Climate Normals and Climate Change

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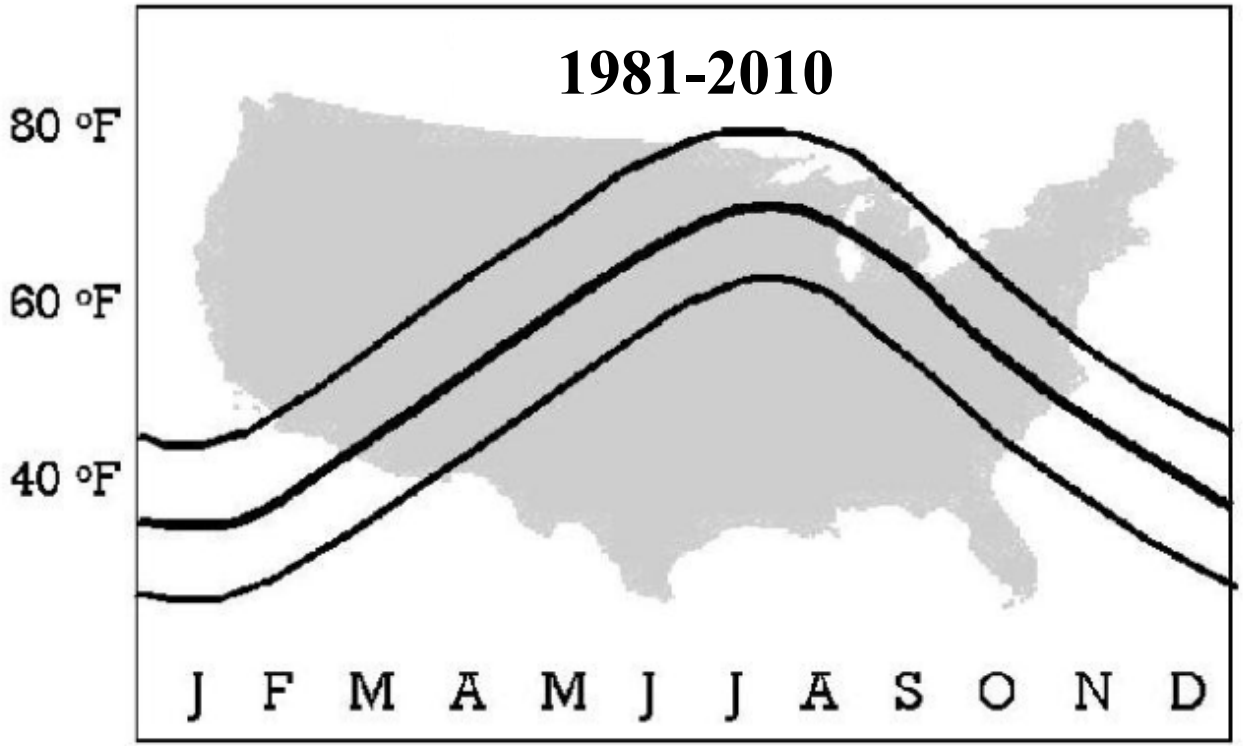
NOAA's National Climatic Data Center

United States Climate Normals



Background

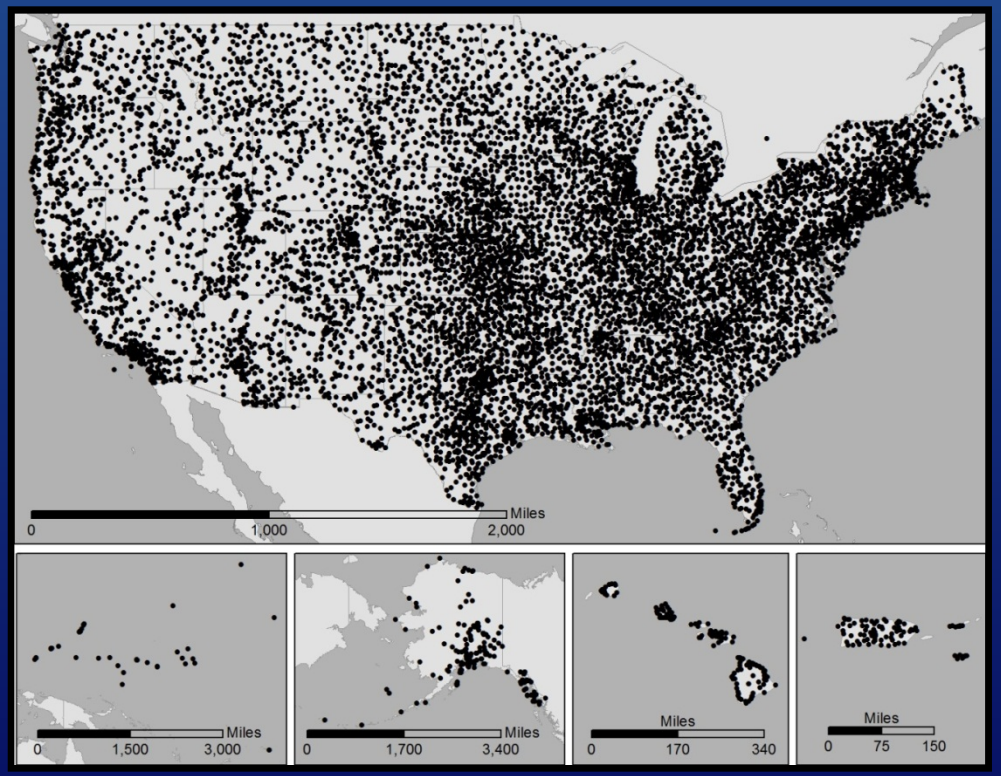
- Normal: 30-Year Average
  - Why does NOAA compute Normals? Congressional mandate :

    "… record the climatic conditions of the United States."

  - NOAA updates normals every 10 years
- Uses of Normals
  - Energy, agriculture, construction, TV, et al.
  - Climate monitoring
  - Base periods for climate projections

1981-2010 Station Portfolio

Normals Period	Temperature Stations	Precipitation Stations
1921-1950	388	388
1931-1960	3656	3656
1941-1970	3145	4928
1951-1980	3349	5506
1961-1990	4775	6662
1971-2000	5556	7926
1981-2010	7501	9307



Also, hourly normals for 262 first-order stations. Elements include temperature, dew point, degree hours, heat index, wind chill...

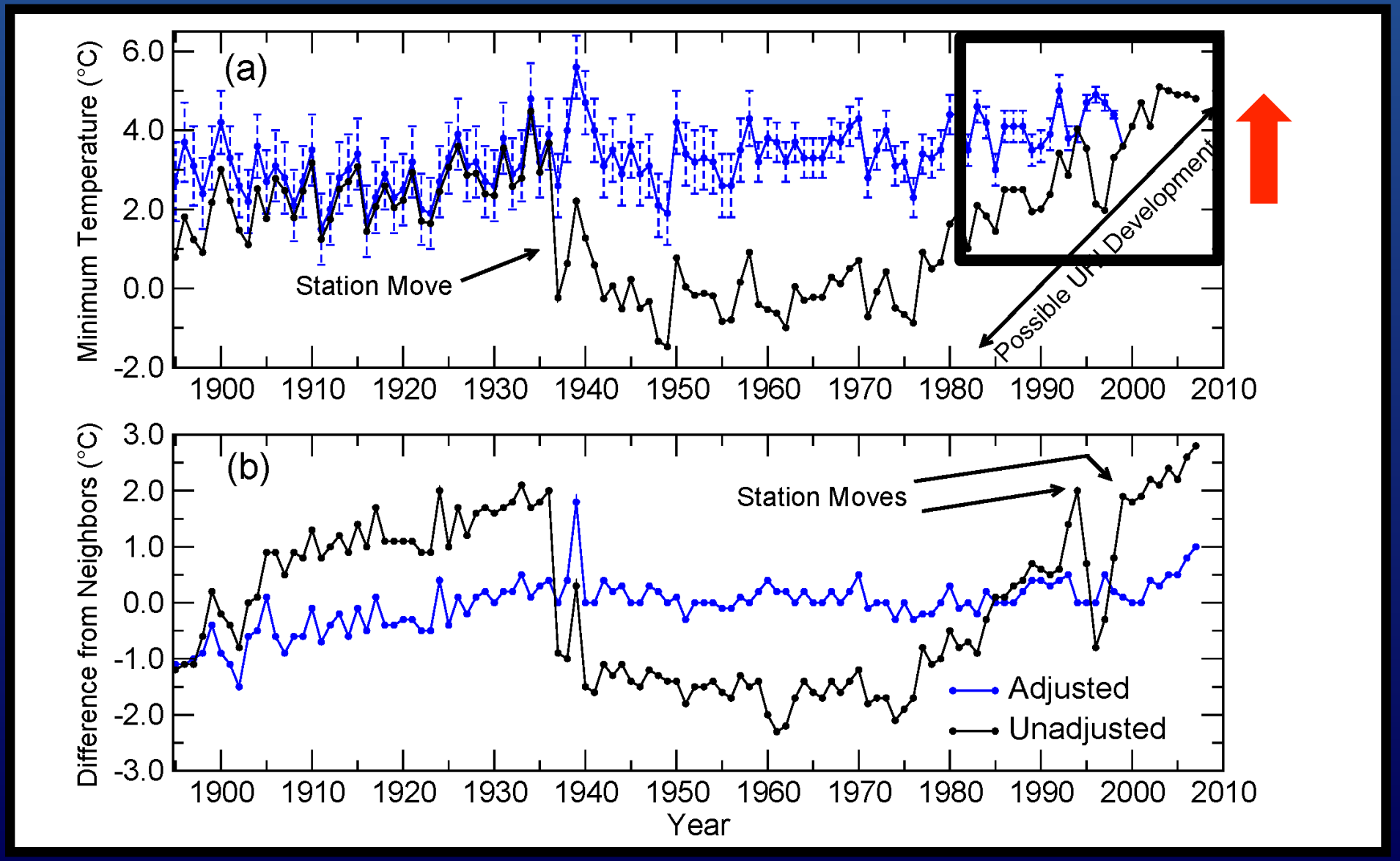
1981-2010 Product Portfolio

Category	Parameter	Daily	Monthly	Seasonal	Annual
Averages	Temperature	✓	✓	✓	✓
	Degree Days	✓	✓	✓	✓
	Precipitation	*	✓	✓	✓
	Snowfall	*	✓	✓	✓
Standard Deviations	Temperature	✓	✓		
Frequencies of threshold exceedance	Temperature		✓	✓	✓
	Precipitation	✓	✓	✓	✓
	Snowfall	✓	✓	✓	✓
	Snow Depth	✓	✓	✓	✓
Percentiles	Precipitation	✓	✓		
	Snowfall	✓	✓		
	Snow Depth	✓			

