

Supporting information for “The evolving distribution of relative humidity conditional upon daily maximum temperature in a warming climate”

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	Period	T ₀
NYC	1990-2005	24.50
	2026-2035	25.03
	2071-2080	27.95
CHI	1990-2005	25.83
	2026-2035	26.71
	2071-2080	29.36
PHX	1990-2005	-
	2026-2035	-
	2071-2080	-
NOLA	1990-2005	-
	2026-2035	-
	2071-2080	-

Table S1. Temperature at the kink (T₀) for the 4 selected cities in July and the three periods. “-” means no kink function is used in the statistical model.

Location	NYC	CHI	PHX	NOLA
HadISD	-0.29*	-0.36*	-0.79*	-0.60*
LENS	-0.46*	-0.3*	-0.59*	-0.84*

Table S2 Correlation coefficient between RH and Tmax in the four cities for the datasets HadISD and LENS, respectively. Asterisks denote the value is significantly different from 0 at p<0.01 level.

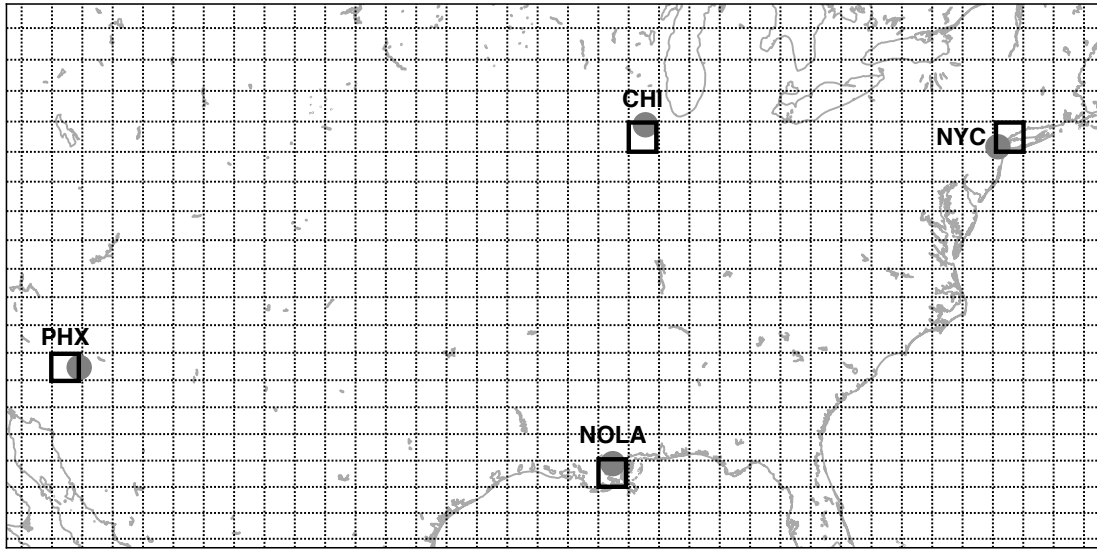


Figure S1. Map of the grid cells used in CESM LENS data. Black squares denote the grid cells used for the four cities: New York (NYC), Chicago (CHI), Phoenix (PHX), New Orleans (NOLA). The gray dots mark stations from HadISD used for validating the model data. The locations of the four stations are: Newark Liberty International airport for NYC, Marseilles, IL for CHI, Phoenix Sky Harbor International Airport for Phoenix, Lakefront Airport for NOLA.

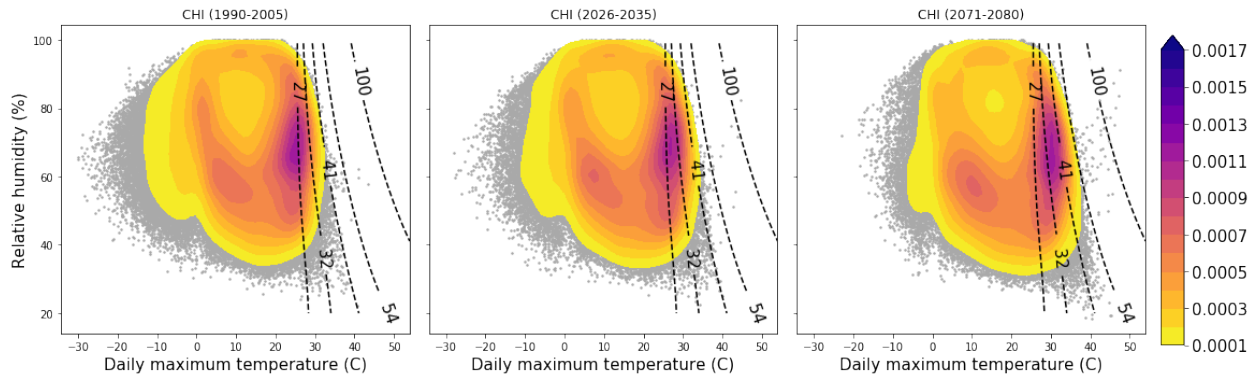


Figure S2. Joint distribution between RH and T_{max} in three periods for CHI using the grid cell including urban CHI. Gray dots are individual values of T_{max} and RH simulated from CESM LENS simulations for regions where density is below 0.0001. Shadings represent the density of the gray dots. Dashed curves are contours for the heat index calculated from RH and T_{max} (Units: $^{\circ}\text{C}$)

