Evaluating the impact of Historical Climate Network homogenization using the Climate Reference Network - Supplementary Materials

Zeke Hausfather[1,2], Kevin Cowtan[3], Matthew J. Menne[4], and Claude N. Williams, Jr[4].

_____

Corresponding author: Zeke Hausfather, Energy and Resources Group, University of California Berkeley, Berkeley CA 94720. (email: hausfath@berkeley.edu, cell: 917-520-9601)
[1]Energy and Resources Group, University of California Berkeley, Berkeley CA 94720.
[2]Berkeley Earth, Berkeley CA 94720.
[3]Department of Chemistry, University of York, Heslington, York, YO10 5DD, United Kingdom.
[3]National Centers for Environmental Information, Asheville NC.

These supplementary materials provide links to data, code, and a number of figures and tables referenced in the article text. Each figure includes a caption describing its contents and (when relevant) how it was calculated.

Data and Code

U.S. HCN v2.5 raw data: ftp.ncdc.noaa.gov/pub/data/ushcn/v2.5/ (.raw files)
U.S. HCN v2.5 adjusted data: ftp.ncdc.noaa.gov/pub/data/ushcn/v2.5/ (.FLs.52j files)
U.S. CRN data: ftp.ncdc.noaa.gov/pub/data/uscrn/products/monthly01/

Annotated Code: http://www-users.york.ac.uk/~kdc3/papers/crn2016/
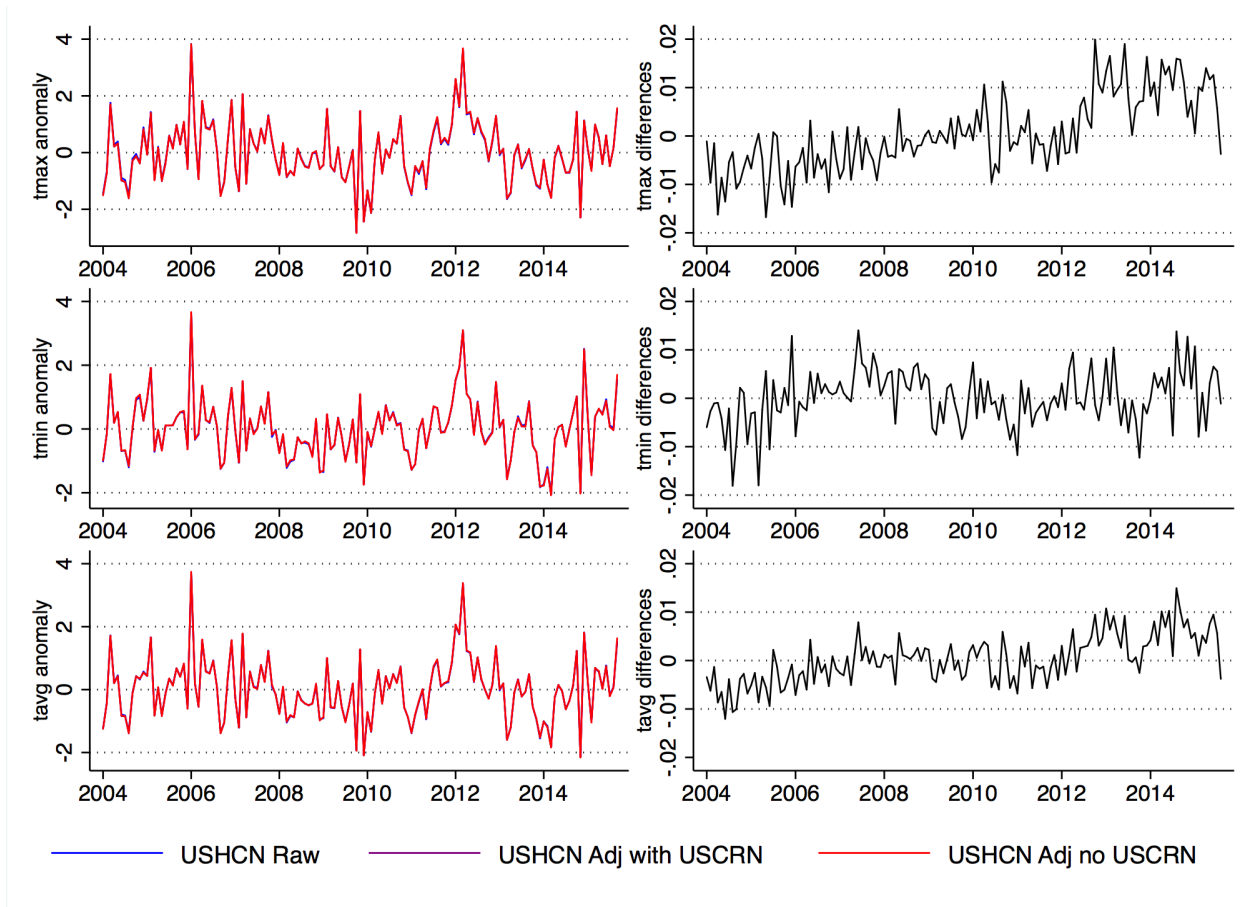
Supplementary Figures

