

SCRIPPS INSTITUTION OF OCEANOGRAPHY

# 2018 ANNUAL REPORT

UC San Diego




SCRIPPS INSTITUTION OF  
OCEANOGRAPHY









Students in the Scientific Diving Program learn how to load and launch small boats from the pier for local dives. The oldest and one of the largest programs of its kind, the program trains and supports the university's scientists, students, and technicians in the use of underwater techniques and technology necessary to safely conduct research underwater.

## DIRECTOR'S COUNCIL MEMBERS

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(EWSA Chair)*

*Mary Ann Beyster*

*Paul Brooks  
(Friends of Collections  
Chair)*

*Julia Brown*

*James L. Cairns*

*Bernard David*

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Aquarium Chair)*

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*Stuart Goode*

*Adam Gordon*

*Richard Gulley*

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**COVER IMAGE:** Scripps graduate student Allison Lee Cusick is working with the International Association of Antarctic Tour Operators to enable vacationers to serve as citizen scientists. With this project, tourists collect samples of phytoplankton from Antarctic fjords, like the one pictured here. The information could help scientists determine what sustains one of the most fertile ocean regions in the world and understand how it may be changing.  
Photo credit: Allison Lee Cusick





## FROM THE DIRECTOR



Scripps Institution of Oceanography at UC San Diego has been a beacon of world-class research and education since its founding in 1903. We are proud of the work that has advanced the understanding of our home planet and addresses the world's most challenging environmental problems.

The student experience at Scripps Oceanography is unparalleled. We take our responsibility to train the next generation of scientists very seriously, and offer a hands-on approach to learning as well as access to top scientists and global research opportunities.

Our undergraduate enrollment has grown rapidly, and with the addition of the new oceanic and atmospheric sciences major, we are now approaching 700 undergraduate students. The marine biology major continues to be in demand, and it's no wonder given the access to our fleet of ships and course work in the field.

The UC Ship Funds program is part of what makes this ship time available for students. On page 14, we've highlighted that unique program as well as a few examples of graduate student work made possible because of this funding, which is exclusive to UC students.

In May, Chancellor Pradeep Khosla hosted the "UP Summit," to which UC San Diego invited regional elected officials, policymakers, and key decision makers to campus. They learned about the breadth of research to understand and protect the San Diego region taking place throughout UC San Diego. These efforts

range from the ALERTWildfire cameras that aid firefighting (page 6) to work in the Biological Sciences division to study the future health of honeybees.

As always, key elements of our research would not be possible without philanthropy and I would like to thank our donors for their generosity. From funding symposia to find solutions to marine plastic pollution to a campaign funding a new workboat for students (page 28), donors find that Scripps can take action on issues and causes of importance to them.

A focus on the student experience would be remiss without mention of Scripps' oldest and highly accomplished alum Walter Munk, who has inspired students on campus for nearly 80 years and recently celebrated his 101st birthday. This summer Munk was awarded the French Legion of Honour for his contributions to oceanography, gaining the title of Chevalier, or knight. Kudos to Walter for inspiring our students to do daring science that leaves a lasting mark on the world.

Thank you, all, for making this a great year.

Margaret Leinen  
Director, Scripps Institution of Oceanography  
Vice Chancellor for Marine Sciences  
UC San Diego





# RESEARCH HIGHLIGHTS

## RESILIENCE TO HAZARDS WILDFIRE WATCH

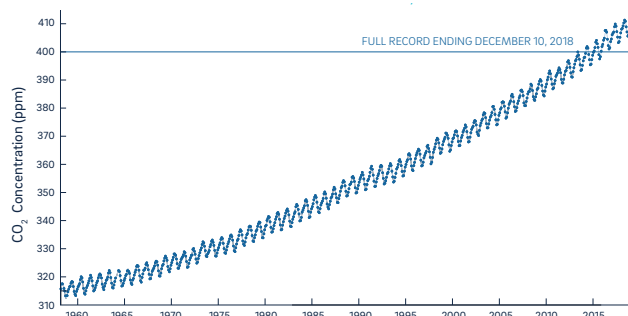
As wildfire danger grows in the West, an early warning camera network administered by a consortium of academic centers that includes Scripps is growing as well. ALERTWildfire cameras were credited for confirming and detecting wildfires in Orange County and San Diego County and providing real-time situational awareness that allows first responders to scale up or down their response. The network covers wilderness areas in several western states and in August expanded to Sonoma County, where 13 cameras were added to the ALERT North Bay cluster. ALERTWildfire leaders plan to add several hundred more cameras throughout the West in the next three years. *The cameras are accessible to the public at [www.alertwildfire.org](http://www.alertwildfire.org).*

ALERTWildfire cameras on top of Santiago Peak in Orange County, Calif., inform fire officials with views of the Holy Fire in 2018.



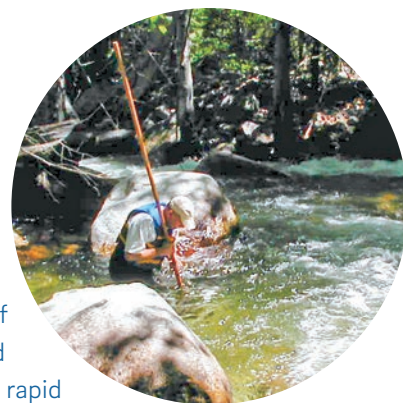
## CLIMATE CHANGE CALCULATING IMPACTS

The research team that maintains the Keeling Curve, which tracks carbon dioxide levels in the atmosphere, reported that CO<sub>2</sub> levels reached 411.31 parts per million of air in May. That made it the highest monthly reading in history. Nearly every year since the Keeling Curve was established in 1958, each annual peak has broken the previous year's record as fossil fuel use escalates.



Carbon dioxide concentration at Mauna Loa Observatory

Scripps researchers coordinated *California's Fourth Climate Change Assessment*, released in August. The report included projections of longer heat waves and fire seasons and more rapid sea-level rise than previously thought. New to the Fourth Assessment was the inclusion of regionally specific forecasts, which noted, among other things, a likelihood that there will be more dry years in the San Diego region but that rainy years will bring an increased chance for flooding.



## THE NEXT LEVEL IN AEROSOL RESEARCH

The largest federally funded lab at UC San Diego received a \$20 million grant extension in May to support five more years of aerosol research.

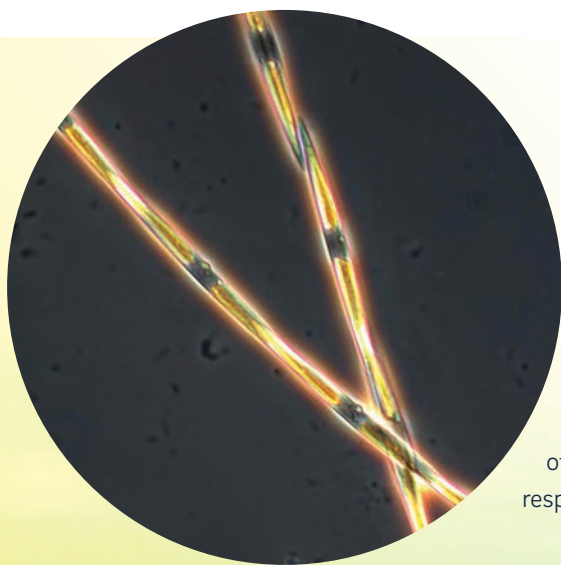
The National Science Foundation award to the Center for Aerosol Impacts on Chemistry of the Environment (CAICE) will support unprecedented work on atmospheric dynamics. CAICE researchers are trying to understand the complex process through which aerosols travel through the sky and how their chemistry and structure change along the way. In the first phase of the program, they had examined the role that natural aerosols including microbes and other organic matter play in cloud formation.

For the second phase, CAICE is designing experiments to determine how pollution from human activities interacts with natural ocean emissions and changes the chemical composition of the atmosphere. The research could provide insights into how these sources are influencing atmospheric temperatures which are leading to heat waves, as well as intense weather extremes leading to drought and flooding. Read more at: [scripps.ucsd.edu/caice](http://scripps.ucsd.edu/caice).



CAICE Director Kimberly Prather, Francesca Malfatti, and Christopher Lee discuss experiment results in front of the Hydraulics Lab wave flume.





## HUMAN HEALTH DOMOIC ACID DECODED

A team led by scientists from Scripps Oceanography and the J. Craig Venter Institute uncovered the genetic basis for the production of domoic acid, a potent neurotoxin produced by harmful algal blooms. Studying the phytoplankton *Pseudo-nitzschia*, they discovered that three genes contain the biological instructions for how to make the toxin and are subsequently "turned on" when *Pseudo-nitzschia* is producing domoic acid. This finding offers hope for increased understanding of harmful algal blooms and the ability to help better project domoic acid events in response to future climate change. Read more at: [scripps.ucsd.edu/domoicacid](https://scripps.ucsd.edu/domoicacid).

