



AOS & CIMES Newsletter

Spring/Summer 2019

Volume 13, Number 2

Sarmiento Earns Emeritus Status

AOS Faculty Member Jorge Sarmiento has transferred to emeritus status, effective July 1, 2019.

Sarmiento has been a leading scientist for 40 years, engaged in analyzing and modeling the fundamental, interconnected processes of ocean chemistry, biology, and climate. With 250 papers published in the field of ocean biogeochemistry and chemical oceanography, his work has had far-reaching influence on the field of climate science over the last four decades.



Jorge Sarmiento, Princeton's George J. Magee Professor of Geoscience and Geological Engineering, Emeritus

Sarmiento serves as the Director of the Southern Ocean Carbon and Climate Observations and Modeling program (SOCCOM), since the initiative's launch in 2014. In addition to SOCCOM Director, he has held and currently holds various prominent posts. Sarmiento was the long-time director of the AOS Program, serving from 1980-1990 and from 2006-2015, and the founding and long-serving director of

the Cooperative Institute of Climate Science (CICS), established in 2003, and the Cooperative Institute for Modeling the Earth System (CIMES), established in 2018.

During his nearly 40 years on the AOS faculty, he has advised 18 Ph.D. students and 58 postdoctoral researchers, many of whom have gone on to distinguished scientific careers of their own and regard Sarmiento as a lifelong mentor and friend. Throughout his tenure as director of the Program, Sarmiento played a pivotal role in building an impressive rank of faculty and in strengthening communication and the academic ties between AOS faculty, graduate students, and postdocs.

Sarmiento's research interests include the global carbon cycle, the use of chemical tracers to study ocean circulation, and the impact of climate change on ocean biology and biogeochemistry. He studies and models ocean circulation, biological processes in the ocean, and the impacts of circulation and metabolism on the oceanic distribution of those elements involved in biological cycles (primarily CO₂, O₂, nitrogen, phosphorus and iron). Sarmiento has used his models to study rates of biological processes in the oceans, responses of ocean biology to global change, and the dynamics of fisheries. He has also tracked transfers of fossil fuel CO₂ from human activities into the atmosphere and oceans, thereby contributing towards understanding the fate of fossil fuel CO₂.

Sarmiento has demonstrated leadership in the scientific planning and execution of a wide range of international and community-wide research activities, including the Joint Ocean Global Flux Study (JOGFS) and the World Ocean Circulation Experiment (WOCE). He was a leader in writing the U.S. Carbon Cycle Science Plan. Among his many honors is the 2009 Roger Revelle Medal from the

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

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TigerTransit/Shuttle Services Operating on Summer Schedule:
<https://transportation.princeton.edu/sites/default/files/F-Forrestal-SUM19.pdf>

American Geophysical Union (AGU) for “outstanding contributions in atmospheric sciences, atmosphere-ocean coupling, atmosphere-land coupling, biogeochemical cycles, climate, or related aspects of the Earth system.” ■

GFDL Director Named Finalist for Service to America Medal

**Contributed by Maria Setzer, GFDL
Communications Director**

GFDL’s Director, Venkatachalam “Ram” Ramaswamy, Ph.D., is among the finalists announced on May 5 for the 2019 Samuel J. Heyman Service to America Medal (Sammies). The nonprofit, nonpartisan Partnership for Public Service announced the finalists - 26 federal employees and teams from more than 20 federal agencies and 15 states as well as Washington, D.C. and Haiti. Each finalist is a contender for one of seven Service to America Medals, awarded annually. In naming Ramaswamy as a finalist for the Paul A. Volcker Career Achievement Medal, the Partnership for Public Service cited his leadership in developing “a state-of-the-art modeling system to enhance understanding and prediction of global climate change and provide earlier and more accurate forecasts of severe weather events, helping save lives and property.”



GFDL Director V. Ramaswamy

Extreme weather events have taken their toll on communities nationwide during the past few years, prompting government researchers to improve weather and climate prediction systems that provide more timely and accurate information to save lives and property at risk from floods, hurricanes, mudslides, wildfires and other natural disasters.

“Dr. Ramaswamy’s exceptional skills have brought revolutionary advancements in U.S. prediction capability,” said Craig McLean, assistant administrator of NOAA’s Office of Oceanic and Atmospheric Research. “What the nation knows today of climate science is largely due to his leadership.”

NOAA has multiple systems for predicting weather over days and weeks, and climate over seasons and decades. Ramaswamy led his lab in developing a streamlined modeling system—a unified, highly accurate forecasting model that extends “across timescales ranging from days to seasons to decades to a century,” McLean said.

More accurate climate predictions offer economic benefits and reduced risks for farmers, water and fishery managers, transportation planners, public officials and others who use these forecasts to plan ahead (e.g., days to seasons to decades) for excess rainfall, drought, heat waves, winter storms and hurricanes. In addition, information from the lab’s modeling system, which demonstrates the effect of climate on fish populations, helps coastal communities become more resilient.

Ramaswamy’s career-long accomplishments in climate science are broad and varied. He has coauthored nearly 200 peer-reviewed scientific publications on subjects ranging from the impact of aerosols on climate to the effects of ozone on temperature changes in the stratosphere. Since 1991, Ram has served as an author for the Intergovernmental Panel on Climate Change, which meets about every six years. These international assessments are the scientific basis for governments worldwide to develop climate-related policies, and they inform United Nations negotiations that have led to multi-nation accords such as the Paris Climate Agreement and the Montreal Protocol.

