

CESM Project Updates

Marika Holland

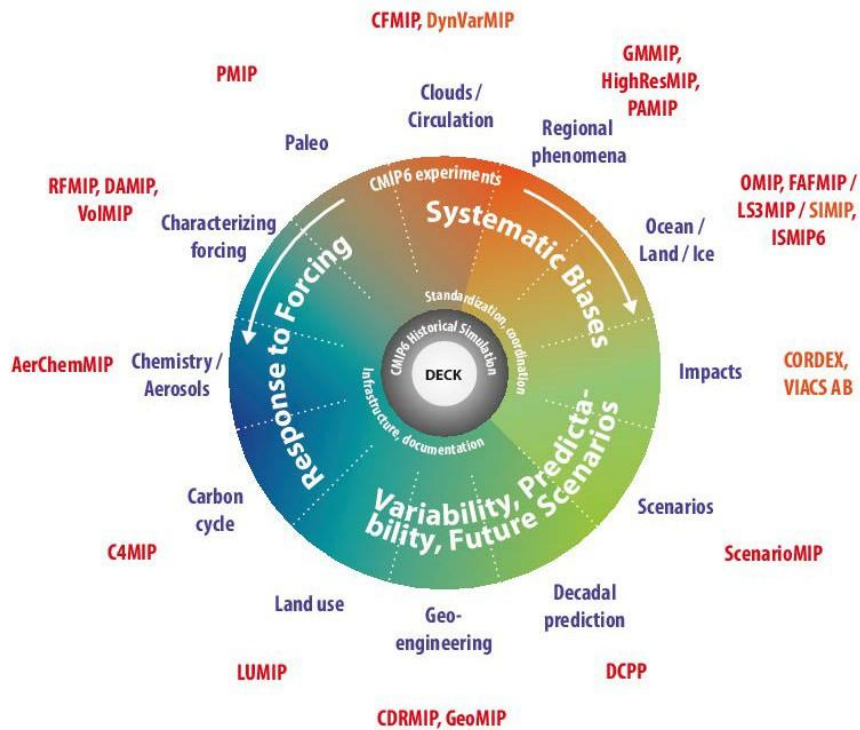
National Center for Atmospheric Research



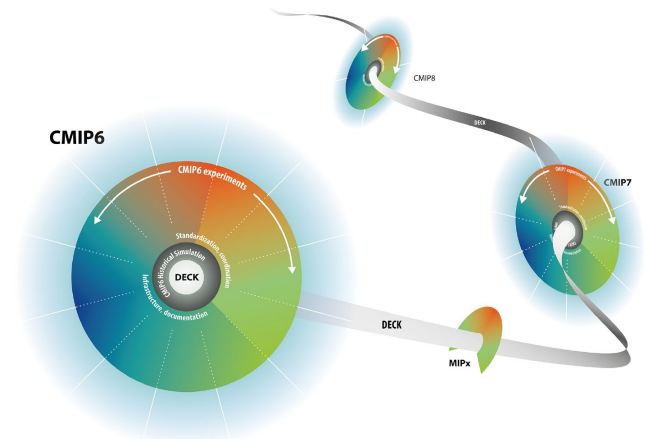
CESM PCWG Workshop
Feb 2020



CESM2 Participation in CMIP6



Diagnostic, Evaluation, and Characterization of Klima (DECK)



