ANNUAL REPORT FOR THE COLLEGE OF MARINE SCIENCE

DEAN JACQUELINE E. DIXON

JANUARY 1 – DECEMBER 31, 2017

Locally Applied, Regionally Relevant, Globally Significant!

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The View from the Bridge

In the 50 years since its official beginning, CMS has expanded in size and capability and is internationally recognized as a leader in ocean science. There are now 25 faculty, ~108 graduate students, 59 full-time support personnel, and 21 temporary staff. CMS researchers have ~$16M in annual research expenditures and a total endowment of ~$20M.

The growth of the College of Marine Science occurred during a transformational period in the study of the solid and fluid Earth. Now we stand at the cusp of a new revolution -- understanding the impact of humans on the planet. There is even a name for this new age – the Anthropocene – the time of man. In the old days it was believed that the ocean's capacity was infinite. We could take as much as we wanted out and put as much as we wanted into it and nothing would change. Many of you remember, like I do, watching the daily bags of trash being dumped over the side of the ship and floating away on the sea. We are now bumping up against limits of the system. Everyday there are headlines with disturbing news. Plastics are everywhere in the ocean and unfortunately in the bellies of marine birds and mammals. PCB has been measured at the bottom of the Marianas Trench. Oxygen minimum "Dead Zones" are expanding offshore of almost every major river. Increased CO_2 in the atmosphere has caused the ocean to become 30% more acidic. Corals are bleaching and the oceans are warming. And, of course, no one can forget the images of oil spewing into the Gulf of Mexico during the Deepwater Horizon Oil crisis.

From the very big to the very small, research by College of Marine Science faculty, students and staff is more important than ever. We are dedicated to understanding the impacts of fishing, red tide, oil drilling, changing ocean chemistry, and sea level rise related to society's addiction to fossil fuels. We are at the forefront of understanding the interplay of physical, chemical, and biological processes that control the ocean ecosystem. Our Marine Resource Assessment Program is setting the agenda on ecosystem management approaches and preparing students for careers in environmental management. We are looking to long-term records in sediments for clues to future climate change. The rates of change today are unprecedented, even when compared to the most extreme spike we see in the geologic record. We are developing new tools to improve ocean observations. We are educating the next generation of marine scientists. And we are striving to communicate our science to the public and policy makers through our Science Festival and other community outreach initiatives.

College of Marine Science Leadership Team

Jacqueline Dixon
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Dr. Jacqueline Dixon is Dean of the College of Marine Science at the University of South Florida. She received her bachelor's and master's degrees in geology from Stanford University in 1981 and 1983, respectively, and her PhD in geochemistry from the California Institute of Technology in 1992. From 1992 through 2010, Dr. Dixon was at the University of Miami, where she served as Director of the Abess Center for Ecosystem Science and Policy's Undergraduate Program, Senior Associate Dean for the Life and Physical Sciences, and Interim Dean of the College of Arts and Sciences. She received an Early Career Development award from the National Science Foundation for excellence in research and education, and is internationally recognized for her research on submarine volcanoes and the role of volatiles in magmatic processes. In 2015, Dr. Dixon was elected Fellow of the American Association for the Advancement of Science.

Dr. Dixon serves as Chair of the Executive Board of the Consortium for Ocean Leadership and is a member of the NOAA Ocean Exploration Federal Advisory Board. Within the community, she serves on the board of the Marine Exploration Center and Aquarium, and as a member on the St. Petersburg Ocean Team, the St. Petersburg Downtown Partnership, and the St. Petersburg Chamber of Commerce Board of Governors.

Gary Mitchum
Associate Dean, College of Marine Science
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Dr. Mitchum is presently a Professor of Physical Oceanography and the Associate Dean in the College of Marine Science at the University of South Florida. After receiving his PhD from the Department of Oceanography at the Florida State University in 1985, he spent 11 years in the Department of Oceanography at the University of Hawaii, first as a postdoctoral researcher and then as a member of the research faculty and as the Director of the University of Hawaii Sea Level Center. He came to the University of South Florida in 1996. His research interests emphasize short-term climate changes, ranging from interannual variations such as ENSO, to decadal processes, to the problem of long-term sea-level rise. He has also done work on continental shelf dynamics, mesoscale eddy interactions with mean flows, internal tide generation and propagation, physical controls on fisheries variables, and storminess changes in the southeastern United States. Although he has used many types of data in his research, he is especially interested in analyses of tide gauge and satellite altimetric data, and notably proposed and developed the presently accepted method of estimating temporal drift in altimeters via comparisons with the global tide-gauge network.

COLLEGE OF MARINE SCIENCE LEADERSHIP TEAM

David Naar
Associate Professor, Associate Dean of Academic Affairs
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Dr. Naar is the Associate Dean of Academic Affairs in the College of Marine Science at the University of South Florida. He oversees the graduate academic program and graduate student matters. He received his bachelor's degree in Geology with an emphasis in Geophysics from University of California, Santa Barbara in 1982, and his PhD in Earth Sciences from Scripps Institution of Oceanography, at the University of California, San Diego in 1990. During this time, he also served as a visiting professional colleague at the University of Hawaii. Since then, Dr. Naar has been at the University of South Florida's Department/College of Marine Science, as an assistant professor and as an adjunct professor at the University of Rhode Island's Graduate School of Oceanography. In 1996, he became an associate professor at USF and subsequently the co-director of the Center of Coastal Ocean Mapping at USF. In 2012, he became the Director of Academic Programs and Student Affairs. In 2017 he was reclassified as Associate Dean of Academic Affairs. His research funding came from the National Science Foundation, Office of Naval Research, the United States Geological Survey, the American Chemical Society Petroleum Research Fund, and the National Ocean and Atmospheric Administration. He has been cited by the Journal for Geophysical Research (JGR) for excellence in refereeing and has served as an associate editor for JGR, Marine Geophysical Researches, and Solid Earth electronic Journal of the European Geophysical Union. His research interests are on microplate tectonics, propagating rifts, plate motions, seamount chains, and seafloor mapping from deep ocean trenches to the shoreline, including mapping several marine protected areas from American Samoa to Florida. Dr. Naar has served on several National Science Foundation, Ocean Observatory Initiative, and ocean drilling site characterization panels for the ODP, IODP(s), and on the United States Scientific Advisory Committee (USSAC).

Chris Schwint
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Chris Schwint is the Budget Director for the College of Marine Science. He received his BA in 1981 from USF. Worked for the US Department of Labor and the University of South Florida in Budget and Policy Analysis.

Tim Trowbridge
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Tim Trowbridge is the Unit HR Administrator for the College of Marine Science. He received his bachelor's degree in business management and minor in leadership studies from the University of South Florida in 2008. Since that time he has been employed by the University of South Florida serving as the Unit HR Coordinator for the Student Affairs Shared Services Center from 2009-2011 and in the

College of Marine Science from 2011-2012. In May 2012, Tim Trowbridge was promoted to Unit HR Administrator for the College of Marine Science and continues to serve in this role. He earned his Professional in Human Resources (PHR) certification in December 2013 and earned Certified Research Administrator (CRA-USF/basic) designation in August 2015.

Joseph Donnelly
Facilities Manager, College of Marine Science
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Mr. Donnelly is the Facilities Manager for the College of Marine Science at the University of South Florida. He received his bachelor's degree in marine biology from The University of West Florida in 1980 and master's degree in marine science from USF in 1986. From 1985 through 2006, he was an assistant/associate in research at CMS working with Dr. José Torres studying the biology and ecology of midwater fish and invertebrates. From 1988 to 1997 he also worked as an adjunct instructor in Earth Science and Oceanography at St. Petersburg Junior College (now St. Petersburg College). After recovering from a serious work-related accident in 2006, he took on the newly-created position of CMS Facilities Manager in 2008. Mr. Donnelly currently serves on several CMS committees (Space, Safety, and Computer) and is also a member of the USFSP campus Gold Team, which deals with all matters relating to the USFSP Campus Emergency Management Plan (CEMP).

E. Howard Rutherford
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E. Howard Rutherford holds a Bachelor of Science degree in Marine Chemistry from Eckerd College, St. Petersburg, FL and attended graduate school at USF CMS. He returned to CMS as Director of Development after a 13-year tenure as President/CEO with The Pier Aquarium d/b/a Marine Exploration Center. Before his tenure at the aquarium, Howard was a research associate in the nutrient chemistry laboratory at USF CMS where he participated in research projects from the Bering Sea to the Arabian Sea to the Southern Ocean.

He has witnessed firsthand the value and fragility of the marine environment, fueling his passion to share these discoveries with the public. His influence extends beyond Tampa Bay as a leader in ocean science education reform. As founding Co-Chair, Howard helped to establish the St. Petersburg Science Festival, and currently participates on the Science Festival Alliance (SFA) Advisory Council at MIT. The SFA Council oversees the activities of over 45 Festivals across the United States and Canada. Howard has served as President to the National Marine Educators Association, a national organization powered by 17 individual, regional chapters that provide the on-the-ground efforts that support and promote national initiatives in education and conservation such as ocean literacy. He actively participates on the City of St. Petersburg's Ocean Team, of which the College of Marine Science plays a major role.

Events and Highlights

FACULTY AWARDS:

- **Cameron Ainsworth:** Award of Tenure and Promotion to Associate Professor
- **Mya Breitbart:** Fellow American Association for the Advancement of Science
- **Don Chambers:** Fellow American Geophysical Union
- **Frank Muller-Karger:** National Oceanographic Partnership Program Excellence in Partnering Award for leading the National Marine Sanctuaries as Sentinel Sites for a Demonstration Marine Biodiversity Observation Network ceremony May 2017 in Washington DC
- **Steve Murawski:** Awarded the 2017 Global Achievement Group Award, presented by USF World to the C-IMAGE consortium for Outstanding Global Engagement following the 2017 Expedition to Cuban waters aboard the R/V *Weatherbird II.*
- **Amelia Shevenell:** Award of Tenure and Promotion to Associate Professor
- **Christopher Stallings:** Award of Tenure and Promotion to Associate Professor

2017 Global Achievement Group Award to the Center of Integrated Analysis of Gulf Ecosystems (C-IMAGE) Consortium led by Drs. Steve Murawski (PI) and David Hollander (Science lead)

Frank Muller-Karger selected for the NOPP's Excellence in Partnering Award for his work on Marine Biodiversity Observation Network

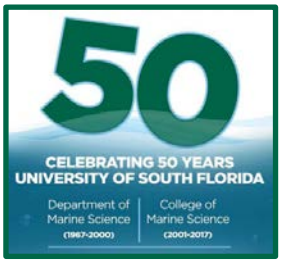
EVENTS AND HIGHLIGHTS

STAFF AWARD:

- **Anita Thompson** received the USF Employee of the Year Award and the Outstanding Staff Award for 2016 at an awards ceremony on April 4, 2017. Anita was nominated by ten people from the College! Anita received a monetary award in addition to a reserved parking space with a sign indicating "Employee of the Year." The award is well deserved and recognizes her incredible competent and dedicated service to CMS.

Provost Ralph Wilcox, Anita Thompson, President Judy Genshaft

EMINENT SCHOLAR LECTURE SERIES:



2017 was the 50th Anniversary of the college in its various forms. Our celebration in April brought alumni and friends from around the world and provided opportunities for faculty, students, staff, and friends of all generations to reconnect. Alumni participated on various panels featuring career opportunities for graduate students to technology and communication and were the speakers at our Eminent Scholars Lecture Series. We hope that the renewed connections remain strong throughout our next 50 years.

50 YEARS Advancing Ocean Science 1967-2017, April 6 to 7, 2017. Four guest lecturers: **Ruoying He** PhD '02, North Carolina State University "Gulf Stream Varibility and its Impacts on Regional Circulation and Marine Biogeochemical Processes; **Lee Kump** PhD '86, Penn State University, "Lessons from the Past to Guide Decisions for the Future"; **Karen Steidinger** MS '71, Florida Wildlife Research Institute, "70 Years of Red Tide Research: Similar Questions, Bigger Tool Box"; and **David Mearns** MS '86, Blue Water Recoveries, "The Art and Science of Shipwreck and Air Crash Investigations".

SciCafé St. Petersburg, April 6, 2017, "Deep Sea Mysteries: Bottoms Up" held at the Dali Museum. Moderator **Rob Lorei**, speakers: **Christina Kellogg** PhD '98; **Tracey Sutton** PhD '01; and **Jyotika Virmani** PhD '05.

USF ANNUAL ALUMNI ROUNDTABLE – NOVEMBER 9, 2017

Moderator: Merrie Beth Neely, MS '96, PhD '08 Marine Habitat Resource Specialist II, Earth Resources Technology, Inc.

Panelists:

Beau Suthard, MS '05 Client Program Manager, APTIM

Beau graduated from Eckerd College in 1997 with a BS in Marine Science (Geology Track), and from USF CMS in 2005 with an MS in Geological Oceanography under Al Hine. After graduating, Beau immediately joined Coastal Planning and Engineering (now known as APTIM) as a Coastal Geologist. Beau is currently a Client Program Manager with APTIM, and is responsible for managing the St. Petersburg, Florida office. This office conducts all of APTIM's offshore geophysical and geotechnical survey work. This work includes seafloor and sub-seafloor

mapping in support of environmental and marine infrastructure projects, including identifying sand resources for shore protection projects and site assessment and clearance for marine infrastructure projects like pipeline routes and offshore wind farms.

Steve Walker, MS '84, P.G., Principal Consultant, ENERCON Services, Inc.

Steve holds a B.A. in Geology from New England College and an M.S. in Marine Science (Geology) from the University of South Florida College Of Marine Science. He began his career as an applied scientist in 1984 at the Southwest Florida Water Management District working as part of a team establishing an ambient ground water quality monitoring network covering most of west-central Florida. In 1986, he became a consulting hydrogeologist and environmental consultant for a national environmental firm and in 1990, along with three colleagues, founded an environmental science and engineering firm (Terra Environmental Services, Inc.) located in Tampa, Florida. Steve has provided consulting services to hundreds of clients throughout the United States for a wide-range of projects including development of ground water supplies for private companies and municipalities, science and engineering studies at contaminated sites including for some of our nation's most complex Superfund sites, environmental construction and operations services to implement cleanups at some of those sites, investigations of marine, riverine and lacustrine sediment investigations, and authored hundreds of technical investigation plans and reports. His work has included extensive interaction and negotiations with state and federal agencies and on some projects, collaboration with academic researchers to bring their knowledge gained from research to difficult-to-solve, real-world environmental problems. He also has provided technical and regulatory support to private-sector clients and litigation support for parties involved in legal actions related to environmental and regulatory matters. In 2015, Terra Environmental was acquired by ENERCON Services, Inc., a growing national firm engaged in providing environmental and engineering services private and public sector clients throughout the US, where he continues his consulting work. Steve is also a volunteer patient advocate for people diagnosed with serious and terminal diseases, and has worked for approximately 17 years to improve patient access to emerging medical progress.

Monica Wilson, MS '07, PhD '13, Oil Spill Research Extension Specialist, Florida Sea Grant College Program, UF/IFAS Extension

Monica graduated from Eckerd College in 2003 with a BS in Marine Science (Geology) and Computer Science. She received her MS from USF's College of Marine Science in 2007 and her Ph.D. in 2013 in Physical Oceanography. After graduate school, Monica joined Florida Sea Grant as a member of the Gulf of Mexico Research Initiative (GOMRI) outreach team. Her role is to transfer information between GoMRI oil spill scientists and coastal stakeholders. The oil spill science outreach program's focus is on the two-way transfer of information between the people whose livelihoods depend on a healthy Gulf of Mexico or who are involved in the protection and management of Gulf of Mexico coastal and marine resources; and the Gulf of Mexico Research Initiative scientists, administrators and board of directors.

ALUMNI SUCCESS:

- **Christine Cass**, PhD '10, promoted to Associate Professor, Humboldt State University
- **Kristine Delong**, MS '06 and PhD '08, Professor at LSU's Department of Geography and Anthropology, featured on NBC's Nightly News on September 24 featuring the amazing, recently discovered exposed bald cypress stumps in ~60 feet of water about 16 miles off the Alabama coast after Hurricane Ivan.
- **Bret Jarrett**, PhD '03, hired as a Visiting Assistant Professor at Coastal Carolina University in Marine Geology.
- **Lee Kump**, PhD '86, named the Dean of Penn State's College of Earth and Mineral Sciences, June 2017
- **Michael Martinez-Colon,** PhD '16, Assistant Professor at FAMU receives 2017 Early-Career Research Fellowship from the Gulf Research Program.

- **David Mearns,** MS '86 , owner of Blue Water Recoveries, a Britain-based scientist and deep-sea shipwreck hunter, has found some of the world's notorious shipwrecks, many of which had once been deemed unable to be found, wrote "The Shipwreck Hunter: A Lifetime of Extraordinary Discoveries on the Ocean Floor".
- **Philip Thompson**, PhD '12, Assistant Professor at the University of Hawaii and has been named Director of the Hawaii Sea Level Center.
- **Robert Ulrich,** PhD '14, Chief Technical Officer of PureMolecular LLC and was recently hired by Teleflex as a Principal Scientist.

ENDOWED GRADUATE STUDENT FELLOWSHIP LUNCHEON:

October 5, 2017 began with a lunch to celebrate our endowed graduate student fellowships and awards. Details are provided in the Development section.

ST. PETERSBURG SCIENCE FESTIVAL:

Scientists, educators, and conservationists bring their work to life at the 2017 St. Petersburg Science Festival on Saturday, October 21, 2017. Crowds arrived from 10 a.m. onwards to expand their minds and appreciate science, that human pursuit responsible for so many advances in society and industry and a source of excitement and wonder to us all. Over 115 interactive activities were offered to more than 15,000 parents and children on the waterfront campus of the University of South Florida St. Petersburg.

Mayor Rick Kriseman championed support for science and recognition of its role in our daily lives as he read a proclamation which established October 21st as "Saint Petersburg Science Festival Day" in the city of St. Petersburg. Inhaling alternately from balloons filled with helium (six times lighter than air) and sulfur hexafluoride (six times heavier than air), the mayor read the proclamation in high-pitched and low-pitched voices and at one point equated science to sports, food, and the arts, suggesting a more common celebration of science within our community traditions. Interim USFSP Chancellor, Dr. Martin Tadlock, also addressed the crowds during the opening ceremony and welcomed future USFSP and USF College of Marine Science students to the Festival and university campus.

Research and innovation were well represented at booths hosted by various laboratories from the College of Marine Science, as well as by NOAA, the USGS, and Eckerd College. Both research and conservation were well showcased by FWC's Fish and Wildlife Research Institute through Marine Quest, the original portion of the festival now celebrating 23 years! Fantastic demonstrations were performed by MOSI and Mad Science and

several ways that science is important to society were on display by Pinellas County, the City of St. Petersburg, Great Explorations, Bay News 9, Duke Energy and many more.

This year, the festival expanded to include the Port of St. Pete which hosted FIO's research vessel, the *R/V Weatherbird II,* and a U.S. Coast Guard vessel, the *R/V Pelican*. Inside the port building, visitors could catch a glimpse of what will be offered at the Marine Exploration Center, opening in 2018. The festival offers a very full day of activities and, thanks to the hard work of all the volunteers, promises to be a success next year, as well.

LAUNCHING AND CHRISTENING CEREMONY OF *R/V W.T. HOGARTH*

The Florida Institute of Oceanography (FIO) and the University of South Florida (USF) System hosted a "Launching and Christening Ceremony" at 11 a.m. on Tuesday, May 23, 2017 at Duckworth Steel Boats shipyard located at 1051 Island Ave., in Tarpon Springs, FL. The new research vessel, the *R/V W.T. Hogarth*, will replace FIO's nearly 50-year-old *R/V Bellows.* The new 78-foot vessel will be instrumental in helping academic researchers and marine science students statewide study situations such as an oil spill or red tide outbreak.

The vessel's name honors Dr. William T. Hogarth, who recently retired after a distinguished 50-year career that included serving as FIO director, dean for the USF College of Marine Science, interim regional vice chancellor of USF St. Petersburg, director of the National Marine Fisheries Service and chair of the International Whaling Commission. He also led the scientific response to the 2010 Deepwater Horizon oil spill.

"The *R/V W.T. Hogarth* is a welcomed addition to FIO's fleet that will provide exciting new technical capabilities to enable world-class research and educational opportunities that helps Florida understand and preserve its critical marine environment," said FIO Director Philip Kramer.

Highlighted Research

SEARCH & DISCOVER

EAST ANTARCTICA'S PAST FORESHADOWS AN UNCERTAIN FUTURE

Research by Dr. Amelia Shevenell highlighted in *Physics Today* (February 2018) by Johanna Miller

Although it's now relatively stable, the immense ice sheet was sensitive to climate fluctuations millions of years ago.

The glaciers of Greenland and Antarctica together contain enough water to raise global sea levels by more than 60 meters. With so much human infrastructure having been planned around current sea levels, if all the polar ice were to melt, the effect on human society would be devastating.