The finalists were honored on May 9 at a breakfast on Capitol Hill, as part of Public Service Recognition Week. Medal recipients will be announced and honored in October, during an awards gala at the Andrew W. Mellon Auditorium in Washington, D.C.

Since its inception in 2002, the Samuel J. Heyman Service to America Medals program has honored more than 500 outstanding federal employees. More

information about the program and the 2019 finalists is available at servicetoamericamedals.org. ■

Machine Learning and Climate Modeling – 7th Annual AOS Program Workshop Planned

As machine learning expands into climate modeling, the AOS Program will host its annual workshop exploring these new computing techniques. The student-organized workshop will be held from July 29-31, 2019 at GFDL, with the generous support of a share of AOS Faculty Member Isaac Held’s BBVA Foundation Frontiers of Knowledge Award.



The workshop will build on the success of the Program’s previous workshops in providing a friendly environment that fosters in-depth scientific discussion around an emerging research topic in climate science and its related disciplines. Machine learning – specifically as it relates to the development of numerical models, is a topic outside of the AOS Program’s formal curriculum and should prove productive in generating discussion between the students and the invited speakers. Postdoctoral researchers who have to make sense of the torrents of data their fields are generating will likely also benefit from the workshop.

The invited plenary speakers include: Noah Brenowitz, University of Washington; Michael Pritchard, University of California, Irvine; and Maike Sonnwald, Massachusetts Institute of Technology.

Brenowitz's research lies at the intersection of applied mathematics, machine learning, and atmospheric science. He is interested in applying machine learning techniques to improve the representation of sub-grid-scale processes in coarse resolution atmospheric models. In addition, he also studies the fundamental dynamics behind the organization of large-scale moist convective processes in the tropics.

Pritchard's expertise is in next generation climate simulation, using new algorithms (cloud superparameterization) and new computing techniques (machine learning) to study clouds and their interaction with climate and weather, in high fidelity.

Sonnwald, who has a background in physical oceanography and data science, uses computers to reveal connections and patterns in the ocean that would otherwise be beyond human capability. Recently, she applied a machine learning algorithm that sifted through a vast quantity of data to identify patterns in the ocean that have similar physics, showing that there are five global dynamically consistent regions that make up the global ocean. For data on what is happening in the ocean, Sonnwald used the Estimating the Circulation and Climate of the Ocean (ECCO) state estimate.

The structure of the 2019 workshop is similar to past workshops, featuring three plenary lectures open to the entire AOS/GFDL community, basics lectures – intended to provide the participants with some of the fundamental concepts of machine learning from a wider perspective, and applications lectures – with a relatively narrow focus on the applications of machine learning as it applies to climate modeling.

Attendance for the basics and applications lectures will be limited to graduate students and postdocs only, as will the two group discussions. There will also be a panel discussion, open to everyone in the broader AOS community and moderated by the workshop committee (comprised of AOS Graduate Students Juho Iipponen, Houssam Yassin, and Yi Zhang), with both invited speakers and AOS/GFDL scientists serving as panelists. Beyond the structured sessions, there will be numerous opportunities for informal and spontaneous interaction between AOS students, postdocs, and faculty. The student organizers hope that these opportunities

reinforce existing social and scientific interactions between the various communities.

Questions related to the upcoming workshop may be directed to workshop committee members. ■

Griffies Takes Leadership Role at Ocean Modelling Workshop

Contributed by Maria Setzer, GFDL Communications Director

Twenty-eight Ph.D. students and early career scientists converged in Tasmania in late April for a very successful, intensive workshop in ocean modelling, taught by expert model developers from around the world. AOS Faculty Member Stephen Griffies, a GFDL senior scientist, was the principal lecturer. Colleagues Andy Hogg (Australian National University) and former AOS Associate Research Scholar Max Nikurashin (University of Tasmania) joined Dr. Griffies in teaching 35 hours of dense and highly advanced facets of ocean modelling.



Students and teachers taking a lunch break at Russell Falls in Tasmania's Mt. Field National Park. AOS Faculty Member Stephen Griffies, front center in the green jacket, and Prof. Andy Hogg from Australian National University, in the back row on the left in the gray jacket

Workshops such as this one, focused on the physical, mathematical, and numerical foundations of the computer models used to study the ocean climate and to produce predictions, enhance the education of the next generation of ocean and climate modelers. Cultivating a cadre of ocean

modelers, both nationally and internationally, also helps to advance the scientific integrity of computer models and improves their accuracy and prediction skills.

The Advanced Ocean Modelling Summer School 2019 covered a broad range of foundational topics, such as the theoretical basis for ocean model dynamical cores; fundamental turbulent processes that affect the ocean climate state; and analysis methods to help scientifically digest the huge amount of output generated by computer simulations.

This workshop was organized by the students, and Ph.D. students and early career scientists attended from five different universities in Australia and New Zealand. The workshop was sponsored by the Antarctic Gateway Partnership, the Australian Research Council Centre of Excellence for Climate Extremes, the Institute for Marine and Antarctic Studies, and the Antarctic Climate and Ecosystems Cooperative Research Centre.

Griffies has published more than 130 peer-reviewed articles about the role of the ocean in the earth system, and is currently Editor of *Journal of Advances in Modeling the Earth System* (JAMES), and a Lecturer in Princeton's AOS Program. Previously, he was CSIRO Distinguished Visiting Scientist Fellow in Hobart, Australia. He has also been a Visiting Scientist at the National Center for Atmospheric Research in Boulder. ■

SOCOM Holds 5th Annual Meeting

The fifth annual meeting of the Southern Ocean Carbon Climate Observations and Modeling (SOCOM) program was held from May 13-15, 2019 at the Princeton Center for Theoretical Science in Jadwin Hall on Princeton's main campus.

Over 40 cross-disciplinary experts from across the United States attended to hear presentations and engage in discussions about the initiative's progress over the past five years and plans for the sixth year.



2019 SOCCOM Annual Meeting Attendees

With over 130 deep-diving biogeochemical floats currently operating in the Southern Ocean, SOCCOM researchers are gathering data on water temperature, salinity, oxygen content and pH, or acidity, used to calculate carbon fluxes in a region that up until the initiative's launch in 2014 had been largely under-explored. All data are made freely available to the public in near-real time via the SOCCOM website and the Argo data system.

Analysis of SOCCOM float data has already revealed a large, previously undocumented wintertime flux of CO₂ to the atmosphere that significantly reduces the estimated Southern Ocean carbon sink, and also suggests that oxygen uptake in the region is twice as large as previously calculated. The floats, which have ice-detection software, have also enabled observation of chemical and biological dynamics under sea-ice. In addition, SOCCOM researchers at Scripps have developed the first multi-basin biogeochemical state estimate, B-SOSE, and SOCCOM is also leading an international Southern Ocean Model Intercomparison Program (SOMIP). Highlights from this year include:

- confirmation of the wintertime CO₂ flux to the atmosphere using additional float measurements
- publication of the first biogeochemical measurements of the Weddell polynya
- publication of a 1/6 degree resolution version of the B-SOSE state estimate with float data assimilation that is available for public use
- simulation of the impacts of Antarctic meltwater on future climate

The meeting afforded researchers the opportunity to share their results in the

areas of Southern Ocean carbon cycling, earth system modeling, sea ice and circulation, ocean physics, and biology among other topics. Attendees at the SOCCOM annual meeting included AOS faculty members, among them SOCCOM Director Jorge Sarmiento who provided opening remarks, GFDL Director V. Ramaswamy, and Steve Griffies, a GFDL physical scientist. Current and former AOS researchers Joellen Russell (University of Arizona), Alison Gray (University of Washington), Seth Bushinsky (University of Hawaii), John Dunne (GFDL), Ben Bronselaer (BP, London), Rick Slater (AOS), Alex Haumann (AOS), Lionel Arteaga (AOS), Haidi Chen (AOS), and Charlie Stock (GFDL) reported on the science and recent research initiatives and advances.

SOCCOM will continue to deploy BGC-Argo floats over the next year and has a goal of ~200 floats operating in the Southern Ocean by 2020, but it has already succeeded in making the Southern Ocean the best-observed region of the ocean in terms of biogeochemistry. "The data are stunning, and continue to reveal surprises as additional measurements become available," Sarmiento said. "We look forward to more discoveries and to having others join us in learning from this public resource."

SOCCOM is supported by the National Science Foundation (NSF). ■

PEI-STEP Fellowship Awarded to Smyth

AOS Graduate Student Jane Smyth has been awarded a 2019 PEI-STEP Environmental Policy Fellowship by the Princeton Environmental Institute (PEI).

Smyth will join fellow 2019 Awardees Claudia Brunner from Mechanical and Aerospace Engineering (MAE) and Emily Wei-Hsin Sun from Civil and Environmental Engineering (CEE) in addressing the environmental policy implications of their thesis research through supplementary course work and policy-oriented research over the course of the next two years.



AOS Graduate Student Jane Smyth

Under the advisement of Michael Oppenheimer, Princeton's Albert G. Milbank Professor of Geosciences and International Affairs and the Princeton Environmental Institute, Smyth will study how projected changes to the South American monsoon brought on by climate change could impact Brazil's hydroelectric output, which generates more than 75% of the country's electricity. She will use models to determine the impact of reduced rainfall on the flow of the waterways that feed the country's hydroelectric dams, and how those altered flows affect electricity production and pricing. Her research could provide insight into how climate change could strain energy systems, as well as how nations such as Brazil can develop more sustainable and reliable electricity infrastructures.

The topic of Smyth's thesis is "Investigating the Physical Mechanisms of Monsoon Variability with a Hierarchy of Climate Models." AOS Faculty Member Yi Ming, a 2001 PEI-STEP fellow, is Smyth's thesis adviser.

Smyth joins an impressive group of PEI-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 Student 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, and current AOS Graduate Student Michelle Frazer who was awarded the fellowship in 2016.

Established in 2000, the program has supported more than 50 PEI-STEP fellows.

Raghuraman Among 2019 Hack Graduate Awardees to take on Water- Related Issues

AOS Graduate Student Shiv Priyam Raghuraman is among nine Princeton University graduate students selected by The Princeton Environmental Institute (PEI) as 2019 recipients of the Mary and Randall Hack '69 Graduate Awards for Water and the Environment.

