Eyes in the Sky → Decisions in the Field

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crop, soil, and environmental sciences

INTRODUCTION

Imagery and videos from affordable consumer UAVs can help **identify the existence and the extent of crop problems** (e.g., nutrient deficiencies, water stress, weeds, diseases, man-made problems) and natural spatial variability in fields. Aerial imagery can help **focus crop scouting efforts** on the ground and improve the **efficiency of the crop problem diagnostic** process, leading to better decisions throughout the entire growing season. Crop researchers can use the reflectance data of aerial imagery to calculate spectral vegetative indices that can then be used to **evaluate the effects of different treatments** in field-scale trials.

In comparison to other sources of imagery, such as satellites or manned aircraft, UAVs often provide better **digital resolution**, **lower cost** per acre, and the **flexibility to fly** whenever the grower or researcher wants. Despite the advantages, there are important **factors to keep in mind** when flying a UAV.

This poster **summarizes our experiences flying** an affordable consumer UAV (DJI Phantom 4 Pro) with a single camera and a more expensive, industrial UAV (DJI Matrice 200) with the capability of carrying alternative cameras / sensors for the past two growing seasons over multiple field-scale trials around Indiana.

FIRST STEPS

Define your goals
Goals will influence the appropriate drone, the sensor/camera mounted on it, and the type of flights that can be made.

FAA Requirements to Fly
- Drone registration
- Remote pilot certificate

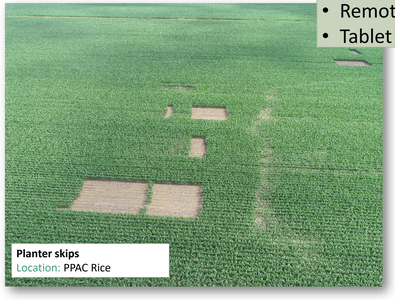
Safe Flying
Check the airspace where your field is located and the weather conditions before going to the field.

IMAGES FROM MANUAL FLIGHTS


Weed patch
Location: Cooperator farm


Weed patch (closer view)
Location: Cooperator farm

MANUAL FLIGHTS
What you need:
- UAV
- Remote controller
- Tablet or smartphone


Planter skips
Location: PPAC Rice


Starter fertilizer trial
Location: SEPAC H3

AUTONOMOUS, PLANNED FLIGHTS

PLANNED FLIGHTS
What you need:
- UAV
- Mobile device
- Planning app
- Software to stich

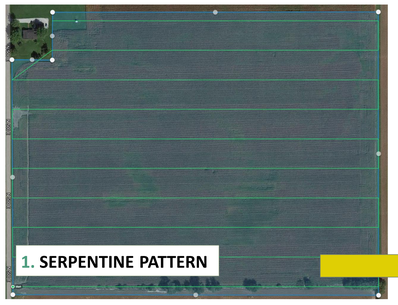
What can be done?
- Fly pre-planned serpentine pattern across field.
- Create whole field images from hundreds of individual ones.
- Calculate areas of problem zones in the field.
- Calculate vegetative indices to assess the plant health status, and other parameters (depending on the sensor used).

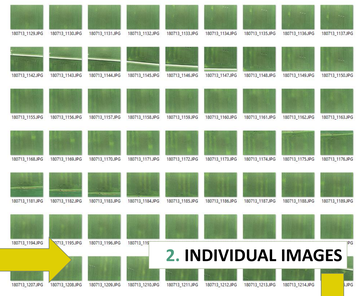
Necessary flight parameters for planned flights

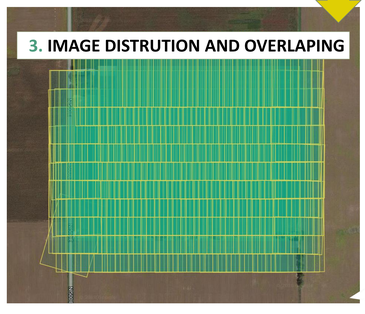
ALTITUDE
Altitude at which the UAV will fly the pattern across the field. We commonly fly at 400ft to maximize battery use without sacrificing much digital image resolution.

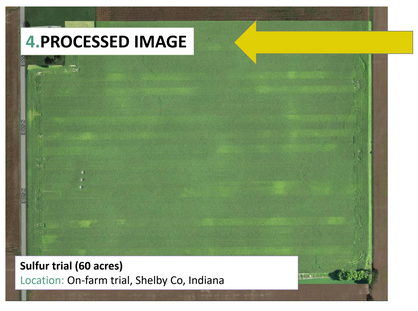
IMAGE OVERLAPS
Overlapping images ensures a successful stitch of the images. We typically use **75% sidelap and 85% frontlap.**

FLIGHT DIRECTION
We prefer to fly **parallel to corn rows** to minimize the risk of "tiling" effects in the stitched images.


