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Supplementary Information for

Natural and managed watersheds show similar responses to recent climate change

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Additional comparison with Lins and Slack (1)

The differences between the streamflow trends found in this study and the Lins and Slack (1) study are largely due to differences in climate within each time period. Decadal-scale internal variability during the time period used in this study (1981-2015) has favored drying across the southwestern United States (2). Importantly, the Lins and Slack (1) analyses end with the midwestern flood of 1993 and some of their longer time series include the Dust Bowl period. This, in combination with different internal climate variability within the respective time periods, produce precipitation and ETo trends that are fundamentally distinct from the 1981-2015 time period used in our analyses (Figure S4). Specifically, the most recent Lins and Slack (1) time period (1964-1993) shows an increase in precipitation for a large portion of the southwestern United States compared to the more-widespread southwestern United States drying for 1981-2015. This result has been documented in other studies as well (e.g., (3)) and is potentially linked to variability associated with the Interdecadal Pacific Oscillation (4). Additionally, the 1964-1993 Lins and Slack (1) time period shows decreases in ETo in many southern regions and increases in ETo for northwestern portions of the United States, while the 1981-2015 time period has widespread increases in ETo throughout the southern and eastern United States.

Climate data used for the Lins and Slack (1) comparison

Monthly gridded maximum temperature, minimum temperature, dew point temperature, and precipitation data for the period 1900-2015 at a 1/24th degree horizontal resolution were acquired from Daly et al., (5). We also used gridded 10-m wind speed and downward shortwave radiation flux on the same grid from Abatzoglou (6) for the period 1979-2015 and extended these estimates back to 1900 using monthly anomalies from the 20th century reanalysis (7). Monthly ETo was calculated using the Penman-Montieth approach for a reference grass surface (8), and further modified ETo to account for reduced demand when monthly temperatures are <5 °C (9).

