CVCWG update

June 12th, 2024

Co-Chairs: Isla Simpson (NCAR), Aixue Hu (NCAR), Sarah Larson (NC State)
Liaisons: Adam Phillips (NCAR), Gary Strand (NCAR)

This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.

NCAR COMMUNITY EARTH SYSTEM MODEL CESM

Reminder: place questions/discussion points for the closing session in the slido

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CESM2 large ensemble

Note: not run by the CVCWG

Historical → SSP3-7.0, 1850-2100

100 members

Articles / Volume 12, issue 4 / ESD, 12, 1393–1411, 2021

https://doi.org/10.5194/esd-12-1393-2021

Article | Assets | Peer review

Research article | **Highlight paper** |

Ubiquity of human-induced changes in climate variability

Keith B. Rodgers, Sun-Seon Lee, Nan Rosenbloom, Axel Timmermann, Gokhan Danabasoglu, Clara Deser, Jim Edwards, Ji-Eun Kim, Isla R. Simpson, Karl Stein, Malte F. Stuecker, Ryohei Yamaguchi, Tamás Bódai, Eui-Seok Chung, Lei Huang, Who M. Kim, Jean-François Lamarque, Danica L. Lombardozzi, William R. Wieder, and Stephen G. Yeager

CESM2 single forcing large ensemble

Historical → SSP3-7.0, 1850-2050

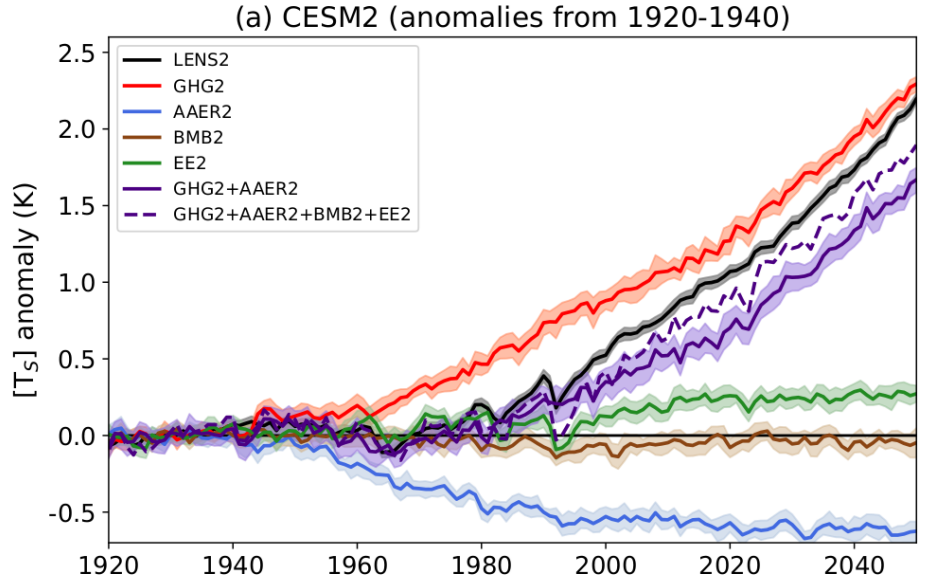
AAER (20 members): only anthropogenic aerosols evolving

GHG (15 members): only greenhouse gases evolving

BMB (15 members): only biomass burning aerosols evolving

EE (15 members): all other forcings evolving

xAER (10 members): everything except anthropogenic aerosols evolving



Simpson et al (2023), J.Clim.

New simulations (since the last summer meeting)

Regionally refined North Atlantic AMIP simulations

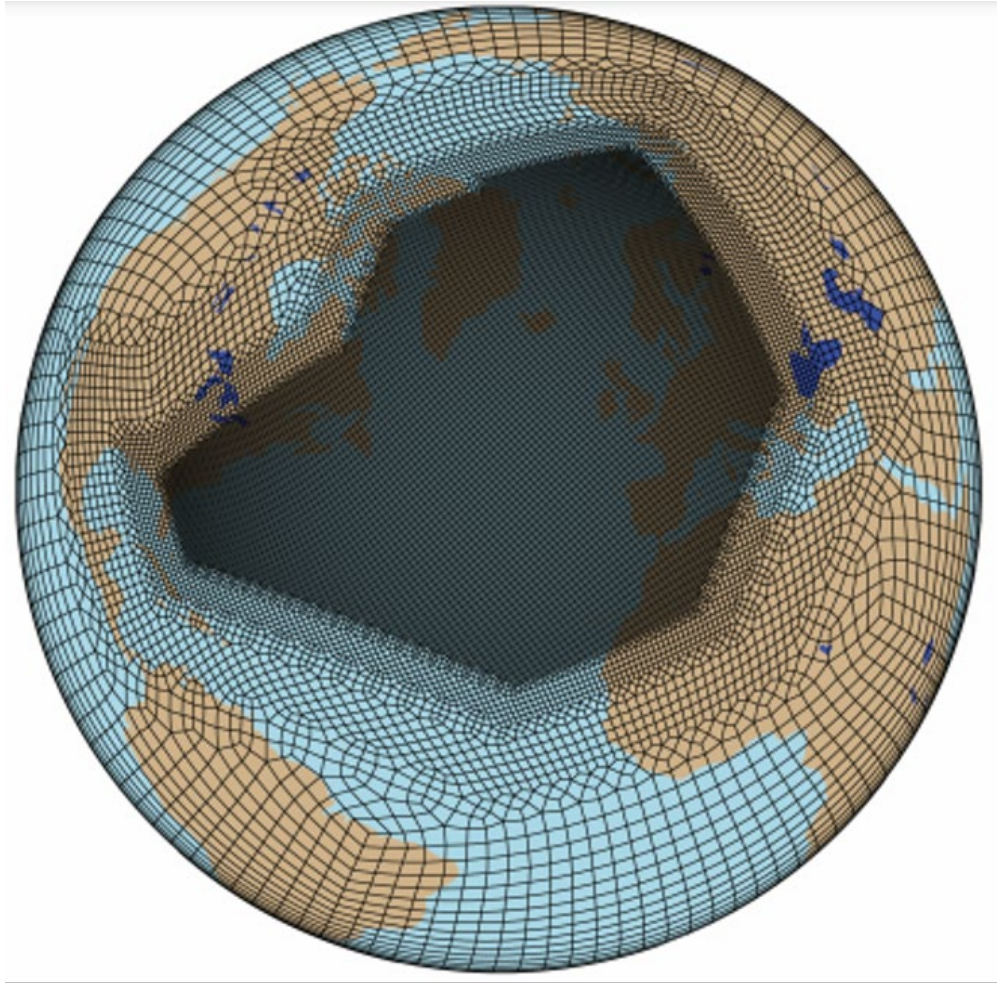
Isla Simpson, Robb Jnglin-Wills, Adam Herrington, and others

