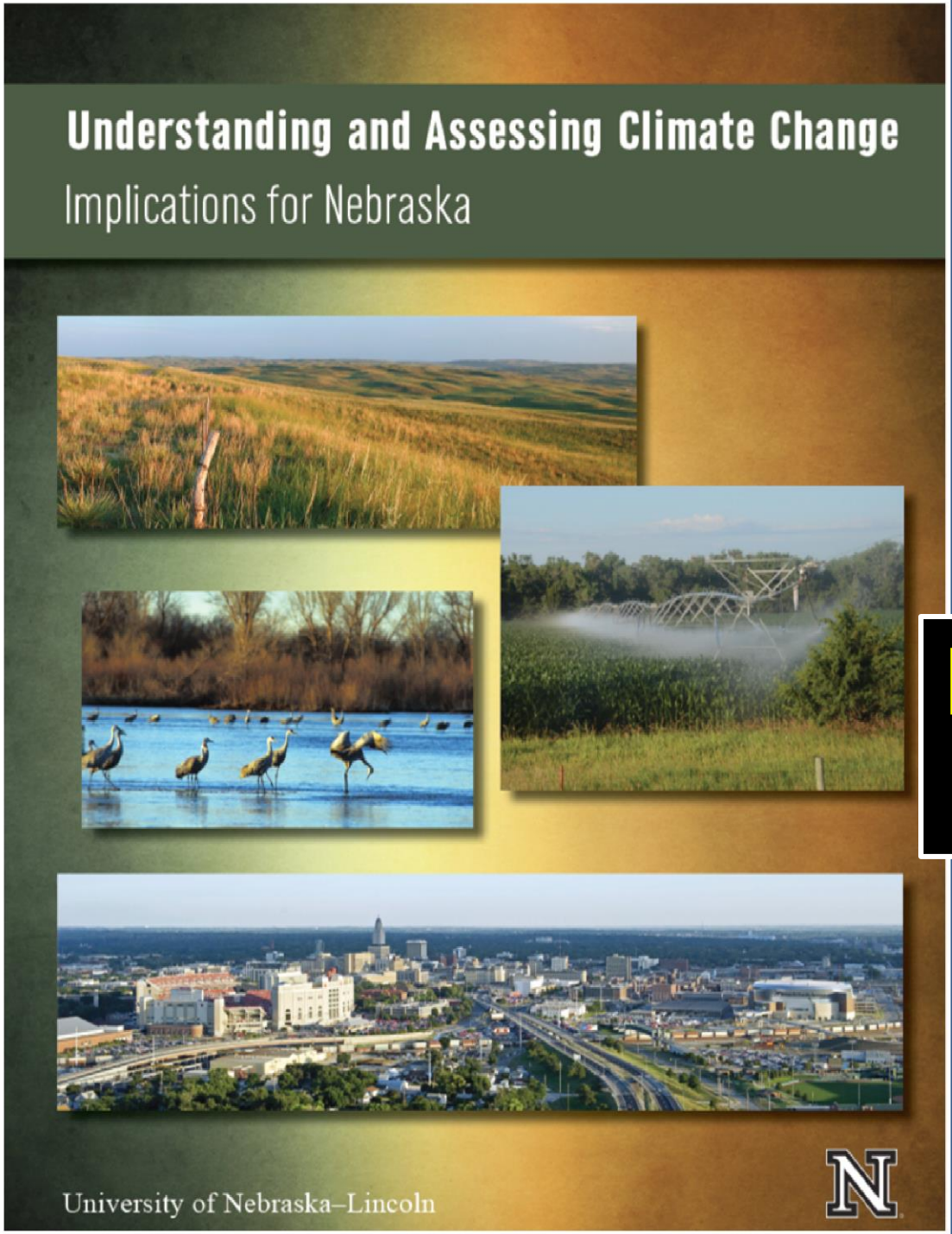
Understanding and Assessing Climate Change:

Implications for Nebraska

Donald A. Wilhite
School of Natural Resources
University of Nebraska-Lincoln

Team Members:
Deborah Bathke
Robert Oglesby
Clint Rowe



Copies of the report are available at

http://go.unl.edu/climatechange

Key Questions

- **Is the Earth's climate changing?**
- **Are 'humans' and their actions the primary cause?**
  - The evidence is overwhelming that the earth's climate is changing and that human actions are the primary cause.
  - **Drivers of change**
    - Increasing greenhouse gas concentrations in the atmosphere
    - Changes in land use
- **How do we respond?** Mitigation vs. Adaptation. Locally, nationally and globally

Most Used Climate Myths . . .

(Source: skepticalscience.com)

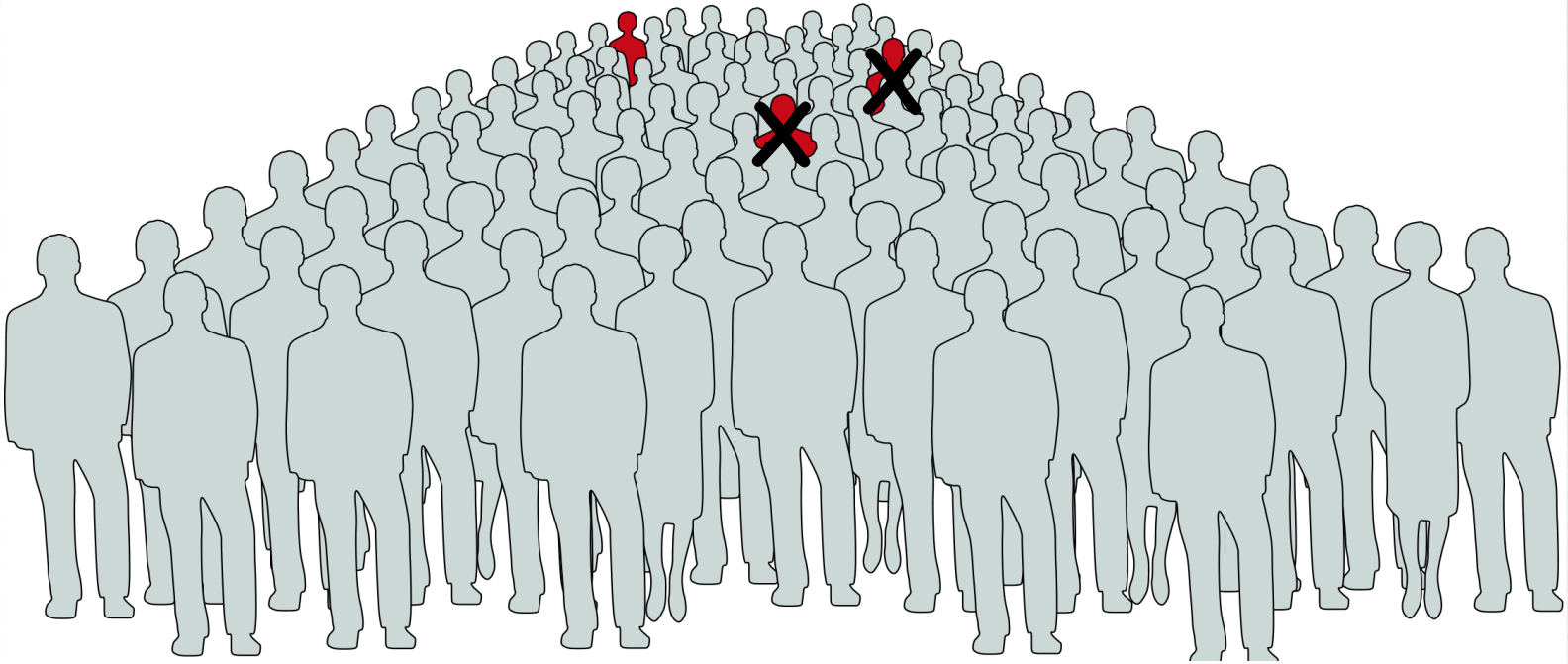
- Climate's have changed before, **BUT**. . .
- It's the sun.
- There's no consensus.
- It's cooling.
- Models are unreliable.
- Temperature record is unreliable.
- Animals and plants can adapt, **BUT**. . . .
- It hasn't warmed since 1998.
- Antarctica is gaining ice.

Everyone's entitled to their own opinion, but not their own facts!

Did you know that . . .

99.999%

~~97~~ ~~XX~~ out of 100 climate scientists conclude that **humans are changing global climate**



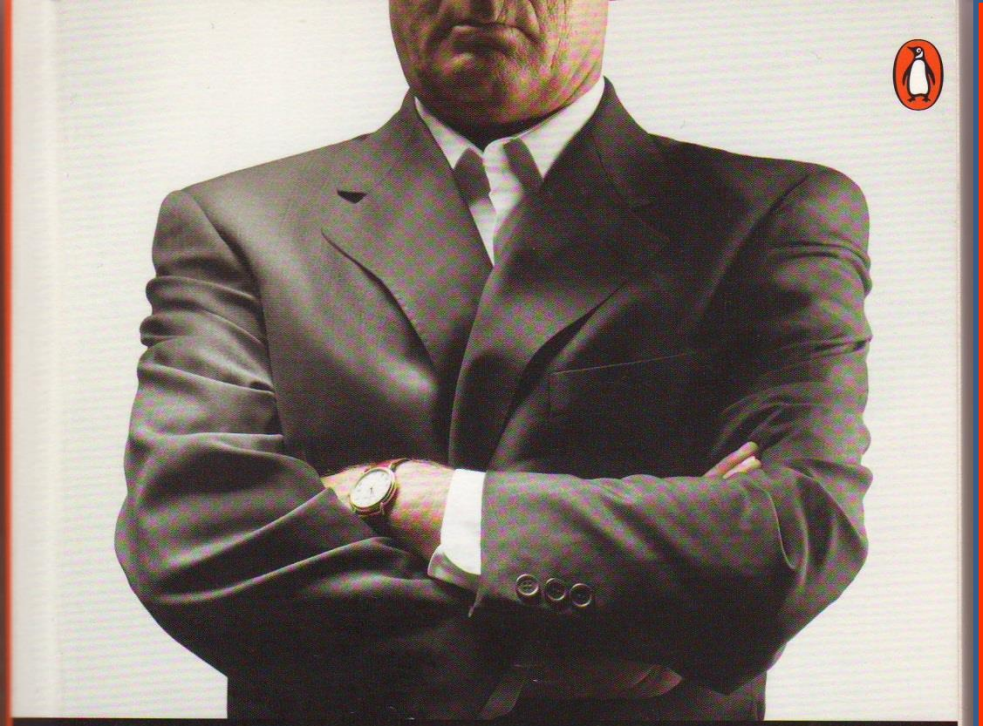
There is a significant misperception by the public about the scientific consensus that exists on this issue.

Five Truths About Climate Change (in 10 words)

Tony Leiserowitz, Yale University

- It's real.
- It's us.
- It's bad.
- Scientists agree.
- **There's hope!**

Addressing climate change is a moral issue now and for future generations! But, we must act **NOW**!



