Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36321

Spatiotemporal trends and drivers of alkalinity in the Northwest Atlantic Shelf

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Rising anthropogenic atmospheric carbon dioxide (CO_2) has increased the uptake of CO_2 in the surface ocean, altering regional carbon content and carbonate system variables. In coastal regions, alkalinity is modified by local biogeochemical processes on climate timescales. However, the carbon observational record on the Northwest Atlantic Shelf is limited temporally, making it difficult to resolve spatiotemporal trends of alkalinity under changing climate conditions. To expand the observational alkalinity record, we apply an empirical algorithm to World Ocean Database (WOD) and Atlantic Zone Monitoring Program (AZMP) oxygen, temperature, and salinity observations on the Northwest Atlantic Shelf. In employing this method, we reconstruct 30 years of alkalinity observations and compute regional long-term trends. We then decompose these trends to quantify the contribution of biogeochemical processes to the historical spatial and temporal variability within our observed trends and patterns. By quantifying these processes, we identify the major drivers of long-term shelf chemistry changes and partition them into local and remote drivers. Biological cycling of organic material, including sedimentary contributions, are large contributors to the trends in several regions. With our observationally based alkalinity reconstructions, we evaluate the performance of simulated alkalinity trends using the regional MOM6-COBALT-NWA model [1]. Because we have decomposed these trends to quantify the contribution from various biogeochemical processes, we then evaluate the model's ability to capture not only the trend but the drivers of that trend.

[1] Sasaki, D. K., C. Schultz, and E. Curchitser. 2026. A high-resolution coupled physical-biogeochemical model of the northeastern US continental shelf: MOM6-COBALT-NEUS25v1.0. https://doi.org/10.5194/egusphere-2025-5672