4th Annual Nordic Plant Phenotyping Network Workshop

Remote Sensing for Soil zoning and Disease detection

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Rungsted, 22nd of November 2018

How it started

A Drone and Hyperspectral Camera in Vineyards

How it started

International research on sensors and robotics

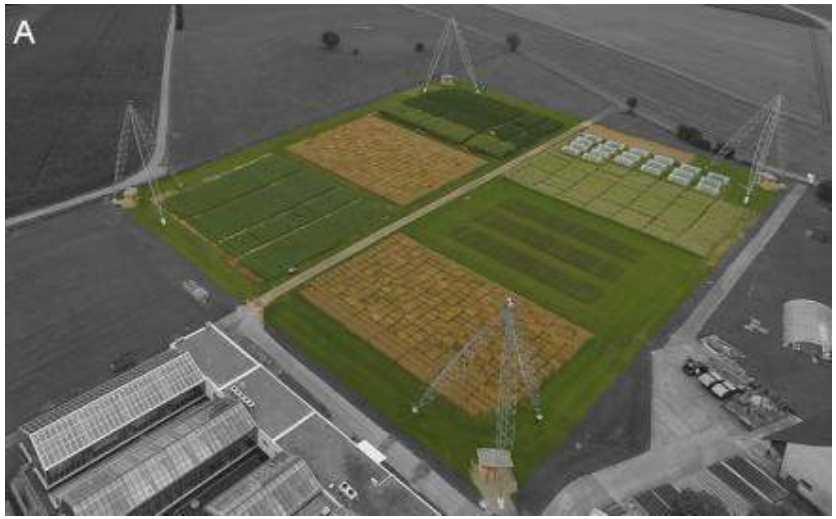
Research in Vineyards

Laboratory analysis

More than 100 samplings performed in 3 seasons
More than 150 drone flights with hyperspectral sensors
Data captures with machinery on ground with several sensors including hyperspec & thermal
Chemical analysis of leafs and grapes together with ZHAW and Uni Geisenheim

Vision of ETH Crop Science

- is to provide innovative pathways to identify and generate more versatile and efficiency-oriented crop production systems of major and alternative crops
- Improved understanding of basic rules governing plant environment-management interactions.



Rope suspended
Field phenotyping platform (FIP)
Kirchgessner et al 2016, FPB

How it continued

Satellite Imagery and Systems used

Sentinel – 1

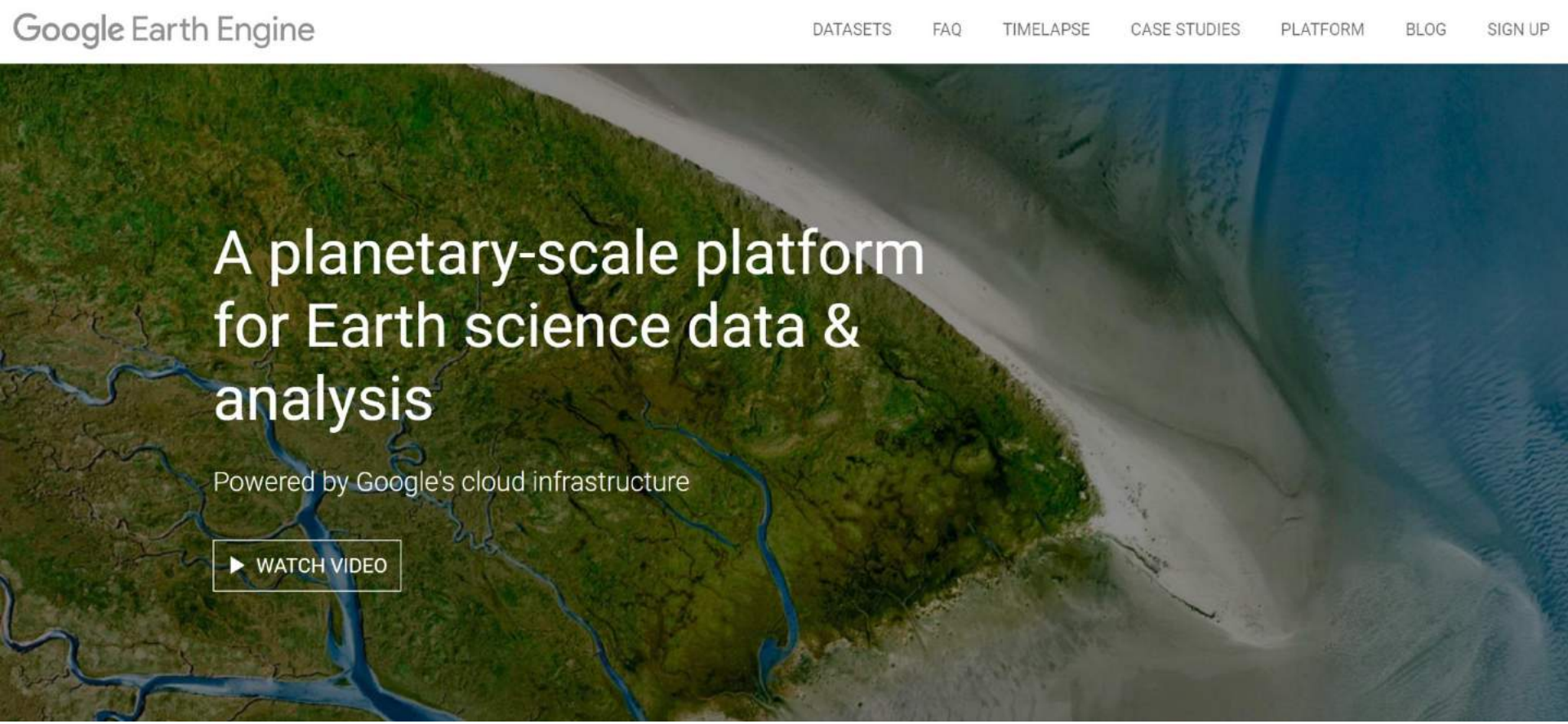
- C-band SAR
- 5 cm wavelength
- 10 meter resolution
- VV and VH polarization channels
- Physical and dielectric properties

Sentinel – 2

- Multispectral Imagery
- 443 – 2190 nm wavelength
- 10 – 60 meter resolution
- Absorption and reflectance properties

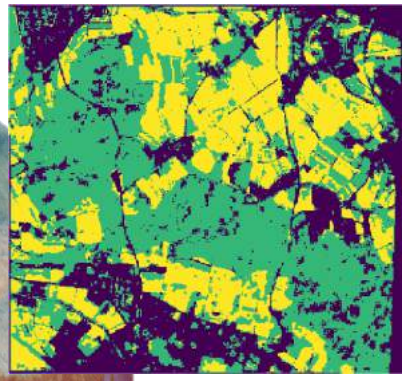
How it continued

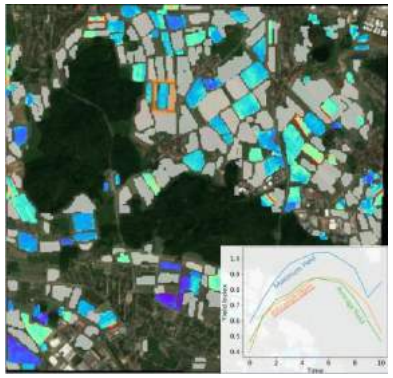
Contract and collaboration with Google Earth Engine

