

## **Department of Earth, Atmospheric and Planetary Sciences**

The Department of Earth, Atmospheric and Planetary Sciences (EAPS) studies Earth, Planets, Climate, and Life and has broad intellectual horizons encompassing the solid Earth, its fluid envelopes, and its neighbors throughout the solar system and beyond. The department seeks to understand fundamental physical, chemical, and biological processes that define the origin, evolution, and current state of these systems and to use this understanding to predict future states and to inform policy and solutions, for example, concerning climate change and natural resources management. The department comprises 43 faculty, including three with a primary appointment in the Department of Civil and Environmental Engineering (CEE), one with a primary appointment in the Institute for Data, Systems and Society (IDSS), one with a primary appointment in the Department of Aeronautics and Astronautics (Aero-Astro), and another with a primary appointment in the Math Department, and more than 310 students, research staff, postdoctoral appointments, and visiting scholars.

EAPS is notable for addressing problems that benefit from (or require) interdisciplinary approaches and is involved in numerous laboratories, centers, and programs that address broad questions in the Earth sciences, including those that are related to the most pressing societal issues of our time: changes in climate and environment; responsible use of natural resources; understanding and forecasting of natural hazards; understanding the origin and evolution of life on Earth and, perhaps, discovering signs of life elsewhere. For example, the Earth Resources Laboratory (under directorship of Professor Laurent Demanet) integrates faculty, staff, and students across disciplinary, department, and school boundaries to investigate geophysical and geological problems in energy and resource development. The Center for Global Change Science (under directorship of Professor Ronald Prinn) builds cross-institute activity in meteorology, oceanography, hydrology, chemistry, satellite remote sensing, and policy. The Lorenz center (under co-directorship of Professors Raffaele Ferrari and Daniel Rothman) aspires to be a climate think-tank devoted to fundamental scientific enquiry. Furthermore, EAPS is MIT's largest participant in the MIT-Woods Hole Oceanographic Institution (MIT-WHOI) Joint Program for graduate education and research in ocean sciences and engineering.

### **Educational Activities**

The EAPS faculty are committed to the development and maintenance of vibrant education programs at both the undergraduate and graduate level. Student engagement with the education program is a continuing departmental goal. Graduate students meet with the Department Head and Associate Head at least once per term to discuss concerns and issues arising in their respective programs with the goal of sustaining active and open conversation around educational and general departmental issues. The Department Head welcomes anybody to his weekly open office hour.

Throughout the 2022-23 academic year EAPS conducted classes predominantly on a residential basis, with hybrid options particularly for courses based in the MIT-WHOI Joint Program. Seminars were predominantly conducted using a hybrid model to

optimize attendance. Thesis and general exams returned to in-person, predominantly, with hybrid options for participants who were unable to attend due to extenuating circumstance or primary location. Both the graduate and undergraduate programs are under review in response to changes in faculty composition and responses from students.

### **Graduate Program:**

EAPS has vigorous graduate educational programs in the areas of Earth, Planets, Climate, and Life, including geology, geochemistry, geobiology, geophysics, atmospheres, oceans, climate, and planetary science. In fall 2022, EAPS had 188 graduate students (185 Ph.D., 3 S.M.) registered in the department, including 114 students in the MIT-WHOI Joint Program. Women constituted 58 percent of the graduate student population, and 13 percent were members of an underrepresented minority group.

The excellence of the EAPS graduate program is built not only on the strength of teaching and supervision by the faculty but also on the involvement of EAPS graduate students in departmental activities. This year, we returned to a full roster of department lecture series, with one occurring almost every day on hybrid schedule. This provided students with opportunities to present their own research, invite external speakers, and participate more in community engagement. “Cookie Hour” and “Peer Hour” were also regularly scheduled as in-person events. Our EAPS Student Advisory Committee (E-SAC) made efforts to understand student concerns holding town halls with the Department Head, Professor Robert van der Hilst, to allow student feedback on departmental issues and worked with Professors van der Hilst.

