Assessment of PRISMA water reflectance using autonomous hyperspectral radiometry

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Outline

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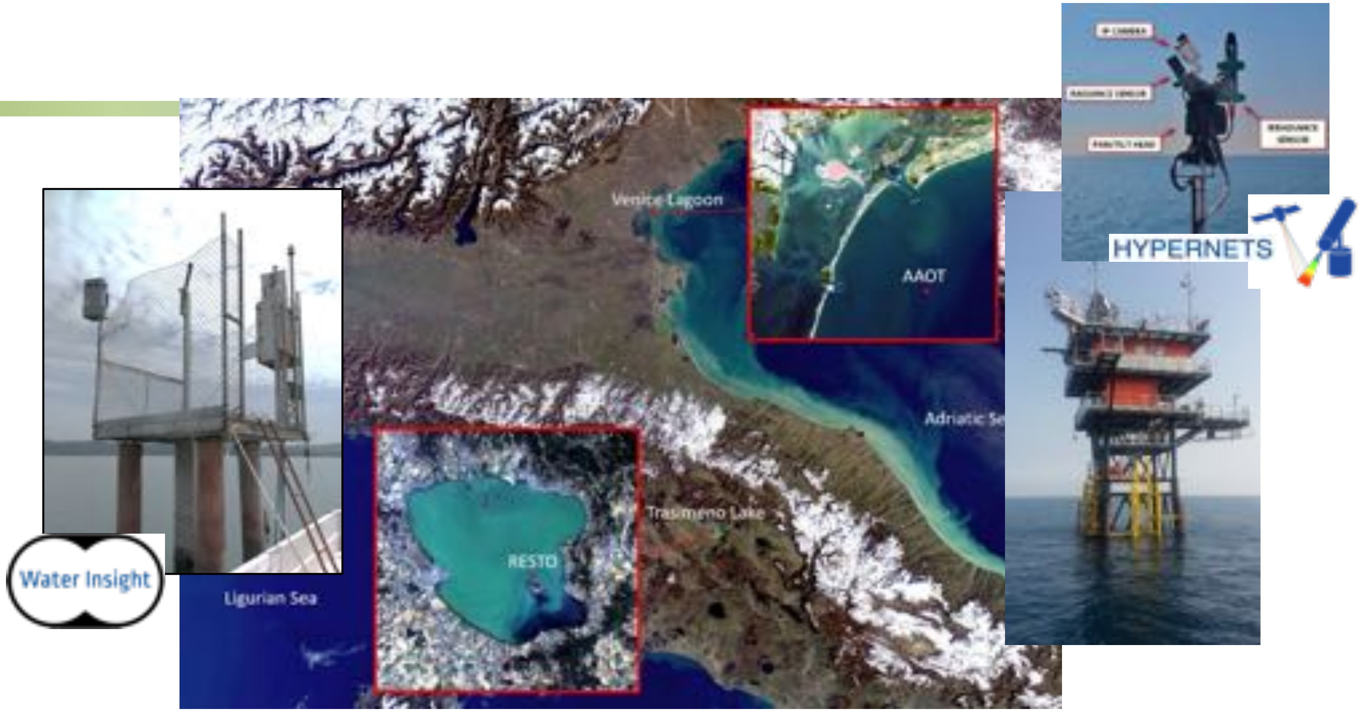
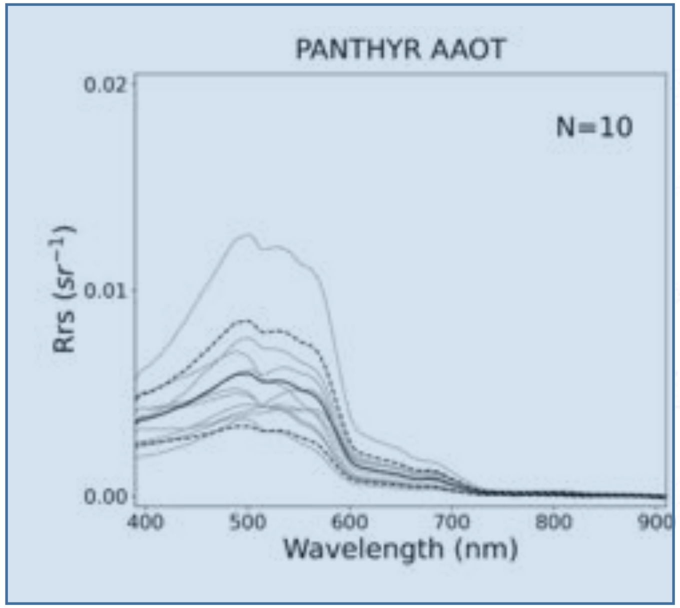
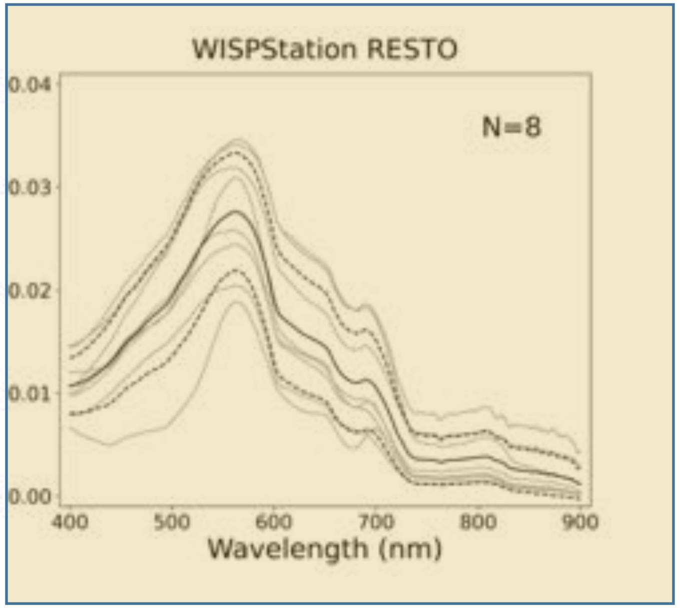
In situ data

