



University of  
Zurich<sup>UZH</sup>

Department of Geography

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# Multi-temporal composites of airborne imaging spectroscopy data for the use in digital soil mapping

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An aerial photograph of a rural landscape featuring a dense patchwork of agricultural fields in various shades of green and brown. A winding river or stream flows through the center of the image. A semi-transparent circular graphic is overlaid on the left side, containing several overlapping leaf-like shapes in different shades of green and brown, representing the multi-temporal compositing process. The text "Multi-temporal compositing" is written in a large, white, sans-serif font in the lower right quadrant.

# Multi-temporal compositing





September 2013



536.213 pixels (1.4%)

April 2014



814.240 pixels (2.1%)

April 2015



634.013 pixels (1.6%)





Basemap 2014 (814.240 pixels)

'13'14 + 58.1%

'14'15 + 56.0%

'13'15 + 32.9%

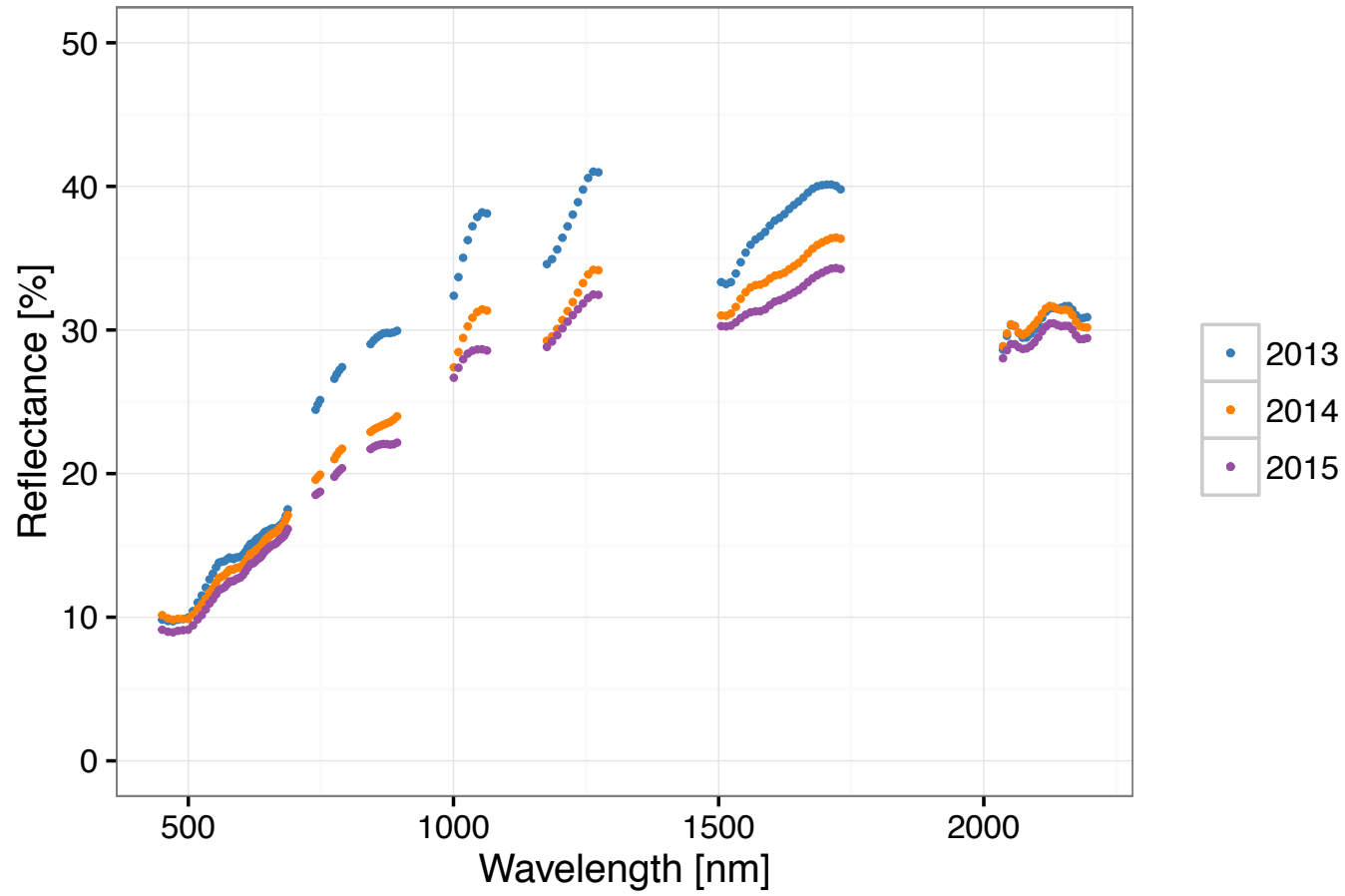
'13'14'15 + 106.4%



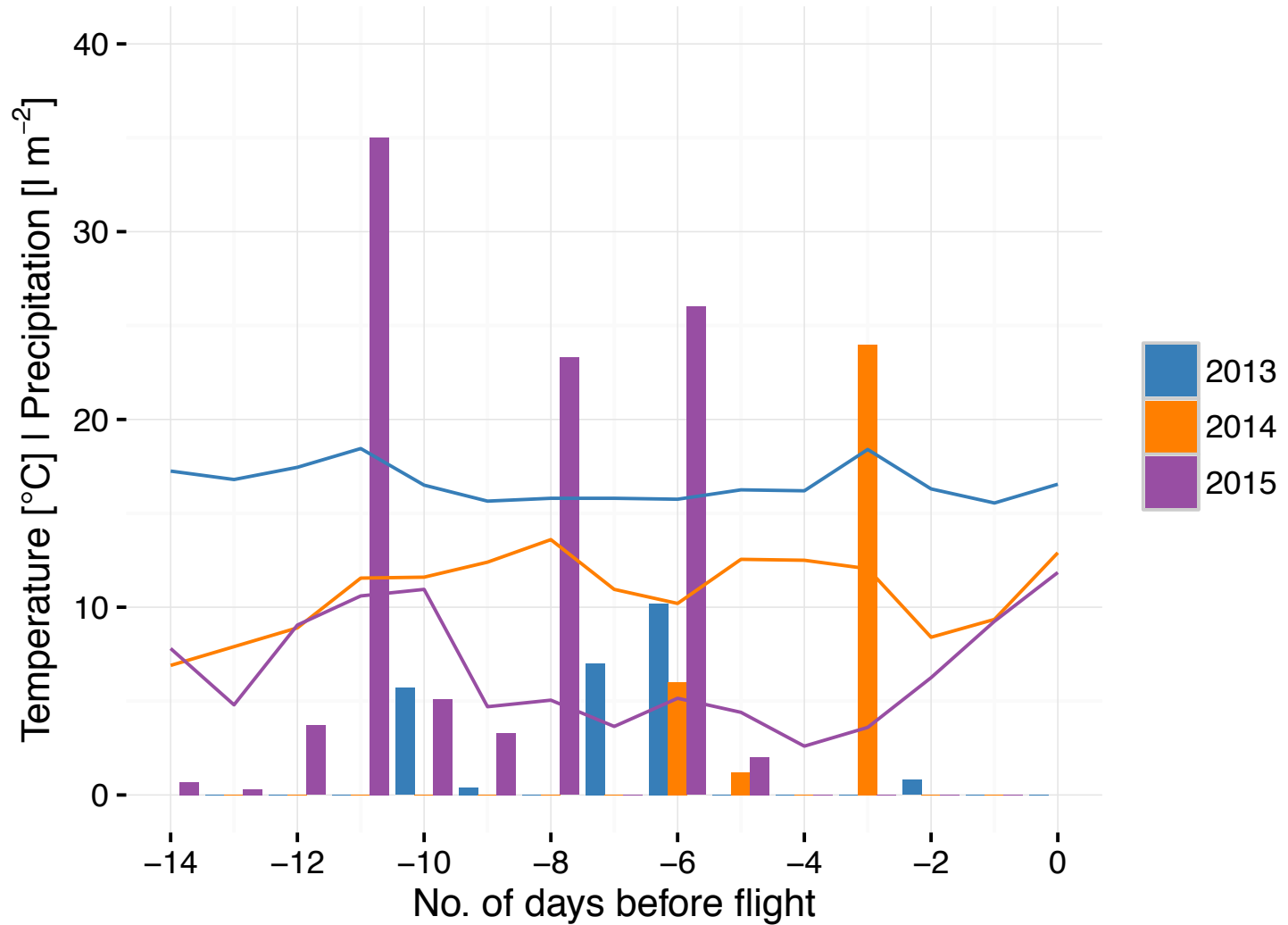
An aerial photograph of a rural landscape featuring a dense patchwork of green and brown agricultural fields, interspersed with clusters of trees and small villages. A large, semi-transparent circular graphic is overlaid on the left side of the image. Inside the circle, there are three stylized, overlapping leaf-like shapes in shades of green and yellow, arranged in a fan-like pattern. The text 'Multi-temporal challenges' is written in a large, white, sans-serif font in the lower right quadrant, partially overlapping the landscape and the circular graphic.

