



**UNIVERSITY OF
SOUTH FLORIDA**
College of MARINE SCIENCE



ANNUAL REPORT

January 1 – December 31, 2021

Submitted by: Dean Thomas K. Frazer

TABLE OF CONTENTS

The View from the Bridge	2
College of Marine Science Leadership Team	5
Graduate Program	9
CMS Research	18
Highlighted Research	19
Faculty Highlights	33
Other Events and Highlights	51
CMS Ocean Technology Group	52
Facilities	53
Education and Outreach	54
Communications	57
Development	62
Appendices	i
Appendix A. Publications	ii
Appendix B. Active Research Awards	xv
APPENDIX C. EVENTS IN THE NEWS	xx

The View from the Bridge



We have plenty to be excited about at the College of Marine Science (CMS) despite the continued challenges posed by 2021. Our crew is solid: our faculty, staff and students reflect the best of USF and its Principles of Community. I'm proud of the dossier we created in 2021 and the tremendous momentum we are building toward an exciting future.

Thanks to seeds of cross-disciplinary efforts planted in 2020 and 2021, USF is now firmly positioned to grow into a global center for the blue-green economy and to stand as a model for what it means to partner across colleges and departments, and with private enterprise and government bodies, to collectively rise to the grand challenges of coastal and climate change.

Here are just a few key highlights detailed in our report:

We are so grateful to the leadership by House Speaker Chris Sprowls who championed Florida Senate Bill 1954 that established our College as home base for the Florida Flood Hub for Research & Innovation.

We collaborated across colleges and campuses to sow the seeds for a new Center of Excellence in Environmental & Oceanographic Sciences and associated and proposed Environmental & Oceanographic Sciences Research & Teaching Facility that will be based on our CMS campus. This is a game-changer for USF – the springboard we need to launch a constellation of cross-cutting programs that empower USF to address today's grand challenges with innovation, collaboration, and resiliency.

One faculty member and our communications director served on the search committee for two new faculty positions in Science Communication and Data Visualization – positions that will be housed in the Department of Journalism and Digital Communication. These faculty will work closely on Center of Excellence initiatives.

A cross-departmental team from USF is one of four groups chosen nationwide to participate in a new National Science Foundation (NSF) pilot program called All-ABOARD, which stands for "Alliance-Building Offshore to Achieve Resilience and Diversity." The goal of this two-year program hosted by Columbia University to advance justice, equity, diversity, and inclusion (JEDI) initiatives in STEM.

THE VIEW FROM THE BRIDGE

We formed an URGE pod (Unlearning Racism in Geosciences) in another effort to deepen our collective and individual knowledge of, and ability to address the effects of racism on the participation of Black, Brown, and Indigenous people who work in the geosciences.

We joined the Ocean Visions Research Consortium. The mission of the Ocean Visions Network is two-fold: to address the disconnect between research and ocean solutions, and to mobilize research universities and institutions, professional ocean-focused societies, NGOs, IGOs, foundations, business and financial institutions into action. Its stated vision is easy to support: “A world where smart design and equitable solutions foster a thriving ocean for all that depend on it.” One key focus area for Ocean Visions is to build coastal resiliency, which aligns well with research priorities at the CMS.

Our TB-PORTS system, the “coastal intelligence” real time data system whose mission is port safety celebrated its 30th anniversary in 2021. Tampa Bay PORTS[®] was a prototype system that was implemented more than a decade after the harrowing 1980 accident in which a ship ran into the Sunshine Skyway bridge. Today PORTS[®] operates in 37 locations around the coasts and Great Lakes of the United States.

Also, celebrating its 30th anniversary was our Oceanography Camp for Girls, an annual 3-week summer ocean science exploration program for young women in Pinellas County.

We ran our first field program for our newest outreach initiative called Guardians of the Gulf, a program about coastal and human resiliency for underserved youth. It is a pilot program for the “Smart City” initiative spearheaded by the St. Petersburg Innovation District.

We mobilized quickly in order to be on the scene in response to the controlled discharges of nutrient-rich wastewater released from the retired Piney Point fertilizer processing plant and continue to process the data to understand the impacts to water quality and inform effective environmental policy moving forward. The Florida Institute of Oceanography made our initial cruise efforts possible and we remain grateful for their partnership.

Our Center for Ocean Mapping & Innovative Technologies (COMIT), a 5-year, \$9 million investment by NOAA, launched its first shallow-water coastal mapping survey here in Tampa Bay and the Gulf of Mexico. The team utilized an uncrewed surface vessel (USV) in this inaugural effort. This vehicle represents the future of marine technology.

We are not alone in continuing to experience the impact of the pandemic and consider this report a strong win given that our research was yet again orchestrated largely from living rooms, dining areas and makeshift home offices rather than ships, small boats and labs. We continue to be externally validated in our ability to rise to the challenges. For example, a 2021 study by Elsevier and Stanford University identified the top 2% of researchers worldwide across all fields of study based on their citation impact up until the end of 2020. The prestigious list included 11 current CMS faculty and one retired-emeritus faculty member – nearly half of our faculty. Collectively, the team published and contributed to more than 150 peer-reviewed journal articles and other scholarly works, including

THE VIEW FROM THE BRIDGE

contributions in prestigious journals such as *Nature Communications*, *Nature Geosciences*, *Geophysical Research Letters*, *Frontiers in Marine Science*, *Oceanography*, and more.

Our graduate students have followed the lead of our accomplished faculty and continue to impress. Collectively, students led or contributed this past year to 34 peer-reviewed publications, including 11 as first author. In spite of travel restrictions and reduced opportunities for dissemination of research findings, CMS students delivered dozens of presentations to national and international audiences, both in person and virtually. They didn't stop there. In 2021, students garnered more than \$300,000 of external funding and were recipients of numerous accolades that included more than 50 scholarships and fellowships.

The seas have been turbulent the past couple of years, but our keel is steady and the horizon is bright.

College of Marine Science Leadership Team

THOMAS K. FRAZER

Dean, College of Marine Science

PhD, UC Santa Barbara, 1995

(727) 553-3369

tfrazer@usf.edu



Dr. Thomas Frazer is a Professor and Dean of the College of Marine Science at the University of South Florida. Prior to his arrival at USF, Dr. Frazer was Director of the School of Natural Resources and Environment at the University of Florida and served also as Chief Science Officer for the State of Florida. Dr. Frazer holds a Bachelor's Degree in Fisheries Biology from Humboldt State University and a Master's Degree in Fisheries and Aquatic Sciences from the University of Florida. He earned his Ph.D. in Biological Sciences from the University of California, Santa Barbara. His research addresses contemporary and emerging environmental issues, and is, by nature, interdisciplinary. His work involves collaborators from disparate disciplines, and it includes sampling and experiments conducted across a wide range of spatial and temporal scales. Dr. Frazer has received research funding from a broad suite of granting entities to address topics pertaining to water quantity and quality, nutrient dynamics, biogeochemical processes, fish population dynamics, food web interactions, and ecological restoration of degraded ecosystems. He has conducted field research in both freshwater and marine systems around the globe, and he is intimately familiar with a broad suite of environmental and natural resource issues (e.g., eutrophication of fresh, estuarine, and coastal waters; invasive species; and the ecological impacts of contemporary environmental change, including coral bleaching, ocean acidification, and sea level rise). Dr. Frazer has authored and/or co-authored more than 175 peer-reviewed publications, technical reports, and book chapters. Dr. Frazer currently serves as a member of the Gulf of Mexico Fisheries Management Council and chairs multiple standing committees. He is also a member of Florida's Environmental regulation Commission.

GARY MITCHUM

Associate Dean, College of Marine Science

PhD, Florida State University, 1984

(727) 553-3941

mitchum@usf.edu



Dr. Mitchum is the Associate Dean and Professor of Physical Oceanography. 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. He

COLLEGE OF MARINE SCIENCE LEADERSHIP TEAM

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. Mitchum serves on numerous local, national, and international committees, most notably he serves as Chair of the Global Sea Level Observing System (GLOSS) Group of Experts and is President of the IUGG/IAPSO Commission on Mean Sea Level and Tides.

DAVID NAAR

Associate Dean of Academic Affairs, College of Marine Science

PhD, Scripps Institution of Oceanography, UCSD, 1990

(727) 553-1637

naar@usf.edu



Dr. Naar is the Associate Dean of Academic Affairs and Professor in Geological Oceanography. He has overseen the graduate academic program and graduate student matters since 2012. 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. Dr. Naar started as an assistant professor at the University of South Florida's Department/College of Marine Science in 1990. In 1996, he became an associate professor and in 2020, a full professor. His research interests include 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. These interests and his role overseeing the graduate program have meshed well with the education component of the USF-NOAA Center for Ocean Mapping and Innovative Technologies. Dr. Naar has served on several panels and working groups for the National Science Foundation, Ocean Observatory Initiative, Ocean Drilling programs, NOAA, and on the United States Scientific Advisory Committee.

MONICA DUFAULT

Budget Director, College of Marine Science

(727) 553-3980

mdufault@usf.edu



Ms. Monica Dufault Leake is the Budget Director for the College of Marine Science. She received her Master's degrees in Research Administration and Nonprofit Management from the University of Central Florida. She began her career in higher education and research administration at the University of Central Florida from 2000-2007 before relocating to Baltimore to work at Johns Hopkins University from 2007-2011. Dufault returned to Florida in 2011 to join the College of Marine Science as the Manager of Business and Fiscal Administration.

COLLEGE OF MARINE SCIENCE LEADERSHIP TEAM

TIM TROWBRIDGE

Unit HR Administrator, College of Marine Science

(727) 553-3375

ttrowbridge@usf.edu



Mr. 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, Trowbridge was promoted to Unit HR Administrator 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 Project Manager, College of Marine Science

MS, University of South Florida, 1986

(727) 553-1190

donnely@usf.edu



Mr. Donnelly is the Facilities Project Manager for the College of Marine Science. 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. Donnelly currently serves on several CMS committees (Space, Safety, and Computer) and is also a member of the USFSP campus EMT, which deals with all matters relating to the USFSP Campus Emergency Management Plan (CEMP).

KRISTEN KUSEK

Director of Strategic Communications

MS, MA, University of South Florida, 1998

kkusek@usf.edu



Ms. Kusek has operated as our Director of Strategic Communications since late 2018. Her primary job is to lead the communications strategy for the College, as well as the tactical execution of that strategy. She serves as the chief storyteller for the College, and is responsible for print and/or digital news, collaborating with USF's news teams on media outreach, and for supporting outreach, strategic fundraising, and community engagement initiatives. She is also spearheading the newest education outreach STEAM program in the CMS portfolio, a partnership with Boys & Girls Clubs of the Suncoast that is focused on coastal resiliency called Guardians of the Gulf. The first to earn dual master's degrees in marine science and journalism/mass communications from USF, Kusek brings to her cross-functional role nearly 25 years of experience working on all sides of the science communications landscape. Her passion is developing programs that leverage the power of

COLLEGE OF MARINE SCIENCE LEADERSHIP TEAM

storytelling to inspire, educate, and empower. Before boomeranging back to USF, she served as Chief Communications and Development Officer for the Boston-based global nonprofit Earthwatch Institute, where her team raised more than \$4 million annually while implementing creative education and marketing campaigns that increased expedition engagement year over year. Career highlights include reporting live from expeditions in the South Pacific and the Arctic, spearheading Earthwatch's first virtual reality experience, leading Harvard's Wyss Institute for Biologically Inspired Engineering in its communication strategy, serving as creative education director in an NSF-funded IMAX film "Volcanoes of the Deep Sea," and founding a Science Journalism Center at USF.

RENATE GOTTSCHKE

Executive Administrative Specialist

M.Ed., Plymouth University 2018

rjurden@usf.edu

Ms. Renate Gottsche is the Executive Administrative Specialist to the Dean of the College of Marine Science. She received her M.Ed. from Plymouth State University. Prior to moving to Florida in 2019 to join the College of Marine Science, Renate worked at the University of New Hampshire. Renate is the first point of contact for the Dean's office. She manages the Dean's calendar, organizes meetings and events for the college, oversees the college's foundation accounts, and acts as a liaison with other colleges, and collaborators in federal and state agencies. She is the central resource person for information, referral, and assistance.



Graduate Program

Academic Programs:

The year 2021 continued to throw challenges due to the continuation of the Covid-19 pandemic. Classes were delivered in a spectrum of modes in an effort to provide quality education within the constraints of staying safe. Some courses that had been taught asynchronously continued without interruption, especially the undergraduate asynchronous online version of OCE 2001, Introduction to Oceanography, which was taught to approximately 1000 undergraduates in 2021 by Dr. Ana Arellano and her team of teaching assistants. Progress towards a non-thesis Master of Arts in Marine Studies, with concentrations in Business was made, but new complications related to using the same core requirements have sent the MA in Marine Studies back to revision for a delayed start for Fall 2023. As part of the USF-NOAA Center for Mapping and Innovative Technologies (COMIT) we have created a hydrographic concentration, which is now ready and will start in Fall 2022. We continue efforts to create a certificate and aim to have the curriculum certified as “Category A” by the International Hydrographic Organization. There has been much excitement from the students involved with COMIT for this concentration or future certificate in Hydrography.

DEGREES AND CERTIFICATES OFFERED

We offer **Master of Science (M.S.) and Doctoral (Ph.D.) degrees with concentrations in** Biological Oceanography, Chemical Oceanography, Geological Oceanography, Physical Oceanography, and Marine Resource Assessment (MRA). We also offer a **Graduate Certificate in Teaching & Communicating Ocean Sciences Broader Impacts.**

Undergraduate Teaching by Marine Science faculty and adjuncts (14 sections, 7 courses, and 1247 total enrolled)

Introduction to Oceanography - Tampa campus (Greely)

Introduction to Oceanography - Online (Arellano)

Geological History of Florida - Online (Arellano)

Marine Aquaculture - Online (Main)

Port Sustainability - Online (Luther)

Coral Reef Ecology - Online (Arellano)

Fish Biology – St. Pete campus (Stallings)

Undergraduate Research in Marine Microbiology – St. Pete campus (Breitbart)

STUDENTS GRADUATED IN 2021 (5 PhD, 2 Master’s)

Doctoral (5)

Chen, Jing, advised by Bob Weisberg, summer, *On the Physical Oceanography of Tampa Bay*

Guitard, Michelle, advised by Amelia Shevenell, spring, *The Role of Ocean Forcing on East Antarctic Ice Sheet Evolution Through the Quaternary: An Ice-Proximal Sedimentary Perspective*

GRADUATE PROGRAM

Hudson-Heck, Ellen, advised by Bob Byrne, fall, *From River to Sea: Improving carbon system measurement methods for use in rivers, estuaries, and oceans*

Vadman, Kara, advised by Amelia Shevenell, summer, *Past Ice-Ocean Interactions on the Sabrina Coast Shelf, East Antarctica: Deglacial to Recent Paleoenvironmental Insights from Marine Sediments*

Venturelli, Ryan, advised by Brad Rosenheim, spring, *Investigating the recent history of a changing planet with innovative isotopic techniques and new geologic archives*

Master's (2)

Burns, Alexandra, advised by Brad Siebel, summer, *Metabolic Rate, Critical Oxygen Partial Pressure, and Oxygen Supply Capacity of *Farfantepenaeus duorarum* at Their Lower Thermal Limit*

Moore, Christopher, advised by Bob Byrne, fall, *Riverine and Estuarine CO₂-System Studies on the West Coast of Florida*

New Students

-8 students entered the PhD program

-12 students entered the MS program

Orientation Activities for New Students

20 new students participated in our New Student Orientation program, held August 16-20, 2021.

Originally planned to be in person, the Delta variant surge of Covid-19 forced all orientation programming to a virtual platform about one week before students were expected to arrive. Academic Affairs staff seamlessly transitioned their entire week of orientation programming online, leveraging Canvas and MS Teams. Orientation programming included:

- Virtually meeting key members of the CMS and USF community
- Life in St. Pete and Student Involvement panels
- Academic Writing Development full day workshop facilitated by Dr. Vernetta Mosely, founder of Cultivate the Writer and Chrysalis Consulting LLC
- Library Services review facilitated by Matt Torrance, USF Libraries
- Diversity Training Workshop facilitated by DeWayne Anderson, USF St. Pete campus Office of Multicultural Affairs
- Conflict Resolution for Student Employees, and Self-Care & Stress Management for Student Employees, both facilitated by Victoria Beltran, USF St. Pete campus Wellness Center
- Mentor/Mentee Relationships presented by Dr. Pam Hallock Muller
- Mandatory safety trainings in: Lab Safety, Emergency Protective Actions & Preparedness, Title IX Mandatory Report & VAWA

Prior to the start of Orientation students received monthly communications from CMS, called Cohort News, with information to assist their transition to graduate school and CMS. Each student received a one-on-one welcome meeting with the Assistant Director of Academic Affairs, which included time to review the graduate handbook, funding, and the student's individual plan of study. New students were also paired with a current student to serve as their peer mentor. New students were also invited

GRADUATE PROGRAM

to college-wide virtual student meetings with college leadership and new student-specific presentations in July and August, respectively.

Presentation Workshop by Dr. Vernetta Mosely

Dr. Vernetta Mosley was invited back to campus in December 2021 to offer a full-day presentation workshop, *Speaking to a Professional Audience: Presentation Skills Needed for Academic and Non-Academic Audiences*. This workshop provided information to organize and present information clearly, succinctly, and confidently to academic and non-academic audiences, including when and how to use visual aids. Students were also given time to practice skills learned in the workshop. Registration was open to all students, and 13 students participated in the workshop.

Student Publications

-23 publications by 17 students

-11 first-authored by students

-Congrats to Yingjun Zhang, advised by Dr. Chuanmin Hu, who published four papers, including two on which he was first author.

Student Presentations

17 students gave 24 presentations in 2021. All but one presentation was given in a virtual setting.

Virtual 2021 Graduate Student Symposium

In response to the Covid-19 pandemic, the Graduate Student Symposium was held virtually in 2021. Presenting students pre-recorded their talks and answered questions live on MS Teams. The 2021 GSS presenters were:

Bea Combs-Hintze, Ph.D. Student, Marine Resource Assessment, advised by Dr. Cameron Ainsworth: *Using Ecosystem Modeling to Assess Changes in Seagrass Meadow Ecosystem Under Various Harmful Algal Bloom Scenarios*

Kiersten Monahan, Ph.D. student, Geological Oceanography, advised by Brad Rosenheim: *Improving our quantitative and mechanistic understanding of organic carbon preservation in the Guianas Mudbanks*

Jill Thompson-Grim, Ph.D. Student, Marine Resource Assessment, advised by Dr. Steve Murawski: *Assessing the Distribution of Fishes Across Relief Anomalies at the South Texas Banks*

Alexander Timpe, Ph.D. student, Biological Oceanography, advised by Dr. Brad Seibel: *Small amounts of oxygen measurement error can drastically affect key metabolic parameters*

Claire Onak, Master's student, Chemical Oceanography, advised by Dr. Tim Conway: *Environmental impacts of copper mining in Michigan's Upper Peninsula*

GRADUATE PROGRAM

The GSS Committee did a commendable job keeping the spirit of the event alive despite ongoing uncertainty and the challenge of transitioning a traditionally in-person event to a virtual setting. The 2021 GSS Committee included:

- Laura Azevedo Carvalho Britto, PhD student
- Catherine Dietrick, PhD student
- Natalia López Figueroa, PhD student
- Macarena Martín Mayor, PhD student
- Lisa Rose-Mann Master's student
- Carlyn Scott, Master's student
- Rebecca Scott, PhD student

STUDENT HONORS, AWARDS, AND ACHIEVEMENTS

2021 Awards by the Numbers

Total Funding: \$1,108,500

- College-based Student Fellowships & Awards: **\$793,000**
- University-based Fellowships & Awards: **\$92,000**
- External Fellowships & Awards: **\$223,500**

2021 STUDENT AWARDS AND HONORS from external sources:

Jessica Caggiano, 2020 NASA Earth Science FINESST Future Investigator for project 19-EARTH20-0209, Understanding Surface Wave Signals in SWOT Altimetry (Year 2 of 3-year award totaling \$128,000), \$43,000

Savannah Hartman, Florida Education Fund McKnight Doctoral Fellowship (Year 4 of 5-year award totaling \$36,000), \$12,000

Luis D. Lizcano-Sandoval, Fulbright-Colciencias (Renewed), \$29,000

Naja Murphy, Florida Education Fund McKnight Doctoral Fellowship (Year 2 of 5-year award totaling \$36,000), \$12,000

Naja Murphy, Ford Foundation Fellowship Honorable Mention

Delfina Navarro-Estrada, NSF Graduate Research Fellowship 2020 Fellow (Year 1 of 3-year award totaling \$128,000), \$43,000

Jonathan Peake, The Guy Harvey Scholarship, \$5,000

Tiffany Raetzel, Fish Florida Scholarship, \$5,000

Tiffany Raetzel, Donald Shepherd Graduate Fellowship (Alumni of the University of Michigan Marching Band), \$10,000

Mostafa Soliman, Embassy of the Arab republic of Egypt Cultural and Educational Bureau Fellowship (recurring), \$21,000

GRADUATE PROGRAM

Jill Thompson-Grim, Suncoast Fly Fishers Scholarship, \$500

Yingjun Zhang, 2019 NASA Earth Science FINESST Future Investigator for project 19-EARTH19-0277: Sub-Mesoscale Eddies Derived from Novel Ocean Color Imagery and ICES at Missions in Support of the SWOT Mission (Year 3 of 3-year award totaling \$126,000), \$42,000

Yingjun Zhang, American Geophysical Union (AGU) Fall Meeting Virtual Student Travel Grant, \$1,000

2021 STUDENT AWARDS AND HONORS from University Awards

Sarah Bartoloni, USF University Graduate Fellowship, \$8,000

Olivia Blondheim, USF Presidential Fellowship (Resumed, Year 4 of 5-year award totaling \$160,000), \$32,000

Rosemary Burkhalter-Castro, USF Delores Auzenne Fellowship (Year 1 or 3-year award totaling \$30,000), \$10,000

Dylan Halbeisen, USF Graduate Student Success Fellowship (Year 1 of 3-year award totaling \$30,000), \$10,000

Jing Shi, USF Presidential Fellowship (Renewed, Year 3 5-year award totaling \$160,000), \$32,000

2021 STUDENT AWARDS AND HONORS from endowed sources

Alyssa Andres, Gulf Oceanographic Charitable Trust Fellowships Endowment, \$12,000

Sean Beckwith, Young Fellowship Program Fund, \$13,000

Bostony Braoudakis, Von Rosenstiel Endowed Fellowship, \$26,000

Imogen Browne, William and Elsie Knight Endowed Fellowship Fund for Marine Science (2017, renewed), \$28,000

Zach Bunnell, Kent A. Fanning Endowed Fellowship in Marine Science, \$10,000

Shannon Burns, Oceanography Camp for Girls Fellowship, \$10,000

April Ellis, Bridge-to-Doctorate College of Marine Science Match Fellowship (Renewed, Year 2), \$32,000

Kalla Fleger, Garrels Memorial Fellowship in Marine Science, \$15,000

Nicola Guisewhite, Wells Fargo Fellowship in Marine Science, \$10,000

Brittany Hernandez, Von Rosenstiel Endowed Fellowship, \$26,000

Alexander Ilich, William and Elsie Knight Endowed Fellowship Fund for Marine Science (2017, renewed), \$28,000

Keith Keel, Bridge-to-Doctorate Endowed Fellowship (Year 1 of 2-year award, totally \$24,000), \$12,000

GRADUATE PROGRAM

Luis Lizcano-Sandoval, Sanibel-Captiva Shell Club / Mary & Al Bridell Memorial Fellowship, \$10,000

Natalia B. Lopez Figueroa, Norman Blake Endowed Memorial Fellowship in Marine Science, \$10,000

Natalia B. Lopez-Figueroa, WLP Dorothy L. Morgan Endowed Scholarship in Marine Science, \$2,000

Macarena Martin Mayor, George Lorton Fellowship in Marine Science, \$10,000

Brianna Michaud, William T. Hogarth Fellowship in Marine Mammals, \$10,000

Kiersten Wallace Monahan, St. Petersburg Downtown Partnership Fellowship in Coastal Science, \$15,000

Naja Murphy, Bridge-to-Doctorate Endowed Fellowship (Year 2 of 2-year award, totally \$24,000), \$12,000

Mark Mussett, Thomas E. Pyle Memorial Fellowship in Marine Science, \$10,000

Claire Onak, Southern Kingfish Association's Fellowship, \$10,000

Caitlyn Parente, Von Rosenstiel Endowed Fellowship, \$26,000

Jonathan Peake, Gulf Oceanographic Charitable Trust Fellowships Endowment, \$12,000

Martina Plafcan, Linton Tibbetts Endowed Graduate Student Fellowship, \$10,000

Shannon Riley, Von Rosenstiel Endowed Fellowship, \$26,000

Catalina Rubiano, Bridge-to-Doctorate Endowed Fellowship (Renewed, Year 2), \$24,000

Kylee Rullo, Paul Getting Endowed Memorial Fellowship in Marine Science, \$13,000

Natalie Sawaya, WLP Dorothy L. Morgan Endowed Scholarship in Marine Science, \$2,000

Natalie Sawaya, William and Elsie Knight Endowed Fellowship Fund for Marine Science (2020, renewed), \$28,000

Katelyn Schockman, William and Elsie Knight Endowed Fellowship Fund for Marine Science (2019, renewed), \$28,000

Michael J. Schram, Tampa Bay Parrot Head Fellowship in Marine Science, \$10,000

Rebecca Scott, Jack and Katharine Ann Lake Fellowship in Marine Science, \$13,000

Alexander W. Timpe, William and Elsie Knight Endowed Fellowship Fund for Marine Science (2021), \$28,000

Christina J. Welsh, Carl Riggs Fellowship in Marine Science, \$10,000

STUDENT AFFAIRS:

Recruitment events for Fall 2021 were conducted in a virtual mode in 2021. Online student evaluations for the courses taught in 2020 remained strong (as compared to years past), despite the challenges resulting from change of course delivery methods. New student activities run by the MSAC group continued to unite the students virtually and outdoors in person. The endurance and flexibility of the students shown in 2021 was quite impressive.

DIVERSITY, EQUITY, and INCLUSION (DEI):

On the heels of too many incidents of racial injustice, such as the horrific deaths of George Floyd, Ahmaud Arbery, and Breonna Taylor in 2020, the CMS devoted well-served time in 2020 and 2021 on our DEI portfolio, which aligns with USF's Principles of Community (<https://www.usf.edu/president/principles-of-community/index.aspx>). Our College's Diversity, Equity, and Inclusion committee (developed in 2020) is a standing committee in the College Governance structure and reports to the Dean's Advisory Council. The committee was officially adopted into the College Governance document during the Spring 2021 semester. Five out of the 19 (~26%) students admitted to the Fall of 2021 were of underrepresented minority status as defined by the National Science Foundation, which reflect our recruitment efforts and the faculty's holistic evaluation of applicants for admittance to the graduate program in 2021.

What follows is a snapshot of our DEI portfolio.

Diversi-Teas

Dr. Ana Arellano, our diversity coordinator, continues to lead *Diversi-teas* virtual meetings, which focus on specific topics related to historical and systemic racism. These are open to all faculty, staff, and students. Following the best practices of the Alfred P. Sloan program, in which the College of Marine Science was a USF Affiliate Member of the University Center of Excellence in Mentoring, we have continued to work in partnership with the College of Engineering and to develop or continue some of our own programs, such as the Graduate Exemplary Mentoring model.

Diversi-Teas are a safe space to hold community wide conversations on DEI issues. The ground rules for attending a Teas are:

- 1) Respect confidentiality.
- 2) Lean into the work (Some topics are challenging. We advise participants to be willing to experience some discomfort in discussions and learn from it as a cohort).
- 3) Use "I" statements.
- 4) Listen actively by respecting others when they are talking, and respectfully by listening even if you disagree.

GRADUATE PROGRAM

5) Step Up, Step Back. Encourage participants who don't talk much to "step up" (speak up, participate), and those who participate a lot to "step back" (say less) to make room for everyone to contribute.

6) Criticize the ideas, not the person.

In Spring 2021, Diversi-Teas attendance was low (4 students and 2 faculty) and only one Diversi-Teas meeting was held. In Fall 2021, the following topics were discussed: types of mentors for URM students, Hispanic Heritage Month, and Native American Heritage Month. In September, there were 4 students, 3 staff, 3 non-tenured faculty, and 3 faculty in attendance to discuss a paper by Marisela Martinez: Collectors, Nightlights, and Allies, Oh My! White Mentors in the Academy. The paper examines "three roles White mentors play for students of Color." In October, there were 3 students, 2 staff, 5 non-tenured faculty, and 6 faculty in attendance. In honor of Hispanic Heritage Month, the group discussed the following article: Yes, We're Calling It Hispanic Heritage Month and We Know It Makes Some of You Cringe. In November, there were 3 students, 3 staff, and 2 faculty in attendance. This Teas was in honor of Native American Heritage Month. The Darker Side of John Wesley Powell by Tamara Pico was discussed.

