

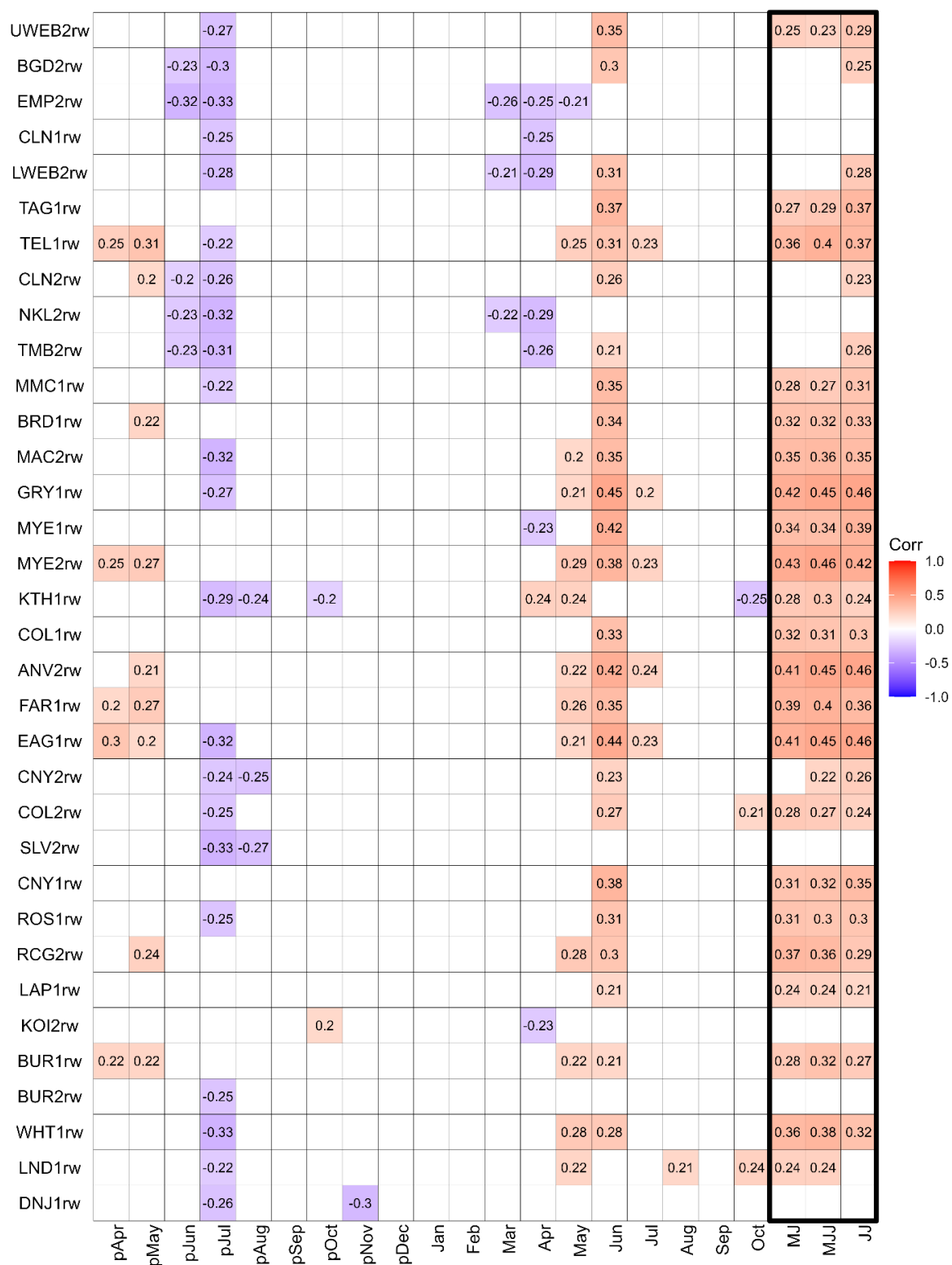


Figure S1. Correlation Response Function Analysis (1901-1997) using CRU TS 4.07 max temperatures with RW chronologies. Includes previous growing season, current growing season, and seasonal correlations. Sites are ordered by distance from upper treeline.

