

Assessing the suitability of different sensor types for deriving soil related differences in plant characteristics

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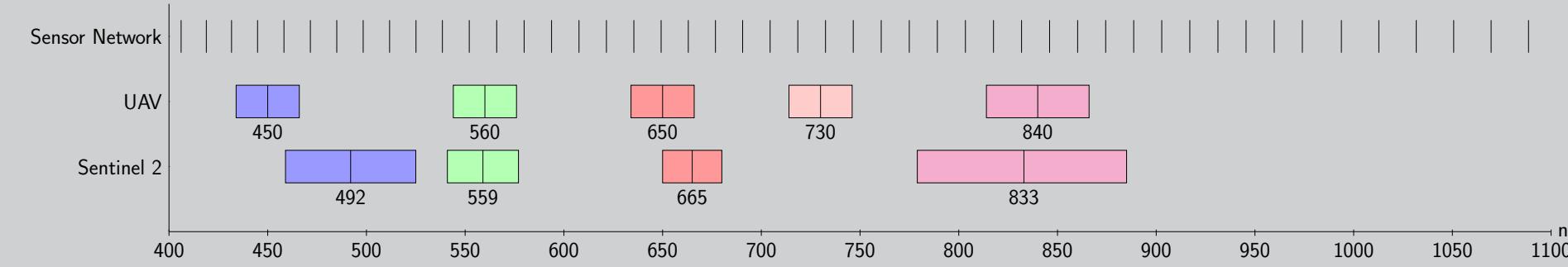
Introduction

- Different soil types provide nutrients and water to crops in varying quantities [?]
- Knowledge about spatial variability in soils is crucial for site-specific management and precision agriculture [?]
- Remote sensing data can be used to derive soil related differences in plants from its spectral information [?]
- Goal: Comparison of three optical sensor systems for soil related plant characteristics

