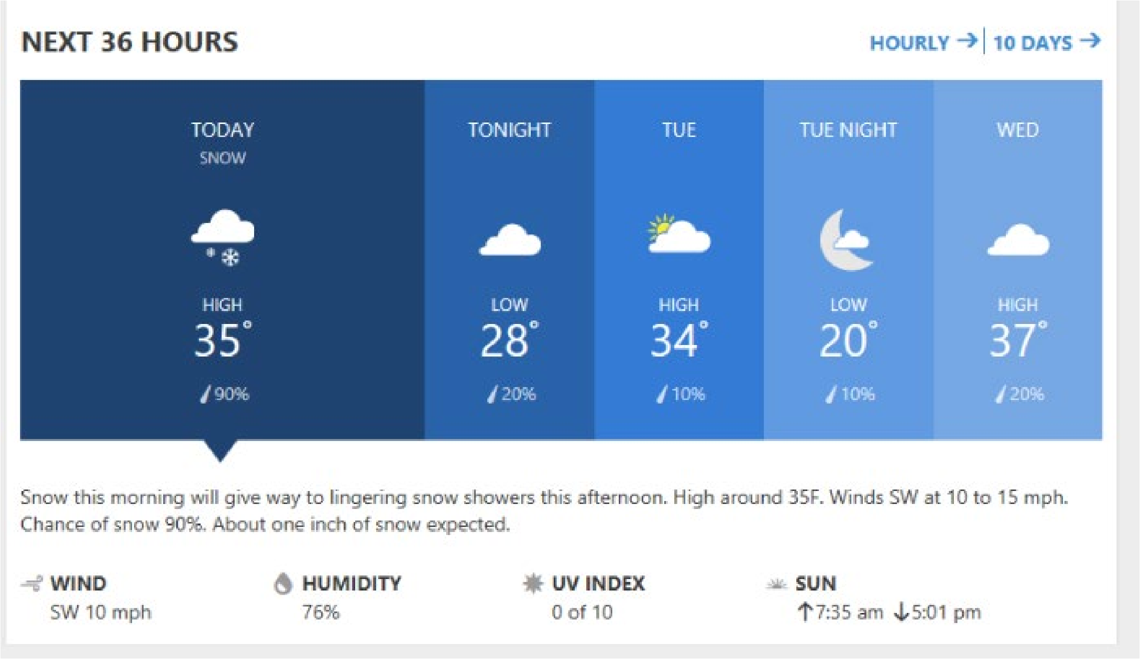
Implications of Climate Predictions on Forage Production in Western States

Alan Rotz

USDA, Agricultural Research Service
University Park, PA

Weather and Climate

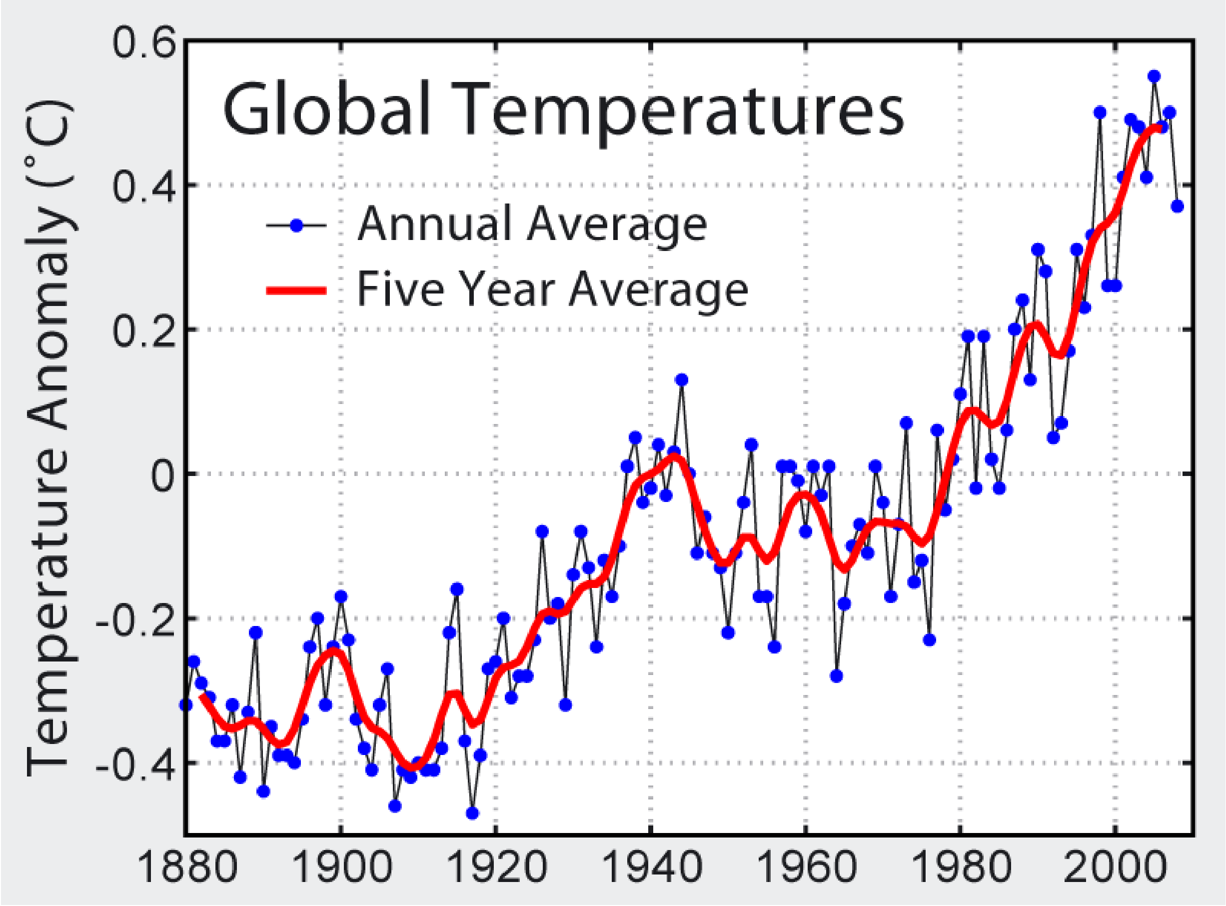
- Weather is the daily temperature, precipitation, etc. that we experience
- Climate is the long term averages and trends in weather



Our Climate is Changing

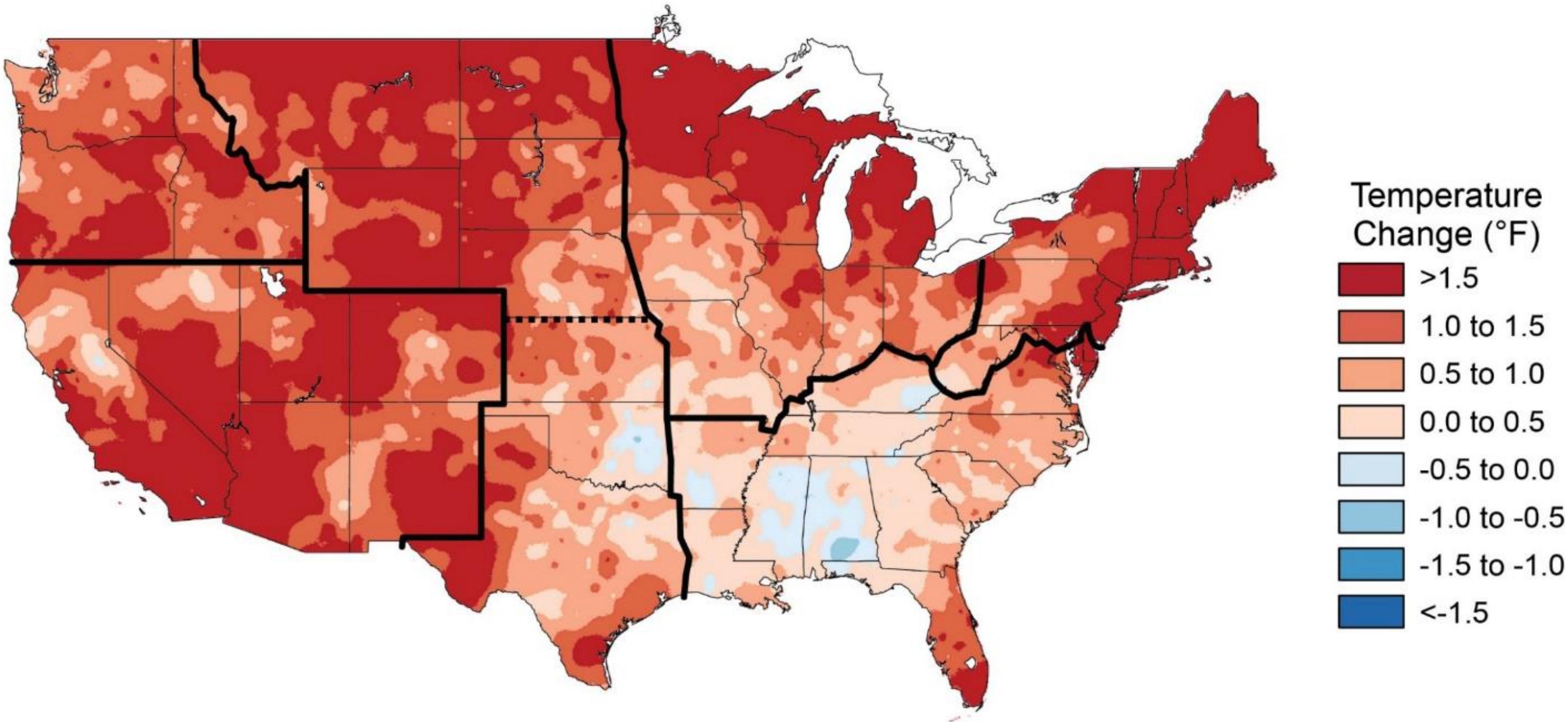
- More variable weather patterns
- Generally warmer temperatures
- Changes in precipitation

