Remote Sensing Archaeological Sites through Unmanned Aerial Vehicle (U.A.V.) Imaging

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ABSTRACT

Advances in technology and lowering cost make drones, or Unmanned Aerial Vehicles (U.A.V.), appealing platforms for remote sensing. Data acquired through these technologies have broad appeal and widespread application across many industries and disciplines. Archaeologists have used aerial imagery derived from many sources as a means of identifying sites and ancient landscapes, yet this imagery has traditionally been acquired through satellite and aircraft platforms making cost and time a primary concern. For this reason, the availability of inexpensive U.A.V.s affords archaeologists access to obtaining their own data at a fraction of the cost. However, are they effective? For the purposes of this study, the DJI Phantom 2 Vision+ UAV, along with supporting software, was evaluated for its ability to create visible light imagery and elevation datasets useful in remote sensing archaeological sites. To test its effectiveness, a site was chosen in Bertie County, North Carolina discovered in 2007. The Salmon Creek site (31BR264), as it is known, is partially understood from previous archaeological studies as the location of a 16th Century Native American village. This previous work provided a foundation which our results could be tested and evaluated against and proved important to our interpretation of the data. The project not only demonstrated the effectiveness of the U.A.V. to acquire usable datasets, but contributed to the ongoing research.

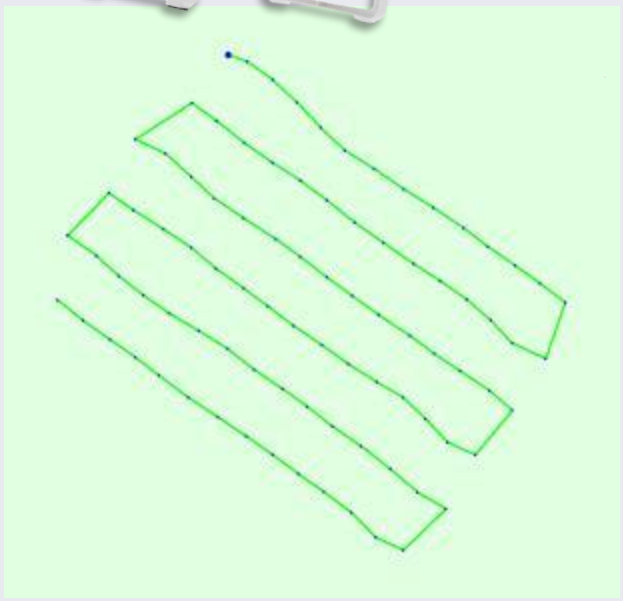
Keywords—archaeology, aerial imagery, DJI Phantom 2 Vision+, drone, remote sensing, U.A.V.

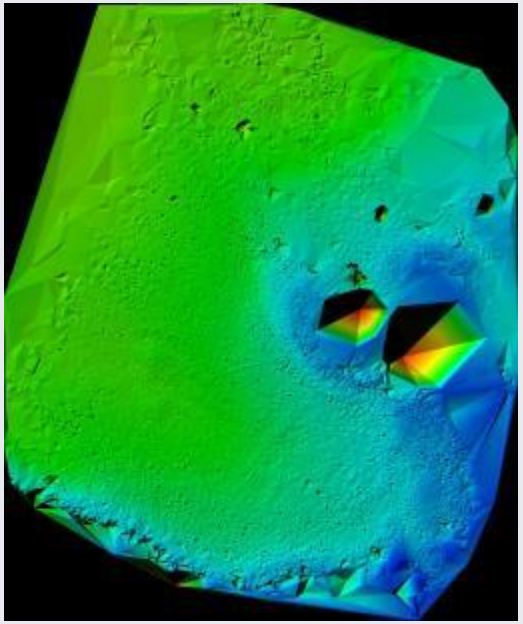
OBJECTIVES

- Primary objective of this research was to develop a working methodology for CERSER's use of U.A.V.s for future remote sensing and archeological purposes.

