

English

Despite decades of archaeological research, much of Madagascar's archaeology remains unexplored and the oldest sites on the island are difficult to locate, as they contain only faint traces of human presence (small pieces of ceramics, eggshells, shell tools, among other small objects). As a result, what we know about the early history of Madagascar is very limited, and usually focuses primarily on areas with more recent histories trading networks.

To help fill gaps in knowledge of Malagasy history, archaeological studies must be expanded in a comprehensive manner. However, funding limitations, large areas requiring investigation, and the small number of active field archaeologists in this area present substantial barriers to research. In this paper, we show how satellite imagery and environmental data can be used to direct survey efforts on Madagascar. Landscape analysis incorporates geographic, environmental, and cultural information. Together, studies of landscapes can provide insight into human-environmental interactions, human settlement choice, and engagement with different ecological contexts. Madagascar has very few such studies pertaining to its earliest human inhabitants, especially at landscape scale, and this is partly because landscape approaches require expansive datasets.

The use of remote sensing (e.g., satellite imagery) has revolutionized landscape archaeology in terms of speed of survey and the amount of information that can be derived at one time. Using technologies like satellite images allow researchers in Madagascar to investigate settlement patterns and landscape use in prehistoric, historic, and modern contexts. The European Space Agency Sentinel-2 satellite (<https://scihub.copernicus.eu/dhus/#/home>) is freely available to the public, and provides datasets that cover the entirety of Madagascar, in addition to most other parts of the world. Using this satellite and several image processing methods, we classified different environmental features which are of importance to Vezo communities today, and coastal peoples historically. These variables include: water, coral reefs, and productive areas of vegetation. Additionally, archaeological evidence suggests that coastal peoples interacted with elephant birds and other extinct species, which lived in many sand dunes present along the coast.

Using this information gathered from satellite data, we calculated the probability of human presence by measuring the distances of these features to different places within the study region (which covers a roughly 1400 km² area in the Velondriake area). To assess the accuracy of this probability assessment, we randomly selected grids throughout the study area. 73 were surveyed during the summer of 2019 and contained "high", "medium", and "low" probability zones.

During surveys, many different materials were recovered, ranging from ceramics and beads to eggshell and seashells. The results suggest that high probability areas contain the greatest amount of cultural materials, and furthermore that these materials decrease steadily in number in lower probability areas. We also find that coastlines are most densely inhabited through time. Ultimately, populations settling on Madagascar in prehistory were likely actively pursuing the most environmentally productive areas.

The results of this study will be used to address questions concerning human-environmental interaction during prehistory on Madagascar. Answering questions about how environmental conditions influence human decision making requires, first and foremost, a well-studied archaeological record. This

study allows us to improve our understanding of past human presence on Madagascar. As such, it will allow future work to focus on understanding important effects of climate change on human societies.

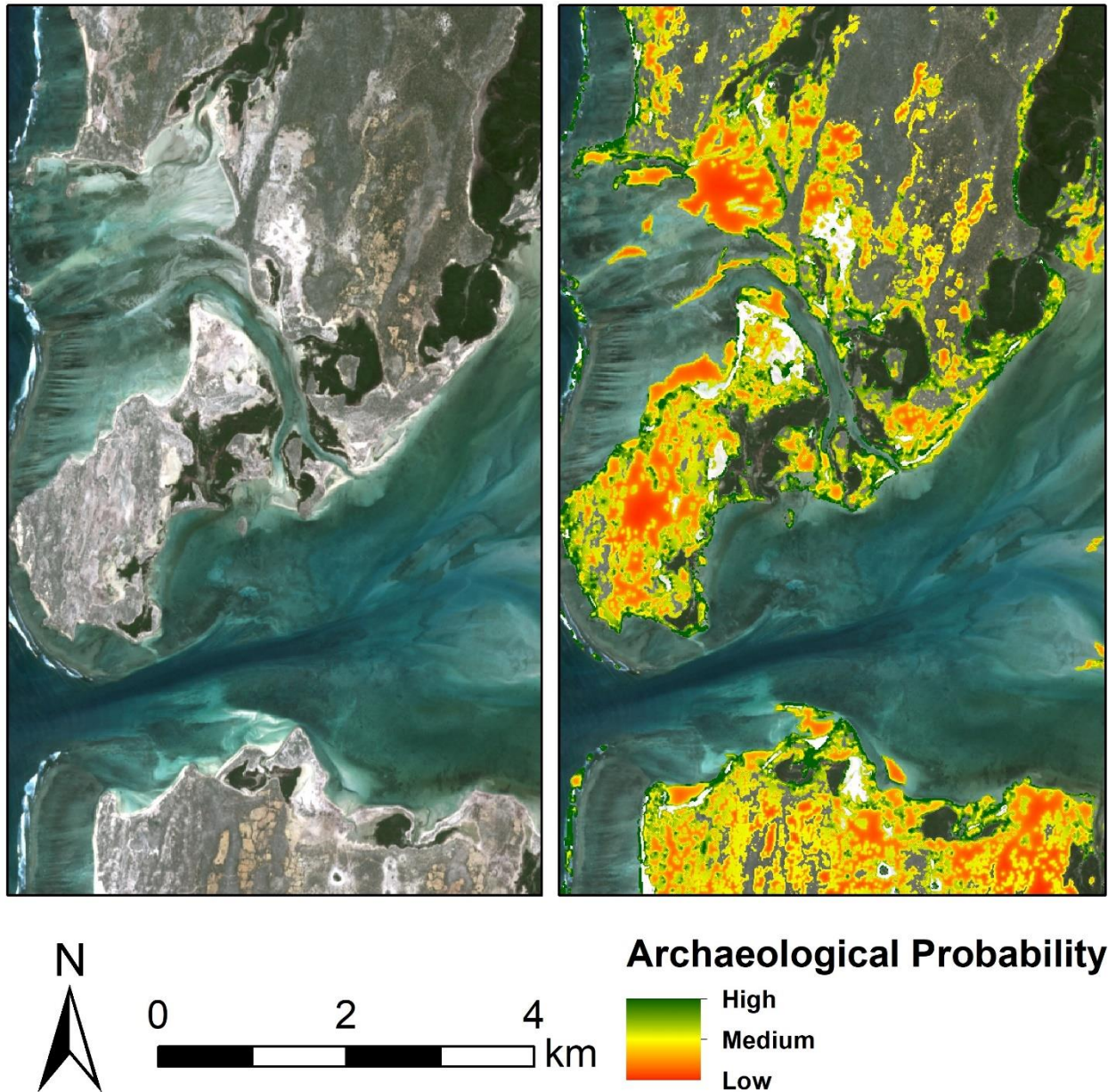


Figure: The left panel shows a normal satellite image of part of the study area. The right panel shows the probability that archaeological sites are located in those areas. Green shows the highest probability while red shows the lowest probability.