

Crop Monitoring Using Small Unmanned Aircraft Systems

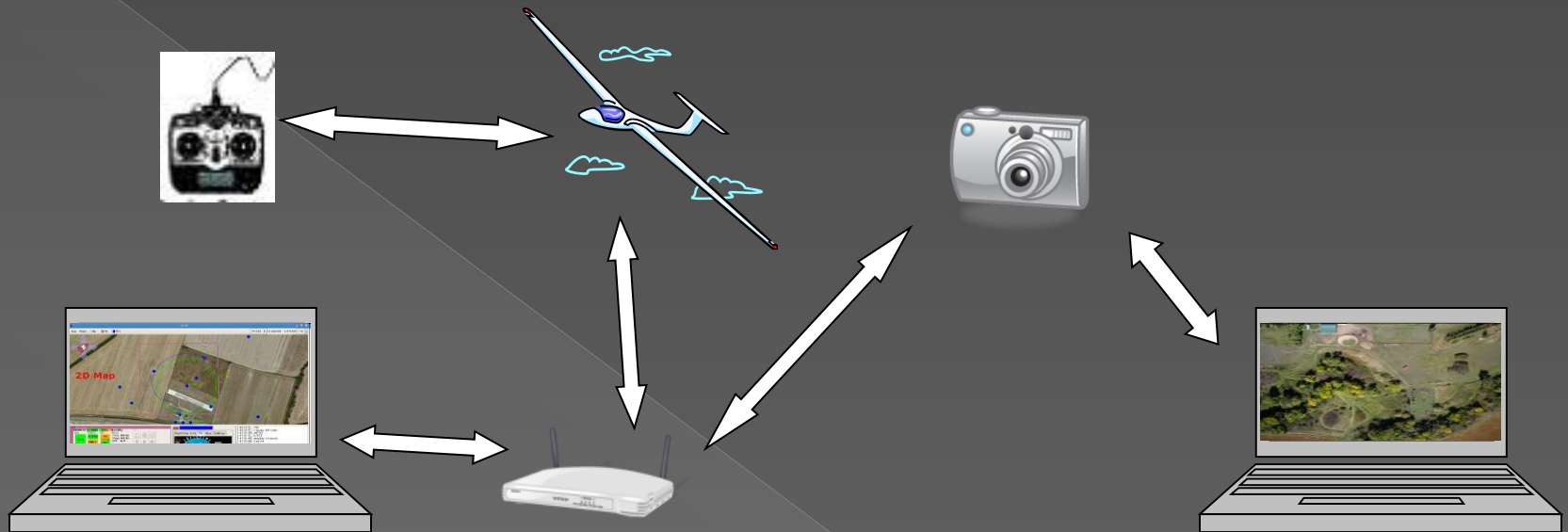
By Jeremy R. Smith

University of North Dakota
April 30, 2012

CropCam



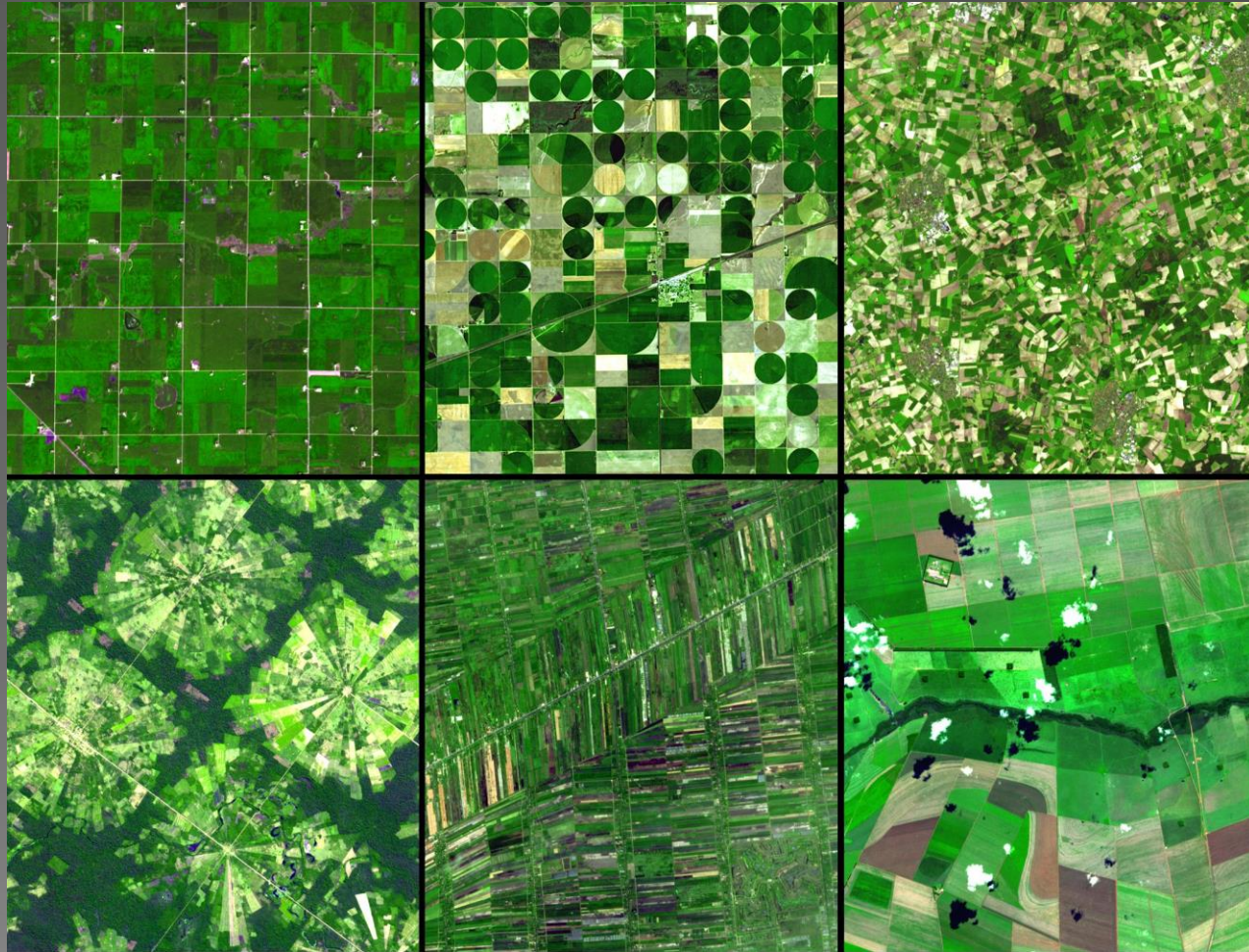
CropCam



CropCam Specifications

Length	4 feet
Wing Span	8 feet
Weight	6 pounds
Engine	Axi Brushless
Duration	20-35 minutes
Batteries	4 L-Polymer
Surfaces	Rudder, elevator and ailerons
Average Speed	60 km/h
Maximum Winds	30 km/h

Remote Sensing for Agriculture



Satellite vs. UAS for Agriculture

◉ Satellite

- Expensive
- Temporal Resolution
 - 16 days
- Cloud Cover
- Delayed Data
- No Choice
 - > Resolutions
 - > File formats

UAS

- Power in farmer's hands
 - Date
 - Height
 - Resolution
 - Location
- Near-real time data
- Data Center

Data Acquisition

Satellite Data

- Six images
 - June 2011 – Sept 2011
- Only 1 suitable image
 - July 30, 2011

AEROCam Data

- 3 dates requested
 - Two days
 - Only one at Flying-S
- 15 Aug 2011

CropCam Data

- 6 flying days
 - Sept 10 – Sept 11
- 400, 600, 800, 1,000ft
AGL

Lowest Altitude

- 400ft AGL
 - Quarter section
 - Cover pass required
 - Weave pattern required
- 1,000ft AGL
 - Half section
 - No cover pass required
 - Weave pattern not required