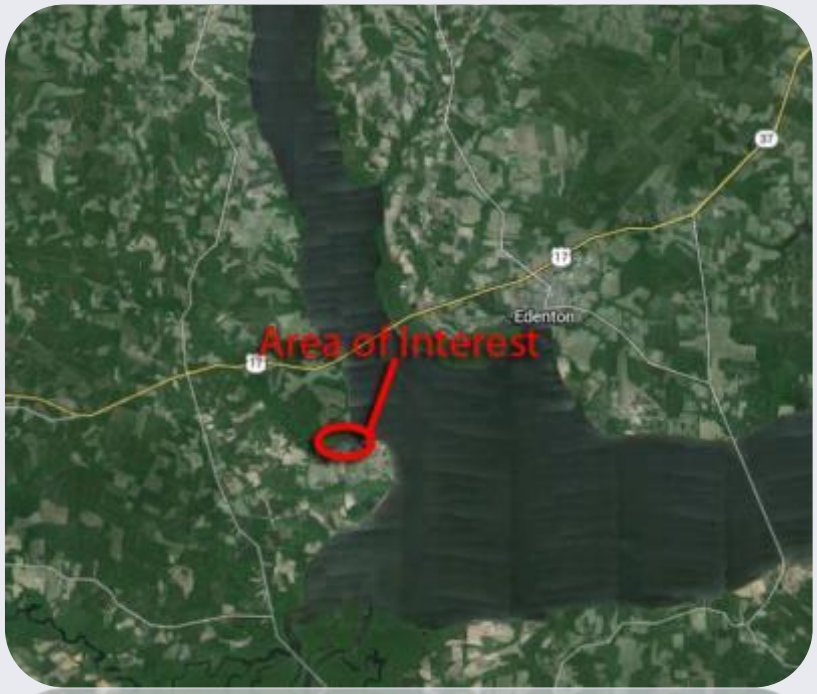
- A secondary objective for the project was to produce new data sets archaeologists could use in future studies.

METHODOLOGY





AREA OF INTEREST



- Salmon Creek site is Located at the western end of the albemarle sound near the Confluence of the chowan & Roanoake Rivers.
- Archaeologists think it is the location of the Indian village MetaCuuem.
- The village of MetaCuuem looked similar to the village of Pomeioc painted in the 16th century by English Artist John White.

EQUIPMENT

DJI Phantom 2 Vision + Key Features

- Inexpensive
- a built-in Naza-M V2 Flight Control System for Autonomous flight
- integrated gimbal and 14 mp camera
- Internal GPS and barometric Altimeter
- Flight Time is approximately 25 minutes

EQUIPMENT

Software Features

- Ability to Stack images to create large Photo Mosaics
- Can process Multispectral Images
- Build 3d Point Cloud from 2d Imagery
- Costly but Alternative Pricing such as Educational Licesnce
- Mobile Application to Plan Flights

DEVELOPING A FLIGHT PLAN

Key considerations

- Establish Survey area within AOI
- Make sure linear transects are properly aligned with survey area
- Take off location is in clear unobstructed location
- Make sure no obstacles are in mission area
- Weather conditions
- Pilot must always be ready to take control of U.A.V