1. SERPENTINE PATTERN


2. INDIVIDUAL IMAGES

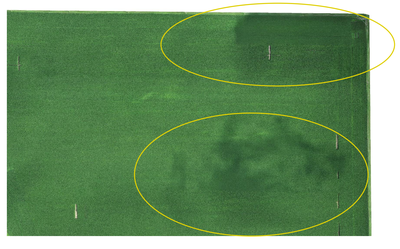

3. IMAGE DISTRUTION AND OVERLAPING


4.PROCESSED IMAGE

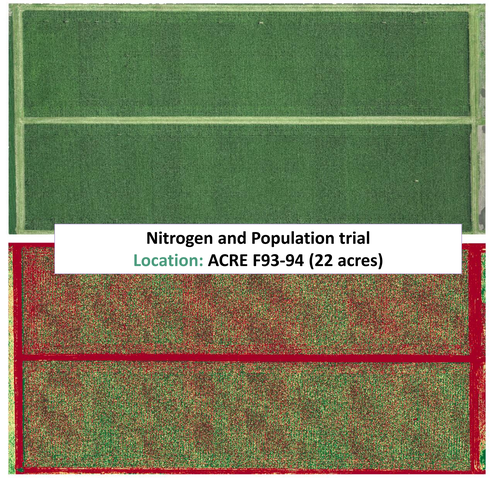
Sulfur trial (60 acres)
Location: On-farm trial, Shelby Co, Indiana

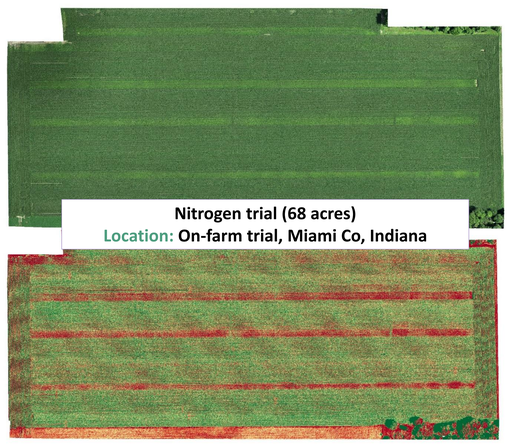
ONE FREQUENT CHALLENGE IN INDIANA: CLOUDS


Nitrogen trial (47 acres)
Location: On-farm trial, Benton Co, Indiana

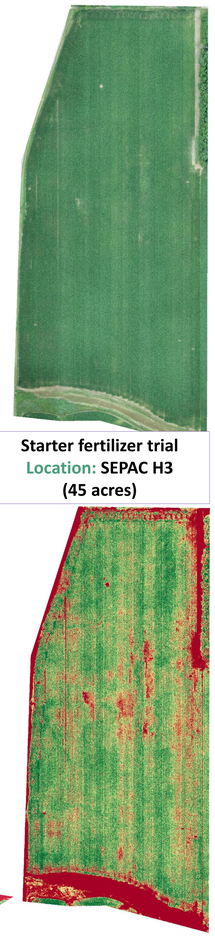


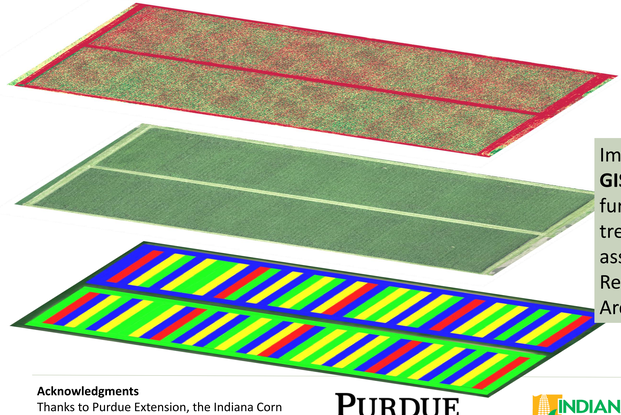
PICTURES ARE WORTH A THOUSAND WORDS…


Nitrogen and Population trial
Location: ACRE F93-94 (22 acres)


Nitrogen trial (68 acres)
Location: On-farm trial, Miami Co, Indiana

Vegetative indices, like NDVI or VARI, can be calculated either with digital numbers provided by images or reflectance data, which is obtained after processing the images.


Starter fertilizer trial
Location: SEPAC H3
(45 acres)



Images can be used as **GIS data layers** to further analyze treatment effects or assess spatial variability. Requires software like ArcGIS or QGIS.

Acknowledgments
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