**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**NASA Jet Propulsion Laboratory**

**Santa Monica Mountains Climate**

*Using NASA Earth Observations to Determine the Extent of Drought and Insect-related Dieback in Oak Woodlands within the Santa Monica Mountains, California*

**Project Overview**

***Project Synopsis*:** This project will work with the Resource Conservation District of the Santa Monica Mountains, National Parks Service, California Department of Parks and Recreation, California Department of Forestry and Fire Protection, Los Angeles County Department of Forestry and Fire Protection, and the University of California Cooperative Extension with a focus on using Earth observations such as Aqua and Terra MODIS, NASA Gulfstream III, and LiDAR to develop a better spatial understanding of how drought and insect infestations are impacting oak woodlands throughout the Santa Monica Mountains. A baseline landscape status assessment will be produced to provide direction on ways to map spread of impacts, develop risk assessment strategies for addressing wildfire risk, and identify and prioritize potential management response strategies to make best use of limited resources. This effort could also set the stage for modeling microclimate distribution shifts of oak woodlands and shrublands to projected conditions associated with climate change.

***Community Concern:*** Oak woodlands and chaparral shrublands throughout the Santa Monica Mountains have recently experienced extensive tree loss and shrub dieback. Yet, as ongoing drought and the proliferation of pests and pathogens impact the Santa Monica Mountains, it is difficult to understand the exact nature and extent of increased shrub and oak mortality, and how these patterns associate with landscape and climate variables. Shrub mortality has been documented to differ among the dominant chaparral species at a single site, but we have no data on the geographic variation among vegetation types.

***Source of Project Idea:*** Former DEVELOP participant, Emily Beck, provided an initial contact to the Resource Conservation District (RCD) Santa Monica Mountains organization and spoke to the Center Lead at JPL, Nick Rousseau, who reached out to Rosi Dagit from RCD for a potential partnership.

***National Application Area Addressed:*** Climate

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

***Study Period:*** January 2010 – December 2016

***Advisor:*** Natasha Stavros (NASA Jet Propulsion Laboratory)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Research Conservation District (RCD) of the Santa Monica Mountains | Rosi Dagit, Senior Conservation Biologist  Jen Mongolo, Conservation Biologist | End-User | Yes |
| National Parks Service, Santa Monica Mountains National Recreation Area | Irinia Irvine, Restoration Ecologist  Marti Witter, Fire Ecologist | Collaborator | No |
| California Department of Parks and Recreation, Los Angeles District | Suzanne Goode, Senior Ecologist, CA Department of Parks and Recreation (CDPR)  Jaime King, Ecologist, CDPR  Danielle LeFer, Ecologist, CDPR | Collaborator | No |
| California Department of Forestry and Fire Protection (CAL FIRE) | Kim Corelle, Forest Health Specialist/Forester II | Collaborator | No |
| Los Angeles County Department of Forestry and Fire Protection | Jay Lopez, Asst. Chief, LA County Forestry and Fire Protection | Collaborator | No |
| University of California Cooperative Extension | Sabrina Drill, Natural Resources Advisor, Los Angeles and Ventura Counties  Tom Scott, UC Berkeley and UC Riverside | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***Data on oak and shrub mortality associated with infestation of newly established pests is currently coordinated through the UC Cooperative Extension. However, these data are also highly 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. Currently, there is no landscape-level or spatial analysis effort which integrates the locations of infected trees with drought-stressed trees. High stress levels make oaks more susceptible to infestation, which leads to mortality, and standing dead trees could increase wildfire danger.

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

RCD of the Santa Monica Mountains – The RCD has not yet had the opportunity to use NASA Earth Observations and looks forward to the results of this study. The end-user will integrate NASA Earth Observations as part of their decision-making process and data analysis based on the results of this study.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

RCD of the Santa Monica Mountains – Will provide a variety of GIS data layers related to existing information on oak woodland distribution and ground level assessments

National Park Service (NPS) – Will provide extensive GIS layers, including a fine scale vegetation map, and detailed fire history data including burn severity. In addition, the NPS has a large vegetation plot dataset from vegetation mapping and post-fire monitoring. The NPS has baseline data for cumulative impacts of drought on net-primary productivity, but has a critical need to map the spatial variability of landscape conditions in order to understand where impacts are localized for management action

California Department of Parks and Recreation – Will provide *in situ* data in Malibu Creek and Topanga Creek State Parks to assist with analysis

CAL FIRE – Kim Corella will be available for assistance in forest pest identification and analysis.

County of Los Angeles Fire Department-Forestry Division – Has produced fire history data since the late 1800s including ignition data; also the Forestry Division manages the Live Fuel Moisture Program for the county. The data collected every two weeks since 1980 will be accessed at this website, http://www.fire.lacounty.gov/forestry-division/fire-weather-report/. Additionally, daily fire danger analysis data will be available. The Forestry Division personnel is composed of professional foresters that are consistently in the field and monitor environmental changes in Los Angeles County

***Dissemination by Boundary Organizations*:**All of the partners in this project will be involved in disseminating the results of the project to decision and policy-makers locally including 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, public and private landowners and managers.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Rosi Dagit will be the main POC for the project. A group teleconference call meeting will initiate the start of the term and will be followed by biweekly meetings to discuss progress and issues that arise, and further define output deliverables possible.

***Transition Plan*:** The decision support tools and deliverables provided by this study will be shared, not only with the main project collaborators, but also disseminated to all interested stakeholders within the Santa Monica Mountains. This will be accomplished via websites, presentations and other print or electronic opportunities immediately once the information is available. The end products that will be handed off to the project partners will not require software release.

***Letters of Support*:**

Irina C. Irvine, Restoration Ecologist and Marti Witter, Fire Ecologist, National Park Service

Suzanne Goode, Senior Environmental Scientist, California Department of Parks and Recreation

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Terra MODIS** | NDVI & EVI, Land surface temperature | A time series of NDVI and EVI will be used to assess the health of the vegetation in the study area and study the trends in vegetation health over time. This data will be coupled with land surface temperature data to analyze the relationship between temperature and vegetation health. |
| **NASA ER-2 Jet AVIRIS** | Specific multispectral bands will be used to isolate absorption features in reflectance data for each vegetation type | AVIRIS will be 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. |
| **NASA Gulfstream III UAVSAR** | Aboveground biomass, surface reflectance, soil moisture | UAVSAR provides the spatial resolution needed to analyze the aboveground biomass and to also map vegetation. The data will also be used to measure the available soil moisture below ground |
| **Shuttle Radar Topography Mission (SRTM)** | Land elevation | A digital elevation model created from this dataset will be used to assess the role of slope and aspect on tree mortality |
| **Sentinel-2 MSI** | Surface reflectance | This dataset provides the spatial (10-20m) and temporal (10 days) resolution needed to classify land cover and vegetation types. |

***Ancillary Datasets:***

RCD Santa Monica Mountains Oak Drought Study Field data from Trippet Ranch and Topanga Elementary School – in-situ data - used for ground-truthing

DEM/DSM – elevation/surface models (role of slope and aspect on tree mortality)

NPS Vegetation Mapping Program for SMMNRA – vegetation inventory – used for testing accuracy of remotely sensed based classification maps

NPS-SAMO and CAL FIRE-FRAP – fire history databases – used to observe fire trends

CAL FIRE FRAP CalVeg – vegetation maps – used to validate remotely sensed vegetation maps

LA County Department of Regional Planning – oak woodland GIS coverage maps – past coverage of oak extent

NPS Inventory and Monitoring plots – vegetation data – used for ground-truthing

County of Los Angeles Fire Department – Fire History Data – used to observe fire history

County of Los Angeles Fire Department – Forestry Division Live Fuel Moisture Data – used to compare with UAVSAR results

***Software & Scripting:***

ESRI ArcGIS – Raster manipulation/analysis, image enhancement & map creation of Terra MODIS

