

Autonomous Studies of Coupled Physical-Biogeochemical Processes- Lessons from NAB08 and Prospects for the Future

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Motivated by the increasing application of autonomous sensors to physical, biological and biogeochemical investigations at the submesoscale, we examine techniques developed during the 2008 North Atlantic Bloom Experiment (NAB08), review successes, failures, and lessons learned, and offer perspectives on how these approaches might evolve in response to near-term shifts in scientific goals and technological advances. NAB08 exploited the persistence of autonomous platforms coupled with the extensive capabilities of a ship-based sampling program to investigate the patch-scale physics, biogeochemistry and community dynamics of a spring phytoplankton bloom. Autonomous platforms (Seagliders following a heavily-instrumented Lagrangian float) collected measurements in a quasi-Lagrangian frame, beginning before bloom initiation and extending well past its demise. This system of autonomous instruments resolved variability at the patch scale while also providing the persistence needed to follow bloom evolution. Biological and biogeochemical measurements were conducted from R/V Knorr during the bloom. An aggressive protocol for sensor calibration and proxy building bridged the ship-based and autonomous efforts, leveraging the intensive but sparse ship-based measurements onto the much more numerous autonomous observations. The combination of sampling in the patch-following frame, persistent, autonomous surveys and focused, aggressive calibration and proxy building produced robust, quantitative estimates of physical and biogeochemical processes. This produced novel perspectives on several aspects of bloom evolution, including the mechanisms that govern initiation, the relative roles of respiration and sinking in driving POC export and an approach for upscaling to estimate export over broader regions. NAB08 offers a suitable model for modest networks, but alternative approaches will be required for larger arrays.