Supporting Information for【Extratropical intraseasonal signals along the subtropical westerly jet as a window of opportunity for subseasonal prediction over East Asia in boreal summer】

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1. Three Tables, nine Figures, and two equations

Table S1. Description of the S2S models.

	Time range	**Resolution**	**Re-forecast**	**Rfc length**	**Rfc frequency**	**Rfc size**
CMA	Days 0–60	~1° × 1°, L40	Fixed	1994–2014	Daily	4
ECCC	Days 0–32	0.45° × 0.45°, L40	On the fly	1995–2014	Weekly	4
ECMWF	Days 0–46	T639/319 L91	On the fly	1996–2015	2/week	11
ISAC-CNR	Days 0–31	0.8° × 0.56°, L54	Fixed	1981–2010	Every 5 days	5
Meteo-France	Day 0–60	~0.5° × 0.8°, L85	On the fly	1993–2014	4/month	15
NCEP	Days 0–44	~1° × 1°, L64	Fixed	1999–2010	Daily	4

Table S2. ROC contingency table for defining event probabilistic prediction parameters.

Bin number	**Prediction probabilities**	**Observed occurrences**	**Observed non-occurrences**
1	0–P_2 (%)	O_1	NO_1
2	P_2–P_3 (%)	O_2	NO_2
3	P_3–P_4 (%)	O_3	NO_3
......	......	......	......
n	P_n–P_{n+1} (%)	O_n	NO_n
......	......	......	......
N	P_N–100 (%)	O_N	NO_N

In ROC contingency table, n is the number of the n^{th} probability interval or bin n. n goes from 1 to N. Pn is the lower probability limit for bin n; P_{n+1} is upper probability limit for bin n; N is the number of probability intervals or bins. The prediction probabilities are the member sizes in each model that predict the event occurrence in this study.

$$O_n = \sum w_i(O)_i;\ NO_n = \sum w_i(NO)_i$$

where O_n/NO_n is the observed occurred/non-occurred frequency in n^{th} probability interval, i is the samples, and w_i is $\cos\theta_i$, representing the weight coefficient of the i^{th}, in which θ_i is the latitude of i^{th}. O_i is 1 when an event corresponding to a prediction in n^{th} probability interval, is observed as an occurrence, otherwise O_i is 0. NO_i is 1 when an event corresponding to a predicion in n^{th} probability interval, is not observed, otherwise NO_i is 0.

The curve formed by the hit rate (HR) and false alarm rate (FAR) is the ROC curve, in which the HR and FAR are calculated as

$$HR_n = \sum_{i=n}^{N} O_i / \sum_{i=1}^{N} O_i;\ FAR_n = \sum_{i=n}^{N} NO_i / \sum_{i=1}^{N} NO_i$$

Table S3. The years and total sample numbers of EISO-SJ-S and EISO-SJ-W summers before and after removing the ENSO-related summers.

Name	EISO-SJ-S	EISO-SJ-W	Sample numbers for EISO-SJ-S and EISO-SJ-W	EISO-SJ-S⁻	EISO-SJ-W⁻	Sample numbers for EISO-SJ-S⁻ and EISO-SJ-W⁻
ERA-Interim	1986, 1988, 2004, 2005, 2007, 2009, 2011, 2013	1984, 1994, 1995, 1998, 2003, 2008, 2010, 2012, 2018	\	1986, 2005, 2009, 2013	1984, 1994, 1995, 2003, 2012, 2018	\
CMA	2004, 2005, 2007, 2009, 2011, 2013	1994, 1995, 1998, 2008, 2010, 2012	738 (6 year × 123 times year^{-1})	2005, 2009, 2013	1994, 1995, 2012	369 (3 year × 123 times year^{-1})
ECCC	2004, 2005, 2007, 2009, 2011, 2013	1995, 1998, 2003, 2008, 2010, 2012	102 (6 year × 17 times year^{-1})	2005, 2009, 2013	1995, 2003, 2012	51 (3 year × 17 times year^{-1})
ECMWF	2004, 2007, 2009, 2011, 2013	1998, 2003, 2008, 2010, 2012	175 (5 year × 35 times year^{-1})	2009, 2013	2003, 2012	70 (2 year × 35 times year^{-1})
ISAC-CNR	1986, 1988, 2004, 2005, 2007, 2009	1984, 1994, 1995, 1998, 2008, 2010	150 (6 year × 25 times year^{-1})	1986, 2005, 2009	1984, 1994, 1995	75 (3 year × 25 times year^{-1})
Meteo-France	2004, 2005, 2007, 2009, 2011, 2013	1994, 1995, 1998, 2008, 2010, 2012	96 (6 year × 16 times year^{-1})	2005, 2009, 2013	1994, 1995, 2012	48 (3 year × 16 times year^{-1})
NCEP	2004, 2007, 2009	2003, 2008, 2010	369 (3 year × 123 times year^{-1})	2009	2003	123 (1 year × 123 times year^{-1})

*EISO-SJ-S⁻ and EISO-SJ-W⁻ are the strong and weak EISO-SJ intensity summers, respectively, without the ENSO-related summers. Green shading years show the ENSO-related summers, which are defined as the absolute values of the boreal summer averaged Oceanic Niño Index (ONI) index are larger than 0.5. ONI index is obtained via https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php.