Global Temperature



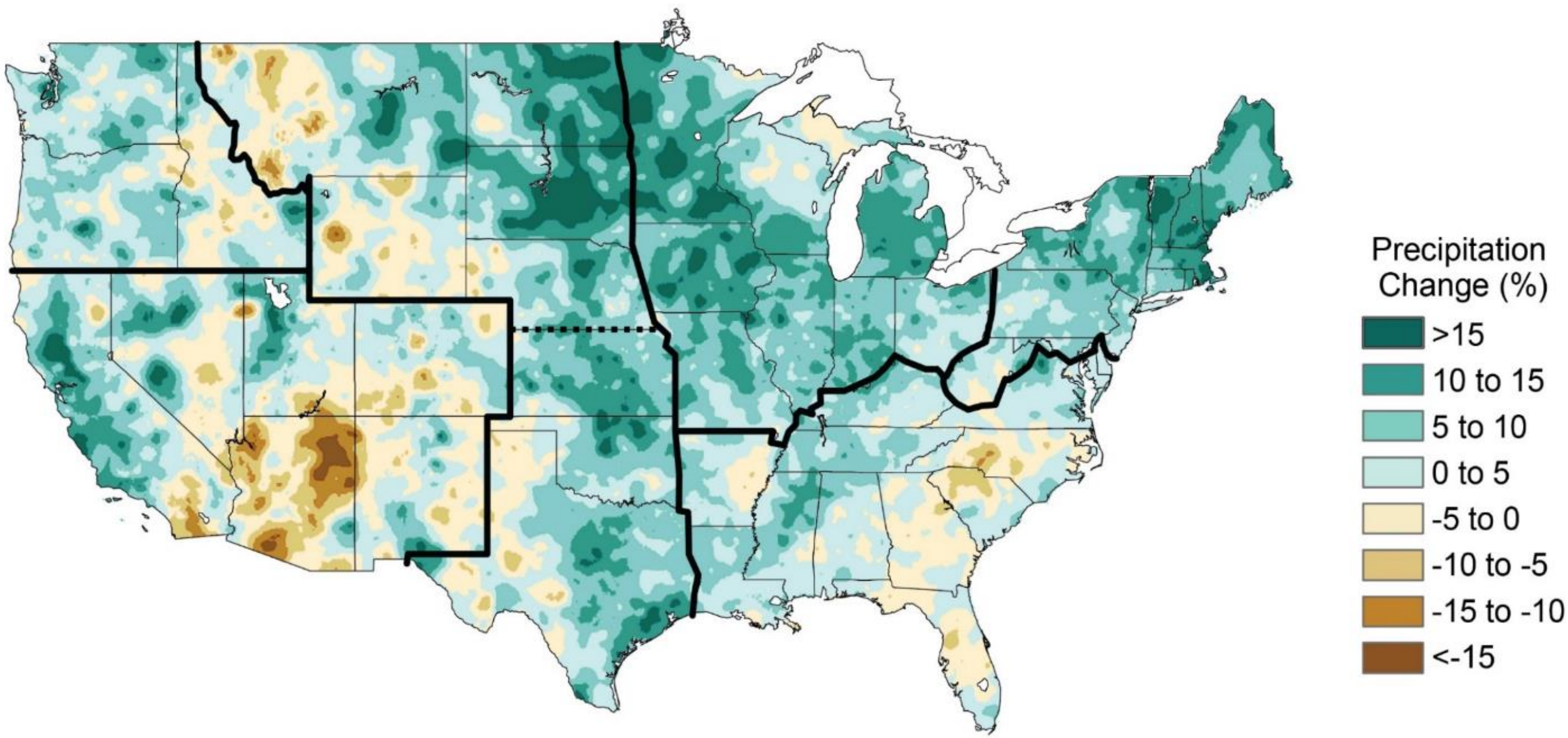
NASA's Goddard Institute for Space Studies. The "zero" on this graph corresponds to the mean temperature from 1961-1990,

