Regional växtodlings- och växtskyddskonferens
Skövde 15-16 January 2026

# VallSAT : Satellite-based digital tools for ley management

Satellitbaserade digitala verktyg för vallskötsel

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**Forage quality, dry matter and height monitoring**

**In situ measurements**

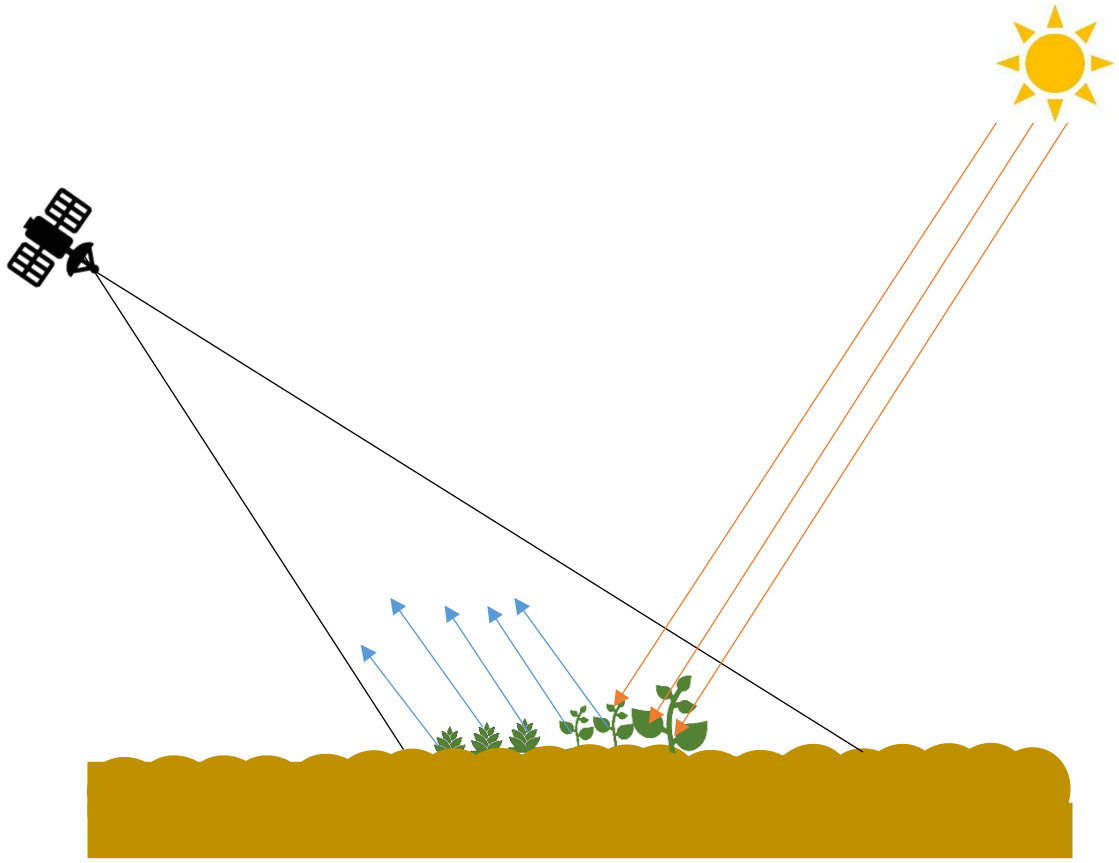
+ Accurate characterization of the sampled area

High number of samples

Time and resources

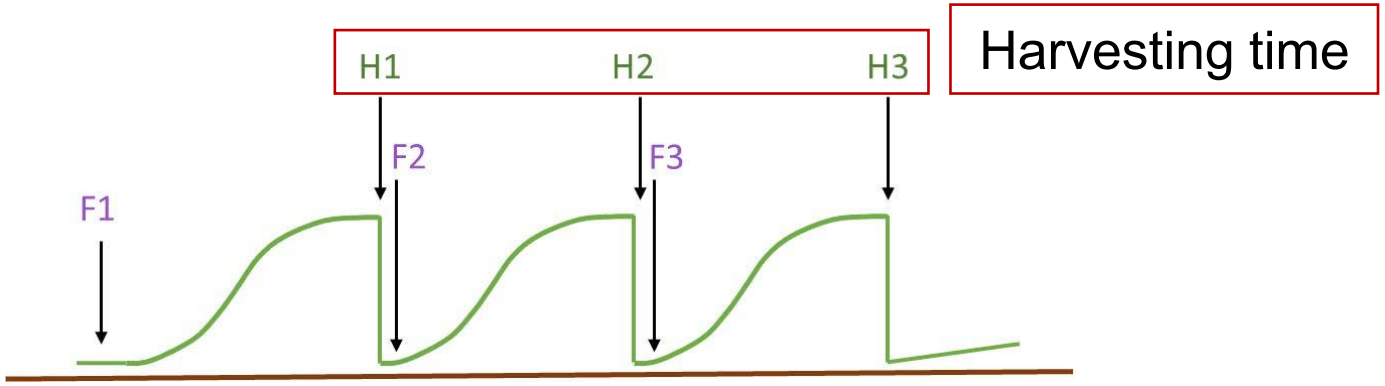
**Remote sensing**

Highly variable over time and space



➡ Use of satellite data to manage leys

➡ Support farmer's decisions




➡ Improve the forecasts of harvesting time and create a useful **D**ecision **S**upport **S**ystem (**DSS**)

- Develop models : Linking open-access satellites' data to forage DM, height (H) and quality variables.

