**NASA DEVELOP National Program**



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Arizona Health & Air Quality II

Enhancing Extreme Heat Intervention and Preparedness Activities in Maricopa County, Arizona with NASA Earth Observations

 **Technical Report** 

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# I. Abstract

[Placeholder - do not put anything here until the final draft submission. The abstract in the project summary is where the working draft of the abstract should “live”]

**Keywords**

Public Health, Urban Heat Island, MODIS, Land Surface Temperature, Landsat, OPeNDAP

# II. Introduction

**Community Concern and Study Area**

For over a decade, academics and decision-makers have recognized the dangers that extreme heat pose to human health and, as a result, many researchers have explored its effects as well as possible mitigation strategies (McMichael et al., 2008; Harlan et al., 2013). The desert ecoregions in the southwest U.S. are becoming at risk for increased rates of heat related illness and death due to global climate change. While populations in arid climates can be more acclimated to elevated temperatures, the elderly, the poor, the homeless, non-native English speakers, and the socially isolated are all more vulnerable to heat related illness and death (MCDPH, 2014). In these arid climates, the majority of heat related service calls are made during the monsoon season in the later summer months of July and August, when elevated temperatures and high humidity are most prevalent (Golden et al., 2008).

The city of Phoenix and its surrounding metropolitan areas within Maricopa County, Arizona delineate the study area for this project. The prevalence of impervious surfaces within the city, such as concrete and asphalt, trap heat from incoming solar radiation through a phenomenon known as the Urban Heat Island (UHI) effect. In a typical UHI, heat trapped during the day will be released into the lower atmosphere at night, increasing nighttime temperatures—thus, the effects of the UHI are relatively greater at night versus during the day (Hardegree, 2006). Elevated temperatures within Maricopa County have an adverse effect on the health of its citizens. In addition to causing heat stroke, elevated temperatures can lead to cramps, exhaustion, heat syncope, and can exacerbate pre-existing respiratory and circulatory conditions (Scott et al., 2004). According to the Maricopa County Department of Public Health (MCDPH) 2013 annual report, there were 632 confirmed heat related deaths between 2006 to 2013.

**Project Partners and National Application Area**

In this study, the UHI effect in Maricopa County was analyzed using Aqua MODIS Land Surface Temperature data acquired during the summer months of April through October from 2006 to 2015. The project maintained its partnership with the Arizona Department of Health Services (ADHS), the Phoenix Heat Relief Network, the National Weather Service (NWS) Phoenix Forecast Office, the Environmental Remote Sensing and Informatics Lab (ERSL) at Arizona State University (ASU), and the Center for Policy Informatics (CPI) at ASU. The project objectives allowed for the creation of an automated python tool that will download MODIS data in near real-time to create heat maps of Maricopa County. The partners will be able to use this tool to understand spatial and temporal patterns of extreme heat events, which will better inform their heat mitigation strategies.

# III. Methodology

**Data Acquisition**

Manual collection of Aqua MODIS MYD11A1 version 005 data and Landsat 8 imagery were available through the NASA EarthData Search Client. This can be a lengthy process if downloading a large temporal range of HDF files. A case study was conducted in conjunction with the Atmospheric Science Data Center (ASDC) to include OPeNDAP data collection. Connection to the data portal was made available through PyDAP code which allowed users of the python tool to acquire near real-time imagery for processing.

Multiple collections of heat anomalies were obtained from University of Utah’s Mesowest API. The same 285 weather stations from the previous study were referenced to establish a baseline of temperature anomalies. Shape files of Maricopa County were obtained from the Maricopa County Health Department.

It was essential to use the same data from the previous term for proof of concept and to establish a baseline for continued analysis during demonstrations of the tool.

**Data Processing**

Data were processed through the automation of a python tool that clipped the image tiles against a .shp outline of Maricopa County. We determined the effectiveness of the clipped files by examining cloud coverage.

Scripts from the previous term were shared via Google Drive and used as a model for the development of the python tool. This helped ensure that results remained consistent between the two projects.

**Data Analysis**

All analysis was completed in python to produce figures or a specific function that will call on scripts written in R.

# IV. Results & Discussion

Insert images, graphs, maps, charts, etc. here. Choose the most important results to highlight here. No word cap, but two to six pages is a good range.

Things to discuss:

* Analysis of Results: What can you tell from your graphs, images, etc? What does this mean for your project?
* Errors & Uncertainty: What factors could you not account for, what things didn’t work out like you expected they would, etc.
* Future Work: If this project was to be selected for another term, what would be the focus? What other areas would be of interest?

# V. Conclusions

Final conclusions. Word count: 200-600 (~a page).

# VI. Acknowledgments

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration.

This material is based upon work supported by NASA through contract NNL11AA00B and cooperative agreement NNX14AB60A.

# VII. References

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# IV. Appendices

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