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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.

Anonymous Referee #1

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Earth's climate exhibits variability on a wide range of different time scales, and temperature time series have significant serial correlations. A 1/f noise can roughly approximate temperature fluctuations in the Holocene up to the industrial age. Applying pseudo-proxy methods to correlated signals, the authors demonstrate that proxy errors depend on the time scale, and they develop a framework for estimating the scale-dependent (frequency-dependent) proxy errors. The method is well-motivated, and it seems very practical, with an associated R-package. In my view, the paper represents an essential contribution to the field, and I congratulate the authors on having written an excellent article.

I have one general suggestion and a few minor comments.

My general suggestion is that the authors explore how different assumptions on the characteristics of the climate fluctuations affect their results. I do not think it is necessary to do this systematically, but it should be straight forward to plug in a few examples. For instance, different power laws and maybe the spectrum with two characteristic time scales (the spectrum of a two-box model driven by white noise). It would also be interesting to see a discussion of the applicability of the method beyond the Holocene climate.

My minor comments are the following:

The authors state that "Currently the temporal covariance structure of proxy uncertainties is largely ignored in the literature". This is true, but there are a few papers. For instance this one: Nilsen et al., Assessing the performance of the BARCAST climate field reconstruction technique for a climate with long-range memory, Climate of the Past, 2018. On line 24: "The power-spectrum of a proxy error contains all the information required to derive timescale dependent uncertainties." My comment is that, yes this is true, if you only consider second-order statistics. In principle, there can be other sources of uncertainty; for instance, changes in the fluctuation level over time. Line 18: calcite should not be in italics, same on line 19, 21, 28, and in Table 1.

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