

Supplementary Materials:

Risk Level Classification

Table S1. Risk Level Classification for model A (Base Model).

Risk level	Precipitation anomalies (mm/day)	Temperature anomalies (°C)	Population densities (count per km ²)	Wind swath of hurricane
Very high	4 (rain anomaly ≥ 15)	4 (temp anomaly > 2)	4 (pop ≥ 1000)	4 ($0 < \text{radius} \leq 50$ miles)
High	3 ($5 \leq \text{rain anomaly} < 15$)	3 ($0.50 < \text{temp anomaly} \leq 2$)	3 ($500 \leq \text{pop} < 1000$)	3 ($50 < \text{radius} \leq 100$ miles)
Moderate high	2 ($3 \leq \text{rain anomaly} < 5$)	2 ($0.25 < \text{temp anomaly} \leq 0.50$)	2 ($250 \leq \text{pop} < 500$)	2 ($100 < \text{radius} \leq 150$ miles)
Low	1 ($1 \leq \text{rain anomaly} < 3$)	1 ($0 < \text{temp anomaly} \leq 0.25$)	1 ($25 \leq \text{pop} < 250$)	1 ($150 < \text{radius} \leq 200$ miles)
Very Low	0 (rain anomaly < 1)	0 (temp anomaly ≤ 0)	0 ($0 \leq \text{pop} < 25$)	0 (no area is designated as zero) (radius > 200 miles)
Weightage	0.25	0.25	0.25	0.25

Table S2. Risk Level Classification for model B.

Risk level	Precipitation anomalies (mm/day)	Temperature anomalies (°C)	Extreme rainfall	Elevation	Population densities (count per km ²)	Wind speed
Very high	4 (rain anomaly > 10)	4 (temp anomaly > 0.65)	Rain ≥ 480	4 (Elv ≤ 25)	4 (pop ≥ 1000)	4 ($120 < \text{wind} \leq 160$ mph)
High	3 ($7 < \text{rain anomaly} \leq 10$)	3 ($0.60 < \text{temp anomaly} \leq 0.65$)	3 ($360 \leq \text{rain} < 480$)	3 ($25 < \text{Elv} \leq 50$)	3 ($500 \leq \text{pop} < 1000$)	3 ($80 < \text{wind} \leq 120$ mph)
Moderate high	2 ($3 < \text{rain anomaly} \leq 7$)	2 ($0.30 < \text{temp anomaly} \leq 0.60$)	2 ($240 \leq \text{rain} < 360$)	2 ($50 < \text{Elv} \leq 75$)	2 ($250 \leq \text{pop} < 500$)	2 ($60 < \text{wind} \leq 80$ mph)
Low	1 ($0 < \text{rain anomaly} \leq 3$)	1 ($0 < \text{temp anomaly} \leq 0.30$)	1 ($120 \leq \text{rain} < 240$)	1 ($75 < \text{Elv} \leq 100$)	1 ($25 \leq \text{pop} < 250$)	1 ($40 < \text{wind} \leq 60$ mph)
Very Low	0 (rain anomaly ≤ 0)	0 (temp anomaly ≤ 0)	0 (rain < 120)	0 (Elv > 100)	0 ($0 \leq \text{pop} < 25$)	0 (wind $= 40$ mph)
Weightage	15%	10%	25%	10%	15%	25%

Table S3. Risk Level Classification for model A Plus.

