

Remote Sensing of Chacoan Roads in the Middle San Juan Region

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Introduction

This project is a test case for the applicability of various GIS visualization methods to determine the presence of linear ditch & swale features (a.k.a., "Chacoan roads") within the rugged terrain of the Middle San Juan Region north of Farmington, New Mexico.

Roads are currently known to extend northwest from Aztec Ruins and southeast from the Holmes Group, two Pueblo II-III period (AD



950-1350) Puebloan communities. It is assumed that these connect, but that has not yet been proven. The ultimate goal of this project is to highlight areas for field work to "connect the dots."

Methods

The utility for using remotely sensed data for finding archaeological sites is widely known, and has been practiced in the Southwest since Charles Lindbergh overflew Chaco Canyon in 1929. Most analyses are done through visual interpretation of true color images, though both slight variations in color and modern impacts preclude easy (and accurate) identification.

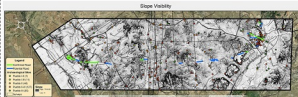
This project utilizes freely available visualization tools to process elevation (LIDAR) data, rather than photographs, to highlight potential road locations. The slight variations in elevation, slope, and angle have proven capable of indicating the presence of previously known roads; it is hoped that these techniques can be used to further trace unknown paths in the project area.

Chacoan Roads must be ground truthed, and several in the vicinity of Aztec Ruins have been verified (Stein & McKenna 1988¹). Staff from the BLM Farmington field office have also verified roads leading from the Holmes Group.



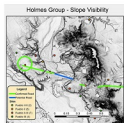
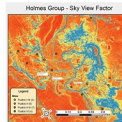
Figure 21. Aerial view Road Segment 1714 near BL Detector 20191

The below four images illustrate visualizing LIDAR elevation data with Slope Visibility (ArcGIS 10.4), Hillshade and Sky View Factor (RVT 2.0²), and Local Relief (LRM Toolbox³). Other methods are available from the tools.

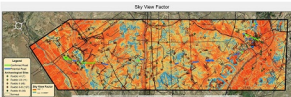


Results

The Sky View Factor, Slope Visibility, and the various Hillshade techniques appear to provide the best results in this case. These higher resolution images illustrate the presence of road features near sites.

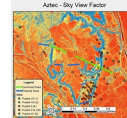
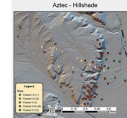


Researchers must still be cautious, however, in extrapolating to patterns in new areas. Roads, trails, pipelines, and fences all present linear anomalies that may lead to incorrect conclusions.



Next Steps

By "connecting the dots" between known road segments, it is possible to predict where roads may be discovered. It is also hypothesized that certain sites are more likely to lie on roads than not; testing this assumption will be the basis of future work. Additionally, the quantitative (rather than qualitative) utility of visualized LIDAR data, as well as remotely sensed satellite imagery such as that obtained from the ASTER instrument aboard the Terra satellite, will be explored. Finally, upon further analysis, the data will be provided to the BLM and field schools in the region for potential ground truthing.



Acknowledgments

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References

1. Stein, John R., and Peter J. McKenna. 1988. An Archeological Reconnaissance of a Late Bonito Phase Occupation near Aztec Ruins National Monument, New Mexico. National Park Service.
2. Relief Visualization Toolbox 2.0. <https://laps.zrc-sazu.si/en/rvt/#>
3. Local Relief Model Toolbox. https://www.researchgate.net/publication/289254539_Local_Relief_Model_LRM_Toolbox_for_ArcGIS_UPDATE_2016-05_-_new_download_link