Practical Considerations for Case-2 AOP Data Acquisition and Data Processing

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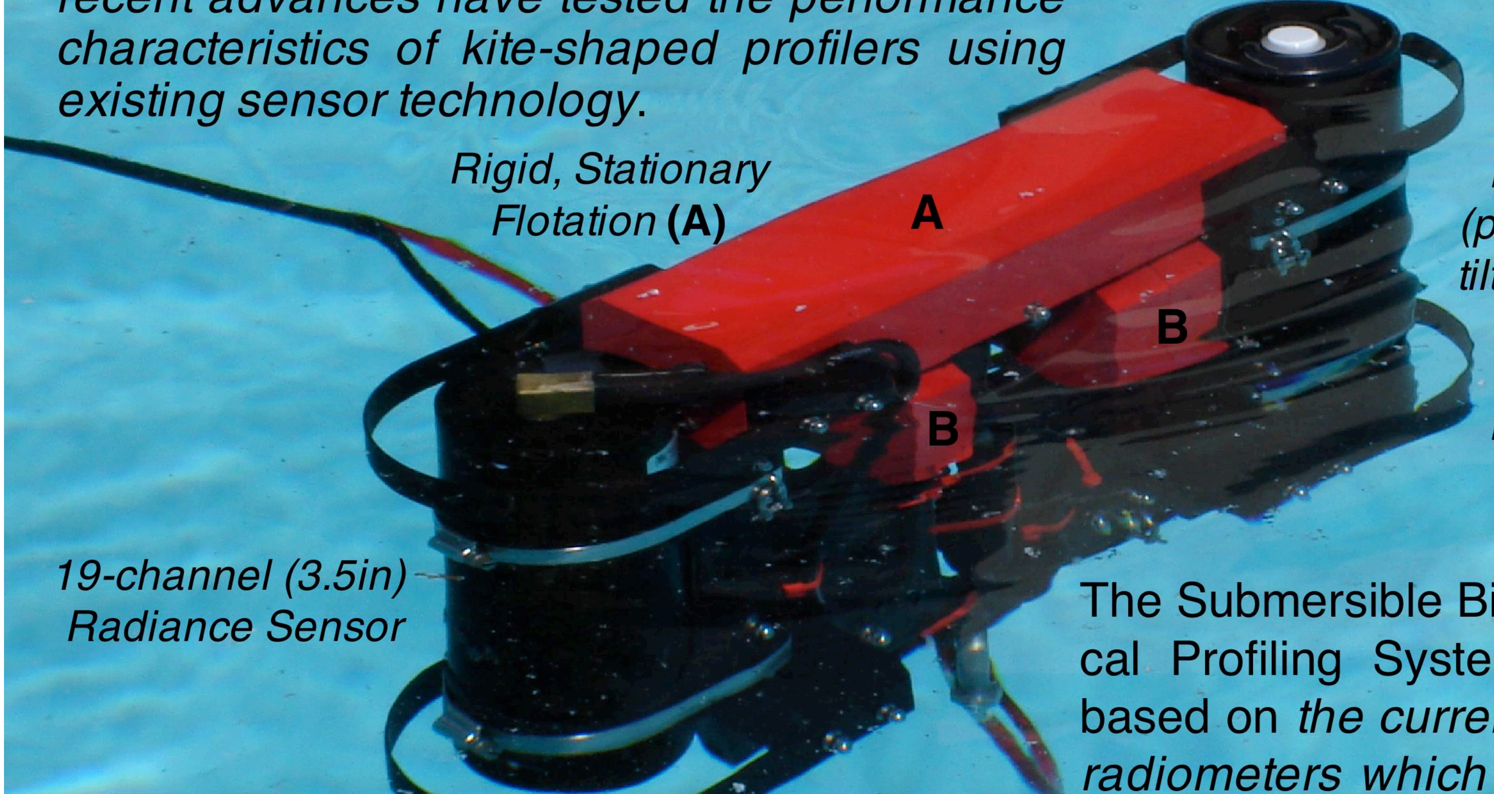
Practical Advancements in AOP Instruments to Improve Observations in Shallow (Coastal) Waters

Free-fall profilers are needed to avoid platform perturbations. Most legacy instruments are rapidly-descending, rocket-shaped devices, but *recent advances have tested the performance characteristics of kite-shaped profilers using existing sensor technology*.

