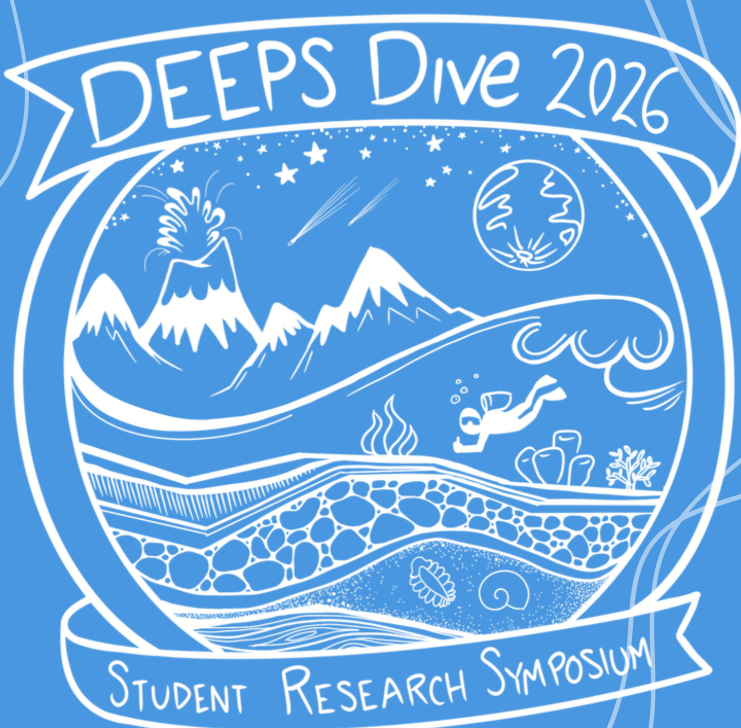
2026 DEEPS DIVE RESEARCH SYMPOSIUM

May 1st, 9:00 AM - 5:30 PM
Sayles Hall



BROWN
Department of Earth, Environmental and Planetary Sciences

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Awards + Evening Social!

Plenary Speaker

Professor Stephen Porder

Stephen Porder is the Acacia Professor of Ecology, Evolutionary, and Organismal Biology and Environment and Society at Brown University, where he served as the inaugural Associate Provost for Sustainability. Dr. Porder holds a B.A. in history from Amherst College, an M.S. in geology from the University of Montana, and a PhD in biology from Stanford University. He brings this multidisciplinary perspective to his work at the intersection of environmental science and society. He has published widely on nutrient and carbon cycling in tropical rainforests, the impacts of industrial agriculture on both people and environment, and the potential for tropical forest reforestation. His recent work focuses on institutional solutions to climate and sustainability challenges. He is the author of *Elemental: Five elements that changed Earth's past and will shape our Future*, and has written for the New York Times, Time Magazine and other popular press outlets. He is also the co-founder and science lead on the Possibly, a podcast/radioshow about sustainability science that airs on National Public Radio and other community radio stations around the United States.

Keynote Speaker

Dr. David Koweek

David Koweek is the Chief Scientist at Ocean Visions, where he is responsible for ensuring scientific accuracy and integrity around the research, policy, and climate solutions developing at the intersection of ocean conservation and climate change. He is a leading authority on the potential of ocean-climate solutions and serves on leadership boards and panels internationally. Trained as a marine and Earth system scientist, he has led and participated in field expeditions around the world. He holds an Sc.B. from Brown University, a Ph.D. from Stanford University, and conducted postdoctoral research at the Carnegie Institution for Science. In addition to his work at Ocean Visions, he serves as a board director for Spark Climate Solutions. At DEEPS Dive, Dr. Koweek will be discussing his work and career journey.

Talk Abstracts

Sara Cuevas Quinones | 10:30 - 10:40 AM

Where are the Deltas? River-sea mixing interactions on Titan with a combined analog and numerical experiment approach

"Titan is the only other body in our Solar System with an active hydrological cycle, possessing all the ingredients for river delta formation: methane–nitrogen precipitation, river networks that have eroded the landscape and feed vast polar hydrocarbon seas, and transportable surface sediment, confirmed by the Huygens probe and Cassini observations of equatorial sand seas. Despite these favorable conditions, deltas on Titan remain poorly understood, limiting our ability to interpret what they may record about Titan's materials, tectonics, and climate history. Whereas most terrestrial rivers terminate in deltas, only two deltas have been confidently identified on Titan, both in the southern hemisphere. We postulate that differences in Titan's fluids and material properties may mean rivers naturally plunge when they encounter the sea, opposite to what happens on Earth, making delta formation inherently difficult.

We combine numerical entrainment modeling with analog flume tank experiments to investigate mixing dynamics at the interface of Titan's rivers with its seas, using the Richardson number to characterize plume behavior. We find that in the cold, methane-rich northern seas, most rivers will plunge beneath the surface and continue along the seafloor as gravity currents, bypassing the nearshore deposition zone where deltas form. In the warmer, more ethane-rich south, rivers are instead buoyant upon entering the sea, promoting sediment deposition and delta formation, consistent with the observed north–south asymmetry."

Cassidy Charles | 10:40 - 10:50 AM

Transient Overyielding in Ocean Microbial Communities

Microbial communities in the ocean exhibit complex behavior and ecological interactions. One important phenomena that occurs in these communities, known as "overyielding," or the "dilution effect," is where the mixing of different populations can temporarily boost the total biomass beyond what would be expected without these interactions. Planktonic blooms are an important component of marine ecosystems, forming the base of the marine food web and playing a vital role in global carbon cycling. These overyielding events can impact primary productivity and the overall marine food web. Understanding the factors that initiate and sustain these blooms, especially in a changing climate, is important for studying larger oceanic ecological dynamics. Our project investigates the conditions under which the mixing of two non-zero phytoplankton and zooplankton populations results in an immediate, temporary increase in total phytoplankton abundance, otherwise known as overyielding. The model consists of five ordinary differential equations featuring a single nutrient source, two phytoplankton species, two specialist zooplankton species each consuming a distinct phytoplankton species, and a dependency of zooplankton grazing ability on the total phytoplankton concentration, which creates a dilution effect. By exploring the mathematical properties of this system, and running numerical simulations to investigate its stability regime, we are able to find valuable insight into planktonic overyielding behavior.

Henry Jurney | 10:50 - 11:00 AM

Regularization in Gravity Inversion: Comparing Standard Methods and Physics-Informed Neural Networks

The Earth's gravitational field is a fundamental observable of the geosystem, providing insight into structures and processes at the surface and deep within the planet (as well as in other planetary bodies). Interpreting this field through inversion allows us to infer otherwise inaccessible subsurface features such as density anomalies. To obtain meaningful solutions, additional prior information is typically introduced through regularization, which stabilizes the inversion and guides it toward preferred results. While regularization is well understood in traditional inversion frameworks, its role in new deep learning based inversion methods has received less attention. Here, we develop a new approach to gravity inversion by utilizing Physics-Informed Neural Networks (PINNs) which ensure that solutions obey governing physical equations, yielding results that rival those produced by standard inversion methods. Through synthetic case studies, we find that PINNs exhibit an implicit regularizing effect that prefers density distributions corresponding to smoothly varying potential fields by avoiding sharp near-surface oscillatory features. This acts as a form of depth weighting as low frequency representations of the same potential fields require deeper anomalies. Standard inversions require explicitly designed empirical weighting functions to accomplish this same behavior. We also find that explicit regularization interacts differently with PINNs than with classical inversions. Adding stronger prior constraints to PINN improves structural coherence between the recovered density and its predicted gravitational influence without inducing the same dramatic trade-off between stability and surface bias that is present in standard inversions.

Olivia E. Anderson | 11:00 - 11:10 AM

Sulfur isotopic composition of garnet pyroxenite-hosted sulfides from Salt Lake Crater, Oʻahu: Insights into the source of rejuvenated melts

"Many Hawaiian volcanoes include a phase of rejuvenated volcanism that follows 0.5–2.5 Myr of quiescence after the shield stage. Rejuvenated-stage lavas are geochemically distinct, being enriched in incompatible elements yet have depleted radiogenic isotope signatures. As part of the rejuvenated volcanic stage, the Salt Lake Crater (SLC) vent on Oʻahu has erupted garnet pyroxenite xenoliths interpreted as high-pressure crystal fractionates from alkalic melts. These deeply sourced xenoliths may provide critical physical and chemical constraints on the origin and nature of rejuvenated volcanism at Hawaiʻi. Sulfur isotopes enable fingerprinting of magmatic volatile processes and distinct melt-source components that may incompletely mix prior to eruption and crystallization. We determined the major element composition of SLC sulfides by electron probe microanalysis, and measured the corresponding $^{33}S/^{32}S$ and $^{34}S/^{32}S$ ratios by secondary ion mass spectrometry. No resolvable $\Delta^{33}S$ anomalies were observed (mean= 0.21 ± 0.71‰, 2SD, n=18), while, excluding an outlier (−6.3‰), $\delta^{34}S$ values ranged from −2.2‰ to +2.1‰. The $\delta^{34}S$ values of SLC sulfides overlap with those characteristic of mid-ocean ridge basalts[3,4] (−0.79 ± 0.87‰, 2SD) and ocean island basalts, such as Samoa[2,5–6] (1.6 ± 2.4‰, 2SD). This $\delta^{34}S$ distribution suggests mixing between a plume-derived mantle component and a depleted mantle reservoir, which may have contributed to the source of rejuvenated volcanism at Oʻahu.

Aikaterini Tavri | 11:10 - 11:20 AM

When Satellite Observations Might Mislead: Understanding Passive Microwave Sea Ice Concentration Biases in Antarctica

Passive microwave sea ice concentration (SIC) products underpin Antarctic sea ice monitoring and are widely assimilated into operational and seasonal forecasting systems. Yet passive microwave sensors do not observe SIC directly; they measure top of atmosphere brightness temperatures that are converted to SIC using empirical algorithms based on simplified linear mixing assumptions. These assumptions may not hold under heterogeneous Antarctic surface conditions, particularly in the marginal ice zone and in the melt season.Here we investigate where and why passive microwave SIC biases emerge in Antarctica through systematic comparison with coincident C-band Synthetic Aperture Radar (SAR) observations. SAR provides higher spatial resolution and greater sensitivity to sea ice structure, enabling identification of concentration regimes that are misrepresented in passive microwave retrievals. We find that SIC underestimation is spatially organized and most pronounced in non compact ice regimes, leading to a systematic broadening of the marginal ice zone. These errors are not random retrieval noise but structured algorithmic biases linked to surface emissivity variability and mixed ice conditions. Because passive microwave SIC fields are routinely assimilated into forecast systems, spatially coherent biases can propagate into model initial conditions and influence predicted ice edge evolution. Our results highlight the need to explicitly diagnose and account for observation related uncertainties in Antarctic sea ice forecasting and motivate closer integration between radiative physics, high resolution SAR analysis, and data assimilation frameworks.

Lucinda Bryce | 11:20 - 11:30 AM

Constraining tropical Pacific Rainwater and Seawater d18O Relationships through the 2023-2025 ENSO cycle

Recent studies provide evidence of changes in the hydroclimate impacts of El Niño Southern Oscillation (ENSO) extremes, but signatures of key hydrological processes remain poorly resolved by available observational data. Specifically, water isotopologues are well-established tracers of local and regional hydroclimatic processes such as precipitation, evaporation, and moisture recycling (Dee et al., 2023 and references therein) in both models (Bong et al., 2024 and references therein; Gao et. al, 2016) and observations (i.e. Moerman et al., 2013), but remain rare in the tropical Pacific, the center of ENSO action. There, existing in-situ data fail to resolve a full ENSO cycle, much less span the large spatial scales to capture key ocean-atmosphere dynamics of the ENSO system. In this study, we present oxygen isotope (d18O) and deuterium (d2H) time series of precipitation, seawater, and time series of sea surface salinity for four sites across the tropical Pacific spanning 2023-2025, covering an El Niño and a La Niña event. Weekly seawater and daily rainwater d18O time series were collected at Fiji, Kiritimati, Palau, and Hawai'i and subsequently analyzed via CRDS at Brown University. Results showed distinct d18O signatures across El Niño and La Niña extremes, as well as differences as compared to previous ENSO extremes where data are available. Analysis of sea-surface salinity measurements paired with isotopologues across the four sites illustrated unique local and regional controls on hydroclimate. Taken together, results provide insights into the local versus regional dynamics governing seawater d18O anomalies in the tropical Pacific across a complete ENSO cycle. Such insights support the development of isotope enabled models and inform the interpretation of paleoclimate reconstructions of hydrological processes. These tools are critical to improving our understanding of past climate variability and change, and to refining projections of future regional hydroclimate change.

Sarah Brown | 11:30 - 11:40 AM

Detecting Ice-Sheet and Subglacial Variations in Antarctica Using Ps Receiver Functions

Subglacial properties play a fundamental role in controlling ice-sheet dynamics and stability, yet the geometry and physical characteristics of subglacial environments beneath West Antarctica remain poorly constrained. This study uses P-to-S (Ps) receiver functions recorded by Antarctic seismic stations to assess internal ice structure and identify subglacial features such as saturated sediments. Ps receiver functions measured at long-running Antarctic stations contain clear Ps conversions from the base of the ice. Some stations reveal temporal changes in ice and/or subglacial layer properties. At station YT.UPTW, on the upper portion of the rapidly flowing Thwaites glacier (West Antarctica), converted phases from the ice layer shows decadal changes. In contrast, on the more stable ice of Dome C in East Antarctica, station G.CCD receiver functions reveal little long term (2009-2024) or seasonal variation. Forward modeling of the data with synthetic Ps receiver functions highlights significant trade-offs among ice and sediment thickness, seismic velocities (Vp and Vs), and internal layering, underscoring challenges in interpretation. To better constrain glacial and subglacial properties, we apply a Bayesian inversion framework to explore the range of ice, sediment, and upper crustal structures compatible with the data. Tests of our inversion framework with synthetic data indicate that input velocity models of ice and subglacial sediment layers can be meaningfully retrieved. Applying this approach to temporally and spatially binned receiver functions will refine interpretations of evolving subglacial conditions. This study provides a framework for detecting changes subglacial conditions, with implications for Antarctic ice-sheet stability and glaciological processes worldwide.

