

# Updates from the climate variability and change working group

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Clara Deser, NCAR (term ended March 2020)  
Isla Simpson, NCAR (term started March 2020)  
Peter Gleckler, PCMDI  
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**Liasons:** Adam Phillips, NCAR  
Gary Strand, NCAR

[www.cesm.ucar.edu/working\\_groups/CVC/](http://www.cesm.ucar.edu/working_groups/CVC/)



*Isla Simpson,*  
NCAR, CGD

June, 2020



### Overview

The goals of the Climate Variability and Change Working Group (CVCWG) are to understand and quantify contributions of natural and anthropogenically-forced patterns of climate 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 climate research communities. These simulations are designed to enable researchers to evaluate and understand mechanisms of internal variability and externally-forced change due to natural and anthropogenic factors, detection and attribution of past climate change, and projections and predictions of future change. These simulations can also serve as baselines for users who wish to perform their own perturbation experiments using the same model version. A complete list of CVCWG simulations available for public download via the Climate Data Gateway at NCAR is available [here](#).

Other CVCWG activities include development of the [Climate Variability Diagnostics Package](#) and [Climate Data Guide](#), as well as contributions to the [AGU CESM2 Virtual Special Issue](#) and the [CCSM4 and CESM1 Special Issues of the Journal of Climate](#).

### Our Simulations

#### Recent / Notable

- [CESM2 Large Ensemble Project](#)
- [CAM6 Prescribed SST Ensembles \(forced with ERSSTv5\)](#)
- [CAM5 Prescribed SST Ensembles \(forced with ERSSTv3b, ERSSTv4 and ERSSTv5\)](#)
- [CESM1.1 Large Ensemble Project](#)
- [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](#)

#### Past (organized by model version)

- [CESM1.0](#) | [CCSM4](#) | [CCSM3](#)

#### Other

- [Multi-Model Large Ensemble Archive](#)

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## Revamped website (Adam Phillips)

### CESM1 "Single Forcing" Large Ensemble Project

The CESM1 "Single Forcing" Large Ensemble Project is a publicly available set of climate model simulations useful for addressing the individual roles of anthropogenic aerosols, greenhouse gases and land-use/land-cover in historical and future climate change. These simulations use the same model, forcing configuration and initialization protocol as the [CESM1 Large Ensemble Project](#), but keep either industrial aerosols (AER), biomass burning aerosols (BMB), greenhouse gases (GHG) or land-use/land-cover (LULC) conditions fixed at 1920 while all other external anthropogenic and natural forcing factors evolve

### Project Details

- **Simulation Names:**
  - XGHG: b.e11.B20TRLENS\_RCP85.f09\_g16.xghg.0XX, XX = 01-20
  - XAER: b.e11.B20TRLENS\_RCP85.f09\_g16.xaer.0XX, XX = 01-20
  - XBMB: b.e11.B20TRLENS\_RCP85.f09\_g16.xbmb.0XX, XX = 01-15
  - XLULC: b.e11.B20TRLENS\_RCP85.f09\_g16.xlulc.00X, X = 1-5
- **Model Version:** CESM1.1 [Codebase](#) | [Documentation](#)
- **Resolution:** 0.9x1.25\_gx1v6 (CESM nominal 1° grid)
- **Years:** 1920-2080 (XGHG, XAER), 1920-2029 (XBMB, XLULC)
- **Ensemble Size:** 20 members (XGHG, XAER), 15 members (XBMB), 5 members (XLULC)

### Data Acquisition

The data is available on the NCAR machine casper at [/glade/campaign/cesm/collections/cesmLE/CESM1-CAM5-BGC-LE/](#) and from the Climate Data Gateway at NCAR.

**The following are step by step directions on how to download CESM1 Single Forcing Project data from the Climate Data Gateway.**

1. Proceed to the [Climate Data Gateway CESM1 Large Ensemble](#) 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.

## Older, but still useful, simulations...

### CESM1 simulations

- Large ensemble: 40 member ensemble of simulations from 1920-2100 under historical and RCP8.5 forcings
  - Coupled pre-industrial control run (2200 years long)
  - Pre-industrial control with prescribed climatological SSTs taken from the run above (2600 years long)
  - Prescribed observed SST ensembles:
    - 10 member TOGA ensemble (ERSSTv3b)
    - 10 member TOGA ensemble (ERSSTv4)
    - 10 member TOGA ensemble (ERSSTv5)
    - 10 member GOGA ensemble (ERSSTv4)
  - 20 member tropical Pacific pacemaker ensemble (coupled simulations with SST anomalies in the eastern equatorial pacific nudged toward observed)
  - 10 member North Atlantic (5N-55N) Pacemaker ensemble
  - 10 member Indian Ocean pacemaker ensemble
- See [www.cesm.ucar.edu/working\\_groups/CVC/](http://www.cesm.ucar.edu/working_groups/CVC/) for all the above
- A variety of high resolution (0.25° atm, 1° ocn) AMIP and coupled simulations (historical, RCP8.5, RCP4.5, RCP2.6) available on request (conducted on hpc other than cheyenne).