# Multi-temporal challenges







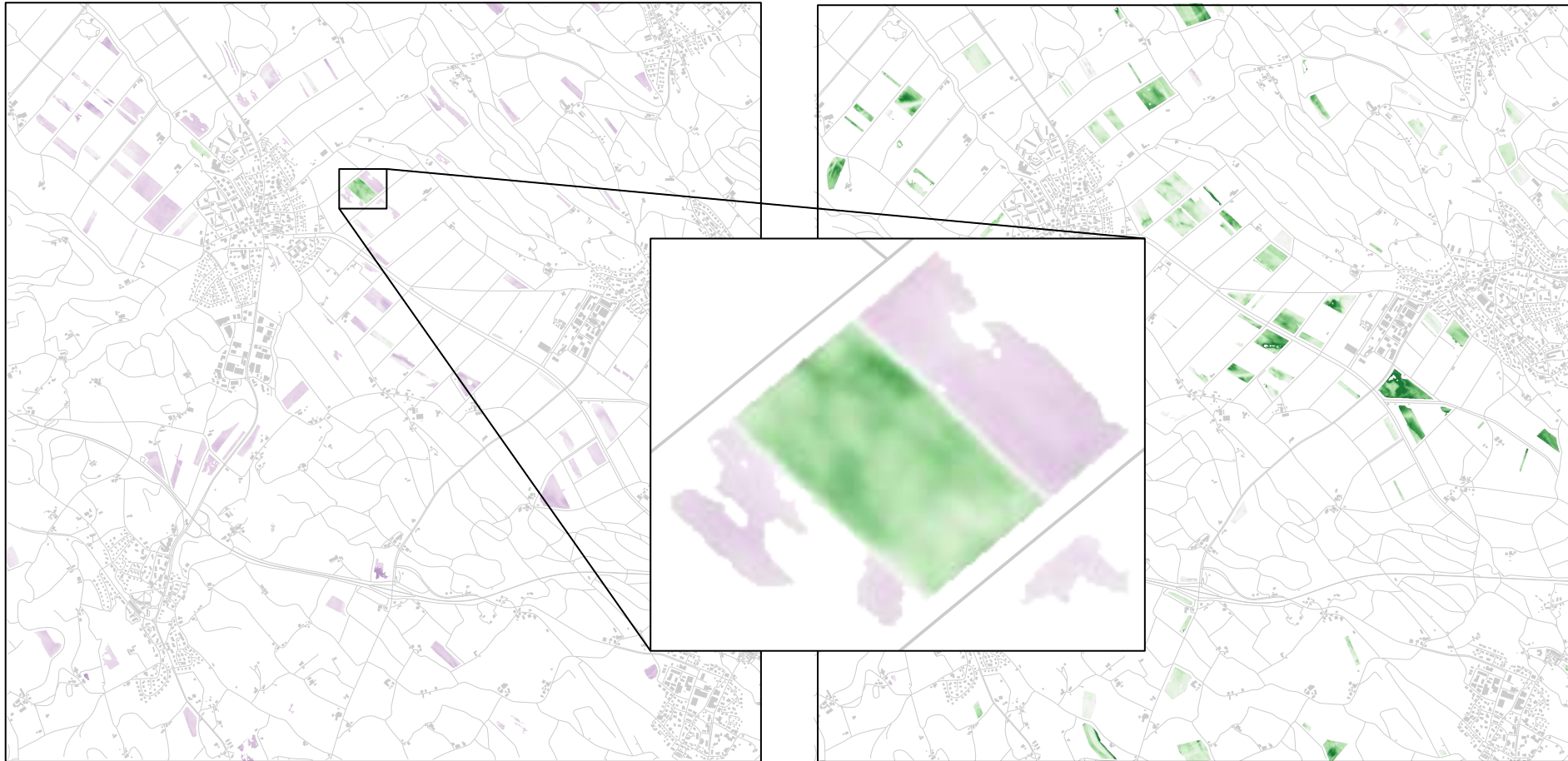




## Normalised difference index

2013 vs. 2014

2015 vs. 2014

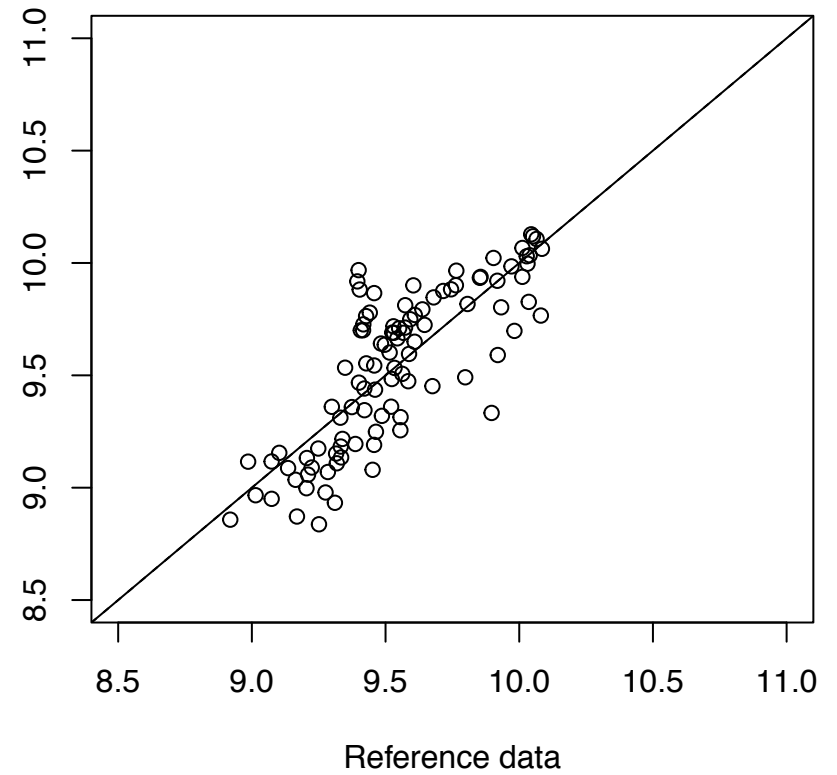
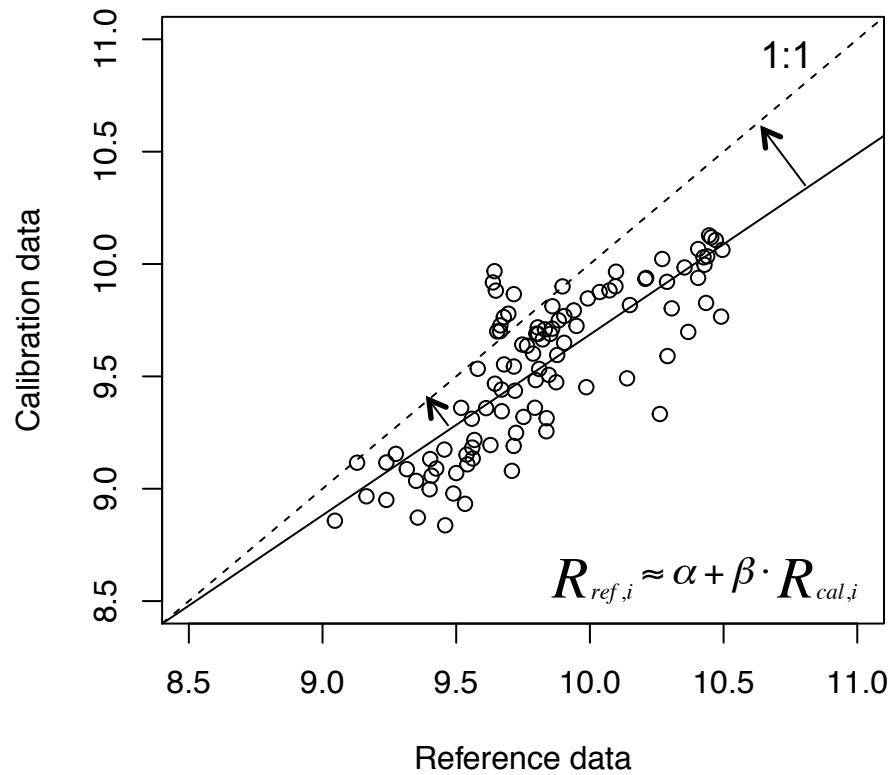




An aerial photograph of a rural landscape featuring a dense patchwork of green and brown agricultural fields, interspersed with clusters of trees and small villages. A large, semi-transparent circular logo is overlaid on the left side of the image. The logo consists of a thin outer ring and a central emblem that resembles a stylized plant or a flower with multiple petals. The text 'Empirical Line Method' is written in a large, white, sans-serif font across the lower right portion of the image.