All-Aboard

USF was selected through a competitive application process as one of four institutions to participate in the first cohort of All-ABOARD (Alliance-Building Offshore to Achieve Resilience and Diversity). The program is funded by the National Science Foundation's (NSF) Geoscience Opportunities for Leadership in Diversity – Expanding the Network (GOLD-EN). It was created to support teams of individuals from four institutions who are committed to advancing their campus DEI efforts.

The USF team, named "A Bull's Eye for JEDI," includes members from the USF College of Marine Science (USF CMS), College of Education, the College of Arts and Sciences, and the College of Engineering. All-ABOARD creates a unique professional development model that provides four intergenerational teams of geoscience leaders — from undergraduate students to graduate students, from early career faculty to deans and chairs — with the tools they need to advance the goal of increasing DEI. The professional development model of All-ABOARD is unique in that it includes participating in a series of webinars, an individual assessment ahead of the retreat, an in-person sea/land retreat, and visits to each of the participating campuses. The webinar curriculum was designed to encourage community building between and among teams and develop a shared understanding of key topics including inclusive science identity, vision and values, strategic priorities, and brave leadership. A couple of webinars were facilitated by BCS & Associates and included Dr. Starks' Four Constructs of Social Justice and the belief that each person can *Be the Messenger* for social equity in their personal and professional lives. During the retreat in 2022, teams will build an institution-specific DEI action plan.

Urge

USF CMS formed an URGE (Unlearning Racism in Geosciences) pod. It was led by Sarah Grasty and included twelve USF CMS participants. URGE encouraged individuals within organized groups to form “pods” that will serve as individual discussion groups to address and take action on accessibility, justice, equity, diversity, and inclusion (AJEDI) initiatives within their communities. Each pod was provided with material (e.g., reading, interviews, inclusivity tips, etc.) in order to address URGE deliverables for each session and create effective action within the community. The URGE curriculum (8 bi-weekly sessions) focused on providing tools and resources to help Geoscientists develop policies that improve AJEDI in the workplace and community.

The primary objectives of URGE were to:

1. Deepen the community’s knowledge of the effects of racism on the participation and retention of Black, Brown, and Indigenous people in Geoscience.
2. Draw on existing literature, expert opinions, and personal experiences to develop anti-racist policies and strategies.
3. Share, discuss, and modify anti-racist policies and strategies within a dynamic community network and on a national stage.
4. Implement and assess anti-racist policies and resources with Geoscience workplaces.

Underrepresented Minority and International Student Support

Meetings with Underrepresented Minority (URM) students continued during the spring. During the summer, this safe space was also reevaluated, and international students were included in URM meetings, now URM Plus meetings. URM Plus meetings are scheduled three times per semester in spring and fall. Prompted by an URGE conversation, a tokenism survey was conducted over the summer and findings were reported to URM students.

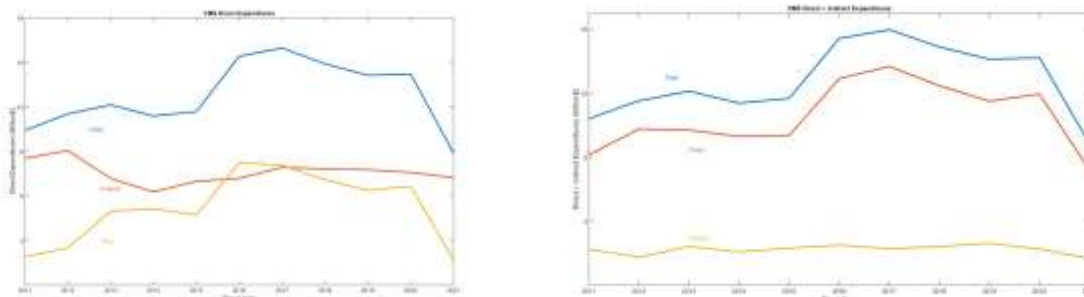
Shadow and Mentorship Programs

We continued our Multi-Dimensional Mentoring (MDM) model by assigning a peer mentor for the new student’s first year. Over the summer, 14 incoming students were paired with current students in their discipline to help them with housing and preparing to do classwork, research, etc. Peer mentors were given general and peer mentor guidelines in a workshop. Currently, there are 17 active members, 14 are URM students.

CMS Research

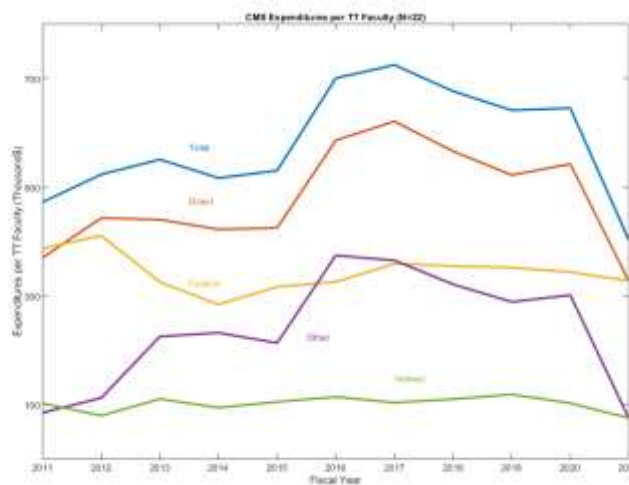
EXCELLENCE IN RESEARCH

We pointed out last year that we expected our total research expenditures for fiscal year 2021 would be lower than what we have achieved in the past 5 years. As expected, we dropped to ~\$9M, as compared to ~\$14M in 2020. Interestingly, the drop was largely in non-federal expenditures, which is positive because the impact on indirect cost recovery is minimized. Specifically, federal expenditures in 2021 and 2020 were ~\$7.2M and ~\$7.6M, respectively, which means that our effective indirect cost recovery rate increased from 19% in 2020 to 24% in 2021.



ANNUAL RESEARCH EXPENDITURES PER FACULTY

As expected for a research-intensive unit, **our faculty generally have some of the highest per faculty research performance metrics in the university.** Over the past 5 years the total research expenditures per full-time equivalent tenure-earning faculty member has been between \$600,000 and \$700,000. This year is a bit lower at around \$400,000, which is still a very good number given the challenges presented by the pandemic. As discussed above, it is very positive that the federal expenditures have remained stable, and we expect that the non-federal expenditures will rebound as we emerge from the pandemic.



Highlighted Research

Our researchers work all over the globe. Field expeditions started to resume in 2021 after a long delay due to the COVID19 pandemic. What follows are snapshots of stories from the field that showcase the local, regional, national, and global impacts of our research portfolio.

USF scientists announce initial findings from Piney Point research effort



ST. PETERSBURG, Fla. (May 24, 2021) – University of South Florida College of Marine Science researchers today shared their initial findings of how the Tampa Bay ecosystem has responded to the controlled discharges of nutrient-rich wastewater released from the retired Piney Point fertilizer processing plant. The scientists launched their first research cruise on **April 7** and have returned to the water several times since.

Key takeaways from the USF research team

- Early results indicate that the effects of the wastewater discharge were localized in nature, not widespread.
- Concentrations of nutrients have declined over time and are now more typical of those in the historical record for this part of Tampa Bay. Model results show that the concentrations of nutrients within the discharged water have been diluted at least 1000-fold since the initial release.
- A diatom bloom of about 25 square kilometers in size around Port Manatee that formed in response to the discharge has dissipated over time. Diatoms are single-celled microalgae called phytoplankton. Chlorophyll concentrations (a proxy for phytoplankton biomass) are within the range generally observed in Tampa Bay during April and May.

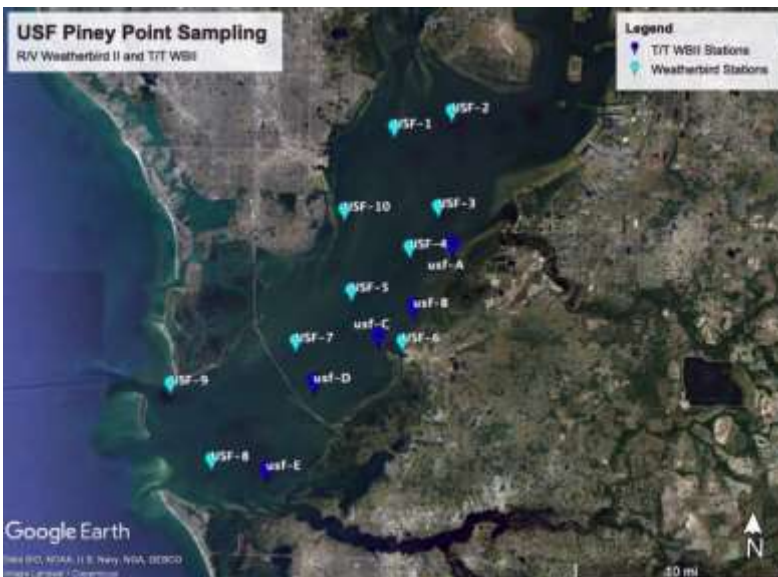
HIGHLIGHTED RESEARCH

Remaining unanswered questions for researchers

- Are longer-term impacts of the discharged water on the Tampa Bay ecosystem likely to be manifested? If so, how?
- The nutrient chemistry of Tampa Bay is complex. Questions remain about nutrient cycling in response to a rapid influx of wastewater. For example:
 - Were nutrients and heavy metals (e.g., lead, copper, zinc) from the discharge sequestered in the sediments? If so, will storms stimulate phytoplankton blooms?
 - Will there be an impact to seagrasses and other marine life that live on the bottom?
- What may have been the impact to fish health?

Additional information from USF scientists

“The area in the immediate vicinity of Port Manatee was subject to a spike in nutrient concentrations and a corresponding increase in phytoplankton abundance,” College of Marine Science **Dean Tom Frazer** said. “Our initial field sampling efforts and data acquired from remote sensing platforms confirmed high concentrations of chlorophyll, which is a proxy for phytoplankton abundance. Recent data indicate, however, that the response was short lived. Phytoplankton abundance continues to decline and water chemistry values are typical of those reported in the historical record.”



The field team, led by USF chemical oceanographer **Kristen Buck** collected water and sediment samples from a suite of stations in the vicinity of Port Manatee and locations beyond the affected area. The sampling and subsequent data analyses confirmed that the phytoplankton responded quickly to the nutrient pulse, but the assemblage was dominated by diatoms and not toxic phytoplankton responsible for red tides. The algal bloom has since dissipated. The end of the algae bloom was confirmed in satellite imagery analyzed by

physical oceanographer **Chuanmin Hu** (see “Hu satellite imagery” [here](#)).

The team’s sampling efforts were guided by a model provided by physical oceanographer **Bob Weisberg**. The model forecasts the movement of discharged water and its constituents based on tides, winds and river input. A summary of this model and its results are included here (see Word doc [here](#), “Piney Point Effluent Concentration Modeling”).

“Although the residency time of water in Tampa Bay is on the order of months and the bay flushes slowly, the discharged water seems to have been diluted pretty quickly,” Weisberg said.

HIGHLIGHTED RESEARCH

Many questions remain and any longer-term impacts on the ecosystem remain unknown. For example, biological oceanographer **Steve Murawski** collected fish to understand any impacts to fish health, but those samples will take longer to process.

“We will continue to work with state agencies leading the response effort and other local partners to sample water and sediments potentially affected by the discharge to better understand the transport, transformation, and fate of its chemical constituents, nitrogen and phosphorus in particular,” Buck said.

The USF research team collected water samples, surface sediments and fish from Tampa Bay and Port Manatee. In total they led five research cruises in April in partnership with the **Florida Institute of Oceanography** (FIO) aboard the *R/V Weatherbird II*, performed additional shore-based sampling on April 12-13 and partnered with the Florida Fish & Wildlife Commission (FWC) for small-boat sampling efforts on April 21 and April 29. Additional research cruises are tentatively scheduled for the end of May and late June.

The full suite of the data being collected at Piney Point, including USF’s data, can be viewed **on a dashboard** maintained by the Tampa Bay Estuary Program.

Use of the ship in the early days was made possible by FIO. USF is working with partners at **Florida Fish & Wildlife Conservation Commission, Eckerd College, Florida State University, Woods Hole Oceanographic Institution**, and more.

CMS team uncovers new insights about viruses and bacteria in Manatee Springs, Florida



Most people visit Manatee Springs to see its charismatic megafauna, from the iconic sea cows that are its namesake to gators and majestic great blue herons. But not Kema Malki.

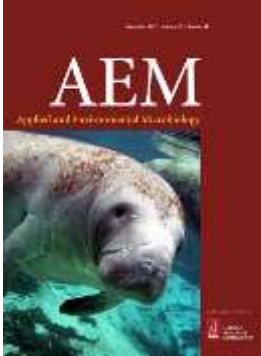
Malki, a microbiologist, visited Manatee Springs to find the things you can’t see: the bacteria and viruses that also live in the sparkly water that flows from its headwaters to the Suwanee River. That volume ranges from 50 to 150 gallons per day. Malki published her findings in what became a spotlight feature in **Applied and Environmental Microbiology**. The study sheds new light on this little understood microbial world and holds broader implications for monitoring and stewardship of this vital water resource.

The key takeaway: springs play only minor roles in seeding viral and bacterial communities further downstream.

HIGHLIGHTED RESEARCH

Microbial communities play a critical role in maintaining the health of Florida’s spring systems but we know so little about them, said Malki, now a Research Specialist at the University of Southern California. She earned her PhD studying these systems at the USF College of Marine Science in the lab of **Mya Breitbart**, senior author of the study.

“It continues to surprise us that we’re the first to undertake this research,” said Breitbart, whose team – again led by Malki – previously conducted the **first census of viruses and bacteria** in five of Florida’s largest springs, including Manatee Springs. The Floridan Aquifer that feeds the springs, one of the largest in the nation, provides drinking water for 10 million people in Florida, Georgia, and Alabama.



*Left: A curious manatee watches as scientists sample Florida’s freshwater springs to examine the prokaryotic and viral communities of these critical ecosystems. This photo by Mya Breitbart was the cover image for the journal issue. Copyright © 2021 Malki et al. **CC-BY 4.0**.*

For the Manatee Spring study, Malki and her team determined the abundance of viruses and bacteria at three diverse sites within the Manatee Springs system at four times over the course of a year. The abundance of the particles increased 100-fold between the source waters and the Suwanee River, and very few bacteria and viruses found at the source were found further downstream. In addition there was significantly less variability in the spring outflow communities than in the Suwanee River, which underscores the stability of these groundwater communities.

The community composition is influenced by the land use along the site – in this case, agricultural activities -- and corresponds to changes in dissolved oxygen, phosphate, ammonium, and nitrate concentrations, Malki said.

“We’re only just now scratching the surface of understanding the dynamics of Florida’s springs,” said Breitbart. “These initial studies revealed a treasure trove of undescribed viral diversity – right here in our drinking water!”

Future research will explore the ecological roles of specific groups of viruses, including those infecting bacteria and aquatic plants, Breitbart said.

This work was funded by the **National Science Foundation** and included collaborators in Maryland, Spain, and Sweden.

Projections of US high-tide flooding show rapid increases and extreme months

While recurrent flooding during high tides has become familiar to many U.S. communities, including the Atlantic and Gulf coasts, these high-tide flooding (HTF) events are projected to increase rapidly in the mid-2030s, according to a study published in **Nature Climate Change**. The team, led by the University of Hawai’i at Mānoa, included **Dr. Gary Mitchum**, physical oceanography Professor and Associate Dean at the USF College of Marine Science.

The team analyzed tide gauge data from 89 coastal locations around the US, including St. Petersburg, and developed a novel statistical technique that combined natural fluctuations in tidal ranges with NOAA sea level rise scenarios to produce the projections of high-tide flooding. The analyses show “tipping points” when the frequency of HTF events increase abruptly.

HIGHLIGHTED RESEARCH

For example, the analyses indicate a tipping point for St. Petersburg may occur around 2033. The St. Petersburg area may see less than ten HTF events every year between 2023-2033, but that projection increases to nearly 70 per year in the following decade (2033-2043).

“Events we used to call extreme are likely to become routine, and the projected number of events is cause for concern,” said Mitchum. “We have to keep in mind that flooding events are highly localized in nature, but these estimates do provide a blueprint that we hope helps guide coastal planning efforts.”

The impact of seemingly minor occurrences of HTF adds up and can exceed the impact of rare extremes over time. These impacts are subtle—for example, the loss of revenue due to recurrent road and business closures—compared with the physical damage of property and infrastructure associated with extreme storm-driven events.

The most rapid increases are along the Gulf of Mexico and the US Pacific, which includes Hawai‘i and other Pacific Islands. “This is important, because this is the point at which high-tide flooding transitions from being primarily a local or regional issue and becomes a national issue affecting a majority of our nation’s coastlines,” said lead author Phil Thompson, director of the UH Sea Level Center and assistant professor of oceanography in the UH Mānoa School of Ocean and Earth Science and Technology (SOEST).

Continued sea-level rise will exacerbate the issue where present, and many more locations will begin to experience recurrent high-tide flooding in the coming decades.



Street flooding in Coffee Pot Bayou, St. Petersburg October 9, 2018. Photo credit Dr. Jackie Dixon, USF College of Marine Science.

The team also found that annual cycles in tides and sea level can combine with oceanographic anomalies to produce many high-tide flooding episodes over a short amount of time—creating extreme months with clustered events. For example, St. Petersburg could see an average of ten HTF events per month by 2050, though some months could see 20 or more.

Further, the scientists found that naturally occurring fluctuations in tidal range from one decade to the next alternately reduce and exacerbate the impacts of sea level rise. For example, while sea level may

HIGHLIGHTED RESEARCH

rise less than two inches over the next decade in St. Petersburg based on these new analyses, it could rise by nearly six inches between 2033-2043.

“This research is a great example of the work we will do as part of the state of Florida’s recently announced **Flood Hub for Applied Research and Innovation**,” said **Tom Frazer, Dean** of the USF College of Marine Science. “Our coastal communities need exactly this kind of tangible information to make solid, data-driven decisions about how to mitigate the impacts of sea level rise and flooding.”

Tampa Bay-PORTS Celebrates 30 Years



View of the first fuel ship entering the Port of Tampa after Hurricane Irma. Credit: NOAA

Harbor pilots entering the mouth of Tampa Bay from the Gulf of Mexico may feel the energy of the ‘home stretch’ when they see the iconic Sunshine Skyway Bridge, but they are wise not to let their guard down. The journey to a berth at Port Tampa Bay, the largest port in the state of Florida, is still another four hours and 45 miles away, down a narrow channel with ample zigs and zags.

Thankfully they have the **Tampa Bay Physical Oceanographic Real-Time System** (TB-PORTS) literally by their side 24/7/365.

PORTS, a “coastal intelligence” system of oceanographic and meteorological sensors, is freely available to all. This year marks its 30th birthday, and those behind its development and operation have a lot to celebrate. Since PORTS became fully operational in September 1991, the number of ship groundings in Tampa Bay has decreased by two-thirds. It has made the final leg of the journey to port facilities around Tampa Bay significantly safer for the 3,000 barges, cruise lines, tugs, and cargo vessels that make the trip every year.

“PORTS tells the harbor pilots all they need to know about the wind, current, and tide conditions so they can make their transit as safely as possible,” said **Dr. Mark Luther**, a physical oceanographer at the USF College of Marine Science who has served as director of operations since 1995.

NOAA manages PORTS®, and local operations and maintenance of the system have been directed by the Greater Tampa Bay Marine Advisory Council - PORTS, Inc., a non-profit consortium of maritime interests, through cooperative agreements with the **NOAA National Ocean Service Center for Operational Products and Services** and the **USF Center for Maritime and Port Studies** at the College of Marine Science (led by Luther).

HIGHLIGHTED RESEARCH

This real-time information is especially important for larger vessels with lower clearance margins, Luther said. More than four billion gallons of oil, fertilizer components and other hazardous materials pass through Tampa Bay each year. If the tide is higher upon entry to Tampa Bay, ships can handle more cargo and therefore increase the profitability of the transit.

“PORTS is a great example of the kinds of digital eyes and ears we need in the global ocean basins so that we can maximize the safety and health of our waterways and monitor them in real time from anywhere on the planet,” said Dr. Tom Frazer, Dean of the USF College of Marine Science.

THE FIRST OF ITS KIND, BORN FROM TRAGEDY

Tampa Bay PORTS® was a prototype system that was implemented more than a decade after a harrowing accident occurred on the Sunshine Skyway bridge. On the morning of May 9, 1980, an intense squall line whipped up 60-knot winds. A bulk carrier, the M/V Summit Venture, was blinded by the storm and struck the southbound part of the bridge, causing a section of it to collapse. A greyhound bus and several cars ended up in the water--killing 35 people.

In the wake of the disaster, the local maritime community -- led by the Tampa Bay Pilots Association and the Tampa Port Authority -- petitioned the US Congress for funding to NOAA to improve monitoring capabilities in the bay. Nearly a decade later, the Tampa Bay Oceanography Project (TOP) began in 1990 as part of NOAA’s Coastal Ocean Circulation Program (COCP). This included a 15-month study of currents, water levels, water temperatures, salinity, winds, and other meteorological/oceanographic parameters, said Luther. By the end of the project, TOP had collected the largest number of circulation measurements in one estuary in the 100-year history of COCP.

TOP was followed by permanent deployment of real-time telemetered sensors measuring winds, currents, and water levels at critical locations in the bay that technically comprised the first official NOAA PORTS® installation.

Within three years of Tampa Bay PORTS® becoming operational, San Francisco Bay and Houston/Galveston Bay implemented their own PORTS® networks. Today PORTS® operates 24 hours a day/7 days a week in 37 locations around the coasts and Great Lakes of the United States.

TB-PORTS continues to expand: the original 12 oceanographic and meteorological sensors at 8 sites have been increased to 35 individual sensors at 15 locations, including additional Acoustic Doppler Current Profilers (ADCPs) at the turn approaching the Port Manatee channel and in Egmont Channel, additional wind sites around the Port of Tampa to support cruise ship transits, two atmospheric visibility (fog) sensors, a directional wave buoy (operated in collaboration with the Coastal Data Information Program - <http://cdip.ucsd.edu/> - and the US Army Corps of Engineers), and a new Air Gap sensor on the Sunshine Skyway Bridge center span measuring instantaneous vertical clearance.

Today Tampa Bay PORTS® is funded by a variety of sources, including Hillsborough County (through the Phosphate Severance Tax Trust, with Mosaic as the primary contributor), Port Tampa Bay, the Tampa Bay Pilots Association, and Port Manatee.

“Ours is also the only PORTS system that is intimately connected to an academic research institution,” said Luther. Not only has PORTS® data streams saved lives; it has been the centerpiece of nine master’s theses and PhD dissertations at USF, 34 refereed publications, and nearly 90 local, regional, and national presentations. It has also played a key role in nearly 20 grants and contracts worth about \$4.3 million.

Not bad for a system that costs about \$200,000 annually to maintain.

HIGHLIGHTED RESEARCH

USF launches first mission to map vulnerable coastal areas in Tampa Bay and Gulf of Mexico using a remotely operated 'uncrewed' vessel

This week, University of South Florida marine scientists launched their first field mission in Tampa Bay and the Gulf of Mexico to test a new approach to mapping shallow coastal areas -- the most vulnerable to coastal changes and storm events, but the hardest to survey.

They are using a suite of technologies to generate high-resolution maps of these coastal areas: acoustic sensors mounted on an uncrewed surface vessel (USV) that is remotely operated, laser-based sensors mounted on an airplane, and satellite-derived imagery.



“Coastal areas may be the easiest to get to, but they are the hardest to survey from large ships that have depth limitations and may be less nimble than smaller craft,” said **Steve Murawski**, who heads the Center for Ocean Mapping and Innovative Technologies (**COMIT**) at the USF College of Marine Science (USF CMS) that is leading the mission in partnership with NOAA and two private companies. “We’re excited to figure out the best mix of agile technologies for surveying complex, shallow areas — a top priority for Florida, the nation and the globe,” Murawski said. “That’s our primary goal.”

The target areas in Tampa Bay and the Gulf of Mexico (above) exhibit an array of conditions with differences in depth, water clarity, boat traffic and habitat types, which makes this area a fertile testing ground. The work will be applicable to other coastal areas around Florida and beyond, said Murawski, who previously led the 10-year

research effort in response to the Deepwater Horizon oil spill.

The mapping products from this approach will also be used to improve storm surge modeling and prediction, maritime safety, fisheries management and more.

“Coastal resiliency is a top priority for our state, whose valuable natural resources and other assets are vulnerable to rising sea levels, escalating storm events and other environmental hazards,” said Florida House Speaker Chris Sprowls. “I’m delighted to see USF and its partners answering the call for research and innovation in coastal mapping.”

More than 50 percent of our nation’s Exclusive Economic Zone (EEZ) remains unmapped, and experts say new approaches are needed.

“COMIT and its partners have achieved a significant milestone in advancing USV technologies with this mission,” said Neil Weston, chief scientist in NOAA’s Office of Coast Survey. “Our office is particularly interested in the outcomes from these field trials, especially when new technology approaches can

HIGHLIGHTED RESEARCH

improve our national priorities such as shallow water mapping, coastal resilience and emergency response."

A DEEPER DIVE INTO THE EXPERIMENTAL TECHNOLOGY APPROACH

The USV, about 16 feet long, is powered by solar panels and was built by a Massachusetts-based company called SeaTrac. The boat is autonomous, meaning it operates on its own once a mission is programmed and remotely controlled from shore. A "chase boat" follows the USV to ensure safety of the boat and anything in its vicinity as it progresses along its track, moving at about 3-5 knots, in a manner similar to mowing a lawn. A team of USF graduate students and undergraduate students from Eckerd College will take shifts on the chase boat to watch for marine mammals or other unexpected hazards. The USV's course can be changed swiftly as needed.

"We're excited to see how our platform can be leveraged in the broader seafloor survey toolkit to efficiently and effectively map in shallow coastal areas," said Hobie Boeschstein, director of business development and operations manager for SeaTrac. "We expect to learn a lot from this inaugural expedition with USF."

SeaTrac's work will be complemented by airplane surveys in early January 2022, executed by a global company called Fugro that developed a lightweight survey technology called a Rapid Airborne Multibeam Mapping System (RAMMS). In total, it will survey about 90 square miles mostly between John's Pass and Anna Maria Island, and one area off Egmont Key in the Gulf of Mexico.

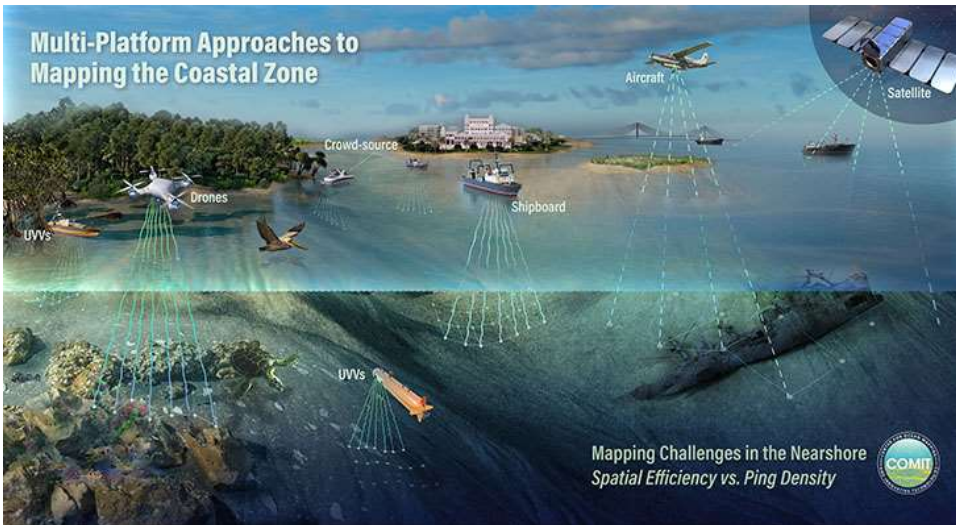
Mark MacDonald, Hydrography Director for Fugro in the Americas, said: "We built RAMMS exactly for this purpose—to deliver efficient, high accuracy nearshore and coastal mapping data that address multiple stakeholder needs, from nautical charting to marine and coastal engineering and coastal zone management. We're looking forward to seeing how the data will help the COMIT team better understand how we can efficiently map our coastal environments."

The sensors used by the surface vessel and the plane vary in their resolution and performance under different conditions of water clarity and more – and each has its place in the mix, Murawski said.

In future missions, the COMIT team plans to test sensors mounted on other kinds of vehicles as well, such as drones and robotic gliders.

"We have a long history of leadership in coastal resiliency," said **Tom Frazer**, dean of the USF CMS, "and it's thrilling to watch our portfolio of action-based research grow in a way that will benefit the state of Florida and beyond."

