



AOS & CIMES Newsletter

Program in Atmospheric and Oceanic Sciences (AOS) &
The Cooperative Institute for Modeling the Earth System (CIMES)



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AOS Alums Anna Trugman & Hannah Zanowski in Conversation



Anna Trugman



Hannah Zanowski

We recently caught up with AOS Alumni Anna Trugman, assistant professor in the Department of Geography, University of California, Santa Barbara, and Hannah Zanowski, assistant professor in the Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, to chat about their paths from AOS graduate students to faculty members. Anna graduated in 2017 with a thesis titled “Understanding the Roles of Climate, Disturbance, and Functional Diversity in the Terrestrial Carbon Cycle: Linking Mechanisms from Regional to Global Scales.” She was advised by David Medvigy. Hannah graduated in 2016 with a thesis titled “The Influence of Antarctic Open-Ocean Polynyas on the Abyssal Ocean.” She was advised by AOS Faculty Member Robert Hallberg.

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HMEI-STEP Fellowship Awarded to Chua



Glen Chua

AOS Graduate Student Glen Chua has been awarded a 2021 HMEI-STEP Environmental Policy Graduate Fellowship, by the High Meadows Environmental Institute (HMEI), for his project “Ways to Mitigate Potential Risks of a Hydrogen Economy from a Chemistry-Climate Perspective.”

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Hogikyan Among 2021 Hack Graduate Awardees to take on Water-Related Issues



Allison Hogikyan

AOS Graduate Student Allison Hogikyan is among eleven Princeton University graduate students selected by the High Meadows Environmental Institute (HMEI) as 2021 recipients of the Mary and Randall Hack '69 Graduate Awards for Water and the Environment.

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Welcome!

“The summer is here and the living is easy” ... at the very least, easier!

That said, we wouldn't be here without you, and we'd like to extend a heartfelt thank you to all of you who have continued to commit yourself to your work and the Program's mission. We look forward to our return to campus and the upcoming academic year, with the promise of in-person instruction and research-related endeavors.

In this issue, we highlight a conversation with AOS Alums Anna Trugman and Hannah Zanowski, AOS Graduate Students Glen Chua and Allison Hogikyan, recent HMEI fellowship/award winners, along with news of GFDL's FV3 improving NOAA's weather forecasting, and our virtual summer internships. Among the stories and events also highlighted in this issue are Science Moms on a mission, the upcoming student-led Climate Tipping Points workshop, and a Q&A with AOS Alum Sarah Kapnick. We welcome all those new to our AOS/CIMES community!

Stephan Fueglistaler, Director AOS, CIMES
Gabe Vecchi, Deputy Director, CIMES

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How did your graduate work mold your academic career path? What factors did you take into consideration when deciding to pursue an academic career?

Trugman: My graduate career gave me the quantitative skills and independence that has helped me throughout my career. What I love about academia is that I get to wake up every day and decide my own agenda. Basic research is a really unique realm where I have the luxury of trying to understand the world around me as part of my job.

Zanowski: Well, by the end of my Ph.D. I was thoroughly sick of what I was doing (absolutely no disrespect to my advisor/committee/mentors) so that was a rather strong catalyst for getting me to do something else! I also never really ‘decided’ to pursue a career in academia. Rather, I made some choices and I wound up here. Since graduating I have been entirely unsure of what I want to do with my life, so trying out this faculty position is simply another step on that path. One thing that has kept me interested in an academic career is that I really enjoy teaching and mentoring, so this is a nice opportunity to do more of that.

In your current research, what questions are you most interested in exploring?

Trugman: My research focuses on understanding terrestrial ecosystem function and the effects of climate change on terrestrial biogeochemistry. I approach this question using a hierarchy of process-based vegetation models, large observational datasets, and field-based measurements.

Zanowski: I am going to shift back to the abyssal ocean so I can understand Antarctic Bottom Water variability a bit more. I also want to do ocean modelling of icy moons such as Enceladus and Europa and maybe some waterworld exoplanets.

How has your research evolved since your Ph.D. years in AOS?

Trugman: The scope of the tools that I use to address my research questions has increased as I have gained more experience.

Zanowski: My research covers a larger range of topics now. I’ve done a lot of different things, from observational equatorial oceanography using Argo floats, to Arctic ocean circulation and freshwater transport, and most recently paleoceanography, including ocean circulation evolution during the last deglaciation as well as mid-Holocene variability in Baffin Bay and its impact on the formation of the North Water polynya.

What interdisciplinary opportunities did you have at Princeton that helped you get where you are today?

Trugman: My Ph.D. advisor’s (David, Medvigy’s) research is highly interdisciplinary, and his research program influenced my own research agenda, which spans disciplines from ecology to Earth system science. I am also deeply grateful to Stephen Pacala and his mentorship in the Ecology and Evolutionary Biology Department.

Zanowski: My research isn’t particularly interdisciplinary (it’s all physical oceanography), but during my time at Princeton I did do a number of non-research activities that helped me get where I am today such as outreach and prison teaching.

What advice do you have for current graduate students and early-career researchers interested in pursuing an academic career? Any particular advice for women in STEM?

Trugman: Make sure that you love what you are doing (at least the majority of the time). It can be a long road to a permanent position and it’s important to enjoy the journey. As a woman in STEM, I’ve worked hard to be more vocal and vulnerable with my ideas. I also don’t apologize when the situation doesn’t merit one. In my experience, the vast majority of my male colleagues have been extremely supportive of me as a scientist and a woman, and they have been great allies when I’ve encountered situations with implicit or explicit bias.

Zanowski: I have absolutely zero interest in upholding the academic enterprise as it currently stands, so my advice to anyone interested in an academic career is to pursue it in a way that completely burns this woefully decrepit and absurdly unfair system to the ground. Please bring all of yourself—your passion, creativity, and most importantly, your humanity—on this journey, and maybe together we can actually build an academia that is truly worthy of its ideals, one where everyone has the same opportunity to do science and change the world, not just white people.

