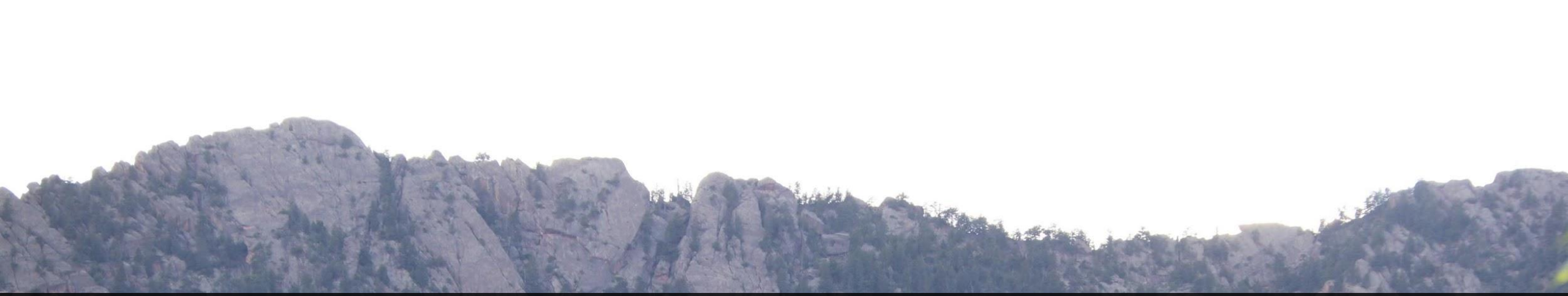

PaleoWeather: leveraging high- and variable-resolution simulations with paleoclimate data to study weather and climate extremes

Bette Otto-Bliesner

Jiang Zhu, Sophia Macarewich, Esther Brady, CJ Sun, *and many more*

NCAR

12 June 2023

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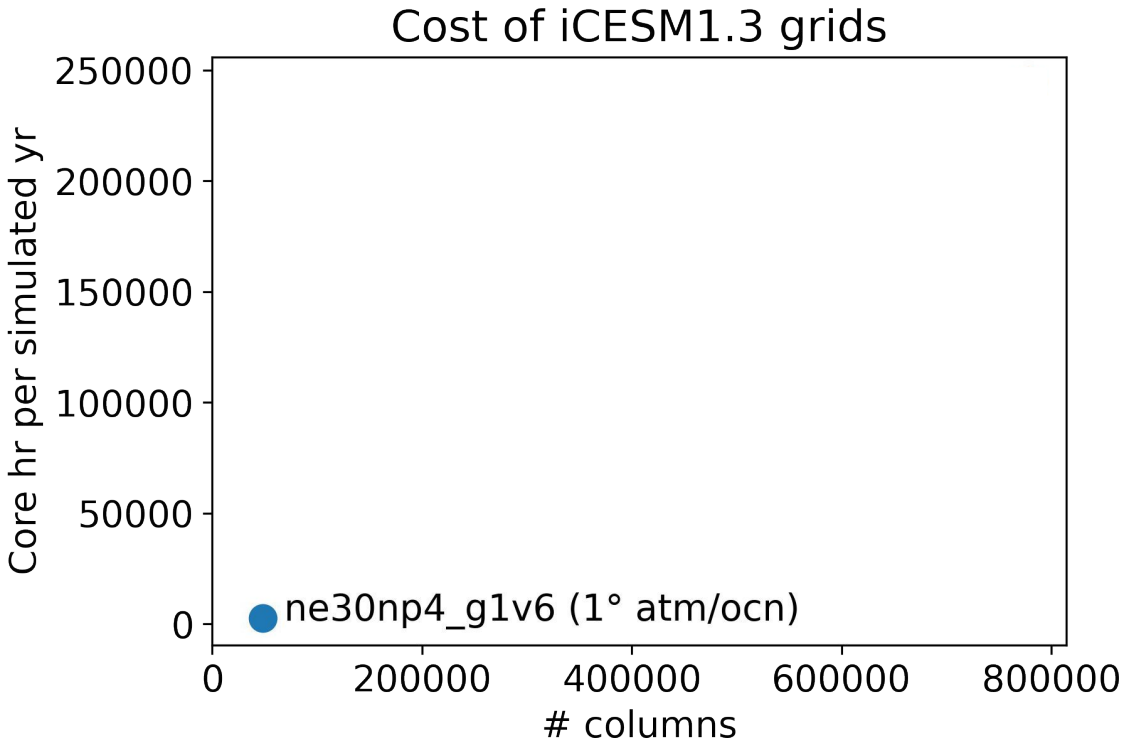
Low-resolution versions of iCESM

