Applicability of Current Atmospheric Correction Techniques in the Red Sea

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Abstract: Much of the Red Sea is considered to be a typical oligotrophic sea having very low chlorophyll-a concentrations. Few existing studies describes the variability of phytoplankton biomass in the Red Sea. This study evaluates the resulting chlorophyll-a values computed with different chlorophyll algorithms (e.g., Chl_OCI, Chl_Carder, Chl_GSM, and Chl_GIOP) using radiances derived from two different atmospheric correction algorithms (NASA standard and Singh and Shanmugam (2014)). The resulting satellite-derived chlorophyll-a concentrations are compared with *in situ* chlorophyll values measured using the High Performance Liquid Chromatography (HPLC). Statistical analyses are used to assess the performances of algorithms using the *in situ* measurements obtain in the Red Sea, to evaluate the approach to atmospheric correction and algorithm parameterization.

Study site

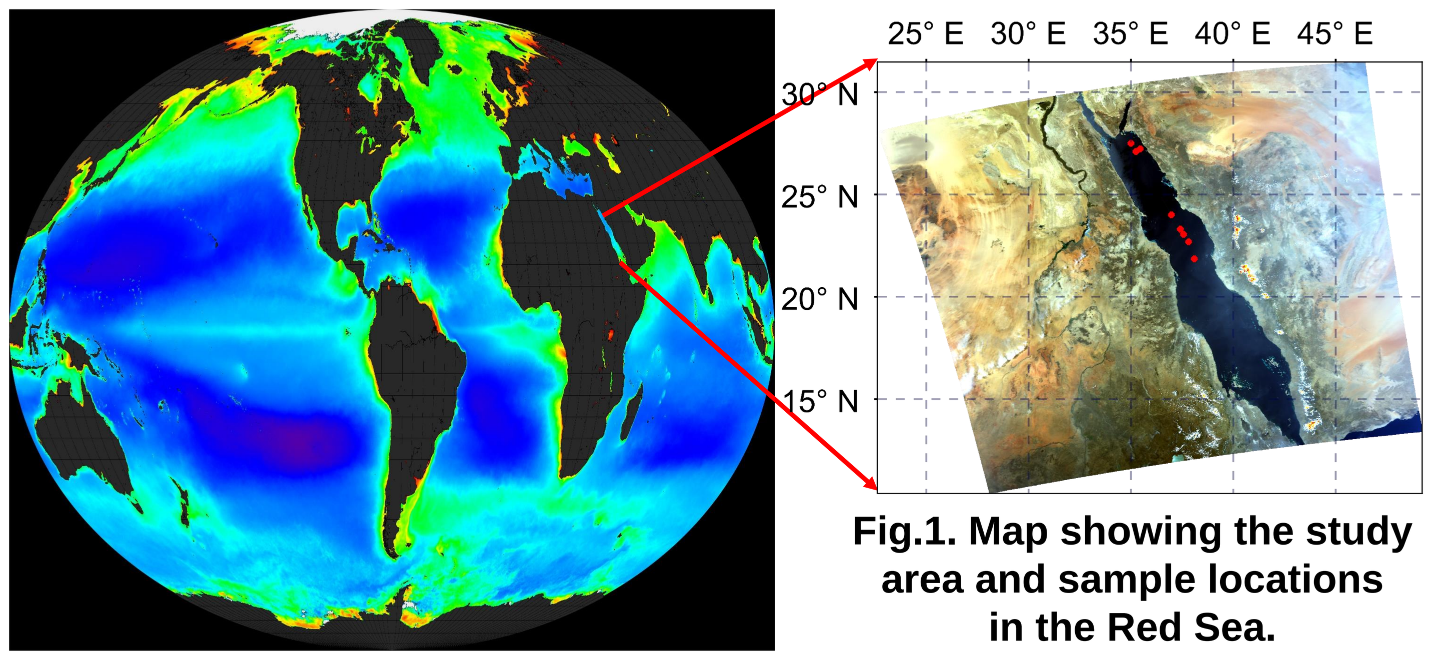

Fig.1. Map showing the study area and sample locations in the Red Sea.

Objectives

The present study aims (1) to implement the atmospheric correction algorithms on the MODIS-Aqua satellite data to compute the remote sensing reflectance and (2) to evaluate the performance of number of algorithms for estimating chlorophyll a from remote-sensing reflectance.

Data and methods

- ➢ MODIS-Aqua Level 1A (L1A, 1 km spatial resolution, LAC-local area coverage) data.
- ➢ HPLC pigment data (October 2014 and April 2015).

