

Biological and Environmental Research (BER) Earth and Environmental Systems Sciences Division (EESSD)

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U.S. DEPARTMENT OF
ENERGY

Office of
Science

[Energy.gov/science](https://www.energy.gov/science)

Office of Science Statement of Commitment & Other Guidance

- **SC Statement of Commitment** – SC is fully and unconditionally committed to fostering safe, diverse, equitable, inclusive, and accessible work, research, and funding environments that value mutual respect and personal integrity.
<https://science.osti.gov/SW-DEI/SC-Statement-of-Commitment>
- **Expectations for Professional Behaviors** – SC’s expectations of all participants to positively contribute to a professional, inclusive meeting that fosters a safe and welcoming environment for conducting scientific business, as well as outlines behaviors that are unacceptable and potential ramifications for unprofessional behavior.
<https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/Harassment>
- **How to Address or Report Behaviors of Concern** – Process on how and who to report issues, including the distinction between reporting on unprofessional, disrespectful, or disruptive behaviors, and behaviors that constitute a violation of Federal civil rights statutes.
<https://science.osti.gov/SW-DEI/DOE-Diversity-Equity-and-Inclusion-Policies/How-to-Report-a-Complaint>
- **Implicit Bias** – Be aware of implicit bias, understand its nature – everyone has them – and implicit bias if not mitigated can negatively impact the quality and inclusiveness of scientific discussions that contribute to a successful meeting.
<https://kirwaninstitute.osu.edu/article/understanding-implicit-bias>

Housekeeping

During the presentation, submit questions using the Zoom Q&A feature. This is accessible at the bottom of your Zoom window. We will answer these live at the end of the presentation as time permits.

After the presentation if there is time, you can ask your question live by raising your hand in Zoom. We will ask you to unmute to ask your question.

If your question is not answered today, or if you have additional questions about a specific topic, please contact any BSSD program manager.

Recordings and slides from office hours will be posted after completion of each office hour. <https://science.osti.gov/ber/officehours>

Agenda

- Overview of the Earth and Environmental Systems Sciences Division (EESSD)
- Research funding mechanisms and FOA priorities
- Program areas
 - Atmospheric Sciences
 - Environmental System Sciences
 - Earth and Environmental System Modeling
- Q&A



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Our Mission:

Deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.



More than **34,000** researchers supported at more than **300** institutions and **17** DOE national laboratories



Steward **10** of the 17 DOE national laboratories



More than **37,000** users of **28** Office of Science scientific user facilities



\$8.1B
(FY 23 enacted)

Office of Science Research Portfolio

Advanced Scientific Computing Research

- Delivering world leading computational and networking capabilities to extend the frontiers of science and technology

Basic Energy Sciences

- Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels

Biological and Environmental Research

- Understanding complex biological, earth, and environmental systems

Fusion Energy Sciences

- Supporting the development of a fusion energy source and supporting research in plasma science

High Energy Physics

- Understanding how the universe works at its most fundamental level

Nuclear Physics

- Discovering, exploring, and understanding all forms of nuclear matter



DOE Office of Science
Harriet Kung, Acting Director

Advanced
Scientific
Computing
Research

Basic Energy
Sciences

Fusion
Energy

**Biological and Environmental
Research**

High Energy
Physics

Nuclear
Physics

Dorothy Koch, Associate Director

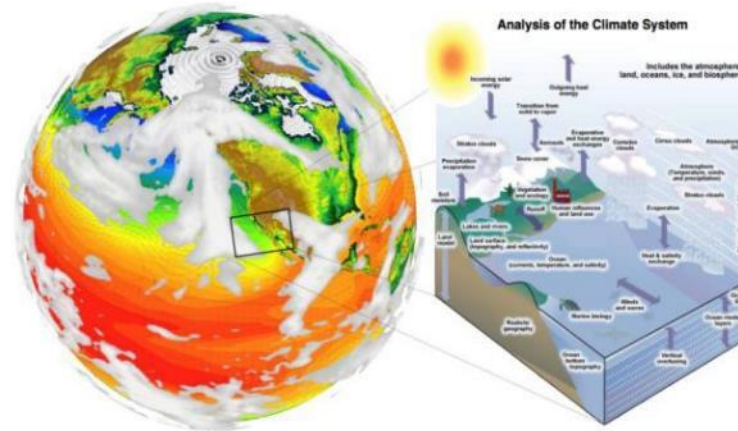
Biological Systems Science
Todd Anderson, Director

- Genomic Science
 - Bioenergy Research Centers
- Biomolecular Characterization & Imaging Science
- Facilities & Infrastructure
 - Joint Genome Institute

Earth & Environmental Systems Science
Gary Geernaert, Director

- Atmospheric System Research
- Environmental System Science
- Earth and Environmental Systems Modeling
- Facilities & Infrastructure
 - Environmental Molecular Sciences Laboratory (EMSL)
 - Atmospheric Radiation Measurement (ARM)

Earth and Environmental Systems Sciences Division (EESSD)



Atmospheric System Research

- Atmospheric Process Science
- Atmospheric Radiation Measurement (ARM) facility

Earth and Environmental Systems Modeling

- Climate, Earth System, and Multi-Sector Dynamics Model Development and Analysis

Environmental System Science

- Ecosystem and Watershed Sciences
- Environmental Molecular Sciences Laboratory (EMSL)

Data Management for Earth and Environmental Sciences

<https://science.osti.gov/ber/Research/eessd>

DOE EESSD Permanent Staff



ATMOSPHERE TEAM



MODELING TEAM



ESS TEAM



Vision, Challenges, and priorities

Vision: Improve a systems level understanding and predictability of the earth system in support of DOE's mission, through integrative theory, modeling, and experiment, over a variety of spatial and temporal scales.

High level Grand Challenges in the current Strategic Plan

- Integrated water cycle
- Biogeochemistry
- High latitudes
- Drivers and responses
- Data-model integration

Priorities emphasize the most difficult issues: boundaries, interfaces, extremes

- Collaborative arrangements: NOAA; USGS; NGA; NSF; NASA; others
- Topics: disturbance, initialization, data analytics (e.g., machine learning), software, advanced technologies, Terrestrial-Aquatic Interfaces, Coastal, Urban, resilience, etc.

Uniqueness of the DOE EESSD strategy and culture

- DOE is a mission agency, and Office of Science focuses on basic research to tackle the Nation's toughest scientific challenges, through an energy and national security lens
- DOE includes an extensive set of national laboratories, each with a unique strategy that includes basic and applied research. The labs are the 'integrators' of different kinds of research that exploits many of the world's most advanced technologies and capabilities
- Our investments exploit the capabilities of the DOE National User Facilities.
- We don't have a responsibility to support operations or services, but we do develop extremely sophisticated prototype capabilities that can, in principle, transition to operations in the future
- Community service: PCMDI, data archives and management

BER User Facilities

The logo for Atmospheric Radiation Measurement (ARM) features the letters "ARM" in a bold, blue, sans-serif font. A light blue curved line arches underneath the letters.

<https://arm.gov/>

The logo for Environmental Molecular Sciences Laboratory (EMSL) consists of the letters "EMSL" in a green, sans-serif font. To the right of the letters is an orange icon of a molecular structure with three spheres and connecting lines.

<https://www.emsl.pnnl.gov/>

The logo for the Joint Genome Institute (JGI) features the letters "JGI" in a large, bold, black, sans-serif font. Below "JGI" is the text "JOINT GENOME INSTITUTE" in a smaller, black, sans-serif font. To the right of the text is a stylized DNA double helix icon with colorful spheres representing base pairs.

<https://jgi.doe.gov>

DOE Scientific User Facilities Provide researchers with the most advanced tools of modern science, including accelerators, colliders, supercomputers, light and neutron sources, as well as facilities for studying the nano world, the environment, and the atmosphere.

BER supports three world class scientific user facilities:

- **Atmospheric Radiation Measurement (ARM)**
- **Environmental Molecular Sciences Laboratory (EMSL)**
- **Joint Genome Institute (JGI)**

Free access to instruments and analysis via annual/regular user proposals.

Office of Science User Facilities

FY 2023
28 scientific
user facilities
>37,000 users



Strategic questions: Earth and Environmental Systems Sciences Division

- How can we understand and predict cloud-aerosol-precipitation interactions, and their influence on the Earth's energy balance?
- Can we design Earth system models that accurately reflect advanced scale-aware process representations of Earth system observations, incorporating physical, chemical, biological, and human components?
- What do we need to know about terrestrial ecosystems, watersheds, urban, and coastal systems to improve how they are represented in Earth system models?
- How can we improve understanding of heterogeneous, climate-sensitive systems, such as urban communities, and their resilience to climate-relevant changes and disturbance?