DENIALISM

How Irrational Thinking
Harms the Planet and Threatens Our Lives

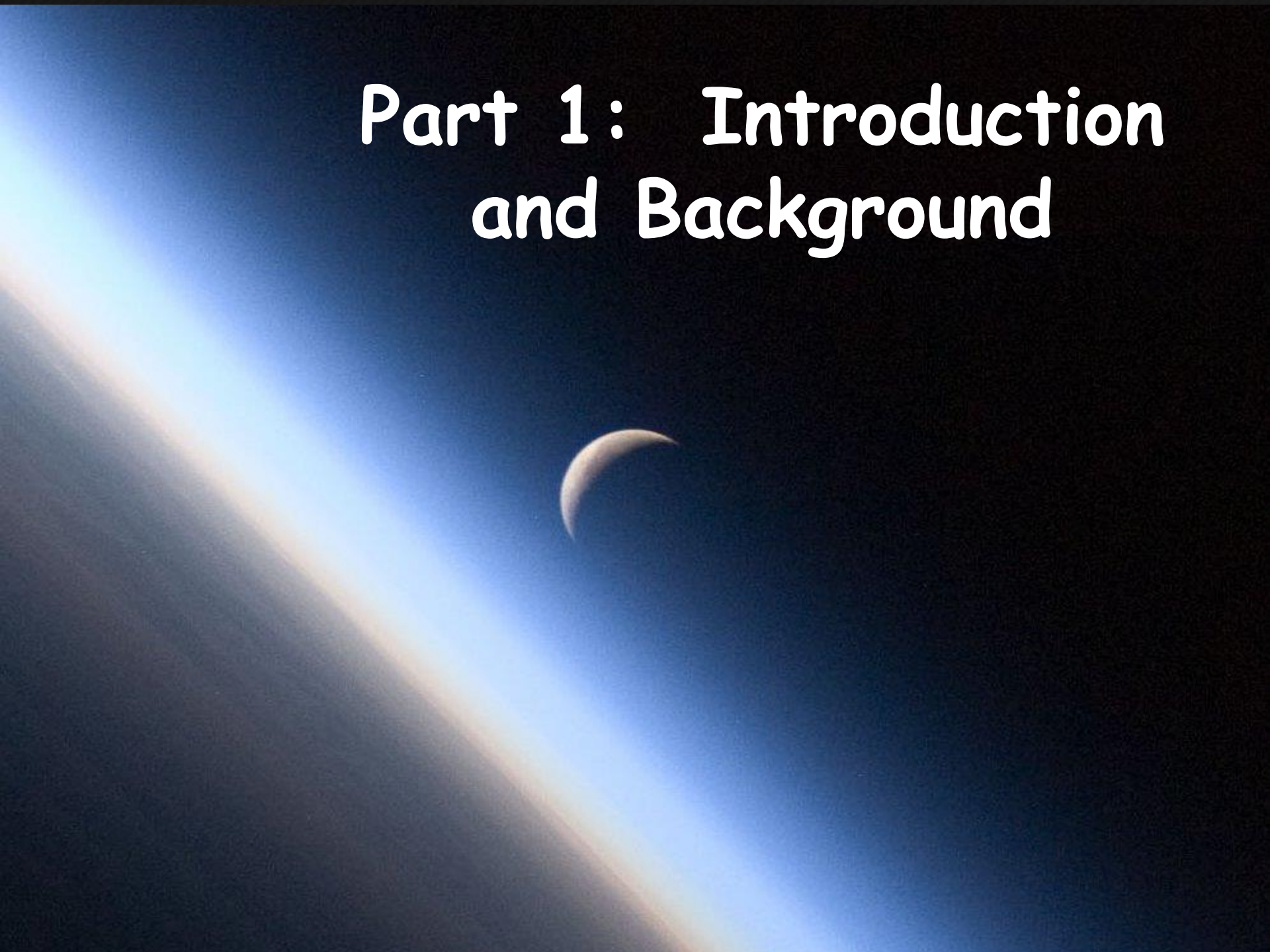
"A superb and convincing work." —MALCOLM GLADWELL,
author of *OUTLIERS, BLINK,* and *THE TIPPING POINT*

MICHAEL SPECTER

It's time to focus on the science, remove emotion and politics from the discussion and find solutions in response to a changing climate. The solutions include both adaptation and mitigation.

IKEA Job Interview

Part 1: Introduction and Background



Definitions

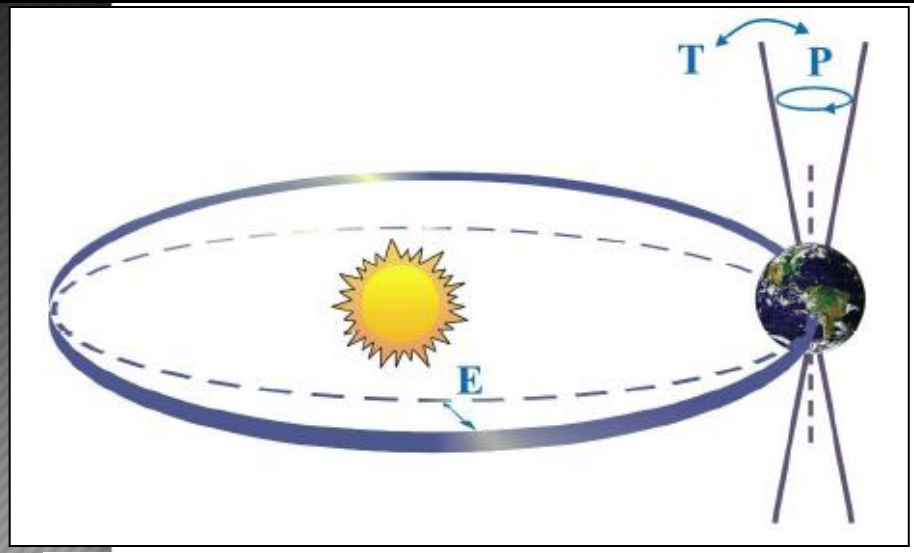
- **WEATHER**
  - The condition of the atmosphere at a particular place and time.
    - Sunny vs. cloudy, winds, temperature, precipitation, humidity, etc.
- **CLIMATE**
  - The composite or average of weather over a long period of time (30 years or longer)— **What are the trends?**
- ***"climate is what you expect, weather is what you get." (Mark Twain)***

Why is 'climate' important?

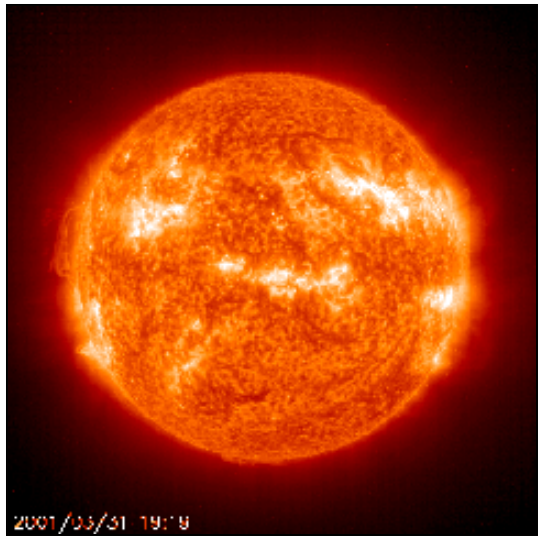
'stationarity vs. non-stationary of climate'


Part 2: Climate
Change Science

Natural forcings affecting climate

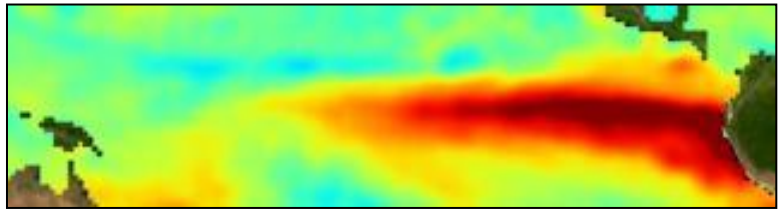


Variations in the Earth's orbit
(Milankovic effect)



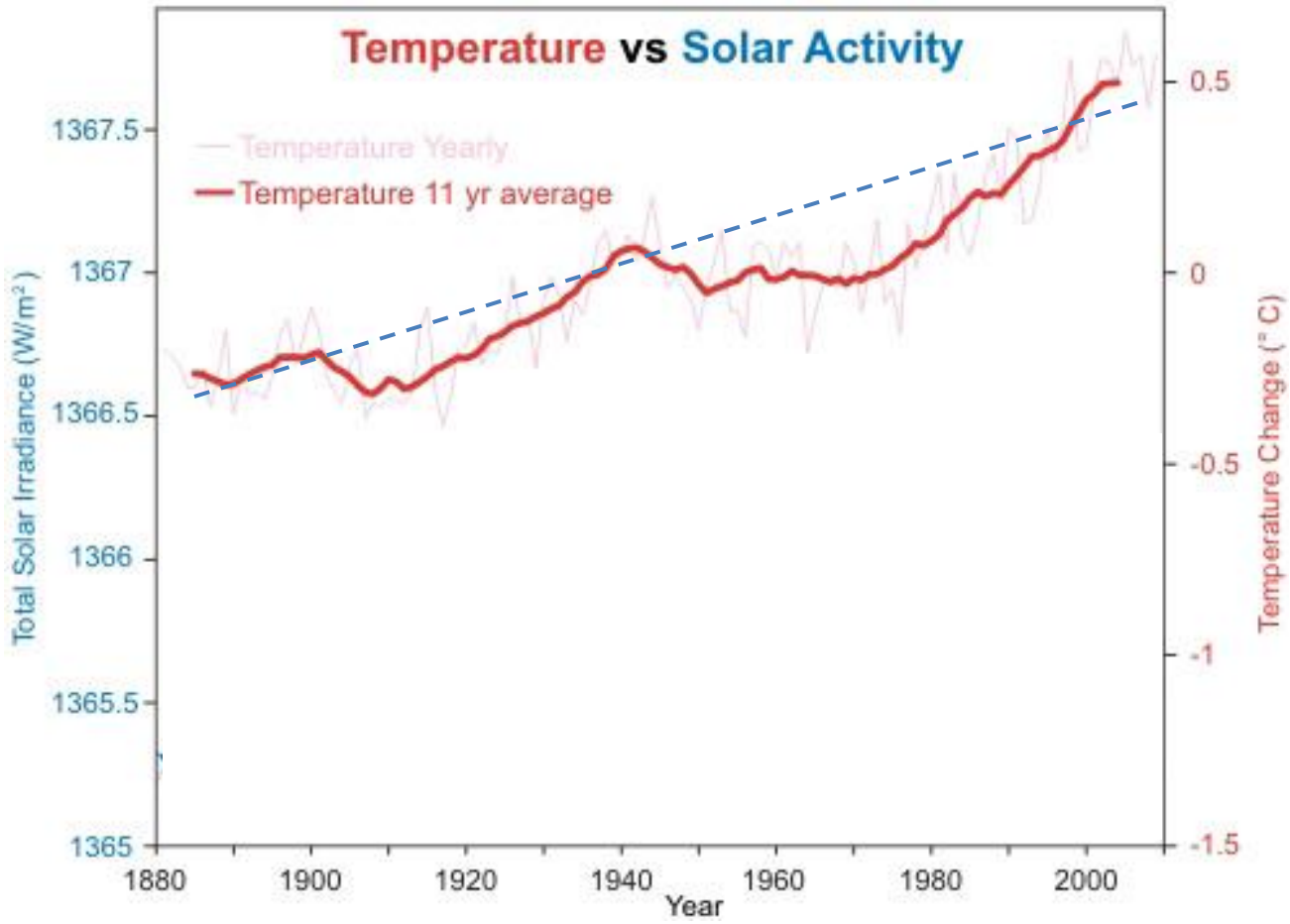
Variations in the energy
received from the sun

Stratospheric
aerosols from
energetic
volcanic eruptions



Chaotic interactions in
the Earth's climate
(e.g., El Nino, NAO)