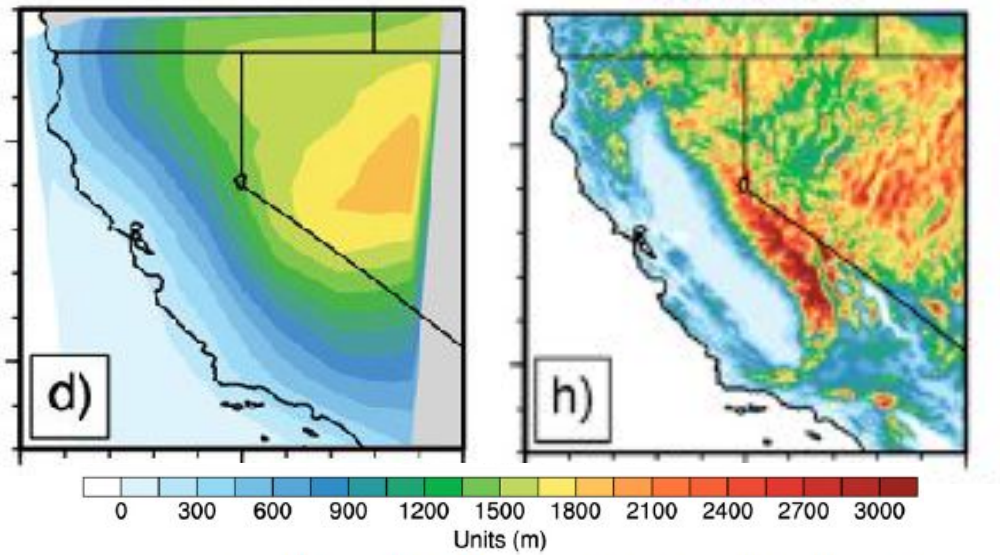


Note that i = also simulates water isotopes

- **Choice of many paleoclimate simulations done at NCAR and by community**
- **Long simulations – for components with long time scales – and for transient simulations**