Data Archives, management, and analytics for EESSD



Repository for environmental system data involving watershed, ecosystem, and manipulation studies, hosted at LBNL



MSD-LIVE: a cloud-based Multi-sector dynamics data and code management system and computing platform, for climate-human interactions, hosted by PNNL



Repository of model-generated data from all climate and Earth system models worldwide, hosted by ORNL-ANL



ARM data archive contains 2 PB of in-situ and remote sensing observations, model simulations, and tools for rapid access, host ORNL-ANL

Funding mechanisms

- National lab projects called 'Science Focus Areas'
 - Typically \$2M-\$10M per year
 - Long term investments but exposed to triennially reviews
 - Encourage university engagement
 - Many are multi-lab yet led by a single lab
- University grants, via Funding Opportunity Announcements
- University cooperative agreements, via Funding Opportunity Announcements

How we set priorities for future FOAs

- Topics are informed by advisory groups, such as the BER Advisory Committee
- Reports from the National Academy of Sciences
- Reports produced from workshops organized by BER, and other organizations
- Appropriations language
- Opportunities to leverage other agencies
- Consideration of DOE uniqueness

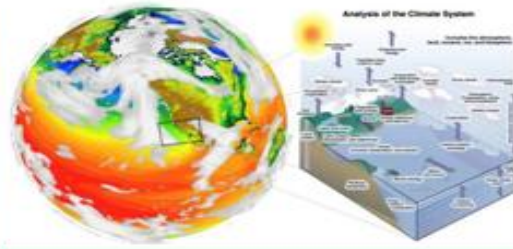
Recent and upcoming workshops

Workshop	Program	Dates	Location
Southeast Land-Atmosphere Research Opportunities (SELARO)	ESS	Aug 23-24, 2023	Virtual
MSD Community of Practice Workshop	Modeling	October 3-5, 2023	UC Davis, hybrid
Decision Relevant Regional Climate Projections	Interagency	Oct 24-26, 2023	LBNL, hybrid
New Directions in Atmospheric Ice Processes Workshop	ASR	Oct 25-27, 2023	Richland, WA
IHTM Interagency Workshop	Interagency	Oct 31-Nov 1	Washington, DC
CAMAS – Community Arctic Science		Feb 13-16, 2024	Santa Fe, NM
Future of LASSO Workshop	ARM	Nov 2-3, 2023	Boulder, CO
Observing marine aerosols-clouds from ships	ASR	March 18-19, 2024	Virtual
Southeast Coastal Research workshop	All programs	March 26-28, 2024	Virtual
Cyberinfrastructure workshop	ESS	April 15, 2024	Reston, VA
Climate Modeling Summit; coupled data assimilation worksho	Modeling	May 1-3, 2024	GFDL, Princeton
Energy Modeling Forum – urban	Modeling	June 24-28, 2024	Snowmass
Lessons learned and best practices from past ecological	ESS, etc.	Fall 2024	
Modeling and Metrics associated with CMIP	Modeling	Fall-Winter 2025	

Earth and Environmental Systems Sciences Division Program Areas



**Atmospheric System
Research**



**Earth and Environmental
Systems Modeling**



**Environmental System
Science**

Atmospheric Radiation
Measurement (ARM)

User Facilities

Environmental Molecular Sciences
Laboratory (EMSL)

Data Management

FY 23 Budget: \$445M

Atmospheric Sciences overview

Jeff Stehr
ASR Program

Atmospheric System Research Program (ASR)

Goal:

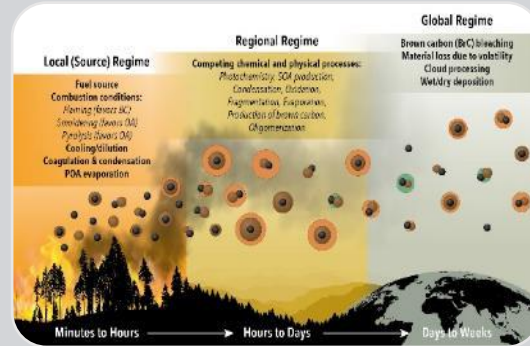
- Quantify the interactions among aerosols, clouds, precipitation, and radiation to improve understanding of key cloud, aerosol, precipitation, and radiation processes that affect the Earth's radiative balance and hydrological cycle, especially processes that limit the predictive ability of regional and global models.



Objectives:

- Support research at DOE National Laboratories, universities, and the broader research community that uses observations (primarily from ARM) along with process modeling and laboratory experiments to improve understanding of atmospheric processes and test the atmospheric physics theories that are the foundation of Earth system models

ASR Priority Research Areas and Working Groups



Convective cloud processes and properties including cloud cover, precipitation, life cycle, dynamics, and microphysics over a range of spatial scales.

Aerosol processes governing the spatial and temporal distribution of atmospheric particles and their chemical, microphysical, and optical properties.

High latitude processes including cloud, aerosol, and surface-interaction processes controlling the surface energy budgets in northern and southern high latitude regions

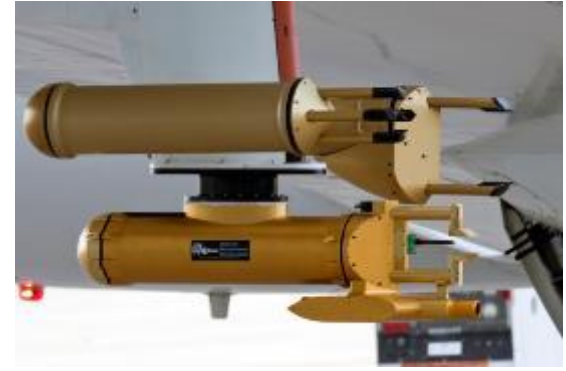
Warm boundary-layer processes controlling the structural and radiative properties of clouds, aerosols and their interactions with the underlying surface in the lowest few kilometers of the atmosphere.

ASR Funding Opportunities

- ASR supports university and research at other institutions through an annual Funding Opportunity Announcement (FOA) call.
 - Each call has a specific scope determined by programmatic objectives.
 - Must make use of DOE-supported observations, products and/or ARM observatories.
 - Applications/proposals should be written so that an atmospheric science generalist can understand.
 - Reach out to the responsible program manager with any questions.
 - Typically, 15 to 30 awards made per year
 - Pre-applications are required and reviewed
 - FOAs have strict deadlines
- Details of all ASR funded projects are available on the ASR website <https://asr.science.energy.gov/projects>
- FY25 ASR Funding Opportunity Announcement Coming

Atmospheric Radiation Measurement (ARM) User Facility

- ARM is a DOE Office of Science user facility - capabilities and data are freely open to the research community
- Long-term in situ and remote sensing observations of aerosol, clouds and radiation to improve the representation of their impacts on the energy budget in Earth system models
- 3 fixed measurement sites (Oklahoma, Alaska, Azores) in different climate regimes; 1 mobile facility for mid-range (~5 year) deployments (SE US, Oliktok Point)
- 2 mobile facilities available for proposal-driven 6 mo. - 2 y deployments
 - e.g., the CAPE-k, CoURAGE, EPCAPE, SAIL campaigns
- 24/7 data collection at fixed/mobile facilities with all data freely available at www.archive.arm.gov
- High-performance computing for working with large ARM data sets
- Aerial facility component

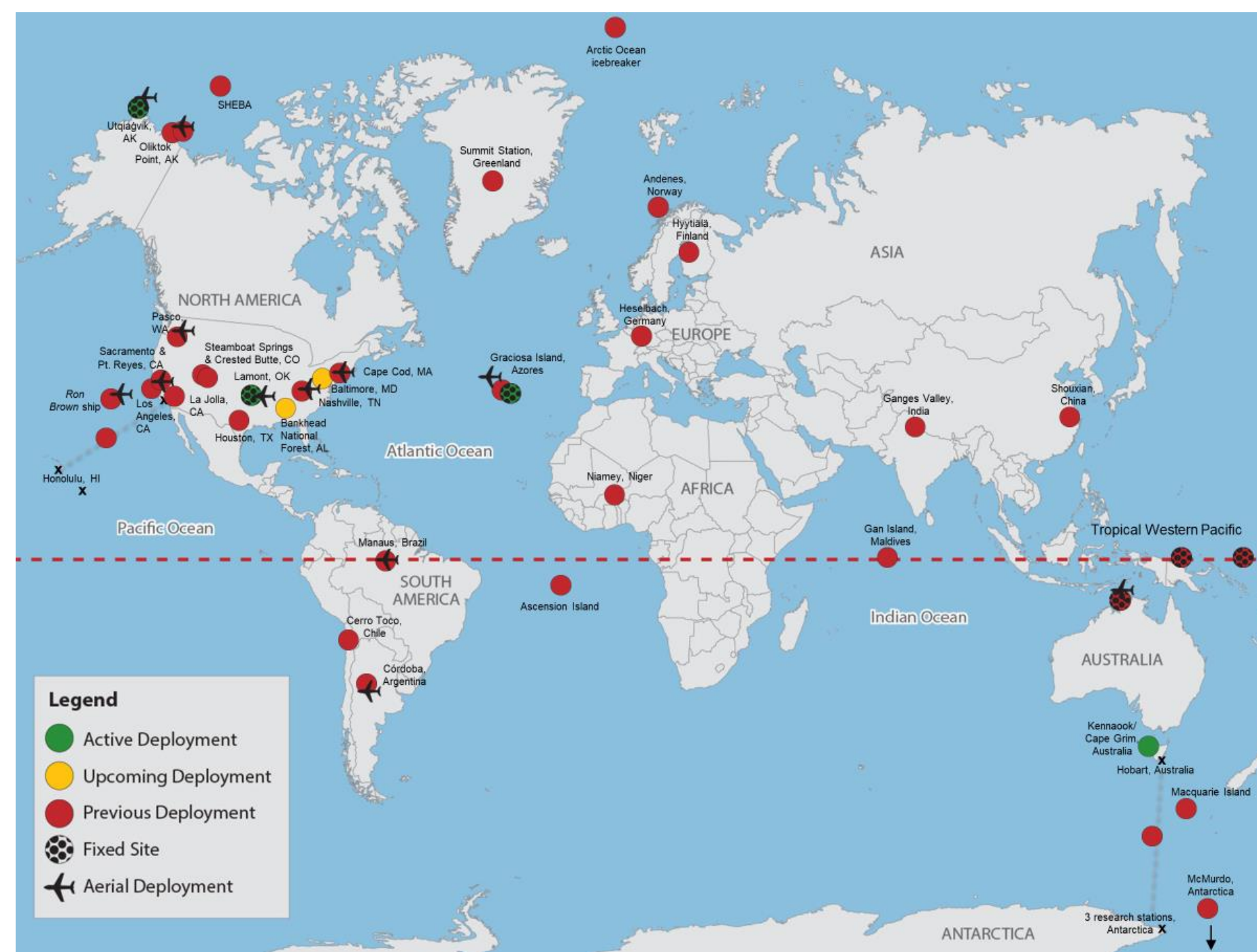


30 years of ARM

Fixed sites, ARM mobile facility deployments, and aerial deployments

Locations with plain circles have 6 month to 2 year data records

Fixed sites (with hash marks) have longer data records



ARM Data and Facilities Support Research Applications, Capability Development and Education

