Hot Science Cool Talks

UT Environmental Science Institute

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The Changing Debate on Global Warming

Dr. Eric J. Barron

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The Changing Debate on Global Warming

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Every credible scientist recognizes that increases in greenhouse gases promote warming

- Incoming solar energy (hot sun, short wavelengths) largely pass through the atmosphere and heat the surface
- Earth's surface radiates to space (cooler body, longer wavelength)
- Gases like carbon dioxide selectively absorb longer wavelengths – reradiate to space and back to the surface
- Without selective absorbers Earth is 5°F
- With selective absorbers Earth is 64°F

The Real Issue in the Debate

- How much will it warm – in response to humans adding more greenhouse gases?
- How fast will it warm?
- How significant will be the impact?

The first two questions will likely remain uncertain for decades.

So, for decision-makers the last question is key.

It is not just a science question.

It depends on what you value.

My debate with an Economist

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- WAIT – what about beauty, habitat, ecosystem services (water)?

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- Suppose I got a contract to cut down all of the trees for lumber on the west side of Austin. Good or bad?
- GOOD – a product brings in dollars; jobs bring in dollars
- WAIT – what about beauty, habitat, ecosystem services (clean water)?
- But in one generation people won't know what they have missed – it doesn't have value

The Changing Debate on Climate Change

What do scientists really believe about global warming?

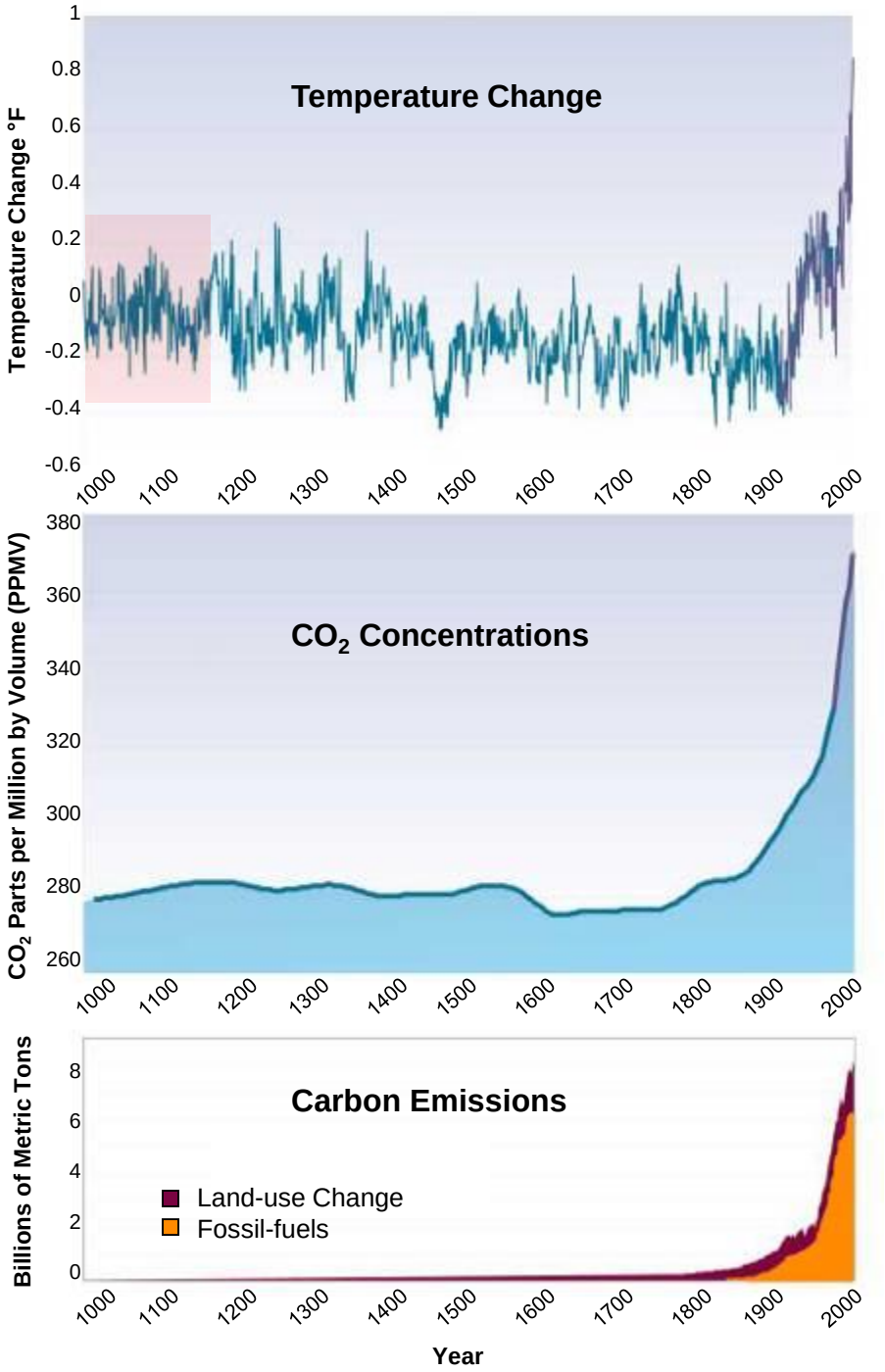
What are the predictions for the future?

What are the potential impacts?

What do climate experts say about global warming?

Foundations

- Carbon dioxide is a selective absorber
- Greenhouse gases are increasing (due to burning oil, coal and deforestation)
- Increased greenhouse gases promote warming
- Draw down of gases will take centuries
- Aerosols have human sources
- Many aerosols promote cooling
- The planet has warmed 1°F in a century

