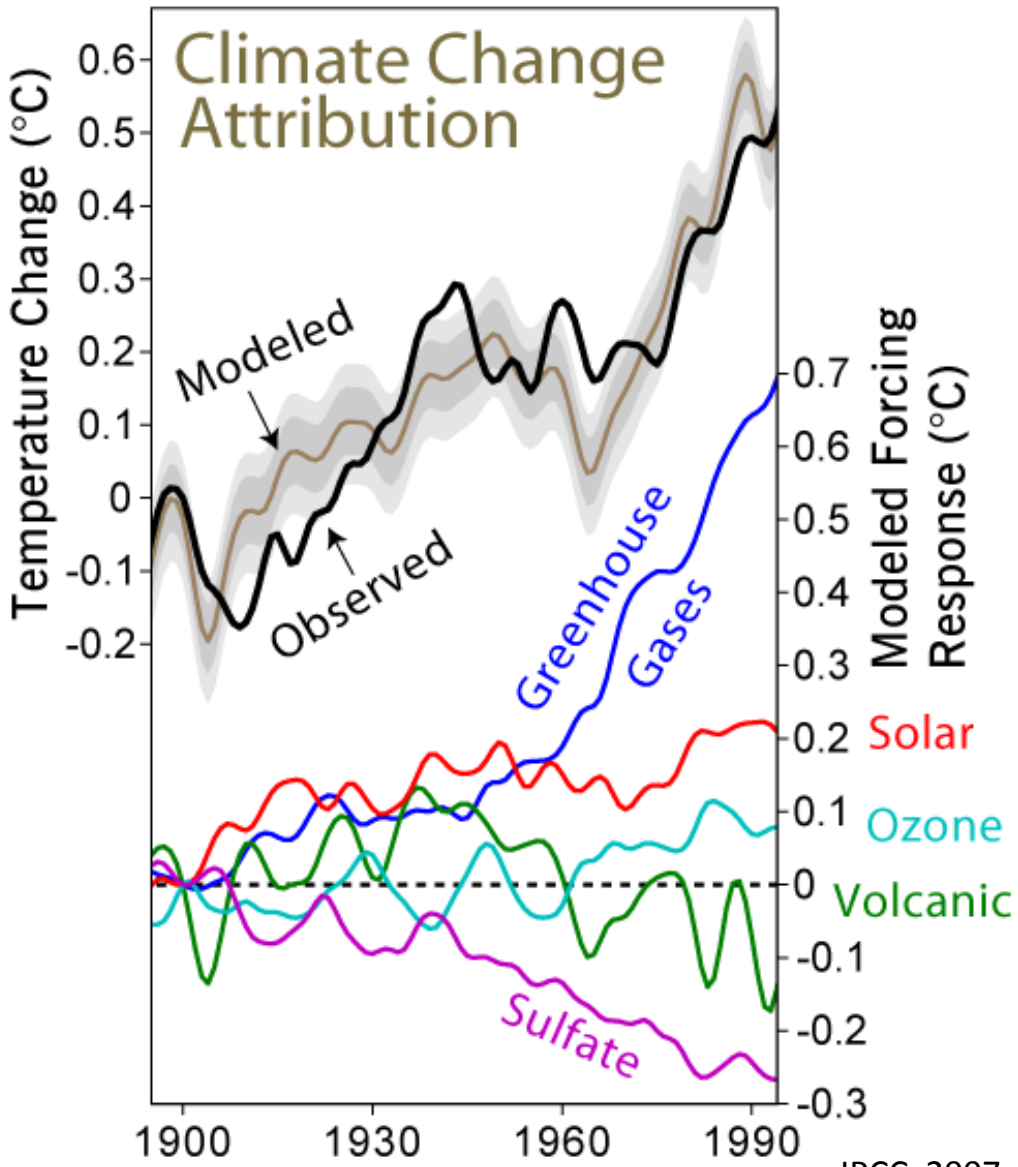
Example: Honeycomb Glacier in the Cascades