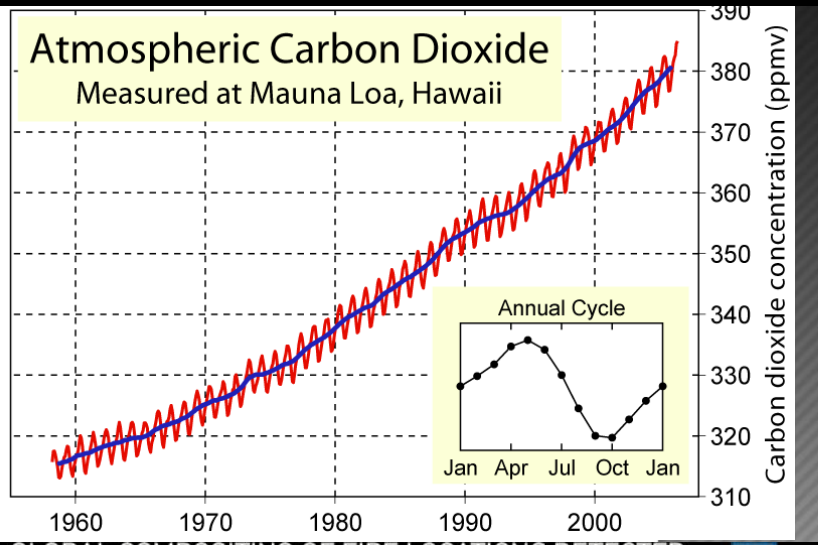
Temperature vs. Solar Activity



Source: NASA (temperature) and Krivova et al 2007 (solar)

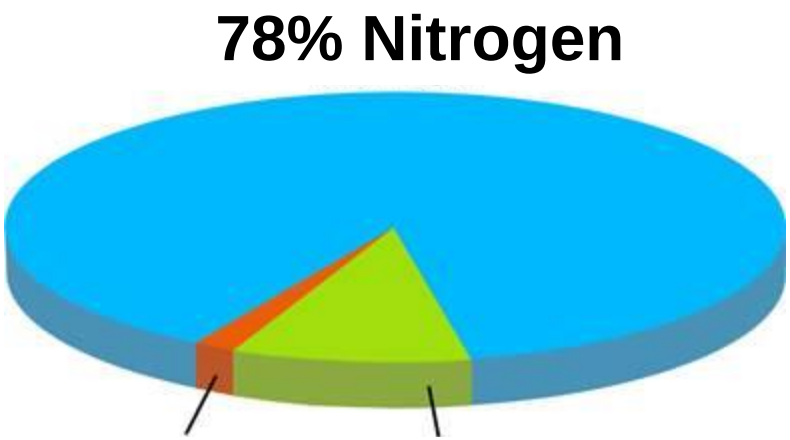
Anthropogenic forcings affecting climate

- **Changes in atmospheric concentrations of radiatively important gases, CO_2 and others**
- **Changes in aerosol particles from burning fossil fuels and biomass**
- **Changes in the reflectivity (albedo) of the Earth's surface due to land use changes**



Composition of the Earth's Atmosphere

- Nitrogen (78%)
- Oxygen (21%)
- ***Carbon Dioxide (CO_2) and other trace gases (1%)***
  - ***Methane***
  - ***Nitrous Oxide***
  - ***Water Vapor***



Without these GHGs, the earth's surface temperature would be about 57°F cooler.

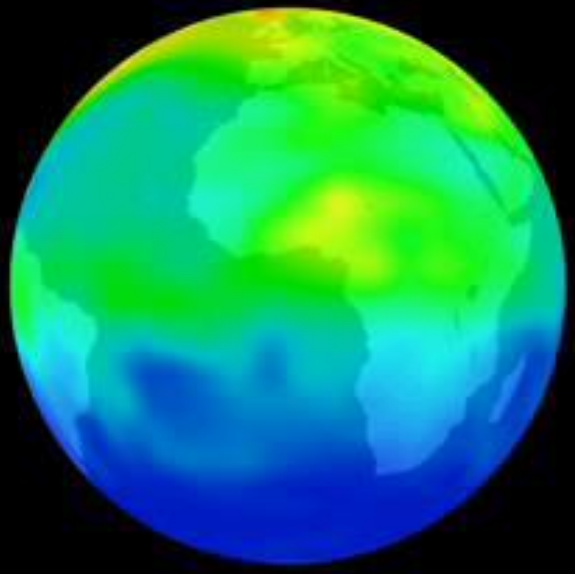
GHGs are the heat regulators for the Earth.

Earth's Energy Balance

Sunlight

Visible Radiation

235 Watts per square meter (Wm-2)



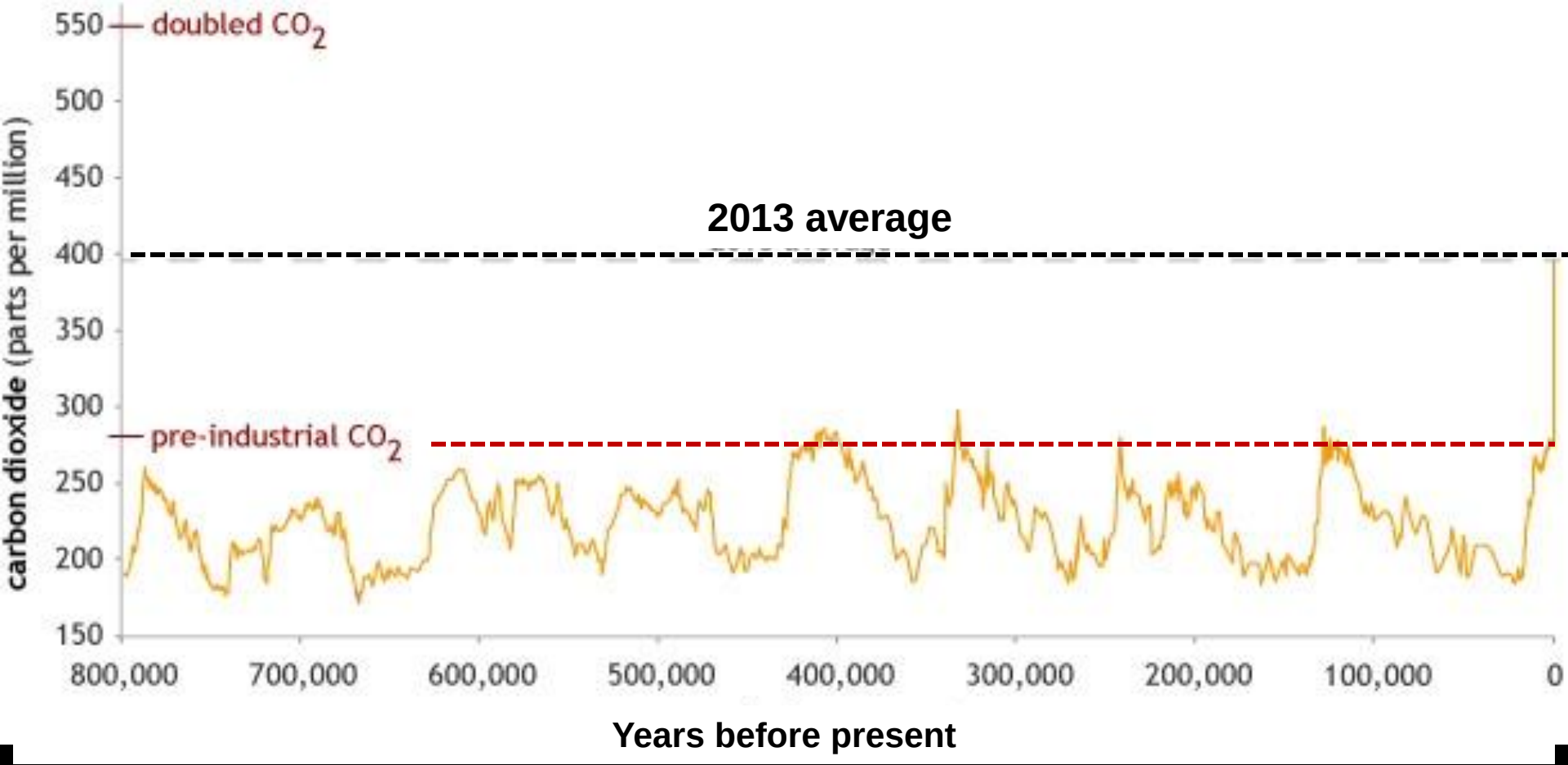
Heat

Infrared Radiation

235 Watts per square meter (Wm-2)

When energy IN = energy OUT, climate is in balance i.e., steady state

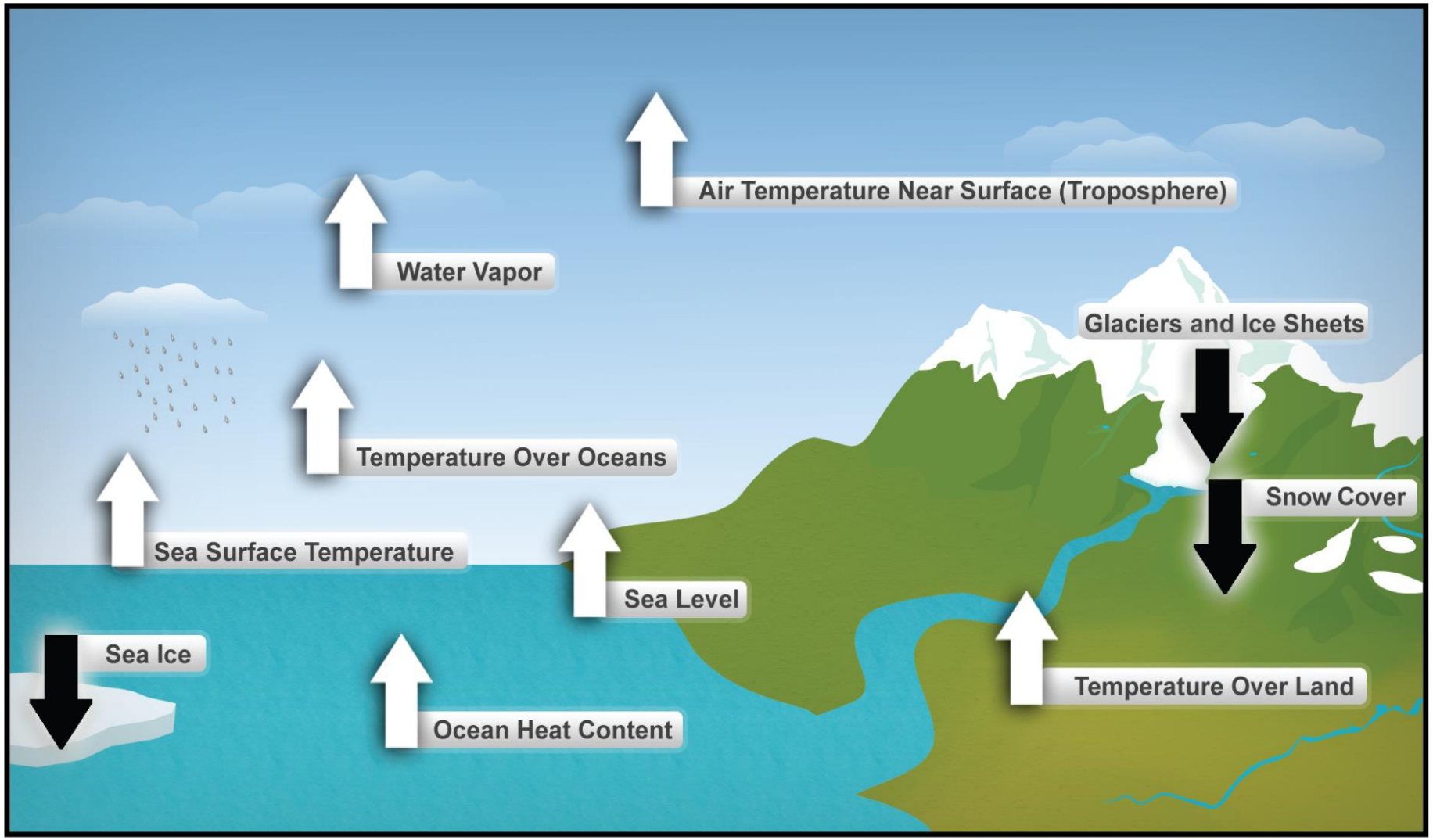
CO_2 Concentrations—800,000 years before present (ppm)