As for women in STEM, keep finding good mentors. They often show up when you least expect it. Be unapologetically yourself, give less of a shit (seriously), and I can’t stress this enough, you don’t owe anyone anything. You have a right to be a scientist in whatever way brings the most meaning to you. And in the moments that you forget that you need not operate under the constraints of the exceptionally dull ‘perfect scientist’ mold, I recommend this quintessential move from the Hannah Zanowski playbook: middle fingers up. I promise it helps.

Alums Anna Trugman & Hannah Zanowski continued from Page 2

What, in your estimation, makes a candidate competitive for a faculty position?

Trugman: A strong research and publication record is important; however, genuine personal excitement about science, and good oral and written communication skills are invaluable.

Zanowski: As Anna mentioned, in today's academic system having typically-expected stuff like a strong publication record won't hurt, but I've never actually cared all that much about that (my own publication record isn't particularly strong). Instead I want to emphasize a couple of other things that are often forgotten: being a good writer and being a decent human being. Both of those go a long way in getting interviews and given the competitiveness of

the faculty job market, it's seemingly small things like this that can help you come out on top when you're in a pool of equally strong candidates. Also luck. That is part of it too no matter how much people insist otherwise.

HMEI-STEP Fellow Glen Chua continued from Page 1

Chua will join fellow 2021 Awardees Shashank Anand from Civil and Environmental Engineering (CEE), Anna Jacobson from the Lewis-Sigler Institute of Integrative Genomics, and Michael Patrick Schwoerer from Molecular Biology in exploring emerging topics in environmental policy. The cohort will address the environmental policy implications of their thesis research through supplementary course work and policy-oriented research over the course of the next two years.

Under the advisement of AOS Associated Faculty Member Denise Mauzerall, professor of civil and environmental engineering and public and international affairs, Chua will study the climate and air-quality impacts of the production and use of hydrogen as an alternative to fossil fuels. He will examine the processes that can lead to hydrogen leakage during the production and use of hydrogen fuel and fuel cells. He will also compare the hydrogen economy's potential emissions to its benefit as a fossil fuel replacement over the whole supply chain, analyzing different production and leakage scenarios. For the latter part of his research, Chua plans to explore policies and regulations that would minimize supply-chain emissions and mitigate the possible negative climate and air-quality effects of a hydrogen economy.

The topic of Chua's Ph.D. thesis is "Studying the Climate and Composition Impacts and Feedbacks of Methane Emissions in a Chemistry-Climate Model." AOS Faculty Member Larry Horowitz is Chua's thesis adviser.

Chua joins an impressive group of HMEI-STEP Fellows, many of whom have gone on to pursue positions of environmental leadership in academic, government, nonprofit, and industry sectors following their time at Princeton, including former AOS Graduate Students Curtis Deutsch who was awarded the fellowship in 2000, former Geosciences Graduate Student Bryan Mignone who was awarded the fellowship in 2001, former AOS Graduate Student Ian Lloyd who was awarded the fellowship in 2009, former AOS Graduate Student Joe Majkut who was awarded the fellowship in 2011, former AOS Graduate Student Geeta Persad who was awarded the fellowship in 2013, former AOS Graduate Student Jane Baldwin who was awarded the fellowship in 2015, former AOS Graduate Student Michelle Frazer who was awarded the fellowship in 2016, and AOS Graduate Student Jane Smyth who was awarded the fellowship in 2019.

Established in 2000, the program has supported more than 70 HMEI-STEP fellows to date.

Hack Awardee Allison Hogikyan continued from Page 1

The award provides research funding to Princeton University graduate students pursuing innovative research on water and water-related topics with implications for the environment, including projects related to climate science, biology, engineering and environmental policy.

Hogikyan received the award for her project “Response of Water and Carbon Cycles’ Coupling to Global Warming.”

Hogikyan will explore how carbon emissions from human activity affect the ocean’s uptake of atmospheric carbon by influencing feedbacks between the global water and carbon cycles. Her project expands on her current experiments focusing on how climate-driven changes to air-sea freshwater exchange — precipitation and evaporation — alter the rate at which the ocean removes carbon from the atmosphere. Because less carbon dioxide in the atmosphere would result in less intense atmospheric warming, Hogikyan’s work could help in understanding what sets the projected rate of warming for the 21st century.

Hogikyan is advised by AOS Faculty Member Laure Resplandy, assistant professor of geosciences and the High Meadows Environmental Institute.

Now in its 10th year, the Hack Award program has provided 61 Princeton Ph.D. candidates with awards in amounts up to \$10,000 for research funding.

AOS and CIMES Researchers Featured on Reuters List of Top Climate Researchers

Contributed by Rachel Kremen, GFDL Senior Science Communicator

Some of the most influential climate scientists in the world are a part of AOS and CIMES, according to Reuters. The international news agency published its “[Hot List](#)” of 1,000 climate scientists in April, as a part of a special report.

CIMES Deputy Director Gabriel Vecchi earned the 70th spot. While he said he was pleased to be on the list, he did question the order.

“There is no list in climate science -- nor should one ever exist -- where I am ahead of [Syukuro] Manabe,” Vecchi said of the climate science pioneer. Manabe, who is an AOS senior meteorologist, held down the 775th spot.

The Reuters rankings are based on the number of publications, citations by other researchers to their work, as well as mentions by the media and policy makers.

“How many times you’ve been cited may not always be the best reference,” Vecchi said, noting that such a system might underrepresent older research that is now so foundational it is considered a basic fact and therefore no longer cited. “But in a gross sense that list captures the most influential people in climate science.”

Stephen Griffies, GFDL scientist, AOS faculty, and editor-in-chief for the *Journal of Advances in Modeling Earth Systems*, is also on the Reuters list. “I’m happy that my work has impact,” said Griffies, adding that making the list recognizes the importance of “long-vision, foundational” research.

