Validation of OCM-2 sensor performance in retrieving chlorophyll and TSM along the southwest Bay of Bengal coast

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The Chlorophyll and Total Suspended Matter (TSM) data retrieved from Ocean Colour Monitor (OCM-2) onboard Oceansat-2 were tested for the accuracy using *in-situ* measurements made along the southwest Bay of Bengal coast during cruises and monthly samplings synchronized with satellite overpass from January 2010 to May 2011. The observed range of *in-situ* chlorophyll *a* and TSM concentrations were 0.10–4.60 μgl^{-1} and 12.70–34.56 mgl^{-1} respectively, while OCM-2 derived chlorophyll *a* and TSM concentration ranged from 0.324 to 1.552 μgl^{-1} and 3.537 to 32.11 mgl^{-1}, respectively. The *in-situ* dataset was grouped into low (0.1–0.5 μgl^{-1}), moderate (0.51–1.0 μgl^{-1}) and high (>1 μgl^{-1}) chlorophyll concentration and low (12.7–17.81 mgl^{-1}), moderate (18.1–29.0 mgl^{-1}) and high (>30 mgl^{-1}) TSM concentration for evaluating the performance of algorithms against different ranges of field measurements. The OCM-2 chlorophyll retrieval algorithm (OC4V4) showed a systematic and large overestimation of low chlorophyll values with $r^2 = 0.607$, root mean square error (RMSE) = 0.33 μgl^{-1} and mean normalized bias (MNB) = 1.57 and consistent underestimation of high chlorophyll values with $r^2 = 0.497$, RMSE = 1.486 μgl^{-1} and MNB = 0.52 especially at nearshore waters due to the interference of suspended matter and coloured dissolved organic matter. However, moderate range of chlorophyll values showed better performance of OC4V4 algorithm in chlorophyll retrieval with $r^2 = 0.676$, RMSE = 0.254 μgl^{-1} and MNB = 0.09 when compared to low and high chlorophyll values. The TSM algorithm (modified algorithm of Tassan 1994) showed large underestimation in TSM retrievals and this was proved by the statistical results which shown maximum $r^2 = 0.551$ for low TSM values with less RMSE = 0.909 mgl^{-1} and MNB = 0.616 error compared to moderate and high TSM values. OCM-2 retrieved TSM values were not well correlated with *in-situ* TSM concentration and constantly underestimates four times lesser than the *in-situ* measurements especially near the coast when TSM concentration was measured high. Though there was significant correlation exists between OCM-2 retrieved chlorophyll and TSM with *in-situ* measurements, the empirical algorithms employed did not give logical retrieval of both chlorophyll and TSM for the southwest Bay of Bengal (BoB). Thus, the present study revealed that the OCM-2 chlorophyll and TSM retrieval algorithms need to be tested further with extensive *in-situ* dataset around BoB to improve the regional algorithms for accurate measurements of chlorophyll and TSM in this region.

Keywords. Ocean colour; chlorophyll *a*; total suspended matter; validation; Bay of Bengal; OCM-2.

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1. Introduction

Oceans occupy almost 70% of the earth's surface, which play an important role in the climatic conditions of the adjacent land regions. Peninsular India divides the northern Indian Ocean into two basins, the Arabian Sea and Bay of Bengal (BoB). Arabian Sea is characterized by intense upwelling and is one of the biologically richest environments of the world oceans, whereas BoB is traditionally known as less productive (Prasannakumar *et al.* 2010). A unique feature of the BoB is extreme variability of the physical properties especially episodic cyclones with torrential rains. The knowledge on BoB waters and its nutrients and circulation dynamics along the coast has paramount importance in understanding the ocean properties like chlorophyll concentration, currents, sea surface temperature, oceanic fronts and eddies, suspended particulate matter, dissolved organic matter, etc. (Dey and Singh 2003). The advent of satellite technology which provides repetitive and wide area coverage has revolutionized the oceanographic observations in the past decades and made easy to map ocean geophysical parameters and their inter-linkages.

Remote sensing of water quality parameter has involved mainly estimation of chlorophyll and total suspended matter (TSM) from sensor derived radiances. This is because of the fact that, these two parameters are optically active and can adequately represent the water quality scenario. Chlorophyll *a* is the major photosynthetic pigment of marine phytoplankton (Beebe 2008) and its value as an indicator of phytoplankton biomass or productivity in the ocean has been well recognized (Jeffrey *et al.* 1997). Chlorophyll *a* is the dominant light harvesting pigment and is universally present in eukaryotic algae and cyanophyceae. TSM are the most common type of pollutants both in terms of weight and volumes in the surface of the water column are helpful in determining water dynamics and spread of pollutants (Ritchie *et al.* 1990). The study of suspended sediment is ecologically important because they are the main carriers of various inorganic and organic matters representing main constituents of biogeochemical processes (Doerffer *et al.* 1989). The suspended sediments also affect the penetration of light and the transport of nutrients or shoreline morphology among other processes (Kunte 2008).

The capability of visible bands of multi-spectral satellite data has been demonstrated to detect the content of water column within certain depth (Gordon *et al.* 1975; Liang and Chen 1988). Absorption and backscattering are caused by phytoplankton and TSM in both open sea and coastal waters and it affects the optical properties of water and the optical penetration depth (Deng and Li 2003). Remote sensing of water bodies is restricted to a relatively narrow range of optical wavelength (400–850 nm) compared to remote sensing of terrestrial object due to low solar irradiance at wavelengths less than 400 nm and by a combination of lower solar energy and the sharply increasing absorption of light beyond ∼850 nm (Dekker 1993). A small part of it is scattered out which is detected by the ocean colour sensor. From the radiances detected in a set of suitably selected wavelengths, the concentration of the oceanic constituents can be estimated through a retrieval procedure (Mohan 2000).

