European Commission

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

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AERONET-OC sites

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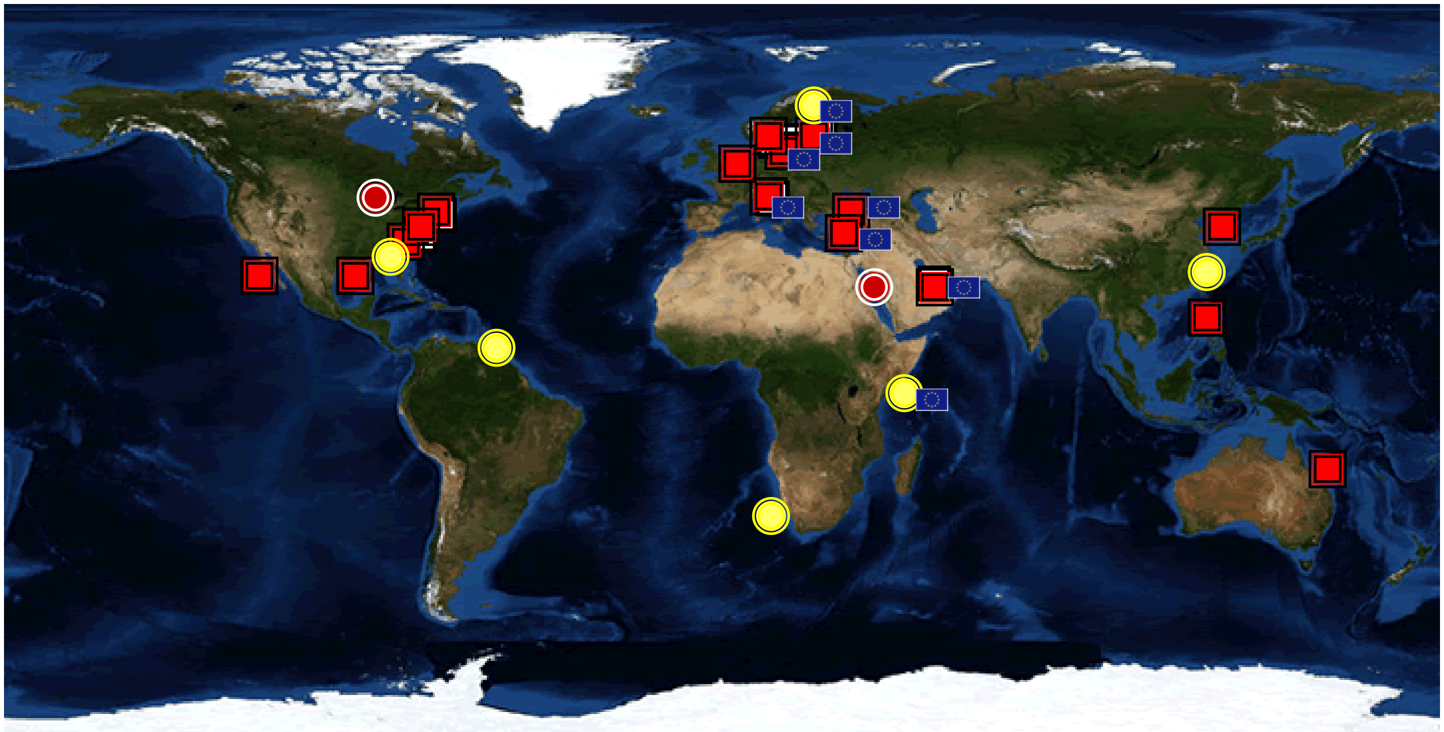
AERONET - Ocean Color is a sub-network of the Aerosol Robotic Network (AERONET), supporting ocean color validation activities with highly consistent time-series of $L_{WN}(\lambda)$ & $\tau_a(\lambda)$.



■ Current sites ● Planned sites ● Potential sites

- **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.**

G.Zibordi et al. A Network for Standardized Ocean Color Validation Measurements. Eos Transactions, 87: 293, 297, 2006.

