Table S1. The total of 61 years from 1950 to 2010 are ranked based on the detrended number of intense U.S. tornadoes in AM. The top ten most active U.S. tornado years are listed with ENSO phase in spring and TNI index in AM for each year. Strongly positive (i.e., the upper quartile) and negative (i.e., the lower quartile) TNI index values are in bold and italic, respectively.

Ranking	Year	ENSO phase in spring	TNI index (detrended)
1	1974	La Niña persists	**1.30 (1.48)**
2	1965	La Niña transitions to El Niño	**1.39 (1.54)**
3	1957	La Niña transitions to El Niño	**0.57 (0.69)**
4	1982	El Niño develops	*-1.11* (*-0.89*)
5	1973	El Niño transitions to La Niña	-0.42 (-0.24)
6	1999	La Niña persists	**0.47 (0.75)**
7	1983	El Niño decays	**1.86 (2.08)**
8	2003	El Niño decays	*-1.24* (*-0.94*)
9	2008	La Niña decays	**1.41 (1.73)**
10	1998	El Niño transitions to La Niña	**1.69 (1.97)**

Table S2. The total of 61 years from 1950 to 2010 are ranked based on the detrended number of intense U.S. tornadoes in AM. The bottom ten years are listed with ENSO phase in spring and TNI index in AM for each year. Strongly positive (i.e., the upper quartile) and negative (i.e., the lower quartile) TNI index values are in bold and italic, respectively.

Ranking	Year	ENSO phase in spring	TNI index (detrended)
52	1958	El Niño decays	-0.61 (-0.49)
53	1955	La Niña persists	-0.27 (-0.16)
54	2001	La Niña decays	0.21 (0.50)
55	1986	El Niño develops	-0.39 (-0.16)
56	1988	El Niño transitions to La Niña	-0.37 (-0.13)
57	1987	El Niño persists	0.10 (0.34)
58	1992	El Niño decays	0.21 (0.47)
59	1952	Neutral	-0.67 (-0.57)
60	1951	La Niña transitions to El Niño	-0.31 (-0.22)
61	1950	La Niña persists	**0.77 (0.86**)

Table S3. Prescribed SSTs in the tropical Pacific region for each model experiment. All model experiments are initiated from April of the prior year to December of the modeling year. For instance, in EXP_TNI, the model is integrated for 21 months starting in April using the composite April SSTs of 1956, 1964, 1973, 1998, and 2007.

Experiments	Prescribed SSTs in the tropical Pacific region
EXP_CLM	Climatological SSTs are prescribed in the tropical Pacific region (15°S–15°N; 120°E-coast of the Americas).
EXP_TNI	Composite SSTs of the five positive phase TNI years transiting from a La Niña identified among the ten most active U.S. tornado years (1957, 1965, 1974, 1999, and 2008) are prescribed in the tropical Pacific region.
EXP_LAN	Composite SSTs of the four years with a La Niña transitioning (1950, 1951, 1955 and 2001) identified among the ten least active U.S. tornado years are prescribed in the tropical Pacific region.
EXP_ELN	Composite SSTs of the four years with an El Niño transitioning (1958, 1987, 1988 and 1992) identified among the ten least active U.S. tornado years are prescribed in the tropical Pacific region
EXP_CPC	Same as EXP_TNI except that the composite SSTs are prescribed only in the western and central tropical Pacific region (15°S–15°N; 120°E - 110°W).
EXP_EPW	Same as EXP_TNI except that the composite SSTs are prescribed only in the eastern tropical Pacific region (15°S–15°N; 110°W-coast of the Americas).
EXP_011	SSTs for 2010-2011 are prescribed in the tropical Pacific region.
EXP_WPW	Same as EXP_011 except that the SSTs for 2010-2011 are prescribed only in the western Pacific region (15°S–15°N; 120°E - 180°).

