MIXED-LAYER DEPTH AND CHL-A VARIABILITY IN THE SOUTHERN OCEAN

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The Southern Ocean contains some of the ocean’s deepest mixed layers. Because deep mixed layers can transport phytoplankton below the euphotic zone, light levels depend on mixed-layer depth (MLD), and phytoplankton growth is hypothesized to be co-limited by iron and light.

Combining satellite ocean colour data and fluorescence, backscattering and hydrographic profiles collected by southern elephant seals, EM-APEX, and Argo floats we evaluate the extent to which MLD influences phytoplankton bloom development and the vertical structure of chlorophyll-a (Chl-a) in the Southern Ocean. In situ measurements indicate that surface Chl-a (i.e. mean Chl-a for the upper light penetration depth) is a relatively good proxy of phytoplankton biomass (i.e. depth-integrated Chl-a) within the euphotic zone but gives an inadequate representation of biomass within the mixed layer, particularly in the summer. Although nearly vertically homogeneous Chl-a within the mixed layer prevails in seasonal mean profiles, subsurface Chl-a maxima are not uncommon from spring through fall. In spring, summer, and fall, the MLD is typically shallower than the euphotic depth, and deep Chl-a maxima can occur near the base of the mixed layer. The fact that the deep Chl-a maximum is found near the base of the mixed layer, closer to the nutrient maximum than the light maximum, suggests that nutrient limitation (i.e., essentially iron) can play a greater role than light limitation in governing productivity, and that mixing processes at the base of the mixed layer control phytoplankton growth and/or accumulation.

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