What can you register with drone cameras?

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Uppsala, Sweden
February 8, 2024

What is reflectance?

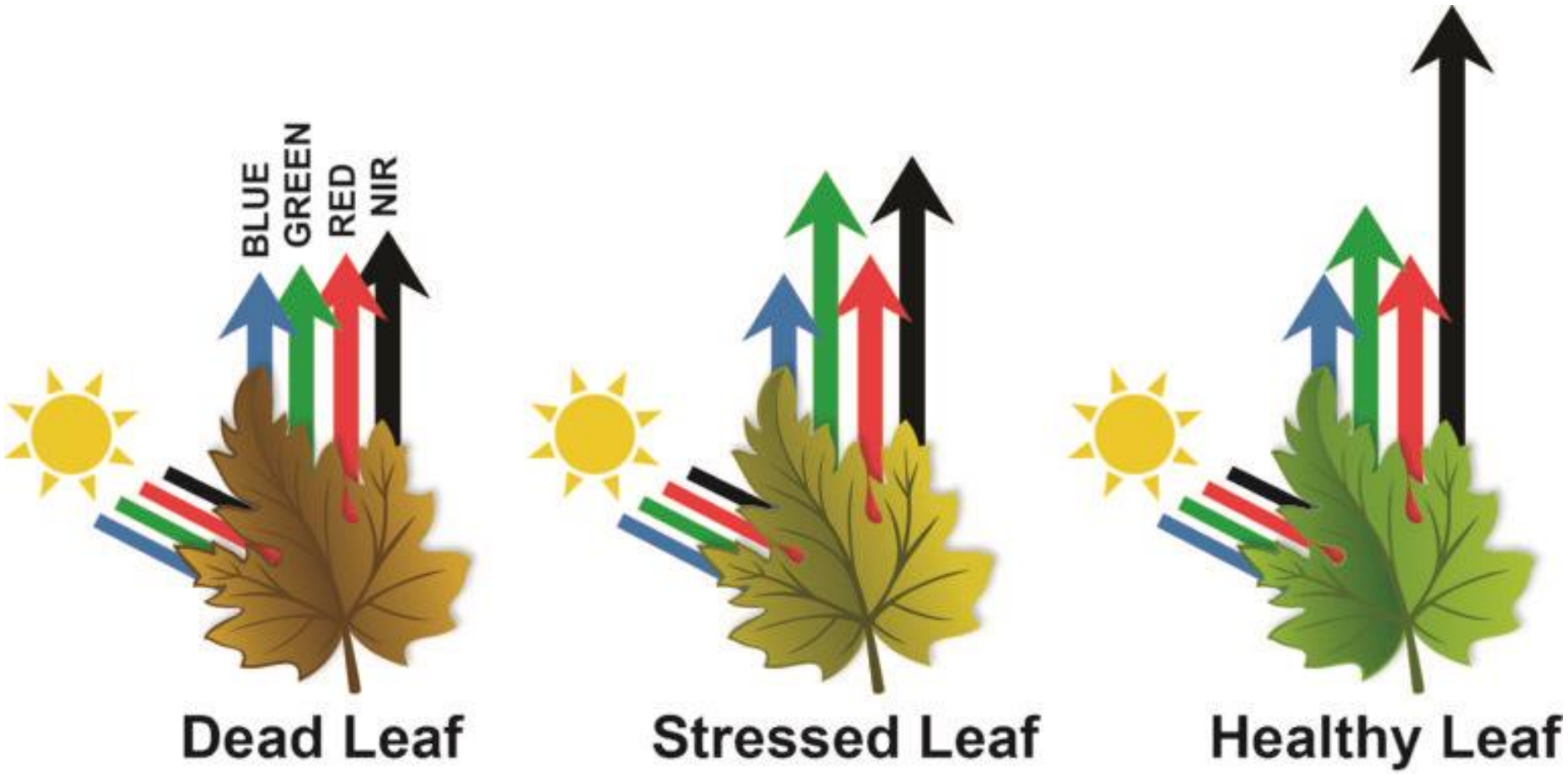


Image Source: https://midopt.com/healthy-crop/

Different objects reflect light differently

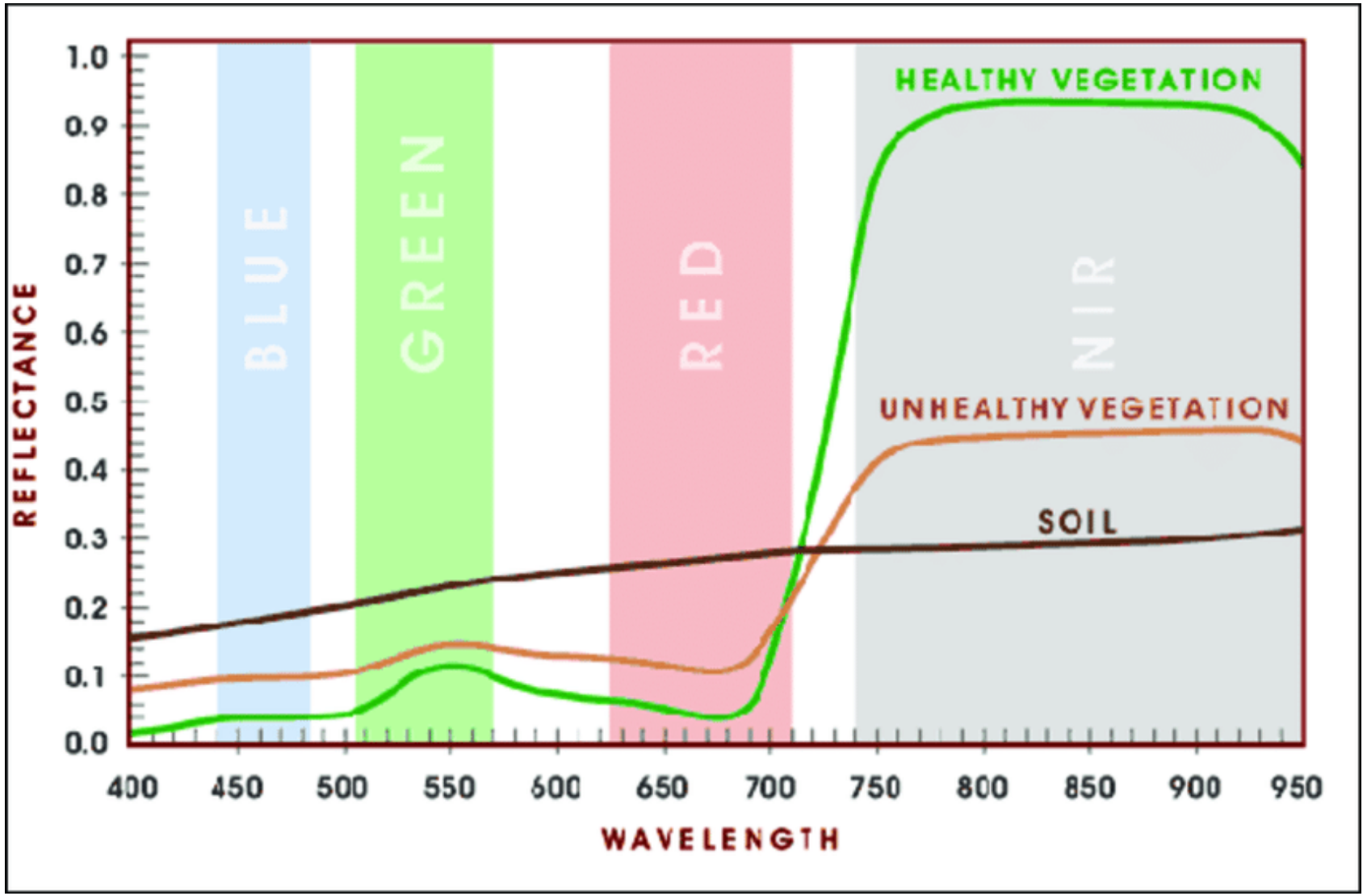


Image Source: https://www.researchgate.net/figure/Spectral-reflectance-of-healthy-plant-unhealthy-plant-and-soil-in-visible-and-NIR_fig1_299388638

Drone cameras measure the reflectance

Reflectance = *Digital Number / Max Value*

- For 8-bit imagery (most RGB cameras):

  170 / 256 = 0,66

- For 16-bit imagery (multispectral imagery):

