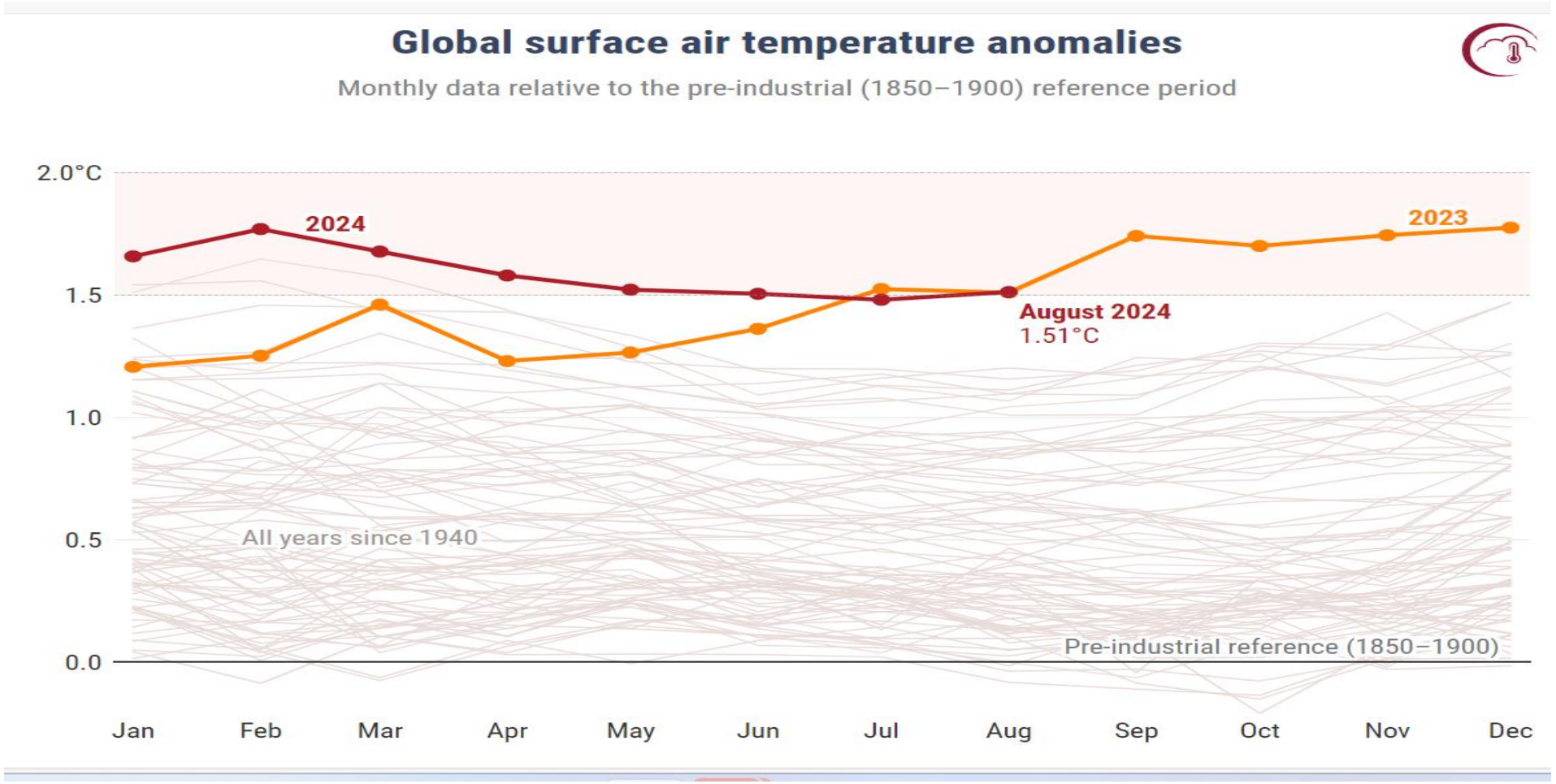
U.S. DEPARTMENT OF ENERGY | Office of Science

Earth and Environmental Systems Sciences Division

BERAC Update

Gary Geernaert

October 24, 2024

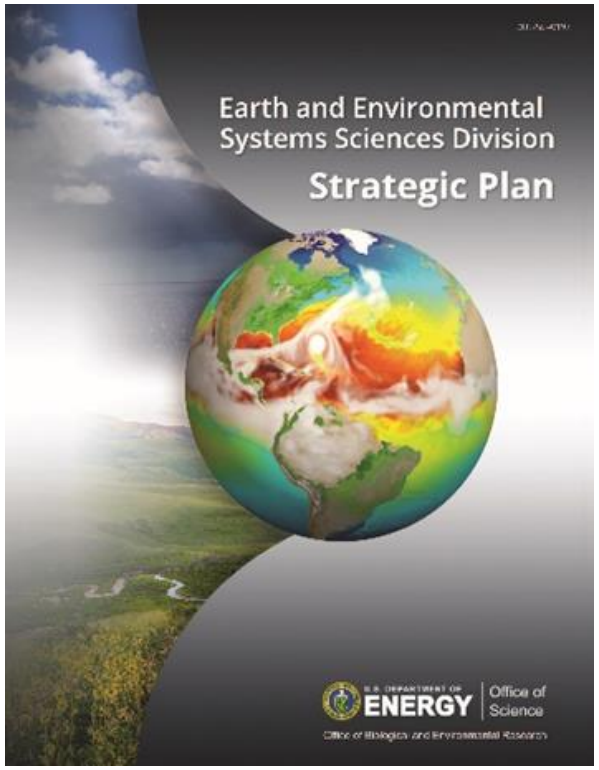

Global surface air temperature anomalies
Monthly data relative to the pre-industrial (1850–1900) reference period
2.0°C
1.5
1.0
0.5
0.0
2024
2023
August 2024
1.51°C
All years since 1940
Pre-industrial reference (1850–1900)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Preview of our next Strategic Priorities 2025-2030

EESSD's Vision: To enhance the seasonal to multi-decadal scale predictability of the Earth system using long term field experiments, DOE user facilities, modeling and simulation, uncertainty characterization, best-in-class computing, process research, and data analytics and management in order to inform the development of advanced solutions to the Nation's energy challenges.

