Climate Change: Implications for Nebraska

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School of Natural Resources
University of Nebraska-Lincoln

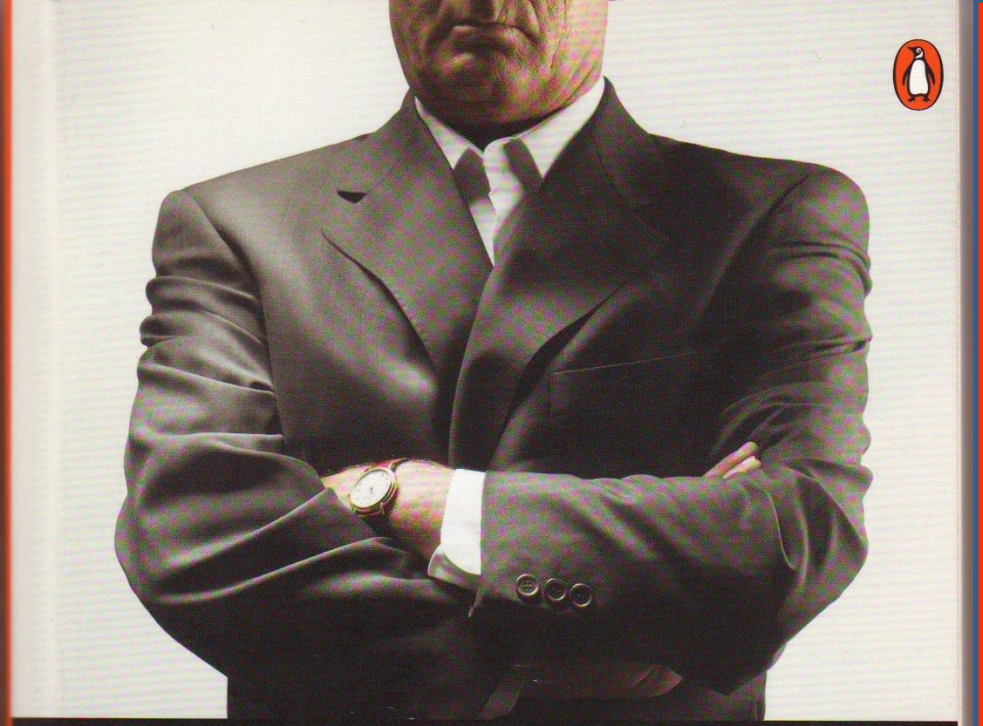
The Politics of Climate Change

Sen. Jim Inhofe (R-Okla.) has, once and for all, disproven climate change. While "eggheads" at "science laboratories" were busy worrying about how the increase in heat-trapping gases in the atmosphere was leading to a long-term upward shift in temperatures and increased atmospheric moisture, Inhofe happened to notice that it was cold outside. *Weirdly* cold outside. So cold, in fact, that water falling from the sky had *frozen solid*.

U.S. Senate votes 98-1 that climate change is real!

"GLOBAL WARMING ISN'T REAL BECAUSE I WAS COLD TODAY! ALSO GREAT NEWS: WORLD HUNGER IS OVER BECAUSE I JUST ATE."

- STEPHEN COLBERT



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 <u>adaptation</u> and <u>mitigation</u>.

Five Truths About Climate Change (in 10 words)

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

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

"CLIMATE CHANGE IS A PROBLEM WHICH CAN NO LONGER BE LEFT TO FUTURE GENERATIONS."

- POPE FRANCIS

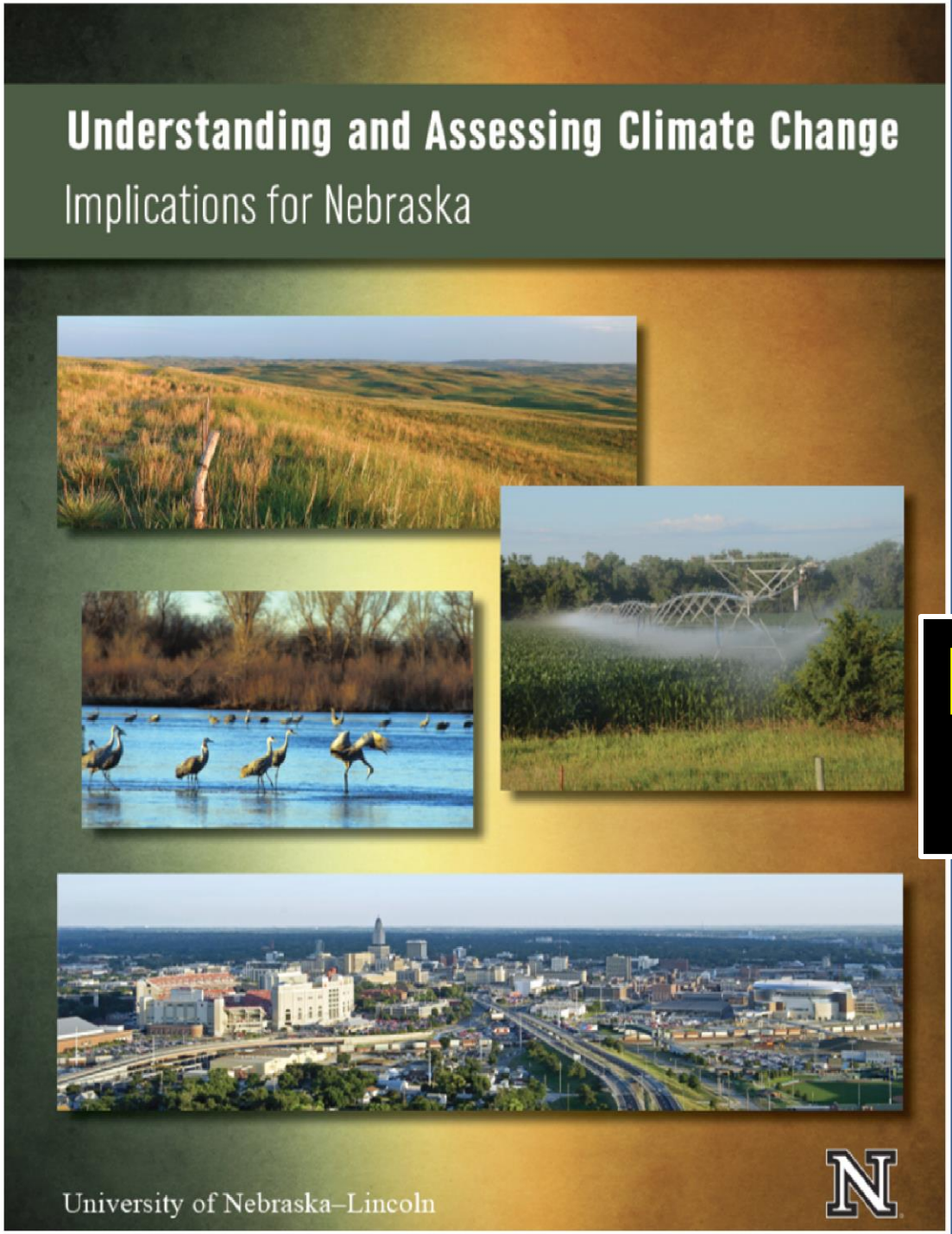
But, we must act NOW for future generations and our planet's health!

Excerpt from President Obama's 2016 State of the Union Address.

"If anybody still wants to dispute the science around climate change, have at it.

You will be pretty lonely because you'll be debating our military, most of America's business leaders, the majority of the American people, almost the entire scientific community and 200 nations around the world who agree it's a problem and intend to solve it."

COP 21, Paris Climate Treaty



Copies of the report are available at

http://go.unl.edu/climatechange

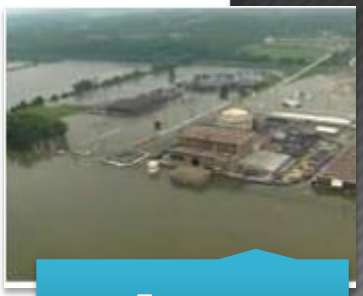
Nebraska's Experts Have Identified Climate Change Impacts to Multiple Sectors

Warmer World


Water Resources

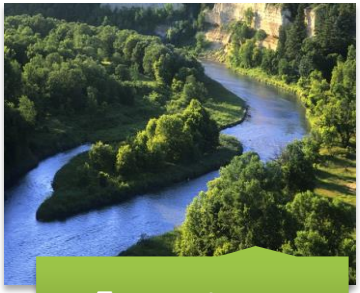

Crops


Livestock

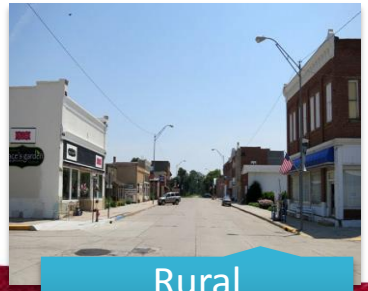

Energy


Health


Forestry


Ecosystems


Urban Systems


Rural Communities

Insurance


Invasive Species

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

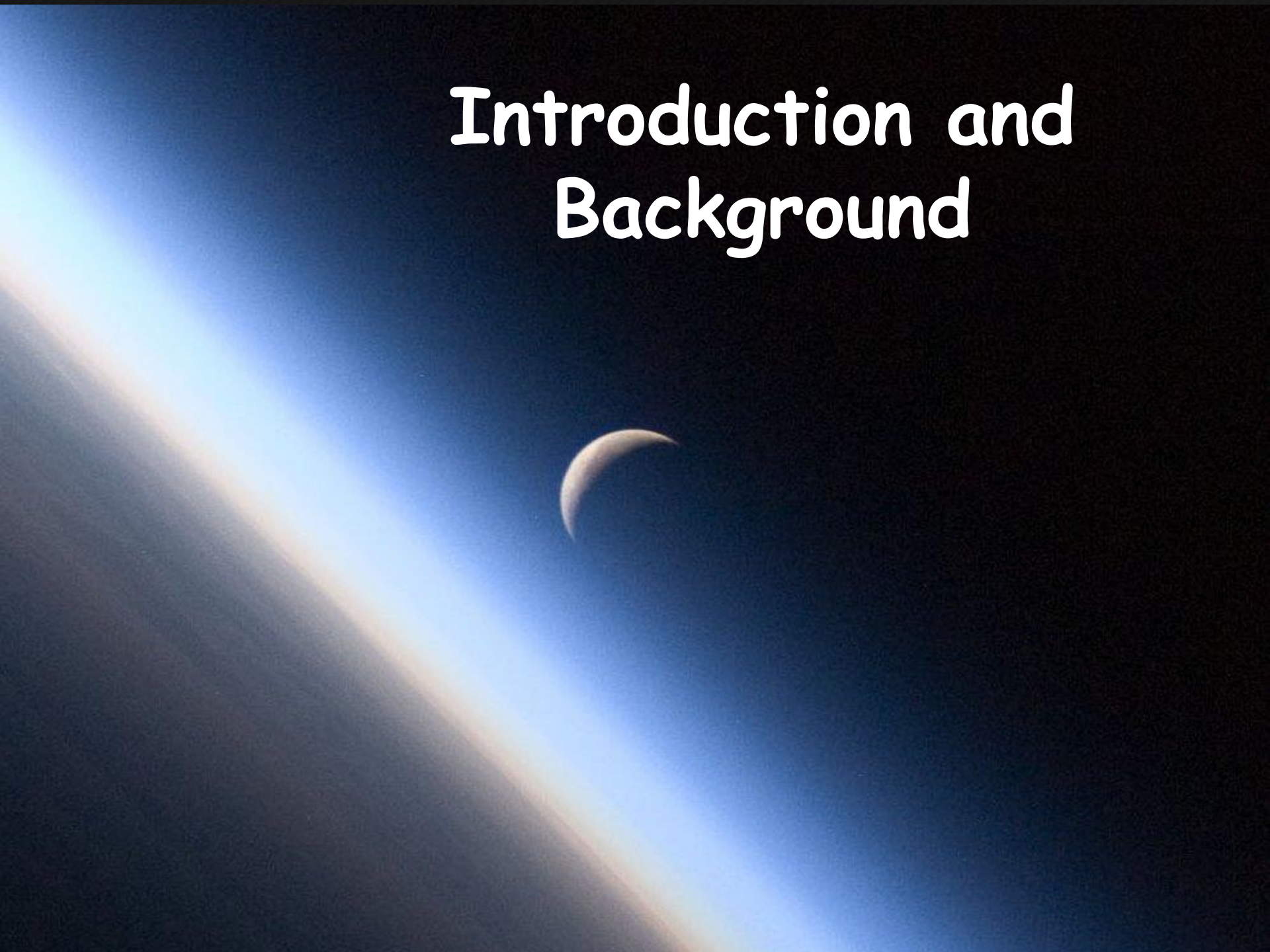
Roundtable: October 20th, 9:30-4pm, East Campus Union

Energy Availability, Use and Management in Nebraska

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

IKEA Job Interview

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)***

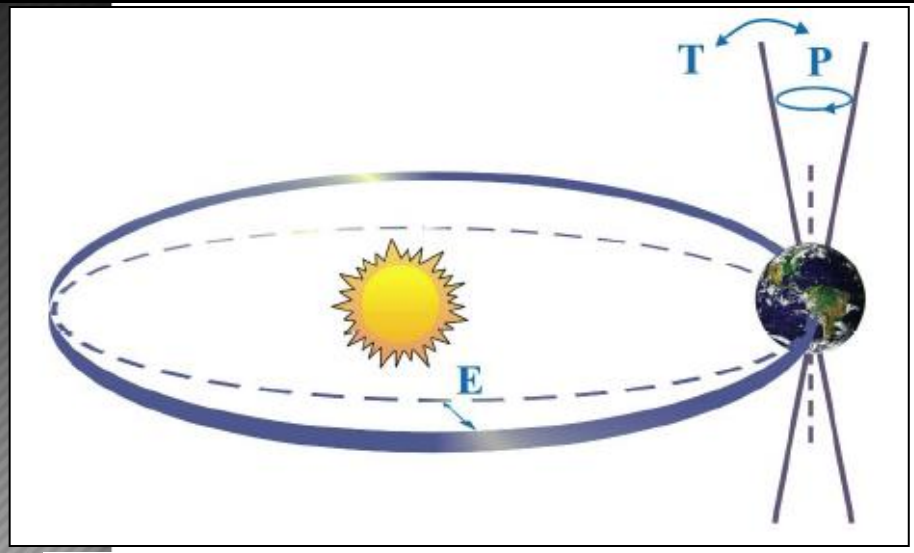
Why is 'climate' important?