  2000 / 32767 = 0,08

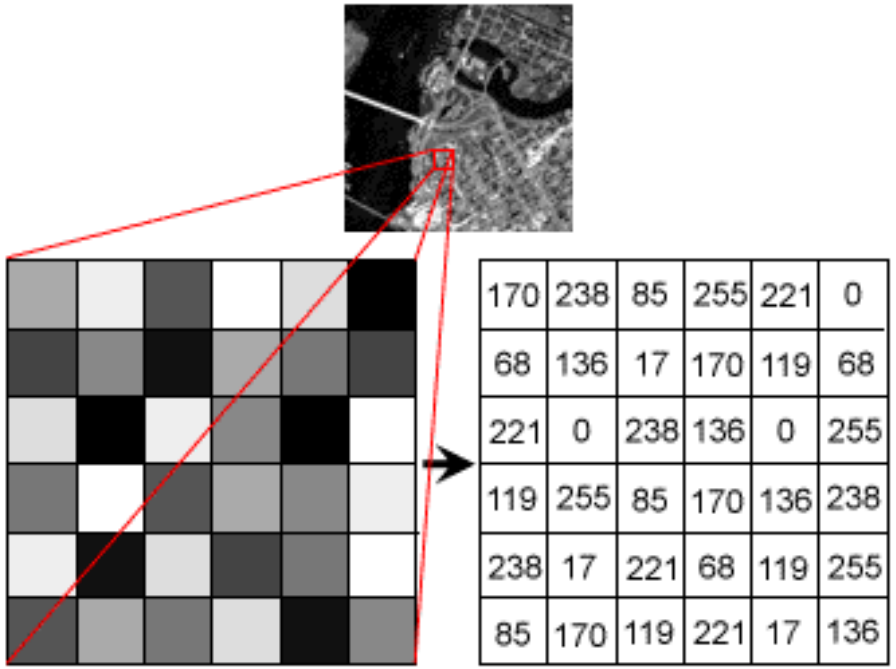
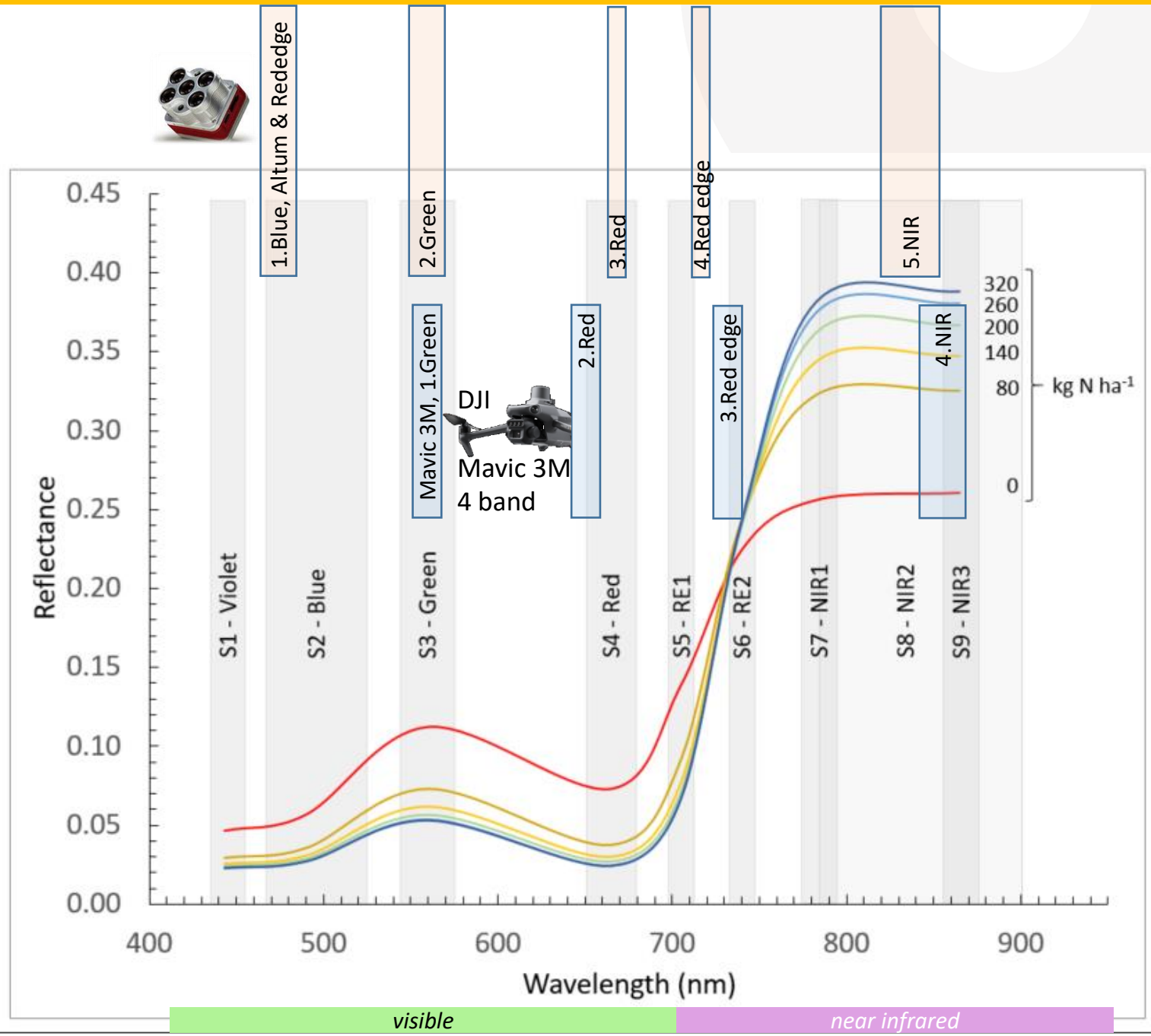


Image Source: https://ai.stanford.edu/~syyeung/cvweb/tutorial1.html

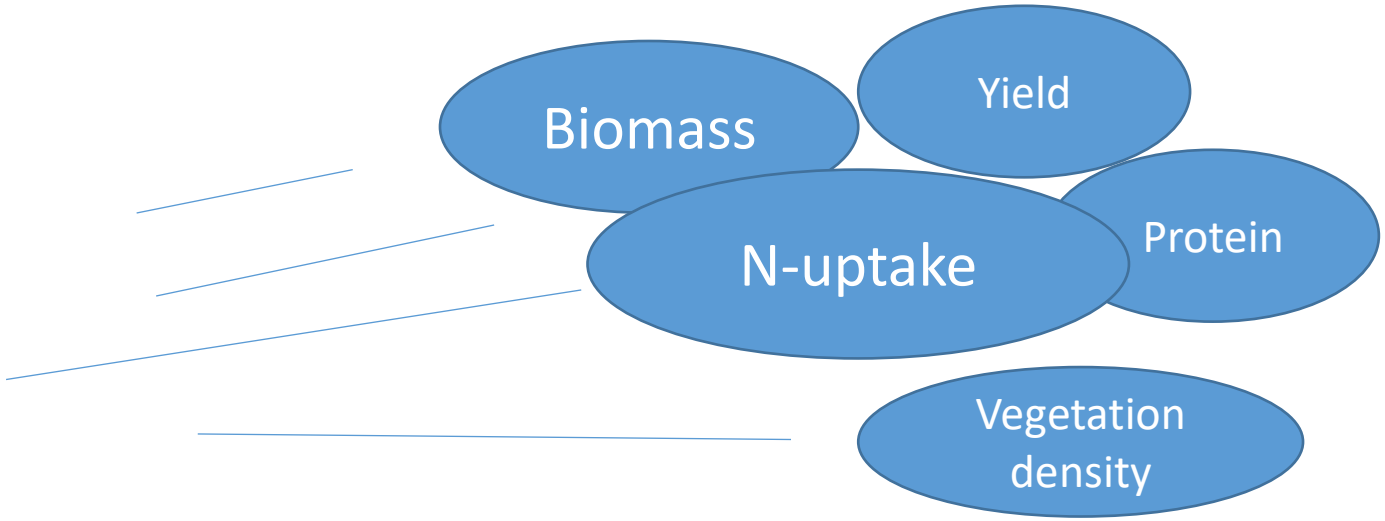
Multispectral cameras measure different parts of light spectrum



Vegetation indices highlight different crop properties

For example:

- NDVI: (NIR-Red)/(NIR+Red)
- NDRE: (NIR-RE)/(NIR+RE)
- Chl Index: = (NIR/RE)-1
- MSAVI2: =0.5((2NIR+1)-SQRT((2NIR+1)^2-8*(NIR-Red)))



Light Conditions Affect Reflectance (and indices)

1) DLS/ILS – sunshine/light sensor

2) Calibration/reflectance panel

44% 23% 9% 2%

What’s the difference?

