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, juliob@ucar.edu, emmons@ucar.edu, or rgarcia@ucar.edu

CAM Updates

NCAR

Outline

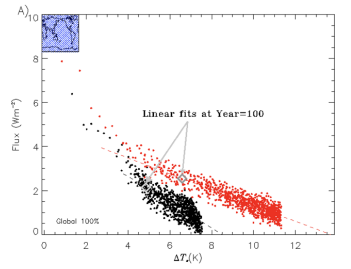
- Some Science highlights from past year
  - Equilibrium Climate Sensitivity (ECS)
  - Variability in CESM2 vs CESM1
  - CAM5 ⇒ CAM6 F-case exploration
  - 2º Configuration
  - Regional-refinement
- Dycore evaluation activity
- Collaborations
  - iHESP
  - CESM2 large ensemble (Korea)
- New development 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

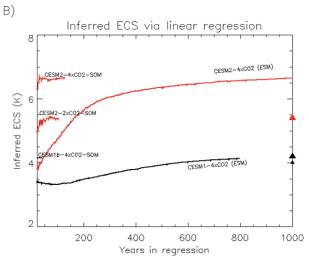
CESM2 paper published
(Danabasoglu et al (2020) ... JAMES,
https://doi.org/10.1029/2019MS001916

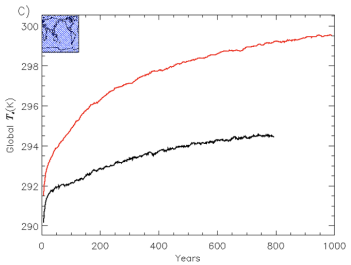
CAM6 paper (Neale et al. 2020 in prep)

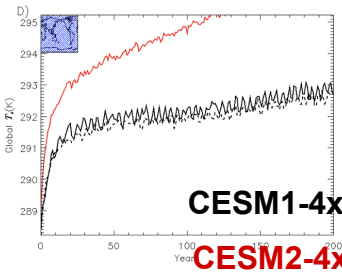
Equilibrium Climate Sensitivity (4xCO2 simulations)

Gregory plots, ECS, timeseries etc.