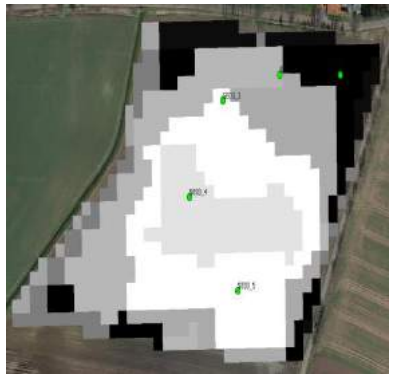


How it continued

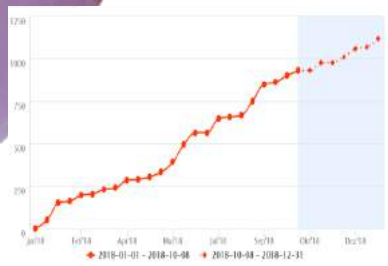
Big scale to single field with best data accuracy

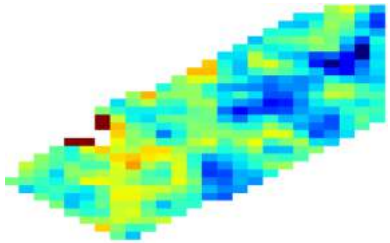






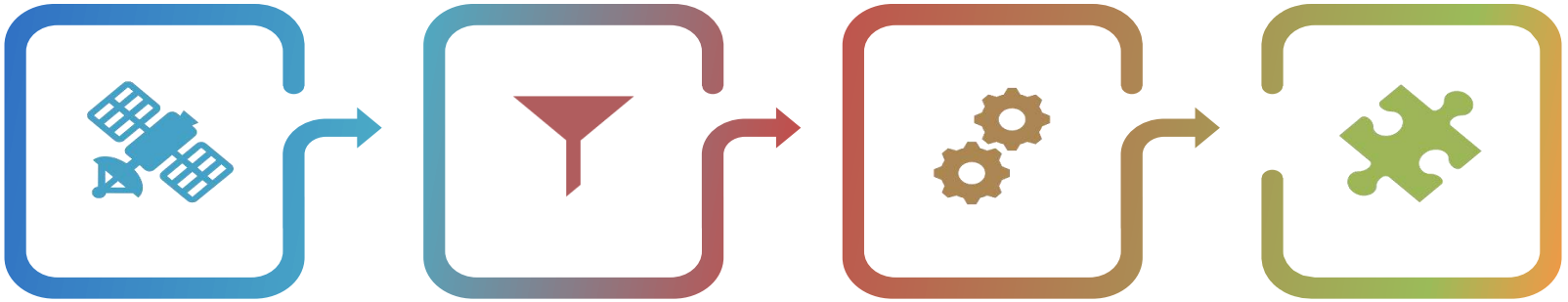
From Global to local

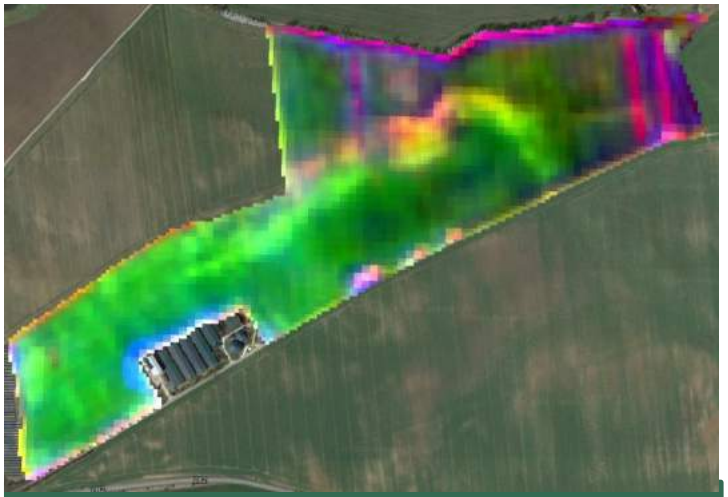




- Go from Global to fields to crops to soil zones to understand fields
- Go from weather with ECMWF data to local high-res temperature and soil moisture
- Farmer would only need to put PLZ and pin for field to deliver recommendations on variety, yield planting density, crop protection/disease risks and fertilizer quantities