Change in Temperature, 1991-2012



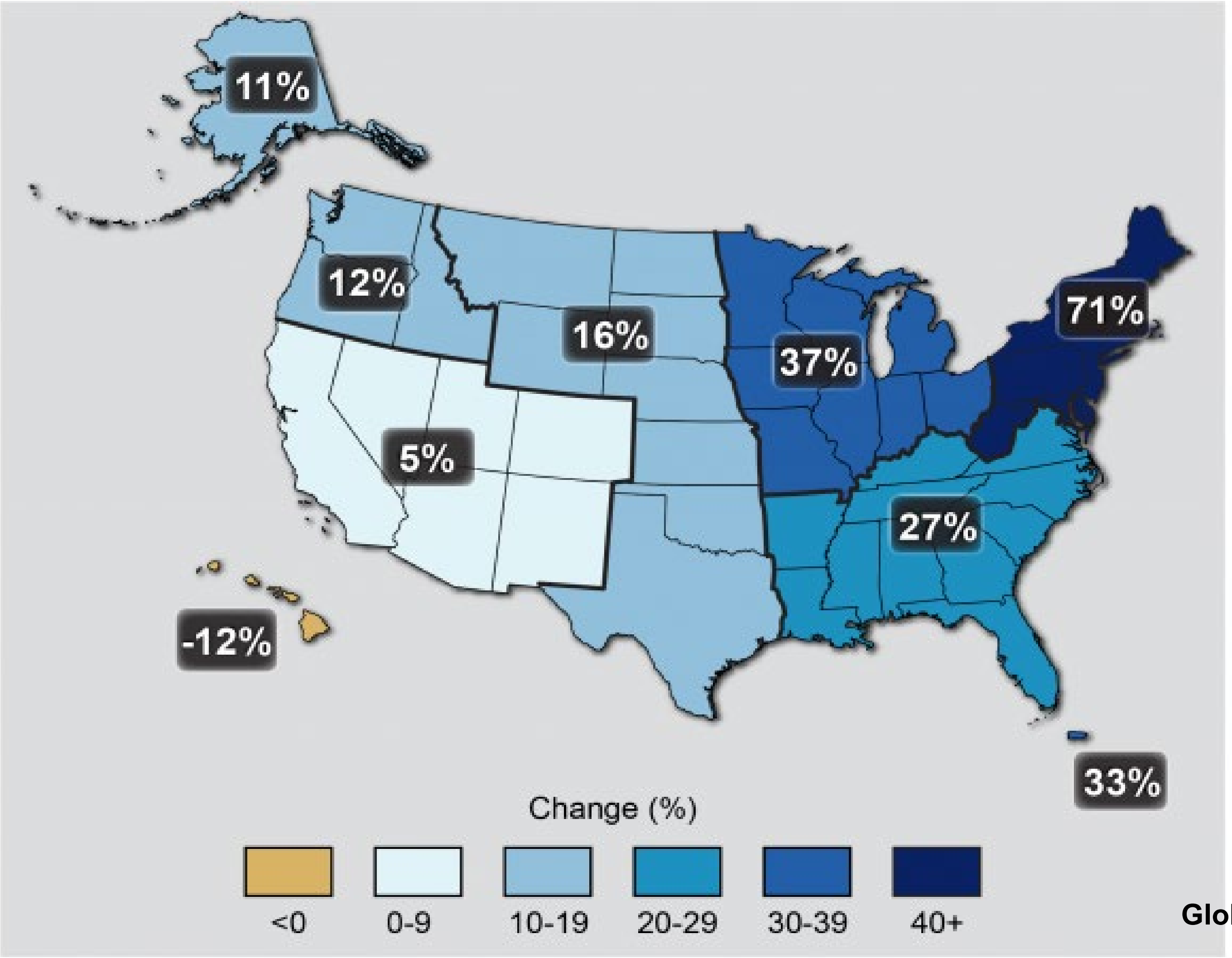
NASA Earth Observatory

Change in Precipitation, 1991-2012



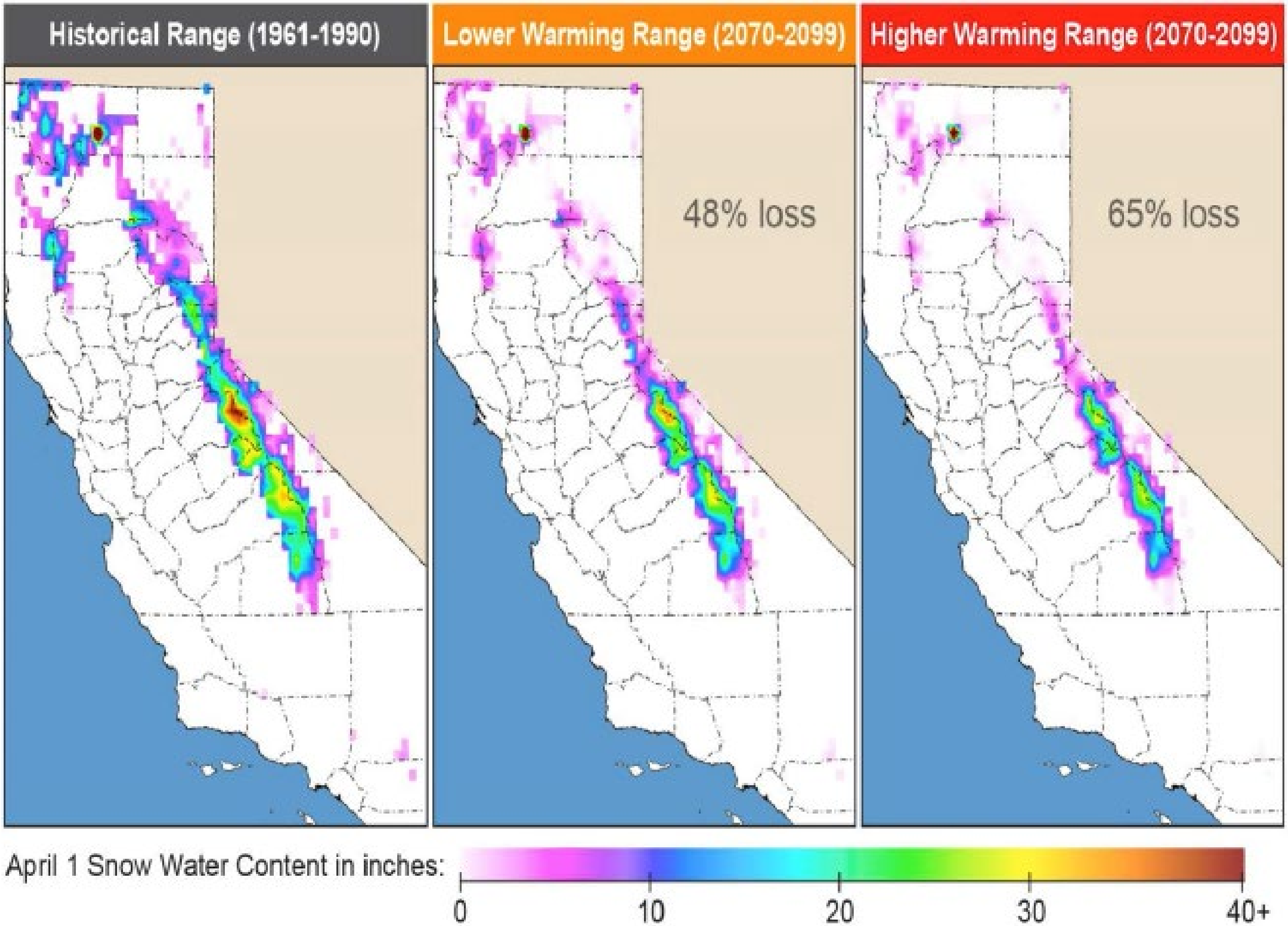
NASA Earth Observatory

Extreme Rainfalls, 1958-2012



