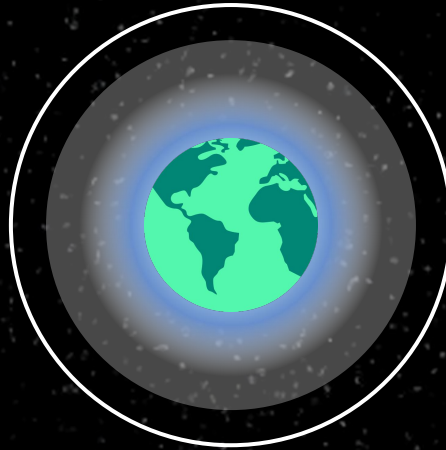# THE VALUE OF CESM:
in users' own words

Open & Important Datasets

"…CESM and its archived large ensemble experiments are **among the most useful, if not singularly the most useful, comprehensive Earth system large ensemble experiments currently or foreseeably available anywhere in the world**."

Support & Documentation

"The documentation, model support, tutorials, and open source nature of the CESM code makes it **the ONLY model that I can easily train my students on**."

Community Model

"CESM in particular is rare in that it is **community-driven and collective**, unlike many earth system models that are closely held and difficult to interact with. CESM and NCAR staff are invaluable to making this possible."

NSF | NCAR
Operated by UCAR

CESM Impact Survey

Overview at the CGD Exchange

August 28, 2025

How can we quantify the value of CESM to the scientific and stakeholder communities?

- The 30th annual CESM Workshop was a unique opportunity to reflect

- NSF and other funders want clear value statements

- One action is to poll the community!

Designing the survey

- Goal: gather input from the CESM Community*, nationally and internationally, on the uses and value of the **CESM activity****

    *We define the CESM Community as inclusive of all users of the activity (data, model development ,etc.), across all sectors

    **Includes use of model, use of model components, use of simulation data and other output, and training/support that is provided through CESM

- Specifically, address -
    - What is the value of CESM to the community?
        - What pieces are unique to CESM?
    - How is CESM being used inside/outside of US academia?
    - What is at stake without ongoing CESM development and support out of NCAR?

Designing the survey

"We are especially interested in **how the activity supports a range of users and stakeholders and how it is delivering impact both in terms of science and societally-beneficial applications**, nationally and internationally. This information will allow us to identify development priorities and will provide examples and testimonials that can be readily used to convey its value."
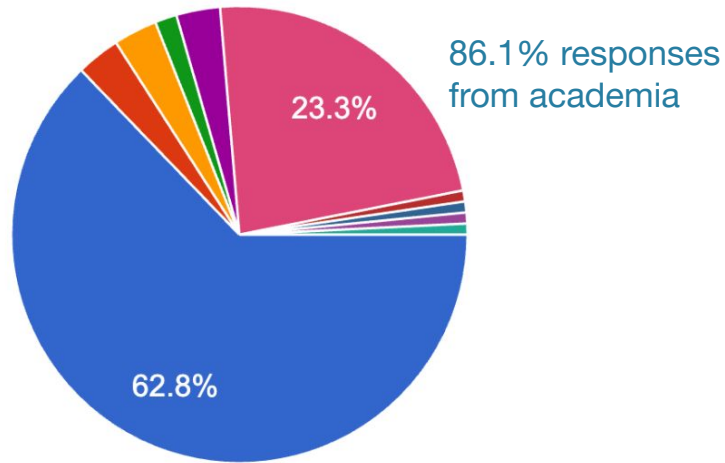
- Mix of quantitative and qualitative questions on use and value of CESM

- Distributed via CESM mailing list, LinkedIn, and personal contacts

Who responded so far?

What type of organization or institution are you primarily affiliated with?

