

# US Forest Service Basic Climate Change Issues

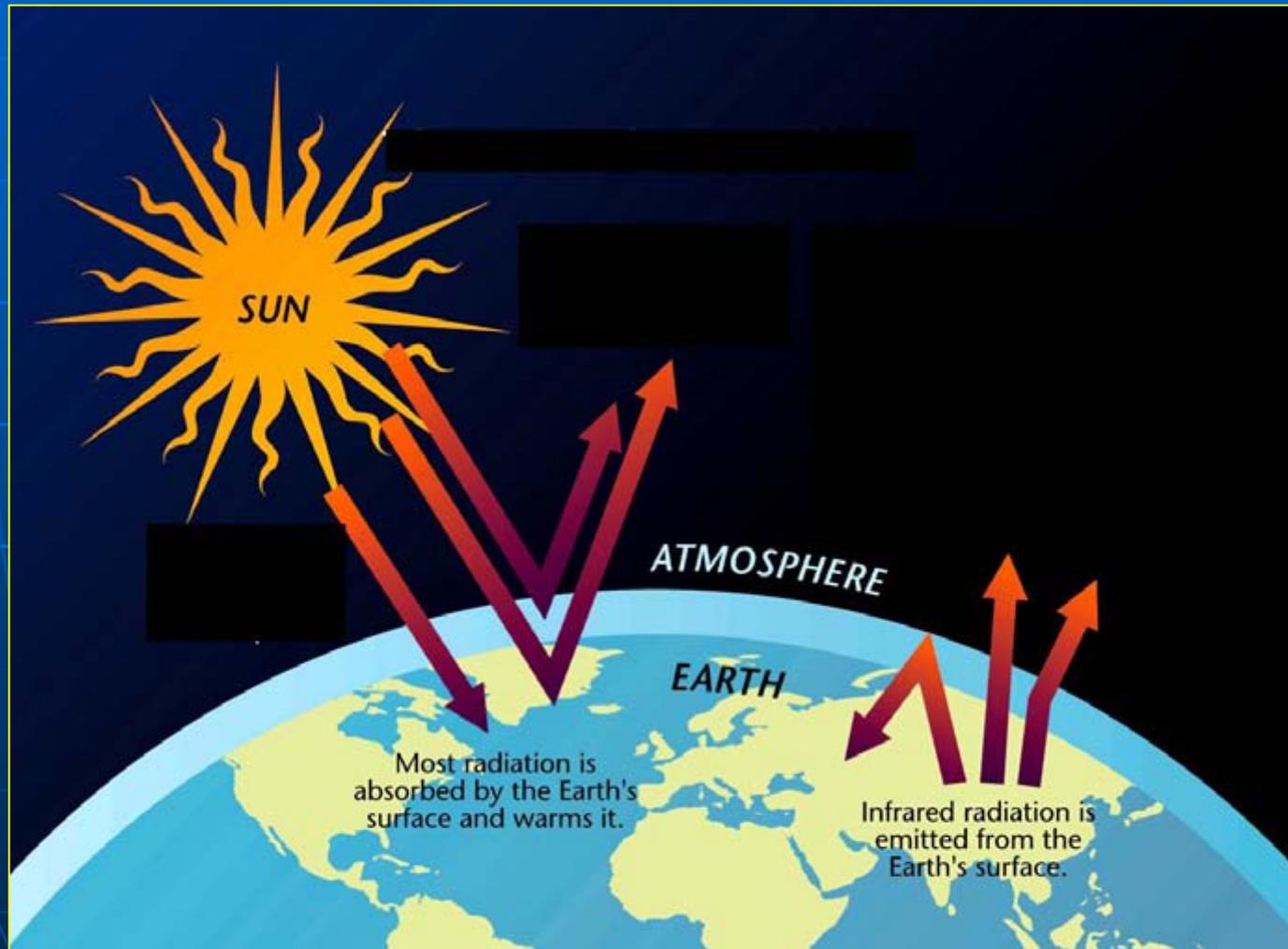
Climate Change and Forest Health Focus Group  
National Forest Health Monitoring Work Group Meeting  
San Antonio, Texas, February 13, 2008

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Vegetation Management Science Staff  
R & D, USFS

# Roadmap of the Talk

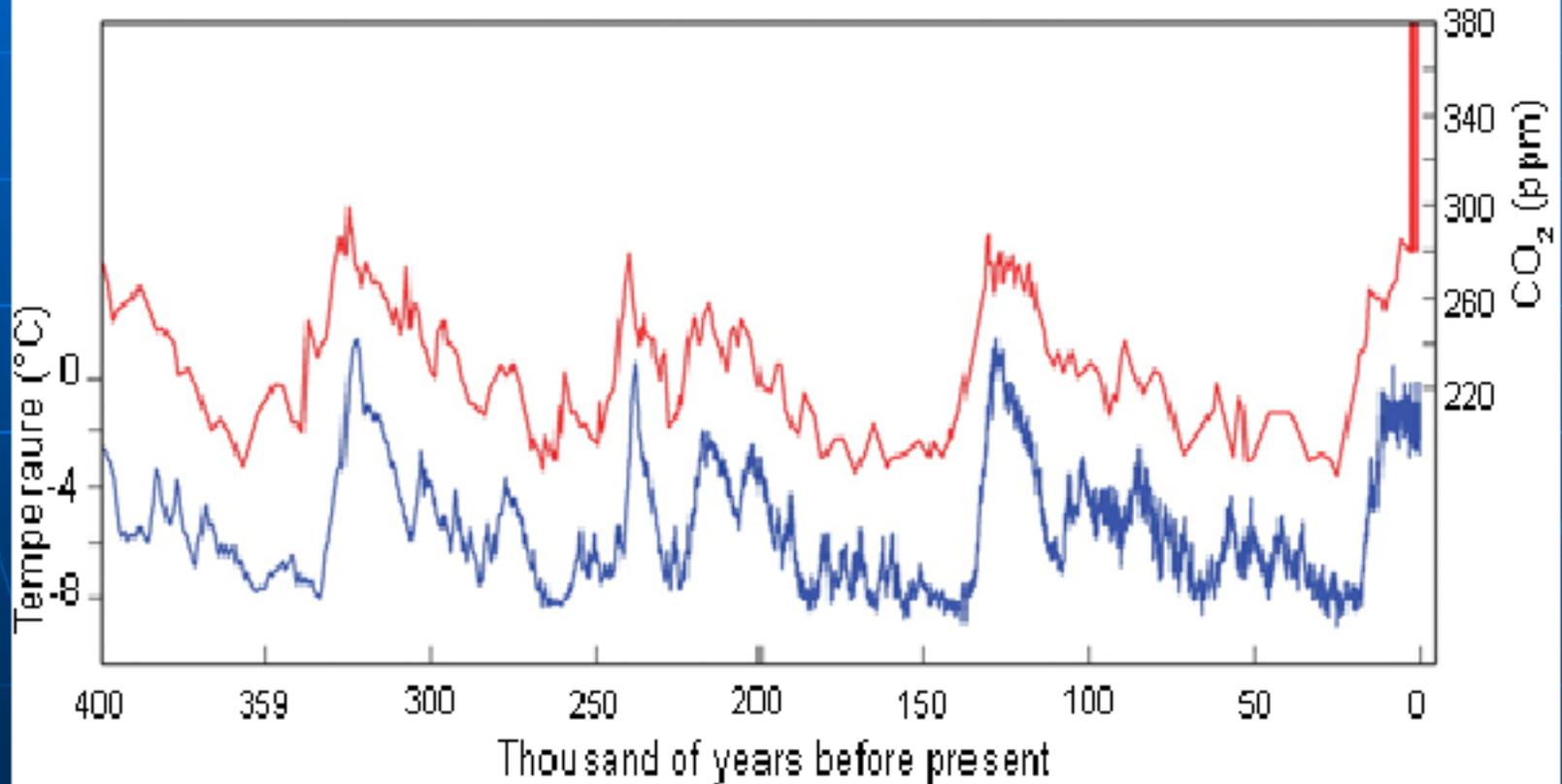
- How real is global climate change?
- How much global change has already occurred and how much can we expect in this century?
- What implications for ecosystem management should we expect?
- What approaches to reduce impacts can management develop?

