19th Annual

Graduate Climate Conference

Conference Program and Abstract Book

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Conference History

The 2025 GCC marks the 19th year of the conference, which started in 2006 when students in the Program on Climate Change at the University of Washington (UW) hosted the first ever all-graduate student climate conference. The conference is planned and organized entirely by graduate students each year. The GCC has been partially funded by a grant from NSF since 2010 with other funding coming from a mix of sources including participating university departments and non-profits. In 2011, the GCC transitioned to a traveling format with alternate years now hosted by students from Massachusetts Institute of Technology (MIT)'s Program on Earth, Atmospheric, and Planetary Sciences and the Woods Hole Oceanographic Institution in Woods Hole, Massachusetts. A total of ten conferences have been hosted by UW at the Charles L. Pack Experimental Forest Conference Center at the base of Mount Rainier in Eatonville, Washington, and this will be the seventh conference hosted at WHOI. Due to safety concerns during the COVID-19 pandemic, the GCC was not held in-person in 2020 and 2021. The conference adapted to a virtual format during those years allowing students to connect and share research remotely. During this time, the organizing committee also expanded its membership and invited graduate students from other institutions to participate, a practice which has continued since in-person conferences resumed in 2022. This year's GCC will be attended by students from 54 different institutions and around ten percent of attendees are international students.

Co-Chairs' Welcome

Welcome to the 19th Annual Graduate Climate Conference, an interdisciplinary climate conference run by graduate students, for graduate students. Over the last nineteen years, graduate students representing hundreds of academic institutions have come together to present research and share ideas on climate and climate change in an array of disciplines. After last year's conference in Pack Forest, we are excited to welcome you back to Woods Hole!

Over the next few days, we'll hear presentations on topics ranging from polar ice dynamics and ocean biogeochemistry to urban resilience, climate communication, and environmental justice.

In addition to the oral and poster presentations, there will be two pairs of workshops. The first pair will be led by graduate students Abby Beilman from Boston University and Mahmoud Rady from Clemson University. In a workshop themed "Scrappy Science", Abby will be sharing ways to carry out scientific research with minimal funding/resources at the pre-college, undergraduate, and graduate levels, as a researcher or mentor to a researcher. Mahmoud's workshop "Bridging Climate Science and Community Outreach" will cover strategies for translating complex research into clear, engaging messages tailored to diverse audiences, including farmers, policymakers, and local communities. The US Geological Survey (USGS) will host a workshop on how to use python for environmental data analysis, as well as a first-of-its-kind lunch&learn on "Understanding Papers with Editors". Moreover, local community representatives from the Woodwell Climate Center, the USGS, Village & Wilderness, Biodiversity Works, as well as the SEA Education Association will engage in a panel discussion about careers in climate science.

We will also hear from two keynote speakers: Dr. Hilary Palevsky from Boston College and Dr. Marcela Loría-Salazar from the University of Oklahoma. Dr. Palevsky will be sharing about her experience navigating an academic climate science career, and a bit about her ocean biogeochemical cycling research. Dr. Loría will discuss her path through academia and how her life experiences have informed the way she approaches research and how she got to studying aerosols. Dr. Loría will also share her journey to academia and the balance of being a professor and also a mother. We are thrilled to welcome both of our keynote speakers to Pack Forest and you can read more about them in a subsequent section.

Just as important as the formal schedule are the conversations that will be held over coffee breaks, meals, and social activities between those from opposite ends of the continent, or those from disparate fields. These conversations may lead to unexpected future collaborations and increase interdisciplinary understanding of climate-related issues. We also encourage you to attend office hours with our keynote lectures and our community partners!

Thank you for being a part of this year's conference, and a BIG thank you to everyone who has volunteered as an organizer, committee chair, driver, and/or Thursday or Sunday night host. Please don't hesitate to reach out anytime during the conference if you have any questions or concerns. We are excited for the opportunity to spend this weekend with you, and hope you are able to make the most of every minute of it.

Sincerely,

Chloe Dean, Joseph Rotondo, and Fadime Stemmer

2025 Graduate Climate Conference Co-Chairs

Code of Conduct

The Graduate Climate Conference (GCC) is organized by graduate students, for graduate students, in order to build relationships and increase understanding and collaboration across all climate-related disciplines. To accomplish these goals, we have set the following ground rules, based on the American Geophysical Union's Scientific Integrity and Professional Ethics policy, to ensure a meaningful and comfortable conference experience for all.

I. Expected Behavior

- Treat all GCC participants and any individuals associated with the GCC with respect and consideration. Recognize value in diversity of backgrounds and perspectives.
- Interact in a considerate, respectful, and collaborative manner. Communicate openly and with respect for others, critiquing ideas rather than individuals.
- Present your research findings accurately and objectively, acknowledging those who made significant contributions to your research. Respect others' requests for confidentiality during presentations of new or unpublished research.
- Meet new people! Consider reaching out to people you don't know whose talk, e-poster and/or workshop you enjoyed.

II. Unacceptable Behavior

- Harassment (including sexual and gender harassment), bullying, physical or verbal abuse, or discrimination in any form will not be tolerated.
- Examples of unacceptable behavior include, but are not limited to:
    - Verbal comments related to gender, sexual orientation, disability, physical appearance, body size, race, religion, national origin, or socioeconomic class;
    - Harassment or intimidation by words, gestures, body language, or any menacing behavior;
    - Inappropriate use of nudity and/or sexual images in public spaces or in presentations;
    - Threatening or stalking any GCC participant, student host, staff member, or other individual associated with the GCC.

III. Consequences

- Anyone requested to stop unacceptable behavior is expected to comply immediately.
- The GCC organizing team may take any action deemed appropriate, including immediate removal.
- We reserve the right to prohibit attendance at any future GCC.

IV. Reporting

- If you are the subject of unacceptable behavior or have witnessed any such behavior, please immediately notify the GCC organizing team (gradclimateconference@gmail.com) or any of the GCC co-chairs individually:
    - Fadime Stemmer (fadime.stemmer@who.edu)
    - Chloe Dean (chloe.dean@whoi.edu)
    - Joey Rotondo (jrotondo@uw.edu)

Schedule

2025 Graduate Climate Conference Schedule

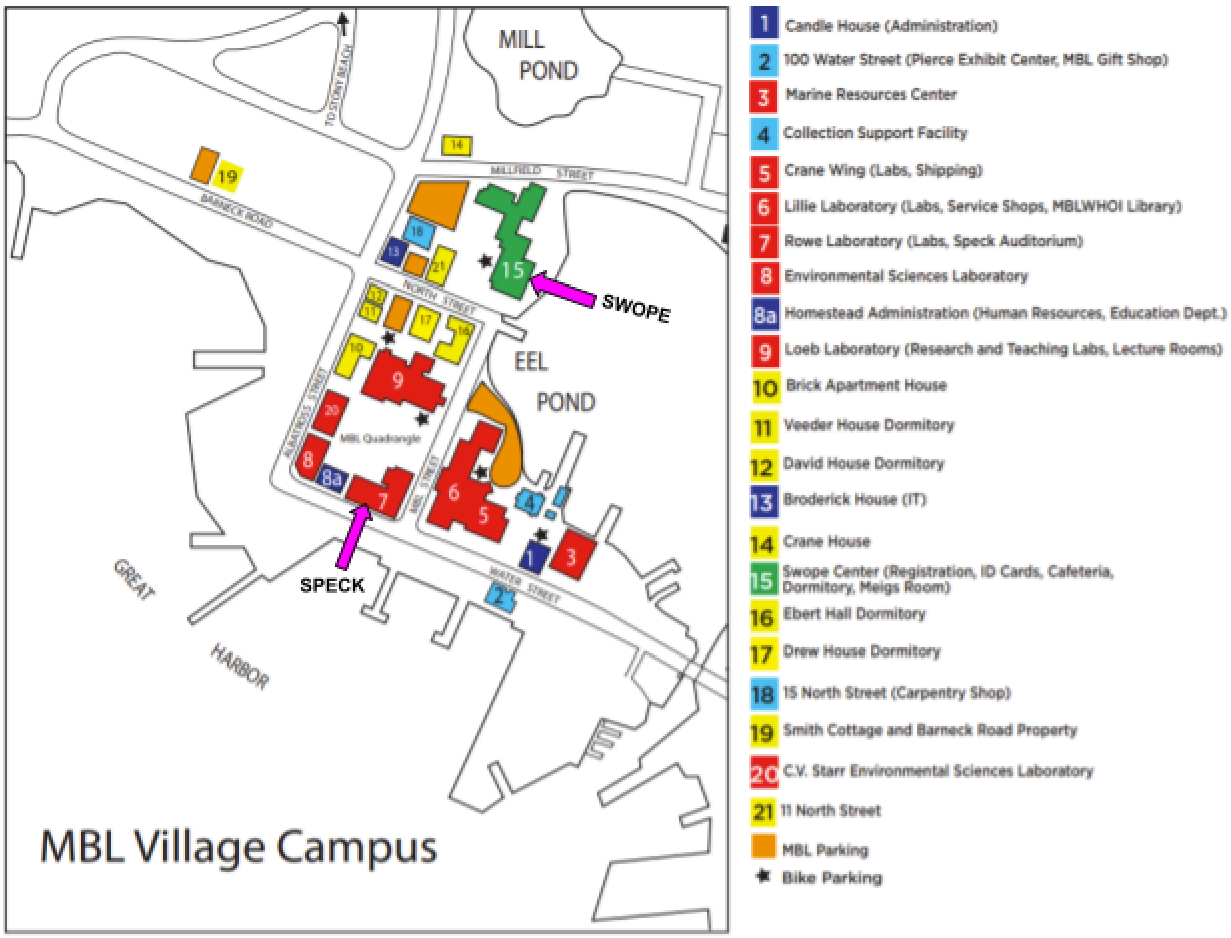
Nov. 7th-9th, Marine Biological Laboratory, Woods Hole, MA

Time (start)		Time (end)	Session	Location	
Friday 11/7					
8:30	*Leaves Promptly*		Early bus from MIT and BOS airport		
10:00	*Leaves Promptly*		Late bus from BOS airport		
10:30	-	12:00	Registration and luggage unloading		
11:30	-	12:45	Lunch	Swope Dining Hall	
13:00	-	13:15	Introduction	Speck Auditorium	
13:15	-	14:15	Keynote 1 -- Dr. Hilary Palevsky	Speck Auditorium	
14:15		15:00	Room check in and public session setup		
15:00	-	16:00	Public poster session and lightning talks, small group discussion with keynotes (occurring simultaneously in SWOPE)	Redfield Auditorium (WHOI)	
16:00	-	17:30			
17:30	-	18:30	Oral Session 1: Life at the Interface: Biology x Climate	Speck Auditorium	
18:30	-	20:00	Dinner	Swope Dining Hall	
20:00	-	22:00	Trivia/Costume Contest	Redfield Auditorium (WHOI)	
Saturday 11/8					
8:00	-	9:00	Breakfast	Swope Dining Hall	Office hours with keynotes in SWOPE Dining hall
9:00		9:15	Day 2 Opening Remarks (buffer period)	Speck Auditorium	
9:15	-	10:15	Keynote 2 -- Dr. Marcela Loría Salazar	Speck Auditorium	
10:15	-	11:30	Poster Session A	Swope Poster Hall	Coffee (10:15 - 11 am)
11:30	-	12:30	Oral Session 2: Big Data in Climate Modeling	Speck Auditorium	
12:30		13:30	Lunch	Swope Dining Hall	
13:30	-	14:45	Coding Workshop Community Partner Panel	Meigs Room Speck Auditorium	
15:00	-	16:00	Oral Session 3: Ground-Up Connections: Soil, Moisture, and Temperature Feedback	Speck Auditorium	
16:00	-	17:15	Poster Session B	Swope Poster Hall	Snacks (4 - 5 pm)
17:15	-	18:15	Oral Session 5: Humans at the fore: carbon removal, mitigation, and adaptation	Speck Auditorium	
18:30	-	19:45	Dinner	Swope Dining Hall	Office hours with keynotes in SWOPE Dining hall
19:45	-	21:00	Poster Session C	Swope Poster Hall	
21:00	-	forever	Game Night/Bar Crawl	Redfield/Captain Kidd	
Sunday 11/9					
7:45	-	8:15	Pack up and remove belongings from housing		
8:00	-	9:00	Breakfast	Swope Dining Hall	
9:00	-	10:00	Workshops (student led)	Speck and Redfield Auditoriums	
10:00	-	10:15	Coffee Break	Rowe Lobby	
10:15	-	11:45	Oral Session 4: Human-Climate Interactions and Hazards	Speck Auditorium	
11:45	-	12:00	Concluding Remarks	Speck Auditorium	
12:00	-	12:15	Lunch (packaged). Grab on the way out!	Speck Auditorium	
12:30	*Leaves Promptly*		Buses to BOS airport and MIT		
14:30	-	18:00	Social activities	Self Organized	
18:00	-	19:00	Dinner (own cost)		

Color Key:
Meals
Transportation
Oral Presentations
Other Presentations
Breaks
Social
Introduction/Conclusion
Important Reminders

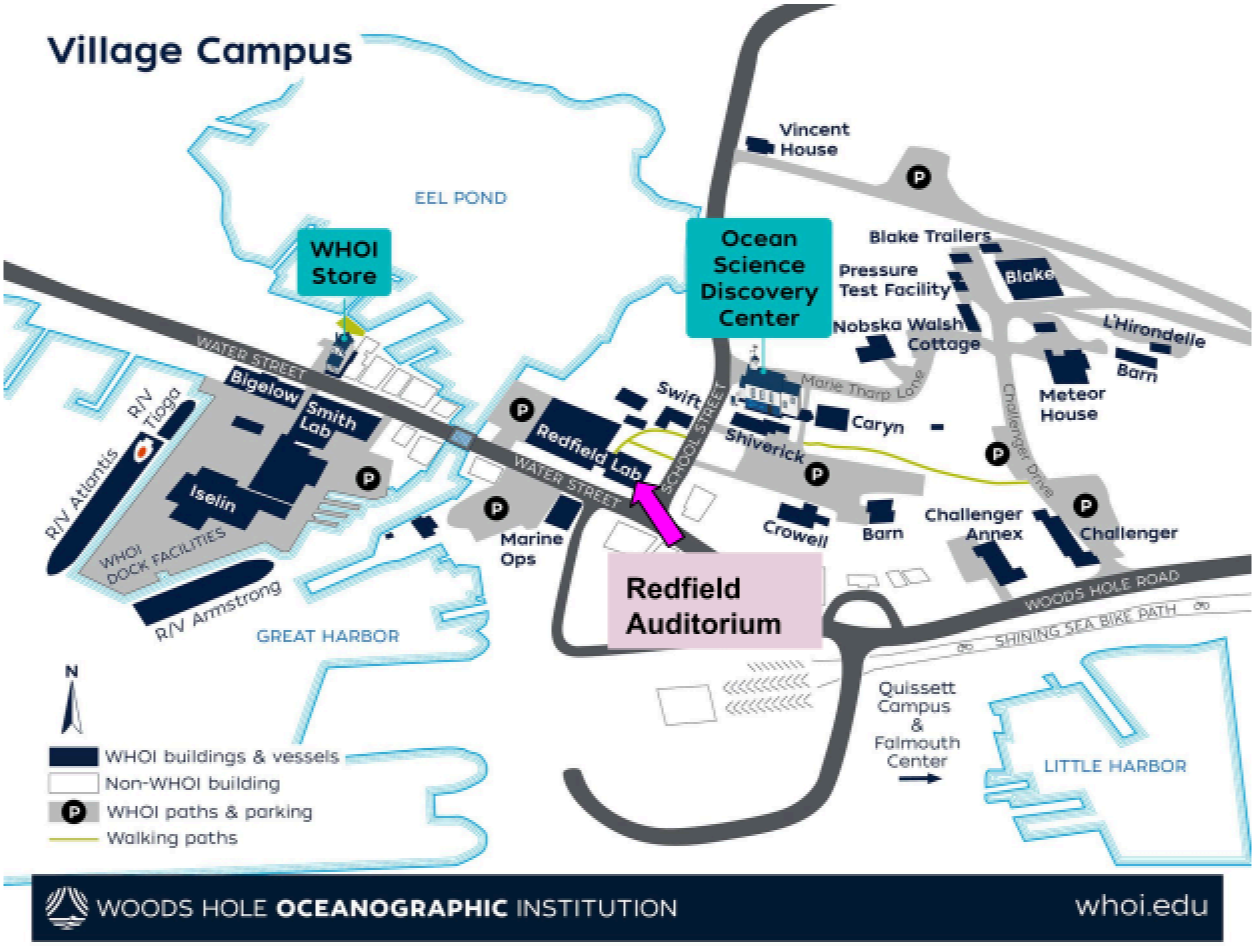
Maps

MBL



Download the map here: [MBL MAP]()

WHOI



Download the map here: WHOI MAP

Keynote Speakers

Dr. Hilary Palevsky

Surviving and Thriving in a World in Crisis: Tales from an Academic Climate Science Career

Hilary is an Assistant Professor in the Boston College Department of Earth and Environmental Sciences. Her research centers on the ocean's role in global biogeochemical cycling, with a particular focus on understanding how the ocean absorbs carbon dioxide from the atmosphere, a key influence on global climate and ongoing climate change. To address these questions, her research group conducts fieldwork to deploy and calibrate autonomous biogeochemical sensors, measures samples in the laboratory, and analyzes data from sensors deployed in the field, often together with complimentary datasets such as from satellite remote sensing and global climate model simulations. She also teaches classes on ocean and climate science from the undergraduate through graduate levels, and considers it essential to her scientific and educational role to work to build a more inclusive, supportive, and equitable scientific community and world.

Before beginning her current position in 2019, she was a Lecturer at Wellesley College, a Postdoctoral Scholar at the Woods Hole Oceanographic Institution, and received her PhD in Oceanography and a graduate certificate in Climate Science at the University of Washington. Prior to beginning her graduate studies, she earned a B.A. in Geology from Amherst College, spent a year studying North Atlantic cod fisheries as a Thomas J. Watson Fellow and taught marine science on traditionally-rigged schooners in Long Island Sound. She lives in the Boston area with her (academic) spouse, their 1-year-old baby, three cats, and a very good dog.

Dr. Marcela Loría-Salazar

Bridging the Gap: Advancing Aerosol Research in the Understudied Central U.S.

Marcela Loría-Salazar is an Assistant Professor in the School of Meteorology at the University of Oklahoma, where she leads interdisciplinary research on atmospheric processes that shape air composition. Her work addresses emissions from urban areas, wildfires, prescribed burns, agriculture, and dust, with a strong emphasis on advancing air quality forecasting and exposure assessments.

Dr. Loría-Salazar is recognized for her innovative integration of aerosol and gas-phase measurements, satellite remote sensing, meteorological data, numerical modeling, deep learning, and big data assimilation. Her collaborative approach has positioned her as a key contributor to major national and international initiatives, including NASA's PACE Mission Early Adopter Program, NOAA's Pathfinders Initiative, CIWRO, and the SPARTAN Global Network.

As a leader in her field, she plays a pivotal role in efforts to improve smoke behavior prediction, including serving on a national initiative led by the National Academies of Sciences, Engineering, and Medicine (NASEM). Her research has earned prestigious recognition, including the NASA Earth and Space Science Fellowship and awards from the University of Nevada, Reno, and the University of Oklahoma.

Dr. Loría-Salazar holds a Ph.D. and M.S. in Atmospheric Sciences from the University of Nevada, Reno, and a B.S. in Meteorology from the Universidad de Costa Rica. She is dedicated to promoting inclusive scientific collaboration and driving innovation to enhance environmental health and resilience.

Keynote Speaker Office Hours

Keynote speakers will be available during the conference to meet with students individually or in small groups. Most of these opportunities will take place informally, such as at meals. During the lightning talks on Friday evening, there will be an opportunity for a small group discussion with the speakers for those who would rather not attend the public lightning talks.

Conference Format

Public Session

Friday, November 7 – 3:00 - 5:30pm (**Redfield Hall at WHOI**)

This year GCC will be hosting a public session for the first time. Lightning talks and poster sessions will be open to members of the greater Woods Hole community who preregistered for the event. The public poster session will take place concurrently with the lightning talks, and guests are encouraged to flow back and forth between posters and talks. Talks and posters in this session will be delivered to a public audience that includes both scientists and members of the broader community, and should be accessible to a wide range of familiarity levels, ensuring clarity for those with little or no prior knowledge while remaining engaging to scientific audiences.

Public Poster Session

25 posters will be presented during the public session in the **Redfield Hall Lobby**. See abstract section for descriptions of each poster.

Lightning Talks

Each session will feature five speakers, with individual presentations lasting three minutes, followed by two minutes for questions and discussion. All Lightning Talks will take place in **Redfield Auditorium.** Speakers and presentation titles are in the following table with longer descriptions in the abstract section.

<table>
<tr><th>Session</th><th>Title and Speakers (Presenting Order)</th></tr>
<tr><td>Session 1

Chair:
Fadime Stemmer</td><td>Climate Change meets People and Politics
Katelin Teigen - Evaluating PurpleAir Sensors and Low-Cost Household Clean Air Interventions Under Wildfire Smoke and Climate Change: A Multi-year Participatory Science Study in King County, WA
Hannah McKinley - Assessing the Efficacy of 14 Low-Cost Indoor Air Sensors: An Analysis of the Usability, Accuracy, and Precision
Hannah Rajput - Taking STRESS Beyond the Lab: Comparing Academic and Community Conceptions of Climate Ris
Emily Cole - Balancing biodiversity and climate targets in local land-use decisions</td></tr>
<tr><td>Session 2

Chair:
Stella Heflin</td><td>Managing Climate Change
Alexander Arnold - Engine Exhaust Fouling and Heat Transfer Impacts of Diesel, Renewable Diesel, and Biodiesel Fuels
Abigail Bonnington - Interactions between groundwater extraction and short-term sea level rise in the Chesapeake Bay
Shreya Sharma - A social cost perspective on climate and air quality damages from the aviation sector</td></tr>
<tr><td>Session 3

Chair:
Bradley Lamkin</td><td>Monitoring and Predicting Climate Change
Aman KC - Iceberg Melt Rates Around the Greenland Ice Sheet: Regional Patterns and Oceanic Controls
Miles Epstein - Forecasting Forecast Errors: Predicting Coverage and Spatial Biases in Convective Outlooks Using CNNs
Yuan-Huai (Wayne) Tsai - Subseasonal-to-Seasonal (S2S) Prediction Skill of Rainfall Diurnal Cycle over the Maritime Continent and Its MJO Dependence
Taydra Low - Where Water Sinks and Models Diverge: North Atlantic circulation in high-resolution ocean models
Christina Draeger - Sensitivity of Glacier Mass Loss Projections to Climate Downscaling Methods in Western Canada</td></tr>
</table>

Poster Sessions

Posters have been assigned a letter corresponding to the session you will present in, and a number corresponding to the location of your poster in the poster hall. Each session has several subtopics, detailed below. Please hang your poster at the start of or slightly prior to your session, but not before any other session (i.e. session C posters should not be up until after session B)

All poster sessions will be held in **Swope Poster Hall**.