EAPS awards an annual prize for excellence in teaching to highlight the superior work of its teaching assistants. During the 2022-23 academic year Mr. Noah Trawicki Anderson (PhD, Geology, Geochemistry, Geobiology) and Mr. Martin Velez Pardo (PhD, Atmospheric Science) each received an Award for Excellence in Teaching for their high performance working as a teaching assistant. In addition, Ms. Arianna Krinos Quinn (PhD, Biological Oceanography) was awarded the 2023 Graduate Teaching Award by the MIT Graduate Student Club.

Our students were also recognized by M.I.T. and their respective professional societies and outside organizations. The sponsor of the MIT School of Science Phillips Fellowship for Sustainability was so impressed after meeting Timur Cinay, (PhD, Climate Science) that he received an extension on his fellowship for two additional years. Alexandra Elizabeth Jones (PhD, Biological Oceanography) was awarded the [Temple University 30 Under 30 Award](#). Isaac Narrett (PhD, Planetary Science) was awarded the NASA FINESST Fellowship. Mariona Badenas Agusti (PhD, Planetary Science), Fatima Husain (PhD, Geology, Geochemistry, Geobiology), Zoe de Beurs (PhD, Planetary Science) and Ze-Wen Koh (Incoming PhD, Planetary Science) were all awarded Office of Graduate Education competitive fellowships. Fatima also received the Graduate Women of Excellence Award. Scott Weiman (PhD, Marine Geology and Geophysics) received the Ocean Engineering and Instrumentation Fellowship from the Link Foundation and Arianna Krinos Quinn won a Thomas Cavalier-Smith Prize from the International Society of Evolutionary Protistology. Ciara Willis (PhD, Biological Oceanography) is the Natural Sciences and Engineering Research Council of Canada Doctoral Scholar (2021-

2024). The School of Science DEI Service Fellowship in the Spring 2023 went to Diana Dumit (PhD, Geology, Geochemistry, Geobiology) and she also awarded the [NOSAMS](#) (National Ocean Sciences Accelerator Mass Spectrometry) Graduate Internship Program to perform radiocarbon analyses on sediment cores taken from Falmouth, MA.

EAPS graduated a total of 27 doctoral students and 2 master's students in AY23.

### **Undergraduate Program:**

EAPS had 31 undergraduate majors in AY22, 20 of whom were women, and 9 were a member of an underrepresented minority group. We note that the EAPS undergraduate population has always been small, but the students are very active in the department and are interested in promoting the department to help increase undergraduate enrollment. In the spring of 2023, EAPS hosted one undergraduate meet and greet with current first year students who might be interested in declaring Course 12 as their major. Two undergraduates and one Research Scientist and the Director of Wallace Astrophysical Observatory, Michael Person, took the time to assist the Education Office during Campus Preview Weekend to talk about their experiences within Course 12. They brought materials to discuss with the incoming students, including rock samples and a star globe. Michael Person and Ann Greaney-Williams, the Academic Administrator, also did a live solar observation demonstration on the Kresge Oval for the visiting first year students.

Our undergraduate representative, Becca Mastrola (SB, Geoscience) produced a report based on information gathered from students and an Outreach Meeting conducted by Profs Oliver Jagoutz and Kristin Bergmann to assess the state of the Geoscience undergraduate track and the difficulty students have had completing the program. This report was submitted to the Department Head and the Committee on the Education Program (CEP) and the CEP has been working to redesign the degree charts for not only Geoscience, but also the other three EAPS undergraduate tracks. Faculty retirements have impacted the courses being offered, as well as other identified problems that interrupt as students' progress through the program. In the summer of 2023, the disciplinary faculty have received guidance from the CEP to evaluate the offerings within their discipline, review timing of offerings, plan for consistency particularly in the core, and eventually produce a multi-term course plan that students can use to plan their trajectory through the program. While it is very early in the process, there is hope that this will progress relatively quickly, aiming at degree chart updates for either fall or spring of AY24.

