NASA DEVELOP National Program
2022 Summer Project Work Plan

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

Project Overview

Project Synopsis: DEVELOP will partner with Idaho's Office of Emergency Management (IOEM), Idaho Department of Water Resources, and Idaho Department of Lands to monitor drought conditions in the state of Idaho, assess drought and fire susceptibility, impacts of past treatment, and plan for future mitigation in Idaho. This project will implement remotely sensed data from Landsat 8 OLI, Landsat 9 OLI, SMAP, ISS ECOSTRESS, Suomi NPP VIIRS, ISS GEDI, GRACE, and SRTM in addition to other existing datasets. The team will conduct a historical analysis of soil moisture and evapotranspiration and develop a repeatable workflow in ArcGIS Pro Tasks for partners to use to continue their drought and fire monitoring moving forward. The first term of this project will serve as a proof of concept over the test region of North Central Idaho and the second term will refine the methodology and expand the analysis into other areas of particular risk to drought and fire impacts such as Blaine County, ID.

Study Location: North Central Idaho
Study Period: January 2001 – July 2022

Advisor: Keith Weber (Idaho State University, GIS Training and Research Center)

Source of Project Idea: This project came out of conversations with Susan Cleverly at Idaho's Office of Emergency Management and Tyre Holfetz from Idaho Department of Lands. Because the state drought plan is so outdated, Susan suggested that we try to integrate Earh observation data with datasets that are currently in use by partners to get more up to date information to inform updates to the plan.

Actionable Decision: Partners want to integrate current Earth observation data into their drought and wildfire monitoring, planning, and mitigation. They hope to use information from this project to aid in updating the state drought plan. Having a better understanding of how drought interplays with fire potential would be valuable information for decision makers.

Partner Overview

Partner Organizations:

Organization	POC (Name, Position/Title)	Partner Type	Boundary Org?
Idaho Office of Emergency Management	Susan Cleverly, Mitigation Section Chief	End User	No
Idaho Department of Water Resources	David Hoekema, Hydrologist	End User	No
Idaho Department of Lands	Tyre Holfetz, Wildfire Risk Mitigation Program Manager	End User	No

End User Overview

End User's Current Decision-Making Process & Capacity to use Earth Observations: The IOEM develops and updates the state of Idaho's Emergency Operations and State Hazards Mitigation plan using the

best available data to guide managers and the state through all hazards from preparation and mitigation to recovery. These plans show historical hazards, areas that are most susceptible to risk, and outline potential mitigation actions to help reduce risk. IOEM is working with Idaho Department of Water Resources and Idaho Department of Lands to update the State Hazard Mitigation Plan and the State Drought Plan which has not been updated since 2004. Partners from IOEM, IDWR, and IDL are members of the Drought and Wildfire Technical Working Group which consists of members from a variety of state and federal management agencies who meet quarterly and work collaboratively on updating these plans. Partners with IOEM, IDWR, and IDL currently use GIS but not much Earth observation data. While some have used Landsat data, the datasets used have focused largely on agricultural land, but not wildlands. This project will provide partners with a workflow for implementing NASA satellite data into their current models and management practices.

Partner Interest/Demand: Partners are very excited to start this project in collaboration with DEVELOP. They are looking for ways to improve state drought and wildfire planning, monitoring, and mitigation with the addition of current Earth observation data.

Partner Communications: Partners have been in discussions with the Idaho DEVELOP location for about a year. Notes from the most recent pre-term synthesis meeting outlines some project goals and are included below.

1. First term goals discussion
    a. First term focus on Palouse ID because it has experienced severe droughts, lots of wildfires
    b. This project should result in something more than the existing drought monitor. Use info that can give more refined data opportunity to make better decisions
    c. Tyre – drought/wildfire potential based on drought indices would be immensely helpful. Could be a benchmark project for fire management nationally.
    d. Soil moistures, drought data, other uses but focus is on the nexus of drought and wildfire
    e. The state doesn't currently track soil moisture effectively on a large scale. They do it at a basin-scale and that isn't representative. Soil moisture drives the potential for wildfire.
    f. This could help inform the drought plan. Other uses:
        i. David – big research hole. Poor grasp on how drought impacts wildland areas. Current efforts are more focused on agricultural land.
        ii. Keith – **his work mostly focuses on wild areas. We'll need a landcover dataset to mask out the built environment. We'll focus attention on natural areas with indices. MODIS - evapotranspiration estimate, vapor pressure deficit (moisture in the atmosphere), vegetation moisture. Landsat for vegetation moisture, wetness indices. Together, this will tell a lot about what's happening to the ecosystem. Palmer drought index (some problems from human influence. Crossing zones with lots of different results), evaporative stress index. Look at trends in incoming drought. Is this second year of drought? Did it just start? The point that we are at in a drought influences vegetation on the landscape and therefore fuels for wildfires.**
2. Anyone who is missing from the discussion?
    a. Becky Rose, IOEM GIS
    b. Wilma Roberston, ITS department for state (Hazards TWG)
    c. Britney Brand, Boise State (Hazards TWG) - working to coordinate state hazard data. May know of datasets that we haven't thought to use yet.
    d. Rick Allen – IDWR – landsat data for evapotranspiration
    e. Linda Davis – IDWR GIS

f. Robyn Dunn, GIS lead with IDL at Boise – interested in the project. Understands the why and data limitations. Will provide technical support via email when available, but will not attend meetings throughout the term.

3. Datasets that we would like to acquire?
    a. **Landsat evapotranspiration data** (set goes back from 1985 to present with some years missing)
        i. Rick Allen has done a lot of work on this dataset, Linda Davis may be able to help us acquire it. The dataset is focused on agricultural lands, not wildlands.
    b. **Irrigated lands dataset** – a little tricky in the dryland/irrigation land nexus. Could buffer around irrigated areas to prevent influence on imagery. Updated every 5 years.
    c. **Live fuel moisture calculations/collections from USFS research stations**. Tell when particular plant species are available to birds. Could determine at what point a plant switches from available to unavailable to birds. Lots of research papers with pieces of this data.
        i. Unconsolidated dataset, potentially difficult to gather, but could be a good time to explore during a feasibility study

Meetings/communication plan:

- Partners will meet with the team on an approximately bi-weekly schedule. Team lead will be the primary point of contact, but all members of the team will communicate with the partners and should be CCed on all partner correspondence. We are aiming to have a mid-term in-person meeting in Boise and the final partner handoff in Pocatello, but these have yet to be scheduled as of the start of the term. There will be a virtual partner meet and greet/project kickoff meeting in the second week of the term.

Earth Observations Overview

Earth Observations:

Platform & Sensor	Parameters	Use
Landsat 8 OLI	Spectral vegetation indices	Vegetation data will be used as an input in drought condition, trend, and risk mapping. Some indices will include NDVI, NDMI, NDWI, MSAVI2, VPD
Landsat 9 OLI	Spectral vegetation indices	Vegetation data will be used as an input in drought condition, trend, and risk mapping. Some indices will include NDVI, NDMI, NDWI, MSAVI2, VPD.
Suomi NPP VIIRS	Spectral vegetation indices	Vegetation data will be used as an input in drought condition, trend, and risk mapping. Some indices will include NDVI, NDMI, NDWI, MSAVI2, VPD.
GRACE	Water level	This data will be used to measure groundwater storage changes for drought condition, trend, and risk mapping.
SMAP	Soil moisture, evapotranspiration	Soil moisture and evapotranspiration data will be used to map drought conditions, trends, and risk.
ISS ECOSTRESS	Evapotranspiration	Evapotranspiration data will be used as an input in drought condition, trend, and risk mapping.
ISS GEDI	Land cover	Land cover data will be used as an input in drought condition, trend, and risk mapping.
SRTM	Land elevation	Elevation data will be used in drought and fire maps in areas where LiDAR is not available.

