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Assessment of atmospheric correction methods of Sentinel-2 in Italian lakes

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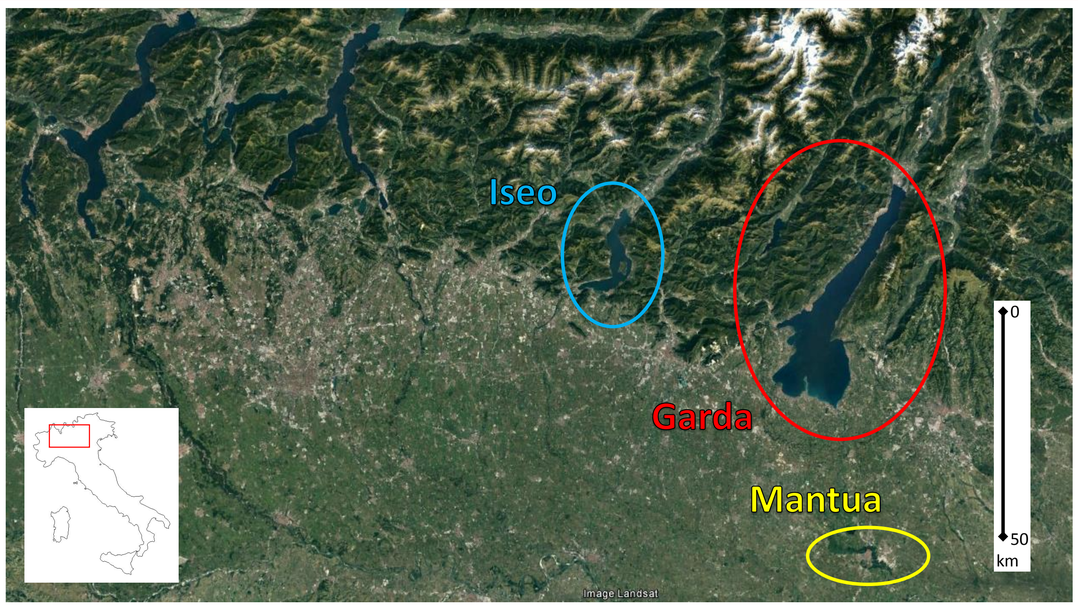
INTRODUCTION

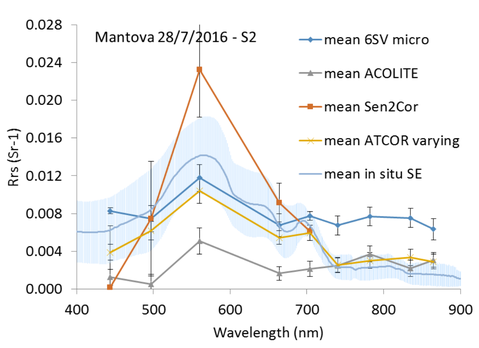
Accurate atmospheric correction (**ac**) products in inland water are required to retrieve water leaving reflectance and water quality parameters from Remote Sensing. In this work, ac over **8** S2A images on three different North Italian lakes, Garda, Iseo and Mantua, was performed through four different processor: a 6SV-based tool with aerosol microphysical properties parametrization ('6SV micro'), ATCOR, SNAP-Sen2cor and ACOLITE.