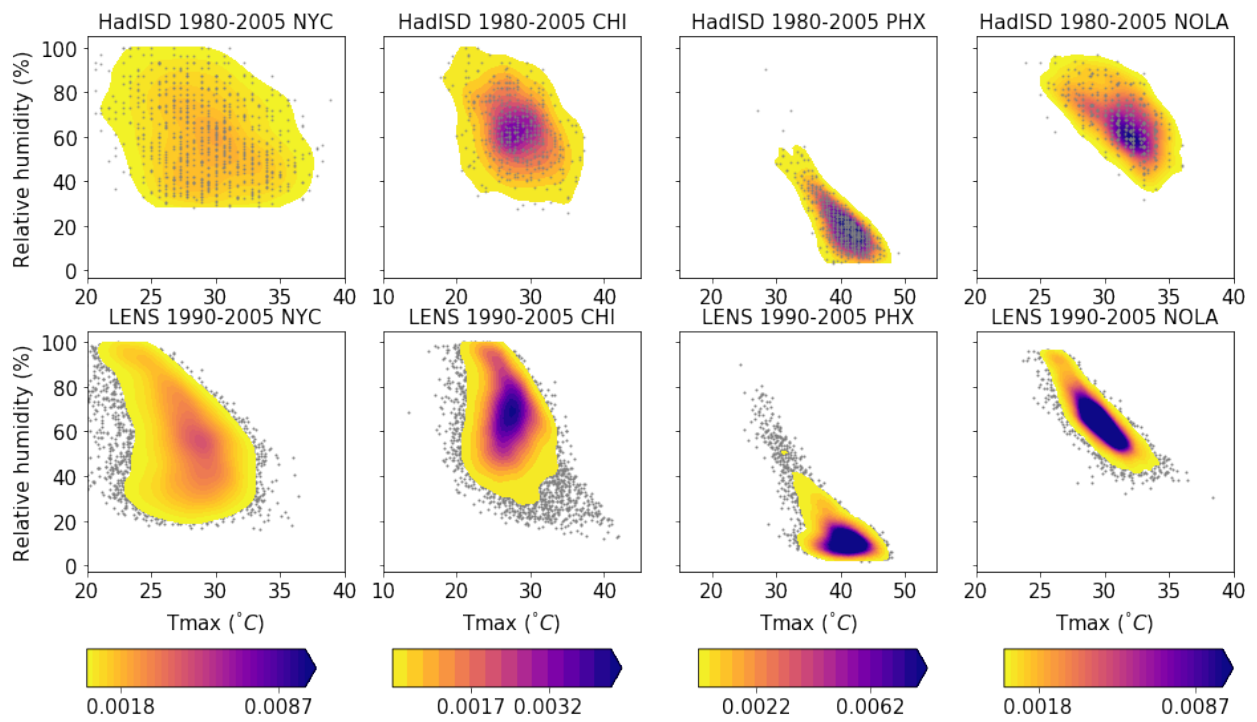


Figure S3. Joint distributions for RH and T_{max} from HadISD station data during the period 1980-2005 for NYC, CHI, PHX, and NOLA (upper panels) in July. Gray dots are individual observations of T_{max} and RH from the HadISD at the selected stations (marked in Fig. S1). Shading represents the density of the gray dots. Lower panels are the same as the upper panels for each city but using LENS data from the corresponding grid cell.