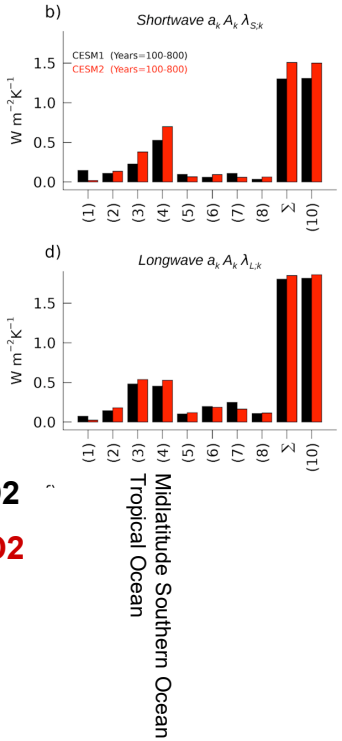


CESM1-4xCO2

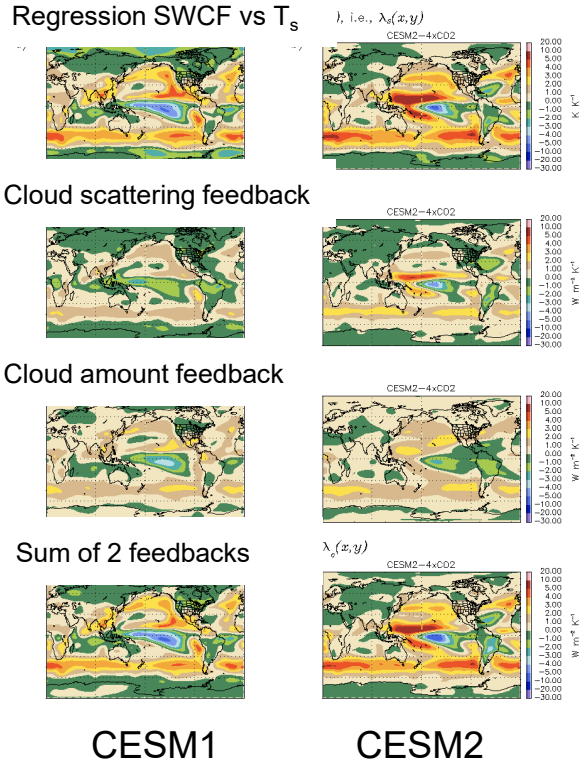
CESM2-4xCO2

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

Regional contributions to feedbacks/sensitivity



APRP analysis

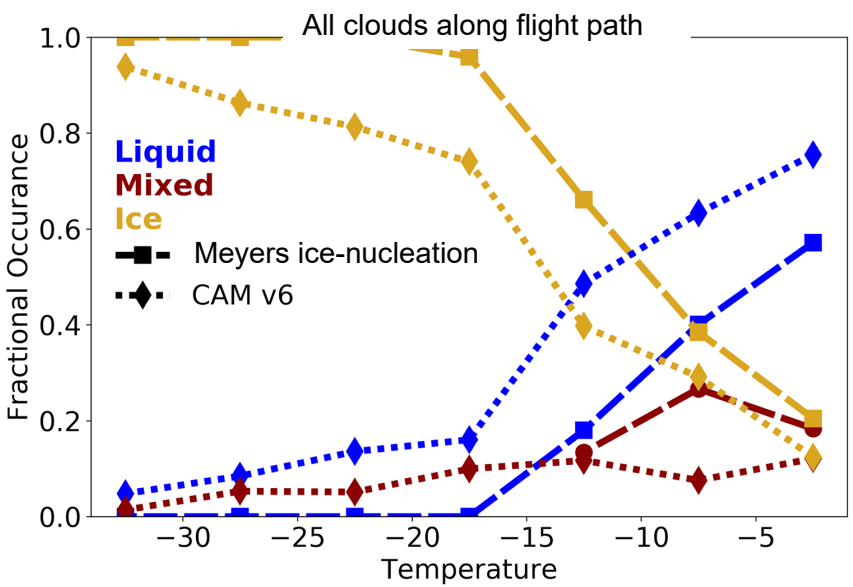


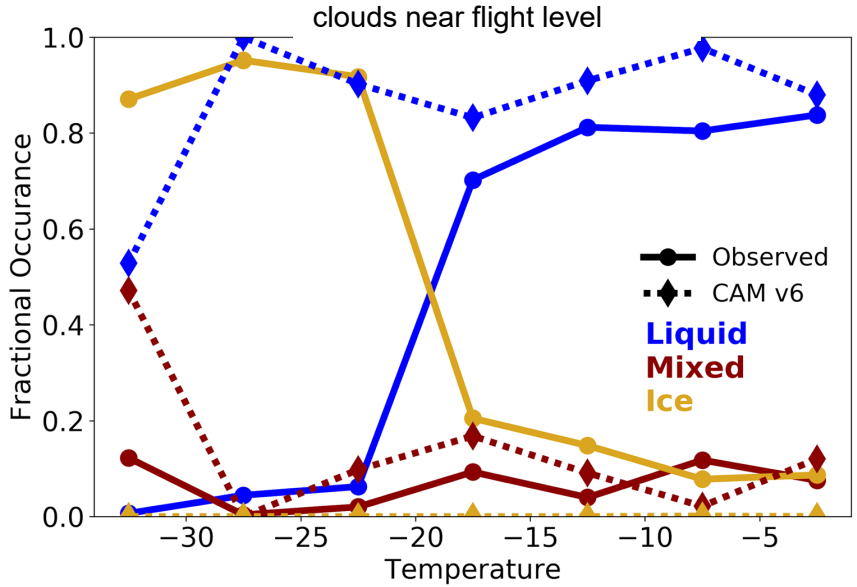
ECS has increased between CESM1 and CESM2. Shortwave feedbacks in the tropics and Southern Ocean are responsible. Increased cloud scattering feedbacks dominate

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.



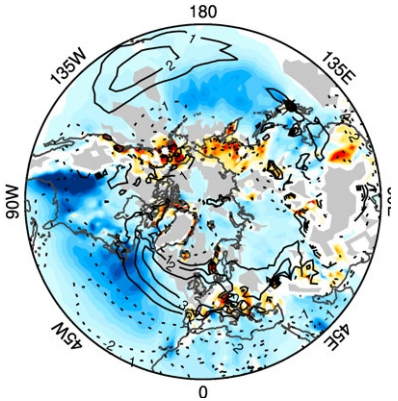


Christina McCluskey

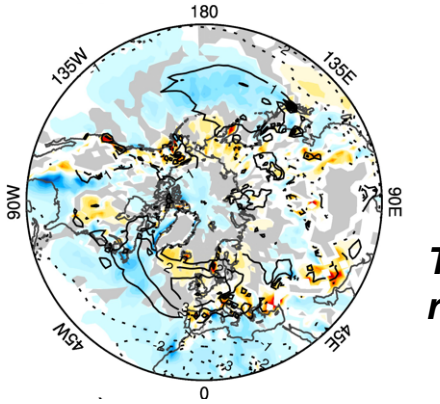
More on CESM clouds from Brian Medeiros and Andrew Gettelman

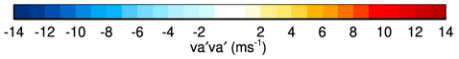
Improvements in stormtracks, NH winter, 850hPa 10-day high pass filtered eddy meridional wind variance