But Earth has seen warm climates and high seas before. During the Mesozoic era—the time of the dinosaurs, which ended 66 million years ago—the planet was far hotter than it is today. The polar regions were ice free.

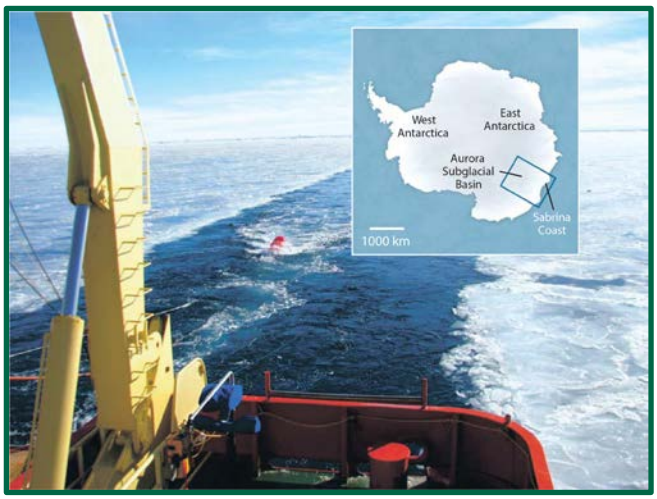


FIGURE 1. OFF THE COAST OF THE AURORA **SUBGLACIAL BASIN** in East Antarctica, researchers used seismic instruments deployed from the back of this icebreaker to acoustically probe the seafloor and the rock below it. (Photo by Sean Gulick; map courtesy of the University of Texas at Austin, Jackson School of Geosciences.)

Since then, temperatures and sea levels have generally been on the decline, and polar ice caps have grown to cover the Antarctic continent and Greenland. That overall trend was punctuated by dramatic bouts of warming and cooling, with glacial periods coming and going. More than a century of Antarctic exploration, on land and by sea, has built up a body of knowledge of how the ice sheet formed and how it has behaved. Geological records of past periods of ice instability during warm times are especially important for estimating the future consequences of anthropogenic climate change.

But there is still a lot more to discover. Global temperature and polar ice coverage aren't related by a simple one-to-one correspondence. Air and ocean temperatures don't always move in tandem, and a glacier can respond to changes in either or both. The collapse of a glacier is a mechanical process that, once initiated, takes time to play out. Glaciers don't all necessarily behave the same way, even in the same part of the world. The local details are important - and in a continent as vast as Antarctica, knowledge of them is incomplete. Much of the Antarctic coast has never been visited by a research vessel.

Four years ago Sean Gulick (University of Texas at Austin), Amelia Shevenell (University of South Florida), and their colleagues undertook the first foray into one of those previously unexplored areas: the Sabrina Coast continental shelf off the shore of the Aurora Subglacial Basin (ASB) in East Antarctica, as shown in the map in Figure 1. They've now analyzed the data they collected.[1] From a combination of seismic measurements and sediment samples retrieved from the seafloor, the researchers found that the ASB glaciers had a dynamic past, advancing and retreating at least 11 times over a period of 30 million years. During much of that time, the atmospheric carbon dioxide concentration was close to what it is today, and the average global

temperature was at a level it may reach again by the end of this century. And the ASB and other East Antarctic regions seem to have responded differently to past climate fluctuations.

Uncharted waters

Most attention to the future of Antarctic glaciers has focused on the precarious situation of West Antarctica. Because of the topography of the underlying rock, much of the West Antarctic ice is dangerously unstable, and some glaciers may have already entered a state of irreversible decline (see PHYSICS TODAY, July 2014, page 10).

The larger, thicker East Antarctic ice sheet rests on firmer foundations, but it's not immune to changes in climate. Evidence has been accumulating that parts of East Antarctica have been responsive to climate in the geological past, including under conditions not too far from what's expected in the coming decades.[2] But the studies are still few and scattered.

When they set out to add another data point to the map, in the austral summer of 2014, Gulick, Shevenell, and colleagues had their sights on Totten Glacier, on the western edge of the ASB. Aerial measurements had shown that Totten Glacier was losing mass faster than anywhere else in East Antarctica, and they wanted to know why. But polar field research doesn't always go according to plan. Sea ice and icebergs dictated where they could go and what they could do - sometimes on an hourly basis. Although conditions precluded reaching Totten Glacier, the researchers found a gap in the heaviest ice on the eastern portion of the Sabrina Coast. For four weeks they zigzagged over the continental shelf, gathering data and sediment samples.

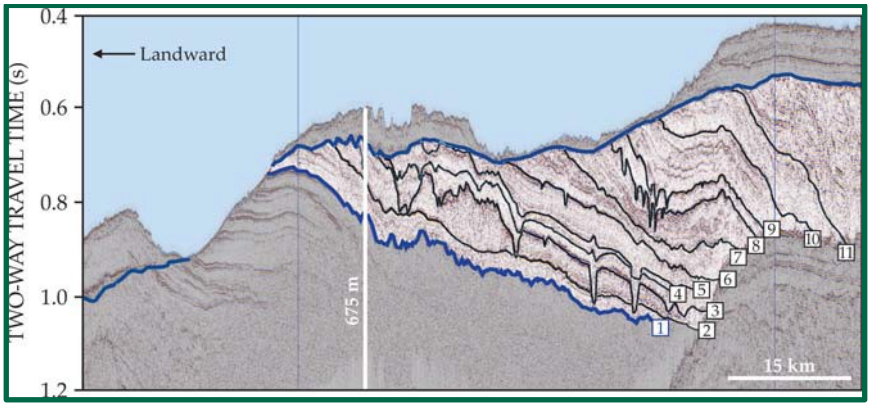


FIGURE 2. A SEISMIC PROFILE tells the history of glacial ice on the Sabrina Coast continental shelf, now underwater. The region between the two blue lines represents a period when the ice was responding dynamically to fluctuations in climate; each of the bold lines marked 1–11 is an erosion surface created by glacial advance and retreat. (Adapted from ref. 1.)

A complicated past

As ice, meltwater, ocean currents, and accumulating debris shaped the continental shelf over tens of millions of years, they created layers of material with different acoustic properties. Seismic profiling - projecting sound waves toward the seafloor and recording their reflections - can uncover that structure, as shown by the profile in Figure 2. The highlighted region corresponds to the period of glacial dynamicism: The layers below it formed before the arrival of ice to the continent, and the layers above formed after the East Antarctic ice sheet stabilized as a polar ice cap. The rough surfaces marked 1 through 11 were created by glacial erosion and correspond to periods of glacial advance and retreat. The layers between them are unusually thick. That means that when the glacier retreated, it must have pulled back far enough -

hundreds of kilometers - to leave behind an open marine environment unsheltered by an overhanging ice shelf.

Some of the erosion surfaces are marked by narrow V-shaped gouges. Those so-called tunnel valleys are a common feature associated with glaciers in the Northern Hemisphere. But they are unusual for Antarctica, with only one known location in West Antarctica and no others in East Antarctica. They are attributed to surface meltwater that seeps through the porous glacial ice and gushes out the bottom. The formation of such deep tunnel valleys means that the ASB was exposed to warm air - as opposed to warm ocean water - for prolonged periods. Surface melting is thought to have little effect on Antarctic glaciers' behavior today. But it must have been a significant driver of glacial dynamics in the past - at least in the ASB.

Converting the seismic profile to a chronology is more complicated than counting layers like tree rings. Erosion surfaces form at irregular intervals, and there's no obvious connection between the features in the profile and events elsewhere on Earth. To pin down the timeline, the researchers collected sediment cores.

Because the ship wasn't equipped with a drill, the samples were collected with a piston corer, a long, heavy tube that plunges into the seafloor sediment like a straw into a milkshake. The cores, therefore, extended just a meter or two beneath the seafloor, so they had to be taken from just the right places where the strata of interest were naturally exposed. And the researchers had to choose those locations on the fly, without the benefit of a full analysis of their data. In fact, they didn't even get access to their sediments until almost six months later, back in their home labs.

Happily, the researchers succeeded in obtaining sediment cores from key moments in the history of the Sabrina Coast, including one core that recorded the transition from the dynamic period to the polar ice-sheet regime. That crucial core was rich in the fossils of ancient silica-shelled diatoms, such as the ones in Figure 3. Many of the microfossils were broken or degraded, but some were sufficiently intact to be identified by species. The diatoms in figure 3 are of different species, but they both roamed the seas at about the same time: between 8.6 million and 4.8 million years ago. Once the researchers had taken into account the species they didn't find in the core, the researchers concluded that the ASB glaciers probably settled down sometime between 6.9 million and 5.6 million years ago.

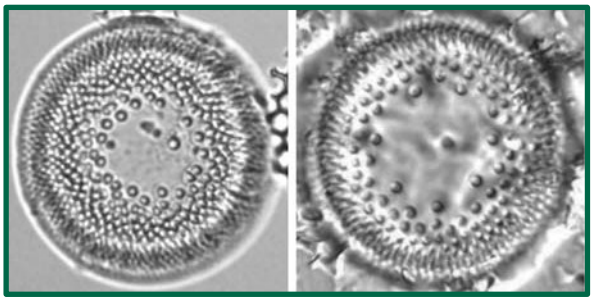


FIGURE 3. THESE FOSSIL DIATOMS, each 30 µm in diameter, were recovered from the sediments of the Sabrina Coast continental shelf. Their species - *Thalassiosira oliverana* (left) and *Actinocyclus ingens* (right) - flourished more than 4.8 million years ago. (Adapted from ref. 1.)

The result puts the ASB in an interesting contrast to other parts of East Antarctica. The nearby Wilkes Subglacial Basin, for example, seems to have still been advancing and retreating in response to climate fluctuations as late as 3.3 million years ago.[3] Still, it's hardly surprising that different parts of the East Antarctic ice sheet - a complex continent-scale system - don't all move in concert.

Estimates of atmospheric CO_2 levels from millions of years ago are subject to large uncertainties, but the past 25 million years have almost certainly included periods when the concentration exceeded the 400 ppm seen today. The global average temperature at the end of the ASB's dynamic period was likely 4 °C

warmer than today, well within the span of projections for the year 2100 if drastic action is not taken to limit greenhouse emissions.

The broad similarities between past and future conditions are not predictive, but they are suggestive. Even the possibility of East Antarctic destabilization highlights the need for more data to better understand the ice sheet's vulnerability. Indeed, several more interdisciplinary expeditions will be visiting East Antarctica in the next few years, and Gulick, Shevenell, and colleagues have a pending proposal with the International Ocean Discovery Program to return to the Sabrina Coast with a scientific drilling rig. The longer cores that they can obtain with a drill could fill in the timeline and help the researchers understand exactly when and how the ice advanced and retreated in the past.

Johanna Miller

PHYSICS TODAY | FEBRUARY 2018 PAGES 16-18

References

1. S. P. S. Gulick et al., *Nature* **552**, 225 (2017).
2. See, for example, R. Levy et al., *Proc. Natl. Acad. Sci. USA* **113**, 3453 (2016); E. Gasson et al., *Proc. Natl. Acad. Sci. USA* **113**, 3459 (2016).
3. C. P. Cook et al., *Nat. Geosci.* **6**, 765 (2013).

USFCMS DEAN JACKIE DIXON PUBLISHES NEW PAPER ON DEEP EARTH CYCLING OF CARBON AND WATER

The origins of carbon dioxide and water lie within the deep earth. In times long past, extensive volcanic outgassing produced our oceans and atmosphere. A new paper by the dean of the College of Marine Science sheds light on recycling of volatiles into the deep Earth by subduction and out of the deep Earth through eruption and degassing of seafloor volcanoes. Her model improves upon the standard model of subduction, known as the "subduction factory".

Jacqueline E. Dixon, Ph.D., a geochemist by training, recently published an article in the AGU journal *Geochemistry, Geophysics, Geosystems* (Dixon, J. E.**,** I. N. Bindeman, R. H. Kingsley, K. K. Simons, P. J. le Roux, T. R. Hajewski, P. Swart, C. H. Langmuir, J. G. Ryan, K. J. Walowski, I. Wada, and P. J. Wallace (2017) Light Stable Isotopic Compositions of Enriched Mantle Sources: Resolving the Dehydration Paradox. *Geochemistry, Geophysics, Geosystems*, doi:10.1002/2016GC006743). Her research explores the origins of water and carbon dioxide on earth using measurements of water and carbon dioxide concentrations and ratios of hydrogen and other stable isotopes.

This recent paper provides a comprehensive review of and presents new data on stable isotopes in mid ocean ridge basaltic glasses. Dr. Dixon and fellow researchers show that water in enriched oceanic basalts is mostly recycled seawater that has been added to the mantle through deep melting of subducted slab igneous crust and sediments. The model proposed in the paper extends the subduction factory concept down through the transition zone of the mantle and recognizes the important role of carbon in melting of sediments and basaltic crust in the downgoing slab. These melts play a role in the complex dehydration and rehydration processes that support recycling of volatiles into the deep mantle, eventually returning to the surface in the form of lavas erupted at mid-ocean ridges and ocean islands such as Hawaii.

HIGHLIGHTED RESEARCH

CLIMATE AND THE REDISTRIBUTION OF LIFE IN THE SEA

Research by Dr. Brad Seibel on oxygen availability in seawater

Marine organisms are affected by ocean warming, acidification and deoxygenation associated with changes in the global climate. Increasing temperatures elevate the metabolic demand for oxygen, while simultaneously reducing its availability. Elevated carbon dioxide in seawater can affect both marine animal oxygen supply and demand. Dr. Brad Seibel and fellow researchers seek to better understand how these changes affect ecologically and commercially important species in the oceans, from microscopic zooplankton to jumbo squids, from the tropics to the poles and from shallow to deep in the ocean. The ultimate goal of this research is to map the metabolically available future habitat, regions and depths where future oxygen availability remains high relative to metabolic oxygen demand and provides sufficient metabolic scope for species to grow and reproduce.

Pterygioteuthis gemmata, a small, vertically-migrating squid that spends daytime in the oxygen minimum zone in the Eastern Tropical Pacific.

Ocean deoxygenation, in particular, has emerged recently as a growing threat to marine ecosystems. Low oxygen zones, called Oxygen Minimum Zones, occur naturally in some regions of the open oceans, but have expanded dramatically in recent decades and the oxygen levels within are declining. Low oxygen in OMZs restricts the vertical and horizontal distribution of organisms thus altering oceanic ecosystems. Additionally, eutrophication has led to larger and more severe coastal hypoxic zones that similarly alter species distributions and sometimes causes mass mortality or “fish kills”. The work in the Seibel lab will facilitate predictions of these important changes.

Photo credit: Stephani Gordon, Open Boat Films.

Pleuroncodes planipes, among the most hypoxia tolerant animals living in the Eastern Tropical Pacific at about 300 meters depth where oxygen is less than 1% of air-saturation.

Japetella diaphana, a pelagic octopus that lives just below the oxygen minimum zone at 800 meters in the Eastern Tropical Pacific

CMS graduate students Kate Dubickas and Jeremy Browning perform plankton tows on a cruise from Tuxpan, Mexico to St. Petersburg aboard *R/V Weatherbird II*, collecting fish eggs for DNA barcoding

NEW, EFFECTIVE DNA METHOD FOR DISCOVERING FISH SPAWNING GROUNDS

Research by Drs. Mya Breitbart and Ernst Peebles on analysis on the DNA in fish eggs

Also appeared in *ScienceDaily* (April 20, 2017)

Towing a plankton net to scoop up fish eggs may be routine, but determining the species is a different matter altogether. A collaboration of two labs at the College of Marine Science uses a new method to discover fish spawning grounds through analysis of the DNA in fish eggs. The vast majority of fish in the ocean are broadcast spawners – the female releases eggs in large quantities to float around until the larvae hatch and swim away on their own. A problem facing many fisheries managers is the time it takes to estimate fish populations. A new method utilizing DNA will likely reduce that time from years to months.

Dr. Ernst Peebles realized that existing fish population methods could be extended to a much larger number of species through new technologies and new databases like FISH-BOL (fish barcode of life). With the development of the Marine Resource Assessment program in 2010 here at the college, Dr. Mya Breitbart was eager to collaborate with fisheries ecologists on gaps in the body of research that molecular biology methods might fill. A process called DNA barcoding focuses on a segment of DNA that is short enough to be efficiently sequenced but long enough to allow for identification of species. While most fish eggs look alike, their DNA does not. Working in one of Dr. Breitbart's microbiology labs, USFSP senior Makenzie Burrows performs much of the hands-on DNA work related to this project. Dr. Breitbart explains the process further, "When we sequence this gene, we can then compare it against the database and that tells us what species each fish egg belongs to." From the original proof-of-concept study done in small Terra Ceia Bay (near the mouth of Tampa Bay), the DNA barcoding of fish eggs has expanded to cover the entire Gulf of Mexico.

With the identification data from Dr. Breitbart's lab, fish population researchers can use the number of floating eggs, compare that with the rate of egg production and calculate the number of females releasing eggs for each species. Dr. Peebles points out that this method is not only rapid, but could be very cost effective in comparison to conventional methods. The most exciting aspect of this project for fisheries scientists is the discoveries that await them. Dr. Peebles notes, "This method is one of the best, if not **the** best, methods of detecting spawning in marine fish." And by identifying new spawning grounds, resource managers have the ability to increase protection of spawning habitats to ensure the longevity of ecologically and economically important species.

HIGHLIGHTED RESEARCH

CMS graduate student Makenzie Burrows extracting DNA from individual fish eggs to determine their identity

Marine biologist Mya Breitbart holds a vial of fish eggs collected in the Gulf of Mexico. *Credit: University of South Florida photographer Ryan Noone*

REMOTE SENSING, A NECESSARY TOOL FOR STUDYING BIODIVERSITY AT EFFECTIVE SCALES

From local to global and micro to macro, applications of remote sensing data are critical to understanding drivers of biodiversity change across regions and filling the data gaps that exist between them.

Dr. Frank Muller Karger and his group at the Institute for Marine Remote Sensing (IMaRS) collaborate with a multi-institutional, nation-wide network of scientists and resource managers to catalog biodiversity as it has never been done before: with consistency of data from region to region and at scales that reveal connectivity among marine habitats, from the coast to the open ocean.

The Sanctuaries Marine Biodiversity Observation Network (Sanctuaries MBON) is part of a global consortium of BONs that are building web portals where real-time and historical data can be consulted by scientists, living resource managers, policy-makers, educators, and the general public to track changes in ecological well-being of the regions they are tasked with studying, maintaining or improving.

On-going bimonthly cruises in the Florida Keys National Marine Sanctuary (FKNMS) are conducted by NOAA Atlantic Oceanographic & Meteorological Laboratory (AOML) scientists and members from IMaRS to gather a suite of water quality and biological data. Pairing water samples with satellite observations, IMaRS member Megan Hepner uses GIS maps to display biodiversity of coral reef fishes along the entire reef tract of the FKNMS. Simpson and Shannon diversity indices – statistical methods used to classify ecosystem integrity and resilience – show that greater diversity is found in the Lower and Upper Keys than in the Middle Keys. Frank Muller-Karger and Enrique Montes oversee the assimilation of the sampling efforts and observations into the Sanctuaries MBON research initiative.

Online data-consulting resources like infographics are a key point of interaction on the sites for both resource managers and members of the general public that provide easy-to-use tools to learn about the biological composition of several protected ecosystems and detect changes in diversity and ecosystem health over time. GIS maps hosted on the MBON web portal provide further spatial and temporal visualizations of ecosystem health and diversity in three National Marine Sanctuaries: the Florida Keys, Monterey Bay and Flower Garden Banks.

HIGHLIGHTED RESEARCH

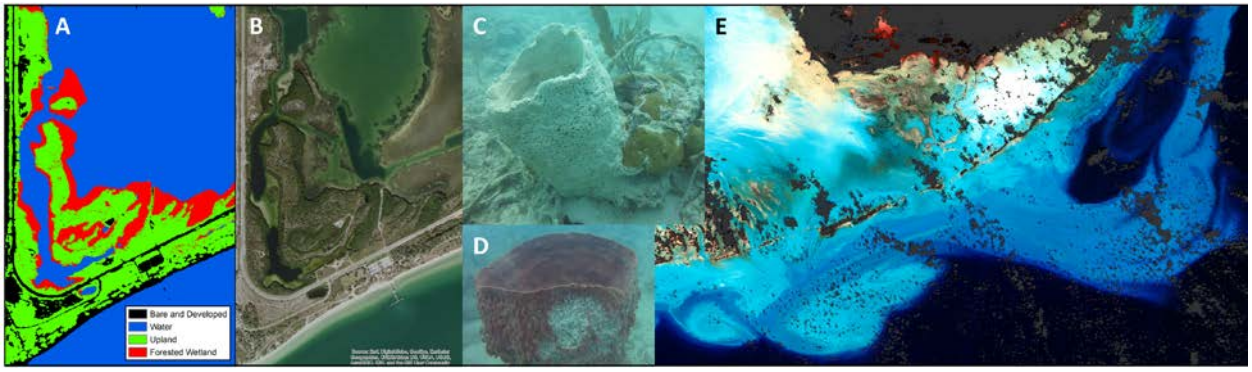
An additional layer of sampling within the MBON initiative is environmental DNA (eDNA). The Marine Genomics Lab led by Dr. Mya Breitbart at the USF College of Marine Science is responsible for analyzing seawater samples for trace amounts of genetic material left behind by marine organisms, from microbes to whales. New methods allow for fast, affordable interpretation of the DNA present in the marine environment.