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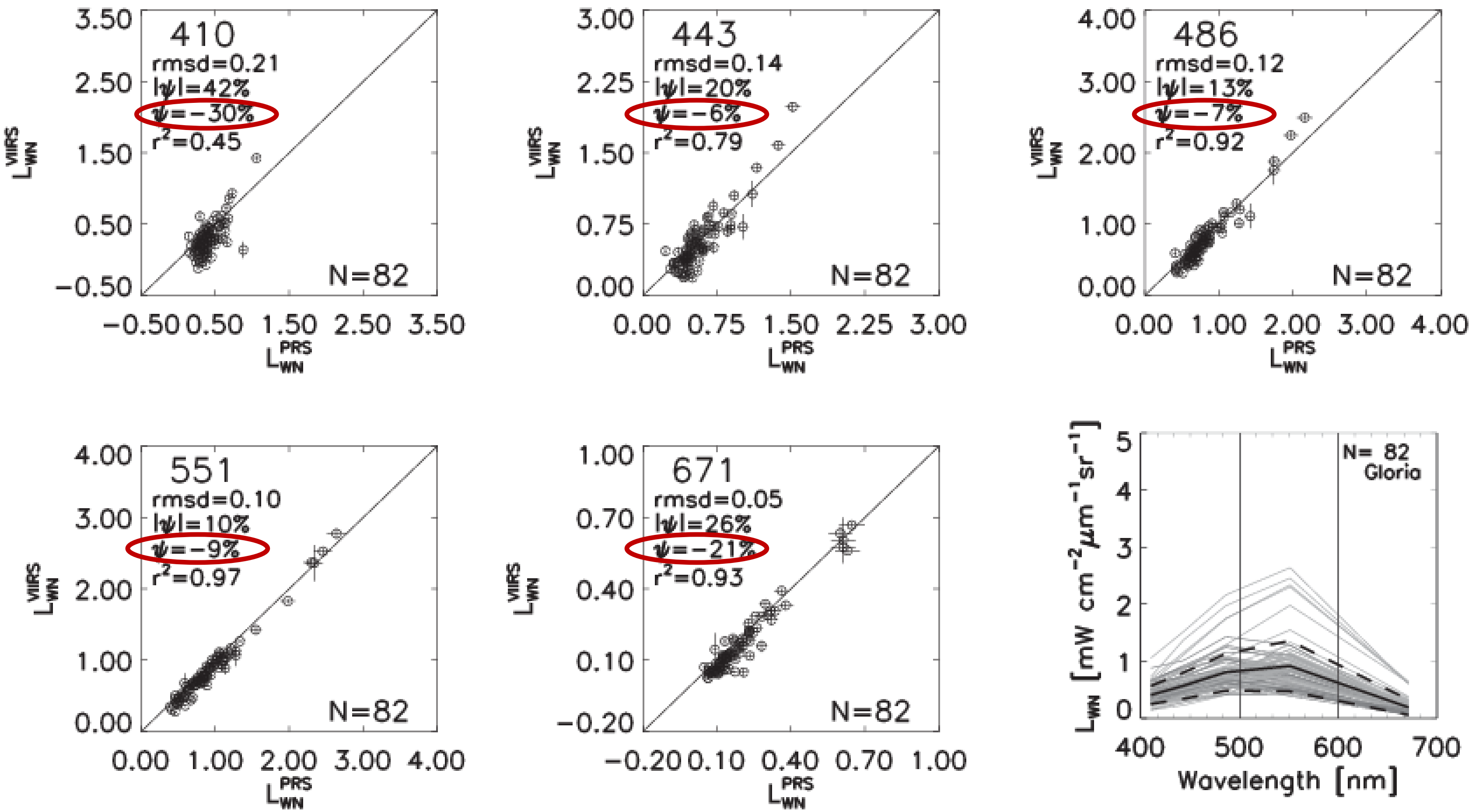
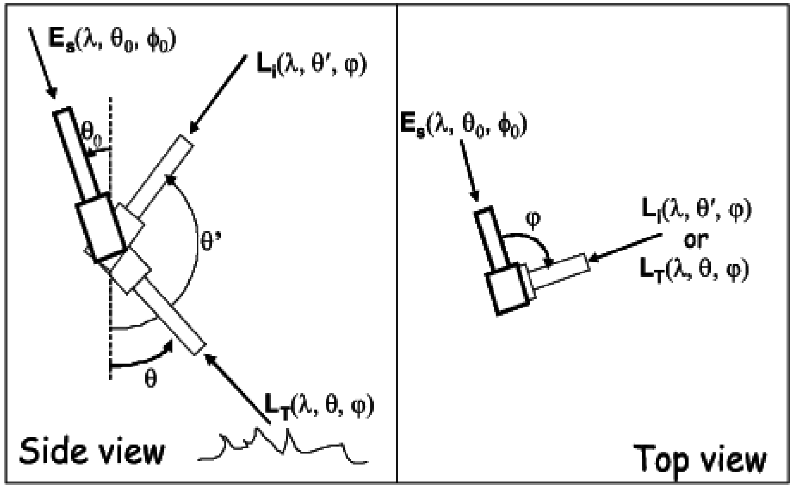
Application of GLR AERONET-OC L_{WN} to VIIRS data products validation



