

NASA DEVELOP National Program

2024 Fall Project Proposal

Colorado – Fort Collins

Santa Ana Pueblo Agriculture

Supporting Rangeland Monitoring and Decision Making in New Mexico with NASA Earth Observations

Project Overview

Project Synopsis:

This project partners with the Pueblo of Santa Ana Department of Natural Resources in New Mexico to support their rangeland monitoring and grazing management planning. The partners are interested in exploring trends in bare ground cover over time based on factors such as pasture management history and vegetation type. The DEVELOP project team will use the Rangeland Analysis Platform which harnesses NASA Earth observations such as Landsat to estimate and compare bare ground cover and herbaceous biomass productivity from 1985 to 2024. The team will use long-term field data collected by the Pueblo of Santa Ana to evaluate and guide interpretation of the Rangeland Analysis Platform products in this arid environment. They will also investigate trends in bare ground over time to identify the range of conditions over time and analyze trends relative to management history and vegetation type.

Study Location: Santa Ana Pueblo, NM

Study Period: January 1985 – August 2024

Advisors: Dr. Paul Evangelista (Colorado State University, Natural Resource Ecology Laboratory), Dr. Catherine Jarnevich (USGS, Fort Collins Science Center), Dr. Anthony Vorster (Colorado State University, Natural Resource Ecology Laboratory), Nicholas Young (Colorado State University, Natural Resource Ecology Laboratory), Christopher Tsz Hin Choi (Colorado State University, Natural Resource Ecology Laboratory)

Partner Overview

Partner Organization:

Organization	Contact (Name, Position/Title)	Partner Type	Sector
Pueblo of Santa Ana, Department of Natural Resources	Raul Marquetti, GIS Manager; Dan Ginter, Range Program Manager; Glenn Harper, Range and Wildlife Division Lead	End User	Tribal

End User Overview

End User's Current Decision-Making Process & Capacity to use Earth Observations:

The Pueblo of Santa Ana has been advancing their rangeland management and grazing programs the last several decades by increasing monitoring efforts and improving grazing practices and administration. They use field monitoring data alongside GIS layers to set livestock stocking rates. While the Department of Natural Resources uses remote sensing for some applications like monitoring riparian restoration efforts, they are intrigued by the possibility of using remote sensing in their rangeland program. They have little trust in the performance of current remote sensing products in their arid environment. This project will work towards providing the Pueblo of Santa Ana with the necessary information to enhance their rangeland monitoring and grazing management planning, particularly during drought periods. Ultimately, this will promote sustainable practices that benefit the landscape, livestock, and community, fostering resilience to future droughts.

Earth Observations Overview

Earth Observations:

Platform & Sensor	Parameter(s)	Use
Landsat 5 TM	Spectral bands and indices	This dataset will provide the temporal (16 days) and spatial (30 m) resolution needed to track range productivity and bare ground cover.
Landsat 8 OLI	Spectral bands and indices	This dataset will provide the temporal (16 days) and spatial (30 m) resolution needed to track range productivity and bare ground cover.
Landsat 9 OLI-2	Spectral bands and indices	This dataset will provide the temporal (8 days) and spatial (30 m) resolution needed to track range productivity and bare ground cover.

Ancillary Datasets:

- Rangeland Analysis Platform – Fractional cover and net primary production derived from Landsat imagery from 1985 - 2024 used to track range productivity and bare ground cover
- Pueblo of Santa Ana field data – Plant composition and biomass data to validate remotely sensed rangeland monitoring data
- National Agriculture Imagery Program imagery – Higher resolution imagery of the rangeland to provide additional context and identify water sources and other features of interest

Modeling:

- Linear and multiple linear regression (POC: Tony Vorster, Colorado State University) – to test relationship between field data and Rangeland Analysis Platform predictions and conduct time series analyses

Decision Support Tool & End Product Overview

End Products:

End Product	Partner Use	Datasets & Analyses
Accuracy Evaluation of Rangeland Analysis Platform in Santa Ana Pueblo	Understand how reliable and how to interpret Rangeland Analysis Platform data for the Pueblo of Santa Ana rangeland units	Use field collected biomass / production and cover data from 2019-2024 to evaluate the productivity and cover layers from the Rangeland Analysis Platform
Summary of Productivity Trends by Range Unit	Evaluate individual pasture productivity to inform future management plans; Inform managers about how the pastures compare historically and presently during drought	Summarize annual maps of productivity and bare ground across the pastures identifying means and extremes for 1985 to 2024 from Rangeland Analysis Platform data; Identify production trends over time and extremes across wet and dry years
Trends in Bare Ground Over Time by Management History and Vegetation Type	Understand rangeland conditions across different management approaches and vegetation type to inform adaptive management	Use the Landsat archive through the Rangeland Analysis Platform to identify areas of improvement and decline over recent decades across pastures/management histories and vegetation types; Trends will be mapped based on pixel-by-pixel time

		series analysis and then summarized by vegetation type and management/pasture boundaries
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Project Timeline & Previous Related Work

Project Timeline: 1 Term: 2024 Fall

Similar Past DEVELOP Projects:

- 2023 Spring (CO) – Southern Rockies Western Slope Agriculture: <https://appliedsciences.nasa.gov/what-we-do/projects/identifying-drivers-rangeland-production-drought-planning-western-slope>
- 2022 Fall (CO) – Colorado Eastern Plains Agriculture: <https://ntrs.nasa.gov/citations/20230000214>
- 2014 Summer (LaRC) – Great Plains Agriculture: <https://develop.larc.nasa.gov/2014/summer/GreatPlainsAgricultureIII.html>
- 2024 Spring (CO) – Oklahoma & Texas Agriculture: (no project website yet)
- 2024 Summer (CO) – Jemez Pueblo Agriculture: (no project website yet)

References:

Jones, M. O., Allred, B. W., Naugle, D. E., Maestas, J. D., Donnelly, P., Metz, L. J., ... & McIver, J. D. (2018). Innovation in rangeland monitoring: Annual, 30 m, plant functional type percent cover maps for US rangelands, 1984–2017. *Ecosphere*, 9(9), e02430. <https://doi.org/10.1002/ecs2.2430>