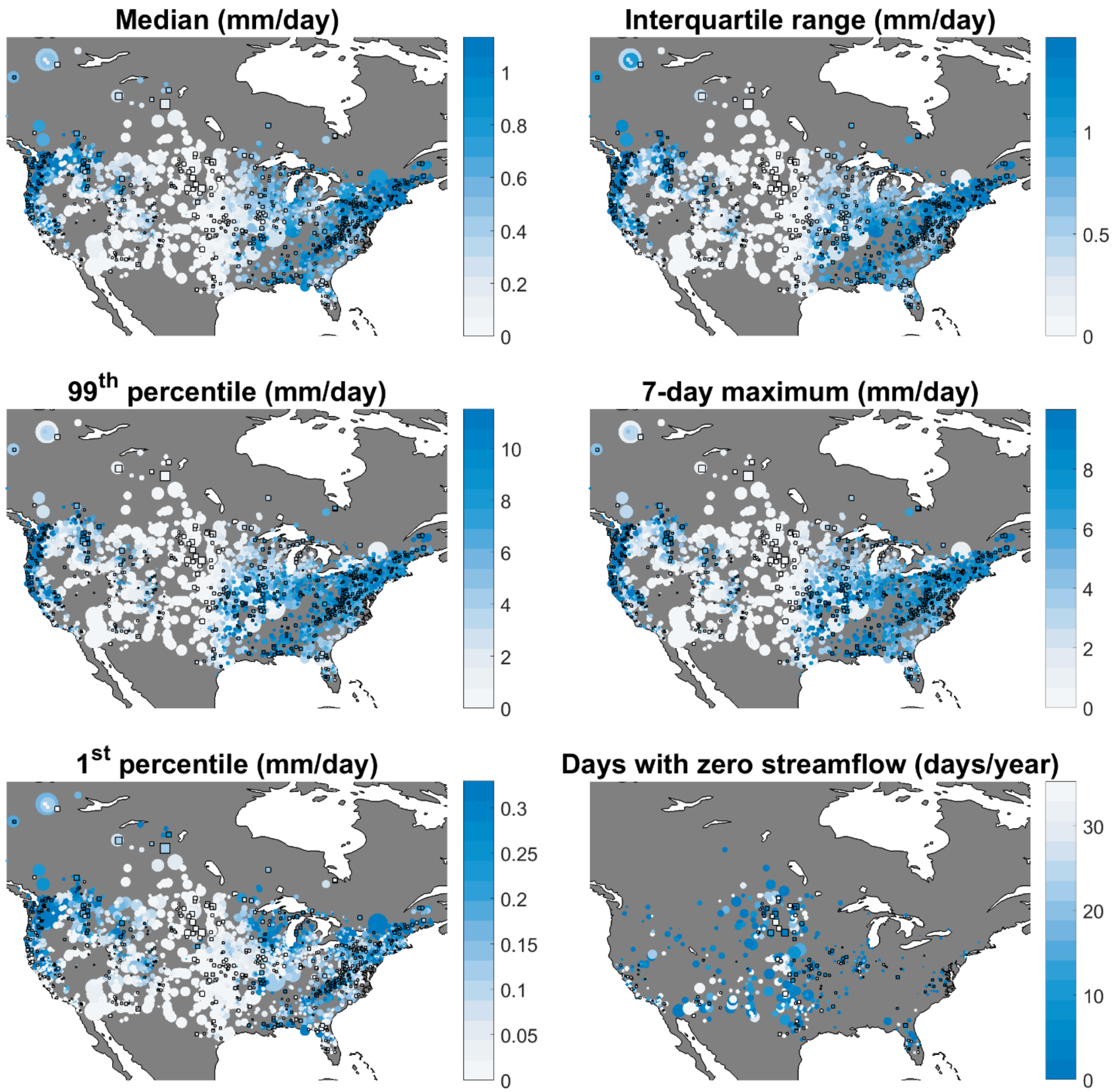

Figure S1. Average values of the streamflow (water yield) metrics for the 1981-2015 water years. The size of the circle and square represents the relative drainage area upstream of the watershed outlet. Natural streamflow gauges are indicated by squares with a black border and human-modified gauges are indicated by circles.

