**NASA DEVELOP National Program**

**California – JPL**

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*Project Summary – Fall 2017*

**Santa Monica Mountains Ecological Forecasting II**

*Utilizing NASA Earth Observations to Determine Drought Dieback and Insect-related Damage in the Santa Monica Mountains, California*

**VPS Title:** Oaks: Getting Quercky

**Project Team**

***Project Team*:**

Kelsey Foster (Project Lead), kels.t.foster@gmail.com

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***Advisors & Mentors*:**

Natasha Stavros (NASA Jet Propulsion Laboratory, California Institute of Technology)

***Past or Other Contributors*:**

Emil Chang

**Project Overview**

***Project Synopsis*:** The Santa Monica Mountains are home to beautiful oak woodlands, which are important to the area for reasons pertaining to both ecosystem function and personal human enjoyment. In recent years, the oaks have experienced massive dieback due to severe drought stress and increased harmful beetle attacks, and they have shown little evidence of recovery despite the recent heavy rains. The change detection maps, physical constraint, and beetle analyses generated by this project aim to inform how and where management practices should be exercised to regain the health of these oak woodlands.

***Abstract*:**

The Santa Monica Mountains (SMM) lie between the city of Los Angeles and the San Fernando Valley, California, enduring as a steadfast haven for native vegetation, wildlife, and recreational activities. Both public and private conservation agencies have secured protection for much of the mountain range, however the severe California drought from 2011-2017 had a major impact on vegetation, including 11,000 acres of oak woodlands. The fall Santa Monica Mountains Ecological Forecasting II project explored how and why vegetation has changed from 2013-2017, a continuation study from the spring term that further investigated the effect of climate, harmful beetles, and varying topography on dieback. The heavy rains of the 2016-2017 winter allowed our team to investigate initial response to post-drought conditions. The team used ER-2 Airborne Visible Infrared Imaging Spectrometer (AVIRIS) imagery, climate data, digital elevation models, and *in situ* beetle and oak data to analyze the extent of vegetation loss over the course of the drought, including which areas will be most vulnerable to drought in the future. The results from these analyses will help the Resource Conservation District of the Santa Monica Mountains determine how to focus efforts towards regaining oak woodland vigor.

**Keywords:**

Remote sensing, AVIRIS, oak woodland, drought, Santa Monica Mountains, SRTM

***National Application Area Addressed:*** Ecological Forecasting

***Study Location:*** Santa Monica Mountains, CA

***Study Period:*** January 2013 – December 2017; Forecasting to 2018

***Community Concern:***

* Oak woodlands and chaparral shrublands throughout the SMM experienced extensive tree and shrub dieback from 2010-2016.
* Loss of oak trees results in loss of ecosystem services such as carbon sequestration, temperature moderation, and soil erosion control.
* Oak trees are an iconic staple in the SMM landscape, and provide irreplaceable aesthetic value to residents and visitors.

***Project Objectives:***

* Determine how much green vegetation has been lost in the SMM over the span of the drought
* Analyze role of physical constraints, climatic variables, and harmful beetles on dieback
* Determine areas in the SMM most vulnerable to future drought

***Previous Term:*** 2017 Spring (JPL) – Santa Monica Mountains Climate

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Resource Conservation District of the Santa Monica Mountains** | Rosi Dagit, Senior Conservation Biologist | End User | Yes |
| **National Parks Service, Santa Monica Mountains National Recreation Area** | Joseph Algiers, Restoration Ecologist Marti Witter, Fire Ecologist | Collaborator | No |
| **California Department of Parks and Recreation, Los Angeles District** | Suzanne Goode, Senior Environmental Scientist  Jamie King, Environmental Scientist  Danielle LeFer, Environmental Scientist | Collaborator | No |
| **California Department of Forestry and Fire Protection (CAL FIRE)** | Kim Corelle, Forest Health Specialist/Forester II | Collaborator | No |
| **County of Los Angeles Fire Department, Prevention Services Bureau, Forestry Division** | Jay Lopez, Assistant Chief | Collaborator | No |
| **University of California, UC Cooperative Extension** | Tom Scott, UC Berkeley and UC Riverside | Collaborator | No |