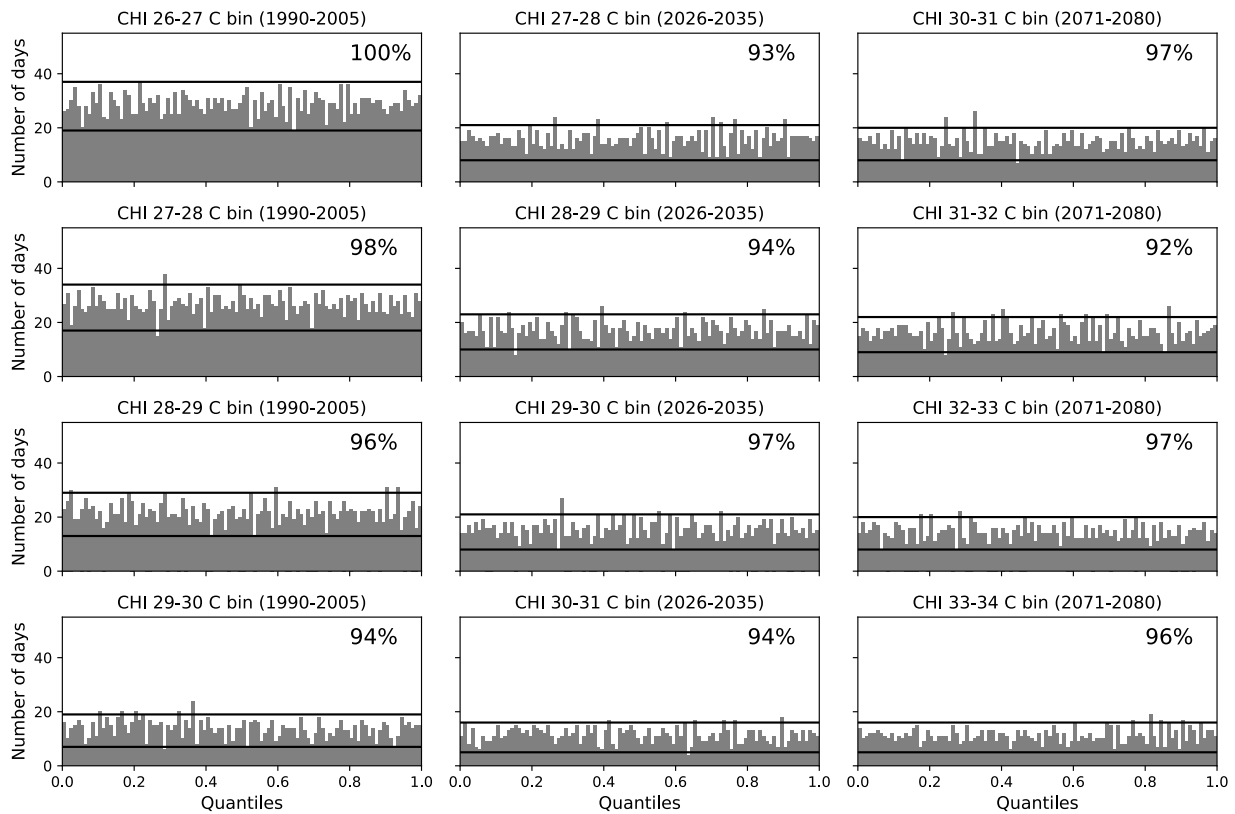


Figure S4. Empirical inverse quantiles of the fitted statistical models as evaluated using a cross-validation procedure described in Section 5 for the simulated data from LENS in Chicago during (first column) 1990-2005; (second column) 2026-2035; (third column) 2071-2080. The histograms represent the number of RH events falling into 100 bins of estimated quantiles of RH in six given temperature intervals (1 degree per interval) in July. In each plot, the solid lines mark the 0.025 (lower line) and 0.975 (upper line) of the binomial distribution the counts should follow if the model is accurate. The percentage in the upper right corner of each panel denotes the percentage of bins for which the observed number of days falls between the two bars, which is close to 95% in all cases as should occur if the model is accurate.

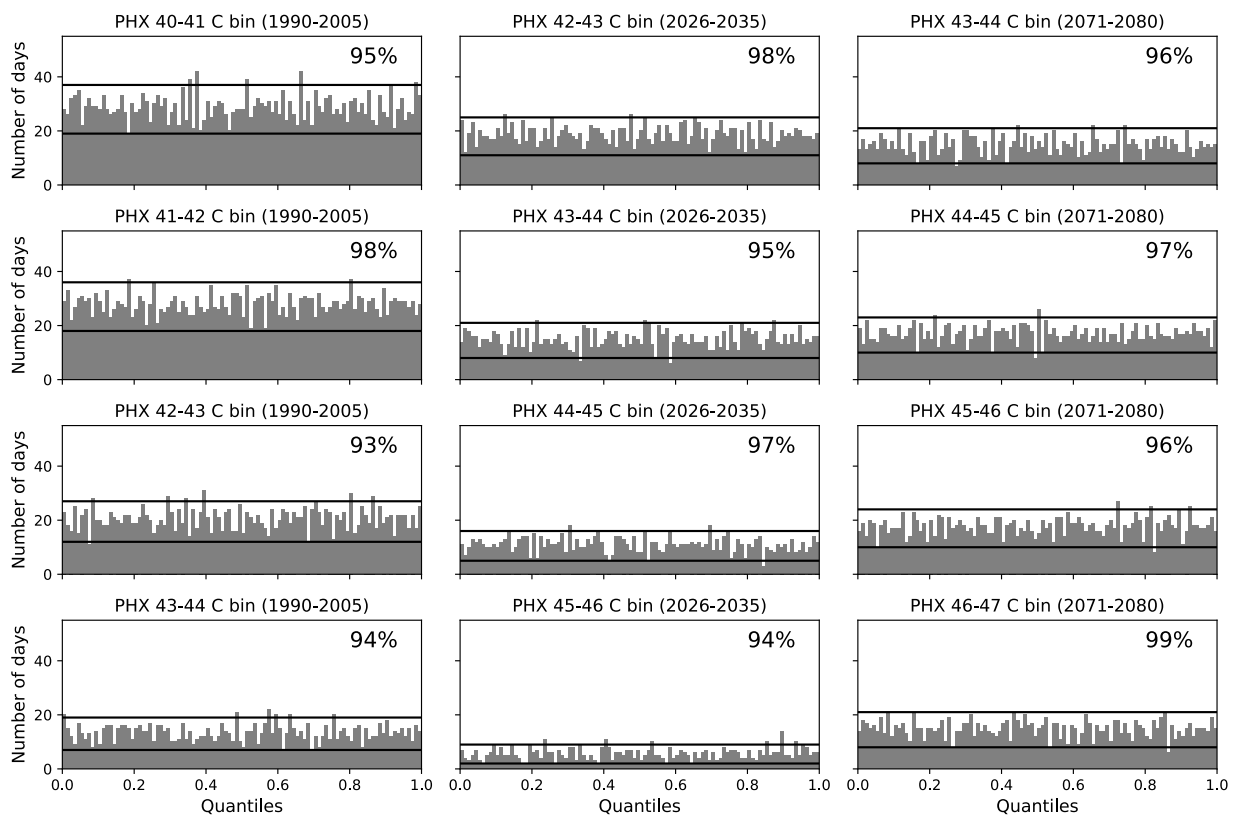


Figure S5. Same as Figure S4 except for Phoenix.

