Expanded Spectral Domain for Global Next-Generation Oceanic Algorithms

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The Scale of the Anticipated Algorithm Spans the Open Ocean to Inland Rivers, Lakes, and Reservoirs

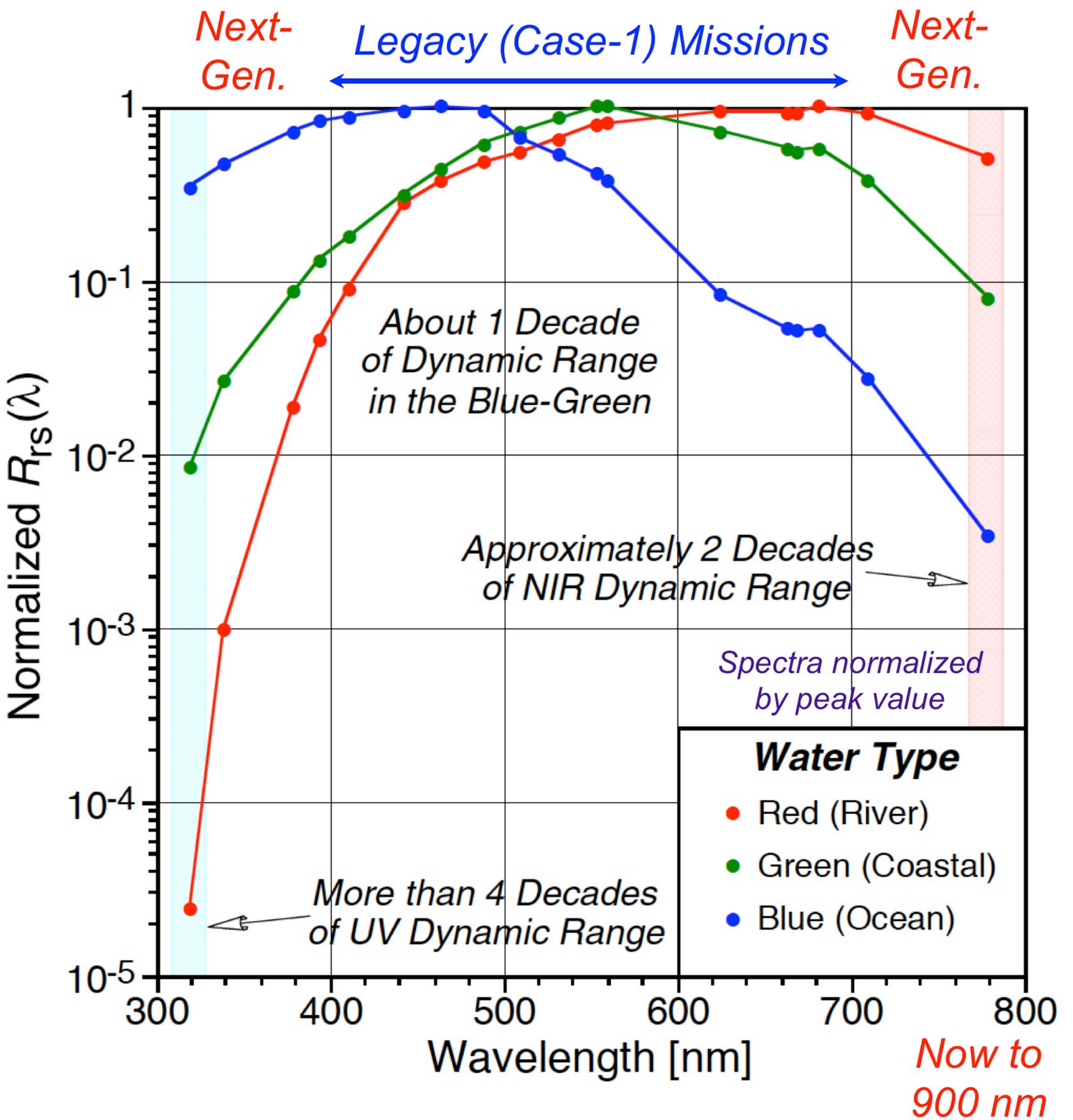
Japanese R/V *Hakuho Maru* (100 m)

American R/V *Recon 18* (5 m)

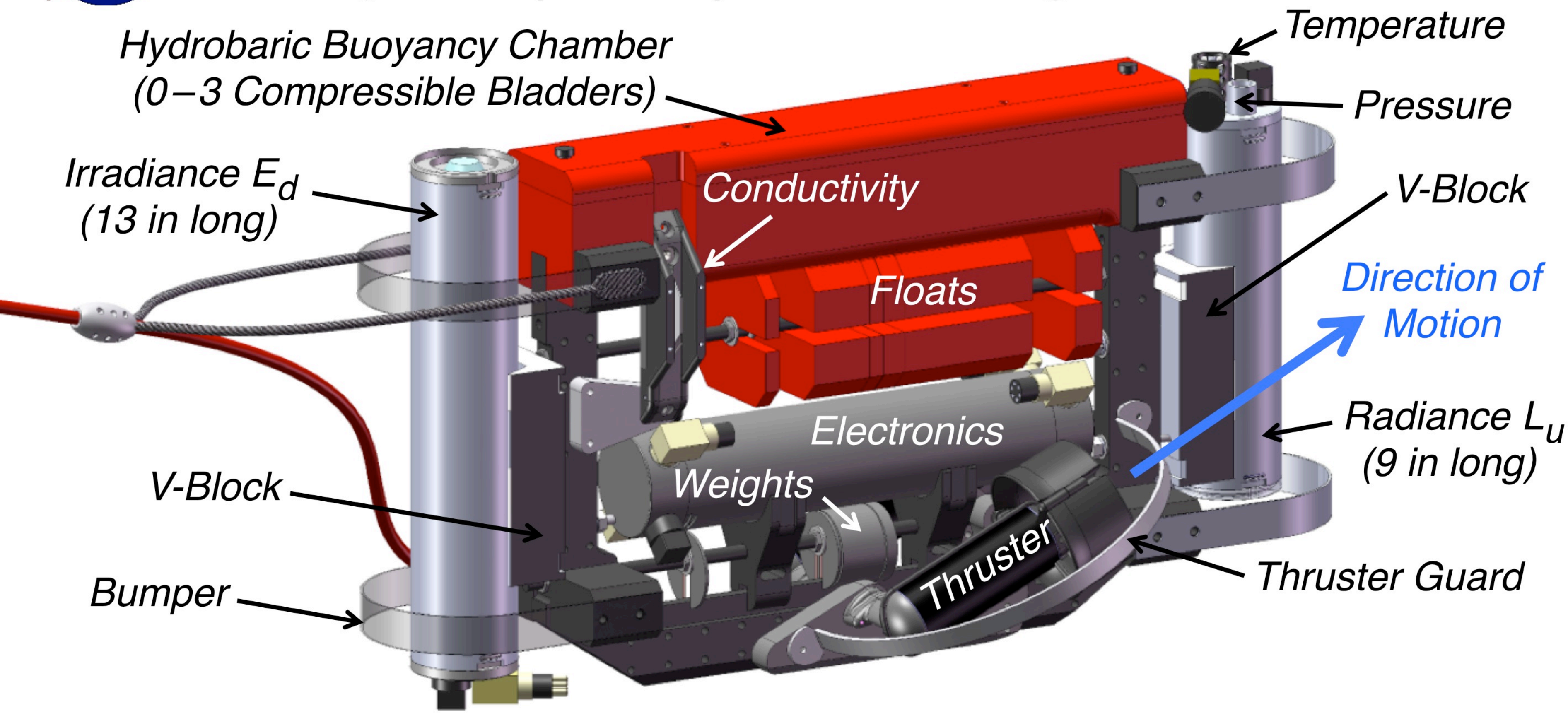
The global field sampling presented here spans nominally oligotrophic (clear) open-ocean waters to eutrophic (turbid) inland rivers, lakes, and reservoirs. This means the scale of the field work is well represented by the size of the attendant sampling platforms. To ensure uniform data quality, significant effort has been made over the last decade, which has been brought to final fruition with ACE (US) and SGLI (Japanese) funding. The principal focus has been to refine a single set of optical protocols for *all* water masses plus time and space scales: a) instruments, b) data acquisition, c) water sampling (biogeochemistry), and d) data processing.

