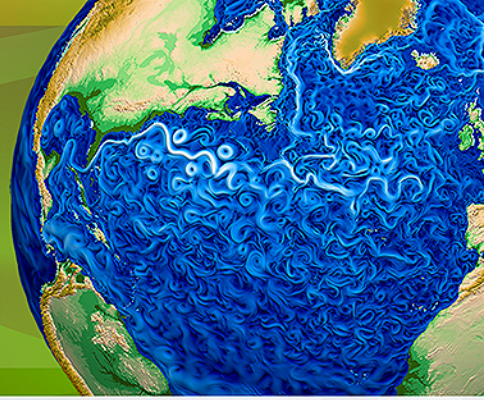
ACME
Accelerated Climate Modeling for Energy



Cryosphere Breakout Summary

U.S. DEPARTMENT OF ENERGY

Cryosphere Breakout Summary

Focus was on (1) characterizing polar climate in E3SM (both hemispheres) and (2) identifying important biases and improvements between v1 and v2

We had three formal presentations (and discussion) around these topics:

- Initial assessment of the v2 E3SM atmosphere over the S. polar region, including with atmos. RRM (*Zhang et al.*)
- An overview of the polar climate in E3SM v1 and v2 (*Roberts et al.*)
- Initial assessment of E3SM skill at simulating the drivers of Greenland ice sheet (GIS) surface melt (*Wang et al.*)

Cryosphere Breakout Summary

- v2 alpha versions produce S. polar climatology similar to v1
- most (but not all) biases over S. polar region are sensitive to atmos. resolution and tuning
  - stubborn 2 m air temperature bias suggests possible structural deficiency in model physics (for this region)
- S. polar atmos. RRM mesh *mostly* reproduces S. polar region features seen in global high-res. simulations
  - recent atmos. tuning from v2 WC finalization improves S. polar region climatology in both uniform low-res. and RRM configs.
  - conclusions around RRM are currently from atmos. only simulations (further analysis from coupled simulations needed)

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- several bugs and previously uncertain physics have been fixed / reduced from v1 to v2 (e.g., ocean advection bug that fixed spurious noise in sea ice melt terms)
- several significant polar climate biases have been reduced from v1 to v2:
  - consistent land-and-sea ice snow radiative transfer
  - improved snow morphology on sea ice
  - consistent sea ice and ocean basal temperature between models
- large Arctic sea ice bias remains in v2
  - possibly surface radiation bias in the high north?
- sea ice & ocean coupling improvements planned for v3, v4 should result in further significant improvements (e.g., consistent ice-ocean vector coupling and embedding)

Cryosphere Breakout Summary

- from observations (PROMICE AWS), sensible and short-wave heating (SH & SW) dominate sub-seasonal GIS melt
- both are enhanced during Katabatic wind events (clear sky = increased SW; wind = increased turbulent heat flux)
- spatial patterns of SH & SW in E3SM are similar to ERA5
- E3SM sub-seasonal variability in SW heating is too large:
  - snow/ice albedo biases
  - humidity biases
- first bias can likely be addressed through new snowpack model improvements (UCI efforts)

Cryosphere Breakout Summary

15 mins at the end of the session discussing:

- phase 3 Cryosphere science, in anticipation of phase 3 proposal, and v3 and v4 model features and configurations

- Cryosphere campaign actionable metrics (revisiting / refining these and progress towards them)

Detailed notes from breakout session are here:

https://acme-climate.atlassian.net/wiki/spaces/ECG/pages/1945470626/10-29-2020+E3SM+All-Hands+meeting+Cryosphere+Breakout