“I kind of represent a whole number of people that don’t get recognized to the degree that I think they should,” he said. “They’re doing the papers and the research that maybe a dozen other people care about, but if they didn’t do that research, our science would be halted or slowed quite substantially.”

Tom Delworth, the senior scientist and division leader for seasonal to decadal variability and predictability at GFDL, also made the list of influential climate scientists. Delworth has made significant contributions to GFDL climate models.

“The area I study is really the intersection between the natural variability of the climate system -- how the system can vary and change without humans -- and what humans have done to the climate system,” Delworth explained. The better we understand naturally occurring variations in weather, he said, the better able we are to detect and predict human impacts.

Larry Horowitz is a physical scientist at GFDL whose work includes studying the chemistry of Earth’s atmosphere and its interactions with climate, air quality, and ecosystems.

“I am honored to be recognized in this way,” said Horowitz. “This recognition reflects the many great collaborations I have been lucky enough to have, both within our laboratory and around the world. Such collaborations greatly benefit our research into important, societally relevant problems such as climate change.”

The list also includes Michael Oppenheimer, the Albert G. Millbank Professor of Geosciences and International Affairs and the High Meadows Environmental Institute, George Philander, the Knox Taylor Professor of Geosciences, Emeritus, and AOS Senior Meteorologist Isaac Held, along with AOS alumni Andrew Wittenberg, a physical scientist at GFDL, UCAR Project Scientist Hiroyuki Murakami, GFDL Research Oceanographer Charles Stock, and Ming Zhao, a GFDL physical scientist.

FV3 Improving NOAA's Weather Forecasting

The GFDL Finite-Volume Cubed-Sphere Dynamical Core, FV3, is used by the National Weather Service (NWS) in the Unified Forecast System (UFS), including the operational Global Forecast System (GFS) and the forthcoming Hurricane Analysis and Forecast System (HAFS). FV3 delivers better numerical accuracy and efficiency, using less computational resources compared to other dynamical cores, and it is the main 'engine' of all weather and climate models developed at GFDL. Consequently, improving FV3 by adding new capabilities is necessary for enhanced forecasts, including short-term forecasts and long-term climate prediction.

This work is a collaborative effort of GFDL's FV3 and FMS teams and part of the broader Hurricane Supplemental project. Led by CIMES/AOS Research Software Engineer Joseph Mouallem and working with GFDL scientists Lucas Harris and Rusty Benson, multiple same level and telescoping nests were implemented in FV3 using GFDL's Flexible Modeling System (FMS). A nest is an additional grid that zooms in over a region of interest to resolve small-scale structures necessary to get a better forecast of localized weather events such as severe storms and hurricanes. The nested grids run concurrently on different sets of processors and interact with their parent grids, thus providing more accurate results on both grids and reducing load imbalances between the different processors.

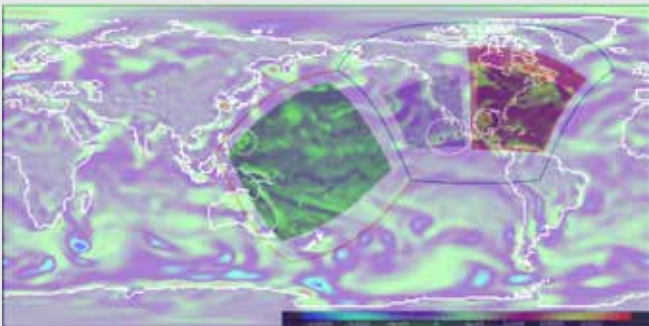
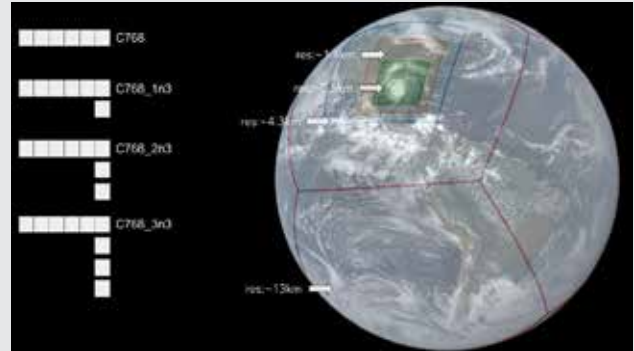


Figure showing the 850mb vorticity during late August 2020 of a low resolution, 200km, global run with multiple same level nests spanning over the east and west coasts and the pacific and a telescopic nest over Hurricane Laura. The two-way feedback on the global parent grid shows that this setup is able to simultaneously capture many weather events such as Hurricane Laura coming from the Atlantic over the east coast, the initial stages of the formation of Typhoon Maysak in the eastern pacific and some intense weather activity in the Gulf of Tehuantepec.

A telescoping nest is a nest within a nest, meaning that “we are now able to 'zoom' in on several levels on multiple simultaneous weather events to very high resolutions,” explained Joseph Mouallem who shared these new functionalities with the AOS/GFDL community during a seminar in mid-May.



A multiple telescoping nest setup spanning over Hurricane Laura of late August 2020. The setup consists of a 13km global resolution and three level telescoping nests with respective resolutions of 4.3km, 1.4km and 0.5km. This case is run within GFDL's System for High-resolution prediction on Earth-to-Local Domains (SHIELD).

Nests could be used in global and regional domains. Starting from the latest FV3 public release of 2021, multiple same level and telescoping nests are now fully functional and available for use by the broader scientific community. This will drastically improve the overall forecast performance, bringing unprecedented accuracy, and open the door to numerous research possibilities for scientists and meteorologists alike.

Students Navigate Virtual CIMES & HMEI Internships

For the second year in a row, AOS and GFDL hosts have adjusted summer internships under the sponsorship of the Cooperative Institute for Modeling the Earth System (CIMES) and the High Meadows Environmental Institute (HMEI) to meet the continued reality of the pandemic. As a result, the 8-10 week 2021 internship program is a virtual experience for all interns.

