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Supplemental Material

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Tropical Cyclones in the GEOS-S2S-2 Subseasonal Forecasts

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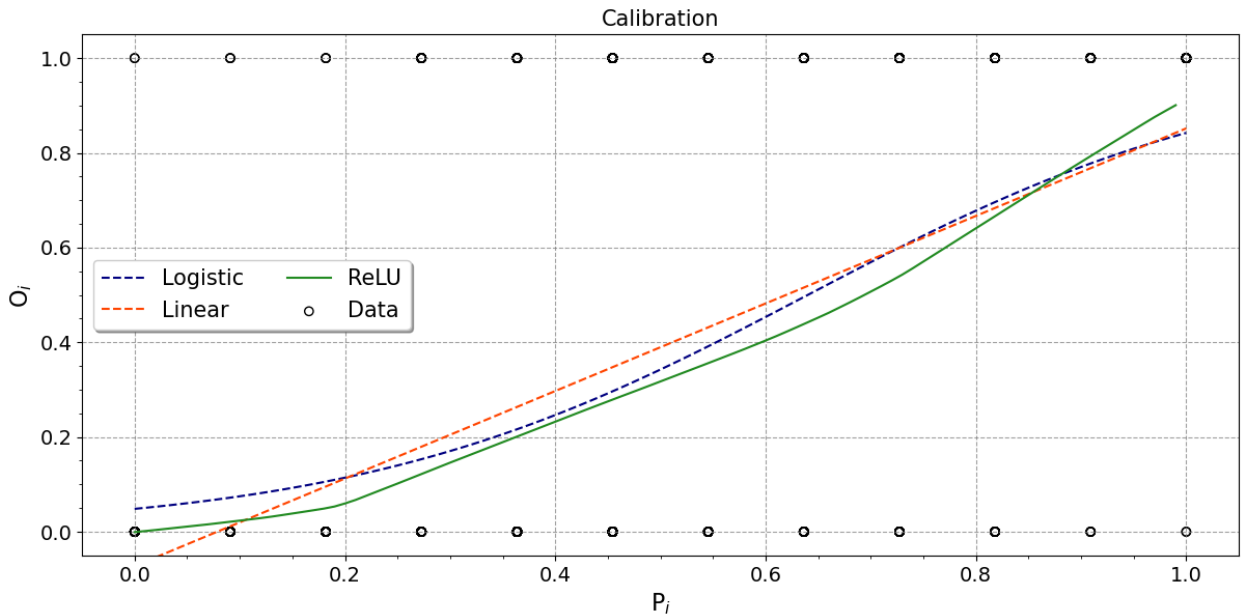
1 **Tropical cyclones in the GEOS-S2S-2 subseasonal forecasts**

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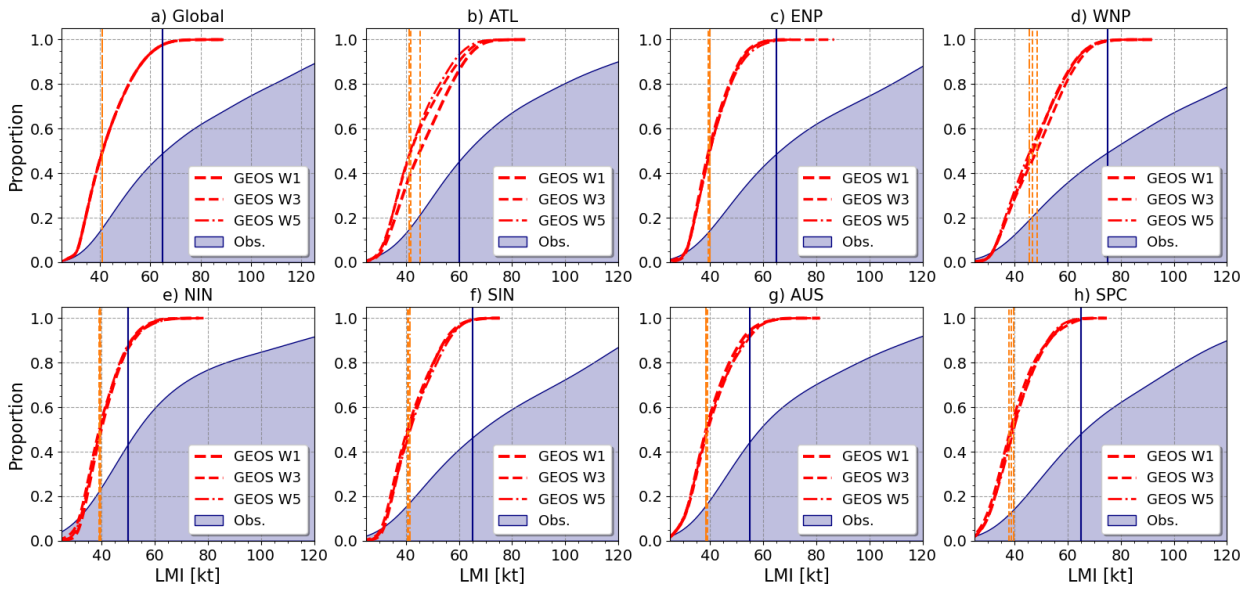
4 **Supplementary Tables and Figures**

