

Global Impacts of Climate Change on Freshwater

Katie Hein

Wisconsin Department of Natural Resources

ESA's Rosetta spacecraft in 2009

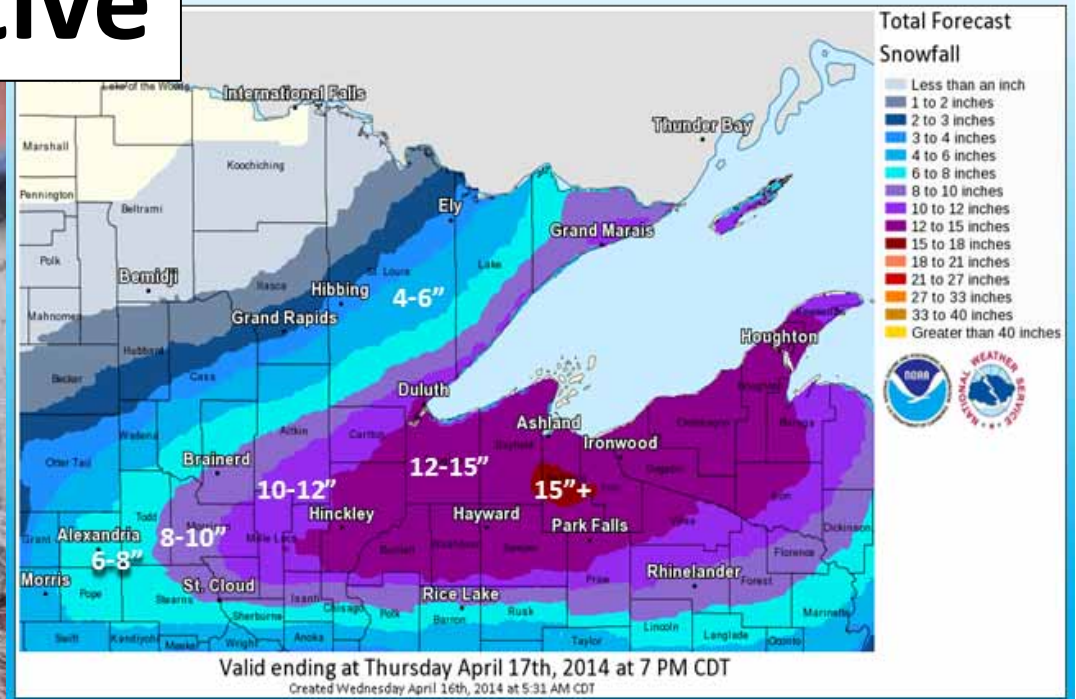
Wisconsin was COLD this winter!

'how about that
climate change?'



Broader Perspective

ing Snowstorm Today into Early Thursday



NWS Duluth, MN

For More Information Please Visit www.weather.gov/dlh



John Hart

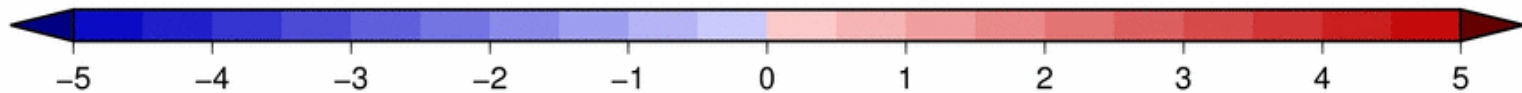
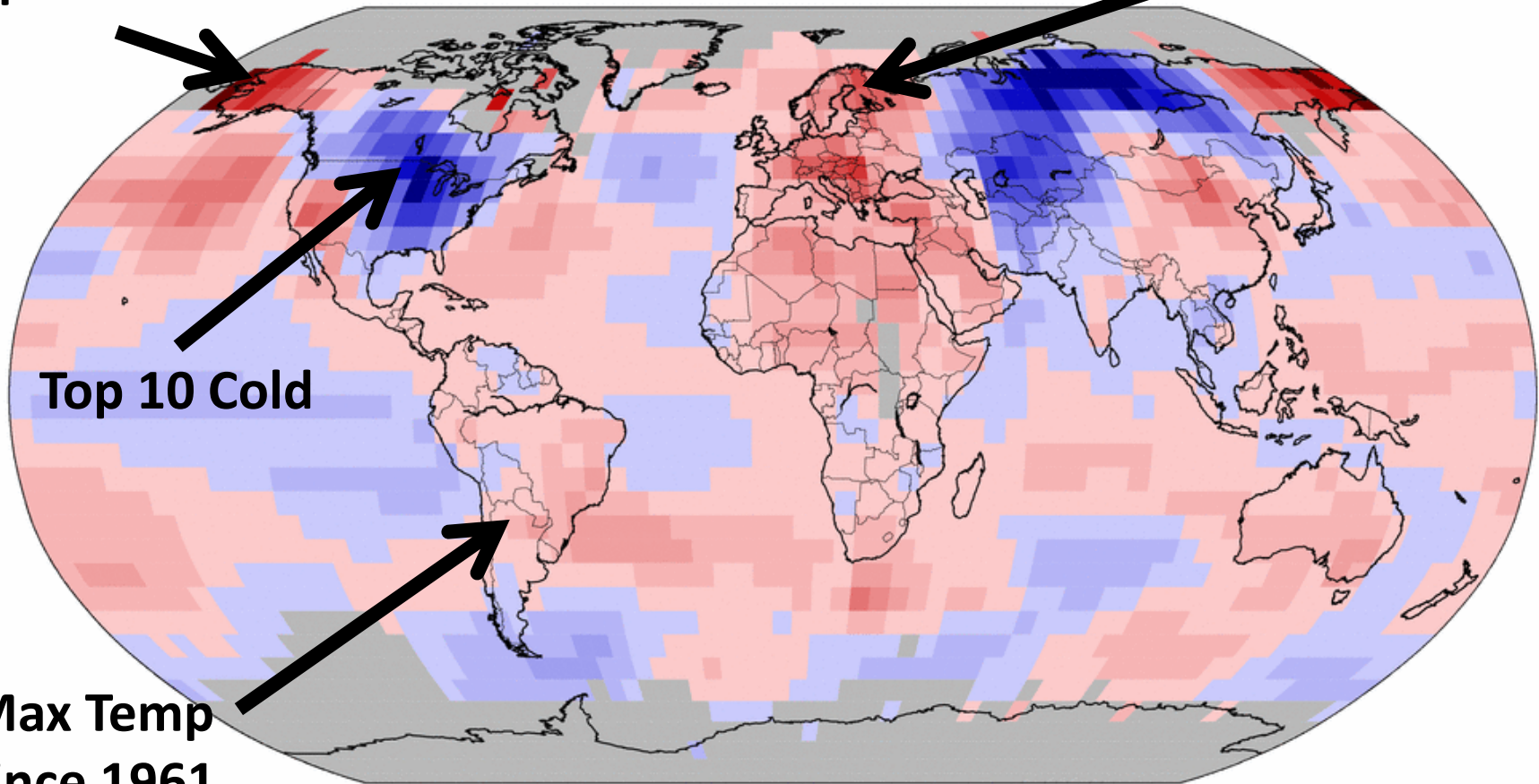
Land & Ocean Temperature Departure from Average Jan–Feb 2014

(with respect to a 1981–2010 base period)