# One Must Obey the Laws (i.e., 1<sup>st</sup> Law of Thermodynamics, etc.)



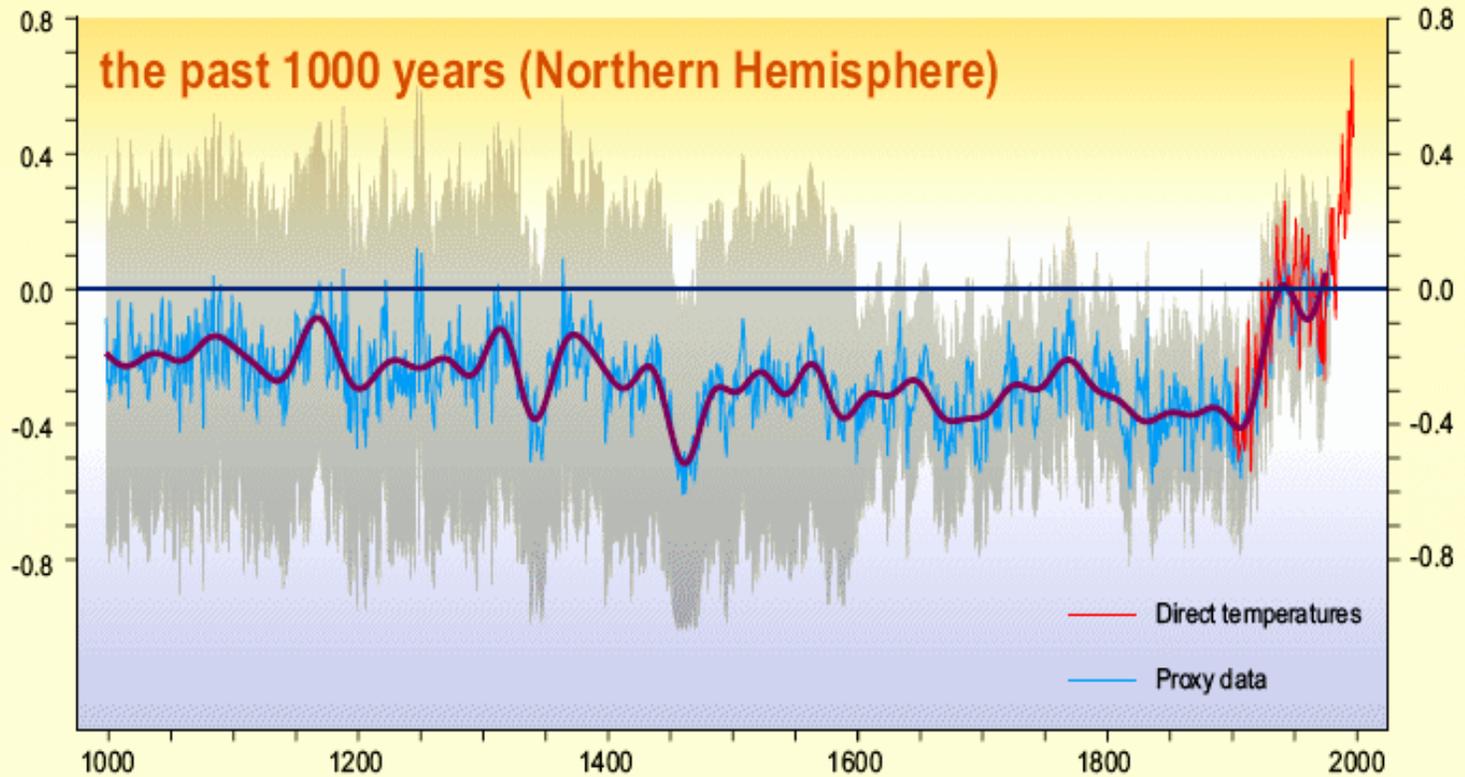
# Temperature and CO<sub>2</sub> track closely, and always have

