Supplemental Material

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How well do we know ENSO's climate impacts over North America, and how do we evaluate models accordingly?

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(a) El Niño	25/26	30/31	40/41	41/42	57/58	63/64	65/66	68/69	72/73	82/83	86/87	87/88	91/92	94/95	97/98	02/03	06/07	09/10	UQ 18
NW SAT 10	-	-	1	-	1	1	2	-	1	2	-	-	1	3	1	2	-	3	**11**
NW SAT 90	1	1	-	2	1	3	-	1	-	-	1	2	-	1	3	-	-	2	**11**
SE SAT 10	-	-	-	-	1	2	1	3	2	-	2	2	1	-	2	-	1	1	**11**
SE SAT 90	1	2	2	4	1	1	1	-	-	-	-	-	1	2	1	1	1	-	**12**
PNW PR 10	-	2	1	-	2	3	1	1	-	1	2	1	-	1	1	1	-	1	**13**
PNW PR 90	-	-	1	-	4	2	1	-	1	1	-	-	1	1	1	1	1	3	**12**
GULF PR 10	3	2	2	-	1	1	-	2	1	1	2	-	-	-	-	-	2	1	**11**
GULF PR 90	1	-	1	1	1	2	-	1	3	1	3	-	-	-	3	1	-	-	**11**
CA PR 10	-	2	-	2	-	1	1	-	1	1	1	2	1	-	1	1	2	2	**13**
CA PR 90	1	1	-	1	2	-	2	3	2	1	1	-	1	-	1	-	1	1	**13**

(b) La Niña	24/25	33/34	38/39	42/43	49/50	55/56	73/74	75/76	84/85	88/89	98/99	99/00	07/08	10/11	UQ 14
NW SAT 10	1	1	3	-	2	-	1	-	1	-	-	1	1	3	**9**
NW SAT 90	-	3	1	-	1	3	1	-	1	-	2	1	1	-	**9**
SE SAT 10	-	2	1	2	-	2	1	-	-	-	4	1	-	1	**8**
SE SAT 90	-	2	-	1	-	-	2	3	1	-	-	2	-	3	**7**
PNW PR 10	1	4	1	-	2	2	-	-	-	1	1	1	-	1	**9**
PNW PR 90	1	2	2	1	1	1	-	-	1	-	-	2	1	2	**10**
GULF PR 10	1	1	1	1	2	-	1	2	1	-	1	1	2	-	**11**
GULF PR 90	2	-	1	-	-	2	-	1	-	2	2	2	2	-	**8**
CA PR 10	1	2	-	1	1	-	2	1	-	-	2	1	1	2	**10**
CA PR 90	2	-	-	-	1	1	1	1	1	3	2	-	-	2	**9**

Table S1. (a) The 18 El Niño events used for the ENSO composites, identified by the years spanning the season December-February (e.g., ‘‘25/26’’ indicates the El Niño event of 1925/26). Shown are the number of times each event was sampled in the synthetic observational ENSO composites based on the 10th- and 90th-percentile values of the: Northwest SAT Index (NW SAT), Southeast SAT Index (SE SAT), Pacific

Northwest Precipitation Index (PNW PR), Gulf States Precipitation Index (GULF PR) and the California Precipitation Index (CA PR). The last column (bold font, labeled UQ18) shows the number of unique events in each composite. (b) As in (a) but for the 14 La Niña events.