Table S4. Correlation coefficients of various long-term climate patterns in DJF, FMA and AM with the intense (F3 - F5) U.S. tornado-days in AM during 1950-2010. All indices including the tornado index are detrended using a simple least squares linear regression. The SWD, ERSST3, and NCEP-NCAR reanalysis are used to obtain the long-term climate indices used in this table. Correlation coefficients above the 95% significance are in bold[a].

Index	DJF	FMA	AM
Gulf-to-U.S. moisture transport	0.05	0.14	**0.36**
Lower-level vertical wind shear	0.04	**0.25**	**0.30**
GoM SST	0.15	0.16	0.19
Niño-4	-0.19	-0.18	-0.18
Niño-3.4	-0.11	-0.12	-0.11
Niño-1+2	0.03	0.11	0.13
TNI	**0.26**	**0.28**	**0.29**
PNA	-0.02	-0.06	-0.16
PDO	-0.09	-0.11	-0.20
NAO	-0.07	-0.14	-0.18

[a]The Gulf-to-U.S. meridional moisture transport is obtained by averaging the vertically integrated moisture transport in the region of 25°N - 35°N and 100°W - 90°W. The lower-level (500 hPa – 925 hPa) vertical wind shear is averaged over the region of 30°N – 40°N and 100°W – 80°W. The North Atlantic Oscillation (NAO) index and the Pacific - North American (PNA) pattern are defined as the first and second leading modes of Rotated Empirical Orthogonal Function (REOF) analysis of monthly mean geopotential height at 500 hPa, respectively. The Pacific Decadal Oscillation (PDO) is the leading principal component of monthly SST anomalies in the North Pacific Ocean north of 20°N.

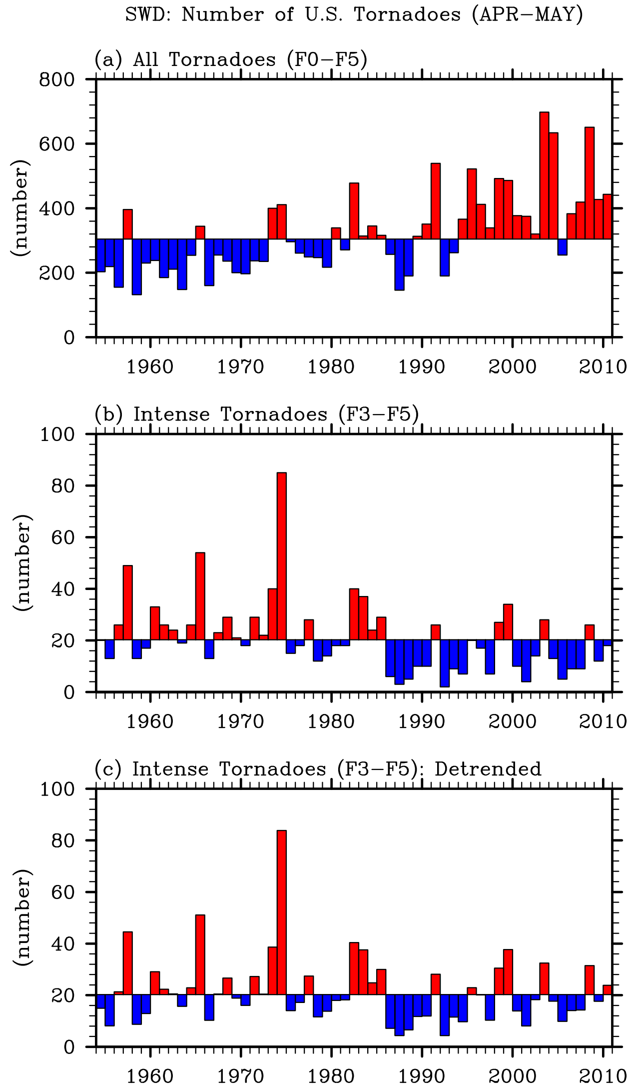

Figure S1. The number of (a) total (F0 – F5) and (b) intense (F3 – F5) US tornadoes for the most active tornado months of April and May (AM) during 1950-2010 obtained from SWD. The detrended number of intense U.S. tornadoes in AM, which is the primary diagnostic index used in this study, is shown in (c).