Data Source: GHCN–M version 3.2.2 & ERSST version 3b

Top 4 Warm

Top 6 Warm



NOAA's National Climatic Data Center
Fri Mar 14 08:13:09 EDT 2014

Degrees Celsius

Please Note: Gray areas represent missing data
Map Projection: Robinson

A hot start to 2014 for Anchorage weather

Craig Medred | January 21, 2014

Like

55

Tweet

6

g+1

7

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

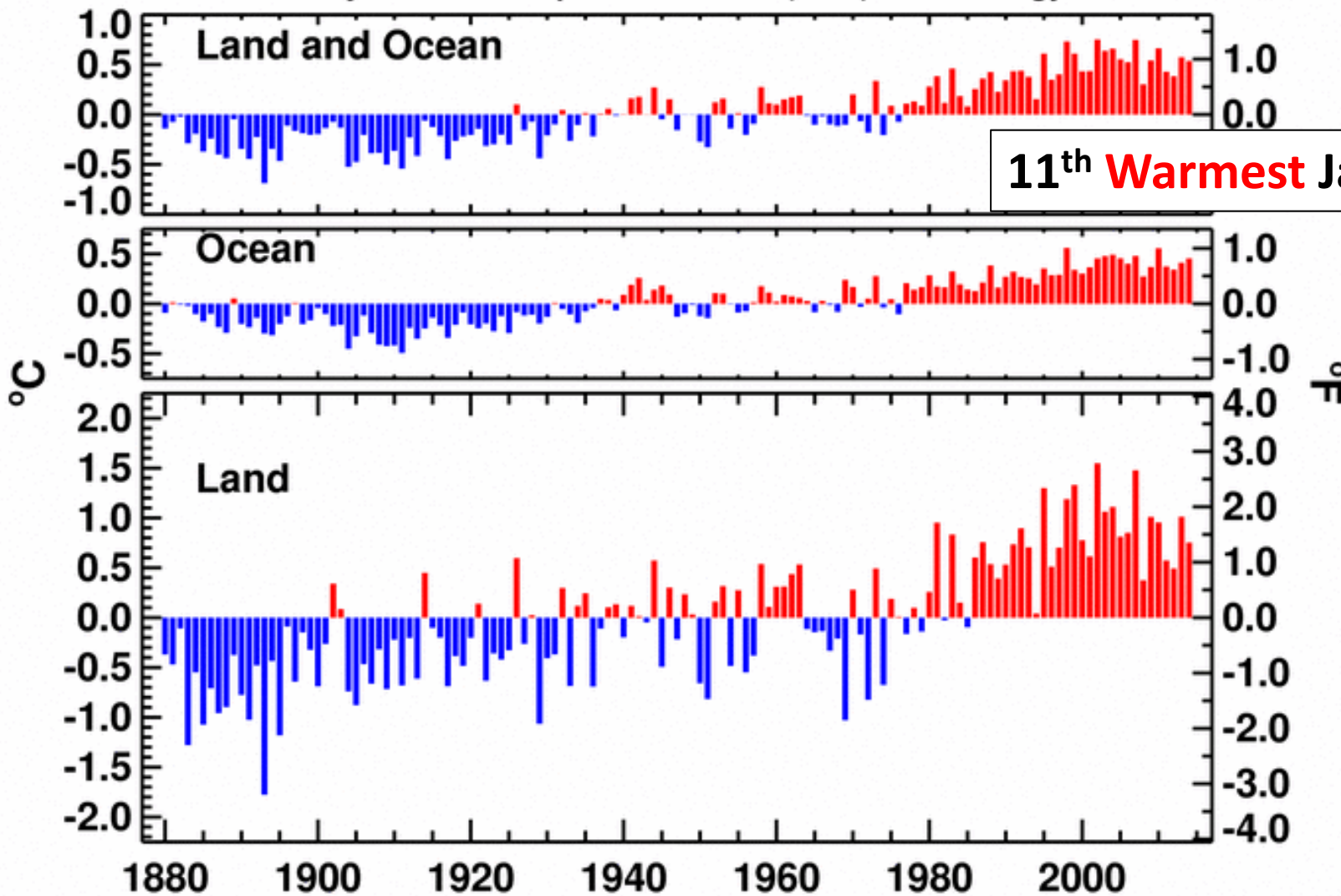


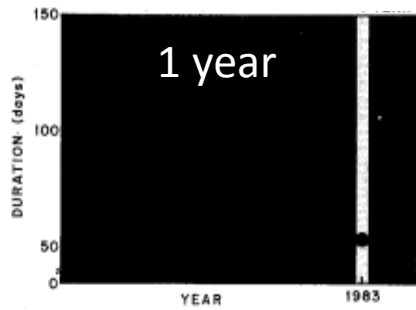
Alaska DOT&PF

Jan-Feb Global Surface Mean Temp Anomalies

NCDC/NESDIS/NOAA

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





Long-term data give context

Days of ice cover on Lake Mendota



John Magnuson

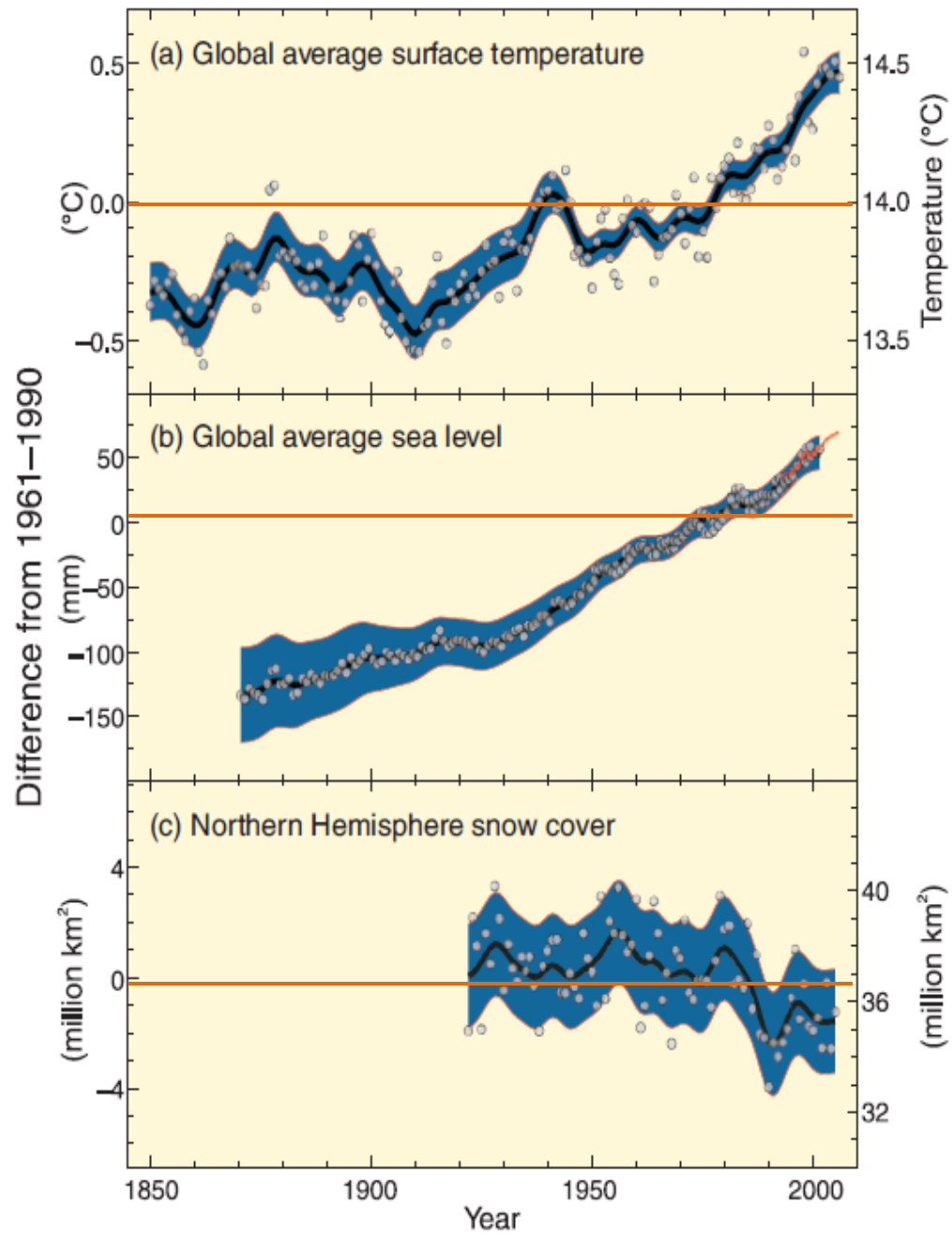
Photo: Peter Essick



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YEAR

Changes in temperature, sea level and Northern Hemisphere snow cover



Glaciers Retreating

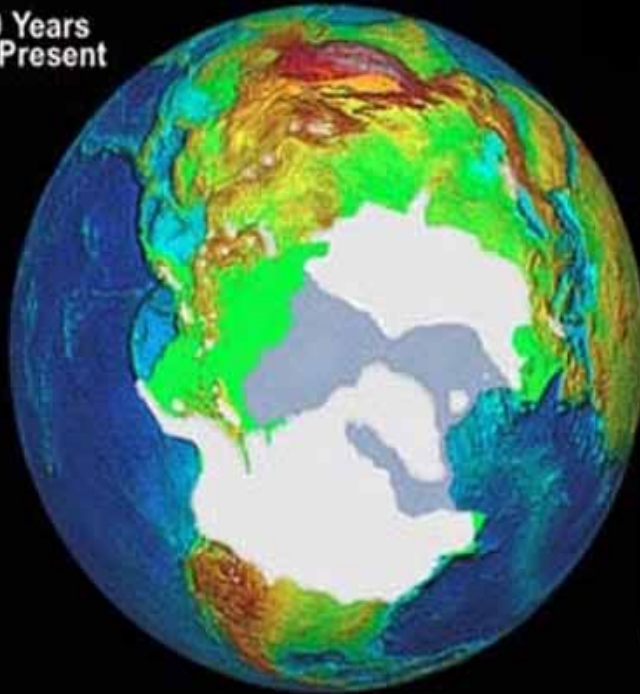
Example: Honeycomb Glacier in the Cascades



