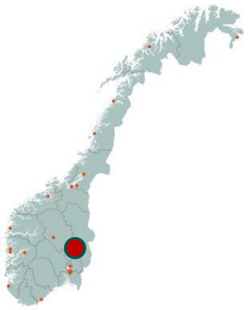
NIBIO

NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

Jakob Geipel

Research Scientist

Experiences from remote sensing in agricultural field trials at NIBIO – Centre for Precision Agriculture



Jakob Geipel, Apelsvoll, Norway, February 8, 2023

The mission of the CPA is to contribute to a resource-efficient and sustainable agriculture by shortening the time-span farmers need to adopt new agricultural technology.

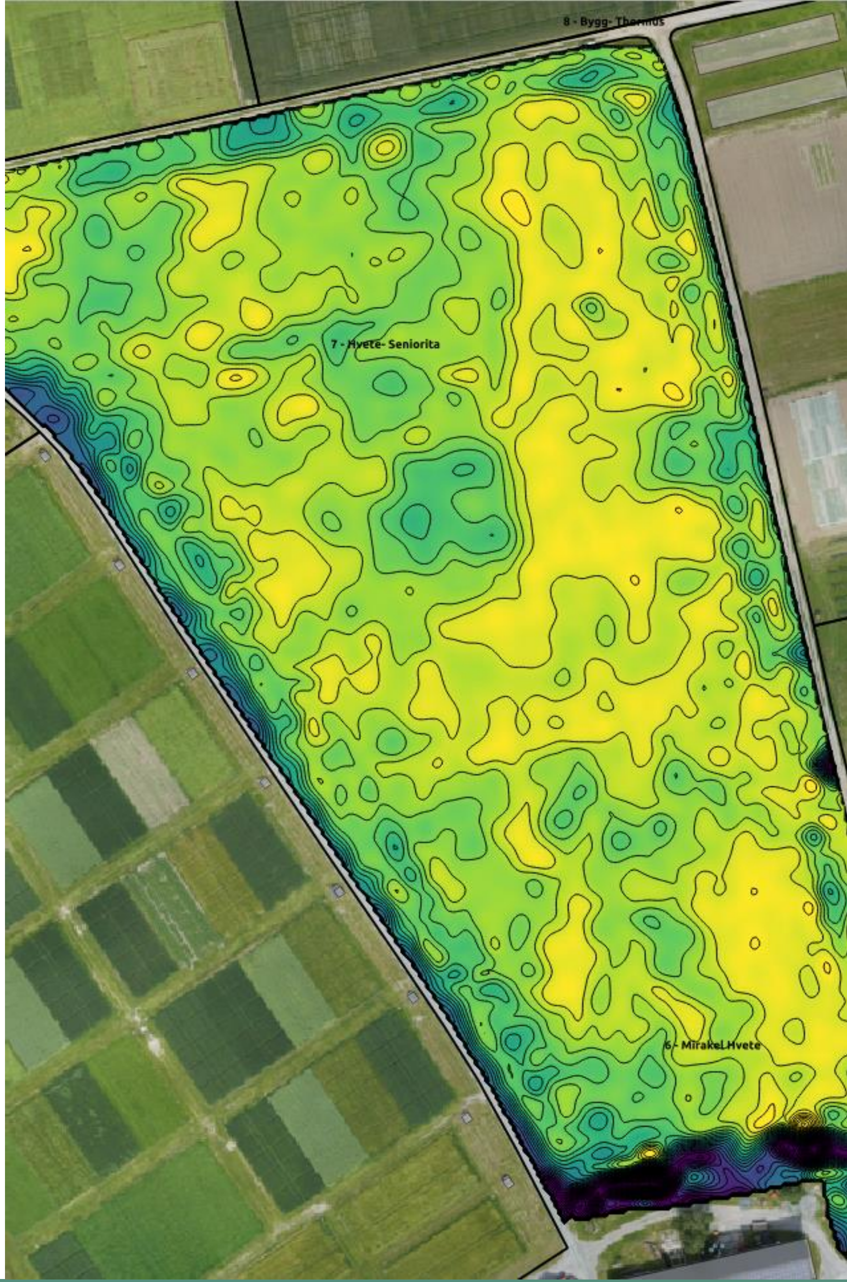
Image: Maximilian Pircher

What is precision agriculture?

Precision agriculture is a **management concept that accounts for within-field variability** by exploiting the possibilities of the latest information and agricultural application technologies.

(Stafford 2000; Whelan and McBratney 2000; Auernhammer 2001)

The terms **precision agriculture (PA)** and **precision farming (PF)** are often used synonymously. Nevertheless, PF can also be interpreted as subdiscipline of PA, focusing crop production on fields.



In simple words…

Use expert knowledge and innovative technologies to perform the **right thing**, at the correct **amount**, **time**, and **place** in the field.

Increase the **use efficiency** of inputs and **reduce losses** to the environment!