The CIMES Research Internship Program, initiated in 2016 under the Program's predecessor CICS, is designed to broaden participation of historically underrepresented groups in Earth system sciences, bridging the gap between NOAA-GFDL, the University, and the wider academic community.

Having learned a lot about virtual connection and collaboration over the past year, the interns, together with their hosts and mentors, were set up for success this summer – armed with first-hand experience, navigating the remote experience with a bit of ingenuity and flexibility. It is particularly important for CIMES interns to have comparable learning opportunities as on-location internships, since they may not have similar opportunities available to them at their home institution or elsewhere.

Following the success of last summer's internship program, the 2021 interns and their hosts have once again created an online community through a slack channel and participated in interactive, virtual climate science tutorials, from different GFDL and AOS scientists, and informal video-conference social gatherings. These activities are important to ensure that the students' virtual experiences are not isolating, and foster an environment of community building. The intention is for the interns to expand their network and develop professional skills, as well as focus on their individual research projects under the guidance of their hosts. The internships are oftentimes a transformative experience for the students, who hail from a variety of ethnic, racial, and socioeconomic backgrounds and universities from around the country, representing varied academic interests and experiences. "Once again, we have a great group of interns, who are bringing their unique perspectives and enthusiasm to learn and applying it to research in earth system science," said CIMES Associate Director Sonya Legg.

Spanning a range of research conducted at GFDL, the remote CIMES summer projects include Validating Ocean Surface Mixed Layer Variability in GFDL's OM4, conducted by Kanoe Aiu (Stanford University) under the mentorship of Brandon Reichl, Alistair Adcroft, and Stephen Griffies; On the Structure of Extreme Winter Storms in the Greater New York conducted by Victor Araya (St. Cloud University, MN) under the mentorship of Xiaosong Yang; Evaluating the Impacts of Initial Conditions on Hurricane Movement in the High-Resolution Global Models, conducted by Tyler Barbero (University of California, San Diego) under the mentorship of Jan-Huey Chen; Forecasting Estuarine and

Coastal Salinity to Improve Fisheries Management and Aquaculture Productivity, conducted by Blaise Enama (Hunter College) under the mentorship of Andrew Ross and Charles Stock; Diurnal Cycles over the Maritime Continent, conducted by Stella Heflin (University of Arizona Honors College), who was recruited through the CIMES internship and is being supported by NOAA-EPP, under the mentorship of Lucas Harris and Kun Gao; Modeling Tabular Iceberg Evolution, conducted by Nuzhat Khan (Hunter College) under the mentorship of Alex Huth, Alistair Adcroft, and Olga Sergienko; and ENSO: Revealing Ocean-Related El Niño Southern Oscillation Dynamics in Climate Model, conducted by Zouberou Sayibou (Bronx Community College) under the mentorship of Maike Sonnewald and Aparna Radhakrishnan.

Mackenzie Blanus (University of Connecticut) opted for a spring 2021 internship. She was hosted by Aparna Radhakrishnan, Chris Blanton, and Raphael Dussin on her project, A CMIP6 Multimodel Analysis of Ocean Heat Content Using Scalable and Efficient Open-Source Software.

Two HMEI interns are also working remotely this summer with AOS hosts under the auspices of HMEI's Environmental Internship Program, which offers Princeton undergraduate students the opportunity to complement their academic course of study with hands-on research and project experiences during the summer months.

Alina Chen '24 is working with Graeme MacGilchrist and Alexander Haumann, exploring interannual variability of primary production in the Southern Ocean sea-ice zone, and Ben Buchovecky '23 is working with Mitchell Bushuk, Graeme MacGilchrist, and Alexander Haumann to address the question, Is the Antarctic sea-ice spring bloom predictable?

Undeterred by the physical distance, the students are engaging frequently with their hosts and participating in remote seminars and events, according to Legg.

The CIMES Associate Director acknowledges the enhanced efforts made by the volunteer mentors and hosts once again this year to not only navigate in this virtual environment, but also to expand diversity and increase participation in the climate-related sciences. "All of our hosts go above and beyond in terms of their commitment to building and supporting diverse talent in the climate sciences, beginning with the recruitment and selection process. They are also central to the personal connections that oftentimes continue long after the internship ends. This summer that commitment also extends to answering numerous questions via the intern slack channel."

The summer of '21 will be remembered for many things and no less so for the way the interns and their mentors stepped up to make the internships meaningful and mutually productive, despite the less than optimal circumstances.

In-person internships are slated to return in 2022.

Virtual AOS Program Workshop to Address Climate Tipping Points

The “Climate Tipping Points” workshop is sure to be one of the highlights of the summer of '21. Organized by AOS graduate students, the workshop aims to develop understanding of various climate tipping points, their relevant timescales, and their role in future climate projections and impacts. The workshop will be held virtually from July 19-22, with the generous support of a share of AOS Senior Meteorologist Isaac Held's BBVA Foundation Frontiers of Knowledge Award.



The workshop will build on the success of the Program's previous eight workshops, bringing together the next generation of students and early-career researchers for four days of in-depth scientific discussion and informal interactions on a topic remote from their own research and chosen by the AOS graduate students. Among the tipping points to be covered are the evolution of the Atlantic Meridional Overturning Circulation (AMOC), ice sheet stability and sea level rise, and the greening of the Sahara.

The invited plenary speakers include: Levke Caesar, Maynooth University; Tim Lenton, University of Exeter; Francesco S.R. Pausata, University of Quebec, Montreal; and Alexander Robel, Georgia Institute of Technology.

A climate physicist and postdoctoral researcher at the Icarus Climate Research Centre, Maynooth University, Levke Caesar's research focuses on the evolution of the Atlantic Meridional Overturning Circulation and its impact on the Earth System. She is part of the A4 project, which is studying how Atlantic changes affect Ireland and northwestern Europe through changes in ocean circulation and sea level and developing capacity to predict likely effects.

