FEB 2nd, 2026

CVCWG UPDATE

Co-chairs:
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Liason:
Adam Phillips

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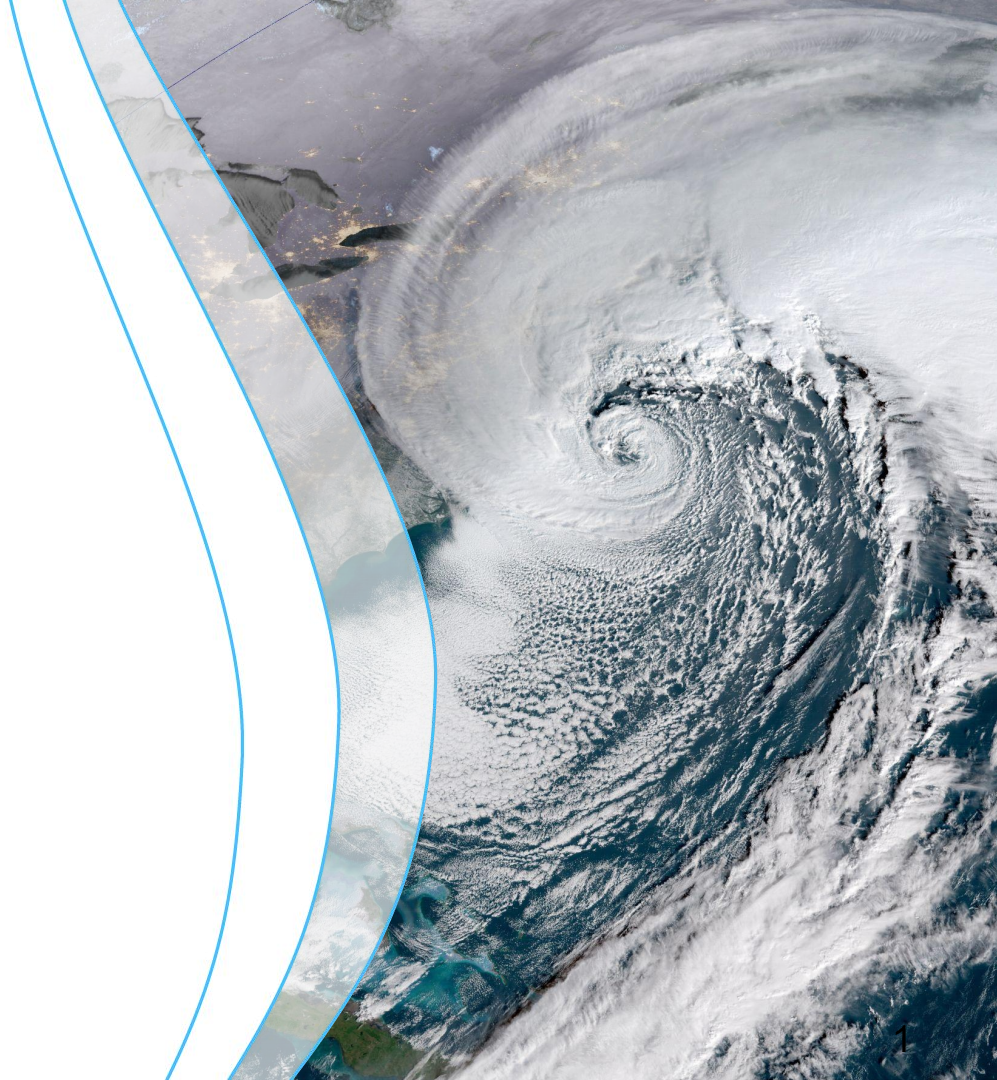
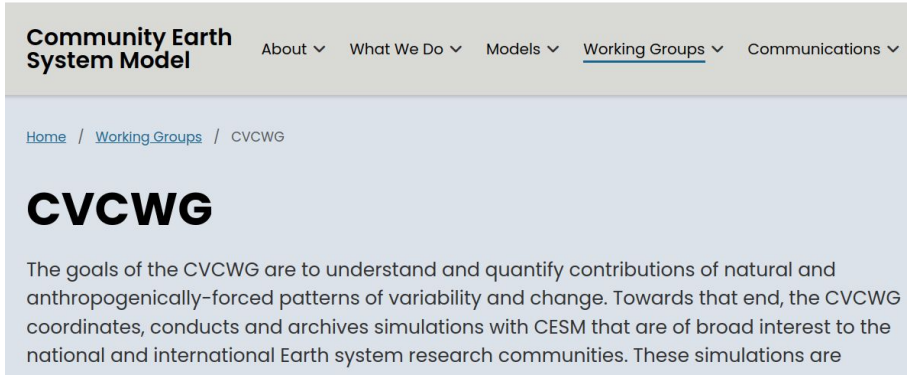