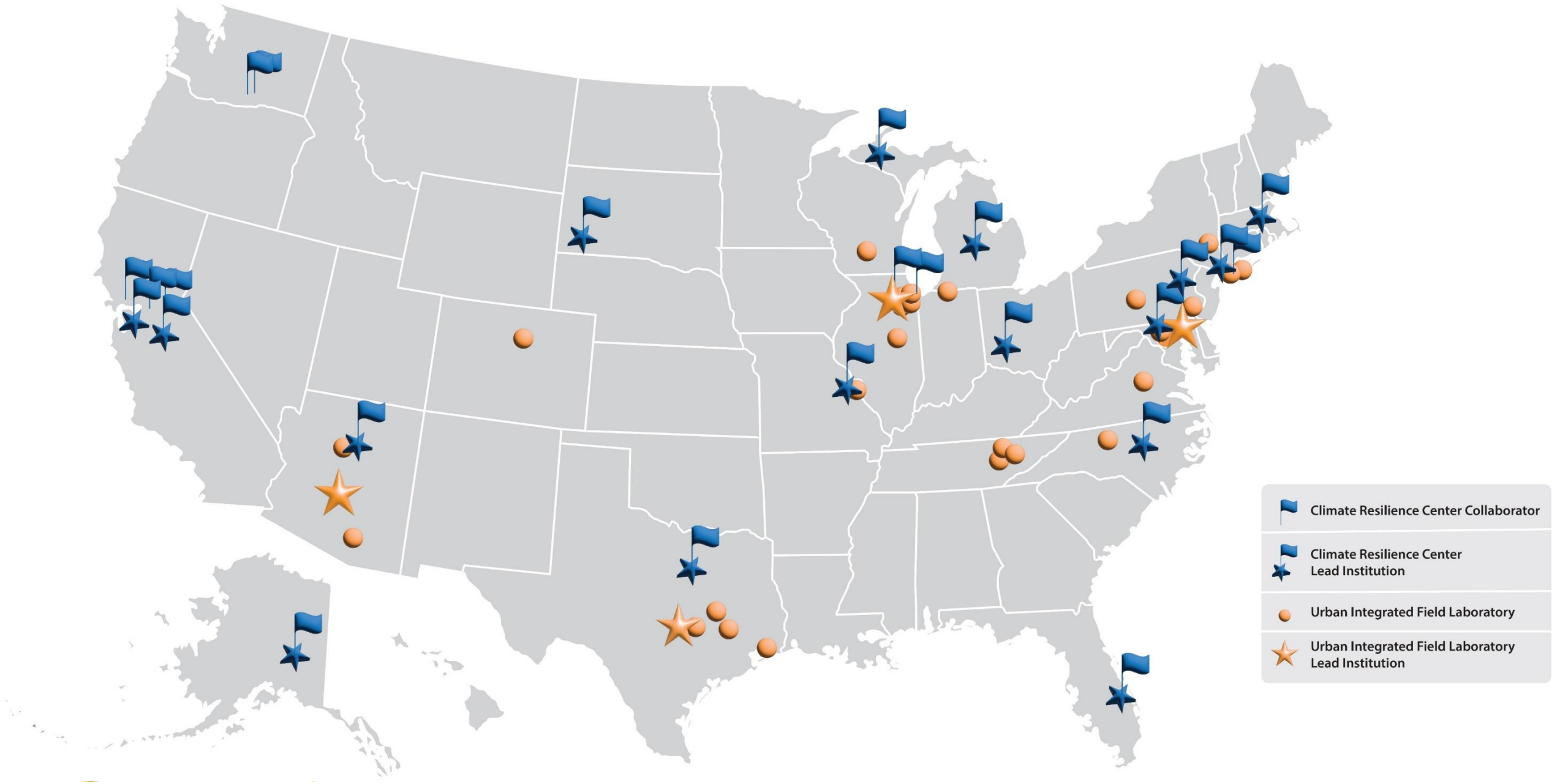
What's going to be new

- Higher level drivers are more apparent in next plan
  - Earth/climate system change is influenced by connections between the natural and human system
  - Economic competitiveness is influenced by the time lag between science discovery and application
- Collaborations with stakeholders will be strengthened
- Compounding disturbances and extremes take on wider dimensions
- Critical systems are broadened, with extensions to collaborate with BSSD
- Exascale and smart uses of AI; quantum and other technologies
- Predictability extends to shorter time scales, e.g., sub-seasonal to multi-decadal
- Coordinate with the BER and BSSD priorities

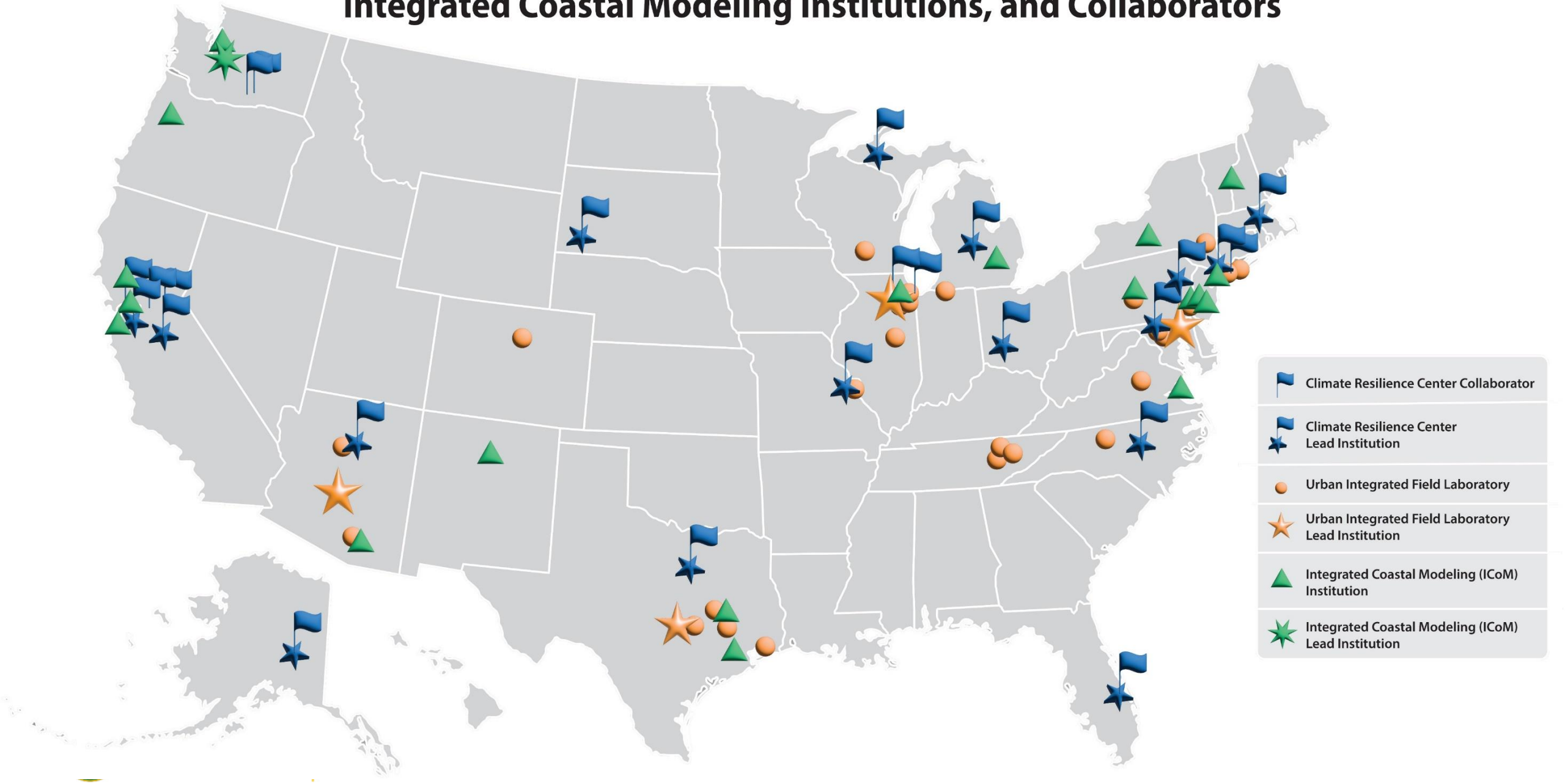


Urban Integrated Field Laboratories and Collaborators

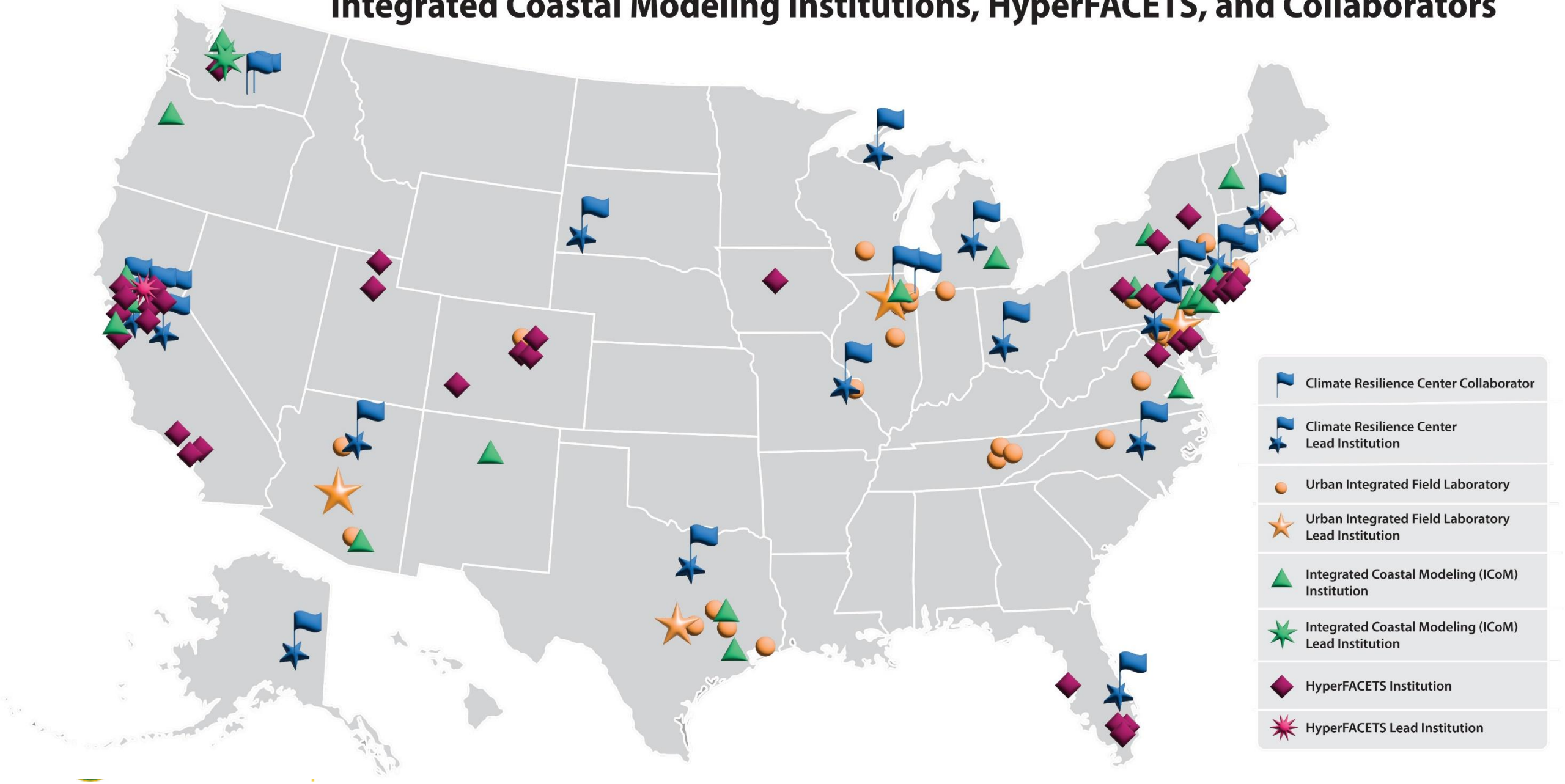
Climate Resilience Centers, Urban Integrated Field Laboratories, and Collaborators