Session and Topics Covered (Poster Numbers)	Time
Session A • Coastal Dynamics (2, 3, 4, 5, 6, 7) • Sensing and Quantifying Air Pollution (8, 9, 10, 11) • Atmospheric Dynamics (12, 13, 14, 15, 16) • Ice Dynamics (17, 18, 19) • Fisheries & Wildlife Management (20, 21, 22, 23) • Risk Assessment (25)	Saturday, November 8 10:15am - 11:30am
Session B • Public Policy (2, 3, 4, 5, 6, 7) • Paleoclimate (8, 9, 11, 12, 13, 14) • Living Earth's Response to Climate Change (15, 16, 17, 18) • Monitoring the Oceans (20, 21, 22, 23) • Heat in the Ocean (24, 25)	Saturday, November 8 4:00pm - 5:15pm
Session C • Forecasting Climate (1, 2, 3, 4, 5, 6, 7, 8, 9) • GHG and Pollution Mitigation (10, 11, 12, 14, 15) • Phytoplankton/ Biological Oceanography (16, 17, 18, 19) • Rainwater Hydrology / Lack Thereof (20, 21, 22, 23, 25)	Saturday, November 8 7:45pm - 9:00pm

A detailed description of each poster can be found in the Abstract section. We recommend that you take a few minutes to look through the posters and find a few that sound interesting!

In the spirit of friendly competition and encouragement, the GCC will also host a poster competition this year. Votes will be aggregated across all poster sessions. The categories are:

- **Most Visually Appealing:** Recognizing the poster with the best organization, layout, and design, including the effective use of graphics and figures.
- **Best Presented:** Honoring the poster accompanied by a high-quality oral presentation and thoughtful responses to questions.
- **Most Creative:** Recognizing posters that use unconventional or inventive approaches, such as metaphors to improve accessibility, additional media (e.g., videos), or exceptionally creative figure design.

Oral Sessions

There will be five oral sessions, split up by topic (described below). Each topic will have a brief (3-5 minute) introduction given by the session chairs. Speakers will have exactly 13 minutes each for both presentations and questions, so we recommend that presentations last about 10 minutes. To make sure that everyone gets their fair share of time, GCC reserves the right to cut off a presentation that goes too long. Presentations are a bit shorter to ensure plenty of time for breaks, so if you don't get your question answered we encourage you to find the speaker after the session ends!

All oral sessions will be held in **Speck Auditorium**.

Session	Title and Speakers (Presenting Order)	Time
Session 1 Chair: Abby Beilman	Life at the Interface: Biology x Climate ● **Yiying Wang** - *Variations of monthly radial growth of Chinese fir [Cunninghamia lanceolata (Lamb.) Hook.)] considering its responses to climatic factors* ● **Rebecca Rust** - *The influence of wind-driven and tidal circulation on N2O and CH4 distributions along the southern coast of British Columbia, Canada* ● **Ellen Jorgensen** - *Resilience of the Amazon in the Late Quaternary* ● **Brandon Chan** - *Investigating the impact bacterial biodiversity and temperature on phytoplankton ecosystem function*	Friday, November 7 5:30pm - 6:30pm
Session 2 Chairs: Stella Heflin Bradley Lamkin	Big Data in Climate Modeling ● **Clairisse Reiher** - *Characteristics of North American Polar–Subtropical Jet Stream Superpositions in CESM2 Climate Projections* ● **Austin Reed** - *Contrasting Atlantic and Pacific Responses in Observed Changes to Extratropical Cyclone Latent Heat Transport: The Role of Latent Heat Release* ● **Peter Van Katwyk** - *Rewiring climate modeling with ML emulators: Insights from Ice Sheet Modeling* ● **Dominik Stiller** - *Reconstruction of past climates using proxies and climate models*	Saturday, November 8 11:30am - 12:30pm
Session 3 Chair: Hanne Borstlap	Ground-Up Connections: Soil, Moisture, and Temperature Feedbacks ● **Ruixuan Ding** - *Investigating Soil Moisture Impacts on Precipitation through Statistical*	Saturday, November 8 3:00pm - 4:00pm

	Modeling ● **Ann Sinclair** - *Uncertainty in hourly precipitation estimates and implications for landslide research* ● **Lily Zhang** - *Soil Moisture Teleconnections Drive Warming in the Western United States*	
Session 4 Chairs: Chloe Dean Silas Emovwodo	Humans at the Fore: Carbon Removal, Mitigation, and Adaptation ● **Alexandra Stevenson** - *Beyond Coral Cover: A Community-Informed Approach to Restoration in the U.S. Virgin Islands* ● **Chloe Dean** - *Assessing the influence of ocean alkalinity enhancement (OAE) on the physiology of key coccolithophore species* ● **Amrita Mukherjee** - *Moisture as Defense: Evaluating the Role of Decayed Deadwood in Forest Fire Resistance and Post-Burn Hydrological Recovery* ● **Suzanne Pan** - *Drywell-Tree Pairs for the Future: Managing Urban Stormwater in a Changing Climate*	Saturday, November 8 5:15pm - 6:15pm
Session 5 Chair: Katie Webb	Human-Climate Interactions and Hazards ● **Hanne Borstlap** - *The Hidden Water Beneath Us: Understanding the Two-Way Relationship Between People and Shallow Groundwater on the Eastern Shore of Virginia* ● **Sebastian Gonzalez Quintero** - *An Exploration of Underwater Soundscapes in the Charles River* ● **Timothy Hoheneder** - *Tracking Spatial and Temporal Patterns of Environmental Degradation in Gaza During Armed Conflict Using Machine Learning and Sentinel-2 Imagery* ● **Jiayu Li** - *Urbanization Amplifies Cumulative Compound Heat and Air Pollution Events in China*	Sunday, November 9 10:15am - 11:15pm

For detailed descriptions of talks please see the Abstract Section.

Workshops

Starting in 2018, the GCC added workshops to the program! One set of workshops is hosted by industry partners and the other by graduate students. During each workshop session, attendees will select one of the two workshops to attend. The topic of this year's workshops were chosen to help GCC attendees improve the skills considered relevant and necessary to scientific careers both within and outside of research. Be sure to leave feedback after your workshops to let us know how to do this better in the future!

Community Partner Workshops

Workshop #1: Introduction to Data Analysis in Python for Earth Science

Saturday, November 8, 2025 – 1:30pm - 2:45pm (**Meigs Room**)

This hands-on workshop, hosted by NSF Postdoctoral Research Fellow Jackie Veatch at WHOI, will focus on the fundamentals of Python, a powerful and widely used programming language for environmental and climate science research. Whether you are new to Python or have used it before, this workshop will introduce modules with various data types common to climate science, reviewing introductory analyses at and beyond the graduate level.

Workshop #2: Panel on Pathways to Professional Science

Saturday, November 8, 2025 – 1:30pm - 2:45pm (**Swope Auditorium**)

The second community partner workshop will take place concurrently with the third, so attendees must choose one to attend. Participants will hear from a diverse group of professionals representing a range of career paths in the environmental sciences:

- **Dr. Jackie Hung**, Soil Biogeochemist and Arctic Ecologist, Woodwell Climate Research Center
- **Dr. Luanne Johnson** and/or **Rich Course, M.S.**, Conservation Biologists, BiodiversityWorks
- **Onjalé Scott Price, M.B.A.**, Director of External Relations, Sea Education Association
- **Tripti Thomas-Travers, M.P.P.**, Program Director, Village & Wilderness

Come prepared with questions about their career trajectories, day-to-day work, and advice for pursuing careers in science and conservation.

Student-led Workshops

Scrappy Science

Sunday November 9, 2025 – 9:00am - 10:00am **(Speck Auditorium)**

Abby Beilman - Boston University

This workshop will cover ways to carry out scientific research with minimal funding/resources at the pre-college, undergraduate, or graduate level, as a researcher or mentor to a researcher. Topics include exploring ethical boundaries for conducting scientific research in today's world, accessing free open access data (including archives of taken-down data),as well as low-cost options for data collection that can be accomplished with a small budget (i.e. $500-$5000), and finding non-government funding sources to do so. Participants will be guided through data access and management resources/exercises and/or experimental design and supply management and selection exercises. This workshop is particularly relevant given our current political/funding landscape, and can help individuals across multiple areas of climate science.

Bridging Climate Science and Community Outreach: Effective Communication Strategies for Graduate Researchers

Sunday November 9, 2025 – 9:00am - 10:00am **(Redfield Hall)**

Rady Mahmoud - Clemson University

Effective communication is essential for ensuring that climate science leads to real-world impact. This workshop will focus on strategies for translating complex research into clear, engaging messages tailored to diverse audiences, including farmers, policymakers, and local communities. Participants will explore storytelling techniques and learn how to connect scientific findings with lived experiences of climate change, fostering meaningful dialogue and collaboration. By strengthening communication skills, graduate researchers can amplify their role in shaping climate decision-making and promoting sustainable solutions.

2025 Organizing Committee

* indicates chair of committee

Co-Chairs / Committees	Committees
Co-Chairs Chloe Dean *(chloe.dean@whoi.edu)* Fadime Stemmer *(fstemmer@whoi.edu)* Joey Rotondo *(jrotondo@uw.edu)* **Abstract Committee** Chloe Dean* *(chloe.dean@whoi.edu)* Fadime Stemmer* *(fstemmer@whoi.edu)* Joey Rotondo* *(jrotondo@uw.edu)* Hiroki Nagao *(hnagao@mit.edu)* Akshay Rajeev *(ar942@cornell.edu)* Helena McDonald *(mcdonh@mit.edu)* **A/V Committee** Dominik Stiller* *(dstiller@uw.edu)* Taydra Low *(tlow2@wisc.edu)* **Communications & Advertising Committee** Hanne Borstlap* *(tpv4jw@virginia.edu)* Ali Fallah *(ali_fallahmaraghi@student.uml.edu)* Allison Stift *(allison.stift@wsu.edu)* Silas Emovwodo *(popesilasmaro@gmail.com)*	**Fundraising Committee** Ashley Lasinsky* *(ashley.schefler@whoi.edu)* Grace Brown* *(grace.brown@whoi.edu)* Rudradutt Thaker *(rudradutt.thaker@wisc.edu)* **Pamphlet & Swag Committee** Abby Beilman* *(abeilman@bu.edu)* Katie Webb* *(krwebb@uw.edu)* Anagha Payyambally *(anagha.payyambally@uconn.edu)* Caitlyn Sutherland *(caitlyn.sutherland@whoi.edu)* **Recording & Evaluation Committee** Christina Draeger* *(cdraeger@eoas.ubc.ca)* Amanda Pinson *(amanda.pinson@whoi.edu)* Zilu Meng *(zilumeng@uw.edu)* **Social Committee** Bradley Lamkin* *(bradl12@ou.edu)* Catherine Zhang* *(catherine.zhang@whoi.edu)* **Website Committee** Manali Nayak* *(manalin@uw.edu)* Stella Heflin* *(smheflin@uw.edu)*

Conference & Transportation Logistics Committee	Relations Committee
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Acknowledgements

MIT Program in Atmospheres, Oceans, and Climate

The GCC has been made possible since it was first created by the continuing support of the MIT Program in Atmospheres, Oceans, and Climate (PAOC). We would like to offer our particular thanks to Kayla Bauer, Ashley Willis, and Prof. Susan Solomon of PAOC.

Marine Biological Laboratory

We would also like to thank Kim Elber and the MBL staff for allowing us to host the GCC there! We are always excited to return to GCC's second home in MA, and this year is no exception.

Woods Hole Oceanographic Institution

This conference also wouldn't be possible with WHOI - thank you especially to WHOI Academic Programs Office and Facilities.

Local Grad Student Hosts

Out of town graduate students attending the conference who arrive on Wednesday and/or leave on Sunday are hosted by volunteer graduate students from the Boston area. We're thankful to all our volunteer hosts this year for offering up their couches to our out of town visitors!

Funding Sources

MIT Lorenz Center	www.lorenz.mit.edu
Woods Hole Oceanographic Institution	www.whoi.edu
The National Science Foundation	www.nsf.gov
The CO2 Foundation	www.co2foundation.org
University of Washington Graduate School	www.grad.uw.edu
Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison	www.aos.wisc.edu
Department of Earth and Environmental Sciences, Boston College	www.bc.edu/bc-web/schools/morrissey/departments/eesc.html

Abstracts

Listed alphabetically by first name within each session

Public Posters & Lightning Talks

Public Posters

Aquatic Carbon Cycling in Michigan's Kalamazoo River Watershed: Drivers of Change and Variability

The carbon cycle is an essential component of how climate change is understood and consequently, there are many aspects of it that are well studied. However, one area that is often left out is inland waters. Despite making up a relatively small proportion of Earth's surface area and the global water budget, inland waters have outsized impacts on carbon cycling, especially when considering how much carbon enters these waters as compared to how much exits, and where those exits are occurring. Streams and rivers are not just passive transporters of terrestrial material but play a large role in the transformation and movement of biogeochemical elements. This project ultimately aims to determine the different contributions of horizontal (through drainage networks) and vertical (water to atmosphere) carbon fluxes and how they connect overall to terrestrial carbon fluxes. Here we present data from 2023-2025, covering 6 sites across the Kalamazoo River Watershed, focusing on greenhouse gas (carbon dioxide, methane) and dissolved carbon (organic, inorganic) concentrations and variability across different sites and ecological/climatological conditions.

Abby Beilman, Boston University, Poster #3

Climate-Driven Increases in Atmospheric Dryness Threaten Water Productivity of Winter Wheat in India

Water scarcity and climate change are intensifying pressure on agricultural systems, especially in South Asia where millions rely on wheat as a dietary staple. My research investigates the impact of rising atmospheric dryness—captured by vapor pressure deficit (VPD)—on the water productivity of winter wheat in India. Using high-resolution satellite datasets, I estimate crop water productivity (CWP) from 2002 to 2014 by combining gross primary productivity (GPP)-derived yield with evapotranspiration (ET) estimates. Fixed-effect panel regression models reveal that even a modest 0.1 kPa increase in VPD results in a 5–6% decline in CWP. While irrigation expansion has been a dominant adaptation strategy, the analysis shows it offers limited benefit, and in some cases, even slightly reduces efficiency. Declining groundwater levels further diminish CWP, revealing a critical vulnerability in regions heavily dependent on groundwater irrigation. Using climate projections from ten CMIP6 models under four shared socioeconomic pathways (SSPs), I find that under high-emission scenarios (SSP585), VPD increases could lead to CWP reductions exceeding 50% by the end of the century. These declines are concentrated in the Indo-Gangetic Plain and central India—areas already facing groundwater stress. The study highlights the diminishing effectiveness of conventional irrigation strategies under changing atmospheric demand and calls for targeted adaptation, including efficient irrigation technologies, water governance reforms, and climate-resilient cropping systems. By integrating satellite observation, statistical modeling, and future climate projections, this research provides actionable insights to support sustainable food production in an era of increasing climatic extremes.

Afshin Shayeghi Moghanlou, University of Oklahoma, Poster #23

Estimating Global Ocean Eddy Kinetic Energy with Autonomous Floats and Satellites

Global circulation and energetics of the ocean are essential to understand due to their direct impact on aspects of the climate system, such as: the formation of weather systems, climate variability, and the carbon cycle. Eddy kinetic energy is a large reservoir of energy in the ocean that plays a key role in ocean circulation, particularly in the movement of heat and nutrients. While satellite data allows for quantification of global eddy kinetic energy at the surface, eddy kinetic energy is sparsely quantified in the ocean interior due to the historical lack of subsurface observations. Autonomous Argo floats offer an unprecedented amount of data about the subsurface ocean's properties with global coverage over the last two decades. Through the combination of Argo float and satellite altimetry data, and statistical methods, this project aims to address this gap in observations of eddy kinetic energy in the global subsurface ocean.

Annabel Wade, Boston University, Poster #5

What Influences Climate Risk Communication? Evidence from 25 Climate Leaders in 18 Global South Countries

Effective climate risk communication is essential to climate governance, yet much of the existing research focuses on audiences and institutional actors in the Global North. This study addresses a critical gap by exploring the lived experiences of 25 young climate leaders across 18 countries in the Global South, examining the structural, epistemic, and institutional factors that shape their ability to understand and communicate climate risk. Using in-depth interviews and thematic analysis, the study identifies three interrelated barriers: (1) a persistent disjuncture between international scientific language and local knowledge systems, which results in semantic misalignment and diminished local relevance; (2) resource constraints, including limited access to communication platforms, materials, and funding, which reduce the visibility and sustainability of local risk messaging; and (3) the absence of institutional support, such as integration into formal education systems or dedicated government channels, which prevents the institutionalization of climate communication as a public good.By shifting the analytical focus from audience reception to communicator agency, the study contributes to decolonizing climate communication research and offers a grounded understanding of how actors in the Global South navigate and resist dominant knowledge hierarchies. It advocates for a restructuring of climate communication infrastructures that prioritize locally rooted communicators, culturally resonant narratives, and long-term institutional support. The findings have practical implications for policymakers, development organizations, and climate education efforts, offering a framework for more equitable and sustainable communication systems that center Global South voices in shaping climate futures.

Chenchen Wang, University of Maryland, Poster #21

High-resolution building detection from satellite imagery increases estimated costs of Arctic permafrost degradation

Near-surface permafrost degradation under projected climatic changes drives geologic hazards that damage infrastructure needed to sustain Arctic communities. A novel deep learning-based building detection workflow was used to map a previously undetected 52 million m2 building area from sub-meter resolution Maxar satellite imagery of Arctic communities. This expands the Arctic permafrost building area in OpenStreetMap by 31%. Combining both datasets, we estimate that 151 to 190 million m2 are exposed to moderate to high loss of bearing capacity, resulting in damages of $123 to $181 billion between 2015–2024 and 2055–2064 under the SSP245 and SSP585 scenarios. Mapped buildings account for damages worth $40 billion (+48%) and $56 billion (+45%) in addition to those accounted for by OpenStreetMap, primarily in Russia (29 to 39 million m2 worth $32 to $48 billion). These findings indicate that current Arctic building damage projections may be underestimated by 62-65%, underscoring the need for high-resolution, geographically comprehensive exposure information in climate impact modelling.

Elias Manos, University of Connecticut, Poster #7

The Role of Land-Atmosphere Coupling in Understanding Summer Precipitation Projections Across the Southern Great Plains

Precipitation is one of the most important components of the hydrological cycle; however, its projections remain highly uncertain across several regions of the world. Over the Southern Great Plains (SGP) of the United States, summer (June-July-August) precipitation projections are particularly uncertain, not only in their magnitude, but also in their sign, and statistical significance. To address this, we investigate the possible sources of these uncertainties across climate models and explore the underlying mechanisms driving them. Our analyses use an ensemble of twenty-eight (28) global climate models from the Coupled Model Intercomparison Project Phase 6 (CMIP6), focusing on outputs from both the pre-industrial control (piControl) and the high-emission future scenario (SSP5-8.5) simulations. We hypothesize that variability in the projection of SGP summer precipitation across models may be connected to large-scale, regional, or local differences between the models. Our analysis shows that large-scale changes, for example sea surface temperature, and regional circulation change, for example the Great Plains Low-Level Jet, do not explain much of the variance in projected precipitation change across the SGP. Instead, this uncertainty is primarily dominated by local processes. In particular, we demonstrate that models that produce stronger land-atmosphere coupling (using the unforced piControl simulations) tend to produce more drying across the SGP region. Further analysis of several reanalysis products indicates that many models underrepresent the strength of land-atmosphere coupling in this region, suggesting that drying may be more probable than increased precipitation. Given the region's limited summer rainfall and its critical role in U.S. agriculture, these findings offer a pathway to improve the predictability of precipitation changes—information critical for regional stakeholders and decision-makers.

Emmanuel Audu, University of Nebraska-Lincoln, Poster #22

Surficial Mapping of the Yukon-Kuskokwim Delta: Insights into Community Resilience

Coastal Communities in southwest Alaska are extremely vulnerable to the impacts of climate change. Particularly, communities in the Yukon-Kuskokwim Delta (YKD) are among the most vulnerable to coastal erosion, flooding, and permafrost degradation due to the low elevation of the delta and the decrease in duration and extent of shorefast sea ice. Rapidly changing landscapes and environments have left communities such as Mekoryuk and Kongiganak to face infrastructure instability, increased challenges with water and sanitation systems, and uncertainty for the future of their communities.This project is a co-collaboration with Mekoryuk and Kongiganak to document current landscape change through community based observations and ground truthing during fieldwork seasons. Centering lived experiences offers new insight on how the landscape is evolving and how it directly impacts the subsistence life-style of many communities in the YKD.The surficial materials of Nunivak Island and the YKD remain largely unexplored and unmapped. To support local adaptation efforts, this project aims to delineate the surficial stratigraphy of Mekoryuk and Kongiganak. Additionally, grain size analysis and geochronology will support these maps. Loess units that form more contiguous terrains in both villages date to the early and mid-Wisconsinan, recording landscape change during MIS-4 and 3 based on several feldspar IRSL age estimates. By integrating the regional stratigraphy, glacial history, community observations, permafrost extent, and high resolution LiDAR, we aim to identify more stable and resistant areas that are suitable for future infrastructure development and support community safety.