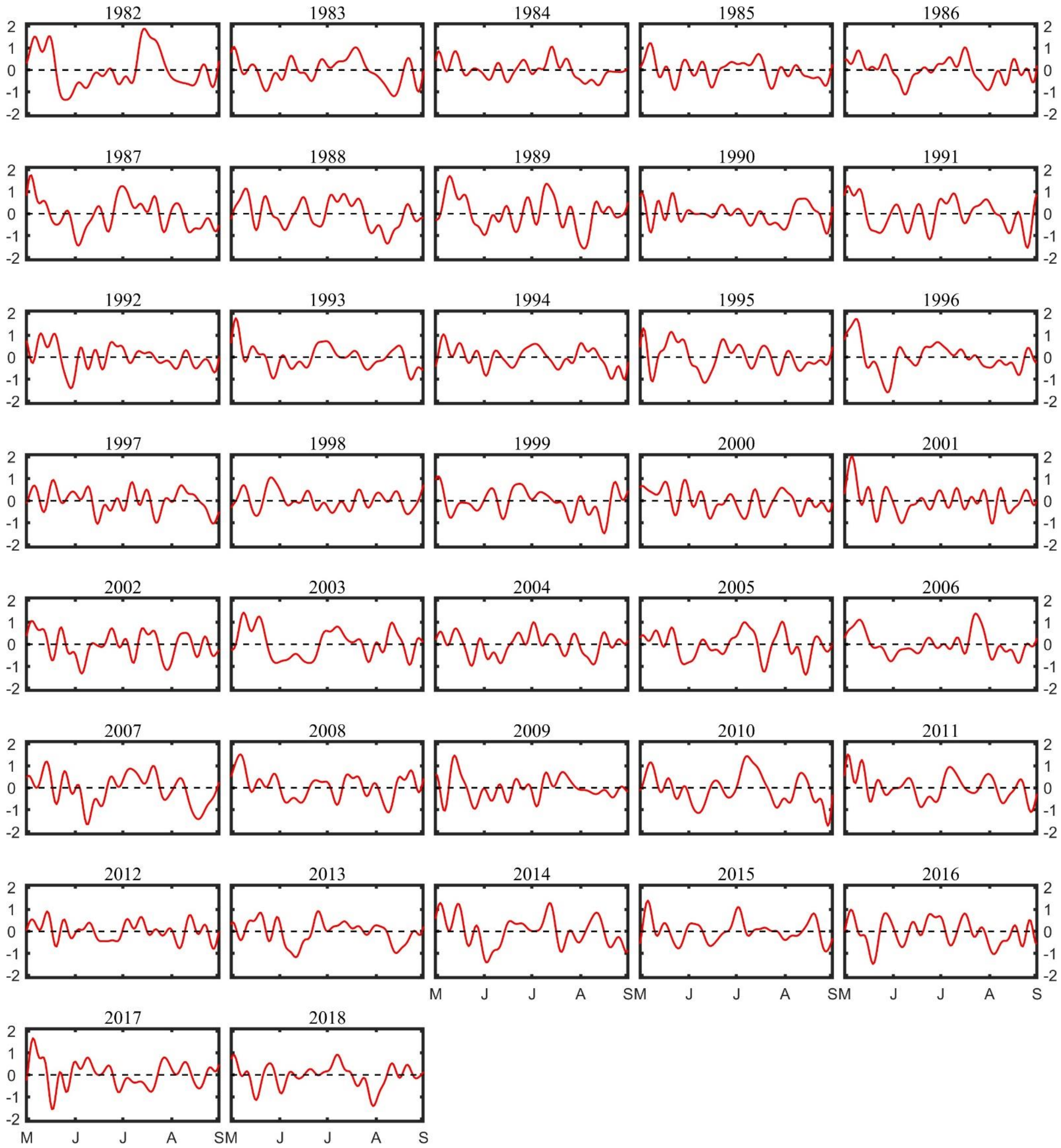

FIG. S1. Time series of the intraseasonal SJ index during each boreal summer (MJJA) of the 37 years.