- ▶ Freely download and use ARM data and LES simulations at ARM sites for your scientific research
- ▶ Access Jupyter notebooks and high-performance computing to work with ARM data
- ▶ Attend ARM short courses/summer schools/webinars to learn how to work with ARM data and/or propose ARM field campaigns
- ▶ Propose a guest instrument deployment at ARM fixed or mobile facilities – solicitation open year-round
- ▶ Propose a larger ARM campaign:
 - ARM Mobile Facility deployment
 - Tethered Balloon System missions (Annual FICUS call)
 - Unmanned Aerial System mission (expect new call for 2025)



Engaging with ARM and ASR

- Sign up for GovDelivery to receive DOE funding opportunity announcements at <https://public.govdelivery.com/accounts/USDOEOS/subscriber/new>
- Check out ARM's resources for new users at <https://arm.gov/about/resources-for-new-arm-users>
- Create an ARM user account to access ARM data and sign up for the ARM mailing list
- Check out ASR's "Engaging with ASR" webpage at <https://asr.science.energy.gov/about/engaging-with-asr>
 - Links to sign up for ASR newsletter and working group mailing lists
 - ASR open house webinar recording
 - Links to ASR research highlights and news
- Volunteer to serve on a review panel - email the program managers



asr.science.energy.gov



arm.gov

Environmental System Science

Goal: advance an integrated, robust, and scale-aware predictive understanding of terrestrial systems and their interdependent microbial, biogeochemical, ecological, hydrological, and physical processes.



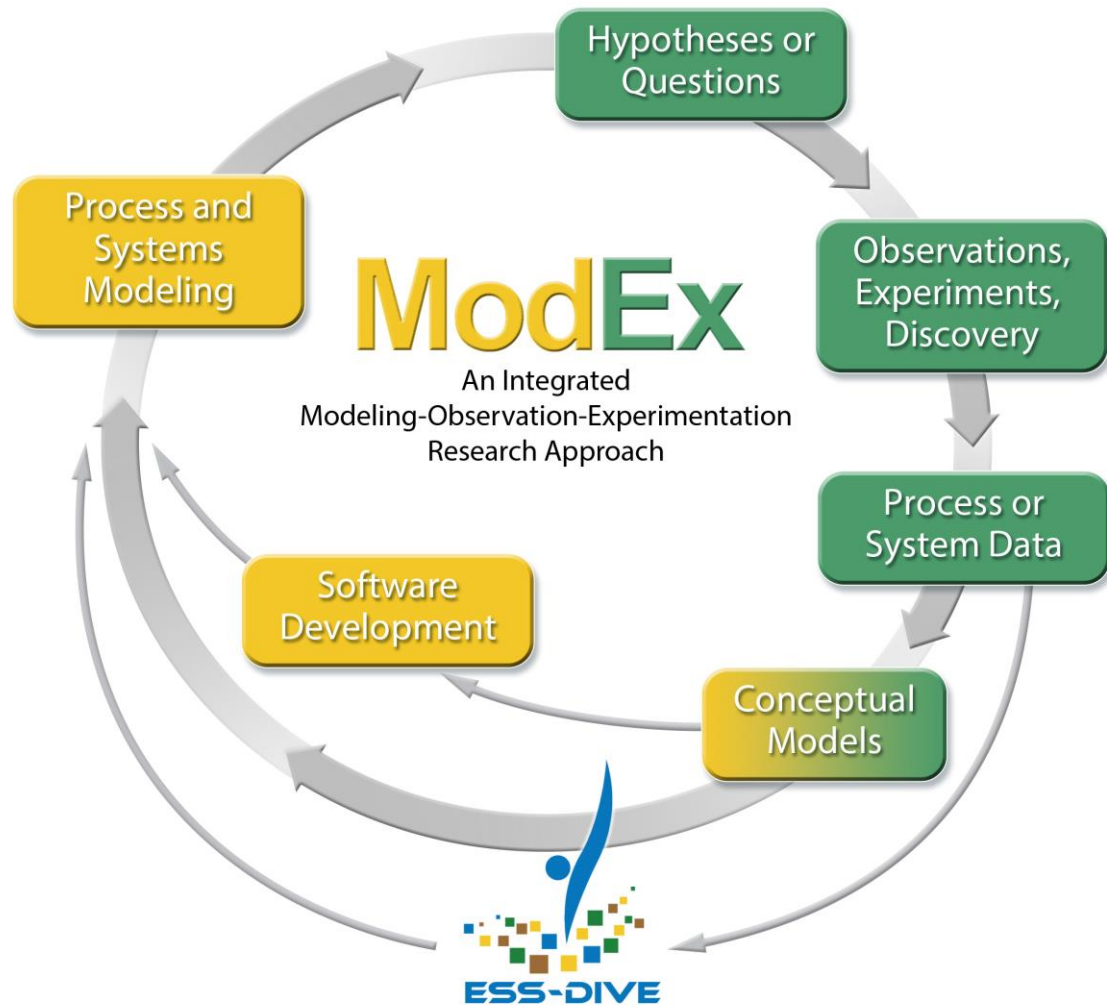
Objectives:

- Develop an integrated framework using a **systems approach**, emphasizing **ecological and hydro-biogeochemical linkages** among system components
- Elucidate the complex processes and controls on the structure, function, feedbacks, and dynamics of **terrestrial ecosystems and watersheds**
- Advance **foundational process knowledge** to address key knowledge gaps and uncertainties across a range of spatial and temporal scales, and
- Incorporate those **scientific findings into process and system models** and use model outputs to inform experiments.

Scope:

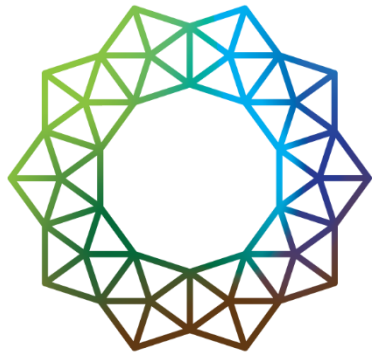
- From the **bedrock through the soil, rhizosphere, and vegetation to the atmosphere**
- From **molecular to global scales** and nanoseconds to decades, with an emphasis on understudied ecosystems and characterizing processes across interfaces

The Model-Experiment (ModEx) Paradigm



- Our “**predictive understanding**” is encapsulated in process, ecosystem, watershed and Earth System models over vast spatial and temporal scales (molecular to global)
- **Identified needs and gaps in state-of-the-art models help motivate ESS research** on ecological and hydro-biogeochemical processes
- Coupling modeling needs with process investigation **generate research hypotheses** that ESS researchers interrogate with lab, field, and observational research.
- Results of ESS process research are incorporated into **new model developments and simulations**
- Comparing model improvements and predictions against observations or field experiments identify uncertainties that need further observational/field research (***not a one-way street***).

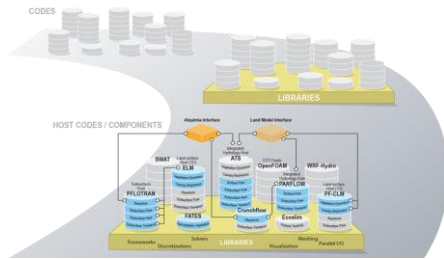
ESS Open Data and Open Science Philosophy



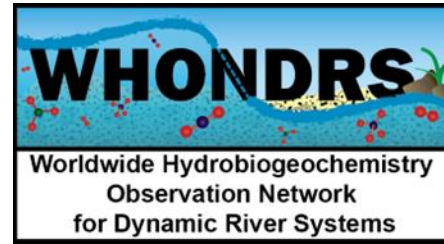
AMERIFLUX
MANAGEMENT PROJECT



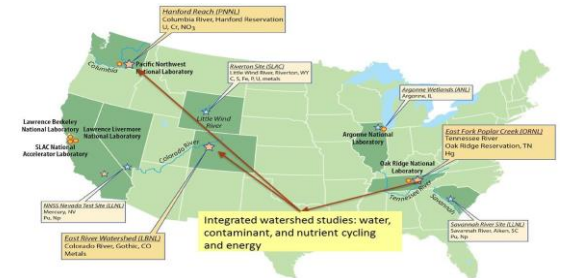
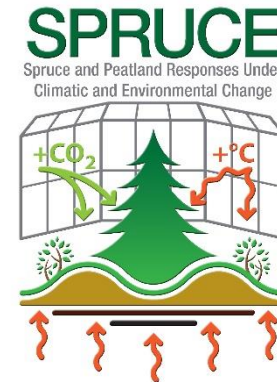
ESS-DIVE
Deep Insight for Earth Science Data