A reminder about CVCWG resources

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



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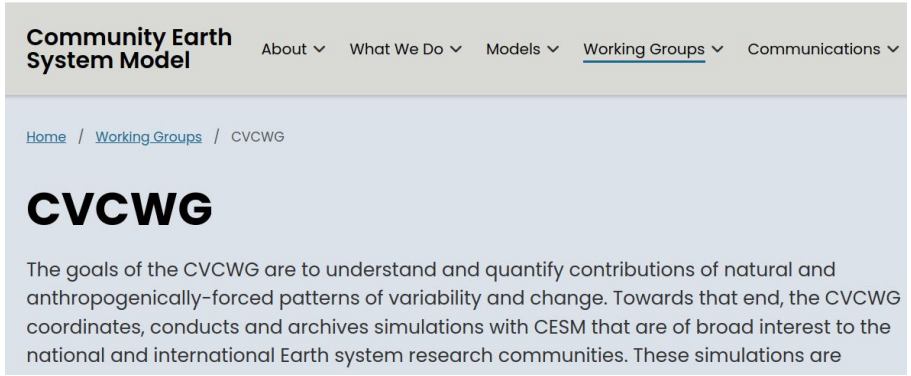

Our Simulations

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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CVCWG

The goals of the CVCWG are to understand and quantify contributions of natural and anthropogenically-forced patterns of variability and change. Towards that end, the CVCWG coordinates, conducts and archives simulations with CESM that are of broad interest to the national and international Earth system research communities. These simulations are

Data Acquisition

- **NCAR Internal**

  Location on NCAR's campaign store (accessible from NCAR CISL machines):

  ```
  /glade/campaign/collections/gdex/data/d651055
  ```

- **Web Access**

  This data is available from the NSF NCAR Geoscience Data Exchange.

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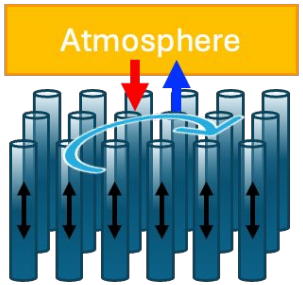
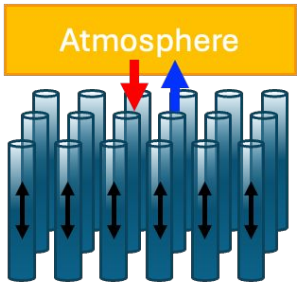
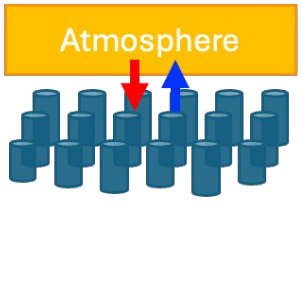
Multi-column ocean model (MCOM)



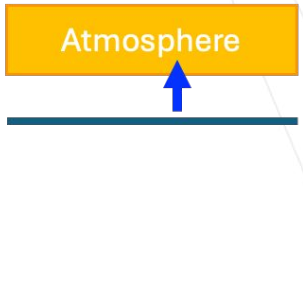
Full 3-D Ocean Model (FOM; POP2)



Multi-Column Ocean Model (MCOM; array of 1-D ocean columns)



Slab Ocean Model (SOM)



Data Ocean

Point of contact:
Young-Oh Kwon

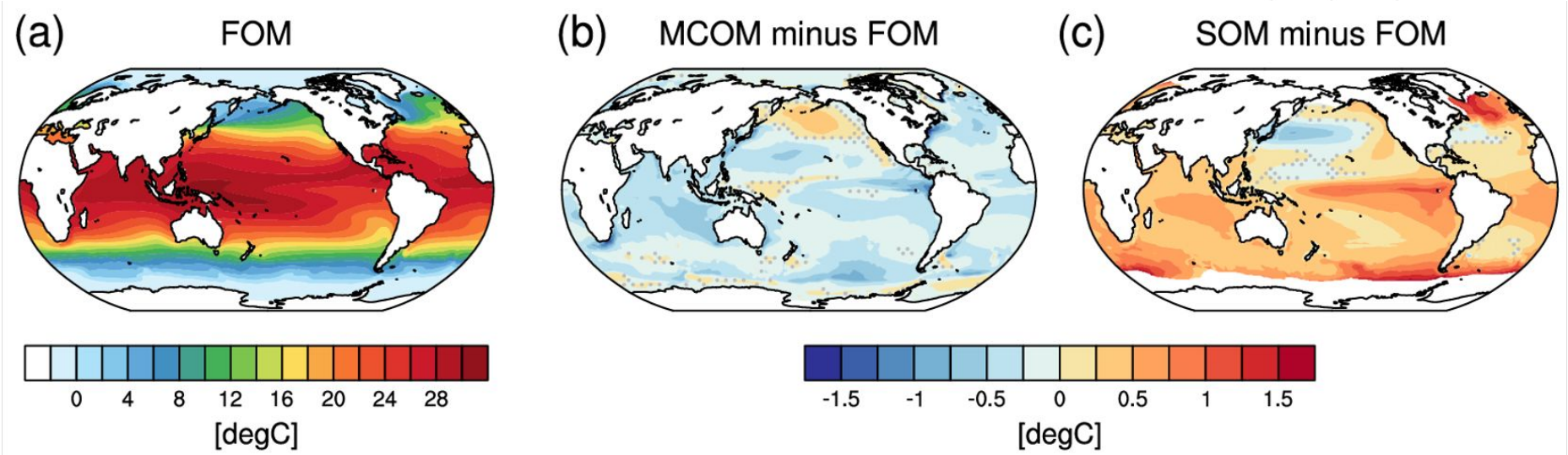
Role of ocean lateral processes

Role of ocean vertical mixing and mixed layer variability

The multi-column ocean model has now been implemented in CESM2 and CVCWG resources have been used to perform a 700 year long piControl. Data will become available once the paper is published. Paper is soon to be submitted.

Multi-column ocean model (MCOM)

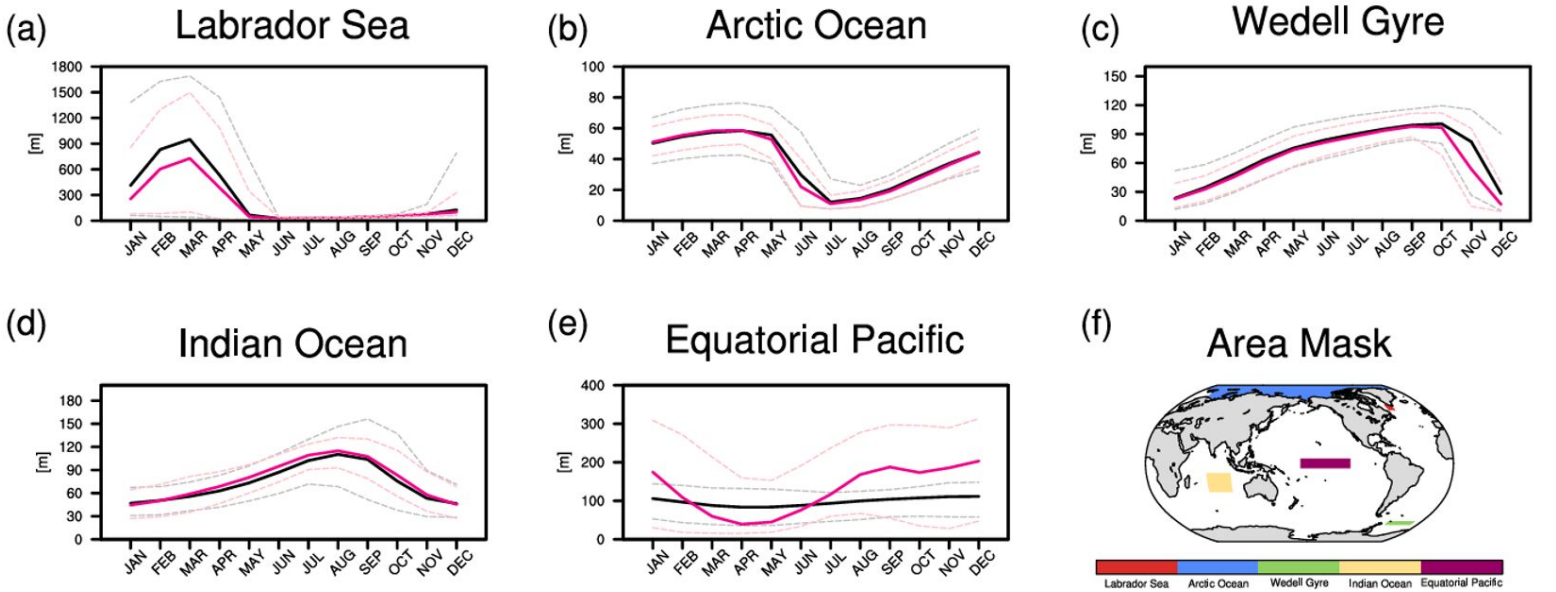
SST climatology in CESM2-MCOM is better constrained than CESM2-SOM



- CESM2-FOM: 2000 yrs (Danabasoglu et al. 2020)
- CESM2-MCOM: 700 yrs (Shin et al. in-prep), employs 3-D monthly climatological flux correction
- CESM2-SOM: 360 yrs (Larson et al. 2024), employs monthly climatological surface flux correction (q-flux)

Multi-column ocean model (MCOM)

Climatological MLD seasonal cycle from the PI control simulations



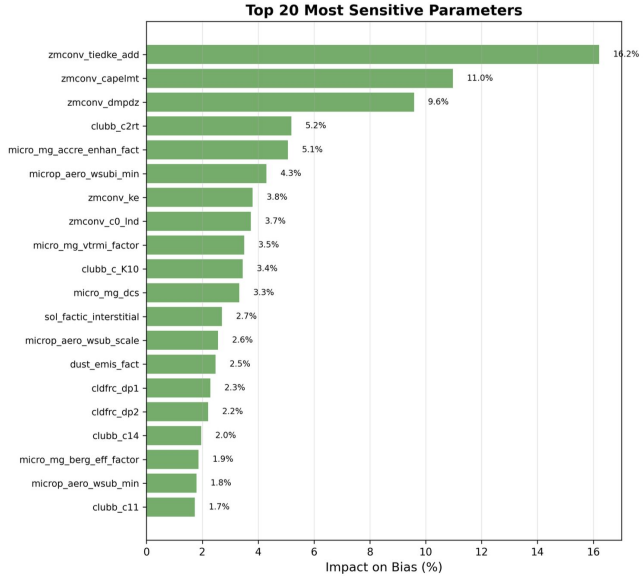
- CESM-MCOM (magenta) and CESM2-FOM (black) mixed layer depths compare well except near the equator

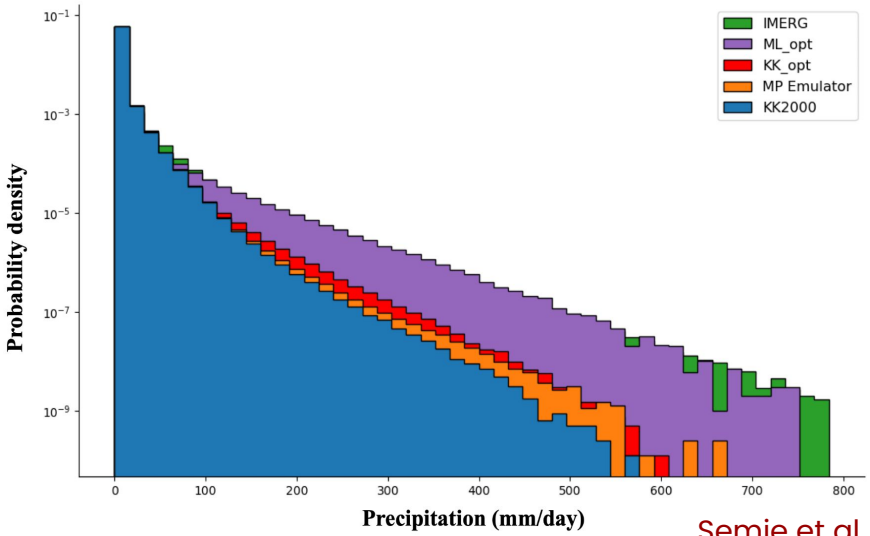
Perturbed parameter work

- Replace autoconversion/accretion of liquid with ML model trained on bin microphysics
- Run a PPE (34 parameters, 100 simulations)
- Train a surrogate model to find optimized parameters for a set of precipitation statistics

Addisu Semie

Brian Medeiros





Semie et al., *in prep*

Perturbed parameter work

Calibration using PPEs

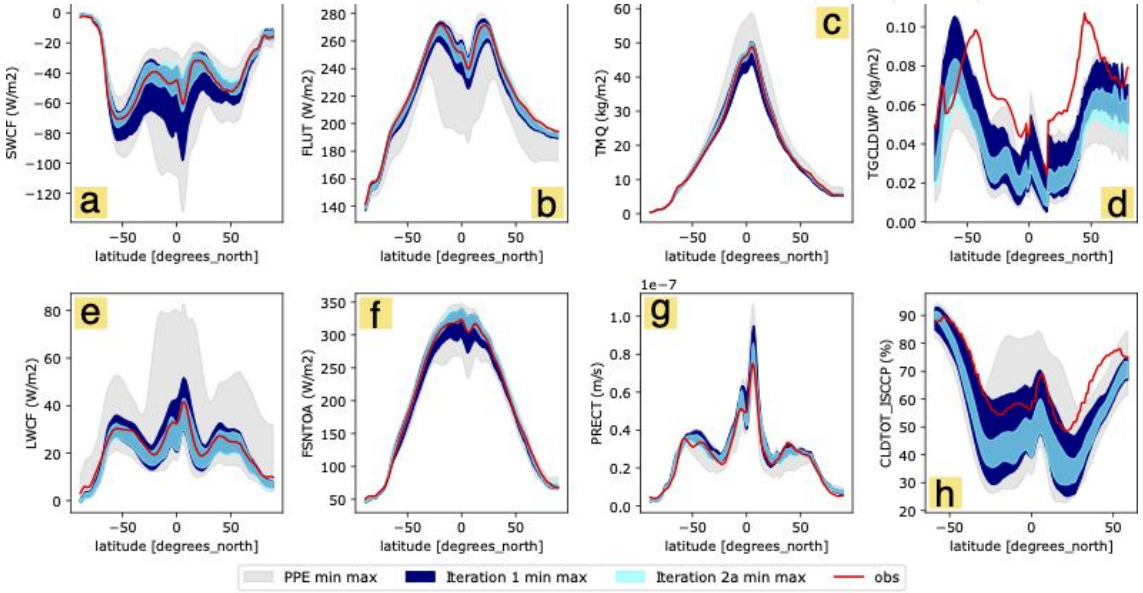
- Applying a new ML-based calibration approach based on “history matching” using the CAM6 PPE and the warm-rain PPE.
- Incorporating regional climatologies as targets and systematically eliminating targets when structural errors introduce compensating biases.
- Method is being tested as an alternative tuning approach for CAM7


Qingyuan Yang


Addisu Semi


Brian Medeiros


Greg Elsaesser



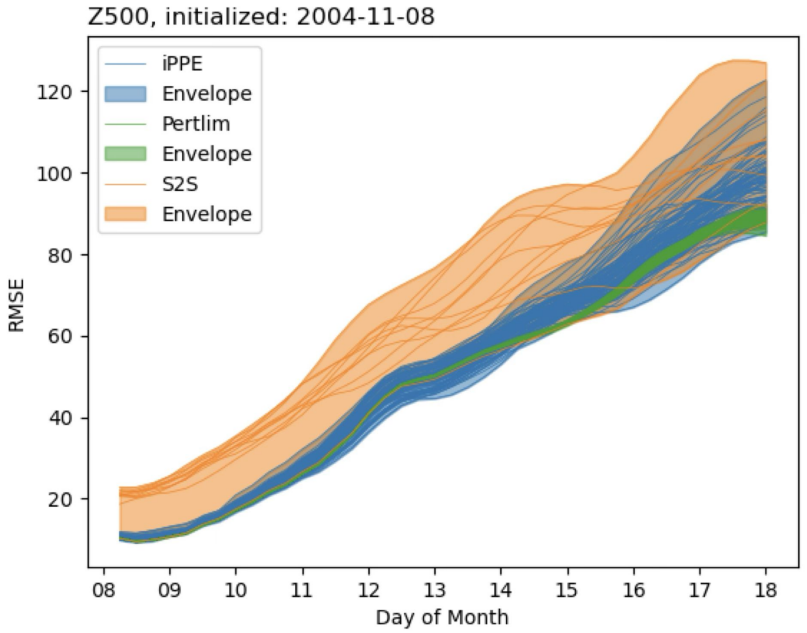
Yang et al., *in prep*

Exploring parametric uncertainty in initialized forecasts (iPPE)

