

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

Mike Buschermohle
Precision Ag Specialist
UT Extension



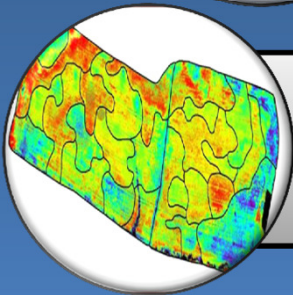
Unmanned Aerial Systems (UASs)



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 UASs activity is currently authorized outside of the Arctic.
 - Commercial UAS flights have met with cease and desist letters & civil fines

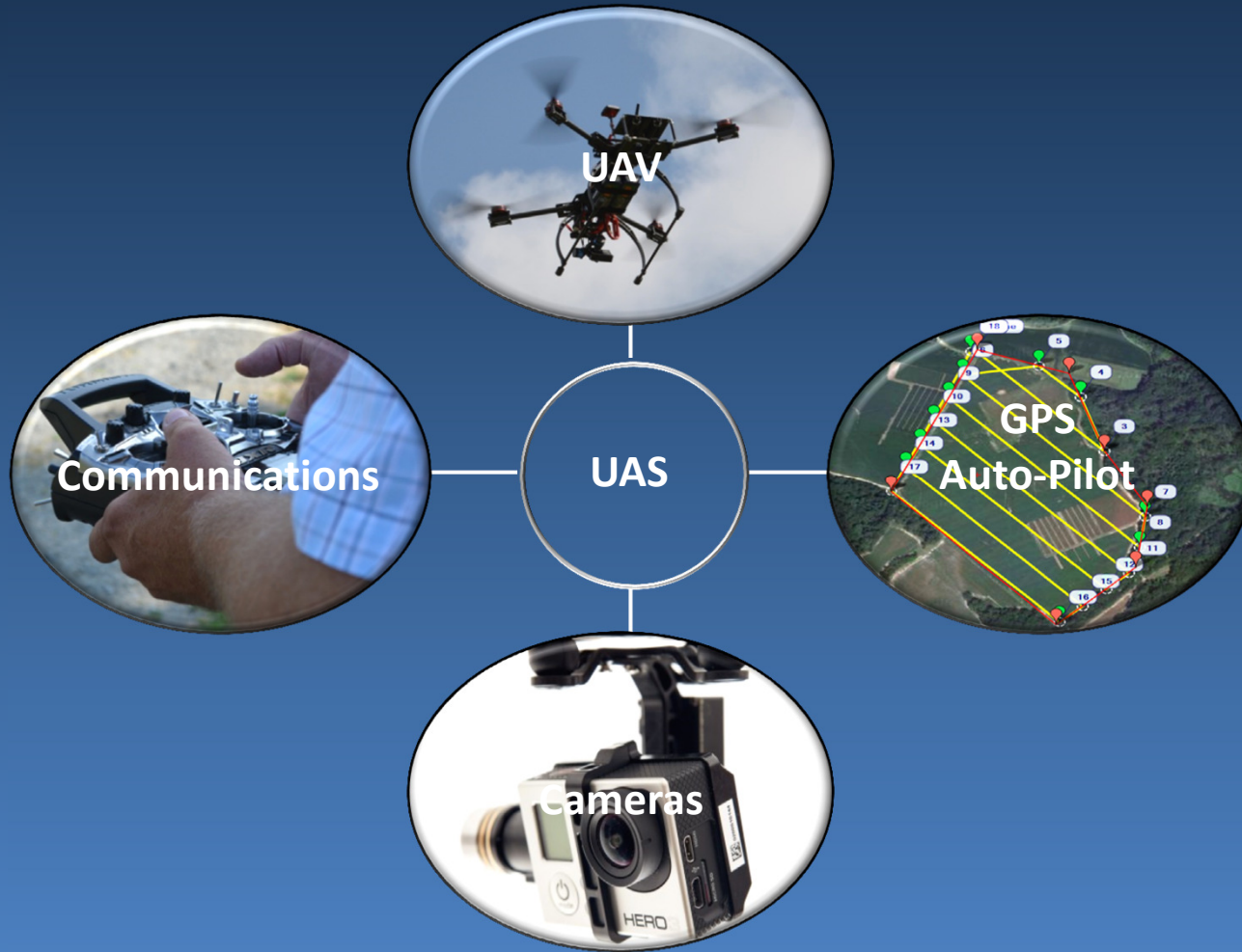
Hobby or Recreation	Not Hobby or Recreation
Flying a model aircraft at the local model aircraft club	Receiving money for demonstrating aerobatics with a model aircraft
Taking photographs with a model aircraft for personal use	A realtor using a model aircraft to photograph a property that he/she is trying 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)