Erik Duchnowski | 11:40 - 11:50 AM

Effects of Lunar Mining on Lunar Gravity

Interest in mining the Moon's reserves of water, oxygen, and helium-3 (^{3}He) through in-situ resource utilization (ISRU) is growing. These materials are predominantly intended for off-world use, so mining entails both a redistribution of material at the mine site as well as a net removal of mass from the Moon. We quantify the resulting alteration to the lunar gravity field via (1) numerical integration of the pit and tailings, giving the theoretical effect, and (2) a spherical harmonic mass-sheet approximation, which estimates the measurable change at the resolution of the Gravity Recovery and Interior Laboratory (GRAIL) mission. We examine the roles of excavation pit depth, tailings mound height, and regolith-to-resource conversion rate, finding the first two to have the greatest effect on maximum change in radial gravity. For all near-surface water-ice mining scenarios, the signal is below the ∼1 mGal detection threshold. Deeper pits and higher mounds do produce measurable changes: oxygen- and ^{3}He-focused ISRU could produce signals on the order of 1 mGal if 10^{10} kg of oxygen were removed from a 100 m deep pit—though such a scenario is unlikely given the impracticality of mining so deep—or if the extraction of 10^4 kg of ^{3}He were accompanied by a 100 m high waste pile.

Yusen Liu | 11:50 AM - 12:00 PM

An interpretation of pacemaker experiments: insights from tropical Pacific–Atlantic interactions

Pacemaker experiments, which prescribe sea surface temperature in a domain of interest in climate models, are widely used to identify the impacts of specific oceanic signals on the climate system. However, the adequacy of pacemaker experiment in isolating one-way impacts from a coupled system hasn't been comprehensively assessed. Within a linear inverse model framework, we evaluate the effectiveness of pacemaker experiments, using the coupled tropical Pacific-Atlantic system as an illustrative example. Here we show that the northern tropical Atlantic (NTA)–El Niño–Southern Oscillation (ENSO) relationship is exaggerated in the Atlantic pacemaker experiment because the restored NTA sea surface temperature (SST) inherits ENSO variability from the two-way coupling. Furthermore, SST restoring disrupts the covariance balance and introduces artificial variance into the un-restored domain, which amplifies the response to the restored forcing. Our results highlight the potential issues of pacemaker experiments in isolating the restored forcing and preserving the energy budget, which have important implications for pacemaker experiment designs to enable robust interpretations of the tropical basin interactions.

Daniel Lukens | 1:05 - 1:15 PM

Exploring the mechanics of creeping faults: a new approach to understand the role of low-temperature plasticity

Creeping faults worldwide are known to host numerous earthquakes of magnitude 5 and greater, posing significant hazard to nearby inhabitants, and especially relevant for the millions of Americans living around the San Andreas Fault Zone. Fault behavior, however, is poorly constrained, leaving large errors in slip deficit and strain energy calculations that could predict rupture magnitude and ground shaking potential. Current rate-and-state friction calculations for creeping faults assume their behavior is dominated by elasticity, disregarding the role of plasticity in accommodating strain energy over long timescales. To better determine the frictional behavior of gouge deforming along the contacts of the fault, we conduct rotary shear deformation experiments on lizardite and calcite gouges, selected for their particular abundance in the San Andreas Fault System. Traditional approaches to analyzing fault creep employ velocity-controlled rate step experiments to determine frictional characteristics. Here, we propose a new, constant-stress step approach that better highlights underlying low-temperature plasticity in gouges active during fault creep. To understand the role of plasticity, we explore a range of normal stresses on the fault. For the same given stress, velocities are orders of magnitude lower during these stress steps than in rate steps, indicating different grain-scale accommodations of strain need to be accounted for. We find a significant role of plasticity on creeping faults that is not integrated into a purely rate-and-state friction approach, with stress controlled logarithmically with velocity. Higher normal stresses have also been found to host faster creep, with significant implications for creeping faults at depth.

Brianna Fernandez | 1:15 - 1:25 PM

Modeling dune-river interactions in the Namib Desert with applications to Titan

Aeolian dunes and fluvial systems are among the dominant sediment transport processes on planetary surfaces, yet the interactions between them remain poorly understood. To better characterize dune-river dynamics, we look to the Namib Desert, which acts as an excellent natural laboratory: Its episodic rivers intersect active dune fields, producing feedbacks in which dunes can obstruct, redirect, or infill channels, while floods erode and reset dune morphology. Here, we develop a new numerical framework within the detachment-limited landscape evolution model MARSSIM that explicitly couples aeolian and fluvial processes to simulate dune-river interactions in three dimensions. System behavior depends strongly on the balance between aeolian transport and flood discharge, with thresholds separating regimes of channel infilling versus fluvial reworking. These results provide a quantitative framework for interpreting dune-river patterns and constraining sediment fluxes. Looking ahead, we plan to extend this framework to Saturn's moon Titan. As these features in Namibia are analogous to those on Titan, we can scale our model parameters accordingly to assess whether dune morphologies are consistent with drying or wetting climates, generating testable predictions for Dragonfly observations of interdune environments.

Mónica Geraldes Vega | 1:25 - 1:35 PM

Millennial-Scale Hydroclimate Responses over Southwest Philippines during the MIS5b – MIS4 Transition

The tropical hydroclimate response to Northern high latitude freshwater forcing, or Heinrich Events (HEs), is well recorded in paleoclimate records across East and Southeast Asia. While most research focuses on glacial periods, less-pronounced interglacial HEs during the MIS5 - 4 transition remain poorly characterized.The shift in climate regime during this long-term transition is associated with significant changes to insolation strength, land-surface configurations, and other climate mechanisms, which can be invoked to better understand the character of millennial scale responses. This work presents a U/Th-dated speleothem record covering 68 – 96 ka BP from the Philippines that reflects hydroclimate change in the northern sector of the Maritime Continent. We apply stable isotopes ($\delta^{18}O$, $\delta^{13}C$) combined with trace metal analyses (Mg/Ca, Sr/Ca, Ba/Ca) to identify local and regional hydrological signals. We observe significant millennial scale influence on local precipitation but find a muted precession-scale response. Interglacial HEs in our record present inconsistent hydroclimate responses when considered through a framework focused on the complex character of the response. Insolation strength, atmospheric CO_2, and sea level may play key roles in modulating HE strength on Southeast Asian hydroclimate, highlighting this region's sensitivity to extratropical climate conditions under transitional climate regimes

Shannon White | 1:35 - 1:45 PM

Tracing Fluid Rock Interactions at Twin Sisters, WA

"Serpentinization of ultramafic minerals, primarily olivine and orthopyroxene, along fault surfaces alters the rheology and structure of their host rocks. The Twin Sisters ultramafic massif in Washington hosts a series of serpentinized brittle faults that cross-cut mostly unaltered dunite in the core of the range. Within thin, anastomosing serpentine-rich fault cores (thicknesses of 10s of cm to a few m), localized slip surfaces are primarily composed of magnetite and/or polished serpentine. In this study, we analyze the textures and the mineralogy of serpentinized fault surfaces to understand what minerals are present and their influence on fault behavior. We conducted textural analysis on six samples, and mineral identification via X-ray diffraction (XRD) on 14 subsamples. Preliminary petrographic observations of the fault surfaces reveal two groups: one with predominantly serpentine and patches of magnetite, and one of predominantly magnetite. Initial XRD results reveal all types of serpentine, with antigorite present on fault surfaces. Other identified minerals include magnetite, talc, forsterite, enstatite, and chromite. Triple-oxygen isotopes, $\delta^{18}O$ and $\Delta'^{17}O$, values range from +3.54‰ to +7.11‰ and -0.020‰ to -0.068‰, respectively. Based on initial observations, the samples, including all subsamples, fall into two groups: one with $\delta^{18}O$ +3.54 to +4.80‰ and one with $\delta^{18}O$ +5.39 to +7.11‰, which may reflect differences in fluid-temperature. We will apply our findings to the understanding of brittle fault behavior in the Twin Sisters, offering insights that may inform interpretations of deformation processes in other ultramafic complexes at Earth's surface.

Nina Gilkyson | 1:45 - 1:55 PM

Brine Entrainment During Ice Shell Growth on Icy Worlds

The role of ocean composition in governing ice shell growth and ocean longevity on icy satellites remains poorly constrained. To address this, we develop a thermomechanical model of small to mid-sized icy worlds that simulates ice shell growth from a saline ocean, explicitly quantifying brine entrainment through a parameterization of reactive transport at the ice-ocean interface. Using NaCl as a representative solute, we simulate a broad range of initial ocean salinities for tidal-free, synthetic icy worlds with characteristics of Europa, Enceladus, Dione, and Mimas. The model tracks shell growth, the initiation of bottom-up fractures triggered by ocean overpressure, and the coevolution of salt concentration in the ocean and the shell. In our simulations, freezing point depression slows basal freezing in saline oceans, which limits the generation of overpressure caused by the density difference between ice and water. At low initial salinities, liquid brine entrainment accelerates early shell growth, while at higher salinities, suppressed freezing lengthens ocean lifetimes. As freezing proceeds, shells develop C-shaped salinity profiles that scale with initial ocean salinity. Under conductive geotherms, liquid brine inclusions within the ice shell enhance radar attenuation, but penetration to the ice-ocean interface remains feasible across a wide-range of shell thicknesses and ocean salinities for most plausible brine geometries. Attenuation becomes significant only for highly elongated brine inclusions, highlighting brine microstructure as a key uncertainty for interpreting radar observations by NASA's Europa Clipper mission and ESA's JUICE mission.

Poster Abstracts

1. Anu Raghunathan

Coupled Ice-Ocean Simulations of Submesoscale Mixing from Sea Ice Melt in the Polar Oceans

Decadal variability of sea ice extent modulates the energy input into the upper polar oceans, with ramifications for the global heat budget. Sea ice itself is a composite material consisting of distinct, mobile floes, and its evolution is driven by complex, multi-scale interactions between sea ice and the upper ocean. Coupled simulations that resolve these interactions lend insight into how sea ice forms and responds to energetic ocean mixing processes. However, sea ice is frequently represented as a continuum in earth system models for computational efficiency, meaning that localized mixing processes induced by its heterogeneity may not be explicitly resolved. At the same time, commonly used ocean mixing parameterizations under-perform at capturing the energetics of the under-ice mixed layer. To investigate the impacts of coupled interactions on under-ice ocean mixing, I conduct a series of coupled ice-ocean simulations of the frontal adjustment induced by lateral buoyancy gradients at a sea ice edge after melt. These simulations utilize a discrete element model of sea ice that allows for floe collision and other mechanical interactions. By analyzing the frontal spindown, I investigate the development of submesoscale eddies across the front forced mechanically by the ice cover.

2. Sierra Khan

Regolith Thickness and Crater Morphology at the Artemis III Landing Regions

This study investigates regolith thickness in candidate Artemis III landing regions near the lunar South Pole. Regolith is the layer of unconsolidated rock and dust that overlies bedrock and is formed primarily by meteoritic bombardment. Thus, regolith thickness provides valuable insight into the geological history and relative age of the lunar surface. To estimate regolith thickness, we analyzed rocky and non-rocky ejecta craters using Narrow-Angle Camera (NAC) images from the Lunar Reconnaissance Orbiter. In total, 276 simple craters were examined. The landing regions were divided into "inner" and "outer" regions based on their proximity to the South Pole. Each crater was classified based on its degree of degradation and the rockiness of its ejecta. Our results indicate an average regolith thickness of approximately 4.84 meters across our regions of interest. Several surprising trends were also identified. For example, craters within the "inner" regions appeared more degraded. These findings are significant because they help constrain regolith thickness in the lunar South Pole region. This is critical for both scientific understanding and mission planning. Characterizing regolith thickness in these candidate landing areas is particularly important as NASA prepares for the upcoming Artemis III human landing mission.

Poster Abstracts

3. Wenhao Zhao

Tidal Heating of the Lunar Magma Ocean: Implications for Lunar Differentiation and Nearside–Farside Dichotomy

Lunar Magma Ocean (LMO)–related samples, including ferroan anorthosites (FAN) and Mg-suite rocks, yield ages clustered near 4.35 ± 0.05 Ga, implying that the LMO remained hot for >100 Myr after Moon formation (~4.50 Ga) yet then solidified rapidly. This strongly nonlinear thermal evolution remains elusive in lunar science. We propose that this behavior arises naturally from rheology-controlled tidal heating within the LMO itself. As the LMO crystallizes, viscosity increases by orders of magnitude; both very low-viscosity melt and very high-viscosity solid dissipate tidal energy inefficiently, whereas tidal heating can increase by several orders of magnitude at intermediate viscosities when viscoelastic relaxation timescales match the tidal forcing period. Using a coupled 0-D thermal–orbital model, we obtain a long-lived stable thermal plateau in which tidal heating (>30 TW) balances heat loss, followed by an unstable thermal cliff where declining forcing and departure from the transitional rheological window shut down heating within <30 Myr. Importantly, the same mechanism can naturally generate nearside–farside asymmetry through spatially variable tidal dissipation and cooling rates, biasing crystallization timing and cumulate formation and producing hemispheric differences in residual melt, incompatible-element enrichment, and early crust–mantle structure. These results indicate that LMO evolution was governed not only by internal processes, but also by gravitational interactions between the Earth and the Moon.

4. Nick Wagner

The Lopsided Moon: Tidal Signals of a Heterogeneous Interior

In the absence of structural asymmetry, the lunar tidal Love numbers should be order independent. Through careful analysis of GRAIL's non-static gravity field, a recent study by Park et al. (2025; Nature) extracted statistically different ordered Love numbers for the monthly Moon tides, indicative of large scale laterally varying internal structure. In their study, they inverted for variations in shear modulus within the lunar mantle and interpreted these variations in the context of temperature variations. In a complementary, though distinct vein, we jointly invert these new Love numbers, augmented with the same Love numbers for the yearly tides, in tandem with the free-air gravity field and the center-of-mass to center-of-figure offset, to produce a long-wavelength tomographic model of the Moon's mantle density, elastic, and anelastic properties. To do this, we adapted a normal mode perturbation theory able to predict tidal deformation derived for the Earth that incorporates the Moon's rotation, lateral variations in density, shear and bulk moduli, attenuation, and boundary topography such as the crustal-mantle interface and the core-mantle boundary (Lau et al., 2015; GJI). Since we self-consistently solve for density, shear modulus and attenuation, we are able to interpret our results in the context of both temperature and compositional variations, finding a lower contribution to variations in temperature than in Park et al.'s work and independent density variations within the nearside-farside mantle asymmetry.