## TECHNOLOGY TRACKING HURRICANES

Scientists from the Lagrangian Drifter Laboratory tracked hurricanes Michael and Florence as the storms traveled through the Gulf of Mexico and Atlantic Ocean with specialized drifting buoys built at Scripps. Managed by scientist Scripps Luca Centurioni as part of the NOAA Global Drifter program with additional support from the Office of Naval Research, this network of 1,500 drifters measures sea surface temperature, currents, and atmospheric pressure and transmits the data in real time. The data is used by NOAA and the international community to validate forecasts of the path and intensity of hurricanes, calibrate and validate satellites measuring the temperature at the ocean surface, as well as for weather prediction, ocean circulation, and climate studies.

During Hurricane Michael, ten drifter buoys were deployed into the Gulf of Mexico from a U.S. Air Force Hurricane Hunter, including five Directional Wave Spectra Drifters. These new drifters detect height, period, and direction of surface waves, which can provide important data to assess the danger of high seas and storm surges.



## NATIONAL SECURITY SCRIPPS ADVISES TASK FORCE OCEAN

Recognizing the U.S. Navy is losing its competitive advantage in the undersea domain and that competitors have a growing capacity for surprise, Chief of Naval Operations John Richardson launched Task Force Ocean (TFO). TFO's goal is to improve understanding of the current state of ocean science and how collaborations can be strengthened to help maintain competitive advantage undersea.

Due to Scripps' longstanding partnership with the U.S. Navy, Director Margaret Leinen and several Scripps scientists were asked to provide input to the TFO Roadmap. Key Scripps personnel advised on increasing the connection between ocean science enterprise and the Navy's operational

challenges; improving transition of research into operation for warfighter efficiency; capitalizing existing science and technology strengths and supporting new technology development; and training tomorrow's workforce with proper skillset to meet future needs.

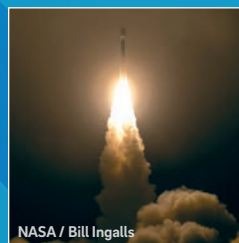
In October 2018, Scripps sent a delegation to the first TFO Tactical Oceanography symposium. At the meeting, the Office of Naval Research committed to fund fifty additional graduate students and fifty postdoctoral scholars at institutions like Scripps to strengthen the next generation of ocean scientists. The Navy is also expected to expand investments and opportunities in basic and applied at-sea research.





## Ice-Measuring Satellite Launched into Orbit

In September 2018, NASA launched ICESat-2 —a satellite that will measure ice with lasers that scientists say will define the next decade of Antarctic research. Several Scripps scientists contributed to the ICESat-2 mission, notably glaciologist Helen Fricker, who has served as a member of NASA's Science Definition Team for more than a decade. The satellite will measure changes in the heights of the polar regions, helping scientists calculate future impacts on global sea level and climate.



NASA / Bill Ingalls

## Records Set at Scripps Pier

In August 2018, water temperature readings off the Ellen Browning Scripps Memorial Pier broke a 102-year record held since readings began in 1916. Over a period of one week, the record was broken four times, with the highest reading at 79.5 degrees Fahrenheit. The Scripps Pier temperature time series ranks as one of the world's longest ocean time series, and the longest on the Pacific Rim.



## Manta Ray Nursery Found

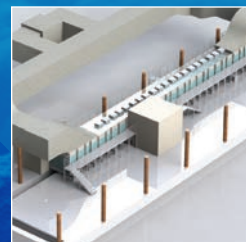
Scripps graduate student Joshua Stewart and colleagues from NOAA's Office of National Marine Sanctuaries confirmed the world's first known manta ray nursery in June 2018. Located in the Gulf of Mexico off Texas, the juvenile manta ray habitat is the first of its kind to be described in a peer-reviewed scientific study.



FGBNMS / G.P. Schmahl

## New Ocean-Atmosphere Simulator Coming to Campus

In November 2017, Scripps was awarded \$2.8 million from the National Science Foundation to construct a replica ocean-atmosphere system. The new Scripps Ocean Atmosphere Research Simulator (SOARS), expected to be complete in 2021, will mimic the ocean with unprecedented accuracy, capturing the interactions of wind, waves, microbial marine life, and chemistry at the sea surface in a laboratory setting.







## MPL INTERNSHIP PROGRAM

Since 2005, undergraduate students from universities across the United States have come together at Scripps Oceanography every summer for a ten-week, research-driven internship program coordinated by the Marine Physical Laboratory (MPL).

In summer 2018, MPL welcomed 16 undergraduates to the program. Each student received a stipend and was paired with a principal investigator (PI) with whom they spent ten weeks working in the lab.

Combining hands-on research experience with group activities like a day cruise aboard R/V *Robert Gordon Sproul*, the MPL internship program goes beyond the typical undergraduate experience by fostering the interns' curiosity and passions and training today's students to become tomorrow's scientists. *Read more at: [scripps.ucsd.edu/MPLinternship](https://scripps.ucsd.edu/MPLinternship).*

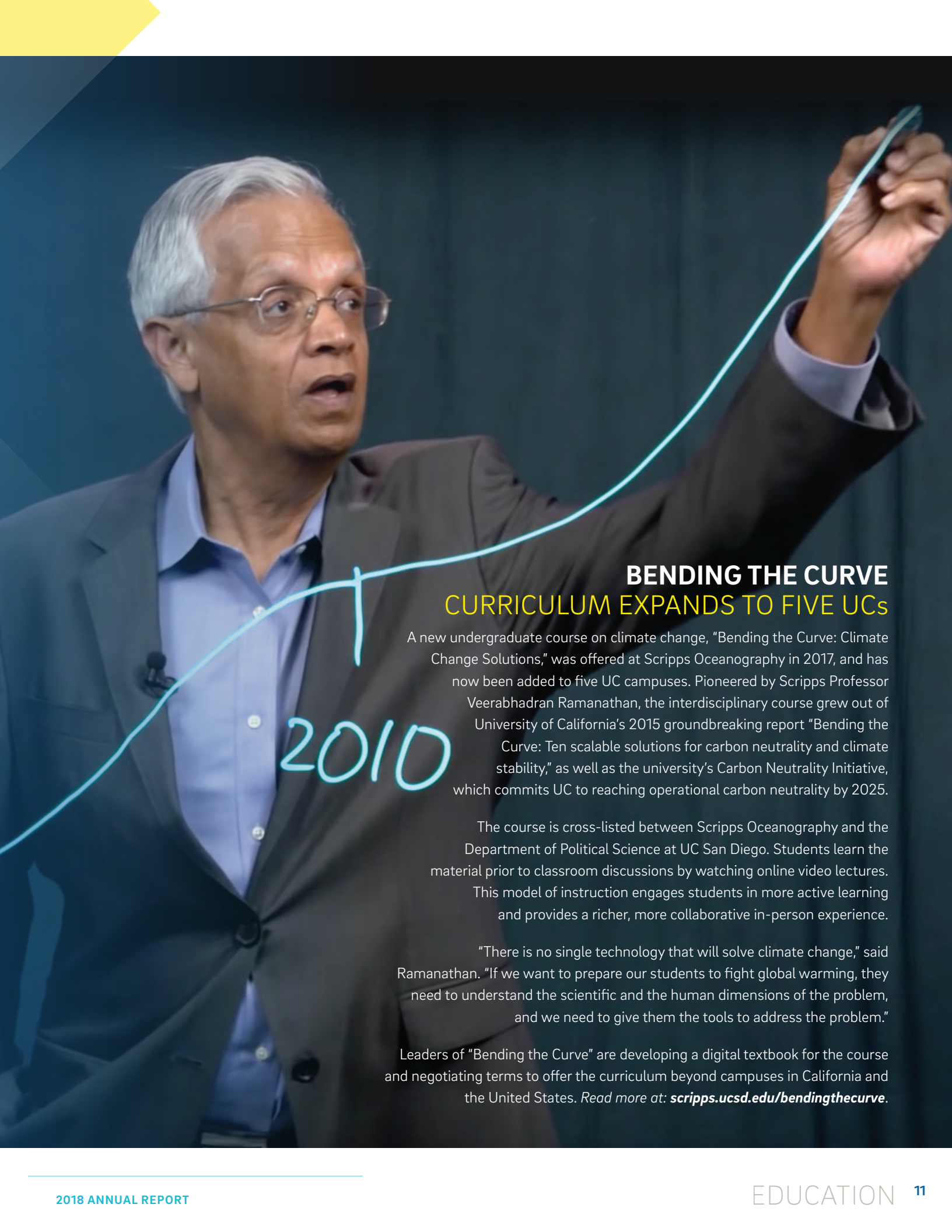
## NEW CLIMATE CHANGE STUDIES MINOR

Starting in 2019, Scripps Oceanography will begin offering a minor in climate change studies, the third minor administered by Scripps for undergraduate students.

The **Climate Change Studies Minor** is designed to help students develop knowledge of climate science, understand the human and social dimensions of climate impacts, and take advantage of opportunities to develop and implement solutions to climate change.

"This minor provides an opportunity for every student in every major across UC San Diego to equip themselves with the tools necessary to combat climate change," said Sarah-Mae Nelson, a former Scripps Master of Advanced Studies student who helped champion the minor as part of her capstone project.