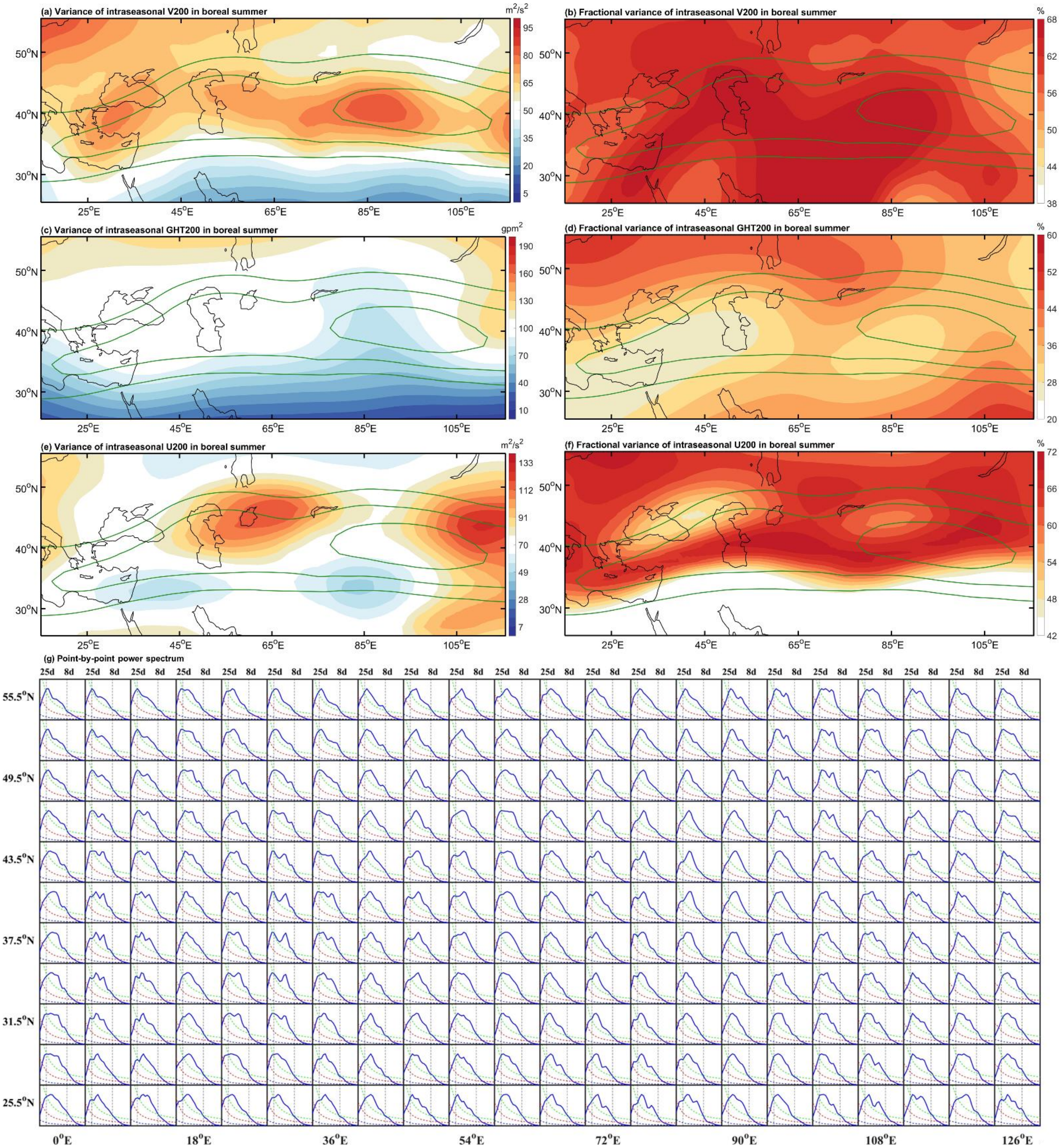

FIG. S2. (a) Variance (shading; unit: $m^2\,s^{-2}$) and **(b)** fractional variance (shading; unit: %) of intraseasonal V200 against total V200 variance in boreal summer. Green lines are the summer–mean U200 contour of 18, 23 and 28 m s^{-1}, which broadly denote the SJ's location. **(c, d)**/**(e, f)** As in **(a, b),** but for GHT200/U200. **(g)** The point-by-point power spectrum of intraseasonal V200 over the SJ region. The red dashed line denotes the Markov red noise spectrum, and the blue/green dashed line represents the a priori/a posteriori 99% confidence. The grid point is chosen at intervals of 4.5 degrees of longitude and 3.0 degrees of latitude.