Poster Abstracts

5. Xi Chen

Orographic Control of Pacific Mean State and Warming Pattern Biases in CESM1

American mountain ranges play a critical role in shaping atmospheric circulation and precipitation, particularly over the Pacific. However, their narrow structure is often overly smoothed in CMIP-class models due to coarse resolution. Previous studies have shown that better representation of these mountains improves simulations of the Intertropical Convergence Zone (ITCZ), marine low cloud feedback, and tropical Pacific sea surface temperature (SST) patterns. These features are closely linked to models' inability to reproduce the observed historical warming pattern, which includes cooling over the southeast (SEP) and northeast Pacific (NEP).

6. Lex Schultz

Brine evolution and habitability in ice shells on ocean worlds: insights from experimental freezing and geochemical modeling

Icy satellites such as Europa and Enceladus are prime astrobiological targets due to subsurface oceans covered by ice shells. In addition to global oceans, brine pockets trapped within the ice shell may provide persistent, nutrient-rich microenvironments capable of supporting microbial life, representing accessible habitats even if the underlying ocean is distant or shielded. Understanding how brines evolve during freezing is therefore critical for assessing habitability and interpreting remotely observable chemical signals during spacecraft missions that cannot reach the subsurface ocean.

We combined laboratory ice core experiments with geochemical modeling in PHREEQC using the FREZCHEM Pitzer database to quantify brine evolution, mineral precipitation pathways, and water properties during progressive freezing. Eight ice cores representing $MgSO_4$-rich (Europa-like), NaCl-rich, and Na_2CO_3-rich (Enceladus-like) endmembers were grown via top-down solidification and sampled at 2 cm intervals. Measured chemistries were used to simulate freezing to in-situ and eutectic temperatures, tracking residual brine composition, phase assemblage, ionic strength, water activity, and porosity.

Modeled precipitate assemblages provided a framework for interpreting ion fractionation in the core analyses, linking observed enrichments and depletions to specific mineral precipitation pathways (e.g., gypsum, mirabilite, meridianiite, picromerite, nahcolite, sylvite, hydrohalite). Results show depth-dependent trends in porosity, ionic strength, and water activity, and highlight how thermal history and ocean composition shape fractionation and habitability conditions.

7. Uijin Cho

Shifts in monsoon transition periods intensify air pollution exposure in Seoul, South Korea

In Seoul, South Korea, the atmospheric environment has been long influenced by the interaction between transboundary pollution and precipitation from the East Asian summer monsoon, whose rainfall plays a central role in removing fine particulate matter through wet deposition. To examine how this relationship has evolved, this study analyzes long-term shifts in atmospheric pollution and rainfall seasonality in Seoul over the last 35 years. Results indicate a significant delay in the onset of the East Asian summer monsoon, which now begins approximately one month later than during the 1990s-early 2000s. Concurrently, the annual peak in fine particulate matter ($PM_{2.5}$) has shifted from spring to winter, occurring roughly three months earlier than historical patterns. This change in seasonal patterns has increased population-level exposure to $PM_{2.5}$ by approximately 50% during the transitional months between peak and minimum pollution levels. Because winter already corresponds to heightened respiratory vulnerability, these changes compound health risks for the city's nearly 10 million residents. These results indicate that climate-driven changes to precipitation seasonality are altering the pollution patterns in Seoul, reinforcing the need for adaptive air-quality management strategies to protect residents from evolving pollution threats.

8. Sophia Wu

Hadley Max 500-Day Design Reference Mission (DRM) to the Apollo 15 Hadley Apennine Region: Visualization Technologies as Aids in Mission Design and Traverse Planning

Inspired by Apollo 15's samples across the Hadley-Apennine region and growing interest in long-term missions to the Moon and Mars, the Hadley-Max 500-Day Design Reference Mission (DRM) uses the more familiar Apollo 15 landing mission to identify mission and technology requirements for a 500-day mission to Mars. This analysis builds on previous research examining the use of digital elevation model (DEM)-derived perspective visualizations to support mission design and traverse planning. A Shape from Shading (SfS)-refined DEM tile synthesized from LROC NAC DTM products was directly imported into a displace modifier in the 3D computer graphics software Blender. Displacement strength could be calculated using elevation range, and elevation was color-scaled using Blender's native color ramp node. This 3D model was then used to simulate mission design aspects such as stills and flyovers. Approach, descent, and landing (ADL) models, as demonstrated during the Chang'e (CE) 3 mission, can help evaluate landing safety and terrain slopes through directional perspective views or circling flyover views for the Hadley-Max DRM. Post-Landing Surface and Rover Images (PLSRI), as developed for the 2003 Mars Exploration Rover (MER) mission, can provide critical surface information of topography, slopes, and crater distributions that inform sample acquisition and traverse planning. Non-Rover Accessible (NRA) models can be visualized with "flythrough" perspectives into otherwise inaccessible areas for hazard assessment and mission planning. Through various perspective renderings, we demonstrate the importance of imaging systems and the ways DEM-derived models enable evaluations of terrain across mission phases.

9. Ellen Jorgensen

Warming, Drying, and Fire: The Amazon under Quaternary Climate Extremes

The Amazon basin, the greatest center of terrestrial biodiversity on Earth, approaches an uncertain future in the face of global climate change due to lack of historical climate observations. Rising temperatures, intensified dry seasons, forest fires, and increased climate variability threaten the stability of the rainforest ecosystem, but models present significant disagreement in their projections. Uncertainty in the degree of temperature and precipitation change as well as the response of the Amazonian ecosystem to that change makes it challenging to predict the threshold of environmental stress that might cause an ecological tipping point, transitioning the lush rainforest into savanna, grassland, or desert. In this study, we reconstruct temperature, precipitation, vegetation regime, and fire history of two late Quaternary lake sediment records from the northwestern and northeastern Amazon basin, respectively. These records tell a story of 4-5°C warming from glacial to interglacial periods and extreme departures from modern precipitation delivery. During the last interglacial period, we identify conditions warmer and significantly drier than the present, yet throughout our records we find evidence of an adaptive and resilient closed canopy forest. Reconstructions of fire history from these sites suggests that, while burning has occurred in the past, the rainforest has experienced unprecedented fire activity in the most modern sections of our cores. Our results suggest that the Amazon rainforest has withstood temperature and hydroclimate stress equal to or greater than present-day conditions, demonstrating a remarkable degree of ecological resilience. However, the scale and intensity of fire activity in the most recent part of our records are unprecedented over the late Quaternary. Human-derived burning, a novel stressor, therefore complicates our ability to predict how the forest will respond under continued anthropogenic pressure.

10. DEEPS DIAC

Brown Department of Earth, Environmental, and Planetary Sciences Diversity, Inclusion, and Action Committee (DIAC)

This poster will provide information on who we (the DIAC) are, what we have done in the past, how you can get involved, future efforts and requests for community participation and feedback.

Poster Abstracts

11. Abhinav Jindal

The Paths that Sculpt a Comet

Cometary surfaces exhibit striking morphological diversity, characterized by a dichotomy between thick, smooth regolith deposits and exposed, fractured bedrock. While this heterogeneity is known to reflect spatially variable sublimation-driven erosion and sediment transport, the specific mechanisms that organize these materials remain poorly understood. This study investigates these dynamics on comet 67P/Churyumov-Gerasimenko using a velocity-resolved ballistic transport model to track the trajectories of cm-dm-sized particles over multiple ejection-deposition cycles.

By isolating distinct velocity regimes (0.1–0.9 m s^{-1}), we demonstrate that the nucleus's irregular shape, gravity field, and rotation act as filters for otherwise chaotic dust trajectories. Our results identify three fundamental geomorphic regimes that govern surface evolution: Collectors, where trajectories converge and sediment accumulates; Shadow Zones, which are sheltered from incoming sediment by upstream topography; and Ejectors, located primarily near the rotational equator, which preferentially lose material to space.

This framework reproduces the observed global distribution of 67P's smooth terrains and provides a physical basis for the spatial patterns of surface activity and inactivity recorded by the Rosetta mission. We conclude that ballistic transport is the primary mechanism driving the long-term organization of cometary landscapes. These findings offer a predictive tool for interpreting the surface evolution of other small bodies and provide essential context for future sample-return missions.

12. Jared Kodero

Soil Moisture–Precipitation Interactions in the Northeastern United States: Using A Convection-Permitting Model (GFLD SHiELD)

Land–atmosphere interactions influence convective precipitation, but their role in temperate regions such as the northeastern United States remains poorly constrained. Previous research has primarily focused on strongly coupled land–atmosphere regions identified in the Global Land–Atmosphere Coupling Experiment (GLACE). This study examines the effect of soil moisture anomalies on convection using the Geophysical Fluid Dynamics Laboratory System for High-Resolution Prediction on Earth-to-Local Domains (GFDL SHiELD) with a convection-permitting nest of approximately 3 km over the northeastern United States. Soil moisture perturbation experiments modify initial soil moisture by $\pm 1\sigma$ and $\pm 2\sigma$ relative to a control simulation. Each experiment runs for 168 hours, with perturbations introduced after a 24-hour spin-up period to allow atmospheric equilibration.

Results indicate that soil moisture substantially modulates convective behavior. Wet soils enhance latent heat flux and boundary-layer moisture, producing greater precipitation totals and broader spatial coverage. Dry soils increase sensible heating and boundary-layer instability, generating stronger but more localized convective updrafts with reduced precipitation area. Soil moisture anomalies also shift the spatial distribution of precipitation events, indicating that land-surface conditions influence convective initiation and storm organization even when large-scale forcing is unchanged.

13. **Katya Yanez**

Spectral Confusion and Misidentification of Altered Augite-Rich Basalts

Pyroxenes are primary constituents of mafic rocks, making them among the most ubiquitous minerals in the Solar System. Pyroxenes are spectrally diagnostic in the VIS-NIR by strong absorption near ~1 and 2 μm bands caused by $Fe2+$ crystal field transitions (Burns, 1993). The position of both these bands shift systematically with calcium content (Adams, 1974; Cloutis & Gaffey 1991; Schade et al., 2004; Denevi et al., 2007, Klima et al., 2011). At high Ca, the ~2 μm band can become subdued or disappear, and the long-wavelength shift of the ~1 μm band increases potential confusion with olivine.

Our results demonstrate that altered, augite-rich basalts can produce VIS–NIR spectra resembling those expected for altered olivine-bearing lithologies. In our samples, pyroxenes with typical augite compositions (~Wo41) lack a detectable ~2 μm band, extending "missing 2 μm" behavior to lower-Ca pyroxenes than previously documented. Spectral features of Fe-rich clays formed during the alteration of these materials overprint mafic features further complicating pyroxene identification. Augite-rich basalts should occur on Mars, as three augite-rich shergottites with broadly similar compositions are recognized in the Martian meteorite collection (Herd et al., 2017; Lapen et al., 2017; Herd, 2022). However, we still don't know how widespread this lithology is on the Martian surface, in part because the VIS–NIR spectral properties of augite-rich materials—both meteorites and terrestrial analogs—remain poorly characterized. Our work aims to document and quantify these spectral signatures to improve identification from remote sensing observations.

14. **Tianyi Li**

Inversion of multicomponent diffusion parameters through Markov Chain Monte Carlo Simulations

Diffusion experiments conducted in piston cylinder apparatus of 9 major oxides were carried out at 1300°C, 1400°C, and 1500°C under 1GPa between two diffusion couples containing Alkali Basalt and Basaltic Andesite melts. Major element concentration profiles were measured using electron microprobe. Markov Chain Monte Carlo simulations were performed on the major element diffusion profiles to estimate key parameters including D0 (pre-exponential factor), alpha and beta (empirical parameters that characterize compositional dependence of self and coupled diffusion), and C_ref (reference composition) to establish the parameterization of composition-dependent multicomponent diffusion. The inferred parameter values are then used to evaluate the temperature dependence and to determine the activation energy for multicomponent diffusion.

Poster Abstracts

15. Savanah Herrera

IN SITU AGRICULTURE AND BASE RESUPPLY: LESSONS FROM THE INTERNATIONAL SPACE STATION (ISS) FOR THE HADLEY MAX 500-DAY DESIGN REFERENCE MISSION (DRM) & MARS.

Long-duration lunar missions will require new approaches to food production, waste recycling, and logistical planning. This study examines how lessons from plant-growth systems on the International Space Station, including Veggie and the Advanced Plant Habitat, can inform in situ agriculture for the Hadley Max 500-day lunar Design Reference Mission. Prior ISS work shows that controlled-environment agriculture can successfully support small, high-value crops in space, but current systems are not yet capable of meeting full crew caloric needs. Instead, lunar agriculture is best understood as a life-support component that supplements crew nutrition, psychological well-being, and water recycling rather than replacing Earth-based resupply.

Based on this assessment, I evaluate the implications for lunar base architecture and resupply strategy. Because bulk calories, seeds, tools, and nutrient supplies will still need to come from Earth, resupply must remain a central part of mission design. At the same time, agricultural systems can be progressively expanded through a three-phase plan: an initial supplemental greenhouse, a larger closed-loop greenhouse integrated with waste and thermal systems, and a long-duration bioregenerative module aimed at greater autonomy. These results suggest that lunar agriculture should be designed as an integrated engineering system and can serve as a valuable prototype for future Mars missions.

16. Mina Bahadori

Revealing Arctic Sea Ice Dynamics Under Cyclones via Simulation

The Arctic is entering a new era characterized by thinner ice, decreased ice extent, and changing weather. Even during extreme events, such as Arctic cyclones, these dynamics exhibit significant variations. Such variations will induce notable changes in sea ice dynamics, including sea ice motion, transport, and distribution, resulting in new trends in sea ice melting. This study investigates the effects of Arctic cyclones on sea ice motion through simulations and observations. We first employed ERA5 data to examine Arctic cyclone structure and dynamics, comparing them to the Rankine vortex model. The retrieved idealized cyclone velocity fields were then used to estimate the upper ocean velocity fields beneath the sea ice. Numerical simulations of sea ice with the wind cyclone and upper ocean fields were conducted using the Subzero discrete-element sea ice model to examine sea ice trajectories under cyclones. The size of the ice floe and the turning angle between the ice and wind field affect the trajectory. The model simulates the motion of pieces of sea ice in response to the wind and ocean currents. This study provides insights into how cyclones influence sea ice motion and ocean dynamics and their potential contribution to sea ice melting.