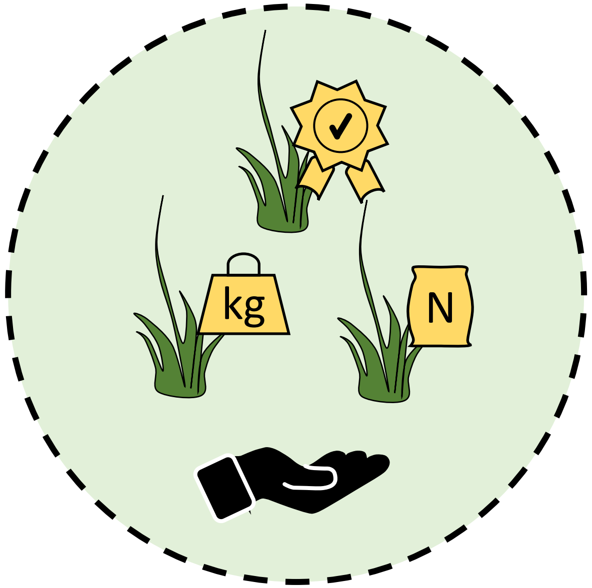


Figure: Jakob Geipel

Decision making is a tough job

- Based on own experience or consultation/service?
- Focus economic or ecologic optimization?
- Often complex and needs to balance different aspects
- **And where do I get updated field information from?!**

Sensing as a key to retrieve information

- In contact with the object of interest (in-situ) or **remotely** (proximal and distant)
- Various platform and sensors
- On-line and off-line approaches
- Qualitative and quantitative information
- Georeferenced by GNSS and INS information
- Can be automated!

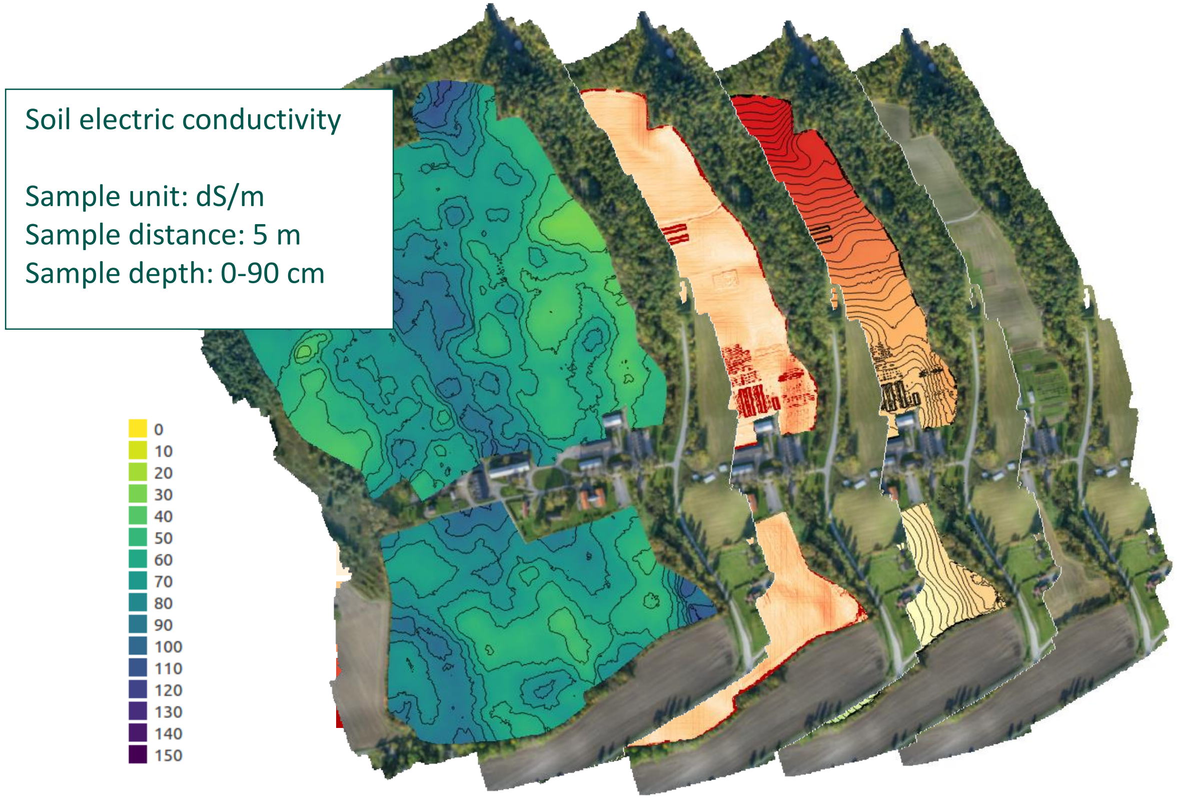
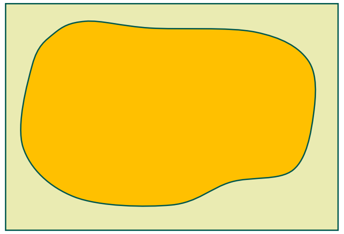


Figure: Jakob Geipel

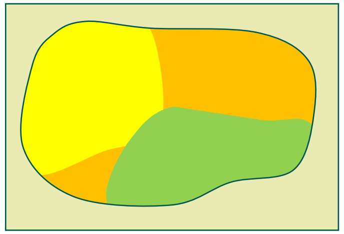
Increasing demands at detailed application levels

