

CVCWG update

Feb 4th, 2025

Co-Chairs: Isla Simpson (NCAR), Aixue Hu (NCAR), Sarah Larson (NC State)

Liaisons: Adam Phillips (NCAR), Gary Strand (NCAR)



Climate Variability and Change Working Group Webpages

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



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Our Simulations

Recent / Notable

- [CESM2 Large Ensemble Project](#)
- [CESM2 83-level simulations](#)
- [CESM2 Single Forcing Large Ensemble Project](#)
- [CESM2 SSP5-8.5 Ensemble](#)
- [CESM2 SSP2-4.5 Ensemble](#)
- [CESM2 RFMIP simulations \(complementary to the CESM2 large ensemble\)](#)
- [CESM2 Tropical Pacific Pacemaker Ensemble](#)
- [CAM6 Pre-industrial Controls](#)
- [CAM6 Prescribed SST Ensembles \(forced with ERSSTv5\)](#)
- [CAM5 Prescribed SST Ensembles \(forced with ERSSTv3b, ERSSTv4 and ERSSTv5\)](#)
- [CESM1.1 Large Ensemble Project](#)
- [CESM1.1 Medium Ensemble](#)
- [CESM1.1 Single Forcing Large Ensemble Project](#)
- [CESM1.1 Tropical Pacific Pacemaker Ensemble](#)
- [CESM1.1 North Atlantic Pacemaker Ensemble](#)
- [CESM1.1 Indian Ocean Pacemaker Ensemble](#)

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Data Acquisition

This data is available on both the NCAR Climate Data Gateway (Web Access) and NCAR's casper system (NCAR Internal).

• NCAR Internal

Location on NCAR's campaign store or on the NCAR machine casper:

`/glade/campaign/cesm/collections/CESM2-SF/timeseries/`

• Web Access

The following are step by step directions on how to download this data from the Climate Data Gateway.

1. Proceed to the [CESM2 Single Forcing Large Ensemble Project](#) page.
2. Scroll to the bottom of that page under *Child Datasets*, and click on the component and time frequency you are interested in.
3. The files are organized by variable, listed at the end of each link. Click on the variable you are interested in.
4. Click on the Download Options button. At this point, if you have not logged into the Climate Data Gateway you can do so now. If you have not registered before, registration is free and quick.

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[Prescribed SST Ensembles \(forced with ERSSTv5\)](#)

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[.1 Large Ensemble Project](#)

[.1 Medium Ensemble](#)

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[.1 Tropical Pacific Pacemaker Ensemble](#)

[.1 North Atlantic Pacemaker Ensemble](#)

[.1 Indian Ocean Pacemaker Ensemble](#)

CESM2 large ensemble

CESM2 single forcing large ensemble

Note: not run by the CVCWG

Historical → SSP3-7.0, 1850-2100

100 members

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

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

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

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Article

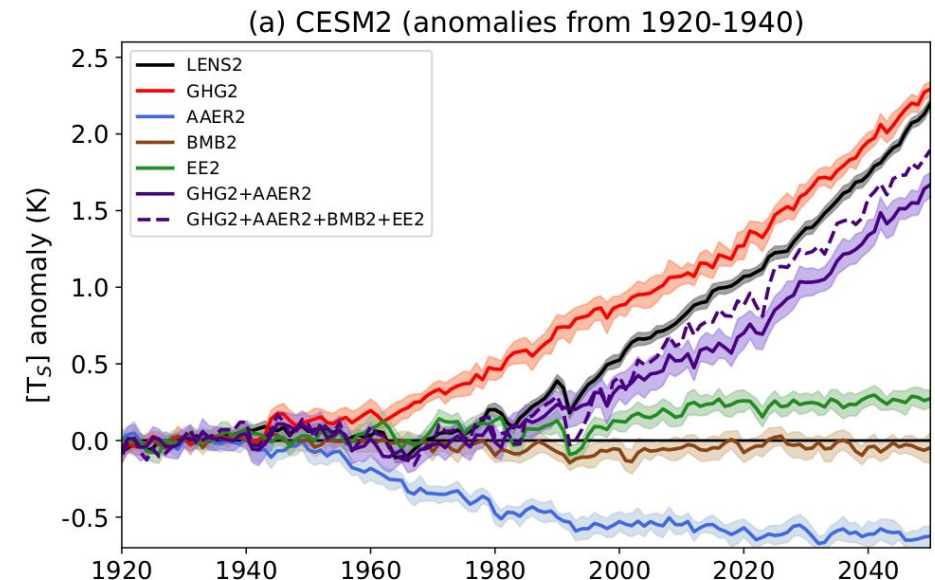
Assets

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 Bódi, Eui-Seok Chung, Lei Huang, Who M. Kim, Jean-François Lamarque, Danica L. Lombardozzi, William R. Wieder, and Stephen G. Yeager

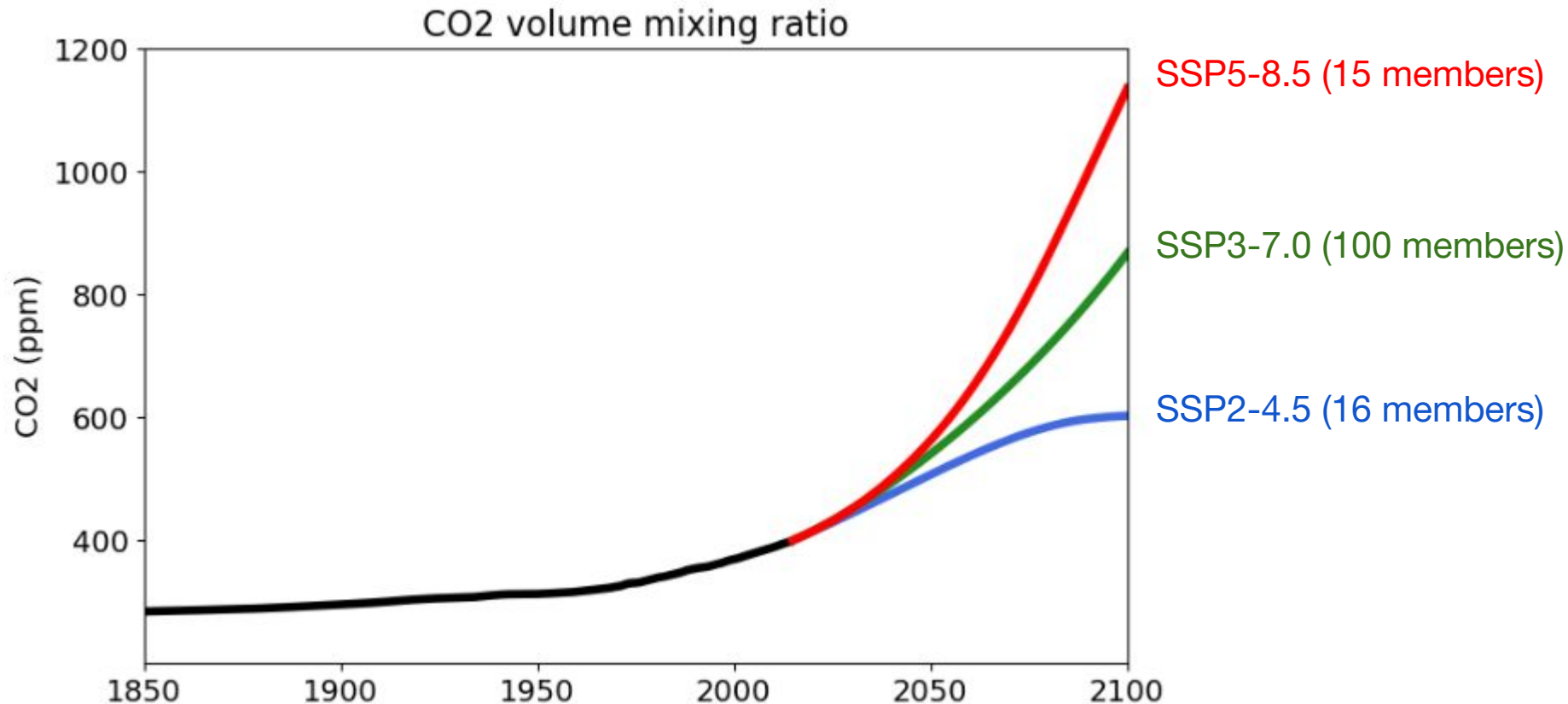


SSP5-8.5 ensemble

Adam Phillips, Nan Rosenbloom

A 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)).