17. **Avery Park**

LIFE-SUPPORT SYSTEMS: LESSONS FROM THE INTERNATIONAL SPACE STATION (ISS) FOR THE HADLEY MAX 500-DAY DESIGN REFERENCE MISSION (DRM)

Life-support systems aboard the International Space Station provide critical insight for designing sustainable habitats for long-duration missions such as the Hadley Max 500-Day Design Reference Mission (DRM). This study focuses on three core Environmental Control and Life Support System (ECLSS) components: the Water Recovery System (WRS), Oxygen Generation System (OGS), and Air Revitalization System (ARS). Lessons from ISS operations emphasize that future missions must prioritize fully closed-loop systems, reduced Earth dependency, and improved durability to ensure cost-effective and sustainable human space exploration.

18. **Chandler Morris**

ENSO-driven hydrological variability in the tropical Pacific – sea surface salinity and oxygen isotope observations versus models

The El Niño-Southern Oscillation (ENSO) drives hydroclimate extremes globally. Emerging evidence of amplified ENSO-related hydrological variability under anthropogenic forcing therefore has broad societal implications. Studies of ENSO and associated hydroclimate extremes are constrained by the limited length of instrumental observations. As such, many studies leverage proxy oxygen isotope records in paleoclimate archives as a tracer of hydrological processes to reconstruct past ENSO variability. However, interpretation of ENSO-related hydrological signals in these isotope archives is hindered by limited understanding of the spatiotemporal expression of ENSO variability in seawater $\delta^{18}O$ ($\delta^{18}O_{sw}$) across the tropical Pacific. Seawater isotopologues, particularly oxygen isotopes, provide valuable tracers of hydrological processes, including atmospheric and ocean dynamics (Stevenson et al., 2018; Dee et al., 2023), and exhibit high correlations to salinity through space and time. In this study, we use in situ $\delta^{18}O_{sw}$ measurements across the tropical Pacific (Atwood et al., 2026), as well as gridded SSS reanalysis datasets (e.g. ORAS5) to evaluate the hydrological representation of ENSO in the Community Earth System Model. We characterize the spatiotemporal expression of ENSO-related hydrological changes in both observational data sets and climate model simulations of SSS and $\delta^{18}O_{sw}$. Through data-model comparison, we quantify model biases in simulated historical seasonal and interannual variability across ENSO events of varying strength and spatial expression. Detailed investigations of the modeled $\delta^{18}O_{sw}$ variability can yield insight into the dynamical linkage to ENSO variability and provide a framework for an improved reconstruction of past ENSO.

19. Brianna Hoegler

Linking Geochemistry and Paleontology to Assess the Impact of Coccolithophore Community Structure on PIC:POC Export

Coccolithophores, calcifying marine algae, play a dual role in the ocean carbon cycle: they sequester carbon as particulate organic carbon (POC) while releasing CO_2 during calcite (particulate inorganic carbon, PIC) production. This distinguishes them from non-calcifying phytoplankton and makes them an important regulator of air–sea CO_2 exchange. As climate change alters marine productivity, shifts in phytoplankton community structure may impact PIC:POC production and burial, making it critical to understand the balance between carbonate and organic carbon export.

Coccolithophore communities are diverse, with some species favoring carbonate export and others exporting primarily POC. Alkenones—lipid biomarkers produced by certain coccolithophores—are widely used to reconstruct past marine conditions and are hypothesized to qualitatively reflect export productivity (EP). However, the relationships among alkenone abundance, PIC:POC export, and community composition remain poorly constrained.

We hypothesize that C_{37} alkenones reflect export by the total phytoplankton community, rather than being coccolithophore-specific. To test this, we analyze core-top sediments from 130+ globally distributed sites, comparing C_{37} alkenone concentrations, fine-fraction PIC content, and nannofossil assemblages. Using SYRACO software, we quantify the relative abundance of modern alkenone producers (*Gephyrocapsa huxleyi, G. oceanica*). We integrate these data with satellite ocean color observations to assess how community composition influences carbonate and alkenone export. Our results refine interpretations of alkenone-based EP reconstructions and improve understanding of coccolithophore-driven carbon cycling.

20. Katarina Merk

Submesoscale Eddies as a Significant Export Pathway of Dissolved Organic Carbon at BATS

(Sub)mesoscale dynamics strongly influence upper-ocean biogeochemistry and tracer transport, yet their role in dissolved organic carbon (DOC) export remains poorly quantified. Although DOC represents the largest oceanic carbon reservoir, key discrepancies remain regarding its cycling and sequestration. Traditionally, DOC is thought to accumulate in the surface and mix into the deep ocean during winter convection. We demonstrate that submesoscale dynamics can drive significant DOC flux year-round. Observations at the Bermuda Atlantic Time Series (BATS) suggest that eddies serve as an export pathway for non-sinking particulate organic carbon (POC), indicating that carbon export is not limited to sinking particles. To evaluate this for DOC, we utilized three model configurations: a 1D model of BATS, a submesoscale-permitting passive tracer model in MITgcm, and the 1D BATS model coupled with the same MITgcm physics. Our results show that submesoscale dynamics change the mean state of DOC, limiting the summertime accumulation of the semi-labile DOC fraction in the surface and increasing DOC and POC concentrations at depth. Additionally, we show that eddies transport DOC below the mixed layer, introducing variance independent of convection while occasionally enhancing productivity. In the model, eddy-driven DOC flux is comparable to POC sinking flux during winter and accounts for approximately one-third of the flux in summer. Notably, biophysical coupling generates significantly larger fluxes of DOC than the passive tracer model alone. These findings identify eddy DOC flux as a major export pathway at BATS and emphasize the necessity of resolving fine-scale physical–biogeochemical interactions to accurately predict carbon export.

21. Vivien Chen

Short-Term PM2.5 Exposure and Emergency Room Visits: A Case-Crossover Study in Providence, Rhode Island

Air pollution causes 7 million deaths worldwide per year, with fine particulate matter (PM2.5) linked to 50,000 premature deaths annually in the U.S.. Long-term PM2.5 exposure is associated with chronic conditions such as COPD and lung cancer. However, PM2.5 levels are highly variable on daily and hourly time-scales due to meteorology, traffic emissions, and industrial activities. Numerous epidemiological studies have shown strong positive associations between short-term exposure to elevated PM2.5 and acute health outcomes like emergency department (ED) visits for cardiovascular and respiratory diseases.

Breathe Providence is a hyperlocal air quality network that was established in summer 2022. It consists of 25 sensors distributed throughout Providence, Rhode Island. Using data from this source, we conducted an in-depth analyses of the temporal and spatial patterns of PM2.5 across the city. Additionally, we have partnered with the Rhode Island Department of Health (RIDOH) to obtain hospital discharge data. This allowed us to perform a time-stratified case-crossover study, using PM2.5 concentrations from the Breathe Providence network as the exposure and cardiovascular & respiratory-related emergency room (ER) visits as the outcome. Our findings revealed significantly increased odds in having an ER visits with same day, next day, and moving-averages exposures to PM2.5, indicating both short-term and accumulated effects. A distributed lag model further showed that the strongest associations occurred 1-2 days after exposure. The overall cumulative odds ratio for a 4 $\mu g/m^3$ increase in PM2.5 was calculated as 1.25, corresponding to a 25% increase in odds of ER visits within five days of exposure.

22. Abby Case

Imaging Rayleigh wave attenuation in the western United States

We are investigating the upper mantle attenuation structure of the western United States with Rayleigh waves observed at EarthScope USArray stations. The sensitivity of seismic attenuation to material properties such as temperature, grain size, and partial melt content is complementary to shear wave velocity. These material properties help to constrain Earth's broadband rheology (Havlin et al. 2021). Rayleigh wave attenuation measurements provide sensitivity to Earth rheology at intermediate periods of tens to hundreds of seconds, which aids in constraining the frequency dependence of Earth's rheology. However, obtaining robust images of attenuation can be challenging, because it is difficult to isolate the attenuation signal in seismic wave amplitude observations. Here, we explore whether factors such as station geometry, back-azimuthal coverage of earthquakes, overtone interference, and earthquake attributes, such as magnitude and focal mechanism, can introduce bias into Rayleigh wave attenuation images recovered using an array-based wavefront-tracking approach (Russell & Dalton 2022). We find that the recovered Rayleigh wave attenuation can be biased by these factors, and we develop an earthquake catalog to minimize bias. We present preliminary Rayleigh wave attenuation maps in the western United States produced with this earthquake catalog.

Poster Abstracts

23. Eleanor Barth Wu

Legacy Industrial Metal Contamination in Urban Soils: A Case Study from Providence, Rhode Island

Providence, Rhode Island has a long industrial history spanning more than two centuries. Urban soils in cities with similar industrial legacies often contain elevated concentrations of heavy metals. This study assesses the modern impacts of legacy industrial metal pollution across Providence by investigating the persistence of heavy metals, particularly As, Cu, Mn, Pb, Zn, at historically hazardous industrial sites in the city. Sampling locations (n = 35) were informed by a citywide compilation of industrial activity spanning the past 150 years and include former laundromats, gas stations, automobile repair shops, textile mills, manufacturing plants, coal refineries, and jewelry manufacturers. We compare the metal concentrations of these legacy sites to nearby, non-industrial areas. X-ray fluorescence (XRF) measurements indicate background metal concentrations comparable to those reported in other cities with long industrial histories, although seven sites exhibit soil metal concentrations 10–100 times above background levels. While sites associated with former laundromats show elevated average metal concentrations relative to baseline soils, high-concentration metal point sources are not associated with any single industry type. Instead, the high outliers in metal concentration may reflect site-specific remediation history or site-specific factors that vary among otherwise similar industries. Ongoing work explores source fingerprinting using industry-specific multi-element metal signatures and Pb isotope measurements.

24. Kathy Sun

Aquatic Phytoplankton Optimal Growth Depends on Salinity Stress

Diatoms are phytoplankton that drive approximately 20% of global carbon fixation, comparable to the productivity of terrestrial rainforests. However, their growth is highly sensitive to environmental fluctuations and the impact of many environmental factors is underrepresented in biogeochemical models. This exploratory study investigates the addition of salt-stress as a regulatory constraint within a proteome allocation model to show how osmotic stress constrains diatom productivity.

Proteome allocation models treat the cell as a system governed by sets of ordinary differential equations. The key idea is that a cell has a limited budget and must strategically allocate its internal resources between various metabolic pathways to maximize its growth rate.

By framing the cell as a resource-limited system governed by differential equations, we model the strategic partitioning of intracellular machinery between competing metabolic pathways, such as light-harvesting and nutrient uptake. We extend this framework by incorporating salinity as a dynamic modifier of catalytic rate constants and metabolic flux, specifically focusing on Photosystem II (PSII) efficiency and enzymatic inhibition. By co-parameterizing salinity with temperature, the model captures shifting proteome trade-offs under environmental stress.

Analytically, this study investigates how salinity-induced inhibitory parameters impact the sensitivity and stability of the proteome allocation model's steady-state solutions. By analyzing the key biological parameters driving diatom life cycle transitions, we can link microscopic cellular mechanics and macroscopic ecological outcomes. Eventually, we hope to better project how shifting ocean salinity will reshape diatom populations and their role in the global carbon cycle.

Poster Abstracts

25. **Sari Woo**

The Gut Microbiome in Long Term Space Missions For the Hadley-Max 500-Day Design Reference Mission & Mars

The gut microbiome is a vibrant community of bacteria, fungi, and other organisms with many key physiological roles which are heavily dependent on the composition and diversity of these microbes. Dysbiosis is characterized by an imbalance or decreased diversity in the microbiome, often inducing an inflammatory cascade. Astronauts on long-term space missions have microbiomes characteristic of dysbiosis.

Long-term space missions can lead to a variety of adverse health outcomes due to factors such as poor nutrition, ionizing radiation, microgravity, isolation, disrupted circadian rhythm, and poor conditions for optimal immune function. The microbiome can either exacerbate or alleviate these challenges.

Nutrition is a key factor in the gut microbiome, with certain elements such as fiber and polyphenols promoting gut health, while added sugars and saturated fats harm gut health.

The gut-bone axis is an emerging field. With microgravity leading to bone loss and increased risk of fractures, it is crucial to minimize other factors causing bone loss. Short-chain fatty acids (SCFAs) produced by commensal bacteria can help stimulate bone formation and blunt bone resorption.

Isolation, confinement, and sleep disturbances can cause stress and decreased performance. The microbiome is heavily implicated in brain health, and dysbiosis has been linked with increased rates of depression and anxiety.

Increased potential of antibiotic resistance, reactivation of latent viruses, biofilms, radiation sickness, increased iron from Martian dust, microgravity impairment (more pro-inflammatory cytokines and less T-reg cells) all contribute to concerns for immune vulnerability. Dysbiosis can contribute to inflammation through immune dysregulation while SCFAs modulate inflammation.

26. **Hairuo Fu**

Advancing Giant-Impact Hypothesis Testing: Integrating Impact Simulations with Pre-Impact Body Differentiation

Coupling SPH impact simulations with magma-ocean differentiation of the pre-impact bodies shows that canonical giant-impact models struggle to explain the Earth–Moon compositional similarity, supporting a high-energy impact lunar origin.

27. Cameron Adams

Oxygen isotope insights into the HIMU source at Mangaia

Geochemical analyses of oceanic hotspot lavas exhibit extreme chemical heterogeneity that is interpreted to reflect a chemically diverse, deep-Earth interior established through partial melting and crustal recycling. In direct contrast, oxygen (O) isotopic compositions are generally considered homogenous in Earth's convecting upper mantle. An extreme example is provided by lavas erupted at the island of Mangaia, a type locality for the high-μ (μ = 238U/204Pb, HIMU) geochemical signal which demonstrates strong geochemical evidence for recycled oceanic crust dominated by >2.0 Ga material in its source. Previous reports of oxygen isotope data from Mangaia lavas are limited and but appear to show minimal departure in $\delta^{18}O$ from that of the assumed upper mantle. This study reports $\delta^{18}O$ and $\Delta'^{17}O$ in olivine and clinopyroxene separated from nine Mangaia basalt samples. The data reveal considerable isotopic variability; $\delta^{18}O$ ranges from +2.378‰ to +6.307‰ (±0.352, 2σ) and $\Delta'^{17}O$ ranges from -0.041‰ to -0.085‰ (±0.008, 2σ). The $\delta^{18}O$ values of olivine and clinopyroxene pairs indicate that they are not in isotopic equilibrium, which may result from a heterogenous mantle source, coupled with assimilation of ancient metasomatized SCLM. The observed co-variation in $\delta^{18}O$ and $\Delta'^{17}O$ lends credence to this hypothesis, but it cannot rule out the involvement of additional processes or sources. Ultimately, this work shows that mantle plume lavas are not homogenous with respect to oxygen isotopes and that the additional measurement of $^{17}O/^{16}O$ is valuable for understanding the extent of plume-lithosphere interaction, as well as the dominant source of recycled materials within a single plume system.

