Temporal dynamics of submarine groundwater discharge in Mississippi coastal waters

DONGJOO JOUNG [1], HANNAH BOX [1], PENG HO [1], LAURA WHITMORE [1], HALEY ANDERSON[1], WILLARD MOORE[2], ALAN SHILLER [1]

[1]Division of Marine Science, University of Southern Mississippi, 1020 Balch Blvd., Stennis Space Center, MS 39529

[2]School of the Earth, Ocean and Environment, University of South Carolina, 701 Summer st. EWS 617 Columbia, SC 29208

Submarine groundwater discharge (SGD) is a critical component of coastal ecosystems, affecting biogeochemistry and productivity. The SGD flux and effect on the ecosystem of the Mississippi (MS) Bight has not been studied due to the region's complex geography with multiple freshwater sources and barrier islands. In this study, we determined Ba, $\delta^{18}O$ of water, and Ra-isotopes, together with nutrients, chlorophyll, and dissolved oxygen (DO) during multiple cruises from fall 2015 to summer 2016. Water isotope distributions ($\delta^{18}O$) suggest that, although the MS River Delta bounds the western side of the Bight, nonetheless, Mobile Bay and other local rivers are generally the Bight's dominant freshwater sources. Elevated dissolved Ba and Ra isotopes, relative to conservative mixing of river and ocean endmembers, were observed in both surface and bottom waters. Based on their high concentrations in saline groundwaters sampled on the barrier islands, the elevated Ba and Ra in MS Bight water are likely due to SGD. In subsurface waters, long-lived Ra isotopes were negatively correlated with DO during spring and summer 2016, suggesting direct discharge of DO-depleted groundwater and/or accumulation of SGD-derived Ra and microbial DO consumption under strongly stratified conditions. At some sites, high Ra isotopes and Ra-224/-223 ratios as well as low DO were observed in surface waters, indicating recent introduction of SGD to the surface. In the MS Bight, the water flushing time is estimated to range from <1 to 3 weeks, with the longest time in summer 2016 and shortest time in fall 2015 after a severe storm event. Spatially, the SGD in the MS Bight likely dominantly occurs near the barrier islands (e.g., Horn and Dauphin Islands) and the mouth of Mobile Bay, probably in association with old buried river channels, or dredged ship channels which may disturb aquifer structures. Our ongoing study suggests that seasonal variability in flushing, water stratification, and SGD input play important roles in biological production and bottom water hypoxia in the MS Bight.