

## ***Interactive comment on “Estimating the timescale-dependent uncertainty of paleoclimate records – a spectral approach. Part II: Application and interpretation” by Andrew M. Dolman et al.***

**Andrew M. Dolman et al.**

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*Extracts of referee's comments appear in italics*

Dear Referee,

Thank you for taking the time to review our work and for your positive comments and suggestions.

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*I agree with the comments of Referee 1 in that it would be interesting to see how different assumptions on the characteristics of the climate fluctuations affect their results, and a discussion of the applicability of this approach beyond the Holocene.*

Regarding the assumptions on the characteristics of the climate fluctuations and discussion of applicability outside of the Holocene, we answer here as for reviewer 1.

We agree that the manuscript would benefit from some exploration of how changes to the assumed power-spectrum of climate affect the estimated time-scale dependent errors.

In brief: if the power of the high-frequency portion of the spectrum (about which we know something from the instrumental record) is held constant, while the slope at lower frequencies is made steeper, this increases the error components due to bioturbation - the smoothing effect and also the amount of climate variation redistributed as white noise. There is however some interaction with the parameter  $\tau_{ub}$ , which controls the amount or depth of sediment mixing and therefore the timescales integrated by the bioturbation filter. The deeper the mixing, the larger the effect of varying the power-spectrum slope. If the power at high frequencies is not kept constant, e.g. if using just a pure power-law spectrum, where changing the slope also affects power at high frequencies, then this interaction with  $\tau_{ub}$  gets more complicated, as a shallower slope can mean more power at high frequencies.

We will add a section exploring these effects either as part of the main manuscript or as a supplemental section.

Regarding the application of this method beyond the Holocene. Many of the error components, such as the bioturbation smoothing and seasonal aliasing, should remain approximately correct; however if we include glacial-interglacial cycles there will be larger variations in both the sedimentation rate and the seasonality of the signal carriers (e.g. foraminifera). For the seasonal cycle of the climate, the amplitude of the seasonal

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cycle and the precession driven modulation of the seasonal cycle will vary with the longer inclination and eccentricity orbital cycles – although the proportional changes are relatively small.

For the assumed stochastic climate spectrum, the key issue is the assumption of stationarity. If multiple glacial cycles are included then one could argue that the spectrum is again stationary and still dominated by a power-law type variation. It becomes more difficult to justify if just one glacial-interglacial is included. In summary, we would argue that current approach also works beyond the Holocene, albeit less accurately than within the Holocene. Nonetheless it is a significant improvement over assuming independent errors. We propose to discuss these issues in the manuscript.

Minor comments:

*Text in subscript should not be in italics: page 4 line 17, page 5 line 1, page 8 lines 19, 21 and 27, page 14 lines 12 and 23, and in Table 1.*

*Page 8 line 9: parenthesis should generally not be preceded by a comma.*

*Page 4 line 2: “an heuristic” should be changed to “a heuristic”.*

*Page 13 line 14: ‘of’ is written twice in “odd multiple of of the sampling interval”.*

*Page 18 line 4: delete ‘to’ in “PSEM allows to other processes”.*

We will correct these textual errors, thank you.

*I also have a few technical comments on the package.*

*Some arguments are not included in the argument description of their respective functions:*

*OrbitalError: "delta\_phi\_c"*

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*OrderStages: rev*

*ProxyErrorSpectrum: n.k, "delta\_phi\_c", sigma.cal, "S\_E": n.k*

*sinc: normalized*

*The argument "tau\_a" is not included in /usage in the documentation file of ‘ProxyErrorSpectrum’.*

These arguments should now be defined in all the relevant help files. tau\_ has been removed from the function definition as the period of the orbital cycle is parametrized by its inverse, nu\_a, the corresponding frequency.

*Generally, data sets located in the /data folder in an R-package should be documented. However, since these files seem to not be intended to be used directly by the end-user, but rather used or processed by other scripts, I would suggest, if possible, to place these files in another folder.*

We will move these data to /R/sysdata.rda which is more appropriate for internal data.

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Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-153>, 2020.

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