Newly available (or  
coming soon) simulations

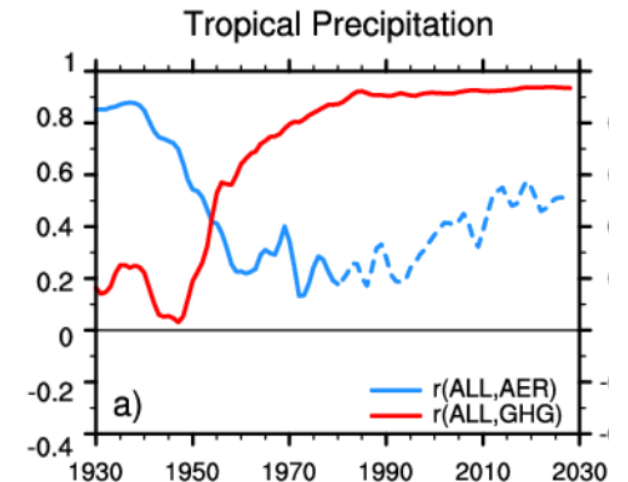
# CESM1 single forcing large ensemble

(Clara Deser, Nan Rosenbloom, Dani Coleman, Adam Phillips, Isla Simpson)

- Using the same model as the CESM1 large ensemble (LENS)
- 4 ensembles
  - XGHG (20 members, 1920-2080): GHG forcing kept fixed at 1920 values
  - XAER (20 members, 1920-2080): Industrial aerosol forcing kept fixed at 1920 values
  - XBMB (15 members, 1920-2029): Biomass burning emissions kept fixed at 1920 values
  - XLULC (5 members, 1920-2029): Land-use/land-cover kept fixed at 1920 conditions.
- The role of each of these forcings can be determined by LENS – X(GHG, AER, BMB or LULC).
- Documented in Deser et al (2020), coming soon

[http://www.cesm.ucar.edu/working\\_groups/CVC/simulations/cesm1-single\\_forcing\\_le.html](http://www.cesm.ucar.edu/working_groups/CVC/simulations/cesm1-single_forcing_le.html)

Pattern correlations between ensemble mean running 50-year trends in tropical precipitation in LENS and the Aerosol contribution (blue) or GHG contribution (red)



# CESM2 simulations

- Extension of the CESM2 long pre-industrial control simulation out to 2000 years (**Cecile Hannay**)
- CESM2 pre-industrial control with prescribed climatological SSTs taken from years 401-1999 of the coupled simulation. Coming soon, 350 years run, 1650 years to go. (**Isla Simpson**)
- CESM2 prescribed SST ensembles (**Adam Phillips**):
  - 10 member GOGA ensemble, 1880-2014, ERSSTv5 (global time varying SSTs prescribed)
  - 10 member TOGA ensemble, 1880-2014, ERSSTv5 (tropical time varying SSTs prescribed, climatological extra-tropics)

[http://www.cesm.ucar.edu/working\\_groups/CVC/simulations/cam6-prescribed\\_sst.html](http://www.cesm.ucar.edu/working_groups/CVC/simulations/cam6-prescribed_sst.html)

These will be extended out to present day soon.
- CESM2 tropical Pacific pacemakers. 10 member ensemble, 1880-present. Coupled simulations with SST anomalies in the eastern equatorial Pacific relaxed toward observed (ERSSTv3b). Coming soon – simulations are about to start (**Isla Simpson, Nan Rosenbloom, Adam Phillips**).

# Participation in various MIPS

Data available on the ESGF for all but FAFMIP.

For any queries about these simulations contact Nan Rosenbloom.

