

CESM Paleoclimate Working Group

Highlights of Activities

Esther C. Brady,
NCARCo-Chair, presenter
Arne Winguth, University of Texas, Arlington,
External Co-Chair



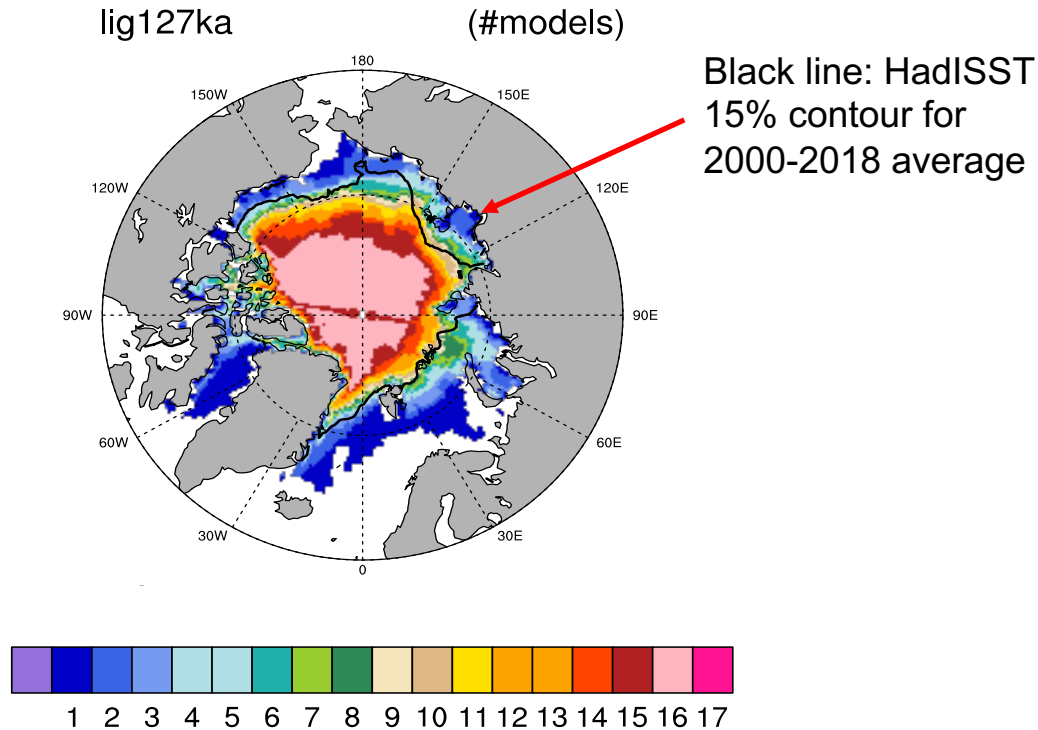
June 15, 2020



CMIP6 Tier1 *lig127k* and *midHolocene* with CESM2(CAM6) at FV1x1

→ Otto-Bliesner et al., *Paleo&Paleo*, submitted, *CESM2 Sp. Issue*, 2020

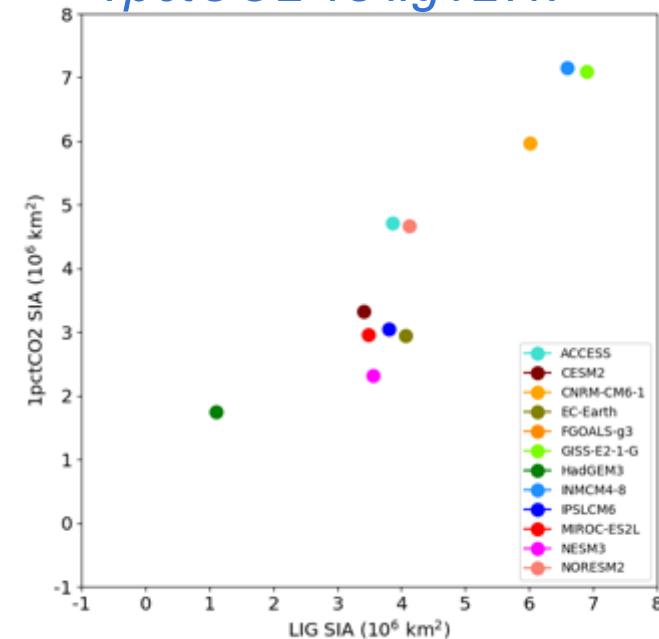
Multi-Model Last Interglacial at 127ka August-September Ave.