Preparing for the Next-Generation Objective of Remotely Sensing Coastal Ecosystems

Next-generation satellite sensors (e.g., PACE, ACE, and SGLI), will initiate a global emphasis on coastal sampling. The coastal zone has a wide diversity of ecosystems with varying levels of optical complexity. Legacy missions (SeaWiFS and MODIS) concentrated on the open ocean, which is optically simpler, and used visible wavelengths (400–700 nm). The ultraviolet (UV) and near-infrared (NIR) channels that will be added to next-generation sensors provide an opportunity to determine more constituents in global water masses, because there is a greater dynamic range in the radiometric expression of water types in these domains, e.g., using the remote sensing reflectance, $R_{rs}(\lambda)$.



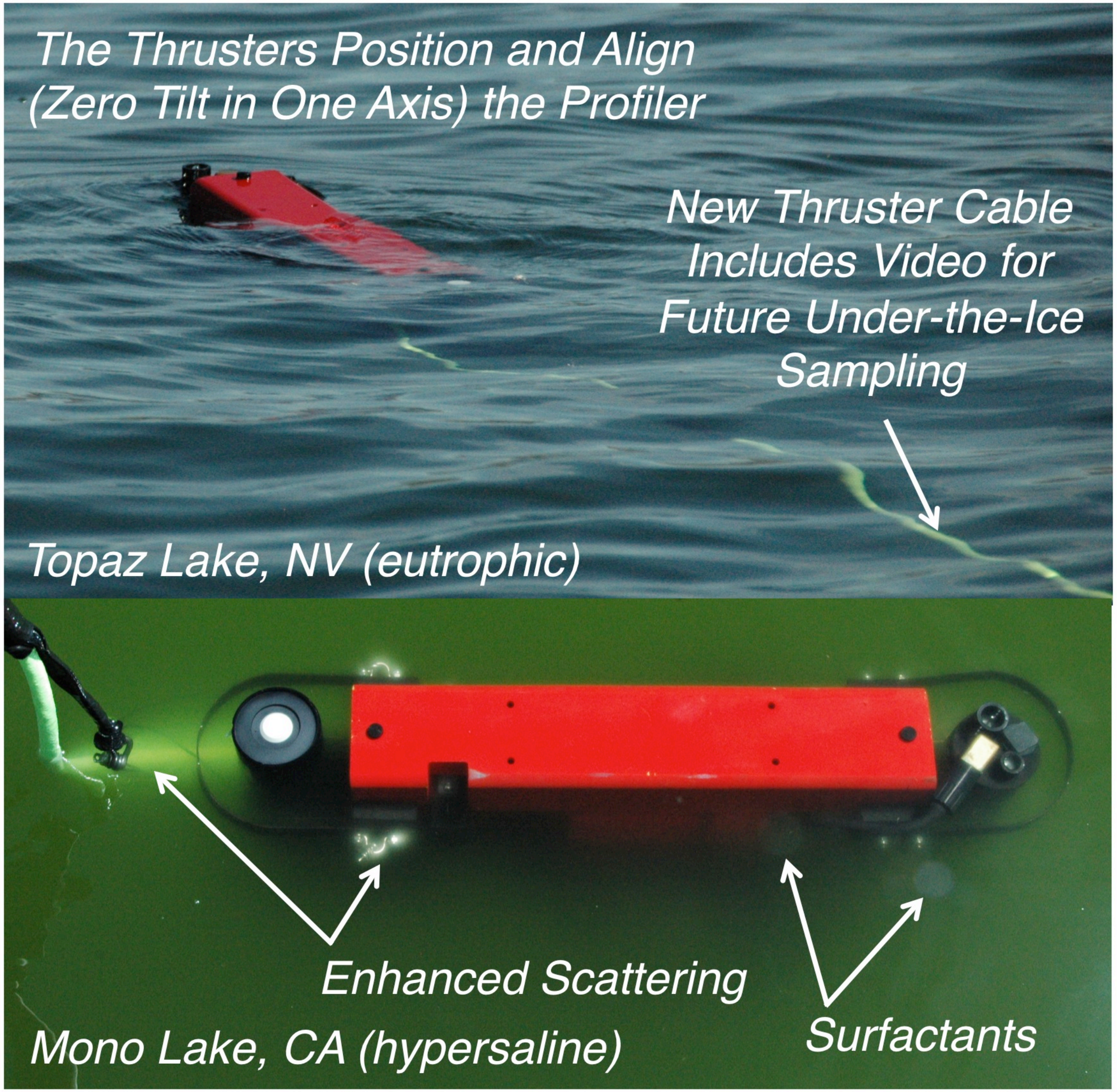
The State-of-the-Art Compact-Optical Profiling System (C-OPS) with Two Digital Thrusters