Though remote sensing has the advantage of large area coverage and repetitive in nature (Ambarwulan and Hobma 2004), it has its own disadvantages like cloud cover and its influence in high latitudes (Sipelgas *et al.* 2006). Satellite ocean colour data also provide the practical means for monitoring the spatial and seasonal variations of near surface phytoplankton and sediment dynamics (Sarangi *et al.* 2008a) and are essential for the study of ocean primary production, global carbon and other biogeochemical cycles as well as fisheries production (Sarangi *et al.* 2008b). Satellite ocean colour research began in the late 1970's with the introduction of Coastal Zone Colour Scanner (CZCS) aboard the Nimbus-7 satellite which acquired data from October 1978 to June 1986 (Evans and Gordon 1994; O'Reilly *et al.* 1998). Ocean colour sensor data is available through a number of satellites such as SeaWiFS (Seastar), MOS (IRS-P3), POLDER, OCM (IRS-P4), MODIS (TERRA and AQUA) and OCTS (ADEOS), etc. With these missions, we entered a new era of ocean colour remote sensing that is expected to provide a highly consistent time series of near-synoptic and global data for many years to come.

Ocean-colour remote sensing has been used as a synoptic and quantitative tool to observe biological features associated with upwelling, ocean gyre systems, oceanic fronts, eddies and phytoplankton blooms. The Oceansat-2 ocean colour monitor (OCM) has been designed to provide continuity to the Oceansat-1 OCM instrument and to obtain quantitative information of ocean colour variables, e.g., chlorophyll *a* concentration, TSM concentration and vertical diffuse attenuation of the light (K_d) characterized at 490 nm. Oceansat-2 OCM is almost identical to Oceansat-1 OCM, however central wavelength of band 6 and 7 have been shifted (table 1). The spectral band 6, which was located at 670 nm in Oceansat-1 OCM, has been shifted to 620 nm for better quantification of suspended sediments and spectral band 7, which was located at 765 nm in Oceansat-1 OCM has been shifted to

Table 1. *OCM-2 spectral bands and its applications.*

Spectral bands	Wavelength range (nm)	Applications
C1	402–422	Yellow substance and turbidity
C2	433–453	Chlorophyll absorption maximum
C3	480–500	Chlorophyll and other pigments
C4	500–520	Turbidity, suspended sediments
C5	545–565	Chlorophyll, suspended sediments
C6	610–630	Total suspended matter estimation
C7	725–755	Atmospheric correction
C8	845–885	Aerosol optical thickness, vegetation, water vapour reference over the ocean

740 nm to avoid oxygen absorption in case of Oceansat-2 OCM. The data products from OCM-2 is available at 360 m spatial resolution for regional studies called as Local Area Coverage (LAC) products and at 1 km spatial resolution for global studies, called as Global Area Coverage (GAC) products. In the present study, an attempt has been made to check the accuracy of the OCM-2 derived chlorophyll and TSM data with the *in-situ* data collected from the southwest Bay of Bengal.

2. Material and methods

The Bay of Bengal is situated in the eastern part of the north Indian Ocean. It is traditionally considered to be a less productive basin compared to the Arabian Sea. Although the riverine flux may bring nutrients, they are thought to be lost to deep because of its narrow shelf, persistent cloud cover and turbidity arising from sediment fluxes limits effective penetration of solar radiation in the upper euphotic column (Qasim 1977; Radhakrishna *et al.* 1978). The BoB is characterized as a large marine ecosystem bounded the territory of many countries and it has a several distinguishing features which make it a particularly unique and dynamic area of study.

Validation of chlorophyll and TSM data products derived from OCM-2 was made by using *in-situ* observations carried out on cloud free days of non-monsoon periods using organized cruises (CRV *Sagar Poorvi* and *Sagar Paschmi* of NIOT) and monthly coastal sampling along northern Tamil Nadu coast, southwest Bay of Bengal between January 2010 and May 2011. Five sampling stations, viz., Chennai, Kalpakkam, Pondicherry, Parangipettai and Nagapattinam were fixed with the help of Global Positioning System (GPS) and samples were collected in five transects a perpendicular to the shoreline (figure 1). Field work was not carried out during the northeast monsoon seasons covering October–December. Surface water samples (1 litre) were collected by using Niskin water sampler from five sampling stations between 10.00 a.m. and 1.00 p.m. at real time satellite overpass.

2.1 *In-situ chlorophyll a measurements*

For chlorophyll *a* measurements, 1 ml of saturated mercury chloride was added to the sample to avoid any planktonic multiplications and the samples were kept in an ice box and transported to the lab for further analysis. Chlorophyll *a* concentration was measured by following the methods of JGOFS (UNESCO 1994) protocol. The samples were filtered immediately through 47 mm GF/C filter papers (Whatmann International Ltd.). One ml of 1% magnesium carbonate suspension was added on to the filter paper to form a thin bed, which will serve as a precaution against the development of any acidity and subsequent degradation of pigments. After filtration, the filter papers were ground with 10 ml of 90% acetone using precooled glass mortar and pestle and transferred to the amber glass screw cap tube. Then the tubes were wrapped in aluminium foil and incubated for 24 hours in darkness in refrigerator. After incubation, all the samples were centrifuged at 4°C at 3000 rpm for 5 minutes. Chlorophyll *a* was estimated by using fluorometer (Turner Designs, Triology) and it was previously calibrated with known concentrations (2, 4, 6, 8, 10 μgl^{-1}) of standard chlorophyll *a* (Sigma – C6144) with an accuracy of $\pm 0.02\ \mu gl^{-1}$ by using 90% acetone.