AgriEye

Multicopter UASs

- 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

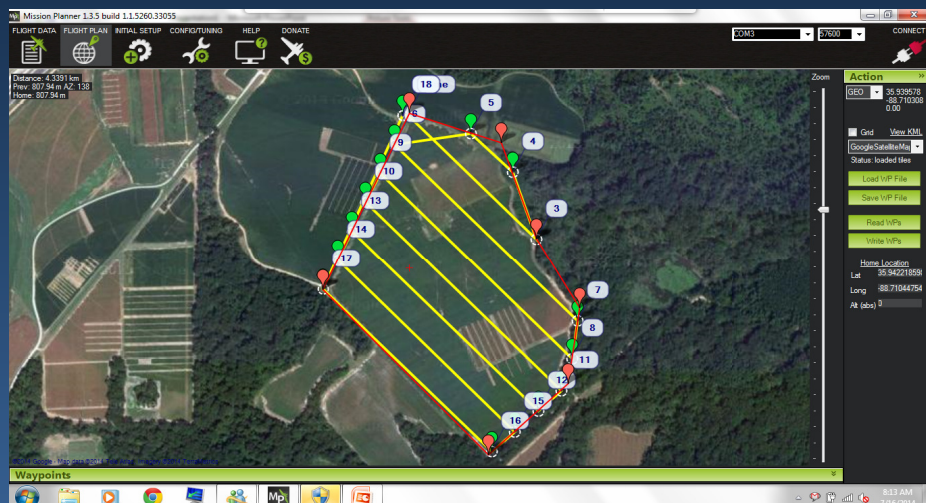


senseFly

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

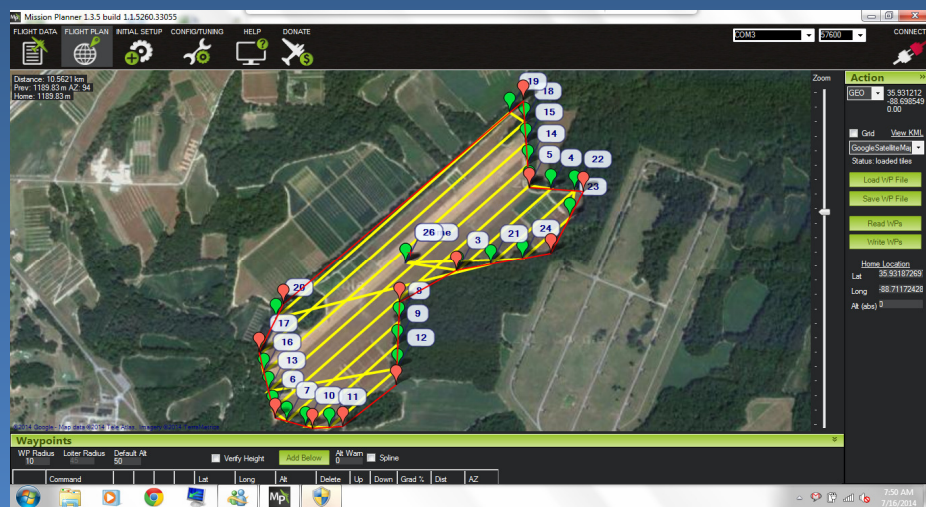
Flight Coverage



Field Size: \approx 40 acres

