Department of Atmospheric and Climate Science Annual Newsletter

UNIVERSITY *of* WASHINGTON

A Message from the Chair

As the title of this newsletter reflects, one of the larger news items from the past year is that we have completed a change to the department's name from Atmospheric Sciences to *Atmospheric and Climate Science*. For those who know our department and its breadth of research, the response has been "Oh, yes, that makes perfect sense." In fact, the original name of the department at its founding in 1947 by Phil Church was the Department of Meteorology and Climatology.

Synthesizing short descriptions of our faculty's and students' research areas and our course offerings for our decadal review of our academic programs made it clear that we are, and have been for decades, a world-leading institution for atmospheric and climate science. Incorporating both into our new name better communicates who we are and what we do for prospective students and community partners.

Of course, that is not all that has happened this year! As you'll read in this newsletter, our field and research areas continue to evolve and in some cases, at a very rapid pace.

Artificial Intelligence (AI) methods are opening up new opportunities for predictability and analysis and our faculty and students are at the leading edge of this new era. Relatedly, I'm pleased to announce that we have hired a new faculty member, Dr. Aditya Grover, who will be jointly appointed in our department and the Paul Allen School for Computer Science and Engineering. Aditya, currently at UCLA, is developing novel AI methods for weather and climate predictability and was recently named one of the "Forbes 30 under 30" for his work.

Our students and faculty are also applying their expertise to not only understand the atmosphere and climate system, but also to examine the scientific validity of proposed solutions to climate change through the novel use of simplified models of the carbon cycle to evaluate carbon offset programs, simulations of cloud brightening efforts, or wind energy projects, among others.

It is in these emerging areas of research where philanthropic support has been essential to giving our faculty and students a leading edge by providing the ability to seed collaborations among students and faculty on an exploratory use of a new method or to start projects where federal agencies have not yet developed relevant programs. On behalf of the department, I want to express my deep gratitude to our many donors in this regard.

I look forward to connecting with you all, either in person at one of our upcoming events or keep us up to date by dropping us a note! We are always glad to hear from our alumni and friends about their new ventures and will be spotlighting some of them in this and future newsletters.

Sincerely,

Joel Thornton

AI Modeling of the Earth System

By Janice Lin, Assistant to the Chair

Generative Pretrained Transformers have changed the world, though they are known more by their acronym, as in the popular large language model ChatGPT. Success with large language models (LLM) has been closely followed by success in computer vision, often building on methods developed for LLM. Similarly, computer-vision AI architectures have been adapted to weather forecasting with significant early advances by former UW graduate student Jonathan Weyn, Professor Dale Durran, and Rich Caruana of Microsoft in a series of three papers from 2019 to 2021. Subsequent developments have produced much larger and more accurate AI models such as Pangu Weather from Huawei and GraphCast from Deep Mind/Google. These models were trained on ERA5 reanalysis data, and when compared at ¼ degree latitude-longitude resolution, show skill similar to or better than the European Centre for Medium-Range Forecasts (ECMWF) world-leading Integrated Forecast System (IFS). ECMWF recently introduced its own AI weather forecast model, the AIFS, which also generally shows excellent skill compared to the IFS.

As these developments in AI-based global medium-range forecasting were occurring, Dale Durran and several grad students developed a deep-learning Earth-system model that successfully couples atmosphere and ocean components and can simulate the current climate over indefinitely long periods. A quick look at the performance of the model is shown in the accompanying figure, which compares 1000-hPa height (proportional to mean sea-level pressure) and 10-m wind speeds in two Nor'easters off the coast of New England. After roughly 1000 years of simulation (730,000 time steps), the model continues to spontaneously produce realistic intense low-pressure systems like that in the ERA5 reanalysis

