



2026-2027 EOAS Colloquium Series

Organic-rich subterranean estuaries (STE) along the northern Gulf of Mexico: implications for coastal groundwater quality

Land development can alter coastal morphology, shallow groundwater flow paths, and the composition of groundwater reaching the ocean. Subterranean estuaries (STEs) are increasingly recognized as biogeochemically reactive zones. Little is known about carbon and nutrient transformations along anoxic groundwater flow paths through deeper (2–3 m), old or recently buried organic-rich deposits. This gap is important because the amount and reactivity of organic matter can strongly regulate the attenuation of land-derived contaminants such as anthropogenic nitrogen and affect coastal water quality.

In this talk, I will present results on biogeochemical transformations in an organic-rich STE in Mobile Bay, AL, which was formed when a salt marsh was buried during residential development in the 1970s. Field shallow geophysical exploration and sediment core collection show that these buried, organic-rich marsh deposits currently act as a conduit for shallow groundwater discharge. Nitrogen balance indicates that these deposits substantially attenuate anthropogenic NO_3^- transported toward the coast. However, degradation of the buried marsh organic matter releases DOC, DON, and NH_4^+ into groundwater. We hypothesize that these products may ultimately reach coastal waters, increase the oxygen demand, and potentially contribute to coastal hypoxia.

More recent experiments also demonstrate that these processes are sensitive to environmental conditions expected to change in shallow coastal aquifers. For example, we found that salinization alters both DOM composition and the mechanisms responsible for NH_4^+ mobilization, while longer residence times lead to accumulation of increasingly degraded DOM.



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