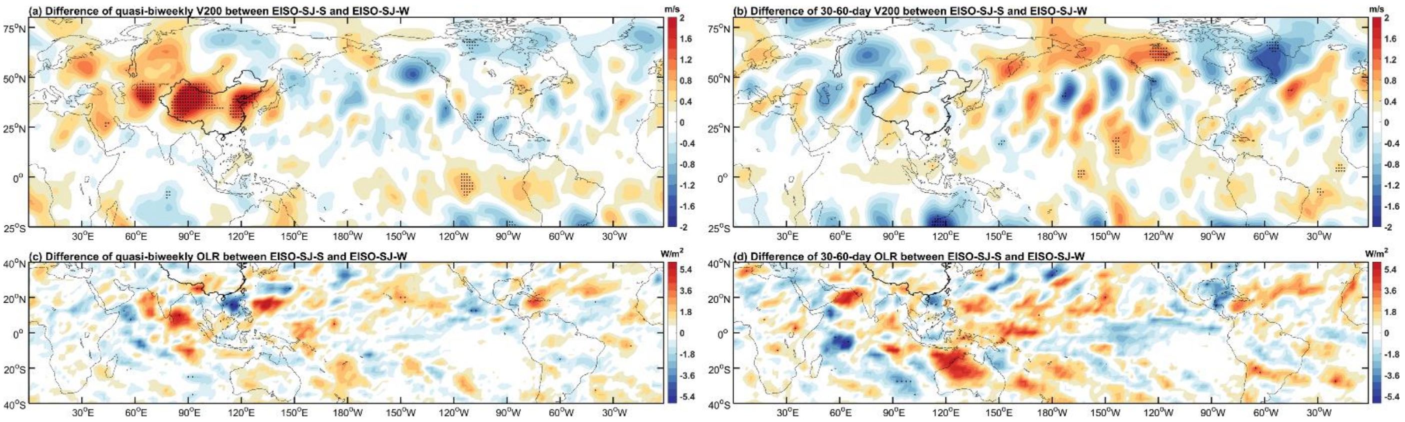

FIG. S3. Differences in composite **(a)** quasi-biweekly and **(b)** 30–60-day V200 intensity (shading; unit: m s^{-1}) between EISO-SJ-S and EISO-SJ-W summers. **(c, d)** As in **(a, b),** but for OLR (shading; unit: W m^{-2}). Black dots show the results above the 95% confidence level.

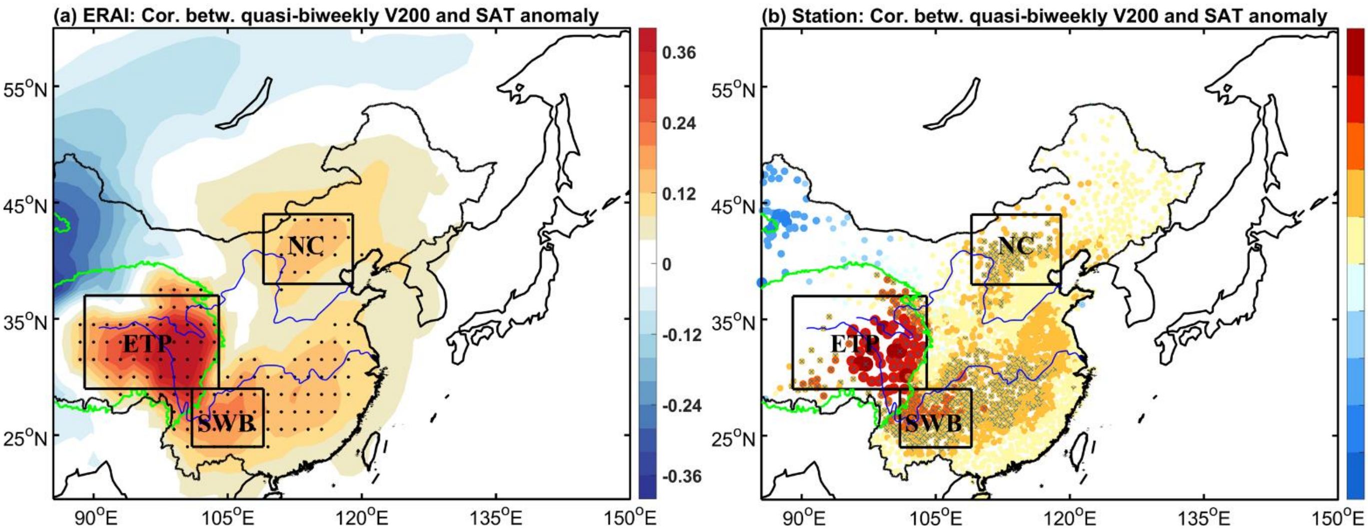

FIG. S4. Correlation coefficients (shading) between the quasi-biweekly V200 and anomalous SAT obtained from the **(a)** ERA Interim (ERAI) and **(b)** 2479-gauge stations. Black dots in **(a)** and blue "x" in **(b)** show the results above the 90% confidence level.