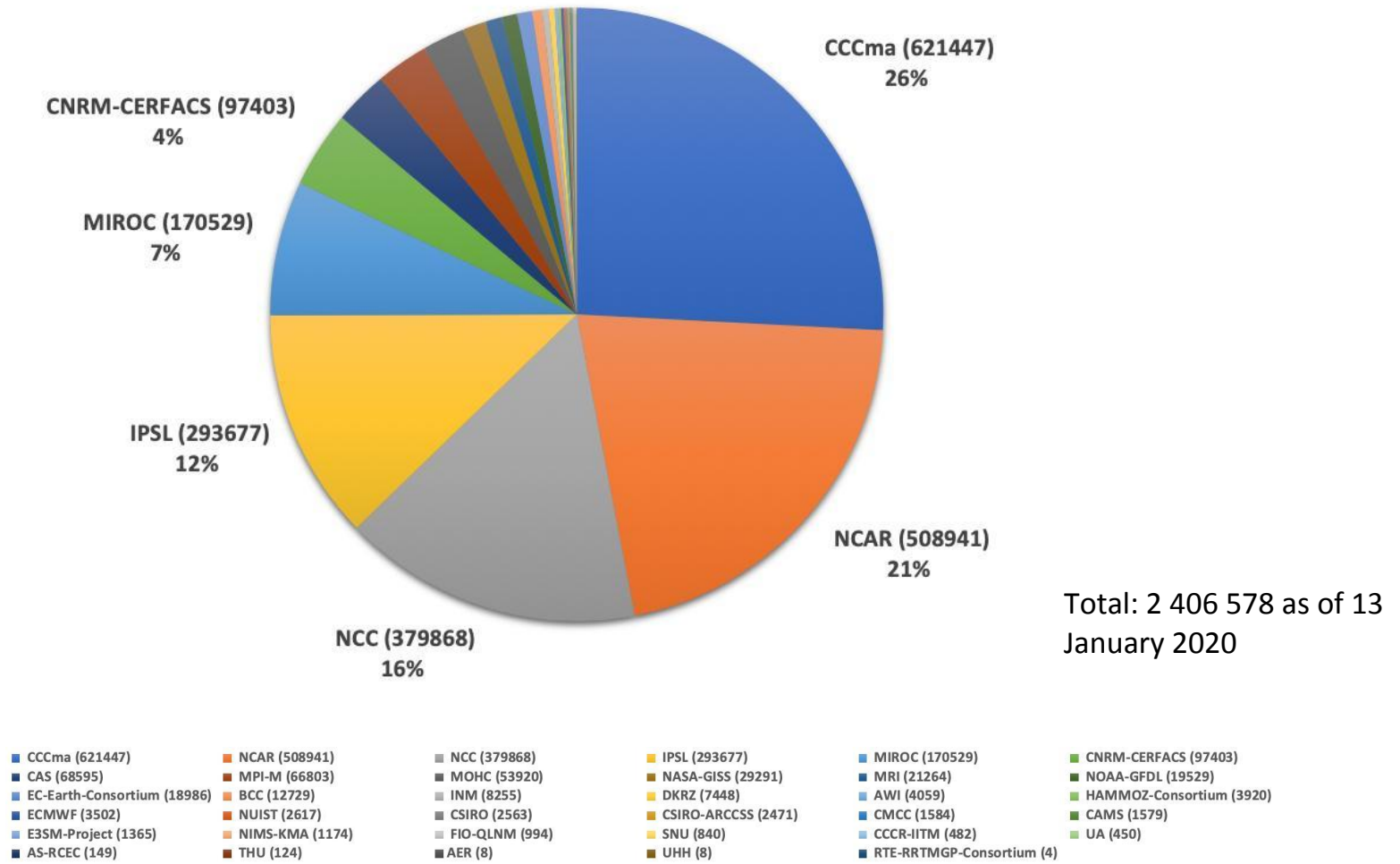
- Pre-industrial control
- 1%CO2
- 4xCO2
- AMIP

Set I: Two nominal 1^o model versions w/ CAM6 and WACCM6 atmospheric model components

Set II: w/ 2^o versions of CAM6 and WACCM6, but otherwise identical (primarily DECK)