In situ measurements from two optically diverse sites in Italy, equipped with fixed autonomous hyperspectral radiometer systems:

- WISPStation (Peters et al., 2018) for the REmote Sensing for Trasimeno lake Observatory (RESTO) positioned in a shallow and turbid lake in the Central Italy;
- PANTHYR (Vansteenwegen et al., 2019) for Acqua Alta Oceanographic Tower (AAOT), located 15 km off the lagoon of Venice in the Adriatic Sea, which is characterised by clear to moderately turbid waters.







PRISMA L1 on-orbit radiometric performances

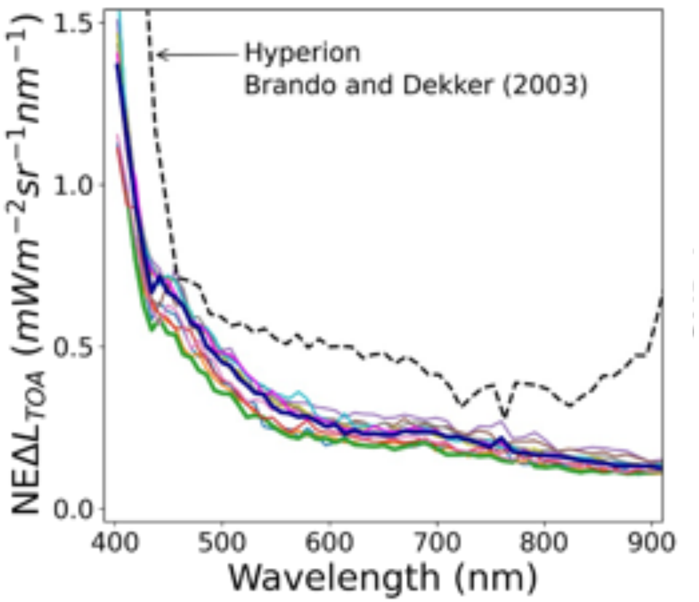
To assess on-orbit radiometric performance of PRISMA over water targets, the overall sensitivity of the entire sensor–atmosphere–water surface system for detecting changes in radiance was estimated (Brando and Dekker, 2003; Wettle et al., 2004).

