The habitat and biogeochemical properties of low-oxygen-adapted tropical ocean phytoplankton.

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Introduction

In regions where the upper bound of the oxygen minimum zone nears the euphotic zone, a unique community of phytoplankton can appear. Found at depths of ~100m, this community is past the optical bounds of satellite remote sensing, and thus, monitoring this community is complex.

Methods

Data were collected from a biogeochemical Argo float in the Eastern Tropical North Pacific. Using the data, we expanded a two-community conceptual model by Brewin et al (2022) by adding a third community, allowing for the isolation of each community to be studied further.

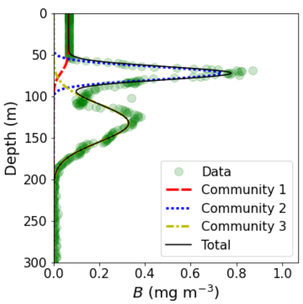

Figure 1: Example fit of rescaled fields in absolute units for chlorophyll.

Scan for Cox et al (2023) paper

Reference

Brewin, R. J. W., and others. 2022. A conceptual approach to partitioning a vertical profile of phytoplankton biomass into contributions from two communities. J. Geophys. Res. Oceans. 127: e2021JC018195. doi:10.1029/2021JC018195

Results

Community Dynamics

C_1 dominate the mixed layer and have a higher concentration during the winter months (Nov–Apr). Whereas, C_2 has a strong presence over the annual cycle, with a depth of peak biomass at around 60 m. C_3, however, resides at a depth of around 100 m (below the 5 μmol kg-1 DO boundary), at times reaching depths of 200 m.

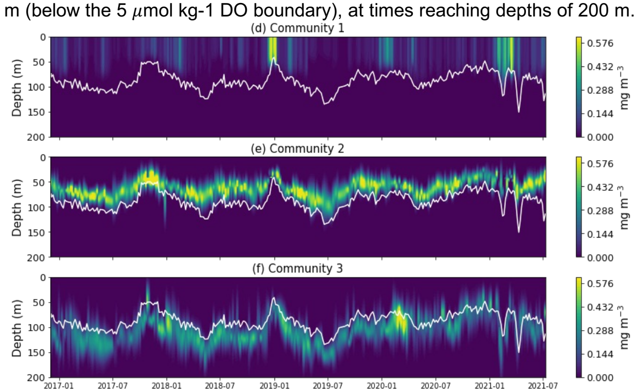

Figure 2: Vertical partitioning of; (a) community 1 (C_1), (b) community 2 (C_2), (c) community 3 (C_3), using the chlorophyll model (mg m-3).

Contributions to Community Stock

There is variation between each community's contribution to integrated stocks. C_2 (44%) and C_3 (41%) have higher average contributions to integrated Chl *a* than C_1. However, C_2 and C_3 contribute less (~ 30%) than C_1 (~ 40%) to integrated particulate backscattering, phytoplankton's depth-dependant variations in the carbon:Chl *a* ratio.

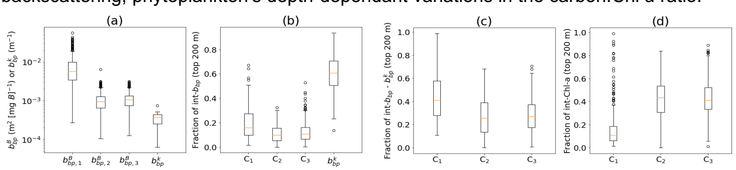

Figure 3: : a) chlorophyll-specific particulate backscattering values and (b) fractions of integrated particulate backscattering for C_1, C_2, C_3 and the background backscattering coefficient (b_{bp}^k), (c) fractions of integrated particulate backscattering and (d) fractions of integrated chlorophyll-*a* for for C_1, C_2, C_3 without b_{bp}^k.

Environmental Conditions

At a depth of ~ 106 m, C_3 thrives in an extreme environment, characterised by low irradiance levels of ~ 0.02 molequanta m−2 d−1 (~ 0.04% of surface irradiance), low temperatures at 14.6°C (median), oxygen depleted waters at 96.63 µmol kg−1 (median), high salinity of 34.74 PSU (median), and resultant higher density at 34.74 PSU (median). Despite C_3 residing in the densest waters, C_2 has the greatest stability due to C_3 being below the thermocline and oxycline.

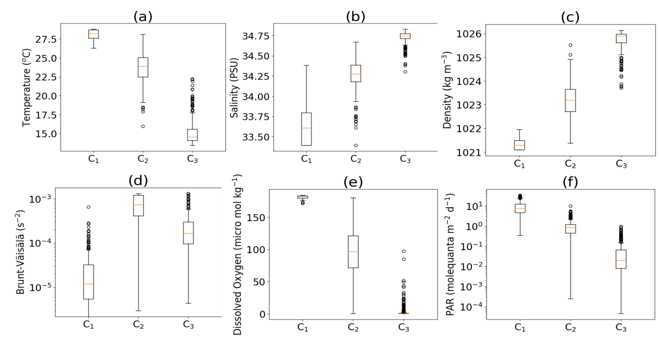

Figure 6: Environmental conditions for C_1, C_2 and C_3. (a) temperature (°C), (b) salinity (PSU), (c) density (kg m^{-3}), (d) Brunt-Välsälä (s^{-2}), (e) DO (µmol kg^{-1}), and (f) PAR (mole quanta m^{-2} d^{-1}).

Summary

Brewin et al's (2022) two-community model has been extended, adding the third community (C_3). Applying the model to data collected by a BGC-Argo float, C_3 is explored. C_3 has a similar chl-specific particulate backscattering to C_2, lower than that of C_1. Both C_2 and C_3 significantly contribute (~41%) to integrated stocks of Chl *a,* and integrated particulate backscattering (~30). Although having a similar contribution as C_2 (found at depths of 60 m), C_3 are found at lower depths (~100 m) – characterised by a low temperatures, high density, low light, low oxygen, and high saline habitat – and have a lower biomass yet have a broader peak. In addition, this unique community appears to thrive in an environment characterised by lower temperatures, higher density, lower light, lower oxygen, and higher saline habitat, than C_2 and C_3.