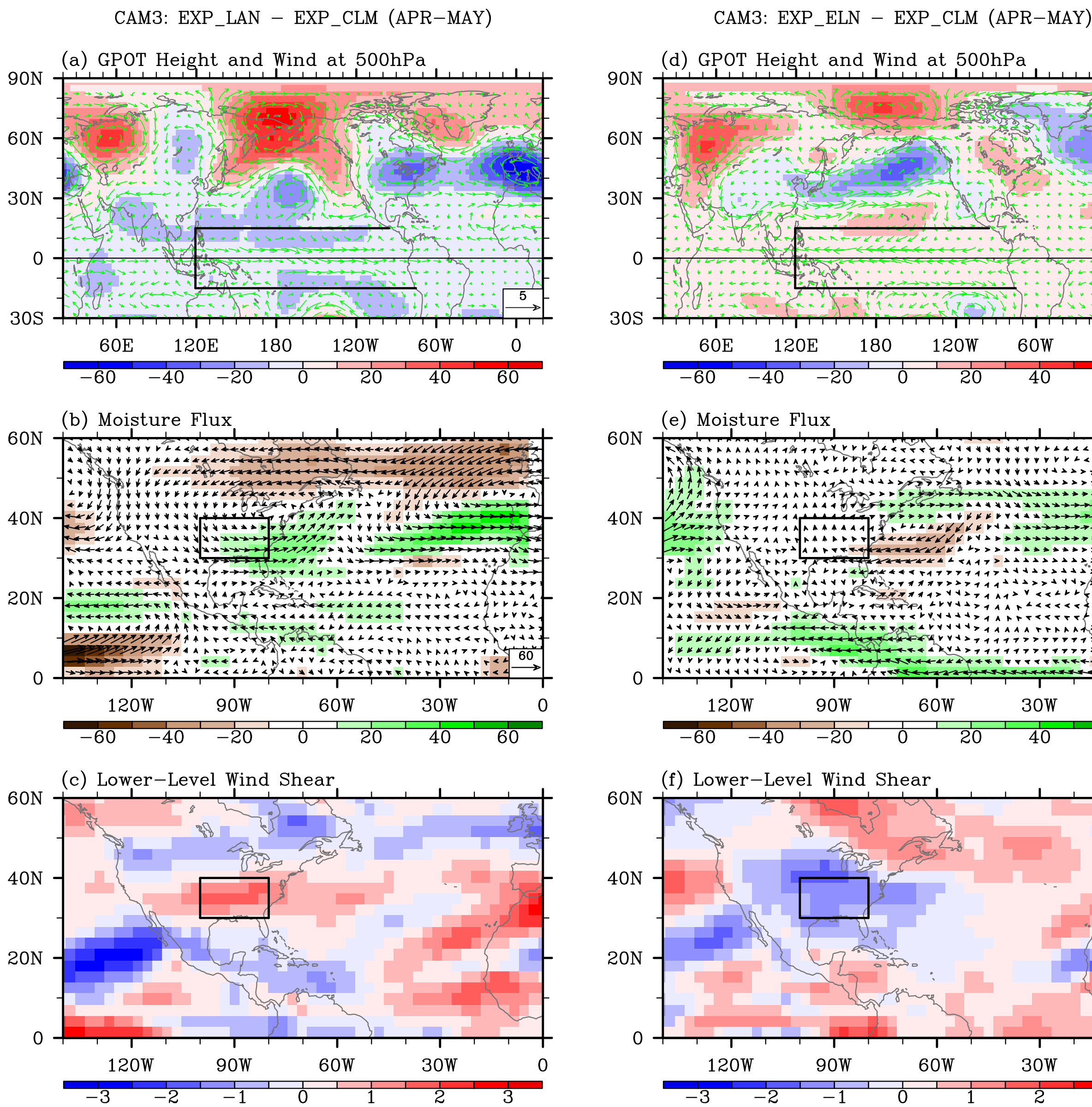

Figure S2. Simulated anomalous geopotential height and wind at 500, moisture transport and (c) lower-level (500 hPa – 925 hPa) vertical wind shear in AM obtained from EXP_LAN – EXP_CLM (a, b and c) and EXP_ELN – EXP_CLM (d, e and f). The unit is kg m^{-1} sec^{-1} for moisture transport, m for geopotential height, and m s^{-1} for wind and wind shear. Thick black lines in (a) and (d) indicate the tropical Pacific region where the