**NASA DEVELOP National Program**

**Alabama – Marshall**

*Project Summary – Spring 2018*

**New Jersey Urban Development**

*Identifying Optimal Regions within New Jersey’s Pine Barrens Forest for Urban Development Based on Wildfire Risk and the Wildland-Urban Interface Theory*

**VPS Title:** Aim to Reduce the Flame! – Fire Risk Assessment for Urban Development in the New Jersey Pinelands

**Project Team**

***Project Team:***

Man Kumari Giri (Project Lead), giri.mannkumari@gmail.com

Mercedes Bartkovich

Olivia Buchanan

Nicholas McVey

***Advisors & Mentors:***

Dr. Jeffrey Luvall (NASA Marshall Space Flight Center)

Dr. Robert Griffin (University of Alabama in Huntsville)

Leigh Sinclair (University of Alabama in Huntsville/Information Technology and Systems Center)

Maggi Klug (University of Alabama in Huntsville)

**Project Overview**

***Project Synopsis*:** In recent decades, housing growth in the state of New Jersey has increased in areas near forest, referred to as the wildland-urban interface (WUI). As New Jersey is densely populated, citizens take advantage of the WUI for privacy, natural beauty, and recreational opportunities requiring developers to build neighborhoods adjacent to natural areas. With the expansion of the WUI, there remains the increasing danger of wildland fire and the threat to life and property due to fire. This project used NASA Earth observations to map the fire risk within the Pinelands to identify areas most suitable for development, aiding the New Jersey Pineland Commission in their urban development planning.

***Abstract*:**

As New Jersey’s population increases, more of this population is relocating to the wildland-urban interface (WUI) of the south-central Pinelands region. Due to this increase in human activity coupled with local environmental conditions, local authorities are concerned about an increased possibility of wildfires that could damage both the area’s infrastructure and ecosystem. To counteract this risk, it is necessary to develop methods for accurate wildfire assessment and mitigation efforts. This project partnered with the New Jersey Pinelands Commission (NJPC) to develop a Fire Risk Assessment Tool that identifies areas with high fire risk based on land cover characteristics. The team incorporated vegetation indices derived from Landsat 8 Operational Land Imager (OLI) and Sentinel-2 Multi-Spectral Instrument (MSI), land-use classification derived from LandFire data and elevation into a fuzzy logic model to generate a 30 x 30 m Fire Risk Assessment Map. The map was used to analyze fire susceptibility in the Pinelands WUI and to identify optimal areas for urban expansion. Fifty-three percent of the total area within the Pinelands WUI was classified as having a moderate fire risk, while high and extremely-high fire risk accounted for 13%. An estimated 200,000 acres of land with a low to moderate risk of fire were identified as areas that would be suitable for development. The results and maps produced will be used by the New Jersey Pinelands Commission to guide urban development planning and decision making.

**Keywords:**

Landsat 8 OLI, Sentinel-2 MSI, wildfire, Pinelands, fire risk assessment, urban development, Fuzzy Logic

***National Application Area Addressed:*** Urban Development

***Study Location:*** NJ

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

***Community Concern:***

* New Jersey is the second most densely populated state with a 1224.4 population per square miles. Many residents inhabit rural/suburban areas, particularly around the Pinelands, increasing land use pressure in the area and the risk of man-made fires.
* Each year, the New Jersey Forest Fire Service responds to over 1,500 wildfires throughout the state. These fires damage 7,000 acres of forest, but the number of wildfires could increase in response to the growth of residential areas and recreational activities in the WUI.
* Currently, more than 25% of the total population of New Jersey live in the WUI. As population growth continues within the WUI, there is a need to identify the best locations for future development.

