Supporting Information for "The Last Millennium Climate Reanalysis Project: Framework and First Results"

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Introduction

Additional analyses ar presented to support results shown in the paper. In particular, LMR Northern-Hemisphere-mean temperature is compared against other reconstructions, and sensitivity of spatial skill to the verification data product is presented. Moreover, results for the zonal mean verification are shown for 2m air temperature and 500hPa geopotential height.

Text S1.

A comparison of the LMR Northern-Hemisphere-mean 2m air temperature against reconstructions summarized in IPCC AR5 (WG1, Fig. 5.7) are shown in Figure 1. The thick red line represents the mean of the reconstructions (without LMR), and is shown in Figure 1 of the paper. The legend gives correlations between each reconstruction and the LMR (left column) and with the mean reconstruction. Comparing these correlations reveals that the other reconstructions are more like each other than they are the LMR.

Verification of zonal-mean 2m air temperature (Fig. 2) reveals that much of the global-mean skill derives from tropical and subtropical latitudes. Verification in midlatitudes is lower, with notably more spread even among the verification datasets, particularly in the Northern Hemisphere. Skill appears to increase again greater at higher northern latitudes, except when verified by ERA-20C.

Spatial verification of 2m air temperature (Fig. 3) reveals considerable differences in how LMR verifies, particularly over land and high latitudes; worst agreement is with 20th century reanalysis products 20CR-V2 (main paper Fig. 7) and ERA-20C. Verifying the 20th century reanalysis products against GISTEMP reveals poor skill over most land areas (Fig. 4). We speculate that skill over the ocean in 20CR-V2 and ERA-20C derives from the prescribed sea-surface boundary condition and that pressure assimilation is relatively ineffective at constraining land temperatures on an annual timescale.

Verification of the LMR zonal-mean 500 hPa geopotential height field reveals results that are similar to those for 2m air temperature, with high skill in the tropics and subtropics, and low skill poleward of about 50° latitude (Fig. 5). Agreement is slightly higher for ERA-20C compared to 20CR-V2.