Climate Resilience Centers, Urban Integrated Field Laboratories, Integrated Coastal Modeling Institutions, and Collaborators



Climate Resilience Centers, Urban Integrated Field Laboratories, Integrated Coastal Modeling Institutions, HyperFACETS, and Collaborators



Management Updates – PI Meetings

PI Meeting	Dates	Location
E3SM PI Meeting	Nov 7-8, 2023	Bethesda, MD
ESS PI Meeting	April 15-17, 2024	Reston, VA
Modeling PI Meeting	August 5-8, 2024	Rockville, MD
Urban IFLs PI Meeting	**Oct 28-29, 2024**	**Rockville, MD**
ARM/ASR PI Meeting	**March 3-7, 2025**	**Rockville, MD**
ESS PI Meeting	**April 15-17, 2025**	**Reston, VA**

Management Updates – Major Reviews in FY2024-2025

Lab	Program	Type	Review date	Decision	Date
ANL	ESS	Wetland Function Resilience SFA	Nov 2-3, 2023	Accept	June 1, 2025
PNNL	ESS	River Corridor Hydrobiogeochem SFA	July 9-10, 2024	Accept	Oct 17, 2024
LBNL	ESS	NGEE Tropics	July 16-17, 2024	Accept	Sept 25, 2024
ORNL/ANL	Data	ESGF review	Aug 13-14, 2024		
LBNL	Data	ESS-DIVE	Aug 27-28, 2024		
PNNL et al	ARM	ARM facility triennial review	Sept 16-18, 2024		
NCAR	**Modeling**	**CATALYST**	**Nov 13-14, 2024**		
PNNL	**ASR**	**PASCALLS SFA**	**Nov 14-15, 2024**		
PNNL	**EMSL**	**EMSL Triennial Facility Review**	**Nov 20-21, 2024**		
PNNL, et al	**ARM**	**ARM Triennial Facility Review**	**Jan 13-15, 2025**		
PSU	**Modeling**	**PCHES triennial review**	**Jan 23, 2025**		
PNNL / LANL	**Modeling**	**ICOM; INTERFACE; COMPASS-GLM**	**SPRING 2025**		
LBNL	**ESS**	**Ameriflux review (virtual)**	**July 2025**		

Management Updates – Solicitations in 2024-2025

Funds	Program lead	Issued	Proposals	Panel (2022)	Selections tbd
FY24	ARM Mobile Facility AMF1 FOA	Jan 2024	7	Mail in (April)	1
FY24	Climate Resilience Centers FOA	Oct 18, 2023	43	April 23-24	10
FY24	ASR FOA	Oct 19, 2023	101	Mar 28-29, Apr 5-6, 9-10	20
FY24	ESS FOA	Oct 30, 2023	80	May 5-9	12
FY24	Modeling FOA	Nov 29, 2023	70	May 23-24, 30-31	13
FY24	Early Career (ASR) FOA	Dec 20, 2023	25	May 21-23	3
FY24	Funding for Accelerated Inclusive Res.	Mar 12, 2024	29	Mail-in (August)	2 (1 EESSD)
FY24	Reaching a New Energy Workforce	Mar 12, 2024	34	Sept 12	3 (1 EESSD)
FY25	EESSD Southeastern US Research	July 25, 2024	29	TBD (winter)	16-20
FY24	Marine clouds and ships lab call	May 23, 2024	5	Mail-in (August)	1
FY25	ASR, ESS, CRC, EC (ESS), etc.				

Management Updates – Workshops FY23-25

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 26-27, 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

Management Updates – Workshops FY23-25

Workshop	Program	Dates	Location
ICAMS Workshop on AI for weather and climate	All agencies	Nov 4, 2024	virtual
ARM BNF workshop for new users	ARM, et al	Dec 4-5, 2024	Huntsville, AL
AI for climate modeling strategy workshop	Modeling	Dec 13, 2024	Wash DC
Designing future ecosystem experiments: 1 (lessons learned)	ESS, etc.	Jan 14, 16, 17, 2025	virtual
Designing future ecosystem experiments: 2 (needs/opport)	ESS, etc.	Summer, 2025	virtual
County Digital Twin Workshop	Modeling	Feb 24-25, 2025	Santa Rosa, CA
ESS Cyberinfrastructure Workshop	ESS	April 14, 2025	Reston, VA

Environmental Molecular Sciences Laboratory

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

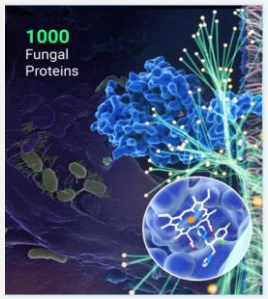
EMSL Strategic Science

MONet – Mol. Observ. Network

- 1506 cores received.
- 16.7 TB Soils Data Available.

DigiPhen – Digital Phenome

- Spring FY25 – AMP^2 workshop for Anaerobic 1st Science .
- 1000 Fungal Proteins Pilot: >100 uncharacterized proteins expressed and 5 functionally annotated.



Proposals Accepted for FY25

Large-Scale Research: 28 total

Funct & Systems Biol	10	Env Transf & Interactions	12	Comp, Anal & Modeling	6

FICUS Research: 13 total

EMSL and JGI	10	EMSL and ARM	3	EMSL, JGI and APS	1

Upcoming FY2025 Outreach Activities

- **EMSL Triennial Review**| Nov 20-21, 2024
- **MONet Community Science Meeting**| Feb 2025
- **Joint EMSL-JGI 1000 Fungal Protein Session (European Fungal Genetic Mtg)**| Mar 2025
- **EMSL S&T Advisory Committee Mtg**| Mar 2025
- **DigiPhen AMP^2 1st Science Workshop** | Spring 2025
- **EMSL Summer School – AI/Automation**| July 2025

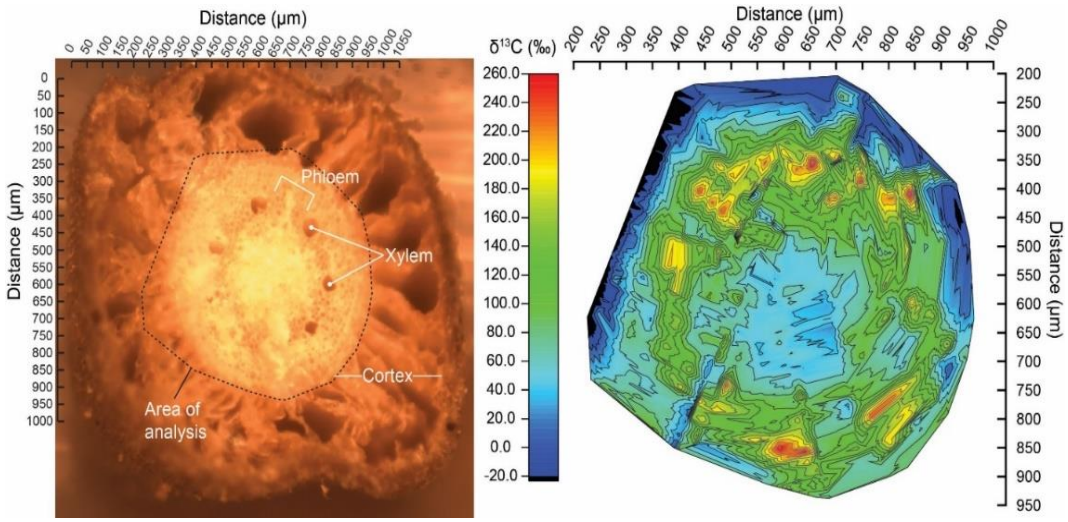
Quantifying Nutrient Exchange in Plant Tissues, the Rhizosphere, and Soils

Objective

- Track nutrient exchanges in spatially focused hotspots of activity in plant tissues, rhizosphere, and soil.