The size, depth, and unforgiving surface conditions of the ocean make it impossible to continuously monitor conditions from all desired locations. Therefore, satellite-based remote sensing provides solutions at useful spatial and temporal scales.

Analysis of satellite data has allowed researchers from IMaRS to study phytoplankton blooms off the Texas coast in the wake of Hurricane Harvey, impacts to coral reef and seagrass beds in the Florida Keys from Hurricane Irma, explore mechanisms behind outbreaks of Dengue fever in the Caribbean, and improve wetland mapping methods for coastal areas. In addition, the lab is improving characterization of the impacts to coastal areas from red tides, storm-generated sediment plumes, water quality events, and land cover changes.

Concurrent satellite observations of biological and physical variables from around the world allow BON's to map data in near real-time. Global earth observations include vegetation biomass (land and ocean), winds, currents, waves, rainfall, cloud cover, land topography, and many more. As Muller Karger states, "This allows us to see how biological processes on land and in the ocean react to, or in some cases modify, environmental variables that force them."

Understanding diversity of life in the oceans is crucial to managing and preserving these resources, and the use of remotely sensed data enables the study of biodiversity on proper scales.



From left, an improved habitat map (A) of Ft. DeSoto Park (B) derived from high-resolution satellite imagery. Damage to sponges (C, D) from sediments suspended by Hurricane Irma. Sentinel-2 satellite image (E) showing sediment transport from the Florida Keys on September 13, 2017, three days after Hurricane Irma made landfall at Cudjoe Key. Sponge photographs courtesy of Steve Gittings, NOAA Office of National Marine Sanctuaries. Satellite image (E) contains modified Copernicus Sentinel data (2017), processed by ESA and USF's Institute for Marine Remote Sensing (IMaRS).

Research Overview

RESEARCH ACTIVITIES IN THE DEAN'S OFFICE

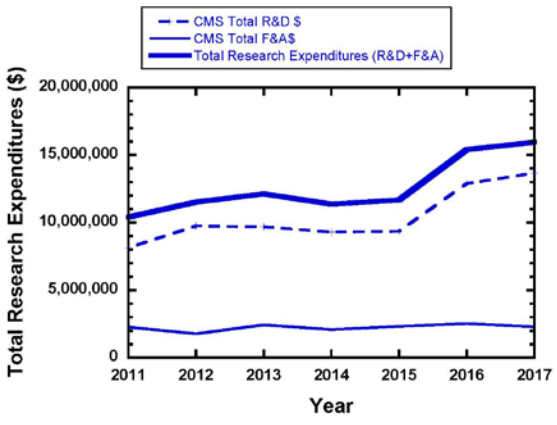
Gary Mitchum continues his work as the USF lead for the Florida Climate Institute (FCI), a consortium of nine Florida universities seeking support for climate-related research. The major accomplishment of the FCI in the past year was the publication of a climate encyclopedia book for Florida. Gary was one of five USF faculty contributing to this book, and three of the five were faculty members in our college. Gary also started a new project funded by NOAA in which he will work with partners around the country to develop forecasts of nuisance flooding frequencies. Saint Petersburg was chosen as one of the testbeds for the application of this research and Gary is working with the mayor and his staff to translate this research to useful products for the city.

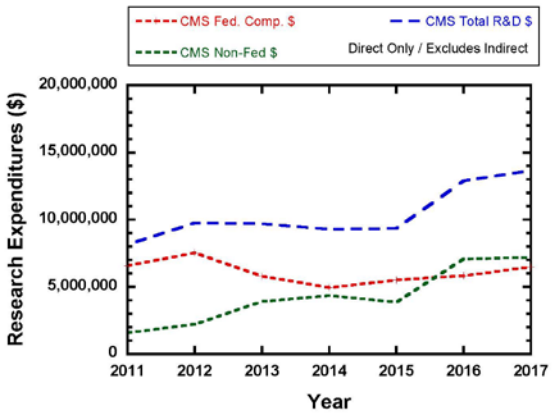
Gary also supervises the CMS Ocean Technology (COT) group as part of his Associate Dean duties. The COT group was involved in two very interesting projects this past year. First, working with Bob Byrne and Lisa Robbins at the USGS, they have built a handheld photometer designed to be portable and inexpensive to build and maintain. The objective is to mass produce these units for usage by citizen scientists around the globe. Second, working with Tim Dixon in the School of Geosciences, they are developing a buoy that contains a high precision sea floor geodetic system. These buoys are intended to be installed in areas of high volcanic and/ or earthquake activity to monitor the sea floor for activity related to these events. The entire buoy was developed and constructed at USF-CMS and is expected to be deployed in the spring of 2018. Finally, COT personnel have managed six ocean glider deployments and supported five cruises in collaboration with the C-SCAMP project.

RESEARCH PRODUCTIVITY

The research profile of the college remains very strong despite increased competition for external grants in general, and especially stiff competition for federal grants. Last year, thanks in part to the startup of the CIMAGE-II project, our total research expenditures increased to ~$15.4 M, with ~$12.9 M in direct research expenditures and ~$2.5 M in indirect cost recovery. In 2017 we have slightly increased these numbers, with total research expenditures of ~$15.9 M, direct research expenditures of ~$13.6 M and ~$2.3 M in indirect cost recovery. As expected for a research-intensive unit, our faculty have some of the highest per faculty research performance metrics in the university. Over the past year the total research expenditures per full-time equivalent tenure-earning faculty member increased to almost $700K.

Anita Thompson, our unit research administrator, continues to keep the research enterprise running smoothly, receiving accolades from everyone she interacts with. Anita's efforts were recognized university-wide this past year when she was named the USF Outstanding Employee of the Year, an award she richly deserves.





Faculty Highlights

Below are highlights from faculty, along with their students and staff, and accomplishments in 2017. Publications for CMS faculty are listed in a separate section.

Dr. Cameron Ainsworth (Fisheries Biology; Ecosystem and Resource Management)

Dr. Ainsworth's research is focused on understanding how human activities and climate influence the structure and functioning of marine communities and developing new tools and methodologies to support ecosystem-based management. Dr. Ainsworth and his students employ a variety of statistical and numerical simulation models to characterize trophic linkages in marine ecosystems, habitat use by fish and invertebrates, and the influence of physical oceanography on the distribution of marine life. His ongoing studies include a management strategy evaluation (MSE) of Gulf of Mexico marine protected area design. The MSE approach is a type of closed-loop policy analysis that simulates each part of Holling's adaptive management cycle (stock assessment, implementation of harvest rules, and policy evaluation). Key to this approach is recognizing feedbacks from the ecosystem that occur in response to management actions and evaluating tradeoffs with respect to socioeconomic and ecological policy objectives. This work is being done in collaboration with NOAA as part of their Integrated Ecosystem Assessment for the Gulf of Mexico, and other Gulf-area agencies. Another major project ongoing in the Ainsworth lab is the evaluation of the Deepwater Horizon oil spill. This study focuses on the short and long-term impacts of oil toxicity in the ecosystem, as well as the impacts of mediation actions like the use of dispersants and fishery closures.

In 2017, Dr. Ainsworth and his students and staff published papers on climate change, oil spills, invasive species, and ecosystem-based fisheries management. This includes five articles in 2017, with an additional five articles in press. Other areas of research included natural and artificial reef succession dynamics and ecosystem connectivity. The Ainsworth lab presented research at the American Fisheries Society Symposium as well as the Gulf of Mexico Oil Spill and Ecosystem Science Conference. At the oil spill conference, Dr. Ainsworth organized a session on coupling large datasets with ecological modeling and delivered a keynote address in a session on ecosystem impacts of the spill. Dr. Ainsworth also supported the Marine Resource Assessment program at the College of Marine Science by providing training to fisheries managers as part of an online real time ecosystem modeling course, which was attended by nine NOAA scientists and one Florida Wildlife Commission scientist. Dr. Ainsworth co-taught, with other NOAA Quest faculty members, a short course on Management Strategy Evaluation at the International Council for Exploration of the Sea Annual Science Conference. With more than 40 attendees, this helped provide tools and train state, federal and international fisheries managers using hands-on exercises. Dr. Ainsworth supported the international mission of the University by training a scientist from Uganda to study invasive species dynamics in Lake Victoria, and publishing a paper with a Brazilian PhD student on invasive species in Brazil. In 2017, Dr. Ainsworth received tenure and he was promoted to Associate Professor.

Dr. Mya Breitbart (Genomics; Marine Microbiology; Wastewater Microbiology; and Virology)

Dr. Breitbart studies oceanic viral abundance, diversity, and biogeography. She has played an integral part in developing the scientific field of viral metagenomics, and her lab continues to expand the application of this technique to new environments and research questions. The Breitbart lab uses molecular techniques to examine the diversity, distribution, and ecological roles of viruses and bacteria in a wide range of environments - including seawater, animals, plants, insects, zooplankton, coral reefs, stromatolites, and reclaimed water. Notable findings include the first discovery of viruses infecting zooplankton (the most numerous animals in the ocean), the first identification of single-stranded DNA viruses in invertebrates, the

first multi-year study of viral abundance in the open ocean, the discovery that plant viruses dominate human feces which enabled the development of new indicators of fecal pollution, the identification of viral pathogens potentially involved in marine mammal mortality events, and the creation of new methods for identifying vector-transmitted viruses.

In 2017, Dr. Breitbart's microbial ecology and genomics laboratory had an extremely successful year, publishing 10 peer-reviewed scientific manuscripts and accomplishing several major goals on federally-funded projects. Major research areas included: 1) Using viral metagenomics to identify and describe the viral communities in a variety of environments and organisms, 2) Influencing the incorporation of sequences generated via metagenomics into formal viral taxonomy, 3) Inclusion of DNA barcoding into marine biodiversity surveys, 4) Microbial water quality and risk assessment, 5) Bacteriophage diversity and dynamics in aquatic environments. In 2017, the Breitbart lab began work on two new exciting National Science Foundation grants, one from the Coastal SEES program focused on integrating water microbiology with ethnography to determine risk of recreating at Costa Rica beaches in a transdisciplinary manner, and another from the Division of Environmental Biology to study viruses in the freshwater springs of Florida. In 2017, two PhD students, Brittany Leigh and Elizabeth Fahsbender, graduated from the Breitbart lab, and are now in postdoctoral positions. One MS student, Amanda Sosnowski, also successfully defended. The Breitbart lab participated in numerous outreach activities to share their research with the public, including the 2017 Saint Petersburg Science Festival. And to cap it all off, Dr. Breitbart was elected as a Fellow of the American Association for the Advancement of Science, one of the highest awards in our field.

Dr. Kristen Buck (Trace Metal Biogeochemistry; Metal-Binding Organic Ligands)

Research in the Buck lab is focused on the biogeochemical cycling of trace metals in marine ecosystems, with particular emphasis on the role of metal-binding ligands in the cycling of bioactive trace elements like iron and copper. Iron (Fe) is an essential micronutrient for phytoplankton that limits primary productivity in large regions of the global open ocean. Copper (Cu), on the other hand, is a common anthropogenic contaminant to estuarine and coastal oceans that can act as a toxicant to microorganisms at elevated concentrations. The organic complexation of dissolved iron and copper by largely uncharacterized natural ligands in seawater has proven to be an integral component in the oceanic biogeochemistry of these metals, governing aspects of their solubility, supply and bioavailability in the marine environment. Recent research projects in the Buck lab have examined the distributions, sources and sinks of natural iron- and copper-binding organic ligands in seawater, biological transformations of iron and copper species, and the influence of copper-binding ligands on bioavailability and toxicity of copper in contaminated coastal and estuarine environments.

In 2017, Dr. Buck had three active NSF grants, and had two additional new awards funded, including her first from NSF Biological Oceanography. Dr. Buck gave two invited seminars at the University of British Columbia and at Oregon State University, and also gave an invited talk at the 100th annual Canadian Chemistry Conference in Toronto and an invited lecture at the GEOTRACES summer school in France. Dr. Buck's work was published this year in *Environmental Microbiology* and an invited review in *Nature*, and lead-authored an Editorial and guest edited an eBook in *Frontiers in Marine Science*. Dr. Buck and two of her students each submitted first author publications this year as well. Dr. Buck co-chaired a session at the 2017 Goldschmidt meeting in Paris and was an invited Discussion Leader for the Gordon Research Conference in Chemical Oceanography. Dr. Buck currently supervises three PhD students and two MS students. One of these PhD students, Chelsea Bonnain, is co-supervised by Dr. Mya Breitbart. Dr. Buck also supervised a postdoc and an undergraduate student intern in 2017. Dr. Buck taught a GEOTRACES summer school module on voltammetry in France in August 2017, and co-taught the Chemical Oceanography core course in Spring 2017. Dr. Buck continues to serve on the Editorial

Board for *Limnology and Oceanography: Letters* as an Associate Editor. She also serves for The Oceanography Society as Co-Chair of the 2018 Ocean Sciences Meeting and Chair in 2020.

Dr. Robert Byrne (Marine CO_2 System Chemistry and Ocean Acidification; Seawater Trace Element Chemistry; and Development of In Situ Methods and Instrumentation for Analysis of Seawater)

Dr. Byrne's research foci are: (1) the speciation and behavior of trace metals in seawater, (2) investigation of marine and riverine CO_2 system chemistry and (3) development of in-situ procedures for observation of the marine environment. His work on trace metals gives special emphasis to investigations of the comparative chemistries of a variety of elements including platinum and palladium, and yttrium plus the rare earths. Other enduring interests and current research includes investigation of the aqueous behavior of iron, and the influence of acantharia on the biogeochemistry of strontium and barium. Work on CO_2 system chemistry includes the development and oceanic application of novel systems for shipboard and in-situ measurements of pH, total inorganic carbon, alkalinity, and CO_2 fugacity. Development of systems for in-situ measurements of metals, nutrients and CO_2 system variables involves close work with a variety of colleagues at the Center for Ocean Technology (within the College of Marine Science).

In 2017, Dr. Byrne marked 25 years of service as an Associate Editor of *Geochemica et Cosmochemica Acta*. Over that period of time Dr. Byrne averaged six peer-reviewed publications per year. In 2017 Dr. Byrne's students were the first author on four peer-reviewed publications, and an additional publication was first-authored by a CMS student for whom Dr. Byrne served as a committee member. A number of the publications of Dr. Byrne's students described the development of ground-breaking methods for assessment of the marine CO_2 system and the phenomenon of ocean acidification.

Dr. Don Chambers (Using satellite observations to understand climate change and ocean dynamics)

Dr. Chambers specializes in using satellite observations such as radar altimetry and satellite gravimetry to better understand ocean dynamics. His primary research focus is quantifying and understanding sea level variability, especially trying to separate natural climate variability from anthropogenic climate change. He is interested in all the dynamical processes that cause sea level change, including ocean circulation, ocean heat storage, ocean mass redistribution, and influx of fresh water from the continents and ice sheets.

In 2017, Dr. Chambers was elected a Fellow of the American Geophysics Union (AGU). The AGU is the world's largest international scientific association dedicated to Earth and space sciences and has 60,000 members. Each year, less than 0.1% of the membership is elected to Fellow status for a major breakthrough, discovery, or paradigm shift in one of the Earth and space sciences. The award recognizes Dr. Chambers' contributions to satellite geodesy that have allowed new understanding of ocean dynamics and sea level change. Dr. Chambers was also the lead author of a new study documenting the relative size of mechanisms that drive modern day sea level rise. The study demonstrated that the melting of ice from Greenland, Antarctica, and other glaciers is now responsible for 70% of sea level rise, up from 50% in the previous decade. Dr. Chambers also led a group of international scientists in writing a chapter in a new reference book on the use of satellite altimetry in Earth science. The chapter deals with the use of satellite gravity measurements along with altimetry to understand ocean circulation and sea level variability.

Dr. Tim Conway (Marine trace elements, trace metal isotopes, biogeochemistry, marine geochemistry, GEOTRACES)

Research in Dr. Conway's group aims to understand the geochemistry of trace metals in the marine and earth system, and the role they play as micronutrients and/or toxins in marine biogeochemical cycles, with effects on the global carbon cycle. Researchers working with Dr. Conway employ isotopic techniques including

measurement of trace metal (Fe, Zn, Ni, Cd, Cu) isotope ratios by multi-collector HR-ICPMS in a range of materials including aerosol dust, rocks, sediments rain, seawater, ice-cores, marine particles and biological materials. His group works closely with national and international collaborators as part of the International GEOTRACES program, working on seawater and other samples collected from all over the world. New acquisition of a Thermo Neptune Plus MC-ICPMS and Element XR high resolution ICPMS at CMS in 2017, together with an ESI-Seafast flow through system for precise measurement of trace metal concentrations in seawater, provides the group with the ideal resources to utilize and develop these isotopic tracers in order to shed new light on the biogeochemical cycling of these metals in the modern ocean.

In 2017, Dr. Conway joined the faculty as an Assistant Professor at the beginning of 2017, appointed jointly between the College of Marine Science and the School of Geosciences. Dr. Conway has overseen the acquisition of new instrumental equipment and the establishment of the new USF funded Tampa Bay Plasma Facility at CMS. This brand new $1 million USF-funded core facility will support multiple PIs at CMS, as well as providing new analytical capabilities to multiple groups in difference colleges at USF and also USGS and other collaborators. These new machines, together with Dr. Conway's newly installed clean laboratories, will allow Conway's group to carry out cutting-edge research and investigate the cycling of important trace elements such as iron, which are present at very small concentrations in the ocean. This new capability at CMS was recognized, with Dr. Conway being awarded funding by the National Science Foundation to investigate the cycling of trace metals such as iron, zinc, cadmium, nickel and copper in the North Pacific Ocean as part of the prestigious US GEOTRACES program. Dr. Conway's research this year has focused on the importance of the Gulf Stream system in influencing nutrient dynamics in the North Atlantic Ocean, including being co-author on a new paper investigating how different metals such as cobalt and zinc affect plankton in this region. Dr. Conway also gave a number of invited seminars during the year, in British Columbia, Paris and Holland, and was a visiting scientist at the Royal Institute for Sea Research in the Netherlands.

Dr. Kendra Daly (Zooplankton Ecology; Gulf of Mexico and Antarctic Ecosystems; Low Oxygen Regions in the Ocean; Ocean Observatories; Sensor Technology)

Dr. Daly's research interests focus on zooplankton ecology with the aim of understanding the physical and biological factors that control the abundance and distribution of zooplankton and the role of zooplankton in marine food webs, biogeochemical cycles, and fisheries oceanography. Currently funded projects include investigations of (1) the Gulf of Mexico lower trophic food web response to the Deepwater Horizon oil spill, (2) the role of marine snow in the sedimentation of Deepwater Horizon oil to the sea floor, and (3) ecosystem dynamics and predator-prey interactions in McMurdo Sound, Antarctica, using the SCINI remotely- operated vehicle with a variety of sensors.

In 2017, Dr. Daly participated in an international collaboration to digitize large Southern Ocean data sets in order to make them available to all potential users. These data were then synthesized to investigate the temporal and spatial trends in abundance of the ecologically and commercially important crustacean, the Antarctic krill, resulting in an important paper: Atkinson, A., S.L. Hill, E.A. Pakhomov, V. Siegel, R. Anadon, S. Chiba, **K.L. Daly**, R. Downie, P. Fretwell, L. Gerrish, G.W. Hosie, M.J. Jessopp, So Kawaguchi, B.A. Krafft, V. Loeb, J. Nishikawa, H.J. Peat, C.S. Reiss, R.M. Ross, L.B. Quetin, K. Schmidt, D.K. Steinberg, R.C. Subramaniam, G.A. Tarling, and P. Ward (2017) KRILLBASE: a multinational, circumpolar database of abundance of Antarctic krill and salps**.** *Earth System Science Data* 9, 193-210; doi:10.5194/essd-2016-52.

Dr. Jacqueline Dixon (Igneous Petrology; Mantle Geochemistry; Role of Volatiles in Magmatic Processes; Deep Earth Geochemical Cycling of Volatiles/Dean)

Dr. Dixon's research interests focus on the role of H_2O and CO_2 in the generation and evolution of basaltic magmas with an emphasis on submarine volcanoes. Her work includes solubility studies of H_2O and CO in basaltic melts, vapor saturation and degassing models, and modeling of volatile contents in primary magmas and the mantle.