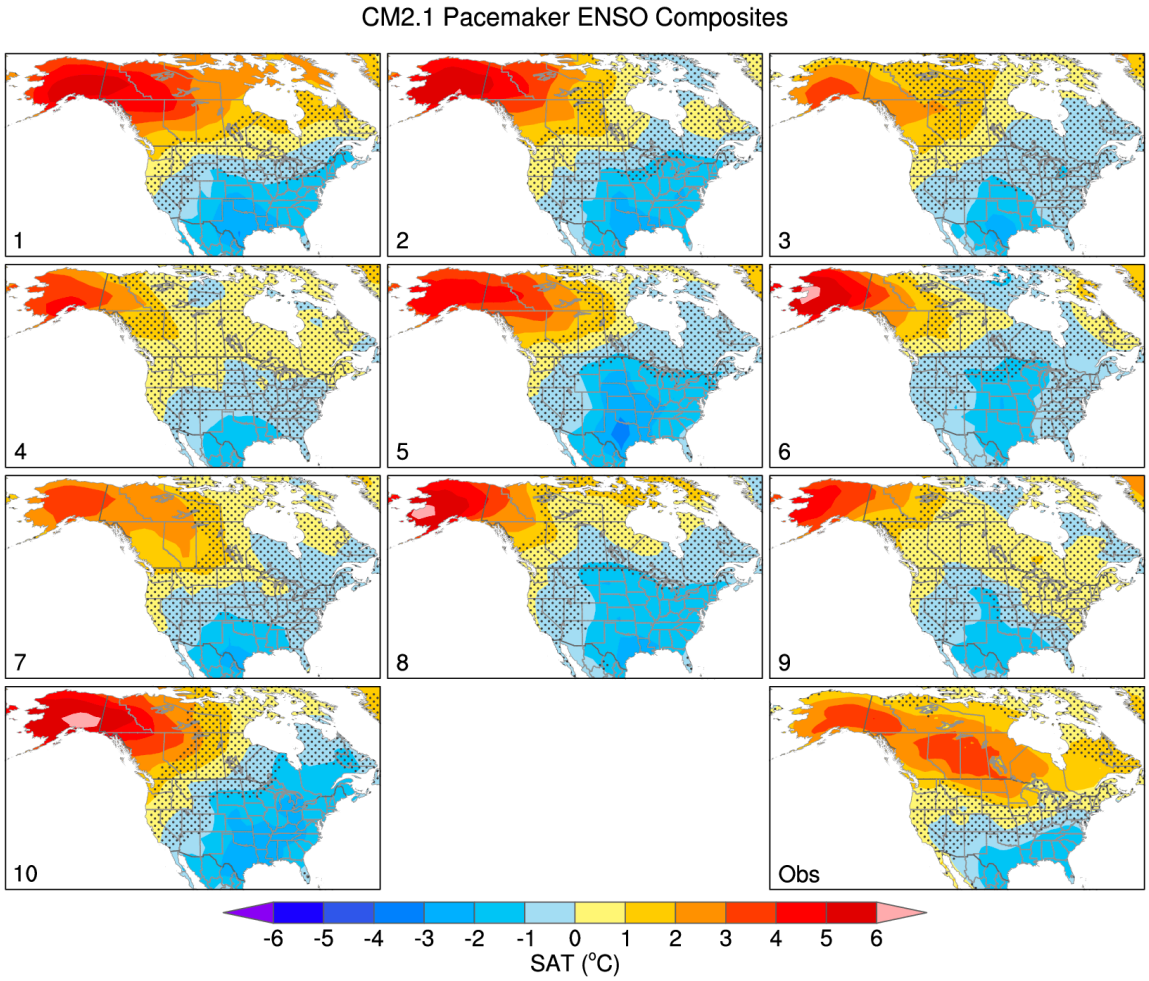

Figure S1. ENSO composites of DJF SAT (°C) from each of the 10 CM2.1 Pacemaker simulations (labeled 1 through 10) and from observations (lower right panel). Each composite is based on the same set of 18 El Niño events minus 14 La Niña events during 1920-2013. Values not significant at the 10% confidence level based on a 2-sided t-test are stippled.