MicaSense Rededge
5 bands

MicaSense Altum
6 bands

Maia, Eoptis
9 bands

Mavic 3 M
4 bands

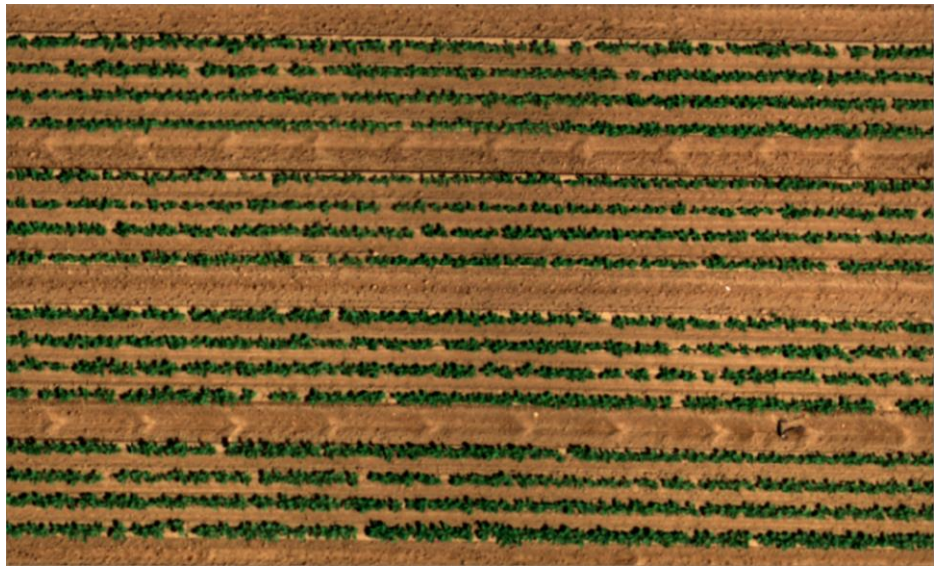
Lanna Research Station, Sweden

Crop: Peas

Date: July 23, 2023

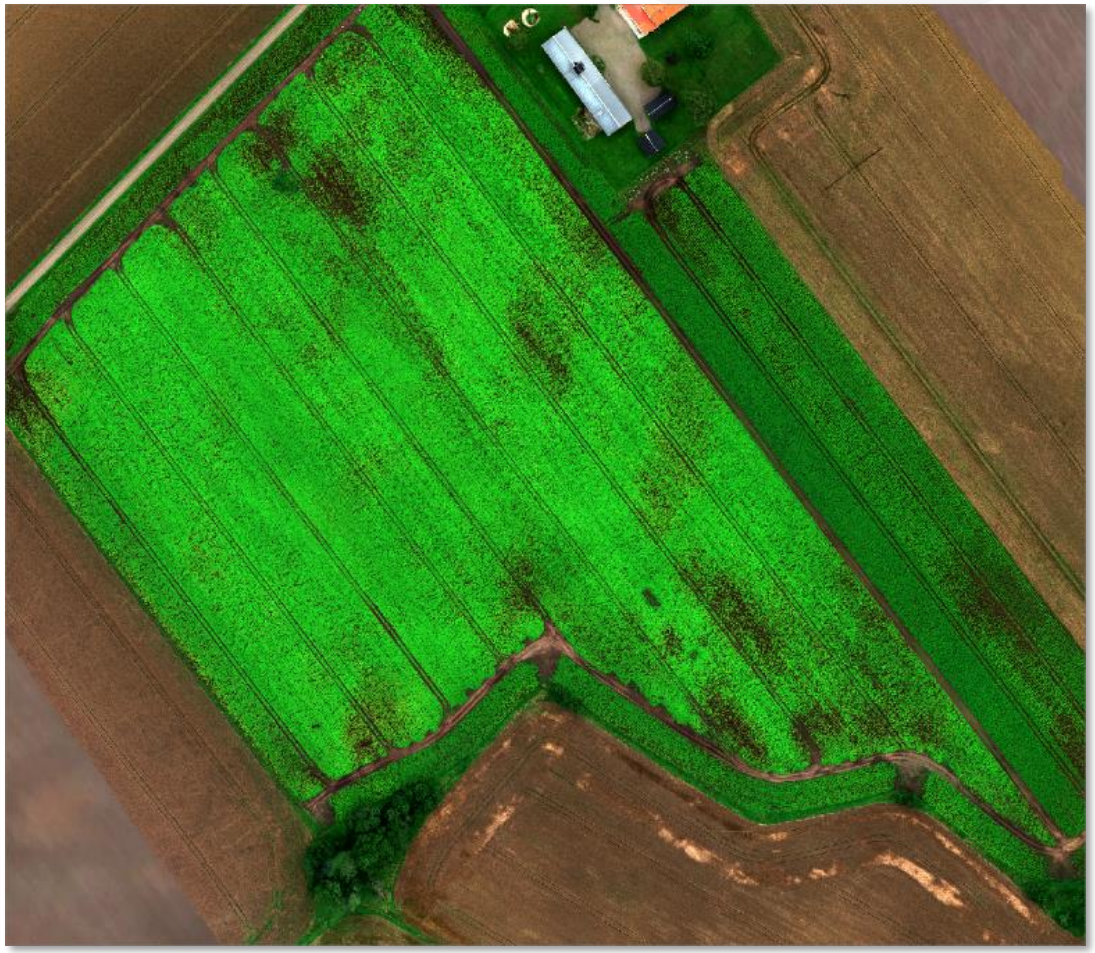
Salinas, California, USA

Crop: Broccoli
Date: April 27, 2023



Arentorp, Sweden

Crop: Potato
Date: August 18, 2023



2023-08-18
7.5 ha potato

Oskar Andersson
Arentorp, Vara

Lady Claire

Inova

Lady Claire
King Edward

Lady Claire

0 25 50 100 m

