
Credit: Prof. Alexandra Anderson-Frey

Department of Atmospheric Sciences Annual Newsletter

UNIVERSITY of WASHINGTON

A message from the Chair

This past year has been truly gratifying as Chair of the department. As you will read in this newsletter, we welcomed our largest incoming cohort of new graduate students (17) in many years. Our faculty and students have received honors and awards for their scholarship and teaching. Our recent graduates are moving on to impressive new endeavors. And, I must also note that we are once again ranked #1 in the world for our scholarly output and impact.

As I worked this summer and fall to prepare for the upcoming decadal review of our academic programs, I was reminded of the elements that make the department a world-leading institution for atmospheric and climate science. Those elements include scientific excellence across a uniquely broad array of topics, the dedication of our faculty, students, and staff to the department's educational mission, the collegial spirit among faculty and students that enables unparalleled collaborative work across the many disciplines needed to advance our understanding of the atmosphere and its societal impacts.

I also became even more aware of the essential role that philanthropic support of our students and faculty plays in enabling these cross-discipline interactions and explorations of new areas of research. From enabling recruitment and support of outstanding graduate students, providing for department quality of life activities, to seeding the initial acquisition of data or equipment, or even funding major multi-year research projects, the role of private support in our research and educational enterprise has substantially increased over the past 5 years. You will read about some examples herein.

Finally, a truly rewarding part of being Chair is being able to help advance the careers of my colleagues. I conclude with a special congratulations to three faculty members who were promoted this year: Abigail Swan (Full Professor), Lynn McMurdie (Research Professor), and Edward Blanchard-Wrigglesworth (Research Associate Professor).

I hope you can join us at one of our upcoming alumni reunions, and social or lecture events in the coming year. I look forward to connecting with you all and please keep us up to date by dropping us a note.

Sincerely,

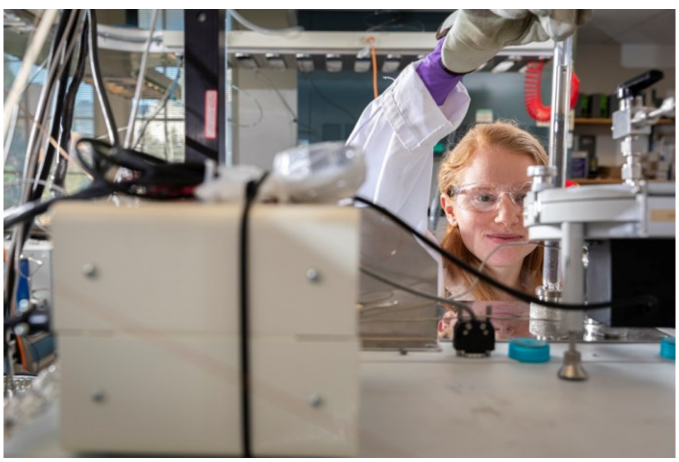
Joel Thornton
Professor and Chair

How is Artic Climate Change Altering Marine Biological Productivity?

By Professor Becky Alexander

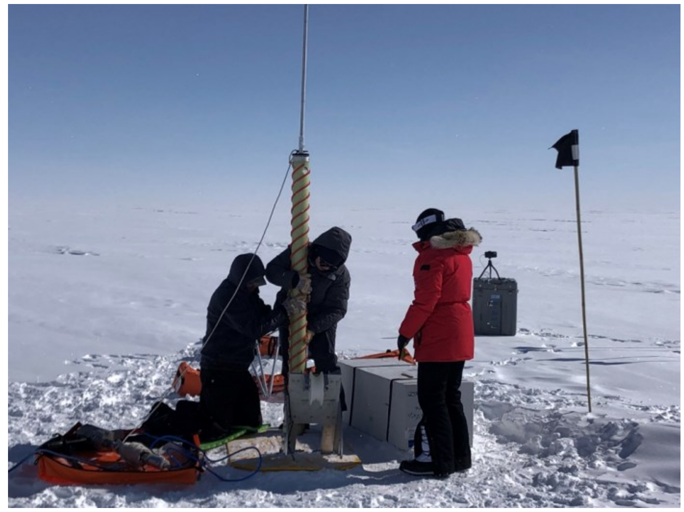
In May 2023, Professor Becky Alexander and her colleague Jihong Cole-Dai from South Dakota State University headed to the middle of the Greenland ice sheet at Summit, Greenland to drill five shallow ice cores. Summit, Greenland is an ideal place to drill ice cores for glaciological reasons and for the permanent NSF-sponsored science station located there.