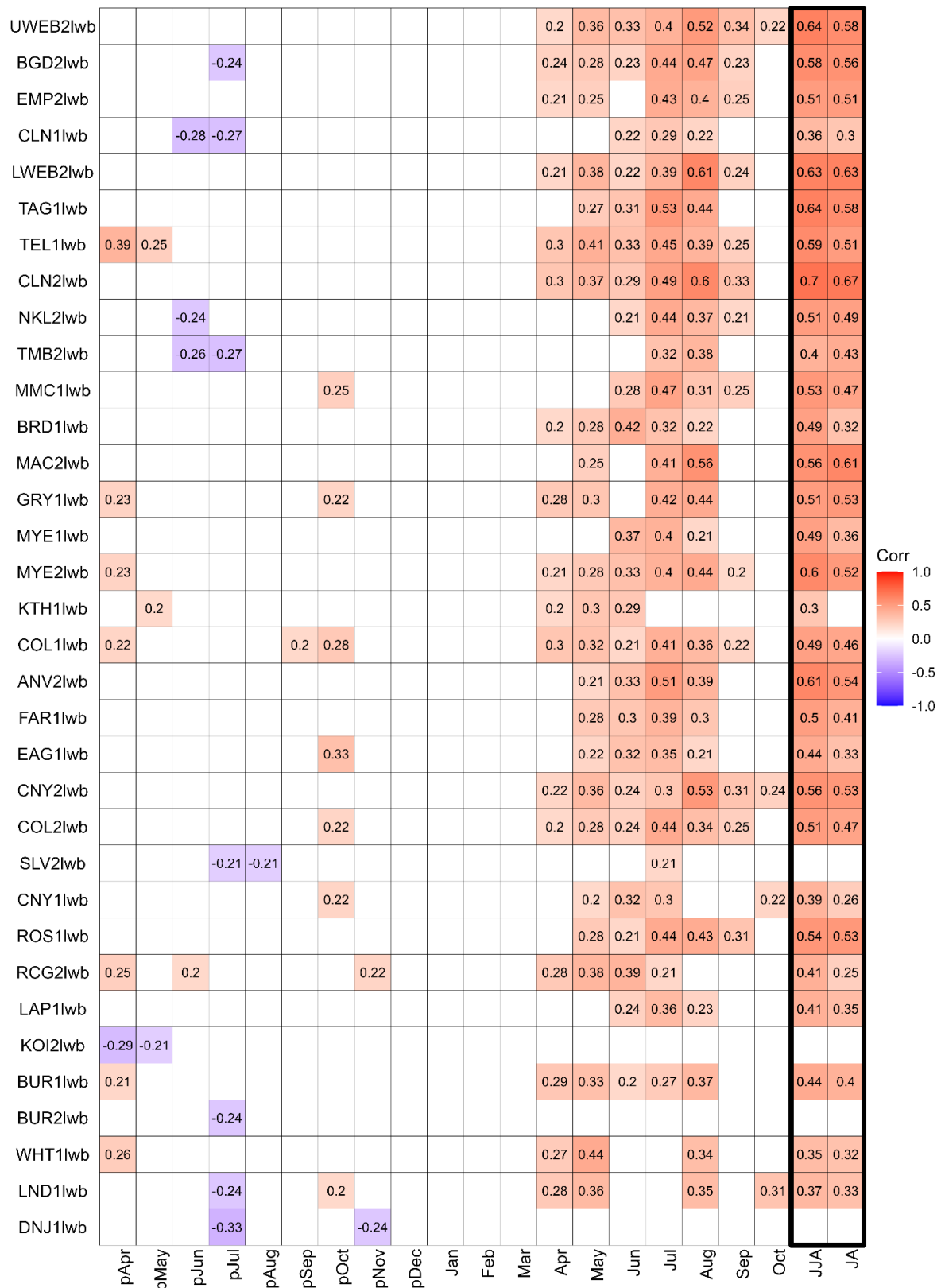


Figure S2. Correlation Response Function Analysis (1901-1997) using CRU TS 4.07 max temperatures with LWBI chronologies. Includes previous growing season, current growing season, and seasonal correlations. Sites are ordered by distance from upper treeline.