Zibordi, G., Mélin, F., Berthon, J.-F., and Talone, M.: In situ autonomous optical radiometry measurements for satellite ocean color validation in the Western Black Sea, Ocean Sci., 11, 275-286, doi:10.5194/os-11-275-2015, 2015.

Above-Water Radiometry



$$(\varphi = \varphi_0 + 90^0; \theta = 40^0; \theta' = 140^0)$$

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

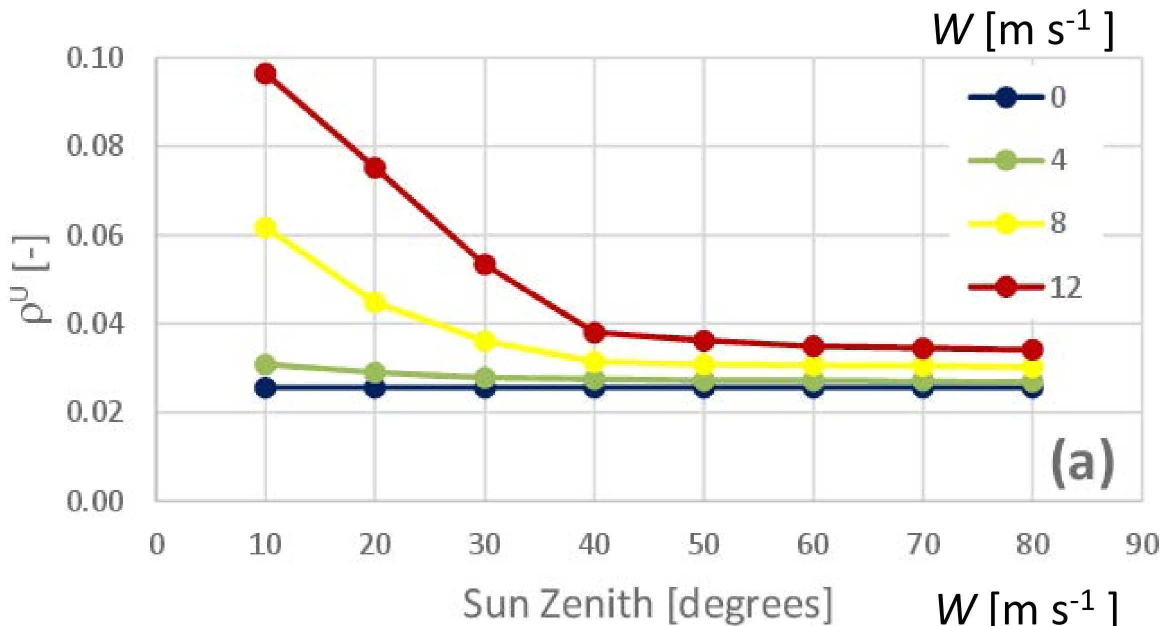
$$L_W(\lambda) = L_W(\varphi, \theta, \lambda) C_{\Im Q}(\lambda, \theta, \varphi, \theta_0, \tau_a, IOP, W)$$

Transformation to exact normalized water-leaving radiance

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

Zibordi, G. et al. (2009). AERONET-OC: a network for the validation of ocean color primary products. *Journal of Atmospheric and Oceanic Technology*, *26*(8), 1634-1651.