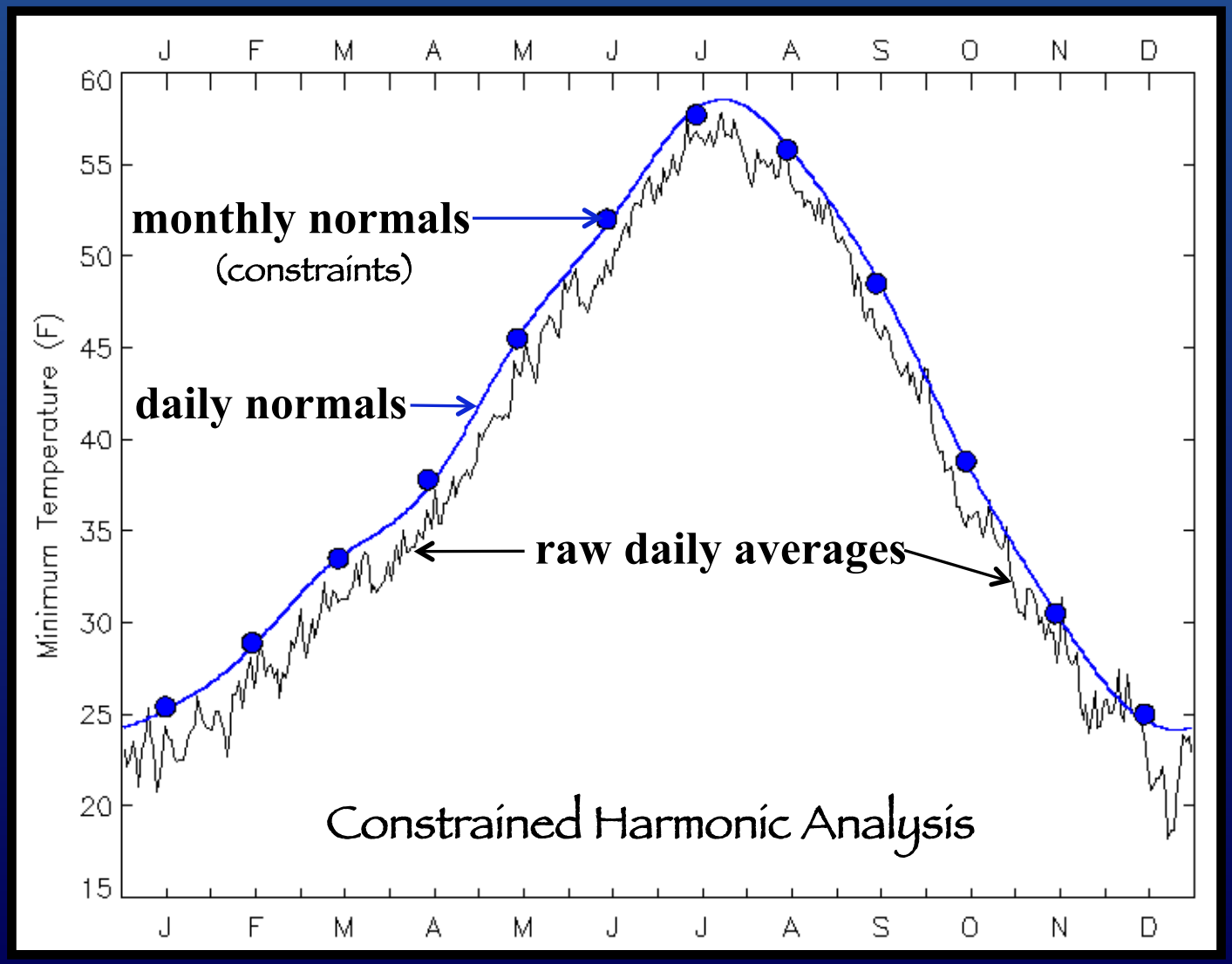
Comparing the "New" and "Old" Normals

- New = 1981-2010
- Old = 1971-2000
- There certainly are differences
- Climate change is the big player
- But there are non-climatic effects as well
  - Changes in station siting and instrumentation
  - Changes in Normals methodology