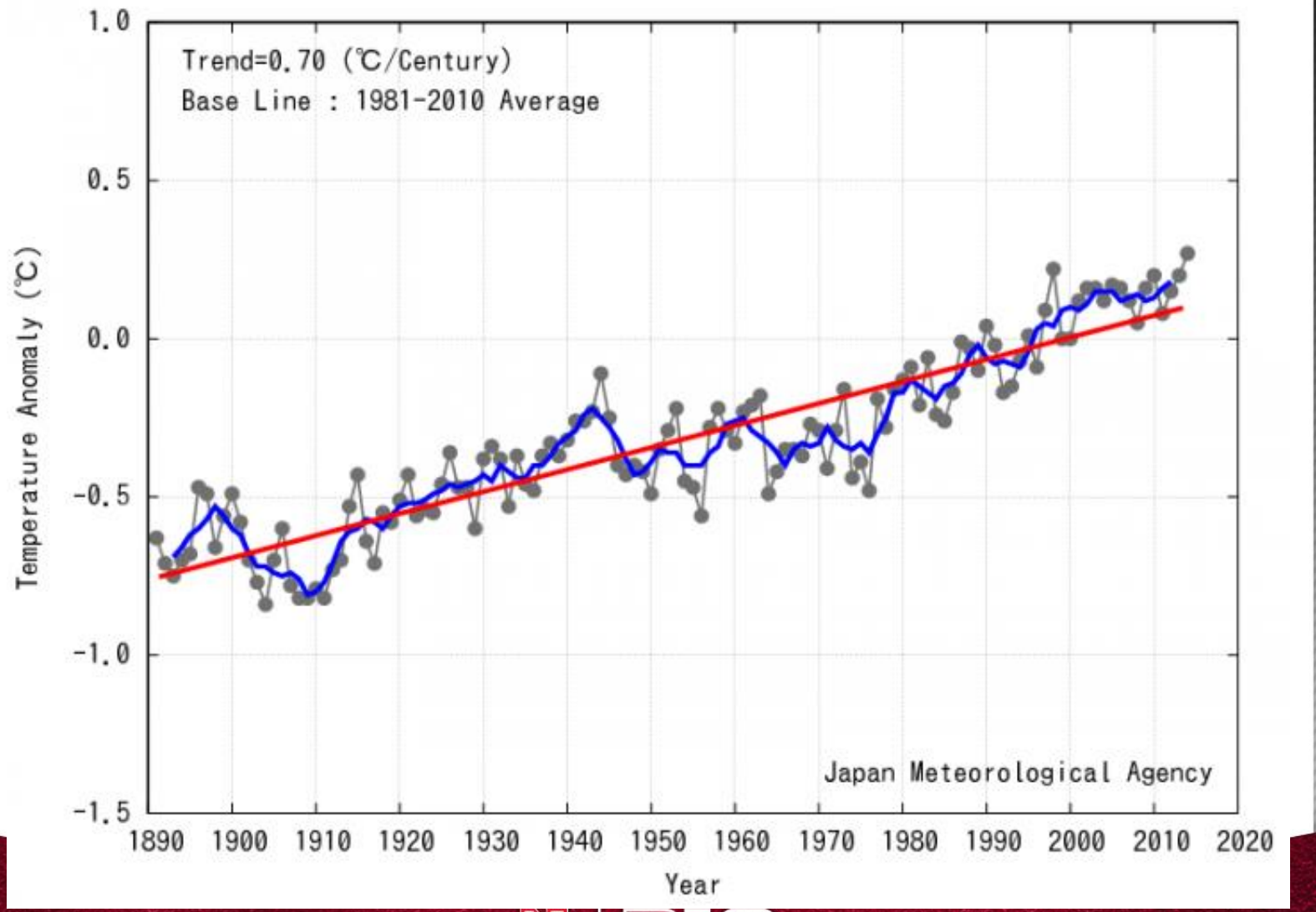
Part 3: Observed Changes in Climate

If global climate is changing . .

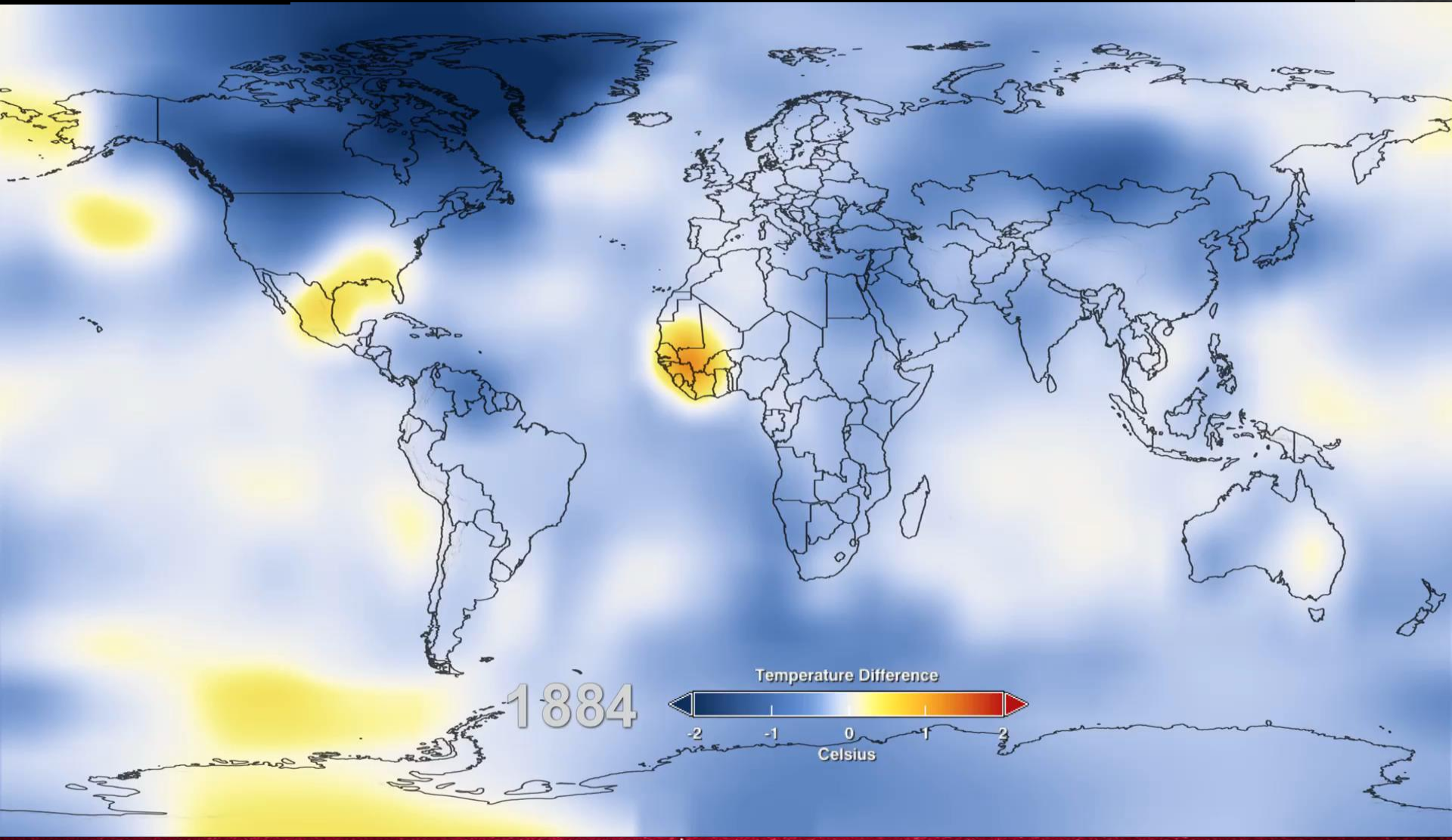
Ten indicators of a warming world



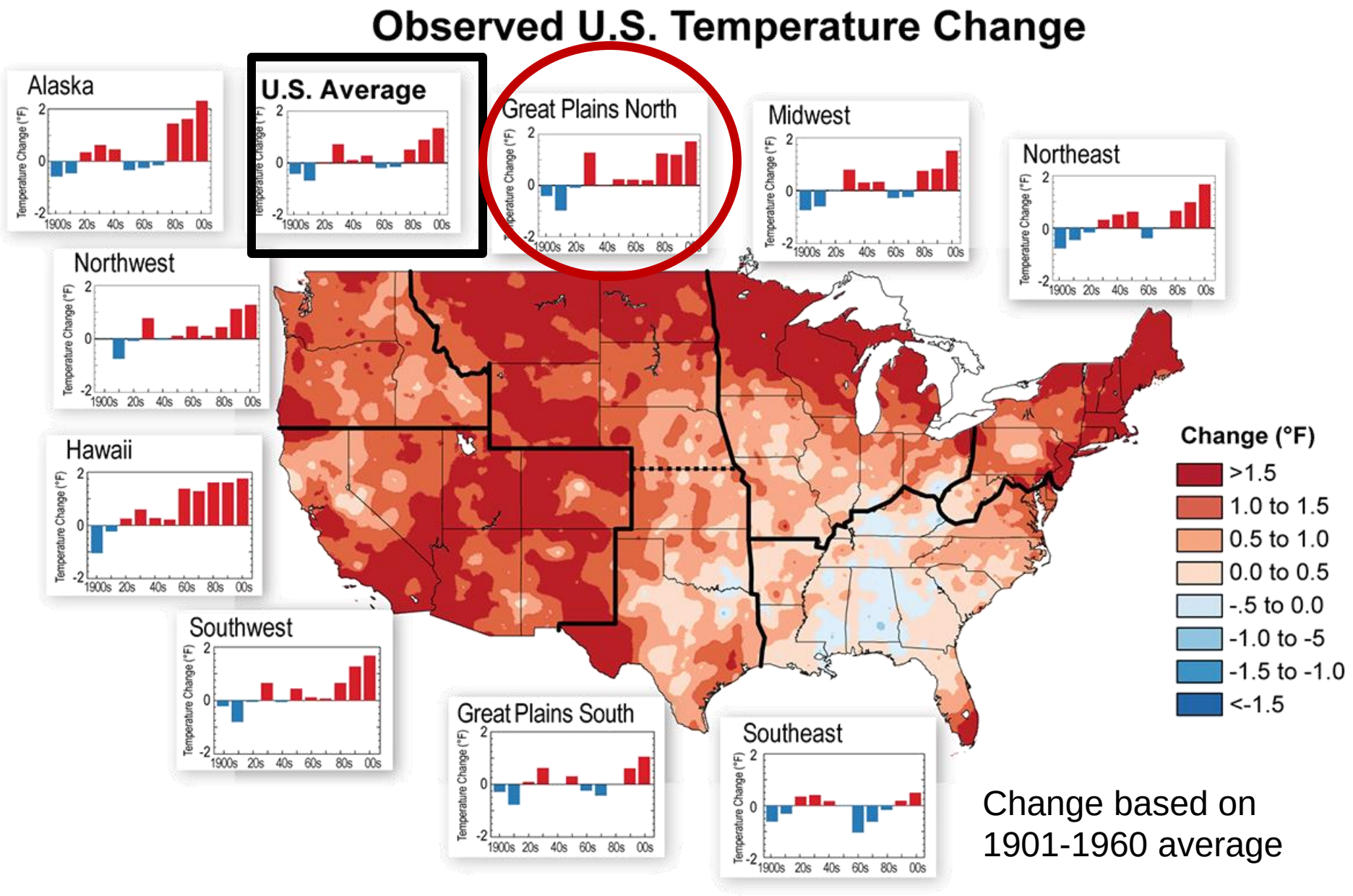
Average Global Annual Temperature, 1880-present



