Thermal Behavior of Urban Surfaces Studied by Infrared Imaging

Antoine Izaguirre[1], Zachary Grandison[2], Thomas Legbandt[3] , and Fred Moshary[3]
[1] North Plainfield High School, North Plainfield, New Jersey, 07060, USA
[2] Frank Sinatra School of the Arts, Astoria, New York, 11101, USA
[3] Dept. of Electrical Engineering, City College of New York, New York, New York, 10031, USA
Email: wiitoine@gmail.com

Heat waves are a growing problem, especially in urbanized areas such as New York City. 2015 was the warmest year recorded in history and 2016 is expected to be even warmer [1]. In this study, we compare heat waves to average summer days using thermal infrared imaging. Temperatures will keep rising due to global warming. The Urban Heat Island(UHI) is also increasing the temperature of urban areas such as New York City which will increase the intensity of heat waves in those areas. The UHI is a cumulative effect of urbanization. It is defined as the rise in temperature of any man-made area, resulting in a well-defined, distinct "warm island" among the "cool sea" represented by the lower temperature of the area's nearby natural landscape. This is due to modified land-cover and the modification of physical and chemical properties of the atmosphere.[2] Climate change is only making the heat waves more common and stronger.[3] UHI's are also contributing to climate change by heating up urban areas and to global warming since it increases the amount of greenhouse gases emitted.[2] NYC needs to take preemptive measures to lower temperatures and decrease human emissions to not only reduce the effects of the urban heat island but to also decrease the effects of climate change and global warming because it can reduce the severity of heat waves.

Thermal images of everyday objects such as sidewalks, building, walls, grassy areas, and parks were taken during heat waves and regular summer days using a FLIR E60 thermal infrared camera. The thermal infrared images give the temperature of all objects in the image using the infrared radiation (which is not visible to the human eye) given off by them. It does this by converting the intensity of the infrared radiation to temperature (Brightness Temperature) using Black Body Radiation Theory. The pictures can be viewed in infrared radiation intensity or false colored temperature images. Pictures were taken around the Grove School of Engineering from the roof in various places. The pictures were taken in 20 minute intervals in two sets of three days, with one set experiencing a heat wave.

Figure 1.

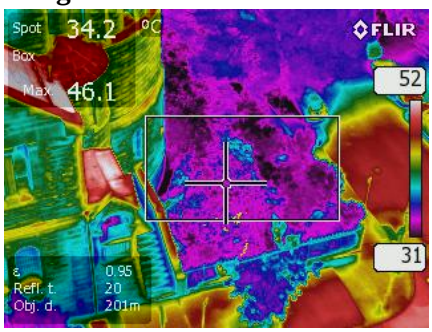

Figure 2.

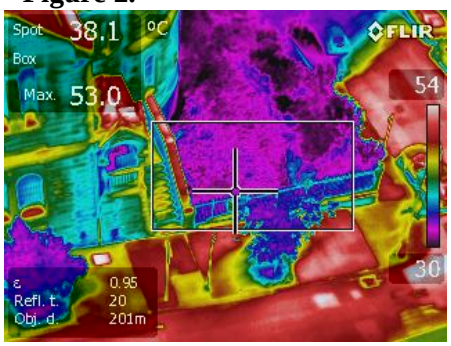

Figure 1. Image of an outdoor area near the Grove School of Engineering. As expected, the grass shows a cooler temperature than sidewalk next to it, but because of the heat wave, it still has a very high temperature even though it's still in the morning. **Figure 2.** This image shows the same area as Figure 1, but in the afternoon. The temperature readings of all surfaces got warmer, especially the sidewalk, which was about 10 degrees(°F) higher.

[1] Kacey Deamer, "Hottest Year Ever? 2016 Burns Through Heat Records, NASA Says**"** (2016).
[2] Camilo Pérez Arrau, Marco A. Peña, "The Urban Heat Island (UHI) Effect" (2015).
[3] Justin Wordland "Why This Summer Is So Hot—And Why the Future Will Be So Much Hotter"(2016).