2024 SURFO Projects

Title: Impacts of water quality and alternative surface gear on oyster production in Rhode Island
Advisor: Hongjie Wang (hwang@uri.edu)
Project Summary: This research project focuses on combining high-temporal resolution of water quality monitoring with oyster health assessments to understand the impact of environmental factors on oyster production. Our objectives include evaluating innovative surface gear techniques, initiating environmental monitoring, and collaborating with local oyster farmers and agencies for sustainable aquaculture management. Join us in exploring the future of Rhode Island's thriving shellfish industry!

Title: How has climate change altered Agulhas Leakage pathways in the Cape Basin?
Advisor: Kathy Donohue (kdonohue@uri.edu)
Project Summary: The Agulhas Current flows south along the eastern coast of Africa until it hits the continent's southern tip. Most of the water then retroflects to the Indian Ocean, but some of it "leaks" into the southern Atlantic Ocean. Agulhas Leakage seasons the South Atlantic with anomalously warm, salty Indian Ocean water. The magnitude of this seasoning directly changes the ocean's influence on global climate. This project will use satellite data to investigate 30 years of leakage pathways through the tracking of Agulhas rings, filaments, and jets, which carry the spicy Agulhas waters within them.

Title: Enabling multi-modal seabed mapping and sensor fusion on AUVs

Advisor: Mingxi Zhou (mzhou@uri.edu)

Project summary: The prospective student will work with the research team on the seabed mapping Autonomous Underwater Vehicle with two main tasks:

First, the students will participate in field trials to collect a multi-modal underwater perception data set in Narragansett Bay.

Second, the student will explore existing computer vision algorithms to reconstruct the scenes from the data sets using the forward-looking sonar images and camera images.

Title: Volcanic processes at volatile-rich oceanic seamounts

Advisor: Katie Kelley (kelley@uri.edu)

Project summary: This project will investigate the volcanism of young intraplate volcanoes in the Revillagigedo islands (Mexico), using lava samples and video collected on recent ROV dives in the region. The project will evaluate the volatile contents of lavas erupted at differing water depths, and their relationships with the expressions of volcanic deposits on the seafloor at both large and micro-scales. The project will use infrared spectroscopy to determine volatile contents of volcanic glass, electron microprobe to analyze major element geochemistry, and scanning electron microscopy to evaluate microscopic textures of glass fragments.

Title: Environmental determinants of the distribution of deep-sea coral species

Advisor: Andy Davies (davies@uri.edu)

Project Summary: Within the marine environment deep-sea coral species remain understudied in comparison to their tropical reef counterparts. Most of our understanding of the distribution of deep-sea corals are driven by spatial analyses, including habitat suitability modeling, and direct habitat analysis. While these approaches provide much needed insight into the responses of coral species to environmental variables that drive their distributions, such as temperature and salinity, they do not capture the necessary co-located data that are needed to fully understand the response of these organisms to factors such as natural and human caused perturbation that can vary significantly over multiple temporal (weeks, months, to seasons and years) and spatial scales (meters to kilometers).

To aid our understanding of the distribution of deep-sea corals and their response to changing environments, SURFO students will be responsible for the analysis of environmental datasets collected using benthic lander platforms deployed at deep-sea coral sites in the Gulf of Mexico. These landers platforms are equipped with a suite of oceanographic sensors, providing multi-parameter datasets (temperature, salinity, chlorophyll fluorescence, turbidity, current speed and direction) with high temporal resolution. The co-analysis of these datasets will provide not only an environmental baseline for these sites and their associated benthic communities, but also insight into how site specific conditions shape these communities and their response to environmental perturbation.