Northern Hemisphere

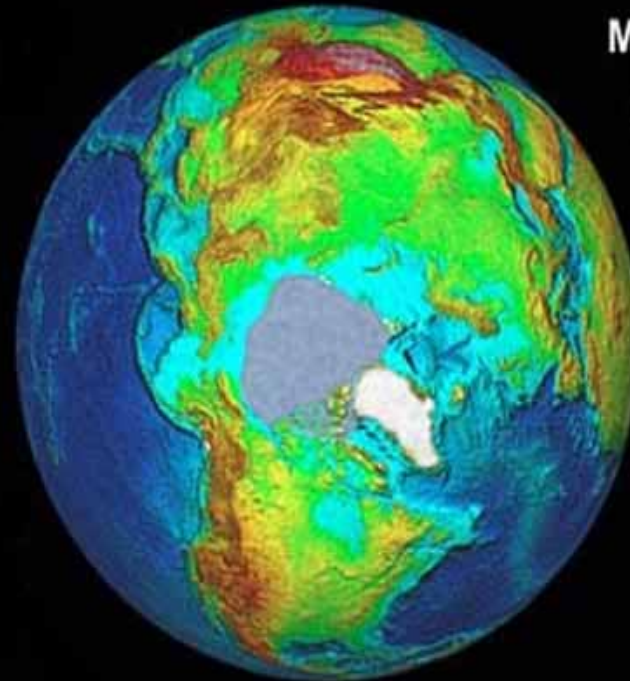
Ice Coverage

18,000 Years
Before Present






Modern
Day

(August)



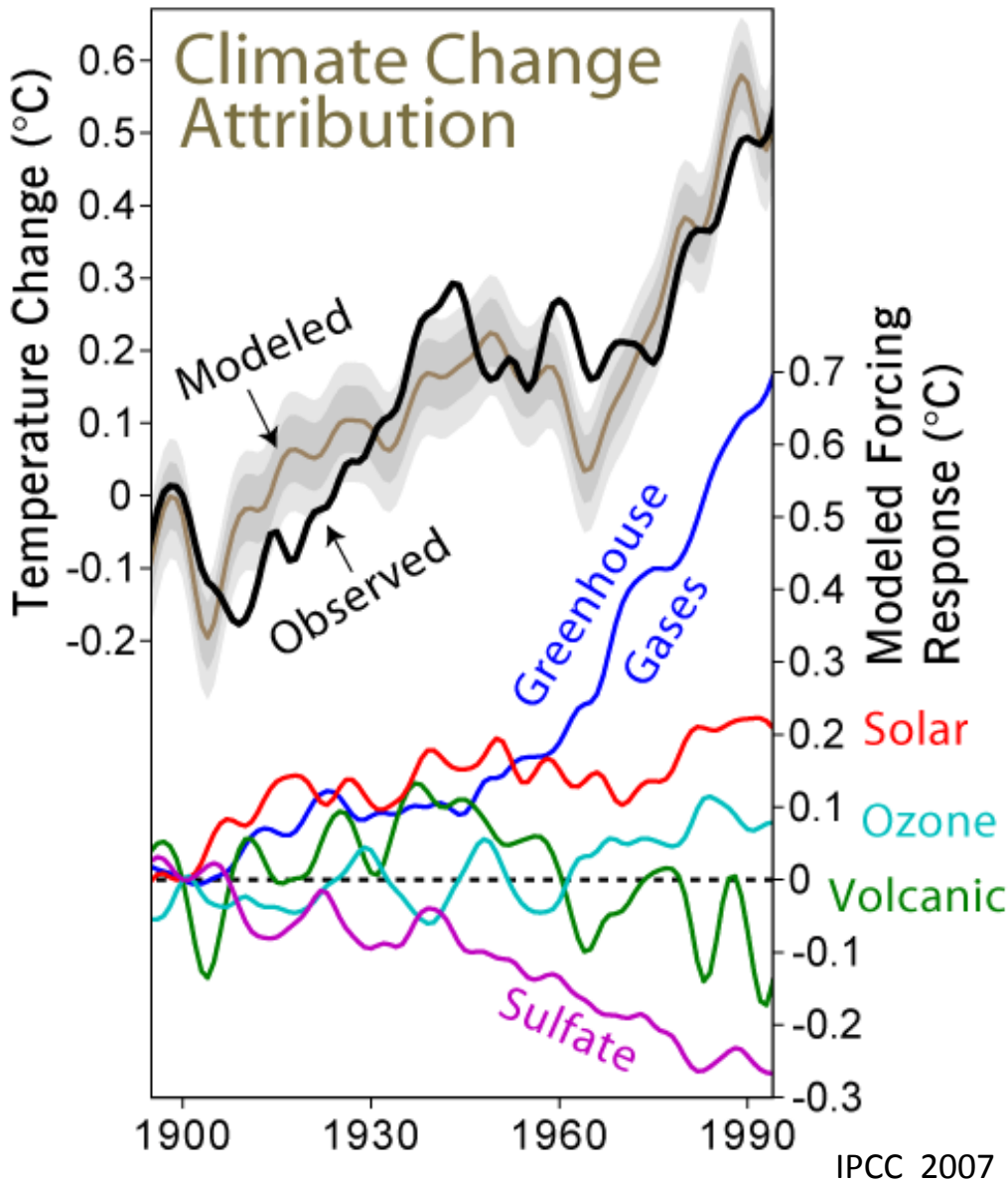
Note: Modern sea ice
coverage represents
summer months.

Legend

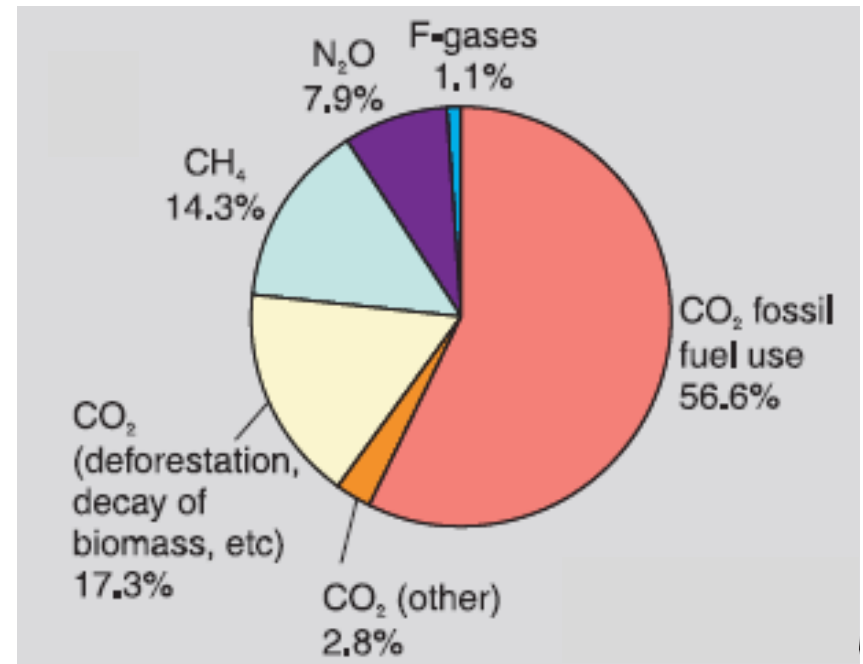
- Continental Ice 
- Sea Ice 
- Land Above Sea Level 



Why is the earth warming?



