Supplementary Materials

The longest-lasting 2023 western North American heat wave was fueled by the record-warm Atlantic Ocean.

Hosmay Lopez[1], Sang-Ki Lee[1], Robert West[2], Dongmin Kim[2], Liwei Jia[3]

[1]Atlantic Oceanographic and Meteorological Laboratory, NOAA, Miami, Florida, USA

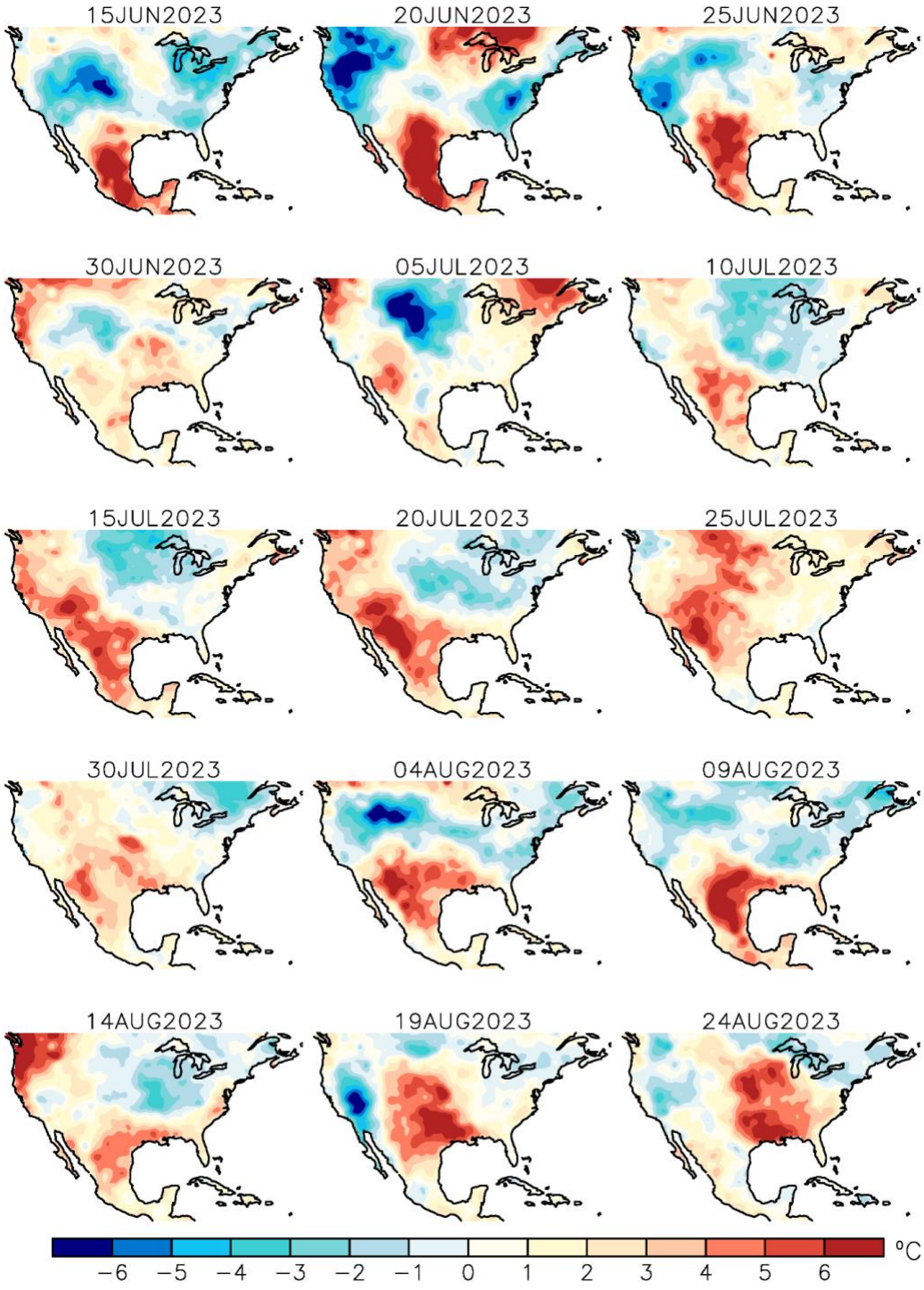
[2]Cooperative Institute for Marine and Atmospheric Studies, University of Miami, Miami, Florida, USA

[3]Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration, Princeton, NJ, United States

