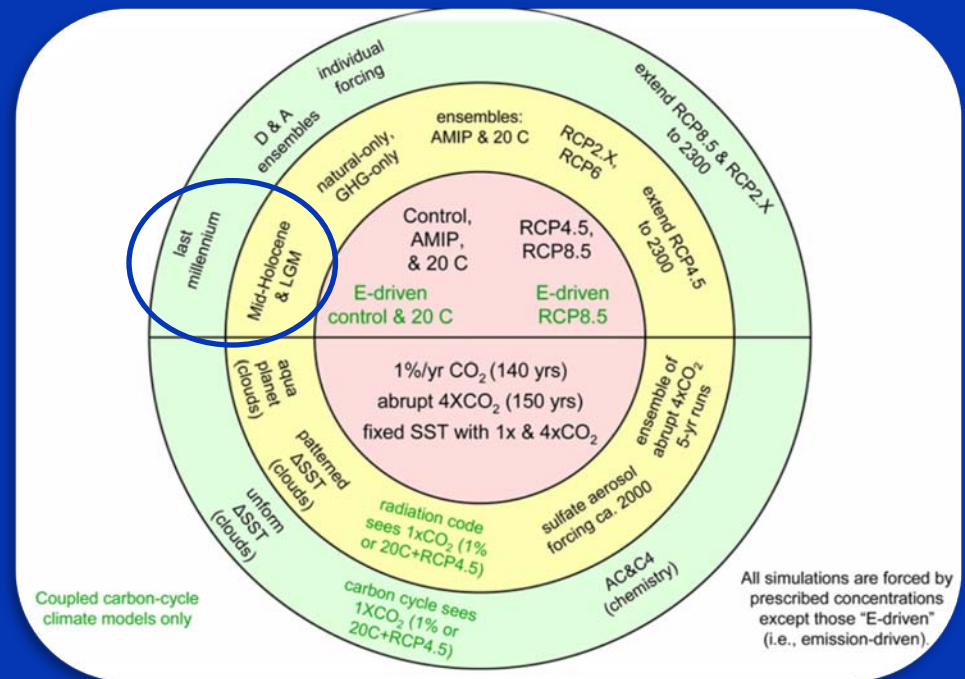


Status of CCSM4 Paleo CMIP5 Climate Simulations [Future Community Paleo Climate Simulations]

Bette L. Otto-Bliesner

Challenge for the PaleoWG is to analyze these simulations, comparing to:

- The other paleo runs
- Future scenario runs
- Runs by other modeling groups
- Data