'stationarity vs. non-stationary of climate'

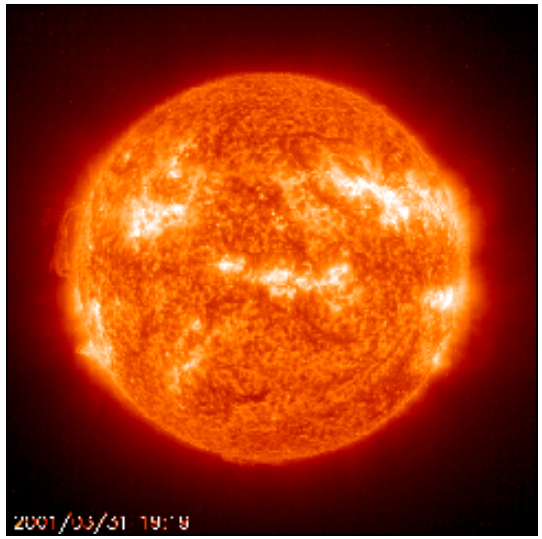
Global warming refers only to the Earth's rising surface temperature, while *climate change* includes warming **and** the "side effects" of warming—like melting glaciers, heavier rainstorms, or more frequent drought. Said another way, global warming is one symptom of the much larger problem of human-caused climate change.


Climate Change
Science

Natural forcings affecting climate

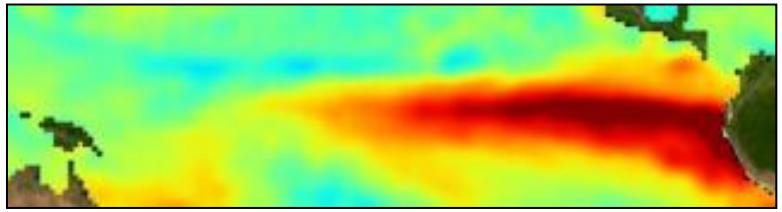


Variations in the Earth's orbit
(Milankovic effect)



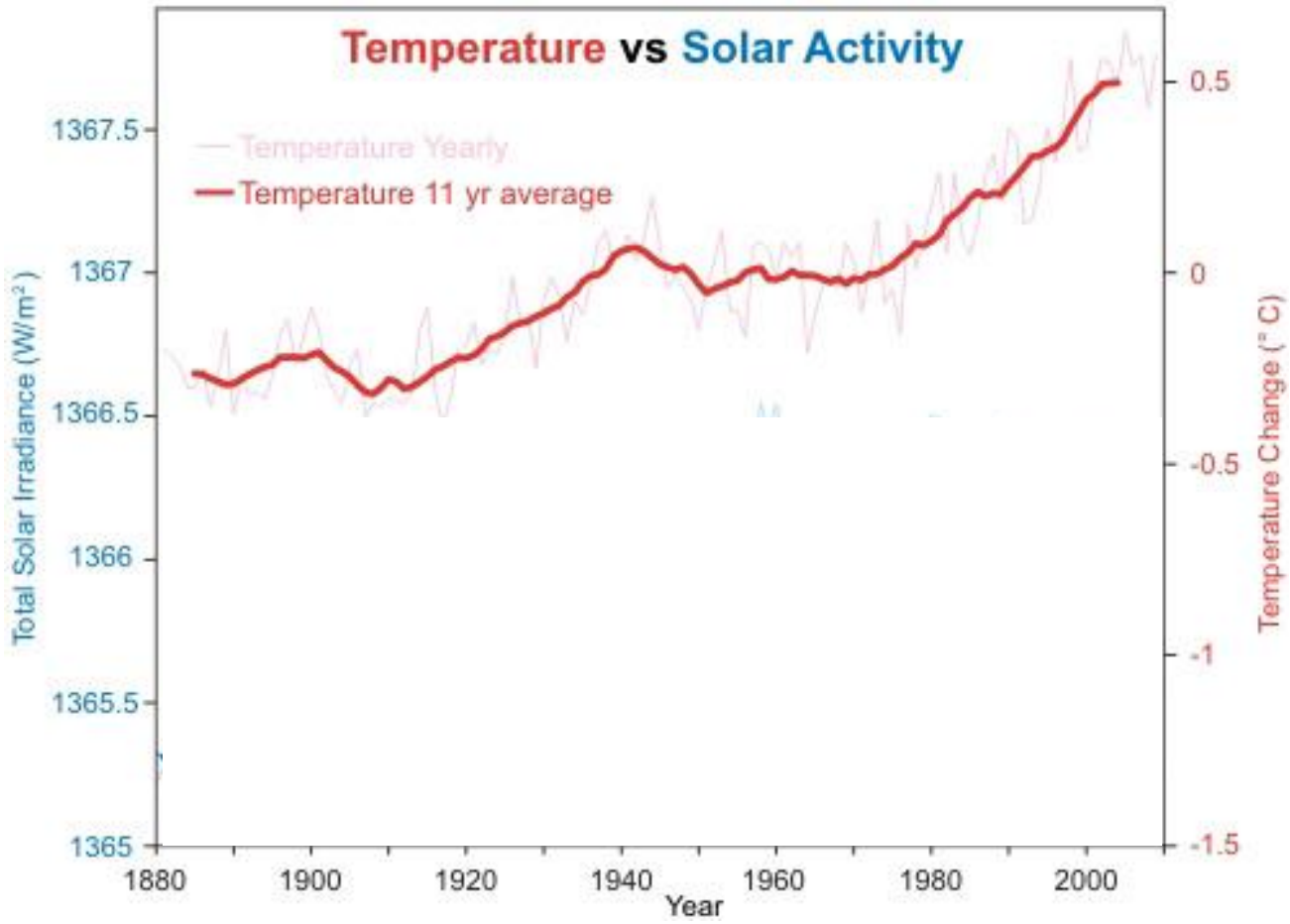
Variations in the energy
received from the sun

Stratospheric
aerosols from
energetic
volcanic eruptions



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

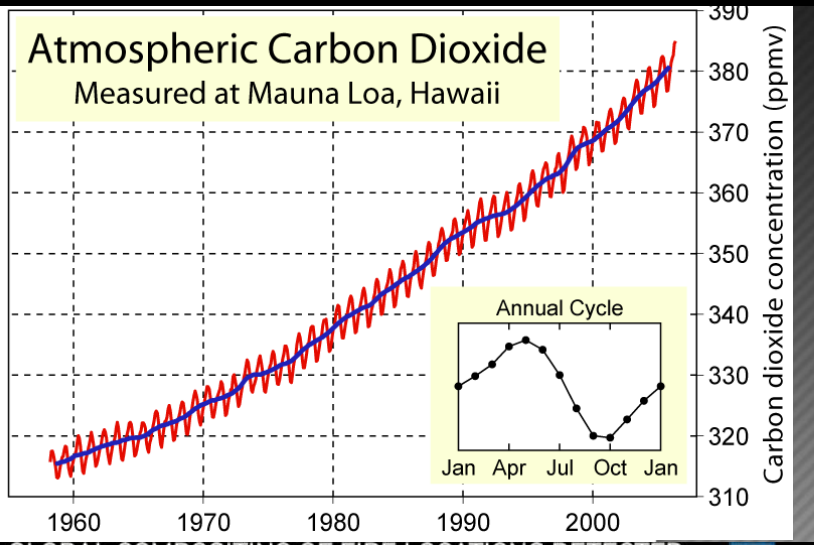
Temperature vs. Solar Activity (1880-present)



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

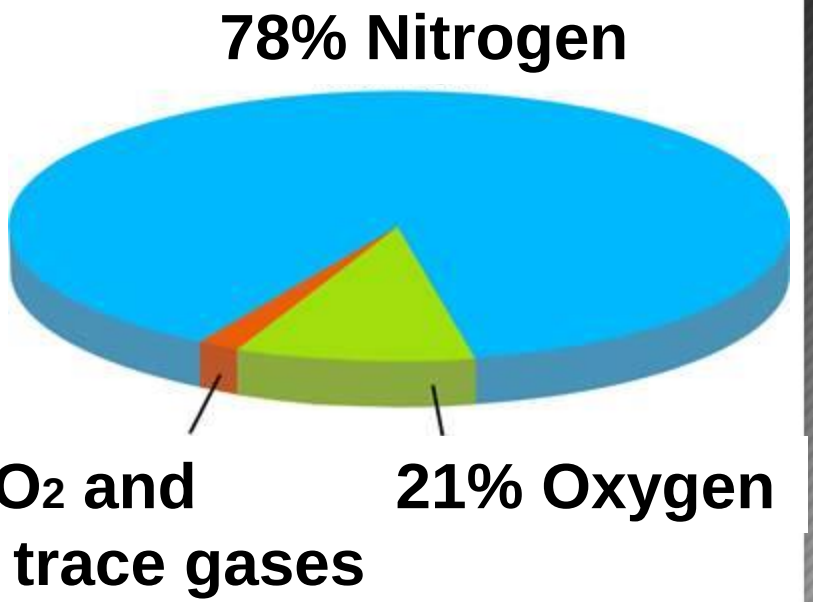
Anthropogenic forcings affecting climate

- **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***

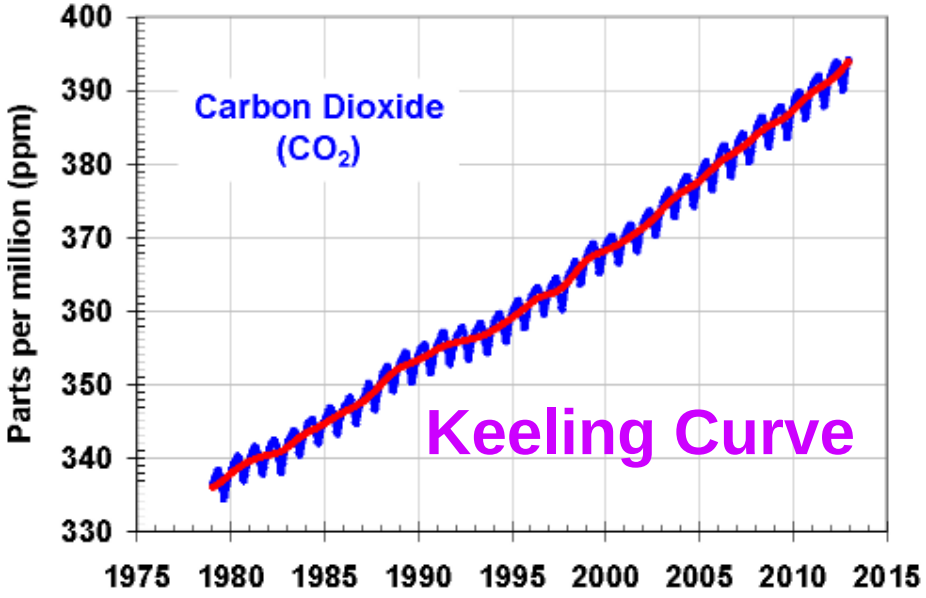


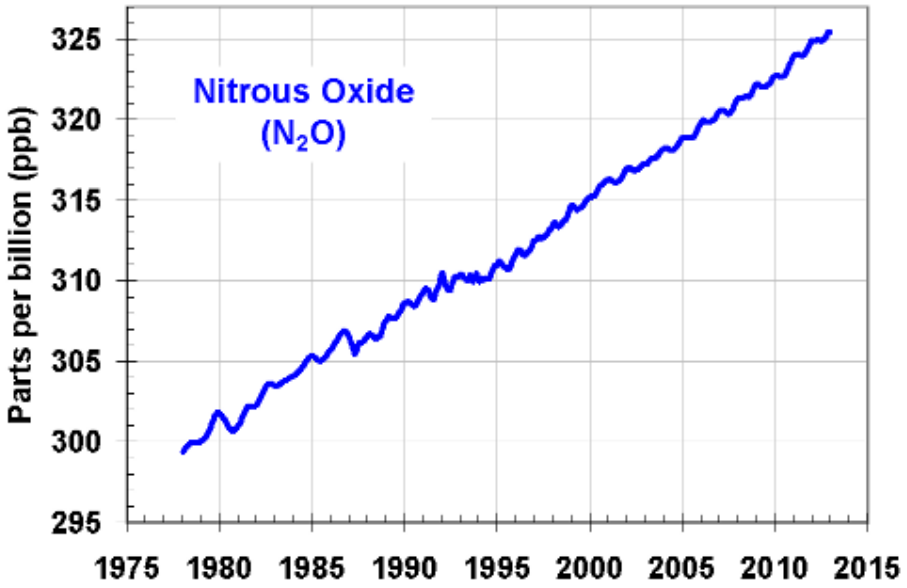
For every 1°F increase in temperature, the atmosphere can hold 4% more moisture.

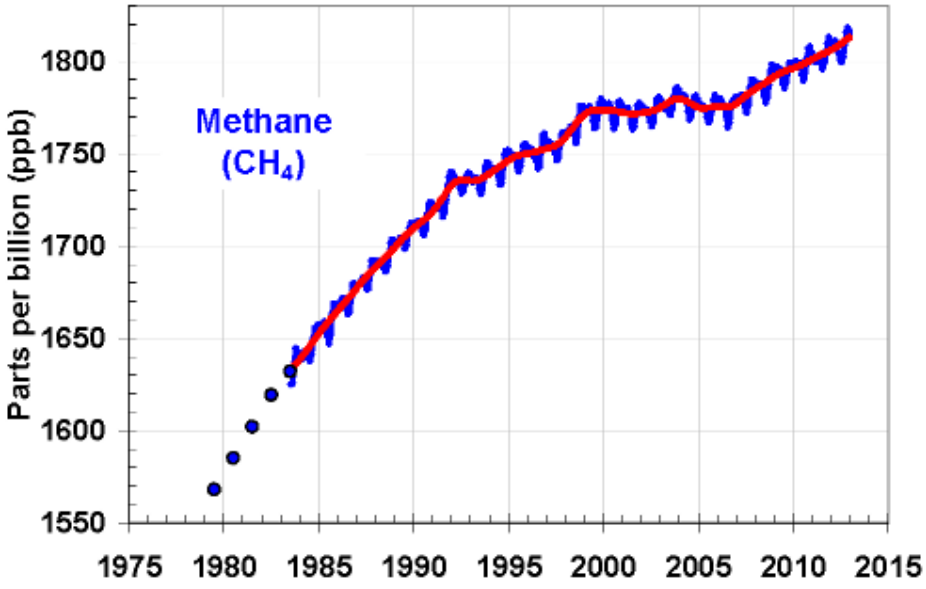
Without these GHGs, the earth's surface temperature would be about 57°F cooler.

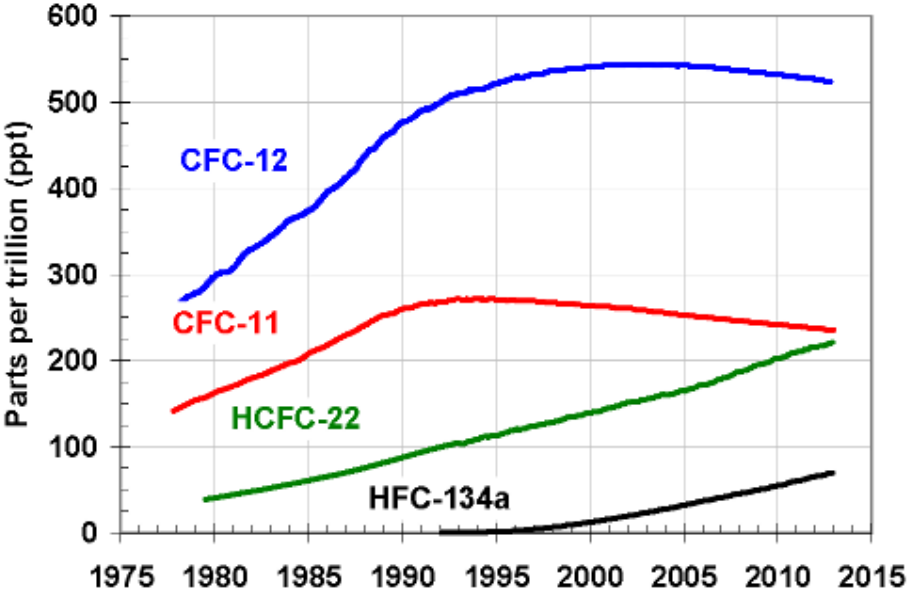
GHGs are the heat regulators for the Earth.

Trends of Principal GHGs







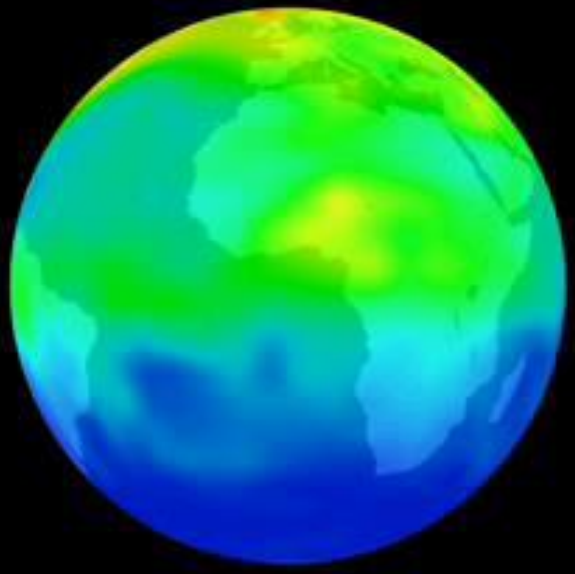


Earth's Energy Balance

The 'Greenhouse Effect'

Sunlight

Visible Radiation



Heat

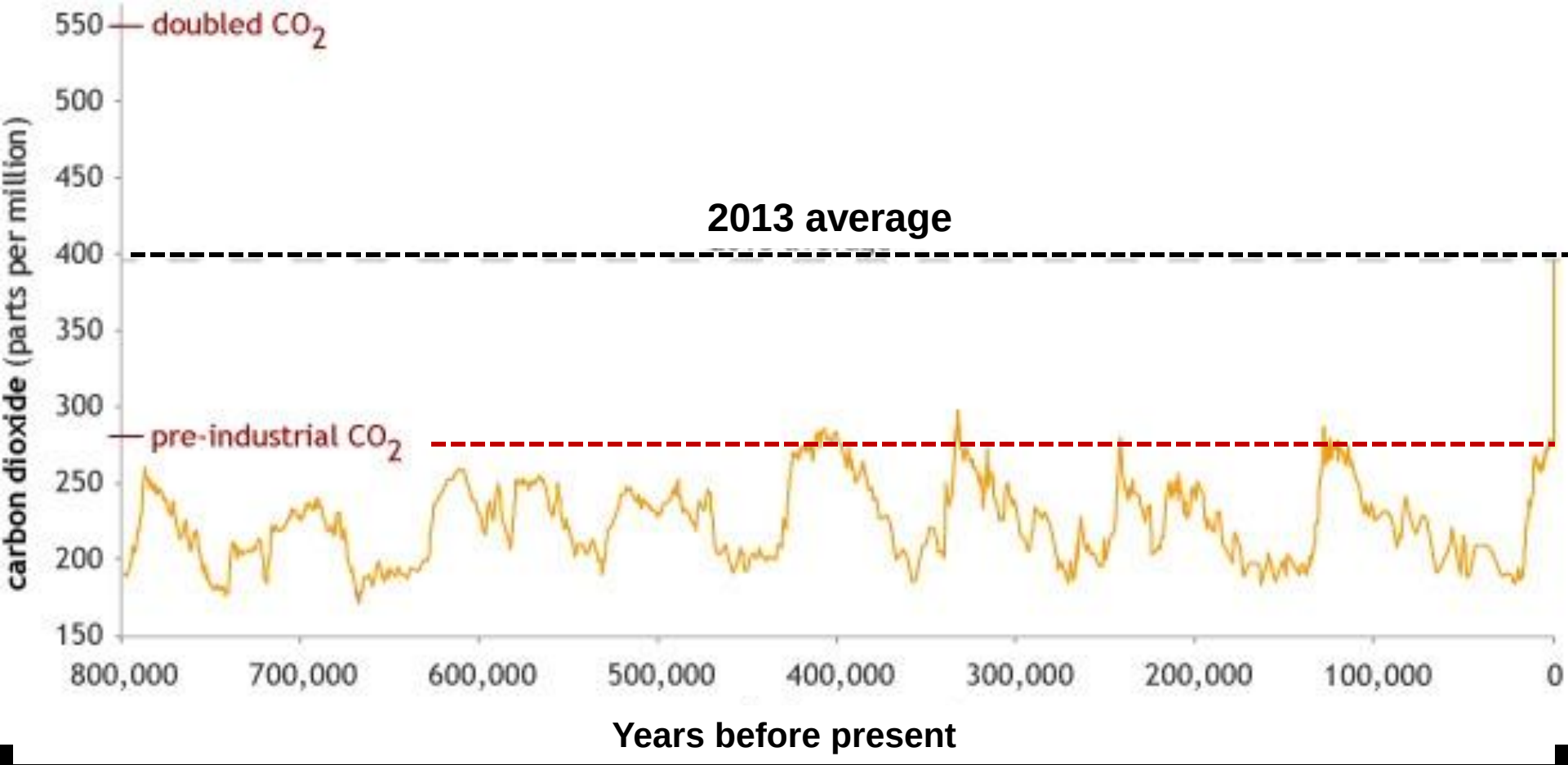
Infrared Radiation

235 Watts per square meter (Wm-2)

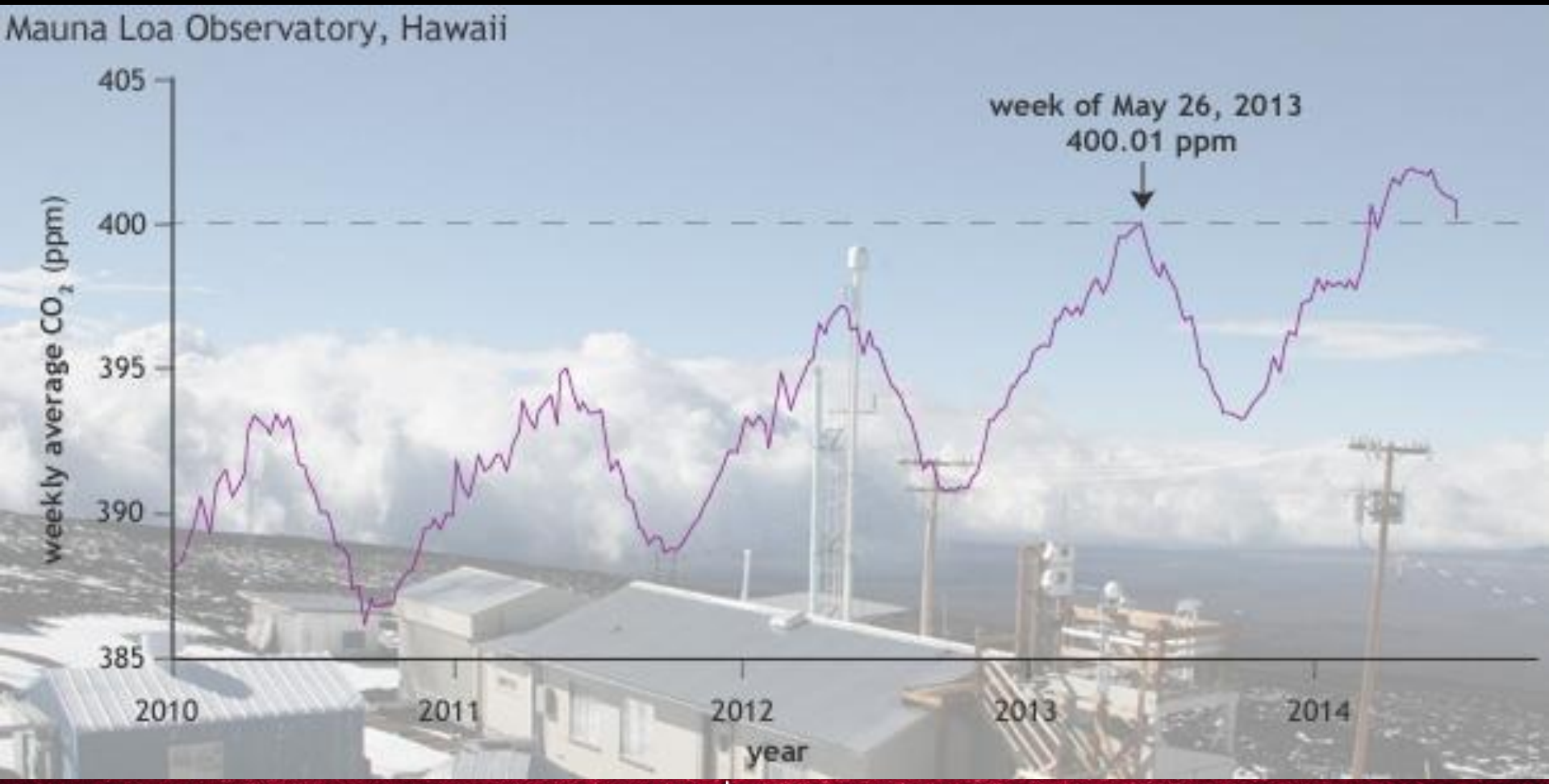
235 Watts per square meter (Wm-2)

