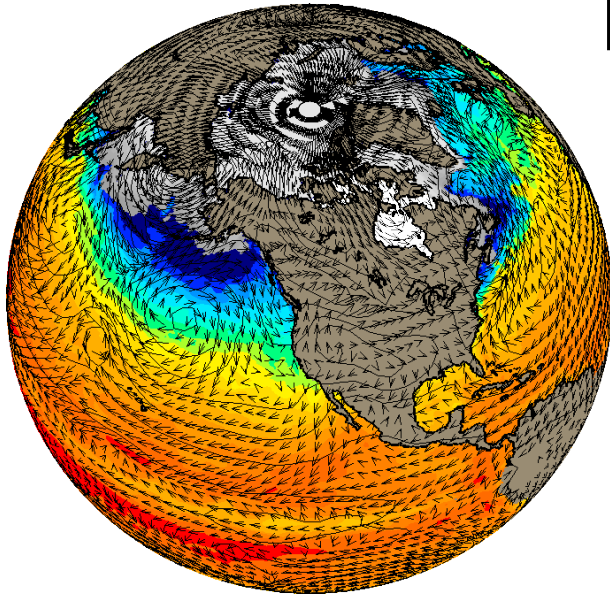


Global Warming and Aspen in the 21st century

Gerald A. Meehl
National Center for Atmospheric
Research
Boulder, Colorado

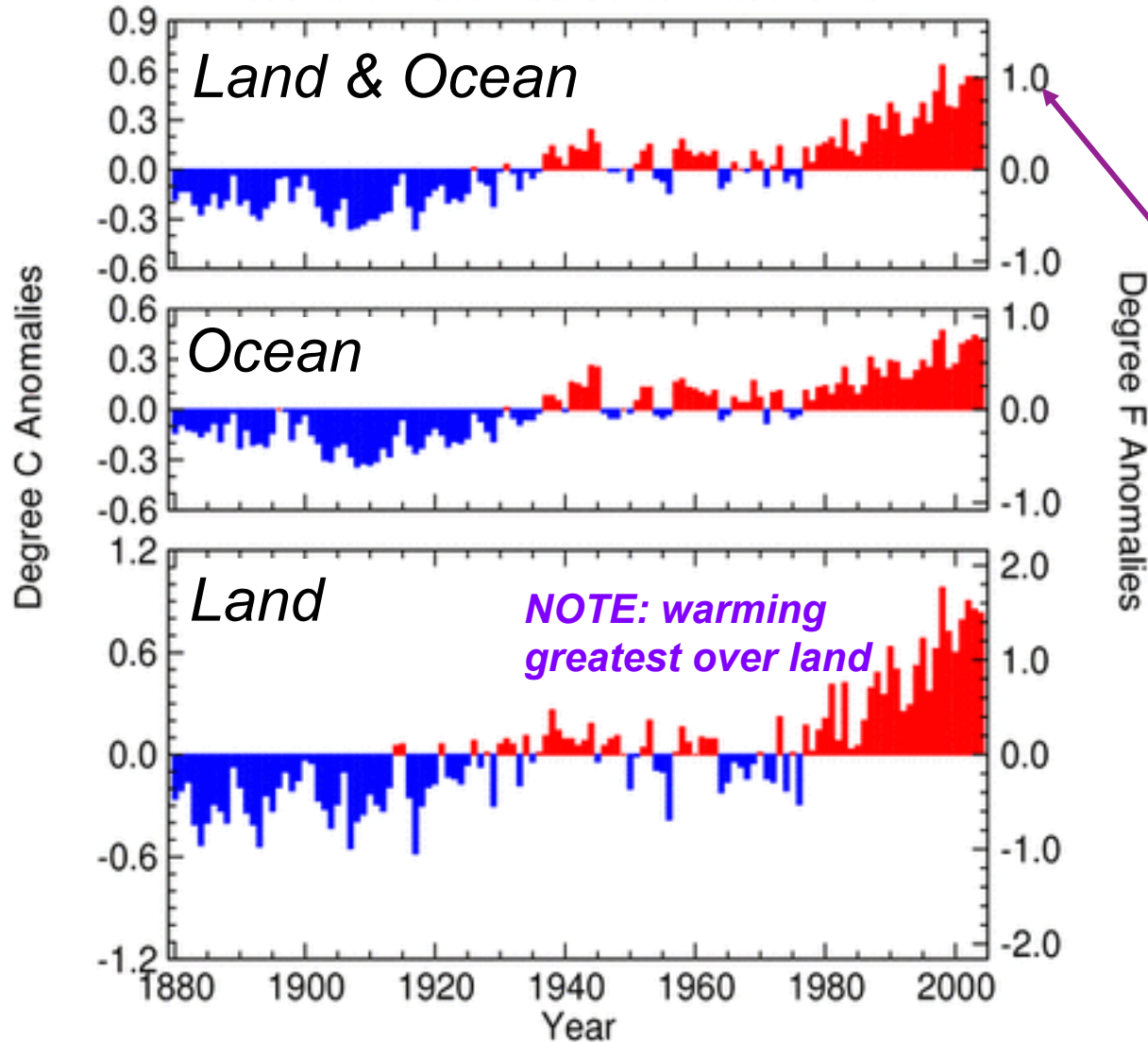


NCAR

“Global Warming” is real ...

Jan - Dec Global Surface Mean Temp Anomalies

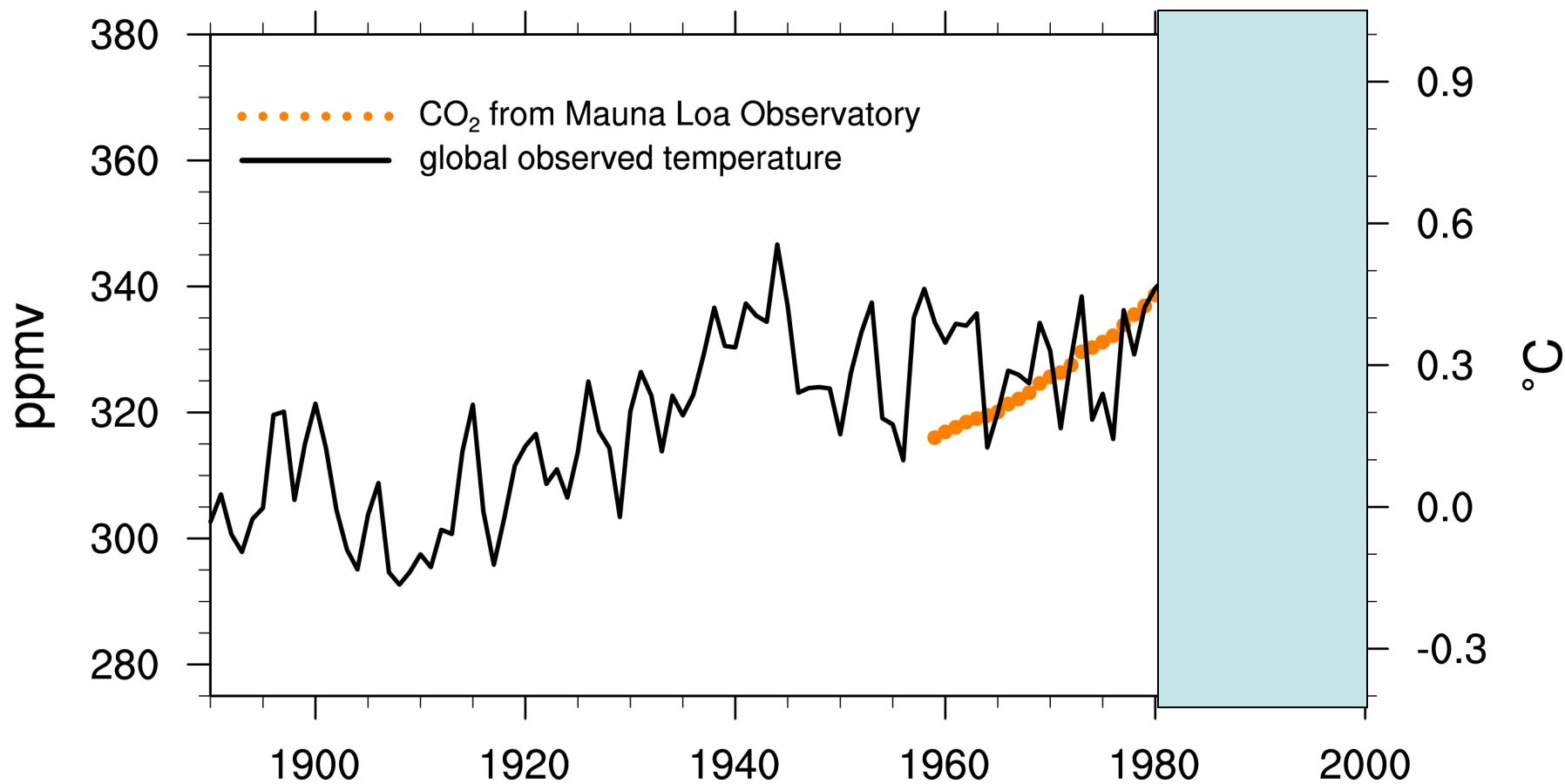
National Climatic Data Center/NESDIS/NOAA