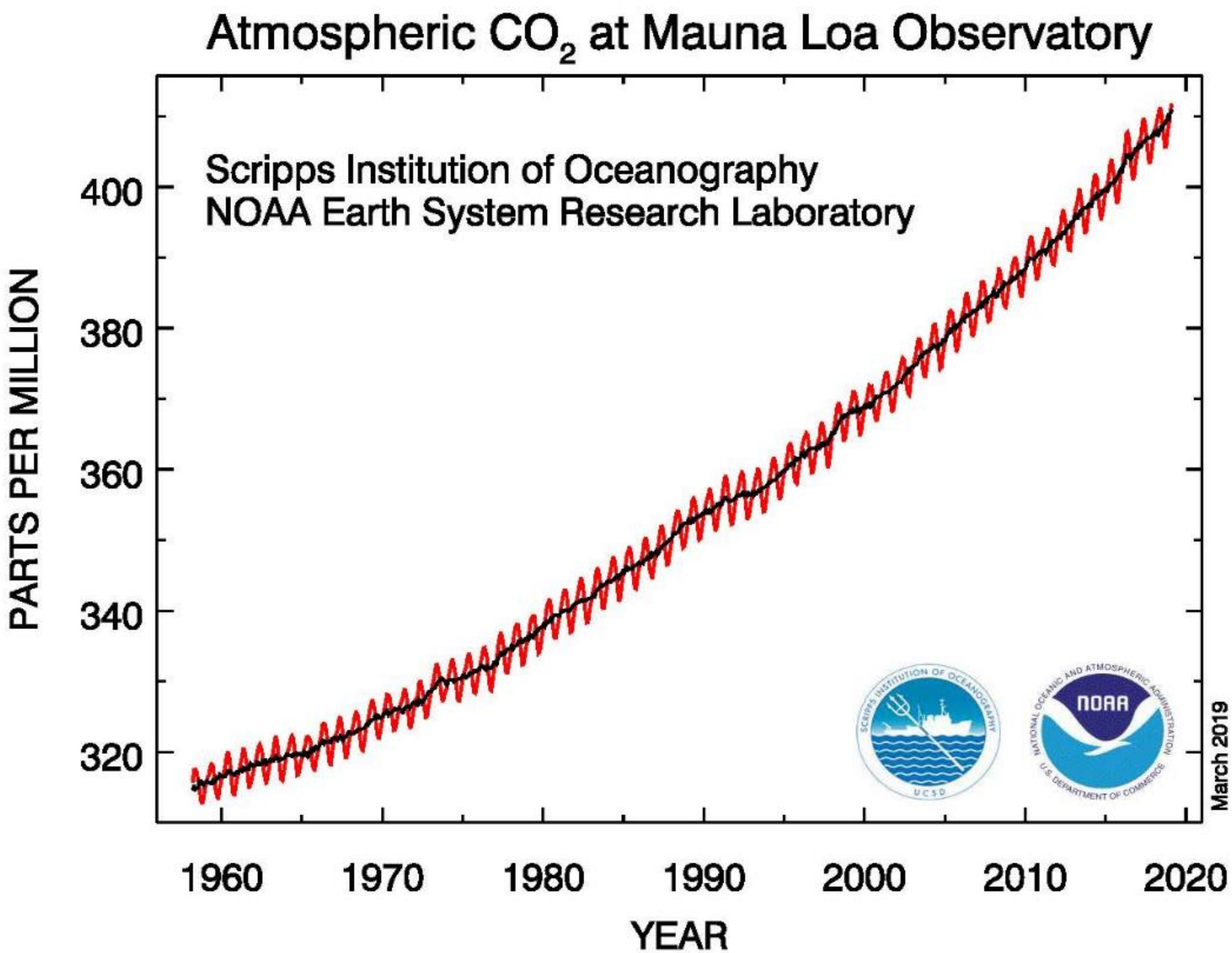
GlobalChange.gov

California Snowpack

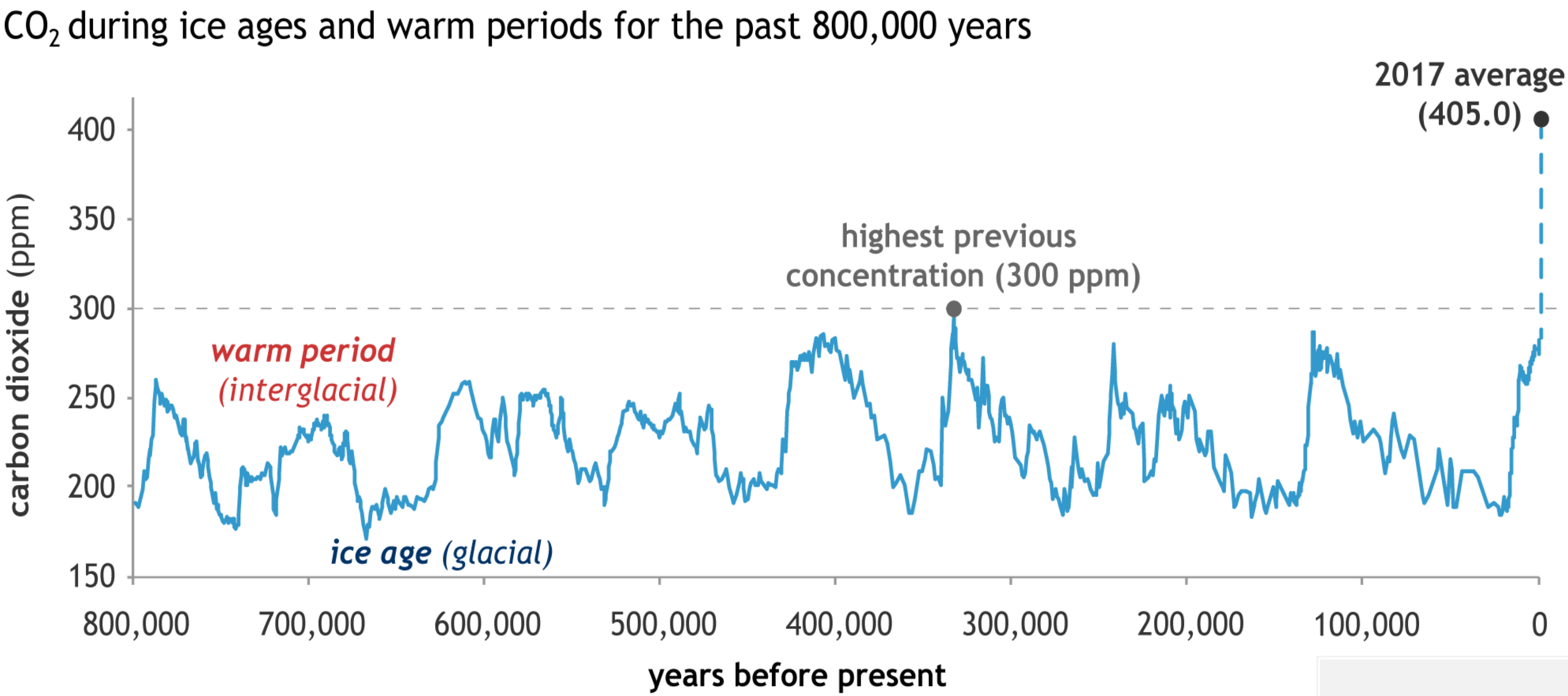


California Water Plan Update, 2013

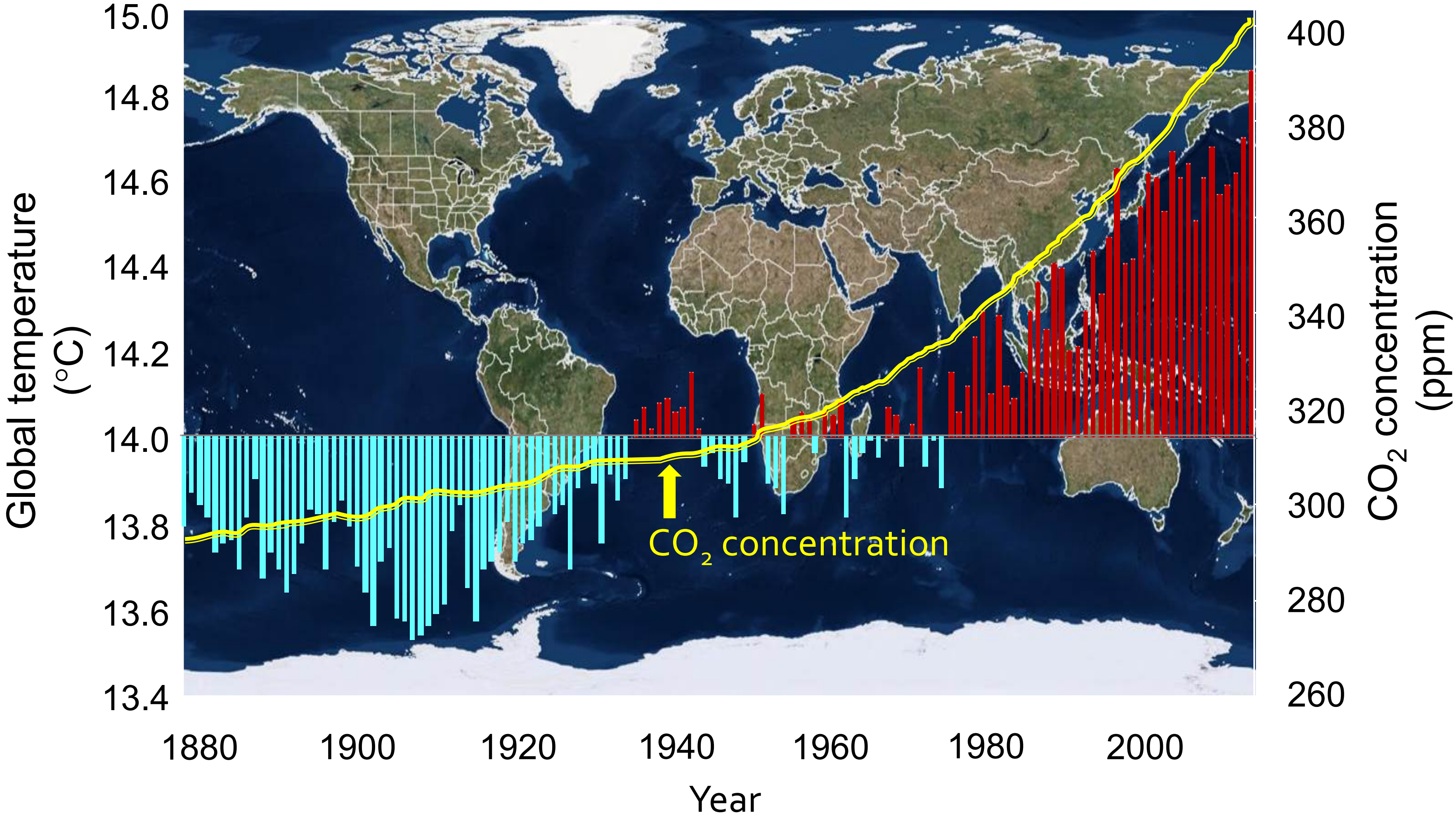
What is causing the change?