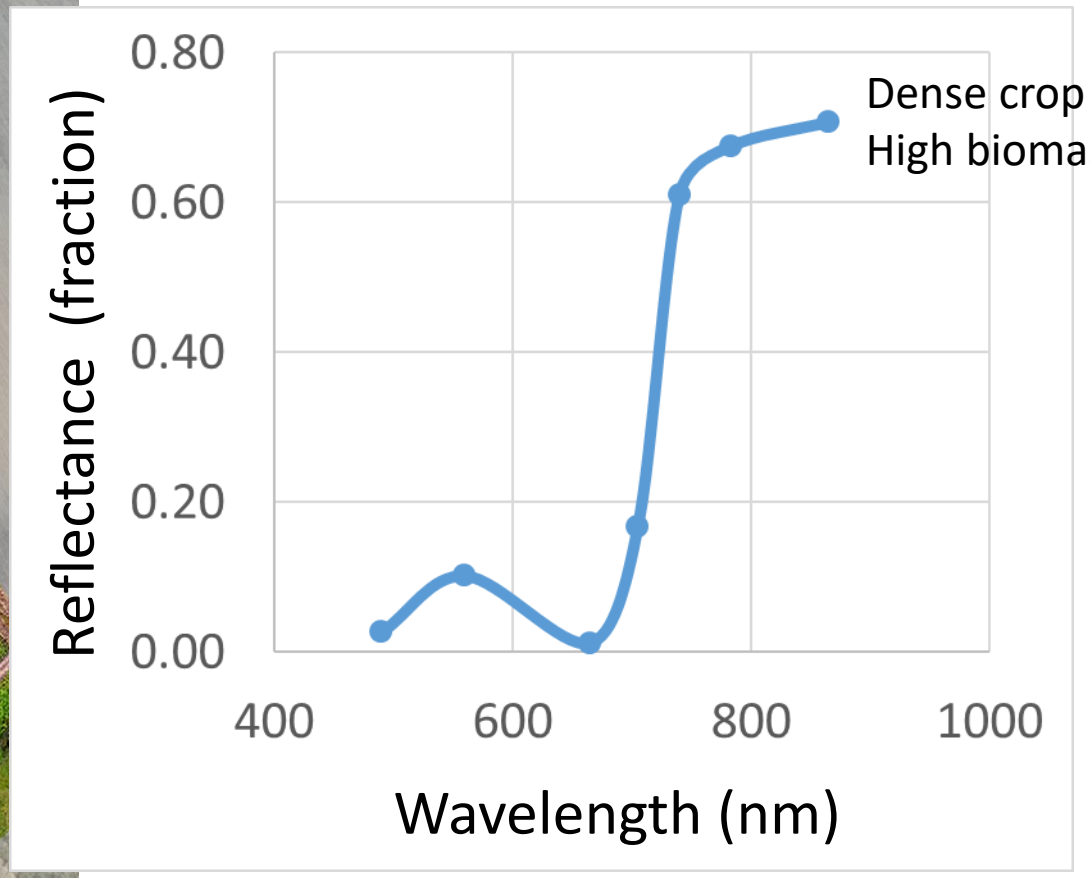
Bildbakgrund: © Lantmäteriet

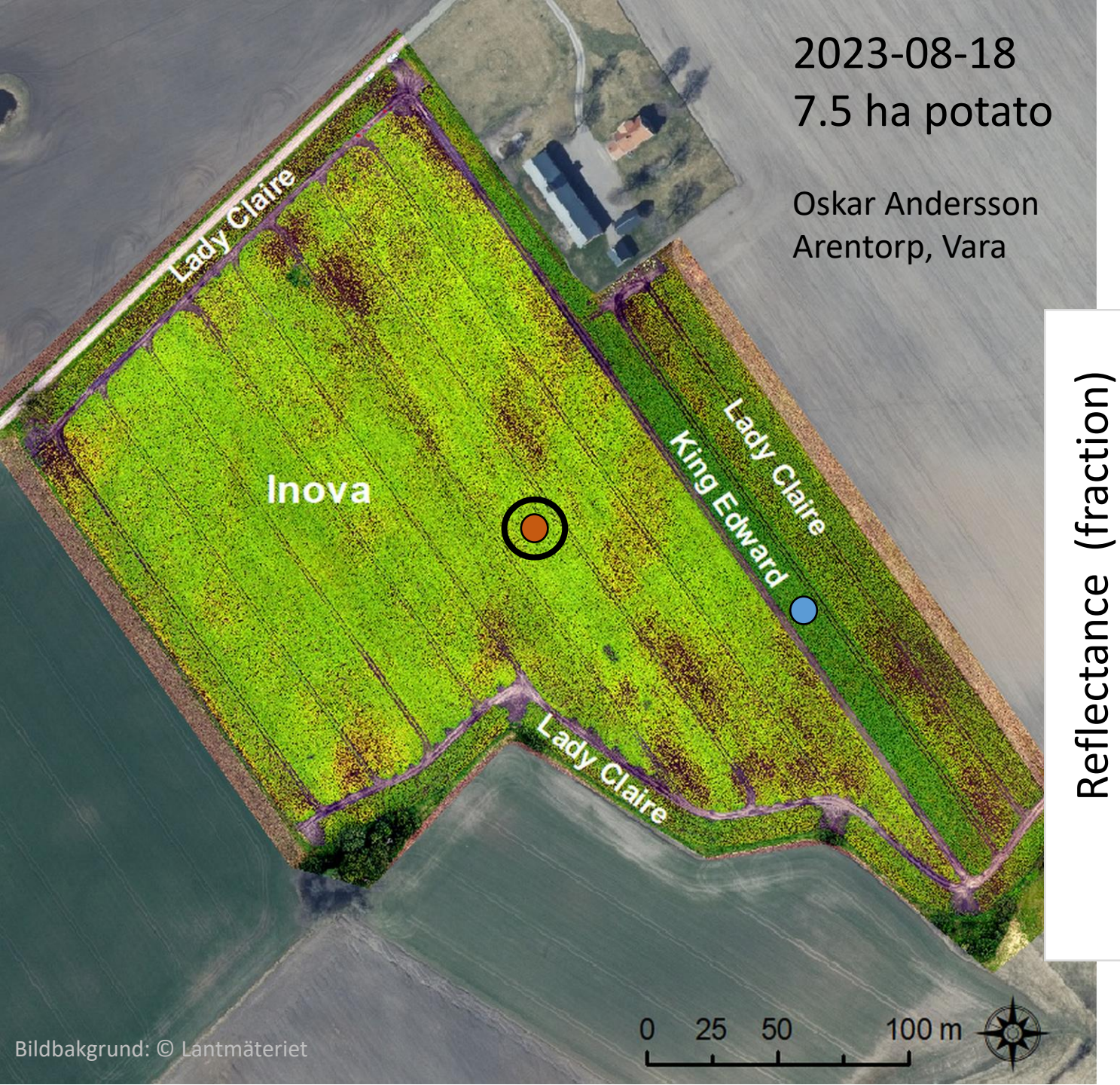
View from the north end (red circle)...

Photo: Bruno Morandin Figueredo

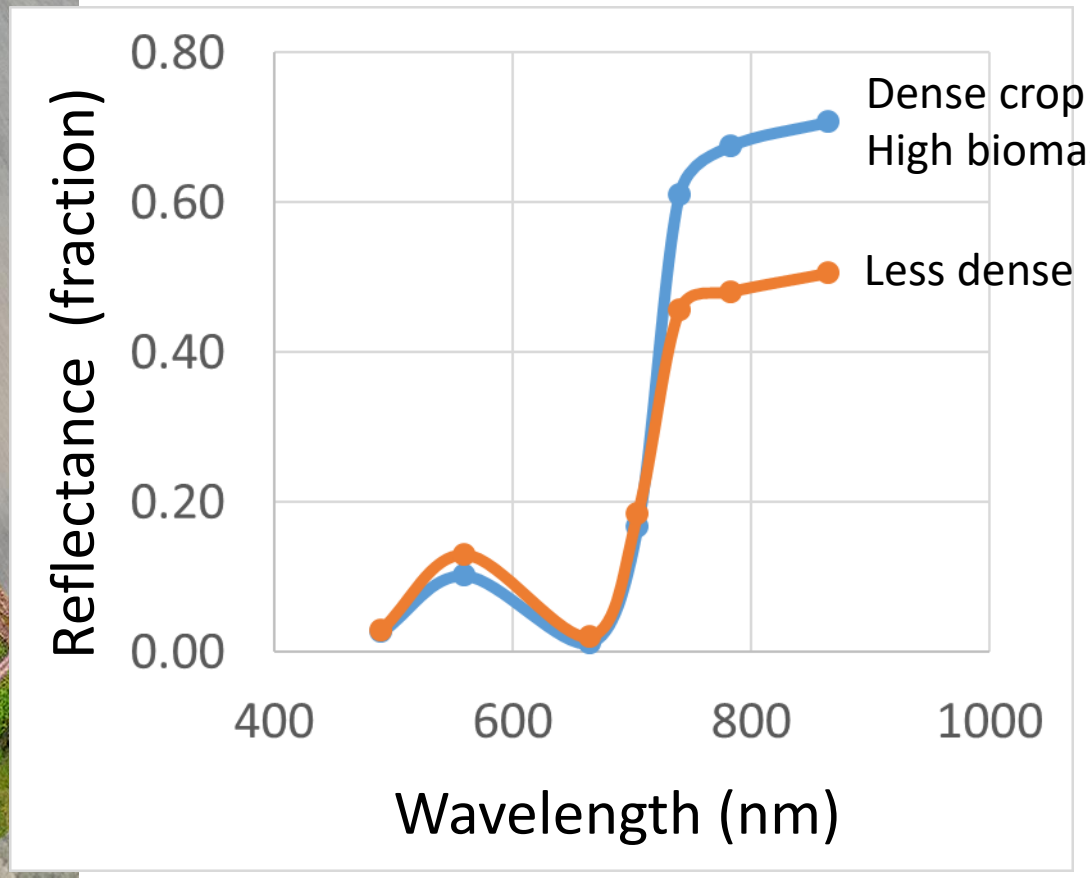
One of the field test sites

Data from a multispectral camera





Data from a multispectral camera



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Lady Claire
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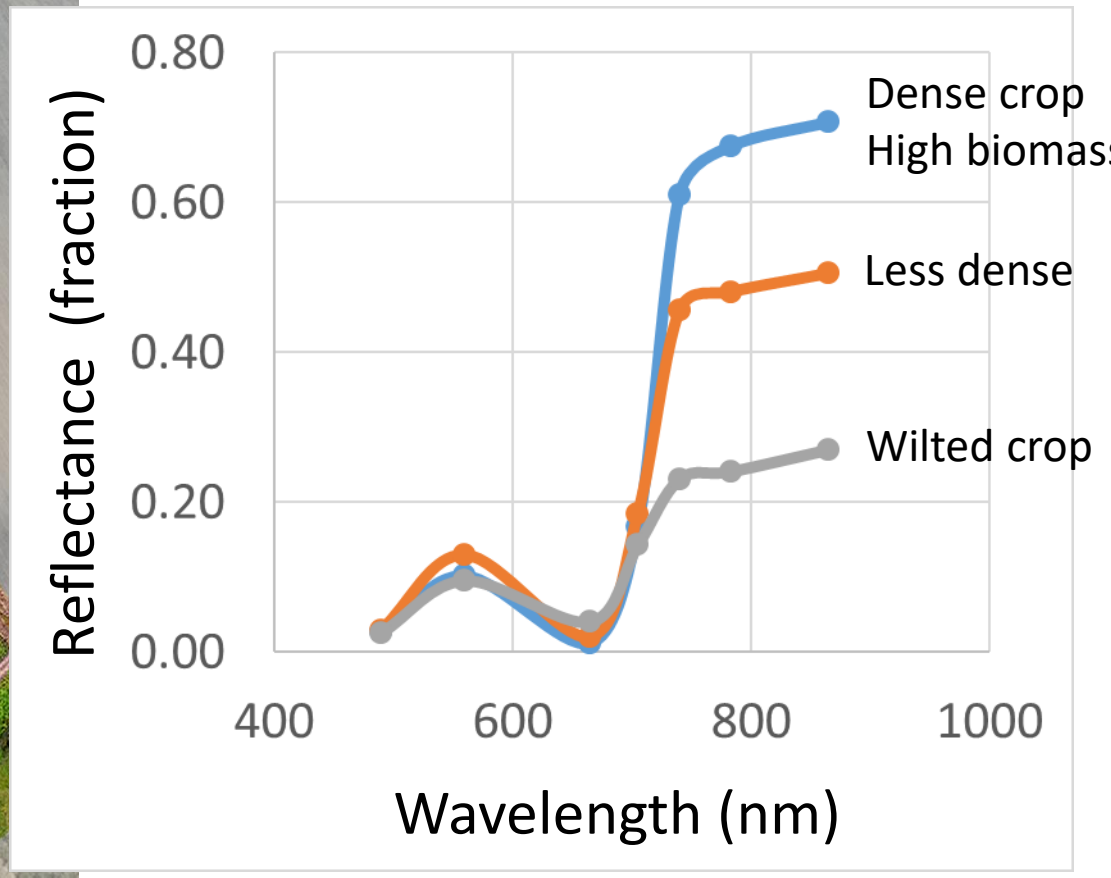
0 25 50 100 m