The project aims to study the impact of Arctic climate change on marine biological primary productivity. Professor Cecilia Bitz and others have demonstrated the impacts of Arctic climate change on megafauna such as polar bears, but the impacts on microscopic organisms that form the basis of the Arctic food web are less clear. Ice cores contain sulfur aerosols that originate wholly or in part from marine phytoplankton and are often used as an approximate gauge ("proxy") for past changes in marine primary productivity.



Graduate student Ursula Jongebloed preparing to run the mass spectrometer to measure the sulfur isotopes of ice-core sulfate.

Marine phytoplankton emits a sulfur gas called dimethyl sulfide (DMS) into the atmosphere that is oxidized to form the sulfur-containing aerosols methane sulfonic acid (MSA) and sulfate. Sulfate aerosol is the main product of the oxidation of DMS, but it is not used as a proxy for marine primary productivity because it has other sources, mainly coal combustion and volcanoes. Since MSA originates solely from marine phytoplankton it is often used as an ice core proxy for marine primary productivity. Past work suggested a decline in marine primary productivity based on declining MSA in ice cores since preindustrial times. The decline in marine primary productivity was hypothesized to be driven in part by declines in sea ice.



Becky Alexander (right) and colleagues Nathan Chellman (Desert Research Institute) and Ben Riddell-Young (Oregon State University) drilling a shallow ice core near Summit, Greenland.

Graduate student Ursula Jongebloed's recent work tells a different story. By measuring the sulfur isotopes of sulfate in an ice core drilled at Summit, Greenland in 2007, Ursula was able to distinguish the marine phytoplankton source of sulfate aerosol from its other sources. Combining this additional information with measurements of MSA in the ice core, she found that total sulfur aerosol (MSA and sulfate) had not changed from preindustrial until 2006, the year representing the top of the ice core. Similar to previous work, Ursula also found MSA had declined since the preindustrial era; however, this decline was compensated for by an increase in sulfate aerosol from phytoplankton. She hypothesized in a paper published this year in the *Proceedings of the National Academy Of Sciences* that the relative changes in MSA and sulfate from this source were driven not by changes in marine productivity, but rather by changes in atmospheric chemistry caused by human activities, such as transportation and energy production, that have increased the emission of nitrogen oxides which change how DMS degrades in the atmosphere.

Since 2007 when this ice core was drilled, there have been large changes in both nitrogen oxides and sea ice, both decreasing. Changes in nitrogen oxide concentrations reversed around the turn of the last century due to air pollution mitigation policies, while sea ice has continued to decline as the Arctic warms. The shallow ice cores drilled at Summit by Alexander and colleagues in 2023 will allow for a more detailed look at the last 30 years that have experienced dramatic changes in human emissions of pollutants and the Arctic climate. They will examine changes in the chemical composition of the Arctic atmosphere as well as look into potential changes in marine primary productivity in the North Atlantic.

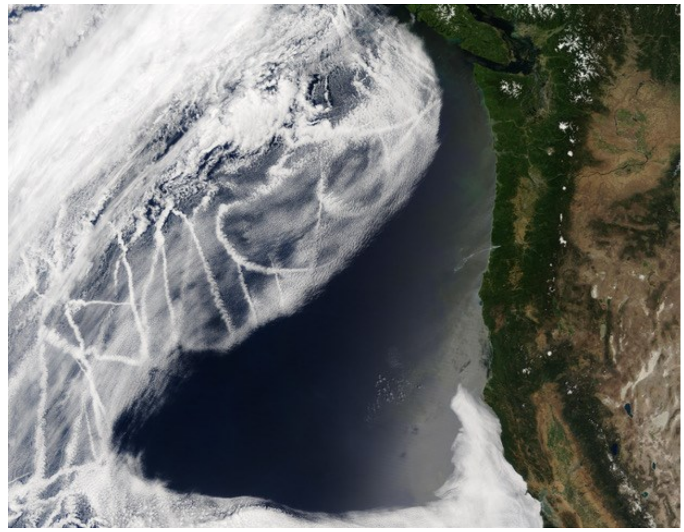
A note from the Chair: The department is aiming to transform our ability to study the composition of ice cores and the chemistry of cold regions of the atmosphere by building a new state-of-the-art laboratory and experimental facility together with the Department of Earth and Space Sciences and the College of the Environment. If you are interested in supporting this effort, please contact James Anderson, Director for Advancement, at jamesa7@uw.edu.

