

Welcome!

Agenda has been fluid

https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fspecific-groups%2Fguidance-business-response.html

Wipe down laptop keyboards (wipes provided)

Wash hands

For problems with remote meeting or other issues please email fair@ucar.edu, julio@ucar.edu, emmons@ucar.edu, or rgarcia@ucar.edu

CAM Updates

NCAR

Outline

- Some Science highlights from past year

- Equilibrium Climate Sensitivity (ECS)
- Variability in CESM2 vs CESM1
- CAM5 ⇒ CAM6 F-case exploration
- 2° Configuration
- Regional-refinement

CESM2 paper published
(Danabasoglu et al (2020) ... JAMES,
<https://doi.org/10.1029/2019MS001916>)

- Dycore evaluation activity

CAM6 paper (Neale et al. 2020 in prep)

- Collaborations

- iHESP
- CESM2 large ensemble (Korea)

- New development efforts

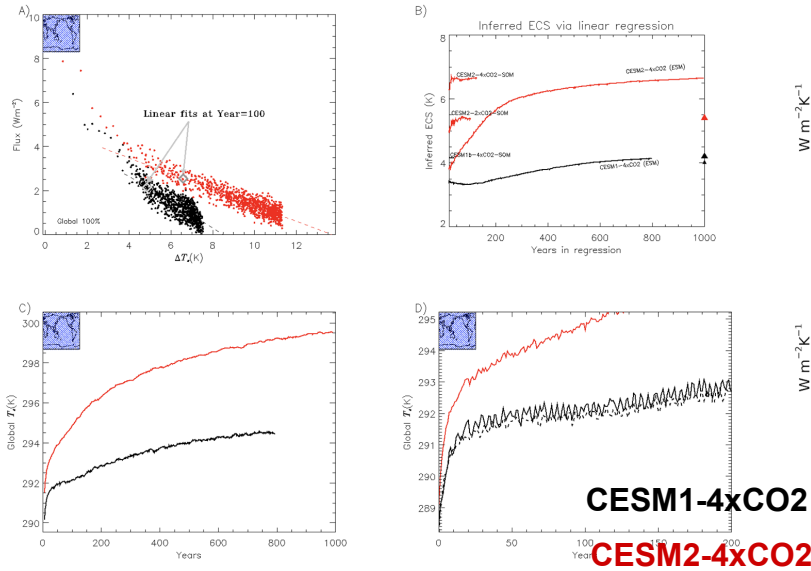
- “CAM7” funding
- EDMF and CLUBB momentum Climate Process Teams (CPTs) funded by NOAA and NSF

- Other Future directions for CAM

- Science: Prediction (sub-seasonal to decadal)
- Infrastructure: SIMA, CCpp

Equilibrium Climate Sensitivity (4xCO2 simulations)

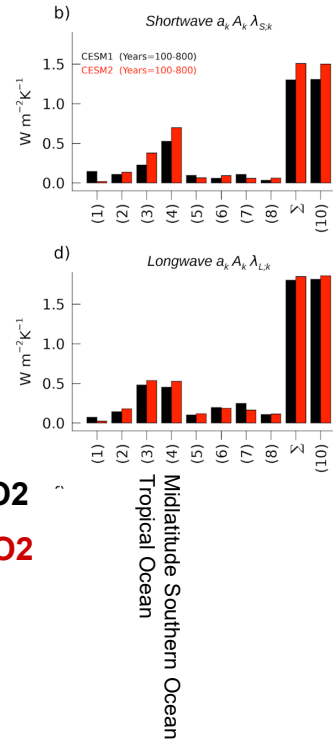
Gregory plots, ECS, timeseries etc.



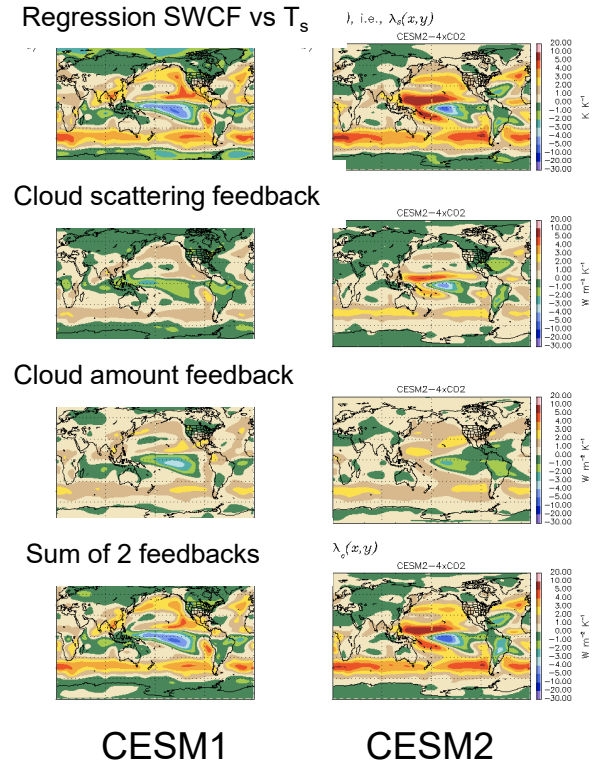
Bacmeister et al. (2020, in prep)
Gettelman et al. (2019) GRL

ECS has increased between CESM1 and CESM2. Shortwave feedbacks in the tropics and Southern Ocean are responsible. Increased cloud scattering feedbacks dominate

