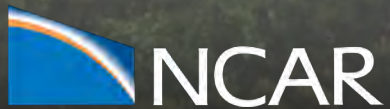# CVCWG update

THE 26th ANNUAL CESM WORKSHOP

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

Outline

- Reminder of existing CESM2 simulations

- Newly available (or almost available) simulations
  - L83 piControl
  - Single forcing large ensemble

- Forthcoming simulations (within the next year)
  - Regionally refined North Atlantic AMIP simulation
  - Pencil model piControl
  - Stochastic physics piControl

- A reminder of CVCWG resources

Existing CESM2 simulations

Check out the webpage for data access: https://www.cesm.ucar.edu/working_groups/CVC/
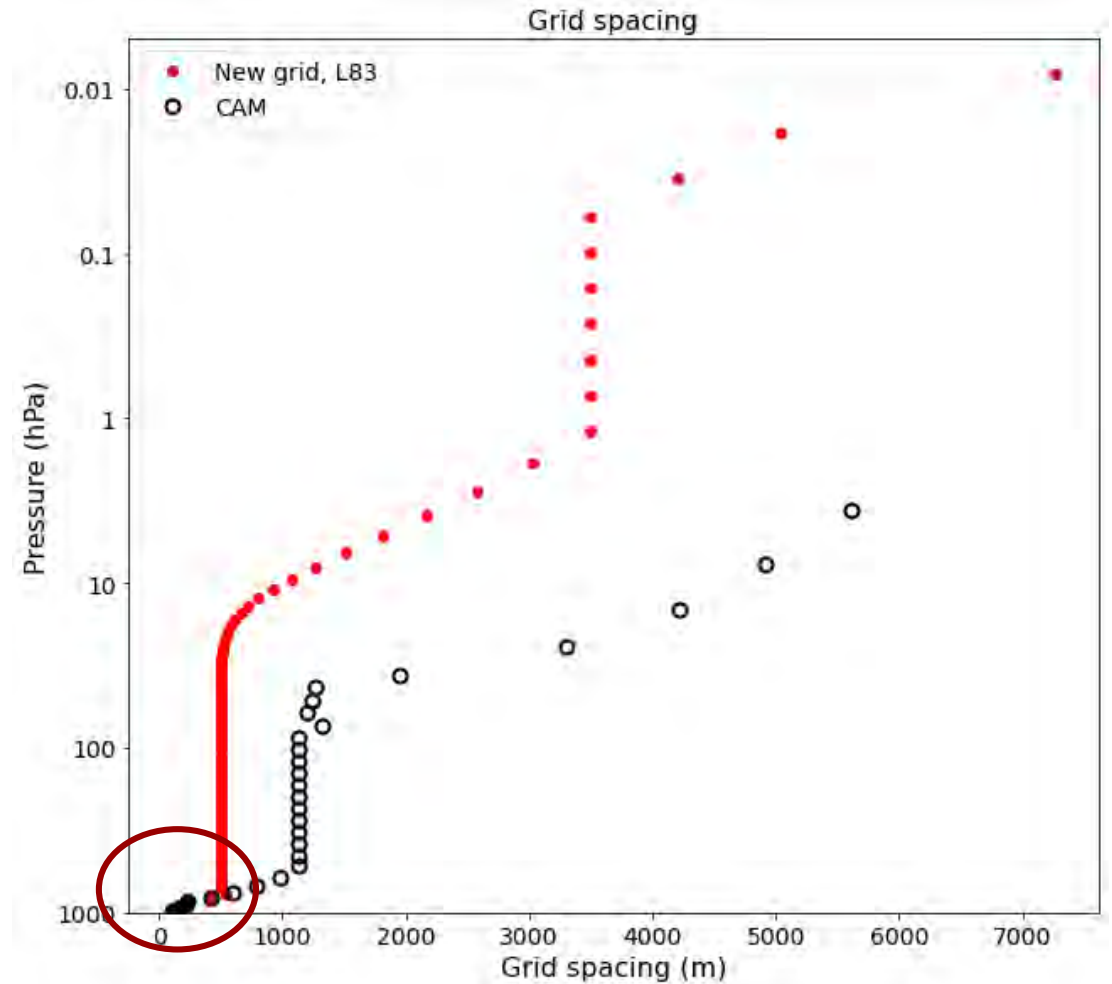
- Pre-industrial control series:
  - Fully coupled (2000 years)
  - Prescribed climatological SSTs taken from the coupled (1000 years)
  - Prescribed time varying daily SSTs from the coupled (500 years)
- 10 member TOGA ensemble = prescribed observation-based (ERSSTv5) time varying SSTs in the tropics, climatological SSTs elsewhere. 1880-2019
- 10 member GOGA ensemble = prescribed, time varying, observation-based (ERSSTv5) SSTs. 1880-2021 ← **New**
- CESM2 tropical Pacific pacemakers = coupled but with SST anomalies in the tropical Pacific nudged to observations. 1880-2019
- SSP2-4.5 ensemble = 16 members run with SSP2-4.5 forcing out to 2100 (with smoothed biomass burning emissions)

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L83 coupled pre-industrial controls