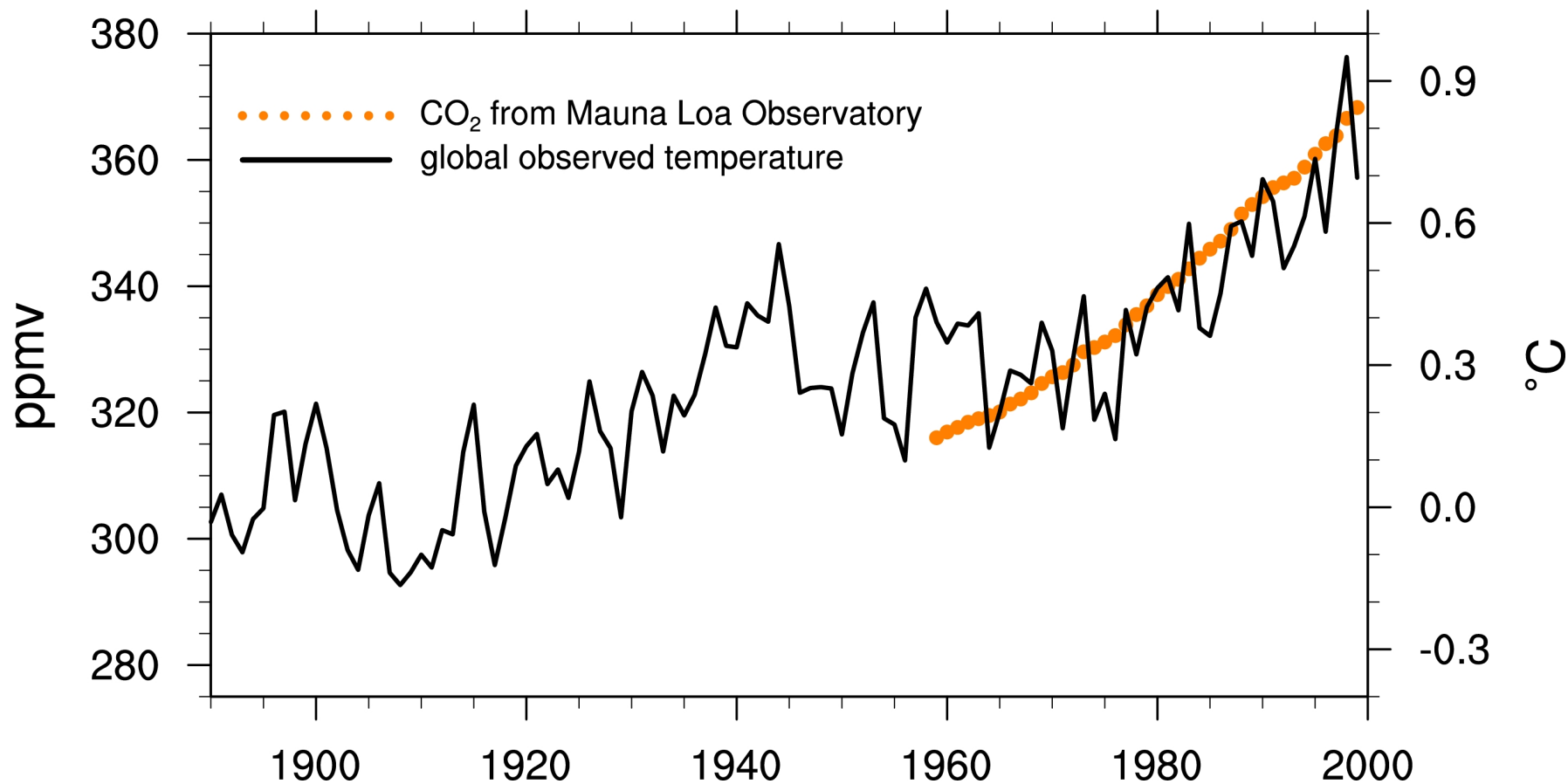


8 of top 10 warmest years have occurred in the last decade

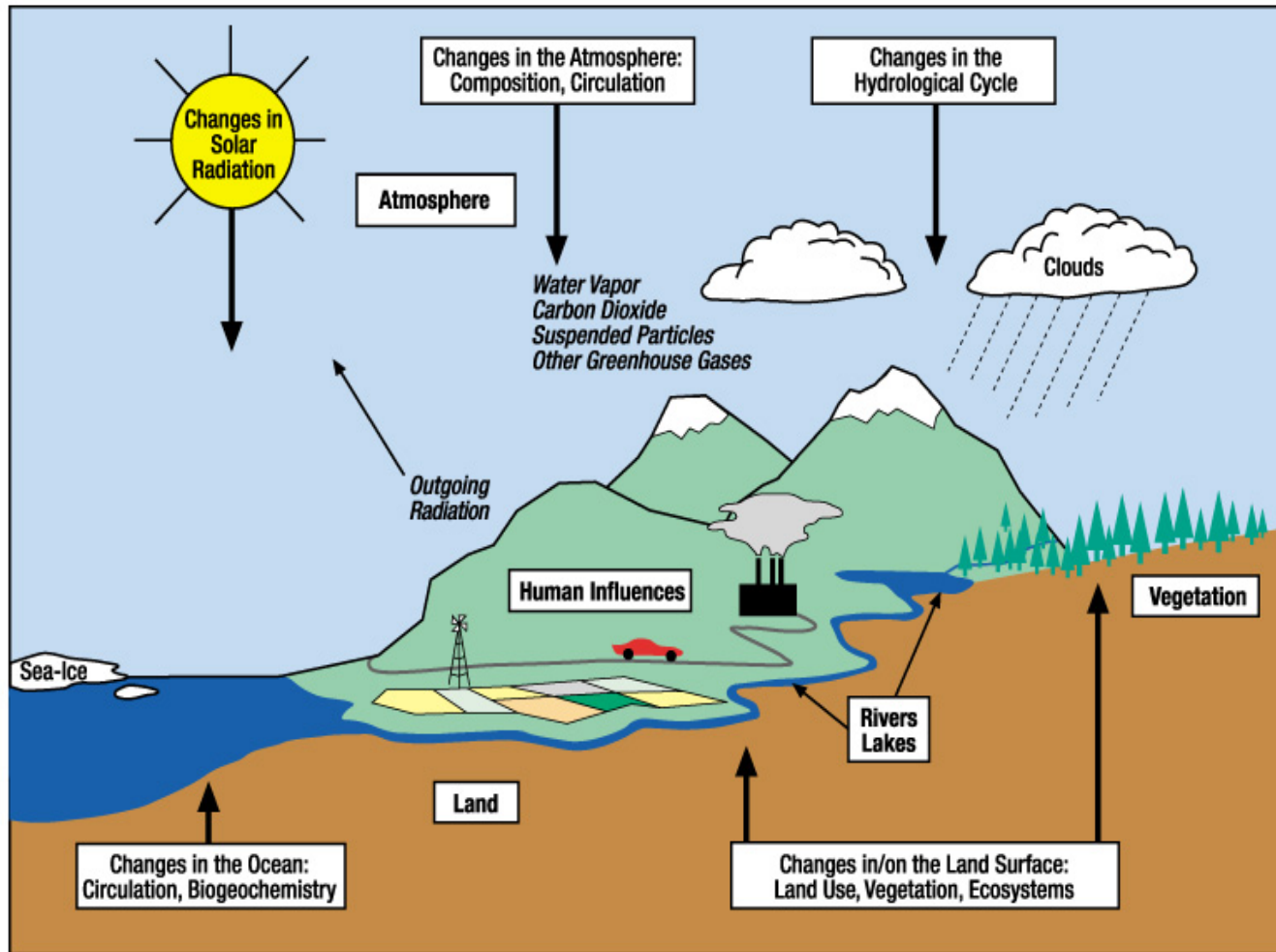


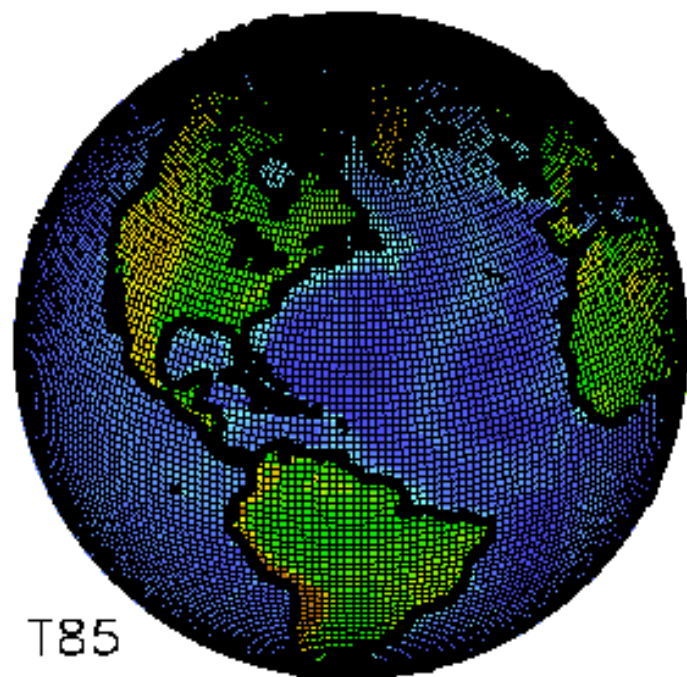
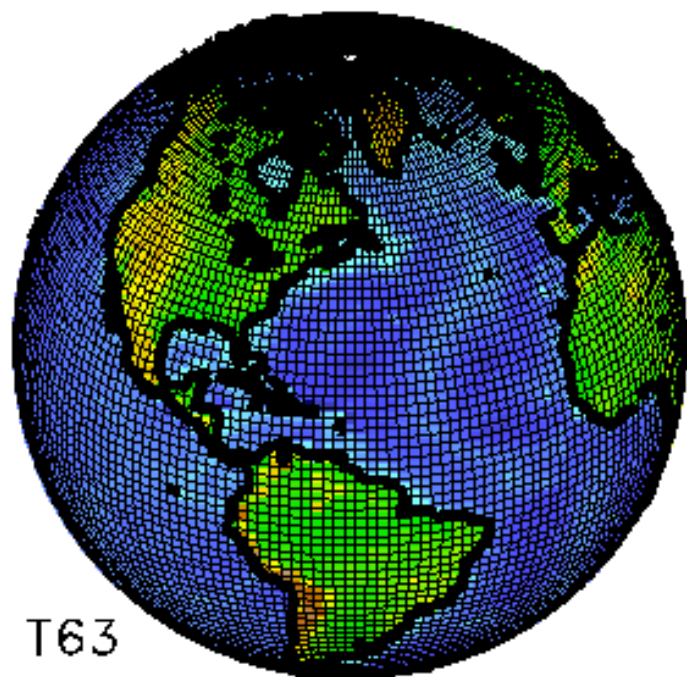
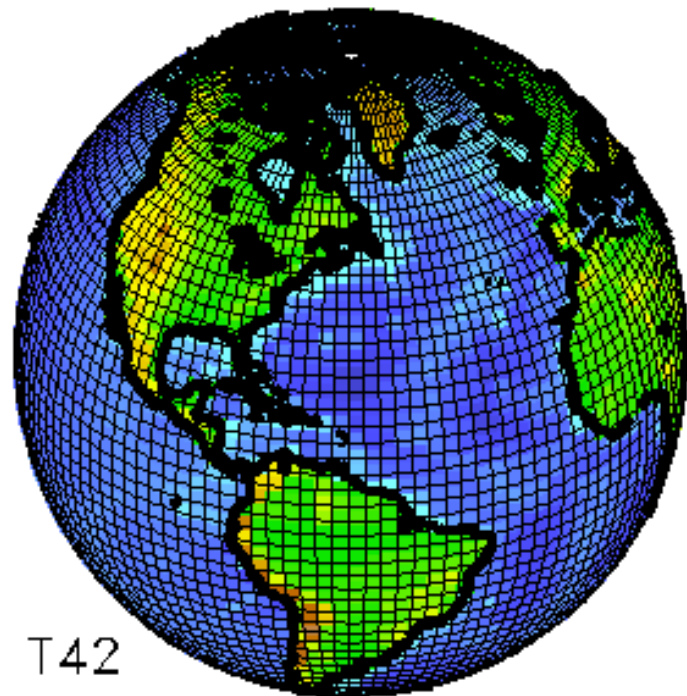
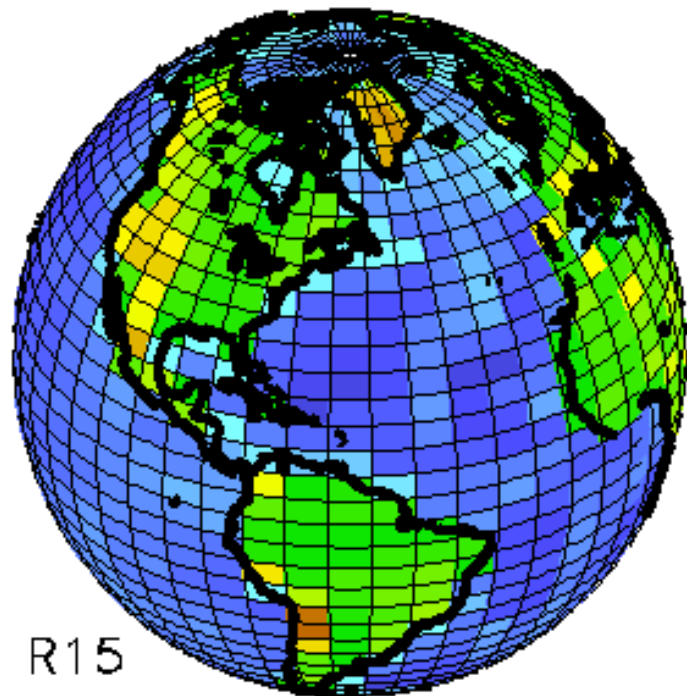
