ANNUAL REPORT 2018

Department of Marine Sciences

Franklin College of Arts and Sciences

UNIVERSITY OF GEORGIA

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FROM THE DEPARTMENT HEAD

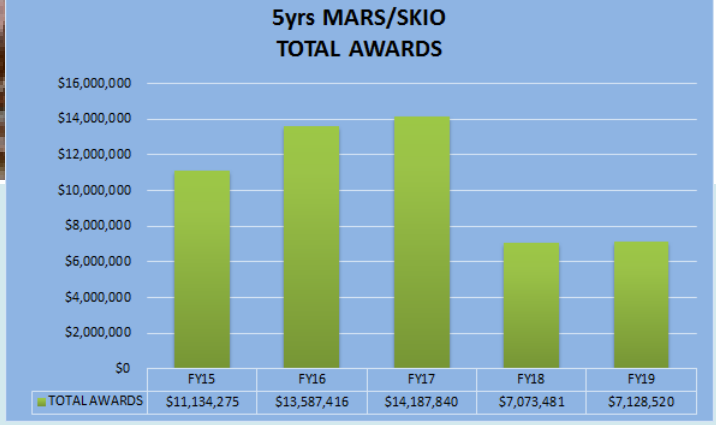
Daniela Di Iorio

I am pleased to introduce our first annual report that documents our departmental productivity and highlights our ongoing interdisciplinary approach to understanding the marine system. During this past year we have grown (we welcome our new faculty, staff and students), we have shrunk (we wish all our graduates success in their future endeavors) and we have changed in other ways, but through it all many milestones were achieved. Our students and faculty are recognized with prestigious awards as a result of their scholarly accomplishments and have published important findings in major journals. It is not possible to highlight the 61 peer reviewed manuscripts written and 115 conference presentations given in 2018 but some of the research highlighted in this report gives a sample of the kind of work that our faculty, postdocs and students are engaged in and shows the broad range of marine science research and teaching carried out in our department.

We acknowledge the new grants and in kind funding for 2018 that we have received from state, private foundations and national funding agencies. We are grateful to our sponsors and to our donors for their support. Our awards for each of the past two years reached over $7 million in extramural grants and provides a solid foundation for our faculty to carry out their research. Students are attracted to our programs because of the excellent research and mentorship opportunities provided and in 2018 we graduated 5 MS and 3 PhD students. One of our senior graduate students, David Miklesh, a PhD candidate in the Department of Marine Sciences, passed away on June 28, 2018. The entire department was devastated by the loss of our friend and colleague. David arrived at UGA Fall 2012 and was immediately recognized for his attention to detail, hard work, great outdoorsmanship and musical talent. In Dec 2018, the University of Georgia awarded a posthumous PhD to David in recognition of his scholarly work that he had completed as part of the requirements for his degree. We are grateful to his family for their donation in his memory which will be used to support our graduate students in their future research endeavors.

Our oceans and coastlines are changing and our future depends on our persistence, creativity and innovation. Together we can meet the needs of our state, nation and the world and I am proud to serve as the Head these past 4 years.

FUNDED GRANTS FOR 2018



ALBER, Merryl
Georgia Coastal Research Council 2018, GEORGIA DEPARTMENT OF NATURAL RESOURCES $48,621
Georgia Coastal Research Council 2019, GEORGIA DEPARTMENT OF NATURAL RESOURCES $46,086
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $2,366,700

BURD, Adrian B
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $676,200

CASTELAO, Renato M
Oceanic transport of meltwater in the Labrador Sea, NATIONAL AERO & SPACE ADMIN, $171,903.50
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $338,100
The impact of the El Nino-Southern Oscillation on sea surface temperature fronts in the California and Humboldt Current Systems, NATIONAL AERO & SPACE ADMIN $124,890