Data Rehabilitation: Reno, Nevada



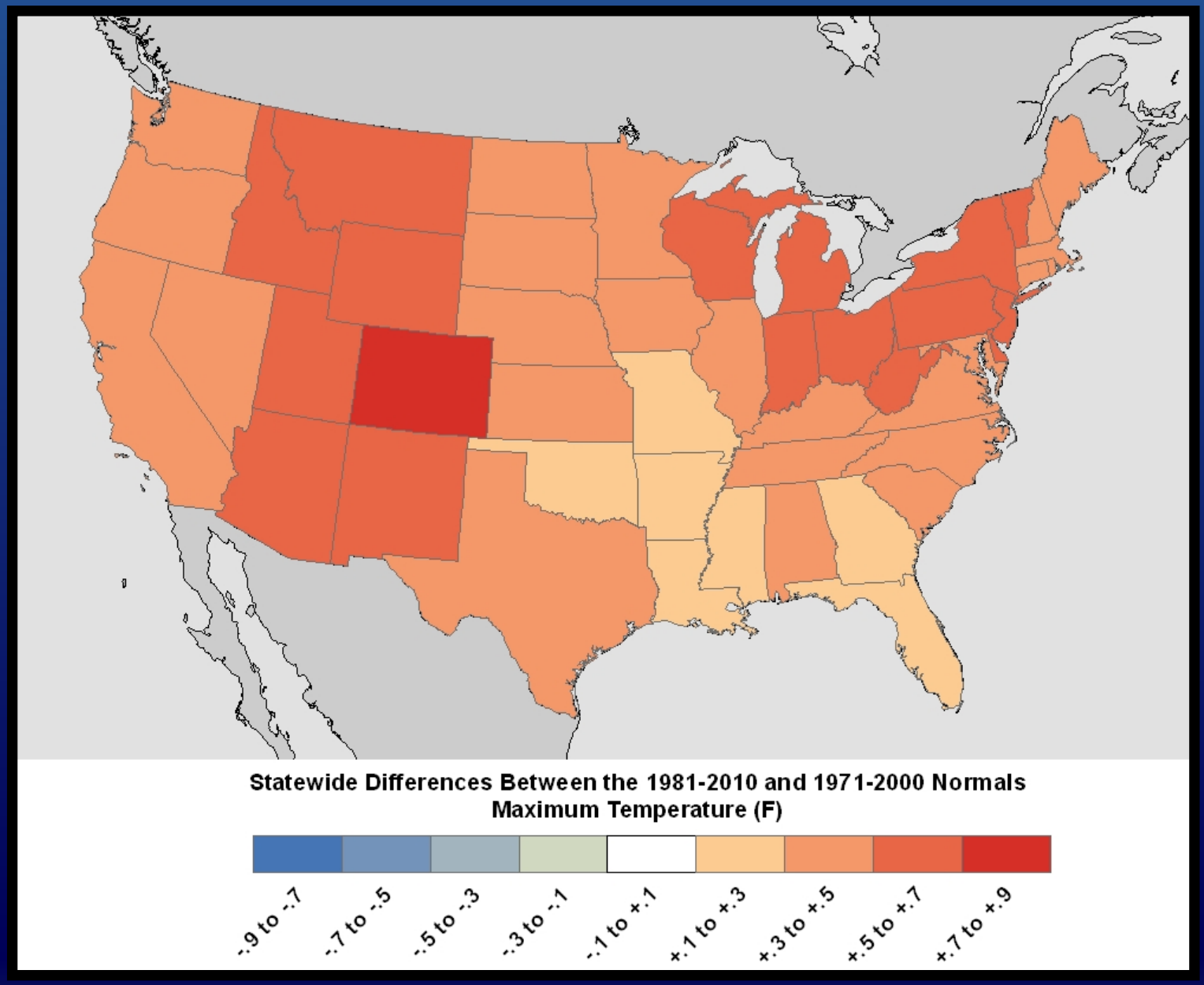
Data Rehabilitation: Reno, Nevada



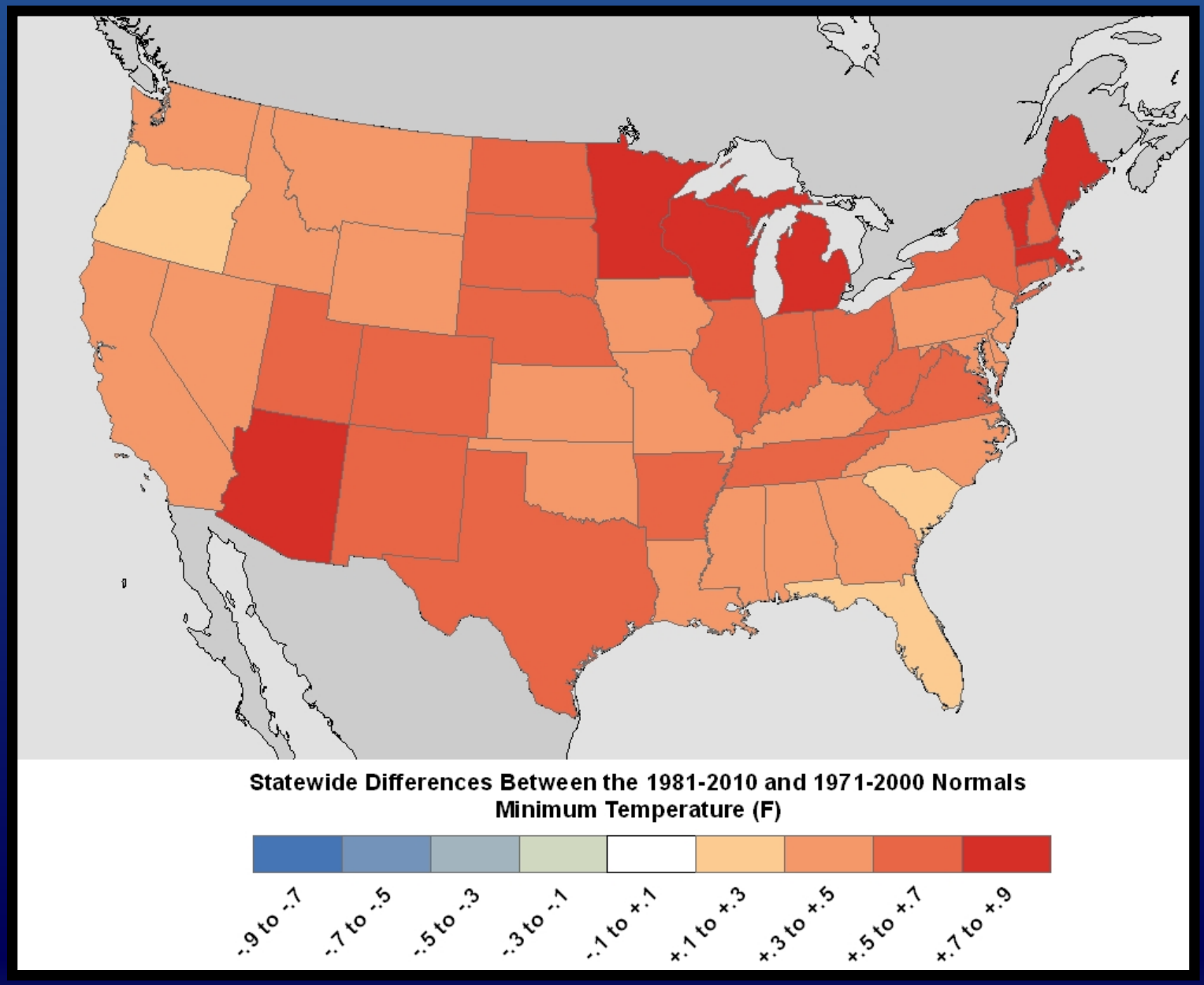
Differences in the "New" and "Old" Normals

- Again, climate change is the big player
- Temperature
  - 1971-2000 Normals included the cooler '70s
  - 1981-2010 Normals dropped the '70s, added the warmer '00s
  - So the New Normals are warmer in most areas
- Precipitation
  - Changes are more complicated