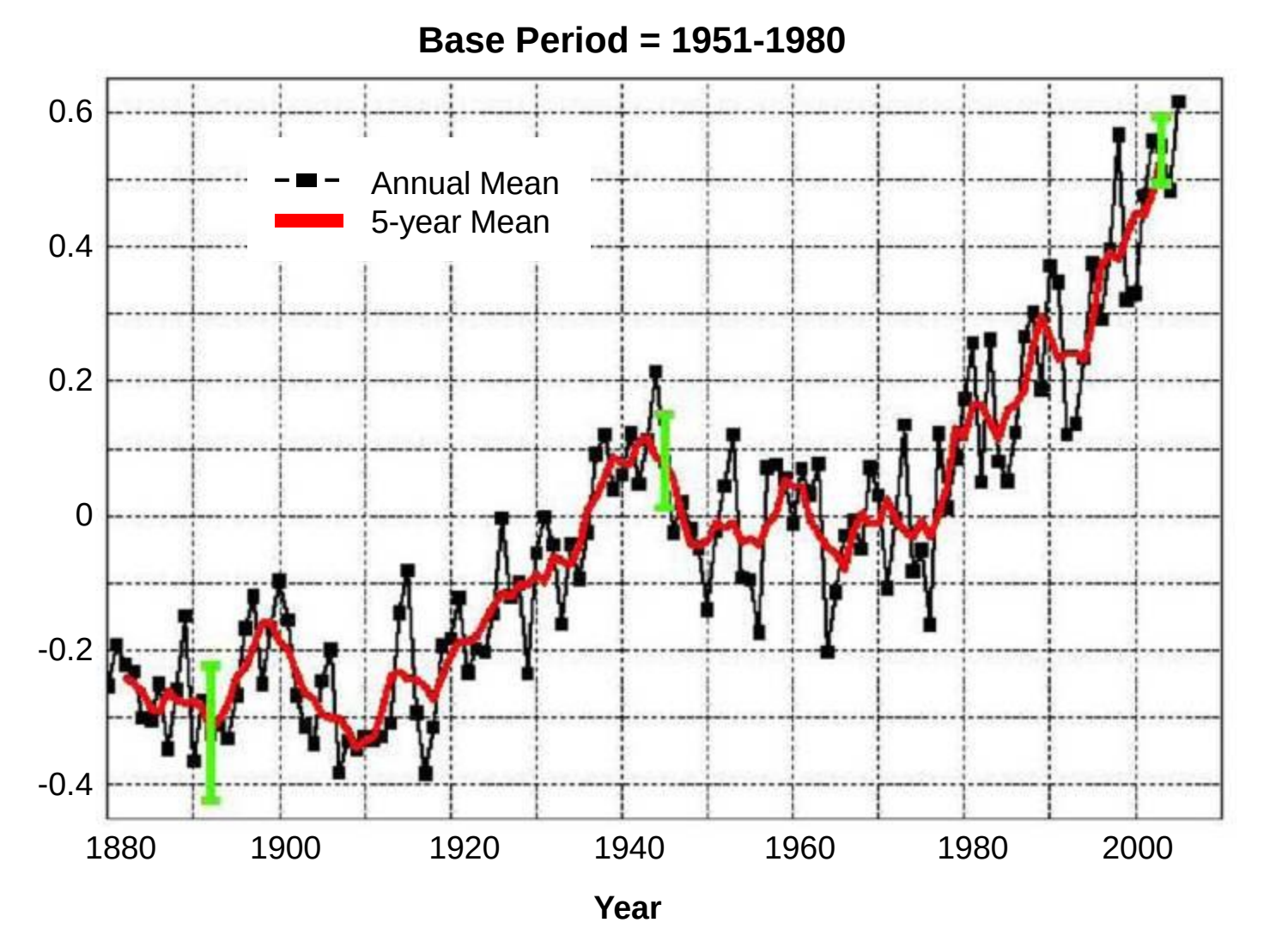


The Smoking Gun

1000 years of global CO_2 and temperature change

U.S. Global Change Research Program

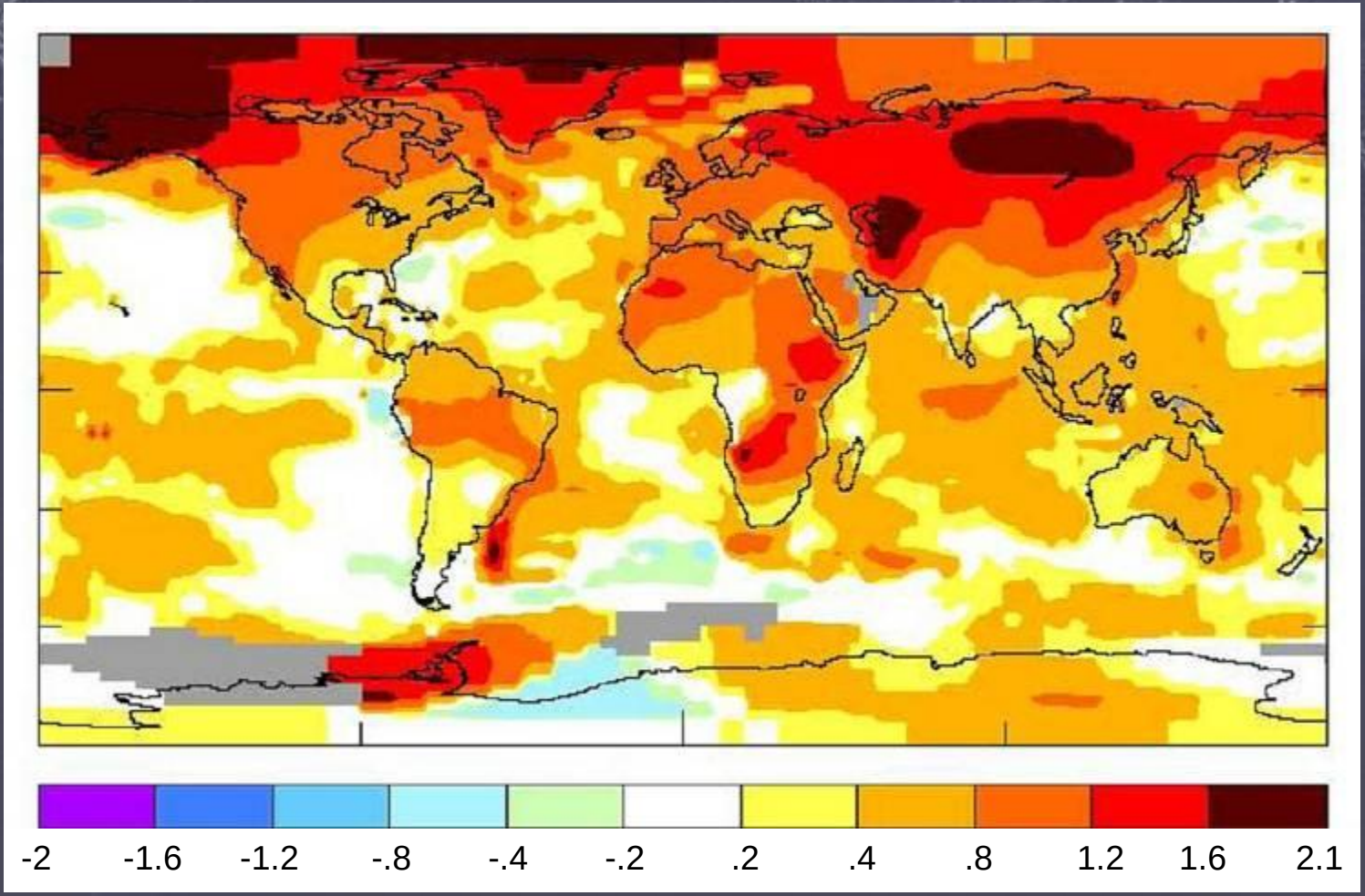
Global Land-Ocean Temperature Anomaly (°C)



J. Hansen, R. Ruedy, M. Sato, and K. Lo (NASA and Columbia University)

2001-2005 Mean Surface Temperature Anomaly (°C)

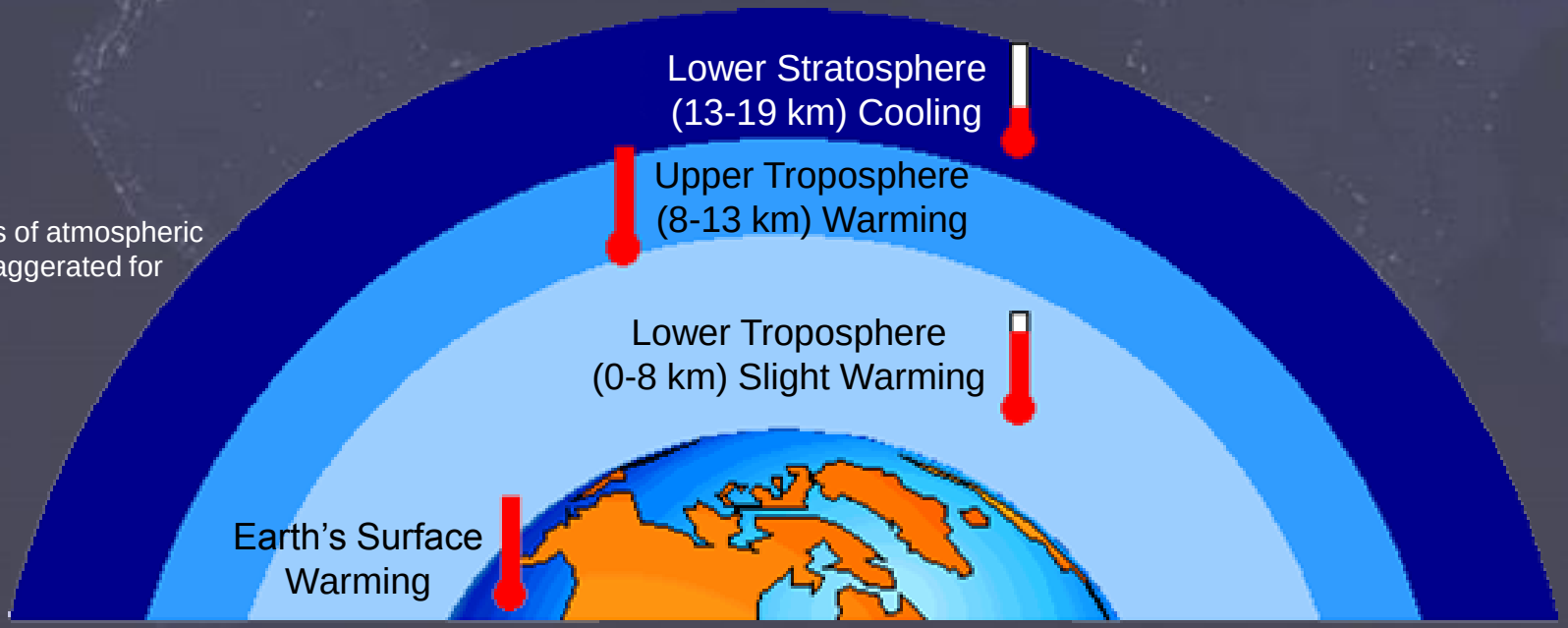
Global Mean = 0.54



J. Hansen, R. Ruedy, M. Sato, and K. Lo (NASA and Columbia University)

Predictions that are virtually certain

The stratosphere will cool.



Thickness of atmospheric layers exaggerated for clarity.

NASA

Predictions that are very probable

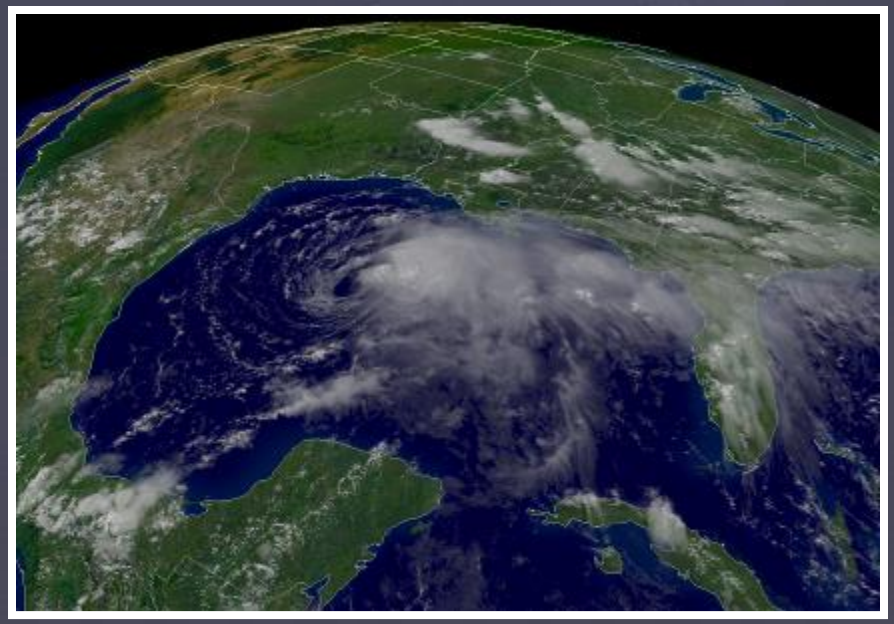
- Surface temperature will increase:
  - 0.5 to 2.0°C by 2050
  - 1.5 to 4.5°C for a CO_2 doubling
  - 2.5°C most likely
- Global precipitation will increase
- Sea ice will retreat in Northern Hemisphere
- Arctic warming

Predictions that are very probable

- Sea level will rise, 5 to 40 cm by 2050
- The effects of solar variability will not be significant over the next 50 years compared to those of CO_2

Predictions that are uncertain

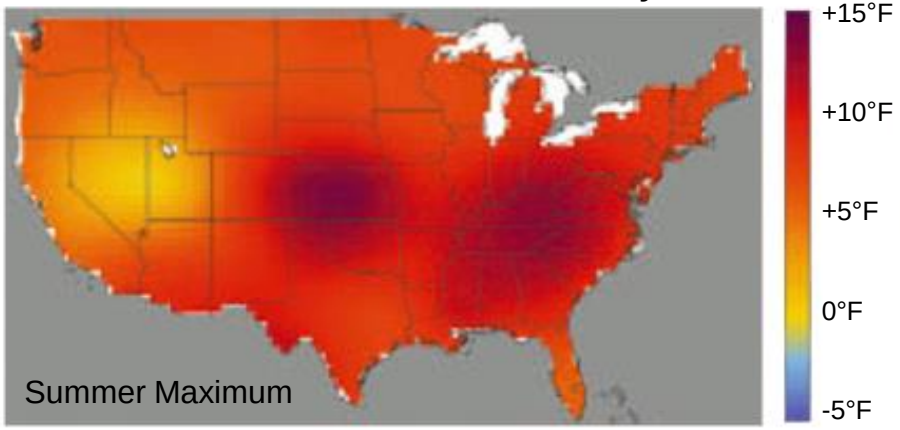
- Climate variability changes
- Regional climate changes
- Tropical storms
- The next 25 years & biosphere feedbacks



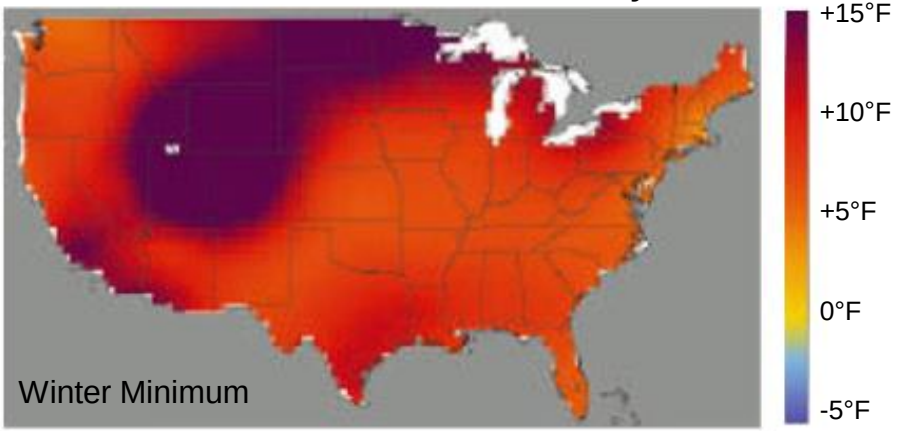
What do climate models predict for the continental U.S. from 2090 to 2100?

