**Idaho Wildfires**

*Assessing Drought and Fire Conditions, Trends, and Susceptibility to Inform State Mitigation Efforts and Bolster Monitoring Protocol in North Central Idaho*

**Project Team**

***Project Team:***

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***Advisors & Mentors:***

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**Project Overview**

***Project Synopsis:***

The Idaho Wildfires DEVELOP team partnered with several state agencies to support updates to the state’s Hazard Mitigation Plan and to enhance their drought and fire monitoring capabilities. As a proof of concept, this project focused on the Palouse and bordering ecoregions, as this area is of particular economic concern. The team utilized NASA Earth observation data to revise the state’s existing fire hazard and susceptibility model. The end products allowed partners to make updates to their models and mitigation plans, assisting them to better stage resources and prepare for annual fire season.

***Abstract:***

Escalating severity and frequency of drought and wildfire call for effective and cost-efficient mitigation planning and monitoring protocols. The Palouse ecoregion, an agricultural epicenter in North-central Idaho, is of particular concern as both drought and wildfire present substantial economic threats. The DEVELOP team implemented Earth observation data to assist the Idaho Office of Emergency Management, Idaho Department of Water Resources, and Idaho Department of Lands in updating the state’s Hazard Mitigation Plan by enhancing their drought and fire monitoring capabilities. The team utilized Landsat 8 Operational Land Imager (OLI), and Aqua and Terra’s Moderate Resolution Imaging Spectroradiometer (MODIS), along with ancillary datasets, to assess drought indicators and map hazard susceptibility. The team upgraded the state’s current fire hazard model by updating existing data layers and adding drought indicator data to support partners’ continued assessment of fire hazard conditions. The team observed Evaporative Demand Drought Index (EDDI) spikes during the highest fire occurrence and burned area years in the study period: 2015 and 2021. Models from dry, high fire occurrence and burned area year 2015 outperformed models from mesic, low fire occurrence and burned area year 2016. The increased understanding of drought conditions and fire susceptibility in this ecosystem will assist partners in improving land management practices.

***Key Terms:***

wildfire, drought, Landsat, NDVI, EDDI, ESI, fire hazard, hazard modeling

***National Application Area Addressed:*** Wildfires

***Study Location:*** North-Central ID

***Study Period:*** 2013 – 2021

***Community Concerns:***

* Climate change produces warmer spring seasons, longer dry seasons, and severe drought conditions such as dry soil and vegetation. These variables work together to increase the frequency and burn acreage of wildfires each year, altering soil and land conditions and increasing the probability of other natural disasters such as landslides.
* As wildfire and drought become more extreme, the health of the soil and land suffers, making restoration efforts more difficult and costly. Extreme climatic events like these cost the US billions of dollars each year.
* Outdated monitoring protocols hinder land managers from appropriately staging resources throughout the state, potentially resulting in uncontrolled fire and more costly recovery.
* Unaddressed, wildfires threaten the ecology, economy, and future not just of the Palouse region, but of the entire US.

***Project Objectives:***

* Determine efficacy of drought indicators by comparing to established vegetative health indicator Normalized Difference Vegetation Index (NDVI)
* Assess and map drought and fire susceptibility in the Palouse and bordering ecoregions using Earth observations
* Construct a fire hazard model in ArcGIS Pro for partners to monitor susceptibility and assist in mitigation planning
* Produce a guide for partners to recreate the model in their agencies and run as new data become available in different areas of interest

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Idaho Office of Emergency Management** | Susan Cleverly, Mitigation Section Chief;  Lorrie Pahl, Mitigation Planner;  Mary Mott, Mitigation Program Assistant | End User | No |
| **Idaho Department of Water Resources** | David Hoekema, Hydrologist | End User | No |
| **Idaho Department of Lands** | Tyre Holfeltz, Wildfire Risk Mitigation Program Manager | End User | No |