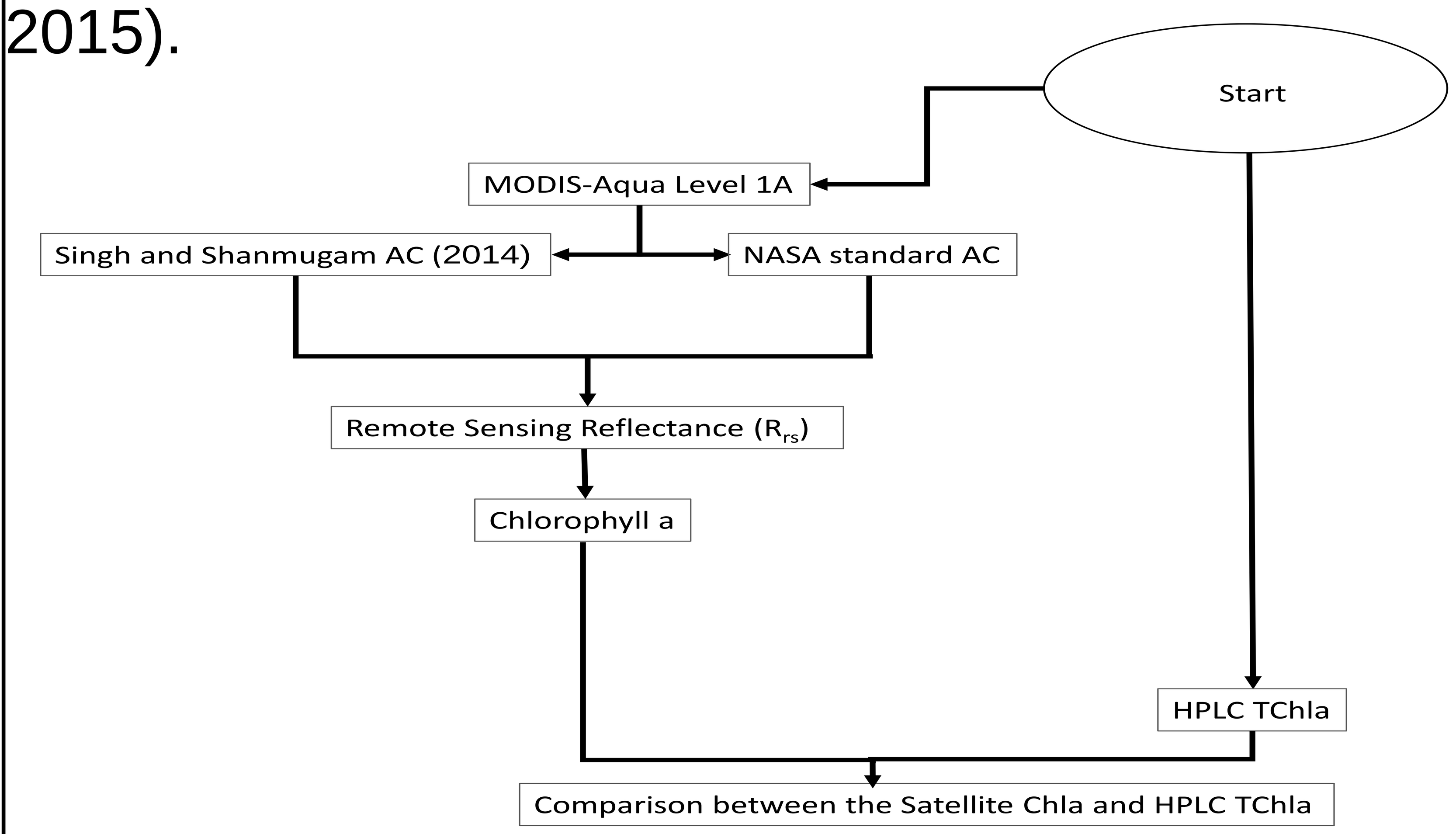

Fig.2. Schematic representation of the Atmospheric correction methods to estimate radiance and comparison of satellite chlorophyll a with HPLC total chlorophyll a.