Flight Speed: \approx 16 ft/sec

Flight Time: 18 minutes



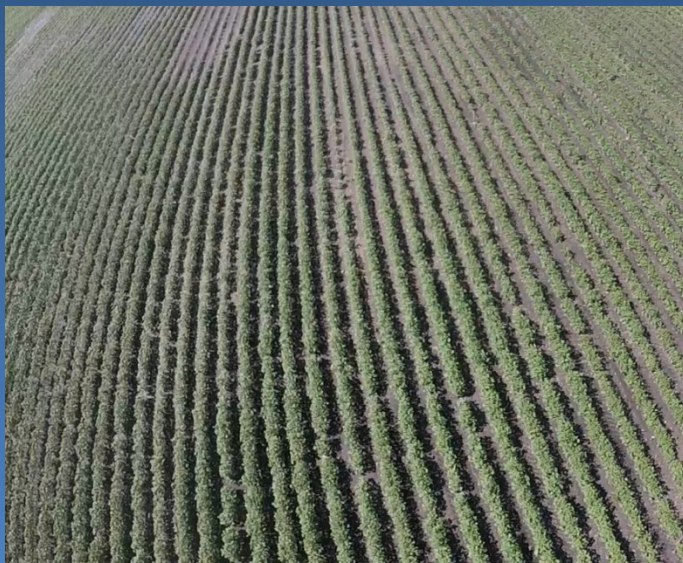
Field Size: \approx 92 acres

Flight Speed: \approx 16 ft/sec

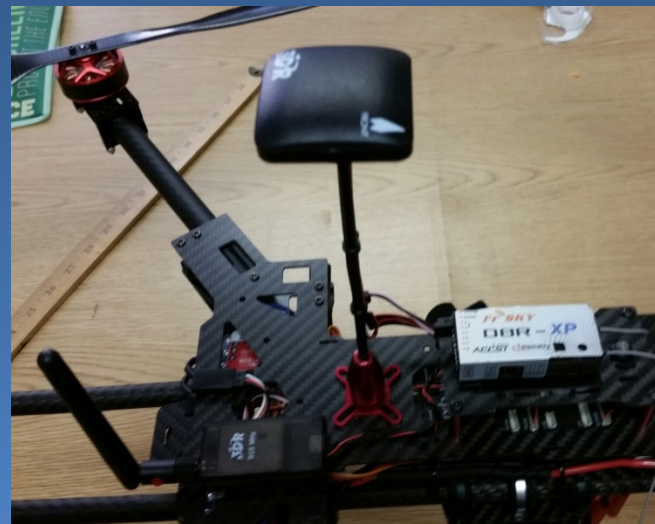
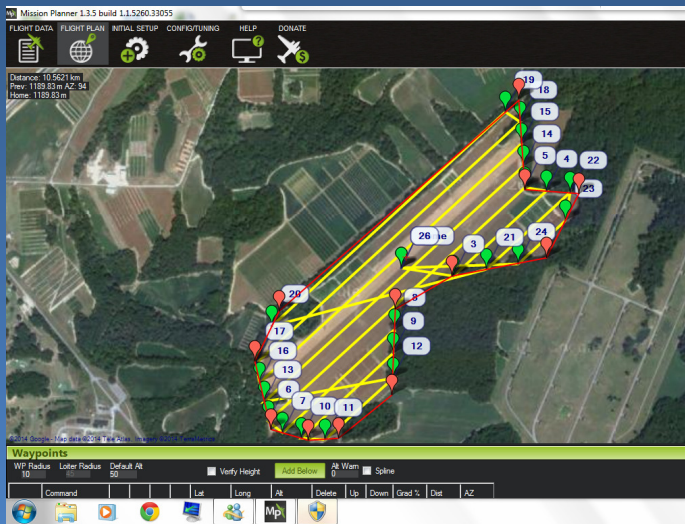
Flight Time: \approx 42 minute