Figure SM1: Maximum (Tmax), minimum (Tmin), and mean (Tavg) CONUS values for HCN raw, and HCN adjusted with CRN, and HCN adjusted without CRN data. Left column: CONUS temperature anomalies for each series. Right column: HCN adjusted with CRN minus HCN adjusted without CRN (in black). CONUS reconstructions are spatially-limited to grid cells where values for all three datasets are present for any given month. The inclusion of CRN in the homogenization process slightly increases Tmax trends (and Tavg trends) but not Tmin trends, consistent with the higher Tmax trends seen in CRN stations vis-a-vis nearby HCN adjusted stations.
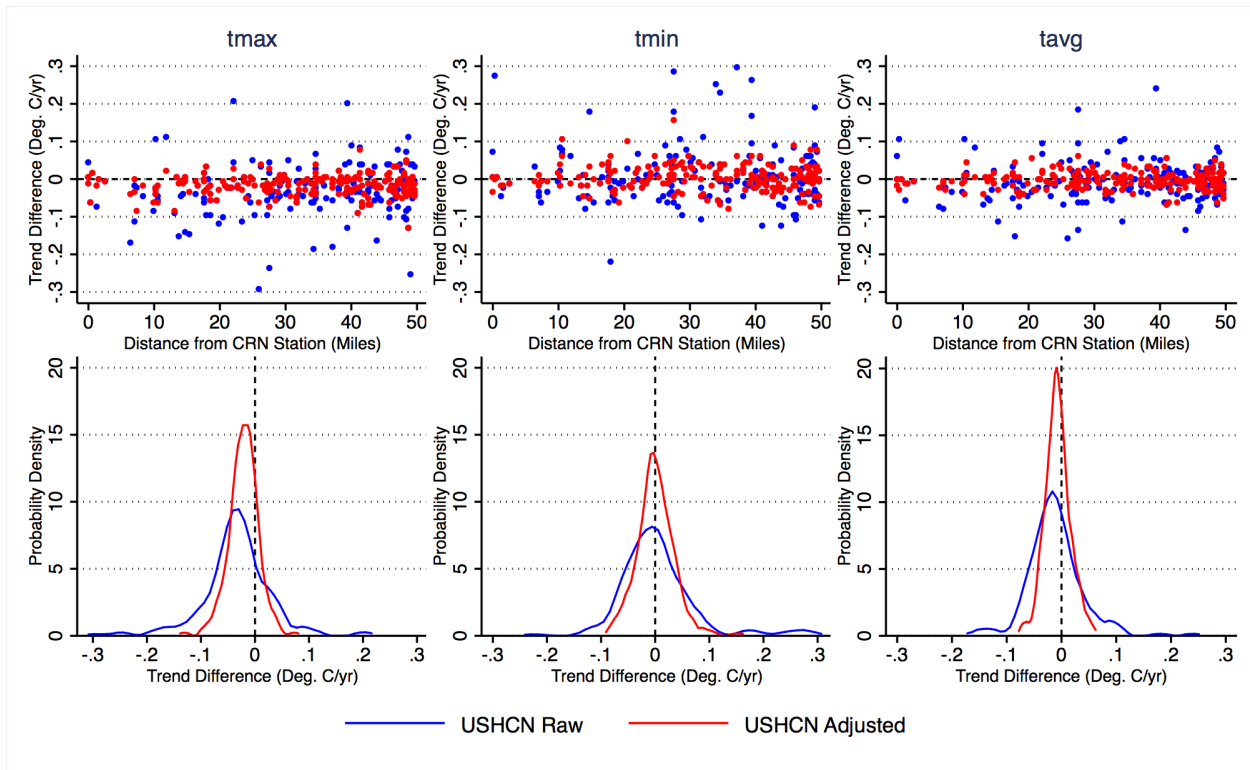