Julia Rogerson, University of Massachusetts Amherst, Poster #10

A Multi-Century Record of Tropical Pacific Climate: Insights from a Massive Coral in American Samoa

Massive Porites corals off the island of Ta’ū in American Samoa rank among the largest and oldest known of this species, with “Big Momma” estimated to be over 500 years old. This rare archive enables high-resolution reconstructions of sea surface temperature (SST) and rainfall variability from the Western Pacific Warm Pool (WPWP), a key driver of global heat and moisture transport. Located beneath the South Pacific Convergence Zone (SPCZ), the region is highly sensitive to shifts in tropical rainfall and ocean-atmosphere coupling, yet instrumental data are sparse before the 1950s. A ~0.6‰ decrease in delta-18O observed by Linsley et al. (2006) in this coral over recent centuries exceeds expectations based on known instrumental SST change alone, raising critical questions about the relative roles of temperature and salinity in this trend. My research addresses this by testing a newer Li/Mg paleothermometer on two cores from the same coral head, providing a unique controlled replication opportunity. This approach allows evaluation of proxy reliability, assessment of geochemical variability within a single coral colony, and construction of a shared del-18O age model back to 1521 CE. By disentangling SST and salinity contributions, this work aims to clarify whether observed trends reflect SPCZ intensification, WPWP expansion, or both. The anticipated outcome is a rare, centuries-long hydroclimate record from a climate-sensitive region. By linking coral geochemistry to regional climate processes, this work provides new insight into tropical Pacific variability, extreme event risks, and coral reef resilience in a warming world.

Kayla Tozier, Columbia University, Poster #1

Assessing the value in and the use of science communication curriculum in atmospheric science undergraduate programs

Science communication plays a critical role in the atmospheric sciences, where the stakes of miscommunication can be high, particularly in the context of climate change. While science communication has been studied across many disciplines, little is known about how it is incorporated into undergraduate atmospheric science education. Given the urgency of climate-related challenges, there is a need to understand how students, as future scientists, forecasters, and communicators, are being trained to share scientific information. This mixed-methods project investigates how atmospheric science communication is valued and taught within undergraduate programs in the United States. Using an exploratory sequential design, we begin with semi-structured interviews with undergraduate atmospheric science students, followed by interviews with faculty. Findings will inform the development of national surveys that will be administered to students and faculty. A key feature of the study is its comparison across subtopics within atmospheric science, particularly weather compared to climate and climate change, to explore where communication training may differ in emphasis or perceived importance. We aim to explore the following questions: (1) Is there an atmospheric science communication “teaching” gap? (How does the value educators place on atmospheric science communication curriculum relate to its weight in the curriculum?) (2) Is there an atmospheric science communication “learning” gap? (How does the value students place on atmospheric science communication curriculum relate to what they are being taught?) This research serves as a foundation for future curriculum design and outreach materials aimed at improving atmospheric science communication, especially in climate-related contexts.

Kierstin Blomberg, University of Nebraska - Lincoln, Poster #14

Supporting Forecast-Informed Climate Adaptation: Characterizing a Decade of Improvements in Hydrologic Ensemble Forecast Service (HEFS) Skill in the Western US

The National Weather Service (NWS) established the national Hydrologic Ensemble Forecast System (HEFS) in 2014, which today provides ensemble streamflow forecasts at thousands of US locations. Over the past five years, these forecasts have become critical to forecast-informed reservoir operations (FIRO), especially in the Western US where climate-driven hydroclimate variability is increasing water-related risks to infrastructure, agriculture, energy, health, and ecosystems. While prior work has shown substantial flood control and water supply benefits from FIRO – and potential for further gains with improved forecasts – there has been no comprehensive evaluation of HEFS performance over time. Therefore, it remains unclear whether we are on a trajectory to realize the full potential of FIRO for water management.This study presents a retrospective analysis of short- and medium-range (1-10 day ahead) forecasts issued by the California Nevada River Forecast Center (CNRFC) at over 80 streamflow locations from water years 2014–2025. We examine trends in forecast performance over the past decade, spatial and lead-time variability, and differences in deterministic versus probabilistic skill metrics. To stabilize trend estimates from the limited 10-year record, we use a hierarchical Bayesian model that partially pools information across sites. This novel approach, applicable to any ensemble forecasting system, enables probabilistic evaluation of local and regional performance trends. The findings of this work can help motivate and guide efforts to improve HEFS in the Western US and more broadly across the nation, ultimately helping accelerate the adoption and realized benefits of FIRO and other forecast-informed climate adaptation strategies.

Madeline Allen, Cornell University, Poster #16

Why do companies' reported emissions tend lower than macro-economic expectations?

Investors increasingly rely on companies' reports of their carbon emissions to construct green investment portfolios. However, the accuracy of these reported emissions, particularly supply chain (upstream Scope 3) emissions, remains uncertain. In this project, I compare reported emissions against macro-economic expectations derived from environmentally extended input-output (EEIO) models. I test three hypotheses as to why reported emissions tend below expectations: a) companies are intentionally or unintentionally under-reporting, b) reporting companies happen to be among the most sustainable companies, and c) reporting companies tend to be larger companies and larger companies have lower emission intensities due to economies of scale. Although results are still forthcoming, I will discuss the project's methods, challenges and potential outcomes.

Martin Staadecker, MIT, Poster #8

Future Changes to Extreme Downslope Windstorms Across the Northern Colorado Front Range

Downslope windstorms are common leeward of the Rocky Mountains across the High Plains of Colorado during October through March and can cause property damage and travel disruptions. These windstorms can also exacerbate fire weather, with one example being the Marshall Fire on 31 December 2021 that destroyed nearly 1,100 homes. In our previous study (Meehl et al. 2025), we found that windstorm peak gusts at the NSF National Center for Atmospheric Research (NSF NCAR) in Boulder, Colorado have decreased in magnitude in recent decades compared to the 1960s–1980s. We hypothesize that the change in observed peak gusts in Boulder is due to a shift in the lower tropospheric temperature structure, including a more elevated temperature inversion layer above mountain-top that promotes decreased winds at the surface.To investigate downslope windstorms in a future climate, we employ high-resolution Weather Research and Forecasting (WRF) simulations and apply the pseudo-global warming (PGW) approach to investigate how climate change impacts downslope windstorm characteristics across the Northern Colorado Front Range. ERA5 initial conditions are perturbed using projected future trends derived from the Community Earth System Model Large Ensemble (CESM-LENS2) to analyze how current windstorms would vary if they occurred in a future climate state. We examine changes in vertical wind shear, temperature, inversion layers, the eastward extent of winds, and other atmospheric conditions on a case-by-case basis to identify what might be causing changes in peak wind speeds observed at NSF NCAR.

McKenzie Larson, University of Colorado Boulder, Poster #17

How a Changing Climate is Fueling Extreme Rainfall: Insights for Enhancing Flood Resilience in the US Gulf Coast

The study assesses the impact of climate change on Precipitation Frequency Estimates (PFE) USA Gulf Coast, states characterized by high flood exposure and vulnerability. Using downscaled CMIP6 global climate model data under SSP370 and SSP585 scenarios for mid-century (2031–2065) and late-century (2065–2100) periods, the research quantifies projected changes in PFE relative to 1980–2014. A key methodological component is the regional bias correction of GCM outputs using the AORC dataset, employing Quantile Delta Mapping (QDM), which significantly improved model accuracy. Precipitation frequency estimates were derived by fitting annual maximum precipitation to a Generalized Extreme Value (GEV) distribution, with a subsequent adjustment of the shape parameter to enhance realism. A novel approach was introduced to manage inter-model uncertainty, weighting model outputs based on their historical. Results indicate a consistent increase in PFE across all SSP scenarios, with the most pronounced changes in coastal Louisiana, southern Mississippi and Alabama, as well as in northern Mississippi and Alabama. For the 2-year return period, PFE is projected to increase by 15.07%-15.11% by mid-century and 19.20%-22.1% by late-century across SSP370 and SSP585 respectively. For the 100-year return period, increases range from 23.29%-25.08% by mid-century and 27.89%-34.59% by late-century. The study found that while models initially underestimated precipitation extremes compared to the observation, bias correction significantly improved their performance. Uncertainty in projections increases with higher emission scenarios and longer timeframes. The findings underscore the critical need for regional bias correction, robust statistical modeling, and the consideration of multi-model ensembles for effective infrastructure planning and flood risk management.

Mostafa Abouelanien Nasser, Louisiana University at Lafayette, Poster #19

Observed changes in surface winds and their extremes over the northeastern U.S.

Climate change is making storms and high extreme weather events more damaging, especially in regions with older infrastructure. In the northeastern United States (NEUS), where dense populations and tree-surrounded energy infrastructure increase the risk of outages, there is limited understanding of how wind patterns have changed over time, and what that means for energy infrastructure in the region. This project uses station and ERA5 reanalysis datasets to study historical changes in surface wind speed and gusts from 1940 – 2024. By analyzing seasonal patterns, extreme wind events, and trends across the NEUS, I identify where wind and wind gust conditions may be increasing infrastructure risk and to what extent these risks are changing over time. Additionally, this research involves developing a framework to study compound weather events, such as when wind and heavy precipitation occur at the same time, like during Hurricane Sandy. These types of events can cause more damage than either variable alone. Preliminary findings suggest that combining methods like PCA (Principal Component Analysis) and K-means clustering can help identify compound wind and precipitation extremes across space and time. Overall, this research contributes to climate science by filling a gap in regional wind research for the NEUS, and emphasizes how climate data can support infrastructure decisions, especially when combined with outage records and known vulnerabilities. Notably, the usability of this research is strengthened by active collaboration with a regional energy utilities company.

Patrick Dugan, University of Rhode Island, Poster #18

Climate and large-scale ocean dynamics as drivers of Pseudo-nitzschia blooms in the Western North Atlantic

Large-scale climate variability is reshaping ocean circulation patterns in the Northwest Atlantic, with profound implications for marine ecosystems. The Nova Scotian Shelf, located at the confluence of major western boundary currents, is a hotspot of environmental change. This dynamic setting influences phytoplankton communities, which play a foundational role in biogeochemical cycling. However, when environmental conditions become unfavorable for phytoplankton growth, certain opportunistic species may dominate, triggering harmful algal blooms (HABs) with serious ecological, economic, and public health consequences. In October 2016, an unprecedented bloom of the toxic diatom Pseudo-nitzschia australis led to shellfish closures in the Bay of Fundy, with record levels of domoic acid (2.5 $\mu g\ l^{-1}$). Evidence suggests that P. australis was advected from the eastern North Atlantic through a subpolar route to the Gulf of Maine via the Scotian Shelf. Yet since 2022, no comparable blooms have been recorded, and the presence of Pseudo-nitzschia has sharply declined.This study investigates the physical drivers that control the occurrence and transport of P. australis in this region. Using regional circulation data, climatological trends, and optical biological surveys, we aim to identify the mechanisms linking large-scale climate forcing to local bloom dynamics. By improving our understanding of these pathways, this work contributes to broader efforts in predicting and mitigating HAB events in a changing climate.

Serena Negroni, MIT/WHOI, Poster #2

Assessing Climate Resilience in Dominica's Tourism Infrastructure: Supporting the Vision of the World's First Climate-Resilient Nation

Dominica's tourism infrastructure is exposed to climate-related events such as hurricanes, floods and landslides. The country has embarked on a journey of positioning itself as the first climate-resilient country in the world which means that there is a need to ensure development within the tourism sector is in line with resilience goals set in the Dominica Climate Resilience and Recovery Plan (CRRP) and the Dominica's National Tourism Master Plan (DNTP). Despite this, there has been so systematic assessment of how tourism infrastructure has adapted since major climate-related disasters such as Hurricane Maria in 2017. To address this, the proposed research will combine a spatial-based Building Classification Model (BCM) with stakeholder surveys and geospatial analysis to assess the physical resilience and adaptive design of tourism infrastructure island-wide. The BCM will capture building materials, story type, security and completeness at tourism structures. Complementary stakeholder interviews will be conducted with hotel and accommodation owners, port managers and other key parties to capture post-disaster adaptation and alignment with national policy standards. A tourism infrastructure resilience index will be then developed to identify strengths and gaps in resilience. This research will provide one of the first empirical evaluations of Dominica's tourism infrastructure resilience. These findings aim to support targeted approaches to climate-resilient planning within the tourism sector and the reduction of risk to a critical sector to Dominica's future.

Shania Scotland, University of Waterloo, Poster #11

Digital Commons in Southeast Asia: How Green Brunei's Instagram Mobilizes Community for Environmental Sustainability

This study investigates how Green Brunei's Instagram platform functions as a digital common to advance environmental sustainability in Southeast Asia, employing digital storytelling to articulate visions of sustainable futures and the common good. Grounded in framing theory, the paper analyzes how curated visual content, and narrative strategies construct thematic frameworks emphasizing environmental stewardship, sustainability efforts, and community resilience. Through a systematic examination of posts and visual narratives via the Russmann and Svensson (2016) Studying Organisations on Instagram model, the study demonstrates how Green Brunei translates complex climate challenges into relatable, localized stories, rendering abstract environmental issues accessible and actionable for its Bruneian audience. Findings reveal that these digital narratives foster cross-sectoral alliances among stakeholders, including governmental bodies, financial institutions, and traditionally influential sectors such as the oil industry. By framing sustainability as a collective imperative that transcends traditional sectoral boundaries, Green Brunei's content encourages collaboration among historically disconnected actors. The effective use of visuals and engaging captions not only raises awareness but also catalyzes tangible environmental initiatives and policy influence, bridging online engagement with offline impact. The study underscores the transformative role of social media in reimagining public participation in environmental governance. By positioning sustainability as a shared responsibility, platforms like Instagram emerge as critical tools for mobilizing community action and shaping policy agendas. These insights enhance understanding of digital communication's evolving role in advancing sustainability and the common good across Southeast Asia, highlighting the necessity for innovative, inclusive climate communication strategies in the digital age. The research ultimately illustrates how digital platforms can democratize environmental discourse, fostering collaborative solutions to regional and global climate challenges.

Silas Emovwodo, Universiti Brunei Darussalam, Poster #12

Climatology and Trends of Abrupt Transition from Dry to Wet Extremes in the Contiguous United States

Abrupt transitions from dry to wet extremes, also known as "weather whiplash," increasingly pose greater risks to agriculture, ecosystem stability, and human wellbeing than single extreme events. For example, dry extremes can deplete water availability for crops, while subsequent wet extremes can lead to waterlogging or nutrient loss, exacerbating adverse impacts on crop yields. However, detailed research on abrupt climatic transitions in the contiguous United States (CONUS) remains limited. This study addresses this knowledge gap by analyzing spatial-temporal patterns of abrupt transitions. Abrupt transitions are identified using the one-month Standardized Precipitation Evapotranspiration Index (SPEI) calculated on a daily moving-window basis. Results indicate regional hotspots in the Northeast and Midwest. Although the frequency of events shows only a slight increasing trend, their transition durations have significantly shortened, accompanied by a marked intensification. Shorter transitions are generally associated with higher event intensity. This study provides information about the frequency, intensity and transitional duration of abrupt climatic shifts. The findings will assist policymakers, agricultural managers, and stakeholders in developing timely adaptation and mitigation strategies to enhance agricultural sustainability and resilience against future hydroclimatic extremes.

Tian Yang, Indiana University Bloomington, Poster #24

Assessing the Impacts of Future Threats on the Implementation of Conservation Targets

The continual survival of biological diversity depends on conserving ecosystems with high ecological integrity. To address this, the Convention on Biological Diversity (CBD) set global targets to conserve 30% of the Earth by 2030 and 50% by 2050, emphasizing both protected areas and Other Effective Area-based Conservation Measures (OECMs) as the implementation tools. OECMs are geographically defined areas outside formally protected areas that are equitably governed and managed to deliver sustained in-situ biodiversity outcomes along with associated ecosystem services. While protected areas have long been the cornerstone of conservation, OECMs offer complementary, cost-effective benefits. Over 50 nations have committed to the 30 × 30 target through their National Biodiversity Strategies and Action Plans, yet many Global South countries still face challenges balancing conservation with economic development. This study assesses the feasibility of achieving conservation targets in six Global South nations (Nigeria, Tanzania, Peru, Colombia, India, and Indonesia) using the Co$ting Nature spatial policy support tool to prioritize potential OECMs. We identified areas of high biodiversity, ecosystem services, and low threats, and examined their overlaps under two scenarios: a Biodiversity and Ecosystem Services Focus Scenario and a Priority Overlap Scenario. Under the first scenario, all countries except India (27.15%) could meet the 30 × 30 target. Under the overlap scenario, only Tanzania (50.72%), Colombia (34.36%), and Peru (30.82%) achieved the desired outcome. Threat impacts reduced priority areas by 7.06% (Tanzania) – 14.63% (India). Overall, this study offers a replicable, spatially driven approach for prioritizing OECMs and advancing global biodiversity and climate goals.

Yetunde Rotimi, Washington State University, Poster #6

Lightning Talks

All lightning talks also have a corresponding internal poster. For these presenters the abstract is included in the Lightning Talk section. The corresponding poster session includes the tile only and a link back to the full abstract in the Lightning Talk session.

Balancing biodiversity and climate targets in local land-use decisions

Ensuring compatibility between climate change and biodiversity targets is essential to manage competing demands on finite land. While local governments play a key role in delivering national environmental targets, often stemming from global goals, there is a growing implementation gap between national ambition and local action. Previous research has addressed local level implementation of individual targets, yet less is known about how the local government decision-making process for both targets, shapes delivery of national policy ambitions. This study uses semi-structured interviews with local government officials in Hampshire, England to investigate local approaches to balancing climate and biodiversity targets. As a densely populated county with a two-tier governance structure, it is a typical representation of the rest of the country. This research reveals that the key challenge is not the compatibility of climate and biodiversity targets, but broader systemic barriers that prevent local government from making environmental decisions at all. Thematic analysis revealed that a lack of financial support, clear legislative support, and land ownership limit delivery of environmental targets, together, separately or at all. Resulting action is often short-term, and low risk contributing to a lack of collective impact toward national goals. To scale up local climate and biodiversity action, greater attention must be paid to overcoming both top-down and internal governance challenges. Future work will aim to identify how local priorities are set when resources, powers and land are limited.

Emily Cole, University of Southampton

Assessing the Efficacy of 14 Low-Cost Indoor Air Sensors: An Analysis of the Usability, Accuracy, and Precision

As climate change intensifies the frequency and severity of wildfires, communities face growing risks from wildfire smoke (WFS), particularly through its impact on indoor air quality (IAQ). There are no federal standards for IAQ, and public guidance remains limited. Individuals spend nearly 90% of their time indoors, where pollutant concentrations can exceed outdoor levels due to both infiltration and indoor sources. Despite these risks, few studies have evaluated the effectiveness of low-cost IAQ sensors for household-level monitoring and decision-making. There is an urgent need to assess the usability, accuracy, and precision of these devices to support informed public health recommendations and empower individuals to mitigate indoor air pollution.
This mixed-methods study aims to address these gaps by evaluating 14 low-cost air quality sensors commonly cited in scientific literature and consumer reports. We used the Consolidated Framework for Implementation Research (CFIR) to systematically assess each sensor's adaptability, complexity, design, and cost, ranking their consumer interfaces and overall accessibility. For performance evaluation, all sensors will be tested in a controlled environmental air chamber, exposing them to wood smoke and comparing their measurements to a reference-grade aerodynamic particle sizer (APS). We generated summary statistics for

quantitative usability data, calculated inter-rater agreement, and conducted thematic analysis of qualitative feedback and survey responses. By integrating laboratory-based performance testing with real-world usability, we synthesized evidence-based policy recommendations for local county health officials. These findings will help guide household-level IAQ monitoring and support strategies to reduce the health impacts of indoor air pollution in wildfire-prone regions.

Hannah McKinley, University of Washington

Taking STRESS Beyond the Lab: Comparing Academic and Community Conceptions of Climate Risk

We live in a data-driven society where we look to, primarily quantitative, data to explain the present, predict the future, and inform our actions. This includes seeking data on 'climate risk,' which includes risks like floods, fires, hurricanes, heatwaves, water quality, air quality, and more. Climate risk is increasingly understood as encompassing socio-economic factors, such as poverty levels, which increase one's likelihood of being harmed by an event like a flood. The System for the Triage of Risks from Environmental and Socio-economic Stressors (STRESS) platform, created by MIT's Center for Sustainability, Science, and Strategy, maps county level social, environmental, and climate risk data across the U.S. and allows users to select and weight risk metrics to create a relative risk metric based on percentile rankings of each individual risk. The idea is that 'hotspots' can be identified - for example places where high rates of poverty coincide with low air quality - for further study and/or resource allocation. However, there are open questions regarding how this climate risk tool can be useful to communities. I thus ask: how does our identification and quantification of climate risks from a scientific lens compare to conceptions of climate risk within the community? Further, how are different risks, such as poverty or food security, understood as being related or not related to the climate and environment? Through working with Essex County Community Foundation's (ECCF) Climate Resiliency Coalition, I explore the challenges and tensions in translating the STRESS methodology to provide high-quality, actionable local information.

Hannah Rajput, MIT

Evaluating PurpleAir Sensors and Low-Cost Household Clean Air Interventions Under Wildfire Smoke and Climate Change: A Multi-year Participatory Science Study in King County, WA

Background: Indoor air quality (IAQ) has largely been understudied and under characterized. As wildfire smoke (WFS) events increase in frequency and intensity with climate change, individuals may need to monitor their own IAQ and make informed decisions on personal air quality improvement and climate adaptation strategies. Objective: We employed participatory community science to evaluate the efficacy of low-cost public health interventions aimed at monitoring IAQ, reducing exposure, and safeguarding public health during WFS episodes.

Methods: King County, WA households were recruited to monitor their indoor air quality throughout the summer months of 2023 and 2024. Participants completed surveys throughout the study period to assess building characteristics, personal decision making, and the performance of air filtration devices. Data and survey responses were summarized across the study.

Results: A total of 13 households in 2023 and 25 households in 2024 completed the study. In 2023, average indoor fine particulate matter concentrations were higher during a WFS event (19.0 μg/m3 ∓ 27.3 μg/m3) than non-WFS events (10.7 μg/m3 ∓ 24.1 μg/m3). There were no WFS events in 2024. Household-level knowledge of risks and health impacts showed variability in the relationship between information uptake and individual perceptions in informing behavioral changes in reducing exposure to indoor IAQ.Conclusion: This community-based approach provides evidence of how IAQ education, risk communication, and IAQ monitoring can be used to protect the public's health from WFS in residential environments, both at present and with future climate change.

Katelin Teigen, University of Washington

Session 2 - Managing Climate Change

Interactions between groundwater extraction and short-term sea level rise in the Chesapeake Bay

Relative sea level rise (RSLR) is a major long-term consequence of climate change for coastal communities and ecosystems, with vertical land motion (VLM) playing a critical yet often overlooked role in shaping local impacts. VLM can result from both long-term geologic processes, such as glacial isostatic adjustment (GIA), and shorter-term anthropogenic drivers, such as groundwater extraction. While many projections, including those in the IPCC's Sixth Assessment Report (AR6), extrapolate historical VLM trends, they typically overlook non-linear and non-stationary influences associated with human activity. This research aims to refine RSLR projections by explicitly linking groundwater resource changes to VLM variability.