The curriculum for the minor follows an interdisciplinary approach to tackling climate change, placing emphasis on climate solutions and practical student internships. An intended hallmark of the minor is the practicum requirement, in which students learn about carbon neutrality initiatives and climate change research on campus.



## BENDING THE CURVE CURRICULUM EXPANDS TO FIVE UCs

A new undergraduate course on climate change, "Bending the Curve: Climate Change Solutions," was offered at Scripps Oceanography in 2017, and has now been added to five UC campuses. Pioneered by Scripps Professor Veerabhadran Ramanathan, the interdisciplinary course grew out of University of California's 2015 groundbreaking report "Bending the Curve: Ten scalable solutions for carbon neutrality and climate stability," as well as the university's Carbon Neutrality Initiative, which commits UC to reaching operational carbon neutrality by 2025.

The course is cross-listed between Scripps Oceanography and the Department of Political Science at UC San Diego. Students learn the material prior to classroom discussions by watching online video lectures.

This model of instruction engages students in more active learning and provides a richer, more collaborative in-person experience.

"There is no single technology that will solve climate change," said Ramanathan. "If we want to prepare our students to fight global warming, they need to understand the scientific and the human dimensions of the problem, and we need to give them the tools to address the problem."

Leaders of "Bending the Curve" are developing a digital textbook for the course and negotiating terms to offer the curriculum beyond campuses in California and the United States. *Read more at: [scripps.ucsd.edu/bendingthecurve](https://scripps.ucsd.edu/bendingthecurve).*



# OUTREACH

## SCRIPPS AT SXSW SAVING CORAL REEFS ONE PIXEL AT A TIME

South by Southwest (SXSW) is an annual conference in Austin, Texas, that explores what's next in the worlds of technology, film, culture, and music. At the March 2018 event, Scripps led its first-ever panel, titled "Saving Coral Reefs One Pixel at a Time," sparking a lively discussion about innovative technology being used to study coral reefs.

Scripps coral reef ecologist Jennifer Smith and Zackery Rago of the production company Exposure Labs and the documentary *Chasing Coral* participated in the panel, with science journalist JoAnna Klein of the *New York Times* serving as moderator. They covered a range of topics including the biology and ecology of corals, the evolution of imagery-based approaches in coral reef research, and the ways technology can be used to educate and inspire communities to protect coral reefs.

Smith discussed novel technology developed at UC San Diego that creates high-resolution photo mosaics and 3D maps of coral reefs by taking thousands of pictures and stitching them together using a customized computer program. Both she and Rago see the potential for technology to help communicate science to the public and to help promote stewardship of the oceans.



## ROSA PARKS TUTORING PROGRAM

Every Saturday you'll find UC San Diego graduate students tutoring youngsters from Rosa Parks Elementary School in the City Heights/Weingart Branch Library. The volunteer-led Rosa Parks Tutoring Program was created in 2010 by graduate students at Scripps.



Through the free program, student volunteers at UC San Diego promote diversity in science, technology, engineering, and math (STEM) fields and seek to give back to a community facing numerous economic and social challenges. During the 2017-2018 academic year, the tutoring program served 48 Rosa Parks students, with 10 to 20 students receiving hour-long tutoring sessions each weekend. The group was recently honored for its outreach efforts by UC San Diego's Equal Opportunity/Affirmative Action and Diversity Awards Program.

Now considered an official UC San Diego student organization, the Rosa Parks Tutoring Program has 23 volunteers, who together tutored a total of 235 hours in the 2017-2018 academic year. The organizers hope to attract more students so they can further expand their reach. *Read more at [scripps.ucsd.edu/rtp](https://scripps.ucsd.edu/rtp).*



## SCRIPPS WELCOMES UC-HBCU STUDENT KENDALL CHANCELLOR

This year, Scripps Oceanography welcomed the first graduate student to take advantage of the University of California Historically Black Colleges and Universities (UC-HBCU) Initiative. The initiative, which provides partial funding to scholars, is an effort by the Office of the President to improve diversity and strengthen graduate programs by investing in relationships between UC faculty and HBCUs.

Kendall Chancellor attended Hampton University where she received her bachelor's degree in marine and environmental science. As part of the UC-HBCU Initiative, Chancellor toured the Scripps campus in 2016 as an undergraduate intern at UCLA. After the tour, Chancellor said she knew she wanted to attend

Scripps and continue researching coral reef ecology. She applied to the Sandin Lab eager to participate in its community outreach efforts to teach small island populations how to better manage and sustain their local reefs.

As she continues to pursue her PhD in the Sandin Lab, Chancellor will use the archive of 3D images of coral reefs gathered from the Scripps-based 100 Island Challenge for her research. Chancellor hopes to close the gap between the public and science by using digital media to educate the public on environmental research.



# EQUITY, DIVERSITY, & INCLUSION

## EDI COMMUNITY ENGAGEMENT FELLOWS

Each year the Scripps Oceanography Community Engagement, Diversity, and Inclusion (C-EDI) Fellows are determined to put Scripps at the forefront of science and diversity. The eleven-month program awards fellows a stipend to work alongside the Scripps diversity initiatives coordinator in efforts to develop and engage the Scripps community around equity, diversity, and inclusion.

The C-EDI Fellows this year are graduate students Osinachi Ajoku, Alyssa Griffin, and Lynn Waterhouse. They collectively strive to increase the retention rate for minority students, actively create solutions to address EDI challenges affecting the Scripps community, and help sustain an open and welcoming campus environment at Scripps.

As women in science, Griffin and Waterhouse decided to become C-EDI fellows to lift other scholars up and serve as role models for women who want to pursue a career in science. Ajoku, also motivated by personal experiences, wants to understand the underlying causes for the low retention rate for minority students, specifically African-American students, in continuing to pursue a PhD.

The fellows are trained on how to effectively navigate conversations regarding issues of equity, diversity, and inclusion for students, staff, and faculty at Scripps. By hosting workshops and encouraging campus members to participate in these critical discussions, the fellows hope to improve the overall campus climate and foster a greater sense of community at Scripps.



EDI Community Engagement Fellows Osinachi Ajoku, Alyssa Griffin, and Lynn Waterhouse.



# SHIPS

Scripps has one of the largest academic research fleets in the world, with three research vessels including R/V *Sally Ride*, the newest in America's research fleet, R/V *Roger Revelle*, R/V *Robert Gordon Sproul*, and the famous research platform FLIP. Equipped with innovative instruments, these ships are mobile laboratories and observatories serving students and researchers throughout the world.

## UC SHIP FUNDS

Research training is fundamental to the Scripps mission, and this commitment is exemplified by the UC Ship Funds Program. Made possible by support from UC San Diego, Scripps, and donors, this program enables graduate and undergraduate students, postdoctoral researchers, and early career faculty to pursue research and instruction at sea.

Program awards are made through a competitive internal peer-reviewed proposal process. Missions can range from one-day trips off San Diego to month-long expeditions from foreign ports. During the 2017 calendar year, 455 students, faculty, and staff obtained first-hand experience at sea courtesy of the UC Ship Funds Program. This year's awards included many innovative student-led programs, for example:



PhD students Drake Singleton and Boe Derosier led an expedition on *Roger Revelle* to study the development of fluvial and estuary environments offshore Oregon that would have existed on the continental shelf during the last glacial maximum.

This research has implications for human habitation in areas that were then exposed to the atmosphere as part of the ancient coastline.



Earth Sciences PhD student Valeria Reyes-Ortega led a project on *Roger Revelle* to study the thermal structure of the ocean crust across the Mendocino Fracture Zone, 373 miles off the coast of Northern California, using observations