Their research will address topics such as lead contamination in urban tap water; the remediation of oil contamination in groundwater; how water availability influences competition among herbivores; the effect of clouds and water vapor on Earth's heat budget; the sealing of underground formations used for carbon capture and storage; the response of plant communities to climate change; the release of a dangerous greenhouse gas due to sea-level rise; how stored carbon dioxide could react with underground aquifers; and how a common contaminant is absorbed by soil.



AOS Graduate Student Shiv Priyam Raghuraman

Raghuraman will use satellite and climate model data to expand his research into how changes in water vapor — the most important greenhouse gas — and clouds alter Earth's heat budget. Specifically, he will examine how inter-annual climate variability, such as El Niño, and anthropogenic influences modulate heat trapped and reflected by liquid and ice clouds. His work aims to provide a deeper understanding of how clouds could mitigate or amplify the warming effects of climate change.

Raghuraman is advised by AOS Faculty Member V. Ramaswamy, director of GFDL. ■

AOS/CIMES Researchers Inspire Girls to Pursue STEM Careers

Some 750 seventh-to-tenth-grade girls engaged in scientific experiments and a day of fun at the 2019 Princeton Plasma Physics Laboratory (PPPL) Young Women's Conference (YWC) in Science, Technology, Engineering, and Mathematics (STEM) on Friday March 22, 2019 at the Frick Chemistry Laboratory on the Princeton University campus. AOS/CIMES researchers were among the exhibitors who volunteered at the event, which brings together young women and accomplished yet approachable scientists and encourages girls to begin to see science as a realistic career choice.

This year's conference featured more exhibitors than any previous year, including interactive demonstrations by several groups from Princeton University. In total, more than 50 volunteers from PPPL, Princeton University, and numerous science organizations staffed over 30 exhibits. Elizabeth Yankovsky (AOS/CIMES), who coordinated the outreach effort within the AOS Program and CIMES, Jane Smyth (AOS/CIMES), Jane Baldwin (PEI/formerly AOS/CICS), and Marion Alberty (AOS/CIMES), with the assistance of Danielle Schmitt (GEO), led the AOS/CIMES hands-on demonstrations.



CIMES Researcher Jane Smyth, an AOS graduate student, leading an ocean acidification experiment at PPPL's 2019 Young Women's Conference in STEM

The first experiment explored the relationship between CO₂ and ocean acidification, according to Yankovsky. The researchers discussed pH scale, using a pH indicator, tap water, and lemon juice, and demonstrated the color change of the pH indicator in the tap water with the acidic lemon juice. The students were then asked to blow bubbles (releasing CO₂) into a third cup, also resulting in color changes, much to the students' delight. The young women stood wide-eyed as a conversation ensued about what is happening as the ocean uptakes CO₂ from the atmosphere, and the resulting damage for the organisms that live in the oceans. The second experiment demonstrated how ice melts differently in fresh water and salt water, based on the behavior of the meltwater from dyed ice cubes. The oftentimes-unexpected outcome of the ice melting faster in the fresh water inspired the students' curiosity and natural knack for scientific inquiry, specifically with regard to the ice cycle in the Arctic.

For the final experiment, the researchers brought in a rotating tank to mimic the Pacific Ocean, placing a map underneath it. Using fans to simulate large-scale winds, the students were asked to place paper confetti along the edges of the tank (or off the coast of Japan and California). Due to gyre circulation that the tank simulated, the paper dots moved in a spiral towards the center of the tank where they all converged. The demonstration led to a dialogue about the Great Pacific Garbage Patch, with the volunteers explaining how the pollution deposited along the coast

makes its way into the interior of the ocean and harms the ecosystems there.



Rotating tank demonstration at 2019 YWC in STEM

The researchers found that students particularly enjoyed the rotating tank demo, something they had not done at this event in the past, according to Yankovsky. “It gives a unique perspective of large-scale ocean dynamics that occurs on scales that we naturally do not have a good sense for,” she said. “Students were active in making hypotheses and were often surprised to see how differently the fluid behaves in their reference frame vs. that of the rotating camera.”

The volunteers were impressed with how engaged and inquisitive the students at the event were, many of whom had prior interest in environmental science and spoke eagerly about documentaries they had seen about the ocean. The consensus among the researchers was that the event helps support young women’s interest in science at a pivotal point in their education and provides them with added confidence to embark on STEM careers.

“It is important to show women that even in traditionally male-dominated fields there is an abundance of support and resources to help them pursue a successful career,” Yankovsky said. “Speaking one-on-one with women at various stages of research and engineering careers is an invaluable experience for middle and high school girls.”

Featured speakers at the conference, in addition to the exhibitors, included Tammy Ma, a plasma physicist at the U.S.

Department of Energy’s Lawrence Livermore’s National Ignition Facility; Kamana Misra, M.D., founder of the companies ContraRx and BioThink LLC; Elaheasadat Naghib, a final-year Ph.D. candidate in Princeton University’s Operations Research and Financial Engineering Department; and Kathryn “Kitty” Wagner, a senior technical staff member in the Princeton University Chemistry Department.

The YWC conference has become more popular each year with registration for this year’s event filling up within one month, according to the program manager for PPPL’s Science Education Office.

Sparking interest in science that might lead girls to consider careers in STEM fields is a key first step in recruiting the most diverse and highly qualified next generation of New Jersey’s scientists and engineers. If enthusiasm, energy, and the large number of young women in attendance at this year’s conference is any indication of what the future holds for STEM fields, New Jersey is in good hands. ■

GFDL Hosts 2019 Poster Expo

Posters spanning a wide range of topics from hurricane prediction to submesoscale mixing processes to dust climatology and forecasting were on display at the 2019 GFDL Poster Expo held on May 8, 2019 in the Smagorinsky Seminar Room.



