

Seasonality of interbasin SST contributions to Atlantic tropical cyclone activity

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Introduction

This supporting information contains Text S1, Figures S1-S4 and Tables S1-S2. Text S1 gives a more thorough description of the relative operating characteristic (ROC) and score (ROCS). Figure S1 shows for comparison the standardized ACE for both JJA and SON. Figure S2 shows the mean 1982-2009 June-November variance for MDR and Niño 3, as well as their relative variance. Figure S3 shows the 1982-2009 JJA standardized MDR SSTAs, Niño 3 SSTAs and interbasin SST indexes from the ERSSTv5 reanalysis and the NMME superensemble mean, while Figure S4 shows the same for SON. Table S1 shows the NMME models included in the study and Table S2 shows the results of the leave-one-out cross validation discussed in section 5. Table S3 shows the deterministic and probabilistic skill scores for the 1982-2009 JJA and SON interbasin SST indices using NMME SST predictors.

Text S1.

The ROC curve is a graphical representation of a forecast's ability to differentiate between two outcomes i.e., events and non-events. A useful forecast would have high hit rates and low false alarm rates, such that the ROC curve lies very close to the top-left corner. An unskilled forecast would lie on or below the grey diagonal of the ROC curve, signifying that false alarm rates occur as often or more often than hit rates, limiting any potential effectiveness. The points on the curve correspond to the number of ensemble members forecasting the event. The ROC score is the area under the ROC curve normalized between -1 and 1, where an area of 1 indicates the forecast can always distinguish between events and non-events. The ranked probabilistic skill score (RPSS) of the combined above-, near- and below-average ACE forecasts is a comparison of the probabilistic forecast of the three categories to climatology, where 1 is a perfect score and a value larger (smaller) than 0 indicates skill better (worse) than climatology.