The study focuses on the southern Chesapeake Bay, Virginia, where decades of groundwater withdrawal have contributed to land subsidence. A 2016 study reported that the rate of VLM in the region halved around 2010, coinciding with an abrupt rise in groundwater pressures. My analysis attributes this shift to operational changes at a major paper mill in Franklin, Virginia: a significant groundwater user that closed in 2010 and reopened at reduced capacity in 2012. Using a VLM "budget" derived from InSAR data, extensometer measurements, and a GIA model, I assess how these changes influenced subsidence rates. Simplified physical models are then applied to connect variations in groundwater pressure to observed VLM and RSLR trends.

By integrating hydrological and geodetic observations, this work provides new insight into how local water management decisions can affect regional sea level outcomes, emphasising the need to incorporate dynamic groundwater processes into future coastal resilience planning.

Abigail Bonnington, MIT/WHOI

Engine Exhaust Fouling and Heat Transfer Impacts of Diesel, Renewable Diesel, and Biodiesel Fuels

Diesel engines power much of global transportation but contribute heavily to greenhouse gas (GHG) emissions, worsening climate change. Exhaust Gas Recirculation (EGR) systems, which recycle exhaust gases to cut harmful nitrogen oxide (NOx) emissions, often lose efficiency due to fouling—buildup of soot and deposits. This study tests how conventional diesel, renewable diesel (R100), and biodiesel (B100) affect fouling and heat transfer in a 1.9 L turbodiesel equipped with a custom shell-and-tube EGR cooler. Over six-hour experiments, we measured deposit buildup hourly revealing diesel caused the most fouling (45 mg), followed by R100 (36 mg), and B100 (23 mg). Renewable diesel's lower soot-forming compounds and biodiesel's cleaner-burning oxygen content reduce deposits, improving efficiency. We used thermogravimetric analysis to explore why biodiesel's fouling is low despite other factors and assessed how fouling impacted heat transfer, which affects engine performance and emissions. These findings guide the shift to cleaner fuels like R100 and B100, reducing GHG emissions from transportation—a key driver of climate change. They also inform engine designs that maintain efficiency, lowering environmental impact. This research connects engineering and climate science, offering practical solutions for sustainable transportation. By clarifying how fuel choices impact engine performance and emissions, this work supports policies for a low-carbon future, accessible to engineers, policymakers, and climate researchers.

Alexander Arnold, University of Michigan

A social cost perspective on climate and air quality damages from the aviation sector.

A social cost perspective on climate and air quality damages from the aviation sector. The aviation industry is expected to grow rapidly in the coming years, and this has broad impacts for both climate (due to the CO2 and H2O emissions) and air quality (due to Nox and BC). To effectively reduce these impacts, we need a tool to rapidly evaluate the total social cost (including climate and air quality) of a policy decision such as using Synthetic Aviation Fuel or implementing more stringent Nox limits on certain aircraft. Some regions in the world – like Asia Pacific - are expected to grow more rapidly than others and different size classes of aircraft are projected to see different demands – for example international travel may not see the same growth as domestic travel. The first step of understanding how to regulate these emissions is to understand what the contribution of the different size classes of aircraft are presently, as well as in a future with different background conditions. To do this, we use a simplified climate model to estimate the share of damages from different size classes of aircraft. In terms of climate, this is an increase in global mean temperatures and for air quality we look at the mortalities due to a change in the surface concentration of ozone and PM2.5. We then monetize these changes to obtain the total social cost associated with each size class of aircraft. This would give an insight into what effective policy or regulations can be made to reduce the environmental damages.

Shreya Sharma, MIT

Session 3 - Monitoring and Predicting Climate Change

Iceberg Melt Rates Around the Greenland Ice Sheet: Regional Patterns and Oceanic Controls

Iceberg discharge accounts for ~50% of Greenland Ice Sheet mass loss in recent decades, making it a major freshwater source to surrounding fjords and the coastal ocean. This influx of freshwater alters ocean circulation, stratification, and nutrient dynamics—processes that influence marine ecosystems and climate feedback. Despite its importance, we have limited knowledge of how quickly icebergs melt within fjords and what controls this variability. In this study, we estimate spatial and temporal variations in iceberg melt rates across 25 fjords around Greenland from 2011 to 2022 using a satellite-based elevation differencing method. To evaluate oceanic controls on melt, we compare these estimates to in-situ hydrographic measurements and outputs from two high-resolution ocean models: a 500-m downscaled ECCO LLC270 simulation and the Arctic Subpolar gyre sTate Estimate (ASTE). Our results show that melt rates generally increase when iceberg depths exceed 100 meters, regardless of fjord location. Although no consistent trends over time are detected, clear regional differences emerge: northeast Greenland has the lowest melt rates (<0.4 m/day), while central east and west Greenland exhibit moderate rates (0.4 -- 0.7 m/day). Surprisingly, comparisons with ocean temperature and modeled thermal forcing reveal no consistent relationship with melt rates, indicating that local fjord dynamics may dominate over large-scale ocean conditions. This work highlights the complexity of ice-ocean interactions and suggests that current model parameterizations may underestimate variability in iceberg melt. These findings have implications for accurately predicting freshwater input to the ocean and its role in future climate change.

Aman KC, Boise State University

Sensitivity of Glacier Mass Loss Projections to Climate Downscaling Methods in Western Canada

Projecting glacier mass balance at regional scales requires downscaling coarse-resolution climate data to glacier-relevant scales. Statistical downscaling is computationally efficient but relies on stationary empirical relationships, while dynamical downscaling provides physically consistent fields but is computationally expensive. Hybrid downscaling, which combines both approaches, offers a promising alternative but remains largely unexplored for glacier modeling. This study evaluates hybrid downscaling for projecting glacier mass changes across western Canada. First, the Weather Research and Forecasting (WRF) model dynamically downscales climate projections from a global climate model under four Coupled Model Intercomparison Project Phase 6 (CMIP6) emission scenarios. The WRF output then trains two statistical downscaling methods – a simple bias correction and a neural network approach – using two training strategies: one incorporating WRF data from both present-day (2015–2024) and late-century (2090–2099) periods, and the other using only present-day data. The resulting downscaled climate fields drive a glacier evolution model that couples a surface energy balance melt scheme to project glacier mass loss from 2025 to 2100. Overall, glaciers in western Canada are projected to lose 45–66% of their current mass by 2100, with the greatest losses in the Interior region (72–86%) and the least in the St. Elias Mountains (26–53%). The primary source of projection uncertainty shifts over time: in the first half of the century, it is dominated by the choice of statistical downscaling method (70% contribution), while in the second half, emission-scenario choice becomes the main driver (58%). Although the choice of training strategy has a minor overall effect, it substantially influences projections at subregional scales, contributing up to 20% of the uncertainty in the Rocky Mountains. These results highlight the scale dependence of downscaling uncertainties and underscore the need for robust downscaling approaches at watershed scales, where glacier retreat will have the most pronounced local impact

Christina Draeger, University of British Columbia

Forecasting Forecast Errors: Predicting Coverage and Spatial Biases in Convective Outlooks Using CNNs

Severe thunderstorms (those producing straight-line winds at least 58 mph, hail at least one inch in diameter, and/or a tornado) pose a substantial threat to life and property. The frequency and severity of these storms varies with both human-forced climate change and cycles of internal variability such as ENSO. To help mitigate impacts, the National Weather Service's Storm Prediction Center issues Convective Outlooks (COs), which estimate the daily probability of severe storms within 25 miles of any point across the Contiguous United States. We recently developed methods to quantify two types of CO errors: coverage bias (e.g., observed storm coverage was twice that forecasted) and spatial bias (e.g., storms occurred 100 miles east of the forecasted area).In this work, we train a convolutional neural network (CNN) to predict the probabilistic distributions of these two biases from time-evolving, gridded environmental variables (temperature, pressure, etc.; via ERA5) on the valid day. The trained model can predict biases to "correct" a CO ahead of time (e.g., given tomorrow's forecasted weather conditions, the model predicts the CO will underforecast storms by 20%) and the spread of the predicted distribution quantifies uncertainty in a CO (e.g., if the model predicts a wide spatial bias distribution, there is high uncertainty in storm location). Additionally, we use explainable AI methods to identify patterns in environmental data that are responsible for our model's predictions, which deepens our understanding of severe thunderstorm processes and may guide future forecasting improvements in a warming and increasingly variable climate.

Miles Epstein, University of Washington

Where Water Sinks and Models Diverge: North Atlantic circulation in high-resolution ocean models

The Atlantic Meridional Overturning Circulation (AMOC) is a major driver of Earth's climate, transporting heat northward and cold, dense water southward. Its strength influences global temperatures, rainfall, and sea level, yet climate models still disagree on how the AMOC operates and responds to change. A key to understanding this lies in water mass transformation—how surface waters change temperature and saltiness, become dense, and sink. This process connects the ocean's surface to its deep circulation and provides a way to estimate the AMOC's strength without measuring every current directly. This study compares water mass transformation in several high-resolution ocean and sea-ice models from around the world, focusing on the subpolar North Atlantic where dense waters form. Results show that high-resolution models generally capture these processes more accurately, but regional differences remain. In some areas—especially near strong currents and boundary regions—models still show persistent biases that influence the simulated AMOC.By linking surface biases to errors in overturning strength, this work helps explain why models differ and how those differences impact North Atlantic circulation. Understanding these connections is vital, as a weakened or collapsed AMOC could trigger major shifts in temperature, rainfall, and sea level worldwide.

Taydra Low, University of Wisconsin Madison

Subseasonal-to-Seasonal (S2S) Prediction Skill of Rainfall Diurnal Cycle over the Maritime Continent and Its MJO Dependence

The Maritime Continent (MC) is one of the rainiest regions globally, where the diurnal cycle contributes significantly to rainfall variability and is modulated by the Madden-Julian Oscillation (MJO). Errors in simulating the rainfall diurnal cycle affect rainfall predictions at larger spatiotemporal scales relevant to climate forecasts; however, the prediction skill of the diurnal cycle in subseasonal forecast models remains poorly understood. This study evaluates the subseasonal prediction skill of rainfall diurnal cycle characteristics over the MC using S2S models and investigates how MJO's modulation influences diurnal cycle forecasts. The evaluated diurnal cycle characteristics include the daily mean, diurnal range, and phase. Significant errors are evident from the first forecast day and increase with lead time. Aggregating forecasts over longer lead windows can sustain or improve skill. Over land, errors mainly arise from earlier rainfall peaks and overestimated diurnal ranges, while over the ocean, errors are concentrated near coastlines and in remote regions such as the tropical northern West Pacific. Furthermore, forecasts are stratified by MJO phase at forecast initialization to examine MJO's modulation of prediction skill. The forecasts become less skillful when the MJO enhances convection over the MC, primarily due to substantial underestimation of the large diurnal range. This is associated with insufficient low-level convergence at the grid scale and misrepresentation of the moisture–rainfall relationship in the models. This study contributes to understanding the subseasonal rainfall prediction skill, the MJO's influence on rainfall prediction, and potential directions for climate model improvements.

Wayne Tsai, School of Meteorology, University of Oklahoma

Oral Sessions

Session 1 - Life at the Interface: Biology and Climate

Investigating the impact bacterial biodiversity and temperature on phytoplankton ecosystem function

Phytoplankton and their ecosystem function are closely linked to symbiotic relationships with their surrounding bacteria, impacting each partner's physiology, the environmental chemistry, and species diversity in the ecosystem. Yet phytoplankton and bacteria interactions are highly impacted by temperature, as increasing temperatures leads to a decrease in biodiversity and altered community assembly. Given the critical role of both phytoplankton and bacteria in marine ecosystem functioning, it is essential to understand how temperature shifts caused by climate change affect bacterial diversity and the performance of phytoplankton. In this study, we investigated how temperature and bacterial species richness influences the growth rate of a focal phytoplankton species, Phaeodactylum tricornutum through thermal performance curve (TPC) experiments. Our preliminary results show that pairwise effects of bacteria on phytoplankton vary across a temperature range, with most having neutral or positive effects on thermal tolerance. These bacteria isolates were then combined into different diversity treatments to examine how both biodiversity and net species interactions affect phytoplankton growth across temperatures. We hypothesize that increasing species richness will increase phytoplankton thermal tolerance and that a greater number of beneficial bacteria in the community will also increase phytoplankton thermal tolerance. These results serve as a baseline for understanding how bacterial diversity impacts the ecosystem function of phytoplankton in a changing world.

Brandon Chan, University of Connecticut

Resilience of the Amazon in the Late Quaternary

In the face of climate change and rapid deforestation, the fate of the Amazon ecosystem remains at best uncertain. Models suggest that warming, drying, and deforestation could trigger a tipping point, causing the rainforest to transition to savannah or dry forest environments. To gauge the Amazonian rainforest's resilience to climate change, we use biomarkers from lake sediment cores in the Amazon basin to reconstruct temperature, precipitation, and vegetation change in the late Quaternary in one of the most significant centers of biodiversity on the planet. To do so, we analyzed branched glycerol dialkyl glycerol tetraethers (brGDGTs) and the hydrogen and carbon isotopic composition of terrestrial plant waxes, respectively, in lake sediment cores from lake sites spanning the penultimate interglacial to the present to understand the relationship between the Amazon ecosystem, the South American Summer Monsoon, and rapid temperature change. Our results suggest that the last interglacial was warmer than the Holocene and indicate glacial-interglacial temperature changes of ~2-3 ºC. Our leaf wax isotope record indicates significant precipitation variability over this time-span, but also indicates limited rainforest conversion. These findings suggest that the Amazon rainforest was resilient to temperature and other climate changes over recent glacial-interglacial cycles.

Ellen Jorgensen, Brown University

The influence of wind-driven and tidal circulation on N2O and CH4 distributions along the southern coast of British Columbia, Canada

We present high spatial and temporal resolution measurements of surface water nitrous oxide (N2O) and methane (CH4) concentrations around Vancouver Island, BC, during summer, 2024. Using an automated, high-frequency measurement system, we conducted a spatial survey of N2O and CH4 concentrations along the east and west coast of the island and obtained one-week of time series observations in Barkley Sound on the island's west coast. These high frequency measurements allowed us to assess the influence of wind-driven circulation and tidal forcing on surface water gas distributions. Across our spatial survey, surface water N2O ranged from 69% to 133% saturation, while CH4 saturation ranged from 83% to 936% saturation. Localized N2O and CH4 'hot spots' were associated with regions of intense tidal mixing in the Strait of Juan de Fuca and Johnston Strait. Waters along the west coast of the island showed greater mixed layer stratification, limiting vertical inputs of N2O and CH4 into the surface. In these waters, our results suggest that elevated surface water N2O and CH4 saturation is more likely attributable to horizontal transport via the Vancouver Island Coastal Current. High frequency measurements conducted in Barkley Sound demonstrated significant N2O and CH4 variability on a range of timescales, with N2O saturation ranging from 76% to 177%, and CH4 saturation ranging from 163% to 556% over the course of our time series. This temporal variability was strongly associated with tidal forcing and diel changes in surface winds, which led to varying contributions of different local source water masses with distinct gas signatures. Our work highlights the utility of high frequency measurements to capture variability in N2O and CH4 in a dynamic coastal region and provides insights into the interacting physical processes driving this variability.

Rebecca Rust, University of Rochester

Climatic Drivers of Radial Growth Variation in Chinese Fir (Cunninghamia lanceolata) Across Subtropical China

Climate change has significantly impacted forest productivity in subtropical China, especially for fast-growing species like Chinese fir. In this study, we investigated the relationship between climate factors and radial growth patterns of Chinese fir across four distinct climatic zones: Fujian, Jiangxi, Hunan, and Yunnan. Using over 17,000 monthly observations from 888 trees equipped with self-designed growth rings, we quantified radial growth variations and established correlations with temperature, precipitation, and drought indices. We employed correlation analysis and structural equation modeling (SEM) to assess both direct and indirect influences of biological and climatic variables. The findings revealed spatial heterogeneity in growth response: unimodal curves dominated coastal regions, while inland zones exhibited bimodal and trimodal patterns due to variable drought and rainfall dynamics. Notably, drought stress promoted growth in water-abundant areas but suppressed it in drier zones. Our results underscore the nonlinear and region-specific nature of tree-climate interactions and suggest that Chinese fir plantations' growth sensitivity increases from coastal to inland regions. This study contributes critical insights for adaptive forest management and highlights the importance of climate-responsive planting strategies under ongoing climate change.

Yiying Wang - University of Nevada, Reno

Session 2 - Climate Modelling and Big Data

Contrasting Atlantic and Pacific Responses in Observed Changes to Extratropical Cyclone Latent Heat Transport: The Role of Latent Heat Release

Extratropical cyclones (ETCs) play a critical role in the Northern Hemisphere cool-season (November-March) poleward transport of heat and moisture in the midlatitudes, however it is still unclear how global warming has impacted this behavior. Global warming affects ETC activity through Arctic amplification, Hadley cell expansion, and increased atmospheric moisture. Enhanced moisture can either reduce the number of storms necessary for poleward transport or intensify individual ETCs through Latent Heat Release (LHR). The first part of this study uses a multi-perspective Eulerian approach to analyze high-frequency transient (and by proxy, ETC) contributions to midlatitude energy transport. Here we show that high-frequency transients contribute 48.1% to the total climatological LH transport from 31-45 N, and contribute largely to the observed 3% increase and poleward shift in Latent Heat (LH) transport, however this manifests through significant opposing shifts in LH transport in the Atlantic (westward) and Pacific (poleward) storm tracks between the early (1980-2001) and late (2001-2022) periods. To understand the mechanism driving these shifts, an Ertel Potential Vorticity (EPV) tendency analysis is used to quantify LHR’s contribution to ETC development, hypothesizing that enhanced poleward propagation in ETCs resulting from greater LHR over the observed period is responsible for this poleward shift in LH transport in the Pacific compared to the Atlantic. We track individual ETCs using the Multiple Object Tracking algorithm, examine the most intense ETCs (90th percentile by minimum pressure) separately from the full distribution, and compare ETCs in the Atlantic and Pacific basins separately. Improved process understanding of LHR in ETCs can foster greater predictability on both weather and climate timescales for damaging ETC impacts like extreme precipitation.

Austin Reed, George Mason University

Characteristics of North American Polar–Subtropical Jet Stream Superpositions in CESM2 Climate Projections

The polar and subtropical jet streams are currents of air in the upper-troposphere that occasionally merge horizontally and align vertically to form a jet superposition. Prior work has found that superposed jets constitute a dynamic environment particularly conducive to high-impact weather, including heavy precipitation and intense winds at the surface. However, no prior study has investigated how characteristics of jet superpositions might change in a future, warmer climate. In this study, we present an updated identification scheme capable of detecting superposed jets during September–May in the ECMWF Reanalysis version 5 (ERA5). The identification scheme searches for upper-level wind speeds ≥ 30 m/s and distinct breaks in the height of the tropopause (i.e., the boundary separating the troposphere from the stratosphere) to identify the presence of a polar and/or subtropical jet. A grid column containing both jets is considered to represent a superposed jet. We apply this identification scheme to produce a climatology of North American jet superpositions in historical and future climate simulations from the Community Earth System Model version 2 (CESM2). We then examine uncertainty in changes to several characteristics of North American superposed jets that are projected to occur by the end of the century under different climate warming scenarios, including their frequency, speed, and location, as well as the upper-level and surface environments that tend to accompany them. Understanding how these characteristics might evolve in the future will help advise efforts to adapt to changes in high-impact weather in a warming climate.

Clairisse Reiher, University of Colorado Boulder

Reconstruction of past climates using proxies and climate models

Natural climate variability provides context for recent climate change. However, the instrumental record is too short and includes strong human-induced forcing. To extend the record of natural variability, climate models and proxies such as tree rings and ice cores have been used to investigate past climates. Here, we present a reconstruction of temperature and energy content over the last millennium (850-2000 CE), a period directly contiguous with the instrumental record. First, we explore how climate variables can be reconstructed using correlations with proxies. Then, we show how atmosphere-only simulations can be constrained using proxies, in contrast to previously used atmosphere-ocean models that diverge from the true climate history. Our reconstruction reveals a last-millennium cooling trend that coincides with energy loss and sea ice growth. Clouds, which affect the emitted and reflected radiation, also change during this period. Our reconstruction reveals that the energy gain after 1980 is unprecedented in the pre-industrial period, providing further evidence that the recent warming is human-induced rather than natural.

Dominik Stiller, University of Washington

Rewiring climate modeling with ML emulators: Insights from Ice Sheet Modeling

Climate models are essential for projecting future climate change, but their high computational cost limits our ability to generate large ensembles, assess uncertainties, and deliver timely, policy-relevant insights. In recent years, emulators—statistical or machine learning (ML) models trained to replicate the outputs of complex simulators—have emerged as powerful tools to address these limitations. Fueled by advances in AI, emulators now offer not only fast approximations of simulator outputs, but also new ways to interrogate, interpret, and even guide Earth system science. In this work, we argue that ML-based emulators are not merely computational accelerators, but a transformative scientific methodology. We illustrate this with ISEFlow, a neural network-based emulator trained on the ISMIP ensemble of ice sheet model simulations. ISEFlow accurately reproduces Antarctic and Greenland ice sheet mass loss trajectories under various forcing scenarios, while also quantifying uncertainty and enabling new forms of sensitivity analysis. Its architecture supports process-based interpretation, offering insight into the drivers of dynamic ice sheet responses under warming. Finally, we offer a forward-looking vision for integrating emulators into the climate modeling workflow—not just to scale simulations, but to broaden the class of tractable scientific and policy questions. We discuss outstanding challenges, including interpretability, generalizability, and scientific trust, and propose research directions that could enable emulators to become foundational components of next-generation climate science.