Regional contributions to feedbacks/sensitivity



APRP analysis



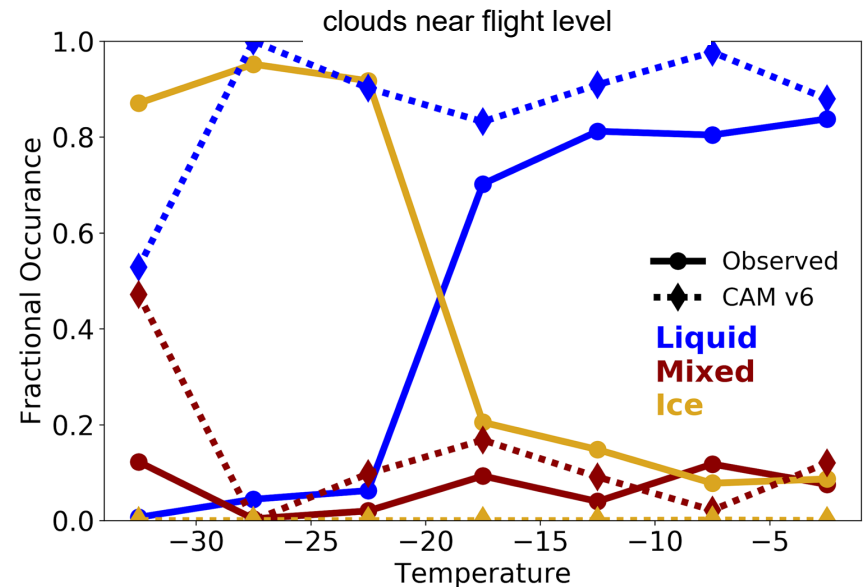
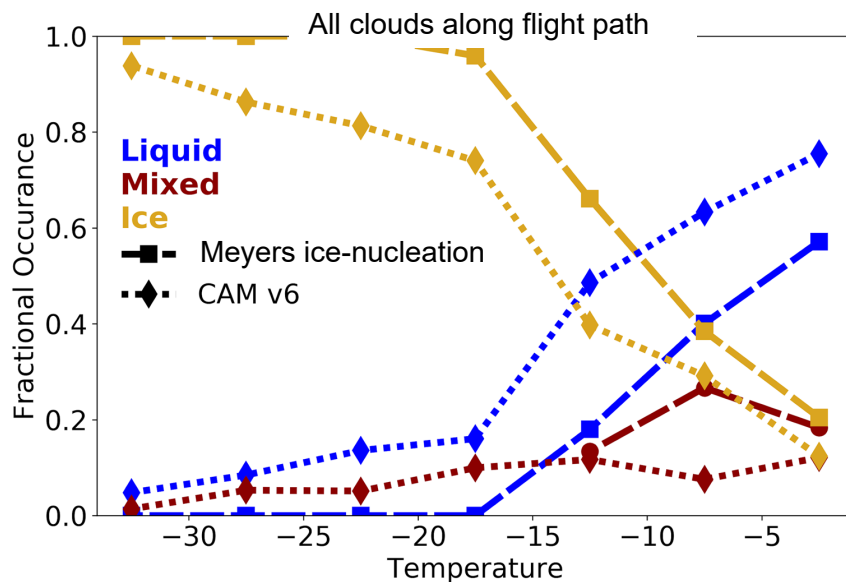
CESM1

CESM2

Southern ocean mixed phase clouds contain more **liquid** in default CAM6 than with modified ice-nucleation scheme (from CAM5)

Observed clouds during SOCRATES were used to characterize cloud phase (right). Observations indicate a phase transition around -20 C.

