

Enhancing the Value of Precision Ag Data with Unmanned Aerial Systems (UASs)

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Unmanned Aerial Systems (UASs)

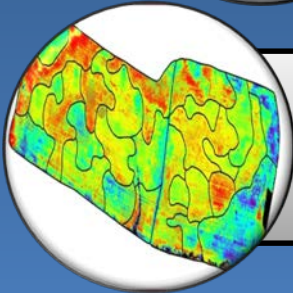


Current FAA Regulations



UASs

UAV, cameras, communications, auto-pilot



Applications

Current FAA Regulatory Environment

- Public UASs can fly under a Certificate of Authorization (COA).
 - Government entities at the Federal & State levels
 - Universities
 - Law Enforcement
 - Fish and Wildlife
 - NRCS
 - USGS
 - UAS that meets the qualifications and conditions required for operation of a public aircraft.
 - Private companies can partner with Government entities to fly under the entity's COA



Current FAA Regulatory Environment

- No commercial UAS activity is currently authorized outside of the Arctic.
 - Commercial UAS flights have met with cease and desist letters & civil fines

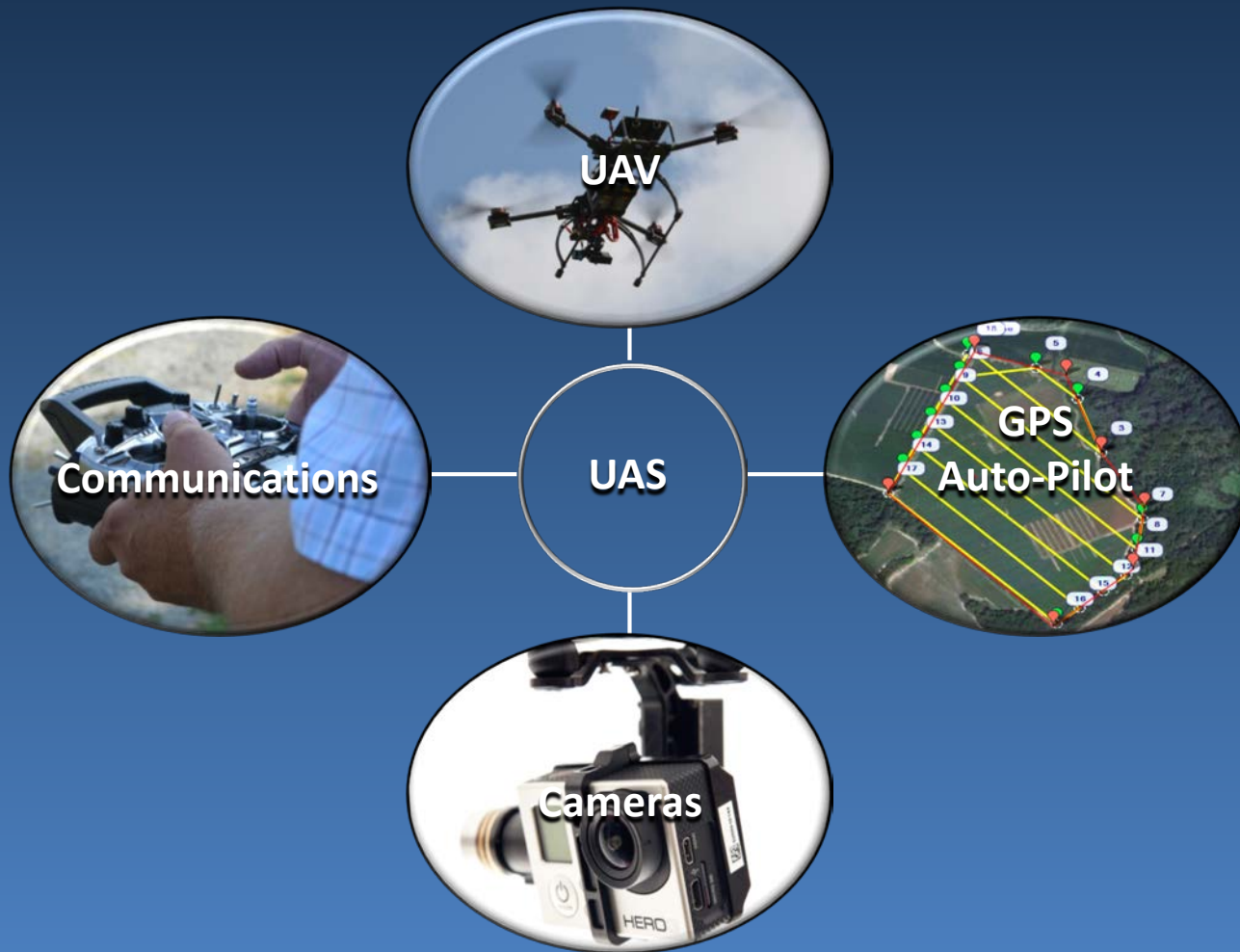
Hobby or Recreation	Not Hobby or Recreation
Flying a model aircraft at the local model aircraft club	Receiving money for demonstrating aerobatics with a model aircraft
Taking photographs with a model aircraft for personal use	A realtor using a model aircraft to photograph a property that he/she is trying to sell and publishing the photos in a real estate listing
Using a model aircraft to move a box from point to point without any kind of compensation	Delivering packages to people for a fee
Viewing a field to determine whether crops need water when they are grown for enjoyment	Determining whether crops need to be watered that are grown as part of a commercial farming operation

