

Growing Population Warming East African Nights?

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Nights are getting hotter in Nairobi and other inland cities as growing populations change sensitive local weather patterns, according to research at The University of Alabama in Huntsville.

Night time low temperatures over cities and towns in Kenya and Northern Tanzania climbed about one degree Fahrenheit (0.56 C) over the past 35 years while daytime high temperatures were stable, says Dr. John Christy, director of UAHuntsville's Earth System Science Center and a former teacher at a Baptist high school in Kenya.

“That’s a clear signal that human development is changing temperatures at the surface by changing the natural surface,” Christy said. “If this change was caused by increases in [greenhouse gases](#) like carbon dioxide you would expect to see both day and night time temperatures rising.”

Results of this research have been published on-line by the American Meteorological Society and have been accepted for publication in the *AMS Journal of Climate*.

Population growth and its associated development warm air near the surface at night by disrupting the formation of a cool, shallow layer of air that often collects near the ground after sundown while warmer air is suspended above it.

Development and population growth do at least three things to disrupt the boundary layer and bring warmer air down to the surface:

-- Buildings increase the surface “roughness,” which increases turbulence in surface breezes;

-- Asphalt and concrete absorb more [solar radiation](#) than the natural landscape. They release that energy as heat after sunset (something they do more efficiently than soil and plant cover). This heat warms the air near the surface, delaying or preventing the cool boundary layer from forming.

-- Small particles (called aerosols) in exhaust from cars and trucks as well as smoke from cooking and heating fires may trap heat rising from the surface that otherwise would radiate into space. This is similar to the warming caused by low-lying night clouds.

“You aren’t really adding any heat to the environment, you’re just mixing heat that was already there down through the boundary layer to the surface,” said study co-author Dick McNider, professor emeritus at UAHuntsville. “Every time the shallow boundary layer breaks up, the surface temperature goes up three, four, five degrees or more. If that happens several times during the year, it is going to show up as a warming trend. It is going to look like heat is being added to the system.”

That regional surface warming trend is exactly what is seen in the major surface datasets, which collect data from a small number of automated thermometers in Nairobi and a few other urban areas in East Africa.

By comparison, Christy looked at data from 111 places in which weather data was recorded as far back as 1904. These include former British coffee and tea plantations, and town weather stations operated by railroads, planters and British colonial officials.

“We see the greatest warming in the past 50 years,” Christy said. “That’s when you see the nighttime trend start upward. That’s when the

population boomed. Just since I was there in 1973 to 1975 the population has jumped from 14 million to about 38 million people.

"When I taught in Nyeri, it was a town about 10,000 people with dirt (or mud) streets leading down to the market. Now it's a city of about 100,000 people. It's easy to see how the local thermometer would be influenced by that growth.

"When you drive into those cities at night you just see a pall of smoke," Christy said. "Much of the tropical, less-developed world is going to have this meteorological feature, so any indication of a warming climate is going to be influenced by population growth and nighttime minimum temperatures."

Because of that and other problems discovered in a 2006 study of temperature trends in Central California, Christy says the most accurate way to measure climate trends at the surface is to measure only daytime maximum temperatures. During most days convection from daytime heating has always mixed air from the surface with air in the troposphere and vice versa, so daytime surface readings have always measured temperatures in a larger portion of the atmosphere.

Christy also looked at upper atmosphere temperature data collected by satellites and by thermometers carried aloft by balloons launched from Nairobi. Neither shows a warming trend over East Africa.

Christy led the study with help from UAHuntsville colleagues McNider and William Norris.

Provided by University of Alabama Huntsville

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