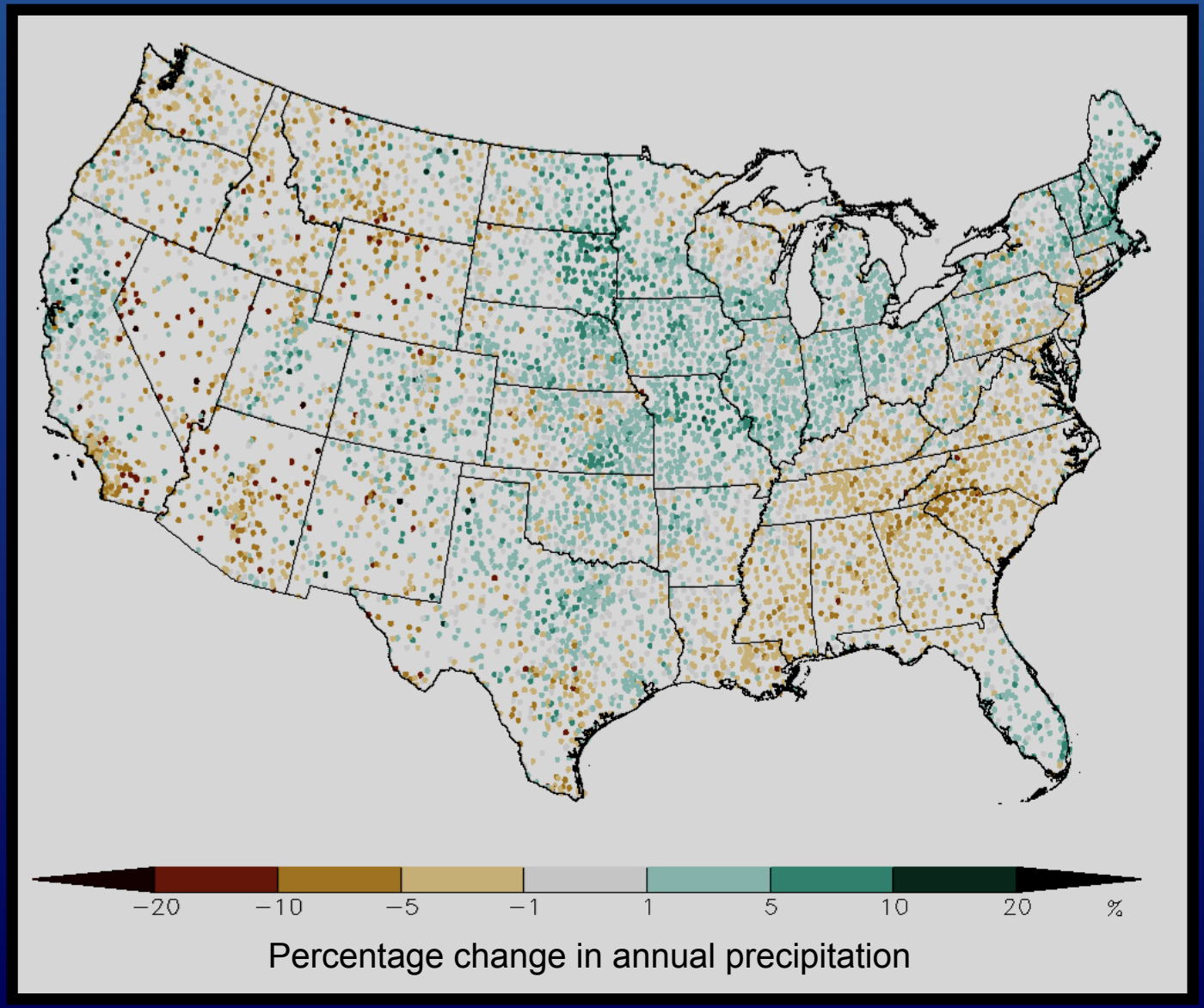
Maximum Temperature



Minimum Temperature

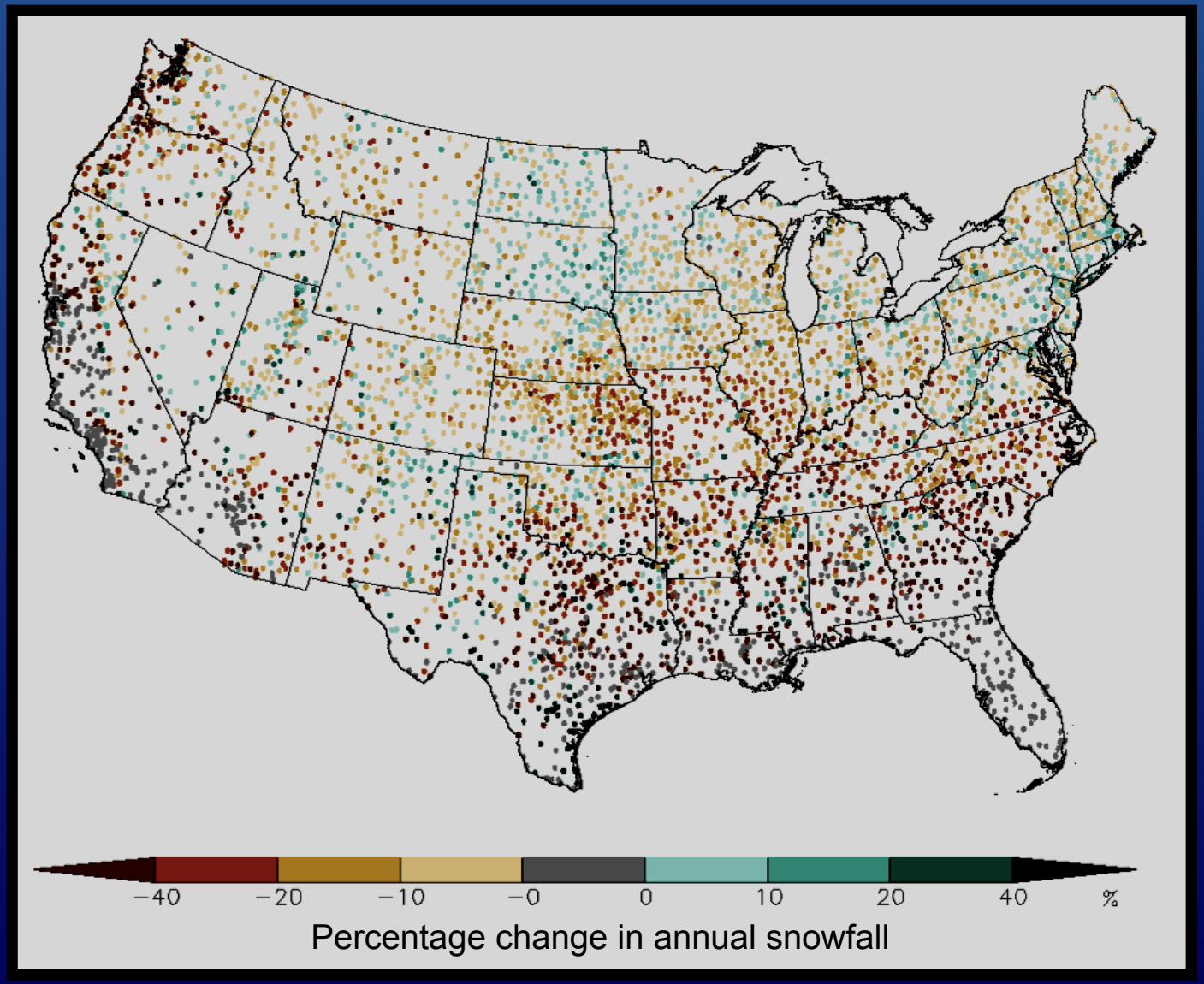


Precipitation



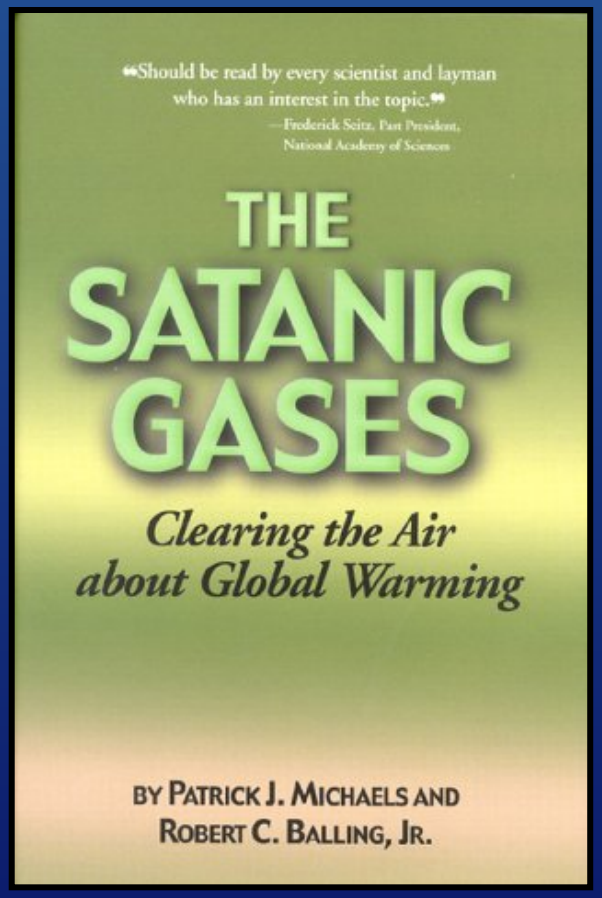
Percentage change in annual precipitation

Snowfall



What about Future Climate Change?