Summer Maximum & Winter Minimum Temperature Change

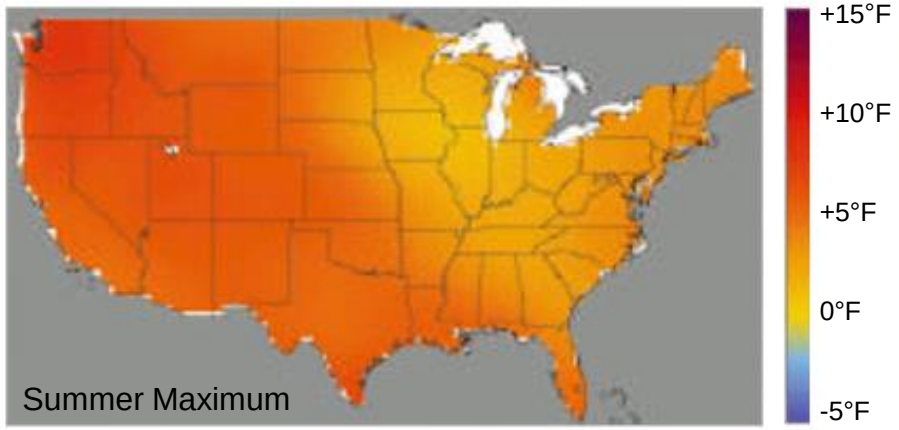
Canadian Model 21st Century



Canadian Model 21st Century



Hadley Model 21st Century



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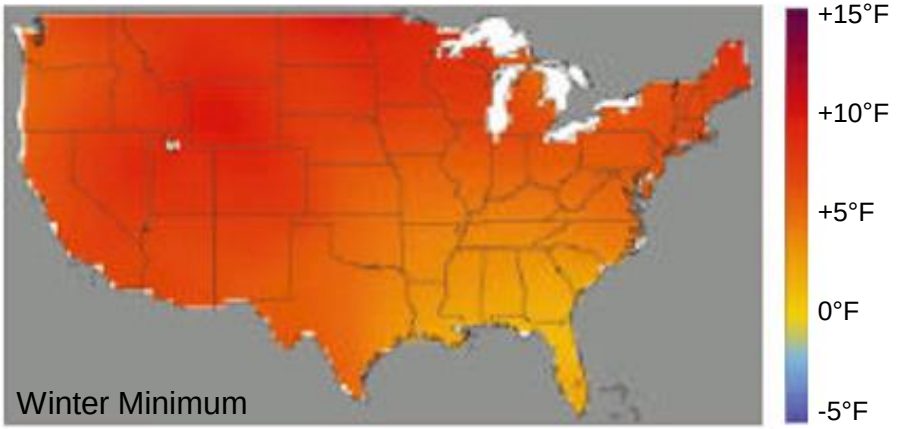
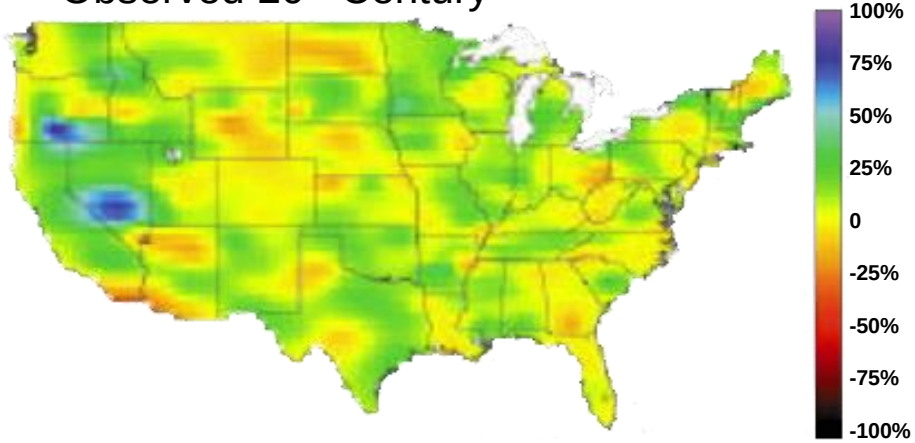
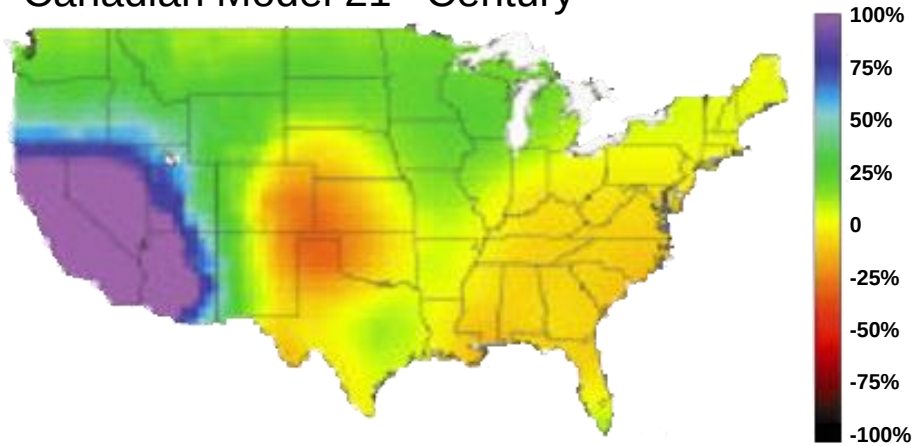