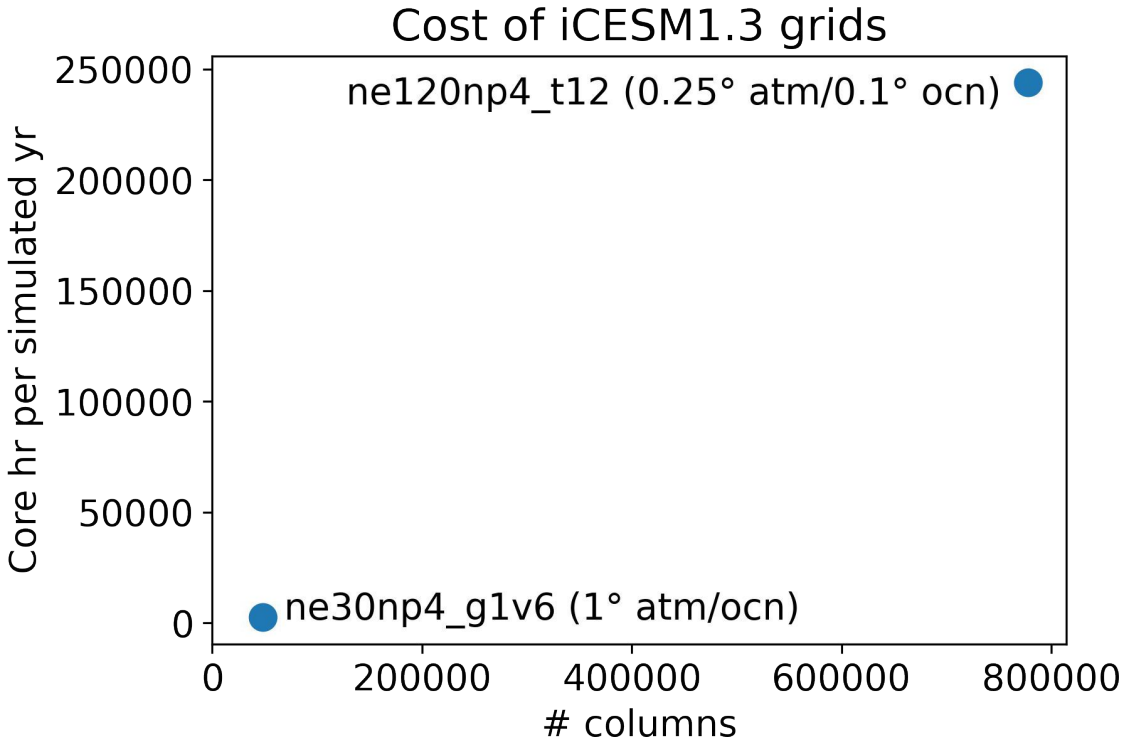
Topography

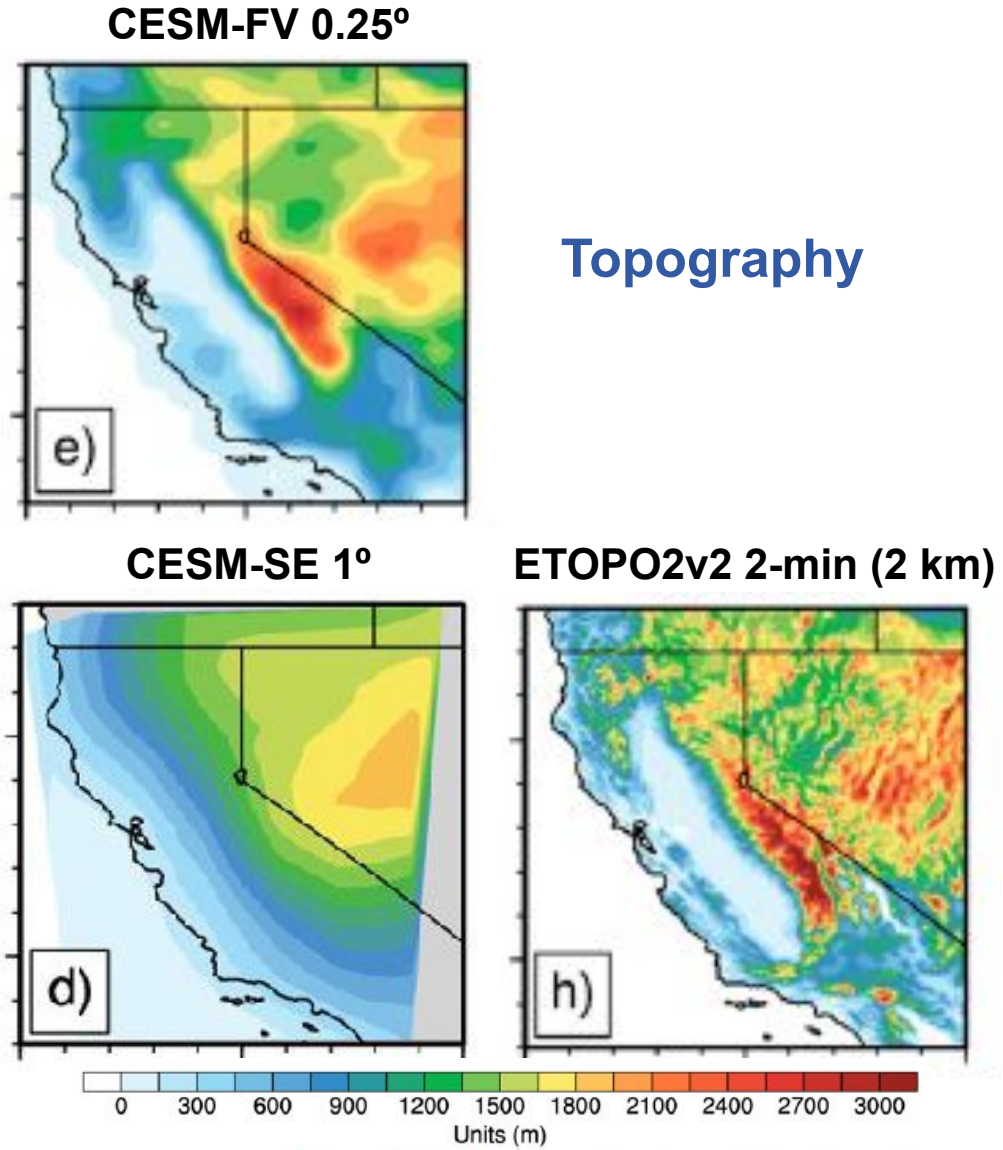
CESM-SE 1º **ETOPO2v2 2-min (2 km)**



Rhoades et al. (2016), *JAMC*

High-resolution versions of iCESM



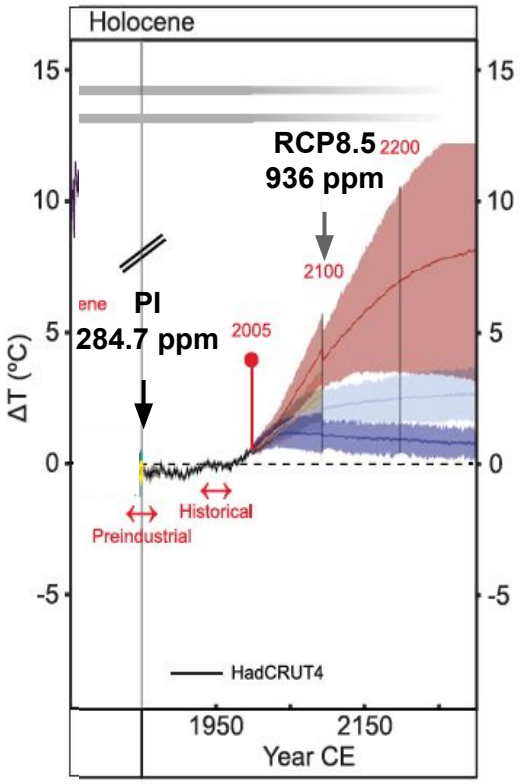


