Paleoclimate perspectives on simulations in deep future time

Speaker: Ran Feng (PWG)
On behalf of Bette Otto-Bliesner, Esther Brady
The mid-Piacenzian warm period (MPWP, 3.0 – 3.3 Ma)
Mid-Piacenzian Warm Period (MPWP): an analogue for the future climate
• 400 ppm CO$_2$ level
  – $\sim$100 ppm uncertainty

Geological reconstructions
- 400 ppm CO$_2$ level —~100 ppm uncertainty

- Similar to present-day geography and topography
Stable climate state of MPWP

- Lisiecki and Raymo (2005) stacked global benthic foram record

De Schepper et al., 2013
Stable climate state of MPWP

- Lisiecki and Raymo (2005) stacked global benthic foram record

- Potential analogue for equilibrium climate state of RCP4.5 & 2.6
Characteristics of MPWP climate: Pliocene Research, Interpretation and Synoptic Mapping (PRISM)

Dowsett et al., 2013
Sea level and polar glacials

- Global mean sea level:
  - $22 \pm 10$ m (Miller et al, 2012; Rohling et al., 2015)

- Reconstruction and simulation of Greenland and Antarctic ice sheet

Dolan et al., CP, 2015
PRISM3 SST Reconstructions

Dowsett et al., Nature Climate Change, 2012
PRISM3 Biome reconstruction

(b) Middle Pliocene Biome Reconstruction

Salzmann et al., 2008
Pliocene Model Intercomparison Project

- Phase I
  - 9 ESMs
Phase II

- 19 ESMs

Time slice (3.205 Ma)

Haywood et al., 2013
• Phase II

• CESM1.2-CAM5.3 results (100 – 150 model years)

Zonal mean surface temperature

- PliomIP2-CAM5 Minus CESM-CAM5 PI (20-yr mean and 1std)
- PliomIP1-CAM4 Minus CCSM4 PI (50-yr mean and 1std)
- PliomIP1-CAM4-new veg Minus CCSM4 PI (50-yr mean) (New vegetation mapping)
- PliomIP1-CAM5 Minus CESM-CAM5 PI (50-yr mean) (Cloud microphysics, Aerosol cloud interactions)

Pristine atmosphere
High density boreal forest
What did we learn?

• MPWP is a good analogue for equilibrium climate state with 400 ppm CO₂

• Absence of majority of Greenland and western Antarctic ice sheets, high sea-level stand (22 ± 10 m)

• Northern high latitude warmth
  – initial results from CESM1.2-CAM5.3: importance of boreal forests and high latitude clouds
• Thanks for listening!

Questions?

Pliocene Canadian Arctic environment
Ocean
Cryosphere/costal line
Biomes/soil
Lakes

PRISM workflow

DOT: Deep Ocean Temperature

Round rectangular: geological archives
Orange & yellow: End products