Precipitation Change

Observed 20th Century



Canadian Model 21st Century



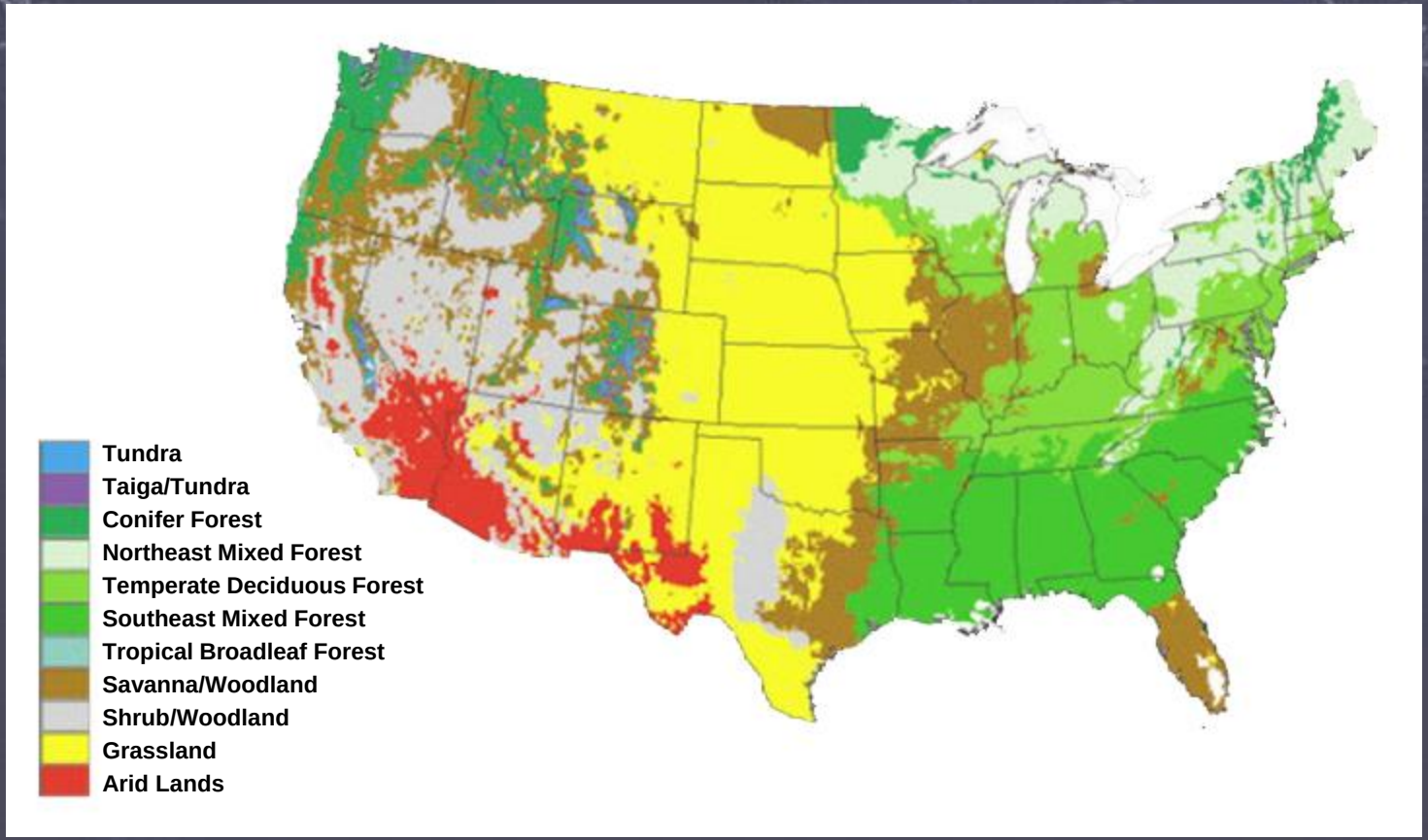
Hadley Model 21st Century

U.S. Global Change Research Program

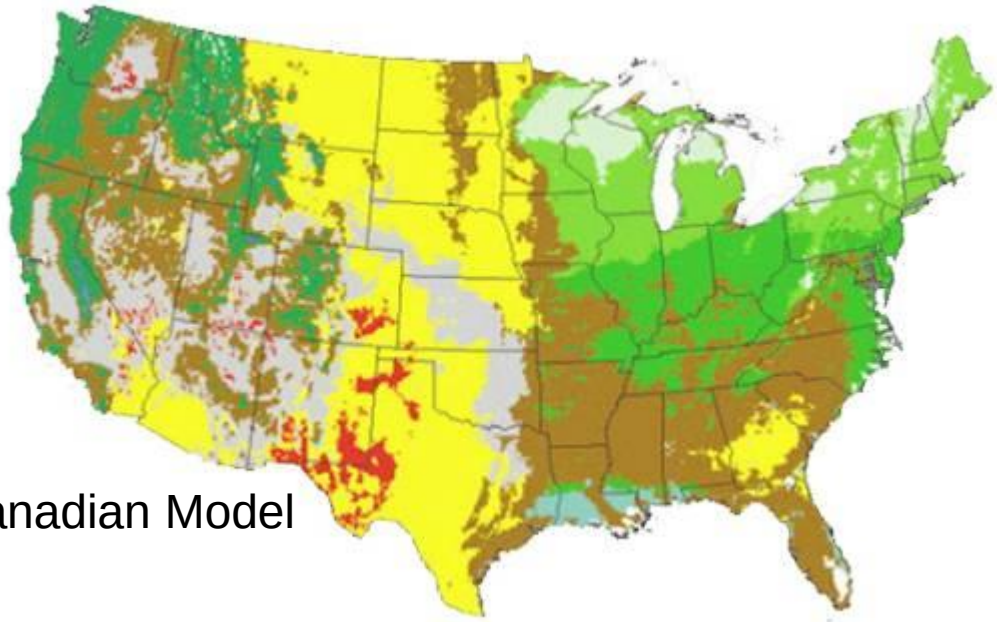
What are the potential impacts for ecosystems, water, agriculture and health?

Ecosystem Models

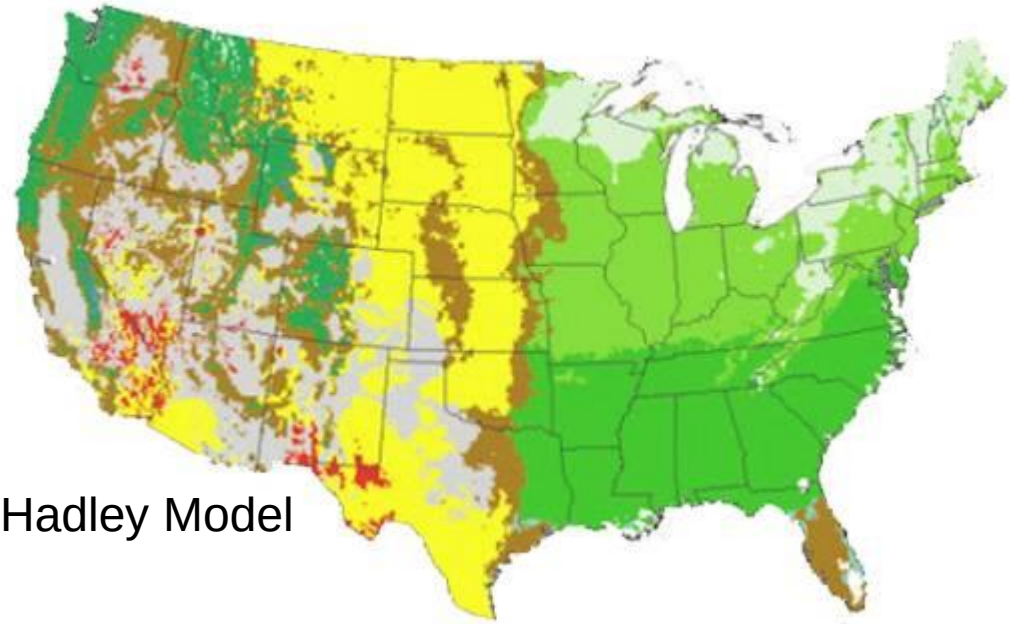
Current Models



Ecosystem Models



Canadian Model

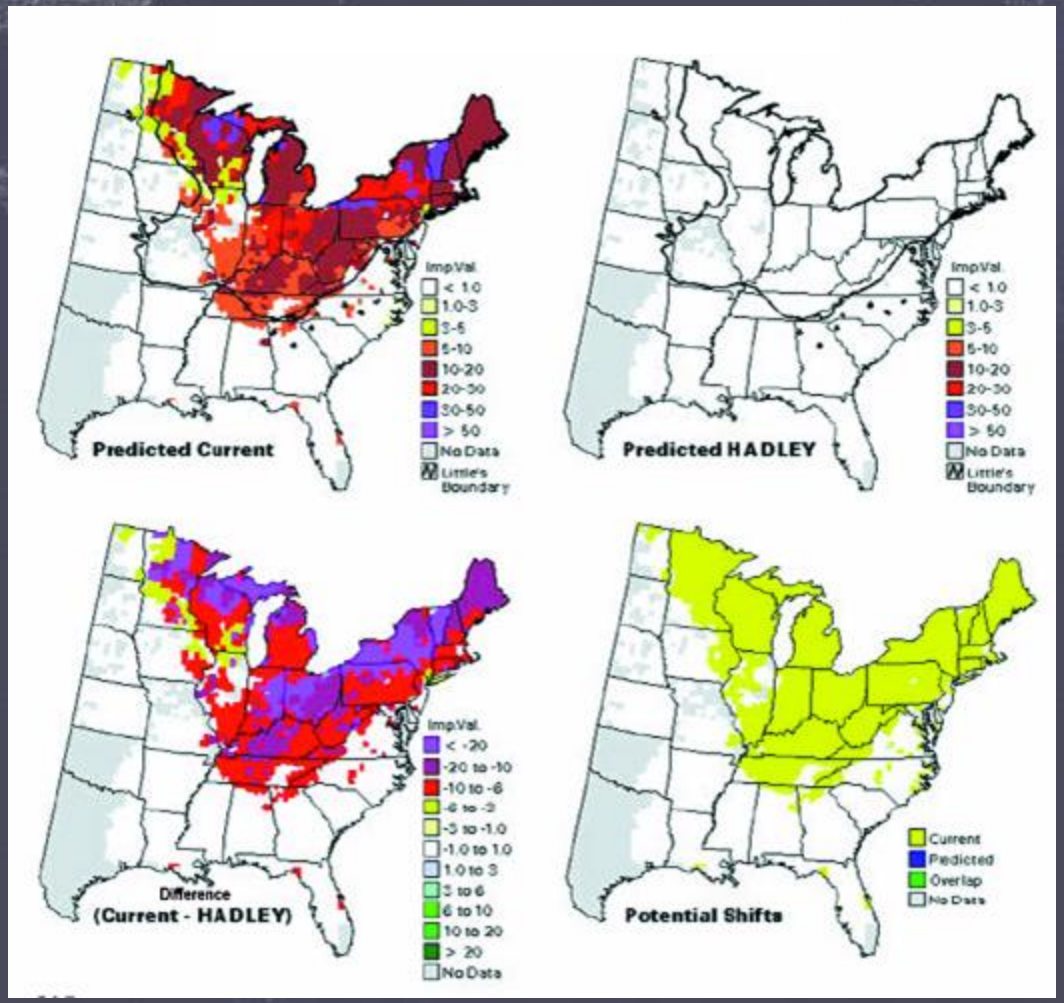


Hadley Model

- Tundra
- Taiga/Tundra
- Conifer Forest
- Northeast Mixed Forest
- Temperate Deciduous Forest
- Southeast Mixed Forest
- Tropical Broadleaf Forest
- Savanna/Woodland
- Shrub/Woodland
- Grassland
- Arid Lands

U.S. Global Change Research Program

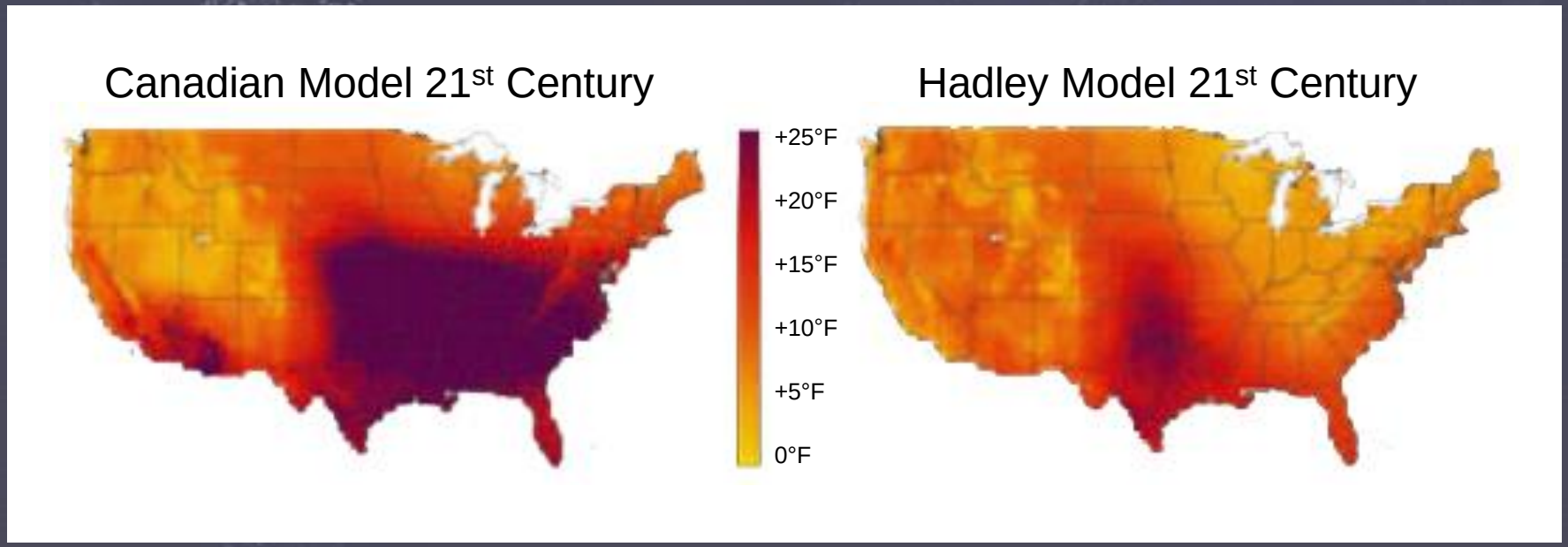
Projected Changes in Distribution of Sugar Maple Trees



Even Hadley model says no sugar maples in the U.S.