Soil Zoning with superior Quality based on soil





Feature RGB Soil based on Sentinel 1 and 2

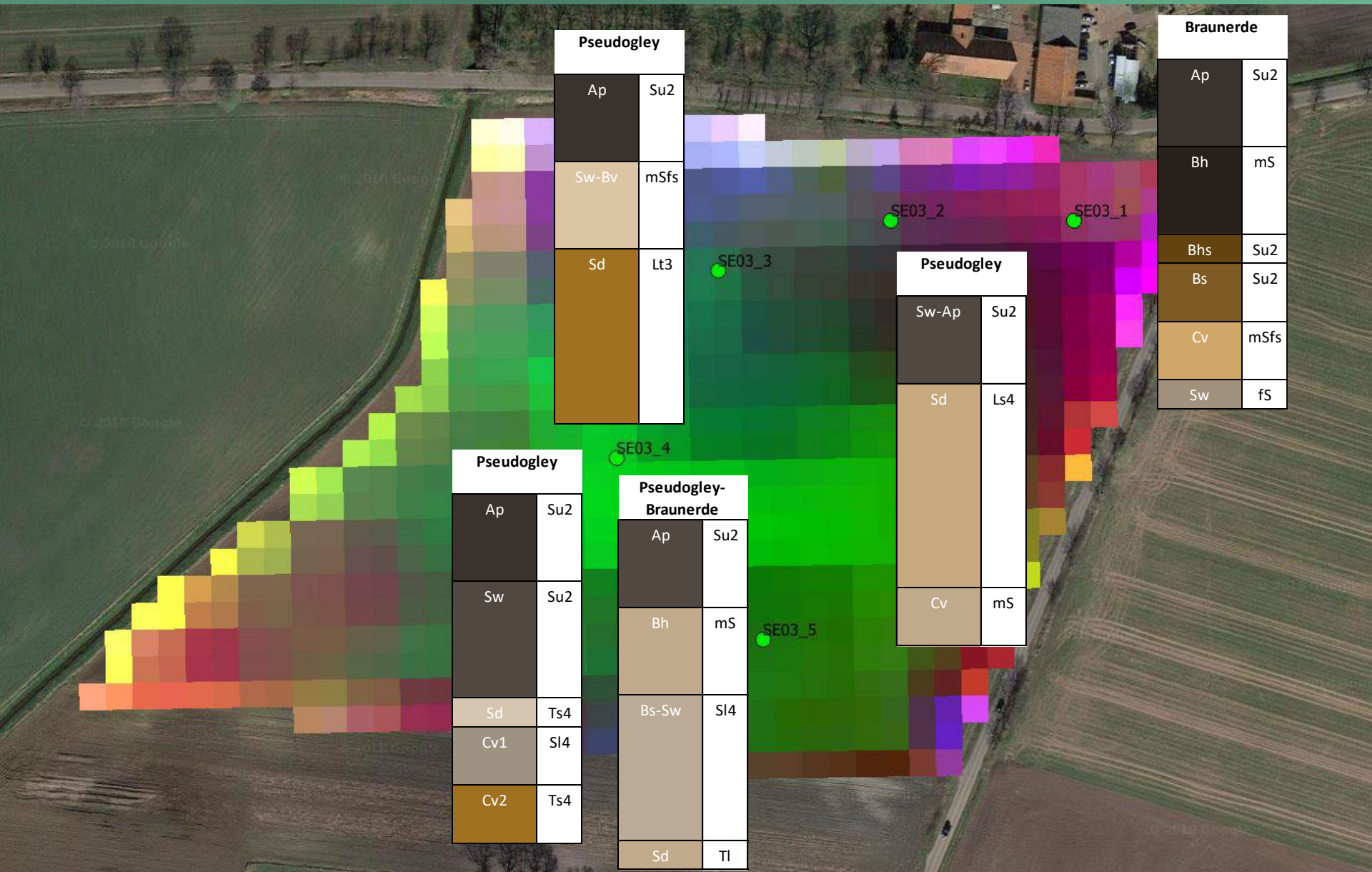
Soil zoning based on Sentinel 1 and 2

Soil zoning validation

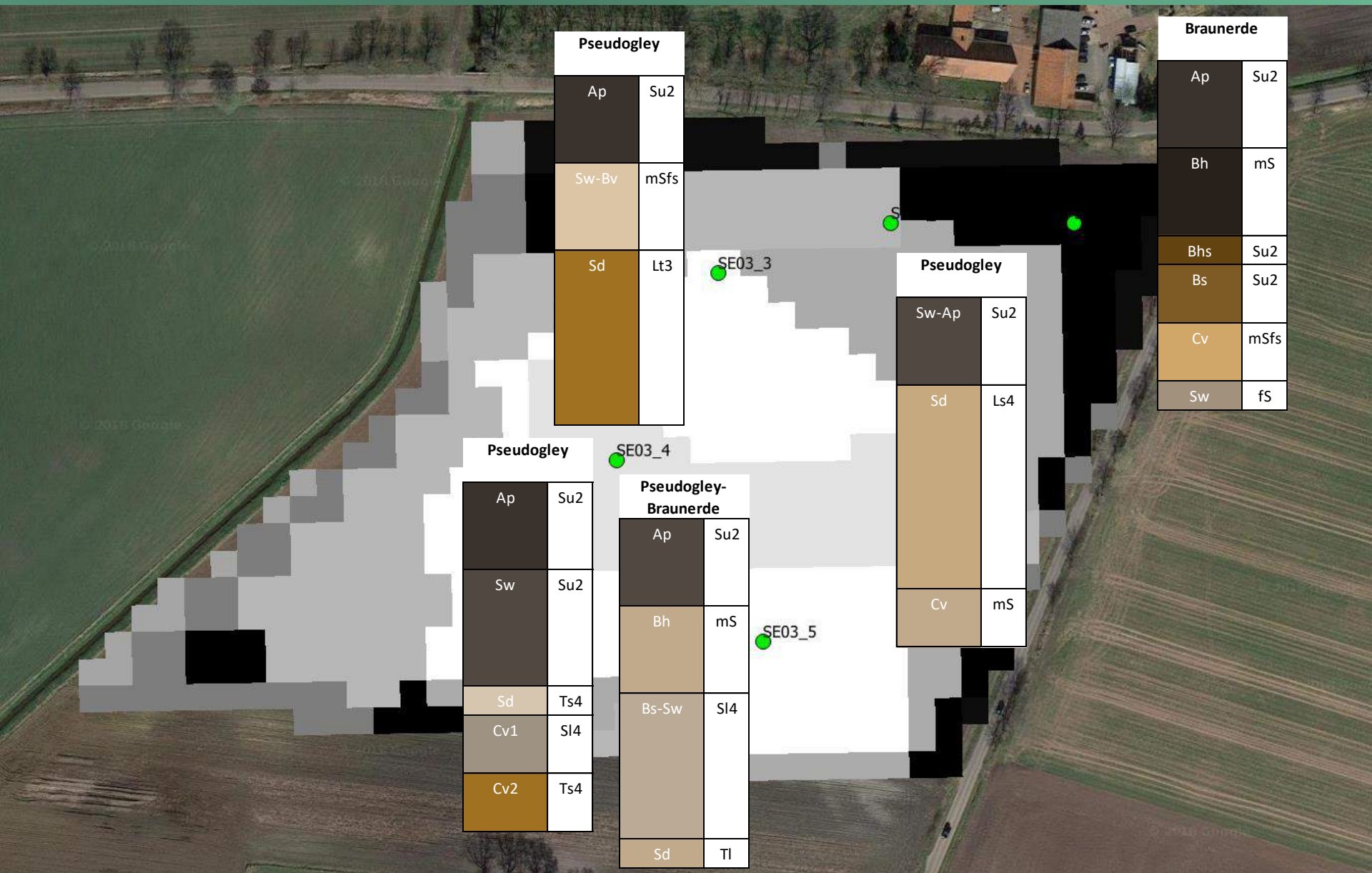
