Biogeosciences Discuss., 12, C9658–C9662, 2016
www.biogeosciences-discuss.net/12/C9658/2016/

Biogeosciences Discussions

Interactive comment on "Changes in optical characteristics of surface microlayers hint to photochemically and microbially-mediated DOM turnover in the upwelling region off Peru" *by* L. Galgani et al.

L. Galgani et al.

aengel@geomar.de

Received and published: 10 February 2016

We thank the referee for the evaluation of our manuscript. Specific issues raised are addressed here below.

1. Referee: Figure 1. S7 and S12_3 are not shown on the map.

Authors: The referee is right. The location of station S7 and S7_2 coincides but S7 is not indicated. We will adjust the figure. S12_3 is shown as S12_1/3 (as S12_1 and S12_3 are in the same location, just different times). We will clarify this in the figure's

legend.

2. Referee: Figure 2. It would be helpful to label the stations shown in the figure so that the reader does not need to go between the text, Figure 1 and Figure 2. Even just putting S10 for all of the S10 sites would help.

Authors: It is very difficult to add all station labels as then figures would be not legible anymore. That is why we split figure 1 in three parts. We will address this issue labelling a few stations, like S10.

3. Referee: Figure 3 caption: The box and whisker plots should be explained in the caption. What are the percentile values for horizontal lines? What do the black circles represent? Are they the individual samples? It would be helpful if these were colored by station number.

Authors: We will address the issues raised by the Referee and explain in the figure caption. The percentiles are 25%, 50% (median) and 75%. Black circles represent outliers and will be coloured for different stations.

4. Referee: Page 19386, lines 7 – 8: It is hard to see that "generally CDOM was enriched in the SML" based on the results shown in Figures 2 and 3. Figure 3 shows a few EF values > than 2 and a few < 1. Based on the text and Figure 2, the higher EFs appear to be associated with regions of terrestrial input or regions of coastal upwelling. The discussion on p. 19386 should reflect this.

Authors: CDOM concentration is expressed as absorption coefficient at 325 nm, a(325). Median EF for a(325) is 1.2 (figure 2). This means that at least 50% of our observations (and more) account for CDOM enrichment in the SML, with a median EF >1 as figure 2 shows. This is also visible in figure 4, where lower EFs (and EFs < 1) are found at higher distance from the coast. Instead of "generally CDOM was enriched in the SML", we will modify the text to "CDOM was enriched in the SML at most stations". We will also address these points in the discussion as suggested.

5. Referee: Page 19386, lines 19 – 21: Figure 3 indicates two populations of S(275-295) values – one with EFs <1 and the other with EFs >1. Are these not statistically different? If they are, reporting a median EF of 1 is misleading.

Authors: We don't understand the point raised by the Referee. In lines 19-21 (page 19386) we describe that values for spectral slope parameter S(275-295) were similar between sea-surface microlayer and underlying water, two distinct compartments. This means, that no real enrichment in one compartment or another was observed. This is clearly visible in figure 3, where median EF for S(275-295) is = 1. No statistically significant differences were found between SML and underlying water for S(275-295).

6. Referee: Figure 4: Again – it would be helpful if the stations were labeled in the figure.

Authors: See comment #2.

7. Referee: Page 19388, lines 21 – 24: On average, F2 did not show a clear enrichment in the SML but it did regionally – especially at S2, S10, and the southernmost stations. It is not clear why average EFs are emphasized rather than the regional values – especially since no data points coincide with the median values (as shown in Figure 7).

Authors: The referee raised an important point and we will address the regional enrichment in as suggested and add explanation on percentiles in the caption of figure 7. Apart for a few stations, F2 was not particularly enriched in the SML as figures 6, and 7 in particular, show, with a median value of EF = 1, that is, similar concentration in SML and underlying water for component F2.

8. Referee: Page 19393, lines 2-4: Not sure what is meant by this sentence.

Authors: We believe the Referee refers to the sentence in bold (here reported from previous page) [. . .] The characterization of CDOM via its optical properties adds relevant information to the organic matter composition in the SML, as it allows discriminating

between terrestrial and marine sources of DOM that may be equally enriched at the surface. Moreover, it helps tracking changes in DOM "quality" deriving from the exposure of SML to solar radiation more than any other marine environment. [. . .]. In this context by the bold sentence we meant that optical analysis of CDOM helps in understanding sources and fate of DOM in the SML, in particular photochemical processes that alter DOM composition (such as compounds and diagenetic state), that, in an environment so exposed to solar radiation such as the SML, might be of extreme importance. We will rephrase the sentence to "Moreover, it helps tracking changes in DOM "quality" deriving from it exposure to solar radiation at the sea surface that is higher than deeper in the water column".

9. Referee: Page 19393, lines 7 – 9: The highest a(325) EFs were observed at S10. Earlier in the paper it is said this may be due to the input of terrestrial material or upwelling. Can anything more be said based on the other reported measurements (F factors, etc.) about the relative importance of terrestrial inputs?

Authors: At S10, we saw an accumulation of CDOM in the SML with respect to the underlying water (measured as a(325)). However, F components of terrestrial origin (F2, F3, F5) were not enriched in the SML of those stations, while F1 and F4 preferentially accumulated in the SML. We may argue that these compounds (F1, F4) containing more protein-like DOM and enriched in the SML as an important component of CDOM, may directly derive from upwelling or from a microbial response to solar radiation, thereby implying an autochthonous microbial source in the euphotic zone or in the SML itself. Terrestrial material, containing more refractory DOM, showed similar concentrations in SML and underlying water (reminding that underlying water is still considered surface ocean, as in this study goes up to $\sim$20 cm). Since amino acids tend to accumulate in the SML quite ubiquitously (e.g. Cunliffe et al. 2013, Progress in Oceanography 109, 104–116), in this setting the contribution of terrestrially-derived material is, in our opinion, overwhelmed by the high productivity of the Peruvian EBUS (reflected in F1 and F4 and amino-acidic compounds). In other words, in highly produc-

tive oceanic regions DOM components prevailing in the SML may have different origin than terrestrial ones, even if close to the coast. Characterizing these features in the SML is important when addressing the issue of gas exchange between the ocean and the atmosphere, in particular within the context of worldwide expanding oxygen minim zones. We will better explain these concepts in the revised version.

Interactive comment on Biogeosciences Discuss., 12, 19373, 2015.