EAPS provided 113 UROP opportunities to undergraduate students in AY23. In the Fall 2022 there were 25 UROPS, 16 during IAP, 35 in spring term and 35 for summer term. The majority of UROPS were conducted on campus.

The department maintains a strong presence in undergraduate education across MIT so that the general MIT student body has ready access to education in geo-scientific aspects of climate and environmental change, natural hazards, and natural energy resources. Several faculty proposed new or revised courses this year, including Andrew Babbin, who proposed 12.004: Introduction to Chemistry of the Habitable Environment and

12.314: Ocean Chemistry Change Laboratory which are currently in process with the Committee on Curricula review. 12.211/12.511: Field Geophysics is also being revised to be offered again in IAP 2024 by William Frank, Brent Minchew, Tom Herring, and Brad Hager. Discover Earth, Atmospheric and Planetary Sciences (DEAPS), offered by Professor Lodovica Illari was again successfully offered and continues to be well regarded by first-year students and serves as a path to students declaring Course 12 as a major alongside 12.000: Terrascope with David McGee.

The Yellowstone Field Trip, also part of the first-year experience, was not held in AY23 due to the retirement of its leading faculty contributor, Professor Timothy Grove. The CEP will be taking up first year experiences in AY24 as we were unable to find a suitable replacement prior to the AY24 startup. CEP and faculty will need to consider whether someone will take over the Yellowstone offering or design a new offering for incoming students. We will also need to consider the pending retirement of Professor Lodovica Illari and the future of her DEAPS offering.

The department continues to support and provide leadership of two major undergraduate programs at MIT, Terrascope (under directorship of Prof. David McGee) and the Experimental Studies Group (under directorship of Prof. Leigh Royden). We are active participants in four interdisciplinary minor programs; the broadly-based Energy Minor, the Astronomy Minor (with Physics), the Atmospheric Chemistry Minor (with Chemistry, Aero/Astro, Civil and Environmental Engineering, and IDSS), and the Environment and Sustainability minor (which is a collaboration of courses from 17 departments).

In the spring of 2023, the Bachelor of Science in Climate Systems Science and Engineering (1-12) was officially approved by the faculty. It began accepting declarations in June and we look forward to seeing how it will impact undergraduate recruitment going forward. Profs Andrew Babbin, Arlene Fiore, and Taylor Perron will serve as its primary advisors/consultants for the 1-12 major within EAPS.

In AY23, the *Goetze Prize* was awarded to Ms. Claire McClellan-Cassivi (advised by Professor Thomas Herring) in recognition of her outstanding senior thesis. Ms. Aviva Intvelt (advised by Professor Tanya Bosak) received the *W.O. Crosby Award for Sustained Excellence*, recognizing her achievement, both academic and intellectual, as well as general contributions to the department. Ms. Becca Mastola (advised by Professor Kristin Bergmann) was the recipient of the *EAPS Achievement Award*, which recognizes a rising senior from across the EAPS disciplines. The award is presented to a student who has distinguished her or himself through a combination of high GPA, focused course work, and leadership within EAPS.

In addition to EAPS-specific Awards, Vela Velasquez (SB, Environmental Systems) was awarded the Emerging Leader Award at convocation this year.

EAPS graduated four Bachelor of Science degrees students in AY23.

### **Mentoring Initiatives**

Mentoring has been a primary focus of the EAPS education programs for the past two years. At the request of the Department Head, the Committee on the Education Program

(CEP) developed the new pre-thesis faculty mentoring structure for PhD and Masters students. Pre-thesis mentors are matched with EAPS graduate students and remain with those students until they have formed a thesis committee (first ~2.5 years). The Pre-thesis mentor is intended to provide additional support and connections for the graduate student in their early years in the program. The goal is to facilitate deeper connections and stronger support for students. Once the thesis proposal and committee are approved by the CEP, students are no longer expected to meet with their faculty mentor but can do so if they find it to be useful. Pre-thesis mentees meet with mentors individually once in Fall term and once in Spring term (or more if desired). This program will replace pre-existing Reg Day Meetings, which students indicated did not provide sufficient feedback or support over time.

