**NASA DEVELOP National Program**

****NASA Langley Research Center

**Spring 2016**

**Short Title: Arizona Health & Air Quality II**

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

**VPS Title:** Phoenix Rising: Urban Heat Island in Maricopa County

**Project Team & Partners**

**Project Team:**

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**Partner Organizations:**

Arizona Department of Health Services (ADHS) (End-user), POC: Matthew Roach; Boundary Organization

Phoenix Heat Relief Network (End-user), POC: Celina Brun

National Weather Service, Phoenix Forecast Office (End-user), POC: Paul Iniguez

Arizona State University, Environmental Remote Sensing and Informatics Lab (ERSL) (Collaborator), POC: Billie L. Turner II

Arizona State University, Center for Policy Informatics (CPI) (Collaborator), POC: Erik W. Johnston

**Project Details**

**Applied Sciences National Applications Addressed:** Health & Air Quality, Disasters, Climate

**Study Area:** Maricopa County, AZ

**Study Period:** April 2006 - October 2015

**Earth Observations & Parameters:**

Aqua, MODIS – land surface temperatures and climatology

Terra, ASTER – elevation

Landsat 7, ETM+ – land surface temperature

Landsat 8, OLI – land surface temperature

Suomi NPP, VIIRS – Day/Night Band reflectance

**Ancillary Datasets Utilized:**

* Arizona Meteorological Network (AZMet) - ground-based meteorological observations
* Weather Underground - ground-based meteorological observations
* Maricopa County Health Department - locations of Heat Relief Network cooling centers
* Arizona State University (ASU)-GIS - census tract shapefiles
* US Census/TIGER - census tract shapefiles
* ASU Urban Vulnerability to Climate Change project - Maricopa County heat vulnerability maps
* Maricopa County Department of Health (MCDPH) - maps of spatial variability in heat health outcomes
* MCDPH, ASU, and ADHS - responses from 2014 cooling center evaluation
* MCDPH - community public health evaluation (CASPER) survey responses
* NOAA NCEI - teleconnection indices
* USGS National Land Cover Dataset (NLCD) - impervious surface estimates

**Software Utilized:**

ArcGIS - Raster manipulation/analysis, image enhancement & map creation of Landsat 7 ETM+, Landsat 8 OLI, spatial statistics, Aqua MODIS, Terra MODIS/ASTER

Qualtrics - Survey and interview development and response recording

R - Statistical analysis of teleconnection indices and heat wave magnitudes and duration

Python 2.7 - Programming language to build the tool

Google Earth Engine - Web based Geospatial research tool

**Project Overview**

**80-100 Word Objectives Overview:**

To automate the creation of heat vulnerability maps of Maricopa Co., Arizona, with a python tool that the end-users can use to monitor heat severity. This will involve a case study with the Atmospheric Science Data center (ASDC) using OpENDAP data collection methods. Front-end development will allow for near real-time processing of MODIS imagery land surface temperature (LST) products. Census data will be used to provide aid to the hottest areas of the county and to assist residents of greatest need. Google Earth Engine or NASA NEX will also be utilized as a web-based GIS mapping service to make the tool more available to the public.

**Abstract:**

Extreme heat causes and exacerbates a number of health problems, leading to hospitalization and death in severe cases. The problem of severe heat is notably felt in Maricopa County, Arizona, where the socially disadvantaged and physically vulnerable are especially susceptible to the effects of extreme heat. Within the Maricopa County limits is the city of Phoenix, a dense urban area surrounded by 300-2000 m ridge lines above the valley floor. The volume of impervious surfaces, lack of shade and vegetation, and the high ridge lines surrounding the city exacerbate the heat stress—known as the urban heat island effect (UHI). After the sun sets, heat retained by the impervious surfaces is released, creating a significant difference between the air temperatures of the urban area and the surrounding rural area. Several organizations, including the Arizona Department of Health Services and the Phoenix Heat Relief Network, are working to create more effectively placed cooling centers and heat warning systems to aid those with the highest risk of exposure. This project created a python tool using Aqua MODIS land surface temperature parameters to generate heat maps that reference demographics data on extreme heat days. In addition to this, using the resources available at the Atmospheric Science Data Center (ASDC) will allow for access to near real-time data acquisition, which will aid the partners in providing spatially distributed relief during extreme heat events.

**Community Concerns:**

* Extreme heat is a chronic health hazard in central Arizona
* Maricopa County experiences an Urban Heat Island Effect due to nightly release of heat retained in buildings and impervious surfaces during the day
* The aging population, as well as the poor, the homeless, and the non-native English speakers of Maricopa County are more susceptible to heat-related health risks
* From 2006 to 2013 there were 632 confirmed heat related deaths in Maricopa County

**Current Management Practices & Policies**:

The National Weather Service issues heat warning products to the service region based on meteorological observations at Phoenix Sky Harbor airport and forecaster opinion on conditions that are dangerous for human health. There is one message for the entire region, which typically covers multiple Arizona counties, and no remotely sensed data are used to customize the warnings based on spatial variability. The Phoenix Heat Relief Network places their heat relief centers based on the location of existing resources (e.g., food banks) and willing participants without explicit consideration of spatial risk patterns.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Teleconnection Indices Correlation Maps | Aqua MODIS, Terra ASTER, Landsat 7 ETM+, Landsat 8 OLI | Allows for seasonal heat preparedness. Improve research on drivers of local temperature change. |
| Revised Heat Vulnerability Map | Aqua MODIS, Terra ASTER, Landsat 7 ETM+, Landsat 8 OLI, Suomi NPP VIIRS | Improve end-user ability to identify vulnerable communities. |
| Extreme Heat Vulnerability Tool | Aqua MODIS, Terra ASTER, Landsat 7 ETM+, Landsat 8 OLI, Suomi NPP VIIRS | Allows end-users to monitor land surface temperature and identify vulnerable neighborhoods in near-real time. |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)

**Software Release Requirements**

Category III