5 TABLE S1. BSS of TC genesis probabilistic predictions for each basin in GEOS and ECMWF reforecasts.
 6 Both the BSS using a climatological reference forecast (BSS_c) and a monthly-varying climatology (BSS_m) are
 7 shown.

Model	Basin Week	ATL		ENP		WNP		SIN		AUS		SPC	
		BSS_c	BSS_m	BSS_c	BSS_m	BSS_c	BSS_m	BSS_c	BSS_m	BSS_c	BSS_m	BSS_c	BSS_m
GEOS	1	0.09	-0.29	0.19	-0.12	0.19	0.0	0.1	0.03	0.1	0.02	-0.03	-0.13
GEOS	2	0.04	-0.34	0.11	-0.21	0.1	-0.09	0.03	-0.06	0.08	-0.02	-0.03	-0.13
GEOS	3	0.06	-0.33	0.15	-0.17	0.13	-0.08	0.01	-0.07	-0.02	-0.11	-0.01	-0.11
GEOS	4	0.07	-0.27	0.14	0.16	0.07	-0.12	0.01	-0.08	0.01	-0.1	-0.05	-0.15
GEOS	5	0.08	-0.28	0.17	-0.14	0.1	-0.1	-0.07	-0.15	-0.01	-0.1	-0.06	-0.16
ECMWF	2	0.29	0.02	0.32	0.06	0.17	-0.01	-0.08	-0.15	-0.03	-0.12	0.05	0.01
ECMWF	4	0.26	-0.02	0.28	-0.0	0.11	-0.08	-0.16	-0.24	-0.15	-0.24	-0.09	-0.18



8 FIG. S1. Illustration of the regression based methods: linear, logistic and ReLU for week 2 occurrence forecasts
 9 of ECMWF. Negative calibrated probabilities are cut-off at 0.



10 FIG. S2. Cumulative distribution function (CDF) plots of the TC lifetime maximum intensity (LMI in kt) for
 11 GEOS reforecasts at different week lead times and observations for each basin. The vertical lines are the median
 12 values of each distribution.