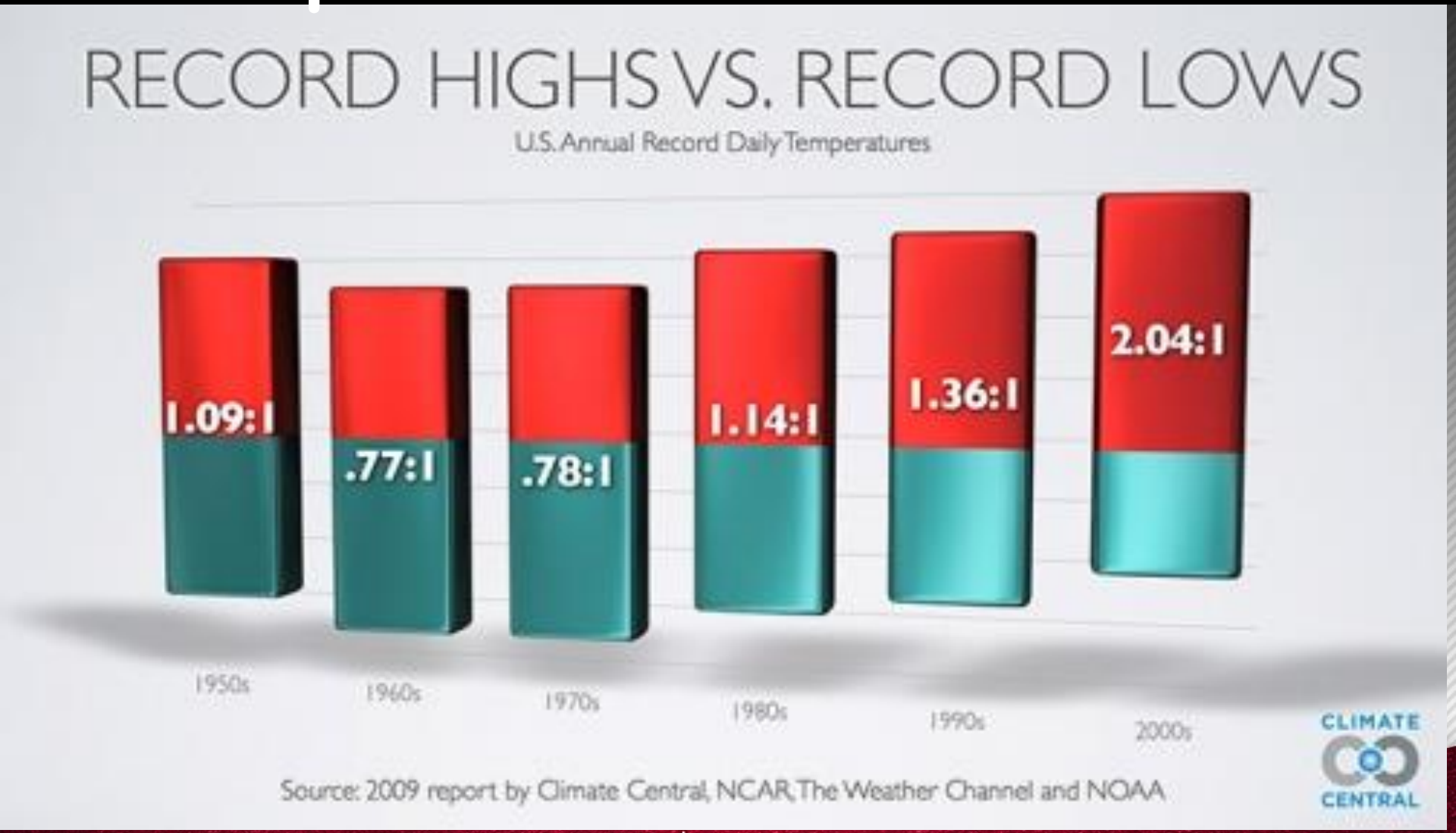
Global Temperatures (1884 – 2012)



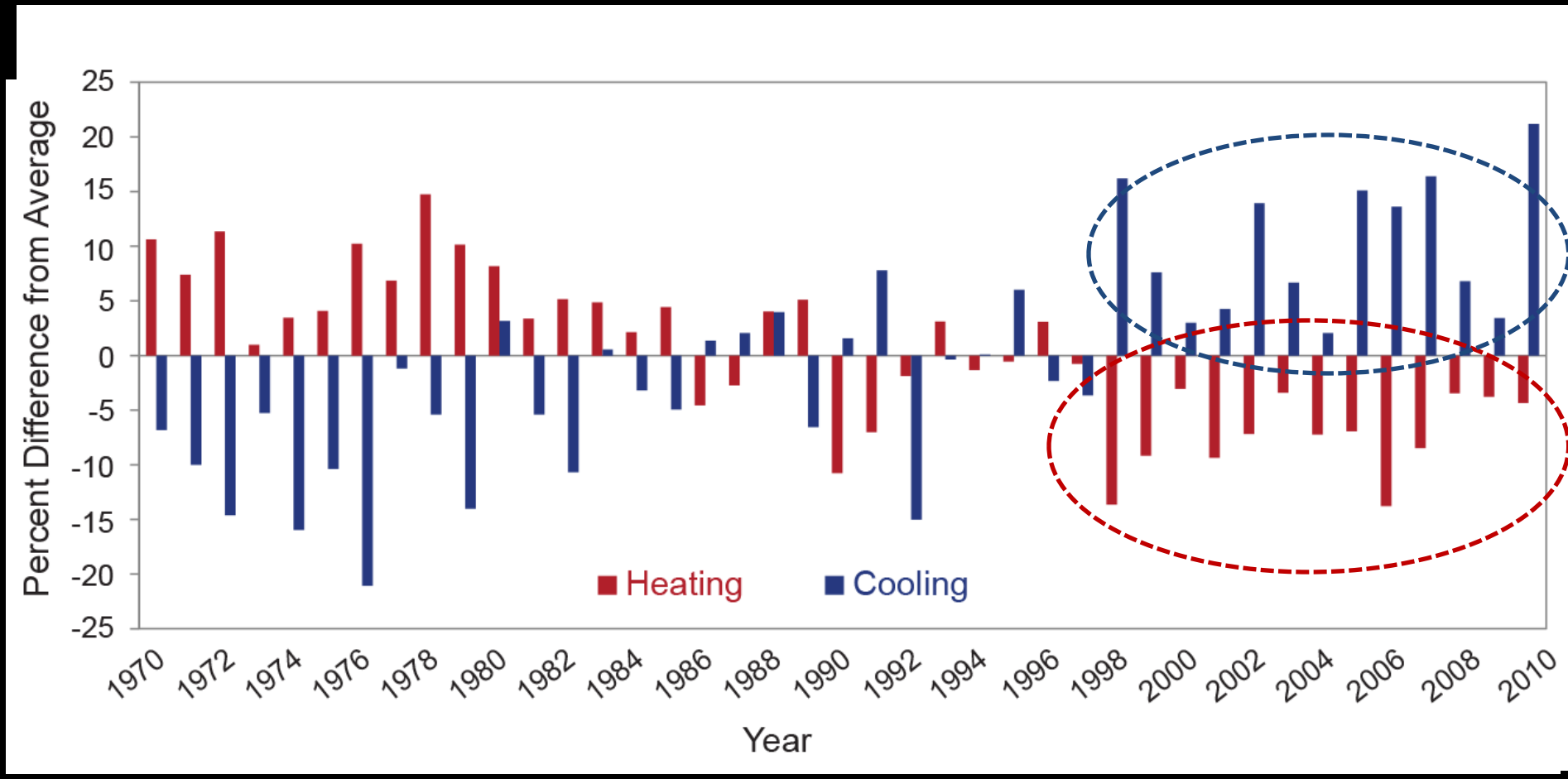
Change is apparent across the U.S.



Ratio of Record Daily High Temperatures to Record Lows



Decrease in Heating Demand and Increase in Cooling Demand



Plant hardiness zones are shifting toward the poles as the climate changes

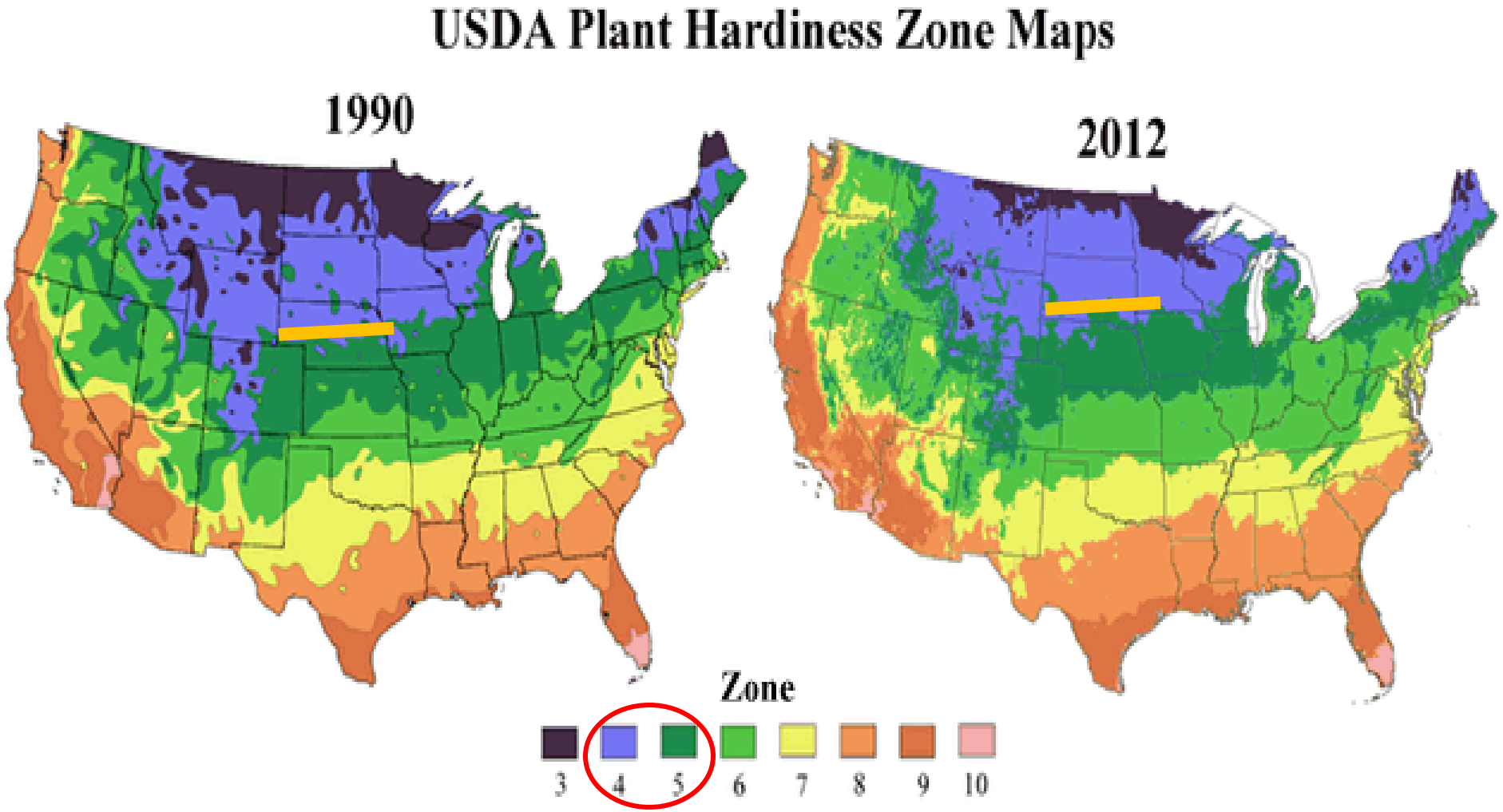


Figure 1. Comparison of the 1990 and 2012 USDA Plant Hardiness Zone Maps. Image credit: USDA and Arbor Day Foundation.