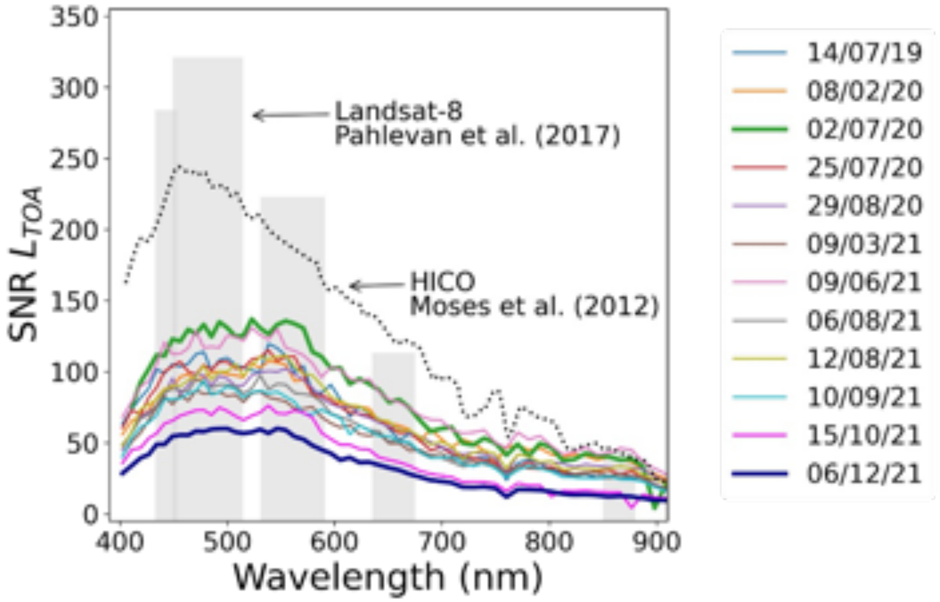
Two image-based parameters were considered in the analysis:

- the environmental noise-equivalent radiance difference ($NE\Delta L_{TOA}$)
- the radiance signal-to-noise ratio ($SNR\ L_{TOA}$).

Applied to PRISMA over AAOT, because offers large homogenous areas of optically deep water as required for the analysis.

Retrieved for a 21 × 21 pixels area over AAOT in different seasons and with SZA ranging within the 25°–69° range.