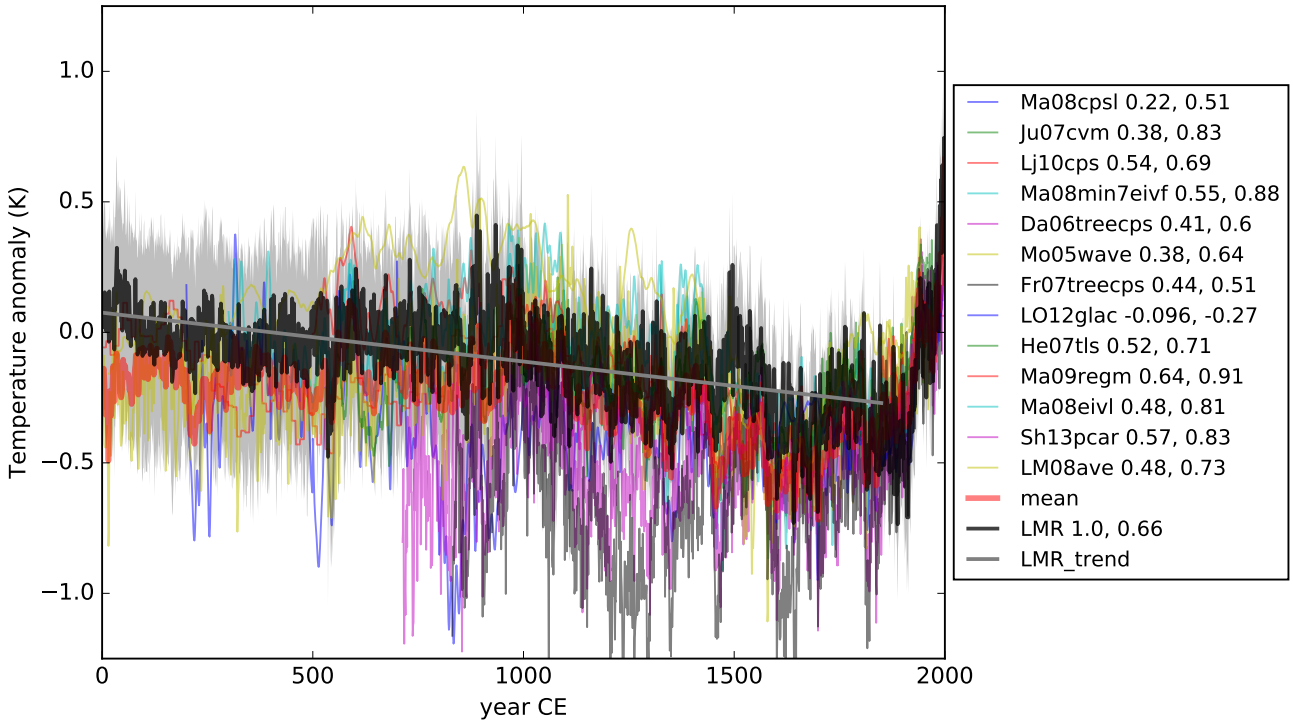

Figure 1. Comparison between LMR Northern Hemisphere 2 m air temperature results and reconstructions summarized in IPCC AR5 (WG1, Fig. 5.7). The LMR mean is taken over 100 realizations of 100-member ensembles for the reconstruction using MLOST for PSM calibration and CCSM4 LM simulationf for the prior is given by the black line; the gray band around the line shows the 5–95% percentile range. The straight solid gray line shows LMR trend over 0–1850CE fit by least squares. Legend abbreviations follow IPCC AR5, with correlation to LMR and to the mean of all reconstructions except LMR for the start of the reconstruction up to 1850CE.