on February 14, 2017. this Deep Learning Earth System Model (DLESyM) is very parsimonious, predicting only 10 prognostic variables compared to 70 in the AIFS, 69 in Pangu Weather, and 227 in GraphCast. Coupling the atmospheric model to an ocean model was essential to the stability of the long-term rollout. Also of note is the HEALPix mesh used to discretize the solution, which is common in astronomy but new to atmospheric science. Further details about DLESyM are at https://arxiv.org/abs/2409.16247
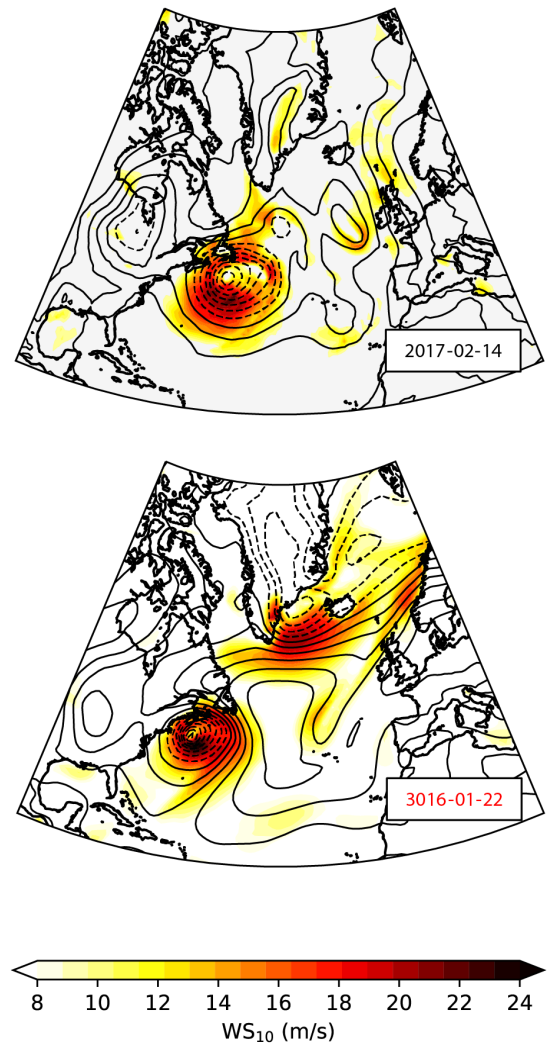
Contours of 1000-hPa height (black) and 10-m wind speed (color fill) for an observed storm on February 14, 2017, and a simulated storm on January 22, 3016. Data are plotted at 1 degree latitude-longitude resolution.

Future efforts are underway at UW to incorporate land surface and sea-ice forcing into the model to better capture the evolution of Earth-system processes on sub-seasonal and seasonal time scales. Durran believes DLESyM's parsimony will lend itself to novel approaches to using AI to understand low-frequency variability in the coupled atmosphere-Earth system.

Finding Pathways to a Stable Climate Using Simple Climate Modeling

By Professor Abigail Swann

To limit warming, and thus harm to people and living things on Earth, emissions of carbon dioxide (CO_2) must be reduced to net zero. Our best understanding from climate models shows that warming goes up linearly with cumulative emissions of CO_2 and that warming stops when emissions stop. However, how much and how fast natural systems on land and ocean will remove CO_2 from the atmosphere, and how those rates compare with heat uptake by the ocean all remain major uncertainties.

Graduate students, postdocs, and faculty from across the Atmospheric and Climate Science department came together to quantify the uncertainty in how the temperature of our planet will respond to declining carbon emissions, and to in particular explore the uncertainty in pathways to net zero stemming from our structural representation of the carbon cycle.

We started with a reading group where we learned about the structure of different simple climate models, each of which represents the climate system uniquely, and considered if there were essential processes that might be missing.

After learning about the simple models that are being extensively used already, especially for climate impact work, we organized a model intercomparison project (or MIP) to assess uncertainty in how carbon is represented using a selection of simple models. Members of the group each chose a model and ran a parallel set of experiments to assess the sensitivity of temperature to emissions of carbon dioxide in different scenarios of future CO_2 emissions, as well as to test how assumptions that were made specifically about carbon cycling change the climate under a given emissions scenario.

