**NASA DEVELOP National Program**

**** BLM at Idaho State University GIS TReC

*Summer 2017*

**Short Title: Southern Idaho Disasters**

**Subtitle:** Enhancing Pre- and Post-Wildfire Vegetation Type Characterization Using NASA Earth Observations

**VPS Title:** Steppe-ing Into Wildfire Recovery

**Project Team**

**Project Team:**

Austin Counts (Project Lead), [austincounts94@gmail.com](mailto:austincounts94@gmail.com)

Nicholas Olsen

Cassidy Quistorff

Caitlin Toner

Courtney Ohr

**Advisors & Mentors:**

Keith Weber (Idaho State University, GIS TReC)

Joe Spruce (Science Systems and Applications Inc.)

**Project Overview**

**80-100 Word Objectives Overview:**

With increasing wildfire frequency in southern Idaho, it is important for land managers to become more efficient at monitoring the ecological conditions of burned areas as they recover over time. Identifying the driving variables of recovery could aid in reseeding efforts and assist land managers with pre- and post-wildfire treatments. Recovery efforts are also important for monitoring carbon storage and carbon sequestration capacity. This project utilized NASA Earth observations to monitor recovery of vegetation and carbon storage potential preceding the Crystal wildfire (2006), while determining the importance of ecological variables to wildfire recovery.

**Abstract:**

Increasing wildfire frequency has emphasized the importance of post-wildfire recovery efforts in southern Idaho’s sagebrush-steppe ecosystem. The changing fire regime favors annual invasive grass species while hindering native grasses and sagebrush habitat regeneration, causing a positive feedback cycle of invasive plants. Due, in part, to this undesirable process the sagebrush-steppe ecosystem is one of the most endangered in the US. In this project, the Idaho NASA DEVELOP team partnered with the Bureau of Land Management, Idaho Department of Fish and Game, and the US Department of Agriculture to characterize ecosystem recovery following the 2006 Crystal wildfire. Vegetation recovery following the Crystal fire (2006) was observed from 2001 to 2016 using NASA Earth observations Landsat 5 Thematic Mapper (TM), Landsat 8 Operational Land Imager (OLI), Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS), and the Shuttle Radar Topography Mission (SRTM). In addition, significant factors affecting recovery were identified, and recovery of the landscapes carbon sequestration capacity was assessed. Key variables analyzed included biomass production, seasonally accumulated precipitation, max seasonal temperature, and elevation including slope and aspect. These factors affect land management by driving the success or failure of recovery efforts.

**Keywords:**

Invasive species, remote sensing, wildfire recovery, cheatgrass, carbon sequestration, Landsat, sagebrush-steppe, MODIS

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Bureau of Land Management (BLM), 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, ISU GIS Director | Collaborator | Yes |

**Community Concerns:**

* Cheatgrass (*Bromus tectorum*)causes a wildfire return interval of 3-5 years while native sagebrush ecosystems exhibit ~60-100 years returns.
* The unknown effects of environmental conditions may negatively impact wildfire recovery and reseeding programs while benefiting the propagation of non-native plant species, such as *Bromus tectorum*.
* Increased wildfire frequency is a major source of ecosystem and urban disturbances in the western United States, requiring additional economic resources from land managers to monitor and aid the recovery of these natural ecosystems.

**Current Decision-Making Practices & Policies**:

Project partners have implemented reseeding programs to help revitalize native species after wildfire events. The Plant Conservation Alliance, chaired by the BLM, created the National Seed Strategy in response to the shortage of native plant seeding materials in 1999 and 2000. These seeding materials are used by land managers following environmental disasters to aid in restoring natural ecosystems. It is common practice for land managers to reseed after wildfire events; the success of these reseeding programs are determined through field surveying during the following 3 years. This method of collecting ground data covers a small spatial and temporal extent, and thus provides limited knowledge on the propagation of reseeding efforts. In addition to field surveys, remote-sensing techniques are used, but are not the primary monitoring techniques.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software**  **Release** |
| Vegetation Recovery Change Maps | Landsat 5 TM, Landsat 8 OLI, Terra MODIS, & Aqua MODIS | Vegetation maps provide information on wildfire affects to the ecosystem. These maps can help identify locations with invasive plants, and can also show regions of successful native plant regrowth. | N/A |
| Economic Value Charts of Carbon Storage | Landsat 5 TM & Landsat 8 OLI | This will relate an economic cost or gain to the recovery of the sagebrush ecosystem. A monetary value allows partners to understand the overall cost of pre- and post-wildfire recovery and can be included in planning or reports. | N/A |
| Key Variable Charts | Landsat 5 TM, Landsat 8 OLI, Terra MODIS, & Aqua MODIS | The partners will be able to distinguish recovery rates based on the presence or absence of key variables such as vegetation regrowth, precipitation, and temperature. | N/A |