We also held meetings with faculty and students to discuss how mentoring and the advising relationships at EAPS can be supported and fostered over time. 46 graduate students, including 17 new admits starting in fall 2022 received an additional faculty mentor.

Professor David McGee and the Diversity, Equity, and Inclusion Officer, EmmaLee Pallai, hosted a dialogue between faculty and students in structured meetings for EAPS to assess needs within and across the various mentoring relationships. These sessions were conducted utilizing small group breakout sessions that included faculty, students. One of our Teaching and Learning Lab Fellows, Meghana Ranganathan, worked with the MIT UROP Office to create a mentoring guide and format for setting expectations of supervisors, which we are hoping to translate into our EAPS mentoring programs.

## **Faculty**

The department continues in its efforts to hire the best young scientists and help them develop successful careers.

Dr. Richard Teague joined the department in July of 2022 as an Assistant Professor. Teague works on understanding the earliest stages of planetary systems, specifically where, when and how they can form.

Dr. Wanying Kang also joined EAPS in July of 2022 as an Assistant Professor. Kang researches large-scale atmospheric and oceanic dynamics, and their effects on the climate of Earth and other planetary bodies. She hopes to bridge multiple geoscience fields by applying tools from climate science on Earth to planetary science questions. Currently, Kang is looking into the atmospheric circulation on superhot lava worlds and the ocean circulation on icy moons, given the potential to observe them in more detail.

Kang earned an undergraduate degree in physics from Peking University and a PhD in applied math from Harvard University. She first joined the Department of Earth, Atmospheric and Planetary Sciences as a distinguished postdoc through the Houghton-Lorenz Fellowship.

We are now halfway through the 12th year of the junior faculty mentorship program introduced in January 2012. Each junior faculty is assigned a mentor team comprising a primary mentor (often a close colleague) and two senior faculty members from outside

the candidate's disciplinary group. They meet – as a group – once a semester and report to the Head of Department. Junior and senior faculty alike are satisfied with this system, but as in previous years, feedback solicited from junior faculty will be used to make further improvements.

### **Promotions (Effective July 2022):**

Effective July 2022, Assistant Professors Andrew Babbin and Timothy Cronin have been promoted to the rank of Associate Professor without tenure.

Also in July 2022, Associate Professor with out tenure Gregory Fournier was promoted to Associate Professor with tenure.

### **Diversity, Equity, and Inclusion Summary**

DEI staff have continued building and growing their partnerships across campus while working on departmental climate. The Diversity, Equity, and Inclusion Committee (DEIC) has deepened its learning and collaboration and has begun sponsoring departmental 'cookie hours' to provide open space for conversation around DEI within the EAPS community. These events are part of the greater communication plan that includes DEI newsletters throughout the semester. With three of our DEIC members moving on, they have also welcomed new members to begin in the fall and look forward to developing the team in the coming year.

After piloting the Lab Culture and Values Workshops in EAPS over the last year, the format is being finalized to launch more widely. This workshop series is the foundation of our curriculum, inviting research groups to define their values, outline the actions associated with those values, and identify factors that may keep members from acting on their values. The department's DEI Officer (DEIO) EmmaLee Pallai worked closely with the first year graduate seminar and hosted a workshop on Imposter Syndrome while also being more integrated into orientation. They also worked with a Undergraduate Research Opportunity Program (UROP) group around inclusive research environments. In addition, the DEIO worked with graduate students to create an EAPS student LGBTQ affinity group, EAPS QUeer ALLiance (EQUAL).

