

Urban Heat Island (UHI) Forecasts over Selected Global Cities

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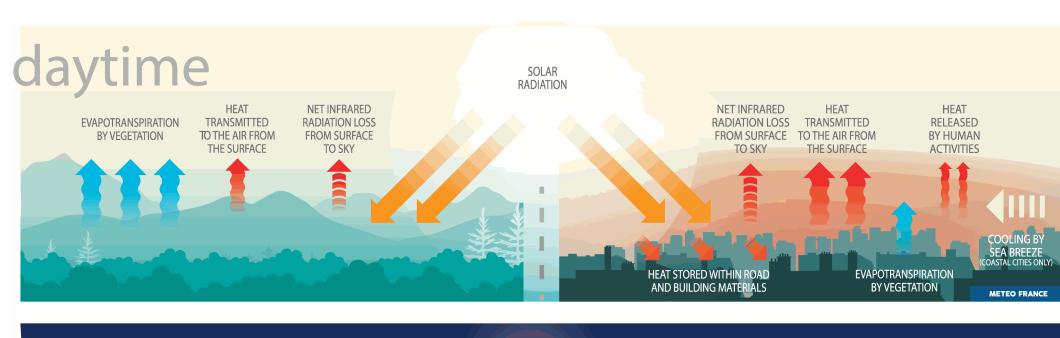
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ABSTRACT

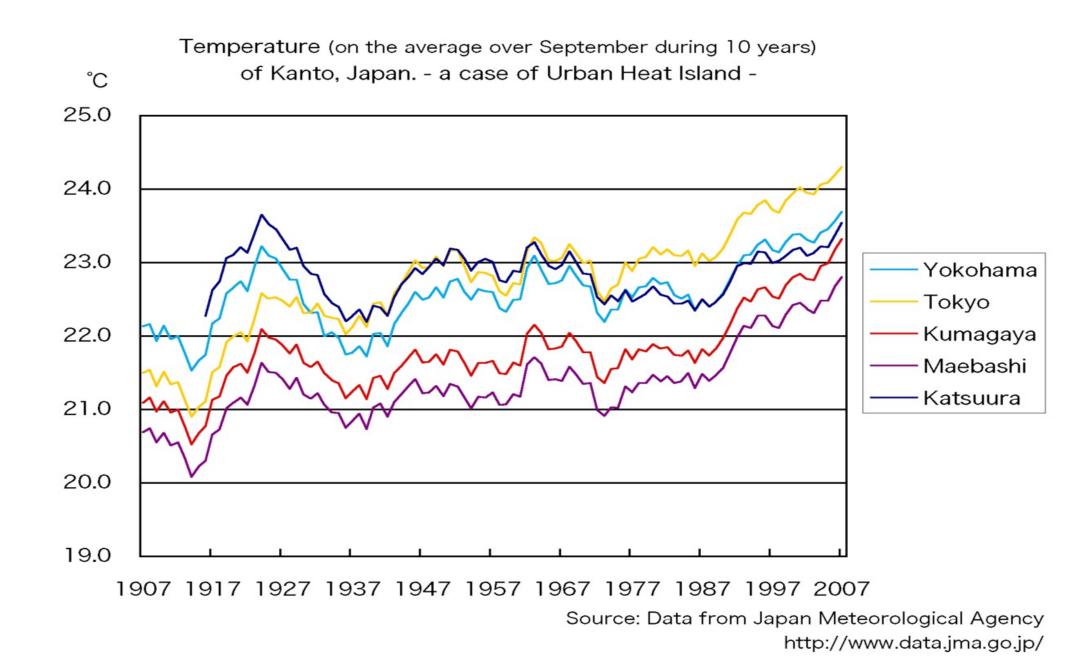
Sub-seasonal Heat-heath early warning is a major focus of the Climate Prediction Center (CPC) International Desk (ID). The CPC ID has developed tools to improve its global heat hazards forecasting capability based on the Global Ensemble Forecast System version 12 (GEFSv12). As part of the President's Emergency Plan for Adaptation and Resilience (PREPARE) project, CPC ID has developed Urban Heat Island (UHI) forecasts across the globe, in more than 400 cities, with a special emphasis on the Caribbean, Pacific Islands, and Africa. This presentation takes a deep dive into the GEFSv12 application for the extreme heat forecast and Urban Heat Island (UHI) alert, which is based on the climatological percentile thresholds computed from GEFSv12 reforecasts. Our week-1 to week-4 forecasts issue three alert levels, with respect to the 80th, 90th, and 95th percentile thresholds, for moderate, severe, and extremely severe heathealth warnings. The UHI product performs well in most cities where there is less topographical variation; however, it suffers from cold biases over small island areas. We will discuss major issues and challenges associated with UHI alert products from the GEFSv12, in particular, the forecast biases across the Caribbean islands. This GEFSv12 application effort represents a critical step in advancing our diagnosing and predicting heatwave and then service capability in heat-health early warning at CPC.

