Using Google Earth for Archaeological Research: A Virtual Survey of the Inka Road Network between Machu Picchu and Choquequirao

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My name is Efrain S. Arroyo, and I graduated from CSUDH in May 2021 and am now an M.A./Ph.D. student in the Anthropology Department at Binghamton University. My major is Anthropology with a focus on Archaeology. I am interested in the Inka Empire, territoriality and city planning, road networks, architecture and power, agricultural practices, communities of practice, and corporate labor systems. I am especially interested in the connectivity of the Inka road networks and tampus (waystations) to Inka settlements such as towns, imperial centers, and elite estates in the Cuzco region and what it suggests about infrastructural power and political or territorial control.

Introduction and Background

In the face of a global pandemic, disciplines like archaeology that rely on field research have had to adapt to remote investigation settings. Following the launch of Google Earth (GE) in 2005, researchers have postulated and tested its utility for archaeological research. Archaeologists have recognized the potential of GE as a tool for visualization, educational purposes, and research applications like remote sensing. For example, since 2016, the GlobalXplorer Project directed by Dr. Sarah Parcak of the University of Alabama at Birmingham, has demonstrated the utility of satellite imagery for identifying and monitoring archaeological looting, in addition to discovering and preserving sites previously unknown to archaeologists. However, more research is needed to assess its usefulness to the survey of previously studied areas in mountainous and heavily forested terrain like in the Central Andes of South America.

The Inka Empire, Tawantinsuyu (c. 1438-1533 CE),was the largest Indigenous polity ever to exist in the Americas, spanning much of western South America.

Tawantinsuyu expanded remarkably fast, with most of its landholdings obtained within a hundred years, its "material achievements were simultaneously political achievements" (Moore 2014). The Inka road network, known as the Qhapaq Ñan, connected the vast territories of the empire with approximately 40,000 km (25,000 mi) of roads, trails, and paths. As the result of a networked polity, the Qhapaq Ñan was the "imperial transport system of the Inca State" (Wilkinson 2019) and a means of connecting settlements, administrative and production and religious centers, and mining and agricultural zones under a state-serving economic, social, and cultural order.

Remote sensing has been a part of archaeology as long as it has been a discipline and is a way to observe landscapes and acquire information from a distance (Parcak 2009). Since the early 1990s, aerial photography has been a significant contribution to archaeology, from discovering to recording archaeological sites and features (ibid). Archaeologists did not begin using satellite imagery until the 1970s, although limited by image quality and resolution. Then, in the late 1990s, higher satellite image resolution and quality greatly improved the way archaeologists use satellite imagery for research (ibid). This remote sensing archaeological research project builds upon prior research to test the viability of publicly available satellite imagery platforms like GE to conduct preliminary archaeological spatial analysis.

Methods

A total of 60 km² of the Inka road network between the archaeological sites of Machu Picchu and Choquequirao were virtually surveyed using Google Earth. The "overlay image" tool was used to set a reference map (Lee 2010) over GE satellite imagery and create "placemarks" for major Inka sites. The "polygon measure" and "line measure" tools were employed to illustrate the survey area and its boundaries. The 60-km² survey area was divided into four 15-km² smaller survey squares. The reference map and the "placemark," "historical imagery," and "path measure" tools were used to identify and trace branches of the Inka roads. Remote sensing methods developed by Parcak (2009) and Inka road identification protocols developed by Hyslop (1984) were both incorporated.

Results

532 placemarks were created to mark the location of Inka roads, identifying 219 km worth of the road system. 63 path measures were created to trace Inka roads, creating a plan for 28 km of the road network. Inka roads were identified in different environments and types of vegetation cover. Inka roads vary in appearance from wide thoroughfares to small footpaths that look like lines and zigzags that cut through the vegetation and landscape. The difficulty of identifying Inka roads depended on image resolution, elevation, vegetation cover, terrain type, and its proximity to modern infrastructure. Although there was

high resolution in the survey area viable enough for archaeological research, limitations included inconsistent image resolution and quality. GE is feasible for archaeological research in this area, but that does not necessarily translate to its viability everywhere in the world.