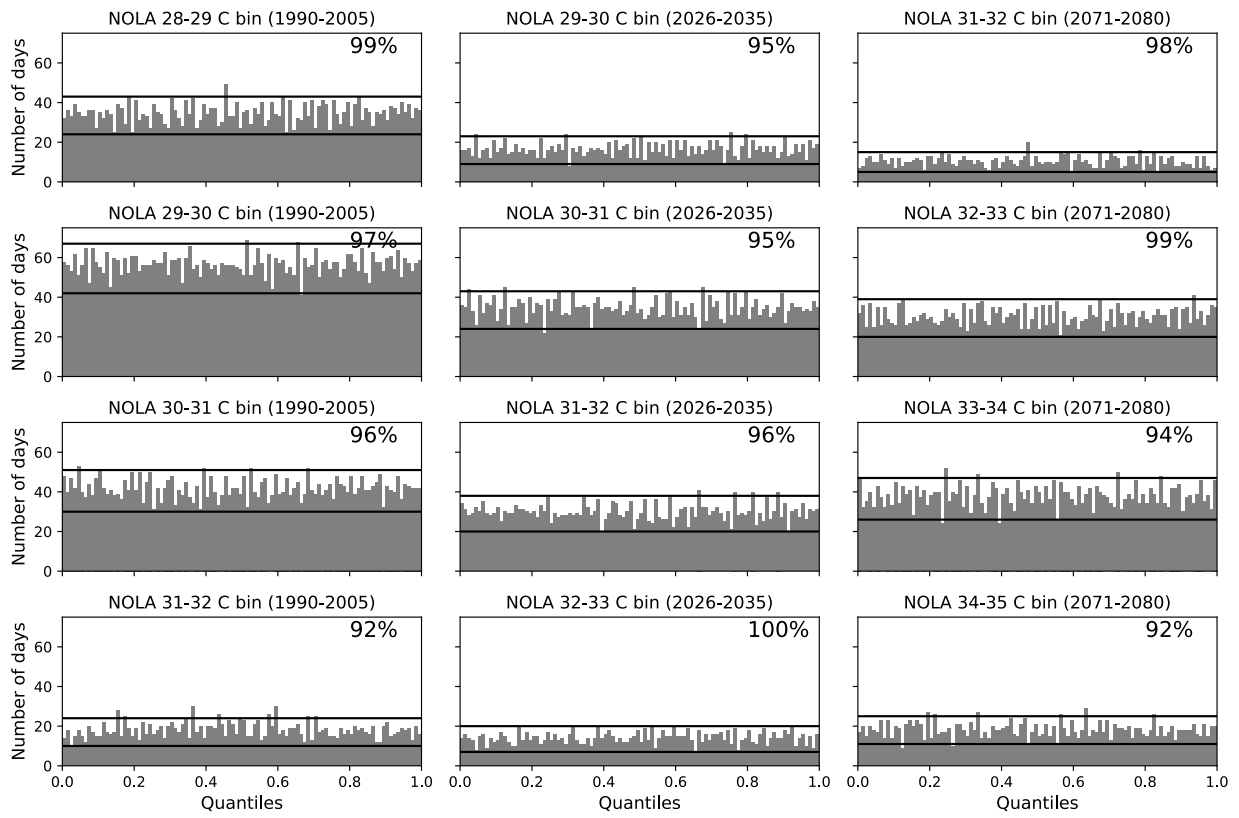


Figure S6. Same as Figure S4 except for New Orleans.

