What is the niche that CESM plus Paleoclimate bring?

Discussion: Towards the CESM Strategic Plan

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CESM Paleoclimate Working Group Survey

We invite you to share your thoughts in advance of our upcoming CESM Paleoclimate working group meeting.

CESM Paleoclimate Working Group Survey

Dear CESM Paleoclimate Working Group Member,

This year our charge from Gokhan Danabasoglu, CESM Chief Scientist, for the discussion portion of our upcoming Working Group meeting (June 18, 2019, Center Green, Boulder CO) is to envision together what is or could be the niche for CESM. What are the challenges that CESM is best suited to address? What challenges should be our focus over the next 5 years?

To get a head start to help us frame the discussion, we are asking you to consider giving us your thoughts in advance. It is especially important to gather contributions from our paleo WG members who can't make the meeting in person.

Any and all responses will be greatly appreciated! Your valuable insight will help inform our discussion and contribute to the development of the CESM Strategic and Implementation Plan to be completed in early 2020. We look forward to reading your responses.

Please respond with as much detail as you'd like before June 17, 2019.

Thank you for your time and consideration,
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Our Charge:

- CESM's Niche?
- Focus over next 5 years?
- Paleoclimate WG Needs?

How do Paleo-WG members use CESM currently?

- Analyzing WG-generated simulation output from Paleoclimate simulations stored on the ESG
  (e. g. PMIP, LME, TRACE-21)

- Using simulation output to force offline models
  (e.g. other land biosphere models, ice sheet models, geomorphological models of landform evolution, etc.)

- Using CESM to setup and run both equilibrium time-slice and transient simulations, both warm and cold past climates, deep time and Quaternary applications

What Paleoclimate application is CESM best positioned to address?

- Simulating key time periods in Earth's past (deep time, periods of abrupt change, glacial-interglacial states, etc.) allowing investigations of climate sensitivity and feedbacks under different radiative and topographic forcings

- *'Past-to-Future'* –simulating past climates vs. proxy reconstructions to probe key processes and feedbacks; eg, investigating terrestrial climate response to warmer than modern climates; sensitivity of AMOC to different forcings; changes in hydrologic cycle; using CESM as a diagnostic tool to investigate complex physical processes across different climate regimes

- Millennial scale climate variability with online water and carbon isotopes and including biogeochemical cycles

- With interactive dynamical ice sheets, to address questions relating to feedbacks between NH ice sheets and the rest of the climate system on multi-millennial time scales.

What is unique about CESM as compared to other ESMs?

- Freely available and widely used community model
- Well documented and supported (mostly), with good access and cyberinfrastructure
- New state-of-science capabilities, e. g. coupled ice sheet model, BGC, carbon isotope tracers in land and ocean.
- One of a few full-complexity ESMs that can simulate isotopic tracers throughout the entire climate system (in CESM1.2 now, TBA CESM2)
- One of a few full-complexity ESMs with the capability of coupling to interactive ice sheets and simulates the SMB fairly well on centennial to millennial time scales
- Relatively flexible which allows a variety of scientific questions to be addressed including Deep time paleoclimates with very different continental configurations and topographies

What is or could be a ‘niche’ for CESM?

- Have the most advanced model physics with the most sophisticated set of geotracers,
- Have the ability to conduct simulations with multiple interactive ice sheets, over multi-millennial periods to investigate the slow feedbacks in the climate system, for greater confidence in future projections (past-to-future).
- Be *the* ESM of choice for direct model to proxy comparisons, especially when geochemical/isotope tracers and proxy system models are incorporated (High-resolution, full-complexity and low-resolution and complexity process models)
- Be the ‘Go-To’ ESM for paleoclimate applications; building on the existing large community user-base

What should be the focus of CESM and the Paleo-WG over the next 5 years?

- Conduct a suite of warm and cold past climate states, and large ensembles of transient simulations at key periods
- Maintain and improve multiple geotracers in CESM
- Keep current advances up to date with future model releases and component changes (eg, POP to MOM) Need to be forward thinking to stay abreast with new developments
- Create robust up-to-date toolkits and easily “tweaked” compsets
- Develop an interactive ocean sediment model to address glacial-interglacial CO_2 cycles
- Expand use for long transient simulations with interactive ice sheets
- Provide a model hierarchy (component/resolution/complexity) for process studies
- Work towards simulating a full glacial cycle. Requires interactive Antarctic IS, improved physics, tackle accelerated spin-up issues (deep ocean transients vs. accelerating IS and orbital forcing), tackle prognostic vegetation dynamics and full carbon cycle.

What are the resource needs of our Paleo WG community?

- Continued/increased NSF support for paleoclimate at NCAR to support the community(eg, liaison, toolkits, simulations) and existing and new CESM developments essential to move forward with paleoclimate applications

Discuss …