CESM1 – ERA5

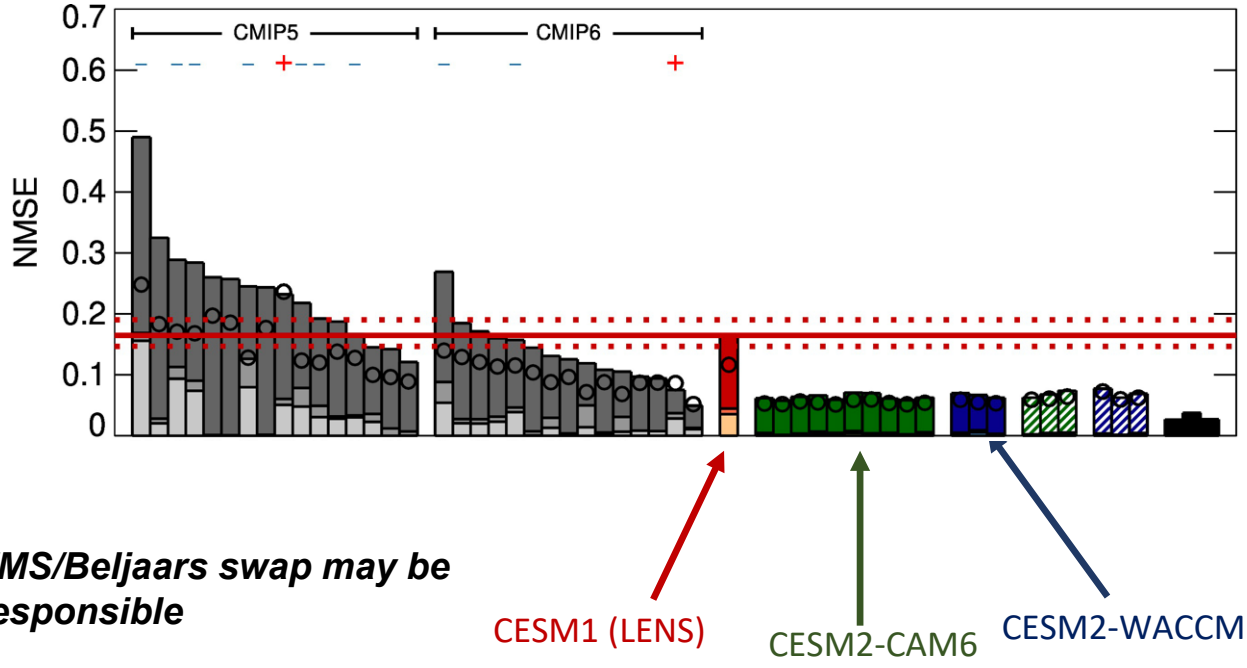


CESM2 – ERA5





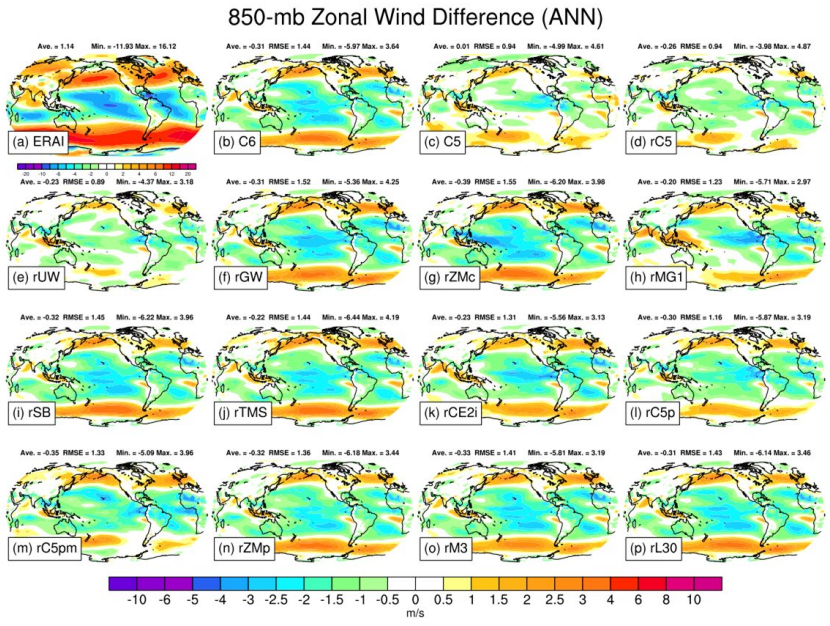
Normalized mean squared error relative to ERA5, 850hPa v'v', Equator-90N