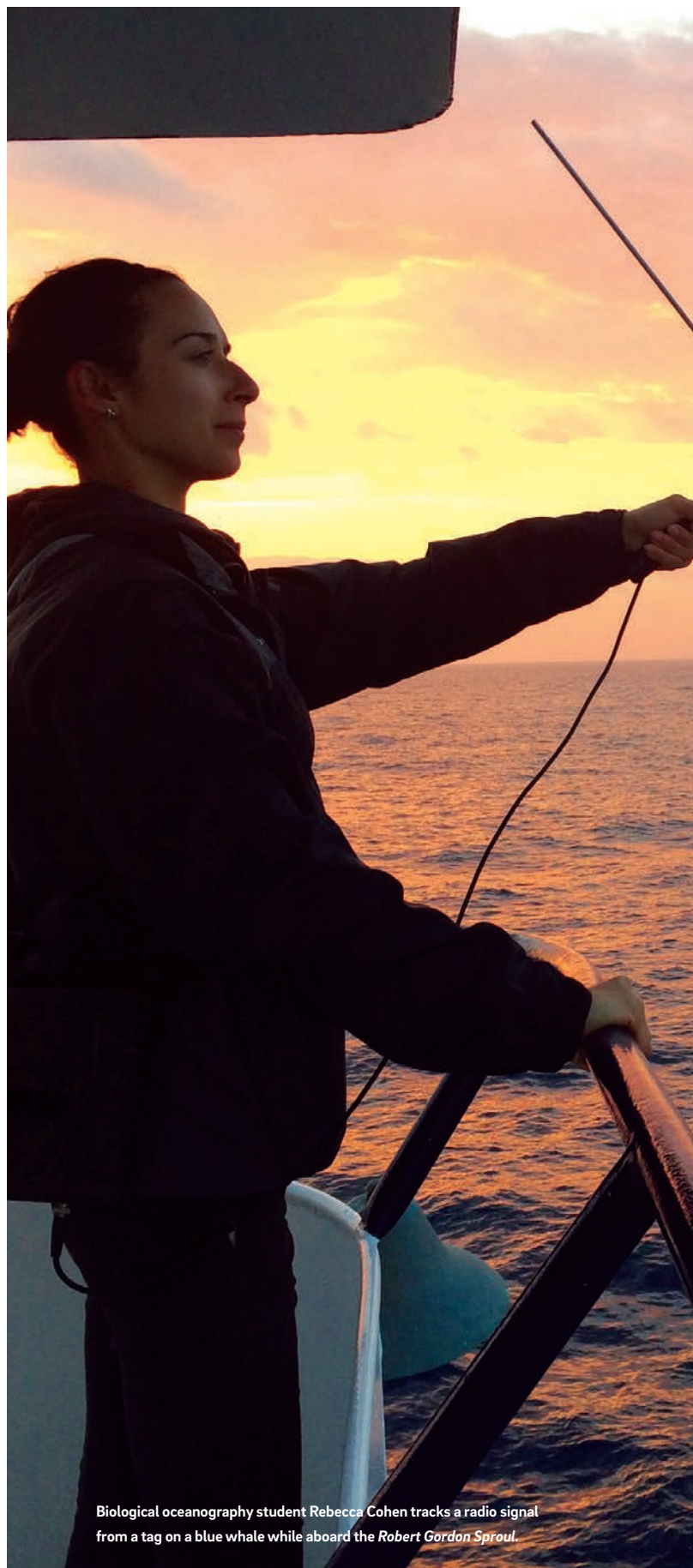
of electrical resistivity and long-period seismic waves. The experiment involved the deployment of several seafloor instruments designed and built at Scripps.





PhD student Angel Ruacho led a research project aboard *Sally Ride* to the California coast between Morro Bay and Santa Barbara. The expedition measured dissolved and particulate iron to determine possible locations where iron

is introduced into the Southern California Bight. Iron in this region has been shown to be a limiting nutrient, and iron limitation can cause changes in phytoplankton communities which form the foundation of the marine food chain.



Biological oceanography student Rebecca Cohen tracks a radio signal from a tag on a blue whale while aboard the *Robert Gordon Sproul*.



# SHIPS

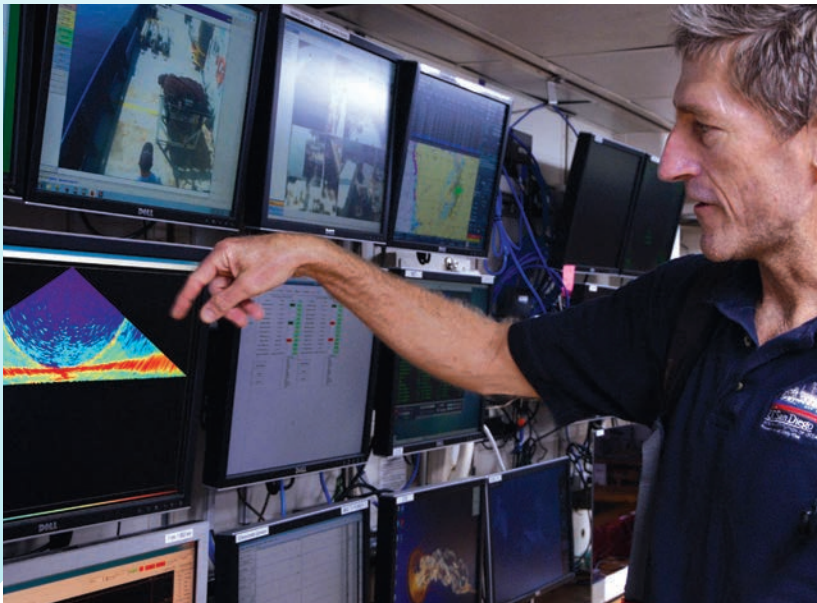
## NASA EXPORTS

*R/V Roger Revelle and R/V Sally Ride embarked from Seattle early August for the Export Processes in the Ocean from Remote Sensing (EXPORTS) campaign.*

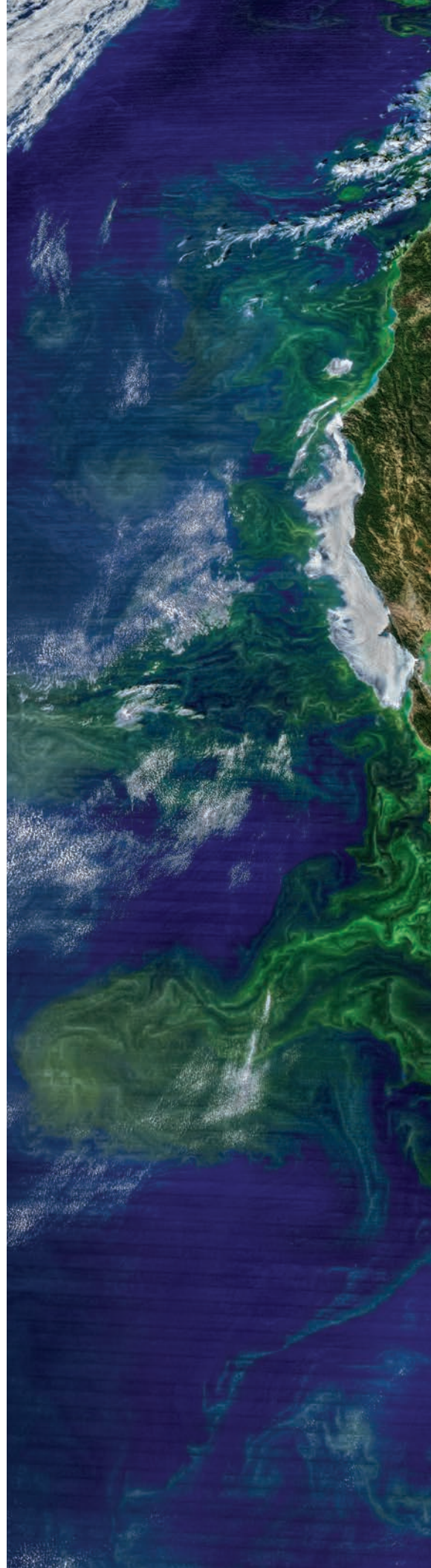
Sponsored by NASA and the National Science Foundation, the project focused on plankton and their role in the carbon cycle in the ocean twilight zone—the dimly-lit depths between approximately 200 and 1000 meters (650-3,300 feet). With more than 100 scientists and crew from nearly 30 research institutions, EXPORTS was the first coordinated

multidisciplinary science campaign of its kind to study the pathways, fates, and carbon cycle impacts of plankton using two research vessels, a range of underwater robotic platforms, and satellite imagery.

Read more at: [scripps.ucsd.edu/exports](http://scripps.ucsd.edu/exports).



Scripps Associate Director Bruce Appelgate describes color-coded swath bathymetry acquired by the deep-water multibeam echosounder aboard *R/V Roger Revelle*. Credit: NASA/Katy Mersmann.








## STUDENT EXPERIENCES

### ABOARD R/V ROBERT GORDON SPROUL

R/V *Robert Gordon Sproul* is the institution's steadfast research vessel for regional and nearshore scientific projects. In 2017, a dozen classes used the vessel as part of the curricula, involving 343 students in seagoing research at the undergraduate and graduate level. Classes taught aboard the vessel include SIO 60: Experiences in Oceanic and Atmospheric Sciences, taught by Professor Drew Lucas, where undergraduates get first-hand experience using equipment like the conductivity, temperature, and depth (CTD) instrument and other oceanographic equipment, to SIO 277: Deep Sea Biology, taught by Professor Lisa Levin, where students collect and study organisms from the seafloor.