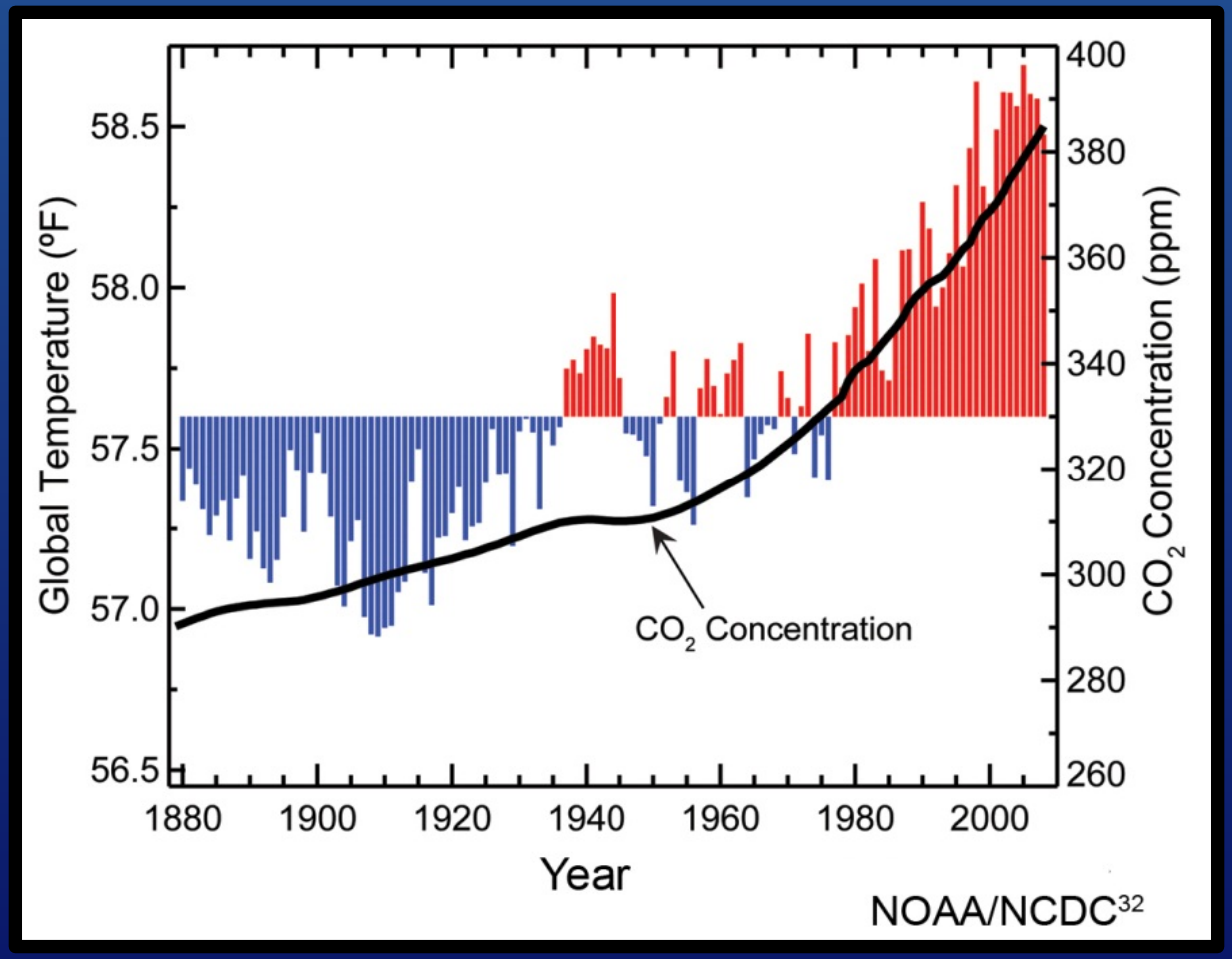
Different Perspectives



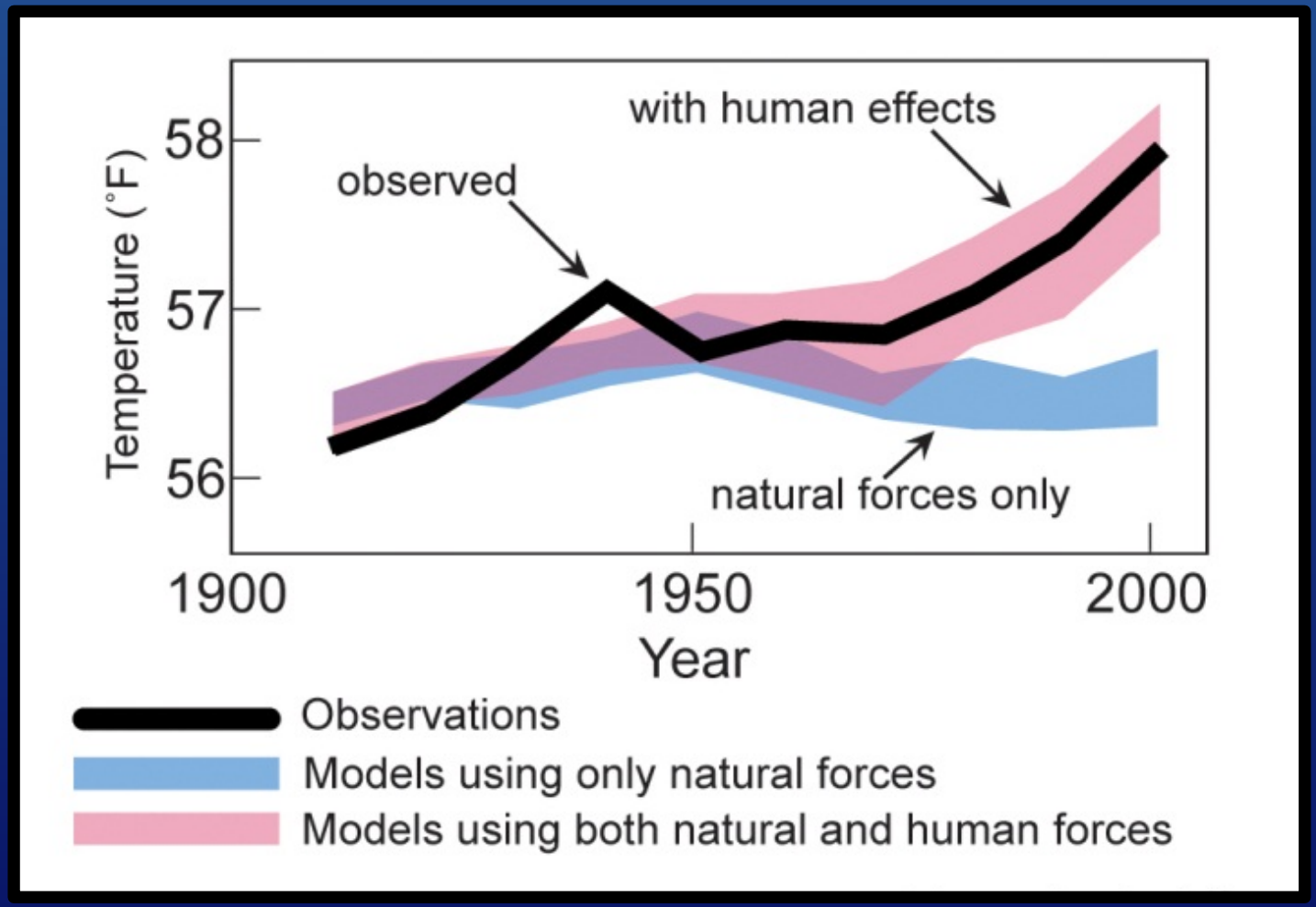
Actively Publishing Climate Scientists

Anderegg, W.R.L., J.W. Prall, J. Harold, and S.H. Schneider: 2010. Expert credibility in climate change. *Proceedings of the National Academy of Sciences*.