Current FAA Regulatory Environment

- Section 333 - Regulatory Exemptions that would allow UAS to operate commercially with FAA approval before an UASs rule is adopted.
 - Industries that have sought exemptions
 - ✓ Motion Pictures (MPPA) - Granted September 25th 2014
 - ✓ **Precision agriculture**
 - ✓ Electric power line and pipeline inspection
 - ✓ Oil and gas flare stack inspection

FAA mandated to develop a 5 year roadmap for “safe integration” of UASs by September 30, 2015.

Unmanned Aerial Systems (UASs)



Unmanned Aerial Vehicles (UAVs)

Multicopter UASs



AgriEye

- Vertical takeoff and landings
- Ability to hover
- Limited flight time
- Difficult to fly if not fully automated
- Requires fully automated flight features for full usability

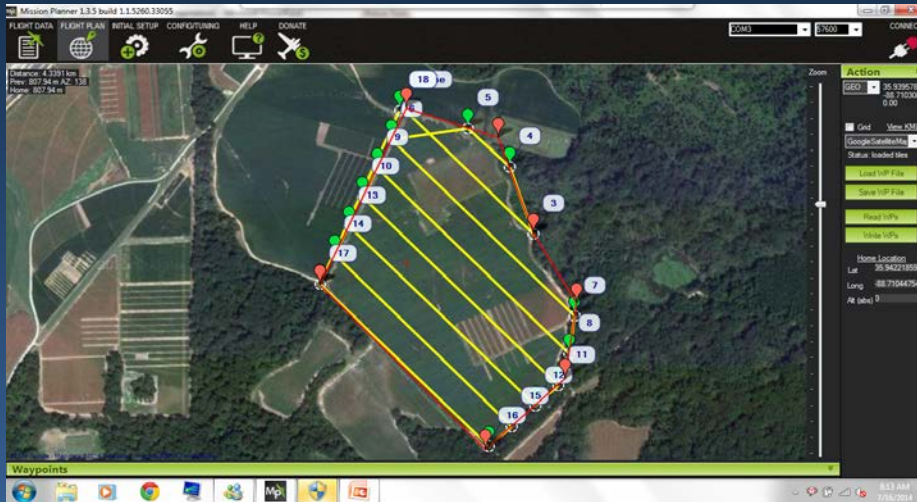


senseFly

Fixed-Wing UASs

- Hand/catapult launched
- Longer flight time, can cover a lot of area
- Difficult to fly if not fully automated
- Requires fully automated flight features for full usability
- Minimal maintenance, modest expenses