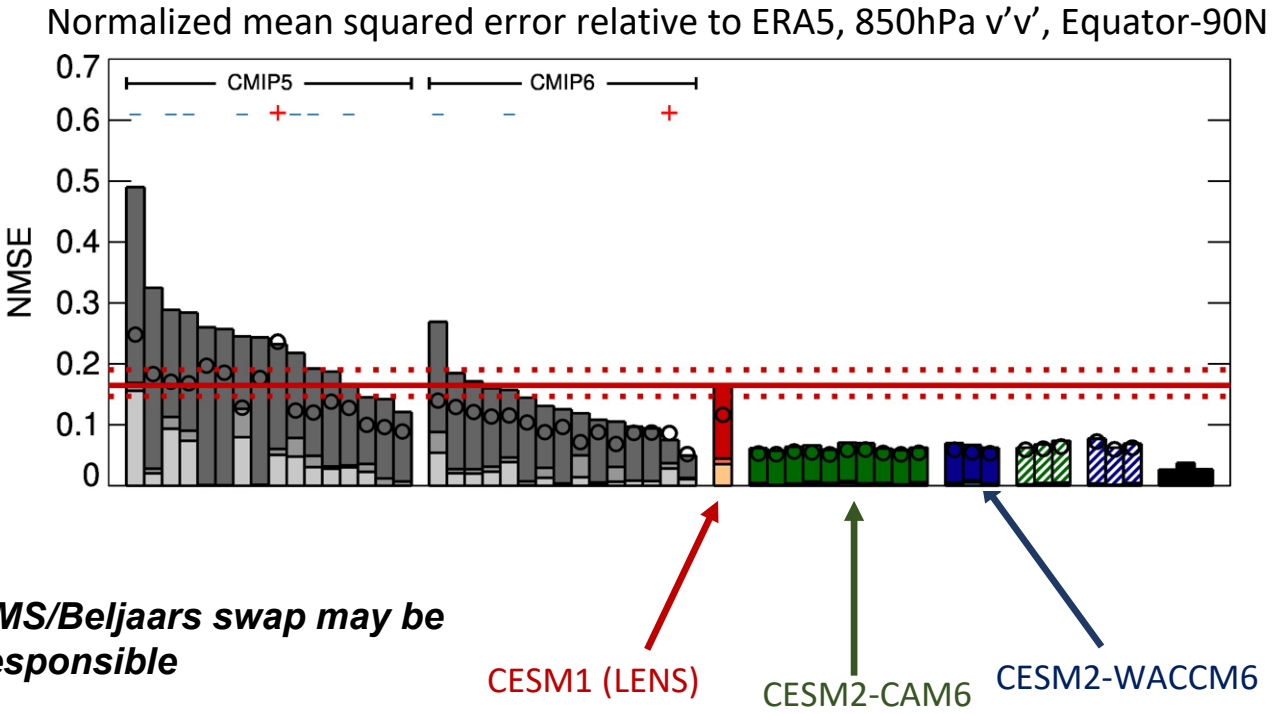
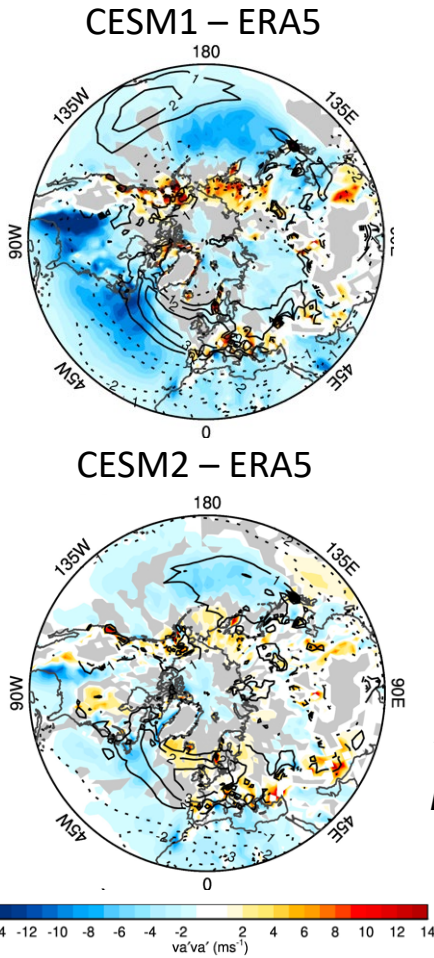
CAM6 simulated clouds (nudged to MERRA2) were sampled along the GV flight track. These clouds were supercooled down to -25C and little to no ice is simulated in CAM6.



Christina McCluskey

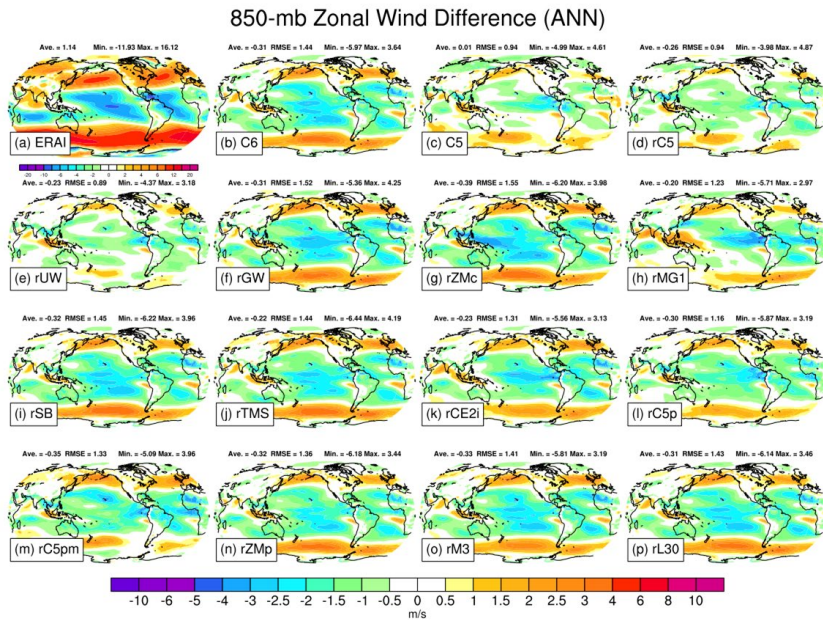
More on CESM clouds from Brian Medeiros and Andrew Gettelman

Improvements in stormtracks, NH winter, 850hPa 10-day pass filtered eddy meridional wind variance



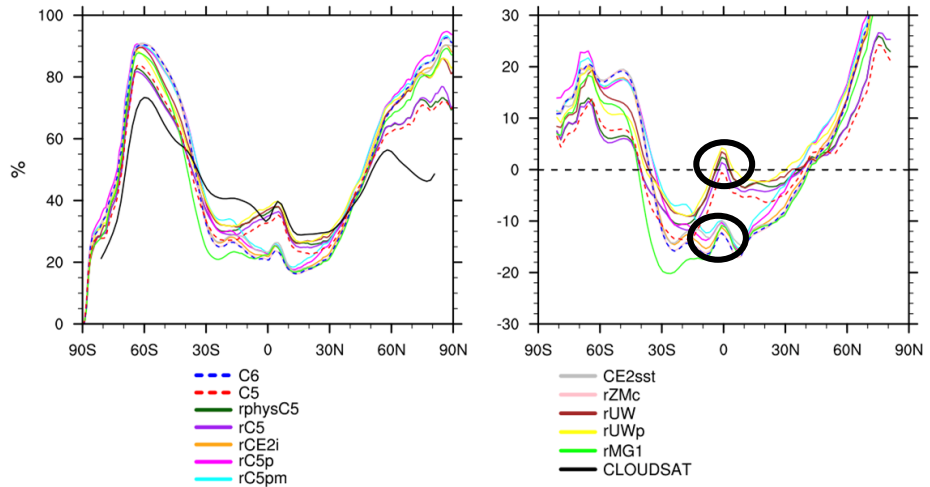
Isla Simpson (Simpson et al 2020 JGR, in review)