INTRODUCTION

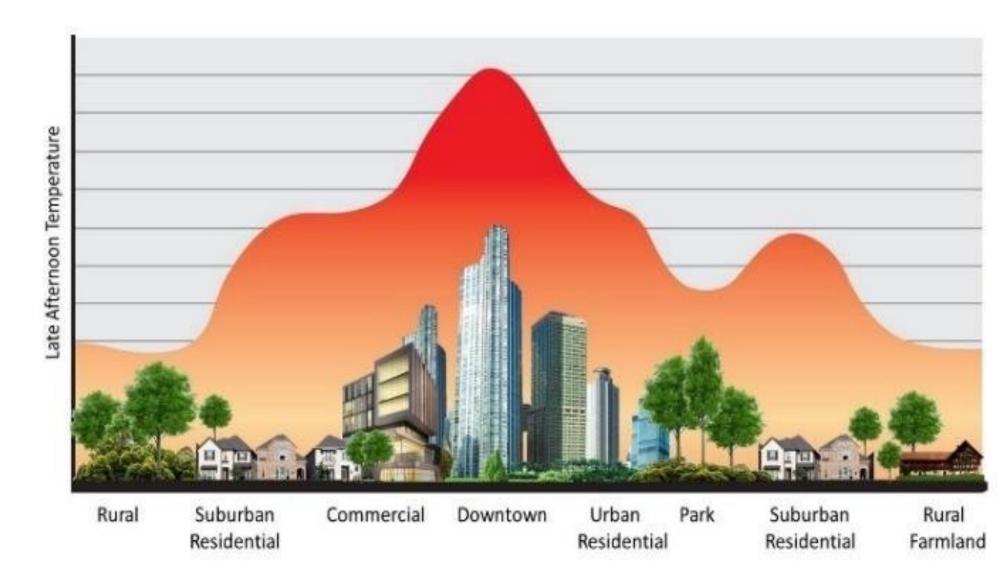




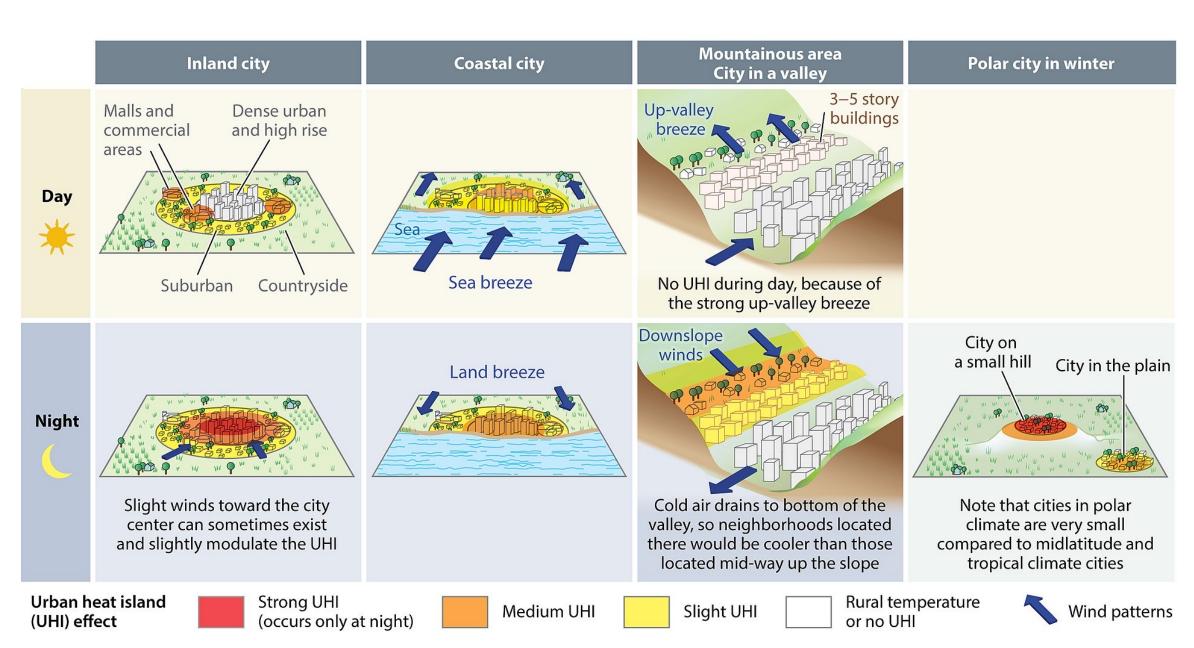
The main processes leading to the urban heat island. Urbanization of the surface and reduction of the vegetation cover strongly modify the energy exchanges. During the day, a large part of the radiation coming from the sun heats the urban materials; this stored heat is released at night, limiting the nighttime cooling of the air in cities and creating the urban heat island. It is also influenced and modulated by the heat released by human activities and the air flow from the countryside and, for