



RUTGERS

School of Environmental
and Biological Sciences

2020
RUCOOL

Center for Ocean Observing Leadership
ANNUAL REPORT

rucool.marine.rutgers.edu

This year has been by all accounts a momentous and challenging time,

and as the current fiscal year ends, we take a moment to look back at where we came from, the current conditions on the ground, as well as future needs and opportunities. Despite the pandemic, civil issues, and economic disruptions, ocean data continues to stream from the Center for Ocean Observing Leadership (COOL) to federal and state agencies, companies, and anyone interested in the ocean. This robust system came into being with the support of SEBS Exec Dean Robert Goodman. Since our formation Bob has acted as coach, mentor, and cheer leader. Dean Goodman is retiring this year and all of us at COOL want to thank him for his support over the years. Our goal moving forward is to build on his vision for a sustained presence in the ocean, and using that information to develop new insights for the good of the planet and humanity.

As the pandemic began, Rutgers quickly determined that the COOL infrastructure was deemed critical for serving state and national needs. The success of maintaining the network throughout the COVID outbreak was a reflection of the dedicated hard-working staff of COOL. They maintained one of the world's largest HF Radar networks and supported glider efforts under difficult working conditions. Activity is now ramping up with the start of hurricane season, and research activity is increasing as we move into the next phase of reopening the university. All that has been accomplished is a reflection of the dedicated efforts of the full COOL team. Finally, COVID raised many challenges, and we now are assessing on how we might increase the ocean observing network's resilience. This will be achieved through continued automation, backups for supply chain disruptions, and improved cyberinfrastructure tools allowing for coordinated control of the network. This becomes a new priority to be tackled in the coming years.



Scott Glenn
Board of Governors
Professor



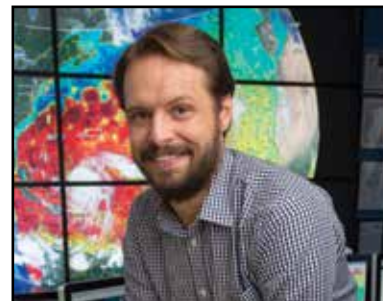
Oscar Schofield
Distinguished Professor



Josh Kohut
Professor



Janice McDonnell
Associate Professor



Travis Miles
Assistant Professor



Grace Saba
Assistant Professor



Nicholas Beard
Assistant Teaching
Professor

LEADERSHIP IN OCEAN SCIENCE

Leading the Charge in Glider-based Ocean Acidification Monitoring



RUCOOL's Grace Saba over the past year focused deploying the newly developed, and worlds first, glider pH sensor to monitor ocean acidification in the Mid-Atlantic Bight. The data is central to Elizabeth Wright-Fairbanks's PhD that is collecting the first high-resolution maps of the seasonal dynamics of carbonate chemistry. Efforts will be supported and expanded to the entire U.S. Northeast Shelf in a newly funded project supported by the NOAA Ocean Acidification Program and U.S. Integrated Ocean Observing System. The Fall 2019 deployment of the pH glider marked a remarkable achievement - RUCOOL's 500th glider deployment! Our team's gliders have now flown distances greater than 6 times around the world and totaled to over 36 years at sea.

Ocean Prediction in the Gulf of Mexico

Rutgers, Texas A&M, the University of South Florida, and the University of Southern Mississippi are funded by the National Academies of Sciences Gulf Research Program. The overall goal of the program is to advance our understanding of Loop Current dynamics in order to improve predictive skills of the Loop Current and associated eddies. RU COOL is developing quality control methods for High Frequency Radar data deployed in the Gulf. These methods include automated real-time measures of vessel signals in the data.



Josh Kohut Becomes an MTS Fellow!

This past fall, Dr. Josh Kohut was awarded the honor of Marine Technology Fellow. This designation is one of the highest accolades awarded by the Marine Technology Society (a leading authority and advocate for marine technology and resources). Josh was recognized for fundamental contributions in the development of novel technologies that allow for sustained spatial sampling of marine systems. He has lead to the deployment and deployment of a range of technologies that are helping science, health and human safety at sea, and sustainable fishery management. At the same meeting, Dr. Kohut won an election to serve as a member of the Board of Directors for the Marine Technology Society as the Vice President for Education.

