Roots and Resilience in Maya Communities

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Introduction

As climate change and privatization of common-land holdings (ejidos) across Mexico occur, **concerns for residents losing their connection with the culture and resources** around them increases. This study supports the development of the Maya Roots mobile app for Tahcabo (Yucatán/MX). Identification of the locations of sinkholes, archaeological sites, and tree canopy density in the study area was undertaken from LiDAR scans. Analyses of these scans will be used as a resource available to Tahcabo residents for **inform land management**.

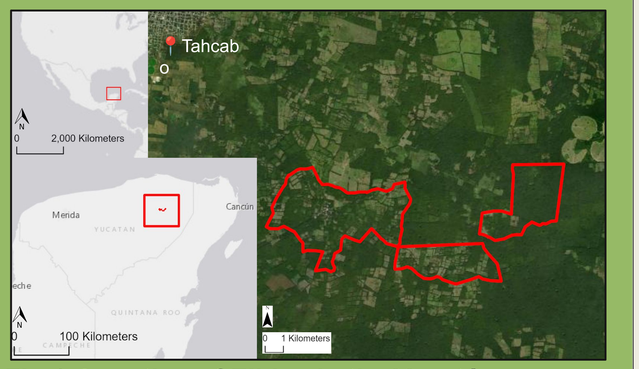


Fig 1. Location of Ejidos in the Yucatán

Research Questions

1. What topographical features collected by LiDAR scanning can indicate locations most productive for agriculture?
2. How can geospatial analysis of geographical and archaeological features be conducted in a user-friendly and easily interpretable manner?
3. What trends exist between canopy height and water access for the Yucatan communities?

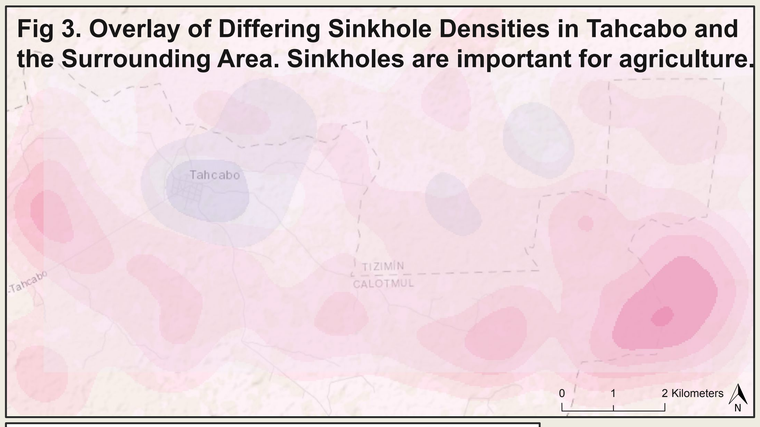
Fig 2. Sequential comparison of Karst landforms.
From left to right: **rejolladas** are fertile-soil sinkholes above the water table; **aguadas** are shallow basins; and **cenotes** are sinkholes that reach the water table.

Methods

1. Using **Red Relief Imaging** on LIDAR Data provided by our community partners, we were able to create maps to define changes in depth. Manual digitizing individual **sinkholes**, while cross examining with elevation maps, answered this question. Identification of additional **archeological sites** were added to the previously created database.
2. **Tree Canopy** created with Raster Calculator.
3. To create the **density maps**, we used the **Kernel Density** tool in ArcGIS on our developed raster files. Kernel Density uses the density of points per area to create heatmaps.

Geospatial Analysis

Fig 3. Overlay of Differing Sinkhole Densities in Tahcabo and the Surrounding Area. Sinkholes are important for agriculture.



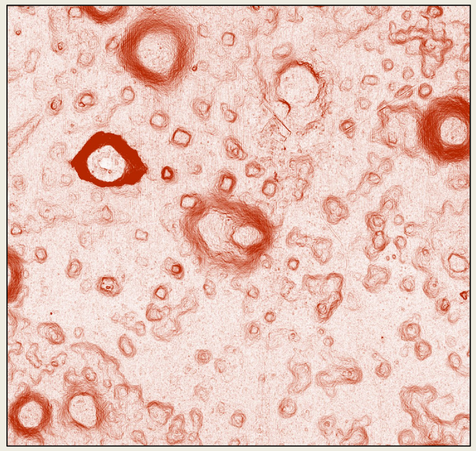
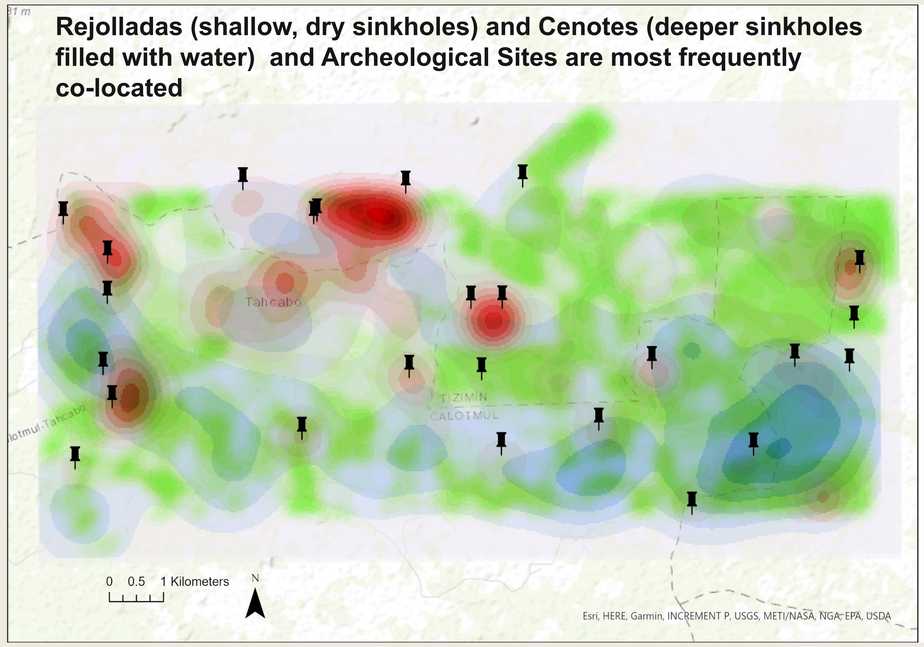


Fig 4. Feature Identification: Close-Up of Simple Local Relief Model (SLRM).
Slope is represented by a chromatic red gradient and topographic openness as a brightness gradient.