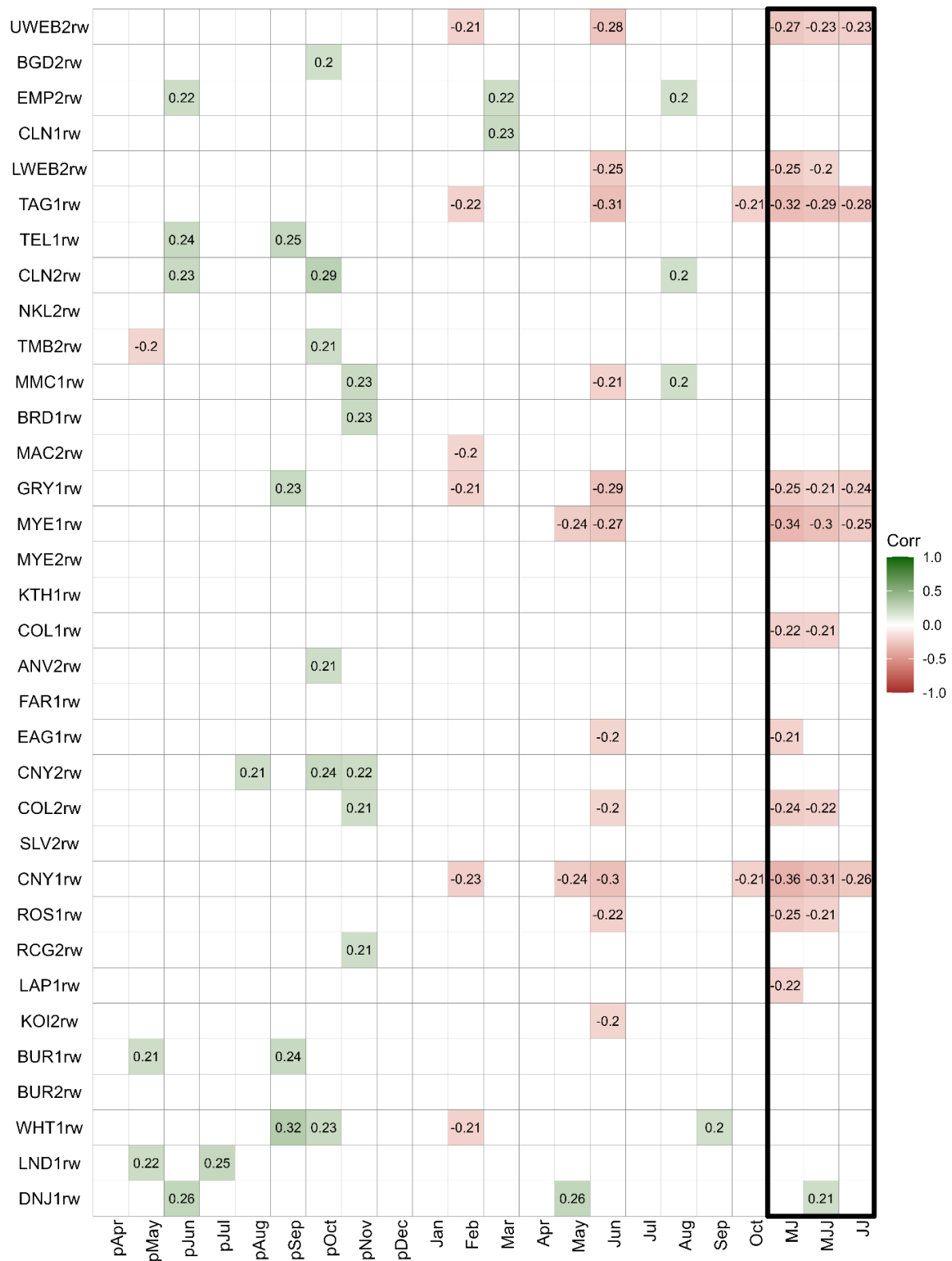


Figure S3. Correlation Response Function Analysis (1901-1997) using CRU TS 4.07 precipitation with RW chronologies. Includes previous growing season, current growing season, and seasonal correlations. Sites are ordered by distance from upper treeline.