Iverson et al. 1999

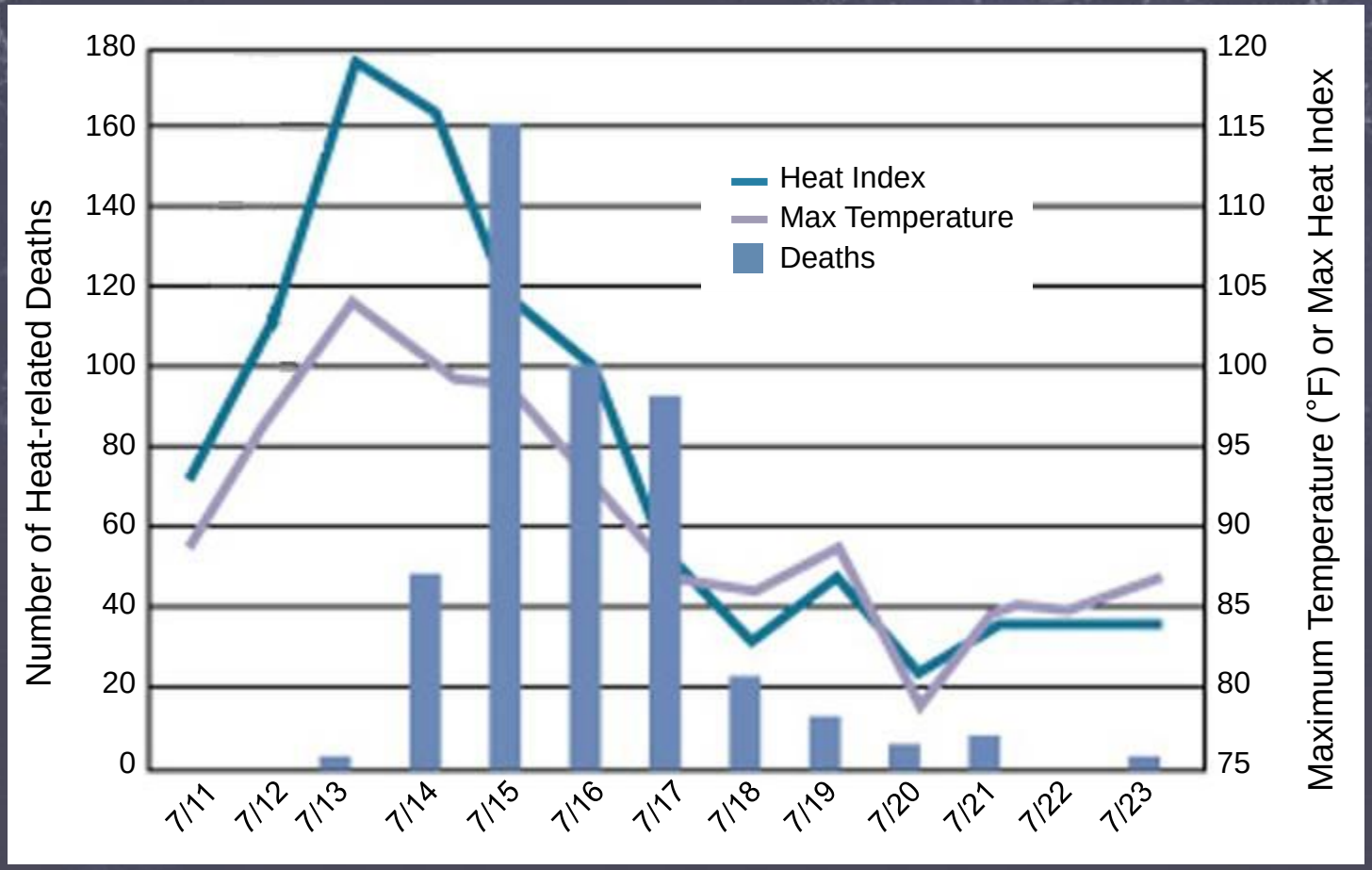
July Heat Index Change



B. Felzer, UCAR

Heat Mortality and Climate Change

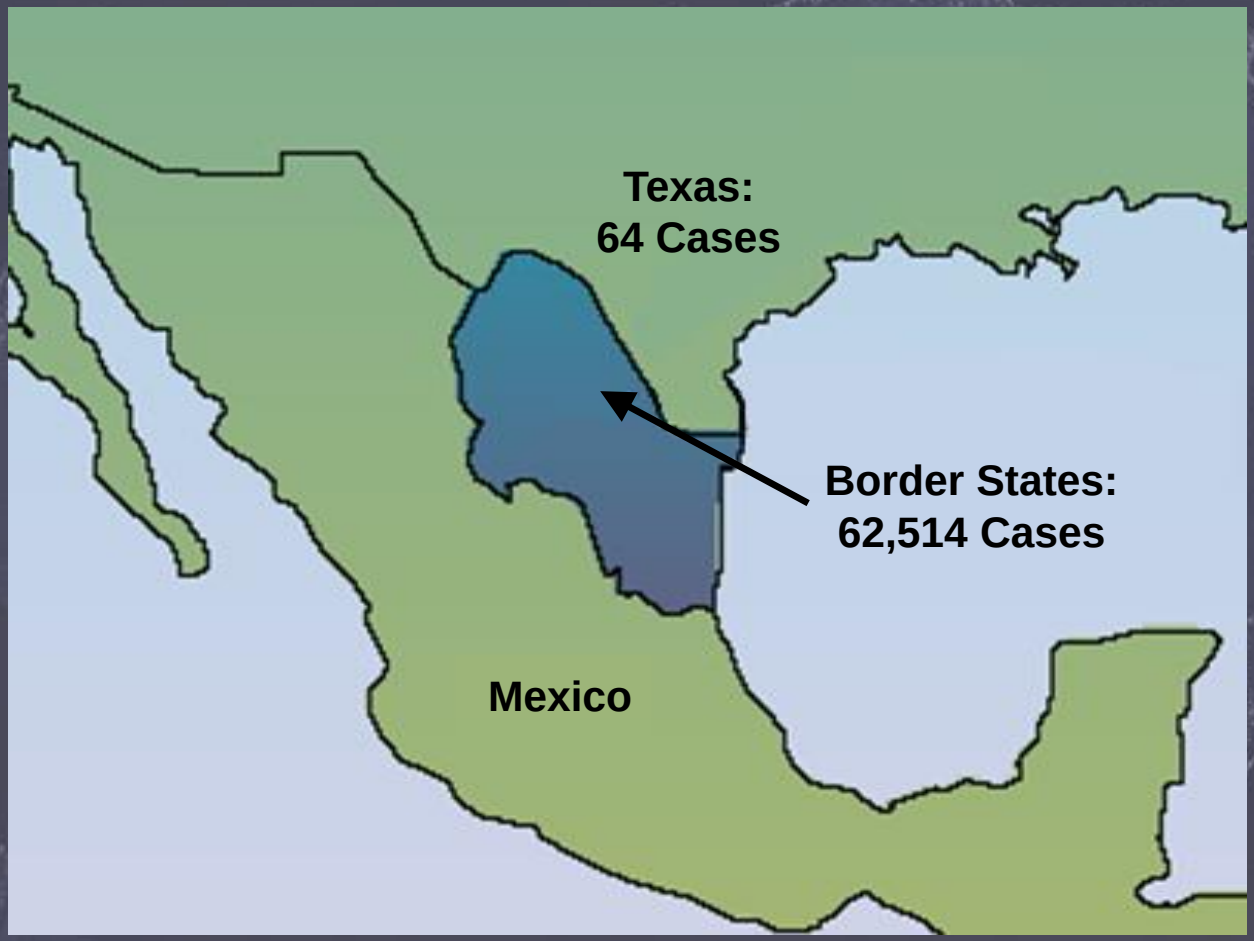
Heat-related deaths in Chicago in July 1995