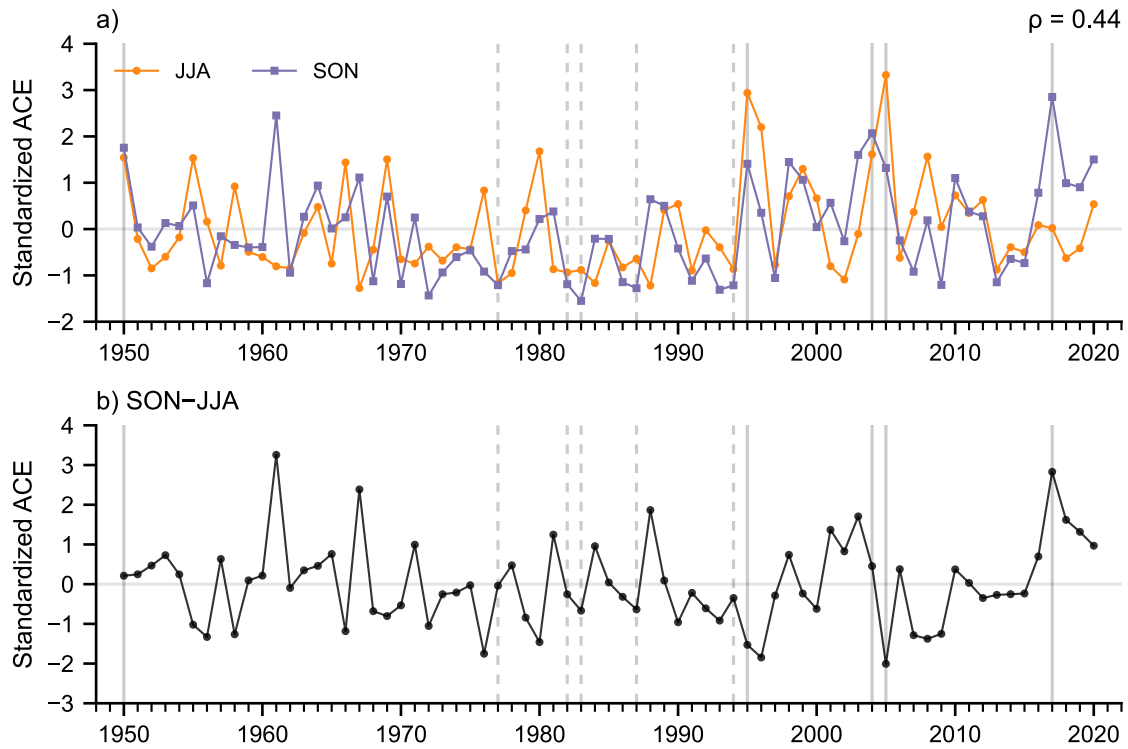


Figure S1. a) Standardized ACE during JJA (orange) and SON (purple) for the 71 year period of 1950-2020. The JJA and SON standardized ACE time series have a positive correlation of 0.44, given at top right. The five least active years are shown by the dotted vertical lines, while the five most active years are shown by the solid vertical lines. b) Difference in standardized ACE from JJA to SON during 1950-2020, with the five least active years shown by the dotted vertical lines and the five most active years shown by the solid vertical lines. Note that even in active hurricane seasons (e.g., 2005 and 2017) the proportion of ACE in JJA and SON varies.