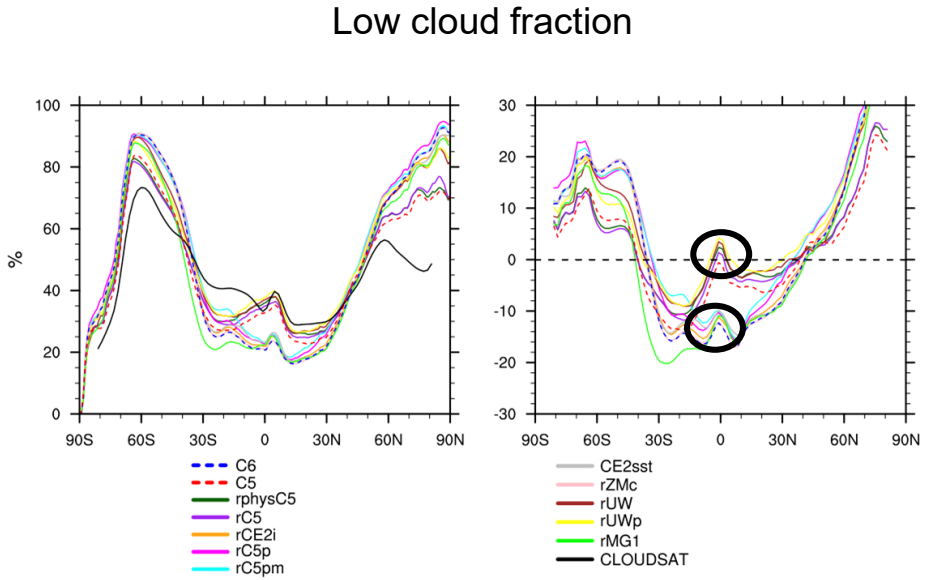
TMS/Beljaars swap may be responsible

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



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

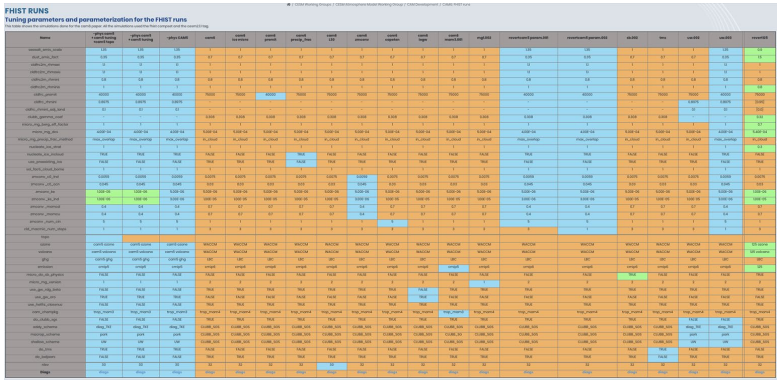
Extensive suite of runs
- revert to cam5 parameterizations
- revert to cam5 tuning parameters
- impact of SSTs

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

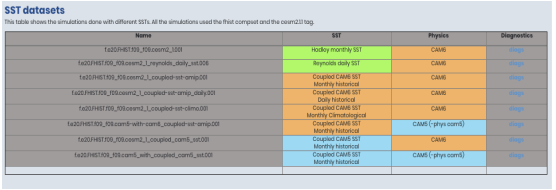
Contact Cecile or Rich to get the data.