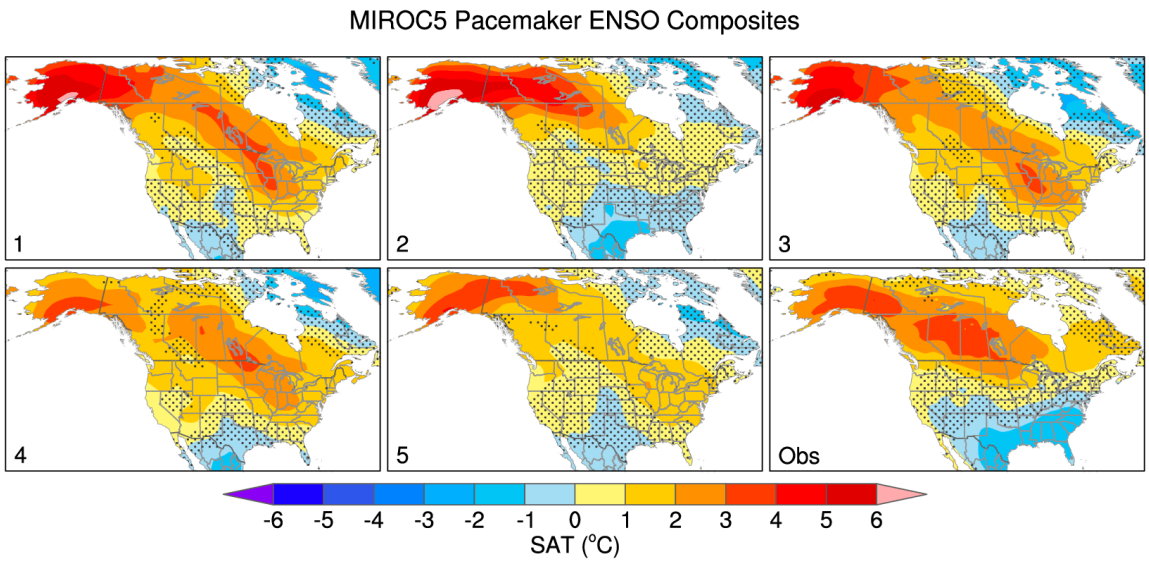

Figure S2. ENSO composites of DJF SAT (°C) from each of the 5 MIROC5 Pacemaker simulations (labeled 1 through 5) and from observations (lower right panel). Each composite is based on the same set of 18 El Niño events minus 14 La Niña events during 1920-2013. Values not significant at the 10% confidence level based on a 2-sided t-test are stippled.

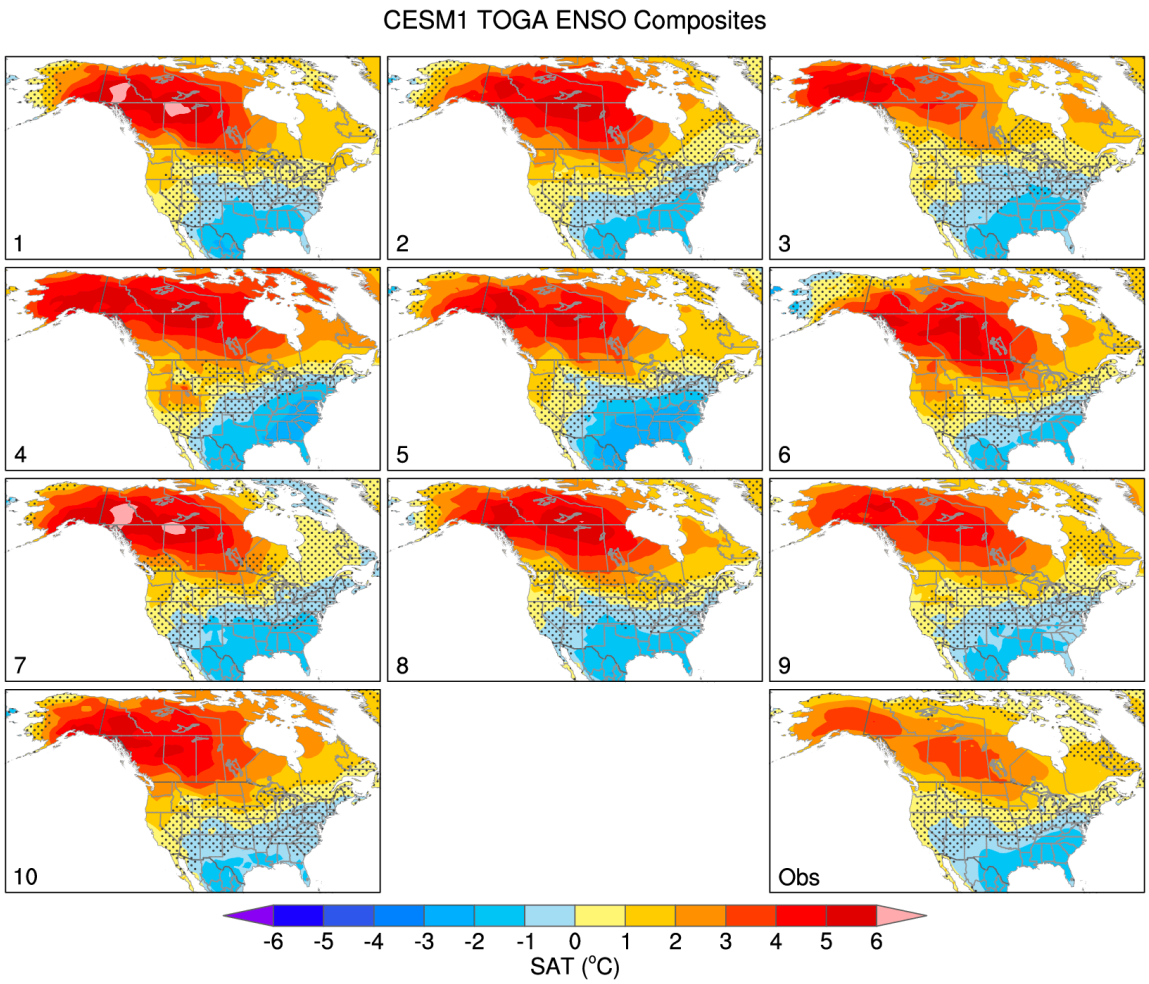

Figure S3. ENSO composites of DJF SAT (°C) from each of the 10 CESM1 TOGA simulations (labeled 1 through 10) and from observations (lower right panel). Each composite is based on the same set of 18 El Niño events minus 14 La Niña events during 1920-2013. Values not significant at the 10% confidence level based on a 2-sided t-test are stippled.

