

UAV Technologies for Louisiana Agriculture

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Summary

- Definition of UAV's
- Current FAA rules
- Typical Manufacturers
- What's available
 - Different sizes, etc.
- Some that we have been using
- Typical data you can get with units

Different Names:

- Drones
- UAV - Unmanned aerial vehicles
- Name listed by FAA and AUAVS society
 - UAS – Unmanned Aerial Systems
 - Includes flying platform and all related equipment to support system (video downlink, FPV – first person flying, etc.)

UAS Economic Potential

- AUVSI's Recently Released Economic Impact Report:
 - The UAS global market is currently more than **\$11 billion** and will total almost **\$140 billion** over the next 10 years.
 - The economic impact of UAS airspace integration will total over **\$13.6 billion** in the first three years and will grow sustainably for the foreseeable future, cumulating to over **\$82.1 billion** between 2015 and 2025.
 - **Precision agriculture** will total **approximately 80%** of the known potential commercial markets for UAS.



Uses in Farming:

- Overhead Images of Field or Crop by Consultants
- Irrigation Monitoring:
 - Far field monitoring, etc.
 - Check pivots
- Spot Spraying and detection of bugs, insects, and weeds



Uses in Shipping:

- Movement of letters and light weight cargo around cities
- Fly cargo planes across oceans and other open expanses of land
- Construction site surveying
- Etc.

UAV – 0.3 KWh



Person– 1.4 KWh in gasoline not including elevator weight movements

Current FAA Rules:

- Currently for research and non commercial use only
 - Should get a license - currently only for research units
- Max 400 feet flying height and maintain line of site
- Do not fly within 5 miles of airports
- FAA will try to have full rules in 2015
- Concern over upcoming rules:
 - Make it hard for individual to get a license

Different Systems:

- Multi-rotor copters:
 - In Place Take off and Landing
 - Slower speeds than others 27-30 MPH
 - Batteries only - last about 10 to 20 minutes
- Regular helicopters
 - Faster speeds, longer flight time
 - Can be gas powered
 - Flight time: 30 minutes to several hours
- RC Airplanes
 - Longer flight times: 30 minutes to 40 minutes
 - Faster speeds (50 to 70 MPH)
 - Need a take off and landing area
 - Some built to “stall” landing without damage



Copters We Have:

- Quadcopters (4 blades)
- Hexcopter (6 blades)
- Tri-copters (3 blades)

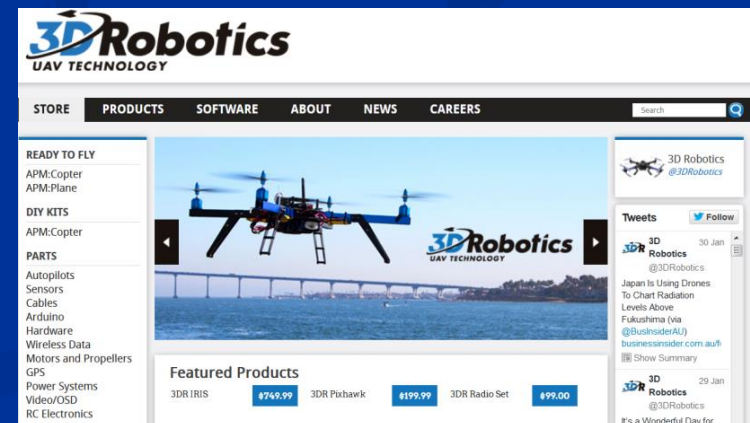
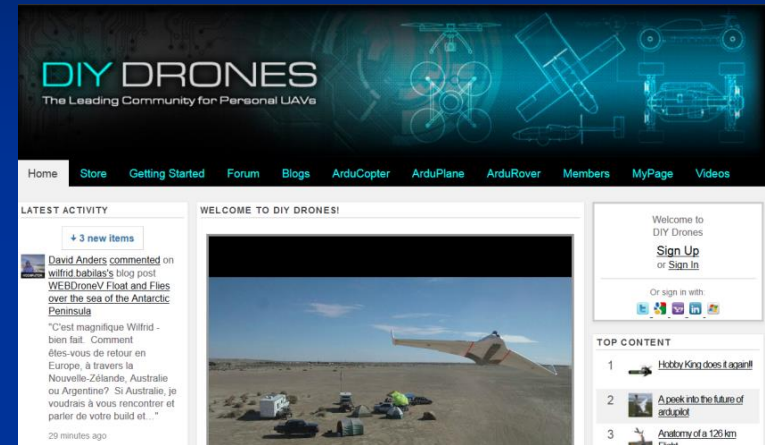