2.2 *In-situ TSM estimation*

For the measurement of TSM, samples were well mixed by vigorous shaking of container and filtered through a pre-weighed polycarbonate filter (Whatmann, 0.45 μm) and rinsed with Milli-Q water. The risk to underestimate the TSM dry weight because of the cell-wall rupture, caused by osmotic gradient when rinsing with Milli-Q water and associated loss of cellular material is certainly lower than the overestimation due to residual salt on the filter (Van der Linde 1998). All the measurements were made by using Sartorius electronic balance with seven place precision. After filtration, the filter papers were dried at 75 °C for 24 hrs by keeping them in between aluminum foil and weighed again to estimate the TSM in terms of mgl^{-1} (Gray *et al.* 2000).

2.3 *Ocean Colour Monitor-2*

Cloud free OCM data (level 2 processed data for chlorophyll and TSM) of path10/row14 covering

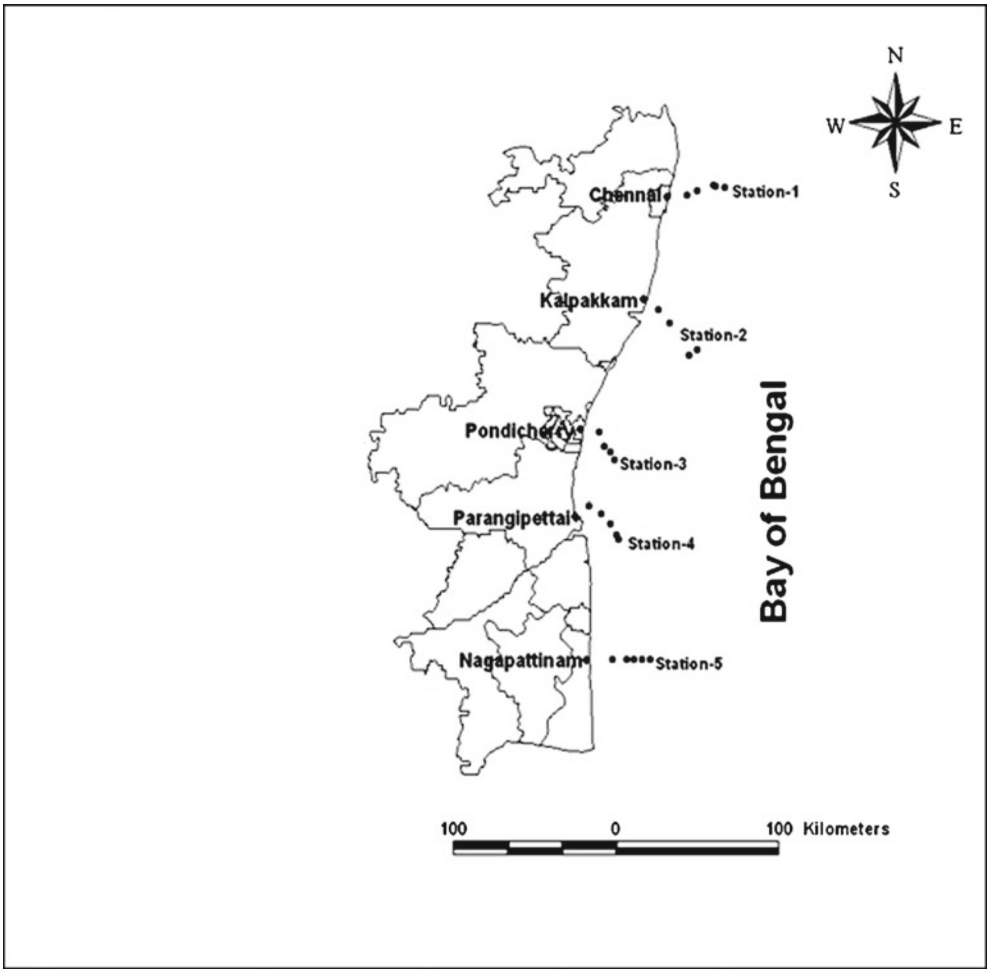

Figure 1. Map showing the study area and sampling points.

southwest Bay of Bengal, were procured for the period of January 2010–May 2011. Calibration and validation of satellite data was performed at CAL-VAL lab of Space Application Centre.

2.4 *Digital image processing*

Sequential OCM-Oceansat-2 data for the study area were analysed to understand the chlorophyll and TSM distribution patterns along the southwest BoB. The data were analysed for different seasons using ERDAS imagine (9.2 ver.) for preprocessing of satellite images. Geometric correction to the datasets was applied. Geometric correction was applied to remove image distortion and bring them to a standard geographic projection (geographic Lat. Long.) with modified Everest datum. Four corner coordinates were extracted from image header file and first level of correction was performed. Finally, the geometrically corrected OCM-2 chlorophyll and TSM images were utilized for validation analysis.

