The Central Great Plains Climate Change Education Partnership

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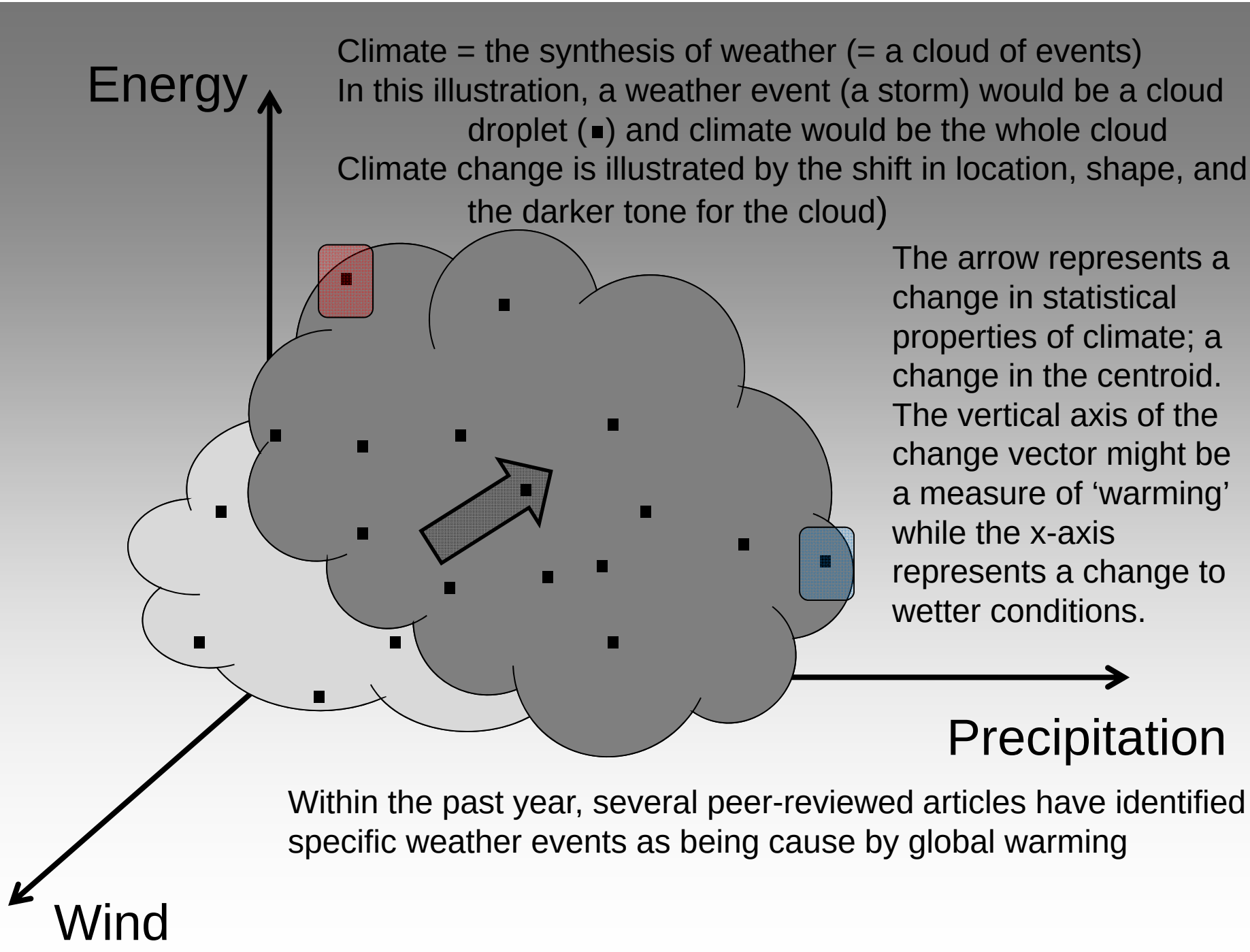
The nature of climate

"Climate cannot be experienced directly through our senses. Unlike the wind which we feel on our face or a raindrop that wets our hair, climate is a constructed idea that takes these sensory encounters and builds them into something more abstract." (p. 3-4)

Mike Hulme, 2009. Why We Disagree About Climate Change. Cambridge Univ. Press

Climate = the synthesis of weather (= a cloud of events)
In this illustration, a weather event (a storm) would be a cloud droplet (▪) and climate would be the whole cloud
Climate change is illustrated by the shift in location, shape, and the darker tone for the cloud)



The arrow represents a change in statistical properties of climate; a change in the centroid. The vertical axis of the change vector might be a measure of 'warming' while the x-axis represents a change to wetter conditions.

Within the past year, several peer-reviewed articles have identified specific weather events as being cause by global warming

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

Climate Change Pushes Groundhog Day to January

Dear John,

The Union of Concerned Scientists and the town of Punxsutawney, Pennsylvania announced today that Groundhog Day will be pushed forward eight days to January 25 in 2012 in recognition of the impact climate change has had in the region.

Spring Comes Eight Days Earlier

Groundhog Day will be pushed forward eight days in recognition of the impact climate change has had on the region.

READ MORE

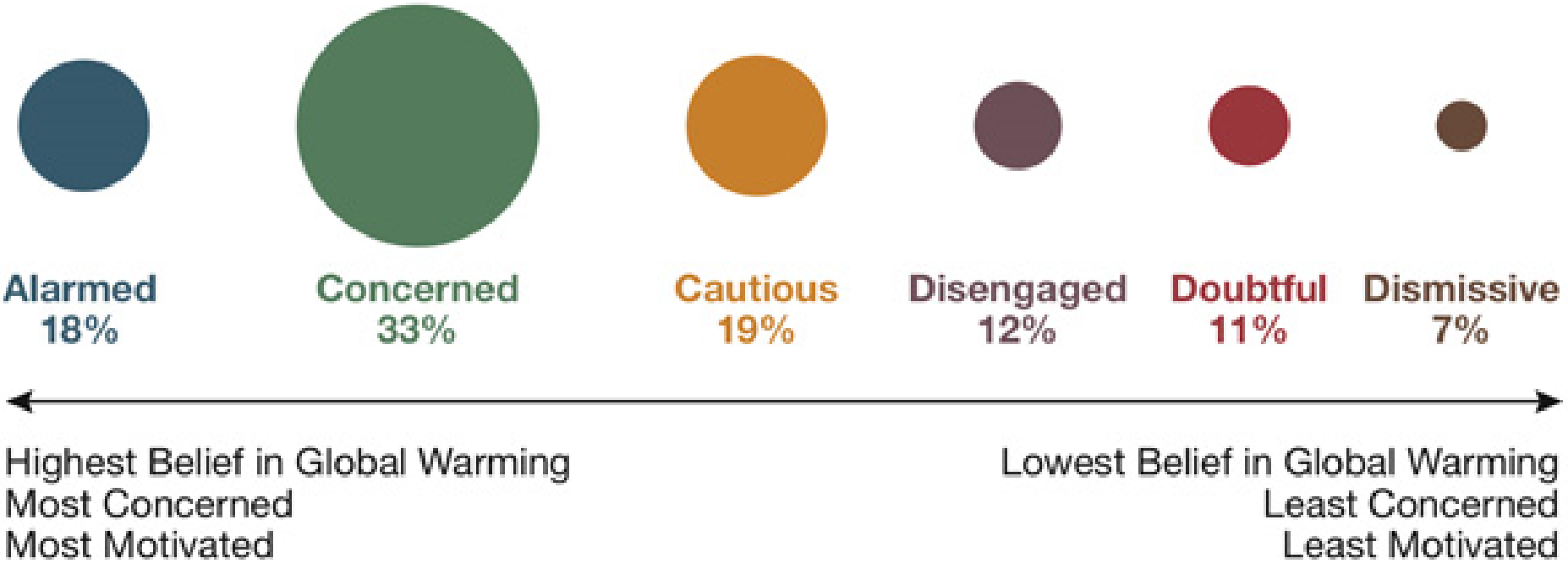
The change is based on analysis by UCS scientists who found that, since 1997, spring has come an average of eight days earlier to western Pennsylvania.

"We hope that the change in date will bring needed attention to the consequences of climate change in Pennsylvania and the importance of investing in a clean energy economy," said Dr. Phil DeGraeve, a climate scientist at Pennsylvania State University.

Read more about the analysis behind the Groundhog Day change and learn how various elected officials are reacting to the news.

Figure 1: Proportion of the U.S. Adult Population in the Six Americas

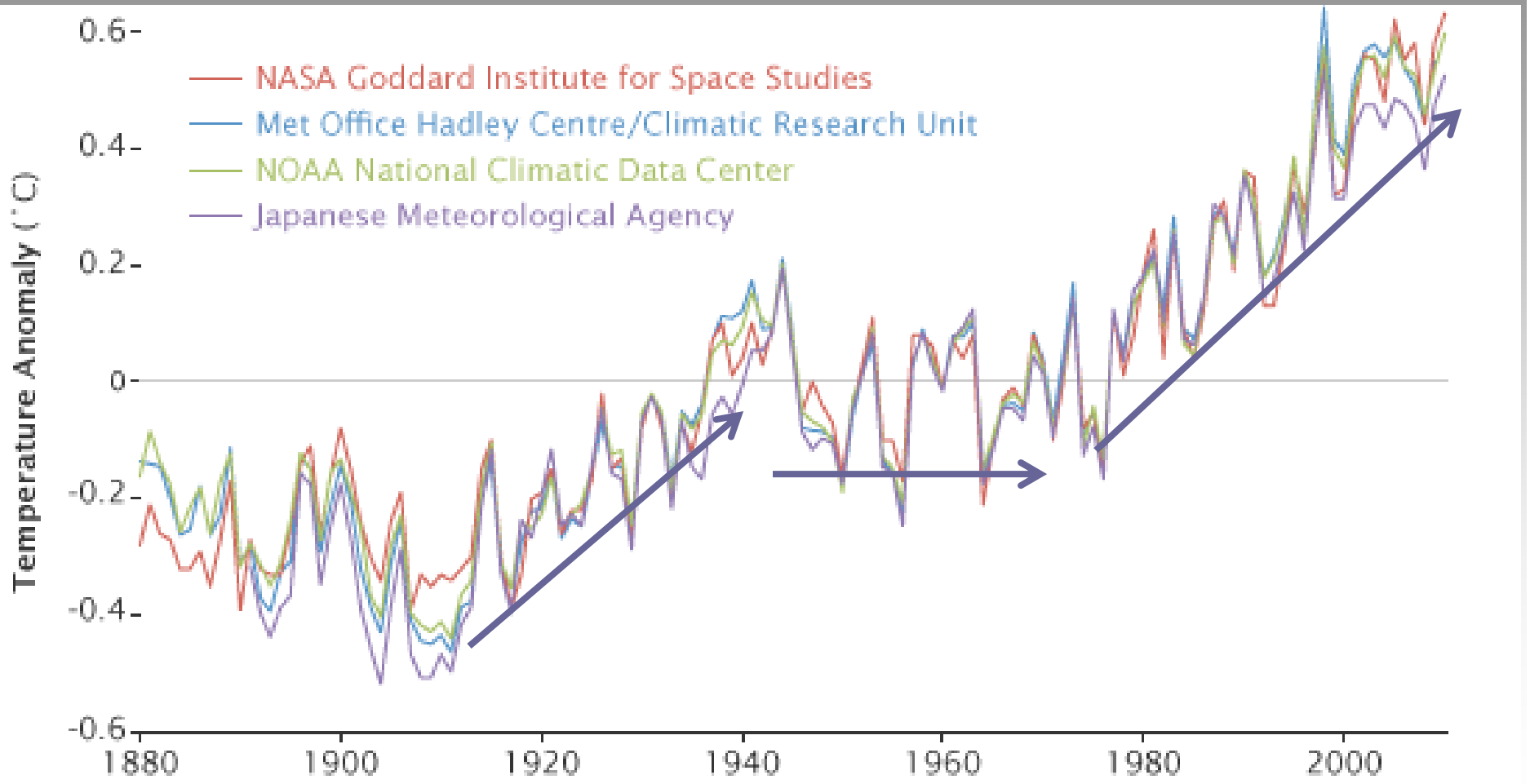
Proportion represented by area



Climate Science (models of future scenarios) suggest we should be very concerned about the future, but the "Merchants of Doubt" have had an impact

Climate Science:

Scientific climatology addresses the **nature and controls** of the earth's climate and the **causes of climate variability** and change on all timescales.



What is Climatology?

Description and **scientific** study of climate.