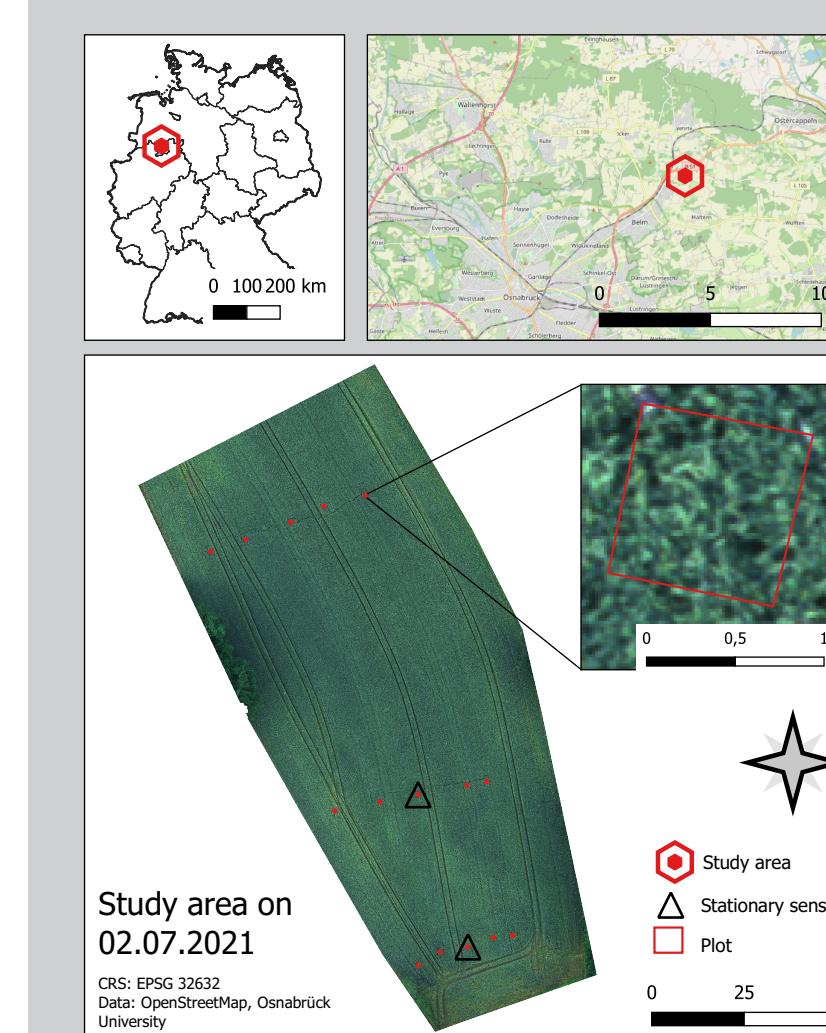
Sensor Systems

Three multispectral sensor systems were used:

- Sensor network [?, ?]
- DJI Phantom 4 Multispectral (2 cm spatial resolution)
- Sentinel 2 (10 m spatial resolution)

