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Galveston Bay Background



Figure 1. Oyster fisherman in Galveston Bay. Houston Chronicle. Photo: J. Patric Schneider.



Figure 3. Map of state superfund sites (), EPA superfund sites (\blacktriangle) and wastewater outfalls (O) surrounding Galveston Bay.



Figure 2. Colors represent model monthly averaged residence times of Galveston Bay water for June 2009 (Rayson et al. 2016).

- Galveston Bay supports billion dollar commercial and recreational fisheries.
- Represents a wide range of conditions applicable to estuaries world wide.
- Highly affected by human (anthropogenic) activities.

Hurricane Harvey





Figure 4. From The Washington Post and National Hurricane Center Tropical Cyclone report. Colors represent rainfall (in.) from Hurricane Harvey in 2017.

Figure 5. Salinity data from three buoys in Galveston Bay, with colors of data corresponding to location in bay. The vertical dotted line shows when Harvey made landfall near Rockport, TX.

- Intense rainfall from Hurricane Harvey emptied into Galveston Bay and flushed all the seawater out of the bay for several weeks.
- Storm runoff dramatically altered the entire bay ecosystem from primary producers to oysters, as well as gas exchange.



Impacts of Primary Productivity on Air-Sea Gas Exchange in an Anthropogenic Estuary

Abiotic and Biotic Response to Flooding





Figure 8. Methane (CH₄) sea-to-air fluxes for each of the sampling sites for the months of June 2018 (Left) and September 2018 (Right).

- Galveston Bay is a source of methane to the atmosphere.
- The elevated methane flux near the San Jacinto River in June (red arrow) is driven by high water concentrations (116.3 nM) suggesting wastewater and/or industrial sources to the Bay.

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- during non-flooding periods.

- following flood events.







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Acidification Following Flooding





Figure 11. Aragonite saturation state (Ω_{ar}) in Galveston Bay from June 2017 through September 2018.

Significant acidification ($\Delta pH \approx -0.25$) and undersaturation of aragonite (Ω_{ar} <1), following Harvey. Larval and juvenile oysters can not make their aragonite shells in undersaturated conditions.

Also see smaller scale reduction of Ω_{ar} following local flooding events (e.g. Mar 2018), which may stress larval and juvenile oysters that make aragonite and are sensitive to $\Omega_{ar} \leq 1.6$.

Conclusions

Hurricane Harvey floodwaters caused changes salinity, nutrients, oxygen, and acidification levels in Galveston Bay.

Primary productivity was significantly altered in the Bay, with a return to pre-storm levels requiring many months.

There are likely substantial anthropogenic sources of methane to the bay, related to wastewater and industrial sources, even

Next Steps

Examine opportunities for invasive and/or bloom forming species to persist and/or establish themselves in Galveston Bay

Investigate potential links between phytoplankton blooms and decreases in acidification following flooding events.

Determine anthropogenic sources of methane using chemical markers, e.g. disinfection byproducts or industrial wastes.