- Develop a DSS that integrates satellite data and simple crop models

Ås field station,
Östersund, 29/08/2023

## WP1: Data collection

- **In-situ measurements**
- Satellite data
- Weather data

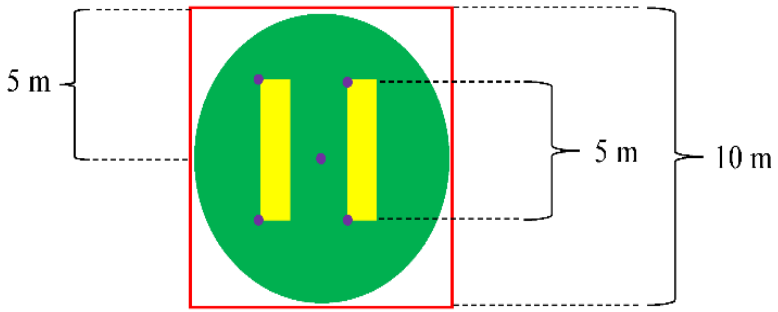
## WP2 : Model simulation

Machine learning algorithms

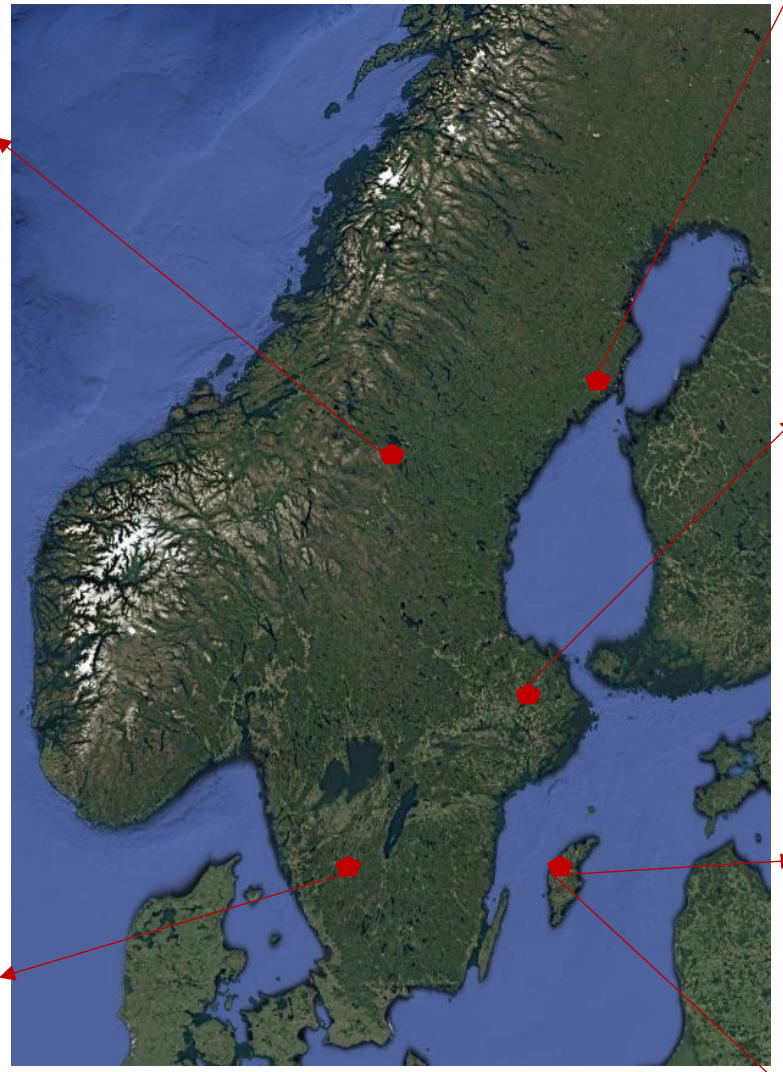
## WP3 : Decision support system

# WP1 : Data collection

Ås, Jämtland

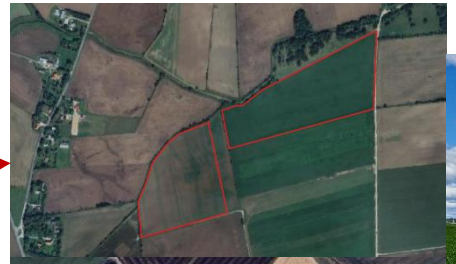



Rådde, Västra Götaland



Röbäcksdalen, Västerbotten

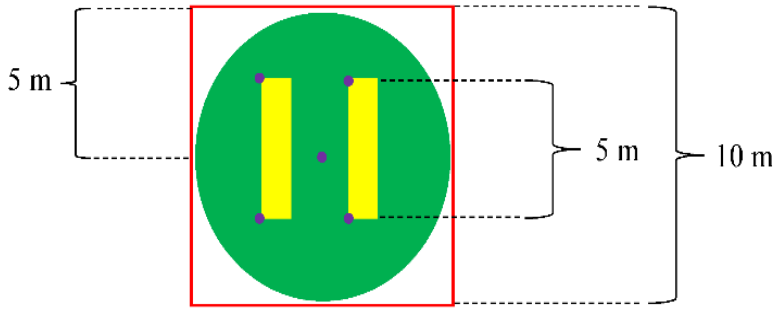
Lövsta, Uppsala



Hallfreda, Gotland

# WP1 : Data collection

## In-situ measurements




RBD field station, Västerbotten, 08/06/2023

### Forage characterization

- Height (H)
- Dry matter (DM)
- Botanical composition

### Forage Quality

- Crude protein (CP)
- Metabolizable Energy (ME)
- Neutral Detergent Fiber (NDF)
- Organic Matter Digestibility (OMD)