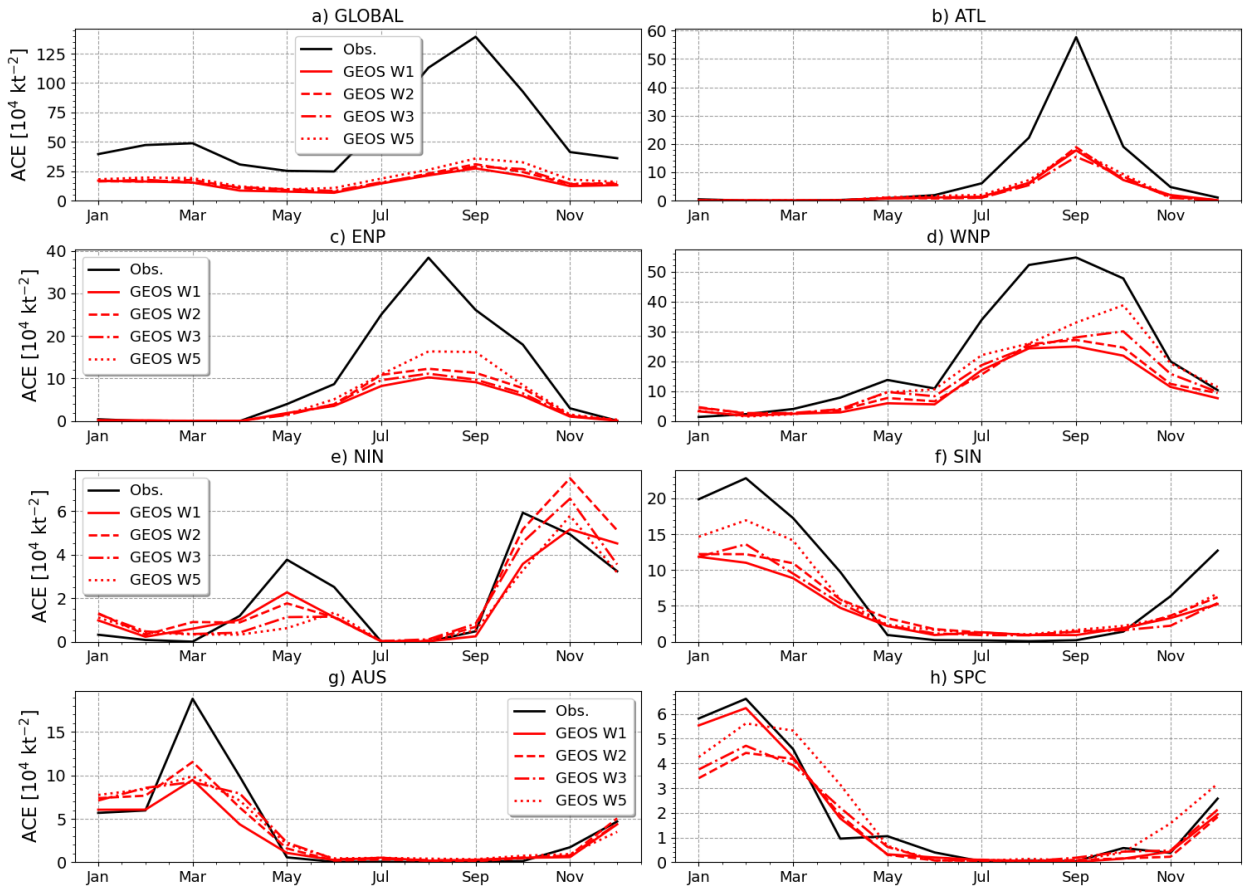
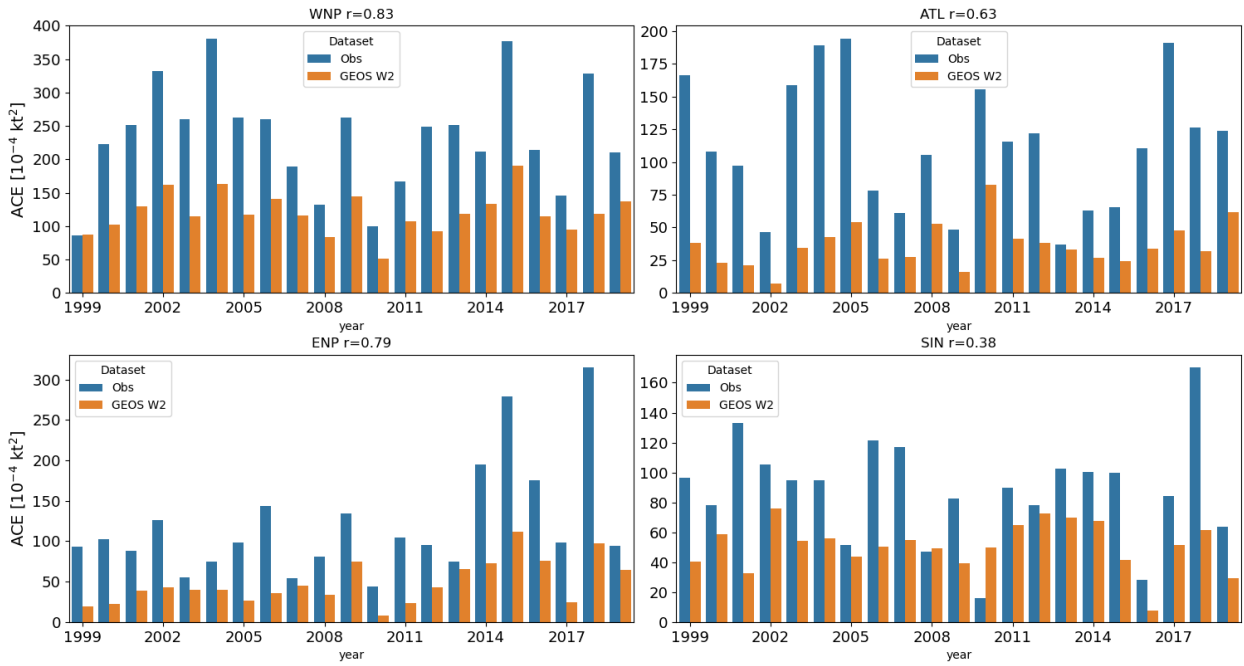