In 2017, Dr. Dixon published an article in the AGU journal *Geochemistry, Geophysics, Geosystems*. Her new paper sheds light on recycling of volatiles, such as water and carbon dioxide, into the deep Earth by subduction and out of the deep Earth through eruption and degassing of seafloor volcanoes. Her model improves upon the standard model of subduction, known as the "subduction factory". This recent paper provides a comprehensive review of and presents new data on stable isotopes in mid-ocean ridge basaltic glasses. Dr. Dixon and her fellow researchers show that water in enriched oceanic basalts is mostly recycled seawater that has been added to the mantle through deep melting of subducted slab igneous crust and sediments. The model proposed in the paper extends the subduction factory concept down through the transition zone of the mantle and recognizes the important role of carbon in melting of sediments and basaltic crust in the down-going slab. These melts play a role in the complex dehydration and rehydration processes that support recycling of volatiles into the deep mantle, eventually returning to the surface in the form of lavas erupted at mid-ocean ridges and ocean islands such as Hawaii. Follow this link to read or download the paper - Light Stable Isotopic Compositions of Enriched Mantle Sources: Resolving the Dehydration Paradox

Dr. Boris Galperin (Atmospheric; Oceanic and Planetary Turbulence; Theory, Modeling, Experiments)

Dr. Galperin's research focuses on theoretical, numerical, and experimental methods to study atmospheric and oceanic turbulence on different scales. One such technique is the Quasi-Normal Scale Elimination (QNSE) model that has been implemented in the state-of-the-art numerical weather prediction system WRF (Weather Research and Forecasting) developed at the National Center for Atmospheric Research (NCAR). On the largest scales, a flow may become strongly anisotropic and self-organize into a system of alternating bands as observed on all giant planets. Similar but much weaker bands exist in the world ocean. Dr. Galperin's group has discovered a new flow regime underlying this phenomenon; today it is known as zonostrophic turbulence. The existence of this regime on Jupiter has been confirmed by the data collected by a spacecraft Cassini.

In 2017, Dr. Galperin extended his studies of atmospheric turbulence and atmospheric and oceanic energetics and energy spectra by computing the corresponding structure functions. Those are powerful characteristics of the intensity and internal making of turbulence. Although the shapes of the structure functions were known from observations, their theoretical explanation, both qualitative and quantitative, represent a significant breakthrough. Dr. Galperin also completed a co-edited (with Professor Peter L. Read from Oxford University) book on zonal jets. In the beginning of 2018, the source files were forwarded to the publisher, the Cambridge University Press, to start the publication process. This is a truly unique book, with contributions from about 70 world leading scientists. The book is highly multi-disciplinary. It connects between Atmospheric Sciences, Physical Oceanography, Planetary Science, Plasma Physics, Turbulence Theory and Laboratory Experimentation. The book is accessible to both graduate students and seasoned researchers. It includes both historical information on the developments in various areas and their interconnections and the description of the recent progress at the frontiers of sciences. In the area of Planetary Science, for example, the book covers new results from the Juno mission to Jupiter and features a chapter in the rapidly expanding field of Extrasolar Planets. A very close connection between geophysical and planetary phenomena and the basic turbulence theory, not often analyzed in the literature, is the book's trademark. The book will promote the preeminent status of CMS and USF.

Dr. David Hollander (Chemical Sedimentology; Isotopic Biogeochemistry and Organic Geochemistry; Oil Spill Ecosystem Impact Assessment)

Dr. Hollander's research focuses on evaluating the influence that anthropogenic and natural climate and environmental change have on the biogeochemical cycling of carbon, nitrogen, and other biolimiting elements in both modern and ancient lacustrine and marine settings. This research couples state-of-the-art analytical techniques in stable isotope and organic geochemistry to provide a detailed characterization of organic matter. The goals of his research are to understand how biological, chemical and physical processes in modern environments control the production, composition, alteration, decomposition and preservation of organic matter. The results of these studies in modern settings are applied to the analysis of ancient organic-rich sediments in order to reconstruct the environmental and climatic factors controlling the accumulation of organic matter throughout the geologic record. Dr. Hollander is a Co-PI and Theme leader for the C-IMAGE consortium funded by the Gulf of Mexico Research Initiative to study long-term impacts of the 2010 Deepwater Horizon oil disaster.

In 2017, Dr. Hollander returned from a highly prestigious University Guest Professorship position (May 2016 – January 2017) at the world-acclaimed Swiss Federal Institute of Technology (ETH) in Zürich, Switzerland. Dr. Hollander was the chief science officer and co-PI on the C-IMAGE III proposal, which was awarded over $5 million in continued funding through mid-2020. Dr. Hollander was also a partner in eight peer-reviewed articles, in the presentation of over 20 talks at national and international meetings, and he presented a number of invited seminars, including seminars at the International Oil Spill Conference in Long Beach CA and the Department of Geological Sciences at the University of Florida. Dr. Hollander was the chairperson of the MOSSFA (Marine Oil Snow Sedimentation and Flocculent Accumulation) working group, running of workshop that included participation of over 70 people, and was a co-convener for two scientific sessions at the national GOMOSES meeting sponsored by the Gulf of Mexico Research Initiative. Most importantly, Dr. Hollander was a co-chief scientist with Prof. Steve Murawski (USF) and Prof. Maickel Armenteros (University of Havana, Cuba) on a C-IMAGE II Research Cruise to the northern coast of Cuba aboard the *R/V Weatherbird II*. This was the first cooperative US-Cuba research cruise in over 60 years, and involved the participation of over 30 Cuban graduate students. Many of these student had never been aboard a research vessel, so we conducted a "student day at sea" where the students were shown the techniques needed for conducting off-shore oceanographic research.

Dr. Chuanmin Hu (**Ocean Optics and Optical Remote Sensing**)

Nearly all marine life depends on light. Dr. Hu's research is focused on addressing coastal ocean problems using primarily optics. These problems include river-ocean interactions (transport and transform of particulate and dissolved matters), carbon cycling, algal blooms, coral reef environmental health and ecosystem connectivity, climate change and anthropogenic influence on coastal/estuarine water quality. Dr. Hu and his group members at the Optical Oceanography Lab approach these problems through 1) characterizing the underwater light field using the state-of-the-art optical equipment; 2) developing satellite remote sensing algorithms and data products specifically targeted to these problems; and 3) integrating these products with other data to understand coastal ocean changes in bio-optical properties as well as their causes and consequences. The current research at OOL emphasizes the use of autonomous underwater vehicles (AUVs) to better understand the 3-dimensional light field and algal bloom formation, and high-resolution satellite remote sensing from which customized data products are derived for estuaries, turbid coastal waters, and optically shallow waters (e.g., coral reefs, seagrass, sargassum). The recent establishment of a virtual antenna system (VAS) and a virtual buoy system (VBS) greatly facilitates data and information sharing on coastal blooms and general water quality with a variety of user groups.

In 2017, Dr. Hu continued his scholarly productivity as in the past. Among his 22 peer-reviewed publications in 2017, of particular importance are those focused on the macroalgae seaweed remote sensing. These seaweeds are found globally but they are most abundant in the tropical Atlantic and Caribbean Sea. Dr. Hu's group has developed forecasting capacity to predict seaweed blooms in the eastern Caribbean to help local management. Another important result from his group is the development of salinity maps using satellite remote sensing over north Gulf of Mexico coastal waters. This is the first time surface water salinity in coastal waters of the Gulf can be mapped from space, and these results have significant implications on ocean circulation, biology, and ecology. His group has further improved the *Sargassum* Watch System (SaWS), Virtual Buoy System (VBS), and Integrated Red tide Information System (IRIS) to monitor coastal ocean blooms and water quality in near real-time.

Dr. Xinfeng Liang (Role of Ocean in the Climate System, Influence of Mesoscale Eddies on Deep Ocean Processes, Ocean Mixing and the Associated Dynamical Processes, Ocean Current Measurement and Ocean State Estimates)

As a physical oceanographer, Dr. Liang is interested in using a combination of observations, numerical models and theory to understand how the ocean works and how the ocean is affected by and responds to the changing climate. In particular, Dr. Liang is interested in how the heat, salt, carbon and other biogeochemical tracers are transported in the global ocean. Another of Dr. Liang's current research interests is the dynamic processes that can supply energy to ocean mixing, and these processes mainly include internal tides, near-inertial oscillations and mesoscale eddies. Dr. Liang has extensive seagoing experience, primarily in acquiring and processing data from Lowered/Vessel - mounted Acoustic Doppler Current Profiler (ADCP). Furthermore, he is familiar with the system of ocean state estimation (e.g. ECCO), which is powerful and has huge potential in addressing fundamental oceanographic questions.

In 2017, Dr. Liang, along with colleagues from MIT and Woods Hole Oceanographic Institution, published an important study on the estimation of the global ocean vertical velocity in *Journal of Geophysical Research: Oceans*, one of the top journals in oceanography. This paper revealed strong upwelling and downwelling in the high latitude regions and provided important insights about the vertical exchange of ocean properties and tracers. Dr. Liang also led another study focusing on the long-term changes in the global ocean vertical heat transport, which is essential for interpreting the recent slowdown of the global surface warming. This study was published in *Journal of Climate*, one of the top journals in climate science. Together with colleagues from the Ocean University of China, Dr. Liang co-authored another paper on mesoscale eddies and mixing in the South China Sea. Dr. Liang was also very successful in seeking external funding. He submitted four proposals as lead PI, two of which were selected (NSF, GoMRI), and the other two are still pending. Finally, Dr. Liang developed and taught two courses: *Introduction to Climate Change and Climate Variability* and *Geophysical Fluid Dynamics*. Both courses were well-received by students and a senior faculty member (Dr. Albert C. Hine) who sat in on the climate course thought highly enough of the course to recommend that it be a "capstone" course.

Dr. Mark Luther (Maritime Safety and Security; Real-Time Ocean Observation Systems; Numerical Models of Ocean Circulation; Coastal Water Quality)

Dr. Luther is Director of the Ocean Monitoring and Prediction Lab in the University of South Florida College of Marine Science, where he co-directs the Coastal Ocean Monitoring and Prediction System. Dr. Luther's research involves the combination of real-time ocean observations with numerical models of ocean currents and processes and their application to various problems ranging from maritime safety and security to water quality in estuaries to variability in large-scale ocean circulation and its relation to climate change. He has provided operation and maintenance support for the NOAA/NOS Tampa Bay Physical Oceanographic Real-Time System (TB-PORTS) since 1995.

In 2017, Dr. Luther continued development of a new USF/CMS Center for Maritime and Ports Studies (CMPS). Objectives of the CMPS are to promote workforce development for the maritime transportation system industry, conduct research to foster sustainable, secure, and resilient maritime and port infrastructure and operations, and promote development and application of maritime sensor technologies. The introductory course for a Certificate in Maritime and Port Studies has been offered for the past five semesters and has been submitted for formal course approval. A curriculum for a graduate certificate has been developed and will be submitted for approval in the very near future. In addition to his scholarly publications, Dr. Luther's work was recognized in the Washington Post, on the NBC Today Show, and on HBO's Last Week Tonight with John Oliver.

Dr. Gary Mitchum (Climate Change; Ocean Eddies; Satellite Remote Sensing; and Sea Level Rise/Associate Dean for Research)

Dr. Mitchum's research focuses on the study of 20th century sea level rise using satellite and in situ data to study sea level variations and climate change. In addition, he also works on a wide variety of problems in the general area of ocean physics, including ocean eddies, the El Nino phenomenon, internal tides and various types of ocean waves. He also has a long-standing interest in the application of ocean physics to improve our understanding of fisheries.

In 2017, Dr. Mitchum and his student, Mr. Yingli Zhu, had a breakthrough of sorts. The study of fluid flow goes back to Sir Isaac Newton, and Newton is largely responsible for the famous, but unfortunately unsolvable, equations that govern ocean and atmospheric variations. These equations determine our weather and climate, so we wish we could solve them, but no such luck. Dr. Mitchum and Mr. Zhu, however, managed to derive what is called an integral solution to a particularly useful subset of these equations. So what does that mean? What it means is that we now have a new set of diagnostics that will allow us to exploit satellite and tide gauge observations of sea level in novel ways. Dr. Mitchum and Mr. Zhu suspect that this is all as clear as mud to you right now, but give them a little time and you might be amazed at the results. Preliminary results were presented at an international sea level conference in New York last July, and a proper paper will be prepared soon.

Dr. Pamela Hallock Muller (Biological, Environmental and Evolutionary Controls on the Production and Accumulation of Carbonate Sediments: Geologic History of Reefs; Modern Coral Reefs; Shelf Ecology; Environmental Management; Micropaleontology; Paleoceanography; Paleoecology)

Dr. Hallock Muller's research focuses on mondern and fossilized ecosystems that provide insight into past and present environments, as well as effects of human activities on future tropical marine ecosystems. Her group utilizes Foraminifera as model organisms for environmental and paleoceanographic research. Ongoing projects include: a) decadal-scale changes in reef communities of the Florida Keys, b) biology and ecology of benthic foraminifera, corals and their algal symbionts, c) development of bioindicator protocols applicable to reef environments worldwide, and d) effects of ocean acidification on calcification of benthic organisms.

With retirement in sight, Dr. Hallock Muller focused on seeing her current graduate students through to graduation and getting their research published. In 2017, Adrienne George graduated, as Dr. Hallock Muller's fourth doctoral student from an under-represented minority to earn a PhD in the past two years. In addition, Dr. Hallock Muller is Editor of the *Journal of Foraminiferal Research*, a quarterly society journal that deals with the most abundant shelled organisms in the world's oceans and that have the most detailed fossil record of any group of organisms. In this editorial role, she is committed to using her expertise in marine science, ecology paleoecology, quantitative analyses and scientific writing to provide opportunities for international researchers, especially young scientists, to see their manuscripts through to publication. As a consequence, she expends huge efforts to ascertain that good science is not lost because of language challenges, and that the papers that

she accepts are well-written, solid scientific contributions. She also brings that commitment to her own work and is a sought-after collaborator by international scientists. For example, Prof. Luis Pomar is a Sorby Medalist, which is the highest award of the International Association of Sedimentologists. Dr. Hallock Muller's collaboration with Prof. Pomar resulted in the 2017 publication of Pomar et al., Reef building and carbonate production modes …, in *Marine and Petroleum Geology*. This massive paper builds upon field research of Spanish and Italian sedimentologists in the context of Prof. Hallock's conceptual and paleoecological interpretations (and insightful editing).

Dr. Frank Muller-Karger (Changes in Marine Ecosystems Using Field-based and Satellite Remote Sensing Time Series)

Dr. Muller-Karger conducts research on how marine ecosystems change in time. He uses time series of observations collected by traditional oceanographic methods and by satellite sensors to study changes in water quality, primary production, and biodiversity in coastal and marine environments. This research helps in understanding how large-scale phenomena, like climate change or other disturbances, affect ecosystems including people. The focus of his present work is to assess the importance of continental margins, including areas of upwelling, river discharge, and coral reefs in the global carbon budget. Dr. Muller-Karger combines the observations from different satellites to measure ocean color, sea surface temperature, winds, salinity and sea surface elevation. He uses field-based time series to measure the vertical structure of plankton and how particles settle in the ocean. Much of this work focuses on improving methods to measure the diversity of phytoplankton using remote sensing.

In 2017, Dr. Muller-Karger's group unveiled a new computer application for biodiversity analyses in the Exclusive Economic Zones of countries around the world at the plenary meeting of the Group on Earth Observations (GEO) in October, 2017, in Washington, DC. The application combines satellite data from Earth-observing satellites with information stored at the Ocean Biogeographic Information System (OBIS) of UNESCO. The target users are governments around the world, non-governmental organizations, and science groups. Also, the National Science Foundation awarded Dr. Muller-Karger a Research Coordination Network (RCN) grant to coordinate Ocean Observations, and he was selected to serve on the OceanObs'19 Program Committee. In addition, the A.P. Sloan Foundation renewed a major grant, co-managed by Dr. Muller-Karger, to provide fellowships to under-represented minorities. His lab employed 13 people: five students (one MS, four PhD), five postdocs, two programmers, and an outreach coordinator. He also hosted three international scholars. Dr. Muller-Karger's group published 23 peer-reviewed. Finally, Dr. Muller-Karger received the National Oceanographic Partnership Program Excellence in Partnering Award for leading the National Marine Sanctuaries as Sentinel Sites for a Demonstration Marine Biodiversity Observation Network.

Dr. Steve Murawski (Population dynamics of exploited marine species; impacts of fishing and other anthropogenic stresses on marine ecosystems; ecosystem modeling and analysis /St. Petersburg Downtown Partnership Peter R. Betzer Endowed Chair)

Dr. Murawski is a fisheries biologist and marine ecologist involved in understanding the impacts of human activities on the sustainability of ocean ecosystems. He has developed approaches for understanding the impacts of fishing on marine fish complexes exploited in mixed-species aggregations. Additionally, his work on impacts of marine protected areas and other management options has formed the scientific basis for regulation. Such assessments can help inform investments to rebuild the Gulf of Mexico from effects of the oil spill, loss of juvenile nursery areas, nutrient enrichment, overfishing and other factors. Dr. Murawski currently serves as Director of the Center for Integrated Analysis and Modeling of Gulf Ecosystems (C-IMAGE), which is funded by a grant from the Gulf of Mexico Research Initiative. Additionally, he is applying advanced technology

solutions to the next generation of marine ecosystem surveys through a joint program with the Center for Ocean Technology to develop towed video systems for fish and habitat assessments.

In 2017, Dr. Murawski led two major research groups engaged in large-scale field and laboratory analyses. The C-IMAGE Consortium (Center for Integrated Modeling and Analysis of Gulf Ecosystems) completed a circumnavigation of the Gulf of Mexico to collect important baseline information for all Gulf continental shelves off the USA, Mexico and Cuba. This achievement was recognized by USF-World, with its prestigious "Global Engagement (Group) award. C-IMAGE was also the recipient of an additional competitive grant of $5.1 million in 2017 to complete its analysis and modeling activities and to author two major books, which will be published in 2018. CSCAMP, the Continental Shelf Characterization, Assessment, and Mapping Project is funded through a $4.2 million grant to Dr. Murawski from the National Fish and Wildlife Foundation's Gulf Benefits Fund, and seeks to map and characterize up to 3,000 km^2 of heretofore undiscovered high-value reef fish and sea turtle habitat on the West Florida shelf. During 2017 about 1,000 km^2 were mapped, and new approaches to auto-classification of video data and analysis of multibeam data were developed. In addition to supervising these major research programs, Dr. Murawski and co-authors published eight research papers and presented nine presentations/posters at major research conferences. He also served on important national committees including the National Academies Ocean Studies Board, NOAA's Fleet Recapitalization External Review Committee, and the national Academies' study of the use of oil dispersants. He also currently supervises eight Masters and PhD committees, and serves on an additional nine student committees.

Dr. David Naar (Marine Magnetics; Mid-Ocean Ridge and Hotspot Interactions; Plate Tectonics; Seafloor Mapping with High-Resolution Multibeam Sonars of Artificial and Real Coral Reefs, Mines, Paleoshorelines, Hydrothermal Vents, and Fish Habitats; and Wax Analog Modeling of Seafloor Spreading Processes/Associate Dean for Graduate Studies)

Dr. Naar's research interests have been addressed with oceanographic seafloor mapping expeditions to the Gulf of Mexico, Atlantic, Pacific, and Indian Oceans. Analyses of multibeam, magnetics, gravity, side-scan sonar are made in conjunction with insight from a seafloor spreading analog wax model. Current projects include: Plate tectonic reconstruction of the Pacific-Nazca plates, Off-axis volcanism along the Easter Seamount Chain, Deep submersible investigations of exposed oceanic crust, Benthic habitat studies of Pulley Ridge, Florida Middle Ground, and Panama City Beach.

In 2017, Dr. Naar published a paper with his PhD student, Josh Kilborn, regarding a new methodology for analyzing large temporal and spatial datasets (Kilborn, J. P., D. L. Jones, E. B. Peebles, and D. F. Naar, Resemblance profiles as clustering decision criteria: Estimating statistical power, error, and correspondence for a hypothesis test for multivariate structure. *Ecology and Evolution 7*:2039-2057, 2017). This same student, co-advised by Dr. Ernst Peebles, gave an excellent commencement speech in December 2017, (http://www.marine.usf.edu/news/inspirational-commencement-speech-delivered-by-joshua-p-kilborn). Two other students, Jennifer Brizzolara and Lewis Steward also graduated in 2017 with their MS degrees. All three students have found employment in their respective fields of training. In collaboration with international co-authors, Dr. Naar contributed to a manuscript submitted to *Geomorphology* documenting previous sea-level heights since the last ice age around Male, an island of the Maldives in the Indian Ocean, using high-resolution multibeam sonar.

Dr. John Paul (Development of Biological Sensors to Detect Harmful Microbes in the Coastal Ocean; Development of "Grouper Forensics" to Detect Authenticity of Seafood in Restaurants and Seafood Suppliers; Importance of Silent Viral Infections on Life in the Seas; Mechanisms of Gene Transfer in the Oceans that Involve Viruses)

The common research theme in Dr. Paul's is the measurement of gene expression as a means to understanding microbially-mediated processes in the oceans. This is divided into specific areas of research that include lysogeny, phytoplankton carbon fixation, and development of sensors. Lysogeny is the process whereby a virus establishes a stable symbiosis in its host. His group is examining the genomes of temperate marine bacteriophages to understand the control of lysogeny in heterotrophic bacteria and picocyanobacteria in the marine environment. His studies in carbon fixation have focused on the control of this process in oceanic river plumes. Such plumes have tremendous CO_2 drawdown, yet also behave as areas of high levels of recycled production. Dr. Paul's group is using their experience in measuring mRNA as a surrogate for microbial gene expression in the design of hand-held and autonomous sensors (in conjunction with the Center for Ocean Technology) for the detection of noxious microorganisms in coastal environments.