Next generation CAM grids
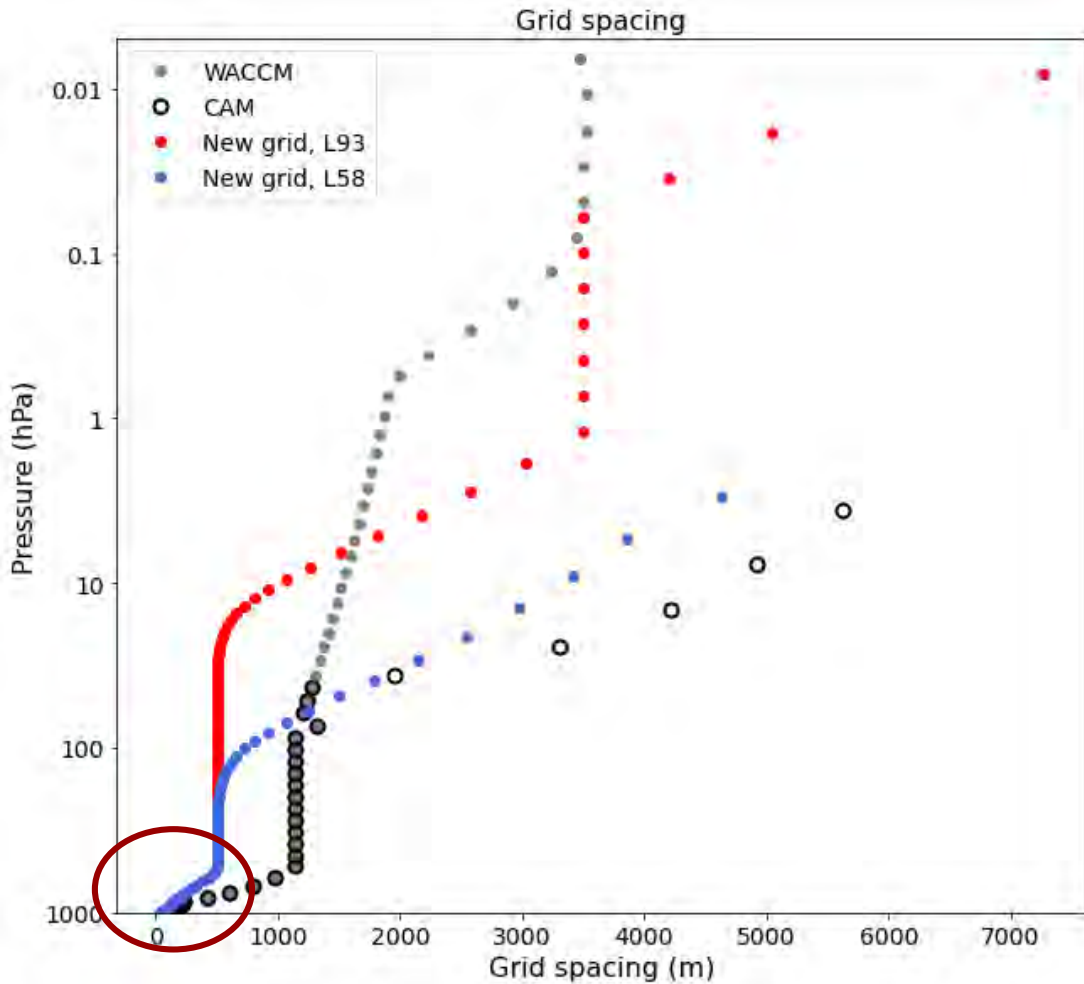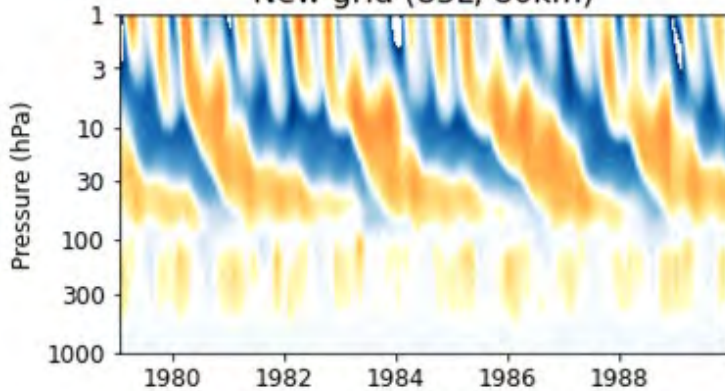
The grid for this simulation

L83 coupled pre-industrial controls

2 piControl simulations of 100 years length:
- one with SC-WACCM physics
- one with CAM6 physics

Small difference in how greenhouse gases are represented and upper boundary conditions

New grid (83L, 80km)

Can explore the role of the stratosphere in climate variability when the QBO is well represented

Note: this is an unsupported and undocumented version of the model. Use with care. We hope to document the process of enhancing the vertical resolution in the free troposphere and stratosphere and its impacts soon.

