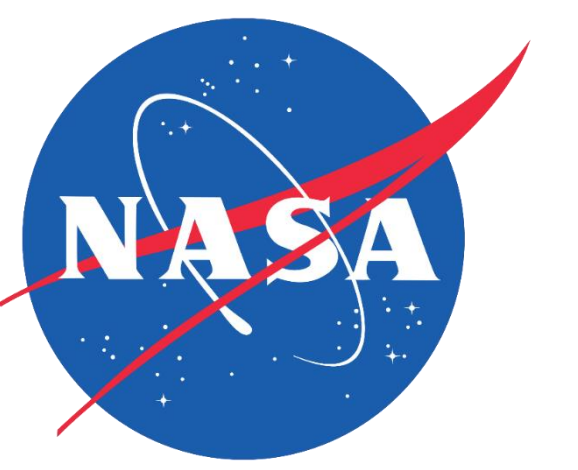




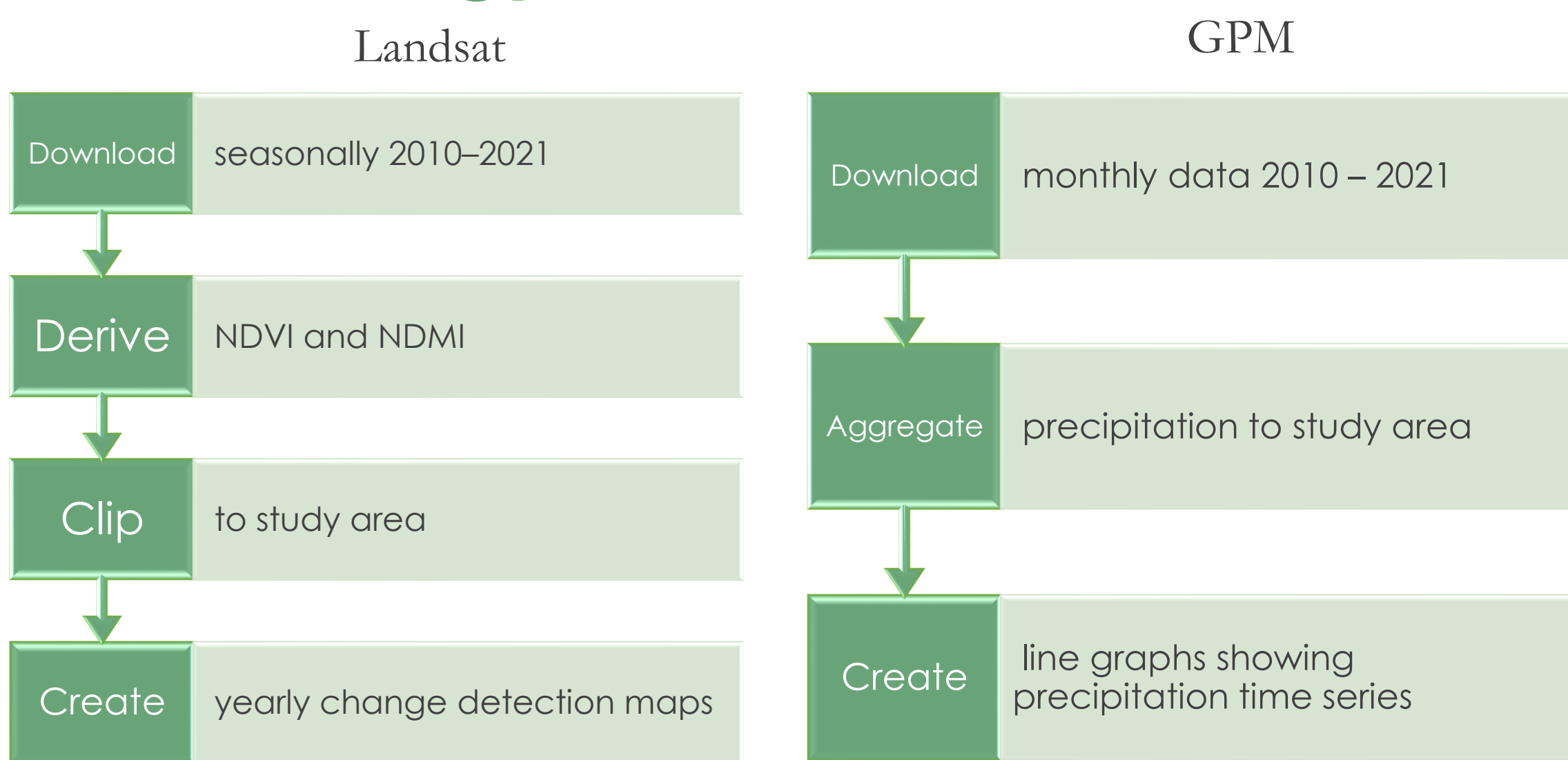
Identifying Vegetation Trends and Atmospheric Stressors in the Guadalupe Mountains and Carlsbad Caverns National Parks