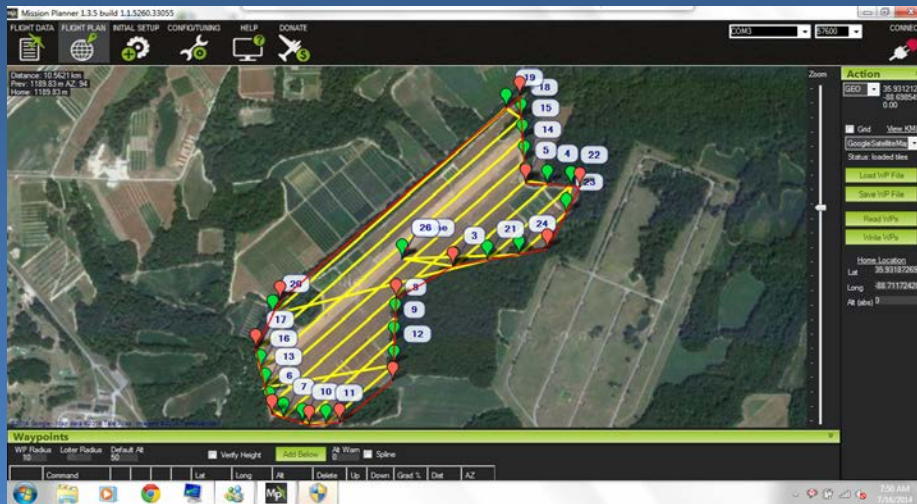
Flight Coverage



Field Size: \approx 40 acres

Flight Speed: \approx 16 ft/sec

Flight Time: 18 minutes



Field Size: \approx 92 acres

Flight Speed: \approx 16 ft/sec

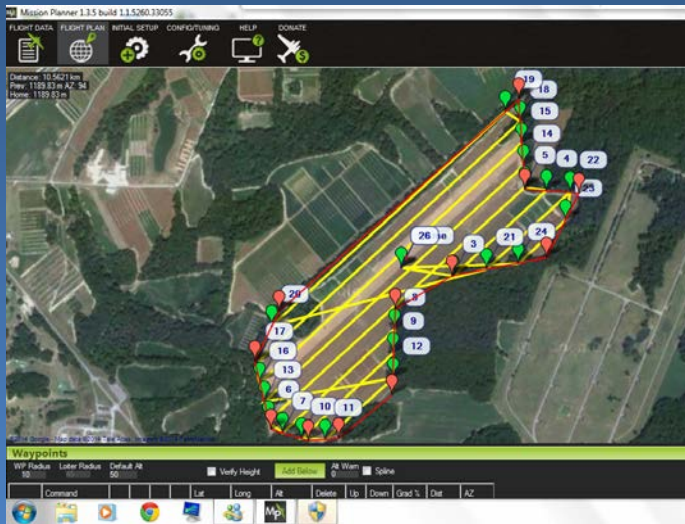
Flight Time: \approx 42 minute

Battery Technology is Evolving

Communications



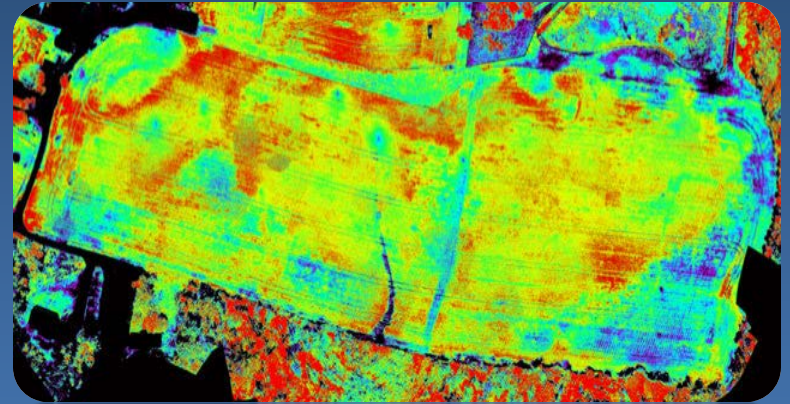
GPS/Autopilot



Cameras

UASs are a Platform to Collect Precision Ag Data

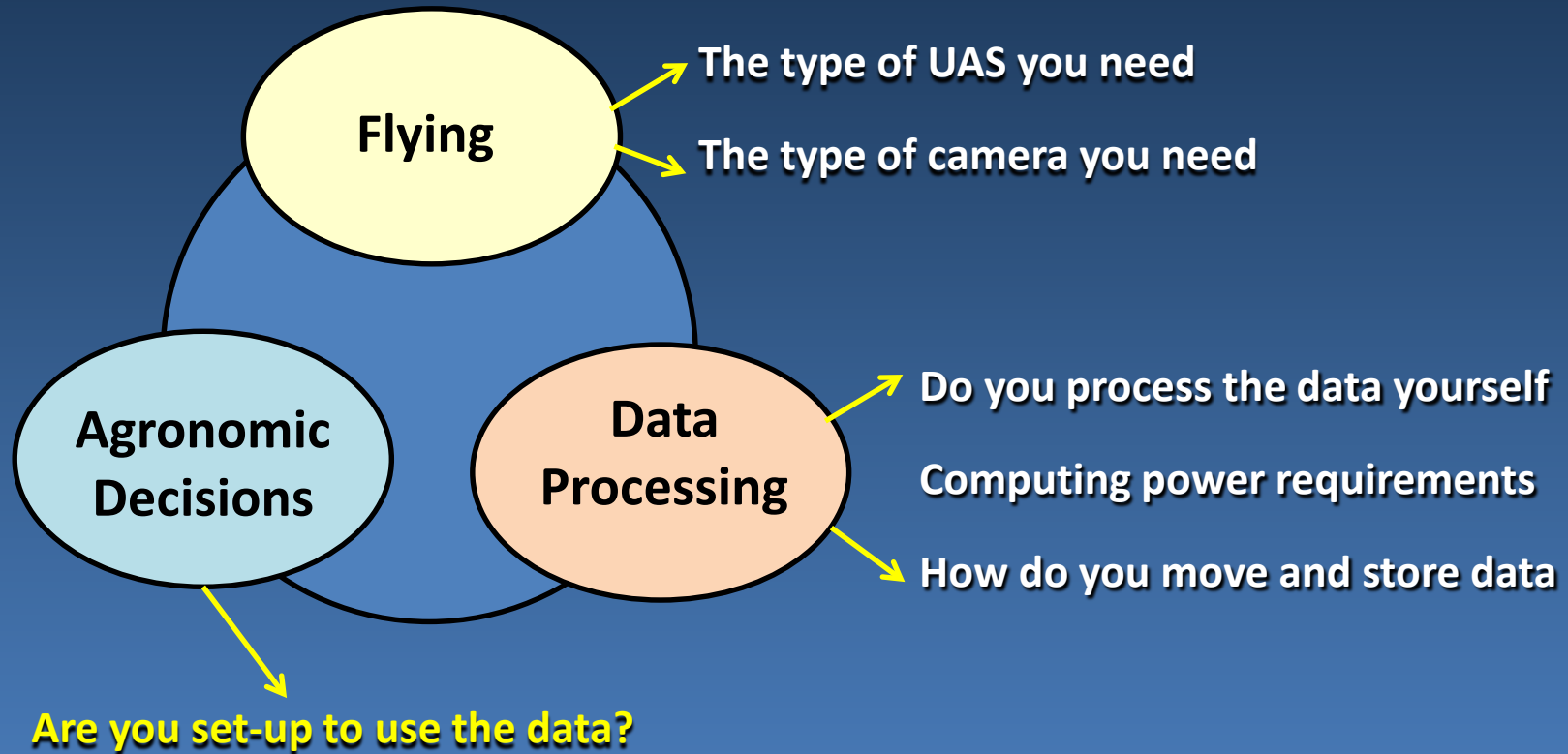
- Video - Get live video feed on monitor, laptop or tablet
- R, G, B Cameras (Red, Green and Blue)
- Multispectral Cameras (R, G, B, NIR)
- Hyperspectral Imaging Cameras
- Thermal Imaging Cameras
- Lidar (Elevation)



Camera Technology is Rapidly Evolving!

Integrating UASs in Your Farming Operation

What are you hoping to do with the data?



