**Climate
of the Past
Discussions**

Interactive comment on "Automated ice-core layer-counting with strong univariate signals" *by* J. J. Wheatley et al.

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Summary. The CPD paper by Wheatley et al. (2012a) is a nice contribution towards automated ice-core layer-counting. The introduced statistical method yields convincing recults on the H_2/O_2 series from the Gomez ice core. This good performance is likely

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owing to (1) the strong annual cycle preserved in that series and (2) the sinusoidal form of the variations (of the log-transformed H_2/O_2 values). Insofar the adaptation of the method and the convincing results regard to that specific Gomez ice core series, it should be helpful to the reader if that fact could be pointed out more clearly in the revised paper version. In my review I raise three major points; the first deals with a better understanding the performance of the method, the second and third with a wider application of it. The Editors of CPD should check the cited paper Wheatley et al. (2012b) in Environmental and Ecological Statistics for the degree of overlap in content with the present paper. I close with minor points. These are few because, unlike many other papers I had to review (here on CPD and elsewhere), the present paper contains so few errors and is so clearly and well written.

Major Point #1: Monte Carlo simulations. The paper by Wheatley et al. (2012a) lacks Monte Carlo simulations. It is good statistical practice to accompany a newly introduced method with Monte Carlo simulations on artificial time series. If the results are satisfactory, and the design of the Monte Carlo runs is comparable to the problem at hand (here: measured Gomez series), then we can more confidently apply the tested method to the measured series. Roughly: prescribe known timescale, generate one artificial series by means of a signal (sinusoid, other) and noise (of red type, additive), estimate timescale using method and compare estimated timescale with prescribed timescale. Repeat the procedure generation–estimation many times and calculate error measures (e.g., root of mean integrated squared error). Study the error measure for various data sizes and for various signal/noise ratios. (Data size and signal/noise ratio should be in the same order as the measured series to be analysed.) By imposing non-sinusoidal signals, you can learn about the performance of the method in such mis-specified situations, that is, one can evaluate the robustness of the method. You can compare your method with other methods, for example, that presented by Winstrup et al. (2012). A general reference for Monte Carlo simulations in climate time series analysis is, please let me mention it, my book (Mudelsee, 2010).

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Major Point #2: Error measures of timescale estimate. The method (Wheatley et al. 2012a) does not give timescale error measures. The estimation target of the presented method is the (layer-counted) timescale. Because (1) data size is less than infinity, (2) noise level is larger than zero and possibly (3) some values may be missing, the estimated timescale cannot be expected to equal the true timescale. Error measures (e.g., standard error) describe the size of the deviation between truth and estimation. It should in my view be straightforward to augment the methodology presented in Section 4 of the paper with the purpose of determining such error measures.

Major Point #3: Simulated timescales. The method (Wheatley et al. 2012a) does not produce simulated timescales. By using the error measures from Major Point #2, it should be straightforward to generate simulated timescales (one has to take into account the serial dependence between depth points, however). Why generate simulated timescales? Please let me cite own work: "Construction of age-depth curves for climate archives on the basis of dating points, constraints (e.g. strictly monotonically increasing curves) and the physics relevant for describing the archive's growth is a challenging task. It is currently being tackled by means of Bayesian and other simulation-based approaches. Construction of these curves is, however, not a means in itself. *Age-depth modelling must also provide simulated curves, which can then be fed into modern resampling methods of climate time series analysis, resulting in realistic measures of uncertainty in our knowledge about the climate*" (Mudelsee et al., 2012, p. 1991, my italics here in this review). That paper from which I quote, for example, takes simulated timescales as input for a bootstrap algorithm in nonparametric regression and studies the effects of dating errors on the widths of bootstrap confidence bands.

Minor Point #1. p. 2477, title. Specify that this is a kind of pilot study on the Gomez series (e.g., via a subtitle).

Minor Point #2. p. 2478, l. 14. Write "In some cases the chemical or isotopic signals

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..."

Minor Point #3. p. 2478, l. 17. Since the meaning of "robustness," which is a term coined by statistician George Box, is often misunderstood by climatologists, I would highly appreciate one extra sentence on the definition of that term.

