Updates from the climate variability and change working group

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Clara Deser, NCAR (term ended March 2020)
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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 CESM Special Issues of the Journal of Climate.

Our Simulations

Recent / Notable

- CESM2 Large Ensemble Project
- CAM8 Prescribed SST Ensembles (forced with ERSSTv6)
- CAM5 Prescribed SST Ensembles (forced with ERSSTv3b, ERSSTv4 and ERSSTv5)
- CESM1 Large Ensemble Project
- CESM1 Single Forcing Large Ensemble Project
- CESM1 Tropical Pacific Pescemaker Ensemble
- CESM1 North Atlantic Pescemaker Ensemble
- CESM1 Indian Ocean Pescemaker Ensemble

Past (organized by model version)

- CESM1.0 | CCSM4 | CCSM3

Other

- Multi-Model Large Ensembles Archive

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Our Simulations

Recent / Notable

- CESMI Large Ensemble Project
- CAM8 Prescribed SST Ensembles (forced with ERSTv5)
- CAM5 Prescribed SST Ensembles (forced with ERSTv5b, ERSTv4 and ERSTv5)
- CESMI Large Ensemble Project
- CESMI1 Single Forcing Large Ensemble Project
  - CESMI1 Tropical Pacific Pacemaker Ensemble
  - CESMI1 North Atlantic Pacemaker Ensemble
  - CESMI1 Indian Ocean Pacemaker Ensemble

Past (organized by model version)

- CESM1
  - CCSM4
  - CCSM3

Other

- Multi-Model Large Ensembles Archive

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Revamped website (Adam Phillips)

CESMI "Single Forcing" Large Ensemble Project

The CESMI "Single Forcing" Large Ensemble Project is a publicly available set of climate model simulation 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 CESM Large Ensemble Project, but keep either industrial aerosols (AER), biomass burning aerosols (BBM), greenhouse gases (GHG) or land-use/land-cover (LULC) conditions fixed at 1995 while all other external anthropogenic and natural forcings evolve.

Project Details

- Simulation Names:
  - XEHG: bai:b2o1TREN_v_1.0g_xehg0.0500_XX = 0-20
  - XER: bai:b2o1TREN_v_1.0g6_xer0.0500_XX = 0-15
  - XMB: bai:b2o1TREN_v_1.0g6_gi5.xmb0.0500_XX = 0-15
  - XULUC: bai:b2o1TREN_v_1.0g6_gi5.xuluc0.0500_X = 1-5
- Model Version: CESM1 codebase (Revision 1)
- Resolution: 0.05° lat/lon grid
- Years: 1995-2099 (XEHG, XER), 1990-2099 (XMB, XULUC)
- Ensemble Size: 20 members (XEHG, XER), 15 members (XMB), 5 members (XULUC)

Data Acquisition

The data is available on the NCAR climate Data Gateway at

www.cesm.ucar.edu/working_groups/CVC/
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/ 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
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
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

  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.

Part of the iHESP project in collaboration with QNLM and TAMU

https://ihesp.tamu.edu/
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/
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), 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) 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/

- 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_8oM5DEyTPYW1ZiOWacAlk7Xa3h07sGftuNC7fh8SE/edit?usp=sharing

  or by emailing Isla Simpson (islas@ucar.edu)
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: 53.8%
- Move to a unified model version with the WACCM resolution: 46.2%

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: 76.9%
- Move to an intermediate top at 1.5x the cost: 23.1%

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

- Fully vetted out-of-the-box standard configurations: 36%
- Tools and guidance for designing my own model configuration for my own scientific purposes: 32%
- I can't pick one. I really need both of these: 20%
- I haven't used any of the above: 12%

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.