

Interactive comment on “Sedimentary response to sea ice and atmospheric variability over the instrumental period off Adélie Land, East Antarctica” by P. Campagne et al.

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Received and published: 31 March 2016

General Comments. This paper focuses on the understanding the diatom, elemental and isoprenoid records preserved in an ~40 year old, annually laminated, interface core from the Durmont D'Urville Trough, Adélie Land, East Antarctica. The study attempts to relate the changes in down core records of the preserved biological and chemical records to both prevailing regional atmospheric and sea-ice conditions for the same time period assuming the laminations are linked.

Although the paper makes a significant advance to our understanding of the environmental conditions of the Adélie –George V Land coastal region as is recorded in a 40 year time series, the paper requires a major refocusing or dividing in to two papers so

C1

that story is more succinctly and clearly delivered. At present it is very hard to read through and follow how the main aims are delivered on. It needs to be significantly reorganised and cut back, which I strongly encourage all the co-authors to assist the first author in undertaking.

The results need to be extracted into their own section and subsections and therefore separated from the heavy discussion sections in which they are currently hidden. Much of the ecological discussion should be cut back and either placed in if relevant to the current understanding of climate interpretations in the Introduction or used to support/provide contrast to the results in a discussion section. For example: qualifications of species groupings and/or resting spores/phases that have been applied prior to analysis should be found in the methods section (3.2) and not in the discussion.

Terminology needs careful attention (for example seasonal sea-ice zone = the area between the winter and summer sea-ice extremes; whilst marginal ice zone = the low sea ice concentration typically found at/near the ice edge and can be either quite diffuse and expansive (and hundreds of kilometres wide) or quite narrow and less than a few kilometres, usually depending on the winds). The use of a hyphen is required for sea ice when used as an adjective (e.g. sea-ice edge, sea-ice concentrations, sea-ice extent) but is not used for the noun (e.g. Antarctic sea ice, polar sea ice). Hyphens should also be used for sea-surface temperature (and salinity).

Adherence to basic protocols in the identification of diatom species in the text should be followed, where the first time that the species is mentioned in the text it should be written in full (*Fragilariopsis cylindrus*) and then the genus name can be abbreviated thereafter (*F. cylindrus*), with exception to the start of a sentence.

Someone will need to check the English to capture minor errors that appear throughout the paper and to add commas where required. I have sent an annotated copy of the paper to the author for this purpose.

There are a lot of acronyms – this might want to be reconsidered, as to how necessary

C2

some are.

Overall, my recommendation is rejection but with major encouragement to reconsider resubmission of two related papers, one building on the other. If the authors don't like that idea, then I have provided some suggestions on how you might want to revise the current structure including all of what you have here.

Specific Comments Abstract: Needs a rewrite to be more specific on the results identified and more direct about what the climatic relationship may be (i.e. does a species or laminae relate to a oceanic, sea ice or atmospheric condition?)

1970-2010 = ~40 years = 72.5cm long CE or AD ?? Editor might need to decide on what they prefer in this journal. Use of contrasting sea ice zone (SIZ vs Marginal IZ) are these zone what you really mean? What are the major elemental "abundances" (concentrations?) that are significant to this study? Can you be more specific? Results are not clearly identified or conveyed- what about the HBI signal? Last sentence should be removed and replaced with a more specific statement on interpretation and impact resolved.

1. Introduction I suggest adding two more short paragraphs (1) on relevant diatom coastal interpretations taken from discussion 4.1 sections and (2) on current HBI interpretations also found in discussion 4.1 sections

2. Environmental Sections 2.1 minor grammatical error (limit→ limits) 2.2. needs tightening up on the English Sentence change suggestions. '... originates from brine rejection, during winter sea-ice formation...' sea bottom → sea floor? 'Adelie Land Bottom Water is a major contributor to Antarctic Bottom Water'. 2.3 Sentence change suggestions '... coinciding with maximum wind speeds...' 2.4 'Sea-ice' conditions This section would benefit significantly by having a figure/images illustrating the core's location in context to the major sea-ice variations described. I would suggest moving the first sentence of this section to follow after the second. 2.5 Please describe more specifically in what way these studies are limited in time and low resolution (in reference to the state-

C3

ment: Most of these studies are either limited in time (refs) or are too low in resolution ...) What is AWS? There is no lead in from this section to the case studies/scenarios that follow- it is very disjointed. 2.5.1 to 2.5.3. I am not sure all the detail presented in these three subsections is necessary within the paper. You need to decide if these subsections are another study that needs to go in a separate paper altogether that you can refer to, or that you have completed a summary analysis (detailed in Supplementary section 1), which is then categorised by the three condition types that you apply as standard atmospheric conditions in this paper's analysis (potentially this could be summarised within one paragraph), or if the analysis itself is a major part of the study and the Case studies should be in the results section instead. At present it is too much information, and looks like results of a separate study and thus ultimately detracts from the paper's aim. The section needs a rethink in terms of what purpose it is serving in this paper. Some final comments on the case studies : it isn't clear on what time scales the associations have been based 1 year, 5 years, 20 years etc. There are too many acronyms. 3 Materials and Methods 3.1 Should the word (CANBERRA) be in the text? Did you mean the analyses were undertaken at the Australian National University in Canberra, Australia? I suggest writing the text in the past tense.

