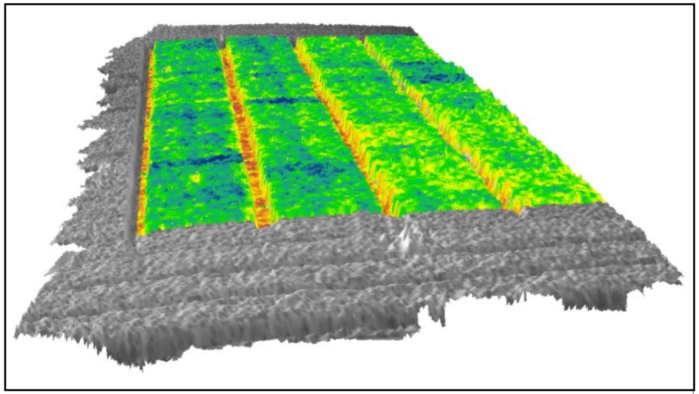

Best practice for UAV Spectral sampling (BUS) - concept and overview of current status-

COST is supported by the EU Framework Programme Horizon 2020

COST EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

Helge Aasen | 27.02.2017 | 0
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Remote sensing in transition

- Lightweight and cheaper sensors available
- Smaller and more flexible platforms
- -> ‘everybody’ could potentially establish their own sensing system

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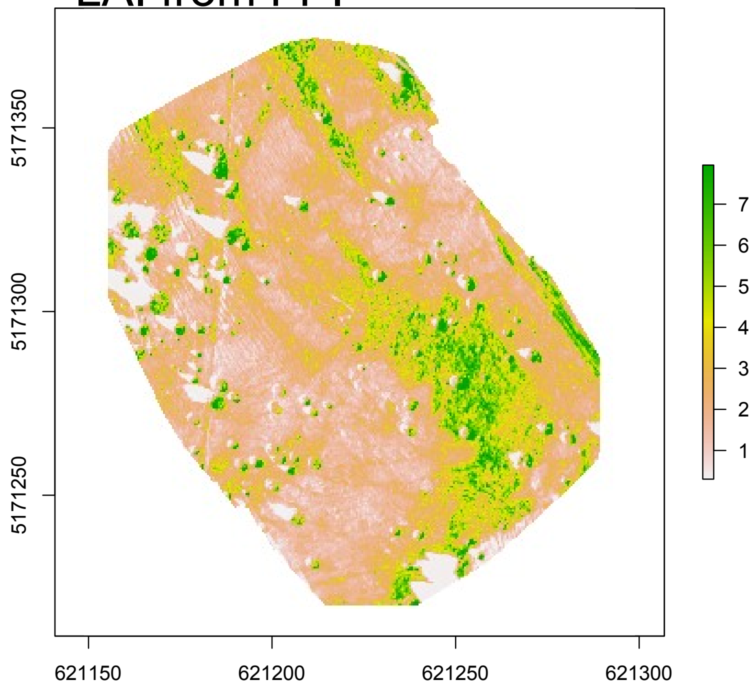
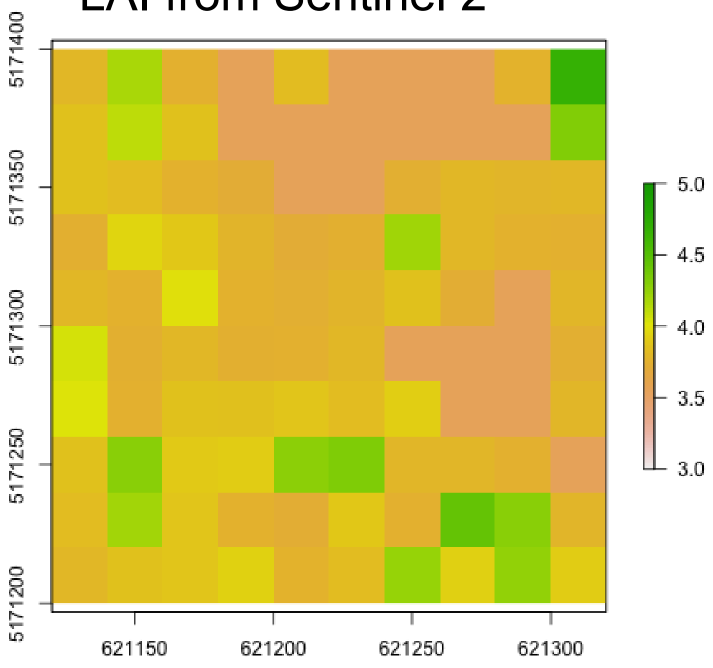
OPTIMISE

Potentials of UAV RS: Leaf Area Index mapping

LAI from FPI



LAI from Sentinel 2



Courtesy Enrico Tomelleri
Warning: different color scale!

Remote sensing in transition

- Lightweight and cheaper sensors available
- Smaller and more flexible platforms
- -> ‘everybody’ could potentially establish their own sensing system

- This brings some issues into focus:
  - Integration of sensors to a small platform is challenging
  - Shift from a few data provides to variety of different research groups, companies and individuals who capture data and data quality need to be ensured in their data products
- => its not just about UAVs, its about the challenges which arises with the transition in remote sensing

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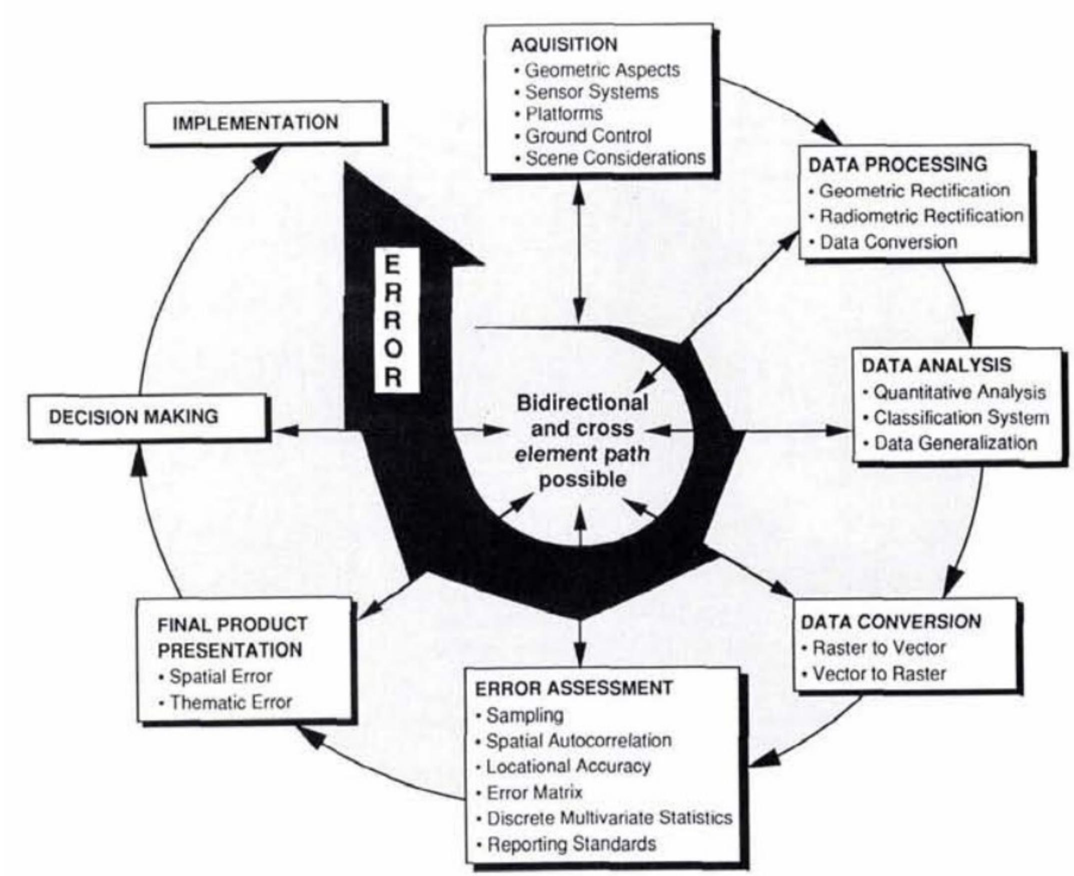
Complexity of the (spectral) remote sensing process



The accumulation of error in a "typical" remote sensing information processing flow (Lunetta et al., 1991)

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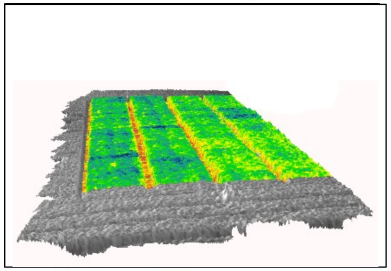
From particle to pixel

field



data product

(Aasen, 2016)

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From particle to pixel

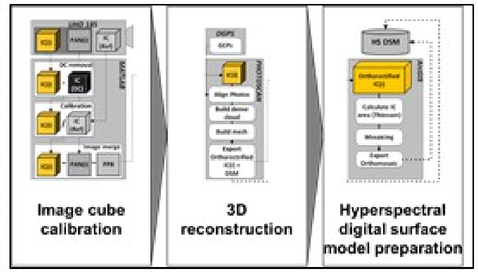
particle in environment

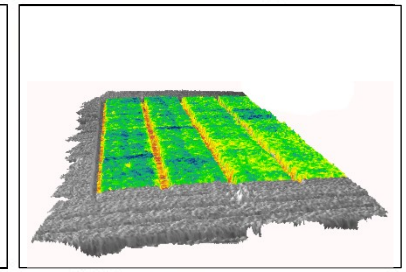
sensor, measurement protocol

data processing

'pixel' in digital representation

field





data product

(Aasen, 2016)