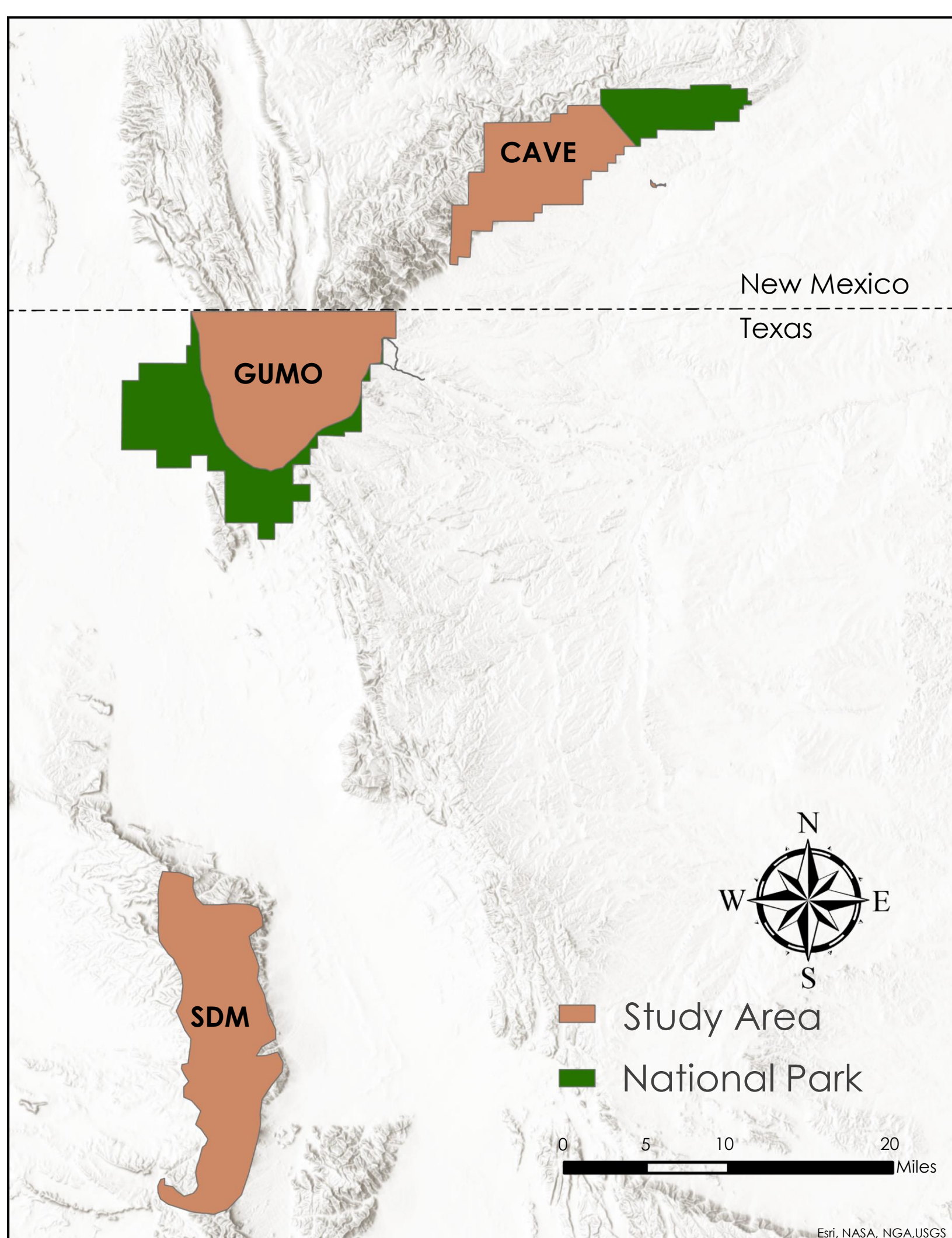
Abstract

The Guadalupe Mountains and Carlsbad Caverns National Parks, located in the Delaware Basin in the southwestern United States, observed both a decrease in precipitation and an increase in temperature over the last decade. Furthermore, activity from local oil fields generated nitrogen dioxide (NO₂) plumes that spread over the parks and augmented the effects of the drought. NO₂ is a precursor for tropospheric ozone (O₃) which is known to have adverse effects on vegetation and ecosystems at large. These new climate dynamics prompted the National Park Service (NPS) to collaborate with NASA DEVELOP to assess the impact on vegetation within the parks. We used NASA Earth observations including Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper (ETM+), Landsat 8 Operational Land Imager (OLI), and Global Precipitation Measurement Integrated Multi-Satellite Retrievals (GPM IMERG) to assess vegetation health, water stress, and precipitation in the affected parks. After creating a homogeneous reference area in the Sierra Diablo Mountains (SDM), the team visualized vegetation health through a Normalized Difference Vegetation Index (NDVI) time