Seelmeyer SE03, German Soil map

Soil zoning validation

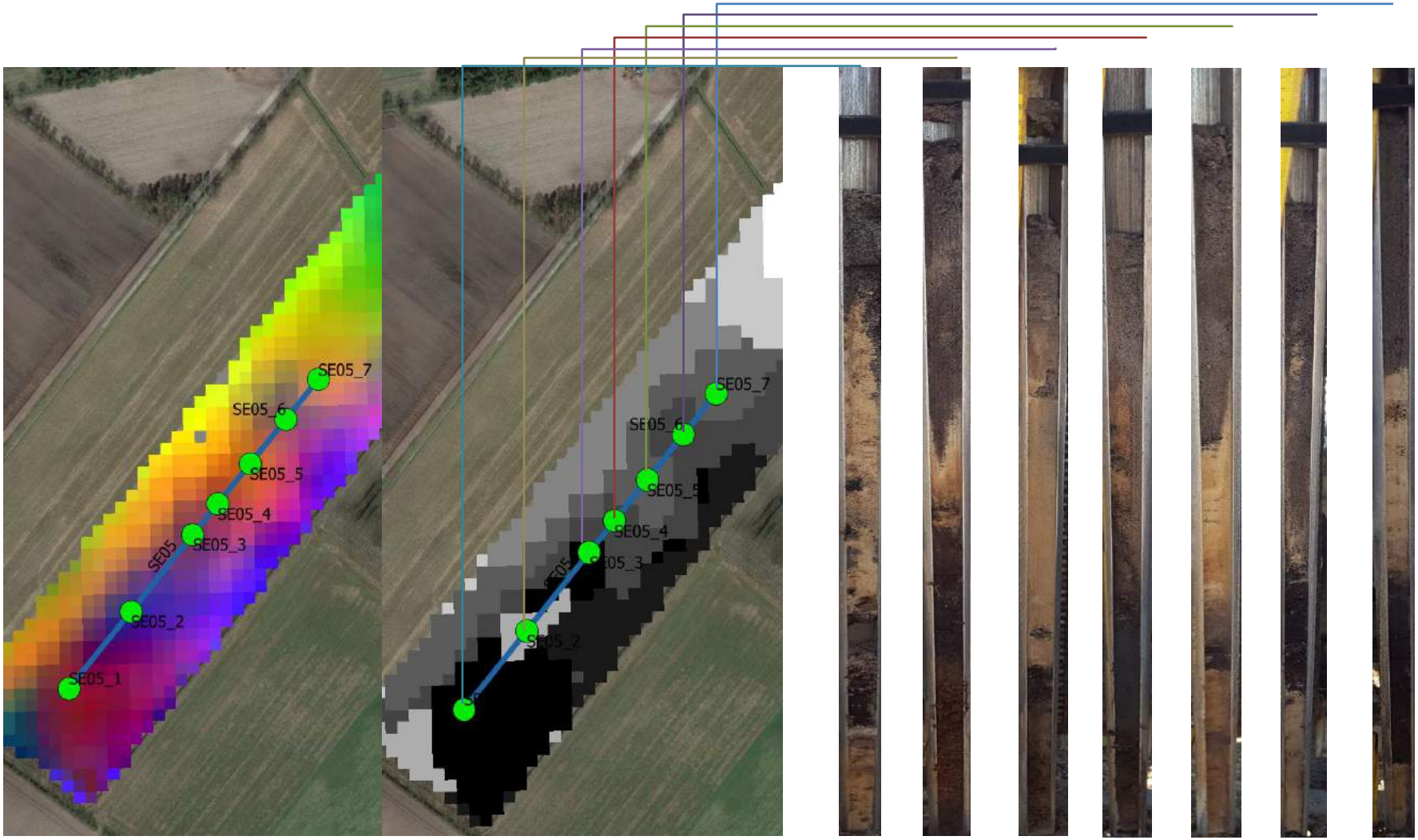
Seelmeyer SE03, RGB-Image



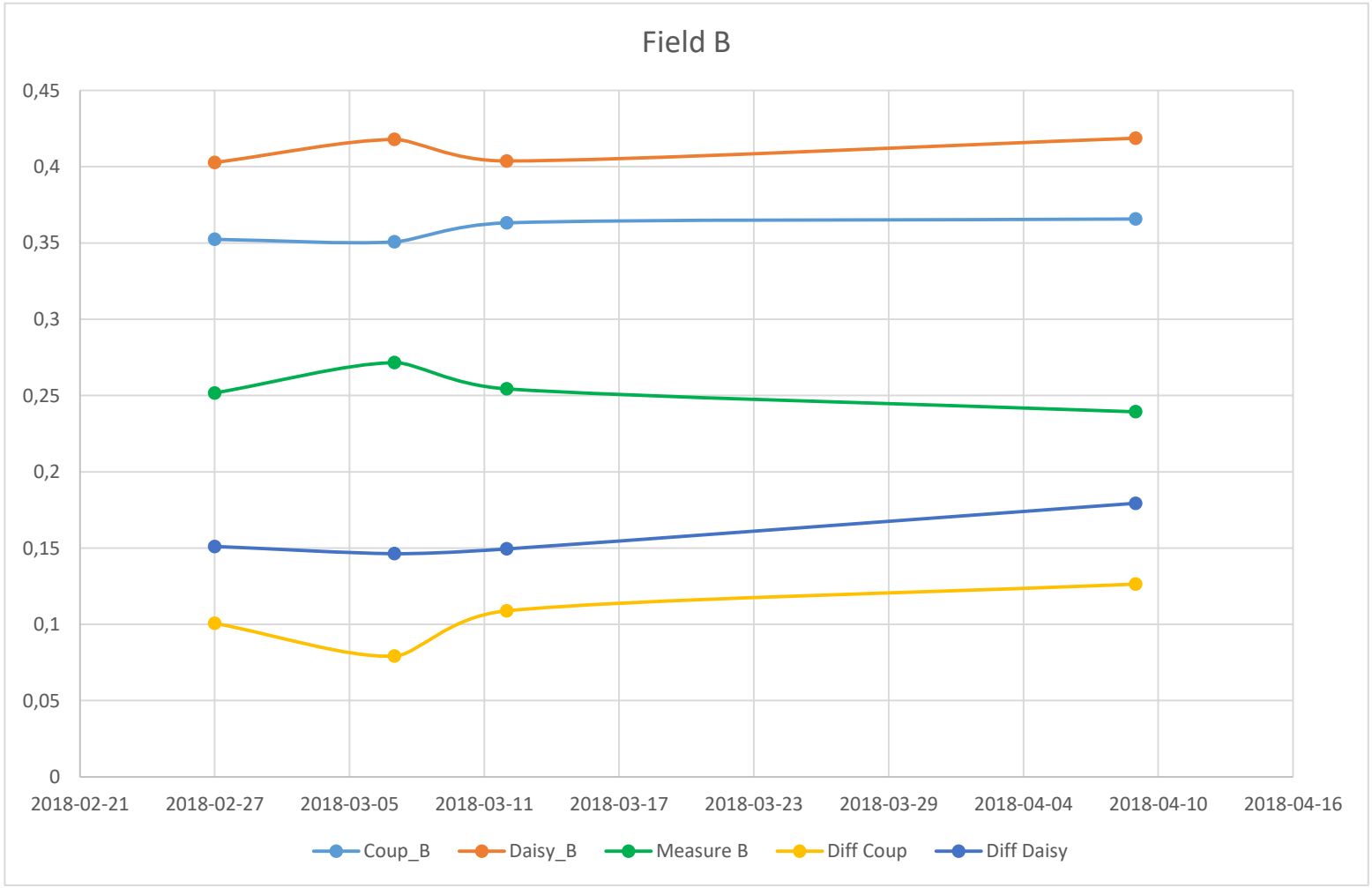
Seelmeyer SE03, Soil zoning and soil profiles