Directed Scouting

Gives you a bird's eye view

➤ **Equipment**

- UASs – Rotary-Wing
- GPS/Autopilot
- GoPro video camera
- Gimbal camera mount
- Ability to live stream video to the ground
- Monitor, laptop, tablet or smartphone



Directed Scouting

➤ Directed Scouting

- Diseases
- Insects
- Weeds
- Crop Progress
- Crop Stress

Diseases



Crop Progress



Weeds



Video: GoPro Camera



Mapping

➤ Equipment

- UAS – Fixed-Wing or Multicopter
- GPS/Autopilot
- Camera
- Laptop, tablet
- Internet access



Altavian
NOVA F6500



Precision Drone
Precision Scout



AgriEye

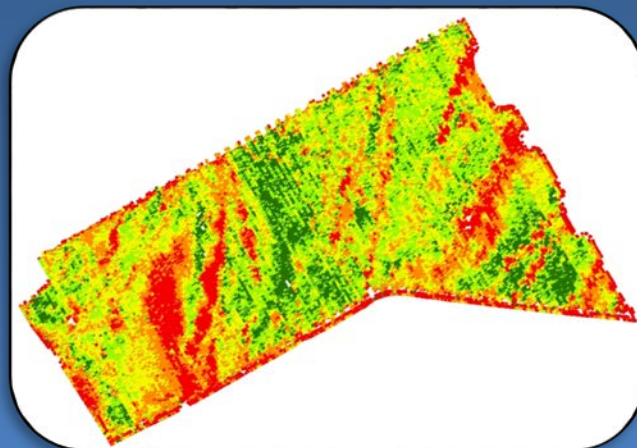


Trimble
UX5

Integrating UASs in Your Farming Operation

➤ Mapping

- Replanting Decisions
- Drainage Issues
- Crop Insurance Claims
- VRA Crop Inputs
- Yield Estimation
- Soil/Vegetation Moisture Monitoring

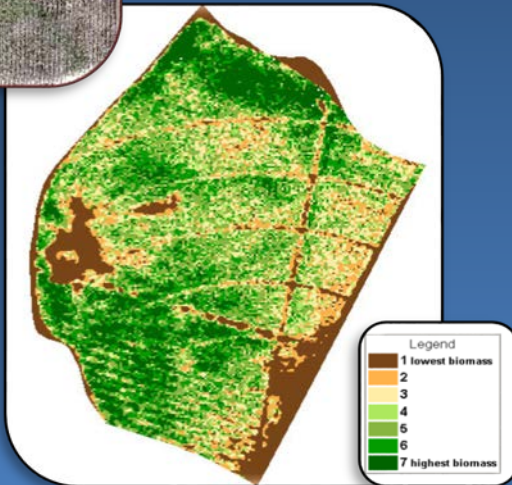


Mapping

Variable Rate Application of Crop Inputs

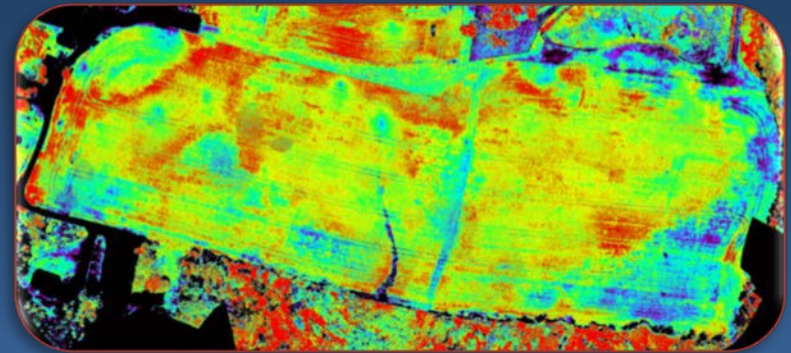


Vegetative Indices



PGRs and Defoliants

Zone Management



Fertilizer, Varieties, Seeding Rate

Factors Influencing the Data

- Sunlight Intensity
- Sun Angle
- Time of Day

The Technology is Evolving!