Figure 1: Changes in Carbon Dioxide and Temperature in the last 400,000 years

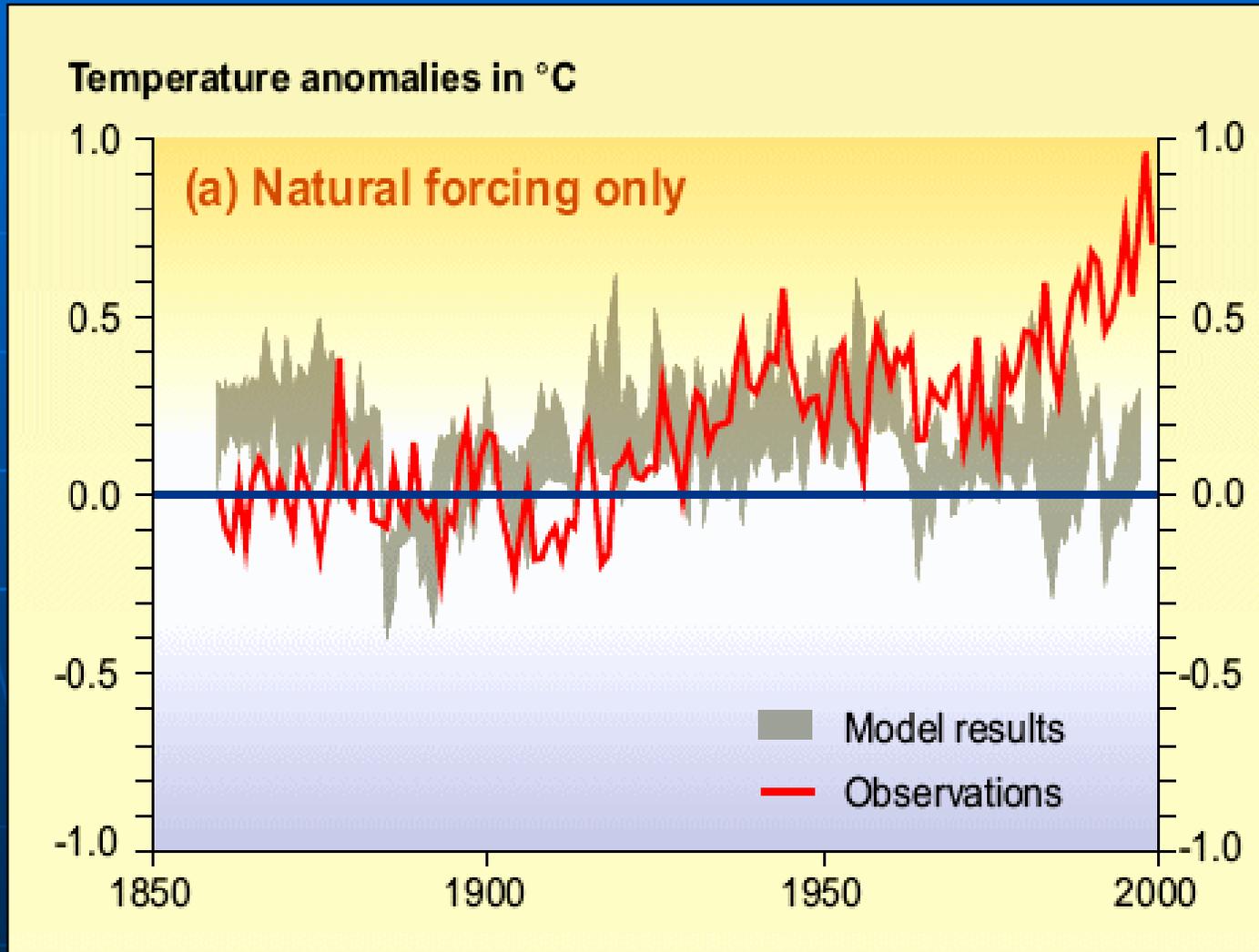


# A Millenium of Variation in the Earth's Temperature

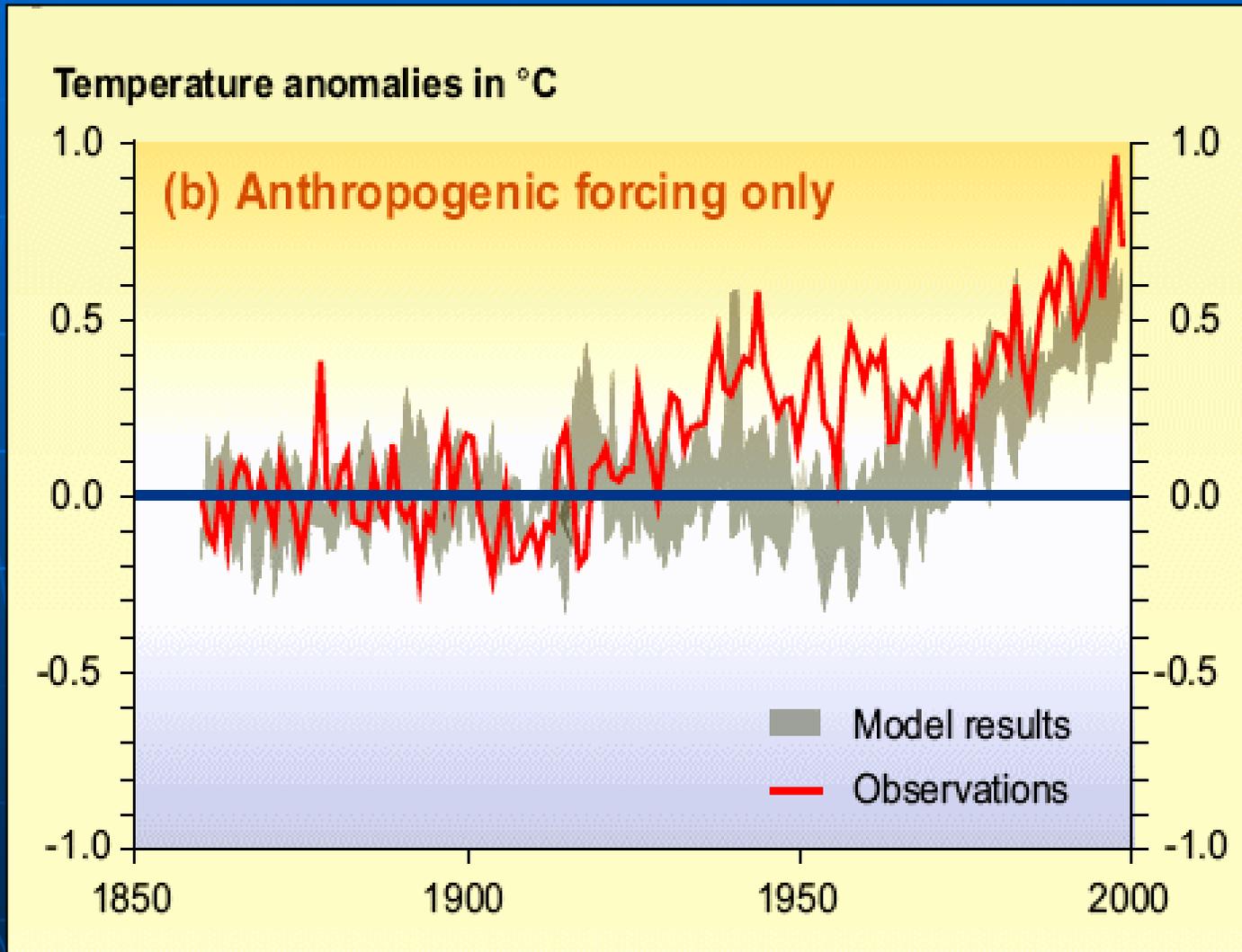
Departures in temperature in °C (from the 1961-1990 average)