A professor of climate change and earth system science at the University of Exeter and Director of the Global Systems Institute, Tim Lenton's research encompasses three main areas: modeling the coupled evolution of life and the planet; identifying tipping points in the Earth system, climate, ecosystems, and human systems; and developing methods to sense the changing resilience of complex systems and provide early warning of tipping points. He and his group actively develop and use process-based models, spanning spatial scales from the sub-cellular to the whole planet, and timescales from days to millions of years. They also develop and apply methods of deducing system stability properties

directly from data.

An assistant professor in atmospheric and climate dynamics at the University of Quebec in Montreal, Francesco S.R. Pausata's research focuses on understanding past climate dynamics with particular focus on the last deglaciation, interpreting the signal recorded in proxy records with the help of climate models. He is currently working on the last African Humid Period assessing the role played by changes in dust and vegetation cover in altering regional and global climate and investigating the associated mechanisms. He also uses global climate models to characterize variations in atmospheric and ocean circulation associated to large high-latitude and tropical volcanic eruptions.

An assistant professor in earth and atmospheric sciences at Georgia Institute of Technology, Alexander Robel's work focuses on understanding the causes of ice sheet change and developing conceptual, mathematical, and computational tools to predict future changes. He includes glaciers and ice sheets; sea level change; climate-cryosphere interaction; computational and mathematical modeling; and dynamical systems and statistical physics among his research interests.

The structure of the 2021 workshop will be similar to last summer's, the first iteration of the virtual format, featuring a combination of lectures, tutorials, and opportunities for interaction between the speakers and the AOS/GFDL community. The pivot to a virtual format presents some unexpected opportunities with the speakers, students, postdocs, and faculty being able to connect from wherever they are located.

Each day will involve four hours of planned activities. In addition to the four plenary lectures, open to the entire AOS/GFDL community, the interactive workshop will include blackboard-style lectures and tutorials for AOS students and postdocs. Informal social events between students and invited speakers are planned, as is a panel discussion between the speakers and the wider AOS community. The discussion will be moderated by an AOS/GFDL scientist, with both invited speakers and AOS/GFDL scientists serving as panelists.

The workshop promises to be a meaningful opportunity for participants to take a deep dive into “climate tipping points” and for casual conversations and organic interactions among the various communities.

Questions related to the upcoming workshop may be directed to members of the workshop planning committee: Maya Chung, Sam Ditkovsky, and Chenggong Wang.

For the Science Moms, Climate Science is Personal

AOS Alums Tracey Holloway, Irina Marinov, and Joellen Russell, along with fellow climate scientists who are also mothers, have teamed up to create **Science Moms**, a nonpartisan outreach initiative on climate science, working to empower and engage the public, especially moms who are not confident in their understanding of the science, to speak up and get involved in climate issues. The \$10 million initiative launched in January.

The group, who has collectively spent decades studying the earth and impact of human activity on our planet, aims to demystify climate change and break down the common misconceptions surrounding it.

“Climate science can be confusing to anyone, and it’s not always clear where to turn for reliable, relatable information,” said Tracey Holloway, the 2017-2021 Gaylord Nelson Distinguished Professor at the University of Wisconsin - Madison, jointly appointed in the Nelson Institute for Environmental Studies and the Department of Atmospheric and Ocean Sciences. “Our goal is to empower busy parents to be part of the climate conversation and part of the solution.”



Tracey Holloway

The hope is that greater understanding will lead to mothers becoming more vocal about the warming threat and the risk climate change poses to our futures, sharing it among their mom networks, and taking action. Historically, parents have been powerful advocates, standing on the frontlines of campaigns against tobacco, drunk driving, and gun violence. As mothers themselves, these accomplished women scientists view other moms as allies and catalysts for positive change.

“Climate change is increasingly in the news around us, and increasingly of concern for all moms and dads of the world,” said Irina Marinov, a climate scientist and Associate Professor in University of Pennsylvania’s Earth and Environmental Science Department. “We look at the major West Coast heat event recently and naturally wonder if this is what our children’s future will look like. To prevent such events from becoming the norm, a broad transformation is needed in our society (where we get our energy from, how we drive, what we buy and where, what we eat). We as scientists can educate and empower parents and their kids so that families can become part of this transformational change.”



Irina Marinov

The Science Moms teamed up with the **Potential Energy Coalition**, a nonpartisan coalition of advertising agencies dedicated to “shifting the narrative” on climate change, to design a website and a series of advertisements that explains what climate change is and how it works and tells the story of some of the Science Moms themselves.

The Science Moms website contains bite-sized educational content -- climate facts and short, relatable videos as well as resources for moms and their kids, including book recommendations and Ted Talks. The group focuses on simple straight-talk with regard to climate change science, breaking it down into a more digestible size, according to Russell, the Thomas R. Brown Distinguished Chair of Integrative Science and Professor at the University of Arizona in the Department of Geosciences.

“It is essential that we talk to, and present accessible climate information to moms in a straightforward, relatable way,” said Russell. “Moms are already effective communicators and don’t need to get bogged down with unnecessary details to further the national climate conversation.”



Joellen Russell

The campaign also hopes to reach groups that have thus far not played a major role in global-warming pressure campaigns, including Black and other minority communities who too often have been on the frontline of impacts like worsening floods and heat. Reaching out to communities disproportionately affected by climate change is vital to the initiative’s core mission.

Equally driven by their passion as climate scientists and mothers, the science moms move the climate conversation forward, educating and empowering other moms along the way.



GFDL Summer Interns Take on a Variety of Projects

Contributed by Rachel Kremen, GFDL Senior Science Communicator

Summer internships are underway at GFDL, despite the limitations posed by the COVID-19 pandemic. Undergraduate students will conduct a research project remotely, under the guidance of GFDL scientists. While many of the interns plan to pursue a career in climate research, some hope to use the skills they learn at GFDL in environmental law or social justice projects.