Discussion

The survey results proved the viability of using publicly accessible satellite imagery like GE for archaeological prospection of archaeological features. Spatial analyses also demonstrated the feasibility of tracing the outlines and plans of Inka roads. Feature types intentionally omitted from the virtual survey were other archaeological features (e.g., waystations, residential architecture) and modern infrastructure. Spatial analyses like those presented in this study can play a role in protecting tangible heritage by helping to identify archaeological features before they are destroyed by modern infrastructural projects. GE satellite images are frequently updated, allowing researchers to track the encroachment of modern projects into archaeological zones over time.

GE is a feasible tool for archaeological research especially because it is a publicly accessible and cost-effective virtual platform that works great for conducting research from afar. Currently, during the COVID-19 pandemic, GE is an exceptional tool for conducting virtual research and allows users to conduct archaeological fieldwork from the safety of their home office despite the unfortunate circumstances. Even though GE makes remote archaeological research more practical, we must also recognize that it raises ethical questions about sharing spatial imagery and data, exposing modern activities, and the lack of the representation of individuals and their property. Furthermore, it is important to keep in mind that such examples of remote research serve as a preliminary survey that must be tested through further, on-the-ground reconnaissance when possible.

Conclusions

The preliminary results of this project indicate that archaeologists should be able to identify and quantify many sections of the Inka road network using GE, allowing them to better prepare for eventual pedestrian survey and LiDAR research. GE provides a cost-effective and publicly accessible virtual platform for archaeological remote sensing research. Lastly, this type of preliminary spatial analysis research can be conducted despite adverse conditions like a pandemic, allowing researchers to continue or prepare for more intensive research from the safety of their office.

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Fig. 1. Google Earth map of the study area.

Fig. 2. Google Earth map of the study area divided into four sectors using the Overlay Tool (Lee 2010).

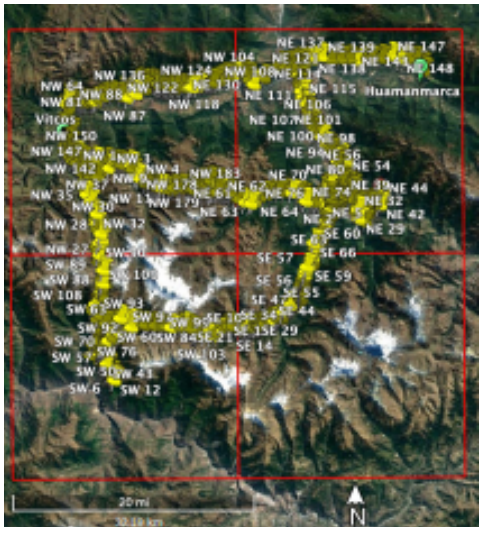

Fig. 3. Google Earth map with points identifying locations along ancient Inka road networks.

Works Cited

Bjørnevad-Ahlqvist, Mathias P., 2013, The Application of Google Earth in Archaeology: A Survey of Northumberland, UK.

Hyslop, John, 1984, The Inka road system. Academic Press, Orlando, Florida.

Lee, Vincent R., 2010, Choquequirao to Machu Picchu at the speed of light: visual signaling among the Incas. Ñawpa Pacha, 30(1), 1–23.

Moore, Jerry D., 2014, A Prehistory of South America: Ancient Cultural Diversity on the Least Known Continent. University Press of Colorado, Boulder, Colorado.

Parcak, Sarah H., 2009, Satellite remote sensing for archaeology. Routledge, London.

Ur, Jason, 2006, Google Earth and Archaeology. SAA Archaeological Record. 6, 35-38.

Wilkinson, Darryl, 2019, Infrastructure and inequality: An archaeology of the Inka road through the Amaybamba cloud forests. Journal of Social Archaeology, 19(1), 27–46. https://doi.org/10.1177/1469605318822551