Approach

- Used laser ablation sampling to enable collection of material with 10s μm spatial resolution.
- Used several EMSL capabilities to conduct stable isotope analysis.



A switchgrass root was imaged with light microscopy (left) to enable mapping of the spatial distribution of a ^{13}C tracer (right) to reveal locations with concentrated recent photosynthate.

Findings and Impact

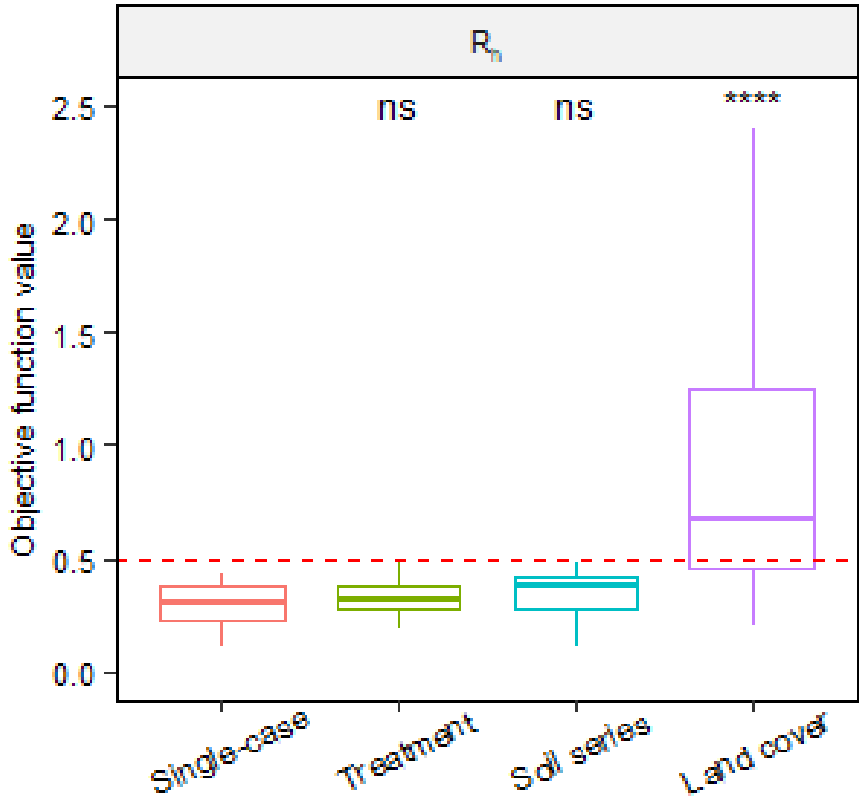
- Continuous ablation and analysis enables dramatic increases in sample throughput.
- Enhanced data collection results in improved, spatially-resolved quantification and mapping of carbon stable isotopes.

D.M. Cleary, et al. "Laser ablation-capillary absorption spectroscopy: A novel approach for high throughput and increased spatial resolution measurements of δ13C in plant-soil systems." *Soil Biology and Biochemistry* (2023), 187, 109208. [DOI: 10.1016/j.soilbio.2023.109208]

Microbial parameters can be generalized in soil biogeochemical model

Novel Findings: Microbial parameters in soil carbon cycling models can be generalized across different soil series, potentially simplifying the application for future soil microbial carbon cycling models

Objective	• Incorporating microbial processes has improved model projections of soil carbon, but parameterization needs simplification to enable widespread application. • The goal of this study was to determine if a common set of model microbial parameters could be generalized across long-term (2y) incubation experiments involving cellulose addition to four distinct soil series from three soil orders, and two land cover types (forest vs. grassland).
New science	• Key microbial parameters for processes controlling microbial growth and maintenance, and extracellular enzyme production and turnover, could be generalized at the soil series level but not across different land cover types.
Impact	• Future microbial model applications can potentially use the same parameters across different soil series but not across plant functional types when implementing models across various sites. • Besides heterotrophic respiration and microbial biomass data, soil extracellular enzyme data sets are needed to achieve reliable microbially-relevant parameters for large-scale soil model projections.



Objective function values < 0.5 imply model parameters for simulating heterotrophic respiration R_h are equally generalizable across a single soil and cellulose addition treatment, across treatments and controls, and across all soil series, but not across forest and grassland land covers.

Jian S, Li J, Wang G, Zhou J, Schadt CW, & Mayes MA (2024) Generalizing microbial parameters in soil biogeochemical models: Insights from a multi-site incubation experiment. Journal of Geophysical Research: Biogeosciences, 129, e2023JG007825. https://doi.org/10.1029/2023JG007825

Soil Warming and Drying both Increase the Age of Soil CO_2 Emissions in Tropical Forest

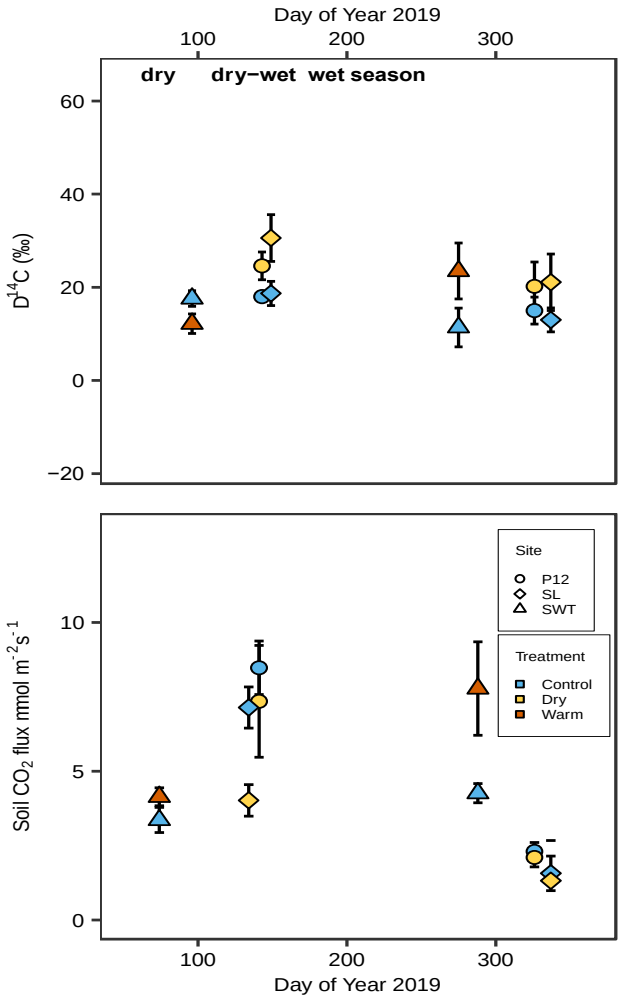


Figure Caption: A throughfall exclusion and control plot. Middle: ^{14}C values increased with warming and drying in the wet and dry-to-wet transition seasons. Bottom: Warming increased soil CO_2 emissions while drying decreased soil CO_2 emissions.

Objective: Quantify the effects of warming and drying on the age and rate of soil CO_2 emissions to the atmosphere in tropical lowland forest.