HIGHLIGHTED RESEARCH



The CMS was recently designated the home of a state-funded Florida Flood Hub for Applied Research & Innovation, which will serve the state of Florida and harness the broad suite of talent that exists within academia, government and private sectors to accomplish its mission. In addition, the college's expertise sits at the heart of a new Center of Excellence in Environmental and Oceanographic Sciences that aims to establish the USF St. Petersburg campus as a nerve center of innovation around the blue-green economy, sustainability and coastal resiliency.

"This mission is a great example of the kind of innovation you can expect from USF moving forward," said Frazer.



In January 2022 SeaTrac's work with the USV will be complemented by airplane surveys executed by a global company called Fugro.

Study of Antarctic ice's deep past shows it could be more vulnerable to warming

Left: Insights into how the West Antarctic Ice Sheet responded to a warmer climate millions of years ago could improve predictions of its future.



Here, USF College of Marine Science Associate Professor, Amelia Shevenell, chief sedimentologist, and Victoria University (NZ) Associate Professor and Antarctic Research Center Director, Rob McKay, co-chief scientist, examine sediment recovered from the Ross Sea during International Ocean Discovery

Program Expedition 374 in 2018 (Credit: Mark Leckie)

In a study published today in ***Nature***, an international team of scientists, including USF College of Marine Science (USF CMS) **Associate Professor Amelia Shevenell** and graduate student Imogen Browne, documented the evolution of Antarctica's ice sheets about 20 million years ago.

At this time, called the early Miocene, Earth experienced both warm and cold climates. Atmospheric concentrations of carbon dioxide were similar to those expected by 2100, if greenhouse gas emissions continue at the present rate. During warm Miocene climates, sea level rose by up to 60 metres – the equivalent of melting all the ice presently on the Antarctic continent.

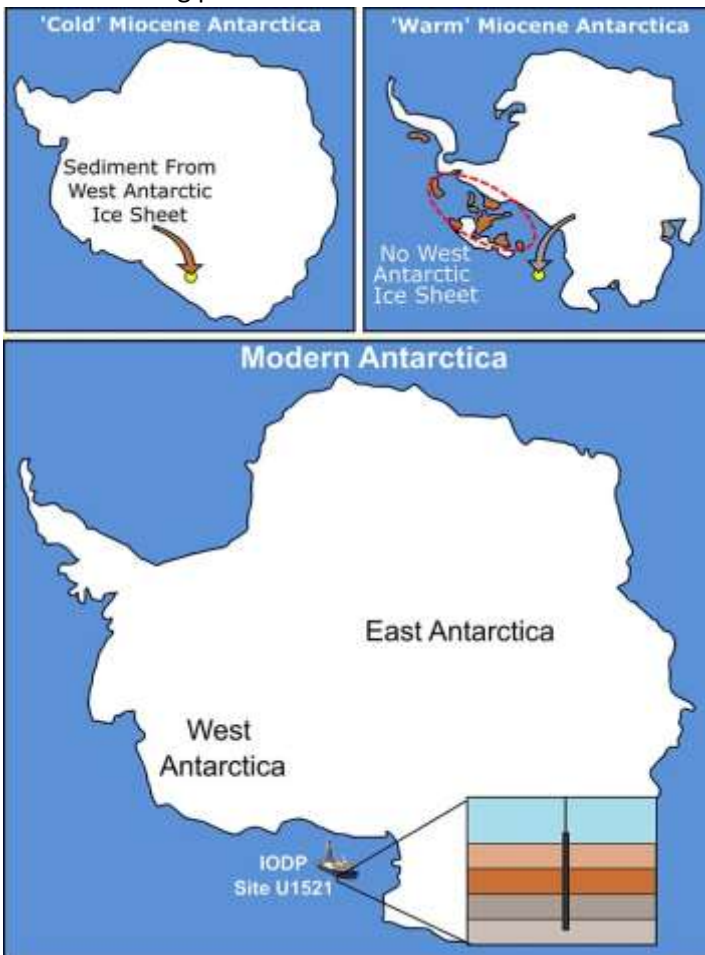
Until now, the contributions of the larger East Antarctic Ice Sheet (EAIS) and the smaller West Antarctic Ice Sheet (WAIS) to past global sea levels was uncertain. The new research was conducted as part of the International Ocean Discovery Program (IODP) Expedition 374 to the Ross Sea in Antarctica. The \$13 million (US) expedition emerged from a 2012 National Science Foundation (NSF) funded workshop at the USF CMS and was drilled in 2018. Expedition 374 recovered ~1.5 kilometers of mud from the ocean floor, which teams of international scientists are analyzing to reconstruct Antarctica's ice sheet evolution over the last 20 million years.

The new research, led by Imperial College London graduate student, Jim Marschalek, shows that the WAIS, the smaller and more climatically sensitive of today's Antarctic ice sheets, existed and contributed significantly to global sea levels 8 million years earlier than previously known. The study also reveals that the young WAIS was highly erosive, which lowered the elevation of the land beneath the WAIS below sea level, further increasing its vulnerability to climate and ocean changes. The study provides essential data for climate models, which are used to accurately predict future global sea levels as Earth warms and Antarctica's ice sheets melt.

Co-author, Amelia Shevenell, an expert on Miocene climate and Antarctic ice sheet evolution, is currently the Principal Investigator of a multi-institutional NSF grant to determine the role of ocean temperature on Antarctica's ice sheet behaviour during the Miocene.

HIGHLIGHTED RESEARCH

“Understanding past climate conditions and the behavior of Antarctica’s ice sheets is essential for



improving climate models used to predict how much and how fast sea levels will rise in the future,” said Shevenell.

Shevenell, who lives in St. Petersburg, Florida, one of the top 10 cities in the United States most vulnerable to sea level rise, continued: “What is happening in Antarctica now and in the past may not seem important in our everyday lives. However, the West Antarctic Ice Sheet is currently contributing to global sea level rise and its contributions are increasing as Earth warms. If this part of Antarctica were to melt completely, global sea levels would rise about 15 feet, which would displace millions of people worldwide, including most people in the state of Florida.”

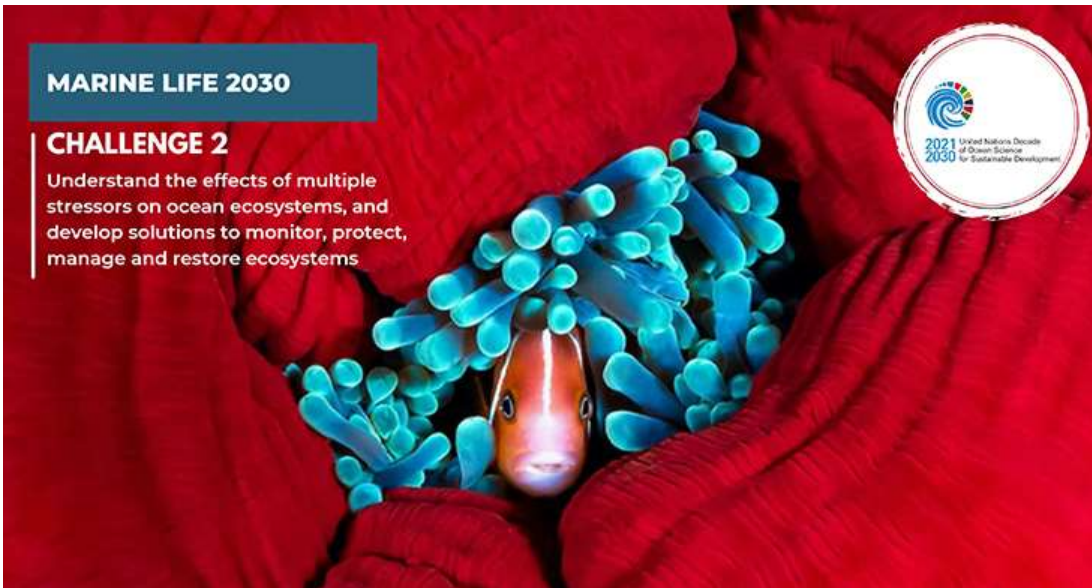
The team says that future work is needed to understand the past history of the low-lying and climatically vulnerable parts of both the smaller West Antarctic Ice Sheet and the larger East Antarctic Ice Sheet.

Map above, Credit: Jim Marschalek

Material from Imperial College London was used in this report.

HIGHLIGHTED RESEARCH

Marine Life 2030 endorsed as part of UN Decade of Ocean Science



The **Executive Secretary of the Intergovernmental Oceanographic Commission of UNESCO (IOC)**, an arm of the United Nations, officially endorsed Marine Life 2030 to officially be part of the **UN Decade of Ocean Science** for Sustainable Development (2021-2030). It is one of 66 actions endorsed by the UN on World Ocean’s Day.

“This program integrates expertise across many institutions, countries, and disciplines,” said **Frank Muller-Karger**, who spearheaded the design of the Marine Life 2030 program. “Societies everywhere need exactly this kind of sustained, all-hands-on-deck effort, and we’re beyond thrilled to have our program endorsed by the UN.”



The goal of the UN Decade of Ocean Science is to do “the science we need for the ocean we want.” The primary goal of the 10-year Marine Life 2030 program is to establish a globally coordinated system to deliver actionable knowledge of ocean life to those who need it – promoting human well-being, sustainable development, and ocean conservation.

HIGHLIGHTED RESEARCH

Many questions remain about how the abundance of marine organisms is changing over time in response to climate change, pollution, acidification, and more. Countless species remain to be discovered and knowledge of the ocean's 200,000+ known species is fragmentary at best – all of this, at a time when human activities are causing the extinction of some **1 million of the estimated 8 million** plant and animals species on the planet.

“There have been several methods used by scientists to track species over time, for example – and we need to much better coordinate so that the science community can make truly actionable recommendations to policy-makers, management officials and other stakeholders,” said Muller-Karger.

Marine Life 2030 will serve as a connector and facilitator between several existing groups, such as the **US Integrated Ocean Observing System** (IOOS), the **GEO BON Marine Biodiversity Observation Network** (MBON), the **Global Ocean Observing System** (GOOS), the **Ocean Biodiversity Information System** (OBIS), the **World Conservation and Monitoring Centre** (UNEP-WCMC), the Ocean Knowledge Action Network of Future Earth, and many more. In addition to a host of national and international government partners, the program, led by the Smithsonian Institution, includes more than 30 NGO partners and nearly 40 academic partners across the globe.

“Today is a good day for the oceans and for all people, since we depend on life in the sea,” said Muller-Karger.

Faculty Highlights

FACULTY AWARDS:

- **Dr. Bob Bryne** Elected to the Academy of Science, Engineering and Medicine of Florida
- **Dr. Pam Hallock Muller** Elizabeth Hurlock Beckman Award for inspiring a former student to create an organization that has demonstrably conferred a benefit on the community at large. She was nominated by Dr. Melanie McField (CMS-USF PhD), who created the Healthy Reefs for Healthy People Initiative
- **Dr. Cheryl Hapke** Awarded the Jahns Distinguished Lecturer by the Association of Environmental and Engineering Geology
- **Dr. Chuanmin Hu** elected to be a fellow of AAAS
- **Dr. Frank Muller-Karger** William T. Pecora Award (Individual); NASA and USGS
- **Dr. Brad Seibel** University of South Florida, Faculty Outstanding Research Achievement Award
- **Dr. Amelia Shevenell** USF Outstanding Faculty Mentor, USF Sloan University Center of Exemplary Mentoring UCEM Student Leadership Council (2021)

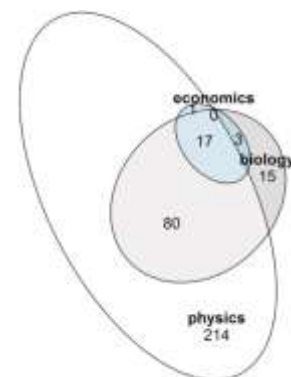
TENURED AND TENURE-TRACK FACULTY ANNUAL UPDATES:

Below are select 2021 highlights reported by faculty, along with their students and staff. Publications for CMS faculty are listed in Appendix A.

DR. CAMERON AINSWORTH (Fisheries Biology; Ecosystem and Resource Management)

In 2021, Dr. Ainsworth was active in planning and supporting Gulf of Mexico Research Initiative (GOMRI) synthesis and legacy tasks. He organized webinars and co-authored 4 synthesis publications. He was also the lead author on a modeling synthesis paper published in *Environmental Modeling and Software* which described every published numerical modeling study of DWH from 2010 to 2020 by GOMRI, NRDA or others. This article includes a review of 330 applications and description of 76 unique models. We had tremendous participation from 27 lead DWH modelers from across consortia and RFPs who were keen to represent their work. This article should long serve as a compendium of DWH modeling methods and lessons learned.

Figure 1. Of 330 Deepwater horizon modeling studies, only 17 (5%) used models like Atlantis to integrate across physical, biochemical and socioeconomic knowledge domains. CIMAGE was dominant in biological modeling and integration across domains.



FACULTY HIGHLIGHTS

His lab continues to foster strong ties to State and Federal fisheries management. PhD student Becky Scott has been modeling large pelagic data and has worked with SEFSC and ICCAT. New Post-doc Holly Perryman will be working directly with SEFSC-NOAA to qualify Atlantis for use in stock assessment. NOAA has made a three-year commitment to this project, and it involves Integrated Ecosystem Assessment folks on the East and West Coasts. The program manager is Michelle Masi (SERO-NOAA) who graduated from my lab in 2016.

Tiff Raetzel is on the home stretch in writing her MSc thesis comparing natural and artificial reefs using food web modeling. New student Hallie Repeta will be working on larval connectivity using a combination of ecosystem modeling and individual based Lagrangian larval transport modeling.

DR. MYA BREITBART (Genomics; Marine Microbiology; Wastewater Microbiology; and Virology)

Dr. Mya Breitbart's genomics and microbial ecology made great strides on several projects, including: 1) Microbial ecology of Florida's freshwater springs, 2) Using viral metagenomics to identify and describe the viral communities in a variety of environments and organisms, 3) DNA barcoding of fish eggs, and 4) Microbial water quality and risk assessment of recreation activities in coastal seawater. In 2021, Kema Malki earned her PhD and the Breitbart lab welcomed 3 new graduate students, a postdoctoral researcher, and 3 undergraduate Honors thesis students. The Breitbart lab published seven peer-reviewed scientific manuscripts reflecting these main research initiatives as well as several interdisciplinary collaborations. Especially noteworthy are the description of spatial and temporal variability of bacterial and viral communities in Florida's freshwater springs (Malki et al. 2021; chosen as an Editor's spotlight article), the development and application of a novel molecular biology technique (colonies) for quantifying single-stranded DNA phage (Sawaya et al. 2021) and a review on the biology of this unique phage group (Breitbart and Fane 2021), the first manuscript describing relationships among microbial indicators of fecal pollution, microbial source tracking markers, and pathogens in Costa Rican coastal waters (Fernández et al. 2021), and an online, hands-on educational activity about DNA barcoding of fish eggs (Kerr and Breitbart 2021). Another major accomplishment was the publication of a paper describing the benefits of a formal course for first-year graduate students (Cooke et al. 2021) and working with Dr. Kristen Buck to create a workbook to accompany our Professional Development I course.

DR. KRISTEN BUCK (Trace Metal Biogeochemistry; Metal-Binding Organic Ligands)

Dr. Kristen Buck had four active NSF awards, one NOAA award and three awards from the State of Florida in 2021; two of these awards were newly funded in 2021. Buck's lab group sailed on 15 research expeditions in 2021 related to these projects; nine of the expeditions were one-day surveys of Tampa Bay leading a USF Piney Point response. Buck's research was published in *Elementa* in 2021. A PhD student submitted a first-author paper in 2021 that is in revision for *Limnology and Oceanography*, and contributed to three additional co-authored papers submitted in 2021. Buck continued to serve on the Editorial Board for *Limnology and Oceanography: Letters* as an Associate Editor, and on the Association for the Sciences of Limnology and Oceanography (ASLO) Board of Directors as a Member-At-Large in 2021. At USF, Buck was co-Chair of the USF Council on Education Policy and Issues (CEPI) and Chair of the USF CMS Safety Committee. Buck currently supervises three PhD students and two MSc students; she also serves on the committees of three additional PhD

FACULTY HIGHLIGHTS

students and one MSc student at USF. Buck was lead instructor of the Chemical Oceanography core course (Fall), and co-taught Professional Development I (Fall) in 2021.

DR. ROBERT BYRNE (Marine CO₂ System Chemistry and Ocean Acidification; Seawater Trace Element Chemistry; and Development of In Situ Methods and Instrumentation for Analysis of Seawater)

Dr. Byrne published three papers in 2021 that were first-authored by his own students. An additional manuscript first-authored by one his students was submitted for publication in 2021. One of the 2021 first-authored student publications described, for the first time, the existence of organic alkalinity in the SIO total alkalinity reference materials that are used as global standards.

In addition to three preexisting NSF-funded grants, Dr. Byrne received three years of new NSF support beginning in February of 2021. He graduated one PhD student and one MS student in 2021 and was elected to the Academy of Science, Engineering and Medicine of Florida (2021).

DR. DON CHAMBERS (Using satellite observations to understand climate change and ocean dynamics)

Dr. Chambers was the senior author on a student-authored paper investigating trends in eddy kinetic energy in the Southern Ocean (Regional Trends in Southern Ocean eddy kinetic energy. *J. Geophys. Res. –Oceans*, 126). This study followed on previous work conducted by Dr. Chambers and international co-authors, who hypothesized that stronger winds resulting from climate change was leading to more turbulence in the Southern Ocean, which can affect air-sea carbon exchange and heat transported southward toward Antarctica. In the recent study, Dr. Chambers and his student (Yang Zhang) found that the energy increase was not as widespread as initially thought but confined to small regions downstream of major underwater seamounts, which suggests a different mechanism is responsible than the general increase in winds, which should affect the entire Southern Ocean. In addition, Dr. Chambers was a co-author on a paper published in *Geophysical Research Letters* (a high impact journal) which demonstrated a significant increase in the amplitude of the seasonal global water cycle, utilizing two decades of data from the GRACE and GRACE-Follow on satellite gravity missions.

DR. TIM CONWAY (Marine trace elements, trace metal isotopes, biogeochemistry, marine geochemistry, GEOTRACES)

Dr. Conway had an excellent year in 2021, receiving tenure and promotion to Associate Professor at USF, publishing 7 journal articles (including one in the prestigious *Proceedings of the National Academy of Science USA*, and one in *Nature Communications*), and being awarded funding three times by the National Science Foundation (totaling \$4.7 million) for cutting edge biogeochemical research in the South Pacific Ocean, the Antarctic, and on the West Florida Shelf. In addition to these three new awards, Conway continued to carry out research on two other NSF-funded awards and on collaborative projects with world-leading international marine scientists at the Royal Institute of Sea Research in the Netherlands and at GEOMAR in Germany; during the year, Conway's group carried out research and collaborations all over world, including oceanic regions as diverse as the Arctic Ocean, the North Pacific Ocean, the South Atlantic Ocean, and the Amundsen Sea in

FACULTY HIGHLIGHTS

coastal Antarctica. His research led to 3 invited and 12 contributed presentations at international meetings, workshops, and institutions during 2021. Conway also participated in USF's rapid response to the Piney Point disaster in Tampa Bay, with a series of cruises funded by the Florida Institute of Oceanography and the Florida DEP investigating how this release contributed different micronutrients to the local ecosystem. Conway also continues to develop and teach graduate courses at USF which aim to equip students with the critical thinking skills and the cutting-edge scientific knowledge to succeed in global research and advises four graduate students and two postdoctoral fellows.

DR. KENDRA DALY (Zooplankton Ecology; Gulf of Mexico and Antarctic Ecosystems; Low Oxygen Regions in the Ocean; Ocean Observatories; Sensor Technology)

Dr. Kendra Daly led a large effort to investigate the impacts of the Deepwater Horizon (DWH) oil spill on the lower trophic food web in the northeast Gulf of Mexico (NEGOM) between 2010 to 2014, funded by the University of South Florida, Division of Sponsored Research, the Florida Institute of Oceanography, and the Gulf of Mexico Research Initiative through its consortia: Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE). This paper evaluated the resilience of zooplankton, which are small marine animals that are critical to controlling ocean productivity and mediating biogeochemical cycles. Zooplankton also are essential to sustaining fisheries, as they are the dominant prey for larval, juvenile, and some adult fish, and most fish species spend their earliest life history stages as zooplankton. There was no evidence that the oil spill had a long-term impact on the zooplankton community. There is no doubt that the DWH oil spill caused mortality and sublethal effects in zooplankton, since oil concentrations high enough to kill zooplankton were present in the upper water column where zooplankton were abundant during spring and early summer in 2010. However, the recovery of the zooplankton community was relatively rapid owing to connectivity with other regions of the Gulf of Mexico ecosystem. In other words, local extinction didn't occur because zooplankton were transported by currents into the oil spill region. Other factors contributing to zooplankton community resilience included their high abundance, high reproductive capability, relatively short generations times, and zooplankton that dwelled deeper in the water column may have experienced a refuge from oil. Instead, seasonal and interannual variability in zooplankton were strongly correlated with changing environmental conditions and riverine processes, especially associated with the Mississippi River.

FACULTY HIGHLIGHTS

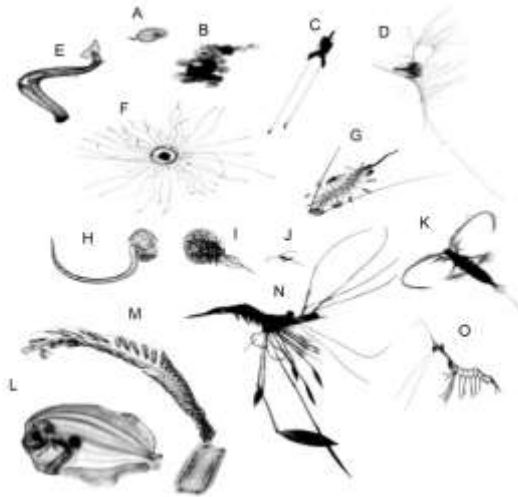


Fig. 1. Zooplankton were assessed using net tows and the SIPPER camera imaging system, developed at the College of Marine Science, USF. The images above show a variety of the common zooplankton present during and after the Deepwater Horizon oil spill in the northeast Gulf of Mexico.

Noctiluca: (A) free and (B) attached to marine-oil-snow, (C) pteropod *Cavolinia* with tentacles extended, (D) cydippid ctenophore with tentacles extended, (E) chaetognath, (F) feeding behavior of the hydromedusae, *Aglaura hemistoma*, (G) pelagic polychaete, *Tomopteris*, (H) larvacean, (I) calanoid copepod, *Copilia*, (J) cyclopoid copepod, *Oithona*, (K) calanoid copepod, *Eucalanus*, (L) larval flat fish, (M) doliolid, (N) Eumalacostracan crustacean, and (O) sergestid shrimp, *Lucifer*. Size not necessarily to scale.

DR. JACQUELINE DIXON (Igneous Petrology; Mantle Geochemistry; Role of Volatiles in Magmatic Processes; Deep Earth Geochemical Cycling of Volatiles)

Dr. Jacqueline Dixon was on professional development leave through May 2021. During spring and summer 2021, she served as chair of the Committee of Visitors for the Earth Science Division of the National Science Foundation charged with reviewing and commenting on the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions. She also served on the Advisory Board for the Smithsonian National Museum of Natural History. In the fall, she focused on course development for a new graduate class on Volatiles in Magmas offered in spring 2022.

DR. BORIS GALPERIN (Atmospheric; Oceanic and Planetary Turbulence; Theory, Modeling, Experiments)

In 2021, Dr Galperin published one paper in the area of Oceanic Turbulence. The paper continued his research directed towards the application of the new theory of turbulence, developed by his colleagues and him and termed QNSE, to oceanic flows. This work offered an innovative view of mixing processes on scales from kilometers to hundreds of km and emphasized the crucial role of planetary rotation. Even though the theory offers new qualitative and quantitative explanations to many

FACULTY HIGHLIGHTS

datasets, it remains provocative and somewhat controversial. One year since publication, the paper collected over 1,500 accesses (i.e., computer downloads) but only 4 citations (the paper's web site is <https://link.springer.com/article/10.1007/s10236-021-01444-1>). A possible reason for this is that the theory advances concepts alternative to those extensively used in oceanographic and atmospheric research since 1971. Diffusion of new ideas in established sciences sometimes takes time, even if these ideas yield superior results.

Over the last two years, the theory was extended to hurricanes and shown to be capable of explaining their kinetic energy spectra, both qualitatively and quantitatively.

This is a major breakthrough as no other theory has been found capable of achieving similar results. The understanding of the physics behind these spectra is an important step towards better comprehending of hurricane dynamics. A paper on hurricane spectra is currently in preparation for submitting to PNAS – Proceedings of the Natural Academy of Sciences.

More generally, our research reveals a deep-rooted similarity between kinetic energy spectra of ocean eddies, hurricanes, the troposphere, and smaller-scale ocean flows. This similarity, clearly seen upon comparison of Figs. 1 and 2, points to the unity of the physical laws governing all these phenomena. The physics behind this similarity will be further elaborated in the forthcoming publications.

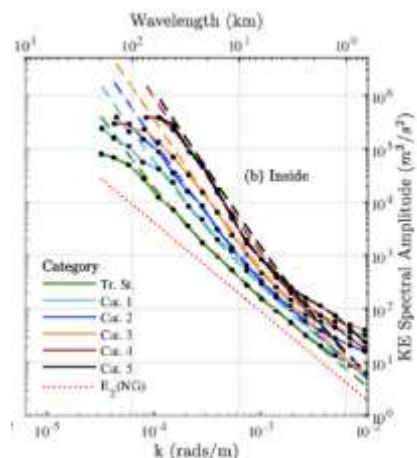


Figure 1. Composite spectra conditioned on storm category for azimuthal winds inside the eyewall. Solid lines are the data, dashed lines are QNSE predictions. The dotted line represents the transverse NG spectrum for the latitude $\phi = 25^\circ N$ and $\Pi_\varepsilon = 5 \times 10^{-5} \text{ m}^2 \text{ s}^{-3}$ as predicted by the QNSE theory (Galperin and Sukoriansky, 2020).

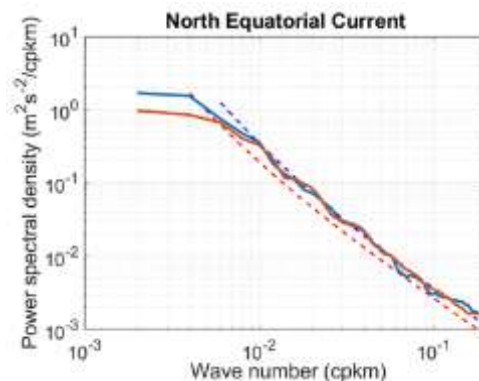


Figure 2. Longitudinal (red) and transverse (blue) spectra obtained along $137^\circ E$ meridian in the North-Western Pacific in the vicinity of the North Equatorial Current (NEC), at the latitude $\phi = 14^\circ N$. The data (solid lines) is from Qiu et al. (2017) where the spectra were averaged over the depths between 40 and 100 m. The dashed red and blue lines are the longitudinal and transverse spectra, respectively, as predicted by the QNSE theory, with the estimated value of $\Pi_\varepsilon = 2 \times 10^{-6} \text{ m}^2 \text{ s}^{-3}$. The figure is adapted from Galperin and Sukoriansky (2020).

FACULTY HIGHLIGHTS

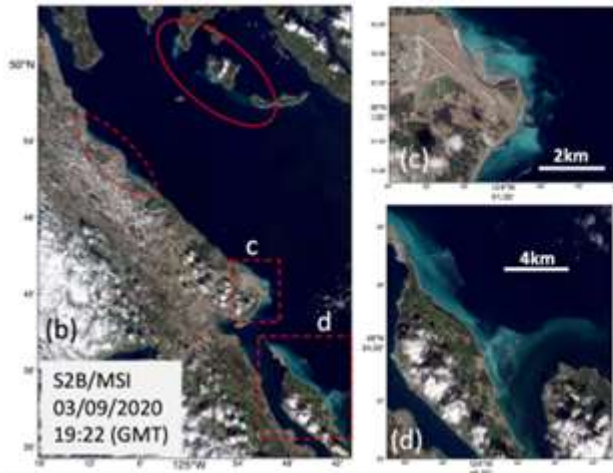
DR. ALASTAIR GRAHAM (Sea-floor Geophysics; Antarctic Marine Geology and Geomorphology; Past Changes in Earth's Cryosphere; Autonomous Instruments for Sea-floor Exploration)

In 2021, Dr. Graham played a leading role in the inaugural research activities of the newly-formed Center for Ocean Mapping and Innovative Technologies (COMIT) at USF College of Marine Science. Graham's lab hosted external partner *SeaTrac* for the Tampa Bay Bathymetry Experiment, setting up a physical space for field operations, and providing scientific and logistical support for new pioneering mapping of the near-shore areas of the west Florida coastline. He took on 3 new graduate students, solidifying the lab as a burgeoning hub for graduate research in sea-floor mapping and exploration. Graham and his group spent time at sea supporting a NOAA-IOCM hydrographic mapping project of the Big Bend region, on the FIO RV *W.T. Hogarth*. Earlier in the year, he co-authored a major study on the pathways of warm ocean water that accesses sub-ice cavities in the vulnerable Thwaites Glacier catchment of West Antarctica. Published in *Science Advances*, the paper was voted amongst 'the best scientific advances of 2021' by the *The Guardian* newspaper in December 2021. The work was supported by the \$2 million NSF-NERC funded 'THOR' (Thwaites Offshore Research) project, on which Graham is a Co-PI. He was Co-PI on two successful proposals: a ship-time bid to FIO, and an international secondary-user proposal to the German DFG funding agency. Graham remains an active Scientific Editor of the *Journal of Glaciology*.

