POSTER
P-GC2.1

Simulations of Committed Climate Change and Sea-level Rise through 2400 AD

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ABSTRACT

The effects of sea-level rise in the next few centuries are of particular concern for coastal regions and many island nations. This talk summarizes simulations of the minimum, or committed, sea-level rise for the 21st through 23rd centuries based upon models analyzed for the IPCC AR4.

The committed sea-level rise is the increase in sea-surface level associated with the historical changes in greenhouse gases to date and the associated trends in ocean temperature and ocean volume. The results, at least for the 21st century, are unaffected by future scenarios of emissions and emission controls.

Both simple and complex models of the ocean atmosphere system suggest that global-average sea level will increase by approximately 10 cm over the next century. These results represent the minimum increase in sea level, since most of the complex models neglect the effects of melting continental ice sheets, including those of Greenland and the Antarctic ice sheets.

Fidelity of the CCSM Simulations for the 20th Century

Summary: We have tested our climate model against observations of ocean temperature change and CFCs for the 20th Century. CFCs are an ideal man-made tracer of mixing from the surface to the deep ocean.

- Fig. 1: Comparison of ocean temperature trends
- Fig. 2: Map of the modeled ocean temperature trends
- Fig. 3: Comparison of CFC amounts in the ocean
- Fig. 4: Comparison of the CFC ocean distributions

IPCC Simulations of Climate Change with CCSM3

Summary: We have simulated climate change from 2000 through 2300 under several emissions scenarios. In the new "20th stabilization" scenario, all pollutants are fixed at year 2000 values.

- Fig. 5: Carbon dioxide concentration in the scenarios
- Fig. 6: Temperature in ensembles of model simulations
- Fig. 7: Simulated change in global-mean temperature
- Fig. 8: Change in temperature at end of 21st Century

Simulated Response of the Ocean and Sea-ice

Summary: Our CCSM3 model predicts that the ocean temperature and sea level will increase in response to global warming. In addition, the ocean circulation decelerates and Arctic sea ice decreases year-round.

- Fig. 9: Change in ocean temperature over upper 3 km
- Fig. 10: Change in ocean sea level (no land-ice melt)
- Fig. 11: Decrease in strength of Atlantic overturning
- Fig. 12: Change in Arctic sea-ice area

Committed and long-term temperature and sea-level rise

Summary: All models in the IPCC AR4 report predict that temperature and sea-level will continue to rise until 2400 and beyond even if all pollutants are stabilized.

- Fig. 13: Multi-model projections of global climate change
- Fig. 14: Multi-model projections for temperature change
- Fig. 15: Long-term projections for sea-level rise

The Community Climate System Model (CCSM) Program

Scientific Objectives:

- Develop a comprehensive climate model to study the Earth's Climate.
- Investigate seasonal and interannual variability in the climate.
- Explore the history of Earth's climate.
- Estimate the future of the environment for policy formulation.

Recent Accomplishments:

Release of a new version (CCSM3) to the climate community.

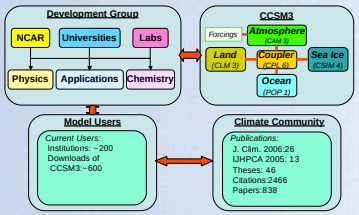
Studies linking SST fluctuations, droughts, and extratropical variability.

Simulations of last 1000 years, Holocene, and Last Glacial Maximum.

Creation of largest ensemble of simulations for the IPCC AR4.

http://www.ccsm.ucar.edu

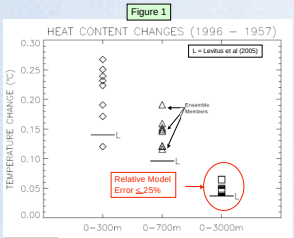
The Role of CCSM in U.S. and International Climate Science



References for the our CCSM Climate-Change Simulations

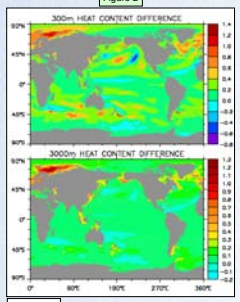
- Collins et al, 2005: *The Community Climate System Model: CCSM3,* accepted, *Journal of Climate.*
- Gent et al, 2005: *Ocean Chlorofluocarbon and heat uptake during the 20th century in the CCSM3,* accepted, *Journal of Climate.*
- Meehl et al, 2005: *Climate change in the 20th and 21st centuries and climate change commitment in the CCSM3,* accepted, *Journal of Climate.*
- Meehl et al, 2005: *How Much More Global Warming and Sea Level Rise? Science.*
- Teng et al, 2005: *21st-century climate change commitment from a multi-model*, accepted to *Geophys. Res. Lett.*
- Wigley, T.L., 2005: *The Climate Change Commitment*, *Science.*