28. Muyu Ye

Seasonal Orographic Influence of the African Mountain Range and Its Remote Control on the Atlantic Climate

African orography plays an important role in shaping multiple existing climate linkages and sea surface temperature patterns. This study investigates the relative seasonal influence of its eastern (EO) and southern (SO) mountain ranges on the SST of the South Atlantic. Here, we use CESM1.2 with a slab-ocean model to conduct 20-year sensitivity experiments by removing EO, SO, and combined orography (SO + EO).

EO removal produces localized temperature and moisture anomalies confined to East Africa and the Indian Ocean with minimal Atlantic responses. In contrast, SO removal triggers larger scale South Atlantic warming, linked to decreased low-level cloud cover east of the Atlantic, reduced evaporative cooling west of the Atlantic, and southward ITCZ displacement. Wind anomalies indicate reorganization of low-level circulation and stationary Rossby waves extending into the South Atlantic, reducing moisture convergence and increased specific humidity south of the equator. Notably, SO and EO removal increases SST with reduction of sea ice fraction near 60S, suggesting hemispheric energy imbalance and possible Southern Ocean teleconnections.

Combined EO+SO removal yields responses broadly additive to SO effects. Our results highlight the distinct roles of African orographic regions in shaping the Atlantic SST and emphasize its role in interhemispheric energy transport, moisture fluxes, and southern ocean teleconnections, those are processes critical for understanding past climates and future projects involving modified topography.

29. Gabriella Giampietro

~1,500 Years of Gardiner's Clay Varves Extend the Record of Laurentide Ice in Southern New England to Before the Last Glacial Maximum

Varves are lacustrine records that provide high-resolution paleoenvironmental and temporal frameworks during glacial time periods.The New England Varve Chronology, centered largely on Glacial Lake Hitchcock (c. 12.5 –18 ka), extends back to c. 20.5 ka. Our project focuses on the Gardiner's Clay, a pre-Last Glacial Maximum (LGM) Pleistocene varved deposit in eastern Long Island. The Gardiner's Clay varve succession predates the oldest cosmogenic nuclide dates associated with nearby Laurentide ice sheet retreat c. 24–25 ka. The Gardiner's Clay also occurs stratigraphically below the Montauk and Hempstead formations, which represent a distinct ice advance-retreat cycle prior to the advance of the Laurentide. The Gardiner's Clay is therefore substantially older than any other varve record in the region and is likely pre-LGM (>26.5 ka) in age. Lower and upper clay-rich units of the Gardiner's Clay each comprise >500 varves separated by a sandier varve-bearing unit which was not counted, resulting in an estimated total of 1,500 years of varve deposition in a proglacial environment. We compared the characteristics of this varve succession to the Hitchcock varves through grain-size, x-ray diffraction, and oxygen isotope analysis. Preliminary results on the clay fraction indicate clays depleted in ^{18}O, suggesting formation from waters derived from the Laurentide Ice Sheet in a pro-glacial lacustrine setting. This new record helps establish a long-lived pre-LGM proglacial lake in southern New England, as well as extending the duration and dynamics of proglacial environmental conditions associated with the advance of the Laurentide into southern New England.

30. Yuke Zheng

A new insight into macromolecular structure in asteroidal sample from pyrolysis study

Macromolecular organic matters are important components of organic matter in carbonaceous chondrites and asteroidal samples. The samples returned from asteroids Bennu and Ryugu from missions OSIRIS-REx and Hayabusa 2, respectively, provide unprecedented opportunity for us to study organic matter in extraterrestrial materials. We performed pyrolysis-GC-MS measurements on bulk powders of Bennu, Ryugu and Murchison. At 600℃, the macromolecules break into small fragments that can be analyzed by GC-MS. With the newly developed system and analytical procedure, we were able to extract information from macromolecular organic matter to an unprecedented extent. This advancement enables the reconstruction of macromolecular structures based directly on analytical data, complementing previously proposed structures that were primarily derived from theoretical hypotheses.

Poster Abstracts

31. Meredith Whitlock

Understanding Carbon Cycling In Urban Watersheds

Urbanization significantly alters river dynamics, influencing the movement of water and carbon throughout the environment. Although aquatic carbon cycling has been widely studied in natural rivers, there is a limited understanding of the sources and fluxes of aquatic carbon in urban regions. Carbon fluxes in watersheds affect biological and chemical interactions while altering atmospheric CO_2 exchange, with varying implications for stream health. In this study, we conduct biweekly synoptic sampling and monthly storm sampling to track chemical fluxes in dissolved inorganic carbon, dissolved organic carbon, and nutrients in two urbanized Rhode Island rivers. Observed trends include lower dissolved organic carbon and higher dissolved inorganic carbon in the more urbanized river, likely as a result of decreased microbial activity. More urbanized sites also exhibit high sulfate and nitrate concentrations, while the lesser urbanized sites share relatively high nitrate levels but exhibit low sulfate concentrations, implying differences in bedrock weathering and fertilizer input. These resulting data will be used in combination with USGS stream gage data to construct a widely applicable hydrologic reactive transport model to analyze patterns of cycling and speciation in Northeastern watersheds. Future sampling will expand to include in-stream chlorophyll concentrations along a rural-to-urban gradient to analyze carbon fluxes as they correlate to microalgae activity.

32. Logan Ramanathan

PLUME-SURFACE INTERACTIONS IN LUNAR OPERATIONS: APPLICATIONS TO THE HADLEY MAX 500-DAY DESIGN REFERENCE MISSION

Continued lunar operations—spanning CLPS landers, crewed HLS vehicles, and pre-deployed infrastructure—require a mature systems-engineering framework for plume-surface interaction (PSI). We outline the current state of PSI modeling, experimental validation, and mitigation, and apply these to the Hadley Max 500-day Design Reference Mission.

Recent theoretical work has revised the foundational erosion physics. Metzger (2024) demonstrated that the Roberts (1963) shear-stress model, the standard basis for CFD-based PSI work for six decades, is not accurate; erosion rate instead scales with kinetic energy flux at the base of the gas laminar sublayer. Calibrated against Apollo 16 descent video, the revised model predicts 11-26 tons of ejected mass per Apollo LM-class landing, roughly 4-10 times prior estimates. Parametric DSMC studies now provide correlations for ejecta velocity as a function of particle diameter, radial position, hover altitude, and lander mass, enabling first-order keep-out zone sizing.

Despite modeling advances, significant uncertainties persist. All current models assume viscous erosion dominates; at higher stagnation pressures, bearing capacity failure, diffused gas eruption, or diffusion-driven shearing could activate, potentially redirecting ejecta upward rather than at the shallow angles underlying existing keep-out estimates. Polar regolith porosity and volatile content introduce further unknowns. In-situ validation via SCALPSS and other experiments will be essential to validate models. We apply this framework to the Hadley Max DRM to assess mitigation strategies and mission operations design across lander classes and asset configurations.

33. **WaTae Mickey**

RESOLVING THE ORIGIN OF HADLEY RILLE: A REVIEW OF HYPOTHESES, REGIONS OF INTEREST FOR TESTING HYPOTHESES, AND IMPLICATIONS FOR EXPLORATION PLANNING FOR THE HADLEY MAX 500-DAY DESIGN REFERENCE MISSION

The Hadley Max 500-Day Design Reference Mission aims to serve as a testing ground for our approach to long-term human habitation on Mars by returning to the Apollo 15 landing site. Remaining on the lunar surface for such an extended duration requires astronauts to pursue a wide range of research objectives. The Hadley Rille is a sinuous rille that served as one of the primary scientific goals of the Apollo 15 mission. Sinuous rilles are winding, canyon-like features on the Moon formed through volcanic processes. Hadley Rille stands out due to its unusual size and prominent setting, which made it a key scientific target for the mission.

More than 40 years after Apollo 15, the origin of Hadley Rille remains uncertain. Proposed explanations include constructional processes, erosional processes, or a combination of both. New data on rock ages and topography, along with reinterpretations of previously observed features, provide insight into which of these hypotheses may best explain its formation while also supporting the development of a new hypothesis.

34. **Arianna Krinos**

Metatranscriptome-informed modeling to parameterize global diatom traits

Diatoms are spring bloom formers and dominant contributors to coastal carbon cycling. To explore diatom ecology and apply quantitative approaches to metatranscriptomic data, we leveraged annotations of diatom transporter genes responsible for import of nutrients into the cell to predict the response of diatoms to nutrient limitations over seasonal timescales and across oceanic nutrient gradients. We normalized the abundance of annotated transporter genes within metatranscriptomes from both time-series and spatial data to inform parameterization of a differential equation model for diatom succession driven by interpolated measured environmental data. We obtained simulation results that recapitulate observed patterns in diatom succession for the regional time-series data. We ran the model over the entire measured period for the time-series data using the consistently collected environmental driver data and compared metatranscriptome-informed predictions to observations from microscopic counts. Using the parameterizations informed by the time-series and transect metatranscriptomes, we ran a global ecological model (Darwin model) to investigate observed shifts in global diatom biogeography. Our results highlight how -omics approaches can refine trait diversity estimates in key phytoplankton taxa and refine global biogeochemical model simulations.

35. **Emily Hu**

A Multi-Omics Approach to Quantifying Eddy-driven Dissolved Organic Carbon Export in an Oligotrophic Ocean

The dissolved organic carbon (DOC) pool, which is released and recycled by marine microbes, constitutes a major reservoir for carbon in the ocean. In the western subtropical North Atlantic, time-series data has shown the accumulation of DOC in the surface ocean in the summertime, which is then introduced to the ocean interior through deep convective mixing in the wintertime. However, ocean eddies have been shown to contribute to particulate organic carbon export and likely also transport dissolved organic carbon to the mesopelagic on sub-seasonal timescales throughout the year. Here, we use a multi-omics approach to observationally demonstrate how microbial community structure and DOC cycling vary across an ocean eddy and to estimate the contribution of eddy subduction to DOC export in the oligotrophic North Atlantic. Taxonomic information from metabarcoding data is complemented by metaproteomics, metatranscriptomics, and metabolomics to interrogate how the metabolic function of these communities varies across an eddy. We compare and interpret our findings with a coupled physical-biogeochemical model for the Bermuda Atlantic Time Series (BATS) region to evaluate whether observed patterns align with mechanistic predictions.

36. **Eads Fouché**

Automated Surface Change Detection on Comet 67P/Churyumov–Gerasimenko

Comets are some of the oldest objects in our solar system and preserve its most primitive elements that reflect the processes that led to the formation and early evolution of the larger planets and moons. The Rosetta mission to Comet 67P/Churyumov–Gerasimenko (67P) provided a unique opportunity to study surface changes on these small, low-gravity bodies by becoming the first spacecraft to track a comet's journey through the inner solar system. Rosetta documented changes across the surface of 67P including erosion and deposition of smooth terrain, cliff collapses, and outbursts (Barrington et al. 2023). That said, the temporal and spatial distribution of these changes remains poorly understood. Here, we provide a novel machine learning pipeline for change detection on 67P. We use DINOV3, a foundational computer vision model, to map, classify terrains, and track surface evolution through 67P's perihelion passage. We document multiple new areas of erosion, deposition of smooth terrains, scarp retreat, boulder migration, and analyze how the comet's surface evolves daily and monthly and find that 67P's surface is more active than previously recorded. Our database highlights the complexity of surface evolution and how localized analyses are necessary to understand the comet's long-term dynamics. These data will be used for follow up studies that address major outstanding post-Rosetta questions including constraining 67P's dust to ice ratio, mass loss rates, and for sample site selection for upcoming sample return missions such as CAESAR. This pipeline will also be vital for other future missions to small bodies enabling for faster and more complete mapping and classification of surface morphology.

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37. **Matthew Moser**

Kaboom: Surface Manifestations of Cometary Outbursts

Comets are among the most primitive objects in the solar system, preserving key evidence of its origins and early evolution. These icy bodies store volatile compounds that are intermittently released, providing insight into their internal structure and composition. Among these processes, outbursts are the most extreme, involving sudden brightness increases and the rapid ejection of material. Such events have been observed across many comet types—including Jupiter-family comets, centaurs, and dynamically new comets—and occur under a wide range of conditions, from perihelion to aphelion and during both day and night. Despite their significance, the mechanisms driving outbursts and their impact on surface morphology remain poorly understood. ESA's Rosetta mission provided over two years of detailed observations of Comet 67P/Churyumov-Gerasimenko, capturing dozens of outbursts near perihelion. However, the comet's complex bilobate shape complicates surface analysis, limiting prior studies: although 34 major outbursts were identified, only 6 associated surface changes had been documented.

To address this gap, we developed a new tool that enables region selection on a 3D shape model of 67P, retrieves all relevant images, and projects them into user-defined coordinate systems. Using this approach, we map outburst-driven surface changes in high resolution and present a comprehensive analysis of how these events reshape cometary terrain. Our results show that cliff collapses, pit formation, and smooth terrain loss can all act as sources of outbursts. These findings provide important constraints for models of cometary dynamics, volatile redistribution, and long-term surface evolution, advancing our understanding of these dramatic processes.