Figure SM2. Maximum (tmax), minimum (tmin), and mean (tavg) trend differences from HCN-CRN station pairs within 50 miles of each other for both raw and adjusted HCN data. The top panel shows a scatter plot of trend differences (in degrees C per year) as a function of distance between station pairs; the bottom panel shows the probability density function of station pair trends.
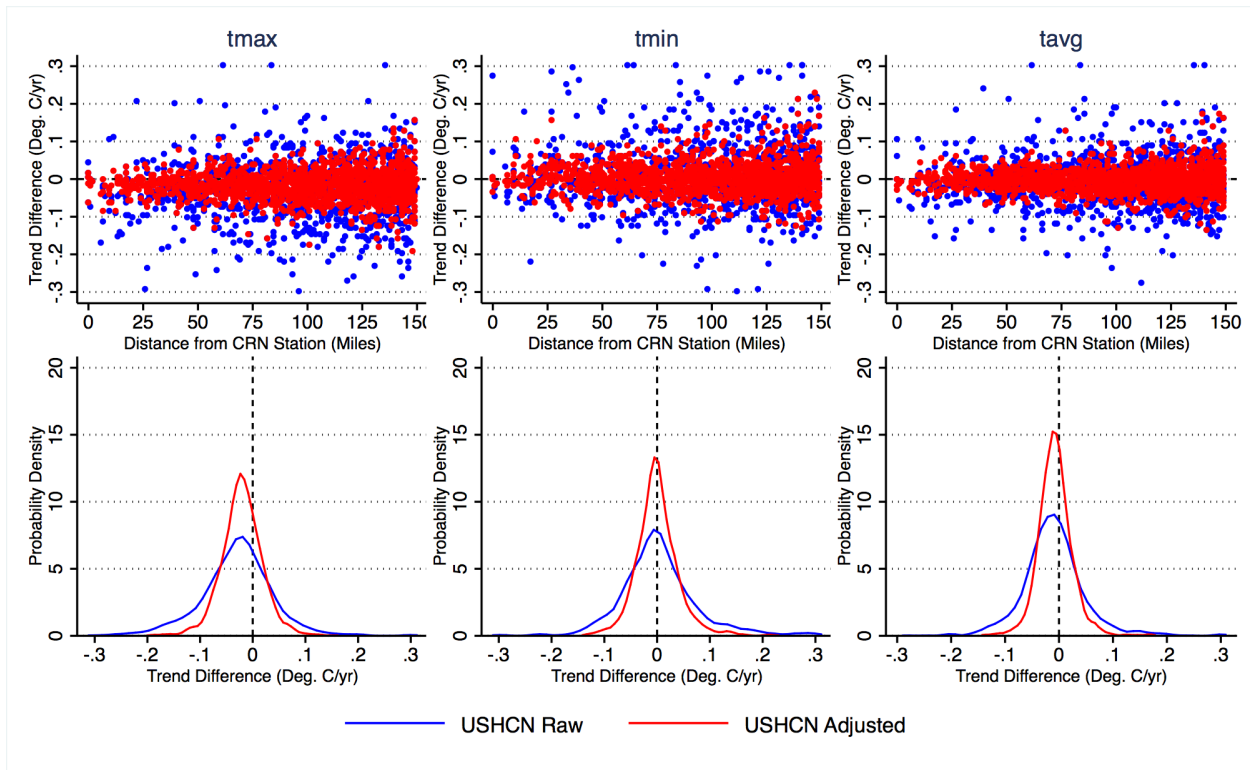
Figure SM3. Maximum (tmax), minimum (tmin), and mean (tavg) trend differences from HCN-CRN station pairs within 150 miles of each other for both raw and adjusted HCN data. The top panel shows a scatter plot of trend differences (in degrees C per year) as a function of