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Imaging the Invisible: Insights into Morphology and Distribution of Particles and Plankton Assessed by Underwater Camera in Both Polar Regions

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1. INTRODUCTION

Recent advances in in situ underwater imaging have opened new horizons for understanding particle and plankton dynamics in marine ecosystems including polar regions. Utilizing the Underwater Vision Profiler (UVP), we conducted high-resolution investigations of particle size spectra and morphology of plankton and marine snow across both polar regions—Admiralty Bay (Antarctica), West Spitsbergen Shelf and fjords (Arctic), and several fjords along East Greenland (Arctic). This modern optical approach not only quantifies particle flux but uniquely enables the morphological classification of marine snow into distinct morphotypes, offering novel insights into their origin, biological composition, and role in the ocean's biological carbon pump.

2. RESULTS AND DISCUSSION

Our results highlight the importance of marine snow quality in regulating vertical carbon export and we demonstrate year-to-year variability in the structure of plankton–particle assemblages, particularly contrasting the summers of 2023 and 2024 in glacier-influenced coastal waters of Admiralty Bay, and summers of 2022 and 2023 in glacier-influenced Spitsbergen Fjords. Coupling UVP imaging with laser-based particle counters further refined our ability to resolve particle fields and provided new metrics to assess the food availability and quality for upper-trophic levels, including Arctic seabirds during the breeding season.

Moreover, underwater imaging allowed us to map glacial outflows and associated biological responses across East Greenland fjords, revealing how physical forcing shapes the spatial co-distribution of zooplankton and organic particles on the shelf. This integrative approach underscores the ecological and biogeochemical value of modern imaging tools and sets the stage for new perspectives in polar marine research.

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