An introduction to the UW's Marine Cloud Brightening (MCB) Program

By: Sarah Doherty, MCB Program Director (and UW Atmospheric Sciences. PhD, 2001)

The Marine Cloud Brightening (MCB) Program, led out of the UW's Department of Atmospheric Sciences, is a research effort involving a consortium of groups designed to reduce uncertainties in the effects of aerosols on clouds and climate, and to study the feasibility and risks of intentionally increasing the reflection of sunlight by marine clouds to reduce the warming caused by anthropogenic greenhouse gases. The program originated some years ago, initially led by (now Emeritus) Professor Tom Ackerman, but only in the past few years has sufficient funding been secured to establish a robust research program. Until very recently, federal programs had not established funding for this type of research, so private support has been essential for putting UW's program ahead of the curve.

For decades, scientists have known that aerosols from human activities have been increasing the reflection of sunlight, both directly and through their effects on clouds, which has partially counteracted greenhouse gas warming. However, this aerosol cooling is highly uncertain, in part because of uncertainties around the complex ways that aerosols affect clouds. Adding aerosols to clouds can reduce the size and increase the number of droplets in the cloud, making the cloud more reflective (or "brighter"), the so-called Twomey effect. Low-altitude clouds with initially low aerosol concentrations, like clean marine stratocumulus, are particularly susceptible to this brightening, as seen visibly in "ship tracks," where emissions from cargo ship engines mix into marine stratocumulus clouds, leaving behind brightened streaks of clouds.

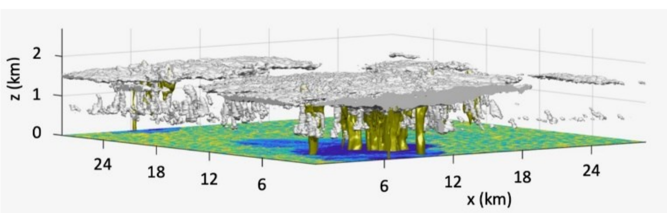


Visible satellite imagery showing ship tracks in the NE Pacific

The prevailing assumption has been that increasing aerosol concentrations in marine stratocumulus would systematically lead to cloud brightening. However, through modeling and observational studies, many conducted by UW faculty and students in the department, have since revealed a more complex set of cloud responses to the addition of aerosols. The decrease in cloud droplet size that comes with the Twomey effect can, in turn, reduce the chance of rainfall, adding to cloud brightening; increasing the mixing of dry air from above the cloud, accelerating cloud water evaporation, offsetting or even overwhelming Twomey brightening; and produce other changes in circulation that can either add to or offset cloud brightening. How these responses play out is strongly dependent on atmospheric conditions and the amount and size of aerosol in the atmosphere – in ways not yet fully understood.

Despite this complexity, scientific studies consistently indicate that aerosols with optimized properties could significantly increase the reflection of sunlight from specific types of clouds, as is seen in ship tracks, and thus that intentional brightening of clouds over parts of the ocean where clouds are most susceptible ("marine cloud brightening", or MCB) might be a way to reduce climate warming from greenhouse gas emissions. In this case, cloud brightening would be achieved using sea salt aerosols generated from seawater rather than pollution aerosols. Estimates of the potential for MCB to reduce climate warming vary substantially, but it is possible that brightening clouds in these regions could provide enough cooling to address a large fraction of climate warming from increasing greenhouse gases.

