Supporting Information

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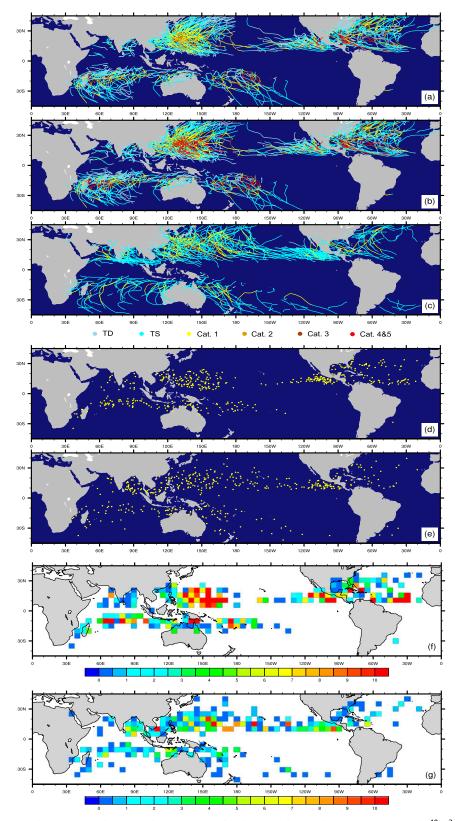


Fig. S1. Observed (A, B, D, and F) and modeled (C, E, and G) TC trajectories (A–C), genesis (D and E), and cumulative PDI (10¹⁰ m³/s²; F and G) in the present-day climate. Observations are based on the International Best Track Archive for Climate Stewardship (IBTrACS) dataset (A, D, and F) from World Meteorological Organization (WMO)-sanctioned forecast agencies and (B) from all agencies and dataset sources. Because the last 5 y of CAM4 results are used here, we just draw observations during a 5-y interval (2001–2005). Selection of different intervals in the observational dataset does not affect the qualitative comparison reported here.

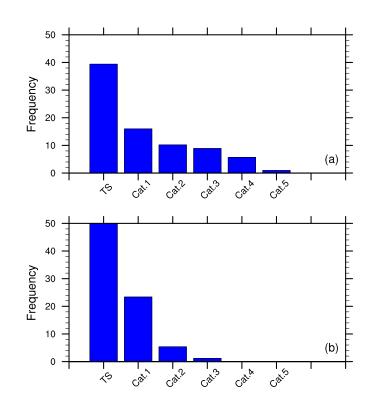


Fig. S2. Observed (A) and modeled (B) mean frequency of each TC category in the present-day climate. Observations are based on the IBTrACS-WMO dataset from 1991 to 2014.

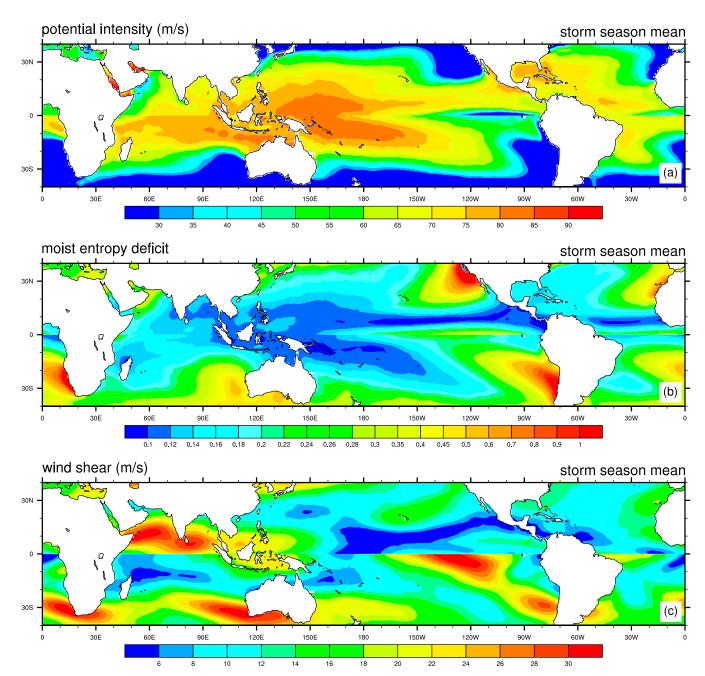


Fig. S3. Modeled storm season mean large-scale environmental conditions in the preindustrial experiment: potential intensity (A, meters per second), moist entropy deficit (B), and vertical wind shear (C, meters per second).