Values of ρ^U and ρ^P for the AERONET-OC measurement geometry

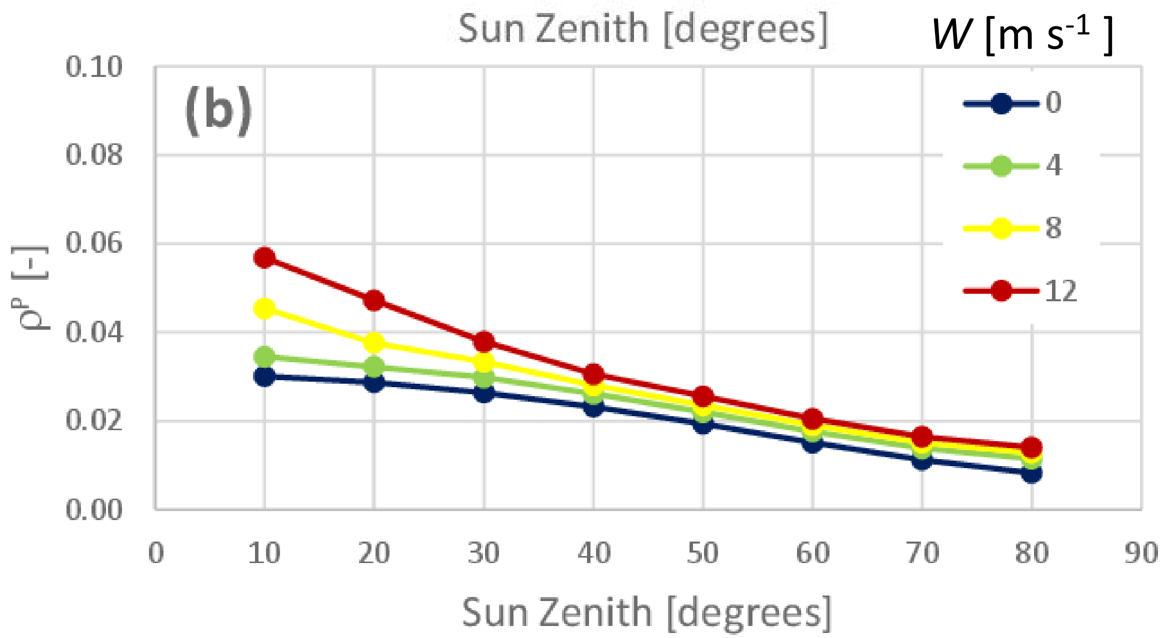


Unpolarized case

Rayleigh sky

Cox-Munk surfaces

Mobley, C. D. (1999). Estimation of the remote-sensing reflectance from above-surface measurements. Applied Optics, 38(36), 7442-7455.



Polarized case

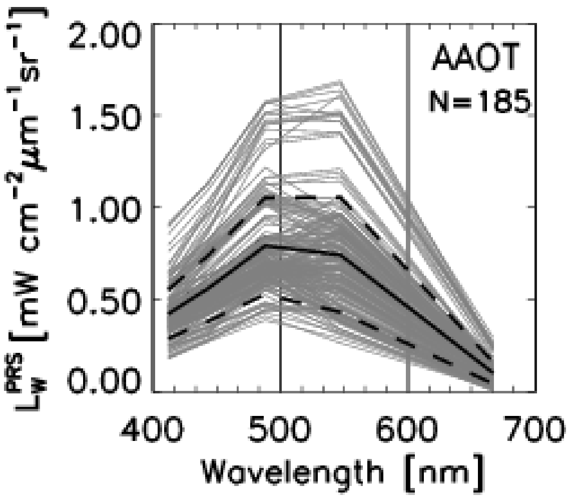
Rayleigh sky

FFT surfaces

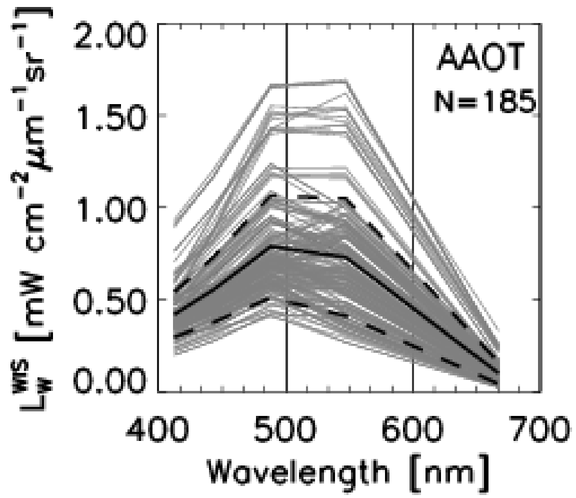
Mobley, C. D. (2015). Polarized reflectance and transmittance properties of windblown sea surfaces. Applied Optics, 54(15), 4828-4849.