New Science

- Tropical forests account for over half of the global terrestrial carbon sink, but climate change threatens to alter the carbon balance of these ecosystems.
- The team identified changes in soil carbon sources contributing to soil surface CO_2 emissions in tropical forests in Panama subjected to either soil warming or drying.
- They found that both warming and drying increased the average age of carbon in soil CO_2 emissions by 2-3 years, but for different reasons.
- Warming accelerated decomposition of older carbon as increased CO_2 emissions depleted newer carbon. Drying suppressed decomposition of newer carbon inputs and decreased soil CO_2 emissions.

Impact: This study demonstrates an acceleration of soil carbon cycling in tropical forests with warming and drying, making soil carbon more sensitive to future events and stressors.

McFarlane, K. J., D. F. Cusack, L. H. Dietterich, A. L. Hedgpeth, K. M. Finstad and A. T. Nottingham (2024). "Experimental warming and drying increase older carbon contributions to soil respiration in lowland tropical forests." **Nature Communications** 15(1): 7084. https://doi.org/10.1038/s41467-024-51422-6

High-Intensity Hurricanes Reduce Soil C Mean Transit Times in a Humid Tropical Forest

Objective

- Quantify the effects of high-intensity hurricanes on soil carbon storage, distribution, and transit times.

New Science

- Multiple high intensity hurricanes over 30 years accelerated soil carbon cycling, resulting in shorter mean transit times for total soil carbon.
- Hurricanes resulted in pulses (during hurricane) and lags (5 years post-hurricane recovery) in plant litter inputs to soils and increased the incorporation of carbon from litter into physically protected organic matter pools.
- Increased incorporation of litter carbon into soil coincided with increased loss of older soil carbon, resulting in no detectable change in overall soil carbon stocks.

Impact

- This study demonstrates an acceleration of soil carbon cycling in tropical forests impacted by hurricanes that suggests increases in the frequency of intense hurricanes will speed up rates of carbon cycling in tropical forests, making soil carbon more sensitive to future events and stressors.

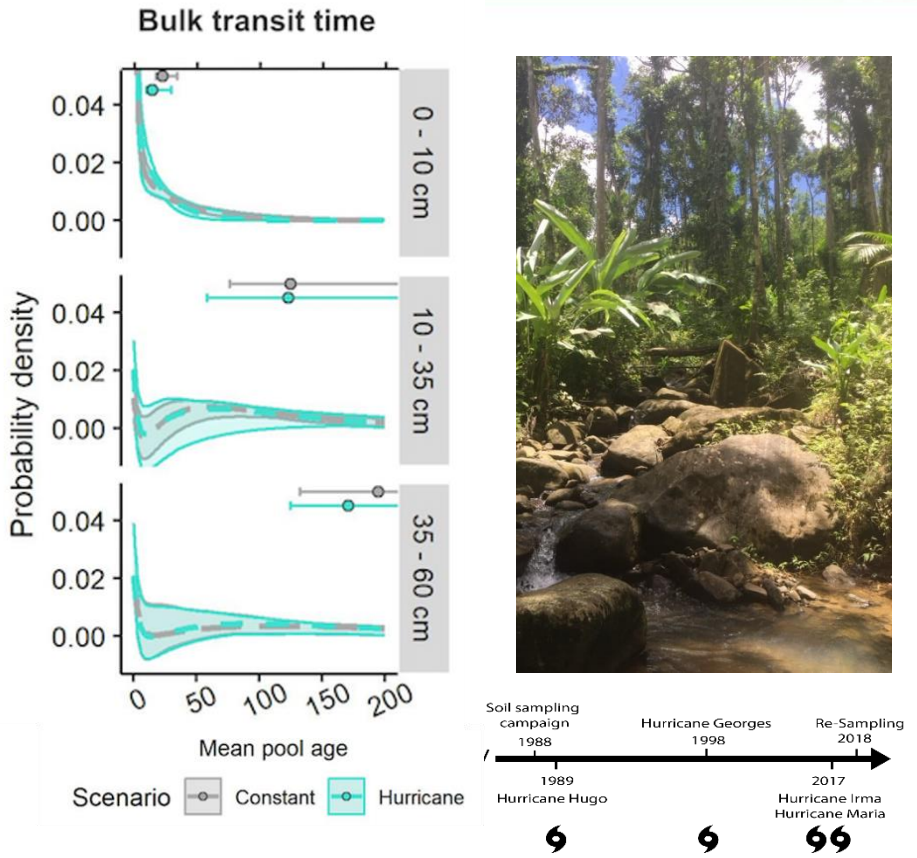


Figure Caption: Left: Modeled mean probability density (y-axis) for the distribution of transit time, the mean time it takes carbon to exit a system under constant carbon inputs (gray) and hurricane-associated pulse inputs (turquoise). Right: Luquillo Experimental Forest at the time of sampling in 2018. Hurricanes Irma and Maria defoliated the forest canopy in 2017. Photo: Allegra Mayer.

Mayer, A. C., K. J. McFarlane and W. L. Silver (2024). "The effect of repeated hurricanes on the age of organic carbon in humid tropical forest soil." **Glob Chang Biol** 30(4): e17265. DOI: 10.1111/gcb.17265

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Atmospheric Radiation Measurement (ARM) User Facility

Bankhead National Forest Site

- Official Start of operations: Oct 1
- Tower install planned for November; scanning radars to be installed spring 2025
- UAS test flights conducted; tethered balloon system flights awaiting FAA approval
- Communications/Outreach:
  - Informational webinar: Oct 18
  - Science kickoff meeting: Dec 3-4
  - ARM Summer School: May 19 - 23

Other ARM Activities

- **Triennial Review – Jan 6-9**
- CoURAGE (Baltimore area) - Starting Dec 1
- *NEW* campaign announced:
  - Desert-Urban SysTem IntegratEd AtmospherIc Monsoon (DUSTIEAIM)
  - PI: Allison Aiken, LANL
  - Phoenix, AZ; Apr 2026 – Sep 2027

Outreach & User Support

- ARM booth at the 2024 National Diversity in STEM (NDiSTEM) Conference Oct 31 – Nov 2
- ARM co-hosting student workshop in Tasmania focused on CAPE-k campaign: Feb 2-7, 2025
  - Student applications due Nov 1
- 11 new/updated data products released since April
  - https://arm.gov/news-events/data-announcements

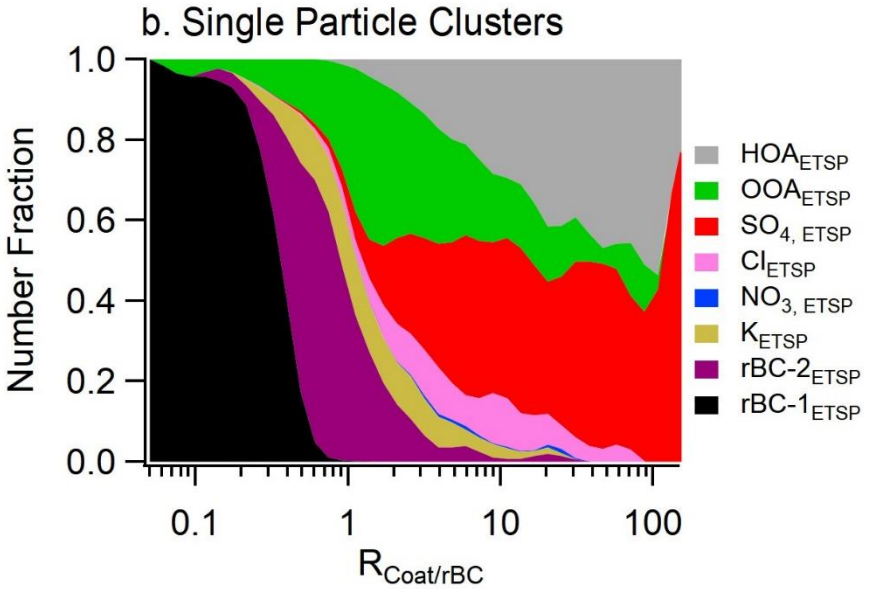
Chemical properties and mixing state of soot in Houston during TRACER

Scientific Challenge

- Black carbon (BC) containing aerosols have a significant impact on climate, but that impact varies as a function of coatings and mixing within aerosols and between different particles.

Approach

- ASR-funded researchers used a high-resolution soot particle aerosol mass spectrometer to make single particle and multi-particle average measurements of refractory BC and its coating in Houston during the ARM TRACER field campaign in summer of 2022.
- They performed positive matrix factorization of the size-resolved average mode data and K-means clustering of single-particle data.



