





### **Delaware Basin** Ecological Forecasting

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

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## COMPONENTS

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- Community Concerns
- NASA Satellites/Sensors Used
- Methodology
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Image Credit: NASA



## NATIONAL PARKS AND STUDY PERIOD

- Guadalupe Mountains National Park
- Carlsbad Caverns National Park
- May 2010 May 2021



# BACKGROUND

- Previous term:
  Delaware Basin
  Health & Air Quality
  Project, Spring 2022
- Mapped nitrogen plumes in the Delaware Basin
- Assisted with identifying if this pollution was causing harm to the vegetation within the national parks





## **STUDY AREAS AND REFERENCE AREA**

 Subset parks to study areas mostly vegetated by trees using LANDFIRE dataset

- GUMO Guadalupe Mountains National Park Study Area
- CAVE Carlsbad Caverns National Park Study Area
- SDM Sierra Diablo Mountains Reference Area





### **OBJECTIVES**



**Identify** the extent of vegetation health decline attributed to the NO<sub>2</sub> plumes Generate maps of Normalized Difference Vegetation Index (NDVI) and Normalized Difference Moisture Index (NDMI)





**Examine** how increased temperature and decreased precipitation have impacted vegetation health from 2010-2021



### **PROJECT PARTNERS**

#### Lisa Devore

Air Quality Specialist Intermountain Region

#### Mike Medrano Resource Stewardship and Science Manager Guadalupe Mountains

Valerie Morgan Biologist Carlsbad Caverns

#### "Big Room" in CAVE



Image Credit: NPS/Michael Larson

**El Capitan in GUMO** 



Image Credit: NPS/Karen Poteet

### **COMMUNITY CONCERNS**

Degradation of vegetation due to air pollution

Degradation of vegetation due to drought

Decline in park tourism



### NASA SATELLITES AND SENSORS



### **METHODOLOGY: LANDSAT**



### **METHODOLOGY: GPM**



## **RESULTS (NO<sub>2</sub> Plume)**





Image Credit: Delaware Basin Health and Air Quality















## **RESULTS (Precipitation)**





Sierra Diablo Precipitation Time Series 31°9'N 105°W, 31°30'N 104°51'W



### **ERRORS AND UNCERTAINTIES**

#### **NDMI Accuracy**

• Quantifying water stress in soil

#### Wildfires

Can affect NDVI and NDMI

#### **Nitrogen Deposition**

Can increase NDVI through fertilization

#### Drought

• Could cause vegetation to deteriorate instead of pollution

#### Invasive Plants

Can impact NDVI and NDMI

## CONCLUSION

- Not enough evidence to determine that the nitrogen dioxide plume was having an adverse effect on vegetation
- Water stress in the region has increased over the study period
- Precipitation in the region has decreased over the study period
- Vegetation health in higher elevations with more trees has increased while vegetation health in lower elevations with more shrubbery has decreased

#### "Desert Winter" in GUMO



Image Credit: NPS

## **FUTURE WORK**

- Quantify and map the spread of invasive plant species
- Incorporate additional vegetation indices such as Inverted Red-Edge Chlorophyll Index (IRECI)
- Further investigate the impact of elevation on vegetation drought response
- Compare sensitivities of different plant species to drought and O<sub>3</sub>

#### Natural beauty in CAVE and GUMO



Image Credit: NPS, NPS/Peter Jones

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