model SSTs are prescribed. The small box in (b), (c), (e) and (f) indicates the central and eastern U.S. region frequently affected by intense tornadoes.

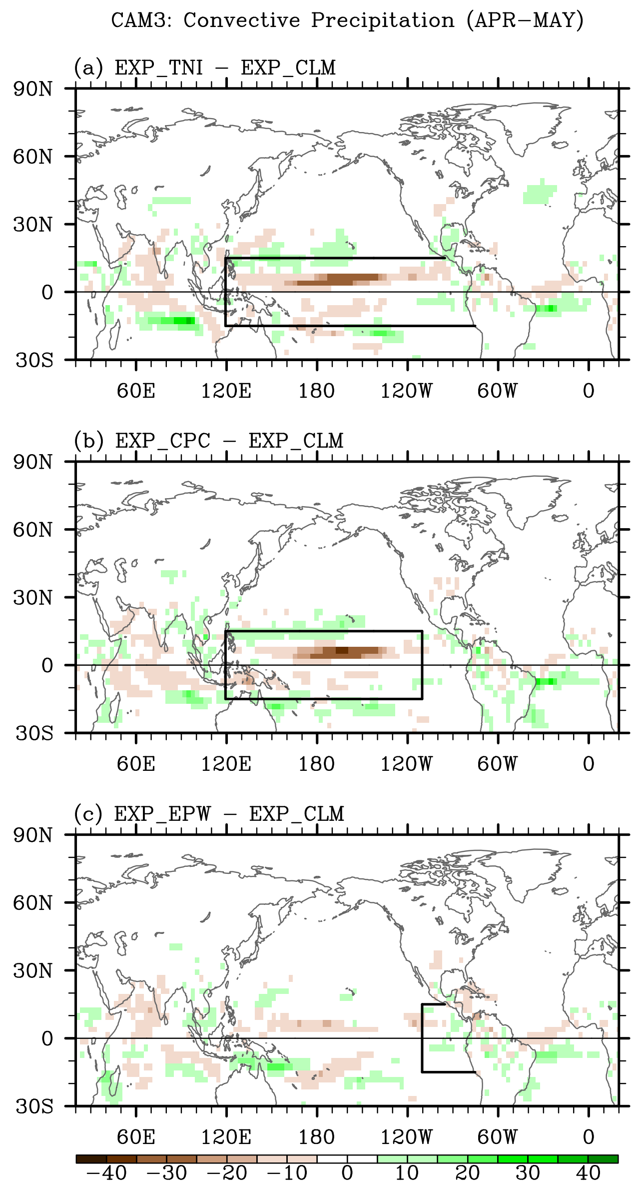

Figure S3. Simulated anomalous convective precipitation rate in AM obtained from (a) EXP_TNI – EXP_CLM, (b) EXP_CPC – EXP_CLM, and (c) EXP_EPW – EXP_CLM. The unit is mm day^{-1}. Thick black lines in (a) - (c) indicate the tropical Pacific region where the model SSTs are prescribed.