- 1958-present day
- CAM-SE (1/8th degree in the North Atlantic)
- Prescribed SSTs from the CESM1 1/10th degree FOSI simulation

Motivation: How does North Atlantic jet stream variability/eddy mean flow feedbacks change at high resolution? Does ocean → atmosphere coupling change at high resolution?

Simulation is completed out to 2014.

Should become available sometime in the coming year



Tropical Belt

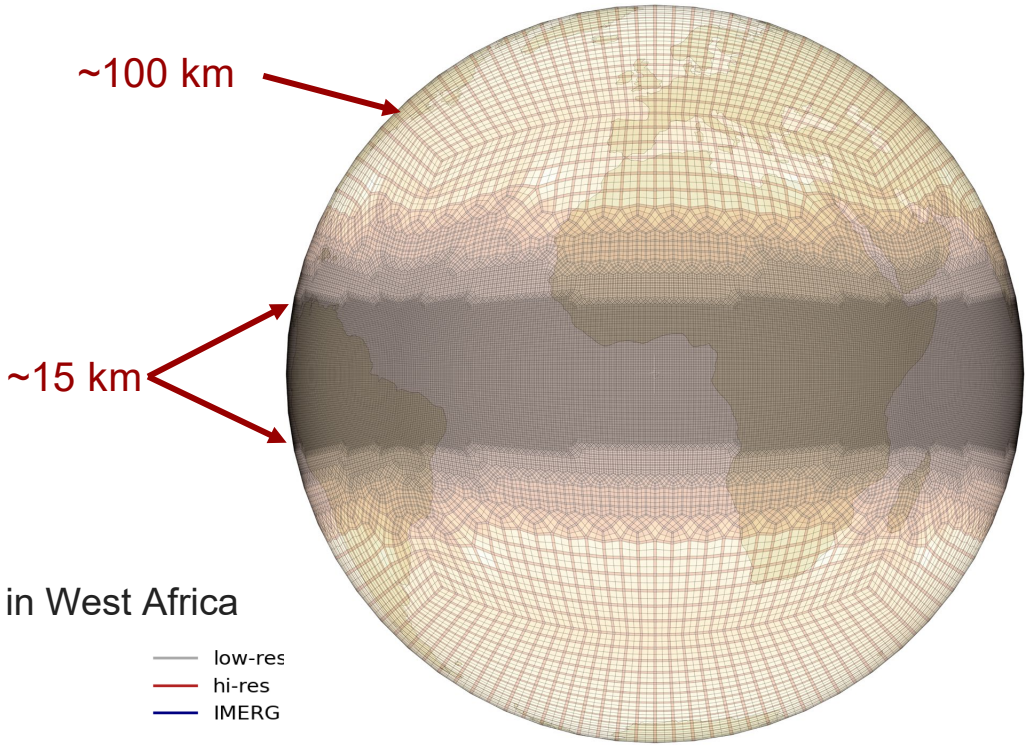
Brian Medeiros

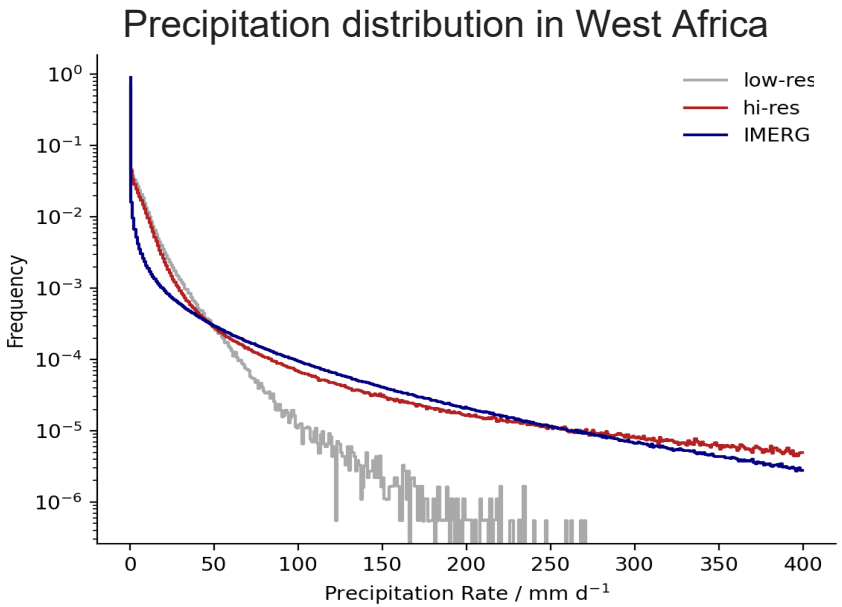
Goal:

- Explore the impacts of enhanced horizontal resolution in the tropics

Setup:

- Regional refinement down to 15 km in the tropics, 100km in extatropics (ne30->ne240)
- Standard CAM6 physics, no re-tuning, 5-minute timestep
- 7-year simulation (F2000, L32), 2-years allowed for spin up
- Limited output because of volume, but designed to describe mean climate, tropical waves, and extremes (including ARs and TCs)
- Data is on glade if there's interest (ask Brian)
- Hoping to follow up with L58, CAM7, and AMIP forcing



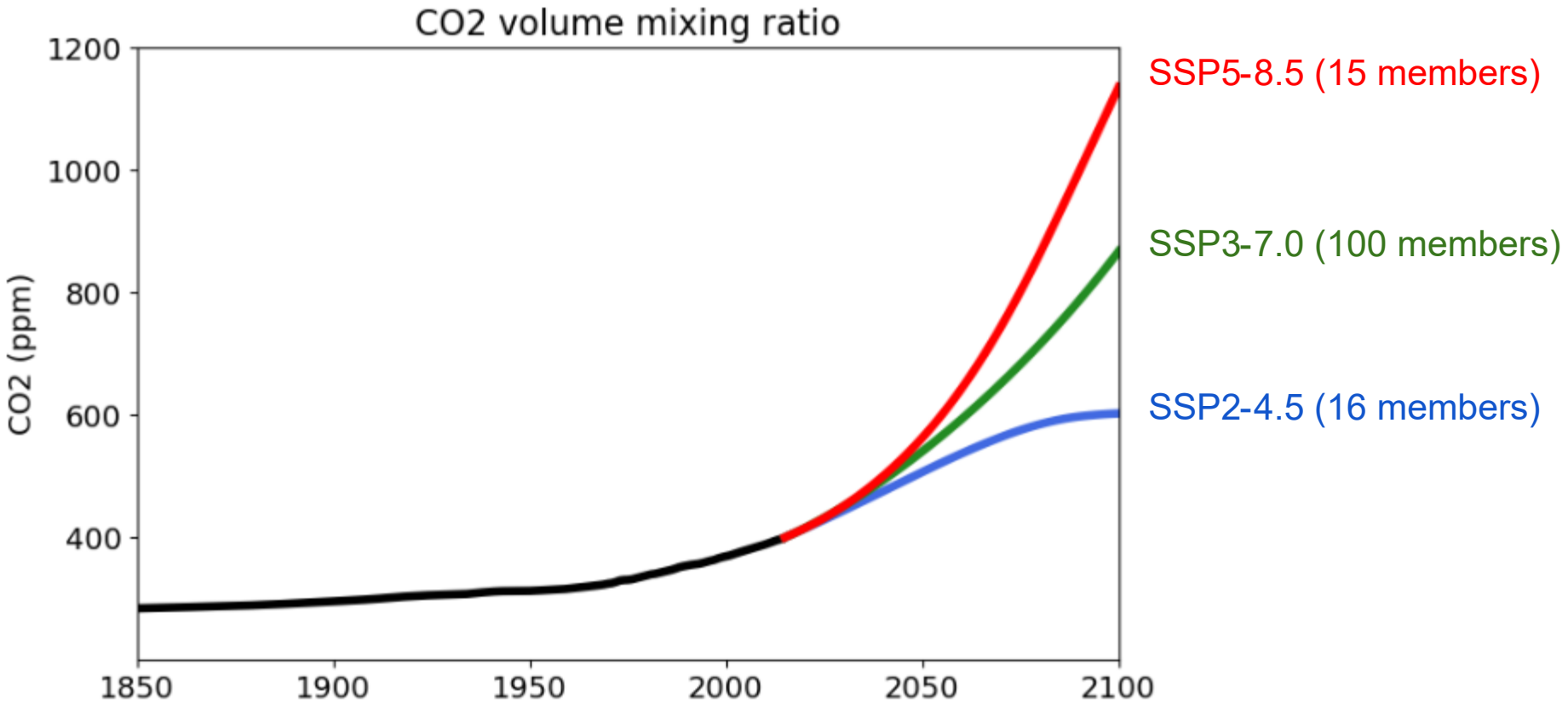


SSP5-8.5 ensemble

Adam Phillips, Nan Rosenbloom

A new 15 member ensemble with the SSP5-8.5 now complements the existing SSP3-7.0 large ensemble and the SSP2-4.5 medium ensemble.

https://www.cesm.ucar.edu/working_-groups/climate/simulations/cesm2_-ssp585



RFMIP simulations

Isla Simpson, Nan Rosenbloom

A 3 member ensemble of the RFMIP “piClim-histall” experiment is available following the protocols of LENS2.

- prescribed climatological SSTs taken from years 401 to 2000 of the CESM2 piControl
- 1850-2014 under CMIP6 historical forcings (with the smoothing of biomass burning emissions in the late 20th/early 21st centuries - the “smbb” forcing of LENS2 (second 50 members)).

