Thermal Behavior of Urban Surfaces Studied by Infrared Imaging

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Abstract

2015 was the warmest year recorded in history and 2016 is expected to be even warmer [1]. The goal of this project is to compare heat waves to average summer days using thermal infrared imaging. As temperatures keep rising heat waves will become more common and will be especially severe in urbanized areas such as New York City. The Urban Heat Island(UHI) is also increasing the temperature of urban areas which will increase the intensity of heat waves in those areas. This is due to modified land-cover and the modification of physical and chemical properties of the atmosphere [2]. Climate change is only making heat waves harsher and more frequent [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].

Methods and Materials

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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. This is the church we took thermal images of to compare the grass and building walls temperature during the heat wave and regular summer days.

Figure 3. This is entrance to the Grove School of Engineering we took thermal images of to compare the concretes temperature during the heat wave and regular summer days.

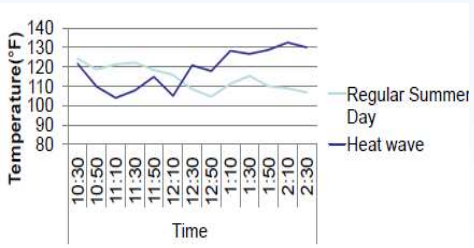

Figure 5. This graph shows the temperature of concrete slabs during a heat wave and regular summer days.

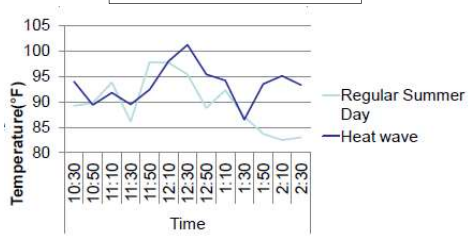

Figure 6. This graph shows the temperature of patches of grass during a heat wave and regular summer days.

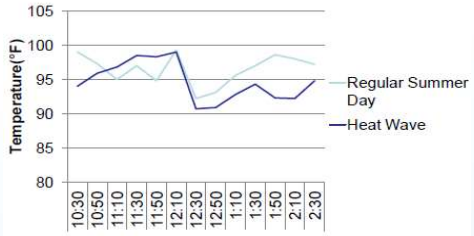

Figure 7. This graph shows the temperature of the wall of the church during a heat wave and regular summer days.

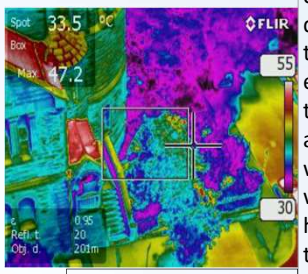

Figure 2. This is the thermal infrared image of the church in Figure 1.

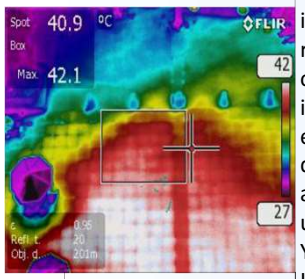

Figure 4. This is the thermal infrared image of the entrance to the Grove School of Engineering in Figure 3.

Observations and Conclusion

•The areas studied around The City College of New York campus were noticeably warmer during the heat wave compared to average summer days. As shown by the graph the concrete and grass experienced increases in temperature during the noon and afternoon and were warmest during the heat wave. The church wall however decreased in temperature around noon, possibly due to an increase in building shade as the day progressed.

•Heat waves noticeably increase the amount of radiation emitted from an object. This could lead to increased amounts of people experiencing heat stroke, dehydration, heat exhaustion and death, especially in urbanized areas such as New York City due to the UHI. However, the effects of heat on urbanized areas can be mitigated effectively by strategically planting vegetation around the area.

References

References

[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).

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