

Modeling Future Climate Change

Warren M. Washington

National Center for Atmospheric Research

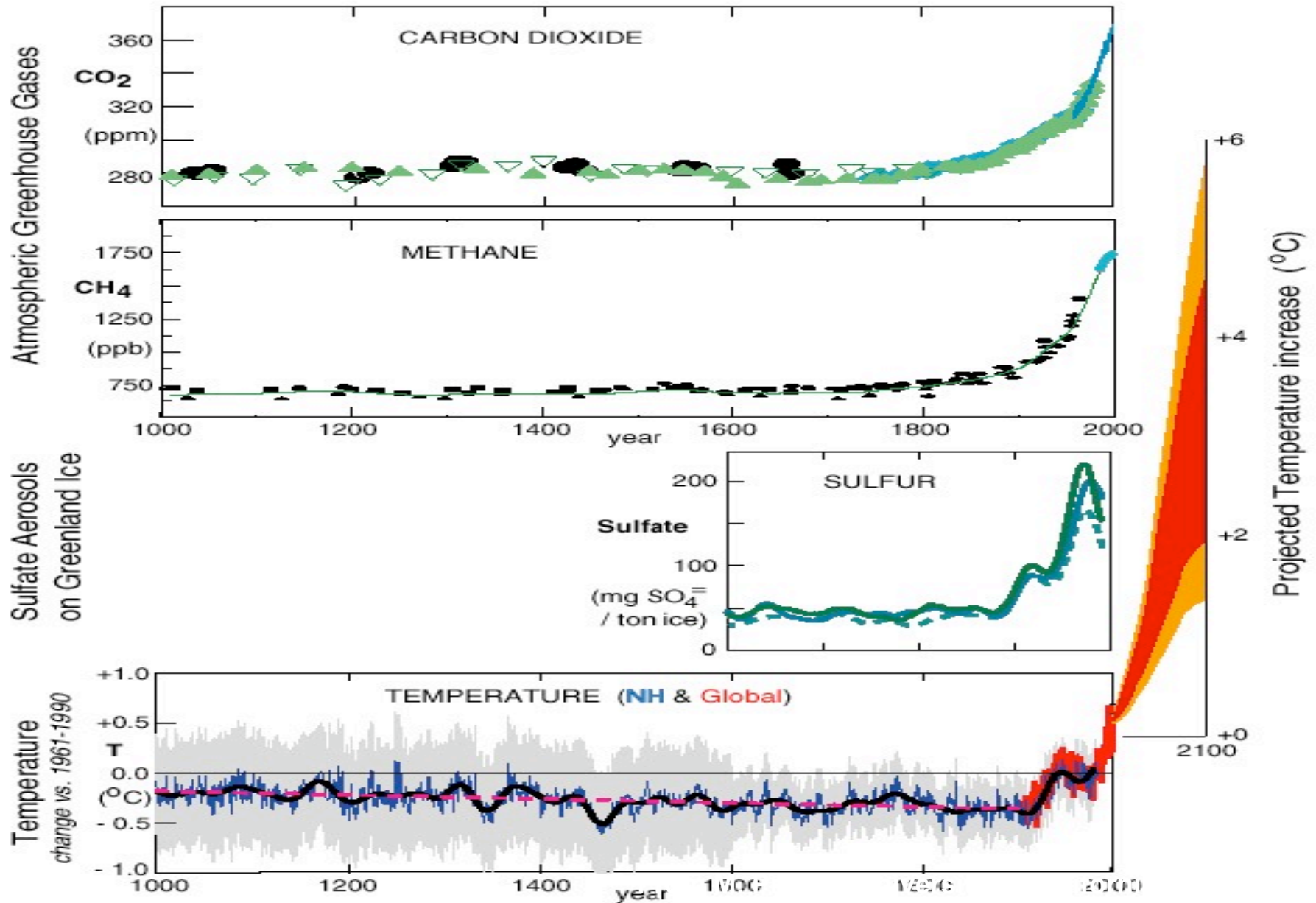
November 2003

Questions

- Can climate models help understand climate change?
- Can we verify climate models with observations?
- Why do model projections of future climates differ?