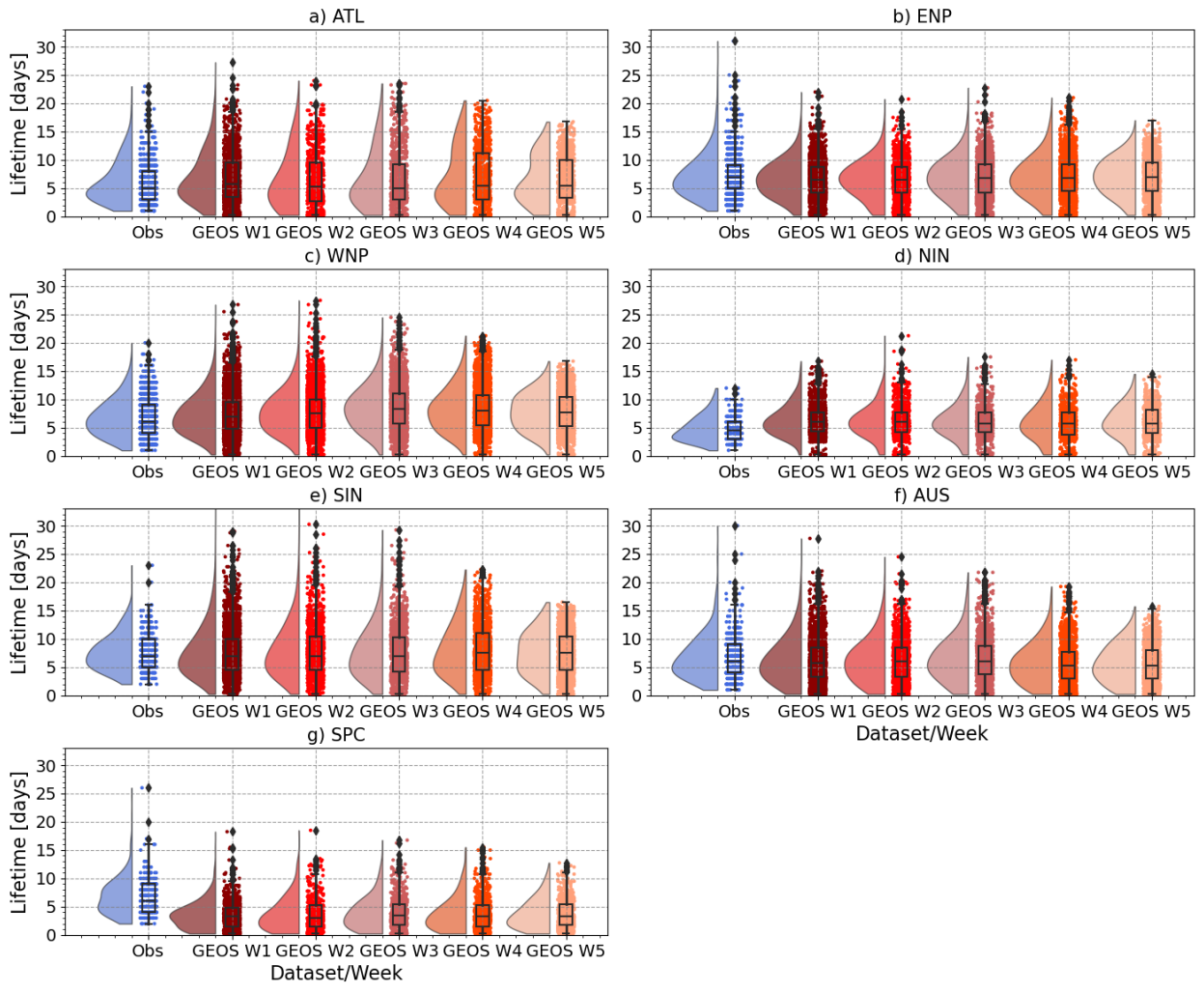