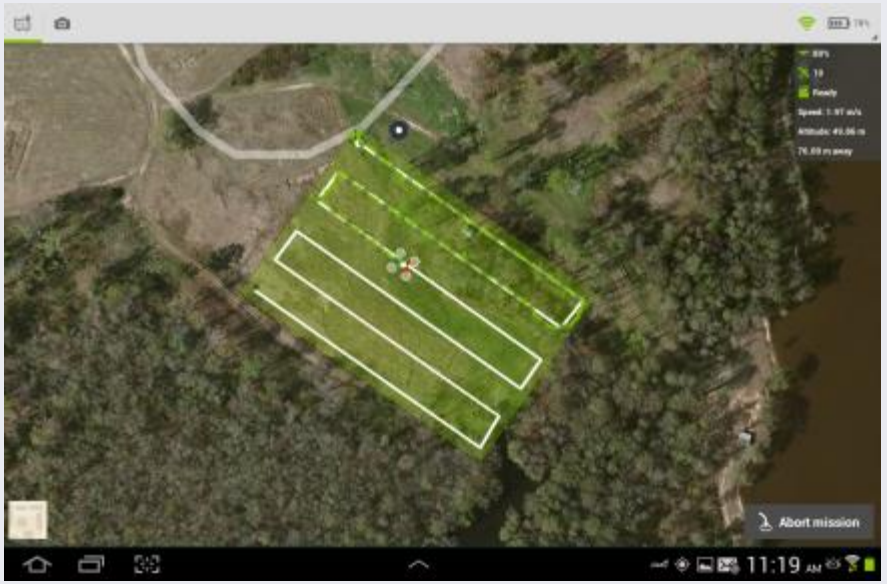


Image Processing

- Goal to Create Photo Mosaic From Individual Images
- 87 Individual images collected
- Geo-referenced images Processed with Pix4d Mapper Pro into Mosaic
- Pix4d finds overlap in images and looks for commonalities to build the larger mosaic
- 3d Point Cloud created from 2d Imagery

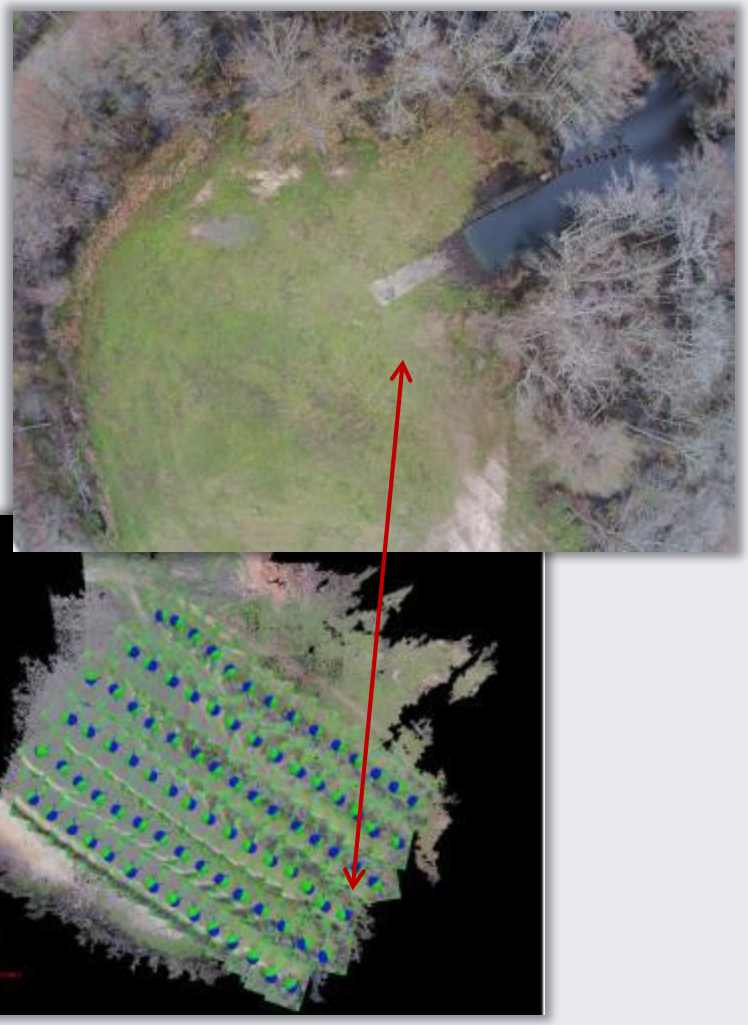
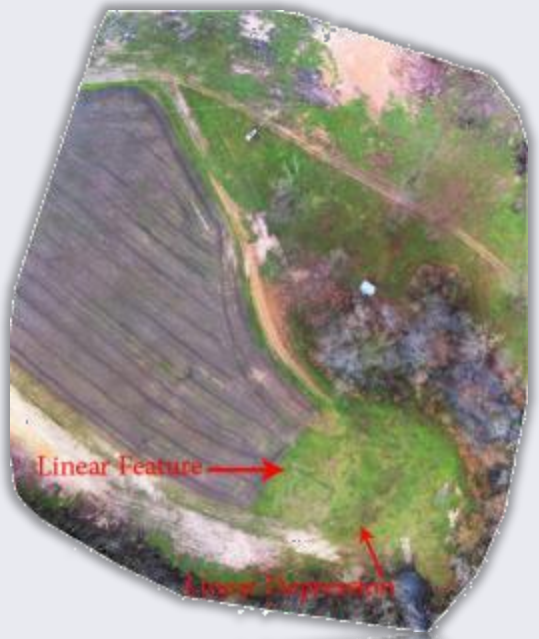