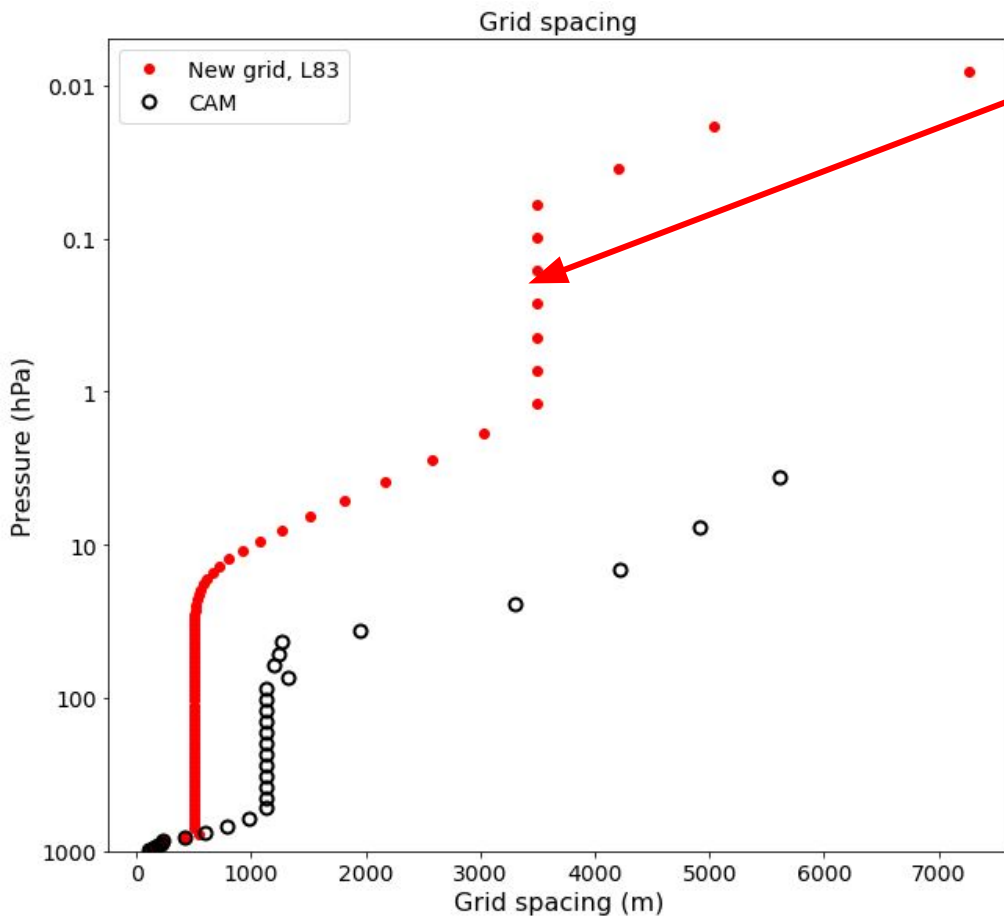
Useful for

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

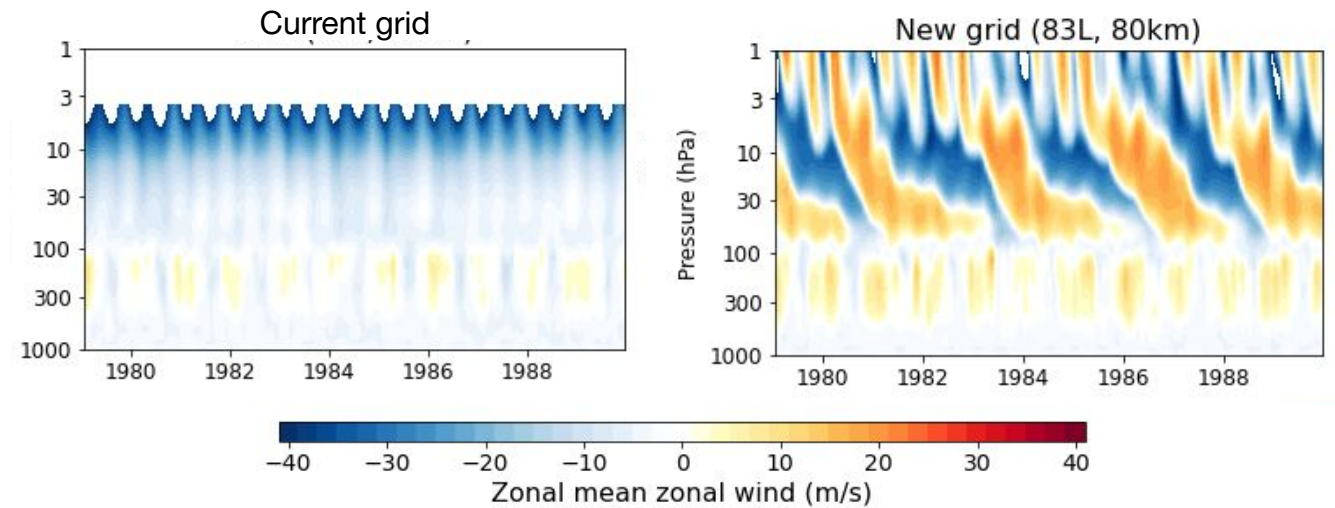
<https://www.cesm.ucar.edu/working-groups/climate/simulations/cesm2-rfmip>

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

Described in Simpson et al, submitted to JAMES

Simulations currently being worked on

Regionally refined North Atlantic AMIP simulations with CESM2

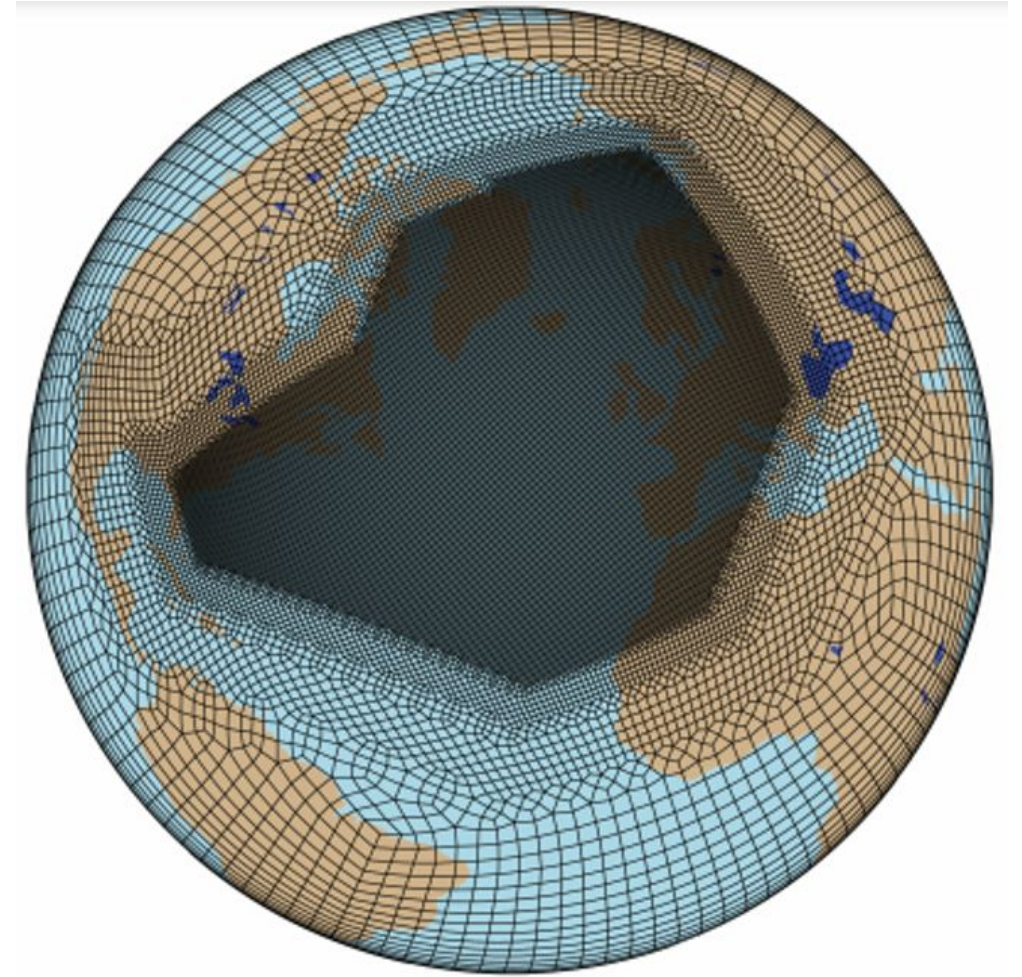
Isla Simpson, Robb Jnglin-Wills, Adam Herrington, and others