In 2017, Dr. Paul and his group had an important paper in *Science*, which is a major journal in our field. This paper was the result of funding from the Moore Foundation that enabled his group to study the Amazon River Plume. Specifically, they studied the control of biogeochemical processes by the genomic capabilities of the organisms in their environment. In addition, Dr. Paul established a lab for a new company in Bayfront Medical Plaza, and provided support for Robert Ulrich, a former student of Dr. Paul's, as well as a USF undergraduate and a St. Petersburg College graduate. This company is developing molecular diagnostic kits for rapid pathogen identification in clinical environments.

Dr. Ernst Peebles (Biological Oceanography/Marine Resource Assessment)

Dr. Peebles' research foci include: 1) spatio-temporal interactions between coastal fishes and their prey, particularly as these are affected by freshwater flows to the coast and other physical processes, to manage environmental flows into estuaries and to develop community-level metrics for establishing the extent of eutrophication in coastal water bodies; 2) use of stable isotope analysis to investigate factors that influence coastal biomass pathways to identify site fidelities and movements that determine geographic habitat connectivity; and 3) DNA barcoding and hydrodynamic models to our effort to characterize habitat connectivity during egg and larval stages. In a related effort, we have been using otolith microchemistry (LA-ICP-MS) to connect adult fish to the geographic regions they used as nursery habitat and to detect exposure of individual fish to stressful events such as oil spills.

In 2017, building on a proposal submitted in 2016, Dr. Peebles and his USF colleagues, Drs. Mya Breitbart, Steve Murawski, and Chris Stallings, successfully established USF as the 2017-18 RESTORE Act Center of Excellence for the State of Florida. This research program also includes Dr. Kevin Boswell of FIU, Dr. David Chagaris of UF, and Dr. Jim Locascio of Mote Marine Lab (Dr. Locascio earned his PhD at USF). The team's idea was to apply DNA barcoding, lifetime chemical records (stored within the eyes and ears of the fish!), and the latest acoustics- and camera-based technologies towards identifying limitations on fisheries production. Their proposed plan was successful, earning them $887,000 for a two-year pilot study, along with the opportunity to renew funding for 15 years thereafter. The team intends to build on this funding to create a larger research effort for Florida's continental-shelf waters, which can extend more than 140 miles offshore. Additional information about the Florida RESTORE Act Centers of Excellence, which is administered by the Florida Institute of Oceanography, can be found at https://www.facebook.com/floridainstituteofoceanography/posts/880959472015865:0.

Dr. Brad Rosenheim (Paleoceanography/Paleoclimate, stable isotopes, carbon cycling)

Research in Dr. Rosenheim's group aims to constrain changes in climate and carbon cycling in the recent geologic past, from the anthropocene to the last glacial maximum. Researchers working with Dr. Rosenheim employ isotopic techniques including conventional stable isotope measurements (H, C, N, O), non-conventional stable isotope measurements ("clumped" isotopes in CO_2 derived from carbonate minerals), and

radioisotopic techniques including uranium system dating and radiocarbon analysis. Dr. Rosenheim's group obtains geologic and oceanographic data from sediment, coral and sclerosponge skeletons, ice, and the open ocean water column.

In 2017, Dr. Rosenheim published four peer-reviewed manuscripts in 2017, one led by a PhD student in his group and another by a postdoctoral investigator in his group. The most important was published in *Geophysical Research Letters* and stemmed from a series of ocean-going research expeditions Dr. Rosenheim led in search of signatures of Deepwater Horizon oil in Gulf of Mexico waters and sediment. In the paper, Dr. Rosenheim and his colleagues (led by Dr. Brett Walker, University of California, Irvine) describe a conspicuous signal of petrocarbon (oil-derived organic carbon) in the water column in 2014, four years after the spill. Most researchers thought that sediment would be the primary record of oil contamination in the Gulf of Mexico years to decades after the storm, but this research creates interesting and important questions for the community and the public to consider. Firstly, what are the oceanographic processes that allow this deep, mesophotic signature to persist for four years? Because the signature is isotopic and not chemical, is this is a sign of toxicity that is still present after the spill? And finally, what processes, microbial or other, allowed the water column to record the oil spill in the dissolved organic matter? In addition to this regionally-interesting endeavor, the other papers published by Dr. Rosenheim's research group and colleagues touch on timing of the deglaciation in Antarctica, cycling of permafrost carbon in the Alaskan arctic, and the stability of the vast soil carbon reservoir on Earth, all important to understand climate change.

Dr. Brad Seibel (**Physiological response of marine animals to extreme environments, ocean acidification, deoxygenation and warming, polar and deep-sea biology, biology of mollusks)**

Dr. Seibel's research employs a unique suite of field and laboratory techniques and approaches to assess the ecological consequences of climate change, including ocean acidification, deoxygenation and warming, and the role of animal energetics in ecosystem dynamics. He carries out broad comparative physiology studies to determine the limits to evolution and ecology. Physiological mechanism provides a foundation upon which ecosystem responses to climate change and consequences for biogeochemical cycles can be understood. His research group compares organisms across size, depth, latitudinal and phylogenetic lines, from microzooplankton to macronekton, ctenophores to fishes, from the poles to the equator and from the abyssal plains to the ocean surface. His research strives to integrate across levels of organization, from mitochondria to ecosystems and focuses on the physiology of individual species and what this can teach us about their origin, behavior, ecology, diversity and the ecosystems in which they live.

In 2017, Dr. Seibel and his collaborators completed a major National Science Foundation funded oceanographic expedition in the Eastern Tropical Pacific studying the expanding low oxygen zone and its impact on marine species. They demonstrated that declining oxygen directly influences the diversity, abundance and distribution of key zooplankton species and as well as top predators. The work informed an UNESCO working group, the Global Ocean Oxygen Network, resulting in a recent publication in *Science*, "Declining oxygen in the global ocean and coastal waters" on which Seibel is an author.

Dr. Amelia Shevenell (Paleoceanography/Paleoclimatology; Trace and minor elements in biogenic calcite and marine sediments; Stable isotopes in carbonate and siliceous marine microfossils; Lipid biomarkers; Sedimentology)

Dr. Shevenell's research focuses on generating high-resolution geochemical records from marine sediments to address questions related to Earth's Cenozoic climate evolution. Her current research interests are geographically diverse (including the Southern Ocean and North Pacific Ocean) and divided into three focus areas: 1) Cenozoic Antarctic ice sheet development from far-field and ice proximal records, 2) the role of the

high-latitude oceans in Glacial-Interglacial carbon cycling, and 3) Antarctic Holocene climate variability. Paleoclimate/paleoceanographic research undertaken by the Shevenell Lab is relevant to IPCC concerns that ongoing climate changes are accelerating polar ice cap melting and global sea level rise. Shevenell and her students develop, calibrate, and employ a wide variety of inorganic and organic geochemical and micropaleontologic techniques to reconstruct past changes in ocean temperature, circulation, productivity, continental ice volume, and carbon cycling on decadal to orbital timescales. This multi-proxy approach enables Shevenell, her students, and their collaborators to address the broadest range of climate and biogeochemical problems.

In 2017, Dr. Shevenell published a first author paper in *Nature* highlighting the results of a 2014 research cruise to the Sabrina Coast, East Antarctica. Using marine geophysical and sediment data, Shevenell and her colleagues hypothesized that large regions of the East Antarctic Ice Sheet are more sensitive to climate changes than previously thought. Large quantities of glacial meltwater during past warm climate intervals may have enabled glaciers near the Sabrina Coast to thin and retreat more rapidly than in other regions of Antarctica. This research has important implications for global sea levels, as Earth's atmosphere and ocean temperatures warm. Their discovery is particularly alarming, as this region of the East Antarctic Ice Sheet is currently thinning and retreating faster than any other East Antarctic region. Dr. Shevenell's Sabrina Coast research was featured in at least 15 mainstream media outlets, including *National Geographic, Wired*, and *Newsweek*. In the coming years, Dr. Shevenell and her colleagues intend to return to the Sabrina Coast with the International Ocean Discovery Program (IODP) to recover longer sediment sequences that will help them better understand the evolution and stability of Antarctica's ice sheets. This is not an easy task, as drilling on Antarctica's continental margins is technically challenging. However, the science is compelling and IODP has requested that Dr. Shevenell develop a multi-million-dollar proposal to drill the Sabrina Coast, East Antarctica.

Dr. Chris Stallings (**Ecology; Marine conservation and management efforts**)

Research in Dr. Stallings' lab focuses on basic concepts in ecology, yet includes a strong applied component to inform marine conservation and management efforts. Overarching efforts seek to estimate the abundance of marine organisms and examine the ecological processes that drive population and community dynamics. His lab's questions are often framed to evaluate the effects of human activities, such as fishing and coastal development, on ecological systems. Therefore, much of the research is field-intensive and involves both experimental and large-scale observational approaches. However, the lab also incorporates an extensive laboratory component through mesocosm experiments and use of stable isotope analysis. Moreover, the Stallings Lab explores large datasets, using multivariate statistics and GIS to reveal broad- scale ecological patterns that may be further explored through focused regional field studies.

In 2017, Dr. Stallings published nine papers in peer-reviewed journals, four of which were led by his graduate students. One of these student-led papers, Tzadik et al. (2017 *Limnology and Oceanography Methods*), was a tremendous accomplishment as it provided the first ever review of using chemical archives in non-otolith (i.e., ear bones – the traditional material used) fish tissues, which is an emerging approach in the field. This review has the potential to be the go-to reference for other researchers wishing to conduct chemical archiving studies on fishes, and possibly other organisms as well. It is also notable that not only were all authors from the College of Marine Science, but it included five graduate students and one postdoc. Graduate students have continued to have success in the Stallings Lab, with the sixth student graduating in 2017 (five MS and one PhD to date). All students have continued in the field after graduation. Some of Dr. Stallings research received quite a bit of media attention in 2017, including a one-hour radio feature on BBC World Service concerning his lionfish research (http://www.bbc.co.uk/programmes/w3csvp6d). Perhaps most importantly, Dr. Stallings was granted tenure and promoted to Associate Professor in 2017.

Dr. Robert Weisberg (**Ocean Circulation; Ocean-Atmosphere Interaction Studies in the Tropics; and West Florida Continental Shelf Circulation**)

Dr. Weisberg is an experimental physical oceanographer engaged in ocean circulation and ocean-atmosphere interaction studies in the tropics, on continental shelves, and in estuaries. His research presently emphasizes the West Florida Continental Shelf (WFS) circulation and the interactions occurring between the shelf and the deep-ocean and between the shelf and the estuaries. Through his Ocean Circulation Group, he maintains a coordinated program of real- time, in-situ measurements, analyses, and numerical circulation models aimed at describing and understanding those processes that determine WFS water properties. Observations consist of surface moorings for real time surface meteorology, water column ocean currents, and temperature/salinity (T/S), some inclusive of waves; subsurface moorings for currents; HF-radar for surface currents; profilers for T/S (in collaboration with the CMS-COT); analyses of satellite data for SST, SSH, and geostrophic currents; and surface drifters. Models consist of WFS regional applications of ROMS nested in the 1/12th degree North Atlantic HYCOM (to study the WFS and deep-ocean interactions) and FVCOM (to study the WFS and estuary interactions) and sub-regional FVCOM applications to individualestuaries. Additional FVCOM applications, making use of the model's high resolution and flooding/drying capabilities, are for coastal inundation by hurricane storm surge.

In 2017, while serving on a National Academy of Science, Gulf Research Program, Loop Current Dynamics Committee, Dr. Weisberg formulated a new, recently published hypothesis on what controls the movement of the Loop Current into the Gulf of Mexico (Weisberg, R.H. and Y. Liu, 2017), On the Loop current penetration into the Gulf of Mexico, *Journal of Geophysical Research - Oceans*, 122, 9679-9694, doi: 10.1002/2017JC013330]. If further demonstrated to be correct, then this will solve the major unanswered question regarding Gulf of Mexico oceanography affecting oil and gas operations and the climate of the United States. The key is the west Florida continental shelf, long neglected by agencies charged with Gulf of Mexico research because there are no oil and gas operations in Florida waters. Yet from Dr. Weisberg's previous studies, the Loop Current is known to greatly influence everything of an ecological nature on the west Florida shelf, and when it does both the work required to transport new water onto the shelf and the energy dissipated on the shelf may exceed the work required for the Loop Current to displace ambient Gulf waters. Thus the region largely ignored by other agency studies may actually be the region determining the Loop Current's behavior. A second study of major importance is Dr. Weisberg's explanation of how Deepwater Horizon Oil arrived on northern Gulf beaches through a combination of the ocean currents and waves because this provided a recommendation on what is required to track oil in the event of another spill.

Research Faculty

Dr. Yun Li (Phytoplankton and ice phenology, Coastal ecosystem, Stratification dynamics, Dissolved oxygen dynamics, Estuarine circulation and secondary circulation, Biophysical interactions, Biogeochemical-physical models)

Marine ecological systems are dynamic and impacted by both natural variability and anthropogenic perturbations. Dr. Li's research aims to better understand the physical processes and the variety of biological-physical interactions that govern the ecosystem responses to climate and human-induced changes, with particular interests focusing on the "bottom-up" effects, which encompass the changes from physical environment (e.g., stratification, circulation, sea ice) to nutrient cycling to marine primary production. Her research spans a wide spectrum of marine environments from estuaries to continental shelves and from low- to high-latitudes. Dr. Li investigates the ecosystem responses mainly through developing and employing coupled biogeochemical-physical models (e.g., ROMS, FVCOM), complemented by analytical approaches and observational data. Her current research includes (1) linking physical dynamics to biological variability in

circum-Antarctic polynyas and (2) investigating the correlation scale between stratification and marine primary production in the global ocean.

In 2017, Dr. Li received two new grants to continue her modeling study of environmental science in the Antarctic and the Gulf of Mexico in the next 2-3 years. In the first grant, Dr. Li was awarded $191K by the National Science Foundation Polar Programs to investigate the homogeneity of physics and biology in circum-Antarctic polynyas, and she served as the sole PI at USF in a multi-institution research team. The second grant was focused on understanding the effects of mesoscale eddies on three-dimensional oil dispersion. As a co-PI, Li received $137K from the Gulf of Mexico Research Initiative and worked with three USF CMS scientists to simulate the oil droplet trajectory under the influence of mesoscale eddies and biochemical degradation. Dr. Li published two articles on the phenology and abundance of Antarctic Penguins, one in the top-tier journal *Nature Communications*, and the other in the high-impact journal *Ecology* (selected as featured cover story). These studies found that phenological mismatches between Adélie penguin and optimal environmental conditions set upper limit on breeding success, yet stochastic (random) processes can exceed the magnitude of climate-driven trends and complicate the population response. Dr. Li was also a co-author of one book Chapter titled "Chapter 6: Modeling physical and biogeochemical controls on dissolved oxygen in Chesapeake Bay: Lessons learned from simple and complex approaches" which was published by Springer, and a co-author of one working group paper that documented the recent phenological shifts in the ecosystem of Gulf of Maine.

Facilities

Major projects that were completed in 2017 involved the remodel of several labs (KRC 1123, 1125, 1127, MSL 227H) in conjunction with the arrival of a new faculty member, the construction of a new clean lab (KRC 1125A, B) for his research, and the acquisition of two shared-use, high-resolution mass spectrometers (one in KRC and one in MSL). Funding was also provided by USF Tampa for the major lab remodel/building upgrade project that was sidelined in 2015. Engineering and design updates were underway through the end of 2017 with the project slated to begin in early 2018.

Numerous minor projects were also completed throughout the year including replacement of KRC exhaust fan #4; installation of nine security cameras (Phase 1 of a multi-year plan); remodel of MSL 222B into a student bullpen office; maintenance repairs to MSL boiler, KRC fire pump and freight elevator; and painting of the KRC lobby and Deans suite hallway.

Graduate Education and Awards

ACADEMIC AFFAIRS

The new format for the PhD Comprehensive Exams implemented in the Fall Semester of 2015 is continually being improved. The new format consists of an early Integrated Marine Science Exam (IMSE) and then later, a PhD Candidacy Exam (PCE). The IMSE is given after PhD students have completed their four core courses: Biological Oceanography, Chemical Oceanography, Geological Oceanography, and Physical Oceanography, usually at the beginning of their second or third year. Eight professors, two from each discipline, provide a written exam that tests the students' ability to integrate concepts from the four core courses. After suggestions made in 2017, the exam will be given a month earlier, in early August, with an oral exam given in early October for students whose written answers required some additional follow-up. Workshops are provided to help prepare students for the exam.

Drs. Ana Arellano, Kevan Main, Mark Luther, and John Paul, taught five online courses to about 300 undergraduate students. The five courses are: *Introduction to Oceanography, Geological History of Florida, Marine Aquaculture, Port Sustainability,* and *Marine Microbiology*. Additional face-to-face undergraduate courses such as *Introduction to Oceanography* taught by Dr. Teresa Greely, and courses to the USFSP undergraduates such as *Scanning Electron Microscopy* taught Dr. Tony Greco and *Fish Biology* taught by Dr. Chris Stallings, were taught in 2017.

New CMS Students Entering Fall 2017

In 2017, fifteen graduate students, who entered the Marine Science Program in the Fall 2017 semester, attended Orientation Week, including taking a two-day NSF Presentation Boot Camp with faculty, which has led to an improvement in the quality of presentations made by our students and faculty. Additional workshops and seminars were provided to assist the students in preparing for graduate school. Many students from this year and previous years were active in educational outreach activities such as the National Ocean Science Bowl – locally called the Spoonbill bowl where High School students compete in their ability to answer oceanographic questions, the Oceanography Camp for Girls – a camp to encourage girls entering high school to do well in school and consider pathway to a STEM career, the St. Petersburg Science Festival – a city wide open house of the scientific programs at the USF St. Petersburg Campus and neighboring scientific agencies, and the Graduate Student Symposium – an internal symposium to provide experience in giving short scientific talks to a large audience . These training activities and the students' strong research and presentation efforts have paid off as documented by the numerous honors, awards, presentations, and publications listed in this annual report. In 2017, nine students graduated with a PhD and ten students graduated with a MS degree. In 2017, 23 students published first-authored peer-reviewed manuscripts. Another 12 students co-published eight more peer-reviewed manuscripts. Thus in 2017, out of 129 college publications, 35 students were involved with publishing 31 publications out of a total of 129 peer-reviewed manuscripts published by the college.

GRADUATE EDUCATION AND AWARDS

DIVERSITY

CMS works hard to increase minority participation in marine science. The percentage of under-represented minority students in our program over the past 13 years has grown to ~15%, which is nearly double the ~8% national average in Oceanography. We have been able to make significant advances in this issue due to the initial funding support by NSF Bridge to the Doctorate awards to USF's College of Engineering and Marine Science and by the Alfred P. Sloan Foundation. Faculty and administration leaders at CMS over the years, including Ashanti Johnson, Peter Betzer, Frank Muller-Karger, and David Naar, as well as José L. Zayas-Castro and Bernard Batson from the College of Engineering have led these efforts. Funding from the Sloan Foundation (provided to USF as an Alfred P. Sloan Foundation University Center of Exemplary Mentoring (UCEM)), the NSF Bridge-to-the-Doctorate, and private funding from the USF Foundation (managed by PIs: Dr. Frank Muller-Karger, Mr. Bernard Batson, Dr. Ana Arellano and others at the College of Engineering) have been instrumental in attracting and training underrepresented minority students who have demonstrated excellence as undergraduates, usually due to support from the NSF LSAMP program.