Matchup spectra and measurement conditions

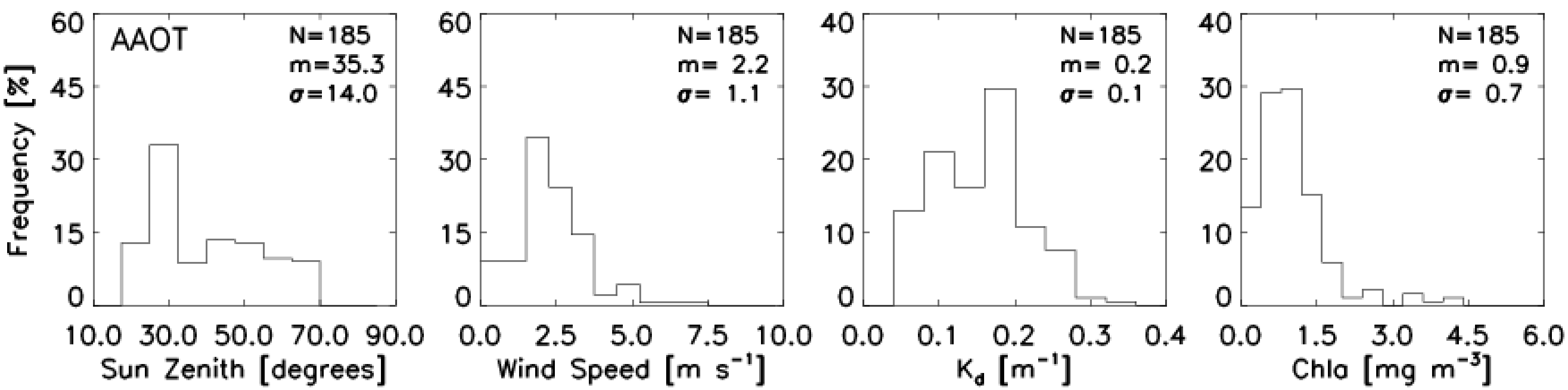
From above-water (AERONET-OC)