Topography

Rhoades et al. (2016), *JAMC*

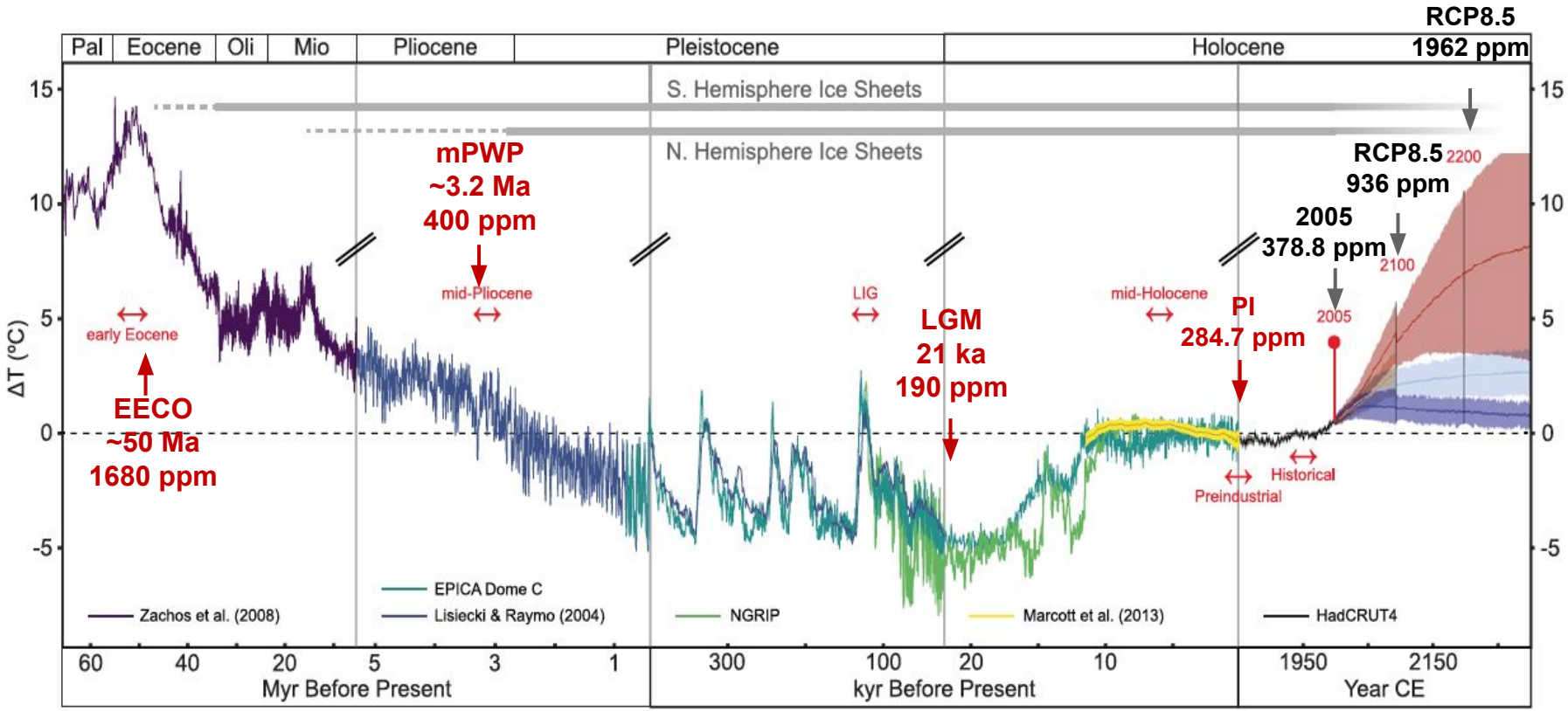
High-resolution version of CESM

- **iHESP HR simulations with CESM1.3**
  - 0.25º atmos & land
  - 0.1º ocean & sea ice
