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Supplementary Material

Supplementary figures and tables for "The detection and attribution of Northern Hemisphere land surface warming (1850-2018) in terms of human and natural factors: Challenges of inadequate data"

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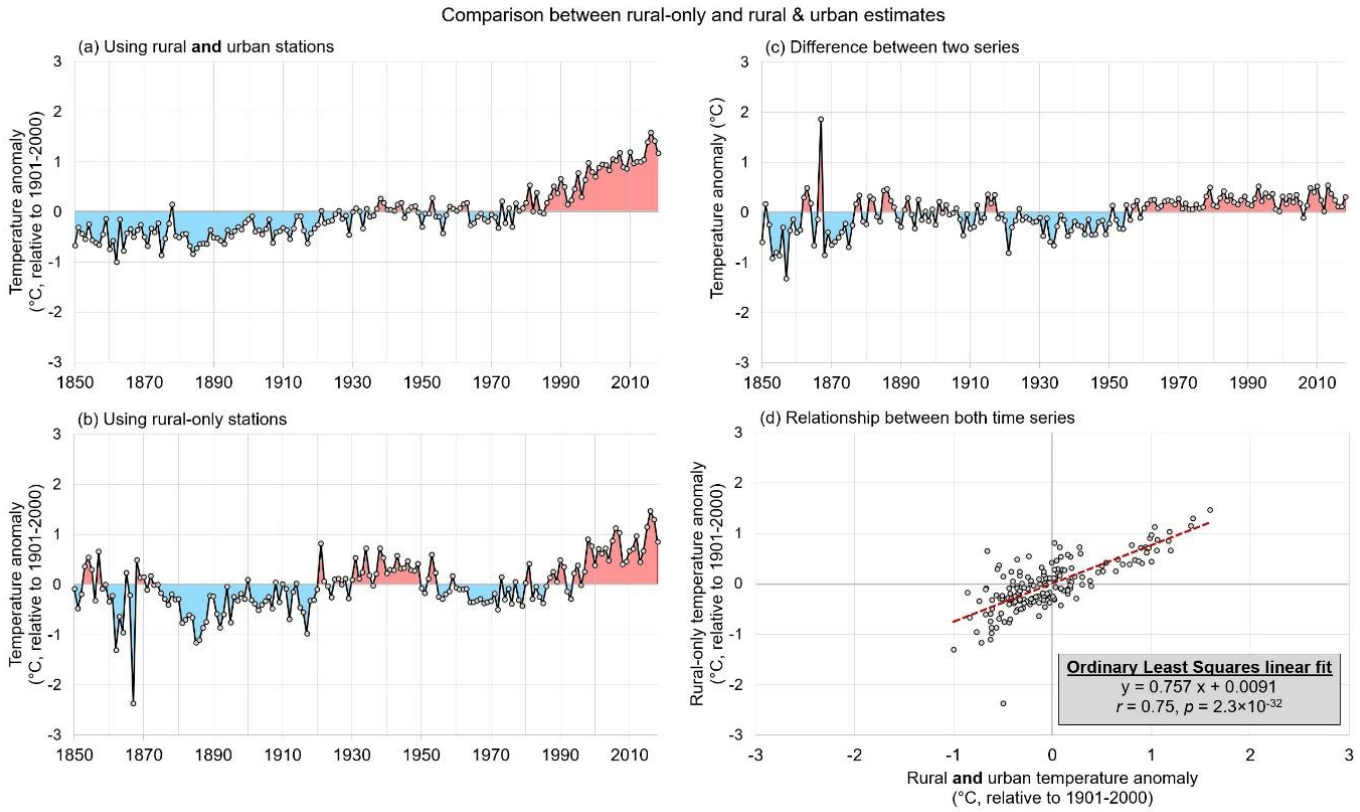
- Fig. S1. Comparison between the "rural-only" and the "rural and urban" based estimates of Northern Hemisphere land surface air temperatures. (a) Using rural and urban stations; (b) Using rural-only stations; (c) Difference between both series; (d) Linear relationship between both time series.
- Fig. S2. (a)-(k) Each of the eleven individual components of the "net anthropogenic forcings" time series used for the analysis in the main manuscript. (l) The net series derived by summing all eleven components. Note the change in the y-axis for this panel. All time series are taken from the IPCC AR6 WG1 Annex III dataset (Smith et al. 2021), downloaded from https://doi.org/10.5281/zenodo.5705390 (Last accessed 06 July 2023), and then converted into the values relative to their 1901-2000 average.
- Fig. S3. The results of fitting (a)–(d) the "rural and urban" or (e)–(h) the "rural-only" temperature records (indicated by thick black lines) using only one component (using ordinary least squares linear regression) over the 1900–2018 period. The best fits for each individual component are indicated in each panel with colored circles joined by a dotted line. (a) and (e) show the best fits for Solar #1; (b) and (f) show the best fits for Solar #2; (c) and (g) show the best fits for volcanic; (d) and (h) show the best fits for the net anthropogenic forcing.
- Fig. S4. The results of fitting the temperature records over the 1900-2018 period using multiple components (using ordinary least squares multiple linear regression) for the "rural and urban" temperature record. (a)-(d) show the best fits for Scenarios 1-4 respectively. The temperature record is shown in each panel by a thick black line. The panels on the left-hand-side show the model fits with green colored circles joined by a dotted line. The other panels show the contribution to the model fit from each of the two or three components.
- Fig. S5. As for Figure S4, except for the "rural-only" temperature records. The results of fitting the temperature records over the 1900-2018 period using multiple components (using ordinary least squares multiple linear regression) for the "rural and urban" temperature record. (a)-(d) show the best fits for Scenarios 1-4 respectively. The temperature record is shown in each panel by a thick black line. The panels on the left-hand-side show the model fits with green colored circles joined by a dotted line. The other panels show the contribution to the model fit from each of the two or three components.
- Table S1. Results of individual component analysis fitting of the "rural and urban" temperature record over the 1900-2018 period in terms of the various evaluation metrics.
- Table S2. Results of individual component analysis fitting of the "rural-only" temperature record over the 1900-2018 period in terms of the various evaluation metrics.
- Table S3. Results of multiple linear regression fitting of the "rural and urban" temperature record over the 1900-2018 period in terms of the various evaluation metrics.
- Table S4. Results of multiple linear regression fitting of the "rural-only" temperature record over the 1900-2018 period in terms of the various evaluation metrics.



