Hypoxia in the Mississippi Bight: Understanding the role of submarine groundwater discharge in a complex coastal ecosystem.

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Coastal areas are key regions in our society. They host 1/3 of the population, play a key role in various economic activities (e.g., tourism, fisheries), and regulate the quality of the ecosystem. For example, the Louisiana Shelf contains productive fisheries which are subject to environmental issues including seasonal hypoxia. In that system, the large nutrient load delivered by the Mississippi River stimulates the production of organic matter which can then lead to oxygen consumption in bottom waters resulting in hypoxia. The coastal waters to the east of the Mississippi River delta, including the Mississippi Sound and Bight also experience seasonal hypoxia. An extended hypoxic area was observed in the bottom waters in summer 2016. Nevertheless, water isotope data show that there was little eastward outflow from the Mississippi River into the Mississippi Bight. Furthermore, local rivers are not enriched in nutrients, suggesting there might be another mechanism involved in the development of hypoxia in the Mississippi Bight bottom waters. Here, we hypothesize that submarine groundwater discharge (SGD) of anoxic water plays an important role in development of hypoxia of the Mississippi Bight. Radium concentrations, widely used as a tracer of SGD, were elevated in bottom waters in areas above the coarse sediments that usually promote high SGD. Furthermore, the radium concentrations were associated with high ammonia concentrations, and inversely correlated with low dissolved oxygen concentrations. These relationships suggest that a "bottom-up" influence of reduced substances on oxygen consumption can be an important contributor to hypoxia in bottom waters. Further evidence for this mechanism comes from a large fish kill, locally known as a Jubilee, that was observed in the Mississippi Sound in July 2017. A sharp increase in dissolved radium and methane was observed shortly after the fish kill, consistent with the key role played by SGD in the Mississippi Bight and Sound ecosystem.