Means in F-case runs with CESM1/CESM2 “physics swaps”



Annual mean low-level winds significantly worse in CESM2 but winter means and variability are better

Low cloud fraction



Tropical clusters defined by UW/CLUBB swap. Southern Ocean changes related to both MG1/MG2 and UW/CLUBB swaps

Rich Neale and Cecile Hannay (discussed in Neale et al 2020)

F-case runs

Extensive suite of runs

- revert to **cam5** parameterizations
- revert to **cam5** tuning parameters
- impact of **SSTs**

All these runs are 1979-2005 with monthly and high frequency data.

Contact Cecile or Rich to get the data.

Impact of parameterizations and tuning parameters



FHST RUNS
Tuning parameters and parameterization for the FHST runs

Run	Parameterization	Physics	Diagnoses
1x01FHST05_05_cam5_1	cam5	HadSSTs	Monthly
1x01FHST05_05_cam5_2	cam5	Reynolds	Daily
1x01FHST05_05_cam5_3	cam5	CESM1	Monthly
1x01FHST05_05_cam5_4	cam5	CESM2	Monthly
1x01FHST05_05_cam5_5	cam5	CESM2	Daily
1x01FHST05_05_cam5_6	cam5	CESM2	Monthly
1x01FHST05_05_cam5_7	cam5	CESM2	Daily
1x01FHST05_05_cam5_8	cam5	CESM2	Monthly
1x01FHST05_05_cam5_9	cam5	CESM2	Daily
1x01FHST05_05_cam5_10	cam5	CESM2	Monthly
1x01FHST05_05_cam5_11	cam5	CESM2	Daily
1x01FHST05_05_cam5_12	cam5	CESM2	Monthly
1x01FHST05_05_cam5_13	cam5	CESM2	Daily
1x01FHST05_05_cam5_14	cam5	CESM2	Monthly
1x01FHST05_05_cam5_15	cam5	CESM2	Daily
1x01FHST05_05_cam5_16	cam5	CESM2	Monthly
1x01FHST05_05_cam5_17	cam5	CESM2	Daily
1x01FHST05_05_cam5_18	cam5	CESM2	Monthly
1x01FHST05_05_cam5_19	cam5	CESM2	Daily
1x01FHST05_05_cam5_20	cam5	CESM2	Monthly
1x01FHST05_05_cam5_21	cam5	CESM2	Daily
1x01FHST05_05_cam5_22	cam5	CESM2	Monthly
1x01FHST05_05_cam5_23	cam5	CESM2	Daily
1x01FHST05_05_cam5_24	cam5	CESM2	Monthly
1x01FHST05_05_cam5_25	cam5	CESM2	Daily
1x01FHST05_05_cam5_26	cam5	CESM2	Monthly
1x01FHST05_05_cam5_27	cam5	CESM2	Daily
1x01FHST05_05_cam5_28	cam5	CESM2	Monthly
1x01FHST05_05_cam5_29	cam5	CESM2	Daily
1x01FHST05_05_cam5_30	cam5	CESM2	Monthly
1x01FHST05_05_cam5_31	cam5	CESM2	Daily
1x01FHST05_05_cam5_32	cam5	CESM2	Monthly
1x01FHST05_05_cam5_33	cam5	CESM2	Daily
1x01FHST05_05_cam5_34	cam5	CESM2	Monthly
1x01FHST05_05_cam5_35	cam5	CESM2	Daily
1x01FHST05_05_cam5_36	cam5	CESM2	Monthly
1x01FHST05_05_cam5_37	cam5	CESM2	Daily
1x01FHST05_05_cam5_38	cam5	CESM2	Monthly
1x01FHST05_05_cam5_39	cam5	CESM2	Daily
1x01FHST05_05_cam5_40	cam5	CESM2	Monthly
1x01FHST05_05_cam5_41	cam5	CESM2	Daily
1x01FHST05_05_cam5_42	cam5	CESM2	Monthly
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1x01FHST05_05_cam5_85	cam5	CESM2	Daily
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1x01FHST05_05_cam5_96	cam5	CESM2	Monthly
1x01FHST05_05_cam5_97	cam5	CESM2	Daily
1x01FHST05_05_cam5_98	cam5	CESM2	Monthly
1x01FHST05_05_cam5_99	cam5	CESM2	Daily
1x01FHST05_05_cam5_100	cam5	CESM2	Monthly

