Using remote sensing to locate archaeological sites in Zimbabwe

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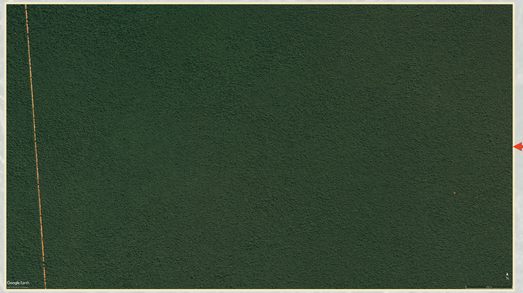
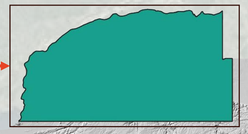


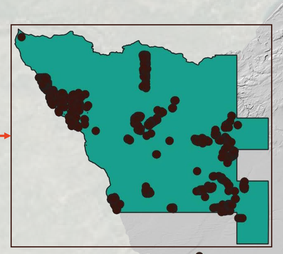
Landscape challenges

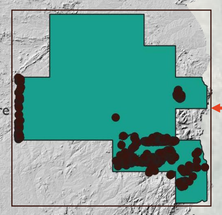
Remote sensing in diverse environmental and climatic regions such as in the case of Zimbabwe means working with different quality resolutions of satellite imagery. For example, in the Zambezi River valley, sections of the landscape are densely covered by trees and other vegetation. This makes visual inspection of these areas challenging. The image above illustrates one such densely vegetated part of the landscape.

MAEASaM and Google Earth

An important part of the MAEASaM project is the use of Google Earth (GE) to visually inspect satellite images for targeted survey areas. Each survey area (represented by green on the map below) is inspected following a grid system along a transect. Features are then documented (the brown dots and light brown areas) as having potential to be of archaeological significance. These sites are then sent to the National Museum and Monuments of Zimbabwe (NMMZ) for further ground validation.

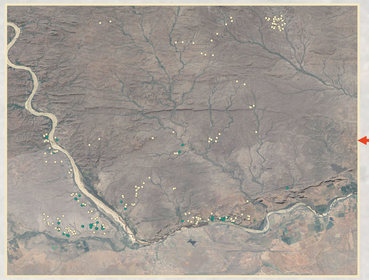


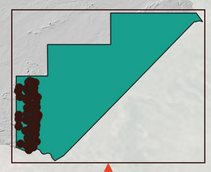




Anthropogenic or natural?

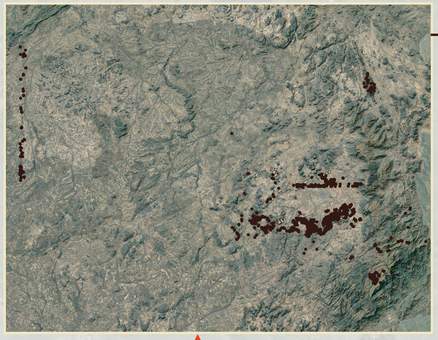
Although dry landscapes make searching for archaeological sites easier, they do come with their own challenges. The landscape of the Hwange National Park (HNP) is characterised by very dry winters and wet summers. As a result, the area has many seasonal pans which in the summer have the same appearance and size on satellite images as central enclosures. The critical question in these landscapes is always: is it an anthropogenic or natural feature?

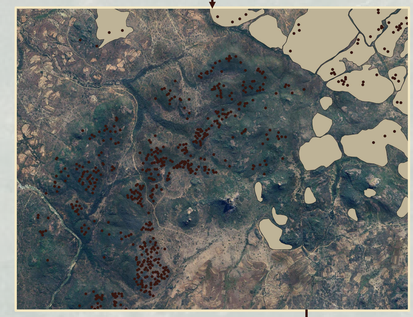




Machine learning

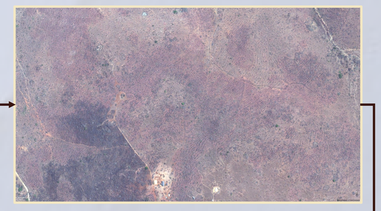
Machine learning (ML) is the process in which computer algorithms are trained using data to determine or predict possible outcomes. MAEASaM uses satellite signatures of already-known archaeological sites to train an ML model to search and identify similar signatures on any provided imagery. Of course, a sample of these sites will need to be verified during fieldwork to ascertain the success of the model. The ML model allows for the survey of very large areas in a short period. Furthermore, the more training data added to the model the more accurate it becomes. The rapid advancement of Artificial intelligence (AI) holds the possibility of improving this technique.





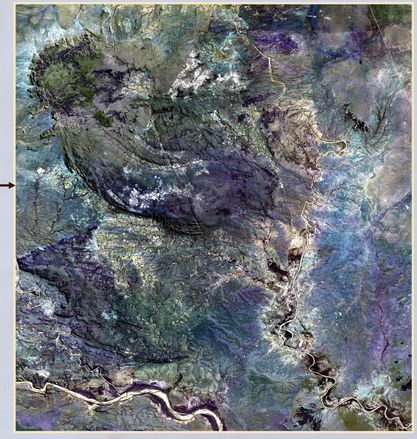
Historical Imagery

A key advantage of Google Earth is the availability of historical satellite imagery. Although the number of available images can vary greatly between different regions, these images generally provide detail of a region during both the dry and wet seasons. For example, the images to the right illustrates a group of sites at Ziwa which are invisible from satellite imagery in the summer but can clearly be seen in the winter.



Multispectral imagery

Another technique utilised in the project is the use of multispectral satellite images. These images, acquired from Planet Labs, provide images in multiple bands (8). This allows for features, such as soil type or moisture content to be distinguished from from other parameters (as can be seen in the image to the right for Gonarezhou National Park). These images allow us to see areas of vegetation that have higher moisture content than the surrounding areas, which often are a signature for the presence of central enclosures. Thus, these sites can be seen even in densely vegetated areas.



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