ALEXANDER, Clark
Mapping and Imaging Georgia's Artificial Reefs for Resource Management and Public Information. US DEPARTMENT OF COMMERCE $77,917
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $338,100
Supplement to Sedimentary Petrology and Geological Framework Investigations in the Southeastern U.S. Outer Continental Shelf, US DEPARTMENT OF COMMERCE $17,086
Attached Periphytic Algae Cultivation and Analysis, GEORGIA SOUTHERN UNIVERSITY $21,308

BRANDES, Jay A
Collaborative Research: Constraining the source of oceanic dissolved black carbon using compound-specific stable carbon isotopes, NATIONAL SCIENCE FOUNDATION $120,803

BUCK, Clifton
Collaborative Research: US GEOTRACES PMT: Quantification of Atmospheric Deposition and Trace Element Fractional Solubility, NATIONAL SCIENCE FOUNDATION $466,135

EDWARDS, Catherine
S&AS: INT: COLLAB: Goal-driven Marine Autonomy with Application to Fisheries Science and Management, NATIONAL SCIENCE FOUNDATION $250,000
Hurricane Gliders in the South Atlantic Bight, NOAA $220,000
Soundscape Metrics to Support Marine Protected Area Management. NOAA/ NAVY $200,000
SECOORA glider observatory Year 3, NOAA $34,469

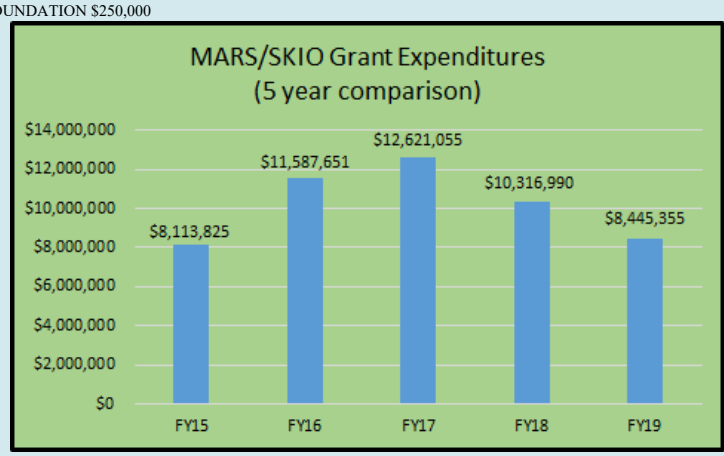
DI IORIO, Daniela
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $676,200

DIAZ, Julia M
Sloan Foundation Fellowship, SLOAN FOUNDATION $65,000

HARVEY, Elizabeth
Oceanographic Instrumentation - 2018 - RV Savannah, NATIONAL SCIENCE FOUNDATION $49,485

MEILE, Christof D
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $338,100

MORAN, Mary A
Genetic and Chemical Basis of Bacterial Community Assembly in Phycospheres (supplement), SIMONS FOUNDATION, $10,000



HOPKINSON, Brian M
Collaborative Research: Antarctic Diatom Proteorhodopsins: Characterization and a Potential Role in the Iron- Limitation Process, NATIONAL SCIENCE FOUNDATION, $226,807
Sensitivity of Gray's Reef Invertebrates and Algae to Ocean Acidification and Implications for the Ecosystem, GEORGIA SEA GRANT, $52,463

JOYE, Samantha B
Collaborative Research: Probing the Metabolic and Electrical Interactions of Cable Bacteria in Anoxic Sediments, NATIONAL SCIENCE FOUNDATION, $369,682
ECOGIG-2 Sample Analysis and Synthesis, GULF OF MEXICO RESEARCH INITIATIVE $458,333
From hot vents to not quite cold seeps: exploring connectivity between geology, chemistry and microbiology in the Gulf of California, SCHMIDT OCEAN INSTITUTE $3,150,000

MEDEIROS, Patricia M
LTER: Georgia Coastal Ecosystems IV, NATIONAL SCIENCE FOUNDATION $338,100
2018 Hurricane Season: Influence on organic carbon input and biodegradation in marsh-dominated estuaries, NATIONAL SCIENCE FOUNDATION $127,146
Oceanic Transport of Meltwater in the Labrador Sea, NATIONAL AERO & SPACE ADMIN, $171,903.50