# WP1 : Data collection

## WP1: Data collection

- In-situ measurements
- **Satellite data**
- **Weather data**

**Sentinel-2**

**Weather data**

## WP2 : Model simulation

Machine learning algorithms

## WP3 : Decision support system

# WP2 : Model simulation

**Features** → **Model** → Forage quality, DM and H

Sentinel-2

SMHI

- **Height (H)**
- **Dry Matter (DM)**
- **Organic Matter Digestibility (OMD)**

**Training** | **Validation**

# WP2 : Model simulation

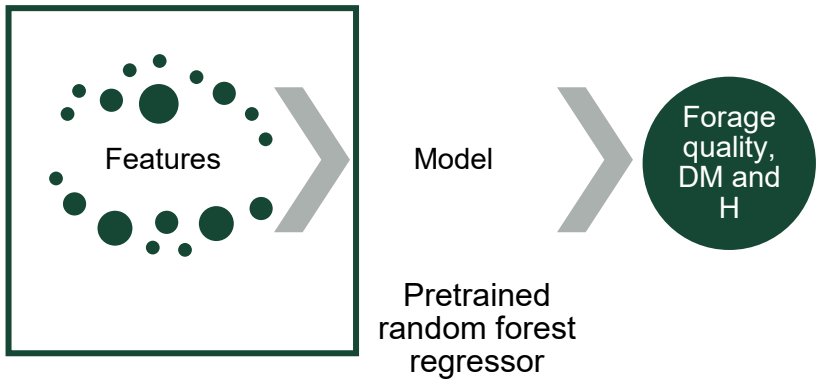

Sentinel-2

- Surface reflectance
- Spectral Indices
- Difference between i-day and S-2 acquisition day

| SENTINEL-2 Radiometric and Spatial Resolutions | | | |
|---|---|---|---|
| Band Number | Central Wavelength (nm) | Bandwidth (nm) | Spatial Resolution (m) |
| 1 | 443 | 20 | 60 |
| 2 | 490 | 65 | 10 |
| 3 | 560 | 35 | 10 |
| 4 | 665 | 30 | 10 |
| 5 | 705 | 15 | 20 |
| 6 | 740 | 15 | 20 |
| 7 | 783 | 20 | 20 |
| 8 | 842 | 115 | 10 |
| 8a | 865 | 20 | 20 |
| 9 | 945 | 20 | 60 |
| 10 | 1375 | 30 | 60 |
| 11 | 1610 | 90 | 20 |
| 12 | 2190 | 180 | 20 |
| TCI* | RGB | Composite | 10 |

**SENTINEL-2 Radiometric and Spatial Resolutions Table | U.S. Geological Survey**

# WP2 : Model simulation




Sentinel-2

Surface reflectance

**Spectral indices**

Difference between i-day and S-2 acquisition day

$$\boldsymbol{NDVI} = \frac{B8 - B4}{B8 + B4}$$

$$\boldsymbol{NDRE1} = \frac{B8 - B5}{B8 + B5}$$

$$\boldsymbol{NDRE2} = \frac{B8 - B6}{B8 + B6}$$

$$\boldsymbol{NDRE3} = \frac{B8 - B7}{B8 + B7}$$

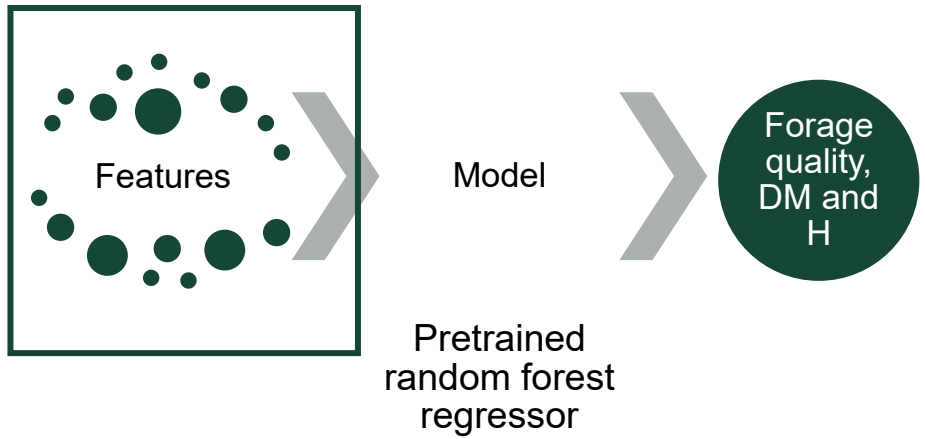
$$\boldsymbol{OSAVI} = \frac{B8 - B4}{(B8 + B4 + 0.16)}$$

$$\boldsymbol{GVMI} = \frac{(B8 + 0.1) - (B12 + 0.02)}{(B8 + 0.1) + (B12 + 0.02)}$$

$$\boldsymbol{EVI} = 2.5 \times \frac{B8 - B4}{B8 + 6 \times B4 - 7.5 \times B2 + 1}$$

$$\boldsymbol{NIRv} = B8 \times \left(\frac{B8 - B4}{B8 + B4}\right)$$

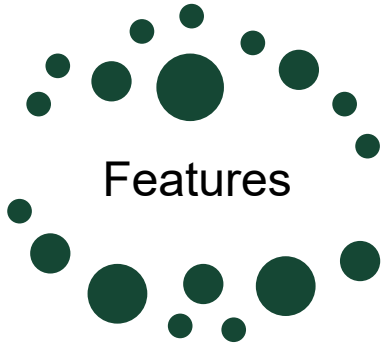
# WP2 : Model simulation




Weather data

- Temperature
  - Value in i-day
  - Cumulative value on i-day and (**2,6,9**,14 and **30**) days before
- Precipitation
  - Value in i-day
  - Cumulative value on i-day and (**2,6,9**,14 and **30**) days before

