

## **Leveraging commercial ships for ongoing phytoplankton community observations**

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Productivity of photosynthetic plankton in the upper ocean is critical to the functioning of marine food webs and the ocean's role in global carbon cycling. These phytoplankton are extremely diverse and respond rapidly to changes in the environment, so chronic undersampling continues to limit understanding of how natural variability and intentional perturbations in ocean conditions impact them. This project meets that challenge head-on by enabling a state change in our knowledge about plankton communities across the dynamic and rapidly changing Northwest Atlantic. New high-throughput automated microscopic imaging will be integrated with detailed physical and chemical observations already being made across seasons and submesoscale-to-basin-scale variations in water masses between the Middle Atlantic Bight and Bermuda. The approach is cost-effective and inherently sustainable through leveraging with the Oleander Project for ship-of-opportunity scientific observations on a commercial vessel and Northeast U.S. Shelf Long-Term Ecological Research (NES LTER), both with on-going NSF funding. CMV Oleander makes twice weekly crossings between New Jersey and Bermuda and separately funded scientific data streams already include ocean velocity and acoustic backscatter, hydrographic properties, and pCO<sub>2</sub>. The addition of an Imaging FlowCytobot (IFCB) to the underway sensor suite for automated measurements of 1000s of individual plankton every hour will provide a state change in our knowledge about plankton communities across this dynamic and rapidly changing part of the ocean. Openly accessible IFCB data products, including size- and taxon resolved concentrations of organisms and their biomass, will be generated leveraging existing computer vision and AI pipelines from the NES-LTER project, which involves similar observations but only on the continental shelf. The unprecedented combination of spatial, temporal, and taxonomic resolution and coverage enabled by this approach will make it possible to assess directly how phytoplankton communities are changing through space and time across the distinctive water mass fronts and patterns of change over weeks to seasons in the western North Atlantic. Integration with other observational and modeling components of OVSN will extend understanding of how plankton community patterns are linked to changes in productivity and the magnitude and pathways of carbon flux to deeper waters. Future funding will be sought to sustain the plankton observations on CMV Oleander to capture year-to-year variations and long-term trends.