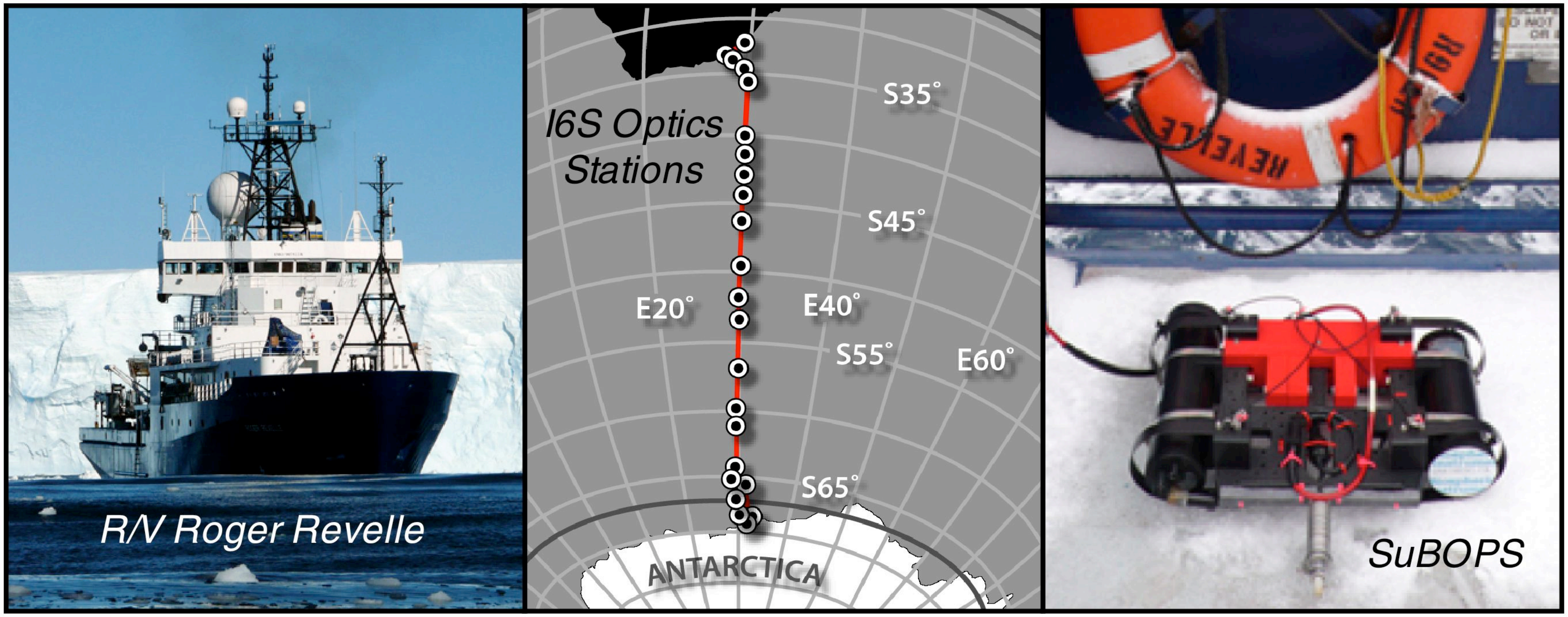


The Submersible Biospherical Optical Profiling System (SuBOPS) is based on *the current PRR series of radiometers which have a spectral coverage of 320–865 nm*. The profiler is about 15 in H and 20 in W.