Title: Nitrogen fixation in the Mozambique Channel during a past warm period

Advisor: Becky Robinson (rebecca_r@uri.edu)

Project Summary: Nitrogen fixation is the primary process that adds new nitrogen to the ocean. The Mozambique Channel is a known hotspot for nitrogen fixation in the modern. How nitrogen fixation varies in response to regional climate and oceanographic changes in the region is currently unknown. Here, we will monitor variations in nitrogen fixation in the past using foraminiferal nitrogen isotope records from sediment cores recovered in the Mozambique Channel. Specifically, the project will focus on a past warm interval, named Marine Isotope Stage 31, where significant ice sheet retreat has been proposed and proximal records suggest nitrogen fixation may have expanded in the region.

The student will work primarily in the lab, preparing and measuring foraminifera for isotope measurements. They will be trained in all of the analytical techniques and given additional datasets for comparison to their generated record.

Project title: Exploration of metabolite extraction from RI coral colonies for GC-MS analysis

Advisor: Kelton McMahon (kelton_mcmahon@uri.edu)

Project summary: Gas chromatography-mass spectrometry (GC-MS) is an analytical technique with powerful applications for biological and chemical samples. GC-MS is used to identify organic compounds from metabolism (e.g., amino acids, fatty acids, steroids). In marine organisms such as coral, GC-MS is essential for identifying small molecules produced in biochemical processes related to growth, development and reproduction as well as trophic strategy evaluation using fatty acid indices. The SURFO student will explore and compare several metabolite extraction techniques for tissue samples of the local RI coral *Astrangia poculata*. The SURFO student will test these approaches with a comparative study between co-occurring symbiont-containing and non-symbiotic corals that have diverging energetic and trophic characteristics. This project has opportunities for local coral collection via snorkel, laboratory chemistry work, analytical instrumentation work, coding and statistical data analysis, and science communication. We seek students with diverse lived-experiences and perspectives, and a strong interest in chemistry, biology, and/or instrumentation.

Project title: PFAS and Plankton

Advisor: Rainer Lohmann

Project Summary: Per-and polyfluoroalkyl substances (PFAS) are highly stable and ubiquitously distributed in the environment. PFAS are commonly found in groundwater, surface water, and drinking water near contamination sites, and can also bioaccumulate in food webs, resulting in contaminated fish, shellfish, and other food sources. Understanding human exposure pathways to short chain and long chain PFAS is of large interest. The bioaccumulation of long chain PFAS in both wildlife and humans drives the need for reliable detection and understanding of the bioaccumulation patterns of PFAS. Consumption of fish and shellfish was associated with elevated PFAS levels in blood in a representative sampling of Americans. Most prior work on bioaccumulation of PFAS focused on the upper trophic level organisms. Much less is known about the accumulation of PFAS in plankton, and associated PFAS concentrations and bioaccumulation factors (BAFs). Presumably, PFAS enter aquatic food webs by enriching in plankton and subsequent trophic enrichment. Thus, there exists a gap in knowledge on understanding the bioaccumulation behaviors of PFAS in the lower trophic levels of marine food webs. This project will analyze samples from the Narragansett Bay and Gulf of Maine.

- Related Tasks:

- Sampling: plankton species from the Narragansett Bay will be collected along with the GSO-plankton assistant as part of the plankton survey trawl. SURFO student will have the chance to be trained on sample collection, handling, and curation.

- Lab work: Extraction of plankton species for the detection of PFAS following an SOP provided with some probable method modification work. SURFO student will have hands on training on analytical methods for PFAS extraction and quantification.

- Training: field sampling and sample handling, sample preparation and extraction techniques, instrumental analysis technique, data analysis and presentation, report writing.

Project title: Do PFAS Compounds become Trapped in Ice?

Advisor: Brice Loose & Rainer Lohmann

Project Summary: Ice cover is a defining feature for high latitude lakes and the polar ocean. Ice cover creates a habitat for organisms, it interrupts surface wave breaking, and it cuts down sunlight to the upper ocean. It creates an environment that is unique, compared to the ice-free surface ocean. We are only beginning to learn about the fascinating chemistry and biology that happens in ice. For example, we have not tested what happens to PFAS compounds during the freezing process. Compounds like perfluoropropanoic acid are surface active, so they prefer the water surface, but they are also too big to fit in the ice crystal lattice, so it is a mystery what happens to them when freezing takes place.