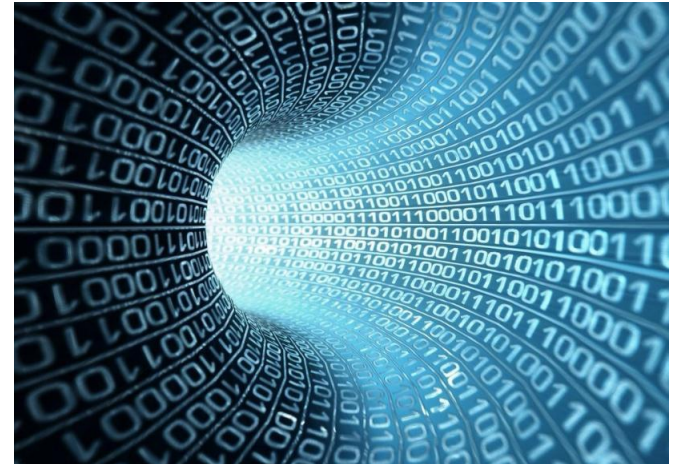
Eyring et al. (GMD, 2016)

Datasets (Number of Files) Contributed by the 35 Centers Participating in CMIP6



By the numbers

- Since August 2018, about 990 CESM2 simulations for CMIP6 have been run, with about 20-30 simulations left to complete
- 1.6 PB of compressed time series files have been generated
- ~410 TB of compressed CMIP6 files from 950 cases have been already published on the Earth System Federation Grid (ESGF), with another 80 TB waiting to be published
- Over 500 000 files have been published on the ESGF
- When we are *done* with CMIP6, CESM2 will have ~500 TB published to the ESGF – 6x the grand total from CESM’s CMIP5 contribution



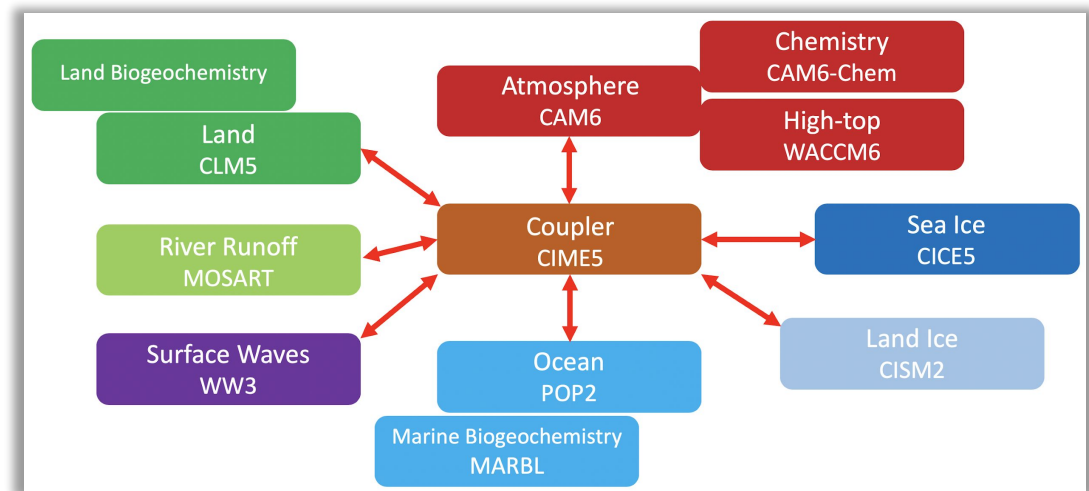
CESM2 *Incremental Releases*

CESM2.1.0 on 10 December 2018

CESM2.1.1 on 10 June 2019

CESM2.1.2 on 14 February 2020

CESM2.1.x series are non-answer-changing* and they further expand the available set of out-of-the-box configurations of CESM2 for readily performing all of the DECK, historical, and many MIP Tier 1 simulations for CMIP6.