The DEIC also focused on analyzing and sharing data related to graduate student attrition in EAPS. Older data (reflecting the average for graduate students entering between 1997-2015) indicated that attrition rates for students from underrepresented minority (URM) backgrounds were almost twice as great as those for other EAPS graduate students, an alarming statistic that we wanted to understand better. With the support of MIT Institutional Research and the EAPS and MIT-WHOI Joint Program education offices, we explored attrition through time and extended this analysis to more recent graduate students. They found three things: first, a decline in overall attrition, from >30% for all students in the late 90s to less than 10% in recent years; second, a substantial increase in the numbers of URM students in the last 10 years; and third, no difference in attrition between URM and non-URM students over the last 10 years. While they do not see these data as justifying complacency, they believe they highlight the importance of diversity in reducing attrition among students with historically excluded identities, and the impact of efforts to promote inclusive environments in EAPS,

including EAPS Taskforce 2023, the Lab Culture and Values Workshops and community-building mentioned above, and the first-year seminar for graduate students and new pre-thesis mentoring program.

The DEIO and Associate Department Head for DEI David McGee supported the two faculty searches in the department this year (one within EAPS, one a joint search with the Schwartzman College of Computing). The DEIO worked with the search committees and graduate student advisory groups around ways to address bias in the search process. The Associate Department Head for DEI served as the Faculty Search Oversight Officer, providing feedback and guidance about equitable practices as the committees stepped through EAPS' faculty search protocols.

The Community Builder award, an award for those who are contributing above and beyond to create an inclusive and open community in the department, was continued with Jeffery R Scott and Lodovica C Illari as our winners this year. They were lauded for their work in creating welcoming spaces open to inquiry in the weather prediction team and the first-year pre-orientation program, [DEAPS](#) (Discover Earth, Atmosphere, and Planetary Sciences).

Outreach has continued through classroom visits organized by the EAPS group Let's Invest in K-12 (LINK-12) and has continued to engage with MIT's Climate Action Through Education (CATE) project. The DEIC coordinated more active engagement with the MIT Summer Research Program (MSRP) in order to increase the number of MSRP students in EAPS, with some success. The DEIC also continued to offer partial funding for undergraduates from historically minoritized groups from other colleges and universities to conduct summer research in EAPS, supplementing the department's participation in MSRP.

In the wake of the recent Supreme Court decision repealing Affirmative Action, the DEIO and Associate Department Head for DEI have participated in meetings exploring the impacts of this decision for our graduate admissions, hiring, and outreach programming. As Earth Science has the lowest racial diversity among STEM fields, continued efforts toward building diversity are essential both to promote equity and to foster innovation; they will need to work closely with other offices and departments at MIT to take effective actions that remain within newly established and emerging restrictions.

## **Communications**

In Fall 2022, EAPS engaged Opus Design to build a new, forward-thinking website and content strategy informed by user data, with an anticipated site launch for October 2023.

Throughout the discovery phase of the project, the analysis of user data from the existing site gave a consistent result: users are interested in learning about faculty and research primarily, with education and students a close second; news comes in as a distant priority for users, accounting for only 1% of total site traffic, with a 96% bounce rate. Armed with this understanding, the new site and overall content strategy are designed to help audiences connect more quickly and deeply to the information they're seeking:

- Draw a straight line to faculty whenever possible. Include faculty features on the home landing page. Have links to relevant faculty appear prominently on topical subpages. Produce faculty “spotlights” for each member.
- Make research relatable. Write research descriptions in plain language. Organize our research by broad topics/questions we are investigating (of interest to the public, donors, prospective students), before funneling down to narrow fields of study (of interest to peers, current students).
- Streamline Content. Elevate lower-level pages for easier access. Improve layout of long pages for better scanning and less page-jumping out of impatience or frustration.
- Create clear calls to action. Less overall text, more prominent links and buttons drawing visitors to next steps (e.g. how to apply, how to give, who to contact).
- De-emphasize news, emphasize people. Continue to pitch news stories aggressively for coverage by MIT News where research publications get the most visibility and traffic (by a factor of 10). Save internal staff time for producing community profiles and “evergreen” stories which site visitors are more interested in and help paint a more well-rounded, relatable picture of the department.