of models with at least 15% sea ice coverage
→ Otto-Bliesner et al., *Clim. Past*, in review, 2020.

Multi-model ensemble CMIP6/PMIP4
midHolocene: 12 CMIP6 models
lig127k: 17 CMIP6 models

JAS Arctic Sea Ice Area *1pctCO2* vs *lig127k*



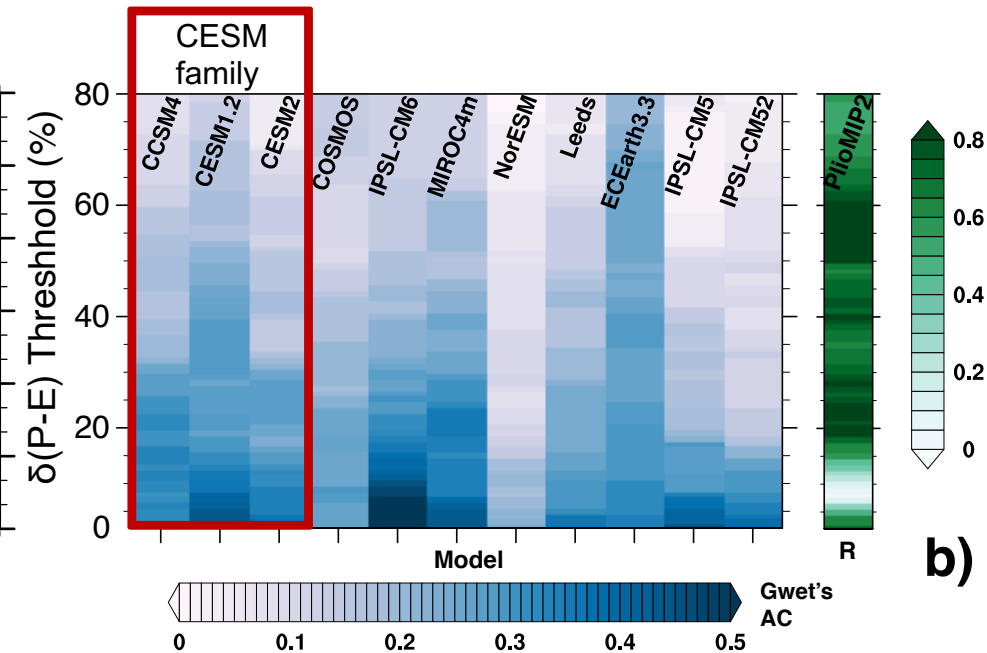
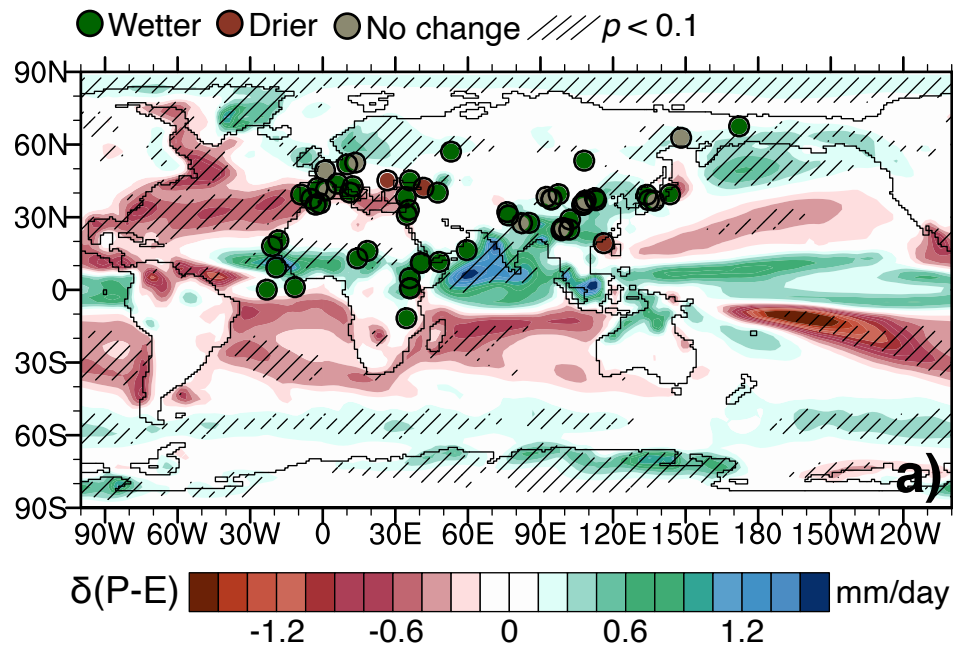
→ Kageyama et al, *Clim. Past*, in review, 2020