Results

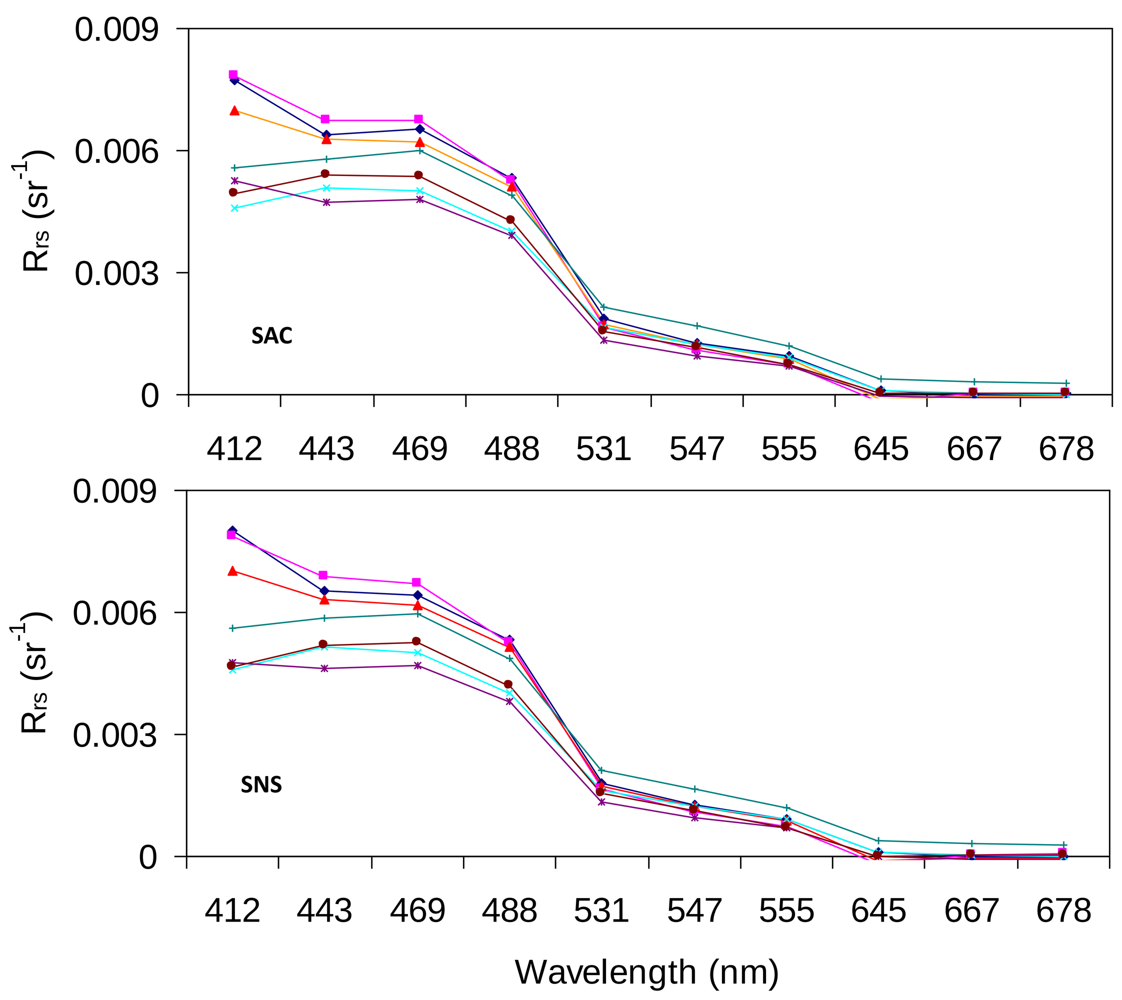

Fig.3. Spectral variation of satellite remote sensing reflectance in the Red Sea.

Table 1. Statistical comparisons between the satellite-derived Chla and in-situ Chla in the Red Sea.

Algorithms	RMSE	BIAS	Slope	Intercept	R^2	MRE	N
			SAC				
Carder	0.618	-0.470	-0.302	-1.753	0.043	-0.323	8
GIOP	0.358	-0.085	-0.303	-1.368	0.027	-0.079	8
GSM	0.411	-0.244	-0.215	-1.440	0.019	-0.198	8
OCI	0.209	0.126	0.090	-0.770	0.064	0.147	8
			SNS				
Carder	0.688	-0.523	-0.382	-1.884	0.051	-0.347	8
GIOP	0.496	-0.180	-0.551	-1.708	0.047	-0.155	8
GSM	0.507	-0.307	-0.399	-1.686	0.042	-0.238	8
OCI	0.202	0.121	0.123	-0.743	0.104	0.140	8