One of the important themes stressed at the Annual Compact for Faculty Diversity is that underrepresented minority graduate students benefit from exposure and interaction with others like them who have succeeded in academia. To this end, the Colleges of Marine Science and Engineering continue to invite speakers to inspire our graduate students and our faculty. Our next goal is to improve diversity within the CMS faculty. Below is a photograph from a recent national meeting that the USF Sloan Students & Directors attended in October 2017, see link for more information. http://www.marine.usf.edu/news/usfcms-sloan-students-and-directors-attend-the-institute

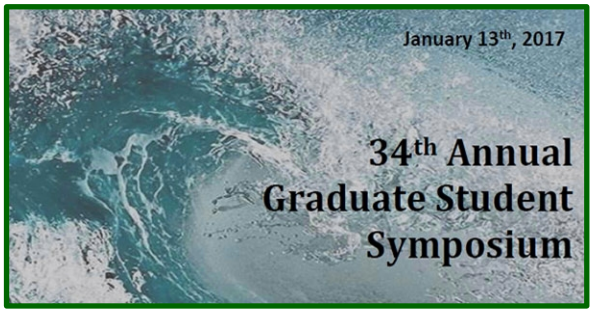
USFCMS SLOAN STUDENTS AND DIRECTORS ATTEND THE INSTITUTE

ATLANTA, GA - CMS Sloan students, scholars and directors attended the 24th Institute on Teaching and Mentoring in Atlanta October 2017. The Institute on Teaching and Mentoring, which is sponsored by Compact for Faculty Diversity, is a four-day conference with the largest gathering of minority doctoral scholars in the country. The Institute focuses on faculty and PhD student diversity. This year the two guest speakers were Judge Glenda A. Hatchett and Margot Lee Shetterly who wrote the book, *Hidden Figures,* which later became a popular 2016 major motion picture

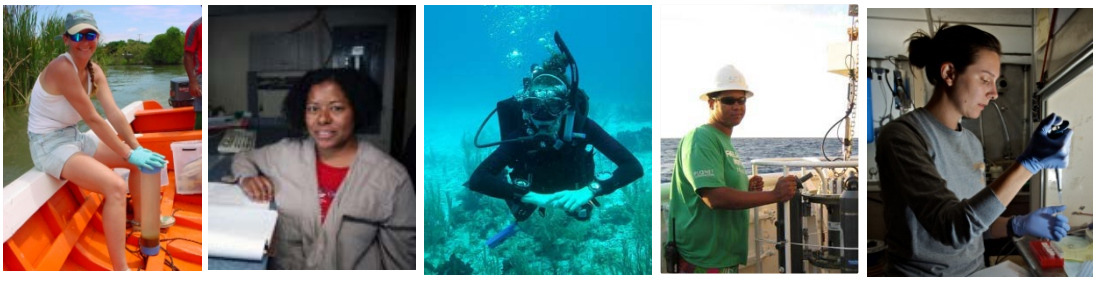
GRADUATE EDUCATION AND AWARDS

CMS Sloan students and directors met Margot Lee Shetterly the author of "Hidden Figures," which reached number one in *The New York Times* Non-Fiction Best Sellers list. This book was partly funded by the Sloan Foundation and was eventually made into a film. Sloan provided autographed books to Sloan students, scholars and directors at the Institute on Teaching and Mentoring.

The annual **GRADUATE STUDENT SYMPOSIUM** held on January 13, 2017 in the MSL Conference Room with 16 oral presentations and eight poster presentations.



- First Place Oral Presentation: Jon Sharp
- Second Place Oral Presentation: Susan Snyder
- Third Place Oral Presentation: Katie Bruder
- Best Poster (a really close call between two):
- First Place: Alyssa Andres
- Runner-up: Kara Vadman



INSPIRATIONAL COMMENCEMENT SPEECH DELIVERED BY JOSHUA P. KILBORN, PHD on Saturday, December 9, 2017, delivered an impactful commencement speech and received a standing ovation from the crowd.

STUDENTS PARTICIPATED IN THE BLUE VISION SUMMIT HEALTHY OCEANS HILL DAY IN WASHINGTON D.C

Thanks to Dean Dixon's generous support, Marcy Cockrell, Megan Hepner, Kate Dubickas, and Alex Ilich participated in the Blue Vision Summit Healthy Oceans Hill Day in Washington, D.C on May 10. Constituents met with 24 Florida Congressional offices, and the CMS team met with 9 of the 24 offices, including Rep. Kathy Castor and Sen. Bill Nelson. They lobbied for efforts to reduce marine debris, maintain federal funding for Florida's coastal resiliency and ocean water quality monitoring programs, and to uphold the moratorium on oil and gas drilling off Florida's coasts. The offices were very receptive and encouraged all students and concerned citizens to reach out to their elected officials, from local to federal, for resolutions of these and other ocean and coastal issues.

STUDENT PERSPECTIVE

BECOMING AN OCEAN ADVOCATE THROUGH EXPERIENTIAL LEARNING

By Kate Dubickas and Alex Ilich

From left to right our class members: Megan Hepner, Ileana Freytes- Ortiz, Stephanie Mills, Kate Dubickas, Dr. Mark Luther, Kelly Vasbinder, Matthew McCarthy, and Alex Ilich

How can scientists most effectively introduce scientific ideas to a broader audience and influence political action? As the culmination of a semester- long ocean policy course at The University of South Florida College of Marine Science, students in the course, including the authors, traveled to Capitol Hill in June 2016 to visit the offices of several US representatives and senators to advocate for ecosystem-based fisheries management (EBFM). During the meetings, we employed knowledge and tactics we gained from the course and from advocacy at the local level. In our classes, we covered a variety of landmark legislation and frameworks that guide management of our ocean, including the Law of the Sea, the National Environmental Policy Act, and the Magnuson-Stevens Fishery Conservation and Management Act. Throughout the class and while in Washington, we honed our policy advocacy skills by meeting with legislative staffers as well as lobbyists and experts from the Pew Charitable Trust, the Ocean Conservancy, and an environmental law firm. These meetings taught us the efficacy of working at the local level, focusing a message on one to three succinct points, and delivering a message in a "problem- solution-ask" framework—clearly presenting a problem, proposing a tangible solution, and directly asking the listener to commit to a specific action.

We began our advocacy training at the local level. As students in the class and as residents of the Tampa Bay area, we wrote and submitted op-eds to local newspapers on ocean issues that directly affect our region, such as the impacts of large pier construction on the Tampa Bay marine environment and the importance of purchasing sustainable seafood and how to identify it in restaurants and supermarkets. This activity put us, the scientists, in charge of the narrative. Working with the newspaper editors taught us how to navigate the press world and make scientific abstractions accessible to a general audience through techniques such as providing understandable metaphors rather than presenting lengthy technical explanations of complex concepts. As a result of this course, a classmate of ours has had several op-eds published in the *Tampa Bay Times*, including "Establish trust fund for coastal recovery," and has continued to contribute to the newspaper.

In addition to working with the local print media, we met with elected officials to discuss local politics. In a meeting with Mayor Rick Kriseman of St. Petersburg, we focused on what a coastal city and marine science hub could do to become a better steward for our ocean. Mayor Kriseman was very receptive to our larger concerns about the marine environment, but we also worked on devising a creative solution to a specific issue—the negative impact of Styrofoam on the local environment. Florida state law "preempts" or prohibits municipalities from banning Styrofoam products in Florida. Thus, instead we asked the mayor if all city events could be made Styrofoam-free, an action that remained within the city's authority. Just a few weeks after our meeting, the mayor announced that the city would stop purchasing Styrofoam products for internal use and events. It wasn't

the city-wide ban we had hoped for, nevertheless, by thinking globally but acting locally and keeping our message focused, we won a small but tangible victory for the local environment.

After meeting with the local Tampa government, we began preparing for our meetings with members of Congress. Using the problem-solution-ask framework, and integrating our expertise in marine science with our increasing knowledge of science policy, our class consulted with expert guest speakers to craft our message, develop a strategy, and schedule meetings with congressional offices. We decided to advocate for EBFM, a fisheries management strategy that takes into consideration a variety of biological interactions and environmental factors when establishing catch limits, as opposed to the traditional single-species approach that assesses the stock of each fish species in isolation. More specifically, we asked Congress to incorporate EBFM in the next reauthorization of the Magnuson-Stevens Act, the primary law governing marine fisheries management in US federal waters. We crafted a message for a bipartisan audience and provided specific state and regional examples to illustrate why addressing this issue was important for constituents of senators and representatives from both parties. Although we didn't achieve our ultimate goal of persuading Congress to include EBFM into the Magnuson-Stevens Act reauthorization, we did win the support of Rep. Kathy Castor, whose district covers the city of Tampa and parts of the surrounding county, and who signed a letter of support in favor of EBFM.

When we enrolled in a course that focused on science policy and communication, we sought to acquire insight into how to address the many problems facing today's ocean and the rising distrust of scientific evidence. We learned that presenting issues in tandem with resolutions in a clear and focused manner, through media outlets and in meetings with elected officials at all levels, communicates scientific ideas to the world outside the university and can influence the actions of the persons who wield governmental power. Through this course, we gained knowledge and practiced skills that not only have made us better advocates for our science but also have helped to facilitate positive change for our ocean.

ACKNOWLEDGMENTS

We would like to thank our Dean, Jacqueline Dixon, and Ocean Policy Professors Frank Muller-Karger and Mark Luther for facilitating experiential learning opportunities for us and many other young scientists. Additionally, much appreciation goes out to the fellow members of our ocean policy course, those speakers who took time to share their expertise, and the University of South Florida College of Marine Science community at large. Lastly, a huge thank you to the fellow members of our small working group, The Blue Stews, comprised of Marcy Cockrell, Megan Hepner, and Matthew McCarthy, for their intellectual prowess, astute insights, and admirable work ethic.

AUTHORS

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Alex Ilich (ailich@mail.usf.edu) are Master of Science students in the College of Marine Science, University of South Florida, St. Petersburg, FL, USA, and co-first authors of this article.

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***Oceanography* | December 2017 | https://doi.org/10.5670/oceanog.2017.403**

STUDENT PERSPECTIVE

DEGREES OFFERED

The following degrees are offered at the College of Marine Science. For more information, please visit our website.

Graduate Certificate

Teaching & Communication Ocean Sciences Broader Impacts

Master's of Science (M.S.)

Biological, Chemical, Geological, Marine Resource Assessment (MRA), and Physical Oceanography Concentrations

Doctoral (Ph.D.)

Biological, Chemical, Geological, Marine Resource Assessment (MRA), and Physical Oceanography Concentrations

STUDENTS GRADUATING IN 2017

Masters (10)

Colna, Kaitlyn advised by Frank Muller-Karger, spring, "Southern Ocean Transport by Combining Satellite Altimetry and Temperature/Salinity Profile Data"

Firesinger, Devon advised by Brad Rosenheim, spring, "Quantity Trumps Quality: Bayesian Statistical Accumulation Modeling Guides Radiocarbon Measurements to Construct a Chronology in Real-time"

Brizzolara, Jennifer advised by David Naar, summer, "Characterizing Benthic Habitats Using Multibeam Sonar and Towed Underwater Video in Two Marine Protected Areas on the West Florida Shelf, USA"

Wall, Kara advised by Christopher Stallings, summer, "Subtropical benthos vary with reef type, depth, and grazing intensity"

Ajandal, Shahd advised by John Paul, fall, "Packaging of Genetic Material by Gene Transfer Agents (GTAs) Produced by Marine Roseobacter Species and Their Effect on Stimulating Bacterial Growth"

Cuyler, Erin advised by Robert Byrne, fall, "Calibration-free Spectrophotometric Measurements of Carbonate Saturation States in Seawater"

Meath, Brenna advised by Ernst Peebles and Heather Judkins, fall, "Stable Isotopes in the Eye Lenses of Doryteuthis plei: Exploring Natal Origins and Migratory Patterns in the Eastern Gulf of Mexico"

Hepner, Megan advised by Frank Muller-Karger, fall, "Reef Fish Biodiversity in the Florida Keys National Marine Sanctuary"

Sosnowski, Amanda advised by Mya Breitbart and Heather Judkins, fall, "Genetic Identification and Population Characteristics of Deep-Sea Cephalopod Species in the Gulf of Mexico and Northwestern Atlantic Ocean"

Stewart, Lewis advised by David Naar, fall, "Investigation of Sedimentary Ridges Using Multibeam Bathymetry and Backscatter near Clearwater, Florida."

PhD (9)

Kosempa, Michael advised by Don Chambers, spring, "Southern Ocean Transport by Combining Satellite Altimetry and Temperature/Salinity Profile Data"

Breithaupt, Joshua advised by Robert Byrne, spring, "Spatio-temporal Dynamics of Soil Composition and Accumulation Rates in Mangrove Wetlands"

George, Adrienne advised by Pamela Hallock Muller, spring, "Characterizing Gross Lesions in Corals on Fringing Reefs of Taiwan and Hainan Island, China"

Fahsbender, Elizabeth advised by Mya Breitbart, summer, "Viruses in marine animals: Discovery, detection, and characterization"

Crowley, Claire advised by Kendra Daly, summer, "Pollutants and Foraminiferal Assemblages in Torrecillas Lagoon: An Environmental Micropaleontology Approach"

Leigh, Brittany advised by Mya Breitbart, fall, "Role of viruses within metaorganisms: Ciona intestinalis as a model system"

Kilborn, Joshua advised by David Naar, fall, "Investigating Marine Resources in the Gulf of Mexico at Multiple Spatial and Temporal Scales of Inquiry"

McCarthy, Matthew advised by Frank Muller-Karger, fall, "Evaluating Satellite and Supercomputing Technologies for Improved Coastal Ecosystem Assessments"

Subt, Cristina advised by Brad Rosenheim, fall, "Resolving Chronological and Temperature Constraints on Antarctic Deglacial Evolution through Improved Dating Methodology"

STUDENT AWARDS AND ACHIEVEMENTS

In 2017, There were 15 external awards (including two honorable mentions) totaling $171,670. There were also multiyear awards from previous years whose 2017 funding totaled $196,000. Combined, the students brought in $367,670 of external funding to the College of Marine Science. Many of the federal awards and the McKnight Fellowships also come with extra funds to cover tuition and health insurance covered, but those amounts are not shown in the award amounts totaled above or listed below.

The graduate students had two best student presentation awards and one runner-up. There were several students and alumni featured in the News.

2017 Student External Awards

Oscar Ayala: Southern Florida Explorers Club ($2,000)

Shannon Burns: NSF Graduate Research 2017 Fellowship Program Award Honorable Mention

Makenzie Burrows: WLP Dorothy L. Morgan Endowed Scholarships in Marine Science Awarded at the Women in Leadership & Philanthropy (WLP) Reception on August 30, 2017 ($500)

Cara Estes: 2016 Gulf of Mexico Coastal Ocean Observing System Fellowship ($20,000/yr for 3 years)

Dinorah Chacin: McKnight Doctoral Fellowship ($12,000/yr for 5 years)

Elizabeth Fahsbender: NSF East Asia and Pacific Summer Institutes (EAPSI) program (to cover travel expenses ~$4,000)

Meaghan Faletti: Ken and Sonia Smith Scholarship awarded through the Florida Skin Divers Association in recognition of her dedication to education and outreach concerning the lionfish invasion ($2,000)

Jonathan Peake: AFS Florida Chapter Travel Grant ($170)

Meaghan Faletti: Guy Harvey Scholarship ($5,000): Pew Oceans Trust ($10,000)

Elizabeth Herdter: Guy Harvey Scholarship ($5,000)

Alex Ilich: Open Science for Synthesis: Gulf Research Program funding to attend a 3-week intensive training, convening in July 2017 at the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, CA, on scientific computing and scientific software for reproducible science (~$3,000)

Meaghan Hepner: John A. Knauss Marine Fellowship NOAA Sea Grant Fellows Program (~$61,000 covers travel, moving expenses, and annual stipend)

Makenna Martin: 2017 Joseph A. Cushman Award for Student Research ($2,000)

Natalie Sawaya: NSF Graduate Research 2017 Fellowship Program Award Honorable Mention

Outstanding Research/Presentation Awards

Jacki Long: Best student poster award (1st place), Astrobiology Science Conference 2017 (LPI Contrib. No. 1965), Mesa, Arizona, 24 – 28 April 2017.

Natalie Sawaya: Best Early Career Presentation at the International Council for the Exploration of the Sea (ICES) conference for her talk about using environmental DNA to decode marine biodiversity in the Florida Keys National Marine Sanctuary

Susan Snyder: 2017 Admiral James Watkins best student paper at the Gulf of Mexico Oil Spill and Ecosystem Conference

Julie Vecchio: Best Poster Runner-up, Florida Marine Science Symposium Oct. 2017

2017 Events in the News or on the www.marine.usf.edu Website

Shaojie Sun: A report in *Public Radio International* (*PRI*): "Forgotten satellite data are helping researchers reconstruct the effects of a 1979 oil spill" by Steve Murawski, Chuanmin Hu & Shaojie Sun highlight results from satellite mapping of 1979 Ixtoc oil spill (https://www.pri.org/stories/2017-06-06/forgotten-satellite-data-helping-researchers-reconstruct-effects-1979-oil-spill)

Kelly Vasbinder, fellow students, Teresa Greely (Alumnus), and Angela Lodge (Staff): The students and staff of "Oceanography Camp for Girls." Were featured at this weblink below: https://oceanographycampforgirls.wordpress.com/2017/06/26/ocg-in-the-field-research-cruise-aboard-the-rv-angari/

Meaghan Faletti: Media research coverage: "I'm a Florida Sportsman: The Scientist" *Florida Sportsman*, October 2017; "Scientist Discovers Secret Lives of Fish – By Peering Into Their Eyes" *Compass Points* (blog), Pew Charitable Trusts July 20, 2017; "Fish Eyes Bring Big Secrets into Focus" *Florida Diver* June 26, 2017

Joshua P. Kilborn: Inspirational Commencement Speech Delivered by Joshua P. Kilborn. http://www.marine.usf.edu/news/inspirational-commencement-speech-delivered-by-joshua-p-kilborn

Natalie Sawaya: Natalie Sawaya wins best early career presentation at international conference http://www.marine.usf.edu/news/natalie-sawaya-wins-best-early-career-presentation-at-international-conference

Makenna Martin: Makenna Martin receives Joseph A. Cushman Student Research Award http://www.marine.usf.edu/news/makenna-martin-receives-joseph-a-cushman-student-research-award

Jon Sharp, Katelyn Schockman, and Ellie Hudson-Heck: CMS Students on NOAA Ocean Acidification Cruise http://www.marine.usf.edu/news/cms-students-on-noaa-ocean-acidification-cruise

Michael Martinez-Colon: Michael Martinez-Colon receives GRP Early-Career Research Fellowship http://www.marine.usf.edu/news/michael-martinez-colon-receives-grp-early-career-research-fellowship

STUDENT PERSPECTIVE

Marcy Cockrell, Megan Hepner, Kate Dubickas, and Alex Ilich: Students participated in the Blue Vision Summit Healthy Oceans Hill Day in Washington D.C. http://www.marine.usf.edu/news/students-participated-in-the-blue-vision-summit-healthy-oceans-hill-day-in-washington-d-c

Jacki Long: Jacki Long wins first place poster award from Astrobiology Science Conference. http://www.marine.usf.edu/news/jacki-long-wins-first-place-poster-award-from-astrobiology-science-conference

Lewis Stewart: Investigating sediment transport over a 15 year time period on the West Florida Shelf http://www.marine.usf.edu/news/investigating-sediment-transport-over-a-15-year-time-period-on-the-west-florida-shelf

Ryan Venturelli: Ryan Venturelli wins second place at 2017 Statewide Graduate Student Research Symposium http://www.marine.usf.edu/news/ryan-venturelli-wins-second-place-at-2017-statewide-graduate-student-research-symposium

Liz Fahsbender: PhD student Liz Fahsbender selected for NSF EAPSI Fellowship in Japan http://www.marine.usf.edu/news/phd-student-liz-fahsbender-selected-for-nsf-eapsi-fellowship-in-japan

Kema Malki: Kema Malki awarded a 2017 NSF Graduate Research Fellowship while working with Dr. Breitbart http://www.marine.usf.edu/news/kema-malki-awarded-a-2017-nsf-graduate-research-fellowship

Susan Snyder: Susan Snyder receives the 2017 Admiral James Watkins award http://www.marine.usf.edu/news/susan-snyder-receives-the-2017-admiral-james-watkins-award

Matt McCarthy: Developing the Capacity to Generate Coastal and Shallow-Water Basemaps for Tropical Island Nations and Territories of the Pacific. http://www.marine.usf.edu/news/developing-the-capacity-to-generate-coastal-and-shallow-water-basemaps-for-tropical-island-nations-and-territories-of-the-pacific

Imogen Browne: Two CMS researchers to participate on IODP Expedition 374 to the Ross Sea, Antarctica http://www.marine.usf.edu/news/two-cms-researchers-to-participate-on-iodp-expedition-374-to-the-ross-sea-antarctica

Education and Outreach

Teresa Greely and Angela Lodge led the college's education programs of E&O in support of the USF mission for Community Engagement. The accomplishments in E&O reflect a diversity of programs and events that have advanced ocean literacy and research amongst K-12 teachers and their students, undergraduate and graduate students, as well as public audiences encompassing community.

- With NOAA B-WET and C-MAGE 2 funding, E&O continued to lead 60 Florida teachers through an experiential field course to monitor and understand Tampa Bay's coastal environments. Teachers learned how to collect and analyze hydrologic, atmospheric, and soil measurements following scientific protocols and sharing internationally.

Teachers in Field Program exploring the watershed from the Bay to the Gulf.

The Spoonbill Ocean Sciences Bowl. E&O team hosted the 14th annual academic brain bowl with over 170 participants, including 115 high school students and teachers from across West Florida. Volunteers, both returning and new, represented the FWCC, Eckerd College, USGS, Clearwater Aquarium, FMSEA, FL Sea Grant, Florida Aquarium, Ocean Optics, USFSP, and USF Marine Science. Congratulations to Eastside High School from Gainesville, Florida who advanced to the NOSB Finals competition.