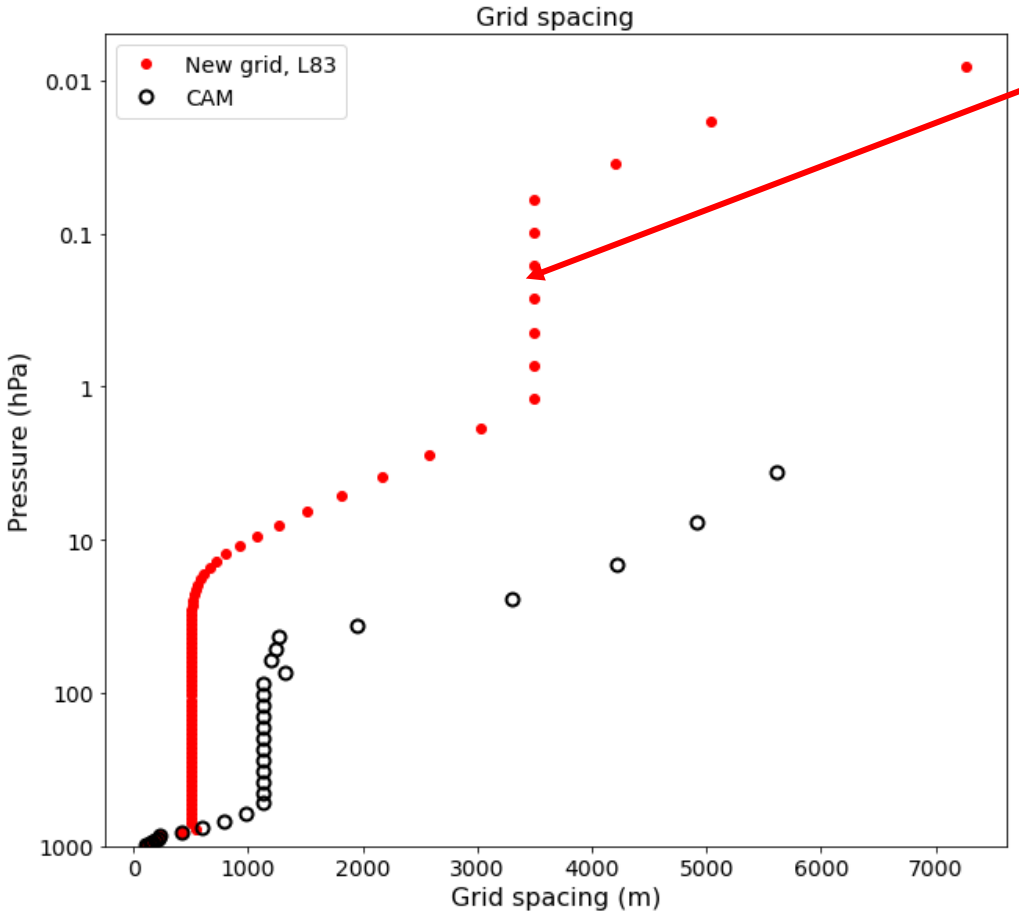
Useful for

a. diagnosing the transient effective radiative forcing
b. examining the direct impact of external forcings more generally

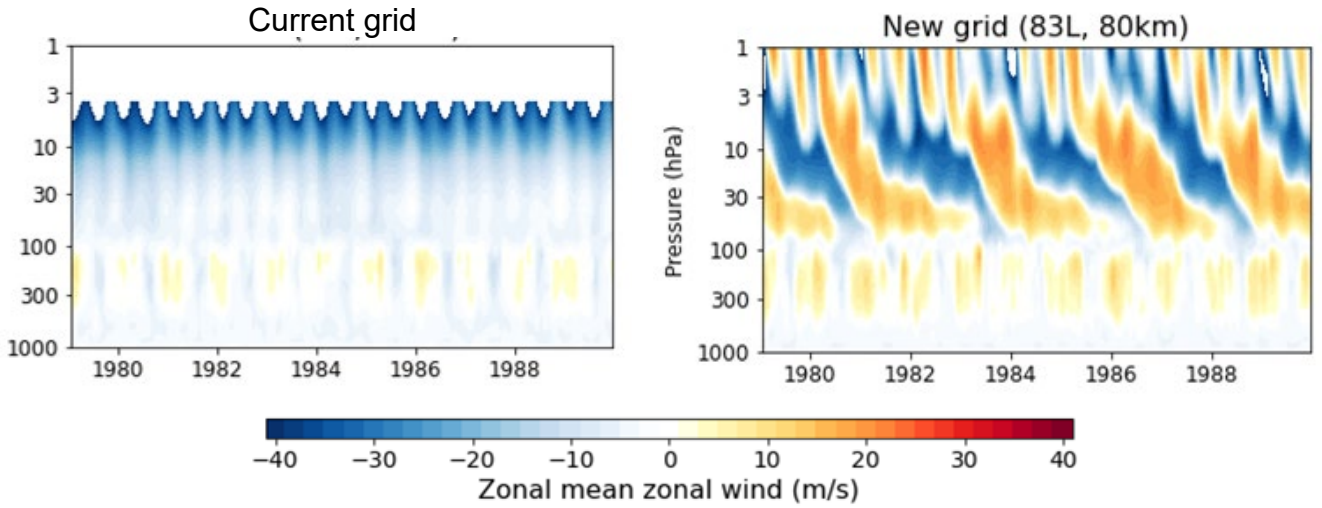
https://www.cesm.ucar.edu/working-groups/climate/simulations/cesm2-rfmip

L83 simulations

Nan Rosenbloom, Isla Simpson



Next generation grid for CAM (excluding additional levels in the boundary layer)