Battery Technology is Evolving

Communications



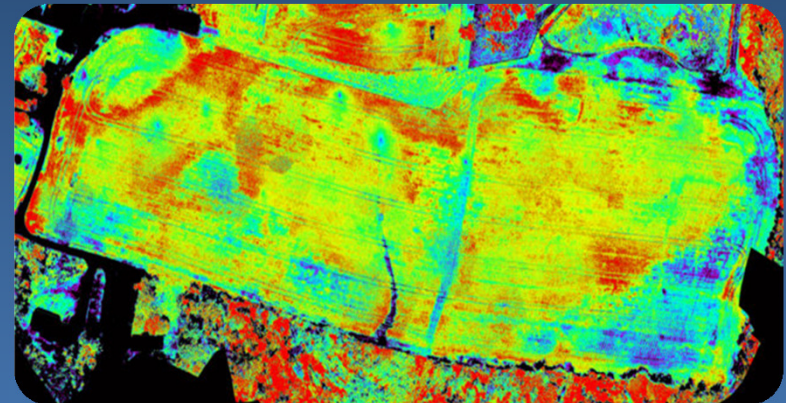
GPS/Autopilot



Cameras

UASs are a Platform to Collect Precision Ag Data

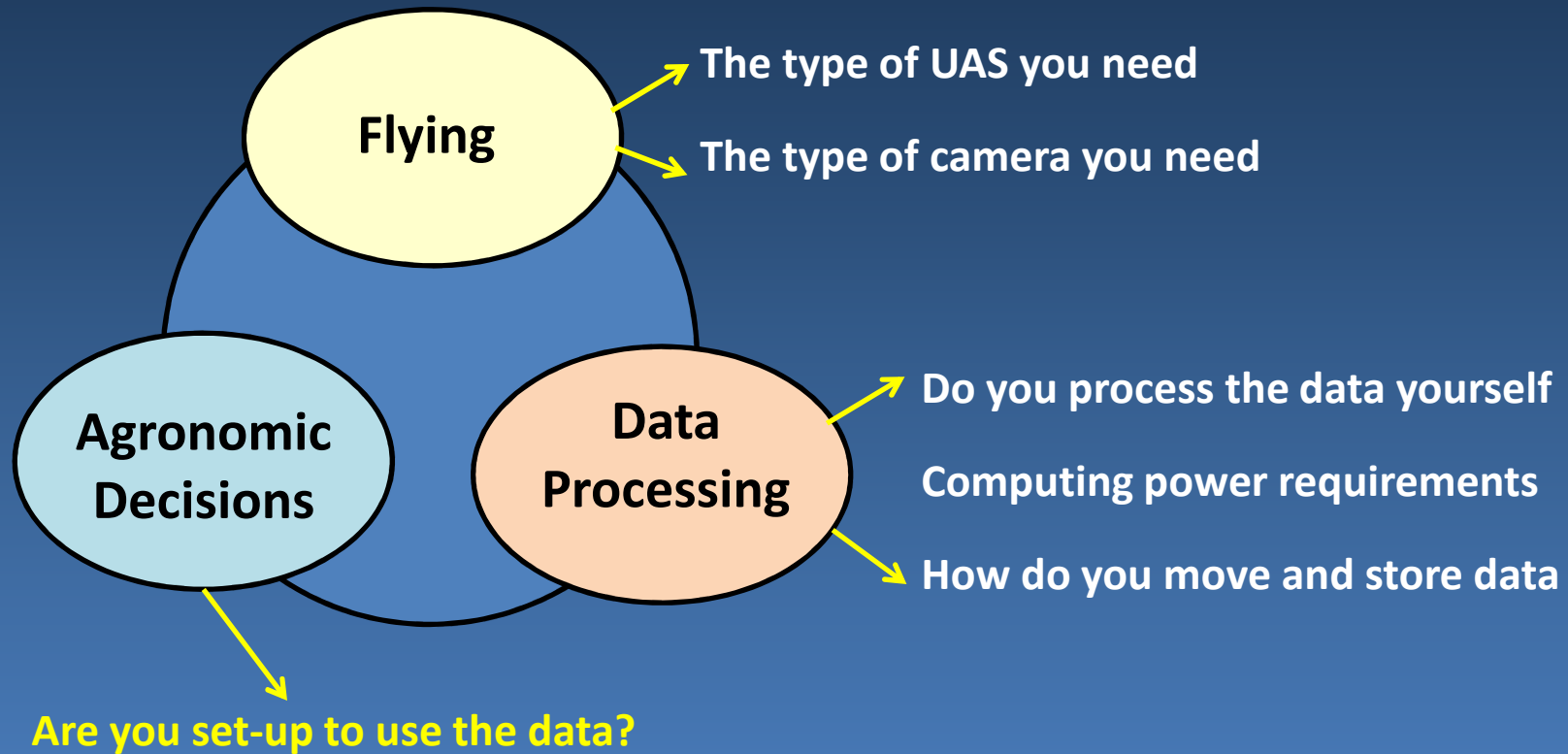
- Video - Get live video feed on monitor, laptop or tablet
- R, G, B Cameras (Red, Green and Blue)
- Multispectral Cameras (R, G, B, NIR)
- Hyperspectral Imaging Cameras
- Thermal Imaging Cameras
- Lidar (Elevation)