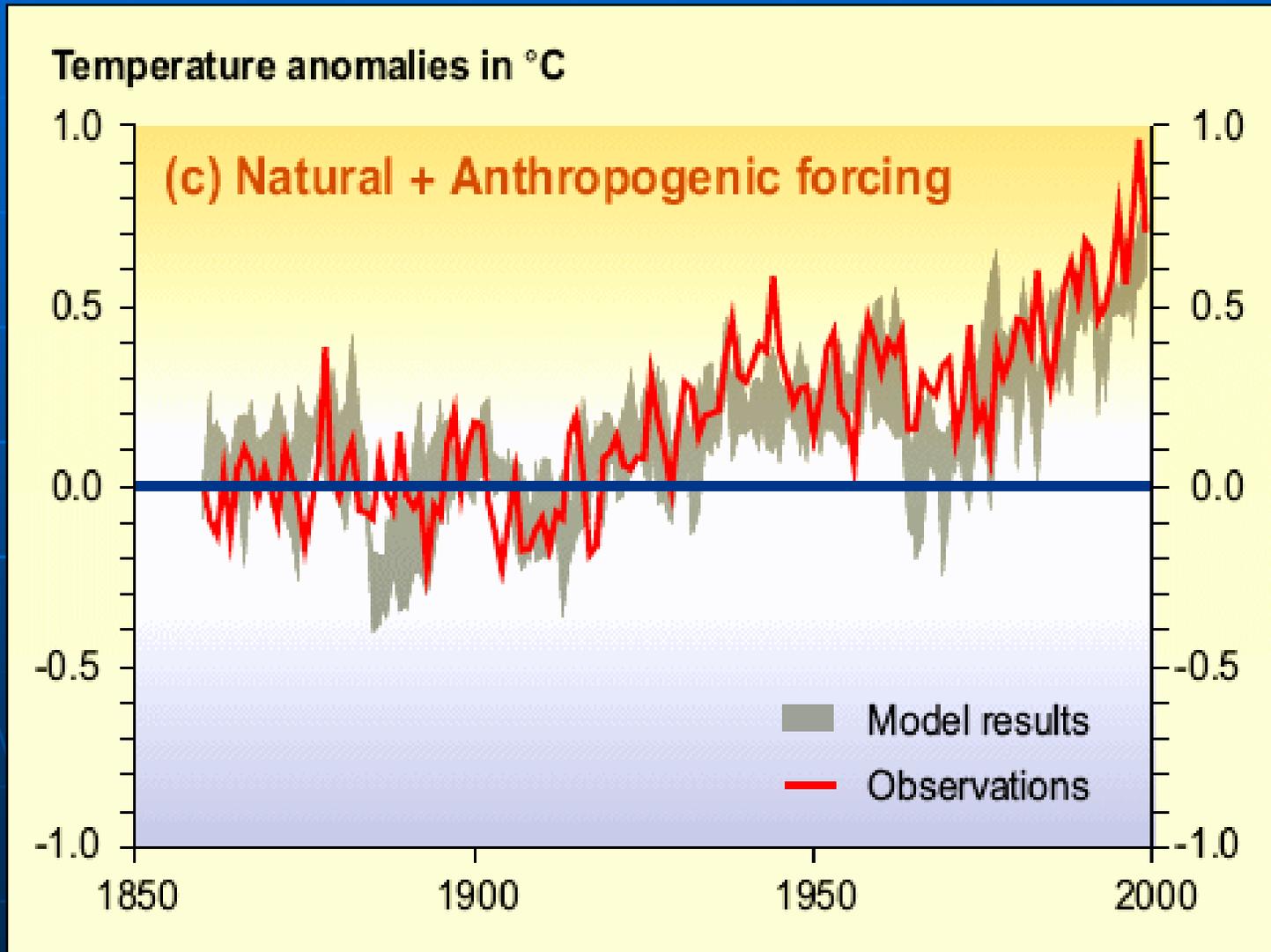
# Simulating the Temperature Record of the Past 150 Years



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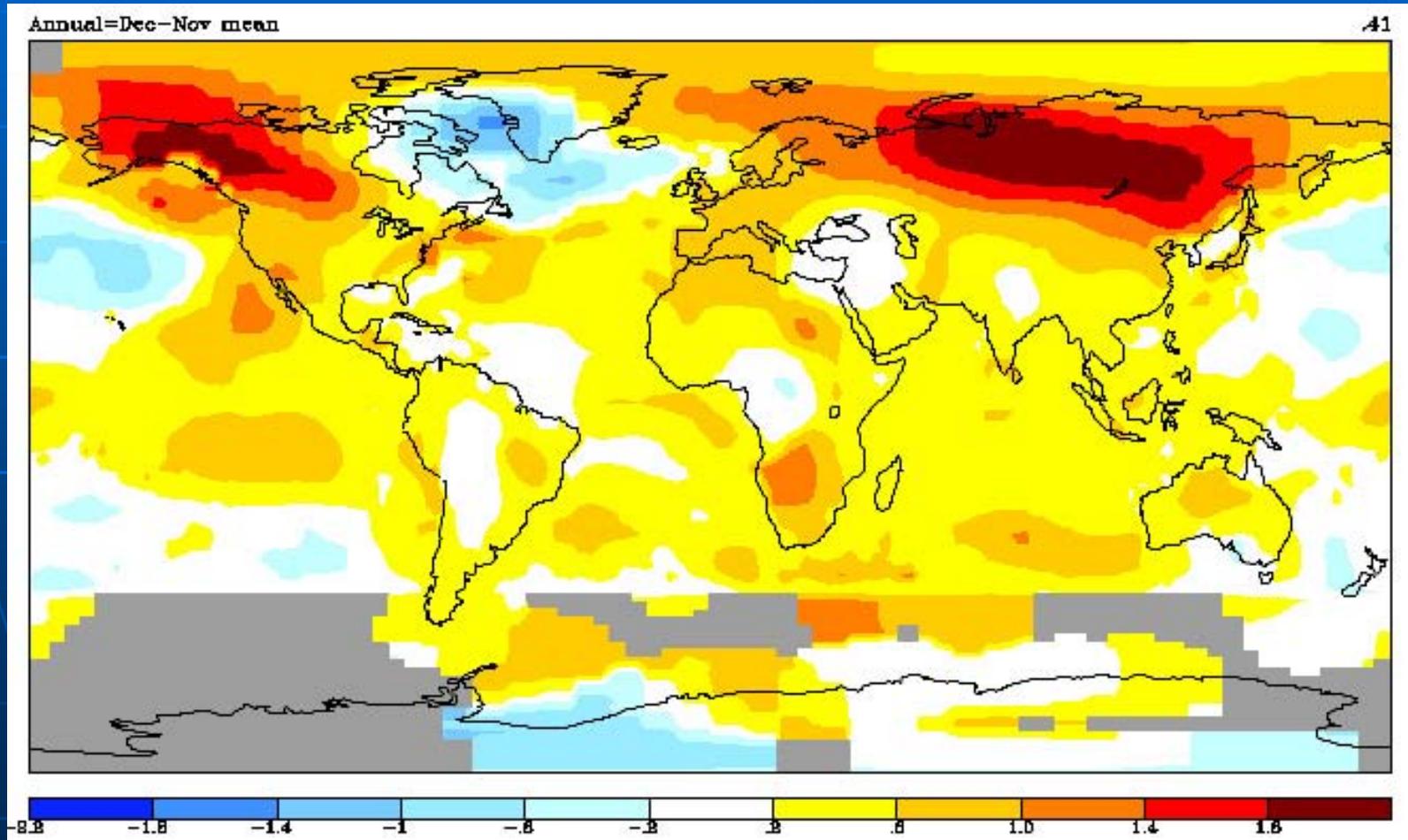
# Simulating the Temperature Record of the Past 150 Years



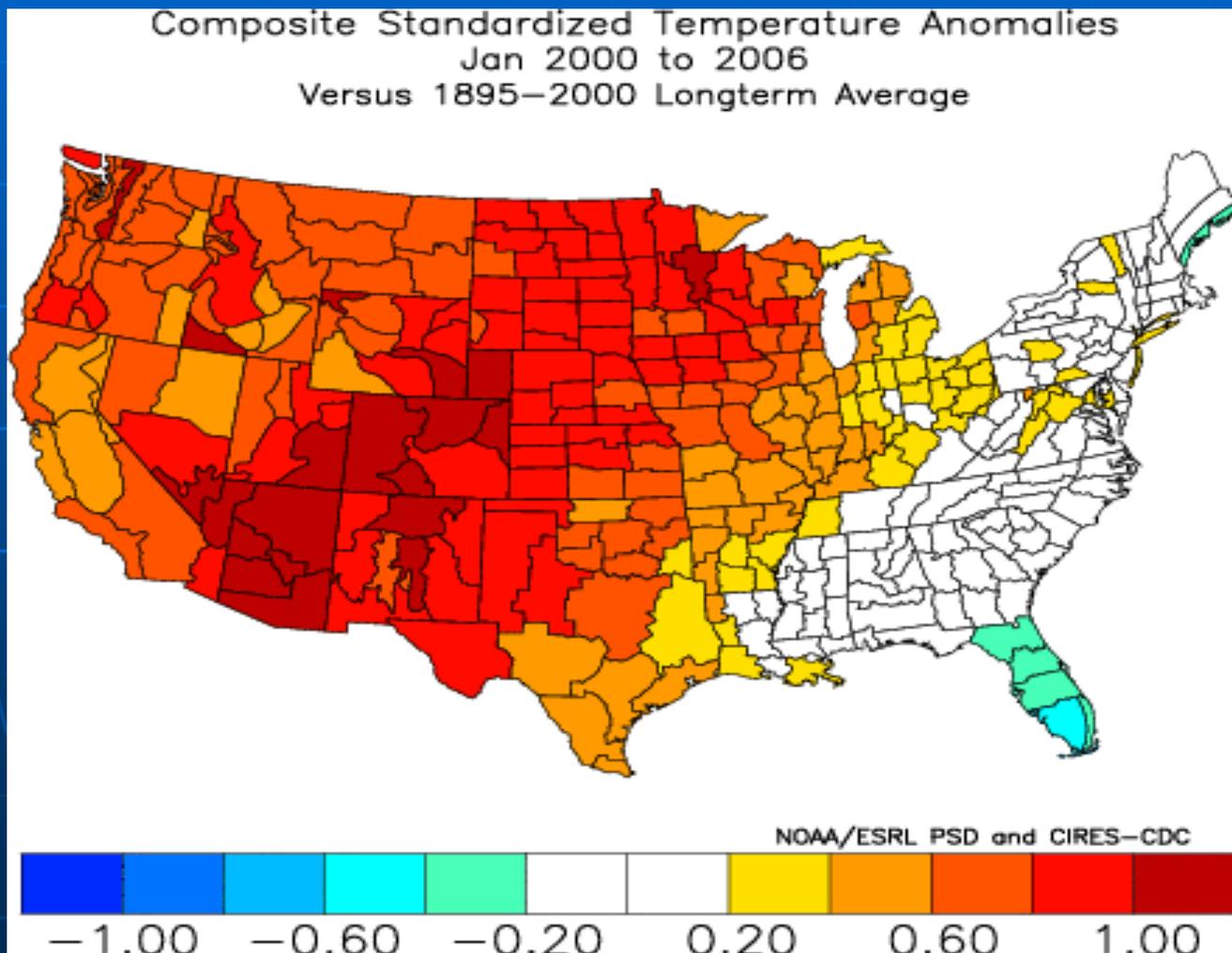
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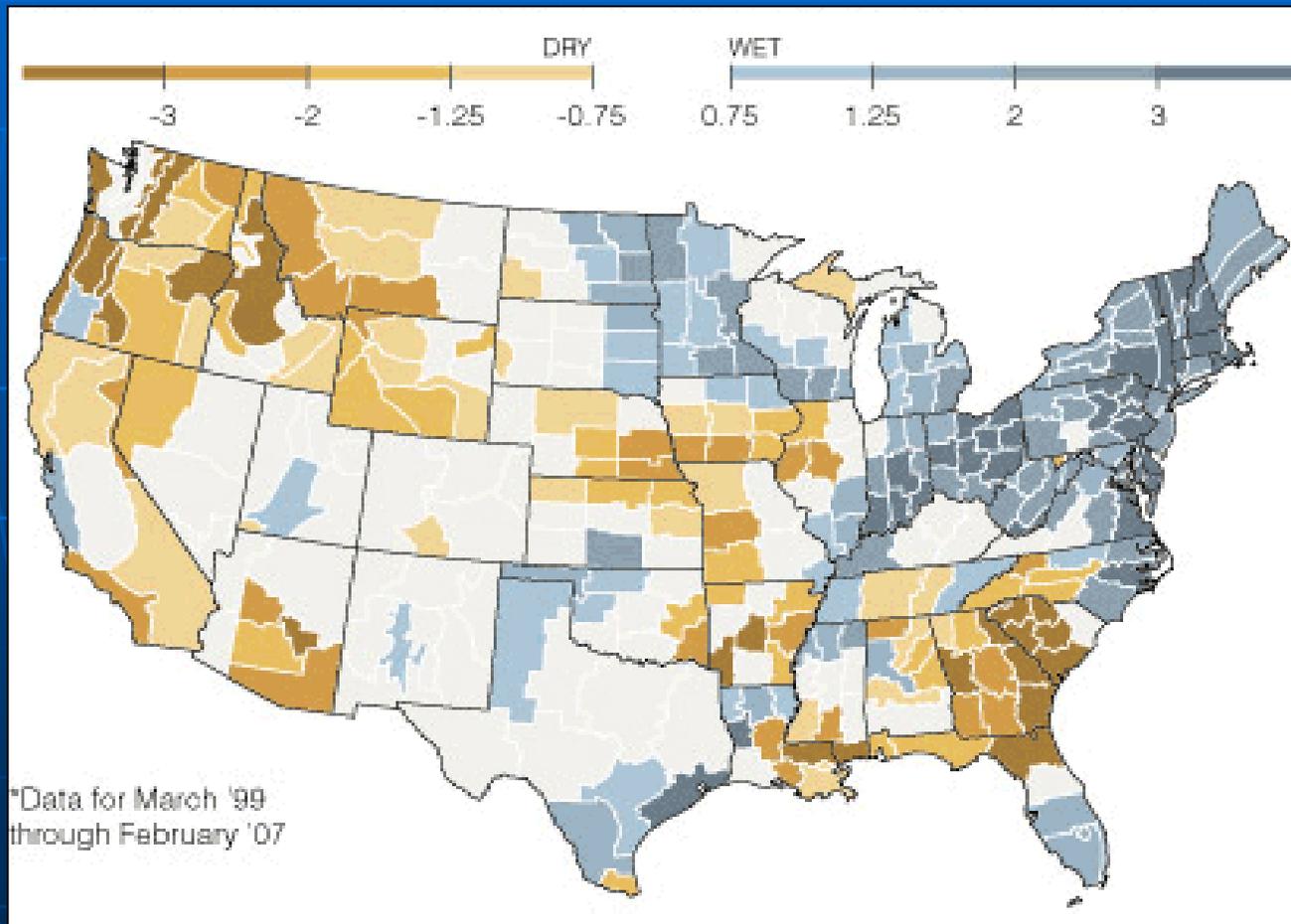
# Annual Temperature Changes From 1965 to 1995