We found that the carbon cycle was represented in very different ways across the models and that this led to different timing and amount of carbon uptake under future scenarios of decarbonization. This has important implications because these simple models are used extensively in climate impact work and for calculating climate risk by the scientific community, public sector, and private sector.

The group presented preliminary results at a department seminar, and graduate student Greta Shum (Ph.D. 2024) presented the findings of the group at the AGU Fall Meeting. The group is currently drafting a commentary piece on the different outcomes from simple models tentatively titled "Simple Models Agree on Everything but the Carbon Sink." Students and faculty alike are excited to continue the work and feel that we have a valuable perspective to contribute.

The team is grateful for the support from Catherine Graubard and Bill Calvin through the Program on Climate Change's Climate Science Research Accelerator Award. This support enabled the initial phase of the project which has in turn spurred ideas and preliminary data for future proposals.
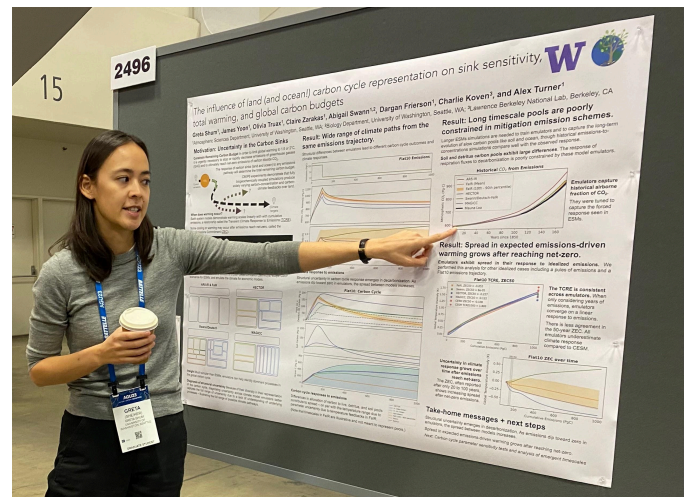
Graduate Student Greta Shum (Ph.D. '24) presented the poster at AGU.

Recent Department Lectures

Graduate Students' Distinguished Lecture

Through the generosity of Alumna Jennifer Francis and partner Peter, we have been able to host the graduate students' choice of a distinguished lecturer (GSDVL) for several years now. The benefits to the students and faculty of the extended visit of an expert in the field are numerous and can often create career-changing moments that inspire new directions. The most rewarding part of these visits is the opportunity for multiple interactions - as part of informal gatherings and time for reflection in between that are enabled by the more relaxed schedule.

This year's GSDVL was hosted by graduate students Chad Small and Lily Zhang. The speaker was Professor Paul O'Gorman from the Massachusetts Institute of Technology, who visited the department in May.

Professor O'Gorman gave 2 talks while he visited the department - "Response of extreme precipitation to climate change: physical understanding and machine learning" and "Extratropical cyclones in warm climates and the limit of purely moist dynamics."

Professor Paul O'Gorman is an expert on large-scale dynamics of the atmosphere, the hydrological cycle, moist convection, and climate change. His recent work has focused on the response of precipitation extremes to climate change, the effect of latent heating on atmospheric circulations, and the use of machine learning to improve climate models. He has been involved in several influential papers about the response of the hydrological cycle to warming, including Singh and O'Gorman (2013) which introduced the zero-buoyancy plume model to explain increases in CAPE extremes.

Professor Paul O'Gorman, Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology

This year, Professor O'Gorman was awarded the American Meteorological Society's (AMS) 2023 Bernhard Haurwitz Memorial Lectureship, which recognizes outstanding mid-career scientists who have made "significant contributions to the understanding of atmospheric and ocean fluid dynamics, the circulation of the middle atmosphere, or the dynamics of climate".