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

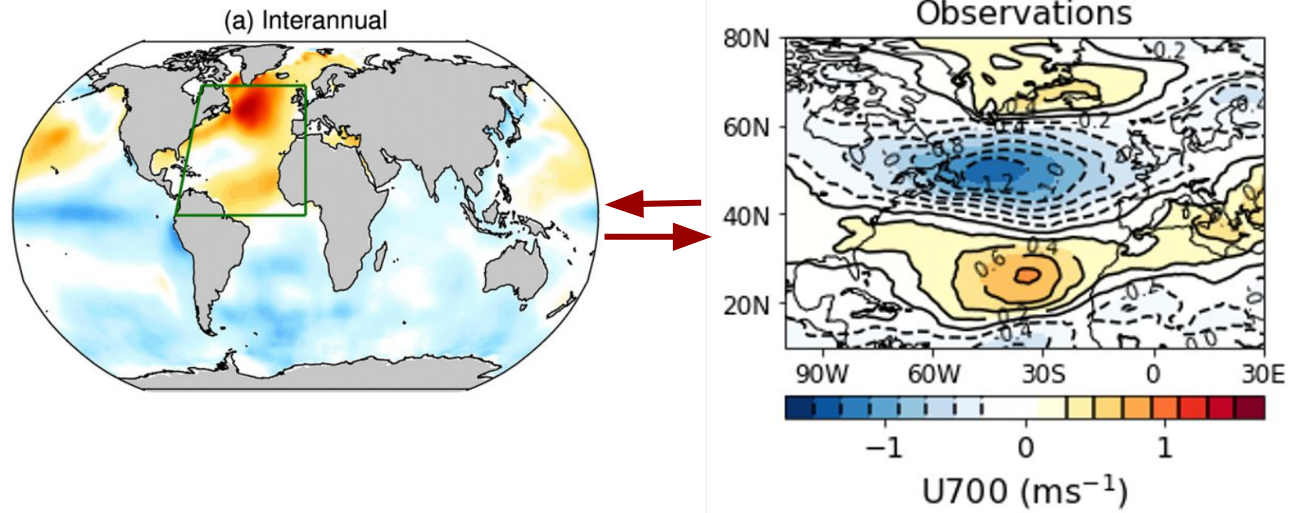
Motivation: How does North Atlantic jet stream variability/eddy mean flow feedbacks change at high resolution? Does ocean → atmosphere coupling change at high resolution?

Simulation is completed out to 2014.

Should become available sometime in the coming year

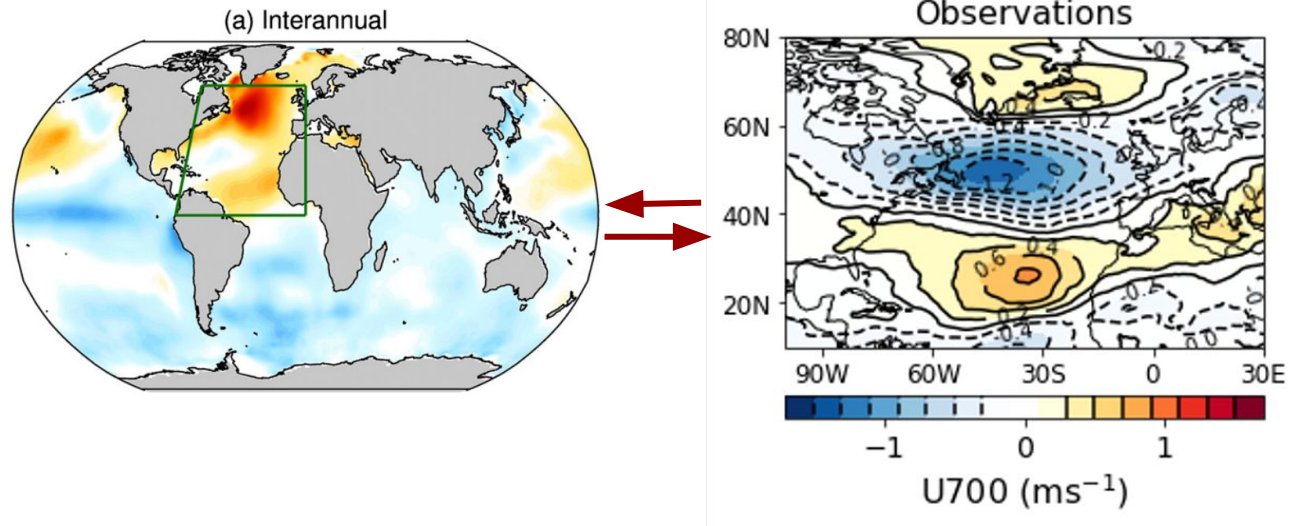


Interannual regression of zonal wind on to the AMV

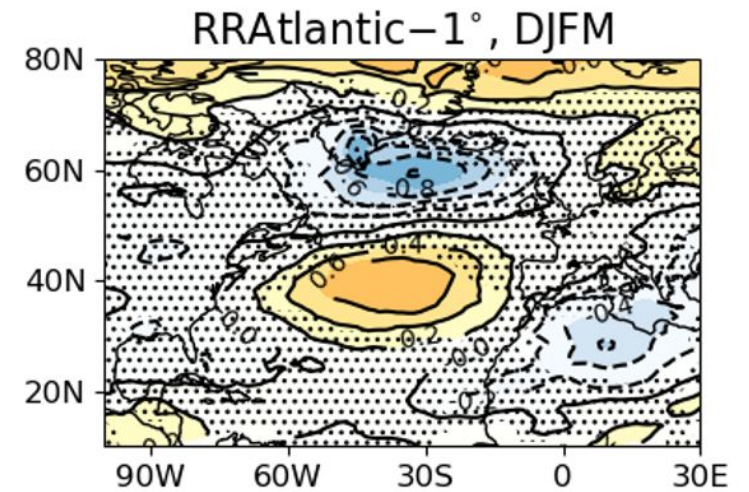
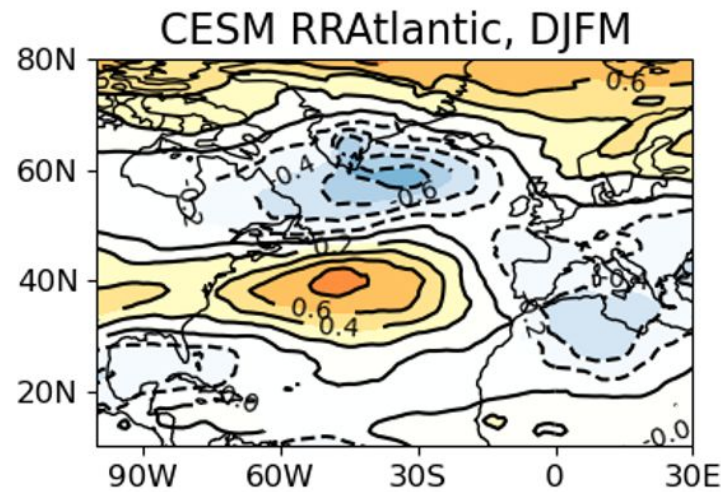
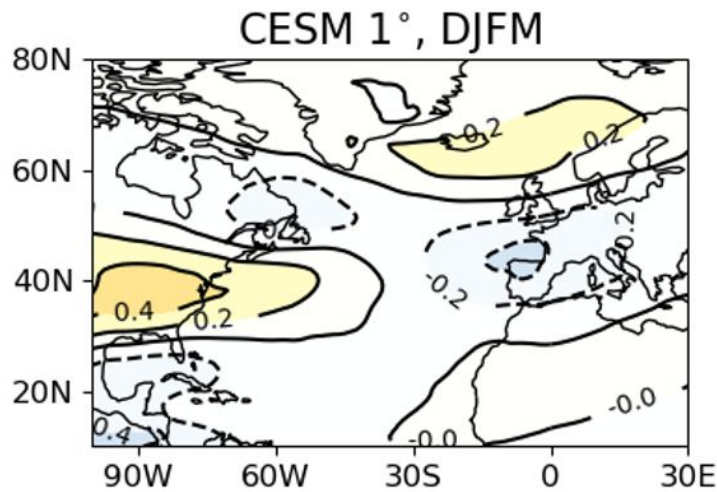


Regression of DJFM 700 hPa zonal wind onto the AMV

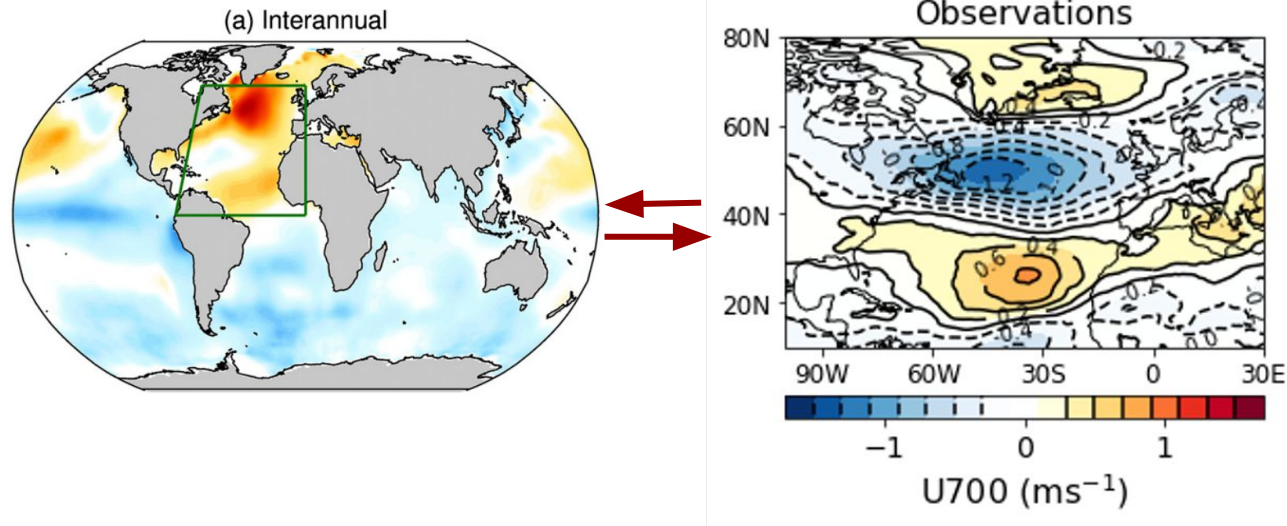
Interannual regression of zonal wind on to the AMV



Regression of DJFM 700 hPa zonal wind onto the AMV



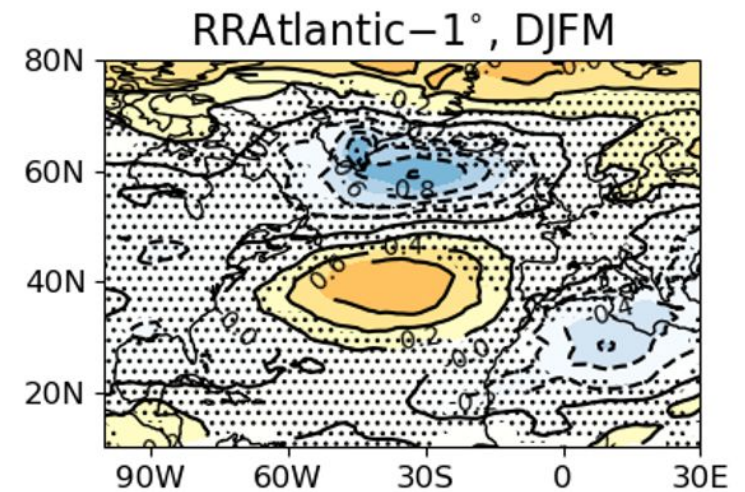
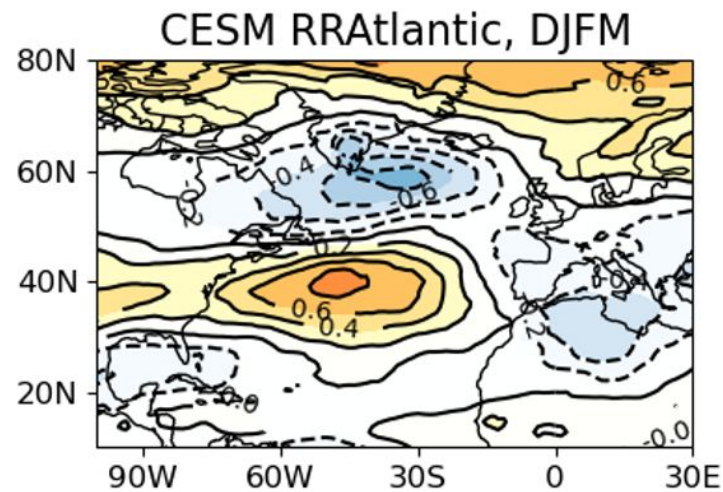
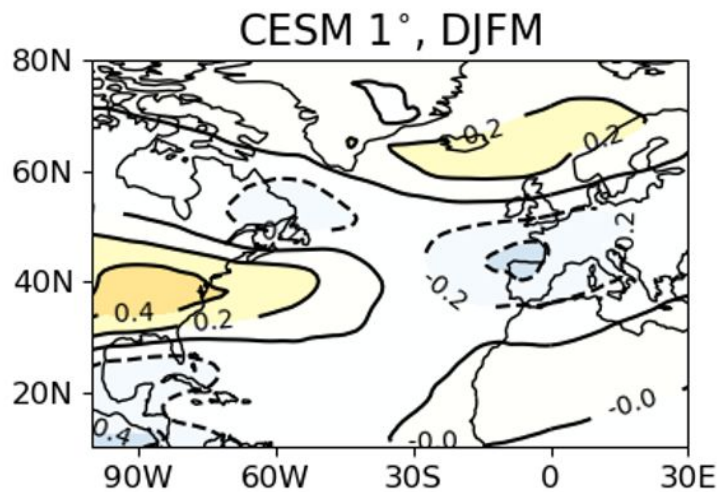
Interannual regression of zonal wind on to the AMV



Regression of DJFM 700 hPa zonal wind onto the AMV

Next Steps:

- Understand this difference
- Run with low resolution SSTs
- Run with SSTs from decadal predictions i.e., SST variability caused by the ocean circulation



Tropical Belt

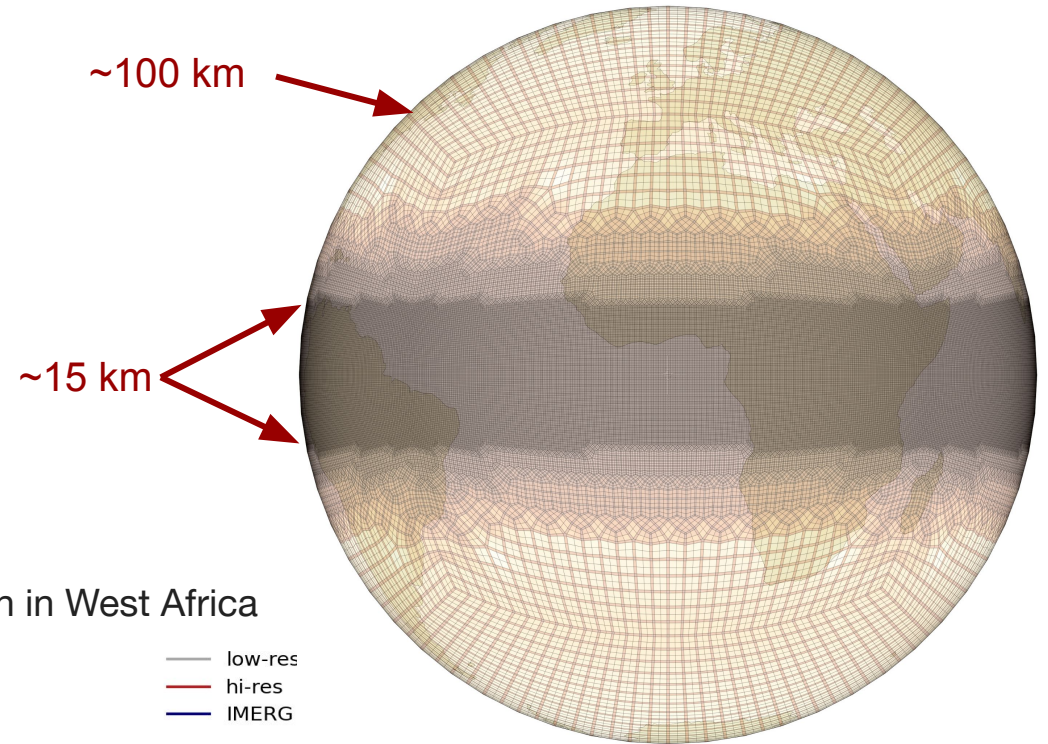
Brian Medeiros

Goal:

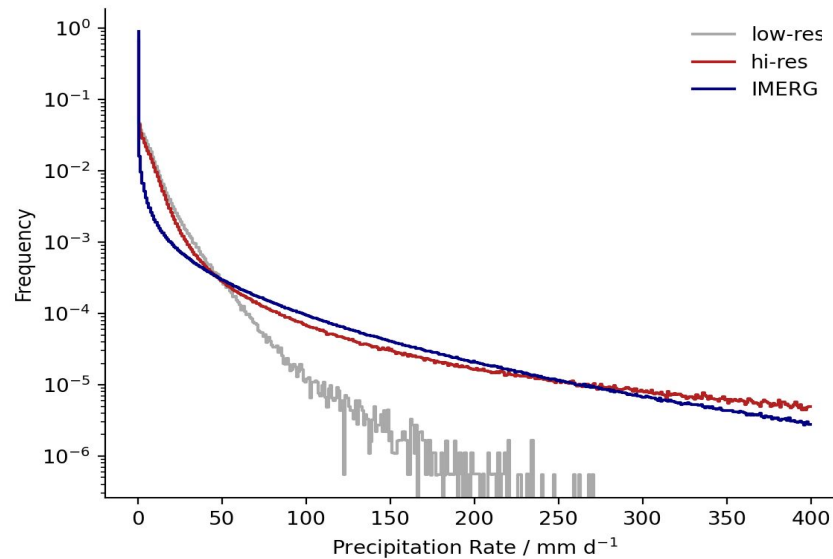
- Explore the impacts of enhanced horizontal resolution in the tropics

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



Precipitation distribution in West Africa

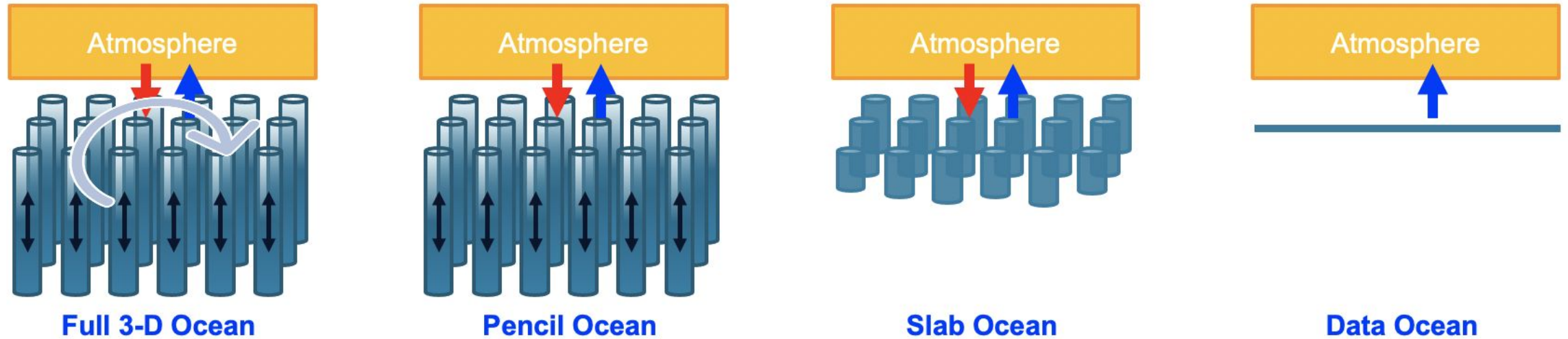


Pencil Model Simulations

Young-Oh Kwon's Group, Gokhan Danabasoglu, and others

A long pre-industrial control simulation with CESM2 with the pencil model is about to begin!

Choices for the ocean model in CESM

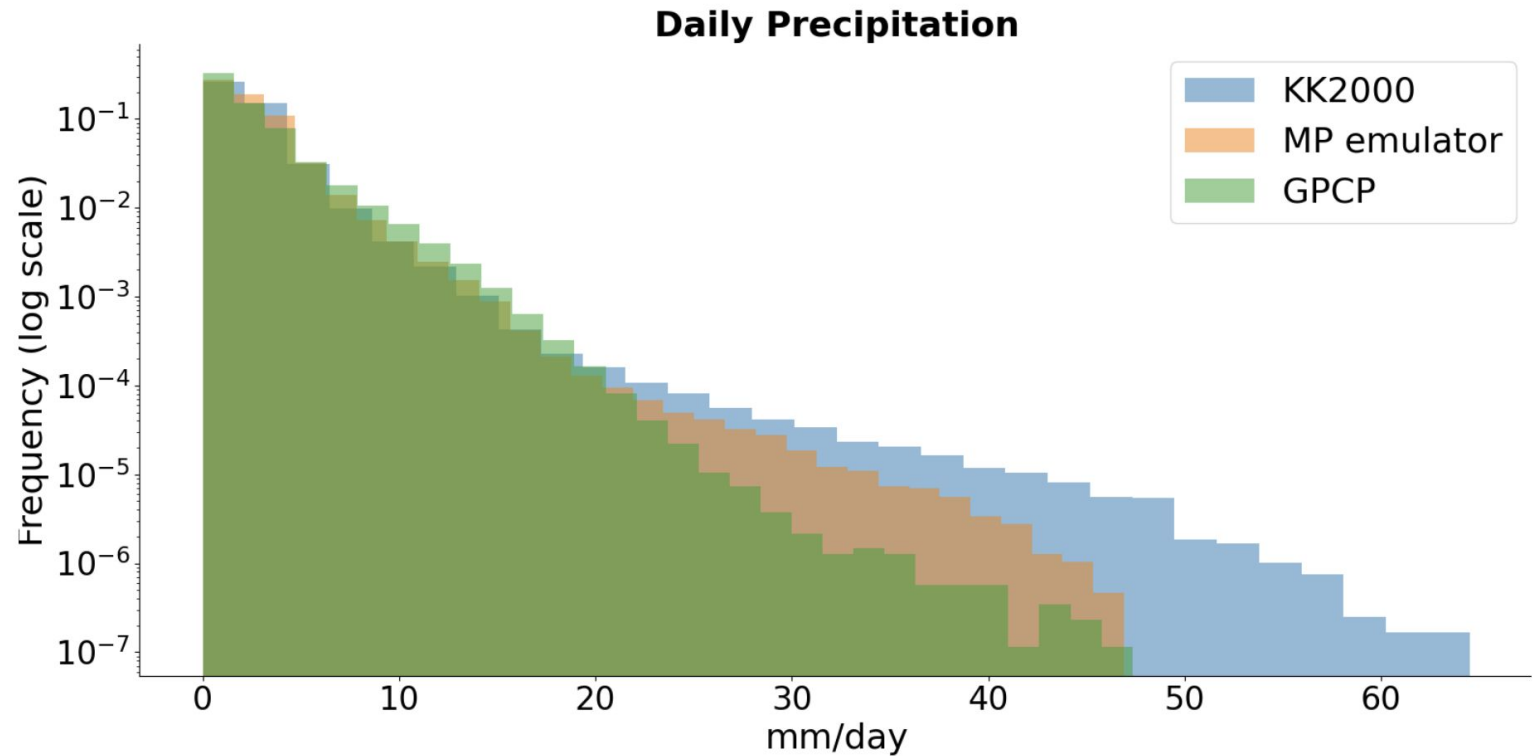


Single column ocean model at each grid point → representation of mixed layer physics, prognostic mixed layer depth etc

PPE work

Addisu Semie, Brian Medeiros

Exploring impacts of parameter perturbations on microphysical processes and the use of a microphysics emulator for warm rain processes.



