**NASA DEVELOP National Program**

****Goddard Space Flight Center

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**Idaho Disasters**

*Using NASA Earth Observations to Determine Wildfire Susceptibility and to Create a Comprehensive Data Atlas for Savannah Ecosystems in Idaho*

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**Applied Sciences National Applications Addressed:**

Disasters

**Study Area:** Idaho, United States

**Study Period:** January 2001 – October 2014

**Partners/Collaborators**

Bureau of Land Management (BLM): Steve Jirik

Idaho Department of Lands (IDL): Dixie Booker-Lair

**80-100 Word Blurb**

The number of wildfires is increasing every year, which has several negative consequences on habitats and human structures. To aid in this increasing risk, we analyzed the Normalized Difference Vegetation Index and surface temperature in the months leading up to a fire to see if there was a unique signature compared to unburned lands. We also created an information database on fire statistics, remote sensing parameters, and precipitation to be easily accessible by wildfire managers. This information will be used by the Bureau of Land Management and Idaho Department of Lands teams when designing ecosystem management plans.

**Community Concerns**

* Wildfires have occurred for millennia, but climate change and related factors have been increasing the amount of burned area by 355 km2 per year since 1984[[1]](#footnote-1). This has created a demand for advanced wildfire decision support capabilities.
* Following fire, ground vegetation is typically eliminated, leaving the landscape devoid of cover. These communities may then experience a series of adverse changes due to landslides, soil erosion, and invasive plant infestations.

**Current Management Practices & Policies**

Prior to the fire season, which peaks in July and August, wildfire managers have to allocate resources between management offices. The Bureau of Land Management has 13 field offices across the state of Idaho that share in firefighting resources such as helicopters, tractors, bulldozers, and fire engines. Currently, they distribute these resources based on *in situ* data on vegetation moisture which is uploaded to the National Fuel Moisture Database. This process requires technicians to visit various sites located throughout Idaho to collect vegetation and then dry out the samples to calculate moisture. Areas that have drier vegetation receive more of these resources. Although these collection points are fairly evenly dispersed across the state, the distance between locations ranges between 15km to greater than 100km apart. In addition, the protocol is to collect vegetation moisture measurements every two weeks, which is maintained at some locations but not at others. NASA Earth Observing Systems can be used to gather information on vegetation moisture continuously across the landscape and at a higher temporal frequency which can then be used to make decisions about resource allocation. Other remote sensing variables may also be used as proxies for fire susceptibility.

**Abstract**

Wildfires play an important role in ecosystem health, with many native plant species dependent on fire to complete their life cycle. Wildfires also burn dead vegetation, which recycles nutrients back into the soil. However, climate change has created favorable conditions in the western United States for larger and more frequent wildfires, which can disrupt ecosystems and human localities. Also, the invasion of cheatgrass (*Bromus testorum*) across the landscape has drastically increased the duration of the fire season by contributing to the fine fuels load. To prepare for the fire season in Idaho, the Bureau of Land Management (BLM) and the Idaho Department of Lands (IDL) use vegetation moisture measurements from the National Fuel Moisture Database to identify and allocate resources to regions with drier vegetation during the year. To supplement that database, this research analyzes the Normalized Difference Vegetation Index (NDVI) and surface temperature (ST) to investigate their ability to identify fire susceptible regions since both of these variables characterize the quality of vegetation, are gathered frequently, and are continuous. The data for each of these variables was obtained from TERRA MODIS from 2001 – 2014 and focuses on shrubland and grasslands as determined by the 2011 National Land Cover Dataset. These land classes were analyzed due to the high abundance of fires occurring in these habitats every year. The NDVI and ST in each land class was compared across the state to the number of fires that occurred each year. On a smaller scale, individual burned regions were compared to unburned areas to determine if NDVI or ST had a unique signature in the months leading up to a fire. In addition to this analysis, a data atlas was created for earth observations with vegetation indices, land cover, and precipitation across the region. The results and data gathered from this study will support Idaho Department of Lands (IDL) and Bureau of Land Management (BLM) in resource allocation early in the fire season and planning fuel load reduction activities following the fire season.

**Decision Support Tools**

* Data atlas of time series raw data, summary maps, and spreadsheet databases on the region and individual fires during the time series
* Graphs and statistical analyses of NDVI and ST prior to the active fire season
* Methodology to analyze additional variables on a per-fire basis
* User guides for the BLM for downloading earth observations online for their day-to-day operations

**Benefit to End-User:**

* The BLM is responsible for the wildland fire management of 12 million acres of land in Idaho. IDL is the primary state-level agency responsible for dealing with wildfire in Idaho. This research aids both agencies in resource allocation across their managed lands.
* Other agencies responsible for wildfire management, such as the U.S. Forest Service, can use these tools in their own decision processes.

**Earth Observations & Parameters**

Terra, MODIS – NDVI, ST

**Future Applicable NASA Missions**

SMAP - Soil Moisture, vegetation moisture

HyspIRI – Vegetation moisture

**Models Utilized**

None

**Ancillary Datasets Utilized**

BLM - Historic Fires shapefiles

U.S. Bureau of Reclamation AgriMet – precipitation

Modern Era-Retrospective Analysis For Research And Applications (MERRA) - precipitation

Parameter-elevation Regressions on Independent Slopes Model (PRISM) - precipitation

Multi-Resolution Land Characteristics Consortium – 2011 National Land Cover Dataset

**Software Utilized**

* ArcGIS - Raster manipulation/analysis of Terra MODIS, map creation
* IDRISI - image processing and raster analysis
* R - statistical analyses
* ArcScene - 3D visualization, analysis, and animation
* Microsoft Excel - Tabular inquiries, formatting, graphing, statistical analyses, and data conversion

1. Dennison, P.E., Brewer, S.C., Arnold, J.D., & Moritz, M.A. (2014). Large wildfire trends in the western United States, 1984-2011. *Geophysical Research Letters*, *41*(8), 2928-2933. [↑](#footnote-ref-1)