**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Alabama - Mobile**

**New Orleans Urban Development**

*Utilizing Earth Observations to Assist Groundwork New Orleans to Reduce Flood Vulnerability in the New Orleans, Louisiana, Metropolitan Area*

**Project Overview**

***Project Synopsis*:** The primary objective of the project is to use Earth observation data to assist Groundwork New Orleans (GWNO) in monitoring flood vulnerability in the Ninth Ward region of New Orleans, LA. The project will apply Landsat 8 OLI and Sentinel-2 MSI data to generate time series land cover classifications of urban trees, non-tree vegetation canopies, and grey infrastructure. Sentinel-1 SAR data will be used to produce discrete-time analysis of flood extent by computing the Normalized Difference Flood Index (NDFI). On a limited basis, Landsat 8 TIRS data and the Suomi-NPP Visible Infrared Imaging Radiometer Suite (VIIRS) Land Surface Temperature and Emissivity (LST&E) products will be executed to monitor urban heat island effects on the communities where flooding has been historically prevalent. The project end-results will promote the end user’s current techniques on monitoring urban tree canopy, mapping land cover variations, and evaluating the municipal zones with higher exposure to surface runoff.

***Community Concern:*** New Orleans is a major metropolitan area in the state of Louisiana with a population of 391,495 people (US Census Bureau, 2016). The city is located on the banks of the Mississippi river on the south section of Lake Pontchartrain, and to the north of Gulf of Mexico. While much of the heavily-populated areas of the city are below sea level, one of the primary community concerns involves frequent flooding events due to tropical storms and hurricanes. The project partner, GWNO, is a local nonprofit organization dedicated to increasing urban resilience to stormwater threats particularly in the underserved communities by planting trees and incorporating other green infrastructure.

***Source of Project Idea:*** The initial communication for this project stemmed from discussions with Curt Collier, the National Youth Program Director at Groundwork USA, and the DEVELOP National Program Office. Mr. Collier then connected the DEVELOP team to Alicia Neal, MFA Executive Director at GWNO, who supported the formation of this project to obtain enhanced geospatial analysis of the areas exposed to flood in New Orleans metropolitan area.

***National Application Areas Addressed:*** Urban Development, Transportation & Infrastructure, Disasters

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

***Study Period:*** March 2013 – June 2018

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

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Groundwork USA, Groundwork New Orleans** | Alicia Neal, MFA Executive Director | End User | Yes\* |

***End-User Overview***

***End User’s Current Decision-Making Process:***GWNO implements projects that mitigate threats of flooding in the area while restoring ecosystems and contributing to a healthier environment throughout the city of New Orleans. The risk-mitigation projects include the use of rain gardens, tree plantings, bioswales, urban gardens, community beautification, and other coastal restoration techniques. At the core of the organization is the Green Team which focuses on youth employment and environmental training in areas such as community redevelopment, plant cultivation, landscape maintenance, soil and water quality testing, and GIS mapping. In addition, GWNO also provides stormwater surveys to residents to determine what green infrastructure is most efficient in their communities.

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

*Groundwork USA, Groundwork New Orleans* – The end user is not familiar with NASA Earth observations and has never used Earth observing data before. This project will assist the partner to build their capacity in remote sensing application and enhance their GIS skills.

***Collaborator & Boundary Organization Overview***

***Dissemination by Boundary Organizations*:**

*Groundwork USA, Ground New Orleans* – GWNO works with local communities struggling with environmental, economic, and social decline. Additionally, GWNO collaborates with government officials, business owners, plus local and national organizations to coordinate their results with one another. The project end-products and methodologies will be disseminated to any of these local and national partners as applicable.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The GWNO Green Team will contribute to the compilation of some of the project’s end-products during the term to build their capacity in remote sensing and Earth observations. In addition to remote sensing and GIS trainings, the DEVELOP team will also provide the end user with weekly or bi-weekly updates on project methodologies throughout the term.

***Transition Plan*:** The project 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 course of the project. A software release is not anticipated for this project.

**Earth Observations Overview**

***Earth Observations:***

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| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 8 OLI** | Land Cover Classifications, Normalized Difference Vegetation Index (NDVI) | Landsat land cover products will be used to identify low urban tree coverage, compute canopy variations over time, and map municipal zones with higher exposure to surface runoff. |
| **Landsat 8 TRIS** | Land Surface Temperature | The Landsat LST product will evaluate annual and seasonal changes in surface temperature to comprehend the impacts of urban heat island on underserved communities and flood events. |
| **Sentinel-2 MSI** | Land Cover Classifications, NDVI | Sentinel-2 land cover products will be used to identify low urban tree coverage, compute canopy variations over time, and mapping municipal zones with higher exposure to surface runoff at a higher resolution. |
| **Sentinel-1 C-SAR** | Normalized Difference Flood Index (NDFI) | Sentinel-1 NDFI flood maps will demonstrate a time series analysis of stormwater coverage in the region to generate flood risk assessment. |
| **Suomi-NPP VIIRS** | Land Surface  Temperature and Emissivity (LST&E) | LST products will compiled to assess urban heat island effects on underserved communities vulnerable to flood. |

***Ancillary Datasets:***

Dartmouth Flood Observatory – The surface water records will be incorporated in the analysis to assess the accuracy of the flood extent products.