IDEAS- Watersheds

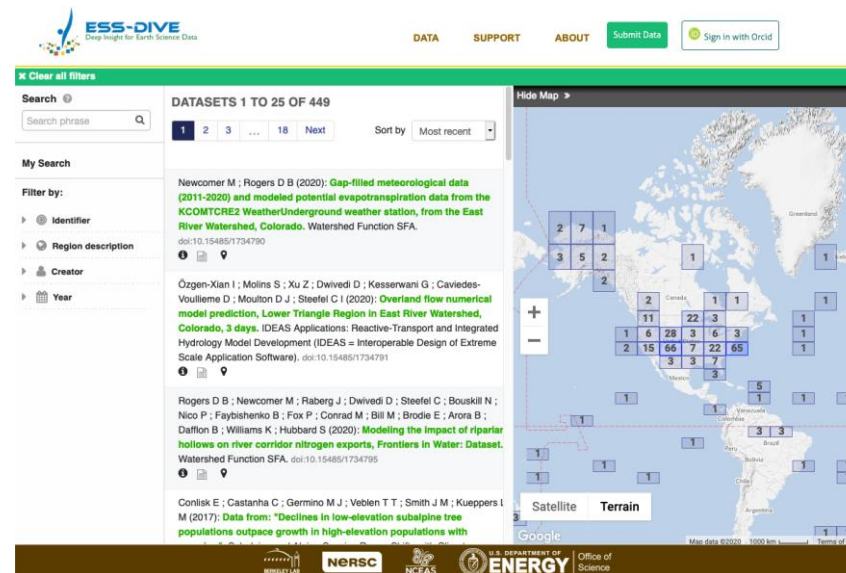


Field Research in Critical Systems



Watershed Testbeds

ESS-DIVE: A Repository for the DOE's Earth and Environmental Science Data



- Long-term repository serving diverse, multi-scale, multi-disciplinary data
- Developing community data formats
- Adheres to FAIR principles
- Operational since 2017
- <http://ess-dive.lbl.gov>

Extensive community involvement fundamental to the approach



Large Projects

- Multi-institutional and Interdisciplinary teams
- Next Generation Ecosystem Experiments (NGEEs)
 - Science Focus Areas (SFAs)



Small Projects

- Universities
- Other Federal Agencies
- Early Career Projects

ESS Research Portfolio

Lab - Science Focus Areas

- Terrestrial Ecosystem Science/SPRUCE (ORNL)
- **Watershed Function (LBNL/SLAC)**
- River Corridor and Watershed Hydro-BGC (PNNL)
- Watershed Dynamics and Evolution (ORNL)
- Belowground BGC (LBNL)
- **Wetland Function and Resilience (ANL)**

Critical Ecosystems

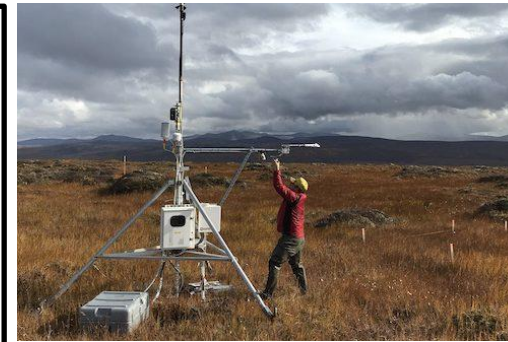
- NGEE- Arctic
- NGEE- Tropics
- Coastal Observations, Mechanisms, and Predictions Across Systems and Scales (COMPASS) – Field Measurements and Experiments (FME)

University Projects

- Early Career projects
- EPSCoR projects

Other Projects

- Urban Integrated Field Laboratories (Urban IFLs)
- National Virtual Climate Lab (NVCL)
- AmeriFlux Management Project
- IDEAS Watersheds



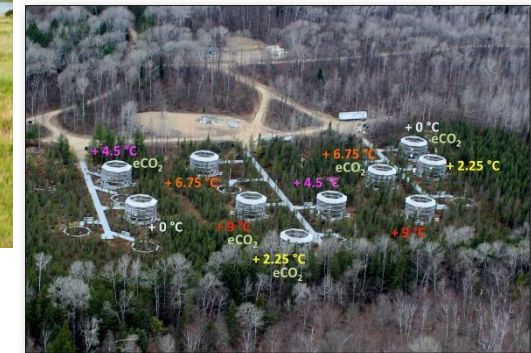
Field research at the NGEE-Arctic site



Field research along the Columbia River



Coastal field research



Field research at the SPRUCE site

Accelerating scientific discovery and pioneering new capabilities to understand biological and environmental processes across temporal and spatial scales

EMSL Strategic Science

MONet – Mol. Observ. Network

- 714 cores received.
- April 30 - Data portal launches.



DigiPhen – Digital Phenome

- Nov 23 - 1000 Fungal Proteins wkshp.
- On-going - 1000 Fungal Proteins pilot.



Letters of Intent submitted for FY25

Large-Scale Research: 98 total

Funct & Systems Biol	31	Env Transf & Interactions	52	Comp, Anal & Modeling	15
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FICUS Research: 79 total

EMSL and JGI	61	EMSL and ARM	11	EMSL and APS	6
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Upcoming CY24 Outreach Activities

- **MONet workshop at Association of 1890's Research Directors Roundtable** | April 2024
- **FY25 Exploratory Proposal call opens** | June 2024
- **EMSL Summer School: 1000 Fungal Proteins** | July 2024
- **EMSL/SLAC Integrated Chemical Imaging workshop** | August 2024
- **MONet symposium at SSSA** | Nov 2024

Recent ESS University FOAs

- **FY2022 ESS FOA 2584 - \$10M over 3 years**
 - 142 pre-apps, 59 applications, 12 projects across 3 SRAs (plant-mediated ecohydrologic processes, impacts of wildfire or floods on system function, role of fungal networks in shaping ecosystem function)
- **FY2023 ESS FOA 2849 - \$13M over 3 years**
 - 182 pre-apps, 67 applications, 17 awards across 3 SRAs (hot spots/moments of BGC in TAs, ecosystem/watershed responses in cold regions, synthesis studies)
- **FY2024 ESS FOA 3196 - Anticipated \$8M over 3 years**
 - 3 SRAs (plant-microbe rhizosphere interactions, consequences of large-scale vegetation shifts, synthesis studies on legacy effects, or on carbon cycle-disturbance dynamics) - *Awards expected September 2024*

Climate Resilience Centers (CRC)

VISION: A network of climate resilience centers at HBCUs, MSIs, and Emerging Research Institutions (ERIs) for two-way translation of basic climate science towards equitable solutions

MISSION AND SCOPE:

- ▶ Engage basic research from across the DOE complex to focus on local climate impacts, resilience, and equitable energy solutions
- ▶ Resource and representation for local-level climate research
- ▶ Leverages ongoing foundational investments in BER research
- ▶ Identify basic science needs to inform future research priorities
- ▶ Provides outreach, community engagement, training, and collaboration opportunities among participants and community level stakeholders



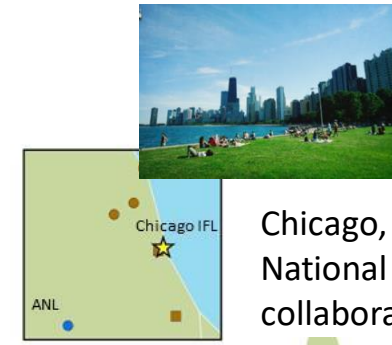
**FY2024 CRC FOA
currently closed**

Applications under review; Decisions
anticipated in September 2024

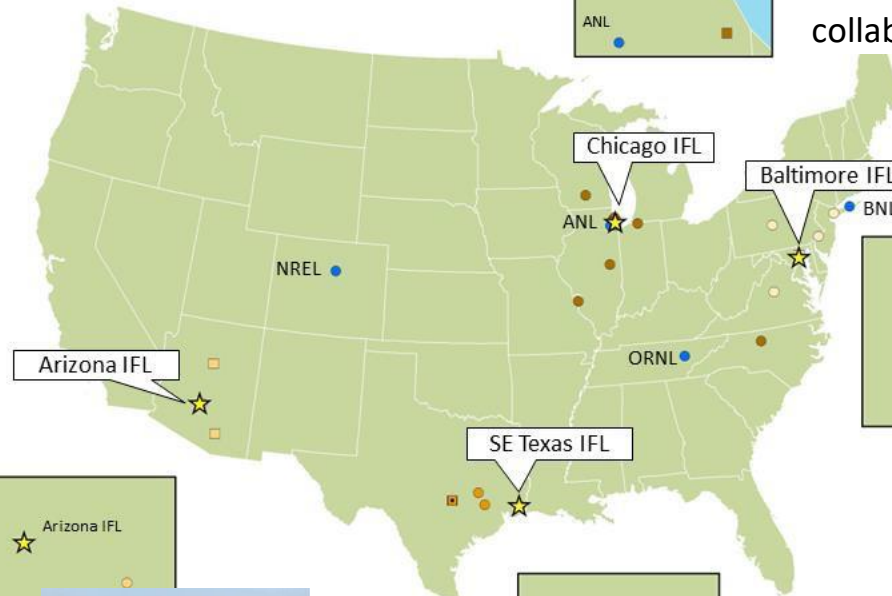
[https://science.osti.gov/ber/Funding-
Opportunities](https://science.osti.gov/ber/Funding-Opportunities)

Urban Integrated Field Laboratories (IFLs)

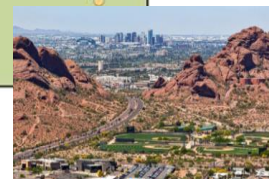
- Four 5-year projects; total IFL funding over \$90M.
- Each IFL encompasses interdependent environmental, ecological, atmospheric, infrastructure, and human components of their selected urban region.
- IFLs will develop innovations in observing and modeling urban systems, digital twins, integrate with DOE's climate modeling, and leverage capabilities from DOE and other agencies.
- Each project is strongly connected to their city through local and Minority Serving Institutions, community organizations, and previous work in the region.
- <https://ess.science.energy.gov/urban-ifls/>



Chicago, IL: led by Argonne National Lab with 13 (6 MSI) collaborators.