- 100 year piControl
- 3 coupled historical simulations (1850 -2100, historical → SSP3-7.0)
- 3 AMIP simulations (1979-2020)
- Nudged QBO simulations for QBOi

Description paper to be submitted within the next few weeks

CAM6 LIM TOGA

Flavio Lehner, Yan-Ning Kuo, Clara Deser, Adam Phillips, Isla Simpson, Matt Newman, Sang-Ik Shin

Goal:

- Investigate *alternative* historical SST trajectories and their teleconnections

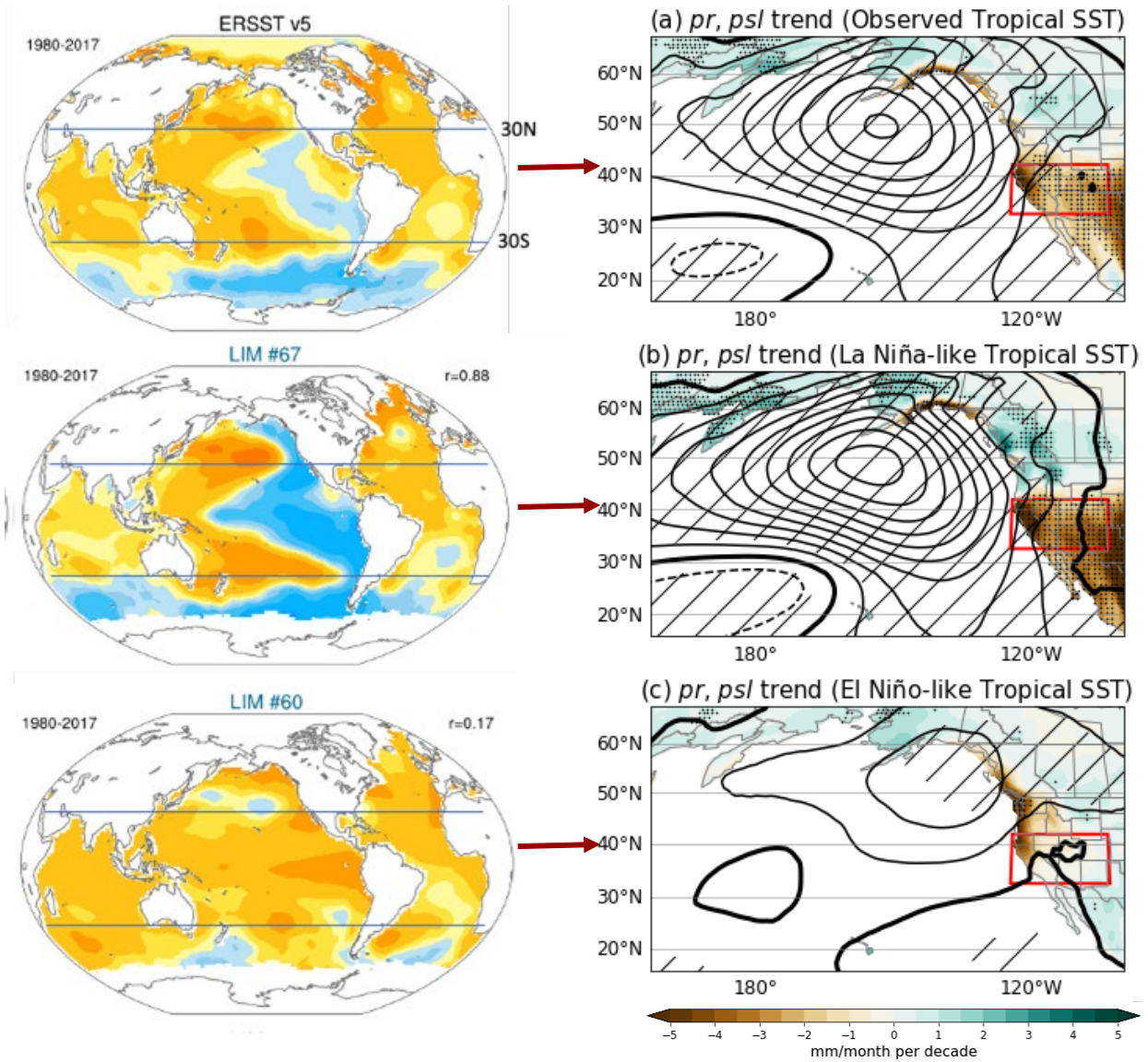
Setup:

- Tropical Ocean Global Atmosphere (TOGA) simulations with CAM6
- SSTs from select realizations of a Linear Inverse Model (LIM) large ensemble trained on ERSSTv5

Existing simulations (time period 1960-2017):

- 10 members w/ observed SSTs
- 10 members w/ La Niña-like SST trend pattern
- 10 members w/ El Niño-like SST trend pattern

Regardless of SST trend pattern, there's still a tendency for a trend toward increased SLP in the North East Pacific and drying of the US Southwest. It's just much weaker without the La Nina-like SST trend

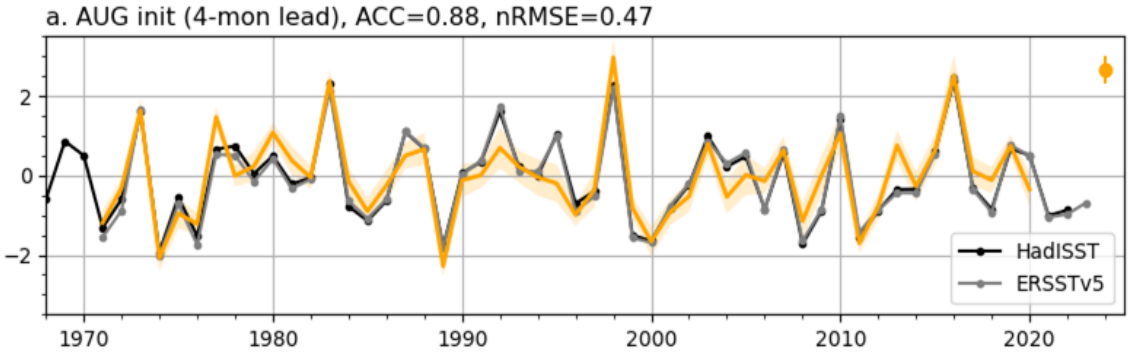


Kuo et al. (in prep.)