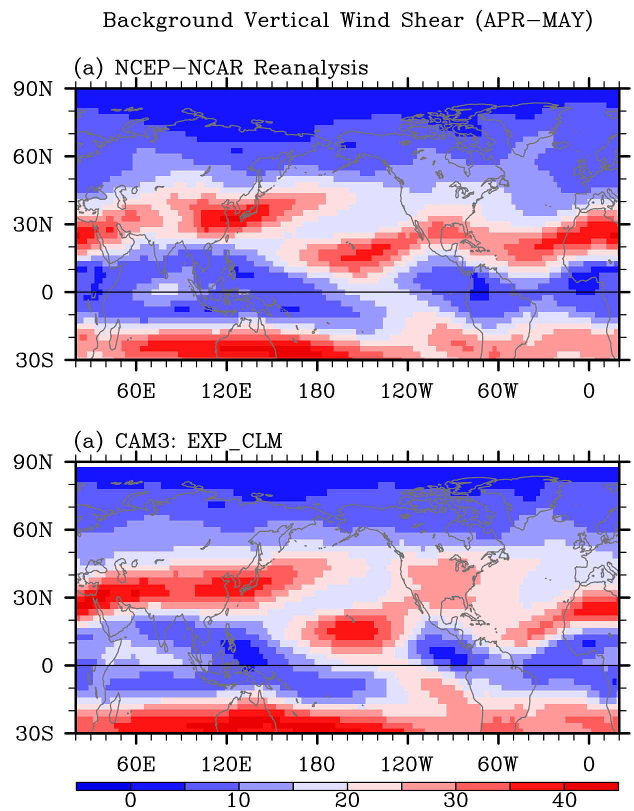

Figure S4. Background (climatological) vertical wind shear between 200 and 850 hPa in AM obtained from (a) NCEP-NCAR reanalysis, and (b) EXP_CLM. The unit is m sec^{-1}.

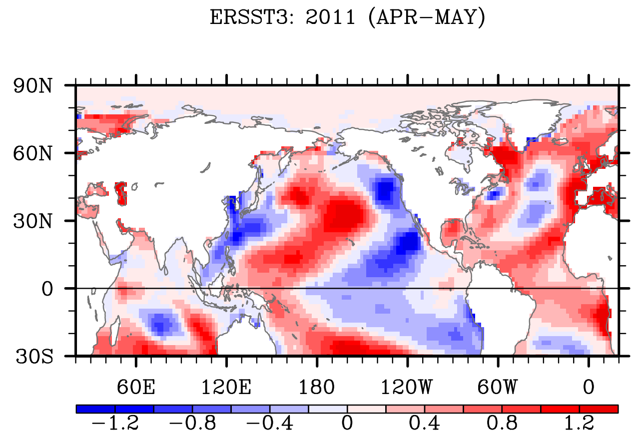

Figure S5. Anomalous SST in AM of 2011 obtained from ERSST3. The unit is °C.

