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Interactive comment on "The composition and distribution of labile dissolved organic matter across the south west Pacific" *by* Christos Panagiotopoulos et al.

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Reviewer #1: This study presents novel DOC and dissolved carbohydrate data along a transect in the South Pacific that spans a range of oligotrophic waters as part of the OUTPACE project. This is an understudied region of the global ocean, and these data provide interesting insights about carbohydrate dynamics in these oligotrophic waters. The study also provides a valuable portrait of DOC and carbohydrates for comparison to other ocean basins. The carbohydrate reservoir in the ocean is large and molecularly diverse. Carbohydrates account for about 15-20% of marine DOC and are among the most abundant biochemicals in seawater (Benner et al. 1992; Pakulski

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Discussion paper

and Benner 1994; Goldberg et al. 2010). Neutral sugars were measured in this study and while they are important and relatively abundant carbohydrates, they are not the only carbohydrates in seawater. This is implied in the Introduction (lines 68-71) and in the first paragraph of the Discussion. The manuscript needs revision to clarify the diversity and abundance of carbohydrates in the ocean and to place neutral sugars within the broader carbohydrate reservoir. For example, many carbohydrates besides neutral sugars contribute to semi-labile DOC (lines 238-241).

We agree with this comment and in the introduction of the revised MS we included a broader spectra of sugars including free monosaccharides (amino sugars, uronic acids, methylated sugars, sugar alcohols) reported in DOM or HMWDOM (see page 4, lines 79-83). We also expanded our discussion about the possible contribution of these compounds to the semi-labile DOC pool (see page 12, line 267-274).

The reported DCNS %DOC values in this study are similar to those observed in the N. Atlantic and N. Pacific (Goldberg et al. 2010, 2011; Kaiser and Benner 2009). This suggests carbohydrates are of a similar diagenetic state among these major ocean gyres. In contrast, the mol% glucose (_50-75%) values in this S. Pacific study are high compared to values reported (_20-50%) in the N. Atlantic and N. Pacific (Goldberg et al. 2010, 2011; Kaiser and Benner 2009). They are particularly high in surface waters (50%). Is this indicative of a different source of carbohydrates in surface waters? Given the similar yields (%DOC) among ocean basins it seems unlikely the high mol% glucose in the S. Pacific is due to greater diagenetic processing. The authors need to address the high mol% glucose values in the Discussion section.

The surface water of the MA area was characterized by a high abundance of Trichodesmium colonies (<200 μm to 2-5μm) size as shown by the underwater vision Profiler mounted on the CTD. The results showed that “fiber tricho-like Trichodesmium” (FTL Tricho) values ranged from 127 to 4125 Col m-3 in the MA whereas they were $\sim$ 0 in WGY area (Dupouy et al., 2018). Moreover, MODIS imagery acquired during the OUTPACE campaign revealed the presence of surface blooms northwest and

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Discussion paper

east of new Caledonia and near 20°S-172°W further indicating the presence of Trichodesmium in relation with the measured fixation rates (Rousset et al., 2018). Therefore the high abundance of glucose (∼ 50%) in surface MA waters may be due to presence of these species that potentially may release exopolysaccharides in the environment during their bloom or after their senescence. However, to the best of our knowledge the carbohydrate composition of these species is poorly known therefore, we do not have a solid evidence to support this statement. On the other hand, the high abundance of glucose in the surface WGY water (∼55%) is in agreement with the previous investigations (Sempéré et al. 2008) observed in the south Pacific gyre and may be due to presence of fresh organic material which is not taken up due to the limited nutrient availability. The above info is now provided in the revised MS (see page 15, lines 365-370).

I recommend the authors include a table with depth, chlorophyll, [DOC], [DCNS], DCNS %DOC, and mol% glucose data from all stations in the upper 200 m of the water column. It is not possible to derive quantitative values from the figures (2, 3).

We agree with this comment and a Table was now included in the revised version. Statistical analyses were made as well (Mann-Whitney test) to compare the MA and WGY areas. DCNS data are available at http://www.obs-vlfr.fr/proof/ftpfree/outpace/db/data/SUGARS/

The authors should take a look at the article by Shen et al. 2016 in L&O. This study shows the accumulation of carbohydrate-rich DOC during the summer in productive waters of the Gulf of Mexico. Nutrient limitation appears to play a role in carbohydrate-rich DOC accumulation.

We agree with this comment and we added this reference in the text (page 13, line 307) and support a part of our discussion using Shen et al (2016) results.