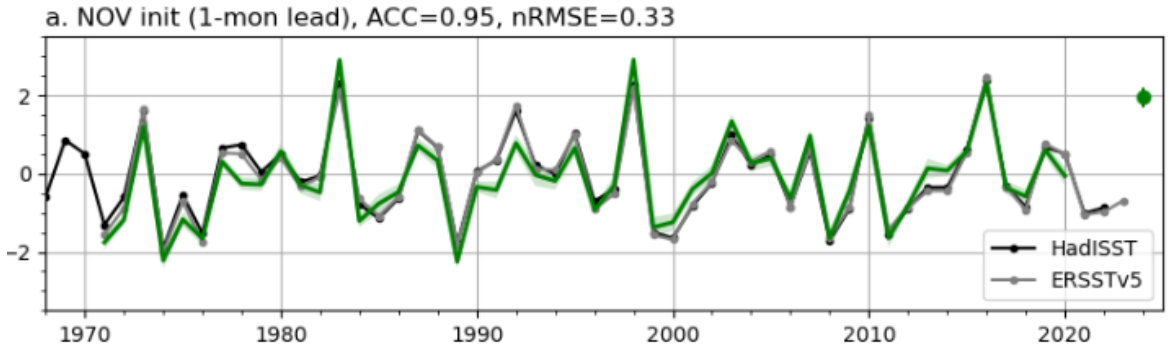
2023/2024 ENSO ensembles

SMYLE predictions of the DJF Nino3.4 index i.e., initialized predictions with CESM2.

Aug initialization



Nov initialization



From Steve Yeager

2023/2024 ENSO ensembles

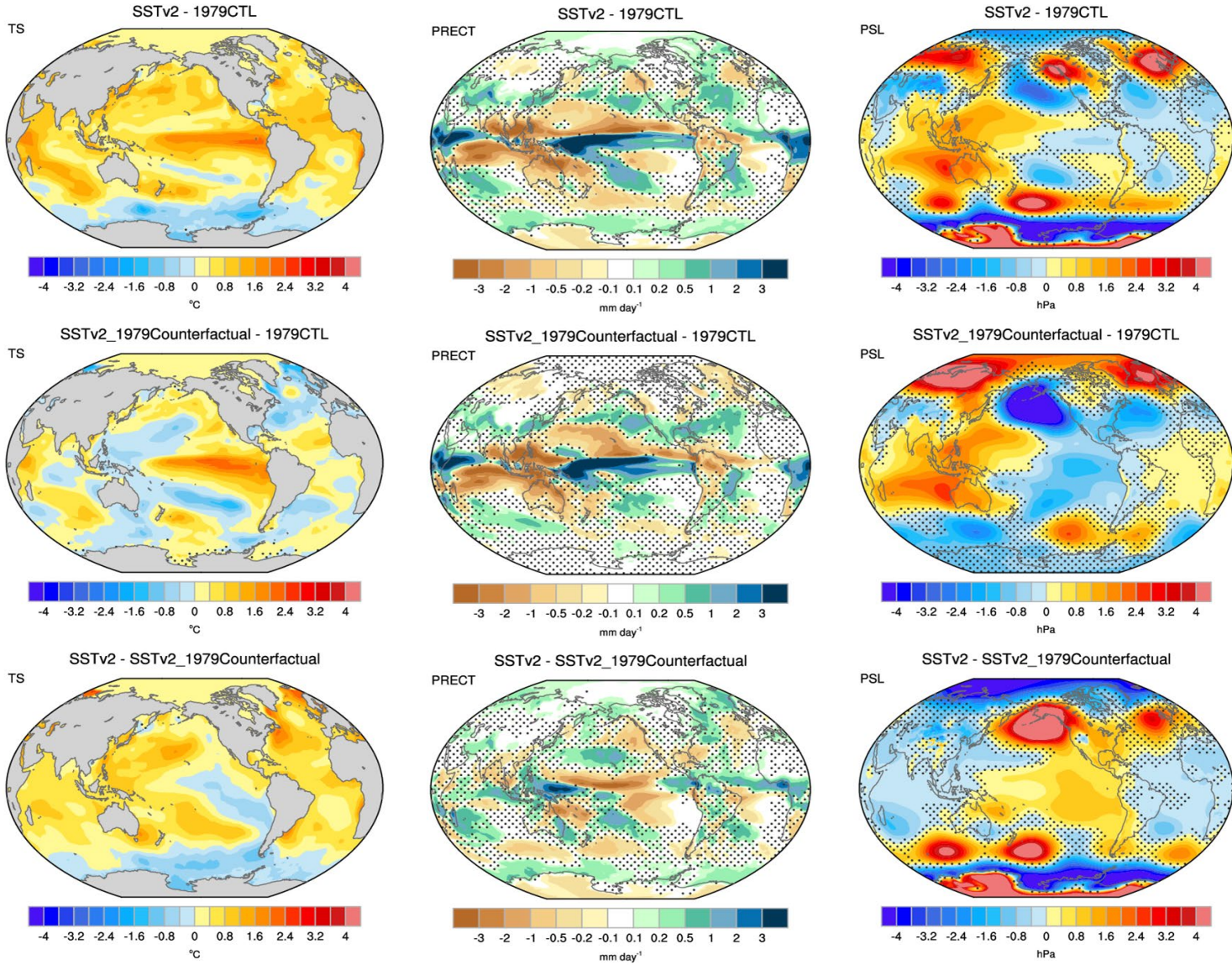
Clara Deser, Steve Yeager, Nan Rosenbloom, Isla Simpson, Adam Phillips, John Fasullo, Pedro DiNezio, Dillon Amaya, Mike Alexander

