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Global reconstruction of surface temperature fields for past equilibrium climates

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Paleoclimate simulations are widely used as a test of the ability of climate models to simulate climate states that are substantially different to the present day, and quantitative reconstructions of these climate states is an essential component of model evaluation. With there being no large network of instrumental observations from these periods, we must rely on inferences from a relatively modest number of unevenly distributed proxy records which are believed to be quantitatively indicative of the climate state. In order to robustly establish climatic conditions over global scales, we require methods for smoothing and interpolating between these sparse and imperfect estimates. In recent years, we have worked on this problem and created a global reconstruction of the Last Glacial Maximum [Annan and Hargreaves, 2013, Climate of the Past] using the data and models which were available at that time. The method uses scaled patterns from the PMIP ensemble of structurally diverse climate simulations, combined with sparse sets of proxy data, to produce spatially coherent and complete data fields for surface air and sea temperatures (potentially including the seasonal cycle) along with uncertainty estimates over the whole field. This approach is more robust than alternative methods, which either perform a purely statistical interpolation of the data or at best combine the data with a single climate model. Here, we aim to improve the method, update the inputs, and apply the same technique to both Last Glacial Maximum and mid Pliocene climate intervals. As well as generating spatially complete and coherent maps of climate variables, our approach also generates well-calibrated uncertainty estimates.