2.5 *Evaluation criteria*

The evaluation process is based on a comparison of the satellite derived values with the field measurements. For validation of OCM-2 with *in-situ* chlorophyll and TSM values regression plots were drawn with the help of Sigmaplot (Ver. 11) software. Statistics such as mean normalized bias (MNB), root mean square error (RMSE) and standard error of the estimate (SEE) has been used to provide a numerical index of OCM-2 performance and graphical criteria such as regression plots provide indication of the linear behaviour of the fit. Mean normalized bias is a measure of the over or underestimation of the true values due to a difference between actual measurements and satellite derived values. Root mean square error provides a good measure of data scatter for normally distributed variables and gives useful information of the accuracy between satellite and *in-situ* data, which are often observed for chlorophyll and TSM datasets and standard error of the estimate is a measure of the accuracy of predictions. These errors are defined as follows:

$$\mathrm{MNB} = \frac{1}{N}\sum\left(\frac{X - X'}{X'}\right)$$

$$\mathrm{RMSE} = \frac{1}{N}\sum\left[(X - X')^2\right]^{1/2}$$

$$\mathrm{SEE} = \sqrt{\frac{\sum (X' - X)^2}{N}}$$

where X is chlorophyll and TSM concentration retrieved from OCM-2, X' is *in-situ* chlorophyll and TSM concentration and N is number of pair of chlorophyll and TSM values.

3. Results and discussion

It was difficult to get sequential cloud free data for OCM-2 data for southwest BoB hence the validation exercise for OCM-2 data was carried out with limited available datasets. Third year *in-situ* datasets are yet to be calibrated with the satellite datasets. Figures 2(a–b) and 3(a–b) show the frequency distribution of *in-situ* measured chlorophyll and TSM with OCM-2 derived chlorophyll and TSM concentrations based on our entire dataset.

The range of *in-situ* chlorophyll a and TSM concentration is approximately 0.1 to 4.6 μgl^{-1} and 12.7 to 34.56 mgl^{-1} respectively (figures 2a and 3a). Figures 2(b) and 3(b) depict the graphical distribution of OCM-2 derived chlorophyll and TSM concentration ranged from 0.324 to 1.552 μgl^{-1} and 3.537 to 32.11 mgl^{-1}, respectively. The *in-situ* chlorophyll values ranged between 0.1 and 0.5 μgl^{-1} are considered as low chlorophyll values and it occurs most frequently with 67% of total measured values. While, chlorophyll values between 0.51 and 1 μgl^{-1} are considered as moderate chlorophyll (12%) and chlorophyll values above 1 μgl^{-1} are treated as high chlorophyll concentration (21%). Likewise, the *in-situ* TSM values varied from 12.7 to 17.78 mgl^{-1} are considered as low TSM values and it falls most frequently with 35% of entire values. Whereas, the TSM values ranged

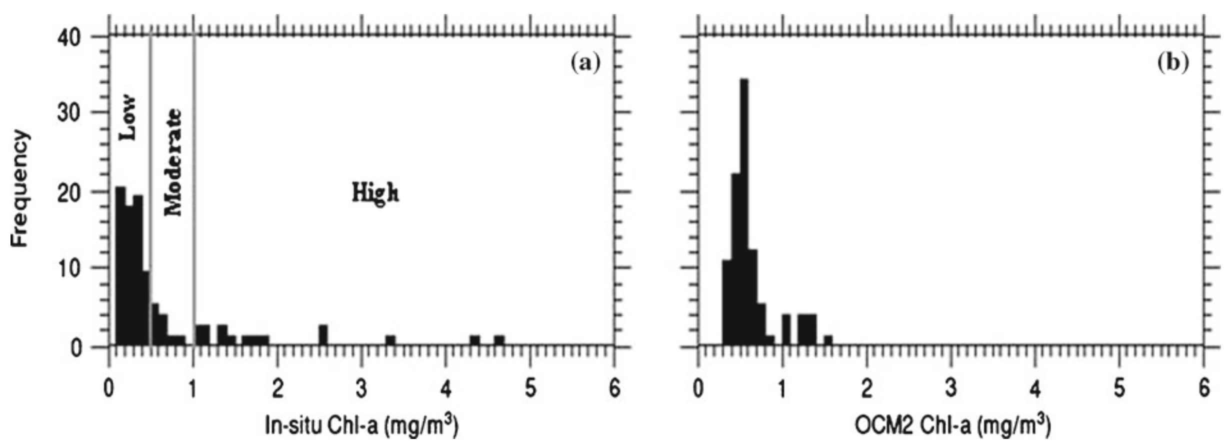

Figure 2. Histogram of **(a)** *in-situ* and **(b)** OCM-2 retrieved chlorophyll measurements.

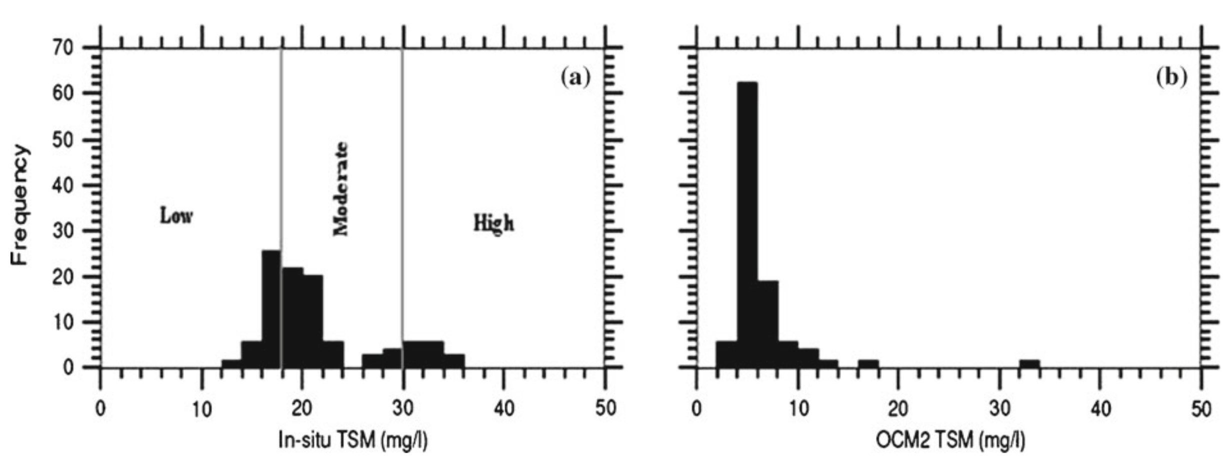

Figure 3. Histogram of **(a)** *in-situ* and **(b)** OCM-2 retrieved TSM measurements.