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

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



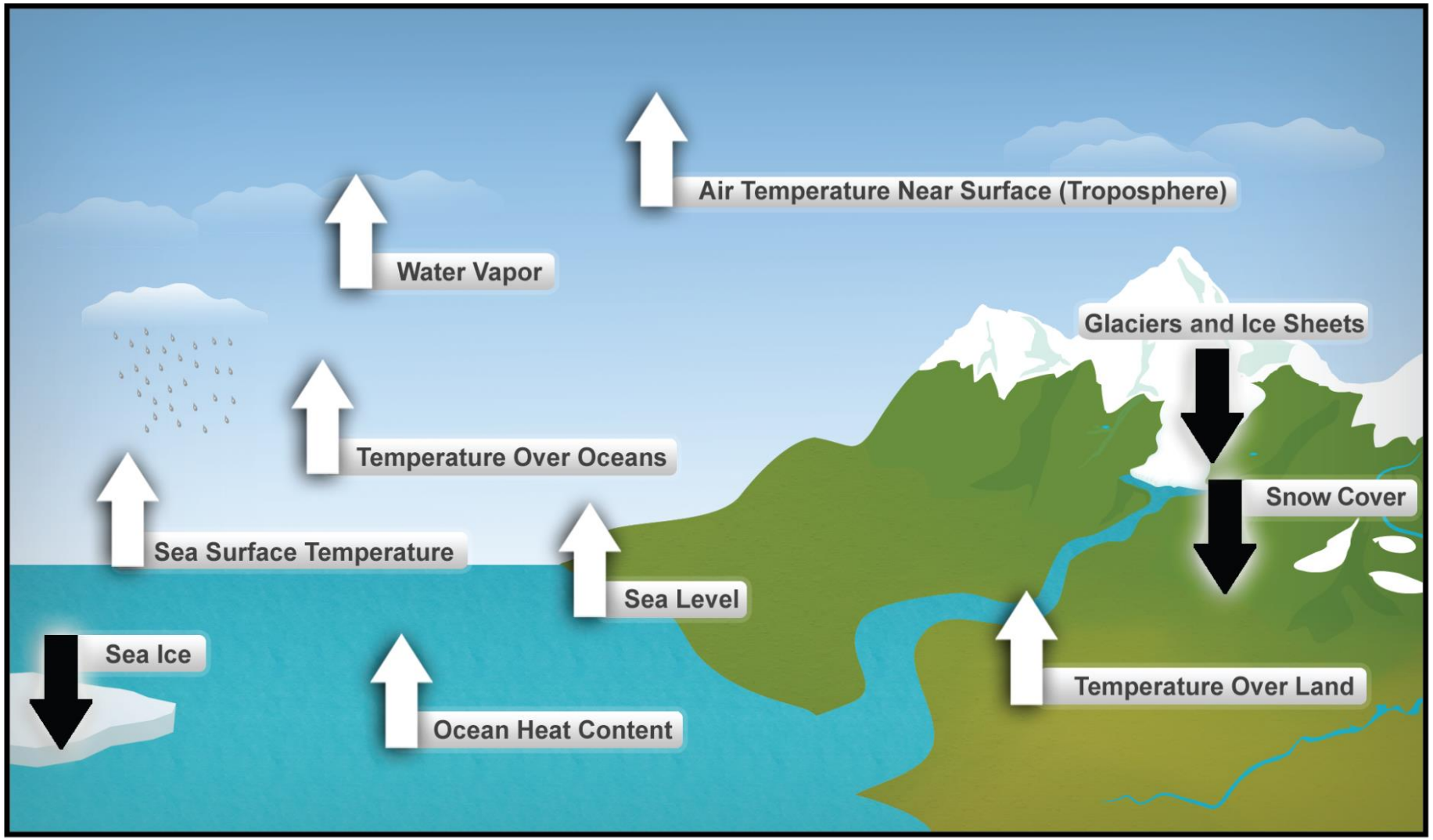
Observed CO_2 Concentrations (ppm) Mauna Loa Observatory, Hawaii 2010-2014



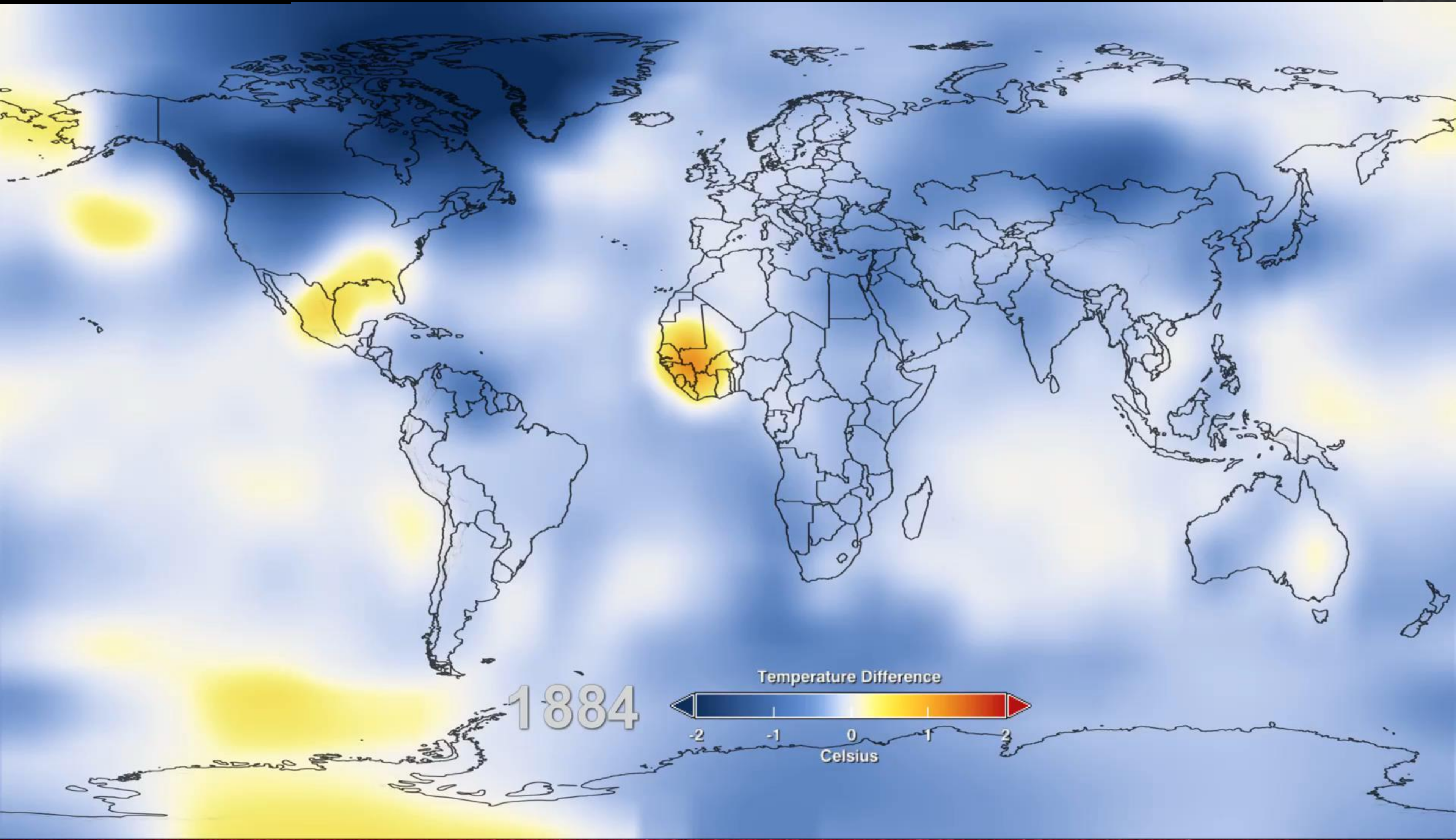

Observed Changes in Climate

If global climate is changing . .

Ten indicators of a warming world



Global Temperatures (1884 – 2012)



2015—Warmest Year on Record!

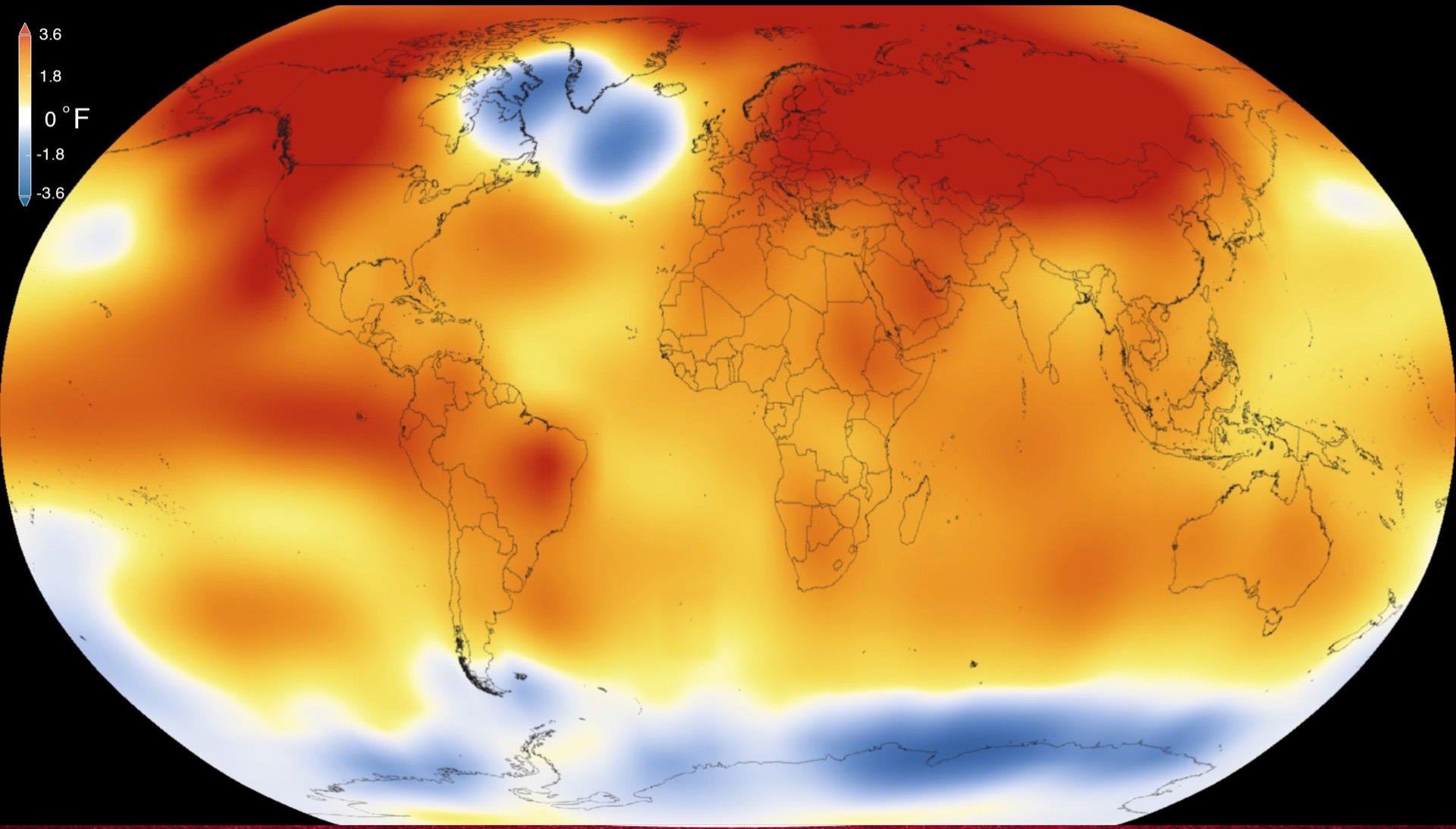
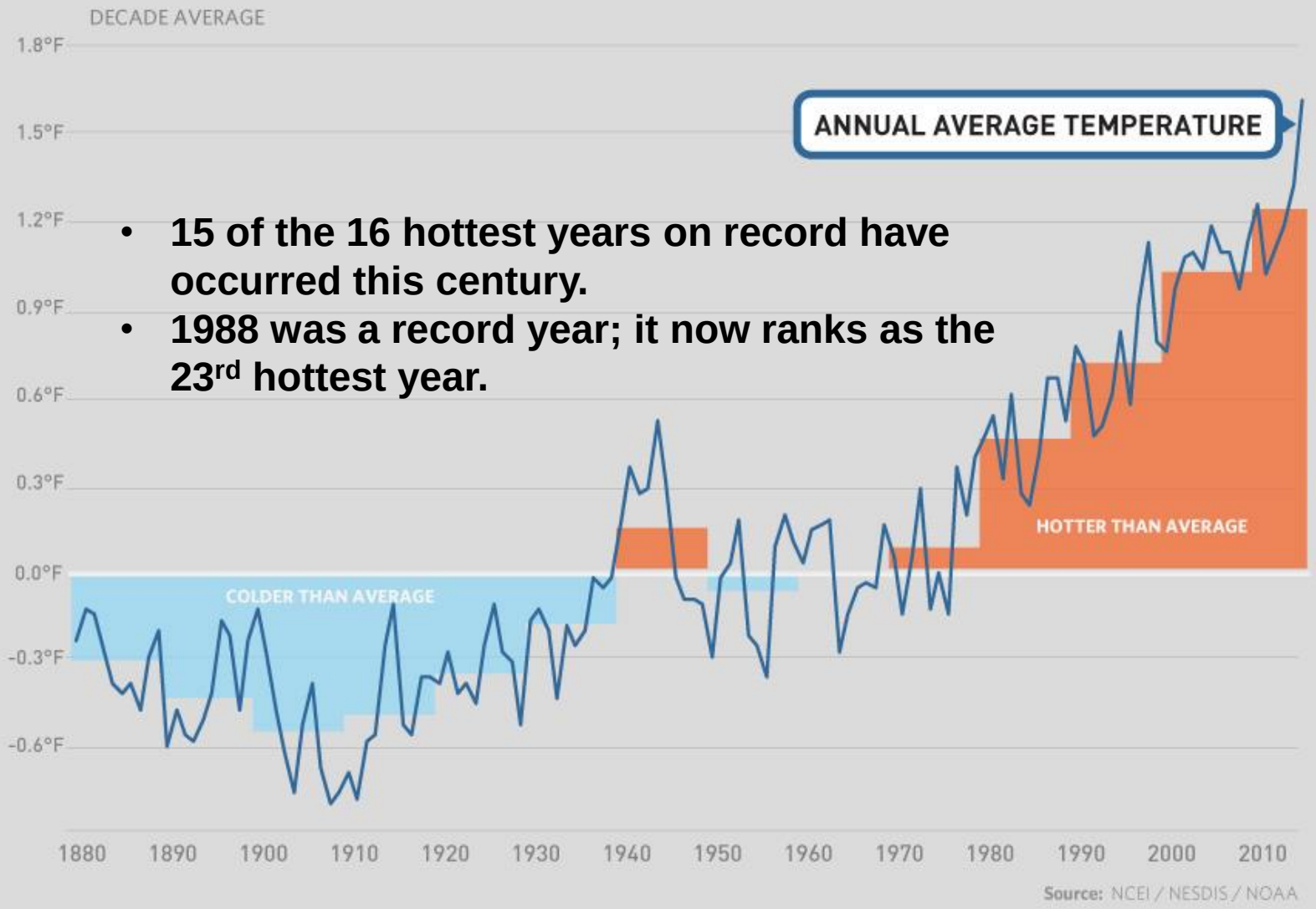