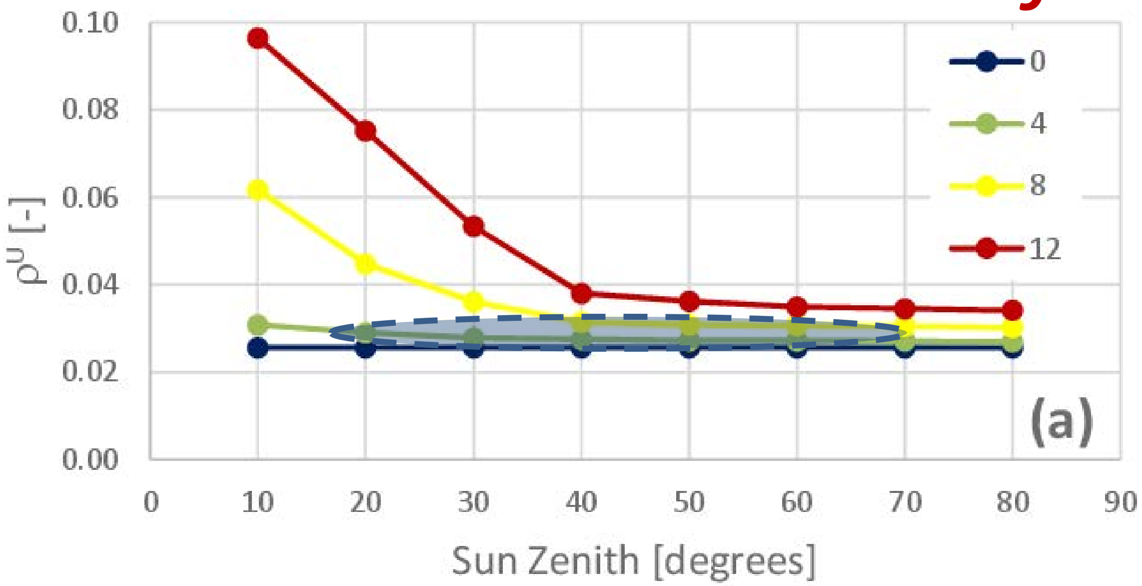
From in-water profiling

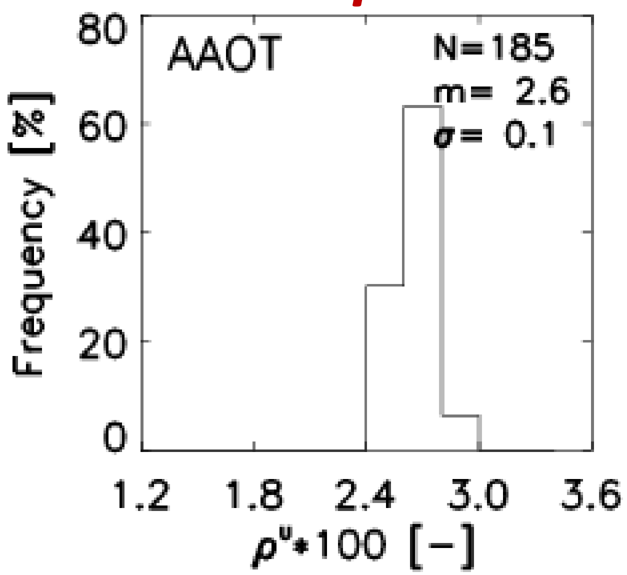


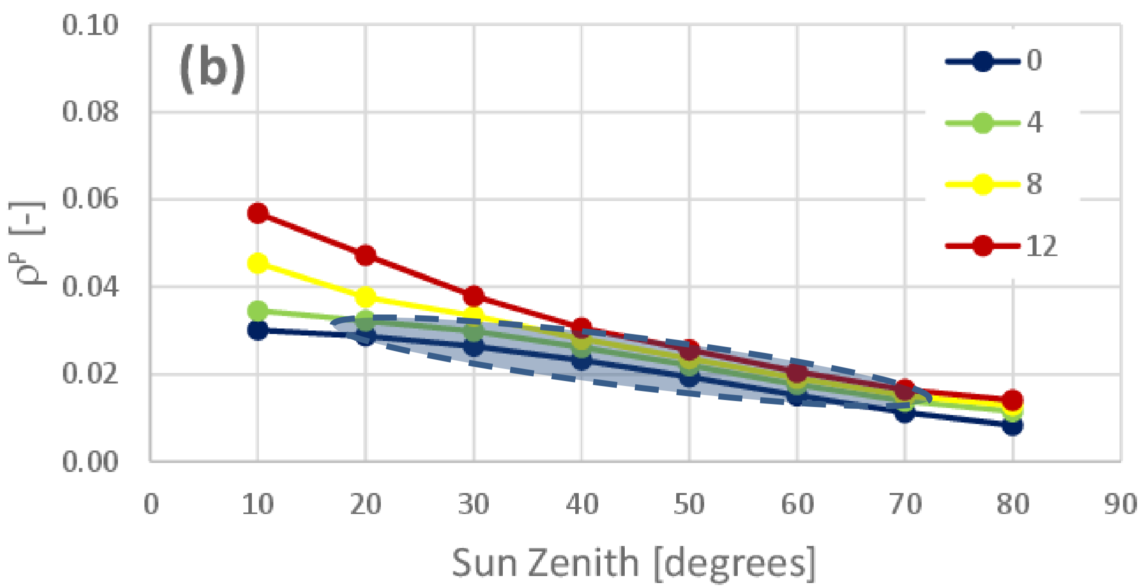
Acqua Alta Oceanographic Tower

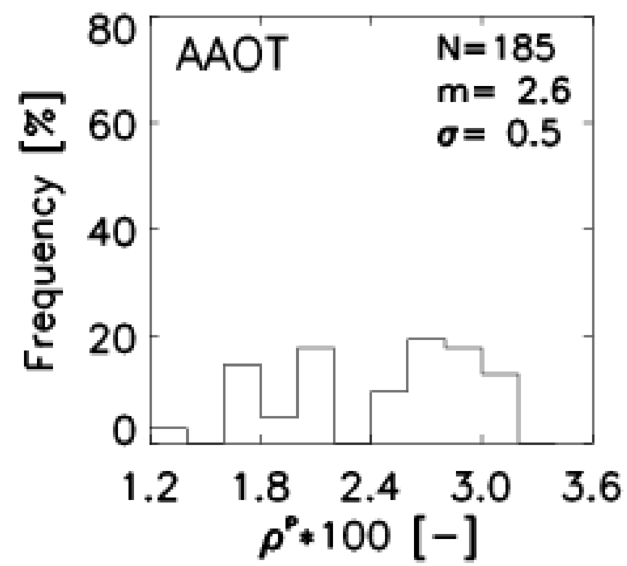