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



Mapping

➤ Equipment

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



Altavian
NOVA F6500



Precision Drone
Precision Scout



AgriEye

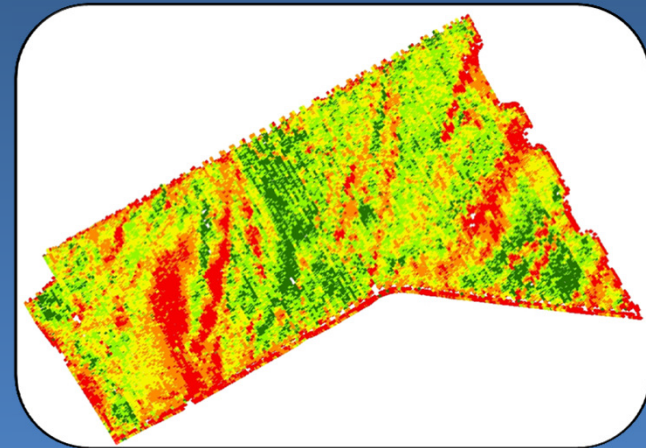


Trimble
UX5

Integrating UASs in Your Farming Operation

➤ Mapping

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

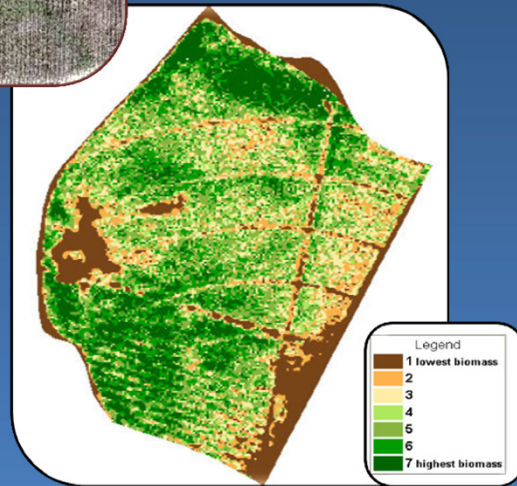


Mapping

Variable Rate Application of Crop Inputs

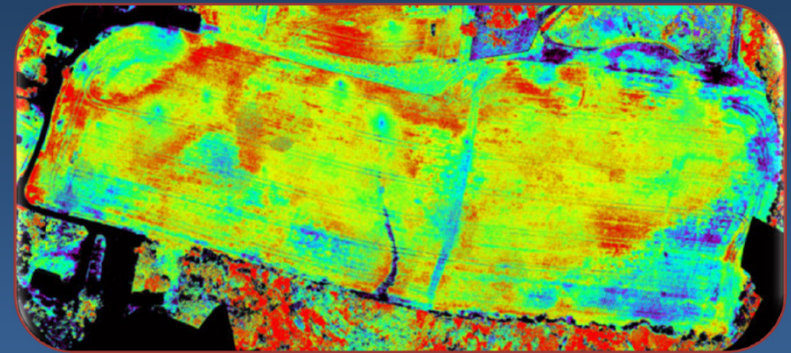


Vegetative Indices



PGRs and Defoliants

Zone Management



Fertilizer, Varieties, Seeding Rate

Factors Influencing the Data

- Sunlight Intensity
- Sun Angle
- Time of Day

The Technology is Evolving!