Peter Van Katwyk, Brown University

Session 3 - Ground-Up Connections

Uncertainty in hourly precipitation estimates and implications for landslide research

In mountainous regions, rainfall triggered landslides (RTLs) pose a serious danger to human lives and infrastructure. Understanding, modeling, and anticipating these natural hazards requires the use of quantitative precipitation data. While many landslide studies rely on precipitation data from rain gauges, spatially-continuous gridded quantitative precipitation estimates (QPEs) are a critical data source in areas with sparse gauge coverage. However, different gridded QPEs tell contrasting stories about the magnitude, timing, and location of precipitation, leading to unaccounted-for uncertainties in studies that use these products. We present a methodology for comparing hourly precipitation intensities from multiple QPEs at the time and location of landslide occurrence, and we demonstrate its utility by analyzing uncertainty among twelve gridded QPE products for hundreds of recent landslides in southern California. At all landslide locations, we find substantial uncertainty among hourly intensities reported by different QPE products. Our results suggest that current levels of disagreement among QPEs are prohibitive to meaningfully constraining a hazard's triggering precipitation. Furthermore, validation against gauge data indicates that no single QPE product outperforms all others across all landslides: the 'best' gridded QPE is not the same for every hazard. This work highlights the ubiquity of uncertainty in gridded hourly precipitation estimates, and we emphasize the importance of accounting for precipitation uncertainty when using QPEs in the context of land surface hazard research.

Ann Sinclair, Northwestern University

Soil Moisture Teleconnections Drive Warming in the Western United States

Time-lagged correlations between climate state variables are an important indicator of predictability in the climate system. When these relationships extend across large distances, they give rise to "teleconnections" that are typically associated with modes of climate variability such as the el Niño Southern Oscillation (ENSO). Observations show that warmer-than-average summertime temperatures in the Western US are associated with drier-than-average springtime soil moisture in the Southwest US, suggesting that land-atmosphere interactions could also modulate teleconnection-like patterns in the climate system. To test this hypothesis, we modify Southwest US soil moisture within a global climate model with no sea surface temperature (SST) variability and find that early spring surface moisture deficits are able to drive summertime heating through their effect on the large-scale atmospheric circulation. These results provide a novel pathway for soil moisture variations to act as a source of atmospheric predictability on seasonal time scales through land-atmosphere coupling.

Lily Zhang, University of Washington

Investigating Soil Moisture Impacts on Precipitation through Statistical Modeling

Soil moisture plays a critical role in regulating land–atmosphere interactions, influencing convective processes and precipitation patterns. While previous studies have identified both positive and negative soil moisture–precipitation feedback, their spatial patterns and dependence on underexplored land cover types remain unclear. In this study, we analyze how morning soil moisture influences afternoon precipitation occurrence using global reanalysis data.We employ grid-level logistic regression to model the probability of precipitation, controlling for antecedent meteorological conditions. To address data imbalance, we compare the imbalanced and balanced classification approaches. Results reveal that negative soil moisture-precipitation feedback dominates, with precipitation more likely over drier soils. Notably, imbalanced models yield stronger feedback magnitudes but fewer significant grids, while balanced models capture broader spatial significance. To evaluate land surface controls, we apply random forest classification. Vegetated areas (e.g., croplands, grasslands) and waterbodies emerge as key drivers of soil moisture feedback sign and significance.Our findings enhance the understanding of land–atmosphere coupling globally, with implications for drought forecasting, hydrological modeling, and climate adaptation. They also highlight the importance of methodological choices (e.g., data balancing) and land surface heterogeneity in climate diagnostics. These diagnostics equip policymakers and resource managers with evidence to prioritize adaptation investments where feedback effects are strongest. Ultimately, this work supports the development of more targeted climate risk reduction strategies worldwide.

Ruixuan Ding, The Ohio State University

Beyond Coral Cover: A Community-Informed Approach to Restoration in the U.S. Virgin Islands

Coral reef ecosystems are among the most vulnerable to climate change, with rising sea surface temperatures, ocean acidification, and increased storm intensity accelerating their degradation worldwide. The decline of coral reefs results in the concurrent loss of critical ecosystem services—such as fisheries production, shoreline protection, and water quality regulation—upon which many coastal and island communities depend. In response, coral restoration has become an increasingly prominent climate adaptation strategy aimed at enhancing reef recovery and ecological resilience. However, most restoration initiatives continue to emphasize ecological indicators—such as coral cover and species diversity—while often overlooking the social and cultural dimensions that are essential to long-term project success. These dimensions include meaningful community engagement, environmental education, and alignment with local values. The absence of these considerations can result in restoration strategies that are ecologically sound but socially misaligned, limiting their relevance, acceptance, and sustainability. This presentation presents findings from interviews and surveys conducted in the U.S. Virgin Islands during the summer of 2024. The data support a co-developed, community-informed definition of restoration success that integrates both ecological and social outcomes. These findings highlight the need to incorporate local knowledge, social equity, and stakeholder priorities into coral restoration planning, thereby enhancing the legitimacy, effectiveness, and durability of climate adaptation efforts in vulnerable coastal regions.

Alexandra Stevenson, East Carolina University

Moisture as Defense: Evaluating the Role of Decayed Deadwood in Forest Fire Resistance and Post-Burn Hydrological Recovery

Deadwood in forest ecosystems is traditionally viewed as a wildfire hazard due to its combustible nature. However, decayed wood's capacity to retain moisture and influence soil water dynamics may provide a natural buffer against fire ignition and aid post-fire recovery—an aspect that remains underexplored. Building on my Master's thesis, which analyzed spatial and temporal soil moisture variability beneath deadwood of different decay stages in a near-natural beech forest, this research extends the investigation by combining high-frequency field moisture monitoring, machine learning models, and laboratory flammability tests. The goal is to quantify how decay stages affect moisture retention and flammability under varying environmental conditions. Understanding these relationships is critical in the context of climate change, where increased drought and rising temperatures elevate wildfire risks globally. By integrating ecohydrological data with fire behavior models, this study aims to provide novel insights for climate-resilient forest management that balances wildfire mitigation with the conservation of ecological functions. The findings will contribute to sustainable forestry practices that enhance biodiversity resilience and ecosystem recovery under shifting climate regimes.

Amrita Mukherjee, TU Dresden

Assessing the influence of ocean alkalinity enhancement (OAE) on the physiology of key coccolithophore species

Ocean Alkalinity Enhancement (OAE) is a proposed ocean-based carbon dioxide removal (CDR) strategy that increases seawater alkalinity to enhance CO_2 uptake. While its chemical potential is well understood, the biological consequences remain uncertain. This study investigates how OAE conditions affect the physiology and carbon cycling of two coccolithophore species, *Gephyrocapsa huxleyi* and *Gephyrocapsa oceanica*—major contributors to marine photosynthesis and calcium carbonate production. In laboratory cultures, we measured growth, carbonic anhydrase activity, and 13C-based particulate inorganic (PIC) and organic carbon (POC) production across elevated alkalinity treatments. G*. huxleyi* maintained stable PIC:POC ratios and enzyme activity, whereas *G. oceanica* showed declines in calcification and growth. These species-specific responses suggest that OAE could shift carbon partitioning between organic and inorganic pools, with implications for net carbon sequestration. Integrating such physiological data into OAE assessments is essential for evaluating biological feedbacks and developing robust Monitoring, Reporting, and Verification (MRV) frameworks.

Chloe Dean, MIT/WHOI

Drywell-Tree Pairs for the Future: Managing Urban Stormwater in a Changing Climate

Climate change and rapid urbanization are intensifying urban flood risks, water scarcity, and extreme heat. In response, green infrastructures offer sustainable strategies to address these challenges. This project investigates a climate- and water-sensitive urban design feature that integrates drywells with trees in residential gardens. Drywells are underground structures, either filled with materials or left empty, that temporarily store stormwater and percolate it into surrounding soils. When paired with tress, the system captures stormwater from roofs, retains it underground, and gradually releases it to support tree growth, reduce flood risk, and cool urban microclimates. The proposed design responds directly to the hydrological disruptions and heat stress caused by increased impervious surfaces and climate change. By enhancing infiltration and sustaining vegetation, it helps mitigate the impacts of more intense rainfall events and prolonged dry periods. A dual-method approach is used in this study, combining field experiments with rainfall-runoff modelling. Field investigations in urban streets and private gardens provide empirical data on the performance of drywell-tree systems at both property and catchment scales. The U.S. Environmental Protection Agency’s Storm Water Management

Model (EPA SWMM) is used to simulate system performance under current and projected climate and urbanization scenarios. The research contributes new, practical knowledge on how small-scale green infrastructure can enhance urban climate resilience. By evaluating system effectiveness under future climate conditions, the study offers scalable, evidence-based solutions for residents and policymakers to address flooding, water scarcity, and urban heat in a changing climate.

Suzanne Pan, Flinders University

Session 5 - Human-Climate Interactions and Hazards

The Hidden Water Beneath Us: Understanding the Two-Way Relationship Between People and Shallow Groundwater on the Eastern Shore of Virginia

Rural coastal communities on the Eastern Shore of Virginia (ESVA) depend almost entirely on groundwater for drinking water, cropland irrigation, and local industries. Yet the same shallow aquifer that sustains the ESVA can also create problems when water levels rise, causing crop waterlogging, flooded roads, and failing septic systems. These challenges are already severe in this flat, low-lying coastal landscape and are expected to intensify with sea-level rise, heavier rainfall, and continued land subsidence. In this study, we examine what controls shallow groundwater levels in a region with almost no topographic relief. By combining ecohydrologic modeling with local knowledge and community inputs, we find that drainage infrastructure and vegetation type, rather than elevation, are the dominant drivers of groundwater dynamics. Comparing the spatial distribution of groundwater levels with census data further reveals that marginalized communities are disproportionately affected, facing recurring septic failures and other groundwater-related damages. Using these findings, this research helps inform the development of effective adaptation strategies for vulnerable coastal regions. like the ESVA.

Hanne Borstlap, University of Virginia

Urbanization Amplifies Cumulative Compound Heat and Air Pollution Events in China

Compound events (CEs) describe combinations of multiple climate drivers and/or hazards that contribute to societal or environmental risks. Many studies on CEs primarily focus on temporally co-occurrent extreme events, overlooking the cumulative impacts of events that are temporally separated but spatially concurrent, which could underestimate the socio-ecological risks. To address this gap, we propose Cumulative Compound Events (CCEs), a framework that captures both temporally co-occurrent and temporally separated yet spatially overlapping extreme events. We applied this framework to compound extreme heat and air pollution events, two well-documented health risk factors, in China from 2000 to 2019. Our results showed that only 10.88% of China’s total land area experienced concurrent events, whereas 75.23% were affected by CCEs, exposing approximately 770 million people. At the national scale, the total number of CCEs days first increased from 2000 to 2013 and then declined from 2013 to 2019, with hotspots in the densely populated regions of East and North China. At the prefecture-level, 85% of cities (306 out of 370) experienced more CCEs days in urban areas than in rural, with urban areas experiencing 13 more CCEs days annually nationwide. This urban–rural disparity varied by city size, with the most significant differences found in largest cities such as Beijing. By introducing a cumulative framework, this study provides a more comprehensive understanding of the spatiotemporal patterns of compound environmental stress. The findings underscore the importance of prioritizing interventions in urban areas, particularly large cities where these compound risks are most severe.

Jiayu Li, Yale University

An Exploration of Underwater Soundscapes in the Charles River

Climate change and human activity affect multiple aspects of the environment, including some that are not directly accessible to human perception. Underwater soundscapes in urban bodies of water are often overlooked as environmental indicators, yet previous research suggests they can reflect ecological conditions and are influenced by nearby human activity. Moreover, urban spaces are complex environments where multiple environmental factors interact with their underwater soundscapes. It is therefore relevant to further investigate this topic in urban rivers. This in-progress research characterizes the underwater soundscapes of the Charles River in Boston, Massachusetts. Short- and long-term recordings have been conducted along the lower, middle, and upper basin of the river. Preliminary results suggest temporal and spatial variations in the underwater soundscape of the river, particularly between the lower and upper basin. Anthropogenic sounds, particularly motorboats and bridge noise, are identified as major contributors to the underwater soundscape, especially in the lower basin, potentially masking other types of sounds. This characterization aims to provide a baseline for additional research that further explores the relationship between underwater sounds and environmental phenomena in the river.

Sebastian Gonzalez Quintero, Northeastern University

Tracking Spatial and Temporal Patterns of Environmental Degradation in Gaza During Armed Conflict Using Machine Learning and Sentinel-2 Imagery

Geospatial analysis offers a powerful framework for quantifying environmental and climatic impacts of the ongoing war in Gaza, revealing the spatial and temporal progression and degradation of natural and built environments. Leveraging high-resolution Sentinel-2 satellite imagery to quantify environmental damage, this study tracks shifts in vegetation and built infrastructure in the Gaza Strip before and throughout the ongoing war. Using 2020 ESA WorldCover land classification data and pre-conflict Sentinel-2 imagery, a Random Forest machine learning approach was applied to generate land cover classifications for both the pre-war period (1 January 2021 to 6 October 2023) and the active conflict period through the initial ceasefire period (7 October 2023 to 15 January 2025). Sentinel-2-derived NDVI and NDBI indices reveal widespread environmental degradation across key agricultural and anthropogenic land covers in Gaza, including croplands, shrublands, and urban areas, illustrating how different landscapes have been distinctly impacted by the conflict. This study identifies that NDVI sharply declined beginning in early 2024, particularly across croplands, shrublands, and urban green spaces, indicating severe impacts on agricultural systems. Concurrent increases in NDBI indicated widespread structural destruction and the likely accumulation of rubble in previously vegetated areas. By disaggregating NDVI trends, this analysis details how distinct land cover classes and regions of Gaza experienced varying spatiotemporal severities of degradation from wartime impacts. These findings underscore the contribution of satellite-based remote sensing approaches to provide comprehensive conflict-environment assessments, particularly in active conflict contexts like Gaza, where in situ monitoring is regularly constrained by military operations and accessibility limitations.

Timothy Hoheneder, University of New Hampshire

Poster Sessions

Session A

Sensing & Quantifying Air Pollution

Engine Exhaust Fouling and Heat Transfer Impacts of Diesel, Renewable Diesel, and Biodiesel Fuels

See Lighting Talks Session 2 for abstract.

Alexander Arnold, University of Michigan, Poster #10

Assessing the Efficacy of 14 Low-Cost Indoor Air Sensors: An Analysis of the Usability, Accuracy, and Precision

See Lightning Talks Session 1 for abstract.

Hannah McKinley, University of Washington, Poster #9

Evaluating PurpleAir Sensors and Low-Cost Household Clean Air Interventions Under Wildfire Smoke and Climate Change: A Multi-year Participatory Science Study in King County, WA

See Lighting Talks Session 1 for abstract.

Katelin Teigen, University of Washington, Poster #11

A social cost perspective on climate and air quality damages from the aviation sector.

See Lighting Talks Session 2 for abstract.

Shreya Sharma, MIT, Poster #8

Coastal Dynamics

Interactions between groundwater extraction and short-term sea level rise in the Chesapeake Bay

See Lighting Talks Session 2 for abstract.

Abigail Bonnington, MIT / WHOI, Poster #3

Lateral Carbon Fluxes in California Wetlands Ecosystems

Blue carbon ecosystems (BCEs), including saltmarshes, mangroves, and seagrasses, are important carbon (C) sinks, sequestering nearly half of the organic C buried in the ocean, despite covering only about 2% of the ocean area. The carbon sequestration capability of these systems is largely attributed to organic matter preserved in sediments. However, there is increasing evidence of previously unquantified C in the form of lateral (or hydrologic) fluxes – carbon that is exported from BCEs to the ocean via surface water. In salt marsh carbon budgets up to 47% of the carbon remains unaccounted for; this "missing" C flux is hypothesized to be in the form of lateral transport. The quantity of these lateral C exports often exceeds burial quantity highlighting the significance of understanding this C pathway.

The study took place at the Elkhorn Slough, the second largest tract of tidal salt marsh in California Surface water samples were collected hourly for 24 hours at 5 sites within the slough (pristine, restored, impounded and freshwater) and analyzed for their inorganic carbon, total alkalinity, organic carbon, and both labile and refractory particulate C. These data were used to constrain the concentration, speciation and quality of C present in surface water and groundwater entering and leaving each site. Understanding the speciation of the C is critical to knowing its fate in terms of potential for long-term sequestration in the ocean. The scope of the study both geographically and temporally makes it one of the most extensive and comprehensive studies of lateral C to date, and the first study to collect data on all C species at a site monitored by eddy covariance towers and where subsurface C dynamics are monitored.

Aliya Khan, University of California, Santa Cruz, Poster #2

Idealized Simulations of Submarine Canyon Mixing

The ocean is the largest carbon sink on the planet, storing nearly one third of all emitted CO_2. The ocean's storage capacity is limited by the amount of CO_2 that lies at its surface— the more CO_2 there already is, the less the ocean can absorb. This limitation is partially mitigated by vertical mixing, a small-scale process that can rapidly move deep ocean waters (containing little CO_2) to the surface, replacing the CO_2-rich waters. My research seeks to understand the small-scale physics associated with this mixing, placing a particular focus on the sizable contributions made by tidal currents interacting with bottom topography. I primarily investigate these processes by way of Large-Eddy Simulations (LES), a type of high-resolution model that can directly resolve meter-scale mixing. In this work, I present results from idealized LES studies of a tidally-dominated submarine canyon. We illustrate that submarine canyon mixing displays notable dynamical differences when compared to other topographic features (e.g., seamounts and ridges). Namely, there appears to be an appreciable set of conditions under which mixing is decreased in the presence of submarine canyons, serving as an interesting contrast to the abundance of flow-topography interaction studies that generally showcase elevated mixing. We discuss the sensitivity of the mixing magnitude to the tidal excursion length scale and overlying stratification. These results suggest that the characteristics of vertical mixing in submarine canyons are distinct from other topographic features, requiring further study to understand their relative importance in maintaining the oceanic carbon cycle.

Isaiah Cuadras, UCLA, Poster #7

Spatial and seasonal trends in greenhouse gases across beaver habitat in southern New England

Beavers create unique and varied wetland ecosystems, composed of sequential ponds, channels, and flooded area, that serve as habitat for birds and many aquatic species, as well as play a role in the storage and emission of methane and carbon dioxide. Wetlands worldwide are a significant natural source of methane, and beaver-created wetlands in particular emit methane in amounts observed to be higher than wetlands lacking beavers, though the contributions of each component of these complex habitats to greenhouse gas emissions is not well resolved. In summer of 2024, we selected thirty different beaver-created ecosystems across southern New England and measured concentrations of dissolved gases and water quality across distinct habitats at each site, including ponds formed by dams and streams above and below ponds. Water sampled from ponds had significantly higher concentrations of dissolved methane and carbon dioxide than upstream or downstream locations, indicating beaver ponds in particular may be a potent source for natural emissions of greenhouse gases. Following the summer of 2025, we will have completed a twice-monthly time series on a subset of five of the beaver-created ecosystems included in the 2024 survey, in order to investigate temporal trends in greenhouse gas concentrations and emissions.

Lev Becker, University of Connecticut, Poster #6

Survival of coastal marshes under rising sea level - a study of US Atlantic Coast

Coastal marshes are dynamic ecosystems that provide critical ecological services, yet their persistence depends on their ability to maintain elevation relative to sea-level rise. This study assessed the vertical resilience of tidal marshes along the eastern United States by integrating long-term Surface Elevation Table (SET) and Marker Horizon (MH) data. The research had compiled and standardized monitoring records from 564 stations across 23 sites along the US Atlantic Coast to analyze elevation dynamics based on surface elevation change (SEC), vertical accretion (VA), and shallow subsidence (SS = VA − SEC). A total of 391 stations met inclusion criteria, requiring both SEC and VA records spanning at least three years. For each site, linear regression was used to estimate SEC and VA rates, and stations were classified into elevation deficit (SEC < VA), equilibrium (SEC ≈ VA), or elevation surplus (SEC > VA) categories. Results indicate that 62.7% of stations exhibit elevation loss primarily due to subsurface subsidence, while only 7.9% maintain vertical balance and 29.4% experience net elevation gain. Regional clustering of elevation deficits was observed in New Jersey, Georgia, and southern Florida, whereas more resilient patterns were evident in parts of Massachusetts and the U.S. Virgin Islands. These findings reveal that shallow subsurface processes are a widespread constraint on marsh sustainability and provide critical insights to guide future monitoring, modeling, and conservation strategies for vulnerable coastal ecosystems.

Md Asif Hasan, Tulane University, Poster #5

Predicting nutrient concentrations in the Chesapeake Bay watershed using long-term turbidity records

Nutrient loading is a critical area of study for the Chesapeake Bay, especially as its watershed continues to experience significant urbanization. Urbanization leads to increased runoff, which carries various pollutants, including nutrients, into the bay. Excessive nutrient loading can result in eutrophication, causing harmful algal blooms and hypoxic conditions that threaten aquatic life and water quality. This can result in reduced catches, impacting commercial and recreational fisheries and leading to economic losses. Therefore, understanding and predicting nutrient loads is essential for effective management and mitigation strategies. This study aims to utilize turbidity measurements in the main tributaries to the Chesapeake Bay as a predictor of nutrient loads. Nutrients such as nitrogen and phosphorus are associated with turbidity both in particulate and absorbed dissolved forms. Turbidity might be a useful proxy for estimating total nitrogen (TN)) and total phosphorus (TP) because turbidity measurements can be automated, affording high frequency data and potentially better predictions of time-varying nutrient loads. Data from the USGS River Input Monitoring stations were analyzed over a 30-year period, focusing on turbidity levels and concentrations of TN and TP. Approximately 78% of the watershed's area drains through one of these stations. The long-term dataset provides a comprehensive view of trends and variations in nutrient loading and turbidity. Statistical analyses were conducted to examine the relationship between turbidity and nutrient concentrations, with the goal of developing predictive models. Preliminary results show a strong correlation between turbidity and nutrient concentrations in several major tributaries. By using turbidity as a predictor, resource managers can better anticipate periods of high nutrient loading and implement timely interventions to reduce pollution. This approach can enhance the ability to protect and restore the health of the Chesapeake Bay, ensuring the sustainability of its ecosystems and the services they provide.