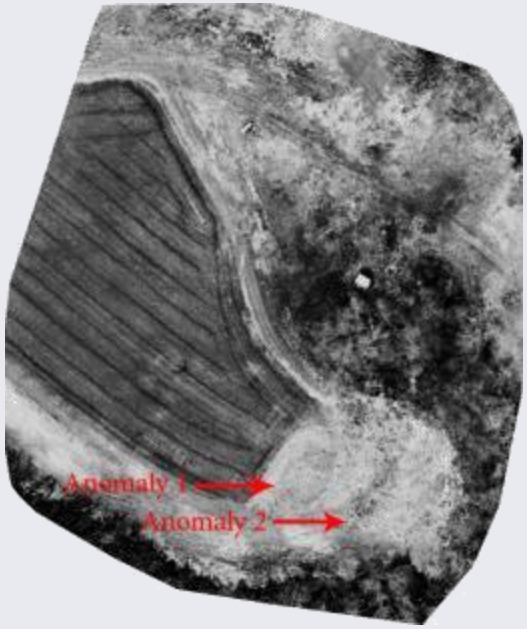
IMAGE PROCESSING

Analysis and Results

Visible Color



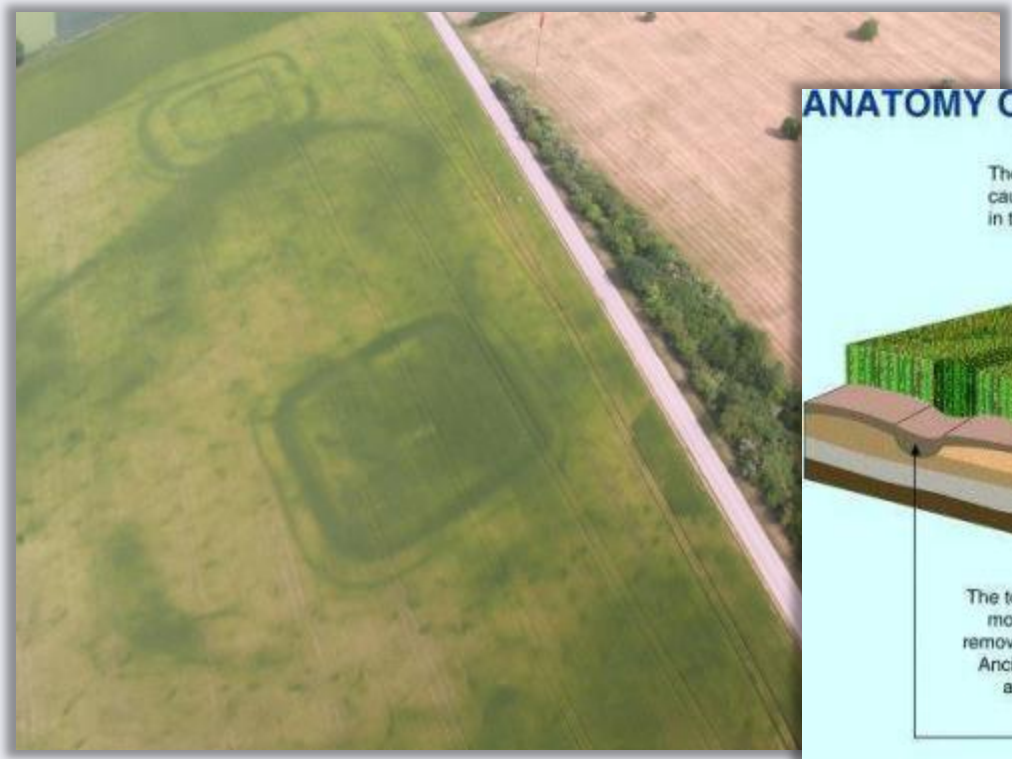
Contrast Enhanced

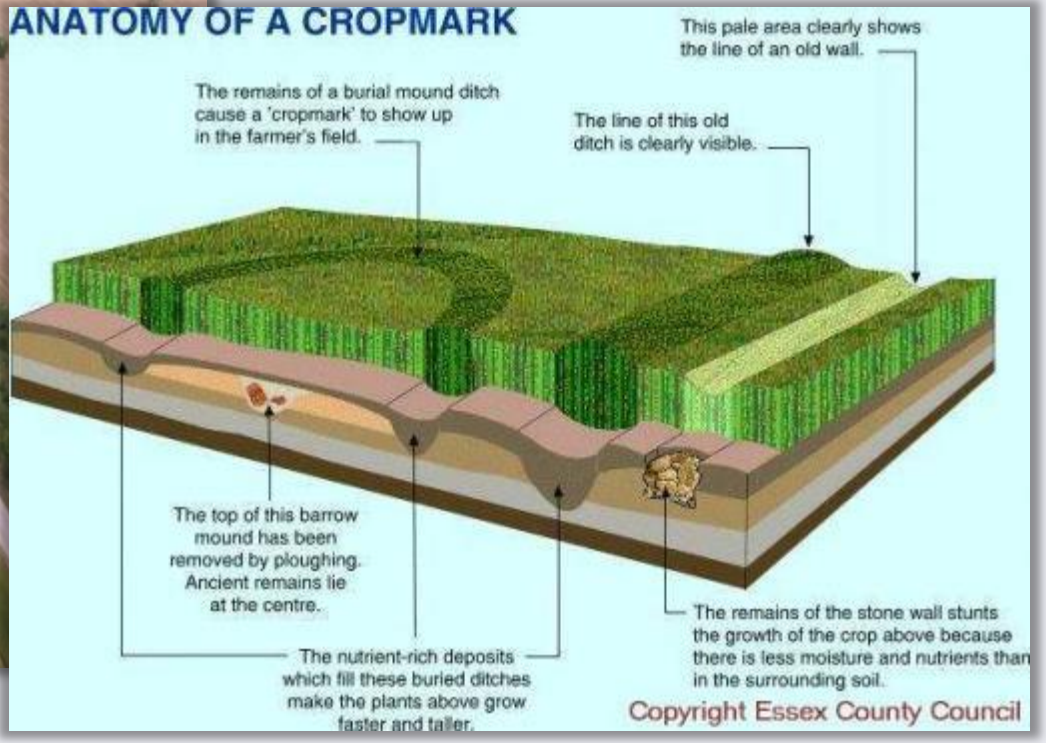


Faked IR

- Processing yielded a visible color mosaic image which we manipulated to emphasize Features and Anomalies
- We Identified Three Features during our analysis