PAMIP

**CMIP6**

**ScenarioMIP**

SSP1-2.6.101 ( 3 mbrs)  
SSP2-4.5.101 ( 3 mbrs)  
SSP3-7.0.101 (10 mbrs)  
SSP5-8.5.101 ( 3 mbrs)

**DECK**

(FV\_g17: 1°- 1°)  
AMIP (10 mbrs)  
BHIST (10 mbrs)

**DAMIP**

hist-nat (3 mbrs)  
hist-nat (3 mbrs)  
hist-ghg (3 mbrs)  
hist-aer (3 mbrs)

CESM2  
(CMIP6)

**HighResMip**

(ne120\_t12: 0.25°- 0.1°)  
High + low resolution  
Coupled - 1950-2050  
AMIP - 1950-2050

**FAFMIP**

FAFstress: 80 yrs  
FAFwater: 80 yrs  
FAFheat: 80 yrs  
FAFall: 57 yrs  
FAFNAOpct: 38 yrs  
FAFheat\_NA50pct 80 yrs

Corrected SOA Forcing

Part of the iHESP project in collaboration with QNLM and TAMU

<https://ihesp.tamu.edu/>

<https://ihesp.tamu.edu/products/ihesp-products/data-release/data-release.html>



# CESM2 large ensemble, coming soon



Gokhan Danabasoglu (NCAR), Clara Deser (NCAR), Keith Rogers (ICCP), Axel Timmermann (ICCP)  
and many others (esp Nan Rosenbloom and Jim Edwards)



- Information can be found here... <http://www.cesm.ucar.edu/projects/community-projects/LENS2/>
- 100 member ensemble from 1850-2100 under SSP3-7.0. Mixture of micro and macro-initialization.
  - 20 members initialized every 10 years between years 1001 and 1191 of the piControl (macro-initialization, initial ocean state is different)
  - 20 members initialized from year 1231 of the piControl (micro-initialization, small perturbation to the surface temperature field)
  - 20 members initialized from year 1251 of the piControl (micro-initialization, small perturbation to the surface temperature field)
  - 20 members initialized from year 1281 of the piControl (micro-initialization, small perturbation to the surface temperature field)
  - 20 members initialized from year 1301 of the piControl (micro-initialization, small perturbation to the surface temperature field)
- Current status: 40 members completed out to 2100
- Expected to be complete toward the end of this year.
- Complementary single forcing (all-but-one) large ensembles to be run at NCAR (likely 2 scenarios, 15-20 members each)

AMOC time series in the piControl simulation

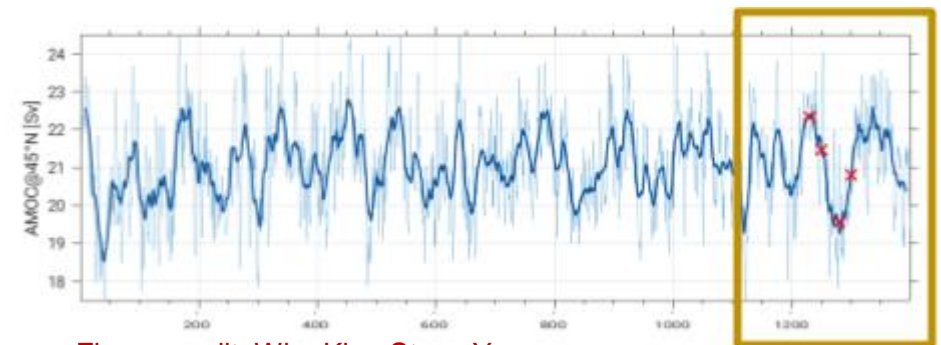


Figure credit: Who Kim, Steve Yeager

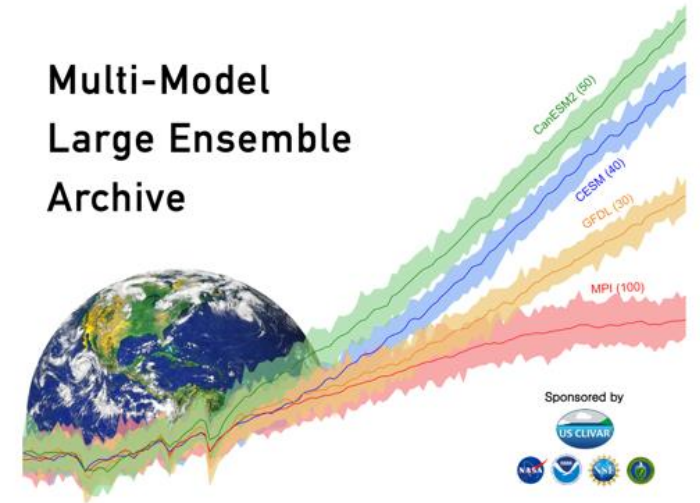
# Other Projects

# Multi-model large ensemble (MMLEA) archive

(Flavio Lehner, Clara Deser)

- Through the activities of the US CLIVAR working group on large ensembles, a centralized data archive of initial-condition large ensembles conducted with 7 CMIP5-class climate models has been produced.
- Resides on glade and publically accessible via the NCAR Climate Data Gateway
- Information can be found here...