The grid for this simulation


Grid spacing

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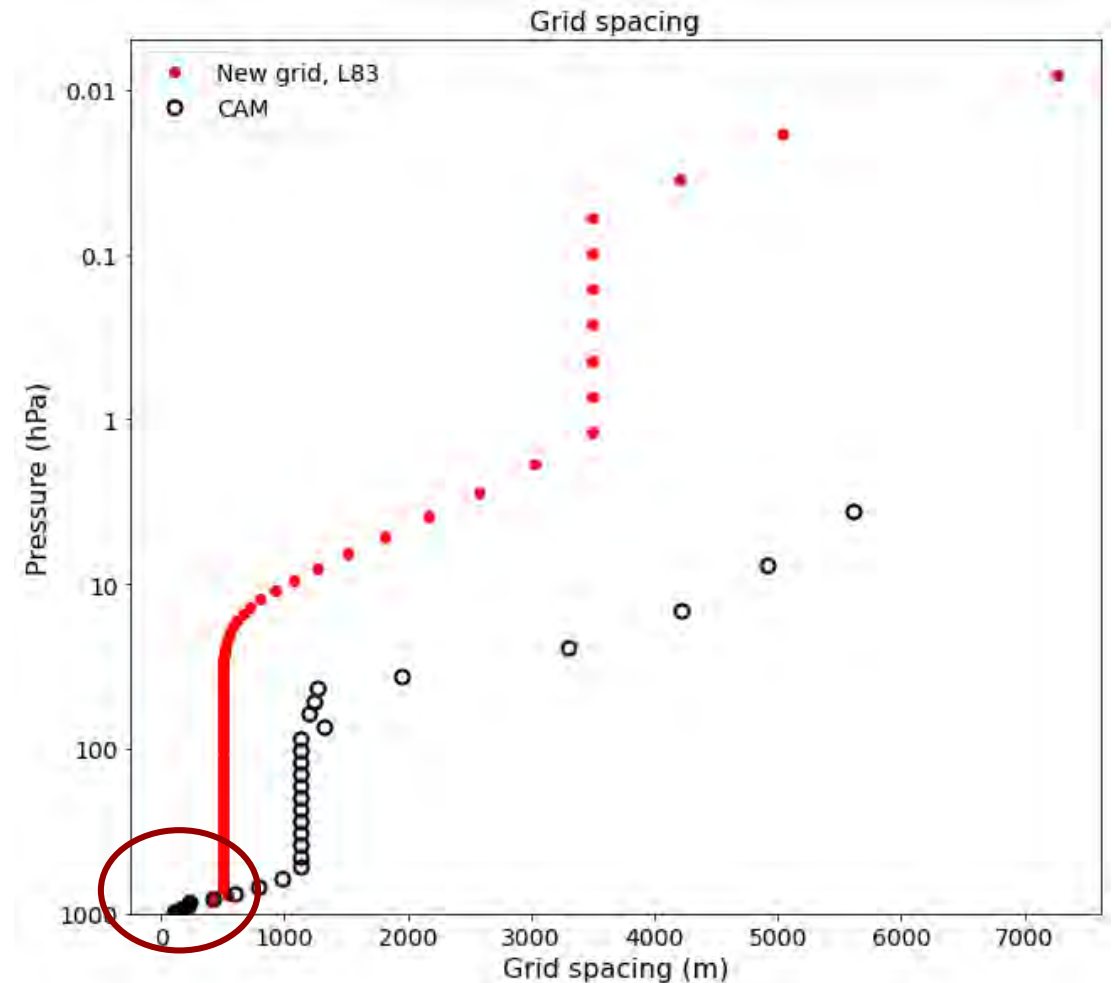
Single Forcing Large Ensemble

(Nan Rosenbloom, Isla Simpson, Gokhan Danabasoglu, Clara Deser, Sasha Glanville)

- Complementary to the second 50 members of the CESM2-LE

- Forcings held fixed at 1850's except those of interest

- 4 ensembles of 15 members (1850-2050)
  - GHG = Greenhouse gases
  - AAER = Anthropogenic aerosols
  - BMB = Biomass burning aerosols
  - EE = Everything else

