**NASA DEVELOP National Program**

**2017 Fall Project Proposal**

**Idaho - Pocatello**

**Southern Idaho Disasters II**

*Characterizing Vegetation Type at Pre- and Post- Wildfire Periods Using NASA Earth Observations*

**Project Overview**

***Project Synopsis*:** NASA DEVELOP is partnering with the USDA Agricultural Research Service (ARS) Northwest Watershed Research Center, Idaho Fish and Game (IDFG), and the Bureau of Land Management (BLM) to characterize ecosystem recovery following four wildfires: Crystal (2006), Jefferson (2010), State (2013), and Soda (2015). Using spaceborne data gathered from Landsat 8, Shuttle Radar Topography Mission (SRTM), and Aqua and Terra MODIS, this project will identify key variables responsible for post-fire recovery. The Crystal wildfire will first be analyzed to discover vital recovery variables and then three additional fires subsequently will be analyzed to assess the similarity of these variables across the other ranges of wildfire severity and spatial footprints. Additionally, this project will monitor invasive species propagation in the burn zones and assess how spatial patterns of wildfires severity are related to land use recovery. This project will provide products and information needed to increase partners’ confidence in using NASA Earth observations (EO) for monitoring natural resources.

***Community Concern:*** Wildfires are a major cause of ecosystem and urban disturbance in the western United States, recently increasing in frequency and severity compared to historical data. The spatial extent, intensity, and return rate for a wildfire-impacted area can play a large role in vegetation composition and ecosystem recovery. Determining pre- and post-fire vegetation cover characteristics (e.g., heterogeneity and density) can be time consuming and the factors affecting ecosystem recovery after fire can be complex. In addition, restoration success is difficult to determine as vegetation composition is not often known prior to wildfire events and monitoring vegetation composition after restoration efforts can be resource intensive. Understanding the key variables that made reseeding and natural recovery successful in some areas, assessing why they failed in others, and identifying factors that made non-native propagation ideal are important issues for land managers in this region of the country.

***Source of Project Idea:*** This project developed during discussions with Shane Roberts (IDFG, Southeast Regional Office) and Michelle Mavor (BLM, Pocatello Field Office) after the 2016 Summer Pocatello node closeout. The topic of discussion involved the difficulties of sage-grouse recovery and monitoring after a wildfire event.

***National Application Areas Addressed:*** Disasters

***Study Location:*** ID, UT, OR

***Study Period:*** May 2005 – September 2016;

***Advisors:*** Keith Weber (Idaho State University), Joseph Spruce (Science Systems and Applications, Inc.)

**Partner Overview**

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

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Bureau of Land Management, Pocatello Field Office | Karen Kraus, Natural Resource Specialist | End User | No |
| USDA, Agricultural Research Service, Northwest Watershed Research Center | Dr. Patrick E. Clark, Range Scientist | End User | No |
| Idaho Department of Fish and Game, Southeast Regional Office | Scott Bergen, Principal Wildlife Research Biologist | End User | No |
| Idaho Department of Fish and Game, Upper Snake Regional Office | Ryan Walker, Habitat Biologist | End User | No |
| NASA RECOVER Science Team | Keith Weber, Idaho State University GIS Director | Collaborator | Yes |

***End-User Overview***

***End User’s Current Decision-Making Process:***After wildfire events, end users implement reseeding programs that are measured for success through field surveys. However, the factors allowing natural and planned vegetation propagation are not always monitored, even synoptically, except when funding is provided during the first 3 years post-wildfire. Currently, remote sensing techniques such as timely NAIP imagery-based analyses are used on a case study basis, but are not the primary monitoring techniques (*in situ* surveys) due to the need for remote sensing data acquisition at key times of year.

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

*Bureau of Land Management, Pocatello Field Office* – The GIS TReC at Idaho State University has worked in close collaboration with the BLM since 1999 on a variety of rangeland research projects that use NASA EO, with many focusing on the effect of wildfire on rangeland health. Beginning with DEVELOP’s Idaho Disasters project in the fall term of 2014, relationships, understanding, and use of remotely sensed data for specific applications has continued to grow.

*USDA, Agriculture Research Service, Northwest Watershed Research Center* – These end users have used NASA Earth observations in the past; however, they have not used such EO data for monitoring efforts. The ARS practices rigorous research for improving agriculture, including husbandry, a large industry in the west that can only be allowed when ecosystems are healthy.

*Idaho Department of Fish and Game, Southeast Regional Office I –* The IDFG has been using GIS and GPS software for many years to track wildlife movement. They have used satellite data on a limited basis in the past to produce species suitability maps. This project will enhance the IDFG’s ability to use NASA Earth observations for wildlife habitat management by incorporating NASA products.

*Idaho Department of Fish and Game, Upper Snake Regional Office* - The IDFG has been using GIS and GPS software for many years to track wildlife movement. They have used satellite data on a limited basis in the past to produce species suitability maps. This project will enhance the IDFG’s ability to use NASA Earth observations for wildlife habitat management by incorporating NASA products.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*NASA RECOVER Science Team* – RECOVER is a fire-specific decision support system (DSS) that automatically brings together all the information necessary for post-fire rehabilitation decision-making in a single analysis environment. In response to a fire detection event, RECOVER uses its rapid resource allocation capabilities to automatically prepare Earth observations data, derived decision products, and historic biophysical data so that when the fire is contained, Emergency Stabilization and Rehabilitation (ES&R) and Burned Area Emergency Response (BAER) teams will have a complete and ready-to-use browser-based RECOVER dataset and GIS analysis environment that is customized for the target wildfire.