DR. CHUANMIN HU (Ocean Optics and Optical Remote Sensing)

In 2021, Dr. Chuanmin Hu and his Optical Oceanography Lab continued high scholarly productivity. With an annual expenditure of > \$800K, Dr. Hu's group published 20 peer reviewed papers and submitted another 14. In addition, they continued to support the research community and other stakeholders through providing near real-time information on the location and amount of *Sargassum* seaweed. They also distributed monthly *Sargassum* bulletins to many groups to support local mitigation efforts as *Sargassum* represents a beach nuisance if large amounts are washed on shore. Of particular interest are several new proof-of-concept papers to show remote sensing of brine shrimp cysts and herring spawn events. For his scholarly achievements and service to the community, in 2021 Dr. Hu was elected to be a fellow of the American Association for the Advancement of Science (AAAS), and he was also recognized as being among top 2% researchers worldwide across his field of study, according to a study by Elsevier and Stanford University.

FACULTY HIGHLIGHTS



Cyan color indicates high concentrations of herring milt in the Strait of Georgia near Vancouver, Canada. Figure from Qi et al. (2021).

DR. MARK LUTHER (Maritime Safety and Security; Real-Time Ocean Observation Systems; Numerical Models of Ocean Circulation; Coastal Water Quality)

Dr. Mark E. Luther and colleagues developed a machine learning algorithm to predict the occurrence of high cross-currents at the entrance to Port Miami up to 48 hrs in advance, using input from numerical models depicting Gulf Stream fluctuations upstream or the channel entrance. These cross-currents, associated with shifts in the Gulf Stream position, cause problems for harbor pilots navigating large vessels into the port. Luther is working with the Port Miami harbor pilots to develop these predictions into a decision support tool that will forecast optimal transit windows for vessels arriving at the port. Luther and collaborators published an article in the journal *Urban Climate* on the effects of future sea level rise on the frequency of occurrence of sanitary sewer overflows (SSOs). Coastal wastewater and storm water systems can be overwhelmed during high precipitation events, particularly when compounded by high storm surge that blocks stormwater drainage. Sea level rise (SLR) brings increased risk of such compound flooding events, triggering SSOs, which release waste water into the local environment. The paper describes a logistic regression model developed to better predict this risk in southern Pinellas County, FL. For a SLR of 0.5 m, the number of SSO days increased by a factor of 42–52 and the number of individual events increased by a factor of ~15. Subtracting recent SLR from maximum water level in observed storm surge events reduced the probability of SSOs over past decades, suggesting that SLR already is increasing the rate of SSOs.

DR. GARY MITCHUM (Climate Change; Ocean Eddies; Satellite Remote Sensing; and Sea Level Rise/Associate Dean for Research)

Dr. Mitchum was a co-author this year on a paper with one of his former PhD students. This paper described how sea level rise coupled with normal variations in the tides will combine to increase the rate of high tide flooding events at many locations around the US. To give an example of local interest, this paper showed that the frequency of high tide flooding events in Saint Petersburg will increase by about a factor of 10 in the next 10 years. Very soon we will be seeing high tides flooding our streets several times a month rather than several times a year. This paper received a great deal of local attention; for example, Mayor Kriseman called Dr. Mitchum for a briefing just a few hours after the

FACULTY HIGHLIGHTS

paper was released from embargo by the publisher. But the attention was not just local. Dr. Mitchum and the other authors gave interviews around the country and around the world, and the Altmetric web site, which tracks media attention given to science articles, ranked this paper in the top 5% of science papers that they have ever tracked.

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)

Prof. Pamela Hallock's major paper in 2021, "Why did some larger benthic foraminifera become so large and flat?" published in *Sedimentology*, addressed a long-standing conundrum in Cenozoic carbonate sedimentology. She also co-authored four papers with the international colleagues, including two with PhD students with whom she had worked in the field. She began the year teaching "Writing a Scientific Paper" and taught "Carbonate Sedimentation" in fall semester. Dr. Hallock is dissertation advisor for Natalia Lopez-Figueroa, who advanced to PhD candidacy in fall 2021. Dr. Hallock and Ms. Lopez submitted a proposal to the NOAA National Estuarine Program to support Ms. Lopez's dissertation research. In addition to USF and CMS committee assignments, Dr. Hallock reviewed numerous manuscripts for journals and proposals for funding agencies, and pre-reviewed several manuscripts for international scholars for whom English is not their first language. Most challenging, she provided detailed scientific and English editing for long-time friend and colleague, Prof. Valentina Yanko's draft manuscript for her book entitled *Quaternary Foraminifera of the Caspian-Black Sea Corridors*. Dr. Yanko is Professor of Marine Geology, Mechnikov National University, Odessa, Ukraine, and this work culminates her 50-year career working in Black Sea-Caspian region. In late December, Prof. Hallock Muller was informed that she had been awarded an Elizabeth Hurlock Beckman Award for inspiring a former student to create an organization that has demonstrably conferred a benefit on the community at large. She was nominated by Dr. Melanie McField (CMS-USF PhD), who created the Healthy Reefs for Healthy People Initiative.

DR. FRANK MULLER-KARGER (Changes in Marine Ecosystems Using Field-based and Satellite Remote Sensing Time Series)

Muller-Karger helped advance several international efforts to observe marine life. Working as co-chair of the international Marine Biodiversity Observation Network (MBON), Muller-Karger steered agreements to coordinate biological observations in the Southern Ocean and to share capacity and preserve data about marine life. One agreement was signed between the MBON and the Scientific Committee on Antarctic Research (SCAR). Another agreement was signed with the LifeWatch European Research Infrastructure Consortium (LifeWatch-ERIC). The United Nations Decade of Ocean Science for Sustainable Development (the Ocean Decade) approved a proposal led by Muller-Karger to establish Marine Life 2030, an international program to monitor marine life to address the needs of people everywhere. Suggested pictures: (LEFT) Muller-Karger (standing to the right) signs agreement to establish a Secretariat of the Marine Biodiversity Observation Network (MBON) at the AIR Centre.

FACULTY HIGHLIGHTS

(RIGHT) Illustration showing one of the Ocean Challenges being addressed by Marine Life 2030. See Article “Reef Robots. Predicting Marine Life Like Weather. Meet the Ocean of 2030” by Smithsonian Voices (Kristen Minogue and Beth King).

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)

The Murawski Laboratories (consisting of elements of the C-IMAGE oil spill consortium and the COMIT mapping project) had an impactful year 2021 despite the challenges imposed by the COVID-19 crisis. Two very significant research programs were completed in 2021 including the Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE, funded by GoMRI) and the Great Red Snapper Count (funded by SeaGrant). C-IMAGE resulted in over \$36 million coming to USF-CMS and partner institutions, and produced over 200 publications. The major research deliverable produced by C-IMAGE researchers in 2021 was a set of synthesis papers published in *Frontiers in Marine Science*, and a special volume of *Oceanography Magazine*. The Murawski Lab, in conjunction with other institutions delivered its final report on the “Great Red Snapper Count” to the Gulf of Mexico Fishery Management Council. Using our state-of-the-art towed video system, lab scientists sampled red snapper from Texas to Florida contributing to population size estimates far exceeding those based on traditional stock assessment methods. Due to the success of the red snapper research, the lab was funded by SeaGrant to conduct similar analyses for greater amberjack (\$1.1 million) to use towed video and hydroacoustics to assess the stock from Louisiana to Virginia. COMIT researchers completed a highly successful bathymetric survey of 160 km² in shallow waters off the coast of Tampa Bay. The Tampa Bay Bathymetry Experiment (TBBEx) used airborne Lidar system combined with an uncrewed surface vessel to produce the highest resolution maps ever made for this region.

DR. DAVID NAAR (Marine Magnetism; 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. David Naar was involved with some of the USF-NOAA Center for Coastal Ocean Mapping and Innovative Technologies activities. Dr. Naar worked with others in the group to design a concentration in Hydrography for the Master’s and Doctoral degrees in Marine Science. The goal was to also create a certificate in Hydrography for those students who did not want to enroll for the full degree. Upon completing and introducing the concentration and certificate curriculum, the International Hydrographic Organization will be invited to evaluate if it meets their Cat-A or Cat-B status, categories demonstrating certain levels of competency in Hydrographic surveying. In addition, to developing curriculum related to Hydrography, Dr. Naar also worked with others in the College of Business in an effort to develop a “Blue MBA”. Stepping stones to the full MBA would include a certificate from the College of Business and from the College of Marine Science. These curriculum efforts are still underway. In addition, Dr. Naar assisted in the planning of operational and research activities of

FACULTY HIGHLIGHTS

COMIT in 2021. Dr. Naar is coauthor on one paper that was submitted and then revised in 2021 from his work in the Maldives. The remainder of his time was related to addressing the academic challenges that COVID-19 pandemic brought to the faculty, staff, and students of the College of Marine Science.

DR. ERNST PEEBLES (Biological Oceanography/Marine Resource Assessment)

During 2021, Dr. Ernst Peebles continued serving as Principal Investigator on a research grant that has established USF as a Florida RESTORE Act Center of Excellence (FLRACE). The primary thrust of this project is a fish-egg survey that is scheduled to be repeated on an annual basis until at least 2033, generating fundamentally important information on linkages among fish stocks in different parts of the Gulf of Mexico. The annual egg surveys will make intensive use of DNA barcoding, an approach that is being enhanced and perfected by Dr. Breitbart's lab. Early results from this effort are presently being published. Also, as part of this larger effort, Dr. Peebles' lab continued pursuing forensic methods that allow re-creation of the lifetime habitat and feeding histories of individual fish and squid using natural, chemical tags that are sequentially stored within fish eye lenses. Additional information about the Florida RESTORE Act Centers of Excellence Program, 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)

Dr. Rosenheim led a team from across USF to apply to the NSF-funded All-ABOARD program intending to use time aboard a research vessel to work on issues preventing recruitment and retention of students, faculty, and staff from minoritized populations in marine science. The USF team represented the College of Marine Science, the College of Arts and Sciences, the College of Engineering, and the College of Education, and was ultimately selected as one of 4 universities involved in the program. To incorporate this effort in his research, Dr. Rosenheim devised a proposal to scale this up at the Florida Institute of Oceanography whereby imaging and sampling of long-drowned barrier islands on the West Florida shelf would be the focus of exercises emphasizing the societal relevance of marine science for an intergenerational crew of USF faculty, staff, administrators, and students. The research portion of this expedition was designed to not only introduce participants to the concepts of sea level rise and loss of coastal landforms/infrastructure, but also to seed a research proposal to date these features using organic matter buried under over wash fans of these coastal features. Dr. Rosenheim's effort to launch a project on the West Florida Shelf will tie together research by the Southern Ocean Science group at CMS and the USF Flood Hub which is anticipated to form and evolve with new state budget allocations. The Rosenheim research group published 7 papers in 2021, 4 of which emanating from efforts to understand the temporal evolution of the last deglacial.

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. Brad Seibel's research in 2021 focused on the response of marine animals to ocean warming and deoxygenation. He and his entire lab group published a novel method to determine the tolerance of

FACULTY HIGHLIGHTS

marine animals to low oxygen. He also contributed to a paper calling for an open-access Global Ocean Oxygen Database and Atlas (GO2DAT) complying with the FAIR principles (Findable, Accessible, Interoperable, and Reusable). He also published papers on the response of deep-sea squids and Antarctic krill to climate change. Seibel has ongoing funding to work on bioluminescence and climate change and acquired new NSF funding to study the effects of climate on oceanic animals.

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)

In 2021, Dr. Amelia Shevenell and collaborators published six papers, including one in Nature, with 4 additional papers accepted/in review. Two of Dr. Shevenell's PhD students graduated in Summer 2021 and are now employed as a postdoctoral fellow at LDEO (Columbia University) and at the JOIDES Resolution Science Office (JRSO) at Texas A&M. Dr. Shevenell's impact/notoriety in Paleoceanography and Antarctic Sciences was recognized by the National Academies of Sciences, Engineering, Medicine, when she was invited to serve on a Committee of Experts to assess NSF Progress on the 2015 Strategic Vision for Antarctic and Southern Ocean Research as well as an invited panelist on the National Science Foundation, Office of Polar Programs/MREFC, Antarctic Research Vessel (ARV) Conceptual Design Review (CDR) Panel. In addition to research and teaching commitments, Dr. Shevenell was appointed to serve on the JOIDES Resolution Facility Board for the International Ocean Discovery Program (IODP) and serves as an Associate Editor for Paleoceanography and Paleoclimatology, the premier journal in her subfield. Dr. Shevenell also served as the Geological Oceanographer Councilor to The Oceanography Society's governance council

DR. CHRIS STALLINGS (Ecology; Marine conservation and management efforts)

Dr. Stallings had a productive 2021. He led a paper that experimentally showed a common estuarine bivalve was not affected by dynamic ocean acidification that mimicked real-world conditions. This finding was important as it adds to an emerging view regarding the complicated effects of climate change on marine organisms. His lab also led several exciting studies that used fish eye lens chemistry to reconstruct entire life histories of ecologically and economically important species. One paper revealed previously unknown juvenile habitats for hogfish while the other study determined where trans-oceanic bluefin tuna originated. These efforts have direct application to fisheries management actions to ensure long-term sustainability of the fisheries these species support. Finally, Dr. Stallings was involved in an international collaboration that show the complex effects of the COVID-19 induced anthropause on ecosystems around the world. This worked showed human activities have both detrimental and custodial effects on different ecosystems. This work received a lot of attention in the mainstream media and was featured in Nature.

FACULTY HIGHLIGHTS

DR. ROBERT WEISBERG (Ocean Circulation; Ocean-Atmosphere Interaction Studies in the Tropics; and West Florida Continental Shelf Circulation)

The Ocean Circulation Lab continued to sustain long-term observations on the West Florida Continental Shelf (WFS) circulation coordinated with Nowcast/Forecast circulation modeling, all aimed at applications of societal relevance. Applications included tracking *K. brevis* red tide and the Piney Point wastewater spill and numerous new science topics were also considered. The most important of these was a new description of how the Gulf of Mexico Loop Current evolves through its various penetrative, ring shedding and retracted states. A graduate student led manuscript (in review) showed a very ordered transition and offered two canonical forms by which the Loop Current either becomes affixed to the southwest corner of the WFS, or not. Such behaviors, being critical to WFS ecology, are relevant to just about anything of an ecological nature on the WFS.

DR. NANCY WILLIAMS (Ocean Carbon Cycle, Carbonate Chemistry, Ocean Biogeochemistry, Ocean Acidification, Earth System Modeling, Autonomous Platforms)

During her second year as an Assistant Professor at USF CMS, Dr. Nancy Williams has made significant progress towards building up her research program despite the ongoing COVID-19 global pandemic. Her first lead NSF proposal for ~\$1.1M has been funded and Dr. Williams' team is currently gearing up for the July 2022 deployment of two Saildrones to the Southern Ocean around Antarctica. Williams also received ~\$162k as Co-PI on a grant from the National Oceanic and Atmospheric Administration, and ~\$300k as lead PI for her NSF Grant which will start in March 2022. Williams was also co-author of two publications in *Geophysical Research Letters*, with one focusing on a very timely subject: "The Ocean Carbon Response to COVID-Related Emissions Reductions." Williams recruited her second graduate student, Sarah Bartoloni, and hired a Scientific Researcher, Dr. Veronica Tamsitt, who brings complementary expertise in physical oceanography to support the Williams Lab's interdisciplinary research agenda. Williams developed and taught two new courses: Ocean Biogeochemical Dynamics Lecture and Lab. Williams has also continued her collaborations with and service to the global ocean carbon community, participating in working groups and most notably serving as a member of the Global Ocean Biogeochemical Argo (GO-BGC) External Advisory Committee. PRESS: for the latest stories and highlights please visit <https://www.marine.usf.edu/nancy-williams>

RESEARCH FACULTY ANNUAL UPDATES:

DR. JOSHUA KILBORN

As Research Assistant Professor at the College of Marine Science in 2021, Dr. Joshua Kilborn has been productive. This year Dr. Kilborn was selected for three-year terms as member of the Special Ecosystem Science & Statistical Committee (Ecosystem SSC) for the Gulf of Mexico Fishery Management Council (Council or GMFMC) and its Ecosystem Technical Committee (ETC). On the Ecosystem SSC, Dr. Kilborn contributed to the scientific evaluation of a variety of contemporary fishery management issues and the development of management advice to be considered for implementation by the GMFMC's standing membership (e.g., determination of best available science for the Great Red Snapper Count, annual catch allocations and overfishing limits). As a member of the

FACULTY HIGHLIGHTS

ETC, he contributed to the ongoing development of a fishery ecosystem plan for the Council. Finally, Dr. Kilborn was invited to participate in the Gulf of Mexico Research Initiative's synthesis efforts, and which resulted in a 2021 publication co-authored with lead author Dr. Steven Murawski called A Synthesis of Deepwater Horizon Impacts on Coastal and Nearshore Living Marine Resources. This work assembled data from investigations conducted over the previous decade to describe community-wide vulnerability and resilience for nearshore and coastal marine resources in the locally affected ecosystem. The publication also added new community-level analyses, and updated previous works' results with contemporary data. This particular work has proven to be high-impact and has already been viewed online and cited 4,927 and 17 times, respectively, since its publication (as of 02/24/2022).

MR. CHAD LEMBKE (Ocean technology and glider operations)

Mr. Lembke attempts to specialize in enabling technology to be used for a diverse set of projects by managing and enabling personnel, coordinating and facilitating operations, and performing lab, field, and facilities work as needed. In 2021 this resulted multiple research operations including:

- Operational utilization of the College's glider fleet for a total of 240 glider days in the Gulf of Mexico and the Atlantic Ocean. This year continued efforts to support multiple research efforts including but not limited to: Red Tide evolution and prediction, hurricane forecasting, and fisheries targeted sampling with data being shared nationally, regionally, and within the College. These efforts supported four separate funded projects from NOAA and the State of Florida and were supported for varied aspects by 9 other CMS engineers and researchers.
- Initiation and first year of the College's Center for Ocean Mapping and Innovative Technologies (COMIT) project (<https://www.marine.usf.edu/comit/>). The first year has focused on set-up of the technological aspects of the project such as IT infrastructure, and field operations initiation including a late Fall exercise utilizing a multibeam sonar equipped Uncrewed Surface Vehicle and an air-borne LIDAR system tasked with bathymetry mapping of lower Tampa Bay and connected intercoastal regions.
- Continued support of the USF Geodesy buoy removed from the mouth of Tampa Bay after two years of data collection. It will be re-deployed offshore with a second mooring being fabricated in 2022.
- Continued support of the CMS COMPS program as needed.
- Maintenance and oversight of a large portion of COT infrastructure.

NONTENURE-TRACK FACULTY RESEARCH UPDATES

DR. BRIAN BARNES (Ocean Optics and Optical Remote Sensing)

In 2021 COVID-19 continued to present many challenges, both personally and professionally. While the logistics of working remotely were not a problem, several bouts of quarantine caused a few headaches. Nevertheless, Dr. Barnes was able to complete a productive year without overwhelming interruption. As such Dr. Barnes continued a transition to a more supervisory role with hiring of an

FACULTY HIGHLIGHTS

additional postdoc (Yuyuan Xie) along with the continued mentoring of the two postdocs hired in 2020 (Min Xu and Shuai Zhang). He also continued to serve in a PhD student committee, and mentored many of the students in Chuanmin Hu's lab. In addition to submitting 5 proposals (3 of which have been selected for funding), he worked to build numerous other collaborative groups which may foster future proposals. Major research activities focused on (1) completing a NASA-funded project to assess vicarious calibration of ocean color sensors, (2) developing an algorithm to derive water quality and benthic parameters for the upcoming NASA PACE mission, and (3) improving derivations of water quality in Biscayne Bay. While these works only resulted in 1 first-author publication in 2021, Dr. Barnes currently has 2 publications already published in 2022, with 5 more under various stages of review.

DR. TERESA GREELY (Education and Outreach Director)

Highlights professionally for 2021 included successful development and facilitation of six hybrid courses while maintaining high marks for teaching based on course evaluations. Another highlight was the adaptation of two major E&O programs to virtual delivery. The most significant was the 2021 Spoonbill Ocean Sciences Bowl competition that was delivered completely virtual, including a career panel event with a 'speed dating' style called the Polar Express to encompass the theme, Polar Oceans. Special recognition to the talented regional coordinators, Sarah Grasty, Ryan Simonson, Savannah Finley and Kate Koenig. As a NOAA Ocean Explorer facilitator, worked with NOAA to adapt educator professional development series for virtual delivery. The new format was well received by over 800 educators who participated nationwide to learn about hydrothermal vents, seafloor mapping, and bioluminescence. Summer 2021 was incredibly special as we completed and reflected upon the impacts of 30 years of the Oceanography Camp for Girls. Fall 2021 provided a new teaching opportunity to develop a study abroad course for the Judy Genshaft Honors College. Conducted visits to the Bahamian islands to identify a suitable location for the course planned for summer 2022. During Fall received a NOAA Gulf of Mexico BWET award to continue bringing elementary scholars and teachers to the Clam Bayou watershed for coastal field trips and stewardship activities.

DR. YONGGANG LIU (Ocean Circulation; West Florida Continental Shelf Circulation)

Dr. Liu's work involves all aspects of data analysis and coastal ocean modeling in the USF/CMS Ocean Circulation Group. One of his main efforts is to maintain our daily, automated West Florida Coastal Ocean Model (WFCOM) & Tampa Bay Coastal Ocean Model (TBCOM, assisted with J. Chen) nowcast/forecast systems, as well as the related red tide short-term forecast products. Our modeling work received wide attention from the public because of the major red tide which occurred in 2021. The highlight of 2021 was the rapid response to an urgent discharge of wastewater from the old Piney Point fertilizer stack which started on March 30, 2021. Dr. Liu took the lead to set up a tracer model nowcast/forecast based on our daily, automated TBCOM nowcast/forecast. The daily updated model forecasts, made freely available online, were used to guide local Tampa Bay Estuary Program (TBEP) and other agencies and academic institutes' response preparations, monitoring, and field operations. Again, at the requests of local and state agencies (TBEP & Florida DEP), we immediately set up a tracer nowcast/forecast model to simulate the spreading of the stormwater that was permitted to discharge from another Piney Point facility starting on August 7, 2021. The stormwater was routed through

FACULTY HIGHLIGHTS

Bishop Harbor, a shallow water body, before entering the Tampa Bay. Our TBCOM nowcast/forecast system was found to be important to provide critical information for the guidance of the environmental monitoring and other field work. These timely model applications motivated a new research project for Tampa Bay funded by Florida DEP.

The work directly contributed to several projects funded by NOAA/IOOS/SECOORA, NASEM, FWC/FWRI, NOAA ECOHAB for the west Florida continental shelf and its estuaries and the greater Gulf of Mexico. In 2021, Dr. Liu had 7 peer-reviewed papers published in 2021, 4 manuscripts accepted for publication in 2022, and another 4 manuscripts submitted/revise. Dr. Liu had seven presentations with published abstracts in national and international meetings. Invited by Memorial University of Newfoundland, he gave an online seminar to the IEEE Newfoundland Ocean Engineering Society Chapter, Canada. He also contributed to proposal writing, and act as PI & Co-PI in four submitted proposals.

Finally, Dr. Liu served as a thesis committee member of two PhD students in USF/CMS (one in our own lab, the other in Dr. Hu's lab), and on the thesis panel of a PhD student at Deakin University, Australia, in addition to regularly advising several other graduate students in our group. Also, he assisted Dr. Weisberg in all aspects of running our research group. He frequently performed refereeing for a variety of journals (~30 times in 2021). According to Google Scholar, Dr. Liu's *h*-index and *i10*-index are 34 and 62, respectively, showing his increasing impacts in academics. He was also actively involved in public services and outreach activities, served on the High Performance Computing Executive Committee at USF and the Stakeholder Committee of SECOORA SOCAN, and volunteered at NOSB Spoonbill Bowl as an Expert Judge.

DR. CLIFF MERZ (Ocean monitoring and prediction)

Dr. Merz is an ocean engineer, senior scientific research faculty member, elected government official, author, and inventor of sustainable marine water/food/energy nexus technologies. Dr. Merz is USF's Coastal Ocean Monitoring and Prediction System (COMPS) Program and Oceanographic Surface Current Measurement High Frequency Radar (HFR) Operations Director and is a 4-time elected commissioner (and 3-time prior Vice-Mayor) of Pinellas County's City of Safety Harbor where he makes policy and budget decisions for 18,000+ residents with a \$73.5 million budget. Dr. Merz is lead PI on a National Academy of Sciences, Engineering and Medicine's (NASEM) grant designed to better understand the Gulf of Mexico's Loop Current. This multi-year, \$1,371,027, multi-institutional (sub awards to UM and Rutgers) effort, entails instrumenting specific locations within the lower Florida Keys with HFR systems and then observing the measured real-time surface current as it moves through the Florida Straits. In addition, Dr. Merz is lead PI and Co-PI on several grants (HFR and Coastal Station) from the Southeast Coastal Ocean Observing Regional Association (SECOORA), part of the federal NOAA U.S. IOOS. Dr. Merz was inducted into the National Academy of Inventors (NAI) class of senior members at the NAI annual meeting in Tampa on November 1, 2021. NAI Senior Members are active faculty, scientists and administrators from NAI Member Institutions who have demonstrated remarkable innovation and produced technologies that have the potential for a significant impact on the welfare of society.

FACULTY HIGHLIGHTS

DR. ISABEL ROMERO (Organic chemistry and oil spill impacts)

Dr. Romero worked on three submitted proposals, one of which was accepted. Also, she spent a significant amount of time in meetings for four potential future proposals, one locally (Myakka Reserve), one off the coast of San Diego (for NASA), and two in open deep waters of the Gulf of Mexico (NOAA). Specifically, for NOAA, Dr. Romero joined several public meetings to understand the frame of work they were proposing, and then got invited to their closed meetings, and even gave a talk in one of them. She proposed to NOAA to use organic geochemistry tools to help monitor the health and understand carbon sources dynamics at specific sites at depth in the northern Gulf of Mexico (close to deep coral reefs and other environments). The studies with NOAA are by invitation only. Dr. Romero hopes she will hear from them in the following months.

Related to scientific publications and engagement, three manuscripts were published and three more are under review. Also, results were presented in ASLO Aquatic Science Meeting, Deep-Sea Biology Symposium, All-hands DEEPEND/NOAA RESTORE Meeting, and National Academies of Sciences.

In addition to the research conducted during 2021, Dr. Romero is a part of the committee of four masters students, helping delineate their thesis and, specifically for three students, teaching them organic geochemical analyses. Some professional services include reviewing manuscripts, proposing a session to ASLO meeting (accepted), and participating in the DEI CMS Committee. Also, as an outside activity of CMS, she taught Marine Pollution at New College of Florida.

DR. KARYNA ROSARIO (Genomics; Marine Microbiology; Wastewater Microbiology; and Virology)

Even though Dr. Rosario was not able to be in the lab for most of 2021, her research and collaborative efforts resulted in three peer-reviewed publications. She also gathered preliminary data for grants through data mining and co-wrote two grants. One grant will subsidize ship time through the Florida Institute of Oceanography (FIO) in summer 2022 in collaboration with Dr. Cliff Ross from the University of North Florida. Ship time will allow us to take students to the Dry Tortugas National Park for teaching and research purposes. The second grant for which Dr. Rosario is Co-PI, seeks funding from the National Science Foundation to investigate seagrass viruses in Tampa Bay. Dr. Rosario also continued to assist graduate students in Dr. Mya Breitbart's lab with their projects and collaborated with groups interested in finding viruses in their systems, including:

- Dr. Nolwenn Dheilily (ANSES, Animal Health Laboratory, France): Collaboration with Dr. Dheilily to investigate parasite-associated viruses. Our work resulted in another publication describing the discovery of over 100 parasite-associated viruses (see [A World of Viruses Nested within Parasites: Unraveling Viral Diversity within Parasitic Flatworms \(Platyhelminthes\)](#))
- Dr. Walter Betancourt (University of Arizona): Collaboration with Dr. Betancourt to investigate viruses found in wastewater and how these viruses might be used to track wastewater treatment efficiency.
- Dr. Jose Ramirez (USDA Agricultural Research Service): Collaboration with Dr. Ramirez and his post-doc Kristin Duffield from the USDA to investigate viruses affecting cricket populations. Our collaboration resulted in the detection of active and covert viral infections in reared

FACULTY HIGHLIGHTS

cricket species that are important for the insect farming industry (see Active and Covert Infections of Cricket Iridovirus and Acheta domesticus Densovirus in Reared *Gryllodes sigillatus* Crickets).