OHNEMUS, Daniel
NSFGEO-NERC: Collaborative Research: Using Time-series Field Observations to Constrain an Ocean Iron Model, NATIONAL SCIENCE FOUNDATION $79,500

SAVIDGE, Dana
Collaborative Research: Characterization of Langmuir Supercells in the Coastal Ocean, NATIONAL SCIENCE FOUNDATION, $298,707
Southeast Coastal Ocean Observing Regional Association (SECOORA) Hurricane Supplemental-Repairs, SE COASTAL OCEAN OBSVG REG ASN $32,724
Workshop on Subtropical Shelf-Western Boundary Current Interactions, NATIONAL SCIENCE FOUNDATION $24,966
Purchase and Redeployment of Presently Leased and Deployed High Frequency Radars for IOOS purposes within SECOORA, SE COASTAL OCEAN OBSVG REG ASN $190,275
SECOORA - Year 3, Coordinated monitoring prediction and assessment… HF Radar component, SE COASTAL OCEAN OBSVG REG ASN $91,000

SAVIDGE, William B
International Workshop on Subtropical Shelf Ecosystems - Western Boundary Current Interactions (Re-submission), NATIONAL SCIENCE FOUNDATION $24,966

TEARE- KETTER, Catherine A
Online learning fellow, UGA OFFICE OF ONLINE LEARNING $3500

YAGER, Patricia L
Georgia Climate Project - Anderson, RAY C ANDERSON FOUNDATION $35,000

$51,084,876

total expenditures over past 5 years

$41,141,366

total awards over past 5 years

Foundation support over past 5 years: $4,890

2018 MARINE SCIENCE GRADUATES

Mary Kate Rogener – PhD, "An assessment of anthropogenic impacts on marine methane and nitrogen cycling in the water column and sediments with an emphasis on greenhouse gas dynamics", Fall 2018

Awards: John A. Knauss Marine Policy Fellowship, 2018

Publications:

Zhuang, G. , Montgomery, A. , Sibert, R. J., Rogener, M. , Samarkin, V. A. and Joye, S. B. (2018), Effects of pressure, methane concentration, sulfate reduction activity, and temperature on methane production in surface sediments of the Gulf of Mexico. *Limnol. Oceanogr.*, 63: 2080-2092.

Fulweiler, Wally & M. Heiss, Elise & Rogener, Mary-Kate & E. Newell, Slivia & LeCleir, Gary & M. Kortebein, Sarah & Wilhelm, Steven. (2015). Examining the impact of acetylene on N-fixation and the active sediment microbial community. *Frontiers in Microbiology*. 6. 418.

Rogener, M.K., Bracco, A., Hunter, K.S., Saxton, M.A. and Joye, S.B., 2018. Long-term impact of the Deepwater Horizon oil well blowout on methane oxidation dynamics in the northern Gulf of Mexico. *Elem Sci Anth,* 6(1), p.73.

Yu Wang – MS, "Modeling near-bottom flow and sediment resuspension in the northern Gulf of Mexico", Summer 2018

Presentations:

Gulf of Mexico Oil Spill & Ecosystem Science Conference, New Orleans LA, Feb 5-8, 2018. Modeling sediment resuspension and methane distribution in the deep Gulf of Mexico under the effect of near-seabottom flow.

GA Water Resources Conference Athens GA, April 19-20, 2017. Model study of near-seabottom flow and its effect on sediment resuspension.

Southeastern Biogeochemistry Symposium Athens GA, April 1-2, 2017. Deep-water sediment resuspension in the northern Gulf of Mexico and the effect of bottom topography.

Graduate School 2016 Alumni of Distinction Awards Reception, October, 2016. Seafloor and sub-seafloor flow at cold seeps in the Gulf of Mexico.