129 responses

Only 4 NCAR folks! Won't quote these in following slides

86.1% responses from academia

62.8%

23.3%

- US Academic/Research Institution
- US Government Agency (federal, stat…
- Private Sector - Environmental Service
- Private Sector - Finance/Insurance
- Non-Governmental Organization
- Media/Communications
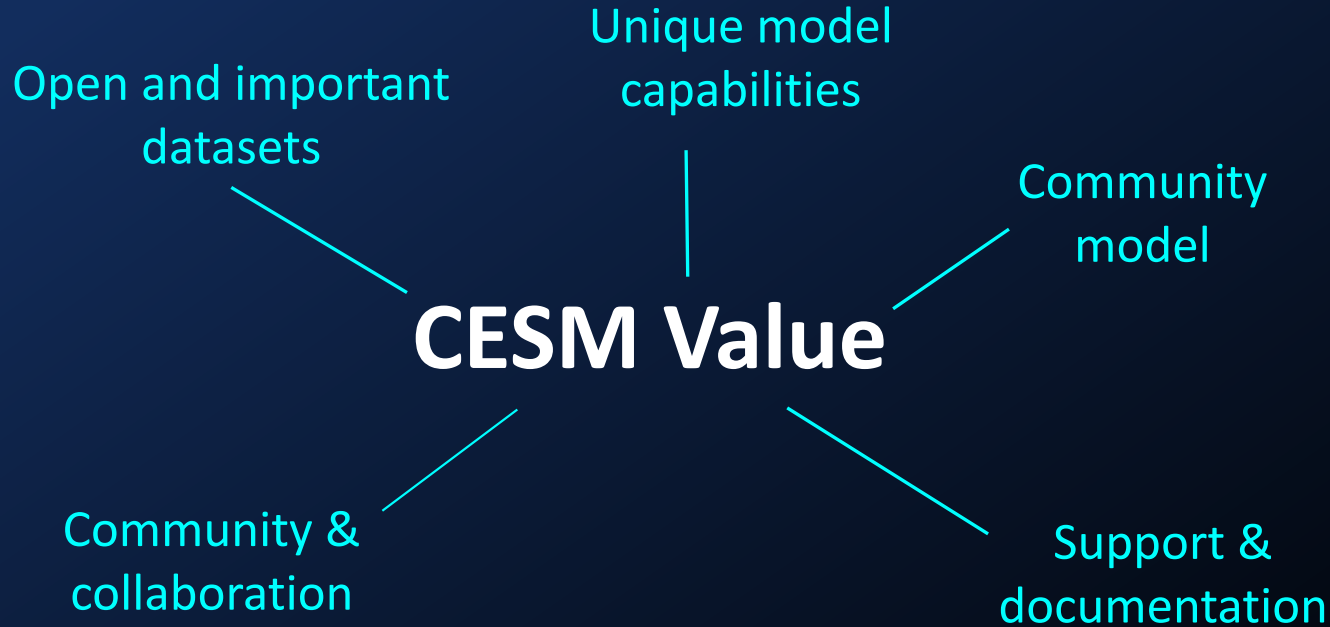- International Academia
- International Gov

1/2

What did they say?*

What did they say?*

Open and important datasets

- Of responses to date:
  - 14 highlight importance of large ensembles
  - 7 highlight high-resolution datasets
  - 25+ highlight data availability and access to CESM simulations more generally

"CESM's unique datasets - particularly the single forcing Large Ensembles and TRACE-21k **have no direct equivalents in other modeling frameworks**."

"**CESM has done a service to the community** by [d]oing relatively large ensemble experiments, such as the LME …"

"…CESM and its archived large ensemble experiments are **among the most useful, if not singularly the most useful, comprehensive Earth system large ensemble experiments currently or foreseeably available anywhere in the world**."

What did they say?*

Unique model capabilities

- Carbon/water isotope tracers
- Interactive fire
- Urban model
- CIME enhances accessibility
- High top atmosphere
- Advanced chemistry and aerosols
- Coupling to ice sheets and SMB
- Invaluable for paleo simulations

"Excellent and versatile land surface model (CLM); probably **the best land surface model available globally**"

"CESM was the only model that included carbon isotopes in CMIP6…"

"…the only model that can be used in paleoclimate, and planetary science due to its amazing conservation of mass, water and energy flux."

"CESM-WACCM has established itself as the world's very best stratospheric and mesospheric model. **It has no peer**."

What did they say?*

Community Model

- Easy to contribute to
- Open source code
- Can be run outside of the center where it's developed (unique aspect of CESM)

"its accessibility is a **huge return for taxpayer money** since anyone could use and access CESM, which can't be said of other ESMs."

"Among all the models out there, **CESM is the only one that truly advanced Earth System Science for the entire scientific community of the U.S**.. Its documentation, ease-of-use, hierarchical model configurations and resolutions, comprehensiveness, model support availability, tutorials are way better than any other models. "

"CESM in particular is rare in that it is **community-driven and collective**, unlike many earth system models that are closely held and difficult to interact with. CESM and NCAR staff are invaluable to making this possible."

"The NCAR community is also fantastic in ensuring the broad community has access to its tools, and model runs, and the availability of model output and computational resources **makes science so much more efficient and impactful**…"

NSF | NCAR
Operated by UCAR

What did they say?*

Support & Documentation

- Tutorials offer an invaluable learning opportunity
- NCAR staff provide extra support via discussion forums, email, etc.
- Clear and comprehensive documentation outpaces most other models'
- All of the above lead to quick spin-up learning the model

"The documentation, model support, tutorials, and open source nature of the CESM code makes it **the ONLY model that I can easily train my students on.**"

"The fact that there are trainings and tutorials for using the model make it a tools that can be used much more broadly than other ESMs."