Paleo CMIP5 Climate Simulations

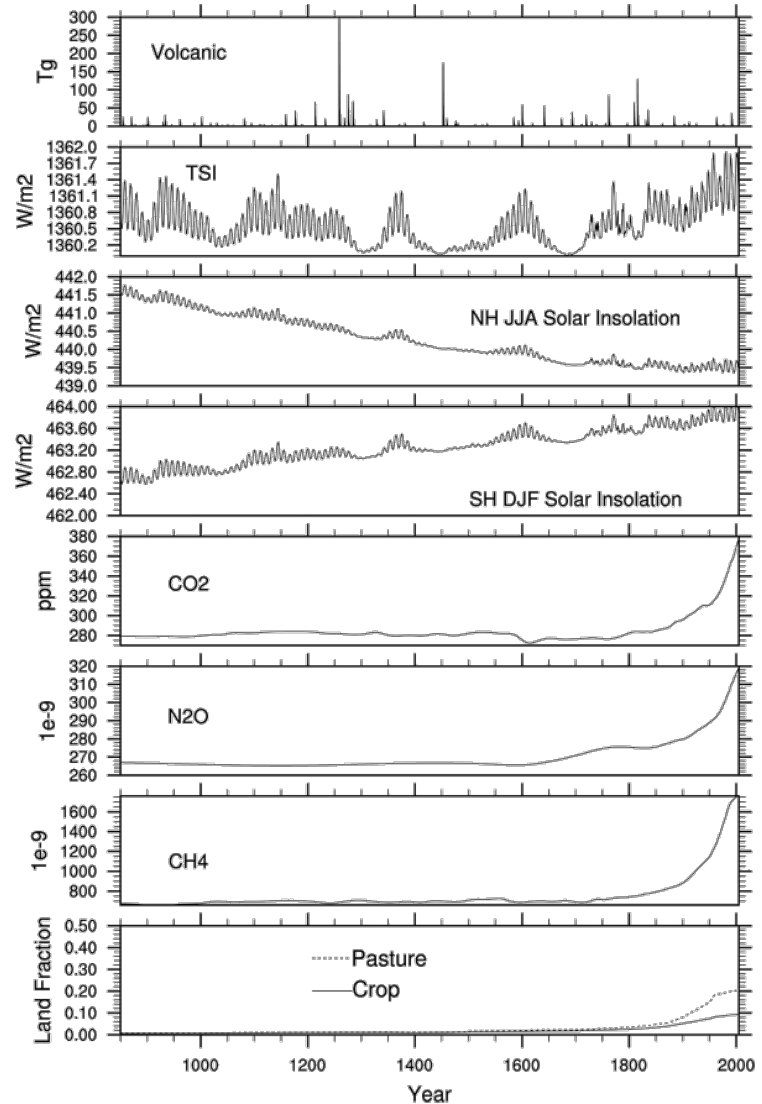
- **CCSM4 CN, 1.25°lat x 0.9°lon atm, Ind, x1 ocn, ice**
 - Last Millennium, 850 – 2005 CE
 - Evaluate the ability of models to capture observed variability on multidecadal and longer time-scales.
 - Determine what fraction of the variability is attributable to “external” forcing and what fraction reflects purely internal variability.
 - Provides a longer-term perspective for detection and attribution studies.
 - Landrum, Otto-Bliesner et al., Last Millennium Climate and Its Variability in CCSM4, J.Climate Special issue, submitted.
 - Mid-Holocene, 6 kyr BP
 - Compare with paleodata the model response to known orbital forcing changes and changes in greenhouse gas concentrations.
 - Last Glacial Maximum, 21 kyr BP
 - Compare with paleodata the model response to ice-age boundary conditions.
 - Attempt to provide empirical constraints on global climate sensitivity.
 - Brady, Otto-Bliesner et al., Climate Sensitivity to Glacial Forcing in CCSM4, J.Climate Special issue, to be submitted.
- **All to be made available on the ESG; plots on the CESM web page.**

Some results so far ...