Goal:

- Investigate impacts of this years El Nino and how those impacts might be affected by long term trends

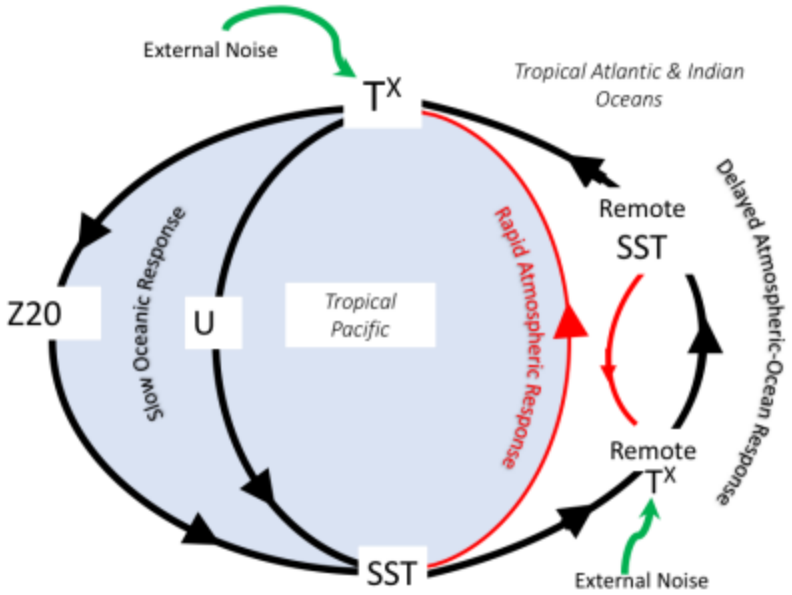
Setup:

- 50 member ensembles
- Prescribed SSTs from SMYLE after bias correction
- Cases in the present day and in a counterfactual (1979) world where SSTs have been detrended and external forcings of 1979 are used



TBI co-EX (For investigating Tropical -Basin Interactions)

Aixue Hu, Steve Yeager, Nan Rosenbloom, Sasha Glanville, Teagan King



Historical pacemaker simulations:

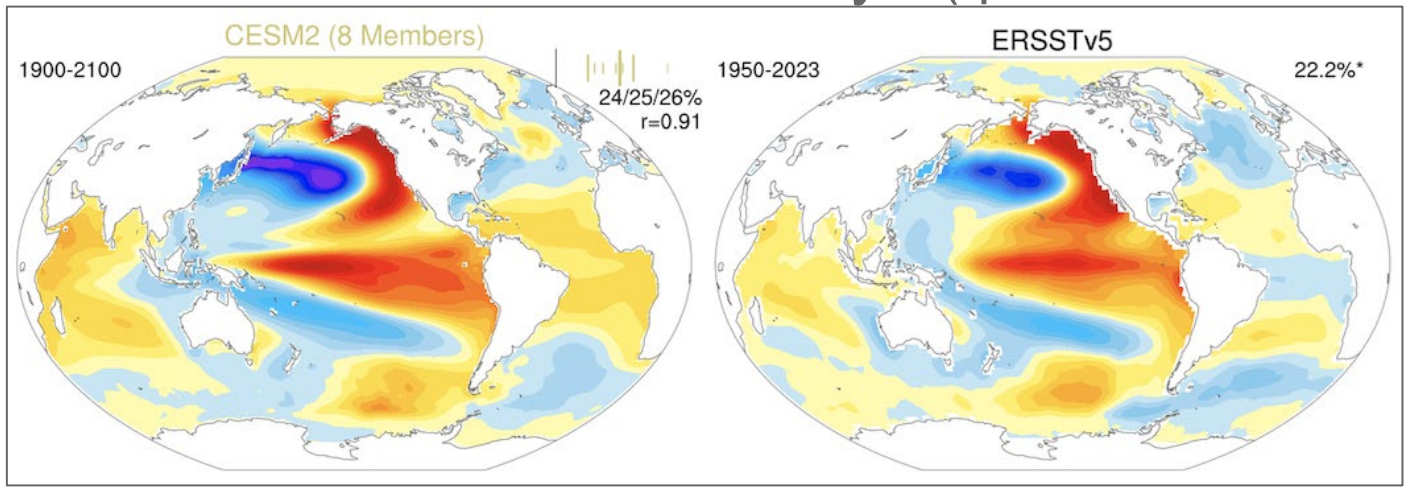
- 10 members from 1850 to 2021
- Relaxation toward observed SST anomalies added onto model climatology
- Pacific, Atlantic, and Indian Ocean simulations
- Pacific ensemble is completed