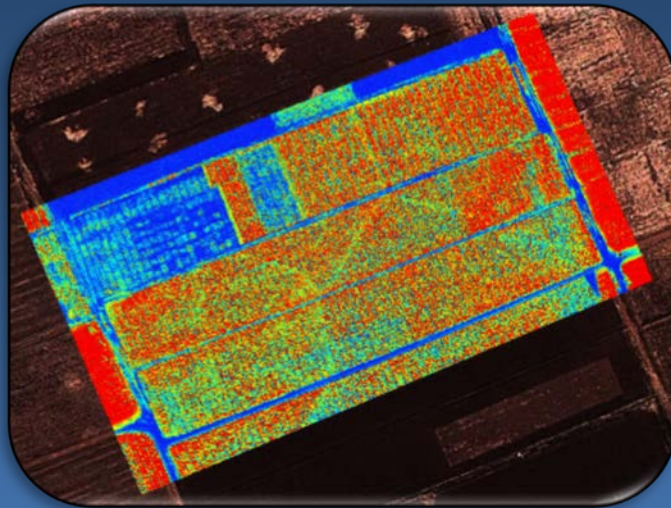
Mapping

Plant Health Monitoring

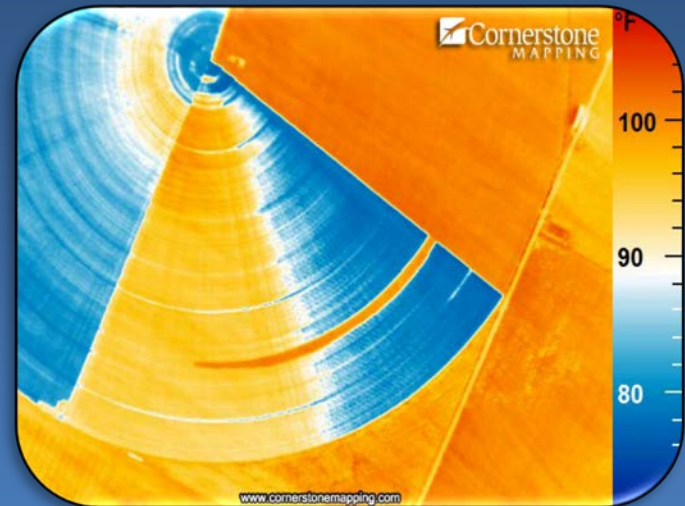
Stressed Plants Have Higher Leaf Temperatures

Factors Influencing the Data

- Cloud cover
- Wind



ROBOFLIGHT



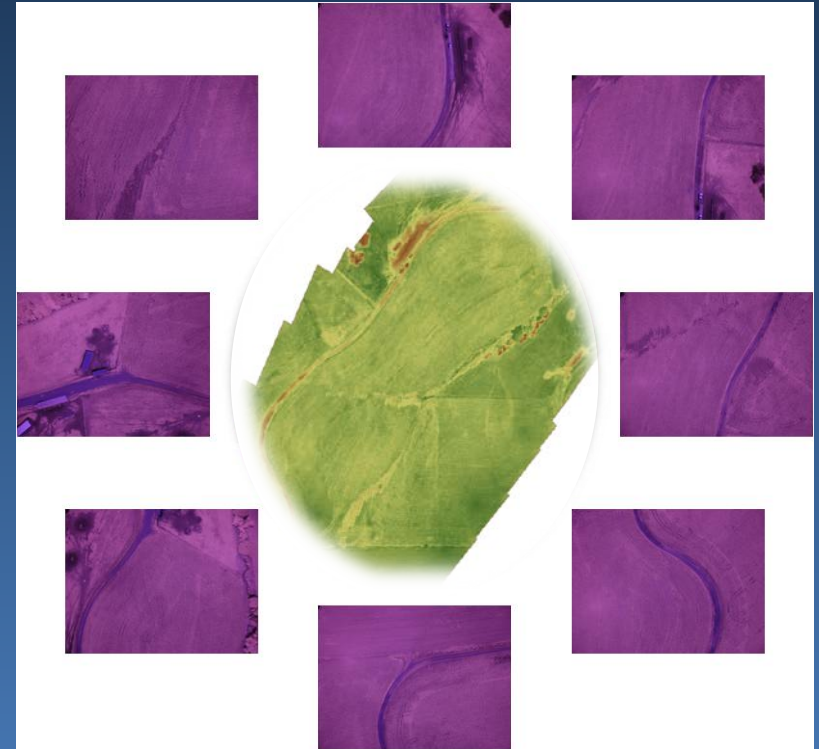
Cornerstone Mapping

The Technology is Evolving!