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

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

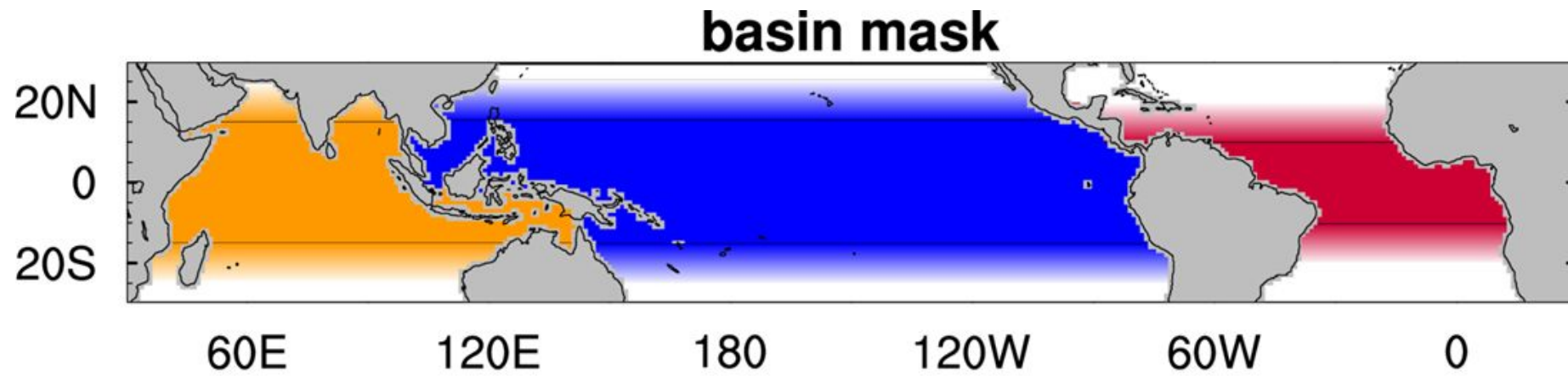
Historical: 1850-2021 (CVCWG); Hindcasts (start years 1978-2021) (ESPWG)

Tier 1: anomaly restoring; a. standard pacemaker

b. pacemaker hindcast

Tier 2: full field restoring; a. standard pacemaker

b. pacemaker hindcast



Richter et al., GMD, 2025

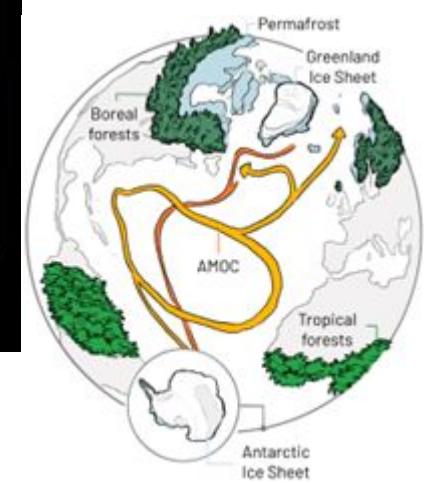
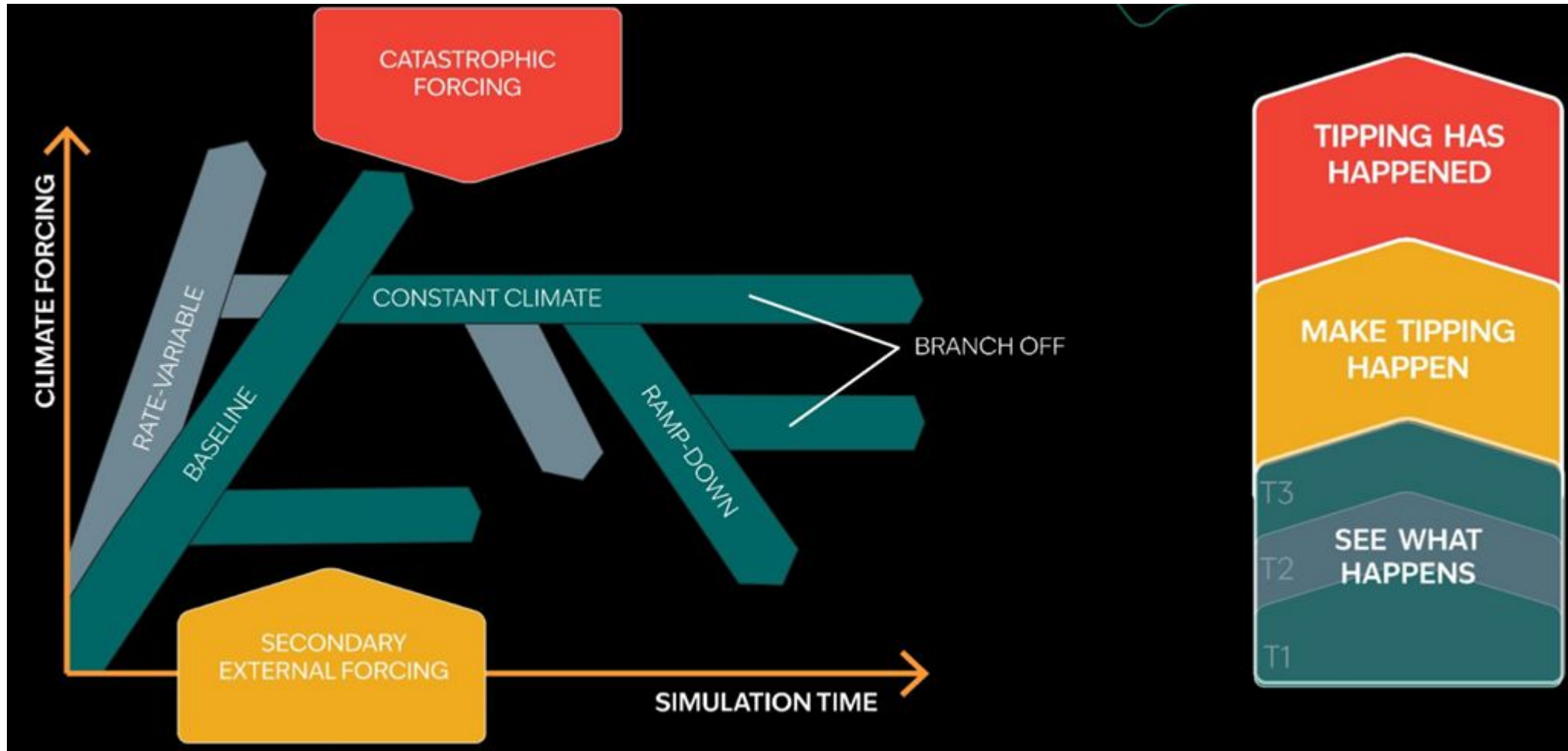
TBI co-EX (For investigating Tropical-Basin Interactions)

Current status of TBI co-EX:

Model	Center	Type of experiment	Status
CESM2	US NSF NCAR	pmaker hindcast	completed
CESM2	US NSF NCAR	standard pmaker	completed
CESM2	SCSIO, China	Tier 2 expmnts	completed
NorCPM	U. of Bergen	hindcast+standard	completed
SINTEX-F2	JAMSTEC	pmaker hindcast	completed
MIROC6	JAMSTEC, University of Tokyo/NIES	hindcast+standard	ongoing
ACCESS-CM2	CSIRO, Australia	standard pmaker	in preparation
IPSL-CM6A-LR	IPSL, France	standard pmaker	completed

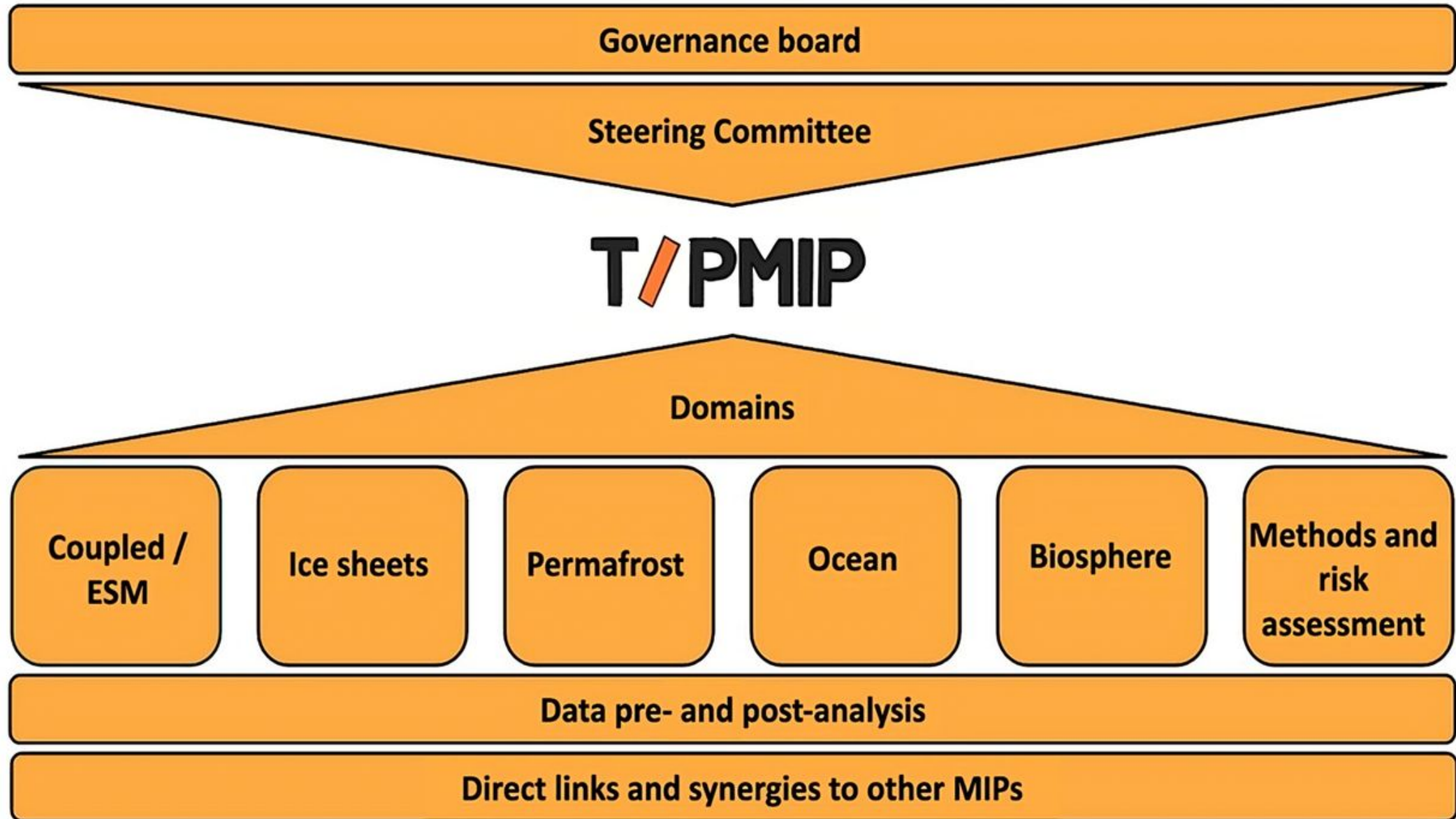
Tipping point model intercomparison project (T/PMIP)