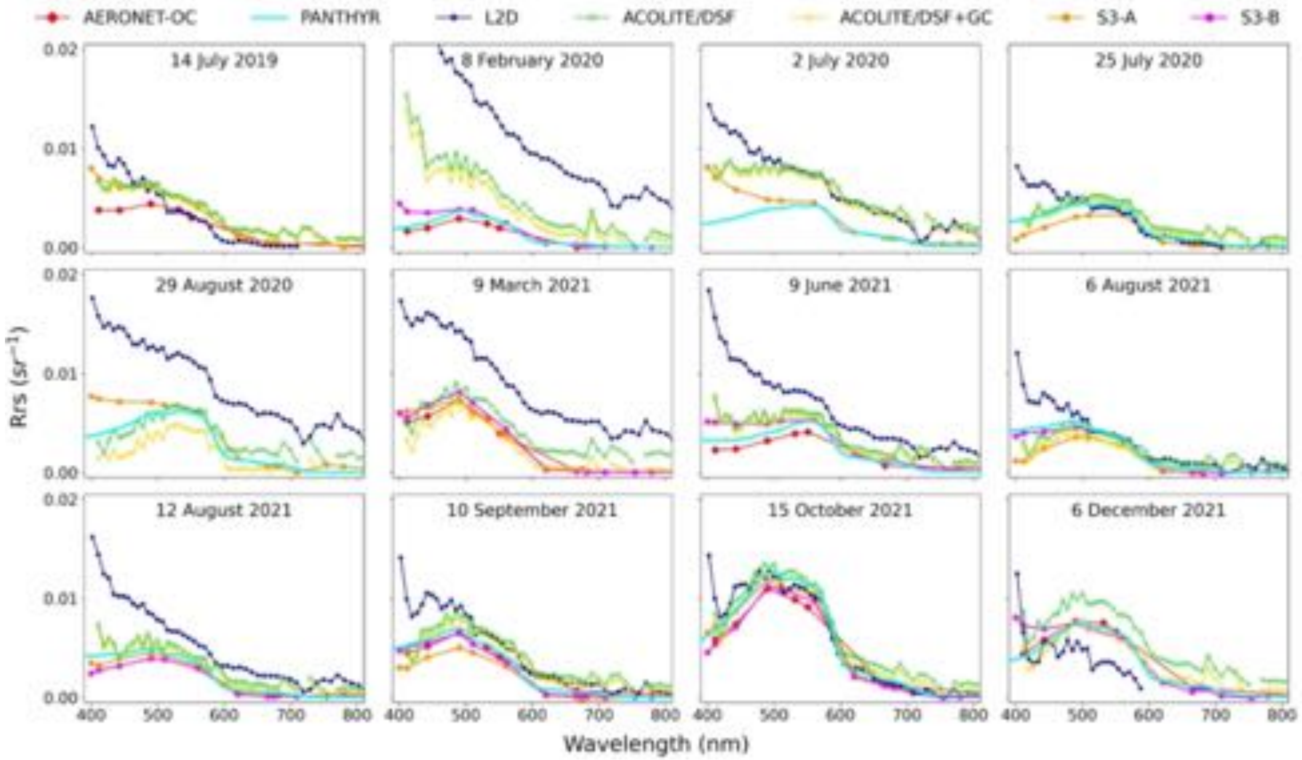


PRISMA L2 products evaluation

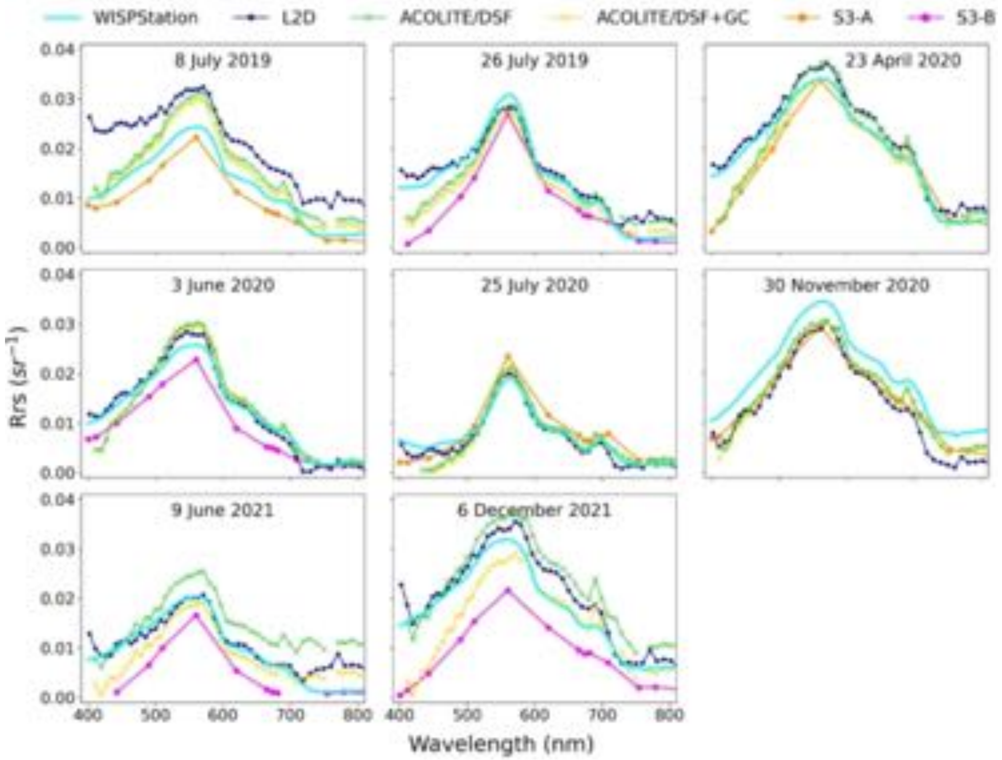
Qualitative comparison of Rrs at their original spectral resolutions:

- Hyperspectral in situ data
- PRISMA - Level 2 standard atmospheric correction processor
- PRISMA - ACOLITE atmospheric correction tool with the dark spectrum fitting algorithm and with the addition of sun-glint correction
- concurrent S3/OLCI baseline water products.

