Activity report on the project "*Microplastic concentration in sediments and waters of Matagorda and San Antonio Bays: Initial assessment and mitigation plans*"

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Undergraduate students - -

Period: April 1st 2024 to June 30th 2024 – Continuation of laboratory microplastics separation and description of filtered material, analyzing the data collected on Colorado Delta.

During the quarter of April to June 2024, we continued to refine the maps by adding additional data.

A numerical model simulating suspended material has been used to understand the dynamics of microplastics in Matagorda Bay. The hydrodynamic model, ANUGA, inputs bathymetry, velocity, winds, tides, and river stage into the particle tracking model (dorado) to commute the paths and the time of particles in suspension that eventually reveal the fate of the particles (microplastics). Further, this model uses a parameter (theta) as a proxy for the particles' buoyancy, which can be adjusted to simulate the range of suspended materials' (i.e., sand, silt, mud, organics) sensitivity to depth (**Figure 1**). "Steady" and "unsteady" conditions are incorporated into the model to variably adjust for changes in tides, winds, and river stage during the model's simulation.

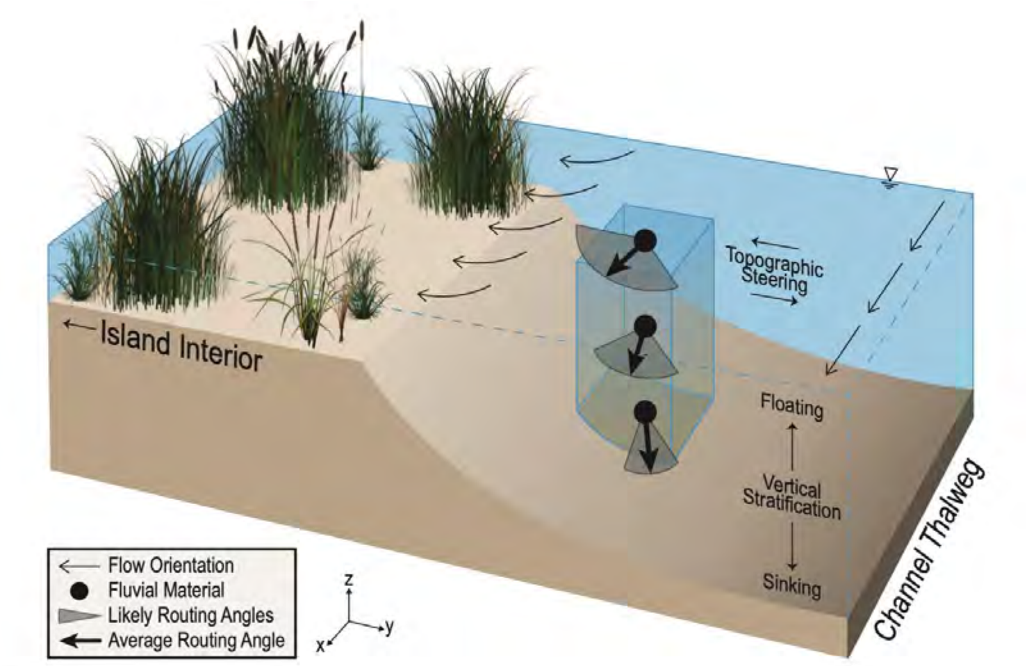

Figure 1. Conceptual schematic model by Wright et al. (2022) illustrating the connection between topographic steering and vertical stratification and the resulting sorting of materials in space.

The particle tracking model was used to simulate island nourishment in Wax Lake and Atchafalaya deltas (Wright et al., 2022), and ongoing work aims to apply the same methods to Matagorda Bay. Future work will simulate microplastic spill events from different locations (e.g., Port Comfort, Colorado River) to calculate residence periods for suspended particles in the bay and quantify the time for particles to escape the bay waters (**Figure 2**).

