# UAS In Entomology

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*Manitoba Potato Production Days,*
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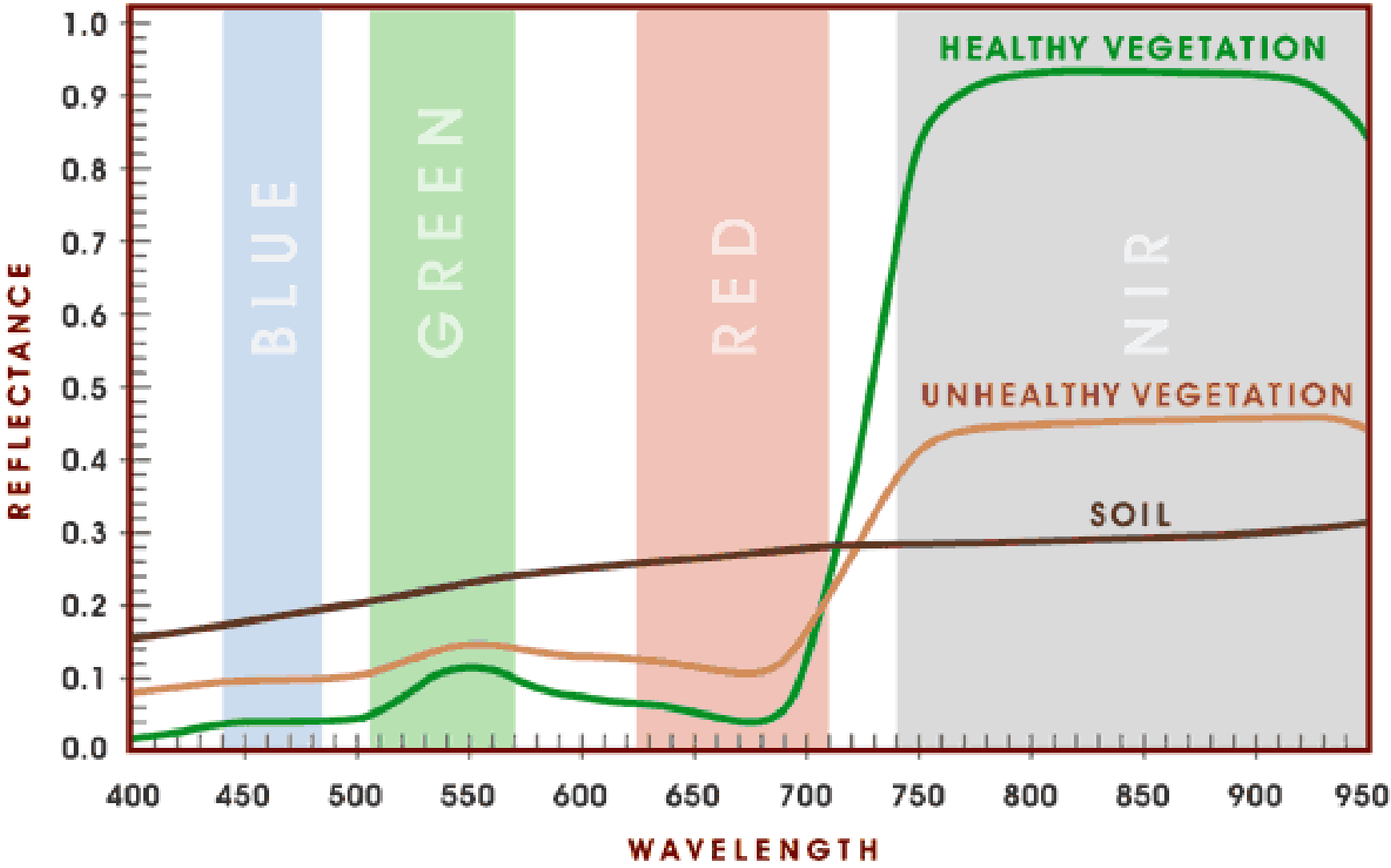
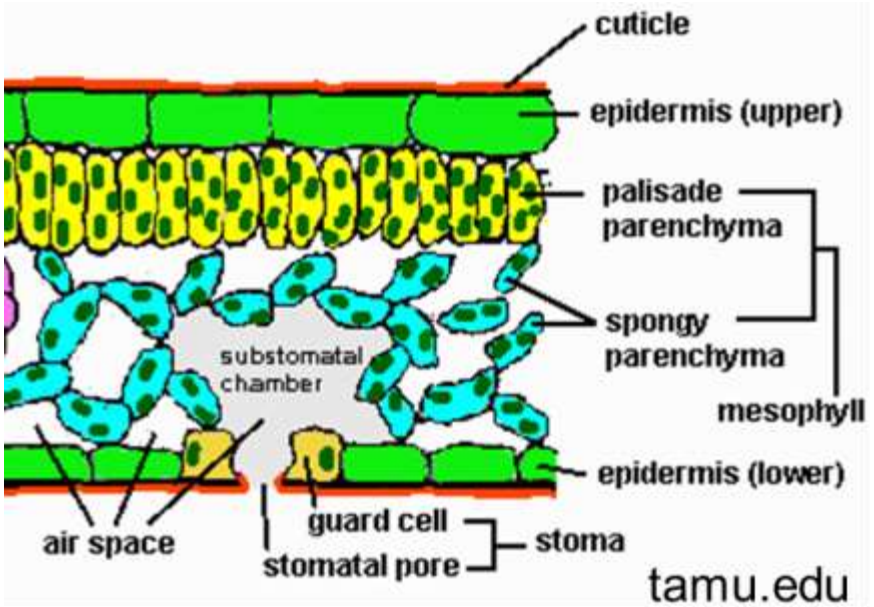
UNIVERSITY OF MINNESOTA
Driven to Discover℠

