**NASA DEVELOP National Program**

**2020 Spring Project Proposal**

**California – Ames**

**Eastern Washington Disasters**

*Integrating NASA Earth Observations to Analyze Spatiotemporal Distributions of Lightning-Caused Wildfires in Eastern Washington*

**Project Overview**

***Project Synopsis*:** Lightning-caused wildfires were responsible for approximately half the acres burned in Washington state over the last decade. Though trends in fire frequency have remained stable over the last ten years, the size and severity of these fires have increased. This project will partner with The Nature Conservancy’s Washington Chapter, the Washington State Department of Natural Resources’ Forest Health and Resiliency Division, and the University of Washington to analyze spatiotemporal distributions of lightning-caused wildfires east of the Cascade crest in Washington. Using VIIRS, MODIS, the ISS Lightning Imaging Sensor, and Landsat imagery, the project will generate a climatology of fire frequency and lightning strikes that will help partners identify areas that are prone to high occurrences of strikes and subsequent fire ignition to better inform land management practices.

***Community Concern:*** Years of fire suppression, intensive logging, mineral extraction, and grazing have led to dramatic land cover changes in Eastern Washington, leaving the land vulnerable to intense wildfires that threaten local communities and ecosystems. Lightning strikes are a leading cause of wildfire ignition in the state, and in 2018, 45,203 lightning strikes were recorded in the Pacific Northwest. There is insufficient research about the spatial distributions of lightning strikes and their ultimate role in the number and severity of wildfires in Washington. These knowledge gaps can prevent managers from evaluating the sources of fires as well as identifying fuel types and conditions predisposed to ignition. This knowledge is essential to assessing the linkages between fire ignition and its subsequent impacts, such as those on nearby air quality.

***Source of Project Idea:*** The preliminary idea for this project came from discussions between California – Ames Fellow Gina Cova and Brian Straniti, Central Cascades Community Coordinator at The Nature Conservancy, Washington Chapter. The project was further refined through conversations between Gina and Chuck Hersey, Forest Health Environmental Planner at the Washington Department of Natural Resources, and science advisor Dr. Kenton Ross.

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

***Study Location:*** Eastern Washington

***Study Period:*** 2000– 2019 (May – October)

***Advisors:*** Dr. Juan Torres-Pérez (Bay Area Environmental Research Institute, NASA Ames Research Center), Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **The Nature Conservancy, Washington Chapter** | Brian Straniti, Central Cascades Community Coordinator | End User | Yes |
| **Washington State Department of Natural Resources, Forest Health and Resiliency Division** | Chuck Hersey, Forest Health Environmental Planner | End User | No |
| **University of Washington** | Ernesto Alvarado, Research Associate Professor | Collaborator | No |

***End User Overview***

***End Users’ Current Decision-Making Process:***The Nature Conservancy (TNC), Washington Chapter seeks to conserve land and natural resources through science-based solutions that integrate local and regional agencies and organizations. Under the Central Cascades Management Plan, the TNC engages in forest restoration practices such as pre-commercial thinning, fire-wise thinning, and prescribed burning. The TNC also conducts outreach to engage community stakeholders to create a shared vision for the land. The Washington State Department of Natural Resources, Forest Health and Resiliency Division works to improve forest resiliency to wildfire, climate change, drought, insects, and disease. Under the 20-Year Forest Health Strategic Plan, the division has set a goal to restore more than 1.25 million acres of Washington forest.

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

*The Nature Conservancy, Washington Chapter* – The Nature Conservancy, Washington Chapter has conducted aerial drone surveys of the region but currently has limited capacity to access and analyze historic datasets and remotely sensed imagery of lightning strikes.

*Washington State Department of Natural Resources, Forest Health and Resiliency Division* – The Washington State Department of Natural Resources, Forest Health and Resiliency Division uses remote sensing in their land management practices, but currently has limited capacity to process and analyze LIS data.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*University of Washington* – The collaborator has performed extensive research in the past related to wildfire risk and behavior in Washington and can provide context and advising on the project.

***Dissemination by Boundary Organizations*:**

*The Nature Conservancy, Washington Chapter* – The end user may disseminate project results to a variety of community stakeholders involved in the Central Cascades Management Plan, including the Tapash Sustainable Forest Collaborative, of which the end user is a member.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** During the term, the team will have biweekly teleconferences with the partners to provide updates on project methodologies and analysis. The Project Lead and the leadership at the California – Ames Node will be the primary points of contact for in-term communications with the partners. Additionally, an in-term remote sensing and GIS webinar may be arranged to further enhance end users’ capacities in geospatial applications.