CHART OF THE WEEK

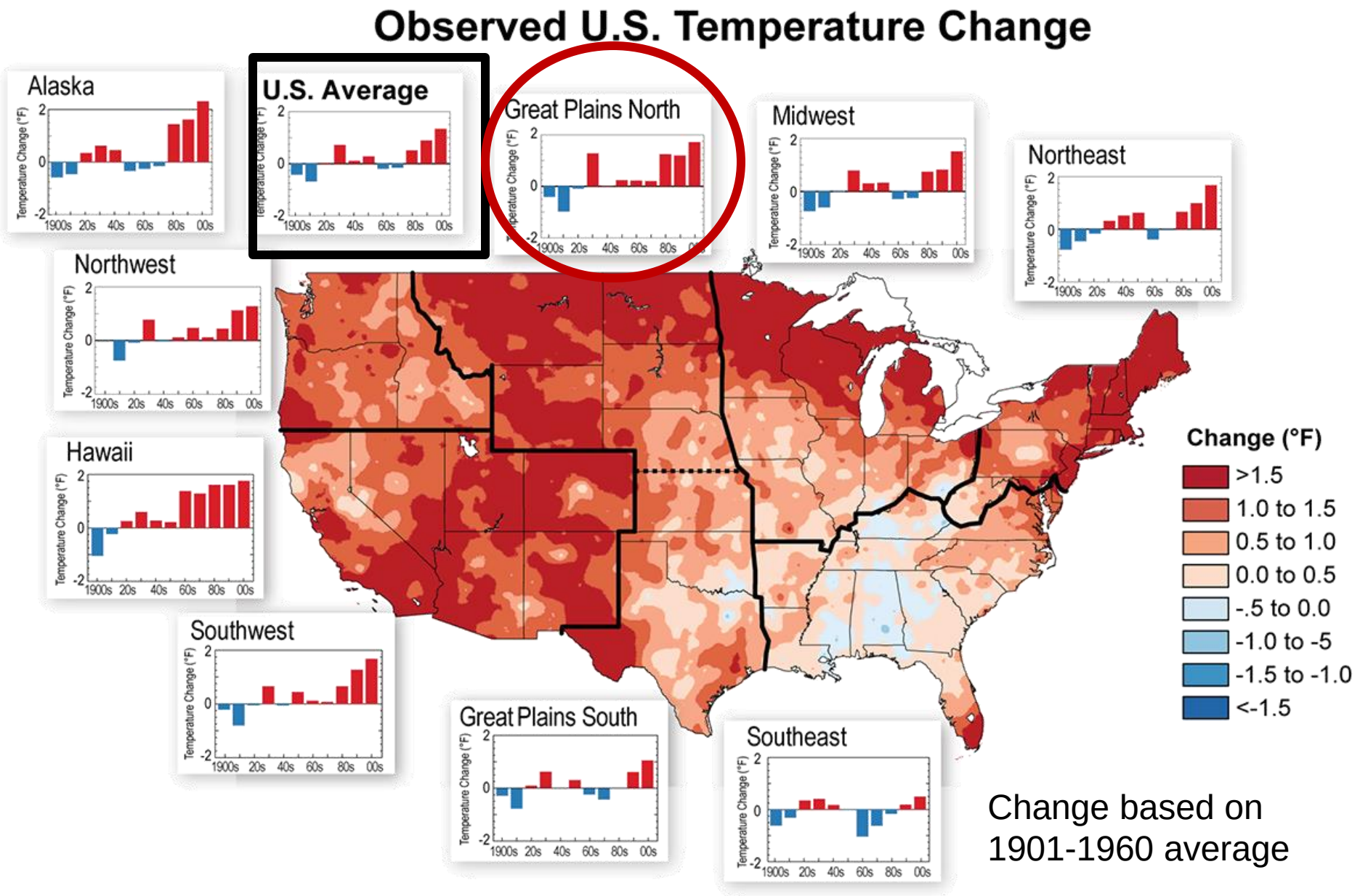
2015 WAS OUR PLANET'S HOTTEST YEAR ON RECORD

Temperature Difference from 20th Century Average (°F)

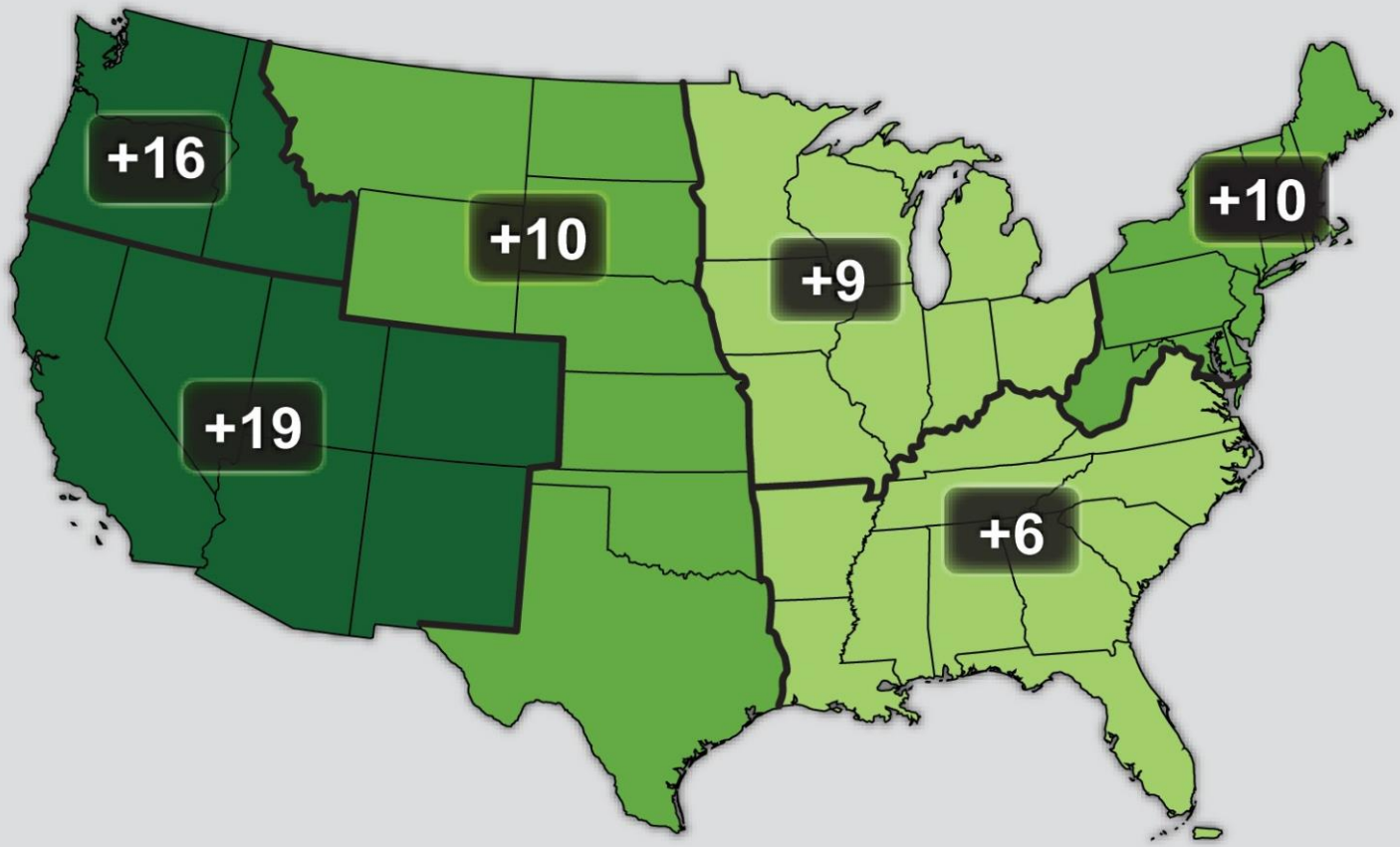


- **15 of the 16 hottest years on record have occurred this century.**
- **1988 was a record year; it now ranks as the 23rd hottest year.**

Change is apparent across the U.S.