CMIP6 Tier1 *midPliocene-eoi400* (PlioMIP2)

Pliocene (3.2Myrs ago) CO₂ ~ 400ppm, Retreat of WAIS, GiS, vegetation, orography and bathymetry changes
CESM2(CAM6) FV1x1--One of 5 CMIP6 models that completed (+ CCSM4 and CESM1.2 completed)

→ Feng, J., B. Otto-Bliesner, E. Brady, and N. Rosenbloom, 2020: Increasing Earth System Sensitivity in Mid-Pliocene simulations from CCSM4 to CESM2, JAMES, CESM2 Sp. Issue, in revision.

Moistening of the Africa and Asian monsoon region during the mid-Pliocene

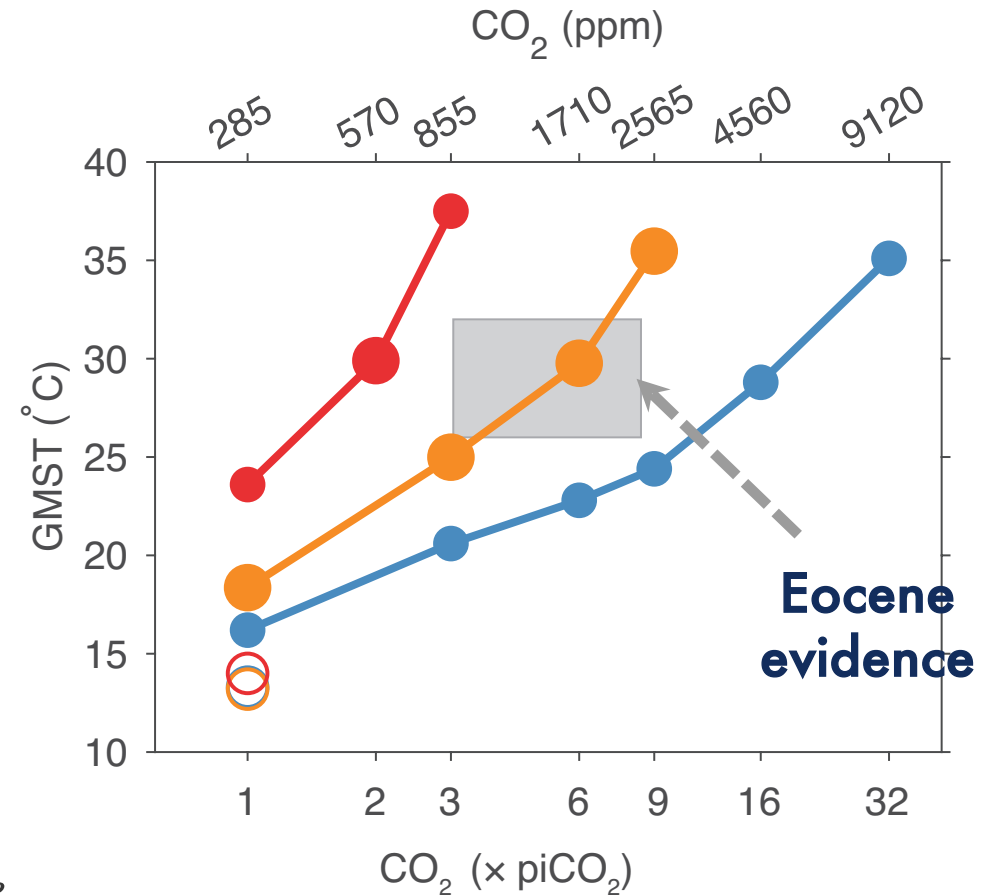