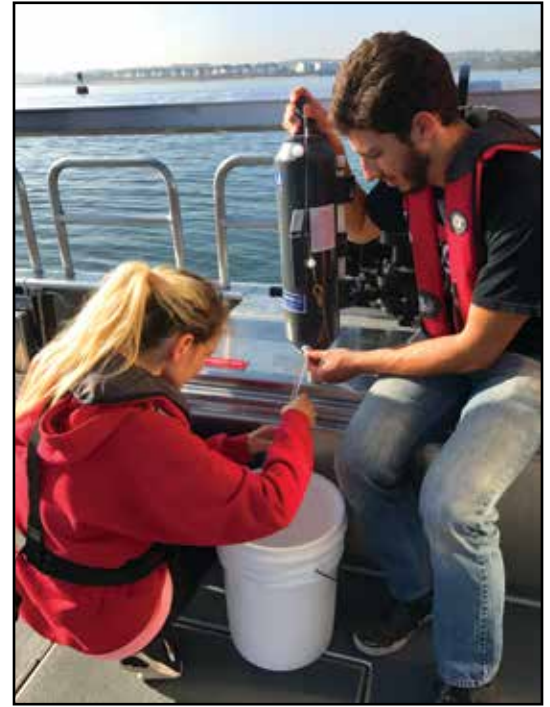
Investigating the Fate of Microplastics in Delaware Bay



Microplastics are pervasive in freshwater and marine ecosystems, posing many threats to marine organisms. Unfortunately, the fate and transport of these microplastics is poorly understood. The NOAA Marine Debris Program is funding RUCOOL 's Grace Saba and other Rutgers partners to examine the role that river plume fronts have on the incorporation of microplastics into the food chain and the sinking of microplastics as they are incorporated into zooplankton fecal pellets. In October 2019, the project team conducted a research cruise at the mouth of the Delaware Bay and completed a set of accompanying laboratory experiments with live zooplankton at the Haskin Shellfish Research Laboratory. Fieldwork for this project will continue through 2021.

R/V Rutgers - A Floating Classroom and Scientific Research Platform

The R/V Rutgers continues its tenure functioning as both a mobile classroom connecting students to the Raritan River, and a research platform aiding scientists in their endeavors afield. From introductory Byrne Seminars giving undergraduates a broad overview of the Raritan and its industrial history to Advanced Geomatics where students use instrumentation and learn water quality sampling techniques, the R/V Rutgers provides a hands-on educational experience that is unparalleled in typical classroom or online environments. Environmental Law students have gained an understanding of litigation and applicable environmental statutes, while marine science students have focused on physical and biological sampling methods and equipment - all while collecting a time series data set distributed and used by various state agencies such as the Department of Environmental Protection. During Rutgers' National Science Foundation Research for Undergraduate Program, students from around the country were introduced to the heavily impacted Raritan to the more pristine Mullica. The R/V Rutgers boasted nearly 50 trips hosting over 400 student and scientists in 2019.



DEVELOPING A BLUE ECONOMY

Offshore Wind Energy: Coming soon to New Jersey

The State of New Jersey continues to develop offshore wind, this year increasing its commitment to 7.5 GW of offshore wind by 2035. RUCOOL is working with state agencies, such as the NJ Board of Public Utilities (BPU), on understanding the amount of offshore wind resource available, using our RU-WRF model. RU-WRF underwent an extensive validation by the National Renewable Energy Lab, which demonstrated the importance of regional knowledge for accurate modeling of the wind resource. This modeling tool is uniquely combined with RU COOL observing tools making the Mid-Atlantic one of best characterized oceans in the world according to the global wind developers.



Working with Wind Developers to Protect the Environment

RUCOOL is working with Ocean Wind (Ørsted) and Atlantic Shores (EDF/Shell), developers of two of NJ's offshore wind farms near Atlantic City. Ørsted and RUCOOL launched the ECO-PAM project that is using passive acoustic sensors deployed on gliders and buoys to detect the presence/absence of the North Atlantic Right Whale. The goal is to develop a better understanding of their habitat and assess potential impact of offshore wind construction and operations. Additionally, Atlantic Shores is working with RUCOOL on improved understanding of visibility regimes impacting how visible offshore turbines would be from shore, along with installing shoreside measurement equipment at RUMFS.



Photo credit: Brian Skerry, National Geographic.



Improving National Hurricane Forecasts

During the summer and fall of 2019, RUCOOL collaborated with NOAA's Integrated Ocean Observing System (IOOS), the Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS), US Navy, Academic, and Industry partners to deploy over 60 ocean gliders to enable improvements to hurricane intensity forecasts at landfall. Research highlights include:

- In collaboration with NOAA's Environmental Monitoring Center (EMC) scientists, RUCOOL used glider data to evaluate the nation's operational and experimental ocean models coupled to hurricane intensity forecast models. We've found that the experimental systems, which ingest glider and other observational data, represent ocean features more accurately, and better represented hurricane intensity in 2019 than last year's operational system. This has led to the phase out of the 2019 operational system resulting in a better ocean forecast for future storm events.
- RUCOOL is working with NOAA EMC to incorporate Rutgers Regional Ocean Modeling System (ROMS) into the National Weather Service's United Forecasting System, that will enable the ROMS ocean model to better inform NOAA's hurricane forecast models.
- In the 2019 hurricane season RUCOOL deployed and recovered two US Navy gliders off the coast of NJ. The US Navy allowed RUCOOL to independently deploy, recover, plan mission activities, and engage in collaborative troubleshooting of critical deployment challenges which is a first in collaborating with the Navy. This work represented an exciting model for operational federal agencies working with academic partners, which will continue next year with additional naval deployment support.

