Leveraging Precision Agriculture for Enhanced Crop Management and Yield Optimization

Will Hayes and James Hufham
Texas Christian University Department of Geological Sciences

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ABSTRACT

Today's farmers must grasp a wide range of topics beyond just planting, including soil composition, weed management, nutrient requirements, weather patterns, pest control, disease prevention, equipment use, and climate considerations. Precision agriculture, a tool that allows for the visualization of data in an agricultural view to help ranchers better understand their land and how to best supply resources to their land, can be a tool to increase efficiency and production to the agricultural industry as a whole. Precision agriculture can help farmers "more precisely determine what inputs to put exactly where and with what quantities" (GIS lounge para. 3). In this proposal we plan to demonstrate how precision agriculture with the use of Landsat satellites analyzes the greenness of vegetation using indices like the Normalized Difference Vegetation Index (NDVI). Using these tools we can use drones to collect plant height and plant count, biomass estimates, the presence of diseases and weeds, plant health and field nutrients, as well as 3D elevation and volumetric data.

BACKGROUND

Precision agriculture entails employing a farming management approach that involves observing, measuring, and reacting to temporal and spatial fluctuations to enhance the sustainability of agricultural production. This method is applicable in both crop cultivation and livestock production. .It provides improved analysis and the discovery and control of both temporal and geographical variations in crop production within a field. Precision agriculture also uses technologies such as GPS or automation to make farms more efficient. . Our data is gathered through the photogrammetry software company Pix4D. Their analysis of a crop field in Uceblens, Switzerland is the dataset we used to analyze leveraging precision agriculture for enhanced crop management and yield optimization.

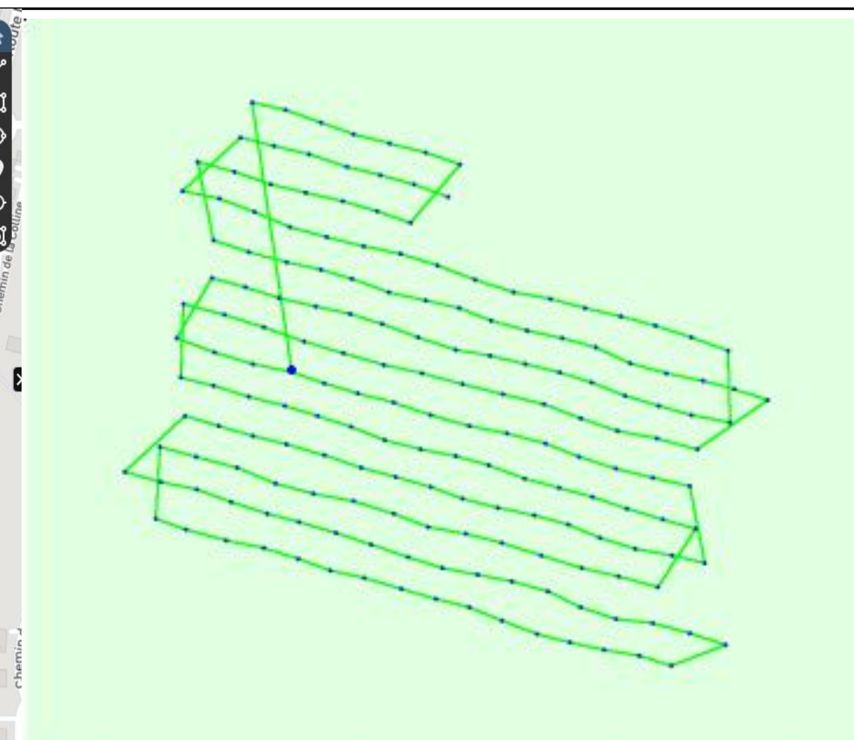
OBJECTIVES

1.Provide data showing increased crop production due to the use of precision agriculture.