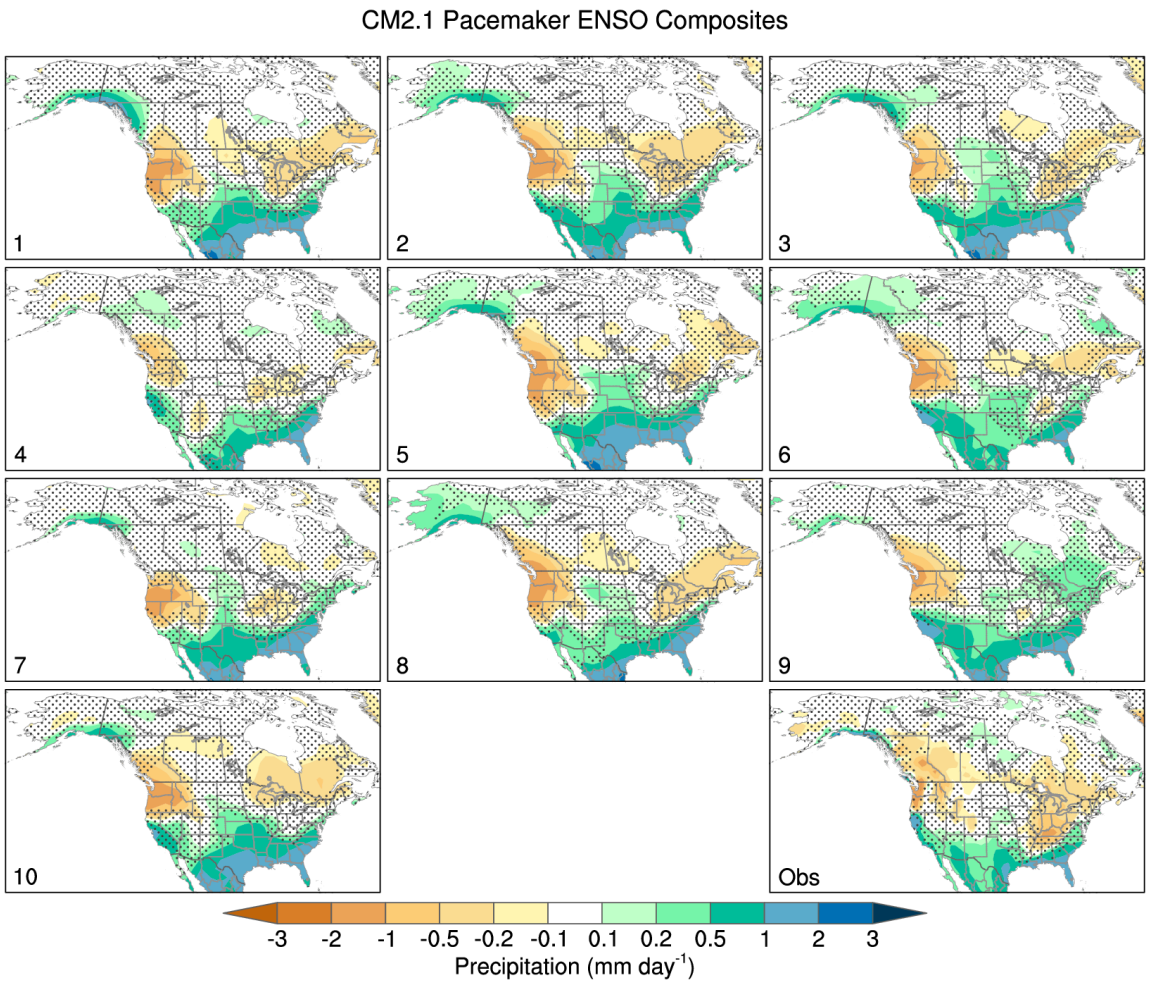

Figure S4. As in Fig. S1 but for precipitation (mm d^{-1}).