between 18.1 and 29 mgl^{-1} are considered as moderate TSM concentration (47%) and the TSM values above 30 mgl^{-1} are treated as high TSM concentration (18%). Comparison and regression plots of *in-situ* measured chlorophyll and TSM values (low, moderate and high) with OCM-2 derived estimates of chlorophyll and TSM concentrations are represented in figures 4–9.

3.1 *Chlorophyll a*

Generally, the chlorophyll *a* concentration is found to be low (<1 mgm^{-3}) in major portion of the Bay of Bengal. In the present study, the lowest chlorophyll concentrations were recorded at offshore waters and the higher chlorophyll concentrations were observed at nearshore waters of the southwest Bay of Bengal. In general, nutrient availability and chlorophyll concentration are reasonably good in southern Bay of Bengal during the late summer period of this region due to the onset of southwest monsoon winds (Vinayachandran *et al.* 2002) and upwelling of nutrient rich water associated with equatorward western boundary current (Rao *et al.* 1994). The offshore waters of the Bay of Bengal have lower nutrient concentrations at the surface when compared to the nearshore waters because of the narrow continental shelf region, which makes water column deeper and at times upwelling processes are not bringing nutrients up to the surface waters. The nutrient limitation is the most important cause of low chlorophyll concentration in the Bay of Bengal. Though, southwest Bay of Bengal receives nutrients from river discharge at the end of the northeast monsoon, the chlorophyll concentration found to be low due to persistent cloud cover, lack of vertical mixing of saline water with the freshwater and increased sediment load in the water column (Qasim 1979; Dey and Singh 2003).

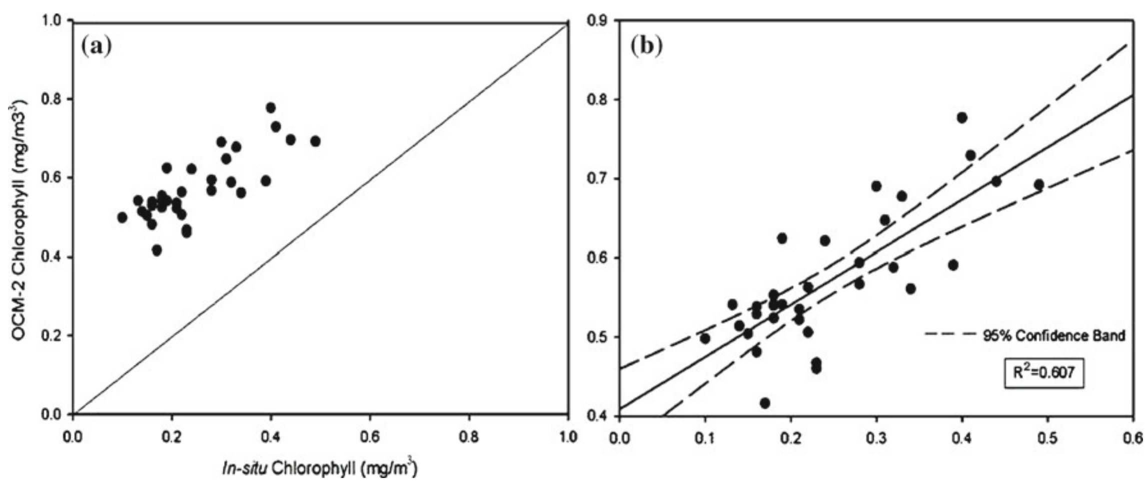

Figure 4. **(a)** Comparison and **(b)** regression plot of *in-situ* (low) *vs.* OCM-2 derived chlorophyll.

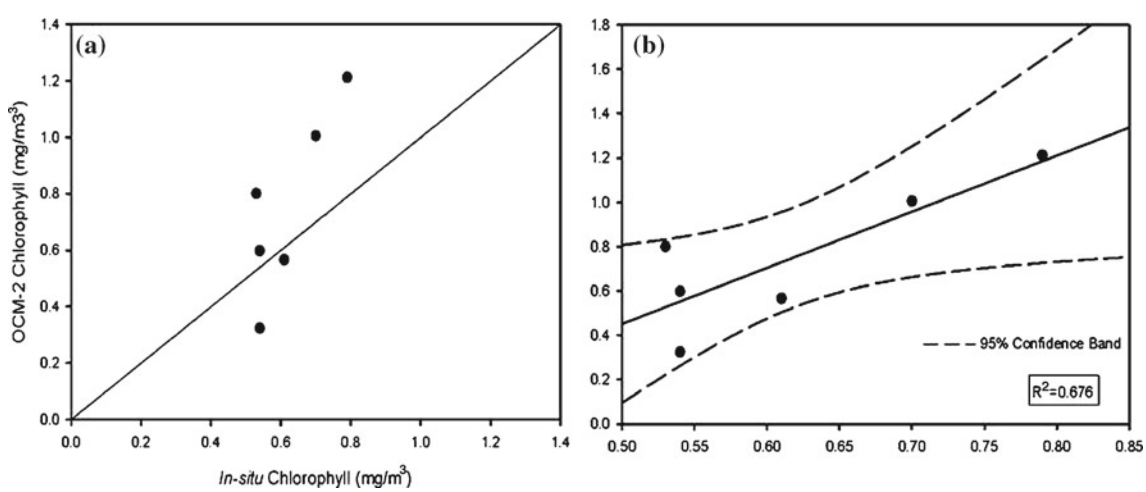

Figure 5. **(a)** Comparison and **(b)** regression plot of *in-situ* (moderate) *vs.* OCM-2 derived chlorophyll.