Upsala glacier in the Andes, Argentina





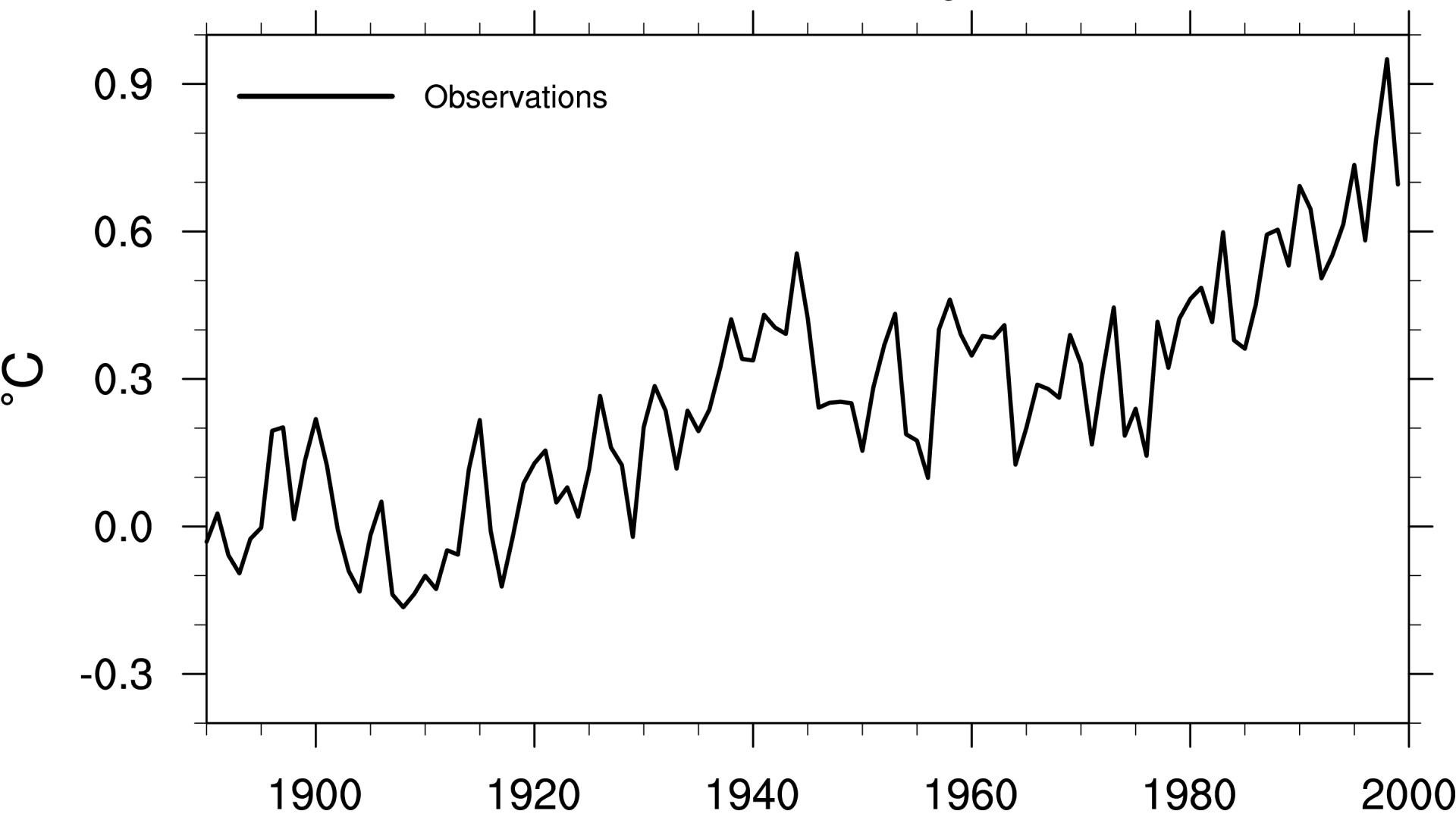
Climate models are a lot like weather forecast models, but include interactive ocean, land surface, and sea ice components, and also account for changes in atmospheric constituents like greenhouse gases