Descriptive climatology

Scientific climatology

Applied climatology

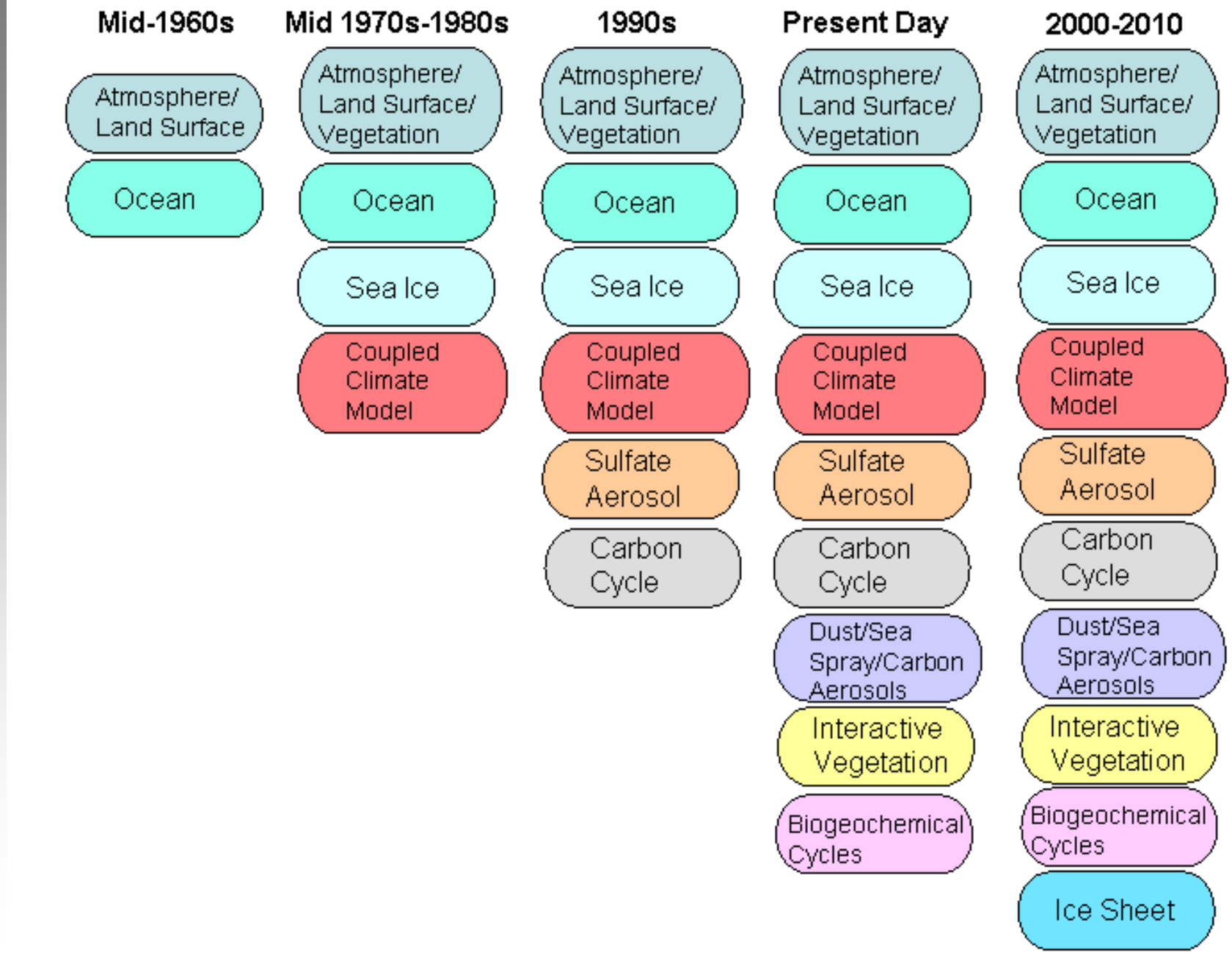
Glossary of Meteorology, 2nd Edition, 2000, AMS

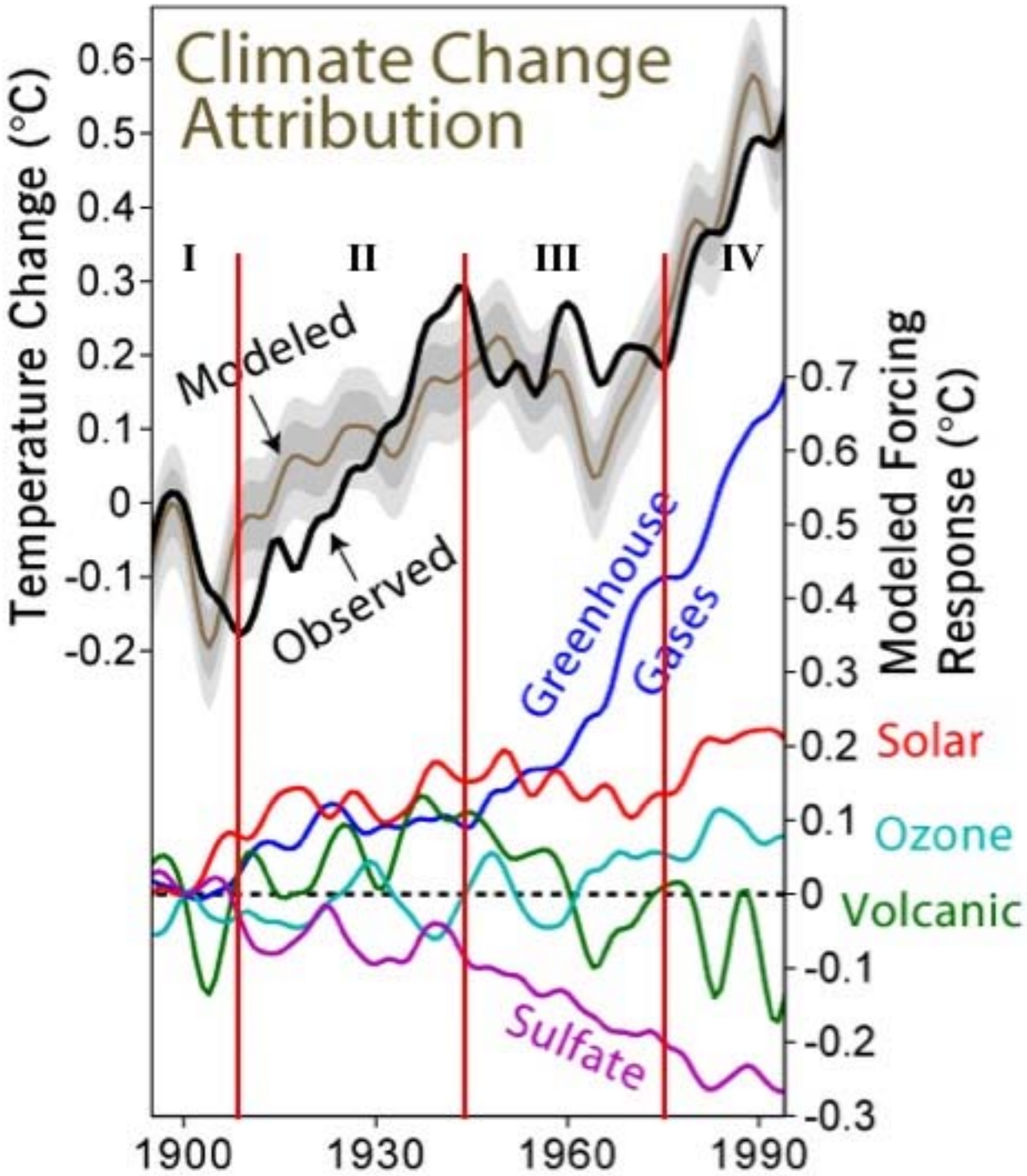
Descriptive = stats of averages and extremes

Scientific = models of physical processes

Applied = sector specific (e.g., water) analysis

Timeline of Climate Model Development – Climate Science is advancing





Natural and anthropogenic contributions to global temperature change (Meehl et al., 2004). Observed values from Jones and Moberg 2001. Grey bands indicate 68% and 95% range derived from multiple simulations.

Model runs suggest that an increase in GHGs since about 1975, has become the dominant reason for increasing planetary temperature

The sum of (i) percentage of the United States with maximum temperatures much below normal and (ii) percentage of the United States with maximum temperatures much above normal.

The sum of (i) percentage of the United States with minimum temperatures much below normal and (ii) percentage of the United States with minimum temperatures much above normal.

The sum of (i) percentage of the United States in severe drought (equivalent to the lowest 10th percentile) based on the PDSI and (ii) percentage of the United States with severe moisture surplus (equivalent to the highest 10th percentile) based on the PDSI.

Twice the value of the percentage of the United States with a much greater-than-normal proportion of precipitation derived from extreme (more than 2 inches or 50.8 mm) 1-day precipitation events.

The sum of (i) percentage of the United States with a much greater-than-normal number of days with precipitation and (ii) percentage of the United States with a much greater-than-normal number of days without precipitation.

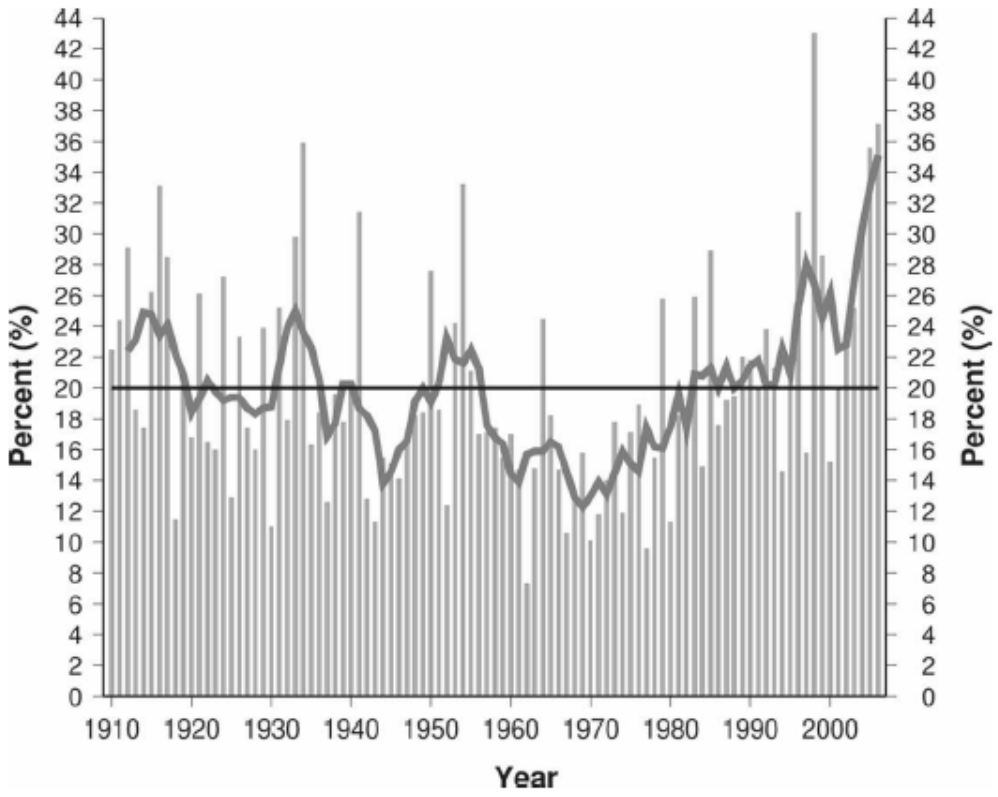


FIG. 4. The U.S. Climate Extremes Index annual period from 1910 to 2006. Bars represent annual extreme values, the dark curve depicts the 5-yr moving average, and the straight line is the period of record average.

The US Climate Extremes Index

M. Schwartz 1995 *Annals of the AAG* Vol 85: 553-568
Detecting Structural Climate Change: An Air Mass Based Approach in the North Central United States, 1958-1992

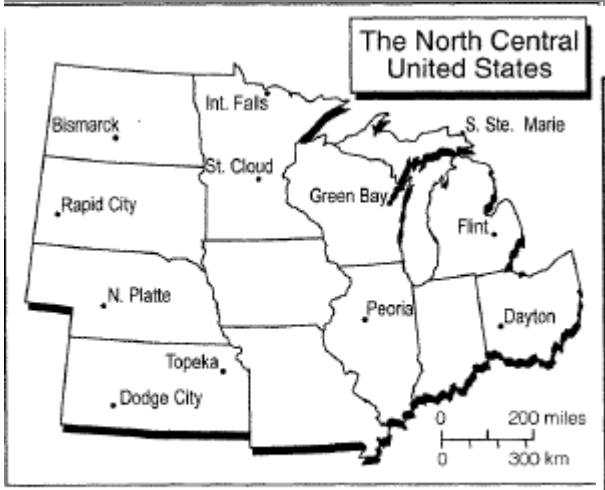


Figure 1. The North Central United States: Study area and station locations.