Exploring parameter uncertainty in initialized forecasts (iPPE)

Brian Medeiros

- Using similar methods as in the other PPE's to assess parametric uncertainty in short (10-day) forecasts with CAM6
- Initialized from the S2S initial conditions
- Perturb parameters (35) instead of initial conditions.
- Ask whether forecasts can be optimized by "tuning" the parameters, and whether the best parameters change with initial state.
- Early results hint that different parameter values lead to the best skill across initial conditions



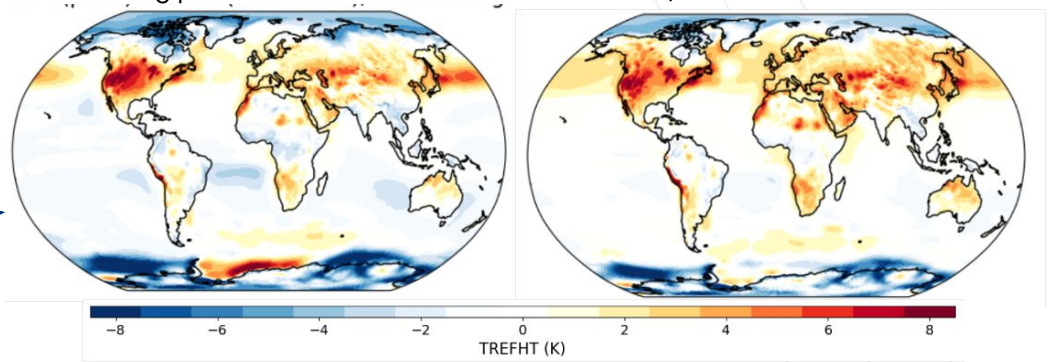
Exploring the use of initialized predictions in coupled model development

A summertime warm bias analogous to what we see in the free running cas appears in initialized predictions

JJA after a May 1st initialization

Free running piControl relative to OBS

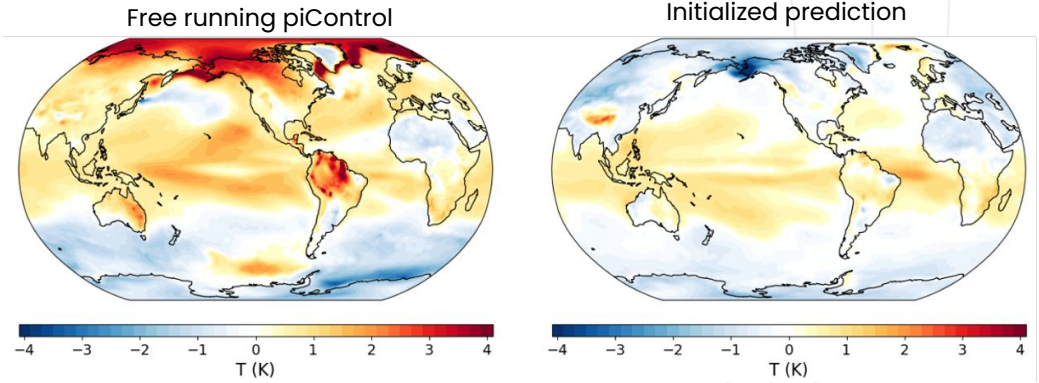
Initialized prediction bias relative to OBS