Conventional

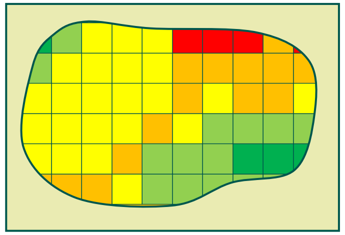
PA



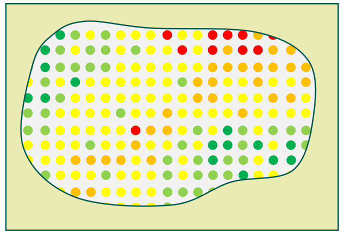
uniform



site-specific
(zones)



site-specific
(cells)

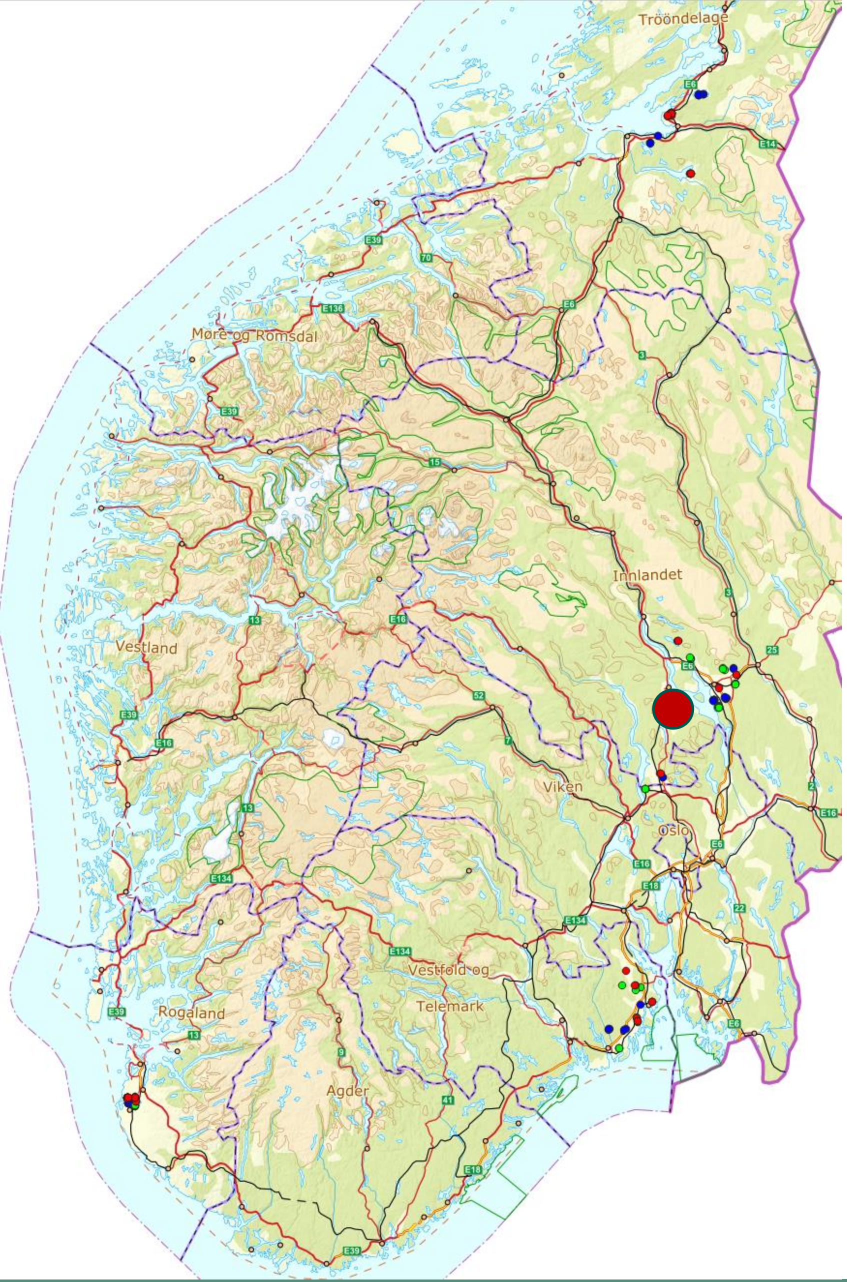


plant-specific

low → high

spatial accuracy
information demand
processing capacity

Figure: Jakob Geipel



Remote sensing at the CPA

- Long lasting tradition at NIBIO Apelsvoll (since 2004)
- Core group of 4 research scientists, 3 research technicians and 1 software developer
- 7 associated crop and soil experts
- Wide variety of sensing and modelling competences
- Wide palette of sensors and other equipment
- Hundreds of sensor measurement campaigns per year
- Custom data storage system and processing pipelines

Figure: Jakob Geipel, Kartverket Norge

NIBIO

Groundtruth sampling and analysis

- Regular small- and large-scale field experiments
- Georeferenced sampling location (RTK-GNSS)
- Destructive and non-destructive plant sampling in the field
- Gravimetric determination of above-ground standing fresh and dry matter
- Lab analysis for quality parameters