  - Multi-century PI, 1920-2015, RCP8.5 to 2100



PaleoWeather Project – Past-to-Future Perspective

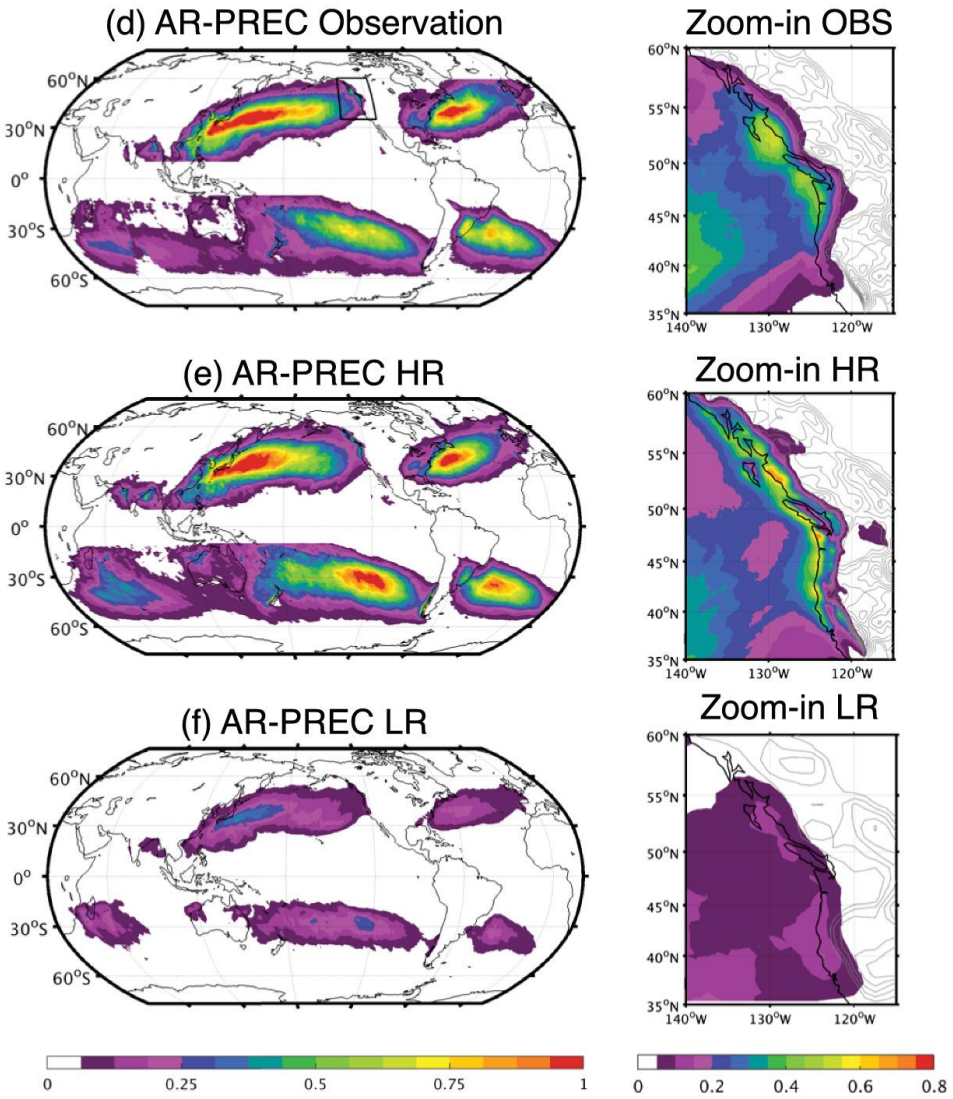
Accelerated Scientific Discovery (ASD) project on new supercomputer Derecho