Savannah Atchley, University of Virginia, Poster #4

Atmospheric Dynamics

A Case Study to Examine how Thermodynamics Affects the Life Cycle of Arctic Low-level, Optically Thin Clouds During the ARCSIX Field Campaign

Clouds impact the surface radiation budget by attenuating a fraction of the incoming solar radiation and interacting with outgoing longwave radiation. In the Arctic, there are large uncertainties in the life cycle of all cloud types, but especially the low-level, optically thin clouds, since these clouds are difficult to detect by remote sensing over sea ice and due to the scarcity of upper-air and surface observations. Due to their significant impact on sea ice melt, a thorough understanding of the formation, structure, and evolution of low-level, thin clouds is needed.This work studies the thermodynamic characteristics of the lifecycles of Arctic low-level clouds over land, open water, and sea ice by examining changes in thermodynamic structure using observations collected in the Arctic Radiation-Cloud-Aerosol-Surface Interaction Experiment (ARCSIX) field campaign. ARCSIX was devoted to studying how Arctic clouds affect the surface radiation budget and their impact on sea-ice melt. The campaign consisted of two deployment periods: Spring 2024 (pre sea ice melt onset) and Summer 2024 (peak sea ice melt). On June 6, 2014, we observed these low, optically thin clouds. We evaluate the properties of these clouds by using a combination of ground-based and airborne measurements. We compare vertical thermodynamic profiles from G-III (high-altitude aircraft) dropsondes, regional radiosondes, and P-3 (low-to-mid altitude aircraft) meteorological measurements with European Center for Medium-Range Weather Forecasts Edition 5 (ERA-5) reanalysis to assess how accurately ERA-5 represents the associated thermodynamics (i.e., relative humidity and liquid water content). In particular, the dropsondes were deployed in short intervals, in which the evolution of the thermodynamic profiles provides insight into the cloud life cycles. We find that ERA-5 oversaturates the 3-D profile when compared to the dropsondes with larger dewpoints of 1-3 K. We also find that reanalysis tends to underestimate the low-level inversion strength, which is a key factor in the development of these clouds. After comparing ARCSIX observations with ERA-5 reanalysis, we use High Altitude Lidar Observatory (HALO)-derived cloud property retrievals to determine the cloud phase and presence of liquid water in low-level clouds. By properly accounting for the moisture variables and inversion strength, we can improve climate models and more accurately project the Arctic sea ice melt rate.

Bradley Lamkin, University of Oklahoma, Poster #14

Evolution of Large-Scale Atmospheric and Land Surface Patterns Related to New England Riverine Peak Flow Events in a Future Climate

Riverine flooding in the New England region of the United States of America is devastating, unpredictable—lacking ties to common climate indices—and arises from multiple processes during any season. Here the connection between large-scale atmospheric patterns and surface conditions prior to and during the occurrence of riverine peak flow events in the heavily-populated, flood-vulnerable region of New England is explored. Understanding the mechanisms governing peak-flows improves the near- and long-term forecasts of hydroclimatic extremes as well as provides supplemental process-level knowledge for regional water resource planning and emergency response. Through the application of self-organizing maps (SOMs), several distinct meteorological and hydrological patterns associated with river discharge events in New England are identified. These patterns are then analyzed in the context of the Community Earth System Model (CESM) V2 Large Ensemble (LENS2) to quantify how New England flood-producing atmospheric and land surface dynamics evolve under future climate projection scenarios.

Lindsay Lawrence, Northeastern University, Poster #15

Chemical Drivers of Summertime Ozone Production in Salt Lake City

In recent years, regular summertime surface ozone (O3) exceedances of the National Ambient Air Quality Standards have been threatening respiratory and ecosystem health around Salt Lake City and the Northern Wasatch Front (NWF). Despite legislation to control emissions of ozone precursors, measurements across the NWF have not shown effective decreases in surface O3 and even show increases in some areas. In support of its new State Implementation Plan to understand the problem and identify solutions, the Utah Division of Air Quality performed regional simulations for ozone with the Comprehensive Air Quality Model and Carbon Bond chemical mechanism. They found that compared with observations, their model predictions were underestimating ozone concentrations by approximately 12%. We hypothesize that a combination of poor representations of the underlying chemistry in their model and poor emissions estimates could be responsible for the discrepancies. To test if differences in the underlying chemistry are significantly affecting prediction of O3 sensitivity to reductions in emissions, we compare modeled ozone by running box model simulations using the Framework for 0-D Atmospheric Modeling (F0AM) Box Model and analyze how an updated chemical mechanism may bring modeled ozone estimates closer to observations. By reducing uncertainties in the chemistry of ozone formation, we hope to improve tools for determining effective strategies that will lower summertime ozone across the NWF.

Vanessa Sun, University of Utah, Poster #16

Atmospheric Rivers of Varying Intensity in the Western United States

Atmospheric rivers (ARs) are extreme precipitation events that account for up to 50% of all annual precipitation in the Western U.S. Under a warming climate, the characteristics of ARs over the west coast of the U.S. are expected to change. Moreover, understanding the specific changes to ARs is important because shifts in AR frequency have implications for water resource management and drought mitigation, whereas shifts in AR intensity have implications for hazard management and emergency response to resulting floods and landslides. On average, Western U.S. ARs are expected to increase in both intensity and frequency with climate change. However, recent work on a small set of regional climate models has shown that changes to AR frequency depend on their intensity. In this study, we apply the same methodology to a large set of global climate models to investigate whether or not this trend holds true. We find that extreme ARs increase in frequency, whereas weak and moderate ARs decrease in frequency by as much as 10%. This finding is consistent with previous work and suggests that the entire spectrum of AR intensity is shifting to become stronger. Furthermore, we explain this trend by examining ARs across the latitude band and dividing changes into their physical components. Overall, the changes in Western U.S. ARs can be explained by changes to the atmospheric moisture content and jet stream position observed in the models used for analysis.

Vlad Munteanu, Boston University, Poster #12

Subseasonal-to-Seasonal (S2S) Prediction Skill of Rainfall Diurnal Cycle over the Maritime Continent and Its MJO Dependence

See Lightning Talks Session 3 for abstract.

(Wayne) Yuan-Huai Tsai, School of Meteorology, University of Oklahoma, Poster #13

Ice Dynamics

Iceberg Melt Rates Around the Greenland Ice Sheet: Regional Patterns and Oceanic Controls

See Lightning Talks Session 3 for abstract.

Aman KC, Boise State University, Poster #19

Sensitivity of Glacier Mass Loss Projections to Climate Downscaling Methods in Western Canada

See Lightning Talks Session 3 for abstract.

Christina Draeger, University of British Columbia, Poster #17

Meteorological and Climate Controls on Seasonal Snowpack Variability

Wintertime accumulation of mountain snow and its delayed melt-off in spring and summer sustains vital ecosystems and annually replenishes glaciers and water reserves around the world. An estimated 22% of the world's population relies on water from mountain snowpacks, glaciers, and reservoirs. Mountainous regions have been shown to particularly sensitive to climate warming, and thus understanding the interactions between meteorological variability and seasonal snow accumulation is essential for grasping how this critical resource might change in the future. This work combines simple quasi-analytic models of seasonal snowpack dynamics with in-situ observations to better understand how weather variability is integrated into inter- and intra-seasonal snowpack variability. First, we will demonstrate the extent to which simple models can capture the complex processes governing snow accumulation and ablation. These models will then be used to assess sensitivity of seasonal snowpacks to climate change and determine the conditions under which snowpacks transition from seasonal to ephemeral. The potential for competing effects on snowpack accumulation from both a lengthening melt season and increasing precipitation intensity with warming will also be explored.

Paul Nicknish, MIT, Poster #18

Fisheries & Wildlife Management

Evaluating Management of the Massachusetts Whelk Fishery in a Changing Climate

Recent concerns about sustainability of the fishery for channeled whelk (Busycotypus canaliculatus) in Massachusetts has led to investigation into management measures for this commercially valuable fishery. We are collaborating with whelk fishermen, state fishery managers and other biologists to study how a changing climate may affect this important species and evaluating the performance of alternative management strategies. Following a review of comprehensive reports on the whelk fishery, research showed that as ocean temperatures continue to rise, reproductive patterns for both male and female whelk may be increasingly affected. Male whelk can delay the early stages of gametogenesis leading to lower copulation events. Varying water temperature can lead to fluctuating incubation time with increased water temperatures resulting in reduced egg viability. The intersection between fishing pressure on channeled whelk and the changing climate is a critical part to predicting future stock. Evaluating reproductive success and juvenile recruitment under changing ocean conditions is essential for continued monitoring and future management of a sustainable and productive channeled whelk fishery.

Alexis Baumgartner, University of Massachusetts Dartmouth, Poster #20

Using process error to determine climate drivers of changing fishery production

As ocean temperatures have warmed over the last four decades, shifts in the distribution and productivity of marine resources, including vital fishery stocks, have become increasingly evident. Given the profound economic and cultural importance of fisheries in the Northeast U.S, understanding how fish population dynamics will alter in the face of climate change is pivotal in creating sustainable long-term fisheries management strategies. However, current stock assessments that model existing and future fish populations rarely include the effects of changing environmental conditions. One approach to mitigate this is to include environmental drivers to inform ‘process errors’ (i.e., random annual deviations from general expectations) in population dynamics using state-space models. To better understand the effectiveness of this method, we are reviewing current practices in state- space models globally, specifically evaluating which aspects of productivity are considered to have process error. Using this information, we will define which model practices are most effective and identify regional trends in process error that may be influenced by climate-related factors. Overall, this research is expected to improve the accuracy of stock assessments by promoting the consideration of climate change effects into these models. This in turn will contribute to more effective projections of future biomass and harvest levels and improve communication with stakeholders, allowing for more climate-informed fisheries management in the Northeast U.S.

Elizabeth Roros, University of Massachusetts Dartmouth, Poster #23

Forecasting Tuna Fishing Grounds Over the Southeastern Indian Ocean in a Changing Climate: A Machine Learning Approach Integrating Ocean Dynamics and Indo-Pacific Climate Variabilities

Tuna species such as skipjack, yellowfin, bigeye, and albacore are economically and ecologically vital across the Indo-Pacific, yet increasingly threatened by overfishing and climate-driven ocean changes. In the Southeastern Tropical Indian Ocean, their distribution is influenced by dynamic oceanographic features—sea surface temperature (SST), thermal fronts, chlorophyll-a, ocean currents, and wind-driven upwelling—that respond to large-scale climate modes like the El Niño–Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD). This study develops a machine learning framework to forecast tuna fishing grounds using 13 years of AIS-derived fishing effort data from Global Fishing Watch and integrated satellite and reanalysis inputs from the E.U. Copernicus Marine Service. Key predictors include SST, chlorophyll-a, SST gradient, sea surface height, surface winds, currents, and Ekman pumping velocity, with ENSO and IOD indices incorporated to capture their lagged climatic effects. The model shows strong predictive skill in mapping tuna habitat suitability, highlighting the coupled roles of mesoscale ocean dynamics and interannual climate variability. Forecast outputs are designed to feed into SEMAR (Sistem Embaran Maritim, https://semar-prototype.brin.go.id), a decision-support platform by BRIN Indonesia that assists fishers and maritime stakeholders in developing strategies for sustainable fisheries, marine navigation, and climate resilience. By integrating ocean data, climate diagnostics, and machine learning, this work advances adaptive, science-based management of tuna resources in a warming and increasingly variable ocean.

Rahaden Hatmaja, University of Maryland, Poster #21

Hydrodynamic Regimes and Contaminant Exposure Risks in a Macrotidal Estuary: Implications for Anadromous Fish under a Changing Climate

Climate change is reshaping estuarine systems through altered freshwater inputs, sea level rise, and increasingly variable storm-driven flows. These changes affect how contaminants move through aquatic environments and influence exposure risk to fish and other wildlife. My research investigates how climate-sensitive hydrodynamic regimes control the transport of contaminated suspended particulate matter in a macrotidal estuary. Mercury, a potent neurotoxin, binds to fine sediments and becomes bioavailable as methylmercury in low-oxygen conditions. Fish are exposed through gill contact and ingestion of contaminated particles, leading to bioaccumulation and impaired growth, reproduction, and behavior. By integrating field measurements with hydrodynamic modeling and an agent-based model co-produced with the Penobscot Nation and local community partners, I identify the timing, location, and mechanisms of peak exposure during critical migratory periods.

In the Penobscot River Estuary in Maine, these findings are directly relevant to ongoing mercury remediation and fisheries restoration efforts. Many fish remain too contaminated for human consumption, including migratory species such as river herring and sturgeon that hold deep cultural, ecological, and subsistence significance. These species are especially vulnerable because their movement patterns and habitat use expose them to spatially and temporally variable contamination. The identification of exposure mechanisms allows managers to target mitigation strategies that account for both physical processes and fish behavior. By linking climate-driven changes in estuarine hydrodynamics to contaminant uptake and fish behavior, this research advances our ability to forecast risk, design adaptive restoration strategies, and protect culturally and ecologically significant fish populations under future climate scenarios.

Vanessa Quintana, University of Maine, Poster #22

Risk Assessment

Geological and Climate Risk Assessment of Bhola Island, Bangladesh

Incorporating sedimentological and geomorphological analyses to assess erosion and storm surge-induced flood risks, this study evaluates coastal vulnerability in Bhola Island in Bangladesh. Prominent features of the region, which include tidal flats, deltaic plains, and erosional zones, were studied in relation to sediment texture, compaction, and distribution. The island's geology consists of unconsolidated deltaic deposits of the Holocene age, including alternating units of fluvial sands, tidal silts, and estuarine clays. Sediment cores and stratigraphy reveal that the eastern margin is shallow and dominated by sands, with permeable, poorly consolidated alluvial sands underneath that enhance sheet erosion caused by waves. By contrast, the western side is composed of thicker cohesive clay-silt sequences derived from tidal sedimentation, which aim to stabilize the bank but are underlain by groundwater and susceptible to subsidence caused by the compaction of organic-rich, water-logged formations. To categorize risk zones, the study uses a GIS-based Coastal Vulnerability Index (CVI), which combines elevation, hydrodynamic forcing, sediment permeability, and geomorphic resilience. The findings show that 25% of the coastline is still moderately resilient in the west, while 35% of the coastline is vulnerable to "high" to "very high" levels, with most of this vulnerability occurring in the eastern and central regions. The findings indicated that vulnerability varied significantly in different areas, with the eastern section experiencing high and rapid erosion with loose, sandy sediment and intense wave action. On the other hand, western sections with cohesive clayey sediments and remnants of mangroves showed some stability.

Rajib K Saha, Washington State University, Poster #25

Session B

Public Policy

From interviews to models: Engaging stakeholders to build socially robust scientific models

While scientific models excel at generating high-quality data and simulations for research, they struggle to gain public trust and effectively inform policy decisions. They have been criticized for failing to reach their intended audience or produce socially relevant research. To make models more meaningful to society, researchers have explored a variety of methods to engage stakeholders in the modeling process from informing model inputs, to commenting on outputs, to actively participating in all phases of modeling. Effective stakeholder engagement faces practical constraints: limited awareness of modeling efforts, varying levels of interest in participation, and the need for strategic selection of appropriate contributors. In this research, we present a method of modeling with expert stakeholders to both cultivate an audience and attain expert input for a statistical model that identifies how agricultural tile drainage impacts streamflow and stream temperature in the Upper Mississippi River Basin, USA. Prior to model building, semi-structured interviews (n=26) were conducted with experts including academic and university cooperative extension specialists, government researchers, NGO researchers, and industry representatives. The purpose of these interviews was to solicit stakeholders' tile-specific interests, suggested model variables, ideas on key user groups, and advice for communicating the model. Interviews also served as a platform for introducing a new model to the appropriate audiences. Results show that expert stakeholder input enhanced model accuracy, increased relevance, and improved practical utility while simultaneously building an audience invested in these statistical agricultural tile models. This framework offers an adaptable approach for others developing stakeholder-informed scientific models to improve model salience and applicability.

Bryn Anderson, Northeastern University, Poster #4

Balancing biodiversity and climate targets in local land-use decisions

See Lightning Talks Session 1 for abstract.

Emily Cole, University of Washington, Poster #5

Taking STRESS Beyond the Lab: Comparing Academic and Community Conceptions of Climate Risk

See Lightning Talks Session 1 for abstract.

Hannah Rajput, MIT, Poster #6

Climate Risk and Financial Stability: Analysing Transmission through Renewable Energy Markets

Climate change is no longer just an environmental issue. It is a growing source of financial instability. This research investigates how climate risks, particularly those affecting renewable energy markets, can transmit into the broader financial system. While green energy sectors are often seen as part of the solution, we argue they can also act as amplifiers of systemic risk under uncertainty.

The study focuses on two types of climate-related risk: physical shocks, such as extreme weather, and transition risks, such as regulatory changes or policy delays. These risks impact investor expectations and renewable asset prices, triggering volatility that spreads through credit markets and financial stress indicators. We use a novel three-layered dataset that combines climate risk indices, renewable asset volatility, and financial system fragility metrics.

Methodologically, this research integrates advanced techniques including variational mode decomposition with long short-term memory (VMD LSTM), dynamic correlation models (DCC GARCH), and visibility graph analysis. These tools help uncover how climate-driven volatility moves through the system over time. The result is a clearer picture of how and when financial instability emerges from climate uncertainty.

Our contribution is twofold. First, we offer a new way to quantify the real-time transmission of climate risk via renewable markets. Second, we provide early warning tools for policymakers and investors aiming to maintain macro-financial stability in a climate-stressed world.

By revealing this climate finance feedback loop, the project supports the broader goal of building more adaptive and resilient financial systems during the green transition.

Junxiang Du, Liverpool John Moores University, Poster #7

Equipping Climate Scientists for Policy Impact Through Congressional Engagement

Communicating the local impacts of climate change to policymakers can shape legislative priorities, but effective engagement requires more than strong communication skills – it demands an understanding of how Congress works. This spring, I co-organized Congressional Visit Days, an annual hands-on policy training hosted by the MIT Science Policy Initiative. While this program has run for nearly a decade, my co-chair and I restructured its focus. Instead of broadly advocating for science funding, we trained students and postdocs to advocate for specific policies connected to their own research, on topics including climate science, energy, and decarbonization.

Over six weeks leading up to two intensive days on Capitol Hill, we guided 24 participants through a structured curriculum. This included understanding the congressional budget process, identifying which offices shape policy relevant to their work, crafting an effective “ask,” writing a policy memo, and navigating the dos and don’ts of engaging with policymakers. Participants left with a deeper understanding of how to translate their science into policy-relevant messages and many felt empowered to build future relationships with legislators.

Throughout the planning process, I helped develop a practical roadmap for graduate students to explore policy and gain real-world experience. Some key lessons were: identify the right offices and staffers to meet with, show up with a sincere desire to help, embrace cross-party dialogue, and recognize that congressional offices truly want to hear from scientists. Students are uniquely respected as impartial advocates, highlighting the need to build science policy literacy and skills among climate-focused graduate students.

Mallory Kastner, MIT, Poster #2

Laboratory pH Data Quality Assessment Methods for an Ocean Alkalinity Enhancement Field Trial

The ocean carbonate system both exerts control over and reflects changes caused by a variety of crucial biogeochemical processes, with particular climate relevance in its role as a buffer to increasing atmospheric carbon dioxide (CO_2). Measuring a critical component of this system, pH, serves as a key tool for monitoring these processes in the context of climate change and emerging climate solutions, such as ocean alkalinity enhancement (OAE), a marine carbon dioxide removal (mCDR) strategy. Autonomous underwater gliders facilitate pH measurement with high spatial and temporal resolution, making them especially important in characterizing pH changes at relevant scales in time and space. In order to draw any meaningful conclusions from glider pH measurements, the quality of the data produced must be well constrained. Here, I present laboratory methodologies used to assess the accuracy and uncertainty of pH measurements made by Deep-Sea Durafets adapted by MBARI for autonomous platforms and ship underway systems. These methods were implemented in support of the LOC-NESS (Locking Ocean Carbon in the Northeast Shelf and Slope) OAE field trial, which took place in August 2025 in the Wilkinson Basin of the Gulf of Maine. I will compare two laboratory methods conducted before and after the field trial: (1) continuous measurement in natural seawater with regular discrete sampling for spectrophotometric pH, and (2) measurement using tris(hydroxymethyl)aminomethane (Tris) buffer in artificial seawater. Results from these experiments elucidate absolute sensor accuracy and uncertainty as well as offsets in measurements between sensors, which will inform further in-situ intercalibrations on data collected during deployment. Although these methods were applied in the context of a single OAE field trial, they provide a potential framework for evaluating pH sensor performance in future mCDR efforts.

Amanda Pinson, MIT/WHOI, Poster #21

Toward Ultra-Compact Ocean Sensors: Wireless Power Transfer for Multiparameter Ocean Microchips

The ocean plays an immense role in global biogeochemical cycles that help to regulate the climate, produce oxygen, and much more. Understanding how the ocean engages in these processes can inform scientists of the past, present, and future states of the global climate. This understanding is also important for techniques like marine carbon dioxide removal which seek to harness the ocean's regulating capabilities to reduce the negative impacts of carbon emissions. Studying these processes requires continuous and sustained monitoring of numerous ocean properties. However, current ocean measurement systems require individual sensors and casings for each parameter, leading to bulky, expensive, and power-hungry integrations prone to leaks, electrical shorts and other failures. This project pioneers a new technology to overcome these challenges by exploiting microfabrication techniques to create ocean sensors directly on encapsulated chips. A microchip has been fabricated with temperature, pH, conductivity, fluorescence, and turbidity sensors in just 1 cm^2 area, and the first version of these microchips has withstood up to 200 bars of pressure. A wireless power and communication system has also been designed and tested with the microchip, proving that ocean wireless power antennas can be reduced in size by more than a factor of 10. This new underwater technology will revolutionize ocean monitoring, significantly reducing the size and cost of future ocean sensors.

Caitlyn Sutherland, MIT/WHOI, Poster #22

Where Water Sinks and Models Diverge: North Atlantic circulation in high-resolution ocean models

See Lightning Talks Session 3 for abstract.

Taydra Low, University of Wisconsin Madison, Poster #20

Living Earth's Response to Climate Change

The Impact of Vegetation Changes on Climate Extremes: A Modeling Investigation of Phenological Shifts

Vegetation is undergoing widespread changes across the globe, with shifts in phenology, structure, and function affecting growing season length, vegetation greenness, and plant water use efficiency. These changes, in turn, have far-reaching consequences for climate extremes by altering surface energy fluxes, air temperature, drought patterns, and wildfire risk. Both direct and indirect effects of rising atmospheric carbon dioxide (CO_2) drive these vegetation shifts—through CO_2 fertilization and changes in stomatal conductance—as well as the broader climatic effects of radiative forcing. This work investigates the complex role of vegetation in shaping high-impact weather and climate extremes, with the goal of constraining vegetation-driven climate uncertainty in models. Using climate model experiments with the Community Earth System Model (CESM), we analyze the effects of changing plant phenology on key climate variables, including temperature, precipitation, soil moisture, and evapotranspiration along with the heatwaves and droughts. The findings quantify the influence of earlier vegetation phenology on projected climate, particularly how changes in water fluxes from vegetation affect both local and remote precipitation patterns, including drought and heavy rain, heat waves, and atmospheric moisture content. Leveraging the moisture tracking capabilities of CESM1.2, this study aims to trace the sources of precipitation and atmospheric moisture, including contributions from ground evaporation, canopy evaporation, and plant transpiration. This approach helps uncover the mechanistic pathways through which earlier phenology impacts hydrological processes and the broader climate system, providing new insights into the interconnected dynamics of vegetation and water cycles in a changing climate.