Image: El Houssein Chouaib Harik

Handheld sensing

- Advantages
  - Sensor instruments and wavebands adapted to agricultural monitoring
  - High degree of freedom regarding spatial, spectral and radiometric accuracy
- Disadvantages
  - Labor intensive and therefore often discrete sampling at *representative?* locations in the field
  - Often reduced data quality and integrity (manual operator)
  - Expert knowledge for post-processing needed

Image: Kristian Rindal

Tractor / vehicle sensing

- Advantages
  - Sensor instruments and wavebands adapted to agricultural monitoring
  - High degree of freedom regarding spatial, spectral and radiometric accuracy
  - Continuous measurement of large areas
  - Sensing can be combined with other field operations
- Disadvantages
  - Weather dependent
  - Few and only specialized sensor systems available

Image: Maximilian Pircher

Drone sensing

- Advantages
  - Sensor instruments and wavebands adapted to agricultural monitoring
  - High degree of freedom regarding spatial, spectral and radiometric accuracy
  - Rapid and continuous measurement of large areas when needed (timing!)
- Disadvantages
  - Weather dependent
  - Uncorrected data (low quality and integrity)
  - Expert knowledge for post-processing needed

Image: https://www.eliteconsulting.it/confronto-dji-mavic-3-multispectral-vs-dji-phantom-4-multispectral/

Satellite sensing

- Advantages
  - Sensor instruments and wavebands adapted to agricultural monitoring
  - High revisit frequencies (e.g. SENTINEL-2 ca. 3 days)
  - High degree of data quality and integrity
  - Often free, full and open data policy for everyone
- Disadvantages
  - Cannot penetrate clouds in the optical domain
  - Relatively low spatial accuracy (1 – hundreds of m GSD)

Image: ESA (https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-2-msi/overview)