Average measured fraction of different coating species measured by single particle mass spectrometry followed by K-means clustering, plotted as a function of the ratio of coating mass to black carbon mass.

Findings and Impact

- Soot aerosols vary widely between internally mixed (many different species in one particle) and externally mixed (pure particles, each of different composition), with considerable variation as a function of source and time.
- Many soot particles had significant hygroscopic coatings, so they should readily adsorb water, grow, and activate into cloud droplets under common atmospheric conditions.

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Farley R, J Lee, L Rivellini, A Lee, R Dal Porto, C Cappa, K Gorkowski, A Shawon, K Benedict, A Aiken, M Dubey, and Q Zhang. 2024. "Chemical properties and single-particle mixing state of soot aerosol in Houston during the TRACER campaign." *Atmospheric Chemistry and Physics*, 24(7), 10.5194/acp-24-3953-2024.

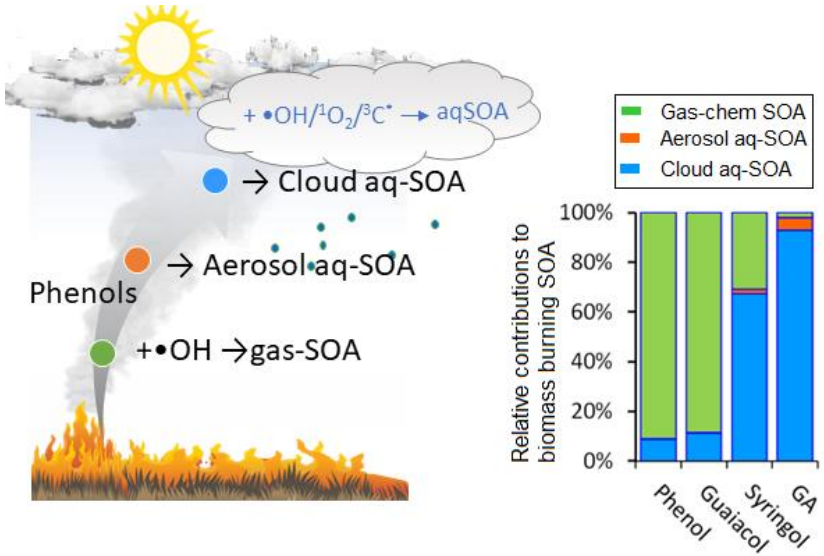
Burning Biomass Gases React within Clouds to Form Secondary Organic Aerosols

Objective

- Assess whether water-soluble organic gases emitted by biomass burning can form secondary organic aerosols (SOA).

Approach

- ASR-supported researchers developed a stand-alone box model to simulate SOA formed by the dissolution of phenols in aerosol and cloud liquid water.
- Parameterized the complex aqueous chemistry of biomass burning organics.



Phenols (organic gases) emitted from biomass burning photochemically react in gas-phase, aqueous aerosols, and clouds forming secondary organic aerosols (SOA).

Findings and Impact

- Results suggest that aqueous and cloud chemistry of wildfire smoke likely has far-reaching impacts on CCN and climate forcing.
- New process representation of biomass-burning SOA appears to resolve key gaps in the understanding of aerosol–cloud interactions.

EMSL

J. Zhang, et al. "Modeling novel aqueous particle and cloud chemistry processes of biomass burning phenols and their potential to form secondary organic aerosols." *Environmental Science and Technology* 024, 58, 8, 3776–3786 (2024). [DOI: 10.1021/acs.est.3c07762]

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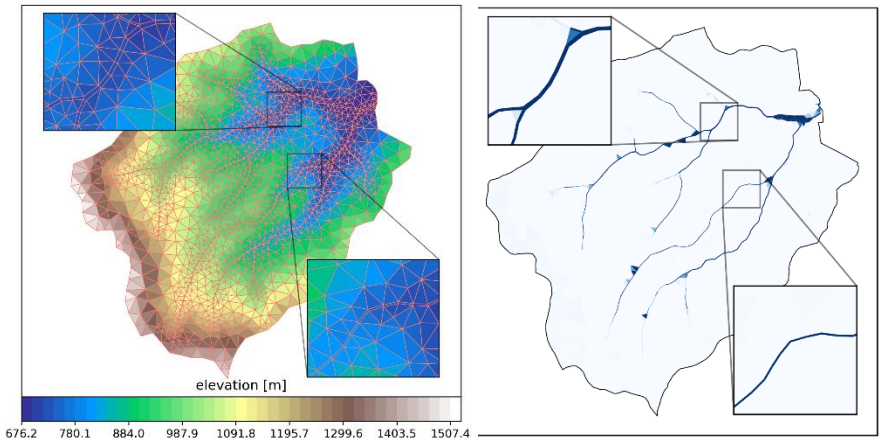
Meshing Strategy Enables Modeling of Narrow River Channels

Scientific Challenge

Because stream-corridors are narrow, biogeochemically important regions, they are difficult to resolve in watershed models because of excessive computational demands.



Left: Variable resolution mixed-polygon mesh resolves stream channels.
Right: Snapshot of ponded water from a simulation with ATS that showsg the emergent stream network with ponded water confined to the stream channels.

Approach and Findings

- Developed a new variable resolution meshing technique that resolves mapped streams with long quadrilateral cells with coarser mesh elements on the remainder of the land surface.
- New method matches the accuracy of highly refined models but uses significantly less computer time (~ 96.43% fewer mesh cells and a 99.75% reduction in computational cost).

Significance and Impact

- A mixed-polygon approach yields more realistic flow and water depth.
- Unlocks new opportunities for representing river-specific processes in basin-scale hydrology models at lower computational cost.

Rathore, S. S., Coon, E. T., & Painter, S. L. (2024). A Stream-aligned Mixed Polyhedral Meshing Strategy for Integrated Surface-Subsurface Hydrological Models, Computers & Geosciences, July 2024, 105617, https://doi.org/10.1016/j.cageo.2024.105617

Influence of Climate Change on Future Atlantic Hurricanes

Objective

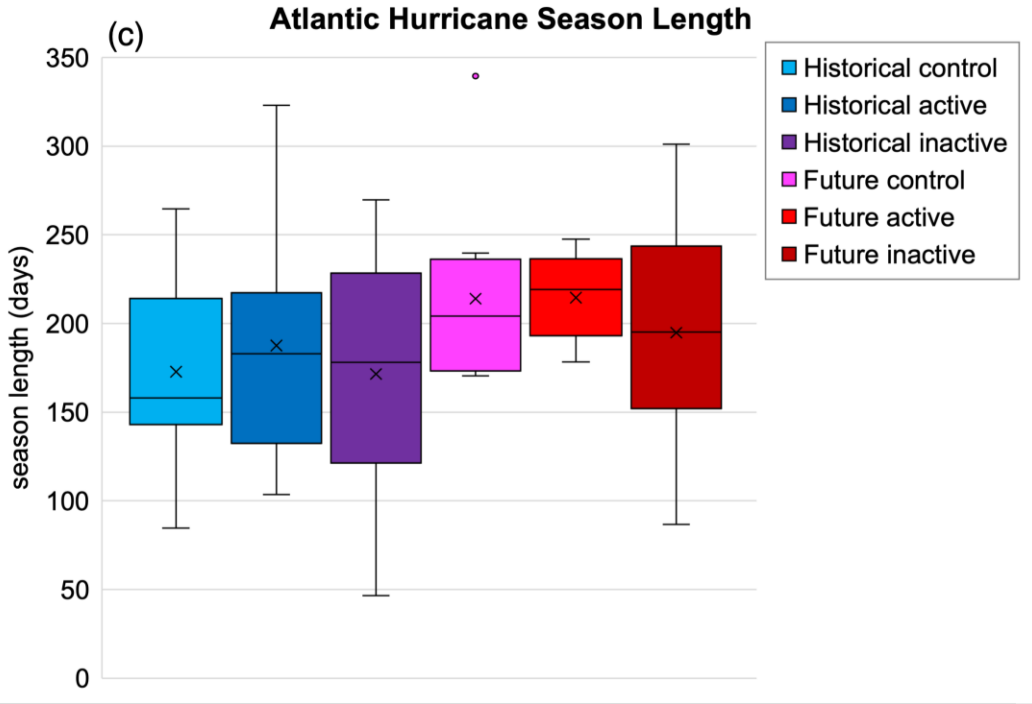
We investigated oceanic sources of predictability in Atlantic hurricane season length, start, and end using historical observations. In addition, we projected future changes in Atlantic hurricane season length using the Energy Exascale Earth System Model (E3SM).