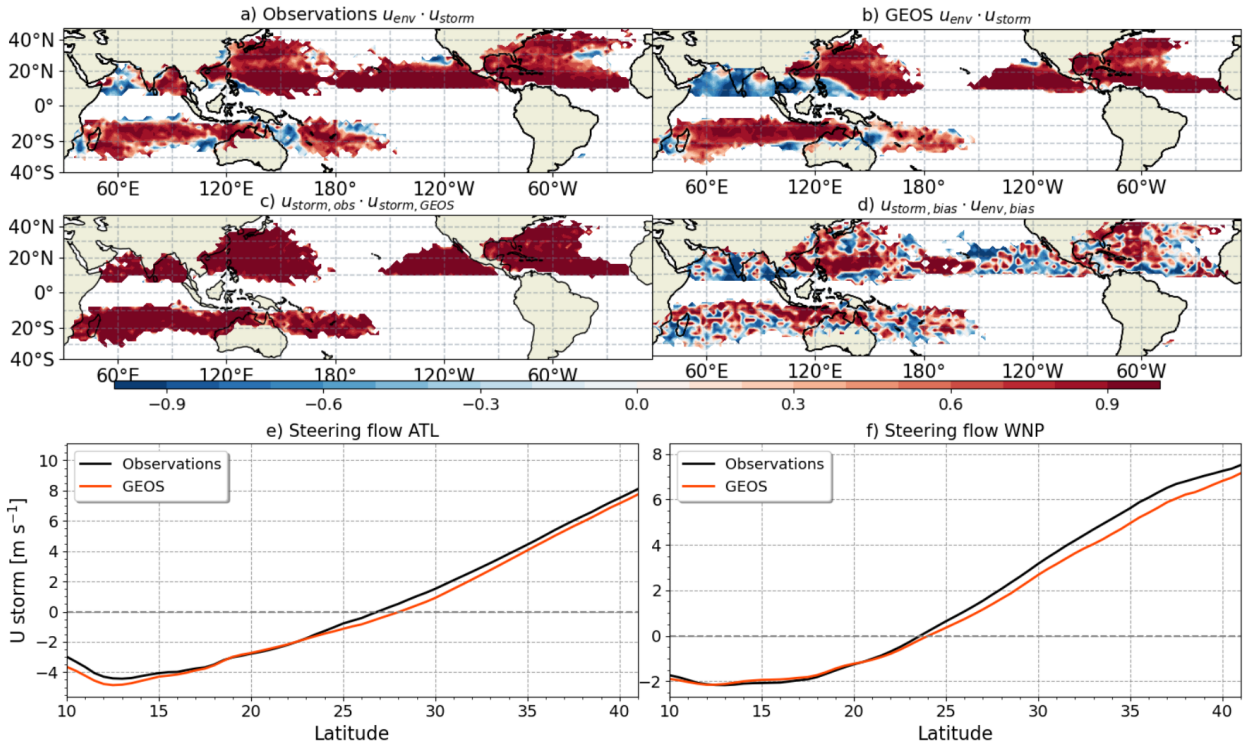
FIG. S3. Average seasonal cycle of ACE per basin in observations and various lead times for GEOS forecasts.



