**NASA DEVELOP National Program**

****USGS at Colorado State University – Fort Collins, CO

**Spring 2016**

**Short Title: Gunnison National Forest Agriculture**

**Subtitle:** Mapping Spruce Beetle Outbreak Severity and Distribution in Gunnison National Forest Using Landsat and Integrative Spatial Modelling

**VPS Title:** Beetle Spruce: Mapping Spruce Mortality in Southwest Colorado

**Project Team & Partners**

**Project Team:**

Eric Rounds (Project Lead), erounds202@gmail.com

Sarah Carroll

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**Advisors & Mentors:**

Dr. Paul Evangelista (Natural Resources Ecology Lab, Colorado State University)

Tony Vorster (Bioenergy Alliance Network of the Rockies)

Brian Woodward (DEVELOP – Fort Collins Center Lead)

**Partner Organizations:**

Bioenergy Alliance Network of the Rockies (BANR) (End-User) POC: Anthony Vorster

Montana State University, Spatial Sciences Center (End-User) POC: Dr. Rick LawrenceColorado State University, Natural Resource Ecology Laboratory (NREL) (End User) POC: Nick Young

USDA Forest Service, Gunnison Ranger District (End User) POC: Matt Vasquez

USDA Forest Service, Rocky Mountain Research Station (End User) POC: Dr. Mike Battaglia

**Project Details**

**Applied Sciences National Application Addressed:** Agriculture

**Study Area:** Southern Rocky Mountains, CO
**Study Period:** Summer 2006 - Fall 2015

**Earth Observations & Parameters:**

Landsat 8, OLI & TIRS – land cover

SRTM V2 - elevation, slope, aspect

**Ancillary Datasets Utilized:**

* National Agriculture Imagery Program (NAIP) - Imagery for model input bands
* USGS LANDFIRE 2012 – Existing vegetation type, tree dominated area

**Models Utilized:**

* Montana State University, Shannon Savage - svm.rf\_10xloop.R
* Montana State University, Shannon Savage - generic\_ZImodeling\_rinput.txt

**Software Utilized:**

ArcGIS - raster manipulation/analysis, imagery processing, and map creation

ENVI - raster mosaicking, imagery manipulation

R - statistical analysis, model application, figure creation

**Project Overview**

**Objectives Overview:**

Bark beetle outbreaks affect millions of acres of Colorado’s spruce and fir forests. As a result, land managers are facing an increasing number of management challenges. To assist in the management of spruce beetle infested forests, our team produced fine scale maps of spruce mortality in southwest Colorado for 2013 and 2015. Our results will be utilized by forest managers to inform treatment plans and decision making, manage wildlife habitat, and assess available biomass for fuel conversion.

**Abstract:**

Over the last fifteen years Colorado forests have experienced epidemic bark beetle outbreaks with increasing severity. The outbreaks have wide-reaching impacts on forest health, wildlife habitat, wildfire regimes, and the safety of recreational forest users. These impacts are of great concern to land managers and project partners at the US Forest Service (USFS) who are working to maintain ecological integrity and safe public access in national forest lands. While the majority of existing studies have focused on the mountain pine beetle (*Dendroctonus ponderosae*), an increasing amount of research is focusing on the ongoing spruce beetle (*Dendroctonus rufipennis*) outbreak. The spruce beetle outbreak in southwest Colorado is the largest ongoing outbreak in the state. This project utilizes Landsat 8 OLI, NAIP imagery, and forest health indices to produce spruce mortality data. These combined data were fed into an integrative spatial model developed by researchers at Montana State University’s Spatial Sciences Center to produce fine scale maps of spruce mortality across southwestern Colorado for the years 2006 to 2015. These maps have the potential to be a significant improvement on the roughly estimated map products available to our partners, and will be used to plan treatment operations and estimate aboveground biomass in the study area.

**Community Concerns:**

* A spruce beetle outbreak is actively occurring in the Gunnison National Forest in southwest Colorado. It is estimated that nearly 1.4 million acres of forest have been affected by the beetle since 1996 and that outbreak severity has likely increased in recent years.
* Land managers are concerned that increased tree mortality will reduce habitat quality and availability for species that rely on spruce forest characteristics, specifically the federally threatened Canada lynx (*Lynx canadensis*).
* Increased mortality and stands of dead trees will likely influence wildfire regimes and intensify wildfires.
* Dead and falling trees will pose a hazard to forest visitors engaging in recreational activities.

**Current Management Practices & Policies:**

Currently the USFS conducts annual aerial surveys of Colorado forests to assess forest health. The maps created from these aerial surveys are the primary source of spatial data used for adaptive management planning and decision making. However, these maps are labor intensive and provide a rough estimate of insect-damaged tree distribution. In 2013 the USFS initiated the Spruce Beetle Epidemic and Aspen Decline Management Response (SBEADMR) project. The SBEADMR project proposes to apply treatment that includes the removal of dead and dying trees and intensive resiliency measures in remaining unaffected stands across Grand Mesa, Uncompahgre, and Gunnison National Forests.

 **Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Spruce Beetle Outbreak Severity and DistributionMap for the Gunnison National Forest- 2013-2015 | Landsat 8 (OLI)SRTM V2NAIP | Assessing available biomass for biofuel conversion, mammal habitat availability, and forestry treatment recommendations; also assessing biomass availability through time |
| Complete statistical analysis of Landsat data performance in the model | Landsat 8 (OLI)SRTM V2NAIP | Contribute to the discussion of the application of integrative spatial modeling and remotely-sensed databases for forest management within the scientific community |

**Project Imagery**

Coming soon

**Software Release Requirements**

Category I