Hobbs Endowed Visiting Lecture

The Peter V. Hobbs Memorial Endowed Lectureship in Experimental Meteorology honors the memory of Professor Peter Hobbs by inviting leading scientists in the areas of cloud and aerosol physics, the structure of fronts and weather systems, and atmospheric chemistry to interact with students, faculty, and the general public. The Hobbs lecturer this year was Professor Jonathan Martin of the University of Wisconsin, who visited the department in October.

Professor Jonathan Martin, Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison

On the first day, Professor Martin met with many faculty and students individually and gave a well-received seminar: Chasing a Giant: Reginald Sutcliffe and the Invention of Modern Synoptic-Dynamic Meteorology. On the second day, Professor Martin met with more department members, had lunch with our students, and then gave a stimulating evening talk in Kane Hall: Warmer Winters and Wavier Jet Streams: The Cold Season in a Changing Climate. Over 150 attended the evening seminar including Sylvia and Steven Hobbs.

Atmospheric and Climate Science recognizes the important contribution of endowed lectureships, such as the Hobbs lecture, which greatly enhances the intellectual environment of the department.

Staff Spotlights

Thomas Kaghan: New Budget/Fiscal Analyst

Thomas Kaghan, Budget/Fiscal Analyst

Thomas is a lifelong Seattle resident and an alumnus of the UW. He received his BA in Biology in 2014. After getting 7 years of staff experience in the School of Medicine and Pharmacy, he'd like to gain more grant administration knowledge at ATMOS.

Beyond his interest in complex financial systems, he is an avid lover of birds. He's set up 5 different bird feeders in his yard and gets a large variety of

feathered friends who visit each day. His personal favorite bird is the gorgeous Northern Flicker, whose coloration and call are simply enchanting. Now only if they didn't peck at his chimney during Spring, his other hobbies are cycling around Seattle, playing tennis, live-streaming video games, and trying all the different great foods around Seattle.

Craig Corvin: New Assistant Director of Computing

Craig Corvin, Assistant Director of Computing

Before joining the department, he led the way as a Software Engineering Manager for a grant-funded program at the UW. However, Craig isn't just about tech— he's a musical powerhouse, playing everything from country and rock to electronic beats with Seattle bands. When he's not jamming, you might find him renovating his Queen Anne home or planning his next adventure— think ancient ruins and pyramid climbs.

Congratulations to Our Faculty

Professor **Qiang Fu** has been elected to the National Academy of Sciences and the Washington State Academy of Sciences.

Professor **Shuyi Chen** has been selected for the 2024 Jacob Bjerknes Lectureship at AGU. It is presented annually to a scientist who has made a major scientific impact in advancing the basic understanding of the atmosphere and Earth's climate.

Professor **Rob Wood** became an AGU Fellow in 2024.

Emeritus Professor Bob Houze was named AMS Honorary Member.

Faculty Retirement

This fall, Dennis Hartmann officially retired after 47 years as a professor in the department and was appointed Professor Emeritus. His impact on the field of atmospheric and climate science has been immense - a short paragraph would not suffice. He has mentored many doctoral students who have become leaders in the field, published seminal papers, written a textbook, received numerous awards, and been elected to the National Academy. He provided a great deal of service to both the department and university, including as Chair and interim Dean of the College of the Environment, and to dozens of national and international scientific advisory committees. I hope you can find time to congratulate him and wish him well in his future endeavors. Although he retired, he went right back to his role helping organize this year's Atmospherics and Winter Social entertainment.

Prof. Dennis Hartmann (2nd from the right) with colleagues and friends at Duke's Seafood South Lake Union celebrating his retirement.

Alumni Updates

Here are some highlights from our alumni!

Dr. Chih-Pei Chang (Ph.D. 1972)
Chih-Pei received the 2024 Asian Oceania Geoscience Society Wing-Ip Medal and will present a lecture entitled, "Maritime Continent Monsoon: Topographic Effects and Mesoscale – Large Scale Interactions" at the AGOS annual meeting in Pyeongchang, South Korea.

Dr. Tsan-Ying Steven Yuen (Ph.D. 1979)
Steven retired in Seattle last year from FirstNet Authority, an independent agency in the U.S. Department of Commerce, where he led the cybersecurity and 5G technology planning for building the nation's wireless communications network dedicated to public safety.