David Miklesh – PhD, Posthumous, Fall 2018

Awards: Travel Grant, International Erosion Control Association (IECA, 2016) and USGS internship (Summer 2018)

Presentations:

DNR Climate Conference on Jekyll Islang GA November 2016. Hydrologic Controls on Porewater Salinity in Southeastern Salt Marsh.

GSA Southeastern Conference in Columbia SC April 2016. Hydrologic Controls on Porewater Salinity in Southeastern Salt Marsh.

IECA Environmental Connection in San Antonio TC Feb 2016. Hydrologic Controls on Porewater Salinity in Southeastern Salt Marsh.

IECA Environmental Connection in San Antonio February 2016. Physical, hydrological, and biological processes controlling Porewater Salinity distributions in Southeastern Salt Marsh.

Publications:

Miklesh, D. and Meile, C. 2018. Porewater salinity in a southeastern United States salt marsh: controls and interannual variation. *PeerJ* 6:e5911

Peterson, R.N., Meile, C. Peterson, L.E., Carter, M. and Miklesh, D. 2019. Groundwater discharge dynamics into a salt marsh tidal river. *Estuarine, Coastal and Shelf Science* 218, 324-333.

Matheus Fagundes – MS, "Exposure of nearshore organisms to climate stressors in the upwelling region of Monterey bay", Fall 2018

Christine Burns – MS, "Historical analysis of 70 years of salt marsh change at three coastal lter sites", Fall 2018

Awards: John A. Knauss Marine Policy Fellowship, 2019

Presentations:

CERF Conference, Providence, Rhode Island. November 2017.Historical analysis of marsh extent at three LTER site along the US Atlantic coast.

Carolina da Silva – MS, "Mississippi river plume variability in the gulf of Mexico based on modis-aqua and smap observations", Summer 2018

Awards: Accepted to prestigious WE-Heraeus Summer School of Physics of the Ocean in Germany during first year.

Publications:

da Silva, Carolina & Castelao, Renato. (2018). Mississippi River Plume Variability in the Gulf of Mexico from SMAP and MODIS-Aqua Observations. *Journal of Geophysical Research: Oceans,* 123, 6620-6638

Yeajin Jung – PhD, "Modeling growth and production dynamics of spartina alterniflora", Spring 2018

Awards:Travel award for the 4th of annual SEED workshop by Korean-American Scientists and Engineers Association (KSEA)

Presentations:

Society of Wetland Scientist, Athens, GA, October 2015. Variability of carbon partitioning an non-structural carbohydrate (NSC) in Spartina alterniflora measures in a Georgia salt marsh

Publications:

Jung, Yeajin & Burd, Adrian. (2017). Seasonal changes in above-and below-ground non-structural carbohydrates (NSC) in Spartina alterniflora in a marsh in Georgia, *USA. Aquatic Botany*. 140.

Trevor Richards – MS, "A spatial and temporal investigation of estuarine and shelf flows on the Georgia coast", Fall 2018

Awards: Departmental Award for Outstanding Teaching Assistant

Presentations:

CERF Conference, Providence, Rhode Island. November 2017. Estuarine and coastal shelf transport processes with experimental and modeling comparisons on the Georgia coast.

WELCOME NEW FACULTY AND STAFF

Amanda Spivak
Associate Professor

"My research focuses on coastal ecosystem ecology. I seek to develop an integrated understanding of ecological and biogeochemical processes in order to refine the role of estuaries and wetlands in the global carbon cycle and predict the likelihood of recovery from human disturbances. I use innovative geochemical tracer approaches, including stable isotopes and lipid biomarkers, in combination with mesocosm and landscape-scale experiments to quantify carbon pathways, transformations, and fate."

Daniel Ohnemus
Assistant Professor

"My research focuses on the geochemistry of marine particles. I use chemical techniques and models to study how trace elements (like iron, cadmium, titanium) enter and move through the oceans and how they are used by marine organisms. These elements help control ocean ecology and can be used as tracers for global-scale processes like natural and human-derived inputs."