Baltimore, MD: led by JHU with 10 (3 MSI) collaborators



Tucson-Phoenix-Flagstaff, AZ: led by ASU with 4 (2 MSI) collaborators.



TX Gulf Coast: led by UT-Austin (MSI) with 4 (1 MSI) collaborators.

National Virtual Climate Laboratory (NVCL)

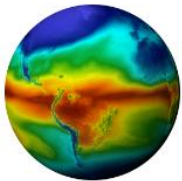


NVCL OBJECTIVES

1 CENTRALIZE ACCESS TO DOE CLIMATE RESEARCH

Offer a well-curated, easily accessible, plain-language inventory of DOE Biological and Environmental Research (BER) projects related to climate research and user facilities with continuously updated portal content.

[VIEW RESEARCH »](#)



2 LIST CLIMATE TRAINING OPPORTUNITIES

Provide students, faculty, and early career scientists access to lab-based education and training opportunities at the national laboratories, including coaching and mentoring opportunities in the skills they need to ensure success in their careers.



3 ENCOURAGE COLLABORATIONS

Facilitate robust, self-sustaining collaborations between national laboratories and interested organizations, including colleges and universities that serve underrepresented students.



DOE's new portal (launched May 2023) will catalyze engagement with BER climate science, SC Scientific User Facilities, and DOE National Laboratory resources to train the next generation of climate scientists and professionals.

[NVCL.energy.gov](https://nvcl.energy.gov)

Earth and Environmental System Modeling overview

**Renu Joseph
Modeling Program**

Earth and Environmental Systems Modeling

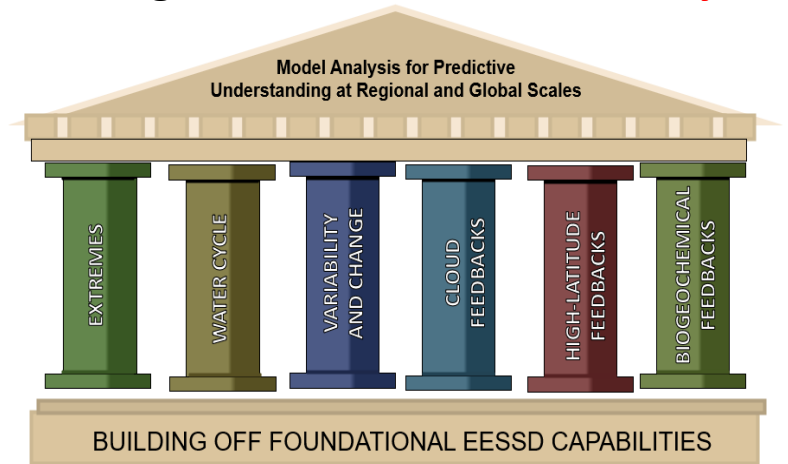
Goal: To develop and demonstrate the most advanced modeling and simulation capabilities, in order to enhance the predictability of the climate system in support of DOE's science and security mission.

Capabilities: : Model development and discovery, using an Integrated Modeling Framework, at the interface of natural and human systems and multisector dynamics, in ultra-high resolution Earth system modeling (E3SM), and hierarchical and multi-model analyses for deep scientific insights.

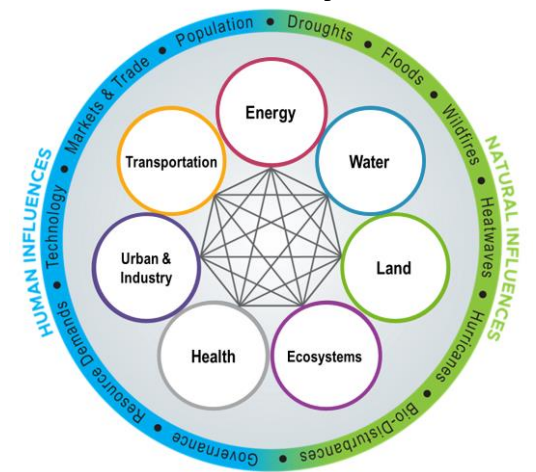
Earth System Model Development



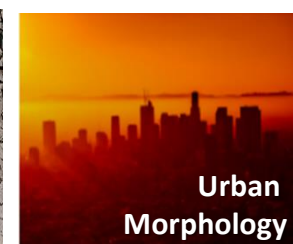
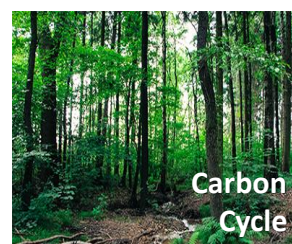
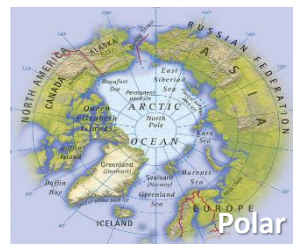
Regional & Global Model Analysis



Multisector Dynamics

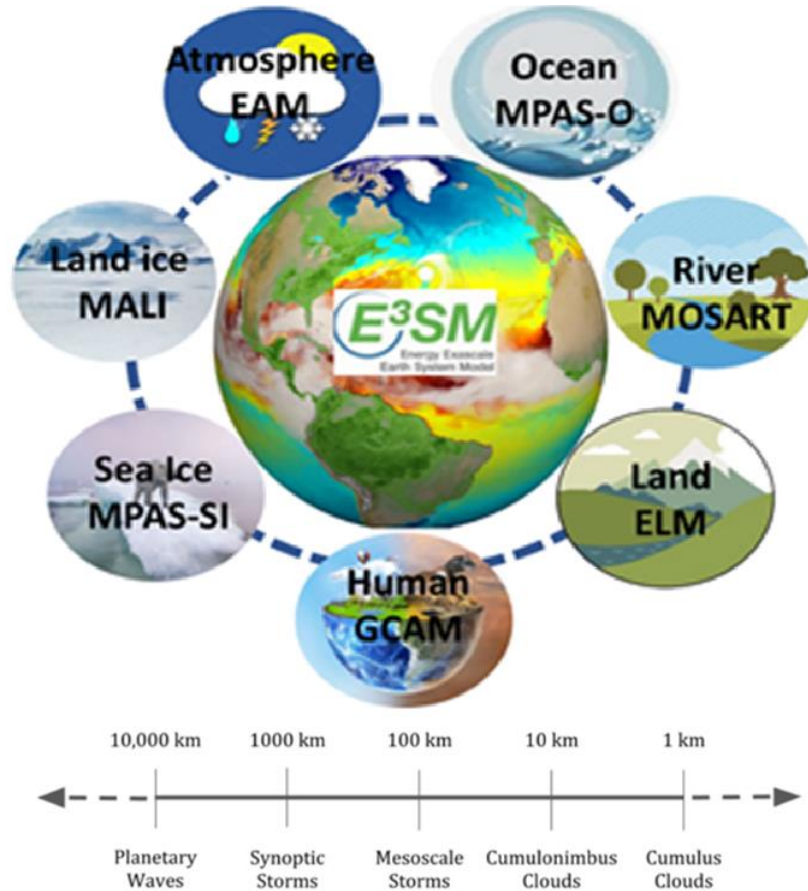


Applications: The capabilities help address high priority climate challenges and contribute to the IPCC and the NCA



Earth System Model Development Focus: The Energy Exascale Earth System Model (E3SM)

Innovative and computationally advanced ESM capabilities, in support of Energy science and mission



Goal: Support the development of E3SM including its subcomponents, to address the grand challenges of actionable predictions of the changing Earth system, emphasizing on the most critical scientific questions facing the nation and DOE

Strategies:

- Science drivers for model development
- Earth system across scales (high-resolution frontier, bridge gaps, quantify uncertainty via LE)
- Prepare for and overcome the disruptive transition to next era of computing, leverage DOE HPC capabilities
- Innovative mathematical, computational methods, tools, algorithms, technologies (e.g., ML/AI)

EAM: E3SM Atmosphere Model; **ELM:** E3SM Land Model ; **GCAM:** Global Change Assessment Model; **MOSART:** Model for Scale Adaptive River Transport; **MPAS-SI:** Model for Prediction Across Scales (MPAS) – Sea Ice; **MPAS-O:** MPAS – Ocean; **MALI:** MPAS-Albany Land Ice Model.