C-OPS uses 7 cm (OD) instruments each with 19 microradiometers (313 – 875 nm) sampling at 12 – 15 Hz. Adjustable v-blocks plus movable flotation and weights counter pitch (e.g., cable tension) and roll biases, typically to within 2.5° (protocols require 5°). Hydrobaric buoyancy (compressible bladders) provides near-surface loitering and less than 1 cm (as low as about 1 mm) vertical resolution. The weights, floats, and bladders set the terminal velocity (usually 10 – 25 cm s^{-1}) at 3 – 5 m.

God never intended Southern California to be anything but desert... Man has made it what it is. —*McWilliams 1946*

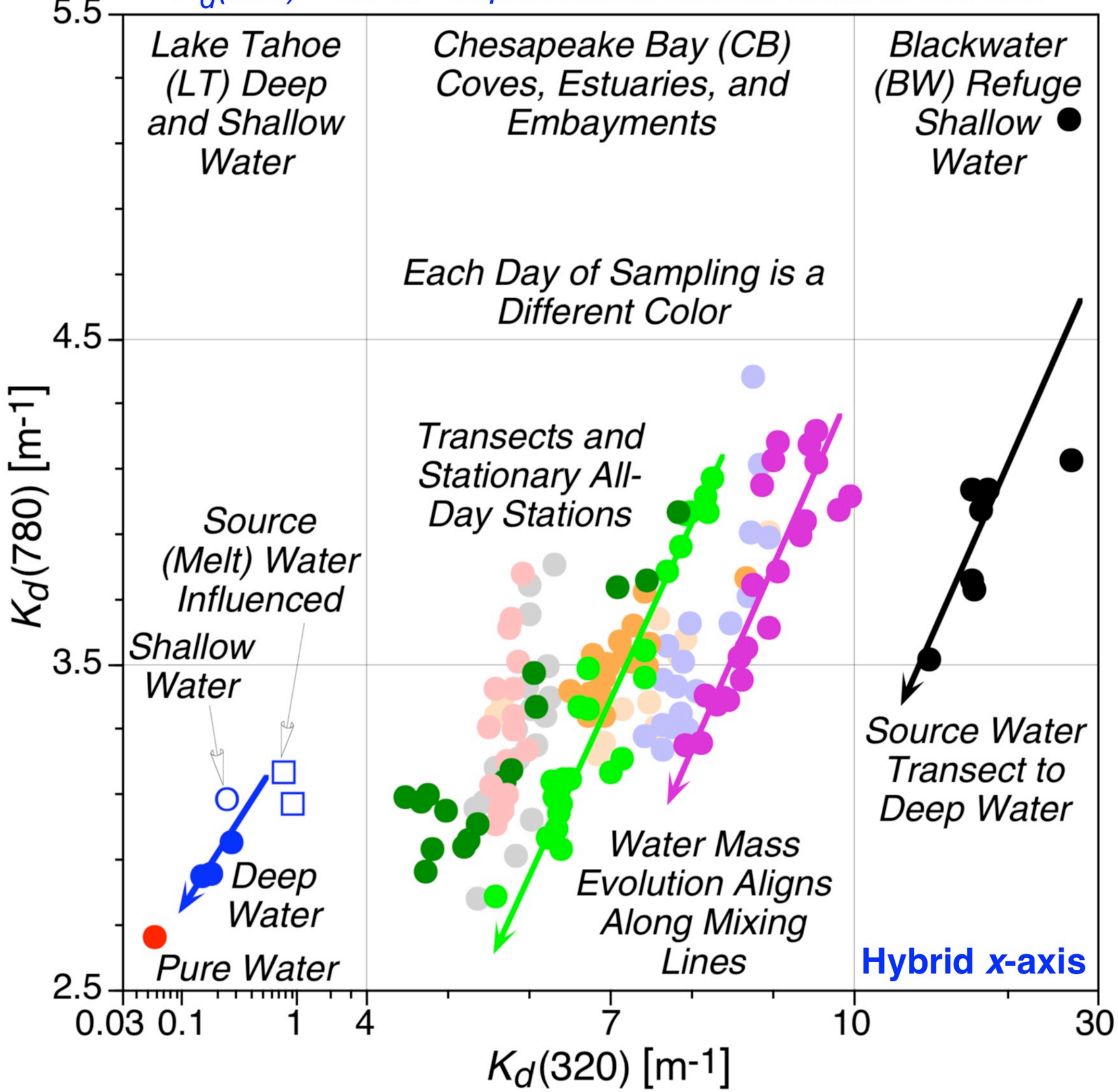
The thrusters are used to set the position of the profiler in the water mass with respect to the usually anchored boat. The small amount of thrust is sufficient to keep the profiler at the surface will a small tilt (the radiance end is tilted up). When the thrust is removed, the profiler *breaches* and the start of the cast is very nearly at $z = 0$ m. After *righting*, the profiler descends with minimal vertical tilts (less than 2.5° in calm water). Once the desired depth is reached, the profiler is hauled to the surface with the aid of the thrusters, which places the profiler away from the boat. The rapid cycling has significantly improved data quality (by a factor of 2).



COTS AOP Instruments Permit an Unprecedented Flexibility in Calibration and Validation Activities

