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

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Summary and recommendation

This is a very interesting manuscript. It deals with the reconstruction of the depth versus age scale for records from climate archives that are known to contain a harmonic signal (e.g., annual cycle). It develops and presents a methodology (model of discrete-time signal, fitted with nonlinear minimization techniques), which has the potential to be a powerful estimator for this type of problem. BG readers should be aware that this problem is only a sub-problem of the quite larger and much more common problem how to reconstruct a depth versus age scale for records that do not contain a nice harmonic signal but rather a noise spectrum with several broad peaks (e.g., ENSO variability or Milankovitch forcing).

Manuscripts representing a new statistical algorithm to solve some applied problem usually appear in an applied statistics journal. But I do not see a reason why BG should not be a place where such type of work could be published. However, in order to serve for the purpose of laying the foundations of the method and being the standard reference for future applications of the method, standard practices from statistical research have to be overtaken.

De Ridder et al. present the problem (Section 1), the signal and time base model (Section 2), minimization techniques and constraints (Sections 3 and 4) and model selection criterion (Section 5) in good detail. (One suggestion for an improvement here would be to be more explicit on how to calculate the age versus depth scale from a data set $t(i), d(i), x(i), i = 1, \ldots, n$. For example, the measurement values, $x(i)$, or the depth values, $d(i)$, seem not to be defined in the manuscript, and I wonder how

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readers should be able to repeat the computations.)

However, the major criticism from my side is that **the method is not tested** in a way that satisfies standard statistical practices. Specifically, I mean that no Monte Carlo simulations have been performed to evaluate the method's performance to reconstruct an unknown age versus depth scale. An outline for a Monte Carlo test of the method might be as follows.

1. Prescribe a "true'' age versus depth curve, say, $t_{\text{true}}(i), d(i), i = 1, \ldots, n$, where $d(i)$ is depth and n is data size.
2. Define the true signal, $x_{\text{true}}(i)$, for example, a harmonic signal (see Eq. (1) in manuscript).
3. Add noise to the time values (see e.g., Eq. (4) in manuscript) using a random number generator.
4. Eventually: Add noise to the $x_{\text{true}}(i)$ values.
5. The resulting series is the first realization of the Monte Carlo experiment with prescribed (known "true'') properties time distortion etc.
6. Use the first realization series as input to the proposed method to estimate the age versus depth curve, resulting in, say, $t_{\text{estimate}}(i), x_{\text{estimate}}(i), i = 1, \ldots, n$.
7. Calculate a measure of the discrepancy between true and estimated age versus depth curves. For example, take $\Delta_T = \left[\sum_{i=1}^{n} \left(t_{\text{estimate}}(i) - t_{\text{true}}(i)\right)^2\right] / n$ as

a kind of squared average deviation for the time values. Calculate something analogous for the x values.

8. Repeat the procedure Monte Carlo simulation, model estimation, Δ_T calculation until a large (10000 is normally used) set of Δ_T values exist.

9. Take the average and standard deviation of the Δ_T values. These values then constitute a measure how good the proposed method performs.

10. One obvious extension would be to compare the proposed method with another method, for example, that of Martinson et al. (1982). Which of the method performs better for a prescribed, artificial example, which one has the lower average Δ_T value?

I sincerely hope that the authors embark on performing Monte Carlo simulations to show that their method works indeed as good as the manuscript suggests. Below I give some references, which hopefully are useful for doing this task.

Davison AC, Hinkley DV (1997) Bootstrap Methods and their Application. Cambridge University Press, 582 pp.

Efron B, Tibshirani RJ (1993) An Introduction to the Bootstrap. Chapman and Hall, 436 pp.

Fishman GS (1996) Monte Carlo: Concepts, Algorithms, and Applications. Springer, 698 pp.

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