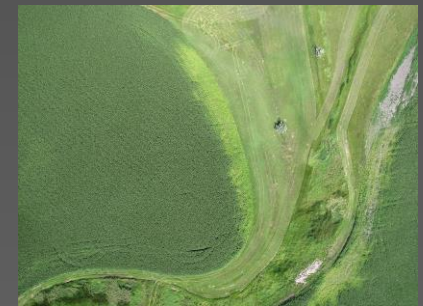
400 ft.
AGL

Approx:
2.5 Acres



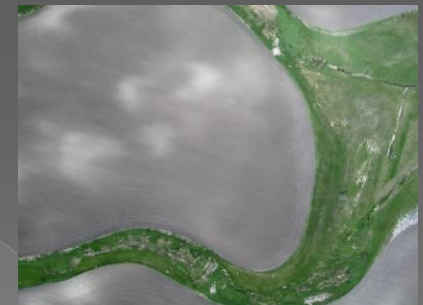
600 ft.
AGL

Approx:
4 Acres



800 ft.
AGL

Approx:
8 Acres



1,000 ft.
AGL

Approx:
14 Acres

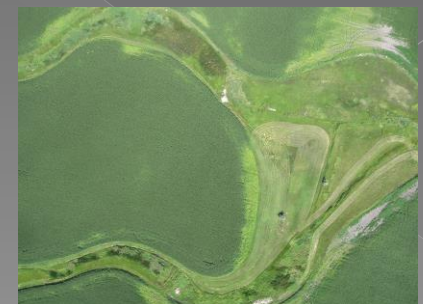


Image Mosaic



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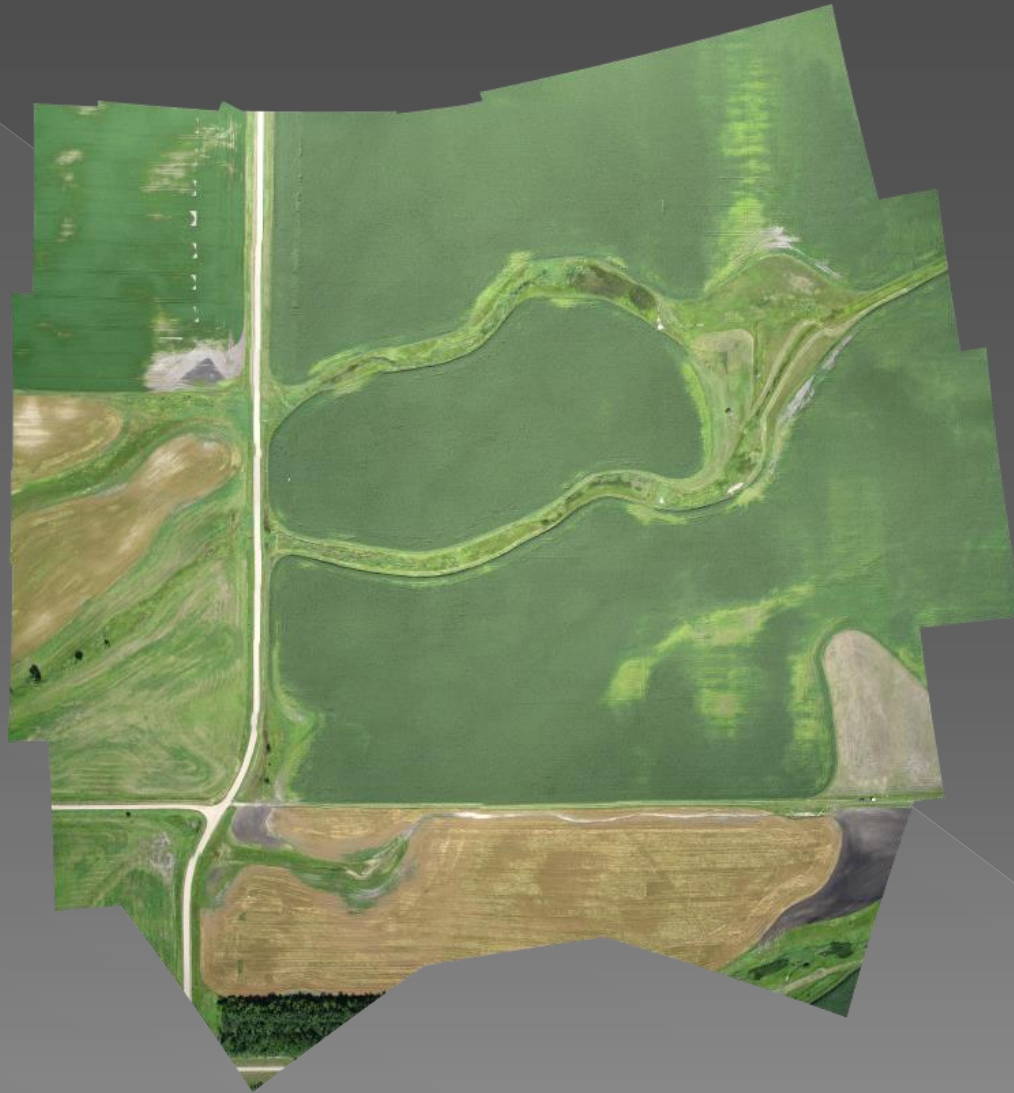
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Quarter Section



