APPLICATION OF UV AND NIR BANDS FOR THE ADVANCED IOP RETRIEVAL ALGORITHMS IN COASTAL WATERS

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Improvement of algorithms for the retrieval of inherent optical properties as well as concentrations of chlorophyll [Chl] and minerals from the reflectance spectra recorded by near water surface, airborne or satellite sensors in coastal waters remains an important issue in the analysis of the water quality in coastal zones [1]. Clearly, separation of CDOM and phytoplankton absorptions could be significantly improved if UV channels are added to the existing VIS – NIR satellite measurements. In addition, NIR bands can be efficient in the retrieval of [Chl] and mineral concentrations in coastal waters as well as in the estimation of the magnitudes of the chlorophyll fluorescence which can be connected to [Chl] and other water parameters [2,3]. However, to make use of these channels, optical spectra must be extended into these regions. We therefore use our synthetic datasets typical of coastal waters simulated by Hydrolight with extension in UV to 300 nm to analyze the impact of inclusion of UV and NIR bands in the hyperspectral or band retrieval algorithms. Bio-optical models were used to connect physical parameters to the water optical properties: absorption, scattering and backscattering coefficients [3]. To take into account usual variability of the phytoplankton absorption spectra in the coastal waters we used more than dozen different spectra modeled and measured by several authors [4, 5] as well as results of our own measurements. The final datasets included more than 2500 reflectance spectra generated over the following regimes [Chl] = 1 – 100 mg/m^3, CDOM absorption at 400 nm $a_y(400)$ = 0 - 5 m^{-1} and mineral concentrations 0 – 100 mg/l.

We also utilized in the analysis field datasets from the Chesapeake Bay, Georgia waters, Long Island Sound, Peconic Bay and NYC Metropolitan area which include measurements of reflectance spectra using Satlantic Hyperspectral profiler (300-900 nm) and GER spectroradiometer (300 -1000 nm) as well as measurements of total absorption and attenuation spectra using a WET Labs hyperspectral AC-S instrument (400-750 nm), CDOM absorption measurements by the AC-S with 0.2 um filter installed in front of it and with both VIS and UV absorption of collocated water samples measured using a spectrophotometer. Together with measurements of [CHL], concentrations of organic and inorganic TSS components at the same stations from the water samples these results are used to explore the impact of including UV and NIR data on the retrieval of IOPs and [CHL].

Several approaches are explored for the retrieval improvement. In one approach at least preliminary estimation of [Chl] can be done using NIR reflectance ratios while CDOM absorption magnitude can be evaluated from the UV reflectance data. Then these results are used in further [Chl] and IOP retrieval. It is shown that in this approach mineral concentrations which are proportional to the values of the backscattering coefficient strongly affect reflectance spectral shapes and retrieval accuracy both in the NIR and UV. Therefore, retrieval of mineral concentrations should be done, at least in the preliminary manner, as a first step and then validated in the further iterative process.

In the other approach over constrained linear matrix model [1] was tested in the hyperspectral and band modes and advantages of inclusion UV and NIR bands were analyzed.

References

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