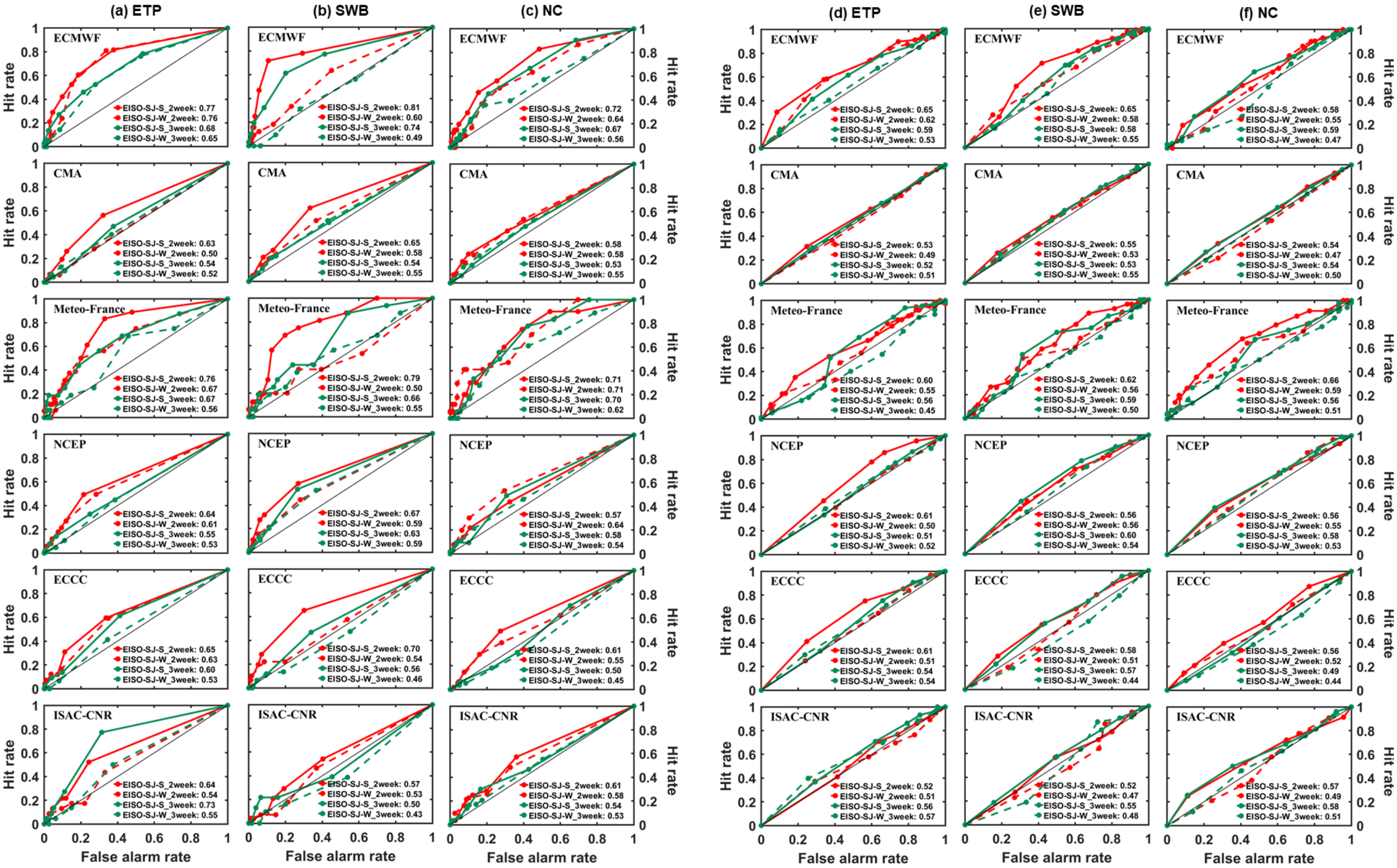

FIG. S5. Relative operating characteristics (ROC) curve for predicting below-normal SAT events over the **(a)** ETP, **(b)** SWB and **(c)** NC from S2S models with two- and three-week lead times for EISO-SJ-S (EISO-SJ-W) group. **(d–f)** As in **(a–c)**, but for normal SAT events. Here the below-normal SAT events are defined as the weekly SAT anomaly of <–1 °C, and the normal SAT event is the weekly SAT anomaly between –1 °C and 1 °C.