International program office: Potsdam Institute for Climate Impact Research



Winkelmann et al., 2025

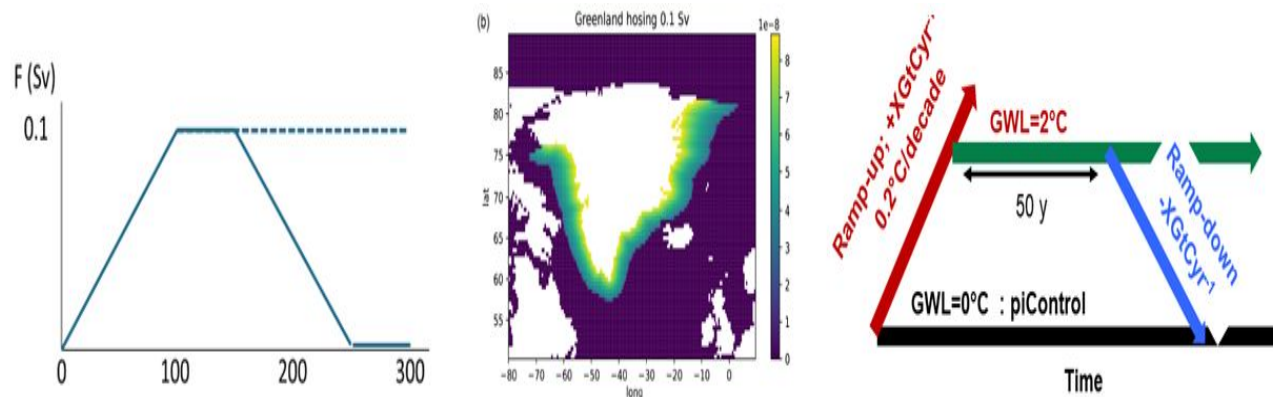
TIPMIP governing structure



TIPMIP Ocean domain experiments

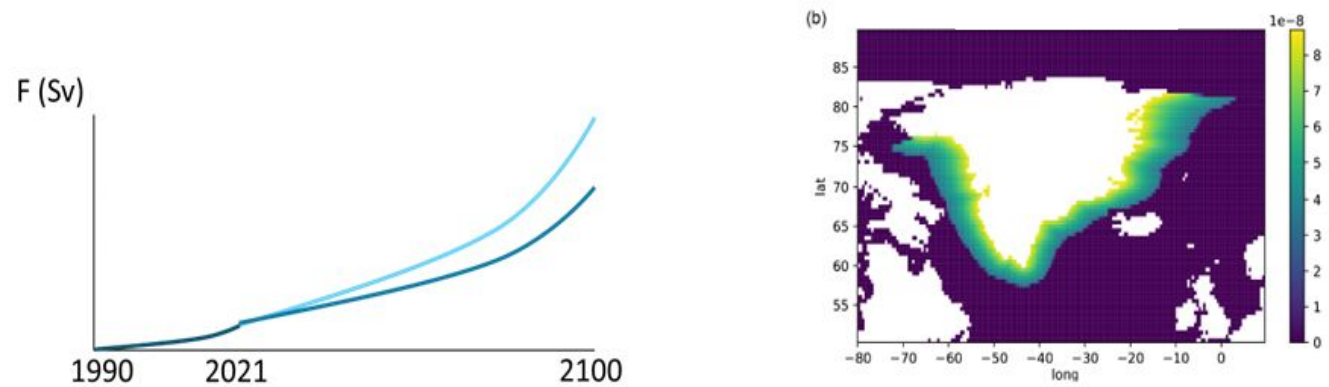
A. TipMIP-AMOC

How does the combination of warming and Greenland freshwater input impact the AMOC and its recovery?



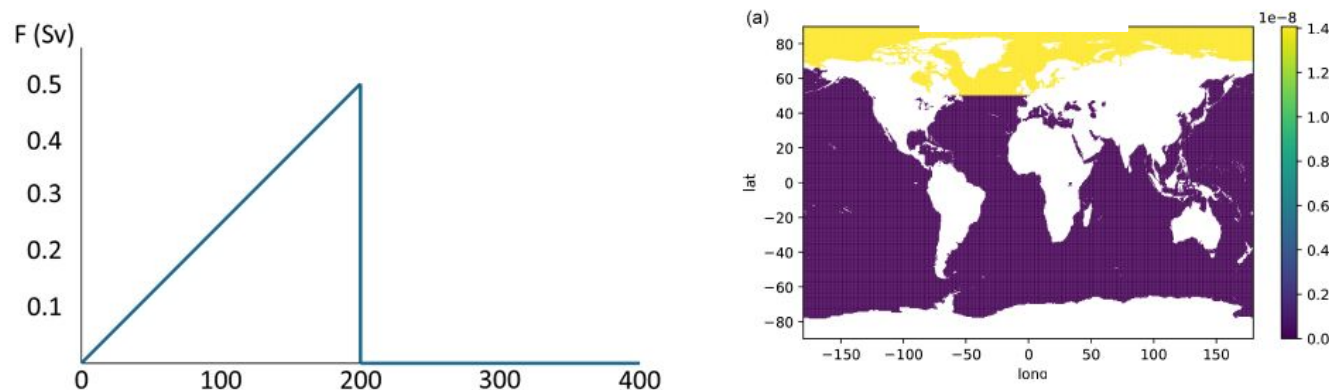
B. Greenland freshwater experiments

How did/will the AMOC respond to realistic and projected sources of Greenland freshwater?



C. Freshwater ramp-up/off

Where is the stability threshold of the AMOC with respect to North Atlantic freshwater forcing?

