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DISCUSSION OF: A STATISTICAL ANALYSIS OF MULTIPLE TEMPERATURE PROXIES: ARE RECONSTRUCTIONS OF SURFACE TEMPERATURES OVER THE LAST 1000 YEARS RELIABLE?[1]

BY L. MARK BERLINER

The Ohio State University

I join the authors in expressing dissatisfaction with some paleoclimate analyses. I endorse their claim that there has been underestimation of uncertainty in paleoclimate studies. The implication that additional participation of the statistics community is needed is undeniable. However, our priorities should be to contribute rich statistical analyses that (i) model the processes and data and (ii) offer useful information regarding the issues of climate change. If achieving these goals requires that we do not continue with questionable assumptions, nor merely offer small fixes to previous approaches, nor participate in uncritical debates, so be it.

The authors note that it is common to assume that proxy observations are linearly related to climate variables and they proceed with this assumption. This seems untenable to me (for an extreme example see the Yellow River data in Figure 6). Even if linearity is plausible, lumping all spatial-temporally distributed data of various types, qualities, and degrees of relationship to climate variables into a variance–covariance based summarization (principal components or EOFs) with no underlying analysis gives me pause. I am not surprised by difficulties in then extracting usable information. Performing various tests and analyses based on these reductions seems of little interest; indeed, it seems to me that they serve as a distraction.

Leaping ahead, though I strongly endorse the application of Bayesian analysis in this context, the concerns of the previous paragraph remain active regarding the Bayesian analysis in this article. Indeed, much like other analyses, the assumption is that regressing onto principal components with coefficients constant in time captures enough of the structure of the process to base the modeling on a stationary, AR(2) model. This places a reliance on the principal components that I find highly questionable. At a minimum, it seems to me that using spatially distributed and proxy dependent regression coefficients should be considered. Such an approach is closer to what I would call a "modern Bayesian analysis."

To provide perspective I return to my remark regarding "uncritical debates." The overarching conclusion of the authors seems to be that warming is real, but

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that the specifics of the rapid uptake associated with the "hockey stick" is not supported by the data. First, the claim is not unequivocal. As mentioned, I find that there are serious concerns with the analyses. In addition, we know that there are many controllers of climate; indeed, we know humans have contributed to some of these controllers. Hence, these analyses have ignored data. There is no use of atmospheric CO_2 data or solar data nor adjustment for climate variations associated with the El Niño-Southern Oscillation, the Pacific Decadal Oscillation, etc. What should we make of results of any analyses that seek to use high-temperature, high-CO_2-level temperatures to back-cast temperatures with no adjustment for CO_2? To me, not much, given that I do not believe the principal components can account for all the known and unknown sources of variation and nonstationarity. [For a very simple example of how we might account for such things, see Berliner and Kim (2008).]

Second, even if we accept the "no-hockey" conclusion, is it critical to the climate policy debate? I believe not, though I acknowledge that some policy makers and a portion of the general public do not understand the issues. The problem of anthropogenic climate change cannot be settled by a purely statistical argument. We can have no controlled experiment with a series of exchangeable Earths randomly assigned to various forcing levels to enable traditional statistical studies of causation. (The use of large-scale climate system models can be viewed as a surrogate, though we need to better assess this.) Rather, the issue involves the combination of statistical analyses *and*, rather than versus, climate science. Combination of information, such as that in Figure 15 along with climate model data based on anthropogenic and natural forcings versus only natural forcings along with uncertainty quantification constitute the basis for contributing to the climate change problem.

REFERENCE

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DEPARTMENT OF STATISTICS
THE OHIO STATE UNIVERSITY
1958 NEIL AVENUE
COLUMBUS, OHIO 43210-1247
USA
E-MAIL: mb@stat.osu.edu