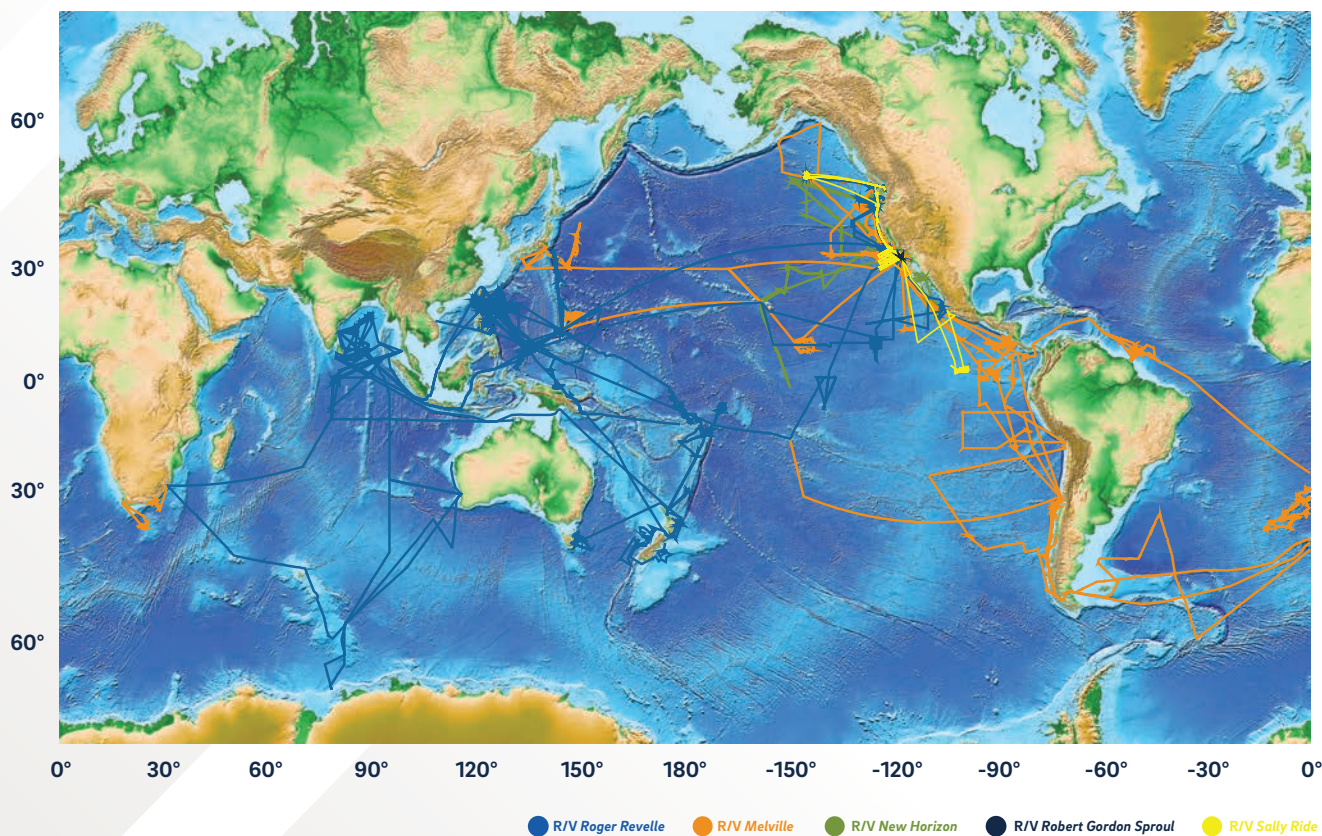
The Pacific Ocean teems with phytoplankton along the West Coast of the United States, as captured by the MODIS instrument on NASA's Aqua satellite. Satellites can track phytoplankton blooms, which occur when these plant-like organisms receive optimal amounts of sunlight and nutrients. Phytoplankton play an important role in removing atmospheric carbon dioxide. Credit: NASA

In a deep-sea biology class aboard the *Robert Gordon Sproul*, students examine small crustaceans collected from the seafloor.



Over the past year, Scripps vessels served a large and diverse group of scientists, students, and educators. During calendar year 2017, Scripps vessels took 1,399 people to sea on 81 separate research missions, and collectively spent 662 operational days at sea conducting scientific research and instruction. Of the people who sailed aboard, 858 were affiliated with Scripps, and 541 were from a total of 118 different institutions representing eight different countries. This is indicative of robust use of the Scripps fleet in support of research and education sponsored by the National Science Foundation, the Office of Naval Research, NOAA, NASA, and other agencies.

# RESEARCH VESSEL TRACKLINES 2010-2018





# BIRCH AQUARIUM

## NEW COMMITMENT TO OUR PLANET

In 2018, Birch Aquarium adopted a new mission—***we connect understanding to protecting our ocean planet***—that values science to inform action. The aquarium explores and innovates at the interface of science and a variety of public and student activations. Taking inspiration from the new mission, the aquarium launched a new Climate Science/Climate Action initiative that will influence everything from exhibits to programming, and impacts the way it teaches the more than 50,000 K-12 students who visit each year.

The remarkable climate science research at Scripps Oceanography and UC San Diego provides a deeper understanding of climate challenges. Birch Aquarium is taking Climate Science/Climate Action to the next level, through collaborations with groups like San Diego Zoo Global, the Scripps Center for Climate Change Impacts and Adaptation (CCCIA), and the California Science Teachers Association. By working closely with stakeholders and incorporating learnings into classrooms, exhibits, and programs, Birch Aquarium will inspire everyone to take steps—big and small—to protect our ocean planet.





## THE OCEAN'S GREATEST ODDITIES

Just in time for Comic-Con International 2018, Birch Aquarium opened *Oddities: Hidden Heroes of the Scripps Collections*, a comic book-inspired exhibition that highlights the astonishing adaptations (aka super powers) of ocean species. The exhibition was created in partnership with teams from all four Scripps Oceanographic Collections, where millions of preserved specimens allow scientists to better understand how the planet works.

From super vision and invisibility to protective armor and the ability to create electricity to zap prey, real marine creatures do amazing things every day that stretch even the wildest imagination. The interactive exhibition includes examples of some of the most unique creatures and samples from all depths and highlights how they have inspired everything from cinema and pop culture to medicine and engineering.



### BY THE NUMBERS

**471,421**

guests  
welcomed\*

**11,200**

member  
households

**50,828**

pre-K-12 students  
served

**23,483**

students received  
financial support

**267**

teachers attended  
professional  
development

**26,968**

guests  
participated in  
public programs

**131,037**

guests engaged  
with aquarium  
interpreters

**32,465**

hours donated by  
**489** volunteers  
(equal to  
\$896,000 in  
labor costs!)

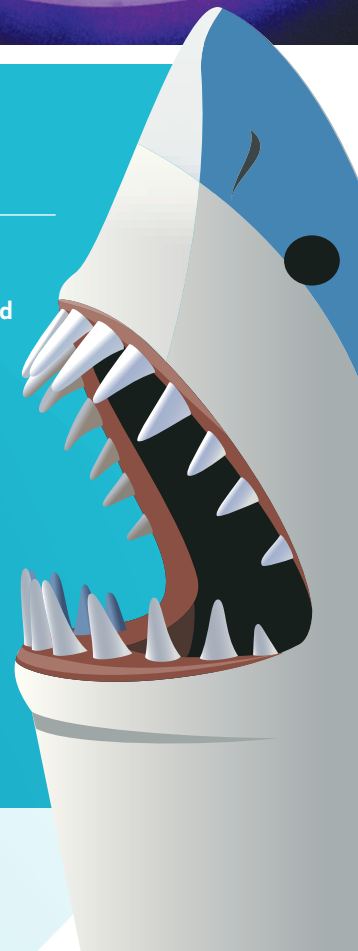
**5,689**

fish and  
invertebrates

**1**

reptile, a  
Loggerhead Sea  
Turtle

\* second highest attendance in the history of the aquarium







## SAVING SEADRAGONS

In May Birch Aquarium will launch a new permanent exhibition that brings seadragon conservation to the forefront. The exhibition will be home to Weedy and Leafy Seadragons, as well as several species of seahorses and pipefish.

The centerpiece will be one of the most expansive seadragon habitats in the world. The 18-foot-wide, 9-foot-tall exhibit will hold 5,375 gallons of water. More than being a stunning display, the habitat has been designed to create the ideal environment to breed Leafy Seadragons, something that has never been done in captivity. Since collecting sea dragons in the wild and climate change pose large potential threats to the species, the aquarium husbandry work represents an important conservation initiative.

This will be the fourth major exhibition Birch Aquarium has opened in three years and the largest indoor aquarium addition since the grand opening in 1992. Read more at [aquarium.ucsd.edu/seadragonexhibition](http://aquarium.ucsd.edu/seadragonexhibition).



# ALUMNI

Alumni of Scripps Oceanography represent nearly 3,000 academics, professionals, experts, and entrepreneurs. Their accomplishments reach far and wide, from education and environment to industry and innovation, and their impact spans the expanse of our planet, from deep oceans to deep space.

Many from our active alumni community stay connected each year, returning to meet and mentor current students, speak at special events, pursue professional goals, and develop partnerships with faculty and researchers. We thank them for returning to share their time and talents here on campus.

## JAMES MCCARTHY

The 2018 Tyler Prize for Environmental Achievement, often described as the “Nobel Prize for the Environment,” was awarded to **JAMES MCCARTHY (PHD '71)** for his decades of leadership in understanding and communicating the impact of climate change. In addition to his pioneering research, he led the development of the International Geosphere Biosphere Programme. The science produced by this program was an important component of the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change (IPCC), of which Dr. McCarthy was co-chair in 2001. He also served the United States in his role as president of the American Association for the Advancement of Science.