This project will use laboratory sea ice freezing experiments to explore the fate of PFAS compounds when ice cover is formed. We are seeking a highly motivated student, preferably with some experience in lab and solvent chemistry who is excited to join our group of analytical chemists, chemical engineers, and polar oceanographers to engage in this exploration.

Project title: Environmental monitoring with an autonomous surface vessel (ASV).

Advisor: Chris Roman croman2@uri.edu

Project Summary: Autonomous surface vehicles (ASVs) are robotic platforms able to collect environmental data for a variety of applications. This project would entail working with new and previously collected camera images and environmental sensor data to derive data products and streamline a processing workflow. The student will also participate in field work during the summer using an autonomous kayak as part of a water quality monitoring project. Depending on the student's interests the specifics of the project could be tailored. Potential options include visualizing and comparing environmental data, using imaging processing tools to classify coastal salt pond bay scallop

habitat, developing the ASV's user interface software and helping test

a new automatic sensor/winch system. Programming experience (Python, Matlab, Open CV) would be helpful.

Project title: Plankton community dynamics

Advisor: Susanne Menden-Deuer

Project summary: Plankton make earth habitable. These microscopic organisms are the basis of fisheries production and affect our climate because they are major players in global biogeochemical cycles. Energy flow in traditional oceanographic analyses contrast two types of plankton: those that generate organic matter, which are primary producers (phytoplankton) and those that consume organic matter (zooplankton); however, recent studies identified a third type of plankton that both produce and consume organic matter: mixoplankton. Our lab works to measure and contrast primary production and consumption in marine food webs, so we can contribute to understanding and predicting processes upon which humanity depends for survival. There is still much to learn. The SURFO project will provide the opportunity to work with lab members to design and implement an independent research project to investigate rates of marine production, consumption and the factors that control these rates. The project will provide the opportunity to learn a variety of skills from microbiology including sterile techniques to data analysis and communication. Exposure to many instruments is provided. There is room for independence and the project could look at aspects such as:

- The function of planktonic food webs and rates in response to change in the physical and biogeochemical environment in coastal ecosystems

- The role of phytoplankton, zooplankton, and/or mixoplankton in relation to transfer of organic matter to depth in pelagic ecosystems

Required/preferred skills:

Interest, excitement and willingness to learn new things. Professionalism and reliability. Autonomy in a lab environment. Interest in quantitative techniques. High level of motivation.

Title: Changes in aerial salt marsh extent in Rhode Island after a major storm events

Advisor: Dr. Kristy Lewis (kristy.lewis@uri.edu)

Project Summary: Salt marshes play a crucial role in providing ecosystem services such as carbon sequestration, serving as nurseries for a fish and shellfish species, providing coastline protection, and storm surge mitigation. Despite their ecological, social, recreational, and economic importance, these coastal ecosystems face high vulnerability to climate change and human disturbances. Specifically, Narragansett Bay has witnessed a 53% reduction in wetland extent from 1832 to 2005. In this project, the SURFO student will evaluate the salt marsh extent using digital aerial photography from the Rhode Island Geospatial Information System (RIGIS). This project aims to improve our understanding of the current aerial salt marsh extent in Narragansett Bay, as well as carryout a before and after analysis of coastline change after major storm events over the past ~20 years. This project will provide opportunities to work with one of the most versatile tool sets an oceanographer can have in their toolbox, Geography Information Systems (GIS). In addition, the student will explore the Narragansett Bay ecosystem where they are conducting the analysis to ground truth and verify the work they are doing within the GIS.

Skills you will learn: GIS, data analysis and management, statistical analysis, teamwork, collaboration, scientific writing, and presenting scientific research.

Qualifications: growth mindset, eagerness to learn, interest in understanding scientific questions over space and time.