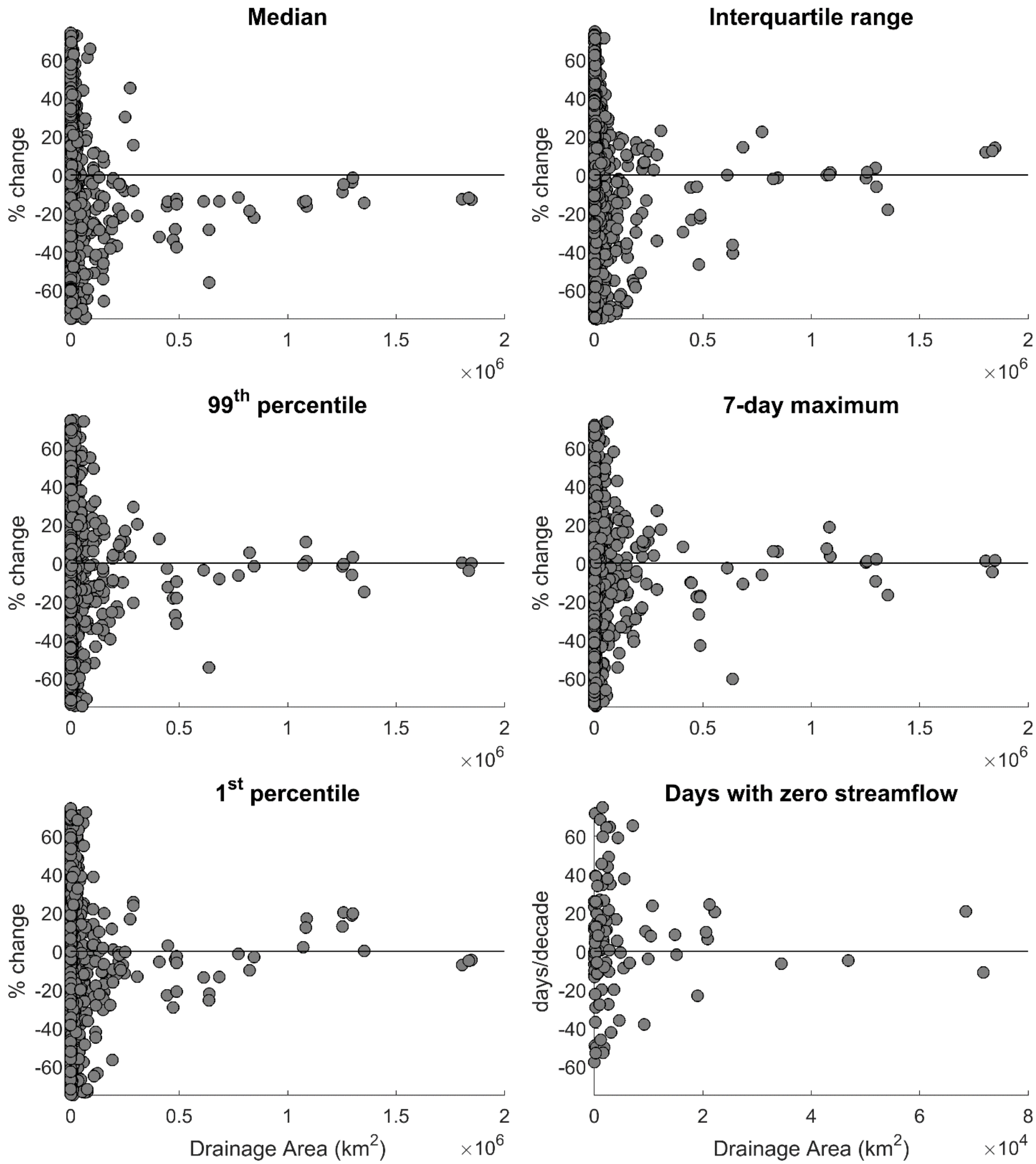

Figure S2. Scatterplots of upstream drainage area and trend in streamflow (water yield) metrics.