Research in the Land Way, Way Down Under

This past austral summer, RUCOOL led two multi-institutional science campaigns along the West Antarctic Peninsula. Dr. Oscar Schofield led the Palmer Long Term Ecological Research (PAL-LTER) program that completed its 30th annual field season focused on understanding the impact of the climate change on the polar marine ecosystems. Project SWARM, led by Dr. Josh Kohut, brought and deployed a polar ocean observatory that integrates ocean and marine ecological observations with a high resolution numerical ocean model. This SWARM observatory was strategically deployed within the footprint of the PAL-LTER allowing results to be extrapolated back in time. Together the larger group will test new hypotheses on the physical forcing of polar food webs. RUCOOL has assumed primary leadership for the PAL-LTER.



EMPOWERING THE NEXT GENERATION

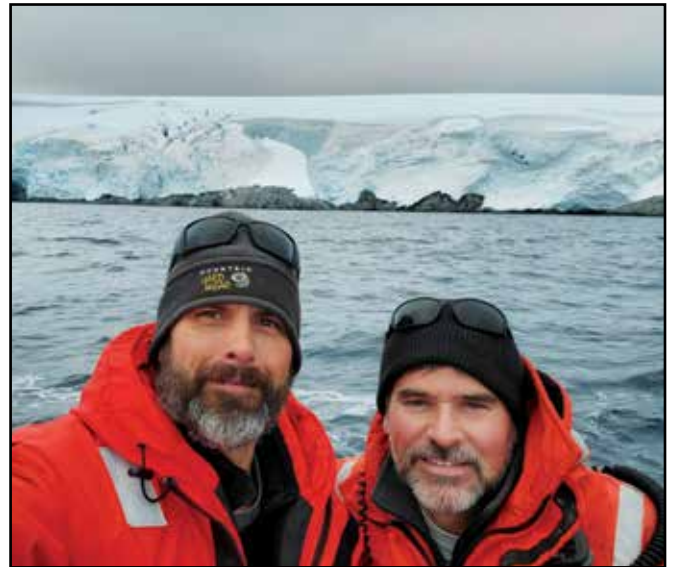


Marine Science Family Nights in New Brunswick Schools

Family involvement in children's science activities is linked to many benefits including improved homework completion, report card grades, achievement test scores and attitudes towards science. These benefits drive the need for school districts to continue to seek family involvement, in particular for children from urban communities. Rutgers scientists from RUCOOL teamed up with the local school district to develop a series of Marine based Science Family Nights. Funded by Rutgers' 4-H Department of Youth Development and Cooperative Extension, and AT&T, this series set out to inspire and engage the next generation of science-informed students. Students and their families had the opportunity to learn about and interact with a live penguin from Jenkinson's Aquarium, be introduced to an RU COOL glider, and ask one-on-one questions and do hands on activities with the faculty, graduate /undergraduate students, and staff of the Marine Science Department.

Students Virtually Visit Palmer Station, Antarctica

RU COOL scientists working on the NSF-funded Palmer LTER and Project SWARM connected with thousands of K-12 students this past winter in 10 live video teleconferences (VTCs) from Palmer Station, Antarctica. The education team recruited and prepared 25 teachers from 21 schools in 11 states, reaching 1060 students directly and many more via the call recordings that are shared online. The VTC program, now in its fourth year, does more than introduce students to scientific research – the interaction helps build science identity as reported by teachers.



Teaching with Data using Data Labs

RUCOOL continued our support of the Ocean Observing Initiative (OOI) through professional development workshops, webinars and fellowships that empowered faculty to incorporate OOI "big data" into their introductory oceanography classes. Faculty from across the country attended week-long workshops held around the country. Working in teams, faculty developed their own educational resources by accessing OOI data. RUCOOL helped faculty mine the data and develop new data widgets that resulted in fifteen new Data Labs. Faculty then led a series of live webinars to introduce their Data labs to the larger community. 62 teachers attended one-day workshops co-located with other conferences in Nashville and San Diego, which were facilitated by other workshop alumni, expanding the community of practice.