Global Carbon Dioxide

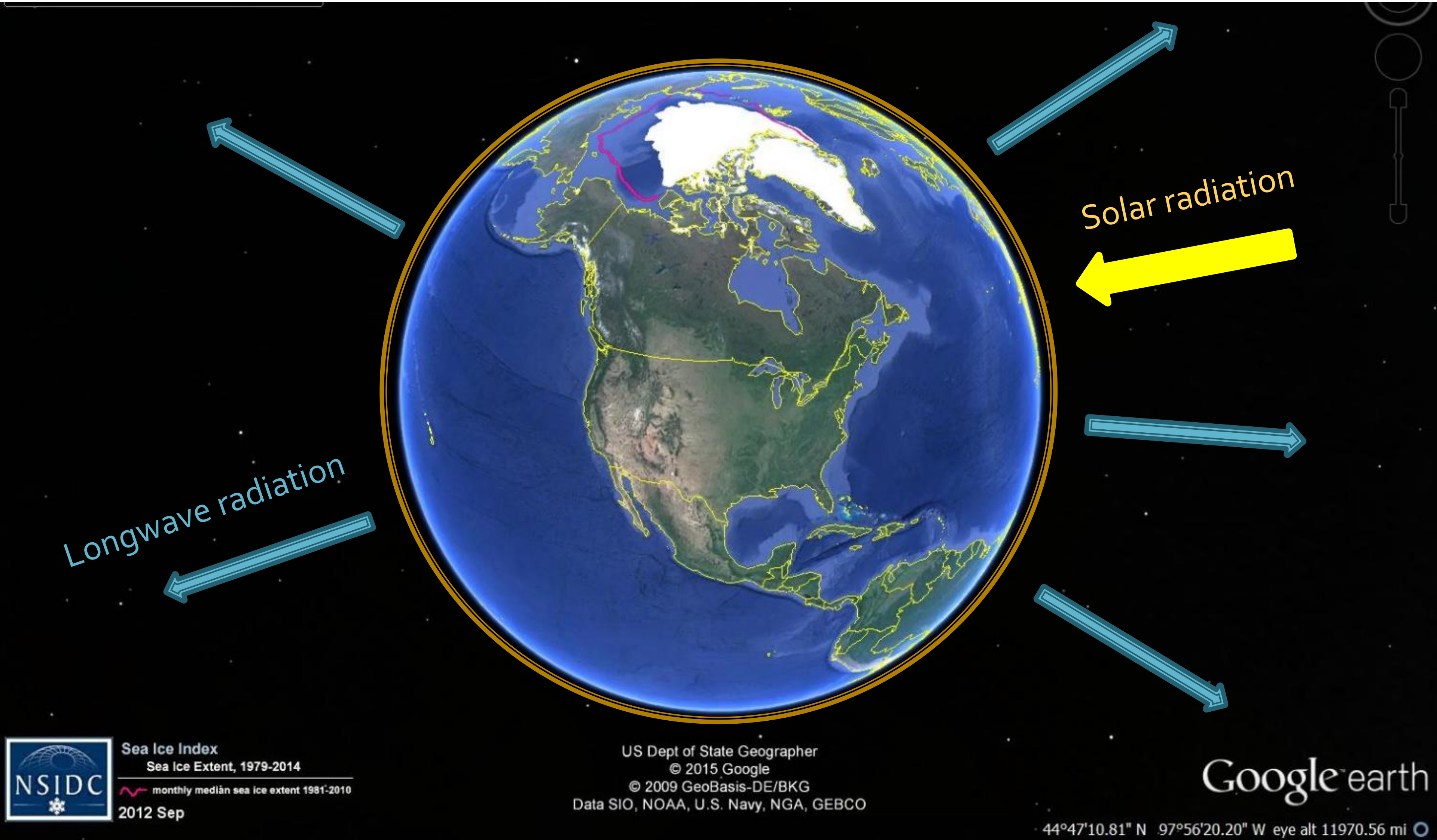


Global Temperature and CO_2

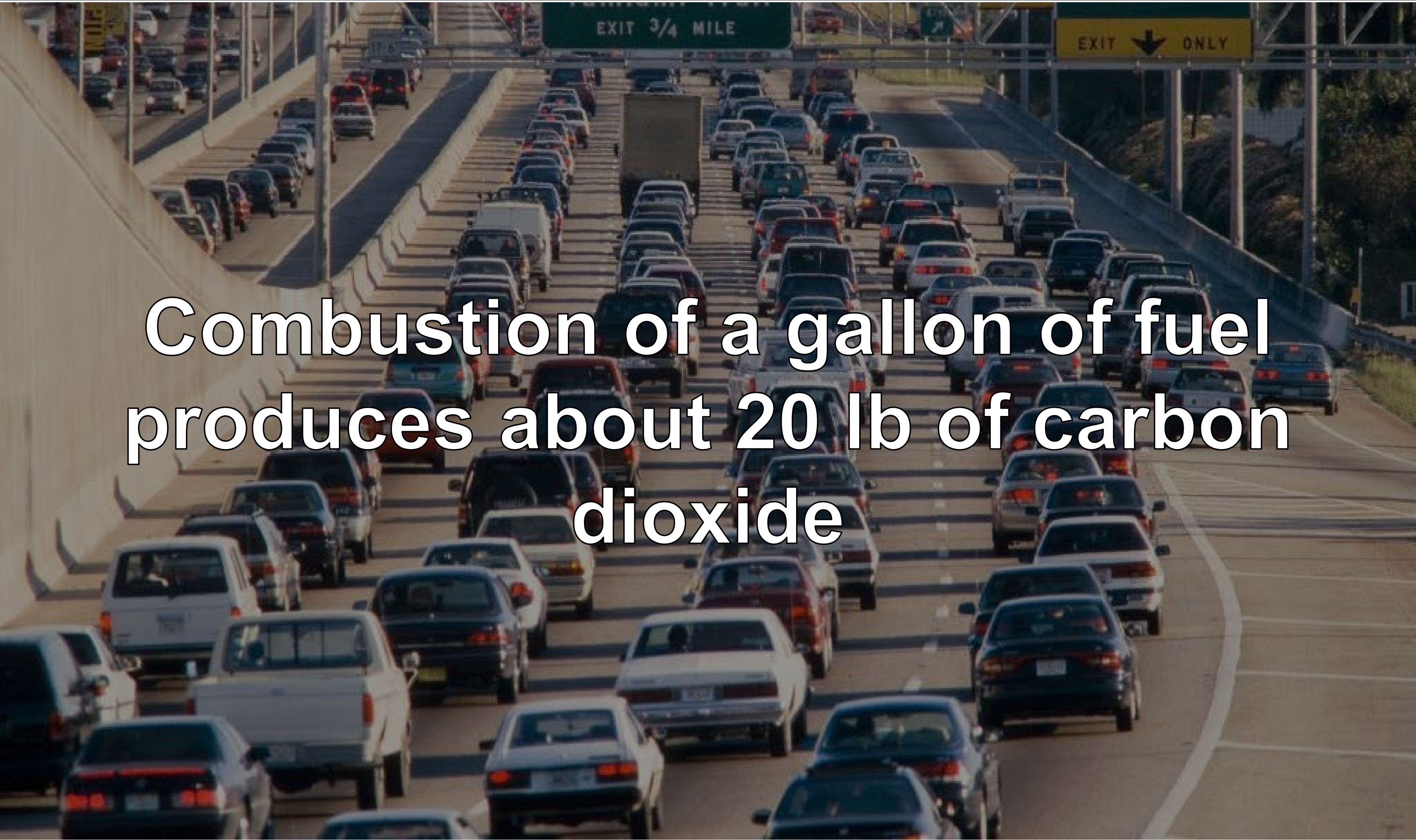


US National Climate Assessment, 2014; Karl et al., 2009

The Global Greenhouse



Fossil Fuel Combustion



Combustion of a gallon of fuel produces about 20 lb of carbon dioxide

Summary on Climate Change

Our atmosphere is changing as a result of human activities, primarily due to the use of fossil fuels

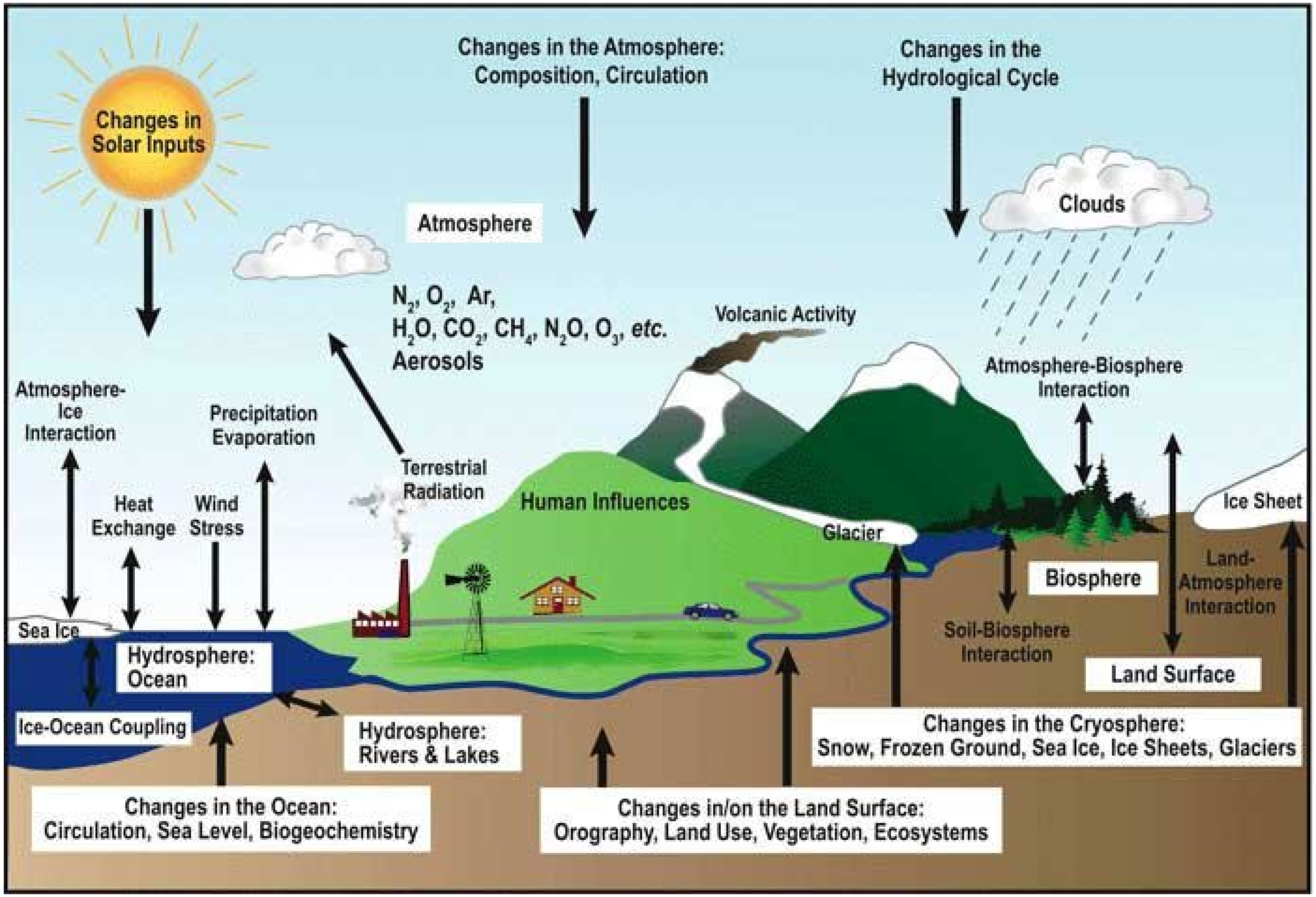
As a result

- **Ambient temperatures are gradually increasing**
- **Variability in temperature is increasing**
- **Variability and amount of precipitation is increasing**

What does this mean for you?

- No drastic changes
- Recent trends in change will continue
- The rate of change will likely increase

