More frequent, more intense heat waves in store for New York

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Heat waves like those that baked the Northeast in July are likely to be more frequent and more intense in the future, with their effects amplified in densely built urban environments like Manhattan, according to climate scientists at The City College of New York (CCNY).

"Manhattan is subject to an urban heat island effect because its physical landscape is significantly different from the surrounding suburbs," said Dr. Jorge Gonzalez, NOAA-CREST Professor of Mechanical Engineering in CCNY's Grove School of Engineering. "This makes heat waves here more intense because Manhattan cannot cool off as readily as outlying areas." Factors that contribute to the urban heat island effect include energy demand, air quality, asphalt surfaces and exhaust fumes.

Data collected by City College's New York City Meteorological Network (NYCMetNet), indicate that during the first July heat wave overnight low temperatures ran 10 to 15 degrees (Fahrenheit) higher in Manhattan than in Long Island or in western New Jersey, while daytime highs were roughly the same. NYCMetNet is a networked system of several hundred ground-based sensors throughout metropolitan New York that gather weather and climate data.

High temperatures do not dissipate as quickly in Manhattan as in other areas because of the large amount of stored energy contained in its massive buildings, Professor Gonzalez explained. "While surrounding suburban and green areas may perceive the same maximum temperatures, the built regions will perceive them for longer periods of

time."

Part of NYCMetNet's mission is to study and better describe urban climate and weather by using New York City as an outdoor laboratory to observe environmental processes in complex urban environments. "Our goal is to produce the next generation of physical models to describe climate and weather," he continued. "Our vision is to show how cities modify climate and weather to scales that are relevant to people's lives."

Among the issues it will address is the role played by climate change in the past and present as well as in the future. Professor Gonzalez expects that climate change will result in more frequent and intense heat waves and that areas subject to urban heat island effect will get larger as the built environment expands.

"To mitigate these effects, landlords and policymakers should strive greening the cities with urban parks and vegetated roofs, and motivate construction and retrofits that are thermally light and reflective to the sun when possible," he said.

Another research thrust is the role played by aerosols, which are fine particles of solids or liquids in the atmosphere. Urban areas tend to generate aerosols, and the resulting humidity could modify precipitation patterns by interacting with clouds and affecting the energy balance, Professor Gonzalez explained. "The presence of pollution could increase or diminish rainfall. It could change the frequency and severity of storms, as well."

Split storms, like the ones that deluged some Long Island communities earlier this month while leaving neighboring villages dry, could also be a phenomenon influenced by cities. "Because of heat and aerosols, cities could play a role by acting as a barrier to storm fronts, resulting in very concentrated storms in scattered areas."

Further complicating the matter is the fact that different aerosols can have complex indirect effects with respect to heating and cooling, said Dr. Mark Arend, a research associate with NYCMetNet. "It's a very complex problem."

NYCMetNet includes roof-monitoring stations with sensors to monitor wind, temperature and humidity as well as surface stations capable of vertical profiling, i.e. gathering data from different altitudes. For analysis purposes, NYCMetNet data is integrated with satellite data obtained through the NOAA-CREST Center at City College, a nationally recognized leader in remote sensing technology and applications.

"The vertical observation capabilities are a unique and important feature," Dr. Arend noted. "To get models to predict accurately, we need a three-dimensional understanding of the atmosphere."

The next research step will be to show what happens when variables such as urban growth or global climate change are changing. The program's long-term goal is to determine how changes to the urban environment impact a region's climate.

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