Observed Increases in Frost-Free Season



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

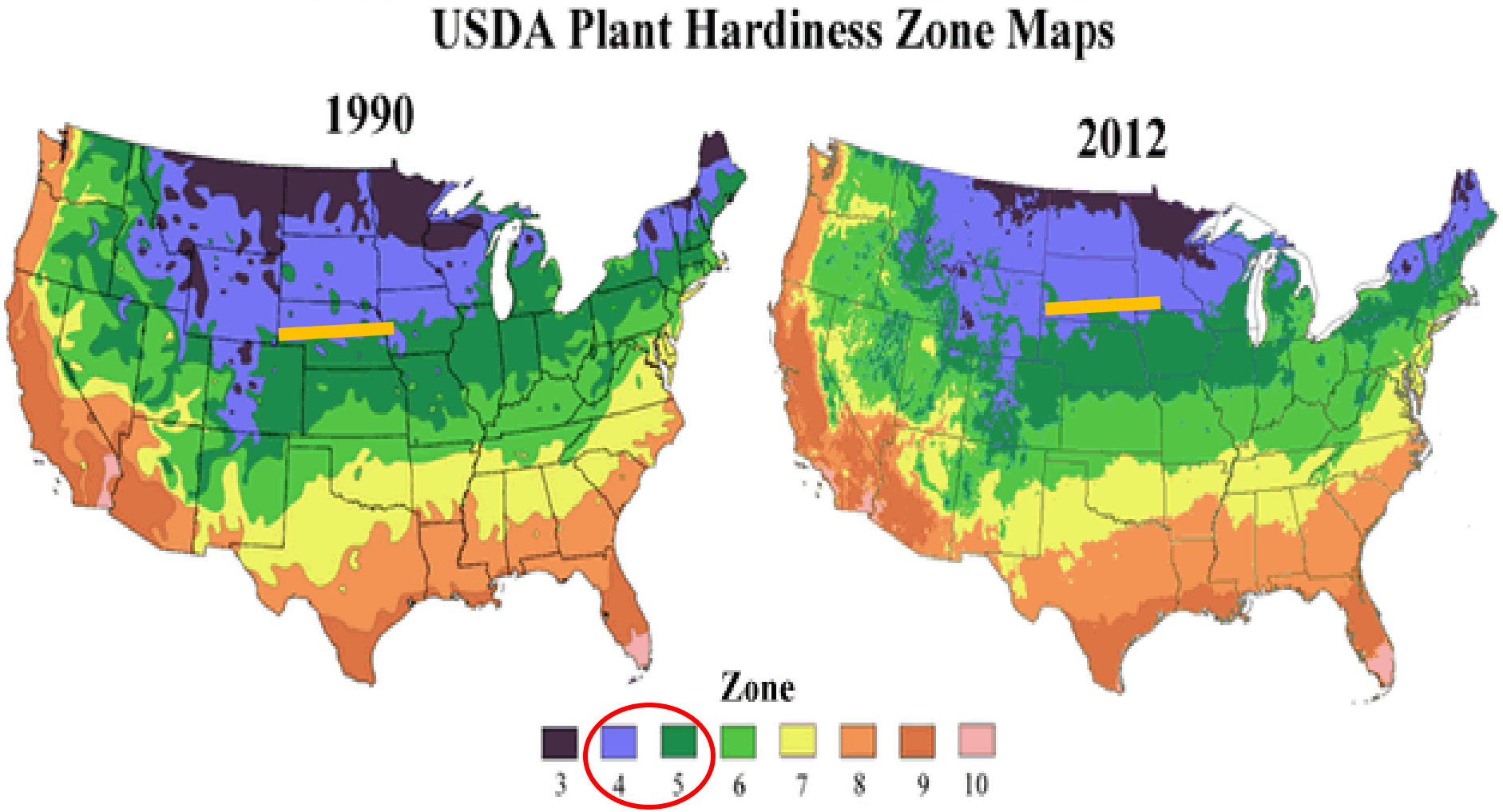
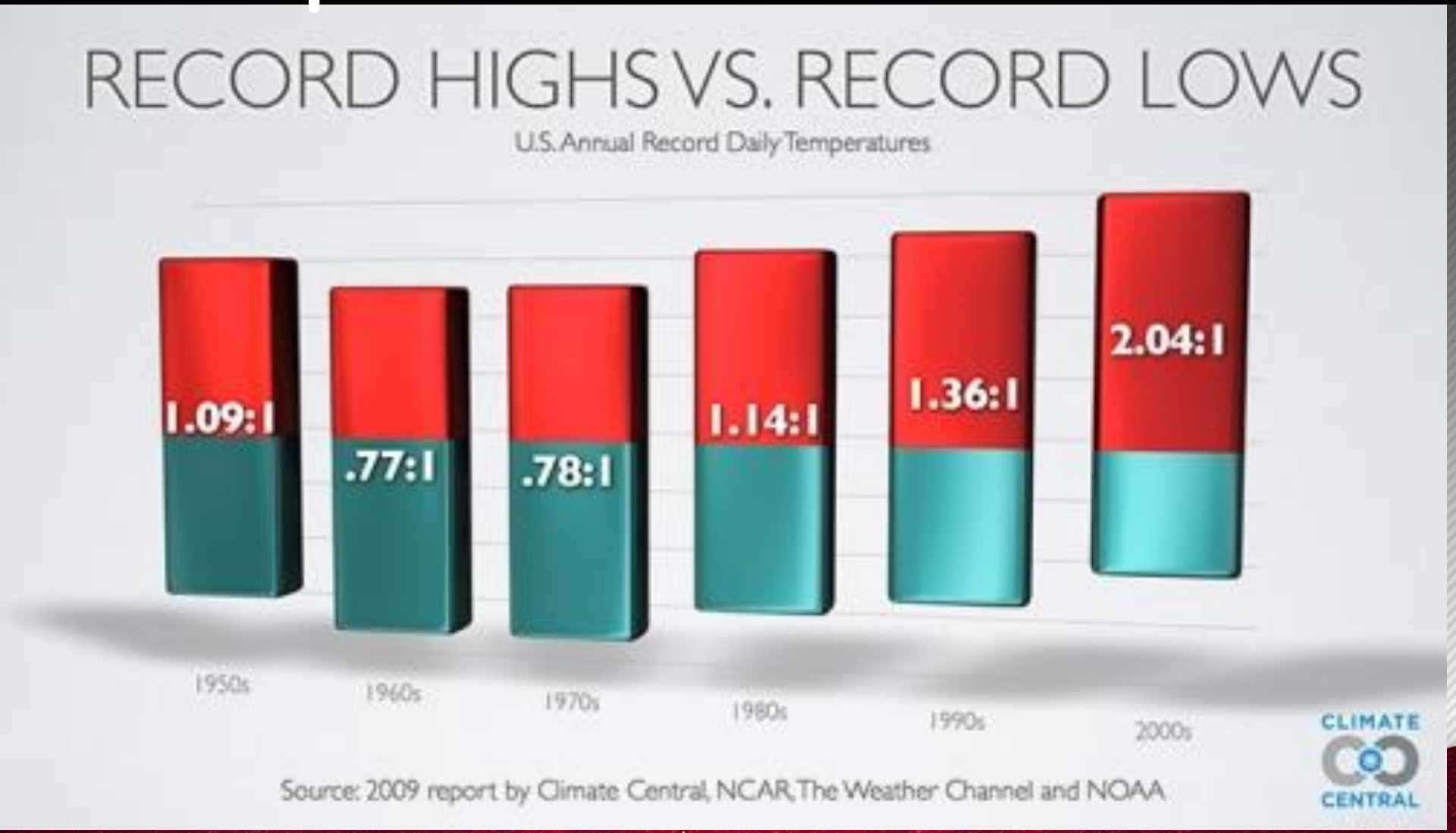
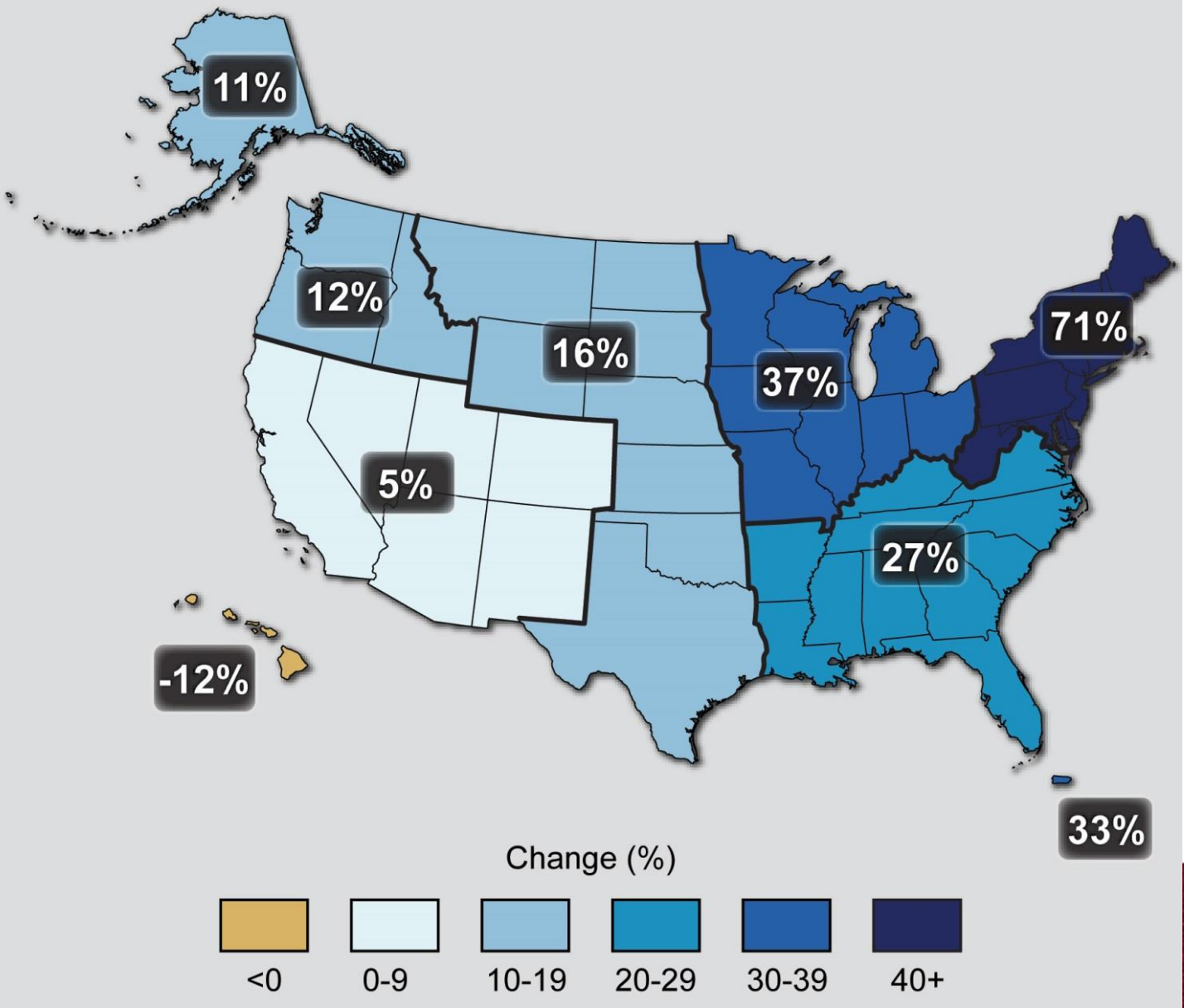


Figure 1. Comparison of the 1990 and 2012 USDA Plant Hardiness Zone Maps. Image credit: USDA and Arbor Day Foundation.

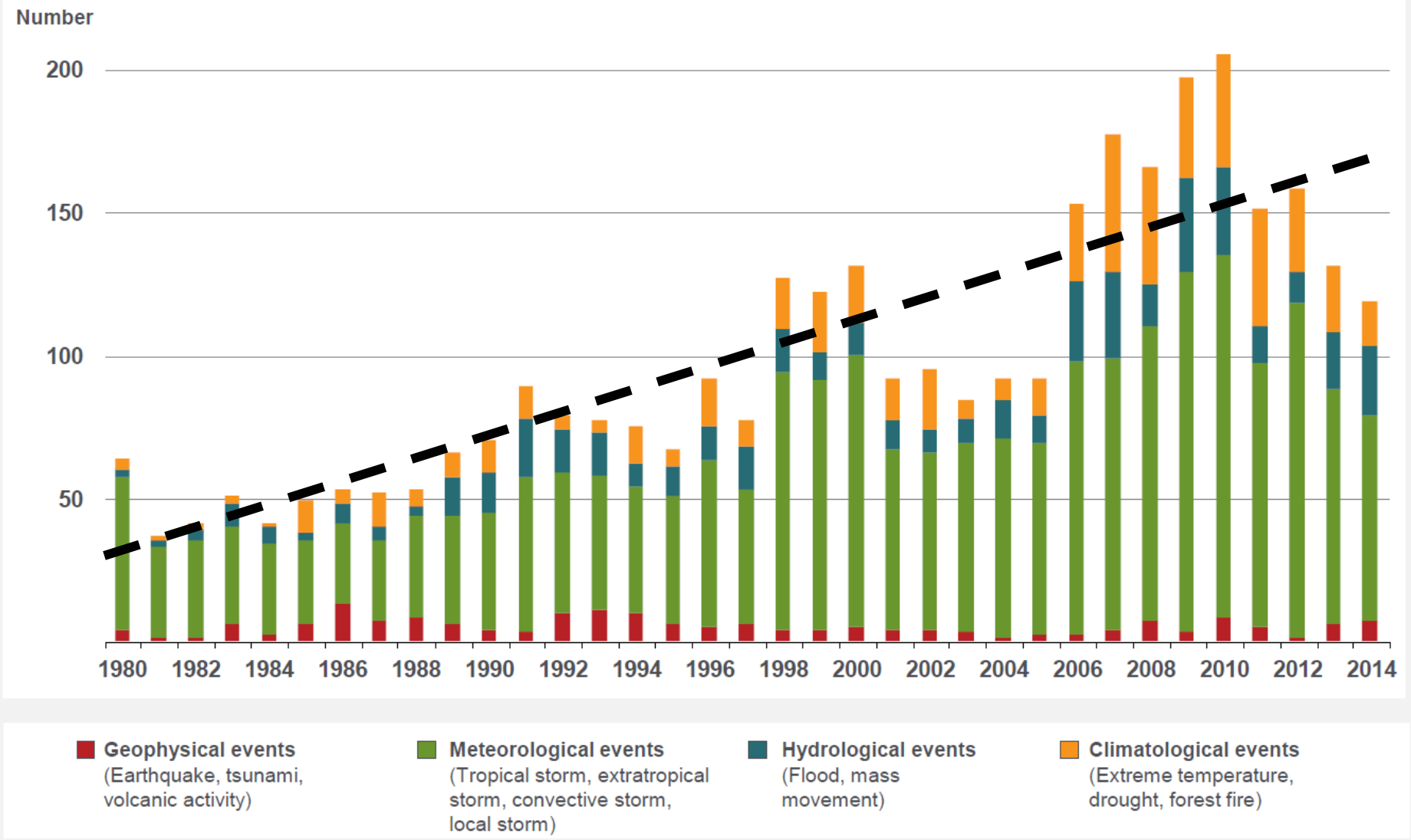
Ratio of Record Daily High Temperatures to Record Lows



Observed Change in Very Heavy Precipitation



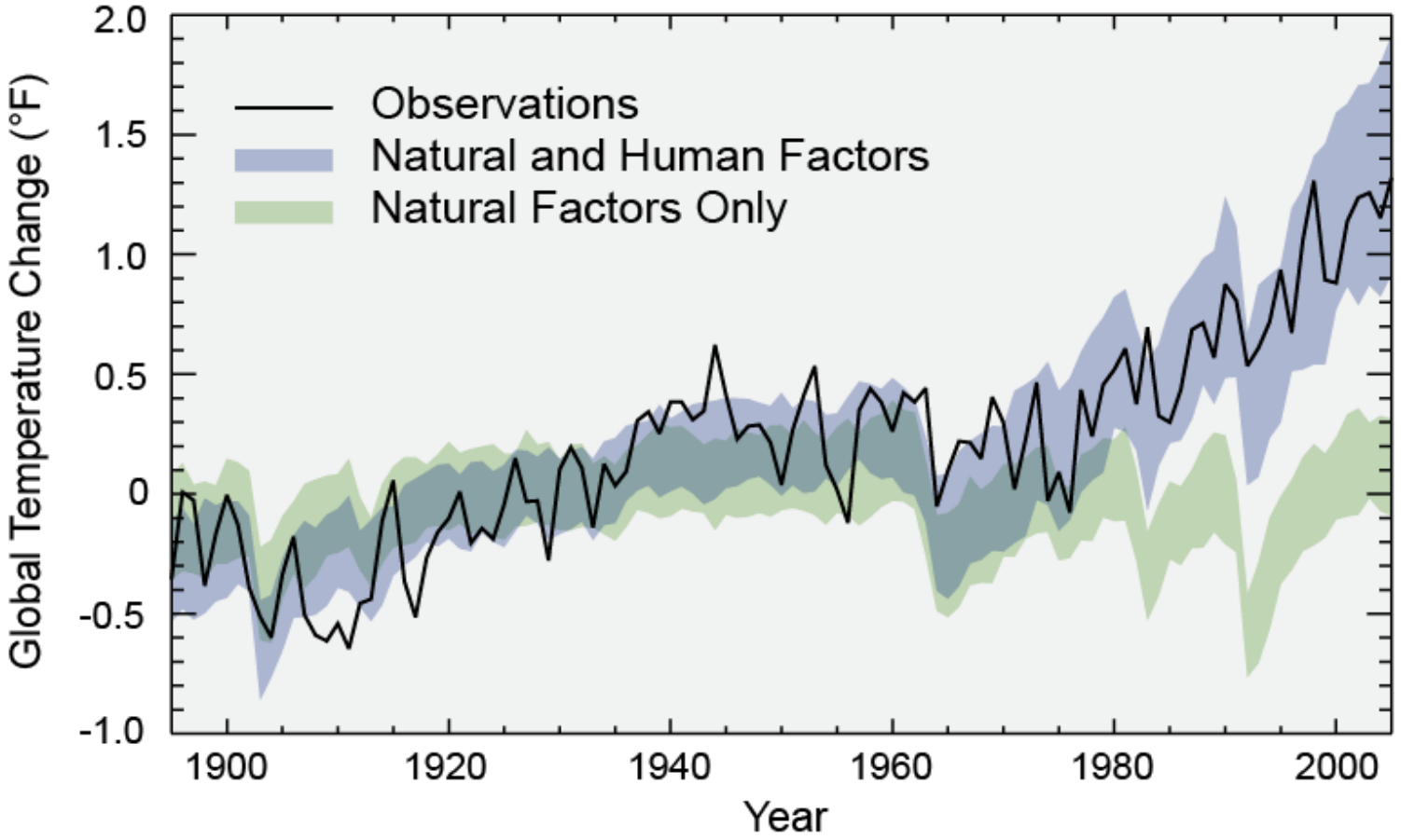
Loss Events in the U.S., 1980-2014, number of events (Munich RE:)