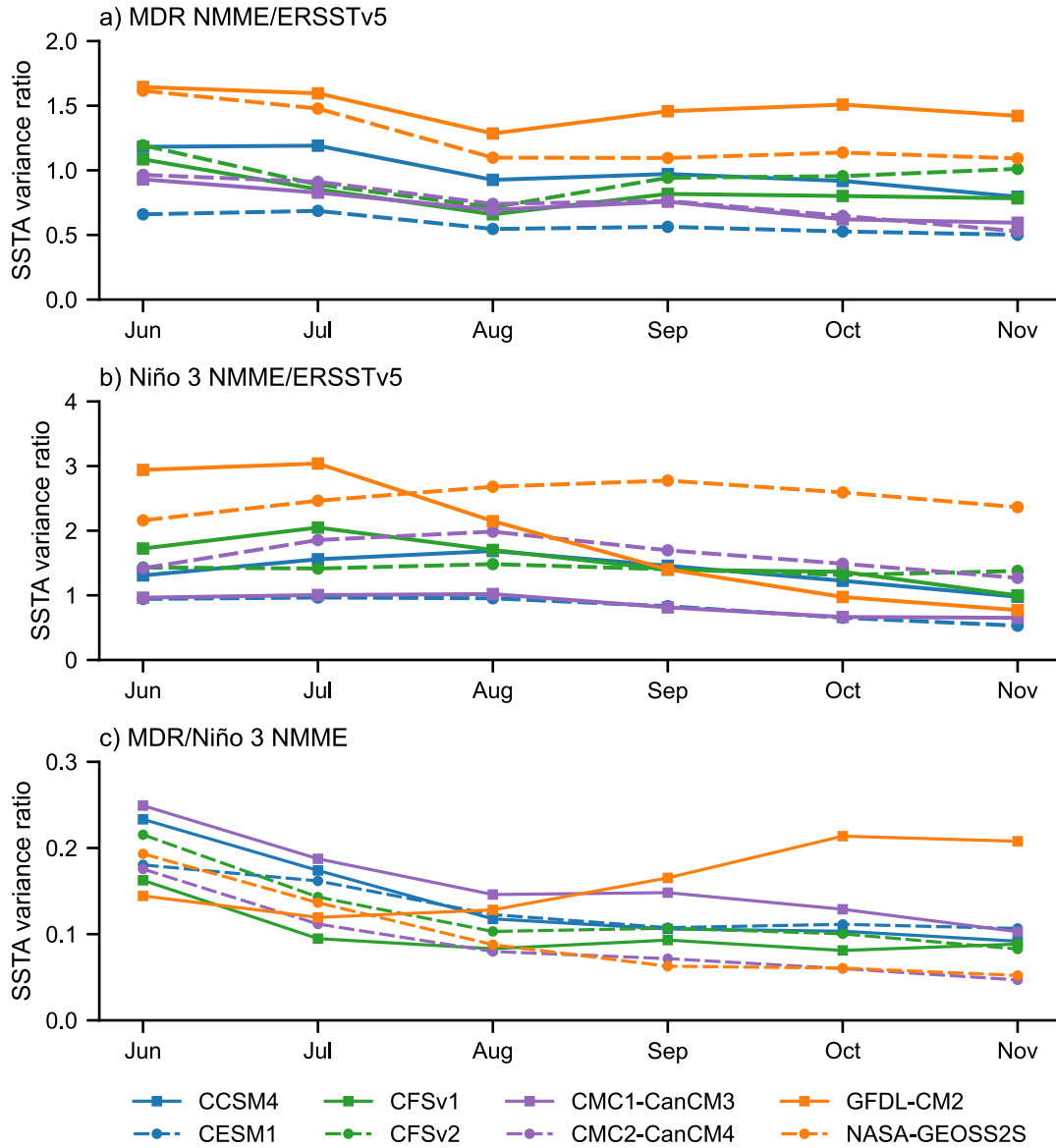


Figure S2. Mean 1982-2009 June-November monthly SSTA variance ratio of NMME model members and ERSSTv5 over the area-averaged a) MDR and b) Niño 3 domains. The NMME model member variance is the mean variance of the respective model ensemble members. c) The ratio of the mean 1982-2009 June-November NMME model member monthly variance between the area-averaged MDR and Niño 3 domains.