Beverly Vantine
Student Affairs Professional

"I joined the office in September 2018 and work closely with the Graduate Coordinator and Undergraduate Coordinator to manage administrative aspects of Marine Sciences degree programs. I also manage the department's social media and website, and am currently developing the department's Alumni database to help facilitate partnerships with our alumni."

2018 GRADUATE STUDENT AWARDS

Hilde Oliver

Caitlin Amos

Chandler Countryman

Jeremy Schreier

Linquan Mu

Leslie Townsell

Caitlin Amos
NASA Earth and Space Fellowship
EPOC 2018 Best Student Presentation
Department of Marine Sciences Teaching & Outreach Award

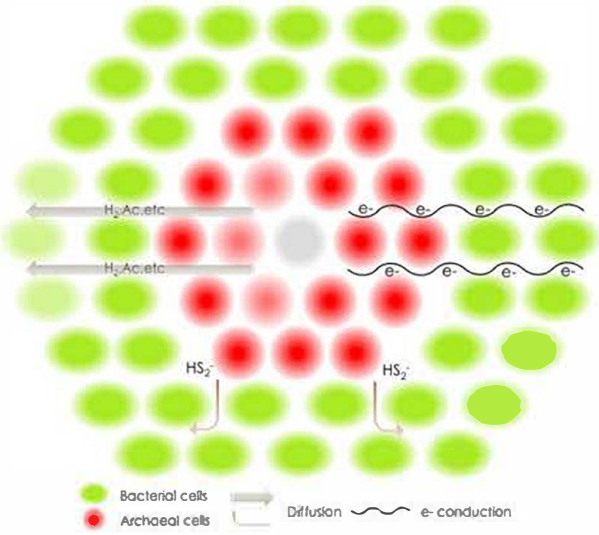
Jeremy Schreier
NSF Graduate Research Fellowship

Leslie Townsell
Osborn Graduate Fellowship

Hilde Oliver
Department of Marine Sciences Research Award

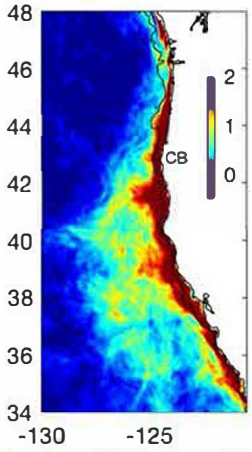
Chandler Countryman
Department of Marine Sciences Teaching & Outreach Award

Linquan Mu
Department of Marine Sciences Teaching & Outreach Award



He, X. , Chadwick, G. , Kempes, C. , Shi, Y. , McGlynn, S. , Orphan, V. and Meile, C. (2019), Microbial interactions in the anaerobic oxidation of methane: model simulations constrained by process rates and activity patterns. *Environ Microbiol*, 21: 631-647.

Anaerobic oxidation of methane (AOM) acts as a significant sink for methane and plays an important role in the global carbon cycle. A microbial consortia carries out this reaction, but the electron transfer between the archaeal and bacterial partners remains enigmatic. Reactive transport model simulations of various mechanisms, including diffusive exchange of soluble electron shuttles and direct electron transfer were compared with measurements of microbial activity within the consortia to identify likely mechanisms. This work advances our understanding of the controls of AOM and the ability of microorganisms to run a current between them through live 'wires'.

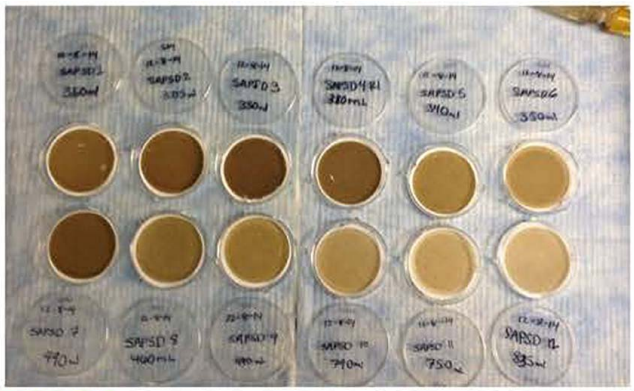


Castelao, R. M., & Luo, H. (2018), Upwelling jet separation in the California current system. *Scientific Reports* (Nature Publisher Group), 8, 1-8.