Finally, Dr. Rosario participated in the Unlearning Racism in Geoscience (URGE) program as a member of the CMS URGE pod. The URGE program aimed to increase knowledge regarding the effects of racism on recruitment and retention of People of Color in geoscience fields and share/discuss anti-racist policies that could help our CMS community. As a pod member, she actively participated in bi-weekly meetings from March through June 2021 and helped write deliverables. The purpose of the deliverables was to document our efforts and identified/discussed actionable plans to improve antiracism, justice, equity, diversity, and inclusion (AJEDI) efforts at CMS.

DR. YUNFANG SUN (Dynamics of coupled oceanic-atmospheric modeling, Estuary and coastal ocean processes)

Dr. Sun modified the new high-resolution West Florida Shelf FVCOM ocean model (WFCOM), including the SST data assimilation, the highest resolution reaches 50 m at the coastal region, and the open boundary condition is multiple layers nested with HYCOM. The new WFCOM is then validated with NOAA tides and currents observation. Based on the new WFCOM, a wave-current interaction case for hurricane Irma 2017 is simulated. Also based on the WFCOM, the Piney Point pollution is simulated.

Other Events and Highlights

ALUMNI HIGHLIGHTS

In 2019 the Communications team started an effort to better track the successes of CMS alums and to share those in a Q&A story format.

These slowed down due to the pandemic but here is an example of a Q&A conducted in 2021:

[A Q&A with CMS Alum, Marina Marrari, PhD: CMS Launched Her Dream Career Path | USF College of Marine Science](#)

Dr. Marine Marrari's advisor was Dr. Kendra Daly. She graduated in 2008 and currently works for the Costa Rica Fishing Federation.

Excerpt:

Q: What is most valuable to you from your time at CMS?

A: I remember those years as some of the best of my life -- full of new experiences, opportunities, and great people that I've kept in my life through the years. It was eye opening and very fulfilling to be exposed to so many new opportunities I didn't even know existed in our field! What is most valuable is definitely the people I met during my years at CMS, many of whom I still collaborate and stay in touch with.



Dr. Marrari wrangles a swordfish in Costa Rica.

CMS Ocean Technology Group

The CMS Ocean Technology (COT) group continues to be involved in a number of high-profile projects totaling over \$17M in current and future grant funding. Our COT people need to be in the field, and they are to be commended for following USF COVID procedures and getting the work done. Some highlights from the past year include:

- COT continues to support observing system activities such as the Coastal Ocean Monitoring and Prediction System (COMPS) in the Gulf of Mexico, including participation in several cruises and service visits. These efforts now have spanned over two decades. Data collected in this capacity is used by researchers and stakeholders throughout the region and is part of the national backbone of oceanographic data.
- This was another banner year for the glider deployments despite the challenges of doing field work during a pandemic. Our glider crew accomplished great things under extremely difficult conditions resulting in 240 glider days over twelve glider deployments spanning the entire year, with efforts continuing in the Gulf of Mexico and Atlantic Ocean. These endeavors support research efforts including understanding red tides, predicting hurricane strength, understanding ocean circulation, and quantifying fish population dynamics. Funding for future work continues to expand.
- The new NOAA collaboration, The Center for Ocean Mapping and Integrated Technologies (COMIT), is moving forward with field experiments and partnerships with agencies and private industries. COMIT is expected to be a long-term fixture of future College efforts with heavy technological support.
- The Geo-Buoy collaboration with Professor Dixon from Geosciences has been successfully continuing by bringing the prototype buoy to shore for refurbishment and beginning the building of a second version. Both are expected to be deployed in the eastern Gulf of Mexico in 2022 to foster research including being networked into the COMIT research efforts.

Facilities

Major projects that were undertaken in 2021 included replacement of the MSL fire alarm system (FAS) and replacement of a standard fume hood in KRC 1125 with an exhausting laminar flow hood. The FAS was on-line and operational by Dec 2021 but due to supply-chain delays, some minor punch list items and final certification were not completed until March 2022. Likewise, the hood installation and associated HVAC system balancing were completed in Dec 2021 but the final certification testing was not conducted until April 2022 due to delays in material availability and vendor scheduling conflicts.

Numerous minor projects were also completed throughout the year including the remodel of MSL offices 126, 130, 140A, and 222H (paint, flooring, electrical); replacement of the frame and double doors in the MSL NW entryway; several HVAC/Controls repair jobs in both MSL and KRC; and various plumbing repairs or improvements: KRC 3124E (roof drain), MSL 157A (HW piping), MSL custodial closets 144E and 235E (demo/reconfiguration).

Education and Outreach

CMS EDUCATION AND OUTREACH PROGRAMS

Dr. Teresa Greely, is a teaching faculty and leads the college's education and outreach (E&O) programs in support of the USF mission for community engagement. Makenzie Kerr works part-time with E&O programs, and contributed significantly to our 2021 successes. 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 collaborations with scientist and community agencies. Although the global pandemic continued into 2021, it provided challenges and opportunities to continue high-quality E&O programming with renewed innovation and creativity.



The Spoonbill Ocean Sciences Bowl. During springtime our 17th annual Spoonbill academic brain bowl was a virtual competition. We hosted 170 participants, including 95 Florida high school students and teachers. Seventy-five volunteers, both returning and new, represented the Eckerd College, FMSEA, FWCC, New College, NOAA, Ocean Optics, USGS, USFSP, and USF Marine Science. To highlight

the Polar Oceans theme, we launched a virtual 'Polar Express Career Shuffle' using Zoom rooms to feature five polar scientists, including our very own Dr. Nancy Williams and her Sairdron research. Congratulations to Gainesville 4-H team led by two coaches who were former Spoonbill competitors in high school and are now completing STEM degrees.

(Left image winning team; right image Polar Express scientists)



The Oceanography Camp for Girls. During spring the OCG continued delivering virtual events for 2020 campers including Fish Banks where campers competed to become the best fishing company. Summertime of 2021 marked a milestone as OCG celebrated its **30th Anniversary**, and we began production of an OCG video to recognize the contributions of donors to the OCG Endowments that have sustained the program.

Our pre-college STEM program returned to in-person and continued to encourage teens to consider careers in the sciences while developing a positive sense of self, science, and the environment. More than **1250 teenaged girls have completed the 3-week program. This past summer 37 teens, 7 peer**

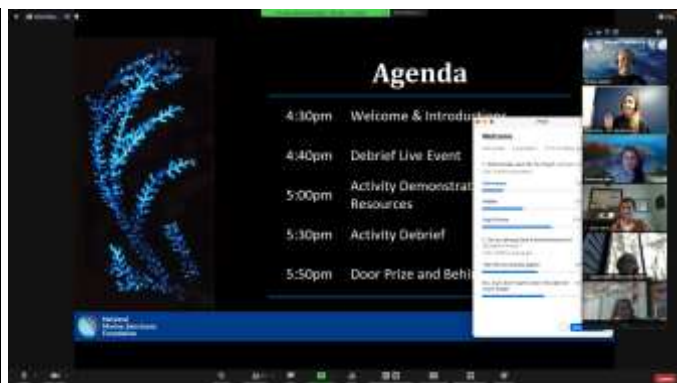
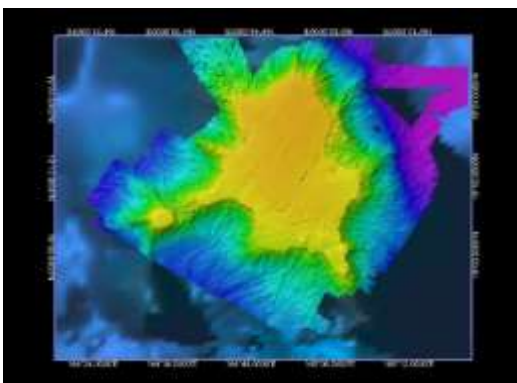
EDUCATION AND OUTREACH

counselors, and 15 science mentors participated in the OCG. Graduate and undergraduate students served as science mentors alongside professional staff, and participating scientists from FWCC, USGS, NOAA and CMS. We continued our Blue Economy component to feature where young ladies' lives intersect the Blue Economy in the Tampa Bay region by highlighting three sectors: ships use of smart shipping, sustainable fisheries, and renewable energy. In addition to providing ten coastal field expeditions and three research cruises, teens joined research labs across USF campuses to engage with scientists and the tools of their science used to answer current questions being pursued about the ocean and our coastlines. (Left image, OCGers in molecular medicine lab of Dr. Larry Dishaw; center image, OCGers aboard R/V Angari examining a sediment sample; right image, OCGers as ocean stewards during coastal cleanup)



As a NOAA Ocean Exploration facilitator, Greely led a series of Teacher Professional Development opportunities. During 2021 NOAA facilitators helped NOAA launch a new virtual PD series, the Deep Ocean Education Project, and companion website. Springtime Florida teachers learned about 'Deep Ocean Hydrothermal Vents' and 'Deep Ocean Seafloor Mapping' in partnership with

National Marine Sanctuaries Foundation, Schmidt Foundation, and Ocean Exploration Trust. NOAA OE strives to engage broad audiences to enhance America's environmental literacy through the excitement of ocean discovery following the NOAA Ship *Okeanos Explorer*. The program provides multimedia resources for teachers, students and the public. Over 80 teachers participated in the inaugural 2021 virtual educator PD series. Our very own, Dr. David Naar participated as our guest scientist for Q&A with teachers during the seafloor mapping PD event for CMS (left image), and Dr. Teresa Greely, was guest scientist for Q&A with teachers during the bioluminescence PD events for CMS and the South Carolina Aquarium (right image).



EDUCATION AND OUTREACH



Paying It Forward: OCG Alumni continued to make waves by informing online STEM programs for teens.

During summer OCG outreach was LIVE through the virtual world. Thirteen OCG alum spent two-weeks with the Brite program, a bold, interdisciplinary summer STEM learning program built especially for girls 13-16. Collaborators included World Science Festival, the National Girls Collaborative Project, and the Hello Studios. OCG Alumni, Abby A shared. “Brite fest was so much fun and my favorite part was coding dances. I learned from our speaker (Yamilée Toussaint Beach) that you don’t just have to choose one career path. More often than not, different career paths intertwine, allowing you to have both and not have to choose between two. Art and science intertwine in my life.”

Other Education & Outreach included:

- Taught undergraduate ocean science courses in Tampa and for the USFSP Honors College
- Led 12 community education events at the Clam Bayou Marine Education Center
- Provided a virtual PD series for 30 Pinellas county teachers on robotics in the ocean including building an ROV for the classroom as part of Duke STEM Boot Camp in partnership with the USFSP College of Education
- Continued support of the Guardians of the Gulf program led by Sarah Grasty and Kristen Kusek, in partnership with the Boys & Girls Clubs of the Suncoast



Leadership St. Petersburg Class of 2022 selected the Clam Bayou Marine Education Center as its class project, ‘Waves of Inspiration.’ The project mission is to enhance the outdoor spaces by May 2022 as a way to foster improved comfort, enjoyment, and by extension, enhanced learning. Class members will create cool, attractive surface areas to extend teaching and recreational space to outdoor areas during the hot summer months; enhance accessibility through inviting connectors and pathway; and, improve landscaping with native Florida seaside plants to educate the youth about coastal ecology.



Awarded second NOAA Gulf of Mexico Bay-Watershed Education and Training (B-WET) grant to continue providing coastal field trips for underserved elementary scholars and teachers, in grades 4-5 in south St. Petersburg schools adjacent to the Clam Bayou Marine Education Center. This is version 2.0 of our The Elementary Scholars and Teachers Exploring the Watershed program that aims to continue educating St. Petersburg, Florida’s 4th and 5th grade students about what makes their home a unique and special ecosystem, how people can influence the Tampa Bay watershed, and how youth can make a difference as ocean stewards.



New partnership with WorldStrides to provide a series of immersive, experiential coastal geology and ecology field trips for middle and high school students as part of WorldStrides Florida Science student education programs.

Communications

Communications Team. CMS alum Kristen Kusek ('98, MS, Marine Science, MA, Journalism/Mass Comm), Director of Strategic Communications, has managed the communications team since the fall of 2018. She is also program lead on the Guardians of the Gulf outreach program for underserved youth, the newest engagement program at the CMS. The communications team includes webmaster Jay Novitzke (full time) and graduate student Carlyn Scott (Sci Comm Assistant, 20 hours/week, up from 10 hours/week in 2020).

2021 Highlights and Challenges. Media engagement was a top performance area for the communications team in 2021. We hosted two major press conferences: the first in response to the Piney Point event in Tampa Bay (April-May) and the second for COMIT's inaugural mapping mission (December). More on these in the MEDIA OUTREACH section below.

Another major area of focus was to support the campaign behind the legislative budget for the Environmental & Oceanographic Sciences Research & Training Facility in partnership with UCM, USF's government affairs team and USF Foundation staff. The new facility is envisioned as a hub for the new Center of Excellence on the St. Petersburg campus (See [Overview | Center of Excellence in Environmental & Oceanographic Sciences | USF St. Petersburg campus](#)). Together with Jackie Dixon, Kusek also served on the search committee for two new faculty positions in Science Communication and Data Visualization, which will be housed in the Department of Journalism and Digital Communication program on the St. Petersburg campus and play a role in the Center of Excellence.

A third major area of achievement was in our outreach portfolio. Kusek helped launch and facilitate a multimedia effort (video production and photography) in celebration the 30th anniversary of the Oceanography Camp for Girls; assisted the outreach team (led by Teresa Greely, Makenzie Kerr) in a campaign to secure the Clam Marine Education Center as the class project for the Leadership St. Pete[®] (LSP) Class of 2022; and with Sarah Grasty, led the first 3-day field program of Guardians of the Gulf in July 2021 (See video, [Home - Guardians of the Gulf \(usf.edu\)](#) and launched the program website. The Guardians team wound up the year with a \$35,000 anonymous donation (adding to the \$45,500 they have raised to date).

Top challenges in 2021 were the following: the pandemic; staff capacity, especially as the College is now poised for growth; and website limitations / decreased autonomy that impacts productivity (in 2020 we migrated the website from Wordpress to OU Campus per the requirements of consolidation and have met significant limitations in the new system).

What follows is a snapshot of key highlights from 2021, broken down into the following categories: MEDIA OUTREACH, WEBSITE, AUDIENCE ENGAGEMENT: SOCIAL MEDIA & NEWSLETTER, STEAM EDUCATION PROGRAM DEVELOPMENT, and OTHER.

COMMUNICATIONS

MEDIA OUTREACH*

*All media coverage, including stories generated by the aforementioned press conferences, is in Appendix C.

- Partnered with USF's University Communications & Marketing (UCM) to execute press strategy around the Piney Point wastewater discharge event. Held two press conferences. See:
 - April 7, [USF leads first research cruise to study Piney Point's environmental impact | USF College of Marine Science](#)
 - April 8, [USF Response to Piney Point Spill | USF College of Marine Science](#)
 - May 24, [USF scientists announce initial findings from Piney Point research effort | USF College of Marine Science](#)
 - See also, an article written for USF St. Petersburg's Innovations magazine, https://issuu.com/usfstpetersburgcampus/docs/innovations_2022_magazine_web/s/14449586
 - In addition, Dean Tom Frazer wrote an opinion piece in the Tampa Bay Times that was published April 29, 2021. It is entitled, "Will the Tampa Bay area be ready to respond to another crisis like Piney Point? See <https://www.tampabay.com/opinion/2021/04/29/a-piney-point-disaster-will-happen-again-will-the-tampa-bay-area-be-ready-to-respond-column/>.
- Developed and executed media strategy for the inaugural mission of the COMIT team. See:
 - Dec 9, [USF launches first mission to map vulnerable coastal areas in Tampa Bay and Gulf of Mexico using a remotely operated 'uncrewed' vessel | USF College of Marine Science](#)
- We reached a new milestone in 2021 with respect to media coverage. In addition to media interest generated by our press releases, we now have reporters routinely approaching us for story ideas, which marks a significant shift from previous years.

WEBSITE (www.usf.edu/marine-science)

- We achieved 34% growth on our website engagement over prior year. We attribute this to the completion of the website migration to a new content management system.
- Significant areas of work included streamlining the Community Engagement pages ([Community Engagement | USF College of Marine Science](#)) and launching a website for Dr. Brad Seibel's lab ([Overview | USF College of Marine Science](#)).

COMMUNICATIONS

Audience Engagement

	Website*	Facebook**	Twitter**	YouTube	Instagram***
2018	43,422	1400	No Data	No Data	N/A
2019	59,199	1726	1880	280	256
2020	52,452	1845	2230	354	533
2021	70,265	1946	2376	397	791*

*We migrated the website to the new CMS in July 2020.

**Note: Facebook and Twitter were launched in December 2012.

***We launched Instagram in 2019.

ENGAGEMENT: SOCIAL MEDIA (Facebook.com/USFMarineScience, Twitter.com/USFCMS, Youtube.com/USFMarineScience, Instagram.com/usfmarinescience)

- Achieved 5.5% growth in Facebook community over prior year.
- Achieved 6.5% growth in Twitter community over prior year.
- Achieved 48.4% growth in on Instagram over prior year.
- Achieved 12.5% growth in YouTube community over prior year.

As indicated above, our largest area of growth is in our Instagram, managed by Carlyn Scott. We view this as a critical channel for current student engagement and prospective student recruitment. Between January 4th – April 3rd (2022) we had saw a 1,197% increase in accounts reached. Being a data-driven communications team, we recently ran a report to see how we compare to our peer institution, University of Rhode Island Graduate School of Oceanography – and found that our posts achieve roughly twice the engagement despite the fact that URI GSO has a larger number of followers overall. Strategies underway to continue to increase our engagement include:

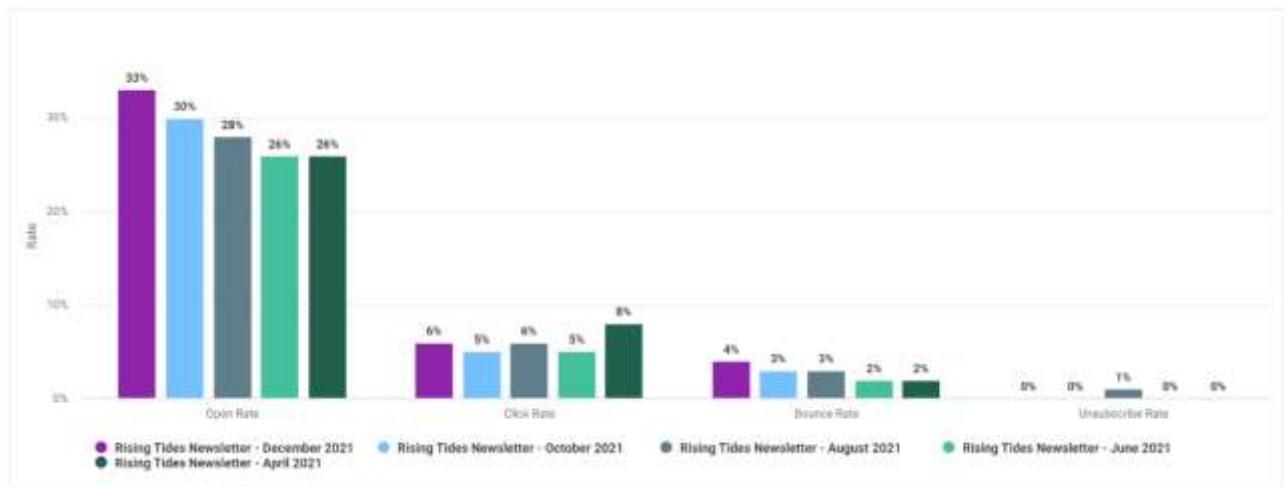
- Increase follower count, especially by high impact community members
- Increase number of hashtags per post to increase engagement across platform
- Increase comments on other pages and posts to stoke higher engagement and start conversations with other brands

Here were the top performers on Facebook in terms of engagement in 2021:



ENGAGEMENT: NEWSLETTER

- We re-designed and re-launched the “Rising Tides” newsletter in October 2019 and continue to deploy it every other month. Our aim is to deploy it monthly but we are limited in staff capacity.
- Highlights from the graph below: We continue to show solid engagement metrics compared to industry standards.
- One main challenge we continue to face is in the quality of our email lists, which we are working on in partnership with Doug Myhre. One goal is to do much more strategic and targeted engagement with our audience (e.g., alum-specific emails) but currently lack the capacity to move this forward at this time.



Graph showing Campaign Comparison Report of last five newsletter campaigns in 2021.

STEAM EDUCATION PROGRAM DEVELOPMENT

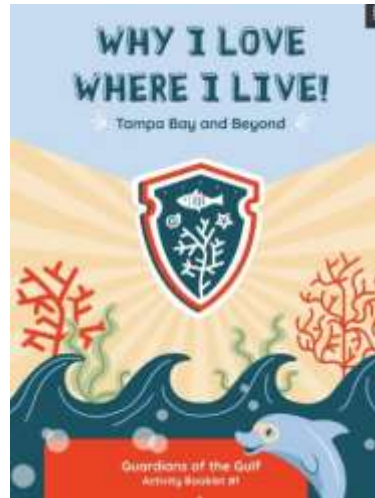
Kusek leads CMS’s newest STEAM program focused on coastal and human resiliency called **Guardians of the Gulf**, a partnership with the Boys & Girls Club of the Suncoast. The program is a pilot program of the St. Petersburg Innovation District’s ‘smart city’ initiative.

USF colleagues include Sarah Grasty (COMIT, education lead) and Teresa Greely. In July 2021 we ran our first mini-camp (three days, funded by Duke Energy Foundation), and produced a video capturing its success, which we now use for fundraising. See www.marine.usf.edu/guardians. We launched this site this year and were fortunate to receive an anonymous donation in December 2021 of \$35,000 – moving the total funding raised for our program to date to ~\$80,000.

Key achievements in 2021: Production of two coastal resiliency STEAM job videos (funded by private donors); finalized two activity booklets funded by Tampa Bay Estuary Program; and the development of the prototype of an augmented reality (AR) app, funded by a USF Creative Innovation Award (due: June 2022). This will form part of the digital component of our multisensory curriculum (including hands-on activities) and will provide the necessary proof-of-concept needed to develop a fully immersive experience with additional funding. It leverages several USF assets while harnessing the

COMMUNICATIONS

strengths of three University entities: the USF CMS; the USF Access 3D Lab; and the USF Advanced Visualization Center. The app experience takes place on Egmont Key in Tampa Bay, a popular island and national bird/wildlife refuge that has been eroding for decades and includes historical sites from the Spanish-American War at risk from coastal change. It leverages augmented reality (AR), making it fun to learn how to save sea turtle nests from storms and predators and use green infrastructure to extend the life of the coastline, for example.



Caption: Left: July 2021 camp participant, right: 1 of 2 activity booklets developed in 2021.



Caption: One of two resiliency job videos created in 2021, featuring Winnie Mulamba, Sustainability Planner on the USF St. Petersburg campus.

OTHER

- Kusek delivered two guest lectures on science communication in 2021:
 - March 2021: Scientific Writing (Pam Muller)
 - October 2021: Professional Development (Mya Breitbart, Kristen Buck)

Development

FUNDRAISING

The College of Marine Science continued to receive generous support from alumni, faculty, staff, friends, and community partners through current and deferred gifts, and in-kind donations.

This year, Bob and Jeanne Jolley made a generous gift to establish the “**Robert R. and C. Jeanne Jolley Endowed Fellowship in Marine Science.**” Bob and Jeanne also decided to include the College of Marine Science in their estate plans to enhance their fellowship. Bob Jolley is an icon at the USF College of Marine Science. Bob was the go-to-person for all matters related to daily operations and facility planning. He was also instrumental in community outreach activities when the college was a department. David Naar was quite impressed, as a newly hired assistant professor, that Bob personally paid \$600 to receive David’s car arriving from Hawaii before David arrived on campus in January of 1990. This was an act of kindness beyond the call of duty, one of many that Bob Jolley provided to the faculty, staff, and students in the Marine Science Program over the years. His many acts of kindness permeated throughout the college and has helped foster a close-knit, caring community. This fellowship was created, in Bob’s own words, “as a paying it forward recognition of Drs. Peter Betzer, Kent Fanning, and Al Hine for their unwavering support and many kindnesses shown me over 37 years.” This endowment will support a full-time graduate student from any of the four major oceanographic disciplines: chemistry, biology, geology, or physical oceanography. The degree-seeking student’s research, at either the Master’s or Doctoral level, should enhance our knowledge and understanding of the many climate change issues facing the planet and future generations. The **Robert R. and C. Jeanne Jolley Endowed Fellowship in Marine Science** will be awarded for the first time in the fall semester of 2023.

Scott ‘77 and Carol Rogers made a gift of \$75,000 to enhance the Thomas E. Pyle Memorial Fellowship in Marine Science. Since the Rogers established this Fellowship in 2017, four (4) highly deserving students have received awards. Scott and Carol continue to marvel at the caliber of graduate students they have met as well as at the trajectory of the College of Marine Science.

Fellowships

The college’s \$23.7 M endowment provided ~\$380,000 for endowed fellowships and awards to 36 CMS graduate students in 2021-2022.

Following is an honor roll of the esteemed winners of the 2021 fellowships and awards:

Alexander Timpe	<i>William and Elsie Knight Endowed Fellowship for Marine Science</i>
Keith Keel	<i>Bridge to Doctorate Endowed Graduate Fellowship</i>
Catalina Rubiano	<i>Bridge to Doctorate Endowed Graduate Fellowship</i>
Kiersten Wallace Monahan	<i>St. Petersburg Downtown Partnership Fellowship in Coastal Science</i>
Kalla Fleger	<i>Garrels Memorial Fellowship in Marine Science</i>
Kylee Rullo	<i>Paul Getting Endowed Memorial Fellowship in Marine Science</i>

DEVELOPMENT

Rebecca Scott	<i>Jack & Katharine Ann Lake Fellowship in Marine Science</i>
Sean Beckwith	<i>Young Fellowship Program Fund</i>
Alyssa Marie Andres	<i>Gulf Oceanographic Charitable Trust Fellowships Endowment</i>
Jonathan Peake	<i>Gulf Oceanographic Charitable Trust Fellowships Endowment</i>
Bostony Braoudakis	<i>Anne & Werner Von Rosenstiel Fellowship in Marine Science</i>
Brittany Hernandez	<i>Anne & Werner Von Rosenstiel Fellowship in Marine Science</i>
Caitlyn Parente	<i>Anne & Werner Von Rosenstiel Fellowship in Marine Science</i>
Shannon Riley	<i>Anne & Werner Von Rosenstiel Fellowship in Marine Science</i>
Christina Welsh	<i>Carl Riggs Fellowship in Marine Science</i>
Macarena Martin Mayor	<i>George Lorton Fellowship in Marine Science</i>
Martina Plafcan	<i>Linton Tibbetts Endowed Graduate Student Fellowship</i>
Natalia Lopez Figueroa	<i>Norman Blake Endowed Memorial Fellowship in Marine Science</i>
Shannon Burns	<i>Oceanography Camp for Girls Fellowship</i>
Luis Lizcano-Sandoval	<i>Sanibel-Captiva Shell Club/Mary & Al Bridell Memorial Fellowship</i>
Claire Onak	<i>Southern Kingfish Association's Fellowship</i>
Michael Schram	<i>Tampa Bay Parrot Head Fellowship in Marine Science</i>
Mark Mussett	<i>Thomas E. Pyle Memorial Fellowship in Marine Science</i>
Nicola Guisewhite	<i>Wells Fargo Fellowship in Marine Science</i>
Brianna Michaud	<i>William T. Hogarth Fellowship in Marine Mammals</i>
Theresa King	<i>Abby Sallenger Memorial Endowment</i>
Ryan Venturelli	<i>Sackett Prize for Innovative Research</i>
Hannah Hunt	<i>Robin B. Perlman Innovation Fund for Marine Science</i>
Katelyn Schockman	<i>Renate E. Bernstein Outstanding Authorship Award</i>
Jill Thompson-Grim	<i>Suncoast Fly Fishers Scholarship</i>

FUNDING PRIORITIES

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:

USF Interdisciplinary Center of Excellence in Environmental and Oceanographic Sciences: The University of South Florida (USF) is advancing a bold new plan to create a center of excellence that will build upon the world-class reputation of the College of Marine Science and connect multiple schools and colleges across USF to address the complex challenges of coastal resiliency, sustainability, and economic vitality. At the center's hub is a new, state-of-the-art 80,000-square-foot facility that will be home to boundary pushing research and provide valuable classroom space for graduates and

DEVELOPMENT

undergraduates. Total project funding is \$105.3 M, of which \$25 M is needed in private support for programming, furniture, fixtures and equipment.

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.

Dean's Innovation Endowment for Research Support: To recruit and retain top caliber faculty, significant resources are 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. Our \$23.7M endowment provides fellowship support for approximately 30 graduate students each year. To stay competitive, we must continue to attract new fellowship support, and also increase the value of many of our existing fellowship endowments.