***Transition Plan*:** A formal handoff will take place at the end of the project term in the form of a video conference via Google Hangouts or WebEx. End products and deliverables will be sent to partners via NASA Large File Transfer within two weeks after the project ends.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Aqua MODIS** | Active Fire Product | MODIS derived fire products will be used to identify fire events. |
| **Terra MODIS** | Active Fire Product | MODIS derived fire products will be used to identify fire events. |
| **Suomi NPP VIIRS** | Active Fire Product | VIIRS derived fire products will be used to identify fire events. |
| **NOAA-20 VIIRS** | Active Fire Product | VIIRS derived fire products will be used to identify fire events. |
| **ISS LIS** | Lightning flashes | ISS LIS climatology data will be utilized to identify lightning strikes throughout Eastern Washington throughout the study period. |
| **Landsat 5 TM** | Burn severity, land cover | Landsat 5 TM may be employed to calculate a normalized burn ratio on fire affected areas and examine land cover where lightning strikes have occurred. |
| **Landsat 8 OLI** | Burn severity, land cover | Landsat 8 TM may be employed to calculate a normalized burn ratio on fire affected areas and examine land cover where lightning strikes have occurred. |

***Ancillary Datasets:***

* NOAA Severe Weather Data – Dataset of lightning strikes to supplement gaps in ISS LIRS data

***Software & Scripting:***

* Esri ArcGIS Pro 2.0 – Raster manipulation and analysis, map creation
* Google Earth Engine API – Image acquisition and preliminary processing
* Python – Batch extraction and processing of LIS data

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Climatology of Fire Frequency** | This product will analyze locations and severity of fires in Eastern Washington over the study period, providing partners with a holistic assessment of large-scale fire trends over time. | Zonal statistics will be calculated and maps will be created from a fishnet grid of fire incidents data sourced from MODIS and VIIRS sensors.  | I |
| **Climatology of Lightning Frequency** | This product will analyze locations of lightning strikes in Eastern Washington over the study period, providing partners with an enhanced understanding of where lightning strikes most frequently occur.  | Zonal statistics will be calculated and maps will be created from a fishnet grid of lightning strike data sourced from the ISS LIS and NOAA. | I |
| **Lightning-Caused Fire Risk Analysis** | A Lightning-Caused Fire Risk Analysis will provide partners with maps and statistics to identify areas that are prone to high occurrences of strikes and subsequent fire ignition. Using this data, partners can better understand fire risk from non-human ignition sources. | This analysis will assess relationships between the Climatology of Fire Frequency and Lightning Frequency end products. This analysis may also explore relationships between lightning-caused wildfire, land cover, and burn severity by incorporating Landsat data.  | I |

***End User Benefit*:** This project will provide The Nature Conservancy, Washington Chapter and the Washington State Department of Natural Resources, Forest Health and Resiliency Division with a set of analyses that can assess trends in historic lightning-caused wildfires to inform current efforts to rebuild forest resiliency. This project will extend into a second term, which will use these initial analyses as a baseline to explore smoke outputs and impacts from wildfires.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2020 Spring

***Related DEVELOP Work:***

2018 Summer (GSFC) – Kenai Disasters: Evaluating Grassland Conversion and the Related Likelihood of Fire Disturbance to Enhance Fire Monitoring and Management in the Kenai Peninsula, Alaska

2018 Summer (MSFC) – Integrating NASA Earth Observations to Monitor Thunderstorms and Assess Lightning Exposure in the Hindu-Kush Himalayan Region

2018 Fall (ARC) – Lassen Volcanic National Park Disasters II: Evaluating Fuel Loading at a Landscape Scale in High Elevation Alpine Forests of Lassen Volcanic National Park

2019 Spring (MSFC) – Evaluating the Atmosphere-Land Exchange Inverse Evaporative Stress Index for the Alaskan Environment to Determine Wildfire Likelihood

**Notes & References:**

***Notes:*** This project will partner with the concurrent Washington Health and Air Quality project at MSFC as a sister project. The two teams will meet biweekly to discuss project progress and will share analyses and end products as needed.

***References:***

Bureau of Land Management, Oregon and Washington (2018). *2018 Pacific Northwest Wildland Fire Season: Summary of key events and issues.* Retrieved from https://www.fs.usda.gov/Internet/FSE\_DOCUMENTS/fseprd611322.pdf

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https://www.dnr.wa.gov/publications/rp\_forest\_health\_20\_year\_strategic\_plan.pdf

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