VALIDATION OF MODIS FLH ALGORITHM USING SATELLITE IMAGERY

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Fluorescence Line Height (FLH) algorithms which estimate magnitude of chlorophyll fluorescence in reflectance (or water leaving radiance) spectra are based on the measurements of reflectance at three wavelengths in the fluorescence spectral zone. They are effective for the fluorescence retrieval in case 1 waters where chlorophyll concentration [Chl] is relatively low, [Chl] is a main driver of water optical properties and where elastic reflectance in the fluorescence zone does not deviate much from the baseline. In case 2 coastal waters, FLH algorithms are significantly complicated by the overlap of the fluorescence and elastic reflectance peaks. The overlap occurs because of the confluence of strongly decreasing algal absorption and increasing water absorption, coupled in a density dependent manner with the scattering by phytoplankton cell structures and is located in the same spectral region as the fluorescence emission. Our recent studies showed that reasonable accuracy of the MODIS FLH retrieval can be achieved only for [Chl] below 4 mg/m^3 and concentrations of minerals less than 2-4 mg/l [1,2]. In addition, accurate retrievals in coastal waters are further limited because of the absence of robust atmospheric correction schemes.

However, recent advances in the atmospheric correction over coastal zones [3] opened possibilities for more detailed study of coastal areas using satellite imagery which includes analysis of spatial and temporal trends in [Chl], FLH and determination of other water parameters which affect performance of FLH retrieval.

To test the fidelity range of MODIS FLH algorithm, we analyzed multiple MODIS Level 2 datasets processed using SeaDAS software and spanning almost 3 years period for the coastal area as well as for open ocean waters of Long Island Sound, Chesapeake Bay and Delaware Bay. It was observed that there is always noticeable spatial structure correlation between the [Chl] and FLH maps typically for the area with [Chl] less than 4 mg/m^3. Correlation between maps of [Chl] and FLH are computed to determine the degree of spatial similarity between those two data. Areas with high degree of spatial similarity are extracted from the whole scene for the further analysis of the other inherent optical properties (IOP) of waters such as mineral scattering, phytoplankton and CDOM absorptions. Then the range of IOP for waters where FLH algorithm works reasonably well was determined based on

phytoplankton, CDOM, and suspended inorganic matter concentrations. Results for both standard NIR and new SWIR atmospheric correction algorithms were compared. On the other hand, we also studied areas with low correlation between [Chl] and FLH maps to determine main water parameters which lead to the break down of the FLH retrieval.

Reflectance data and results of retrieval for several stations are compared with our field measurements where reflectance spectra were acquired using GER spectroradiometer and Satlantic Hyperspectral Profiler above and below water surface. Water IOP's were measured by WET Labs package which includes absorption, attenuation and backscattering sensors.

Our synthetic datasets were also used in the analysis. They were created using the HYDROLIGHT radiative transfer code with IOP's connected to parameterized microphysical models in accordance with the procedures used to generate the IOCCG dataset, but with some added improvements. These included higher (1 nm) spectral resolution and a wider range of parameters typical of coastal waters. Simulated fluorescence magnitudes were compared with retrieved ones using FLH approach.

Results generally confirmed our previous conclusions about the ranges of [Chl] and mineral concentrations where MODIS FLH algorithm is applicable. It was also shown that retrievals are not very sensitive to the choice of the atmospheric correction algorithm which can be explained partially by the closeness of the FLH bands to the bands utilized in the atmospheric correction as well as by the low [Chl] and mineral concentrations for which sensitivity to the atmospheric correction procedure is much smaller than for higher values of these parameters.

REFERENCES

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