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Interactive comment on “Estimation of sedimentary proxy records together with associated uncertainty” by B. Goswami et al.

Anonymous Referee #1

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In the manuscript "Estimation of sedimentary proxy records together with associated uncertainty" Goswami et al. demonstrate how to derive proxy records with associated uncertainties based on the corresponding archives depths and its age estimation. Using a Bayesian framework they propagate the age uncertainty, calibration uncertainty and the proxy's variance to estimate the expected proxy values as well as their uncertainty. Therefore the proposed method can improve the reliability of the proxy and provides a better uncertainty measure.

Clearly this work is novel and a natural, but still clever, extension of S.F.M. Breitenbach et al. COPRA paper (Climate of the Past 8, 1765-1779, 2012). One would hope that the authors will provide their method ready to use in a similar software package. The representation of the paper is throughout and the more tedious calculations are summarised

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in the appendix. Therefore scientists with some background in Bayesian statistics can easily check the method while the main text is free of lengthy mathematical arguments so that it still is accessible to researchers from a more applied field.

In my opinion one of the strong points of the paper is that the authors must have spent some time thinking about how to present their arguments. In Sec. II they provide the basic theory of their method and first of all clarify for which data sets their method can be used and in 2.2 list all the necessary assumptions behind their method. As a consequence researchers can assess their own data sets and immediately realise that they are missing for example the C14 calibration curve. In this sense the clear presentation could also be thought of as a tutorial for researchers in the field or laboratories on what data is needed for more advanced time series analysis.

The method developed in Sec. II is tested in Sec. III using a simulated stalagmite proxy and a simulated lake sediment core. Using simulated data for testing is good practice since direct comparisons between truth (the simulation) and the estimates are possible. Moreover the two examples chosen come with different uncertainties: while the lake core needs C14 calibration, the stalagmite is dated using U/Th and does not have age uncertainty. Consequently the reader realises the impact of the C14 calibration on the final uncertainty. Finally they apply their method using a real time series from Lake Lonar in central India. This analysis is quite interesting since two measurements are recorded after 1950 and therefore the "post-bomb" calibration has to be used along the "pre-bomb" calibration for the earlier measurement points. The discussion of the analysis is given in Sec. IV. While for the Lonar record they show that the C14 uncertainty plays a minor role for the overall uncertainty, the data analysis is used to demonstrate how to check the major sources of uncertainty. Following their analysis by setting C14 uncertainty to 0 in certain parts of the record one can evaluate whether it is worthwhile to get more data points in some particular part of the record to reduce the uncertainty.

Overall the paper is well written, addresses a major problem in time series analysis

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of proxy records and the Bayesian propagation method is a novel contribution to the field. The authors do not fall into the trap of overselling and clearly state for what kind of records their method can be applied. In addition one would hope that they continue their work and incorporate discrete proxy variables and measurement errors in the depths observations as well. I do recommend publication of the manuscript as it is.

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1023, 2014.

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