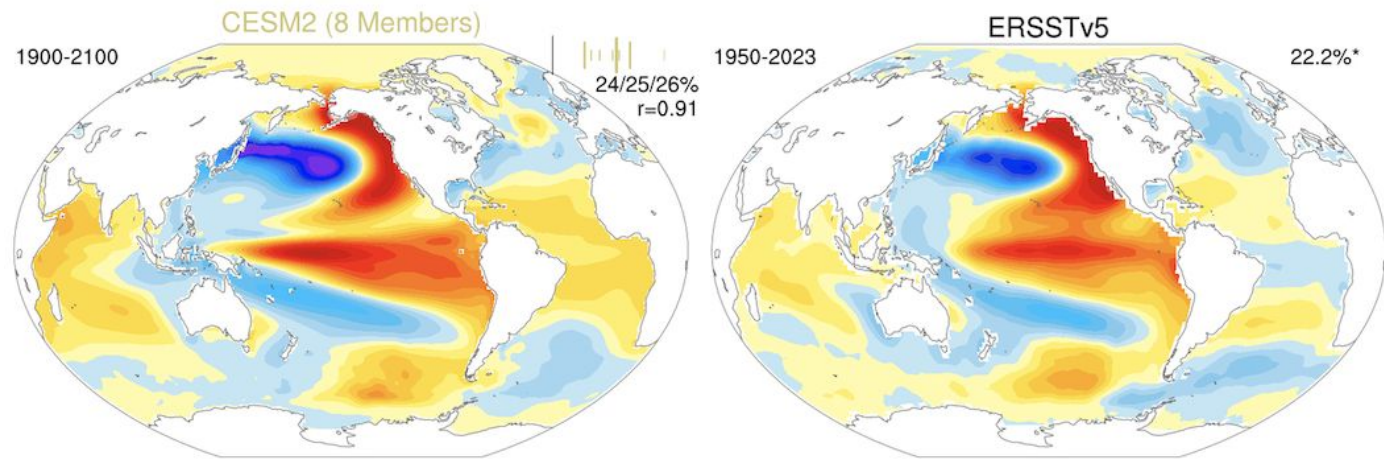


Diagnostics and other datasets

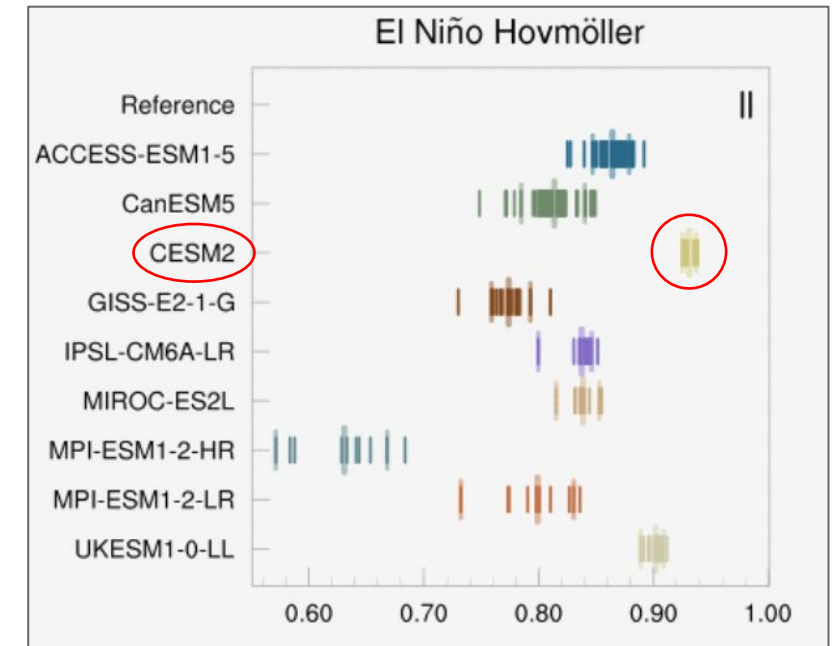
NEW-ish Climate Variability Diagnostics Package (version 6 release)

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

EOF1 Pacific Decadal Variability (quadratic detrending)



Pattern Correlation w/ Obs



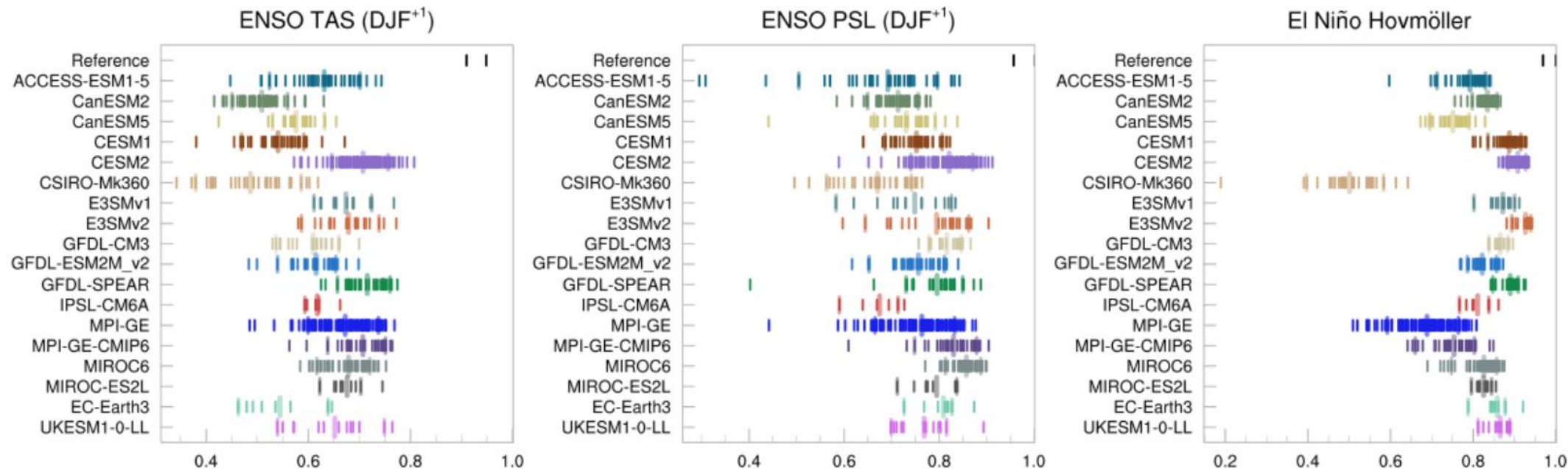
- New detrending options: linear and quadratic, 30-year high-pass filter, remove ensemble mean
- Reference data can be either observations or model simulations.
- CAM-SE data is regridded automatically.
- <https://www.cesm.ucar.edu/projects/cvdp>
- Aiming for a python version by the end of this year

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

NEW Multi Model Large Ensemble Archive v2

Updated large ensemble archive with 18 models, 15 2D variables, all on a consistent grid

Pattern Correlation w/ Obs



- We have applied the CVDPv6 to the entire archive
- Links to the CVDPv6 analysis and data on casper and the RDA will be available early Feb
- <https://www.cesm.ucar.edu/community-projects/mmlea/v2>

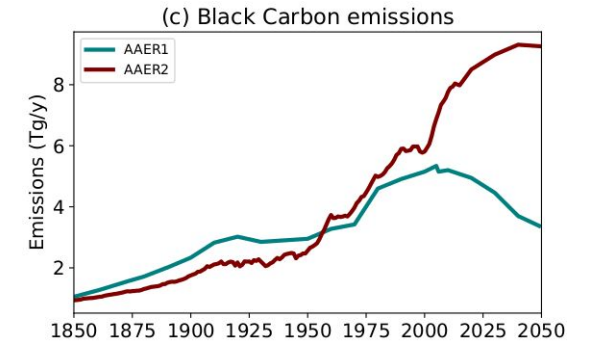
Contact: Nicola Maher (nicola.maher@anu.edu.au) or Adam Phillips and Clara Deser (Climate Analysis Section)

See Nicola Maher's talk tomorrow afternoon

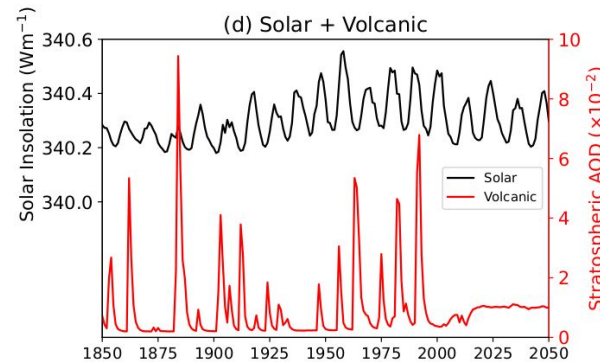
Future simulation plans

Forthcoming Simulations with CESM2

- 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



- More regionally refined work (North Atlantic and Tropics)
- Simulations in which the mean state of the tropical Pacific is bias corrected
 - *There are indications that biases in the mean state of the tropical Pacific could be impacting on forced trends in the tropical Pacific and preventing models from capturing the La Nina-like trend seen in obs (Zhuo et al. 2024).*

Plans for simulations with CESM3

- GOGA simulations, 1850-2024
*CESM3 with prescribed observation-based SSTs and sea-ice.
3 members for 1850-2024, 7 members for 1958-2922*
- Mid-top 1850 piControl with prescribed climatological SSTs
Allows for characterization of the internal variability of the atmosphere-land alone without SST variability or feedbacks.
- Contribution to additional CESM3 ensemble members to whatever form of CESM3 large-ensemble we decide to do.
- Development of a CESM3 mechanically decoupled simulation with CESM3 (S. Larson)
The ocean only experiences time variations in the buoyancy forcing from the atmosphere and momentum fluxes are prescribed. Has been used to gain insights of the dynamical of natural variability in CESM.

Questions? Discussion?



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