Title: Genetic analysis of Pompeii worms from deep-sea hydrothermal vents

Advisor: Roxanne Beinart (rbeinart@uri.edu)
Project Summary: Deep-sea hot springs, also called hydrothermal vents, are home to dense communities of animals that rely on chemosynthetic bacteria for their nutrition. Alvnellid (Pompeii) worms are extremophiles that live very near hydrothermal vent chimney orifices, where very hot, chemically-enriched fluid is emitted from the seafloor. These worms host a microbial community on their dorsal surface that they farm as a food source and can tolerate temperatures up to 80 degrees Celsius. This project will use genetic barcoding to confirm species identify and assess population diversity and structure in relationship to vent fluid chemistry in pompeii worms collected from hydrothermal vents in the eastern Pacific. This project will include DNA extractions, PCR gene amplifications, and gene sequencing and analysis.

Title: Evaluating Coastal Liming for Carbon Dioxide Removal Efficiency
Advisor: Hongjie Wang (hwang@uri.edu)

Project summary: The Wang lab is excited to present the SURFO 2024 project, an initiative focused on exploring the efficacy of Ocean Alkalinity Enhancement (OAE) as a method for marine Carbon Dioxide Removal (mCDR). As the quest for carbon neutrality intensifies, the need for effective mCDR techniques becomes increasingly urgent. This project is to assess the carbon dioxide removal efficiency following coastal liming interventions. Specifically, we will be closely monitoring the carbon chemistry dynamics of Winnapaug Salt Pond, a small coastal lagoon in Rhode Island, both before and after the application of calcitic limestone on a nearby golf course.

We invite a SURFO student to join this research to 1) collaborate with Dr. Wang in validating the continuous data sets from autonomous sensors—measuring parameters such as temperature, salinity, dissolved oxygen, pH, and pCO2—against discrete bottle sample comparisons. 2) the student will distinguish the CDR signal resulting from coastal liming to quantify its mCDR efficiency, a promising OAE technique. This project offers hands-on experience with autonomous sensor technology, benchtop instruments, learning the fun carbonate chemistry system, and of course, the opportunity to contribute to climate change mitigation. If these challenges excite you, we welcome you to join our research group!

For more information or to express your interest, please contact Dr. Hongjie Wang at hwang@uri.edu.

Title: Cell-flux model of phytoplankton and nutrients in upwelling zones
Avisor: Prof. Keisuke Inomura
Project summary: The Inomura Quantitative Microbiology lab seeks an undergraduate student to assist on a project to investigate macromolecular allocation in marine phytoplankton in an upwelling zone. This project uses the Python language to couple a cell flux model of phytoplankton to a 2D physical model. In this work, the student will apply different nutrient and temperature simulations to investigate how phytoplankton allocate nutrients in an upwelling zone. The student does not need previous experience with Python, just the enthusiasm to learn. Ultimately, the student will gain experience in biogeochemical modeling, reading scientific literature, and producing scientific communication products (e.g. papers, posters). The graduate student hosting the SURFO student will aid with Python, oceanography and biochemistry principles, modeling, as well as general skills for scientific research and/or graduate school.

Title: Combining measurements from surface and subsurface oceanographic platforms to understand controls on surface ocean variability
Advisor Prof. Jaime Palter
Project Description: In Spring 2022, we collected extensive oceanographic and meteorological measurements just north of the Gulf Stream with an underwater glider, a Saildrone autonomous surface platform, and aboard the Research Vessel Endeavor. All of these measurements can reveal how ocean circulation transports properties from the subsurface ocean towards the surface, where interactions with the atmosphere influence weather and climate. In this project, the SURFO student researcher will examine data from each of the three platforms, visualizing them in ways that help us understand the connection between surface and subsurface ocean. We expect signatures of upwelling and vertical mixing influencing surface temperature, chlorophyll and carbon concentrations.

The project could be done remotely, but I have a strong preference for the student to be in residence.

The student should have a background in coding and plotting data in Matlab or Python.