# Northern Hemisphere

## Ice Coverage

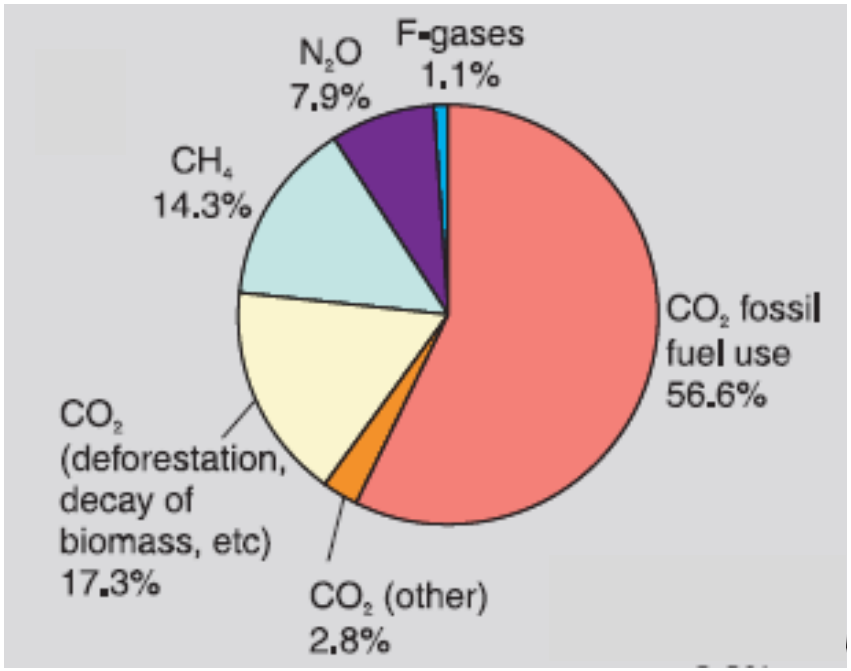


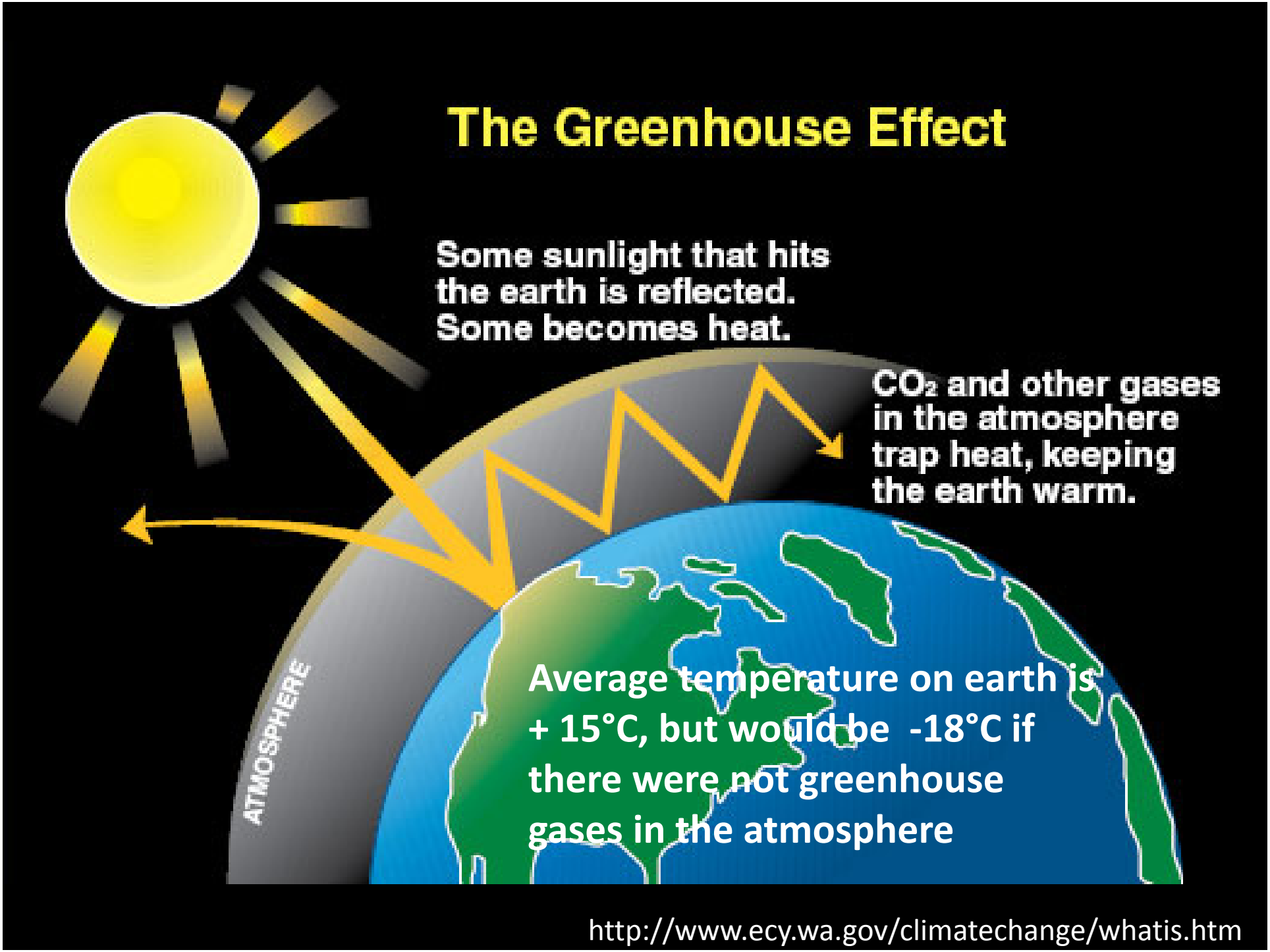
# Why is the earth warming?