Evolution of global temperature (anomalies) for the past 65 Ma and the future.
Adapted from Burke et al., 2018.

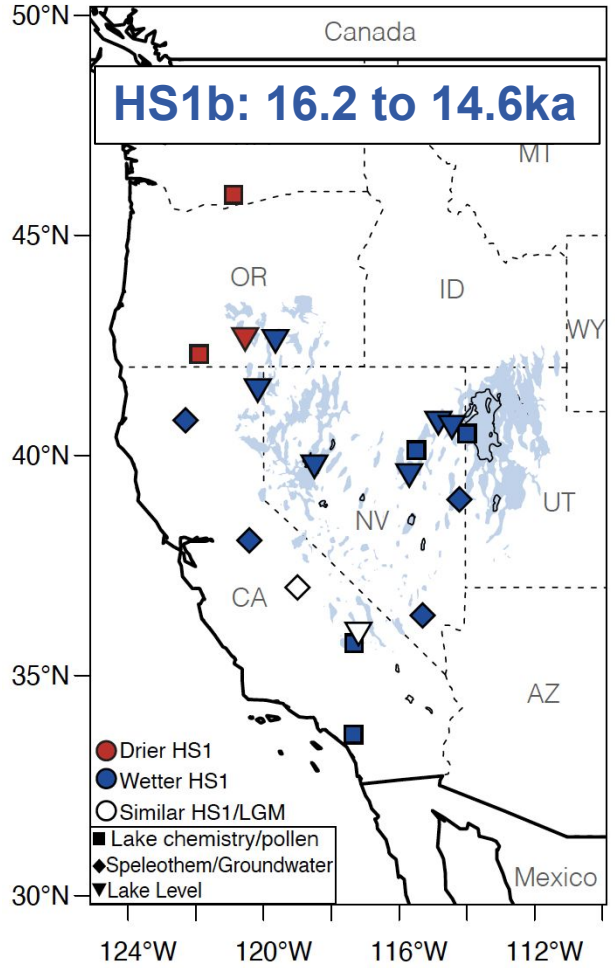
- **Proposed 50-yr simulations**
  - LGM (21 kyr ago)
  - Pliocene (3.2 Myr ago)
  - Eocene (~50 Myr ago)
  - an extension of PI to include water isotopes
- **Start from spunup LR simulations**