distance between station pairs; the bottom panel shows the probability density function of station pair trends.
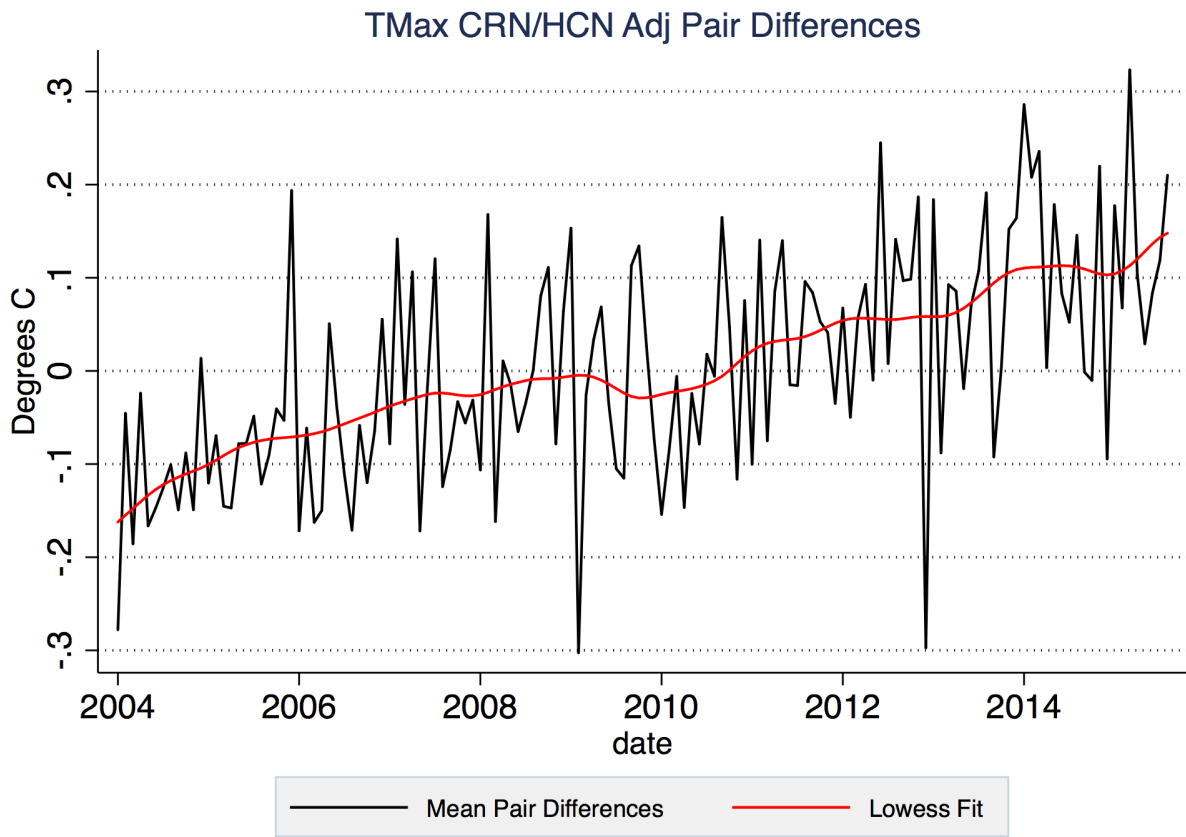
Figure SM4: TMax mean difference between CRN and HCN-adjusted station pairs, with the mean calculated by weighting each unique CRN station by inverse of the number of unique HCN stations that it is paired with for each month in order to avoid overweighting CRN stations with more HCN pairs in the analysis. A lowess fit (bandwidth 0.2) is also shown for reference.
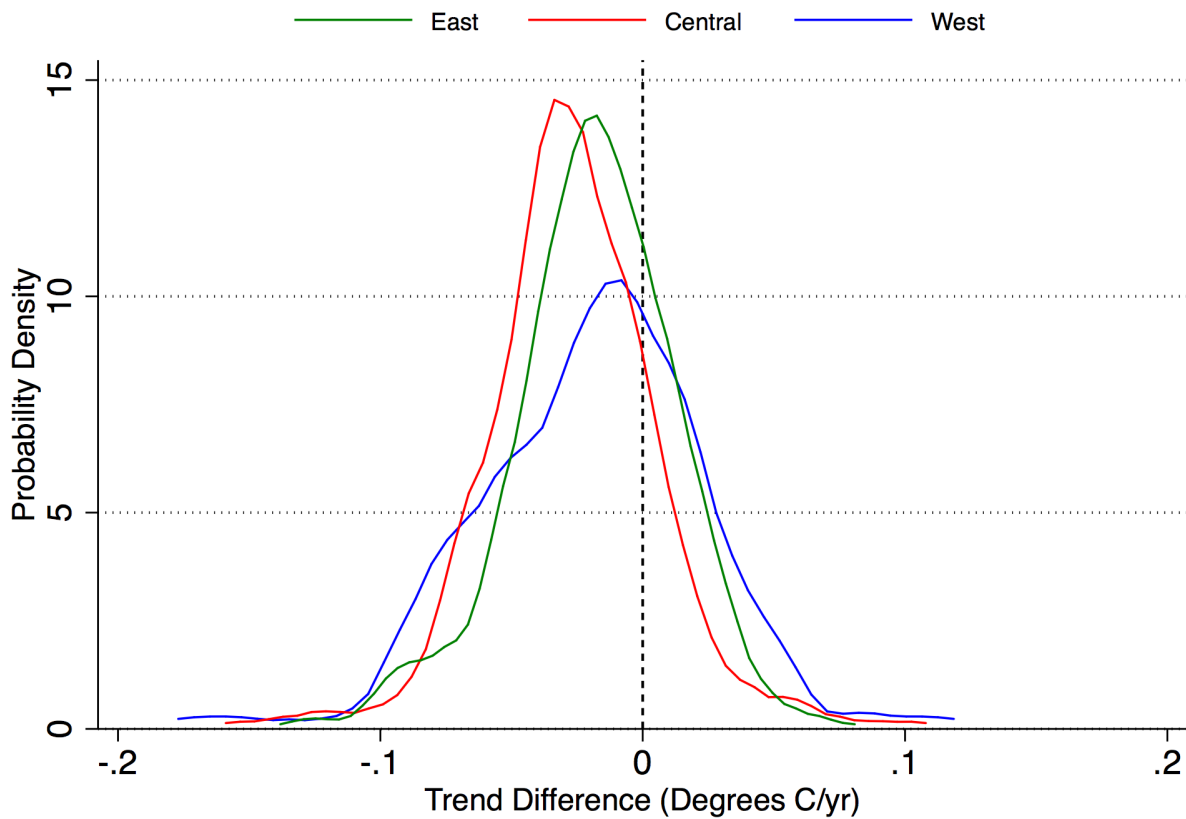
Figure SM5: Probability density function of tmax trend differences between CRN and HCN adjusted pairs within 100 miles by