Human contributions to greenhouse gases



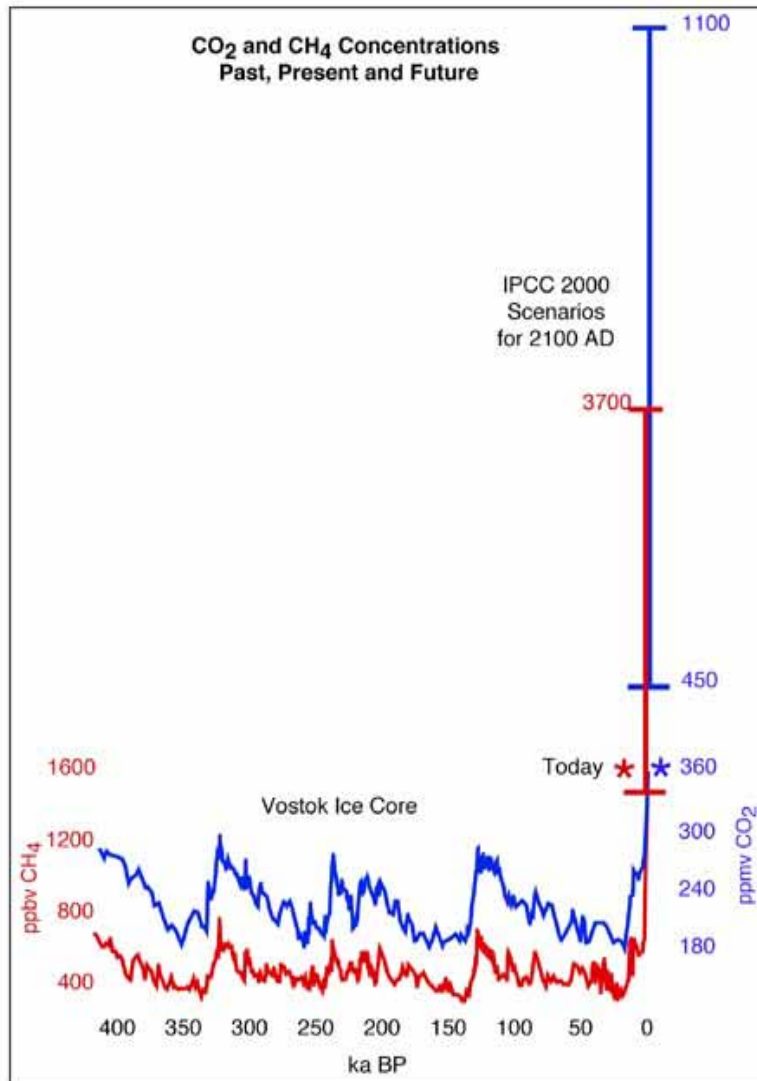
The Greenhouse Effect

Some sunlight that hits the earth is reflected. Some becomes heat.

CO₂ and other gases in the atmosphere trap heat, keeping the earth warm.

Average temperature on earth is + 15°C, but would be -18°C if there were not greenhouse gases in the atmosphere

Greenhouse Trace Gas: Past Changes from Vostok and IPCC Estimates



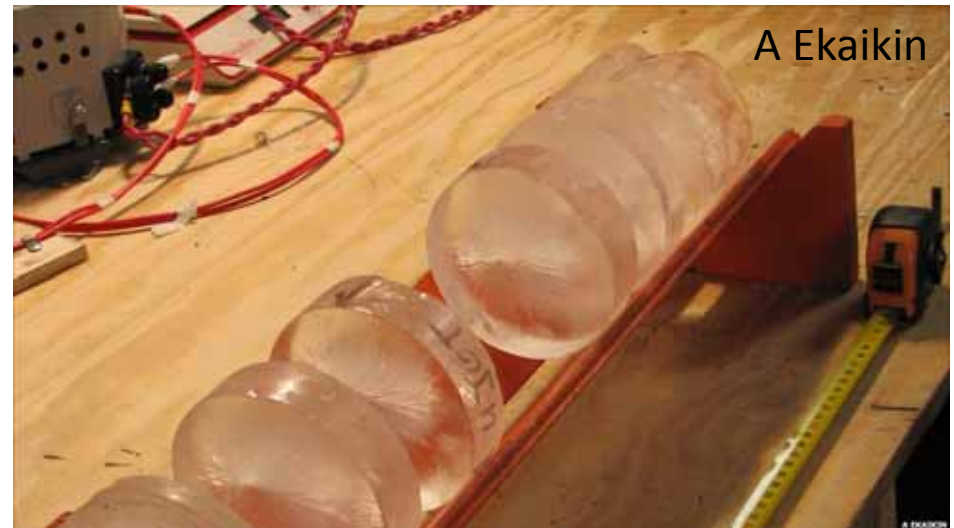
Paleoclimate, Global Change and the Future
Alverson, Bradley and Pederson eds., 2002

GLOBAL
I G B P
CHANGE

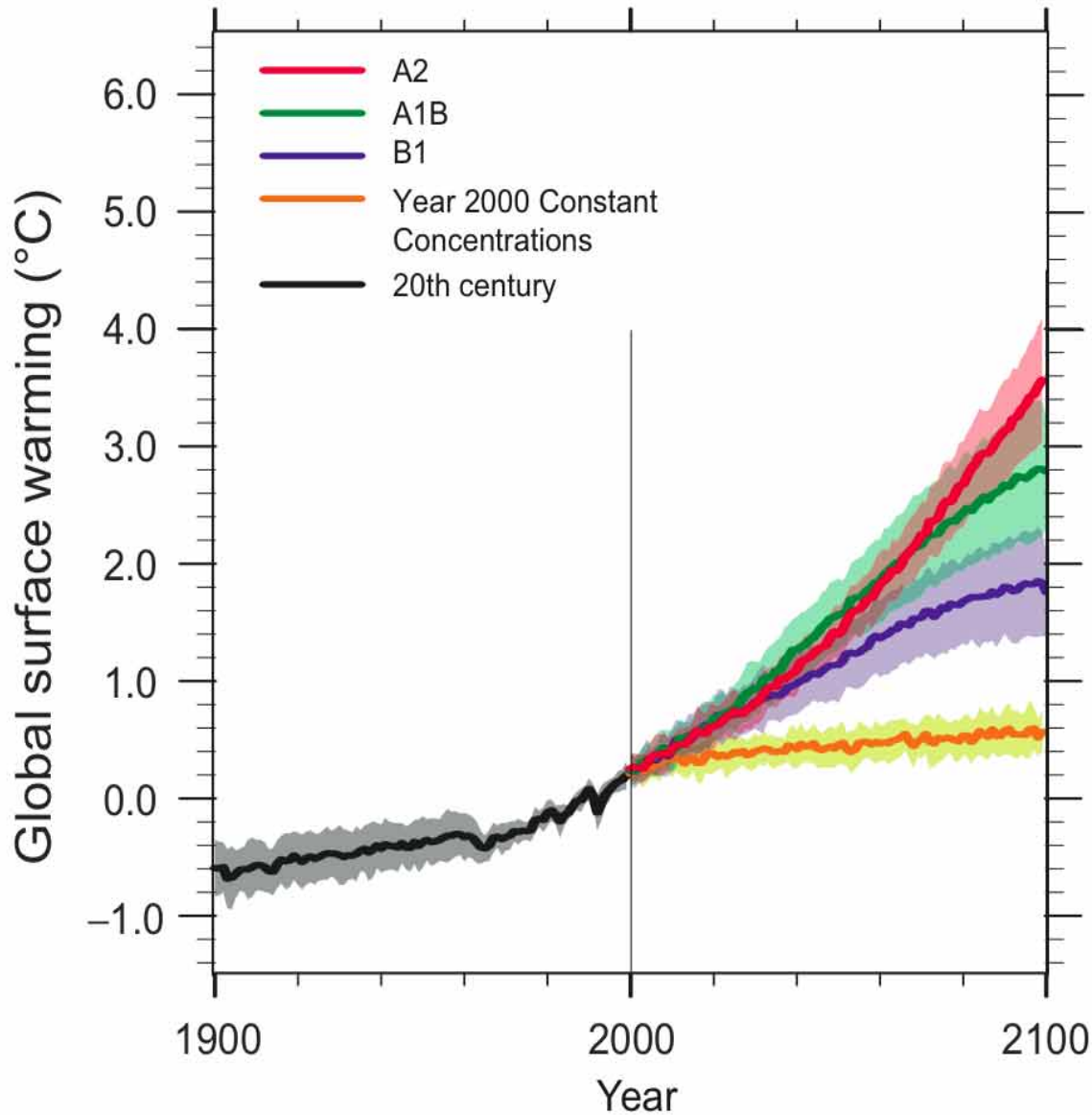
Chapter 1: F. Oldfield, K. Alverson, fig. 1.6, p. 6