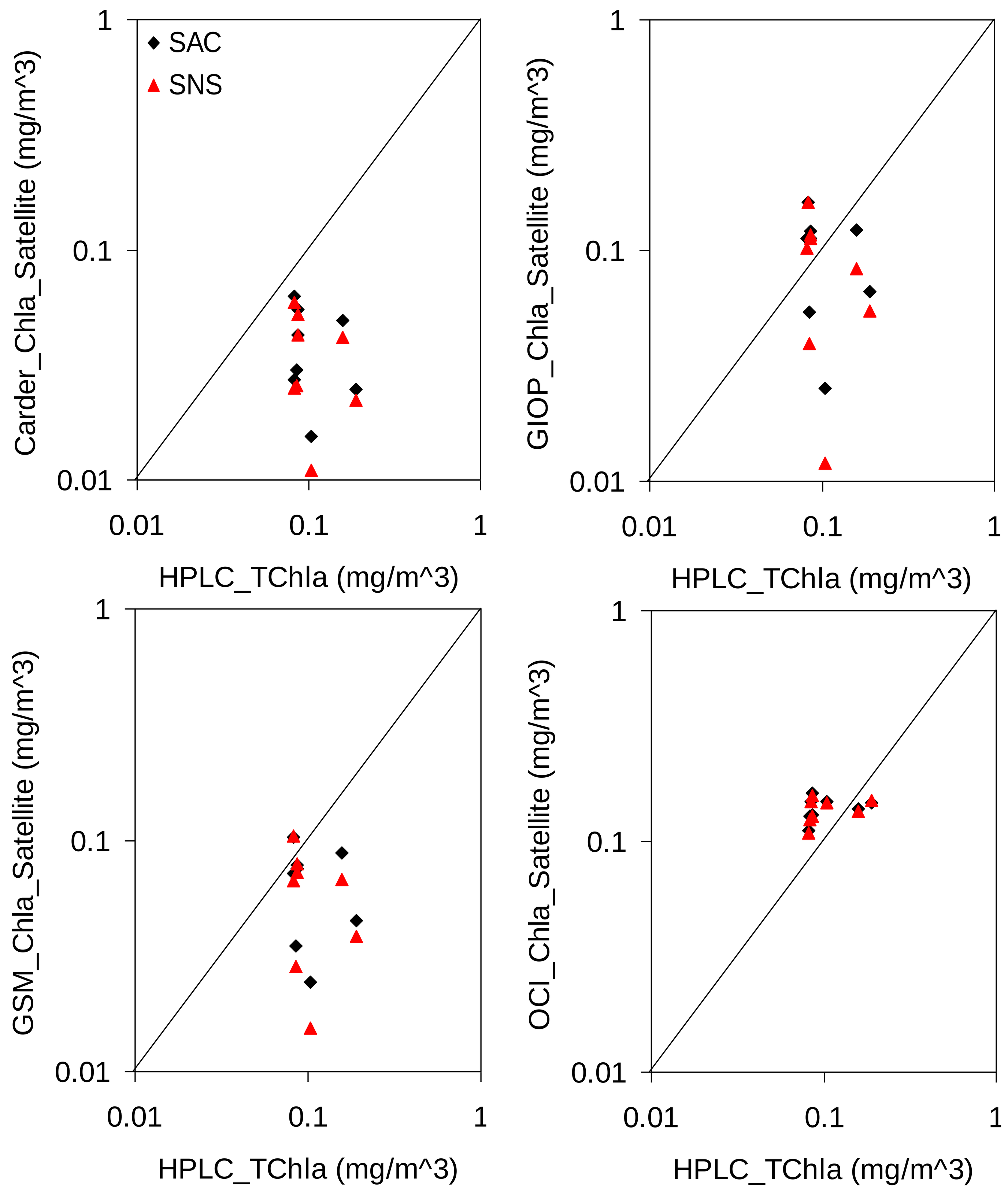

Fig.4. Comparisons between the satellite-Chla and *in situ* Chla in the Red Sea.

Conclusions

➢Comparison between the *in situ* and satellite based Chla values are not consistent with each other.

➢The results show both overestimation and underestimation of satellite observations compared with *in situ* observations.

➢Mismatch between *in situ* and satellite observations in the Red Sea is likely due to the effect of colored dissolved organic matter (Brewin et al. 2015; Tiwari et al. 2016) and/or failure of atmospheric correction algorithms with the high atmospheric aerosol concentrations.

➢Future study will be focused to improve and develop the new algorithms for the retrieval of chlorophyll a in the Red Sea.

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