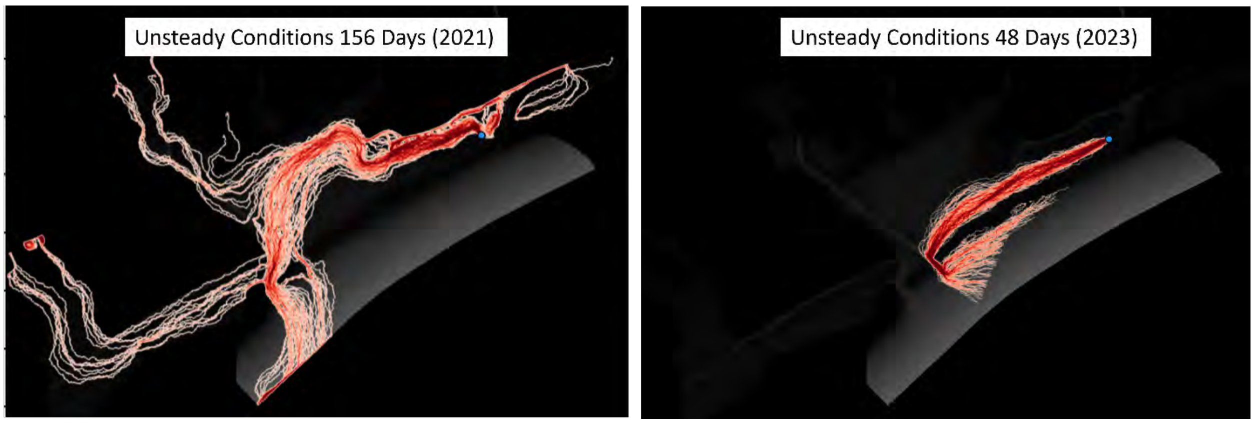

Figure 2. Example of numerical particle tracking model residence time output results for two scenarios where buoyant particles were seeded at the mouth of the Colorado River into Matagorda Bay. Left) Unsteady conditions ran for 156 days (May 15 to October 1, 2021) to simulate the period when sediment and water samples were collected. Right) Unsteady conditions ran for 48 days (May 1 to July 1, 2023) to simulate a period when longshore current reverses.

PhD student Will Bailey visited the University of Perpignan in France to collaborate with a group doing similar research on two lagoons in the Mediterranean. As part of the Chateaubriand STEM Fellowship, an international collaboration between the French and US universities, he applied our methods developed at the University of Texas at Austin to an unstudied region. Ongoing microplastic analyses will test for correlations with grain size, total organic content, and wind direction to further our understanding of coastal plastic concentrations (**Figure 3**).