coastal cities, from the sea or large lakes. Figure reproduced with permission from Météo-France 2020; copyright Météo-France. (From Masson et al 2020)



URBAN HEAT ISLAND (UHI)



"Urban heat islands" occur when cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. This effect increases energy costs (e.g., for air conditioning), air pollution levels, and heat-related illness and mortality



Masson V, et al. 2020.

Impact of UHI

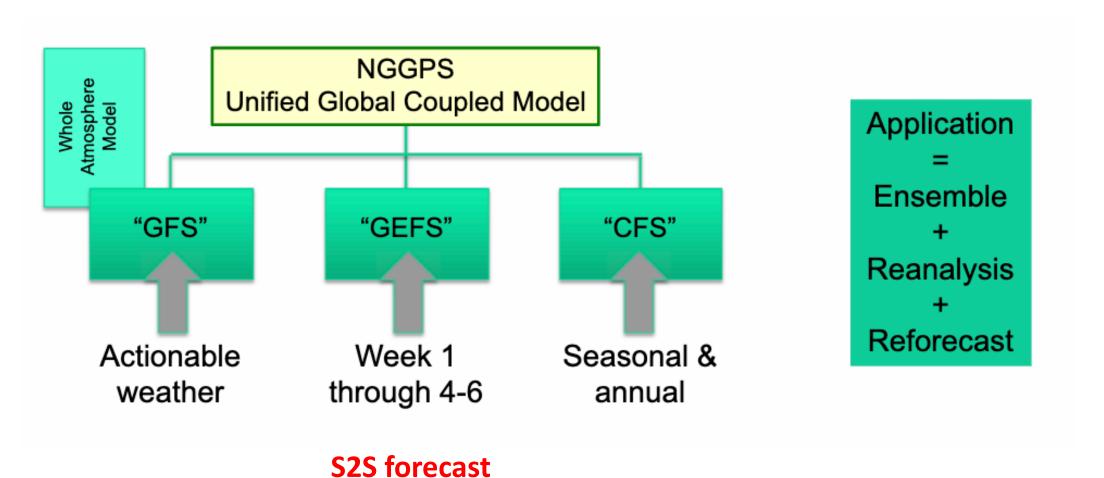
- On weather and climate
- On human health
- On energy usage for cooling
- On water bodies and aquatic organisms
- On animals

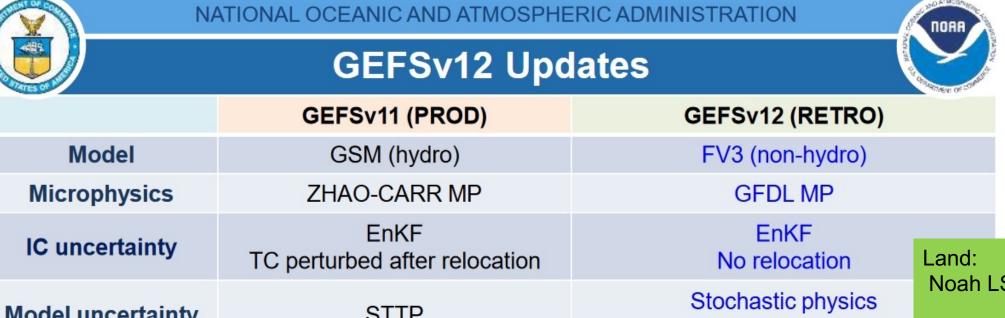


Urban Heat Indices

- Primary
- Tmax/HI: Probability (POE) Tmax/HI > a threshold
- Supplementary
- Dry/Rain event: PRCP < threshold
- Wind Speed: daily wind speed < 5m/sec
- Cloud Cover: cover <50%
- The tools are available online @ <u>https://ftp.cpc.ncep.noaa.gov/International/extreme_fcst/</u> under Excessive Heat/ GEFS – Heat

GEFSV12 FORECAST





IC uncertainty	TC perturbed after relocation	No relocation Land		
Model uncertainty	STTP	Stochastic physics	Noah LSM GEFSv13:	
Resolution	TL574L64 (~33km), 0-8 days TL382L64 (~50km), 8-16 days	C384L64 (~25km)	MP LSM	
Forecast days	16 days	16 days (06Z, 12Z and 18Z) 35 days (00Z)		
Ensemble size	21 members	31 members		
Ocean forcing	Persistent + relaxation SST	NSST and 2-tiered SST		

Heat Alert

Severe Heat:

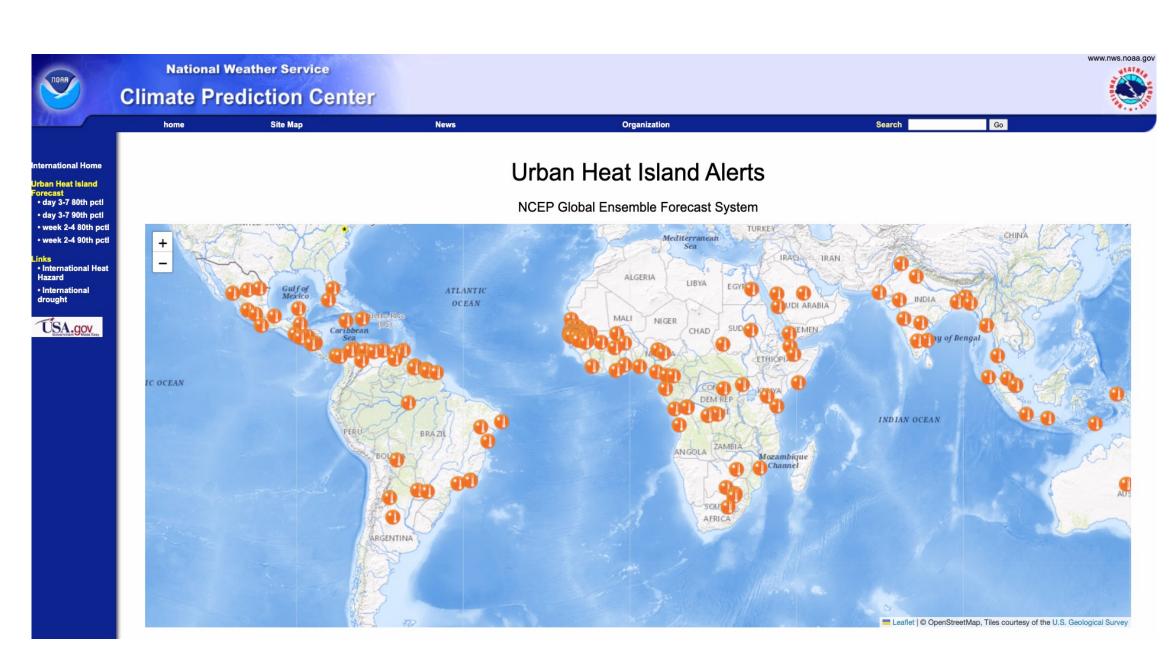
Tmax/HI > 90th percentile

Excessive Heat:

Tmax/HI > 80th percentile

For the Sahel region in Africa: Tmax/HI hybrid > 41°C for at least 3 consecutive days is also considered as Excessive Heat

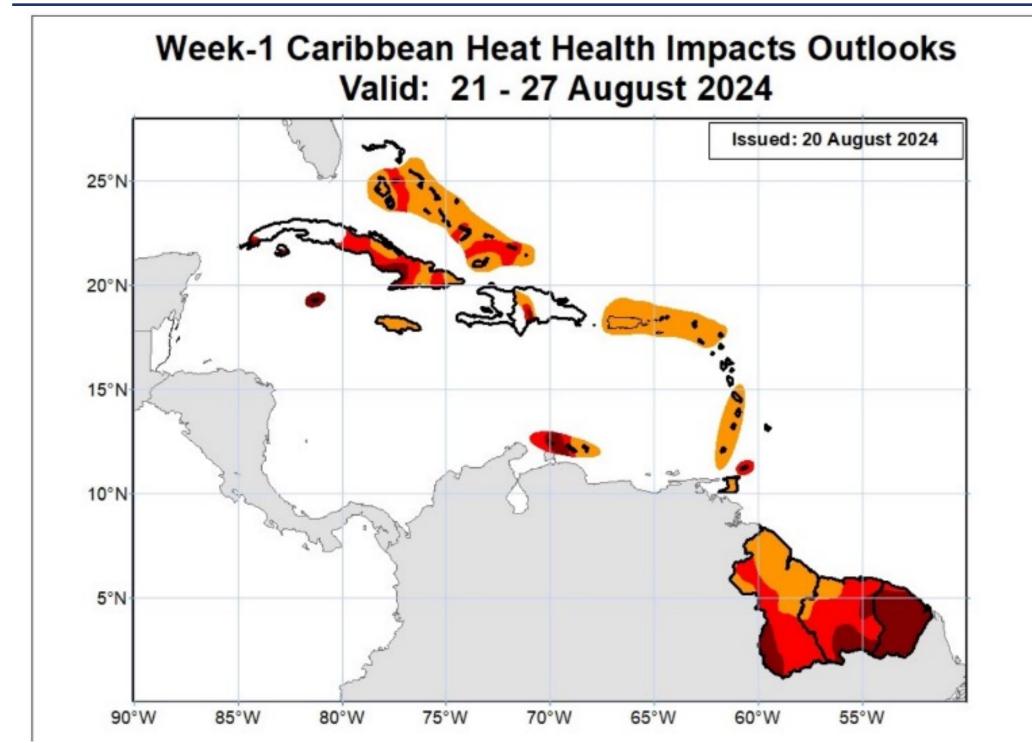
For each category, ensemble forecast probabilities (POE) in excess of 55% are used as a guidance from UHI alert.