“Internships at GFDL provide a unique opportunity to demystify the complex and interdisciplinary field of Earth system modeling towards building the next generation of researchers demanding not only description of the Earth processes but understanding the context, connections, and implications,” said John Dunne, GFDL Research Oceanographer.

Howard University undergraduate Trinity Gbla appreciates that Dunne, her mentor, was open to her ideas. “He really took into account my interest in climate change science, and that I want to tie it to social justice issues. I wanted to mesh those two areas of my life together,” she said. Gbla, who is majoring in Environmental Engineering, is researching anthropogenic heat stress. “I also thought that this would be a good challenge for me... because it was something I had never studied before.”



Trinity Gbla

Gbla won a scholarship through the José E. Serrano Educational Partnership Program with Minority Serving Institutions. Congressman Serrano of New York City's South Bronx, was dedicated to social and environmental justice.

Nadia Vidal Difre, a Biology major at the University of Central Florida, also won a Serrano scholarship. Her project focuses on the impact of climate change on loggerhead turtle habitats. Influenced by her father's Coast Guard career, Vidal Difre has long been interested in climate change and ocean studies.



Nadia Vidal Difre

“When I was in Puerto Rico for hurricane Maria, I got to see the Office of Response and Restoration taking out capsized vessels from one of the main roads,” she said. “It was all just fascinating to me, to see how many different things you can do in NOAA. It is such a great organization.”

After she completes her undergraduate studies with a focus on marine biology, Vidal Difre plans to pursue a Masters in Chemical Oceanography.

GFDL Intern Shane Russett, winner of an Ernest F. Hollings Undergraduate Scholarship, is interested in the related field of biogeochemistry. The scholarship is named after Senator Hollings of South Carolina, a champion for ocean policy and conservation. Russett considers the scholarship program an “invaluable tool” for gaining experience and “a stepping stone for graduate school.” He is currently an undergraduate student at University of California, Berkeley, where he is studying atmospheric science and working in the Silver Lab on biogeochemical research. “The outside world has always captivated me,” Russett said. “My summer project is looking at future projections of short-term climate forcers, such as ozone and [fine] particulate matter.”

GFDL Physical Scientist Larry Horowitz is mentoring both Russett and another Hollings Scholar: Johanna Vonderhorst. Her project looks at the effect of the Clean Air Act. Vonderhorst is currently completing a double major in chemistry and political science at Monmouth University. Like Russett, Vonderhorst is also considering law school. “If I am going to go into climate law... I want to get some real life experience working with the science research that goes into making these laws,” Vonderhorst said.



Johanna Vonderhorst

Penn State University student Katherine Seikel is also considering going to law school, so she can impact policy decisions. “Whether I'm doing my Masters or Ph.D. I'm not 100 percent sure yet but this internship at GFDL is really going to help me build those skills that I'll need for graduate school,” she said. Seikel said she first heard about the Hollings Scholarship from upperclassmen at her school. “They thought it was really valuable,” Seikel said. Her interests in atmospheric dynamics and coding led her to GFDL's FV3 group.

AOS Postdoctoral Research Associate Marion Alberty said the internship programs at GFDL provide great exposure to a field that is sometimes overlooked in education. “In my experience, Earth Sciences was not highlighted in the K through 12 and even undergraduate curriculum... so I think having these kinds of opportunities are so important for giving young budding scientists a sense of what you can do as an earth scientist,” said Alberty, who is supervising Intern Macy Chang.

GFDL Summer Interns continued from Page 9



Macy Chang

Macy Chang is an Environmental Engineering student at the University of California, Berkeley. She is also a participant in the William M. Lapenta NOAA Student Internship Program, which is named after the former director of the National Centers for Environmental Prediction.

"I enjoy the challenge of learning what underlies all these models," she said. "We are investigating changes in the transport of both water masses and dissolved iron content in the tropical Pacific, specifically in this region called the Solomon Sea." These water masses feed nutrients such as iron to the Pacific Ocean so it's important to understand how we can accurately represent those flows, and how they might change with climate.

Chang said she's always been interested in science, even as a child. But it took her a while to find her niche. "I enjoy the challenge of learning what underlies all these models," she said. "It's fascinating."

It also took Hollings Scholar Justin Sankey a while to figure out what he wanted to do in science. Initially, he wanted to go into medicine and follow in his parents' footsteps. "I was miserable," Sankey said. A [Semester at Sea](#) helped Sankey realize he was a natural on the water. "We got stuck in a two-week-long gale that had like 30-foot seas and 50-knot winds... and I was fine." Sankey, a student at Lawrence University in Wisconsin, said there are a lot of career paths that interest him but he can see himself getting a Ph.D. in chemical oceanography. "I would love to just be in the field as much as I can," he said. "I absolutely love being out on the ocean and doing deployments."

Sankey's project involves studying reactive oxygen species in the ocean. "Phytoplankton will release reactive oxygen species as a defense mechanism, sometimes towards parasites. So I'm looking at [phytoplankton] as a source of reactive oxygen species, but also looking at how they interact with reactive oxygen species."

As a child, Hollings Scholar Theo Frantz said he was largely interested in astronomy. It wasn't until his senior year of high school that he discovered his love of meteorology. "I got a very, very amazing opportunity to do research with a professor at North Carolina State," Frantz explained. Now Frantz is a Meteorology student at the University of Oklahoma. For his internship, Frantz is studying the interaction between climate change and severe weather. "We are still figuring out the rules of tornadoes, hurricanes and that kind of stuff. But they are changing as we're figuring them out. We need to figure out how they're changing, so that we can still be on top of it, help people and save lives," Frantz said.