***Decision-Making Practices & Policies:***

The team’s project partners, along with the Idaho Department of Transportation, currently organize hazard mitigation plans for the state of Idaho. The State of Idaho Hazard Mitigation Plan (SHMP) involves coordination between local, state, and federal agencies, as well as private partners and public feedback. Last updated in 2018, the SHMP summarizes both the Idaho Statewide Implementation Strategy for the National Fire Plan (2006) and the Idaho Drought Plan (2001). In the decision-making process, partners consider both state and federal historical data to inform risk assessment and mitigation planning. To assess wildfire risk, they used the Idaho BLM Relative Risk to Wildfire GIS layer. Elimination of wildfire is not the goal— the goal is to reduce risk to human lives, property, and natural resources. Therefore, the mitigation approach consists of creating fire-resistant landscapes and fire-adapted communities, reducing possible ignition and fuel sources (including rehabilitating grassland and forested areas with high amounts of invasive species), and increasing public awareness. To assess drought risk and conditions, they used EDDI and ESI. The existing mitigation plan includes weather modification, improving water quality, reducing water waste, and restoring damaged ecosystems.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 8 OLI** | NDVI | Vegetation data were used as an input in drought condition, trend, and risk mapping. |
| **Aqua MODIS** | NDVI | Vegetation data were used as an input in drought condition, trend, and risk mapping. |
| **Terra MODIS** | NDVI | Vegetation data were used as an input in drought condition, trend, and risk mapping. |

***Ancillary Datasets:***

* National Oceanic and Atmospheric Administration, Physical Science Laboratory: Evaporative Demand Drought Index (EDDI) – Drought index for analysis and input for fire model
* NASA SERVIR, MODIS Aqua & Terra: Evaporative Stress Index (ESI) – Drought index for analysis and input for fire model
* Idaho State University (ISU) GIS Training and Research Center (GIS TReC): Historic Fires Database (HFD) – Preliminary statistical and historical analysis and input for fire model
* Bureau of Land Management (BLM): Wildland-Urban Interface (WUI) – Input into fire model
* United States Geological Survey, The National Map: Digital Elevation Models (DEM) – Input into fire model
* European Space Agency, Copernicus Sentinel-2: Dynamic World Landcover – Analysis of drought indices by landcover type

***Modeling:***

* New Simple Fire Hazard Model 2019 (POC: Andrew Mock & Tyre Holfeltz, Idaho Department of Lands) – Recreated by the team in ArcGIS Pro to compare performance of Idaho’s original model and the team’s updated version
* Drought Indicator-Modified Fire Hazard Model (POC: Jessica Hiatt, Colorado School of Mines) – Assess fire susceptibility within the study area

***Software & Scripting:***

* Esri ArcGIS Pro 2.9.3 – Data analysis, map and model creation
* Python 3.7.11 – Automation of data acquisition and analysis
* Idrisi TerrSet 19.0.6 – Raster and data analysis and vegetation index processing
* Google Earth Engine API – Data acquisition
* R Studio 2022.02.1.461 – Statistical analysis and data visualization

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Drought Indicator Analysis** | Landsat 8 OLI  Terra MODIS | These data investigate historic drought conditions throughout the study period and correlations with known drought indicator NDVI, allowing the team to add useful data into the fire model. | N/A |
| **Drought & Fire Susceptibility Maps** | Landsat 8 OLI  Terra MODIS | These maps show past and present drought and wildfire conditions and risk to assist partners in updating current mitigation plans. | N/A |
| **Wildfire Hazard ArcGIS Guide** | N/A | This guide provides partners with instructions for interagency recreation of the updated fire hazard model, allowing partners to repeat monitoring and analysis as data for new regions become available. | N/A |

***Product Benefit to End User:***

This project will allow partners to generate up-to-date information regarding drought and wildfire conditions and risk for regions of interest. Using both GIS and Earth observations will equip partners with a more comprehensive overview of relevant on-the-ground conditions. These new data will allow them to make better informed decisions while implementing much-needed updates to their hazard mitigation planning practices.

***Project Continuation Plan:***

The second term of this project will refine the methodology, analyze new datasets, and include additional areas of interest, including Blaine County, ID. This will allow the partners to rerun analyses as new data becomes available. Partners will continue to meet with the team and public outreach may take place.

**References**

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United States Environmental Protection Agency. (2016, July 1). *Climate Change Indicators in the United States*. <https://www.epa.gov/climate-indicators>