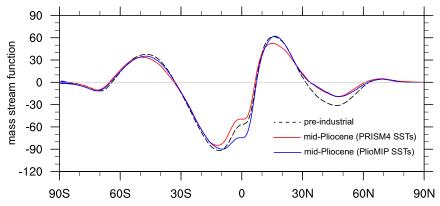


Fig. S4. Latitudinal cross-section of the annual mass stream function (10^9 kg s^{-1}) at 500 hPa in the preindustrial and two mid-Pliocene experiments. Hadley cell edges are defined as the latitudes where the mass stream function of the mean meridional circulation in the troposphere (at 500 hPa) becomes zero poleward of the subtropical maxima. It can be observed that Hadley cell expands poleward in both mid-Pliocene experiments, especially in the Northern Hemisphere.

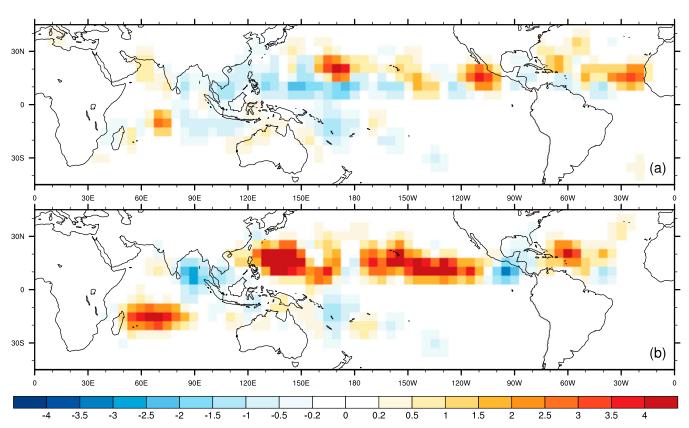


Fig. S5. Annual cumulative PDI anomalies (smoothed) between the mid-Pliocene forced by the PRISM4/PlioMIP SSTs (A and B) and present-day experiments; units are 10^{10} m³s⁻² per $5^{\circ} \times 5^{\circ}$ gridbox.

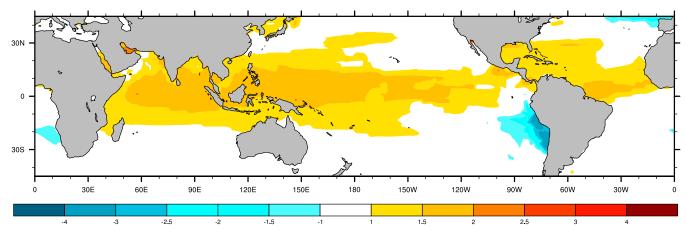


Fig. S6. Differences in SST (°C) between the mid-Pliocene SST anomalies from the PRISM4 dataset and from the ensemble mean of the PlioMIP models (PlioMIP SSTs minus PRISM4 SSTs).

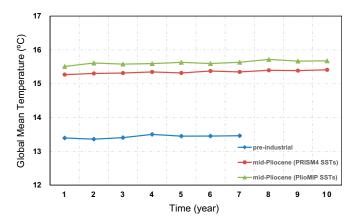


Fig. S7. Time series of global annual mean surface air temperature in the preindustrial and mid-Pliocene experiments. The simulated mean temperature shows no significant shift in all of the experiments, indicating the model has reached quasi-equilibrium.

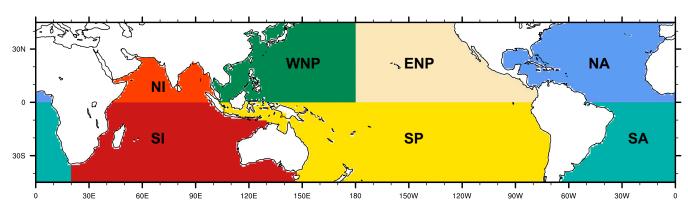


Fig. S8. Regions of individual ocean basins. ENP, Eastern North Pacific; NA, North Atlantic; NI, North Indian Ocean; SI, South Indian Ocean; SP, South Pacific; WNP, Western North Pacific.