Ali Fallah, University of Massachusetts Lowell, Poster #17

Mapping and Modeling Characteristics of Rocky Habitat and Habitat Suitability for Rock-Dwelling Wildlife in the Cascade Mountains

Broken rock (e.g., talus) habitats play a key role in the survival of many species in the Cascade Mountains in western North America, yet high resolution maps of these habitats over broad scales are lacking. The crevices between rocks in these habitats provide protection from both predators and extreme temperatures for alpine small animals. This is critical to rock-dwelling species that are vulnerable to high temperatures and must also survive cold, snowy winters either by hibernation or by staying active and consuming cached food. Climate change has increased the chance of extreme climate events, so characterizing important features of rocky habitats and mapping them across landscapes is increasingly critical. Therefore, our objectives are to 1) use close proximity and satellite remote sensing to create maps of rocky habitat across the Cascade Mountains, and 2) use these maps coupled with animal surveys to determine characteristics of these habitats that are selected by vulnerable wildlife such as Hoary Marmots (Marmota caligata), American Pikas (Ochotona princeps), and Larch Mountain Salamanders (Plethodon larselli). Our research efforts will lead to models and maps that will predict habitat suitability in the Cascade Mountains of Washington. These high-resolution maps and models of habitat use can then be used by wildlife and land managers to identify potential habitat and distribution of rock-dwelling wildlife, and how management activities (including visitor experience and infrastructure projects) and climate change might affect species distribution.

Allison Stift, Washington State University, Poster #16

Evaluating the Predictive Accuracy of Climate-based Species Distribution Models

Climate-based species distribution models (SDMs) are commonly used in conservation planning to forecast range shifts, yet their reliability has been insufficiently tested. Assessing their predictive accuracy is critical for understanding their value in guiding adaptive management under climate change. We compared the projected range shifts from SDMs with the observed population trends of North American grassland bird species with low and high climate vulnerability. Using annual point counts from the Breeding Bird Survey, we applied time-series models to estimate climate-induced population trends while accounting for human-related factors such as land cover change. These site-specific trends were then compared with predicted range contractions and expansions under two climate scenarios (RCP4.5 and RCP8.5).

Lilac Hong, University of Washington, Poster #18

Dynamics of oxygen in the Deep North Pacific Ocean over the past 25,000 years

As waters move along the bottom of the ocean from the Southern Ocean to the North Pacific, their dissolved carbon concentrations increase. This makes the deep North Pacific one of the world's largest carbon repositories. As these waters move northward, their oxygen concentrations become depleted as a function of both surface productivity and water aging. Previous work has suggested that the oxygen concentrations of the deep oceans were lower during the Last Glacial Maximum (LGM), as a result of slowed global overturning circulation rate, and may have been lowered in the deep equatorial Pacific Ocean by up to 100 mmol/kg. This would suggest substantially enhanced carbon storage in the Pacific Ocean during the LGM. However, quantitative measures of oxygen dynamics in the high latitude North Pacific have not yet been made, which limits our understanding of how this large carbon repository responded to rapid climate changes.

Here, we present high resolution measurements from core W8709A-8TC/PC (3111 m, 42°10'N, 127°35'W), currently bathed in waters with a bottom water oxygen concentration of ~107 mmol/kg. As oxygenation proxies function well <100 mmol/kg oxygen, lowered past ocean oxygen content should be remarkable in this record. We have generated a multi-proxy record of oxygen concentration, using both qualitative and quantitative proxies, and productivity variations. This multi-proxy approach allows for the contribution of productivity changes to bottom water oxygen variations be independently constrained, revealing the circulation-side signal. Comparison between conditions at the LGM and the modern show limited variations in oxygen concentration, with a depletion centered around a period of northern hemisphere warming (Bølling-Allerød, 14,700 – 12,900 years ago) while productivity increased throughout the deglaciation. This record suggests that the proposed change of 100 mmol/kg for the full basin of the deep Pacific may be an overestimation, and that glacial reductions in Pacific Ocean productivity may be more pronounced than previously considered.

Cassandra Bartels, MIT/WHOI, Poster #8

A 375,000-year Biomarker and Hydrogen Isotope Record of Hydroclimate Variability in Tropical North America from Sediments of Lake Chalco, Mexico

The Basin of Mexico, encompassing Lake Chalco and Mexico City, is experiencing increasing water stress due to prolonged drought and warming. As climate projections for central Mexico predict intensified droughts and reduced precipitation, paleoclimate reconstructions are essential for contextualizing future scenarios. Lake Chalco, with a sediment archive spanning 350,000 years, one of the longest in the Americas, offers a great opportunity to investigate long-term climate variability in a region influenced by the Intertropical Convergence Zone (ITCZ), North American Monsoon, and ocean-atmosphere interactions. This study reconstructs hydroclimate and temperature variability in the Basin of Mexico using molecular biomarkers preserved in Lake Chalco sediments. Recently obtained low-resolution n-alkane and hydrogen isotope (δD) data from leaf waxes provide a baseline for reconstructing precipitation and evaporation patterns. Building on this, compound-specific δD and carbon isotope ($\delta^{13}C$) analyses of leaf waxes will document changes in precipitation amount and vegetation regimes across glacial-interglacial timescales. To constrain paleotemperature, lipid biomarkers produced by lake-dwelling microbes called branched glycerol dialkyl glycerol tetraethers (brGDGTs) will be analyzed, offering a microbial lipid-based record sensitive to temperature and pH. Together, these data will clarify the magnitude and pacing of tropical climate shifts and the sensitivity of central Mexico to both tropical and extratropical climate forcing. This work provides critical insights into the hydroclimate history of a water-stressed region and will inform both paleoclimate understanding and future water resource planning in subtropical North America.

Emeka Elmer Emordi, University of Pittsburgh, Poster #14

Noble Gases in Fossil Groundwater as a Paleoclimate Archive: A Case Study from the Otway Basin, Southeastern Australia

Fossil groundwater (> 12 ka) is widespread within the upper kilometer of the Earth's crust and sustains irrigation, drinking water, and industrial use worldwide. Noble gases are powerful tracers for exploring paleo-hydroclimate due to their chemical and biological inertness. Beyond the conventional application of dissolved noble gases (He, Ne, Ar, Kr, Xe) in constraining surface temperatures at the time of recharge, recent analytical advances in heavy stable noble gas (Ar, Kr, Xe) isotope measurements now allow quantitative reconstruction of paleo-water table depths (WTD) due to depth dependent fractionation in the unsaturated zone.

Here we apply these noble gas tracers, together with radiocarbon and stable water isotope (δ18O, δ2H) analyses, to reconstruct recharge conditions in the unconfined aquifer system of the Otway Basin in southeastern Australia. Groundwater recharged between the Last Glacial Maximum (LGM) and the Holocene records a consistent, shallow paleo-WTD of 5.0 ± 1.9 m, with no clear temporal evolution despite evidence from other proxies for large-scale hydroclimatic change during this interval. In contrast, reconstructed noble gas temperatures (NGTs) show a distinct temporal structure: wells with apparent 14C ages between 27.5 and 41.6 ka yield reproducibly cool NGTs (9.8 ± 0.2°C), interpreted as a best estimate of LGM mean annual surface temperature. These values agree closely with an independent, unpublished dataset from the basin. Relative to modern mean annual surface temperature (ERA5-Land Reanalysis: 16.0 ± 0.6°C), this implies an overall LGM-to-Holocene warming of 6.2 ± 0.6°C across southeastern Australia. This work demonstrates the value of noble gas tracers in fossil groundwater for reconstructing terrestrial paleoclimate and provides new insight into the hydroclimatic controls on societally relevant groundwater systems in southeastern Australia.

Grace Brown, MIT/WHOI, Poster #12

Changes in deep water circulation dynamics in the South Atlantic Ocean during Marine Isotope Stage 11

Persistent deep-water formation in the North Atlantic and Southern Ocean is believed to ventilate the global deep ocean during late Pleistocene interglacial periods. This view was challenged by evidence of deep ocean deoxygenation at Ocean Drilling Program (ODP) Site 1094 in the Antarctic Atlantic, attributed to perturbations in Antarctic Bottom Water (AABW) formation during Marine Isotope Stages (MIS) 5e and 11. A link to West Antarctic Ice Sheet instabilities, possibly triggered by warming Circumpolar Deep Water, has been postulated, but the drivers and spatial extent of these “AABW stagnation events” remain incompletely known. Here, we present new bottom water oxygen (BWO) reconstructions based on authigenic uranium enrichments in benthic foraminiferal coatings (Uvigerina spp.) from Subantarctic Atlantic sediment core MD07-3077 (44.15°S, 14.23°E; 3770 m) for MIS 11 (424–374 ka). These BWO estimates are combined with Uvigerina Mg/Ca-derived bottom water temperature (BWT) and δ18O-derived bottom water salinity (BWS) reconstructions from the same site, providing insights into the extent and mechanisms of AABW stagnation in the Atlantic Southern Ocean. Our results show predominantly well-oxygenated deep-water conditions during MIS 11, with only one brief low-BWO event at 395 ka. This suggests AABW stagnation was largely confined to the Antarctic Atlantic Ocean, with limited northward expansion of low-oxygen waters. While this supports a southern driver, variability in BWT and BWS points to differing hydrographic settings and mechanisms across events. These data provide important constraints on climatic (in)stability in the Atlantic Southern Ocean and near the Antarctic ice sheet margin during MIS 11.

Lisa S. Oelkers, Columbia University, Poster #9

Sensitivity of Marine Sediment Proxies to Archive Processes: Insights from a Process Model

Paleoclimate reconstructions provide critical context for recent climate trends, helping to disentangle exogenous sources of variability. Data assimilation (DA), which blends climate model output with proxy observations, is providing reconstructions of unprecedented quality and detail (e.g. the Last Millennium Reanalysis). DA relies on forward-modeling proxy observations, which often harbor noisy, multivariate relationships with climate. So far, LMR has assimilated only annually resolved observations using linear proxy system models (PSMs). A new frontier is the assimilation of marine sedimentary observations (Mg/Ca, δ18O, TEX86, and Uk’37), which provide a unique perspective on low-frequency climate variability. However, these archives are influenced by seasonal biases and post-depositional processes, including sedimentation, bioturbation, and age uncertainty, which need to be explicitly modeled.

Here, I present sedPSM, a Python-based process model for these observations, which extends a previous model, sedproxy (Dolman & Laepple, 2018), designed for eventual integration into LMR, with a suite of Bayesian calibrations for our observations. Using sedPSM, we perform sensitivity experiments that explore the role of these post-depositional processes. These tests use data from the Ocean2k network to evaluate how archive and sampling parameters affect signal preservation and the recovery of low-frequency variability.

Results show that interactions between these archive processes influence how climate signals are preserved, affecting both their amplitude and variability. By quantifying the effects of these processes, the goal of sedPSM is to simulate realistic marine pseudoproxies and improve the assimilation of sediment records along with other applications like model-data comparisons, sensor placement, or detection and attribution.

Tanaya Gondhalekar, University of Southern California, Poster #11

Coupled Seasonal Data Assimilation of Sea Ice, Ocean, and Atmospheric Dynamics over the Last Millennium

“Online" data assimilation (DA) is used to generate a seasonal-resolution reanalysis dataset over the last millennium by combining forecasts from an ocean--atmosphere--sea-ice coupled linear inverse model with climate proxy records. Instrumental verification reveals that this reconstruction achieves the highest correlation skill, while using fewer proxies, in surface temperature reconstructions compared to other paleo-DA products, particularly during boreal winter when proxy data are scarce. Reconstructed ocean and sea-ice variables also have high correlation with instrumental and satellite datasets. Verification against independent proxy records shows that reconstruction skill is robust throughout the last millennium. Analysis of the results reveals that the method effectively captures the seasonal evolution and amplitude of El Ni\~{n}o events, seasonal temperature trends that are consistent with orbital forcing over the last millennium, and polar-amplified cooling in the transition from the Medieval Climate Anomaly to the Little Ice Age.

Zilu Meng, University of Washington, Poster #13

Heat in the Ocean

Observed Recent Multidecadal and Centennial Trends in the Tropical Pacific Sea Surface Temperature Gradient Are Statistically Significant Based on Multiple Null Hypotheses

The equatorial Pacific Ocean exhibits warm sea surface temperatures (SSTs) in the west and cooler SSTs in the east; the difference between these SSTs is often referred to as the zonal SST gradient. The mean state and variability of the gradient influence climate conditions worldwide, as exemplified by the El Niño-Southern Oscillation. Understanding how this gradient responds to anthropogenic forcing is thus essential for accurate climate projections. Despite its importance, it remains controversial: observational records suggest a strengthening trend, while climate models simulate a weakening trend, highlighting a major discrepancy in our understanding of the tropical Pacific's response to radiative forcing.

A key challenge in reconciling this debate is that past studies have used different trend intervals and observational datasets, complicating direct comparisons among studies. This work aims to address that gap by estimating observed trends in the zonal SST gradient across all possible multidecadal and centennial intervals from 1870 to 2024, using multiple datasets. These observed trends are subsequently evaluated against a series of statistical significance tests.

Our results reveal that, although both strengthening and weakening trends are observed, the multidecadal-scale strengthening trends since 1950 and the centennial-length strengthening trends extending into the present decade are unlikely to be solely due to internal variability. We verify these findings using multiple SST datasets, indicating that data uncertainties have minimal impact on our results. We conclude that the observed trends, especially those with recent end dates, likely reflect the tropical Pacific's response to human-induced climate forcing.

Ibuki Sugiura, Columbia University, Poster #24

Northwest Atlantic Marine Heatwaves

Marine heatwaves (MHWs) are prolonged periods of anomalously warm ocean temperatures with major ecological and socioeconomic consequences. Understanding and predicting these events requires identifying their physical drivers. The Northwest Atlantic experiences some of the most intense MHWs globally, where the complex circulation of the Gulf Stream influences their evolution. Although eddy-resolving climate models better capture MHW statistics, the physical mechanisms behind these improvements remain uncertain. Here we analyze two major MHWs (2011–12 and 2015–16) using ocean-only simulations from the Community Earth System Model Forced Ocean Sea Ice (CESM-FOSI) framework, which applies identical atmospheric forcing to eddy resolving (HR-FOSI: 0.1°) and non-eddy resolving (LR-FOSI: 1°) ocean configurations. The LR-FOSI is warmer and saltier, with a poor representation of the Gulf Stream, leading to biases in MHW intensity and evolution. The high-resolution run reproduces observed MHW characteristics more faithfully, largely due to better representation of advection and surface heat fluxes. Resolved eddy advection is essential during MHW development, whereas parameterized eddies fail to capture these dynamics. These findings demonstrate how explicitly resolving eddies improves the physical realism of extreme ocean events and could be critical for predicting future marine heatwaves.

Rudradutt Thaker, University of Wisconsin Madison, Poster #25

Session C

Forecasting Climate

Seasonal Evaluation of the Energetic Framework of ITCZ Shifts in Reanalysis Data

The seasonal cycle of rainfall associated with the meridional migration of the intertropical convergence zone (ITCZ) is one of the defining features of tropical climate, but even basic details like its amplitude and phase remain incompletely understood. The energetic framework of ITCZ shifts is a promising theory that has emerged in recent years to diagnose meridional ITCZ shifts by relating ITCZ position to the meridional atmospheric energy transport (AET) via the close association between the ITCZ and the Hadley circulation. We evaluate the agreement between reanalysis data and theory over the seasonal cycle for a larger sample of both reanalysis datasets and energy budget closure methods than has been done previously. We find that the ITCZ latitude robustly covaries with that of the energy-flux equator (EFE) and is strongly anticorrelated with the cross-equatorial energy transport (AET0), but that a seasonal phase offset between energetic quantities and precipitation is also robust and remains unexplained. Our results also indicate that transient eddies contribute negligibly to AET0, suggesting that the discrepancies between data and theory are due to gaps in our understanding of the large-scale circulation over the seasonal cycle. Finally, we find large spreads in estimates of EFE latitude and AET0 across reanalysis datasets and budget closure methods that have not been documented previously, indicating a need for greater care in handling energy budget residuals in reanalysis data. We discuss paths forward that may improve our understanding of why it rains when and where it does at large scales in the tropics.

Alex Parsells, Columbia University, Poster #9

Climate Modes in the Indian and Pacific Oceans: A Rocky Relationship

The tropical oceans play a key role in the global climate system and influence weather conditions around the world. The influence of the El Niño Southern Oscillation (ENSO), the dominant mode of coupled atmosphere-ocean variability in the Pacific, is well known, while its analogous neighbor, the Indian Ocean Dipole (IOD), is less well understood. IOD and ENSO events frequently co-occur, and ENSO is known to have a strong influence on the IOD, while the role of the IOD in this relationship is still debated. Furthermore, their connection varies on multidecadal timescales and has weakened in recent decades; what controls this variability remains uncertain. In this study, we use a global coupled climate model ensemble to investigate what modulates the strength of the IOD-ENSO connection, identifying key mechanisms of interaction and how these mechanisms can be disrupted. We find that periods of weaker connection are associated with a stronger Pacific Walker circulation, i.e. strengthened easterly winds in the tropical Pacific, while the opposite is true for periods of stronger connection. On rare occasions, the connection breaks down entirely; using these disconnect events as case studies, we find that during these periods El Niño events are weaker and westward-shifted, and are unable to generate the atmospheric convective response that stimulates a concurrent IOD event. Under future warming, our results indicate that a weakening of the Pacific Walker circulation may lead to a strengthening and decrease in variability of the IOD-ENSO connection.

Ashley Lasinsky, MIT-WHOI, Poster #4

Variability of the Seasonal Cycle in the Atlantic Meridional Overturning Circulation at 26°N

The Atlantic Meridional Overturning Circulation (AMOC) is an important component of the heat and carbon transport in the Atlantic Ocean, and its seasonality has been hypothesized to influence hurricane development and flood risk. Here, we focus on the variability and dynamics of the AMOC seasonal cycle at 26°N. Using 19 years of data over 2004-2023 from the RAPID-MOCHA AMOC monitoring array, we find that the peak-to-peak amplitude of the seasonal cycle has a time average of 5.2 Sv. However, the magnitude of the seasonal cycle fluctuates over time with a standard deviation of 1.4 Sv and exhibits a trend that reduces the seasonal amplitude by half over the timeseries. We also find that the timing of the seasonal cycle changes annually: seasonal transport maxima vary between late September and December, and minima vary between late January and late April. The shifting strength and timing of the AMOC seasonal cycle reflect both ageostrophic (Ekman) and geostrophic (Upper-Mid Ocean and Gulf Stream) processes. While local zonal wind stress controls the ageostrophic Ekman component of the overturning (by definition), the dynamics of the geostrophic component are not as obvious. As a first step towards understanding, we seek to identify mechanisms underlying the variations of the seasonal cycle in the interior gyre's contribution to the geostrophic transport. We hypothesize that the variation in the seasonal cycle of the interior gyre transport can be explained by changes in wind stress curl across the basin. We test this hypothesis by comparing RAPID observations with predictions from simple analytical models of the linear wind-driven response (e.g., Sverdrup balance, Rossby waves). Results have implications for meridional heat transport and AMOC trend calculations.

Catherine Zhang, MIT/WHOI, Poster #5

Recent changes in the distribution and properties of overflow waters in the subpolar North Atlantic as revealed by shipboard hydrographic transects

In the subpolar North Atlantic, warm waters from the subtropics are transformed into cold waters, setting the deep ocean circulation that is critical for regulating the climate and transferring dissolved oxygen and carbon dioxide to the deep ocean. One key component of this circulation system is the overflow waters, which make up the deepest layers of the subpolar North Atlantic. Overflow waters facilitate the communication of climate signals from the surface to the deep ocean, both directly from their source in the Nordic Seas and from the vigorous mixing of warmer mid-depth waters further downstream. While numerous studies have documented variability in the upper and mid-depth waters of the subpolar North Atlantic, less attention has been paid to recent changes in the distribution and the properties of the deep overflow waters. This study investigates how the distribution and properties of overflow waters in the subpolar North Atlantic have evolved over the past three decades, using repeat shipboard hydrographic transects. Preliminary observations suggest that overflow waters have experienced salinification around the turn of the 21st Century and possible changes in the vertical extent of the salinity minimum. Ongoing analysis seeks to further investigate the response of the distribution and properties of overflow waters to recent convective activity in the upper ocean during the late 2010s. Understanding these changes is essential for assessing the response of the North Atlantic's deep circulation to climate change.

Hiroki Nagao, MIT-WHOI, Poster #6

AI-Informed Model Analogs for Subseasonal-to-Seasonal Prediction

Subseasonal-to-seasonal forecasting is crucial for public health, disaster preparedness, and agriculture, and yet it remains a particularly challenging timescale to predict. We explore the use of an interpretable AI-informed model analog forecasting approach, previously employed on longer timescales, to improve S2S predictions. Using an artificial neural network, we learn a mask of weights to optimize analog selection and showcase its versatility across three varied prediction tasks: 1) classification of Week 3-4 Southern California summer temperatures; 2) regional regression of Month 1 midwestern U.S. summer temperatures; and 3) classification of Month 1-2 North Atlantic wintertime upper atmospheric winds. The AI-informed analogs outperform traditional analog forecasting approaches, as well as climatology and persistence baselines, for deterministic and probabilistic skill metrics on both climate model and reanalysis data. We find the analog ensembles built using the AI-informed approach also produce better predictions of temperature extremes and exhibit more reliable forecast uncertainty.

Jacob Landsberg, Boston University, Poster #1

Leveraging Data Assimilation for Accurate Sea Ice State Prediction

Data assimilation (DA) plays a vital role in improving predictive skill in polar regions. Yet, traditional polar DA systems rely heavily on a limited set of observations—primarily sea ice concentration (SIC) and sea ice thickness (SIT). These variables, while valuable, provide an incomplete picture of the sea ice state, particularly under changing seasonal and radiative conditions.

One critical but underused surface property is sea ice albedo (SIAL). Albedo varies significantly across time and space, and its influence on seasonal ice evolution makes it a compelling candidate for data assimilation. However, it remains largely absent from operational DA systems, due in part to unknown observational uncertainty and limited precedent for its assimilation.