Unrestricted Gifts: These gifts are a powerful form of private support because they allow for flexibility in addressing education and research opportunities and challenges that affect both the college and the community. For example, when fast-breaking, unforeseen environmental crises strike such as the Piney Point discharge of contaminated water into Tampa Bay, researchers in the college can access unrestricted funds to act in a timely manner and provide the science necessary to inform an effective response.

Appendices

Appendix A

Publications

Appendix B

Active Research Awards

Appendix C

Events in the News

Appendix A. Publications

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

CMS JOURNAL PUBLICATIONS (142 peer-reviewed journal articles)

- Allen, T et al. (32 co-authors, including **R.H. Weisberg**) (2021), Anticipating and Adapting to the Future Impacts of Climate Change on the Health, Security and Welfare of Low Elevation Coastal Zone (LECZ) Communities in Southeastern USA, *Jour. Mar. Sci. and Engr.* 9, 1196. <https://doi.org/10.3390/jmse9111196>.
- Anisworth, C.H.**, E.P. Chassignet, D. French-McCay, C.J. Beegle-Krause, I. Berenshtein, J. Englehardt, T. Fiddaman, H. Huang, M. Huettel, D. Justic, V.H. Kourafalou, **Y. Liu**, C. Mauritzen, **S. Murawski**, S. Morey, T. Ozgokmen, C.B. Paris, J. Ruzicka, S. Saul, J. Shepherd, S. Socolofsky, H. Solo-Gabriele, T. Sutton, **R.H. Weisberg**, C. Wilson, L. Zheng, and Y. Zheng (2021), Ten years of modeling the Deepwater Horizon oil spill, *Environmental Modelling and Software*, 142, 105070, <https://doi.org/10.1016/j.envsoft.2021.105070>.
- A.E. Bates, **C.D. Stallings**, et al. (340 co-authors) (2021) The global COVID-19 lockdown highlights humans as both threats and custodians of the environment. *Biological Conservation* 109175.
- Barnes, B. B.**, **C. Hu**, S. W. Bailey, N. Pahlevan, B. A. Franz (2021). Cross-calibration of MODIS and VIIRS long near infrared bands for ocean color science and applications. *Remote Sens. Environ.*, 260, 112439, <https://doi.org/10.1016/j.rse.2021.112439>
- Bassi, D., J.C. Braga, G. Di Domenico, J. Pignatti, S. Abramovich, **P. Hallock**, J. Koenen, Z. Kovács, M.R. Langer, G. Pavia, and Y. Iryu (2021) Palaeobiogeography and evolutionary dynamics of the larger foraminifer *Borelis* de Montfort (Borelidae). *Pap. Palaeontol*, 7(3), 377–403, doi: 10.1002/spp2.1273.
- Benson, Abigail, Tylar Murray, Gabrielle Canonico, Enrique Montes, **Frank Muller-Karger**, Maria T. Kavanaugh, Joaquin Trinanes, and Lynn M. deWitt. (2021). Data Management and Interactive Visualizations for the Evolving Marine Biodiversity Observation Network. Special Issue on the Marine Biodiversity Observation Network: An Observing System for Life in the Sea. *Oceanography*. Vol 34, No. 2. <https://doi.org/10.5670/oceanog.2021.220>
- Beth Polidoro, Cole W. Matson, Mary Ann Ottinger, D. Abigail Renegar, **Isabel C. Romero**, Daniel Schlenk, John Pierce Wise, Jesús Beltrán González, Peter Bruns, Kent Carpenter, Dorka Cobián Rojas, Tracy K. Collier, Thomas F. Duda, Patricia González-Díaz, Richard Di Giulio, R. Dean Grubbs, J. Christopher Haney, John P. Incardona, Guillermo Horta-Puga, Christi Linardich, Jon A. Moore, Daniel Pech, Susana Perera Valderrama, Gina M. Ralph, Kyle Strongin, Amy H. Ringwood, Bernd Würsig. 2021. A Multi- taxonomic Framework for Assessing Relative Petrochemical Vulnerability of Marine Biodiversity in the Gulf of Mexico. *Science of the Total Environment*, <https://doi.org/10.1016/j.scitotenv.2020.142986>
- Bosquilia, Raoni W.D., and **Frank E. Muller-Karger**. (2021). Analysis of the wetland classification using optical satellite imagery in the environmental protection area of Guaraqueçaba, PR, Brazil. *Journal of South American Earth Sciences*. <https://doi.org/10.1016/j.jsames.2021.103615>.
- Bravo, Gonzalo, Nicolas Moity, Edgardo Londoño-Cruz, **Frank Edgar Muller-Karger**, Gregorio Bigatti, Eduardo Klein, Francis Choi, Lark Parmalee, Brian Helmuth, Enrique Montes Herrera. (2021). Robots versus humans: automated annotation accurately quantifies Essential Ocean Variables of rocky intertidal functional groups and habitat state. *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2021.691313>.

APPENDIX A. PUBLICATIONS

- Breitbart, M** and BA Fane (2021) Microviridae. *Encyclopedia of the Life Sciences* (eLS). 2, doi: 10.1002/9780470015902.a0029280.
- Breithaupt, J.L.; Smook, J.M.; Bianchi, T.S.; Vaughn, D.; Sanders, C.J.; Radabaugh, K.R.; Osland, M.J.; Feher, L.C.; Lynch, J.C.; Cahoon, D.R.; Anderson, G.H.; Whelan, K.R.T.; **Rosenheim, B.E.**; Moyer, R.P.; Chambers, L.G. (2021). Reply to comment by R. Parkinsonon “Increasing rates of carbon burial in southwest Florida coastal wetlands. *Journal of Geophysical Research: Biogeosciences*. v. 126, n. 4. doi:10.1029/2021JG006245.70.
- Cael, B. B., Kelsey Bisson, Maureen Conte, Manon T. Duret, Christopher L. Follett, Stephanie A. Henson, Makio C. Honda, Morten H. Iversen, David M. Karl, Richard S. Lampitt, Colleen B. Mouw, **Frank Muller-Karger**, Corinne A. Pebody, Kenneth L. Smith, and Jr. David Talmy. (2021). Open ocean particle flux variability from surface to seafloor. *Geophysical Research Letters*, 48, e2021GL092895. <https://doi.org/10.1029/2021GL092895>
- Campbell, M., A. Huddleston, D. Somerton. E. Clarke, W. Wakefield, **S. Murawski**, C. Taylor, H. Singh, Y. Girdhar and M. Yoklavich. 2021. Assessment of attraction and avoidance behaviors of fish in response to the proximity of transiting underwater vehicles. *Fishery Bulletin* 119(4) 216-230. doi: 10.7755/FB.119.4.2).
- Caragnano A., D. Basso, S. Spezzaferri, **P. Hallock**, and Conférence Universitaire de Suisse Occidentale Scientific Party (2021) A snapshot of reef conditions in North Ari Atoll (Maldives) following the 2016 bleaching event and *Acanthaster planci* outbreak. *Mar. Fresh. Res.* 72(7), 987-996, doi: 10.1071/MF20119
- Cause-Nicholson, Kerry-Anne, Philip A. Townsend, David Schimel, Ali M. Assiri, Pamela L. Blake, Maria Fabrizia Buongiorno, Petya Campbell, Nimrod Carmon, Kimberly A. Casey, Rosa Elvira Correa-Pabón, Kyla M. Dahlin, Hamid Dashti, Philip E. Dennison, Heidi Dierssen, Adam Erickson, Joshua B. Fisher, Robert Frouin, Charles K. Gatebe, Hamed Gholizadeh, Michelle Gierach, Nancy F. Glenn, James A. Goodman, Daniel M. Griffith, Liane Guild, Christopher R. Hakkenberg, Eric J. Hochberg, Thomas R.H. Holmes, **Chuanmin Hu**, Glynn Hulley, Karl F. Huemmrich, Raphael M. Kudela, Raymond F. Kokaly, Christine M. Lee, Roberta Martin, Charles E. Miller, Wesley J. Moses, **Frank E. Muller-Karger**, Joseph D. Ortiz, Daniel B. Otis, Nima Pahlevan, Thomas H. Painter, Ryan Pavlick, Ben Poulter, Yi Qi, Vincent J. Realmuto, Dar Roberts, Michael E. Schaeppman, Fabian D. Schneider, Florian M. Schwandner, Shawn P. Serbin, Alexey N. Shiklomanov, E. Natasha Stavros, David R. Thompson, Juan L. Torres-Perez, Kevin R. Turpie, Maria Tzortziou, Susan Ustin, Qian Yu, Yusri Yusup, Qingyuan Zhang. (2021). NASA’s Surface Biology and Geology Designated Observable: A Perspective on Surface Imaging Algorithms. *Remote Sensing of Environment*. Volume 257,112349,<https://doi.org/10.1016/j.rse.2021.112349>.
- Cause-Nicholson, K., P. A. Townsend, D. Schimel, et al. (2021). NASA’s surface biology and geology designated observable: A perspective on surface imaging algorithms. *Remote Sens. Environ.*, 257, 112349, <https://doi.org/10.1016/j.rse.2021.112349>
- Chandanpurkar, H. A., Reager, J. T., Famiglietti, J. S., Nerem, R. S., **Chambers, D. P.**, Lo, M.-H., et al. (2021). The seasonality of global land and ocean mass and the changing water cycle. *Geophysical Research Letters*, 48, e2020GL091248. <https://doi.org/10.1029/2020GL091248>.
- Chavez, F.P., M. Min, K. Pitz, N. Truelove, J. Baker, D. LaScala-Grunewald, M. Blum, K. Walz, C. Nye, A. Djurhuus, R.J. Miller, K.D. Goodwin, F.E. **Muller-Karger**, H.A. Ruhl, and C.A. Scholin. (2021). Observing life in the sea using environmental DNA. *Oceanography* 34(2), <https://doi.org/10.5670/oceanog.2021.218>

APPENDIX A. PUBLICATIONS

- Chavez, F.P., R.J. Miller, **F. Muller-Karger**, K. Iken, G. Canonico, K. Egan, J. Price, and W. Turner. (2021). MBON— Marine Biodiversity Observation Network: An observing system for life in the sea. *Oceanography* 34(2), <https://doi.org/10.5670/oceanog.2021.211>
- Chen S, Sutton AJ, **Hu C** and Chai F (2021) Quantifying the Atmospheric CO₂ Forcing Effect on Surface Ocean pCO₂ in the North Pacific Subtropical Gyre in the Past Two Decades. *Front. Mar. Sci.* 8:636881. doi: 10.3389/fmars.2021.636881.
- Cooke, M, **M Breitbart**, EHG Cooperdock, N Levin, N Niemi, C Bell, L Stevens, K Viskupic (2021) First year graduate courses foster inclusion. *Nature Geosciences.* 14, 539-540.
- Conte, R., Rebesco, M., De Santis, L., Colleoni, F., Bensi, M., Bergamasco, A., Kovacevic, V., Gales, J., Zuger, F., Accetella, D., De Steur, L., Ursella, L., McKay, R., Kim, S., Lucchi, R.G., the IODP Expedition 374 Scientists (2021) Bottom Current Control on sediment deposition between the Iselin Bank and the Hillary Canyon (Antarctica) since the late Miocene: An integrated seismic-oceanographic approach. *Deep Sea Res.* 176, 1–22.
- Conway, T. M.**, Horner, T. J., Plancherel, Y., and González, A.G. (2021) Highlighting a decade of progress in understanding cycles of trace elements and their isotopes in the oceans. *Chem. Geol.* 580, 120381.5.
- Daly, K.L.**, A. Remsen, D. Outram, H. Broadbent, K. Kramer, and K. Dubikas (2021) Resilience of the zooplankton community in the northeast Gulf of Mexico during and after the Deepwater Horizon oil spill. *Marine Pollution Bulletin* 163, 112074, <https://doi.org/10.1016/j.marpolbul.2020.111882>.
- Diercks A, **Romero IR**, Schwing P, Larson RA, Harris A, Bosman S, Chanton JP, Brooks G. (2021) Resuspension, Redistribution, and Deposition of Oil-Residues to Offshore Depocenters After the Deepwater Horizon Oil Spill. *Front Mar Science*, <https://doi.org/10.3389/fmars.2021.630183>
- Di Roberto, A., Scateni, B., Di Vincenzo, G., Petrelli, M., Fisauli, G., Barker, S.J., Del Carlo, P., Colleoni, F., Kulhanek, D.K., McKay, R., De Santis, L., and the IODP Expedition 374 Scientific Party (2021) Tephrochronology and provenance of an early Pleistocene (Calabrian) tephra from IODP Expedition 374 Site U1524, Ross Sea (Antarctica). *Geochemistry, Geophysics, Geosystems* 22(8):e2021GC0097396.
- Dubicka, Z., M. Gajewska, W. Kozłowski, **P. Hallock**, and J. Hohenegger (2021) Photosynthetic activity in Devonian Foraminifera. *Biogeosciences* 18(20), 5719-5728, doi 10.5194/bg-18-5719-2021.
- Duffy, M.L., Tibbett, E.J., Smith, C., Warny, S., Feakins, S.J., Escarguel, G., Askin, R., Leventer, A., and A.E. Shevenell (2021) Snapshots of pre-glacial paleoenvironmental conditions along the Sabrina Coast, East Antarctica: New palynological and biomarker evidence. *Geobios.* <https://doi.org/10.1016/j.geobios.2021.09.0015>.
- Estes, Maurice, Clarissa Anderson, Ward Appeltans, Nic Bax, Nina Bednaršek, Gabrielle Canonico, Samy Djavidnia, Elva Escobar, Peer Fietzek, Marilaure Gregoire, Elliott Hazen, Maria Kavanaugh, Franck Lejzerowicz, Fabien Lombard, Patricia Miloslavich, Klas O. Möller, Jacquomo Monk, Enrique Montes, Hassan Moustahfid, Monica M.C. Muelbert, **Frank Muller-Karger**, Lindsey E. Peavey Reeves, Erin V. Satterthwaite, Jörn O. Schmidt, Ana M.M. Sequeira, Woody Turner, Lauren V. Weatherdon (2021) Enhanced monitoring of life in the sea is a critical component of conservation management and sustainable economic growth. *Marine Policy.* Volume 132. <https://doi.org/10.1016/j.marpol.2021.104699>. <https://www.sciencedirect.com/science/article/pii/S0308597X21003109>

APPENDIX A. PUBLICATIONS

- Faletti M.E., and **Stallings C.D.** (2021) Life history through the eyes of a hogfish: trophic growth and differential juvenile habitat use from stable isotope analysis. *Marine Ecology Progress Series* 666,183-202.2021 Papers led by other labs
- Fernández, AG , EM Symonds, J Gallard, B Mull, JO Lukasik, PR Navarro, AB Aguilar, J Peraud, M Brown, DM Alvarado, **M Breitbart**, MR Cairns, VJ Harwood (2021) “Relationships among microbial indicators of fecal pollution, microbial source tracking markers, and pathogens in Costa Rican coastal waters. *Water Research*. 188, 116507.
- Galperin, B.**, and Sukoriansky, S. (2021) Seasonal oceanic variability on submesoscales: A turbulence perspective. *Ocean Dynamics*, 71, 475-489, DOI: 10.1007/s10236-021-01444-1.
- Gregoire et al. (56 authors in alphabetical order- **B. A. Seibel**). (2021) A global ocean oxygen data base and atlas for assessing and predicting deoxygenation and ocean health in the open and coastal ocean. *Frontiers Mar. Sci.* 10.3389/fmars.2021.724913.
- Gupta, A., H. Hadj-Moussa, R. Al-attar, **B. A. Seibel**, and K. B. Storey. (2021) Hypoxic jumbo squid activate neuronal apoptosis *but not* MAPK or antioxidant enzymes during oxidative stress. *Physiological Biochemical Zoology*. DOI: 10.1086/714097.
- Halanych, K.M., **C. H. Ainsworth**, E. E. Cordes, R. E. Dodge, M. Huettle, I. A. Mendelssohn, **S.A. Murawski**, C.B. Paris-Limouzy, P.T. Schwing, R.F. Shaw, T. Sutton, C.A. Wilson. (2021) Chapter 11: Effects of petroleum by-products and dispersants on ecosystems. *Oceanography* 34(1):152–163, <https://doi.org/10.5670/oceanog.2021.123>.
- Hallock, P.**, and Seddighi, M. (2021) Why did some larger benthic foraminifera become so large and flat? *Sedimentology*, 69,74-87, doi:10.1111/sed.12837.
- Homoky, W. B., **Conway, T. M.**, John, S. G., Koenig, D., Deng, F., Tagliabue, A. & Mills, R. (2021) Lithogenic colloid production dominates sedimentary iron supply in the ocean interior. *Proc. Natl Acad. Sci. U. S. A.* 118, e2016078118.2.
- Horner, T. J., Little, S. H., **Conway, T. M.**, Farmer, J. R., Hertzberg, J. E., Lough, A. J. M., Mckay, J., Tessin, A., Galer, S. J. G., Jaccard, S. L., Lacan, F., Paytan, A., Wuttig, K., and GEOTRACES–PAGES Biological Productivity Working Group Members (2021) Bioactive tracemetals and their isotopes as paleoproductivity proxies: An assessment using GEOTRACES-era data. *Global Biogeochem. Cycles*. 35, 11
- Hu, C.** (2021) Remote detection of marine debris using satellite observations in the visible and near infrared spectral range: Challenges and potentials. *Remote Sens. Environ.*, 259, 112414, <https://doi.org/10.1016/j.rse.2021.112414>
- Hu, C.**, M. Wang, B. E. Lapointe, R. A. Brewton, and F. J. Hernandez (2021) On the Atlantic pelagic Sargassum's role in carbon fixation and sequestration. *Science of the Total Environment*, 781, 146801, <https://doi.org/10.1016/j.scitotenv.2021.146801>
- Hu, C.**, Y. Lu, S. Sun, and Y. Liu (2021) Optical Remote Sensing of Oil Spills in the Ocean: What Is Really Possible? *J. Remote Sens.*, 2021, 9141902, <https://doi.org/10.34133/2021/9141902>.
- Huang, M., X. Liang, Y. Zhu, **Y. Liu**, and **R.H. Weisberg** (2021) Eddies connect the tropical Atlantic Ocean and the Gulf of Mexico, *Geophys. Res. Lett.*, 48, e2020GL091277, <https://doi.org/10.1029/2020GL091277>.

APPENDIX A. PUBLICATIONS

- Hudson-Heck, E., X. Liu, and **R.H. Byrne** (2021) Purification and physical–chemical characterization of bromocresol purple for carbon system measurements in fresh waters, estuaries, and oceans. *ACS Omega* 6(8): 1794–17951. <https://pubs.acs.org/doi/10.1021/acsomega.1c01579227>.
- Ilich, A. J. Brizzolara, S. Grasty, J. Gray, M. Hommeyer, **C. Lembke**, S. Locker, A. Silverman, T. Switzer, A. Vivlamore, **S. Murawski** (2021) “Integrating Towed Underwater Video and Multibeam Acoustics for Marine Benthic Habitat Mapping and Fish Population Estimation”, *Geosciences*, DOI: 10.3390/geosciences11040176
- Jiang, J.Q., R.A. Feely, R. Wanninkhof, D. Greeley, L. Barbero, S. Alin, B.R. Carter, D. Pierrot, C. Featherstone, J. Hooper, C. Melrose, N. Monacci, J.D. Sharp, S. Shellito, Y. Xu, A. Kozyr, **R.H. Byrne**, W. Cai, J. Cross, G.C. Johnson, B. Hales, C. Langdon, J. Mathis, J. Salisbury, and D.W. Townsend (2021) Coastal Ocean Data Analysis Product in North America (CODAP-NA) —an internally consistent data product for discrete inorganic carbon, oxygen, and nutrients on the North American ocean margins. *Earth System Science Data* 13 (6): 2777–2799. <https://doi.org/10.5194/essd-13-2777-2021224>.
- Jiao, J., Y. Lu, **C. Hu**, J. Shi, S. Sun, and Y. Liu (2021) Quantifying ocean surface oil thickness using thermal remote sensing. *Remote Sens. Environ.*, 261, 112513, <https://doi.org/10.1016/j.rse.2021.112513>.
- Justić, D., V.H. Kourafalou, G. Mariotti, S. He, **R.H. Weisberg**, Y. Androulidakis, C. Barker, A. Bracco, B. Dzwonkowski, C. Hu, H. Huang, G. Jacobs, M. Le Henaff, **Y. Liu**, S. Morey, J. Nittrouer, E. Overton, C.B. Paris, B.J. Roberts, K. Rose, A. Valle-Levinson, and J. Wiggert (2021) Transport processes in the Gulf of Mexico along the river-estuary-shelf-ocean continuum: A review of research from the Gulf of Mexico Research Initiative, *Estuaries and Coasts*, <https://doi.org/10.1007/s12237-021-01005-1>.
- Justić, D., V. Kourafalou, G. Mariotti, et al. (2021) Transport Processes in the Gulf of Mexico Along the River-Estuary-Shelf-Ocean Continuum: a Review of Research from the Gulf of Mexico Research Initiative. *Estuaries and Coasts*, <https://doi.org/10.1007/s12237-021-01005-1>
- Kavanaugh, M.T., T. Bell, D. Catlett, M.A. Cimino, S.C. Doney, W. Klajbor, M. Messié, E. Montes, **F.E. Muller-Karger**, D. Otis, J.A. Santora, I.D. Schroeder, J. Triñanes, and D.A. Siegel (2021) Satellite remote sensing and the Marine Biodiversity Observation Network: Current science and future steps. *Oceanography* 34(2), <https://doi.org/10.5670/oceanog.2021.215>.
- Kerr, M and **M Breitbart** (2021) DNA Detectives: Outreach activity teaching students how to identify fish eggs using DNA barcoding. *Journal of Microbiology and Biology Education*. 22, doi:10.1128/jmbe.v22i1.2191.
- König, D., **Conway, T. M.**, Ellwood, M. J., Homoky, W. B., and Tagliabue, A. (2021) Constraining the processes governing marine iron isotope cycling with a global ocean model. *Global Biogeochem. Cycles*. 35, 9. e2021GB006968.
- Krisch, S. Hopwood, M. J., Schaffer, J., Al-Hashem, A., Höfer, J., **Conway, T. M.**, Summers, B. A., Lodeiro, P. Ardiningsih, I., Steffens, T. & Achterberg, E. P. (2021) The 679°N Glacier cavity modulates subglacial iron export to the NE Greenland Shelf. *Nature Comms. Nature Comms*.12, 3030.4.
- Lapointe, B. E., R. A. Brewton, L. W. Herren, M. Wang, **C. Hu**, D. J. McGillicuddy, Jr., S. Lindell, F.J. Hernandez, and P. L. Morton (2021) Nutrient content and stoichiometry of pelagic Sargassum reflects increasing nitrogen availability in the Atlantic Basin. *Nature Communications*. 12:3060, <https://doi.org/10.1038/s41467-021-23135-7>.

APPENDIX A. PUBLICATIONS

- Le, C., Chen, Y., Lehrter, J. C., **Hu, C.**, Bouman, H., Cai, W.-J., & Qi, L. (2021) Greenland blocking promotes subtropical North Atlantic spring blooms. *Geophysical Research Letters*, 48, e2020GL092252. <https://doi.org/10.1029/2020GL092252>.
- Lewis, K.A., Rose, K.A., De Mutsert, K., Sable, S., **Ainsworth, C.**, Brady, D., Townsend, H. (2021) Using multiple ecological models to inform environmental decision making. *Front. Mar. Sci.*, 24 March 2021 <https://doi.org/10.3389/fmars.2021.625790>
- Liang, X., C. Liu, R. M. Ponte, and **D. P. Chambers** (2021) A Comparison of the Variability and Changes in Global Ocean Heat Content from Multiple Objective Analysis Products During the Argo Period. *J. Climate*, 34, 7875-7895, <https://doi.org/10.1175/JCLI-D-20-0794.1>.
- Liu, Y., C.R. Merz, R.H. Weisberg**, L.K. Shay, S. Glenn, and M. Smith (2021) Evaluation of altimetry and model products in the Straits of Florida with high-frequency radar radial currents. *Ocean Remote Sensing Technologies: HF, Marine and GNSS-Based Radar*, IET, edited by E. Huang and E. Gill, pp. 117-144.2.
- Liu Y., Merz C.R., Weisberg R.H.**, Shay, L.K., Glenn, S., and Smith, M., (2021) 'An initial evaluation of high-frequency radar radial currents in the Straits of Florida in comparison with altimetry and model products'. Chapter 5 in *Ocean Remote Sensing Technologies: High Frequency, Marine and GNSS- Based Radar, IET*, E. Gill and W. Huang (eds.), pp. 117-146. ISBN 978-1-83953-162-0.
- Long, X., M.J. Widlansky, C.M. Spillman, A. Kumar, M. Balmaseda, P.R. Thompson, Y. Chikamoto, G.A. Smith, B. Huang, C.-S. Shin, M.A. Merrifield, W.V. Sweet, E. Leuliette, H.S. Annamalai, J.J. Marra and **G.T. Mitchum**, Seasonal forecasting skill of sea-level anomalies in a multi-model prediction framework. *Journal of Geophysical Research: Oceans*, 126, e2020JC017060. <https://doi.org/10.1029/2020JC017060>.
- Lovenduski, N. S., Swart, N. C., Sutton, A. J., Fyfe, J. C., McKinley, G. A., Sabine, C., & **Williams, N. L.** (2021) The Ocean Carbon Response to COVID-Related Emissions Reductions. *Geophysical Research Letters*, 48(6), 1–11. <https://doi.org/10.1029/2020GL092263>
- Malki, K, NA Sawaya, MJ Tisza, FH Coutinho, K Rosario, AJ Székely, **M Breitbart** (2021) Spatial and temporal dynamics of prokaryotic and viral community assemblages in a lotic system, Manatee Springs, Florida. *Applied and Environmental Microbiology*. 87, e00646-21.
- Marschalek, J.W.**, Zurli, L., Talarico, F., van de Fliertdt, T., Vermeesch, P., Carter, A., Beny, F., Bout-Roumazeilles, V., Sangiorgi, F., Hemming, S.R., Pérez, L.F., Colleoni, F., Prebble, J.G., van Peer, T.E., Perotti, M., **Shevenell, A.E.**, Browne, I., Kulhanek, D.K., Levy, R., Harwood, D., Sullivan, N.B., Meyers, S.R., Griffith, E.M., Hillenbrand, C.D., Gasson, E., Siegert, M.J., Keisling, B., Licht, K.J., Kuhn, G., Dodd, J.P., Boshuis, C., De Santis, L., McKay, R.M., and the IODP Expedition 374 Scientists (2021) A large West Antarctic Ice Sheet explains early Neogene sea-level amplitude. *Nature*, 600(7889), 450–455.4.
- McCay Merritt, B., J. Abbott, L. Anderson, C.L. Carothers, J.H. Cowan, J. Eagle, T. Essington, S. Larkin, **S. Murawski**, S. Powers, M. Smith, T. Yandle (2021) The Use of Limited Access Privilege Programs in Mixed-Use Fisheries. National Academies of Science, Engineering and Medicine (NASSEM). *National Academies Press*.
- McKenney, L., W. Hogarth, T. Sutton, D. Yoskowitz, R. Caffey, S. Joye, T. Ozgokmen, **S. A. Murawski** and C. Wilson (2021) The Gulf of Mexico: An overview. *Oceanography* 34(1):30–43, <https://doi.org/10.5670/oceanog.2021.115>.
- McCarthy, Matthew J.; Benjamin Dimmitt; Sebastian DiGeronimo; **Frank E. Muller-Karger** (2021) Forest Loss is Accelerating along US Gulf Coast. *Estuaries and Coasts*. DOI: 10.1007/s12237-021-01000-6.