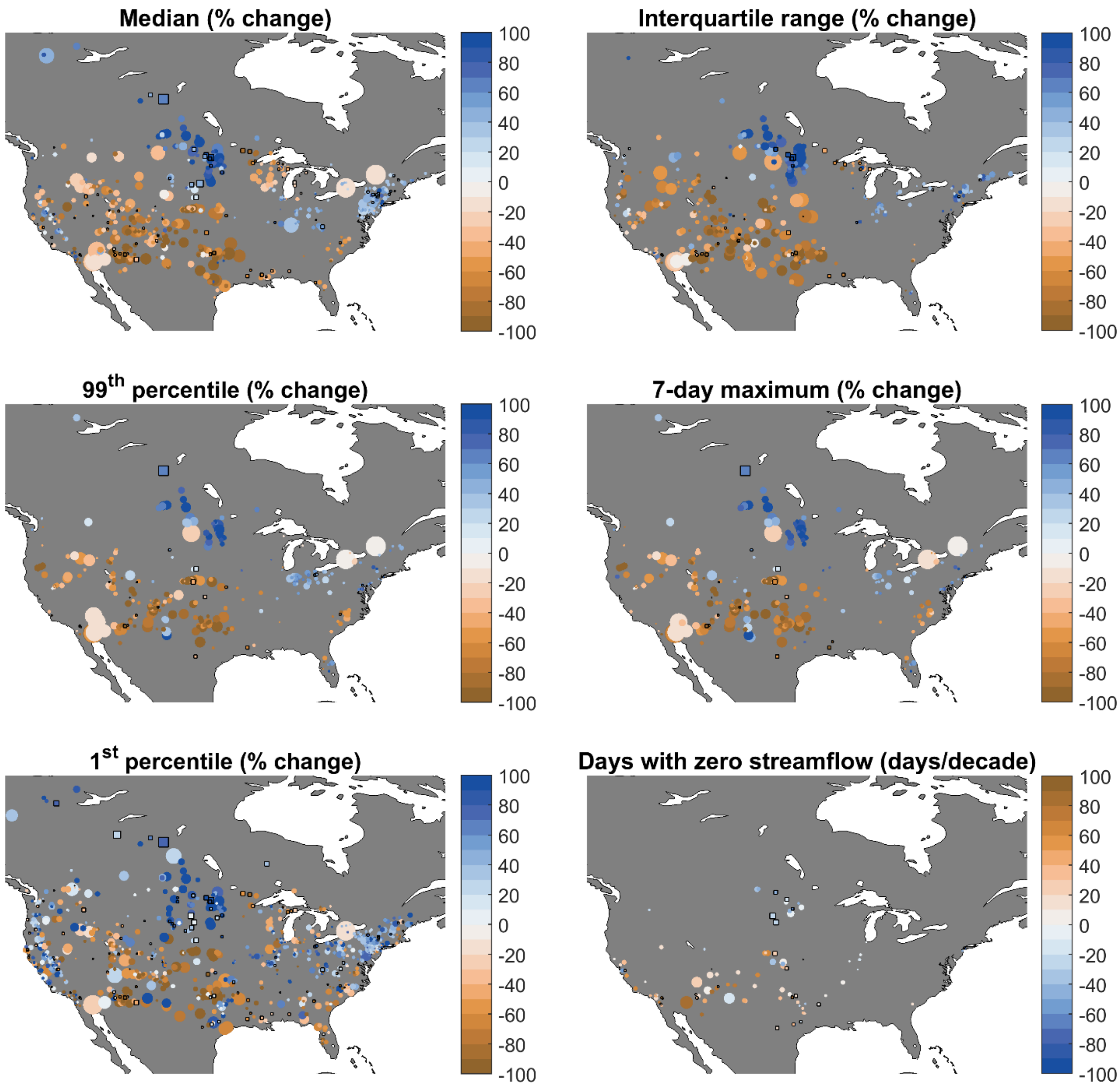

Figure S3. Streamflow gauges where significant ($p < 0.05$) trends exist for each streamflow metric.