C = Continental

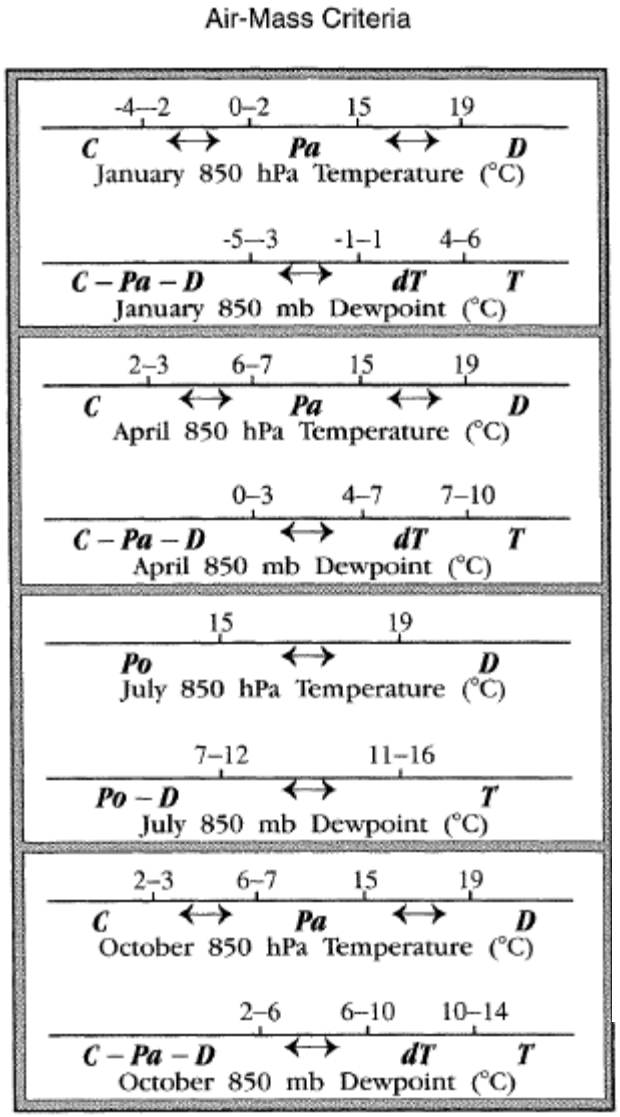
Pa = Pacific

Po = Polar

D = Dry Tropical

dT = dilute Tropical

T = Tropical



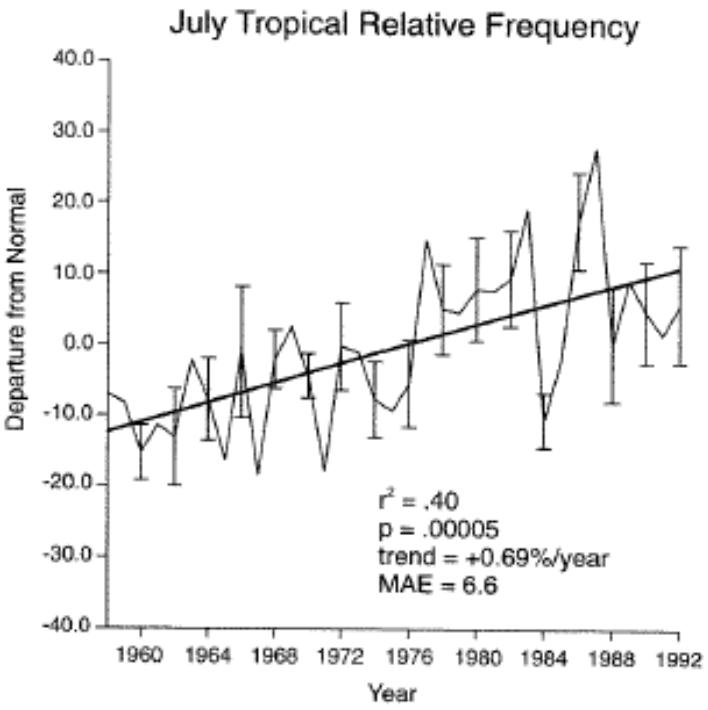
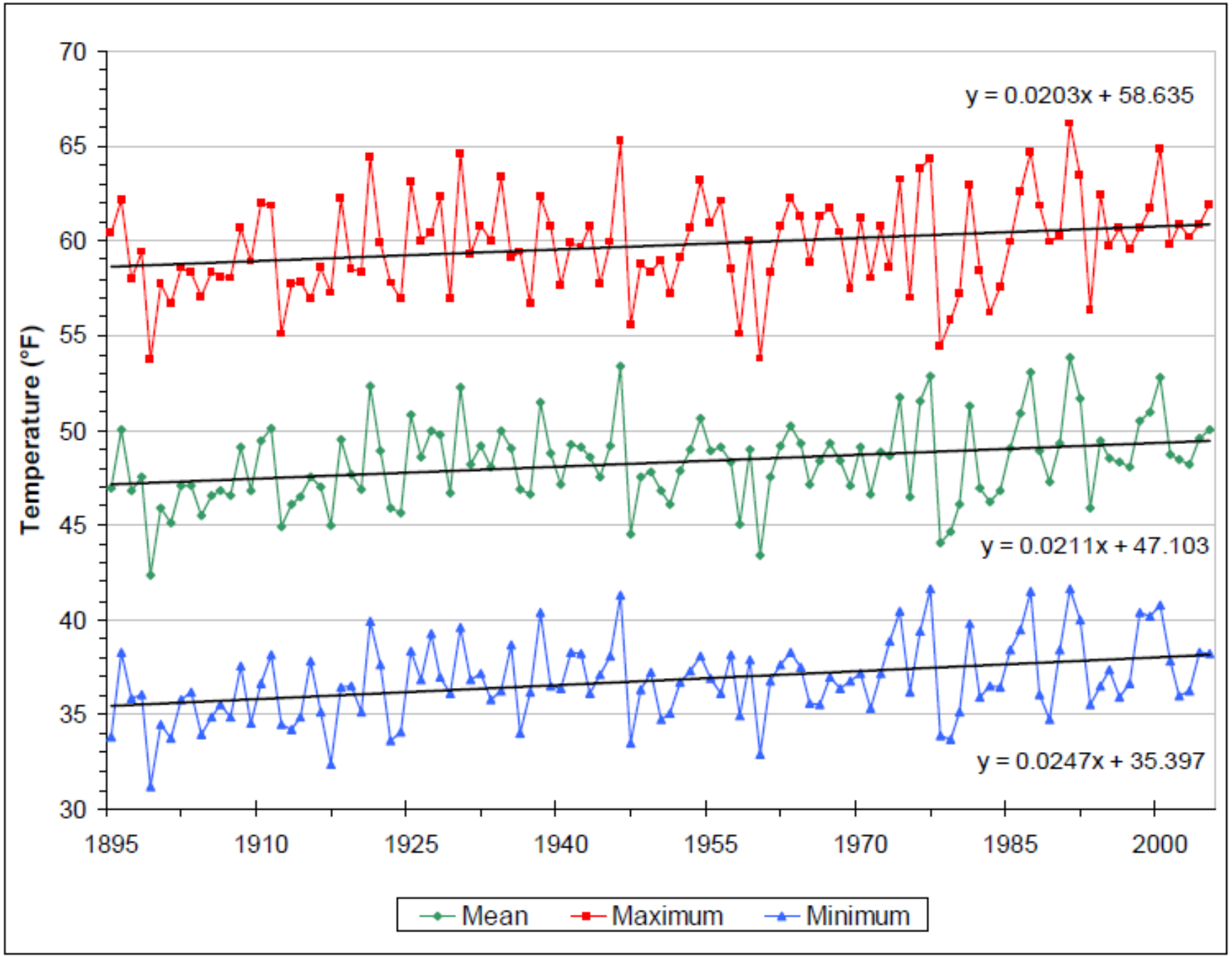


Figure 4. Six-station mean July Tropical (*T*) air-mass relative frequency departures from 1961–1990 normals (average of all data over the period), with ±1 s.e. bars at regular intervals and a regression trend line including r-squared, probability, trend, and mean absolute error terms. The six stations with significant individual trends include Dayton, Flint, Green Bay, Peoria, Sault Ste. Marie, and Topeka.

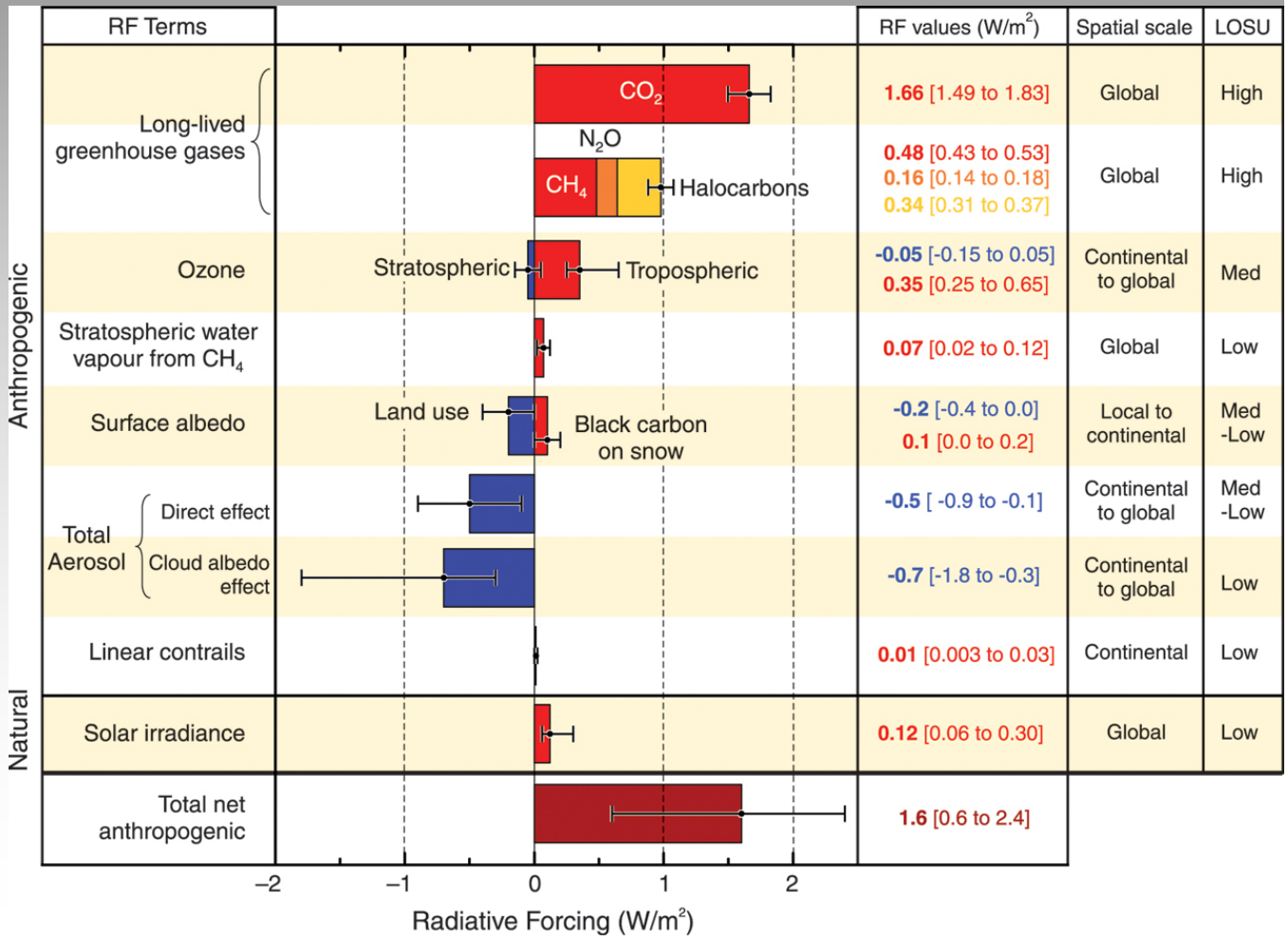
Figure 4.4 – Northeast Kansas Spring Temperatures Trends

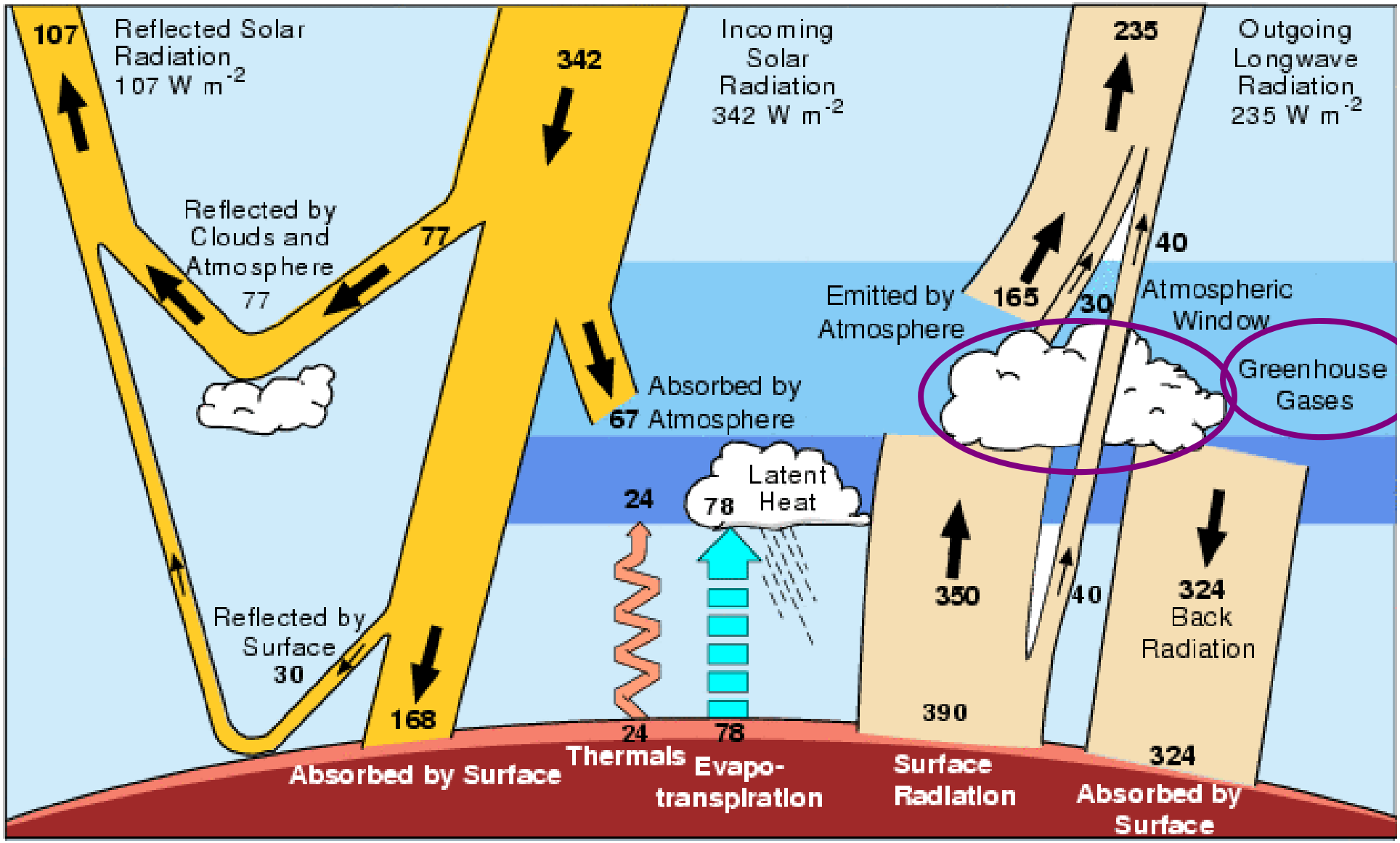


Climate Science:

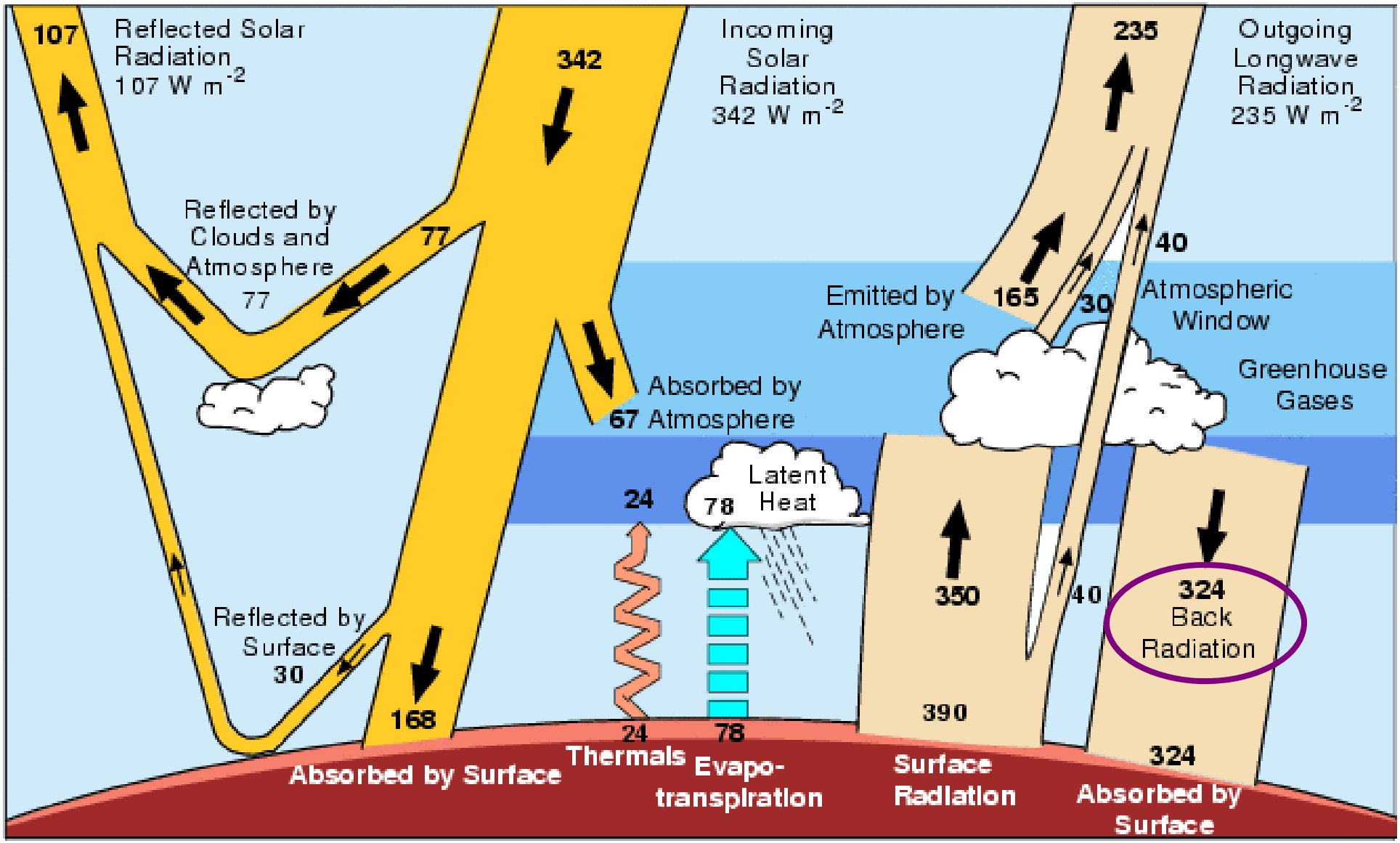
The modern treatment of the nature and theory of climate, as opposed to a purely descriptive account, must deal with **the dynamics of the entire atmosphere-ocean-land surface climate system** in terms of its **internal interaction** and its **response to external factors**, for example, incoming solar radiation.

IPCC diagram of recent changes in radiative forcing

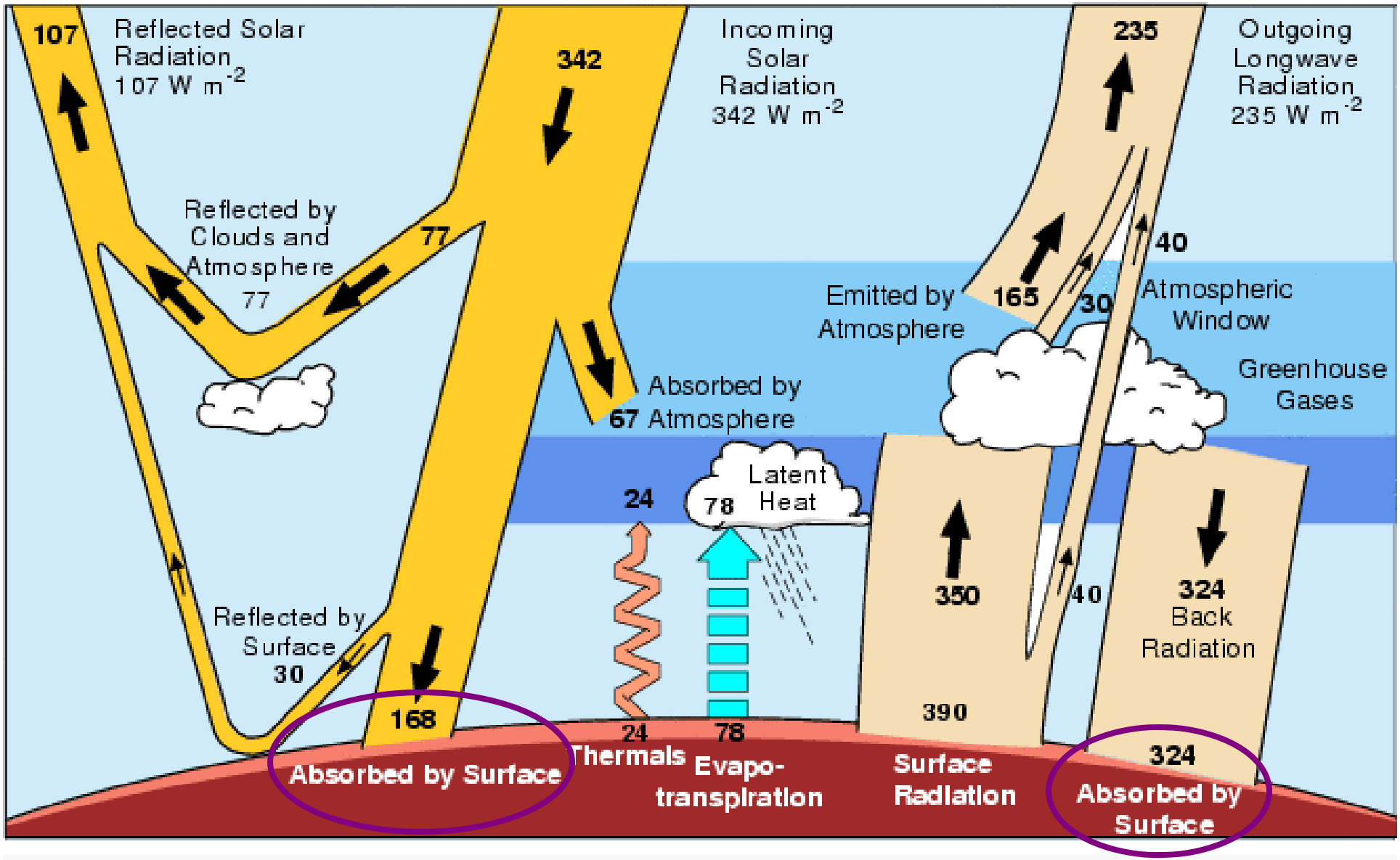




On the right-hand side of the diagram, greenhouse gases and clouds help trap (absorb) energy (heat) and then produce (emit) considerable radiation.



A major effect of the back radiation is to keep the Earth's surface warm. Climate scientists calculate that the Earth would be 32ºC cooler without this natural 'greenhouse effect.'



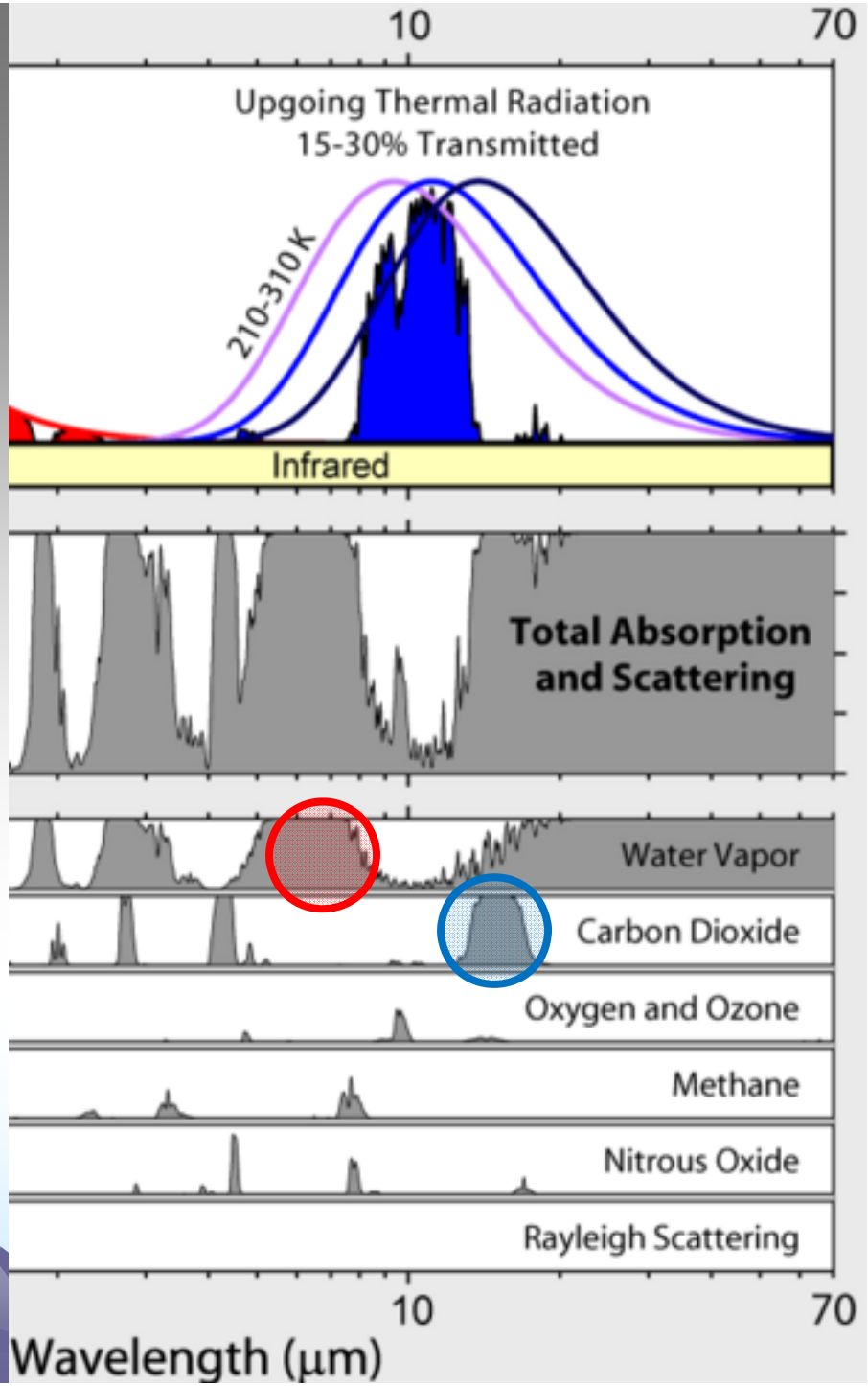
Notice that the amount of energy absorbed by the surface from incoming solar radiation (168 Wm^{-2}) in about ½ the amount of back radiation or recycled energy (324 Wm^{-2}).

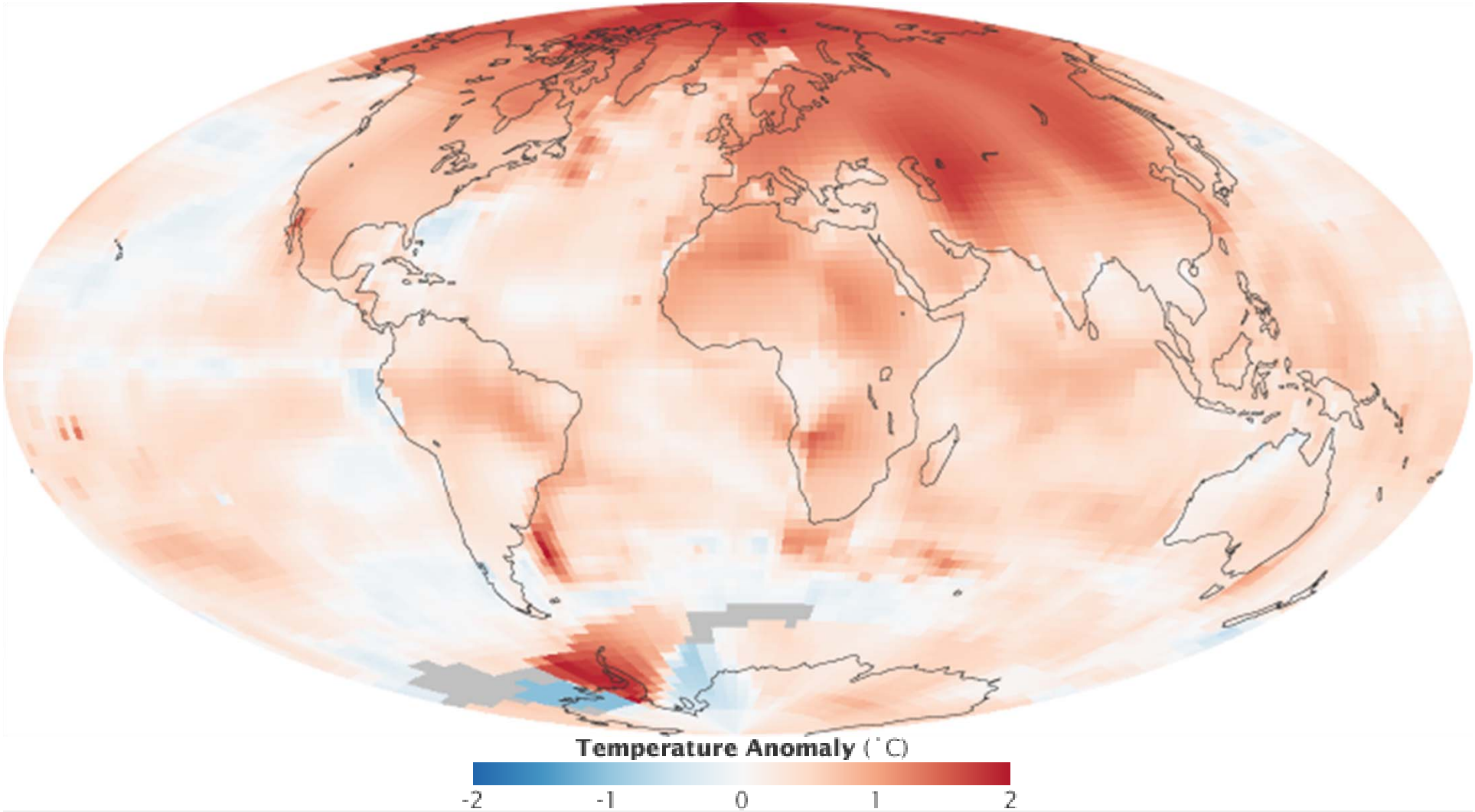
- Where will more CO_2 warm the Earth?

thermal radiation

- Warmer areas on Earth will emit slightly shorter wavelengths and water vapor is the main GHG

- Cooler areas on Earth will emit slightly longer wavelength energy and CO_2 is the main GHG

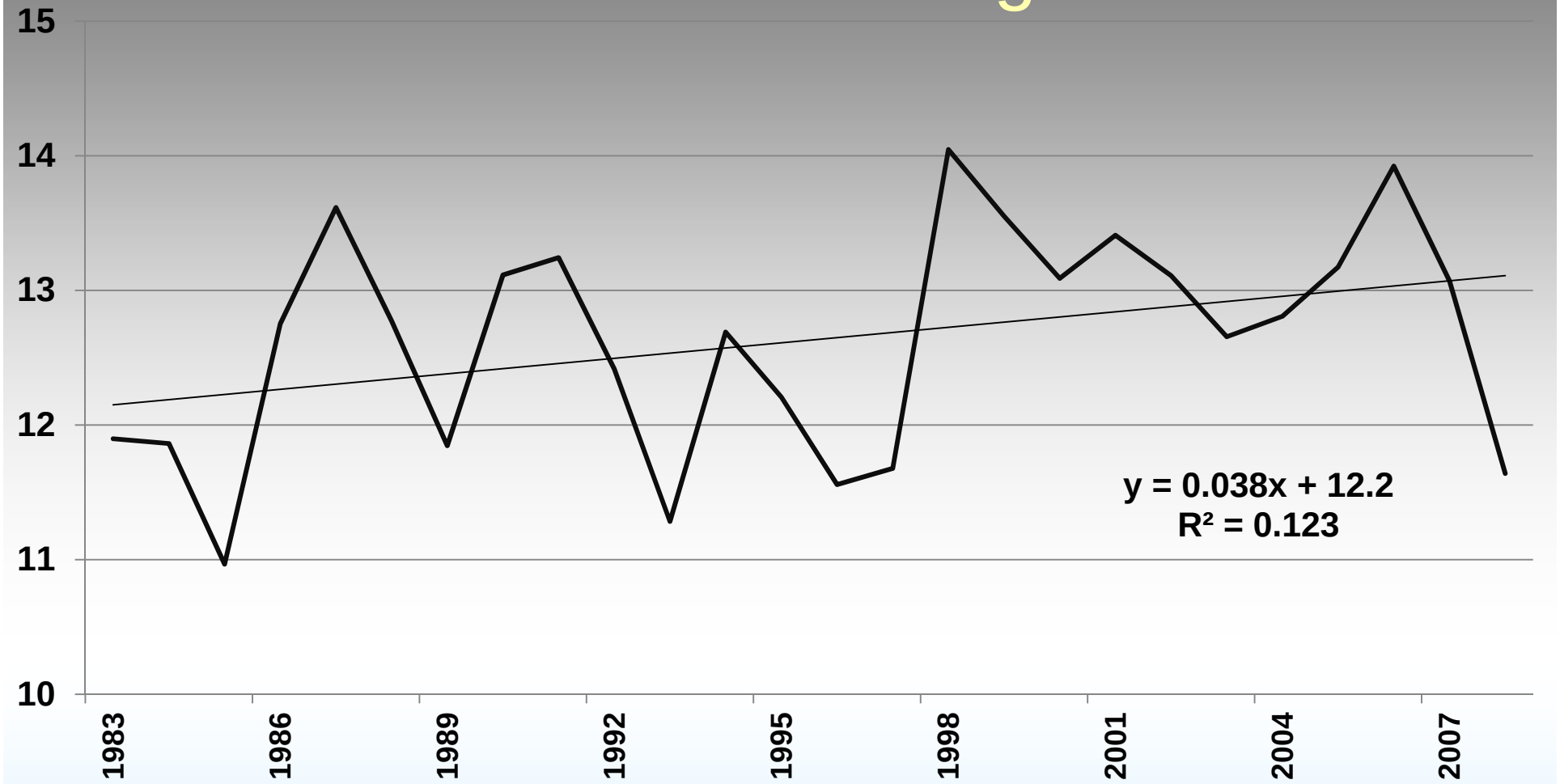




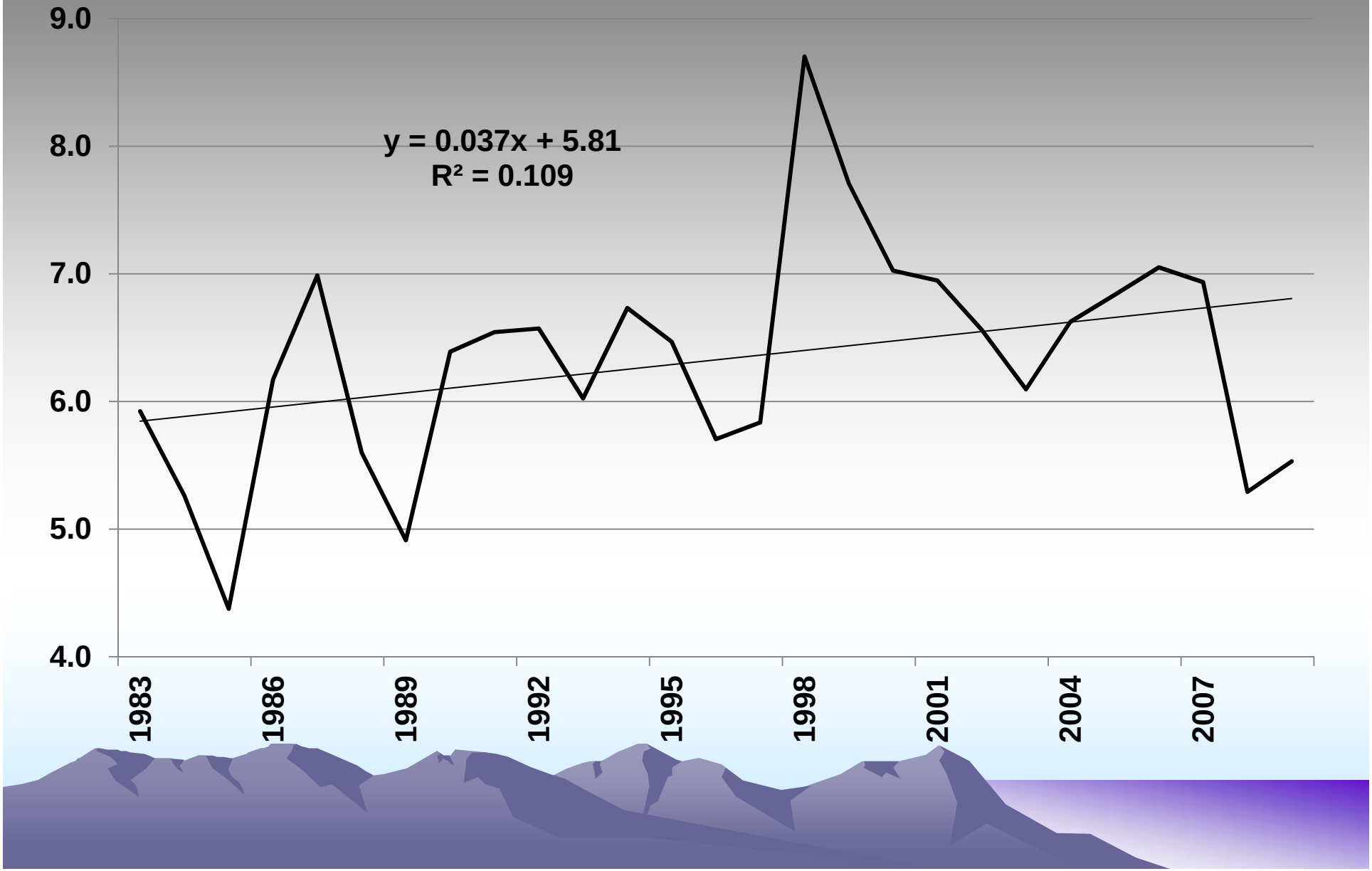
Global pattern of temperature anomalies for 2000-2009 compared with the 1950-1980 base period.

With lots more CO_2, warming is occurring at high latitudes

Mean annual temperature trend
Konza warming!