APPENDIX A. PUBLICATIONS

- Medina M., Estes C., Best B., **Stallings C.D.**, Montes E., McEachron L.G., and **Muller-Karger F.E.** (2021) Reef-fish abundance, biomass, and biodiversity inside and outside no-take marine zones in the Florida Keys National Marine Sanctuary: 1999 –2018. *Oceanography* 34,42-51. 2021
- Medina, Megan, Cara Estes, Benjamin Best, **Christopher D. Stallings**, Enrique Montes, Lucas G. McEachron, **Frank E. Muller-Karger** (2021) Reef-Fish Abundance, Biomass, and Biodiversity Inside and Outside No-Take Marine Zones in the Florida Keys National Marine Sanctuary: 1999 –2018. *Oceanography*. Special Issue on the Marine Biodiversity Observation Network: An Observing System for Life in the Sea. <https://doi.org/10.5670/oceanog.2021.214>
- Merz, C.R., Y. Liu, and R.H. Weisberg** (2021) Sea surface current mapping with HF radar: A premier, *Ocean Remote Sensing Technologies: HF, Marine and GNSS-Based Radar*, IET, edited by E. Huang and E. Gill, pp. 95-116
- Meyers, Steven D., Laura Azevedo, and **Mark E. Luther** (2021) A Scopus-based bibliometric study of maritime research involving the Automatic Identification System. *Transportation Research Interdisciplinary Perspectives*, <https://doi.org/10.1016/j.trip.2021.100387>.
- Meyers, S.D., **M. E. Luther**, S. Landry, and M. Beck (2021) Using Logistic Regression to Model the Risk of Sewer Overflows Triggered by Compound Flooding with Application to Sea Level Rise. *Urban Climate*, <https://doi.org/10.1016/j.uclim.2020.100752>.
- Meyers, S.D., **M.E. Luther**, S. Ringuet, G. Raulerson, E. Sherwood, K. Conrad and G. Basili (2021) Ship Wakes in Tampa Bay. *Ocean and Coastal Management*, 211, [doi.org/ 10.1016/j.ocecoaman.2021.105749](https://doi.org/10.1016/j.ocecoaman.2021.105749).
- Meyer-Gutbrod, Erin, **Frank Muller-Karger**, the TOS Justice, Equity, Diversity, and Inclusion Committee (2021) FROM THE TOS JEDI COMMITTEE • TOS Expands Efforts to Promote Justice, Equity, Diversity, and Inclusion in the Ocean Sciences. *Oceanography*. Volume 34, No.1. Pages 9 -9 <https://doi.org/10.5670/oceanog.2021.109>.
- Montes, E., J.S. Lefcheck, E. Guerra-Castro, E. Klein, M.T. Kavanaugh, A.C.A. Mazzuco, G. Bigatti, C.A.M.M. Cordeiro, N. Simoes, E.C. Macaya, N. Moity, E. Londoño-Cruz, B. Helmuth, F. Choi, E.H. Soto, P. Miloslavich, and **F.E. Muller-Karger** (2021) Optimizing large-scale biodiversity sampling effort: Toward an unbalanced survey design. *Oceanography* 34(2), <https://doi.org/10.5670/oceanog.2021.216>.
- Muller-Karger, Frank**, Kavanaugh, Maria, Iken, Katrin, Montes, Enrique; Chavez, Francisco; Ruhl, Henry; Miller, Robert; Runge, Jeffrey; Grebmeier, Jackie; Cooper, Lee; Helmuth, Brian; Escobar-Briones, Elva; Hammerschlag, Neil; Estes, Maury; Pearlman, Jay; Hestir, Erin; Duffy, Emmett; Sarri, Kristen J.; Hudson, Charlotte; Landrum, Jason; Canonico, Gabrielle; Jewett, Libby; Newton, Jan; Kirkpatrick, Barbara; Anderson, Clarissa; Bates, Amanda; Sousa-Pinto, Isabel; Nakaoka, Masahiro; Soares, Joana (2021) Marine Life 2030: Forecasting Changes to Ocean Biodiversity to Inform Decision-Making: A Critical Role for the Marine Biodiversity Observation Network (MBON). *Marine Technology Society Journal*, Volume 55, Number 3, May/June 2021, pp. 84-85(2). DOI: <https://doi.org/10.4031/MTSJ.55.3.28>
- Murawski, S.A.**, C.B. Paris, T. Sutton, M. Cockrell, S. O’Farrell, J. Sanchirico, E. Chancellor, L. Perruso (2021) Impacts of *Deepwater Horizon* on Fish and Fisheries: What Have we Learned about Resilience and Vulnerability in a Coupled Human-Natural System? *Proceedings of the International Oil Spill Conference*, New Orleans, LA. (May 2021).

APPENDIX A. PUBLICATIONS

- Murawski, S. A., J.P. Kilborn, A. Bejarano, D. Chagaris, D. Donaldson, F. Hernandez, T. MacDonald, C. Newton, E. B. Peebles** and K.L. Robinson (2021) A synthesis of Deepwater Horizon impacts on coastal and nearshore living marine resources. *Frontiers in Marine Science* 7:594862. doi: 10.3389/fmars.2020.594862.
- Murawski, S.A.**, M. Grosell, C. Smith, T. Sutton, K. Halanych, R. Shaw and C.A. Wilson (2021) Impacts of Petroleum, Petroleum Components and Dispersants on Organisms and Populations. *Oceanography* 34(1):136–151, <https://doi.org/10.5670/oceanog.2021.122>.
- Murawski, S.A.** (2021) When you come to a fork in the road, take it! *ICES Journal of Marine Science* 78(7): 2359–2370. <https://doi.org/10.1093/icesjms/fsab138>.
- Naidu, R. M. Ford, P. Kench, **P. Hallock**, and P. Prasad (2021) Growth and fecundity of *Marginopora vertebralis* and *Amphistegina lobifera* in laboratory culture. *J. Foramin. Res.* 51(3),210-224, ISSN:0096-1191.
- National Academies of Sciences, Engineering, and Medicine Committee of Experts (A. Shevenell)** (2021) Mid-Term Assessment of Progress on the 2015 Strategic Vision for Antarctic and Southern Ocean Research. Washington, DC: The National Academies Press. <https://doi.org/10.17226/26338>.
- Pearlman, Jay, Pier Luigi Buttigieg, Mark Bushnell, Claudia Delgado, Juliet Hermes, Emma Heslop, Cora Hörstmann, Kirsten Isensee, Johannes Karstensen, Arno Lambert, Ana Lara-Lopez, **Frank Muller-Karger**, Cristian Munoz Mas, Francoise Pearlman, Peter Pissierssens, Rachel Przeslawski, Pauline Simpson, Jordan van Stavel, Ramasamy Venkatesan (2021) Evolving and Sustaining Ocean Best Practices to Enable Interoperability in the UN Decade of Ocean Science for Sustainable Development. *Frontiers in Marine Science*. Section Ocean Observation. <https://doi.org/10.3389/fmars.2021.619685>.
- Pérez, L.F., De Santis, L., McKay, R.M., Larter, R.D., Ash, J., Bart, P.J., Böhm, G., Brancatelli, G., Browne, I., Colleoni, F., Dodd, J.P., Geletti, R., Harwood, D.M., Kuhn, G., Sverre Laberg, J., Leckie, R.M., Levy, R.H., Marschalek, J., Mateo, Z., Naish, T.R., Sangiorgi, F., **Shevenell, A.E.**, Sorlien, C.C., van de Flierdt, T., and the International Ocean Discovery Program Expedition 374 Scientists(2021) Early and middle Miocene ice sheet dynamics in the Ross Sea: results from integrated core-log-seismic interpretation. *GSABulletin* 134 (1-2),348–370.
- Priscu, J. C.; Kalin, J.; Winans, J.; Campbell, T.; Siegfried, M.R.; Skidmore, M.; Dore, J.; Leventer, A.; Harwood, D.; Duling, D.; Zook, R.; Burnett, J.; Gibson, D.; Krula, E.; Mironov, A.; Roberts, G.; **Rosenheim, B. E.**; Christner, B.; Kasic, K.; Fricker, H.A.; Lyons, W.B.; Barker, J.; Bowling, M.; Collins, B.; Davis, C.; Gagnon, A.; Gardner, C.; Gustafson, C.; Li, W.; Michaud, A.B.; Patterson, M.O.; Tranter, M.; Venturelli, R.A.; Vick-Majors, T. (2021) Scientific Access into Mercer Subglacial Lake: Scientific Objectives, Drilling Operations and Initial Observations, *Annals of Glaciology* v. 62, n. 85-86. pp. 340-352. doi:10.1017/aog.2021.10.68.
- Pulster, E. L., A. E. Wichterman, S. M. Snyder, B. F. Da Silva, K. A. Costa, J. Aufmuth, **S. A. Murawski**, K. L. Deak, J. A. Bowden(2021) Detection of long chain per-and polyfluoroalkyl substances (PFAS) in the benthic Golden Tilefish (*Lopholatilus chamaeleonticeps*) and their association with microscopic hepatic changes. *Science of the Total Environment* 151143 <https://doi.org/10.1016/j.scitotenv.2021.151143>
- Pulster, E.L., S. Fogelson, B.E. Carr, J. Mrowicki, and **S.A. Murawski** (2021) Hepatobiliary PAHs and prevalence of pathological changes in Red Snapper. *Aquatic Toxicology* 230 105714 <https://doi.org/10.1016/j.aquatox.2020.105714>
- Qi, L., and **C. Hu** (2021) To what extent can Ulva and Sargassum be detected and separated in satellite imagery? *Harmful Algae*, 103, 102001, <https://doi.org/10.1016/j.hal.2021.102001>.

APPENDIX A. PUBLICATIONS

- Qi, L., S. Zhang, A. J. Manos, D. E. Hay, B. McCarter, M. Wang, K. Mikelsons, and **C. Hu** (2021) Satellite remote sensing of herring (*Clupea pallasii*) spawning events: A case study in the Strait of Georgia. *Geophysical Research Letters*, 48, e2020GL092126. <https://doi.org/10.1029/2020GL092126>.
- Qi, L., Y. Yao, D. E. English, R. Ma, J. Luft, and **C. Hu** (2021) Remote sensing of brine shrimp cysts in salt lakes. *Remote Sens. Environ.*, 266, 112695, <https://doi.org/10.1016/j.rse.2021.112695>.
- Quigg, A., J.W. Farrington, S. Gilbert, **S.A. Murawski**, and V. (2021) A decade of GoMRI dispersant science: Lessons learned and recommendations for the future. *Oceanography* 34(1):98–111, <https://doi.org/10.5670/oceanog.2021.119>.
- Quigg, A., M. Parsons, S. Bargu, K. Ozhan, K.L. Daly, S. Chakraborty, M. Kamalanathan, D. Erdner, S. Cosgrove, E. Buskey (2021) Marine phytoplankton responses to oil and dispersant exposures: Knowledge gained since the Deepwater Horizon oil spill. *Marine Pollution Bulletin* 164, 112074, <https://doi.org/10.1016/j.marpolbul.2021.112074>
- Rashid M. M., T. Wahl, **D. Chambers** (2021) Extreme sea level variability dominates coastal flood risk changes at decadal time scales. *Env. Res. Ltrrs.*, 16, <https://doi.org/10.1088/1748-9326/abd4aa>.
- Rogers, K.L.; Bosman, S.H.; Wildermann, N.; **Rosenheim, B.E.**; Montoya, J.P.; Hollander, D.H.; Zhao, T.; Chanton, J.P. (2021) Mapping spatial and temporal variation of seafloor organic matter $\delta^{13}\text{C}$ in the northern Gulf of Mexico following Deepwater Horizon oil spill. *Marine Pollution Bulletin*. v. 164. doi:10.1016/j.marpolbul.2021.112076.71.
- Romero IC**, Chanton JP, Brooks G, Bosman S, Larson RA, Harris A, Schwing P, Diercks A. (2021) Molecular markers of biogenic and oil-derived hydrocarbons in deep-sea sediments following the Deepwater Horizon spill. *Frontiers in Marine Science*, doi:10.3389/fmars.2021.637970
- Ruhl, H.A., J.A. Brown, A.R. Harper, E.L. Hazen, L. deWitt, P. Daniel, A. DeVogelaere, R.M. Kudela, J.P. Ryan, A.D. Fischer, **F.E. Muller-Karger**, and F.P. Chavez (2021) Integrating biodiversity and environmental observations in support of national marine sanctuary and large marine ecosystem assessments. *Oceanography* 34(2):142–155, <https://doi.org/10.5670/oceanog.2021.221>.
- Saba ,G. E., Bockus, A. B., C. T. Shaw and **B. A. Seibel** (2021) Combined effects of ocean acidification and elevated temperature on feeding, growth and physiological processes of Antarctic krill (*Euphausiasuperba*). *Mar. Ecol. Prog. Ser.* doi:10.3354/meps13715. Featured Article.
- Satterthwaite, Erin Vera, Nicholas J Bax, Patricia Miloslavich, Lavenia Ratnarajah, Gabrielle Canonico, Daniel C. Dunn, Samantha Elisabeth Simmons, Roxanne J Carini, Karen Evans, Valerie Allain, Ward Appeltans, Sonia Batten, Lisandro Benedetti-Cecchi, Anthony Bernard, Sky Bristol, Abigail L Benson, Pier Luigi Buttigieg, Leopoldo Cavaleri Gerhardinger, Sanae Chiba, Tammy Davies, J. Emmett Duffy, Alfredo Giron-Nava, Astrid Hsu, Alex C Kraberg, Raphael M Kudela, Dan Lear, Enrique Montes, **Frank Edgar Muller-Karger**, Todd D O'Brien, David Obura, Pieter Provoost, Sara Pruckner, Lisa-Maria Rebelo, Elizabeth Selig, Olav Sigurd Kjesbu, Craig Starger, Rick D Stuart-Smith, Marjo Kristiina Vierros, John Waller, Lauren V. Weatherdon, Tristan P Wellman, Anna Milena Zivian (2021) Establishing the foundation for the global observing system for marine life. *Frontiers in Marine Science*. DOI:10.3389/fmars.2021.737416.
- Sawaya, NA, N Baran, S Mahank, A Varsani, D Lindell, **M Breitbart** (2021) Adaptation of the polony technique to quantify the Gokushovirinae, a diverse group of single-stranded DNA phage. *Environmental Microbiology*. 23, 6622-6636.

APPENDIX A. PUBLICATIONS

- Sayre, Roger, Kevin Butler, Keith Van Graafeiland, Sean Breyer, Dawn Wright, Charlie Frye, Deniz Karagulle, Madeline Martin, Jill Cress, Tom Allen, Rebecca J. Allee, Rost Parsons, Bjorn Nyberg, Mark J. Costello, Peter Harris, and **Frank Muller-Karger** (2021) A Global Ecological Classification of Coastal Segment Units to Complement Marine Biodiversity Observation Network (MBON) Assessments. *Oceanography*. Special Issue on the Marine Biodiversity Observation Network: An Observing System for Life in the Sea. <https://doi.org/10.5670/oceanog.2021.219>.
- Sayre, R., K. Butler, K. VanGraafeiland, S. Breyer, D. Wright, C. Frye, D. Karagulle, M. Martin, J. Cress, T. Allen, R. Allee, R. Parsons, B. Nyberg, M. Costello, **F. Muller-Karger**, and P. Harris (2021) Earth's Coastlines. In Wright, D. and C. Harder (eds). GIS For Science, Volume 3: Maps for Saving the Planet. Esri Press, Redlands, California. Skidmore, Andrew K., Nicholas C. Coops, Elnaz Neinavaz, Abebe Ali1,4, Michael E. Schaepman, Marc Paganini, W. Daniel Kissling, Petteri Vihervaara, Roshanak Darvishzadeh, Hannes Feilhauer, Miguel Fernandez, Néstor Fernández, Noel Gorelick, Ilse Geizendorffer, Uta Heiden, Marco Heurich, Donald Hobern, Stefanie Holzwarth, Frank E. Muller-Karger, Ruben Van DeKerchove, Angela Lausch, Pedro J Leitão, Marcelle C. Lock, Caspar A. Múcher, Brian O'Connor, Duccio Rocchini, Woody Turner, Jan-Kees Vis, Tiejun Wang, Martin Wegmann, Vladimir Wingate. (2021). Priority list of biodiversity metrics to observe from space. *Nature Ecology and Evolution*. <https://doi.org/10.1038/s41559-021-01451-x>
- Schijf, J. and **R.H. Byrne** (2021) Speciation of yttrium and the rare earth elements in seawater: Review of a 20-year analytical journey. *Chemical Geology*. <https://www.sciencedirect.com/science/article/abs/pii/S0009254121004228229>.
- Schmid, S., D. Chaput, **M. Breitbart**, R Hines, S Williams, HK Gossett, SD Parsi, R Peterson, RA Whittaker, A Tarver, KM Scott (2021) Dissolved inorganic carbon accumulating complexes from autotrophic bacteria from extreme environments. *Journal of Bacteriology*. 203, e00377-21.
- Schockman, Katelyn M. and **Robert H. Byrne** (2021) Spectrophotometric Determination of the Bicarbonate Dissociation Constant in Seawater. *Geochimica et Cosmochimica Acta* 300: 231-245. <https://doi.org/10.1016/j.gca.2021.02.008>
- Seibel, B. A.**, Andres, A., Birk, M. A., Burns, A., Shaw, C. T., Timpe, A. and C. Welsh (2021) Oxygen supply capacity breathes new life into the critical oxygen partial pressure (Pcrit). *Journal Experimental Biology*. 224, jeb242210. doi:10.1242/jeb.242210.
- Seibel, B. A.**, Andres, A., Birk, M. A., Shaw, C. T., Timpe, A. and C. Welsh (2021) Coming up for air: response to Farrell, Mueller and Seymour. Correspondence. *J. Exp. Biol.* doi:10.1242/jeb.243148.
- Sharp, J.D. and **R.H. Byrne**. Excess alkalinity in carbonate system reference materials (2021) *Marine Chemistry* 233: 103965. <https://doi.org/10.1016/j.marchem.2021.103965226>.
- Shen, Z.; **Rosenheim, B.E.**; Törnqvist, T.E.; Lang, A. (2021) Engineered continental-scale rivers can drive changes in the carbon cycle. *AGU Advances* v. 2, e2020AV000273. doi:10.1029/2020AV000273
- Shi, J., and **C. Hu** (2021) Evaluation of ECOSTRESS Thermal Data over South Florida Estuaries. *Sensors*, 21,4341. <https://doi.org/10.3390/s21134341>
- Sieber, M., **Conway, T. M.**, de Souza, G. F., Hassler, C.S., Ellwood, M.J. and Vance, D. (2021) Isotopic fingerprinting of biogeochemical processes and iron sources in the iron-limited surface Southern Ocean. *Earth and Planetary Science Letters*. 567, 116967.3.

APPENDIX A. PUBLICATIONS

- Siegel, D.A. et al. (2021) An operational overview of the Export Processes in the Ocean from RemoTe Sensing (EXPORTS) Northeast Pacific field deployment. *Elementa: Science of the Anthropocene*, 9(1): 00107.
- Smith, J.A.; Hillenbrand, C.-D.; Subt, C.; **Rosenheim B.E.**; Fredrichs, T.; Ehrmann,W.; Andersen, T.J.; Wacker, L.; Mackinson, K.; Anker, P.; Venables, E.J.; Nicholls, K.J. (2021) History of Larsen C Ice Shelf reconstructed from sub-ice shelf and offshore sediments, *Geology*. doi:10.1130/G48503.1.67.\
- Smith, M; Glenn, S; **Merz, C.R.**; Liu, Y; Weisberg, R; Shay, L; Howden, S; Knap, A. (2021) 'A Unified Approach to HF Radar Radial Quality Control for Understanding Gulf Ocean Systems'. MTS/IEEE OCEANS 2021 - San Diego, CA.
- Soliman, Mostafa A., Sameh B. El Kafrawy, Rashad E.M. Said, Samy A. Saber, **Frank E. Muller-Karger**, Geomatics approach to assess nesting habitat of green turtles Wadi El Gemal, Red Sea, Egypt. *The Egyptian Journal of Remote Sensing and Space Science*. <https://doi.org/10.1016/j.ejrs.2021.09.001>.
- Solo-Gabriele, H., T. Fiddaman, C. Mauritzen, **C. Ainsworth**, D.M. Abramson, I. Berenshtein, E.G. Chassignet, S.S. Chen, R.N. Conmy, C.D. Court, W.K. Dewar, J.W. Farrington, M.G. Feldmann, A.C. Ferguson, E. Fetherston-Resch, D. French-McCay, C. Hale, R. He, V.H. Kourafalou, K. Lee, Y.Liu, M. Masi, E.S. Maung-Douglass, S.L. Morey, **S.A. Murawski**, C.B. Paris, N. Perlin, E.L. Pulster, A. Quigg, D.J. Reed, J.J. Ruzicka, P.A. Sandifer, J.G. Shepherd, B.H. Singer, M.R. Stukel, T.T. Sutton, **R.H. Weisberg**, D. Wiesenburg, C.A. Wilson, M. Wilson, K.M. Wolk, C. Yanoff, and D. Yoskowitz (2021) Towards integrated modeling of the Long-term impacts of oil spills, *Marine Policy*, 131, 104554, <https://doi.org/10.1016/j.marpol.2021.104554>.
- Solo-Gabriele, H.,...**S.A. Murawski** and 40 co-authors (2021) Modeling of the long-term impacts of oil spills. *Marine Policy* (in press).
- Stallings C.D.**, Freytes-Ortiz I.M., Plafcan M.M., and Langdon C. (2021) Inducible defenses in an estuarine bivalve do not alter predator handling times and are not affected by elevated pCO₂. *Marine Ecology Progress Series* 679, 73-84.
- Stammerjohn, S., Scambos, T. A., Adusumilli, S., Barreira, S., Bernhard, G. H., Bozkurt, D., **et al.** (2021) Antarctica and the Southern Ocean. *Bulletin of the American Meteorological Society*, 102(8), S317–S356. <https://doi.org/10.1175/BAMS-D-21-0081.1>
- Steiner, Z., A. Sarkar, X. Liu, W.M. Berelson, J.F. Adkins, E.P. Achterberg, P. Sabu, S. Prakash, P.N. Vinaychandran, **R.H. Byrne**, and A.V. Turchyn (2021) On calcium-to-alkalinity anomalies in the North Pacific, Red Sea, Indian Ocean and Southern Ocean. *Geochimica et Cosmochimica Acta* 303, 1–14. <https://doi.org/10.1016/j.gca.2021.03.027>
- Sun, D., T. Pan, S. Wang, and **C. Hu** (2021) Linking phytoplankton absorption to community composition in Chinese marginal seas. *Progress in Oceanography*, 192, 102517. <https://doi.org/10.1016/j.pocean.2021.102517>
- Sutton, A. J., **Williams, N. L.**, & Tilbrook, B. (2021) Constraining Southern Ocean CO₂ Flux Uncertainty Using Uncrewed Surface Vehicle Observations. *Geophysical Research Letters*, 48(3), 1–9. <https://doi.org/10.1029/2020GL091748>
- Suzuki, K.; Yamamoto, M.; **Rosenheim, B.E.**; Omori, T.; Polyak, L. (2021) New radiocarbon estimation method for carbonate-poor sediments: A case study of ramped pyrolysis 14C dating of postglacial deposits from the Alaskan margin, Arctic Ocean. *Quaternary Geology*. v. 66. doi:10.1016/j.quageo.2021.101215.

APPENDIX A. PUBLICATIONS

- Takeshita Y., J.K. Warren, X. Liu, R.S. Spaulding, **R.H. Byrne**, B.R. Carter, M.D. DeGrandpre, A. Murata, and S. Watanabe (2021) Consistency and stability of purified meta-cresol purple for spectrophotometric pH measurements in seawater. *Marine Chemistry* 236: 104018.
<https://www.sciencedirect.com/science/article/pii/S0304420321001031228>.
- Thompson, P.R., Matthew J. Widlansky, Benjamin D. Hamlington, Mark A. Merrifield, John J. Marra, **Gary T. Mitchum** and William Sweet, Rapid increases and extreme months in projections of United States high-tide flooding. *Nature Climate Change*, <https://doi.org/10.1038/s41558-021-01077-8>.
- Thompson, P.R., M.J. Widlansky, E. Leuliette, W. Sweet, D.P. Chambers, B.D. Hamlington, S. Jevrejeva, J.J. Marra, M.A. Merrifield, **G.T. Mitchum**, R.S. Nerem, Sea level variability and change [in “State of the Climate in 2020”]. *Bull. Amer. Met. Soc.*, 102(8), S169-S172, <https://doi.org/10.1175/BAMS-D-21-0083.1>.
- Triñanes, J., **C. Hu**, N.F. Putman, M.J. Olascoaga, F.J. Beron-Vera, S. Zhang, and G.J. Goni (2021) An integrated observing effort for Sargassum monitoring and warning in the Caribbean Sea, tropical Atlantic, and Gulf of Mexico. Pp. 68–69 in *Frontiers in Ocean Observing: Documenting Ecosystems, Understanding Environmental Changes, Forecasting Hazards*. E.S. Kappel, S.K. Juniper, S. Seeyave, E. Smith, and M. Visbeck, eds, *A Supplement to Oceanography* 34(4), <https://doi.org/10.5670/oceanog.2021.supplement.02-26>.
- Trinanes, J., N. F. Putman, G. Goni, **C. Hu**, and M. Wang (2021) Monitoring pelagic Sargassum inundation potential for coastal communities. *J. Operational Oceanography*, DOI: 10.1080/1755876X.2021.1902682
- van Putten, Elizabeth Ingrid, Rachel Kelly, Rachel Dawn Cavanagh, Eugene J Murphy, Annette Breckwoltd, Stephanie Brodie, Christopher Cvitanovic, Mark Dickey-Collas, Lisa Maddison, Jess Melbourne-Thomas, Haritz ARrizabalaga, Kumiko Azetsu-Scott, Lynnath Elizabeth Beckley, Richard Bellerby, Andrew Constable, Greg Cowie, Karen Evans, Marion Glaser, Julie Hall, Alistair James Hobday, Nadine M Johnston, Joel Llopiz, Franz Mueter, **Frank Edgar Muller-Karger**, Kevin Weng, Dieter Alfred Wolf-Gladrow, José C Xavier (2021) A decade of incorporating social sciences in the Integrated Marine Biosphere Research project (IMBeR): Much done, much to do? *Frontiers in Marine Science*. doi: 10.3389/fmars.2021.662350.
- Vaz, Sofia Ana; Odirilwe Selomane; Laurence Jones; Arjan Gosal S.; Guy Ziv; **Frank Muller-Karger**; Enrique Montes; and Maria Vallejos (2021) The journey to monitoring ecosystem services: Are we there yet? *Ecosystem Services*. <https://doi.org/10.1016/j.ecoser.2021.101313>
- Vecchio, J.L., J. Ostroff, and **E.B. Peebles** (2021) Isotopic characterization of lifetime movement by two demersal fishes from the northeastern Gulf of Mexico. *Marine Ecology Progress Series* 657:161–172
- Venturelli, R.A.; Vick-Majors, T.; Collins, B.; Gagnon, A.; Kasic, K.; Kurz, M.; Li,W.; Priscu, J.C.; Roberts, M.; **Rosenheim, B.E.**; and the SALSA Science Team (2021) A framework for transdisciplinary radiocarbon research: Use of natural-level and elevated-level ¹⁴C in Antarctic field research. *Radiocarbon*. v. 63, n. 5. pp. 1555-1568. doi:10.1017/RDC.2021.55. 69.
- Wang, M., and **C. Hu** (2021) Satellite remote sensing of pelagic Sargassum macroalgae: The power of high resolution and deep learning. *Remote Sens. Environ.*, 264, 112631,
<https://doi.org/10.1016/j.rse.2021.112631>
- Wang, Q., Y. Lu, **C. Hu**, Y. Hu, M. Zhang, J. Jiao, J. Xiong, Y. Liu, and Z. Zhang (2021) Discrimination of Biomass-Burning Smoke From Clouds Over the Ocean Using MODIS Measurements. *IEEE Trans. Geosci. & Remote Sens.*, <https://doi.org/10.1109/TGRS.2021.3084042>

APPENDIX A. PUBLICATIONS

- Wåhlin, A., **A.G.C. Graham**, B. Queste, K. Hogan, L. Boehme, K. Heywood, R. Larter, E. Pettit, J.S. Wellner (2021) Pathways and modification of warm water flowing beneath Thwaites ice shelf, West Antarctica. *Science Advances*, 7 (15), abd7254.
- Westerholm, D.G., C.H. Ainsworth, C.H. Barker, P.G. Brewer, J.W. Farrington, D. Justic, V.H. Kourafalou, **S.A. Murawski**, J.G. Shepherd, and H.M. Solo-Gabriele (2021) Preparedness, Planning and Advances in Operational Response. 34(1):212–227, <https://doi.org/10.5670/oceanog.2021.127>.
- Xie, S., J. Chen, T.H. Dixon, **R.H. Weisberg**, and M.A. Zumberge (2021) Offshore Sea Levels Measured With an Anchored Spar-Buoy System Using GPS Interferometric Reflectometry, *J. Geophys. Res. Oceans*, 126, e2021JC017734. <https://doi.org/10.1029/2021JC017734>
- Yang, Y., J. C. McWilliams, X.S. Liang, H. Zhang, **R.H. Weisberg**, **Y. Liu**, and D. Menemenlis (2021) Spatial and temporal characteristics of the submesoscale energetics in the Gulf of Mexico, *J. Phys. Oceanogr.*, 51(2), 475-489, <https://doi.org/10.1175/JPO-D-20-0247>.
- Yang, S.-C., Kelly, R., Bian, X., **Conway, T. M.**, Huang, K.-F., Ho, T.-Y., Keil, R. G., Moffett, J. W. and John, S. G. (2021) Biogeochemical Cycling of Dissolved and Particulate Nickel Isotopes in the Water Columns of the Eastern Tropical North Pacific Oxygen Deficient Zone. *Geochim. Cosmochim. Acta*. 309, 235-250.6.
- Yurganov, Leonid, **Frank Muller-Karger**, Ira Leifer (2021) Enhanced Methane Emission from Arctic Seas in Winter: Satellite Data. In: *New Prospects in Environmental Geosciences and Hydrogeosciences*. ISBN978-3-030-72542-6. DOI: 10.1007/978-3-030-72543-3_10
- Zhang, Y., **D. Chambers**, and X. Liang (2021) Regional Trends in Southern Ocean eddy kinetic energy. *J. Geophys. Res. –Oceans*, 126, e2020JC016973, <https://doi.org/10.1029/2020JC016973>.
- Zhang, Y., & **Hu, C.** (2021) Ocean temperature and color frontal zones in the Gulf of Mexico: Where, when, and why. *Journal of Geophysical Research: Oceans*, 126, e2021JC017544. <https://doi.org/10.1029/2021JC017544>
- Zhu, Y., **G.T. Mitchum**, K.S. Doran, D.P. Chambers and X. Liang (2021) Distinguishing between regression model fits to global mean sea level reconstructions. *Journal of Geophysical Research: Oceans*, 126, e2021JC017347, <https://doi.org/10.1029/2021JC017347>.
- Zhu, Y., **G.T. Mitchum**, P.R. Thompson and G.S.E. Lagerloef, Diagnosis of large-scale, low-frequency sea level variability in the northeast Pacific ocean. *Journal of Geophysical Research: Oceans*, 126, e2020JC016682, <https://doi.org/10.1029/2020JC016682>.