<http://www.cesm.ucar.edu/projects/community-projects/MMLEA/>

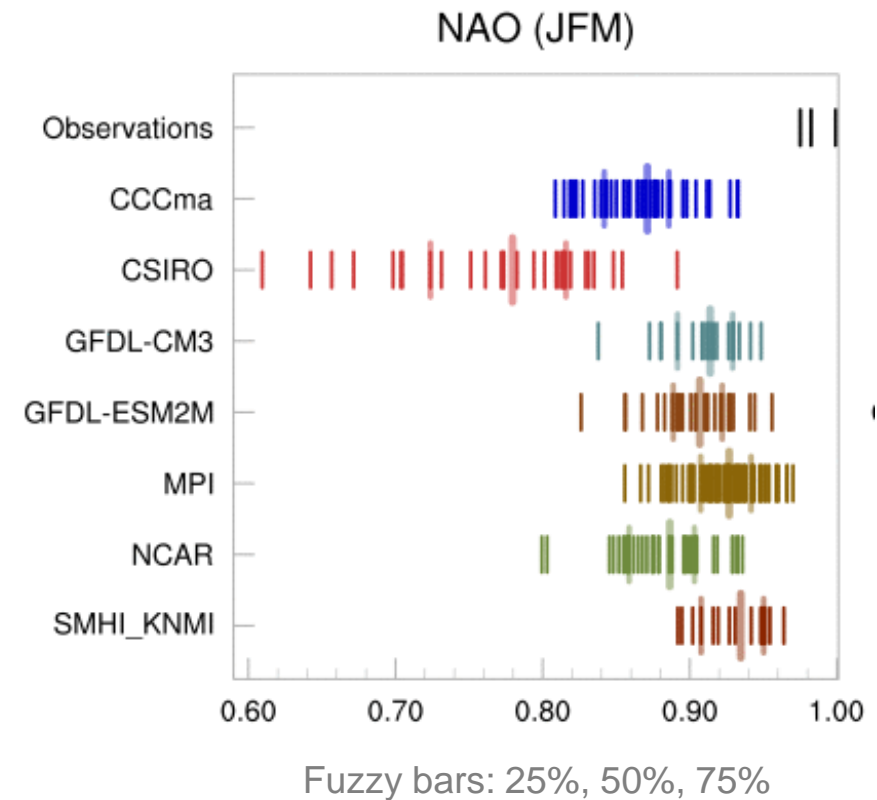


# Climate Variability Diagnostics Package for large ensembles (CVDP-LE)

(Adam Phillips, Clara Deser)

- A version of the CVDP that is geared toward analysis of large ensembles is under development
- Expected to be released by the end of the summer.

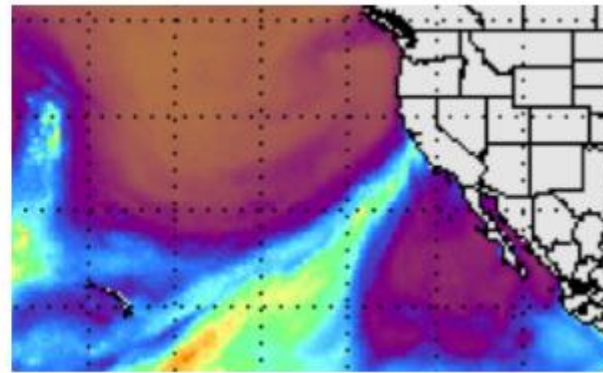
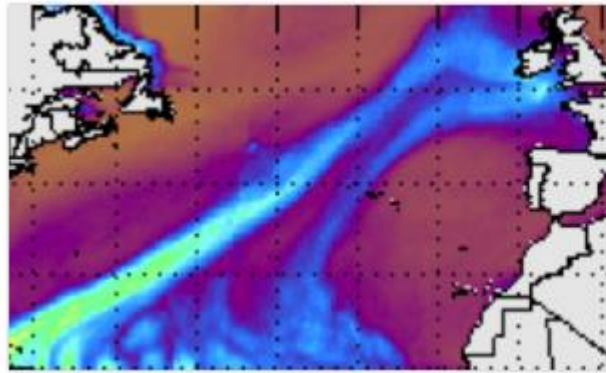
Pattern correlations of JFM NAO structure for each member against a primary observational dataset as well as different observations against that primary observational dataset.