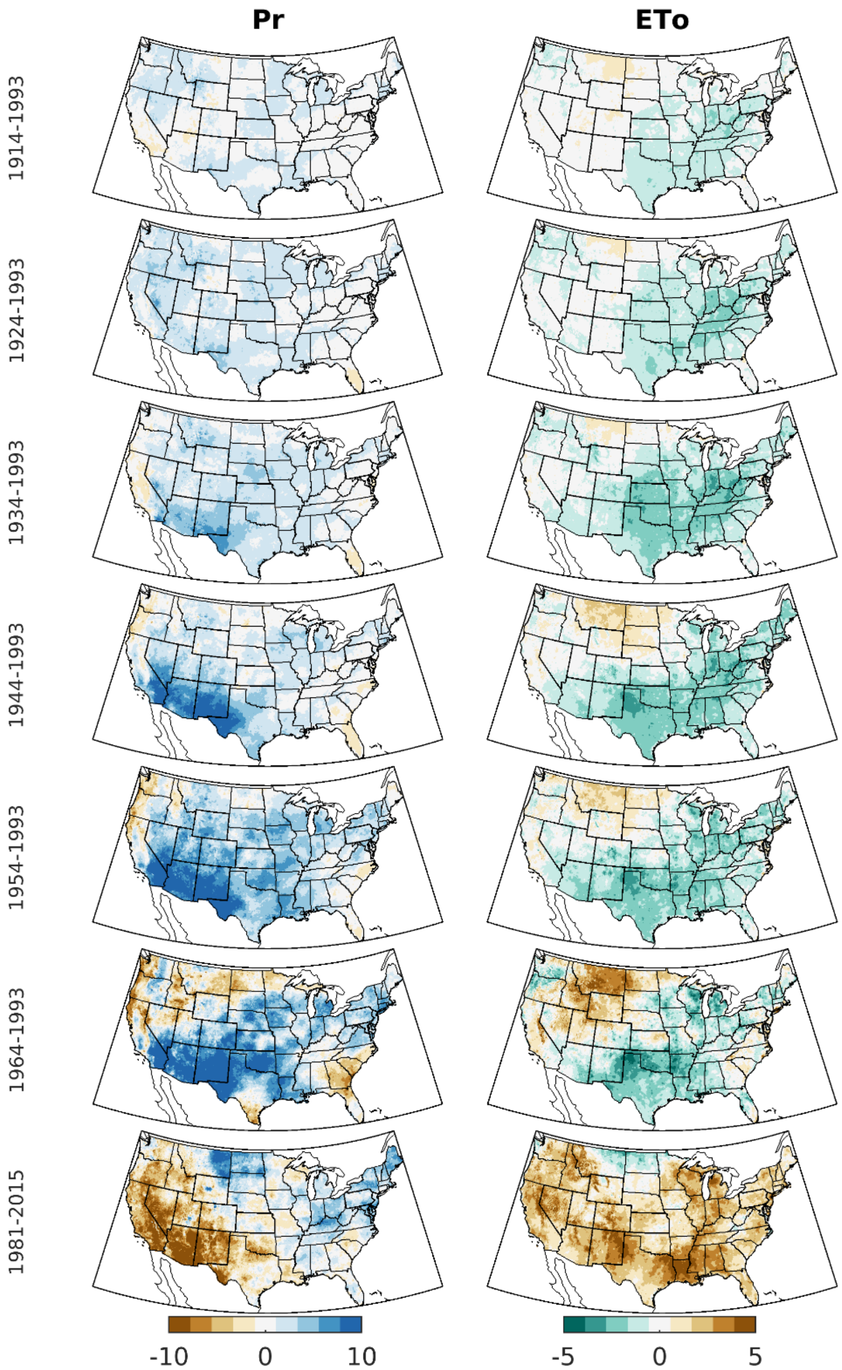

Figure S4. Trends in precipitation (Pr) and reference evapotranspiration (ETo) for each time period in Lins and Slack (1) as well as the time period used in this study (1981-2015). All trends are shown and reported in % change per decade (percent compared against the 1981-2010 normal).