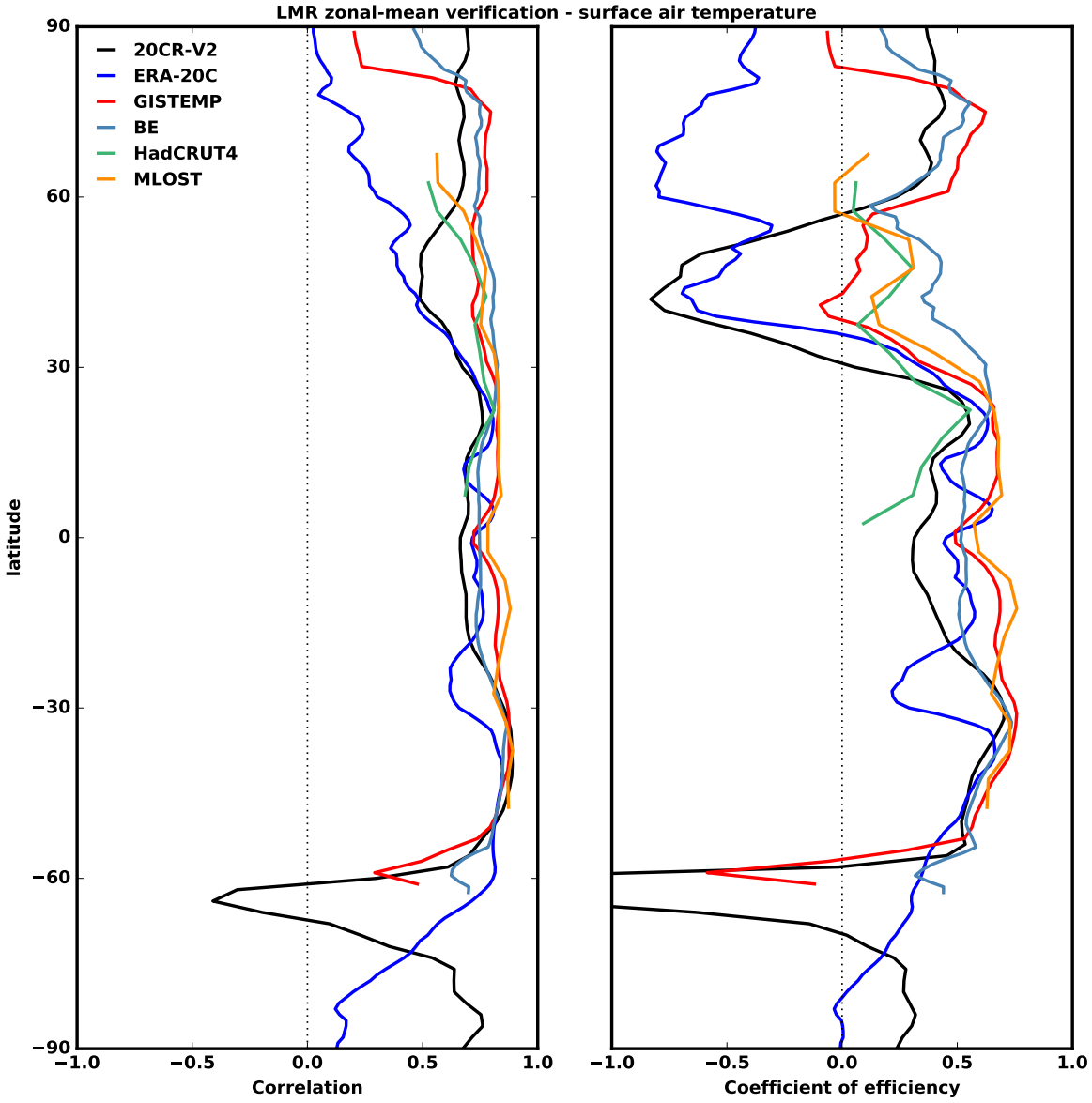

Figure 2. Verification of LMR zonal-mean 2 m air temperature 1880-2000CE for correlation (left) and coefficient of efficiency (right).