Data processing and modelling

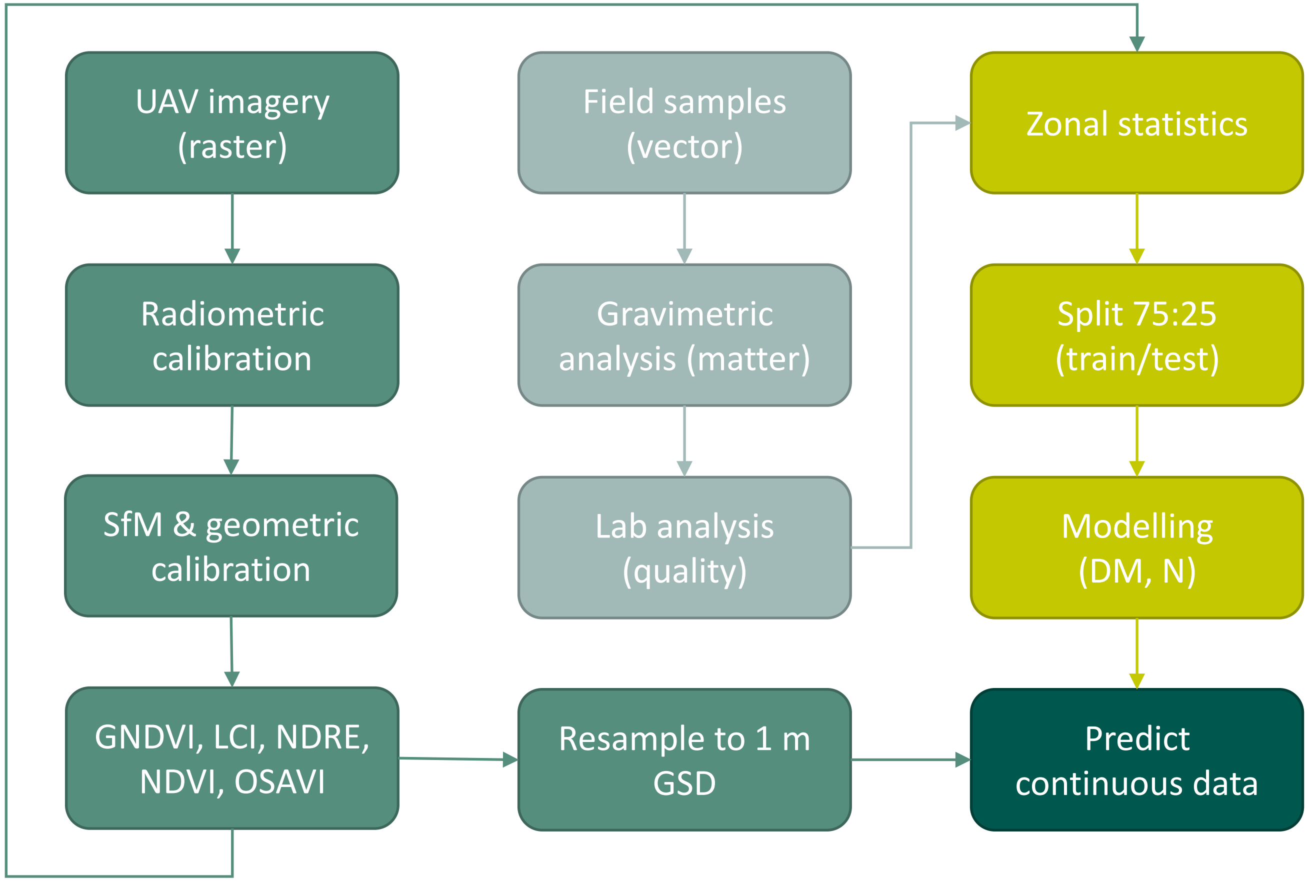
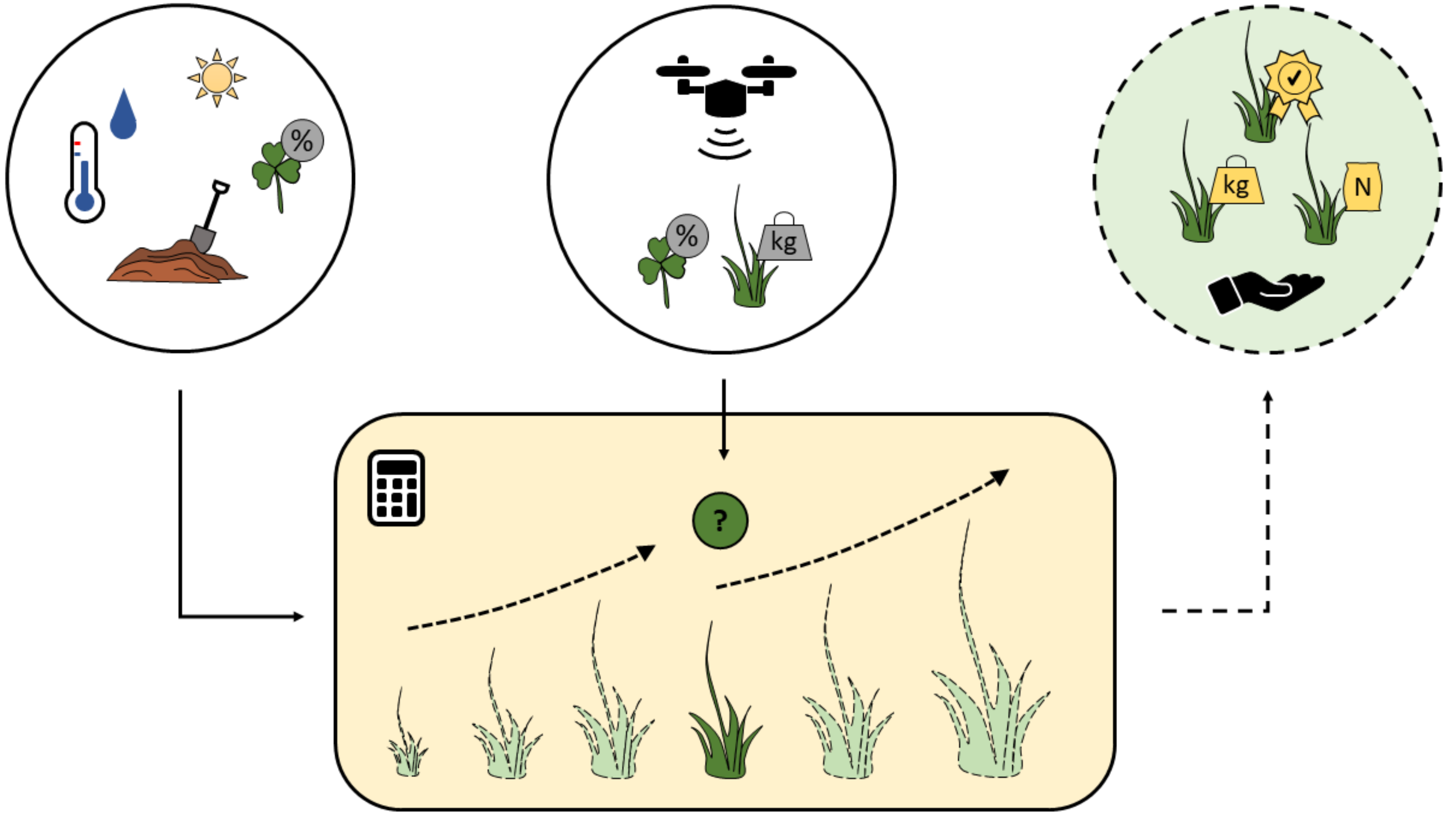


Image: Jakob Geipel, Norge I bilder

Figure: Jakob Geipel (COPERNICUS project, NIBIO & Norwegian Space Agency)

NIBIO

Coupling of remote sensing and expert knowledge (i.e. crop growth model)