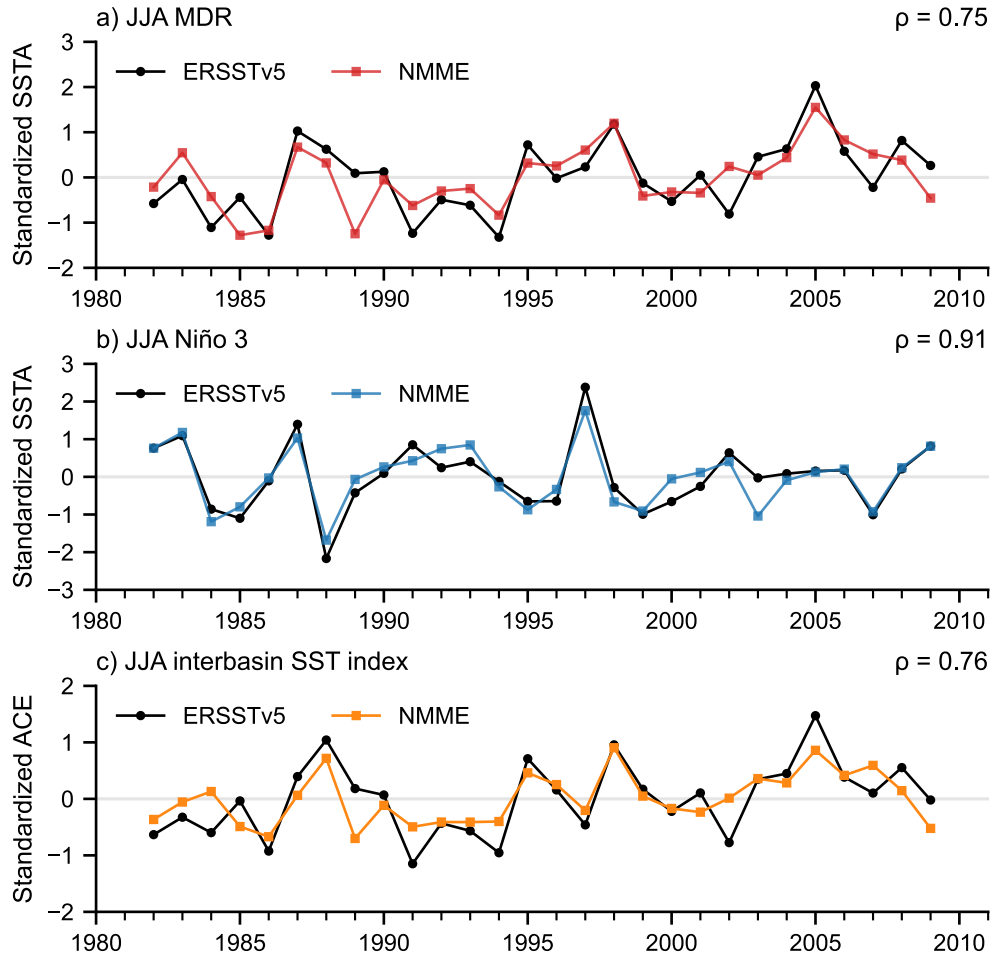


Figure S3. 1982-2009 JJA standardized SSTAs from the ERSSTv5 reanalysis and the NMME superensemble mean for the a) MDR and b) Niño 3 regions. The respective correlation coefficient of the observed and modeled standardized SSTAs is given at top right. c) The 1982-2009 JJA interbasin SST index using ERSSTv5 and NMME superensemble mean SST predictors, where the observed and modeled standardized ACE $\rho = 0.76$.