NOAA/NCDC

Vector-borne Disease

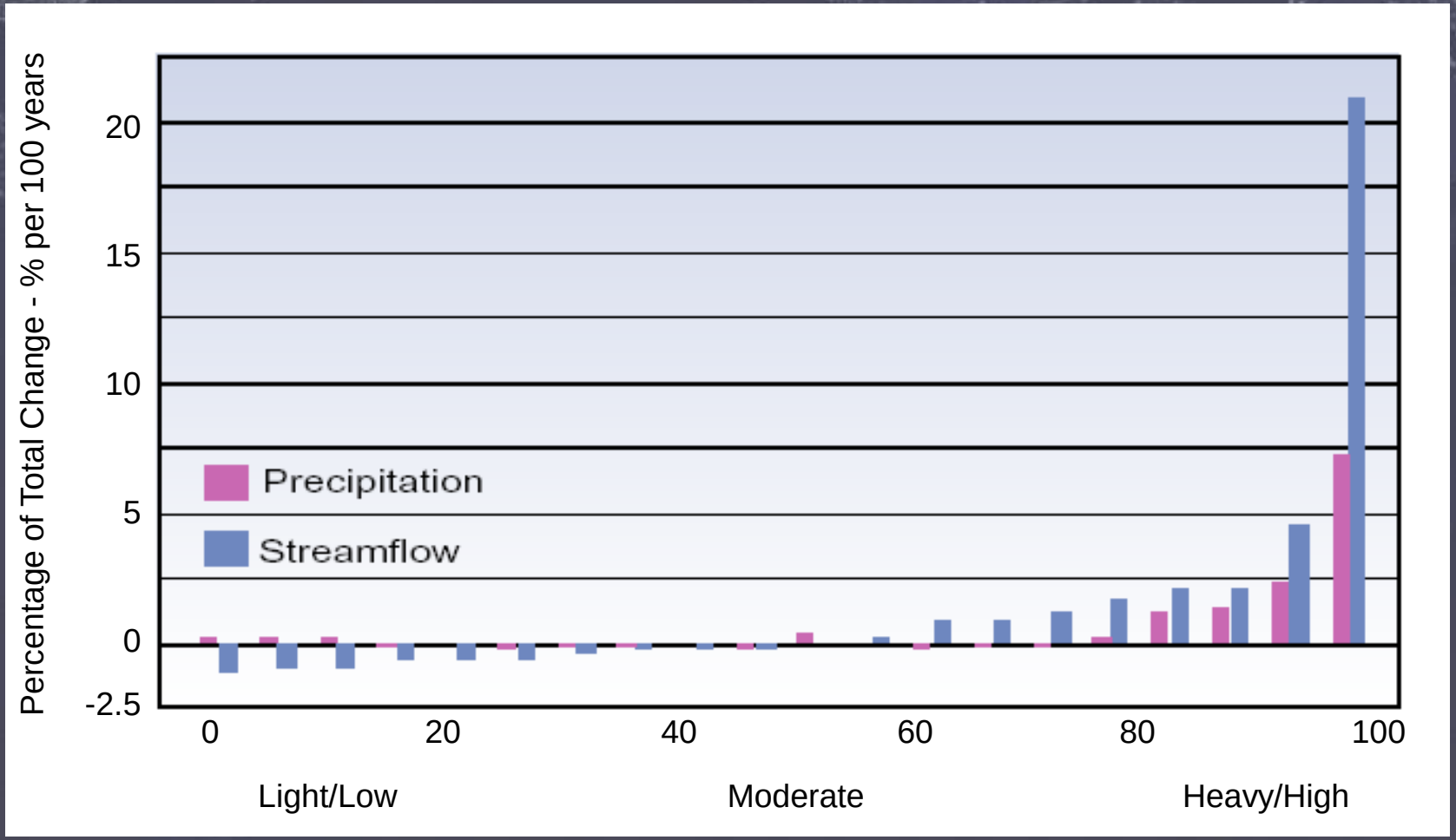
Reported Cases of Dengue 1980 - 1999



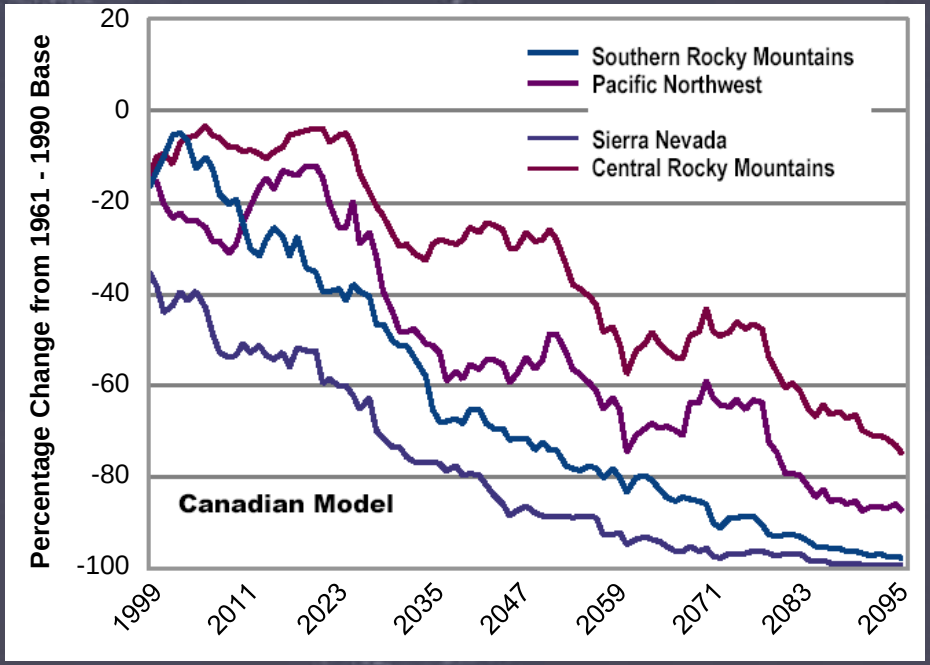
HIH, Mexico; TDH; U.S. PHS

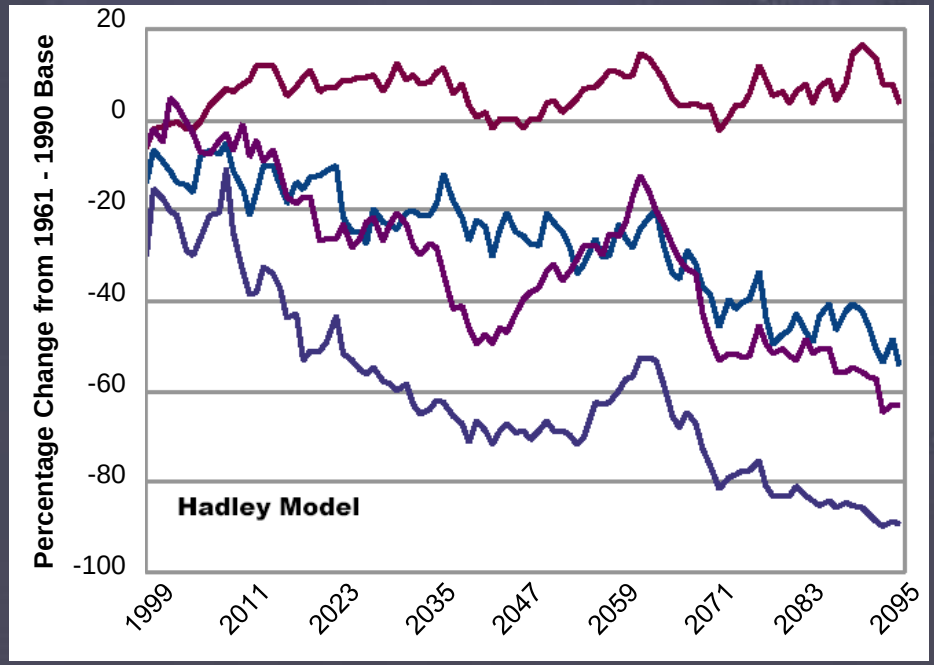
High Precipitation and "Flashy" Streams

Observed changes in streamflow and precipitation (1939-1999)