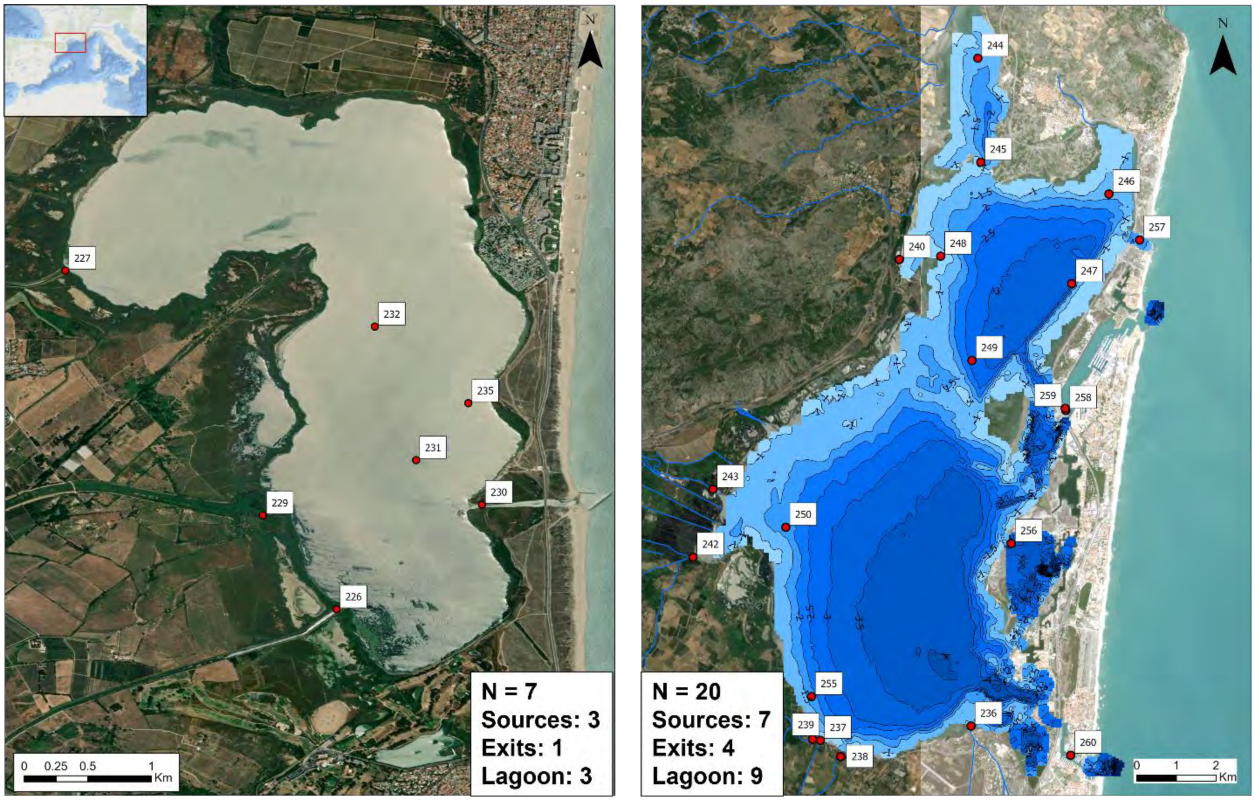

Figure 3. French Mediterranean lagoons sampled for microplastic concentrations between January and April 2024. Left) Canet Lagoon; right) Leucate Lagoon, where push cores (60 cm) were collected. Sediment core locations form transects between fluvial sources ("sources") and connections with the sea ("exits"). Intermediary locations ("lagoon") test for gradient between sources and exits with the prevailing offshore wind regime.

Lastly, with the completion of microplastic quantification and bay sediment characterization, the Matagorda Bay results are being prepared for submission to a peer-reviewed journal later this year. In addition to developing the numerical model, ongoing analyses will refine microplastic profiles at depth from cores collected in the bays and characterize microplastic concentrations at the mouth of the Colorado River.

Method development of Pyrolysis-GC/MS

The previous 'punch' method for analyzing purified samples revealed issues with the heterogeneous distribution of microplastics (**Figure 4**). Additionally, manually creating calibration curves for 12 polymers and fitting the sample data to each curve was time-consuming. After receiving training at Frontier Lab, we are now in the process of purchasing a cryogenic mill and upgraded F-search software. These tools will allow for sample homogenization and the simultaneous quantification of all 12 polymers (polyethylene, polypropylene, polystyrene, acrylonitrile butadiene styrene copolymer, styrene-butadiene copolymer, polymethyl methacrylate, polycarbonate, polyvinylchloride, polyethylene terephthalate, polyurethane, Nylon 6, and Nylon

66). With these upgrades, we expect to process all sediment samples from the Matagorda Bay system by the next quarter.

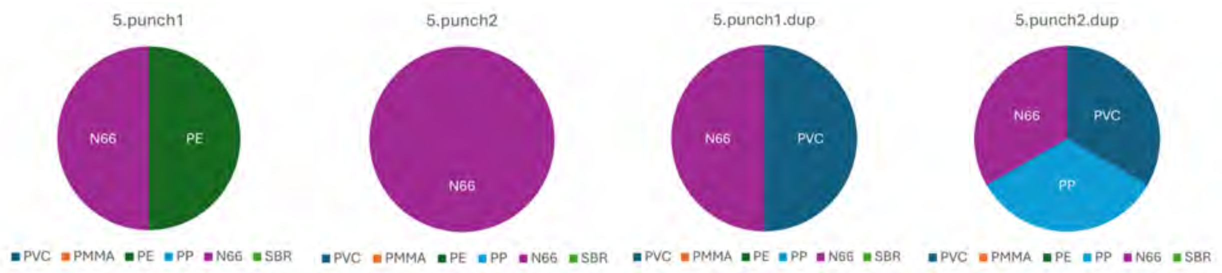

Figure 4. Bar charts displaying the polymer types identified in all of the samples loaded through the Pyrolysis-GC/MS in site 5 of Copus Christi Bay. Four polymers were found in site 5: N66, PE, PVC, and PP.

References

Wright, K., Hariharan, J., Passalacqua, P., Salter, G., & Lamb, M. P. (2022). From grains to plastics: Modeling nourishment patterns and hydraulic sorting of fluvially transported materials in deltas. *Journal of Geophysical Research: Earth Surface*, *127*(11), e2022JF006769.