The comparison of low chlorophyll with OCM-2 estimates results clearly depicts the 100% overestimation data points spread above the 1:1 line (figure 4a). Linear regression between *in-situ* and OCM-2 measured chlorophyll values with correlation coefficient of 0.607 and standard error of estimate (SEE) of ±0.053 (figure 4b), in which data points fall above or below 95% confidence band suggest that the observed values are higher or lower than they should be in natural waters, and mean normalized bias (MNB) and root mean square error (RMSE) are 1.264 and 0.330 μgl^{-1}, occurs respectively. Comparison plot (figure 5a) of moderate chlorophyll with OCM-2 derived chlorophyll estimates portrait 66% overestimation and 34% underestimation of data points spread around 1:1 line. Regression between retrieved and measured chlorophyll concentration (figure 5b) was 0.676 with SEE = ±0.205 and MNB and RMSE are 0.021 and 0.25 μgl^{-1}, respectively. Comparison of high observed chlorophyll and retrieved chlorophyll values are shown in figure 6(a) and it represents the 100% underestimation of data points spread below the 1:1 line. The correlation coefficient (figure 6b) between both chlorophyll values was 0.497, SEE = ±0.328 and MNB and RMSE were 0.520 and 1.486 μgl^{-1}, respectively.

Selvavinayagam *et al.* (2003) validated OCM-1 derived chlorophyll concentration with field measurements in Tuticorin coastal waters with the correlation coefficient of $r^2 = 0.89$. Before launching Oceansat-2, Nagamani *et al.* (2008) tested the performance of OCM-2/OC4V4 algorithm with the SeaWiFS chlorophyll measurements and got very good correlation coefficient of $r^2 = 0.9$. Present results confirm that OCM-2 (OC4V4) algorithm overestimates the chlorophyll concentration and some underestimations were also observed at high concentrations (>1–5 μgl^{-1}) of chlorophyll along the nearshore waters. This study agrees with the previous studies of O'Reilly *et al.* (1998) using SeaWiFS data, Darecki and Stramski (2004) using

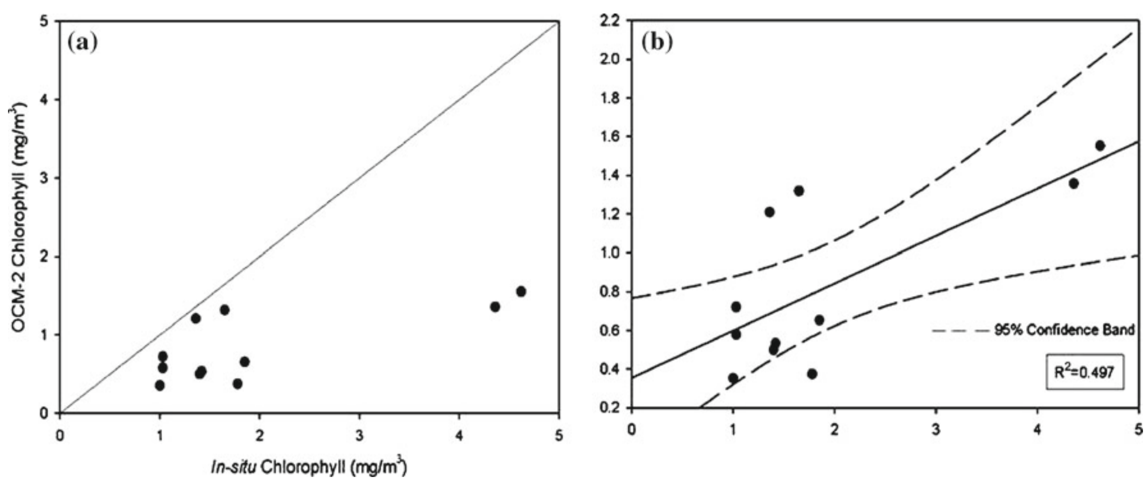

Figure 6. **(a)** Comparison and **(b)** regression plot of *in-situ* (high) *vs.* OCM-2 derived chlorophyll.