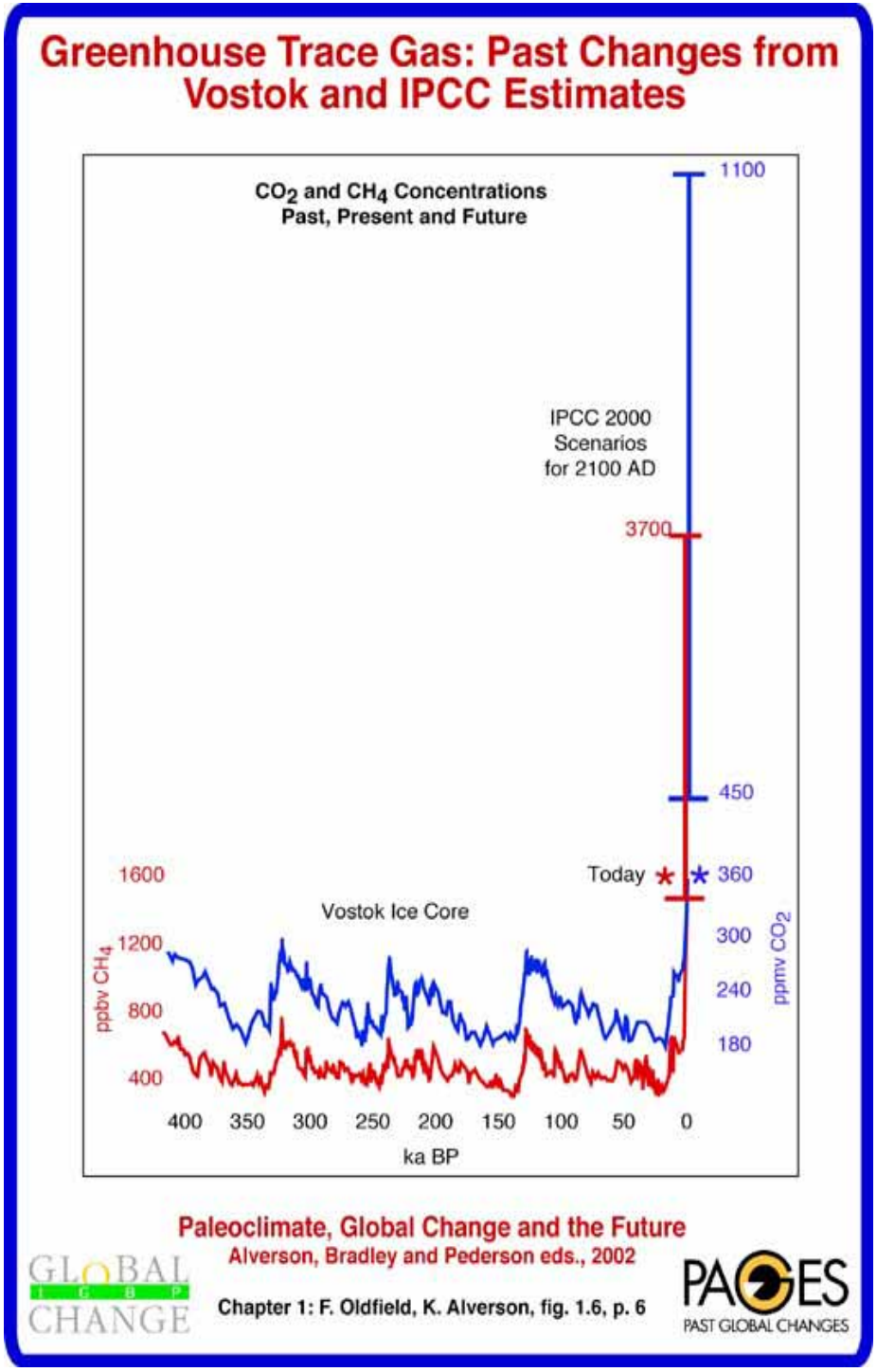

IPCC 2007

Human contributions to greenhouse gases

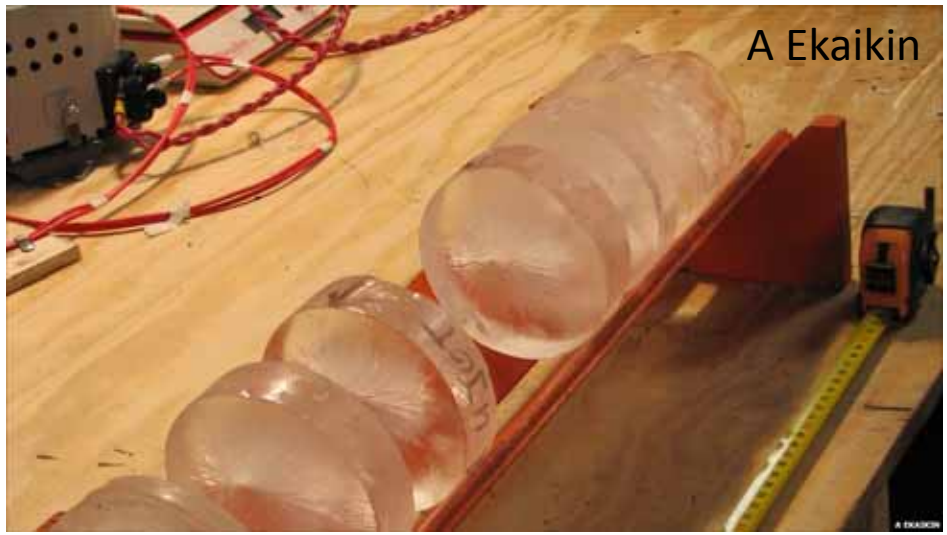




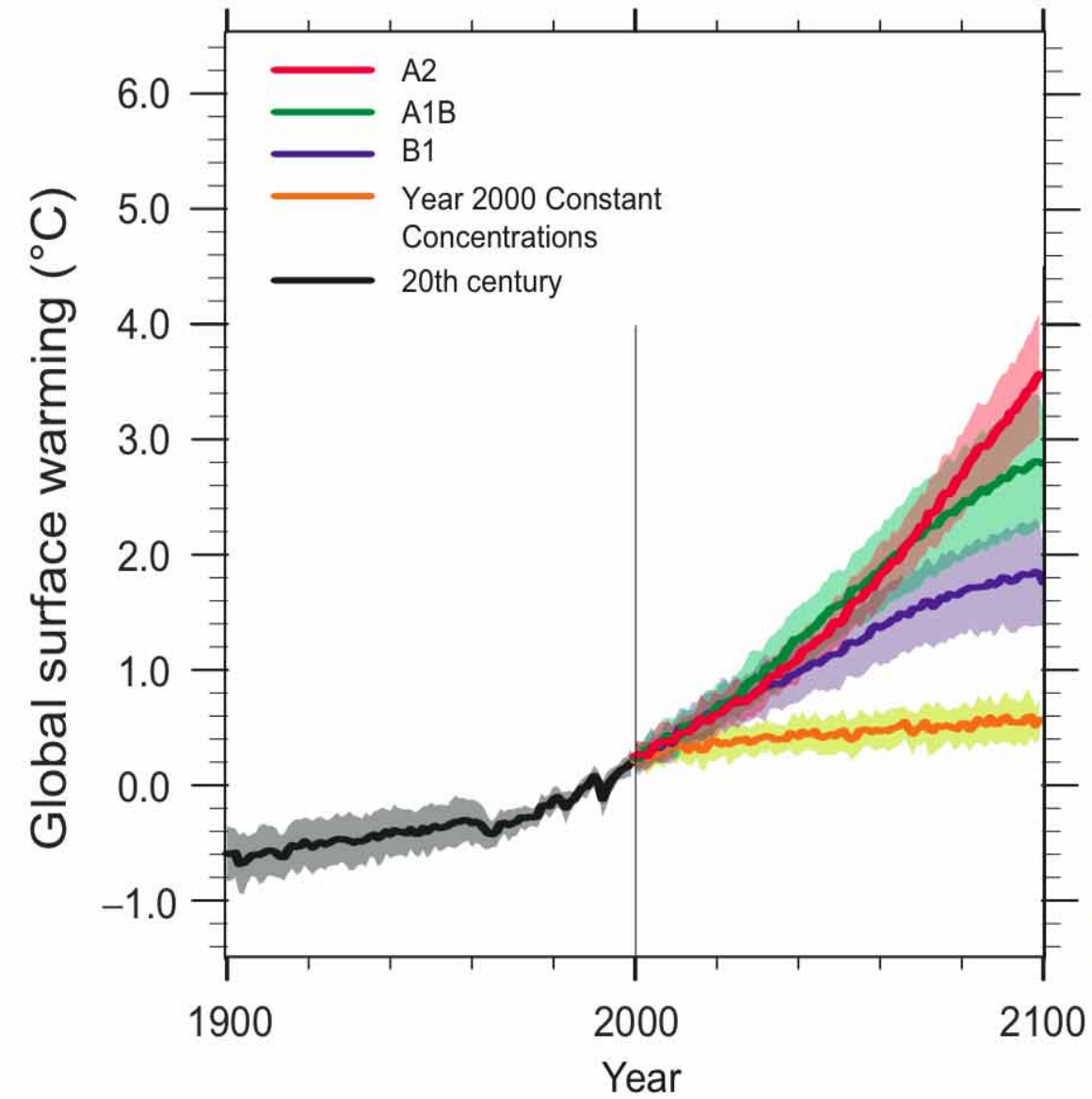

http://www.ecy.wa.gov/climatechange/whatis.htm




- The concentration of $CO_2$ is at a record high compared to the past 650,000 years.
- The rate of increase in $CO_2$ is faster than before at 80ppm over the past 100 years compared to 80 ppm over 5,000 years following previous ice ages.