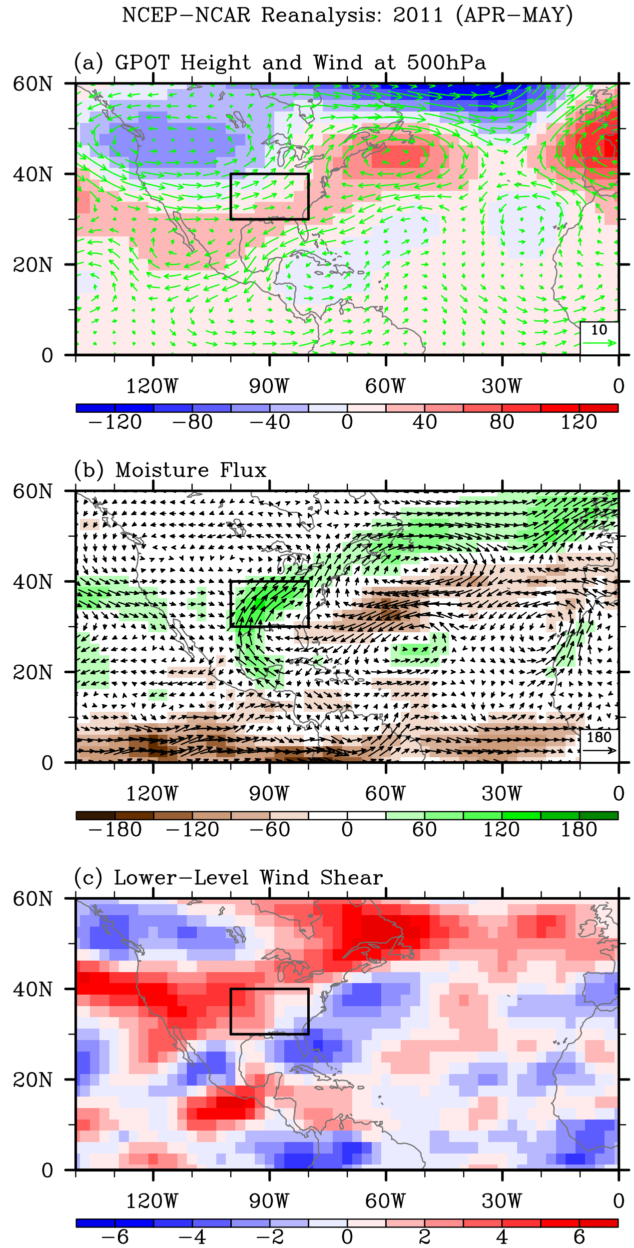

Figure S6. Anomalous (a) geopotential height and wind at 500 hPa, (b) moisture transport and lower-level (500 hPa – 925 hPa) vertical wind shear in AM of 2011. The moisture transport, geopotential height, wind and wind shear are obtained from NCEP-NCAR reanalysis. The unit is kg m^{-1} sec^{-1} for moisture transport, m for geopotential height, and m s^{-1} for wind and wind shear. The small box in (a), (b) and (c) indicates the central and eastern U.S. region frequently affected by intense tornadoes.

