An experimental evaluation of sea surface reflectance factors relevant to AERONET-OC above-water radiometry

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AERONET - Ocean Color is a sub-network of the Aerosol Robotic Network (AERONET), supporting ocean color validation activities with highly consistent time-series of $L_{WN}(\lambda)$ & $\tau_a(\lambda)$.

- NASA manages the network infrastructure (i.e., handles the instruments calibration and, data collection, processing and distribution within AERONET).
- JRC has the scientific responsibility of the processing algorithms and performs the quality assurance of data products (in addition to the management of 5 out of 15 sites).
- PIs establish and maintain individual AERONET-OC sites.

Above-Water Radiometry

\[ E_s(\lambda, \theta_0, \phi_0) \rightarrow L_i(\lambda, \theta', \varphi) \rightarrow L_T(\lambda, \theta, \varphi) \]

Side view

\[ \theta_0 \quad \varphi \quad \theta \]

Top view

\[ \theta' \]

Sky-radiance: \( L_i \)

Sea-radiance: \( L_T \)

Removal of sky-glint contribution

\[ L_W(\varphi, \theta, \lambda) = L_T(\varphi, \theta, \lambda) - \rho(\varphi, \theta, \theta_0, W)L_i(\varphi, \theta', \lambda) \]

with \( L_T \) and \( L_i \) passing strict QA/QC tests, and \( L_T \) determined from the mean of relative minima

Correction for off-nadir view

\[ L_W(\lambda) = L_W(\varphi, \theta, \lambda)C_{3Q}(\lambda, \theta, \varphi, \theta_0, \tau_a, IOP, W) \]

Transformation to exact normalized water-leaving radiance

\[ L_{WN}(\lambda) = L_W(\lambda)(D^2t_d(\lambda)\cos\theta_0)^{-1}C_{f/Q}(\lambda, \theta_0, \tau_a, IOP) \]

Values of $\rho^U$ and $\rho^P$ for the AERONET-OC measurement geometry

Unpolarized case
Rayleigh sky
Cox-Munk surfaces

Polarized case
Rayleigh sky
FFT surfaces


Matchup spectra and measurement conditions

From above-water (AERONET-OC)  
From in-water profiling

Acqua Alta Oceanographic Tower
Distributions of $\rho^U$ and $\rho^P$ for matchups
Assessment AERONET-OC $L_W$ from $\rho^u$
Assessment AERONET-OC $L_W$ from $\rho^p$
Conclusions

The experimental assessment of the sea surface reflectance factors $\rho^U$ and $\rho^P$ (proposed by C. Mobley on 1999 and 2015, respectively) applied for the generation of AERONET-OC $L_W$ data, beyond

a. limitations due to a restricted range of measurement conditions (e.g., low wind speeds which are however an intrinsic feature of AERONET-OC data products),

b. constrains (but also advantages) due to the applied technology and measurement methodology,

c. and the strict QA/QC criteria embedded in the AERONET-OC processing scheme designed to ensure the highest accuracy to data products at the expenses of their number:

1. indicates a generic better performance of $\rho^U$ factors;

2. but it also indicates that most appropriate sea surface reflectance factors would vary between the ideal values of $\rho^U$ and $\rho^P$, likely because of depolarization effects not accounted for in the computation of $\rho^P$ (e.g., like those due to aerosols).

The previous findings do not presently suggest to revert the use of current $\rho^U$ to $\rho^P$ factors, nor any significant revision of the uncertainty budget for AERONET-OC data products determined with wind speed tentatively lower than 5 m s⁻¹.