PaleoWeather Project – Atmospheric Rivers

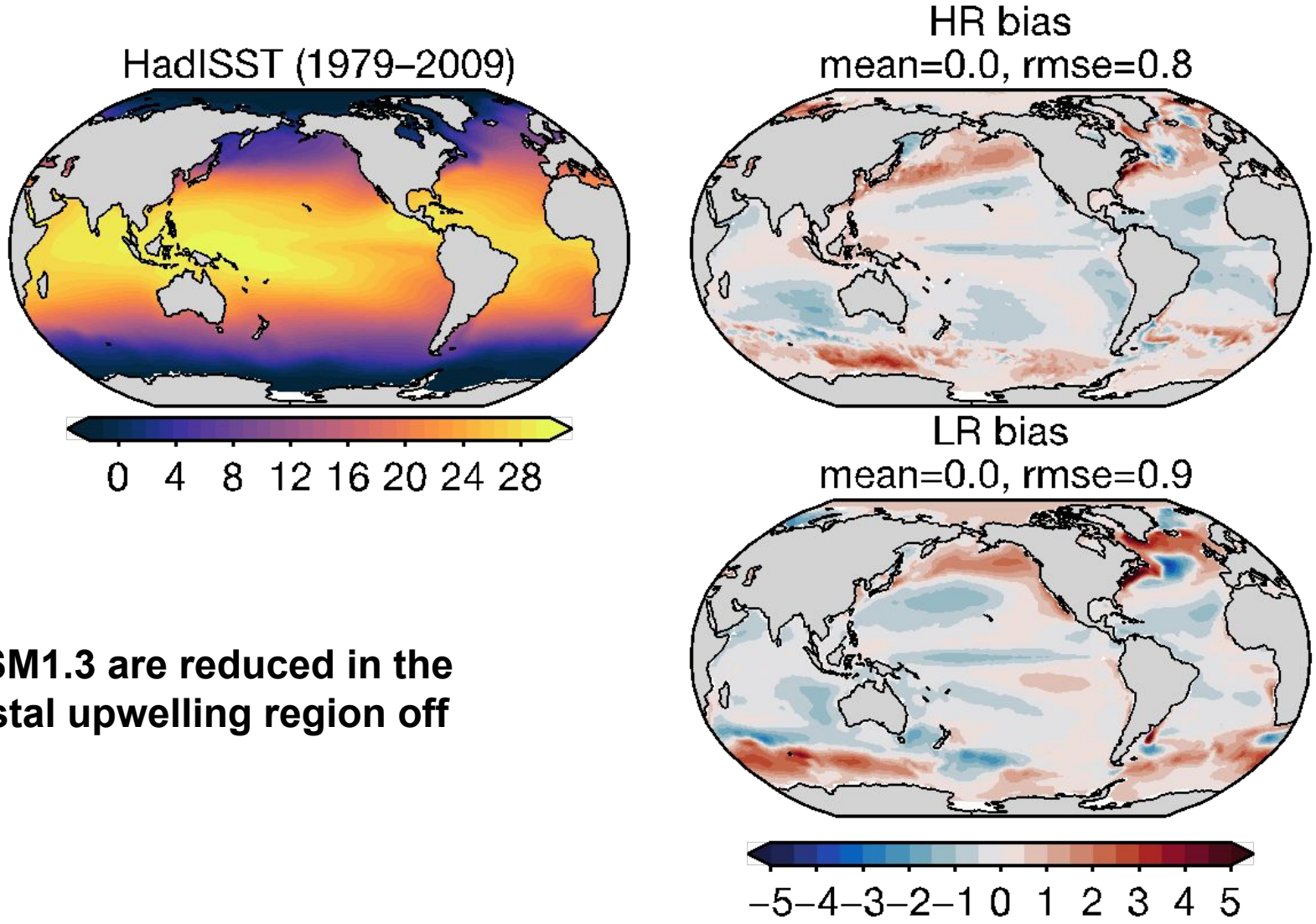


Paleoclimate Data

Much reduced AMOC



PaleoWeather Project – Coastal Upwellings



- **Biases in the LR CESM1.3 are reduced in the HR CESM1.3 for coastal upwelling region off California and Baja.**

Credit: Jiang Zhu, NCAR

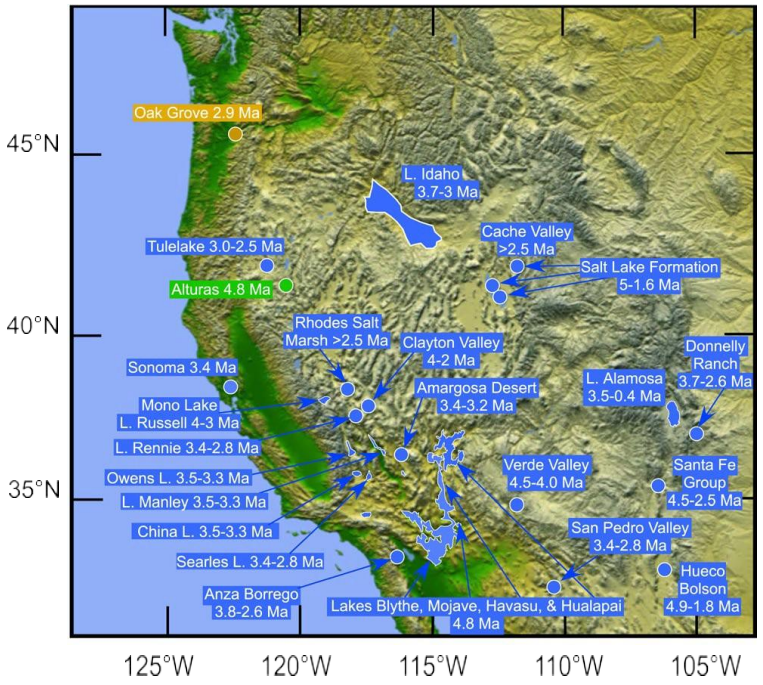
PaleoWeather Project – Coastal Upwellings

Pliocene (~3.2 Ma, ~400 ppmv CO_2)

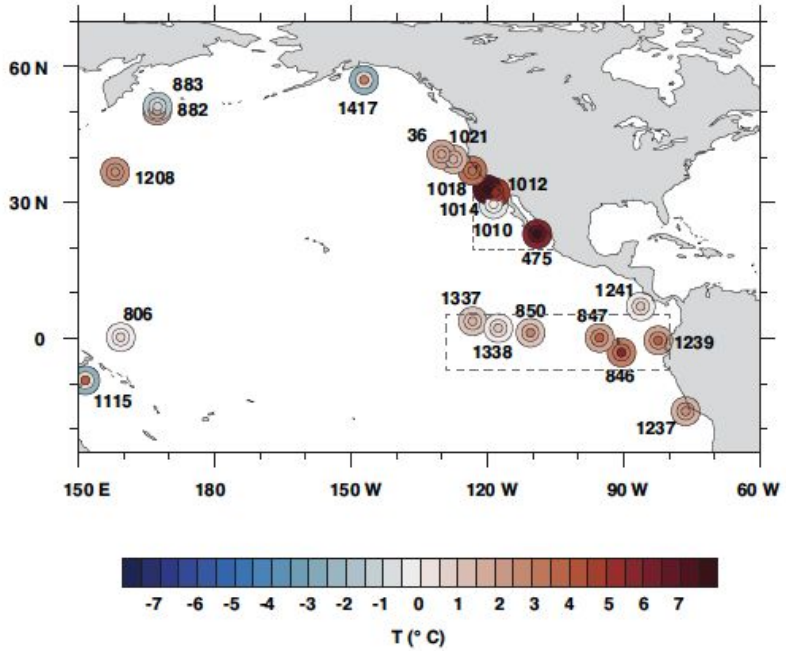
- **PlioMIP (LR) simulations generally underestimate precipitation increases over the SW US**