Global Climate Models

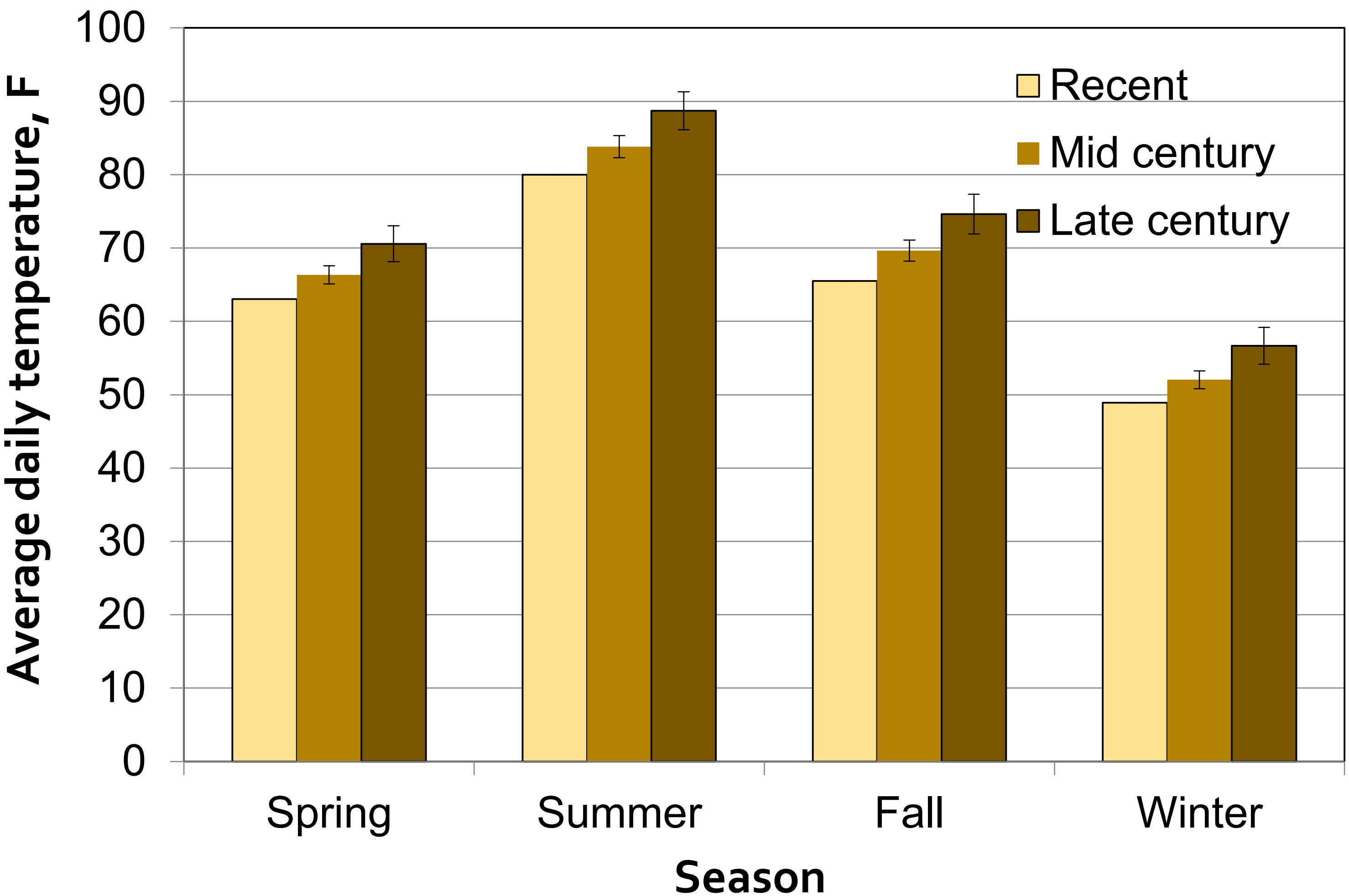


Le Treut et al. 2007. Climate Change 2007: The Physical Science Basis, IPCC

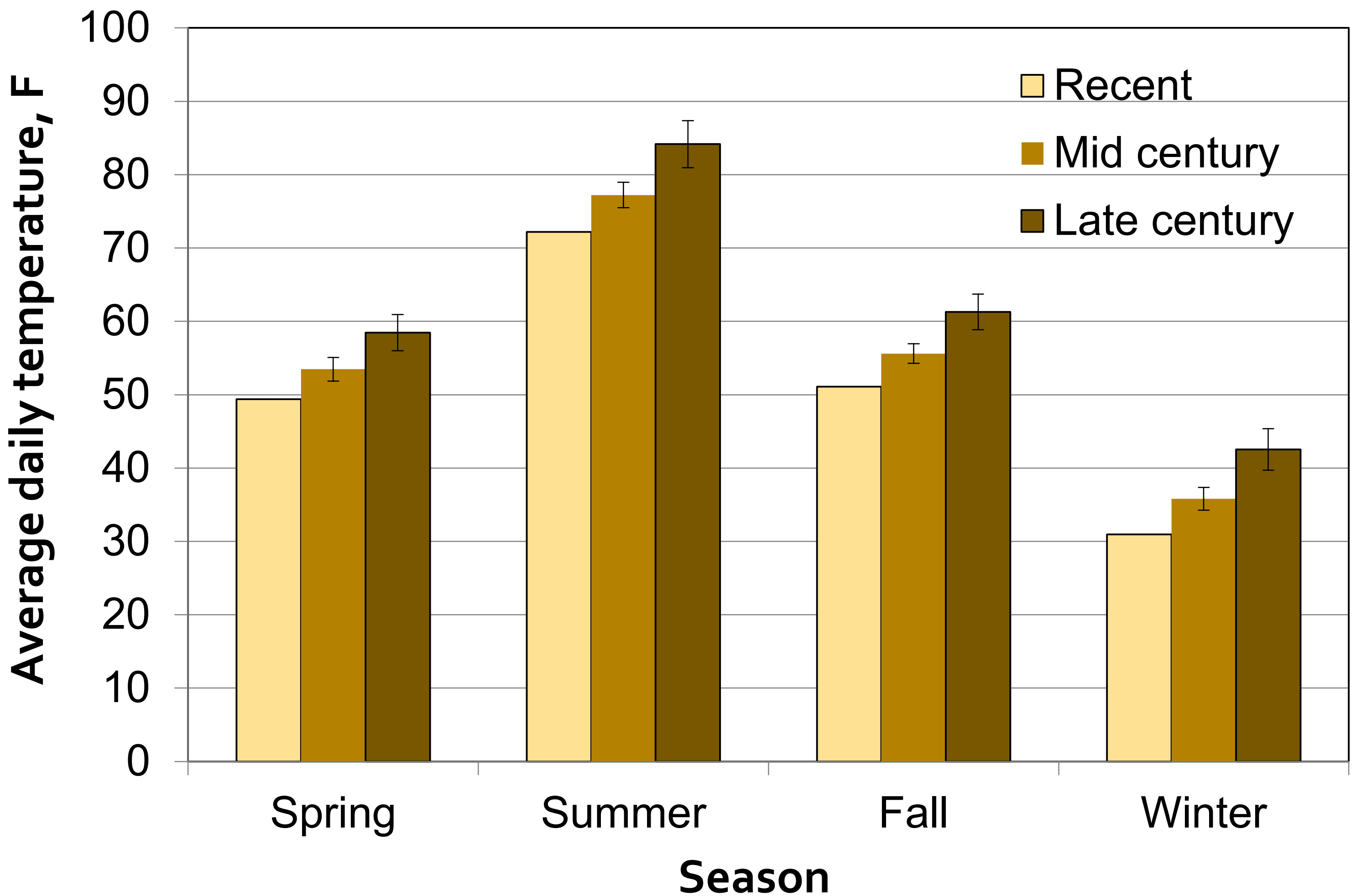
Future Climate

- Nine global climate models were used to predict future climate
- Based upon projected changes in the atmosphere, i.e. different emission scenarios
- Downscaled projected climate to obtain daily weather for the western US