Average min temperature



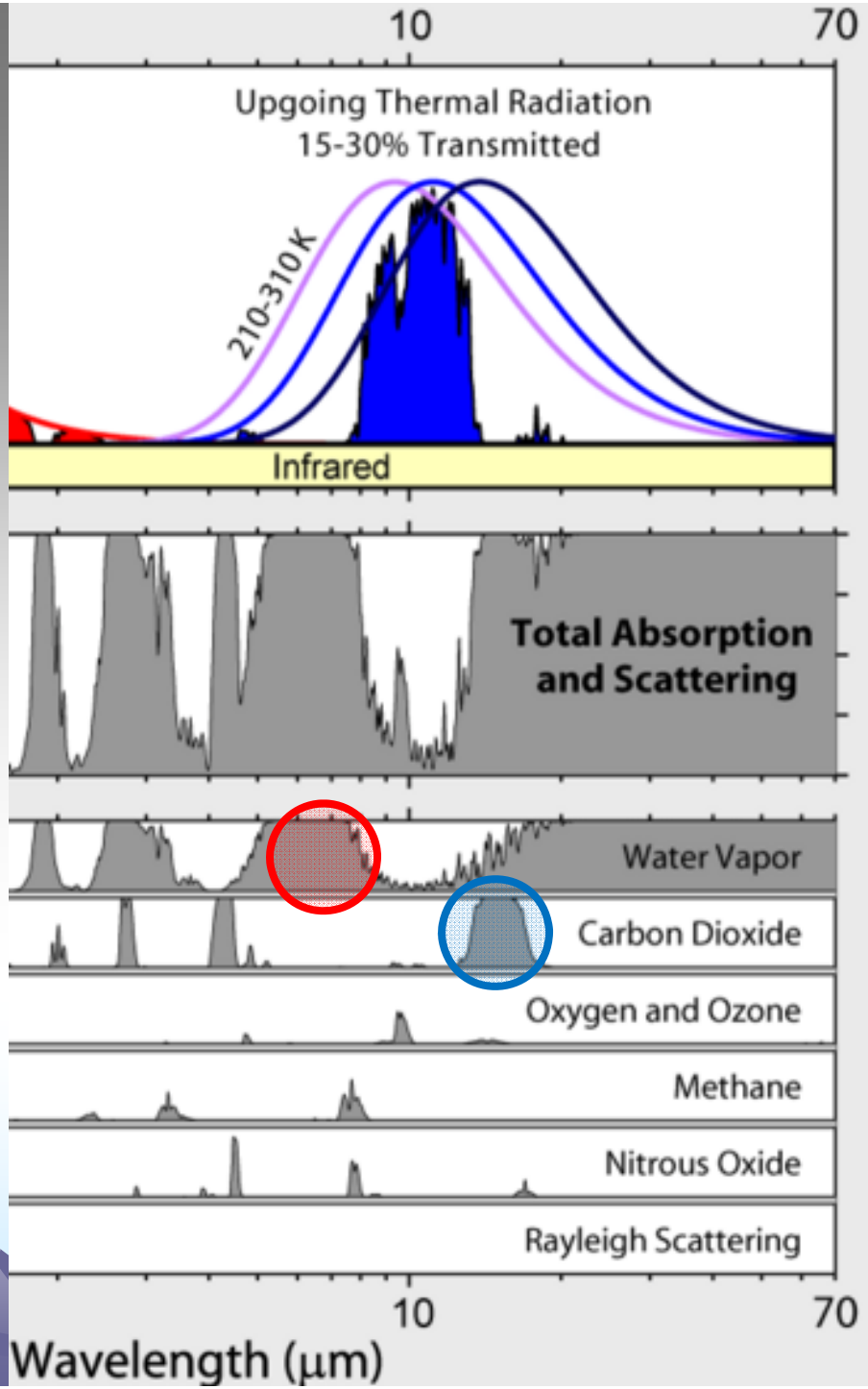
- Earth-emitted or thermal radiation

- Topeka average temperature in:

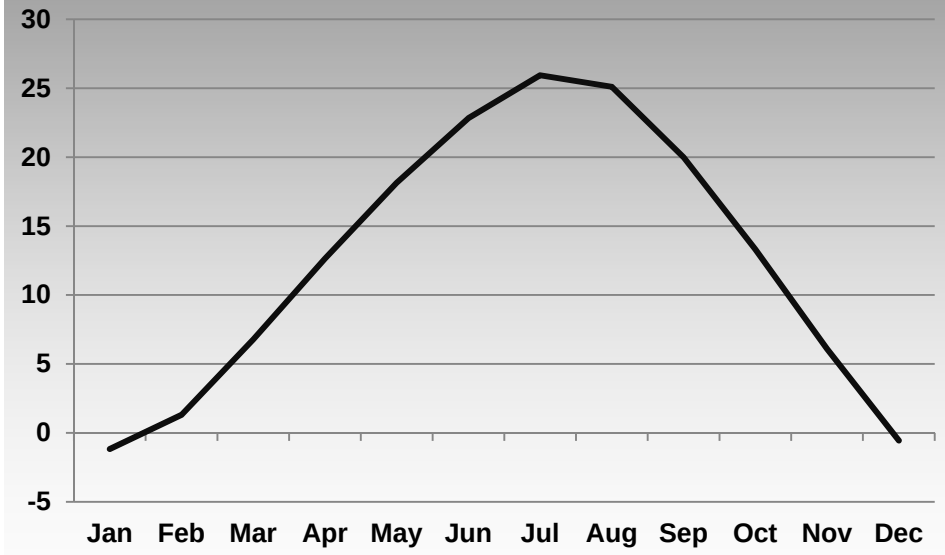
  July = 79 (26.1)

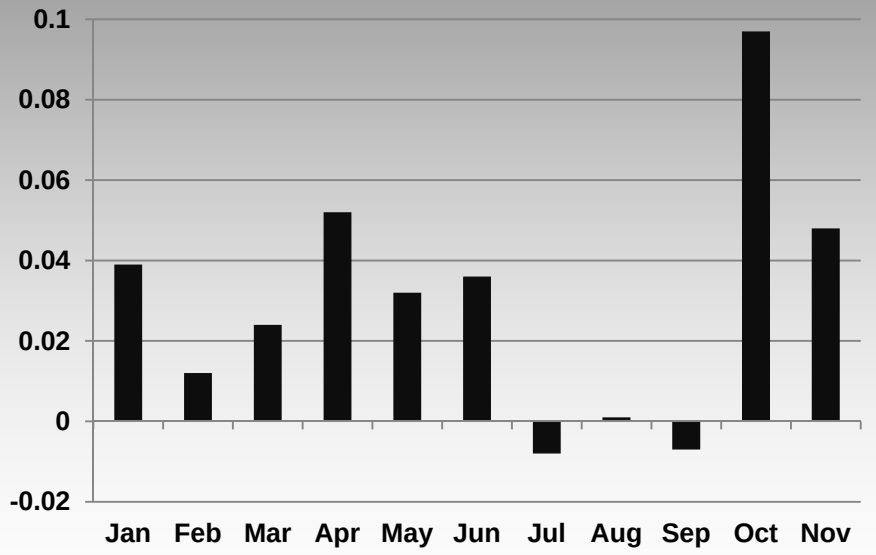
  January = 26 (-3.3)

	Peak wavelength
14.0°C	10.1 µm
26.1	9.7
-3.3	10.7



Mean monthly temperatures
Monthly temperature trends





Monthly values are the slope of a linear trend line

.04 = an increase of .04°C per year

Overall average = .0296

or 2.96°C in 100 years

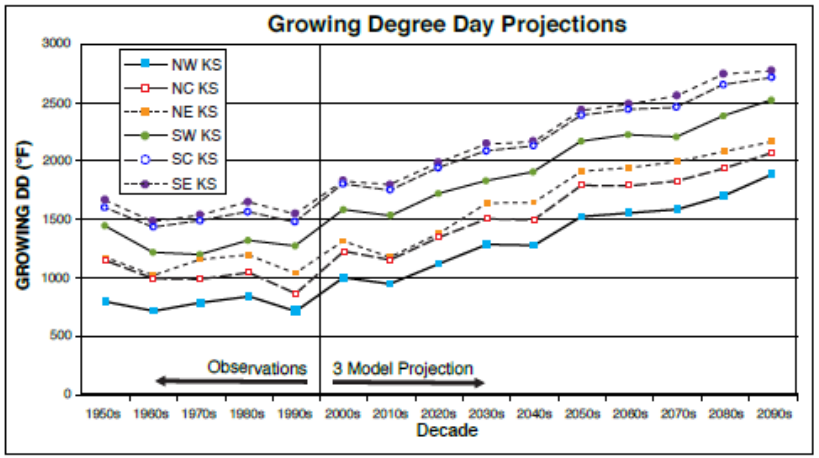
http://www.climateandenergy.org/LearnMore/InTheNews/ClimateStudy.htm

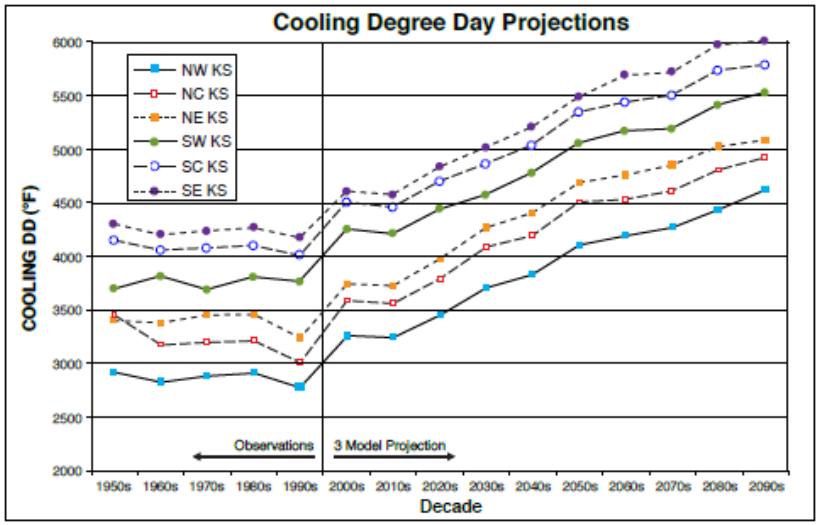
Climate Change Hits Home

The Risks to Kansas

Summary of research carried out by University of Kansas scientists Drs. Nathaniel Brunsell and Johannes Feddema, and assistants Trish Jackson, Aubrey Jones, and Kelly Logan

November 2008





Climate Change in Kansas

Prepared for the Climate and Energy Project of the Land Institute by
Johannes J. Feddema, Nathaniel A. Brunsell, Trish L. Jackson and Aubrey R. Jones
Dept. of Geography, Univ. of Kansas, 1475 Jayhawk Blvd, Lawrence, KS 66045
Contact: feddema@ku.edu or (785) 864 5534