The coastal ocean off the US West Coast is characterized by strong currents and upwelling, which fuel a productive ecosystem. The upwelling jet generally separates from the coast during summer moving offshore, exporting nutrients and carbon to the open ocean. This process was thought to be controlled by interactions of the flow with topography. Here, we demonstrated that jet separation is instead driven primarily by spatial variations in winds. This indicates that future changes in wind forcing can result in substantial changes in the distribution of nutrient-rich upwelled waters that ultimately control biological productivity off the US West Coast.

Vorobev, A. , Sharma, S. , Yu, M. , Lee, J. , Washington, B. J., Whitman, W. B., Ballantyne, F. , Medeiros, P. M. and Moran, M. A. (2018), Identifying labile DOM components in a coastal ocean through depleted bacterial transcripts and chemical signals. *Environ Microbiol*, 20: 3012-3030.

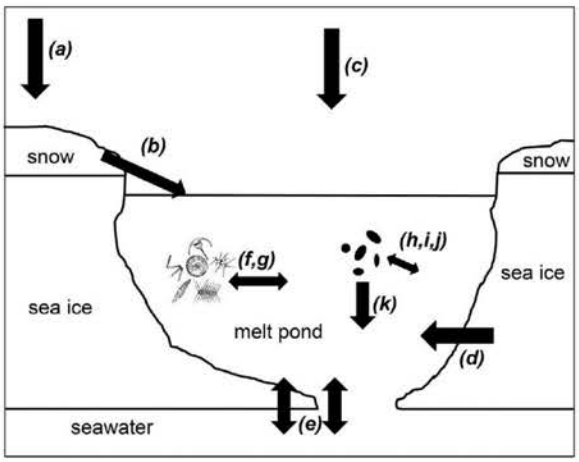
A quarter of Earth's annual photosynthesis is processed by the marine bacteria that live in the surface ocean. Bacteria carry out this very important step in the global carbon cycle by recognizing compounds dissolved in seawater and transporting them into their cells for energy and nutrition. To learn more about which dissolved compounds are important, we examined bacterial gene expression patterns in communities of bacterial living in coastal waters. The bacteria survive by using a wide variety of different molecules, ranging from organic sulfur compounds, to small organic acids and sugars. The picture here shows the collected samples in garbage bags (to keep out the sunlight) incubating at Marsh Landing.



Liu, Q., Tolar, B. B., Ross, M. J., Cheek, J. B., Sweeney, C. M., Wallsgrove, N. J., Hollibaugh, J. T. (2018). Light and temperature control the seasonal distribution of thaumarchaeota in the South Atlantic bight. *The ISME journal*, 12(6), 1473–1485.

Previous work on the Georgia, USA coast revealed consistent mid-summer peaks in the abundance of Thaumarchaeota accompanied by spikes in nitrite concentration. We found that the abundance of ammonia oxidizing organisms increased at inshore and nearshore stations starting in July and peaked in August. The bloom did not extend onto the mid-shelf. Our analysis of environmental data suggests that Thaumarchaeota abundance in the SAB is controlled primarily by photoinhibition (inshore-offshore gradient) and secondarily by water temperature (seasonality). Experiments with enrichment cultures where all other variables are held constant verified the strong dependence of ammonia oxidation rates on temperature. Instantaneous rates of ammonia oxidation in field samples appear to controlled primarily by Thaumarchaeota abundance and ammonium availability.