The MCB Program aims to better quantify the potential for marine cloud brightening to reduce climate warming, to determine how predictably and reliably this brightening could be achieved, and to assess how different implementations would affect climate under various future greenhouse gas scenarios. The program is particularly focused on deepening our understanding of how aerosols affect marine stratocumulus clouds – the expertise of Professor Robert Wood, who is the P.I. on the project. Professor Wood, along with Research Associate Professor Peter Blossey, and a growing team of students, postdoctoral fellows, and research scientists, are using a large-eddy simulating model (LES) to explore marine stratocumulus cloud responses to aerosol additions. The LES simulations utilize very high spatial and temporal resolution to better resolve most of the dynamical processes that determine cloud properties and their evolution.



Example simulation of marine stratus clouds using the UW LES model system (courtesy of Prof. Peter Blossey)

The team is also using state-of-the-art global climate models to explore how increasing cloud brightness in different regions of the ocean thought to be susceptible to MCB ultimately affects regional and global climate. This aspect of the Program is led by Dr. Phil Rasch, Affiliate Professor & Distinguished Faculty Fellow in the Department, and involves an international set of collaborators. Through a coordinated multi-model study, the team's goal is to provide information on how MCB might be able to address different risks that come with increasing climate warming, and equally to identify how and where different implementations of MCB could create its own set of climate risks.

Finally, while models are currently the best tool available to simulate clouds and cloud responses to aerosol perturbations, as with any model they still include approximations, and could be missing or misrepresenting important factors that control clouds. The MCB Program team is therefore also working toward conducting field studies of aerosol-cloud interactions – as is observed in ship tracks, but where the cloud perturbation is produced by a sea-salt aerosol plume optimized for MCB.

We are grateful for the growing number of private and public partners enabling us to develop the knowledge and information society will need to make well-informed decisions about whether and how to use MCB as part of a response to a warming climate. As the research is deeply rooted in understanding aerosol-cloud interactions, and how they play out in the climate system, we hope to help reduce the long-standing large uncertainties in the role of aerosols in present-day and near-future climate change.

FETCH$_4$: Understanding Atmospheric Methane Trends Across Time

By John Meyer, College of the Environment

Alex Turner, Assistant Professor, and Calvin Professor of Atmospheric Sciences (right), and the FETCH$_4$ project logo (left)

The Department of Atmospheric Sciences is a recent recipient of a gift from the Virtual Earth System Research Institute (VESRI), an initiative of Schmidt Futures. This ambitious multi-year project, co-led by the UW and the University of Rochester, is aimed at improving understanding of the fate of atmospheric methane and its influence on climate.

Leading the charge at UW is Atmospheric Sciences Professor Alex Turner, a holder of the Calvin Professorship in Atmospheric Sciences, who specializes in climate and air quality. The Fate, Emissions and Transport of CH_4 (FETCH$_4$) project brings together scientists from 19 institutions around the world to shed light on the lesser-known aspects of the methane (CH_4) cycle.

Methane is a key component of the global carbon cycle, and understanding the processes controlling the abundance of atmospheric methane is profoundly important for understanding future climate and mitigation options. Major sources of methane include both natural- and human-driven pathways, including wetlands, fossil fuels, agriculture, landfills, and fires. Atmospheric methane concentrations have exhibited large variations over time, and have rapidly grown since 2020, yet the drivers of these variations remain scientifically elusive. Scientists know variations can be driven by other aspects of atmospheric chemistry as well, which are also currently poorly understood.

To fill these gaps, the FETCH4 team will collect data from both Greenland ice cores and air samples from stations around the world and measure their unique chemical fingerprints. Their goal is to single out individual aspects of the methane cycle, like those coming from fossil fuel emissions, and identify both their sources and sinks. Using what they learn, the team will develop and sharpen the capability of global climate models to account for methane. Scientists hope that by creating more efficient models, which will be accelerated by machine learning, they can better interpret these chemical fingerprints and more efficiently capture the methane feedback mechanism in global climate models.

Through VESRI, Schmidt Futures, a philanthropic initiative of Eric and Wendy Schmidt, seeks to help coordinate hundreds of climate and data scientists across the globe and at various institutions to identify solutions for pressing complex scientific and computational problems in climate science. By addressing current, foundational knowledge gaps in climate data, VESRI aims to establish baseline measurements of methane, investigate the carbon cycle, and build accessible emulators to help decision-makers around the world access the most accurate climate system data.