***Project Objectives:***

* Classify fire risk throughout the WUI and ensure the usability of the Fire Risk Assessment Tool by our partners for years to come
* Analyze fire risk in the Pinelands WUI to aid our partners in identifying suitable areas for urban development
* Locate areas where our fire mitigation efforts could minimize fire induced economic and infrastructure losses

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org** |
| **New Jersey Pinelands Commission** | Gina Berg, Resource Planner | End User | No |

***Decision Making Practices & Policies***:

With the rapid growth in WUI development, the New Jersey Pinelands Commission (NJPC) has increased research efforts on fire suppression and prevention and has continued to use best management practices for rural development. Currently, the NPJC performs risk assessments in forested areas using historic maps and field surveys. During field surveys, the assessor uses a visual scoring system to evaluate the fire risk of a particular area, which can be time consuming and subjective. The NJPC has collaborated with other organizations in the past to assess wildfire risk and implement wildfire mitigation plans.

***Project Benefit to End User***:

The end products generated from this study will provide the NJPC with an analysis of current fire risk in the Pinelands region, as well as an analysis of the wildland-urban interface by identifying optimal areas for urban growth. This analysis includes a number of variables that were not previously incorporated into the NJPC’s 1981 wildland fire hazard classification, such as distance to ignition sources, canopy density, seasonal fuel loads, and soil moisture. The end products obtained will allow the NJPC to examine and update existing policies to better accommodate the changing environment in the Pinelands region as population growth continues to increase.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Landsat 8 OLI** | Surface Reflectance | Imagery was used to derive the Normalized Difference Vegetation Index (NDVI) and Tasseled Cap Wetness (TCW) band indices using spectral bands at a 30 m resolution |
| **Sentinel-2 MSI** | Surface Reflectance | Imagery was used to derive the NDVI and TCW band indices using spectral bands at a 10 m resolution |

***Ancillary Datasets:***

USGS 3D Elevation Program (3DEP) – 3.4 meter resolution elevation data used to derive aspect and slope and used as topographic variable for wildfire analysis

USGS LANDFIRE Reference Database (LFRDB) – vegetation type used to examine study area’s vegetation and fuel data

US Census Bureau TIGER dataset – primary and secondary roads shapefile used for the analysis of wildfire risk and development suitability

New Jersey Forest Service – ignition sources and fire history data used to identify ignition sources and wildfire events within the study area

***Modeling:***

Fuzzy Logic (POC: Mercedes Bartkovich, NASA DEVELOP) – identify fire risk and areas that are suitable for urban development within the Pinelands WUI

***Software & Scripting:***

Esri ArcGIS 10.4 – raster manipulation and analysis, imagery processing, and map production

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Fire Risk Assessment Tool** | Landsat 8 OLI, Sentinel-2 MSI | This tool is a Model Builder package from ArcMap that will allow our partners to replicate our methods and incorporate more recent data as it becomes available. | N/A |
| **Fire Risk Assessment Map** | Landsat 8 OLI, Sentinel-2 MSI | The map will classify an area’s risk to wildfire based on five classes ranging from extremely low to extremely high risk. By identifying fire risk areas, this map will provide useful information for the allocation of resources to minimize risk of potential wildfires occurring in the near future. | N/A |
| **Fire Risk Analysis of Pinelands WUI** | Landsat 8 OLI, Sentinel-2 MSI | This analysis will identify suitable areas for urban development within the WUI based on the fire risk assessment. This will allow partners to better understand and accommodate urban growth in the area. | N/A |
| **Fire Risk Assessment Tool Tutorial** | N/A | This tutorial will help the project partner better understand the assessment tool and enhance their ability to implement it in the future. | N/A |

**Project Handoff Package**

**Transition Plan:**

At the end of the term, end products and results will be disseminated to the project partners via Google Hangout. During this meeting, the team will give a brief presentation of the results followed by the Fire Risk Assessment Tool Tutorial explaining how to interpret and use the end products.

**Team POC:** Man Kumari Giri, giri.mannkumari@gmail.com

**Partner POC**: Gina Berg, gina.berg@njpines.state.nj.us

**Handoff Package:**

* Fire Risk Assessment Tool and Tutorial
* Fire Risk Assessment Map and Fire Risk Analysis of Pinelands WUI
* Tech Paper
* Presentation
* Poster
* GIS data used as inputs for the tool
* Project Video

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