Hollings scholar Julian Schmitt is spending his internship studying snow drought frequency and severity in the Western

U.S. using the SPEAR large ensemble model. A competitive

Nordic skier and Applied Math major at Harvard University, Schmitt is pleased his project combines his interests in snow and math. Schmitt explained that snow drought is an important research area because it impacts "everything from summer water supply and population dynamics to the ski and tourism industries. Will there be enough moisture in the next 100 years to prevent really devastating fires or extreme water shortage?" Questions like these, Schmitt said, are why this area really matters.



Julian Schmitt

Both Frantz and Johnson are working with the same mentor: GFDL Meteorologist Nathaniel Johnson. "I hope that they experience the joy that comes with applying their creativity to solve cutting-edge science problems that potentially may impact people and that this experience enriches their education in ways that cannot be accomplished in a classroom alone," Johnson said.

Intern	Mentor(s)	Scholarships
Macy Chang	Marion Albery	William M. Lapenta NOAA Student Internship Program
Theo Franz	Nathaniel Johnson and Kai-Chih Tseng	Ernest F. Hollings Undergraduate Scholarship
Trinity Gbla	John Dunne	José E. Serrano Educational Partnership Program with Minority Serving Institutions
Shane Russett	Larry Horowitz	Ernest F. Hollings Undergraduate Scholarship
Justin Sankey	John Dunne	Ernest F. Hollings Undergraduate Scholarship
Kate Seikel	Lucas Harris	Ernest F. Hollings Undergraduate Scholarship
Julian Schmitt	Nathaniel Johnson	Ernest F. Hollings Undergraduate Scholarship
Nadia Vidal Difre	John Dunne	José E. Serrano Educational Partnership Program with Minority Serving Institutions
Johanna Vonderhorst	Larry Horowitz	Ernest F. Hollings Undergraduate Scholarship

2021 SOCCOM Annual Meeting Held Virtually



Over 70 cross-disciplinary experts from institutions across the United States attended the annual meeting of the Southern Ocean Carbon Climate Observations and Modeling (SOCCOM) program to hear about the initiative's progress over the past seven years and plans for the future. The meeting was held virtually from Tuesday, June 8 through Thursday, June 10, 2021. The cross-disciplinary exchange and connection was a welcomed change for meeting participants after a year of COVID, leading to many fruitful discussions around the past year's major results, challenges, and future priorities in SOCCOM's multi-institutional observation and modeling efforts.

At the heart of the SOCCOM project is an array of autonomous biogeochemical floats that transmits measurements of ocean oxygen, nitrate, and pH, as well as bio-optical measurements, from the remote Southern Ocean. 115 deep-diving biogeochemical floats are currently operating in the Southern Ocean and have continued to report data throughout the pandemic. This includes 14 floats deployed in 2020 and 2021 through heroic efforts by SOCCOM participants and their research partners to overcome challenges from altered cruise tracks and travel restrictions in the midst of the pandemic.

Production of new floats for the array was also significantly

impacted by COVID-19, but members of float and sensor teams at the University of Washington and the Monterey Bay Aquarium Research Institute were able to continue work under strict protocols and build a supply of floats that will replenish the array as cruise restrictions are relaxed. In recognition of their outstanding service, "Climate Heroes" on both the float production and deployment teams were honored at the meeting.

Science presentations at the meeting focused on multi-year biogeochemical SOCCOM records including novel under-ice measurements, and resulting insights into carbon, oxygen, nutrient and productivity cycles of the Southern Ocean and their relationship to physical processes. Participants in the meeting included Princeton PI Jorge Sarmiento and current and former AOS researchers Sarah Schlunegger (AOS), Alex Haumann (AOS), Graeme MacGilchrist (AOS), Alison Gray (UW), Joellen Russell (University of Arizona), Seth Bushinsky (University of Hawaii), and Lionel Arteaga (NASA Global Modeling and Assimilation Office), who presented a variety of observational and model-based approaches to study Southern Ocean carbon cycling and circulation. Bob Key (AOS) reported on the program's adopt-a-float initiative, that was praised by SOCCOM's funding agency for providing entertaining and educational opportunities for primary and secondary school students during pandemic-driven remote learning.

The SOCCOM Project was launched in 2014 with the goal of improving our understanding of the role of the Southern Ocean in climate change and biogeochemistry. Since the program's inception, SOCCOM floats have increased the number of profiles in the Southern Ocean by about 10-fold, making one of the harshest marine environments on Earth the best-observed region of the ocean in terms of biogeochemistry.

SOCCOM is supported by the National Science Foundation (NSF) under NSF Award PLR-1425989 and OPP-1936222.

Q&A: Sarah Kapnick '04, former GFDL Physical Scientist & AOS Postdoc

Sarah Kapnick reflects on her recent experience as a program developer and expert for the BBC series, "Greta Thunberg: A Year to Change the World." Sarah recently left NOAA and accepted a position as a Senior Climate Strategist for a financial institution, effective June 2021.

How did you become involved in the BBC project?

A producer from the BBC reached out to me. She had seen

me previously discuss climate change on Business Insider and read my interviews in a wide variety of outlets. She wanted to see if I could serve as an expert (on camera as well as help discuss various concepts to guide their formulation of the docuseries) and help them find people in the U.S. to interview as well.

You had a dual role as a program developer and expert. Can you please describe each of these roles?

In an expert capacity, I answered various questions relating to science and worked to help the producers understand the material/subject. As they were coming from Europe, they also wanted help finding a diverse set of experts in the U.S. on various subjects.

Sarah Kapnick Q&A continued from Page 11

I directed them to others who could talk on specific subjects and were seasoned communicators. They wanted to make sure they cast a wide net to find a diverse set of climate experts with representation from underrepresented groups in STEM.

What did you most enjoy about your involvement in the docuseries?

The initial conversations were fascinating to understand what the producers saw as important points to convey to the public and what I saw as the story. Both sides were surprised when a subject was vetoed either due to uncertainty in science or difficulty in visual storytelling. I came away from those conversations thinking that at the very least, I had educated a handful of nature documentary filmmakers.

Why is public access to the science behind climate change, through projects like this one, important?