Bildbakgrund: © Lantmäteriet

Data from a multispectral camera



NDVI

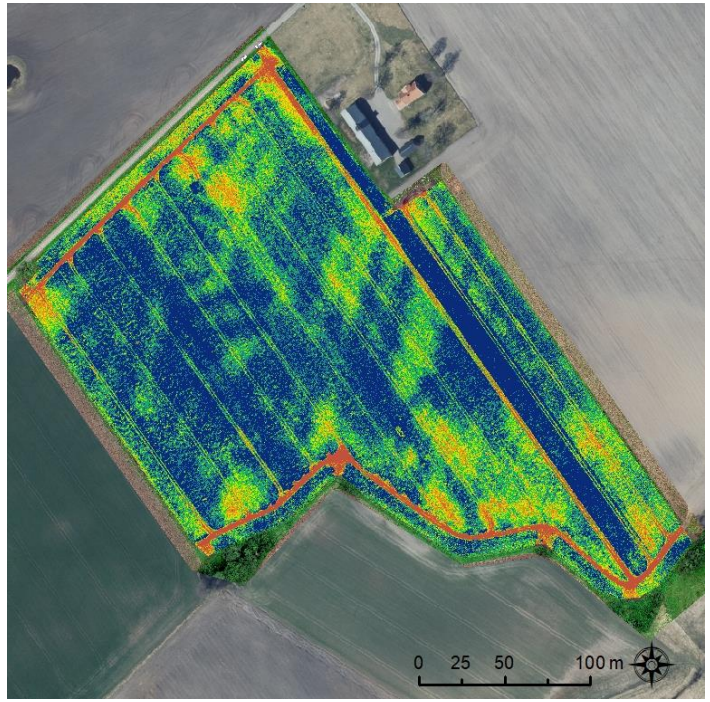
Different cameras

Relative variation

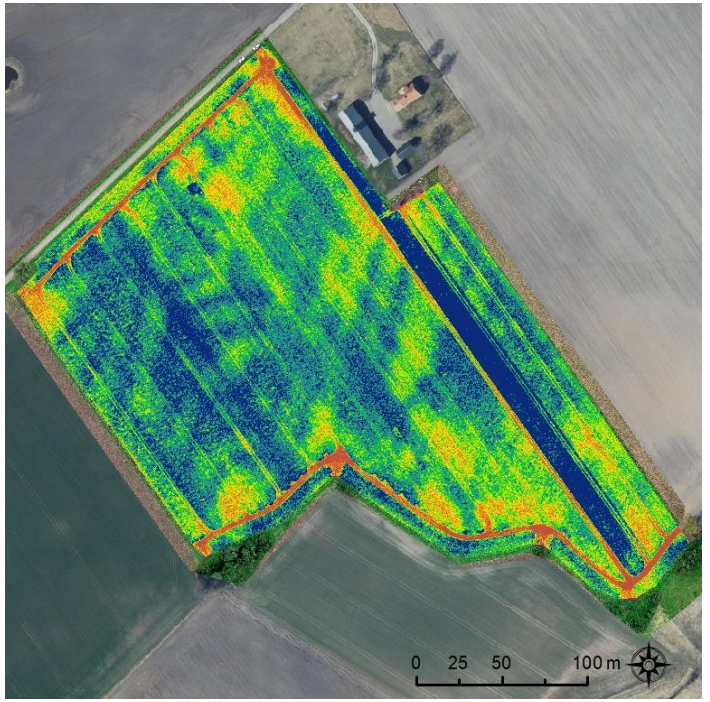
High

Low

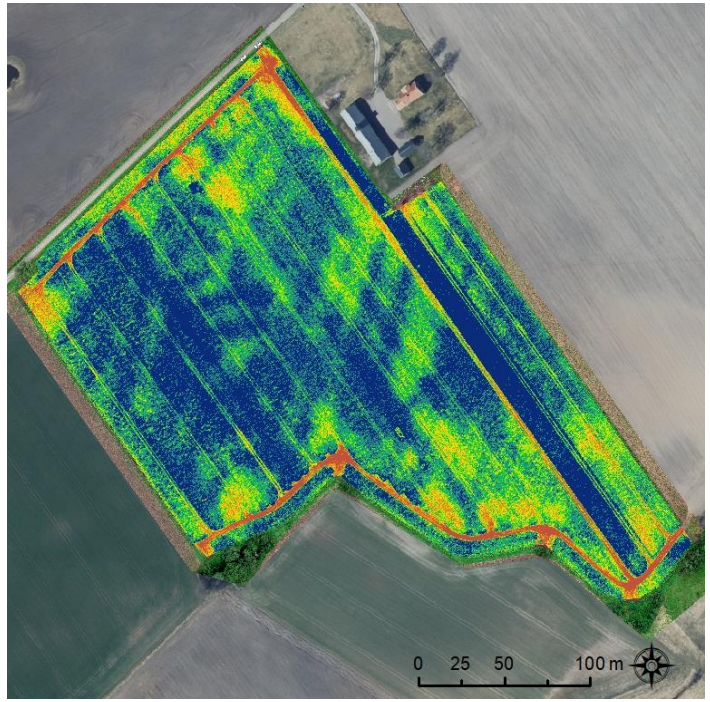
Micasense Altum



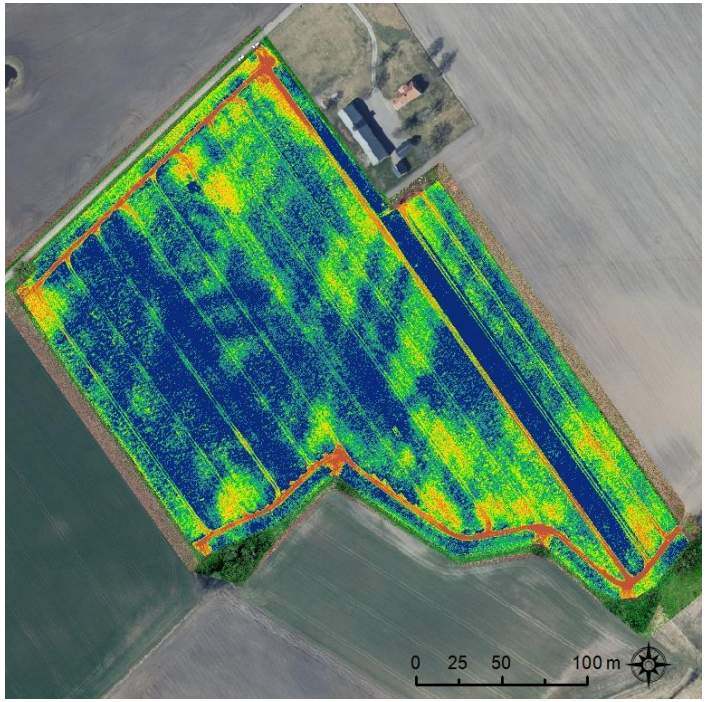
Mavic 3M



Micasense Rededge



Maia



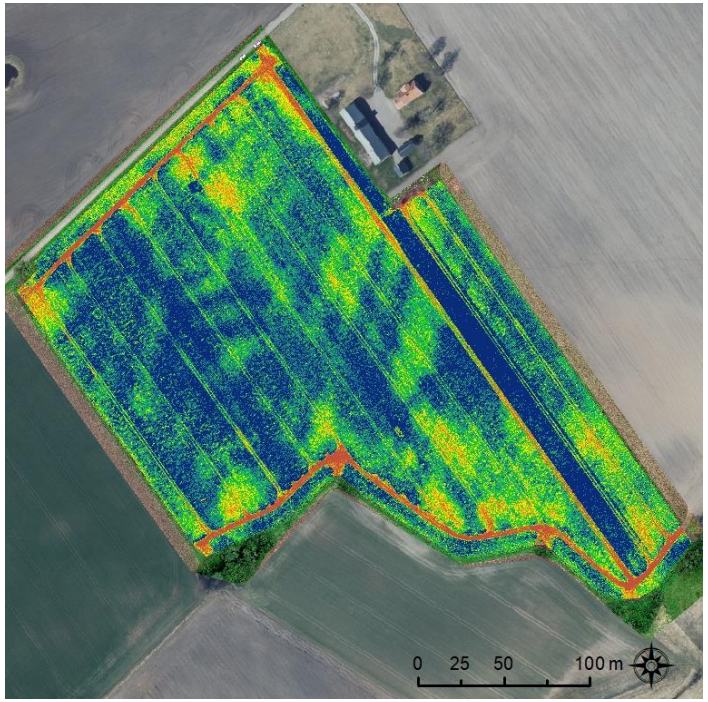
NDVI

Different cameras

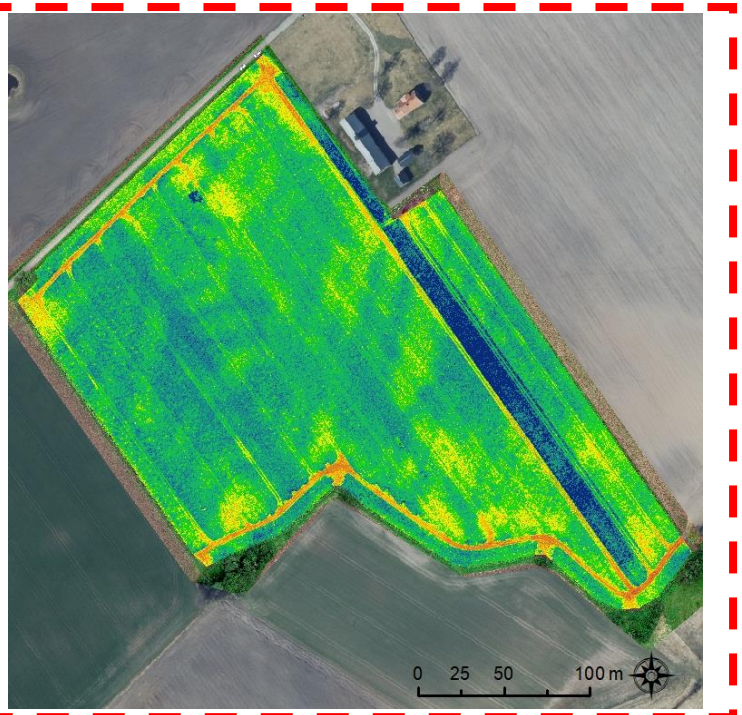
Fixed classes

>0.85
0.80 - 0.85
0.70 - 0.80
0.60 - 0.70
0.50 - 0.60
0.40 - 0.50
0.30 - 0.40
<=0.30

