**NASA DEVELOP National Program**

**2018 Fall Project Proposal**

**Alabama – Mobile**

**New Orleans Health & Air Quality**

*Monitoring the Urban Heat Island Effect on the Health of Residents of the New Orleans, Louisiana Metropolitan Area with Landsat, Sentinel, and MODIS Land Surface Temperature Products*

**Project Overview**

***Project Synopsis*:** This project aims to generate a time series analysis of Land Surface Temperature (LST) to assist the Louisiana Public Health Institute (LPHI) to identify and monitor areas with higher vulnerability to extreme urban heat level. The team will acquire data from Landsat 5 TM, Landsat 8 OLI/TIRS, Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR), and Terra MODIS Land Surface Temperature and Emissivity (LST&E) products to observe the annual and seasonal surface temperature scale and extent across the New Orleans metropolitan area. Additionally, Sentinel-2 MSI and Landsat data will be used to produce land cover classifications to assess the impacts of urban geographies and vegetation canopies on the city’s surface temperature. The project methodologies will contribute to the LPHI’s current monitoring systems that integrate geospatial applications, environmental, behavioral, and clinical services to efficiently improve New Orleans’ health outcomes and initiate future urban heat mitigation practices.

***Community Concern:*** The Urban Heat Island (UHI) effect can directly impact the health of urban residents and has been a growing concern for community, government, and the local institutions of New Orleans, LA. The city’s paved surfaces, dark roofs, and the grey infrastructure contribute to the UHI and increase the temperature of the city significantly higher than its surrounding areas. This phenomenon can increase the rate of hospitalization, stroke, respiratory difficulties, tiredness, fainting, and the risk of mortality. The LPHI, founded in 1997, is a statewide nonprofit and public institution that translates evidence into strategy to optimize healthy ecosystems in this area.

***Source of Project Idea:*** The preliminary idea for the project developed from a discussion with Dr. Thomas Carton, the Chief Business Development Officer and Jamie Clesi, the PMP Associate Director at the LPHI, and the DEVELOP Alabama – Mobile node at the Mobile County Health Department. The LPHI supported the formation of the project due to its relative affiliation to their clinic database and the growing community concern regarding the harmful impacts of extreme heat on the health of residents in the city.

***National Application Area Addressed:*** Health & Air Quality

***Study Location:*** New Orleans, LA

***Study Period:*** 2000 – 2018 (June – September)

***Advisors:*** Joe Spruce (Science System & Applications, Inc), Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Louisiana Public Health Institute**  | Dr. Thomas Carton, Chief Business Development Officer; Jamie Clesi, PMP Associate Director  | End User | Yes |

***End-User Overview***

***End User’s Current Decision-Making Process:***The LPHI does not have any existing procedure to mitigate severe urban heat in the New Orleans metropolitan area. The institute partners with local and regional organizations to translate evidence into strategy to optimize health ecosystem and promote the communities’ resiliency to any public-health threats. The project analysis will assist the LPHI to collaborate with government administrations, non-profit organizations, and academic institutions to initiate a decision-making process to moderate the impacts of extreme city temperature on the health of the communities in this area.

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

*Louisiana Public Health Institute* – The end user is familiar with NASA Earth observations but does not have direct experience using remote sensing applications. Previously, the LPHI integrated some geospatial analysis to link environmental conditions to individual-level clinic data to investigate the correlation of health and the geographic characteristics. The project methodologies will promote their current capacity to use satellite imagery to monitor surface temperature variations at a municipal and regional scale.

***Collaborator & Boundary Organization Overview***

***Dissemination by Boundary Organizations*:**

*Louisiana Public Health Institute* – The institute focuses on uncovering complementary connections across sectors to combine the social, economic, and human capital needed to align action for health. The LPHI will collaborate with the public, academic, and private sectors to disseminate the project methodologies and analysis.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team will participate in weekly or biweekly teleconferences with the LPHI to provide the end user with updates on project methodologies and analysis throughout the term. Additionally, an in-term remote sensing and GIS webinar training will be arranged to enhance the end user’s capacity in geospatial applications.

***Transition Plan*:** The end products will be delivered to the partner electronically. In addition, a virtual or in-person presentation of the project results will be arranged. Efforts will also be made to compile a tutorial for the partner, providing instruction on the project methodologies and data utilized during the term. A software release is not anticipated for this project.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 8 OLI** | Land Cover Classification, Normalized Difference Vegetation Index (NDVI) | Landsat 8 OLI land cover classifications will be used to identify municipal zones with higher grey infrastructure density and lower urban tree coverage to investigate the correlation between canopy disparities and extreme urban heat level over time.  |
| **Landsat 8 TIRS** | LST | The Landsat 8 TIRS LST product will evaluate annual and seasonal changes in surface temperature to comprehend the impacts of urban heat island on the health of the communities |
| **Landsat 5 TM** | Land Cover Classification, NDVI, LST | Landsat 5 TM land cover classifications will be used to identify municipal zones with higher grey infrastructure density and lower urban tree coverage to investigate the correlation between canopy disparities and extreme urban heat level over time. Additionally, the LST product will evaluate annual and seasonal changes in surface temperature to comprehend the impacts of urban heat island on the health of the communities in this area. |
| **Sentinel-2 MSI** | Land Cover Classification, NDVI | Sentinel-2 MSI land cover classifications will be used to identify municipal zones with higher grey infrastructure density and lower urban tree coverage to investigate the correlation between canopy disparities and extreme urban heat level over time.  |
| **Sentinel-3 SLSTR** | LST | Sentinel-3 SLSTR LST products will be used to examine the city’s surface temperature variations. The analysis will be compared to the LPHI clinical data and socioeconomic records to comprehend the impact of severe urban heat on health-related disparities.  |
| **Terra MODIS** | LST | Terra MODIS LST products will be compiled to study the city’s surface temperature and classify areas with higher vulnerability to severe urban heat at a regional scale and to further validate the land surface temperature products derived from Landsat imagery. |