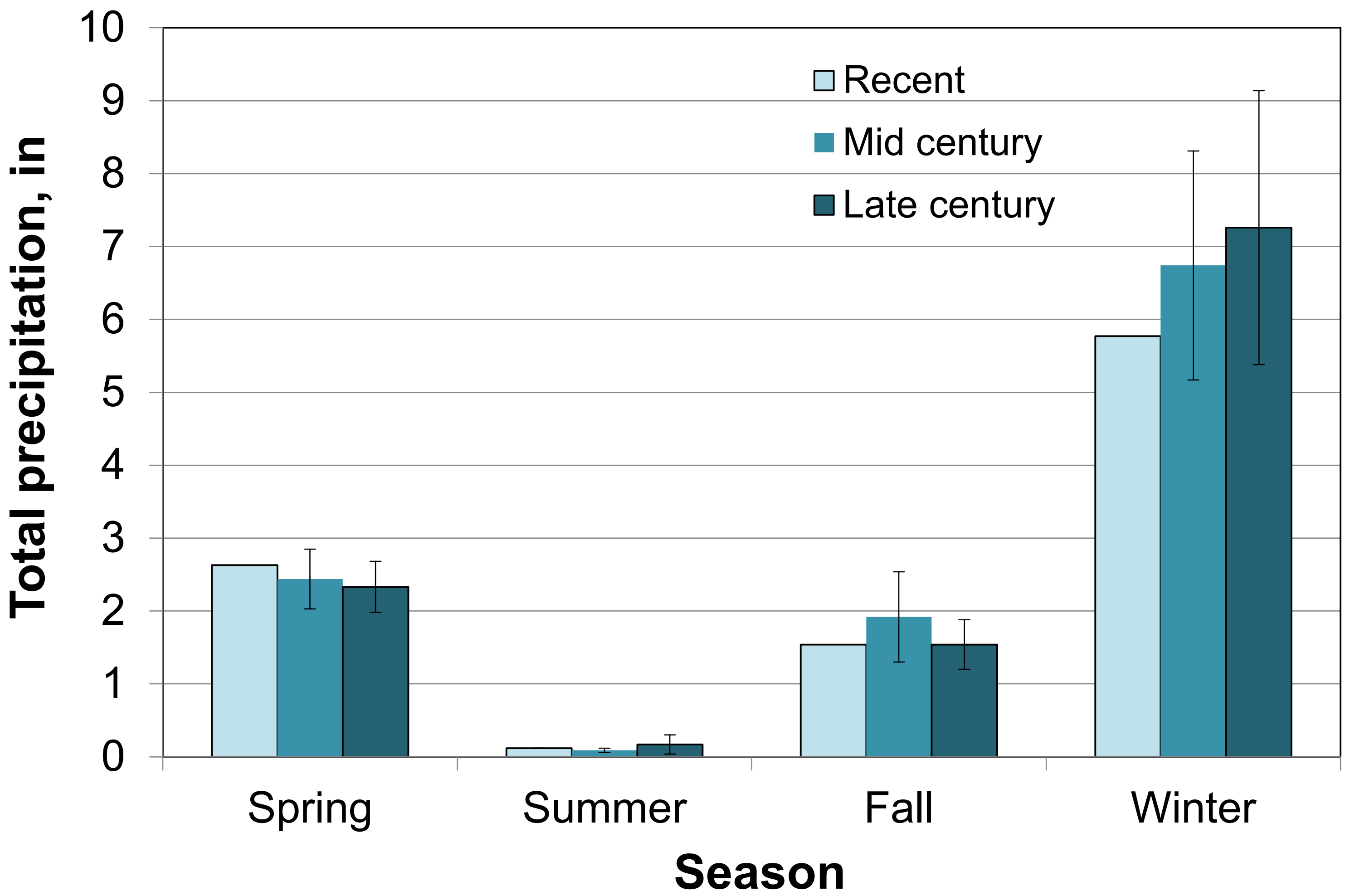
California Temperature



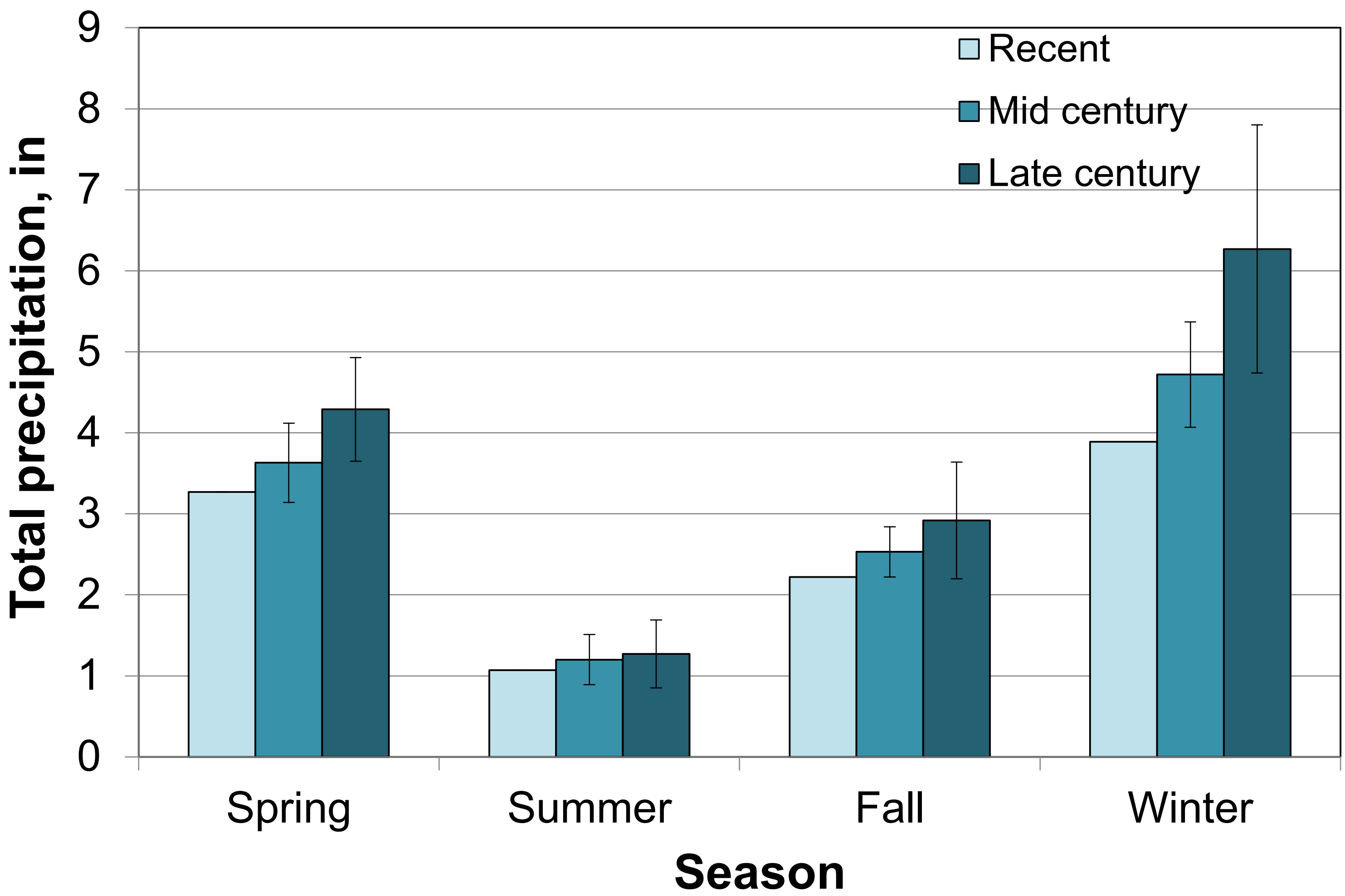
Idaho Temperature



California Precipitation



Idaho Precipitation



How this will affect crops

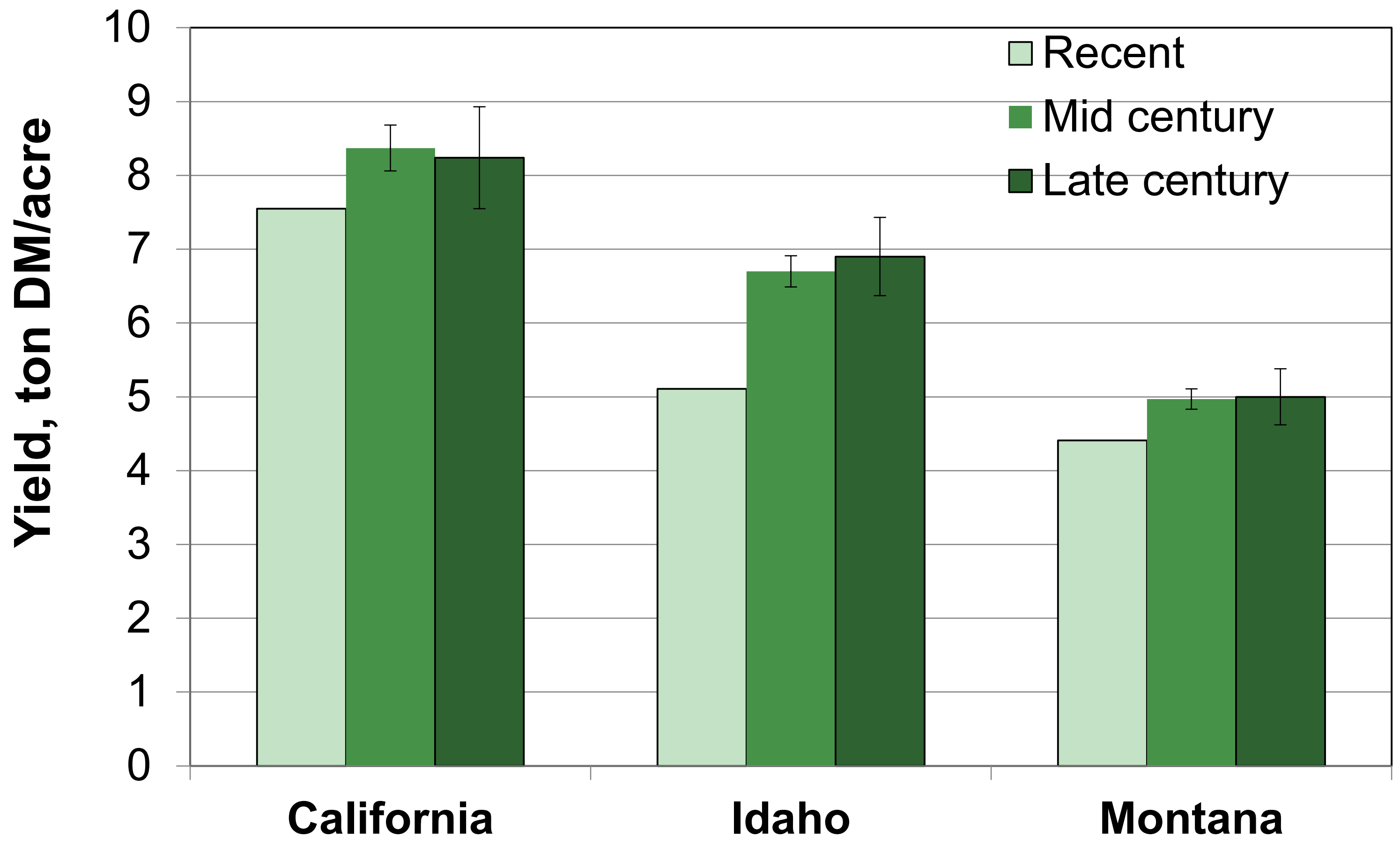
- Increasing atmospheric CO_2 stimulates growth of many crops, particularly forages
- Increasing ambient temperatures increase growing season
- Increasing temperatures can promote growth of some crops
- Increasing temperature increases evapotranspiration, potentially offsetting increases in precipitation

Crop Models

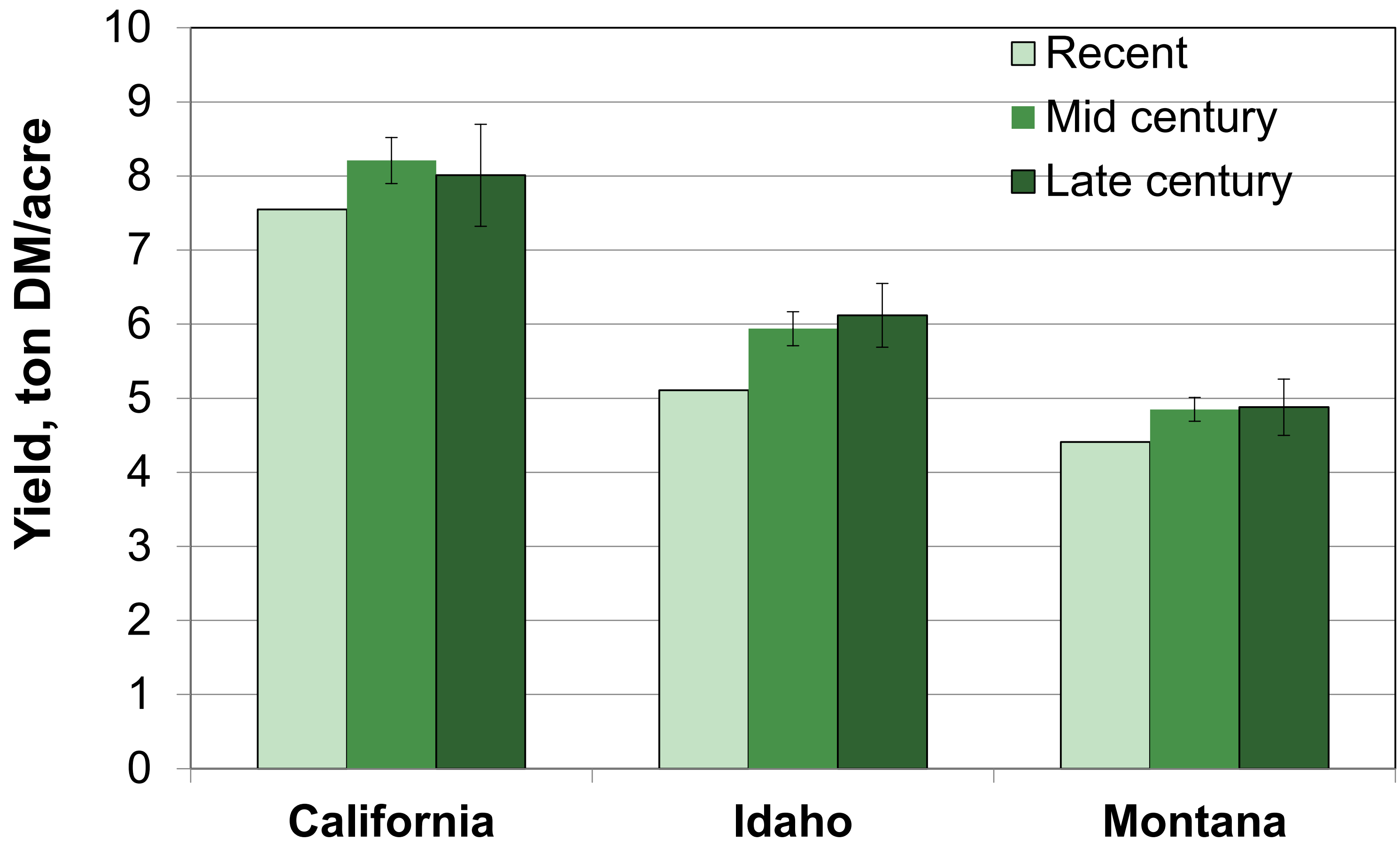
Represent the physiology of crop growth and development as influenced by