# Temperature Anomalies: 2000-2006 versus 1895-2000

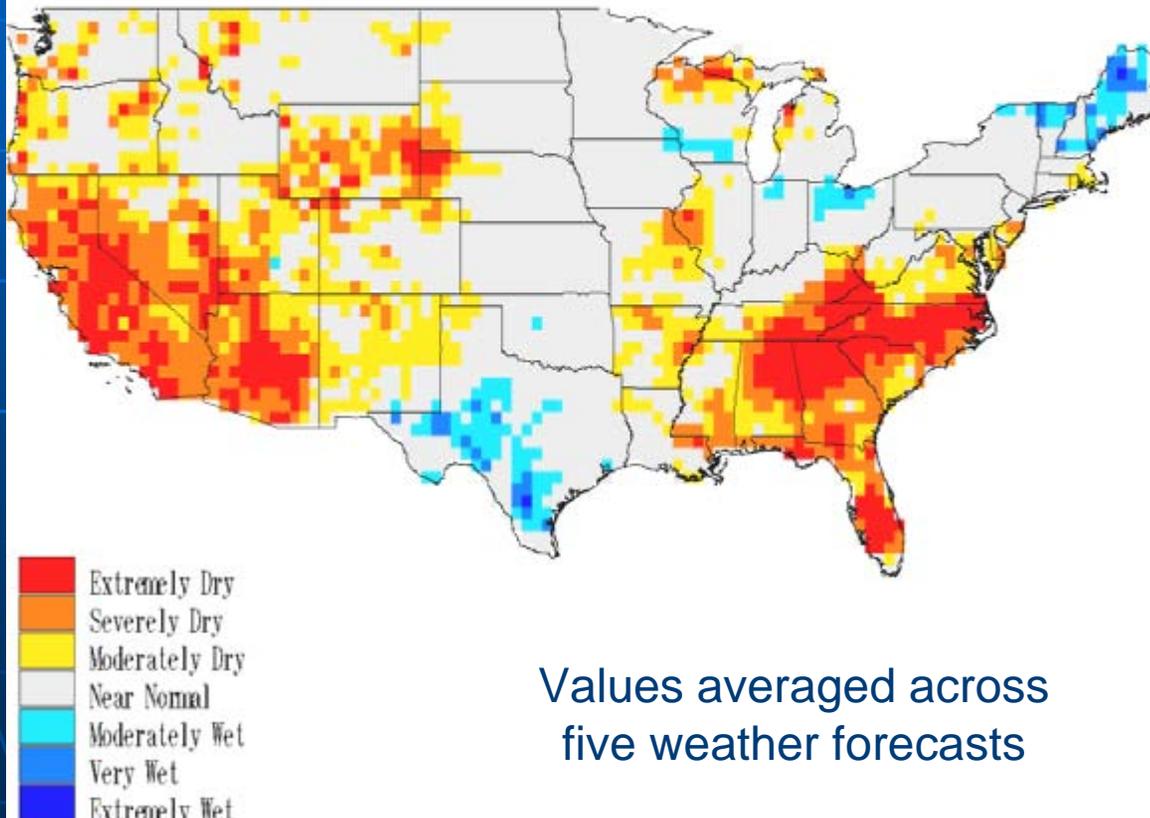


# Precipitation During the 21<sup>st</sup> Century: 8 Years of Drought Index (PDSI)



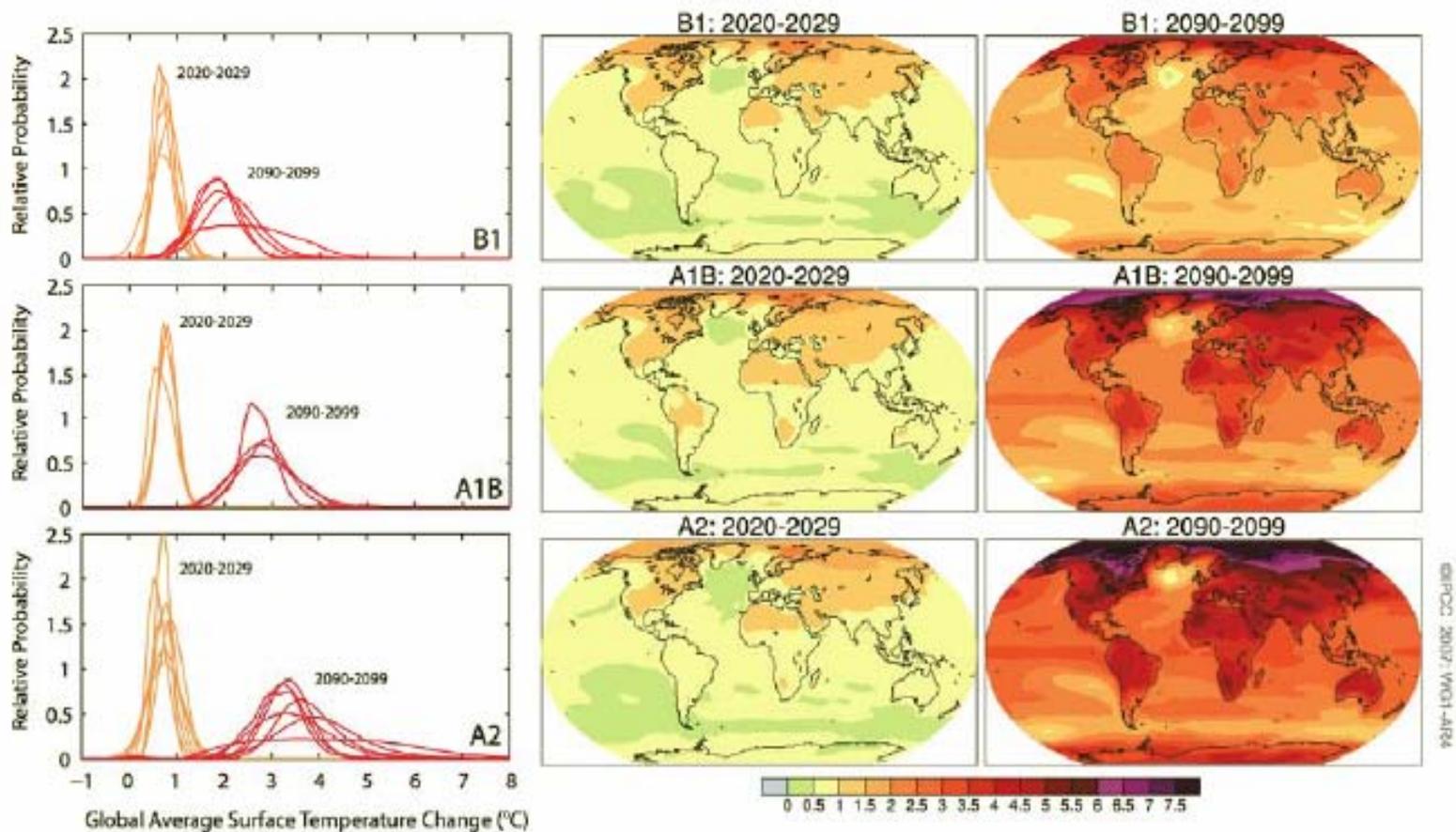
# 2008 Drought (PDSI) Forecast: April-June