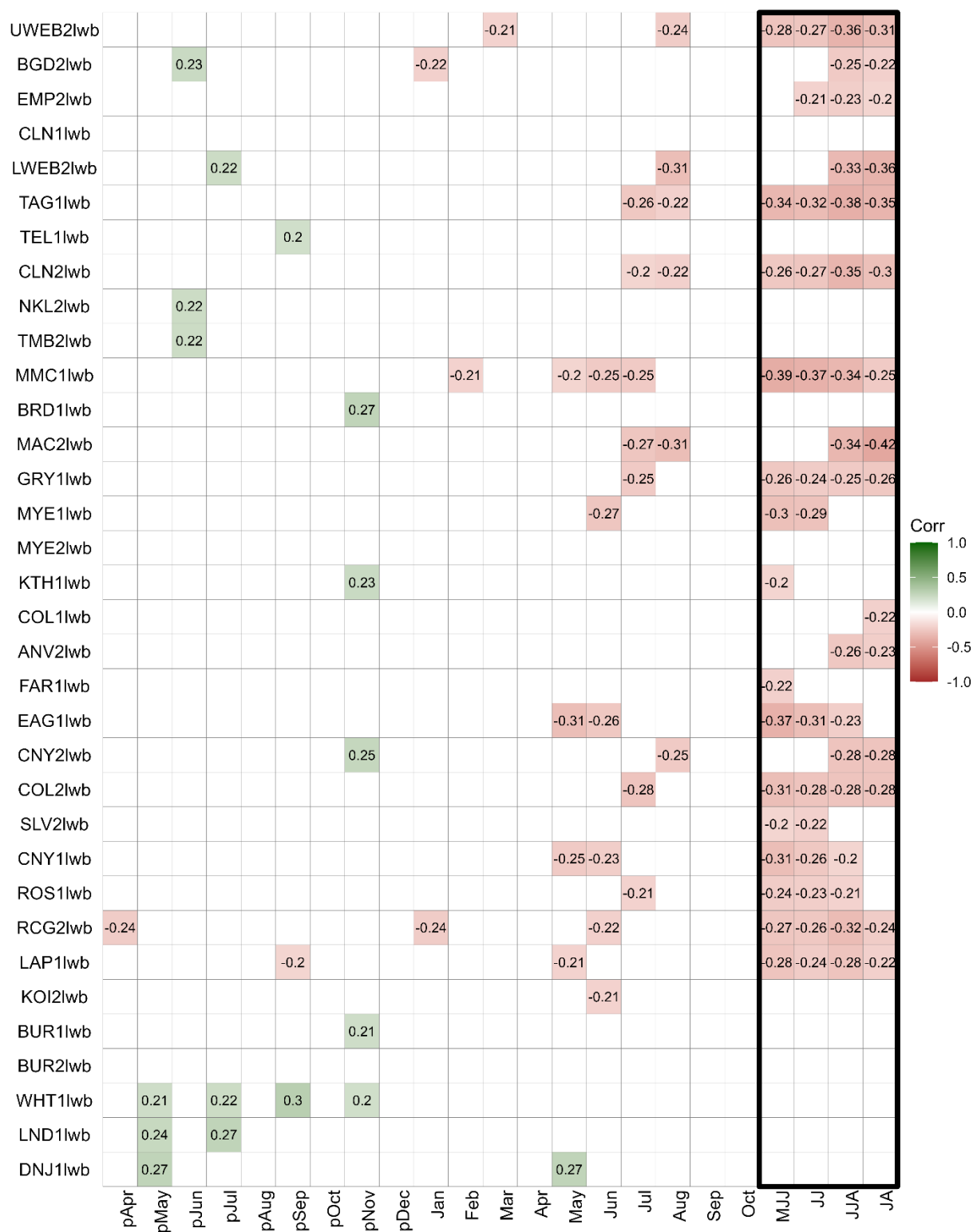


Figure S4. Correlation Response Function Analysis (1901-1997) using CRU TS 4.07 precipitation with LWBI chronologies. Includes previous growing season, current growing season, and seasonal correlations. Sites are ordered by distance from upper treeline.