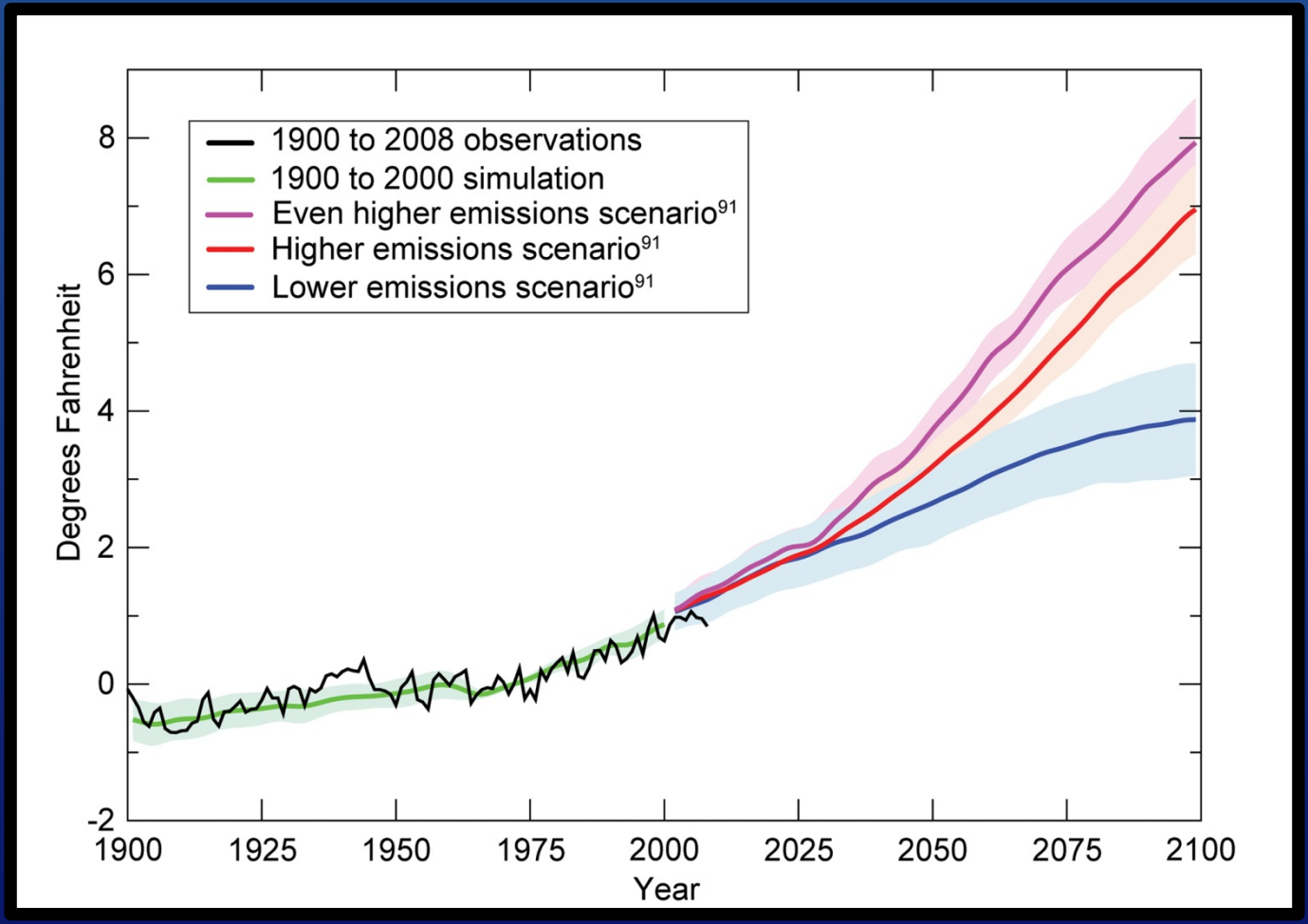
Observed Global Temperature



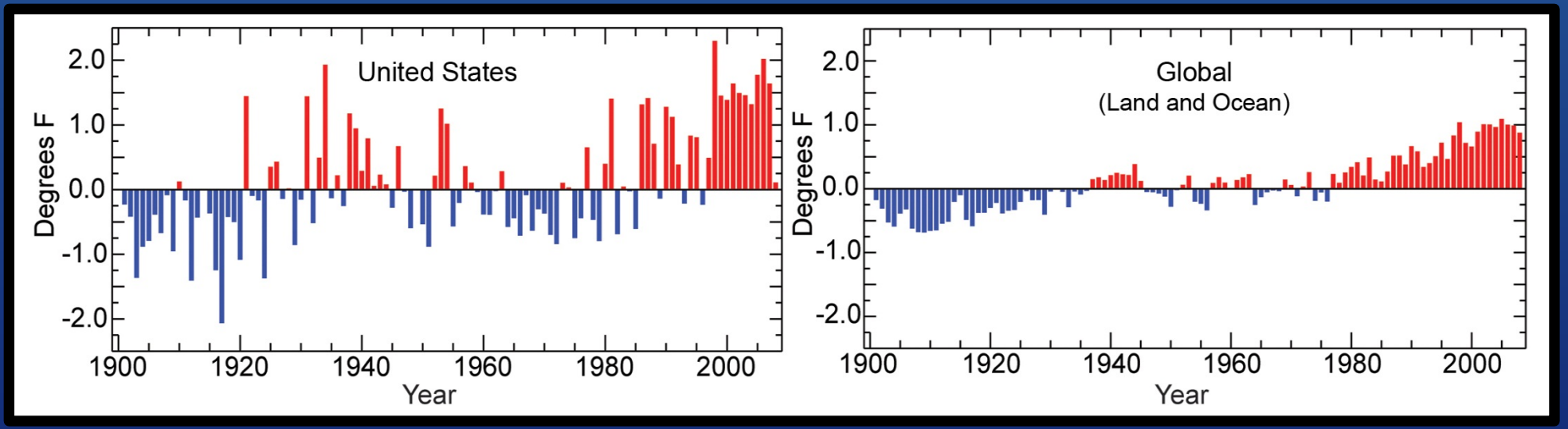
“Modeled” Global Temperature



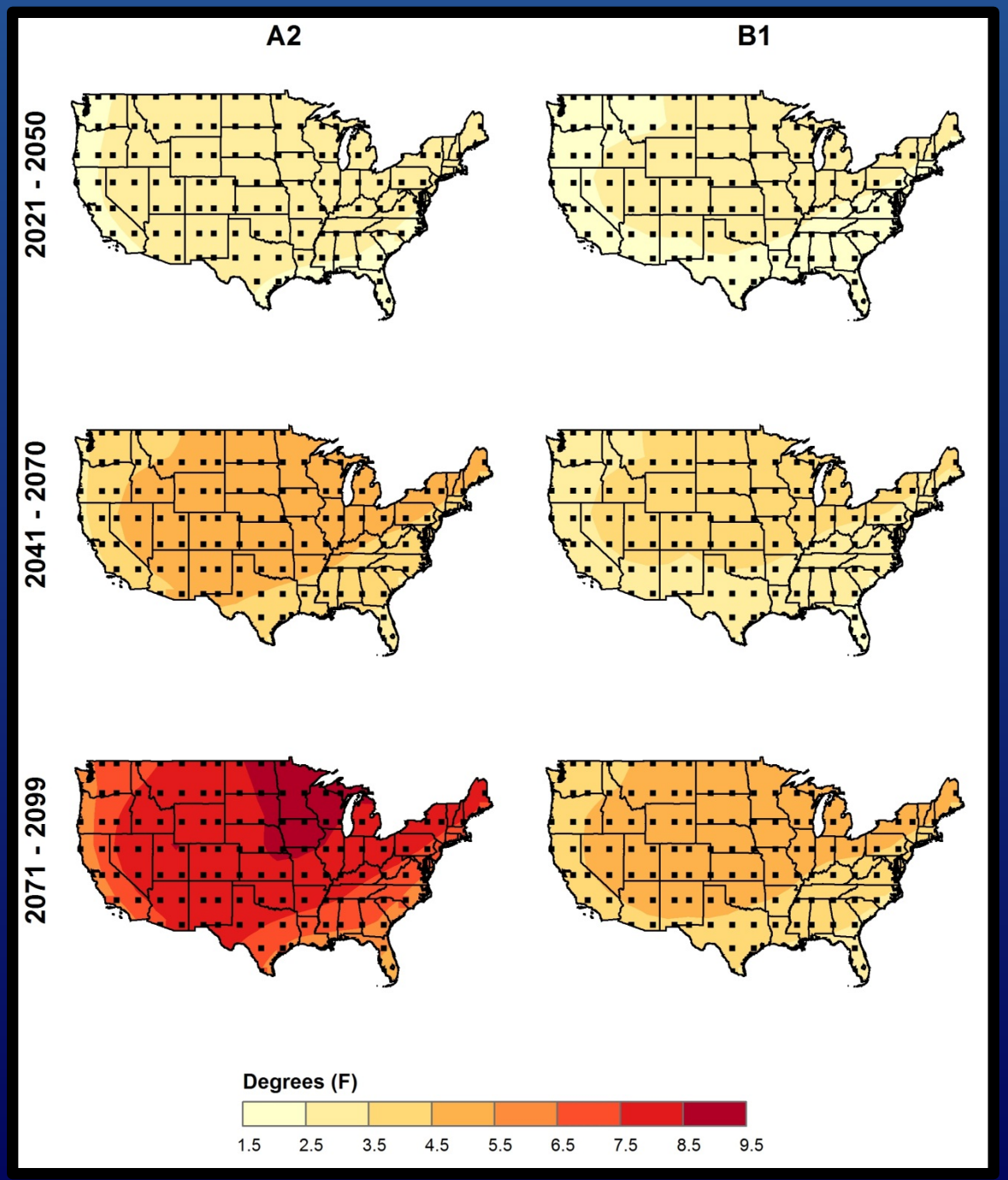
Future Global Temperature



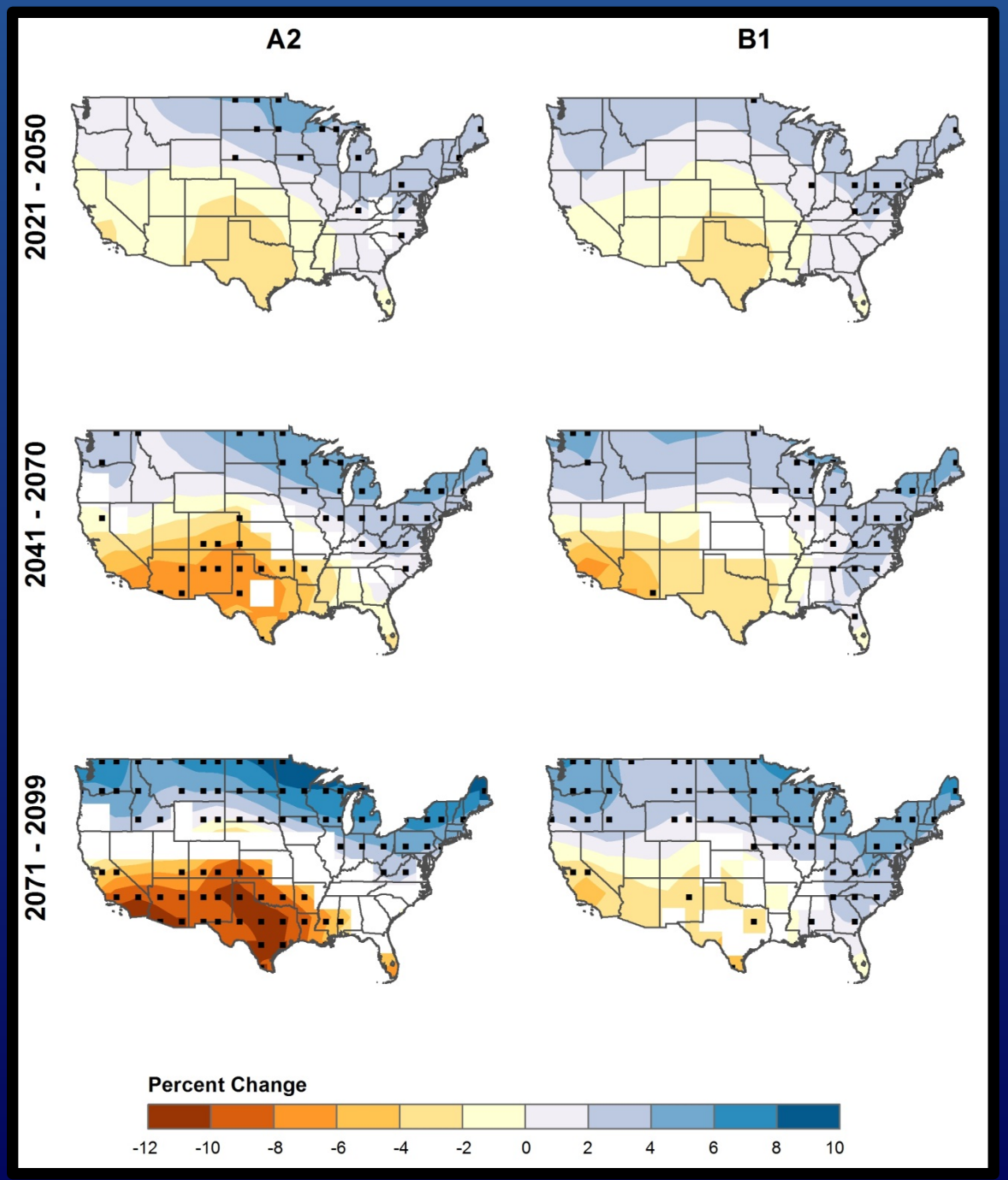
Observed U.S. Temperature