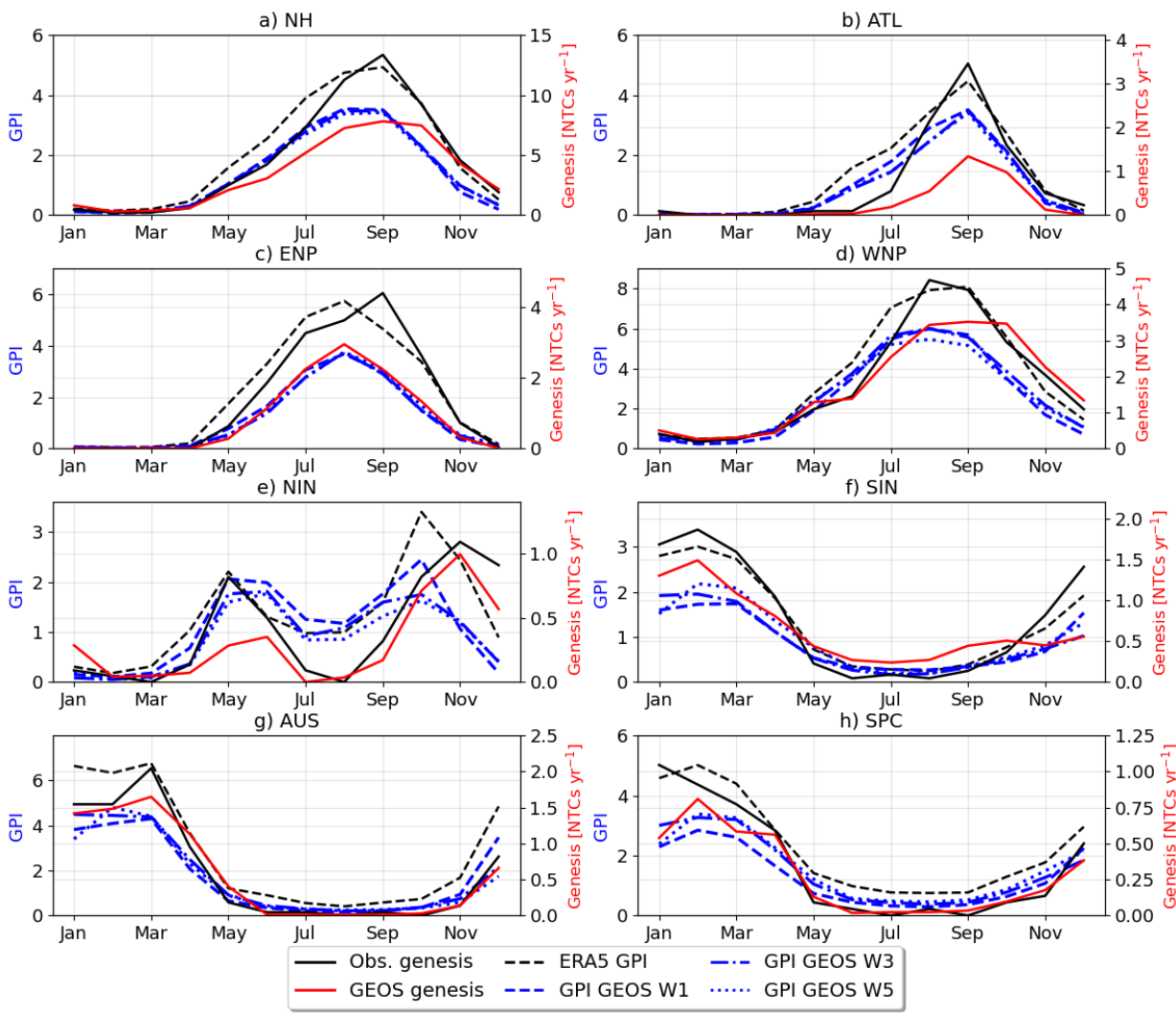
13 FIG. S4. Bar plots of seasonal ACE time-series in GEOS and week forecasts. The correlation coefficient (r) is
 14 shown at the top of each panel.