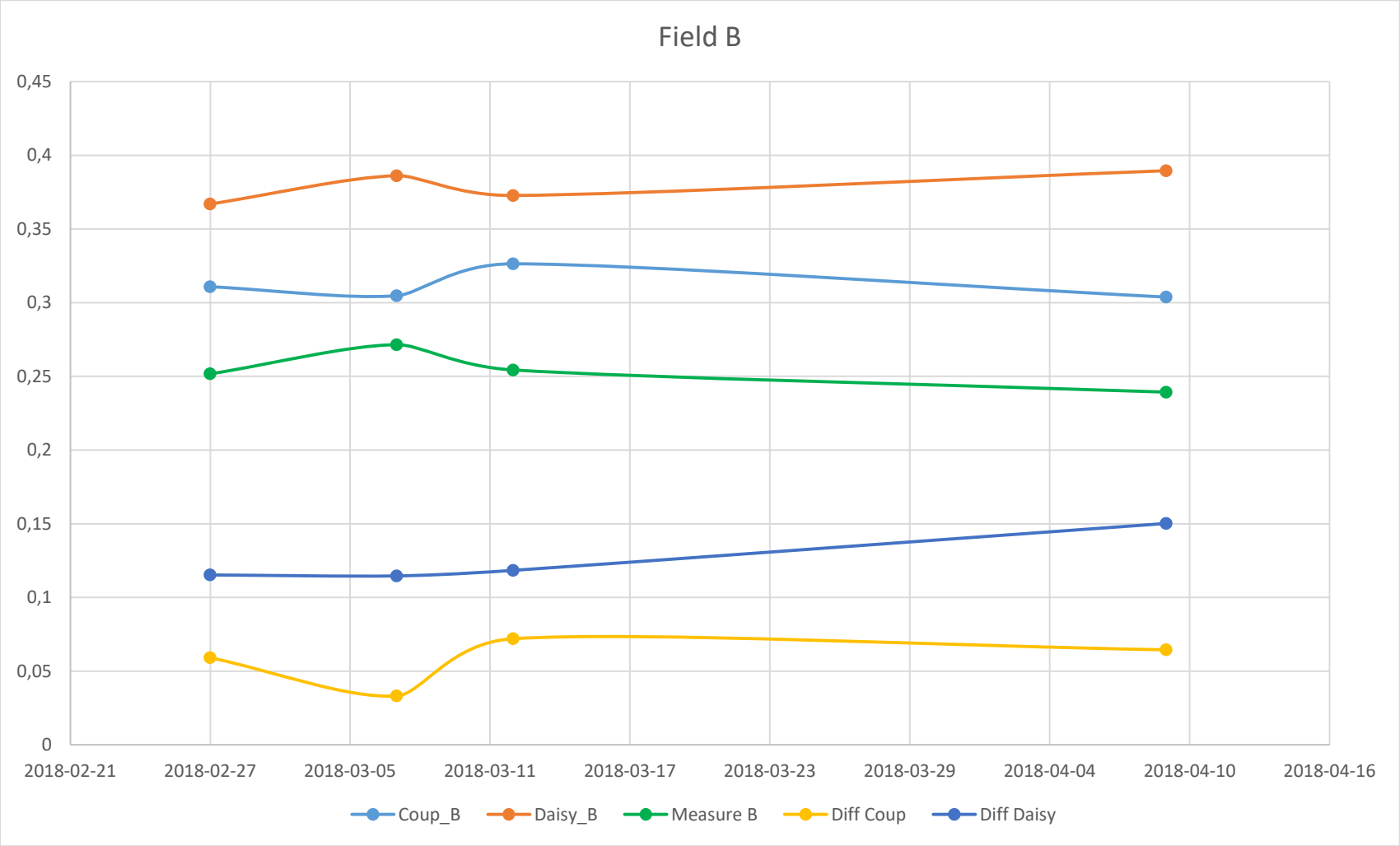
Soil zoning and Profile pics



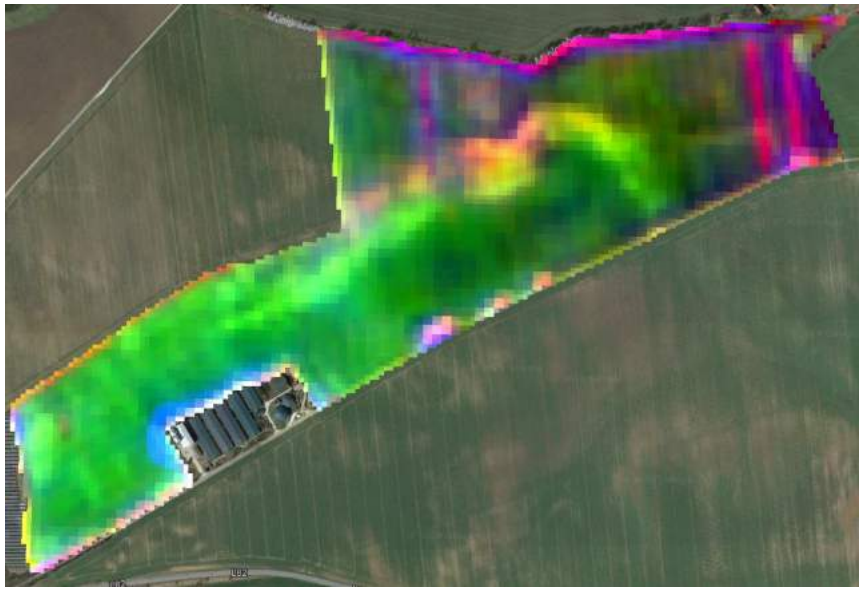
Soil Moisture Field B Soil geological data



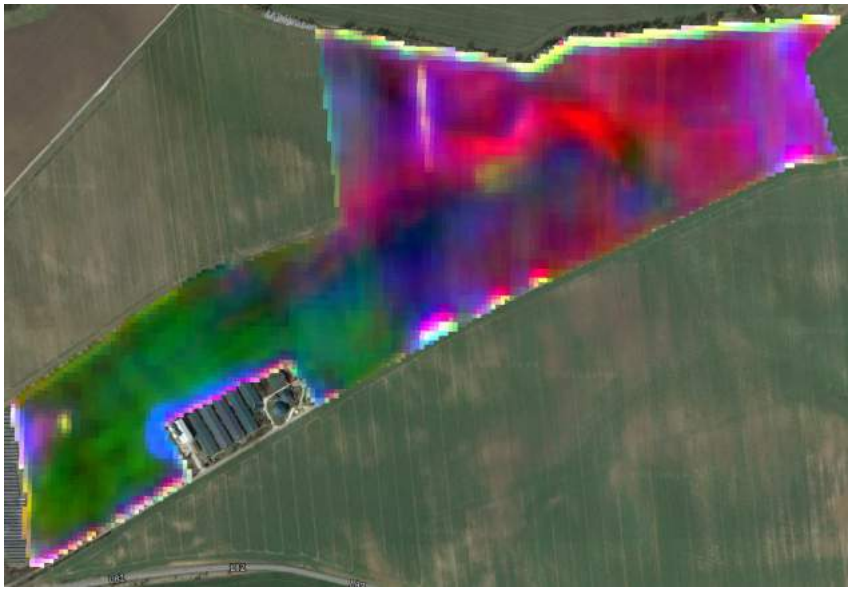
Soil Moisture – Field B Soil Sampling Analysis



RGB Soil vs. Plant to see issues over time



RGB Soil



RGB Plant

Zoning Soil vs. Plant

Soil based zoning

Plant based zoning

Get your results directly at the end of the flight

Live on flight data processing of up to 150ha per flight

- Sensor captures 30+ bands between 450-950nm
- Data gets automatically calibrated
- Drone covers up to 150ha per flight
- Sensor able to detect diseases, infections, weed populations, mechanical damage and more

Measurement of INFECTIONS and diseases

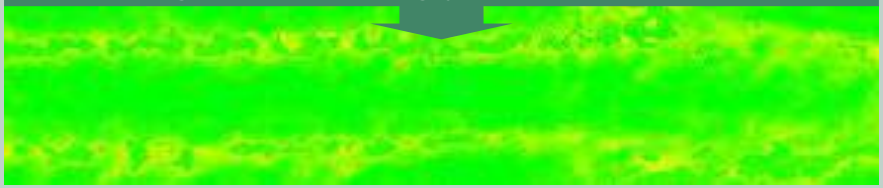
Infection and disease measurements

- Detect infections of crops
- Identify and quantify diseases
- Measure leaf and produce ingredients
- Measure mycotoxines in produce
- Detect best timing to spray crop protection and plant activators through direct drone measurements

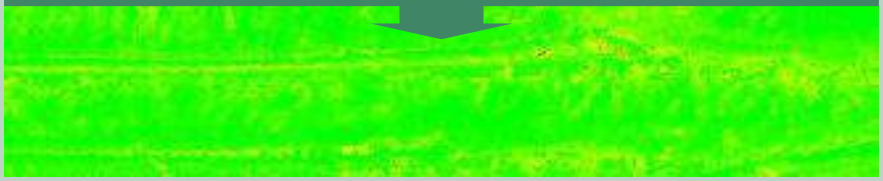
Measurements allow for:

- Identification of infection and spread
- Spot treatment of infected areas
- Diseases not to become epidemic?

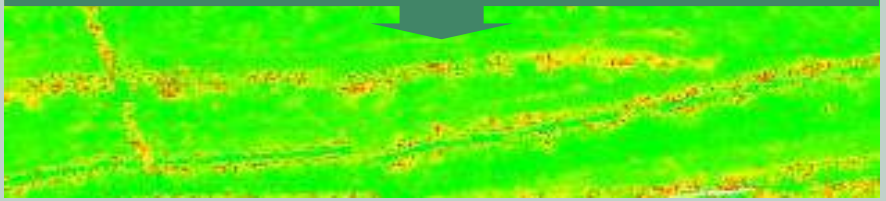
2 rows of grapes showing yellow “aura” of protection



Measurement of auto immune reaction in field



Heavy spread of disease in all rows 10 day later



What works in Vineyards also works in Potatoes?