38. **Cecilia D'Hondt-Gorbea**

Mapping Titan's Mountains Using Terrestrial Analogs

Mountains give us insight into the geological history and internal processes of planets. They can be used to study tectonics, crustal evolution, volcanism, and more. The Cassini RADAR Mapper revealed mountain belts on Saturn's moon, Titan, that are extremely similar to those found on Earth. Titan is the only icy body with large-scale linear mountain belts. This is particularly interesting because it's also the only icy body whose surface is subject to weathering from its active, global, liquid methane cycle. Past research has tried to establish the origins of Titan's mountains, however, due to the coarseness of Cassini Synthetic Aperture Radar (SAR) data and limited amount of topographical data, no consensus has been reached. Through this project we identify mountain ridges with the final complete imaging dataset and at a higher resolution than previous work. We classify mountains into one of six categories based on shape, texture, and interaction with surrounding geological features. We then use Cassini-quality SAR images of a variety of mountainous regions on Earth to more quantitatively constrain mountain formation pathways on Titan. Ultimately, our new mapping will help us to build a final global map of Titan's mountains, which we will then use to explore Titan's tectonic history. It will also broaden our understanding of orogenic processes beyond rocky bodies and into environments with very different chemical compositions.

39. **Anthony Merchan**

IBEX: A Unified Framework for Small Body Analysis

Understanding the surfaces of asteroids and other small bodies holds the key to unlocking some of the most fundamental questions about how our solar system formed and evolved. Yet the tools available to analyze and interpret the datasets returned by planetary missions have remained limited in scope, often built for a single mission, a single instrument, or a single target. IBEX was developed to change that.

IBEX, the Irregular Bodies Explorer, is a general small body mapping tool that combines Near-IR spectroscopic, thermal, and optical imaging data into a single unified pipeline. Designed to work across missions and be openly accessible, IBEX allows researchers to explore the surface of small bodies, filter observations by geometry, and project spatially resolved images directly onto high-resolution shape models. What usually requires a custom development for every new mission becomes a streamlined, repeatable process

The broader goal of IBEX is to close the gap between researchers and planetary data. There is no shortage of data in planetary science, what has been missing is an accessible, mission independent resource that makes those datasets truly usable. IBEX is designed to be that resource that is fully validated, openly documented, and built to grow alongside the missions and questions that define the next generation of small body science.

40. **Julia Miller**

Outgassing Rates as a Probe of Cometary Interiors

Comets are some of the most primitive objects in the solar system, and their structure and composition can provide clues about planetesimal formation and conditions during our solar system's early history. However, most telescope observations of comets do not resolve the nucleus itself, and the small number of spacecraft missions to comets have provided limited data on cometary interiors. In this study, we show that simple numerical and analytical models can be used to connect outgassing data from telescopes to the comets' interior properties.

Poster Abstracts

41. Emily Snell

Characterizing the SCLM: Insights from Patagonia

Understanding the formation, composition, and structural variation of the subcontinental lithospheric mantle (SCLM) in time and space offers broad insights into the stability of the Earth's continents, dynamics of continental glaciers, and the mantle compositional evolution. However, many global anomalies observed in the thickness, structure, and viscosity of the SCLM are poorly understood. I present work on 43 mantle xenoliths from nine different volcanic centers in Southern Patagonia, spanning regions affected by the subduction of the Nazca plate to areas affected by the subduction of the Chile ridge generating a present-day slab window. This enables me to examine the SCLM's response to these significant tectonic transitions.

I integrate (1) major- and trace-element mineral thermometry and oxybarometry to constrain pressure–temperature conditions and thermal histories, (2) crystallographic preferred orientations and microstructures to quantify mantle deformation and flow, (3) mineral volatile contents to estimate mantle viscosity, and (4) whole-rock radiogenic isotopes to determine the timing of metasomatic processes. These datasets provide a comprehensive framework to identify the tectonic and magmatic processes that alter the SCLM and the overlying continent's stability.
My results have implications for a broad range of questions in mantle dynamics and global Earth processes. In future work, I will validate mantle flow models in Patagonia and Antarctica using my microstructural and viscosity data. Both regions are experiencing rapid uplift due to mantle upwelling, weakening their continental ice sheets. Improved mantle flow models will better constrain continental ice-sheet evolution, linking mantle processes to our understanding of long-term global warming impacts.

42. Justin Custado

Mapping Southeast Asian climate research production: A bibliometric perspective

The academic publication process is a key mechanism for generating and disseminating scientific knowledge. Thus, patterns in bibliographic datasets can offer insights into who participates in research, and where it is funded, conducted, and published.

Climate change research is critical for regions such as Southeast Asia (SEA), where environmental and socioeconomic issues heighten vulnerability to a warming planet. International research partnerships help bridge knowledge gaps, particularly in countries with limited scientific capacity. However, this situation also raises concerns about balancing representation between local and external collaborators.

In this study, 729 publications were used to evaluate the publication and funding trends from 2014 to 2023 to assess the representation of SEA- and non-SEA-affiliated institutions in SEA physical climate research. We quantified author affiliations, publisher locations, funding acknowledgments, and citations by country and region. On a regional-scale, SEA-affiliated authors comprise 30.8% of total author country-affiliation counts, contributing to 53.6% of the manuscripts analyzed. This puts the combined research output of the 11 SEA countries slightly ahead of other geographical regions. SEA-based institutions were mentioned 251 times in funding statements, compared to 283 mentions for USA and European institutions combined.

Country-scale analysis, however, shows a concentration of authors with USA, Chinese, and Japanese affiliations. These three countries comprise 37.5% of country-affiliation counts and contribute to 56.8% of the manuscripts. Additionally, 90.3% of the journal publishers are based in the USA and Europe.

Analyzing the data on two levels offer differing perspectives on representation in different stages of the publication process. By quantifying these trends, this study provides baseline statistics to inform discussions and identify opportunities to improve local participation in SEA climate research.

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43. Elizabeth Brummit

Analysis of Volcanic Tephra Layers at Imuruk Lake, Alaska

Imuruk Lake, located on the Seward Peninsula in Western Alaska, preserves a continuous sediment record dating beyond 225 ka. Even as one of the most tectonically active regions in the United States (Freymueller et al., 2013), local marine sediments typical for tephra identification are subject to significant post–depositional mixing from periodic land exposure in the Bering Strait and sediment transport South to the Bering Sea. These sediments lack suitability for late-Pleistocene tephra identification. By comparison, Imuruk Lake is less susceptible to these variables, providing the current most accurate record of local tephra. Volcanic ash is well preserved at Imuruk Lake as local wind patterns favor the transport and definition of light pyroclastic materials North from the Aleutian arc, directly over the Seward Peninsula. This study details the process of sampling, mounting, and analyzing sediment samples from an Imuruk Lake sediment core for major geochemical data. Four tephra layers are identified by referencing the core's age model and published geochemical data on local eruptions. Analysis utilizing the electron microprobe confirms age and geochemical data related to the Old Crow (22L10) and IM#1 (16L37) tephra layers. Additionally, this project identifies either a former eruption related to Old Crow or the presence Sheep's Creek F (24L21) and a previously unrecognized ultramafic cryptotephra layer (26L4) at Imuruk Lake.

44. Morgan Rafferty

Identifying Novel Climate Proxies Through Computational Analysis of GC–MS Data

Widely used climate proxies like IP25 and alkenones were originally discovered through coincidental observations rather than systematic discovery. Their application has been critical to paleoclimate reconstructions of sea ice and sea surface temperatures. Seeing as their discovery was somewhat accidental, this project sets out to move beyond chance discovery by developing a computational framework for systematically identifying novel climate proxies from GC-MS datasets. Proxy-Digger, a newly created program for annotating GC-MS data, can classify and categorize unknown organic compounds and store them in a library. By assigning identifiers and storing unknown compounds in this way, users are able to track peak repetetion across samples. By establishing this recurrence before chemical structure, Proxy-Digger enables recognition of environmentally relevant compounds prior to full structural characterization. This relevance-first approach accelerates proxy discovery, but still requires an accompanying method to quantitatively link compound behavior to environmental variables. This project develops a computational workflow capable of identifying statistically significant correlations between organic compounds detected in GC–MS data and external environmental parameters such as temperature and salinity. The program analyzes chromatogram reconstructions generated by Proxy-Digger to detect relationships between individual peaks or peak ratios and environmental gradients. The viability of this program is shown in its ability to identify the ratios between alkenone peaks as a proxy for temperature in surface sediment samples.

45. Thomas Czernik

Creep, and stress relaxation of solids in the ice Ih–$MgCl_2$• $12H_2O$ system: Implications for Europa.

Laboratory deformation experiments were conducted on Europa-relevant solids in the H2O-$MgCl_2 \cdot 12H_2O$ system using a cryogenic uniaxial deformation apparatus with a N_2 gas confining medium (Pc > 12 MPa). Two sample types representative of Europa's surface were prepared: eutectic aggregates composed of fine-scale intergrowths of water-ice and $MgCl_2 \cdot 12H_2O$, and pure endmember $MgCl_2 \cdot 12H_2O$. Pre- and post-deformation microstructures were characterized using cryoSEM. Creep experiments on eutectic aggregates were performed at -50, -60, and -70 °C under constant deviatoric stresses of 5-25 MPa until steady state strain rates were reached. Additional creep experiments on pure $MgCl_2 \cdot 12H_2O$ were conducted at -70 °C over deviatoric stresses of 16-23 MPa. These data were fit numerically to constrain constitutive behavior, extrapolate deformation to planetary conditions, and evaluate implications for processes such as solid-state convection within Europa's ice-rich shell. Stress relaxation experiments were also performed on eutectic aggregates at -60 and -70 °C by allowing an imposed load to relax at nominally constant strain (4.1-26.1%). Stress relaxation results at approximately constant microstructure are interpreted alongside creep data to provide additional constraints on underlying deformation mechanisms and are used to calculate key quantities related to Europa's energy budget using viscoelastic models. Together, the creep and relaxation experiments provide new constraints on the rheology of Europa-relevant ice-salt materials, with implications for Europa's thermomechanical evolution.

46. Kat Scanlon

Hydrology of a Warm Early Mars at Low Spin-Axis Obliquity

The distribution of Noachian-Hesperian valley networks on Mars differs from the distribution of precipitation east of Hellas, south of Tharsis, and west of Tharsis in GCM simulations with present-day Martian topography. These discrepancies are decreased in GCM simulations with pre-Tharsis topography, but formation of the valley networks before Tharsis-driven true polar wander is inconsistent with stratigraphic relationships and crater ages for Noachian-Hesperian circumpolar landforms. Recent work has shown that rainfall patterns consistent with valley network distribution can occur in GCM simulations with present-day topography at low spin-axis obliquity. Other recent work has proposed atmospheric collapse at low spin-axis obliquity as a source for cyclic flooding of the Argyre basin and the Uzboi-Ladon-Morava outflow channel system. To investigate potential links between these two hypothesized processes, we are conducting an integrated GCM and ice-sheet modeling investigation into the hydrology of a warm early Mars at low obliquity. Here we present the first part of this investigation: results of new LMD Planetary Climate Model simulations at 0°, 15°, 25°, and 45° with a 1-bar CO_2-H_2 atmosphere and present-day Martian topography.

Poster Abstracts

47. **Ali Siddiqui**

Solar Heating of the Arctic Ocean Driven by Changes to Sea Ice Albedo

The sea ice albedo feedback is the process by which Arctic warming causes sea ice retreat, which due to the reduction in surface albedo leads to further Arctic warming through increased solar absorption. This definition, however, neglects important associated changes in cloud cover that can mitigate this effect, as well as covariant changes in the albedo of ice-covered regions. Here we investigate a decomposition of the solar forcing of the Arctic Ocean into ice-edge, ice-albedo, and solar forcing related effects. We find that changes to solar heating of the Arctic Ocean are projected to be equally driven by changes to sea ice albedo as they are by the decline of sea ice extent. We show that changes to the parameterization of sea ice surface process and Arctic clouds contribute more to uncertainty in projections of the albedo feedback response than uncertainty in sea ice area loss.

48. **Noah Johnson**

~1,500 Years of Gardiner's Clay Varves Extend the Record of Laurentide Ice in Southern New England to Before the Last Glacial Maximum

Pleistocene sea level models and field studies have argued that southern New England remained above sea level during Marine Isotope Stage 2 (29-14 ka) while regions in northernmost New England were transiently inundated by seawater. This study spanning eastern Long Island (NY), Block Island (RI), and Cuttyhunk Island (MA) in southern New England aims to re-evaluate this claim by using Pleistocene iron oxides, as sea level indicator. The iron oxide precipitates occur as prominent coatings, rinds, and nodules that consist of goethite, magnetite and associated sulfides and sulfates within quartz-rich sediment. The post-depositional iron oxide precipitates and associated minerals occur within a proglacial succession that was intensely deformed by glaciotectonic processes during the advance of the Laurentide ice sheet during the Last Glacial Maximum. The stratiform iron oxides are tilted and folded, indicating that they formed after deposition of the proglacial sediments and prior to glaciotectonic deformation. To test the origin of the iron oxides, we determined the source water from which the iron oxides formed by using triple oxygen isotope analysis and isotopic end-member mixing models informed by mineralogical x-ray diffraction, elemental flux fusion, and microprobe EDS analysis. Diagnostic minerals such as Na-Cl-K-Sr crystals, and Sr rich barite which are formed in the presence of saltwater, indicate marine inundation. These findings suggest that iron oxides can be used as sea-level markers in Pleistocene age sediments, which has ice thickness and lithosphere implications for New England and potential implications for Laurentide ice sheet volume and global sea-level.

Poster Abstracts

49. **Caleb Ukaonu**

Investigating Spatial and Temporal Impacts on Convective Storm Development Over a Changing Amazon Rainforest

The Amazon Basin continues to be impacted by deforestation, causing decrease in evapotranspiration and the expansion of hotter, drier land surfaces, two factors that impact spatial precipitation distribution. Recent modeling studies show a wide range of predicted impacts on Amazonian precipitation, and this stems from uncertainty around how and where convective systems initiate and develop, resulting in flawed model representations of the mesoscale convective systems that are large contributors to the Amazon's precipitation. To explore how changes in evapotranspiration and increased surface heating have impacted storm development, we analyzed 20 years of satellite observations of precipitation and a storm tracks from a large contiguous deforested region and surrounding forest in southwestern Brazil. We find that wet season precipitation is enhanced over the downwind forested area, while dry season precipitation is preferred over the downstream side of the deforested area. By examining the cause of these opposing responses, we have found a key mechanism for the seasonal nuances in the location of downwind enhancement. In both seasons, convection is enhanced over the hotter deforested surface in the late afternoon due to moisture convergence, and during the dry season, weak winds keep the precipitation in the deforested area. However, stronger monsoonal winds and higher moisture levels in the wet season shift this enhancement further downwind over the forest. Hence, our results provide a greater understanding of how convective system initiation and evolution are modulated by the complex interaction of large-scale dynamics, evapotranspiration, and land-surface change.