Impact of parameterizations and tuning parameters

cam5 *cam6* *other*

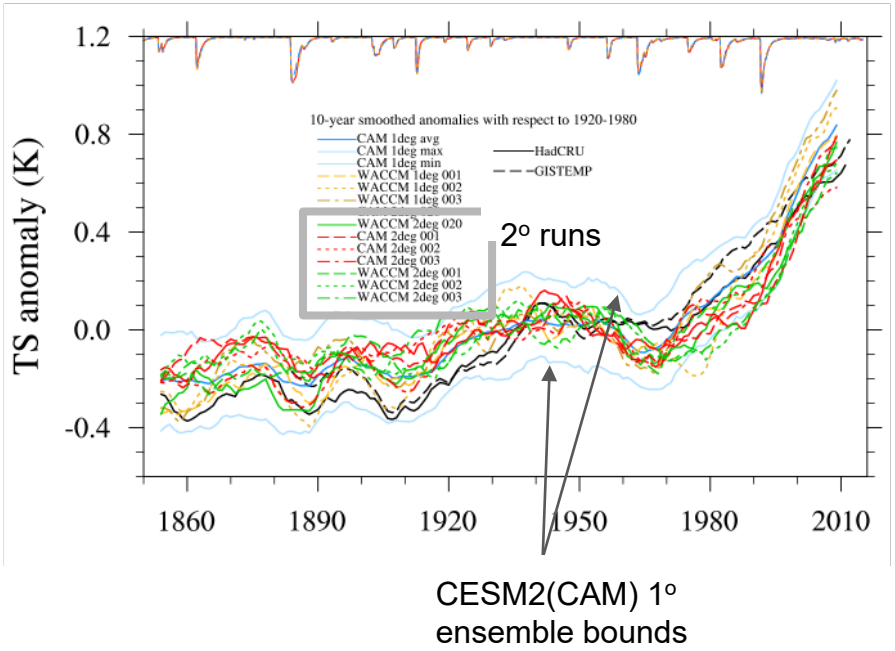


Impact of SSTs datasets



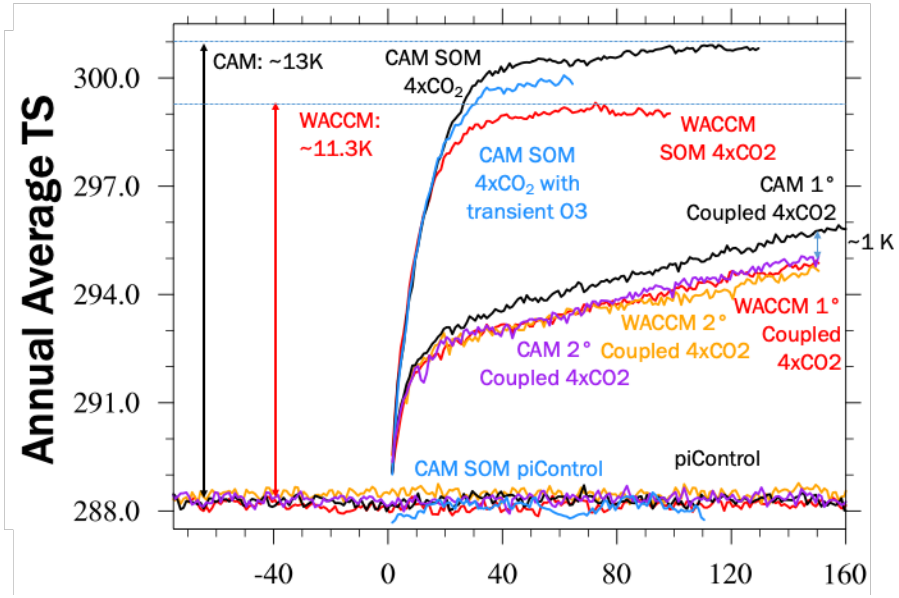
HadSSTs, Reynolds,
CESM1 vs CESM2 SSTs
daily vs monthly SSTs

Two degree configuration



CESM2(CAM) 1° ensemble bounds

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



2° configuration less sensitive than 1°

Mike Mills & Rolando Garcia

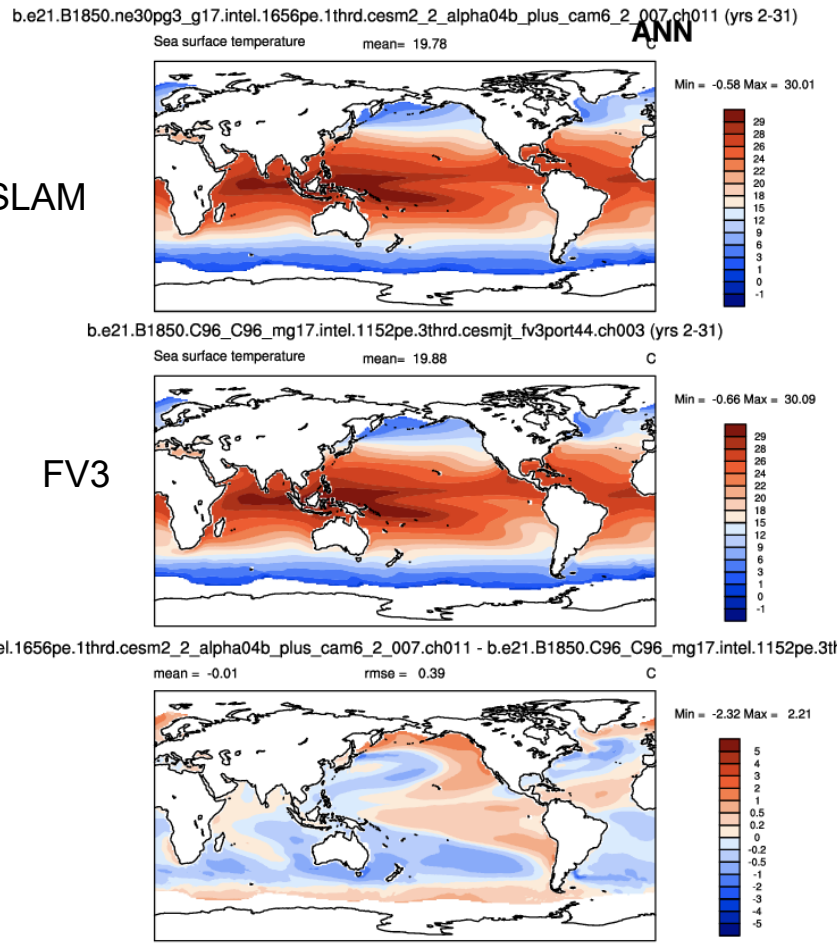
Dycores

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)