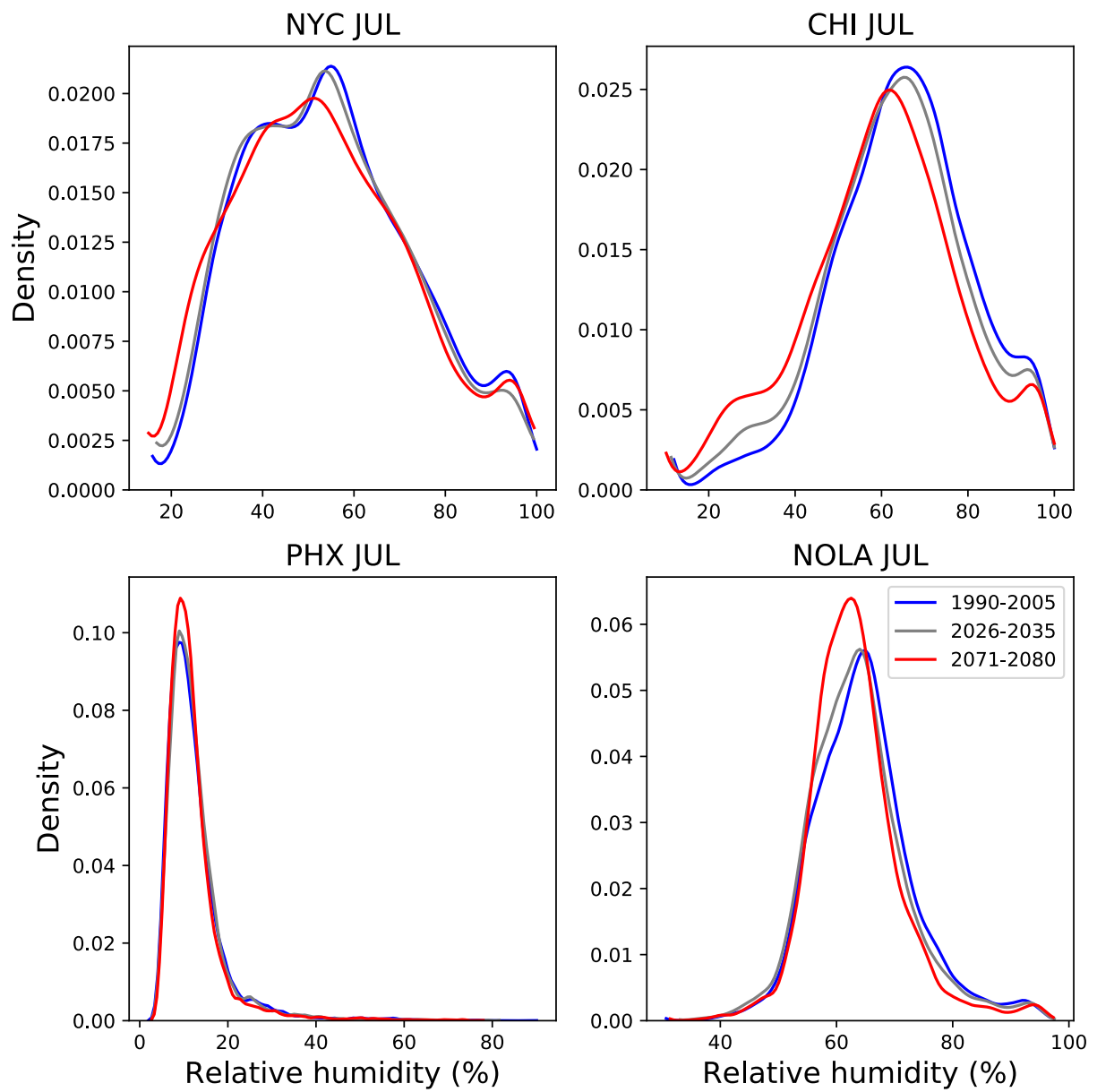


Figure S7. Frequency distribution of relative humidity (RH) in July at New York (NYC), Chicago (CHI), Phoenix (PHX), New Orleans (NOLA) using the CESM LENS data (Units: °C). Blue lines denote the period 1990-2005, grey 2026-2035, red 2071-2080.