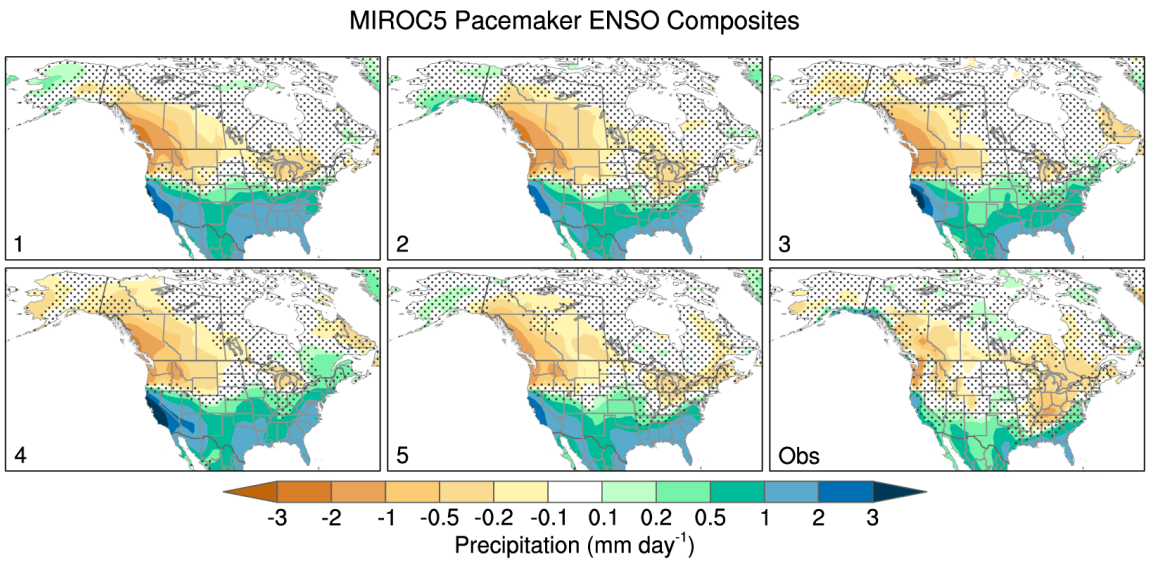

Figure S5. As in Fig. S2 but for precipitation (mm d^{-1}).