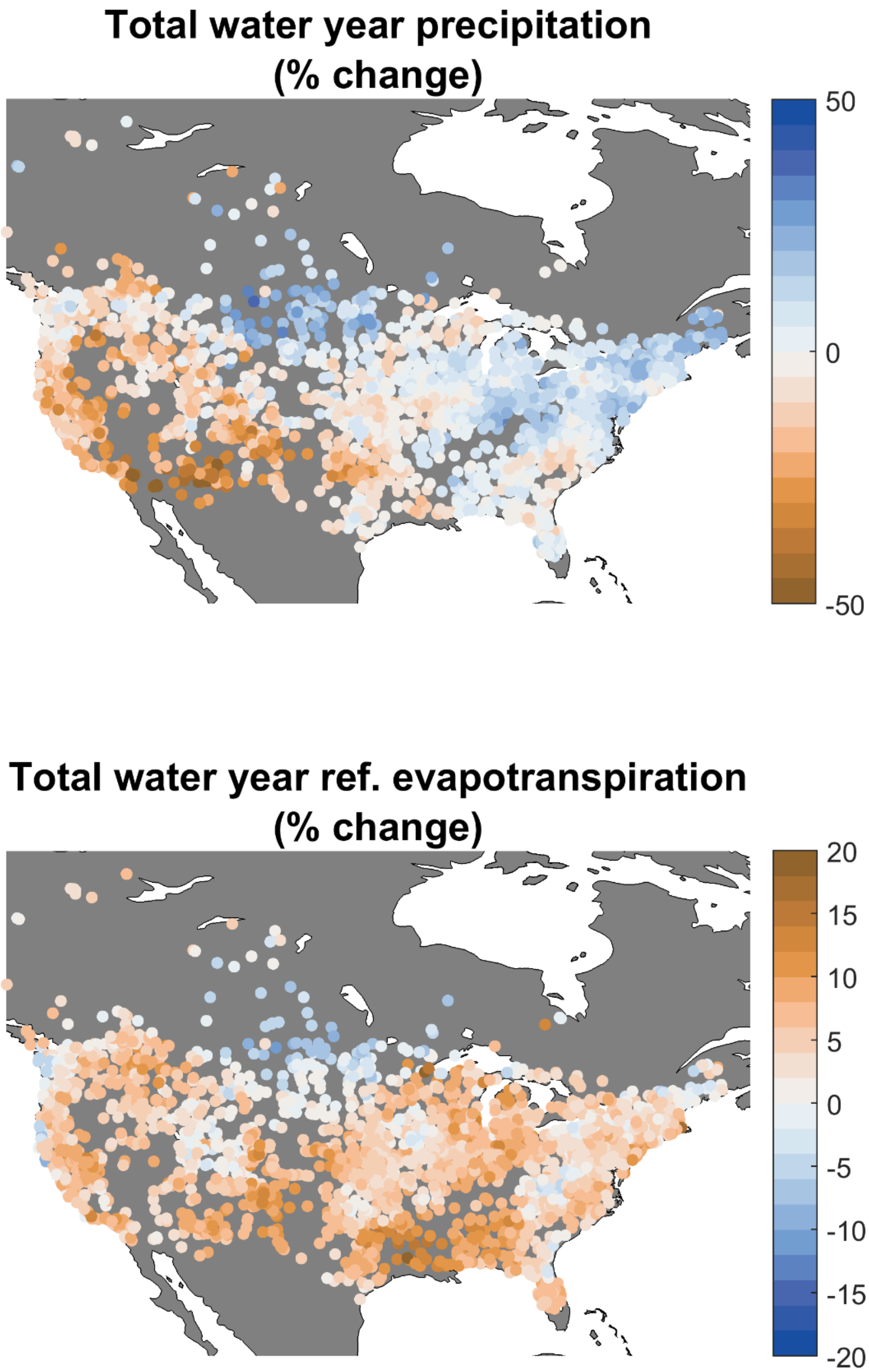

Figure S5. Trends in total water-year precipitation and reference evapotranspiration (in percent change) at the gridMET(6) or TerraClimate(9) grid point that is closest to each streamflow gauge.