Distributions of ρ^U and ρ^P for matchups









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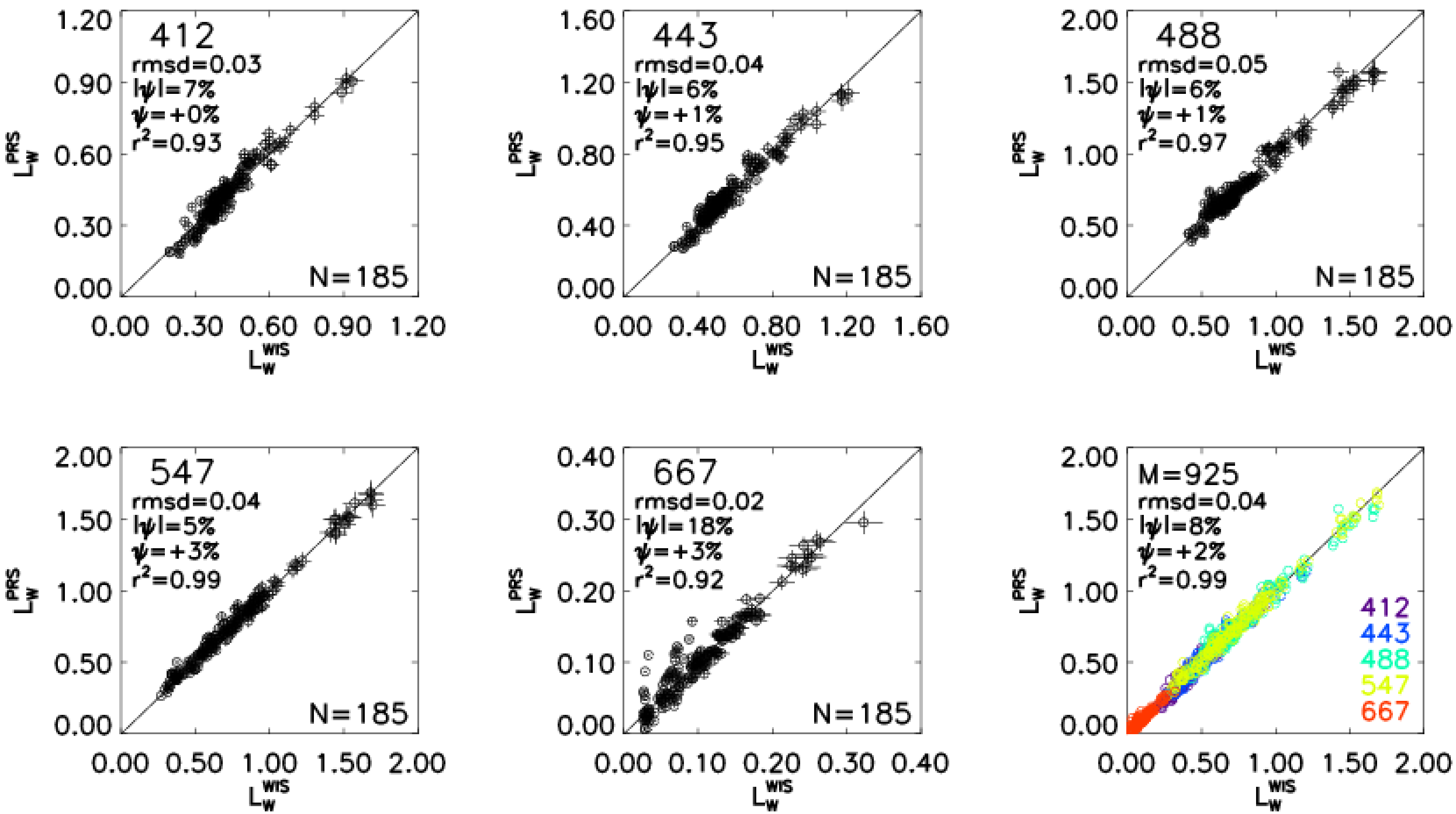
Assessment AERONET-OC L_W from ρ^U