*CESM2.2 release will be answer changing anticipated to be available in late Spring 2020

CESM PUBLICATIONS

AGU CESM2 Virtual Special Issue

Below you can find a list of manuscripts that are published, in press, and submitted from the AGU CESM2 Virtual Special Issue, or view the [complete AGU CESM2 Virtual Special Issue](#)

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entries

Citation

Bonan, G. B., Lombardozzi, D. L., Wieder, W. R., Oleson, K. W., Lawrence, D. M., Hoffman, F. M., & Collier, N. (2019). Model Structure and Climate Data Uncertainty in Historical Simulations of the Terrestrial Carbon Cycle (1850–2014). *Global Biogeochemical Cycles*, 33. <https://doi.org/10.1029/2019GB006175>

Capotondi, A., Deser, C., Phillips, A. S., Okumura, Y., Larson, S. M. (2019). ENSO and Pacific Decadal Variability in the Community Earth System Model Version 2. *Manuscript submitted for publication to Journal of Advances in Modeling Earth Systems*.

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Danabasoglu, G., Lamarque, J.-F., Bachmeister, J., Bailey, D. A., DuVivier, A. K., Edwards, J., Emmons, L. K., Fasullo, J., Garcia, R., Gettelman, A., Hannay, C., Holland, M. M., Large, W. G., Lawrence, D. M., Lenaerts, J. T. M., Lindsay, K., Lipscomb, W. H., Mills, M. J., Neale, R., Oleson, K. W., Otto-Bliesner, B., Phillips, A. S., Sacks, W., Tilmes, S., van Kampenhou, L., Versteinsten, M., Bertini, A., Dennis, J., Deser, C., Fischer, C., Fox-Kemper, B., Kay, J. E., Kinnison, D., Kushner, P. J., Long, M. C., Mickelson, S., Moore, J. K., Nienhouse, E., Polvani, L., Rasch, P. J., Strand, W. G. The Community Earth System Model version 2 (CESM2). *Manuscript submitted for publication to Journal of Advances in Modeling Earth Systems*

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Emmons, L. K., Orlando, J. J., Tyndall, G., Schwantes, R. H., Kinnison, D., Lamarque, J.-F., Marsh, D., Mills, M., Tilmes, S., Buchholtz, R. R., Gettelman, A., Garcia, R., Simpson, I., Blake, D. R., Pétron, G. The Chemistry Mechanism in the Community Earth System Model version 2 (CESM2). *Manuscript submitted for publication*.

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Feng, R., Otto-Bliesner, B., Brady, E., Rosenbloom, N. (2019). Increasing Earth System Sensitivity in mid-Pliocene simulations from CCSM4 to CESM2. *Manuscript submitted for publication to Journal of Advances in Modeling Earth Systems*.