Impact of SSTs datasets

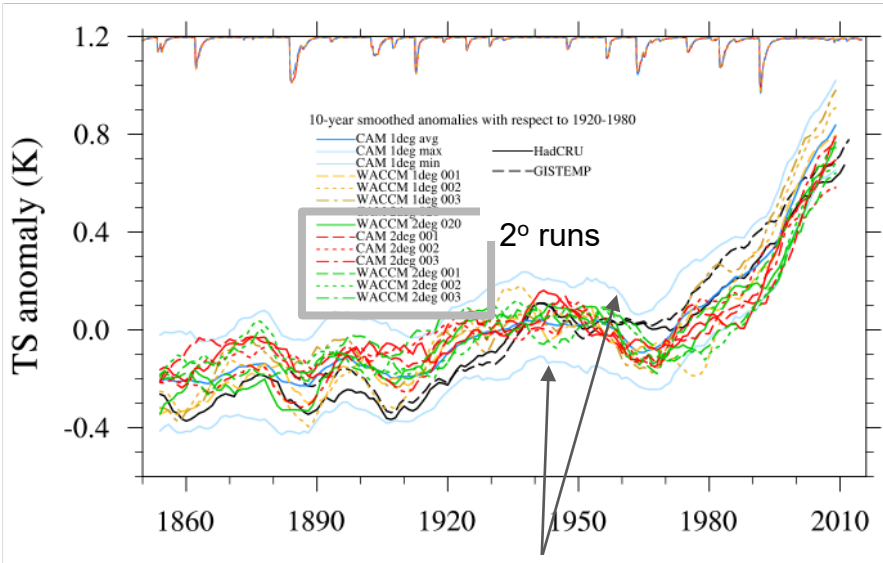
SST datasets
This table shows the simulations done with different SSTs. All the simulations used the Fv01 compset and the cam5211 log.

Run	SST	Physics	Diagnoses
1x01FHST05_05_cam5_1	Hadley monthly SST	CAAM	Monthly
1x01FHST05_05_cam5_2	Reynolds daily SST	CAAM	Daily
1x01FHST05_05_cam5_3	Coupled CAAM SST	CAAM	Monthly
1x01FHST05_05_cam5_4	Monthly historical	CAAM	Monthly
1x01FHST05_05_cam5_5	Coupled CAAM SST	CAAM	Monthly
1x01FHST05_05_cam5_6	Daily historical	CAAM	Daily
1x01FHST05_05_cam5_7	Coupled CAAM SST	CAAM	Monthly
1x01FHST05_05_cam5_8	Monthly Chronological	CAAM (phys cam5)	Monthly
1x01FHST05_05_cam5_9	Monthly historical	CAAM	Monthly
1x01FHST05_05_cam5_10	Coupled CAAM SST	CAAM	Monthly
1x01FHST05_05_cam5_11	Monthly historical	CAAM (phys cam5)	Monthly
1x01FHST05_05_cam5_12	Coupled CAAM SST	CAAM (phys cam5)	Monthly

HadSSTs, Reynolds, CESM1 vs CESM2 SSTs daily vs monthly SSTs

Two degree configuration

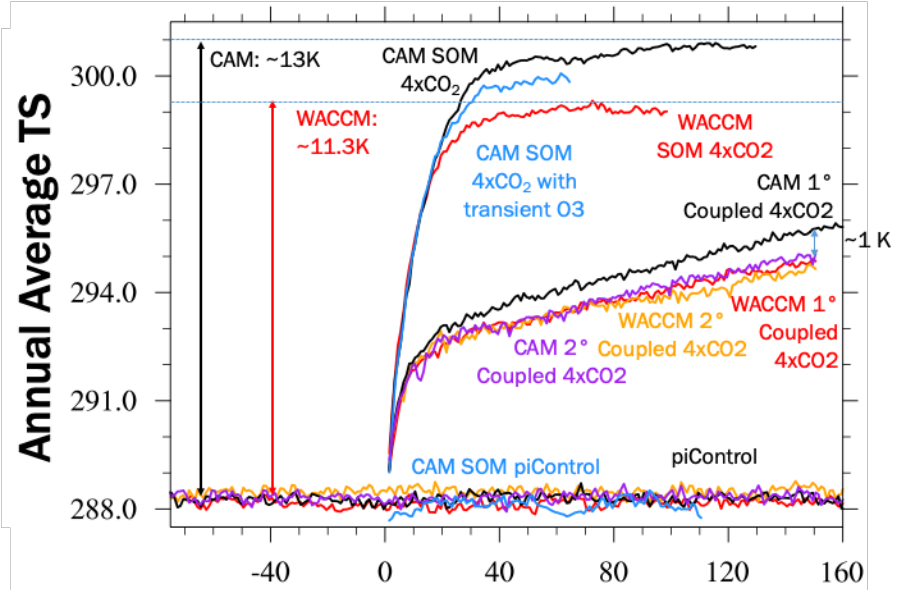
CESM2 FV 2° 20th C Simulations



CESM2(CAM) 1° ensemble bounds

Tangle of lines means 2° configuration is similar to 1°

Climate Sensitivity: WACCM vs CAM



2° configuration less sensitive than 1°

Mike Mills & Rolando Garcia

Dycores

Peter Lauritzen will discuss more extensively on Wednesday

Coupled simulations with CESM2 , using FV3 and SE-CSLAM dycores have begun. Both yield reasonable SSTs (still short runs)

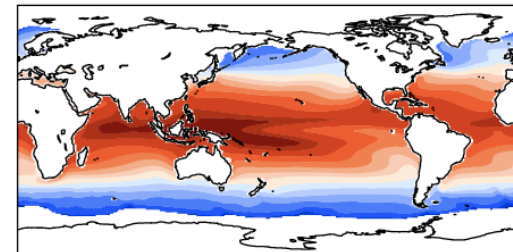
SSTs in fully coupled simulations with FV3 and SE-CSLAM

b.e21.B1850.ne30pg3_g17.intel.1656pe.1thrd.cesm2_2_alpha04b_plus_cam6_2_007.ch011 (yrs 2-31)