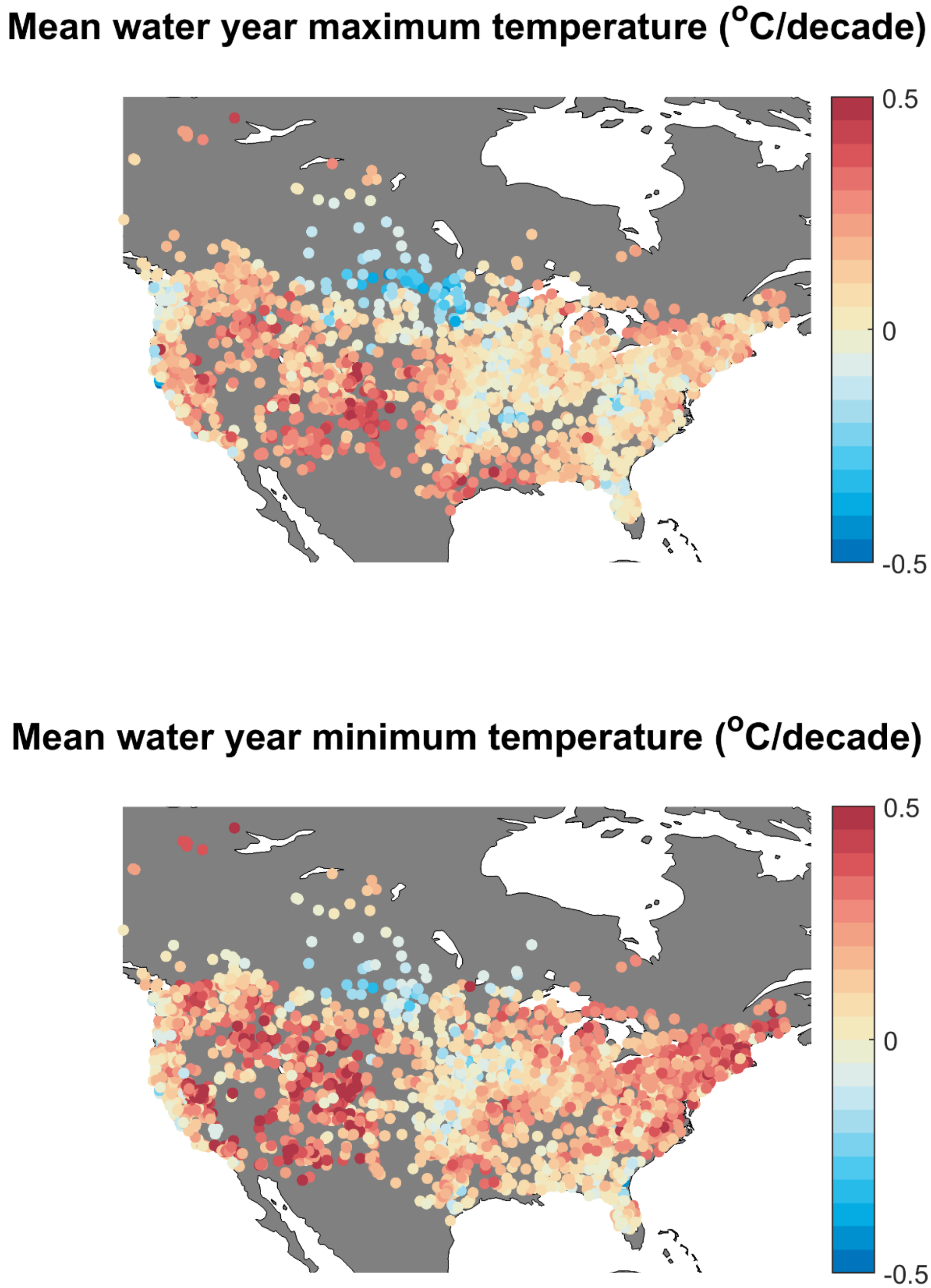

Figure S6. Trends in mean water year maximum and minimum air temperature (in °C/decade) at the gridMET(6) or TerraClimate(9) grid point that is closest to streamflow gauge.

