**NASA DEVELOP National Program**

**2017 Summer Project Proposal**

**NASA Langley Research Center**

**Colorado National Monument Eco Forecasting**

*Assessing Detection of Invasive Species Using NASA Earth Observations to Improve Monitoring and Response Management in Colorado National Monument*

**Project Overview**

***Project Synopsis*:** Colorado National Monument (COLM) is home to scenic views, high quality stands of pinyon-juniper woodlands, grasslands, and upland shrub communities, in addition to many ecological and cultural significant species and artifacts. However, with increased tourism brings enhanced risk for invasive species disturbance, particularly cheatgrass. Using Landsat, MODIS, and Sentinel-2 data, the NASA DEVELOP team will create historical and current trend maps in cheatgrass coverage within and around the park boundaries to help NPS staff better understand where sources of cheatgrass are found in the lands surrounding the park and where to focus their monitoring and management efforts.

***Community Concern:*** Land managers require accurate information about invasive species patch locations in order to effectively allocate resources and management efforts. However, searching for invasive species patches is time intensive and may not be feasible on large spatial scales. Invasive species can dramatically alter the function of natural ecosystems, so effective monitoring and management is essential to future ecosystem stability. In particular, COLM is especially sensitive to cheatgrass, as it poses a major threat to the old-growth pinyon-juniper woodlands due to its ability to carry fire into these long unburned areas. As such, managers consider it to be a greater threat than any other invasives.

***Source of Project Idea:*** This project developed out of a discussion between members of the National Park Service and DEVELOP.

***National Application Area Addressed:*** Ecological Forecasting

***Study Location:*** Colorado National Monument (CO)

***Study Period:*** January 1995 to May 2017

***Advisor:*** Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service, Colorado National Monument | Ann Rodman, Chief of Cultural and Natural Resources  Molly Murphy, | End-User | No |
| Colorado Mesa University | Dr. Deborah Kennard, Associate Professor | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***The NPS currently utilizes in situ data to assess locations of invasives that require herbicide or other management treatments. While they are actively pursuing remote sensing technologies to enhance their current efforts, they do not have a system currently in place to expand their detection methods.

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

*NPS, Colorado National Monument* – The end-user is familiar with GIS and NASA Earth observations, and recently tested remote sensing techniques in partnership with Colorado Mesa University and the U.S. Geological Survey to detect early season invasives from 1986-2012. However, the broader application of this project’s results will allow for a better understanding of invasives in recent years, as well as historical sources of invasives in lands surrounding the park.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*Colorado Mesa University* – Dr. Deborah Kennard will be assisting the project by providing information on previous work testing remote sensing techniques for the detection of early season invasives, in addition to subject matter expertise in the region.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team lead will be the main point of contact for the project during the ten-week term, and the center lead will act as a secondary point of contact at that time. The team will communicate with the project partners weekly via email to update the partners on project progress and to ask questions as needed. Biweekly teleconference or video calls will also be used to have more discussion about project methodology and initial results.

***Transition Plan*:** An initial project hand-off will occur at the end of the term, in which maps and other visuals will be given to the partners.

**Earth Observations Overview**

***Earth Observations:***

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| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI** | Surface reflectance | Landsat products will be used to assess land use change through spectral indices in specific testing regions in the Pacific Southwest, and to create normalized burn ratio for masking fires. |
| **ESA Sentinel-2A MultiSpectral Imager (MSI)** | Surface Reflectance | Sentinel-2A products will be used to compare with Landsat results. |
| **Terra MODIS** | Surface Reflectance | MODIS products will be used to enhance the temporal resolution of Landsat and Sentinel-2 data, as well as provide phenology information to classify cheatgrass from other native species. |

***Ancillary Datasets:***

ForWarn – NDVI – assess changes in NDVI

***Modeling:***

USGS DESI (Detection of Early Season Invasives) (POC: Ray Kokaly, U.S. Geological Survey)

***Software & Scripting:***

Google Earth Engine API – manipulate data, create methodology

Esri ArcGIS – manipulate data, create visuals

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Current Cheatgrass Distribution Map | Current distributions of cheatgrass will be used to influence management and monitoring efforts within the monument. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Terra MODIS, and Sentinel-2A MSI data will be processed to create spectral indices and vegetation phenologies, and then used to create current distribution maps. | I |
| Forecasted Cheatgrass Distribution Map | Forecasted distributions of cheatgrass will be used to influence management and monitoring efforts within the monument. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Terra MODIS, and Sentinel-2A MSI data will be processed to create spectral indices and vegetation phenologies, and then used to create forecasted distribution maps. | I |
| Trends Maps of Cheatgrass Coverage | Annual cheatgrass distribution maps will be used to assess potential trends in cheatgrass coverage during the study period. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Terra MODIS, and Sentinel-2A MSI data will be processed to create spectral indices and vegetation phenologies, and then used to create annual distribution maps. | I |

***End-User Benefit*:** The NPS is actively managing and monitoring cheatgrass stands within Colorado National Monument, but developing tools and resources to enhance early season detection of invasives would be especially valuable within the park and in the surrounding Bureau of Land Management lands. Early season treatments of invasives have resulted in successful control, so continued early detection is essential to reducing costs and manhours necessary for invasive control.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Summer

***Related DEVELOP Work:***

2016 Summer (NASA Langley Research Center) – Southwest U.S. Eco Forecasting: Mapping Invasive Species to Efficiently Monitor Southwestern National Park Areas