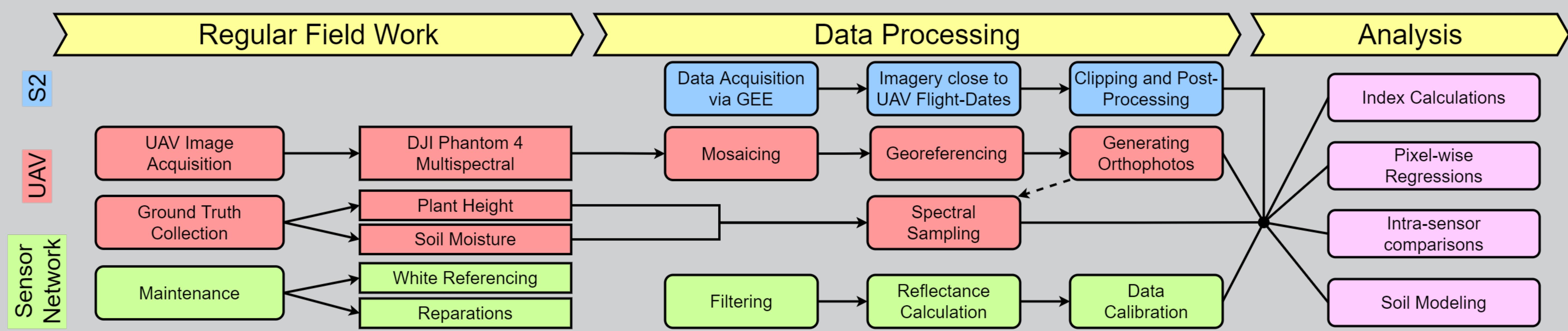


Study Area and Duration

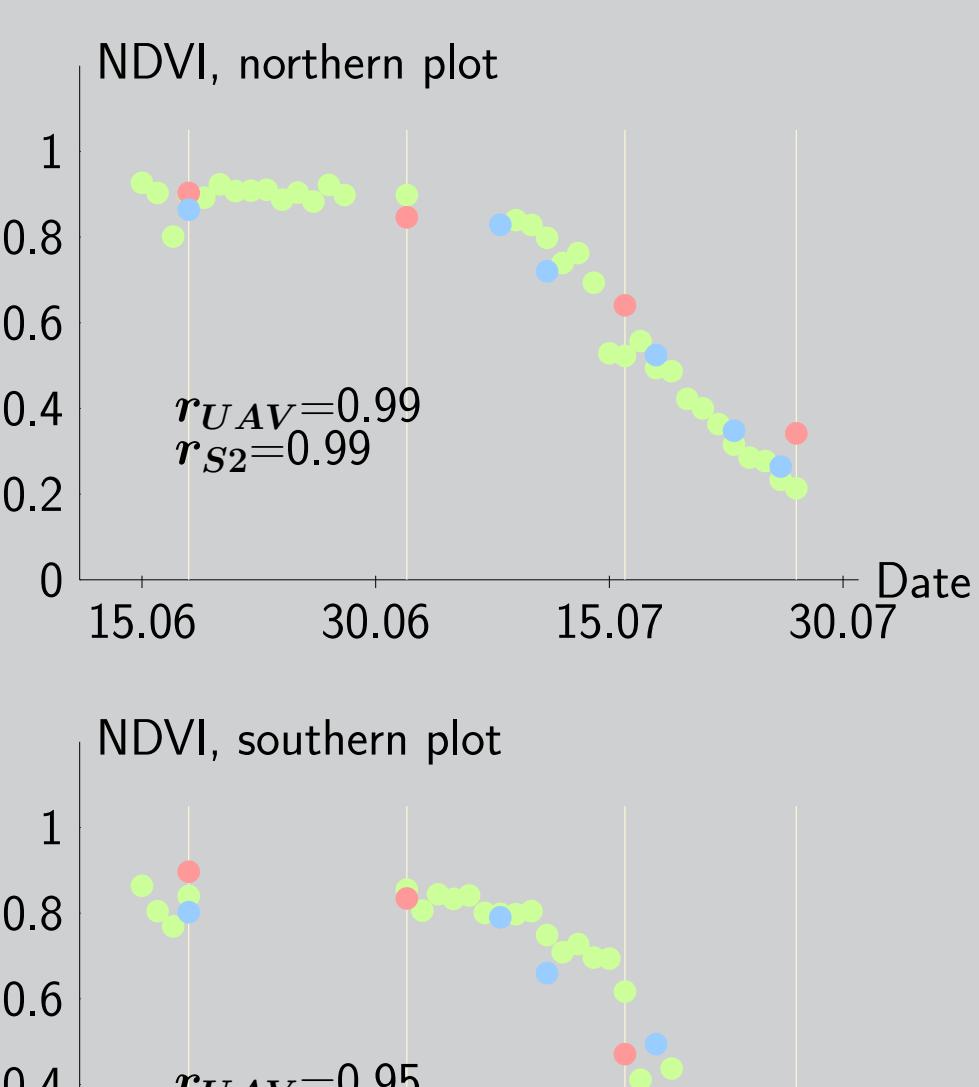


- Located northeast of Osnabrück, Germany
- 2.7 ha field with winter wheat and 15 plots for ground truth (1 × 1 m)
- 15.06.2021 – 27.07.2021
- Daily sensor network measurements and biweekly UAV flight campaigns

