Session I-Room A1

THE GALVESTON BAY FOUNDATION'S OYSTER GARDENING PROGRAM AND IT'S IMPACT ON VOLUNTEERS, THE COMMUNITY, AND THE BAY.

Michael Niebuhr, Galveston Bay Foundation, Houston, TX

A critical component of a healthy estuarine ecosystem, oyster reefs filter contaminants from the water, protect shorelines, stabilize sediment, and provide food and shelter for other species. Yet, oyster reefs are documented as the most threatened marine habitat worldwide, with global losses of 85% (Beck et al, 2011). Galveston Bay has experienced a significant decline in oyster habitat due to extreme weather events and unsustainable harvesting. In 2008, Hurricane Ike destroyed over 50% of the reefs in Galveston Bay. The removal of shells from the bay along with sedimentation from Hurricane Ike, has led to a shortage of hard substrate, a key component of successful oyster development. While oyster larvae can attach to many surfaces, oyster shells are the preferred substrate for larval attachment and growth (Coen and Luckenbach, 2000). In the years since Hurricane Ike, optimal conditions for oyster growth have been few and far between. With periods of significant drought, resulting in increased salinity, followed by years of intense rainfall resulting in extremely low salinities throughout the bay, oyster populations have struggled to thrive.

In an effort to supplement oyster reef populations, the Galveston Bay Foundation's Oyster Gardening Program partners with local waterfront property owners to help collect and raise juvenile oysters, or spat, throughout the spawning season. Wild oysters living nearby to the volunteers' docks and piers will spawn, sending millions of fertilized eggs into the waters, and this program is designed to help collect these eggs on recycled oyster shells. Volunteers are educated on Galveston Bay oysters, their impacts to the water quality, importance to local economies, and the overall ecologic value they provide to the bay. Volunteers are then shown how to build their "gardens"; recycled shell placed in either mesh bags, metal cages, or strung on metal wire, and then taught how to care for their gardens and new spat that will collect naturally from their local waterways. Since 2011, more than 600 volunteers have participated in recruiting and raising juvenile oysters for transplant onto established reefs throughout the bay.

While the program originated more as a method to supplement oyster reefs throughout the bay, the outreach and education provided to the public has provided invaluable advocates for Galveston Bay oysters. Volunteers truly take on the role of program promoters, recruiting friends and neighbors to join in the efforts, and over the last 2 years, entire new communities have joined, increasing awareness across the bay. The ownership these volunteers have taken to both their own gardens, and oyster health throughout the bay has gone above and beyond the initial goals of the program. Some volunteers have now taken their knowledge and enthusiasm for Galveston Bay oyster in schools to educate students. A partnership with L.A. Morgan Elementary School in Galveston, TX has provided students the opportunity to learn about oysters, what they do to benefit the bay, how they grow and spread, and ways for even children to do their part. In spring of 2019, students helped build gardens and will get a chance to see the results of their gardens at the end of spawning season in the fall of 2019. This program has been fully implemented and completed by Oyster Gardening volunteers based on the passion they cultivated through efforts with Galveston Bay Foundation. New oyster transplant will always remain a goal of the Gardening Program, but as recent years have proven, public engagement and outreach for oysters has taken on a much more prominent role, one that will continue to strengthen as more volunteers participate.

Session I-Room A1

INCREASING AWARENESS THROUGH AWARDS PROGRAMS

Andrea Tantillo, Community and Environmental Planning, Houston-Galveston Area Council, Houston, Texas

The goals of engagement are to increase awareness, make lasting impressions, and spur long-term behavior change. Making sure your message is heard and resonates with your audience is a challenge.

This presentation will focus on the Houston-Galveston Area Council's efforts to increase awareness and interest in protecting and preserving water quality through an awards and recognition program. The goal of this presentation is to demonstrate how public relations in the form of non-traditional outreach, such as an awards and recognition program, can forward and reinforce messaging campaigns and lead to community behavior change.

For more than a decade, H-GAC has honored outstanding projects that expand parks and natural areas for improved quality of life, habitat, and water quality. In 2019, H-GAC added the Water Innovation Strategies of Excellence Awards to recognize projects and programs that help improve water quality conditions through innovative water infrastructure projects and improvements. Any public or private project owner is eligible to apply for either award. Both awards programs inform a repository of best management practices that serve as models for other projects across the region.

The presenter will discuss the evolution of the awards program, beginning with the development of a non-traditional communications program. The speaker will also highlight how award-winning project owners not only demonstrate and maintain water quality improvement projects, but also promote the awards and messaging through their own communications and outreach efforts.

