

# NASA DEVELOP National Program

## 2022 Summer Project Proposal

### Virginia – Langley

#### Delaware Basin Ecological Forecasting

*Identifying Vegetation Trends and Atmospheric Stressors in the Guadalupe Mountains and Carlsbad Caverns National Parks*

### Project Overview

**Project Synopsis:** Guadalupe Mountains and Carlsbad Caverns, located in the Delaware Basin, encompass over 6,000 acres of public lands in the American Southwest. In recent years, the National Park Service (NPS) has observed decreased precipitation and increased temperatures in the parks. However, the effects of these conditions on vegetation health have not been quantified. This project aims to use Landsat 7 ETM+, Landsat 8 OLI, ISS ECOSTRESS, Sentinel-2 MSI, and GPM IMERG to create an NDVI change map, a precipitation time series, and a water stress map. These end products will help partners at the NPS Intermountain Region to evaluate vegetation health throughout the Delaware Basin and effectively plan for their preservation and maintenance.

**Study Location:** Delaware Basin, NM, TX

**Study Period:** January 2010 – August 2021

**Advisors:** Joseph Spruce (Science, Systems, and Applications, Inc.) [josephspruce@yahoo.com](mailto:josephspruce@yahoo.com), Dr. Kenton Ross (NASA Langley Research Center) [kenton.w.ross@nasa.gov](mailto:kenton.w.ross@nasa.gov)

**Source of Project Idea:** The NPS reached out to DEVELOP in 2021 to host a series of projects together. Langley was chosen to host a two-term project in partnership with Carlsbad Caverns and Guadalupe Mountains National Parks to look at air pollution and its impact on vegetation in the parks. These became the Spring 2022 Delaware Basin HAQ project and the Summer 2022 Delaware Basin Ecological Forecasting project. The spring project focused on mapping NO<sub>2</sub> emissions within the study area, while the summer project will focus on quantifying vegetation health.

### Partner Overview

#### Partner Organization:

Organization	POC (Name, Position/Title)	Partner Type	Boundary Org?
National Park Service, Intermountain Region	Lisa Devore, Air Quality Specialist	End User	No

### End User Overview

**End User's Current Decision-Making Process & Capacity to use Earth Observations:** Guadalupe Mountains and Carlsbad Caverns are both granted special air quality and visibility protections due to the Clean Air Act of 1970. These parks also provide input to the Bureau of Land Management and state agencies regarding oil and gas leases based on their assessment of the park's health. Partners have observed that recent years have seen decreased rainfall and increased extreme warm days, which can affect plant health through high water loss. The NPS Intermountain Region ensures that NPS resources are not adversely impacted and therefore would like to understand the status of vegetation health to maintain a functioning ecosystem as well as improve visitor experiences. The NPS Intermountain Region has used Earth observations before, and they hope to build on past DEVELOP partnership work to understand park vegetation health and make informed management decisions.

## Earth Observations Overview

### Earth Observations:

Platform & Sensor	Parameters	Use
<b>Landsat 7 ETM+</b>	Surface Reflectance	Landsat 7 ETM+ surface reflectance data will be used to calculate Normalized Difference Vegetation Index (NDVI) and evaluate vegetation health in the parks from 2010-2013.
<b>Landsat 8 OLI</b>	Surface Reflectance	Landsat 8 OLI surface reflectance data will be used to calculate Normalized Difference Vegetation Index (NDVI) and evaluate vegetation health in the parks from 2013-2021.
<b>ISS ECOSTRESS</b>	Evapotranspiration	ISS ECOSTRESS evapotranspiration data will be used to explore the effects of drought on park vegetation.
<b>Sentinel-2 MSI</b>	Surface Reflectance	Sentinel-2 MSI surface reflectance will be used to calculate Enhanced Vegetation Index (EVI) and evaluate plant water status across the parks.
<b>GPM IMERG</b>	Precipitation	GPM IMERG will be used to observe precipitation trends across the study period. Precipitation will be compared to NDVI vegetation trends to explore the effects of drought on vegetation.
<b>Aqua MODIS</b>	Surface Reflectance	Aqua MODIS surface reflectance data will be used to calculate Normalized Difference Vegetation Index (NDVI) and evaluate vegetation health in the parks from 2010-2021.
<b>Terra MODIS</b>	Surface Reflectance	Terra MODIS surface reflectance data will be used to calculate Normalized Difference Vegetation Index (NDVI) and evaluate vegetation health in the parks from 2010-2021.

### Ancillary Datasets:

- USDA National Agriculture Imagery Program (NAIP) – Evaluate sections of interest within study area for more detailed vegetation analysis
- USDA Land Fire Vegetation Dataset – Use to provide more details for vegetation type, quality, and health within the study area

## Decision Support Tool & End Product Overview

### End Products:

End Product	Partner Use	Datasets & Analyses	Software Release Category
<b>NDVI Change Map (2010 – 2021)</b>	An NDVI change map will allow partners to visualize vegetation trends and understand the combined impacts of drought, high heat days, and fossil fuel development in the study area by comparing the results to reference areas not impacted by air pollution.	Surface reflectance and NDVI from Landsat 7 ETM+ and Landsat 8 OLI will be used to explore vegetation changes in the study area.	N/A

<b>Precipitation Time Series</b>	A time series of precipitation data will allow partners to visualize rainfall trends and understand the combined impacts of drought high heat days, and fossil fuel development in the study area.	GPM IMERG precipitation will be used to explore the effects of rainfall on vegetation changes in the study area.	N/A
<b>Water Stress Map</b>	A map of water stress across the parks will allow partners to designate areas that have been highly impacted by drought and extreme weather.	ISS ECOSTRESS and Sentinel-2 MSI will be used to evaluate plant health and explore if water availability is causing a decrease in vegetation health.	N/A

## Project Timeline & Previous Related Work

**Project Timeline:** 1 Term: 2022 Summer

## Notes & References:

### Notes:

Links for some data collection:

- NAIP imagery can be found here: [USDA:NRCS:Geospatial Data Gateway:Home](#)
- Landfire data can be found here: [LANDFIRE Program: Home](#)

### References:

Cogato, A., Pagay, V., Marinello, F., Meggio, F., Grace, P., De Antoni Migliorati, M. (2019). Assessing the feasibility of using Sentinel-2 imagery to quantify the impact of heatwaves on irrigated vineyards. *Remote Sensing*, 11(23), 2869. <https://doi.org/10.3390/rs11232869>