***Ancillary Datasets:***

NASA Socioeconomic Data and Applications Center (SEDAC) Gridded Population of the World (GPW) – socioeconomic data will be incorporated in the analysis to observe the vulnerability of the communities to extreme urban heat level in New Orleans, LA

Patient – Centered Outcome Research Institute (PCORI) records – clinical data provided by the LPHI will be used to evaluate the impacts of UHI on the rate of hospitalizations in the area

US Census Bureau Population Dataset – census data will be employed to observe the demographic characteristics in city of New Orleans, LA

USDA National Agricultural Imagery Program (NAIP) – high resolution (1 meter) land cover and tree canopy assessments can be useful for detecting smaller stands and individual trees

***Software & Scripting:***

Esri ArcGIS Pro 2.0.0 – raster manipulation, map product generation, and image classification development

QGIS – raster manipulation, land cover maps compilation, and geo-spatial data visualization

**Decision Support Tool & End Product Overview**

***End Products:***

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| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Landsat Surface Heat Analysis** | This will provide the LPHI with a discrete-time analysis of LST level and will help identify areas with higher concentration of urban heat level and evaluate its impact on the communities’ health outcomes. The analysis allow partners to identify and monitor areas of extreme heat to better target interventions.  | Data from Landsat 8 TIRS-based brightness temperature and Landsat 5 TM will be employed to create time series analysis of land surface temperature at a 30 m resolution from 2000 to 2018.  | N/A |
| **Sentinel Land Surface Temperature Assessment** | The product will deliver a LST assessment of New Orleans to examine the concentration of severe urban heat at a regional scale and compare the results with the socioeconomic and demographic characteristics records to further recognize the relationship between two variables.  | Sentinel-3 SLSTR level-2 products will be used to generate seasonal analysis of temperature level at a 0.5 Km to 1 km spatial resolution from 2016 to 2018. | N/A |
| **MODIS Urban Heat Island Analysis**  | The analysis will deliver annual and seasonal assessment of surface temperature to contribute to LPHI’s current clinic monitoring system to better recognize the impacts of the city’s extreme temperature level on health-outcomes in this area. | MODIS LST products will be used to assess temperature characteristics within the study area at a 1 km spatial resolution from 2000 to 2018. | N/A |
| **Urban and Vegetation Canopy Assessment**  | The analysis will provide the LPHI with a land cover classification of urban geographies and vegetation canopies to evaluate the correlation between the city’s land surface characteristics and the concentration of urban heat over time.  | Data from Landsat 8 OLI, Landsat 5 TM, and Sentinel-2 MSI will be used to generate a land cover classification of urban geographies and vegetation canopies at a 30 m and 10 m resolution from 2000 to 2018.  | N/A |
| **NOLA Heat Vulnerability Analysis** | The end product will identify areas vulnerable to severe urban heat by comparing the produced heat analysis products to the number of heat related hospitalizations to comprehend the impact of UHI on health disparities. | SEDAC GPW socioeconomic statistics will be combined with US Census Bureau demographic information and LPHI clinical data to evaluate the link between the extreme temperature and the communities’ characteristics and the rate of hospitalizations. | N/A |

***End-User Benefit*:** The project methods and analysis will contribute to the LPHI’s current clinic monitoring system by recognizing and monitoring severe urban heat level in New Orleans, LA, and identify the relationship between New Orleans’ urban heat island, the city’s land cover characteristics, and the health-outcome disparities. By participating in this project, LPHI will advance two of the organization’s priority goals: (1) advance systems changes that integrate behavioral, clinical and social services; contribute to efficiencies; and drive improved health outcomes, and (2) serve as a reliable source and translator of data information for future decision making about health.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2018 Fall

***Related DEVELOP Work:***

2017 Summer (AZ) – Las Cruces Health & Air Quality: Assessing Urban Heat as it Relates to Social Vulnerability and Land Use Changes in Las Cruces, New Mexico

2017 Spring (AZ) – Phoenix Health & Air Quality: Utilizing NASA Earth Observation to Assess the Impacts of Extreme Heat on Transit Riders in Phoenix, Arizona

**Notes & References:**

***References:***

Environmental Protection Agency. (2018). Measuring Heat Islands. Retrieved from

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and vulnerability to heat stress. *Social Science & Medicine, 63(11)*, 2847–2863. <https://doi.org/10.1016/j.socscimed.2006.07.030>

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