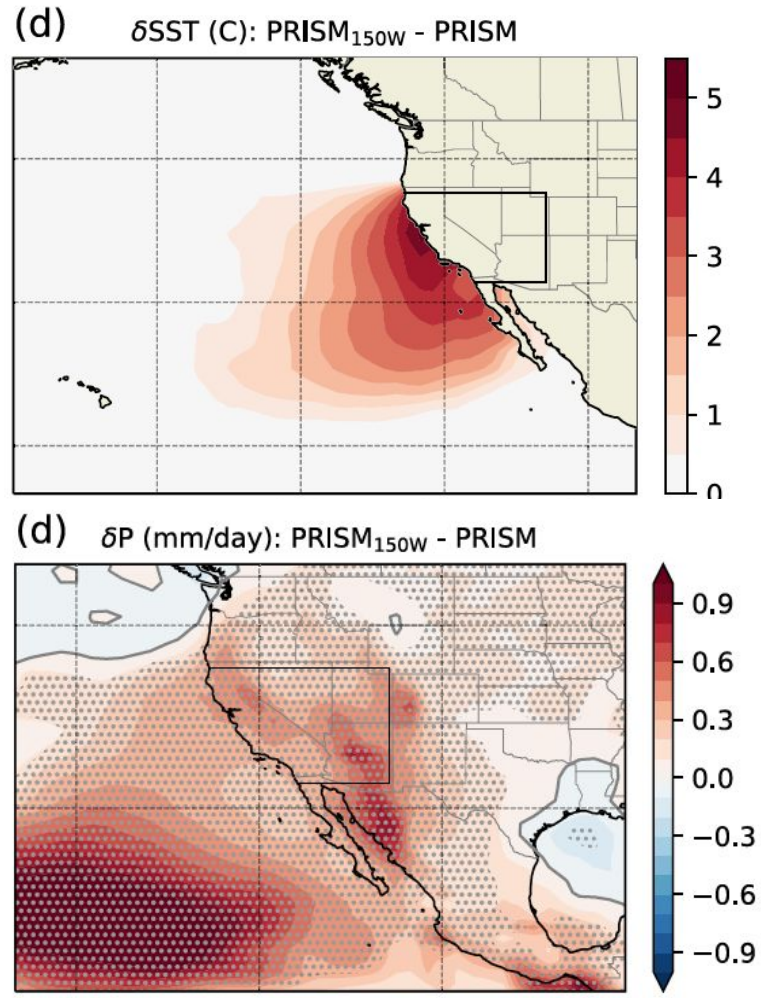
Paleoclimate Data - Pliocene

High lake levels in SW US

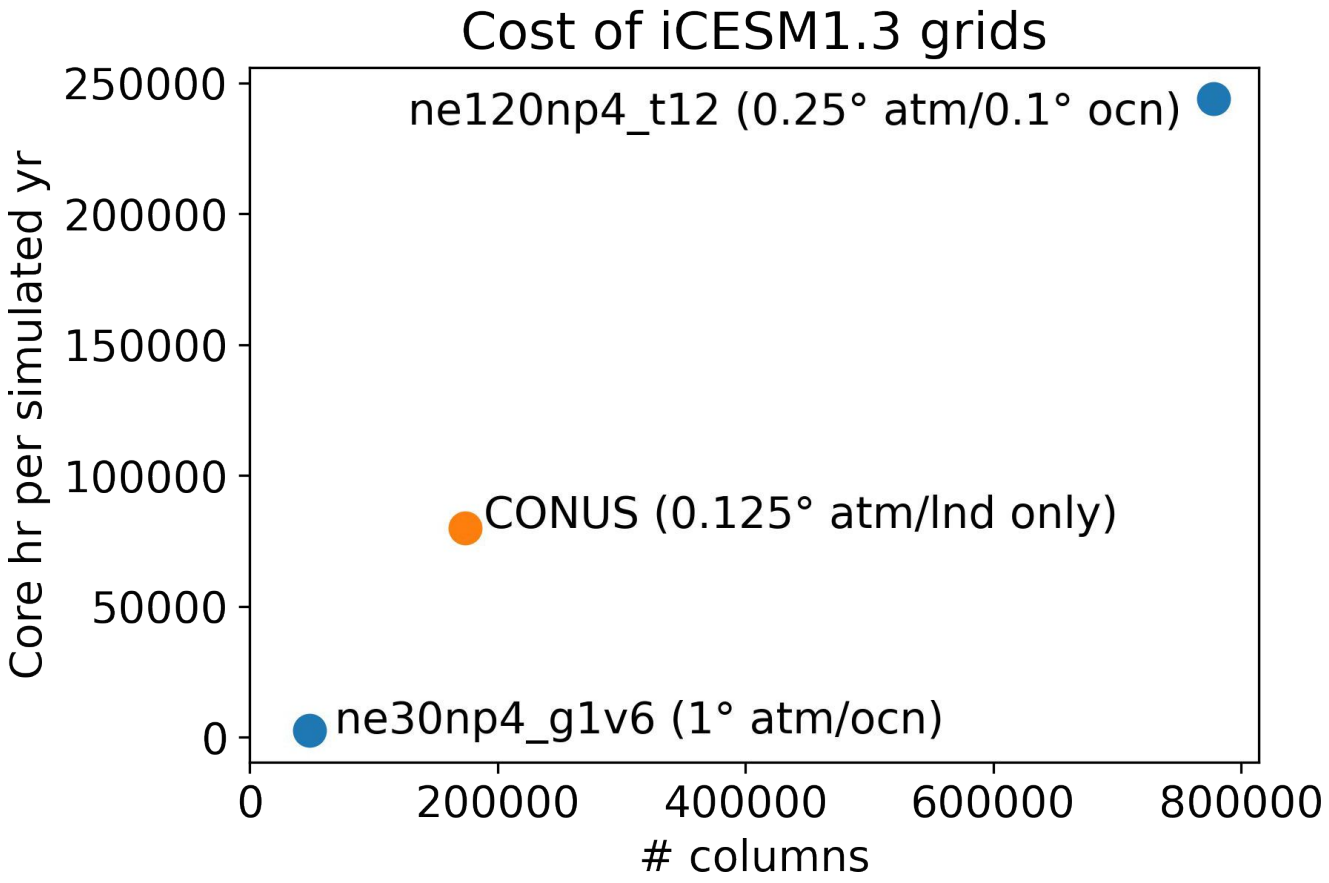


Much warmer SSTs off California



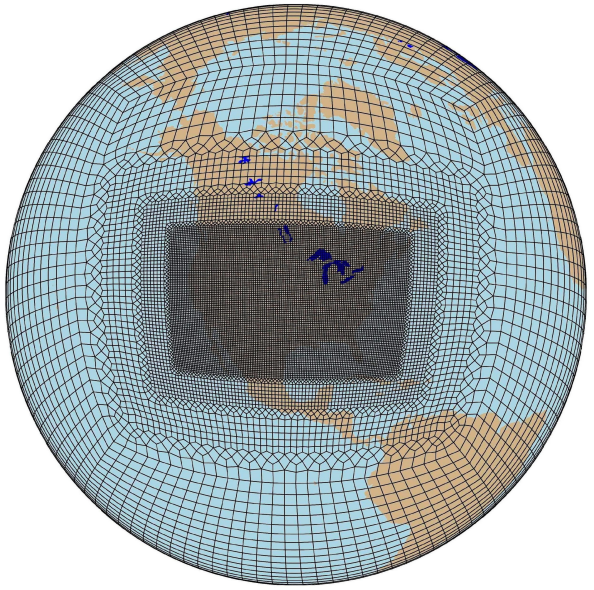


Variable-resolution versions of iCESM



CONUS grid

1º to 0.125º
Prescribed SSTs



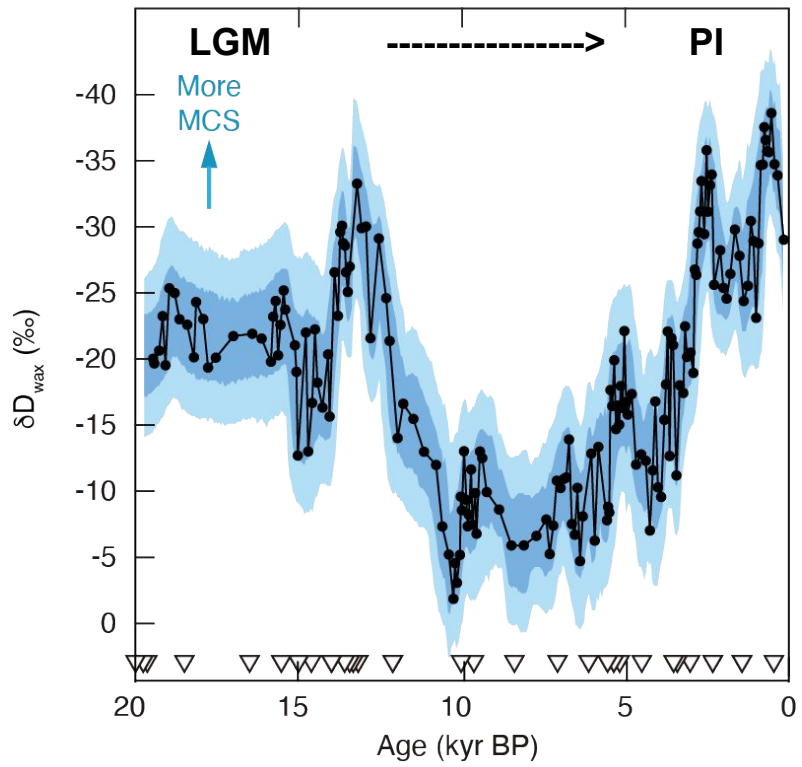
ne0CONUSne30x8_ne0CONUSne30x8_mt12

PaleoWeather Project – Mesoscale Convective Systems

Paleoclimate Data

LGM to present

Records of δDwax at Hall's Cave, Texas interpreted as changes in Mesoscale Convective System (MCS)



Sun et al. (2021), *Nature Geoscience*

Thank you!

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