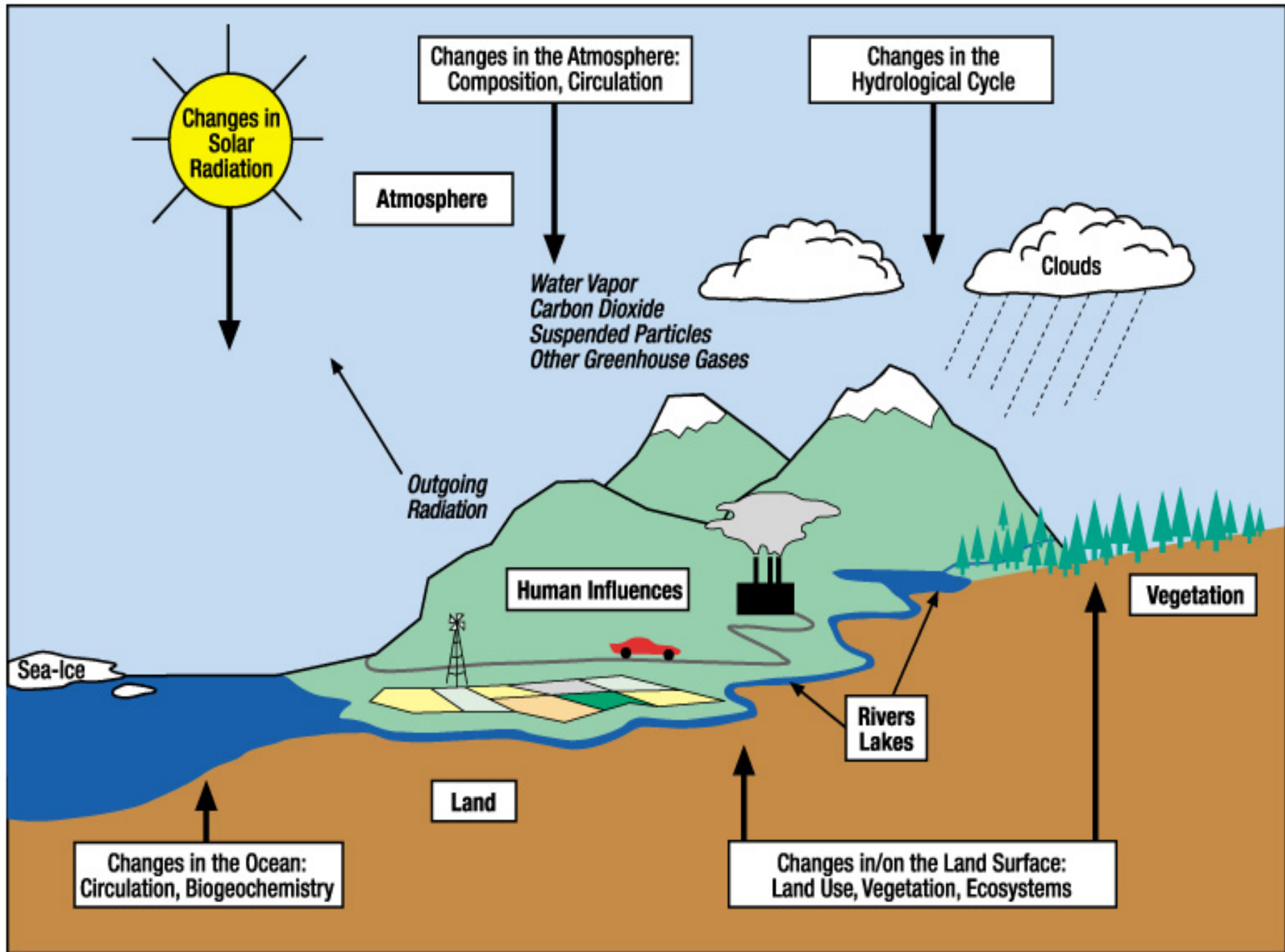
THE HUMAN INFLUENCE ON ATMOSPHERE & CLIMATE