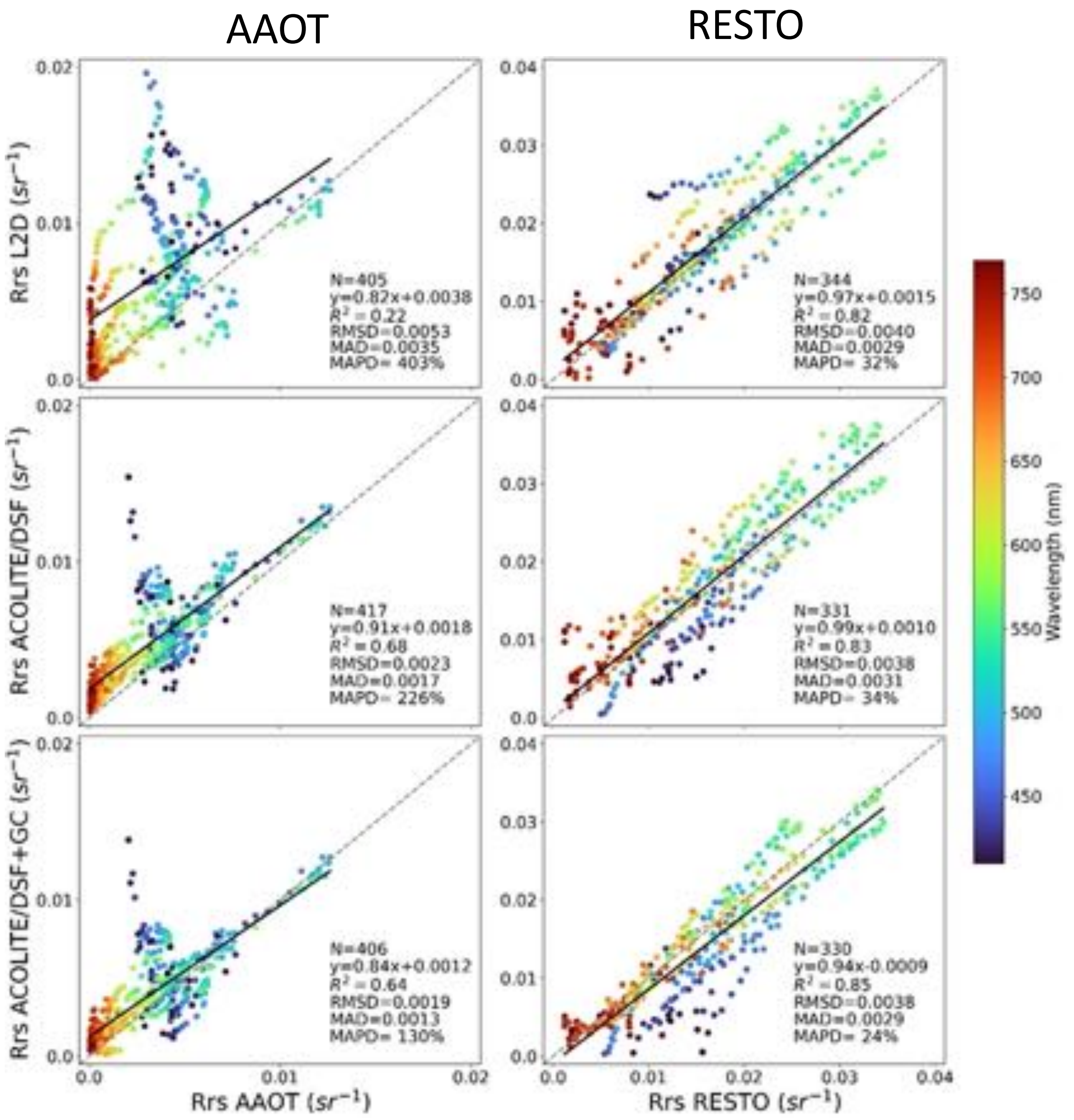
AAOT



RESTO



PRISMA L2 products evaluation



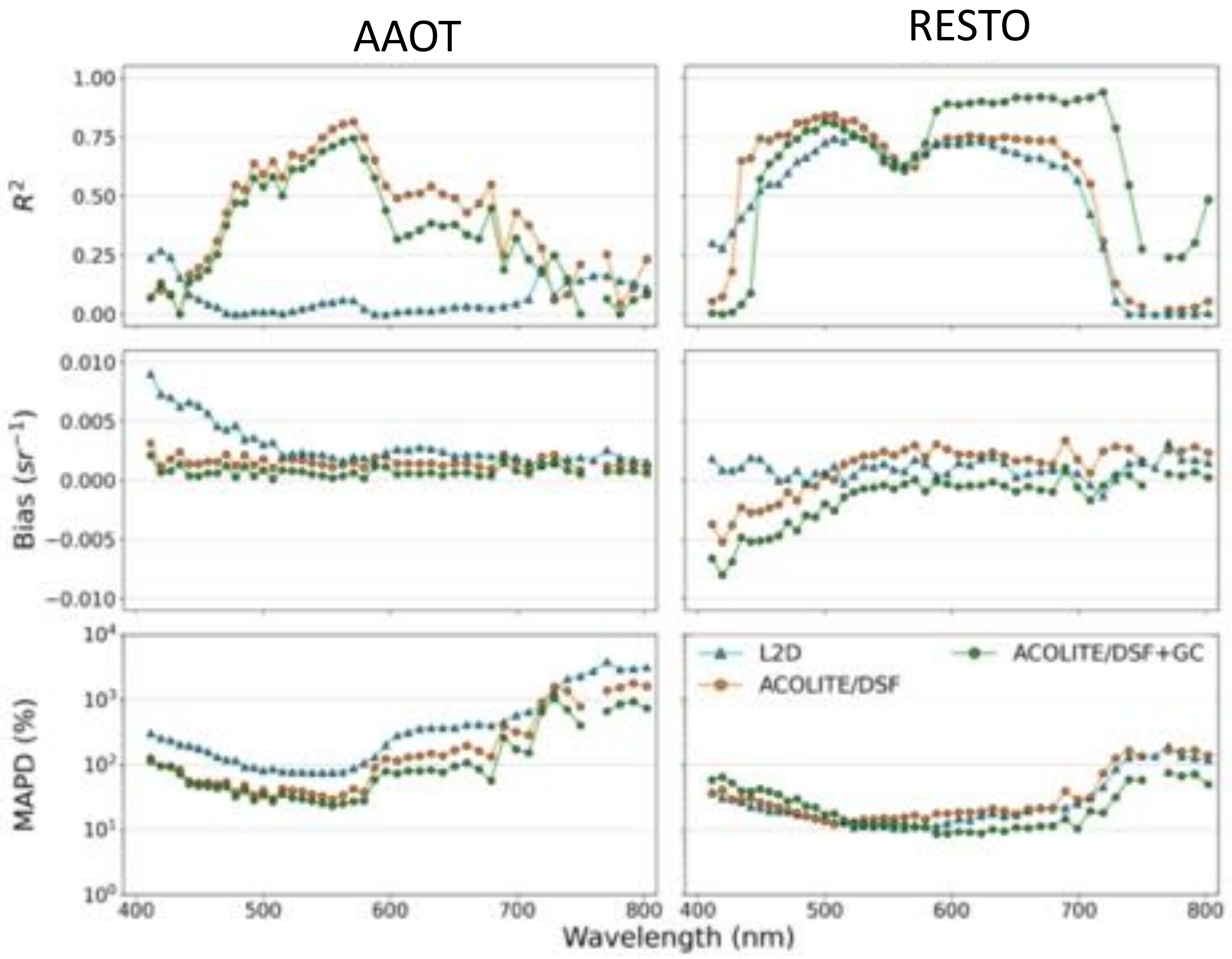
Quantitative comparisons between PRISMA reflectances and in situ hyperspectral data (spectrally resampled to the FWHM of PRISMA bands) for the 410–770 nm spectral range.