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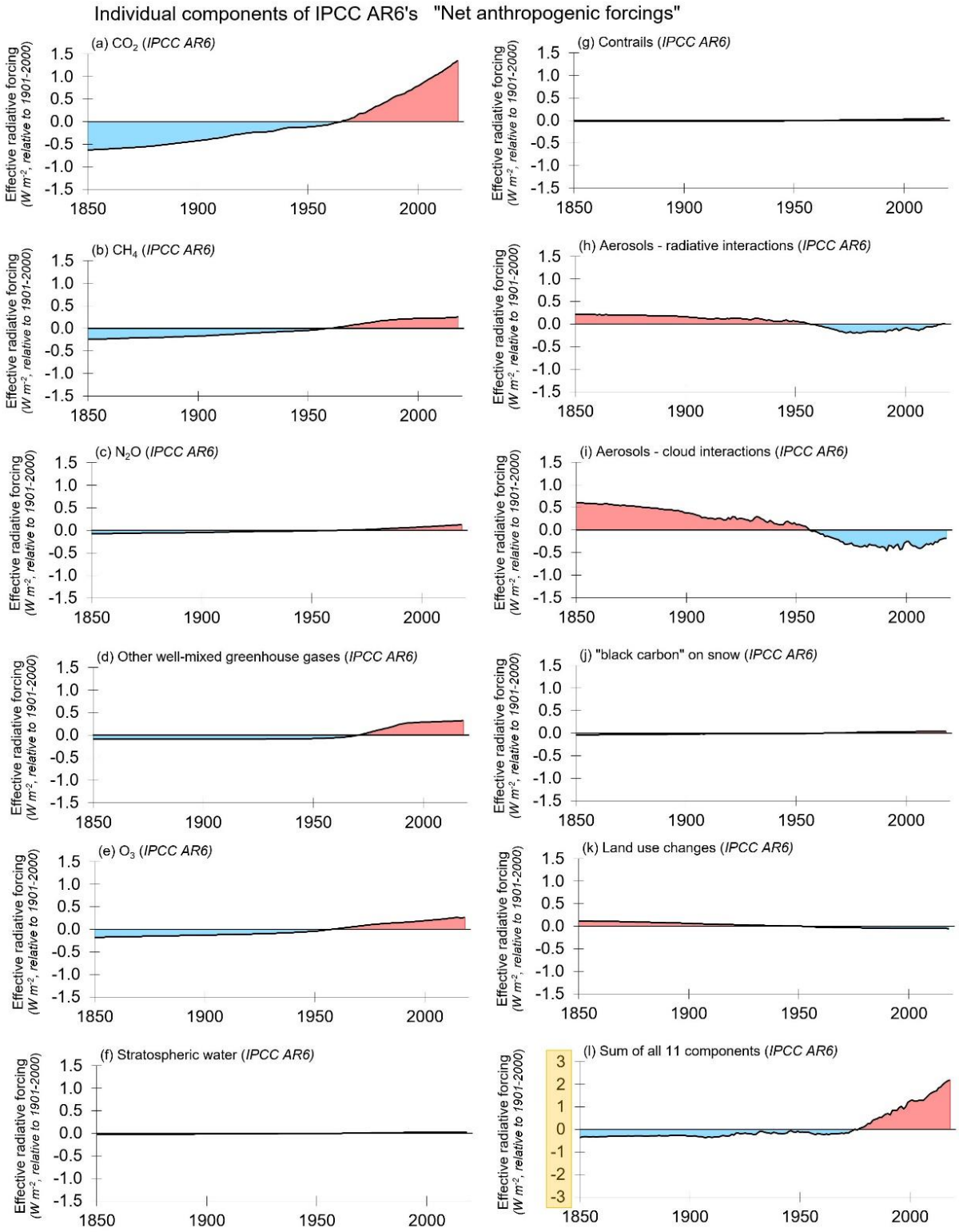

