

**Author Comments on “Physico-chemical and biological factors influencing dinoflagellate cyst production in the Cariaco Basin”, by Manuel Bringué et al. (bg-2017-497)**

**Response to Referee 3 (Anonymous)**

The authors wish to thank Referee 3 for her/his thoughtful critical review which will help improve the manuscript. Our response to each point raised by the referee is detailed below:

- *Pg. 2 Line 7: Replace “southern Caribbean upwelling system” for Southeastern Caribbean Sea, so it’s not as redundant:* This will be implemented in the revised version of the manuscript.

- *Pg. 2 Line 9: Please add Rueda-Roa, 2012 as citation for the secondary upwelling:* This will be implemented, even though this references to an unpublished or peer-reviewed - PhD thesis. Thank you for providing this reference.

- *Pg. 3 Line 3-5: Please pick the most relevant citations; there are too many:* We respectfully disagree with the referee on this, as we find it important to acknowledge previous work that set the ground for this study.

- *Pg. 3 Line 8: Please add ‘subsequently’ between ‘has’ and ‘been’:* This will be implemented.

- *Pg. 4 Citing figure 1 with location/map would have been helpful also in line 1 of pg 4, when reference is made to the CARIACO site:* The reference to Fig. 1 will be added.

- *Pg. 4 Line 15-19: this has been stated in the introduction; I suggest removing/reducing the sentence in the introduction and leaving the longer description in the Env. Setting section:* Thank you for bringing this to our attention; however, we think it is appropriate to mention the presence of laminated sediments in the basin both in the Introduction (where it highlights the relevance of this calibration effort given the basin’s potential for paleoreconstructions) and the Environmental Setting section (where the question of how surface processes affect the nature of the sediments should be detailed).

- *Pg. 4 Line 25: The CARIACO site is mentioned anew; I would suggest being more concise – the authors can choose whether to provide location in the setting section (top of pg. 4) or in the methods, but fragmented as it is now it’s repetitive:* We respectfully disagree with the referee on this point, as we think station CARIACO needs to be mentioned in both sections. The mention in the Environmental Setting section is necessary because we need to be specific about the location of measured parameters (e.g., primary productivity) mentioned in the text, and it is also necessary in the Material and Methods section for the specific location (with coordinates) of the sediment trap mooring and water column sampling site.

- Pg. 8 Line 3-19: *This does not seem to belong in the statistical analysis section; it should be moved to the beginning of the methods, to the 3.1 Sample collection and analyses part:* The physico-chemical and biological parameters mentioned in Lines 3-19 were mostly extracted from previously published literature (thus not new in this study) and were used exclusively in multivariate statistical analyses. Thus, we find it more appropriate to retain the text in Section 3.4.

- *Results, section 4.1: Was there a reason why the authors decided to define their own upwelling/non-upwelling seasons, instead of following already defined ‘seasons’ from previously published literature? (e.g. Astor et al., 2013; Lorenzoni et al., 2011; Taylor et al., 2012)? They mention their definition is consistent with others, then why not go with those?* This is an excellent point which was discussed extensively within co-authors and with other colleagues who are involved in the Cariaco Basin Ocean Time Series and/or familiar with the hydrography of the basin. The ‘already defined seasons’ in the papers mentioned by the referee relate to general trends (e.g., upwelling season from January – May, non-upwelling from June – November, plus secondary upwelling events) and failed to capture the detailed dynamics of the system at the time scale of interest (and resolution) for this study. All the papers mentioned above also acknowledge that upwelling varies greatly between years. The upwelling index provided in Astor et al. (2013; their Fig. 2C) provided a much more detailed picture of upwelling dynamics but was derived entirely from wind data. Consensus was reached upon adopting this definition of upwelling because it relies on in-situ water column measurements and it captures the timing of upwelling events in much more detail, which was paramount for the interpretation of dinoflagellate cyst data. It was also agreed that providing a lengthy discussion on this particular point in the manuscript was unnecessary, as the definitions of respective upwelling intervals are clearly defined.

- *Line 31: Please be quantitative; what does “higher temperatures in shallow waters” refer to? What is higher? What is shallow?* This sentence is meant to give a general overview of variations in temperatures in the upper 100 m of the water column. The specific values of SST are stated (‘between ~ 19 and 28 °C’). The words ‘in shallow waters’ will be replaced by ‘close to the surface’ to avoid confusion.

- *Pg 10 Line 19: Is there an ‘of’ missing between the words ‘contribution Echinidinium’?* This will be addressed, thanks for noticing.

- *Pg 10 Line 28: ‘pulses’ should be singular (pulse):* Indeed, this will be changed.

- *Pg. 12 Line 9-8: is repetitive, as has already been stated in the introduction:* It is actually necessary to mention these studies here again as the paragraph is about comparing the cyst record of the trap time series (this study) with previously reported taxa from the basin’s sedimentary record.

- Pg. 12 Line 23-27: *Revise sentence and perhaps break it up; as it is, it's a bit confusing*: Thanks for pointing this out, it will be addressed in the manuscript by rewording and splitting the sentence.