APPENDIX B. ACTIVE RESEARCH AWARDS

Appendix B. Active Research Awards

Award PI Name	Sponsor Name	Total Expense	Awd Begin Date	Awd End Date
Ainsworth, Cameron	University of Florida	73,519.11	06/01/2020	12/31/2021
Ainsworth, Cameron	Florida Inst. Of Oceanography	62,213.36	02/01/2019	03/03/2023
Barnes,Brian B	Kent State University	97,189.41	5/1/2016	4/30/2021
Barnes,Brian B	National Aeronautics & Space Admin.	75,343.53	01/01/2017	12/31/2021
Barnes,Brian B	FL Fish & Wildlife Research Inst.	56,620.01	09/22/2018	12/31/2020
Barnes,Brian B	National Aeronautics & Space Admin.	7,074.19	08/01/2020	07/31/2022
Bonin,Jennifer A	National Aeronautics & Space Admin.	123,643.50	03/01/2017	02/28/2022
Breitbart,Mya E	US-Israel Binational Science Fdn.	279.25	09/01/2015	08/31/2020
Breitbart,Mya E	National Science Foundation	101,746.98	07/01/2016	06/30/2023
Breitbart,Mya E	National Science Foundation FL Fish & Wildlife Conservation	81,964.37	09/15/2016	08/31/2022
Breitbart, Mya	Comm.	29,717.84	09/14/2020	06/30/2021
Breitbart, Mya	National Aeronautics & Space Admin.	8,732.87	08/18/2014	08/17/2021
Buck,Kristen N	National Science Foundation	86,047.54	09/14/2020	06/30/2025
Buck,Kristen N	National Science Foundation	50,903.73	09/01/2018	08/31/2022
Buck,Kristen N	National Science Foundation FL Fish & Wildlife Conservation	9,412.24	01/01/2019	12/31/2022
Buck,Kristen N	Comm.	122,359.24	09/14/2020	06/30/2021
Byrne,Robert H	National Science Foundation	48,748.33	02/01/2017	01/31/2022
Byrne,Robert H	National Science Foundation	68,539.32	01/01/2017	01/31/2022
Byrne,Robert H	National Science Foundation	34,175.51	02/15/2020	01/31/2023
Byrne,Robert H	National Science Foundation	27,344.28	02/01/2021	01/31/2024
Chambers,Don P	National Aeronautics & Space Admin.	28,240.68	02/16/2016	08/31/2020
Chambers,Don P	University of Miami	30,611.83	07/01/2017	09/30/2021
Chambers,Don P	Arizona State University	16,479.13	08/22/2017	08/21/2020
Chambers,Don P	University of Central Florida	1,068.12	09/01/2017	08/31/2020
Chambers,Don P	NASA Jet Propulsion Laboratory	79,525.40	05/27/2019	09/30/2023
Chambers,Don P	National Aeronautics & Space Admin.	150,613.12	05/07/2020	05/06/2024
Chambers,Don P	National Aeronautics & Space Admin.	21,638.38	09/01/2020	06/30/2025
Chambers,Don P	University of Miami	12,910.13	12/01/2020	11/30/2022
Chambers,Don P	NASA Jet Propulsion Laboratory	14,461.17	01/25/21	01/24/2023

APPENDIX B. ACTIVE RESEARCH AWARDS

Award PI Name	Sponsor Name	Total Expense	Awd Begin Date	Awd End Date
Conway, Timothy Mark	National Science Foundation	164,298.13	08/15/2017	07/31/2022
Conway, Timothy Mark	National Science Foundation	101,508.89	09/01/2018	08/31/22
Daly, Kendra L	University of Rhode Island	43,384.35	05/01/2020	09/30/2022
Dixon, Jacqueline Eaby	US Geological Survey	1,412,519.00	08/01/2017	07/31/2022
Galperin, Boris	University of Miami	5,413.02	07/01/2017	09/30/2021
Galperin, Boris	University of Miami	10,894.90	12/01/2020	11/30/2022
Gilbert, Sherryl	Consortium for Ocean Leadership	486.50	01/01/2018	06/30/2020
Graham, Alistair	Nat'l Oceanic & Atmospheric Admin.	20,121.07	10/01/2020	09/30/2025
Grasty, Sarah E	FL Fish & Wildlife Research Institute	52,120.80	07/01/21	06/30/2022
Grasty, Sarah E	Ocean Conservancy	4,824.39	10/23/2020	01/31/2021
Grasty, Sarah E	Tampa Bay Estuary Program	1,981.76	01/08/2021	12/31/2021
Greely, Teresa M	National Marine Sanctuary Foundation	3,137.59	02/01/2021	07/31/2021
Hapke, Cheryl	Nat'l Oceanic & Atmospheric Admin.	51,764.93	10/01/2020	09/30/2025
Hu, Chuanmin	National Aeronautics & Space Admin.	38,295.33	03/01/2015	02/28/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	143,620.88	01/01/2017	12/31/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	19,152.46	02/21/2017	02/20/2023
Hu, Chuanmin	Pennsylvania State University	15,227.52	02/24/2017	02/23/2022
Hu, Chuanmin	Univ. of Southern Mississippi	23,134.16	06/01/2017	05/31/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	44,945.96	02/12/2018	12/31/2020
Hu, Chuanmin	National Aeronautics & Space Admin.	296,353.25	07/15/2019	07/14/2022
Hu, Chuanmin	Global Science & Technology	84,235.53	06/01/2019	05/31/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	40,803.71	09/01/2019	08/31/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	23,615.58	09/01/2019	08/31/2022
Hu, Chuanmin	National Aeronautics & Space Admin.	84,186.00	11/01/2019	10/31/2022
Hu, Chuanmin	FL Fish & Wildlife Research Institute	647.14	10/03/2019	06/30/2020
Hu, Chuanmin	FL Fish & Wildlife Research Institute	6,914.13	12/12/2019	05/31/2021
Hu, Chuanmin	National Aeronautics & Space Admin.	9,396.35	09/02/2020	09/01/2023
Hu, Chuanmin	FL Fish & Wildlife Conservation Comm.	111,964.10	09/14/2020	06/30/2022

APPENDIX B. ACTIVE RESEARCH AWARDS

Award PI Name	Sponsor Name	Total Expense	Awd Begin Date	Awd End Date
Kilborn,Joshua	National Oceanic & Atmospheric Adm.	112,683.17	09/01/2017	08/31/2022
Kilborn,Joshua P	Gulf of Mexico Fishery Mgmt. Council	26,683.02	12/30/2019	12/31/2020
Landry, Shawn	Tampa Bay Estuary Program	10,469.79	01/01/2019	12/31/2020
Lembke,Chad E	SE Coastal Ocean Observing Region	64,199.75	06/01/2016	11/30/2021
Lembke,Chad E	Florida International University	36,556.62	09/01/2018	08/31/2021
Lembke,Chad E	SE Coastal Ocean Observing Region FL Fish & Wildlife Conservation	40,820.10	07/01/2019	06/30/2021
Lembke,Chad E	Comm. FL Fish & Wildlife Conservation	54,360.39	10/28/2019	09/01/2020
Lembke,Chad E	Comm.	3,566.22	06/01/2020	08/31/2021
Lembke,Chad E	Florida Atlantic University FL Fish & Wildlife Conservation	26,389.07	09/25/2020	06/30/2021
Lembke, Chad	Comm.	110,811.36	09/14/2020	06/30/2021
Lembke, Chad	Texas A&M University	36,967.53	06/01/2016	05/31/2022
Lembke, Chad	Nat'l Oceanic & Atmospheric Admin.	110,919.00	10/01/2020	09/30/2025
Liu,Yonggang	Gulf of Mexico Research Initiative	18,493.74	01/01/2018	06/30/2020
Luther,Mark E	Greater Tampa Marine Adv. Council	24,586.29	04/09/2004	03/06/2024
Luther,Mark E	SE Coastal Ocean Observing Region	29,175.85	06/01/2016	05/31/2022
Luther,Mark E	Texas A&M University	43,940.34	06/01/2016	05/31/2022
Luther,Mark E	Tampa Bay Estuary Program	9,153.67	01/01/2019	12/31/2020
Luther,Mark E	SE Coastal Ocean Observing Region	8,476.30	04/01/2019	03/31/2021
Luther, Mark	Nat'l Oceanic & Atmospheric Admin.	33,931.00	10/01/2020	09/30/2025
Luther,Mark E	SE Coastal Ocean Observing Region	29,185.93	01/15/2021	01/31/2022
Luther,Mark E	Pinellas County (Florida)	149.92	02/05/2021	01/31/2022
Merz,Clifford R	National Academies of Sciences	86,888.48	11/01/2018	06/30/2022
Mitchum,Gary T	University of Hawaii	15,708.21	09/01/2017	08/31/2022
Montes Herrera,Enrique	National Aeronautics & Space Admin.	61,534.55	01/02/2018	08/31/2022
Muller-Karger,Frank E	National Aeronautics & Space Admin.	267,657.16	08/18/2014	08/17/2021
Muller-Karger,Frank E	Texas A&M University	42,522.00	06/01/2016	05/31/2021
Muller-Karger,Frank E	National Science Foundation	55,426.24	08/15/2017	07/31/2022
Muller-Karger,Frank E	Oregon State University	32,437.93	01/18/2018	01/17/2022
Muller-Karger,Frank E	National Science Foundation	147,227.18	08/15/2018	07/31/2022
Muller-Karger,Frank E	University of Puerto Rico	41,705.74	02/01/2019	01/31/2023

APPENDIX B. ACTIVE RESEARCH AWARDS

Award PI Name	Sponsor Name	Total Expense	Awd Begin Date	Awd End Date
Muller-Karger, Frank E	Nat'l. Oceanic & Atmospheric Admin.	208,880.38	09/01/2019	08/31/2022
Muller-Karger, Frank E	National Aeronautics & Space Admin.	29,877.77	10/10/2019	10/10/2022
Muller-Karger, Frank E	Florida International University	17,471.99	11/01/2020	10/31/2023
Murawski, Steven	Nat'l Fish & Wildlife Foundation	49,481.47	01/01/2015	12/02/2020
Murawski, Steven	Consortium for Ocean Leadership	179,964.65	01/01/2018	06/30/2020
Murawski, Steven	Consortium for Ocean Leadership	3,136.79	01/01/2018	06/30/2020
Murawski, Steven	Texas A&M Research Foundation	27,800.39	10/01/2017	10/31/2020
Murawski, Steven	Tampa Bay Estuary Program	136,401.86	09/01/2019	12/31/2021
Murawski, Steven	Nat'l Oceanic & Atmospheric Admin.	195,927.97	09/01/2019	03/31/2022
Murawski, Steven	Nat'l Oceanic & Atmospheric Admin.	176,076.07	10/01/2020	09/30/2025
Otis, Daniel B	National Aeronautics & Space Admin. FL Fish & Wildlife Conservation	34,496.72	10/11/2019	10/10/2022
Otis, Daniel B	Comm. FL Fish & Wildlife Conservation	12,682.31	01/09/2020	06/30/2021
Otis, Daniel B	Comm. FL Fish & Wildlife Conservation	12,810.65	01/09/2020	06/30/2021
Otis, Daniel B	Comm.	23,948.33	03/05/2021	06/30/2021
Peebles, Ernst B	University of Miami	155,424.44	10/01/2015	09/30/2021
Peebles, Ernst B	Florida Gulf Coast University	17,290.45	12/09/2020	04/28/2023
Peebles, Ernst	Florida Inst. Of Oceanography	162,765.45	03/01/2019	08/31/2022
Romero, Isabel C	National Academy of Sciences	75,934.00	09/01/2019	08/31/2021
Romero, Isabel C	Nova SE University	416.16	09/01/2019	08/31/2022
Rosenheim, Brad	National Science Foundation	19,170.40	06/15/2016	05/31/2021
Rosenheim, Brad	Natioan Science Foundation	41,045.83	09/15/2016	08/31/2021
Rosenheim, Brad E	National Science Foundation	46,485.84	03/15/2017	02/28/2023
Rosenheim, Brad E	National Science Foundation	115,519.70	08/01/2019	07/31/2022
Rosenheim, Brad (Ryan)	Columbia University	18,028.70	08/01/2015	01/31/2021
Seibel, Brad A	University of Washington	71,637.19	09/01/2018	08/31/2021
Seibel, Brad A	University of Washington	31,556.99	09/01/2018	08/31/2021
Seibel, Brad A	University of Washington	39,778.20	12/01/2018	11/30/2021
Seibel, Brad A	University of Washington	24,359.10	12/01/2018	11/30/2021
Seibel, Brad A	Florida Atlantic University	15,659.04	07/22/2020	07/21/2024
Shevenell, Amelia	National Science Foundation	78,051.87	08/01/2018	04/30/2022
Shevenell, Amelia (Ryan)	Columbia University	17,999.80	08/01/2015	01/31/2021

APPENDIX B. ACTIVE RESEARCH AWARDS

Award PI Name	Sponsor Name	Total Expense	Awd Begin Date	Awd End Date
Shevenell, Amelia	National Science Foundation	30,184.40	03/15/2017	02/28/2023
Stallings, Christopher	FL Fish & Wildlife Commission	8,480.36	01/30/2020	10/31/2023
Stallings, Christopher	Nat'l Oceanic & Atmospheric Admin.	6,748.13	09/01/2020	08/31/2022
Stallings, Christopher	FL Dept. of Ag & Consumer Services	57,945.88	12/14/2020	09/30/2021
Weisberg, Robert H	SE Coastal Ocean Observing Region	54,823.16	06/01/2016	05/31/2022
Weisberg, Robert H	SE Coastal Ocean Observing Region	365,439.93	06/01/2016	11/30/2021
Weisberg, Robert H	Pinellas County Restore Act	72,583.03	11/29/2016	12/31/2020
Weisberg, Robert H	National Academy of Sciences	224,370.70	01/01/2018	12/31/2021
Weisberg, Robert H	Tampa Bay Estuary Program	20,222.36	06/01/2018	09/30/2021
Weisberg, Robert H	SE Coastal Ocean Observing Region	49,080.60	04/01/2019	03/31/2021
Weisberg, Robert H	Mote Marine Labs	64,516.41	09/01/2019	08/31/2024
Weisberg, Robert H	FL Fish & Wildlife Conservation			
Weisberg, Robert H	Comm.	20,674.05	12/19/2019	05/31/2021
Weisberg, Robert	FL Fish & Wildlife Conservation			
Weisberg, Robert	Comm.	126,691.55	09/14/2020	06/30/2021
Weisberg, Robert	Nat'l Oceanic & Atmospheric Admin.	26,629.35	10/01/2020	09/30/2025

APPENDIX C. EVENTS IN THE NEWS

APPENDIX C. EVENTS IN THE NEWS

- December 15, 2021, [USF will seek \\$80 million for 'centerpiece' building on St. Pete campus](#)
- December 15, 2021, [New study finds USFSP's economic impact is nearly \\$443 million annually](#)
- December 14, 2021, [College of Marine Science, Innovation District unveil new facilities](#)
- December 14, 2021, [USF drone ships used for high-definition mapping of gulf floor](#)
- December 14, 2021, [St. Pete Mayor Rick Kriseman: Why I love the 'Burg](#)
- December 14, 2021, [US team mapping ecologically vulnerable coastal areas off Florida](#)
- December 13, 2021, [First USF Uncrewed Mission to Map Vulnerable Coastal Areas in Florida](#)
- December 11, 2021, [Opening of Florida Flood Hub to help St. Pete become a mecca for marine science](#)
- December 10, 2021, [The governor's wish-list for resilience spending is big on flooding, not climate change](#)
- December 10, 2021, [USF launches project to map shallow sea floors in Tampa Bay and Gulf of Mexico](#)
- December 9, 2021, [Fabrican dispositivo para estudiar a fondo las inundaciones y realizar mapas que permitan evitarlo](#)
- December 9, 2021, [USF launches coastal mapping mission with remote-controlled boat](#)
- December 9, 2021, [USF College of Marine Science unveils automated coast-mapping vessel](#)
- December 9, 2021, [USF launches autonomous boat to map Bay Area coast](#)
- December 3, 2021, [Offshore oil drilling regulations would strengthen under federal legislation](#)
- November 27, 2021, [Chief Resiliency Officer named to oversee Florida's climate challenges](#)
- November 23, 2021, [St. Pete ocean science center tops USF's legislative wish list](#)
- November 11, 2021, [USFSP hopes to make a splash with new oceanographic science center](#)
- November 10, 2021, [Innovation District event sheds light on its evolution, new scientific discoveries](#)
- November 10, 2021, [Kriseman discusses his trip to Scotland for world climate change conference](#)
- November 4, 2021, [Red tide blooms could still return during winter months, researchers say](#)
- October 31, 2021, [Smithsonian scientist lauded for pioneering novel 'reef health' approach](#)
- October 28, 2021, [A majority of the land in the USF Forest Preserve is not suitable for development, a report says](#)
- October 27, 2021, [Much of USF Forest Preserve not suited for development, consultant says](#)
- October 22, 2021, [Red tide in Sarasota and Manatee remains patchy. Could a new bloom be on the way?](#)
- October 17, 2021, [100 years later, Tarpon Springs Hurricane reminds Tampa Bay it can happen here](#)
- October 15, 2021, [It's official: Maritime and Defense Tech Hub on the way, tenants announced](#)
- October 12, 2021, [A seaweed explosion is besieging the Caribbean - 'we don't expect this to end anytime soon'](#)
- October 7, 2021, [Oil slicks and algae blooms marring Venezuela's largest lake are visible from space](#)
- October 6, 2021, ['It is there pretty much forever': Huntington Beach oil spill may permanently affect birds](#)
- October 4, 2021, [A century of calm: Tampa continues avoiding major hurricanes](#)
- October 2, 2021, [Some news outlets now call Dr. Monty Graham, head of Florida Institute of Oceanography, the "king of sting](#)
- October 1, 2021, [Moon's orbital wobble can add to sea-level rise and flooding](#)
- September 29, 2021, [Besieged by seaweed, Caribbean scrambles to make use of the stuff](#)
- September 27, 2021, [Florida Legislature can do even more to make us resilient to climate change and sea level rise | Column](#)
- September 20, 2021, [Red tide and algae blooms: Florida waters in crisis](#)

APPENDIX C. EVENTS IN THE NEWS

September 12, 2021, [TWiV 804: A tangled web of viruses with Mya Breitbart](#)

September 11, 2021, [Deepwater Horizon: Oysters off the Gulf of Mexico plagued with tissue abnormalities after 2010 oil spill](#)

September 9, 2021, [I'm a science storyteller. Before COVID misinformation, I used to know why.](#)

September 2, 2021, [10 years later: Scientists learn long-term impact of Deepwater Horizon spill](#)

August 27, 2021, [Red Tide is still floating out there and could return. But when?](#)

August 23, 2021, [Can science solve the seaweed problem on Mexican beaches?](#)

August 20, 2021, [MegaTV climate change interview with Dr. Frank Muller Karger](#)

August 19, 2021, [U.S. Rep. Castor: The time to act on the climate crisis is now](#)

August 18, 2021, [Fred, like storms before it, peaked in the Gulf of Mexico. Why is that?](#)

August 17, 2021, [Red tide levels are the lowest in weeks around Anna Maria Island, new water samples show](#)

August 13, 2021, [Seaweed raises a stink on Fla. beaches: 'Just get away'](#)

August 10, 2021, [Red Tide is further offshore. Thank the wind and sea currents.](#)

August 7, 2021, [Red tide 'rock stars' talk facts and future at Tiger Bay event](#)

August 4, 2021, [Why so many dead fish are washing up on Florida's beaches](#)

July 30, 2021, [Red Tide expected to stay around Pinellas coast this weekend](#)

July 26, 2021, [No, there isn't 'scientific consensus' on red tide impact from Piney Point](#)

July 24, 2021, [Red tide prediction map shows worsening conditions on Pinellas County beaches](#)

July 21, 2021, [Sewage spills around Tampa Bay add fuel to red tide, scientists say](#)

July 21, 2021, [Florida Gov. DeSantis Surveys Impacts And Provides Updates On Red Tide Bloom](#)

July 19, 2021, [Red Tide Leaves Hundreds of Tons of Fish Dead in Florida's Tampa Bay](#)

July 19, 2021, [Sunny day flooding could get a lot worse in St. Petersburg, study shows](#)

July 17, 2021, [Tampa Bay has Red Tide questions. Here are some answers](#)

July 15, 2021, [St. Pete mayor calls for state help during emergency meeting on red tide](#)

July 14, 2021, [Algae Abound Along Florida Coast](#)

July 15, 2021, [The moon's natural wobble alters Earth's tides. With climate change, that's bad news.](#)

July 14, 2021, [Moon 'wobble' and climate change could mean 'double whammy' of flooding in 2030s, NASA warns](#)

July 14, 2021, [New projections for rapid increases in high-tide flooding for St. Petersburg & elsewhere](#)

July 13, 2021, [At Least 600 Tons Of Dead Fish Have Washed Up Along Tampa Bay's Shore](#)

July 12, 2021, [Red tide continues and conditions are ripe to get worse](#)

July 9, 2021, [Red tide, dead fish persist in Tampa Bay region](#)

July 8, 2021, [St. Pete crews collect more than 6 tons of dead fish as red tide continues](#)

July 7, 2021, [Scientists predict record year for sargassum](#)

June 30, 2021, [Beyond coronavirus: the virus discoveries transforming biology](#)

June 29, 2021, [Why Did the Surfside Condo Tower Collapse? Here Are All the Theories](#)

June 28, 2021, [Unraveling the mysteries of trace elements in the oceans](#)

June 28, 2021, ['We take this report very seriously': Study predicts more tidal flooding in St. Pete over next 10 years](#)

June 24, 2021, ['We take this report very seriously': Study predicts more tidal flooding in St. Pete over next 10 years](#)

June 22, 2021, [Climate change debate in Tampa Bay area is evolving from denial to action](#)

APPENDIX C. EVENTS IN THE NEWS

June 21, 2021, Reef Robots. Predicting Marine Life Like Weather. Meet the Ocean of 2030

June 18, 2021, 'The beaches are open': Florida welcomes tourists amid red tide outbreak

June 17, 2021, 'This is not 2018,' Gov. DeSantis says of Red Tide in Pinellas

June 17, 2021, Gov. DeSantis hosts red tide roundtable in St. Petersburg

June 17, 2021, Governor DeSantis Holds Roundtable to Discuss Florida's Efforts to Combat Red Tide

June 16, 2021, An expert's view on how 3 people were swept to their deaths in Apollo Beach

June 14, 2021, Expert: Variety of sources could be enhancing red tide bloom

June 9, 2021, The Effects of Nutrient and Light on Phytoplankton Communities: Implications for Carbon Export

June 7, 2021, Three massive concentrations of sargassum heading on to Quintana Roo beaches

June 7, 2021, Manatee deaths spike as seagrass disappears

May 31, 2021, Intelligent Robots Could be the Best Choice to Mine the Deep Seafloor

May 30, 2021, Nature may ruin your summer beach trip to Cancun — and we're not talking about COVID

May 28, 2021, Seaweed is good for the environment, except when nutrients cause massive algal blooms

May 25, 2021, What - or who - is most likely to blame for the bounty of sargassum that keeps coming?

May 25, 2021, Samples suggest Piney Point discharge is diluting, USF researchers say

May 24, 2021, USF scientists announce initial findings from Piney Point research effort

May 24, 2021, USF researchers release initial findings on Piney Point leak

May 24, 2021, Contamination from Piney Point has diluted in Tampa Bay, researchers say

May 24, 2021, 'Initial pulse' of nutrient-rich water from Piney Point has dissipated, USF research shows

May 20, 2021, Hundreds of Florida Manatees Dying Because of Starvation, Human Pollution

May 12, 2021, New Florida law seeks to protect state from sea level rise

May 12, 2021, Gov. Ron DeSantis signs coastal resiliency bill

May 3, 2021, University of South Florida shows evolution of pollution from Piney Point

April 29, 2021, Will the Tampa Bay area be ready to respond to another crisis like Piney Point? | Column

April 29, 2021, Cruise ships' fix for dirty smoke led to water pollution in South Florida ports, study finds

April 22, 2021, There Are Massive Chemical Dumps In The Gulf We Know Almost Nothing About

April 22, 2021, Academy of Science, Engineering and Medicine of Florida Elects 15 Members

April 18, 2021, Adapt with nature, not against it

April 14, 2021, USF will play valuable role in clean up effort

April 12, 2021, Forecasting what comes next from Piney Point for Tampa Bay

April 10, 2021, Wastewater from Piney Point has Tampa Bay on edge for possible red tide, algae bloom

April 9, 2021, Scientists measure ocean currents underneath 'Doomsday Glacier'

April 9, 2021, First-Ever Observations From Under Antarctica's 'Doomsday Glacier' Are Bad News

April 9, 2021, Measuring Piney Point's Impacts On Tampa Bay Will Take Time, USF Researchers Say

April 8, 2021, Scientists studying potential effects on Tampa Bay from Piney Point discharge

April 8, 2021, Legislation to fight sea level rise goes to Florida governor

April 7, 2021, Piney Point updates: USF scientists launch first research cruise into Tampa Bay

April 7, 2021, USF Team of Researchers To Test Tampa Bay Waters Near Piney Point

April 7, 2021, USF scientists testing the waters to study effects of Piney Point reservoir release

April 7, 2021, Long-term Plan for Piney Point: County Votes To Inject Treated Phosphate Wastewater into Aquifer

April 7, 2021, Sea level rise bills pass Senate unanimously

APPENDIX C. EVENTS IN THE NEWS

- April 6, 2021, USF scientists begin searching for Piney Point environmental impacts in Tampa Bay, Port Manatee**
- April 6, 2021, USF researchers to study Piney Point leak's environmental impact**
- April 6, 2021, Scientists Monitor Water Quality Near Piney Point Leak As Threat Of Algal Blooms Remains**
- April 6, 2021, USF launches research cruise to study Piney Point's environmental impact**
- April 6, 2021, As Piney Point drains, concerns grow over potential impact of wastewater in Bay**
- April 5, 2021, Millions of gallons of wastewater released from Piney Point will cause ecological damage**
- April 5, 2021, '50,000 bags of fertilizer:' What could Piney Point do to Tampa Bay?**
- April 2, 2021, When will Israel's beaches recover from the tar spill?**
- March 28, 2021, Rocks at bottom of deep ocean provide marine food chains with vital nutrients**
- March 27, 2021, Brown tide of sargassum threatens Caribbean tourist beaches**
- March 24, 2021, 3 Times as Many Red Snapper Doesn't Mean Tripled Quotas**
- March 23, 2021, How a Yorkshire scientist's deep sea discovery may help protect the food chain**
- March 22, 2021, Amazon destruction linked to the largest belt of algae on the planet**
- March 17, 2021, Study finds significant liver damage in Gulf of Mexico red snapper**
- March 13, 2021, Warming Trends: The Value of Natural Land, a Climate Change Podcast and Traffic Technology in Hawaii**
- February 26, 2021, Florida lawmakers reveal their 'most robust agenda' on flooding, sea-level rise**
- February 26, 2021, Florida lawmakers unveil new plan to combat sea level rise**
- February 11, 2021, Is the Southern Ocean absorbing or emitting carbon dioxide?**
- January 31, 2021, College of Marine Sciences receives \$3 million gift**
- January 26, 2021, USF has received a \$3 million gift to Advance USF that will benefit students from the University of South Florida College of Marine Science**
- January 25, 2021, USF receives \$3 million gift to benefit the College of Marine Science**
- January 25, 2021, Latest multimillion-dollar donation to USF St. Pete will boost marine sciences**
- January 25, 2021, USF College of Marine Science receives \$3 million gift**
- January 25, 2021, USF College of Marine Science gifted \$3 million endowment**
- January 14, 2021, How red tide is impacting estuaries & beach conditions in SWFL**