PAGES
PAST GLOBAL CHANGES

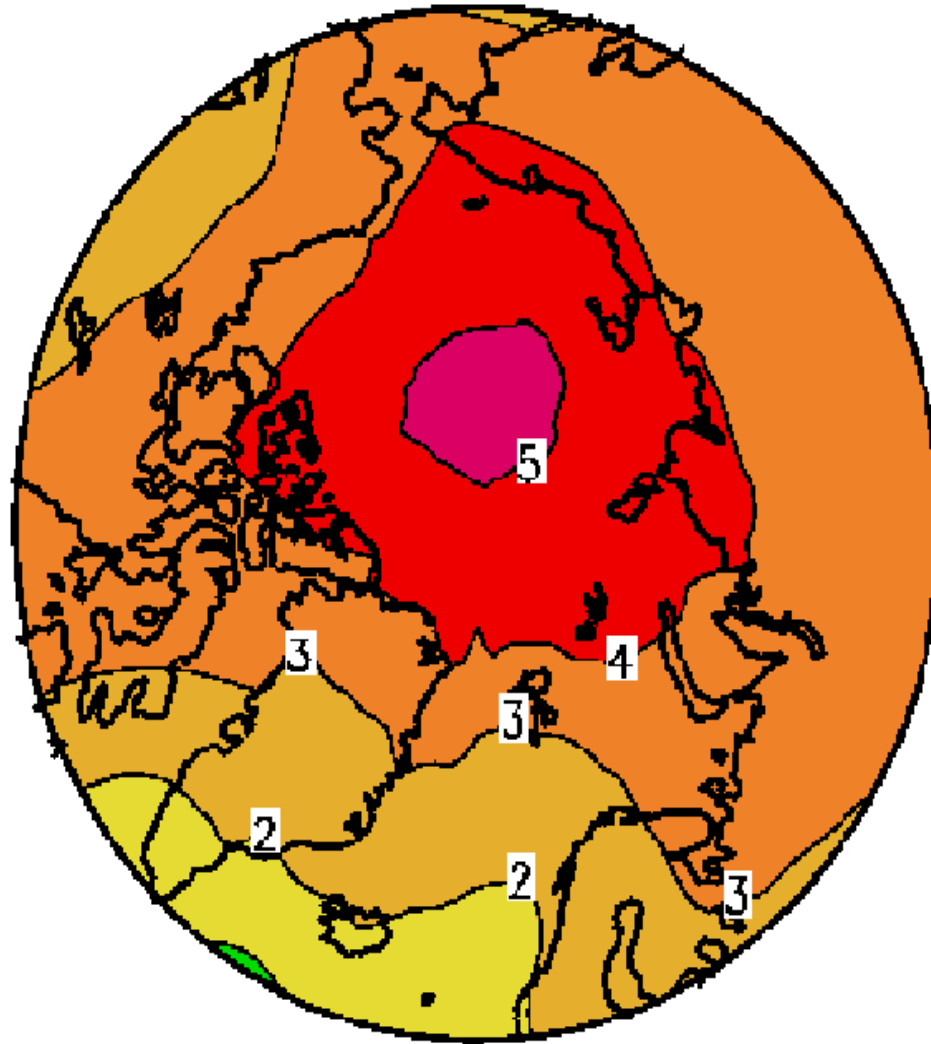
- The concentration of CO₂ is at a record high compared to the past 650,000 years.
- The rate of increase in CO₂ is faster than before at 80ppm over the past 100 years compared to 80 ppm over 5,000 years following previous ice ages.



Future Climate Projections Based on Emissions Scenarios



Degree of change depends on location



Climate in 2070

Stories from around the globe

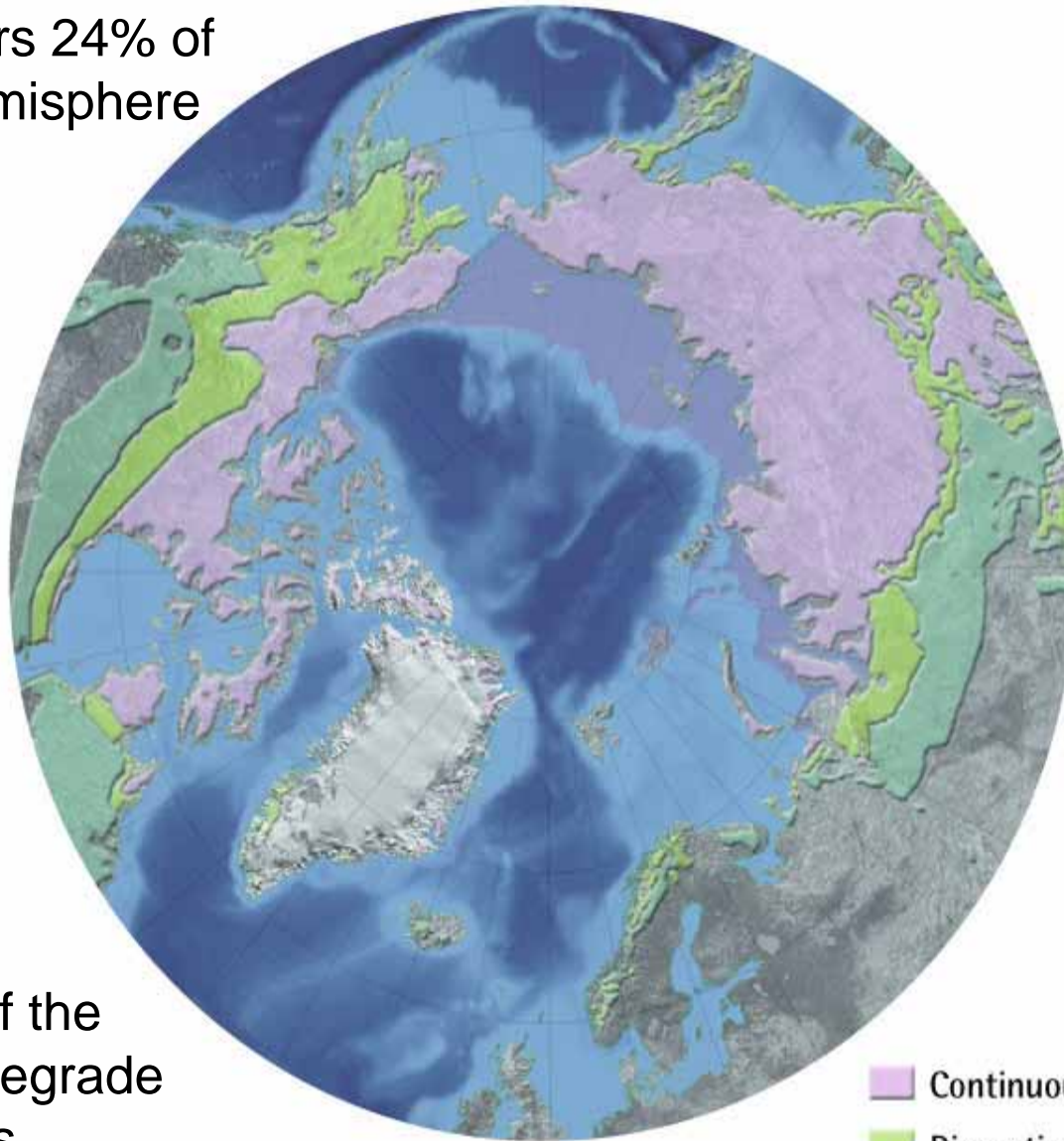


An aerial photograph of a tundra landscape. The terrain is characterized by a complex pattern of dark green, brown, and yellowish patches, which are indicative of permafrost. The patches are irregular in shape and size, creating a mosaic-like appearance. The overall color palette is dominated by earthy tones, with some darker areas suggesting wetter or more vegetated ground. The lighting is bright, highlighting the textures and colors of the ground.

