
SeaFlow: A novel underway cytometer for continuous observations of phytoplankton in the ocean

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Abstract

A novel cytometer, named SeaFlow, has been developed for continuous real-time observations of natural assemblages of small phytoplankton cells, including *Prochlorococcus*. Unlike other flow cytometers, SeaFlow does not use sheath fluid. Instead, a virtual-core is used to determine the position of a particle in the stream of seawater. By eliminating sheath fluid, SeaFlow can continuously sample the seawater stream directly from a ship's intake system. Image analysis is used to automatically align the laser with the optical system and then monitor and correct for drift. SeaFlow performs rapid quantification (up to 24,000 cells per second) of multidimensional characteristics of phytoplankton cells in the pico- to nanophytoplankton size range (0.5-20 μm) to analyze the equivalent of 480 traditional flow cytometry samples per day while on board a research vessel. Data analysis tools have been created to automatically cluster and count phytoplankton populations with geo-referenced data visualization. SeaFlow makes it possible to explore surface phytoplankton dynamics at a spatial scale ranging from a few meters to thousands of kilometers. To date, approximately 150 days of continuous cytometry data traversing 35,000 km in the north Pacific has been collected, a data set comparable to collecting ~70,000 traditional flow cytometry samples.

Keywords: cytometry, phytoplankton, distribution, time series

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