3.2 There are two different references outlined in two sentences in this section as having been followed (Crosta and Koç 2007 and Crosta et al. 2004), this should be clarified better. The references used in taxonomic identification should have been detailed here (even if in an appendix or supp. material) particularly given that some of the sea-ice taxa are not necessarily found in the Crosta works listed. Details defining the categories, groupings of taxa or use of resting spores (RS) should have been documented here rather than in the discussion sections. It may be worthwhile placing reference to Table 1 in this section given it is a summary of the published diatom ecological data. Remove the third sentence, but retain the NOA61 usage, detail the type of microscope. Indicate where the data is can be accessed (in a proper public data repository for future use) particularly if you do not provide a sup. table with this information with the paper. How can anything be verified from this work? Note here you indicate 70 species

C4

identified and only 25 species are greater than 2% of total relative abundance, later you indicate under PCA there are 65 species that are used many with abundances less than 1%. I would like to see a table summarising the diatom abundance data in the paper at the very least and related to full public data repository table. 3.3. The last statement is not sufficient (details about analytical parameters found elsewhere). Equally, an indication of where the data are available from should be identified here. 3.4 Can you please check all the dates (1978-2012; 1956-2011; 1979-2009) and make it clear what series you are using, or confined to, for the various instrumental data series given you have from Pb dates indicating the core is 40 years old (1970-2010). I found this section very difficult to follow any reasoning, when some years went beyond or started prior to the core's actual record of preserved conditions. Remove the reference to PCA here as you are only describing the data used not the analyses undertaken upon it later. Why was the 40% sea-ice concentration threshold chosen as the difference between sea ice covered and non-covered periods? Is this threshold one that has been identified by the sea-ice observation community as a valid concentration along the coast of Adélie Land for this sort of open or closed cover? I know that it makes sense out in the offshore SIZ, but wonder if that holds true close to the Adélie Coast. Please provide a reference and/or images in Section 2.4 that help to support your choice. If it was arbitrarily chosen to represent these conditions, as they occur in the offshore SIZ, then just say so. 3.5 Please make sure that you add the two identified points provided as reasons behind the PCA analyses to your introduction aims undertaken to answer your hypothesis. Start a new paragraph with the text beginning with 'In a second PCA...' and then rewrite this being clearer about what you mean by 'significant sedimentary data, in terms of population and ecological preferences' and 'interpolated at one year' (did you mean averaged over one year?). Delete the last half of the last sentence or weave that into the Introduction (, to support. ...).

Should there have been a material and methods section also focused on the elemental analyses undertaken?? Where is this data located publically?

C5

4. Results and discussion. The majority of text in the first part of Section 4 could be used in the Introduction; much is neither results nor discussion. Also 'George V Land' typo fix.

4.1 Should be re-labelled as the RESULTS section. In here you really should place the results of each analysis that has been covered in the order previously delivered in the paper under methods and materials. Tables, Figures and reference to Supplementary metadata should be identified in the relevant results subsections. Having read through the rather hefty sub-sections of section 4. I have two suggestions on how you may want to reconfigure the paper to provide a clearer message. (1) if you are to keep all elements, these are my suggested new headings based on what you have all through section 4.

4.1 Results 4.1.1 Atmospheric Analysis – resulting in three scenarios – if you make it part of the paper's results. 4.1.2. Pb210 dating/age model ?? 4.1.2. Diatom distributions and abundances in the core in general. 4.1.3. PCA analysis of diatoms – clustering results. Diatoms of significance to this study. 4.1.4 HBI Analyses down core 4.1.5 Elemental analyses down core 4.1.6 PCA/Pearson's analyses on diatoms and environmental parameters

4.2 Discussion. 4.2.1 Significant diatoms and environmental significance (to sea ice, HBI, Atmospheric, ? elemental) in general. 4.2.2 Scenarios of laminae preservation and proxy alignment (sea ice, open ocean, stratification as 2 paragraphs max each). 4.2.3. Physical parameter alignment (seasonal atmospheric and sea ice links to laminated records) 4.2.3 Adélie Land specific proxies (compared to other regions previous papers).

Or (2) Due to the extensive detail in the paper and the fact that the atmospheric case studies also sit awkwardly earlier on in the paper, I recommend you cut the paper in to two papers. This BG paper should concentrate uniquely on the diatom evaluation with the HBI, sea ice and elemental data and the PCA results, therefore focusing on

C6

the important species that this evaluation highlights. A second paper should then be based on this analysis and its final findings, and thus provide the broader climatological interpretation in clear context to the case studies of atmospheric and physical studies. I think implementing this two paper approach will allow the true value of the comprehensive study to shine through what is currently a very heavy discussion with far too much detail and no clear synthesis by the end. I have provided an annotated copy to the authors with respect to grammatical changes and suggested text refinements.

5. Conclusion. The conclusion is far too broad and sweeping, and fails to clearly highlight the important findings of the two major themes of this study. In part, I think the lack of clarity here is symptomatic of the huge amount of information that has been covered in the discussion and, secondly, because the main aims are not re-addressed. I suggest a complete rewrite in context to how the authors wish to move forward in a future resubmission.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2015-610, 2016.