DIY Drones:

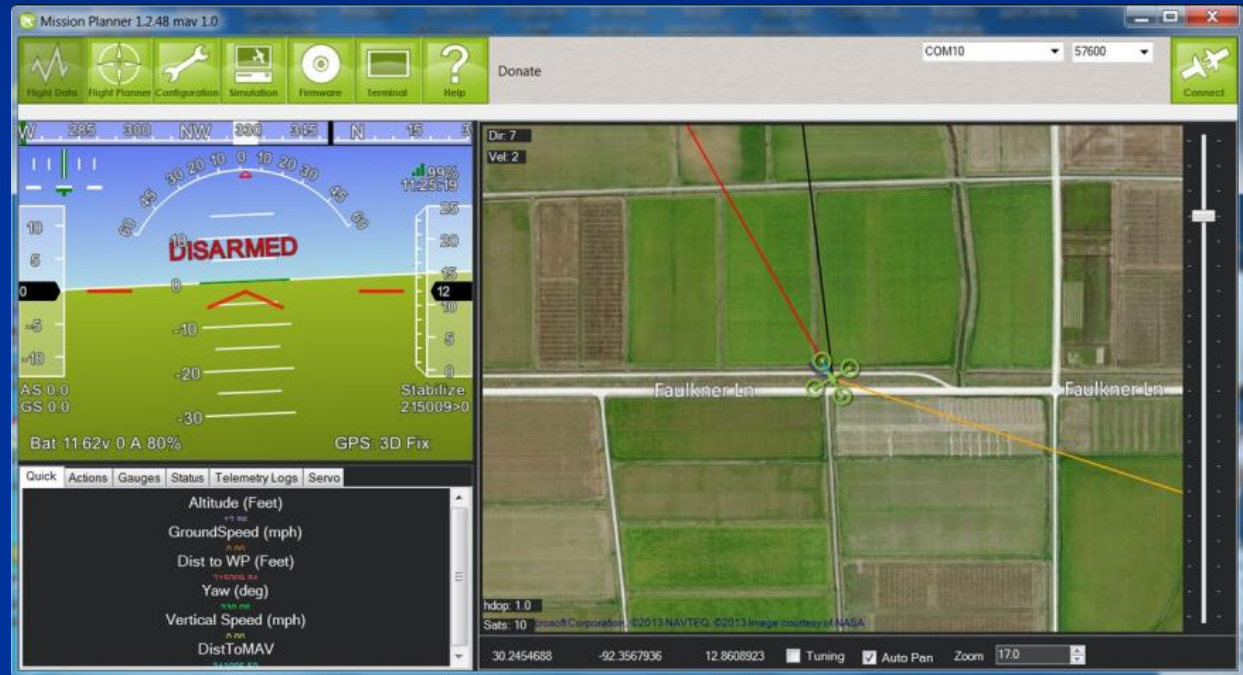


- Free Software
- Purchase the electronics board
 - 3-D robotics (America)
 - RCTIMER (China)
- Works very well
- For planes, helicopters, multi-rotors, boats
- Fully stabilized flight, fully autonomous options from take off to landing
- Up to 500 waypoints
- Inexpensive:
 - \$250.00 for flight system
 - Frame: \$300 to \$1000
 - Camera: \$300 to \$1000