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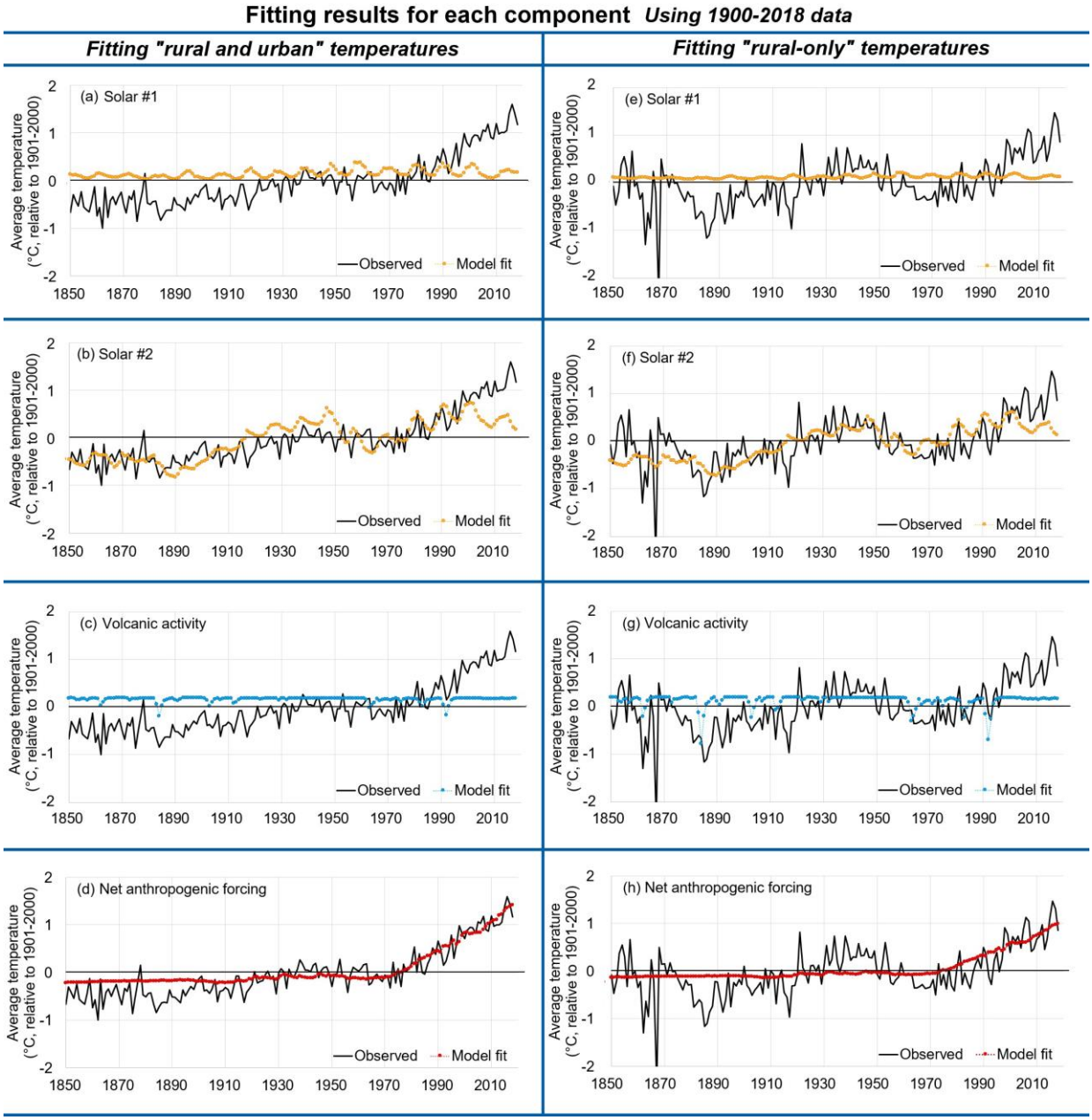