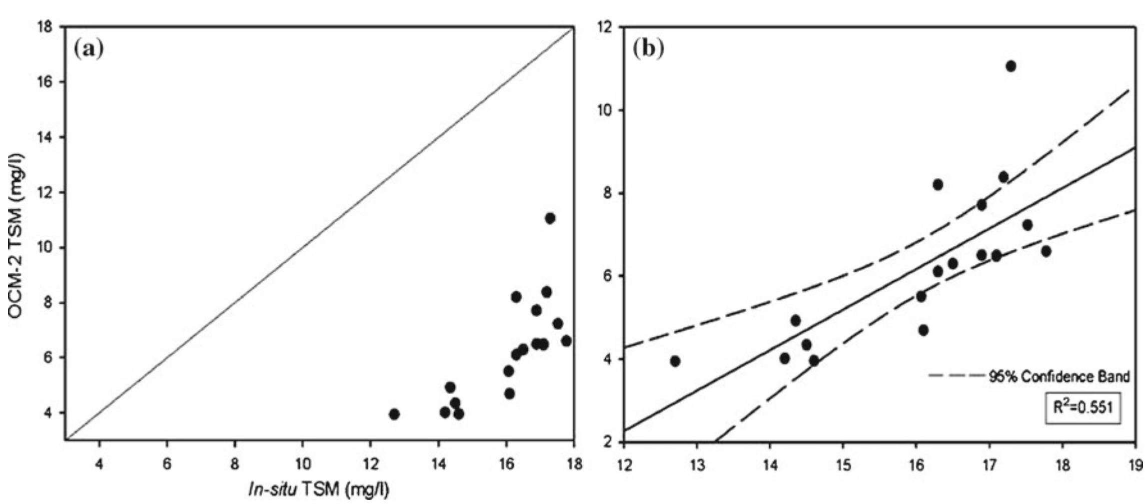

Figure 7. **(a)** Comparison and **(b)** regression plot of *in-situ* (low) *vs.* OCM-2 derived TSM.

SeaWiFS and MODIS data, Nagamani *et al.* (2007) using OCM-1 data and Xiu *et al.* (2007) and Montres *et al.* (2008) using MODIS data.

Possibly, the overestimation of chlorophyll could be due to the interference of suspended sediment and CDOM in the water leaving radiances. Besides this, other possible sources of errors are also identified and are bottom effects (Rundquist *et al.* 1995), the mixtures of organic and inorganic suspensions (Dekker 1993; Goodin *et al.* 1993; Han *et al.* 1994), absorption due to CDOM (Liew *et al.* 2001; Hyde *et al.* 2007) and turbulent effect of wind agitation. Ahn *et al.* (2001) suggested that the presence of suspended sediment in coastal areas can lead to 20–500% overestimation of chlorophyll *a* concentrations. However, Chauhan *et al.* (2002) got good correlation coefficients of $r^2 = 0.85$ for both OC2 and OC4 algorithms with *in-situ* measurements of Arabian Sea and preferred the OC4 algorithm for OCM-1 sensor because it uses a 490/555 nm band ratio and the atmospheric correction is much better in the 490 nm compared to the 443 nm band of OCM.

3.2 *Total suspended matter*

The BoB receives fresh water from many perennial river inflows including Ganges, Krishna, Godavari and Mahanadi besides several seasonal river inputs like Palar, Vellar and Coleroon all forming fertile, heavily populated deltas and wetlands. Large scale fluvial discharge also brings large amount of sediments and contributes to the high TSM in this Bay throughout the year (Sridhar *et al.* 2008). In general, the distribution of TSM in surface waters was abundant during pre-monsoon season especially the southern part of the Bay which is an area where southwest monsoon winds are prevalent during June–September and makes the water column more turbid, moreover along the southern Tamil Nadu coast, the southwest monsoon brings copious rainfall during this period and subsequent

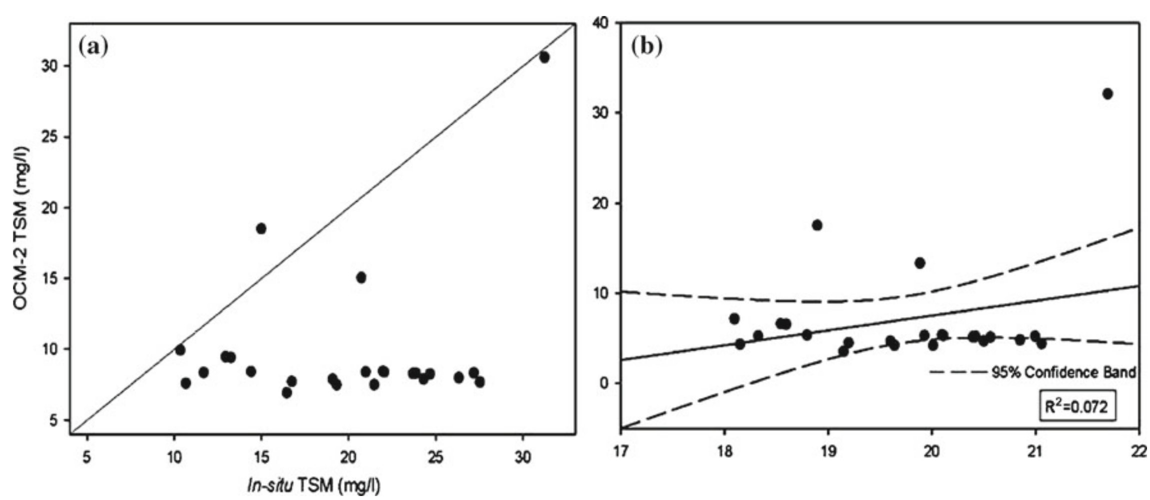

Figure 8. **(a)** Comparison and **(b)** regression plot of *in-situ* (moderate) *vs.* OCM-2 derived TSM.