Will be released very soon. Hopefully July.
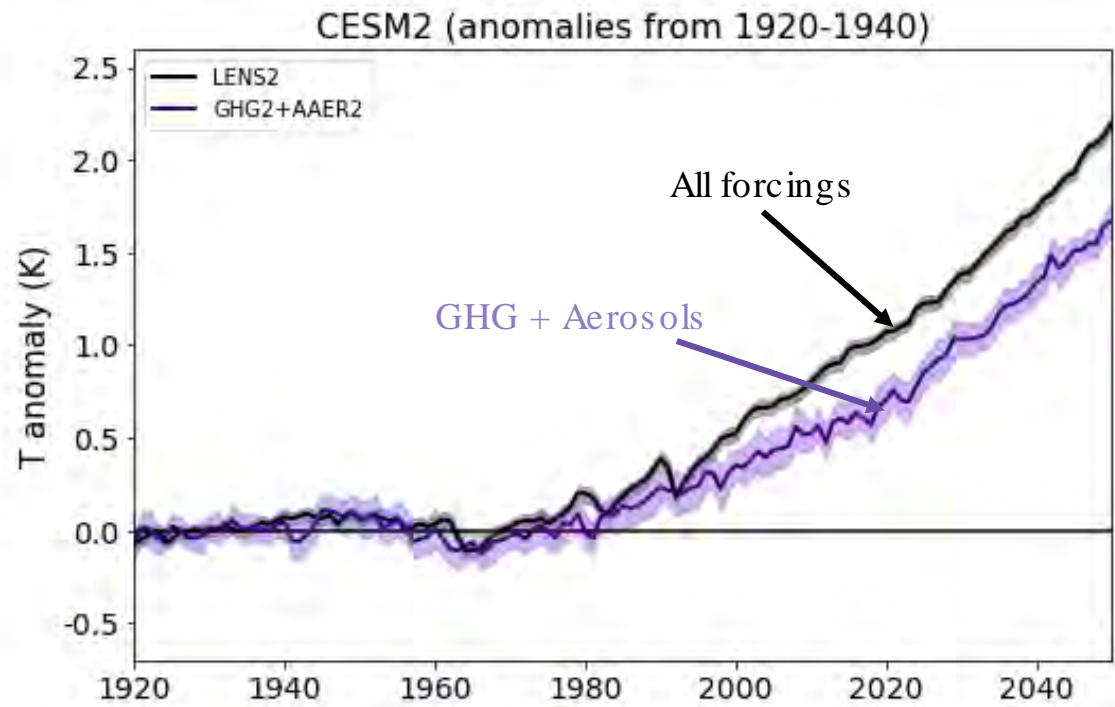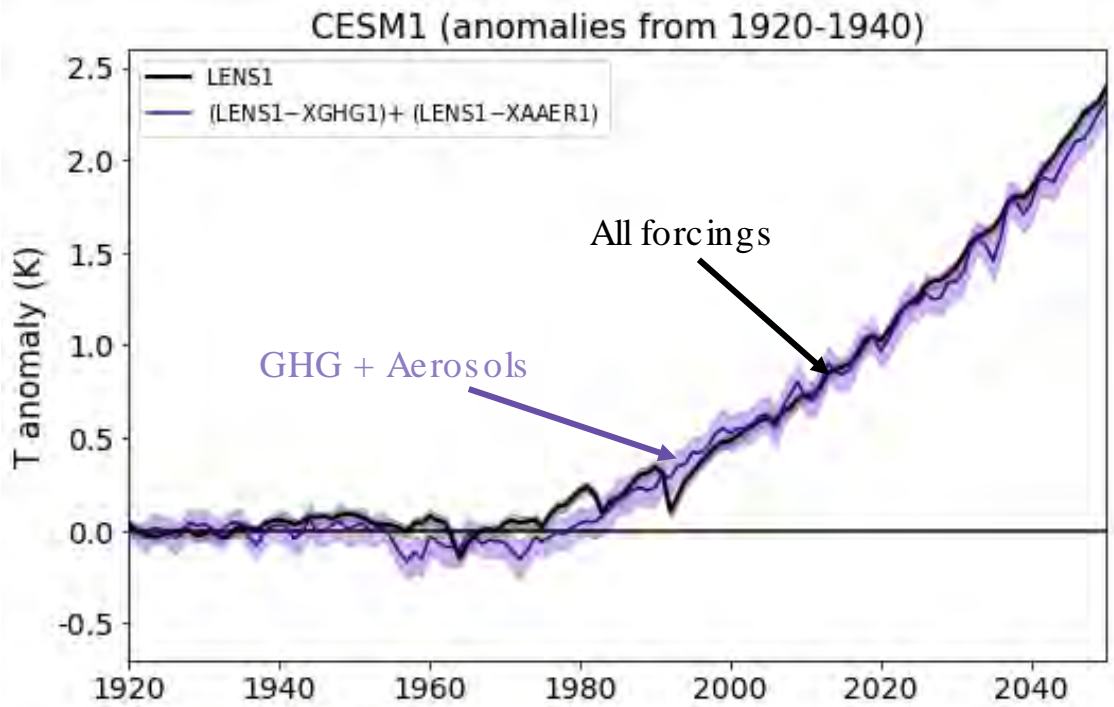Description manuscript is currently being finished
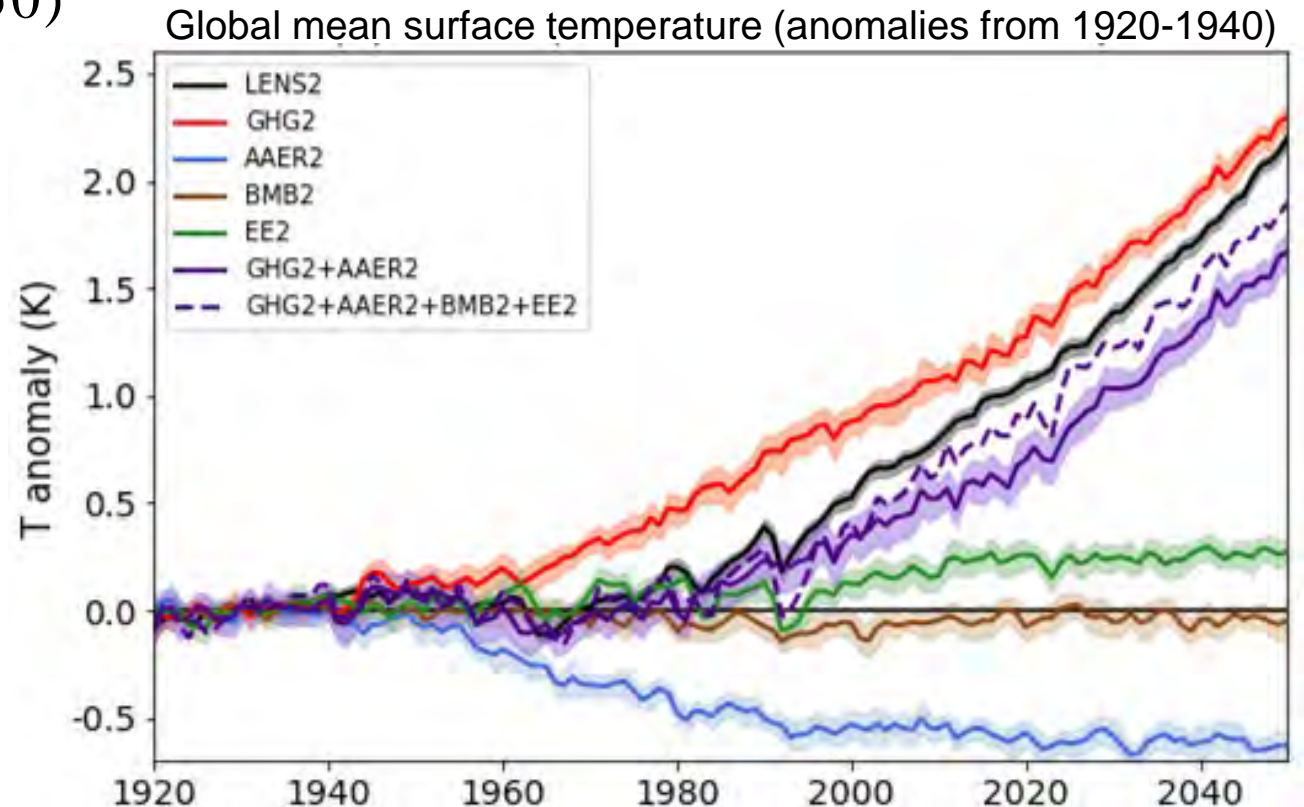
Global mean surface temperature (anomalies from 1920-1940)