Attendees should leave the presentation with information on choosing non-traditional communications programs, making a case for an awards program, getting a program off the ground, and maintaining momentum through promotion and reporting.

Session I-Room A2

FROM RESTAURANTS TO REEFS – THE GALVESTON BAY FOUNDATION'S OYSTER SHELL RECYCLING PROGRAM, PAST, PRESENT, AND FUTURE

Haille Leija, Galveston Bay Foundation, Houston, TX
Dr. Laura J. Jurgens, TX A&M University at Galveston, Galveston, TX

Galveston Bay, the heart of the TX oyster industry, has experienced a significant decline in oyster habitat. The TX Parks and Wildlife Department (TPWD) estimates that over 50 percent of Galveston Bay reefs have been destroyed as a result of extreme weather events such as Hurricanes Ike and Harvey coupled with decades of heavy exploitation. The removal of shells from Galveston Bay, due to storm-driven sedimentation and unsustainable harvesting, has led to a shortage of hard substrate, a key component for sustaining oyster populations. While many surfaces are suitable cultch for oyster larvae attachment and growth, oyster shells are proven to be the preferred substrate (Coen and Luckenbach, 2000).

In an effort to reverse local oyster population declines, the Galveston Bay Foundation (GBF) partners with local seafood restaurants to collect shucked oyster shells for reuse in reef restoration throughout the Galveston Bay estuary. GBF has managed this program since 2011, collecting over 955 tons (1.9 million pounds) of oyster shells. Nearly 500 tons have been incorporated in oyster reef restoration projects, and the remaining shells will be returned to the bay within the next three to five years. Upon their return to the bay, the recycled oyster shells serve as new oyster habitat, thus enhancing the local oyster population.

GBF's Oyster Shell Recycling Program not only reclaims a valuable resource, it also provides hands-on volunteer opportunities for schools, corporate teams, and other groups seeking community service as well as research opportunities for universities. The engagement and education of the community is integral to the Foundation's mission; therefore, the focus has been on volunteer-based oyster reef restoration. To accomplish this restoration with volunteers, GBF has employed the "oyster shell breakwater" technique which incorporates oyster shells in a living shoreline complex. By using this technique, volunteers can perform the entire construction phase, creating mesh "shell bags" which are placed on the bay floor in a pyramid formation to create an intertidal breakwater. Not only do these shell breakwaters provide cultch for oysters, they also absorb wave energy, reduce shoreline erosion, and facilitate marsh restoration. To date, over 2,500 volunteers have participated in GBF's oyster restoration efforts. As a result, 2,200 linear feet of oyster reef has been constructed to provide oyster habitat and shoreline protection.

While the oyster shell breakwater technique has proven successful in recruiting oysters and providing food and shelter for numerous aquatic species, it is not applicable in all locations nor is it without flaws. The lessons learned over the last eight years of oyster shell recycling and reef restoration have led GBF to enter an evaluation and assessment phase. Oyster shell recycling is an expensive and complex operation, making the recycled shells collected through this process a prized and invaluable resource. These shells must be utilized in the most effective method(s) to ensure restoration success and minimize waste of this precious material. Through a partnership with TX A&M University Galveston (TAMUG), GBF plans to assess multiple reef restoration techniques that utilize both loose and contained oyster shell in Galveston Bay. This assessment will also help GBF find a balance between successful reef restoration and community engagement. Furthermore, TAMUG plans to incorporate monitoring of GBF's existing oyster shell breakwaters into at least two courses to provide baseline data and assist GBF in developing a new Volunteer Reef Monitoring Program. These monitoring efforts will inform future restoration efforts and allow for adaptive management as GBF strives to improve reef restoration techniques in Galveston Bay.

Session I-Room A3

Coordinated Monitoring in the Wake of Hurricane Harvey Lighting Round*

Session Moderator: Stephanie Glenn, Program Director, Hydrology and Watersheds, Houston Advanced Research Center (HARC), The Woodlands, TX, 77381. sglenn@harcresearch.org.

The Lightning Round session "Coordinated Monitoring in the Wake of Hurricane Harvey" will focus on data collection efforts organized and executed immediately following Hurricane Harvey and the lessons learned from scientific and logistical standpoints that can be applied to future disasters. A Lightning Round is a time-limited and slide-limited presentation format. This fast-paced program is intended to focus on the heart of the issue and engage the audience.