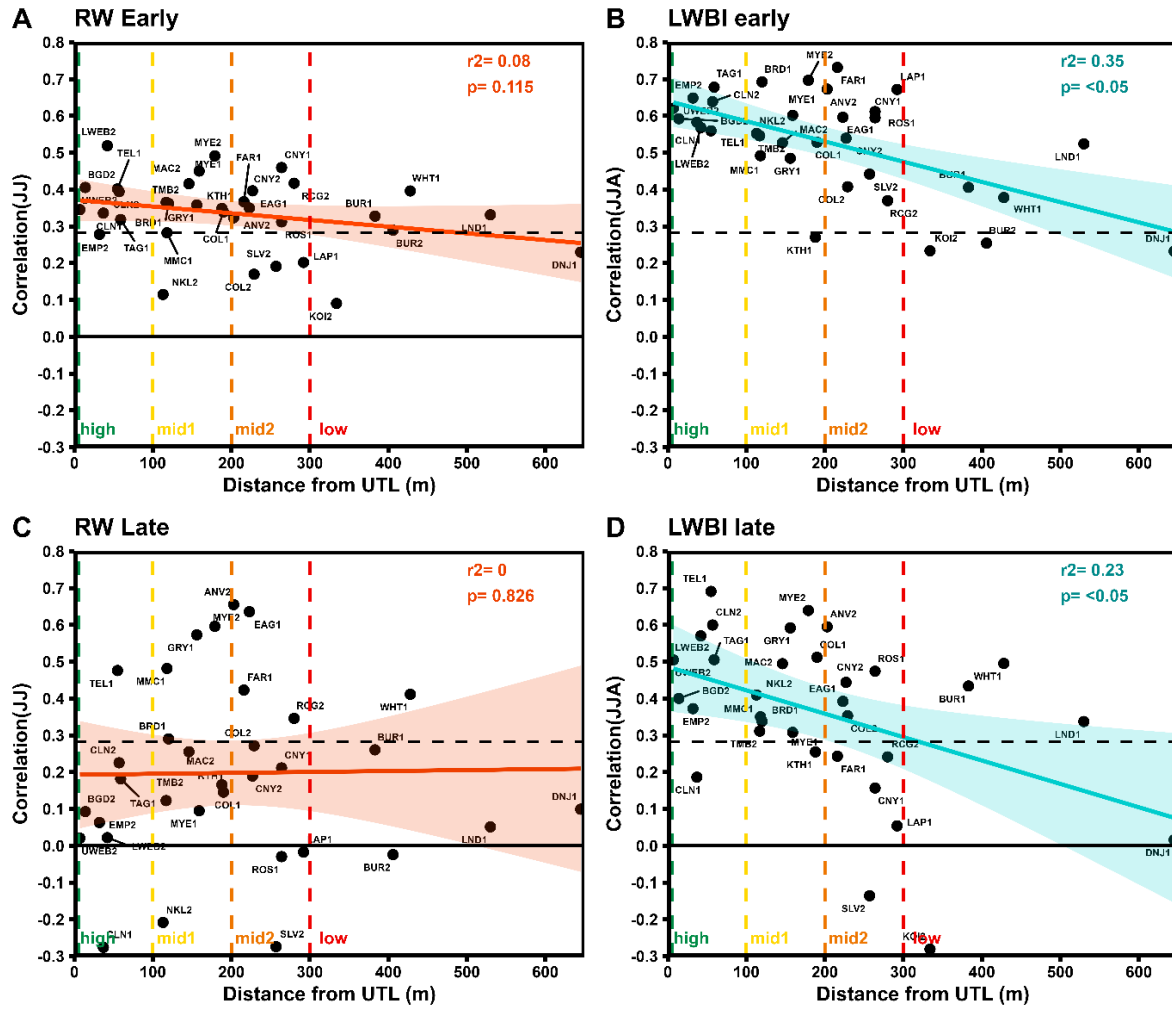


Figure S5. Split period relationship between dominant season correlation and distance from upper treeline (UTL) using **BEST** maximum temperature data (see Figure 2.3 for CRU TS 4.07 equivalent). **A.** Early period (1901-1944) June-July (JJ) RW correlations vs distance from UTL. **B.** Early period (1901-1944) June-July-August (JJA) LWBI correlations vs distance from UTL. **C.** Late period (1945-1997) JJ RW correlations vs distance from UTL. **D.** Late period (1945-1997) JJ LWBI correlations vs distance from UTL. Linear functions added to each relationship. Coloured vertical lines denote boundaries for splitting chronologies into subgroups based on strength of the relationship.

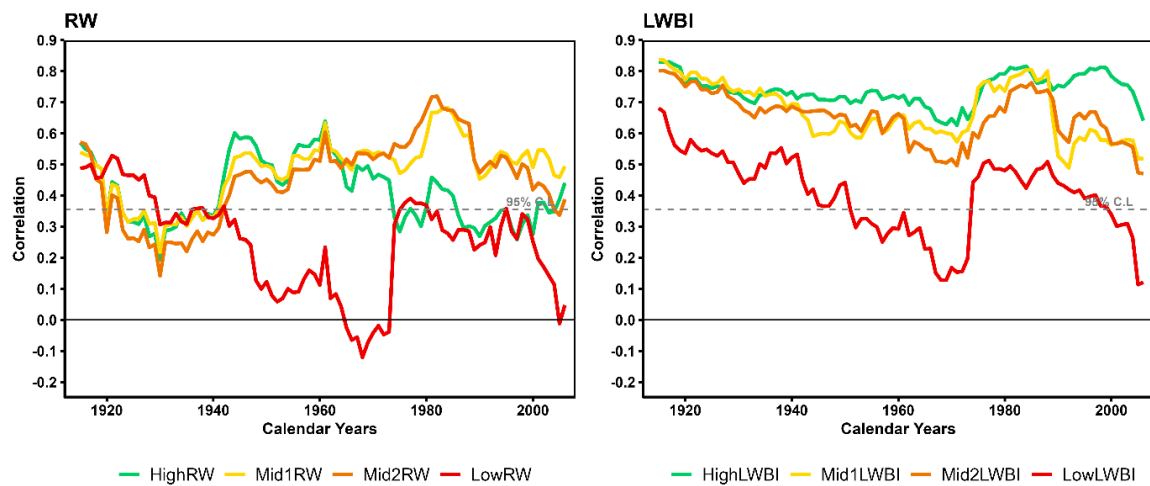


Figure S6. Running 31 years running Pearson's correlations between subgrouped chronologies and dominant season **BEST** Tmax. Dashed grey line denotes 95% confidence level.