This series balanced the personal story of Greta Thunberg with scientific information on climate change. They wanted to personalize the issue, but also ensure it had the highest quality science possible, and have the story told by a diverse

set of voices, so viewers could relate to the speakers. I've been amazed by the response, I've had acquaintances from Denmark, Columbia, and South Africa see it and reach out asking additional questions. It's allowed me to have new conversations within my own network in a way other media experiences have not. I think this is reflected in the expert storytelling of the BBC and inclusion of a broader set of climate experts than previous work.

Why is science outreach, communication, and advocacy important to you personally?

I don't think all scientists should feel an obligation to do outreach, communication, or advocacy if they do not want to. We all have constraints of time, employers, and emotional energy to engage. But broadly, if scientists want to engage with the public, there are numerous ways to do so. We need conversations and understanding in all corners of society and the world to galvanize people to support and develop climate solutions.

The three-part docuseries premiered on PBS on Earth Day and is available for streaming on Hulu.

More Alumni News

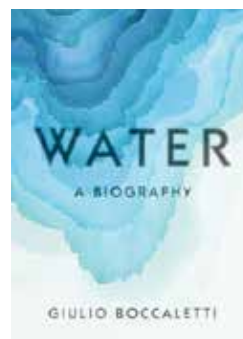
A new paper, published recently and led by AOS Alum Jane Baldwin (University of California, Irvine), with CIMES Deputy Director Gabe Vecchi, an AOS faculty member, among others, suggests that a significant portion of the double Inter-Tropical Convergence Zone (ITCZ) bias originates from low biases in Central American orography in models. The [study](#) offers a simple and computationally inexpensive yet physically based method for improving pervasive double ITCZ bias. The research is based on the work Jane began while at Princeton and is published in AGU Advances and highlighted as an [Eos Editor's Highlight](#). Jane has accepted a faculty position at the University of California, Irvine as an assistant professor of earth system science, effective July 2021.

GFDL Physical Scientist Nadir Jeevanjee, a former AOS associate research scholar, was interviewed for Adam Sobel's [Deep Convection podcast](#), which features real conversations between climate scientists (or sometimes those working in areas adjacent to climate science). Nadir studies the physics of clouds, radiation, and climate, using a hierarchy of approaches ranging from pencil-and-paper theory to comprehensive computer simulations.

In a recent paper, led by AOS Alum Elizabeth Yankovsky (NYU) with AOS Faculty Members Sonya Legg and Robert Hallberg, the authors develop a parameterization for representing the

effects of submesoscale symmetric instability (SI) in the ocean interior. SI may contribute to water mass modification and mesoscale energy dissipation in flow systems throughout the World Ocean. The need for such a parameterization emerges as models move toward resolving increasingly finer-scale flows but not the small-scale turbulent mixing within them. The [research](#), which was based on Elizabeth's thesis work, is published in AGU's Journal of Advances in Modeling the Earth Systems.

AOS Alum Giulio Boccaletti, an honorary research associate at the Smith School of Enterprise and the Environment, University of Oxford, has a new book coming out in September, titled "[Water: A Biography](#)," a revealing history of how the distribution of water has shaped human civilization.



AOS & CIMES News

Congratulations to **Aaron Match** who successfully defended his Ph.D. Thesis, "The Unified Internal Dynamics and Global Interactions of the Quasi-Biennial Oscillation," on April 30. Aaron is continuing his research at Princeton, working with Stephan Fueglistaler as an AOS postdoc for the time being.

Congratulations to **Yi Zhang** who successfully defended her Ph.D. Thesis, "Some Theoretical Thinking on the Changing Tropical Climate," on June 1. Yi accepted a prestigious Postdoctoral Fellowship from the Miller Institute at UC Berkeley. Yi was advised by Stephan Fueglistaler.

Arrivals

Bosong Zhang arrived in early June, from the University of Miami, to work with Ming Zhao as a postdoc.

Youtong Zheng arrived in early June, from the University of Maryland, to work with Yi Ming as an associate research scholar.

Noemi Vergopolan da Rocha, who comes to the Program from CEE at Princeton, arrived in early June to work with Elena Shevliakova as a postdoc.

Aakash Sane is scheduled to arrive in mid-July, from Brown University, to work with Alistair Adcroft and Brandon Reichl as a postdoc.

Jing Feng is scheduled to arrive in early August, from McGill University, to work with David Paynter as a postdoc.

Jie Chen is scheduled to arrive in mid-August, from Purdue University, to work with Tom Knutson and Lucas Harris as a postdoc.

Joseph Clark is scheduled to arrive in mid-August, from Penn State, to work with Yi Ming as a postdoc.

Yanda Zhang is scheduled to arrive in mid-August, from SUNY, Albany, to work with Tom Knutson and Elena Shevliakova as a postdoc.

Henri Drake will join the Program as a visiting postdoctoral research associate through the 2021 NOAA Climate & Global Change Postdoctoral Fellowship Program, effective August 30. He will be hosted by Sonya Legg.

Departures

AOS Postdoc **Matthew Wozniak** left the Program in early May. He accepted a position as a high school physics teacher at Saddle River Day School.

AOS Postdoc **Yongqiang Sun** left the Program at the end of May. He accepted a research scientist position at Rice University.

Princeton COVID Resources



AOS faculty, staff, and students should continue to check the University's [COVID Resources website](#) for information about the vaccine requirement and FAQs. You may also find other updated information regarding travel questions and support for international students and scholars on the [International Princeton](#), [Davis International Center](#), and University [COVID websites](#).

When asked this past spring where they were from or have lived, 28 members of the AOS community responded, resulting in an artistic word cloud created by AOS Graduate Student Maya Chung. With the Program attracting faculty, postdocs, and students from far and wide, we endeavor to bolster our global and inclusive community. We look forward to coming back together in the fall!



AOS Community Word Art courtesy of AOS Graduate Student Maya Chung