Presenters and attendees interacting at the 2019 GFDL Poster Expo

Now in its sixth year, the 2019 event was attended by approximately 40 of GFDL’s local partners, including Princeton University, UCAR visiting scientists, Engility, and Rutgers, the State University of New Jersey, as well as a number of

visitors from the Northeast Fisheries Science Center (NEFSC)/Sandy Hook Lab, Howard University, and neighboring NYC institutions.

The Expo proved to be a vibrant and inspiring environment, showcasing the research of 28 presenters – nearly one half of them AOS and CIMES researchers, ranging from graduate students and postdocs to early-career scientists and established investigators. Attesting to the interdisciplinary and collaborative nature of work conducted in the wider GFDL/Princeton community, the posters were a snapshot of the work being carried out on the Forrester Campus.



CAMES Researcher Salvatore Pascale, an AOS associate research Scholar

Current and former AOS/CIMES researchers Salvatore Pascale, Liping Zhang (GFDL), Jian He, Xi Chen, Yi Zhang, Fabien Paulot (GFDL), Xiaoqin Yan, Pu Lin, Brandon Reichl (GFDL), Kun Gao, Elizabeth Yankovsky, Marion Alberty, and Mariona Claret (University of Washington) all presented posters highlighting their research.

The Expo began with a lightning round of one-minute introductions given by the presenters, a quick and efficient way to inspire attendees to search out the presenter’s poster. Lead organizer Jasmin John, a GFDL physical scientist who organized the event with GFDL Scientific Illustrator Cathy Raphael, noted that the presenters and many of those in attendance enthusiastically embraced these inaugural lightning introductions.

The annual event provides a unique opportunity for networking in an informal,

intimate setting, encouraging the exchange of ideas between presenters and attendees who may not always have the opportunity to interact locally. For students, the event is an opportunity to gain confidence in talking about their research, and for the broader community, the Poster Expo has become a highly anticipated, collegial event, celebrating both high-caliber scholarship and research.



CIMES Researcher Elizabeth Yankovsky, an AOS graduate student

“The Expo has become an extremely enriching part of the GFDL community,” said John Dunne, a GFDL research oceanographer. “It is a unique opportunity for researchers to interactively survey the breadth of Earth, physical, biological and computational sciences associated with GFDL.”

In an expression of sincere thanks to the poster presenters and everyone in attendance, John noted that their “participation and contributions – particularly lightning introductions and inspiring posters – made for another successful event.” According to the Poster Expo Team, future Poster Expos are planned, with the next likely to take place in the spring of 2020.

Further details, including a listing of posters presented at the Expo, can be found on GFDL’s website:

<https://www.gfdl.noaa.gov/poster-expo-program-list/>. ■

Researchers Bring Science to the Jersey Shore

AOS/CIMES/GFDL researchers welcomed record-breaking crowds to their interactive, tabletop ocean science demonstrations at the 16th annual Ocean Fun Days at the Jersey Shore, held at Island Beach State Park on May 18 and Sandy Hook on May 19. Sponsored by the New Jersey Sea Grant Consortium and New Jersey Natural Gas, the yearly event promotes the wise use of New Jersey’s marine and coastal resources through research, education, and outreach.

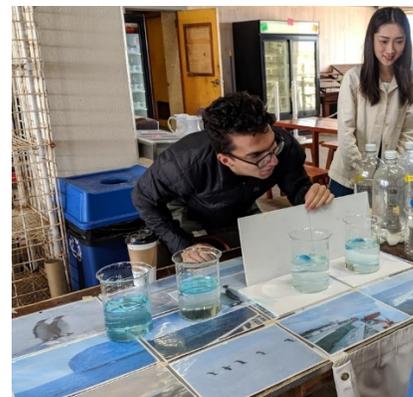
CIMES Associate Director Sonya Legg, an AOS faculty member, coordinated the outreach effort. She was joined by Jasmin John (GFDL), Jessica Luo (GFDL), Houssam Yassin (AOS/CIMES), Lingwei Meng (AOS/CIMES), and Elizabeth Yankovsky (AOS/CIMES) on Saturday at Island Beach State Park, a narrow barrier island stretching for 10 miles between the ocean and Barnegat Bay and one of the few remaining undeveloped barrier beaches on the north Atlantic coast. On Sunday, Kisei Tanaka (AOS), Allison Hogikyan (AOS/CIMES), Xiao Liu (AOS/CIMES), and Feiyu Lu (AOS/CIMES) joined Legg at the historic Fort Hancock section of Sandy Hook, home to NJS GC headquarters.



L to R: Jasmin John (GFDL) & CIMES Associate Director Sonya Legg

With a continuous stream of children with their parents at their table, the AOS/CIMES/GFDL researchers led hands-on iceberg melting and ocean acidification experiments, fielding questions from kids and parents alike. The researchers, who came to the event hoping to spark curiosity and interest in science, came away from the

experience satisfied that their mission was accomplished.



L to R: AOS Graduate Students Houssam Yassin & Lingwei Meng

“I think this event is a process in which scientists and children learned from each other,” said Lingwei Meng, an AOS graduate student. “Children learned simple scientific knowledge from our fun experiments and even stimulated their interest in climate science.”

