

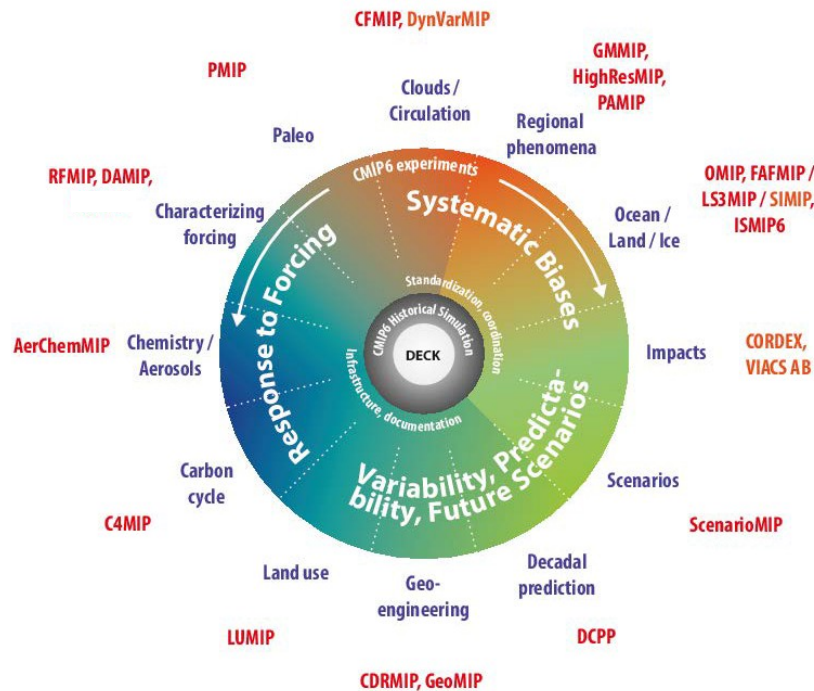
Community Earth System Model (CESM) and CMIP6

Gokhan Danabasoglu
CESM Chief Scientist

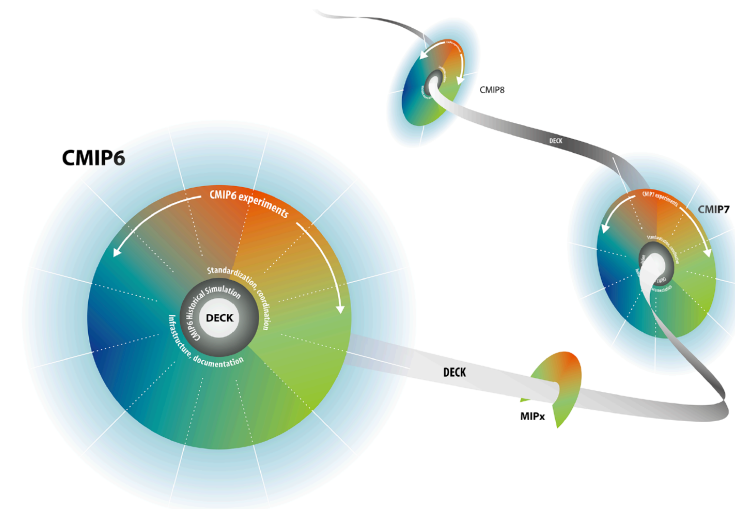
15 DECEMBER 2020



CESM2 Participation in CMIP6



Diagnostic, Evaluation, and Characterization of Klima (DECK)



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

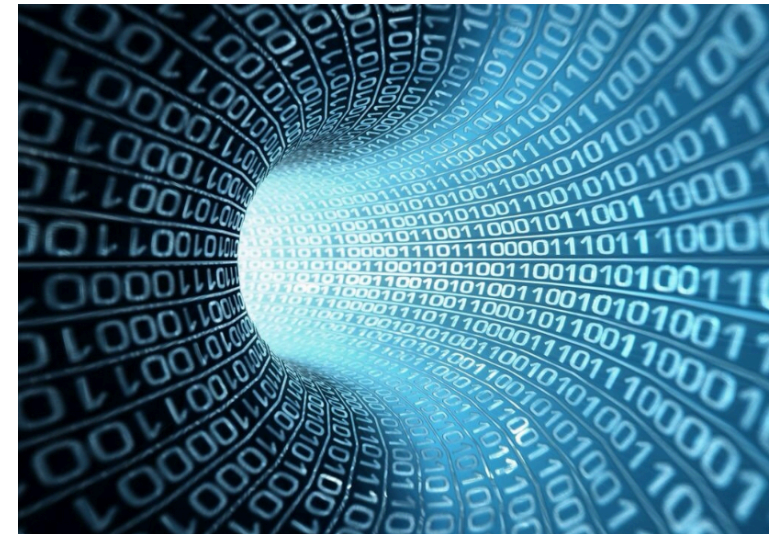
Set II: w/ 2° versions of CAM6 and WACCM6, but otherwise identical (primarily DECK)