Each Lightning Round session will last 90 minutes with a maximum of 10 presentations in each session. Each presenter gives a 5-minute presentation accompanied by 1- 2 slides. After five minutes, there will be an immediate transition to the next presentation. There will be 15 minutes for Q&A at the end of the session. The goal is to present information succinctly and effectively to maximize the information covered in a session. The proposed presentations and presenters for the proposed session are as follows:

1) Jamie Steichen, jamie.steichen@tamu.edu

Water Quality Sampling in Galveston Bay following Hurricane Harvey

A group of TAMUG researchers mobilized in the days following Harvey. 5 cruises were conducted on the TAMUG R/V Trident to collect water samples in Galveston Bay following Harvey. This was a collaborative effort with faculty from both the Marine Science and Marine Biology departments at TAMUG. Immediately after the flooding, the salinities in Galveston Bay decreased to 0-5 psu relative to pre-Harvey salinities of 20-30 psu. The generally dominant bacteria of the marine coastal community were replaced by microorganisms of terrestrial, sedimentary, and freshwater origin. In the 4 weeks following the storm, concentrations of nutrients and organic pollutants began to decrease coinciding with rising salinities as the freshwater was flushed into the Gulf of Mexico and seawater began moving back into the Bay. Although the water quality parameters and microbial community showed signs of returning to pre-Harvey conditions within the month following the flood event, long-term impacts need to be measured in the years following the flood.

2) Caimee Schoenbaechler, M.E.M., Manager, Bays and Estuaries - Texas Water Development Board. Caimee.Schoenbaechler@twdb.texas.gov

Impacts on Freshwater Inflow and Salinity

The Texas Water Developed Board estimated that Hurricane Harvey delivered 11.5 million acre-feet of freshwater inflow, an amount roughly equivalent to the annual average inflow, to Galveston Bay. Modeled runoff from ungauged watersheds surrounding the bay was estimated to account for half of this surface inflow although coordination with Texas A&M University suggests this may be an under-estimate. Despite extreme precipitation from Hurricane Harvey, 2017 otherwise was a year with below-average freshwater inflow. Active monitoring stations in

the bay recorded sharp reductions in salinity and temperature during the storm with sustained effects in the following months.

3) Kristen Thyng, kthyng@tamu.edu, Assistant Research Professor, Department of Oceanography, Texas A&M University

Estimate of Harvey freshwater inflow to Galveston Bay from bay data

Kristen M. Thyng, Robert D. Hetland, Scott A. Socolofsky, Nelun Fernando, Evan L. Turner, Caimee Schoenbaechler

Using publicly-available data in Galveston Bay and conservation of volume and salinity in the bay (with no hydrological data), we estimated the freshwater inflow to Galveston Bay from Hurricane Harvey to be 22 km^3 or 18 million acre-feet. This estimate is close to the amount of rainfall in the greater drainage basin as measured by radar, however, it is higher than other estimates of freshwater inflow to Galveston Bay. Comparing with the TWDB estimate of freshwater inflow, a possible reason for the discrepancy could be the extreme patchiness of the Harvey rainfall and difficulty capturing it in a runoff model.

4) Kathryn E. F. Shamberger, katie.shamberger@tamu.edu, Assistant Professor, Department of Oceanography

Hurricane Harvey: Time series study of Galveston Bay water and sediment biogeochemistry

Results from a time series study of Galveston Bay water and sediment biogeochemistry including data from the June before Harvey, immediately after Harvey, and then quarterly through this year. The data show a dramatic increase in acidification levels in the bay following Harvey and persistently high acidification levels near East Bay that could impair recruitment of new oysters to the reefs there. Texas Parks and Wildlife Department data show a particularly severe oyster die off in East Bay following Harvey (up to 100% mortality on some reefs); the questions is whether or not acidification levels in East Bay could slow oyster recruitment and recovery of these reefs.

5) Hui Liu, liuh@tamug.edu, Associate Professor, Department of Marine Biology,| Texas A&M University at Galveston

Near-term responses of estuarine pelagic communities to extreme flooding after a catastrophic hurricane in Galveston Bay

Rapid response to large-scale natural disasters and subsequent assessment and restoration require long-term baselines of key ecosystem components. Zooplankton are sensitive to climate change and hydrographic conditions with significant ecological implications for fisheries and ecosystem functions. In August 2017, Hurricane Harvey made catastrophic rainfall and extreme flooding in Southeast Texas. Immediately after Harvey, we started monthly sampling of zooplankton and hydrographic factors in Galveston Bay funded by NSF to examine the resilience of pelagic communities to the storm and the flood related damage and restoration of estuarine ecosystems. So far, we have collected an annual cycle of monthly time series of zooplankton, water temperature, salinity, Chl-a, dissolved oxygen and pH. Our data showed that the hydrographic conditions tend to recover quickly, whereas the post-storm data exhibited a relatively slow recovery of zooplankton with a significant decrease in species composition and

density. This study has laid the foundation in terms of zooplankton and hydrography fostering response and recovery of estuarine ecosystems to next natural disasters.