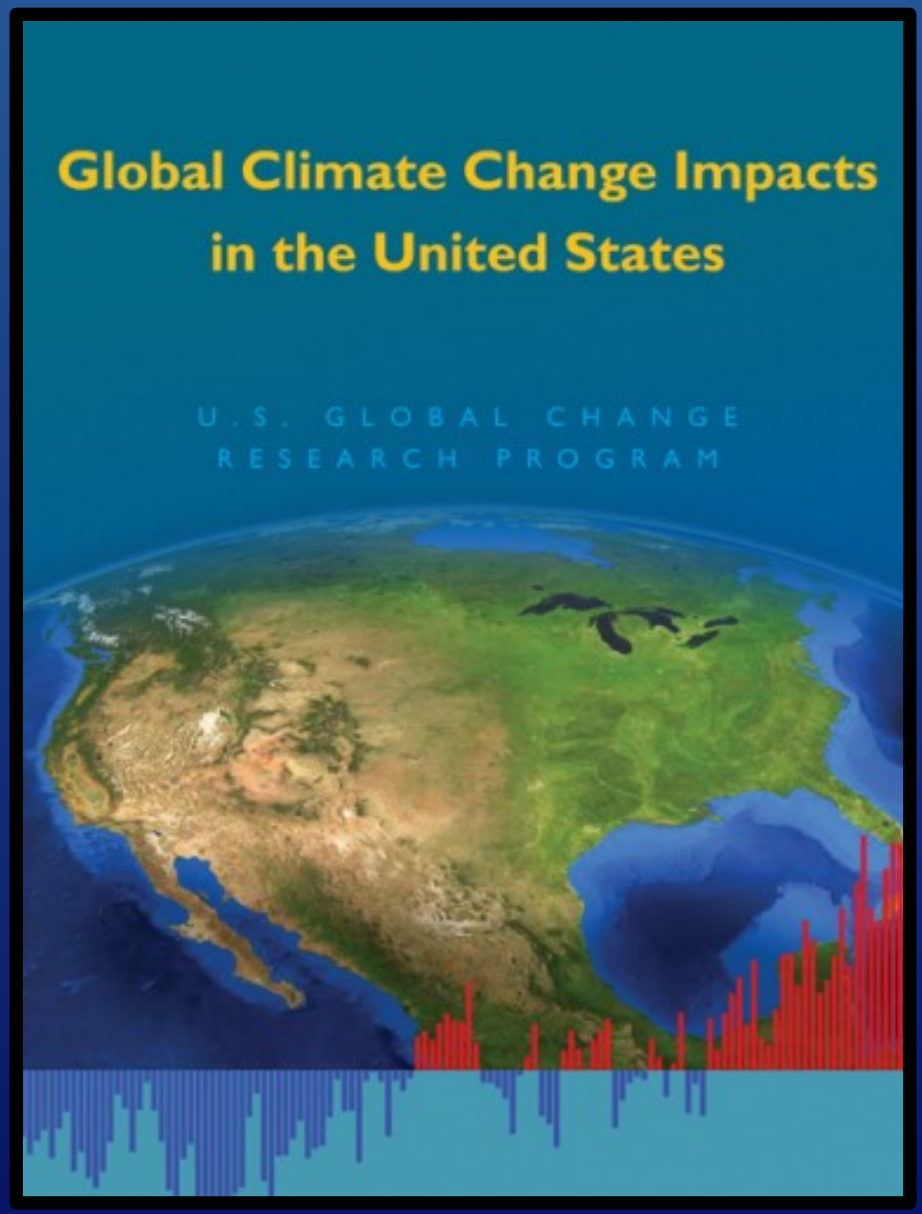
Future U.S. Temperature



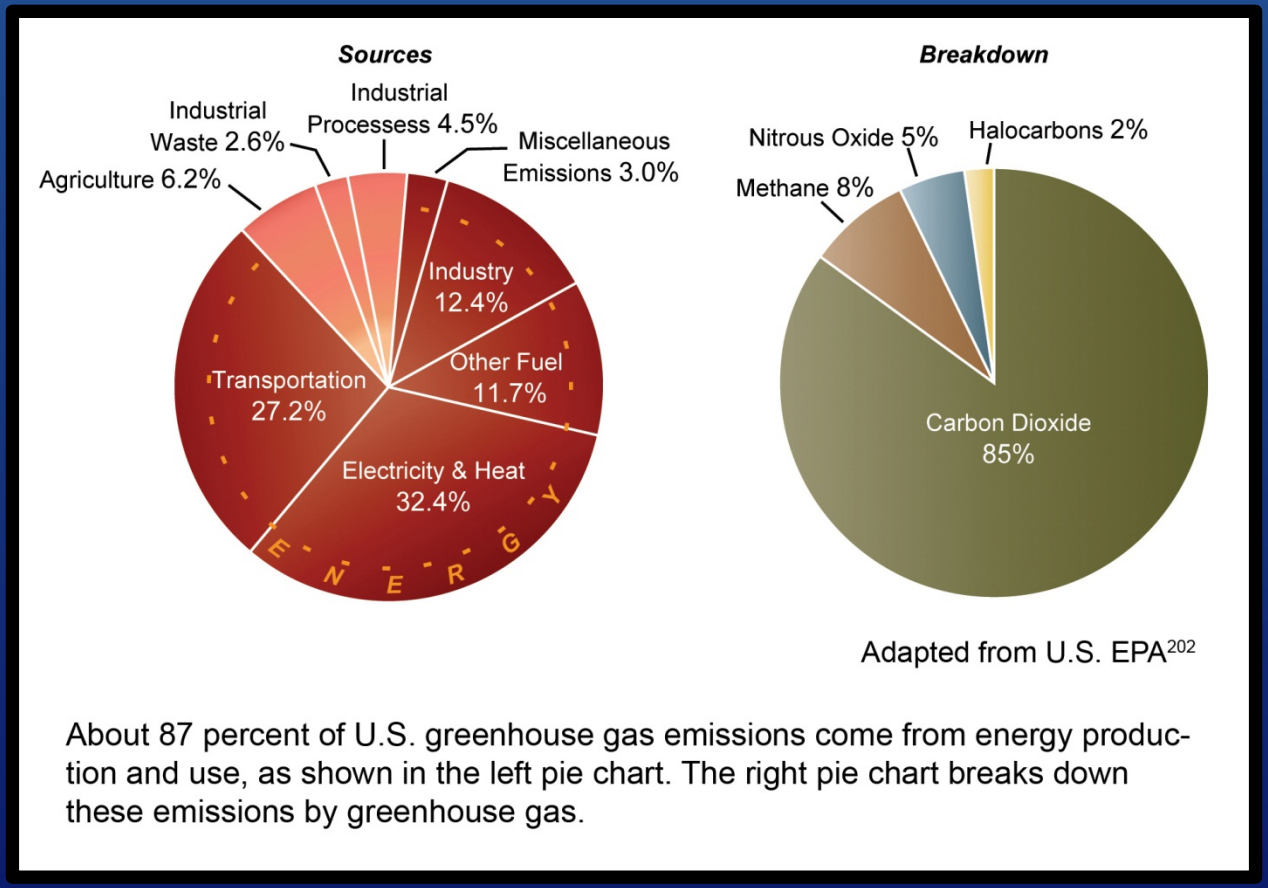
Future U.S. Precipitation



What Does This Have to Do with Energy?

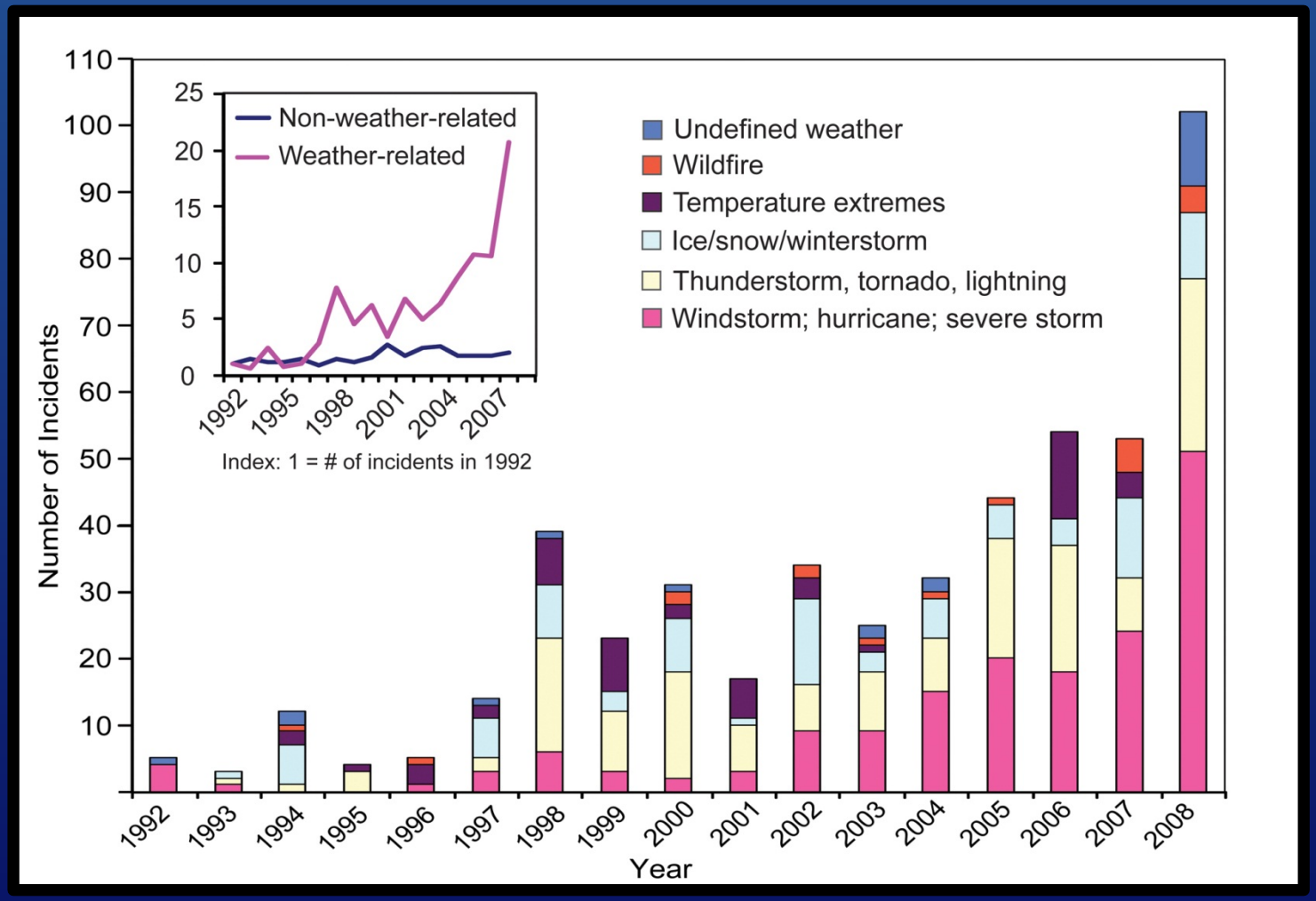

Global Climate Change Impacts
in the United States
U.S. GLOBAL CHANGE
RESEARCH PROGRAM