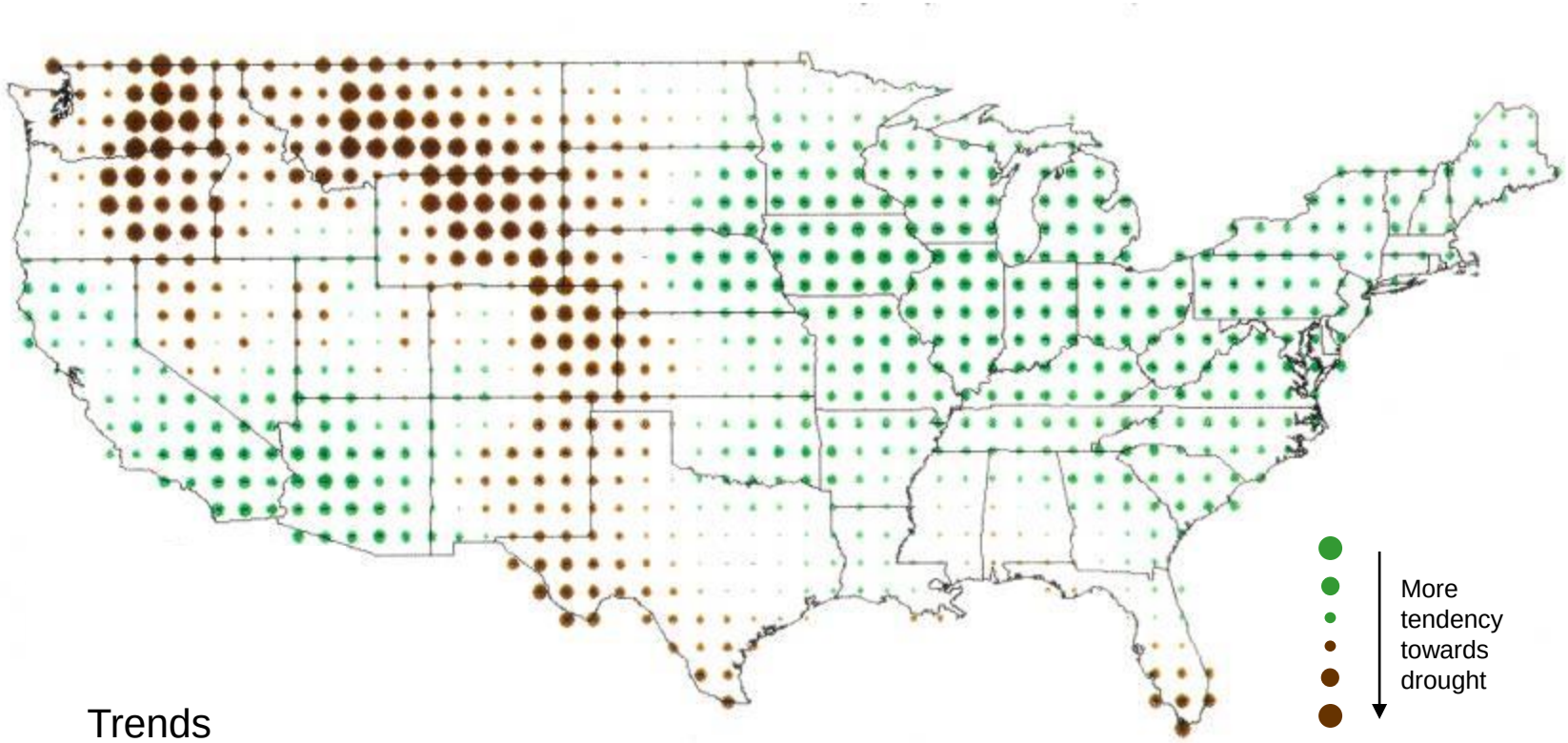
Changes in Western Snowpack





Projected Trends in the PDSI

21st Century Hadley Model



Trends
Palmer Drought
Severity Index / 100yr

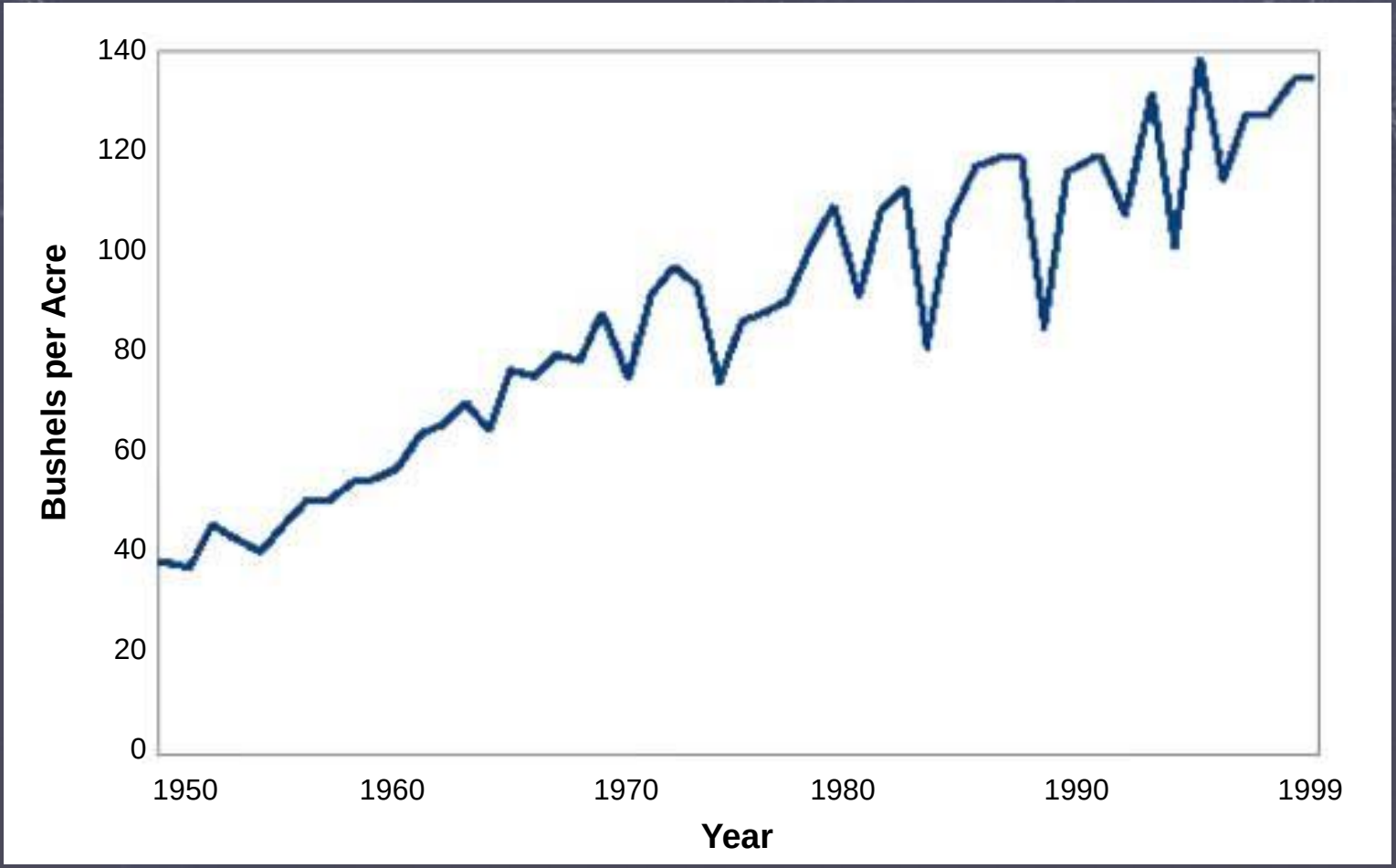
Projected Trends in the PDSI

21st Century Canadian Model

Trends
Palmer Drought
Severity Index / 100yr

Corn Yields and Weather Events

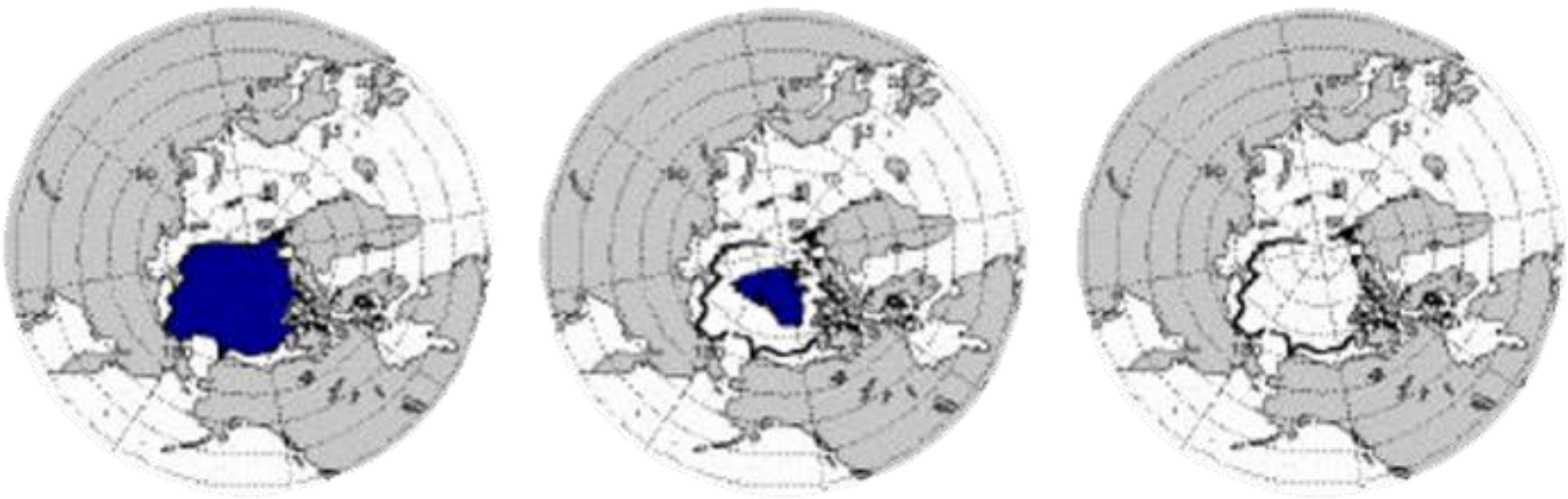
Corn Yields in U.S. 1950 - 1999



U.S. Global Change Research Program

Projected Summer Sea Ice Change

Canadian Model: An ice-free Arctic summer



U.S. Global Change Research Program

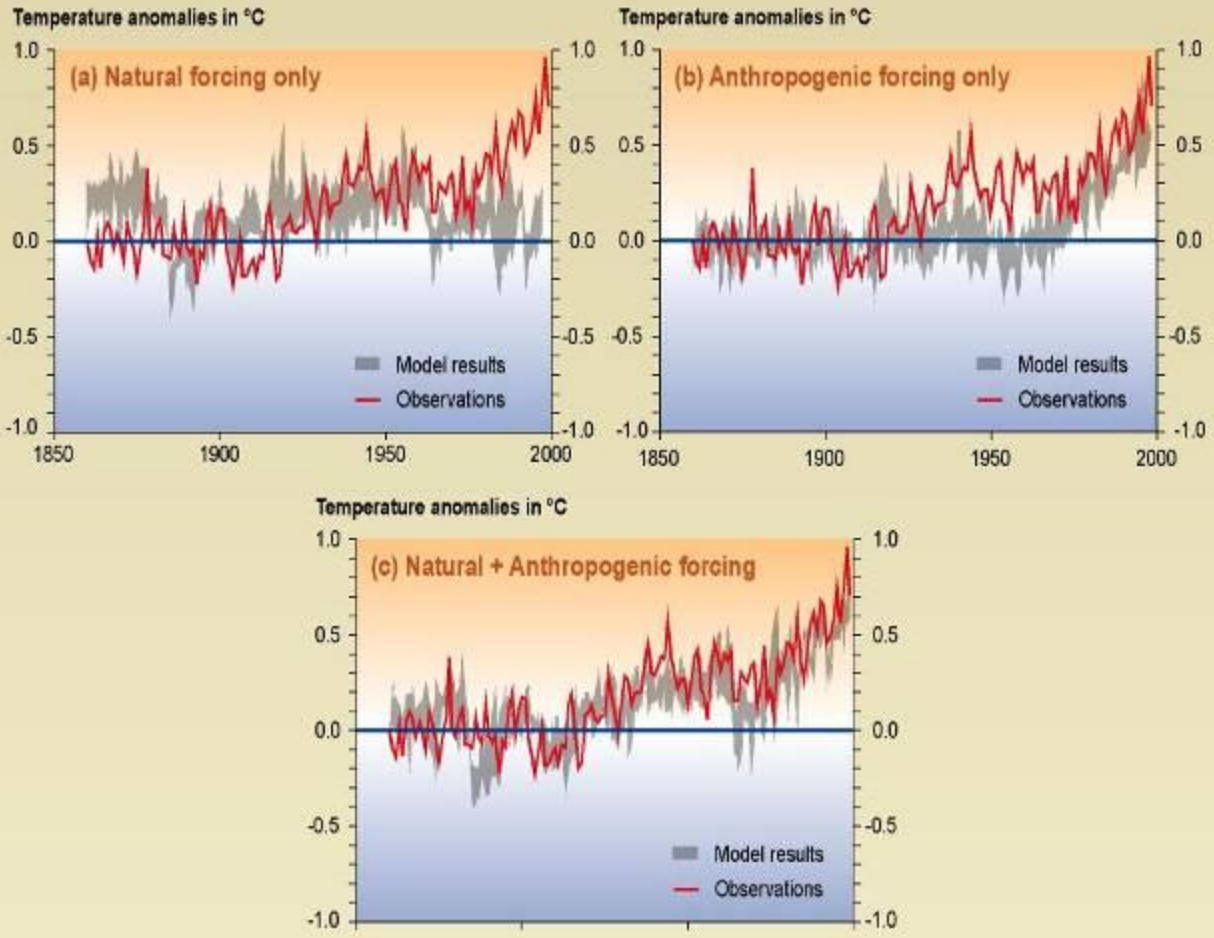
The Changing Debate on Global Warming

What do scientists really believe about global warming?