Dr. Aaron Hill (B.S. 2012)
After a four-year stint at Colorado State University as a Postdoc and Research Scientist, Aaron Hill joined the faculty at the University of Oklahoma's School of Meteorology as an Assistant Professor in Fall 2023!

Welcome to our new Postdoctoral Scholars

David Bonan, Ph.D., California Institute of Technology (CICOES)

Camille Hankel, Ph.D., *Harvard University* (CICOES)

Haruki Hirasawa, Ph.D., *University of Toronto* (Wood)

Litai Kang, Ph.D., *University of Washington* (Wood/Blossey)

Chan-Pang Ng, Ph.D., *Peking University* (Fu)

Yakelyn R. Jauregui, Ph.D., *University of Washington* (CICOES)

Huan Song, Ph.D., *Peking University* (Thornton)

Troy Zaremba, Ph.D., *University of Illinois Urbana-Champaign* (McMurdie/Blossey)

Welcome to our new Graduate Student Cohort for 2024-2025

Benjamin Buchovecky
Kyndra Buglione
Angel Chui
Je-Yun Chun
Iana Ferguson
Eliot Kim
Andy Liu
Sofia Vakhutinsky
William Yik

Congratulations to our recent Graduates

Bachelor of Science

Noah Brown
Ariana Constance
Skye Cruz
Haley Furutani
Emma Harper
Nikhil Khanal
Zihua Liu
Jasmine Lee
Carina Leighton
Haley Lowes-Bicay
Shauna Luckey
Harrison MacMurchie
Krista Matuska
Jared McGlothlin

Barbara Milewski
Declan Mullin
Alex Patel
Jack Philbrick
Sarah Phillips
Vince Qian
Samantha Smith
Thanpicha Tanadumrongsak
Laken Welsh
Yinquan Zhang
Xuan Zhao

Master of Science

Nikhil Dadheech, Emulating Atmospheric Transport using Machine Learning for Greenhouse Gas Emission Flux Estimation

Nelly Emlaw, The Role of Precursor Disturbances in the Modulation of Western Pacific Tropical Cyclogenesis on Intraseasonal Timescales

Zac Espinosa, Machine Learning Gravity Wave Parameterization Generalizes to Capture the QBO and Response to Increased CO_2

Ariel Jacobs, Investigating Summer 2022 Arctic Cyclone Structure and Evolution

Amy Liu, Photosynthesis responses to intrinsic water use efficiency depend on atmospheric feedbacks and modify the magnitude of response to elevated CO_2

Allison Moon, Sulfur and Oxygen Isotopes Show That Primary Sulfate is the Dominant Source of Particulate Sulfate in Fairbanks, AK

Spencer Ressel, Numerical Solutions of a Simple Linear MJO Model on an Equatorial Beta-Plane: Comparison with Analytical Solutions and Parameter Sensitivity

Celeste Tong, Predicting the Frequency of Low Cloud Mesoscale Morphologies in Extratropical Cyclones Using Cloud-Controlling Factors

Chris Wright, Lightning Declines Over Shipping Lanes Following Regulation of Fuel Sulfur

Doctor of Philosophy

Mu-Ting Chien, Convectively Coupled Kelvin Waves in Current and Future Climates

Carley Fredrickson, Quantifying and Understanding Reactive Nitrogen Emissions and Chemistry from Wildfires Through Remote Sensing and Modeling

Litai Kang, Southern Ocean Precipitation and Aerosol-Cloud-Precipitation Interactions: A Synthesis of Aircraft Observations, Simple Process Model, and Earth System Model

Yakelyn R. Jauregui, Multiscale Air-Sea Interactions of the MJO and Onset of El Niño: A New Prospective of Precipitation and Density Current Coupling

Adam Sokol, Tropical convection, clouds, and climate: Insights from idealized models of radiative-convective equilibrium