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

Eyring et al. (2016, GMD)

By the numbers

- ~1000 CESM2 simulations for CMIP6 have been run
- ~1.7 PB of compressed time series files have been generated
- ~600 TB of compressed CMIP6 files (>830K files) from these simulations have been published on the ESGF
- This data volume is ~7x the total from CESM's CMIP5 contribution



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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Citation

Bacmeister J. T., Hannay C., Medeiros B., Gettelman A., Neale R., Fredriksen H. B., Lipscomb W. H., Simpson I., Bailey D. A., Holland M., Lindsay K., Otto-Bliesner B. (2020). CO₂ increase experiments using the Community Earth System Model (CESM): Relationship to climate sensitivity and comparison of CESM1 to CESM2. *Manuscript submitted for publication to Journal of Advances in Modeling Earth Systems*.

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Bailey D. A., Holland M. M., DuVivier A. K., Hunke E. C., Turner A. K. (2020). Impact of a New Sea Ice Thermodynamic Formulation in the CESM2 sea ice component. *Manuscript submitted for publication to Journal of Advances in Modeling Earth Systems*.

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Bonan, G. B., Lombardozzi, D. L., Wiedner, 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., Bacmeister, 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 Kampenhout, L., Vertenstein, 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). *Journal of Advances in Modeling Earth Systems*, 12. <https://doi.org/10.1029/2019MS001916>

DeRepentigny, P., Jahn, A., Holland, M. M., Smith, A. (2020) Arctic Sea Ice in Two Configurations of the Community Earth System Model Version 2 (CESM2) During the 20th and 21st Centuries. *Manuscript submitted for publication to JGR: Oceans*

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DuVivier, A. K., Holland, M. M., Kay, J. E., Tilmes, S., Gettelman, A., Bailey, D. A. (2019) Arctic and Antarctic sea ice state in the Community Earth System Model Version 2. *Manuscript submitted to JGR: Oceans*.

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JAMES

Journal of Advances in
Modeling Earth Systems

RESEARCH ARTICLE

10.1029/2019MS001916












































Special Section:

Community Earth System
Model version 2 (CESM2)
Special Collection

Key Points:

- Community Earth System Model Version 2 includes many substantial improvements

The Community Earth System Model Version 2 (CESM2)

G. Danabasoglu¹ , J.-F. Lamarque¹ , J. Bacmeister¹ , D. A. Bailey¹ , A. K. DuVivier¹ , J. Edwards¹ , L. K. Emmons² , J. Fasullo¹ , R. Garcia² , A. Gettelman^{1,2} , C. Hannay¹ , M. M. Holland¹ , W. G. Large¹ , P. H. Lauritzen¹ , D. M. Lawrence¹ , J. T. M. Lenaerts² , K. Lindsay¹ , W. H. Lipscomb¹ , M. J. Mills² , R. Neale¹ , K. W. Oleson¹ , B. Otto-Bliesner¹ , A. S. Phillips¹ , W. Sacks¹ , S. Tilmes² , L. van Kampenhout⁴ , M. Vertenstein¹ , A. Bertini¹ , J. Dennis⁵ , C. Deser¹ , C. Fischer¹ , B. Fox-Kemper⁶ , J. E. Kay⁷ , D. Kinnison² , P. J. Kushner⁸ , V. E. Larson⁹ , M. C. Long¹ , S. Mickelson⁵ , J. K. Moore¹⁰ , E. Nienhouse⁵ , L. Polvani¹¹ , P. J. Rasch¹² , and W. G. Strand¹ 

45 already published or submitted

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

Ongoing engagement with CMIP science

- Continuing analysis of simulations and documenting results
- Performing several additional Tier 2 and higher simulations for several MIPs
- Identified some (minor) issues with ScenarioMIP simulations with the low-top model version; those have now been corrected, re-run, re-processed, and posted
- Participating in new MIPs, such as, AMOCMIP, CovidMIP,

CESM2 Large Ensemble (CESM2-LENS)

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

- A 100-member ensemble for the 1850-2100 period, using the SSP-3.70 scenario for the future extension;
- 60 members have been completed;
- Anticipated completion date for the full ensemble is February 2021;
- Data are being transferred to NCAR and being CMORized; and will be available for use of the broader community via ESGF in late Spring 2021.



Appetite for CMIP7

Not much at the moment, however, we are moving towards the next generation CESM, CESM3, with many planned updates that include:

- A new ocean model,
- A new atmospheric dynamical core,
- Increased number of atmospheric vertical levels,

Also performing / pursuing:

- High-resolution simulations with 0.25° atmosphere and land coupled to 0.1° ocean and sea-ice models,
- Ultra high-resolution simulations with 5 km resolution in all its components.