**OBSERVED WEATHER PERIOD:** thru NOV 2007  
**FORECAST WEATHER PERIOD:** DEC 2007 - JUN 2008



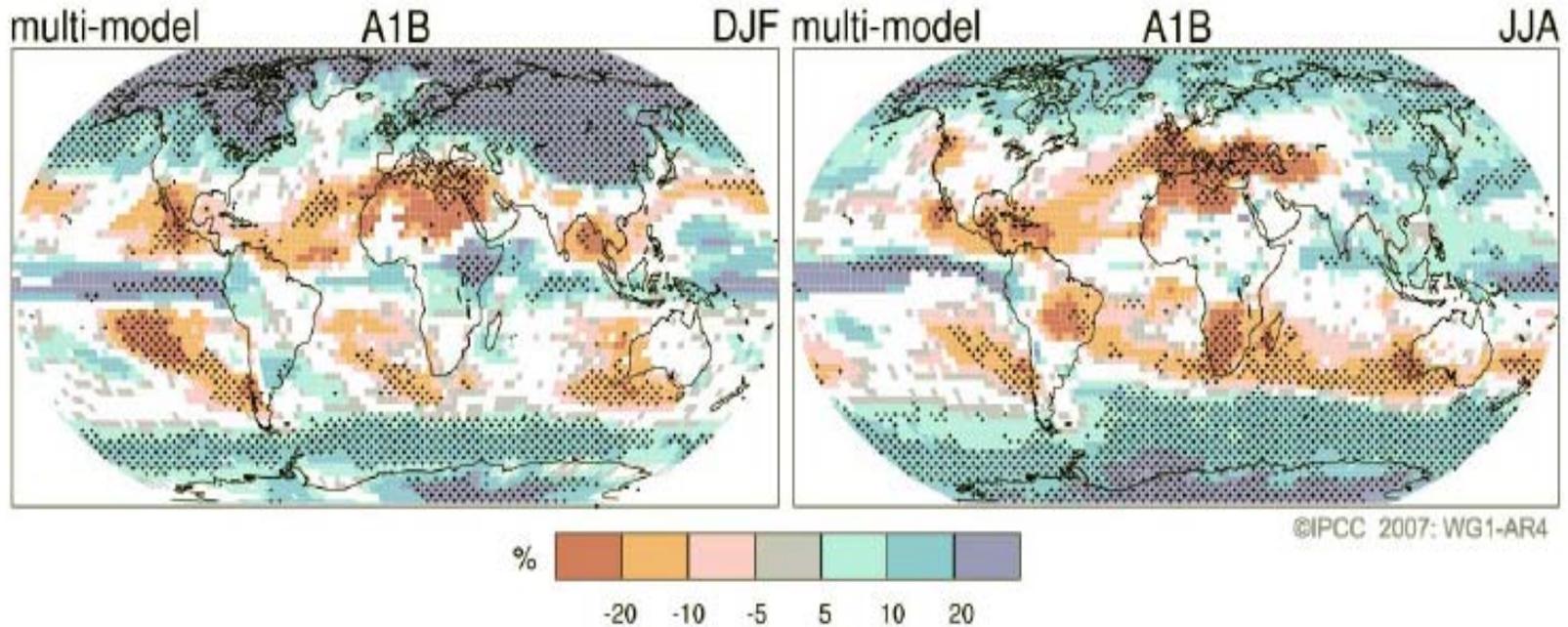
# IPCC Projections of Future Temperature: 1980-1999 Average vs. 2090-2099 Average

AOGCM Projections of Surface Temperatures



# IPCC Projections of Future Precipitation: 1980-1999 Average vs. 2090-2099 Average

## Projected Patterns of Precipitation Changes



white <66% agree; stippled, >90% agree

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# Indirect Effects of Climate Change on Forests: Drought into Pests

Insect and disease epidemics are increasing in number and spreading rapidly in dense, warm and dry forests



# Indirect Effects of Climate Change on Forests: Drought and Pests into Catastrophic Fires

Severe US wildfires burned more area this year than in any of the past 80 years

Area burned in each of the past 5 years is above 1995-2005 averages

Many fires were in diseased and drought stressed forests.



# Indirect Effects of Climate Change on Forests: Enhanced Growth of Ladder Fuels

- Grazing consumed fine fuels for the past 100+ years
- Fire suppressed for the past 50 years
- Logging severely reduced for the past 20 years



# Direct Effects of Climate Change on Forests: Black and White Spruce Dieback in Alaska



# Direct Effects of Climate Change on Forests: Increasing Hurricane Intensity



Katrina damaged or destroyed 19 billion board feet of timber up to 100 miles inland

Along with higher sea levels, hurricanes are likely further north on the Atlantic Coast.