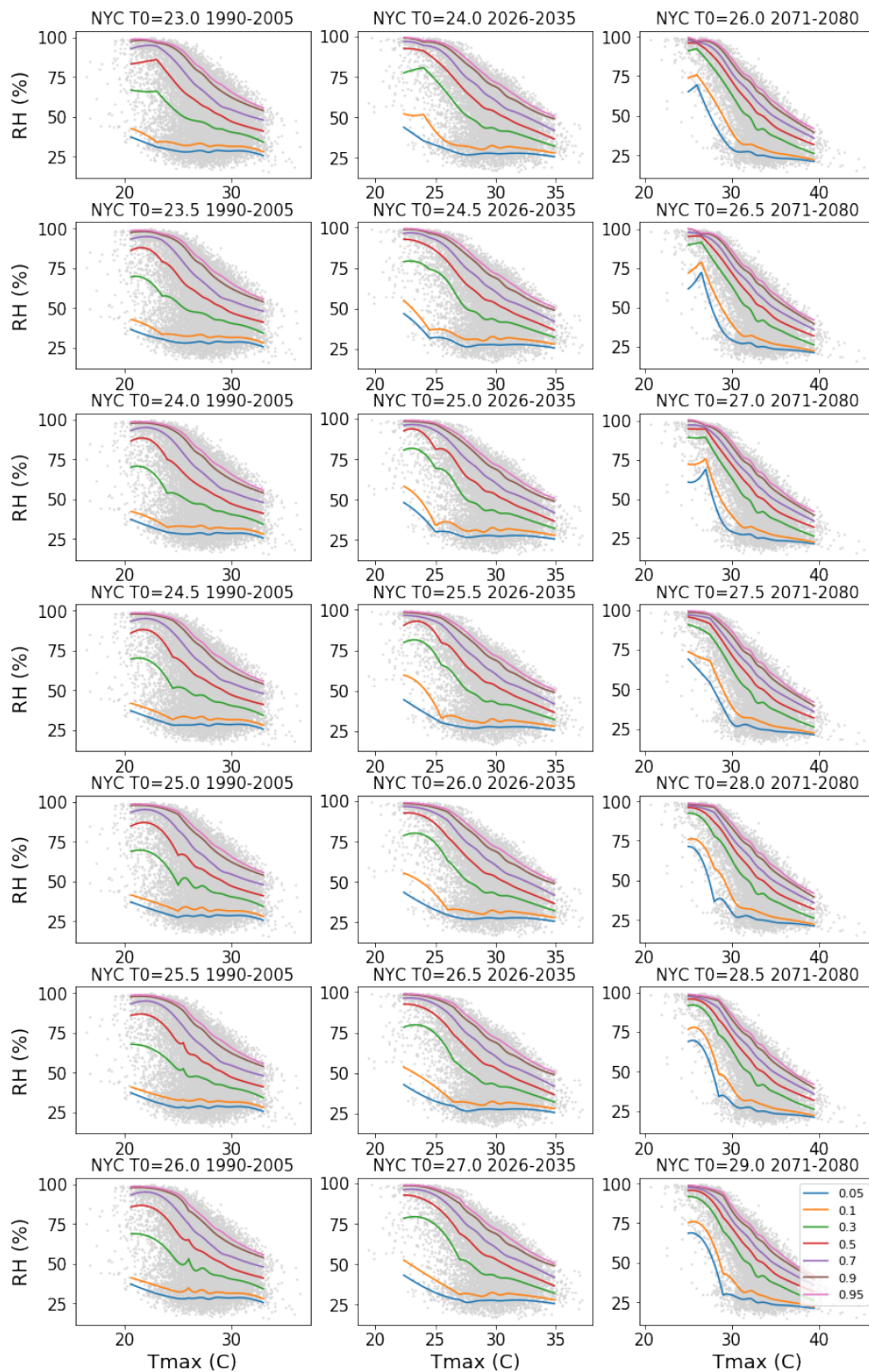


Figure S8. Impact of varying T_0 used on the quantile regression model for NYC in July during the period 1990-2005 (first column), 2026-2035 (second column), 2071-2080 (third column). Gray dots are LENS output of T_{max} and RH from CESM LENS simulations. Lines represent the estimated quantiles at 0.05, 0.1, 0.3, 0.5, 0.7, 0.9, 0.95. The T_0 values used in the model are marked in the title of each subplot.

