



## Here Comes Urban Heat

NASA scientists are using space age technology to understand how characteristics of the urban environment create "urban heat islands."

**March 16, 2000:** As sweltering summer days linger just around the corner, scientists are working to demonstrate the verity of Atlanta's popular epithet - "Hotlanta."

Urban Atlanta can reach 5 to 8 degrees Fahrenheit or higher than surrounding rural areas.

"Heat hunters" Dr. Dale Quattrochi and Dr. Jeff Luvall study the urban heat island effect for the Global Hydrology and Climate Center, managed by NASA's Marshall Space Flight Center in Huntsville, Alabama.



**Above:** Equipped with remote sensing technology developed for the space program, "heat hunters" fly NASA aircraft over urban areas, documenting patterns of heat formation in large metropolitan centers. [This simulation](#) shows how these remote sensing studies identify thermal "hot spots" in metropolitan Atlanta and its suburbs. It also shows potential weather phenomenon created by Atlanta's sizeable urban heat island.

Heat islands are created when city growth alters the urban fabric by substituting manmade asphalt roads and tar roofs and other features for forest growth. Trees provide shade and cool the air through evaporation. The hard, dark surfaces like pavement store heat during the day, heat that is then released at night, keeping the city hotter for longer periods of time. Air-conditioning is then kicked into overtime to combat the heat.



The urban heat island phenomenon was first discovered in the early 1800s in London. The focus of research now is on the driving forces, magnitude and overall extent of the effect.

Quattrochi says that two major goals of their studies are to "understand how the characteristics of the urban landscape drive this urban heat island effect and how urbanization and growth shape the dynamics of the effect."

One concern is the ability of urban heat islands to create or alter weather patterns - specifically to cause thunderstorm activity.

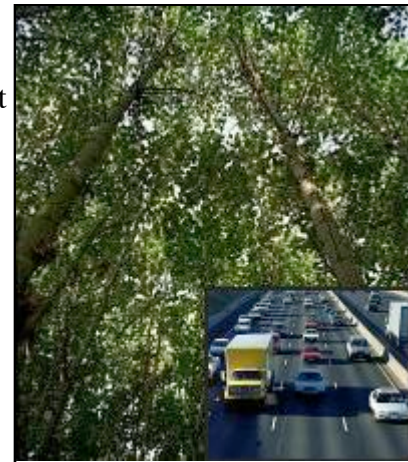
As heat is generated and trapped in a city, hot air rises and forms a "chimney sitting over a city [and] ... sucks in the cooler air," creating winds. The dome of heated air generates convective clouds that bring rain and thunderstorms. Urban heat islands cause precipitation to fall at unusual times like 2 a.m. - "not your typical garden variety southeastern storm," says Quattrochi.



The 1996 Olympics in Atlanta afforded scientists a chance to scrutinize data collected by the National Weather Service's ground-based meter used to predict weather for the athletes. Urban meteorologists Robert Bornstein and Qing Lu Lin of San Jose State University found that 5 of 9 days of precipitation were caused by the urban heat island effect.

By analyzing Landsat 7 images from the 1970s to the present, scientists can determine trends in urbanization and rising temperatures. They found that suburban development in Atlanta gobbled up 380,000 acres of trees from 1973 to 1992.

**Right:** Heat builds in a city when forests are cut down to build roads. Not only do paved roads hold in heat, cars also compound the problem by generating smog and more heat (inset). Photo credits: Department of Energy, Warren Gretz.



"If you believe in averages," says Quattrochi, "that's 55 acres of trees per day."

While much of the growth in Atlanta has been residential in nature, Quattrochi cautions that commercial and residential development often go hand-in-hand. As Atlanta expands, more trees are cleared to accommodate the growth. Trees are replaced with paved roads that retain heat and host the deluge of traffic -- traffic that now must travel the longest average daily commute in the nation.

Vehicle emissions and rising temperatures also contribute to an increase in ozone, a pollutant detrimental to the environment and human health. During last year's ozone season in Atlanta, which runs from the end of April to the end of September, the city suffered through 62 straight days of ozone alerts. Quattrochi says that, based on models, there is potential for a temperature decrease of 2 degrees Celsius in Atlanta to lower the ozone by 10 to 14 percent, a significant drop.

With no indication that urban sprawl will slow in the near future scientists are searching for ways to curb urban heat islands.

"Why do rooftops and asphalt have to be black?" asks Quattrochi.



**Left:** A worker installs white roofing on an Atlanta school. Photo credit: Department of Energy.



Quattrochi and other team members hope that state and local governments will use their findings as a springboard to adopt "cool community measures." These alternatives include planting trees and using reflective roofing materials that can reflect 60-80 percent of incoming sunlight, more politically viable options than air quality restrictions.

The 1996-2000 NASA-funded study in Atlanta, The Atlanta Land-use Analysis: Temperature and Air-quality (ATLANTA), has been mirrored by the Urban Heat Island Pilot Project (UHIPP). This study sequence, also funded by the US Environmental Protection Agency, has been conducted in Baton Rouge, Sacramento and Salt Lake City. Up next for satellite data analysis are Los Angeles, Phoenix, Tucson, Chicago, Nashville and Houston. Houston -- the nation's fourth largest and most heavily polluted city -- has no zoning laws.

Quattrochi professes an ulterior motive for his work. He is concerned with the prediction that by 2025, 80 percent of the world's population will live in cities.

"We need to make cities more sustainable, habitable environments -- for our kids, their kids and future progeny."

*The Global Hydrology and Climate Center is a joint venture between government and academia to study the global water cycle and its effect on Earth's climate. Jointly funded by NASA and its academic partners, and jointly operated by NASA's Marshall Space Flight Center in Huntsville, Ala., and the University of Alabama in Huntsville, the Center conducts research in a number of critical areas.*

[High in the Sky, NASA 'Heat Hunters' Combat Urban Phenomenon](#) - - NASA Press Release

[Welcome to the Thunder Dome](#) - Scientists will use Landsat-7 data for further research on Urban Heat Islands. (April 26, 1999 story)

[Stepping back to get a closer view](#) - Scientists will use Landsat-7 data for further research on Urban Heat Islands. (April 21, 1999 story)

[Salt Lake City shows hot and cold spots](#) - Mountains to east provide cool refuge. (July 21, 1998 story)

[Sacramento glows with Urban Heat](#) - More data from further west. (July 1, 1998 story)

[NASA Climate News](#) - research on urban heat islands.

[Global Hydrology and Climate Center](#) - NASA Earth science

[Heat Island Group](#) - definitions and developments of urban heat islands.

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