Video on work in Potatoes:
https://www.youtube.com/watch?v=Rd_0iQRL0YQ

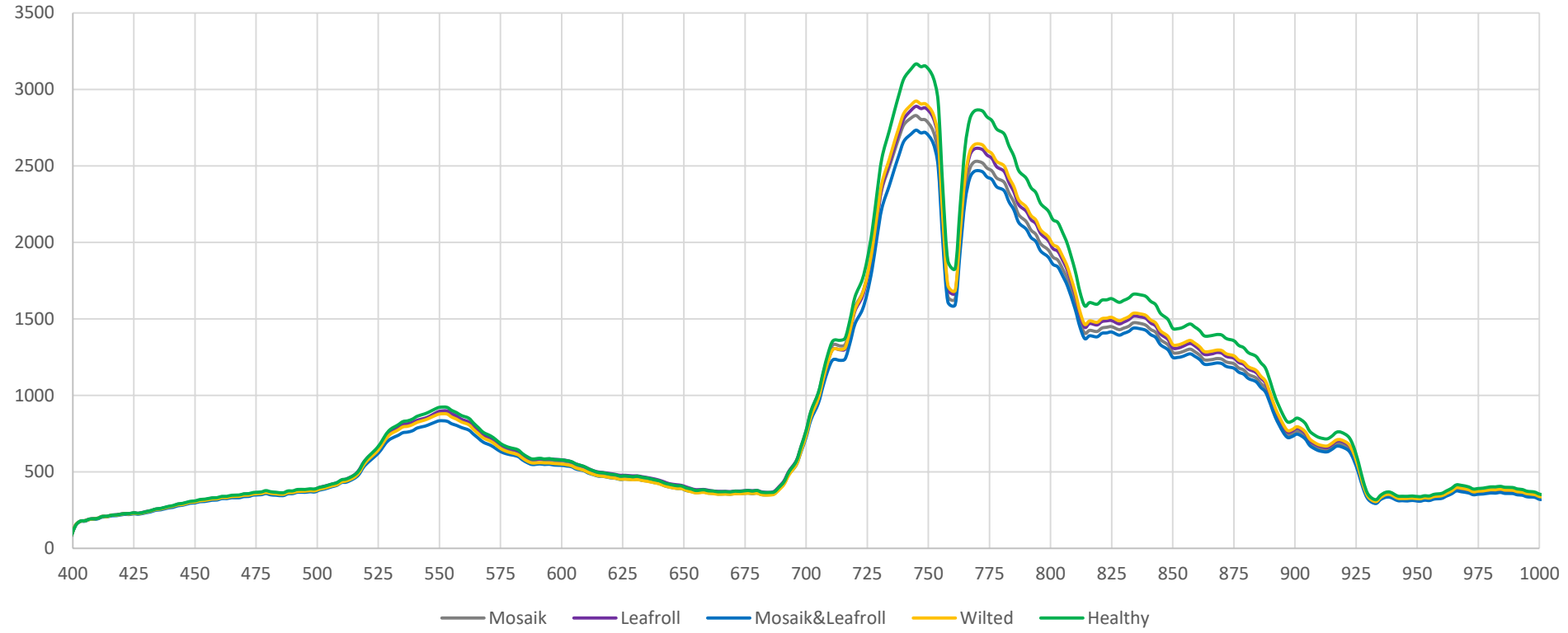
The trial setup

- Matrice 600 Pro
- Ronin MX
- Headwall UAV Nano with 272 bands
- Photonfocus with 41 bands

- Panels measured at fligth
- Diseased and healthy plants measured
- Panels used for every flight

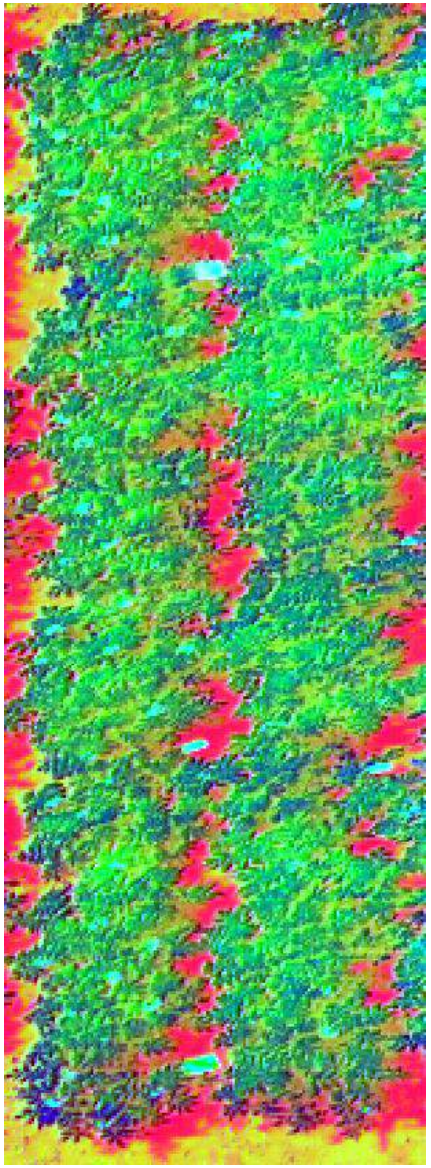
- Each plant is marked with labels always north of the infestation