AOP Free-Fall Profiles: 102 Casts, $Z_W = 3.5 - 254$ m, $Z_{1\%} = 3 - 28$ m, and $K_d = 0.15 - 3.36$ m^{-1}

A continuing amount of effort is applied to improving the protocols for AOP sampling.

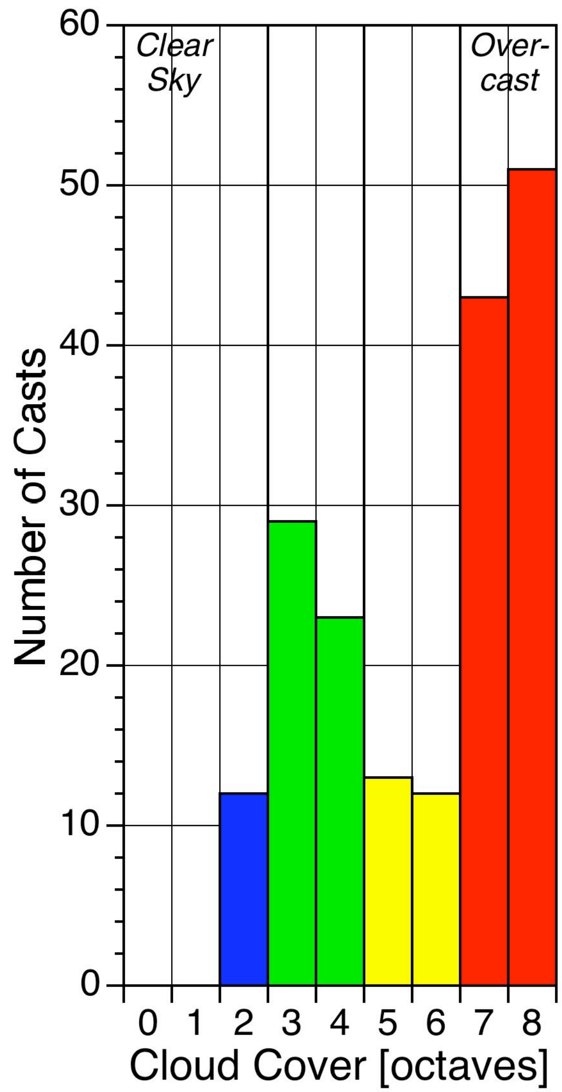
Climate Variability (CLIVAR) I6S Cruise: Durban (South Africa) to the Antarctic Ice Edge