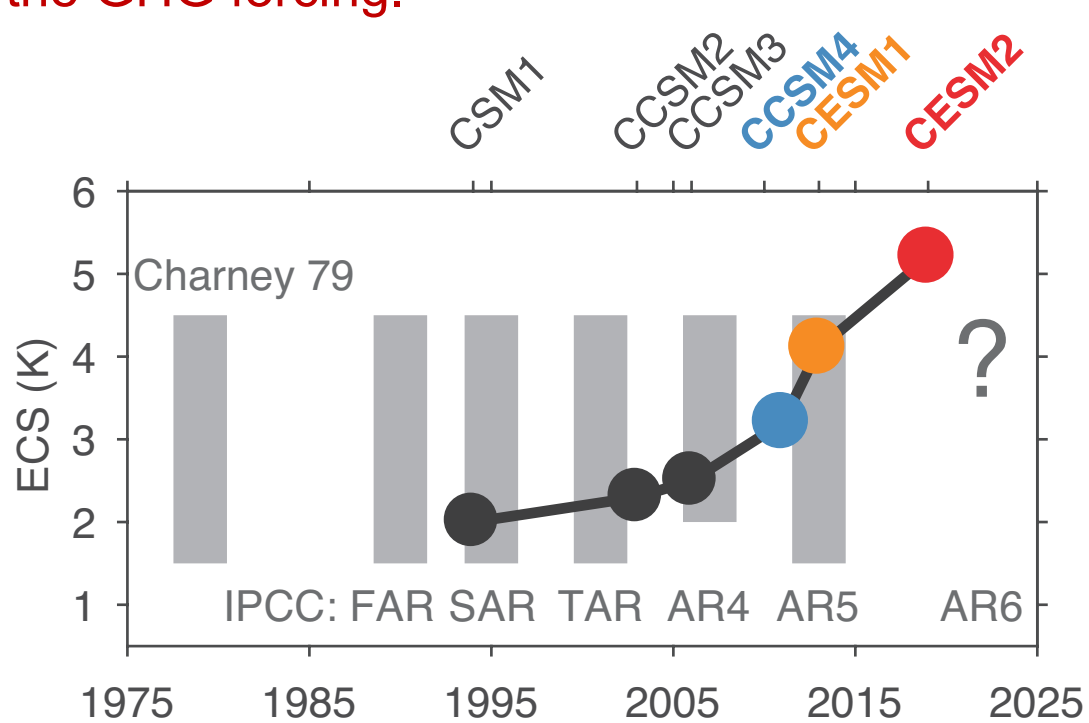


Among three versions of CCSM4, CESM1.2, CESM2, CESM1.2 shows the best pattern correlation with proxy for a wide range of thresholds.

→ R. Feng, Battachaya T., et al, Moist continental climate driven by elevated CO₂, afforestation and loss of Greenland ice sheet during the Pliocene, in prep, 2020.

DeepMIP-PMIP4: Early Eocene: ~50 Million years ago

Past warm climates like the Early Eocene provide unique constraints on the model behaviors under the GHG forcing.