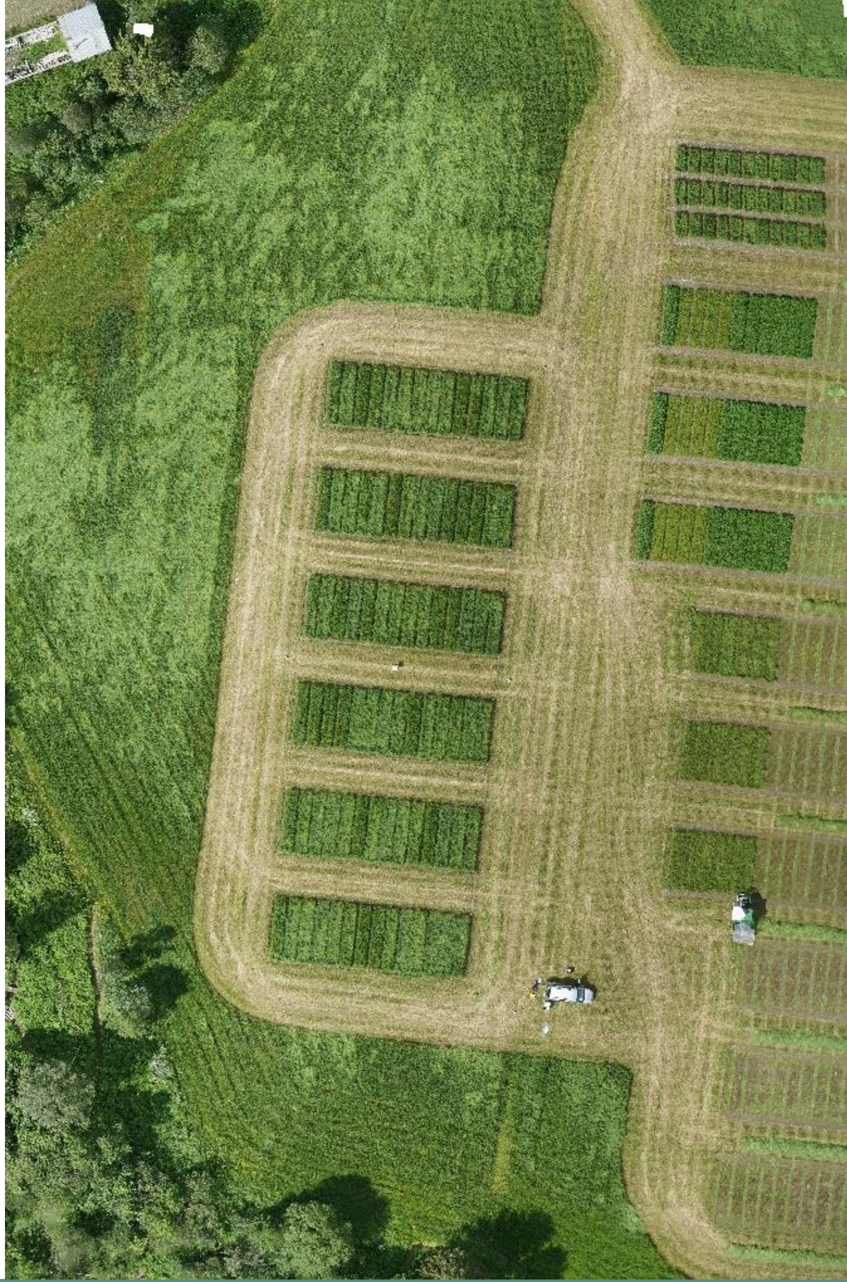
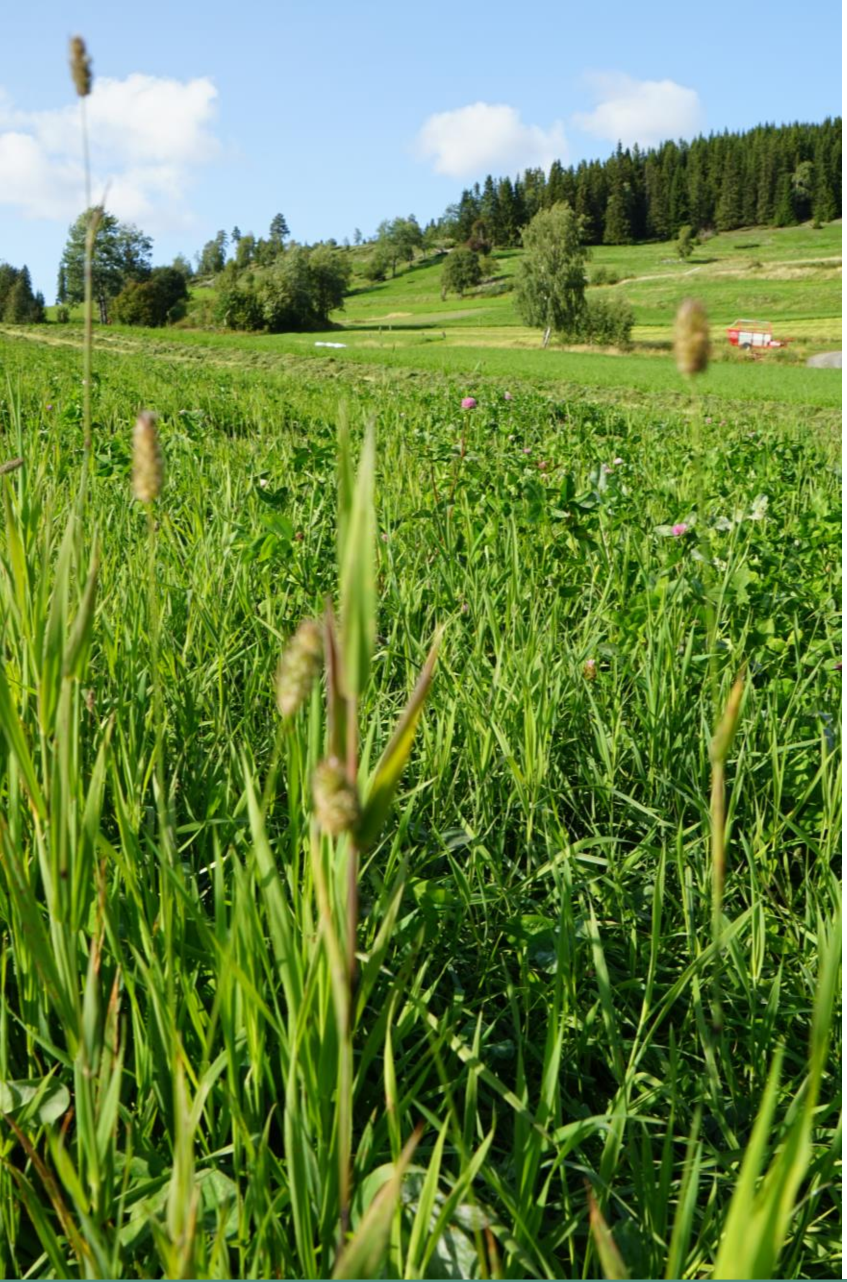


Image: Maximilian Pircher

Figure: Jakob Geipel (IMPRESS project, NIBIO & The Research Council of Norway, NFR 280332)

NIBIO



Assimilation methods - DM (forcing & calibration)

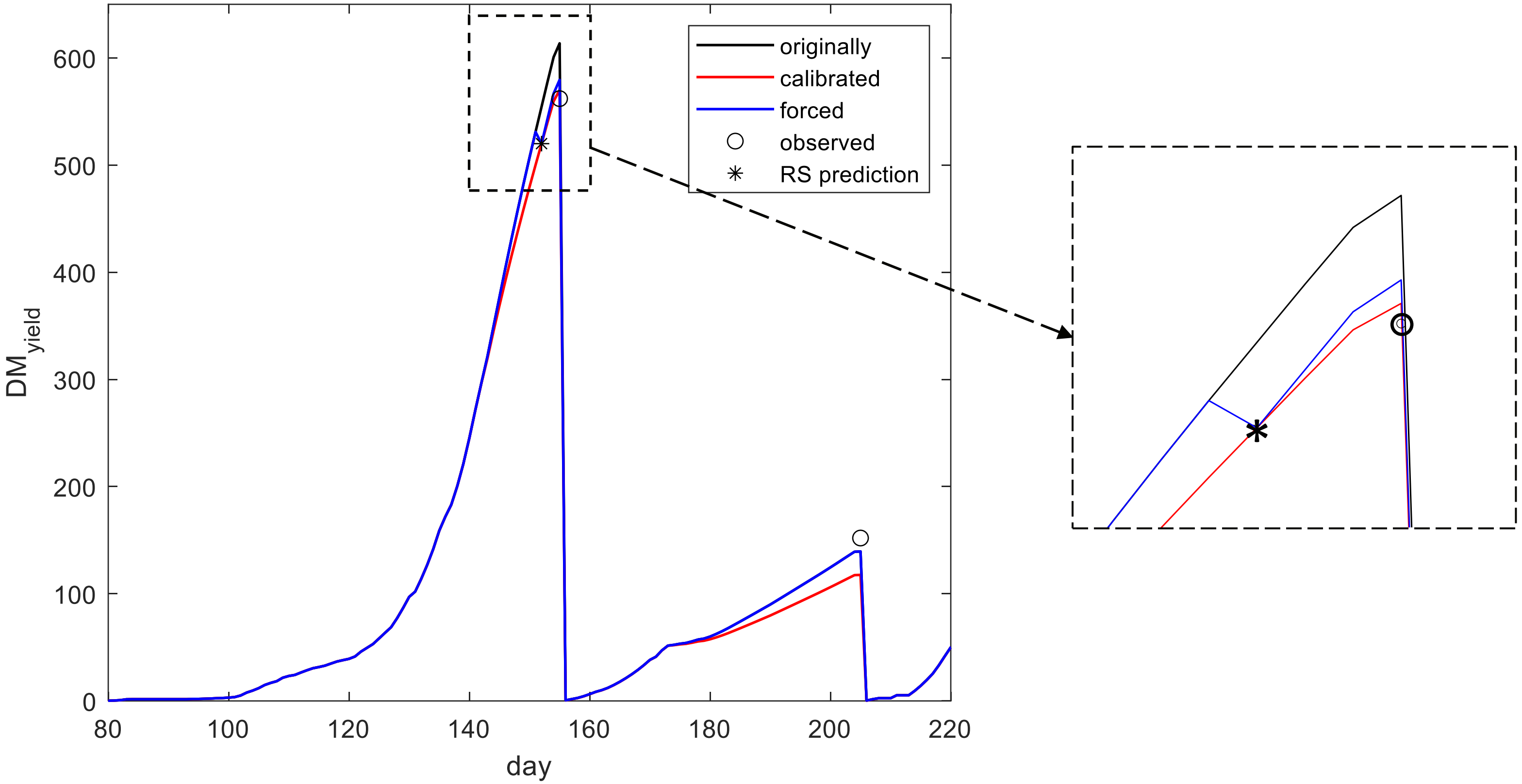
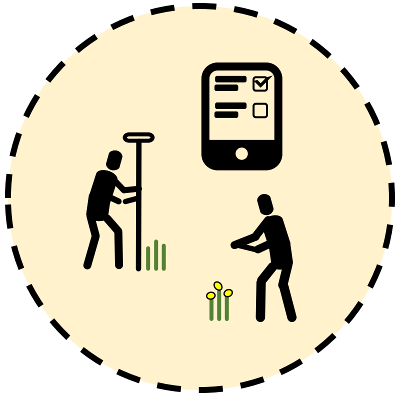