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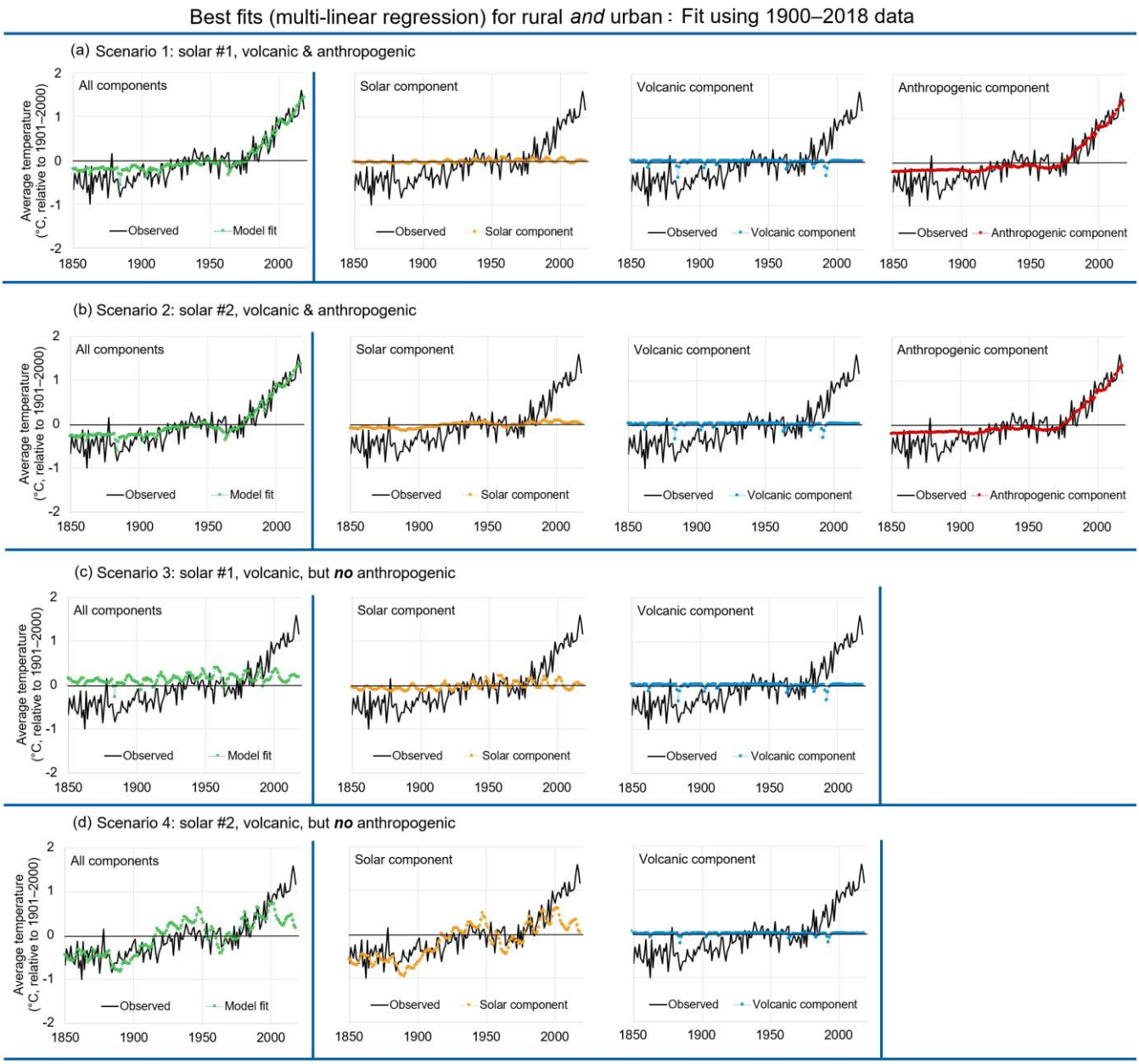