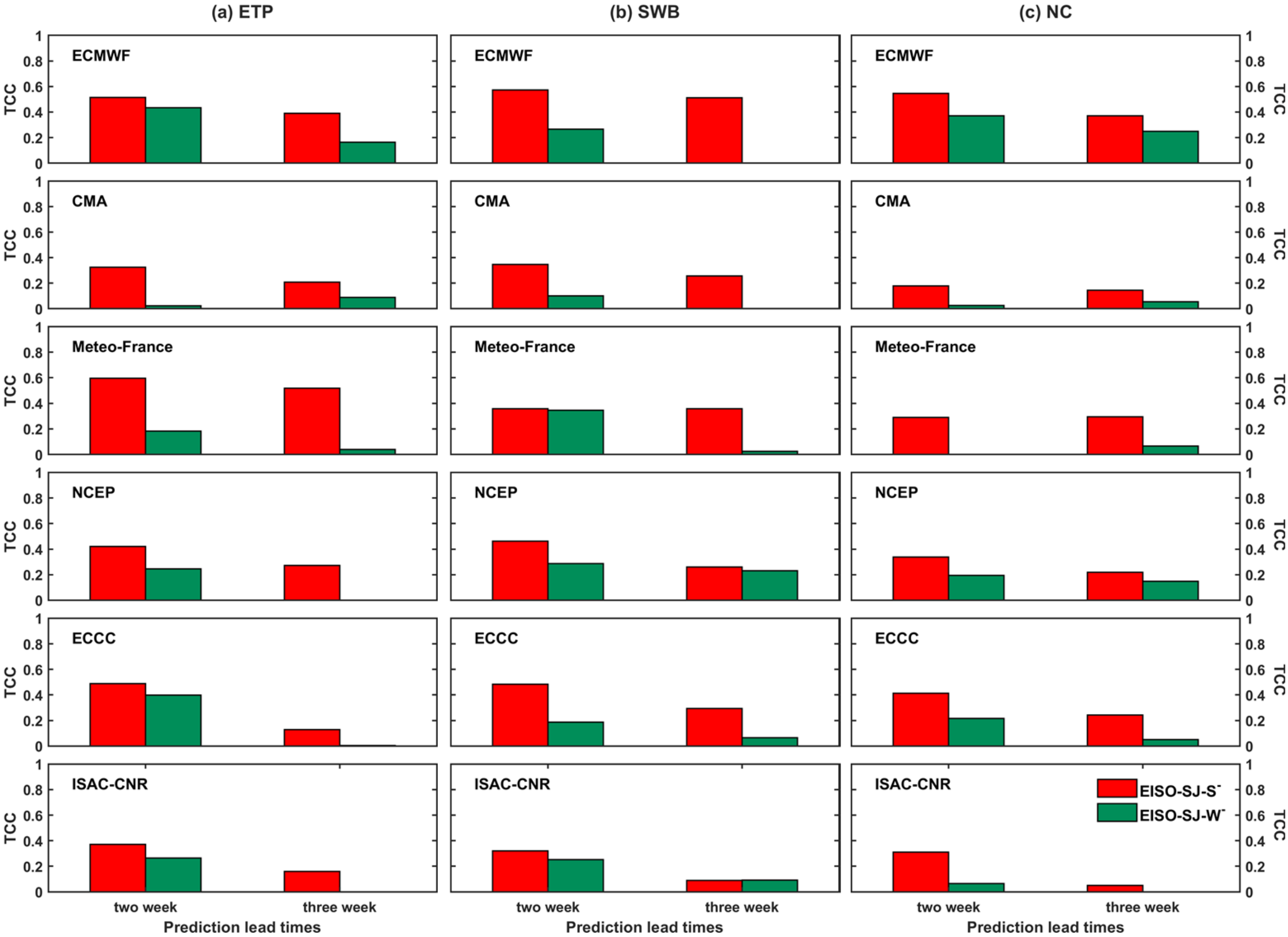

FIG. S6. Temporal correlation coefficient (TCC) between the observed weekly SAT anomaly and the predicted ensemble-mean weekly SAT anomaly over the **(a)** ETP, **(b)** SWB, and **(c)** NC with two- and three-week lead times. The red (green) bars show the TCC for EISO-SJ-S$^-$ (EISO-SJ-W$^-$) group. EISO-SJ-S$^-$ and EISO-SJ-W$^-$ groups are the prediction results in strong and weak EISO-SJ intensity summers, respectively, without the ENSO-related summers.