PMIP3 Forcings

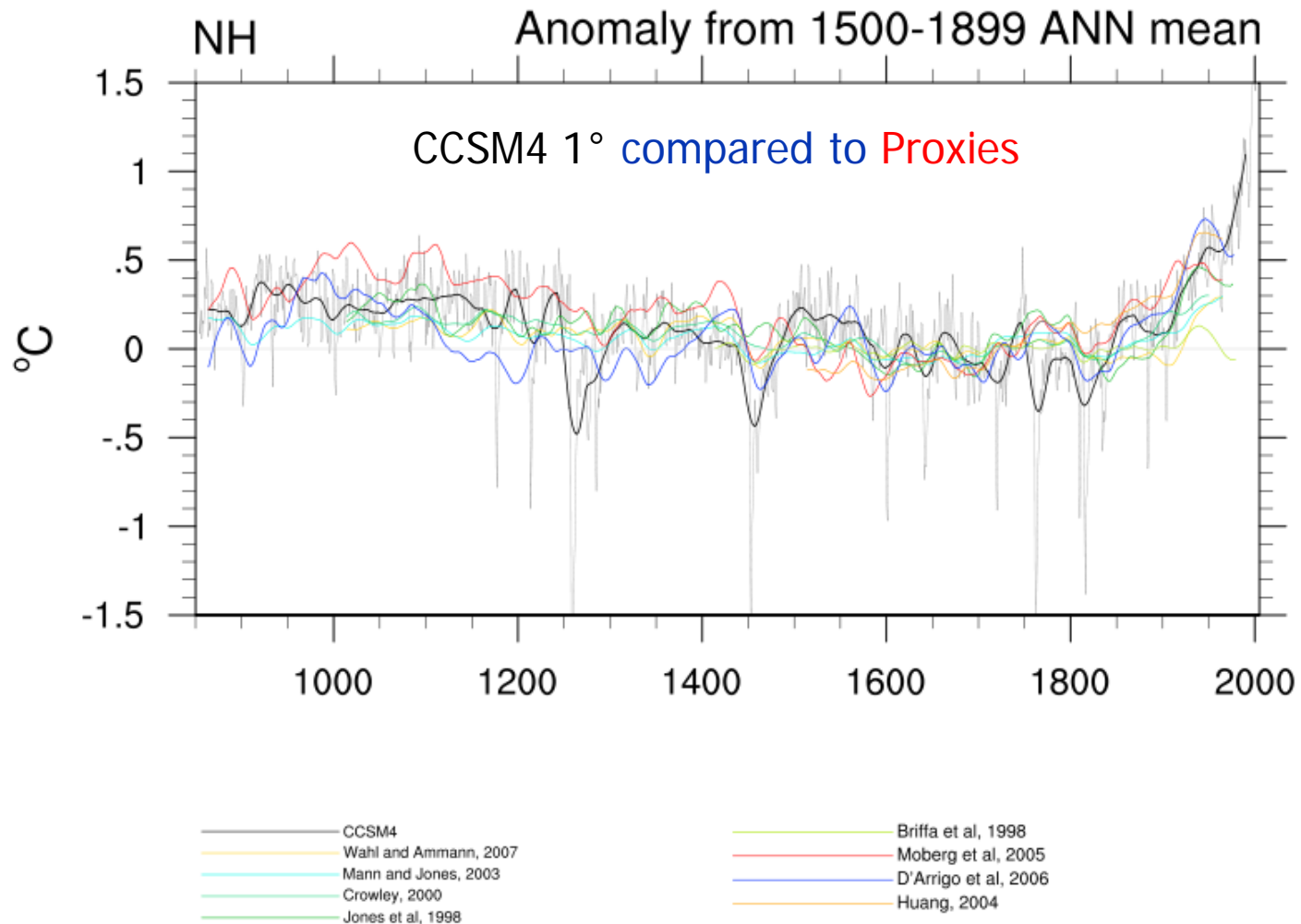
Last Millennium
850-2005CE

□ Forcings



Last Millennium

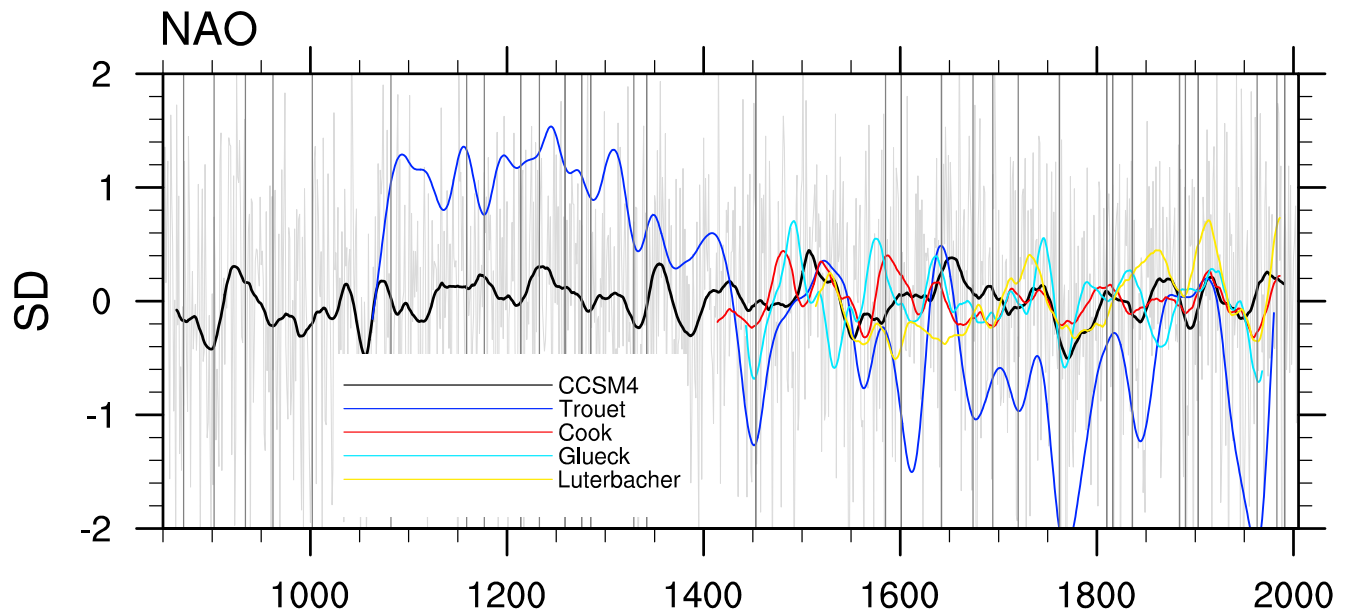
850-2005CE