What are the predictions for the future?

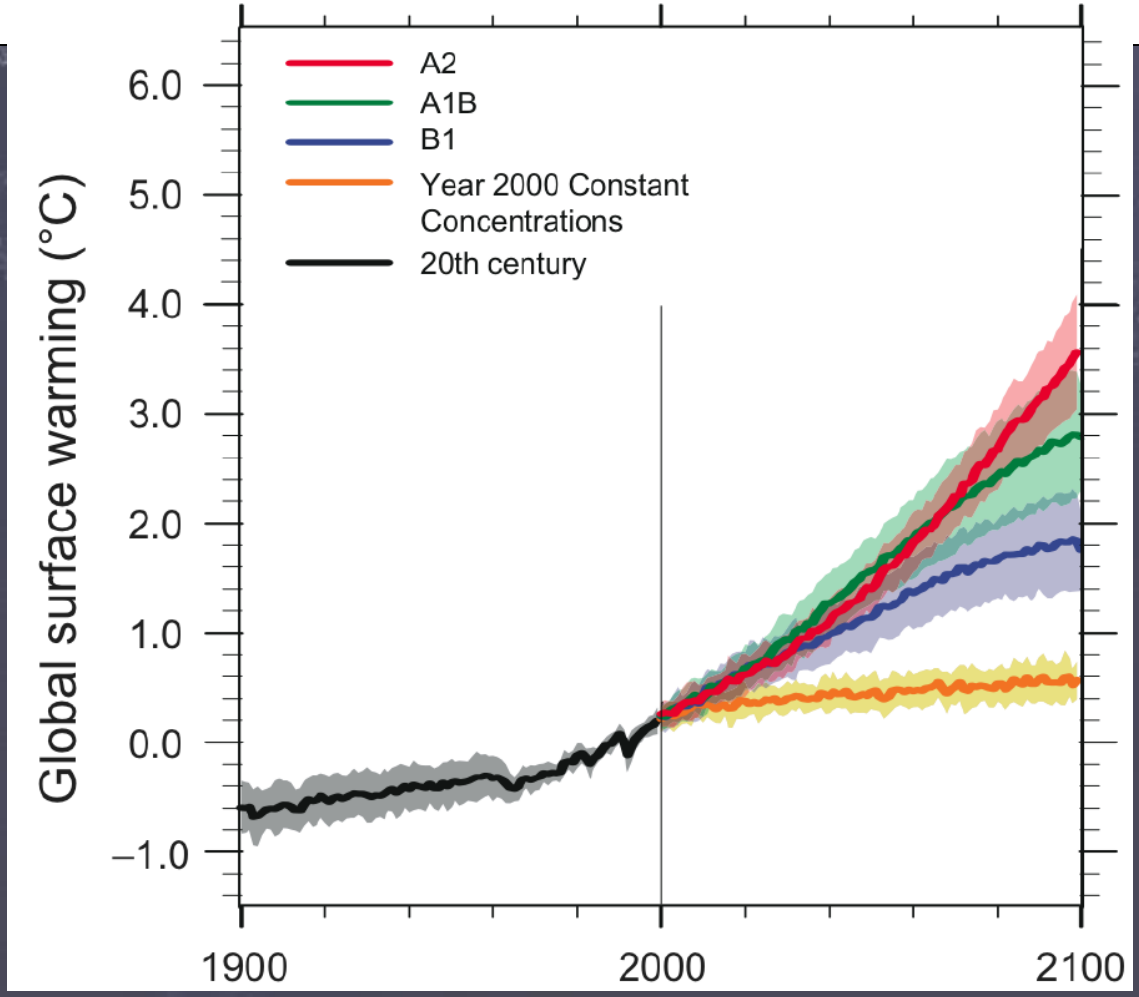
What are the potential impacts?

Comparison between modeled and observations of temperature rise since the year 1860



SYR - FIGURE 2-4

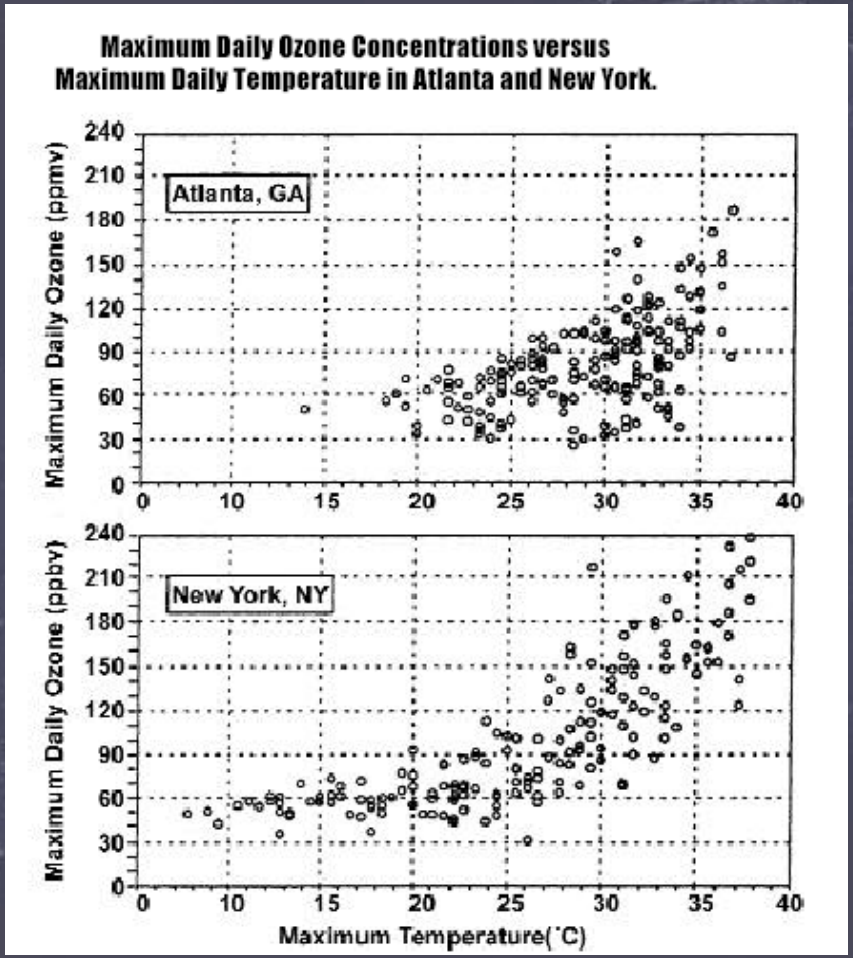
Uncertainty Grows with Time: **Emissions and Models**



1.1°C to 6.4°C

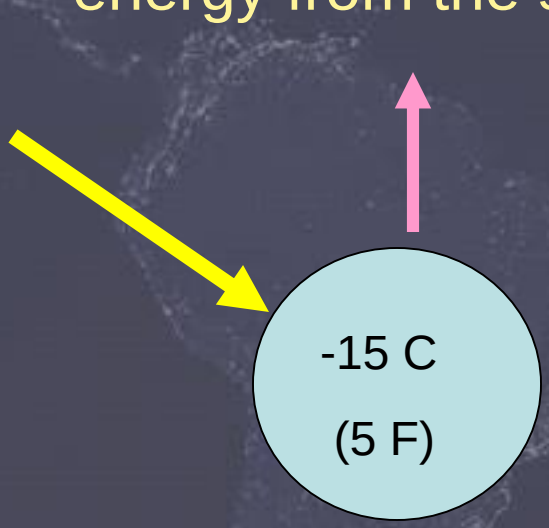
(2°F to 11.5°F)

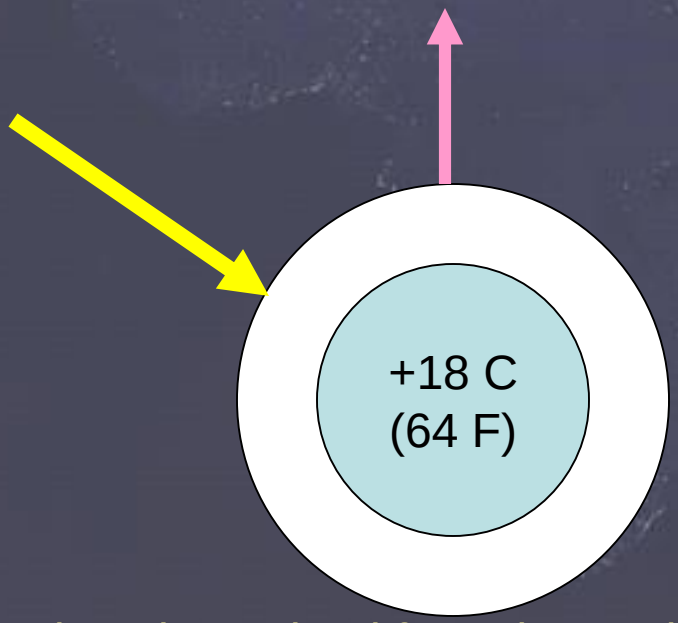
Air Quality and Climate Change



Every credible scientist recognizes that increases in greenhouse gases promotes warming

- The temperature of a planet is what it takes to have the heat radiated from the planet balance the incoming energy from the sun





Gases selectively absorb long wavelengths emitted from the earth and Radiate this energy in all directions including toward the surface

Dr. Eric J. Barron

Eric J. Barron is Dean of the Jackson School of Geosciences at The University of Texas at Austin, where he holds the Jackson Chair in Earth System Science. He began a career in geology as an undergraduate at Florida State University. His interest in geology and oceanography resulted in a master's degree (1976) and a doctorate (1980) in oceanography from the University of Miami.

In 2006, he joined The University of Texas at Austin as Dean of the recently formed Jackson School of Geosciences. Barron's research interests are in the areas of climatology, numerical modeling, and Earth history. During his career, he has worked diligently to promote the intersection of the geological sciences with the atmospheric sciences and the field of earth system science.

Barron is a fellow of the American Geophysical Union, the American Meteorological Society, and the American Association for the Advancement of Science. In 2002, he was named a fellow of the National Institute for Environmental Science at Cambridge University. In 2003, he received the NASA Distinguished Public Service Medal.