↑ Policy Pressure: Greenhouse Gases

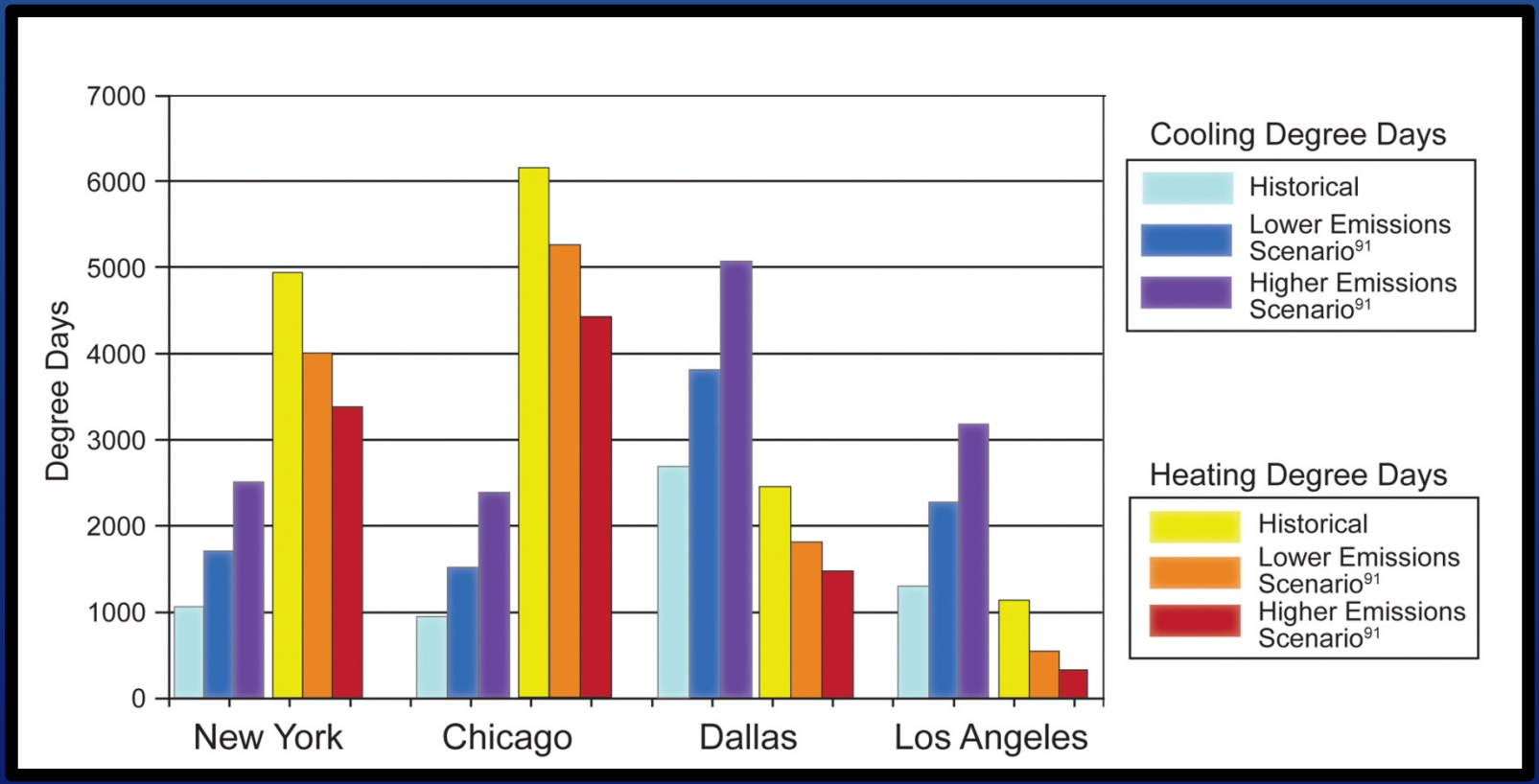


Evolving regulatory landscape creates uncertainty for climate adaptation investments and may result in inconsistent standards.

↑ Weather-Related Grid Disturbances

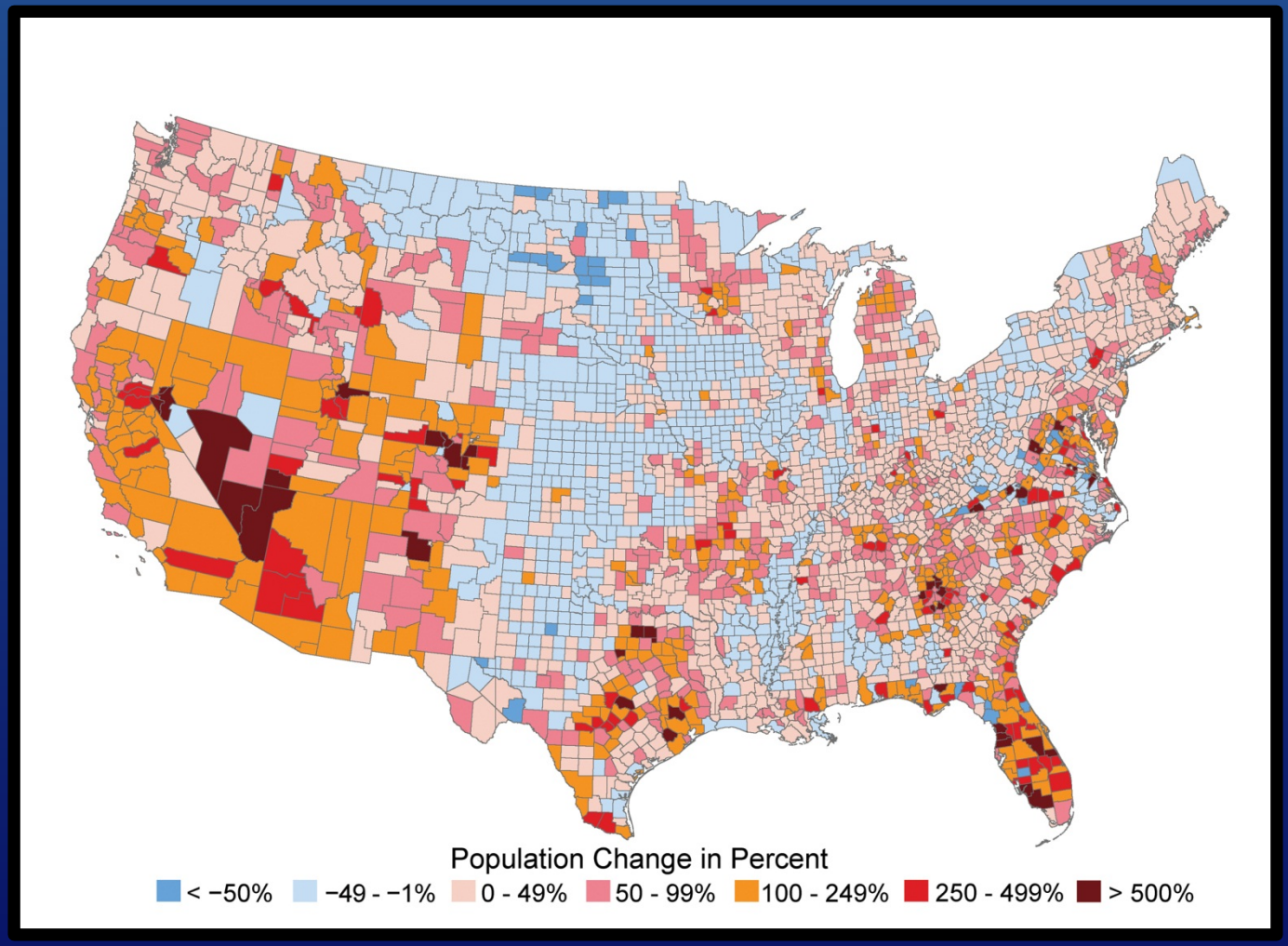


Shifting Energy Demand



Decrease in demand for heating energy and increase in demand for cooling energy.

Accelerated by Population Changes



Adapting to Climate Change: A Guide for the Energy and Utility Industry

Tiffany Finley, Associate, Advisory Services
Ryan Schuchard, Manager, Climate and Energy

Changing Access to Energy Fuel Supplies

Impacts
Changes to the natural landscape, including rises in sea level, ice melt, and permafrost melt, will have an uncertain impact on access to, and sustainability of, fossil fuel reserves.
Increased resource shortages and scarcity, in particular for fossil fuels, due to weather variability, will increase costs of exploration and extraction.
As resource availability fluctuates, access to fossil fuels and water will change, driving up wholesale energy prices.

Greater Demand for Management Solutions

Impacts
Changes in temperature will impact equipment operations, including heat exchange, cooling processes, and limited days for drilling wells, leading to increased costs for equipment modifications, new assets, and relocation.
A more variable and extreme climate will result in strains on the grid. In particular, the change in hot days and cold days geographically will result in decreased network reliability and increased power outages.
Unpredictable weather and temperature changes may lead to greater fluctuations in consumer demand for energy.
As the electrification of vehicles increases, demand for electricity during off-peak times will rise.
Increased consumer awareness of energy use and management will lead to an increase in demand for products and services, including home energy audits and energy tracking systems.

Water Availability

Impacts
Water supply shortages will constrain cooling operations, leading to equipment malfunctions, depreciation, and electricity outages.
Drastic variations in the water supply could result in the temporary or permanent closure of hydroelectric generation plants due to drought or excessive flooding.
Increased competition for water supplies among sectors and communities will lead to higher costs, reduced availability, and regulation of water permits.
Hydroelectric generation may outcompete other energy generation sources due to favorable water supply conditions in certain geographical regions.

Policy and Investor Pressure

Impacts
Investors may seek companies with fewer risks related to fossil fuels, and greater opportunities for renewable energy and technology development.
Increased public scrutiny involving corporate energy and water use may lead to decreased investment and damage to companies' reputations.
Companies face a changing and uncertain policy landscape, in particular on the global level, resulting in increased risks in connection with inaction.
Policy incentives have been designed to reward utilities for achieving energy efficiency that can be achieved through consumer engagement as well as new adaptive product and service offerings.

Workforce Safety and Security

Impacts
As sea levels rise and severity and frequency of storms, fire, and other dangerous environmental changes increase, physical risks to employees will rise.
Higher temperatures and changes in water tables will increase the spread of disease, threatening employees in high-risk locations.
As unpredictable weather events increase, accessibility to the workplace and available work in functioning facilities may decrease, resulting in uncertain working hours for employees and a restless workforce.
As migration attributed to climate change increases, it will force employees out of their current residences, causing a shift in workforce availability, including an increase in climate refugees.

Adaptive Practices

- Value protection
  - Risk assessment and disaster planning (prepare for extremes)
  - Investment in climate-resilient assets (improve infrastructure)
  - Strategic diversification (↑ operations in high risk/density areas)
- Value creation
  - Customer energy management (e.g., smart meters)
  - Renewable energy technology investments
  - Strategic partnerships – e.g., NOAA, CICS – Alternative Normals?