Permafrost

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

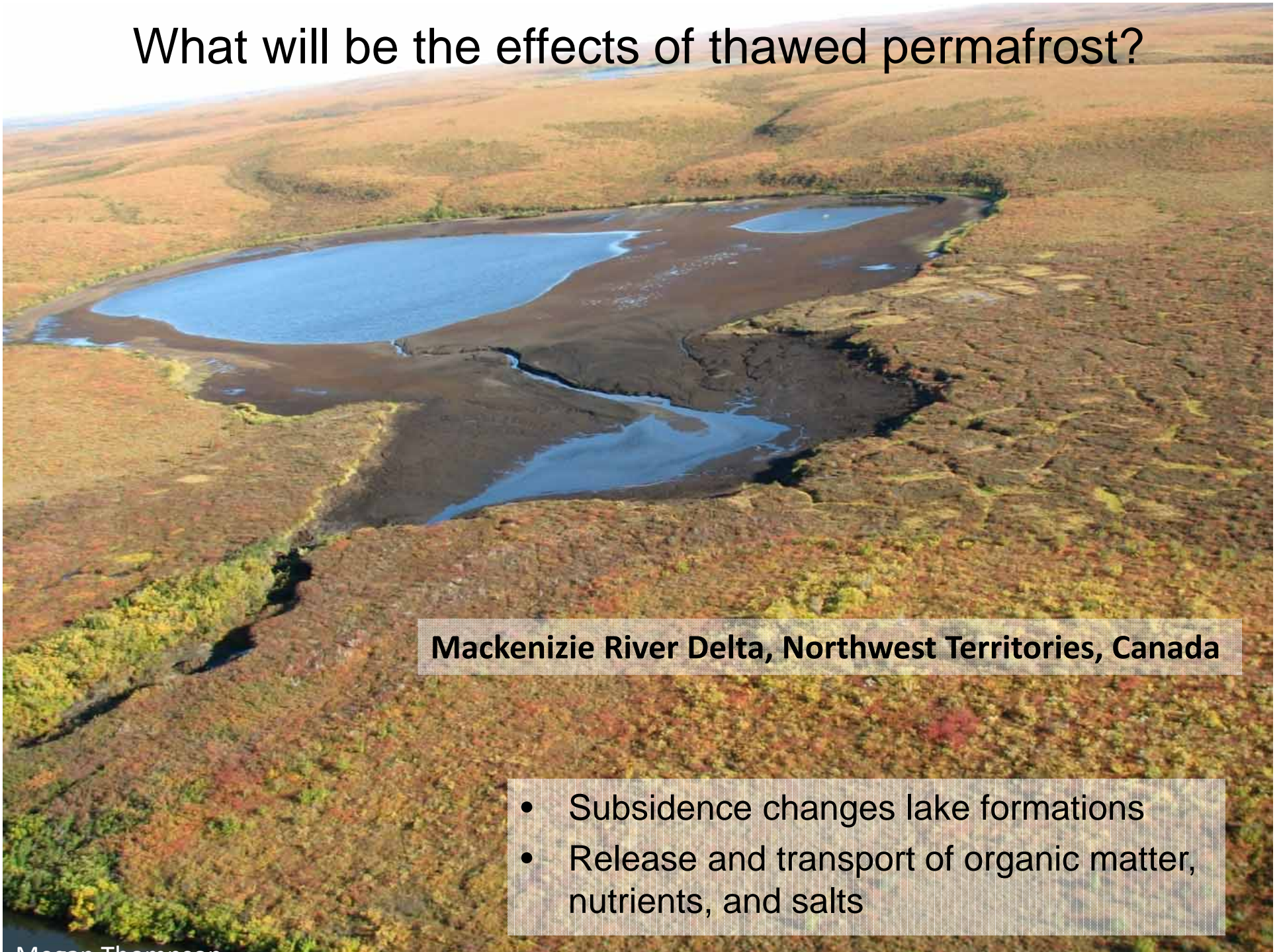
Permafrost covers 24% of the Northern Hemisphere



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

- Continuous
- Discontinuous
- Sporadic
- Subsea

What will be the effects of thawed permafrost?



Mackenzie River Delta, Northwest Territories, Canada

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

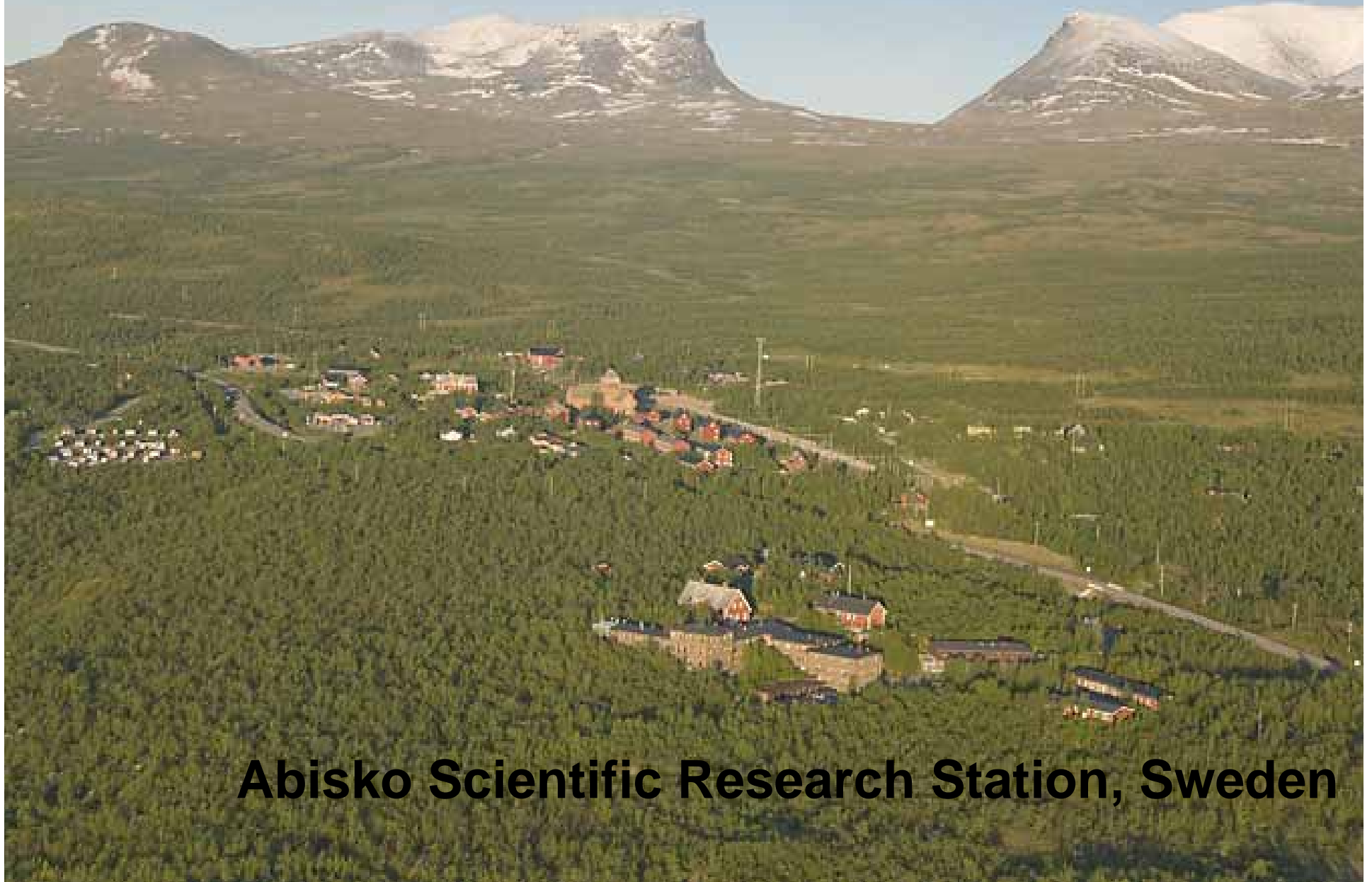
Mackenzie River Delta, Northwest Territories, Canada



Megan Thompson



Climate Impacts Research Centre



Abisko Scientific Research Station, Sweden

Will melting permafrost release methane?