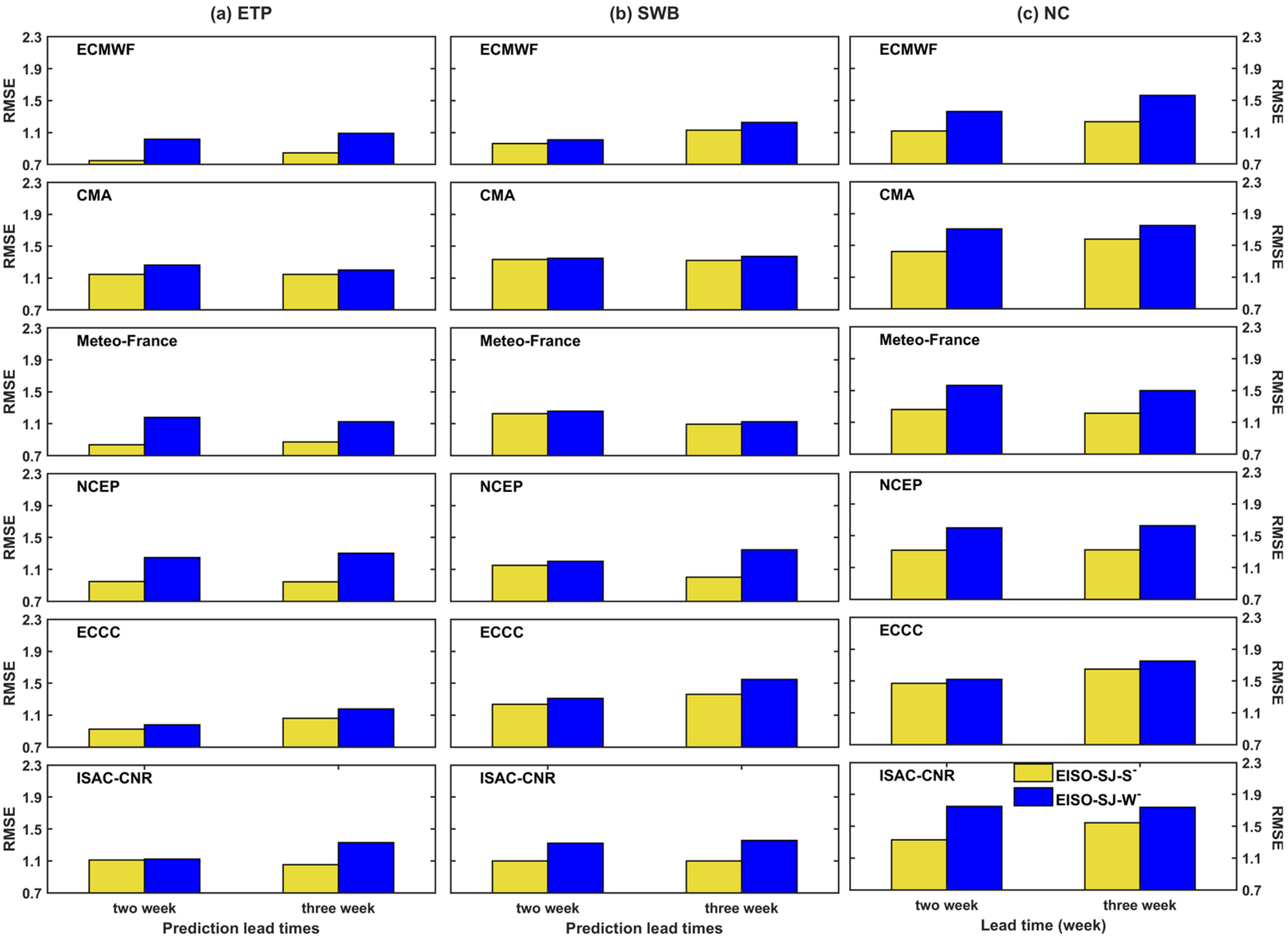

FIG. S7. Root Mean Square Error (RMSE) between the observed weekly SAT anomaly and the predicted ensemble-mean weekly SAT anomaly over the **(a)** ETP, **(b)** SWB, and **(c)** NC with two- and three-week lead times. The yellow (blue) bars show the RMSE for EISO-SJ-S⁻ (EISO-SJ-W⁻) group. EISO-SJ-S⁻ and EISO-SJ-W⁻ groups are the prediction results in strong and weak EISO-SJ intensity summers, respectively, without the ENSO-related summers.

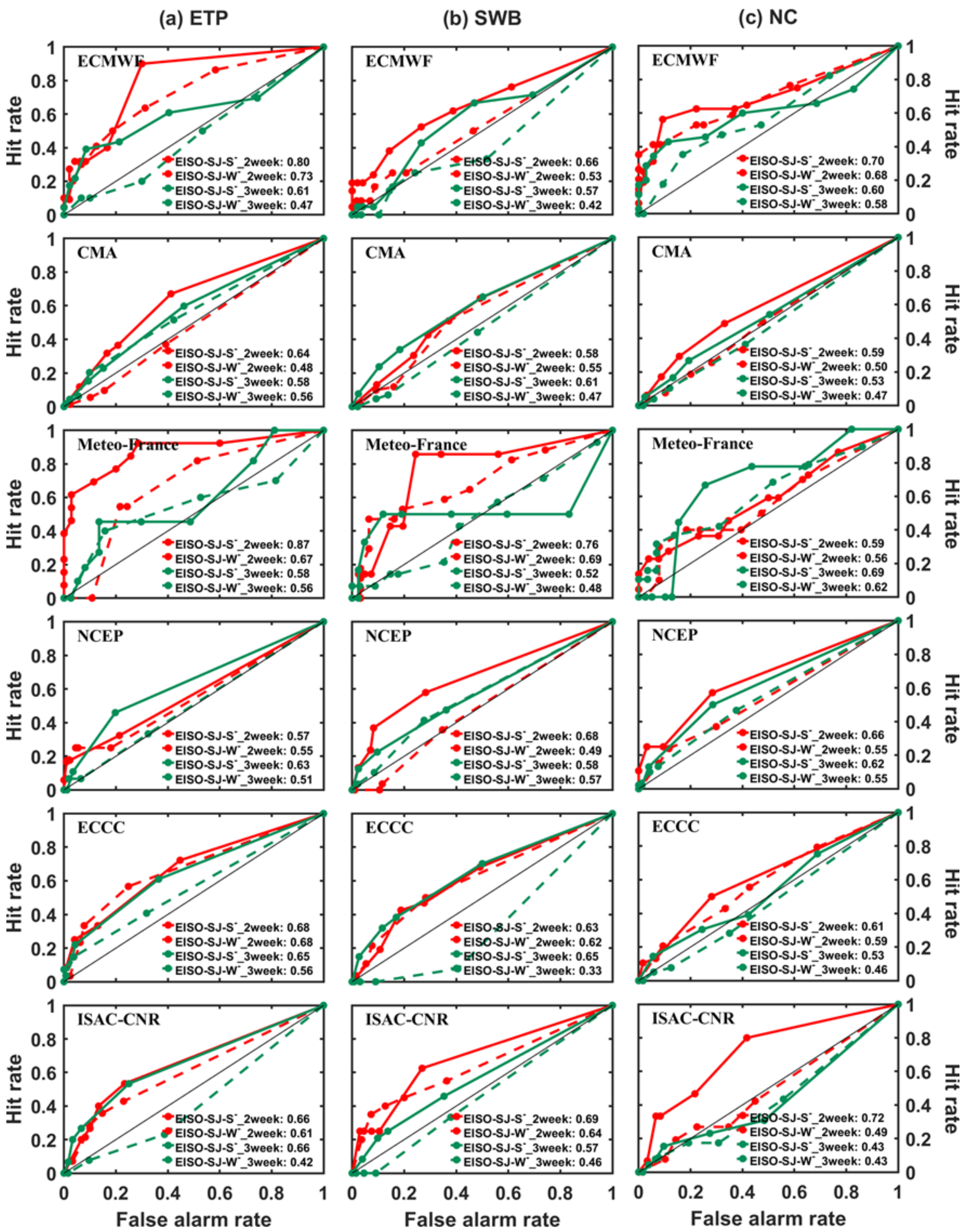

FIG. S8. ROC curve for predicting above-normal SAT events over the **(a)** ETP, **(b)** SWB, and **(c)** NC from the six S2S models with two- and three-week lead times for EISO-SJ-S^{-} (EISO-SJ-W^{-}) group. EISO-SJ-S^{-} and EISO-SJ-W^{-} groups are the prediction results in strong and weak EISO-SJ intensity summers, respectively, without the ENSO-related summers.