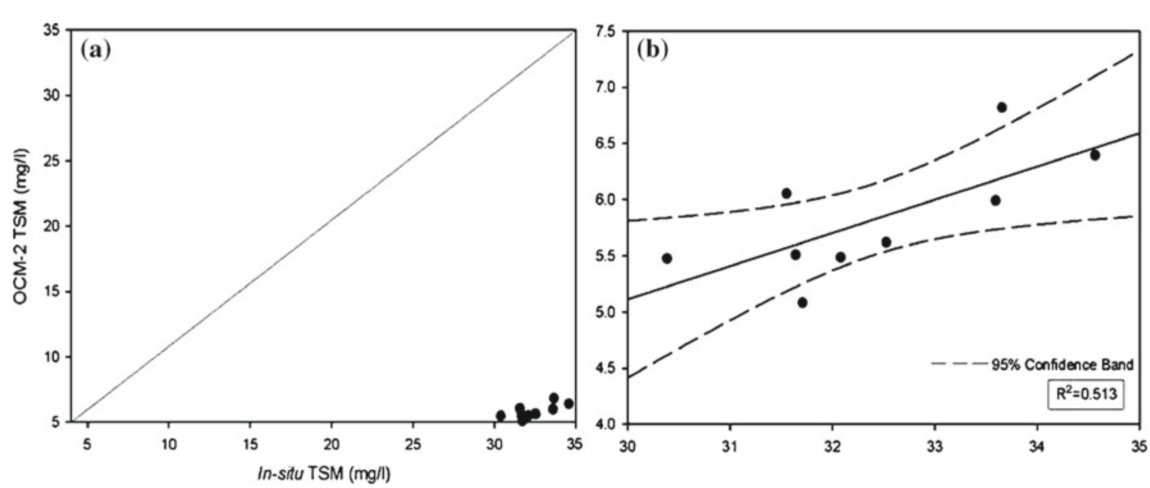

Figure 9. **(a)** Comparison and **(b)** regression plot of *in-situ* (high) *vs.* OCM-2 derived TSM.

land runoffs add significant TSM input into the Sea (Ram and Rao 2005). During summer season, the TSM was moderate or less in surface as well as subsurface waters due to the increased near surface stratification because of the warm SST and less stronger winds which inhibits the vertical mixing in the Bay of Bengal (Prasannakumar *et al.* 2007). The higher concentration of TSM was noticed in nearshore regions, such higher TSM within the surf zones are result of river discharge and littoral drift (Barua *et al.* 1994), resuspension of bottom sediments shear stresses generated by wave action (Sridhar *et al.* 2008) and also the tidal currents (Castaing *et al.* 1999).

Comparison between low TSM concentration and OCM-2 retrieved values clearly depict 100% underestimation of data points spread above the 1:1 line (figure 7a). Linear regression between *in-situ* and OCM-2 retrieved TSM (figure 7b) values with correlation coefficient of 0.551 with SEE = ±1.284, in which data points occurred outside of the 95% confidence line suggest that the values are higher or lower than they should be in natural waters and MNB and RMSE are 0.616 and 9.909 mgl^{-1}, respectively. Comparison plot of moderate TSM (figure 8a) with OCM-2 TSM values showed 95.83% of underestimation and 4.17% overestimation of data points spread around 1:1 line. Regression between retrieved and measured TSM concentration (figure 8b) was 0.072 with SEE = ±6.066 and MNB and RMSE were 0.644 and 13.93 mgl^{-1}, respectively. Comparison of high observed and retrieved TSM values represents 100% underestimation of data points spread below the 1:1 line (figure 9a). The correlation coefficient (figure 9b) between both TSM values was 0.513, SEE = ±0.402, MNB and RMSE were 0.820 and 26.60 mgl^{-1}, respectively.

The correlation of $r^2 = 0.78$ and 0.79 for IRS LISS II data (Chauhan *et al.* 1996) and $r^2 = 0.85$ and 0.95 for OCM-1 (Surendran *et al.* 2006) derived TSM with *in-situ* data were reported earlier from Tamil Nadu coast. Several studies were carried out using OCM-1 data for sediment dispersal pattern and validation because of its high spatial resolution (Anuradha *et al.* 2000; Prasad *et al.* 2002; Pradhan *et al.* 2004; Ramaswamy *et al.* 2004; Rajawat *et al.* 2005; Sridhar *et al.* 2008; Yan and Tang 2009; Sridhar and Ramana 2010) and are all resulted with significant interrelationships between OCM derived and *in-situ* measurements. Ramana (2010) tested the preliminary qualitative analysis on impact of shifted bands in OCM-2 on Suspended Sediment Concentration (SSC) retrieval and found that the retrieved SSC values for case-1 waters were almost same and for case-2 waters the retrieved SSC values were increased because of the shifted bands of OCM-2 when compared to OCM-1. Sridhar and Ramana (2010) have studied the sediment dynamics and transport in the coastal waters which helped in identifying the cause and effect of coastal erosion and port sedimentation using Oceansat 1&2 OCM-SSC data. Though there is significant correlation exists, the OCM-2 TSM algorithm does not give logical TSM retrieval for the southwest BoB as all the OCM-2 values consistently underestimates 4 times lesser than the *in-situ* measurements. From this it is clear that OCM-2 derived TSM concentration underestimates the real TSM concentration. The *in-situ* data did not match with the OCM-2 derived TSM and always underestimated the TSM values especially near the coast where TSM concentration was high.

4. Conclusion

Despite, the better agreement obtained between satellite chlorophyll measurements and *in-situ* chlorophyll *a* measurements, OCM-2 clearly underestimates the high chlorophyll concentration (*in-situ*) and overestimates the low chlorophyll concentration (*in-situ*). Validation of OCM-2 derived TSM with *in-situ* measurements found that OCM-2 values consistently underestimate the *in-situ* measurements. The study also revealed that inconsistency in the retrieval of chlorophyll concentration and underestimation of TSM concentration, which pointed out that the maximum band ratio algorithms (OC4V4 and Tassan 1994) of OCM-2 need to be improved for further applications. Though the satellite technology provides better platform for mapping chlorophyll and TSM concentrations, persistent cloud cover remain to be a critical problem in the southwest Bay of Bengal for continuous monitoring of the region.

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