Last Millennium

850-2005CE

□ Modes of Variability



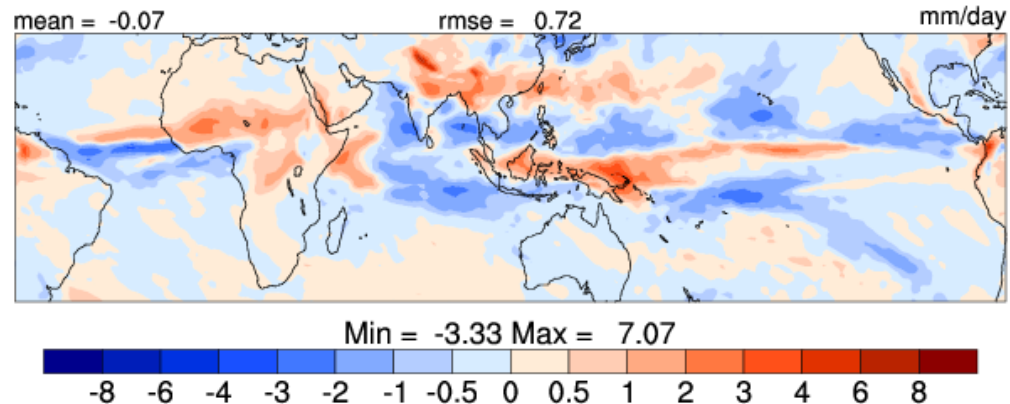
- Only AMO and AMOC show more multi-decadal variability than control 1850CE simulation