"We are pleased to support these highly innovative scientists and interdisciplinary climate modeling initiatives as Schmidt Futures deepens its commitment to climate science," said Stuart Feldman, Chief Science Officer at Schmidt Futures. "We aim to empower decision-makers, scientists, and stakeholders worldwide with invaluable insights to inform evidence-based decision-making, advance mitigation efforts, and strengthen our resilience to the impacts of climate change. VESRI is set to significantly enhance the accuracy and reliability of major climate models while fostering global cooperation and accessibility to vital climate data."

Recent Department Lectures

Fleagle Endowed Visiting Lecture

In May, the Department of Atmospheric Sciences hosted Dr. Myles Allen, Professor of Geosystem Science, at Oxford University for the 2023 Fleagle Endowed Visiting Lecture. Dr. Allen's lecture, "*Geological Net Zero: How We Will Stop Fossil Fuels from Causing Global Warming*," discussed what it would take to achieve a durable halt to global warming. A global Alliance for Geological Net Zero may be the only way to stop fossil fuels from causing further global warming in time to meet Paris Agreement goals.

Dr. Myles Allen, Professor of Geosystem Science, Oxford University

The Fleagle Endowed Lectureship is made possible through an endowment established by the late Professor Robert Fleagle and his family to enable our faculty and students to appreciate and understand the deep connections between atmospheric science and environmental policy.

Graduate Students' Distinguished Lecture

Professor Adam Sobel, Columbia University's Lamont-Doherty Earth Observatory and Engineering School

In May 2023, the Graduate Students' Distinguished Visiting Lecture was given by Professor Adam Sobel, from Columbia University's Lamont-Doherty Earth Observatory and Engineering School. Professor Sobel was once a postdoctoral fellow in UW's Department of Atmospheric Sciences , and returned to give a lecture titled, "*Climate Risk Science: An Applied Field in Need of Synthesis and Theory*." The lecture provided a framework for how the science of atmospheric and climate predictability can be used to inform how best to insure against societal risks associated with climate. The Graduate Students' Distinguished Lecture, which is made possible by private support each year, enables our students to engage with leaders in the field from outside the department.

Staff Spotlight

Cathy Liao: Atmospheric Sciences' new Counseling Services Coordinator

Cathy's educational journey has taken her from a small town in China to Canada and the United States. She obtained her MA in Higher Education from the University of British Columbia in Canada and later moved to Los Angeles, where she earned her Ph.D. in Comparative and International Education from the University of California, Los Angeles.

Cathy joined UW Atmospheric Sciences in July 2023 because of the opportunity to work with both undergraduate and graduate students and has hit the ground running. In fact, Cathy enjoys running for a hobby, though she's not tried marathons (yet). She also enjoys hiking with her family, trying new boba tea places, enjoying ice cream, and exploring diverse cuisines. She also loves to travel. Tibet is one of her dream destinations.

Cathy Liao, Student Services Coordinator

Janice Lin: Atmospheric Sciences' new Assistant to the Chair

Janice launched her career in higher education administration while working as a student assistant at her college's School of Education while obtaining a BS in Business Administration with a concentration in Information Systems from Cal Poly San Luis Obispo. Upon graduation, she became a Lab Manager at UC Berkeley, where she held responsibilities such as HR, grant management, and lab operations. She recently obtained an MS degree in Technology Innovation from the University of Washington. During her time in grad school, she worked as an operations assistant at the University of Washington's Global Innovation Exchange. She has been living in the Greater Seattle Area for about two years and enjoys exploring the Pacific Northwest.

Janice Lin, Assistant to the Chair

Congratulations to our Faculty

Professor [Becky Alexander] received the *Future Horizons In Climate Science-Turco Lectureship*. This is presented annually and recognizes significant interdisciplinary scientific research, discoveries, or advancements in climate science. Prof. Becky Alexander is this year's recipient and was invited to present the lecture at the AGU 2023 annual meeting.

Professor [Alex Turner] won the UW's 2022-2023 *Atmospheric Sciences Teaching Award*. This award, coordinated by the graduate students, is given to a faculty member based on student nominations received over an academic year.

Professor [Qiang Fu] has been named an inaugural holder of the *Calvin Professorship in Atmospheric Sciences*.

Professor [Dale Durran] won the *Jule G. Charney Medal* from AMS 2023. This medal is granted to individuals in recognition of highly significant research or development achievements in the atmospheric or hydrologic sciences.