6) Gerardo Gold-Bouchot, Ph. D., Professor, Oceanography Department, Texas A&M University

Impact on the Biogeochemistry of CDOM by Hurricane Harvey in Galveston Bay

As part of a two-year monitoring of CDOM components in Galveston Bay the impact of hurricane Harvey was assessed. CDOM characteristics after Harvey more closely resembled CDOM from the San Jacinto river than from the Trinity river and returned to pre-Harvey conditions in two months. These results have important implications for environmental management of the bay.

7) George Guillen, guillen@uhcl.edu, Executive Director - Environmental Institute of Houston, Professor of Biology and Environmental Science, University of Houston Clear Lake

Effects of Hurricane Harvey on Bottlenose Dolphin Populations and Saltmarsh Fish Communities in Galveston Bay

Authors: George Guillen (presenting); Kristi Fazioli; Jenny Oakley.

Long-term monitoring programs are crucial for understanding the influence of man-made and natural phenomenon on natural resources. Prior to Hurricane Harvey monitoring programs that monitor Bottlenose Dolphin in upper Galveston Bay provided baseline information on resident population levels and skin lesions (a health indicator). Similarly monitoring programs had been previously conducted which provided baseline information on the inter-annual and seasonal fluctuations of saltmarsh nekton. Using these data sets we observed that 1) The distribution of Bottle nose dolphins shifted and the incidence of skin lesions increased in response to lower salinity, and 2) Nekton communities recovered rapidly after passage of Harvey. These findings provide useful information on the role of tropical storms in structuring estuarine ecosystems.

8) Michael T Lee, mtlee@usgs.gov, Texas Coastal Science Program Coordinator, U.S. Geological Survey

Hurricane Harvey: USGS and the Water Data

This talk will introduce the audience to the U. S. Geological Survey and the role they play as a federal scientific agency in Texas in response to tropical events such as Hurricane Harvey. Specific information focusing on water quality and surface water data collected for the Hurricane Harvey event will be provided.

Session I-Room A4

TOXIC AND NUTRIENT METALS IN GALVESTON BAY: A QUARTERLY TIME-SERIES 2017-2019

Jessica N. Fitzsimmons, Laramie T. Jensen, Hannah Adams, Brett Farran, Nathan Lanning, Janelle Steffen, and Dylan Halbeisen

Department of Oceanography, Texas A&M University, College Station, Texas

In estuaries, metals can serve as either 1) passive tracers of mixing between freshwater and seawater, 2) nutrients for photosynthesizing plankton and microbes that fuel the food web, or 3) anthropogenic pollutants from non-point source pollution. Understanding which of these roles a given metal falls into is critical for regulating its concentrations in an estuary, especially on seasonal timescales as freshwater fluxes change.

We collected filtered water and sediment samples during a two-year time-series of sampling across Galveston and Trinity Bays during 2017-2019. Metal concentrations in Galveston Bay have not been published in the scientific literature for nearly two decades, during which time significant cleanup efforts have been undertaken in the Bay, making our time-series particularly important for constraining water quality improvements. We targeted sampling immediately following several catastrophic events including Hurricane Harvey flooding, when we sampled ~10 days following the storm and about a month after that, as well as two days after the Deer Park ITC chemical spill and fire.

We measured iron, manganese, copper, cadmium, zinc, lead, and nickel in the waters of Galveston Bay. Of these metals, lead, cadmium, zinc, copper, and nickel can be toxic at sufficient concentrations, but none were recorded in Galveston Bay to have concentrations above EPA toxicity thresholds for drinking water. However, clear estuarine cycling of metals was observed. For example, cadmium was conserved in estuarine waters and had a clear saltwater source, with concentrations that varied depending on Trinity River discharge. In contrast, nickel and copper had freshwater sources, and copper showed clear contamination from San Jacinto/Buffalo Bayou freshwater inputs seasonally. Iron and lead showed extremely large freshwater inputs in the bay during wet season, as these metals flocculate in the estuary near a salinity of two, and thus during wet seasons these freshwaters penetrate Galveston Bay, while in dry seasons the concentrations appear lower as the bay holds mostly saltwater where the iron and lead have already flocculated out. Hurricane Harvey did not show any non-point source increases in these metals above typical wet seasons, which would be indicative of anthropogenic inputs, though nickel was removed from the bay following Harvey. The Deer Park ITC event did result in lead enrichments in the waters, though these may not be higher than normal concentrations for this region, pending further analyses.