Specific comments: Methods: It is unclear how Dissolved Combined Neutral Sugar (DCNS) is calculated. The DCNS terminology implies that free sugars have been sub-

tracted from total sugars. If so, this should be stated. If not, the DCNS terminology needs clarification because the term implies free sugars are not included. Clarification is important for comparison of values among studies using different terminologies.

We agree with this comment. In fact the desalination procedure described in page 6 (lines 128-143) does not allow the determination of dissolved free monosaccharides (i.e monosaccharide monomers present in samples with a MW $\sim$180 Da) because these compounds are lost/poorly recovered during the dialysis step (cut off of dialysis tubes 100-500 Da). This info is now included in the revised MS (page 6; lines 140-143).

Experiments in my lab with a STD glucose solution at 1μM final concentration showed a recovery of 20-25 % (n=3) indicating that our approach is not well adapted to measure free monomers. Therefore the term DCNS used in this study corresponds indeed to combined monosaccharides found in polymers.

Line 31: change “also reflected” to “observed

DONE

Line 34: delete “high” and change “higher” to “longer”

DONE

Line 39: change “higher” to “longer”

DONE

Line 49: change to “life” to “productivity “

DONE

Line 72-73: The carbohydrate pool also includes oligosaccharides.

We agree with this comment and we added this information in the revised MS (see line 77).

Line 75: add reference McCarthy et al. (1996)

DONE

Line 78: change “that” to “they”

DONE

Line 79: delete “ultra”

DONE

Line 116-118: Are these values for multiple injections of a single sample or replicate samples? Report the average _ SD concentration for the reference standard.

DONE see lines 121-122 in the revised MS.

Line 154: provide a reference for the carbon conversion factor

We added the reference Kirchman, 1993 in the text (see page 7 line 166 in the revised MS) & reference section.

Line 165-166: include the range of mixed layer depths observed along the transect

We agree with comment and we added the mixed layer depth in the text (page 8, lines 182-184) as well in Fig. 3a in the revised MS along with the deep chlorophyll maximum.

Line 173: change “prokaryotic” to “bacterial” production (BP)

DONE (see page 8, line 187)

Line 182-183: reported range (55-78) is inconsistent with the highest value being 85, add the median value along with the range.

In the revised MS we provided the mean values of MA and WGY areas (Table 1).

Line 242-246: This sentence needs revision for clarity, e.g. 3H leucine concentrations. Duhamel et al. 2018 is not in the references. Total dissolved amino acids are known to contribute to semi-labile DOC and are measurable in mesopelagic waters of the Pacific.

The points raised by the reviewer were carefully addressed in the MS (see lines 279-282).

Line 194 and 196: add reference Kaiser and Benner 2009, values for the Pacific HOT station should be added for comparison

DONE. See revised MS page 9, line 216.

Line 211: Fig. 5 is presented before Fig. 4. Figure 4 is first presented in the Discussion and should therefore be presented as Fig. 5.

DONE

Line 251-252: Residence time (d) should be changed to Turnover time (d-1) because the calculation is based on microbial utilization (BCD) of DOC.

We computed the ratio DOCSL (mmol C m-2) to BCD (mmol C m-2 d- 1) which is in units of days (See Fig. 7 in the revised MS). It represents the time that would be necessary for the DOCSL pool to disappear completely due to its utilization by heterotrophic bacteria to satisfy their bacterial carbon demand, assuming no permanent renewal of this pool. The turnover rate (d-1) is simply the inverse of this ratio and it is not what we have decided to plot.

Fig. 1: The station symbols and numbers should be changed to colors that standout from the background.

The Figure has completely modified as the reviewer#2 suggested. It now contains a locator map (as reviewer#2 suggested) and we have changed the color of the sampled stations of the cruise. The legend was also changed accordingly.

Fig. 2: The legend states data are presented from 0-300 m depth, but the figure shows 0-200 m depth.

Corrected in the revised MS.

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Fig. 3: The masking of data on figures 2B and 2C due to abnormal extrapolation of data is confusing and inappropriate. Rather than mask areas on the figures, these odv plots should be adjusted to properly extrapolate among profiles (i.e. not connected between profiles that are many kilometers apart).

We agree with the reviewer comment and we have adjusted the resolution to obtain adequate ODV figures (see Figures revised MS).

Fig. 4: Residence time (d) should be changed to Turnover time (d-1).

See reply above.

Fig. 5: The relative abundance of dissolved monosaccharides should be referred to as the mole percentage (mol %).

DONE, also corrected in the Fig. legend

Additional editing for grammar would improve the text.

DONE

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