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Climate of the Past Discussions

Interactive comment on "Technical Note: Correcting for signal attenuation from noise: sharpening the focus on past climate" *by* C. M. Ammann et al.

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I find that the previous reviewers have covered many of the same concerns and comments I have, so my review will largely reinforce many of their points rather than raise new issues. Like several of the other reviewers, I note that I have benefited from previous and ongoing discussions amongst the EU Millennium Project members of many of the issues addressed in this manuscript.

In general and overall, this technical note will be a useful addition to the literature examining the methods for paleoclimate reconstruction from high resolution proxy data. There are several issues, however – most also raised by previous reviewers – that the

authors need to address, all of which are reasonably accomplished during revision:

[1] Many other disciplines have wrestled with issues of 'measurement error' models. Similar in nature to some of the problems encountered in paleoclimatology are those in astronomy, addressed starting nearly 2 decades ago. A few examples are Isobe et al. 1990, Akritas & Bershady 1996, and Kelly 2007. It would be useful to incorporate and briefly relate the past experience of other fields dealing with these issues if possible.

[2] Figure 1 shows the range of solutions for different methods in the presence of noise in the simple linear regression case. However, the OLS solution shown in Panel C appears to be for OLS (Y|X) – that is, the direct reconstruction of 'climate' from 'proxy'. For the indirect approach to reconstruction, where the coefficients are calculated by OLS (X|Y) – a more physical interpretation of proxy as a function of climate – OLS actual does slightly better in my own emulation of the ACOLS method (in the ensemble sense that the scatter of solutions around the true mean is smaller), in this simple bivariate case, than ACOLS. For single predictor (proxy) situations then, where the long-term mean is the desired metric, OLS can perform as well or better than ACOLS (with the caveat of course – widely recognized and also noted by the authors in Page 1646, Lines 18-20 – that the MSE is not minimized and the variance is too large). Obviously, ACOLS is not a solution when the annual and interannual variability (perhaps decadal?) is of interest. Given that this is the case, how does ACOLS influence traditional measures of reconstruction calibration and validation (this point was also raised by Zorita, Page C397, and is also explored in the J. Climate paper by Christiansen, Schmith, and Thejll earlier this year)? If traditional measures of calibration and validation skill are not appropriate ones when an unbiased mean is of primary importance, which should be used?

[3] Most of the other reviewers have commented that red noise is both more realistic and more difficult to deal with. In my own emulations of the ACOLS method, red noise (lag 1, $0 < r < 1$) can introduce spurious variance at the decadal and multidecadal scale, although the longest-term multicentury or millennial mean may still be captured.

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Lower SNR situations don't necessarily have 'worse' spurious variability at decadal to multidecadal scales when considering a grand mean of a large ensemble simulation, but any given member in an ensemble can have substantial (larger even than the direct multivariate OLS) spurious variability at decadal-multidecadal time scales. The manuscript would benefit most from additional tests and representative examples and comparisons using realistic red noise.

[4] I agree with other reviewers that an expanded description of the calculation of 'k' is necessary (Page 1648, Lines 2-3). In which instances, however, is k > 0, since the noise in W is almost certainly much greater than the noise in Y? It would be useful to explore, or better yet illustrate, the consequences for miscalculating k or assuming k = 0 when in fact k > 0. This and point [3] above go to some of the same points raised by Zorita, Brohan, Moberg, and the anonymous reviewer about the larger point of the nontrivial difficulties in accurately calculating sigma_U – and particularly when the noise in the proxies is red.

[5] Finally, I agree with the anonymous reviewer #3 that parts of the discussion concerning awareness of variance loss in large-scale millennial temperature reconstructions is incomplete in places, notably the on-going discussion in the literature between Mann et al. and Smerdon et al. (and others) about the sources of variance loss in previous iterations of Northern Hemisphere climate field reconstructions.

[6] The title 'Technical Note: Correcting for signal attenuation from noise' is sufficient, I would leave out the 'sharpening the focus ...', given that the manuscript is focused on a particular statistical application.

Interactive comment on Clim. Past Discuss., 5, 1645, 2009.