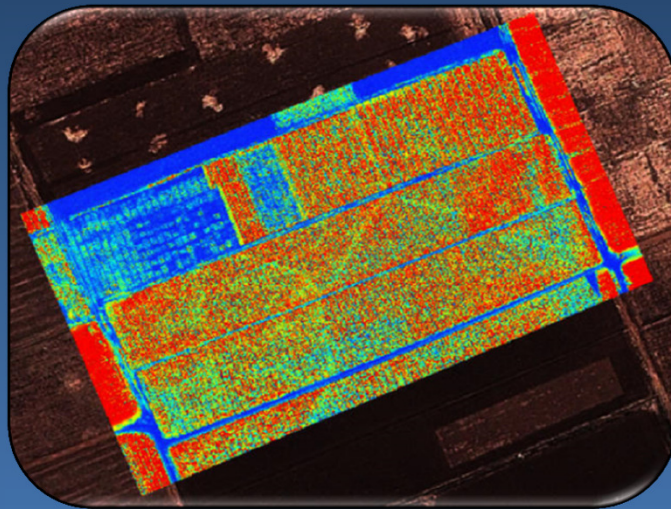
Mapping

Plant Health Monitoring

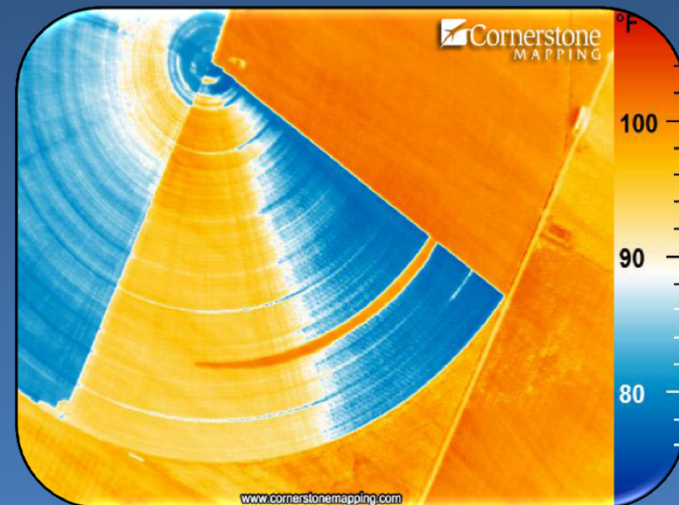
Stressed Plants Have Higher Leaf Temperatures

Factors Influencing the Data

- Cloud cover
- Wind



ROBOFLIGHT



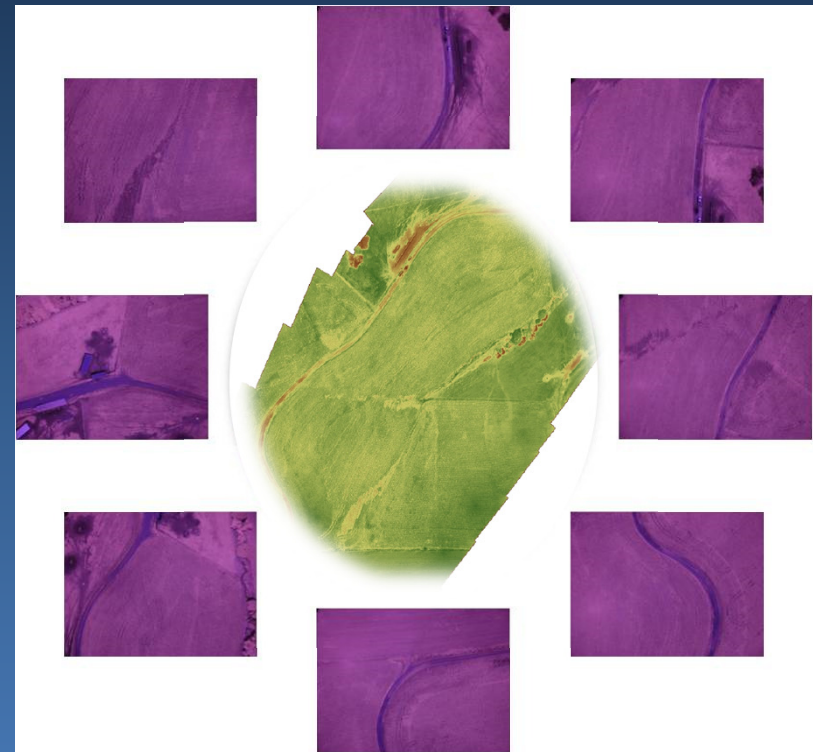
Cornerstone Mapping

The Technology is Evolving!