# Empirical Line Method

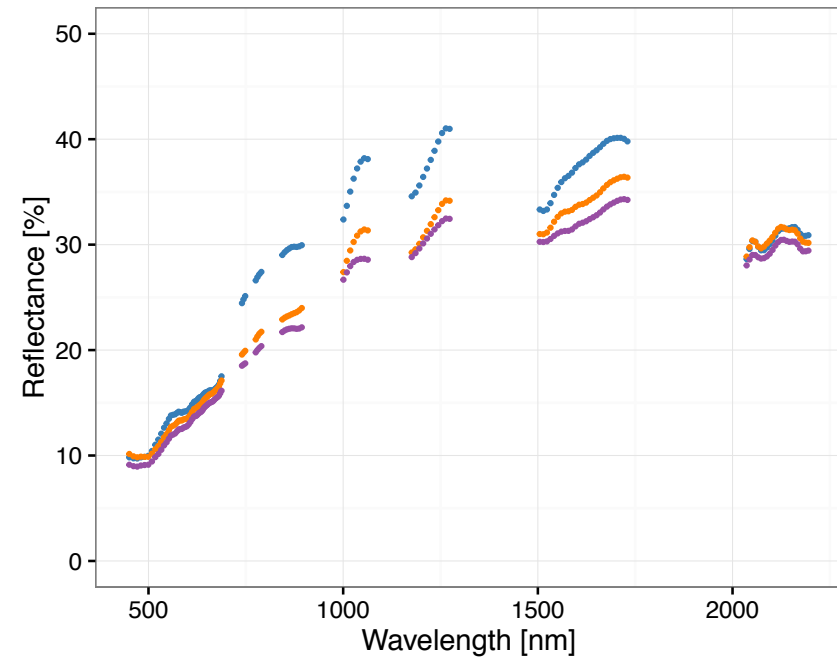




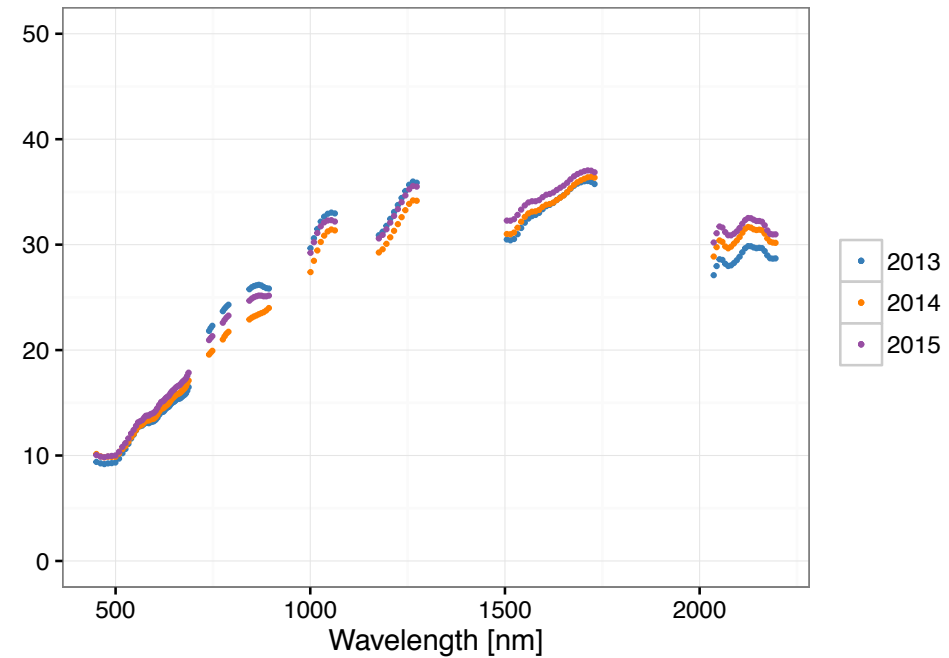
$$R_{cor,i} \approx \alpha + \beta \cdot R_{cal,i}$$