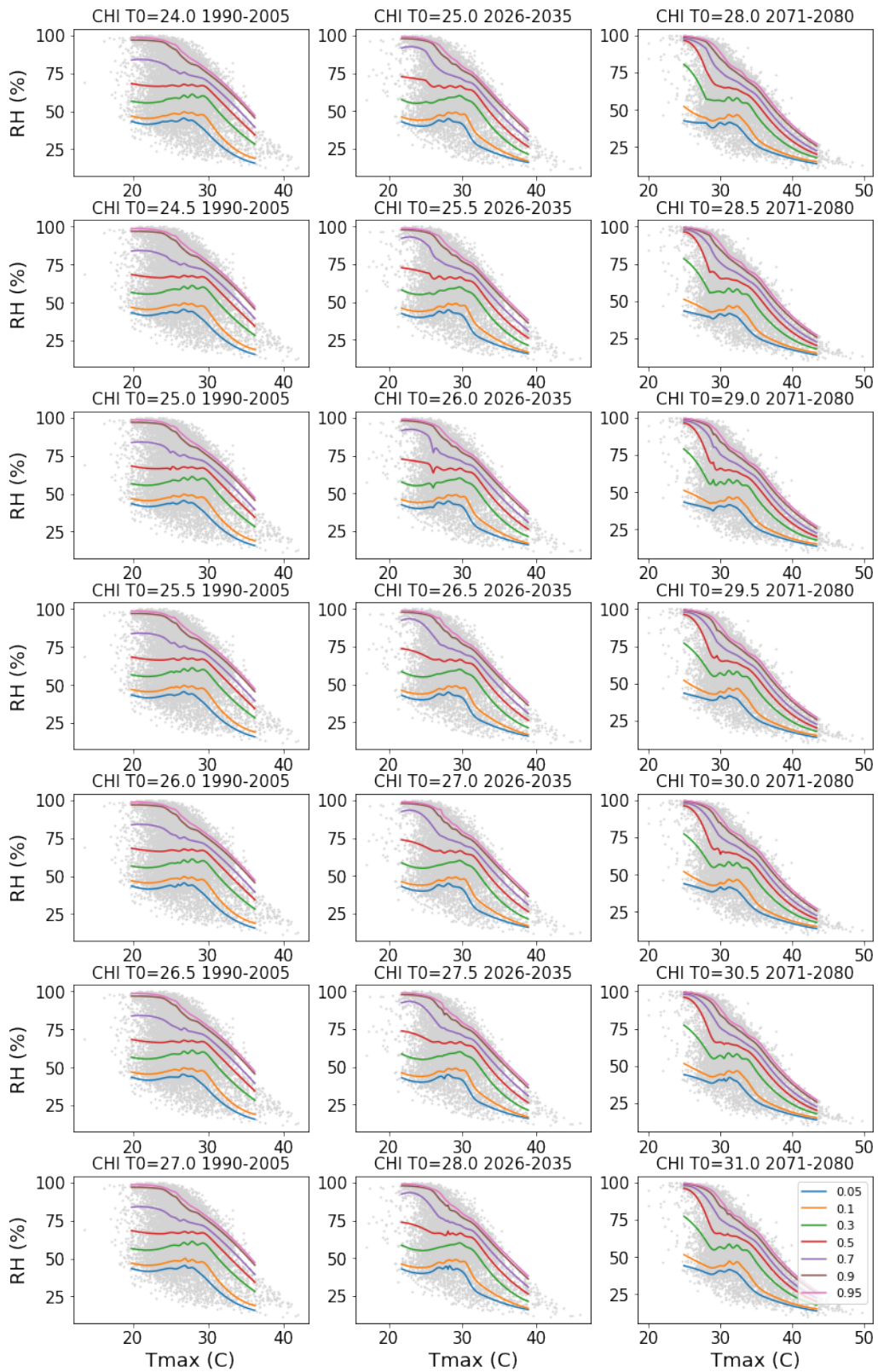


Figure S9. The same as the Figure S8 except for CHI.