First results – The Spectra

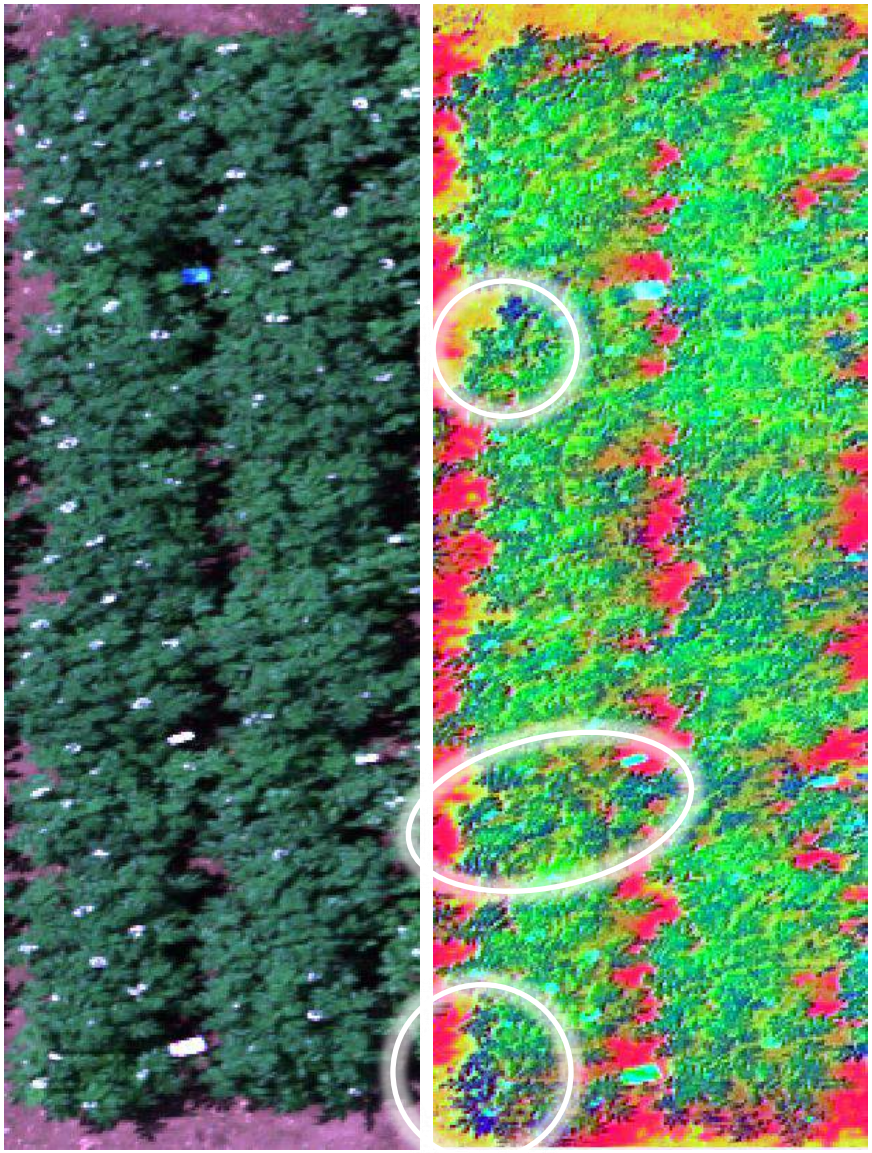


- The different diseases and healthy have different spectra
- The spectra vary per variety and a healthy spectra of Variety A can be disease on Var. B
- Therefor we only have limited sample sizes and can only do limited classification

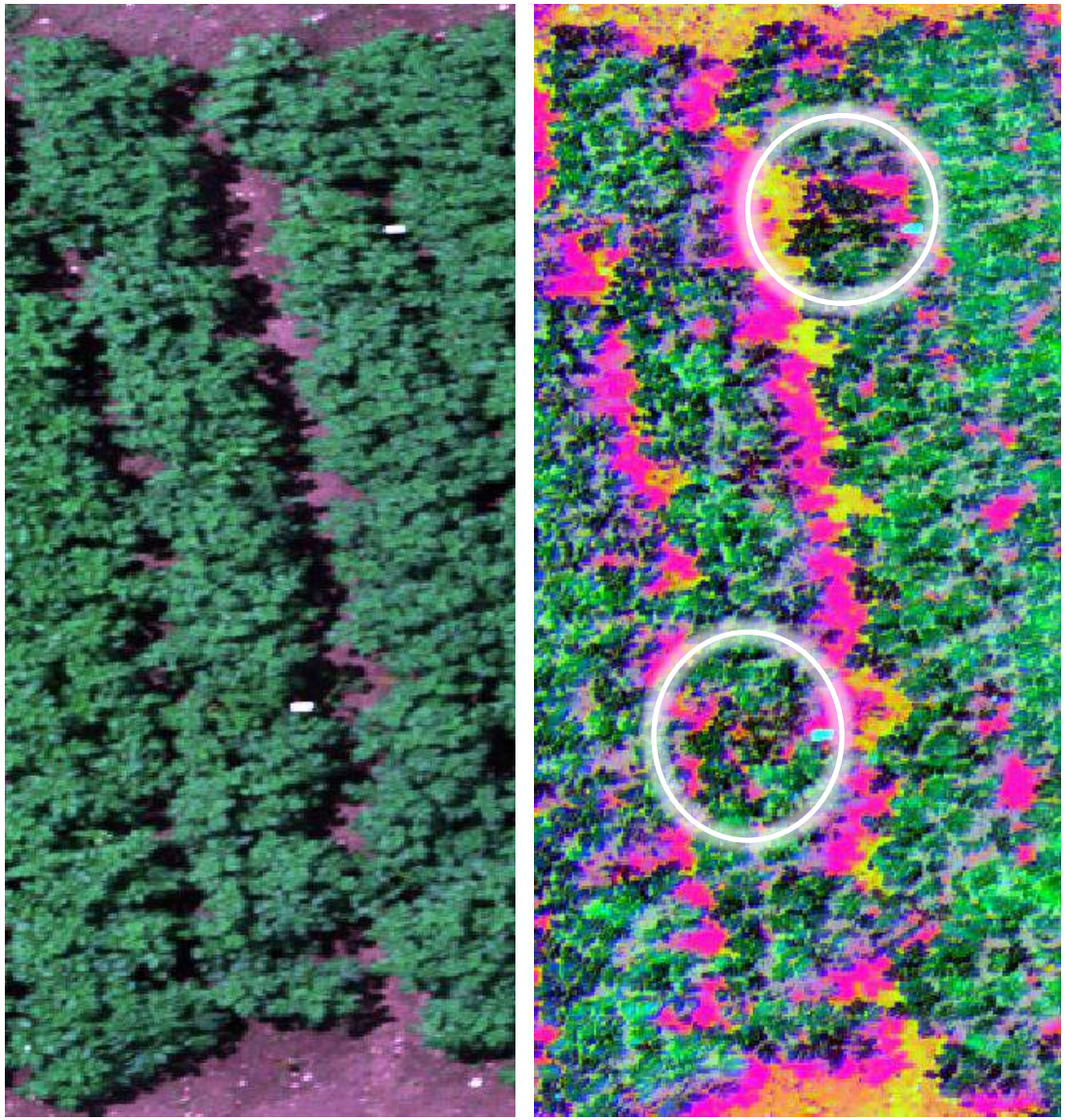
Identification of Mosaic and Leafroll Virus



