The question uniqueness in remote sensing of the Inherent Optical Properties of ocean water.

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Abstract:
We examine the problem of uniqueness in the relationship between the Remote Sensing Reflectance (Rrs) and the Inherent Optical Properties of ocean water (IOPs). The results point to the fact that diffuse reflectance of plane irradiance is inherently ambiguous. Furthermore, in the $400 < \lambda < 750$ nm region of the spectrum, Rrs(λ) also suffers from ambiguity caused by the similarity in the wavelength dependence of the absorption by particulate and the absorption by Color Dissolved Organic Matter (CDOM). The two absorption coefficients have overlapping exponential response leading to the fact that more than one combination of IOPs can produce nearly same Rrs spectrum. This ambiguity in absorption parameters demands that we identify the regions of Rrs(λ) spectrum where we can isolate effects that can be attributed only to the scattering by particulate and absorption by pure water. Our result indicate that spectral shape of the absorption coefficient by phytoplankton, $a_{ph}(\lambda)$, cannot be derived from multi-parameter fit to Rrs(λ). However, its magnitude and its spectral dependence can be estimated from the difference between the measured $R_{rs}(\lambda)$ and the best fit to Rrs(λ) in terms of IOPs that exclude $a_{ph}(\lambda)$.

This investigation was prompted by two questions:

1. Why do we have trouble with remote sensing algorithms for IOPs in certain areas of the oceans where CDOM is present, i.e. why are algorithms for IOPs not global?
2. Why do we need hyperspectral measurements of Rrs(λ) rather than measuring Rrs at few well-placed wavelengths λ in order to retrieve IOPs from Rrs data?