E3SM Acronyms: <https://e3sm.org/resources/help/acronyms/>

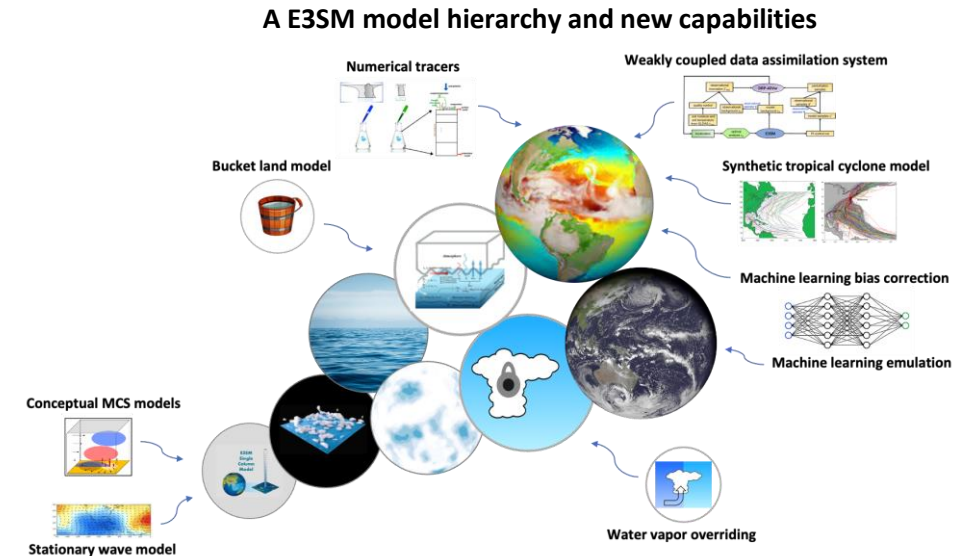
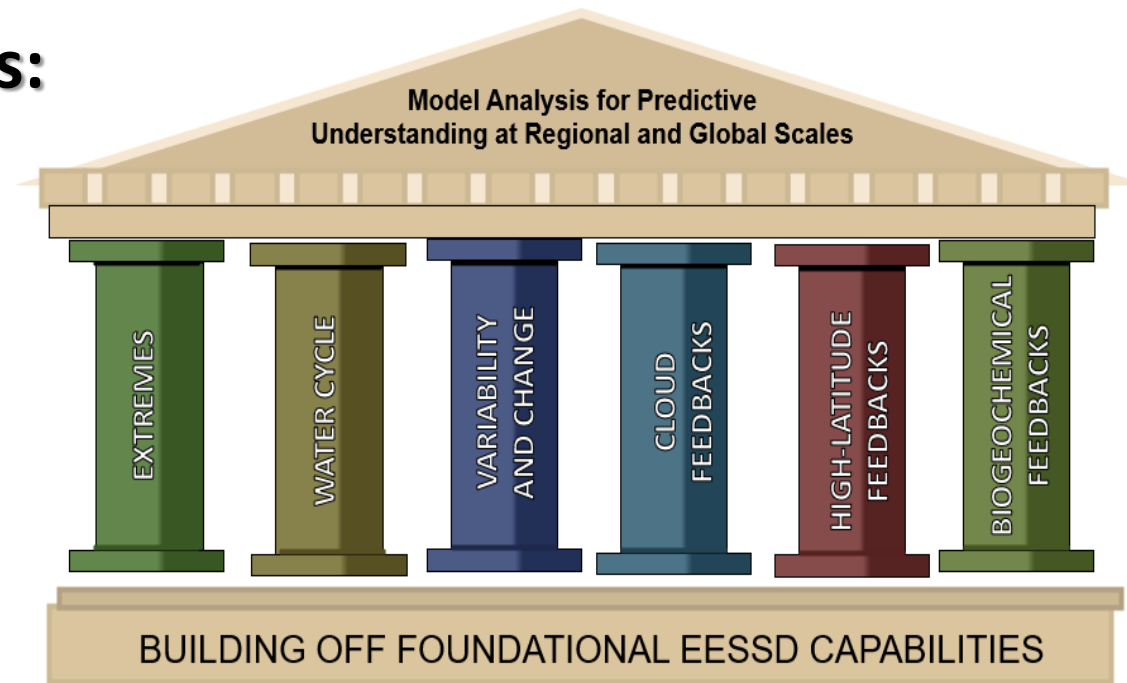
Regional and Global Model Analysis Focus:

Goal: To quantify and enhance a predictive, process-level, and decision-relevant understanding of Variability and Change in the Earth system by advancing capabilities to design, simulate, evaluate, diagnose, and analyze global and regional earth system models informed by observations.

Time scales of interest are from subseasonal to centennial

Enhances scientific understanding of the Earth system through:

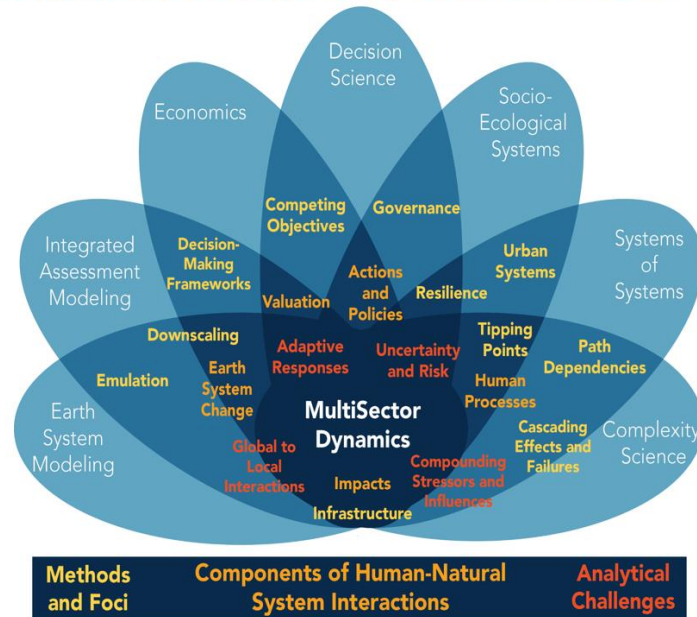
- Development/use of model hierarchies, multi-model approaches, large ensembles, initialized predictions (E3SM to emulators, Global to Regional and local models)
- Development and use *diagnostics* and *metrics* to evaluate models (CMEC, PMP, ILAMB)
- Develop tools for streamlining workflows for analysis
- Innovative modeling tools (e.g., ML/AI)



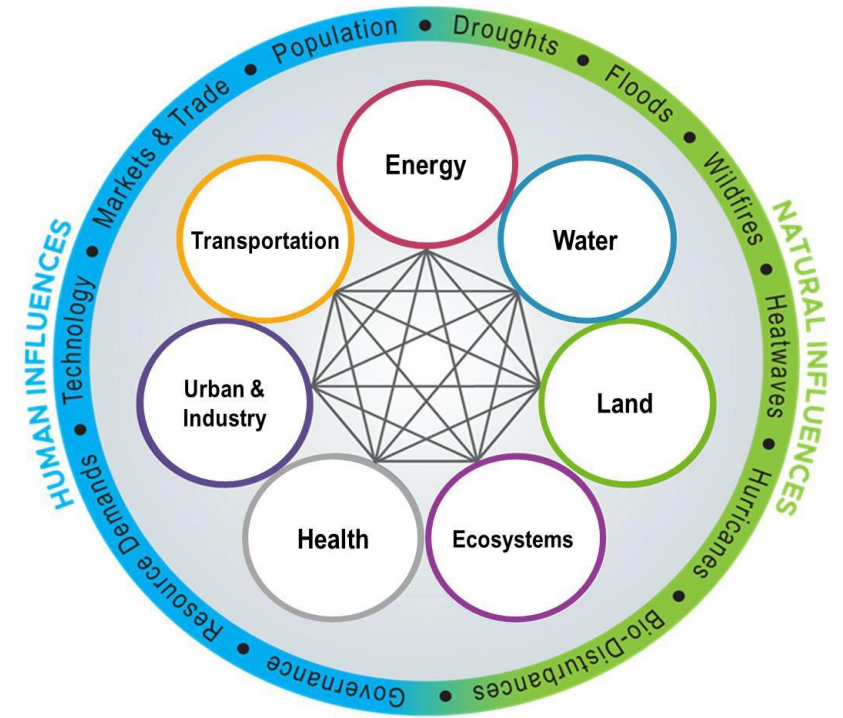
MultiSector Dynamics (MSD) Focus:

Explore the *complex interactions and potential co-evolutionary pathways* within the integrated human-Earth system, including natural, engineered, and socioeconomic systems and sectors.