geographic region. East is > -90 latitude; West is < -110 latitude; Central is between the two. The East region contains 320 station pairs, the Central region contains 255 station pairs, and the West region contains only 76 station pairs.
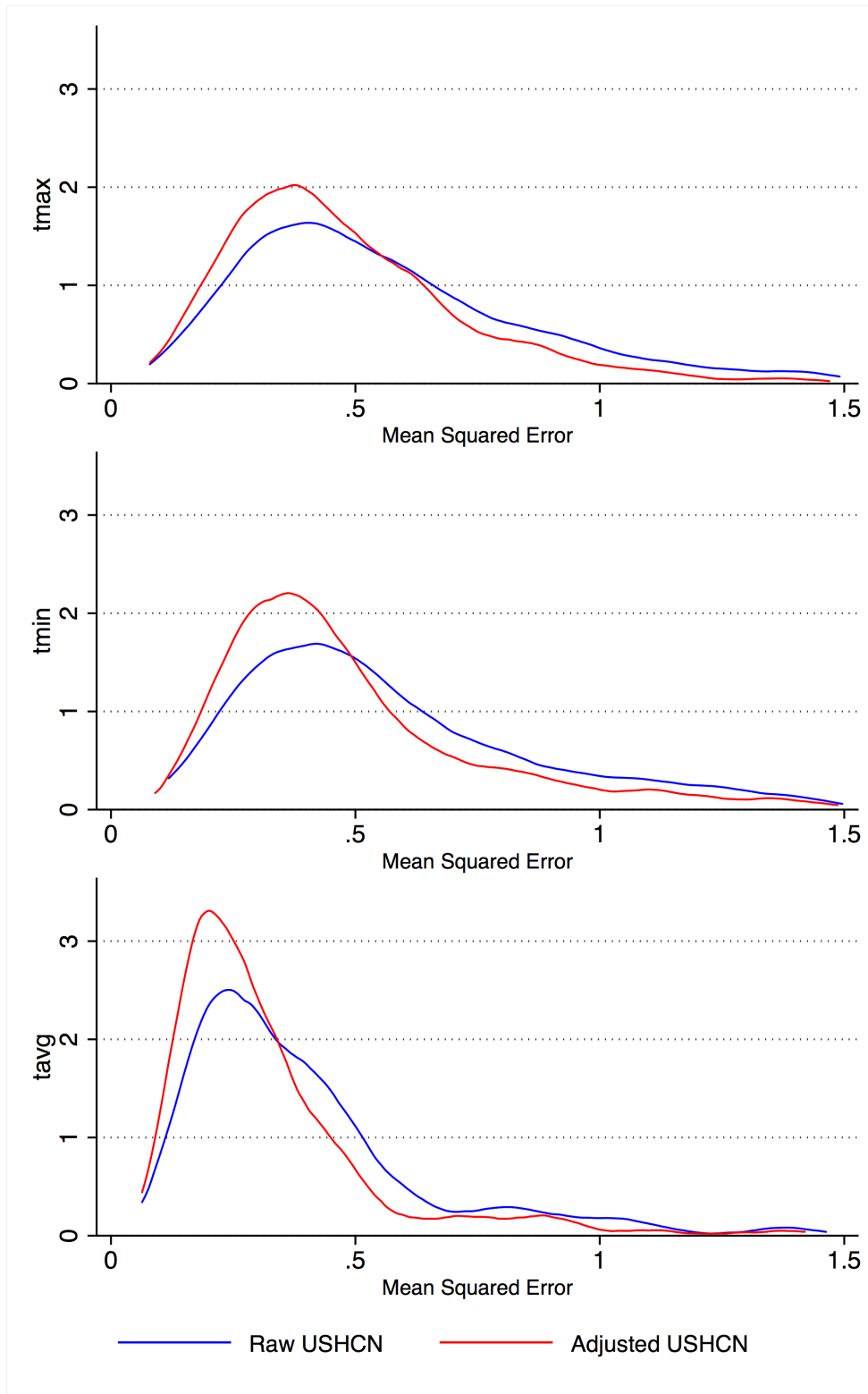
Figure SM6: Probability density of maximum (tmax), minimum (tmin), and mean (tavg) mean square errors from USHCN-USCRN station pairs within 100 miles of each other for both raw and adjusted USHCN data. Values on y-axis are in degrees C.
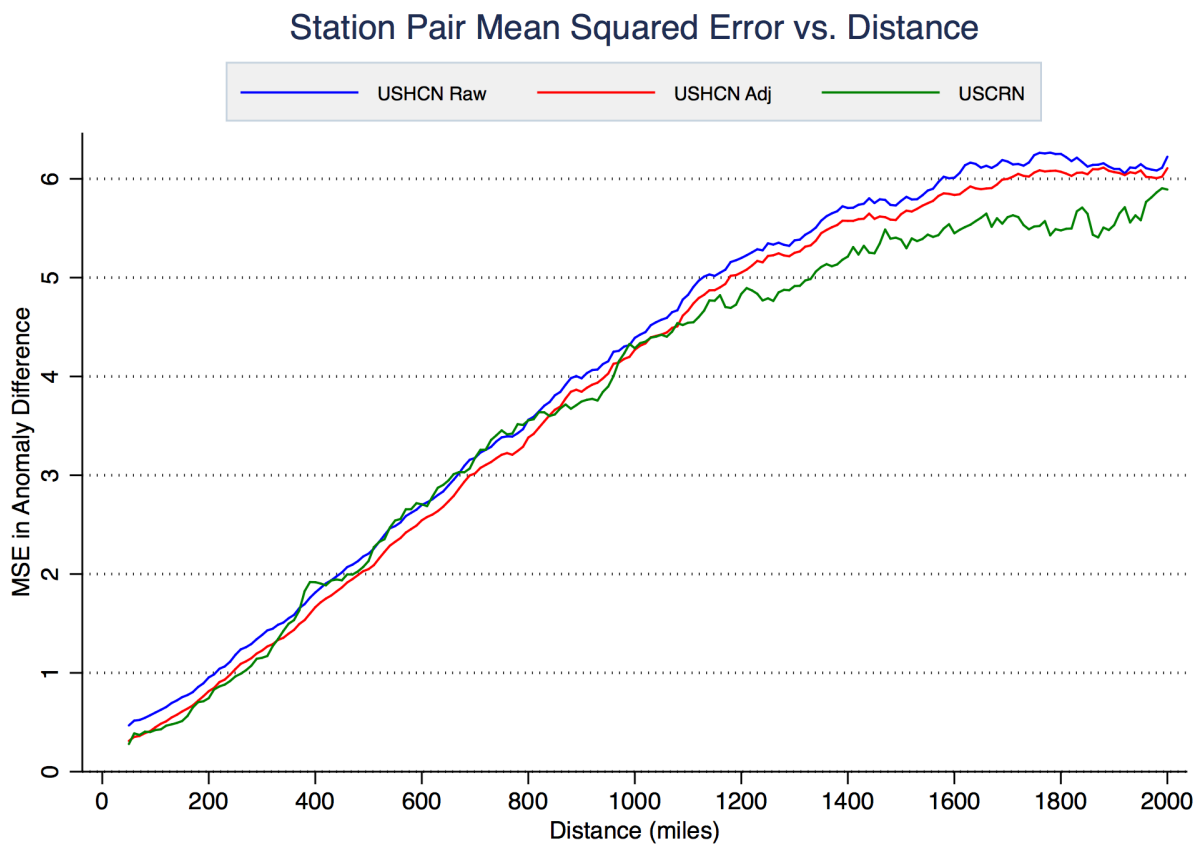
Figure SM7: Mean squared errors in differences between in-network station pairs as a function of distance out to 2000 miles.

