Potential for monitoring plankton and particles with the Underwater Vision Profilers during open-ocean carbon dioxide removal deployments

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In the open ocean, the first building blocks of organic particles can be produced through different pathways among which primary production is the most important, converting dissolved inorganic carbon (DIC, previously exchanged with the atmosphere) into particulate and dissolved organic carbon (POC and DOC). Thereafter, physical (coagulation) and biological (zooplankton grazing) processes produce larger detritus as waste products of the pelagic ecosystem. Sinking, fragmentation and respiration processes of POC together with downward mixing of POC and DOC, can sequester carbon as DIC in the water column for relevant time scales (>100 years). Several open-ocean mCDR approaches aim to enhance these natural processes but their effectiveness and their impacts on natural ecosystems are difficult to assess.

Simultaneous detection and sizing of plankton and marine particles is now possible at scale with the Underwater Vision Profiler (UVP) deployed from ships or on autonomous platforms such as biogeochemical (BCG) Argo floats and gliders. Such observation delivers physical and biogeochemical data, from nutrients to plankton (>600μm) and detritus (>100μm), critical for monitoring and modeling carbon fluxes. Based on UVP results obtained in different ocean regions, in naturally fertilised and iron fertilised blooms, we present potential and limits of using cameras mounted on various platforms to detect plankton and POC surface accumulation, vertical export, flux attenuation (and thus release of DIC) and impact on mesopelagic plankton communities. We discuss how these data can be used to constrain the modelling of these natural processes to better assess carbon century-scale sequestration and ecosystem impacts.