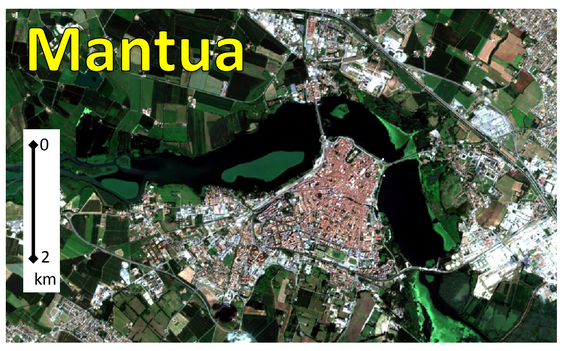
MATERIALS AND METHODS

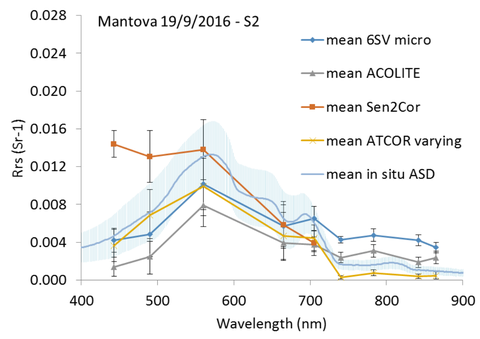
6SV micro was parametrized with microphysical properties retrieved by Sirmione **AERONET** station, when available. ACOLITE was run with SWIR bands for ac, with per pixel variable ε. ATCOR was run with both varying and fixed visibility and water vapour. Results were compared to *in situ* radiometric measurements, from **field campaigns** synchronous to S2A overpass, performed with WISP-3, Fieldspec ASD-FR (ASD), or Spectral Evolution SM 3500 (SE): Rrs was obtained according to SeaWiFS protocol. S2A Rrs was extracted by **3x3 pixels ROIs** over *in situ* stations. **Mean** values of all the stations for each date was reported in the figures below, while each station was considered separately for statistical analysis. In addition, 6SV micro ac was performed on synchronous **L8 images** and compared to S2A products.

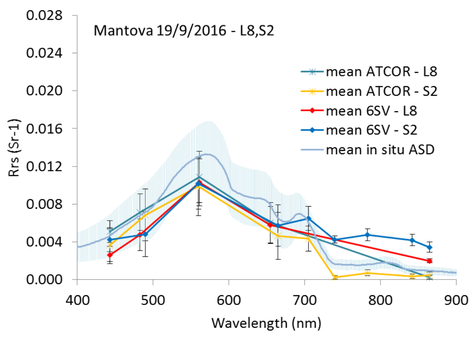


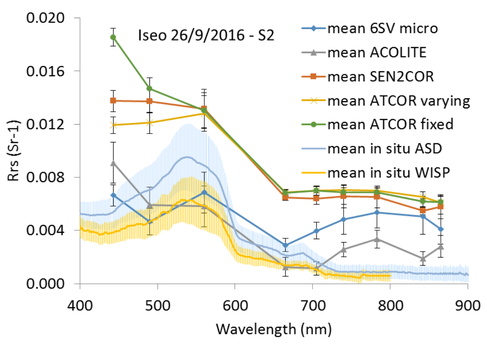
Study area. For ac, also altitude for each lake was taken into account: 185 m a.s.l. for Lake Iseo, 60 m a.s.l. for Lake Garda, and 15 m a.s.l. for Mantua lakes.