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CESM2 exhibits some non-additivity. CESM1 did not. This implies some dependency on (a) model version, (b) forcings, (c) the method

CESM1 used an "all-but-one" approach with all forcings except the one of interest time evolving and the one of interest fixed at 1920

CESM2 used an "only" approach with only the forcing of interest evolving and others held fixed at 1850's levels

Global mean surface temperature anomalies

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Aerosol Influence

T_{2m} anomalies (21 year running mean)

LENS1-XAAER1 (using the all-but-one method)
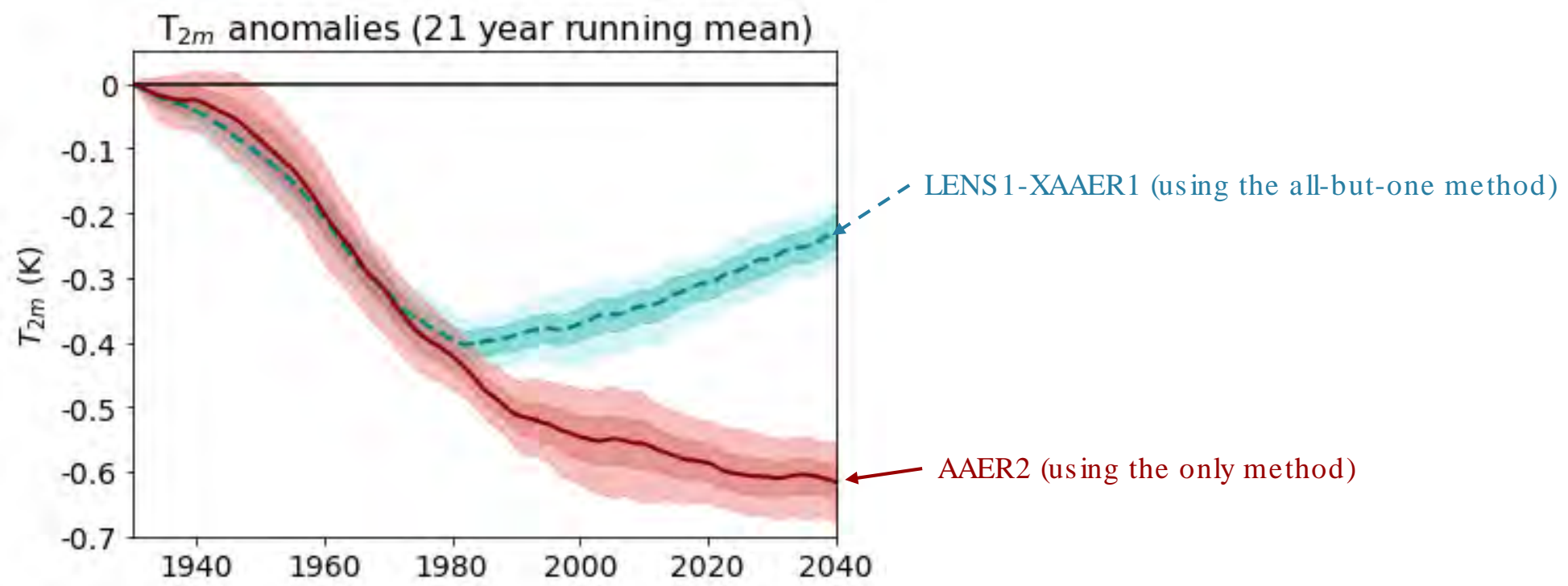
AAER2 (using the only method)

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Aerosol Influence

T$_{2m}$ anomalies (21 year running mean)

LENS1-XAAER1 (using the all-but-one method)