CMIP5 Mid-Holocene: 500 yr run

Orbital changes

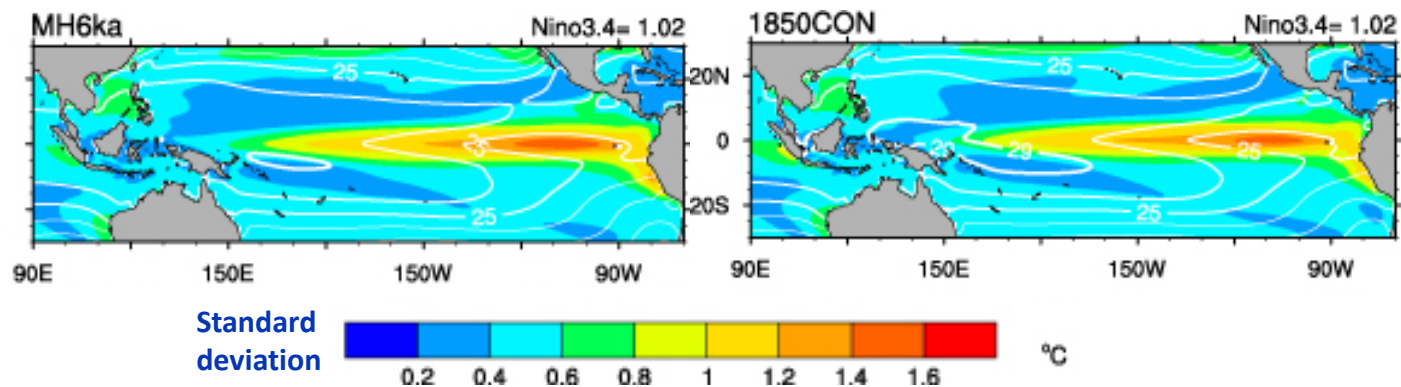
Mid-Holocene
6000 years BP

□ Monsoons



Δ JJA
precip

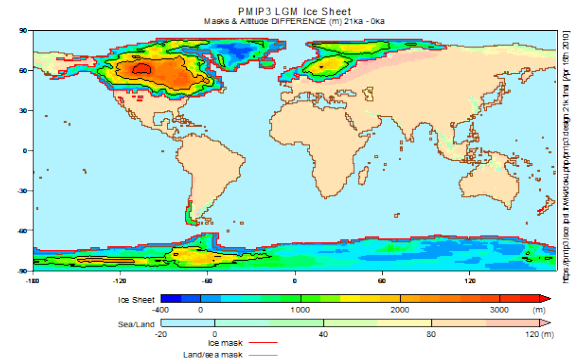
□ ENSO



CMIP5 Last Glacial Maximum +++

Last Glacial Maximum
21000 years BP

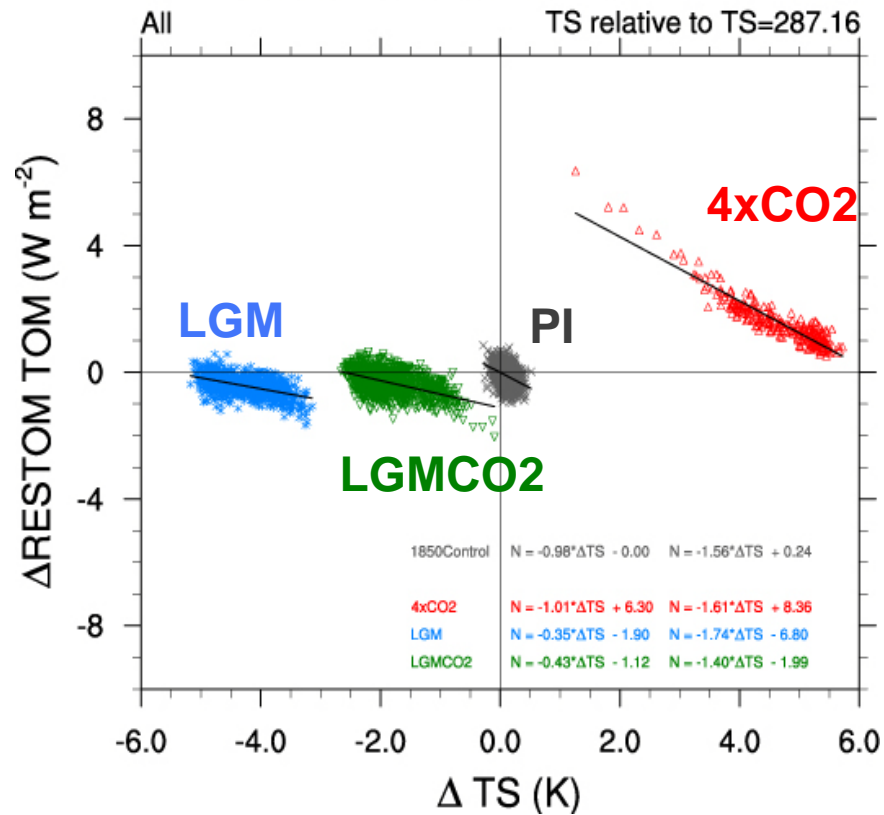
- Abrupt LGM CO₂ : 1100 years
- LGM : 1000 years
 - ▣ GHGs: CO₂ = 185ppm, CH₄=350ppb, N₂O=200 ppb
 - ▣ Ice sheets/sea level
 - ▣ Orbital
 - ▣ Vegetation, aerosols:
Present-day, but CLM CN allows for climate-induced changes in vegetation phenology
- Abrupt 4xCO₂ : 250 years