Processing the Data

Mapping Requires

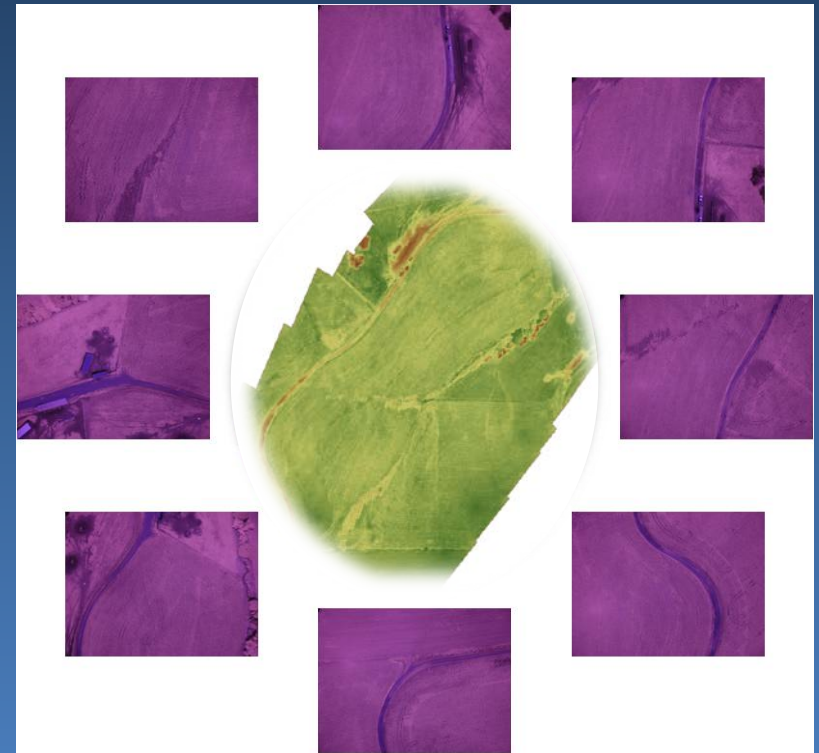
- Stitching pictures together
- Orthorectifying the image
- Georeferencing the image
- Process the data
- Generate a useable map



Processing the Data

You Process the Data

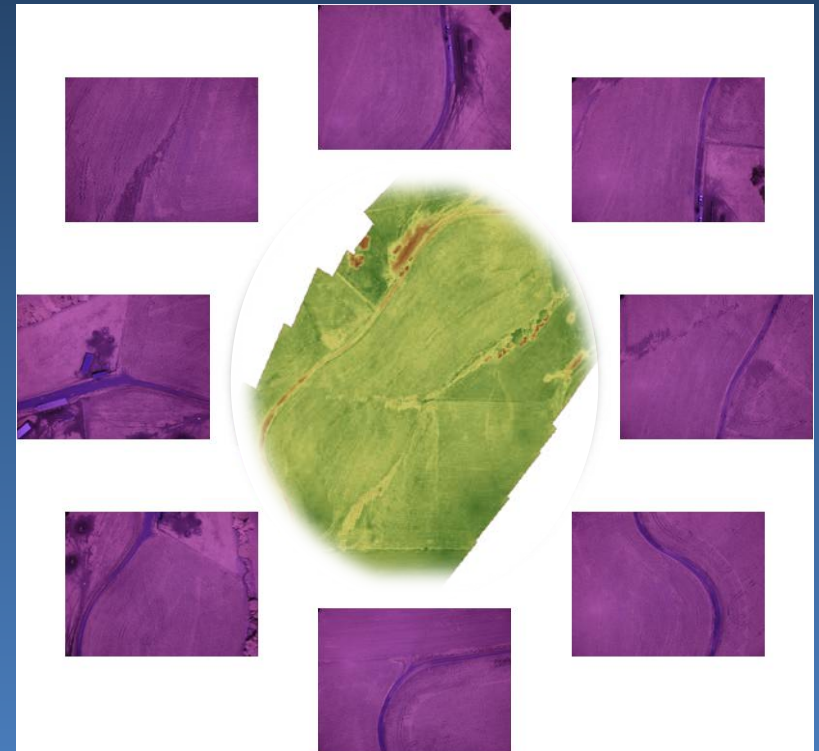
- Open source software (VisualSFM & CMVS)
 - Free!
- Agisoft Photoscan Pro
 - ~\$3500
- Pix4D
 - Rent or..
 - ~\$8500
- Vendor Supplied Software
 - Included in the price of the UASs



