**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**University of Georgia**

**Southeast United States Disasters**

*Using NASA Earth Observation to Monitor Vulnerability, Wildfire Damage, and Recovery in the Appalachian Forests*

**Project Overview**

***Project Synopsis*:** The proposed DEVELOP project will explore social and ecological vulnerability to heightened fire susceptibility during dry conditions in the Southern Appalachian and monitor vegetation changes pre and post 2016 wildfires. This project will use and produce regional geospatial mapping products from MODIS and Landsat data to accurately monitor vegetation conditions (e.g., vegetation greenness and phenology) throughout the southeastern US with a focus on areas that suffered the most damage.

***Community Concern:*** Dozens of wildfires across the Southeast United States have recently burned and destroyed forests and residential areas. Over 15,000 acres within Great Smoky Mountains National Park, a designated UNESCO World Heritage Site and one of the world’s most biologically diverse and intact forests, and the adjacent popular tourist areas of Gatlinburg and Pigeon Forge are estimated to have burned over a two-day period (28-29 November 2016) due to fires spread by 90 mph winds, low humidity, presence of fire fuels and drought. Nearly 60 individual wildfires burning in seven states surrounding the Southern Appalachian Mountains (Georgia, Tennessee, North Carolina, South Carolina, Kentucky, West Virginia, Virginia) have damaged hundreds of buildings, caused power outages, and led to the evacuation of several populated areas. Forest resource agencies require a thorough understanding of vulnerability, damage and recovery related to wildfires in remote and economically depressed areas such as Southern Appalachia.

***Source of Project Idea:*** This project idea was formed during the Fall 2016 term when wildfires swept through the north Georgia mountains. Heavy smoke was noticeable as far south as Atlanta. UGA participants, the ACL, and CL simultaneously thought of projects to assess the fire. After a massive wildfire burned over 15,000 acres within Great Smoky Mountains National Park, UGA’s Center Lead approached NPO with the project idea, UGA’s Center for Geospatial Research has established relationships with the partner organization and UGA DEVELOP assisted them in mapping Hemlock decline in the past. UGA’s Center Lead, Fellow, Lead Science Advisor, U.S. Forest Service partner and NPO worked together to outline this projects goals and potential end products.

***National Application Area(s) Addressed:*** Disasters, Climate, Health and Air Quality

***Study Location:*** GA, TN, SC, NC

***Study Period:*** June 2015 - June 2017

***Advisor(s):*** Dr. Marguerite Madden, University of Georgia

**Partner Overview**

***Partner Organization(s):***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Great Smoky Mountains National Park | Thomas Remaley, Ecologist | End-User | No |
| US Forest Service, Southern Research Station | Dr. Cassandra Johnson Gaither | End-User | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***The end-user organizations are eager to incorporate remote sensing data into their decision making processes. While they are familiar with GIS, they are both particularly interested in the current data that NASA Earth observations provide so that they can examine the impacts of the recent drought, wildfire, and early forest recovery. The U.S. Forest Service is especially interested in the role Heirs Property (i.e., property lacking clear title of ownership that has been passed down by multiple generations to numerous heirs and is often over-grown and unmanaged) located adjacent to large tracts of conservation lands/parks plays in providing areas of uninhabited shrubland and downed woody debris contributing to fire fuels and increased risk for wildfire ignition and spread.

***End-User’s Capacity to Use NASA Earth Observations:*** The end-user organizations are familiar with GIS and NASA Earth observations. They have used DEVELOP products in the past and have interacted with DEVELOP teams for partner calls and an in-person project hand-off.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Bi-weekly telecons will be planned to ensure frequent communication between the team and partners. In-person meetings with local partner contact (Dr. Johnson Gaither is located in the U.S. Forest Service office located on the UGA campus) will be organized as often as possible. The Team Lead will serve as the primary contact.

***Transition Plan*:** Deliverables will be shared with partners through Google Drive and an in-person presentation to the local partners will summarize the results of this project. Final results will be used immediately to increase understanding of this wildfire event, social vulnerability and projected forest recovery.

***Letters of Support*:** Dr. Cassandra Johnson Gaither,U.S. Forest Service.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Aqua/Terra MODIS** | Spectral vegetation indices and phenology products | Data will be used for vegetation phenology |
| **Landsat 8 OLI** | Land cover | Data will be used for vegetation phenology and time lapse of burn scars before, during, and after the fire |
| **ER-2 Aircraft** | AVIRIS | Simulated HyspIRI Data: Burn Severity and Vegetation Condition |
| **ER-2 Aircraft** | MASTER | Simulated HyspIRI Data: Burn Severity and Vegetation Condition |

***Ancillary Datasets:***

UGA Center for Geospatial Research – Pre-fire Vegetation Database – Detailed classification of overstory and understory vegetation polygons for Great Smoky Mountains National Park and Foothills Parkway – Data will be used for training sets for vegetation classification of pre-fire conditions and the location of potential fire fuels from Eastern hemlock forests damaged approximately 10 years ago by the exotic invasive hemlock wooly adelgid.