RESEARCH HIGHLIGHTS OF SELECTED PUBLICATIONS

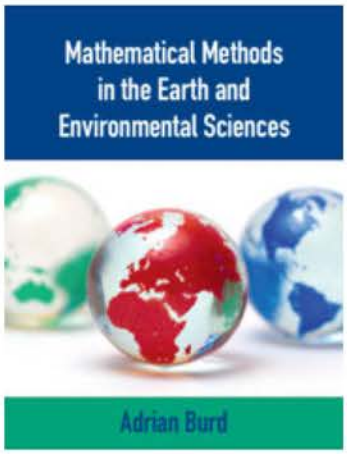


Marsay, C.M., **A.Aguilar-Islas, J.N. Fitzsimmons, M.Hatta, Jensen, L.T, John, S.G., Kadko, D., Landing, W.M., Lanning, N.T., Morton, P.L., Pasqualini, A., Rauschenberg, S., Sherrell, R.M., Shiller, A.M., Twining, B.S., Whitmore, L.M., Zhang, R.,** Buck, C.S., **(2018), Dissolved and particulate trace elements in late summer Arctic melt ponds.** ***Marine Chemistry*****, 204, 70-85.**

Because of warming in the Arctic, sea ice extent and thickness is being reduced and the amount of multi-year ice has plummeted. During summer, melted ice accumulates in depressions in the sea ice and forms melt ponds. These ponds create unique environments which impact the ways that biogeochemical cycles operate. Our results indicate that melt ponds represent a transitional environment in which some elements carried to the ice from falling dust and pollution undergo physical and/or chemical changes before their release to the surface ocean. As a result, the ongoing changes in sea ice areal extent, thickness, and melt season length are likely to influence the availability of atmospheric element inputs to organisms in the surface Arctic Ocean. Our unique dataset represents a snapshot of melt pond biogeochemistry from late summer to early fall and reveals some of the different controls on dissolved and particulate elements in melt ponds, and can provide a guide for future studies of biogeochemistry during the evolution of these transient features.

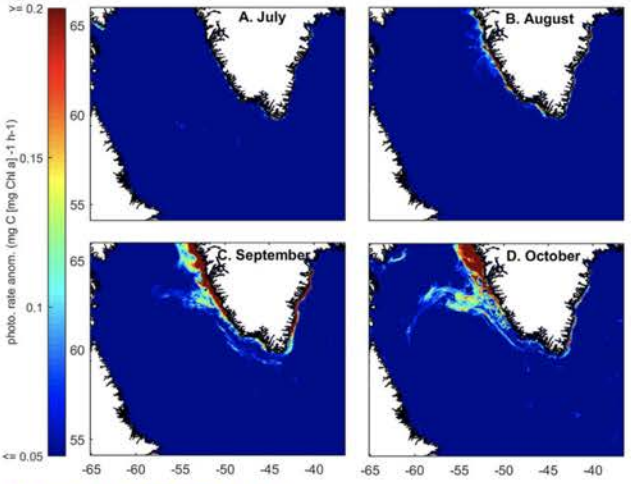
Frischer, M.E., **Fowler, A.E., Brunson, J.F., Walker, A.N., Powell, S.A., Price, A.R., Bulski, K., Frede, R.L., and Lee, R.F. (2018). Pathology, effects and transmission of black gill in commercial penaeid shrimp from the South Atlantic Bight.** ***Journal of Shellfish Research,*** **37(1): 149-158.**

Penaeid shrimp support one of the most valuable commercial fisheries in the US Southeast. In the South Atlantic Bight region including Georgia and South Carolina, however, the shrimp fishery has been in dramatic decline. Coincident with this decline has been severe outbreaks of shrimp black gill (sBG), a condition in shrimp that results in darkened and damaged gills. Our previous studies have identified the cause of this condition is an apostome ciliate that elicits the innate immune response of the shrimp. In this study we describe pathology associated with sBG that results in shrimp morbidity and mortality. We also demonstrate that the sBG causing ciliate is infectious and that other crustacean species may harbor the ciliate and serve as a reservoir for new infections. These studies support the conclusion that BG is negatively impacting the penaeid shrimp fishery and highlight the challenges that remain in understanding and managing the ongoing shrimp BG epidemic in the southeastern USA.