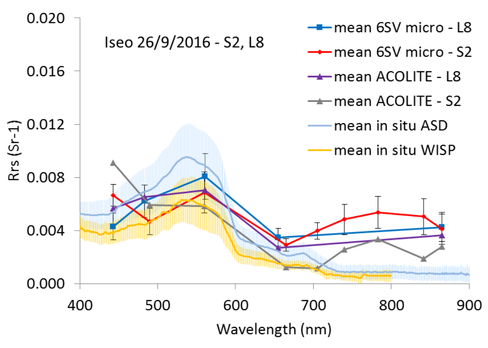


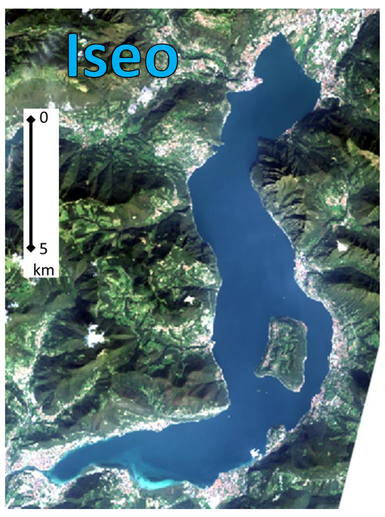


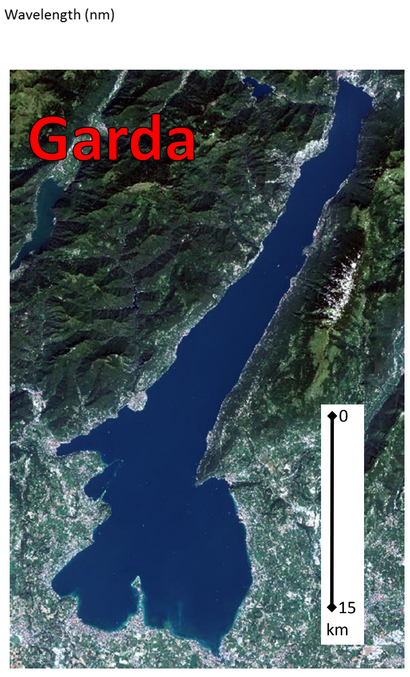


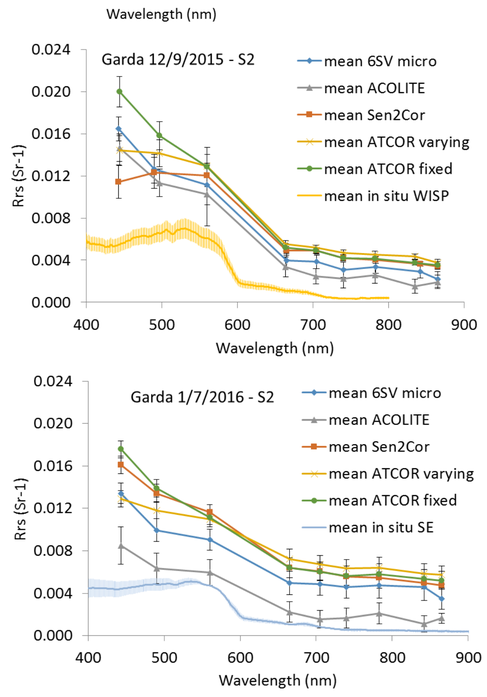


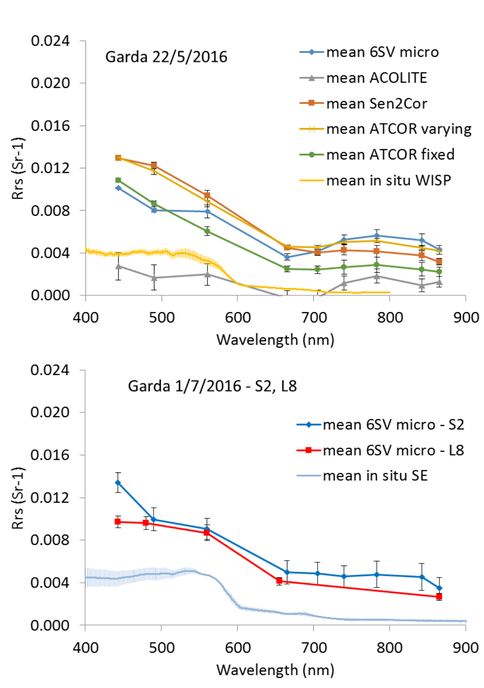


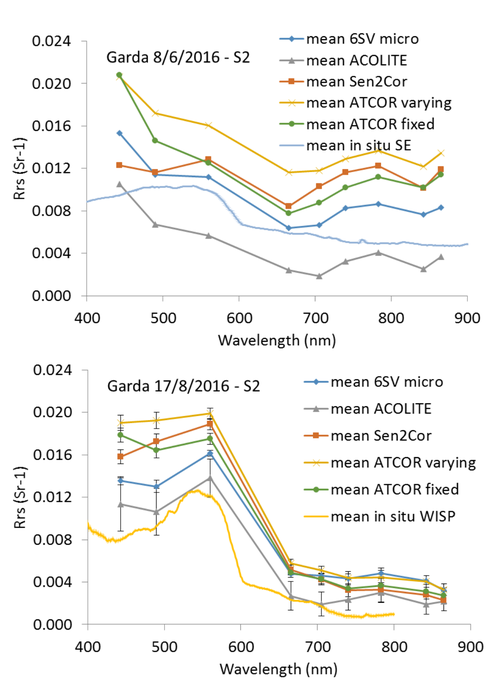








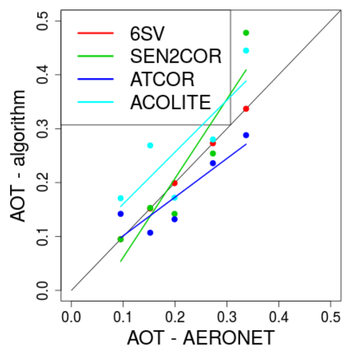


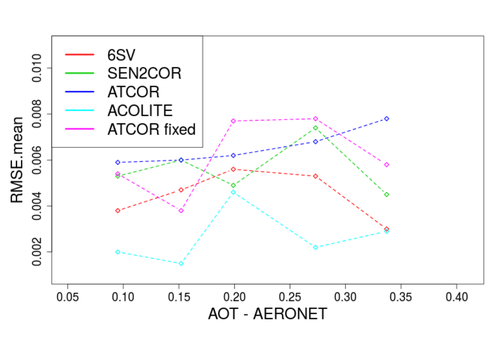


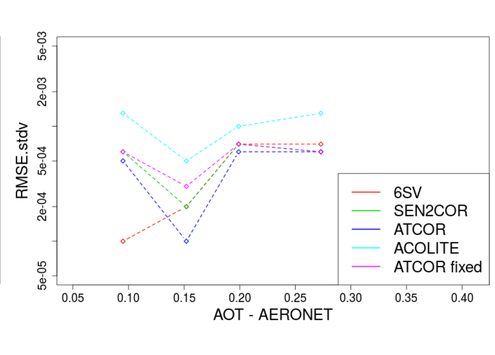
STATISTICAL ANALYSIS

For Lake Garda results, where a larger number of synchronous images were available, statistical analysis were performed to underline the role of the different parameters affecting **ac** results.

DATE	*In situ* cloud free stations	SZA	VZA	AOT AERONET	O3 AERONET	Water Vapour AERONET	Water Vapour ATCOR	Size (type)	Refractive index imagery part (type)
22/05/2016	3	26.8	8.5	0.15	0.36	2.06	1.67	Bimodal (continental)	$5 \cdot 10^{-4}$ (maritime)
08/06/2016	1	25.6	7.4	0.34	0.35	2.59	1.78	fine_dom bimodal (rural)	$5 \cdot 10^{-4}$ (maritime)
01/07/2016	3	25.0	8.4	0.3	0.34	3.34	2.38	fine_dom bimodal (rural)	$5 \cdot 10^{-4}$ (maritime)
17/08/2016	4	35.0	7.2	0.1	0.31	2.96	2.37	fine_dom bimodal (rural)	$5 \cdot 10^{-4}$ (maritime)
12/09/2015	16	43.1	7.0	0.20	0.30	2.58	2.15	fine_dom Bimodal (rural)	$1.5 \cdot 10^{-2}$ (rural)







RMSE (mean and standard deviation) calculated over first 7 S2A bands over all the available cloud-free stations. NB: for AOT=0.34 only station was available

CONCLUSIONS

- Variability in atmospheric condition and thus in ac products shows the importance of a prudent choice of ac algorithm mainly for oligotrophic lakes, where signal is very low compared to atmospheric contribution.
- On Mantua fluvial lakes optical closure showed that best results were performed by ATCOR and the 6SV micro, with which comparison between L8 and S2 showed good accordance.
- On Lake Iseo best results were obtained through ACOLITE and 6SV micro, with which comparison between L8 and S2 showed good accordance.
- From statistical analysis: A) error in retrieving AOT increases with increasing AERONET AOT, excepted for ACOLITE which tends to overestimate AOT; B) accuracy (RMSE_mean) decreases with increasing AOT, while ACOLITE is in general the most accurate; C) ACOLITE precision (RMSE_stdv) is the lowest.

More images are required and will processed as they become available to generalize this analysis.

ACKNOWLEDGMENTS

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