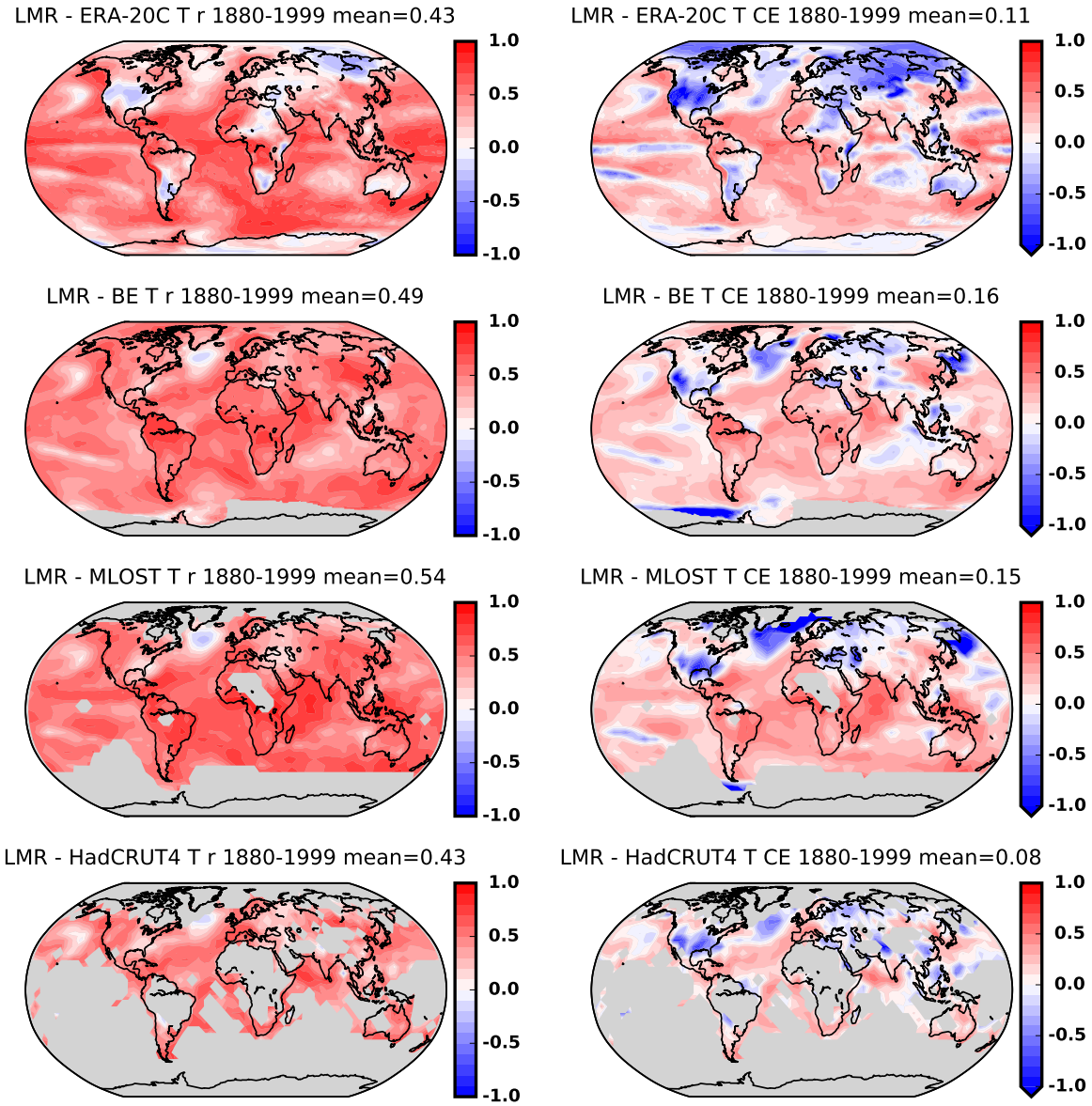

Figure 3. Verification of LMR 2 m air temperature against 20CR-V2 (first row), GISTEMP (second row), Berkeley Earth (third row), NOAA/MLOST (fourth row), and LMR-HadCRUT (fifth row). (left) time series correlation and (right) coefficient of efficiency. Gray areas have valid data in less than 50% of time period.

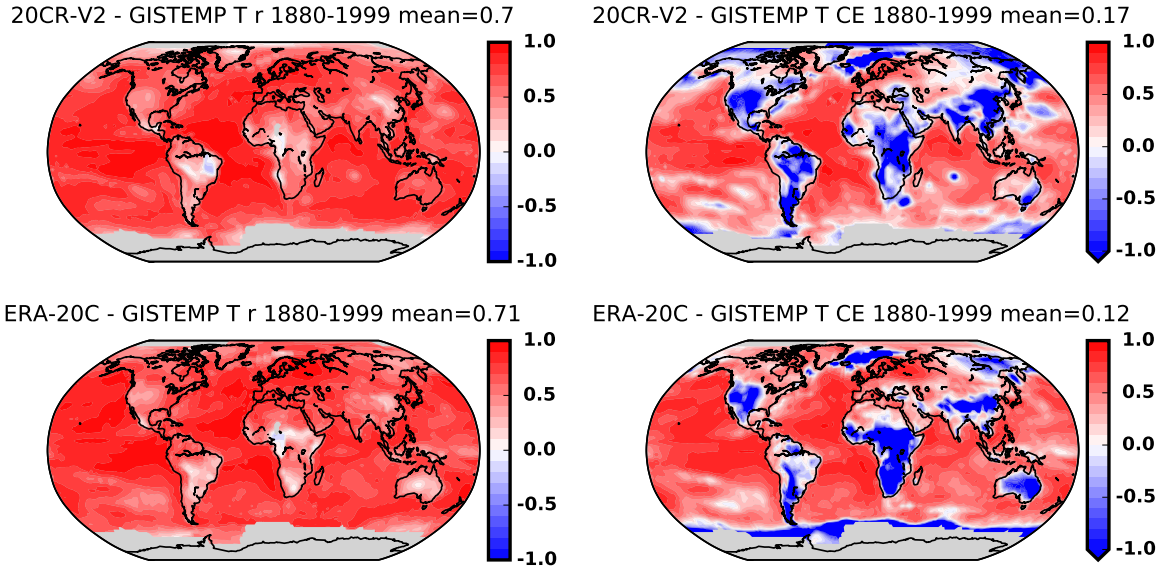

Figure 4. As in Fig. (3), except verifying 20CR-V2 and ERA-20C against GISTEMP.