October 23, 2008

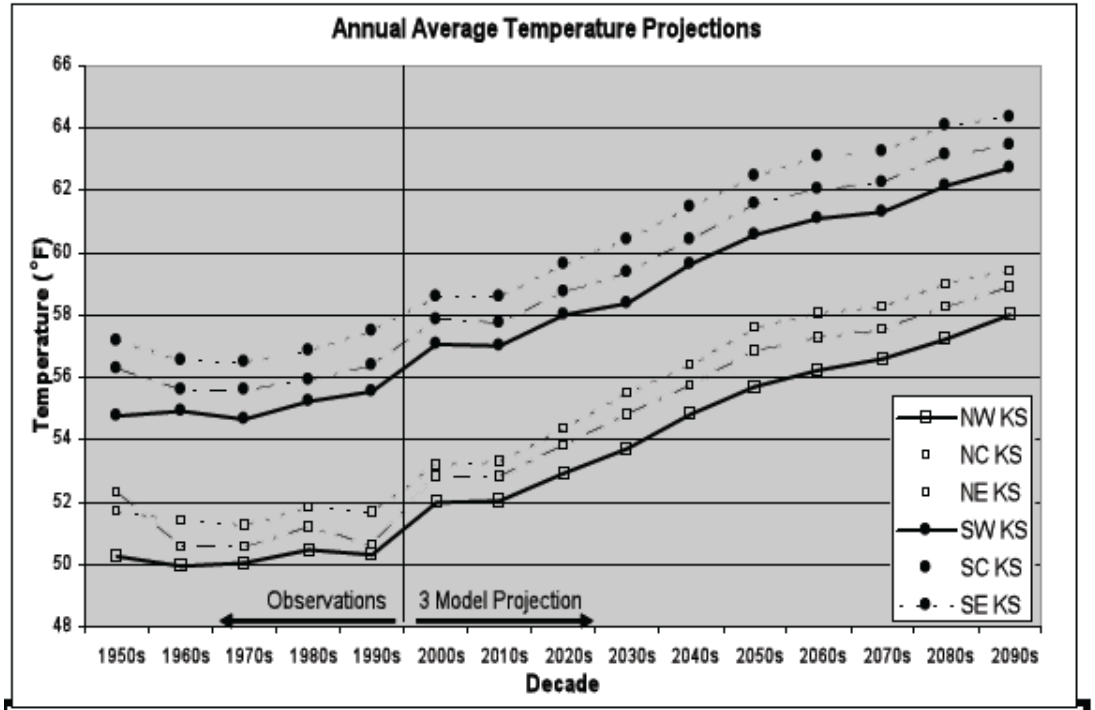


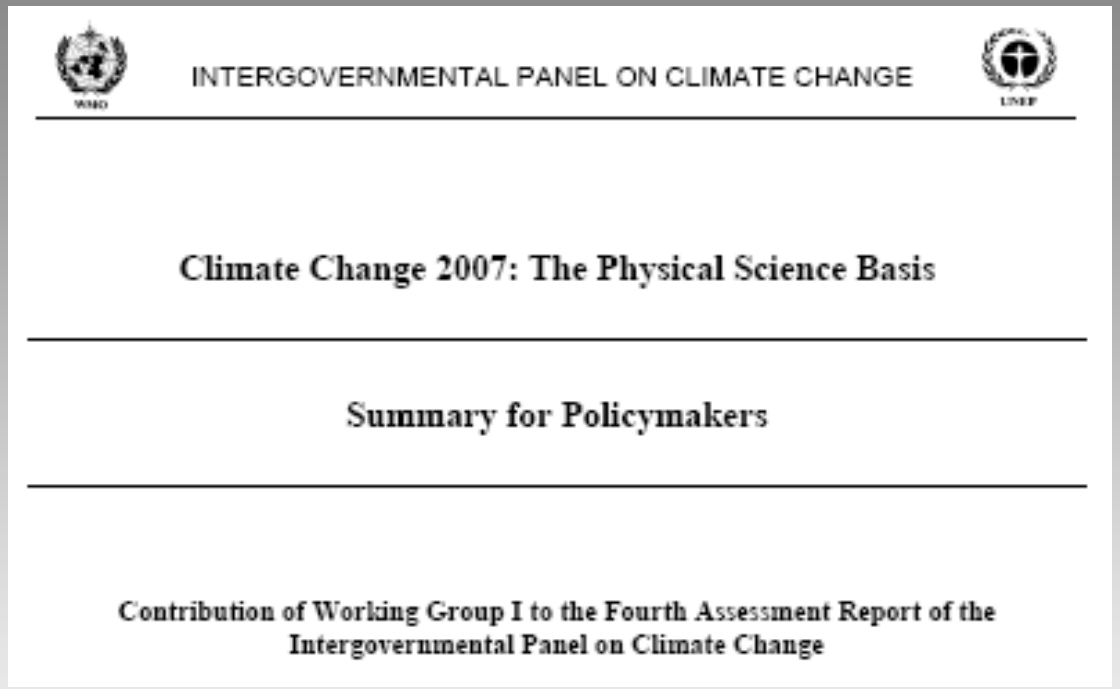
Figure 8. Historical observations (left of the vertical line) and projected temperature changes based on future climate simulations from three global climate models that best simulated the Kansas Climate conditions over the 20th Century. Projections are based on middle of the road (IPCC A1B) greenhouse gas emissions scenarios, and are given for 6 regions in the state.

A Parrot Head Looks at the IPCC

"wasted away in Margaritaville"

- FAR = First Assessment Report 1990
  - **'Its nobody's fault' [Jimmy Buffett – Margaritaville]**
  - **"Thus the observed increase could be largely due to this natural variability: alternatively this variability and other human factors could have offset a still larger human-induced greenhouse warming."**
- SAR = Second Assessment Report 1995
  - **'It could be my fault'**
  - **"The balance of evidence suggests that there is a discernible human influence on global climate. "**
- TAR = Third Assessment Report 2001
  - **'It's my own damn fault'**
  - **"There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."**

In February 2007, the IPCC released a Summary for policymakers with results of the fourth assessment of our collective understanding of the Physical Science Basis related to climate change.



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Climate Change 2007: The Physical Science Basis

Summary for Policymakers

Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

"The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report (TAR), leading to *very high confidence* that the globally averaged net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to + 2.4] Wm^{-2}."

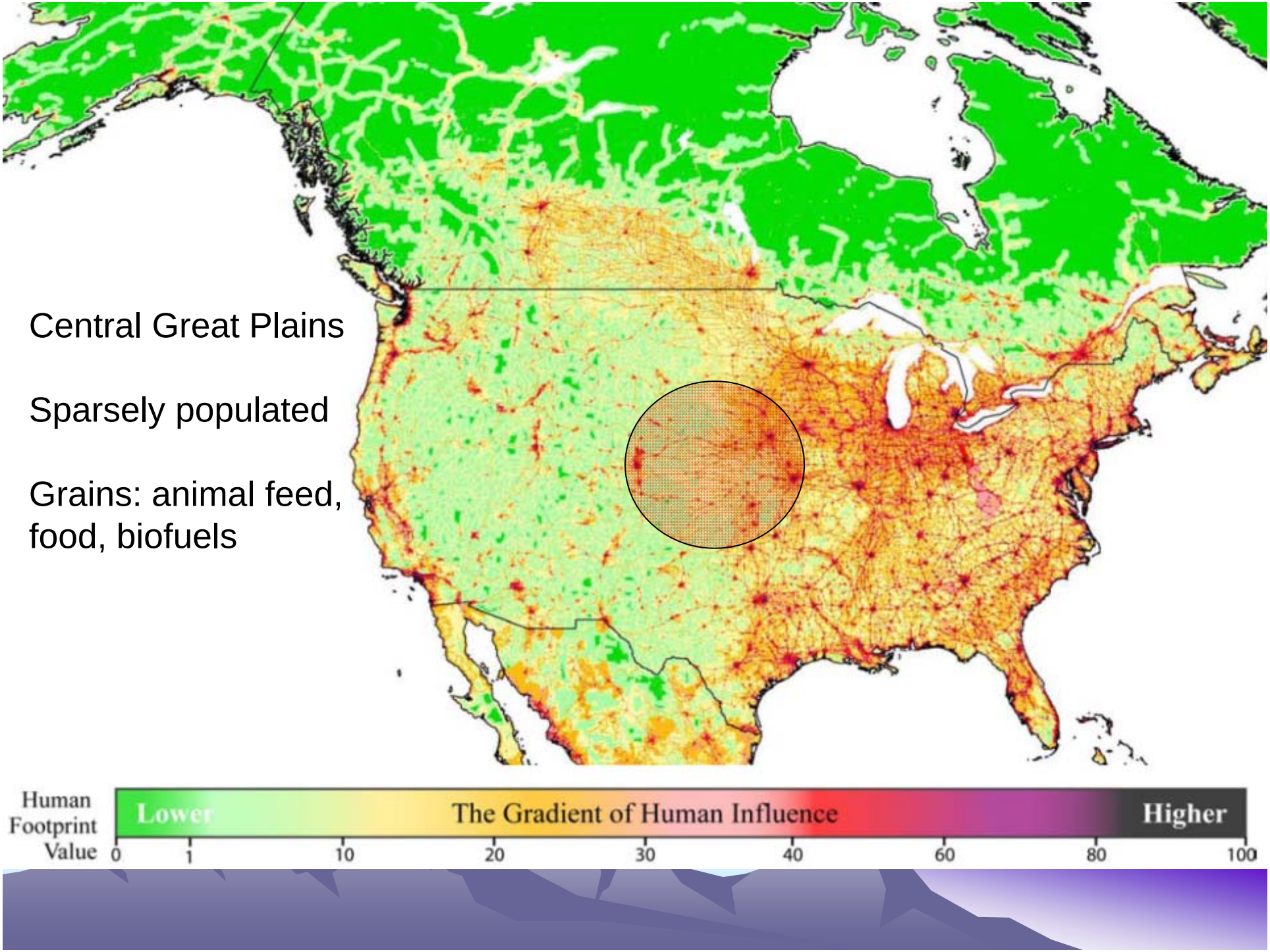
Great Plains Climate Education

Central Great Plains Climate Change Education Partnership

PI: Ben Champion, sustainability director, Kansas State University
Co-PI: Chuck Rice, agronomy professor, Kansas State University
Co-PI: Dan Devlin, agronomy professor, Kansas State University
Co-PI: Roger Bruning, cognitive psychology professor, University of Nebraska, Lincoln

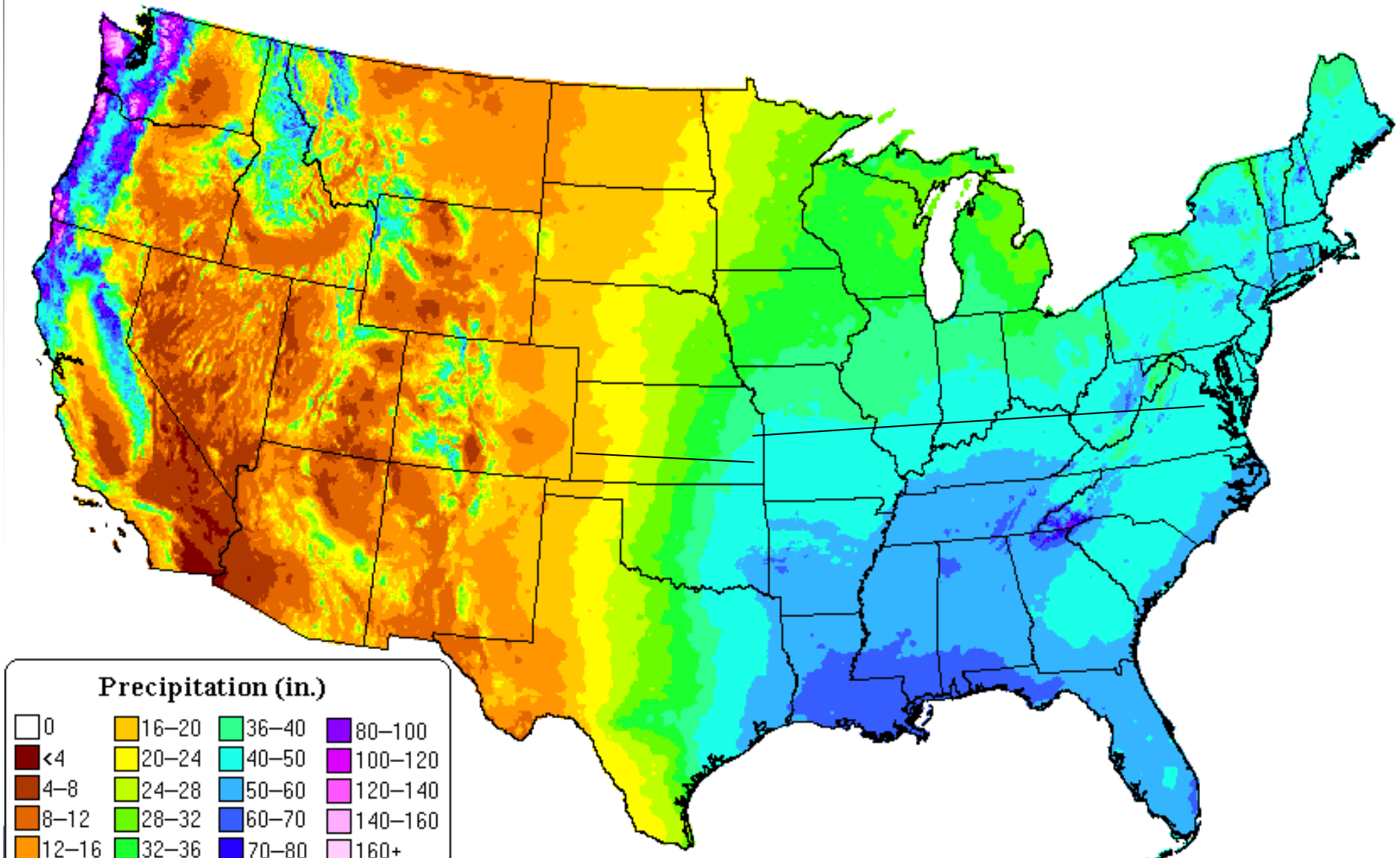
Senior Personnel:

John Harrington, Jr. – geography professor, Kansas State University
Dan Kahl – community development extension associate, Kansas State University
Lisa Pytlik Zillig – public policy research professor, University of Nebraska, Lincoln
Jackie Spears – education professor, Kansas State University
Tim Steffensmeier – communications asst. professor, Kansas State University
Shannon Washburn – agricultural communications assoc. professor, Kansas State University


Central Great Plains
Sparsely populated
Grains: animal feed, food, biofuels
Human Footprint Value
Lower
The Gradient of Human Influence
Higher
0
1
10
20
30
40
60
80
100

Precipitation: Annual Climatology (1971–2000)