Greta Shum, Adventures in Wonder of Land: How Bio geophysical and Biogeochemical Feedback at the Surface Determine Habitability in Two Extreme Worlds

Emily Tansey, An Observations-Based Portrait of Southern Ocean Low-Cloud Characteristics and Optical Depth Feedback from the Macquarie Island Cloud and Radiation Experiment (MICRE)

Sami Turbeville, Tropical cirrus in high-resolution global and regional models

Claire Zarakas, Impacts of vegetation on climate and the global water and carbon cycles

Student Fellowships & Awards

Undergraduate Fellowships & Awards

Atmospheric Sciences Undergraduate Student Support Fund: **Coco Lipe**

Bruce Caldwell Memorial Scholarship Fund: **John Cramblitt** and **Laura Pong**

Dani Elenga Environment Scholarship: **Marky Mayanja**

Leo Reitan Endowed Scholarship: **Nicholas Shepard**

Richard and Joanne Reed Undergraduate Endowed Scholarship: **Nicholas Shepard**

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

Graduate Fellowships & Awards

Bruce Caldwell Memorial Scholarship Fund: **Benjamin Buchovecky**

DOE Computational Science Graduate Fellowship: **Zac Espinosa** and **William Yik**

Hobbs Quality Enhancement Fund: **Andy Liu**

James Holton Endowed Graduate Support Fund: **Sofia Vakhutinsky** and **William Yik**

Jan and Conway Leovy Endowed Graduate Support Fund: **Sofia Vakhutinsky** and **William Yik**

Joost A. Businger Endowed Fellowship in Atmospheric Sciences: **Kyndra Buglione**

Lorraine and Dennis Hartmann Endowed Fellowship in Atmospheric Sciences: **Je-Yun Chun**

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

NASA FINESST Award: **Aodhan Sweeney, Nikhil Dadheech, Randall Jones**, and **Celeste Tong**

NSF Graduate Research Fellowship: **Spencer Ressel, Amy Liu, Lily Zhang, Nelly Emlaw,** and **Miles Epstein**

Program of Climate Change Fellowship: **Iana Ferguson**

Provost Fellowship: **Angel Chui**

Robert Fleagle Endowed Graduate Support Fund: **Kyndra Buglione**

Wallace Holton Endowed Graduate Support Fund: **Angel Chui**

Upcoming Alumni and Friends Event

Reception at AMS 2025 – New Orleans, LA

We are hosting an Alumni and Friends Reception for our department at the 2025 Annual Meeting of the American Meteorological Society. Join us on **Tuesday, January 14, at 7:00 p.m.** at the [Hilton New Orleans Riverside](), Grand Salon A Section 3, for this special opportunity to connect with students, postdocs, alumni, faculty, and friends of the Department. To attend, [RSVP here]().

Many thanks to our generous Donors

We are deeply grateful for our growing community of donors who generously give to the Department of Atmospheric and Climate Science 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.

This year, in addition to the philanthropic support of research, the generosity of our donors specifically for student support continues to be truly gratifying. Alum Chih-Pei (CP) and Hedy Chang recently created an endowed fund to support graduate students. We were also able to create the Steve Pool Memorial Scholarship Fund to honor Steve's commitment to undergraduates in our program who are interested in broadcast meteorology.

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 and Climate Science. To learn more about opportunities to make an impact, we invite you to explore our featured funds at the link below or contact Laura Perez Hamilton, Senior Director for Advancement for the Department of Atmospheric and Climate Science at lphamil@uw.edu. The Department's priority funds are:

- Friends of Atmospheric Sciences Fund
- Atmospheric Sciences Graduate Education Fund
- Atmospheric Sciences Undergraduate Student Support Fund
- Steve Pool Memorial Fund for Students in Atmospheric Sciences

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

Please indicate if your gift is a joint gift so we may recognize your generosity accordingly. Your gift to the Department of Atmospheric and Climate Science 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 and Climate Science
University of Washington
Box 351640
Seattle, WA 98195-1640

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

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

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

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