Table SM.1: Statistics on CONUS raw/adjusted USHCN and USCRN trends			
Measurement	**Series**	**Trend**	**Confidence Interval**
Tmax	USHCN Raw	-0.058	-1.150 to 1.034
Tmax	USHCN Adjusted	-0.055	-1.165 to 1.055
Tmax	USCRN	0.179	-0.916 to 1.276
Tmin	USHCN Raw	-0.086	-0.717 to 0.546
Tmin	USHCN Adjusted	-0.159	-0.793 to 0.475
Tmin	USCRN	-0.176	-0.821 to 0.47
Tavg	USHCN Raw	-0.074	-0.897 to 0.749
Tavg	USHCN Adjusted	-0.108	-0.938 to 0.722
Tavg	USCRN	-0.028	-0.872 to 0.817
Tmax	USHCN Raw minus USCRN	-0.238	-0.300 to -0.176
Tmax	USHCN Adjusted minus USCRN	-0.234	-0.244 to -0.225
Tmax	USHCN Adj minus USHCN Raw	0.003	-0.042 to 0.048
Tmin	USHCN Raw minus USCRN	0.09	0.011 to 0.169
Tmin	USHCN Adjusted minus USCRN	0.017	-0.057 to 0.091
Tmin	USHCN Adj minus USHCN Raw	-0.073	-0.097 to -0.049
Tavg	USHCN Raw minus USCRN	-0.046	-0.102 to 0.009