Ancillary Datasets:

- FEMA/ISU GIS TReC risk map LiDAR data – elevation and topography data used in drought mapping and analysis
- NRCS Snotel data – snow depth data used in drought mapping and analysis
- USGS Stream Gauge data – drought mapping and analysis
- NRCS and USDA soil moisture data – drought mapping and analysis
- Reservoir level data

Modeling:

- ArcGIS Pro ModelBuilder (POC: Keith Weber, Idaho State University's GIS Training and Research Center) – this may be used in conjunction with Tasks to create a workflow that can be run by partners as data is updated and as they want to perform drought and fire analysis in other regions of interest

Decision Support Tool & End Product Overview

End Products:

End Product	Partner Use	Datasets & Analyses	Software Release Category
Drought and Fire Susceptibility Maps	These maps will show trends in drought and wildfire conditions, risk, and mitigation treatment impacts to assist partners in making updates to their current drought and wildfire mitigation plans.	Vegetation, soil moisture, evapotranspiration, and elevation data from Landsat, VIIRS, SMAP, GEDI, and ECOSTRESS will be used as inputs to create these maps.	N/A
ArcGIS ProTask for Drought and Fire Monitoring	This Task will allow partners to run and repeat drought and wildfire monitoring analysis over different areas of interest and as new data becomes available.	Vegetation, soil moisture, evapotranspiration, and elevation data from Landsat, VIIRS, SMAP, GEDI, and ECOSTRESS will be integrated into this task.	I
Task Guide	This guide will provide partners and additional end users to instructions for running the ArcGIS Pro Task for different areas of interest and as new data becomes available.	N/A	N/A

Project Timeline & Multi-term Objectives

Project Timeline: 2 Terms: 2022 Summer to 2022 Fall

Multi-Term Objectives:

- **Term 1 (Proposed Term):** 2022 Summer (ID) – Idaho Water Resources
    - The first term of this project will focus on historical analysis of drought and fire conditions, impact, and treatment impact in the Palouse area of Idaho. It will serve as the groundwork and proof of concept for a workflow that will be tested over a moderately sized initial study area (ex: Palouse area of ID). Partners will meet with the team virtually every other week for most of the term and will provide ancillary data, context for the work, and feedback and guidance with project directions. There is potential for a day of in-person collaboration and an in-person handoff event.

- **Term 2:** 2022 Fall (ID) – Idaho Water Resources II
    - The second term of this project will refine methods for remote drought monitoring and result in an ArcGIS Pro Task that the partners will be able to use to rerun analyses as new data becomes available and over additional areas of interest. In refining the methods for this workflow, additional areas of interest will be analyzed including Blaine County, ID. Partners will continue to meet with the team every other week virtually and may be able to host the team for an in-person field day and potentially an in-person handoff event. Public outreach on drought and wildfire topics may take place this term.

Similar Past DEVELOP Projects:

- 2020 Spring Great Basin Ecological Forecasting II – https://www.devpedia.developexchange.com/dp/index.php?title=Great_Basin_Ecological_Forecasting_II_ID_Spring_2020
- 2019 Fall Great Basin Ecological Forecasting – https://www.devpedia.developexchange.com/dp/index.php?title=Great_Basin_Ecological_Forecasting_ID_Fall_2019

Notes & References:

***Notes*:** In a conversation with Keith and DKR, ArcGIS Pro Tasks were discussed as a possible option that may not require software release or at least not as rigorous of a process to get into the hands of partners. DKR said that he would bring this up with Esri reps and possibly software release lawyers for clarification on this matter.

References:

Idaho Department of Water Resources. (2001, May). *Idaho Drought Plan*. https://idwr.idaho.gov/wp-content/uploads/sites/2/water-data/Idaho-Drought-Plan.pdf