Zhu, Poulsen, & Tierney, 2019, *Science Advances*

Zhu, Poulsen, & Otto-Bliesner, 2020, *Nature Climate Change*

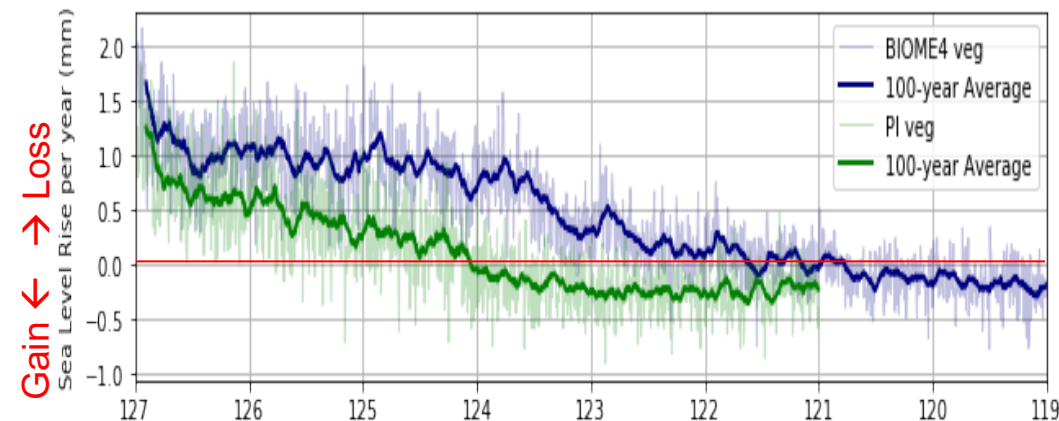
Best model-data match in Eocene simulations using CESM1.2 with CESM2 being too warm and CCSM being too cold.

Transient CESM2/CISM2 Simulation of the Last Interglacial (127-119 ka)

Paleo + Land Ice WG Collaboration: Greenland Ice Sheet evolution 127 ka → 119 ka

Transient forcing: Orbital & Vegetation forcing

CESM2(CAM6) FV1x1 CISM2: 4km GrIS
Same as for CESM2-CISM2
future scenario simulations