- Atmospheric CO_2
- Ambient temperature
- Available soil moisture

Alfalfa Yields



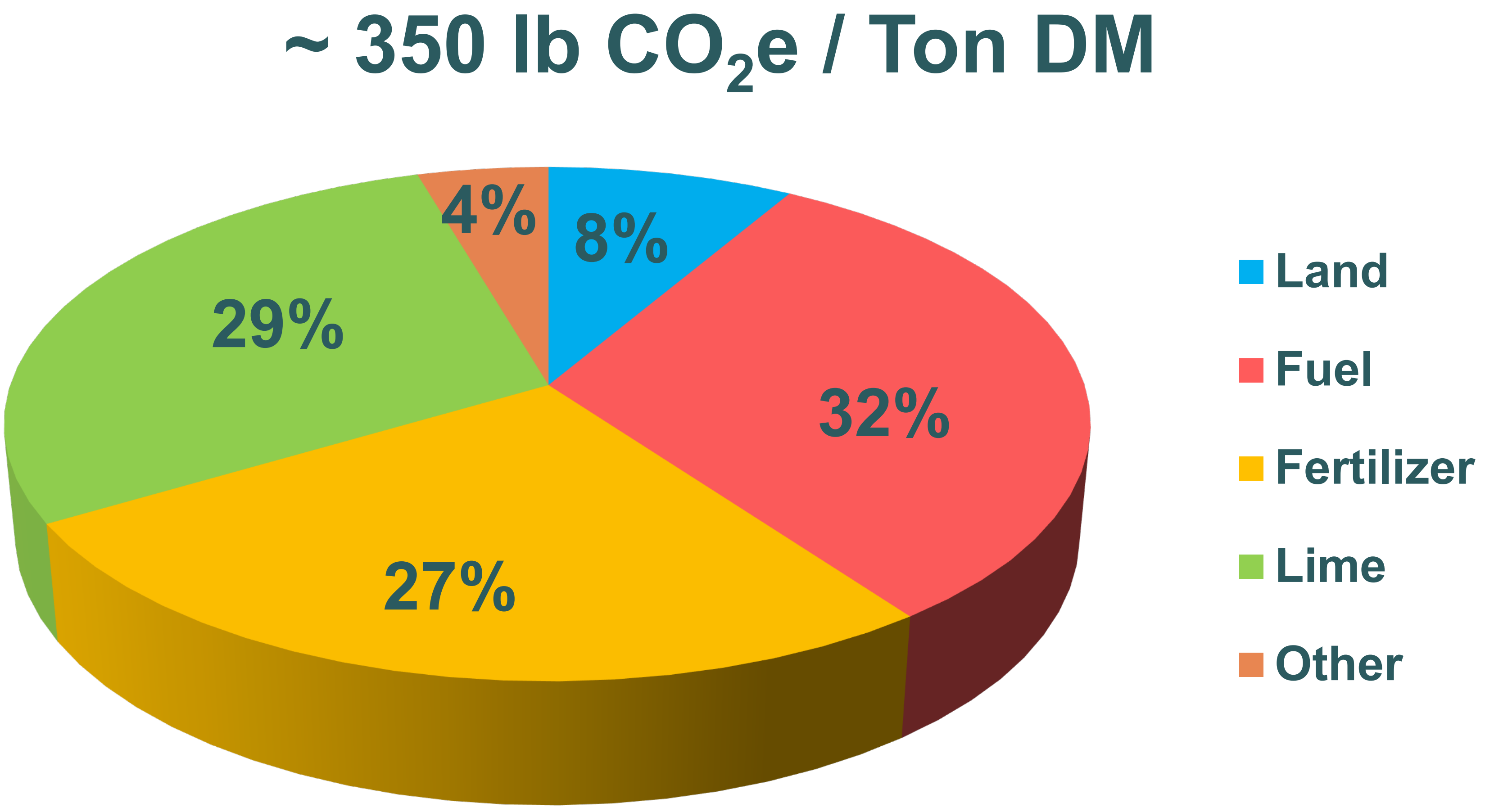
Limited Water



Weeds and Insects

Milder winters and a longer growing season will also promote weed growth and insect damage and disease

Carbon Footprint



Carbon Footprint

Global warming potential in producing a ton of hay is similar to that of driving a pickup truck 200 miles

Mitigation

- Consider more fuel efficient machinery
- Reduce field and road travel
- Soil test and apply fertilizer efficiently
- Use manure nutrients where feasible



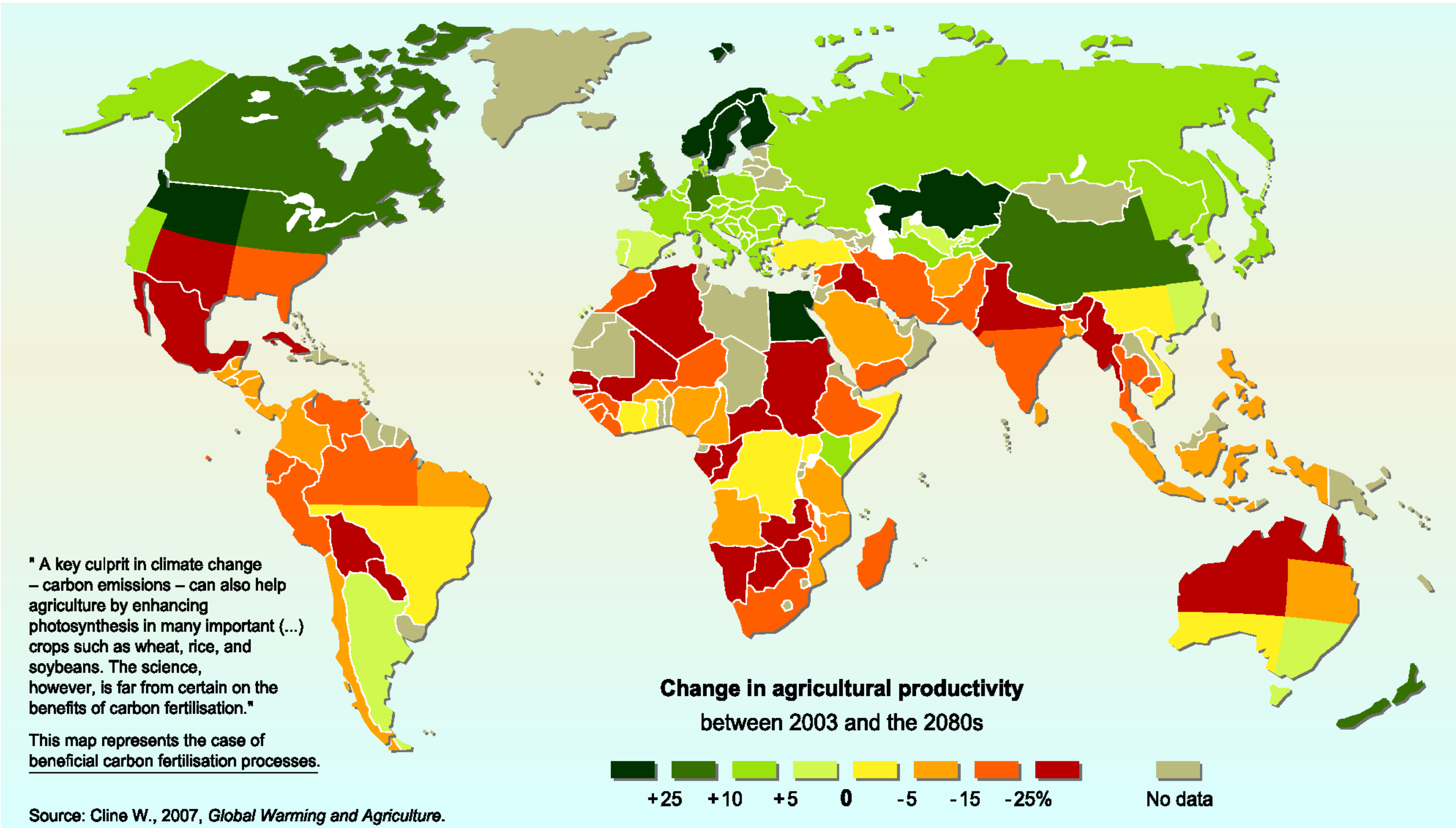
Summary of Climate Impacts

- Forage growth may benefit from projected climate change as long as adequate water is available to meet crop needs
- Challenges in weed, insect and disease control may increase
- Adaptations in management may maintain or improve forage production

The Rest of the Story

- Not all regions and countries are affected the same
- Food security is a growing issue, and climate change is adding complication
- Can we continue to feed our growing global population?

Projected Impact Agricultural Yields



Take Home

- Changes in climate are affecting forage production in the western U.S.
- Gradual changes in management will be needed to maintain production (planting dates, harvest dates, crop genetics, pest control, etc.)
- Some areas of the U.S. and many other regions of the world have much greater challenges ahead
- Global impacts on food security is the greater concern

Agricultural Research Service

Pasture Systems and Watershed Management Research Unit

University Park, Pennsylvania