LENS2-XAAER2 (using the all-but-one method)
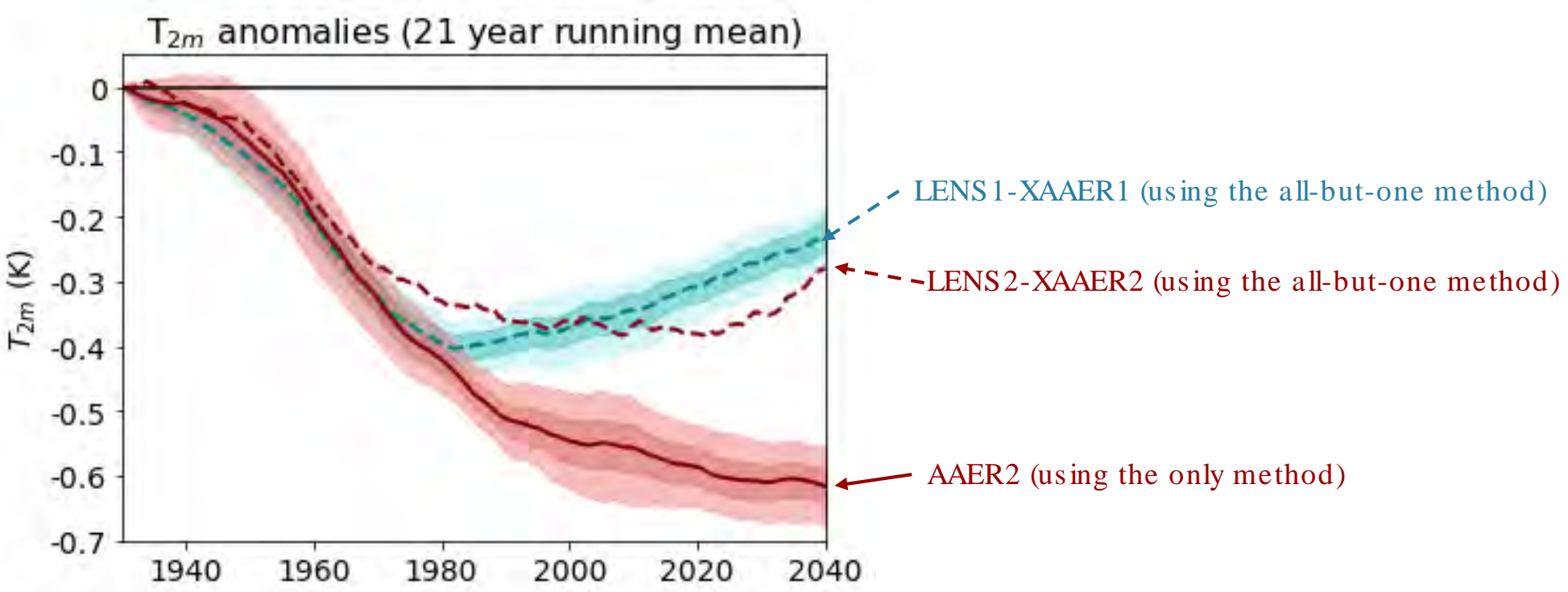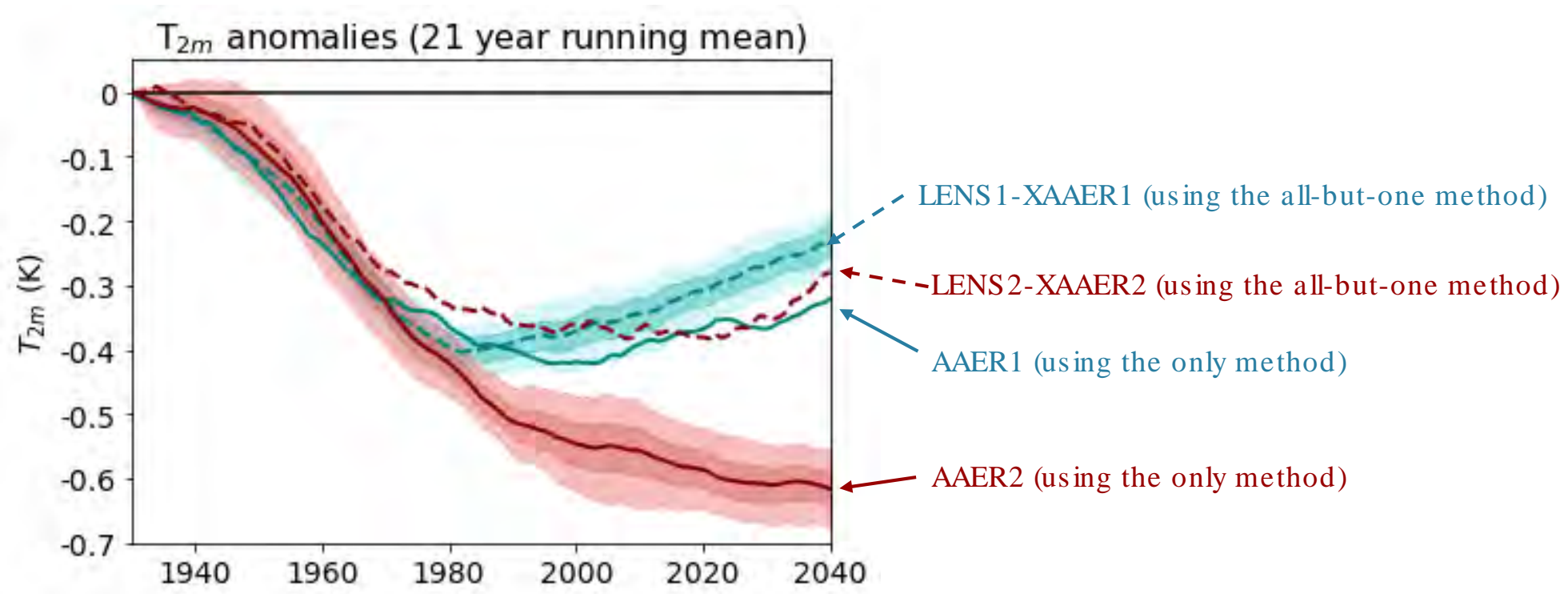
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Aerosol Influence