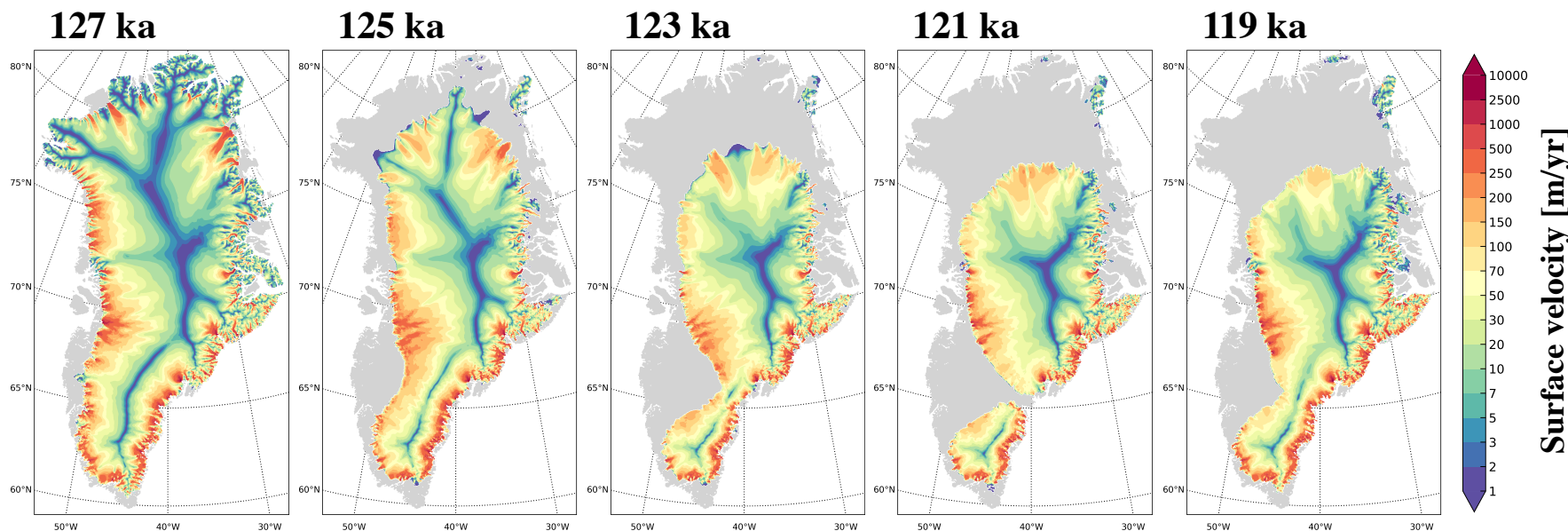


Key Results:

GrIS retreats to a minimum extent at 121 ka, followed by regrowth. GMSLR~4.2m

Good agreement with ice core records

Vegetation distribution has a strong influence on ice sheet behavior.



Sommers, et al., in prep.

Cross-Working Group Projects –On Going

1) CMIP6 Tier 1 *past1000*

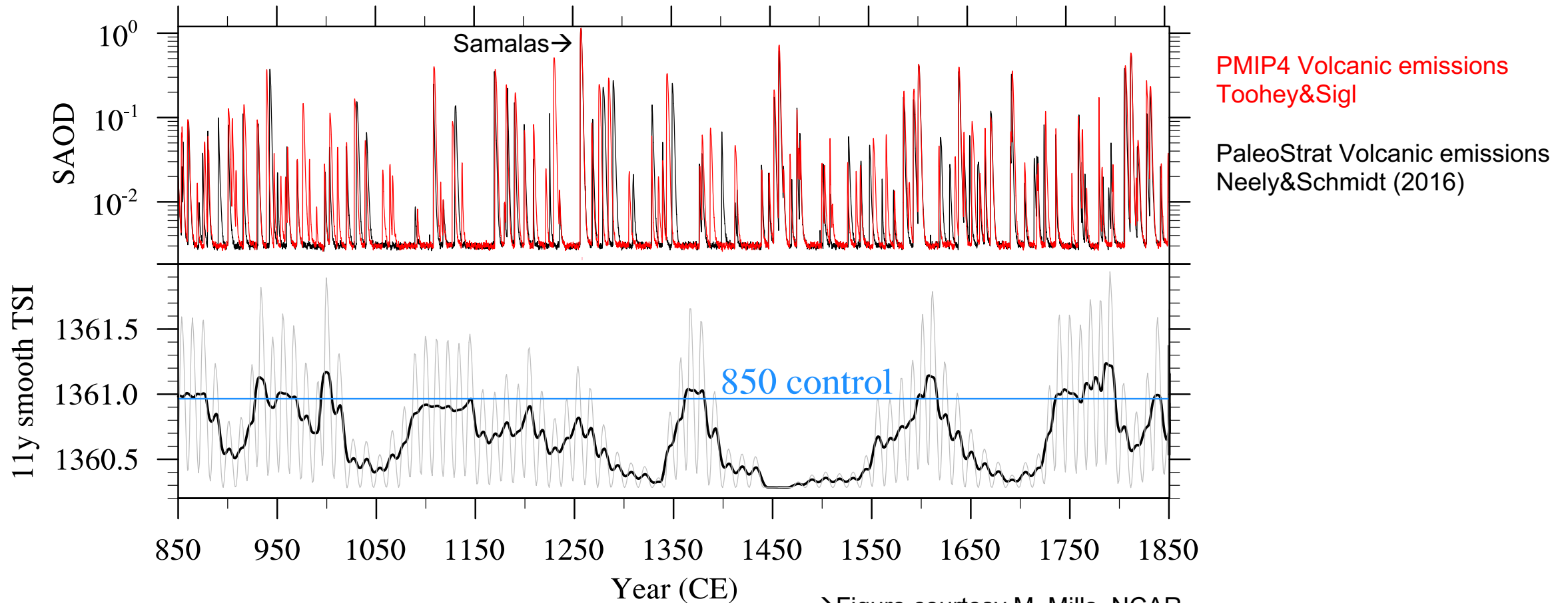
CESM2-WACCM6ma FV2x1

Ensemble with 2 different volcanic emissions
+ Solar variability, LULC, GHG, Orbital