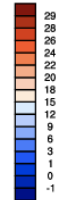
Sea surface temperature

mean= 19.78

ANN



Min = -0.58 Max = 30.01



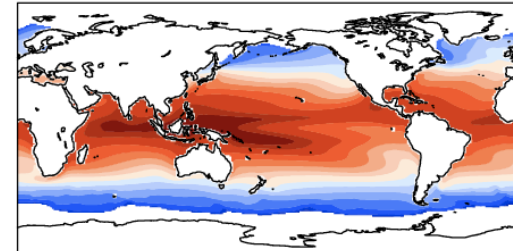
SE-CSLAM

b.e21.B1850.C96_C96_mg17.intel.1152pe.3thrd.cesmjt_fv3port44.ch003 (yrs 2-31)

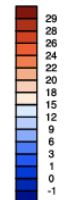
Sea surface temperature

mean= 19.88

C



Min = -0.66 Max = 30.09



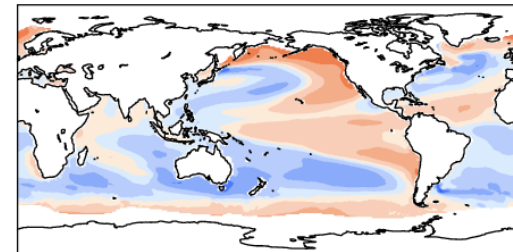
FV3

g17.intel.1656pe.1thrd.cesm2_2_alpha04b_plus_cam6_2_007.ch011 - b.e21.B1850.C96_C96_mg17.intel.1152pe.3thrd.ces

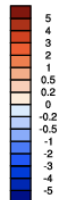
mean = -0.01

rmse = 0.39

C

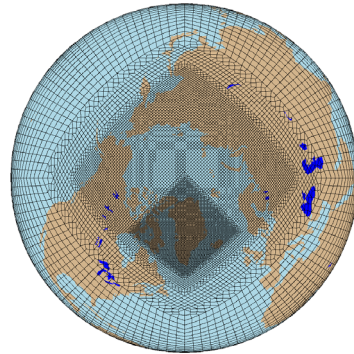
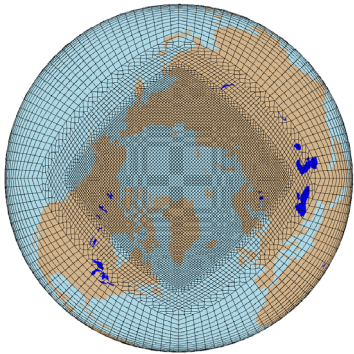


Min = -2.32 Max = 2.21



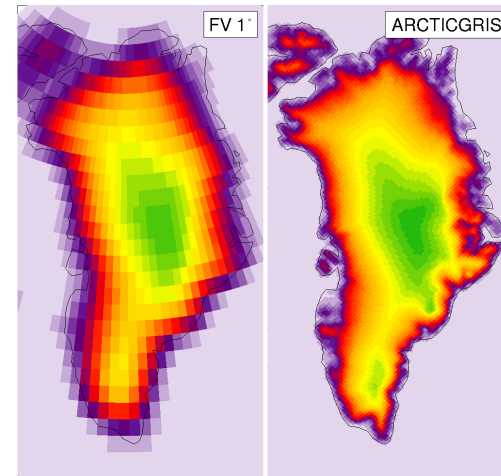
'ARCTIC' (28 km)

'ARCTICGRIS' (14 km)



- CESM2.2 spectral-element dycore
- Variable-resolution (VR) topography
- Scale-aware tensor hyper-viscosity
- MG3 microphysics with improved ice phase
- 6X cheaper than global uniform 28km
- 20X cheaper than global uniform 14km

Greenland Ice Sheet (GrIS) Topography

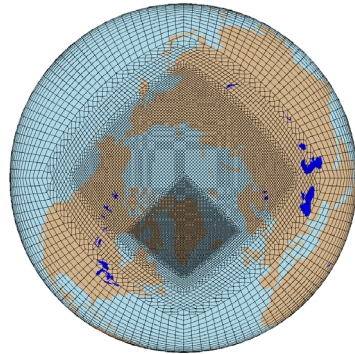
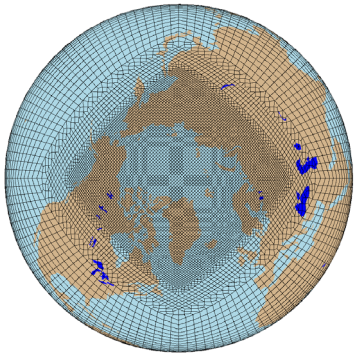


1° finite-volume (left) and ARCTICGRIS (right)

- **Substantial improvement in GrIS SMB over the standard 1° model** (van Kampenhout et al. 2019)
- **2-way coupling with CISM for comprehensive GrIS sea-level study** (Led by ASP Postdoc Adam Herrington)

'ARCTIC' (28 km)

