Mid-latitude Winter Carbon Export Is Missed Using Prescribed BCG-Argo Sampling ProtocolsAbstract

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The mixed-layer pump (MLP) significantly augments the global carbon transport from the surface mixed layer to deeper waters when ephemeral springtime surface blooms are repeatedly mixed to depth by storms. Exploiting an unusual 8-month BGC-Argo dataset of daily profiles in the mid-latitude (31° N) northwestern Pacific, here we show repetitive mid-winter MLP episodes that generated a seasonally-averaged particulate organic carbon (POC) export of ~130 mg C m^{-2} day^{-1}; roughly 25% of the export from the North Atlantic spring bloom. But subsampling this dataset on a 5 or 10-day cycle, as planned in the BGC-Argo program, generated an order of magnitude less export (5-day & 10-day), or even totally missed all MLP events (10-day). These findings demonstrate that more frequent profiling data are needed in at least mid-latitude regions, but such daily cycling would shorten float lifetimes and thereby threaten BGC-Argo program sustainability. We propose that a small number of targeted floats be tasked with daily profiling, and that machine learning strategies be used to link these data with satellite-derived physical and biological parameters to estimate POC export; an approach that did show promise here with our limited dataset. The unexpected large magnitude of the mid-winter POC export suggests that this or other new strategies are essential if the BGC-Argo program is to adequately estimate global carbon export from MLP processes.

Keywords: Ocean carbon cycle, BGC-Argo, Mixed-layer pump, POC, Chlorophyll-a, Carbon export