2) Transient Holocene (6050BCE to 850CE)

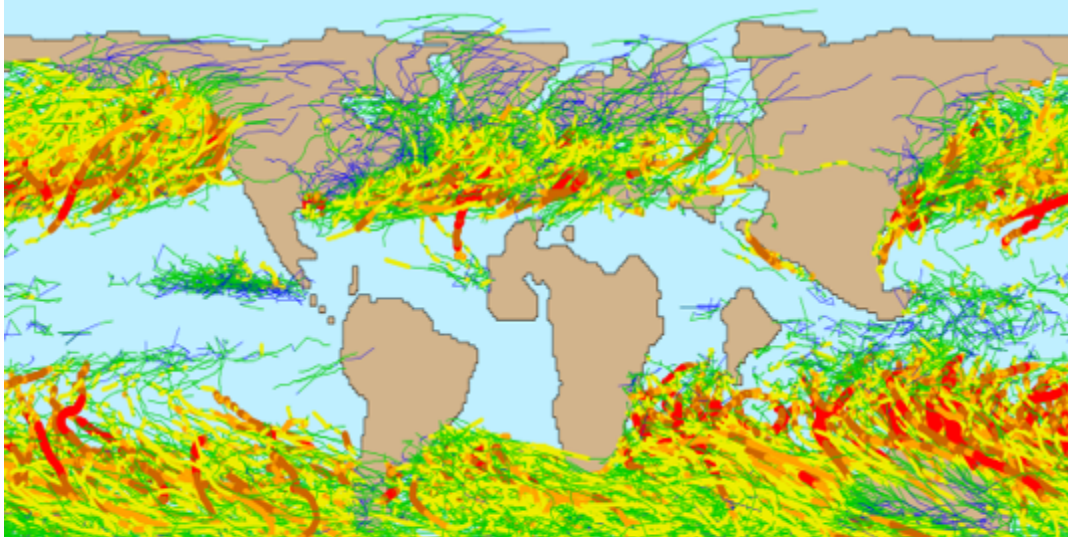
CESM2(CAM6-Chem) FV2x1

Also volcanic emissions, solar variability,
LULC, GHG, Orbital



→Figure courtesy M. Mills, NCAR

NCAR Deep Time Activities (HSF Projects)