2. Measure how drone imagery and NDVI can be used to increase crop production and improve field management

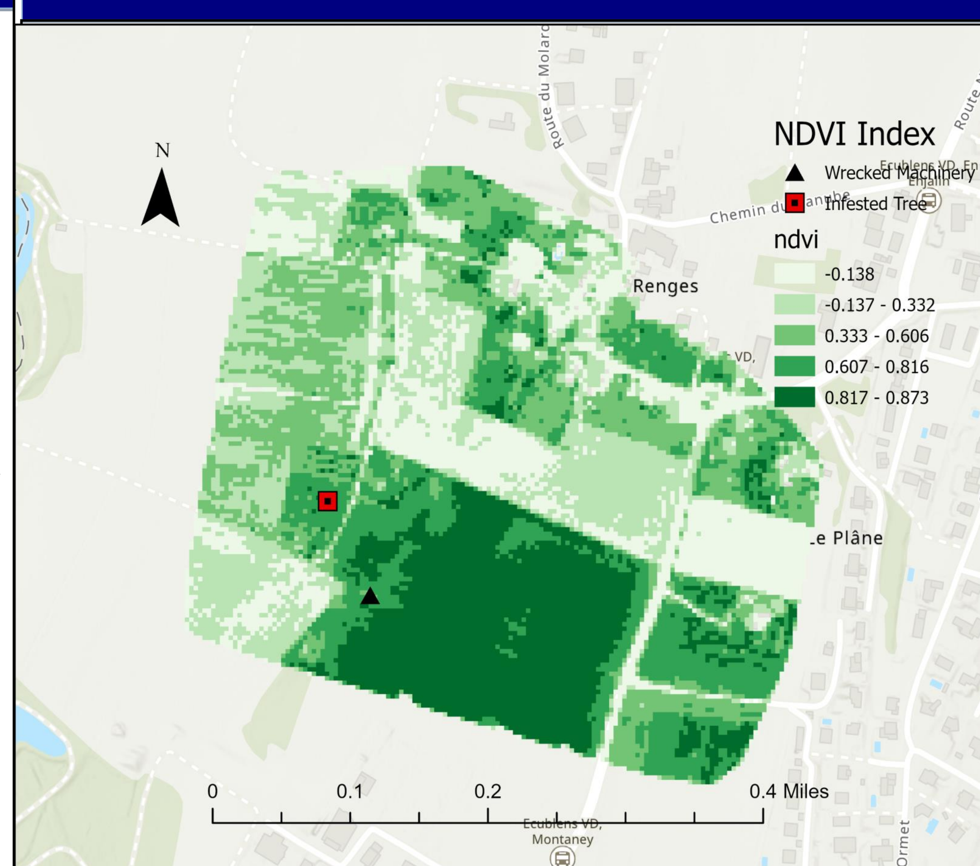
3. Show how yield optimization can be improve fertilization rates using drone imagery.