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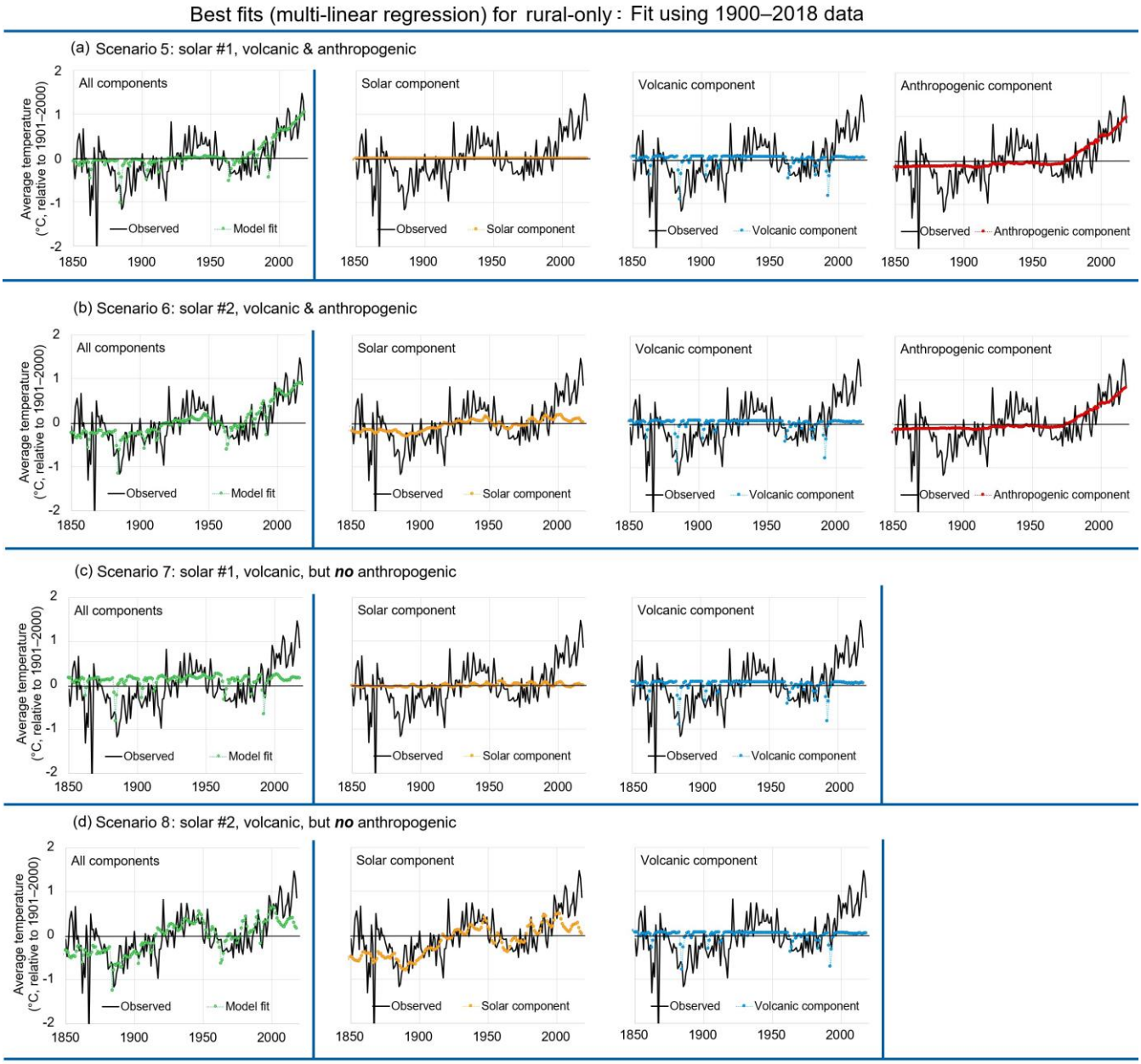