Global Temperature Anomalies

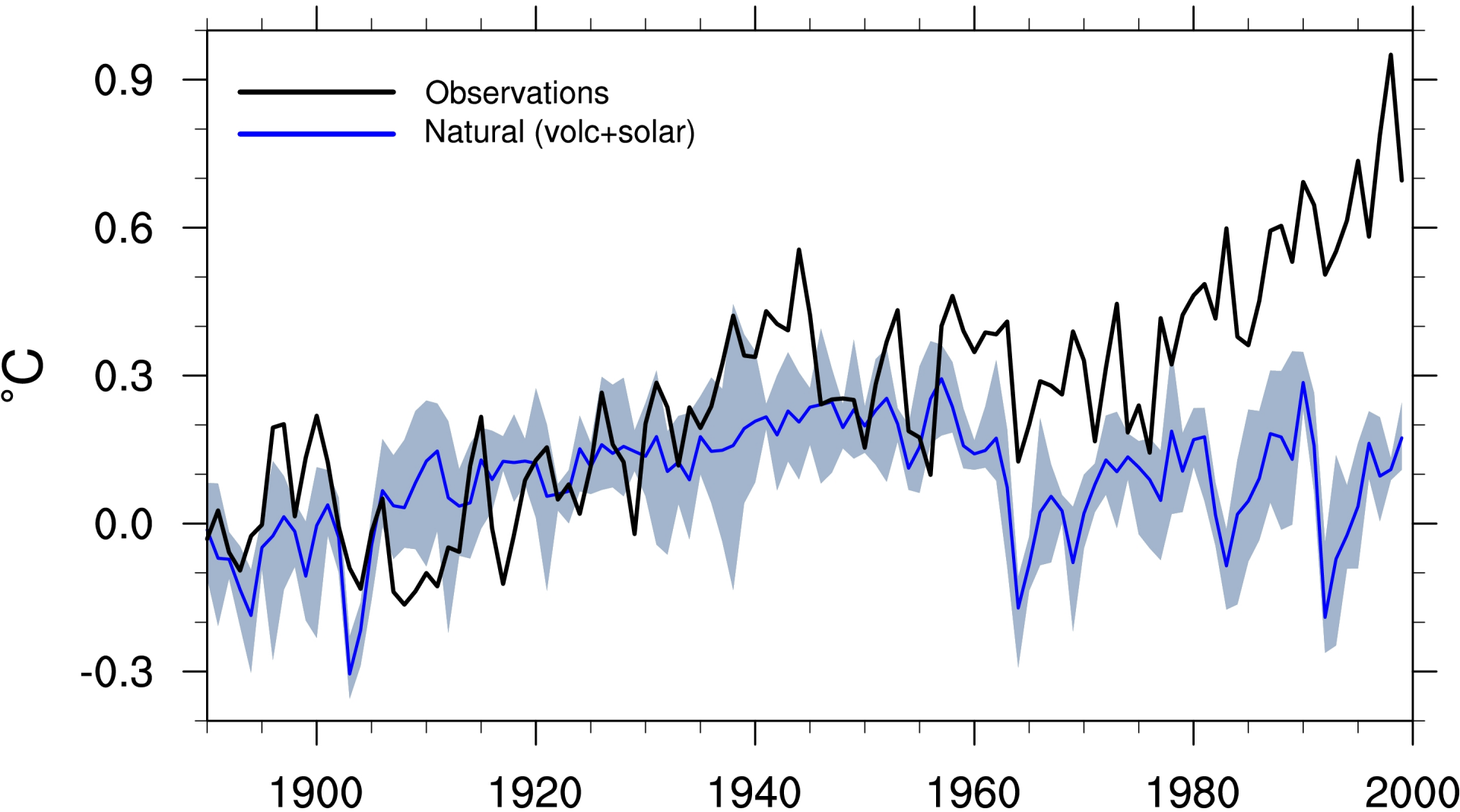
from 1890-1919 average



Parallel Climate Model Ensembles

Global Temperature Anomalies

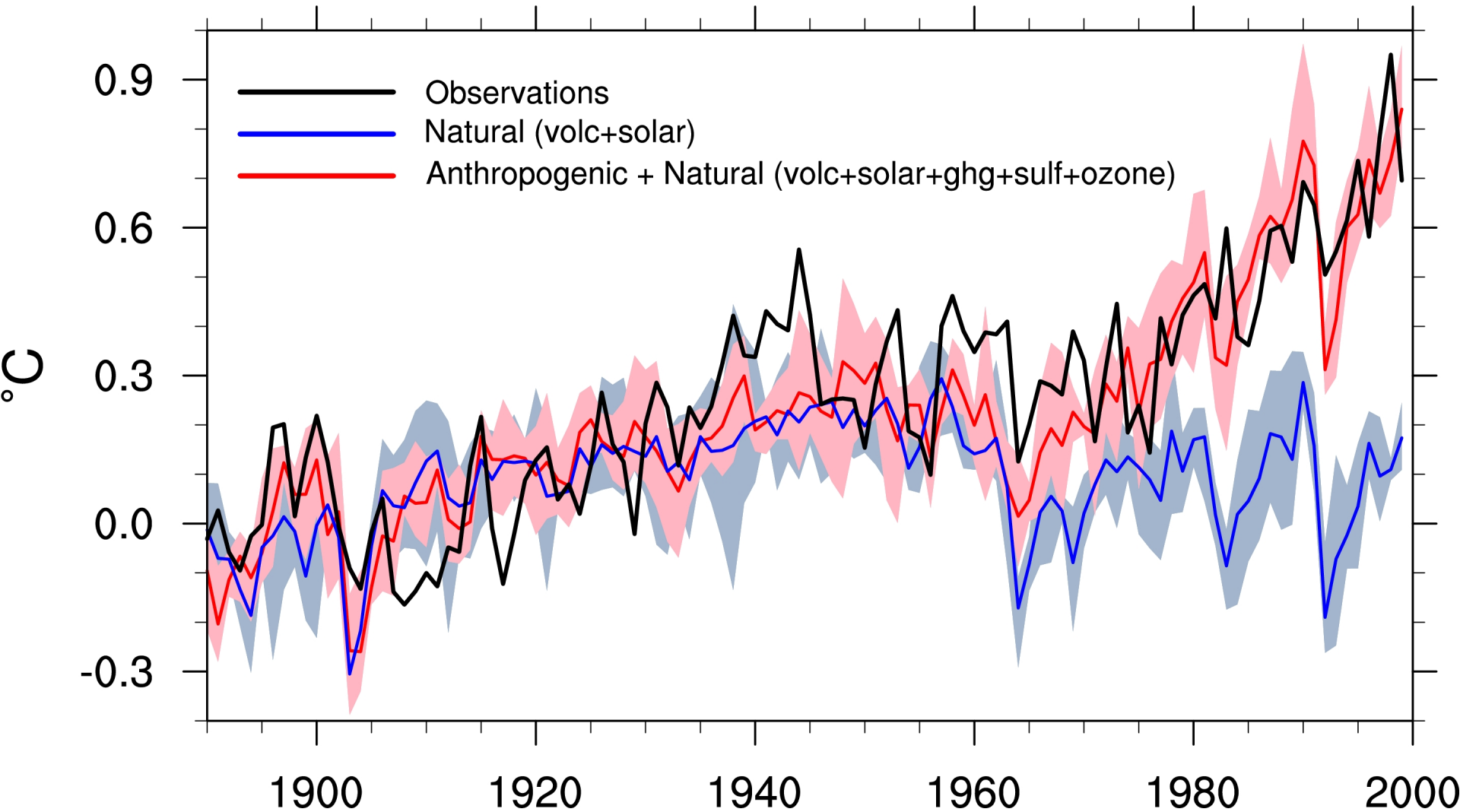
from 1890-1919 average



Parallel Climate Model Ensembles