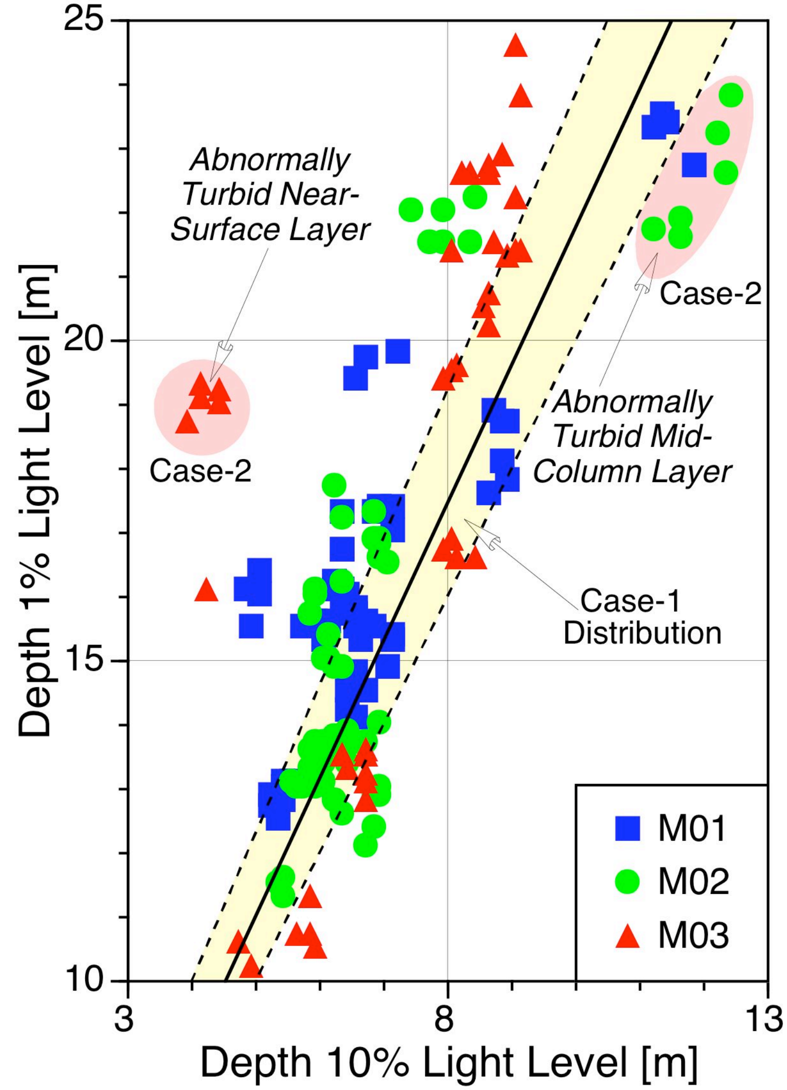


The primary reason for participating in the CLIVAR I6S cruise was to address the paucity of data in SeaBASS for high latitudes. SuBOPS was deployed at 24 stations (66 casts). Of the total, 39 casts (59% of the data) were at the crucial 50 °S or higher latitudes. Seawater was also collected after each AOP cast for HPLC pigment analysis, particulate absorption, particulate organic carbon and nitrogen, and total suspended matter. In addition, biogeochemical samples for chromophoric dissolved organic matter (CDOM), flow cytometry, special CDOM characterization, and future CDOM experiments were also obtained for N. Nelson (UCSB).

Sources of Variability in AOP Measurements in Coastal (Case-2) Waters

Two problems with the collection of high-quality AOP data in coastal waters that must be addressed are: a) greater atmospheric variability from working close to the land–ocean interface, and b) greater variability in optical relationships from the increasing influence of Case-2 waters. The first can only be overcome with a combination of persistence and good luck, and the latter requires instruments with excellent vertical sampling resolution.