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

The Resource Conservation District of the Santa Monica Mountains currently collects data about oak woodlands and the impacts of drought and pest infestation on oak trees through survey plots and citizen science programs. Data on oak mortality associated with newly established pests are currently coordinated through the UC Cooperative Extension. However, the data are reliant on reports from affected property owners, including local, state, and national park agencies, Los Angeles and Ventura County Forestry and Fire Departments, and involved arborists and pest control applicators. There are currently no efforts to use landscape level analysis to integrate the locations of infected trees with drought stressed trees.

***Project Benefit to End User***:

The Resource Conservation District of the Santa Monica Mountains has a long history of involvement in establishing collaborative efforts to address resource management issues. The development of a large-scale overview of oak woodland conditions will aid land managers in prioritizing areas of concern to focus scarce resources for monitoring. Assisting managers in identifying high-risk areas of infestation and mortality will provide direction on the extent of the current problem and allow for more targeted education and outreach.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **SRTM** | Elevation | SRTM was used to draw relationships between vegetation dieback and topographical characteristics including elevation, slope, and aspect. |
| **ER-2 AVIRIS** | Spectral reflectance | AVIRIS was used to map and detect specific shrub and woodland vegetation based on each species’ spectral reflectance. The data will be used to map the distribution of vegetation and investigate the changes in distribution over time. |

***Ancillary Datasets:***

Resource Conservation District of the Santa Monica Mountains Oak Drought Study – oak and beetle *in situ* field data

National Park Service Vegetation Mapping Program for Santa Monica Mountain National Recreation Area (SMMNRA) – map of vegetation types

NOAA Light Detection and Ranging (LiDAR) for Los Angeles County – oak woodlands GIS coverage maps

PRISM Climate Data – precipitation, temperature, dew point, vapor pressure deficit

***Software & Scripting:***

Esri ArcGIS – Raster manipulation and analysis, image enhancement, and map creation

UCSB Viper Tools – Multiple endmember spectral mixture analysis (MESMA)

Exelis ENVI – Analysis of vegetation, VIPER tools add-on

R – Used to plot fraction of alive (FAL) vegetation cover change and perform regression analysis

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Change in FAL Map** | AVIRIS | This product shows partners where the areas of greatest loss of live vegetation have occurred in the given timeframe. This will help them assess drought damage and create a management plan. | N/A |
| **Vegetation Type Map** | AVIRIS | This product shows how the drought may have affected the distribution of different key vegetation types in the SMMNRA. This will help partners understand which vegetation types need more attention and resources during drought recovery. | N/A |
| **Drought Risk Map** | AVIRIS,  SRTM | This map combines components of climate data, invasive beetle data, and topographic data to determine areas in SMMNRA that are especially likely to suffer harmful effects from future drought due to already present stressors. This will give the partners target areas for management practices. | N/A |

**Project Handoff Package**

**Transition Plan:**

The DEVELOP team will share this study’s decision support tools and deliverables with the main project collaborators, and the Resource Conservation District of the Santa Monica Mountains will disseminate them to interested stakeholders. These include the cities of Agoura Hills, Calabasas, Hidden Hills, Los Angeles, Malibu, Thousand Oaks, Westlake Village, Los Angeles and Ventura County Planning Departments, Forestry and Fire Protection, Public Works, and public and private landowners and managers. We will present our end products through a PowerPoint presentation and email the handoff package to the Resource Conservation District of the Santa Monica Mountains.

**Team POC:** Kelsey Foster, kels.t.foster@gmail.com

**Partner POC**: Rosi Dagit, rosidagit@gmail.com

**Handoff Package:**

* Final presentation
* Change in FAL Map
* Vegetation Type Map
* Drought Risk Map