Separating
Natural from
Human
Factors

Separating Human and Natural Influences on Climate

Climate models can capture the observed 20th century temperature change



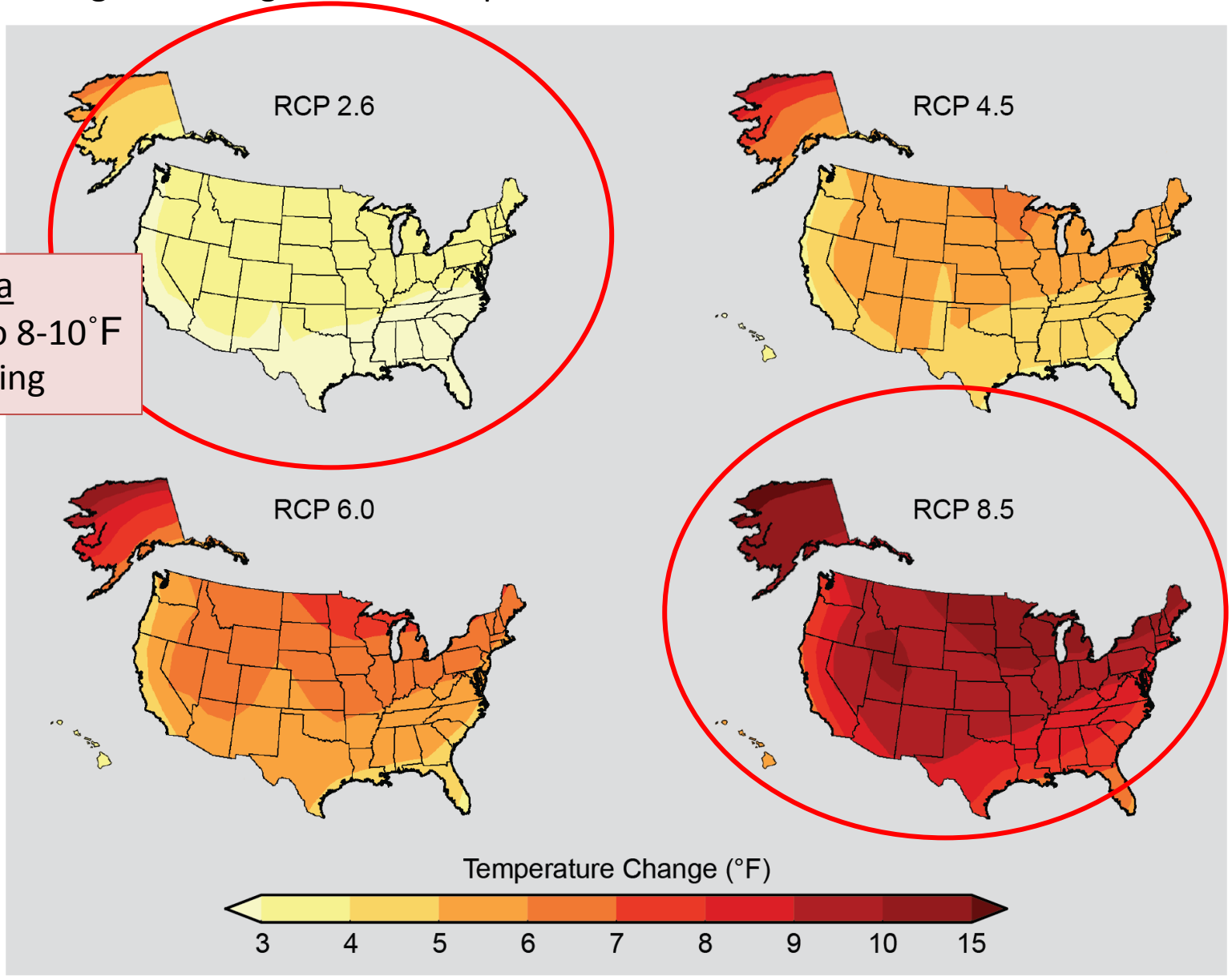
Projections of Future Climate: Implications for Nebraska

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 increases.
  - Frost-free season continues to increase by an **additional 2 weeks** by the end of the century.

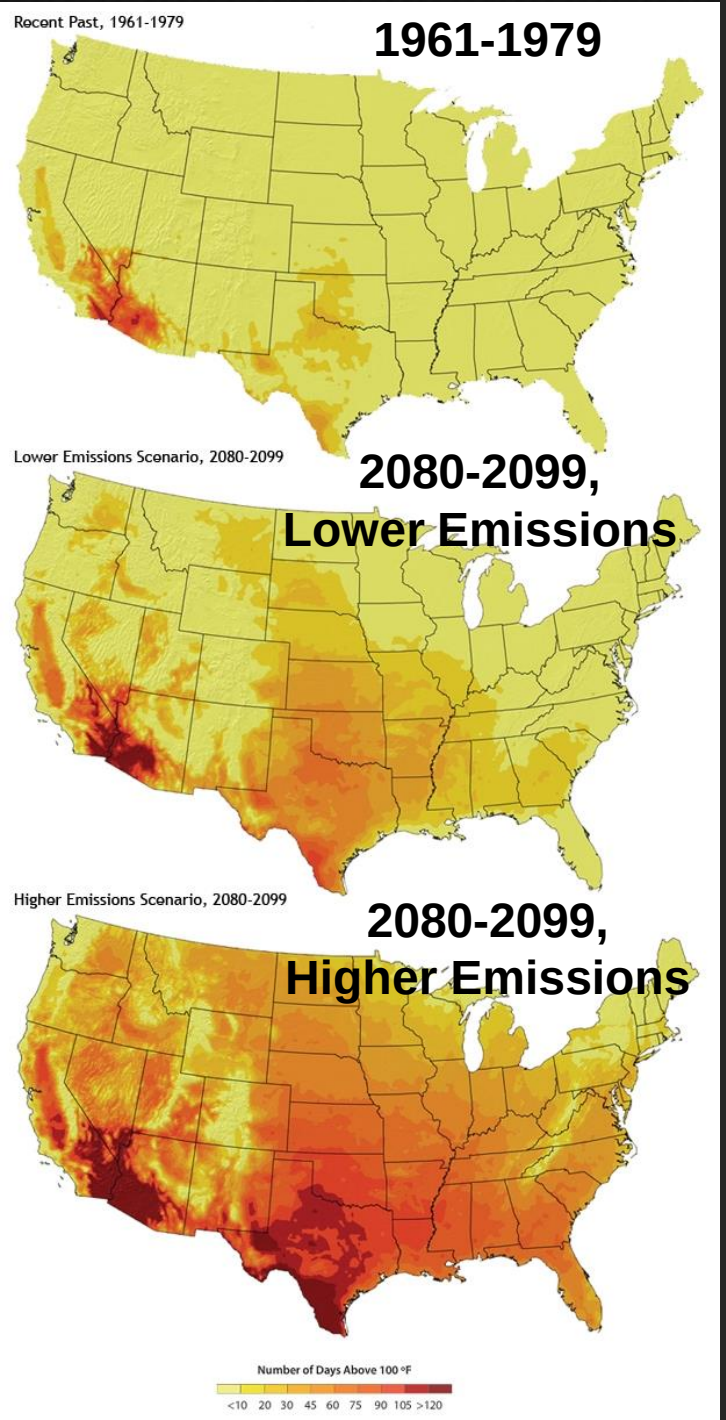
The inevitability of climate change, U.S.

Change in average annual temperature in 2071-2099 relative to 1970-1999



Nebraska
4-5 ˚F to 8-10˚F of warming

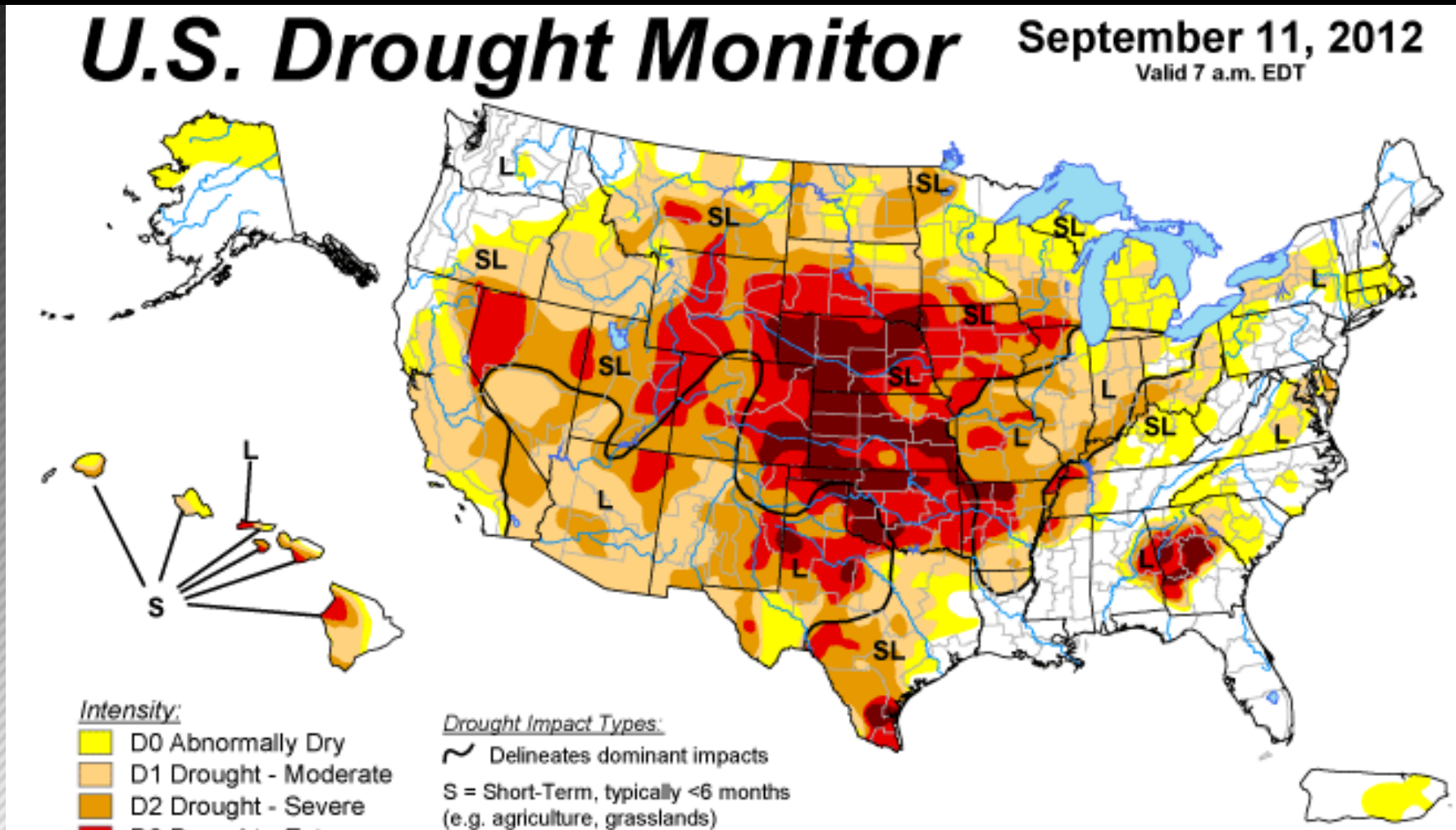
NCA (2014)



Number of Days Above 100° F.