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70+ total manuscripts

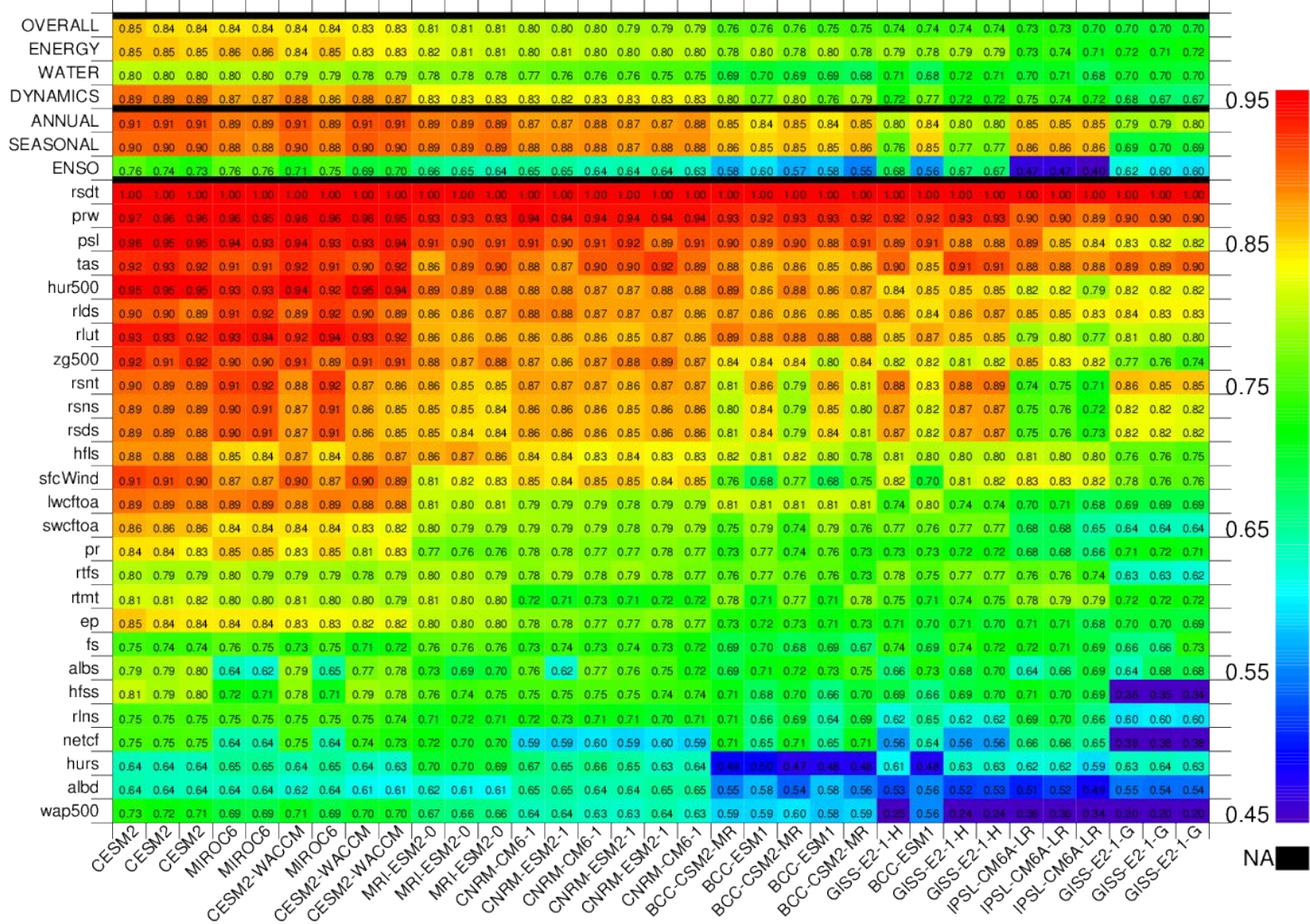
~30 already published or submitted

Submission deadline: 31 March 2020

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

A Model Performance Summary

Model Performance Summary: Mean Pattern Correlation: Sorted for Overall Score



Other simulations of note

CESM2 Simulation with CESM1-LENS (CMIP5) Forcing

We have a new model that has been run with new forcings
How do we disentangle the model effect vs forcing effect?
A CESM2 runs with “old” forcings!

PI Control:

~200 years of spin up

~200 years of overlap with transient runs

20th Century Runs

Multiple Ensemble Members

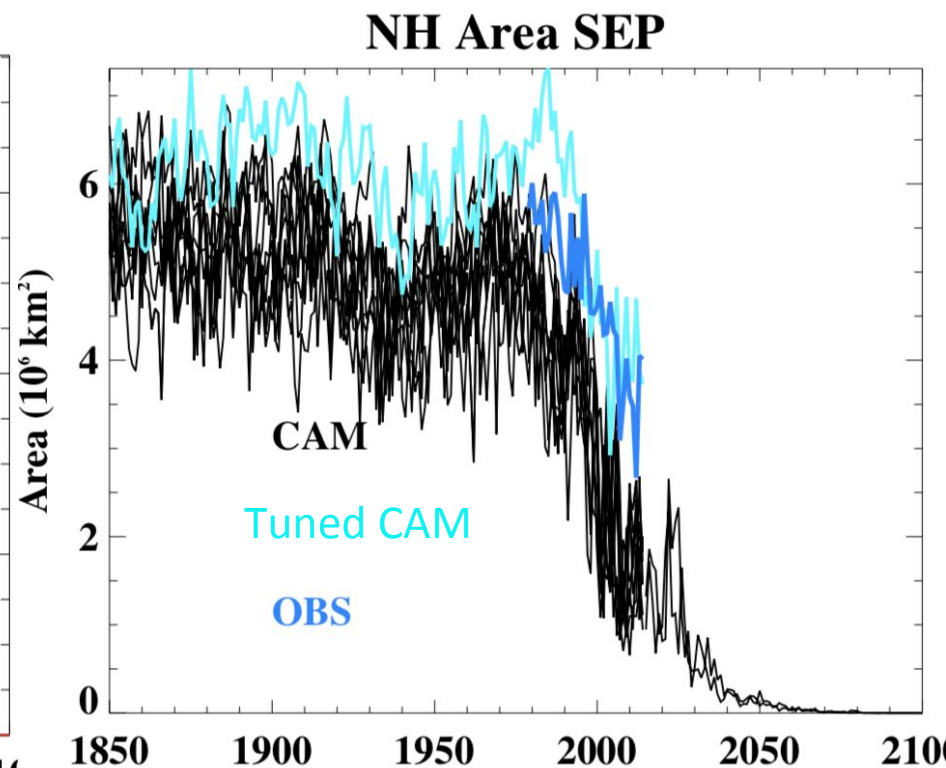
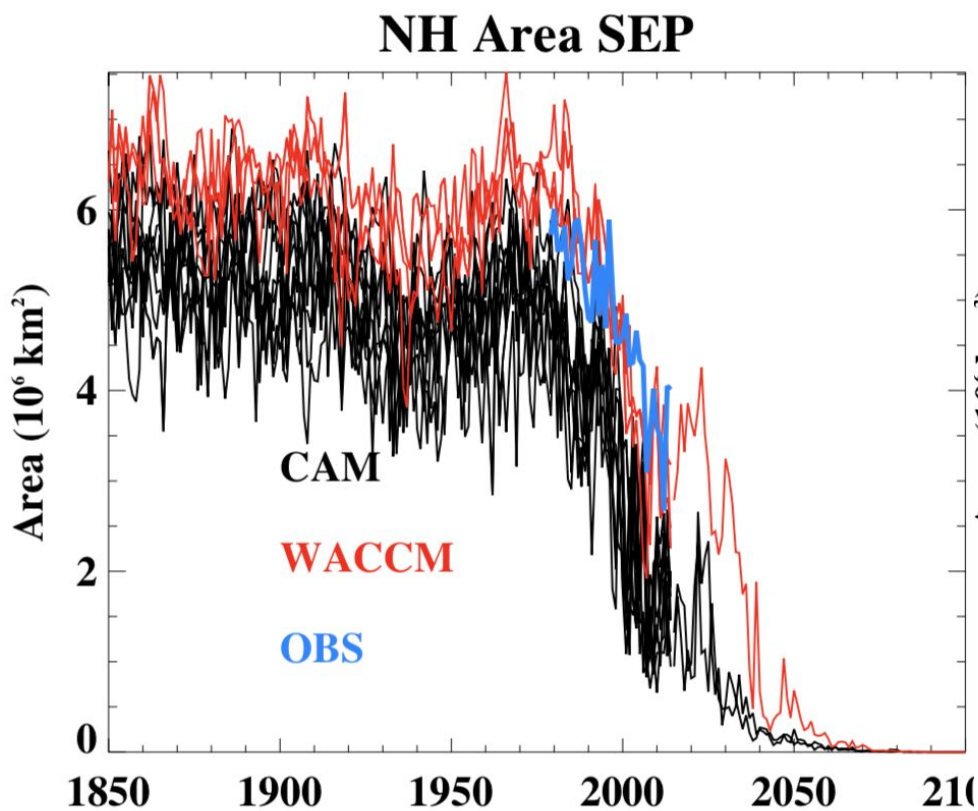
21st Century Runs:

RCP8.5 Forcing

Multiple Ensemble Members

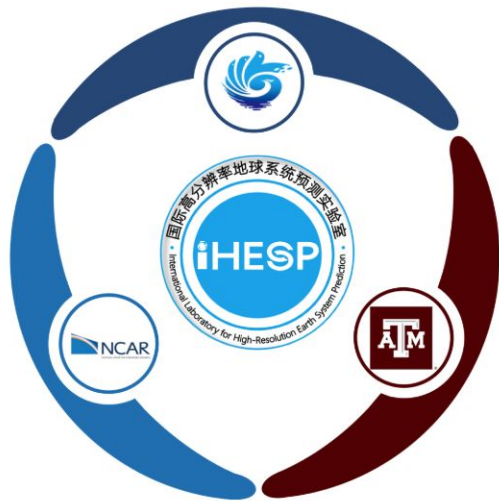
Requires: MAM4 aerosol forcing, ozone, nitrogen deposition, volcanoes, solar, oxidants, land surface (land use change) datasets

CESM2 Simulation with "Tuned" ice albedos



CESM High Resolution Simulations iHESP Project

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



A partnership between

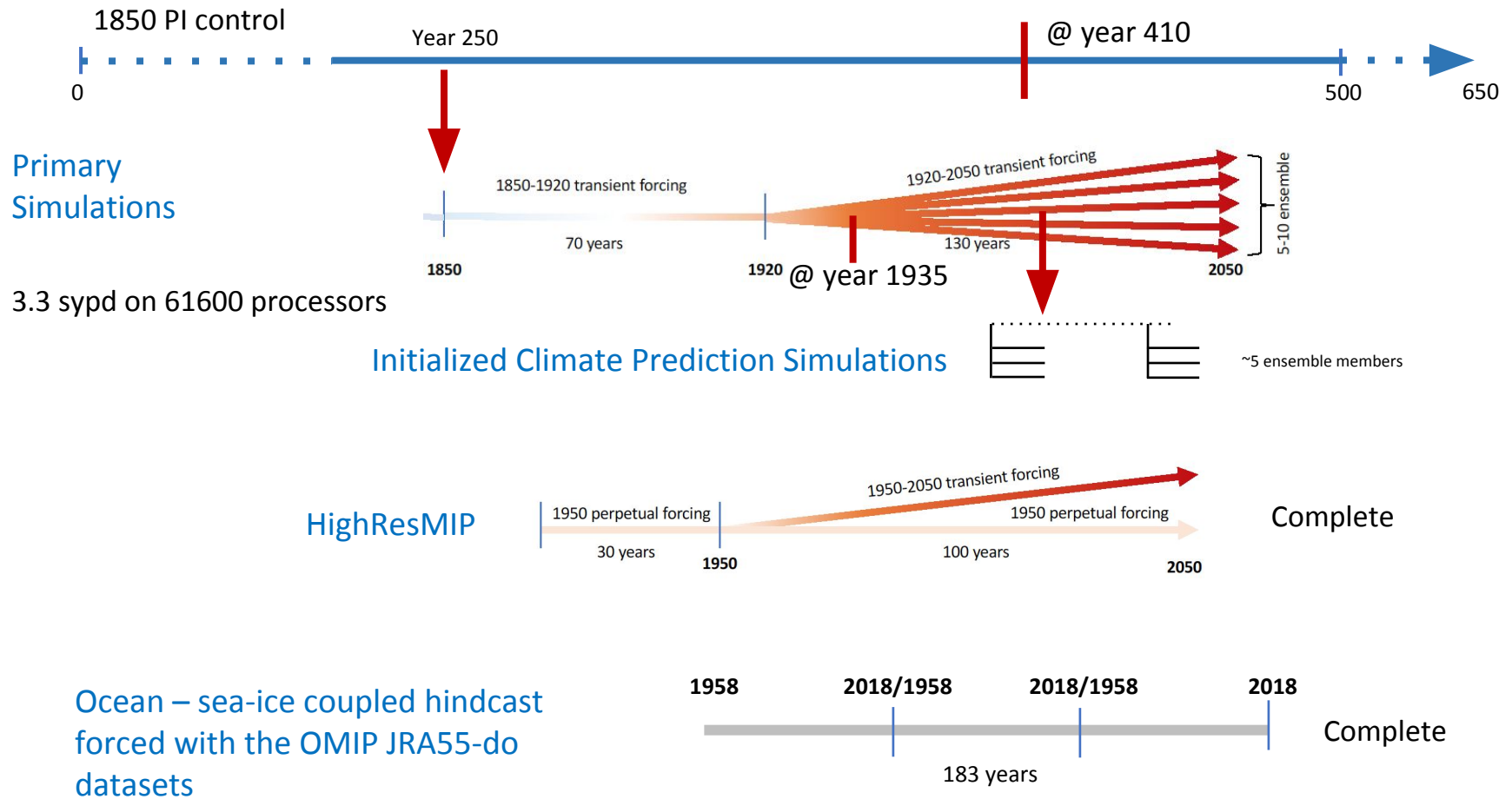
Qingdao National Laboratory for Marine Science and
Technology (QNLN)