Half Section



Spatial Resolution

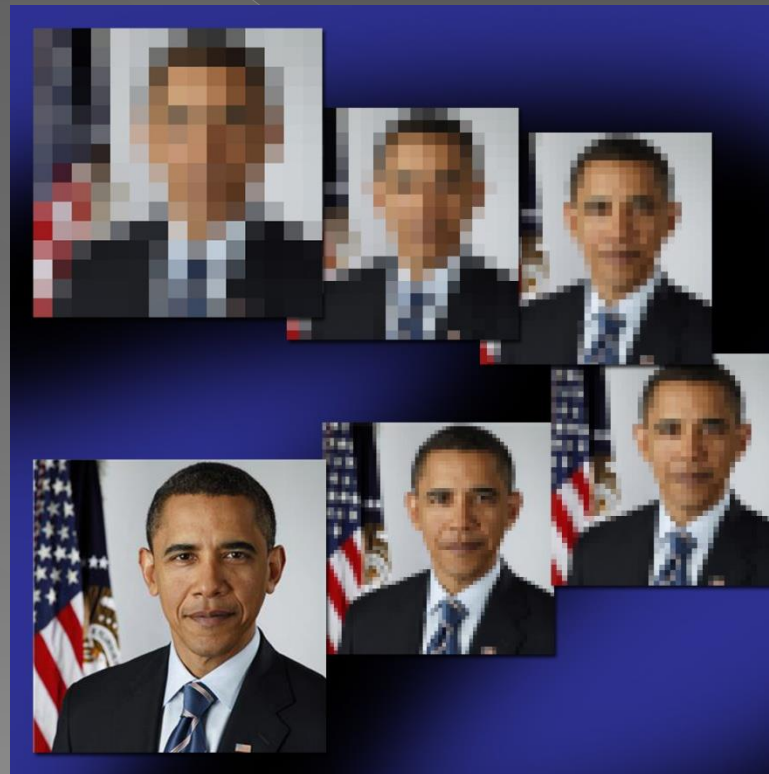
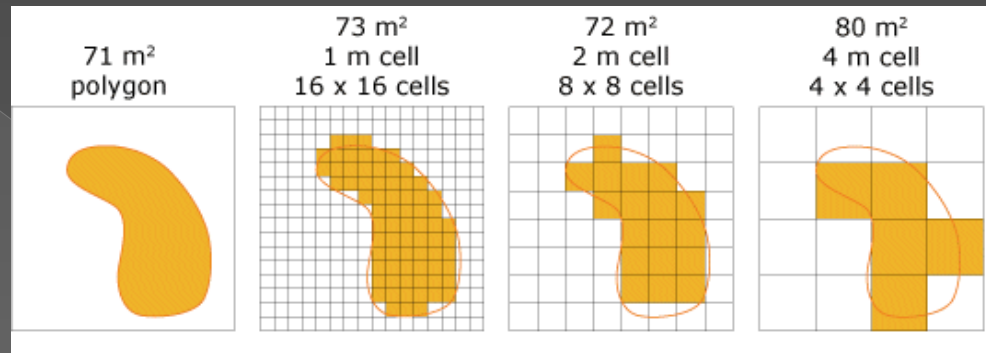


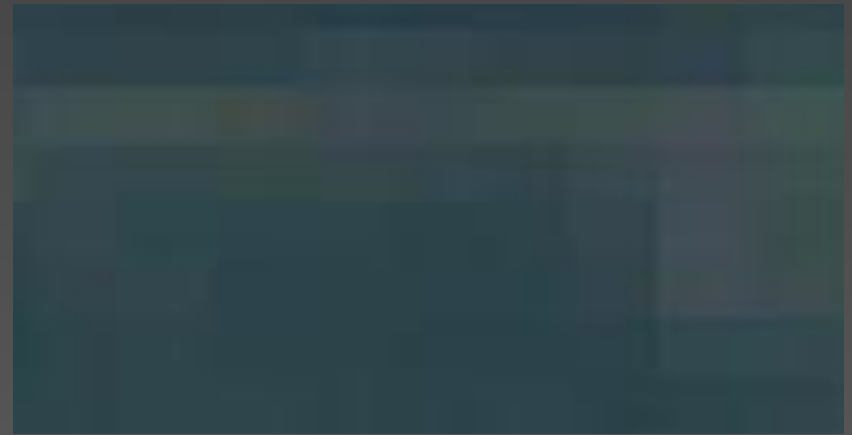
Image Comparison

- Landsat
 - 30m
 - 0.22 acres per pixel
 - Acre = five pixels
- AEROCam
 - 1m
 - 0.00025 acres per pixel
 - Acre = 4,000 pixels
- CropCam
 - 20 cm
 - 0.0000099 acres
 - Acre = 101,010 pixels