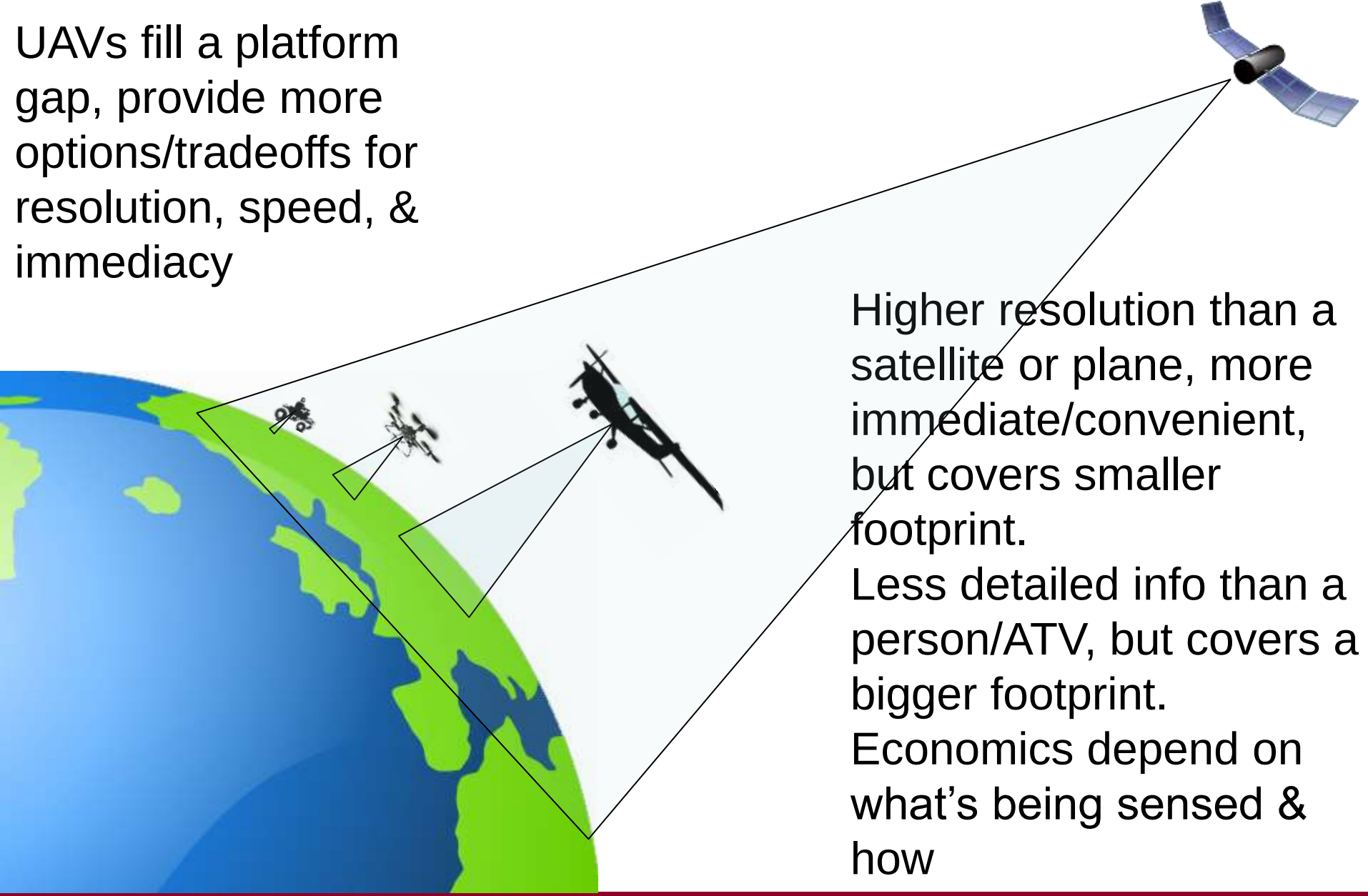

HEALTHY VEGETATION
UNHEALTHY VEGETATION
SOIL
BLUE
GREEN
RED
NIR
REFLECTANCE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
450
500
550
600
650
700
750
800
850
900
950
WAVELENGTH

