**NASA DEVELOP National Program**

**2024 Spring Project Proposal**

**Pop-Up Project**

**Intermountain West Wildland Fires**

*Mapping Tree Mortality and Burn Patches using NASA Earth Observations to Determine Fire Risk and Inform Forest Management Practices*

**Project Overview**

***Project Synopsis*:** Monitoring fuel reduction projects is a major concern for wildland fire management efforts in the intermountain west. In partnership with the US Forest Service (USFS), the objective of this project is to determine high fuel loading areas near development to address community safety from wildfires and inform forest management decision-making efforts on the ground. NASA Earth observations, including Landsat 9 OLI-2, Landsat 8 OLI, and ISS GEDI, will be utilized to study tree density alongside ancillary products to map tree mortality, growth, and detect burn patches informing the partner’s wildfire crisis strategy plan. Burn maps, fuel load maps, and a tutorial will inform the partners of recent trends and illustrate new remote sensing-based methods to replicate in their future work enhancing their management practices.

***Study Location:*** Intermountain West Wildfire Crisis Strategy Sites and/or Yellowstone

***Study Period:*** 2018 – 2023 (June – October)

***Advisors:*** Di Yang (University of Wyoming) dyang1@uwyo.edu, Austin Madson (University of Wyoming) amadson@uwyo.edu

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** | **Sector** |
| **USDA, US Forest Service, Region 4** | Jed Gregory, Remote Sensing Program Manager Intermountain Region | End User | Federal Government |

***End User Overview***

***End User’s Current Decision-Making Process & Capacity to Use Earth Observations:***As wildfires continue to grow in size and severity in the intermountain west region, there has been increasing concern on communities near these events. The US Forest Service developed a wildfire crisis strategy identifying priority sites for its decision-making and management practices. The crisis strategy seeks to reduce wildfire risk to people and create fire-resilient forests. The partner’s highest priority is fuel reduction work, determining areas of high fuel loads and monitoring forests after fuel reduction efforts as forest regeneration takes place. The project partner and teamwork with remote sensing and are interested in broadening their utilization of NASA Earth observations. Replicating methods incorporating LiDAR-based Earth observations like ISS GEDI into their current work will inform the partners on their fuel reduction practices as part of their wildfire crisis planning efforts. The USFS also informs other agencies including the Bureau of Land Management.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 9 OLI-2** | Surface reflectance | Surface reflectance will be used to generate burn and spectral indices to map wildfire events. |
| **Landsat 8 OLI** | Surface reflectance | Surface reflectance will be used to generate burn and spectral indices to map wildfire events. |
| **ISS GEDI** | Canopy cover | Canopy cover will be used to monitor tree mortality, growth, and fuel loads. |

***Ancillary Datasets:***

* USGS National Land Cover Database (NLCD) – identify developed land cover in relation to wildfire crisis strategy sites
* NSF National Ecological Observatory Network (NEON) Yellowstone National Park (YELL) – train and validate remote sensing methods
* NASA Global Learning and Observations to benefit the Environment Program (GLOBE) – include citizen science in situ based forest and tree canopy parameters into remote sensing methods

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |
| --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** |
| **Burn Maps** | Detecting burn patches will identify fire events (prescribed burn and wildfires) in recent years in relation to the fuel load maps and will identify forest impact informing the partner of recent trends. | Landsat 9 OLI-2 and Landsat 8 OLI will be used to examine recent prescribed burn and wildfire spatial and temporal trends in and surrounding wildfire crisis strategy sites. |
| **Fuel Load Maps** | LiDAR mapping of key forest structure traits supports assessing and modeling forest trajectories, identifying areas at risk of wildfire spread, and evaluating effectiveness of fire mitigation treatments through consistent structural quantification. Descriptive map products and statistical outputs showcase current status and trends to guide management. | ISS GEDI will be used to relate tree canopy to fuel loads in wildfire crisis strategy sites. |
| **Tutorial** | A tutorial document in ArcGIS Pro will demonstrate to the partners how to replicate project methods and expand to other wildfire crisis strategy sites. | ISS GEDI will be used to illustrate step-by-step methods of the project methods. |

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2024 Spring

***Similar Past DEVELOP Projects***:

* 2023 Spring (ARC) – Marin County Wildland Fires: <https://appliedsciences.nasa.gov/what-we-do/projects/examining-fuel-load-and-land-cover-change-inform-fire-prevention-and>
* 2022 Fall (NC) – Gatlinburg & Beatty Wildfires: <https://appliedsciences.nasa.gov/what-we-do/projects/evaluating-role-soil-moisture-determining-vegetation-health-fuel-loads-and>

**Notes & References:**

***Notes*:** Links to relevant data & resources

* [Wildfire Crisis Implementation Plan](https://www.fs.usda.gov/sites/default/files/Wildfire-Crisis-Implementation-Plan.pdf)
* [NEON YELL](https://www.neonscience.org/field-sites/yell)
* Study Area: Jed is reaching back out to forest management at these sites and will confirm soon on study locations to focus on and data availability for the team. The backup area is at or near Yellowstone since there is NEON data available that the team could use then. As a backup option with available in situ data, focusing on USFS Region 4 districts or the Yellowstone NEON site could work well.

***References:***

Hoffrén, R., Lamelas, M. T.,, de la Riva, J., Domingo, D., Montealegre, A. L., García-Martín, A., & Revilla, S. (2023). Assessing GEDI-NASA system for forest fuels classification using machine learning techniques. *International Journal of Applied Earth Observation and Geoinformation, 116*. <https://doi.org/10.1016/j.jag.2022.103175>

Myroniuk, V., Zibtsev, S., Bogomolov, V., Goldammer, J. G., Soshenskyi, O., Levchenko, V., & Matsala, M. (2023). Combining Landsat time series and GEDI data for improved characterization of fuel types and canopy metrics in wildfire simulation. *Journal of Environmental Management, 345*. <https://doi.org/10.1016/j.jenvman.2023.118736>.