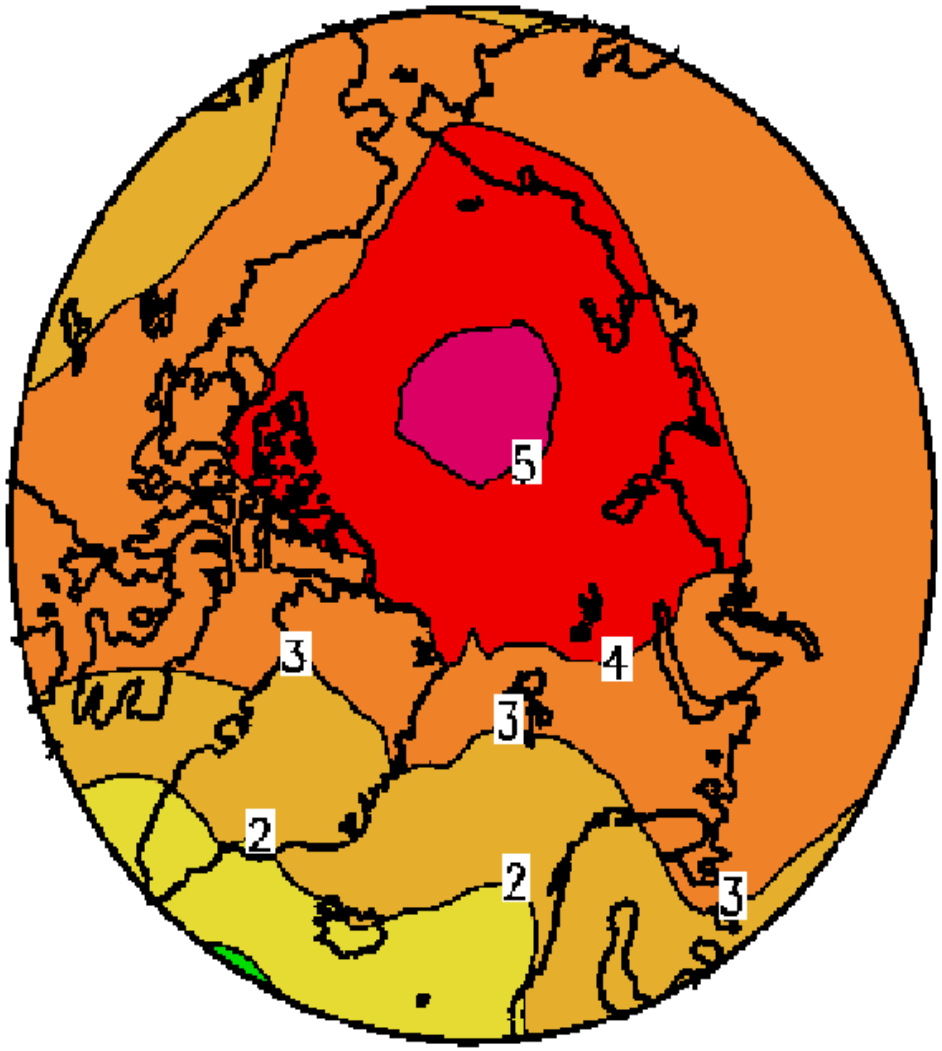


# Future Climate Projections Based on Emissions Scenarios



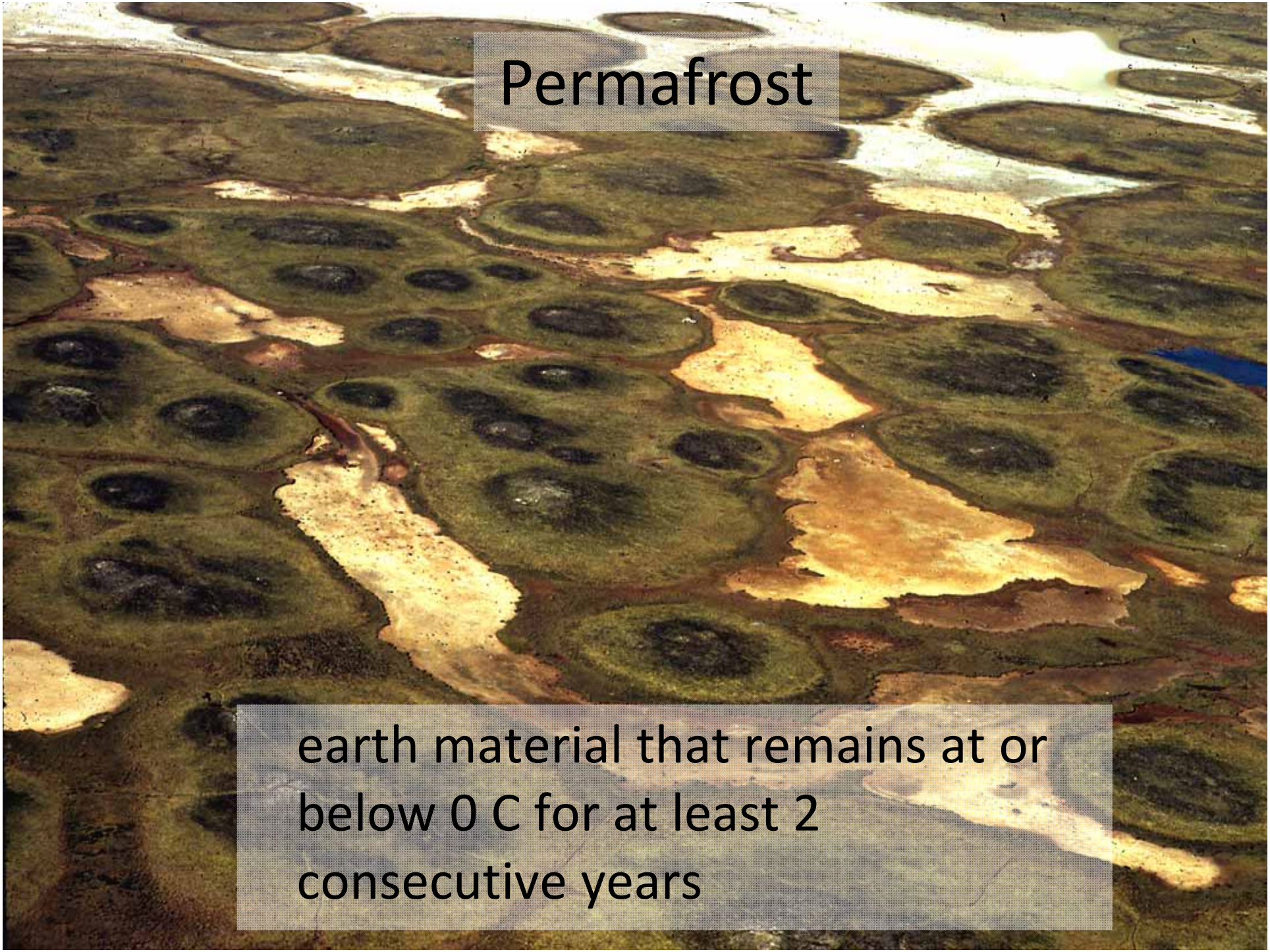

IPCC 2007

# Degree of change depends on location

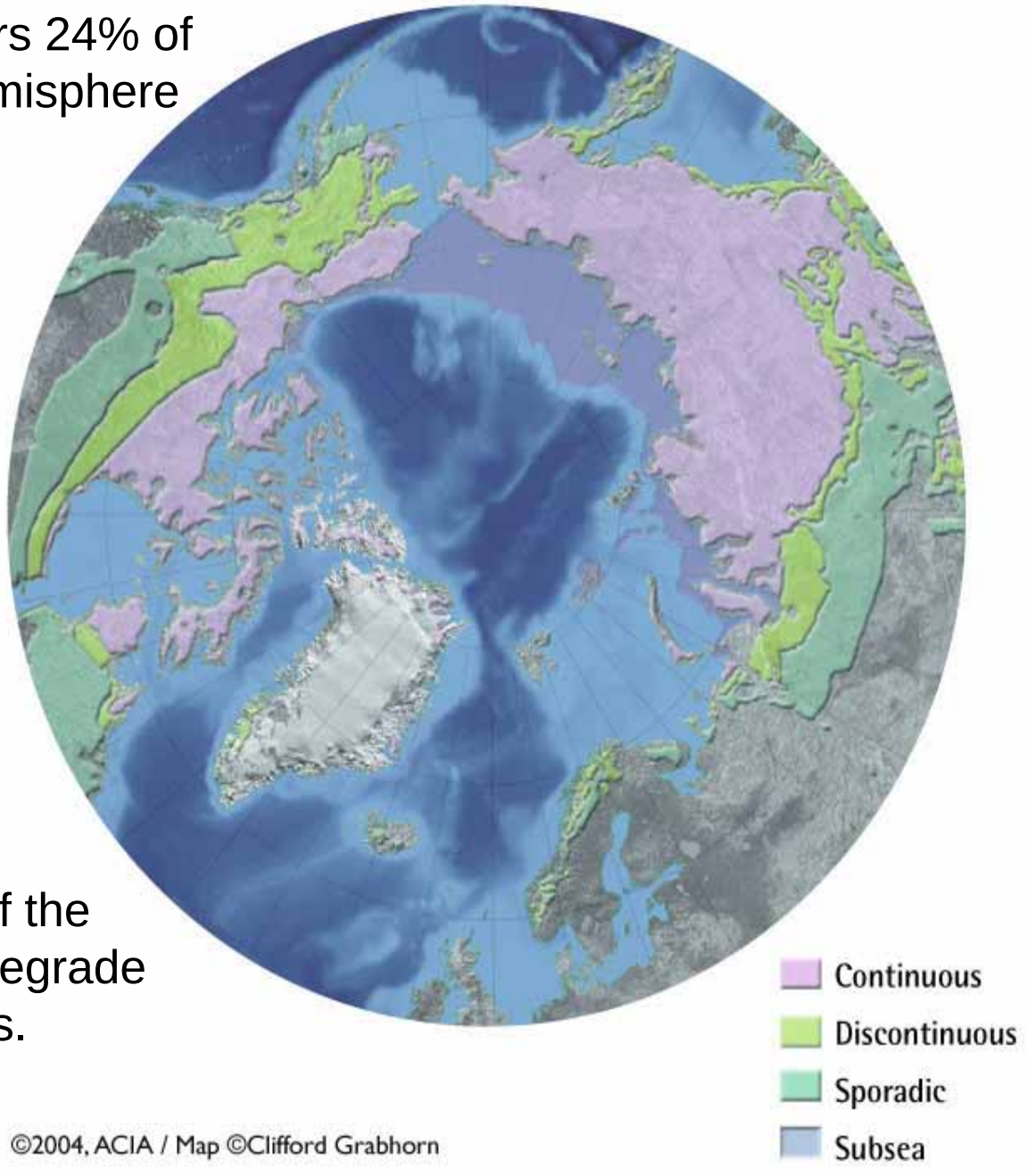



Climate in 2070

# Stories from around the globe

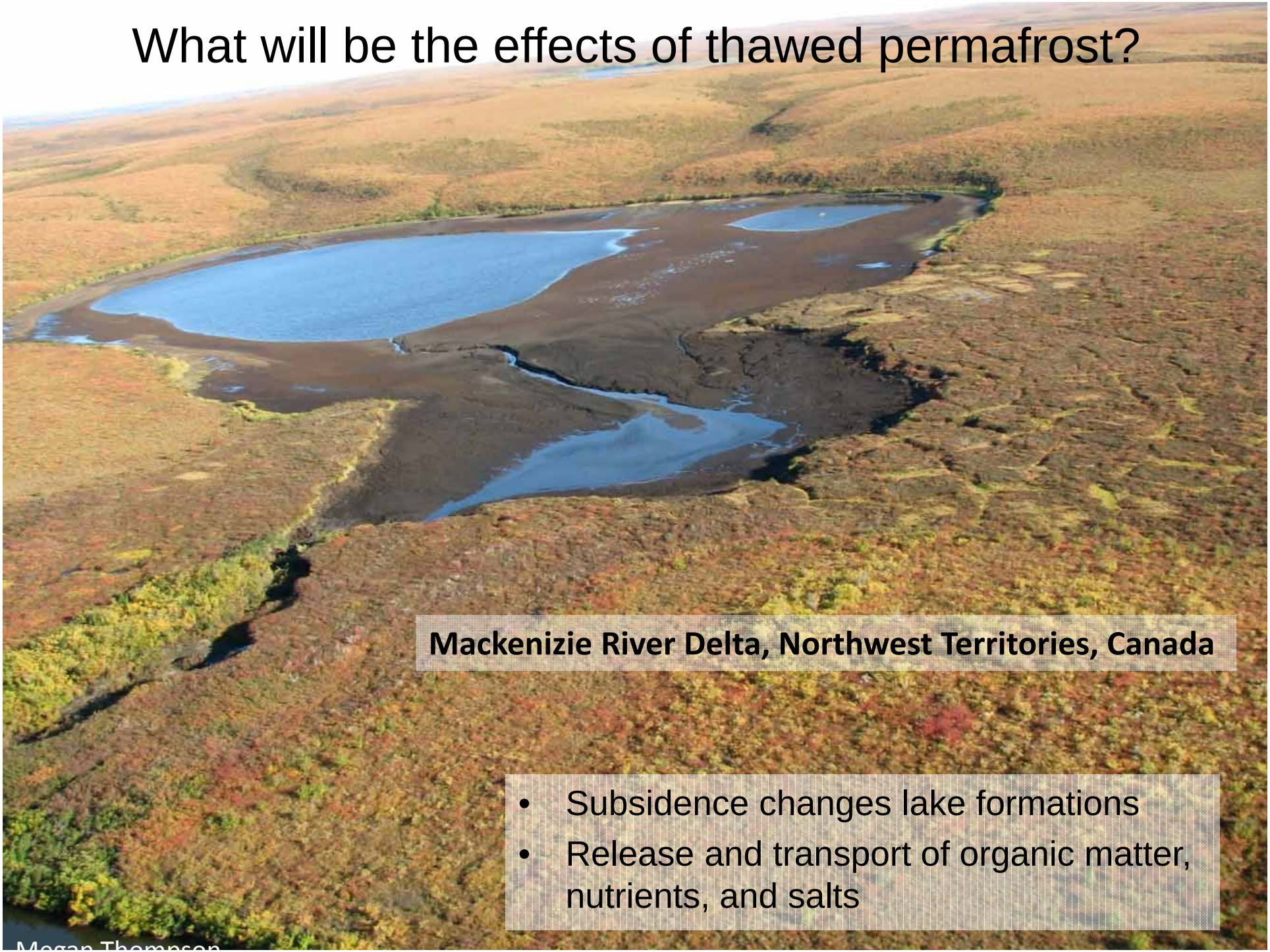

Permafrost
earth material that remains at or below 0 C for at least 2 consecutive years