Minor Point #4. p. 2479, l. 22. "... requires no prior knowledge" is a bit too strong wording. Later (e.g., p. 2484, l. 13–17) you explain nicely how expert knowledge may set in at a later stage of the analysis.

Minor Point #5. p. 2479, l. 24. "Depth i": I have problems here since depth in general is not an integer. It is an integer when you count it in units of bags of the ice core, but other ice-core measurements (continuous-flow analysis) exist and also other archives exist. Please re-write.

Minor Point #6. p. 2480, l. 1. Detrending: give further details (regression model type, estimation method).

Minor Point #7. p. 2480, l. 16–17. Perhaps "... moving standard deviation of x" is easier to comprehend.

Minor Point #8. p. 2481, l. 6–7. Give more details on that algorithm used to segment the series into β subsections.

Minor Point #9. p. 2481, l. 11. Write "Fourier analysis (McGwire et al., 2011) and ice flow modelling (Shimohara et al., 2003)."

Minor Point #10. p. 2481, l. 12. Mention your core: "... and fifth (stars) section of the Gomez ice core ..."

Minor Point #11. p. 2481, l. 15–16. $INT[6 \times 24.2] = INT[145.2] \neq 142$.

Minor Point #12. p. 2482, l. 2–6. You should say that your method and the derived probabilities are not necessarily related to the "3/4 consensus ratio".

Minor Point #13. p. 2482, l. 12–15. Omit the spaces before and after the slashes.

Minor Point #14. p. 2482, l. 24. Write "So the stretch of data in Fig. 3a has potential run label pattern:".

Minor Point #15. p. 2483, l. 22–23. As in Minor Point #14: replace "(top)" by "Fig. 3a" and so on.

Minor Point #16. p. 2484, l. 6–7. As in Minor Point #14.

Minor Point #17. p. 2484, l. 11. Write "For the Gomez core data and $\beta = 6$: ..."

Minor Point #18. p. 2486, l. 9–14. What is written here relates specifically to the Gomez core data. Do mention this core here.

Minor Point #19. p. 2487, l. 1. Write "... show a linear trend for the Gomez series."

Minor Point #20. p. 2487, l. 3. Expand in one short paragraph on the "standard linear modelling assumptions" as: fit method, goodness-of-fit measures, determination of predictive intervals, etc.

Minor Point #21. p. 2487, l. 24. As in Minor Point #14.

Minor Point #22. p. 2488, l. 19–25. Strictly speaking, you have not done anything on $\nu > 0.8$: re-write mathematically correctly.

Minor Point #23. p. 2489, l. 3. As in Minor Point #14.

Minor Point #24. p. 2489, l. 4. Write "For $\beta < 5$ and $\nu = 1/\sqrt{2}$ ..."

Minor Point #25. p. 2491, reference Shimohara. Do not capitalize title of that article.

Minor Point #26. p. 2491, reference Wheatley. Do not capitalize title of that article.

Minor Point #27. p. 2498, caption Fig. 7. Give ν value.

Minor Point #28. p. 2500, caption Fig. 9. Give ν and β values.

References

Mudelsee, M.: Climate Time Series Analysis: Classical Statistical and Bootstrap Methods, Springer, Dordrecht, www.manfredmudelsee.com/book, 2010.

Mudelsee, M., Fohlmeister, J., and Scholz, D.: Effects of dating errors on nonparametric trend analyses of speleothem time series, Clim. Past Discuss., 8, 1973–2005, doi:10.5194/cpd-8-1973-2012, 2012.

Wheatley, J. J., Blackwell, P. G., Abram, N. J., McConnell, J. R., Thomas, E. R., and Wolff, E. W.: Automated ice-core layer-counting with strong univariate signals, Clim. Past Discuss., 8, 2477–2502, doi:10.5194/cpd-8-2477-2012, 2012a.

Wheatley, J. J., Blackwell, P. G., Buck, C., Lee, L., Röthlisberger, R., and Wolff, E. W.: Statistical layer-counting in ice cores, Environmental and Ecological Statistics, submitted, 2012b.

Winstrup, M., Svensson, A. M., Rasmussen, S. O., Winther, O., Steig, E. J., and Axelrod, A. E.: An automated approach for annual layer counting in ice cores, Clim. Past Discuss., 8, 2519–2555, doi:10.5194/cpd-8-2519-2012, 2012.

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