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A GCM-reality intercomparison for the last millennium

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A set of global climate model (GCM) simulations for the last thousand years developed by the Max Planck Institute is compared with palaeoclimate proxy data and instrumental data. This GCM/reality intercomparison utilizes a newly developed statistical framework using optimized quadratic distance and correlation based statistical measures of goodness-of-fit. An advantage of this statistical framework is that a range of regions with different data quality, seasonal representativeness and time periods covered can be used to evaluate the performance of GCM simulations. Moreover, it includes a significance test of whether a forced simulation performs better than unforced (control) simulations. A selection of high quality proxy series and instrumental records are used to compare with corresponding model simulation output. Given the present uncertainty in solar forcing history over the last millennium, it is helpful to attempt to constrain these estimates by comparing simulations over this period driven with varying solar forcing histories. The climate model simulations used here are driven by a "low" and "high" solar forcing series in both single-forcing and full-forcing (i.e. also with volcanic, land-use and greenhouse gas forcing) settings; they are therefore suitable for this task. High and low solar simulations have been compared with a range of recently published hemispheric/global mean reconstructions, as well as various configurations of regional proxy and instrumental series, using both the correlation and distance goodness-of-fit measures. At present, neither low or high solar forcing histories can be ruled out, but further analysis incorporating additional high quality proxy series from around the world is expected to yield greater understanding as this research progresses.