Permafrost covers 24% of the Northern Hemisphere




Forecast: 20% of the permafrost will degrade in the next 80 yrs.

# What will be the effects of thawed permafrost?

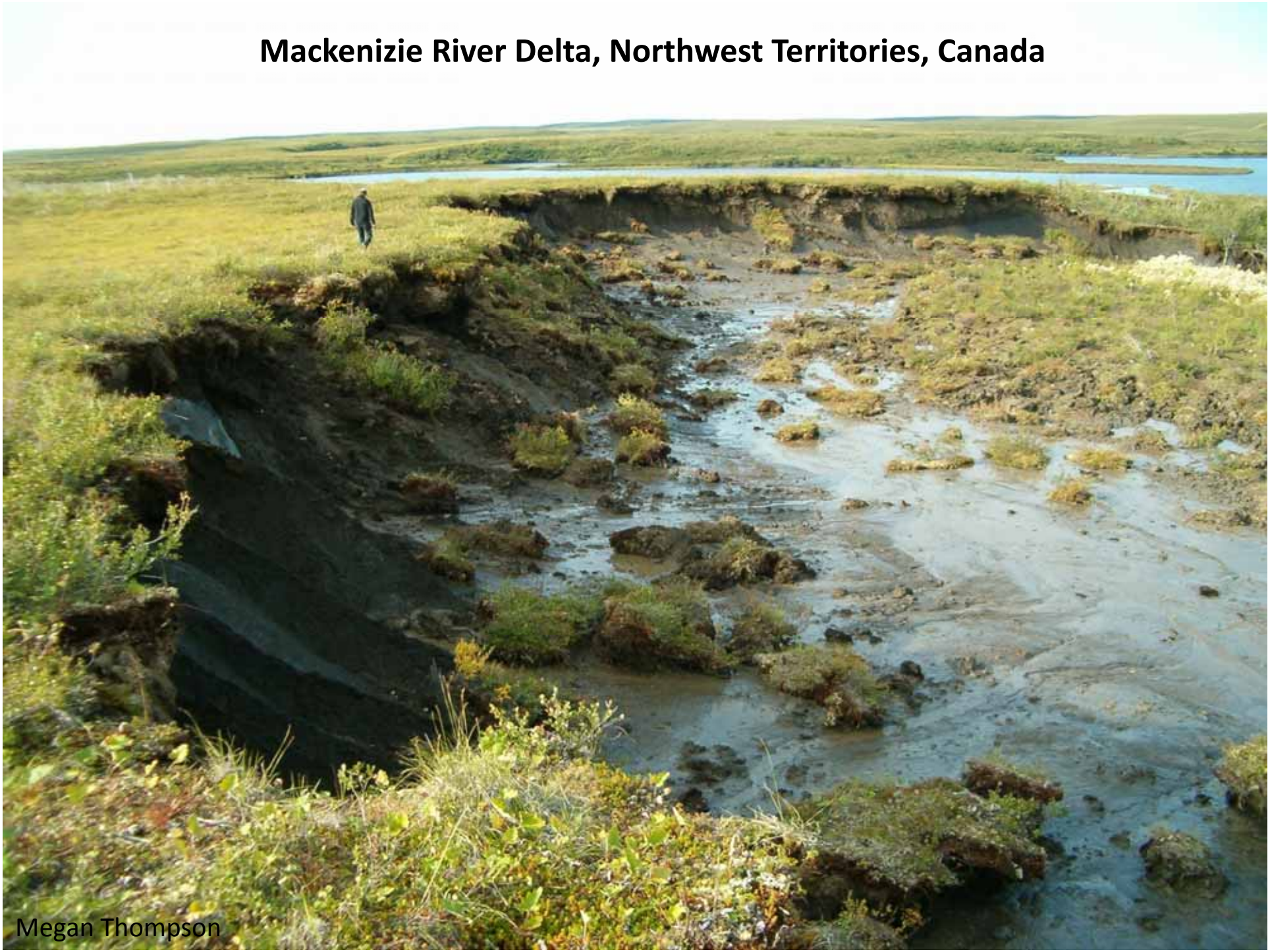


**Mackenizie River Delta, Northwest Territories, Canada**

- Subsidence changes lake formations
- Release and transport of organic matter, nutrients, and salts