50. **Wyatt Sieminski**

Effects of Diurnal Surface Heating on Horizontal Buoyancy Gradients in a Salinity Stratified Ocean

In a number of regions of the world, salinity, in addition to temperature, plays a key role in setting the density structure for the upper layers of the ocean. Recent surface observations suggest that globally, submesoscale fronts dominated by salinity's contribution to density exhibit stronger horizontal buoyancy gradients than temperature dominated fronts given the same large scale density gradients. This work aims to advance mechanistic understanding of the differences in temperature and salinity driven frontogenesis ranging from the mesoscale down to the submesoscale, specifically isolating the effects of diurnal surface heating. To achieve this goal, a process modeling approach is taken using the Massachusetts Institution of Technology General Circulation Model (MITgcm). We find that a surface diurnal heat flux serves to strengthen buoyancy gradients at the grid scale, while preferentially increasing the variance in horizontal buoyancy gradients from the mesoscale down to the dissipation range in salinity dominated mixed layers. Continued work aims to connect this preferential increase in variance to changes in vertical buoyancy flux and the ageostrophic component of frontogenesis.

Poster Abstracts

51. **Olivier Bernard**

Melt extraction by compaction from the mantle of planetary bodies

The Moon exhibited volcanic activity until at least a billion years ago. However, the processes responsible remain weakly constrained because several physical barriers limit magma production and ascent, including slow mantle convection, low volatile content, and negative buoyancy in the crust. This raises key questions: how much magma can be generated at different stages of lunar evolution as cooling progresses and the lithosphere thickens, and how it must be extracted from the mantle to build sufficient pressure to reach the surface. We use a numerical approach based on a one-dimensional, two-phase porous flow model of a simple upwelling mantle column. The model solves mass and momentum conservation for both melt and mantle matrix over time and depth. As a first test case, melt is produced instantaneously at the base of the column, causing melt and matrix to separate and rise toward the top boundary, where they can flow freely. In a second step, we will introduce a thermal profile to generate partial melting at varying depths within the column. Our goal is to explore different thermal structures and lithospheric thicknesses and to estimate the pressure at the base of the lithosphere, which constrains the potential size of dikes that could form. Current results show wave-like instabilities that develop preferentially when buoyancy contrasts between melt and matrix are large. We are investigating their physical origin before further refining the model.

52. **Claire Xu**

Constraining Triple Oxygen Isotope Signatures of Western US Precipitation During the 2023-2024 Strong El Niño

It is uncertain how the hydroclimate of the Western US will respond to warmer temperatures driven by anthropogenic climate change. In particular, predicting the impact of future El Niño Southern Oscillation (ENSO) events is complicated by various factors, such as differences in projected precipitation between models and the difficulty of untangling SST changes from climate change with the natural internal variability of the ENSO system. Stable isotope techniques can allow for monitoring of these hydrological processes by constraining how ENSO is affected by changes in climate and its influence on the Western US hydroclimate—dynamics imperative to understand, as ENSO events significantly impact precipitation patterns.

Here, we analyze precipitation samples collected from 6 stations across the Western US during the 2023-2024 El Niño event for their $\delta^{18}O$, d-excess, and $\Delta'^{17}O$ values. Notably, the data will provide the first $\Delta'^{17}O$ record to span an El Niño event and give insight into whether it captures hydroclimate changes associated with ENSO or reflects similar processes captured by d-excess. Results show mean seasonal $\Delta'^{17}O$ values (per meg) of 38.4 ± 8.5 (winter), 27.5 ± 5.6 (spring), 21.6 ± 6.8 (summer), and 15.3 ± 8.5 (fall), potentially indicative of distinct seasonality. These analyses will contribute to a better understanding of how ENSO events affect triple oxygen isotope signatures and provide constraints and interpretations for $\Delta'^{17}O$ as a new geochemical proxy, aiding water management and a better understanding of past, present, and future climates.

53. Tiffany Gao

Automated Image Processing Pipeline for Mapping Lunar Impact Albedo Zones

Recent work has identified over 200 new impact craters on the Moon by comparing Lunar Reconnaissance Orbiter (LRO) Narrow Angle Camera (NAC) images taken at different times (Speyerer et al., 2016). These fresh impacts are often surrounded by extensive radial albedo features, which are regions of anomalously bright or dark material extending tens of kilometers from the crater, far beyond what traditional ejecta models predict. These features bear a striking resemblance to thermally distinct "cold spots," low-density surface regions that have not yet been compacted by space weathering (Bandfield et al., 2014; Williams et al., 2018), suggesting shared formation mechanisms.

This project builds on my prior work "Characterizing Ejecta Mobility in Cold Spot Craters" (Gao & Sokolowska, 2025), extending the analysis to a new catalog of smaller, recently confirmed impacts and introducing an automated image-processing pipeline. I developed this pipeline to query LROC NAC images via the IM-LDI API, identify before-and-after image pairs for new craters, and filter for optimal lighting and incidence angle conditions. These images are then processed into georeferenced GeoTIFFs, tone-matched, and differenced to isolate albedo changes. Using QGIS, I am mapping ejecta extents, measuring crater diameters, and characterizing ejecta asymmetry, azimuthal distribution, and radial mobility across a catalog of 77 confirmed new impacts.

Preliminary results from completed crater mappings will be presented, alongside initial correlations between albedo zone scale and parameters such as latitude and crater diameter.

54. Exiquio Salinas

Examining the Role of S/O and F/O Ratios in Fluorination Stoichiometry- Implications for understanding the formation of Mercury using triple oxygen isotopes

Analytical methods used to determine triple oxygen isotope compositions ($\delta^{17}O$, $\delta^{18}O$, $\Delta'^{17}O$) of silicates have not yet taken into account the influence of sulfur species during fluorination reactions. However, orbital spectroscopic data of Mercury's surface from the MESSENGER mission indicate the presence of sulfur-rich regions. Therefore, it is necessary to test whether oxygen isotope compositions measured using standard analytical methods are affected by the presence of sulfur before making interpretations of future data collected in situ on Mercury. In this study, a rock standard with oxide compositions similar to those predicted for the surface of Mercury, JA-2, is utilized. We examine how S/O and F/O molar ratios of JA-2 and sulfur-species (S, FeS) mixtures affect triple oxygen isotope compositions measured using laser fluorination isotope ratio mass spectrometry. Preliminary experiments demonstrate that $\delta^{18}O$ and $\Delta'^{17}O$ decrease with increasing S/O ratios, illustrating offsets of 1.0‰ in $\delta^{18}O$ and 0.04‰ in $\Delta'^{17}O$ trending away from the Terrestrial Fractionation Line. The findings suggest that when sulfur is present in concentrations found in Mercury's Northern Volcanic Plains, S/O ratios will change the apparent silicate isotopic composition. Furthermore, they provide a necessary framework for correcting oxygen isotope data obtained from sulfur-rich planetary materials, which is critical for accurately determining the surface composition of Mercury.

55. Gabriella Giampietro, Sofia Hernandez, Matty Berman

Alkenone Record of Climate Variability Through Plio-Pleistocene Transition

Long-term climate change is dictated by highly predictable shifts in the Earth's orbit. Less well-understood are millennial-scale climate changes occurring within icehouse and hothouse conditions. The transition from the Pliocene to the Pleistocene is characterized by the onset of millennial climate variability (MCV). MCV is a form of millenial-scale climate change featuring decadal periods of warming followed by longer periods of cooling. Unlike orbital cycles, MCV occurs on a human timescale, placing duress on biological systems. Investigating climate conditions throughout the Plio-Pleistocene periods is essential in anticipating the behavior of future millennial climate changes. Our project contributes to a high-resolution record of sea surface temperatures (SSTs) from >5 Myr to the present, with a focus on documenting the intensification of MCV around ~2.5Myr using alkenone paleothermometry. This method involves extracting organic compounds from marine sediments and analyzing their concentrations using gas chromatography. We use Iberian Shelf sediment cores derived from several International Ocean Discovery Program sites, some spanning up to 1.5 Ma of near-continuous sediment deposition. We compare graphs of alkenone-derived SST records to Ca/Ti records by correlating across a shared depth index, determining their date and their alignment with orbital climate variations. While the dataset is not yet complete, preliminary results indicate a high degree of correlation between the alkenone record and the Ca/Ti record during the Pliocene-Pleistocene transition period. Observation of threshold conditions and climate events as recorded in biological records provides insight into key climate actors, helping to further document millennial variability.

56. Eric Ericson

Mapping Recent Sea Ice Patterns in the Barents Sea Using Alkenone Biomarkers and Establishing Utility for Sea Ice Reconstructions

Sea ice is rapidly decreasing in the polar oceans, which decreases the Earth's albedo and increases solar energy absorption at the poles. This heats the ocean water and accelerates global warming. We urgently need quantitative proxies of past sea ice to provide accurate data for climate model parameterization in order to better project future sea ice changes. In this study we demonstrate the viability of tetra-unsaturated alkenone biomarkers for past sea ice reconstructions and their ability to enhance our understanding of the dynamics of polar regions.

The alkenone molecules we are looking at are largely produced by group 2i haptophyte algae living in and around sea ice. This group of algae produces a characteristically high percentage of tetra-unsaturated alkenones, and because they are associated with the presence of sea ice, tetra-unsaturated alkenones are potentially great proxies for sea ice distribution. By analyzing alkenone concentrations in arctic surface sediments and comparing them to recent measurements of sea ice concentration, we can test this hypothesis. To collect this data, we extracted organic matter from ocean sediments from the Barents Sea and performed column chromatography to isolate the alkenone fraction. We then analyzed the concentration of 18 different alkenone compounds in the sediments via HPLC-MS. The resulting calibration curve shows that sedimentary tetraunsaturation ratios demonstrate a good correlation with overlying sea ice concentration in this region, and therefore alkenones show promising reliability as a proxy for sea ice in arctic paleo-reconstructions.

57. **Alejandra Lopez**

Integrating Community Data and Machine Learning to Model Hydrogen Sulfide Emissions at the Salton Sea, CA

Monitoring air quality in and around saline lakes is critical for public health and environmental stewardship, but conventional monitoring systems lack the spatial and temporal coverage needed to effectively understand these rapidly changing systems. At the Salton Sea, a hypersaline lake in Southern California, surrounding communities experience episodic releases of hydrogen sulfide (H_2S) that arise from hypoxia and nutrient-rich inflows. These emissions pose significant risk to residents, yet they remain poorly understood due to sparse in-situ observations and the limited reach of existing monitoring networks. A key challenge is developing tools to predict emission events for early warning and long-term management decisions that respond directly to community-identified air-quality concerns. While satellite instruments like TROPOMI offer regional atmospheric data, their resolution is unable to detect small-scale H_2S emission events within this lake system. Recent studies suggest that changes in optical properties of the water may serve as proxies for H_2S outgassing. To explore this possibility, we used satellite-derived spectral indices, additional band-ratio combinations, and machine-learning approaches to assess potential indicators of H_2S activity. By integrating remote sensing, machine learning, and community-informed monitoring priorities, this work focuses on developing a scalable framework for anticipating conditions linked to H_2S emissions originating from saline lakes, particularly in regions where in-situ monitoring is limited. Co-developed through community workshops, this approach supports environmental health policies and informs adaptive management in high-risk regions.

58. **Nadia McGlynn**

Preliminary insights into faulting and exhumation in the Iberia-Newfoundland Hyperextended Margins

In magma-poor, hyperextended margins, the transition from continental to oceanic crust is extended, leading to thinned crust and exhumation of the mantle. Despite the prevalence of magma-poor passive margins around the world, the interactions between passive magmatism, faulting, exhumation, and alteration of mantle during continental breakup and sea floor spreading are poorly understood. The timing and directionality of mantle exhumation in these hyperextended margins has implications for our understanding of the evolution from continental breakup to seafloor spreading and the relationship between magmatism, faulting, and mid-ocean ridge development.

We use zircon and apatite from marine core samples in the Iberia-Newfoundland hyperextended margins to describe the timing of cooling in these rocks below ~200°C, which implies chronology of fluid-rock interactions and faulting. With this low temperature thermochronology, we build upon existing geochronological, thermochronological, and geophysical data from literature to characterize timing and directionality of faulting in the margins. Zircon (U-Th)/He data from 8 core samples exhibit a trend of general younging towards the west during the Late Cretaceous, consistent with extant data and the prevailing hypothesis of exhumation driven by a lithosphere-scale, westward-dipping detachment fault. Additionally, we plan to conduct thermal history modeling to constrain evolution of the lithosphere during hyperextension and describe when serpentinization and ophicalcite formation was able to occur.

59. Emma Witanowski

Characterizing Urban Heating in Rhode Island Using Fine-Scale Modeling and Long-Term Station Data

Urban heat poses challenges to public health and climate resiliency, as cities tend to experience temperatures 1-7 °F higher than rural surroundings. Despite these elevated risks, the development of effective urban planning and emergency strategies is impeded by the difficulty of resolving finer-scale temperature dynamics due to sparse monitoring infrastructure. To address these limitations, this study investigates temperature patterns across Rhode Island by integrating modeled XIS-temperature data with in-situ observations. The dataset uses a spatio-temporal machine learning framework to reconstruct daily mean air temperature from 2005 to 2023. We validate modeled temperatures against five NOAA station records utilizing a simple weighted scaling approach, allowing for direct cross-comparability between modeled and observed data. To characterize dominant patterns, we identify the primary modes of spatial and temporal variability in the dataset (EOF and PC). Results reveal broadly uniform temperature variability across the region, with reduced variation along coastal areas relative to inland locations, consistent with observed station data and coastal thermal moderation effects. The model demonstrates strong statistical agreement with ground-truth data, with temperature anomalies showing strong correlation (R2 = 0.84-0.90), explaining approximately 80% of non-seasonal variability. Weight scaling validation results confirm high performance, with R2 values ranging from 0.738 to 1.00 across all stations. These findings suggest that integrating machine learning models with limited observational data can resolve high-resolution thermal fields, providing a scalable tool for urban heat island mitigation and climate resiliency planning.