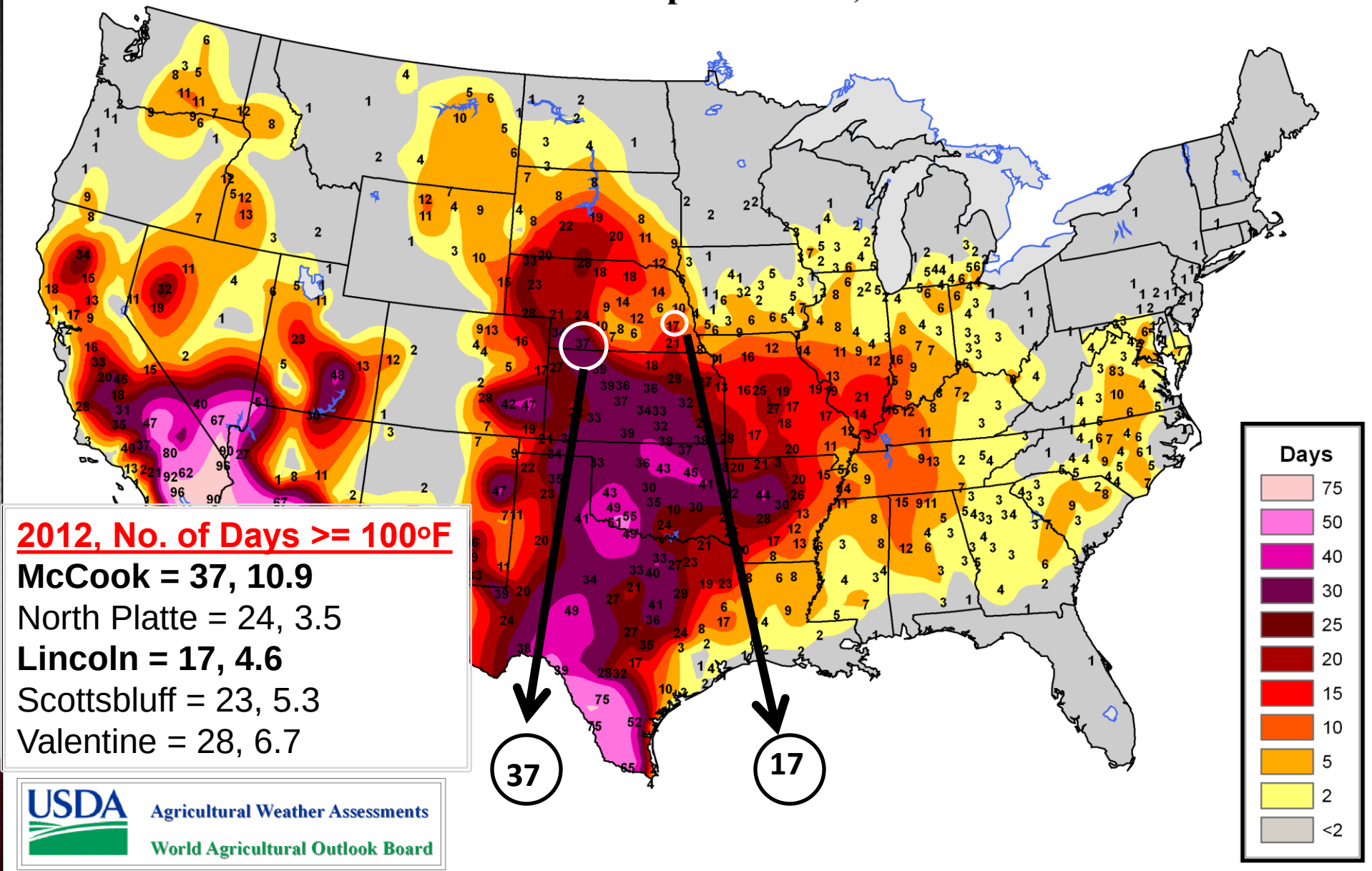
Observed and Projected

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

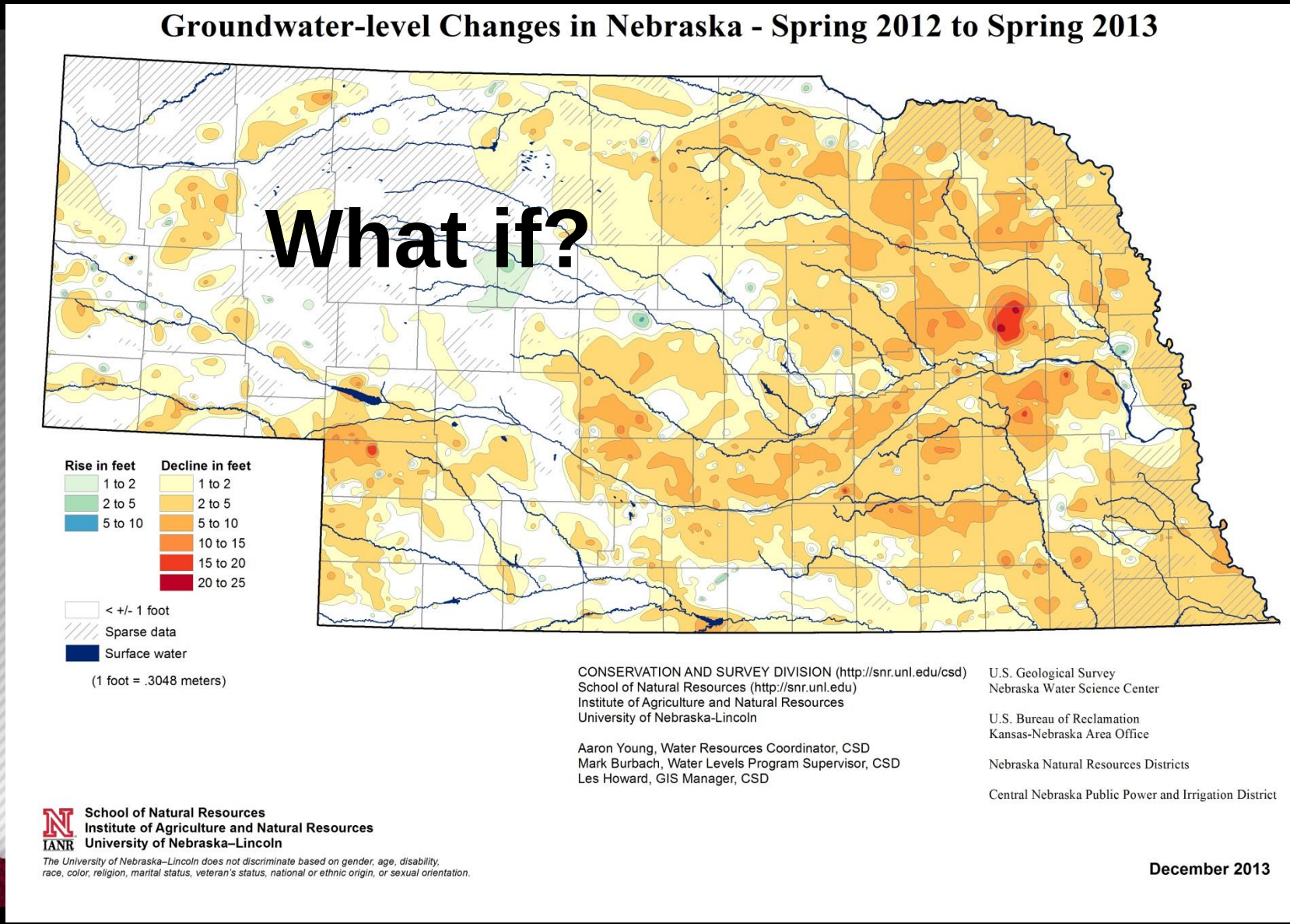
Scottsbluff = 23, 5.3

Valentine = 28, 6.7

USDA Agricultural Weather Assessments

World Agricultural Outlook Board

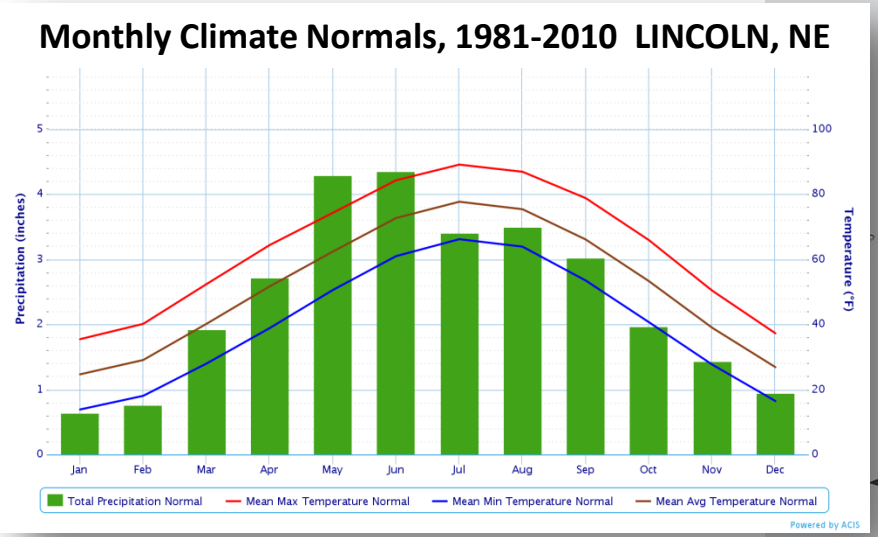
Groundwater Resources

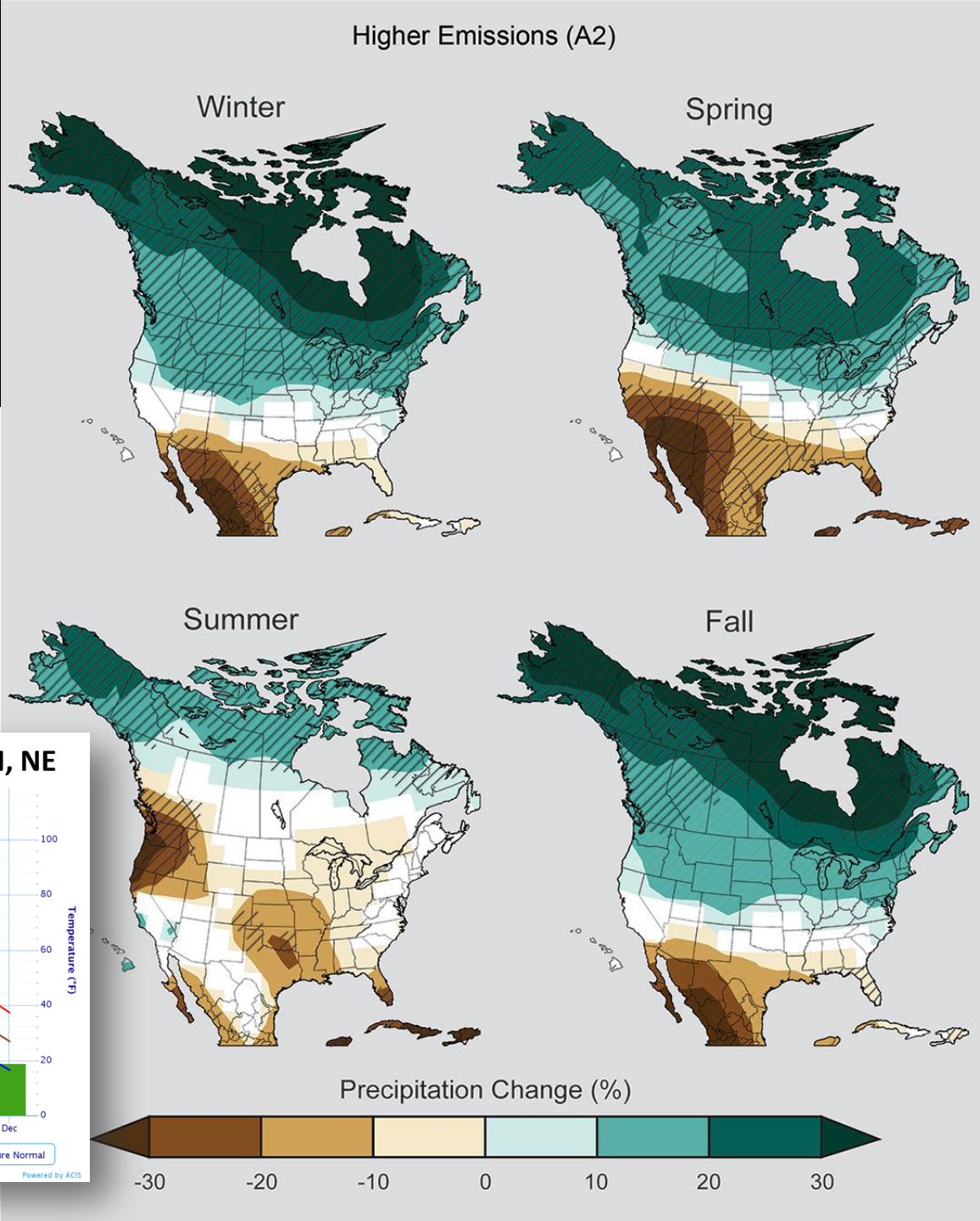


Source: UNL Conservation and Survey Division

Projected Precipitation Change by Season

2071-2099 scenario compared to the period 1970-1999





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


Takeaway Points, Challenges and Opportunities

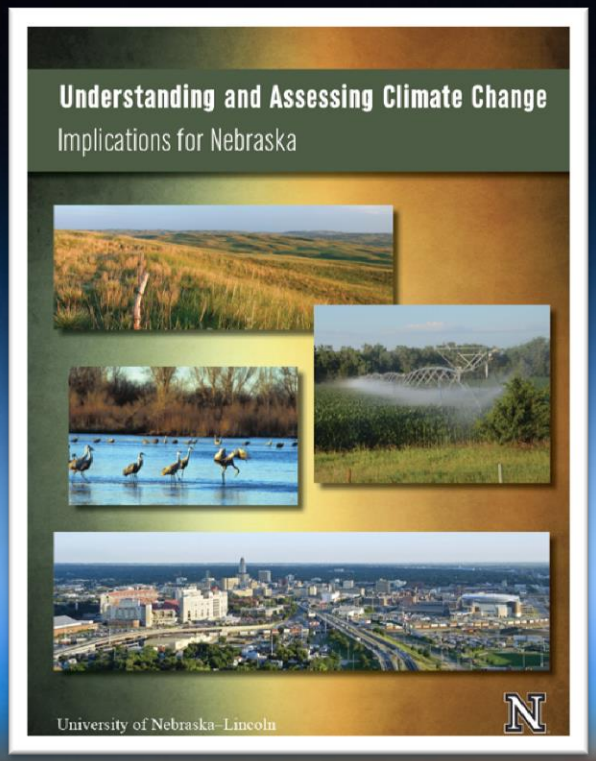
Nebraska Climate Projections

- **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 meet 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?

- COP 21, Paris Climate Treaty
- Many grassroots organizations have used the UNL Climate Change Report to launch educational efforts and action programs.
- UNL Roundtable Report will further our discussion and promote actions from government, universities and stakeholder organizations.
- Individually and collectively, **YOU** can influence your peers, high school, university or organization to focus research and education efforts on solutions!
- **VOTE!!!** Challenge all candidate's statement on climate change—local, state and Presidential candidates.

Thanks for your attention!
Actively engage in the conversation!



Questions?

The report is available on line at
http://go.unl.edu/climatechange