**PALOMA AGUIRRE (MAS '15)** was elected to the Imperial Beach City Council in November, and will be the first Latino to represent the coastal community. Aguirre is also the coastal and marine director for WildCoast, a non-profit organization that conserves coastal and marine ecosystems and wildlife.



**ALICIA AMERSON (MAS '15)** is the founder of Alimosphere, a small business using technology and collaboration to reduce human-wildlife conflicts. This past year, Amerson received the TOP Operator award from the Association for Unmanned Vehicle Systems International for establishing international drone protocols to protect wildlife.



Geoscientist **MEINRAT ANDREAE (PHD '78)** received the Alfred Wegener Medal and Honorary Membership of the European Geosciences Union, for his groundbreaking research in atmospheric, biogeochemical, climate, and Earth system sciences. A prolific author, Andreae has published more than 500 scientific research papers and has been cited nearly 39,000 times.





**MICHAEL FREILICH (PHD '82)**, director of the Earth Science Division at NASA since 2006, announced that he will retire in early 2019. During



a productive tenure at NASA, Freilich established and expanded innovative programming for the agency, oversaw 16 successful major mission and instrument launches, and 8 small-satellite launches. He will leave the agency with some 20 additional missions and instruments well in development for launch before 2023.

**MIRIAM GOLDSTEIN (MS '08, PHD '12)**

joined the Center for American Progress (CAP) in July, as director of ocean policy for the Energy and Environment Policy team. At CAP, Goldstein will focus on supporting science-based policies that protect and restore ocean health for the benefit of America's economy, environment, and coastal communities.



**AYANA ELIZABETH JOHNSON (MS '09, PHD '11)** is the founder and CEO of Ocean



Collectiv, a strategy consulting firm for ocean sustainability grounded in social justice. Johnson returned to Scripps in September as the keynote speaker at the Scripps Student Symposium, an annual

research conference organized by Scripps students, where she discussed her career path, her successes and failures, and her experience working in science policy.

In June, Scripps alumna **JESSE C. TRALLER ('08, MS '16, PHD '17)** returned to Scripps as

the keynote speaker at the annual Scripps Day celebration for scientists, students, alumni, and staff. Traller works at Global Algae Innovations, where she is helping tackle the challenge of developing large-scale algae production to provide food and fuel for the world in her work as a senior phycologist—a biological scientist that specializes in the study of algae and phytoplankton.



## SCRIPPS CLASS OF 2018

Graduates: 226

Female: 144 (64%) Male: 82 (36%)

### UNDERGRADUATE

Female: 67 (57%) Male: 50 (43%)

**12**

Total BA degrees

ESYS Environmental  
Policy: 12

**105**

Total BS degrees

BS-ESYS Earth Sciences: 11  
BS-ESYS Ecology, Behavior,  
and Evolution: 20  
BS-ESYS Environmental  
Chemistry: 4  
BS-Earth Sciences: 17  
Marine Biology: 53

### MASTER OF ADVANCED STUDIES

Total MAS degrees: 27

Female: 22 (81%) Male: 5 (19%)

**19**

Total MAS-MBC, Marine  
Biodiversity and Conservation

Female: 15 (79%)  
Male: 4 (21%)

**8**

Total MAS-CSP, Climate  
Science and Policy

Female: 7 (87.5%)  
Male: 1 (12.5%)

### MASTER'S

Total MS degrees: 16

Female: 12 (75%) Male: 4 (25%)

**7**

Earth Science

**2**

Oceanography

**7**

Marine Biology

### PhD

Total MS degrees: 39

Female: 21 (54%) Male: 18 (46%)

**12**

Earth Science

**20**

Oceanography

**7**

Marine Biology

*Data on non-binary Scripps graduate students is not currently available. UC San Diego has only recently started collecting data on non-binary graduate students and has a plan to make that data available for reporting.*



# INTERNATIONAL RELATIONS



## GLOBAL CLIMATE ACTION SUMMIT

Scientists from Scripps participated in the Global Climate Action Summit in San Francisco in September 2018. California Gov. Jerry Brown hosted the summit, designed to address climate change by bringing together leaders at the state, local, and international level.

Scripps climate scientist Veerabhadran Ramanathan participated in a session on scaling education to meet climate action goals. Scripps Director Margaret Leinen joined the Center for American Progress to discuss the next frontier of climate science, and environmental archaeologist Isabel Rivera-Collazo co-led a workshop on climate heritage mobilization.

## COP23: BONN, GERMANY

UC San Diego sent 23 students, faculty members, and staff to Bonn, Germany, in Nov. 2017 for the international climate negotiations known as COP23.

The conference gave the oceanographers, marine biologists, and climate scientists of Scripps and the international affairs students of UC San Diego's School of Global Policy and Strategy an inside view of the United Nations Framework Convention on Climate Change (UNFCCC). The annual climate talks provide Scripps an opportunity to inform an international audience about technologies for observing the oceans and atmosphere—and to spread the use of those technologies to new countries.



## POGO AT SCRIPPS

Representatives from the world's leading oceanographic institutions were at Scripps Oceanography in January 2018 to showcase advances in the technology used to observe the oceans. At the 19th annual meeting of the Partnership for Observation of the Global Oceans (POGO), which Scripps co-founded in 1999, leaders from 23 member organizations representing 13 countries attended. The organization seeks to build consensus among scientists to create a global voice calling attention to issues ranging from ocean acidification to deoxygenation and sustainable fishing.

## UN DECADE OF OCEAN SCIENCE'S EXECUTIVE PLANNING GROUP

In 2018, Director Margaret Leinen was selected as a member of the Executive Planning Group for the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). This group is composed of 16 to 20 members who will serve as an advisory body to the Intergovernmental Oceanographic Commission to support the development of the implementation plan and preparatory activities of the next decade.



## SCRIPPS STARTUP RECEIVES

### CALSEED FUNDING

PhD student Jack Pan was awarded \$150,000

from the California

Energy Commission and California Clean Energy Fund's CalSEED program, which supports the state's most promising energy entrepreneurs. Pan's

Ocean Motion Technologies—a startup focused on clean energy applications in the maritime industry—was selected among 18 awardees out of over 400 applications. Ocean Motion Technologies is incubating at the Maritime Alliance's BlueTech Incubator and MiraCosta College's Technology Career Institute.



## CALIFORNIA SEAWEED COMPANY SELECTED FOR INNOVATION

### SHOWCASE

In September,

Scripps coral reef ecologist

Jennifer Smith and

Scripps alumnus and

current staff member

Brant Chlebowski (MAS

MBC '17) were selected to

present their startup, California Seaweed

Company, at the Global Climate Action

Summit (GCAS) Innovation Showcase in

San Francisco. The company was one of

25 startups invited and was recognized

for its work in the sustainable cultivation

of top quality culinary seaweeds.



## LICENSE TO INNOVATE

Scripps Professor of Geophysics John Orcutt and collaborators successfully licensed their ocean bottom seismograph system to Canadian company Nanometrics.

The device, the Autonomous Broad Application Low Obstruction Noise

Exempt System (ABALONES),

will now be marketed,

manufactured, and

distributed to research

institutes worldwide.



# INNOVATION

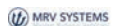


## SCRIPPS CORPORATE ALLIANCE

The Scripps Corporate Alliance, a community of member companies furthering Scripps' mission and working collaboratively with students and research programs, launched in 2017 and has continued to grow. Now with 14 members spanning software, electronics, life sciences, and blue technologies, Scripps Corporate Alliance facilitates collaborations, talent recruitment, and innovation.

Member companies visited Scripps to meet with scientists and global leaders visiting for the POGO meeting in January 2018, presenting new technologies for ocean observations. Saildrone began a nearly year-long circumnavigation of Antarctica in Dec. 2018 and will be sharing physical and biogeochemical oceanographic data with Scripps scientists. Scripps also welcomed companies to campus throughout the year for recruitment events, trainings, and product demonstrations, including Teledyne, RBR Ltd., Saildrone, Mathworks, Oracle, Northrop Grumman, Amazon Web Services, and Esri.