PRISM: Parameter-elevation Regressions on Independent Slopes Model

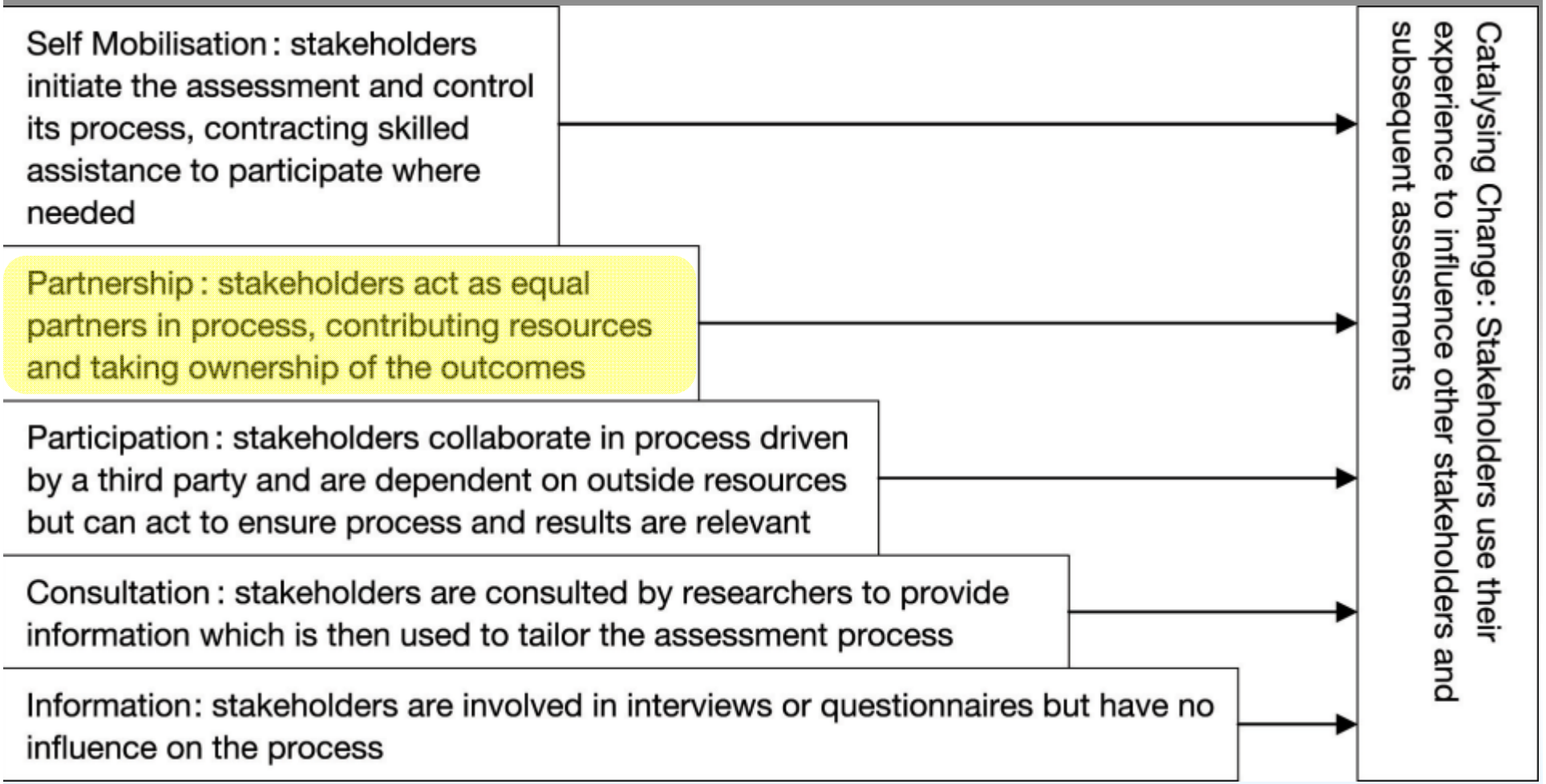


Copyright (c) 2006, PRISM Group, Oregon State University
http://www.prismclimate.org – Map created Jun 16 2006

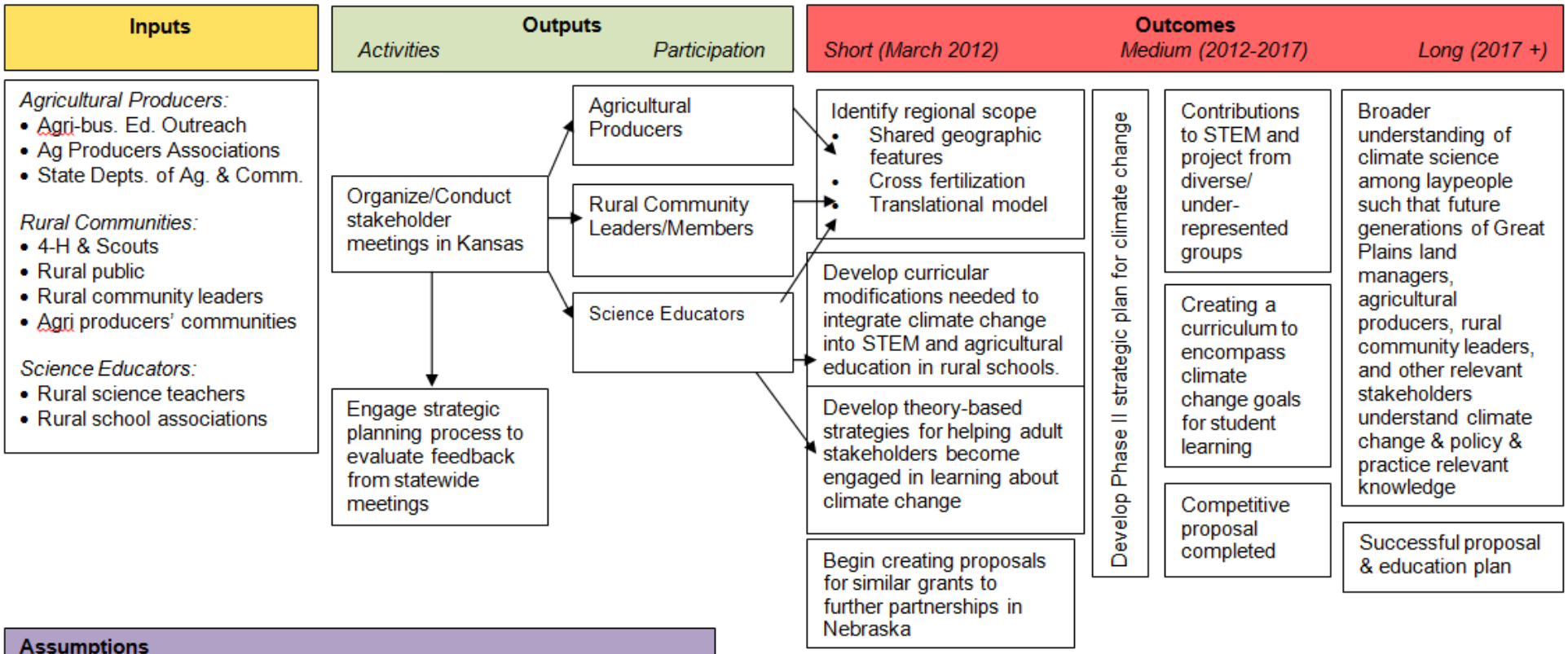
A Planning Grant

- Current effort is a 2-year Phase I grant to explore education programming most needed
- Preparation for 5-year Phase II funding for implementing new programming
  - Proposal due March 15, 2012

Goal = building a partnership



The Logic Model = our guide to success



Assumptions

1. If target stakeholders attend meetings, partners will be able to ascertain knowledge gaps and develop educational programs to fill gaps or misconceptions in climate change knowledge.
2. If target audience engages in developed education programs, they will replace misconceptions with a broader understanding of climate change science.
3. With broader understanding of climate change science, stakeholders will apply knowledge gained to decision making regarding current and future agricultural activities and policies.

External Factors

Extreme weather events will have significant impacts on crop and livestock production. Agricultural disruptions may potentially disrupt national and global food supply. The gap between scientific findings and individual opinions about climate change is not exclusively an informational issue; it is also a social and political issue.

In education, an awareness of 21st Century Skills, evolution & climate change conceptualizations.

Overall Project Outcomes

1. Better understanding of climate knowledge among agricultural producers and rural communities in our region
2. Regional partnership for climate literacy
3. Strategic plan for climate change education in Central Great Plains agricultural and rural communities
4. New education programs that prepare agriculture and rural communities for future climate change forces and impacts

Central Great Plains Regional Focus

- Economic well being heavily dependent on agriculture
- Need for knowledgeable land managers
- help prepare one of the world's breadbaskets for climate change

Kansas and Central Great Plains

- In Kansas, over 90% of the land area is used for grazing livestock (11 million hectares) or growing crops (7.7 million hectares).
- The state has wide variation in precipitation, ranging from a high of 1143 mm in the southeast to a low of 590 mm in the far west.
- Kansas among the top two states for total cattle on feed and total cattle processed in the United States.
- Kansas traditionally the largest wheat producing state in the U.S. Wheat is particularly vulnerable to heat and drought stress.

Nebraska and the Central Great Plains

- Nebraska number 1 in land area used for farming and ranching (93%) and ranks in the top 5 states for total agricultural and livestock receipts.
- Nebraska ranks number 1 in irrigation with over 8 million irrigated acres.
- Nebraska annual precipitation ranges from 900 mm in the east to 370 mm in the west.

Three Stakeholder Groups

- Agricultural producers
- Rural communities
- Rural education

Three Types of Partners

- Climate scientists
- Learning sciences
- Educational practitioners - informal and formal

Two States and Two Universities

- Kansas and Nebraska are the heart of the Central Great Plains
- Kansas State University and University of Nebraska, Lincoln
  - Both land-grant universities serving their entire states through Extension systems

Partners

- Office of Sustainability, KSU
  - Partnership leadership and management
- Institute for Civic Discourse and Democracy (ICDD), KSU
  - Organizing and facilitating town hall meetings and group discussion
- Public Policy Center (PPC), UNL
  - Expertise in public engagement, diffusion of innovation, and factors affecting trust and confidence in institutions and information

Partners

- Cooperative Extension Service, KSU
  - Extensive agricultural and community ties throughout Kansas
- Soil Carbon Center, KSU
  - Connects climate science and agricultural practices
- High Plains Regional Climate Center (HPRCC), UNL
  - expertise in climate data (monitoring, availability, and management), and transitioning of climate data into public use

Partners

- Center for Instructional Innovation, UNL
  - Focuses basic cognitive and learning science
- Center for Science Education, KSU
  - Extensive STEM educational background
- National Center for Research on Rural Education (R^2Ed), UNL
  - rural educator professional development, including professional development for inquiry-based science instruction

Combined Expertise

Insures that our educational programs and resources will reflect:

- current understanding about climate science
- the best theoretical approaches for teaching such a complex topic
- realistic means to reach the intended learner audience(s)

Process

- 36 meetings with stakeholders for input into shaping education programs
- Development of region-wide partnership
- Strategic planning for educational programming
  - Development of program concepts based on existing climate education models and stakeholder needs
  - Feedback from stakeholders about program concepts, and refinement of concepts
  - Phase II proposal development
- Implementation of education programs consistent with strategic planning

Evaluation

(Evaluation Required by NSF During Phases I & II)

Internal Evaluation: Office of Educational Innovation and Evaluation (OEIE) at Kansas State University, led by Dr. Jan Middendorf

- Conducts *formative* evaluation activities that monitor the potential capacity of the CCEP to engage key rural and community stakeholders (i.e., ongoing feedback to CCEP)
- Collaborates with External Evaluator (Dr. Fendt)
- With External Evaluator, monitors and documents the progress of the partnership and efforts to determine the extent to which intended outcomes have been achieved

Evaluation

(Evaluation Required by NSF During Phases I & II)

External Evaluation: Dr. Carol Fendt, PRAIRIE Group, independent external evaluator

- Provides *summative* evaluative feedback on project impact (i.e., cumulative feedback to CCEP at the conclusion of each phase)
- Collaborates with Internal Evaluators (OEIE)
- With Internal Evaluator, monitors and documents the progress of the partnership and efforts to determine the extent to which intended outcomes have been achieved

To This Point

Inventories:

- What is climate science telling us?
- What is science education telling us?
- What is learning science telling us?
- What models and resources for climate education exist?
- Who are potential partners in helping implement new programs to have regional impact?

To This Point

Focus groups

- Initial focus groups with agricultural and rural stakeholders have begun – 5 completed, 2 in progress
  - Smith Center
  - Seward County
  - KELP Meeting
  - Dialog on Sustainability Conference
  - Sedan
  - Geary County
  - Goodland
- Organized through County/District Extension Program Development Committees

Next Steps

- Continue to inventory climate education resources and stakeholder partners
- Conduct baseline survey of stakeholder opinions
- Continue focus group meetings with stakeholders throughout summer and early fall months

Next Steps

- Identification of synergistic events/activities with potential partners for next year or so
- Begin to implement additional research and stakeholder engagement in Nebraska
  - General public baseline survey
  - Learning experiments with UNL students on climate literacy
  - Additional stakeholder meetings in Nebraska to see similarities/differences with Kansas

Focus Group Early Lessons

- Producer and community groups represent all of the “6 Americas”
  - “Cautious” is the most common response, with “Concerned” coming in second
- Producers mainly concerned about how climate relates to their productivity and profitability
- Community members and non-producers more interested in cultural or ideological implications

Focus Group Early Lessons

- Almost everyone is concerned that they don't know what information to trust
  - Distrust those who seem like they could have ulterior motives – politicians, corporations, even some scientists
- Land-grant extension services are viewed as trusted sources, as are local weathermen
- Most notice evidence of changing climate, but not all willing to admit "climate change" is happening

Focus Group Early Lessons

- Climate change is acceptable to discuss
- Causes of climate change are much more controversial
  - Often emotionally charged by public conversations that could lead to impacts on economic livelihood
    - Methane from cows is a common area of dissonance and disbelief

Great Plains Climate Education

Central Great Plains Climate Change Education Partnership

CGP C¢EP

Kansas State University

National Science Foundation
WHERE DISCOVERIES BEGIN

University of Nebraska-Lincoln

- Agricultural producers
- Rural communities
- Rural education