LENS1-XAAER1 (using the all-but-one method)

LENS2-XAAER2 (using the all-but-one method)

AAER1 (using the only method)

AAER2 (using the only method)

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Forthcoming simulations

Regionally refined 1/8th degree North Atlantic AMIP simulation

- 1950's to present day
- Prescribed daily SSTs and sea ice from a 1/10th degree forced ocean simulation (iHESP FOSI)

Primary science goals:

- Explore ocean-atmosphere coupling at high resolution
- Does this improve the representation of low frequency North Atlantic jet stream variability?
- Any evidence of a stronger eddy-mean flow feedback as argued in the context of signal-to-noise paradox issues

Lots of other things to look at:
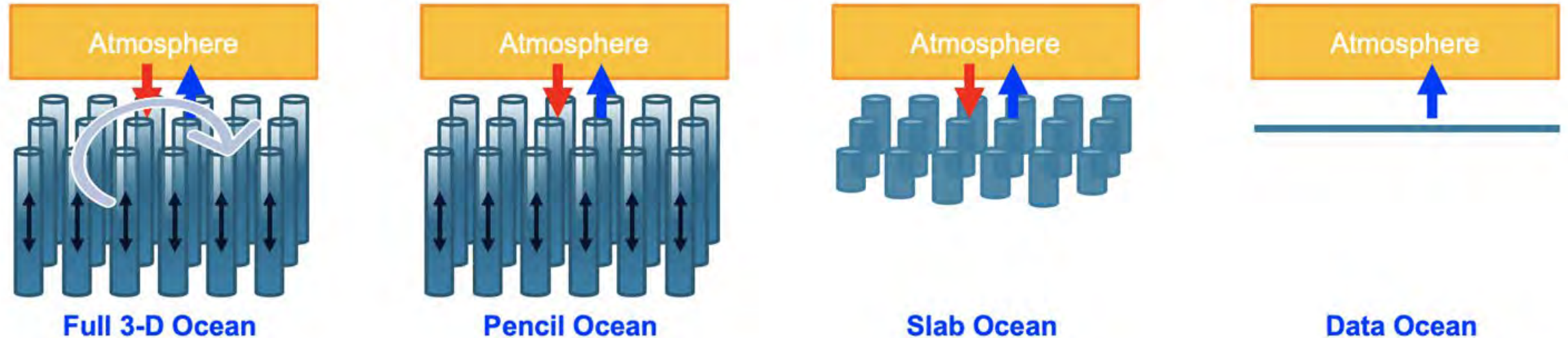Polar lows, storm track dynamics, atmospheric rivers
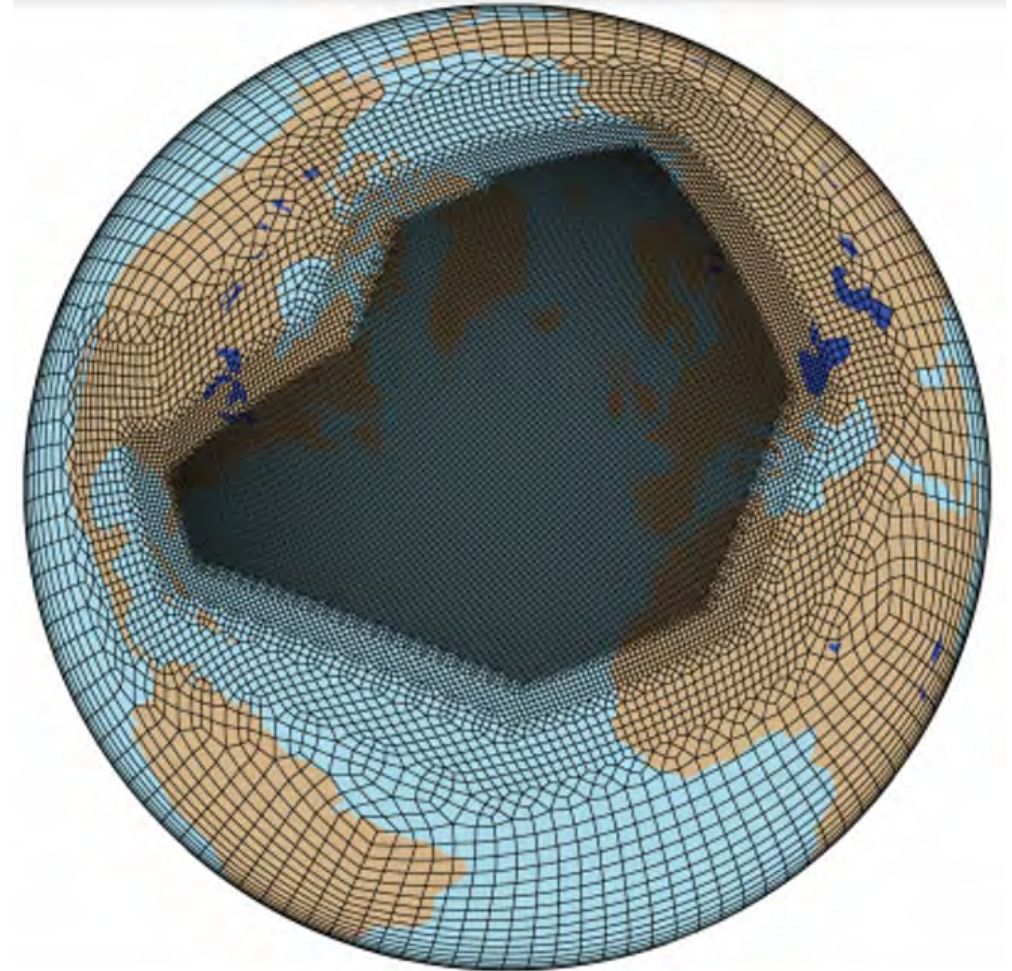
Thanks to Robb Jnglin Wills, Adam Herrington