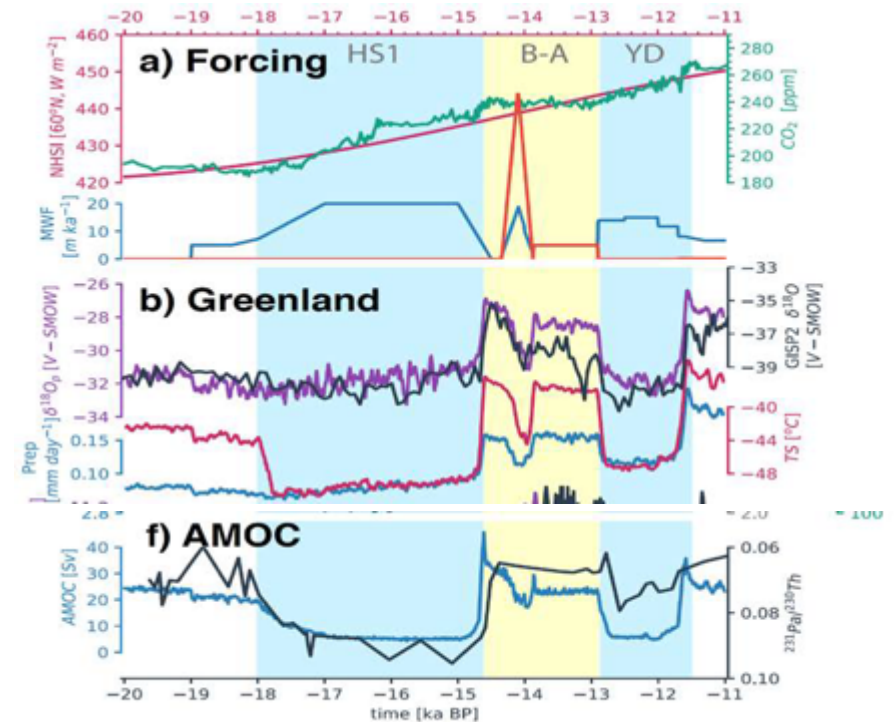


PETM (~56Ma) Tropical Cyclone Track (FV0.25 CAM5)

The lack of TC in the subtropical bands can be linked to the increased wind shear, figure courtesy of C. Zarzycki.

- ❑ Intensification of the hydrologic cycle along the North Atlantic during the PETM: A data /model comparison (Rush et al., in prep).
- ❑ Extreme weather in the PETM (Kiehl et al, in prep).
- ❑ Moisture transport in the PETM through atmospheric rivers, Shields et al, in prep).
- ❑ Global change in continental climate during the Paleocene- Eocene Thermal Maximum: a view through the window of terrestrial palynology, Koradis et al, in prep).

Transient Climate through the last Deglacial (iCESM1.2)



- ❑ Hydroclimate Footprint Accompanying Pan-Asian Monsoon Water Isotope Evolution during the Last Deglaciation, C. He, Liu, Z. et al, submitted to Science, 2020.

PALEOCLIMATE RESOURCES

Recipes

See below for Step by Step instructions for setting up...
 *More links will be added as recipes become available

- [DT-CESM1.2: Deep Time CESM1.2 Simulations](#)

Other recipes to follow. Community contributes welcome!

User-contributed Code

Miscellaneous code for paleo simulations. See recipes for location of github toolkit code, or go to [Scripts/Code repository](#)

- [Calendar adjustment Code](#)
- [Glacier topography for CESM2](#)

FAQ

A reference for various aspects of the CESM1.2 paleo Toolkit. Some of this is old; please use only as a general guide.

*Note that for Deep-time step by step instructions, the Recipe for DT-CESM1.2 should be used.

<http://www.cesm.ucar.edu/models/paleo/faq/>

Compsets

We now have a number of paleo component sets, i.e. "Compsets". Please see the version navigator to determine which version to use.

- Last Interglacial
- Mid Holocene
- PETM
 - [BPETMC5CN](#)
 - [EPETMC5CN](#)
 - [FPETMC5](#)

PWG INFORMATION

- Overview
- Priorities
- Developers Guidelines
- CESM1 Experiments
- TraCE 21ka BP to Present
- Last Glacial Maximum CCSM4
- Last Millennium CCSM4 (CAM4)
- Last Millennium Ensemble CESM1 (CAM5)
- Paleo Resources

PWG COMMUNICATION

Email: [PWG Members](#)



Paleo Tools and Documentation are stored on Github and can be found through Paleo Working Group "Resources" link.

<https://github.com/CESM-Development/paleoToolkit/wiki/Paleoclimate-Resources-for-CESM>

Model Version	Purpose	Link	Composet
CESM1.2/iCESM	General Quaternary, Isotopes	FAQ , Isotope Recipe pending	Use Pre-Industrial
DT-CESM1.2	Deep-Time	Recipe	BPETMC5CN, FPETMC5, EPETMC5CN
CESM2	Quaternary, Deep-time pending	Recipe's pending	Last Interglacial, Mid Holocene

THANK YOU!

Output from many of our CESM paleoclimate simulations is available (or soon will be) On the CMIP6 ESGF or NCAR CDG.

For more CESM Paleoclimate science talks, discussion, and lunch chats:

Joint Session: Polar, Land Ice and Paleoclimate Working Groups

Wednesday, June 17, 2020 830-1230