CROPMARKS

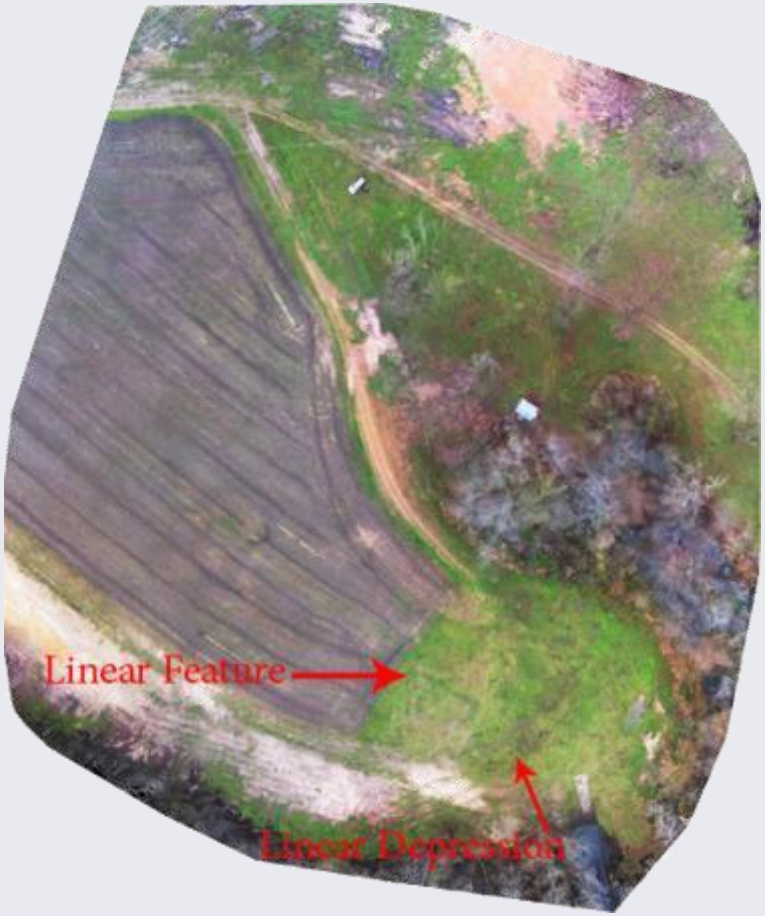




Crop marks are formed by variations in the subsoil, which can be caused by buried archaeological features, such as bricks and other various items or structures which cause differential crop growth

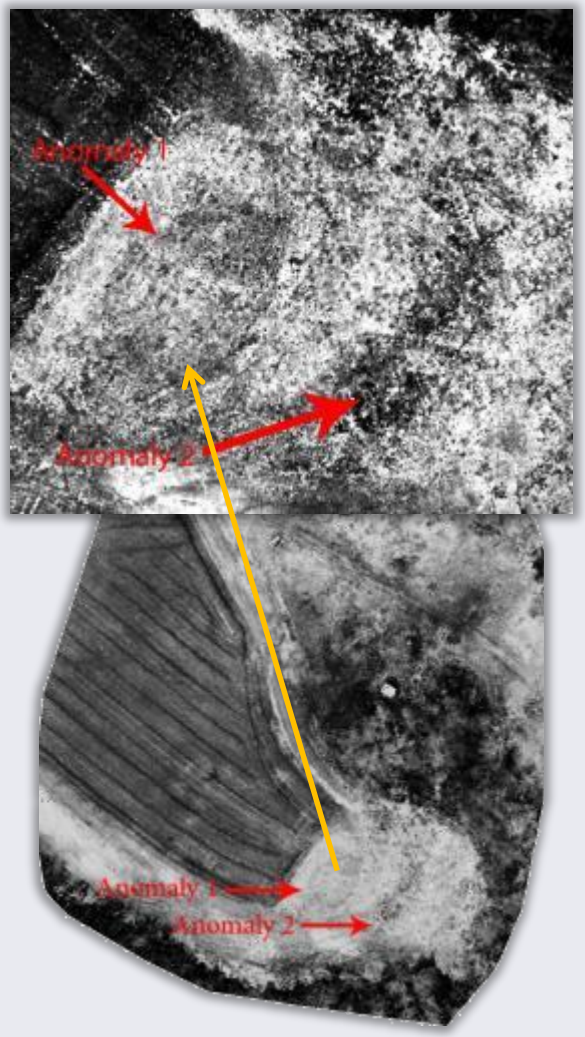
LINEAR FEATURE

- This feature seen in Fig. 11 is best described as a positive crop mark
- It is linear, oriented roughly north/south
- We are confident it represents one of several trenches excavated by archaeologists in 2007
- demonstrates the major concept of how variations in vegetation color and type denote subsurface features