Excelis ENVI – Analysis of vegetation

Google Earth Engine – time series and image processing of MODIS data

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| 2010-2016 Time Series of Oak Woodland Distribution and Condition in the Santa Monica Mountains | Landscape-level maps will describe the extent and condition of oak woodlands and illustrate changes in mortality over time. They will be used to prioritize risk areas, examine the rate of mortality and potential causal factors, focus monitoring efforts, as well provide guidance on where restoration is possible and management is needed. | A variety of existing and new landscape-level data sets will be compiled and integrated including topography, vegetation, chlorophyll analysis or other proxy for evaluating health and condition. These will be validated using data collected from individual trees in randomly selected plots distributed throughout the western Santa Monica Mountains. | I |
| Drought Effects on Oak Woodlands in the Santa Monica Mountains | These analyses will describe the relationship between drought conditions and rate of mortality correlated with topographical features, drainages and possible groundwater access, and proximity to the wildland urban interface. End users will identify high risk areas, assess increases in wildfire dangers, and inform the public about how to reduce risk. | Building upon the datasets developed for distribution and condition, soil moisture and rainfall overlays, as well as drainages, vegetation types and individual tree mortality data from small plots can be combined. | N/A |
| Beetle Infestation Effects on Oak Woodlands in the Santa Monica Mountains | Documenting the spread of infestations is a focus of the UC Cooperative Extension and its many collaborators. Incorporating the known locations of beetle infestations with the drought and overall landscape distribution patterns of oak woodlands will provide managers with a way to develop prioritized monitoring and treatment sites. | The infestations are currently marked as points and compiled by UC Riverside and Cooperative Extension. Integrating this dataset with the other products will enhance the analysis. | N/A |
| Drought Die-back in Shrubland Vegetation Types in the Santa Monica Mountains | Landscape-level maps will describe the spatial extent of areas of die-back among the shrubland vegetation types of the SMMs from 2010-2016. They will be used to identify the community types that have been most severely impacted by drought and the degree of increased fire risk. | Existing knowledge of physiological and life history traits and analysis of the relationship to biophysical and environmental variation will be used to model the observed dieback patterns. | N/A |

***End-User Benefit*:** RCD of the Santa Monica Mountains has a long history of leadership in establishing collaborative efforts to address resource management issues on a regional and local scale. These documents will provide a suite of tools that can help direct risk reduction efforts, improve containment efforts and provide a road map towards protecting and preserving oak woodlands in the Santa Monica Mountains in the face of anticipated climate changes.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Spring

***Related DEVELOP Work:***

2014 Spring (UGA) – Smoky Mountains Ecological Forecasting: Utilizing NASA Earth Observations to Monitor Long Term Hemlock Decline Caused by Invasive Hemlock Wooly Adelgid in Great Smokey Mountains National Park

2014 Spring (MSFC) – Cumberland Ecological Forecasting II: Using NASA Earth Observations to model a Representative Species’ Future Geographic Distribution in the Cumberland Plateau to Aide in Conservation Efforts

2016 Spring (FC) – Gunnison National Forest Agriculture: Mapping Spruce Beetle Outbreak Severity and Distribution in Gunnison National Forest Using Landsat and Integrative Spatial Modelling

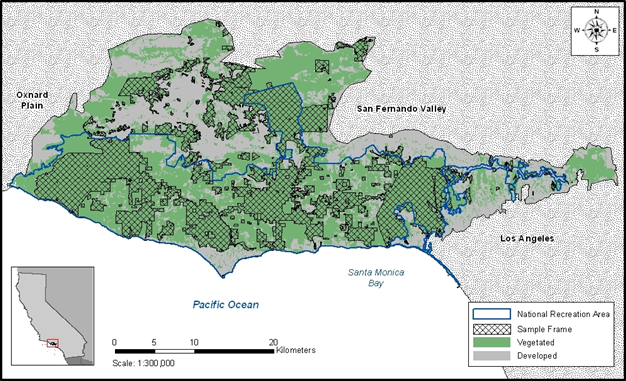
**Notes & References:**

***References:***

Montgomery, E. 2016. Evaluating the application of Landsat 8 remote sensing imagery to measuring drought impacts in a Santa Monica Mountain Oak Woodland. Remote sensing term paper.

Venturas, M. D., E. D. MacKinnon, H. L. Dario, A. L. Jacobsen, R. B. Pratt, and S. D. Davis. 2016. Chaparral Shrub Hydraulic Traits, Size, and Life History Types Relate to Species Mortality during California’s Historic Drought of 2014. PloS one 11:e0159145.

Willis, K. S., T. W. Gillespie, S. Ostermann-Kelm, F. Federico, L. Lee and G. M. McDonald. (2016 draft). Assessment of Landscape dynamics in Channel Islands Nations Park and Santa Monica Mountains National Recreation Area using MODIS. Natural Resource Report NPS/MEDN/NRR-2016/XXX.



Santa Monica Mountains study area