Lecturer [Kat Huybers] won the 2022-2023 UW *College of the Environment Outstanding Teaching Award*. The award is presented in recognition of teaching that richly exemplifies the high standards at the heart of the academic mission of the College.

Welcome to our new Postdoctoral Scholar

Hongwei Sun, Ph.D., *Harvard University* (Wood)

Welcome to our new Graduate Student Cohort for 2023-2024

Jason Barr
Cong Dong
Miles Epstein
Skylar Gale
Stella Heflin
David Lopez
Aakash Manapat
Eric Mei
Zilu Meng
Manali Nayak
Jay Pillai
Drew Pronovost
Joey Rotondo
Dominik Stiller
Trent Vonich
Geraint Webb
Richard Zhuang

Congratulations to our recent Graduates

Bachelor of Science

Raphael Alan Bakin
Ryan Joseph Boyd
Peixi Cheng
Anthony Bradley Edwards
Qi Ge
Zhourui Ray He
Henry Michael Kessler
Abigail King
Olivia Elizabeth Lee
Collin Joe Paulk
Olivia Pierpaoli
Vince Qian
Nolan Scelzi
Thanpicha Tanadumrongsak
Ling Celeste Tsiang
Autumn Eve Vandehey
Linh Vu
Flora R Walchenbach

Master of Science

Rebecca Cleveland Stout, Fingerprinting low-frequency Holocene temperature variability in forced and unforced climate models

Nathaniel Cresswell-Clay, A Sea Surface Model for Coupled Data-Driven S2S Forecasting

Randall Jones, A Hemispheric Analysis of Aerosol Particle-Lightning Relationships

Ellen Koukel, Facing Arctic Climate Change: Sea Ice Freeze Through the Lens of a Community

Piero Rodrigo Rivas, An index for predicting precipitation in the northern coast of Peru using logistic regression

Ejha Larasati Siadari, Low-level Wind Shear Alert Prediction System Using Machine Learning

Morgan Tatum, Investigating Decoupling of the Stratocumulus-topped Marine Boundary Layer at the ARM Eastern North Atlantic Site

Terrell Freddrick Wade, Predicting ENSO Diversity Using the Pacific Meridional Modes: an Observational Analysis

Doctor of Philosophy

Benjamin Barr, Seastate-Dependent Sea Spray Heat Fluxes and Impacts on Tropical Cyclone Structure and Intensity Using Fully Coupled Atmosphere-Wave-Ocean Model Simulations

Tyler Cox, Atmospheric Heat Transport: Variability, Trends, and the Role of Orography

Lily Hahn, Mechanisms of polar-amplified warming: understanding hemispheric and seasonal asymmetries)

Edoardo Mazza, Understanding Multiscale Tropical Cyclone-Environment Interactions: A Step Toward Bridging Knowledge Gaps Across the Weather-Climate Continuum

Jacqueline Nugent, Overshooting Convection, Cirrus, and the Cold Point Tropopause in Global Storm-Resolving Models and Satellite Observations

Lindsey Taylor: Linear Inverse Models for Coupled Atmosphere–Ocean Analysis and Prediction

Mingcheng Wang, Ozone Stratosphere-Troposphere Exchange in the Past, Present, and Future

Daniel Lloveras, The two- to four-day predictability of midlatitude cyclones: Idealized and real-world case studies

Shuting Zhai, Anthropogenic Impacts on Tropospheric Reactive Chlorine and Bromine Since the Preindustrial

Travis Aerenson, Cloud Changes in Climate Models: Response to Solar and CO2 Forcing and the Relationship between Model Bias and Feedbacks

Undergraduate Fellowships & Awards

Atmospheric Sciences Undergraduate Student Support Fund: **Vlad Munteanu**

Bruce Caldwell Memorial Scholarship Fund: **Marky Mayanja** and **John Cramblitt**

Richard and Joan Reed Undergraduate Endowed Scholarship: **Jared McGlothlin**

Mindlin Endowed Fund for Undergraduate Support: **Alyssa Tou**

Graduate Fellowships & Awards

Atmospheric Sciences Enrollment Support Endowed Fund: **Joey Rotondo**

Atmospheric Sciences Graduate Education Fund: **Jay Pillai, Dominik Stiller**, and **Skylar Gale**