Water Damage Comparison

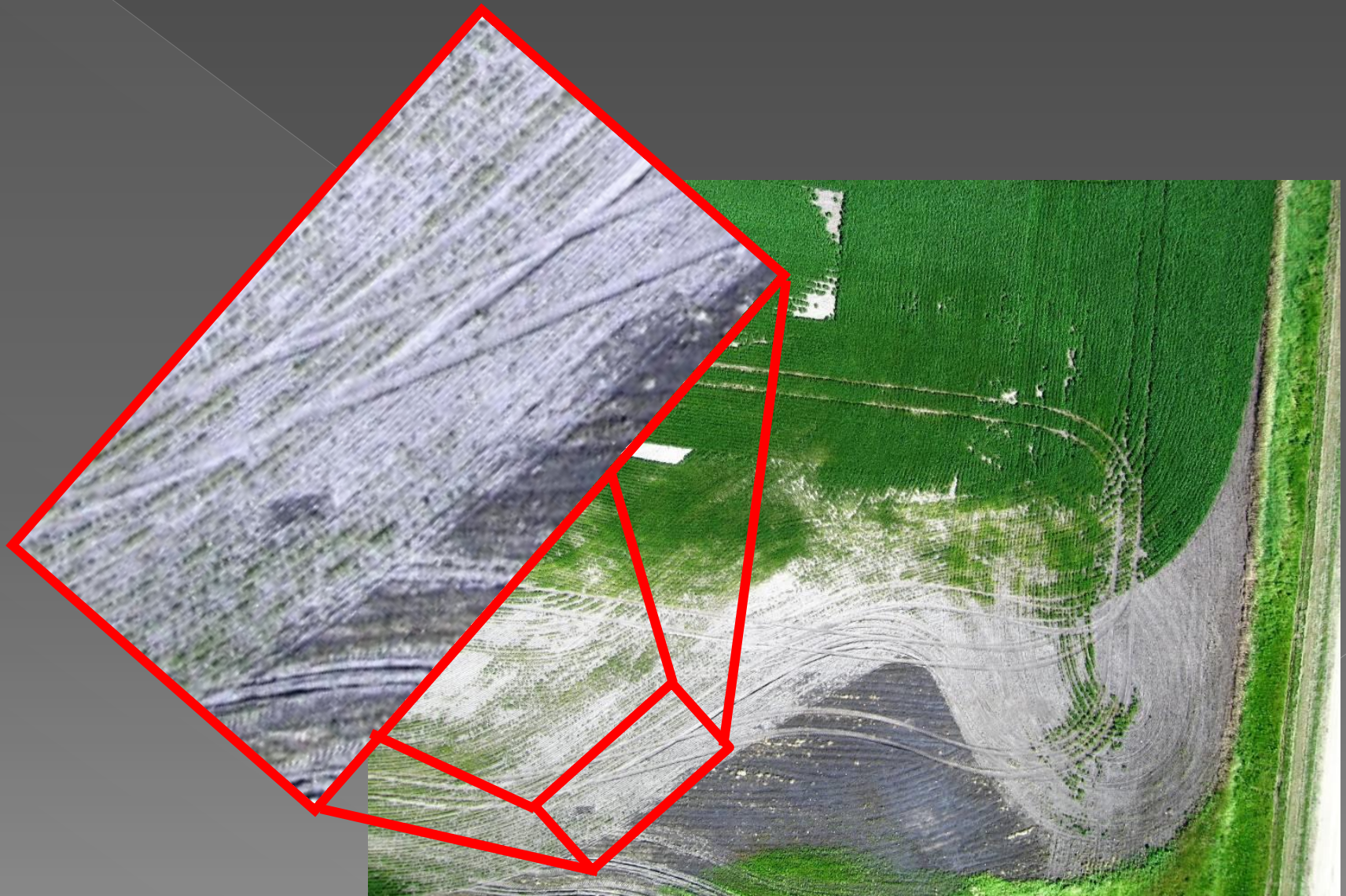
- Landsat
 - Undistinguishable
- AEROCam
 - Water damage is clearly visible
 - Spots of low productivity
- CropCam
 - Water damage is clearly visible
 - Spots of low productivity
 - Issue with machinery



Water Damage Comparison



High Resolution



Questions?