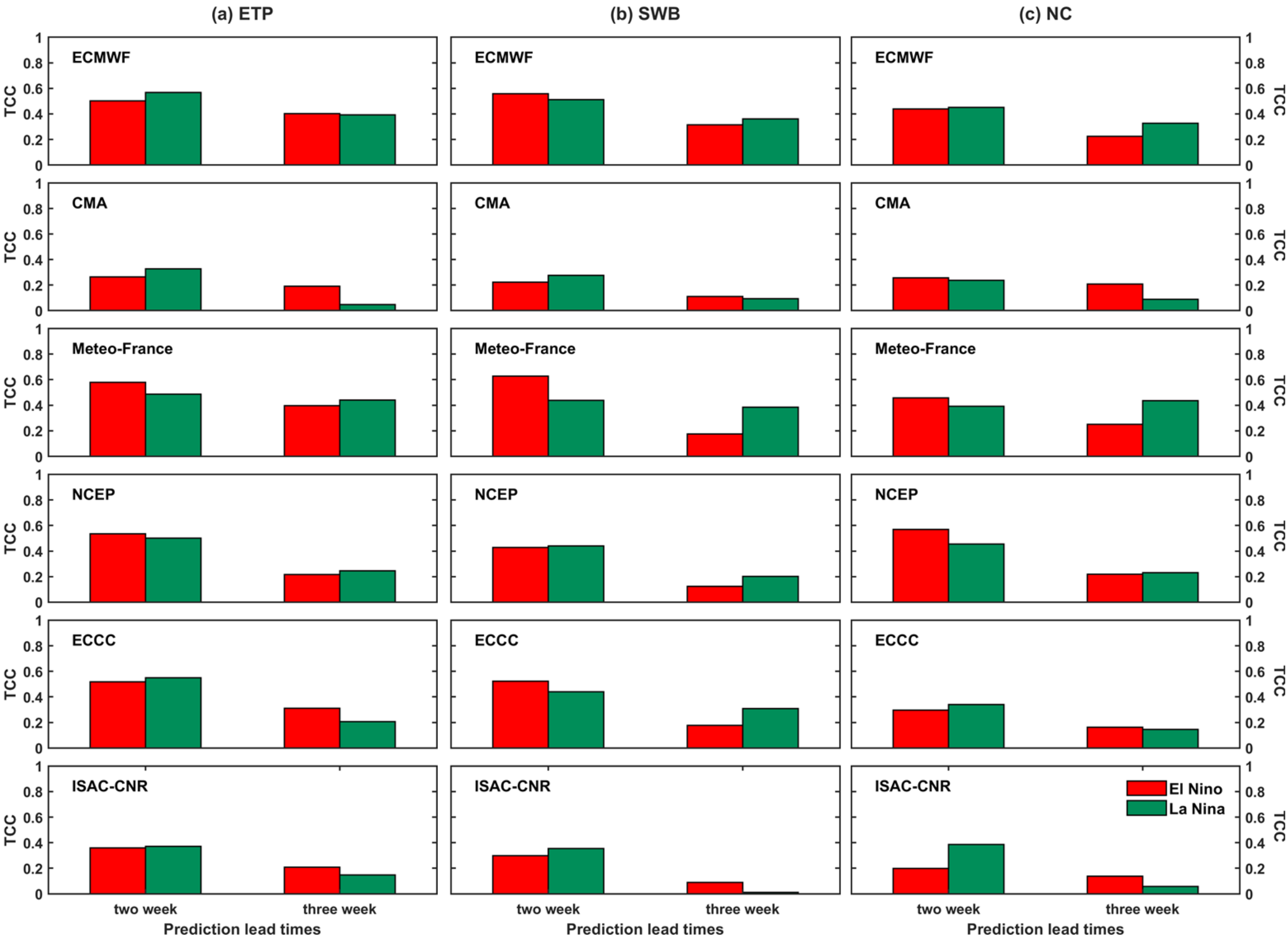

FIG. S9. As in **FIG. S6**, but for the TCC for El Niño-related (red bars) and La Niña-related (green bars) summers.

$$TCC = \frac{\sum_{i=1}^{N}(x_i \times f_i)}{\sqrt{\sum_{i=1}^{N} {x_i}^2}\sqrt{\sum_{i=1}^{N} {f_i}^2}} \tag{S1}$$

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - f_i)^2} \tag{S2}$$

where N, x_i and f_i are the sample numbers, observed and predicted ensemble-mean weekly anomaly (SAT & precipitation), respectively.