(IPCC/WG1: Climate Change 2001, SPM & Chapters 2, 3, 4, 5, 9)

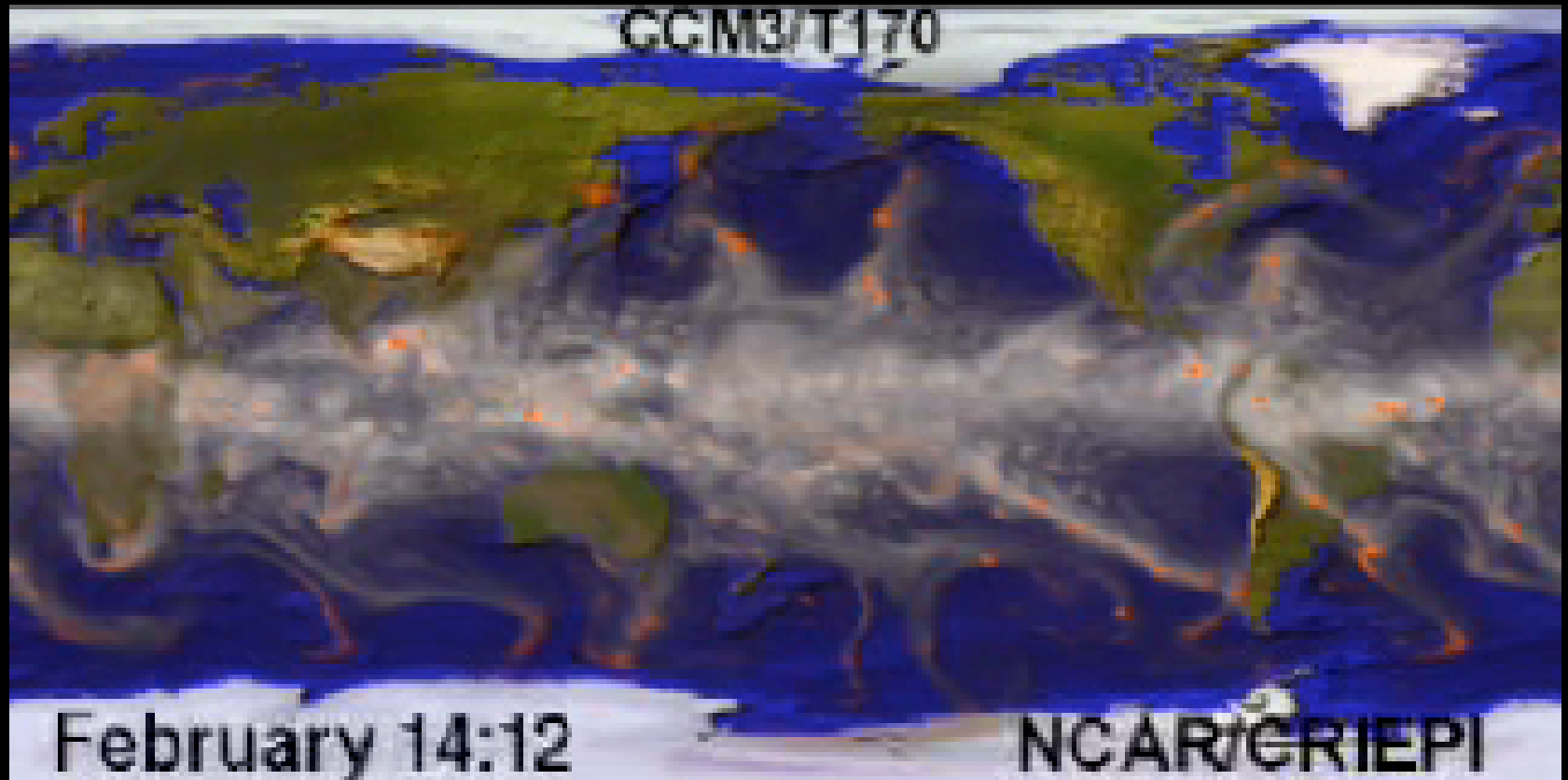


Present and Future Sea Ice Change



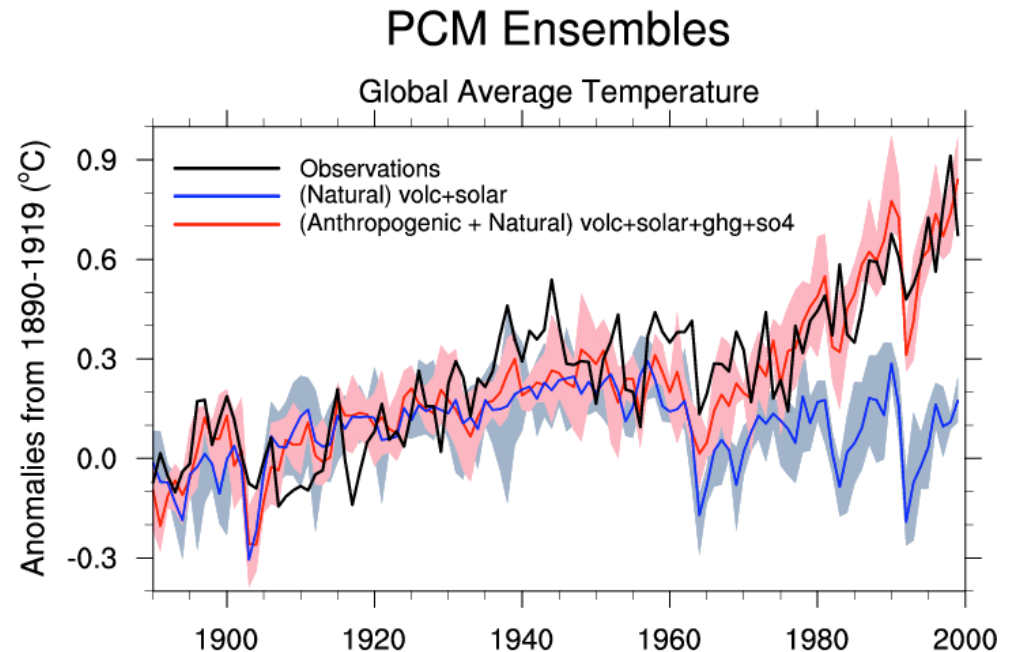


Global Atmosphere



Natural Variations Do Not Explain Observed Climatic Change

- Climate models with natural forcing (including volcanic and solar) do not reproduce warming
- When increase in greenhouse gases is included, models do reproduce warming
- Addition of increase in aerosols (cooling) improves agreement



Modeling and Observational Consensus

“An increasing body of observations gives a collective picture of a warming world and other changes in the climate system”-IPCC

- Global average surface temperature has increased over the 20th century by about 0.6°C
- The last decade of the 20th century was the warmest decade of the past millennium
- Temperatures have risen during the past four decades in the lowest 8 kilometers of the atmosphere
- Snow cover and ice extent have decreased.
- Global average sea level has risen and ocean heat content has increased

Climate Modeling Priorities

- Understand why models give different projections of future climate changes
- Combine biogeochemistry and climate models. e.g. carbon, sulfate cycles
- Higher resolution for regional impacts
- Improved cloud-radiation processes
- Include better hydrological and ecology components