Further, the new site architecture will take advantage of a host of advancements and automations available in the current iterations of the WordPress platform. These features will help keep pages dynamic and up-to-date with less manual data entry and management, including automatic directory updates by pulling feeds from MIT’s database, integrations with our e-newsletter, and a robust tagging system allowing for the latest relevant news to automatically populate to faculty pages and topical research/academic program pages. The ease-of-use of the WordPress platform will also democratize the upkeep of the site, allowing editorial delegation for certain pages to additional administrators, thereby easing the current bottleneck in page management.

Social Media — While at first glance our overall monthly impressions on Twitter appear to have dropped by half in the last 18-24 months, this decline coincides with major changes to the Twitter algorithm and the way they report analytics—an abrupt shift also experienced by DLC peers across the board since mid-2021. Marketing analysts have for years questioned Twitter’s methods for counting impressions, suspecting inflation to boost ad sales, and these changes were understood to be an effort to produce more realistic numbers. Compounding our difficulty in interpreting post reach and user behavior is the extreme volatility in the platform since the takeover by Elon Musk in the fall of 2022. Even still, the EAPS following on Twitter has grown to 7.9K. We have also raised the department’s Twitter profile by promoting proactive tagging of our handle by institutional research collaborators (e.g. NASA, JPL, other universities), as well as by journals and professional societies (e.g. AGU, GSA, Nature publications, IOP Publishing, etc.). As Twitter evolves on its current erratic course, we are continually reevaluating the EAPS investment in a presence there, and are looking into some of the emerging competing platforms.



Instagram and Facebook algorithms and metrics have also evolved, making current comparisons to data prior to 2021 more difficult. Despite this, in broad terms, our progress growing our audiences on both platforms has continued. The EAPS Instagram following has increased to 3.1K followers; post engagement has increased by 16%, and average reach per post increased by 5%. On Facebook, our following grew to 10.3K total, with an overall increase in post reach of 9.4%.

## **Resource Development**

Academic year 2022–2023 was a successful year for EAPS Resource Development.

In FY23, new gifts and pledges to EAPS totaled \$11.36M. This total includes several major grants that EAPS faculty received from private foundations including the Simons Foundation, Schmidt Futures, and the VoLo Foundation. New gifts and pledges were also received from generous individuals in support of the new media wall that will be a prominent feature in Building 55, fellowships, student support, research, and discretionary funding for the department. In addition, the department received payments from the pledges that our many generous supporters made to the Building 55 project.

We were very happy to return to in-person events this year. In August, we had a dinner in Houston, TX for EAPS alumni attending the Society of Exploration Geophysicists (SEG) conference. In October, we held the annual Carlson Lecture at the New England Aquarium. The lecture was given by Prof. Jess Adkins (PhD '98 (XII)), Smits Family Professor of Geochemistry and Global Environmental Science at Caltech. The lecture was followed by a small dinner for EAPS supporters, along with faculty and students. In December, EAPS held a reception for our alumni attending the American Geophysical Union (AGU) conference in Chicago, IL. In April, we held our Patrons Circle dinner. This annual dinner and student presentation session recognizes our donors who support fellowships, faculty, and research in EAPS.

Planning has already commenced for two major EAPS event during the spring of 2024, the dedication of Building 55 and the EAPS 40th anniversary celebration. We are looking forward to celebrating with the EAPS community, our alumni and friends, and the greater MIT community.

EAPS is grateful to its many alumni and friends for their philanthropic support during the past year and we look forward to hopefully seeing many of them back on campus next spring.

**Robert D. van der Hilst**  
**Department Head**  
**Schlumberger Professor of Geosciences**