# Crop reflectance

- Leaf reflectance
  - Pigments
  - Internal leaf structure
  - Water content
- Canopy reflectance
  - Leaf reflectance
  - Plant geometry
    - Orientation & distribution




UAVs fill a platform gap, provide more options/tradeoffs for resolution, speed, & immediacy



Higher resolution than a satellite or plane, more immediate/convenient, but covers smaller footprint.

Less detailed info than a person/ATV, but covers a bigger footprint.

Economics depend on what's being sensed & how

3-D Robotics Iris

DJI s-1000 with A-2 Autopilot

ADC TetraCam


GoPro Hero3



Sentera NIR imagers

Sony NEX-T5

# Visible data

- Currently collaborating on stand counts in experiment plots
- Think hail damage, herbicide drift, planter skips, flooding, heavy defoliation….


- Any problem you can easily see from the ground, you can probably see from the air.

# Software Tools

- Stitching (putting the images together)
  - E.g. Autopano giga, GIS (e.g. ArcInfo), ENVI
- Image / Data Analysis
  - incl. ENVI, PixelWrench (for simple analysis of TetraCam)
- Depends on what analysis is necessary

# Other Ongoing Projects

- Damage from insect feeding
  - Rice borer, sugarbeet root maggot, soybean aphid & ***Colorado Potato Beetle***
- Disease
  - ***Potato Virus Y (vectored by aphids)***
  - Bacterial Leaf Streak
- Differentiating between stressors
  - Can't yet do this – can see stress but difficult to assign cause!
  - Aphids vs BSR and SDS in soybean

# Defoliation estimates

- Percent defoliation estimated weekly by 3-4 RAs, 4-5 total plants sampled in center 2 rows of each plot center rows avoid border effect) & mean % defoliation calculated
  - All workers synchronized estimate values prior to sampling

# Canopy segmentation

- Many NIR cameras have proprietary software, most have supervised classification – you can 'train' the software to differentiate between vegetative and non-vegetative pixels (e.g. soil)
- based on min & max red & NIR values (e.g. red<6, NIR <20), non-vegetative pixels rendered to a user-specified solid color while leaving

- Process - Identify spectral reflections of representative non-plant areas to create selection sieve values for selection decisions
- Delineate the area of interest and perform analysis.
- % canopy coverage then calculated, if images is geocoded, then area can be determined

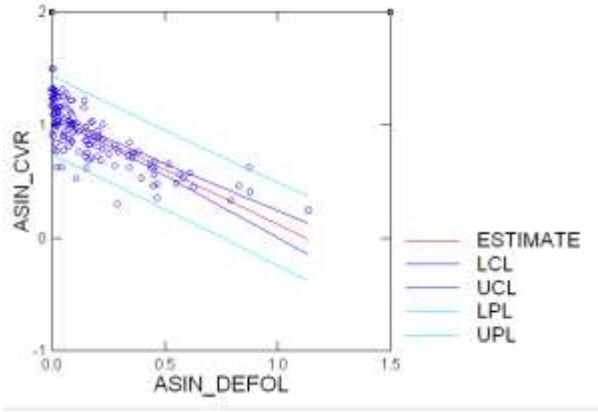
# Results

- Observed % canopy defoliation and calculat… % canopy coverage arcsin transformed
- % calculated canopy coverag… % observed defoliation to… using methodology to …
  - P<0.001

**Defoliation estimates from aerial images are at least as accurate as estimates from ground observers!!**

| | |
|---|---|
| Dependent Var… | |
| N | |
| Multiple R | |
| Squared Multiple R | |
| Adjusted Squared M… | |
| Standard Error of Est… | |

| Effect | Coeffi… | Standard Error | Std. Coefficient | Tolerance | t | p-Value |
|---|---|---|---|---|---|---|
| CONSTANT | 1.083 | 0.020 | 0.000 | . | 55.164 | 0.000 |
| ASIN_DEFOL | -0.964 | 0.071 | -0.766 | 1.000 | -13.655 | 0.000 |



# Gravity sucks!

What goes up, will come down – sometimes in a spectacular fiery manner…