# Differential growth and mortality rates of Prochlorococcus, Synechococcus and picoeukaryotes across subarctic and subtropical waters

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**Abstract**

The open ocean represents 60% of the earth's surface area and is characterized by a biological community dominated by organisms smaller than 10 microns in size, such as the cyanobacteria Prochlorococcus and Synechococcus. In some regions of the ocean, such as in the subtropical Pacific, these organisms represent more than 90% of the total number of phytoplankton, and dominate primary production as well as carbon export. Strong temporal and spatial distributions of the open ocean community have been observed, however our understanding of the selective forces that shape these patterns remain unclear in part due to the low sampling frequency. Accurate descriptions of microbial community distributions and abundance require observations that occur at a higher frequency than the rate of cell division or mortality, or the rate of environmental changes. We used our novel underway flow cytometer, SeaFlow, to collect the equivalent of one sample every three minutes to study the fine-scale distribution of Prochlorococcus, Synechococcus and picoeukaryotes in surface waters across a 8000-km long latitudinal transect from the subarctic to subtropical oceans. A clear diel variation in cell size was observed for all three populations suggesting that cell growth and cell division rates were highly synchronized to the light/dark cycle despite strong gradients in other environmental conditions. Cell division for Synechococcus and picoeukaryotes began at dusk while Prochlorococcus divided at dusk or at dawn. South of 40-degree latitude, increases in cell concentrations for the three populations coincide with cell division while decreases occur during cell growth, suggesting a strong grazing pressure. We have estimated daily specific growth rate of each population based on the size distribution, cell growth and cell division. The results showed that overall changes in cell concentrations of Prochlorococcus, Synechococcus and picoeukaryotes in subtropical waters could be attributed to a variation in their specific growth rates and grazing pressure, while the dynamics of the three populations in subarctic waters is driven by physical transport.

**Keywords:** Cell growth, Grazing, Prochlorococcus, Synechococcus, SeaFlow

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