# Direct Effects of Climate Change on Forests: Synergy with Atmospheric Pollutants

Tropospheric ozone  
reduces growth

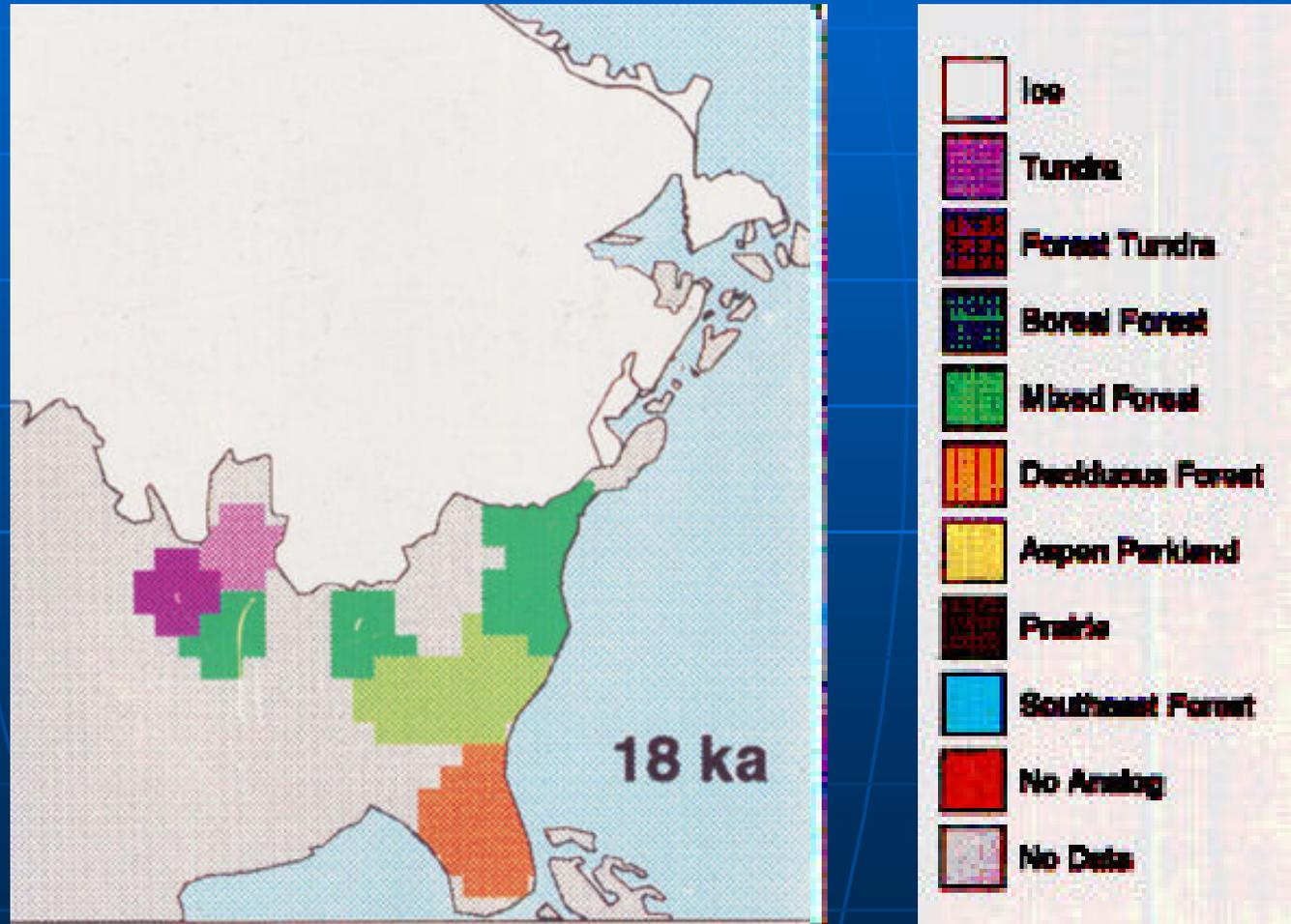
Acid rains and fogs  
reduce growth

Nitrogen deposition  
increases growth

Atmospheric CO<sub>2</sub>  
increases growth



# Potential Redistribution of forest biomes: the past 18,000 years and the next 100 years



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# Increasing Forest Resilience: How Much to Decrease Forest Density?



# Increasing Forest Resilience: How to Enhance Diversity of Provenances and Species?

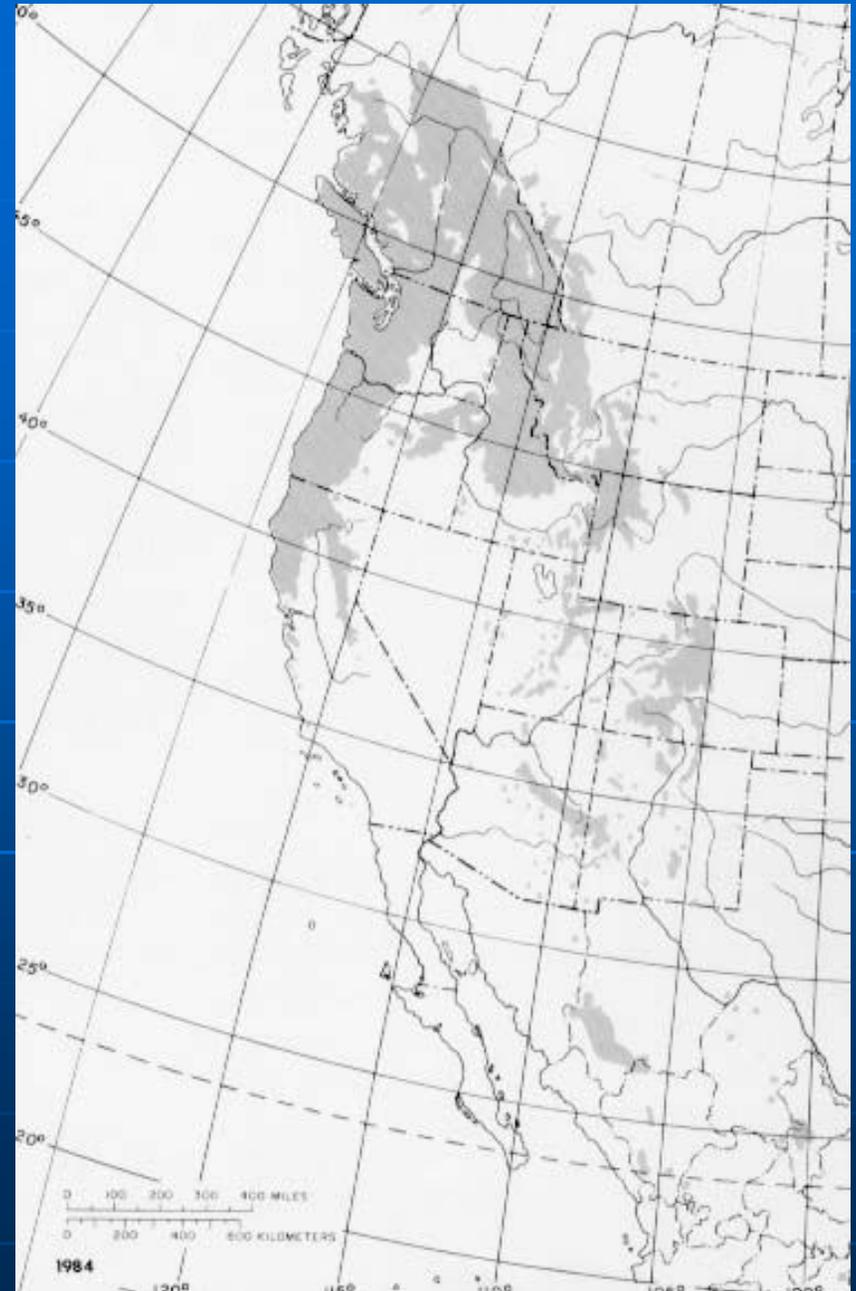


# Increasing Forest Resilience: How to Assist Migration of Provenances and Species?



# Geographic Range of Douglas Fir

Replace today's northern trees with southeastern and southwestern stocks



# Decision Support: Scientific Assessments of approaches to manage our land resources

1 **Preliminary Review of Adaptation Options for**  
2 **Climate-Sensitive Ecosystems and Resources**

3  
4 **Synthesis and Assessment Product 4.4**  
5 **U.S. Climate Change Science Program**

6  
7 DRAFT FOR PUBLIC COMMENT—AUGUST 2007

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# CCSP SAP 4.4: Management response recommendations

- Develop formal CC training for FS land managers (guides, primers, websites, videos, workshops)
- Establish action priorities under resource limits
- Develop early detection and rapid response systems for post-disturbance management
- Educate stakeholders and partners on climate change role in management
- Integrate CC across all agency planning levels
- Increase collaboration across federal and private ownerships
- Reframe the role of uncertainty by learning to manage for change

# US Forest Service Research Strategy Draft issued Feb 2008



United States Department of Agriculture  
Forest Service  
Research and Development



Global Change Research Strategy

2009-2019

Synthesis  
February, 2008

# Program Elements of the Forest Service Global Change Research Strategy

Enhance *ecosystem resilience*, increase retention of newly sequestered carbon, and avoid carbon losses from major disturbances.

Enhance *carbon sequestration* via through increased forest growth rates and area of forested lands; enhanced biomass extraction and utilization.

Develop *decision support tools* and approaches for policymakers and land managers.

Meet needs for *national infrastructure*, scientific collaboration, and technology transfer to facilitate and implement the research and applications in the first three elements.