Observed Changes in Nebraska's Climate

- Minor increase in annual mean temperature, mostly since the 1970s
- Warmer winters, especially higher nighttime temperatures
- Longer growing season—average 2 weeks
- More intense rainfall events, especially in eastern Nebraska
- Annual precipitation—slight increase or decrease depending on location
- More dramatic changes in the decades ahead

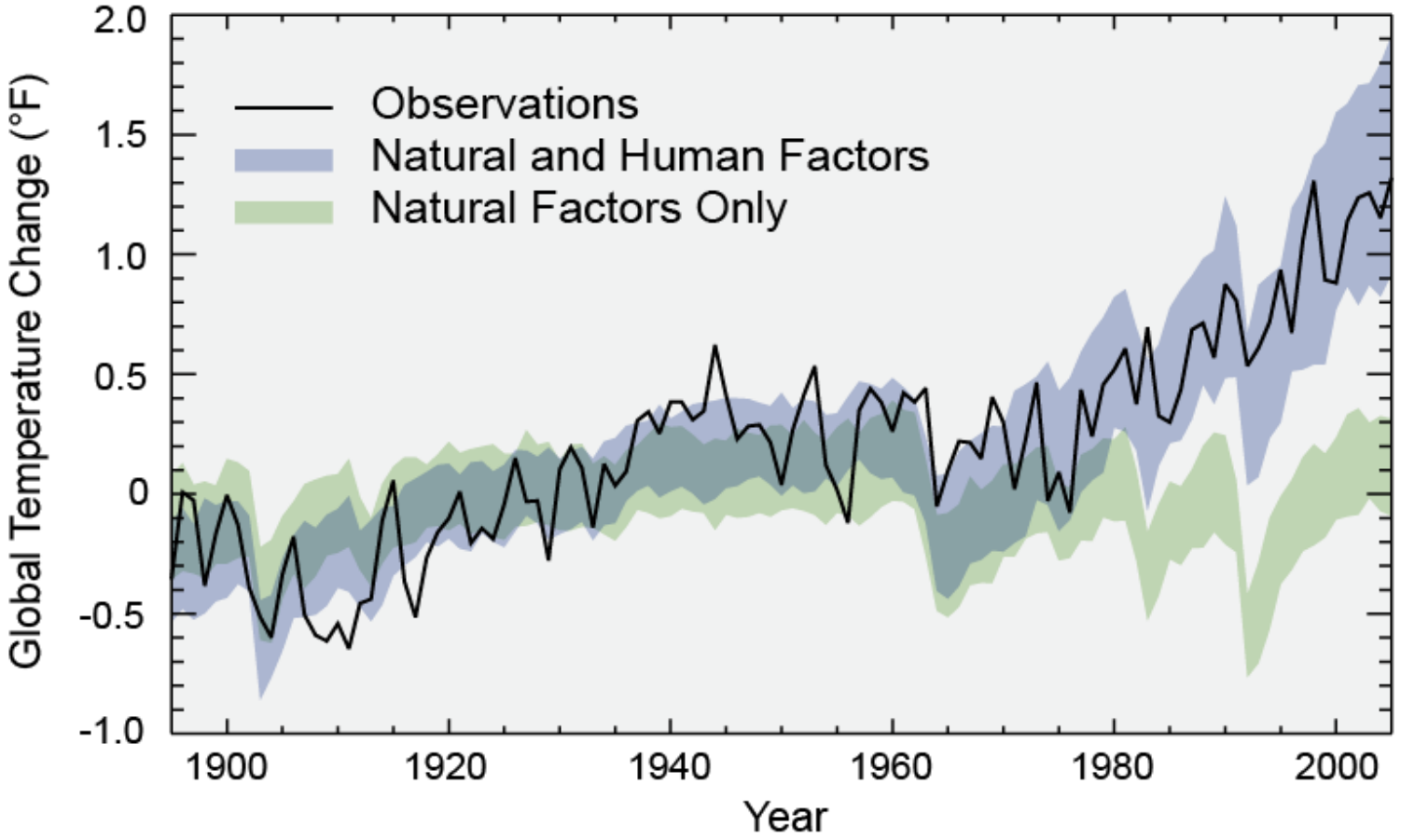
Higher Education's Response to Climate Change

- Mitigation vs. Adaptation
  - Reducing carbon emissions
  - Adapting to a changing climate
- Recruitment: The importance of a 'green' campus
- Programs, curriculum and majors
- Campus image: Role model for the community—stewardship of natural resources

Part 4: Separating Natural from Human Factors

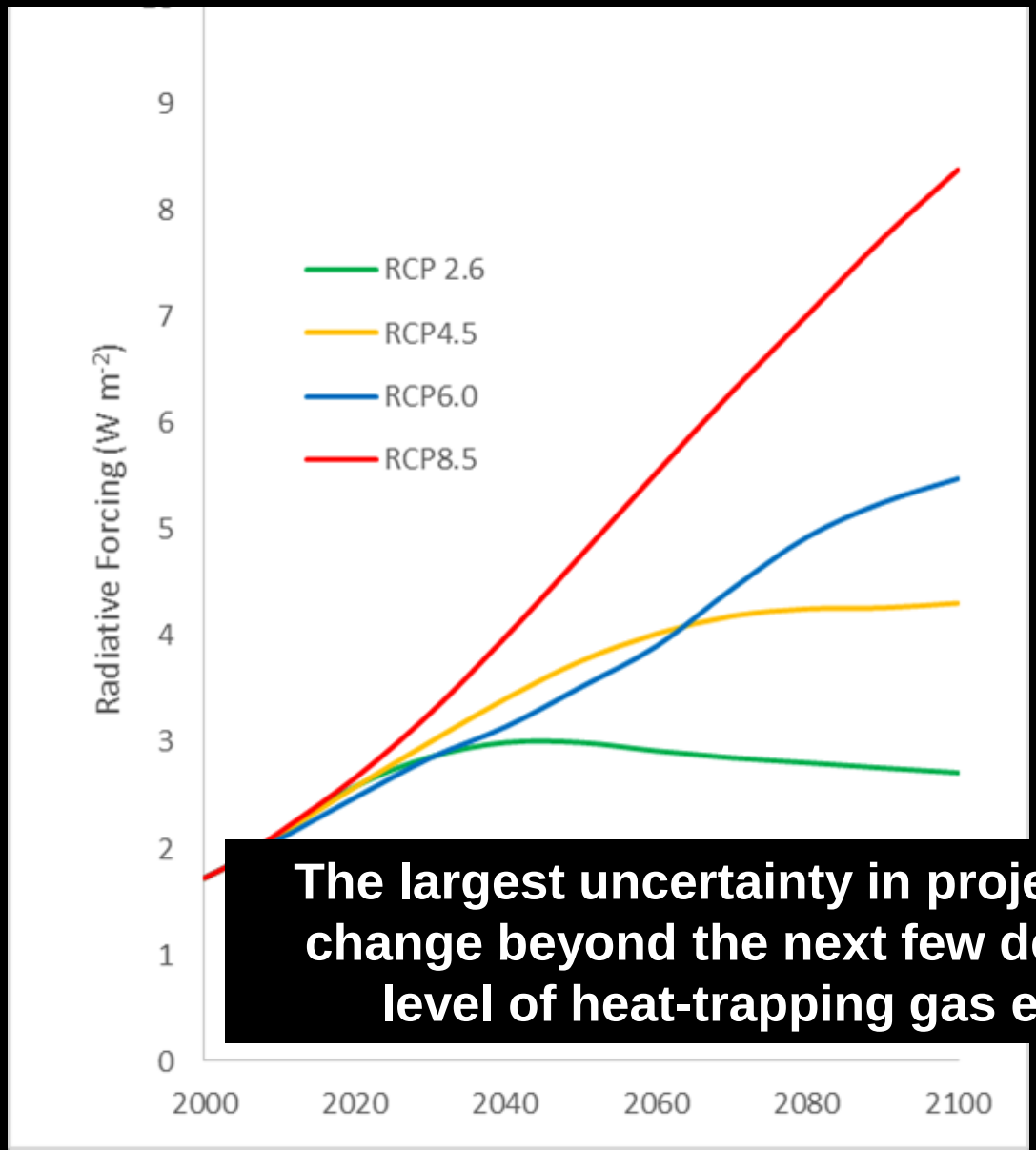
Separating Human and Natural Influences on Climate