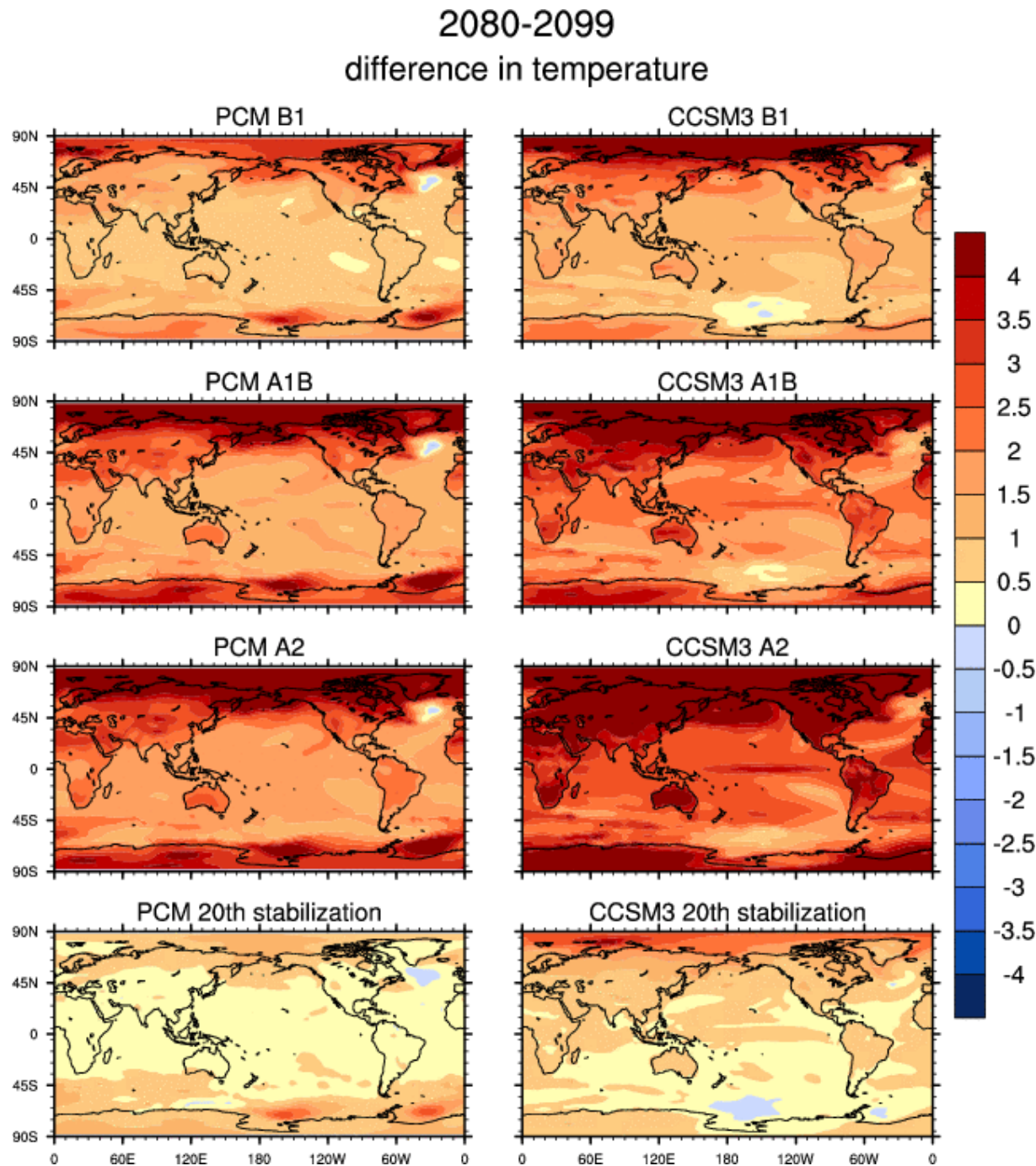
Global Temperature Anomalies

from 1890-1919 average

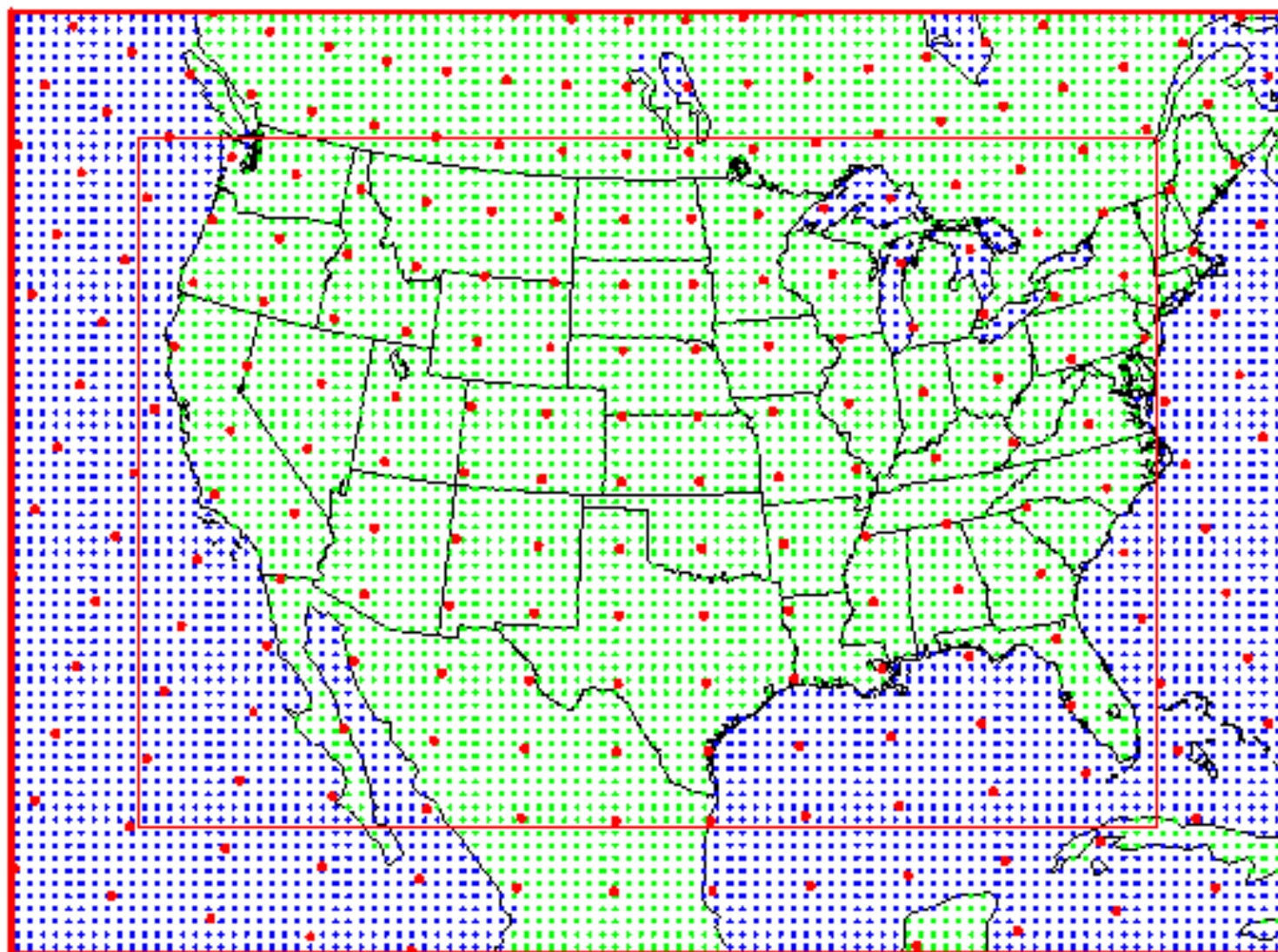


By the end of the 21st century, greater warming occurs at high northern latitudes and over the continents in the scenario simulations.