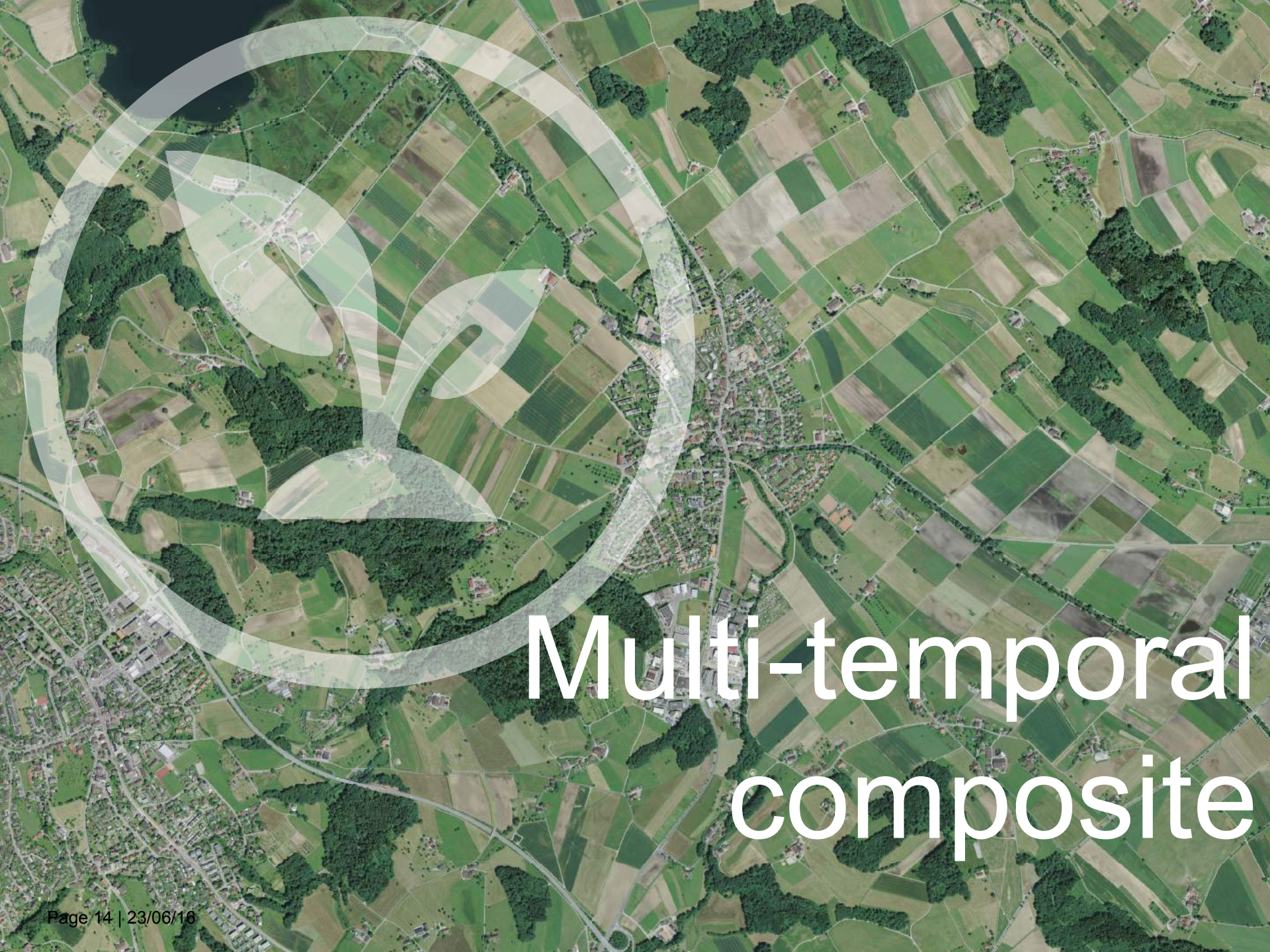
Before calibration



After calibration

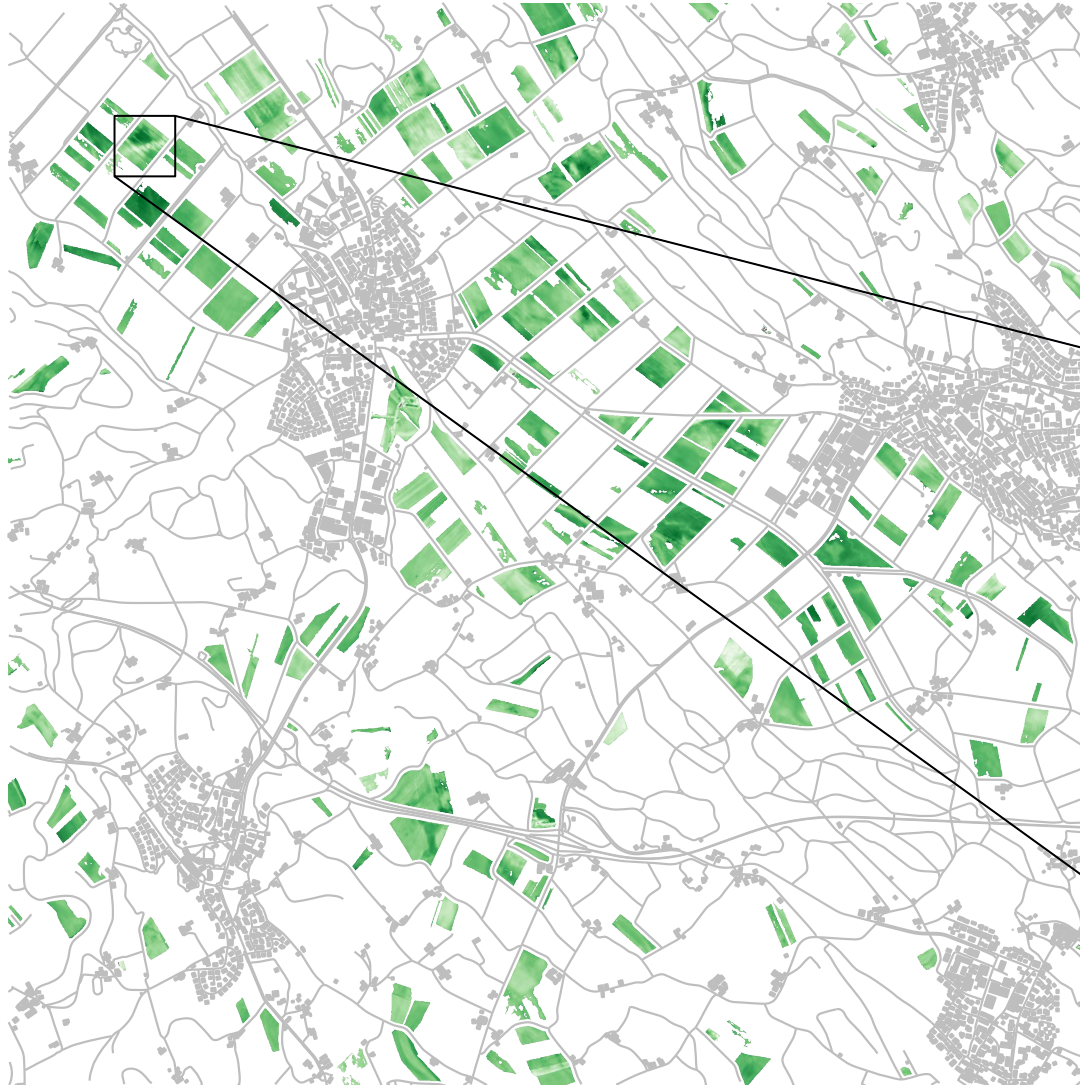




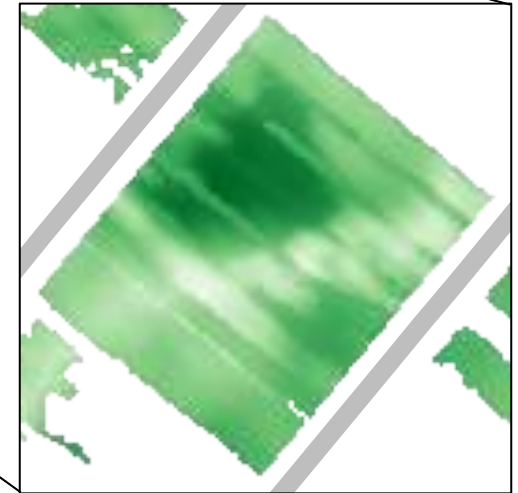


# Multi-temporal composite

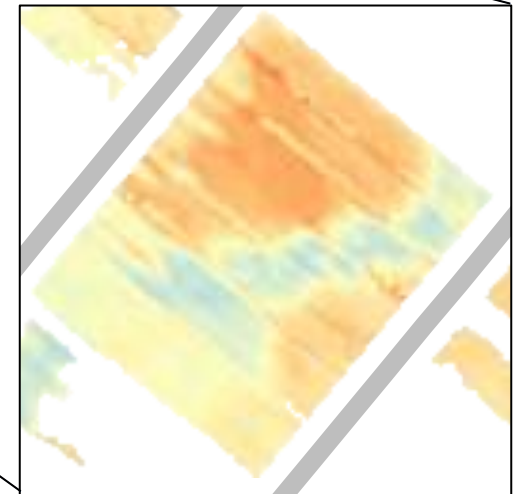
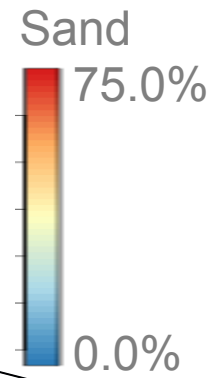




PC 1: ca. 85.0% of the variability









An aerial photograph of a rural landscape featuring a dense patchwork of green and brown agricultural fields, interspersed with clusters of trees and small villages. A large, semi-transparent circular logo is overlaid on the left side of the image. The logo consists of a thin outer ring and a central emblem that resembles a stylized leaf or a flower with three petals. The text 'Conclusions and outlook' is written in a large, white, sans-serif font across the lower right portion of the image.