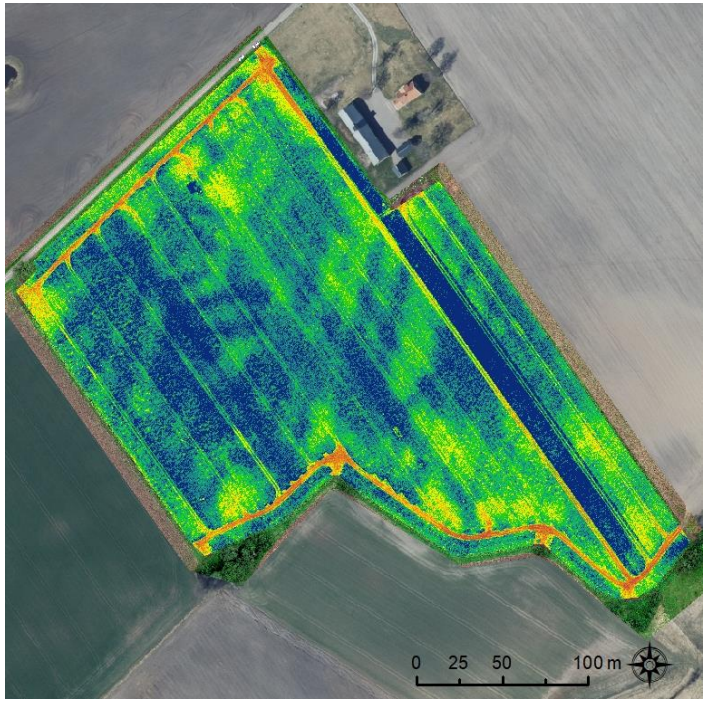
Micasense Altum



Mavic 3M



Micasense Rededge



Maia

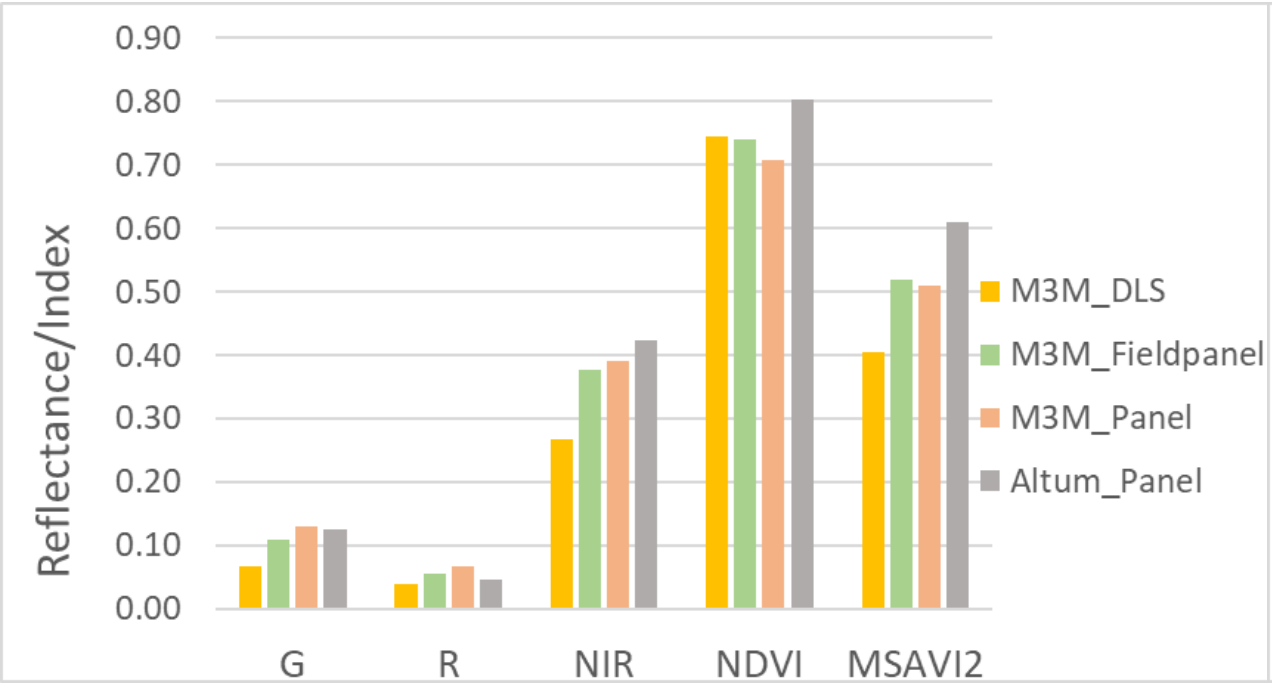
M3M

Field panels

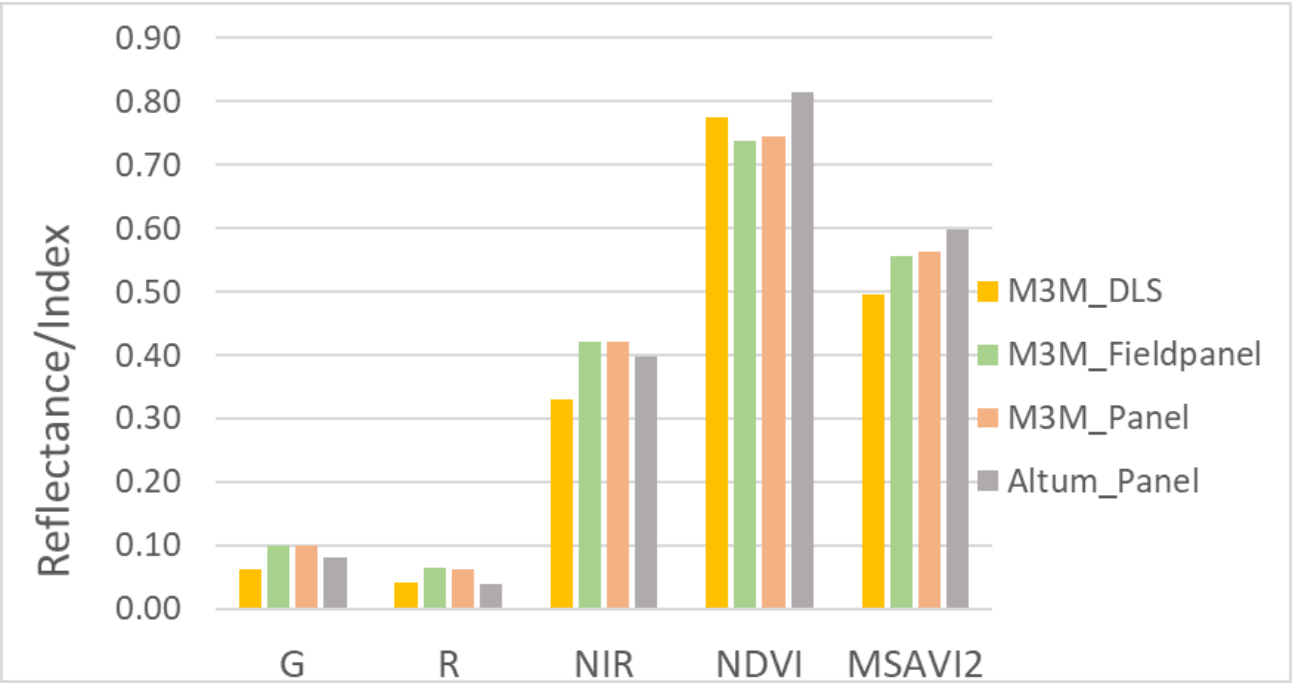
Altum

Altum panel

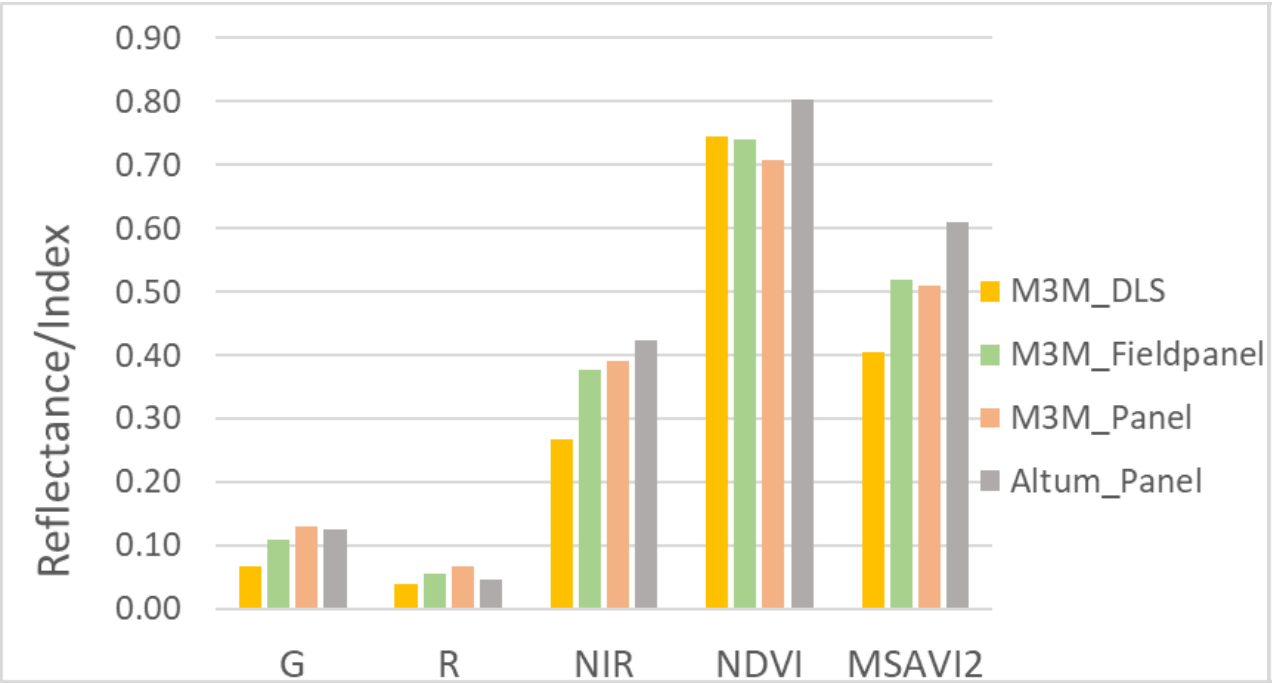
Arentorp 2023-08-18 - potato



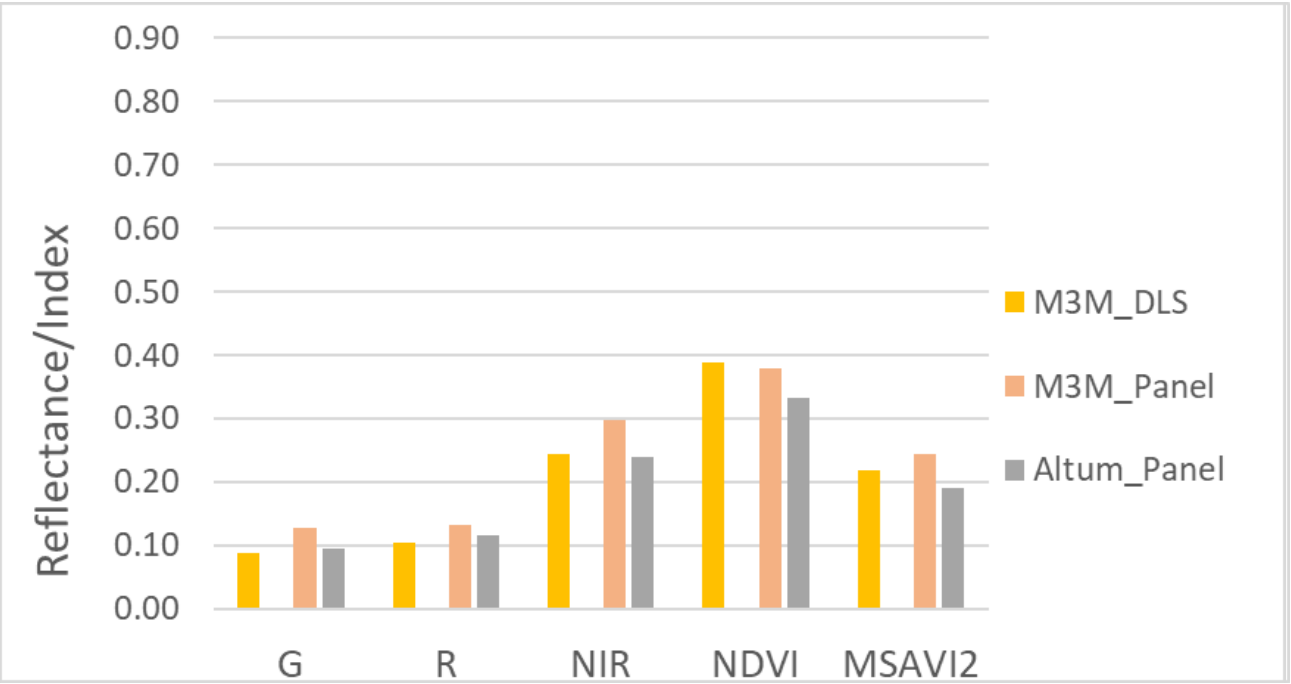
Lanna 2023-07-23 - peas



Arentorp 2023-08-18 - potato

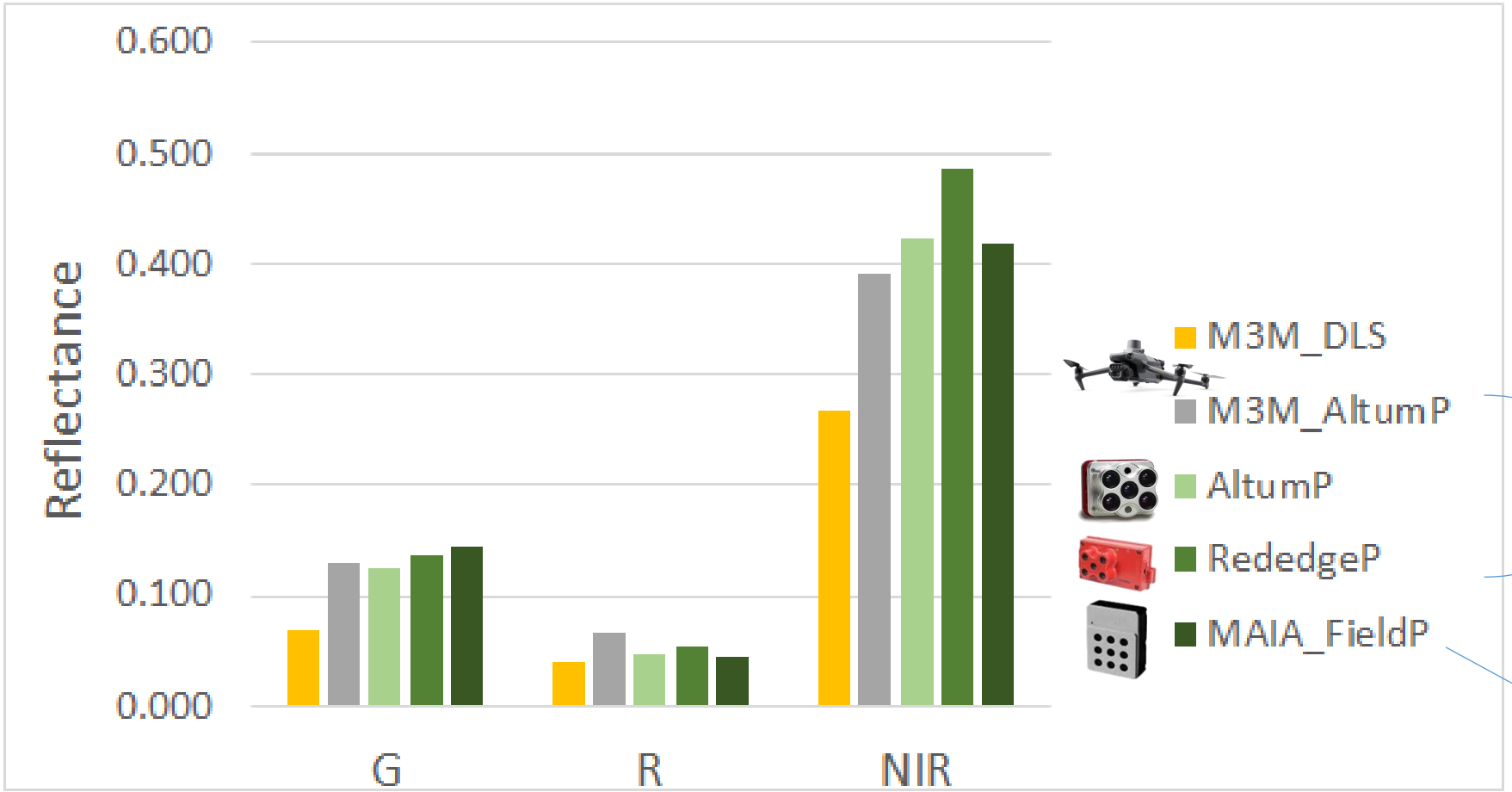


Broccoli (Altum-PT – slightly broader bands vs. old Altum)



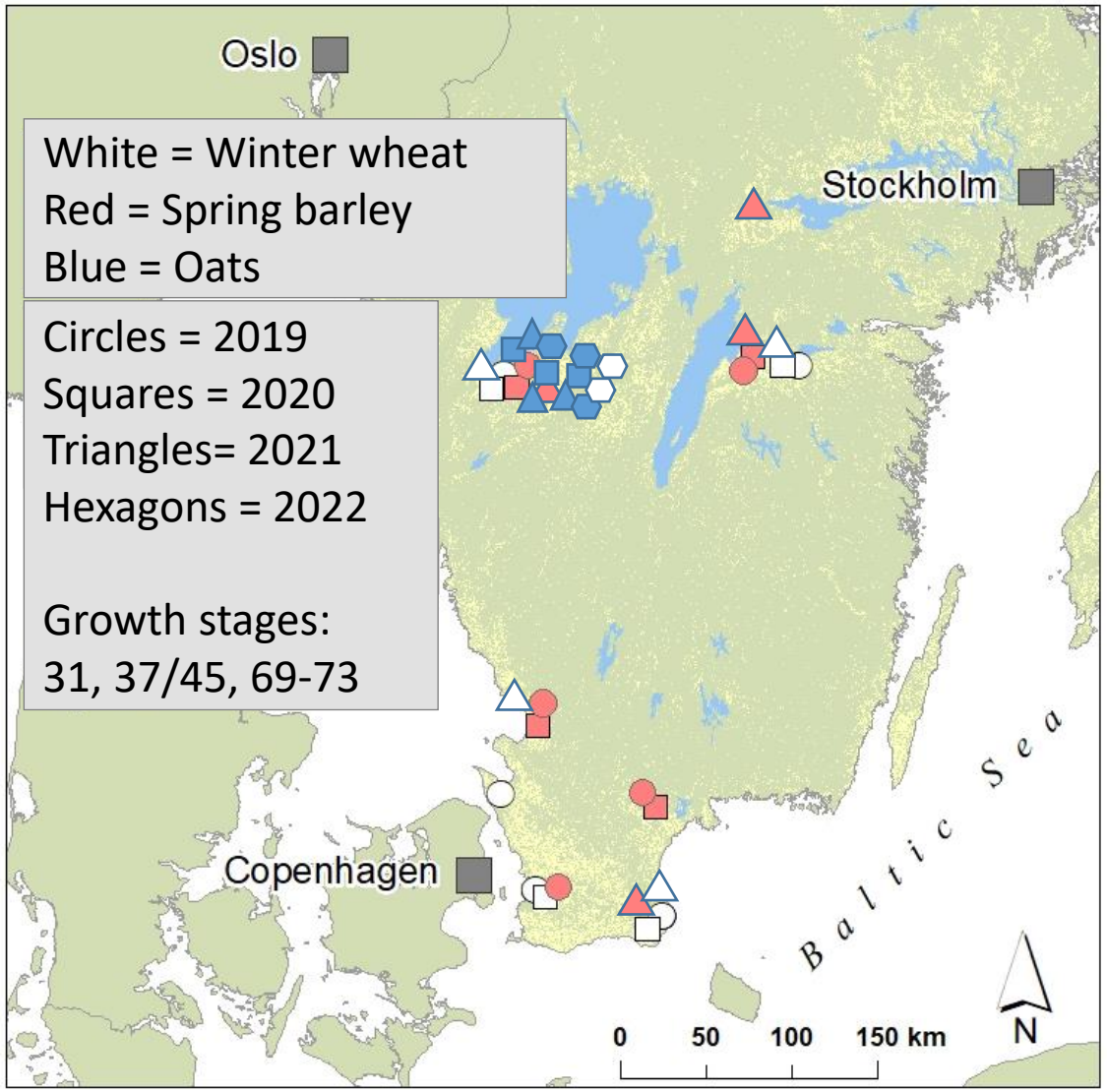
Different from the tests in potato and peas

--> Only small differences between the cameras

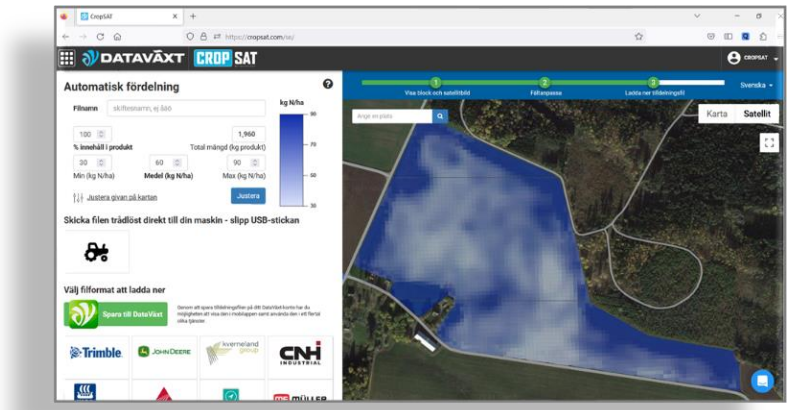

0.600