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Pencil model pre-industrial control

(Young-Oh Kwon, Ivan Lima, Gokhan Danabasoglu, Amy Clement, and others)

Choices for the ocean model in CESM

Full 3-D Ocean

Pencil Ocean

Slab Ocean

Data Ocean

After some issues with salinity and temperature drift, the method has been refined, the model appears stable and a long piControl is about to begin (probably 1000 years)

Pre-industrial control configurations:

Prescribed SSTs → Pencil Model → Fully Coupled

Mechanically decoupled CESM. Ocean does not see surface wind stress variability (Sarah Larson's group)

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Stochastic Physics piControl

(Judith Berner)

- Stochastically Perturbed Physics Tendency (SPPT) scheme (Buizza et al. 1999, Palmer et al. 2009)
- Perturbs accumulated tendencies for U,V,T,Q from physical parameterizations

$$\frac{\partial X}{\partial t} = D_X + (r+1)P_X$$

Dynamical tendencies | Physical tendencies

- Random pattern r has spatial and temporal correlations ("mesoscale organization")
- "Moisture" fix to ensure conservation of moisture
- Has shown big impact on ENSO variability in previous CESM versions (Christensen et a. 2016, Berner et al. 2017, 2018)
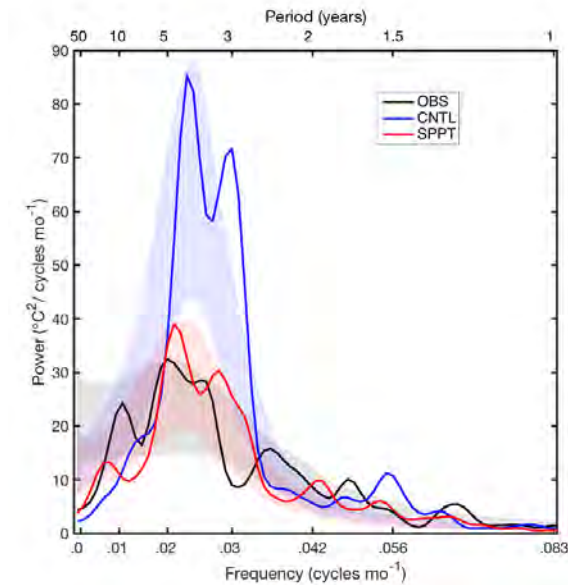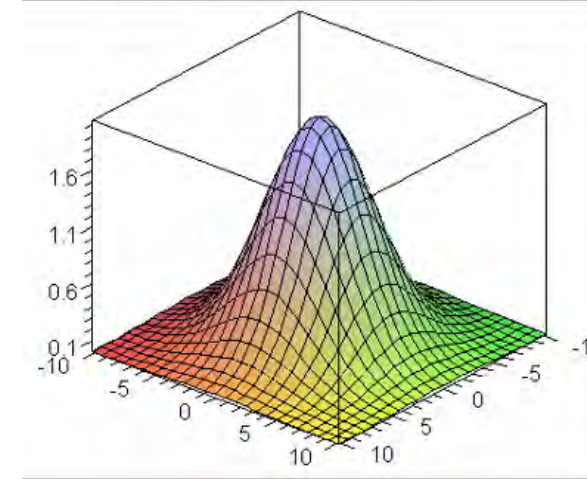
A reminder about CVCWG and related resources

- Website for simulation info: https://www.cesm.ucar.edu/working_groups/CVC/

- Climate Variability Diagnostics Package (including large ensembles version): https://www.cesm.ucar.edu/working_groups/CVC/cvdp/ https://www.cesm.ucar.edu/working_groups/CVC/cvdp-le/

- Climate Data Guide: https://climatedataguide.ucar.edu/ !! New Website coming soon !!

Contacts   Co-chairs: Isla Simpson (islas@ucar.edu)   Liaisons: Adam Phillips (asphilli@ucar.edu)
                   Aixue Hu (ahu@ucar.edu)   Gary Strand (strandwg@ucar.edu)
                   Sarah Larson (slarson@ncsu.edu)

Session: Wednesday 1pm-4:30pm, Posters: Tuesday 3:20pm-4:50pm

Please join the discussion to provide input to the next computing allocation proposal, or provide suggestions for simulations here
https://docs.google.com/document/d/1cR4UlPRYhcSyzo29wRPeA9_Yiv5hH3olg2FX8LXgLqY/edit?usp=sharing

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