Risk level	Precipitation anomalies (mm/day)	Temperature anomalies (°C)	Cloud height (m)	Building damage	Cloud temperature (k)	Population densities (count per km²)	Wind speed
Very high	4 (rain anomaly ≥ 15)	4 (temp anomaly > 2)	4 (Height > 5450)	4 (HADR > 0.11)	4 (cloud temp > 126)	4 (pop ≥ 1000)	4 (wind > 18)
High	3 (5 \leq rain anomaly < 15)	3 (0.50 $<$ temp anomaly ≤ 2)	3 (3500 $<$ Height ≤ 5450)	3 (0.08 $<$ HADR ≤ 0.11)	3 (100 $<$ cloud temp ≤ 126)	3 (500 \leq pop < 1000)	3 (10 $<$ wind ≤ 18)
Moderate high	2 (3 \leq rain anomaly < 5)	2 (0.25 $<$ temp anomaly ≤ 0.50)	2 (2000 $<$ Height ≤ 3500)	2 (0.04 $<$ HADR ≤ 0.08)	2 (50 $<$ cloud temp ≤ 100)	2 (250 \leq pop < 500)	2 (5 $<$ wind ≤ 10)
Low	1 (1 \leq rain anomaly < 3)	1 (0 $<$ temp anomaly ≤ 0.25)	1 (500 $<$ Height ≤ 2000)	1 (0 $<$ HADR ≤ 0.04)	1 (5 $<$ cloud temp ≤ 50)	1 (25 \leq pop < 250)	1 (2 $<$ wind ≤ 5)
Very Low	0 (rain anomaly < 1)	0 (temp anomaly ≤ 0)	0 (Height ≤ 500)	0 (HADR ≤ 0)	0 (cloud temp ≤ 5)	0 (0 \leq pop < 25)	0 (wind ≤ 2)
Weightage	15%	10%	15%	10%	15%	10%	25%

Table S4. Risk Level Classification for model B Plus.

Risk level	Precipitation anomalies (mm/day)	Temperature anomalies (°C)	Extreme rainfall	Elevation (m)	Population densities (count per km²)	Wind speed	Building damage	Cloud height (m)	Cloud temperature (k)
Very high	4 (rain anomaly ≥ 10)	4 (temp anomaly ≥ 0.65)	Rain ≥ 480	4 (Elv ≤ 25)	4 (pop ≥ 1000)	4 (wind > 18)	4 (HADR ≥ 0.11)	4 (Height > 5450)	4 (cloud temp > 126)
High	3 (7 \leq rain anomaly < 10)	3 (0.60 \leq temp anomaly < 0.65)	3 (360 \leq rain < 480)	3 (25 $<$ Elv ≤ 50)	3 (500 \leq pop < 1000)	3 (10 $<$ wind ≤ 18)	3 (0.08 \leq HADR < 0.11)	3 (3500 $<$ Height ≤ 5450)	3 (100 $<$ cloud temp ≤ 126)
Moderate high	2 (3 \leq rain anomaly < 7)	2 (0.30 \leq temp anomaly < 0.60)	2 (240 \leq rain < 360)	2 (50 $<$ Elv ≤ 75)	2 (250 \leq pop < 500)	2 (5 $<$ wind ≤ 10)	2 (0.04 \leq HADR < 0.08)	2 (2000 $<$ Height ≤ 3500)	2 (50 $<$ cloud temp ≤ 100)

Risk level	Precipitation anomalies (mm/day)	Temperature anomalies (°C)	Extreme rainfall	Elevation (m)	Population densities (count per km ²)	Wind speed	Building damage	Cloud height (m)	Cloud temperature (k)
Low	1 (0 < rain anomaly < 3)	1 (0 < temp anomaly < 0.30)	1 (120 ≤ rain < 240)	1 (75 < Elv ≤ 100)	1 (25 ≤ pop < 250)	1 (2 < wind ≤ 5)	1 (0 < HADR < 0.04)	1 (500 < Height ≤ 2000)	1 (5 < cloud temp ≤ 50)
Very Low	0 (rain anomaly ≤ 0)	0 (temp anomaly ≤ 0)	0 (rain < 120)	0 (Elv > 100)	0 (0 ≤ pop < 25)	0 (wind ≤ 2)	0 (HADR ≤ 0)	0 (Height ≤ 500)	0 (cloud temp ≤ 5)
Weightage	10%	5%	15%	12.5%	10%	12.5%	10%	12.5%	12.5%