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Experimental Reconstructions of Surface Temperature using the PAGES 2k Network

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Climate field reconstructions (CFRs) of the Common Era provide uniquely detailed characterizations of natural, low-frequency climate variability beyond the instrumental era. However, the accuracy and robustness of global-scale CFRs remains an open question. For instance, *Wang et al.* (2013) showed that CFRs are greatly method-dependent, highlighting the danger of forming dynamical interpretations based on a single reconstruction (e.g. *Mann et al.,* 2009).

This study will present a set of new reconstructions of global surface temperature and compare them with existing reconstructions from the IPCC AR5. The reconstructions are derived using the PAGES 2k network, which is composed of 501 high-resolution temperature-sensitive proxies from eight continental-scale regions (*PAGES2K Consortium*, 2013). Four CFR techniques are used to produce reconstructions, including RegEM-TTLS, the *Mann et al.* (2009) implementation of RegEM-TTLS (hereinafter M09-TTLS), CCA (*Smerdon et al.,* 2010) and GraphEM (*Guillot et al.,* submitted).

First, we show that CFRs derived from the PAGES 2k network exhibit greater inter-method similarities than the same methods applied to the proxy network of *Mann et al.* (2009) (hereinafter M09 network). For instance, reconstructed NH mean temperature series using the PAGES 2k network are in better agreement over the last millennium than the M09-based reconstructions. Remarkably, for the reconstructed temperature difference between the Medieval Climate Anomaly and the Little Ice Age, the spatial patterns of the M09-based reconstructions are greatly divergent amongst methods. On the other hand, not a single PAGES 2k-based CFR displays the La Niña-like pattern found in *Mann et al.* (2009); rather, no systematic pattern emerges between the two epochs.

Next, we quantify uncertainties associated with the PAGES 2k-based CFRs via ensemble methods, and show that GraphEM and CCA are less sensitive to random noise than RegEM-TTLS and M09-TTLS, consistent with pseudoproxy studies (*Wang et al.,* 2014). The updated set of reconstructions, with uncertainties, will provide a broader context for the evaluation of the unusual character of the 20^{th} century warming. The reconstructions will also be used to constrain fingerprinting analyses, which is particularly useful in discriminating between externally forced signals and internal variability.

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