Texas A&M University (TAMU)

National Center for Atmospheric Research (NCAR)

CESM-HR Simulations

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



Includes multi-century PI Control, multiple 1920-2050 ensemble members, initialized prediction simulations, ocean-ice hindcast simulations

Questions?

Discussion

Topic 1. Future activities of the PCWG.

- Model Developments
- Model Integrations

Topic 2. Involvement in CMIP:

- What value do you see (or is there) in CESM's participation in the CMIP efforts?
- Relatedly, how have CESM CMIP simulations / experiments helped you advance your science?
- What fundamental science does the CESM's CMIP participation come at the expense of?

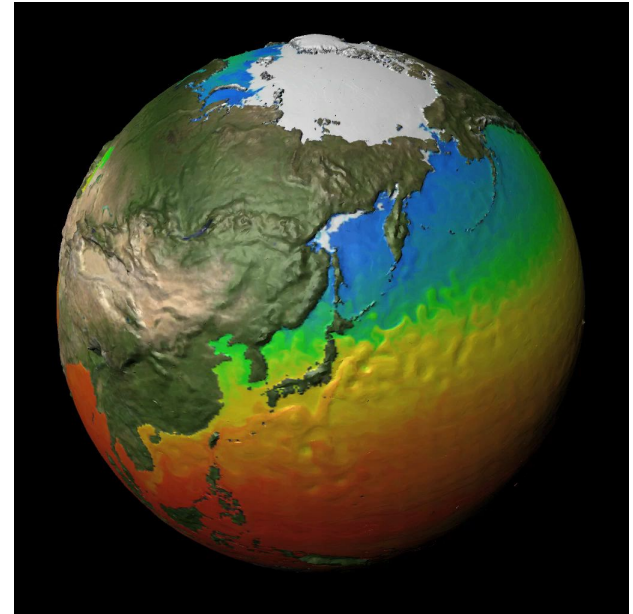
Research Activities During the First 2-3 Years

- Performing high-resolution climate simulations, including prediction experiments
- Development of a new advanced modeling capability enabling “online” dynamical downscaling within the CESM framework
- Development of a new *online* coupled data assimilation capability for CESM for both global and regional applications

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

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



From J. Small and T. Scheitlin