DJF after a Nov 1st initialization

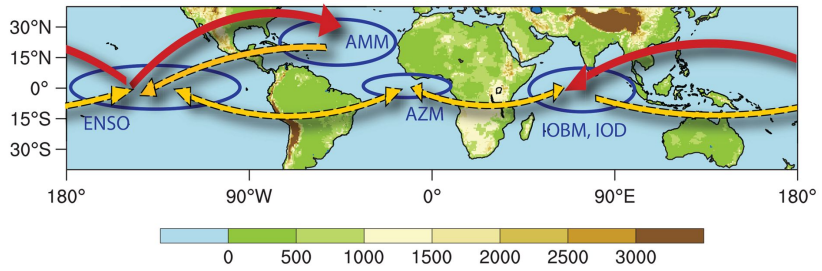
Free running piControl

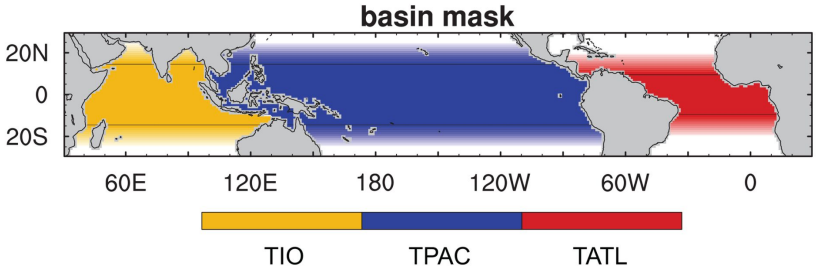
Initialized prediction



Difference in temperature between clubb explicit diffusion on or off. A case where we don't see the full impact of a parameterization change with the initialized predictions

TBI-coEX





	Branch 1: standard pacemaker		Branch 2: pacemaker hindcast	
	Name	Description	Name	Description
Tier 1	TBI-hist-ctrl	Reference experiment: coupled ocean–atmosphere simulation with radiative forcing from historical (up to 2014) and ssp585 (2015–2021). If historical has already been performed, only extension from 2015 to 2021 is needed.	TBI-hind-ctrl	Hindcast experiment for the period 1982–2021 with ocean initialization in February (mandatory), May, August, and November (recommended). Depending on the initialization method, there may be a need for a separate control experiment. See the experiment design for details.
	TBI-pace-P-anom	Pacemaker experiment with SST restoring in the tropical Pacific Ocean (15° S–15° N). The restoring target is the model SST climatology plus observed SST anomalies.	TBI-hind-P-anom	Restore SST anomalies in the tropical Pacific Ocean to the lead-time-dependent model climatology plus observed anomalies during the forecast period.
	TBI-pace-A-anom	Like TBI-pace-P-anom but for the tropical Atlantic Ocean (10° S–10° N)	TBI-hind-A-anom	Like TBI-hind-P-anom but for the tropical Atlantic Ocean
	TBI-pace-I-anom	Like TBI-pace-P-anom but for the tropical Indian Ocean (15° S–15° N)	TBI-hind-I-anom	Like TBI-hind-P-anom but for the tropical Indian Ocean
Tier 2			TBI-hind-ctrl	As in Tier 1
	TBI-pace-P	Like TBI-pace-P-anom but restoring full-field SST observations	TBI-hind-P	Like TBI-hind-P-anom but restoring full-field observations
	TBI-pace-A	Like TBI-pace-A-anom but restoring full-field SST observations	TBI-hind-A	Like TBI-hind-P but for the tropical Atlantic Ocean
	TBI-pace-I	Like TBI-pace-I-anom but restoring full-field SST observations	TBI-hind-I	Like TBI-hind-P but for the tropical Indian Ocean
Tier 3		*Reserved for future experiments*		*Reserved for future experiments*

Model	Center	Type of experiment	Status
CESM2	US NSF NCAR	Hindcast + standard	Completed
CESM2	SCSIO, China	Tier-2 experiments	Completed
NorCPM	University of Bergen	Hindcast + standard	Completed
SINTEX-F2	JAMSTEC	Pacemaker hindcast	Completed
MIROC6	JAMSTEC, University of Tokyo/NIES	Hindcast + standard	Ongoing
ACCESS-CM2	CSIRO, Australia	Standard pacemaker	In preparation
IPSL-CM6A-LR	IPSL, France	Standard pacemaker	Completed

Richter et al., 2025, [The Tropical Basin Interaction Model Intercomparison Project (TBIMIP)](), *GMD*, 18, 2587-2608.

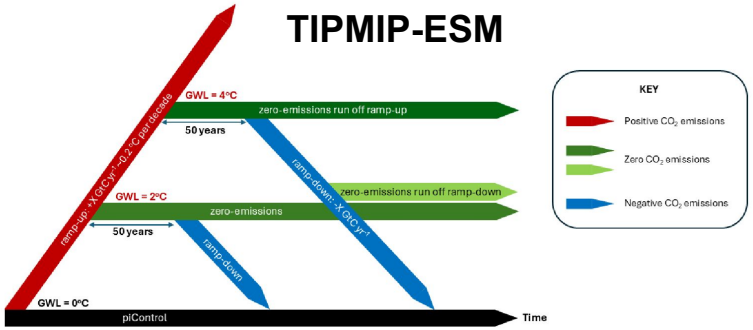
Historical: /glade/campaign/cgd/ccr/AMOC/cesm2/timeseries; hindcats: ask Steve (yeager@ucar.edu)