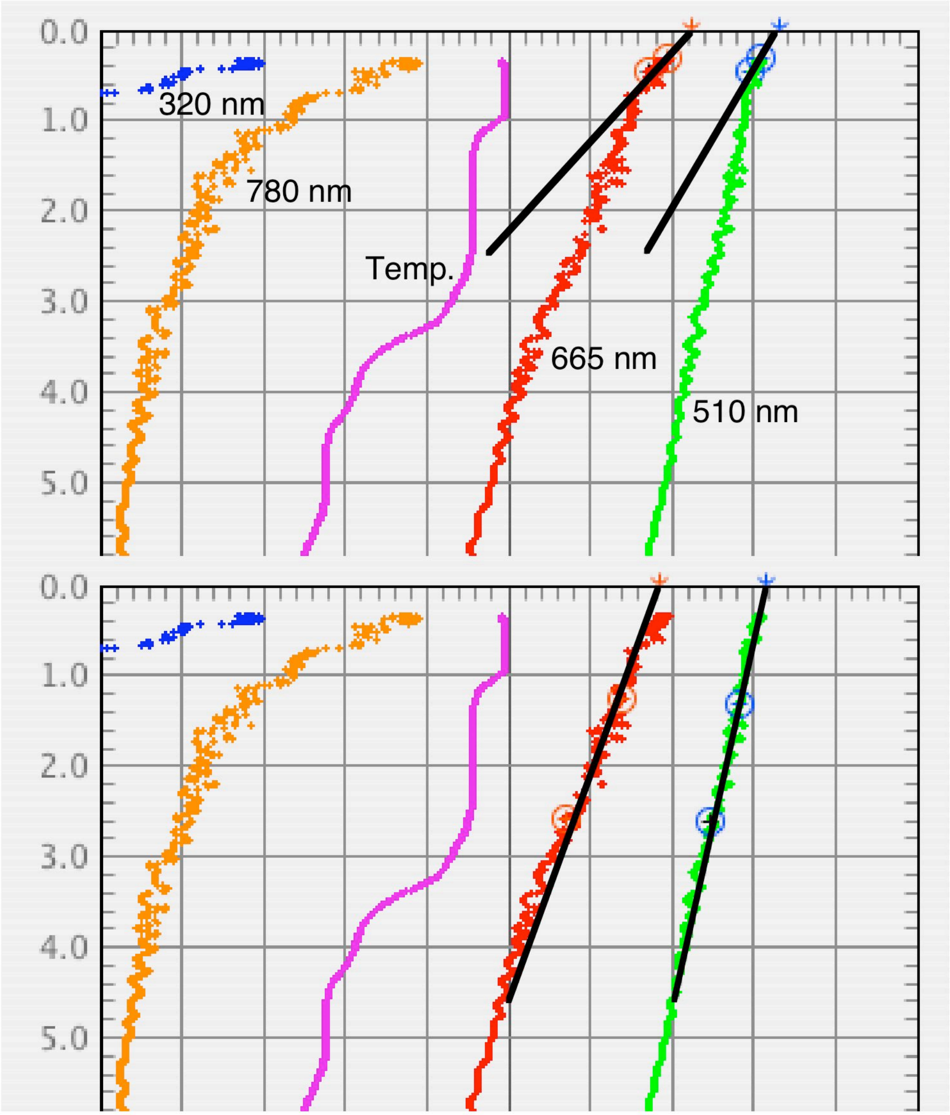




Estimating Extrapolation Intervals in Turbid (Case-2) Water Requires Unprecedented Vertical Resolution

Coastal waters frequently have significant vertical complexity. Although the length scales can be detected by instruments having coarse sampling capabilities, *the derivation of AOPs requires an accurate determination of an extrapolation interval from which all data products are derived*.