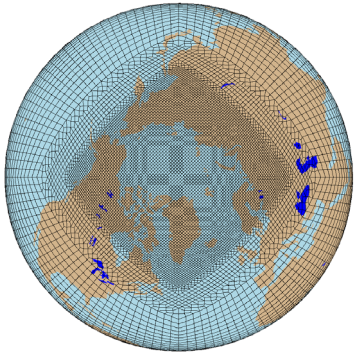
SSTs in fully coupled simulations with FV3 and SE-CSLAM

SE-CSLAM

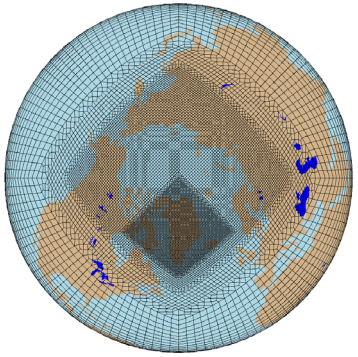


FV3

‘ARCTIC’ (28 km)

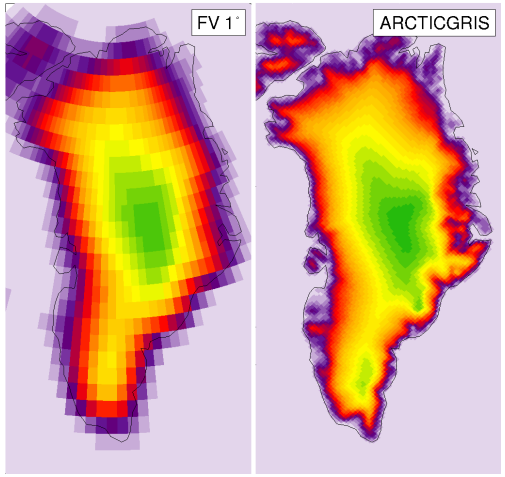


‘ARCTICGRIS’ (14 km)



- 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

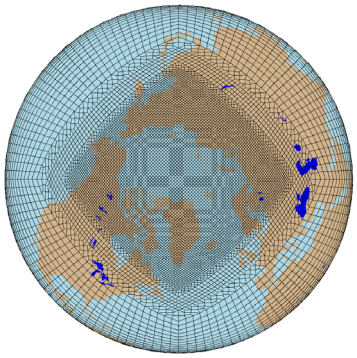
Greenland Ice Sheet (GrIS) Topography



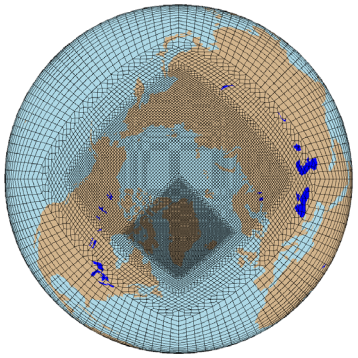
1º finite-volume (left) and ARCTICGRIS (right)

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

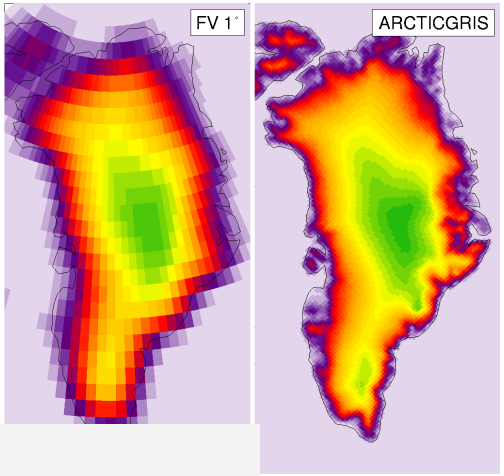
‘ARCTIC’ (28 km)



‘ARCTICGRIS’ (14 km)



Greenland Ice Sheet (GrIS) Topography



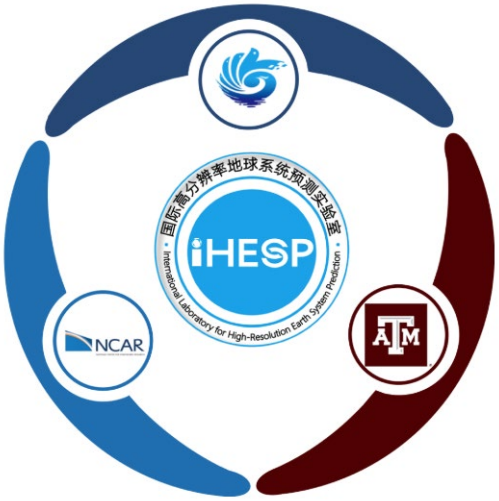
- CESM2.2 spectra
- Variable-resolutio
- Scale-aware tens
- MG3 microphysics
- 6X cheaper than
- 20X cheaper than

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

eft) and ARCTICGRIS (right)

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

Texas A&M University (TAMU)

National Center for Atmospheric Research (NCAR)

Planned simulations:

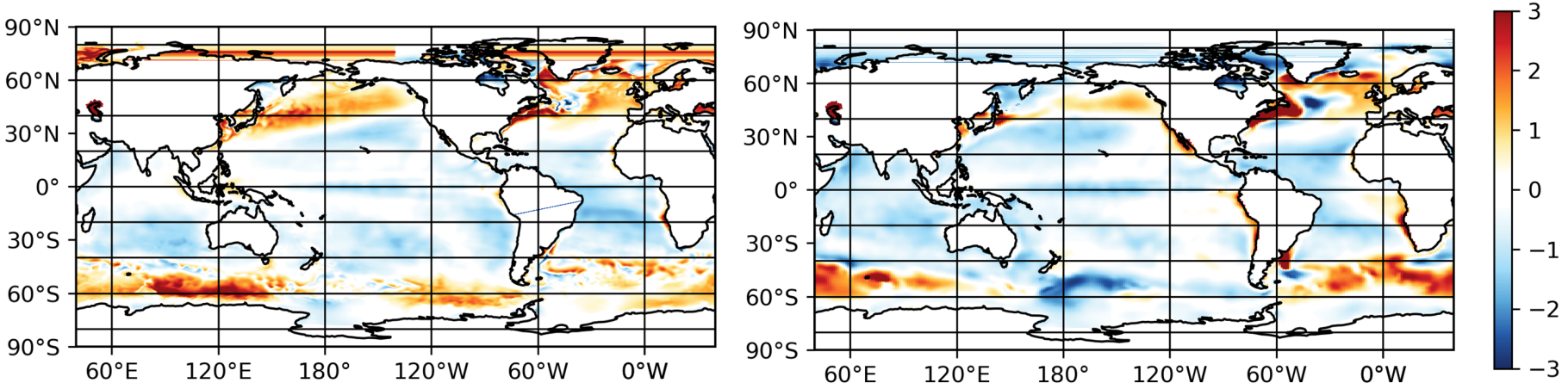
- 500-year 1850 PI-control (@450)
- HighResMIP
- Event based decadal predictions

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

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

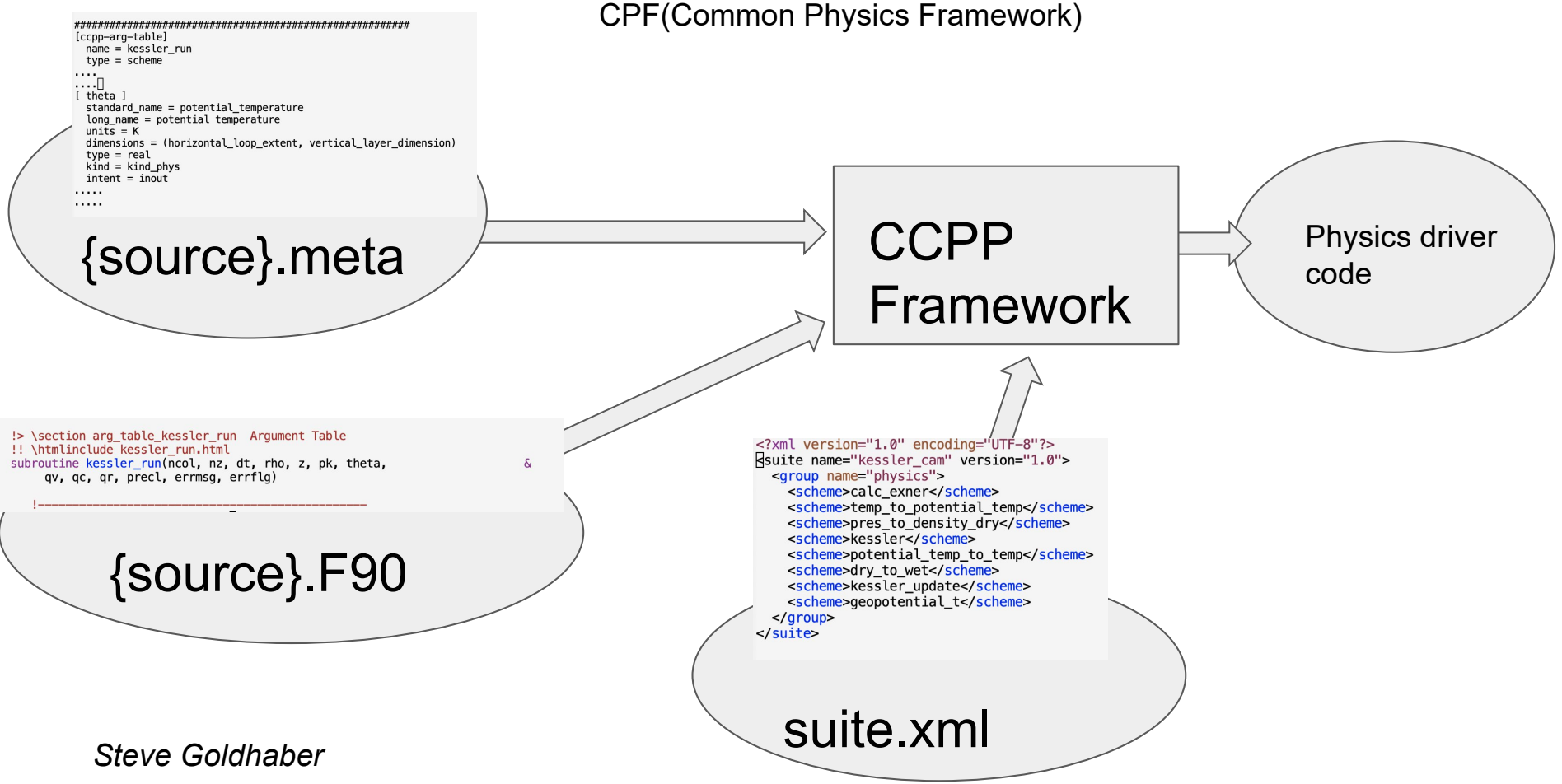
- The CCPP Framework is jointly developed and governed by NOAA and NCAR via an agreement signed by NOAA and NCAR (upper) management.
- The new NOAA Unified Forecast Model (UFS) uses CCPP physics suites (ported from GFS physics).
- The NRL NEPTUNE model has been converted to a CCPP “host model” and runs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