# ARTMIP (Atmospheric River Tracking Method Intercomparison Project)

Christine Shields ([shields@ucar.edu](mailto:shields@ucar.edu)), Jonathan Rutz, Michael Wehner, Ruby Leung, Marty Ralph, Ashley Payne, Travis O'Brien

A framework for comparing different atmospheric river tracking algorithms. Provides a catalogue of atmospheric river events in different reanalysis products and CMIP5 and CMIP6 simulations.



Check out <http://www.cgd.ucar.edu/projects/artmip/> or contact Christine Shields for more information.

# CVCWG CESM2 papers

- Capotondi et al (2020) ENSO and Pacific Decadal Variability in the Community Earth System Model Version 2, JAMES
- Meehl et al (2020) Characteristics of Future Warmer Base States in CESM2, JAMES
- Meehl et al (2020) Intraseasonal, seasonal and interannual characteristics of regional monsoon simulations in CESM2, JAMES
- Simpson et al (2020) An evaluation of the large scale atmospheric circulation and its variability in CESM2 and other CMIP models, JGR-Atmospheres

Check out all CESM2 papers here...

<http://www.cesm.ucar.edu/publications/>

# Conclusions

- Check out the CVCWG website for information on available simulations

[http://www.cesm.ucar.edu/working\\_groups/CVC/](http://www.cesm.ucar.edu/working_groups/CVC/)

- Join our mailing list for updates

<http://mailman.cgd.ucar.edu/mailman/listinfo/ccsm-cvcwg>

- We are soliciting input for the next CSL proposal i.e., proposal for computing resources. Please provide input on simulations you'd like to see performed by the CVCWG here

[https://docs.google.com/document/d/1\\_8oM5DEYiTPYw1ZiOWacAlk7Xa3h07sGftuNC7fh8SE/edit?usp=sharing](https://docs.google.com/document/d/1_8oM5DEYiTPYw1ZiOWacAlk7Xa3h07sGftuNC7fh8SE/edit?usp=sharing)

or by emailing Isla Simpson (islas@ucar.edu)

# Extra slides



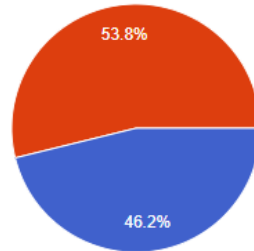


# Results of CVCWG questionnaire on model needs

(26 responses)

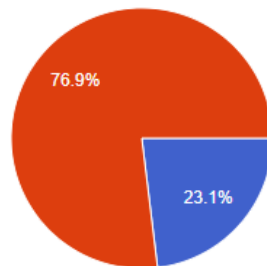
If we faced the choice of keeping the standard L32 CAM or moving to a unified model with the layer structure of WACCM becoming the standard, which would you choose?

- keep the low top CAM
- move to a unified model version with the WACCM resolution



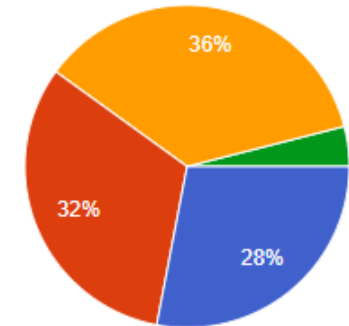
If we faced the choice of keeping the standard L32 CAM or increasing the model top to e.g., 80km to improve the representation of the stratosphere but at say 1.5x the cost, which would you choose?

- keep the low top CAM
- move to an intermediate top at 1.5x the cost



In terms of model configurations and support provided by NCAR, what would you value the most?

- Fully vetted out-of-the-box standard configurations.
- Tools and guidance for designing my own model configuration for my own scientific purposes
- I can't pick one. I really need both of these.
- I haven't used any of the above



Based on results of this survey and survey's to the other working group, investigations are under way in to the vertical grid for the next "workhorse" version of CESM that will have a lid at about 80km, with around 80 vertical levels. Likely with a low-top option available.

The CVCWG also intends to provide enhanced documentation for non-standard model configurations e.g., how to set up pacemaker simulations. Keep an eye on the website.