Rejolladas (shallow, dry sinkholes) and Cenotes (deeper sinkholes filled with water) and Archeological Sites are most frequently co-located



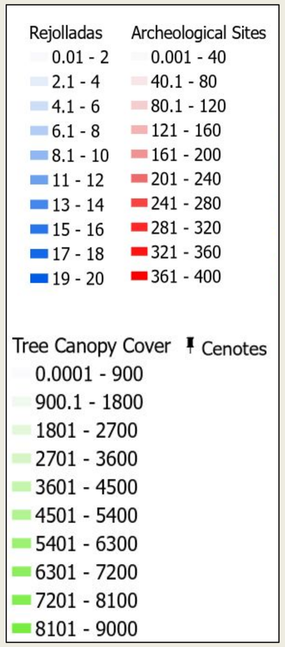
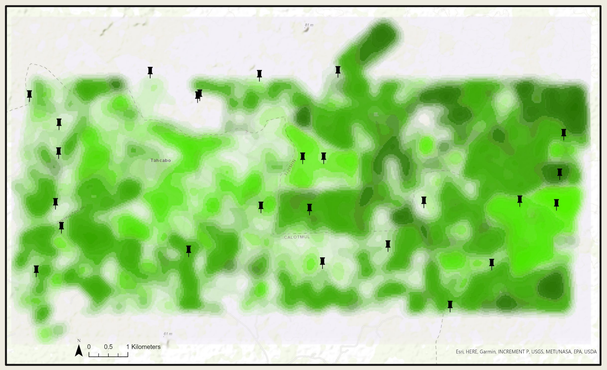


Fig 5. Density Overlay Map showing the intersection of sinkholes, archeological sites, and tree canopy cover in the Maya Communities.



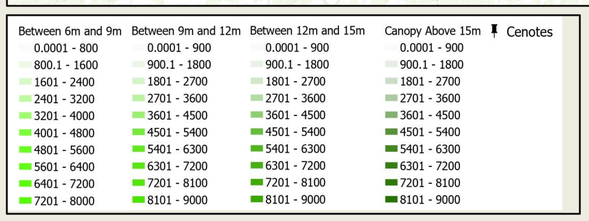


Fig 6. Density Maps of Tree Canopy Cover, with Cenotes Pinned

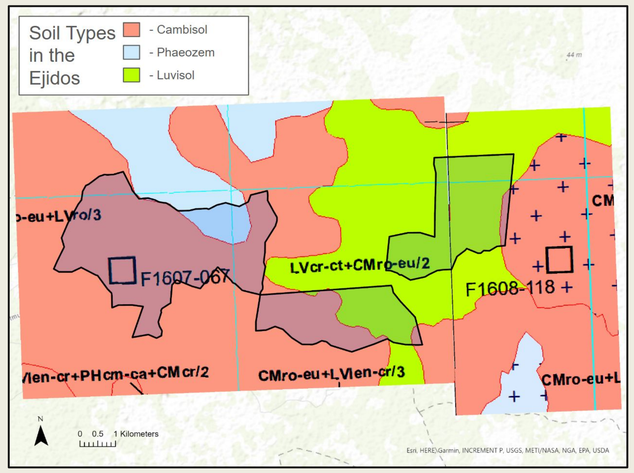


Fig 7. Soil Map of Studied Area with Ejidos

Conclusions

1. Fig. 3 displays where ground is closer to the water table, higher-density areas indicate potential for more fertile soils. Red relief imaging revealed a frequent co-location between **archaeological sites** and **rejolladas/ cenotes**. The tree canopy cover shows the **highest forests** on the eastern side of the study area (Fig. 6). The western side has the lowest tree canopy cover, and is potentially most suitable for agriculture.
2. Contrasting colors tescribe the three main topographical sites in Fig. 5. The dark red in the Local Relief Modeling identifies outlines of the r**ejolladas/ cenotes** (Figure 4).
3. No widespread co-location was found between **sinkhole** location and **tree canopy cover** (Fig 6), without distinguishing between cenotes and rejolladas.
4. The processing of LiDAR data and subsequent analysis supports the visualization of **decision-relevant layers for land managment in the MayaRoots mobile app**.

Fig 8. The lower, moister ground in rejollada sinkholes provide a unique, nutrient-rich, and humid microclimates for vegetation

Next Steps

Future iterations of the app will incorporate high-resolution details, including

- Distinguishing between cenotes and rejolladas and their relevance for landluse
- internal architecture of cenotes (such as stairs) and precise depths of sinkholes.
- data optimization for offline compatibility in remote communities

Acknowledgements

Our team thanks our community partners at the SCU Department of Anthropology, Dr. Maia Dedrick and her work done in with Dr. Iván Batún Alpuche at the Universidad de Oriente, Valladolid, Yucatán, MX. Geospatial analysis of the archaeological sites could not have been done without Dr. Luke Auld-Thomas's and Northern Arizona University, as well our mentor Dr. Iris Stewart-Frey.