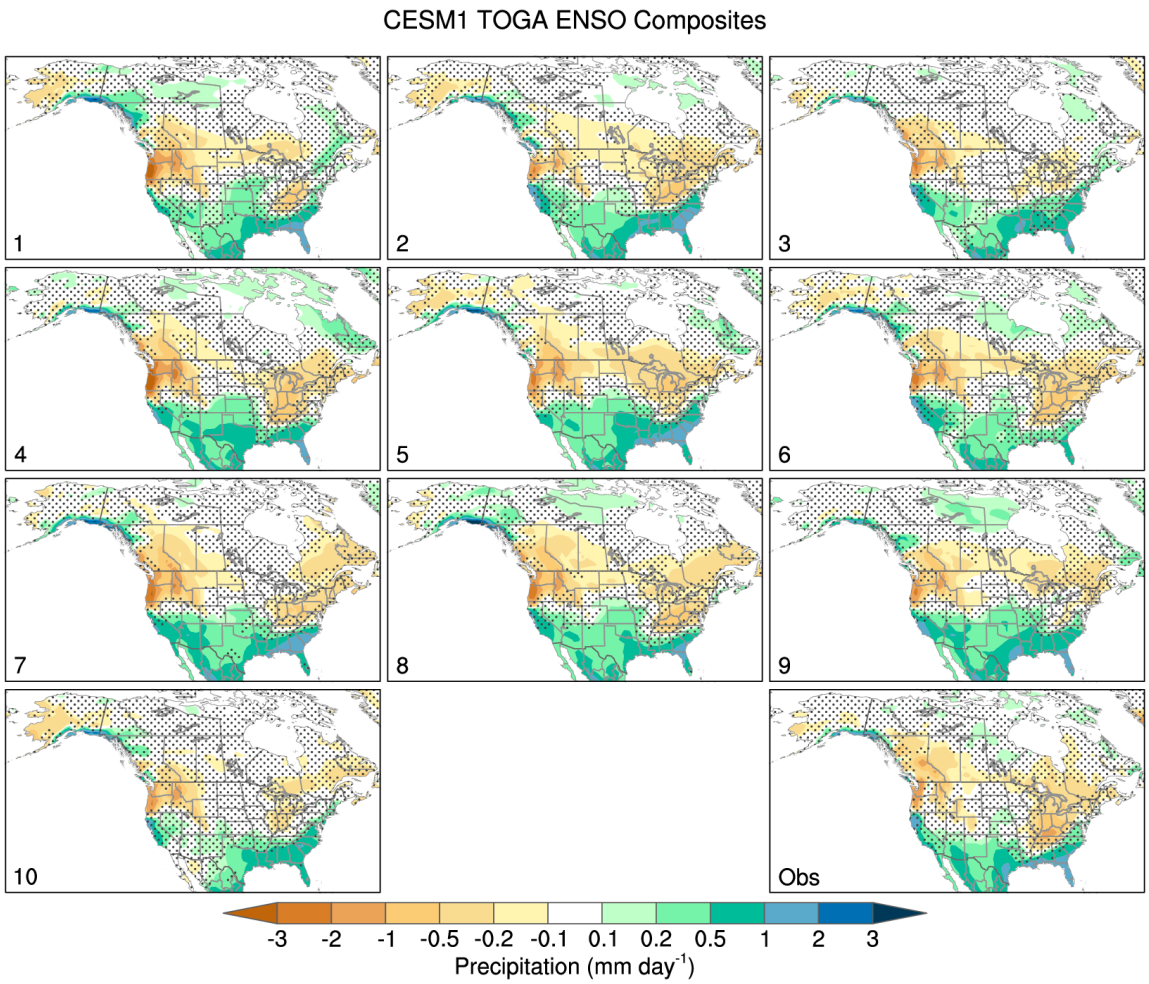

Figure S6. As in Fig. S3 but for precipitation (mm d^{-1}).

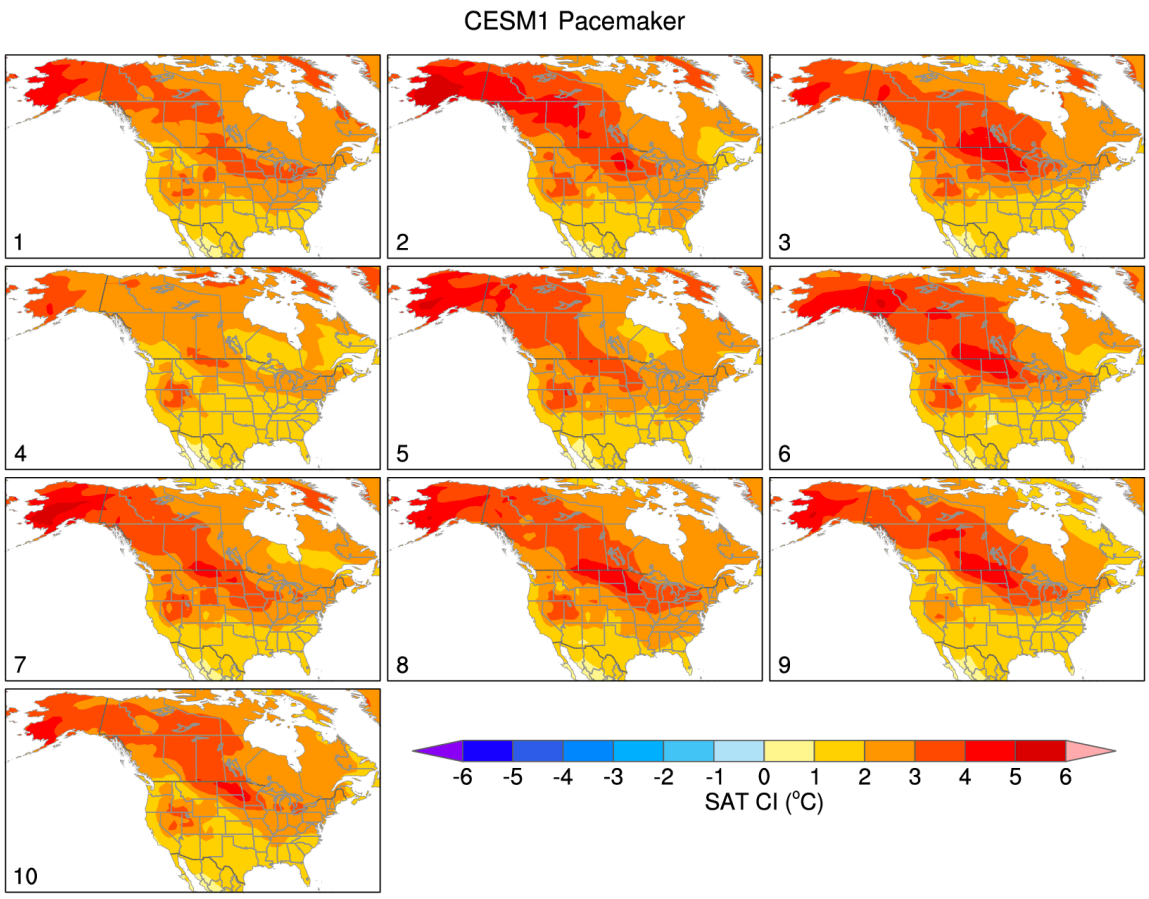

Figure S7. 5-95% confidence intervals (CI; °C) on the SAT ENSO composites based on 2000 bootstrapped samples for each of the 10 CESM1 Pacemaker simulations (labeled 1-10).