# WP2 : Model simulation




- **B1 → B11 surface reflectance**
- **NDVI // NDRE 1 + 2 +3 // NIRv // EVI // OSAVI // GVMI // NDWI**
- Difference between i-day and S-2 acquisition day
- Temperature
- Cumulative temperature
- Precipitation
- Cumulative precipitation

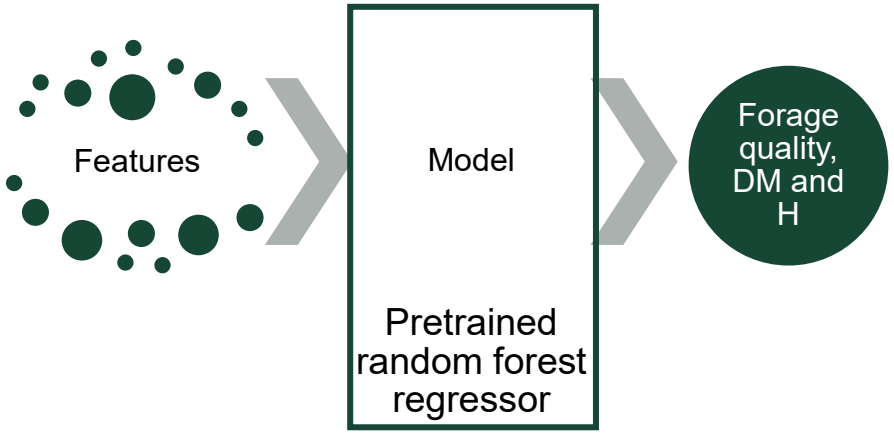
Model

Pretrained random forest regressor

Forage quality, DM and H

- **Vegetation height**
- **Biomass**