The sediments were analyzed for a suite of 20 elements, including tracer, nutrients, and toxic elements. Of the 8 most toxic elements according to NOAA (mercury, antimony, arsenic, nickel, lead, copper, chromium, and zinc), none were recorded to have “toxic” concentrations in sediments, but five had concentrations “at risk of toxicity,” including mercury, antimony, arsenic, nickel, and chromium.

Session I-Room A4

THE EVALUATION OF LEGACY AND EMERGING POLLUTANTS IN GALVESTON BAY

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The Galveston Bay watershed is a sink for major industrial, agricultural, municipal effluent discharges, and also serves as a hub for regional oil refineries and industries. As a result, Galveston Bay waters and its resident biota are traditionally key focus areas for environmental monitoring studies for mainly 'legacy' pollutants, such as petro- and pyrogenic polycyclic aromatic hydrocarbons (PAHs), or persistent pollutants such as polychlorinated biphenyls (PCBs). More recently, there is increasing concern for the presence of 'emerging' pollutants, such as pharmaceuticals, biocides and polyfluoroalkyl substances (PFAS) in Galveston Bay. While attention has mainly focused on measuring PAH and PCB levels, the presence of emerging pollutants in this important Gulf watershed has been understudied.

In this presentation, data from our surveys of PAH and PCB levels in various Galveston Bay (and northwestern Gulf of Mexico) biota, such as fish and invertebrates will be presented. In addition, the levels of pharmaceutical and biocide compounds measured in Galveston Bay waters following the catastrophic flooding of Hurricane Harvey will also be presented. Our analyses show characteristically different body-burdens of PAHs and PCBs in biota comprising various trophic levels. The measurements of pharmaceutical and biocide compounds show the presence of pharmaceuticals that are highly reflective of human use and consumption. Finally, data from the analysis of PAH and PFAS pollutants following the recent petrochemical spills following the Deer Park fire (3/17 to 3/20/19) and barge collision (5/10/2019) in the Houston Ship Channel, will also be presented. The ecological impacts of both disturbances are not fully known at this time, therefore, concern remains for the exposure of aquatic biota to oil-derived PAHs and likely PFAS's used as fire-fighting (or flame retardant) agents.

The research presented will provide unique insights into the presence of legacy and emerging pollutants in Galveston Bay waters and biota. Such information can help to provide a framework that is amenable to water quality assessments and environmental (including human) risk assessments.

Session I-Room A4

DISTRIBUTION OF PER- AND POLYFLUORINATED ALKYL SUBSTANCES (PFAS) IN GALVESTON BAY, TX

Yina Liu (Geochemical and Environmental Research Group, Texas A&M University, College Station, TX)

Garrett Walsh (Oceanography Department, Texas A&M University, College Station, TX)

Shari Yvon-Lewis (Oceanography Department, Texas A&M University, College Station, TX)

The presence of per- and polyfluorinated alkyl substances (PFAS) in surface waters has received increasing attention from the national and international scientific community and policy makers. Galveston Bay, TX is an urbanized estuary surrounded by many industries (including various Superfund sites) receiving river (San Jacinto and Trinity) effluents from highly industrialized areas. Extensive research on contaminant levels in Galveston Bay has existed for decades. Surprisingly, however, little information on concentrations and distributions of PFAS is available. We examined the spatial distribution of PFAS in Galveston Bay seawater. Samples from eight stations along a salinity gradient were collected from September 2017 to June 2019, on a quarterly basis. This time series captures the dynamics and concentrations of PFAS across different seasons with different hydrographical conditions. Additionally, the time series also captures PFAS concentration levels after extreme events such as Hurricane Harvey and the Deer Park Intercontinental Terminals Company (ITC) fire. Elevated total dissolved PFAS (C4 to C8) were observed in the upper bay, near the San Jacinto and Trinity rivers. Elevated PFAS, compared to background concentrations, were also observed after the ITC fire. This study highlighted the importance of time series observations on understanding the distribution and fate of emerging contaminants such as PFAS. Concentration variabilities due to hydrographic changes provide a critical baseline for understanding how extreme events affect the health of Galveston Bay.