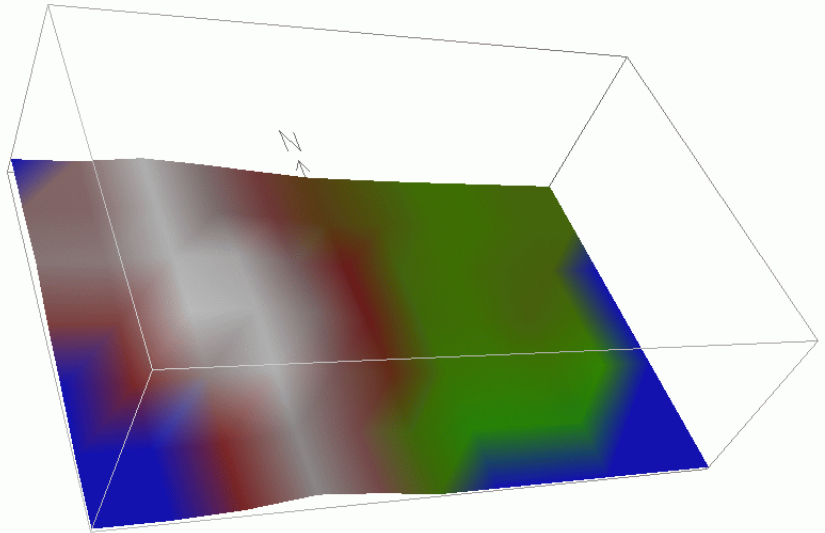
We are already committed to about another half a degree of warming over North America by the year 2100.