Figure 1



Gent et al, 2005

Figure 2



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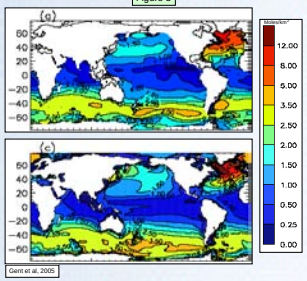

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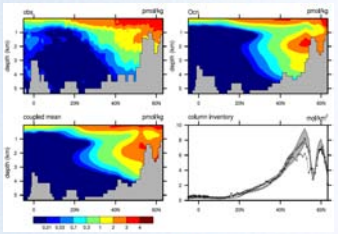

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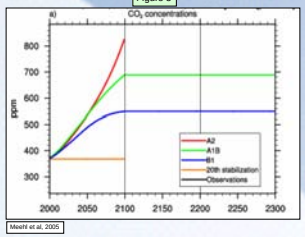

Meehl et al, 2005

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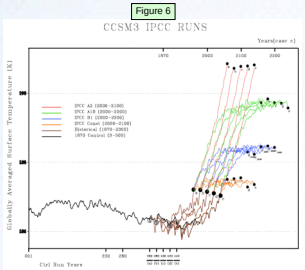

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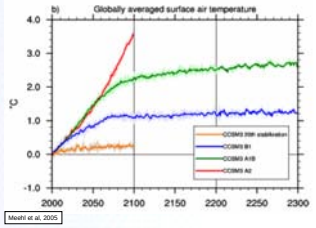

Meehl et al, 2005

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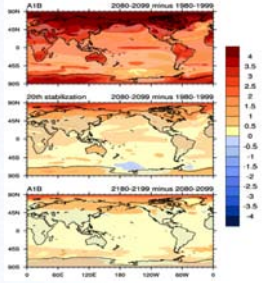

Meehl et al, 2005

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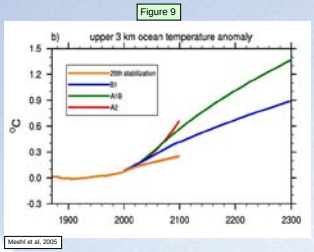

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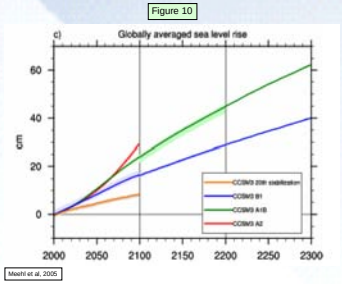

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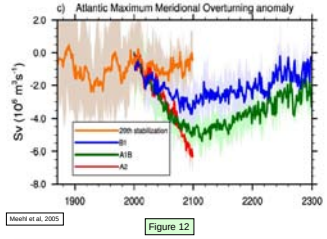

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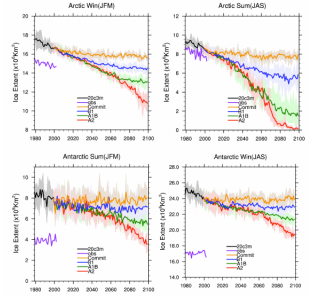

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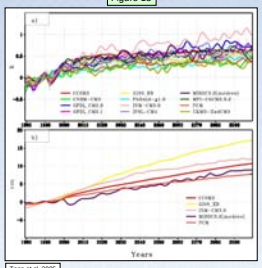

Teng et al, 2005

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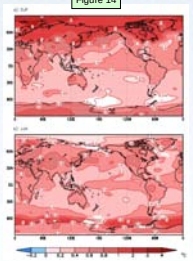

Teng et al, 2005

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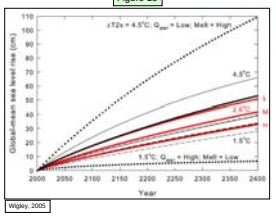

Wigley, 2005

CONCLUSIONS

- All the climate models included in the IPCC AR4 predict global warming over the next century.
- The committed temperature increase is 0.5 ± 0.2C by 2100 in the multi-model ensemble.
- The committed sea level rise is roughly 10 cm by 2100 in the multi-model ensemble.
- The actual effects of global warming will likely be considerably larger than the committed change.

Acknowledgements:

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