| Tavg | USHCN Adjusted minus USCRN | -0.080 | -0.134 to -0.026 |
| Tavg | USHCN Adj minus USHCN Raw | -0.034 | -0.063 to -0.004 |

Table SM1: Mean and 95% confidence intervals in trends and trend differences from data shown in Figure 1. Trend differences confidence intervals are in degrees C per decade from January 2004 through October 2015. Confidence intervals are calculated using an ARMA[1,1] approach to account for autocorrelation.

Table SM.2: Statistics on raw/adjusted USHCN/USCRN pair differences				
Measurement	**Pair Distance**	**Pair Type**	**Trend Diff Mean**	**Trend Diff StDev**
Tmax	50	Raw	-0.033	0.063
Tmax	50	Adjusted	-0.021	0.027
Tmax	100	Raw	-0.029	0.071
Tmax	100	Adjusted	-0.022	0.033
Tmax	150	Raw	-0.030	0.070
Tmax	150	Adjusted	-0.021	0.039
Tmin	50	Raw	0.004	0.071
Tmin	50	Adjusted	0.001	0.034
Tmin	100	Raw	0.003	0.073
Tmin	100	Adjusted	0.000	0.034
Tmin	150	Raw	0.005	0.079
Tmin	150	Adjusted	0.000	0.040
Tavg	50	Raw	-0.012	0.050
Tavg	50	Adjusted	-0.007	0.023
Tavg	100	Raw	-0.010	0.058
Tavg	100	Adjusted	-0.008	0.026
Tavg	150	Raw	-0.010	0.060
Tavg	150	Adjusted	-0.007	0.032

Table SM2: Mean and standard deviation in trend differences from data shown in Figure 2, Figure SM2, and Figure SM3. Pair distance is in miles; trend differences and standard deviations are in degrees C per year (following the convention in Figure 2) from January 2004 through October 2015.