Processing the Data

Mapping Requires

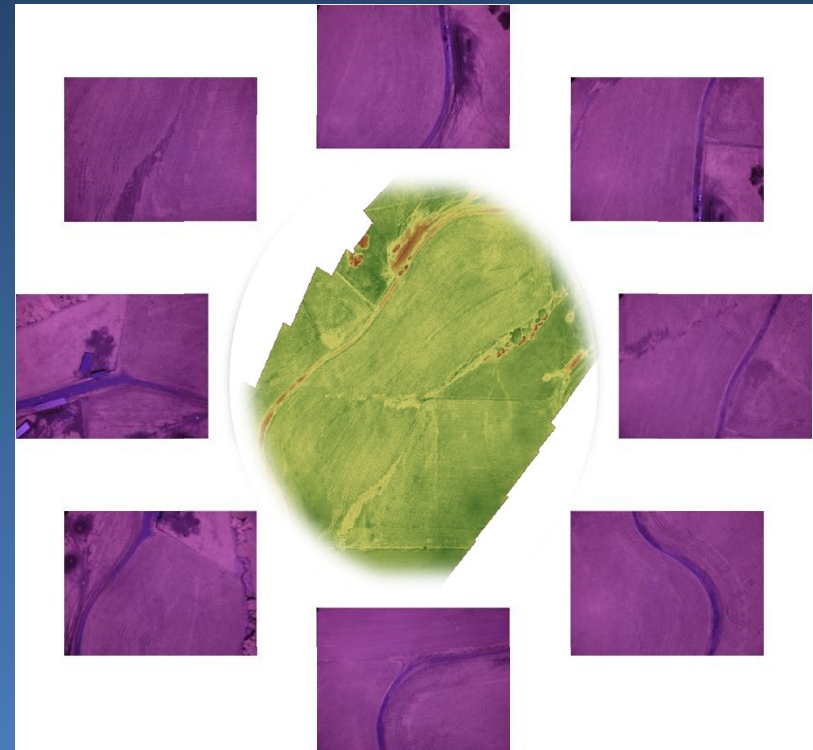
- Stitching pictures together
- Orthorectifying the image
- Georeferencing the image
- Process the data
- Generate a useable map



Processing the Data

You Process the Data

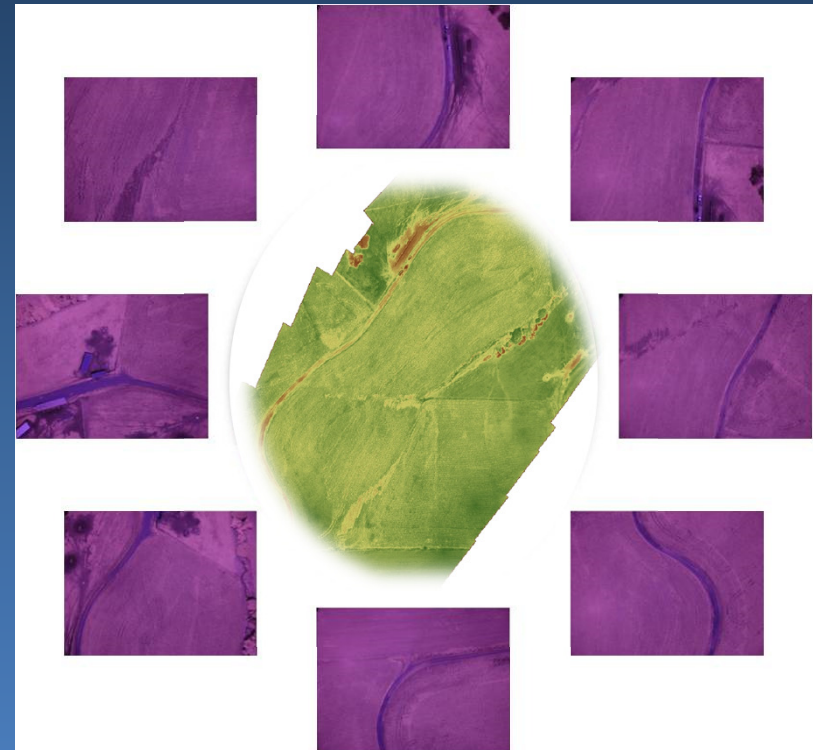
- Open source software (VisualSFM & CMVS)
 - Free!
- Agisoft Photoscan Pro
 - ~\$3500
- Pix4D
 - Rent or..
 - ~\$8500
- Vendor Supplied Software
 - Included in the price of the UASs