Results

We found that a warm western subtropical Atlantic ocean in boreal spring drives early Atlantic hurricane season starts and La Niña events in autumn drive late hurricane season ends. In addition, **E3SM projected an 27-41 increase in Atlantic hurricane season length in the future.**

Impact

This research documents sources of predictability for Atlantic hurricane season length. In addition, E3SM simulations indicate that a future lengthening of the Atlantic hurricane season may exacerbate impacts associated with more intense tropical cyclones.



North Atlantic hurricane season length from the 10-member ensemble of E3SM experiments in historical and future climates representing conditions for active hurricane seasons (La Niña and positive Atlantic Meridional Mode; AMM), inactive seasons (El Niño and negative AMM), and the control (neutral El Niño – Southern Oscillation and AMM).

Patricola, Christina M., Grace E. Hansen, and Ana C. T. Sena 2024. "The Influence of Climate Variability and Future Climate Change on Atlantic Hurricane Season Length." *Geophysical Research Letters*, 51(8), e2023GL107881. https://doi.org/10.1029/2023GL107881

Discovering Drought Scenarios for Future Water Planning in Colorado

IM3 INTEGRATED MULTISECTOR MULTISCALE MODELING

Objective

Introduce a framework for discovering scenario storylines that describe diverse stakeholder impacts and consequential dynamics in multi-actor human-natural systems facing change.

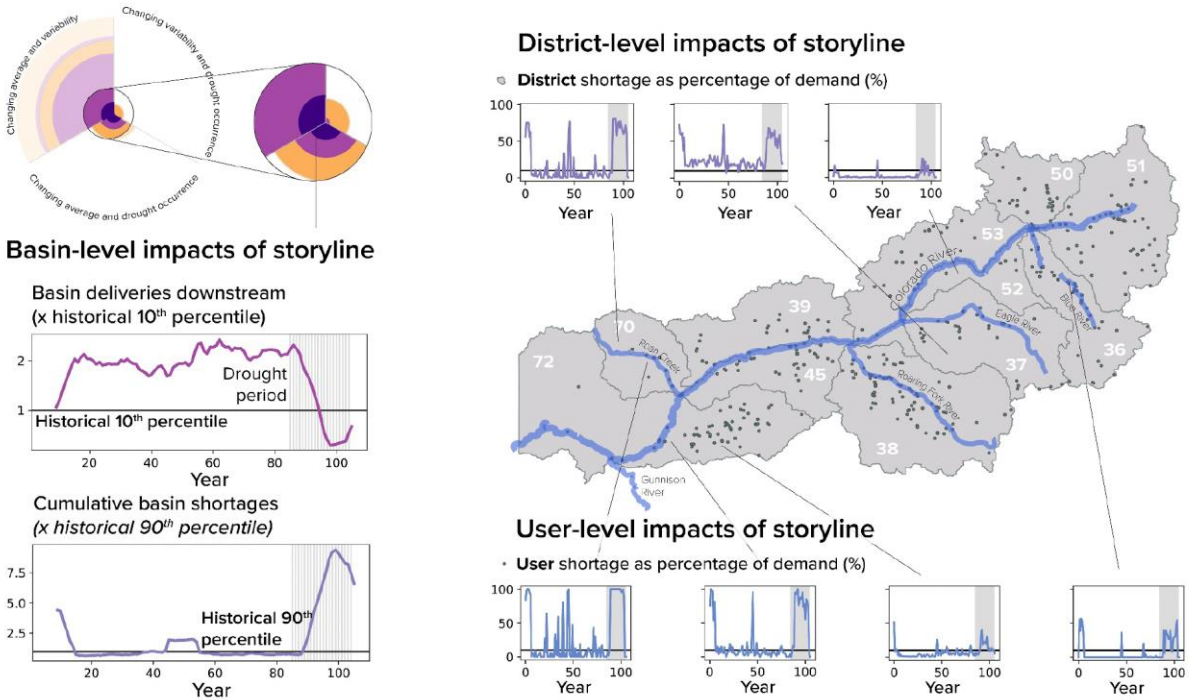
Approach

- Develop the FRamework for Narrative Storylines and Impact Classification (FRNSIC) to organize and investigate consequential scenarios using hierarchical classification of diverse outcomes across actors, sectors, and scales.
- Implement exploratory modeling to generate large ensembles of possible futures, allowing for the identification of scenario storylines that capture key system dynamics and consequential outcomes.
- Utilize set theory and hierarchical classification to integrate dynamic properties and robustness performance measures, facilitating the discovery of impactful scenario storylines that inform future adaptation planning.

Impact

- FRNSIC classifies dynamic properties and impacts of states of the world (SOWs), highlighting significant effects on water shortages and deliveries.
- The study reveals that many SOWs have dynamic properties beyond historical ranges, primarily due to projected climate changes and internal variability, resulting in more frequent and severe droughts.
- FRNSIC's exploration of alternative impact thresholds offers flexibility in scenario selection, enabling stakeholders to focus on different plausible futures and impacts, thus enhancing decision-making in complex human-natural systems.

Impacts and dynamics of scenario storyline with changes in hydroclimatic conditions



This figure illustrates how a possible drought could impact different parts of a river basin. On the left, it shows the effects on the entire basin. The top right panels (with purple lines) break down the impacts on specific water districts, and the bottom right (with blue lines) shows how individual water users are affected. The highlighted water districts are number 70 (Roan Creek Basin), 37 (Eagle River Basin), and 52 (Piney/Cottonwood Creeks).

Hadjimichael, Antonia, Patrick M. Reed, Julianne D. Quinn, Chris R. Vernon, and Travis Thurber. 2024. Scenario Storyline Discovery for Planning in Multi-Actor Human-Natural Systems Confronting Change. Earth's Future 12: e2023EF004252. https://doi.org/10.1029/2023EF004252.

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Modeling the Climate at Exascale

E3SM Energy Exascale Earth System Model

See article featured in EOS.org

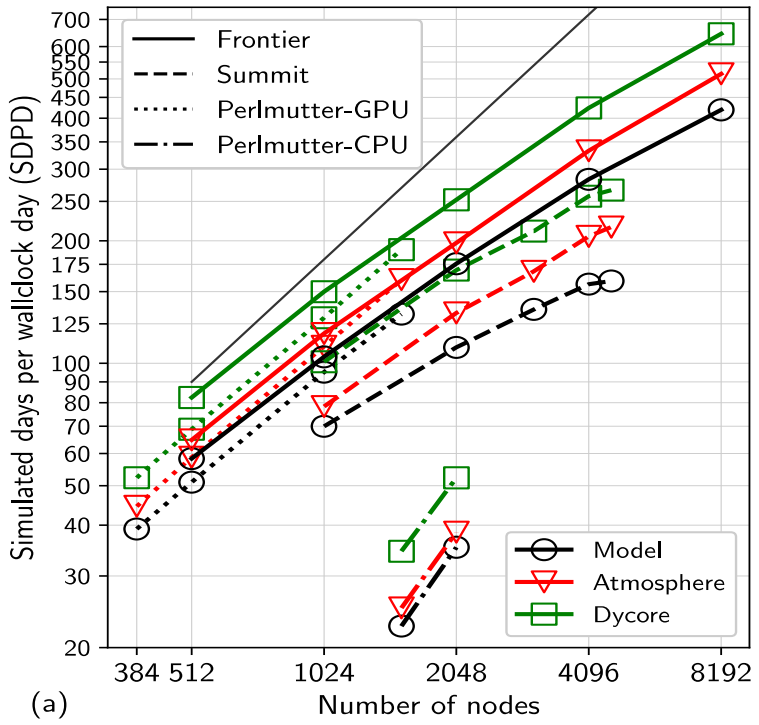

Fig: Leveraging the power of GPUs, SCREAM achieves an **unprecedented** >1 simulated year per day (SYPD) at 3km resolution.

Objective

Create a global atmospheric model which can take advantage of GPUs to run efficiently at very high spatial resolution. This paper describes the design of this new code, performance on CPU and GPU machines, and its ability to simulate real-world climate.

Approach

- 40 day 3.25km global resolution simulations are conducted for all four seasons.
- When evaluated against observations, SCREAM is shown to capture the diurnal cycle well. More work is needed to improve mid-level clouds in the tropics.