PIRCS Grid and Domain - RCM vs. GCM

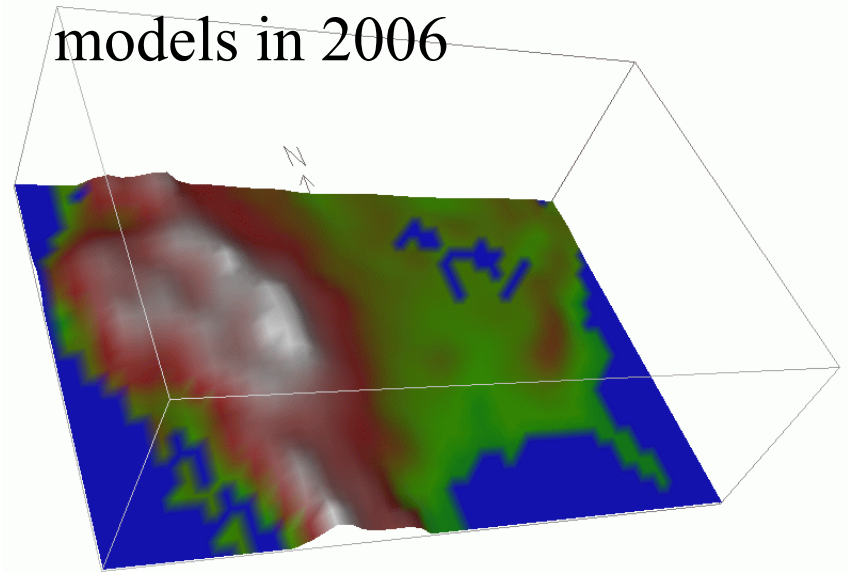


Climate Models circa early 1990s



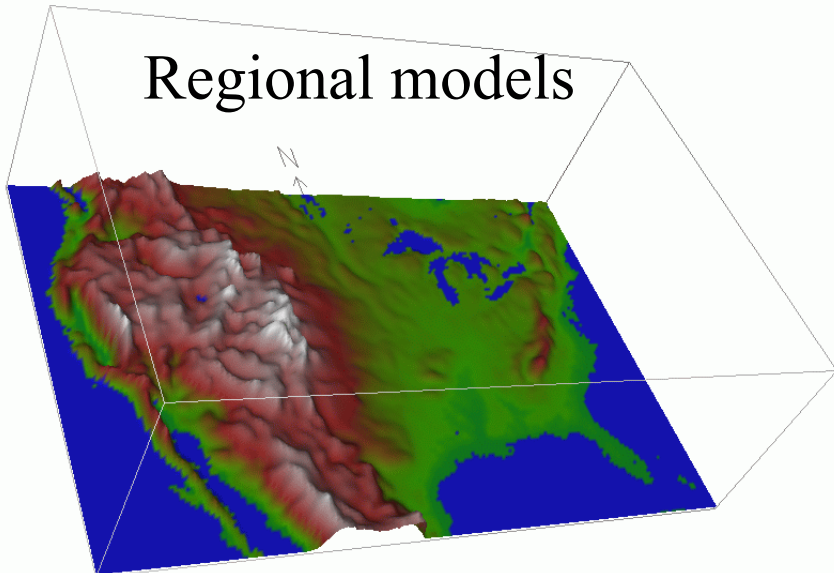
400 km

Global coupled climate models in 2006



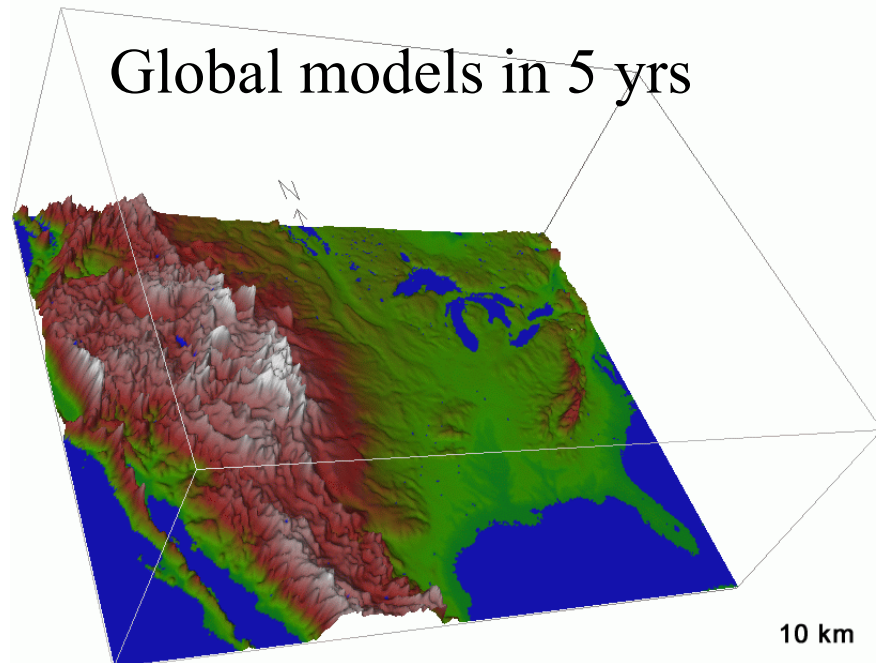
100 km

Regional models



25 km

Global models in 5 yrs



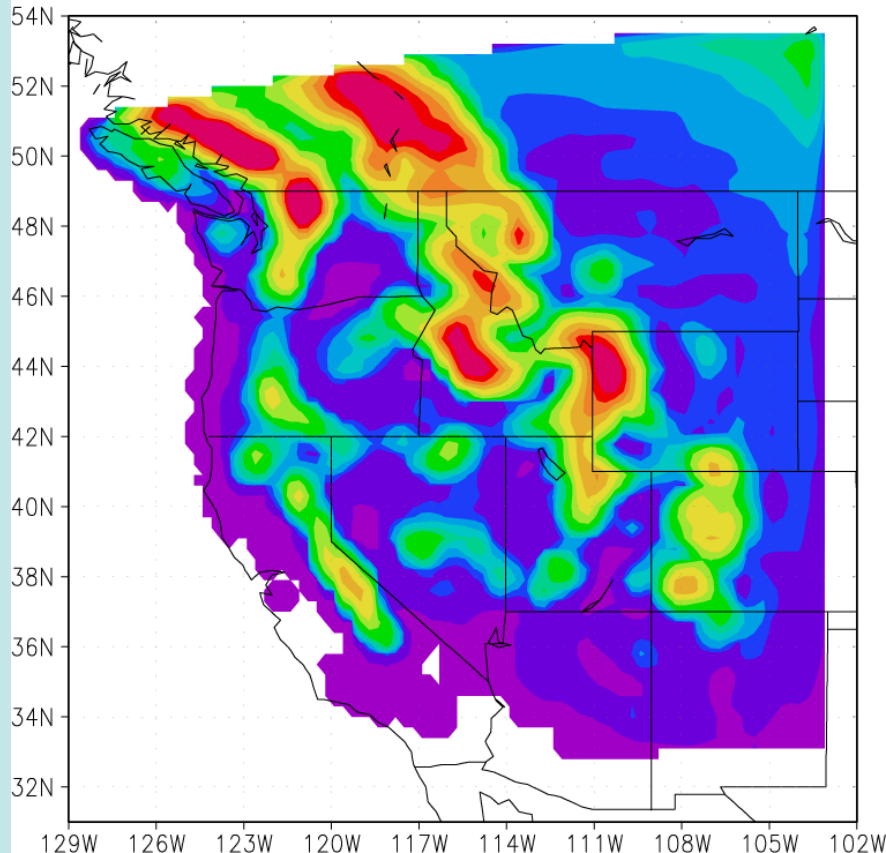
10 km

Global and Regional Simulations of Snowpack

Regional Simulation

March snowpack

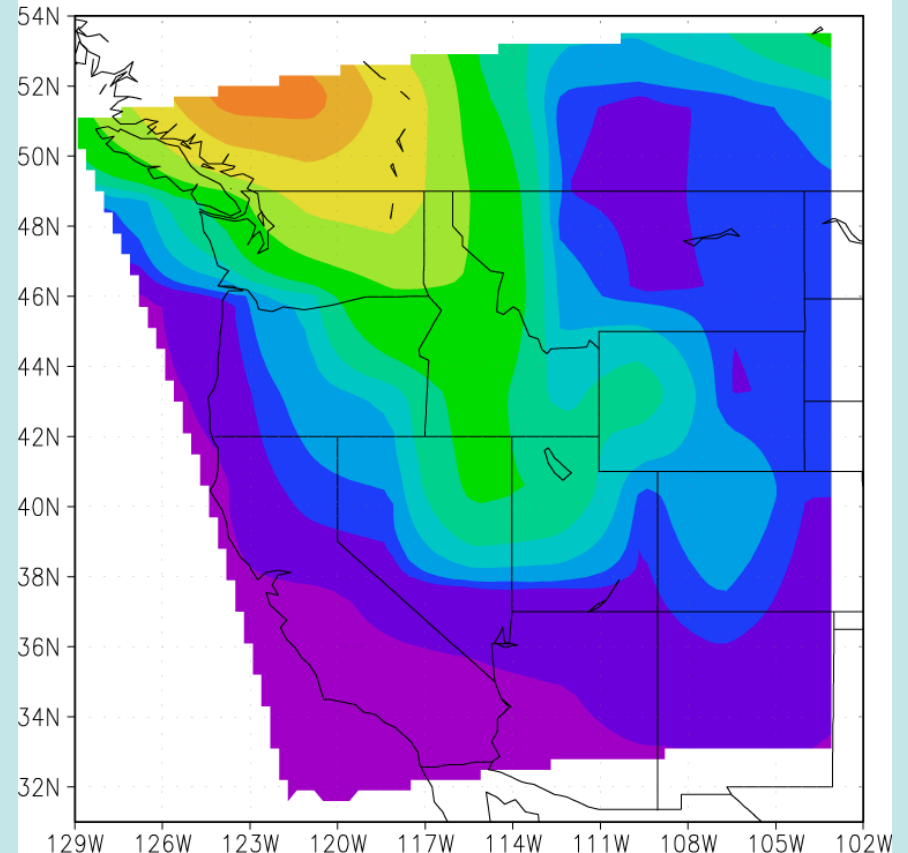
MM5



Global Simulation

March snowpack

PCM



Three 21st century scenarios

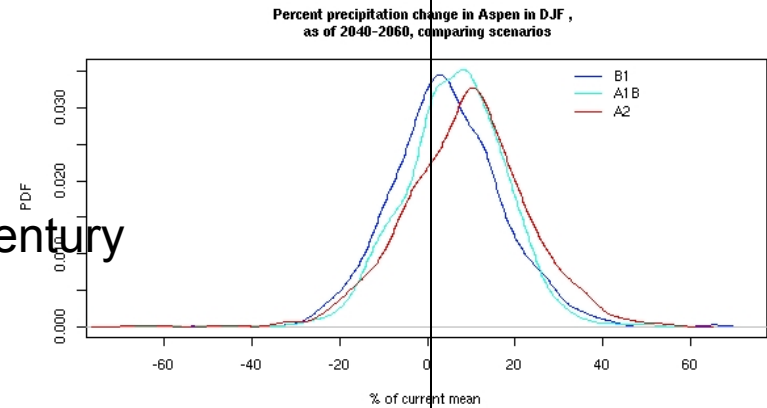
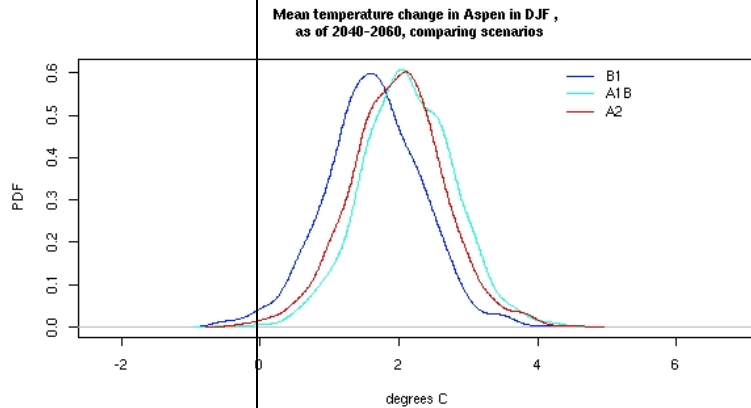
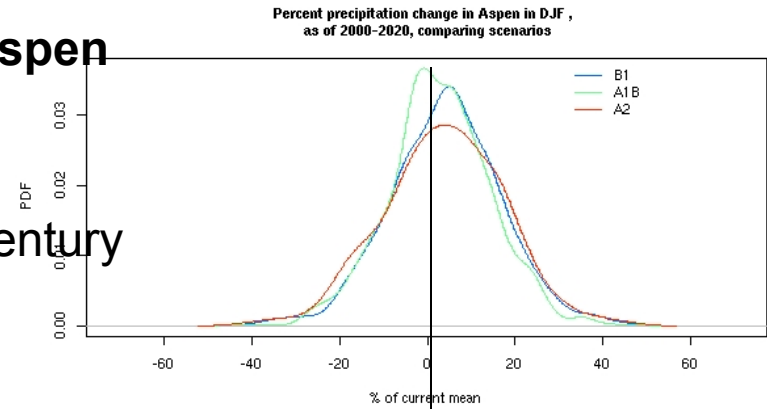
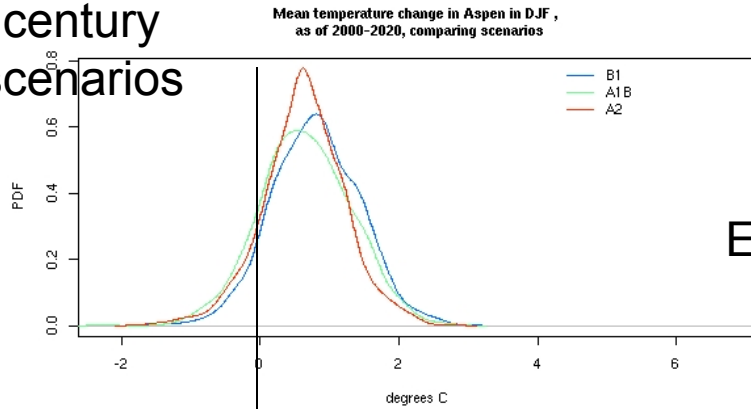
Temperature