U.S. Forest Service – Pre-fire Anderson Fire Fuel Model Database – U.S. Forest Service Anderson Fire Fuel Model Classifications – U.S. Forest Service Anderson Fire Fuel Models for Great Smoky Mountains National Park derived from pre-fire vegetation types and density will be correlated with fire damage identified from current NASA EO data.

Computer-Assisted Mass Appraisal (CAMA) Data – Potential Heirs Properties in counties adjacent to preserved forest lands – Information on parcels with multiple owners and no recent changes in ownership indicate high probability of Heirs Property and fire fuels.

U.S. Census Bureau Census Tract Data – Socio-economic data – Indicators of economically depressed areas are correlated with increased probability of Heirs Properties, fire fuels and social vulnerability.

Community Wildfire Protection Plan (CWPP) – Data Preparedness for wildfire, resilience and improved recovery – The presence or absence of CWPPs may be an indicator of social and ecological vulnerability to widfires.

***Software & Scripting:***

Excelis ENVI 5.0 – visualization and digital number extraction, stacking and processing of hyperspectral AVIRIS and MASTER imagery (e.g. vegetation/burn severity indices, contrast enhancement, change detection)

ESRI ArcGIS 10.2 – Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat, Aqua/Terra MODIS

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product(s)** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Drought Severity Indices | Aid in monitoring drought severity | Derived from Landsat 8 OLI, MODIS, and ancillary datasets | Options:  N/A |
| Vegetation and Fire Fuels Change Maps | Allocation of wildfire management and community preparedness resources | MODIS and Landsat data will be processed to create geospatial products depicting forest phenology as it relates to fire fuels and wildfire risk | N/A |
| Social and Ecological Vulnerability Index | Assess both the risks and the impacts of wildfires Heirs Properties bordering and potentially connecting conservation lands | Index of Social and Ecological Vulnerability will be modeled from CAMA, Census Tract and CWPP data, combined with drought, aerosol transport, vegetation change and fire fuel model datasets | N/A |
| Post Fire Vegetation Recovery Assessment | Time series illustrating changes in the areas affected by recent wildfires | Derived from Landsat 8 OLI and MODIS will be used to create time series maps for the Southeast US | N/A |

***End-User Benefit*:** This project will enhance our partners’ management efforts in this region by demonstrating the use of NASA data for assessing social and ecological vulnerability in an economically depressed area while monitoring effects of wildfire and post-fire decision support.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2017 Spring (Start) to 2017 Summer (Completion)

***Multi-Term Objectives:***

* **Term 1** **(Proposed Term):** 2017 Spring (University of Georgia) – Southeast US Disasters
  + The Drought Severity Indices and Vegetation and Fire Fuels Change Maps will be created during the first term. We expect that the team will have several in-person interactions with project partner, Dr. Johnson Gaither, whose office is located in the U.S. Forest Service office on the UGA campus.
* **Term 2:** 2017 Summer (University of Georgia) – Southeast US Disasters
  + The Socio-Ecological Vulnerability Index and Post Fire Vegetation Recovery Assessment will be completed during the second term. The Center Lead and Lead Science Advisor plan to organize an in-person hand-off at the U.S. Forest Service office.

***Related DEVELOP Work:***

Summer 2015 (Stennis Space Center) -Texas Disasters: Utilizing NASA Earth Observations to Assist

the Texas Forest Service in Mapping and Analyzing Fuel Loads and Phenology in Texas Grasslands

Summer 2015 (Stennis Space Center) -California Disasters II: Assessing the Effectiveness of

Simulated HyspIRI Data for Use in USDA Forest Service Post-Fire Vegetation Assessment and Decision Support

Spring 2014 (University of Georgia) - Great Smoky Mountains Ecological Forecasting: Utilizing NASA Earth Observations to Monitor Long Term Hemlock Decline Caused by Invasive Hemlock Woolly Adelgid in Great Smoky Mountains National Park

**Notes & References:**

***Notes*:** Detailed data available for the Great Smoky Mountains National Park and adjacent Foothills Parkway will be used to inform drought, vegetation, fire fuels, vulnerability, fire damage and recovery in a multi-state area surrounding the Southern Appalachian Mountains.