**Chile Disasters**

*Automating Wildfire Risk and Occurrence Mapping in Google Earth Engine to Improve Wildfire Detection and Response Time Efforts*

**Project Team**

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**Project Overview**

***Project Synopsis:***

This project aimed to improve wildfire detection, monitoring, and response time efforts in Chilean forests by utilizing Earth observations to map wildfire risk and burned areas in near real-time. The project used data sources including Landsat 8 OLI, NOAA GFS, SRTM to map burned areas and predict wildfire conditions by identifying red flag warnings via a Google Earth Engine app. The goal of the project was to support decision-making at the Corporación Nacional Forestal (CONAF) by providing automated and rapidly available wildfire monitoring toolkits to allow for more efficient direction of forest resources.

***Abstract:***

Wildfires in Chile in the last decade were the worst on record, destroying homes and livelihoods, polluting the air, and displacing whole towns. To predict where wildfires were likely to start, the Corporación Nacional Forestal (CONAF) created a wildfire risk model within ArcGIS Pro and Google Earth Engine (GEE) that utilized the NOAA Global Forecast System (GFS) and the NASA Shuttle Radar Topography Mission (STRM) 90-meter datasets. The previous CONAF model was very resource-heavy and time-intensive to run. NASA DEVELOP, in partnership with CONAF, automated the previous model and transferred it fully into GEE where all Earth observation datasets could be used without downloading. The new model improved upon the previous by reducing the run time from multiple months to under five minutes. The final model was used to create a near real-time wildfire monitoring application as well as fire severity maps. The end products will be used by CONAF for wildfire prediction and management to prevent more destruction in the future.

***Key Terms:***

Fire Risk Location Automated Model (FLAMe), CONAF fire algorithms, Fire Risk ArcGIS ModelBuilder, red flag warning, probability of ignition

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

***Study Location:*** Chile

***Study Period:*** January 2015 to December 2021

***Community Concerns:***

* In 2017, Chile experienced the worst wildfire season on record, with large and destructive fires burning more than 600,000 hectares.
* Fires sustain biodiversity and prevent dispersal of invasive species; however, Chile’s megafires pose a threat to the country’s diverse ecosystems, unique biodiversity, communities, infrastructure and economy.
* It is vital to understand the relationship between fire occurrence and climatic conditions in the region by monitoring populated and fire vulnerable areas so community members and environmental departments can make more informed management decisions regarding forest, land-use and development.

***Project Objectives:***

* Derive a set of fire severity and estimated burned area maps from an automated workflow
* Incorporate NASA Earth observations to compare and evaluate methods for identifying wildfires and burned areas
* Generate an automated workflow to improve wildfire predictive models and reduce human error and variability

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Corporación Nacional Forestal** | Jordi Brull, Forest Engineer; Jorge Saldias, Head of Department of Development and Research | End User | No |
| **Embassy of Chile** | Fernando Vasquez, Agricultural Specialist, Andrez Rodriguez, Agricultural Attache | Collaborator | No |

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

CONAF is overseen and funded by the Ministry of Agriculture of Chile. CONAF governs all of Chile’s national parks and natural monuments, covering 18.6 million hectares. In addition, CONAF has programs to monitor, prevent, and respond to wildfires. CONAF currently uses NASA EOs to calculate anomalies for vegetation moisture content, soil moisture, and temperature within Google Earth Engine (GEE). These parameters are then used to understand historical conditions. To predict, monitor, and respond to wildfires, CONAF uses meteorological data taken from the Global Forecast System (GFS) and Shuttle Topography Radar Mission(SRTM) elevation data. These datasets are filtered and processed within GEE. These parameters are then exported from GEE and input into an ArcGIS ModelBuilder workflow to model fire risk. They also use Landsat 8 OLI and Sentinel-2 imagery to further understand fire impact, calculate burn area and create burn area maps.

This current workflow can take up to 3-4 months to prepare all datasets utilized for fire risk, occurrence, and recovery monitoring.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 8 OLI** | Surface reflectance | Landsat imagery will be used to calculate burned area ratios to characterize historical fires |
| **Sentinel-2 (A&B)** | Spectral vegetation | Sentinel imagery will be used to calculate burned area ratios to characterize historical fires |

***Ancillary Datasets:***

* CONAF Historical Fire – location and extent of burn of previous fire in the study region
* NASA’s Shuttle Radar Topography Mission (SRTM) 90-meter Digital Elevation Model (2005) – Used to create fire severity maps

***Modeling:***

* CONAF Fire Risk ArcGIS ModelBuilder (Contact: Jordi Brull, CONAF) – ArcGIS model that converts parameter outputs from GEE into red flag warnings
* Global Forecast System – NOAA weather forecast model that generates data for temperature, wind, humidity and precipitation for 16 days

***Software & Scripting:***

* Google Earth Engine (JavaScript) – streamline the CONAF Fire Risk model by converting the ArcGIS model to a GEE model
* ArcGIS Pro 2.8 – analyze the current CONAF Fire Risk ModelBuilder model

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Fire Severity Maps** | Landsat 8 OLI  Sentinel-2 (A&B) | These maps will showcase an automated approach to map fire severity and burned area when fires have occurred. Partners can use this data to compare fire risk and fire occurrence to improve their predictive models. | N/A |
| **Fire Risk Location Automated Model (FLAMe)** | NOAA GFS  SRTM  Landsat 8 OLI  Sentinel-2 (A&B) | Partners will use this app for near real-time monitoring of wildfire risk, burned area, and wildfire parameters to inform how monitoring and recovery resources should be allocated. | IV |
| **Code Tutorial** | N/A | Partners will use this tutorial to understand the documentation and application of the products while their scripts are cleared by Software Release | N/A |

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

CONAF is a crucial organization in Chile for monitoring and managing wildfire events. This project will provide partner organizations with fire risk maps and fire severity maps to help partners understand how wildfire risk has changed and monitor rural areas that are difficult to reach. Partners can also use this data to compare fire risks and fire occurrence to improve their predictive models. In addition, a Wildfire Risk Google Earth Engine App will allow them to utilize GEE to observe and predict future wildfire events in near-real-time using Earth observations. Finally, partners will also be able to use this information to inform how monitoring and recovery resources should be allocated in the decision and policy-making processes.

**References**

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