"The friendly and available staff and researchers who are so committed to making the model accessible and useable have been the most valuable to my work."

"The **documentation of CESM is incredible**, one of the best, if not best, earth system model documentations available. "

What did they say?*

Community & Collaboration

- Working groups build a strong community working towards common goals
- CESM tutorial and other events are especially useful for early careers
- Ease of use makes the model accessible to many experience levels

"It bears emphasis that ease of use has made CESM also **the central tool for students and postdocs**, thus fostering career growth."

"CESM stands head and shoulders above all other US models in this regard (one doesn't have to be "in the club" to make use of CESM), **and I doubt any model in the world can compare to the overall user experience**."

"Attending the CESM workshop might be the most impactful single event for my research career. "

"…CESM has the most experiments and the **best documentation**, which creates a positive feedback loop where more folks want to use it because they know they can lean on the community for problem solving."

Survey goals:

- Specifically seeking to answer:
    1. What is the value of CESM to the community? What is unique?
    2. **How is CESM being used outside of US academia?**
    3. What is at stake without ongoing CESM development and support out of NCAR?

What did they say about international uses?*

"CESM and its CLM land model are a **international benchmark** for climate and land modelling"

"**If CESM were no longer supported this would be a major blow to the global modeling enterprise,** which relies on your leadership in model development."

"If CESM3 were not submitted to CMIP7, it would severely limit the utility of that crucial dataset, because CESM has been in all previous CMIP efforts and has been one of the most skillful in at least the last two, making it one of the most interesting models in CMIP. "

"CESM and the support offered by NCAR is absolutely critical for the functioning of my research team at the **University of Brussels**."

"CESM has been the main "workhorse" for the research in our **IBS Center for Climate Physics**"
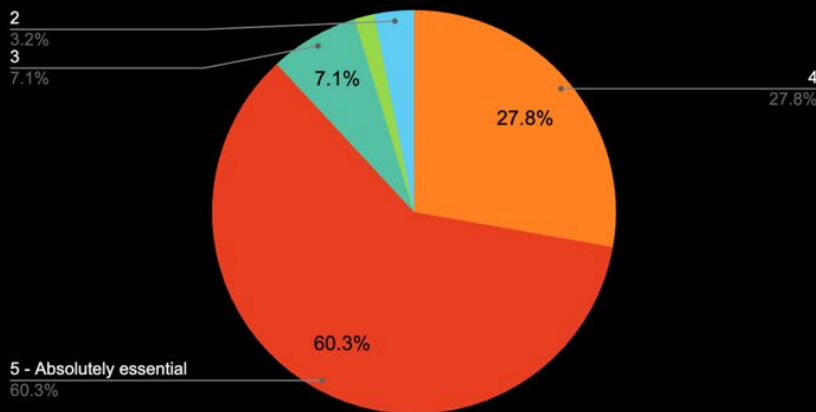
Survey goals:

- Specifically seeking to answer:
    1. What is the value of CESM to the community? What is unique?
    2. How is CESM being used outside of US academia?
    3. **What is at stake without ongoing CESM development and support out of NCAR?**

What did they say about importance of NCAR support?*

What's at stake?

- Research and career disruptions
- Loss of community and support
- Reduction in education/training opportunities
  - Loss of tutorials especially noted as detrimental
- Significant damage to US leadership
- Potential consequences beyond academia

How critical is the CESM activity (model use and/or use of community simulation output) to your current work?

2 3.2%
3 7.1%
4 27.8%
7.1%
27.8%
60.3%
5 - Absolutely essential 60.3%

88% answered 4+

What did they say about importance of NCAR support?*

"…a substantial loss to society"

"Loss of support for CESM would **be an immeasurably devastating blow** to science around the world, and even more so for the public beyond science."

"Discontinuing the development of CESM would leave a large part of the climate science community "**in the dark**"."

"This would be devastating."

"It would be a major blow to US leadership in the sciences."

"[The]US, as well as the world's weather and water enterprises**, will lose something that can not be replaced and repaired** --- our weather and water security will be compromised"

"Data sharing and academic cooperation is a two-way street. If the US stops providing valuable information to the community in other countries, **the negative impacts are grave**."

What's next?

- Jumping off point to engaging more directly with non-academic users
- Useful data for engaging with NSF and foundations
- Part of a broader effort to develop capabilities to regularly quantify impacts of CESM

Want to share your perspective?

The survey is still open!

Access the survey with the QR code or this link.