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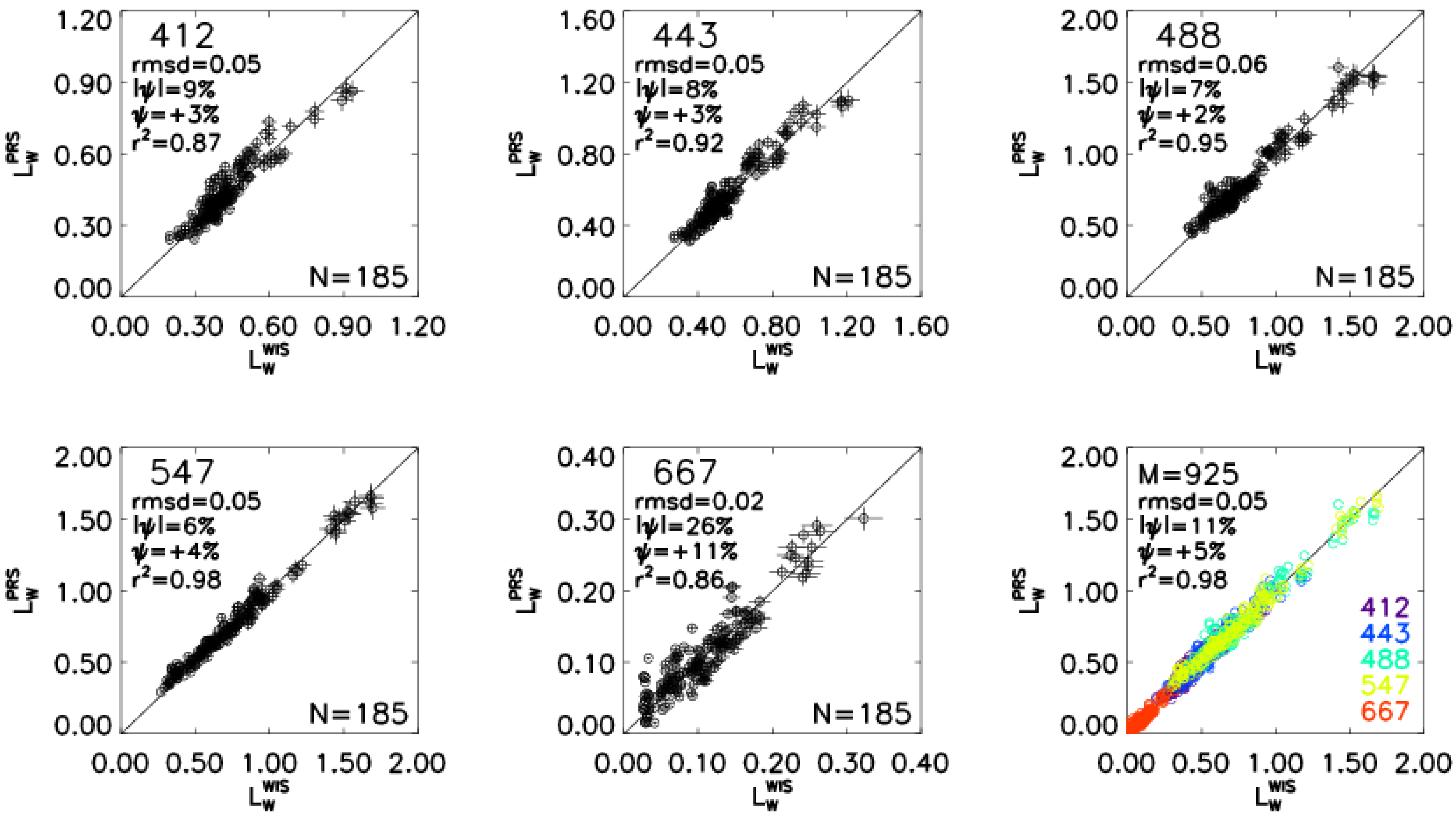
Assessment AERONET-OC L_W from ρ^P



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Conclusions

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

The previous findings do not presently suggest to revert the use of current ρ^{U} to ρ^{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}.