

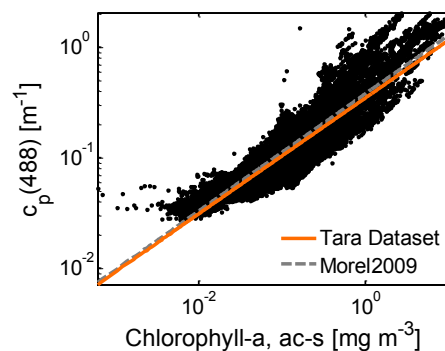
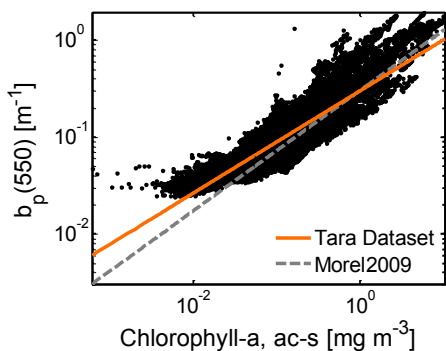
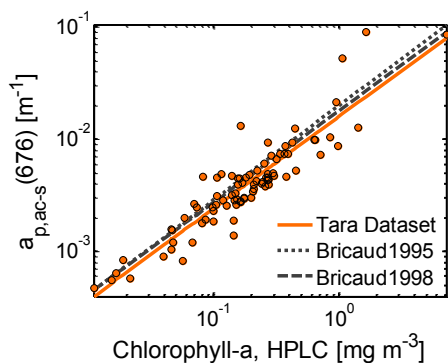
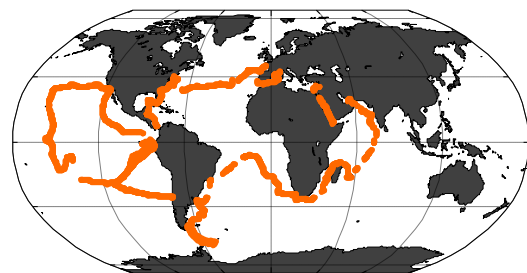


## FlowControl System Instrumental in Collecting Optical Property Data during Tara Oceans Expeditions

Sequoia Scientific's FlowControl-Lab is being used on R/V Tara with WET Labs (Philomath, OR) ac-s spectrophotometers to make robust, high-quality, measurements of inherent optical properties while underway. The system was installed in the bilge of the research vessel and minimally attended during the 2.5-year long Tara Ocean Expedition, except for roughly weekly cleaning of optics and scheduled replacement of the ac-s instrument. A similar system is currently being used during the Tara Oceans Polar Circle Expedition.

*"Tara Expeditions organizes voyages to study and understand the impact of climate change and the ecological crisis facing the world's oceans."*  
—visit [oceans.taraexpeditions.org](http://oceans.taraexpeditions.org)

The 2009-2012 Tara Oceans Expedition focused on a global study of marine plankton. Measurements of the absorption and scattering of seawater provide an ability to quantify and characterize phytoplankton, and are also a direct link between the organisms and ocean color satellite sensors designed to sense them, such as NASA's MODIS instrument. The optical property dataset from the 2009-2012 expedition contains nearly 70,000 absorption and 60,000 scattering spectra from around the world.



Optical property data from the Tara Expeditions are found to be consistent with chlorophyll samples measured using HPLC, and with published relationships between chlorophyll concentration and optical scattering ( $b_p$ ) and beam attenuation ( $c_p$ ). These results indicate that the Tara dataset, facilitated by the use of the FlowControl system, are of high quality and useful for developing ocean color bio-optical algorithms.

For more information, this unprecedented dataset is described in detail in the following articles:

Boss, E., M. Picheral, T. Leeuw, A. Chase, E. Karsenti, G. Gorsky, L. Taylor, W. Slade, J. Ras, and H. Claustre. The characteristics of particulate absorption, scattering and attenuation coefficients in the surface ocean; Contribution of the Tara Oceans Expedition. *Methods in Oceanography*, in press (2013).

Werdell, P.J., C.W. Proctor, E. Boss, T. Leeuw, and M. Ouhssain. Underway sampling of marine inherent optical properties on the Tara Oceans expedition as a novel resource for ocean color satellite data product validation. *Methods in Oceanography*, in press (2013).

The operating principle of the FlowControl system is to make periodic filtered seawater measurements, resulting in high-accuracy differential measurements of particle properties. For more information on the method, see:

Slade, W.H., E. Boss, G. Dall'Olmo, M.R. Langner, J. Loftin, M.J. Behrenfeld, C. Roesler, and T.K. Westberry. Underway and moored methods for improving accuracy in measurement of spectral particulate absorption and attenuation. *Journal of Atmospheric and Oceanic Technology* 27, 2010, 1733-1746.

Two different models exist: FlowControl-Lab for laboratory use, typically as part of a ship's flowing seawater lab or dockside sampling; and FlowControl-Sub, for submersible use down to 500 m on optical profiling packages, moorings, or tripods.



*The FlowControl-Sub typically profiles unfiltered water on down casts and filtered water on up casts. An on-board data logger monitors the depth and switches to filtered water on the up cast. The filtered and unfiltered measurements allows for differential measurements of particle properties from a single cast, saving time and resulting in higher quality profiles in highly variable waters..*



*FlowControl-Lab connects with a PC and Windows-based software controls the timing of valve switching. The lab version also includes a high-resolution inline flow sensor for monitoring flow rates.*