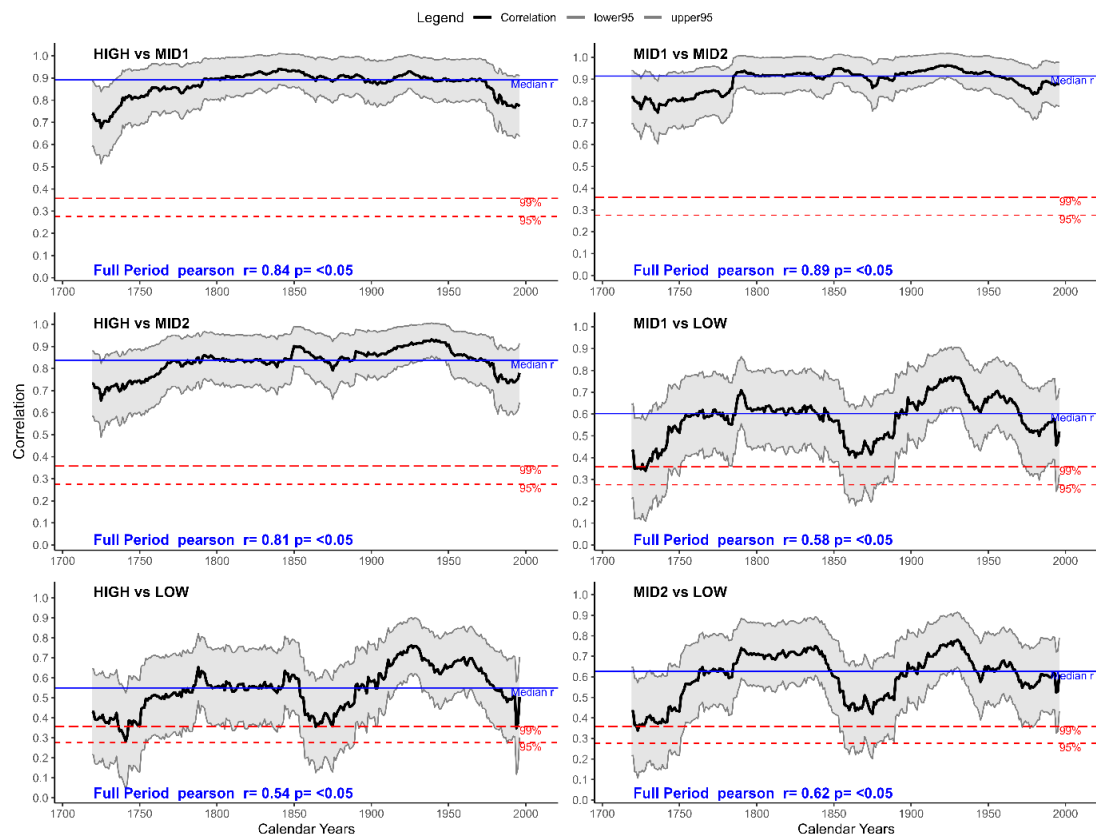


Figure S7. Between series Pearson correlations. 99% and 95% confidence levels denoted in red. Highlights a breakdown in the common signal between all other subgroups and the Low subgroup which contains sites furthest from upper treeline.