# Conclusions and outlook



RGB-image

2013 calibrated



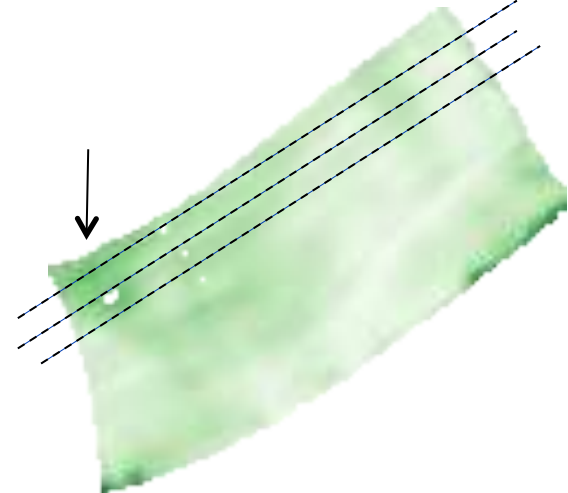
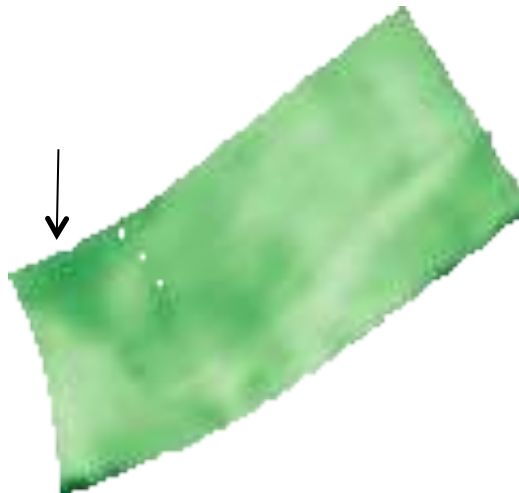
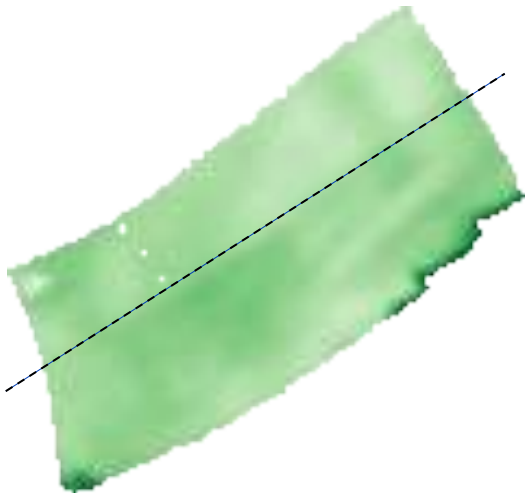
2014



2015 calibrated



PC 1











## Summary

- Successfully created a multi-temporal composite which doubles the bare soil area in a temperate climate
- The multi-temporal composite can be used to derive soil properties (e.g. texture percentages, organic matter, etc.)
- The composite can be improved by taking into account non-linear local differences in soil moisture and land management
- Final aim is to create a full-coverage map of soil properties containing the high spatial resolution of spectroscopy data





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# Thank you!

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Financially supported by:

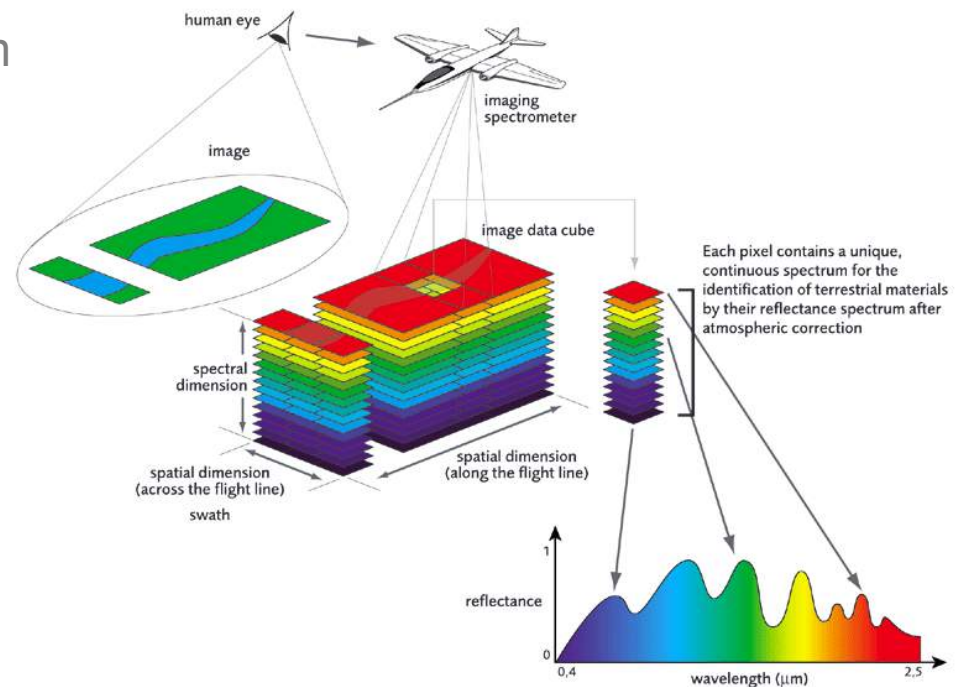


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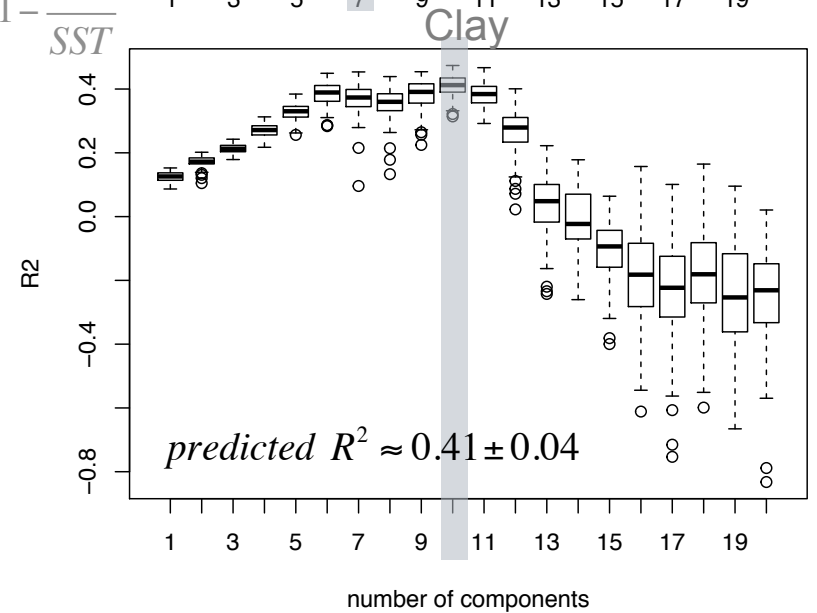
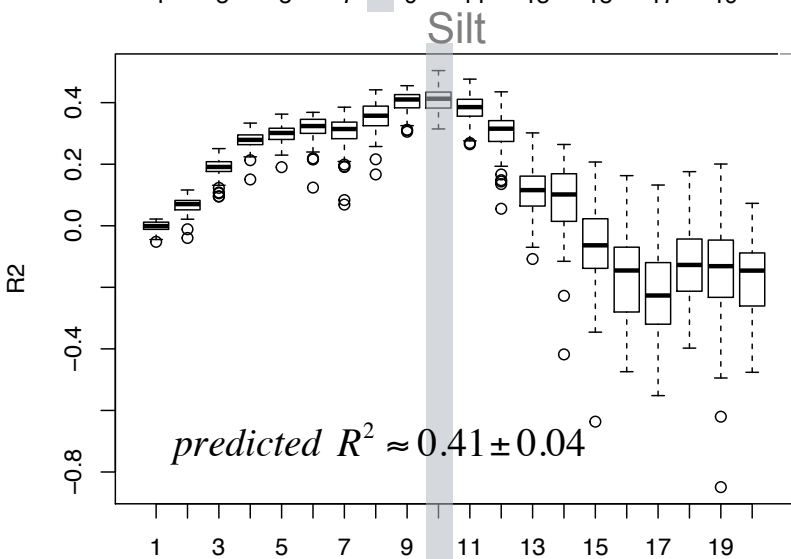
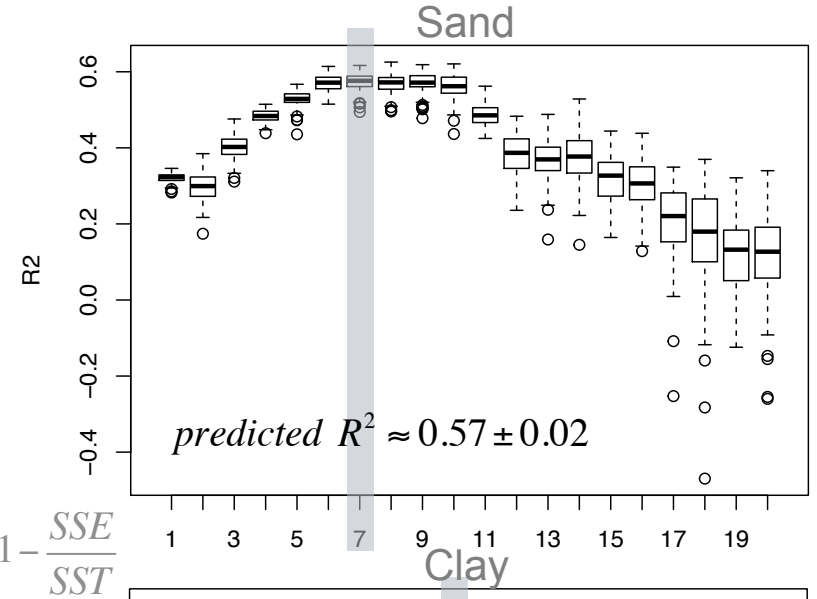
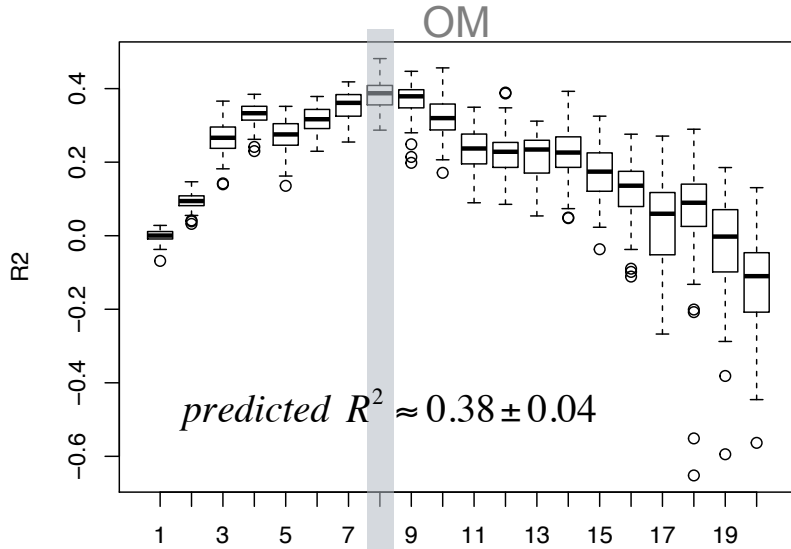