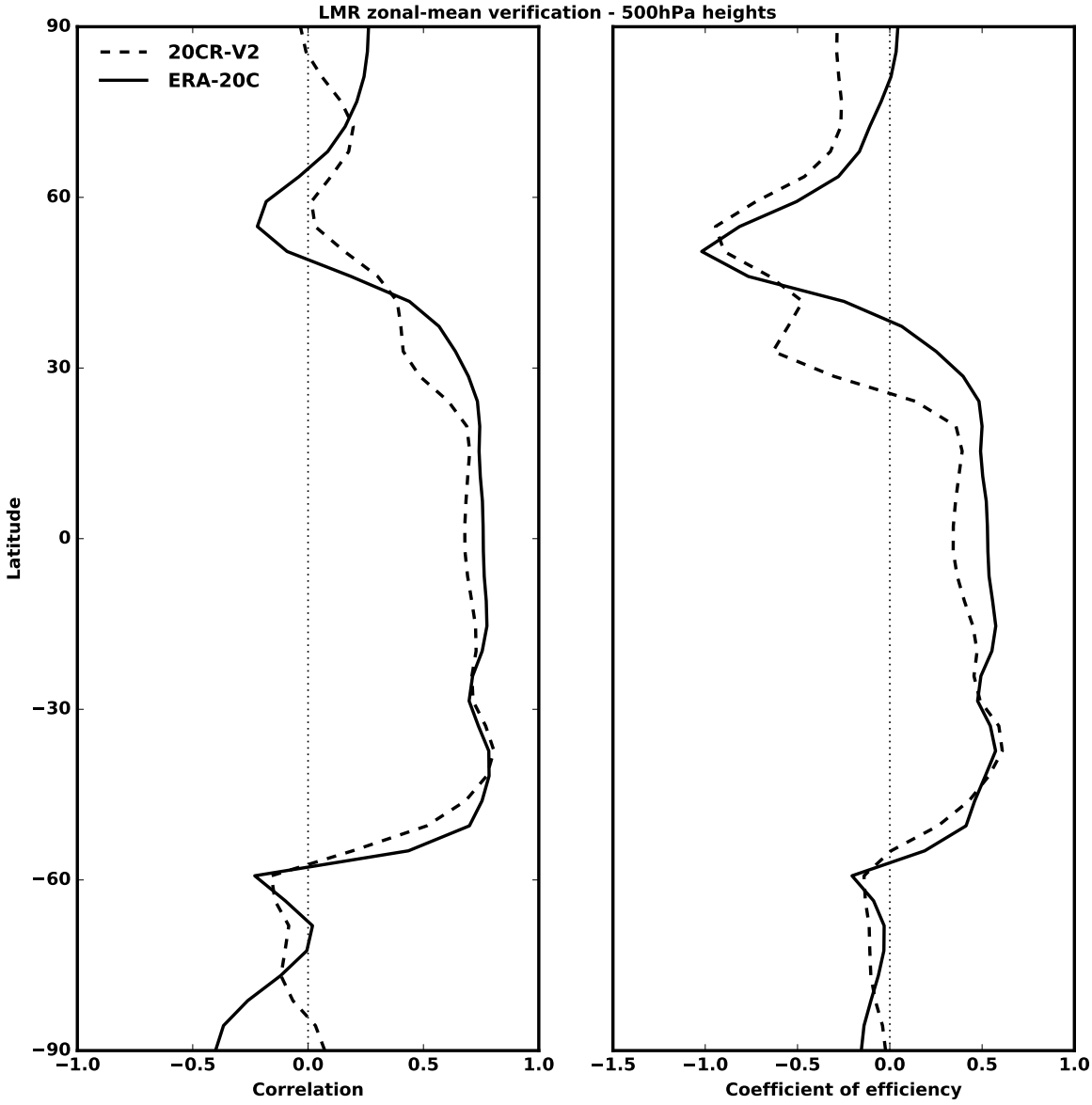

Figure 5. Verification of LMR zonal-mean 500 hPa geopotential height against ERA-20C (solid) and 20CR-V2 (dashed) for time series correlation (left) and coefficient of efficiency (right).