**Project Benefit to End User**:

This project will provide valuable information on the 2006 Crystal wildfire and the ecological variables that drove recovery. By knowing which of these variables lead to the re-establishment of native species, partners will be able to increase the success of post-wildfire recovery efforts. The use of NASA Earth observations allow partners to monitor future wildfire recovery more effectively and on a larger scale than what field surveys can provide.

**Project Details**

**Applied Sciences National Application Addressed:** Disasters

**Study Area:** Southern Idaho (ID), Crystal Fire extent

**Study Period:** 2001 – 2016 (April – August)

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| Landsat 5 TM | NDVI, dNBR, MSAVI2, spectral classification | Landsat 5 TM was used to examine vegetation extent & health using surface reflectance to see spectral ranges necessary for hosting ideal propagation environments. Used for years 2001-2012. |
| Landsat 8 OLI | NDVI, dNBR, MSAVI2, spectral classification | Landsat 8 OLI was used to examine vegetation extent & health using surface reflectance to see spectral ranges necessary for hosting ideal propagation environments. Used for years 2013-2016. |
| SRTM Version 2 | Elevation | SRTM provided the elevation data necessary to create aspect and slope which was important for discovering propagation conditions. |
| Terra MODIS | NDVI, and surface reflectance | MODIS was used to monitor vegetation propagation health, extent, and wildfire scar presence. NDVI was used to show the spatial extent and health index of vegetation. |
| Aqua MODIS | NDVI, and surface reflectance | MODIS was used to monitor vegetation propagation health, extent, and wildfire scar presence. NDVI was used to show the spatial extent and health index of vegetation. Using both Aqua and Terra improves the temporal resolution. |

**Ancillary Datasets Utilized:**

* NASA RECOVER Wrangler system, ISU GIS– Normalized Burn Ratio, Fire Severity Maps
* USGS National Land Cover Database (NLCD) – land cover type
* Agrimet Weather Station – precipitation, temperature
* US Forest Service ForWarn - Forest Disturbance Datasets, NDVI

**Software Utilized:**

* TerrSet – Image processing and vegetation change analysis of Landsat 5 TM, Landsat 8 OLI, Terra and Aqua MODIS Earth observations
* InVEST– Decision making and calculated carbon cost estimations
* Esri ArcGIS – Data processing

**Project Handoff Package**

**Transition Plan:**

Project end users will have access to the data, technical paper, and VPS via the ISU GIS TReC Spatial Data Library, the NASA RECOVER server, or directly through electronic transfer devices. 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.

*Project Continuation Plan*: The second term of this project will complete analysis for recovery following the Jefferson, Henry’s Creek, and Soda wildfires. This will include continuing exploration of key variables driving recovery and rehabilitation, but also determining how variables differ depending on spatial location, i.e. supported ecosystem, and aerial extent of the burned area footprint. The team will then identify when ecosystems can support livestock grazing and selected habitats post-wildfire. A significant component of the second term will include studying the effects of grazing on recovery after a wildfire event.

**Team POC:** Austin Counts, austincounts94@gmail.com

**Partner POC**: Dr. Patrick E. Clark, Pat.Clark@ars.usda.gov

**Handoff Package:**

* Vegetation propagation change maps
* Wildfire recovery maps
* Ecological variable statistics and graphs
* Project video
* Final Presentation
* Technical paper