Table S1. Modeled and observed (shown in parentheses) modern annual mean TC number and mean LMW (meters per second), duration (days), PDI (10¹⁰ m³/s²), and latitude of the LMW (°) of a TC

Region	Number	LMW	Duration	PDI	Latitude of LMW
Globe*	79.8 (78.5)	30.8 (36.0)	5.8 (5.4)	1.17 (2.0)	20.7 (19.6)
NH	58.2 (56.4)	31.1 (36.2)	6.0 (5.5)	1.25 (2.1)	20.7 (20.4)
SH	21.6 (22.1)	30.1 (35.6)	5.4 (5.3)	0.96 (1.7)	-20.8 (-17.5)
WNP	24.4 (23.6)	32.4 (34.8)	6.1 (6.1)	1.46 (2.1)	21.5 (20.4)
ENP	18.6 (15.6)	29.7 (38.5)	6.6 (4.5)	1.27 (2.1)	19.0 (16.6)
SP	10.0 (9.0)	29.9 (36.2)	5.1 (5.4)	0.94 (1.8)	-24.0 (-18.2)
NA	7.6 (13.4)	31.0 (37.1)	4.8 (5.8)	0.93 (2.3)	29.0 (26.1)
NI	7.6 (3.8)	30.4 (32.4)	5.1 (4.1)	0.84 (1.2)	13.7 (15.8)
SI	11.6 (13.1)	30.2 (35.2)	5.7 (5.3)	0.98 (1.7)	-18.1 (-17.0)

Observations are based on the IBTrACS-WMO dataset (version v03r08) for the 1991–2014 period.

Table S2. Changes in number of each TC category between the mid-Pliocene experiment forced by the proxies-based (PlioMIP model-based) SSTs and the preindustrial experiment

Region	Category 3	Category 2	Category 1	Tropical storm	Total
Globe	+1 (+4.2##)	+1.4 (+8.4**)	-1.2 (+3.0 [#])	-9.4 (+3.6)	-8.2 (+19.2 ^{##})
NH	+1 (+4.2##)	+1.2 (+6.6##)	+1.4 (+1.8)	-10.6 ^{##} (+4.8)	-7.0 (+17.4 ^{##})
SH	1	+0.2 (+1.8##)	-2.6 [#] (+1.2)	+1.2 (-1.2)	+0.2 (+1.8)
WNP	+0.4 (+2.2##)	+0.6 (+4.8##)	-2.6 (+1.8)	-8.2 ^{##} (+1.8)	-9.8 [#] (+10.6)
ENP	+0.2 (+1.2 ^{##})	-0.4 (+1)	+2.2** (+3.2**)	-4.4 ^{##} (+3.2)	-2.4 ^{##} (+8.6 ^{##})
SP	1	-0.6 (-0.4)	-0.2 (-0.2)	+1.6 (0.0)	+0.8 (-0.6)
NA	+0.4 (+0.8)	+1# (+0.6)	+1 (-0.6)	-0.4 (-0.6)	+2.0 (+0.2)
NI	1	0.0 (+0.2)	+0.8 (-2.6##)	+2.4## (+0.4)	+3.2** (-2.0*)
SI	/	+0.8# (+2.2##)	-2.4 [#] (+1.4)	-0.4 (-1.2)	-2.0 (+2.4)

 $^{^{*}}$ Value that passes the 90% significance Student t test.

Table S3. Summary of the experimental design for CAM4

Boundary conditions	PI	MP_PRISM	MP_PlioMIP
SST	Modern	PRISM4	PlioMIP models
Land-sea mask	Modern	Modern	Modern
Topography	Modern	PRISM4	PRISM4
Land cover*	Modern	PRISM4	PRISM4
Greenhouse gases	$CO_2 = 280 \text{ ppm}, N_2O = 270 \text{ ppb},$	$CO_2 = 405 \text{ ppm}, N_2O = 270 \text{ ppb},$	$CO_2 = 405 \text{ ppm}, N_2O = 270 \text{ ppb},$
	$CH_4 = 760 \text{ ppb}$	$CH_4 = 760 \text{ ppb}$	$CH_4 = 760 \text{ ppb}$
Solar constant	1,365 W/m ²	1,365 W/m ²	1,365 W/m ²
Orbital parameters	1950 A.D.	1950 A.D.	1950 A.D.

^{*}Including vegetation, ice sheets, lake distribution, and soil color.

^{*}TCs that occasionally occur over the South Atlantic are excluded.

^{**}Value that passes the 95% significance Student t test.