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

BY MURALI HARAN AND NATHAN M. URBAN

Pennsylvania State University and Princeton University

We thank the authors for a thought-provoking paper (henceforth MW). Their work may be divided into two parts: *reconstruction*, where the authors develop a Bayesian model for reconstructing historic temperatures based on proxies, along with associated measures of uncertainty; and *validation*, where they study how accurately their model corresponds to data by using cross-validation techniques or comparing proxies to simulated time series that are unrelated to temperature. We discuss both aspects of the paper although we focus mostly on reconstruction. While our comments may seem critical of MW, our views apply more generally to much of the existing work in this area.

We begin with a discussion of the reconstruction in MW. Given the advances in modeling for large, rich, complicated space–time processes and the availability of temperature proxies in the form of space–time data sets, we believe statistical approaches to paleoclimate reconstruction should make full use of such spatial data instead of using spatially aggregated forms of the data (as in MW). Such spatial aggregation may have the effects of removing interesting signals and of making it more difficult to define a credible error structure since proxy data are less directly related to global temperature than local temperature. This is an issue not only with MW, but also the reconstruction work of many others. In addition, recent advances in computationally efficient approaches for fitting hierarchical spatiotemporal models open up the possibility of developing more realistic models that account for various sources of error while incorporating specialized scientific knowledge into the models as appropriate [cf. Banerjee, Carlin and Gelfand (2004); Gelfand et al. (2010) and the references therein]. We believe that such models are likely to provide more reliable estimates along with associated uncertainty estimates, both of which are important for drawing sound scientific conclusions.

We outline some ways in which we believe the model in MW can be improved upon.

(i) The authors approach this as a regression problem where they treat the proxies as the predictor and the temperature observations as response, and then use the proxies to extrapolate the temperature backwards. We believe it is more appropri-

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