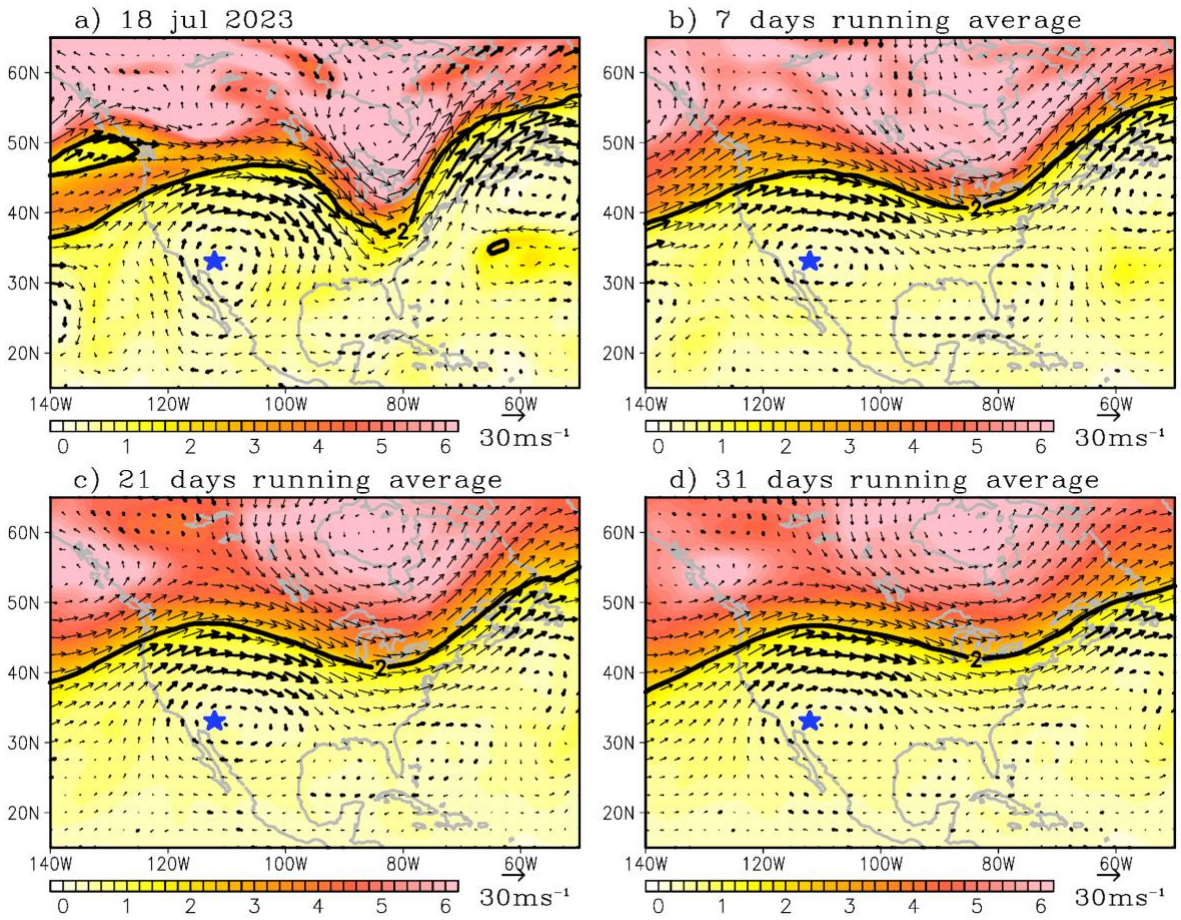
Included Materials:

Supplementary Figures 1, 2, 3, and 4

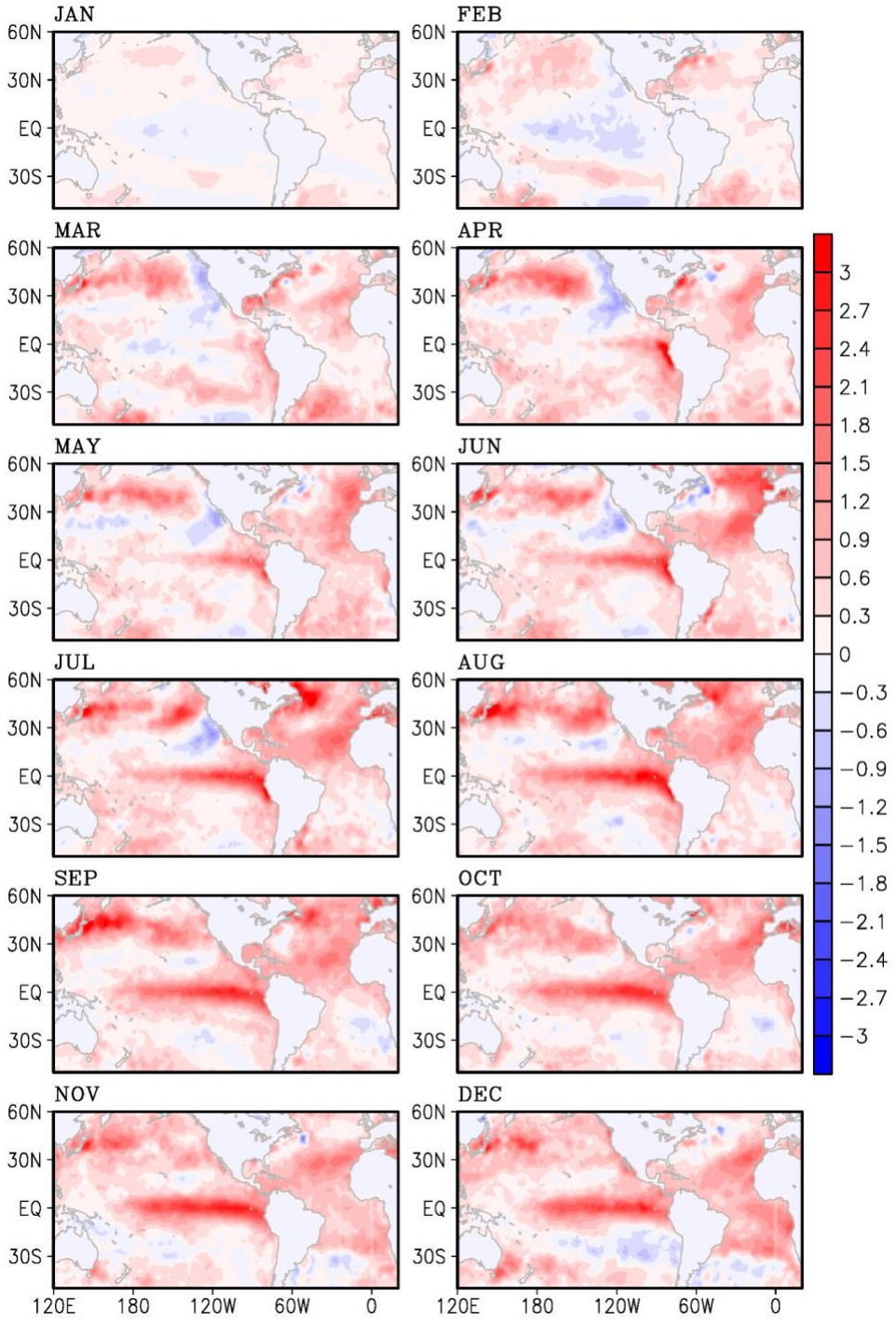
Supplementary Table 1



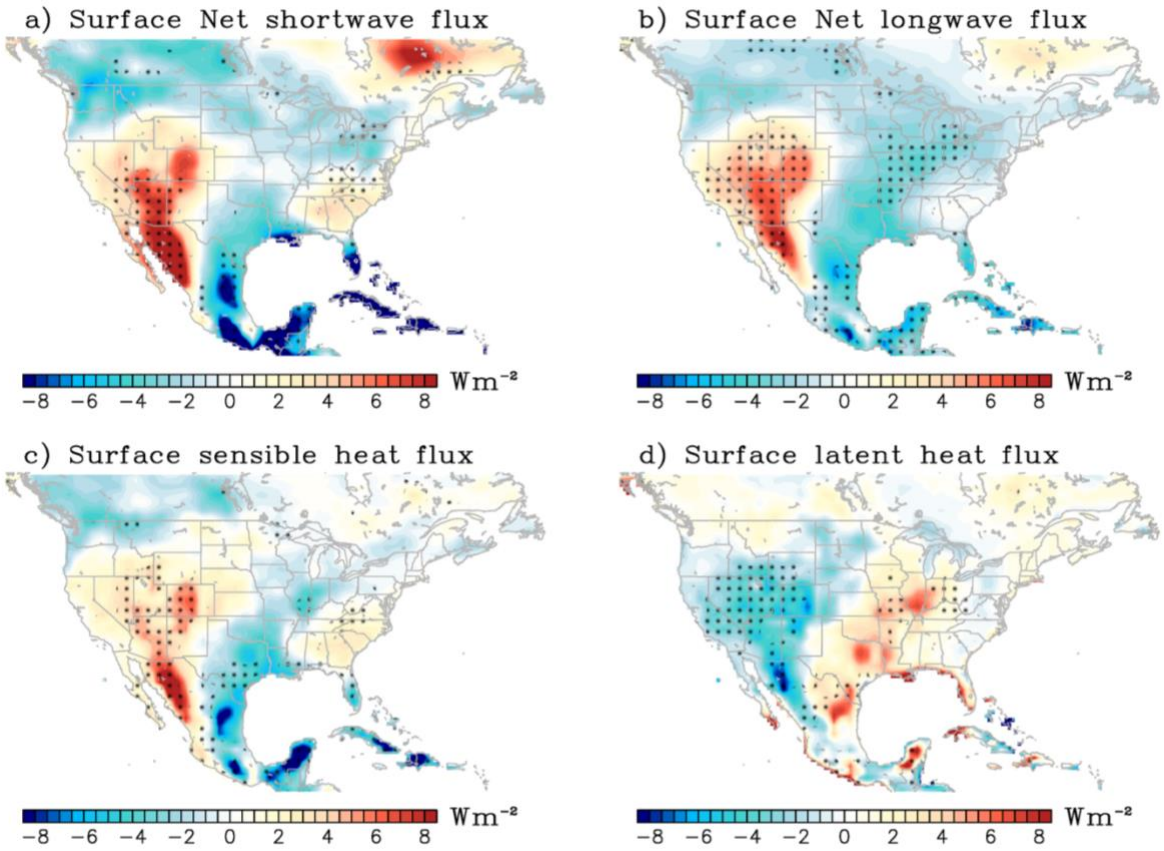
Supplementary Figure 1. Surface temperature anomaly evolution during the 2023 heatwave event averaged every pentad (five days centered at the labeled day) from 15 June to 24 August 2023.



Supplementary Figure 2. a) Potential vorticity and wind at the 350K isentropic level during the maximum amplitude of the heat wave on 18 July 2023. Thick vectors depict anti-cyclonic fluid trapping, a proxy for heat dome and air flow stagnation. b), c), and d) are the same as a) but for the 7-, 21-, and 31-day running average centered on 18 July 2023. The thick black line indicates the location of the dynamical tropopause. The blue star on each panel represents the location of Phoenix, Arizona.



Supplementary Figure 3. Sea surface temperature anomalies (SSTA) prescribed to the atmospheric general circulation model experiment. These anomalies correspond to the year 2023. The amplitude of the anomalies was ramped up from climatology by prescribing one-third anomalies for January, two-third for February, and the full 2023 anomalies for the rest of the months (see Methods).



Supplementary Figure 4. Composite difference of simulated 2023 minus control AGCM experiments of surface heat fluxes during JJA for a) net shortwave radiation, b) net longwave radiation, c) sensible heat flux, and d) latent heat flux. The dot hatching indicates the 95% significance based on bootstrapping technique.