- **OMD**

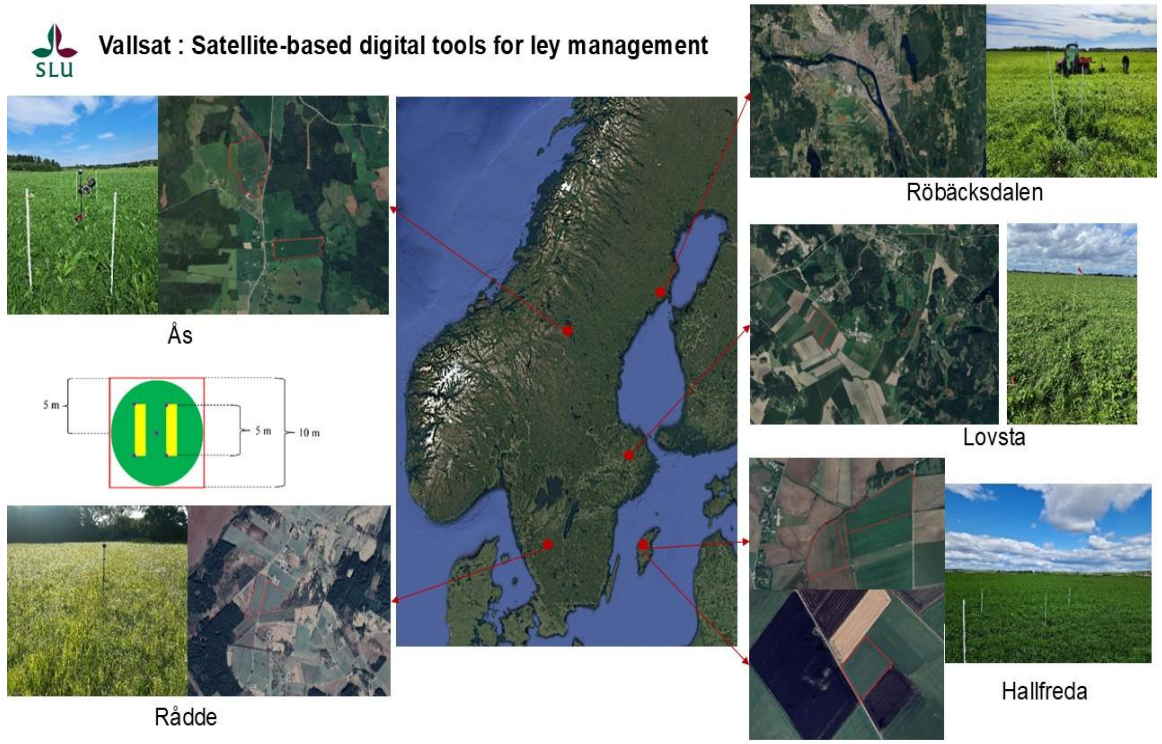
# WP2 : Model simulation

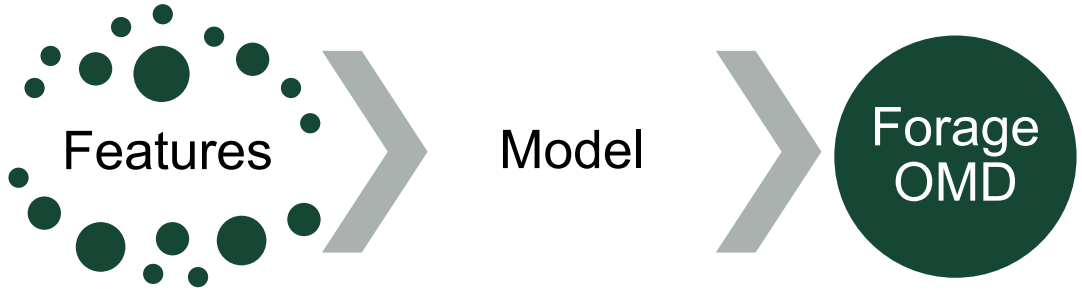


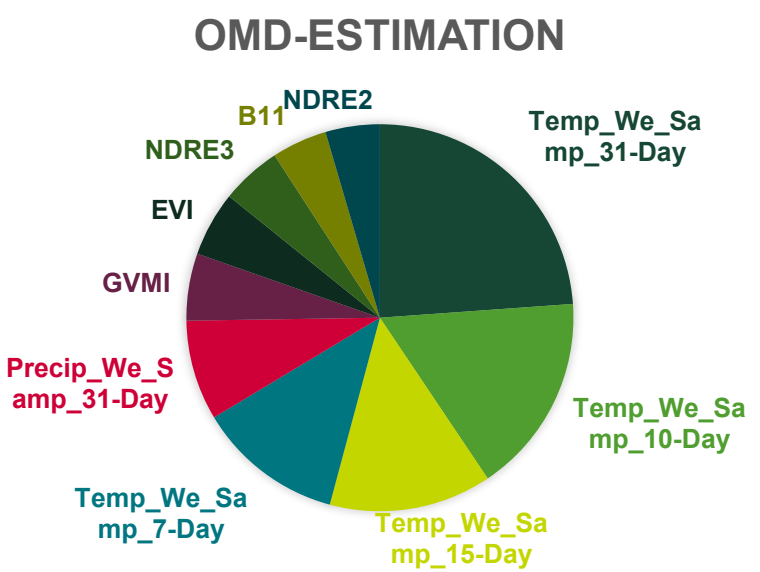

**Machine Learning Algorithm :**
Random forest regressor

**Training :** In-situ measurements collected over Sweden (**70%**)

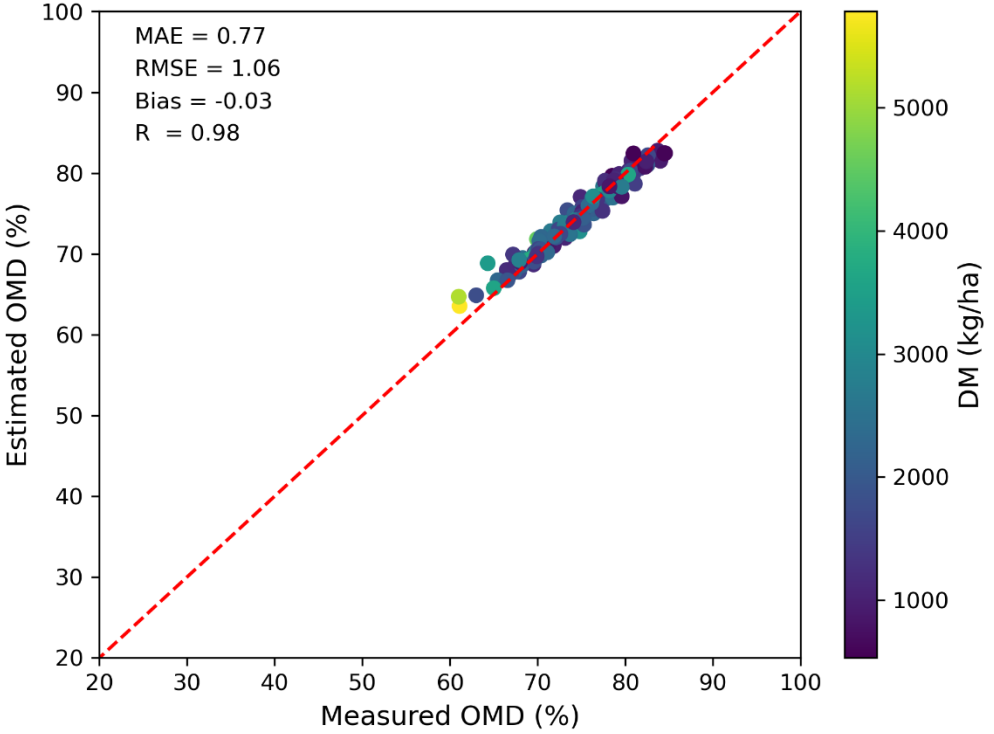
**Validation :** In-situ measurements collected over Sweden (**30%**)



