

Review

Spatial and temporal variability of solar penetration depths in the Bay of Bengal and its impact on SST during the summer monsoon

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General Comments

This study combines observations from floats and gliders together with a simple one-dimensional model to quantify the potential impact that solar radiation absorption by chlorophyll has on Sea Surface Temperature, and consequently precipitation, in the Bay of Bengal. A novel method to derive chlorophyll-a depth profiles from downwelling irradiance is developed and described. The data and results are new and of current scientific interest, warranting publication in Ocean Science.

Below are a number of minor comments which I think could improve the manuscript.

Specific Comments / Technical Corrections (in the order of the manuscript)

1. **paragraph 105:** the scale depth, h_2 , is not previously defined as h_2 in the introduction
2. **paragraph 145:** can it be assumed that the shipboard CTD fluorescence sensor was itself calibrated to in situ bottle samples?
3. **paragraph 220:** are these uncertainties of the scale depth linearly related? And are they quoted later in the text?
4. **paragraph 230:** when averages are quoted it is nice to see standard deviations as well
5. **paragraph 235:** might be nice to be reminded from what values the ML is freshening and warming to, e.g. “....freshens from 34 to 33.3 g kg⁻¹”
6. **paragraph 245:** “the variability of h_2 is large” (add standard deviation?; Fig 4a)
7. **paragraph 260:** looking at figures 6a and 6b, it appears that the ML only deepens around the 26th July – perhaps mark on the figure the time the period you refer to. Might also be useful to the reader to mark out the barrier layer definition in the caption or on the figure again.
8. **paragraph 260:** “similar to the sub-daily variability of h_2 observed from the glider in the SMC.” Quote the values or reference figure 3 here
9. **paragraph 265:** Could abbreviate mixed layer depth to MLD here and elsewhere in the text
10. **paragraph 270:**
 - 10.1. The transition from describing the conditions observed by float 629 to that observed by the glider presumably is a bit confusing here. Suggest beginning the following sentence with “in contrast” or “conversely”

Closer to the East India continental shelf, the influence of the freshwater runoff from rivers entering the basin enhances the supply of biological material and the nutrient supply to the upper water column (Lotliker et al., 2016).

- 9.2 “As a result h2 is reduced” – does this imply h2 getting deeper or shallower. Suggest rephrasing for clarity.
- 9.3 “Sedimentary material also reduces the solar penetrative depths and increases solar absorption in the surface layers of the coastal region. As a result, h2 is reduced to the west of 83°E (Fig.5b), associated with higher remotely sensed chlorophyll concentrations in this region (Fig. 5a).” – the second sentence here seems to be referring to increased nutrients from river runoff, not sedimentary material.
- 9.4 ..., associated with increased satellite chl-a concentrations. The previous sentence mentions sedimentation also being a factor in setting h2 depth. Suggest relooking at this paragraph for increased readability.
- 9.5 Add anticyclonic eddy track to supplementary? (maybe not necessary?)

- 11. paragraph 280:** “Towards the end of September, the SMC influence at 89° E reduces and the current shifts to the western side of the basin (Fig. 1f), consistent with climatological observations (Webber et al., 2018).”

Suggest changing to active voice: “...at 89E, the influence of the SMC (*on chl-a concentration?*) decreases and the current shifts to the western side ...”

- 12.** Float 631 yields h2 values greater than 20 m – replace greater with deeper?
- 13. Paragraph 290:** The chlorophyll concentration of the surface layer, where the majority of visible radiation is absorbed, is a key control on the amount of visible radiation absorbed and thus on the radiant heating rate of the surface layer. Suggest rewording
- 14. Paragraph 340:** “all determined values...” Is this referring to all values of h2 derived from observations during that period?
- 15. Paragraph 370:** “from 26 m to 14 m leads to an increase in daily average SST of 0.35°C” suggest “...has the potential to increase daily average SST by 0.35°C”
- 16.** “Decreasing h2 from 26 m to 17 m, 19 m and 21 m, leads to progressively smaller increases” – this order appears unintuitive. Should one not decrease from 26 m to 21, 19 17? Or perhaps I have misunderstood.

17. Discussion

The authors demonstrate that chlorophyll-a concentration impacts the radiative absorption capacity of the surface ocean. While shallower scale depths induce larger changes in SSTs, it appears that the net impact of this warming is dependent on the depth of the mixed layer – which itself has multiple forcing mechanisms. Particularly, there is a large body of literature which discusses submesoscale variability which could be mentioned in the discussion on implications and assumptions. The assumption that the region is 1D forced should be discussed given the available literature on submesoscale 3D processes active in the BoB. It could also be interesting to suggest possible links between horizontal processes of SMS, shoaling of ML/added nutrients and

the link the chl-a concentration and warmer waters. Suggested literature: Ramachandran et al., 2018; Jaeger and Mahadevan, 2018; Shroyer et al., 2020.

18. General: punctuate equations

19. Average chl-a in surface 0-30 m is repeated a number of times throughout the text. Suggest defining and abbreviating at the beginning.

20. Figure 10: It is difficult to see differences between simulations in figure 10f. Suggest zoomed in inset.

21. A1d – would it be worth plotting a chl-a profile from the glider compared the float 629 which look to be close in space/time (looking at Figure 5?)