21 Models, Winter

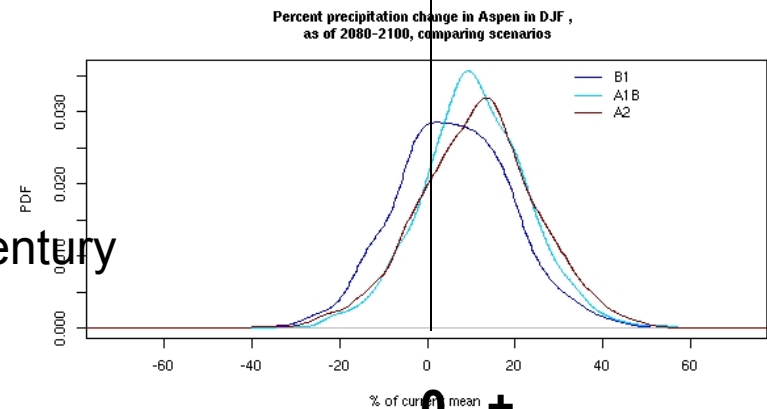
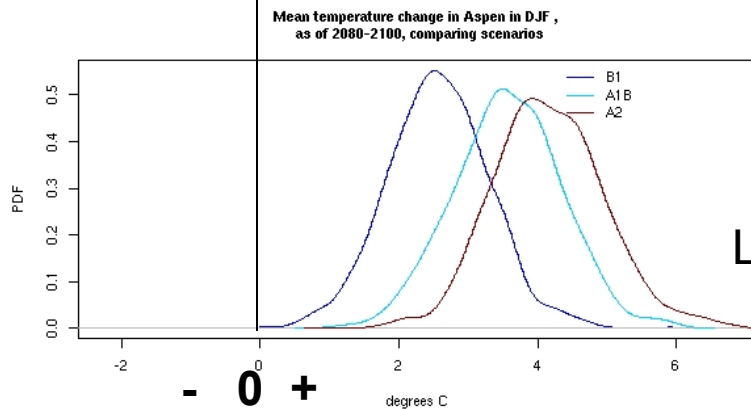
Precipitation

For Aspen

Early century



Mid-century



Late-century

- 0 +

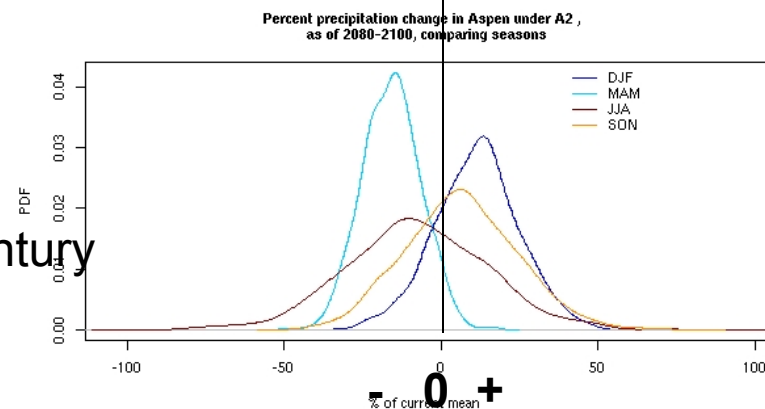
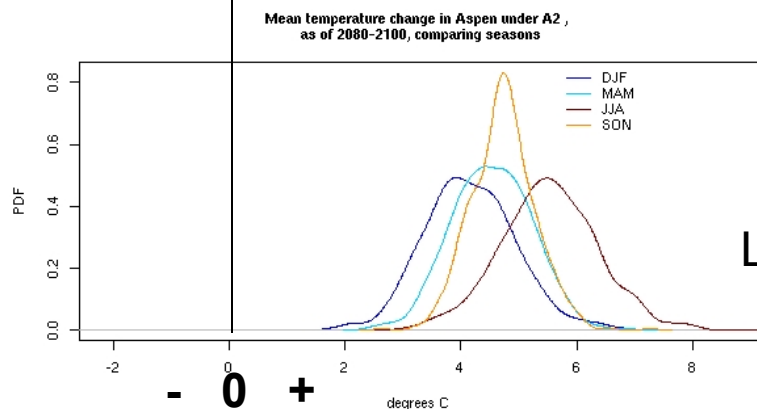
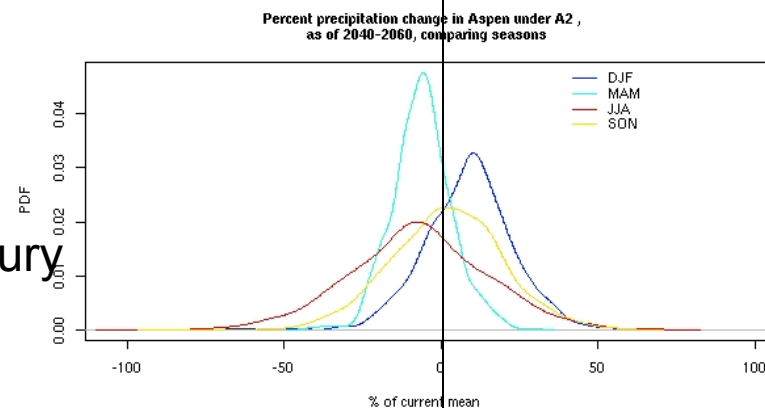
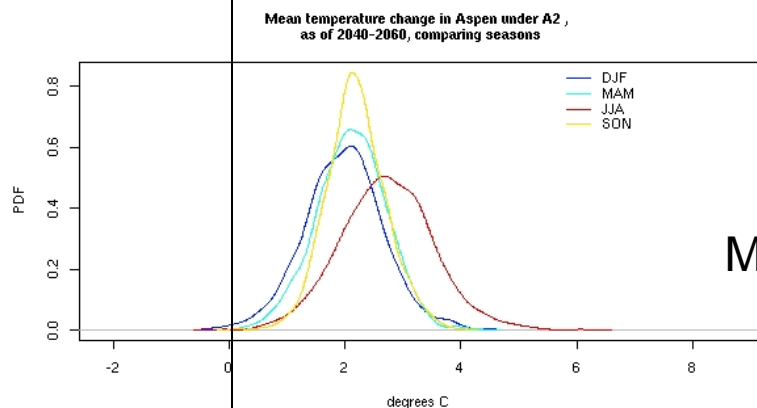
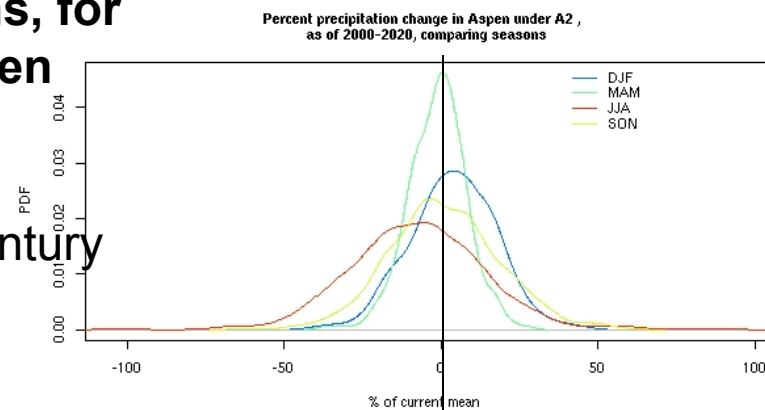
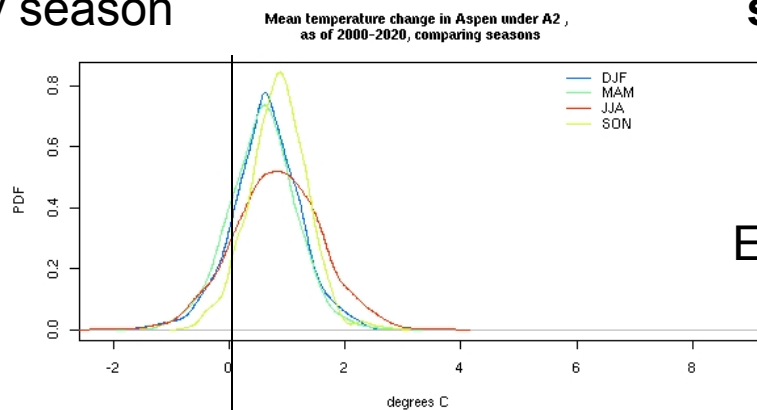
- 0 +

A2 scenario by season

Temperature

21 Models, four seasons, for Aspen

Precipitation



Early century

Mid century

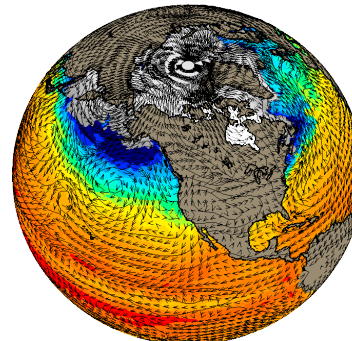
Late century

- 0 +

- 0 +

Summary

1. Global warming is real, and most of the warming in the past several decades is due to human activity.
2. Global climate models are used for climate change projections over large regions. Statistical downscaling techniques or regional models embedded in the global models are used to obtain climate change information for smaller regions (like the Aspen area).
3. Climate change projections from the models indicate that Aspen will be warmer, with a shorter snow season especially at low elevations; higher elevations are less affected. Changes in precipitation are dependent on model and season.



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