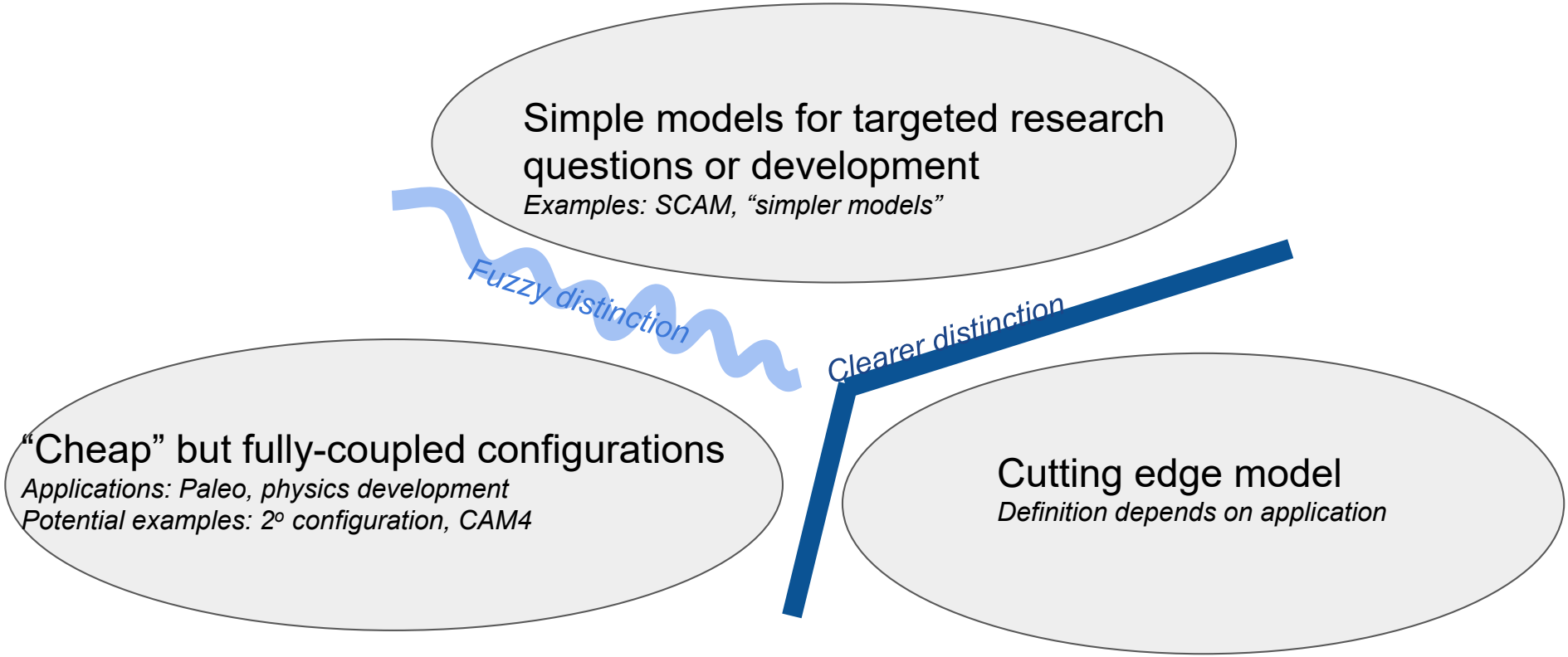
Steve Goldhaber

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



Steve Goldhaber

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?