

Interactive comment on “Identification of the accretion rate for annually resolved archives” by F. De Ridder et al.

Anonymous Referee #3

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De Ridder et al. outline a method for estimating the accretion rate in climate proxy archives that preserve an annual cycle. Of particular importance, the method does not assume a simple sinusoidal shape for the time model, but rather a variety of shapes are considered. Another important feature of the method is the implementation of an algorithm to simultaneously estimate the accretion rate and optimal model shape. The approach shows promise for developing very high-resolution (sub-monthly) timescales in climate proxy archives, and should be particularly useful in two situations: (1) when the environmental variable (e.g., temperature) has an annual signal that deviates from a simple sinusoid, or (2) when the relationship between the proxy response and environmental change is non-linear.

General Comment

Overall, the methodology outlined in this paper represents a significant contribution,

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however I do have several concerns. Most importantly, although the method permits development of an ultra-high resolution chronology, an estimate of the error on the reconstructed chronology is not included. This is essential if the method is to be used to synchronize multiple proxy reconstructions for paleoenvironmental interpretation. An additional, but related concern is the robustness of the method in the presence of background weather/climate noise, as well as the noise inherent in the proxy record (the impact of multiple controlling factors, etc.). How much noise (white, autocorrelated, etc.) is permitted before the method fails to reconstruct an accurate chronology? These issues will need to be considered before the manuscript is suitable for publication. If they are adequately addressed, I believe the technique will be of great utility in paleoclimate studies.

Specific Comments:

1. If this manuscript it is to be published in Biogeosciences, it should be rewritten in a form that will be accessible to the general Biogeosciences readership. Much of the background literature and statistical jargon will be unfamiliar to this audience. In the main text, supplement statistical jargon with non-technical descriptions. Place more technical descriptions (including supporting equations from the background literature) in an Appendix.
2. In section 1, note that Bruggemann (1992) previously developed a method for simultaneous estimation of an optimal chronology and model, although not explicitly for annually resolved archives. (Bruggemann, W., 1992, A minimal cost function method for optimizing the age-depth relation of deep-sea sediment cores, *Paleoceanography*, v. 7, p. 467-487.)
3. In section 2, please describe the splines used in the time base distortion parameter. Include their mathematical description in an Appendix.
4. In section 3, please include a brief description of the frequency demodulation technique of De Ridder et al. (2004), which is used as a starting point in the new method.

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The method can be outlined in detail in an Appendix.

5. In section 4, a time base distortion “constraint” is described, which becomes active when the minimal sample period is lower than 20% of the average sample period. Please explain how this value was determined.

6. In section 5, the discussion of equation (6) is not sufficiently detailed. Please elaborate and include supplementary information (as well as supporting equations) in an Appendix.

7. In section 5, the last paragraph indicates that the user must select the maximum values for h and b . How does the user identify the appropriate maximum values to employ?

8. Before application of the new method to the *Saxidomus giganteus* 18O data, the authors should demonstrate the robustness of the technique to background noise using a series of numerical simulations (see General Comment).

9. The authors will need to conduct a more comprehensive analysis of the *Saxidomus giganteus* 18O data. First, clams generally preserve growth increments from which one can reconstruct in situ timescales, sometimes down to a daily resolution. How does the chronology determined with the new method compare to that derived by counting the growth increments? Second, what is the primary control on the 18O signal (e.g., temperature, salinity)?

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