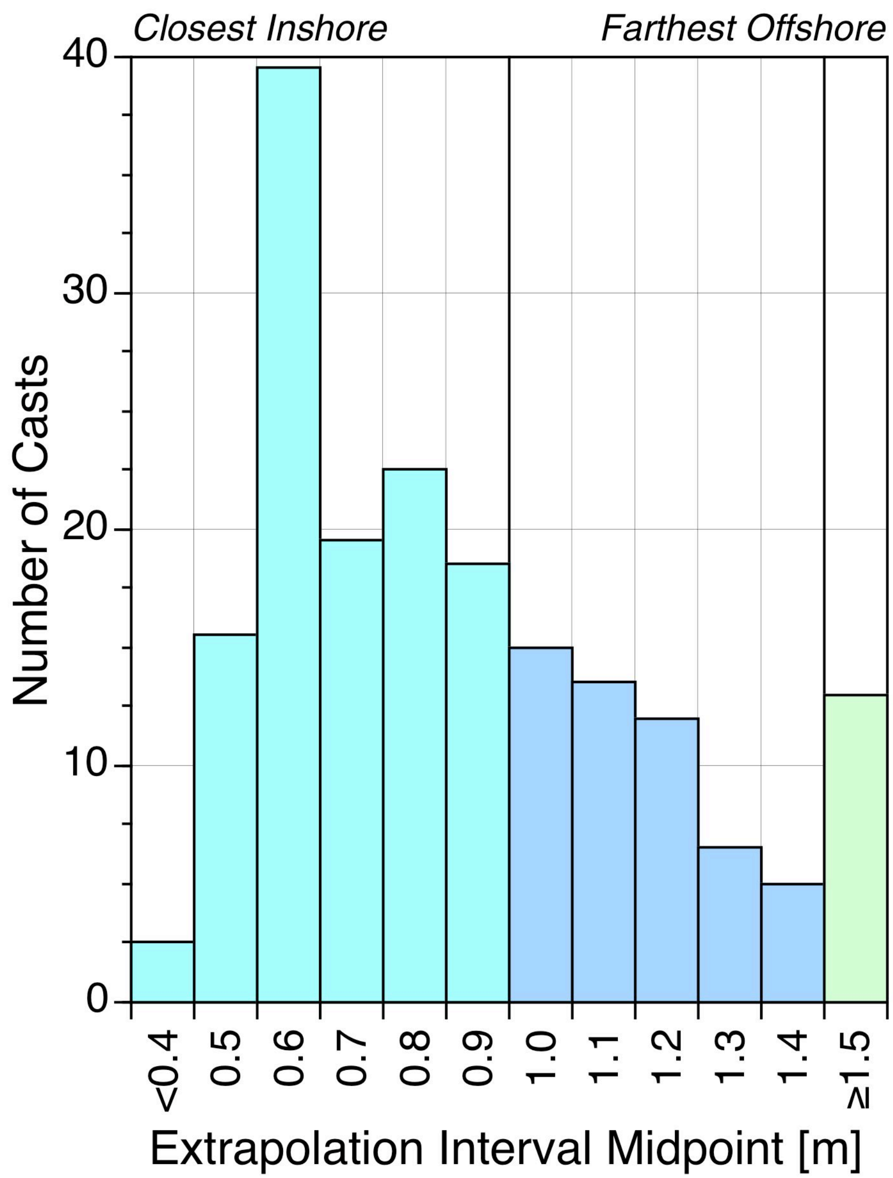
The top panel shows a near-surface estimation of the extrapolation interval, which is within a surface layer that is approximately 1 m thick. The data are from the upwelled radiance measurements made by SuBOPS. The (sloping) black lines are the K_{Lu} values. The bottom panel shows the best determination of K_{Lu} from a less capable instrument wherein the extrapolation interval starts deeper in the water column, but is restricted to the next obvious layer.