Megan Thompson

## Mackenizie River Delta, Northwest Territories, Canada



Megan Thompson

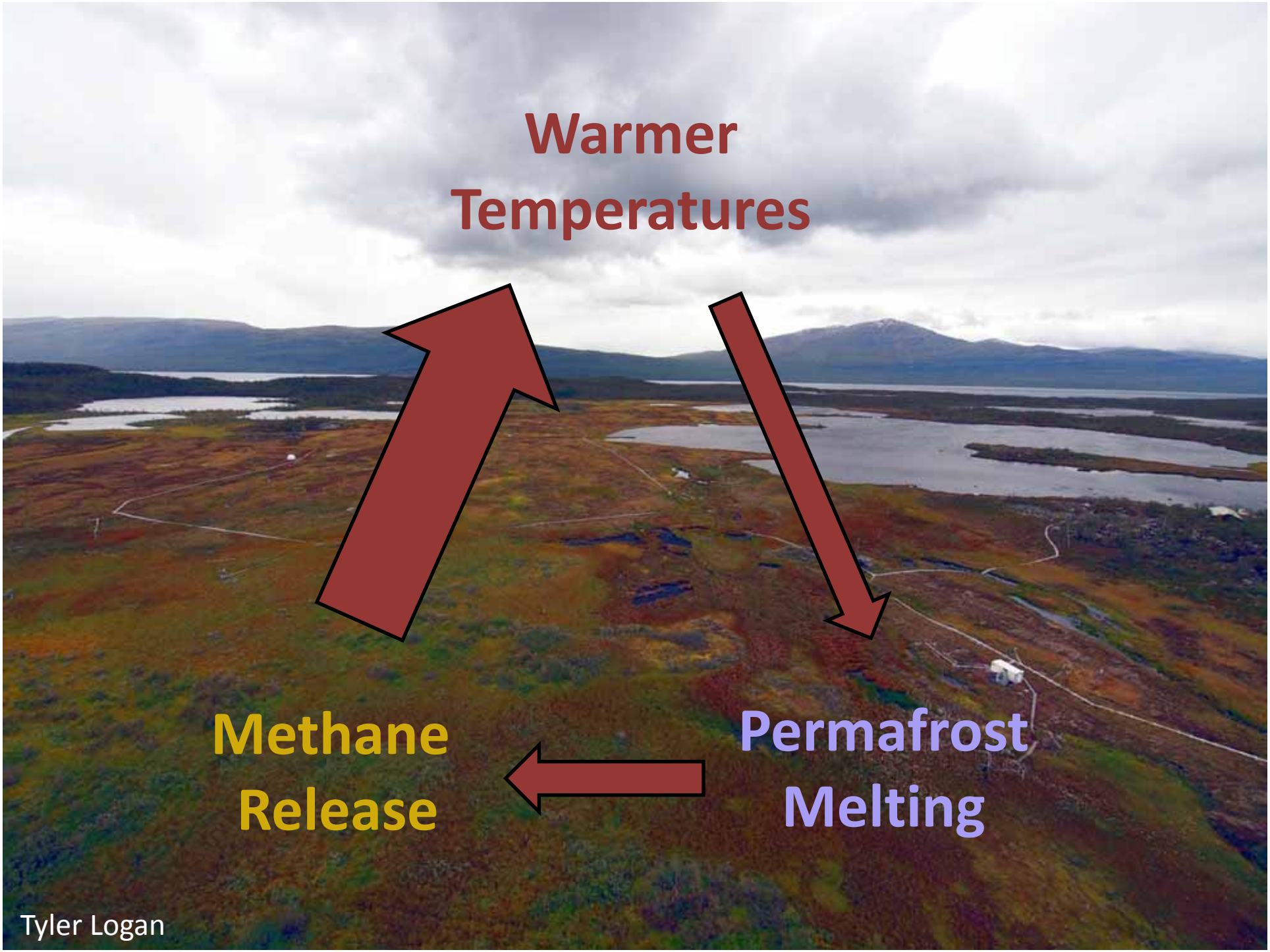
# Climate Impacts Research Centre

## Abisko Scientific Research Station, Sweden

# Will melting permafrost release methane?


NATIONAL GEOGRAPHIC
Mark Thiessen


NATIONAL GEOGRAPHIC
Mark Thiessen


Warmer
Temperatures
Permafrost
Melting
Methane
Release
Tyler Logan

# Swedish lakes may become “browner” as concentrations of dissolved organic carbon increase

ALTITUDE

~ 300 | 300 - 400 | 500 - 1000



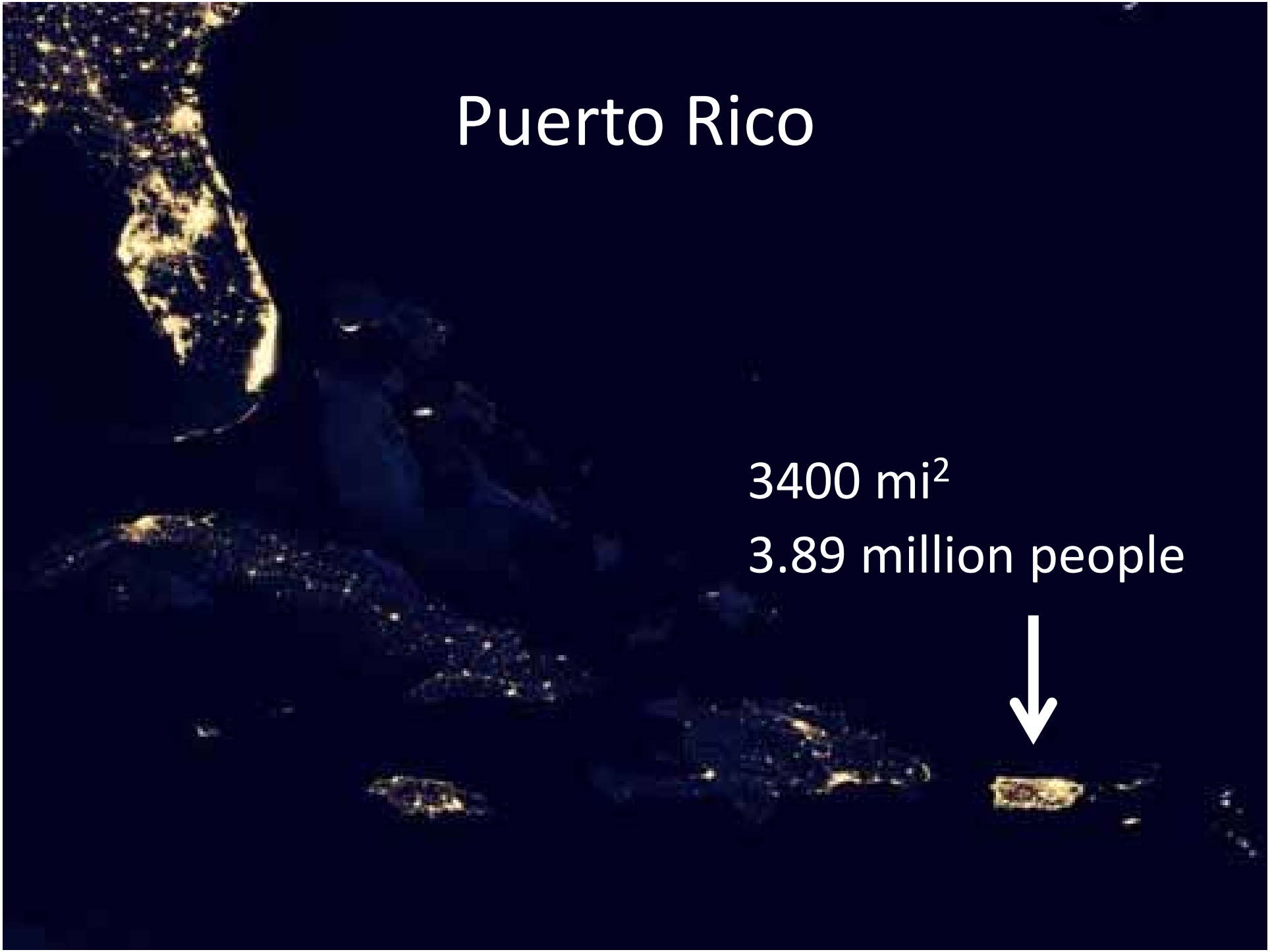


~ 15 | ~ 10 | ~ 2 - 4