Significance and Impact:

- The new exascale-enabled E3SM Atmosphere Model (EAMxx) is the first truly exascale global atmosphere model. It will soon be the only atmosphere model in E3SM, at which point E3SM will truly be an exascale earth system model.
- The performance and accuracy of SCREAM will unlock new science inquiries in the E3SM community, providing unprecedented benchmarks for broad climate modeling science community
- Leveraging the fastest machines in the world, E3SM scientists achieved >1 SYPD of throughput at 3.25km resolution, an accomplishment recognized with the inaugural Gordon Bell Prize in Climate.

Donahue, A. S., et al. (2024). To exascale and beyond—The Simple Cloud-Resolving E3SM Atmosphere Model (SCREAM), a performance portable global atmosphere model for cloud-resolving scales. *Journal of Advances in Modeling Earth Systems*, 16, e2024MS004314.

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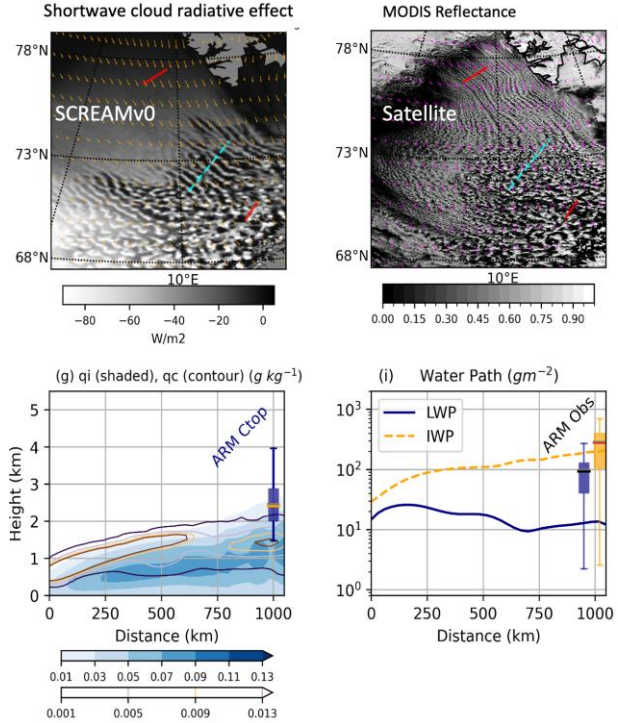
Using ARM data to evaluate SCREAM global cloud resolving model

Scientific Challenge

- Cold air outbreaks (CAOs) occur when cold, dry air flows over warmer ocean areas, creating extensive boundary-layer clouds.
- CAOs present challenges for numerical models because the scales of shallow convection and related mixed-phase microphysical processes are much finer than the models' effective resolution.

Approach

- ASR-funded researchers develop a model evaluation method that selects observational references based on similar large-scale conditions rather than exact time-matched comparisons
- Researchers use both satellite and ARM observations during the COMBLE field campaign to evaluate the global Simple Cloud-Resolving E3SM Atmosphere Model (SCREAM)



SCREAM simulation compared to satellite and ARM observations.

Significance and Impact

- SCREAM successfully simulates three distinct cloud patterns during cold air outbreaks with credible mesoscale structures; however, it tends to underestimate supercooled liquid water.
- Using high-resolution observations under similar large-scale conditions can effectively evaluate global storm-resolving models without requiring expensive simulations designed for specific cases.

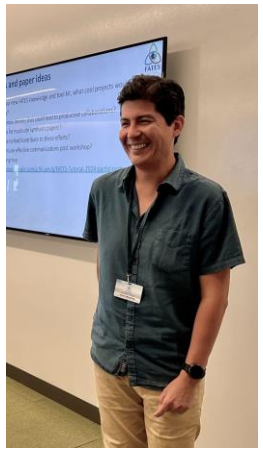
U.S. DEPARTMENT OF ENERGY | Office of Science

Zheng X., et al. 2024. "Using Satellite and ARM Observations to Evaluate Cold Air Outbreak Cloud Transitions in E3SM Global Storm-Resolving Simulations." *Geophysical Research Letters*, 51(8), e2024GL109175, 10.1029/2024GL109175.

Tenth ESGF Conference

- Held 23–26 April 2024 in Rockville, Maryland
- CMIP Co-chair John Dunne attended to share CMIP priorities and the current timeline
- ~50 in-person attendees from 8 countries (Australia, France, Germany, Italy, Japan, Sweden, United Kingdom, USA)
- ~69 virtual registrants from 18 countries
- **Primary objectives** of conference were to
  - **Share all current development activities** across the Federation
  - **Develop a roadmap** for collaborative activities necessary to deploy operational ESGF infrastructure to support CMIP AR7 Fast Track

NGEE-Tropics 2024 FATES Tutorial



Scientific Achievement

Tropical forest scientists from across the world were introduced to the vegetation model ELM-FATES. Participants successfully ran simulations at their study sites, applying the model in novel contexts. Feedback was overwhelmingly positive and the NGEE-Tropics team look forward to productive collaborations with participants post-tutorial.

"This tutorial really broadened my interest in FATES, and I'm now much more motivated to explore further learning and ways to use the model."

Significance and Impact

The model development team gained valuable feedback addressing the attendee's questions as they pushed the boundaries of the hands on lessons. **Engagement between modelers and experimentalists facilitates ModEx and expands the community of FATES users and contributors.**

Details

- In person, week-long workshop hosted at LBNL
- 19 participants: 16 early career, 13 from tropical countries
- Introduction to running ELM-FATES at participants' study sites
- Laptop-based simulations enabled by Docker software stack
- Received >75 applications

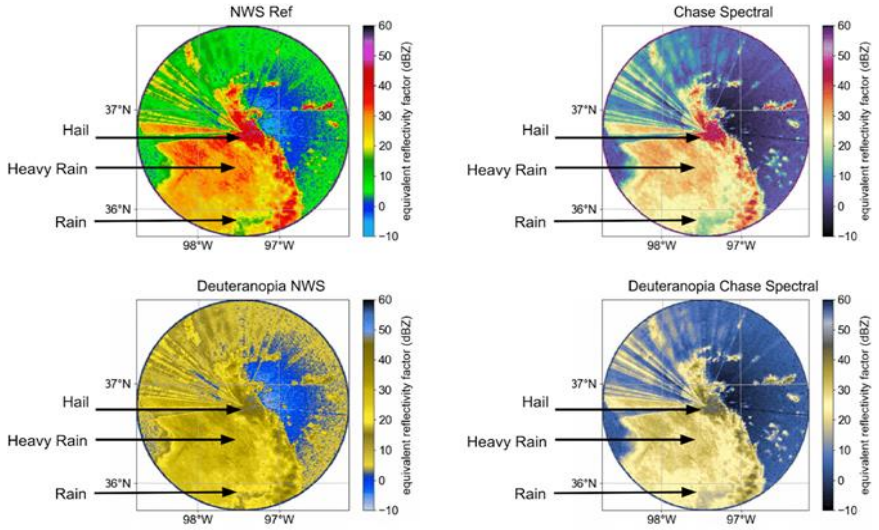
ARM Makes Accessible Radar Maps for Colorblind Scientists

Scientific Challenge

- Color vision deficiency (CVD) is a decreased ability to discern between particular colors, such as red and green.
- Individuals with CVD can have issues reading data plots depending on the colormap that is used.

Approach

- ARM researchers created CVD friendly colormaps.
- New and existing colormaps were tested on different weather events using software that visualized the data through the eyes of an individual with CVD.



Viewing a storm system using the old (NWS Reflectivity) colormap (left) and the new Chase Spectral CVD friendly colormap (right). The first row shows what an individual without CVD sees and the bottom row shows what an individual with CVD sees. Image courtesy of Zachary Sherman, Argonne National Laboratory.

Significance and Impact

In the new colormaps, different phenomena from drizzle to rain to hail all have their own color. The colors were chosen with thought given to perceptual uniformity, which is when changes in color or lightness and data values have equal weight. The colormaps are close to perceptually uniform, making them easier for everyone, regardless of color vision, to read.

Sherman, Z. et al. 2024. "Effective Visualization of Radar Data for Users Impacted by Color Vision Deficiency." *Bull. of the American Met Soc* 105(8):E1479-E1489, https://doi.org/10.1175/BAMS-D-23-0056.1.

Thank you!!