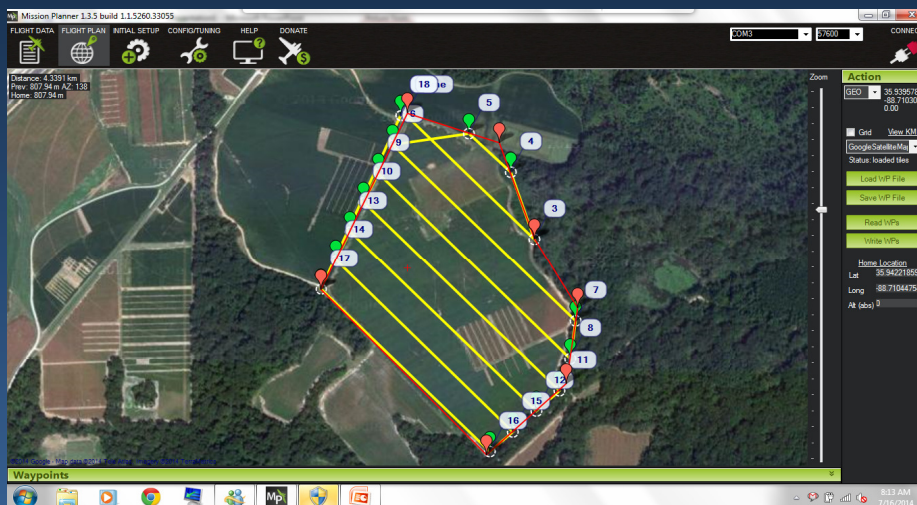
Processing the Data

Third Party Vendors

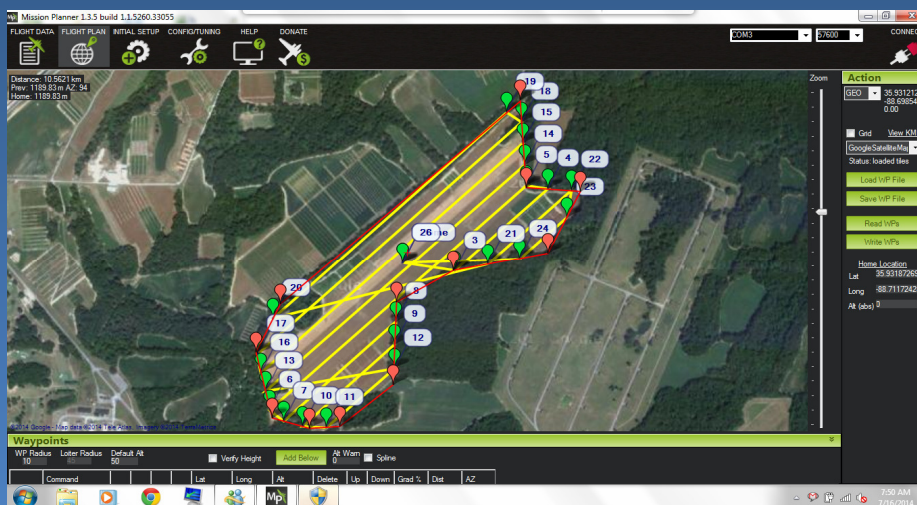
- **Dronemapper** dronemapper.com/
 - 1 sq. mi. ~ \$60
 - (high res. \$180)
- **ROBOFLIGHT** roboflight.com/
 - AgPixel
 - ~\$500/year
- **New Startup Companies**



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



Questions



UF Extension
PRECISION AG