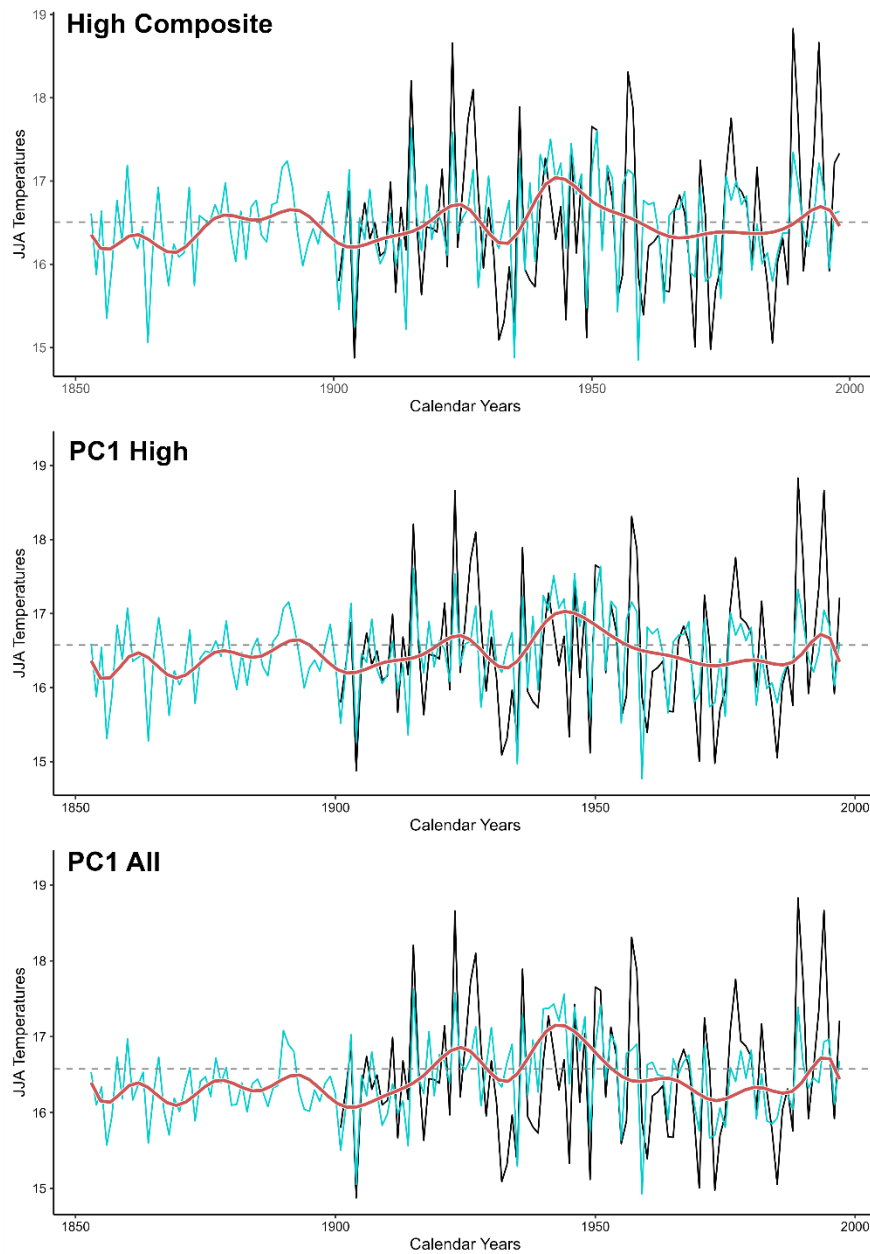


Figure S8. Comparison of the JJA reconstruction variants over the full common period (1853-1997). Calibration/Validation statistics are found in Table 2 in the main manuscript. Red line is a 20yr flexible spline added to assess the low frequency trends.

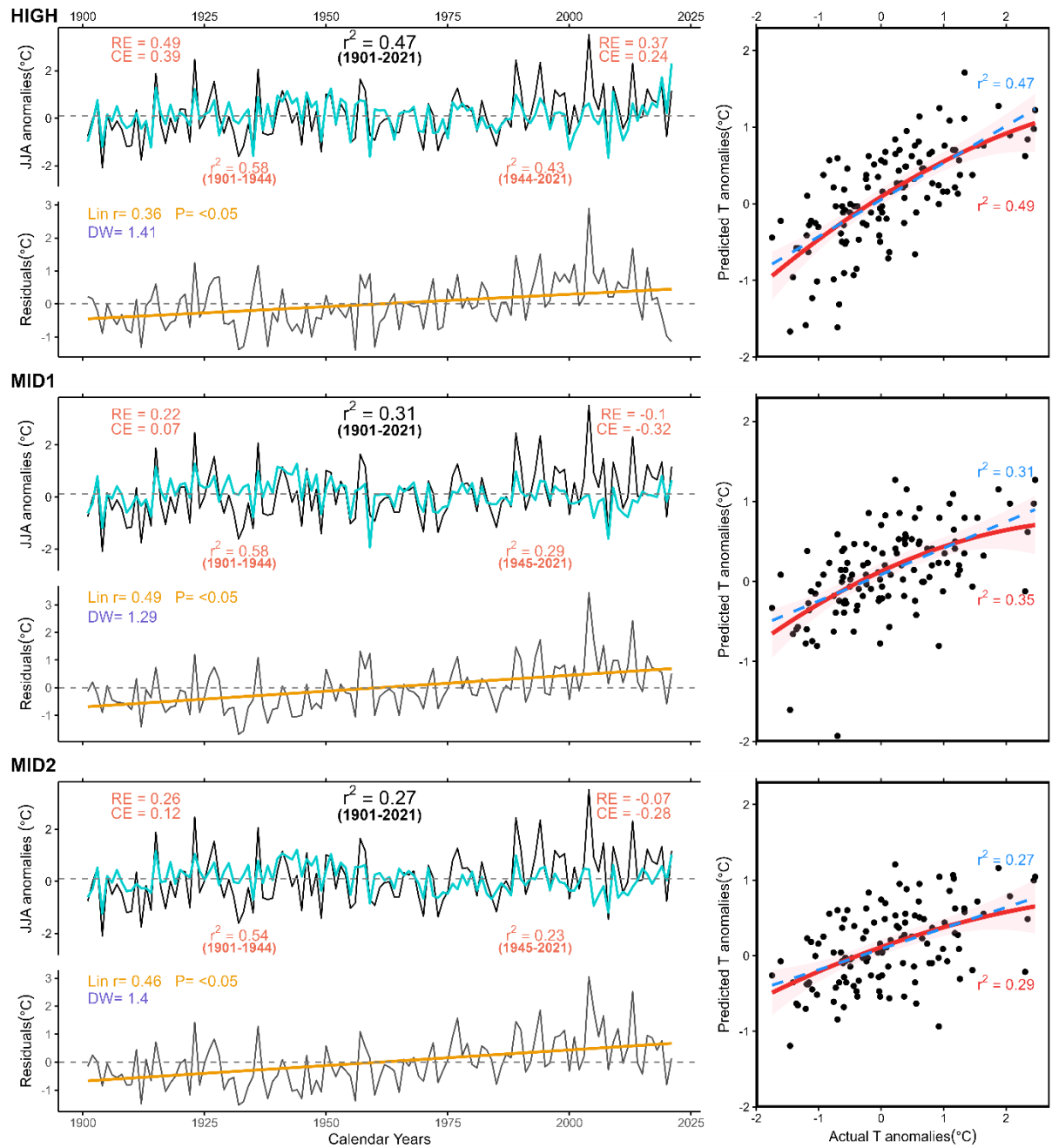


Figure S9. BEST Tmax full period reconstruction (1901-2021), residuals analyses, and actual vs predicted temperature anomalies. Full period r^2 , calibration period r^2 (1901-1944) and validation period r^2 (1945-2021) represented in the upper plot of the left panels. Linear r^2 of the residuals shown in yellow and Durbin Watson test for residual autocorrelation in purple. Scatter plots have a quadratic function plotted with error in red and the linear function in blue dashed line.

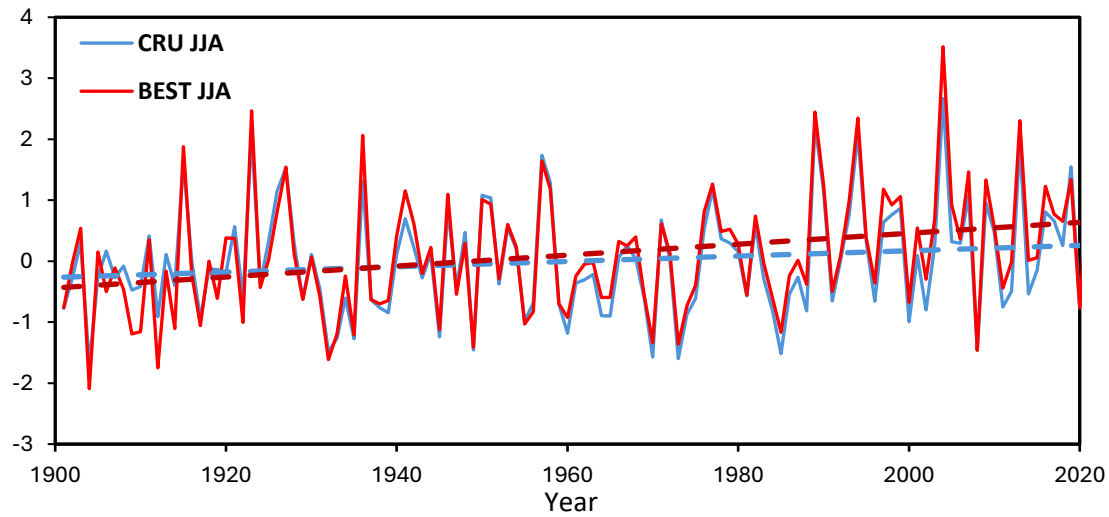


Figure S10. Comparison of CRU TS JJA and BEST JJA Tmax.

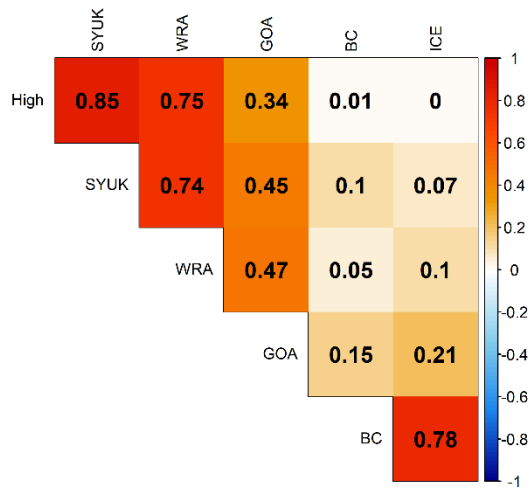


Figure S11. Correlation matrix comparing optimum High LWBI chronology from this study with other existing NWNA chronologies.