Groundwater-derived alkalinity fluxes to a seondary bay: a temporal and spatial perspective

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With the continuing rise of carbon dioxide (CO_2) production worldwide, global concerns over oceanic and estuarine acidification have ascended. There are only a handful of studies that have studied submarine groundwater discharge (SGD) as a potential source of total alkalinity (TA) in coastal areas. However, no studies have investigated the fluctuations in TA as a result of changing hydrologic conditions (e.g. floods vs. drought) at both temporal and spatial scales and in semi-arid estuaries. We hypothesize that controls of SGD on estuarine TA could be significant at temporal and spatial scales associated with factors controling pathways of discharge and biogeochemical processes. A combination of innovative geophysical and geochemical techniques were applied at differene temporal and spatial scales over a year in a secondary bay in the semi-arid coastal area of south Texas near the Gulf of Mexico. SGD-derived TA inputs vary seasonally and spatially within the bay with a significant contribution throughout the entire year. For instance, while the highest SGD-derived TA input occurred mid-bay ($6.27 \cdot 10^6$ $\mu M/m^2/d$) during the dry season, post-flooding the input was the lowest ($1.26 \cdot 10^6$ $\mu M/m^2/d$). On the contrary, the largest input after a major flooding event was measured along the shoreline stations ($6.14 \cdot 10^6 \mu M/m^2/d$) which correlates with higher SGD rates induced by recharge to surrounding water table aquifer. Relatively high supersaturation indices with respect to calcite (0.51–1.0) and lower TA levels during the dry season suggest calcification may occur at some locations (i.e. calcification by oysters). Although this study shows that groundwater could play an important role in increasing the buffering capacity of estuaries, it is not clear how, and if, micro- and bio-geochemical processes within the top few centimeters of the bottom sediment are altering the SGD signature (i.e. TA consumption (e.g., environments where oxic degradation of organic matter occurs in the absence of calcium carbonate precipitation) before its output into the bay.