“What impressed me even more was that as a first-year graduate student, I learned much more from these children,” she said. “They completely abandoned the theoretical fixed thinking, and only paid attention to the phenomenon of the experiment itself, such as the volume of the ice, the color of the acid and alkali reagents in the water, and every small change could make them very excited, which actually reflected the pure purpose of doing science.”



L to R: AOS Postdocs Xiao Liu & Kisei Tanaka, & AOS Graduate Student Allison Hogikyan

Facilitating connections between scientists and the community has become increasingly important over recent years with regard to public understanding and support of science. For the children, in particular, the fun-filled weekend was an interactive reminder of the importance of

science education, reinforced by the opportunity to meet with the actual scientists who do the work each day.

The two-day event also encouraged the volunteers to get out of their scientific and academic comfort zones and take their science to a wider audience. Additionally, it presented a platform for the researchers to buck stereotypes about scientists, particularly gender stereotypes.

In addition to the demonstrations and exhibits, activities at both locations included seining, coastal crafts, an energy-saving scavenger hunt, youth fishing clinics, face painting, touch tanks, and the NJSJC's famous fiddler crab races.

The James J. Howard Marine Sciences Laboratory held its open house May 19, in conjunction with *Ocean Fun Days* at Sandy Hook. As part of the NOAA Fisheries' Northeast Fisheries Science Center, the lab focuses on the effects of human activities on the aquatic environment and the creatures that live there. Researchers and their high school interns showed off the various tools and projects currently underway, including a wave generator for studying beach erosion, assessing fish populations via environmental DNA in water samples, and the potential effects of offshore wind turbines on aquatic life.

Additional sponsors of the event included NOAA, NJDEP Division of Parks and Forestry, Gateway National Park – Sandy Hook, and the Asbury Park Press. ■

AOS & CIMES Research in Action

[This column is intended to focus on AOS & CIMES research accomplishments and milestones, past, present, and future. In this issue, we highlight the accomplishments of AOS Associate Research Scholar Seth Bushinsky who spent 3.5 years in the AOS Program.]

AOS Associate Research Scholar Seth Bushinsky left AOS in July after spending over 3.5 years at Princeton University. Before joining the program, Seth earned his Ph.D. in Oceanography from the University of Washington, where he worked on in situ calibration of oxygen sensors on profiling floats and development of an upper ocean box model

to interpret observations from those floats. While at Princeton, Seth worked with Jorge Sarmiento as part of the Southern Ocean Carbon and Climate Observations and Modeling project.



AOS Associate Research Scholar Seth Bushinsky

The mechanisms and processes that determine the exchange of carbon dioxide and oxygen between the atmosphere and ocean are critical to our understanding of ocean biogeochemistry but also difficult to observe and measure. Observations of upper ocean oxygen and carbon dioxide have traditionally been made from ships and moorings, but the development and deployment of autonomous vehicles equipped with biogeochemical sensors has given oceanographers significant new observational capabilities.

In his work at Princeton, Seth used newly available observations of oxygen from SOCCOM floats to quantify the air-sea exchange of oxygen in the Southern Ocean, finding almost twice the oxygen uptake of previous work based on sparse shipboard observations. By decomposing the total oxygen flux into thermal and non-thermal components, it was possible to show that the subtropical Southern Ocean oxygen flux was seasonally dominated by thermal effects but had a net biologically driven outgassing, while more southern regions took up large amounts of oxygen due to ventilation. This work was published in the *Journal of Geophysical Research: Oceans*.

In a continuation of work initiated by former AOS Research Scholar Alison Gray, Seth investigated the air-sea carbon dioxide exchange in the Southern Ocean by analyzing the impact of adding SOCCOM observations to the traditional carbon

dioxide flux estimates based on shipboard observations. In this work, he found that the addition of float observations to the observational products decreased the Southern Ocean uptake and that some of this change could be explained by differences in sampling times and locations between the different datasets. The magnitude of the reduction in the Southern Ocean carbon sink is equal to ~20% of the total annual contemporary oceanic uptake of carbon, which atmospheric inversions indicate must be balanced within the Southern Hemisphere, either in the ocean or land sinks. This work is currently undergoing review at *Global Biogeochemical Cycles*.

In addition to these main research activities, Seth supervised two Princeton Environmental Institute summer interns on problems relating to gas exchange parameterizations. He also recently published a review of how autonomous measurements are changing ocean carbonate observations in *Current Climate Change Reports*. The development of pH sensors for autonomous vehicles yields new opportunities for understanding the carbonate system, but without the ability to measure a second carbonate parameter the community is reliant on predictive algorithms, with reduced uncertainty over traditional shipboard measurements.

Seth accepted a position as an assistant professor at the University of Hawaii at Mānoa, where he will continue work on the carbon and oxygen cycles and air-sea gas exchange. He will continue to collaborate with researchers at Princeton and GFDL on large-scale observational analyses and evaluation of model output.

“Seth has made fundamental contributions to our understanding of Southern Ocean carbon and oxygen fluxes through his analyses of float data,” said Sarmiento. “We look forward to seeing more great discoveries from him in his new role.” ■

AOS & CIMES News

Congratulations to **Sarah Schlunegger** who successfully defended her Ph.D. Thesis, “Natural Variability in a Changing Ocean: Emergence and Impacts” on May 10, 2019.