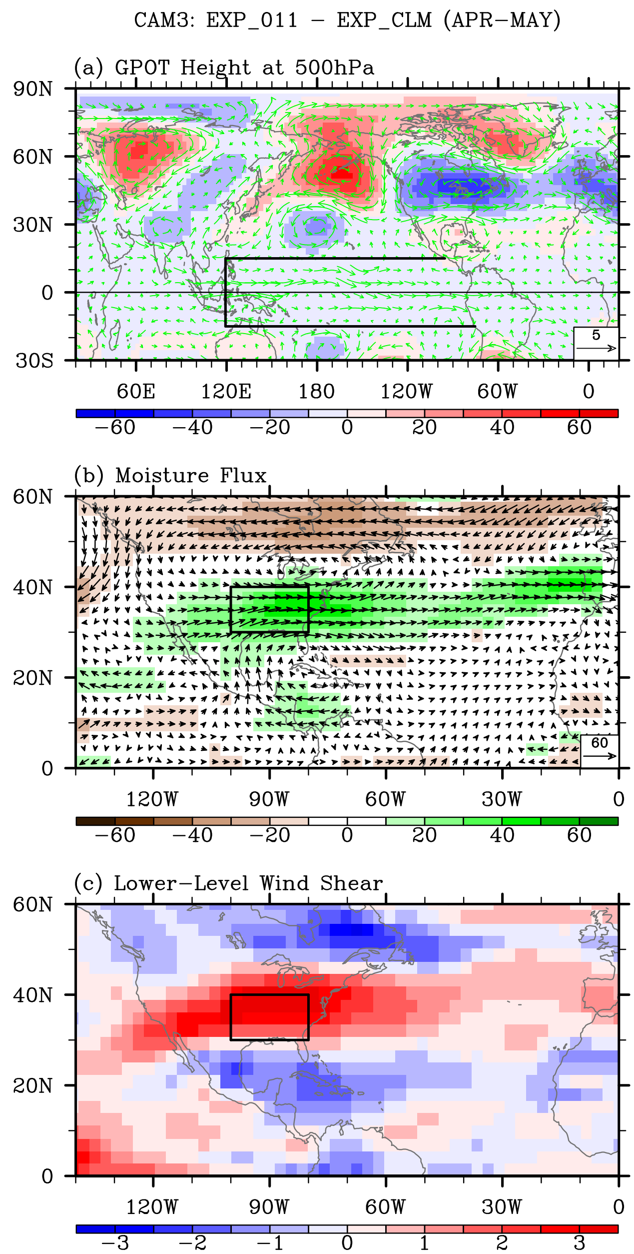

Figure S7. Simulated anomalous (a) geopotential height and wind at 500 hPa, (b) moisture transport and (c) lower-level (500 hPa – 925 hPa) vertical wind shear in AM obtained from EXP_011 – EXP_CLM. The unit is kg m^{-1} sec^{-1} for moisture transport, m for geopotential height, m s^{-1} for wind and wind shear. Thick black lines in (a) indicate the tropical Pacific region where the model SSTs are prescribed. The small box in (b) and (c) indicates the central and eastern U.S. region frequently affected by intense tornadoes.

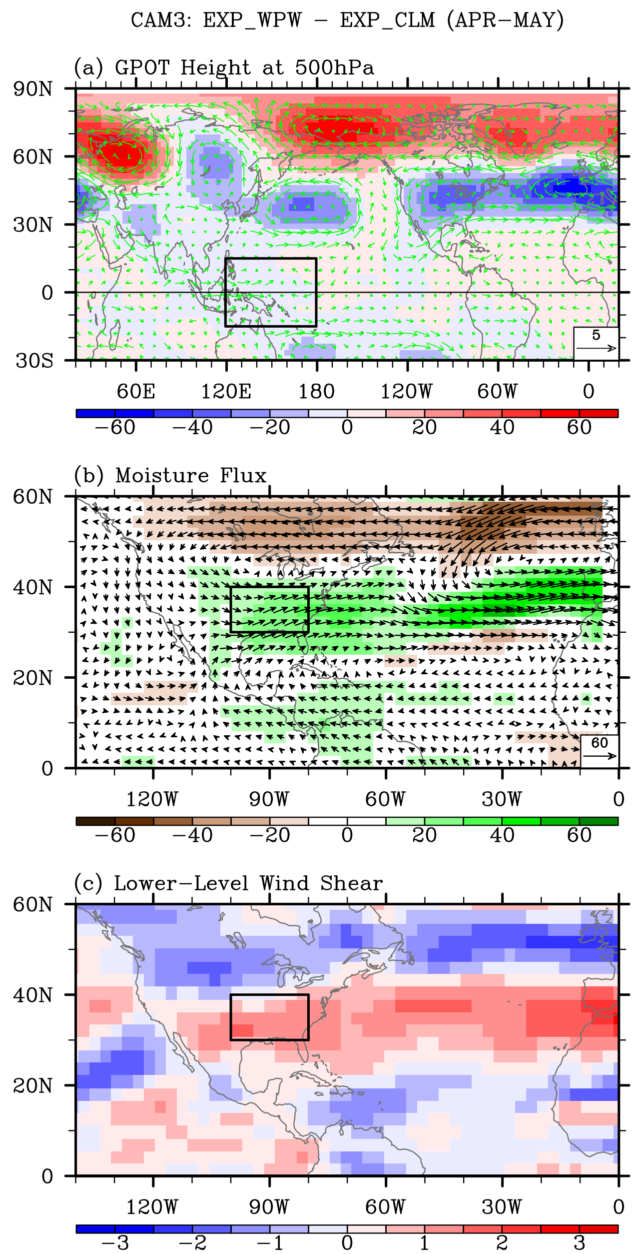

Figure S8. Simulated anomalous (a) geopotential height and wind at 500 hPa, (b) moisture transport and (c) lower-level (500 hPa – 925 hPa) vertical wind shear in AM obtained from EXP_WPW – EXP_CLM. The unit is kg m^{-1} sec^{-1} for moisture transport, m for geopotential height, m s^{-1} for wind and wind shear. Thick black lines in (a) indicate the tropical Pacific region where the model SSTs are prescribed. The small box in (b) and (c) indicates the central and eastern U.S. region frequently affected by intense tornadoes.