***Dissemination by Boundary Organizations*:**

*NASA RECOVER Science Team* – The RECOVER DSS is made up of a RECOVER Server and a RECOVER Client. The RECOVER Server is a specialized server deployed at ISU’s GIS TReC and in the Amazon Elastic Compute Cloud. The RECOVER Client is a full-featured Adobe Flex Web Map GIS analysis environment. When provided a wildfire name and geospatial extent, the RECOVER Server aggregates site-specific data from pre-designated, geographically distributed data archives. The results of this project will be shared through the RECOVER DSS process described above.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Communication between the DEVELOP team and project partners will occur every two weeks via teleconference, in-person meetings, or e-mail communications. Lines of communication will remain open if questions arise, but these meetings will primarily involve project updates and high-level results. The Center Lead will coordinate an initial project meeting within the first two weeks of the term, and will transition this responsibility to the project lead. Initial communications will be collaborative, involving all partners to determine study area and key project goals. As the term progresses, the project lead will keep partners updated on project progress and filter feedback on partner advice.

***Transition Plan*:** Project end users will have access to the data, technical paper, and VPS via the ISU GIS TReC Spatial Data Library or directly through electronic transfer devices. End users will be engaged on a frequent basis during and after the project. Final images and maps will be handed off during closeout and an electronic copy will be sent so the end products and data can be used for planning purposes as soon as possible. Currently, software release is not anticipated as necessary.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 8 OLI** | Spectral classification: MSAVI2 | Landsat 8 OLI will be used to examine vegetation extent & health using surface reflectance to see spectral ranges necessary for hosting ideal propagation environments. |
| **SRTM Version 2** | Elevation | SRTM will provide the elevation data necessary to create aspect and slope which will be important for discovering propagation conditions. |
| **Terra & Aqua MODIS** | Chlorophyll-a, NDVI, FPAR, and surface reflectance | Combined Terra & Aqua MODIS products will be used to monitor vegetation propagation health, extent, and wildfire scar presence. NDVI and fraction of photosynthetically active radiation (FPAR) will be used to show the spatial extent and health index of vegetation. |

***Ancillary Datasets:***

NASA RECOVER Wrangler system, ISU GIS TReC – Historic Fire polygons – wildfire boundaries

US Geological Survey – National Land Cover Database – forest cover change

Agrimet Weather Station – Soil temperature, precipitation, temperature – analyze wildfire recovery variables

Modern-Era Retrospective Analysis for Research and Application (MERRA) – daily average precipitation, temperature, atmospheric water vapor, and atmospheric radiation

US Forest Service ForWarn – Forest Disturbance Datasets, Climate & Weather Datasets – determine vegetation responses to droughts, precipitation data, and changes in vegetation phenology

***Software & Scripting:***

TerrSet – progress of vegetation propagation and wildfire recovery analysis and regression analysis

Esri ArcGIS – temporal change analysis and making vegetation indices (MSAVI2 or NDVI)

QGIS – spatio-temporal remote sensing and vector-based GIS data visualization and analysis

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Vegetation Propagation Change Maps | These maps will identify areas of propagation and where reseeding or natural vegetation recovery failed. | Landsat 8 OLI, ForWarn MODIS, and MERRA data will be used to identify wildfire time range and then track the progress of recovery for all three wildfires. | N/A |
| Control of Wildfire Recovery Maps | These maps will identify the variables and ranges that were necessary for wildfire recovery. | Climate data and variables developed from elevation data, will be used as independent variables in a regression analysis to identify the key variables necessary for wildfire recovery, defined as a MODIS NDVI close to the averaged three year pre-fire value. | N/A |

***End-User Benefit*:** The locations of these wildfires are not easily accessed and field work is time intensive. Additionally, data from prior field surveys for vegetation composition are normally unavailable and wildfire recovery is not always regularly monitored. This project will give partners the capabilities and know-how needed to regularly monitor wildfire sites and give them some experience and increased familiarity in the use of EO data for wildfire burn recovery monitoring efforts.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2017 Summer to 2017 Fall

***Multi-Term Objectives:***

* **Term 1:** 2017 Summer (ID) – Southern Idaho Disasters
  + The first term not only included data mining, but also identified the key variables necessary for monitoring and assessing vegetation regeneration after a wildfire. This included the initial step of processing data from 2005-2016 for the 2006 Crystal fire. The team contacted partners to determine what types of ecosystem variables were necessary to allow husbandry permits and to support quality mule deer and sage grouse habitat. The participants computed mapping products showing when regeneration after the Crystal fire would be able to again host the previously discussed land uses that occurred prior to a given fire. The team then began the process of characterizing vegetation regeneration of the other three wildfires (Jefferson, State, & Soda).
* **Term 2 (Proposed Term):** 2017 Fall (ID) – Southern Idaho Disasters II
  + The second term of this project will complete analysis for recovery following the Henry’s Creek, State, and Soda wildfires. The trend analysis of these three wildfires will be compared to the previous terms’ results and to one another, in order, to determine if recovery is dependent upon fire history and invasive species propagation. This will include initial exploration of key variables for characterizing habitat recovery and rehabilitation, but also determining how variables differ in value depending on spatial location. The team will then identify when husbandry and selected species habitats could be supported by the ecosystem.

***Previous Terms:***

2017 Summer (ID) – Southern Idaho Disasters

***Related DEVELOP Work:***

2015 Fall (ID) – Juniper Encroachment and Management in the Western U.S. Relative to Catastrophic Wildfires: Southeast Idaho Disasters

2011 Fall (LaRC) – Utilizing NASA EOS to Assess Burn Severity, Risk Mapping, and Effects on Air Quality Caused by the 2011 Texas Wildfires: Texas Disasters