In this study, we evaluate the potential of assimilating SIAL into sea ice models using a perfect model framework. We use the one-dimensional Icepack model to generate synthetic sea ice evolution and designate a single ensemble member as the truth. Synthetic observations of SIAL are then assimilated into the remaining ensemble using a quantile-conserving ensemble filter, implemented within the Data Assimilation Research Testbed (DART). Importantly, we apply a bounded DA approach, which maintains the physical realism of variables like SIAL, SIC, and SIT.

We conduct experiments across four Arctic locations, introducing ensemble spread through small perturbations in atmospheric forcing. Results show that assimilating SIAL leads to statistically comparable or improved estimation of the mean sea ice state in three out of four regions compared to assimilating SIC or SIT alone. Notably, when SIAL observational uncertainty is reduced below current literature estimates, its assimilation improves performance across all regions. This sensitivity highlights the importance of better characterizing uncertainty in SIAL measurements.

Our findings suggest that SIAL is an untapped observational resource for sea ice DA. The use of bounded assimilation further supports the integration of nonlinear, physically constrained variables like albedo. While this work is idealized, it motivates the development of operational DA strategies that include SIAL and supports the case for expanded satellite and airborne albedo measurement campaigns.

Joseph Rotondo, University of Washington, Poster #8

Forecasting Forecast Errors: Predicting Coverage and Spatial Biases in Convective Outlooks Using CNNs

See Lightning Talks Session 3 for abstract.

Miles Epstein, University Washington, Poster #2

Springtime Arctic Amplification from 1980-2022: The Role of Internal Variability based on Machine Learning

According to observations, Arctic Amplification (AA) is as large as 4.2 during 1980-2022. Climate models robustly simulate AA but seldom replicate this observed magnitude. The discrepancy between simulated and observed AA has raised concerns that models may not correctly represent the Arctic’s response to greenhouse gas forcing. This simulated response is critical to understanding physical mechanisms and future climate of the Arctic, which can impacts local communities, wildlife, and ecology. However, AA has large seasonality and so the simulated and observed AA discrepancy strongly depends on season. To best understand the seasonal impacts from external forcing, we need to breakdown the role of internal variability and compare the simulated AA with observations on a seasonal scale. We use climate model data to train a ML algorithm that uses the seasonal multi-decadal surface air temperature and pressure trend pattern maps to determine the influence of internal variability on seasonal Arctic and global-mean temperature trends. The observationally derived forced trends from this study will help better understand climate feedback processes, identify model biases, and constrain simulated forced trends in the Arctic for better prediction purposes.

Sky Gale, University of Washington, Poster #7

Comparing Environmental Conditions of Tropical Mesoscale Convective Systems Across Datasets

Mesoscale convective systems (MCS) are highly organized thunderstorms with both a convective and stratiform component that play an essential role in the Earth's hydrologic cycle and dictate water availability and flood risk in much of the world, especially the tropics, where they account for more than 50% of total precipitation. Additionally, environments favorable for convection are expected to become more frequent under climate change, especially in the tropics, and given this, it is important to understand the connection between near-storm environments and the initiation and evolution of tropical MCS. Previous studies have approached this topic by tracking MCSs in observational datasets, then spatiotemporally co-locating the resulting tracks with environmental conditions (such as moisture) from reanalysis data like ERA5. To test previous assumptions made about this the validity this method, this study compares the evolution of environmental conditions associated with two 14-year MCS datasets created using PyFLEXTRKR, a global dataset of MCS tracks in ERA5 and an IMERGv7 satellite-based MCS dataset. Environmental variables from ERA5 data, such as water vapor and moisture flux convergence, are then collocated with the two MCS datasets. Preliminary results reveal that the evolution of the co-located near-storm environment around convection initiation is different in timing and magnitude between the two MCS datasets. These results have important implications for whether co-locating satellite-based MCS tracks with reanalysis environments could lead to potential biases in our understanding of the environmental factors controlling MCS characteristics, which may in turn impact our understanding of how climate change will affect these storms.

Stella Heflin, University of Washington, Poster #3

Onset of the rainy season in Central America and the role of the Pacific-Atlantic Ocean Interactions

The timing of the rainy season is critical for agriculture in Central America. A significant delay in its onset can cause crop failures that threaten food security in vulnerable regions. In this study we determine onset dates using high-resolution rainfall daily data for 1981–2022 and evaluate the influence of the El Niño–Southern Oscillation (ENSO), with particular emphasis on the atmospheric conditions that lead to a delayed onset. We find that the ENSO response in the Atlantic Ocean evolves intraseasonally in May; specifically, warming in the Tropical North Atlantic (TNA) alters the low-level circulation, resulting in moisture-convergence anomalies and changes in moist-static-energy stability that separate early- and late-May precipitation regimes. A decaying El Niño triggers onset delays primarily on the Pacific side of Central America through an anomalous meridional pressure gradient. Conversely, La Niña combined with a warm TNA can also delay the onset, in this case toward the Caribbean side of the isthmus. Understanding these mechanisms can improve subseasonal prediction systems. We also note that many delayed-onset areas lie within the Central America Dry Corridor, a region that urgently needs climate services to support subsistence farmers.

Alan Garcia, Columbia University, Poster #22

Determining the Causes of the Delayed Wet Season Onset in the Southern Amazon

The Amazon rainforest, a vital component of South America's hydrological and carbon cycles, has seen notable changes to its climate in recent decades. In particular, the Southern Amazon's wet season has shortened by about a month, increasing the risk of droughts, wildfires, and other disastrous ecological impacts in the region. This change is mostly due to recently observed delays in the wet season onset (WSO). While previous studies have discussed the mechanisms responsible for the WSO, it remains unclear how these mechanisms have changed to shift the WSO towards later dates. We identify some key thermodynamic changes responsible for delaying the WSO and determine to what degree anthropogenically forced climate change plays a role in doing so. We find that rising temperatures above the boundary layer and decreases in humidity reduce convective buoyancy during the dry and dry-wet transition seasons, suppressing precipitation and delaying the WSO in the region. Additionally, we find that climate change-driven warming of tropical North Atlantic sea surface temperatures reduces upper-level humidity over the southern Amazon, further suppressing precipitation and delaying the WSO. These findings suggest that anthropogenic warming has significantly changed the hydrological cycle in the Amazon. Understanding these changes is crucial to improving our understanding of and how to prepare for the impacts that the delayed WSO and shorter wet seasons will have on the Amazon as a whole.

Alex Chang, UCLA, Poster #21

Seasonal Variation, Crustal Enrichment, and Source Attribution of Radionuclides in AZ National Park Systems

Water scarcity and an increasing reliance on rainwater harvesting in the arid Southwest elevates the importance of characterizing wet-deposition water quality. This study examines the presence, variability, and potential sources of radiogenic-associated elements in wet-0nly deposition collected from five National Atmospheric Deposition Program (NADP) sites across Arizona between 2018 and 2022. A total of 162 samples were collected during monsoon (June 15-September 30) and winter (December 1- February 28) precipitation events at Chiricahua National Monument, Grand Canyon National Park-Hopi Point, Organ Pipe Cactus National Monument, Oliver Knoll and Petrified Forest National Park-Rainbow Forest. Using inductively coupled mass spectrometry (ICP-MS), concentrations of uranium (U), thorium (Th), cesium (Cs), strontium (Sr), and ruthenium (Ru) were quantified and evaluated using non-parametric tests, Multiple Factor Analysis (MFA), Spearman correlation heat mapping, and crustal enrichment factors (EFs).

Strontium, uranium, and cesium were detected in over half of all samples (Sr=100%, U=84%, Cs=57%), whereas thorium (Th=17%) and ruthenium (Ru=13%) were less frequently detected. Kruskal-Wallis with Dunn post hoc testing revealed that seasonal variability, rather than site location, was the dominant driver of variability, with Sr and Cs concentrations in rainwater being significantly higher ($p \leq 0.05$) during monsoon sampling windows compared to winter sampling windows. MFA further verified this temporal signal, with clearer separation by sampling window and overlap across sites, with the first two dimensions explaining 35.2% of variance.

EFs and the Spearman correlation heat map indicated distinct source pathways Sr, Cs, and Ru exhibited moderate to extreme crustal enrichment factors, suggesting inputs from human-related activities including industrial combustion, metallurgical processes, and vehicular emissions. In contrast, U and Th displayed minimal enrichment and strong positive correlations with rare earth elements (REEs) and lithogenic markers, reflecting natural geogenic inputs from REE-bearing pegmatites and breccia-pipe mineralization. Cs also correlated with select REEs, reflecting mixed crustal and industrial influences. REE and correlation patterns complemented EF results, clarifying that distinct groupings arise from both geogenic and industrial sources.

Overall, these results demonstrate that even within protected landscapes, wet deposition is shaped by both natural crustal dust and transported industrial emissions, underscoring the need to consider atmospheric pathways when assessing rainwater quality in arid regions.

Andreanna Roros, University of Arizona, Poster #20

Phytoplankton / Biological Oceanography

Understanding Phytoplankton Dynamics in the Bering and Chukchi Seas

The Bering and Chukchi Seas in the Pacific Arctic Region (PAR) are areas of high biological activity undergoing extensive environmental changes. Along with recent warming, the region has exhibited extreme declines in sea ice extent and changes to sea ice seasonality, with delays in sea ice formation and earlier sea ice retreat. These changes in marine conditions have direct spatial and temporal impacts on phytoplankton community composition, which in turn affects overall food web dynamics. For example, a large and unusual Tufted puffin mortality event in the Eastern Bering Sea from 2016 to 2017 was attributed to shifts in lipid-rich, nutritious phytoplankton types. Furthermore, climate change also impacts harmful phytoplankton populations that can cause illness and death in humans and marine animals, with cases documented for over 200 years in Alaska. Given the broad importance of these primary producers, further research is needed to continue monitoring changes in phytoplankton community characteristics and distribution in relation to changing environmental conditions and drivers. This project presents one of the first comprehensive observational records of phytoplankton assemblages in the Bering and Chukchi Seas at Distributed Biological Observatory (DBO) sites in the PAR from 2019 to 2024. The results from this project can help better inform broader marine ecosystem health monitoring in the region.

Anna Zhu, Clark University, Poster #17

The Exo-proteomic Framework for Nitrogen Acquisition from Proteinaceous Organic Matter in the Model Marine Heterotroph Ruegeria Pomeroyi DSS-3

Nitrogen-rich proteinaceous compounds are a key component of surface and upper mesopelagic particulate organic matter, and their rapid degradation by heterotrophic bacteria is an important process in releasing bioavailable nitrogen when other nitrogen containing substrates are deficient. Heterotrophs encode a wide variety of hydrolytic enzymes and nutrient transporters, which provide them with the ability to sustain nutrient stresses and inhabit protein-rich niche habitats such as sinking or suspended particles. Despite their important contribution to the oceanic nitrogen cycle, and marine biogeochemical cycles, the exact protein-level response of heterotrophic bacteria to nitrogen limitation in these environments remains unknown. In this study, Ruegeria pomeroyi strain DSS-3, a marine heterotrophic bacterium, served as model organism to investigate the shift in protein expression and secretion upon nitrogen limitation in the presence of extracellular protein. We tie these observations to extracellular protease rates determined from a fluorescence-based proteolysis assay. Our analyses reveal an increase in extracellular protease activity in response to nitrogen deficiency in DSS-3, due to increased production and secretion of type 1 secretion system dependent proteolytic enzymes into the extracellular environment. We found serine-, and metalloproteases to be important for periplasmic proteolysis, and propose an essential role for metalloproteases in the acquisition of proteinaceous nitrogen. Increased amino acid and oligopeptide uptake capabilities as well as higher abundance of amino acid dehydrogenases in the intracellular proteome further highlight this alternative process heterotrophic bacteria employ to challenge nitrogen limitation. Our study contributes to a better understanding of adaptation strategies of marine heterotrophic bacteria to protein-rich and inorganic nitrogen-limited niches, such as sinking and suspended particulate organic matter.

Fadime Stemmer, Massachusetts Institute of Technology, Poster #16

AR95 Cruise Report: A Survey of Diatom Parasites on the Northeast U.S. Shelf

The NES-LTER 2025 Fall Cruise (AR95) aboard the R/V *Neil Armstrong* expanded ongoing efforts to understand planktonic influences on marine food webs on the Northeast U.S. Shelf. While the NES-LTER has long investigated trophic dynamics through coordinated work across multiple institutions, our contribution aboard this cruise marked the first dedicated effort to study diatom–parasite interactions as a new dimension of ecosystem functioning within the program. Our objective was to conduct the first broad-scale survey of diatom parasites, with a focus on fungi and fungal-like pathogens of diatoms that may alter bloom dynamics and trophic transfer. Sampling along the inshore-to-offshore NES-LTER transect included microscopy slides prepared with parasite-specific stains, high-resolution imaged flow cytometry, environmental profiles, and molecular samples (including 18S rRNA gene sequencing). Preliminary observations suggest parasite presence across much of the shelf but with higher infection rates at nearshore, more productive stations and markedly lower prevalence offshore.

All samples are being processed to quantify infection prevalence, identify novel and dominant parasite taxa, and assess relationships with host communities and environmental gradients. Initial lessons emphasized the importance of rapid fixation, consistent staining protocols, and close coordination with core NES-LTER sampling initiatives to enhance data overlap. Integrating microscopy, molecular, and cytometric datasets proved feasible but highlighted the need to further streamline sampling plans for a small science crew.

Next steps include refining classification methods, integrating manual and automated community measurements, isolating and sequencing infected diatom-parasite pairs, and developing consistent workflows for tracking parasitism as part of the NES-LTER time series. Methodological approaches will continue to be evaluated to better capture the NES diatom parasite community. These outcomes will guide preparations for the 2025 Winter Cruise in January, and lay the foundation for incorporating parasitism into long-term ecosystem models and food web analyses.

Jo Hickman, MIT, Poster #19

Assessment of Methylmercury Accumulation and Interaction with Temporal and Spatial Parameters in Gulf of Maine Plankton

Methylmercury (MeHg) is a potent neurotoxin that bioaccumulates in marine food webs, with the bioconcentration of MeHg in marine phytoplankton recognized as the most significant step in this process. Despite this, the mechanisms of MeHg uptake among various algal species remain unclear. Understanding the fate and transport of MeHg in phytoplankton is crucial to grasp the parameters that impact MeHg biomagnification up the food chain, particularly in coastal ecosystems such as the Gulf of Maine (GoM). The GoM is a major contributor to fishery feeding grounds in the northeastern United States, accounting for a significant portion of the region's commercial fish and shellfish harvests. It has also been identified as one of the fastest-warming bodies of water globally, which has significant implications for marine ecosystems and biogeochemical cycles. To evaluate the impact of MeHg uptake and bioavailability in the GoM, a time-series assessment was conducted from April 2023 to April 2024. This study involved coupled size-fractioned particulate MeHg measurements with Flow Cytometer and Microscope (FlowCam) assessments of plankton size, abundance, and biovolume to investigate temporal and spatial variability throughout the GoM shelf regions. Dissolved MeHg, DOC, and other ancillary variables were also measured, understanding how long-term regional climate trends impact plankton communities is essential for comprehending the factors affecting MeHg incorporation into plankton. This knowledge can significantly enhance our understanding of MeHg trophic transfer and, importantly, human exposure to MeHg.

Melissa Sanchez, University of Connecticut, Poster #18

Pollution Mitigation

A Metagenomic Investigation of Nitrogen's Impact on Soil Carbon and Microbial Decomposition Pathways

Global agriculture is a significant source of greenhouse gases (GHG) like CO_2 and N_2O. A promising climate mitigation strategy involves using perennial bioenergy crops, such as Miscanthus, to capture and store soil carbon (C) through sequestration. However, the success of this strategy depends on nitrogen (N) fertilizer management, as the vast communities of soil microbes that control C and N cycling can respond in ways that either help store C or release more GHG. We are testing two competing hypotheses in a long-term Miscanthus field with varying N fertilization rates: 1) The "N mining" hypothesis posits that N-starved microbes decompose soil organic matter (SOM) to access its N; therefore, adding fertilizer should reduce CO_2 release. 2) The "stoichiometric decomposition" hypothesis suggests added N makes SOM more accessible to microbes, accelerating decomposition and increasing both CO_2 and N_2O emissions. Using shotgun metagenomics, we will reconstruct microbial genomes to analyze the genetic blueprints for key metabolic pathways. This powerful approach allows us to identify the prevalence of specific genes encoding enzymes for both recalcitrant C degradation and key N cycling processes like nitrification and denitrification. By tracking how the abundance of these functional genes changes with fertilization, we can reveal the dominant microbial mechanisms driving SOM decomposition and GHG production. Linking this genetic-level information to ecosystem measurements will clarify how N fertilization impacts soil C storage, providing crucial insights for designing more sustainable and climate-friendly bioenergy systems.

Danyang Duan, University of Illinois, Urbana-Champaign, Poster #15

Aqueous Methods for Metal Uptake from Rock

Advancing the electrification of the grid, and thus reducing emissions from nonrenewable energy sources, will rely upon an increasing supply of critical materials, notably transition metals. Unfortunately, standard mining techniques are energy intensive, contributing to 4-7 % of global GHG emissions. Additionally, available ore grades of these materials have been decreasing, necessitating the extraction of greater amounts of earth for similar yield, which in turn produces greater amounts of potentially hazardous tailings. However, this mining waste is a promising medium in which to investigate metals extraction techniques – highly reactive rock containing metals of interest. We investigate the use of various organic ligand chemistries to induce metal complexation and stabilization in solution, showing how common, industrial chelating agents can be used to foster the dissolution of copper from mine tailings, which could then be recovered from solution. The approach also has potential for implementation in conjunction with carbon mineralization, which could help to create an economic incentive for future carbon sequestration efforts.

Henry Price, MIT, Poster #14

Carbon Sequestration Potential of Seaweed in Agriculture

Green tides, near-shore seaweed blooms driven by anthropogenetic eutrophication of coastal waters, are becoming more frequent and severe. To prevent shellfish mortality, commercial shellfish growers routinely remove seaweed from shellfish beds and dump it to decompose on the shore because they lack other disposal options. When left on the shore, decomposing seaweed releases nutrients back into the aquatic environment and greenhouse gases such as methane into the atmosphere, perpetuating the conditions that drive green tides. Repurposing seaweed as an agricultural soil amendment has potential to enhance nutrient circularity and build soil carbon. Seaweed harvested from a commercial shellfish farm in the Puget Sound during the summer of 2024 was dried and applied at different rates using a randomized complete block design to two vegetable farms in Skagit County, WA during the 2024 and 2025 growing seasons. To monitor greenhouse gas emissions, portable survey chambers were used to measure soil fluxes of carbon dioxide, methane, and nitrous oxide following seaweed application on the farms. The percent of applied carbon lost through soil respiration is used to estimate the proportion of carbon remaining in the soil. Early results indicate that between 5 and 39% of the applied carbon was not lost to gaseous fluxes during the first year. Nitrous oxide emissions from seaweed are comparable with other organic amendments, but agricultural seaweed use may present a significant reduction in methane emissions compared to being left in the tidal marine ecosystem. Funding disruptions in 2025 limited data collection, but this data will eventually be paired with soil and harvest data to estimate overall benefit to climate, soil health, and food security.

Katie Webb, University of Washington, Poster #11

Climate-Smart Anaerobic Soil Disinfestation Using Cover Crops as In Situ Carbon Sources for Sustainable Weed Management

Anaerobic soil disinfestation (ASD) is a sustainable pre-plant soil management technique that uses readily degradable carbon sources to create anaerobic conditions, suppressing soilborne pathogens and weeds. However, conventional ASD relies on industrial carbon inputs like molasses and chicken manure, which increase cost and carbon footprint. This study explores the use of cover crops, sunn hemp (Crotalaria juncea) and sorghum-sudangrass (Sorghum bicolor × S. sudanese), as alternative, in situ carbon sources for ASD in collard (Brassica oleracea var. viridis) production systems in South Carolina.

An experiment was conducted using a factorial randomized complete block design with three replications. Treatments included four cover crop residue types (none, sunn hemp, sorghum-sudangrass, and their 1:1 mixture) and three rates of conventional carbon source (0%, 50%, and 100%) of molasses 14,000 L/ha and 20,000 kg/ha chicken manure. Soils were sealed with a totally impermeable film for six weeks before transplanting collards.

Results showed that cover crops, particularly sunn hemp, increased cumulative anaerobicity and suppressed weeds without requiring industrial carbon inputs. Sorghum-sudangrass significantly reduced soil pH from 6.0 to 5.3, enhancing weed seed mortality. However, it also reduced collard vigor, likely due to allelopathic effects. In contrast, sunn hemp alone reduced weed coverage to <5% and enhanced collard biomass and vigor across all carbon source levels. In conclusion, sunn hemp residues can serve as an effective, climate-smart alternative to industrial carbon sources in ASD, reducing input costs and improving sustainability. This approach supports weed suppression and crop performance, offering a viable strategy for integrated climate-smart weed control in southeastern vegetable systems.

Mahmoud Rady, Clemson University, Poster #12

From Wood to Carbon Brownies: Hydrothermal Carbonization for Negative Emissions

The availability and accessibility of natural resources are fundamental to sustaining quality of life and economic progress. As such, advancing a circular economy (CE), which focuses on using resources efficiently, reducing waste, and reusing materials, is important for long term sustainability. My doctoral research supports this framework by exploring hydrothermal carbonization (HTC) technology, a thermochemical process that converts wet organic waste like forestry residues and woody biomass into dense, carbon-rich solids (hydrochar), affectionately dubbed as “carbon brownies.” The hydrochar forms in a closed system at 180–280°C and mimic natural coal formation on an accelerated timeline, all without energy-intensive drying. To improve scalability and operational efficiency, I developed a novel continuous-flow HTC reactor system that enables better heat transfer and real-time control, both of which are critical for industrial deployment. My work also evaluates how HTC process conditions influence hydrochar yield, composition, and energy content. Results show increased fixed carbon content, higher energy density, and lower O/C and H/C ratios, which are beneficial for long term carbon sequestration and soil improvement. In addition to experimental work, I integrate techno-economic modeling to assess the cost-effectiveness and scalability of HTC systems under various operational scenarios. I also apply machine learning techniques to optimize reaction parameters for improved product quality and energy efficiency. By converting organic waste into stable carbon-rich products, my research contributes to climate change mitigation through negative emissions and supports sustainable land use and waste management practices.

Manikandan Pandiyan, University of Michigan - Ann Arbor, Poster #10