Session I-Room A4

ROLE OF EXTREME WEATHER EVENTS, POLLUTANTS AND FRESHWATER INFLOWS ON PHYTOPLANKTON COMMUNITY COMPOSITION IN GALVESTON BAY, TEXAS: INSIGHTS FROM A DECADE LONG STUDY

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Climate change leads to increased frequency and intensity of extreme weather events. In Texas, the Houston area has experienced varying levels of droughts, floods and severe storms within the last decade. Houston is located in the watershed of Galveston Bay, an economically and ecologically important estuary on the coast of the Gulf of Mexico. Changes in freshwater inflow quality and quantity due to extreme weather can impact the ecology of the Bay. At discrete stations, surface water quality parameters (temperature, salinity, dissolved oxygen and water clarity) were recorded and water samples were collected for nutrient and phytoplankton pigment analyses. Phytoplankton community dynamics indicate ecological response to changes in water quality including those incurred by extreme events such as droughts and floods. Our findings show that ratios of Bacillariophyta and Dinophyta (estuarine and marine phytoplankton) compared to Chlorophyta and Cyanophyta (freshwater indicator phytoplankton) are influenced by magnitude and duration of freshwater inundation. Drought periods were dominated by Bacillariophyta and Dinophyta Prolonged flooding in 2015, 2016 and 2017 led to freshwater phytoplankton dominance (primarily Chlorophyta and Cyanophyta) in the northern sector of the Bay. . In the flooding event during and after the passing of Hurricane Harvey in 2017, the phytoplankton community only took a little over a month to begin to re-establish itself in the southern portion of the Bay. The consequences of these shifts in community composition to the overall productivity and success of the Bay is yet to be determined. Compounding factors include but are not limited to introductions of phytoplankton via ballast water discharged directly into the Bay and losses due to petrochemical spills (Texas City Y spill in 2014, reformate spill in 2019) and other adverse events which introduce pollutants into the Bay (Deer Park Fire, 2019). Algal blooms (some being harmful) occur periodically although most blooms have not been linked to fish kills. This decade long study highlights the value of the phytoplankton community as an effective means of monitoring the ecological response within the Bay following a variety of perturbations.

Session I-Room A4

DISTRIBUTION OF HALOGENATED VOLATILE ORGANIC COMPOUNDS (VOCs) IN GALVESTON BAY, TX

Garrett Walsh (Oceanography Department, Texas A&M University, College Station, TX)

Shari Yvon-Lewis (Oceanography Department, Texas A&M University, College Station, TX)

Yina Liu (Geochemical and Environmental Research Group, Texas A&M University, College Station, TX)

Many halogenated volatile organic compounds (VOCs), such as carbon tetrachloride, CFC-11, and CFC-12, are banned by the Montreal Protocol due to their destructive effect on the stratospheric ozone layer. Recent studies show the continued emission of some of these halogenated VOCs in regions around the globe, including in the Houston area. Galveston Bay is heavily affected by the industry and chemical plants of Houston through their discharges into the freshwater inputs for the bay, including the San Jacinto River, Trinity River, Dickinson Bayou and Buffalo Bayou. Little information is available on the water concentrations of these halogenated VOCs in either the bay or its freshwater sources. In March and June 2019, samples were collected from nine sites in Galveston Bay and in June 2019 they were collected from two to three sites in each of the major freshwater sources. All of the samples were analyzed for a suite of halogenated VOCs to assess the spatial distribution of these species in and entering Galveston Bay.

The Deer Park Intercontinental Terminals Company (ITC) fire began March 17, 2019, was ultimately extinguished on March 20, however there was a breach in the wall surrounding the tanks on March 22 that released chemicals into the Houston Shipping Channel, lower San Jacinto River. When we sampled on March 23, 2019, halogenated VOCs were observed at higher than expected concentrations in Galveston Bay, TX, with noticeably elevated concentrations in the lower San Jacinto River as compared to other areas of the bay. The abundance of these halogenated VOCs decreased over time in the bay following the ITC fire, yet elevated concentrations remain in the major freshwater sources, leading to elevated fluxes of halogenated VOCs into the bay. Continued monitoring of the freshwater sources into Galveston Bay, along with Galveston Bay itself, is necessary to understand whether the elevated concentrations are directly related to the ITC fire.