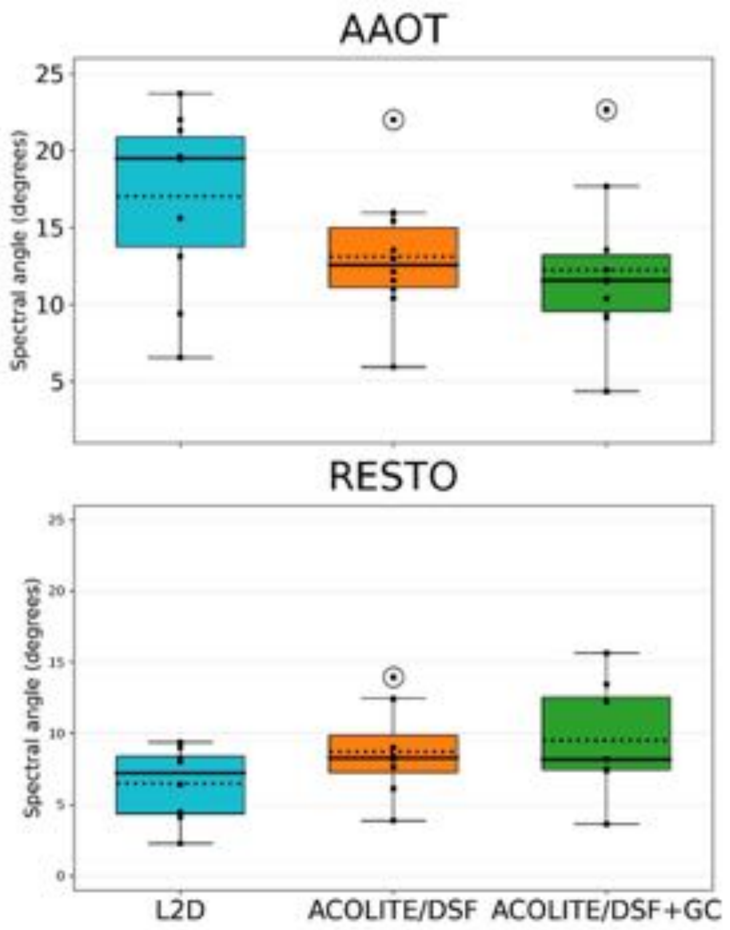
The match-up comparison depicted different results for the two sites with the best performances at RESTO for both L2D and ACOLITE data.

At AAOT, ACOLITE showed better correlation with PANTHYR data, returning lower uncertainties and bias than L2D.

For RESTO, both L2D and ACOLITE showed closer correlation and lower MAPD.

PRISMA L2 products evaluation





Descriptive statistics and error metrics are reported spectrally for each atmospheric correction algorithm versus in situ data, calculated for AAOT and RESTO

Spectral Angles to assess the capability of reproducing the spectral shape of in situ data and retrieve specific features (i.e. abs. peaks of Chl-a and secondary pigments).

Conclusions

- ✓ Both L2D and ACOLITE performed adequately in inland waters, while ACOLITE showed better results compared to L2D in coastal waters.
- ✓ The land-based atmospheric correction L2D processor showed satisfactory performance in inland waters. L2D is better suited to correct inland water bodies rather than coastal zones.
- ✓ ACOLITE performed satisfactorily at AAOT with a more accurate estimation of AOT and a further improvement given by the correction of sun-glint.

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Validation of spaceborne imaging spectrometry remains challenging in comparison to data from multispectral satellites in aquatic applications.
Crucial issues are:

- ✓ the availability of hyperspectral fiducial reference measurements;
- ✓ atmospheric correction, including the air–water interface effects;
- ✓ signal-to-noise ratio and the overall sensitivity of water reflectance.

Thanks for your attention

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