

CESM1(BGC) Historical Carbon Cycle Characterized

Objective:

Characterize the fidelity of the Community Earth System Model (CESM1) carbon cycle with terrestrial carbon–nitrogen dynamics and an ocean biogeochemical model.

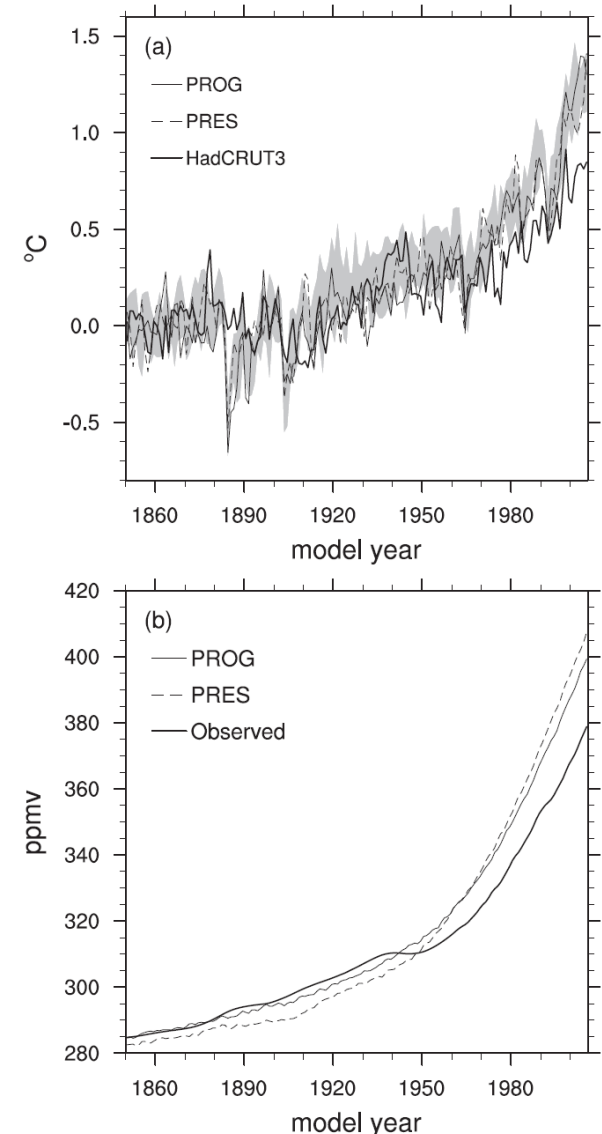
Approach:

Two sets of preindustrial-control and 20th century experiments were initialized and forced with prescribed CO₂ emissions (PROG) and CO₂ mole fractions (PRES).

Results/Impacts:

- CESM1(BGC) configuration used for CMIP5 experiments was introduced and described.
- Model broadly reproduced observed 20th century carbon cycle, but exhibited notable biases.
- Model exhibited excessive increase in atmospheric CO₂ due to weak land and ocean carbon uptake.
- Model had a weak seasonal cycle of atmospheric CO₂ in the Northern Hemisphere due to seasonal biases in land-to-air CO₂ fluxes.
- Model response of atmospheric CO₂ to El Niño Southern Oscillation was too weak.

Lindsay, Keith, Gordon B. Bonan, Scott C. Doney, **Forrest M. Hoffman**, David M. Lawrence, Matthew C. Long, Natalie M. Mahowald, **J. Keith Moore**, **James T. Randerson**, and **Peter E. Thornton** (2014), Preindustrial-Control and Twentieth-Century Carbon Cycle Experiments with the Earth System Model CESM1(BGC), *J. Clim.*, 27:8981–9005, doi:[10.1175/JCLI-D-12-00565.1](https://doi.org/10.1175/JCLI-D-12-00565.1).



Time series of 20th century (a) 2-m air temperature anomalies and (b) surface net CO₂ tracer compared to observations.