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Climate of the Past Discussions

Interactive comment on "Technical Note: Probabilistically constraining proxy age–depth models within a Bayesian hierarchical reconstruction model" *by* J. P. Werner and M. P. Tingley

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We thank the anonymous reviewer for the assessment of our article. The reviewer raises an important question, that of the appropriateness of the spatial covariance structure. We acknowledge this problem, and it is indeed one of the limitations of BARCAST, as implemented here and in (Tingely and Huybers 2010 a,b; Tingley 2012, Tingely and Huybers 2013; Werner et al. 2013, Hanjihärvi et al. 2013), and it is discussed as such (including possible extensions / modifications) in most of these (especially Tingely and Huybers 2010 a,b; Tingley 2012). However, pseudo proxy ex-

periments have repeatedly shown that, especially for sub-hemispheric domains, the predictions from BARCAST are on par or superior to those from methods based on reduced-rank approximation to the sample spatial covariance (Tingely and Huypers 2010 a,b, Werner et al. 2013). The method could in principle be augmented by using a weighted decomposition of the covariance matrix:

$$\Sigma = \lambda_1 \cdot v_1^T v_1 + \lambda_2 \cdot v_2^T v_2 + \lambda_3 \cdot v_3^T v_3 + \Omega, \quad (1)$$

where the v_i are the leading eigenvectors of some estimate of the full spatial covariance structure (from data or from a GCM), Ω is a spatial part, either exponential (like in BARCAST) oder Materne, as suggested by Tingley et al. (2012). In the experiments leading to (Werner et al 2013) this was actually tested but did not significantly improve the reconstruction (thus it is still unpublished, the code that will be published with this article will contain pointers on how to include this). The results essentially hold as long as the spatial correlation lenghts are sufficiently large (even without the aforementioned modification), as also described in the cited literature. Regarding our specific results, two specific proxies need a shared signal so that they can be corrected against each other. Whether this is simply due to closeness in space, or through long distance correlation is insubstantial. We tried to stress this a bit more in the results section.

Of course all methods that rely on a spatial mapping of information will fail in the absence of spatial covariance – including RegEM, CCE, GraphEM, BARCAST. Gomez-Navarro et al. (2014) found that BARCAST essentially fails for short spatial correlation lengths, and CCA does not fare substantially better.

We address the other comments line by line:

- The various quantities used to evaluate the reconstructions (Sec. 4) need to be explained a little bit more, perhaps by giving the adequate range of values as well as their mathematical definition. Additionally, looking Fig. 7, some of those coefficients seem redundant?

- this was also a remark by M. Crucifix (see the other review), and we extended the description a bit. We do not think, however, that giving the mathematical definition would be all that helpful. The reades are referred in this case to the excellent articles by Gneiting et al. (2007) and H. Herbach (2000).
The average CRPS and potential CRPS are really close in our case, as the Reliability is so good (very low values).

• BARCAST: what does the acronym means?

- Bayesian Algorithm to Reconstruct Climate Anomalies in Space and Time, see (Tingley and Huybers 2010a,b)

• Eq 1b: epsilon t should be e t

- fixed.

Page 4510 , line 22: “A final technical issue concerns the convergence . . .”

• fixed

P4512 , l23: “saved”

• no, ‘save’ in the sense of ‘except for’

P4513 , l6: “ADMs”

• fixed.

P4513 , l16: “from the true ADM”

• fixed

P4515 , l7 “covariance structure of the climate field”

• fixed.

Interactive comment on Clim. Past Discuss., 10, 4499, 2014.