Climate models can capture the observed 20th century temperature change



Part 5: Projections of Future Climate: Implications for Nebraska

Projecting Future GHG Concentrations

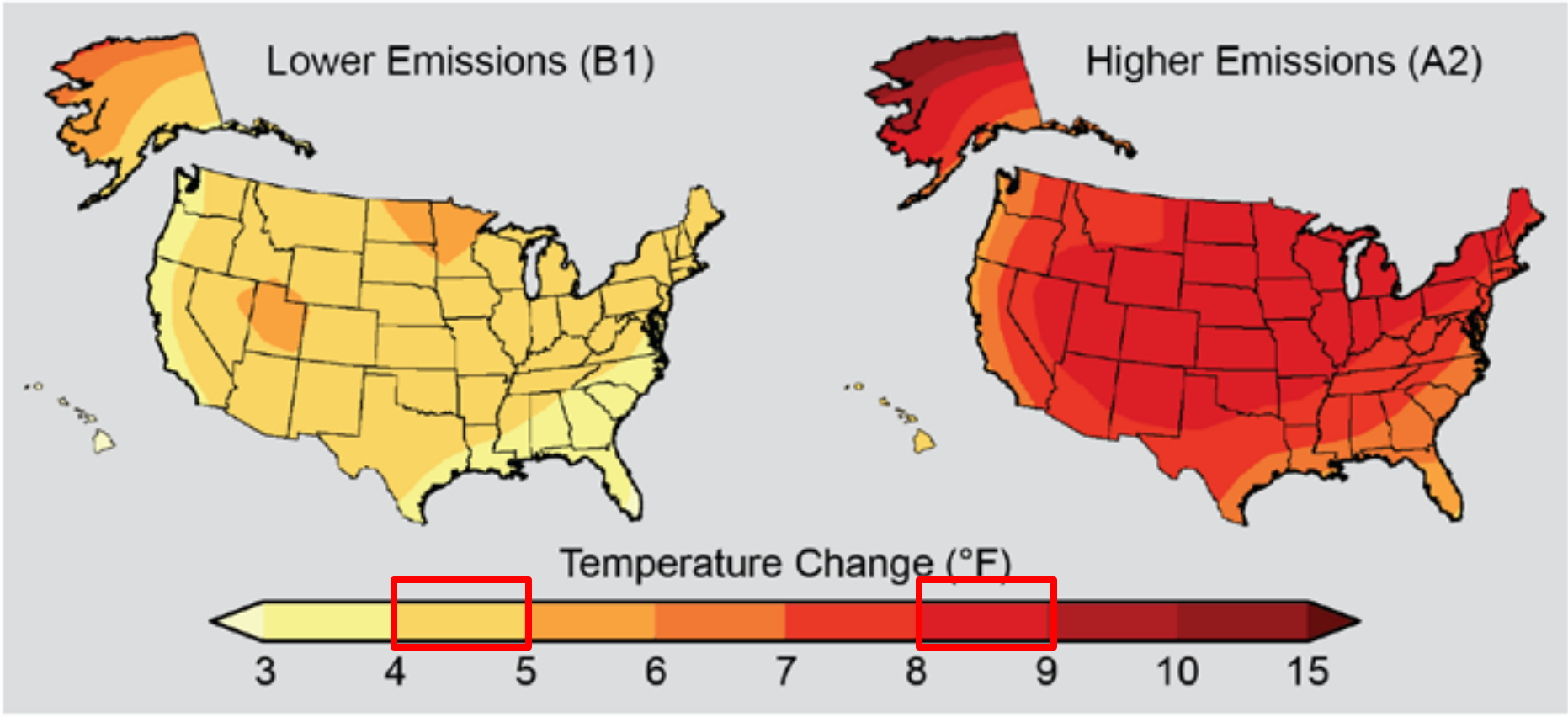


The largest uncertainty in projecting climate change beyond the next few decades is the level of heat-trapping gas emissions.

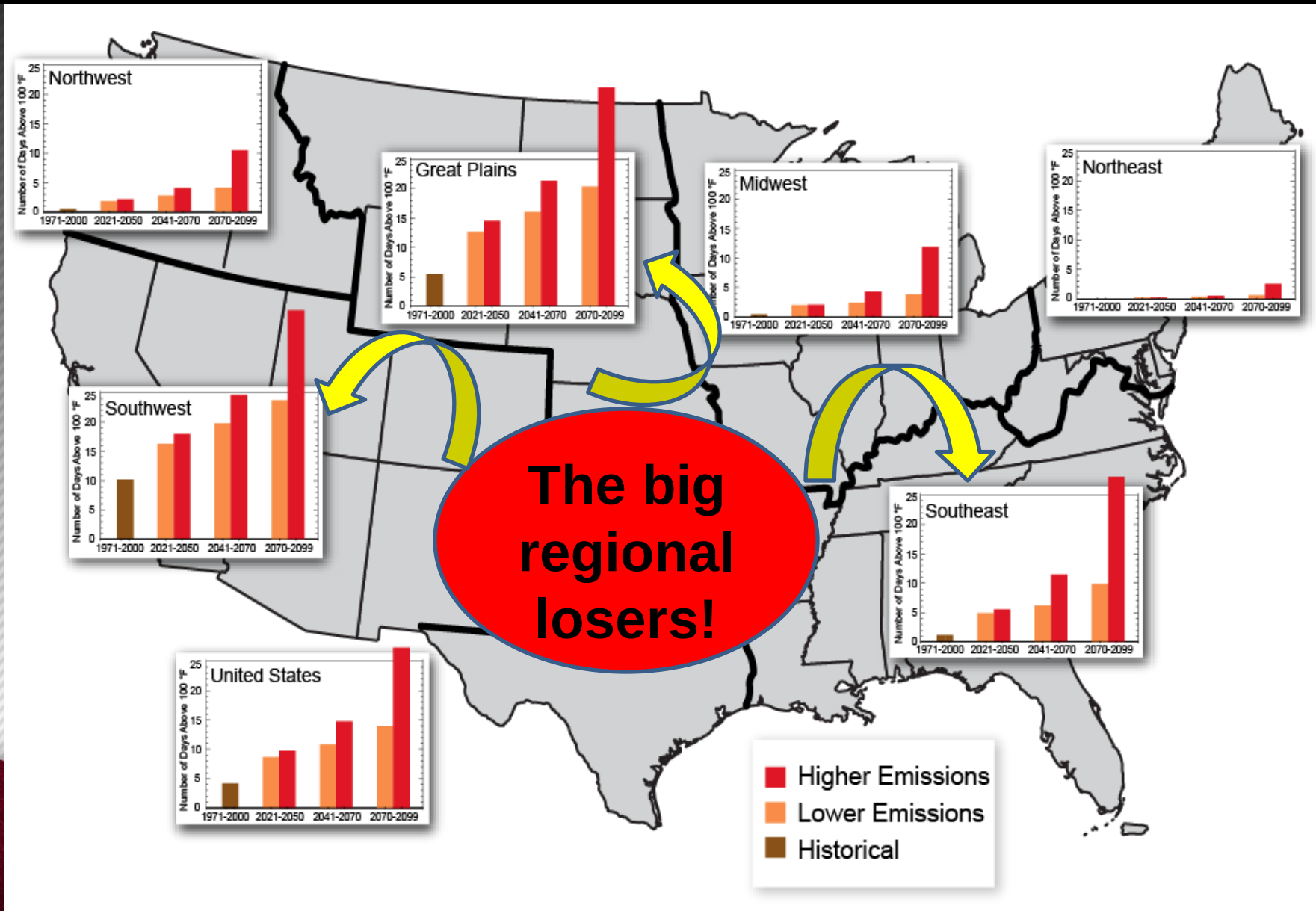
Nebraska Climate Projections

- **Temperature**
  - Increases range from **4-5˚ to 8-9˚F by 2071-2099.** The range is largely due to **uncertainties in future emissions**.
  - Projected high temperature stress days (>100°F), increasing to **13-16 additional days** (lower emissions) to **22-25 additional days** (higher emissions).
  - Number of warm nights increase, winter and summer.
  - Frost-free season continues to increase by an **additional 2 weeks** by the end of the century.

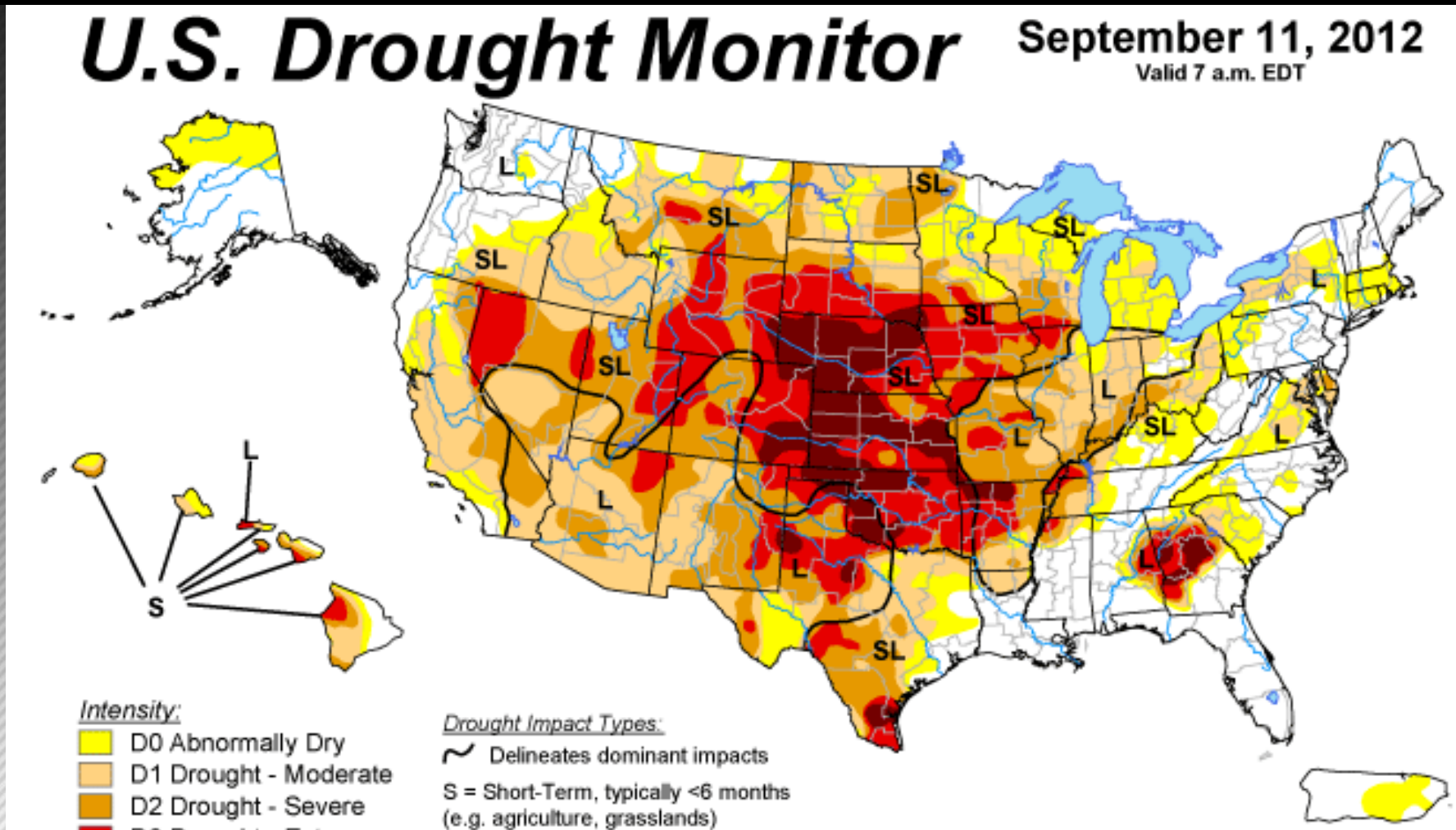
Projected temperature change, 2071-2099



Projected Increase, Number of Days Over 100˚F, 2021-2099, Low and High Emission Scenarios

