**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Virginia – Langley**

**Richmond Health & Air Quality**

*Synthesizing Temperature, Reflectance, and Socioeconomic Data to Provide Spatial and Temporal Temperature Analyses in Richmond, Virginia*

**Project Overview**

***Project Synopsis*:** As Richmond, Virginia is becoming more developed, more impervious surfaces and less tree canopy cover are to be expected as a result. Because of these expected changes, extreme heat is of increasing concern to city officials and other organizations. Groundwork RVA is interested in better understanding surface temperature and air quality as they relate to socioeconomic conditions. This project will use Terra, Landsat 5, Landsat 8, & Sentinel-2 data to assess the spatial and temporal trends of surface temperature in the Richmond, Virginia area and combine those results with socioeconomic data to determine vulnerable populations within the region. This will help prioritize and structure green-up projects across the city.

***Community Concern:*** As urban areas become more developed, they usually experience higher temperatures for longer periods of time. This change has potential negative impacts on the environment and residents, as ecosystems and humans are vulnerable to the more extreme weather conditions. Many efforts have been made to mitigate the impacts of increased temperatures like green-up projects, but it is difficult to prioritize locations for these projects and gauge their potential effectiveness. By assessing temperature trends spatially and temporally, organizations like Groundwork RVA can identify populations more vulnerable to extreme temperature events, and locations where projects will be more effective.

***Source of Project Idea:*** This project is a product of a broad engagement between DEVELOP and Groundwork USA. The idea was sparked through conversations after the DEVELOP National Program Office presented to representatives at the local Groundwork RVA trust.

***National Application Areas Addressed:*** Health & Air Quality, Urban Development

***Study Location:*** Richmond, VA

***Study Period:*** January 2007 – December 2017

***Advisor:*** Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Groundwork USA, Groundwork RVA** | Giles Harnsberger, Executive Director | End User | No |

***End User Overview***

***End User’s Current Decision-Making Process:***Currently there is no standard framework for making decisions related to air quality and temperatures effects in Richmond.

***End User’s Capacity to Use NASA Earth Observations:***

*Groundwork USA, Groundwork RVA* – Groundwork RVA does not currently use NASA Earth observations in their decision-making processes. However, they are interested in potential applications, and in ways to educate students and recent grads in the trust about their usage.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The Center Lead and the Project Lead will be the main POC’s for the project. Weekly emails and biweekly telephone calls will be used to discuss project progress and receive input from the partner.

***Transition Plan*:** A handoff at the end of the term will be conducted in-person. All end products and project deliverables will be emailed to the partner after this handoff meeting, allowing time for feedback.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Terra MODIS** | Land surface temperature | Surface reflectance will be used to assess land cover types. Land surface temperate will be used to estimate the extent, magnitude, and temporal trends in the surface temperature in Richmond, VA. |
| **Landsat 8 OLI** | Top of atmosphere reflectance | TOA reflectance will be used to assess land cover types, namely impervious surfaces and tree canopy cover. |
| **Landsat 8 TIRS** | Land surface temperature | TIRS data will be used to estimate the spatial and temporal trends of surface temperature. |
| **Landsat 5 TM** | Land surface temperature, top of atmosphere reflectance | TOA reflectance will be used to assess land cover types. Land surface temperature data will be used to estimate the spatial and temporal trends of ground temperatures in Richmond, VA. |

***Ancillary Datasets:***

US Census American Community Survey (2010) – The team will use these data to develop a city-specific heat vulnerability index based on demographic and socioeconomic indicators.

USDA National Agricultural Imagery Program (NAIP) – Imagery interpretation will be used to assess vegetation prevalence throughout Richmond, VA.

CDC Social Vulnerability Indicators (SVI) – The team will use these data to develop a city-specific heat vulnerability index based on health-related variables.

***Software & Scripting:***

Esri ArcGIS – raster manipulation, map creation

Google Earth Engine API – potential use for raster manipulation

Python – data acquisition and land surface temperature calculation

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Extreme Heat Social Vulnerability Assessment** | Maps and statistics will be used by the partners to understand which areas of Richmond, VA are more impacted by extreme surface temperatures. | US Census and CDC datasets will be used to add socioeconomic factors to the surface temperature assessments produced using Earth observations. | N/A |
| **MODIS Surface Temperature Assessment Maps** | A time series of trend maps will be used to display temporal trends in surface temperature for partners to assess efficiency of potential green-up projects and resource allocation. | Terra MODIS will be used to create the maps once land cover classifications and a temperature assessment are conducted. | N/A |
| **Landsat Surface Temperature Assessment Maps** | A time series of trend maps will be used to display spatial trends in surface temperature on an aggregated temporal scale for partners to assess efficacy of potential green-up projects and resource allocation. | Landsat 5, Landsat 8, and NAIP will be used to create the maps once land cover classifications and a temperature assessment are conducted. | N/A |

***End User Benefit*:** This project would provide new information on air quality and temperature in the City of Richmond and surrounding region, which would help Groundwork RVA prioritize locations for green infrastructure projects. Further, these results would give Groundwork RVA additional resources to pursue partnerships with local organizations. Finally, this study will help Richmond residents begin to build resilience and plan ahead for major immigration as more populations move inland from coastal Virginia.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2018 Summer

***Related DEVELOP Work:***

2017 Summer (AZ) – Las Cruces Health & Air Quality: Utilizing NASA Earth Observations to Estimate Urban Heat Island Intensity and Vulnerability to Extreme Heat in Las Cruces, NM

2018 Spring (AZ) – Ajax Urban Development: Utilizing NASA Earth Observations to Assess Urban Forestry as an Adaptation Strategy for Extreme Heat in Ajax, ON, Canada