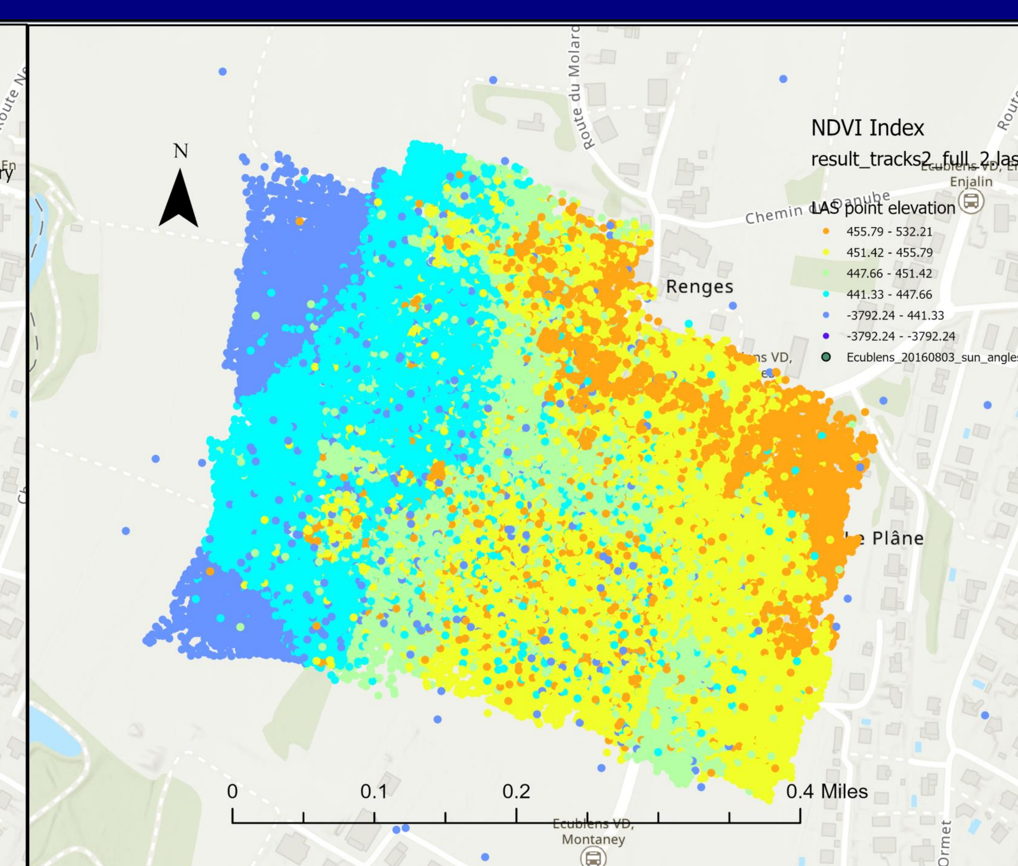
DATA



Images	median of 10000 keypoints per image
Dataset	716 out of 724 images calibrated (98%), 12 images disabled
Camera Optimization	0.85% relative difference between initial and optimized internal camera parameters
Matching	median of 4437.29 matches per calibrated image
Georeferencing	yes, no 3D GCP

RESULTS





Project	Ecublens_20160803
Processed	4/3/2017 8:24
Camera Model Name(s)	Sequoia_4.0_1280x960 (Green), Sequoia_4.0_1280x960 (Red), Sequoia_4.0_1280x960 (Red edge), Sequoia_4.0_1280x960 (NIR)
Rig Name(s)	<<Sequoia>>
Average Ground Sampling Distance (GSD)	10.66 cm / 4.19 in
Area Covered	0.233 km^2 / 23.2964 ha / 0.09 sq. mi. / 57.5965 acres
Time for Initial Processing (without report)	06m:58s

METHODOLOGY

For this analysis the NDVI index was sued to measure crop health across a field. NDVI or the normalized difference vegetation index is used to quantify the health and density of vegetation health and sustainability. NDVI data is gathered using spectrometric data at two bands: red and near-infrared. In this particular dataset the data was gathered using remote sensors, specifically Sequoia a_4.0_1280x960 (Green), Sequoia_4.0_1280x960 (Red), Sequoia_4.0_1280x960 (Red edge), Sequoia_4.0_1280x960 (NIR) camera. The sequoia camera uses ground control points to take images to analyze using the NDVI index. The sequoia camera used 716/724 images to calibrate this dataset.

DISCUSSION

The maps shown below (from left to right) show the NDVI (green), elevation (multicolor), and infrared of a field in Ecublens, Switzerland. The black triangle represents wrecked machinery on the field, showing that there is a interference for planting methods. The red square represents infested trees on the field. The use of the infested trees imagery demonstrates where not to plant crops. The NDVI index ranges on a scale from –1 to 1, where negative values represent poor vegetation rates, where on the other hand, positive values represent optimal vegetation rates. Dark green NDVI values range from 0.817-0.873, with the lighter greens being –0.128. The highest elevation values (orange) range from 455.79-532.21 meters, and the lowest elevation values (dark blue) range from -3792.24 to -3792.24 meters.

CONCLUSION

Through our analysis we were able to find data relating to our discussion that the use of precision agriculture can be used to enhance both crop management and yield optimization. The NDVI index shows where plant health flourishes, causing an increase in in crop production. The biggest perk of optimizing precision agriculture through the use of drone imagery is the time that is saved rather than doing it manually. The time used for processing this data took a total of 6m and 58s. The time difference for analyzing data through remote sensing compared to manual inputs is astronomical saving hours if not days of labor in analyzing ones property.