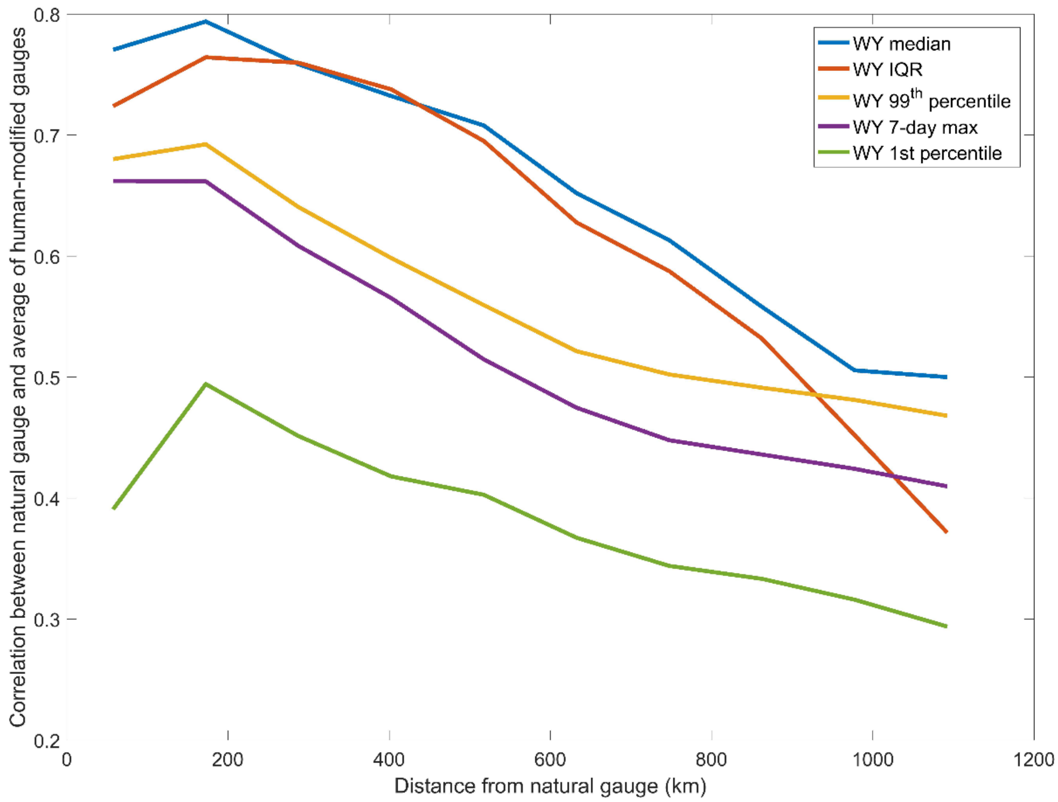

Figure S7. Changes in correlation based on distance between near-natural streamflow trends and human-modified trends for each streamflow metric for the continental United States

Table S1. Summary of significant (α=0.05) trends for human-modified streamflow gauges for the 1981-2015 water years.

Water year water yield statistic for human-modified streamflow gauges	Percent with significant positive trends	Percent with significant negative trends	Percent of stations with a significant trend
Median	9.8	12.2	22.0
Interquartile range	5.4	9.1	14.5
99th percentile	4.6	6.7	11.3
7-day maximum	3.5	6.4	9.9
1st percentile	16.8	12.4	29.2
Days with zero streamflow	3.0	2.6	5.6

Table S2. Summary of significant trends (α=0.05) for natural streamflow gauges for the 1981-2015 water years.

Water year water yield statistic for all natural streamflow gauges	Percent with significant positive trends	Percent with significant negative trends	Percent of stations with a significant trend
Median	6.7	9.8	16.5
Interquartile range	2.3	5.4	7.7
99th percentile	1.4	3.2	4.6
7-day maximum	0.7	2.1	2.8
1st percentile	8.4	12.1	20.5
Days with zero streamflow	4.2	1.9	6.1

Table S3. Summary of significant (α=0.05) trends for the streamflow metrics used by Lins and Slack (1) for human-modified streamflow gauges for the 1981-2015 water years.

Water year water yield statistic for <u>human-modified</u> streamflow gauges	**Percent with significant positive trends**	**Percent with significant negative trends**	**Percent of stations with a significant trend**
Minimum	18.4	12.8	31.2
10th percentile	13.5	12.8	24.9
30th percentile	11.8	13.1	25.1
50th percentile	9.8	12.2	22.0
70th percentile	7.5	10.8	18.3
90th percentile	6.1	9.3	15.4
Maximum	3.8	5.6	9.4

Table S4. Summary of significant (α=0.05) trends for the streamflow metrics used by Lins and Slack (1) for the natural streamflow gauges for the 1981-2015 water years.

Water year water yield statistic for all natural streamflow gauges	Percent with significant positive trends	Percent with significant negative trends	Percent of stations with a significant trend
Minimum	8.8	11.9	20.7
10th percentile	7.9	11.4	19.3
30th percentile	9.1	11.4	20.5
50th percentile	6.7	9.8	16.5
70th percentile	4.4	8.9	13.3
90th percentile	3.0	5.3	8.3
Maximum	1.6	2.1	3.7

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