Last Glacial Maximum

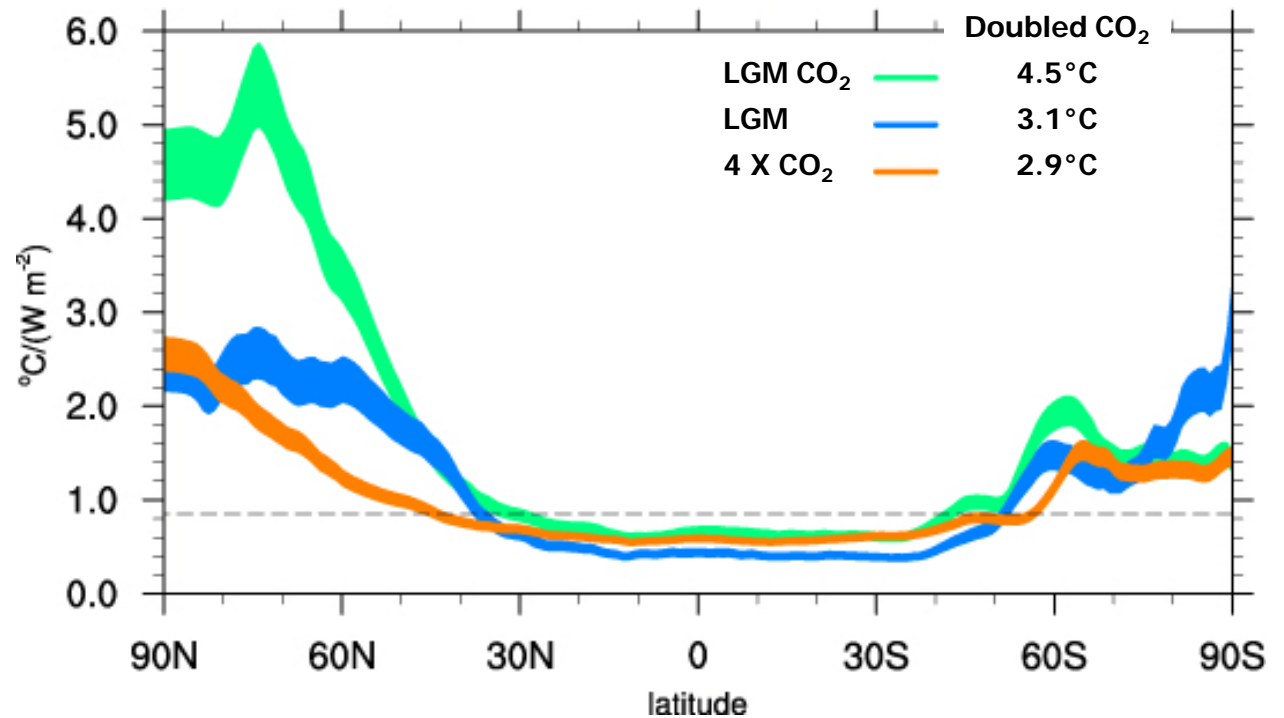
21000 years BP

Gregory diagram



Last Glacial Maximum
21000 years BP

□ Climate sensitivity



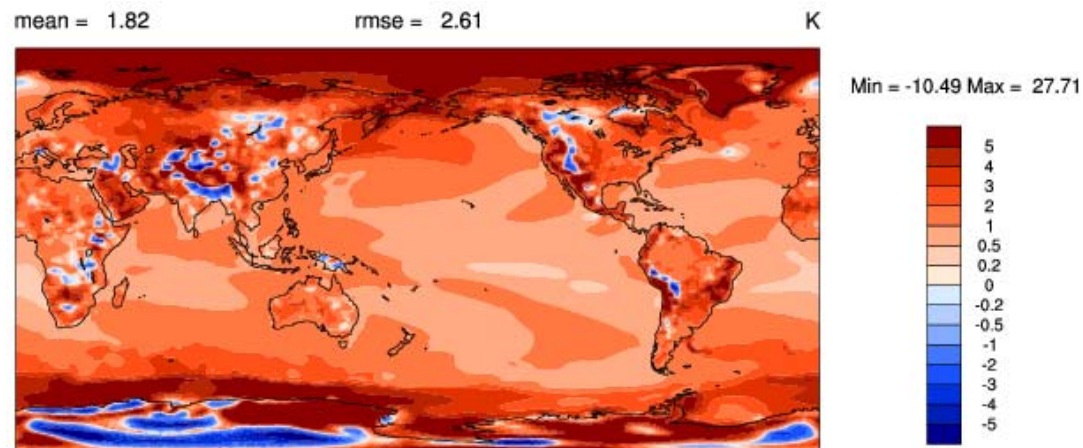
More Community Paleo Climate Simulations

- CCSM4 CN, 1.25°lat x 0.9°lon atm, Ind, x1 ocn, ice
 - ▣ 30-year MOARs : LGM and Mid-Holocene
 - Regional modeling, such as WRF

More Community Paleo Climate Simulations

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 - ▣ 30-year MOARs : LGM and Mid-Holocene
 - Regional modeling, such as WRF
 - ▣ Mid-Pliocene Warm Period, ~3 million years BP

Δ annual
surface
temperature



More Community Paleo Climate Simulations

- CCSM4 CN, 1.25°lat x 0.9°lon atm, Ind, x1 ocn, ice
 - ▣ 30-year MOARs : LGM and Mid-Holocene
 - Regional modeling, such as WRF
 - ▣ Mid-Pliocene Warm Period, ~3 million years
- CCSM4, T31x3, Permian, ~250 million years ago

- *in planning* CCSM4 BGC LGM : diagnostic CO₂
 - ▣ PCMIP
- *in planning* CESM – Glimmer CISM Last Interglacial
 - ▣ Greenland ice sheet first, then ...
- *in planning* High-resolution CAM last 21,000 years and PETM

CESM Paleoclimate WG Directions

- Expanding the model toolkit
 - ▣ High-resolution CAM
 - ▣ WRF and other regional models
- Simulation data to the community
 - ▣ Static: ESG; Dynamic: Purdue
- Enhancements to the model and its toolkit
 - ▣ New model components in CESM: BGC, ice sheets, WACCM, ... methane
 - ▣ Aerosols
 - ▣ Offline forward modeling: hurricanes, speleothems, ...
 - ▣ Real-time isotopes and geotracers: $\delta^{18}\text{O}$, δD , Radiocarbon, $\delta^{13}\text{C}$, Pa/Th, Neodymium
- Sensitivity simulations