AOS Faculty Member **Laure Resplandy**, an assistant professor in Geosciences and the Princeton Environmental Institute, was awarded the prestigious 2019 Sloan Research Fellowship, a highly competitive grant given to outstanding young scholars working at the frontiers of their fields.

[Read more](#)

[Seasonal to Multi-Annual Marine Ecosystems Prediction with a Global Earth System Model](#)

Climate variations profoundly impact marine ecosystems and the communities that depend upon them. Anticipating these shifts using global Earth System Models (ESMs) could enable communities to adapt to climate fluctuations and contribute to long-term ecosystem resilience. The authors of a new [paper](#), led by former AOS Associate Research Scholar **Jong-Yeon Park** (Chonbuk National University, Korea), show that newly developed ESM-based marine biogeochemical predictions can skillfully predict observed seasonal to multi-annual chlorophyll fluctuations in many regions. The authors also provide an initial assessment of the potential utility of such predictions for marine resource management. GFDL's **Charlie Stock**, **John Dunne**, **Xiaosong Yang**, and **Anthony Rosati** (now retired) are among the paper's co-authors. The study was published in *Science*.

[GFDL Research Highlight](#)

[A Review of the Role of the Atlantic Meridional Overturning Circulation in Atlantic Multidecadal Variability and Associated Climate Impacts](#)

A recent [paper](#), led by AOS Faculty Member **Rong Zhang**, a GFDL senior scientist, provides a comprehensive review of the linkage between multidecadal Atlantic Meridional Overturning Circulation (AMOC) variability and Atlantic Multidecadal Variability (AMV) and associated climate impacts, by synthesizing recent studies that employed a wide range of approaches (modern observations, paleo reconstructions, and climate model simulations). The AMOC, which includes a northward flow of warm

salty water in the upper Atlantic and a southward flow of the transformed cold fresh North Atlantic Deep Water in the deep Atlantic, transports a huge amount of heat northwards in the Atlantic. There is strong observational and modeling evidence that multidecadal AMOC variability is a crucial driver of the observed AMV and associated climate impacts, and an important source of enhanced decadal predictability and prediction skill. The paper was published in the *Reviews of Geophysics* journal.

[GFDL Research Highlight](#)

A new paper led by CIMES Researcher **Salvatore Pascale**, an AOS associate research scholar, addresses the question: What modulates the regional response to El Nino?

El Nino is expected to bring drought to southern Africa, but this does not always occur. The authors investigate the influence of the Angola Low and the driver of its interannual variability, and conclude that a complex variety of atmospheric and oceanic drivers can contribute to anomalous states of the Angola low. The study highlights that the interannual variability of the Angola low is determined by a nontrivial interaction of low-frequency extratropical atmospheric variability and tropical and subtropical SST anomalies. This poses a challenge to subseasonal and seasonal prediction of summertime rainfall over subtropical southern Africa. Former AOS Postdoc **Sarah Kapnick '04** (GFDL) and former AOS Postdoc **Honghai Zhang** (LDEO) are among the study's co-authors. The findings were published recently in the *Journal of Climate*.

<https://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-18-0745.1>

Alumni News

Former CICS Researcher **Karin van der Wiel** (Royal Netherlands Meteorological Institute (KNMI)) was recently awarded the World Meteorological Organization's 2019 Research Award for Young Scientists for her paper, [Rapid attribution of](#)

[the August 2016 flood-inducing extreme precipitation in south Louisiana to climate change](#). CIMES Deputy Director Gabriel Vecchi, an AOS faculty member, and GFDL Physical Scientist Sarah Kapnick '04, a former CICS researcher, are among the paper's co-authors. The study was published in *Hydrology and Earth System Sciences* and was funded by the Cooperative Institute for Climate Science (CICS).

Congratulations to AOS Alum **Irina Marinov** on having been granted tenure and on her promotion to Associate Professor of Earth and Environmental Science at the University of Pennsylvania.

AOS Alum **Geeta Persad** has accepted an assistant professor position in the Jackson School of Geosciences at the University of Texas – Austin, effective in the fall of 2020. As an AOS graduate student, she was co-advised by V. Ramaswamy and Yi Ming.

AOS Alum **Robert Nazarian**, an assistant professor at Fairfield University, was awarded a faculty research grant by The NASA Connecticut Space Grant Consortium (CTSGC) to support a summer-long study on the global impacts of ocean mixing in submarine canyons. Read more: <https://www.fairfield.edu/news/archive/2019/may/fairfield-physics-professor-awarded-10k-nasa-ct-space-research-grant.html>

AOS Alum **Hannah Zanowski** (University of Washington) was awarded the 2018 Editor's Citation for Excellence in Refereeing for *Geophysical Research Letters*.

Former AOS Postdoc **Kieran Bhatia** (BP Sunbury, London) received the 2019 Carbon Mitigation Best Paper Award for the following paper: <https://journals.ametsoc.org/doi/full/10.1175/JCLI-D-17-0898.1>. The research was conducted while he was affiliated with the AOS Program.

UPcoming EVENTS

AOS Program Workshop 2019 - Machine Learning



July 29-31, 2019



The Department of Commerce's **Feds Feed Families (FFF) campaign** is in full swing with an ambitious goal to donate as much food as possible by **August 9, 2019**. Donation boxes are set-up in the main lobby of GFDL and Sayre Hall.

AOS Program Annual Retreat



Tuesday, September 10, 2019

Mountain Lakes House

Arrivals

Welcome to our 2019 CIMES summer interns:

Nana Yaa Takyia Afreh (Bronx Community College), hosted by Vaishali Naik & Larry Horowitz - *Spatial Distribution and Emission of Carbon Monoxide in the Atmosphere*

Nkeh Boh (Bronx Community College), hosted by Chris Blanton & Aparna Radhakrishnan - *The Pangeo Project: A New and Better Approach for Working with Big Data*

Ana Bolivar (Florida International University), hosted by Liping Zhang - *Simulated Changes of North Atlantic Air-Sea Heat Flux Feedback in a Warm Climate*

Alex Chang (University of California, Berkeley), hosted by Ming Zhao - *An Analysis of Atmospheric Rivers Simulated in GFDL 50km Resolution AM4/CM4*

Maurizia De Palma (Kean University), hosted by John Krasting - *Assessing Ocean Acidification in Earth System Models*

Mariela de Jesus Arceo Madriz (University of California, Merced), hosted by Fabien Paulot - *Representation of Marine Organic Aerosols in the GFDL Earth System Model*

Alexandra Matthews (Rutgers, The State University of New Jersey), hosted by Steve Griffies & Graeme MacGilchrist - *Evaluating the Biological Carbon Pump in a Water Mass Framework*

PEI Summer Undergraduates working with the Sarmiento Group

Welcome: **Amy Amatya** (Princeton), who is working with Lionel Arteaga; **Al Liang** (Princeton), who is working with Kisei Tanaka; and **Tyrone Zhang** (Princeton), who is working with Graeme MacGilchrist.

Elisa Mantelli arrived in early May from Stanford University to work with Olga Sergienko as a postdoctoral research associate.

Isabel Martinez Cano, a PEI associate research scholar, has been working with Elena Shevliakova as a CIMES researcher since mid-May.

Jun-Ichi Yano, the director of research - CNRM, Meteo-France, arrived in late June, for two months, to work as a visiting research scholar with Leo Donner.

Kai-Chih Tseng will be arriving in late July from Colorado State University to work with Nathaniel Johnson as a postdoctoral research associate.

Hyung-Gyu Lim will be arriving in early August from Pohang University of Science and Technology (POSTECH) to work with John Dunne as a postdoctoral research associate.

Khaled Ghannam, currently a CEE postdoctoral research associate, will join the AOS Program in early August to work with Elena Shevliakova as a postdoctoral research associate.

Suqin Duan will be arriving from Tsinghua University's Department of Earth System Science in early August to work with Stephan Fueglistaler as a postdoctoral research associate.

Aparna Radhakrishnan will arrive from Engility/SAIC in early August to work with V. Balaji as a professional specialist.

Welcome Back!

We welcome back former AOS Postdoc **Dan Li**, an assistant professor at Boston University, who is working with Elena Shevliakova from early June through August as a visiting research scholar.

Monika Sikand, an assistant professor at Bronx Community College, arrived in mid-June to work with V. Ramaswamy, for two months, as a visiting research scholar.

We welcome back **Gabriel Lau**, a former faculty member and GFDL scientist, who arrived in early July to work with his AOS/GFDL colleagues through the end of August.

Pablo Zurita-Gotor, a returning faculty member from the Universidad Complutense de Madrid, arrived in early July. Pablo is working with Isaac Held and

Stephan Fueglistaler throughout the summer.

Former AOS Postdoc **Mehmet Ilicak**, an associate professor at ITU Eurasia Institute of Earth Sciences, arrived in early July to work with Bob Hallberg, as a visiting research scholar, for one month.

Former AOS Postdoc **Nadir Jeevanjee** will transfer back to AOS/CIMES from GEO. He will be working with V. Ramaswamy as a postdoc.

Departures

AOS Associate Research Scholar **Fabien Paulot** accepted a physical scientist position at GFDL, effective mid-April.

Liping Zhang, an AOS research scholar, began her UCAR affiliation (Project Scientist I) effective mid-April; she continues to have an office in GFDL.

AOS Associate Research Scholar **Brandon Reichl** accepted a research oceanographer position at GFDL, effective late April.

AOS Postdoctoral Research Associate **Xiaoqiong (Sage) Li** accepted a quantitative analyst position at the Macquarie Group, NYC. April 24 was her last day in the Program.

AOS Postdoctoral Research Associate **Xiaoqin Yan** left the Program at the end of her appointment (May 22) to return to China.

AOS Postdoctoral Research Associate **Sina Khani** accepted a postdoctoral position at the Applied Physics Laboratory and School of Oceanography, University of Washington, effective August 1. He left the Program in late May.

AOS Visiting Research Scholar **Xianan Jiang** returned to the Joint Institute for Regional Earth System Science and Engineering at UCLA at the end of June to resume his appointment as a researcher.

AOS Visiting Postdoctoral Research Associate **Benjamin Bronselaer** ended his AOS appointment as a collaborator in mid-July. He accepted a position at BP, London as a MetOcean Engineer.

AOS Associate Research Scholar **Seth Bushinsky** accepted a position at the University of Hawaii as an assistant professor. Seth left the Program in mid-July.

AOS Postdoctoral Research Associate **Kisei Tanaka** accepted a research scientist position at the Monterey Bay Aquarium. He will be leaving the Program in mid-August.

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We want to hear from
you.

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