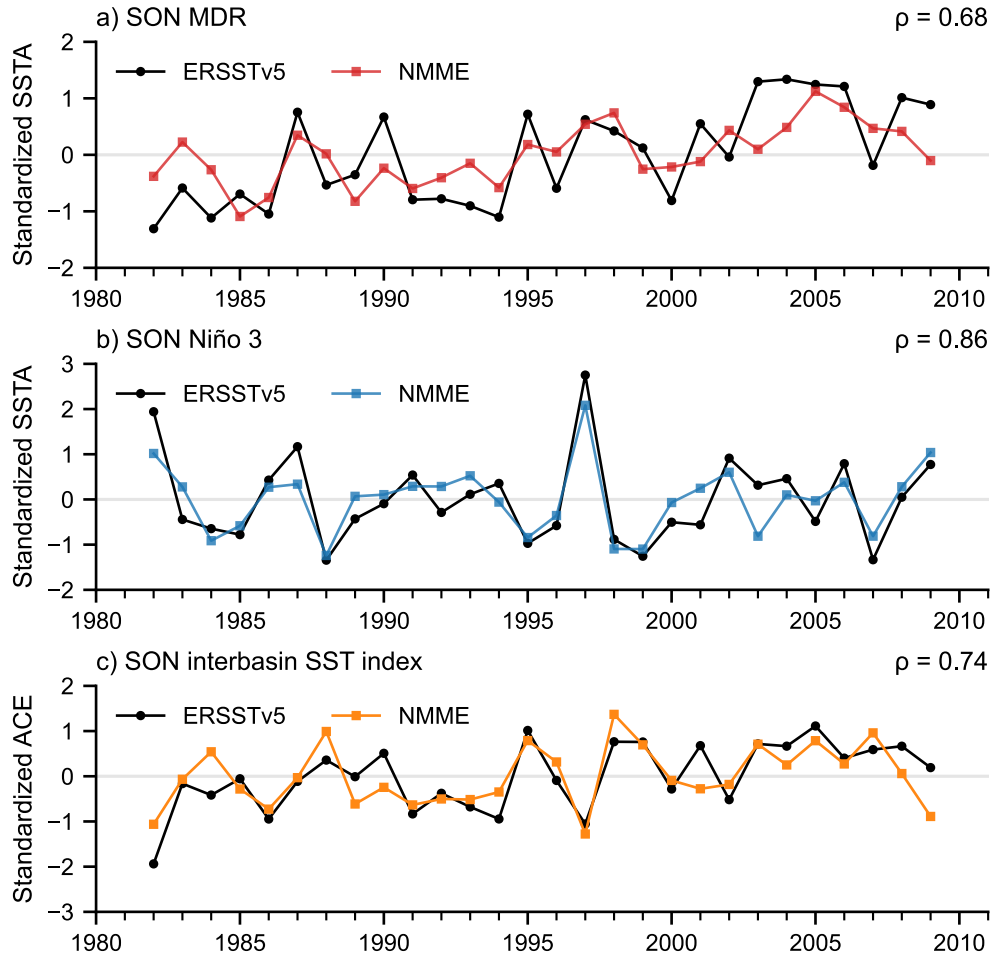


Figure S4. 1982-2009 SON standardized SSTAs from the ERSSTv5 reanalysis and the NMME superensemble mean for the a) MDR and b) Niño 3 regions. The respective correlation coefficient of the observed and modeled standardized SSTAs is given at top right. c) The 1982-2009 SON interbasin SST index using ERSSTv5 and NMME superensemble mean SST predictors, where the observed and modeled standardized ACE $\rho = 0.74$.

Model	Ensemble Members
CCSM4	10
CESM1	10
CFSv1	15
CFSv2	24
CMC1-CanCM3	10
CMC2-CanCM4	10
GFDL-CM2	10
NASA-GEOSS2S	4

Table S1. Models included in the study as part of the North American Multi-Model Ensemble (NMME). For more information on the models that comprise the NMME, see Kirtman et al. (2014). NMME model data was obtained from <https://iridl.ldeo.columbia.edu/SOURCES/.Models/.NMME/>.

	MDR	Niño 3	Interbasin
JJA	0.934 (0.735)	1.021 (0.815)	0.937 (0.725)
SON	0.954 (0.772)	0.960 (0.773)	0.846 (0.664)

Table S2. Results of a leave-one-out cross validation scheme to assess the predictive skill of the interbasin SST index. The root mean square error (RMSE) and mean absolute error (MAE, given in parenthesis) are computed during JJA and SON using only the MDR as a predictor, using only Niño 3 as a predictor and using both MDR and Niño 3 as predictors (interbasin).

Model	Season	Anom. Corr.	RMSE _{sat}	RPSS	ROCS _{below}	ROCS _{above}
CCSM4	JJA	0.483	0.790	-0.339	0.346	0.385
	SON	0.667	0.642	0.426	0.699	0.606
CESM1	JJA	0.390	0.862	-0.142	0.106	0.381
	SON	0.704	0.618	0.277	0.817	0.679
CFSv1	JJA	0.468	0.813	-0.047	0.373	0.505
	SON	0.636	0.694	0.407	0.871	0.594
CFSv2	JJA	0.500	0.816	-0.072	0.386	0.547
	SON	0.456	0.866	0.111	0.527	0.426
CMC1-CanCM3	JJA	0.443	0.830	-0.268	0.072	0.469
	SON	0.570	0.743	0.094	0.548	0.440
CMC2-CanCM4	JJA	0.480	0.792	-0.212	0.261	0.500
	SON	0.711	0.590	0.421	0.864	0.664
GFDL-CM2	JJA	0.489	0.798	-0.102	0.367	0.487
	SON	0.648	0.707	0.109	0.462	0.566
NASA-GEOSS2S	JJA	0.799	0.618	-0.144	0.152	0.463
	SON	0.859	0.493	0.321	0.519	0.636
NMME	JJA	0.515	0.788	-0.186	0.234	0.479
	SON	0.710	0.630	0.430	0.864	0.624

Table S3: Deterministic (anomaly correlation, saturation RMSE) and probabilistic (RPSS, ROCS) skill scores for the interbasin SST index using NMME model member SST as predictors in forecasting observed ACE during 1982-2009 JJA, SON. Bold RPSS values indicate scores that outperform climatology (RPSS > 0). Bold below- and above-normal ROCS values indicate forecasts that generally discriminate skillfully between categorical events (ROCS > 0.5).