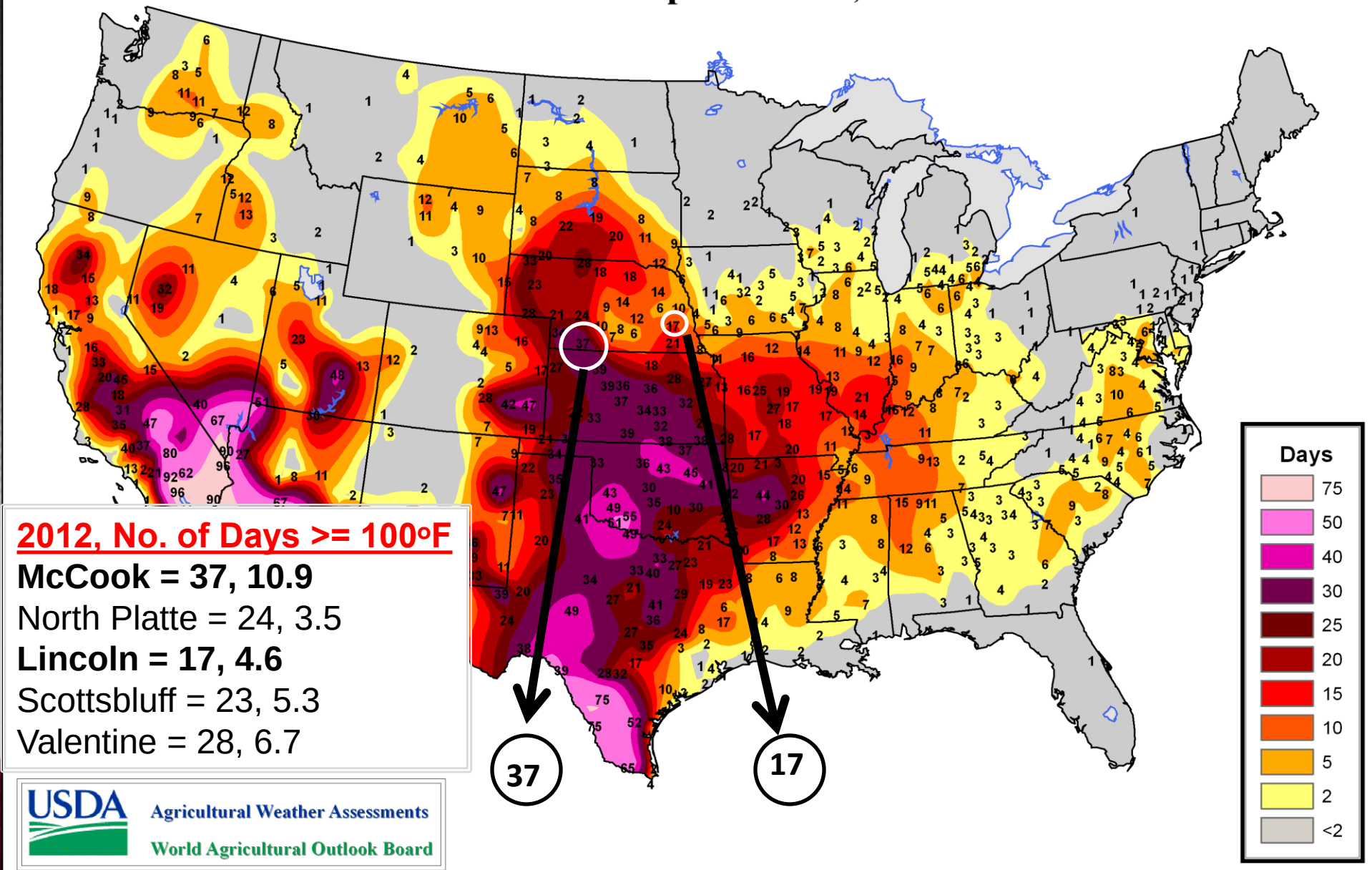


Remember when?



Number of Days >= 100°F

June 1 - September 15, 2012



2012, No. of Days >= 100°F

McCook = 37, 10.9

North Platte = 24, 3.5

Lincoln = 17, 4.6

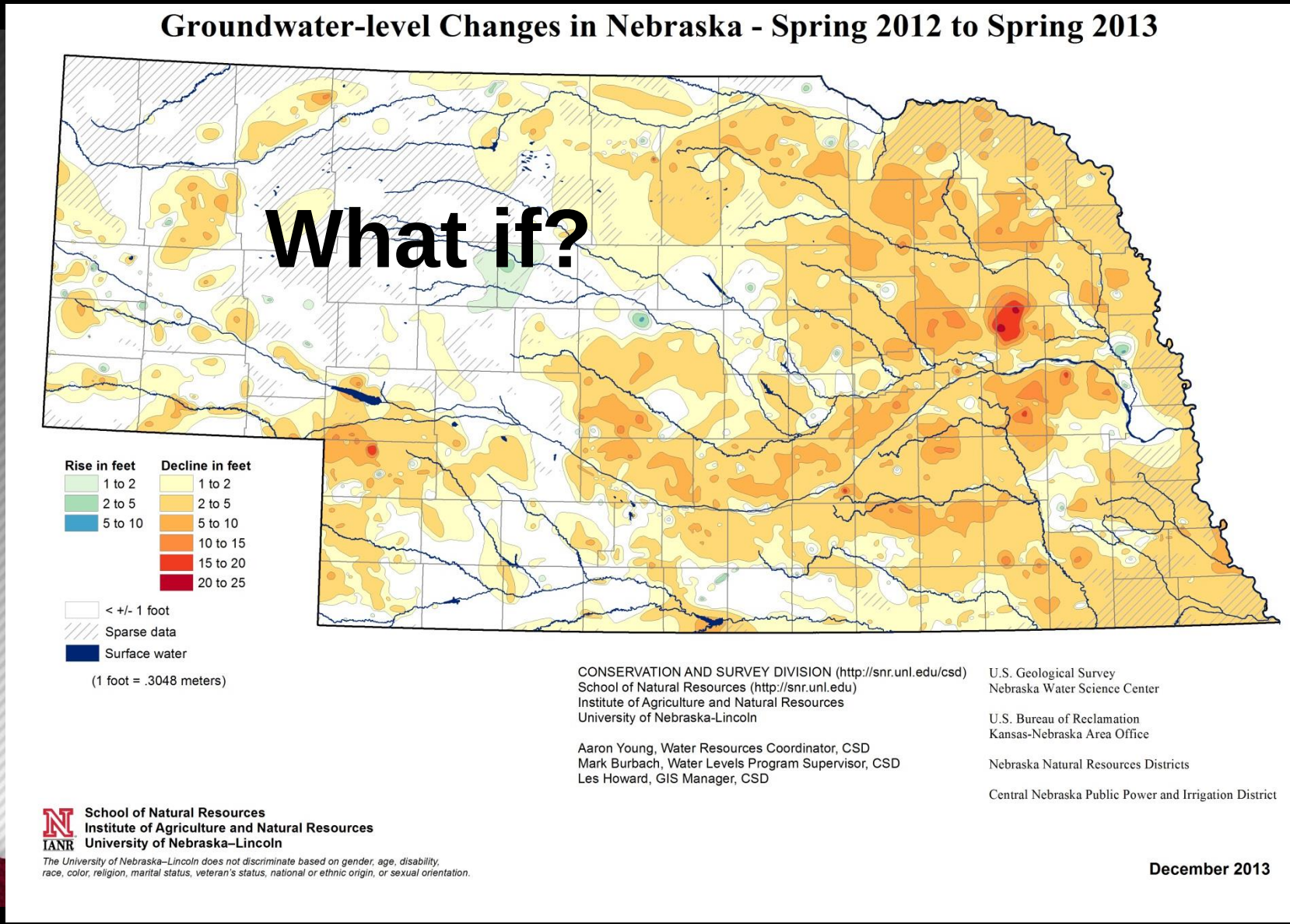
Scottsbluff = 23, 5.3

Valentine = 28, 6.7

USDA Agricultural Weather Assessments

World Agricultural Outlook Board

Groundwater Resources



Source: UNL Conservation and Survey Division

Nebraska Climate Projections

- **Precipitation**
  - Trend for increased precipitation in the northern Plains, decrease in southern Plains, to continue.
  - Little change in winter/spring precipitation in NE.
  - Small projected changes in summer and fall with a drying trend in the central Plains in summer.
  - Increase in heavy precipitation events expected to continue for Great Plains states—a 16% increase has been observed for the region.
  - Increased precipitation, if any, will likely be ineffective when temperature increases are factored into the assessment.

Nebraska Climate Projections

- **Soil Moisture**
  - Decrease in available soil moisture between 5-10% for Nebraska
- **Flood Magnitude**
  - Flood magnitudes have been increasing in the eastern portions of the Great Plains, reflecting increased heavy rainfall events
- **Snow Cover**
  - Reduced snowpack in the central/northern Rockies → reduced Platte/Missouri river flow

Part 6: Takeaway Points, Challenges and Opportunities

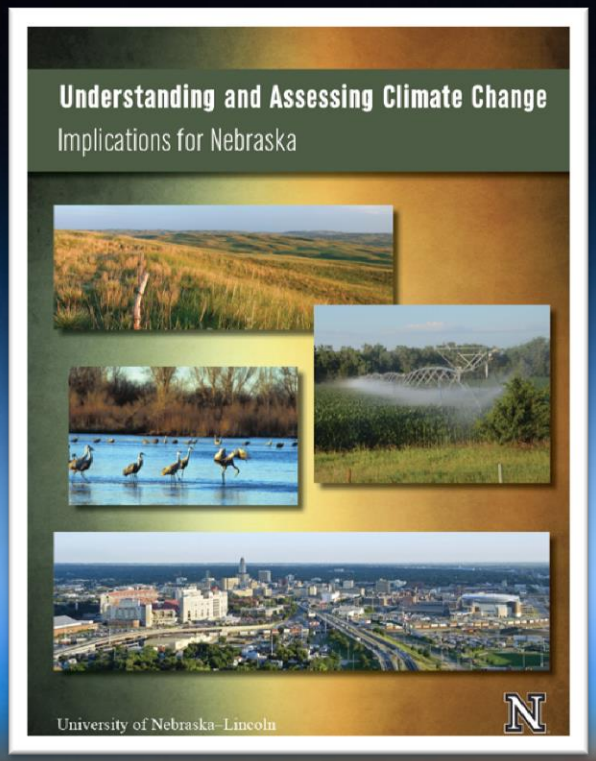
Nebraska Climate Projections

- **Assessing the impact of projected changes**
  - consequences depends on the sensitivity of key sectors to these changes—can we increase resilience?
  - the ability of sectors to adapt to these changes as they occur;
  - how proactive these sectors are in adapting to change;
  - the availability of ground water to respond to the increased demand for water;
  - mitigation measures adopted to reduce GHG emissions.
- **With slight changes in precipitation amounts projected, increasing temperatures and the number of high temperature stress days will be the critical factor affecting impact and the ability of various sectors to adapt to a changing climate.**

Where Do We Go From Here?

- Sector-based roundtable discussions on adaptation and mitigation measures
  - Scheduled, Fall 2015
  - Sectors/organizers
    - Faith community (Interfaith Power and Light)
    - Urban/rural communities (Lincoln & Rural Futures Inst.)
    - Universities/colleges (UNL Facilities)
    - Ecosystems/ecosystem services (Game & Parks)
    - Human Health (COPH/UNMC)
    - Forests and Fire (Neb. Forest Service)
    - Agriculture, food and water (IANR, DWFI)
    - Energy (UNL Energy Science Center)
  - Wrap-up session for organizers, November 2015
  - Up Next! Nebraska Climate Action Plan?
    - 61% of rural Nebraskans agree or strongly agree

Thanks for your attention!
Get engaged in the conversation!



Questions?

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Roundtable Discussions on Climate Change

Climate Change and the Faith Community

Public lecture: September 17, 7:00 pm, Sheridan Lutheran Church

Roundtable: September 18, 2015, 9:30-4:00 pm, Sheridan Lutheran Church

Urban & Rural Communities

Roundtable: September 22, 1:00-5:00pm, Cornhusker Hotel

College/University Campuses

Roundtable: October 1, 9:00 am-4:00 pm, Student Union, City Campus

Wildlife, Ecosystems and Ecosystem Services

Public lecture: October 5, 7:00 pm, Hardin Hall

Roundtable: October 6, Game and Parks Commission

Human Health in Nebraska

Public lecture: October 6, 4pm, UNMC.

Roundtable: October 7, 9am-4pm, UNMC.

Forests and Fire in Nebraska

Public lecture: October 13, 7pm Hardin Hall.

Roundtable: October 14, Nebraska Innovation Campus.

Agriculture, Food and Water

Roundtable: October 20th, 9:30-4pm, East Campus Union

Energy Availability, Use and Management in Nebraska

Roundtable: October 22, 9:30-4pm, East Campus Union