60. Samantha Levin

Understanding Hydrologic Variability and Extremes in Rhode Island Through Community Science

The impacts of anthropogenic climate change on hydrology pose threats to coastal communities across Rhode Island. Recent flooding related to extreme rainfall, king tides, and storm surge highlight the need to better understand the full scope of risk related to hydrological extremes in a changing climate. Process level studies can guide the development of model-based forecasting tools to aid in resilience planning, while community science can engage communities in local resilience. In this study, we employ a community science-based approach to develop a network of hydrological time series across Rhode Island, collected and analyzed by high school student interns. Timeseries span from fall of 2023 to fall of 2025, and include daily rainfall from the TF Green Airport, high-resolution streamflow, and seawater salinity, as well as new oxygen isotopic timeseries of rainwater, surface waters, and seawaters. Our Narragansett Bay time series document significant correlations between salinity and seawater oxygen isotopes and reveal a trend of decreasing salinity associated with increasing annual precipitation. Drawing from six different sites of river, stream, and pond sampling, our freshwater oxygen isotope time series capture watershed-wide responses to both extreme rainfall events and extended drought conditions, as well as identify temperature as a dominant driver of freshwater seasonality. Going forward, we will extend our time series to corroborate seasonal trends and investigate year-to-year changes. We also plan to perform a comparison of our empirical data with coastal ocean model outputs to improve the accuracy of local flood models and increase flood preparedness in vulnerable communities.

SPECIAL SHOWING: DEEPS EXHIBITION HALL

The DEEPS Exhibition Hall is a special showcase of artwork and handmade creations by members of the DEEPS community. Featuring pieces across a range of media, the exhibition highlights the creativity that exists alongside research in our department and celebrates the many ways DEEPS members engage with the natural world through both science and art. Located at the back of Sayles Hall, the Exhibition Hall will open after the talks. We invite you to explore the featured works, learn more about the artists, and enjoy this unique part of DEEPS Dive.

FEATURED ARTISTS

OLIVIA E. ANDERSON

OLIVIA E. ANDERSON IS A POSTDOC IN JAMES DOTTIN'S GROUP. OLIVIA, INSPIRED BY THE NATURAL WORLD, WORKS ACROSS MULTIPLE MEDIA, INCLUDING LINOCUT BLOCK PRINTING, JEWELRY, POTTERY, AND DRAWING.

GILLIAN CHEONG

GILLIAN CHEONG IS A PHD STUDENT, WORKING WITH CHRIS HORVAT. SEEING HERSELF MORE OF A HOBBYIST THAN AN ARTIST, GILLIAN ENJOYS MAKING FUNCTIONAL CERAMICS. SHE ALSO MAKES POLAR BEAR-THEMED CERAMICS, IN ACTIVE DEFIANCE OF THE PENGUIN OBSESSION ALLEGATIONS.

EADS FOUCHÉ

EADS FOUCHÉ IS A PHD STUDENT WITH SAM BIRCH. HE EXPLORES THE RELATIONSHIP BETWEEN SCULPTURE AND GEOLOGY BY REPRESENTING THE CONNECTIONS BETWEEN SPACE AND PLACE. HIS WORK BLURS THE LITERAL AND METAPHORICAL LINE BETWEEN THE ARTS AND GEOLOGY BY BUILDING SCULPTURES BASED ON 3-DIMENSIONAL LINE.

MÓNICA GERALDES VEGA

MÓNICA IS A GRADUATE STUDENT WORKING WITH DAN IBARRA AND KIM COBB. SHE'S INSPIRED BY THE ABILITY TO ENGAGE WITH THE HUMAN CONDITION (WHATEVER THAT MEANS), WITH A SENSE OF INFORMED NAÏVETÉ. TO THEM, THAT LOOKS A LOT LIKE CAPTURING EMOTION AND MOVEMENT IN IRONIC YET NOSTALGIC SETTINGS VIA OIL PASTEL/MARKER/CRAYON SKETCHES.

SPECIAL SHOWING: DEEPS EXHIBITION HALL

EMILY SNELL

EMILY IS A PHD STUDENT WITH ALBERTO SAAL AND GREG HIRTH. EMILY IS INSPIRED BY THE UNPLANNED AND THE UNORGANIZED. FROM SKETCHBOOK DOODLES TO RAW PHOTOGRAPHY SHE LIKES TO CAPTURE WHATEVER EXISTS IN THE MOMENT.

ARTWORK DESCRIPTIONS: SKETCHBOOK STICKERS & PHOTOGRAPHY PRINTS

KATHY SUN

KATHY IS AN UNDERGRADUATE RESEARCHER IN THE FREILICH LAB. HER CREATIVE PRACTICE INCLUDES GRAPHIC DESIGN, WATERCOLOR, AND ACRYLIC PAINTING. TAKING INSPIRATION FROM JOAQUÍN SOROLLA'S MASTERY OF LIGHT AND PLEIN AIR TECHNIQUES, SHE USES ACRYLIC AND GOUACHE TO EXPLORE COLORS IN NATURE. SHE VIEWS HER ARTWORK AS A TOOL FOR GROUNDING HERSELF AND BETTER APPRECIATING HER SURROUNDINGS.

ARTWORK DESCRIPTION: ACRYLIC AND GOUACHE PAINTINGS FOCUSED ON VIVID COLOR PALETTES AND THE MOVEMENT OF LIGHT.

MAE JACKSON

MAE IS THE DEPARTMENT'S COMMUNICATIONS SPECIALIST, WORKING ON THE DEEPS WEB PRESENCE, NEWSLETTER, EVENT PROMOTION, AND MORE. OUTSIDE THE OFFICE, MAE IS A SELF-PROCLAIMED "PROUD AMATURE" OF A WIDE RANGE OF ART MEDIUMS, FROM PAINTING AND PRINTMAKING TO BOOKBINDING AND SCRIMSHAW. THEIR WORK HAS BEEN ON DISPLAY AT AS220 AND THE BAI'S AFTER HOURS: ANNUAL STAFF ART EXHIBITION.

ARTWORK DESCRIPTIONS: ACRYLIC ON CANVAS, DEPICTING SAMPLE SLIDES FROM DEEPS. (MORE SPECIFIC DETAILS WILL BE AVAILABLE UPON DISPLAY.)

KAT SCANLON

KAT IS A POSTDOC WORKING WITH JIM HEAD. SHE DRAWS, PAINTS, AND TAKES PHOTOS BOTH TO ILLUSTRATE HER SCIENCE AND TO PROCESS STORIES AND EVENTS. KAT'S DRAWINGS AND PAINTINGS ARE INFLUENCED BY MID-CENTURY ILLUSTRATORS, IN THIS CASE ESPECIALLY CHARLES MIKOLAYCAK'S CONTRIBUTIONS TO THE 1964 TIME-LIFE SCIENCE LIBRARY VOLUME MAN AND SPACE.

ARTWORK DESCRIPTIONS: ACRYLIC AND METAL LEAF PAINTINGS (MINIATURE STUDIES FOR A FUTURE TRIPTYCH)

ANDREA BRYANT

ANDREA IS A POSTDOC FELLOW STUDYING TITANQUAKES AND WORKING WITH SAM BIRCH. SHE LOVES PAINTING, SKETCHING AND SINGING IN HER SPARE TIME.

ARTWORK DESCRIPTIONS: ACRYLIC AND WATERCOLOR PAINTINGS INSPIRED BY NATURE'S COLOR PALETTE.

NADIA MCGLYNN

NADIA IS A FIRST YEAR PHD STUDENT WORKING WITH EMILY COOPERDOCK. SHE KNITS, EMBROIDERS, AND CREATES LINOCUT PRINTS. HER WORK IS INFLUENCED BY 1970S FASHION AND THE NATURAL WORLD.

ARTWORK DESCRIPTION: WOOL AND COTTON KNIT CLOTHING. HAND CARVED LINOCUT PRINTS.

JUDGES

We extend our sincere thanks to all who volunteered as judges for the 2026 DEEPS Dive Student Research Symposium, including Brown University faculty, staff, postdoctoral researchers, and graduate students. Your time and support are essential to making this event a success.

OLIVIA ANDERSON
POSTDOC

ANDREA BRYANT
POSTDOC

JUSTIN CUSTADO
GRADUATE STUDENT

COLLEEN DALTON
FACULTY/STAFF

INGRID DAUBAR
FACULTY/STAFF

BRIANNA FERNANDEZ
GRADUATE STUDENT

EMILY FISCHER
GRADUATE STUDENT

HAIRUO FU
POSTDOC

MEREDITH HASTINGS
FACULTY/STAFF

RILEY HAVEL
GRADUATE STUDENT

TAKAHIRO HIROI
FACULTY/STAFF

BLAKE HODGIN
FACULTY/STAFF

BRIANNA HOEGLER
GRADUATE STUDENT

CHRIS HUBER
FACULTY/STAFF

DAN IBARRA
FACULTY/STAFF

ABHINAV JINDAL
POSTDOC

JUDGES

We extend our sincere thanks to all who volunteered as judges for the 2026 DEEPS Dive Student Research Symposium, including Brown University faculty, staff, postdoctoral researchers, and graduate students. Your time and support are essential to making this event a success.

MATT JONES
FACULTY/STAFF

ELLEN JORGENSEN
GRADUATE STUDENT

HARRIET LAU
FACULTY/STAFF

JANIE LEVIN
GRADUATE STUDENT

JULIA MILLER
GRADUATE STUDENT

STEPHEN PARMAN
FACULTY/STAFF

SEBASTIAN PÉREZ-LOPEZ
GRADUATE STUDENT

LINA PÉREZ-ANGEL
POSTDOC

SEDA SALAP-AYCA
FACULTY/STAFF

HANNAH SHABTIAN
GRADUATE STUDENT

AIKATERINI TAVRI
POSTDOC

PETER VAN KATWYK
GRADUATE STUDENT

MAISY WAECH
GRADUATE STUDENT

KATYA YANEZ
GRADUATE STUDENT

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AWARDS & JUDGING CHAIR

BRIANNA HOEGLER
LOGISITICS CHAIR

STEVEN RAMIREZ
DESIGN & ADVERTISING CHAIR

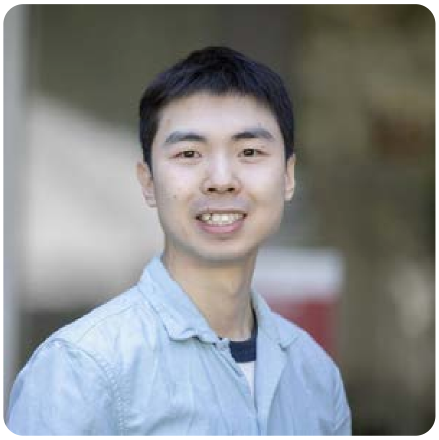
AWARDS AND JUDGING COMMITTEE

J. CAMERON ADAMS
AWARDS DESIGN AND PRIZES LEAD

MAISY WAECH
JUDGING CRITERIA LEAD

ELLEN MAY JORGENSEN
COMMUNITY AWARDS LEAD

JANIE LEVIN
JUDGING RECRUITMENT LEAD



HAIRUO FU
JUDGING RECRUITMENT LEAD

DEEPS DIVE COMMITTEE

LOGISTICS COMMITTEE

ANURAG BHAT
PROGRAMMING LEAD

CALEB UKAONU
FOOD AND BEVERAGE LEAD

ABIGAIL CASE
KEYNOTE LEAD

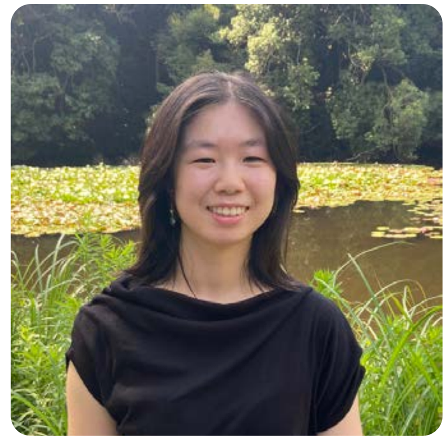
DAGNY KELTNER
REGISTRATION AND NEWSLETTER LEAD

GILLIAN CHEONG
ART EXHIBITION HALL LEAD

DESIGN AND ADVERTISING COMMITTEE

ANU RAGHUNATHAN
PROGRAM DESIGN LEAD

MONICA GERALDES VEGA
EVENT DESIGN LEAD



CLAIRE XU
NAMETAGS LEAD

DEEPS DIVE COMMITTEE

DESIGN AND ADVERTISING COMMITTEE

EMMA WITANOWSKI
EVENT DESIGN LEAD

OLIVIA ANDERSON
NAMETAGS LEAD

THANK YOU FOR HELPING MAKE DEEPS DIVE POSSIBLE

ACKNOWLEDGMENTS

Dear Attendees,

Welcome to the second annual Brown University DEEPS Dive Student Research Symposium. We are excited to gather again as a department to celebrate the wide range of research being carried out by our undergraduate students, graduate students, postdoctoral scholars, and broader DEEPS community.

DEEPS Dive 2026 continues our goal of creating a department-wide space for sharing research, building connections, and highlighting the intellectual breadth of Earth, environmental, and planetary sciences at Brown. Throughout the events program, you will see oral and poster presentations spanning many areas of DEEPS, reflecting both the diversity of topics studied in the department and the creativity of the students and researchers presenting them. We hope this symposium gives attendees the chance to learn something new, engage with work outside their own area, and connect with others across the department.

This year's event also includes plenary speakers, whose perspectives help place our research in a broader scientific and societal context. We are grateful to all of our presenters for sharing their work, and to everyone attending for helping make this a lively and supportive research community. To conclude DEEPS Dive, we welcome everyone to join us for the post-symposium social at Narragansett Brewery (271 Tockwotton St). We hope you will take this opportunity to relax, connect with fellow attendees, and celebrate the presenters and all those who helped make the day a success.

We would like to sincerely thank all of those who contributed to the planning and success of DEEPS Dive 2026. This event depends on the time, energy, and generosity of many people, including our organizing committee, faculty, staff, volunteers, judges, and presenters. Your support has helped this symposium grow into a meaningful department tradition.

We also extend our gratitude to LunaSCOPE for their generous sponsorship of DEEPS Dive 2026 and for helping support this year's event.

Finally, we offer special thanks to Meredith Hastings, Patricia Davey, Dina Egge, and Mae Jackson for their continued support, guidance, and encouragement. Your help has been invaluable not only in launching this symposium, but also in helping it continue to grow.

Emily Fischer, Brianna Hoegler, and Steven Ramirez
Co-Chairs, 2026 DEEPS Dive Student Research Symposium