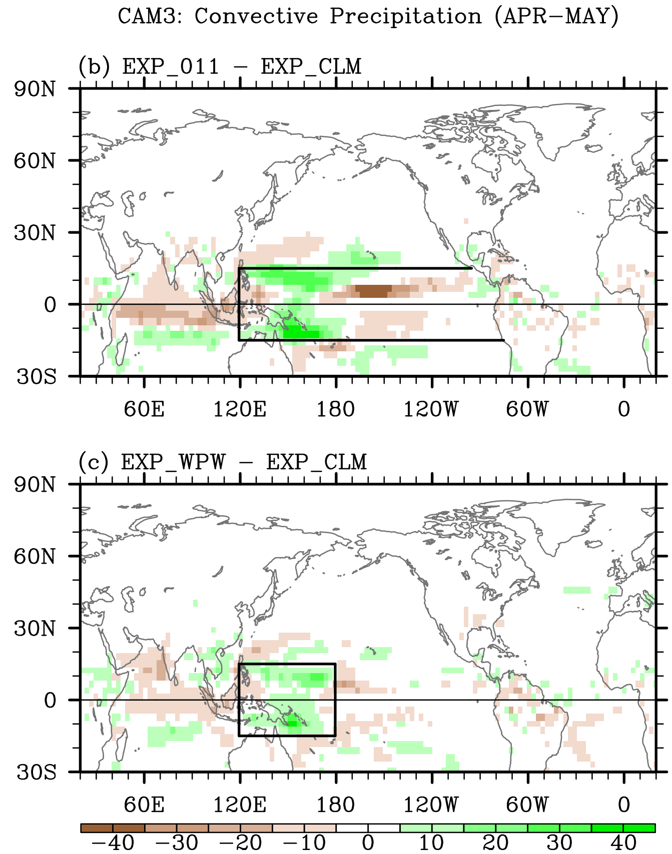

Figure S9. Simulated anomalous convective precipitation rate in AM obtained from (a) EXP_011 – EXP_CLM, and (b) EXP_WPW – EXP_CLM. The unit is mm day^{-1}. Thick black lines in (a) and (b) indicate the tropical Pacific region where the model SSTs are prescribed.

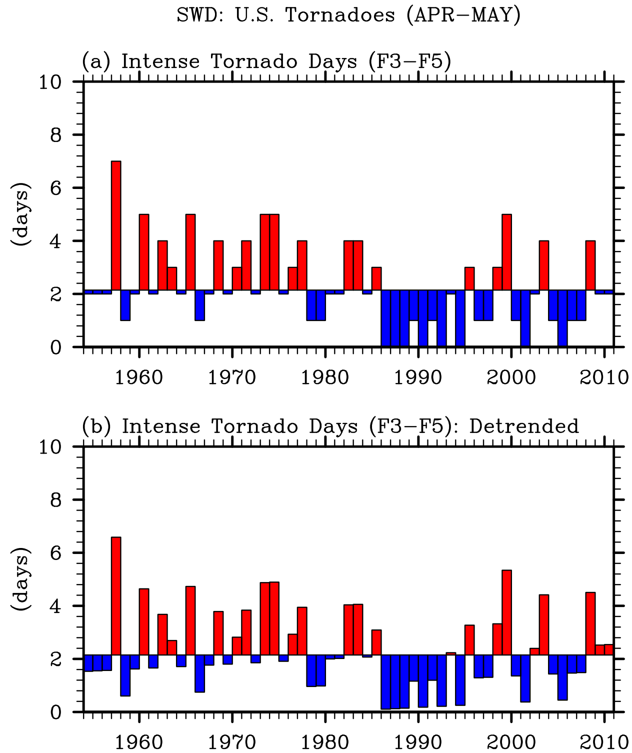

Figure S10. The intense (F3-F5) U.S. tornado-days in AM during 1950-2010 derived from SWD. The intense U.S. tornado-days is obtained by counting the number of days in which more than three intense (F3 and above) tornadoes occurred. The detrended intense U.S. tornado-days in AM is shown in (b).