Figure S5. As for Figure S4, except for the "rural-only" temperature records. The results of fitting the temperature records over the 1900-2018 period using multiple components (using ordinary least squares multiple linear regression) for the "rural *and* urban" temperature record. (a)-(d) show the best fits for Scenarios 1-4 respectively. The temperature record is shown in each panel by a thick black line. The panels on the left-hand-side show the model fits with green colored circles joined by a dotted line. The other panels show the contribution to the model fit from each of the two or three components.

Table S1. Results of individual component analysis fitting of the "rural and urban" temperature record over the 1900-2018 period in terms of the various evaluation metrics.

Evaluation metric	**Rural *and* urban**	**Solar #1**	**Solar #2**	**Volcanic**	**Anthropo-genic**
Trend-based	Trend (°C/century)	%	%	%	%
1850-2018	0.89	10%	76%	0%	73%
1900-2018	1.17	8%	43%	-1%	95%
1885-1938	1.07	13%	218%	7%	19%
1938-1972	-0.77	-16%	240%	27%	16%
1972-2018	3.25	-3%	19%	3%	97%
Period-based	Difference (°C)				
AR6	1.37	6%	71%	1%	78%

Table S2. Results of individual component analysis fitting of the "rural-only" temperature record over the 1900-2018 period in terms of the various evaluation metrics.

Evaluation metric	**Rural-only**	**Solar #1**	**Solar #2**	**Volcanic**	**Anthropo-genic**
Trend-based	Trend (°C/century)	%	%	%	%
1850-2018	0.55	5%	105%	-2%	82%
1900-2018	0.7	4%	61%	-6%	110%
1885-1938	1.9	3%	105%	9%	7%
1938-1972	-2.8	-2%	57%	19%	3%
1972-2018	3.07	-1%	18%	9%	71%
Period-based	Difference (°C)				
AR6	0.95	3%	87%	5%	78%

Table S3. Results of multiple linear regression fitting of the "rural and urban" temperature record over the 1900-2018 period in terms of the various evaluation metrics.

Evaluation metric	**Rural *and* urban**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
Trend-based	Trend (°C/century)	%	%	%	%
1850-2018	0.89	76%	80%	9%	75%
1900-2018	1.17	96%	95%	6%	42%
1885-1938	1.07	30%	57%	20%	220%
1938-1972	-0.77	36%	77%	13%	255%
1972-2018	3.25	98%	97%	0%	21%
Period-based	Difference (°C)				
AR6	1.37	81%	85%	7%	72%

Table S4. Results of multiple linear regression fitting of the "rural-only" temperature record over the 1900-2018 period in terms of the various evaluation metrics.

Evaluation metric	**Rural-only**	**Scenario 5**	**Scenario 6**	**Scenario 7**	**Scenario 8**
Trend-based	Trend (°C/century)	%	%	%	%
1850-2018	0.55	80%	105%	5%	100%
1900-2018	0.7	106%	110%	0%	56%
1885-1938	1.9	16%	53%	12%	109%
1938-1972	-2.8	22%	41%	17%	71%
1972-2018	3.07	80%	74%	7%	25%
Period-based	Difference (°C)				
AR6	0.95	83%	102%	8%	89%