Supplementary Table 1. Changes in the mean and return period (days) of excess over a very high threshold temperature from the CTL (climatology), GLB23 (2023 SST sensitivity), ATL23 (Atlantic-only 2023 SST sensitivity), and PAC23 (Pacific-only 2023 SST sensitivity) AGCM experiments for JJA maximum and minimum temperatures for the grid-point closest to Phoenix, Arizona. The last row shows the Atlantic-Pacific synergy component (see Methods). The return periods are computed from a generalized Pareto distribution. Heat wave characteristics like, number of events, heat wave days, average (longest) duration in days, and average (strongest) amplitude temperature anomaly above the daily climatology temperature are shown.

	Maximum temperature		Minimum Temperature		Heat wave Characteristics			
	Mean (°C)	Return T=45°C	Mean (°C)	Return T=31°C	Number	Days	Duration (longest)	Amplitude (strongest)
CTL	39.1 ±0.30	45 years	25.8 ±0.31	30 years	77	307	3.9 (9) days	5.1 (7.7) °C
GLB23	40.2 ±0.31	14 years	26.8±0.34	11 years	184	853	4.6 (14) days	5.3 (8.3) °C
ATL23	39.7 ±0.31	19 years	26.6 ±0.33	10 years	135	581	4.3 (10) days	5.3 (8.8) °C
PAC23	39.2 ±0.31	31 years	25.8 ±0.33	29 years	101	391	3.9 (9) days	5.2 (8.2) °C
Syn*	39.5±0.31	32 years	26.0±0.33	43 years	102	495	4.2 (13) days	5.0 (6.7) °C