Analytic challenges and disciplinary breadth of MSD research



Source: Reed et al., 2022
<https://doi.org/10.1029/2021EF002621>



Overview of the EESM Portfolio's Lab Projects

Earth System Model Development

Regional & Global Model Analysis

Multisector Dynamics

Energy Exascale Earth
System Model (E3SM)

SciDAC Projects

To accelerate E3SM via collaboration
with mathematical and
computational scientists

7 projects: AMOC, Antarctic icesheet,
Sea ice mechanics, atmosphere
coupling across scales, QBO, river
dycore, Coastal and open ocean small
scale processes

Enabling Aerosol-cloud interactions at
Global convection-permitting scales
(EAGLES)

Water Cycle and Climate Extremes Modeling (WACCeM)

Calibrated and Systematic Characterization, Attribution and
Detection of Extremes (CASCADE)

Reducing Uncertainty in Biogeochemical Interactions Through
Synthesis and Computation (RUBISCO)

High-Latitude Application and Testing (HiLAT)

Program for Climate Model Diagnosis & Intercomparison
(PCMDI)

Cooperative Agreement to Analyze variability, change and
predictability in the earth SysTem (CATALYST)

A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at
Regional Scales (HyperFACETS)

Integrated Multi-sector Multi-scale
Modeling SFA (IM3)

Global Change Intersectoral Modeling
System SFA (GCIMS)

Program on Coupled Human Earth Systems
(PCHES) Cooperative Agreement

Integrated Global Systems Modeling
(GSM) Cooperative Agreement

University and Early Career Projects (through joint FOAs)

Integrated Coastal Modeling (ICoM)

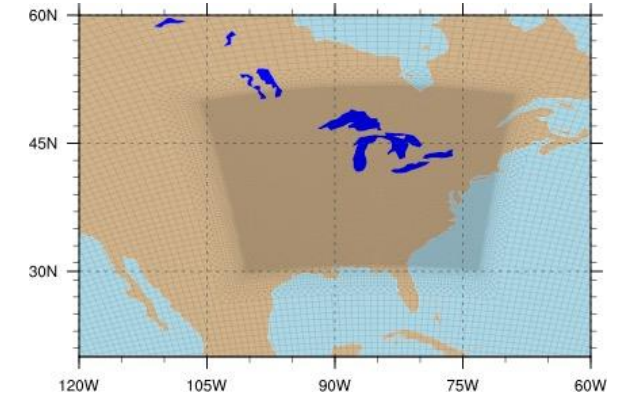
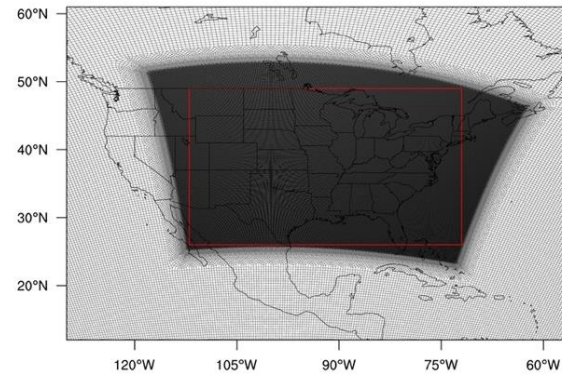
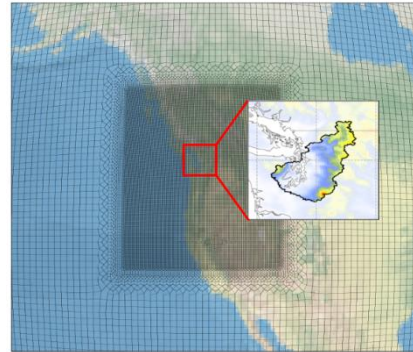
Interdisciplinary Research for Arctic Coastal Environments (InterFACE)

COMPASS-Great Lake Modeling (GLM)

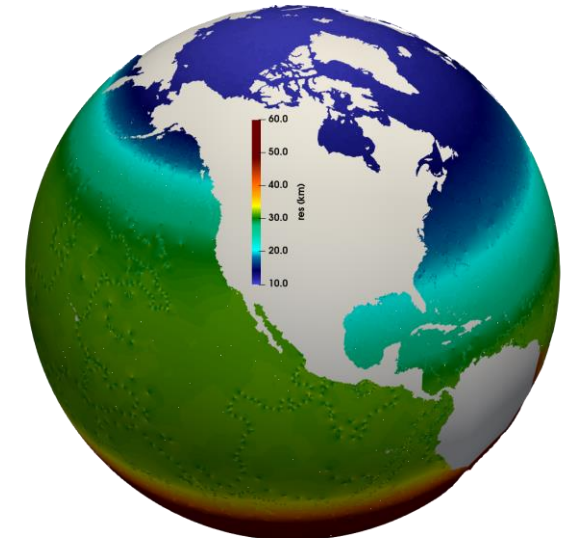
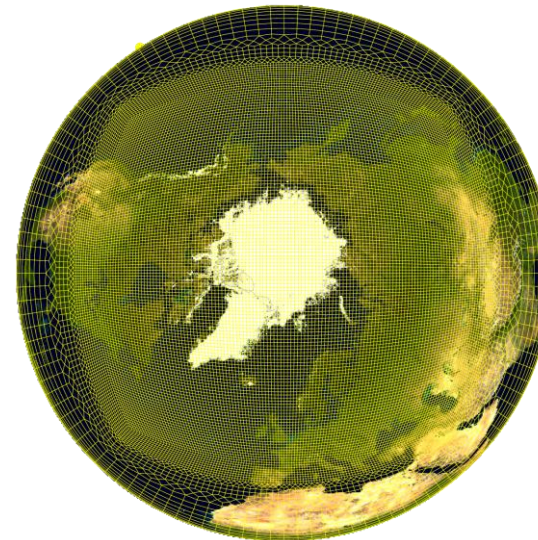
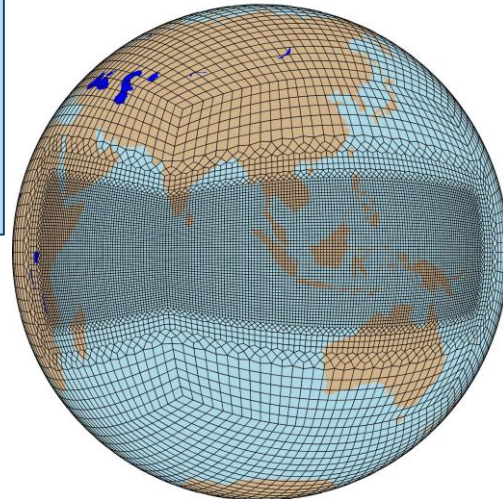
Interagency Efforts (e.g., US CLIVAR, USGCRP-IGIM, IARPC, ICAMS, existing projects)

Key tool for regional scale predictability: Regionally Refined E3SM

- DOE's flagship climate model
- 7 nat'l labs and NCAR
- Includes the full earth system and many human systems
- Can "zoom in" to regions of interest
- Uses DOE High Performance Computers

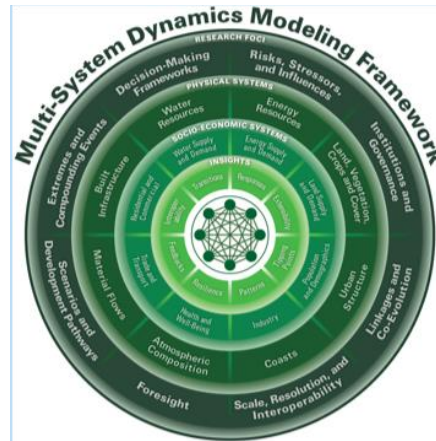


Indian Ocean/Maritime Continent (IOMC)

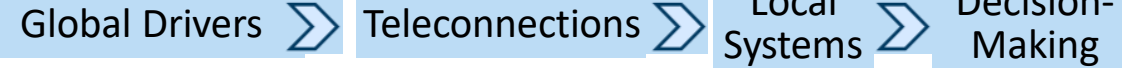


AI/ML techniques is a new priority to more rapidly advance science and prediction

Multi-system, multi-sector modeling framework to explore stressors, risks and responses, tipping points, of interconnected physical and socioeconomic systems

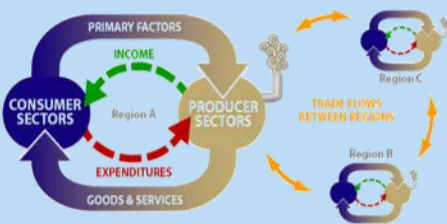


Multi-Scale Interactions

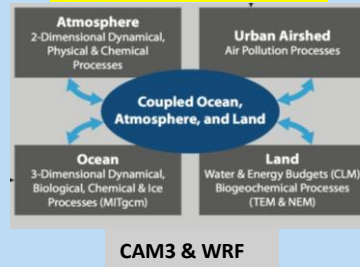


Toolbox for Multi-Sector Modeling

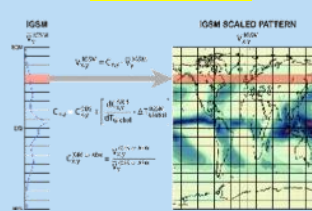
Human Systems



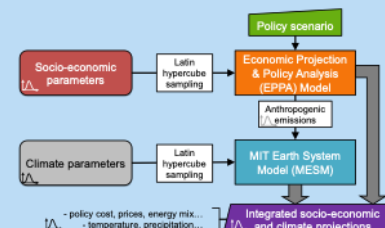
Natural Systems



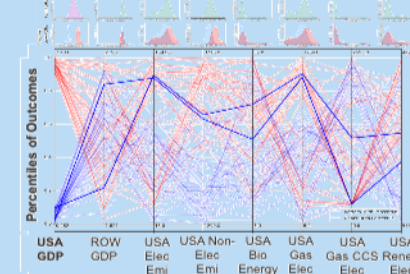
Pattern Scaling Extremes



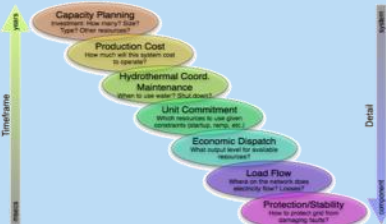
Probabilistic Ensembles



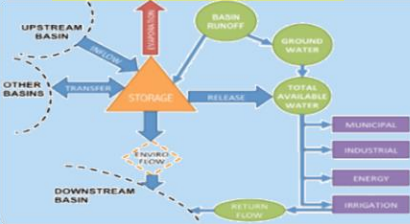
Scenario Discovery



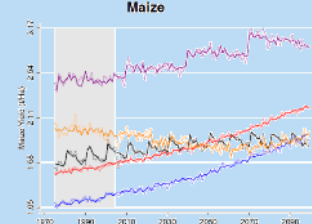
Electricity Models



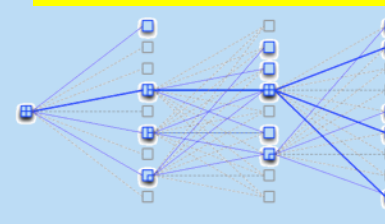
Water Resources



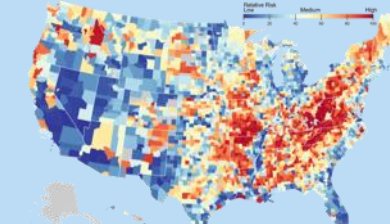
Emulators



Decision Frameworks



Risk Triage



Major Tasks:

- Human-Natural System Interactions
- Transportation Infrastructure
- Stress-Testing Paired Systems

EESM Funding Opportunities

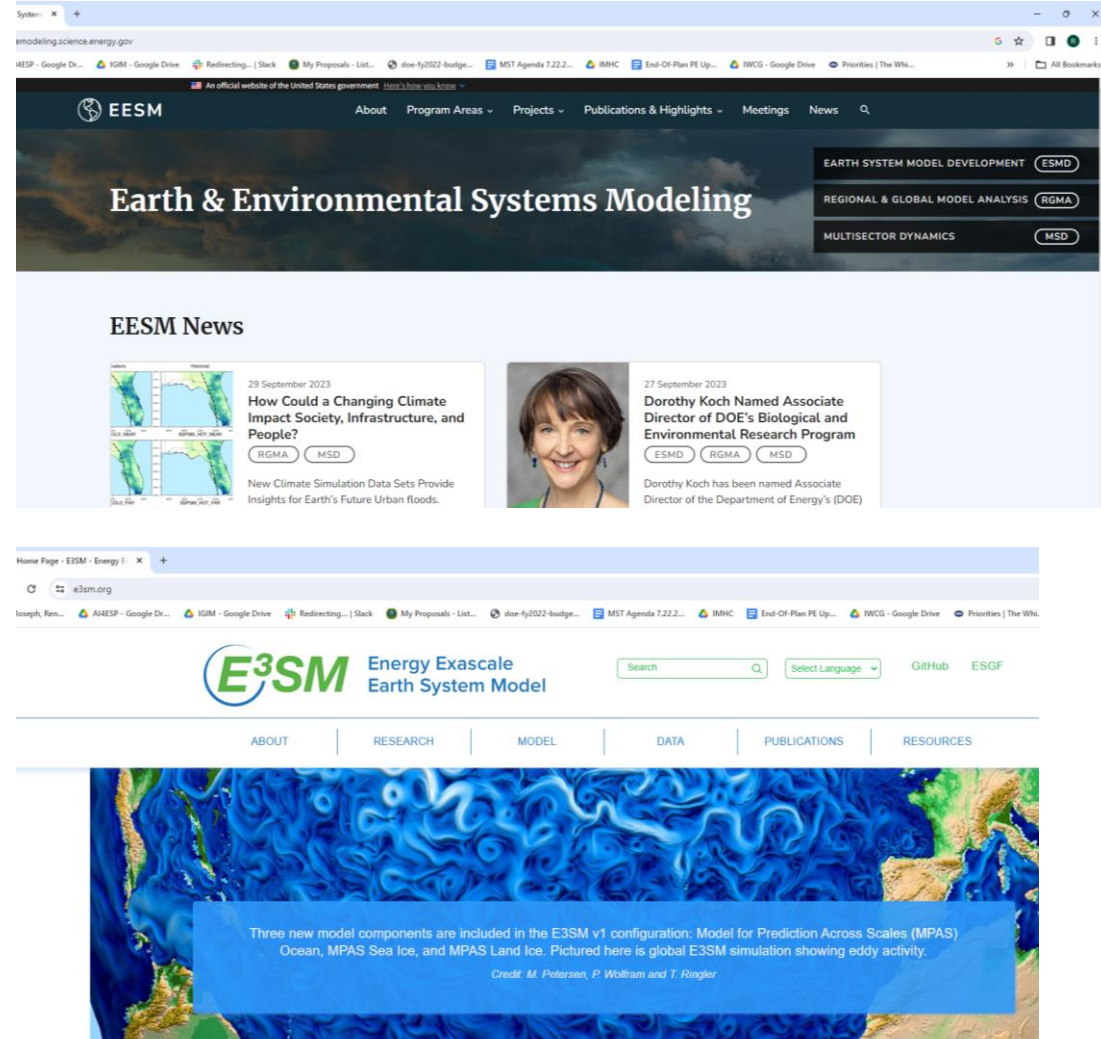
EESM supports university projects through Funding Opportunity Announcement (FOAs) every other year.

- The Model development and Model Analysis topics have been the foci of these.
- Examples of topics include:
 - Model development that enhances E3SM
(Marine BGC development, model development that helps reduce biases in E3SM)
 - Model analyses topics have included emphasis on enhancing predictability
(Modes of climate variability, Water cycle, extreme events, Feedbacks and interactions [High latitudes, Biogeochemical interactions, aerosol/cloud, aerosol-cloud interactions])
- Typically, 20% success rate – same applications are considered for funding for two years
 - Always has been a 3-year award
- Early Career topics have included a focus on Coastal, Urban, and Extreme Events
 - The E3SM Model development activities need partners from the E3SM team and should contribute to model development
 - The Model analyses component should emphasize the use of E3SM, but are encouraged to also supplement the work with a modeling hierarchy and a multi-model approach (e.g., use of CMIP)
- Details of all EESM funded projects <https://climatemodeling.science.energy.gov/projects>

EESM Websites, Newsletters, Weblinks, Youtube

Websites

- <https://climatemodeling.science.energy.gov> (and ESMD, RGMA, MSD sites within)
- <https://e3sm.org/> (exclusively E3SM)
- <https://multisectordynamics.org/>
- Newsletters and updates
 - [E3SM newsletter quarterly](#)
 - [RGMA newsletter quasi-annual](#) but EESM website is often updated
 - [MSD Community of Practice Newsletter](#)
- Blogs and YouTube
 - [E3SM YouTube](#)
 - [RGMA YouTube](#)
 - [MSD Community of Practice Blog](#)



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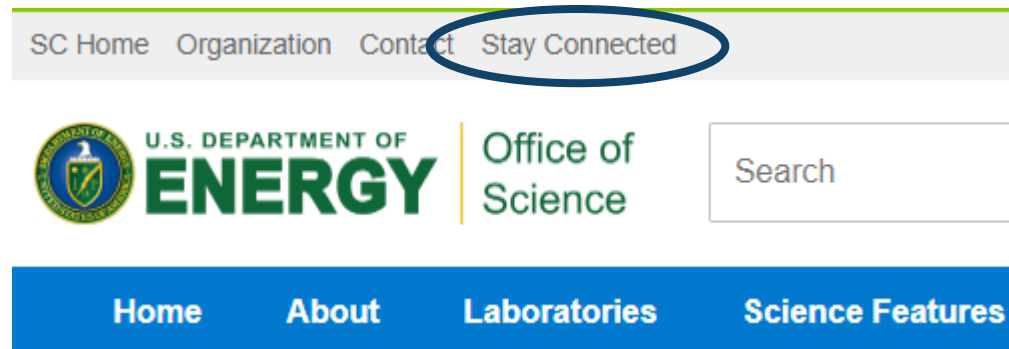


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Use the QR Code or visit:

<https://science.osti.gov/ber>

https://public.govdelivery.com/accounts/USDOS/EOSS/subscriber/new?qsp=office_of_science



Future BER Office Hours

- Upcoming dates/topics:
 - Tuesday, June 25, 2024 at 2:00-3:00 pm ET
BER User Facilities
- Additional information and registration links here:
<https://science.osti.gov/ber/officehours>
- **Zoom Poll**
 - How did you hear about BER office hours?
 - What additional office hours topics interest you?

Questions & Answers

Questions asked during the presentation through the Zoom Q&A will be answered live now.

If there is time available and you would like to ask your question live, raise your hand in Zoom and we will ask you to unmute to ask your question.

If your question is not answered today, or if you have additional questions about a specific topic, please contact any EESSD program manager.

Where to find more information

Biological and Environmental Research (BER)

<https://science.osti.gov/ber>

Earth and Environmental Systems Sciences Division (EESSD)

<https://science.osti.gov/ber/Research/eessd>

Atmospheric System Research (ASR)

<https://asr.science.energy.gov/>

Environmental System Science (ESS)

<https://ess.science.energy.gov/>

Earth and Environmental System Modeling (EESM)

<https://climatemodeling.science.energy.gov/>

Data Management

<https://science.osti.gov/ber/Research/eessd/Data-Management>

Atmospheric Radiation Measurement (ARM) user facility

<https://www.arm.gov/>

Environmental Molecular Sciences Laboratory (EMSL)

<https://www.emsl.pnnl.gov/>

BER Funding Opportunities

<https://science.osti.gov/ber/Funding-Opportunities>

Office of Economic Impact and Diversity

<https://www.energy.gov/diversity/office-economic-impact-and-diversity>

Promoting Inclusive and Equitable Research (PIER)

<https://science.osti.gov/grants/Applicant-and-Awardee-Resources/PIER-Plans>



Thank you!