# Spectrometer

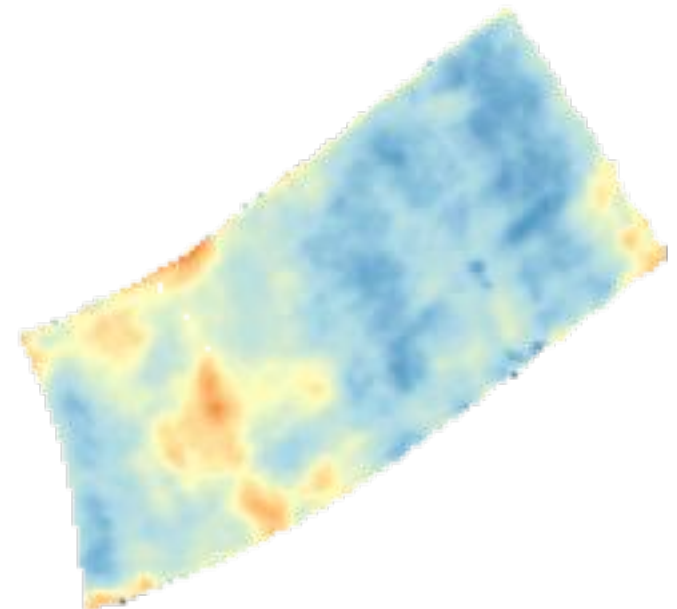
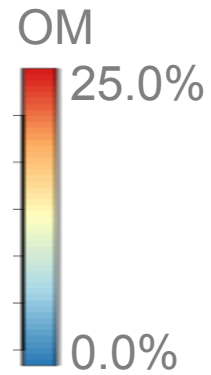
- Airborne Prism EXperiment (APEX)
- Pushbroom imager
- Unbinned configuration: 312 spectral bands
- Spectral range: 400 – 2400 nm
- Spatial resolution: 2 m





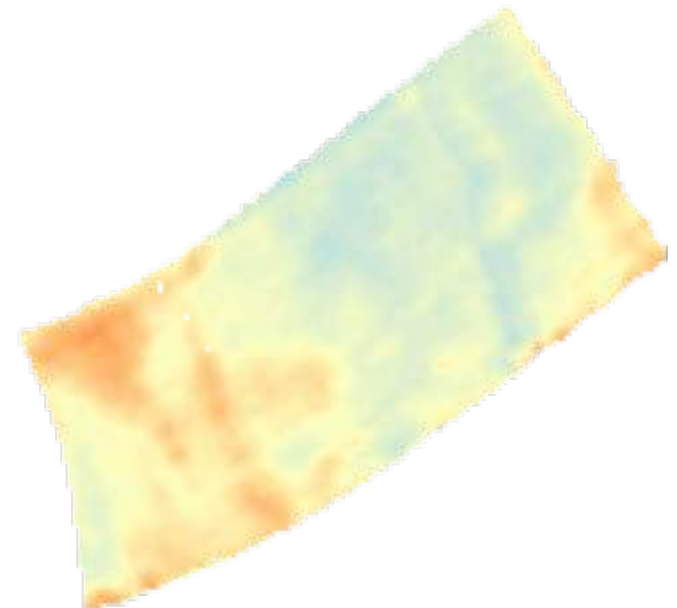
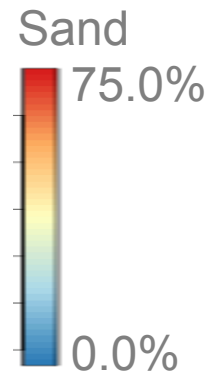




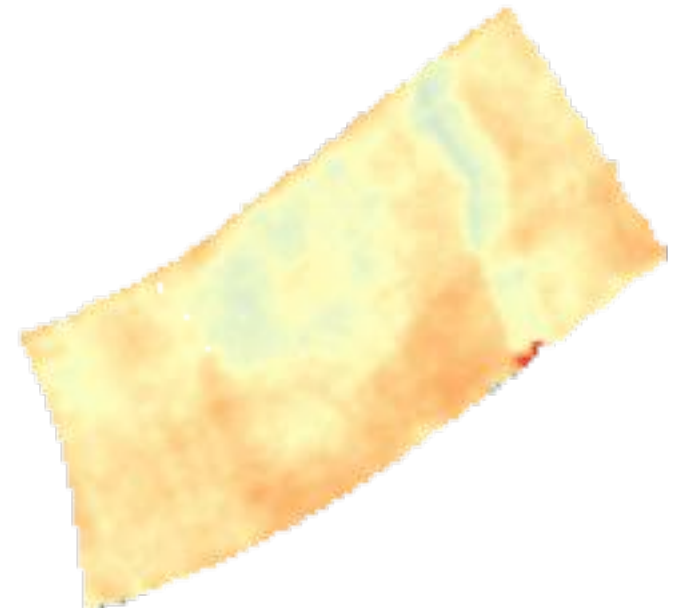
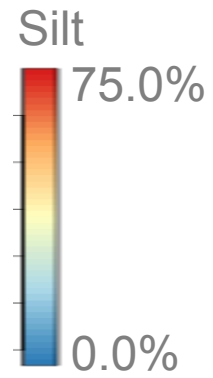


*predicted  $R^2 \approx 0.38 \pm 0.04$*



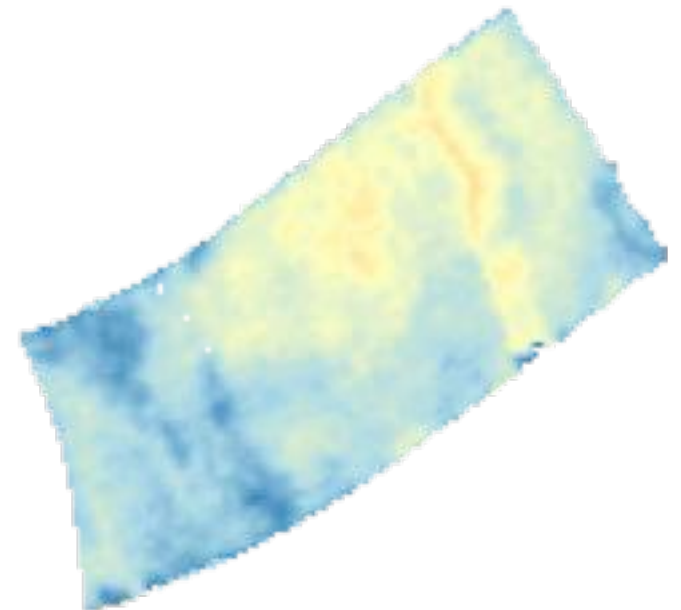
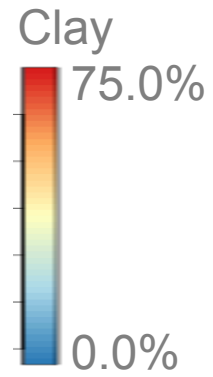






*predicted  $R^2 \approx 0.41 \pm 0.04$*





*predicted  $R^2 \approx 0.41 \pm 0.04$*