The present capabilities of C-OPS data acquisition and PROSIT data processing provide complete data products across the UV–VIS–NIR (320 – 875 nm). All data products, including $R_{rs}(\lambda)$, are produced within the top 1–2 m of the water column, because the hydrobaric buoyancy system allows surface loitering and vertical resolution of about 1 mm). The resulting data products permit fine-scale discrimination of both daily and along-track evolution of water masses. *This is seen across a very wide range in turbidity (about 3 decades) spanning hyper-oligotrophic (Lake Tahoe) to eutrophic (Chesapeake Bay) conditions*.

$K_d(320)$ = 25 m^{-1} represents a vertical scale of 3.6 cm.



A Global CDOM Algorithm from State-of-the-Art End-Member Optical Data Acquisition and Processing

Using southern Mid-Atlantic Bight (SMAB), Gulf of Maine and Arctic optical end-member pairs (UV and NIR), Hooker et al. (2013) created (light gray) and also validated (dark gray) a colored dissolved organic matter (CDOM) algorithm. Extending the algorithm with Antarctic, Lake Tahoe, and additional Chesapeake Bay (GEO-CAPE) data revealed a likely global optical relationship between CDOM and the diffuse attenuation coefficient, K_d. Recently added SGLI data from the Chukchi Sea and North Pacific gyre plus ACE shallow-water campaigns (US west coast) establish the robustness of the emerging global algorithm.

The algorithm spans 2–3 decades of dynamic range.