Fulbright Fellowship: **Alton Daley**

James Holton Endowed Graduate Support Fund: **Stella Heflin** and **Richard Zhuang**

Jan and Conway Leovy Endowed Graduate Support Fund: **Trent Vonich** and **Jason Barr**

Joost A. Businger Endowed Fellowship in Atmospheric Sciences: **Geraint Webb**

Lorraine and Dennis Hartmann Endowed Fellowship in Atmospheric Sciences: **Stella Heflin**

National Defense Science and Engineering Graduate Fellowship: **Nathaniel Cresswell-Clay** and **Ariel Jacobs**

NASA FINESST Award: **Andrew DeLaFrance, Yakelyn Ramos Jauregui, Aodhan Sweeney, Nikhil Dadheech, Randall Jones**, and **Celeste Tong**,

NSF Graduate Research Fellowship: **Zac Ian Espinosa, Spencer Ressel, Amy Liu,** and **Lily Zhang**

Provost Fellowship: **Cong Dong**

Robert Fleagle Endowed Graduate Support Fund: **Zilu Meng**

Stephen G. Warren Endowed Graduate Student Support Fund: **Cong Dong**

William and Carol Lau Term Fellowship in Atmospheric Sciences: **Aakash Manapat**

Upcoming Alumni and Friends Event

Reception at AMS 2024, Baltimore (Jan 30, 2024)

We are hosting an Alumni and Friends Reception for our department at the 2024 Annual Meeting of the American Meteorological Society. Join us on Tuesday, January 30 at 7:30 pm at the Marriott Baltimore Inner Harbor at Camden Yards for this special opportunity to connect with students, postdocs, alumni, faculty, and friends of the Department. To attend, please RSVP here.

Our new graduate students (a subset pictured above) joined members of the department for a hike up Rattlesnake Ridge this September. Photo courtesy of Prof. Shuyi Chen.

Many thanks to our generous Donors

We are deeply grateful for our growing community of donors who generously give to the Department of Atmospheric Sciences each year. Philanthropy continues to play a key role in strengthening the department, which through its excellence in teaching and research, strives to understand and address pressing climate, weather, and air quality issues, and to provide valuable, timely observations and forecasts for decision-making.

The generosity of our donors also enhances our ability to recruit world-class faculty and students and train the next generation of scientific leaders.

Making a Gift

Gifts of all sizes are vital in empowering our community and accelerating their research and scholarship, and we hope you will consider making a gift to a fund or cause that is meaningful to you.

Your gift can be directed to support students, faculty, or programs across the Department of Atmospheric Sciences. To learn more about opportunities to make an impact, we invite you to explore our featured funds at the link below or contact James Anderson, Director for Advancement for the Department of Atmospheric Sciences at jamesa7@uw.edu. The Department's priority funds are:

- Friends of Atmospheric Sciences Fund
- Atmospheric Sciences Graduate Education Fund
- Atmospheric Sciences Undergraduate Student Support Fund

Or, you may give to one of our named funds in honor of a faculty mentor. Additional gift funds can be found at: atmos.uw.edu/alumni-and-community/giving

To make your gift by phone, please call James Anderson at 206-685-4423, or send a check to the address listed on this page.

Please indicate if your gift is a joint gift so we may recognize your generosity accordingly. Your gift to the Department of Atmospheric Sciences is also tax-deductible. The University of Washington Foundation is registered as a charitable organization, and its Federal Tax ID number is: 94-3079432

Contact Us

Department of Atmospheric Sciences
University of Washington
Box 351640
Seattle, WA 98195-1640

Phone: (206) 543-4250
Fax: (206) 543-0308
Web: www.atmos.uw.edu

The Atmospheric Sciences newsletter is published annually for alumni, friends, and members of the UW's Department of Atmospheric Sciences.

Please send alumni news and comments to: chair@atmos.uw.edu

Contributors: Janice Lin, Cathy Liao, James Anderson

UW Atmospheric Sciences graduate students now hold an annual retreat to welcome our new student cohorts and to build community. Donors to our Friends of Atmospheric Sciences Fund help make this formative event possible.