Clim. Past Discuss.,
https://doi.org/10.5194/cp-2018-110-RC2, 2018

Climate of the Past Discussions

Interactive comment on "High resolution EPICA ice core dust fluxes: intermittency, extremes and Holocene stability" *by* Shaun Lovejoy and Fabrice Lambert

Anonymous Referee #2

Received and published: 5 November 2018

SUMMARY
Lovejoy & Lambert describe and analyze a high resolution dust flux time series from the EPICA Dome C ice core using 'fluctuation analysis' and spectral analysis, both over the full 800,000 year-record as well as for individual glacial cycles.

GENERAL COMMENTS

1. The authors apply interesting and novel concepts to a high-resolution record, so there should be a considerable potential for new insights.

2. However, the structure of the paper is too chaotic (almost intermittent) with data, methods, results and discussion randomly mixed. This renders the result barely readable and obscures potential interesting results. The introduction and discussion is currently myopic.
3. There are inconsistencies in the results, with the Holocene transition time Tau_C identified at 4, 3-5 and 7.9 kyrs at different points in the paper.

Without a substantial restructuring this paper is not acceptable.

DETAILED COMMENTS

p1l12/13 please indicate that you are using the definitions you provided in earlier work. These are not common concepts in (palaeo)climatology.

p1l20 what are the hypotheses underlying these two analyses with fixed/variable cycle durations?

p1l25 τ_c=4kyrs

p1l30–p2l4 A sharp peak in a spectrum due to a periodic component in the signal would be blurred and broadened by temporal uncertainty – which is, conceivably, larger in the earlier parts of the Pleistocene, the "41kyr world", for which data is based off marine records. The ratio of age uncertainty to period length is less favourable then, and many records are orbitally tuned (although possibly not using the analyzed signal).

p2l7 A brief definition of macroweather vs. climate regimes would be helpful here.

p2l16020 Mitchell's drawn spectrum was conceptual, and we know that it isn't accurate from earlier work (Huybers & Curry, 2006; Laepple & Huybers 2013)

p2l34/p3l1 This lacks recent literature. Interglacial vs. Glacial period climate scaling and variability have been repeatedly compared in the literature. Whereas Ditlevsen et al. (1996) and Shao & Ditlevsen (2016) investigated the scaling properties for the different climate periods and found strong differences, Rehfeld et al (2018) suggested that on millennial scale Glacial vs Holocene variability is approximately 4:1.

p3l4-9 This implies that you are analyzing dust as a temperature proxy, but the two signals scale differently. Dust concentrations are non-negative and non-Gaussian by definition.

p4l1 How were these spectral analyses performed? Why are there no confidence intervals? It would help if fluctuation analysis and spectral analyses were performed and displayed for the same datasets, given that most readers would be familiar with the latter.

p4l14/15 Presumably these estimates (like most others in this paper) have some uncertainty. Please state them!

p5l22 : Definitions belong to the methods, not the results. It would benefit the paper – and justify it – if methods, results and discussion were separated. Then the authors could devote a couple of paragraphs to the actual discussion of the processes and dynamics suggested by their results - such as the progression of deserts during Glacials that could be one of the reasons for the larger variance mid-cycle - which are lacking.

p6l26 To bear in mind: Mitchell draws a spectrum for temperature (conceptually), but data-based estimates have to rely on proxies for temperature, which potentially nonlinearly transforms the original processes.

p6l4 Haar fluctuations and intermittency should be introduced in a methods section.

p7l6/7 Please add a statistical test, considering age uncertainty, uncertainty in the transfer function and measurement noise. Otherwise robustness of the results cannot be judged

p9 Dust concentrations cannot be Gaussian, as they are counted variables and by definition positive definite.

p10l18 Holocene τ_c=7.9kyrs

p12l22 Holocene τ_c=3-5kyrs

p13l1-3 Maybe this early analysis can be progressed to an actual robust analysis of this dataset.

Dataset Is this the dataset used? Please provide links to the versions and/or where the data is available. https://doi.pangaea.de/10.1594/PANGAEA.779311

Figure 2 presumably the hourly temperatures from Landers Wyoming and the daily temperatures at 75 degrees North were not measured by the authors, could you give the original references, please?

Figure 3b The axes here are unreadable. Rather than show the obvious (Gaussian assumption makes no sense for dust fluxes), why not consider nonparametric confidence levels, or show at least the log of the dust flux).

Figure 4 The decrease in power towards the lowest frequencies (>400,000, beta=-2) may well be an artifact: By construction, periods longer than the time-series length divided by two cannot be interpreted, and rules of thumb/good practice is to stick to 1/3rd of the record length. For this 800,000 year-record this would mean that the spectrum could be considered estimable up to timescales of $\sim$1/266,000 years. It would further be good practice to subtract at least a linear trend (Chatfield 2016).

Figure 10 How can the Holocene, being 11,700 years long, have a transition time scale τ_c of 7,900 years?

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