How can imaging flow cytometry serve ocean color science?

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Since launch of the first ocean color satellites after 1970s, the understanding of global phytoplankton biomass, distribution, community composition, bloom mechanism and estimation of total primary production has been greatly promoted, thanks to the rapid development of ocean color science. With more observations from the unique top-view macroscopic perspective, demand on having more accurate in situ microscopic observations of phytoplankton is also growing. To correct and validate modeling and retrieval algorisms, and to complement underwater depths beneath photic layer, in situ observation methods are expected to achieve accurate measurement on ever larger tempo-spatial scale with high sampling frequency. This stimulated the advent and development of imaging flow cytometry (IFC), an automated flow-through optical microscopy method in equivalent, for high-throughput in situ quantitation and characterization of phytoplankton in natural seawater.

IFC can automatically extract multi-parameter statistical information of phytoplankton water samples by computer analyzing numerous digital micrographs captured while they flow through an optical interrogation area. This means is much faster than traditional microscopy. However, taking fast yet accurate measurement of diverse natural phytoplankton with extreme heterogeneity remains challenging for current IFC instruments. Without new solutions to resolve technical issues such as deficiency in sensitivity and resolution, compromise between imaging throughput and image quality, and trade-off between analyzable water volume and statistical accuracy, the advantages and potential of this technology in taxonomy and automation will remain underscored, as its resultant analyzing throughput is much smaller than other underway methods such as spectrophotometry that can be used for inline observation on R/Vs cruise.

This talk will first introduce the basics and review typical instruments of IFC technology for in situ phytoplankton observations, followed by a progress report on FluoSieve, a new fluorescence IFC developed by our team towards resolving the aforementioned issues. Finally, the challenges and trends of IFC technology development for future in situ phytoplankton observation will be discussed.