The Scripps Corporate Alliance also enabled the creation of the Scripps Talent Recruitment Portal, where graduate students can feature their resumes and portfolios to partners and corporate members throughout the year for facilitated career recruitment. *Read more at [scripps.ucsd.edu/corporatealliance](https://scripps.ucsd.edu/corporatealliance).*





# THANK YOU TO OUR DONORS!\*

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### \$1,000,000 +

Anonymous

### \$100,000 +

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Mr. James F. Beyster  
Ms. Mary Ann Beyster  
Ms. Julia R. Brown  
Mr. Lawrence J. Lukis  
Mr. John A. McQuown and Mrs. Leslie McQuown  
Ms. Lucy A. Neale  
Mr. Thomas A. Page  
Mr. Joel Safran  
Mr. William H. Scripps and Mrs. Kathy Scripps  
Mr. Stephen M. Strachan and Mrs. Linda D. Strachan  
Ms. Irma R. Waser

### \$50,000 +

Mrs. Betty J. Beyster  
Mr. Gilbert C. Binnering and Mrs. Pamela S. Binnering  
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## FOUNDATIONS

### \$500,000 +

G. Unger Vetlesen Foundation  
Simons Foundation, Inc.

### \$250,000 +

Anonymous  
Cecil H. and Ida M. Green Foundation for Earth Sciences  
International Community Foundation  
Mark Walk Wolfinger Foundation  
Moore Family Foundation

### \$100,000 +

The David and Lucile Packard Foundation  
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Life Sciences Research Foundation  
Pew Charitable Trusts  
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### \$50,000 +

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### \$25,000 +

The Archie Arnold Trust  
Charles H. Stout Foundation  
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The Kenneth T. and Eileen L. Norris Foundation  
The Mary Gard Jameson Foundation  
Murray Galinson San Diego - Israel Initiative Fund of  
the Jewish Community Foundation  
Price Philanthropies Foundation  
Union Bank N.A. Foundation

## CORPORATIONS

### \$100,000 +

Acacia Partners  
State Water Contractors

### \$50,000 +

Global Ocean Design  
Leidos Holdings, Inc.

### \$25,000 +

Boeing Company  
SDG&E

\*This includes donors who gave \$25,000 and above in FY18. For a full list of our generous supporters, visit [scripps.ucsd.edu/giving/donors2018](https://scripps.ucsd.edu/giving/donors2018).



# DEVELOPMENT

## SEA-LEVEL RISE READY

Imperial Beach is a low-lying coastal community that is one of the most vulnerable in California to sea-level rise. During periods of extreme high tides and winter swell, Imperial Beach experiences flooding that impacts residents, businesses, and infrastructure.

Now, thanks to a \$250,000 donation from the David C. Copley Foundation, Scripps Institution of Oceanography is helping Imperial Beach upgrade its flood alert capabilities and better prepare for sea-level rise.

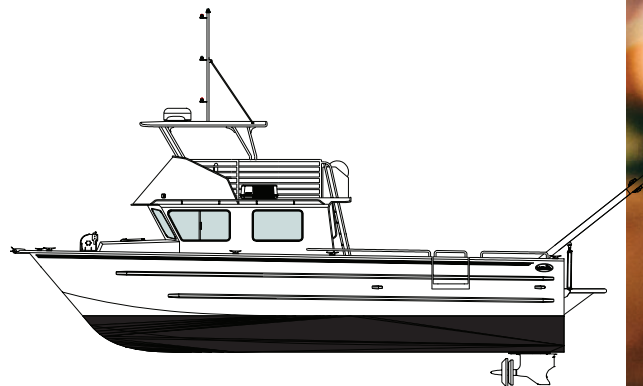
Developed by the Center for Climate Change Impacts and Adaptation (CCCCIA) at Scripps, the funding will support installation of equipment including an off-shore wave buoy, tide gauge, and series of pressure sensors designed to assess wave heights, wave direction, water levels, and duration, depth, and arrival times of flood waters.

The funding also contributes to coastal modeling advancements that will be used to refine the flood forecasting system. "We hope to provide today's coastal communities with better tools to track extreme events and predict risks," said CCCCCIA Director Mark Merrifield. *Read more at [scripps.ucsd.edu/ImperialBeach](https://scripps.ucsd.edu/ImperialBeach).*

Researchers install pressure sensors in the sand at Imperial Beach in November 2018.



## NEW VESSEL HEADED TO SCRIPPS THANKS TO PHILANTHROPIC SUPPORT



A new coastal research vessel will join the fleet of ships managed by Scripps Institution of Oceanography in 2019 thanks to a philanthropic campaign that raised more than \$1.1 million in honor of the late Dr. J. Robert Beyster, founder of Science Applications International Corporation (SAIC), and his widow Betty Beyster.

Research Vessel (R/V) *Bob and Betty Beyster* will enable scientists at Scripps to conduct local research, technology development, and ocean-based education. The vessel is a 42-foot scientific workboat that will be owned by Scripps, and will fill a need for a vessel with a nearshore range, low daily cost, and adaptability to support advanced research.

In 2017, Cindy Glancy, a member of the Scripps Director's Council, identified this vessel as an opportunity to memorialize the impact of SAIC and Bob and Betty Beyster, particularly Bob's vision in starting an employee-owned company and Betty's friendship and mentorship.

Betty and the Beyster family embraced the project. Glancy and the Beysters' daughter, Mary Ann, who also is a member of the Scripps Director's Council, along with her

brother Jim Beyster, Tom Dillon, and Mindy Pawinski, then formed a committee that solicited and raised the funds. Donors included committee members and their spouses, friends and family members, former SAIC associates, Leidos Holdings and other council members. The total raised included \$800,000 for the cost of the vessel and \$200,000 for scientific instrumentation for the workboat. There is a goal to raise at least an additional \$200,000 for a student endowment to support time at sea.

"This opportunity aligned my dad's love for being on the water along with his and my mom's philanthropic interests in investing in students and giving them direct access to hands-on science," said Mary Ann Beyster. "The family was excited to support the vessel and students, and in awe by the outpouring of generosity from the donors to name it in their honor."

An additional \$100,000 was raised for a floating dock for the vessel to be installed at the Nimitz Marine Facility in Point Loma through contributions from 15 members of the Scripps Director's Council, spearheaded by Paul C. Brooks.

Additional contributions to this endowment to support student time at sea can be made by contacting the development office at Scripps at (858) 822-1865 or [supportscripps@ucsd.edu](mailto:supportscripps@ucsd.edu).

## GLOBAL PLASTICS AWARENESS INITIATIVE



In early October, the Center for Marine Biodiversity and Conservation hosted a four-day workshop around marine plastic pollution. Made possible through the generosity of the Wilsdorf Mettler Future Foundation and Dr. Igor Korneitchouk, a UC San Diego alumnus, the event gathered leading scientists, researchers, government and non-profit coordinators, and artists into a comprehensive forum to discuss the most pressing needs and promising projects for reducing marine plastic pollution. Dedicated to both understanding the science behind plastic pollution and the many solutions underway to combat the problem, the first two days culminated in evenings of presentations and panel discussions for the public. *Read more at [scripps.ucsd.edu/plastics](http://scripps.ucsd.edu/plastics).*





## WATCH US GROW MARINE CONSERVATION AND TECHNOLOGY FACILITY



Fundraising is underway for the proposed new Marine Conservation and Technology Facility, with one-third of the need raised via private philanthropy to support the infrastructure for this new state-of-the-art learning and innovation hub. The Marine Conservation and Technology Facility will bring together marine conservation scientists from the Center for Marine Biodiversity and Conservation, leading instrument development engineers, and specialists in data visualization and big data from the Halıcıoğlu Data Science Institute.

Together they will study the effects of climate change in marine habitats and develop the tools for more sophisticated sampling and investigation with the capacity to analyze large data. The facility will also be home to a seafood demonstration kitchen and a café to teach students and the public about sustainable seafood, both wild-caught and grown via aquaculture, as well as use of the whole fish and by-catch.

## THE SUSTAINABILITY OF LOCAL SEAFOOD

A behind-the-scenes event in August sponsored by E.W. Scripps Associates, a premier membership group of annual donors, was devoted to local San Diego seafood. Chefs, fishermen, fisheries experts, and Scripps researchers came together to discuss the sustainable bounty found right off our coasts. After a panel discussion about global seafood trade and the many underutilized species in Southern California, guests were able to try these local fish and shellfish, prepared by some of San Diego's top seafood chefs and innovators. *For more information on E.W. Scripps Associates membership, visit [scripps.ucsd.edu/giving.ewsa](https://scripps.ucsd.edu/giving.ewsa).*

A plant-based shrimp was prepared by vegan chef Ashlie Morgan and served with chipotle maple lime vinaigrette, kale and broccoli slaw, chipotle aioli, and micro cilantro. The shrimp was created by Scripps alumna Dominique Barnes, founder of New Wave Foods.