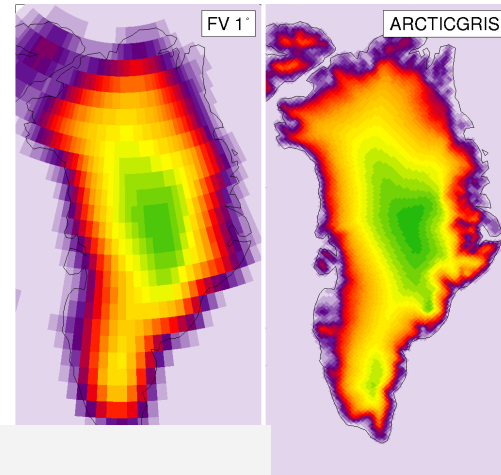
'ARCTICGRIS' (14 km)



- CESM2.2 spectral
- Variable-resolution
- Scale-aware tensors
- MG3 microphysics
- 6X cheaper than
- 20X cheaper than

Patrick Callaghan will demonstrate regional refinement tools on Wednesday (1PM)

Greenland Ice Sheet (GrIS) Topography

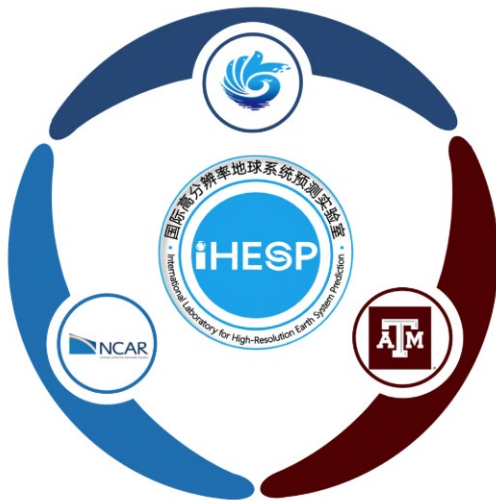


(left) and ARCTICGRIS (right)

refinement in GrIS SMB over the
(van Kampenhout et al. 2019)

using CISM for comprehensive
/ (Led by ASP Postdoc Adam

International Laboratory for High-Resolution Earth System Prediction (iHESP): An Unprecedented Set of High-Resolution Simulations



A partnership between

Qingdao National Laboratory for Marine Science and Technology (QNLN)

Texas A&M University (TAMU)

National Center for Atmospheric Research (NCAR)

Planned simulations:

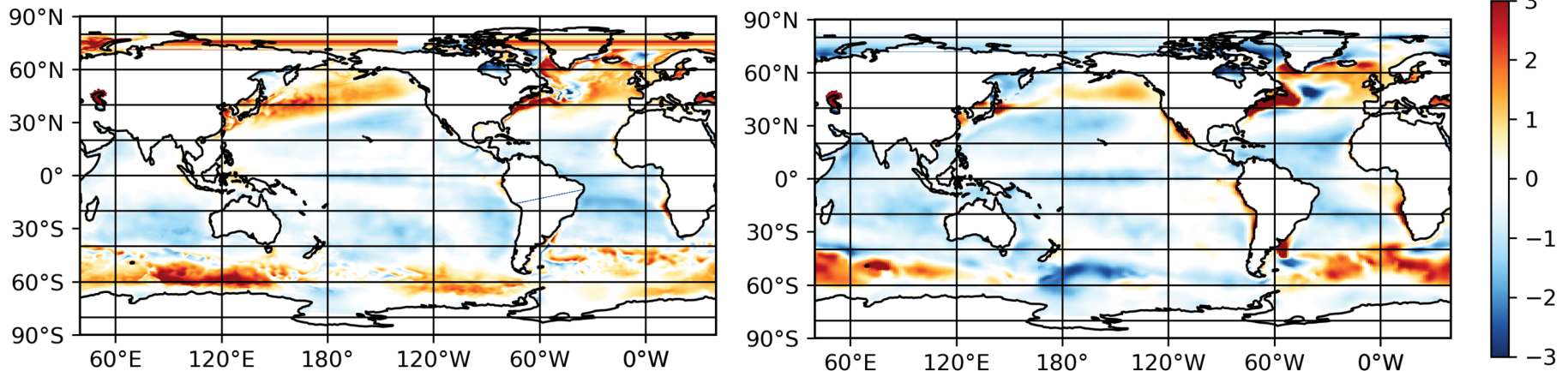
- 500-year 1850 PI-control (@450)
- HighResMIP
- Event based decadal predictions

Community Earth System Model High-Resolution Version (CESM-HR)

Based on cesm1.3 with atmosphere and land at 0.25° and ocean and sea-ice at nominal 0.1° resolution

CESM1.3 has been recoded substantially to run on the Sunway System efficiently.

Time-Mean Sea Surface Temperature Bias



Results available to community Summer 2020

CESM2 Large Ensemble

A new collaboration / partnership with the Institute for Basic Science (IBS) Center for Climate Physics (ICCP) in Busan, S. Korea

A set of CESM2 Large Ensemble simulations are being performed which started in February 2020 with an anticipated completion date of July - August 2020



CESM2 Large Ensemble

- 100 ensemble members for the 1850-2100 period.
- The computational resources are provided by ICCP.
- Received community-wide input on ensemble initialization; output fields; etc.
- Ensembles are generated using a combination of macro (different ocean initial conditions) and micro (round-off perturbations of the atmospheric temperature) initialization approaches.
- Data are being transferred to NCAR; will be CMORized; and posted on the ESGF for use of the broader community.