Eastside High School from Gainesville, Florida

Oceanography Camp for Girls Team

EDUCATION AND OUTREACH

- The Oceanography Camp for Girls. Our pre-college STEM program completed 25 years of encouraging teenagers to consider careers in the sciences while developing a positive sense of self, science, and the environment. Over 1000 teen girls have completed the 3-week program, with 32 girls participating this past summer. Graduate and undergraduate students served as science mentors along professional staff, and participating scientists from FWCC, USGS and USF Marine Science.
- Celebrated 25 years of OCG during a donor luncheon to commemorate program milestones

Research Cruise Measuring Fishes

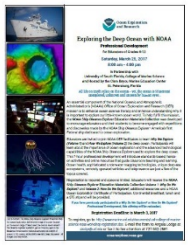
Caladesi Island Coastal Geology – Substructure

- As NOAA Ocean Explorer facilitators, E&O led a series of Teacher Professional Development opportunities. Florida teachers learned '*How We Explore, and Why We Explore the Oceans'* through support by the NOAA Office of Ocean Exploration and Research. NOAA OER strives to engage broad audiences to enhance America's environmental literacy through the excitement of ocean discovery. The NOAA Ship *Okeanos Explorer* Education Materials Collection encourages educators and their students to become engaged with expeditions and discoveries made by the NOAA Ship *Okeanos Explorer*—America's first Federal ship dedicated to ocean exploration. Participants learned about the importance of ocean exploration and the advanced technological capabilities used to explore the deep ocean. Educators received standards-based, hands-on activities and online resources to guide classroom teaching and learning. Over 50 educators completed the *Exploring the Deep Ocean with NOAA* 7-hour professional development

"It helped provide resources relating material to daily life for students."

"Excellent, very informative… Thank YOU!"

"Live stream with Okeanos was wonderful!"



Other Education programs included:

- Led GLOBE teacher professional development trainings to prepare Florida teachers to lead their students to be citizen environmental scientists
- Taught marine sciences courses for the USFSP Honors College and USF Tampa
- Hosted 5 school groups for summer Precollege STEM programs, lab tours and career explorations
- Over 400 college and K-12 students engaged in coastal field trips at Clam Bayou Marine Education Center

- Led 'A Day for the Ocean' service event for Girls Scout troops of West Central Florida
- The E&O team presented ocean literacy research and the Gulf Oil Spill Science with an international audience of educators at the European Marine Science Educators Association conference.

The College continued coordination and participation in the annual St. Petersburg Science Festival. This is a College-wide outreach effort, which brought over 25,000 visitors to campus to experience the research and E&O programs taking place in the marine sciences. http://www.stpetescifest.org/.

OTHER OUTREACH ACTIVITIES

In addition, many faculty and students engaged with the community in creative ways. Makenzie Burrows and Ellie Hudson-Heck from the Breitbart lab worked with Girls Incorporated in 2017.

Girls Inc of Pinellas visits the College of Marine Science:

Over 30 girls, ages 7 to 9, visited the College of Marine Science to interact with the faculty, researchers, and student scientists on campus. The afterschool program blooms into a full camp during the summer months, touring a variety of facilities and interacting with members of the various organizations to exercise mind and body and expand the campers' horizons. Led by Makenzie Burrows and Ellie Hudson-Heck, a group of students from CMS and other participant showed the girls what it means to be a marine scientist by creating several hands-on activities to emphasize some important discoveries made in marine science, from the microscopic to the global.

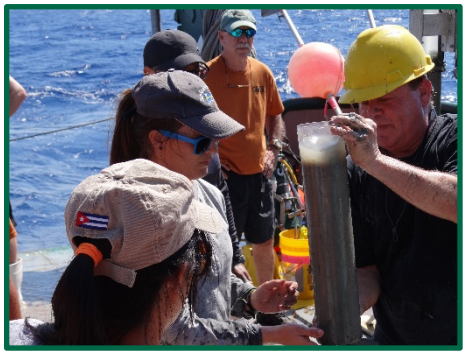
Participants from the Florida Institute of Oceanography and from the Center for Ocean Technology added richly to the program of activities through demonstrations and explanations of the technology utilized at sea and in the laboratory.

EDUCATION AND OUTREACH

C-IMAGE CONSORTIUM

The Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE Consortium) is an international research group studying the lasting impacts of the *Deepwater Horizon* and *Ixtoc I* spills - the two largest spills in Gulf history. C-IMAGE shares findings with international partners to provide a better understanding of the processes and impacts of oil spills. The goal of our outreach program is to provide a humanizing aspect to our science through audio podcasts, public events, and interactive websites.

***OneGulf* Cuba Education Day:**



During the May 2017 research expedition to Cuba, 21 graduate students from the University of Havana and Centro de Estudios Ambientales de Cienfuegos joined the science party for an education day. Students were able to participate in fishing and coring activities, interact with fellow Gulf researchers and students, and tours of the *R/V Weatherbird II* boat and its equipment. Students who joined the cruise wrote blogs about their experiences found on the C-IMAGE website.

For many of the Cuban students, this was their first time on a research vessel or in deeper waters collecting fish & and seafloor sediments. USF students conversed with the Cuban students comparing their research projects, progress in their degrees, and goals for the future.

Community & Conference Events:

2017 presented a unique opportunity to engage the public and fishery science community through information booth. Partnering with the Marine Exploration Center, C-IMAGE hosted an education booth at the monthly St. Pete Food Truck Rally. Engaging St. Petersburg's public with news about offshore drilling and seafood safety made for a worthwhile experience with the general public. The annual conference for the American Fisheries Society was hosted in Tampa in August where the College of Marine Science accompanied a booth highlighting the Marine Resource Assessment program, C-SCAMP Project, and C-IMAGE Consortium. Flyers were distributed to prospective researchers and students throughout the week-long conference.

Story Collider – The Story Collider believes everyone has a story about science—a story about how science made a difference, affected them, or changed them on a personal and emotional level. We find those stories and share them in live shows and on our podcast.

In conjunction with the Gulf of Mexico Oil Spill and Ecosystem Sciences Conference, C-IMAGE hosted a Story Collider in New Orleans, LA featuring the personal perspectives of five people tied to the BP spill. The spoken word event featured oil spill researcher, a first responder, a restoration manager, and a fisherman sharing their stories of science, each focused around the 2010 *Deepwater Horizon* oil spill.

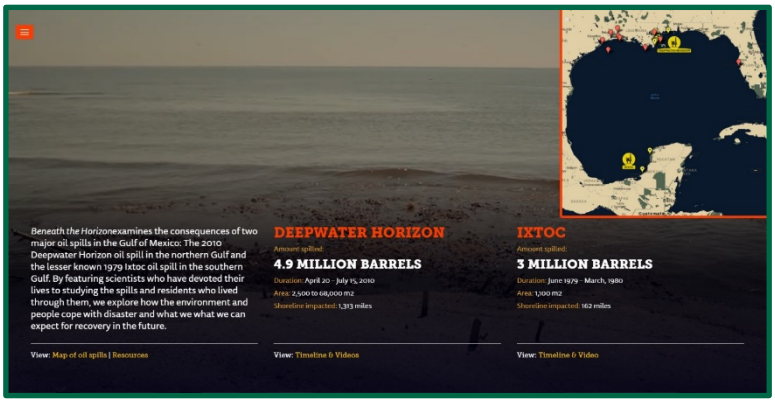
EDUCATION AND OUTREACH

Professional Development:

Proposal Writing Weekend – 11 early-career scientists were given a crash course on applying for funding and writing grant proposals – the lifeline of scientific research. With advice from proposal reviewers and writers, participants were challenged to create a research project and find potential funding sources.

Beneath the Horizon:

In addition to environmental impacts, personal and economical impacts remain across the Gulf. C-IMAGE releases Beneath the Horizon, an interactive oil spill timeline examining the consequences of the two major oil spills in the Gulf of Mexico: The 2010 Deepwater Horizon oil spill in the northern Gulf and the lesser-known 1979 Ixtoc oil spill in the southern Gulf.



Beneath the Horizon features scientists who have devoted their lives to studying the spills and residents who lived through them, and explores how the environment and people cope with disaster and what we can expect for recovery in the future. To learn more, please visit www.beneaththehorizon.org.

Audio Products:

The Loop Podcast - Produced by independent journalist David Levin, *The Loop* provides 10-minute episodes about varying aspects of C-IMAGE research. Interviews with USF-Marine Science faculty and students gives expert opinions about spill impacts on fishes and the sea floor, ecosystem modeling, and satellite oceanography.

Development

FELLOWSHIPS

On October 5, 2017, CMS recognized fellowship and award recipients and their generous supporters at the Sixth Annual College of Marine Science Fellowships and Awards Luncheon held at the Johns Hopkins All Children's Hospital Education and Conference Center. Through the leadership of Dean Jacqueline Dixon and former Deans Peter Betzer and William Hogarth, our $20M endowment provides ~$404K/yr for endowed fellowships to 31 CMS graduate students. Carol and Scott Rogers '77, from Denver CO, presented the inaugural Thomas E. Pyle Memorial Fellowship in Marine Science, established in honor of Thomas E. Pyle (Scott's major advisor). This fellowship will now be awarded annually to a graduate student in marine science pursuing a career in geology or geophysics.

E. Howard Rutherford, Dean Jacqueline Dixon, Michelle Guitard, Carol Rogers and Scott Rogers

The luncheon provides an opportunity for fellowship and award recipients to meet the individuals and families who have helped to make it possible for these students to pursue a degree at the College of Marine Science.

2017-2018 Endowed Fellowship Recipients

DEVELOPMENT

The 2017-2018 Endowed Fellowships were provided to the following students:

Chelsea C. Bonnain - Linton Tibbetts Fellowship
Imogen Mireille Browne - William and Elsie Knight Endowed Fellowship for Marine Science
Gabriel A. Browning - St. Petersburg Downtown Partnership Fellowship in Coastal Science
Shannon Burns - Gulf Oceanographic Charitable Trust Endowed Fellowship in Marine Science
Shuangling Chen - Tampa Bay Parrot Head Fellowship in Marine Science
Marcy L. Cockrell - Garrels Memorial Fellowship in Marine Science
Alexandria Creasy - George Lorton Fellowship in Marine Science
Meaghan E. Faletti - George Lorton Fellowship in Marine Science
Michelle E. Guitard – Thomas E. Pyle Memorial Fellowship
Greta Helmueller - William Hogarth Marine Mammal Fellowship
Elizabeth S. Herdter - George Lorton Fellowship in Marine Science
Adrienne Hollister - The Wells Fargo Fellowship in Marine Science
Alexander Ilich - William and Elsie Knight Endowed Fellowship for Marine Science
Theresa King - Carl Riggs Fellowship in Marine Science
Brittany Leigh – Mahaffey Family Graduate Fellowship in Marine Science
Loraine Martell-Bonet - Bridge to the Doctorate Fellowship
Makenna Martin - Oceanography Camp for Girls Fellowship
Travis Mellett - Sanibel-Captiva Shell Club / Mary & Al Bridell Memorial Fellowship
Garrett L. Miller - Anne & Werner Von Rosenstiel Fellowship
Luis Sorinas Morales - Anne & Werner Von Rosenstiel Fellowship
Dana M. Nieuwkerk - C. W. Bill Young Fellowship
Catherine Prunella - Anne & Werner Von Rosenstiel Fellowship
Natalie A. Sawaya - Gulf Oceanographic Charitable Trust Endowed Fellowship in Marine Science
Katelyn Schockman - Paul Getting Endowed Memorial Fellowship
Brent Summers - Anne & Werner Von Rosenstiel Fellowship
Ryan Venturelli - The Jack and Katharine Ann Lake Fellowship in Marine Science

Also recognized were achievements of students, alumnae, and researchers through the Bernstein Outstanding Authorship Award, the Sackett Prize for Innovative Research, and the Costello Interdisciplinary Award. The 2017-2018 Award Recipients were:

The 2017-2018 Award Recipients:

Anthony Greco – David K. Costello Interdisciplinary Engineering Award
Brittany Leigh– Renate E. Bernstein Outstanding Authorship Award
Erin Symonds – Sackett Prize for Innovative Research
Mengqiu Wang– Renate E. Bernstein Outstanding Authorship Award

DEVELOPMENT

FUNDRAISING

In addition to fellowship support, alumni, faculty, staff and friends donated $742,840 support for current and new endowment funds as well as for current operations. This year, the Anne Von Rosenstiel Innovation Fund for Marine Science was established through a generous gift from Anne Von Rosenstiel. This endowment will enable graduate students to explore new ideas they have developed that have the potential to advance the field of marine science. In addition, David Mearns ’86 and Lee Kump ’86 established the Albert Hine Travel Award Fund in honor of Albert Hine who retired in 2017. This fund will be used to support graduate student travel for field work, with a preference for work with a geology focus.

(left to right standing) Dr. Peter Betzer, E. Howard Rutherford, Dr. Susan Betzer, Kelly Vasbinder, Erin Culer, Alexander Ilich, Susan Snyder, Jordan Meyer, Dr. Robert Byrne
(left to right seated) Kathleen David, Anne Von Rosenstiel

While the college currently has many of the basic components in place for achieving preeminence among oceanographic institutions, it seeks to create the critical mass of intellectual capital necessary to ensure advancement to the next level of national and international prominence.

Specifically, support is needed in the following areas:

Dean’s Innovation Endowment for Research Support: To recruit and retain top caliber faculty, significant resources needed for acquisition and maintenance of state-of-the-art instrumentation, for seed funds for research and commercialization of new technologies, and for competitive start-up and retention packages.

Graduate Excellence: The College of Marine Science strives to attract and retain the highest quality graduate students, while also ensuring that its educational programs are available to all qualified students without regard to financial circumstances.

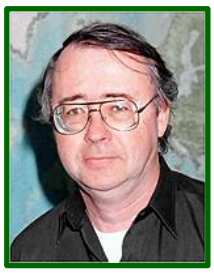
Postdoctoral Fellowship Program: Postdoctoral research fellow programs are a long-standing tradition at the nation’s best research universities and oceanographic institutions. Implementation of a successful postdoctoral research program is pivotal to the success of the college.

Endowed Chairs and Professorships: To further enhance its ability to undertake fundamental research, CMS seeks to attract and retain key faculty operating on the frontiers of their respective fields.

Retirees

Professor Albert C. Hine
USF College of Marine Science
1979 to 2017

Al Hine has had a distinguished career as a sedimentary geologist. He published over 140 scientific papers and produced over 30 MS and PhD students. His research focused on using geophysical remote-sensing tools, such as seismic reflection profiling, swath bathymetry and side-scan sonar, and direct sampling techniques, such as drilling into the geologic strata, to provide basic understanding of the geology and tectonics of continental margins and carbonate platforms. Al was awarded the Society of Sedimentary Geology's Francis P. Shepard Medal in 2009 for sustained excellence. He served as Associate Dean at CMS from 2003-2011 and as my ambassador for alumni relations for the last six years. Al is the author of a book entitled, "***Geologic History of Florida—Major Events that Formed the Sunshine State***" and a senior-authored a 2nd book with four other CMS faculty and alumni entitled, "***Sea Level Rise in Florida—Science, Impacts, and Options".***



Distinguished Research Professor John J. Walsh
USF College of Marine Science
1984 to 2017

Dr. John Walsh served as a faculty member in the Department/College of Marine Science for 33 years. As a biological oceanographer, he focused on systems analyses of continental shelves over the last 40 years, publishing more than 100 books, papers, and reports. As Co-director of the USF Center for Prediction of Red Tides (CPR), emphasis is now placed on the applied aspects of plankton ecology. With coupled biophysical models for operational forecasts of the initiation, landfall, and demise of ichthyotoxic red tide asthma triggers, with implications for management of both fisheries and human asthma onsets, within coastal waters and on adjacent beaches of the southeastern United States from the Florida Panhandle to the outer banks off Cape Hatteras, North Carolina.

Obituary

Dr. Eugene Domack (Gene), Professor in Geological Oceanography at the USF College of Marine Science (CMS), died on Nov. 20, 2017 after a brief illness.

Gene received his Ph.D. in Geology from Rice University in 1982. He was hired at Hamilton College in 1985, after working for two years as an Exploration Geologist for Union Oil Company of California. He joined USF College of Marine Science in 2014. His scientific career was dedicated to the study of climate change, which he advanced through the development of international interdisciplinary programs. He was highly recognized for his research, including awards in 2011 as Fellow of the American Geophysical Union and 2012 as Fellow of the American Association for the Advancement of Science. His fieldwork led him all over the globe, on both land (Namibia, Australia, Greenland, Svalbard, Oneida Lake NY, and Whidbey Island WA) and sea (Chief-Scientist or Co-Chief Scientist on 15 Antarctic cruises).

His primary passion was Antarctic research and he generously shared that passion with others, including numerous students. He captured the interest and imagination of young scholars and enabled them to experience the excitement of science first-hand. He mentored hundreds of students throughout his career as a professor at the University of Wisconsin, Eau Claire, Hamilton College in Upstate New York, and the University of South Florida. He left a rich legacy: many of his former students are now passing along that passion, including Ian Howat (Professor at Ohio State University and invited 2013 Eminent Scholar Lecture Series speaker at CMS), Amelia Shevenell (Associate Professor at CMS), and Matt Kirby (Professor at Cal State Fullerton).

Born in Wisconsin, Gene had a life-long love for the Green Bay Packers, Milwaukee Brewers and his alma mater, the Wisconsin Badgers. But most of all he loved his daughter, Maddie. Gene is survived by his wife Judi and daughter Madison, both of St. Petersburg; his mother Vivian Domack of Brookfield, WI; sister Deborah (Todd) Hill of Trempealeau, WI; brother Randy (Kasey) Domack of Holmen, WI; sister Julie (Jeff) Borkowicz of Brookfield, WI; and several nieces and nephews. He was pre-deceased by his father Benjamin and his younger brother Shawn.

Contributions may be made to: The Madison Domack Education Fund. Checks can be sent to David C. Gross Funeral Home, 6366 Central Avenue, St. Petersburg FL 33707 for the family, or Temple Beth El “Religious School Special Projects Fund”, 400 Pasadena Ave. S, St. Petersburg, Florida 33707.

Appendices

Appendix A

Publications

Appendix B

Active Research Awards

Appendix A. Publications

Bold indicates Faculty and Research Staff/Faculty; Underline indicates CMS graduate student or post-doc

CMS BOOKS (10)

Chambers, D. P., O. Andersen, S. Bettadpur, M.-H. Rio, R. Rummel, and D. Wiese (2017) Auxiliary Space-Based Systems for Interpreting Satellite Altimetry: Satellite Gravity, in *Satellite Altimetry over Oceans and Land Surfaces*, D. Stammer and A. Cazenave (eds.), Taylor & Francis, Boca Raton, FL, 2017. [This book chapter was peer reviewed].

Buck, K. N., M. C. Lohan, S. G. Sander, C. Hassler, and I. Pižeta (2017) Organic ligands in trace metal biogeochemistry. *Frontiers in Marine Science*, eBook compilation of Research Topic, doi: 10.3389/978-2-88945-376-4.

Buck, K. N., M. C. Lohan, S. G. Sander, C. Hassler, and I. Pižeta (2017) Editorial: Organic Ligands – A Key Control on Trace Metal Biogeochemistry in the Ocean. *Frontiers in Marine Science*, doi: 10.3389/fmars.2017.00313.

Liu, Y., C. Merz, **R. H. Weisberg**, B. K. O'Loughlin, and V. Subramanian (2017) Data return aspects of CODAR and WERA high frequency radars in mapping currents, in *Observing the Oceans in Real Time*, edited by Venkatesan et al., Springer, 227-241, http://dx.doi.org/10.1007/978-3-319-66493-4_11.

Lorenzen, K., **C. H Ainsworth**, S. Baker, L. Barbieri, E. Camp, J. Dotson, and S. Lester (2017) Climate change impacts on Florida's fisheries and aquaculture sectors and options for adaptation. Chapter 14 in Florida's Climate: Changes, Variations & Impacts. *Florida Climate Institute*.

Merz, C. R., and K. L. Main (2017), Microalgae Bioproduction – Feeds, Foods, Nutraceuticals, and Polymers, in *Fuels, Chemicals and Materials from the Oceans and Aquatic Sources,* edited by Kerton, F.M., Yan, N., John Wiley & Sons Ltd., 84-112. doi: 10.1002/9781119117193.ch5.

Moses, E.F., P. **Hallock,** and J. Fauth (2017) Dynamics of larger benthic foraminiferal populations in the upper Florida Keys Reef Tract, USA: Comparisons with other coral reef bioindicators. p. 15-39, *in* Kathal, P.K., Nigam, R., and Talib., A. (eds.), *Micropaleontology and its Applications*, Scientific Publishers, New Delhi. (ISBN 978-93-8665-209-6).

Naidu, R., P. **Hallock,** J. Erez, and M. Maata (2017) Response of *Marginopora vertebralis* (Foraminifera) from Laucala Bay, Fiji, to Changing Ocean pH. p. 137-150, in Filho, W.L. (ed.), *Climate Change Adaptation in Pacific Countries*. Springer, Heidelberg, doi: 10.1007/978-3-319-50094-2_8.