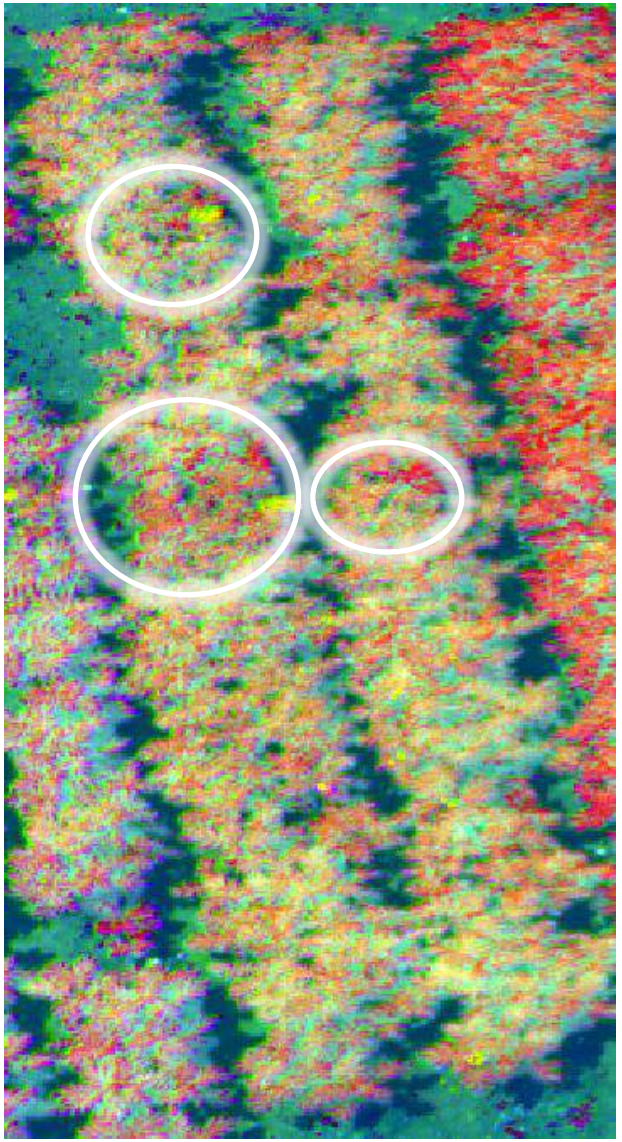
Fontane



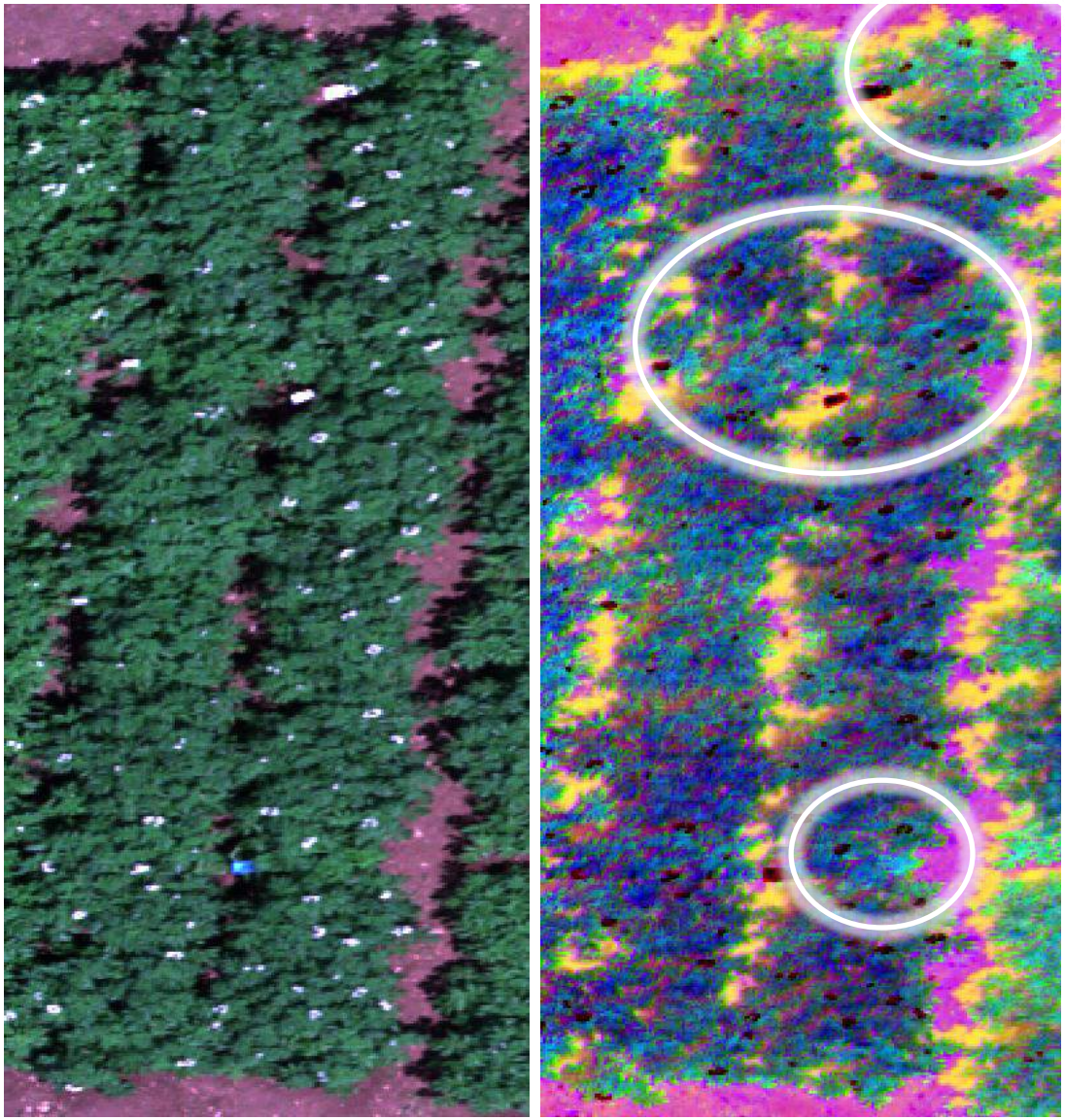
Ditta



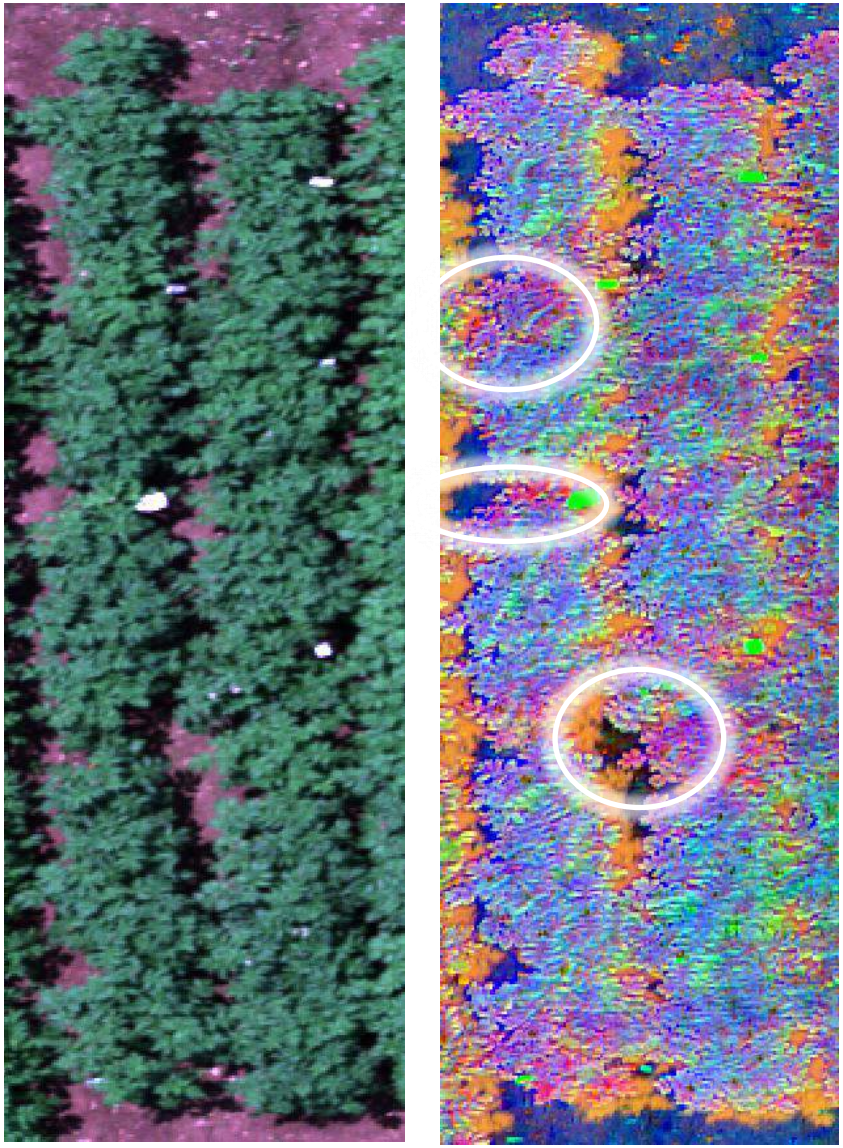
Amandine



Innovator



Victoria



Results in Potatoes

Identification of Alternaria

THANK YOU