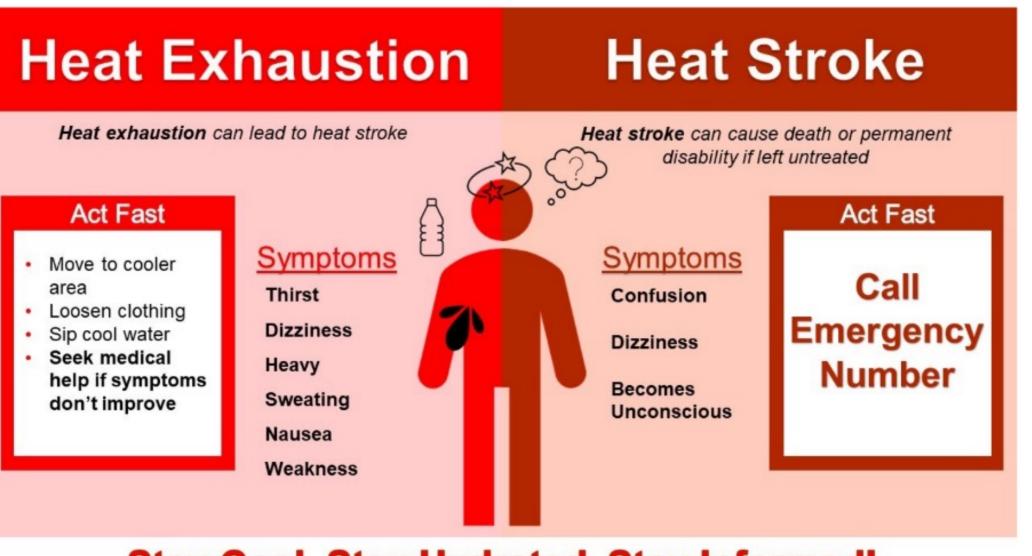
Currently, CPC international desk daily real-time forecast 400+ cities globally. the detail station list

https://www.cpc.ncep.noaa.gov/products/international/UHI/stn/glb_day_80.html

PREPARE CARIBBEAN EARLY WARNING WORKSHOP

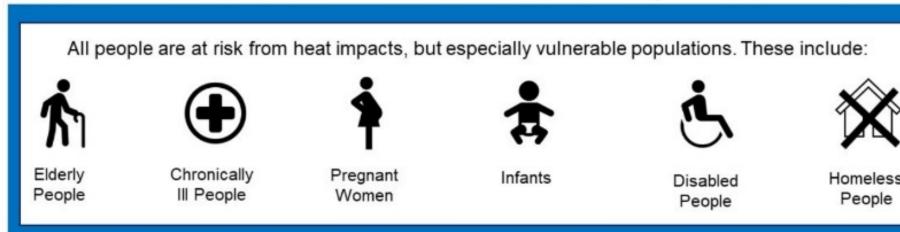


LEVEL OF ALERT	ALERT	PEOPLE MOST AT RISK	HEALTH IMPACTS
	Extremely Severe Heat Extremely Hazardous	Entire Population	Possible Aggravation of Cardio-Vascular and Pulmonary Diseases.
	Severe Heat Very Hazardous	People involved in outdoor activities, homeless, and other vulnerable groups	Fatigue, Severe Dehydration, Cramps and Fainting.
	Moderately Severe Heat Hazardous	People sensitive to heat, people with pre-existing health conditions, infants, young children, and the elderly	Dehydration, Headache, Dizziness, Confusion.



Stay Cool, Stay Hydrated, Stay Informed!

Vulnerable Groups



General Recommended Actions



ACKNOWLEDGEMENT

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