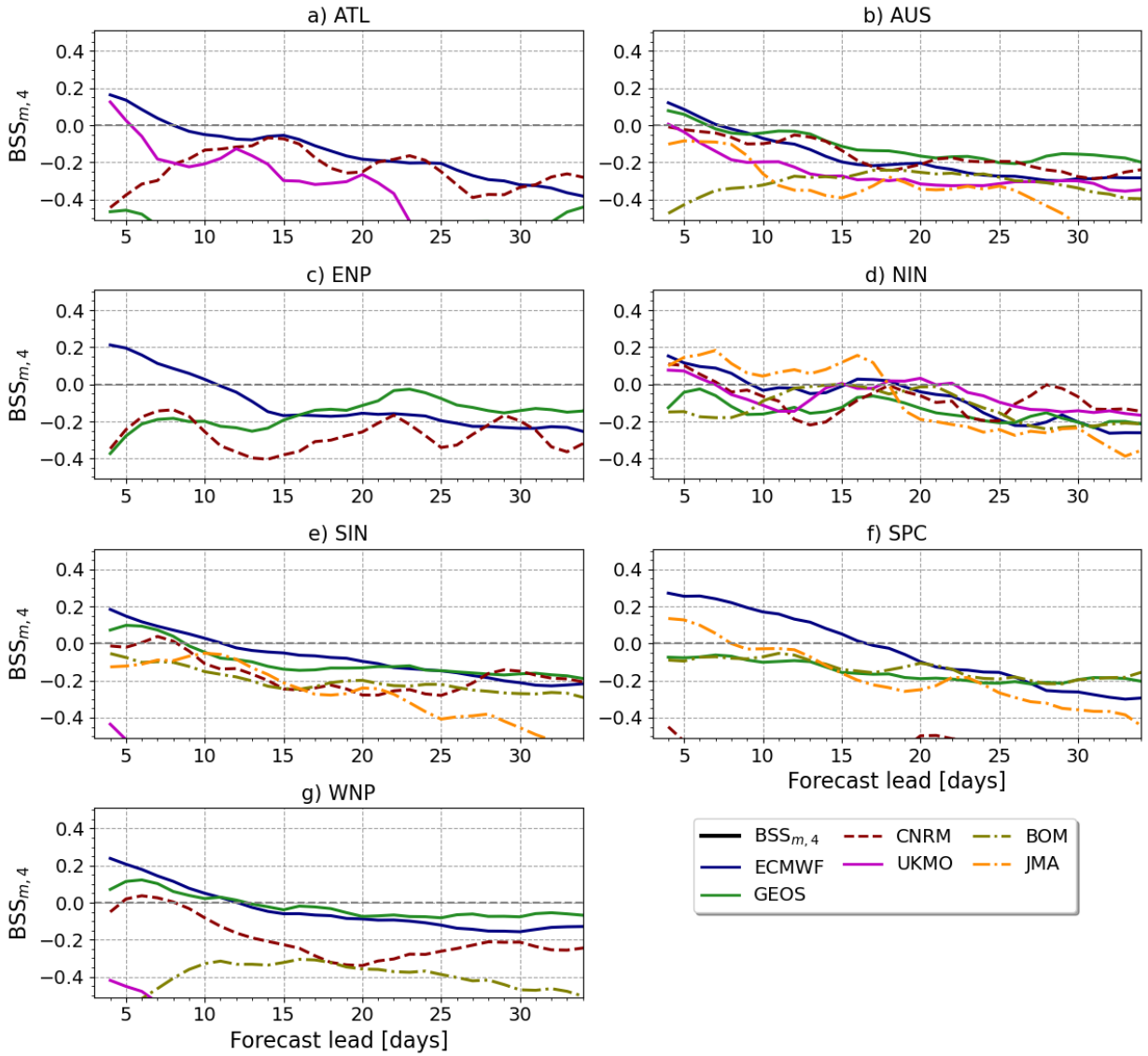
15 FIG. S5. Rain cloud plots of the distribution of storm lifetime [days] in each basin for observations and each
 16 forecast week. For each observed and forecast distribution, the plots show the violin plot of the probability
 17 density function, the box plot showing the median, interquartile range and the scatter of all points.