0.500
0.400
0.300
0.200
0.100
0.000
Reflectance
G
R
NIR
M3M_DLS
M3M_AltumP
AltumP
RededgeP
MAIA_FieldP

Why may calibrated reflectance be important?

For example – in models based on real numbers, e.g. Target-N®



1. Drone data collected multiple dates, years, sites, crops
2. Sensor-based models for precision N fertilisation developed
3. Transfer of drone models to satellite data
4. Application of models in satellite images based decision support system

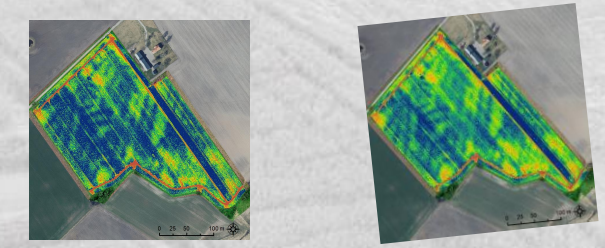


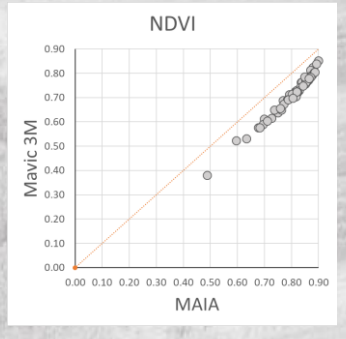
CropSAT.se

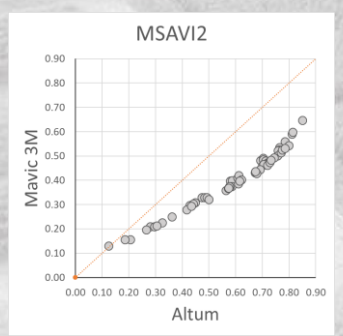
*Piikki, K., Söderström, M., Stadig, H. (2022). Field Crops Research, 289, 108742. https://doi.org/10.1016/j.fcr.2022.108742

What did we learn from this?

- Measured reflectance varies a little between sensors
- The difference is reduced when translated to vegetation indices
- Indices that use red-edge band (NDRE etc) give different results with Mavic 3M imagery (because of different wavelength)
- Using calibration panels provides most consistent / comparable results across sensors







Thank you!

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Get The Complete UAV Handbook for Agricultural Research at https://solvi.ag

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VÄSTRA GÖTALANDSREGIONEN SLU solvi

Read more:
www.slu.se/LADS