Vertical Complexity Can Lead to Very Shallow Extrapolation Intervals

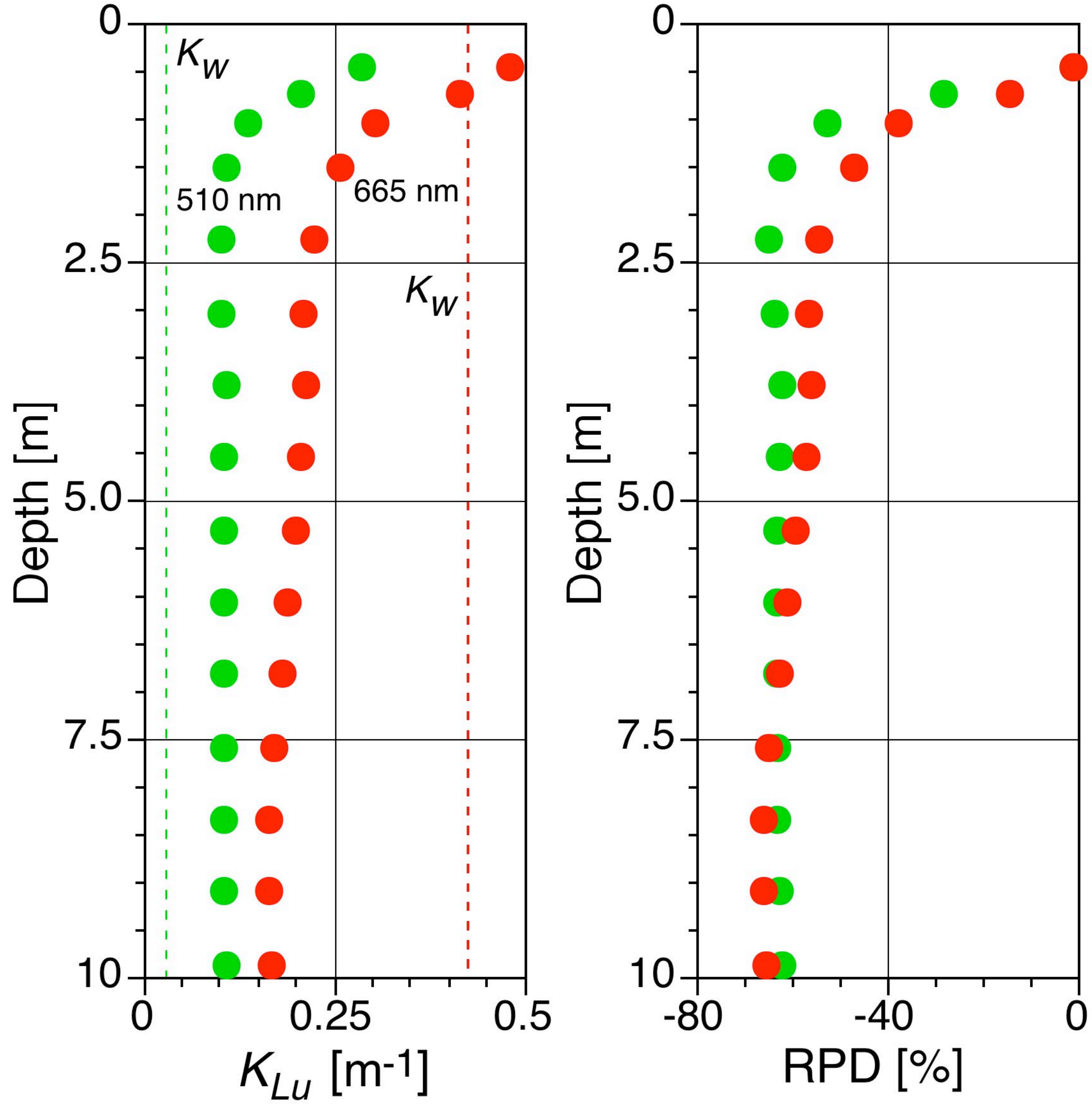
Coastal waters frequently have significant vertical complexity. Although the length scales can be detected by instruments having coarse sampling capabilities, *the derivation of AOPs requires an accurate determination of an extrapolation interval from which all data products are derived*.

In fact, for a recent series of three coastal cruises in the Gulf of Maine, *about 71% of the AOP products for the three cruises were derived from extrapolation intervals with midpoint depths less than 1 m*. In most cases the shallowness of the extrapolation interval was caused by thin surface layers having significantly different optical properties than the underlying layer (with subsequent layers having different optical properties as well).



Uncertainties in the Attenuation Coefficients, and thus the Water-Leaving Radiances, Can Be Large

The importance of accurately resolving the vertical distribution of water properties in the coastal ocean and how that effects the uncertainties in the data products is easily seen in the radiance data. If the bottom of the extrapolation interval is slowly made deeper for the cast from the previous slide, the effect on K_{Lu} is dramatic. In fact, for the 665 nm channel, the value immediately falls below the pure water value, K_w. Although this is not the case for the 510 nm channel, the relative percent difference (RPD) with respect to the shallowest extrapolation interval is about the same and quickly reaches 60% as the interval is made deeper.



Establishing Good Extrapolation Intervals in Coastal Waters for UV Wavelengths is a Challenge

The difficulties with determining correct extrapolation intervals can be quantified by computing the relative percent difference (RPD) between the in-water irradiance transmitted through the air-sea interface with the above-water solar reference. If the extrapolation interval is correct, *these two parameters should agree to within ±5% for very good data, and to within ±15% for good quality data*. A plot of the RPD versus the depth of the 10% light level, shows good extrapolation intervals for the clearer (Case-1) waters, but problems in the UV for the more turbid (Case-2) waters.