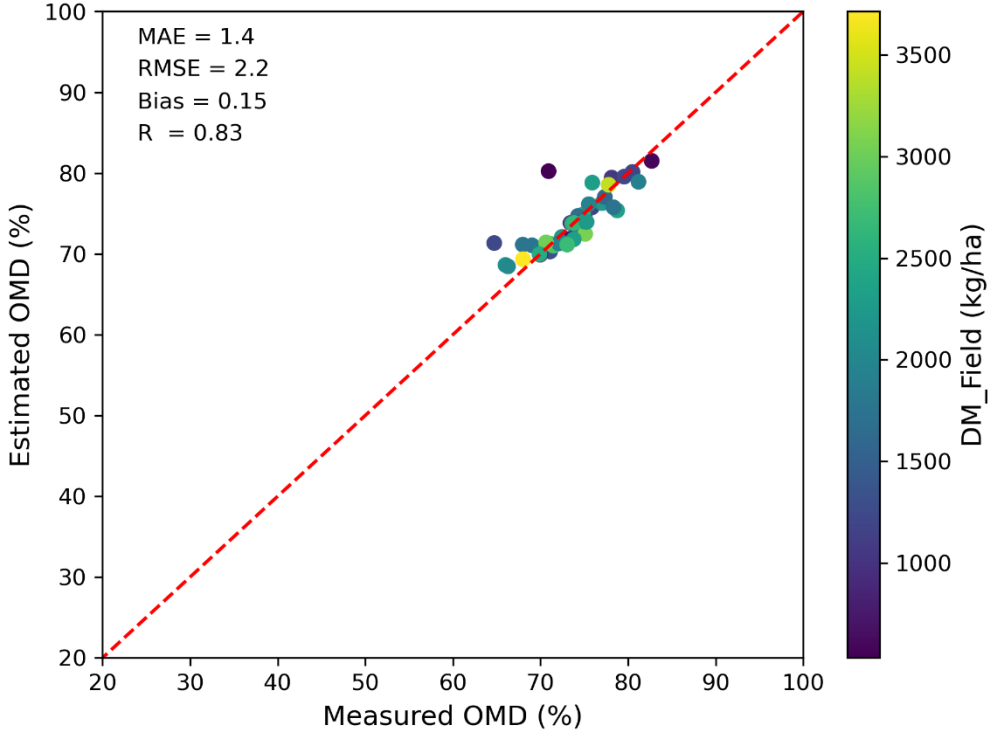


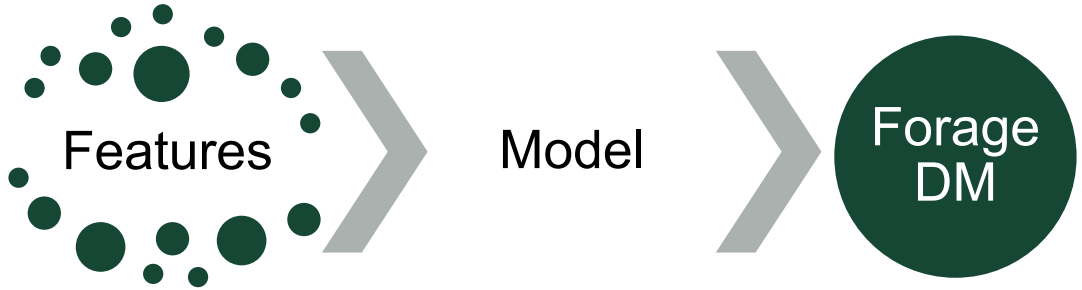

## Training

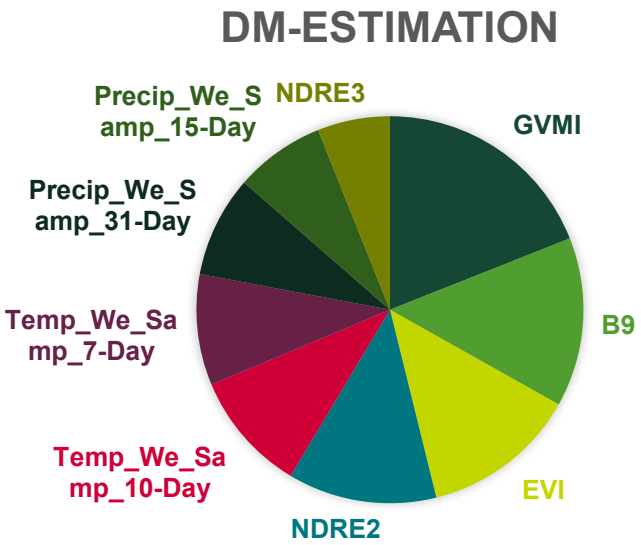



## Validation

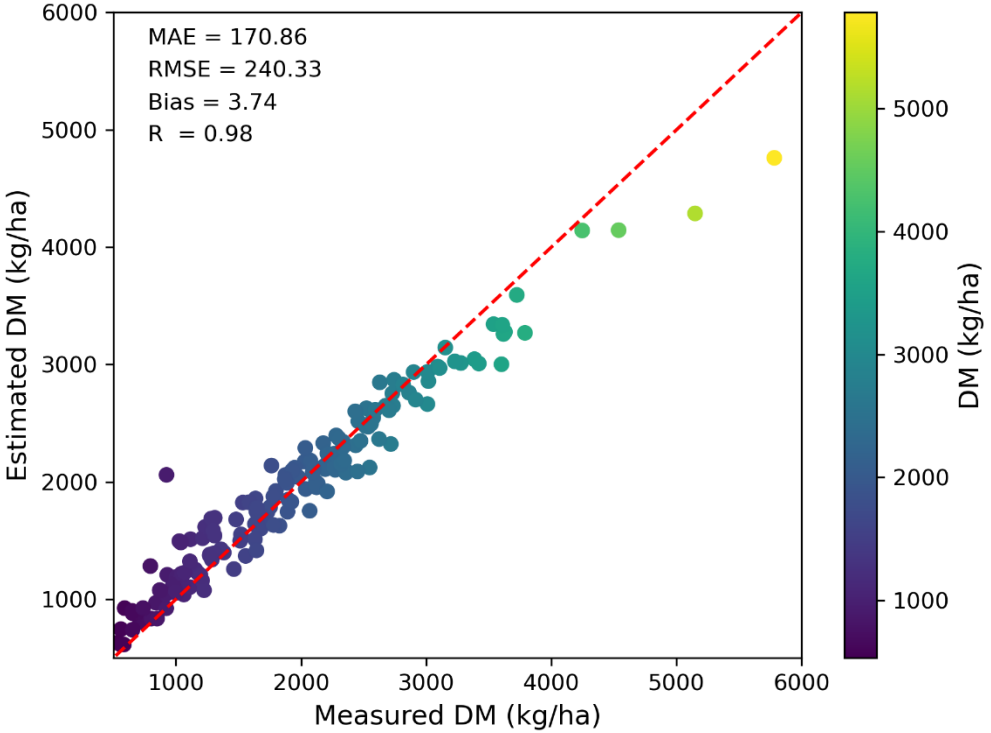


SLU

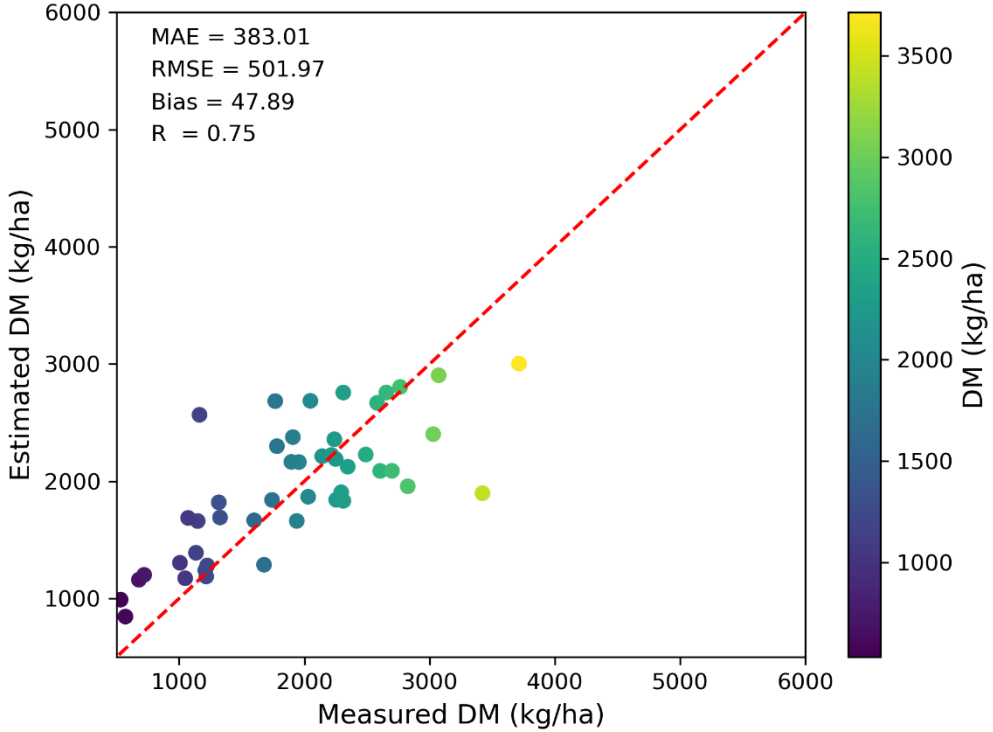


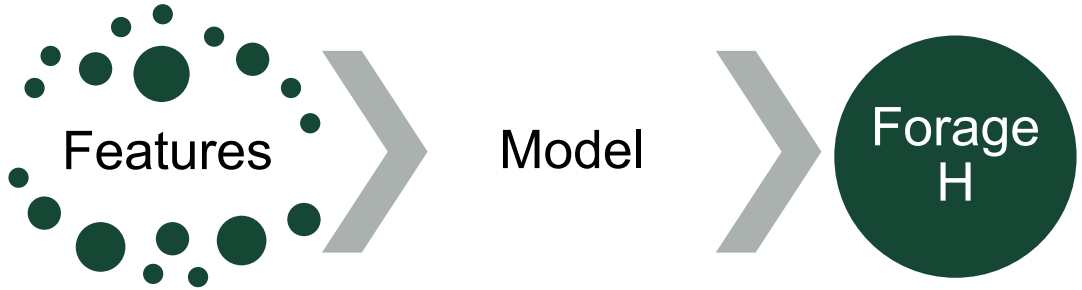