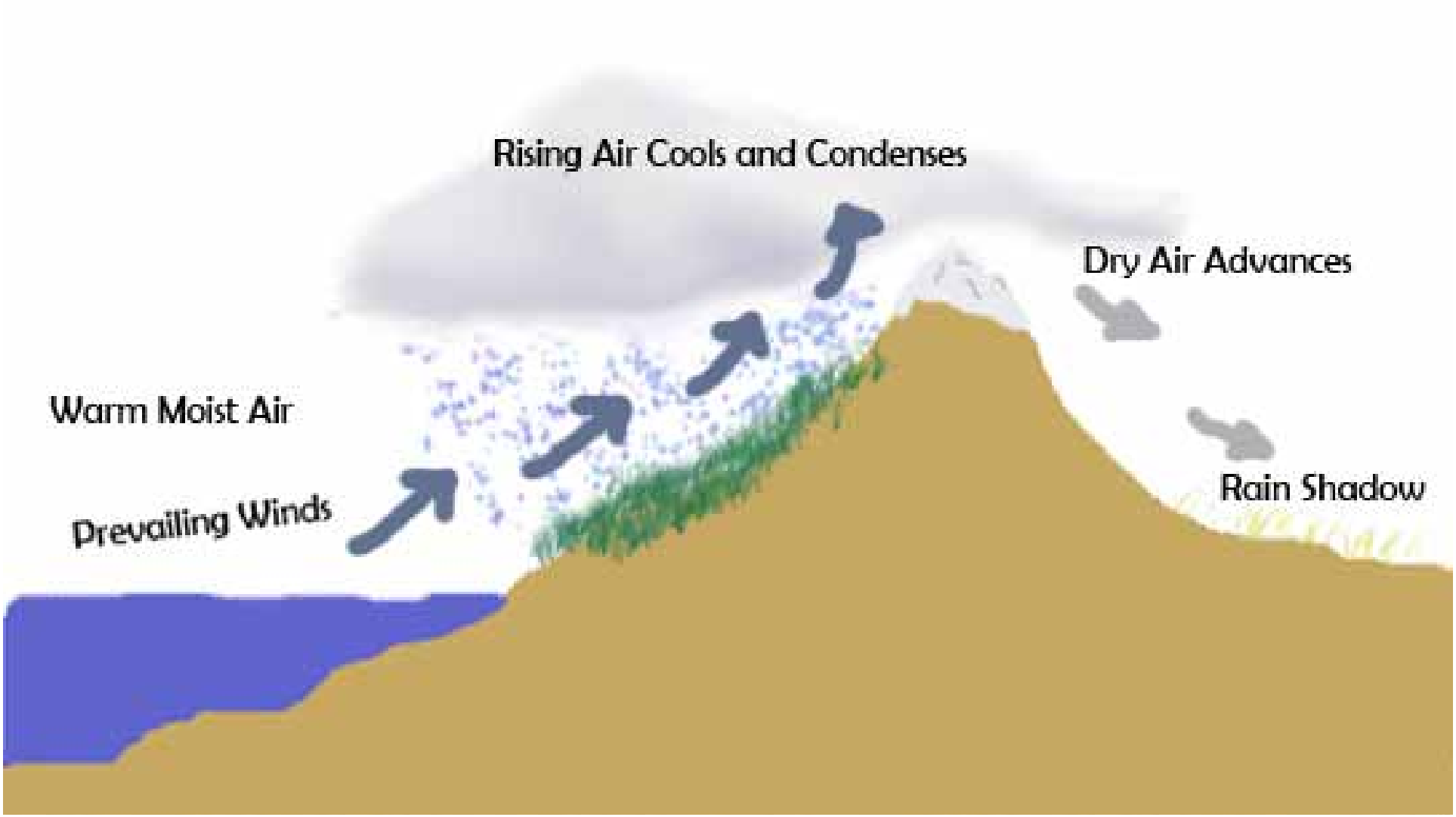
DOC

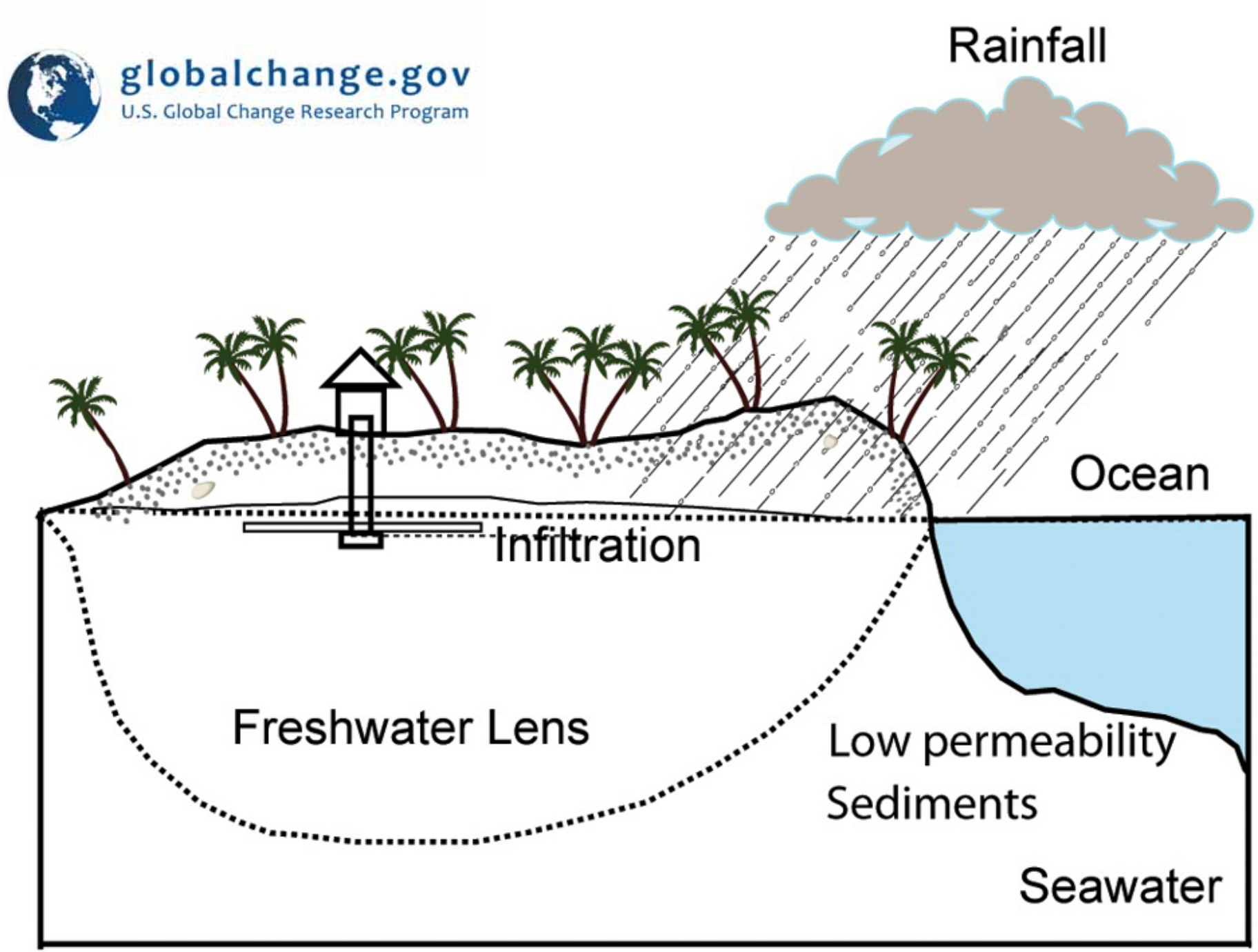
# Challenge: treating drinking water

# Lake Mälaren provides drinking water for 2 million people in Stockholm


Puerto Rico
3400 mi2
3.89 million people

# Precipitation provides drinking water

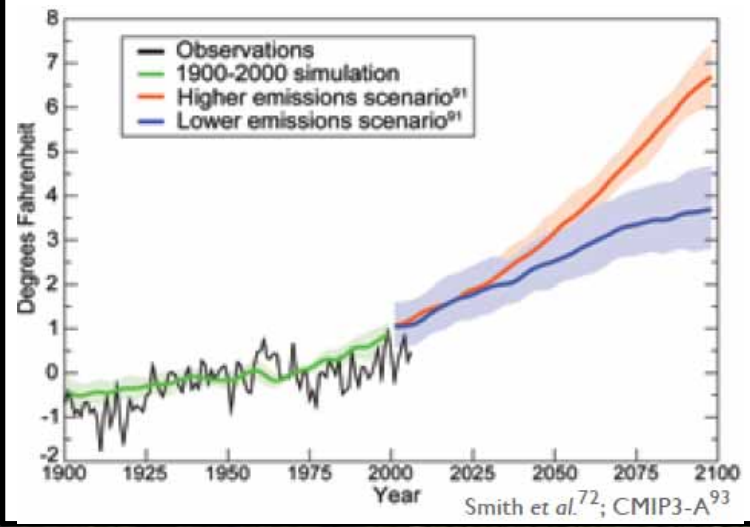




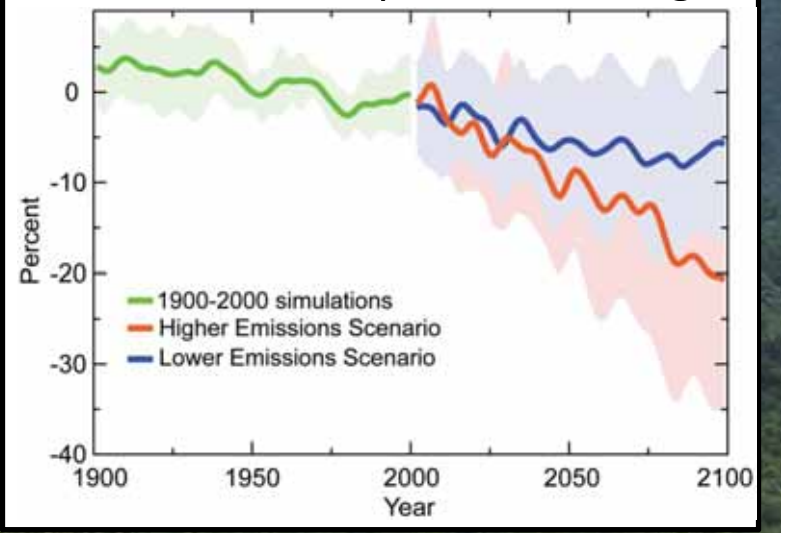

USGCRP (2009) Global Climate Change Impacts in the United States

# Declines in rainfall threaten water supply

Caribbean Temperature Change




Caribbean Precipitation Change




USGCRP (2009) Global Climate Change Impacts in the United States

