**NASA DEVELOP National Program**

****Maricopa County Department of Public Health and Arizona State University

*Spring 2017*

**Short Title: Phoenix Health & Air Quality**

**Subtitle:** Utilizing NASA Earth Observations to Assess the Impact of Extreme Heat on Transit Riders in Phoenix, Arizona

**VPS Title:** Beating the Heat: Assessing Extreme Temperatures of Public Transit

**Project Team & Partners**

**Project Team:**

Tamara Dunbarr (Project Lead), tdunbarr@asu.edu

McKenzie Murphree

Lance Watkins

**Advisors & Mentors:**

Dr. David Hondula (Arizona State University)

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| City of Phoenix, Public Transit Department | Bernard Venegas, Engineer | End-User | No |
| Arizona State University, Center for Policy Informatics | Dr. Erik Johnston, CPI Director and Associate Professor | Collaborator | No |
| Arizona State University, Urban Climate Research Center | Dr. David Sailor, UCRC Director | Collaborator | No |
| Maricopa County Department of Public Health | Kate Goodin, Epidemiology and Data Services Program Manager | Collaborator | No |
| Vitalyst Health Foundation | CJ Hager, Director of Healthy Community Policies | Collaborator | No |

**Project Details**

**Applied Sciences National Applications Addressed:** Health & Air Quality

**Study Area:** Phoenix, AZ

**Study Period:** 2015-2016 (May - Oct)

**Earth Observations & Parameters:**

Terra, Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) – land surface temperature

Landsat 8, Operational Land Imager (OLI) – normalized difference vegetation index

**Ancillary Datasets Utilized:**

* Oak Ridge National Laboratory – Daymet
* Phoenix Valley Metro – Ridership Data
* Arizona State University – Transit Survey
* Arizona Meteorological Network – Weather Data
* National Centers for Environmental Information – Integrated Surface Database
* US Census Bureau 2010 Census of Population and Housing – population data

**Software Utilized:**

* ESRI ArcGIS – data processing and map creation
* Python – data processing
* R – data processing

**Project Overview**

**80-100 Word Objectives Overview:**

This project aims to utilize data from NASA’s Terra and Landsat 8 satellites to characterize the thermal environment of the thousands of bus stops that support the Valley Metro transit network in greater metropolitan Phoenix, Arizona. Working alongside partners at the City of Phoenix, Public Transit Department, Maricopa County Department of Public Health, and Arizona State University’s Center of Policy Informatics, the team will combine NASA Earth observations with transportation and socioeconomic data to quantify the impact of thermal conditions on transit riders and enhance prioritization criteria for the installation of additional shade structures.

**Abstract:**

Phoenix, Arizona is home to over 1.5 million people and summer temperatures regularly exceed 106 °F (42.1 °C). Exposure to extreme temperatures can lead to heat-related illnesses, such as heat stroke and heat exhaustion, and increased heat-related mortality. This has been a chronic public health issue that the City of Phoenix and Maricopa County Department of Public Health have heavily invested in addressing though infrastructure development and initiatives aimed at reducing the risk of heat exposure. While extreme heat is known to have a detrimental impact on the general population, it is of particular concern for the Phoenix Transit Department since bus riders are exposed to extreme heat during their trip to bus stops and while waiting for buses to arrive. The Phoenix Transit Department’s current method of determining priority for implementing improvements like shade structures is based solely upon ridership and the quality of existing structures at each stop. Using Terra Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and Landsat 8 imagery, the Phoenix Health & Air Quality team enhanced the partner’s current methodology by assessing vegetation prevalence and land surface temperature around the Department’s 4,000 bus stops. Mapping information about vegetation cover and land surface temperature provided the City of Phoenix, Public Transit Department with an estimation of the radiative load riders experience at bus stops. These maps also identify bus stops that could benefit from structures that promote thermal comfort. These results will contribute to the Phoenix Transit Department’s efforts to reduce the risk of heat-related illness.

**Keywords:**

Remote sensing, transit stops, thermal conditions, Landsat 8, ASTER LST

**Community Concerns:**

* Thermal conditions at bus stops are a concern for community members who use the transit system and summer 2016 survey data indicate that a high percentage of riders report being too hot at bus stops.
* Thermal conditions also jeopardize the long-term sustainability of the transit network since sufficiently hot conditions deter ridership in the absence of adequate cooling resources.

**Current Management Practices & Policies**:

Bus stop shade structure deployment is supported by the T2050 transit tax passed in Phoenix in 2015. Over the next five years, the City of Phoenix is investing $1 million in the installation of shade structures at public bus stops to reduce heat exposure and discomfort. The current prioritization criteria for selecting bus stops for shade structure implementation is the daily count of riders. Bus stops that have more riders are planned to receive new structures ahead of stops with fewer riders. However, this allocation scheme may not accurately reflect ridership needs related to mitigating heat exposure. The transit department is interested in alternative metrics by which stops could be prioritized, and desires quantitative information regarding the impact of shade structure deployment at bus stops.

**Decision Support Tools & Benefits:**

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| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software**  **Release** |
| Terra ASTER Land Surface Temperature Time Series | Terra ASTER | ASTER LST will be collected and processed for the study period and area. A spatially explicit average of the time series will be created and cells corresponding to the bus route and stops will be extracted. | N/A |
| Landsat 8 Vegetation Prevalence 2015 & 2016 | Landsat 8 OLI | Landsat NDVI will be collected and processed for the study period and area. Average NDVI (i.e. NDVI thermal indicator) values for an area surrounding each bus stop and route will be calculated and extracted. This will be used to understand the influence of vegetation on thermal comfort along the transit network. | N/A |
| Thermal Indicator Ridership Regression Model | Terra ASTER  Landsat 8 OLI | This model will help our end user better understand who each variable, e.g. surface temperature and NDVI, impact ridership. Additionally, this model will help inform the suitability model, which will be created in term II. | N/A |