Mitigation vs Adaptation: Likely both will be needed

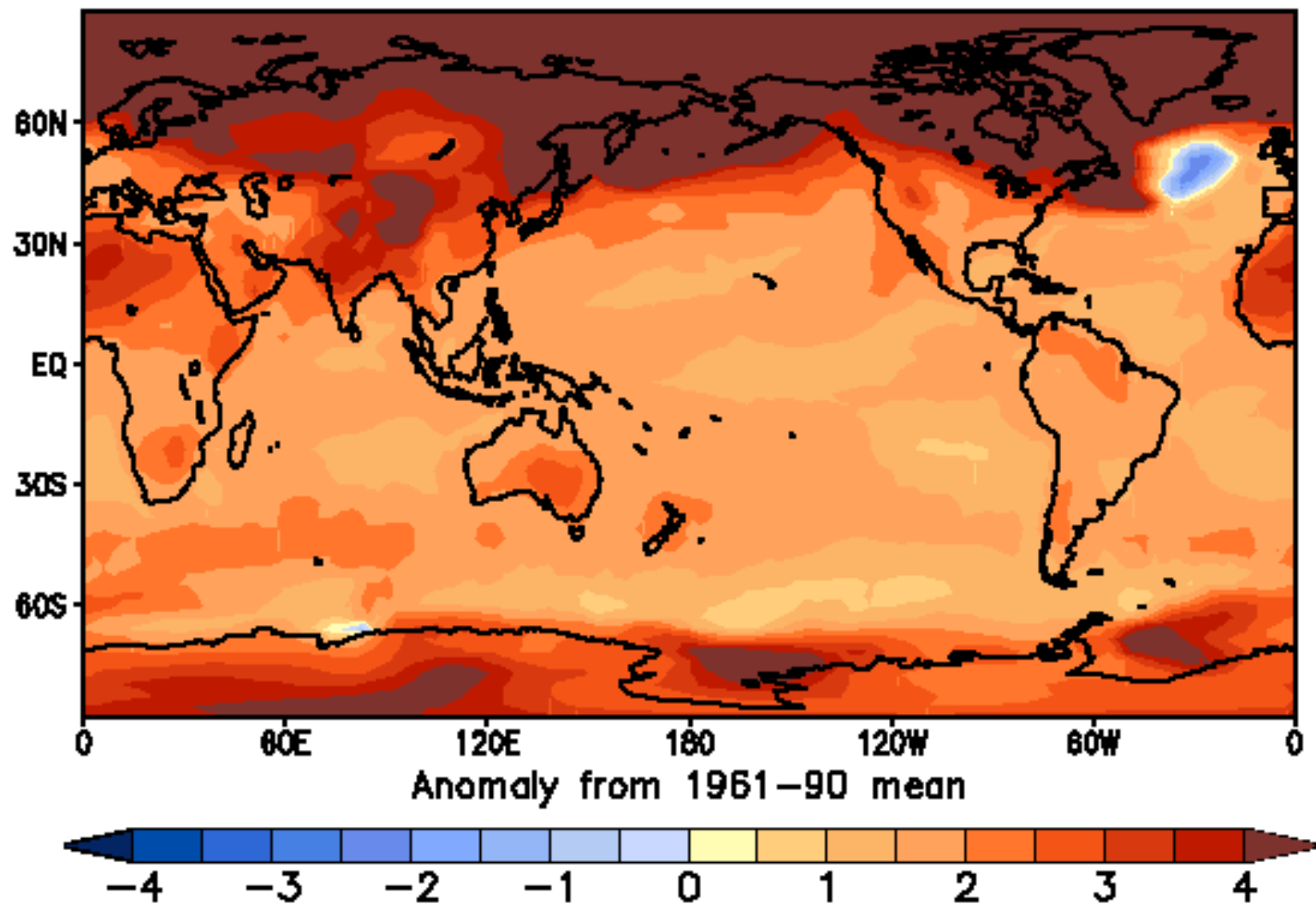
Climate models can provide an examination of options and provide insights about whether to "geoengineer" the climate system

Climate Models Can Help the Policy Debate



The End

PCM Surface Warming – 2090s





Source: World Resources 2000-2001

Time Magazine - 9 April 2001