Similar hindcasts (start years 1978-2014) with pacemaking have been performed by ESPWG

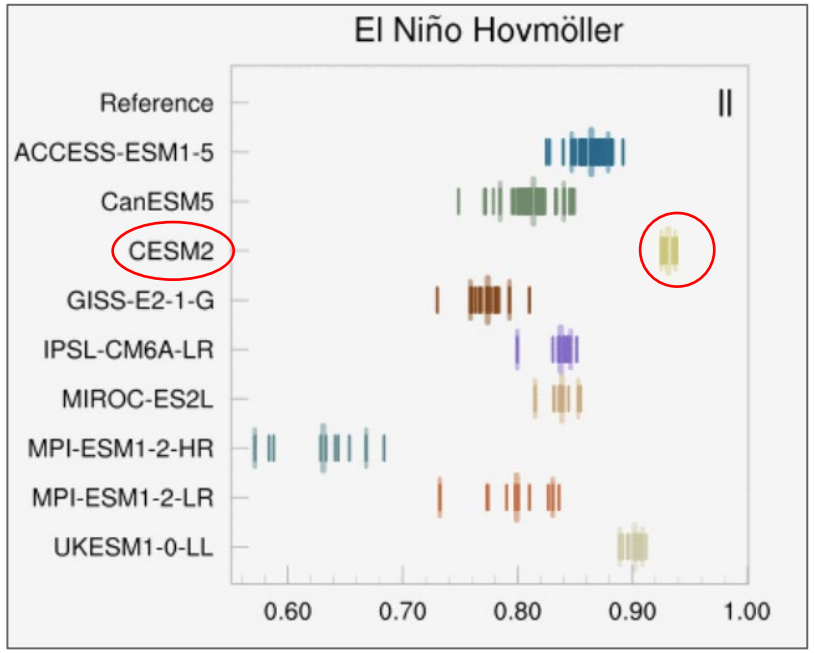
NEW Climate Variability Diagnostics Package (version 6 release)

Automated analysis tool and data repository for assessing modes of variability and trends.

EOF1 Pacific Decadal Variability (quadratic detrending)



Pattern Correlation w/ Obs

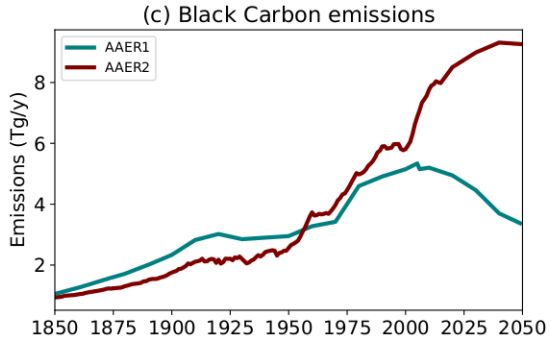


- Combines capabilities of CVDP and CVDP for Large Ensembles (CVDP-LE).
- New detrending options: linear and quadratic, 30-year high-pass filter, remove ensemble mean.
- Reference data can be either observations or model simulations.
- CAM-SE data is regridded automatically.

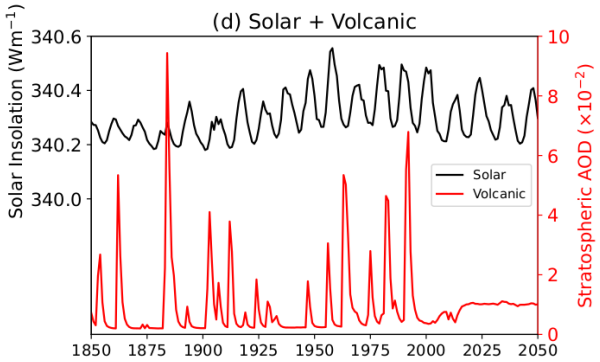
Contact: Adam S. Phillips and Clara Deser (Climate Analysis Section)

Forthcoming Simulations

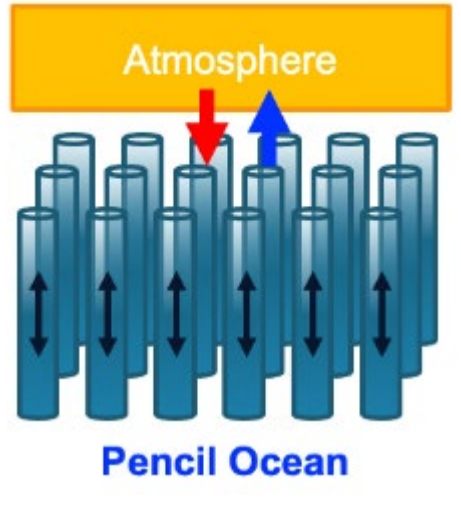
- Aerosol only ensemble with CESM2 with CMIP5 aerosol emissions.
  - *Needs some work to figure out the forcings*
    CMIP6 piCtrl + (CMIP5 historical - CMIP5 piCtrl)



- Volcanoes only ensemble



- Pencil model piControl (Young-Oh Kwon)
  - *Pencil model might be close to being ready, in which case a piControl simulation with that can be started.*



Questions? Discussion?

Please be thinking about what simulations you would like to see the working group perform in the next allocation cycle. We'll be discussing this at the end of the session.

https://www.cesm.ucar.edu/working -groups/climate

What would you like to see the working group do in the next allocation?

Baseline simulations with CESM3? (AMIP ensemble, TOGA, pacemaker?)

Build on high resolution CESM1 efforts e.g., contribute to building out the hierarchy of mixing and matching ocean and atmosphere high resolution?

More regionally refined work?