New development efforts (funded) at NCAR

- “CAM7” funding from NSF
 - 2-3 new project scientist positions + 2 software engineering positions focused on CAM development. Possible ladder track opening. (see https://ucar.wd5.myworkdayjobs.com/UCAR_Careers)
 - Aimed at: a) Physics parameterization development including LES component; b) Developing streamlined tools for prediction, regional refinement
 - In response to recent experience with ECS in CESM2 and other community input
- Climate Process Teams (CPT), funded by NOAA and NSF
 - EDMF (P.I. J. Teixeira)
 - CLUBB Momentum transport (P.I. C. Zarzycki)

CCPP (Common Community Physics Package)

Who is using it/funding it?

- The CCPP Framework is jointly developed and governed by NOAA and NCAR via an agreement signed by NOAA and NCAR (upper) management.
- The new NOAA Unified Forecast Model (UFS) uses CCPP physics suites (ported from GFS physics).
- The NRL NEPTUNE model has been converted to a CCPP “host model” and runs CCPP physics.
- MPAS-A is being converted to be able to run CCPP physics and a WRF physics suite is being ported.

What about CAM?

- A new version of CAM is under development that is a CCPP “host model” (i.e., it will run CCPP physics suites).
- Kessler physics suite has been ported to the CCPP,
- Plans are being finalized to port all of CAM6 physics to CCPP .

Steve Goldhaber

CCPP(Common Community Physics Package) / CPF(Common Physics Framework)

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    kind = kind_phys  
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  qv, qc, qr, precl, errmsg, errflg)
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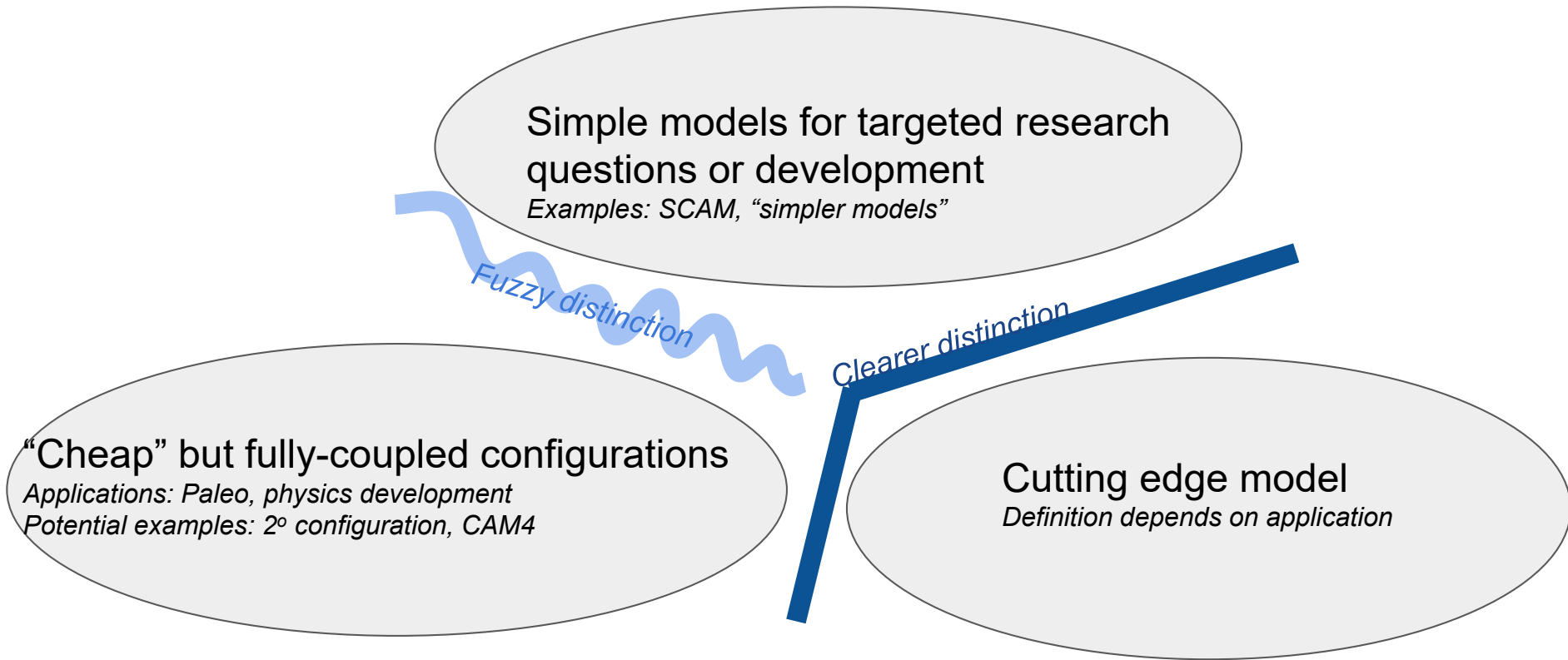
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suite.xml

CCPP
Framework

Physics driver
code

Future Directions for CAM (???)



Discussion Topics this meeting

- Directions and challenges for CAM
 - Prediction (sub-seasonal to decadal)
 - Process understanding
 - Resolution (horizontal and vertical)
 - Value of simplified CESM/CAM configurations
 - CCpp
 - ...
- Value of CMIP
- WACCM/CAM/CAM-Chem Unification

Communication ???

Communication with the community has been an issue

Are the winter WG meetings the best format for communication?

Would a slightly longer CESM summer meeting with longer WG-specific sessions be better?

What if supplemented by monthly/bi-monthly remote ZOOM meetings?