18 FIG. S6. (a-d) Non dimensional measure of the alignment between vectors, measured by the dot product of the
 19 normalized (a) observed and (b) simulated environmental steering flow versus observed storm motion vector, (c)
 20 the alignment of the observed versus simulated storm motion vector and (d) the alignment of the vector associated
 21 with the bias in the steering flow versus the bias in the storm motion. (e-f) Zonal mean zonal wind [$m s^{-1}$]
 22 of the steering flow averaged in the (e) Atlantic and (f) western north Pacific basins.



23 FIG. S7. Seasonal cycle of GPI for six TC basins computed from ERA5 and GEOS reforecasts at different
 24 lead-times.



25 FIG. S8. As in Figure 9 of the main manuscript, showing the BSS_m of TC occurrence of select reforecast
 26 models but only using 4 ensemble members, which is the ensemble size of the GEOS forecast system.

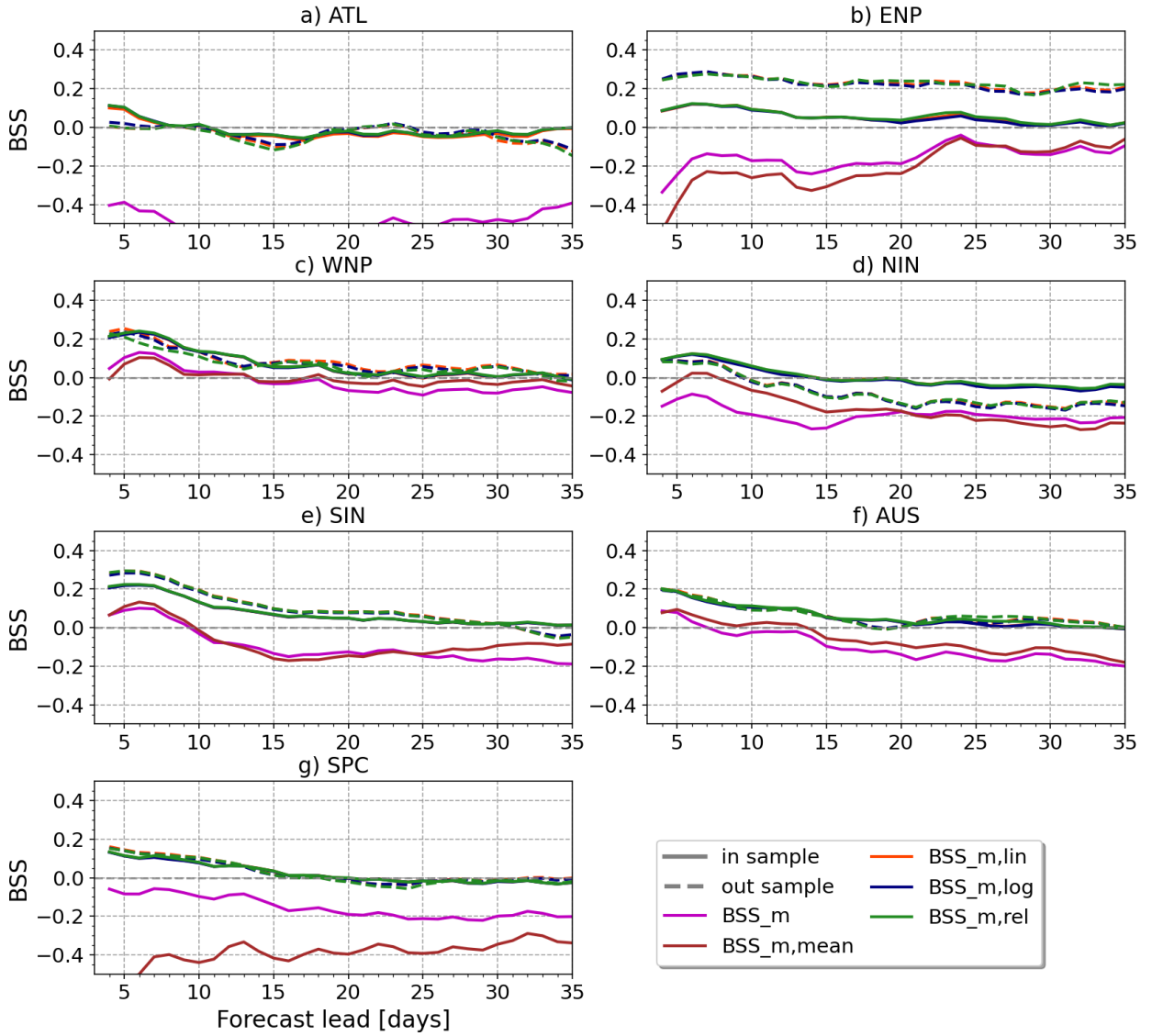
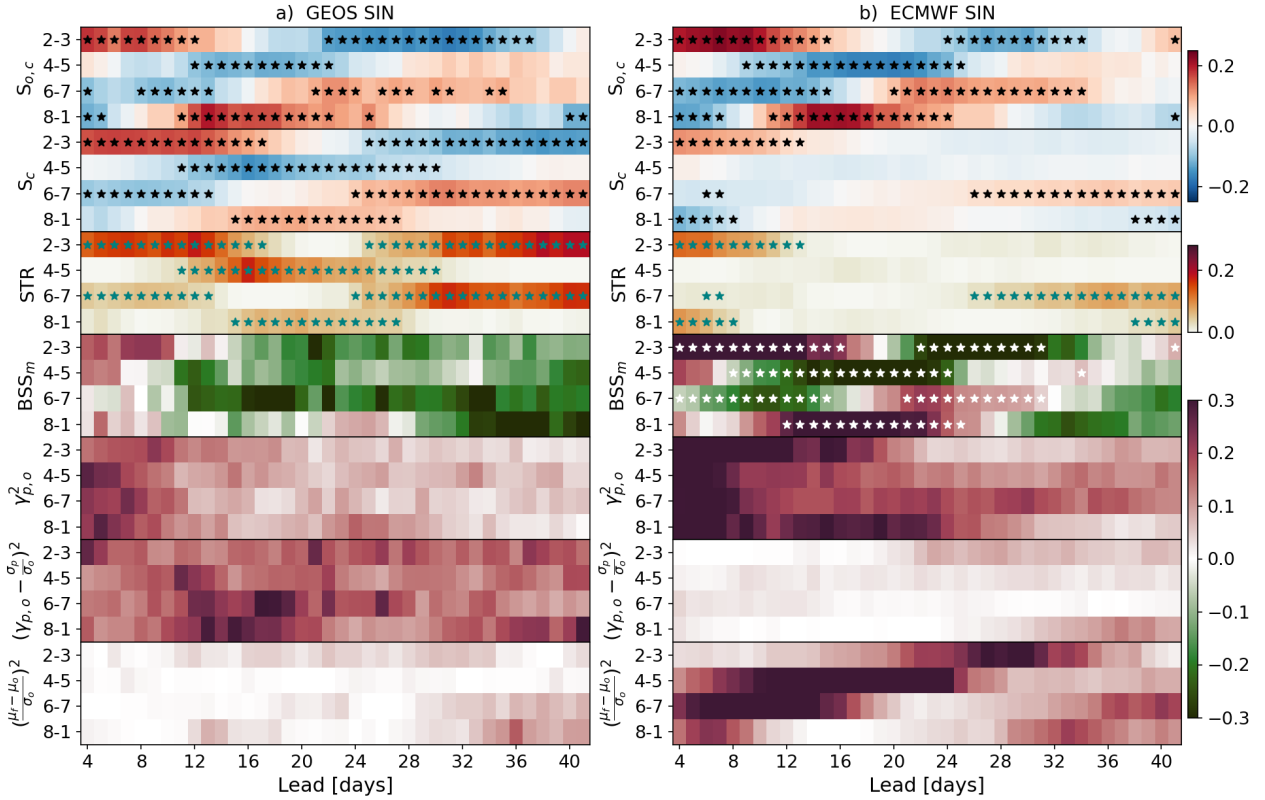


FIG. S9. BSS of calibrated forecasts comparing the fitting process when done in-sample and out of sample



27 FIG. S10. As in Figure 14 of the main manuscript but with the decomposition of the BSS terms in the bottom
 28 three rows, that is the correlation ($\gamma_{p,o}^2$), the conditional bias ($\gamma_{p,o} - \frac{\sigma_p}{\sigma_o}$)² and the unconditional bias ($\frac{\mu_f - \mu_o}{\sigma_o}$)².