series map from 2010-2021, which did not show strong evidence that the NO₂ plume is causing vegetation decline. Following this, we created a water stress map with a Normalized Difference Moisture Index (NDMI) time series map from 2010-2021, which revealed a pattern of increasing water stress. We also confirmed that precipitation in the region decreased over the span of 2010-2021. These observations and findings will allow the NPS Intermountain Region to more effectively plan for the preservation and maintenance of vegetation health within the parks.

Methodology



Study Area



Team Members



Jack Mezger
(Project Lead)



Mark Bossinger



Gillian
McNamara



Quinn Heiser

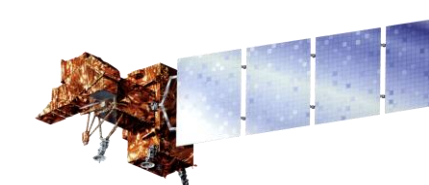
Objectives

- ▶ Identify the extent of vegetation health decline in the Delaware Basin attributed to the NO₂ plumes observed over the national parks and the ongoing drought in the southwestern United States
- ▶ Analyze changes of vegetation health from 2010 to 2021
- ▶ Generate maps of NDVI change and water stress to visualize said changes
- ▶ Examine rainfall trends through a precipitation time series in order to isolate climatic effects from atmospheric effects

