**NASA DEVELOP National Program**

**Idaho – Pocatello**

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*Project Summary – Fall 2017*

**Southern Idaho Disasters II**

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

**VPS Title:** Steppe-ing Into Wildfire Recovery II: Cheatgrass’ Revenge

**Project Team**

***Project Team*:**

Brandon Crawford (Project Lead), crawbra2@isu.edu

Dane Coats

Jacob Ramthun

Leah Kucera

Rituraj Yadav

***Advisors & Mentors*:**

Keith Weber (Idaho State University GIS TReC)

Joseph Spruce (Science Systems and Applications, Inc)

***Past or Other Contributors*:**

Austin Counts

Nicholas Olsen

Cassidy Quirstorff

Caitlin Toner

Courtney Ohr

**Project Overview**

***Project Synopsis*:** As wildfire prevalence increases across the state of Idaho, effective monitoring and management of pre- and post- burn landscapes will be vital for conservation applications. In the previous iteration of this project (Summer 2017), several parameters for wildfire recovery were determined from observations of the Crystal Wildfire (2006), establishing a preliminary methodology for informing recovery efforts. This project will utilize NASA Earth observations in expanding these methods to the Jefferson (2010), Henry’s Creek (2016), and Soda (2015) wildfires to evaluate their larger-scale applicability.

***Abstract*:**

Wildfire is a key driver of ecosystem change in sagebrush steppe ecosystem. Fire-related disturbances can facilitate the propagation of invasive vegetation threatening native wildlife and shaping a fire regime that is increasingly hazardous to adjacent urban communities. Applying the methodology created during the previous DEVELOP term that characterized the 2006 Crystal fire, we worked to identify correlations between climatic and biophysical conditions and effective recovery of sagebrush-steppe cover across multiple recent fires (Jefferson, Henry’s Creek, and Soda) in southern Idaho. Our research integrated imagery from NASA’s Landsat 5 Thematic Mapper (TM) and Landsat 8 Operational Land Imager (OLI). In addition, ForWarn spatial phenology products derived from the Terra and Aqua satellite’s Moderate Resolution Imaging Spectroradiometer (MODIS) sensor were used to investigate temporal variation. We used pre- and post-wildfire trends in normalized difference vegetation index (NDVI) and differenced normalized burn ratio (dNBR) values as metrics for recovery in a multiple regression analysis paired with historic climate and fire data. With a refined understanding of how disturbance alters long-term land cover change and future fire regimes of semiarid landscapes, land management agencies will be better equipped to protect plant and animal species from habitat loss and minimize the threat posed to urban areas.

**Keywords:**

MODIS, NDVI, dNBR, ForWarn, cheatgrass, sagebrush-steppe, MODIS, wildfire recovery

***National Application Area Addressed:*** Disasters

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

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

***Community Concerns:***

* Cheatgrass (*Bromus tectorum*), an invasive species that propagates rapidly following wildfires, can exhibit recurrence intervals of 3-5 years while native sagebrush ecosystems exhibit ~60-100 year fire returns.
* 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.
* Understanding the key variables making reseeding and natural recovery successful in some areas, assessing why they failed in others, and identifying contributing factors to non-native propagation are vital issues for a variety of stakeholders in this region.

***Project Objective:***

* Our primary objective is to apply the model characterizing the 2006 Crystal fire to identify correlations between climatic and geophysical conditions and effective recovery of shrub cover across multiple recent fires (Jefferson, Henry’s Creek, Soda) in southern Idaho.

***Previous Term:*** 2017 Summer (ID) – Southern Idaho Disasters

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Bureau of Land Management, Idaho Falls District Office** | Ben Dyer, Fire Ecologist | 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 |

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

After wildfire events, land managers 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 following wildfire events. Currently, remote sensing from timely NAIP imagery-based analyses are used on a case-study basis, but *in situ* surveys remain the primary monitoring technique.

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

The locations of these wildfires are not easily accessible, making field work costly and 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 knowledge and capability needed to regularly monitor wildfire sites via remotely-sensed data while providing them an increased familiarity in the use of NASA EO data for wildfire burn recovery monitoring efforts.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 5 TM** | NDVI, dNBR, MSAV12, spectral classification | Landsat 5 TM was used to examine vegetation extent & health using surface reflectance to determine spectral ranges necessary for hosting ideal propagation environments. Used for years 2001-2012. |
| **Landsat 8 OLI** | NDVI, dNBR, MSAV12, spectral classification | Landsat 8 OLI was used to examine vegetation extent & health using surface reflectance to determine spectral ranges necessary for hosting ideal propagation environments. Used for years 2013-2016. |
| **SRTM** | Elevation | SRTM provided elevation data necessary to create aspect and slope which are important variables for discovering propagation conditions. |
| **Terra MODIS** | NDVI, surface reflectance | MODIS data were used to monitor vegetation health, extent, and wildfire scar presence. NDVI was used to show spatial extent and provide a more robust temporal record. |
| **Aqua MODIS** | NDVI, surface reflectance | MODIS data were used to monitor vegetation health, extent, and wildfire scar presence. NDVI was used to show spatial extent and provide a more robust temporal record. |

***Ancillary Datasets:***

NASA RECOVER Wrangler system, ISU GIS TrEC – historic fire polygons, wildfire boundaries

USGS National Land Cover Database (NLCD) – land cover type

Agrimet Weather Station – precipitation, temperature

US Forest Service ForWarn – forest disturbance datasets, NDVI

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

***Software & Scripting:***

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

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

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

Python – scripting and analysis

Adobe Creative Suite – graphic creation and map manipulation/layout

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Earth Observations Used**  | **Partner Benefit & Use** | **Software Release Category** |
| **Vegetation Propagation Change Maps** | Landsat 8 OLI, Terra MODIS, Aqua MODIS, SRTM | These maps will identify areas of propagation and where reseeding or natural vegetation recovery failed. | N/A |
| **Control of Wildfire Recovery Maps** | Landsat 5 TM, Landsat 8 OLI, Terra MODIS, Aqua MODIS | These maps will identify the variables and ranges that were necessary for wildfire recovery. | N/A |

**Project Handoff Package**

**Transition Plan:**

Project end users will be engaged on a frequent basis during and after the project. End users will have access to the data, technical paper, and project video via the ISU GIS TReC Spatial Data Library 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.

**Team POC:** Brandon Crawford, crawbra2@isu.edu

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

**Handoff Package:**

* Vegetation Propagation Change Maps
* Control of Wildfire Recovery Maps
* Ecological variable statistics and graphs
* Project video
* Final presentation
* Technical paper