Tyler Logan



NATIONAL
GEOGRAPHIC

Mark Thiessen

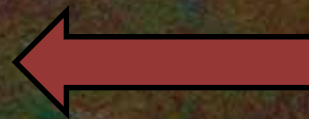


**Warmer
Temperatures**

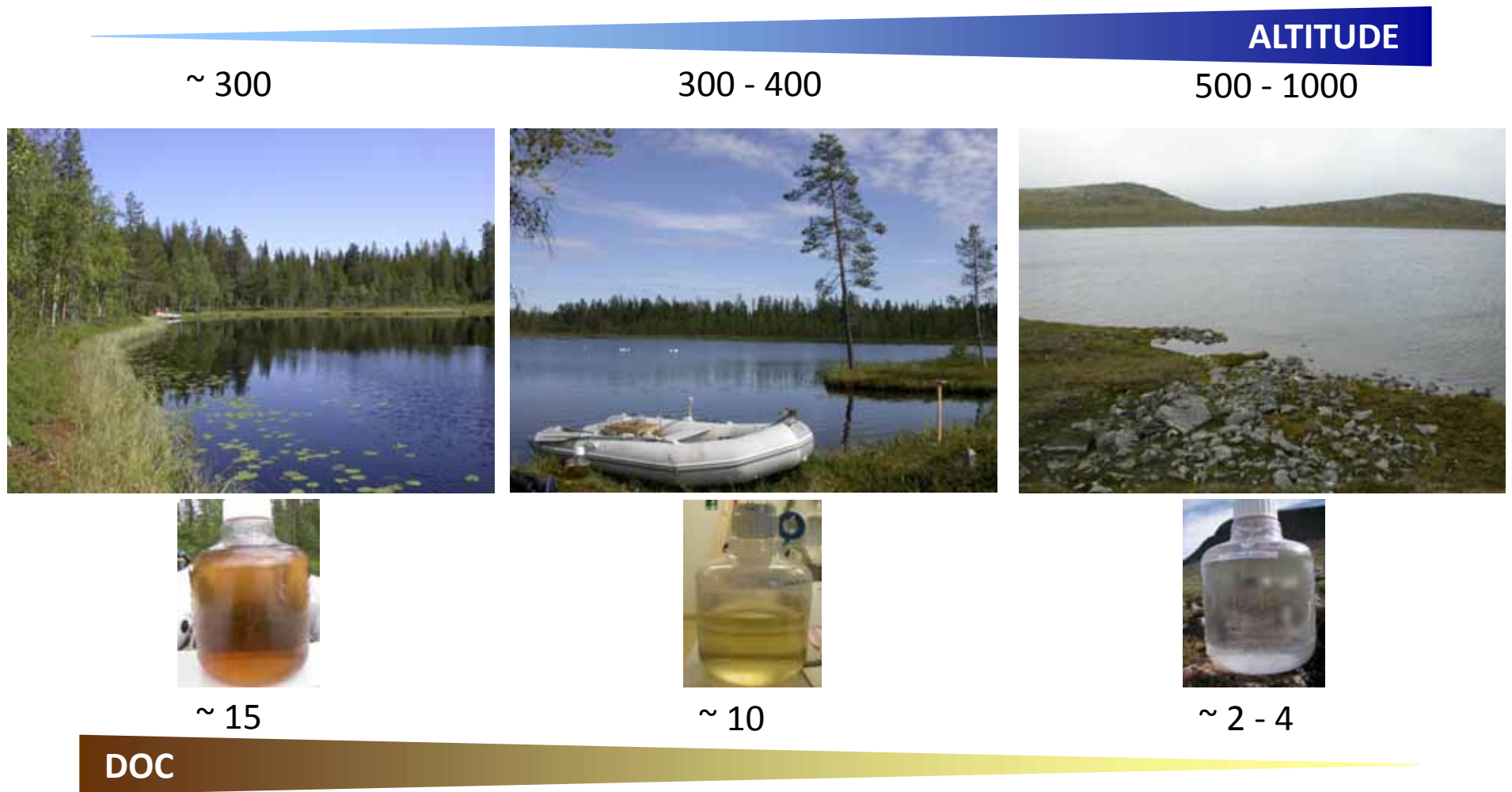


**Methane
Release**

**Permafrost
Melting**



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



Challenge: treating drinking water



Lake Mälaren provides drinking water for 2 million people in Stockholm



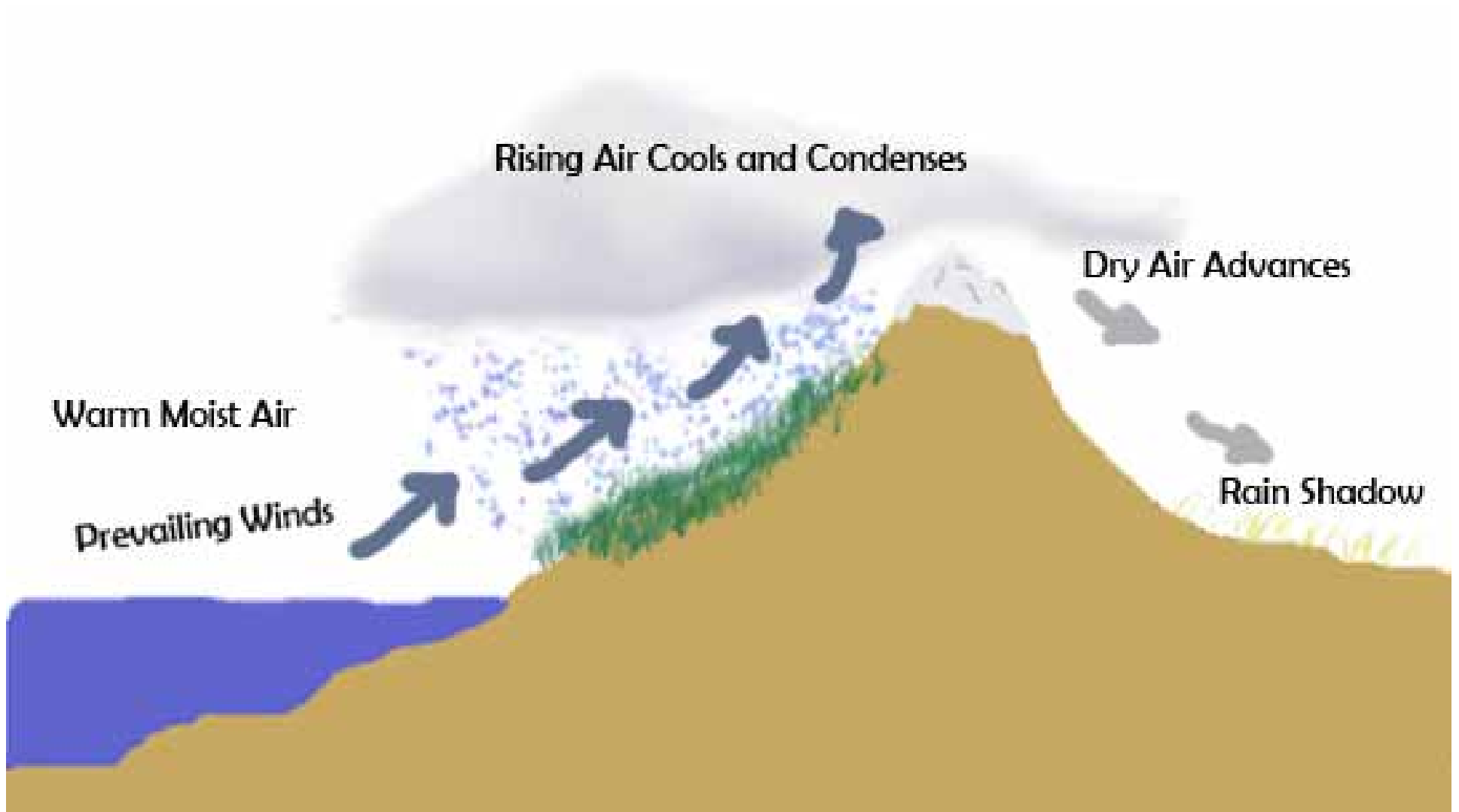
Puerto Rico

3400 mi²

3.89 million people

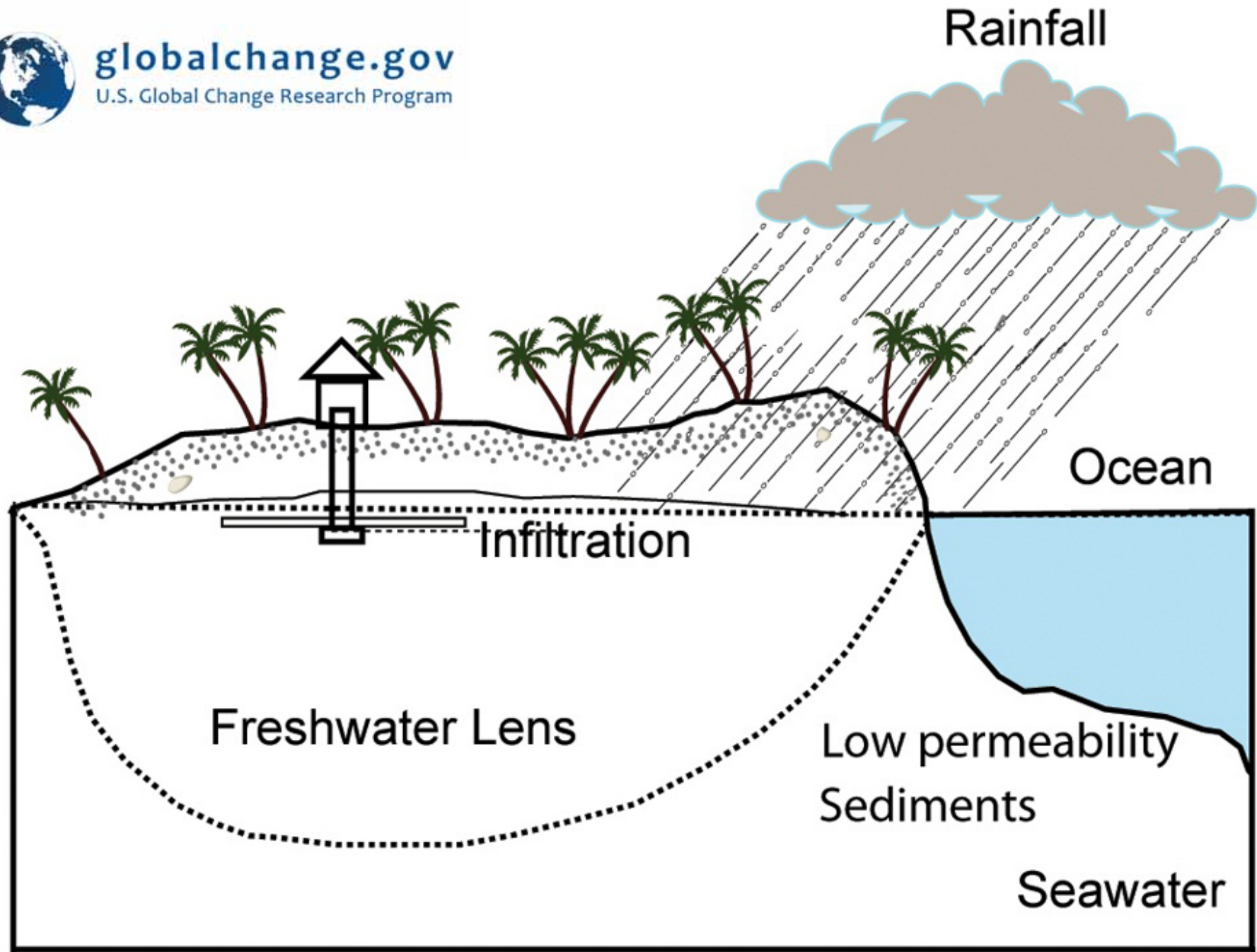


Precipitation provides drinking water



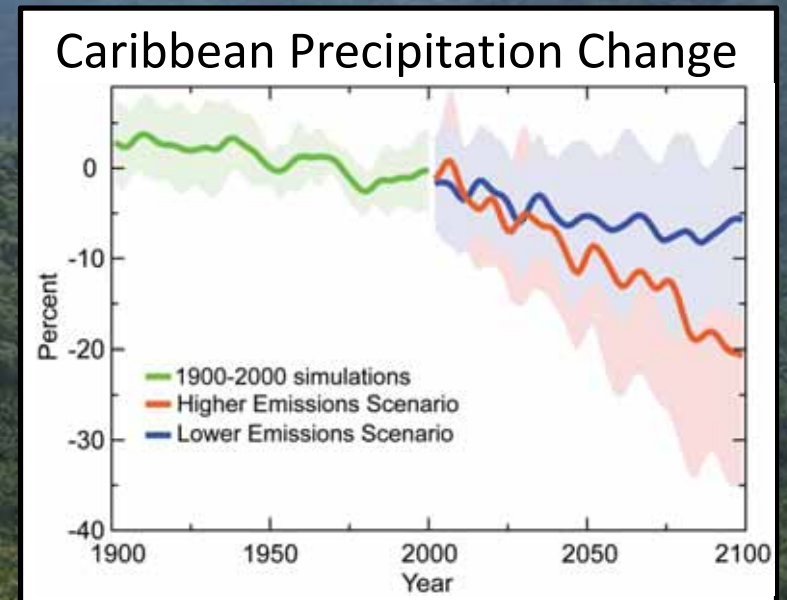
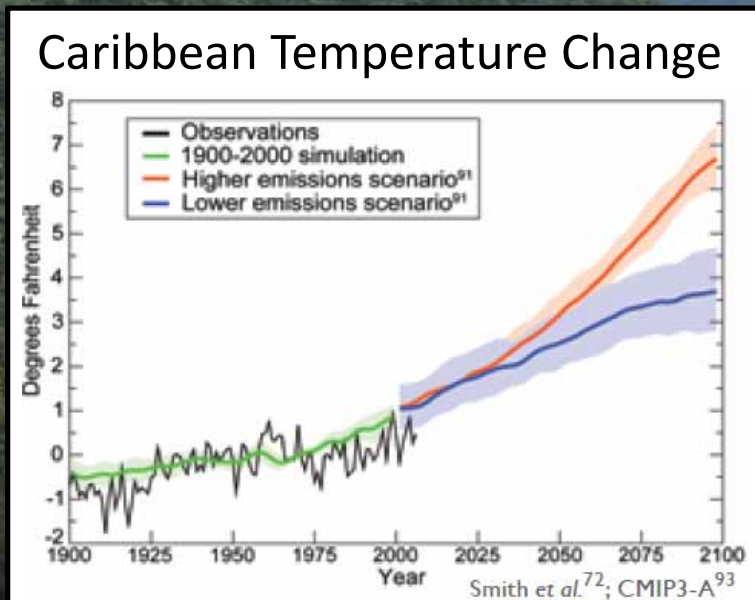


globalchange.gov
U.S. Global Change Research Program