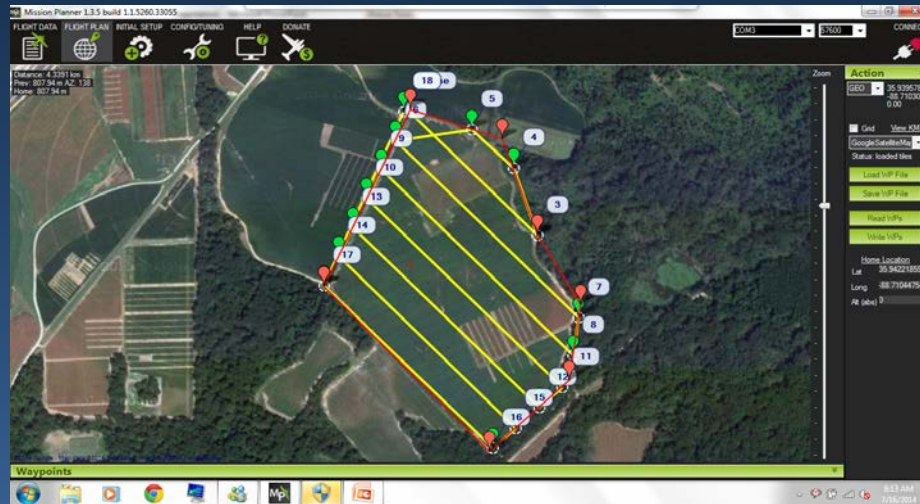
Processing the Data

Third Party Vendors

- **Dronemapper** dronemapper.com/
 - 1 sq. mi. ~ \$60
 - (high res. \$180)
- **ROBOFLIGHT** roboflight.com/
 - AgPixel
 - ~\$500/year
- **New Startup Companies**



Flight Coverage



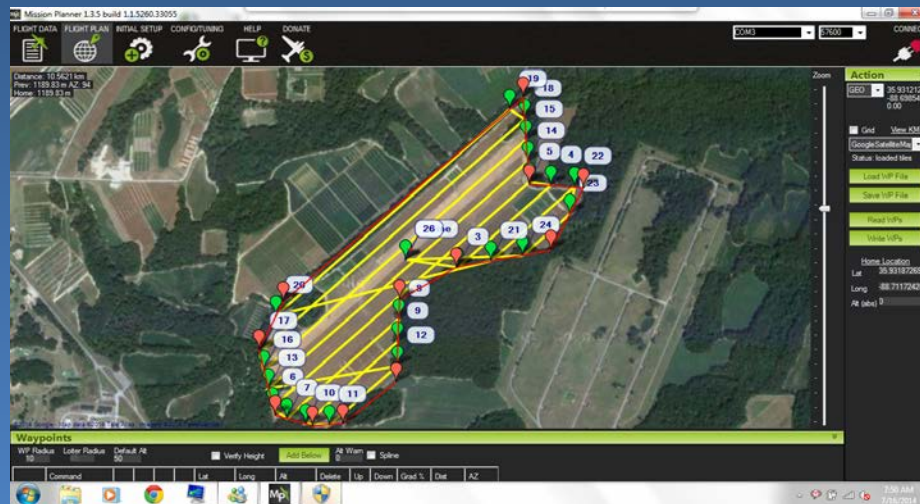
Field Size: \approx 40 acres

Flight Speed: \approx 16 ft/sec

Flight Time: 18 minutes

Number of Pictures: 37

File Size: \approx 111 MB



Field Size: \approx 92 acres

Flight Speed: \approx 16 ft/sec

Flight Time: \approx 42 minutes

Number of Pictures: 152

File Size: \approx 450 MB

Processing the Data

Questions to Think About

- **Moving data around**
 - What kind of internet speed do you have
 - Consumer grade internets are built for download not upload
 - Companies may throttle your internet with too much use



The Industry is Evolving!

Take Home Message

- UASs have the potential to make your farming operation more sustainable
- Know what you want to do with a UAS before buying one
- Directed scouting is the easiest application
- Mapping brings about data processing challenges
- Potential for inaccurate data without proper data capture and processing
- While UASs maybe fun to fly, don't consider them toys