Earth Observations



Landsat 5 TM
2010-2012



Landsat 7 ETM+
2012-2013

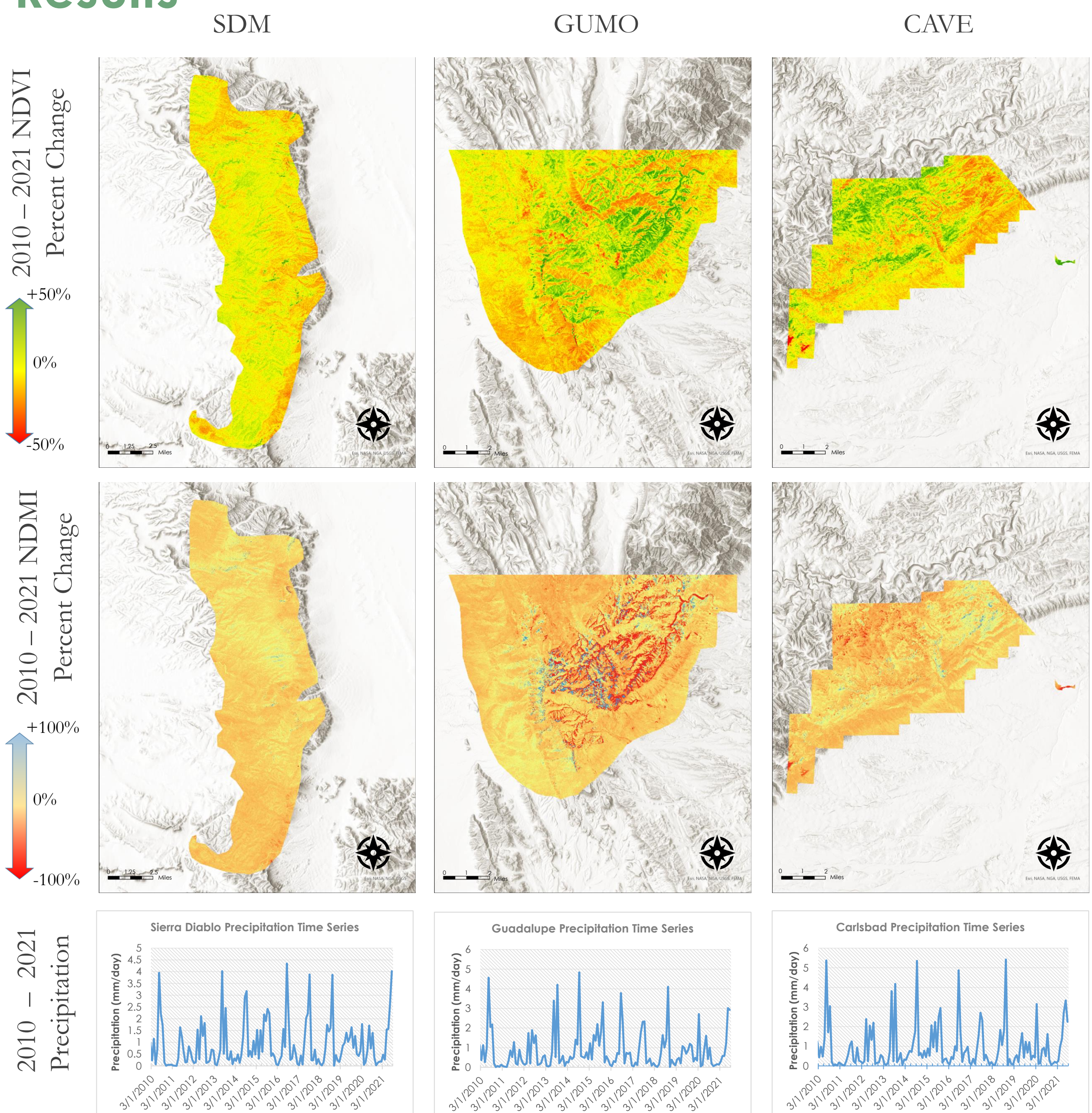


Landsat 8 OLI
2013-2021



GPM IMERG
2010-2021

Results



Conclusions

- ▶ There was not enough conclusive evidence to determine that nitrogen dioxide plumes were having an adverse effect on vegetation within the parks.
- ▶ 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, mainly pinyon-juniper woodlands, has increased while vegetation health in lower elevations with more shrubbery has decreased.

Project Partners

- ▶ National Park Service Intermountain Region
- ▶ Guadalupe Mountains National Park
- ▶ Carlsbad Caverns National Park



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- ▶ **Science Advisors:** Joseph Spruce (SSAI), Dr. Kenton Ross (NASA LaRC), Dr. Elizabeth Wiggins (NASA LaRC)
- ▶ **Fellow:** Adriana Le Compte (DEVELOP LaRC)
- ▶ **Past Contributors:** Sean Cusick (DEVELOP LaRC), Amber Schlessiger (DEVELOP LaRC), Billy Henshaw (DEVELOP LaRC), Perrin Krisko (DEVELOP LaRC)