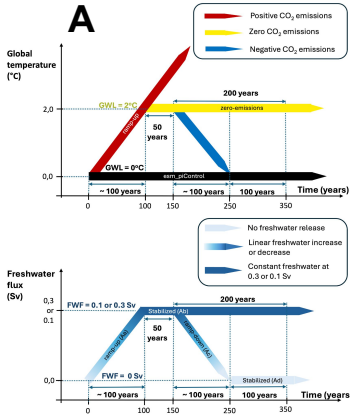
TBIMIP → CLIVAR CDP TBI WG

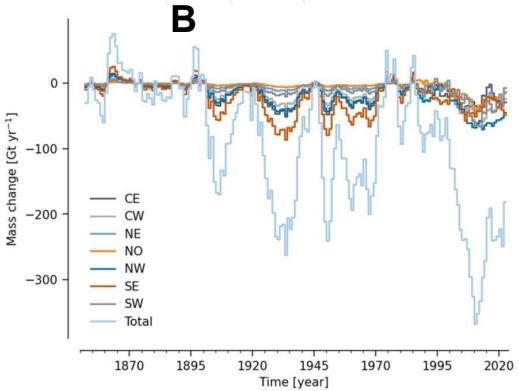
TIPMIP

Tipping point model intercomparison project (Winkelmann et al., GMD, under review)

Jones et al., GMD, under review)

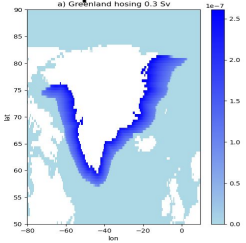




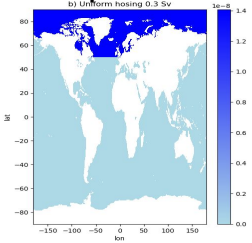


TIPMIP-OCEAN

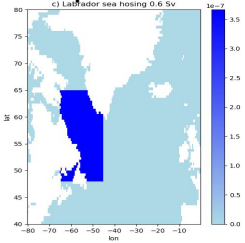
Exp: A, B



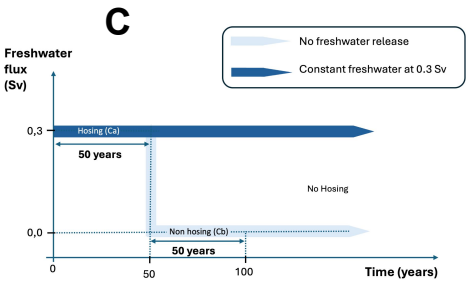
Exp: C

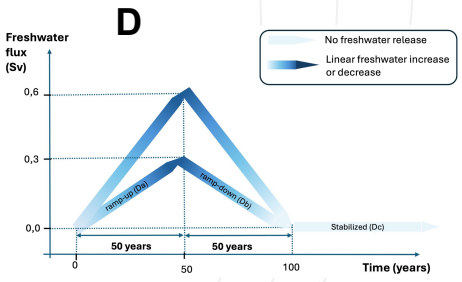


Exp. D



Swingedouw et al., GMD, to be submited





TIPMIP domains: **ESM,** Ice sheet, **ocean**, permafrost, **biosphere**, regional, **what if**, methods

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Future plans

- Work is on-going to pythonize CVDP. Expected completion date, summer 2026
- Exploration of the impacts of CMIP5 vs CMIP6 vs CMIP7 aerosol emissions in a single forcing context
- Perform the standard baseline simulations that CVCWG typically performs e.g., AMIP ensemble, pacemaker ensembles etc. Potential contributions to CMIP7 e.g., single forcing simulations.
- Plan for some sort of large-ish ensemble with CESM3. Up for discussion what that looks like e.g., initial condition or perturbed parameter ensemble etc.
- Continued work with regionally refined configurations to explore resolution impacts.
- Glad to hear thoughts in the discussion at the end of the day

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Discussion topics

- Which MIPs do you think are important to participate in for CMIP7?
- Do you have any thoughts on the design of a CESM3 Large(ish) Ensemble
- Any thoughts on experiments you'd like to see performed by the ESP or CVC working groups?
- Any thoughts on future directions / areas of focus for Atmosphere or Chemistry Model development