Authors thank reviewer for critical reviewing the article. Special thank for the suggestion of including Chlorophyll image based on climatological data. Figure obtained per suggestion verifies the obtained classification is best way of presenting / categorizing Arabian Sea based on Chl-a characteristics for the winter.

Major comments:

1. On what basis, principal component analysis based six ecological zones were divided into two Longhurst provinces? It should be elaborated in the section 4.1.

Authors' comment: 'Our analysis of 'Chl-a winter variability revealed six distinct ecological zones in the Arabian Sea, which has been compared with the Longhurst biogeographical classification of marine provinces for the study area.' This comparison is done as Longhurst's biogeographic classification is the well accepted one for the world oceans including the Indian Ocean. The statement provide in quotes will be included in the main text.

2. Because of the lack of satellite data during the monsoon seasons, authors have considered only winter data. We know that the Arabian Sea is most productive during summer. Authors should discuss how ignoring monsoon would impact the delineation of ecological zones?

Authors' comment: Yes, this is a limitation of our study approach, however the amount of comparable high quality (satellite Earth observation) data coverage in time and space make the statistical analysis and zonal classification robust. Combining satellite Earth observation data with seasonal ship measurements would have been advantageous; however we did not have access to such data to be incorporated in our analysis. The most productive period during summer coincides with persistent cloud cover in the study area (Saha, 1974). Since this work utilises satellite ocean colour data, which are limited by cloud cover, ocean colour data cannot be utilised to study the chosen area during the summer (Martin, 2004). Accordingly our analysis focuses on data from the winter period (Nov-March) in order to examine intra- as well as inter-Chl-a variability in the study area. With this limitation in our study we clearly claim that we have analyzed the intra and inter-winter variability, though the obtained zones would likely be different had it been possible to include the whole year. How it would change is hard to say, but a more prominent signal from the summer northwest Arabian Sea upwelling region is likely.

3. It appears that only surface chlorophyll values were used. But we know that ocean has a deep chlorophyll maximum (DCM). The justification provided on pages 2-3 (line 34, line 1-2; "the fact that during: : :: : :: : :: : :.content") is not correct. There are numerous studies showing DCM in the Arabian Sea. Authors have covered almost entire Arabian Sea, and it is not possible to have a weak DCM everywhere. Authors should explain how this analysis would be affected by excluding the most productive parts of the ocean?

Authors' comment: Yes, the present work utilized depth integrated surface chlorophyll values, which is remotely sensed by ocean colour satellite sensors. Reflected radiance is measured by the ocean colour sensor which contains scattered light containing information from ocean recorded

upto the depth where it is no longer reflected back to the surface (i.e., 0.1 photosyntheically available radiation (PAR) depth) (Martin, 2004). Hence remotely sensed Chl-a represents the average of Chl-a concentration from surface upto layer where 0.1 PAR with that of surface is available.

As pointed out, authors do admit the factor that Arabian Sea is not showing weak DCM everywhere during winter (Breves et al. 2003; Revichandran et al. 2012; Prasanakumar 2000). Also, some productivity may be excluded as we are not considering DCM-variability; however with lacking in-situ observations, there is no good way to include the deep layers. Furthermore, the increased chlorophyll at depth is sometimes a result of the phytoplankton having higher Chl/C ratio, to compensate for low light, not necessarily higher biomass. Again we will argue that our homogenous data set with extensive coverage in time and space found a basis for robust statistical analysis as long as the limitations of using satellite EO data are taken into consideration.

4. Provide a climatological data based Chlorophyll image as Fig. 4 (c). It would help to see whether chlorophyll content are drastically different in these six zones (particularly for sentence on Page 10, lines 17-18)

Authors' comment: Valid comment – Thanks! A Chl-a image (revealing the seasonal average Chl-a values over the winter period (Nov-March) from 2002 to 2013) is provided as a new figure 1, and it can be placed as 4 (c) as per the suggestion. Also, the following sentence provided in quotes can be included in the manuscript. 'The annual winter climatology (seasonal average Chl-a values over the winter period (Nov-March) from 2002 to 2013) of Chl-a distribution revealed distinct features for each of the identified ecological zones (Figure 4 (c)). Based on the variability of Chl-a concentrations, zone 1 experiences maximum bloom intensity between 1.5 to 9.6 mg m^{-3} with a mean of ~2.6 mg m^{-3} and standard deviation of 0.7 $mg.m^{-3}$. Next to Zone 1, high Chl-a prevails in Zone 2, with a range of 1.4 to 7.0 mg m^{-3} and a mean ~ 2.8 mg m^{-3}. Standard deviation observed in Chl-a are same for both zones. Moderate values of Chl-a (1.3 to 1.9 mg m^{-3}) are observed in Zone 3, Zone 5 and Zone 6. Though similar range are observed for these three zones, the statistics are different. In zone 3, Chl-a varies between 0.5 to 4.2 $mg.m^{-3}$, with 0.3 $mg.m^{-3}$ deviation. Among coastal zones, zone 6 Chl-a deviation is high (0.8 $mg.m^{-3}$) with a range of 0.9 to 6.8 $mg.m^{-3}$ than for zone 5 (0.5 $mg.m^{-3}$) between 1.0 to 4.3 $mg.m^{-3}$. Minimum value of Chl-a for the winter is observed in zone 4 (0.2 to 1.2 $mg.m^{-3}$), also in this zone least mean (0.6 $mg.m^{-3}$) and standard deviation (0.2 $mg.m^{-3}$) is observed. As Chl-a geo-spatial statistical variation in the study area clearly demarcates different ecological zones, the present classification of ecological zones is best way of presenting / categorizing Arabian Sea based on Chl-a characteristics for the winter.'

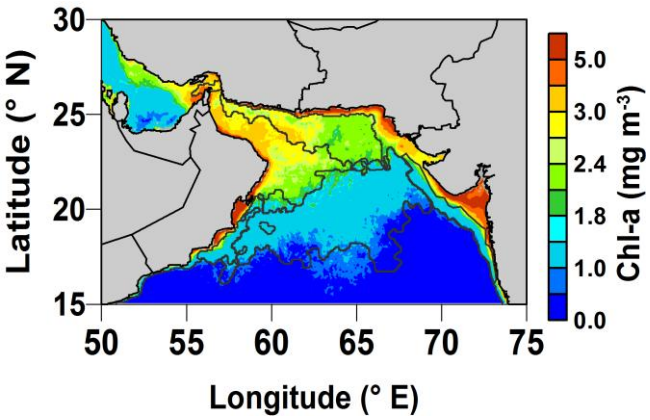

Figure 4c: Annual winter climatology (seasonal average Chl-a values over the winter period (Nov-March) from 2002 to 2013) of Chl-a revealed from satellite data. The black line indicated the delineated zonal boundaries.

Minor comments:

1. Title should be revised as "Delineation of marine ecosystem zones in the northern Arabian Sea during winter"

Authors' comment: The suggested title is appropriate for this work and hence it will be changed according to suggestion.

2. Page 3, lines 9-12 can be deleted as they do not provide any info

Authors' comment: The sentence is retained, as this sentence connects various supplementary data used in this work.

3. Page 4, lines 12-13, same font should be used for variables

Authors' comment: Suggestion will be incorporated in manuscript.

4. Page 4, line 19: (Levitus, 1982) has proposed density criteria to estimate MLD which is used widely (Gardner et al., 1995) and a better criterion than temperature.

Authors' comment: We thank the reviewer for this suggestion. The reason we use a MLD based on temperature criteria is because numerous other studies, including Rao et al. 1989; Rao and Sivakumar, 2000 and Kumar and Narvekar, 2005 used MLD based on temperature criteria in the Indian Ocean basin to study the MLD dynamics in the area. By using the same definition of MLD as these authors allows us to compare our results qualitatively to these previous studies. In addition, Kara et al. 2000 found monthly scale variability of MLD deduced from temperature criteria from Ocean Weather Station data have good agreement with Levitus et al. 1994 and Levitus and Boyer, 1994. Moreover, a comparison of MLD obtained from the HYCOM modeled data using both temperature as well as density criteria's with the Argo datasets available for winter are carried out. A total of 6256 points are collocated for winter for the entire study area for the comparison. MLD calculated from density criteria have more RMSD value and error percentage (RMSD: 36 m and an error of 68 %) compared with that derived from temperature criteria using 1^{o} C, 0.5^{o} C and 0.2^{o} C (RMSD: 20 m and an error of 28 %). This analysis showed better MLD derivation is with temperature criteria. Hence, a second analysis based on different