- Pg. 12 Line 28: *There is a 'are' missing at the end of the line, after 'sites'*: This section of the sentence between commas is part of an enumeration of characteristics shared by the Cariaco and Santa Barbara basins that does not need a verb - the actual conjugated verb in this sentence is found later at Line 30 ('...cyst fluxes *are* about five times lower...').

- Pg. 12 Line 27-31: *revise sentence; it's not clearly written and can be worded better*: We acknowledge that the sentence is rather long but we believe it is the most effective way to provide a comparison between sites (Santa Barbara and Cariaco basins) and cyst records, without making the text heavy.

- Pg. 13 Line 14-15: *Statistical significance is provided for correlations between fluxes and cyst, and the text suggests that the relationships are significant, though the provided suggests otherwise ( $p = 0.000$ ). Generally, the  $p$  is set at 5% or 1%. The authors are advised to check their statistics and their interpretations*: The notation ' $p = 0.000$ ' actually means that  $p$  is well below the typical thresholds of either 5% ( $= 0.05$ ) or 1% ( $= 0.01$ ). In statistics, ' $p$ ' refers to the probability determined by the test, which is then compared to a threshold value (usually 5% or 1%); if  $p$  is inferior to the threshold value, one can safely reject the null hypothesis ( $H_0$ ), and safely accept the alternative hypothesis ( $H_1$ ). We thank the referee for ensuring the statistics are sound, but we find nothing to change. We will change ' $p = 0.000$ ' to ' $p < 0.001$ ' to avoid confusion.

- *The discussion in general presents many results which may be more appropriate to move to the 'results' section. For example, Pg. 16 has abundant results and references to figures which may be better moved to results, and the discussion section may then focus better on the actual discussion of results*: We thank the referee for her/his suggestion, but we find it appropriate to retain the current organisation. While some statements in Section 5.2 appear to present information not explicitly detailed in the Results, they are necessary to discuss the interactions between dinoflagellates and other major planktonic groups and are only relevant in this section. We have considered moving some of the content to Results, but found it more appropriate in the Discussion. Note that this difference in style may arise from different practices observed in varying fields of study.

- Pg. 17 *Please revise correlation coefficients and  $p$  values – as they are it's impossible to tell whether they are significant or not*. All  $p$ -values mentioned being smaller than 0.05, all correlation coefficients stated in the text are statistically significant. We have considered changing the text to something like ' $SST \times NAO$ : Pearson's  $r = -0.33$ ,  $p = 0.011$ ;  $SST \times MEI$ :  $r = -0.28$ ,  $p = 0.031$ ' but found it to be more

confusing. The sentence of Pg. 17 Lines 15-17 will be reworded to specify that each correlation is significant.

- *The reference to the ENSO impact in the Strait of Georgia is out of context – the geographic location is farther north and not even in the same ocean. It is suggested that it be removed as it adds nothing to the discussion.* We respectfully disagree with the referee on this point, as the Strait of Georgia record is the ONLY other record of a possible influence of ENSO on dinoflagellate cyst production in the world. This absolutely needs to be discussed here, despite the relatively distant geographical locations.

- *Pg 19 Line 1: The authors conclude that “On interannual time scales, dinoflagellate cyst production seems to be influenced by the strong 1997/98 El Niño event, with a one year lag”, though from their data and discussion it was apparent that they were not able to draw this conclusion?* The study makes a case that clear impacts of ENSO on dinoflagellate cyst production are not detected when no time-lag is applied. However, considering a one year lag (as suggested in Enfield and Mayer, 1997; Giannini et al., 2001), the data strongly suggest that cyst production is negatively impacted by the strong 1997/98 El Niño event, a response that is compared with other records of such impacts on the lower trophic levels from various locations in Section 5.3. The only limitation is that due to the relatively short duration of the sediment trap time series (2.5 years), there are not enough data points to compute robust and meaningful correlations with the ENSO index. The statement (Pg. 19 Line 1) is carefully worded and it is also clearly stated that longer time series are needed to properly investigate ENSO effects’ (Pg. 18 Line 7).

- *It is also unclear how the “work expands our knowledge of cyst-producing dinoflagellate ecology, helping the interpretation of fossil assemblages from the basin’s sedimentary record and worldwide.” It would have been a benefit if the authors had included in the discussion a paragraph where they tied it all together and specifically explained how this work would help the interpretation of fossil assemblages from the basin’s sedimentary record. The authors stress the importance of the work in the introduction, but then limit themselves at characterizing the cysts and seasonality and don’t put the results in the context of why this is important.* We appreciate the referee’s comment which reflects her/his care to ensure the authors keep a larger perspective in mind. While we acknowledge that someone outside the field might expect more on the interpretation of fossil assemblages, such a discussion would be out of the scope of this study. The introduction clearly makes a case that such sediment trap studies constitute a ‘calibration’ effort, which in turn help in the interpretation of fossil assemblages. It is the intention of the authors to continue investigating the dinoflagellate cyst sedimentary record in the basin (and elsewhere), and the findings of the present study will be extremely valuable at that time.