Ocean circulation and biogeochemistry moderate inter-annual and decadal surface water pH changes in the Sargasso Sea

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The oceans are absorbing anthropogenic CO_2 from the atmosphere lowering surface ocean pH, a concern for calcifying marine organisms. Predicting the impact of this ocean acidification is challenging for two reasons: 1) each species appears to respond differently and 2) our observations of natural pH changes are limited in both time and space. Carbonate $\delta^{11}B$ is a promising proxy for investigating ocean pH, particularly in corals where records can be long and high-resolution (monthly). However, offsets from thermodynamic relationships found in corals have made it challenging to reconstruct accurate records of pH from corals. Here we reconstruct 222 years of biennial seawater pH variability in the Sargasso Sea from a brain coral, *Diploria labyrinthiformis*. Hydrographic data from the Bermuda Atlantic Time-Series Study (BATS) are available to calibrate the coral $\delta^{11}B$ to Sargasso Sea pH, lessoning the challenges of coral specific offsets. The coral-derived record allows for differentiation of pH changes from surface temperature versus those from ocean circulation and biogeochemical changes. We find that ocean pH does not simply reflect atmospheric CO_2 trends; rather, circulation/biogeochemical changes account for >90% of pH variability in the Sargasso Sea and more variability in the last century than would be predicted from anthropogenic uptake of CO_2 alone.