Methodology



NDVI Comparison



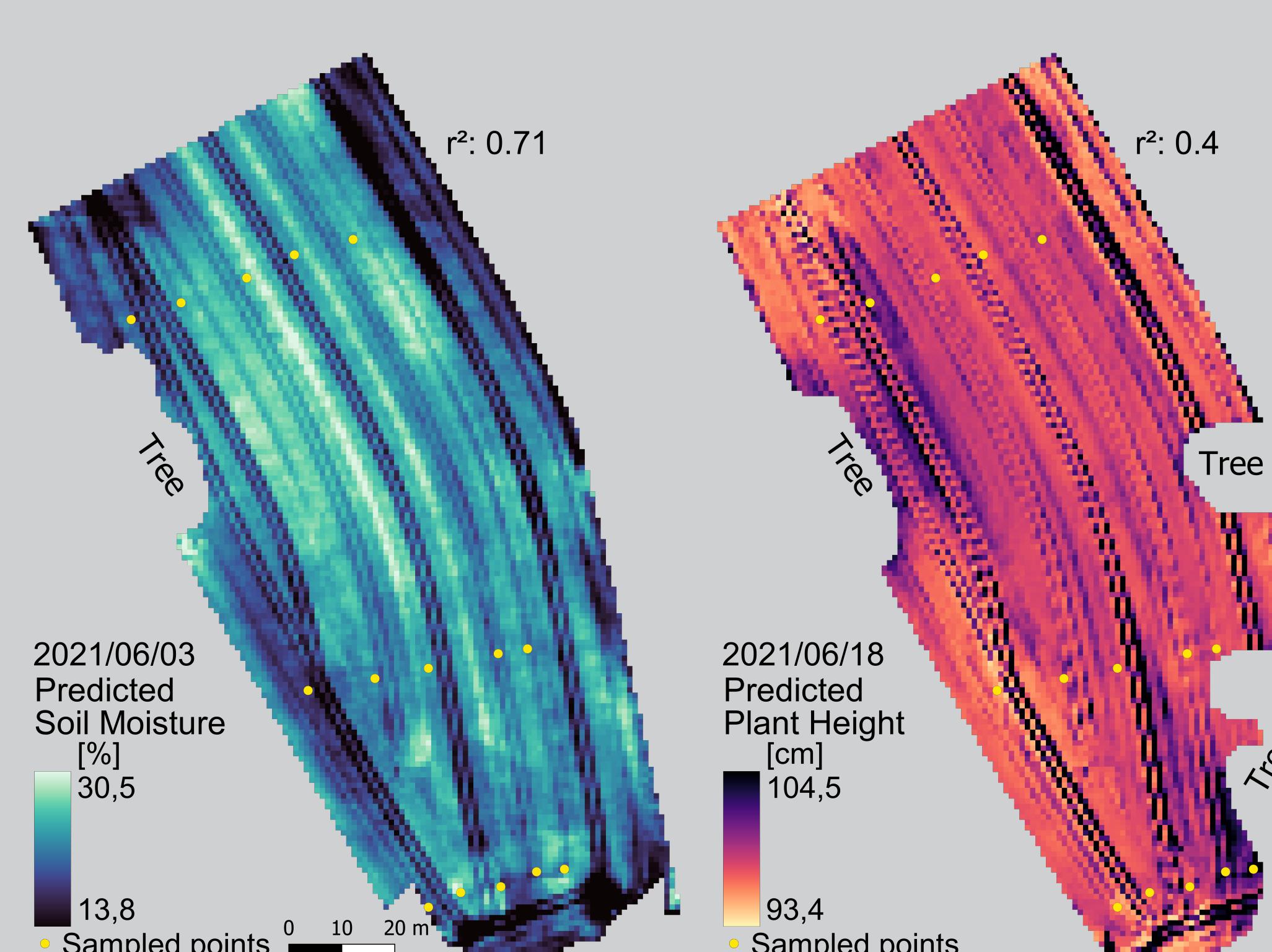
Left: NDVI values for the three sensor systems for both observed plots. Below: Comparison of a subset of Sentinel 2 (top) and UAV (bottom) NDVI time series with the calculated sensor NDVI values at the four marked dates

Conclusion & Future Work

- Each sensor has different advantages, as shown in the table on the right
- UAV data has proven itself useful to monitor site-specific small scale spatial differences and calculate plant characteristics with regression models based on ground truth measurements
- For further research, a larger ground truth sample size might be advantageous in order to reduce the influence of outliers
- Stationary sensors can be used to monitor differences at specific positions in a high temporal resolution and independent from weather conditions
- Further research should use a greater amount of sensors within the sensor network to show site-specific differences in a high temporal resolution

	Sensor	UAV	S2
Historic data		X	
Remote use		X	
High temporal resolution	X		
High spatial resolution		X	
Plant characteristics	X	X	X
Site-specific monitoring	X	X	depends on size
Weather independent	X		
Expandability of spectral bands	X		

Regression Results



- Support Vector Regressions for soil moisture (left) and plant height (right) with grid searched parameters
- High degree of uncertainty in plant height regression: Correlation between height and spectral values seems low
- Promising initial results for soil moisture; experiment will be repeated with larger sample size

References



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