The development and validation of a profiling glider deep ISFET-based pH sensor for high resolution observations of coastal and ocean acidification

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Abstract (Oral Presentation)

Coastal and ocean acidification can alter ocean biogeochemistry, with ecological consequences that may result in economic and cultural losses. Yet few time series and high resolution spatial and temporal measurements exist to track the existence and movement of water low in pH and/or carbonate saturation. Past acidification monitoring efforts have either low spatial resolution (mooring) or high cost and low temporal and spatial resolution (research cruises). We developed the first integrated glider platform and sensor system for sampling pH throughout the water column of the coastal ocean. A deep ISFET (Ion Sensitive Field Effect Transistor)-based pH sensor system was modified and integrated into a Slocum glider, tank tested in natural seawater to determine in the U.S. Northeast Shelf. Comparative results between glider pH and pH measured spectrophotometrically from discrete seawater samples indicate that the glider pH sensor is capable of accuracy of 0.011 pH units or better for several weeks throughout the water column in the coastal ocean, with a precision of 0.005 pH units or better. Furthermore, simultaneous measurements from multiple sensors on the same glider enabled salinity-based estimates of total alkalinity and aragonite saturation state. During the Spring 2018 Mid-Atlantic deployment, glider pH and derived total alkalinity and aragonite saturation state data along the cross-shelf transect revealed higher pH and aragonite saturation state associated with the depth of chlorophyll and oxygen maxima and a warmer, saltier water mass. Lowest pH and aragonite saturation state occurred in bottom waters of the middle shelf and slope, and nearshore following a period of heavy precipitation. Biofouling was revealed to be the primary limitation of this sensor during a summer deployment, whereby offsets in pH and total alkalinity increased dramatically. Advances in anti-fouling coatings and the ability to routinely clean and swap out sensors can address this challenge. The data presented here demonstrate the ability for gliders to routinely provide high resolution water column data on regional scales that can be applied to acidification monitoring efforts in other coastal regions.