Burd, A. **(2019). Mathematical Methods in the Earth and Environmental Sciences. Cambridge: Cambridge University Press, pp584.**

Students in marine science, as well as other Earth and environmental sciences, study a wide range of topics including biology, physics, and chemistry and how they help us understand the oceans. In addition to these subjects, marine scientists need to be able to use mathematical tools. This is partly because the techniques used to understand and interpret the increasingly large and complicated data sets found in the geosciences requires more and more mathematically sophisticated tools. These may include machine learning algorithms, or the use of mathematical and computational models. However, for many students their last foray into mathematics may have occurred long ago. In teaching both undergraduate and graduate students, Dr. Burd found that there was no book that covered the mathematical tools students needed in an easily accessible and relevant way. He was encouraged by the editor at Cambridge University Press to write one, and this book is the result.



Oliver, H., Luo, H., Castelao, R. M., **van Dijken, G., Mattingly, K. S., Rosen, J. J., Mote, T.L., Arrigo, K. R., Rennermalm, Å. K., Tedesco, M.,** Yager, P. L., **(2018). Exploring the potential impact of Greenland meltwater on photosynthetically active radiation and primary production in the Labrador Sea.** ***J. Geophys. Res: Oceans,*** **123, 2570-2591.**

This paper highlights the potential impact of melting ice sheets on ocean ecosystems. When glaciers melt, the runoff contributes to sea level rise, but it can also have an effect on the physical and chemical environment of coastal phytoplankton. Hilde Oliver, who recently defended her PhD in the Department of Marine Science, led this paper in collaboration with Professor Patricia Yager, Professor Renato Castelao, and a larger interdisciplinary team supported by NASA. They found that Greenland meltwater enhanced stratification of sub-polar waters, especially in the fall, reducing light limitation and making it possible for phytoplankton to grow when they otherwise could not. It's not all good news, however, since the runoff could also trigger phytoplankton community shifts that would impact the larger food web.

FACULTY AWARDS & RECOGNITIONS

Samantha Joye

Fellow of the American Academy of Microbiology
Djerassi Resident Alumni, Ocean Memory Fellowship
National Fellow of the Explorer's Club

Mary Ann Moran

UGA Regents' Professor
Wenner- Gren Foundations Distinguised Lecturer
Southeastern Conference Faculty Achievement Award

Julia Diaz

Sloan Research Fellow in Oceans Sciences
SCOR Visiting Scholar Award

Catherine Teare- Ketter

Online Learning Fellows Program

Jay Brandes

One Hundred Miles 100 Award

Adrian Burd

Make Our Planet Great Again Short Stay Award

William Miller

James Hollibaugh

Patricia Medeiros

UGA Career Center Acknowledgement for greatly contributing to the career of students

Thank you to all of our Alumni and Friends for your support. Our shared passion for Marine Sciences will inspire and train future leaders and we thank you for investing in us. Below are the names of those who made gifts to the Department of Marine Sciences from July 1st, 2014- June 30th, 2019

Andrew and Jolene Miklesh*

The Agouron Institute

Wanda Honeycutt

Rachel Jane Jakuba

Casey M. Kaliher

Scott P. Mohr

Matthew B. Ogburn, MS '04

James Andrew Sommerville

Tara C. Walker

Amanda B. Wrona, PhD '04

Lydia C. Babcock- Adams, MS '16

Melanie Butler

Tanya L. Crowe Boles

Dr. Collin John- Erik Closek

Anthony William Gilkes

William A. Hudson

Danielle Elizabeth Jenkins

Dr. Karen Lynn Nelson

Randy Thomas Pepper

Ming- Yi Sun, Emeritus

***in memory of David Miklesh to support graduate student research**

Through the newly launched UGA Mentor Program, we have an excellent opportunity for our Alumni (including faculty and staff) to connect with our students. Please visit mentor.uga.edu and invest in a student's future.