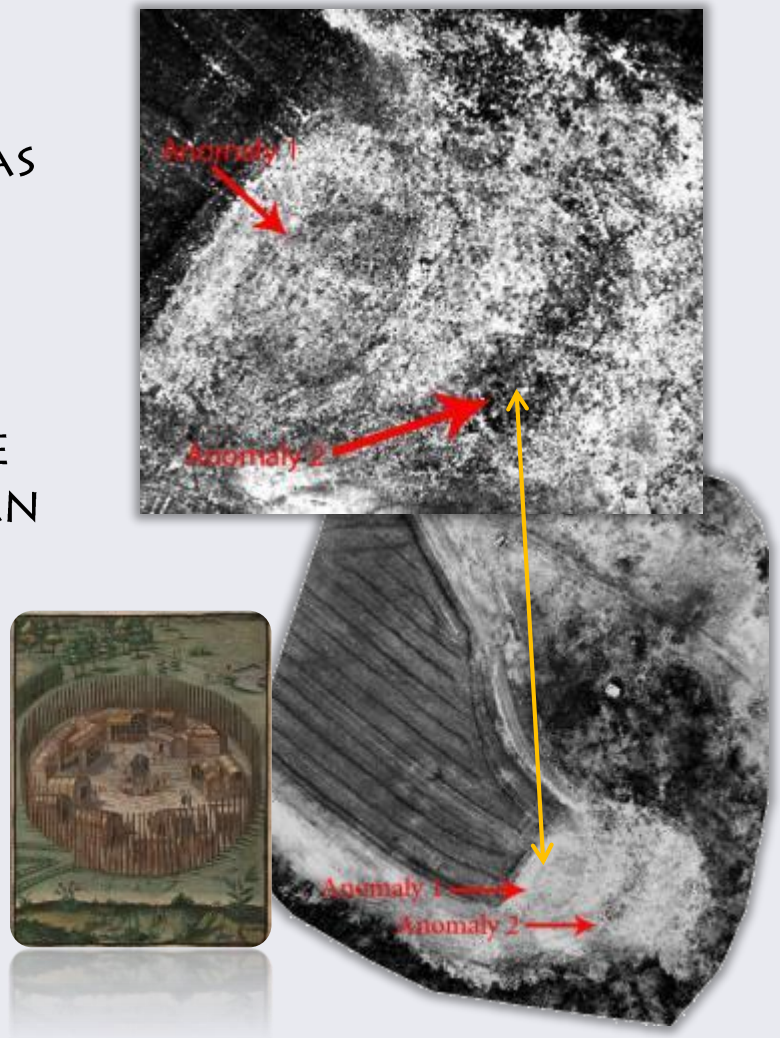
ANOMALY ONE

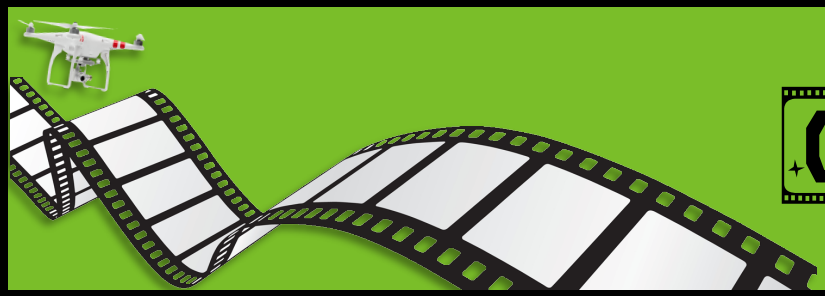
- large oval feature only visible in the faked IR image
- Its dimensions are roughly 60 feet by 45 feet oriented east/west.
- The linear feature, or the 2007 trench, cuts directly through its center which suggest It is not related to the 2007 trench
- plants within the radius are sparse suggesting more compact soils inhibiting plant growth
- Could represent or indicate the location of Houses or refuse area



ANOMALY TWO

- Anomaly 2 is present in all images as well as 3d Point Cloud
- It is linear, oriented east/west
- The darker coloring of this feature suggests that it is saturated from an overly wet winter
- Feel are certain it is man made
- Possibly could represent a ditch associated with the Indian Village





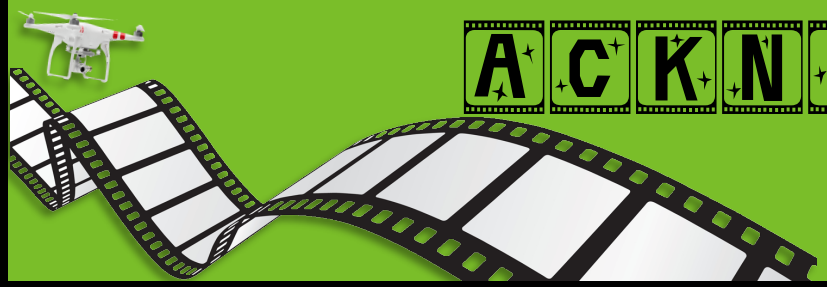
CONCLUSION

- Our primary objective for this research was Acquire, test, and develop a working methodology for CERSER's use of U.A.V.s as a platform for future remote sensing and archeological purposes.

Our Results demonstrate that the technology is accessible and that the methodology we employed was highly successful

- A secondary objective for the project was to produce new data sets archaeologists could use in future studies.

Using the available technology and our methodology, we were able to identify Anomalies we feel archaeologists should investigate further



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