Read, P. L., **B. Galperin**, S. E. Larsen, S. R. Lewis, A. Määttänen, A. Petrosyan, N. Renno, H. Savijärvi, T. Siili, A. Spiga, A. Toigo, and L. Vázques (2017) The Martian Planetary Boundary Layer. In: *The Atmosphere and Climate of Mars,* pp. 172-202. Edited by R.M. Haberle, R.T. Clancy, F. Forget, M.D. Smith, and R.W. Zurek. Cambridge University Press. https://books.google.com/books/about/The_Atmosphere_and_Climate_of_Mars.html?id=bokmDwAAQBAJ&printsec=frontcover&source=kp_read_button#v=onepage&q&f=false or https://www.cambridge.org/core/books/atmosphere-and-climate-of-mars/CA5316BF24A89891563B2E17EF185E19#.

Testa, J. M., **Y. Li**, Y. J. Lee, M. Li, D. C. Brady, D. M. Di Toro, and W. M. Kemp (2017) Chapter 6: Modeling physical and biogeochemical controls on dissolved oxygen in Chesapeake Bay: Lessons learned from simple and complex approaches, in *Modeling Coastal Hypoxia - Numerical Simulations of Patterns, Controls and Effects of Dissolved Oxygen Dynamics*, edited by D. Justic, K. Rose, R. Hetland, and K. Fennel. Springer International Publishing AG, Switzerland. doi: 10.1007/978-3-319-54571-4_5.

CMS JOURNAL PUBLICATIONS (128)

Ainsworth, C. H., C. B. Paris, N. Perlin, L. N. Dornberger, W. Patterson, E. Chancellor, **S. Murawski**, **D. Hollander**, **K. Daly**, **I. C. Romero,** F. Coleman, and H. Perryman (2017) Impacts of the Deepwater Horizon oil spill evaluated using an end-to-end ecosystem model. *PLoS One* (online).

Ainsworth, C.; C. Paris, N. Perlin, L. Dornberger, W. Patterson, E. Chancellor, **S. Murawski**, **D. Hollander**, **K. Daly**, **I. Romero**, F. Coleman, and H. Perryman (2017) Ecosystem Impacts of the Deepwater Horizon oil spill. *PLOsOne*.

APPENDIX A. PUBLICATIONS

Ambriz-Arreolaa, I., J. Gomez-Gutierrez, M. Fanco-Gordo, R. Palomares-Garcia, L. Sanchez-Velasco, C. J. Robison, and **B. A. Seibel** (2017) Vertical pelagic habitat of euphausiid species assemblages in the Gulf of California. *Deep-Sea Res. Part I* http://dx.doi.org/10.1016/j.dsr.2017.03.008.

Archer, C., M. B. Andersen, C. Cloquet, **T. M. Conway**, S. Dong, M. Ellwood, R. Moore, J. Nelson, M. M. Rehkämper, O. Rouxel, M. Samanta, K-C. Shin, Y. Sohrin, S. Takano, and L. Wasylenki (2017) Inter-calibration of a new proposed primary reference standard AA-ETH Zn for Zn isotopic analysis. *J. Anal. Atom. Spectrom*.32, 415-419, doi:10.1039/C6JA00282J.

Arnold, W. S., **S. D. Meyers**, S. P. Geiger, **M. E. Luther**, D. Narváez, M. E. Frischer, and E. Hofmann (2017) Predicting larval dispersal patterns of the eastern oyster (*Crassostrea virginica*) in Pensacola Bay, Florida, using a validated biophysical model. *J. Shellfish Research*, 36, 1, 101–118, doi: 10.2983/036.036.0112.

Astor, Y., L. Guzmán, L. Troccoli, **L. Lorenzoni**, and **F. Muller-Karger** (2017) Síntesis de las tendencias de los parámetros oceanográficos y ópticos en la estación serie de tiempo CARIACO (enero 1996–diciembre 2013). *Memoria de la Fundación La Salle de Ciencias Naturales* 74 (181-182).

Atkinson, A., S. L. Hill, E. A. Pakhomov, V. Siegel, R. Anadon, S. Chiba, **K. L. Daly**, R. Downie, P. Fretwell, L. Gerrish, G. W. Hosie, M. J. Jessopp, So Kawaguchi, B. A. Krafft, V. Loeb, J. Nishikawa, H. J. Peat, C. S. Reiss, R. M. Ross, L. B. Quetin, K. Schmidt, D. K. Steinberg, R. C. Subramaniam, G. A. Tarling, and P. Ward (2017) KRILLBASE: a multinational, circumpolar database of abundance of Antarctic krill and salps**.** *Earth System Science Data* 9, 193-210; doi:10.5194/essd-2016-52

Barros, N. H. C., A. A. de Souza, **E. B. Peebles,** and S. Chellappa (co-senior author) (2017) Dynamics of sex reversal in the marbled swamp eel (*Synbranchus marmoratus* Bloch, 1795), a diandric hermaphrodite from Marechal Dutra Reservoir, northeastern Brazil. *Journal of Applied Ichthyology* 33: 443-449, doi:10.1111/jai.13273.

Beckley, B.D., P. S. Callahan, D. W. Hancock III, **G. T. Mitchum**, and R. D. Ray (2017) On the "Cal-Mode" Correction to TOPEX Satellite Altimetry and Its Effect on the Global Mean Sea Level Time Series. *JGR-Oceans*, 122, https://doi.org/10.1002/2017JC013090.

Benkwitt, C. E., M. A. Albins, K. L. Buch, K. E. Ingeman, T. L. Kindinger, T. J. Pusack, **C. D. Stallings**, and M. A. Hixon (2017) Is the lionfish invasion waning? Evidence from the Bahamas. *Coral Reefs* 36, 1255-1261.

Biller,S. J., **L. D. McDaniel**, **M. Breitbart**, E. Rogers, **J. H. Paul,** and S. W. Chisholm (2017) Membrane vesicles in seawater: heterogeneous DNA content and implications for viral abundance estimates. *ISME- The ISME Journal* 11, 394–404; doi:10.1038.

Bockus, A.. and **B. A. Seibel** (2017) Synthetic capacity does not predict elasmobranchs' ability to maintain trimethylamine oxide without a dietary contribution. *Comp. Biochem. Physiol*. *A*. https://doi.org/10.1016/j.cbpa.2017.12.008.

Bode, A., H. W. Bange, M. Boersma, E. Bresnan, K. Cook, A. Goffart, K. Isensee, and et al. (2017) North Atlantic Ocean. In What are Marine Ecological Time Series telling us about the ocean? A status report, pp. 55–82. Ed. by T. D. O'Brien, **L. Lorenzoni**, K. Isensee, and L. Valdés. IOC-UNESCO, IOC Technical Series, No. 129. 297 pp.

Breitbart, M., E. Delwart, **K. Rosario**, J. Segalés, and A. Varsani (2017) ICTV virus taxonomy profile: *Circoviridae*. *Journal of General Virology* 98: 1997-1998, doi:10.1099/jgv.0.000871.

Bumbeer, J., R. M. da Rocha, H. Bornatowski, M. de Castro Robert, and **C. Ainsworth** (2017) Predicting impacts of lionfish (*Pterois volitans*) invasion in a coastal ecosystem of southern Brazil. *Biological Invasions* https://doi.org/10.1007/s10530-017-1625-8.

Chambers, D. P., A. Cazenave, N. Champollion, H. Dieng, W. Llovel, R. Forsberg, K. von Schuckmann, and Y. Wada (2017) Evaluation of the Global Mean Sea Level Budget between 1993 and 2014. *Surv. Geophys. 38*, 309-327, doi:10.1007/s10712-016-9381-3.

Chan, F., J. A. Barth, C. A. Blanchette, **R. H. Byrne**, F. Chavez, O. Cheriton, R. A. Feely, G. Friederich, B. Gaylord, T. Gouhier, S. Hacker, T. Hill, G. Hofmann, M. McManus, B. A. Menge1, K. J. Nielsen, A. Russell, E. Sanford, J. Sevadjian and L. Washburn (2017) Persistent spatial structuring of coastal ocean acidification in the California Current System. *Scientific Reports* 7: *2526,* doi:10.1038/s41598-017-02777-y.

Che-Castaldo, C., S. Jenouvrier, C. Youngflesh, K. Shoemaker, G. Humphries, L. Landrum, M. Holland, **Y. Li**, R. Ji, and H. Lynch (2017) Pan-Antarctic analysis reveals the importance of stochastic forcing for Adelie

penguins: How moisy is too moisy for adaptive management? *Nature Communications* 8, doi:10.1038/s41467-017-00890-0.

Chen, S., and **C. Hu** (2017) Estimating sea surface salinity in the northern Gulf of Mexico from satellite ocean color measurements. *Remote Sens. Environ.* 201:115-132, http://dx.doi.org/10.1016/j.rse.2017.09.004.

Chen, S., **C. Hu**, W-J. Cai, and B. Yang (2017) Estimating surface pCO2 in the northern Gulf of Mexico: Which remote sensing model to use? *Cont. Shelf Res.* 151:94-110. https://doi.org/10.1016/j.csr.2017.10.013.

Churnside, J. H., R. Marchbanks, **C. Lembke**, and J. Beckler (2017) Optical Backscattering Measured by Airborne Lidar and Underwater Glider. *Remote Sensing*, doi:10.3390/rs9040379.

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APPENDIX A. PUBLICATIONS

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APPENDIX A. PUBLICATIONS

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APPENDIX A. PUBLICATIONS

USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp. [**F. Mueller-Karger** is a Contributing Author].

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Appendix B. Active Research Awards

Awd PI Name	Name - Co PI If Applicable	Sponsor Name	Total Expenses	Awd Begin Date	Awd End Date
Ainsworth		Alfred P. Sloan Foundation	12402.56	9/15/2013	9/14/2017
Barnes	Hu	Kent State University	15145.60	5/1/2016	4/30/2019
Barnes	Hu	National Aeronautics & Space Admin	5055.79	1/1/2017	12/31/2019
Breitbart		National Science Foundation	123053.61	12/1/2012	11/30/2018
Breitbart		National Science Foundation	3124.13	12/1/2012	11/30/2018
Breitbart		US Israel Binational Science Foundation	20729.08	9/1/2015	8/31/2018
Breitbart		National Science Foundation	15947.27	7/1/2016	6/30/2019
Breitbart		National Science Foundation	42635.48	9/15/2016	8/31/2020
Buck		National Science Foundation	40244.07	2/1/2014	2/28/2017
Buck		National Science Foundation	70623.36	3/1/2014	8/31/2017
Buck		National Science Foundation	118602.49	7/15/2015	6/30/2018
Buck		National Science Foundation	40599.23	2/1/2017	1/31/2019
Byrne		National Science Foundation	60252.41	9/15/2012	3/31/2018
Byrne		National Science Foundation	102188.74	8/1/2014	7/31/2018
Byrne		US Geological Survey	51979.97	9/1/2014	8/31/2017
Byrne		Texas A & M University	105149.41	9/1/2015	8/31/2018
Byrne		Sunburst Sensors	39999.08	6/13/2016	12/13/2016
Byrne		National Science Foundation	2137.05	2/1/2017	1/31/2020
Chambers		National Aeronautics & Space Admin	53738.40	8/6/2012	8/5/2017
Chambers		National Aeronautics & Space Admin	82004.00	3/13/2013	3/12/2018
Chambers		NASA Jet Propulsion Laboratory	32774.87	6/1/2013	5/31/2018
Chambers		US Geological Survey	49914.97	7/16/2015	7/15/2016
Chambers		National Aeronautics & Space Admin	136252.48	2/16/2016	2/15/2020
Daly		National Science Foundation	2895.59	6/1/2011	11/30/2016
Daly		University of Georgia	58491.64	1/1/2016	12/31/2018
Dishaw	Breitbart	National Science Foundation	50672.72	5/1/2015	4/30/2018
Dixon	Mitchum	US Geological Survey	24924.41	8/1/2012	7/31/2017
Dixon	Mitchum	US Geological Survey	1205176.00	8/1/2012	7/31/2017
Dixon	Naar, David	US Geological Survey	4277.92	8/1/2014	7/31/2016
Dixon	Naar, David, Daly	US Geological Survey	20168.45	3/26/2015	3/25/2017
Dixon,T	Lembke	National Science Foundation	50322.10	12/1/2015	11/30/2018
Greely		National Marine Sanctuary Foundation	3220.77	10/1/2014	10/1/2016
Greely		Natl Oceanic & Atmospheric Admin	61516.71	9/1/2015	5/31/2017
Greely		National Marine Sanctuary Foundation	5767.42	7/1/2016	8/31/2017
Hu		National Aeronautics & Space Admin	152549.22	8/5/2013	8/4/2017
Hu		National Aeronautics & Space Admin	144996.30	7/8/2014	7/7/2018
Hu		National Aeronautics & Space Admin	216053.49	1/15/2015	1/14/2018
Hu		National Aeronautics & Space Admin	89433.47	10/9/2014	10/8/2018
Hu		Nova Southeastern University	182587.19	1/1/2015	12/31/2018

APPENDIX B. ACTIVE RESEARCH AWARDS

Awd PI Name	Name - Co PI If Applicable	Sponsor Name	Total Expenses	Awd Begin Date	Awd End Date
Hu		National Aeronautics & Space Admin	66771.17	3/1/2015	2/29/2020
Hu		University of Miami	98942.59	10/1/2015	6/30/2018
Hu		Florida Fish and Wildlife Conservation	66782.44	10/1/2015	4/30/2017
Hu		University of Miami	63451.31	1/1/2016	12/31/2018
Hu		National Aeronautics & Space Admin	26855.22	9/1/2016	8/31/2018
Hu		National Aeronautics & Space Admin	27054.69	1/1/2017	12/31/2019
Hu	Romero	Nova Southeastern University	60552.13	1/1/2015	12/31/2018
Kramer	Breitbart	US Department of Treasury	20262.54	9/1/2015	2/28/2019
Kramer	Lembke	US Department of Treasury	141215.12	9/1/2015	2/28/2019
Kramer	Peebles	US Department of Treasury	45997.19	9/1/2015	2/28/2019
Kramer	Peebles	US Department of Treasury	70620.77	9/1/2015	2/28/2019
Lembke		Florida Atlantic University	122602.28	7/1/2015	12/31/2016
Lembke		SECOORA	3209.34	6/1/2016	5/31/2019
Luther		Greater Tampa Marine Advisory Council	7757.41	4/9/2004	3/6/2019
Luther		University of Maryland	38254.33	6/1/2011	5/31/2017
Luther		Texas A & M Research Foundation	50466.66	6/1/2011	5/31/2017
Luther	Merz	SECOORA	12392.32	6/1/2015	11/30/2016
Luther	Merz	SECOORA	38612.00	6/1/2016	5/31/2018
Mihelcic	Muller-Karger	National Science Foundation	31030.58	10/3/2012	12/31/2018
Mitchum		US Geological Survey	10263.00	7/15/2012	7/14/2017
Mitchum		NASA Jet Propulsion Laboratory	159648.50	10/1/2013	9/30/2018
Mitchum		US Geological Survey	20657.03	9/13/2013	9/14/2018
Mitchum		University of Colorado	96653.86	3/14/2013	3/13/2018
Muller		Florida Fish and Wildlife Conservation	9367.63	6/19/2015	6/30/2018
Muller		Florida Fish and Wildlife Conservation	66974.47	6/19/2015	6/30/2018
Muller		US Geological Survey	38627.44	8/1/2016	7/31/2017
Muller-Karger	Breitbart	National Aeronautics & Space Admin	202834.02	8/18/2014	8/17/2019
Muller-Karger		National Aeronautics & Space Admin	89895.82	9/1/2012	8/31/2016
Muller-Karger		National Science Foundation	108859.59	9/1/2013	8/31/2018
Muller-Karger		National Science Foundation	431354.39	2/1/2014	7/31/2018
Muller-Karger		Natl Oceanic & Atmospheric Admin	33751.64	8/1/2014	12/31/2016
Muller-Karger		National Aeronautics & Space Admin	532.31	8/4/2014	5/17/2017
Muller-Karger		National Aeronautics & Space Admin	1155427.53	8/18/2014	8/17/2019
Muller-Karger		Bubbleology Research International	81505.01	10/1/2014	9/30/2017
Muller-Karger		University of Fiji	34083.55	4/15/2015	4/14/2018
Muller-Karger		National Aeronautics & Space Admin	31242.53	9/1/2015	8/31/2018
Muller-Karger		University of Miami	55381.14	9/1/2015	8/31/2017
Muller-Karger		National Aeronautics & Space Admin	125048.08	5/1/2016	4/30/2018
Muller-Karger		National Aeronautics & Space Admin	25785.75	5/1/2016	4/30/2018
Muller-Karger		Texas A&M	9062.57	7/25/2016	11/30/2016
Murawski	Ainsworth	Consortium for Ocean Leadership	209382.97	1/1/2015	12/31/2018
Murawski	Daly	Consortium for Ocean Leadership	82953.43	1/1/2015	12/31/2018

APPENDIX B. ACTIVE RESEARCH AWARDS

Awd PI Name	Name - Co PI If Applicable	Sponsor Name	Total Expenses	Awd Begin Date	Awd End Date
Murawski	Greely	Consortium for Ocean Leadership	41650.95	1/1/2015	12/31/2018
Murawski	Hollander	Consortium for Ocean Leadership	644346.99	1/1/2015	12/31/2018
Murawski	Hu	Consortium for Ocean Leadership	104643.37	1/1/2015	12/31/2018
Murawski		National Science Foundation	229964.72	10/1/2013	9/30/2017
Murawski		Consortium for Ocean Leadership	3865512.75	1/1/2015	12/31/2018
Murawski		Consortium for Ocean Leadership	395963.63	1/1/2015	12/31/2018
Murawski	Lembke	National Fish and Wildlife Foundation	899030.63	1/1/2015	6/30/2019
Murawski		Gulf of Mexico Alliance	6795.60	10/1/2016	6/30/2018
Murawski	Paul	Consortium for Ocean Leadership	68274.11	1/1/2015	12/31/2018
Murawski	Peebles	Consortium for Ocean Leadership	37114.53	1/1/2015	12/31/2018
Paul		Natl Oceanic & Atmospheric Admin	253870.17	9/1/2015	8/31/2018
Peebles		University of Miami	6119.83	8/1/2012	11/30/2016
Peebles		University of Miami	344451.41	10/1/2015	9/30/2017
Rosenheim		University of Miami	33434.86	9/15/2016	8/31/2019
Rosenheim		Louisiana State University	32751.23	5/1/2014	1/31/2017
Rosenheim		National Science Foundation	53361.49	7/1/2015	6/30/2018
Rosenheim		National Science Foundation	659.76	11/1/2015	10/31/2016
Rosenheim		National Science Foundation	16261.41	3/15/2017	2/29/2020
Seibel		National Science Foundation	45333.57	12/22/2015	4/30/2017
Seibel		National Science Foundation	10000.00	2/8/2016	7/31/2017
Seibel		Natl Oceanic & Atmospheric Admin	82739.32	1/1/2017	12/31/2018
Seibel		University of Rhode Island	2120.84	12/1/2016	9/30/2018
Shevenell		National Science Foundation	106446.63	4/1/2013	4/30/2018
Stallings		Florida State University	8501.79	9/1/2011	8/31/2016
Stallings		FL Department Environmental Protection	51766.33	5/30/2014	8/30/2017
Stallings		FL Department Environmental Protection	18948.15	5/30/2014	8/30/2017
Stallings		Florida Fish and Wildlife Conservation	18346.07	1/27/2016	7/31/2018
Stallings		Northeastern University	26558.29	9/1/2016	2/28/2017
Stallings		Florida Fish and Wildlife Conservation	16326.95	2/26/2016	9/30/2016
Weisberg	Walsh	Natl Oceanic & Atmospheric Admin	35638.49	9/1/2015	8/31/2018
Weisberg		Florida Fish and Wildlife Conservation	22240.00	10/20/2016	11/17/2016
Weisberg		Pinellas County Florida (Restore Act)	90934.91	11/6/2016	7/31/2018
Weisberg	Russell	Pinellas County Florida (Restore Act)	4867.50	11/6/2016	7/31/2018
Weisberg		Pinellas County Florida (Restore Act)	62750.55	11/29/2016	8/31/2019
Weisberg		National Aeronautics & Space Admin	12869.95	1/10/2013	1/9/2017
Weisberg	Merz	SECOORA	394.43	6/1/2015	11/30/2016
Weisberg	Liu	SECOORA	7851.56	6/1/2015	11/30/2016
Weisberg	Hu, Lenes, Liu, Walsh, Zheng	Natl Oceanic & Atmospheric Admin	10485.38	9/1/2015	8/31/2018
Weisberg	Merz	SECOORA	116925.65	6/1/2016	5/31/2019
Weisberg	Liu	SECOORA	185216.60	6/1/2016	5/31/2019