FEMA Flood Map Service Center – FEMA flood map products will be used to compare the historical flood extent analysis to generate an accuracy assessment.

Louisiana Statewide Lidar-based DEM – The five-meter elevation data files will be incorporated in the analysis to evaluate the historical flood extent products and to understand the vulnerability of low elevated lands to stormwater runoff.

Louisiana’s Flood Maps - LSU AgCenter – The LA flood maps will be implemented in the analysis to assess the accuracy of the flood extent products.

SEDAC Gridded Population of the World (GPW) – Socioeconomic data will be incorporated in the analysis to observe the vulnerability of the underserved communities to flooding incidents.

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

USGS NLCD Impervious Land Cover Data – The 100-meter resolution products will be used to further identify impervious surface covers in the Ninth Ward region.

***Modeling:***

FEMA Flood Map Service Center (MSC) HAZUS 3.2 Model (POC: FEMA Risk MAP CDS)

Land Use Conflict Identification Model (LUCIS Plus model) (POC: Paul Zwick, University of Florida)

Soil and Water Assessment Tool (SWAT) Model (POC: Jeff Arnold, USDA Agricultural Research Service)

***Software & Scripting:***

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

QGIS SCP plugin – Raster manipulation, land cover maps compilation, and geo-spatial data visualization

ERDAS Imagine – Image classification, raster data product generation and geo-spatial data analysis

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Urban Tree Canopy Assessment** | The Urban Tree Canopy Assessment products will allow end user to identify areas with low tree coverage, compute canopy variations over time, and to provide further information on to what degree their current tree planting project has reduced the Ninth Ward region vulnerability to flood. | Landsat 8 OLI and Sentinel-2 MSI data will be deployed to assess the tree and non-tree vegetation canopies using unsupervised and supervised classification techniques at a 30 m and 10 m resolution from June 2013 to June 2018. | N/A |
| **Gray Infrastructure and Impervious Surface Cover Analysis** | Partner will use the end-product to determine the civic zones with higher risk to surface runoff. Additionally, the product will provide a discrete-time analysis of urban expansion in the region to understand the land cover modification to grey infrastructures. | Normalized Difference Vegetation Index (NDVI) will be derived from Landsat 8 OLI and Sentinel-2 MSI data to identify impermeable surfaces and municipal structures at a 30 m and 10 m resolution from June 2013 to June 2018. | N/A |
| **Flood Extent Analysis** | The product will provide a series of stormwater surface coverage maps to allow partner to expand their current techniques in detecting the flooded lands and to mitigate the flood risk in the area for future practices. | Normalized Difference Flood Index (NDFI) will be applied to Sentinel-1 SAR data to generate flood risk analysis across the region at a 20 m resolution. | N/A |
| **Surface Heat Assessment** | The surface heat assessment product will deliver annual and seasonal analysis of surface temperature to contribute to the partners’ current techniques in understanding the impacts of the urban heat island on the communities and stormwater threats in the area. The result will demonstrate the correlations between the urban geographies and the surface temperature level over time. | Landsat 8 TIRS-based brightness temperature data at a 120 m resolution and VIIRS Land Surface Temperature and Emissivity (LST&E) products will be used to assess temperature characteristics within the study area from June 2013 to June 2018. | N/A |
| **Ninth Ward Socioeconomic and Demographic Characteristics**  **Evaluation** | The analysis will observe the socioeconomic status and the demographic characteristics in the Ninth Ward and will compare the variables to the generated end-products to expand the partners’ understanding of the vulnerability of the underserved communities to flooding incidents. | SEDAC GPW socioeconomic data will be combined with US Census Bureau demographic information including income, age, gender, and family structure to compare them to the Urban Tree Canopy Assessment, and the Grey Infrastructure and Impervious Surface Cover Analysis products. The analysis will deliver a valuation of socioeconomic variables in response to the geographic setting of the area as proxy to vulnerability to flood. | N/A |

***End-User Benefit*:** The project methodologies and end-products will contribute to GWNO’s current techniques on mapping tree coverage, generating flood maps, and determining the areas with higher exposure to storm surface runoff in the underserved communities of New Orleans metropolitan area. The partner will use the end-results to better understand how their current tree-planting project has mitigated the stormwater threats and to disseminate the information to the public to enhance the communities’ awareness in the region. Additionally, the GWNO Green Team will receive trainings and will contribute to project deliverables to build their capacity in remote sensing and GIS applications.

**Project Timeline & Previous Related Work**

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

***Related DEVELOP Work:***

2018 Spring (ARC) – Quantifying Changes in Urban Canopy Cover and Land Surface Temperature to Understand Their Impacts on the Neighborhoods throughout Richmond California

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

2016 Fall (GA) - Atlanta Water Resources III: Identifying Key Urban Areas to Reduce Stormwater Runoff and Maximize Conservation Efforts in Metropolitan Atlanta

2018 Spring (GA) – Miami Beach Urban Development II: Utilizing NASA Earth Observation to Assess Sea Level Rise and Develop Optimal Green Infrastructure Plans to Restore Mangrove Habitat and Enhance Coastal Resiliency

**Notes & References:**

***References:***

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