# Global Climate Change

- Rate of warming is faster than any known period in the past
  650,000 years
- Weather ≠ Climate
- Broad perspective in
  space and time
- Projected temperature
  change greatest near the poles
- The past century is no longer a reasonable guide to the future for water management

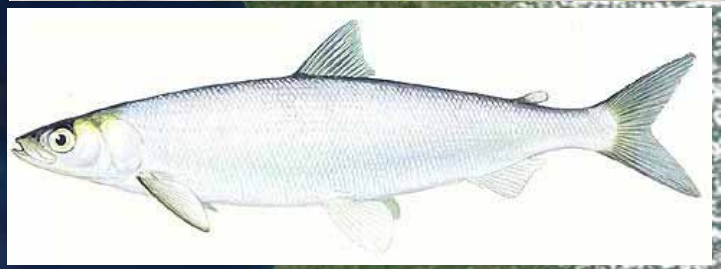
# Climate Change in Wisconsin

Dick Lathrop

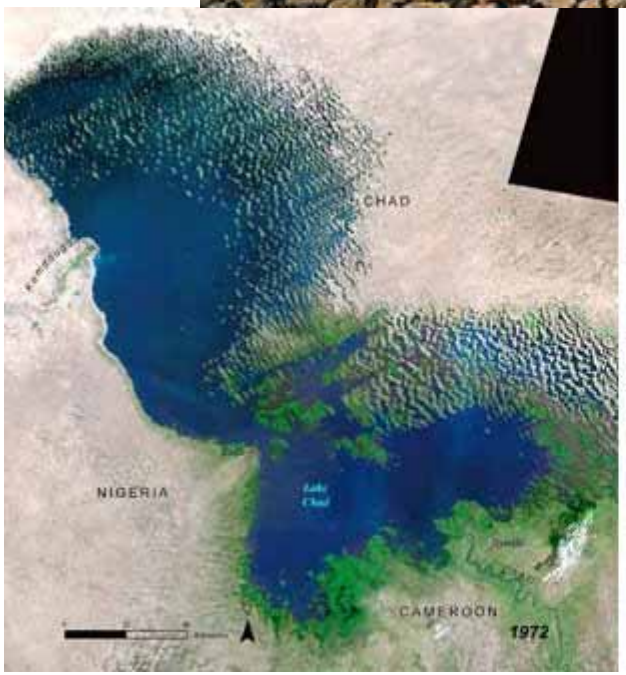
Michael Kienitz

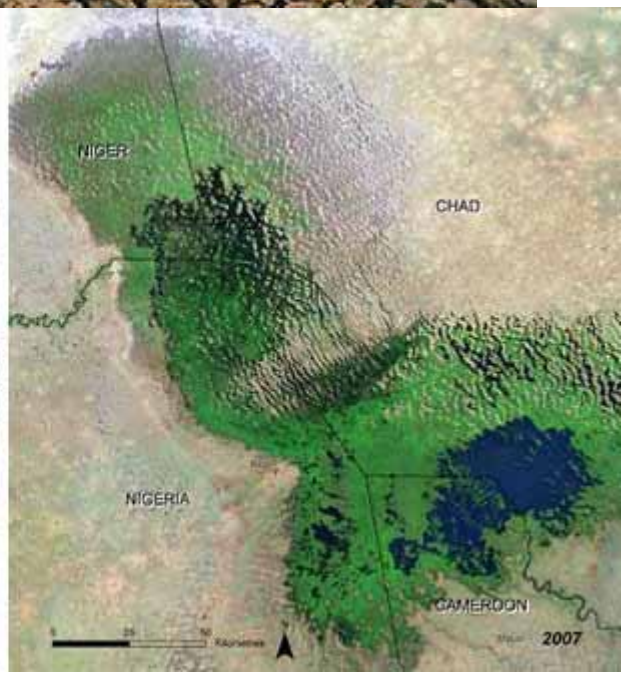
© Daniel Poleschook, Jr. and Virginia R. Gumm


WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS



# Disappearing Lake Chad



# Perspective in Space