Mission Planner – DIY Drones

- Free
- Available on the iPhone, Android systems



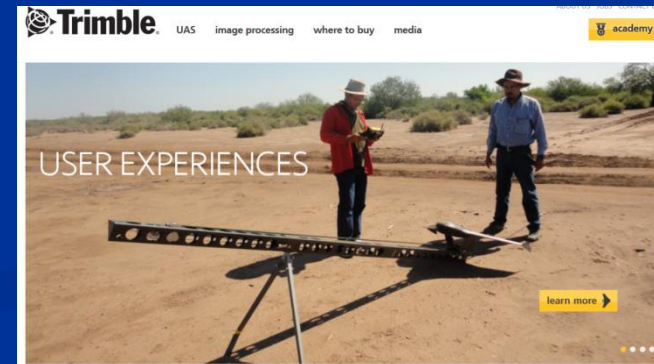
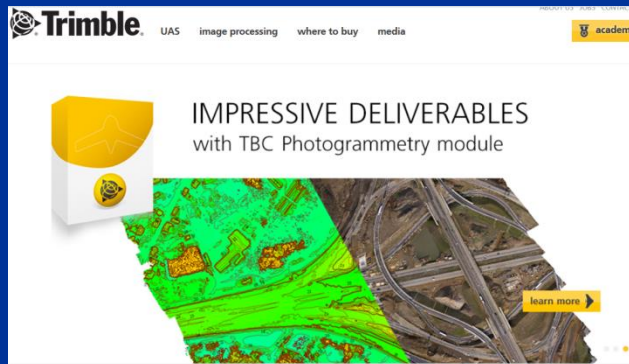
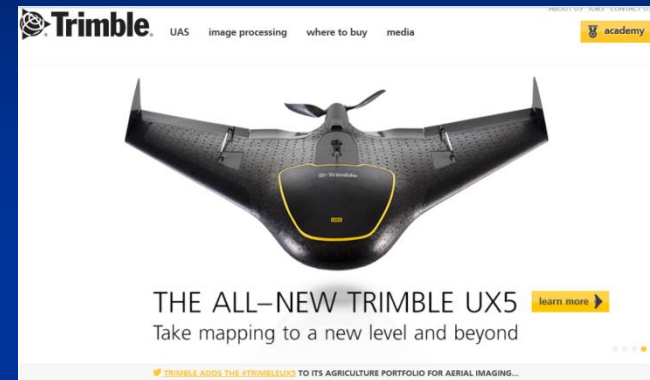
Other Manufactures - DJI Drones

- Phantom:
- Top Speed: 21 MPH
- Phantom 2 Vision:
 - Built-in camera
 - Wireless FPV for 900 ft.
 - Position hold
 - Price: \$1,000



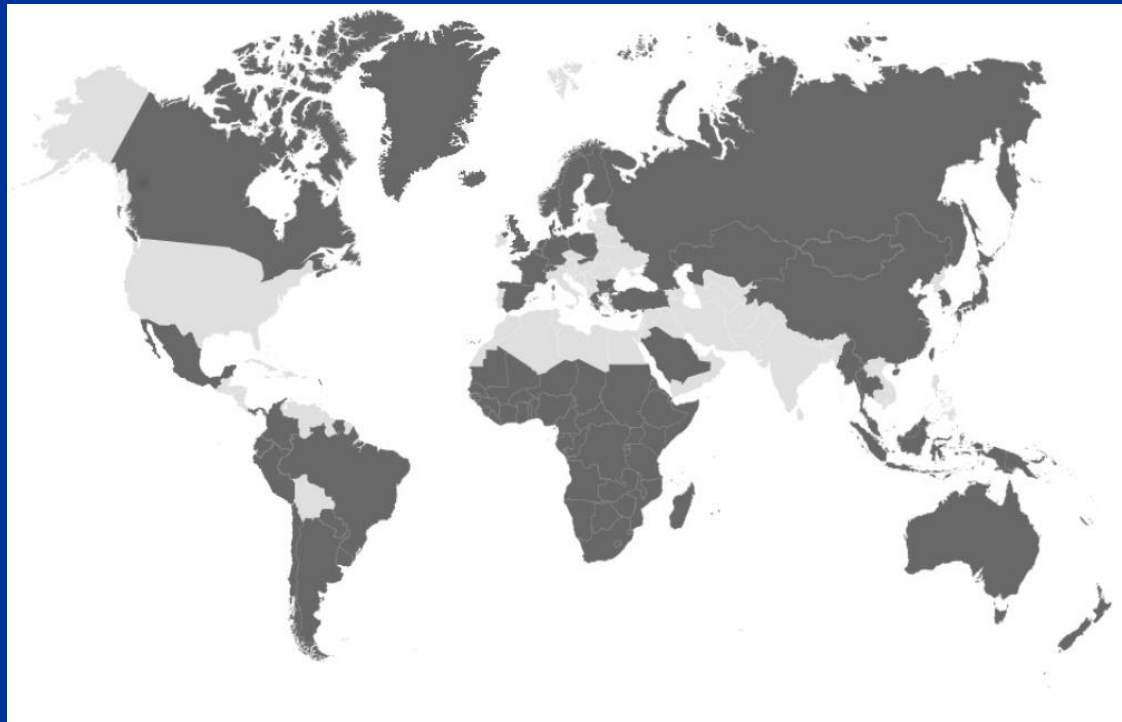
Trimble Unit:

- UX5:
 - Airplane type
- High-end digital 35 mm camera
- Software:
 - Trimble Business Center (TBC) photogrammetry module
- Uses a Yuma for ground control
- Sold in many other countries, but not the U.S. yet
- Currently listed for construction and mining



Where Trimble UAV is Sold:

- White: not sold in that country
- Grey: sold and used in that country

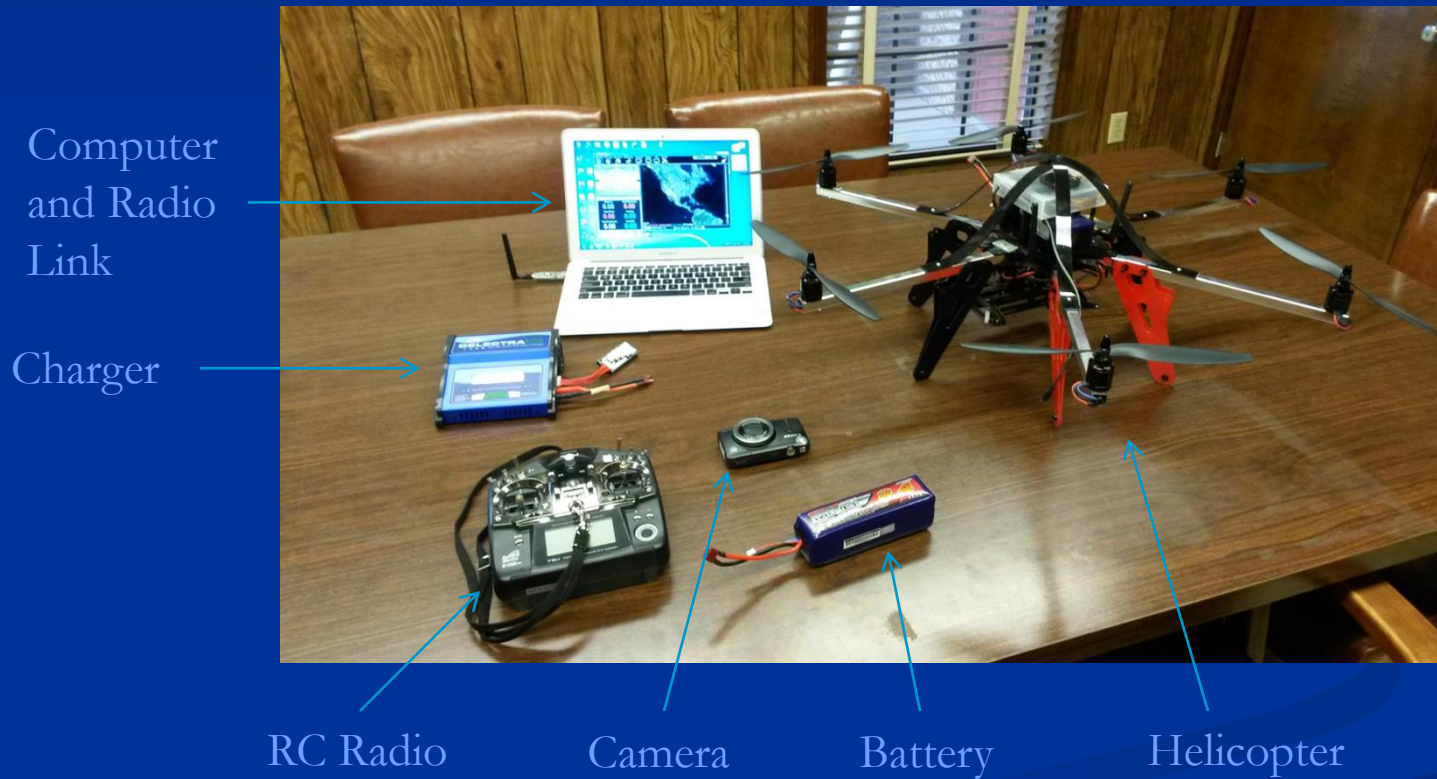


Biggest difference between systems:

- Most system have a GPS,
 - Some only hold position when invoked
 - Other can actually fly waypoints autonomously



Typical Components Needed For System:



Training:

- Some training to operate systems – 1/2 to 2 days
 - Learn about systems
 - Flying and take off / landing skills needed
 - Minor adjustments to system:
 - Some “hobby” skills required



Typical Flight Parameters:

- Flying Time
 - About 10 minutes per battery (6 to 8 minutes usable time)
- Flight speed
 - 10 MPH in Automode (fastest speed – 27 MPH)
- Weight Capacity: Lift 0.5 to 5 lbs
 - Small Size Copters:
 - GoPro type cameras
 - Medium to Large Size:
 - Multiple cameras (NDVI and RGB, etc.), larger single cameras.
- Area Covered:
 - 40 to 100 acres dependent upon how you use system



Cameras for Agriculture Work:



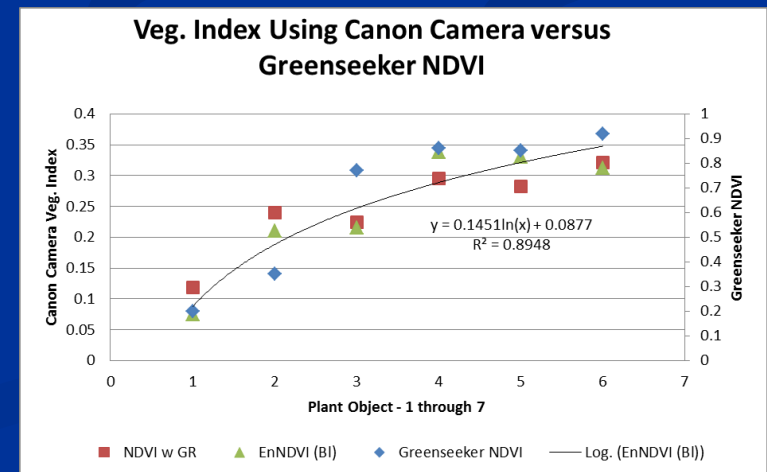
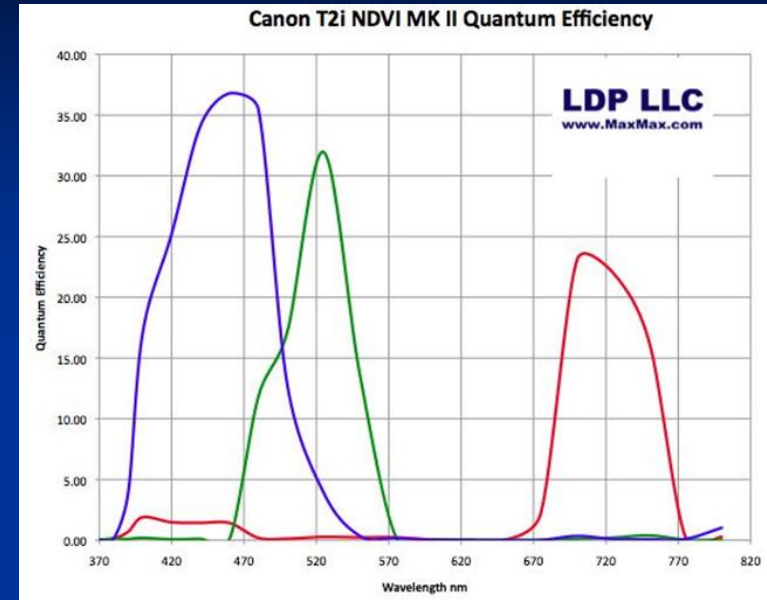
- RGB and NDVI
- NDVI Types Camera:
 - Vegetative indexes related more to chlorophyll and plant health
- Regular RGB Camera:
 - Visual assessment
 - Drain cuts, etc.
 - Burn down assessment



Newer NDVI

Cameras:

- Have special filter to block red and allow NIR input maxmax.com
- Calculate vegetative index using Blue or Green ENNDVI, etc.
- Tests against Greenseeker produced similar results

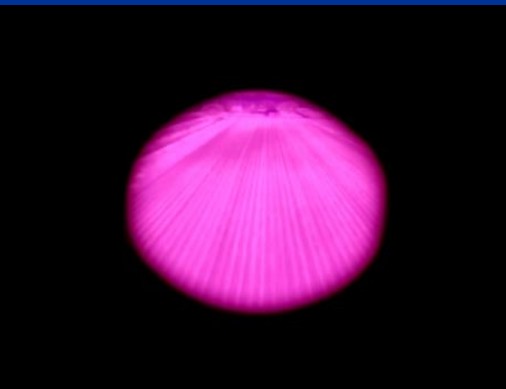


Typical Pictures:



Typical Pictures with GoPro:

- Live video from airplane => GoPro Black / 1000 mW 1.2 Ghz Transmitter

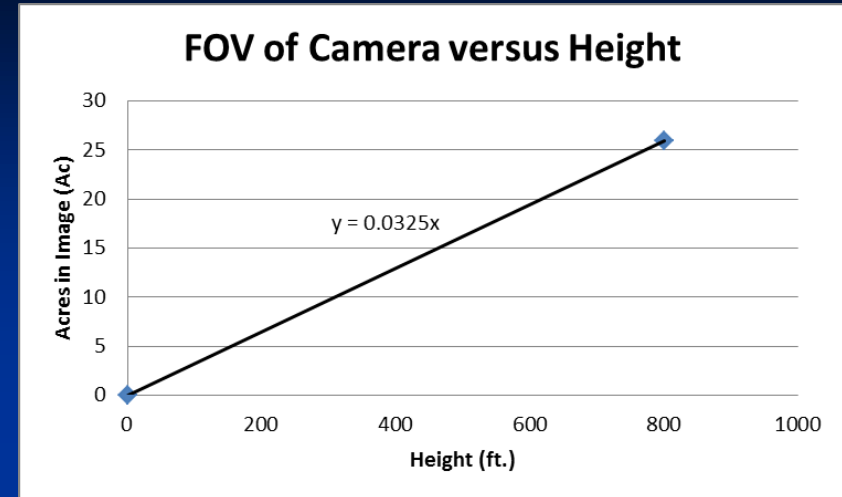


Automated Flight over Field:

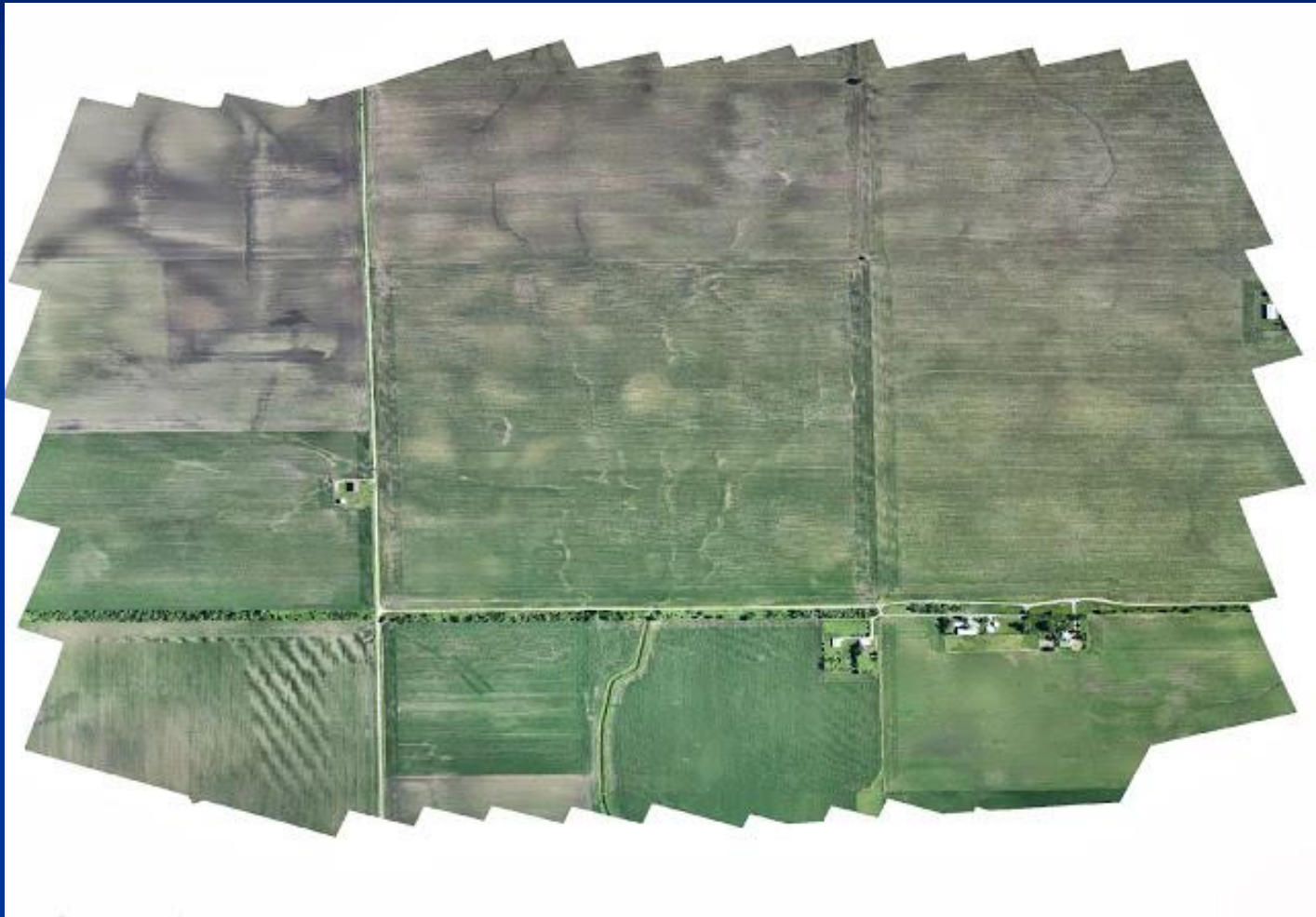


Typical Acres per Image:

- 800 ft
- Canon 300 Camera:
- Acres = $0.0325 * (\text{ft. of flying height})$
- 26 acres in photo
- At 450 ft. => 15 acres

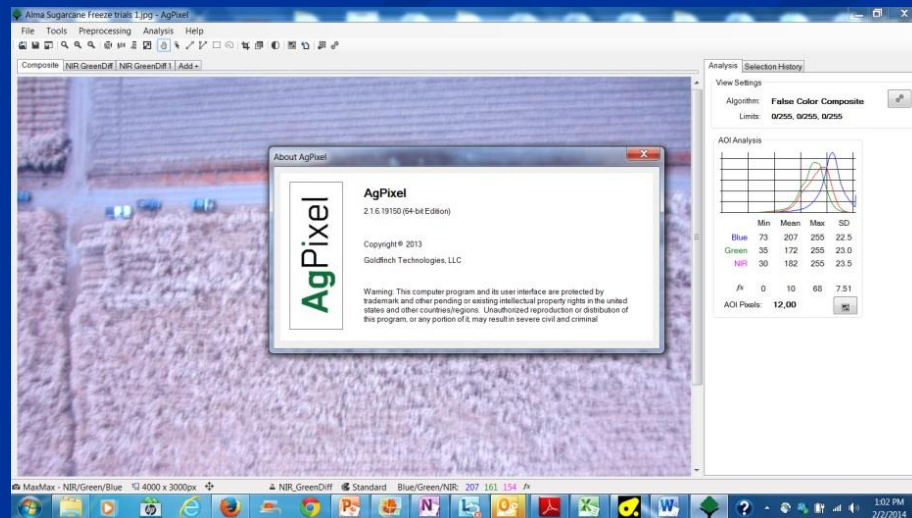
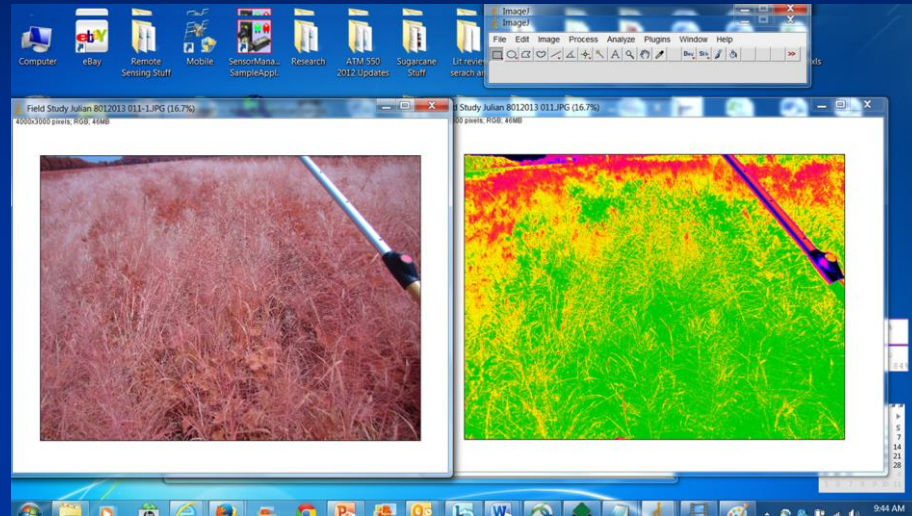


Stitched Imagining – Photoshop:



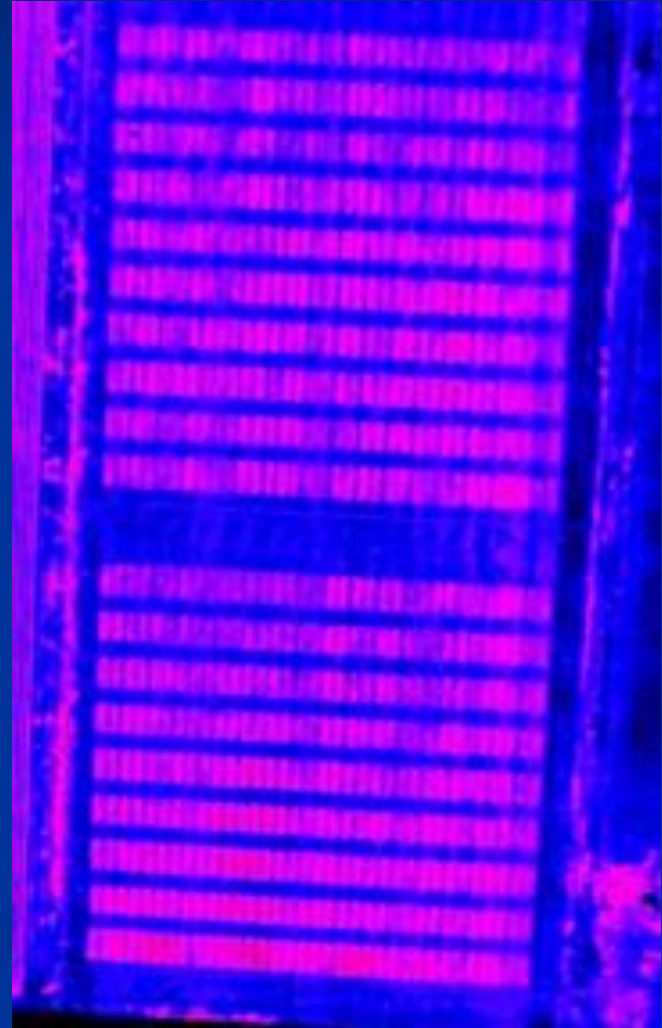
Software:

- Image J
 - Free
- AgPixel
 - \$300
- Photoshop



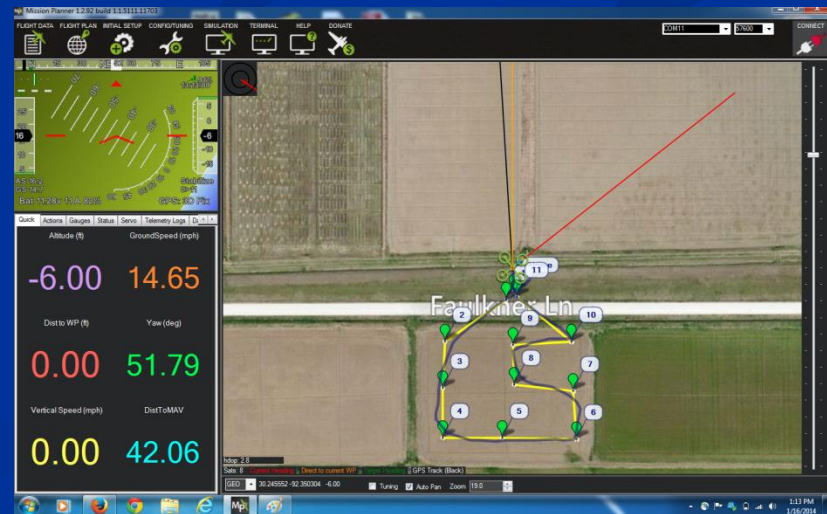
EnNDVI Transformation of Image:

- More pink areas have higher vegetation levels
- Use histogram to obtain average numbers for individual areas or plots for analysis



Multiple Flights Paths:

- Systems work good for repeating flight paths
- Four continuous passes in a row
- Very windy day
 - 20 MPH wind
- 6 blade helicopter



Longer Flights with UAV:

- 6 rotor hex/5000 maHr battery/6 minutes/10 MPH/No Wind
- Covered the perimeter of a 2000 ft x 825 ft area: 37.8 acres



Airplane UAV:

- Same autopilot as copters units
- 6 ft. wingspan
- All foam
- Very safe
- Approximate cost:
 - \$950 without camera
- Things we noticed about system:
 - Take off was harder
 - System flown much higher because size was bigger – 1200 ft.



Images from Airplane:



Some Companies Already Providing Flying Services:

- Provide service to obtain overhead images:
- Mark Townsend
- www.louisianahelicam.com
- (318) 680-9885



Conclusions:

- UAS Flight systems mature and available at “reasonable” prices
 - Flight technologies and auto-pilots exceptional
 - Some hobby / technician skills needed, but system seem fairly easy to use and maintain
- Camera and Image Technologies
 - Getting better, but still need faster methods to automatically pull images from camera and analyze
 - Ground truth still needed
 - Video systems work well!

Where to Get:

- Build your own
- Buy from someone else:

C and C Performance LLC
Eye in the Sky Imaging
9312 Pecan Tree Drive
Baton Rouge, La. 70810
[225-284-8919](tel:225-284-8919)



Vishal Singh
Pixobot, LLC
www.pixobot.com
402-419-9555

Mark Townsend
www.louisianahelicam.com
(318) 680-9885



- Other vendors:
 - Ury Manufacturing

The End

Questions?

Automatic Take-off and Landing:

