Spectral Matching Atmospheric Correction Algorithm for Sentinel-3 Ocean Color Imagery

Frouin Robert[a*], Steinmetz François[b], Mazeran Constant[c], Chimot Julien[d], Dessailly David[d], and Kwiatkowska Ewa[d]

[a] *Scripps Institution of Oceanography, La Jolla, United States*
[b]*HYGEOS, Lille, France*
[c]*Solvo, Antibes, France*
[d]*EUMETSAT, Darmstadt, Germany*

***Corresponding author e-mail**: rfrouin@ucsd.edu

An algorithm is presented for estimating diffuse water reflectance from Sentinel-3 Ocean and Land Colour Instrument (OLCI) imagery. Spectral matching is used, which consists in fitting the Rayleigh-corrected top-of-atmosphere (TOA) reflectance in the OLCI visible to near-infrared bands with a model comprising aquatic and atmospheric components. The algorithm, referred to as Spectral matching Atmospheric Correction for Sentinel Ocean color measurements (SACSO), builds on the POLYMER approach [1], but uses an alternative non-linear modeling of the residual atmospheric signal and a different optimization scheme involving per-pixel uncertainties at input and output. This alternative multiple scattering aerosol (MSA) modeling allows one to fit the spectral variation of the perturbing signal to within ±1.5% for a wide range of aerosol and cloud models, optical thickness up to 1, in the presence of glint or not, and for all expected angular geometries. Evaluation against in-situ measurements at AERONET-OC sites shows that, without system vicarious calibration (SVC), the proposed algorithm, like POLYMER, tends to overestimate water reflectance, especially in the blue bands. However, both SACSO and POLYMER outperform the operational OLCI Level-2 processor, with an increased number of valid match-ups of about 50%. The dependency of the retrieved water reflectance on aerosol optical thickness is lowest with these algorithms. SVC gains significantly reduce biases across the spectrum, but not completely in the blue bands. Examining scenes of a diverse diagnostic data set, SACSO is more robust than the IPF algorithm in the presence of glint, adjacency effects, thick absorbing aerosols, and thin clouds, with no negative reflectance and good spatial continuity, but over-correction occurs in extremely turbid waters. Global difference maps and time series analysis indicate similar trends, and results are consistent and stable in oligotrophic waters. SACSO, with a more constraining aerosol reflectance model, a more rigorous and generic definition of the cost function, a more stable numerical inversion, an uncertainty propagation scheme, and associated flags, constitutes a major improvement to the baseline POLYMER. Extension of SACSO to other sensors presents no major difficulties and is contemplated in future work.

Keywords: Atmospheric correction, diffuse water reflectance, spectral matching, Ocean and Land Colour Instrument

References

[1] Steinmetz, F., P. Y. Deschamps, and D. Ramon, 2011: Atmospheric correction in presence of sun glint: application to MERIS. *Opt. Express* 19, 9783.