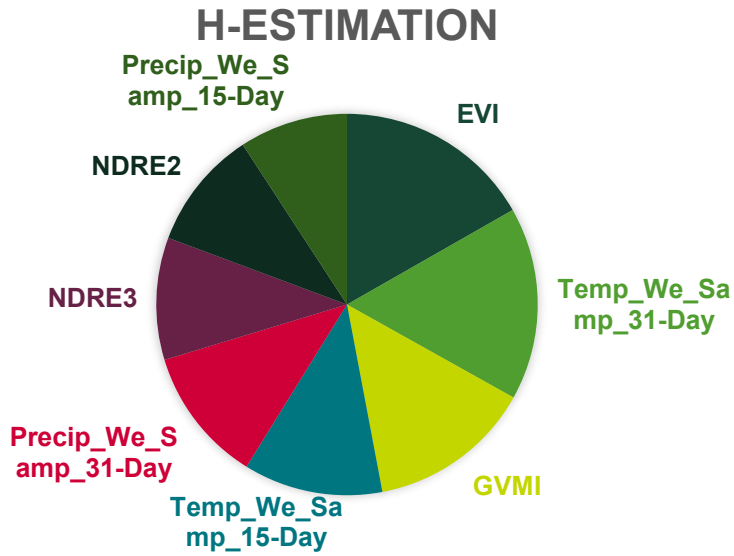

## Training



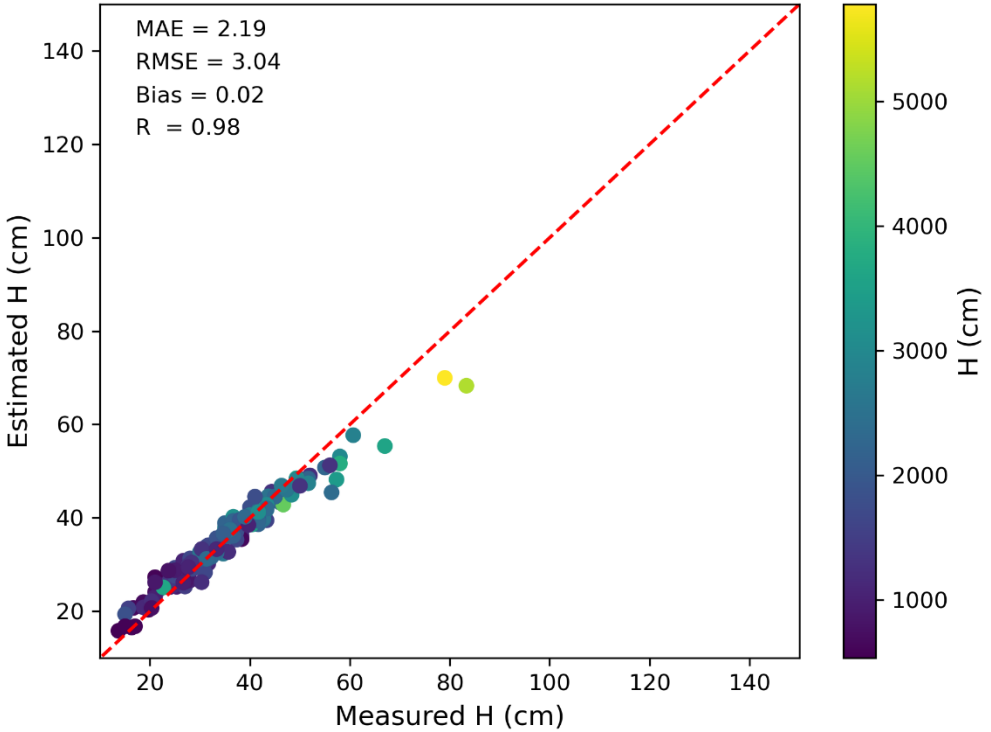

## Validation



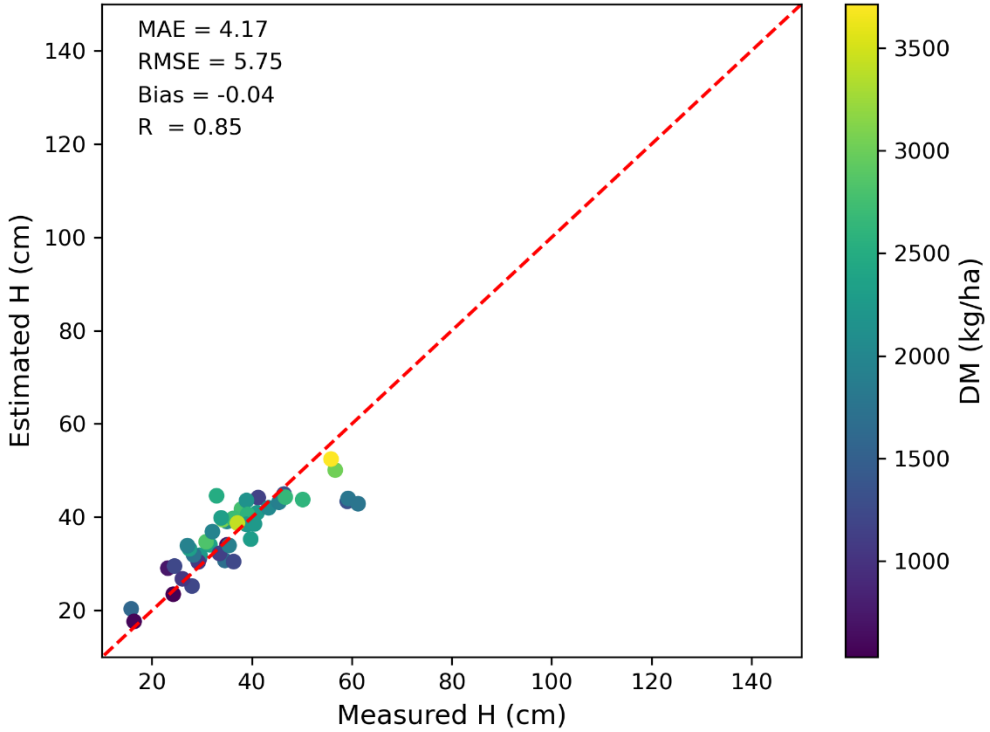



## Training




## Validation



# Conclusions and perspectives

- Optical data is useful for monitoring forage quality and biomass
- The models developed are integrated into a decision support system to assist farmers in their decision-making
- The models developed are useful for precision agriculture
- The radar data will be analyzed in order to update the models

# Thank you for your attention