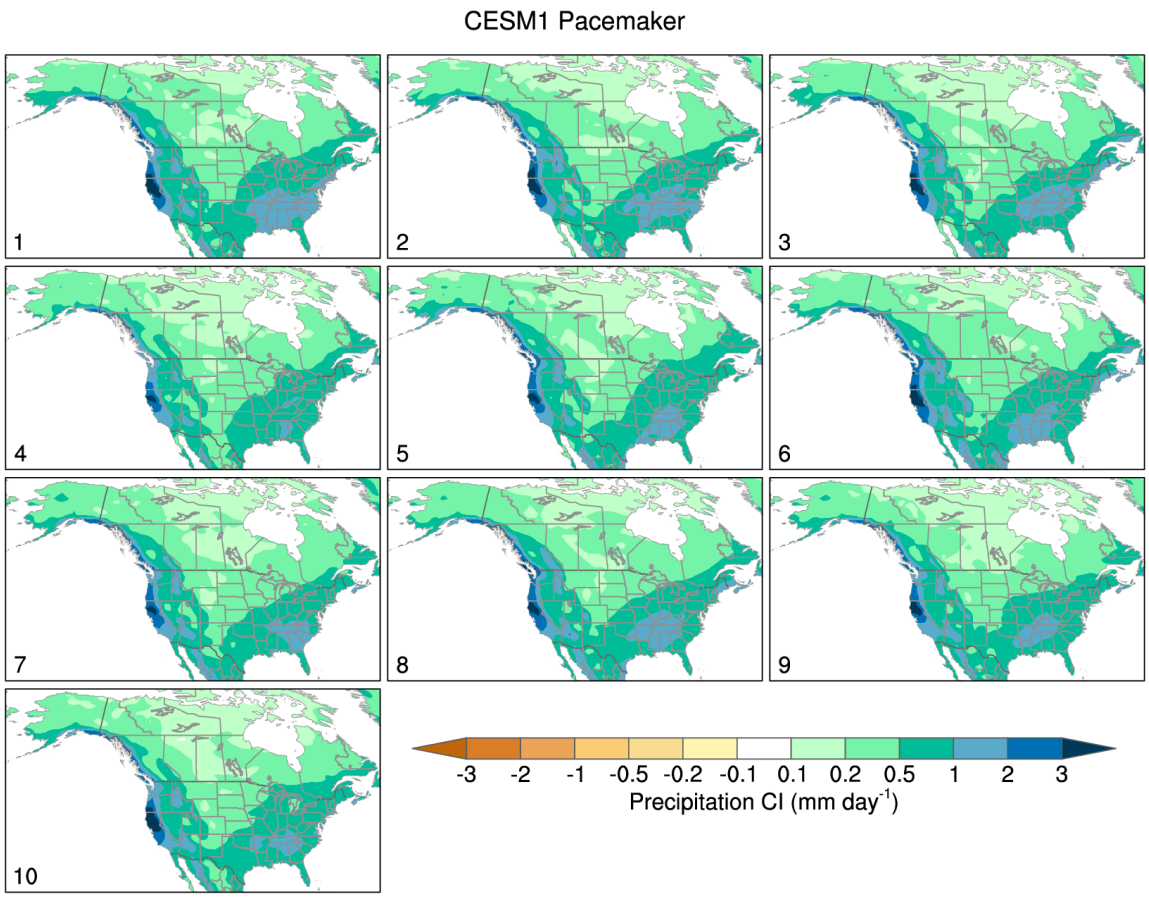

Figure S8. As in Fig. S7 but for precipitation (mm d^{-1}).

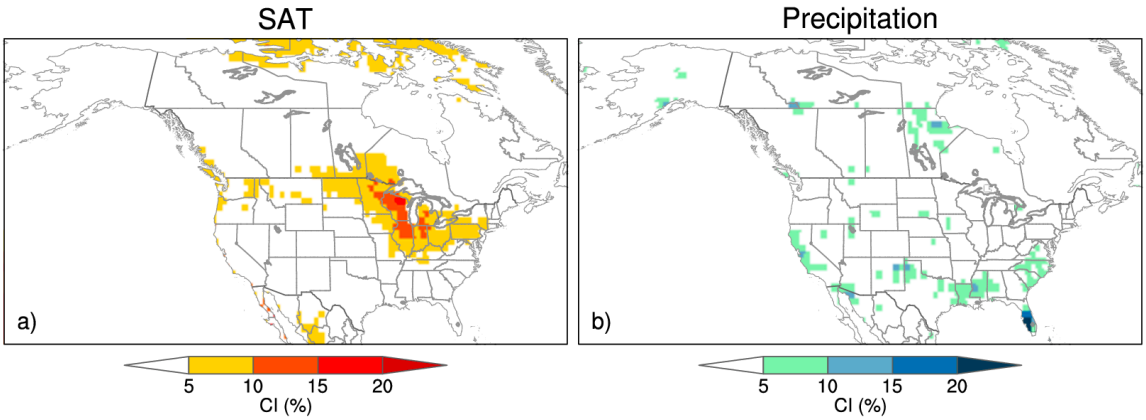

Figure S9. Percent contribution of ENSO to the observed CIs on ENSO composites of DJF (a) SAT and (b) precipitation. See main text for details.