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

Declines in rainfall threaten water supply



Global Climate Change

- Rate of warming is faster than any known period in the past 650,000 years
- Weather \neq 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



WARNING

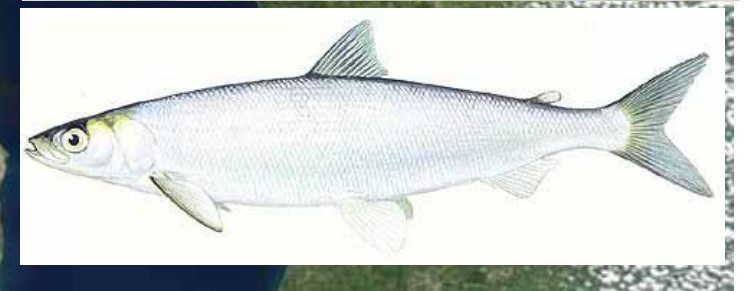
Unsafe for swimming

High levels of bacteria in these waters may pose a risk to your health.

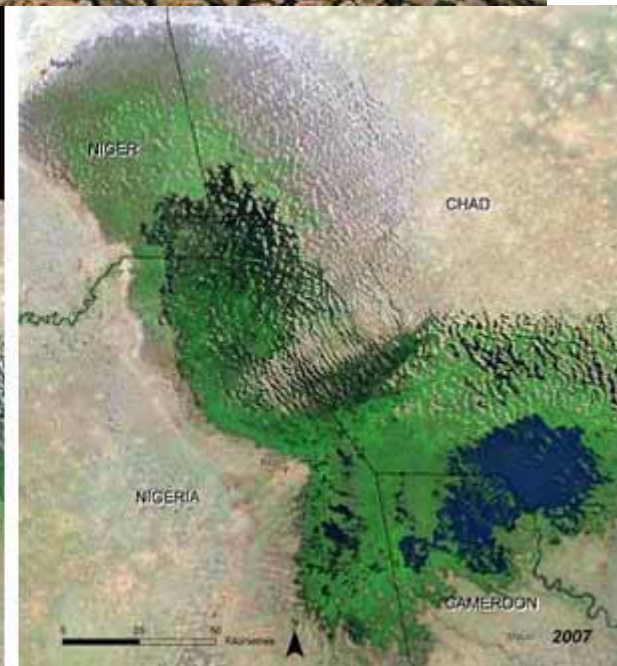
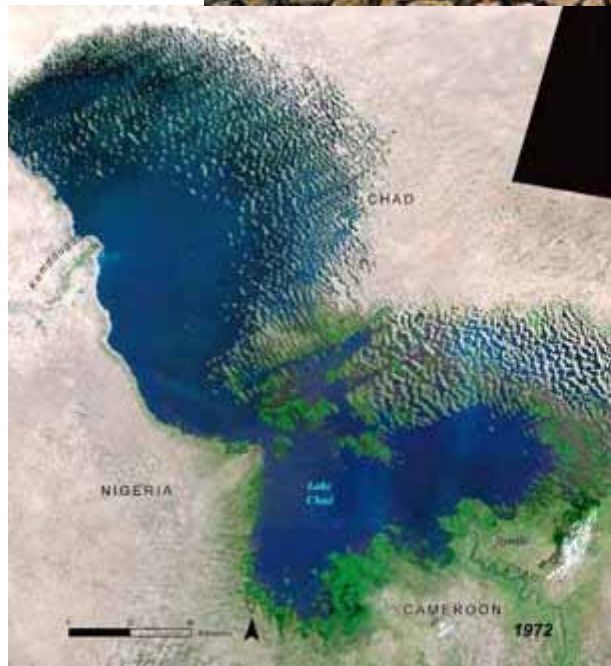
Medical Officer of Health

It is an offense to damage or remove this sign.

WISCONSIN
INITIATIVE ON
CLIMATE
CHANGE
IMPACTS



Disappearing Lake Chad





Perspective in Space