Image: Jakob Geipel

Figure: Anne-Grete Roer Hjelkrem (IMPRESS project, NIBIO & The Research Council of Norway, NFR 280332)

NIBIO

Barriers to adopt NFTS in remote sensing research



- Lack of a geographical module for field trial georeference on a plot level (vector geometries)
- Lack of a well-defined application programming interface (API) for data-exchange with third-party field management and analysis tools

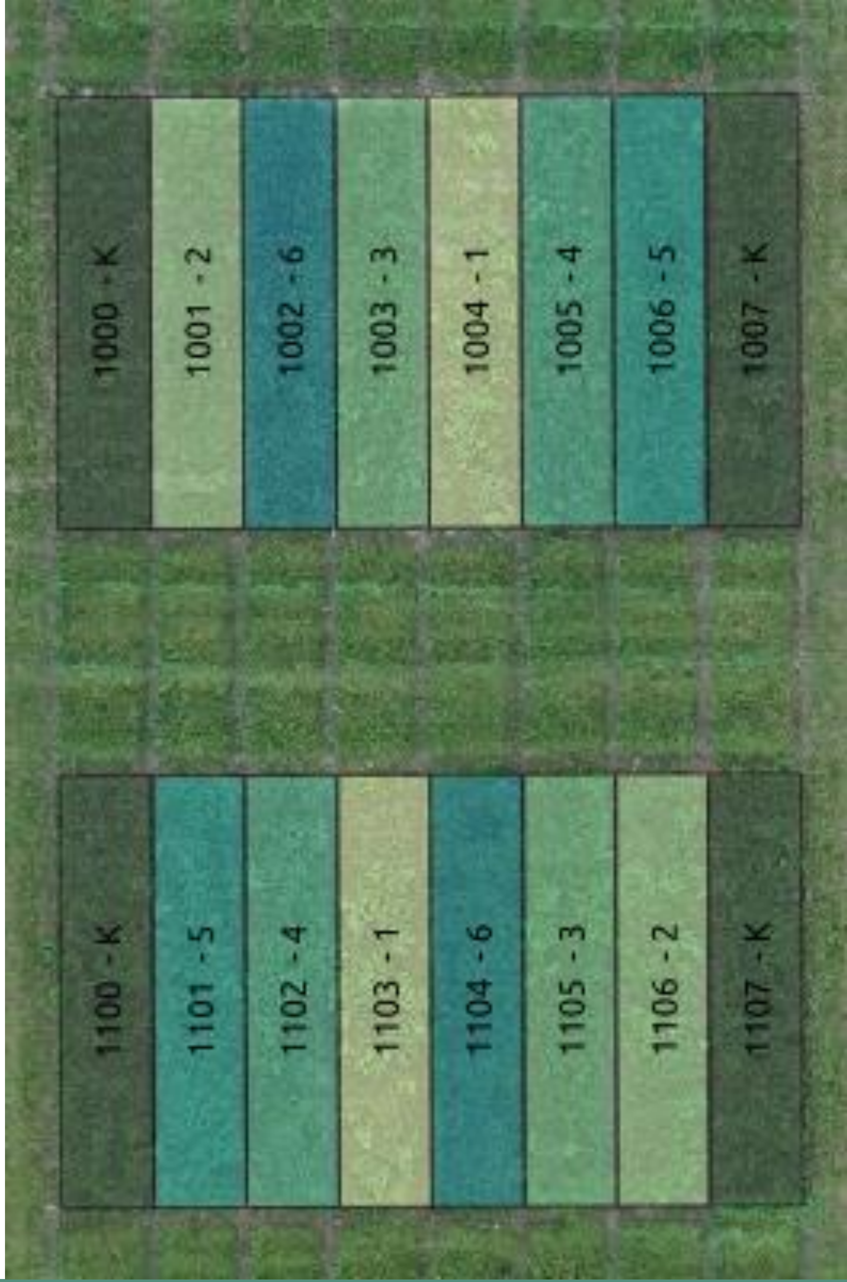


Figure and image: Jakob Geipel

Thank you for your attention

Jakob Geipel
jakob.geipel@nibio.no
www.precisionag.no

NIBIO

NORSK INSTITUTT FOR BIOØKONOMI

NIBIO_no

NIBIO.no

NIBIO_no

www.nibio.no