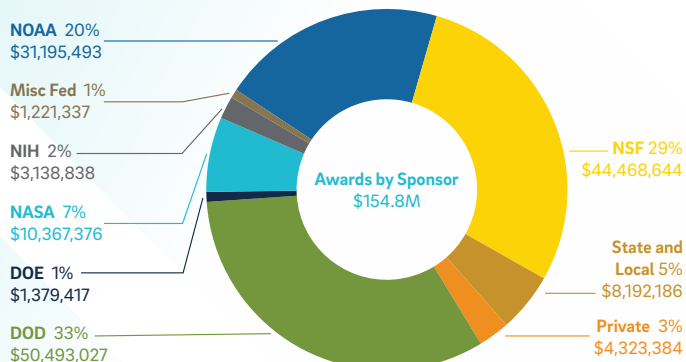
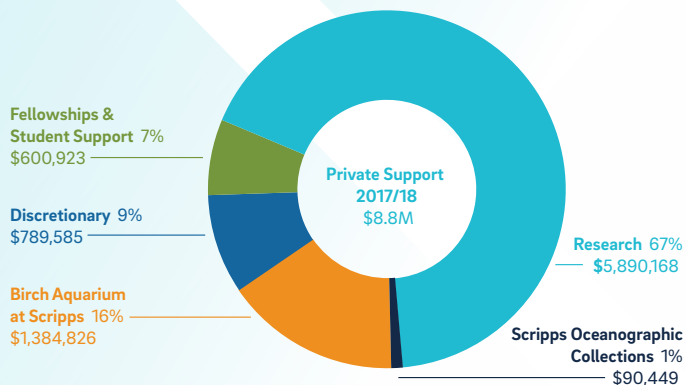
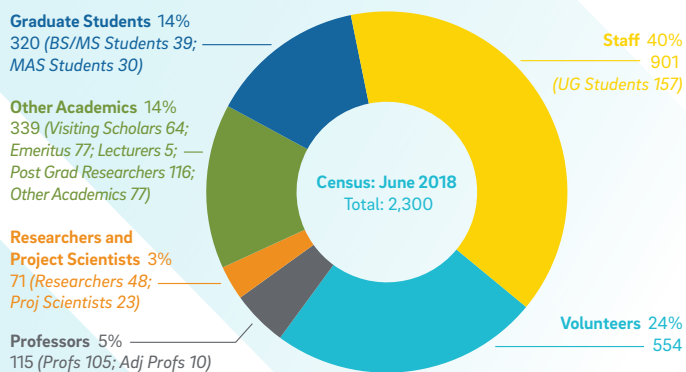
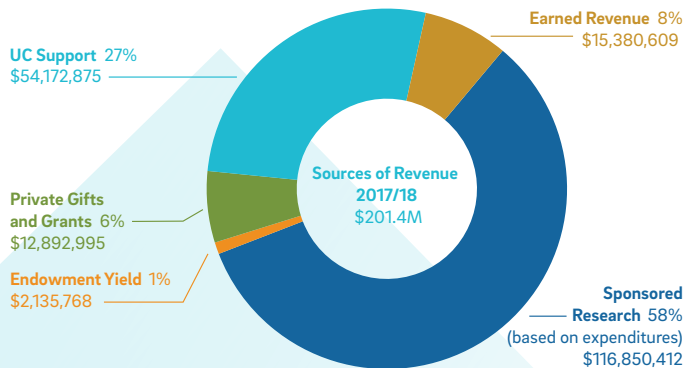
# MULTI-YEAR STATEMENT OF ACTIVITY

	FY 16/17	FY 17/18	FY 17/18	
	(expensed this period)		Awarded this period	
REVENUE	SPONSORED RESEARCH			
	137,925,597	116,850,412	154,779,702	
	Federal Government	124,584,325	106,906,547	142,264,133
	National Science Foundation	36,457,382	36,478,158	44,468,644
	Department of the Navy	45,454,020	25,284,064	43,057,526
	National Aeronautics and Space Administration	6,975,035	7,578,974	10,367,376
	National Oceanic and Atmospheric Administration	21,499,590	22,676,798	31,195,493
	Department of Energy	1,862,443	1,528,833	1,379,417
	Other Department of Defense Agencies	8,544,011	9,760,744	7,435,503
	Other Federal Departments	1,185,694	1,384,845	1,221,337
	National Institutes of Health	2,606,150	2,214,131	3,138,838
	State Government	8,321,462	5,225,279	7,223,142
	Local Government	793,804	1,041,686	952,544
	Private Contracts	3,914,730	3,573,152	4,323,384
	UC Sponsored Research	311,277	103,748	16,500
	UNIVERSITY OF CALIFORNIA SUPPORT	50,034,159	54,172,875	
	EARNED REVENUE			
	13,345,076	15,380,609		
	Birch Aquarium at Scripps (BAS)	6,605,041	6,836,130	
	Recharge Unit Revenues	5,628,081	7,606,095	
	Intellectual Property and Royalty Income	115,688	65,866	
	Other Revenue	996,265	872,518	
	PRIVATE GIVING			
	11,960,480	12,892,995		
	Birch Aquarium at Scripps (BAS)	1,992,566	1,755,738	
	Private Gifts	7,437,937	8,993,470	
	Private Grants¹	2,529,978	2,143,787	
	INTEREST INCOME			
2,117,701	2,135,768			
Interest Earned	(5,588)	0		
Endowment Yield	2,123,290	2,135,768		
TOTAL REVENUE				
215,383,013	201,432,659			
RESEARCH PROGRAMS - SEEK				
(174,040,825)	(162,353,456)			
Sponsored Research²	(138,233,754)	(128,907,831)		
Ships	(31,259,537)	(29,137,194)		
Oceanographic Collections	(485,408)	(341,770)		
Contract & Grant Administration	(1,302,118)	(1,076,814)		
Research Development & Planning	(740,503)	(862,735)		
Research Infrastructure & EH&S	(667,327)	(703,509)		
OP Tax on Research Expenditures	(1,352,180)	(1,323,603)		
INSTRUCTION PROGRAMS -TEACH²				
(12,793,598)	(24,412,002)			
OUTREACH -COMMUNICATE				
(11,774,134)	(12,042,790)			
Birch Aquarium at Scripps (BAS)	(8,858,679)	(9,095,575)		
Business Development	(153,276)	(119,032)		
Communications (Scripps share) & Web Group	(1,136,243)	(1,150,694)		
Development (Scripps share)	(350,674)	(392,363)		
Diversity	(152,994)	(169,091)		
Special Events (including lectures, awards, conferences)	(274,717)	(314,293)		
Conference Facilities (Forum debt service, staff, maintenance)	(847,551)	(801,741)		
INSTITUTIONAL SUPPORT				
(7,478,881)	(8,718,866)			
Scripps Administration	(2,827,154)	(3,150,441)		
IT Services	(1,483,255)	(1,632,029)		
Facilities Maintenance & Capital Improvements³	(2,915,473)	(3,597,397)		
OP Tax on non-core Expenditures	(253,000)	(339,000)		
TOTAL EXPENSES⁴				
(206,087,439)	(207,527,114)			
Annual Balance/(Deficit) from Current Activities				
9,295,574	(6,094,455)			

1. Private grants are typically restricted funds and considered Sponsored Research; however UC San Diego counts them as Private Giving
2. In FY 17-18, Faculty Salary Expense reclassified from Research to Teaching.
3. Does not include funds transferred to UC San Diego Facilities Design and Construction or Facilities Management and spent by those units on Scripps projects which causes variability in the year-to-year totals. FY 17-18 total facility/capital improvement expenses paid by Scripps were approximately \$6.6M.
4. This statement does not reflect all annual expenditures associated with operating Scripps. Services provided by campus departments are captured in UC San Diego financial reports, e.g. utilities, custodians, central administrative services such as payroll, purchasing, and general accounting, transportation, deferred maintenance costs, etc.



# SPONSORED RESEARCH FY 17-18 SUPPORT



## FEDERAL

### Department of Agriculture

- U.S. Forest Service

### Department of Commerce

- National Oceanic and Atmospheric Administration
- National Institute of Standards and Technology

### Department of Defense

- Air Force Office of Scientific Research
- Army Corps of Engineers
- Defense Advanced Research Projects Agency
- Defense Threat Reduction Agency
- Naval Air Systems Command
- Naval Facilities Engineering Command
- Naval Research Laboratory
- Naval Sea Systems Command
- Office of Naval Research
- Pacific Fleet Commander
- Space & Naval Warfare Systems Command
- Strategic Environmental Research and Development Program

### Department of Energy

- National Energy Technology Laboratory

### Department of Health and Human Services

- National Institute of Allergy and Infectious Diseases
- National Institute of General Medicine Science

### Department of Interior

- Bureau of Ocean Energy Management
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

### Environmental Protection Agency

### National Aeronautics and Space Administration

### National Science Foundation

## STATE OF CALIFORNIA

- Air Resources Board
- Coastal Commission
- Energy Commission
- Natural Resources Agency
  - Fish and Wildlife
  - Parks and Recreation
  - Water Resources
- Ocean Protection Council
- San Francisco Bay Conservation and Development Commission
- State Coastal Conservancy
- State Lands Commission
- State Water Resources Control Board

## REGIONAL GOVERNMENT

- City of San Diego
- County of Sonoma
- Orange County Water District
- San Diego Unified Port District

## INTERNATIONAL GOVERNMENT

- Australian Museum
- Engineering and Physical Sciences Research Council
- European Union/European Commission
- Japan Aerospace Exploration Agency
- Research Council of Norway
- U.S.-Israel Binational Science Foundation

## OTHER

- BGP Inc., CNPC
- BP Group
- Chevron Corporation
- Idemitsu Petroleum Norge As
- JGI, Inc.
- King Abdullah University of Science and Technology
- KMS Technologies
- Ocean Floor Geophysics, Inc.
- Petrobras S.A.
- Petroleum Geo-Services ASA
- Petromarker AS
- Repsol Service Company
- Royal Dutch Shell PLC
- Shandong Jiejing Group Corporation
- State Water Contractors





UC San Diego



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