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TITLE: Advancing Observation of Ocean Biogeochemistry, Biology, and Ecosystems With Cost-Effective in situ Sensing Technologies

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ABSTRACT:

Advancing our understanding of ocean biogeochemistry, biology, and ecosystems relies on the ability to make observations both in the ocean and at the critical boundaries between the ocean and other earth systems at relevant spatial and temporal scales. After decades of advancement in ocean observing technologies, one of the key remaining challenges is how to cost-effectively make measurements at the increased resolution necessary for illuminating complex system processes and rapidly evolving changes. In recent years, biogeochemical and biological in situ sensors have been emerging that are three-fold or more lower in cost than established technologies,; cost reduction for many biological in situ sensors has also been significant, although the absolute costs are still relatively high. with cCost savings in these advancements has been driven by miniaturization, new methods of packaging, and lower-cost mass-produced components such as electronics and materials. Recently, field projects have demonstrated the potential for sciencequality data collection via large-scale deployments using cost-effective sensors and deployment strategies. In the coming decade, it is envisioned that ocean biogeochemistry and biology observations will be revolutionized by continued innovation in sensors with increasingly low price points and the scale-up of deployments of these in situ sensor technologies. The goal of this study is therefore to: (1) provide a review of existing sensor technologies that are already achieving costeffectiveness compared with traditional instrumentation, (2) present case studies of cost-effective in situ deployments that can provide insight into methods for bridging observational gaps, (3) identify key challenge areas where progress in cost reduction is lagging, and (4) present a number of potentially transformative directions for future ocean biogeochemical and biological studies using cost-effective technologies and deployment strategies.

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