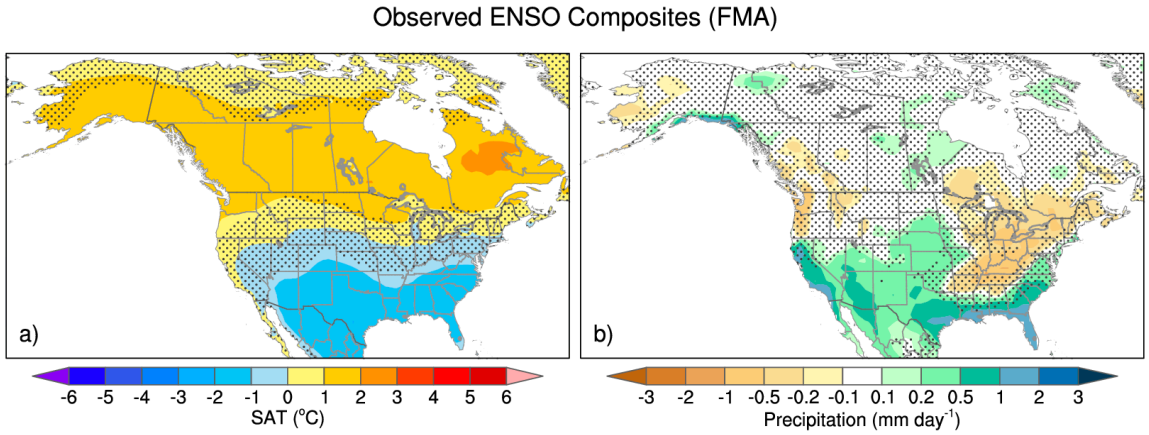

Figure S10. Observed ENSO composites of FMA (a) SAT (°C) and (b) precipitation (mm d^{-1}) based on 18 El Niño events minus 14 La Niña events during 1920-2013. Values not significant at the 10% confidence level based on a 2-sided t-test are stippled.

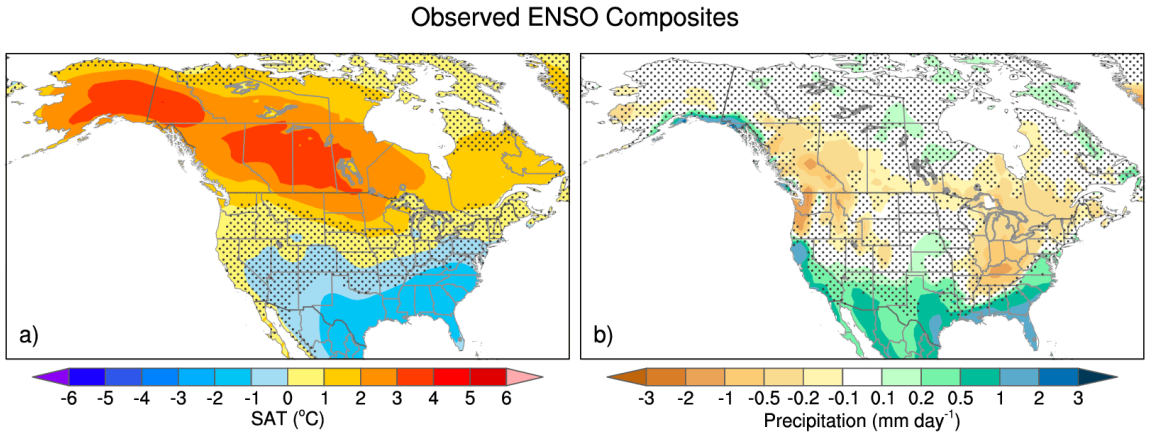

Figure S11. Observed ENSO composites of DJF (a) SAT (°C) and (b) precipitation (mm d^{-1}) based on 18 El Niño events minus 14 La Niña events during 1920-2013. Stippling indicates where values are within the 5-95% confidence interval based on 2000 bootstrapped samples after removing the linear dependence on the composite Nino3.4 SST Index. See main text for details.