EMPOWERING THE NEXT GENERATION



Polar Literacy Initiative

The RUCOOL Engagement & Outreach team is partnering with The Ohio State University Byrd Polar and Climate Research Center to develop Out of School Time (OST) programs that bring polar science to underserved and underrepresented youth in OH, CO, PA, and NJ. This project is our team's first NSF award focused on informal science learning and researching and evaluating effective practices for building data literacy skills in OST learning environments. Our advisory team consists of leaders in the informal science-learning field, our implementers at The Franklin Institute, Colorado Discovery Program, and nationally through the 4-H program, and the development teams at Rutgers and Byrd Center are working together to design innovative learning programs for middle school youth.

Masters in Operational Oceanography

RUCOOL's inaugural cohort of Operational Oceanography Masters students have completed their first year. The students have had a rich, wide-ranging, immersive experience drawing on the activities and faculty across the Center. The first year of the program was a great success with students engaged in active learning and real world operational experiences. The students have excelled in the field and classroom, and are having great success already on the job market with one being hired prior to graduation at NOAA's CO-OPS operational oceanography data service. Student-led thesis projects were submitted the Marine Technology Society annual conference. RUCOOL is encouraged by the outcomes and excited to build on this year's successes and lessons for the second cohort starting August 2020.



STEM: Exploring Life in the Southern Ocean

During the spring of 2020, Rutgers 4-H launched a Virtual 4-H at Home Short Term Exploratory Program (STEP), partnering with the Virginia Institute of Marine Science. The program was entitled: Exploring Life in the Southern Ocean and consisted of three 1.5 hour classes geared towards 5th-8th grade students. This STEP Club was offered to the NJ statewide 4-H list serve, and reached capacity in just a few hours. Young people from across the state participated in this inaugural program led by the RUCOOL. Students identified "mystery" creatures from a research cruise off the coast of the Western Antarctic Peninsula, interpreted penguin population data, explored benthic fishes and their adaptations, and participated in a discussion on global warming effects of climate change.

RUCOOL's MISSION

RUCOOL is creating knowledge of our ocean planet by pushing the limits of science and new technologies while inspiring future generations of ocean explorers, with four core focus areas:

LEADERSHIP IN OCEAN SCIENCE

Focused on understanding the underlying processes that impact our ability to predict marine systems through the integration of observing and modeling technologies.

DEVELOPING A BLUE ECONOMY

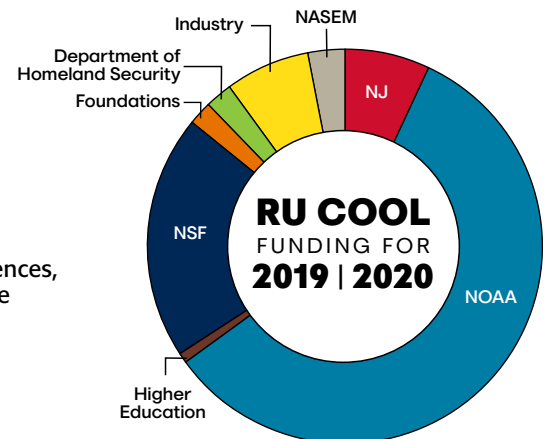
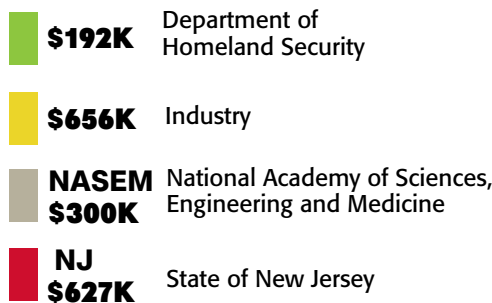
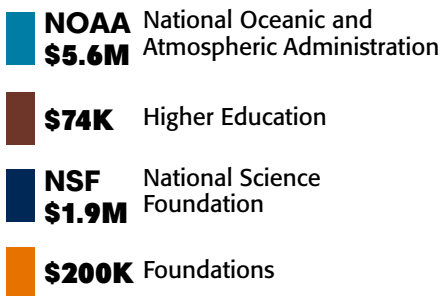
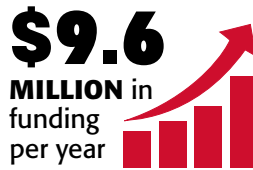
Provides comprehensive ocean and atmospheric data supporting business and local-state-federal agencies to ensure smart and sustainable use of the coastal Mid-Atlantic, including operating a real-time weather model since 2011 for offshore wind resource assessment.

EXTREME OCEAN ENVIRONMENTS

Studying the most extreme ocean environments on Earth, spanning typhoons to ice-covered seas. This includes exploring the vital air/sea connections that drive hurricanes and coastal storms here in the Mid-Atlantic.

EMPOWERING THE NEXT GENERATION

Innovating education practices to enable all humanity to be active explorers of their ocean planet, including a recently launched Masters of Integrated Ocean Observing program to further support this mission.



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