temperature based MLD criteria (1^o, 0.5^o and 0.2^o drop from that at surface) with the Chl-a in the six zones were carried out. From this analysis, it was found that MLD calculated using temperature criteria (1^oC degree) could explain the Chl-a pattern in each of the six selected zones more accurately than those computed using other temperature values. This is the reason for include temperature based MLD in the present work.

5. Page 5, line 18: I should be in italic, in fact all the variables should be made italic throughout

Authors' comment: Suggestion will be incorporated in manuscript

6. Page 7, line 4: Oman is an upwelling so how could it be oligotrophic (Wyrtki, 1973)

Authors' comment: Author accepted the mistake, it is to be replaced as mesotropic. However, explanation of Principal Component Analysis (the corresponding paragraph) is rewritten based on periodicity of Principal Components and hence this sentence will be removed from manuscript.

7. Page 8, line 2: (Naqvi et al., 2010) have not done sampling off Gujarat and Pakistan

Authors' comment: Author apologies for the mistake. The reference Naqvi et al. 2010 should be replaced by Sarma et al. 2012. However, this sentence too coincides with Principal Component Analysis which is rewritten and this sentence will be removed.

8. Page 8, line 13: How was coastal Chl a found erroneous?

Authors' comment: We used the NASA OBPG chlorophyll-a product derived with the OC4 band ration algorithms performing well only in Case-I waters (see also reply to question 5) [O'Reily et al., 1998]. Since the coastal zone is loaded with turbid waters (due to river inflow or resuspension) and may be optically shallow, the OC4 algorithm is not applicable and these zones were excluded from the analysis.

9. Page 9, line 2: blows should be replaced by blow

Authors' comment: Suggestion will be incorporated in manuscript

10. Page 9, line 17: "These coastal areas: : :: : :.winter." Reference is needed.

Authors' comment: Reference viz. Kumar and Prasad, 1994; Kumar et al. 2001 will be included in the manuscript.

11. Page 10, line 2: zone 6 is also an upwelling region (Sudheesh et al., 2016)

Authors' comment: Two reference will be added including Sudheesh et al. 2016 and Shalin and Sanilkumar 2014 in the manuscript

12. Page 10, lines 3-4: "Nutrient supply: : :: : :.zones". Provide reference, perhaps (Singh et al., 2012; Singh and Ramesh, 2011)

Authors' comment: Suggestion will be incorporated in manuscript

13. Page 10, line 9: parts has should be parts have; and this whole sentence should be revised for grammar

Authors' comment: Suggestion is incorporated will be included by incorporating following sentence given in quotes in the manuscript. 'However, we have identified high Chl-a concentration (>0.5 mg m^{-3}) in the entire study area, with significant differences between various parts, particularly higher values to the waters closer to the coast.'

14. Page 20, lines 5-25: These points should (also) be discussed in the main text (preferably in the discussion).

Authors' comment: Suggestion of included lines 5 to 25 from summary to discussion section will be incorporated in the manuscript.

15. Page 20, line 13: (Kumar et al., 2017) is another new reference for higher N2 fixation.

Authors' comment: Suggestion will be incorporated in the manuscript.

16. It is not clear what Fig. 8 conveys

Authors' comment: Sorry for the oversight mistake for not including colour description. Sentence provided in quotes will be included in the Figure caption. "Zones 1 to 6 are represented by violet, blue, green, light green, yellow and red lines respectively."

17. Units have periods (.) at most places (e.g., Fig. 5, mg.m-3, m.s-1). These periods should be removed throughout the manuscript.

Authors' comment: Suggestion will be incorporated in the manuscript.

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