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OPTIMISE

From particle to pixel

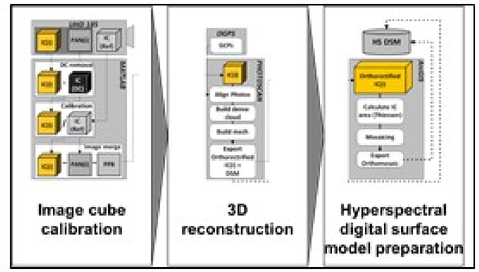
particle in environment

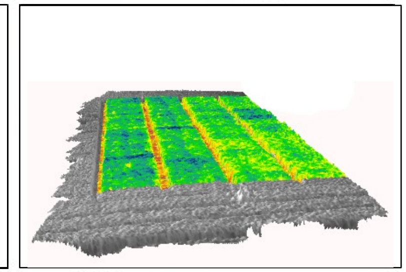
sensor, measurement protocol

data processing

'pixel' in digital representation

field





data product

Data modification

Information

What (and why)?
How much?
Correctable?
Traceable?

metadata

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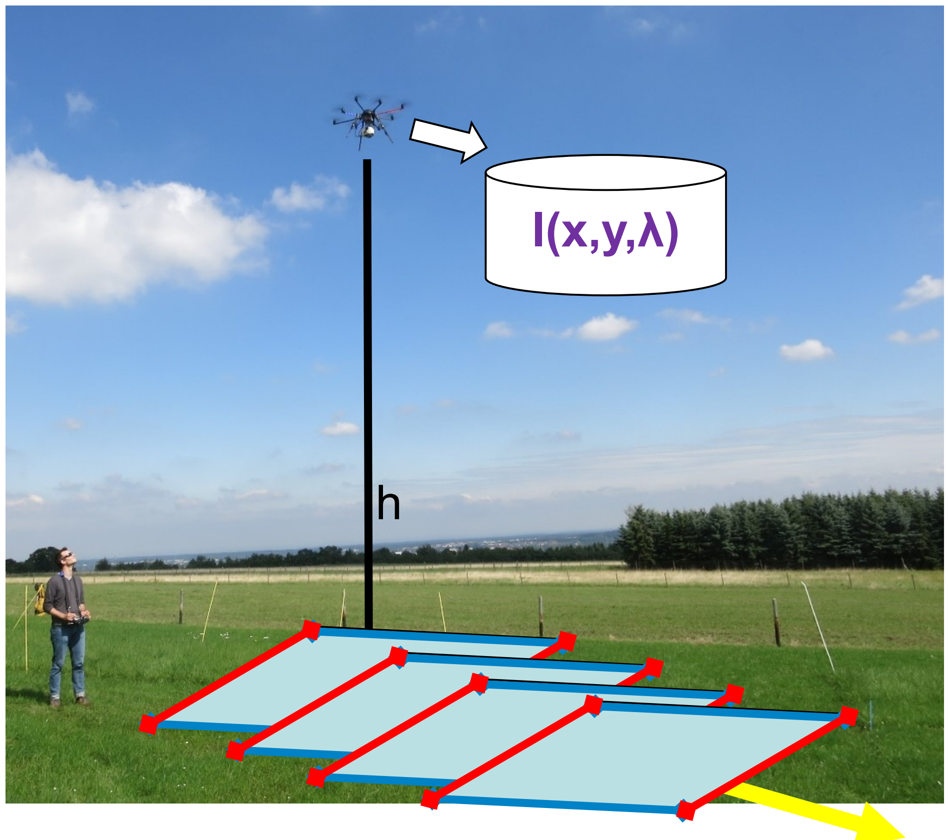
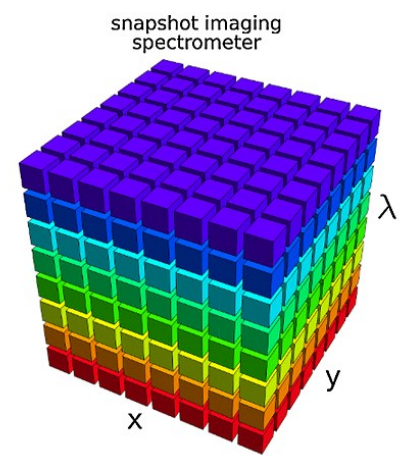
(Aasen, 2016)



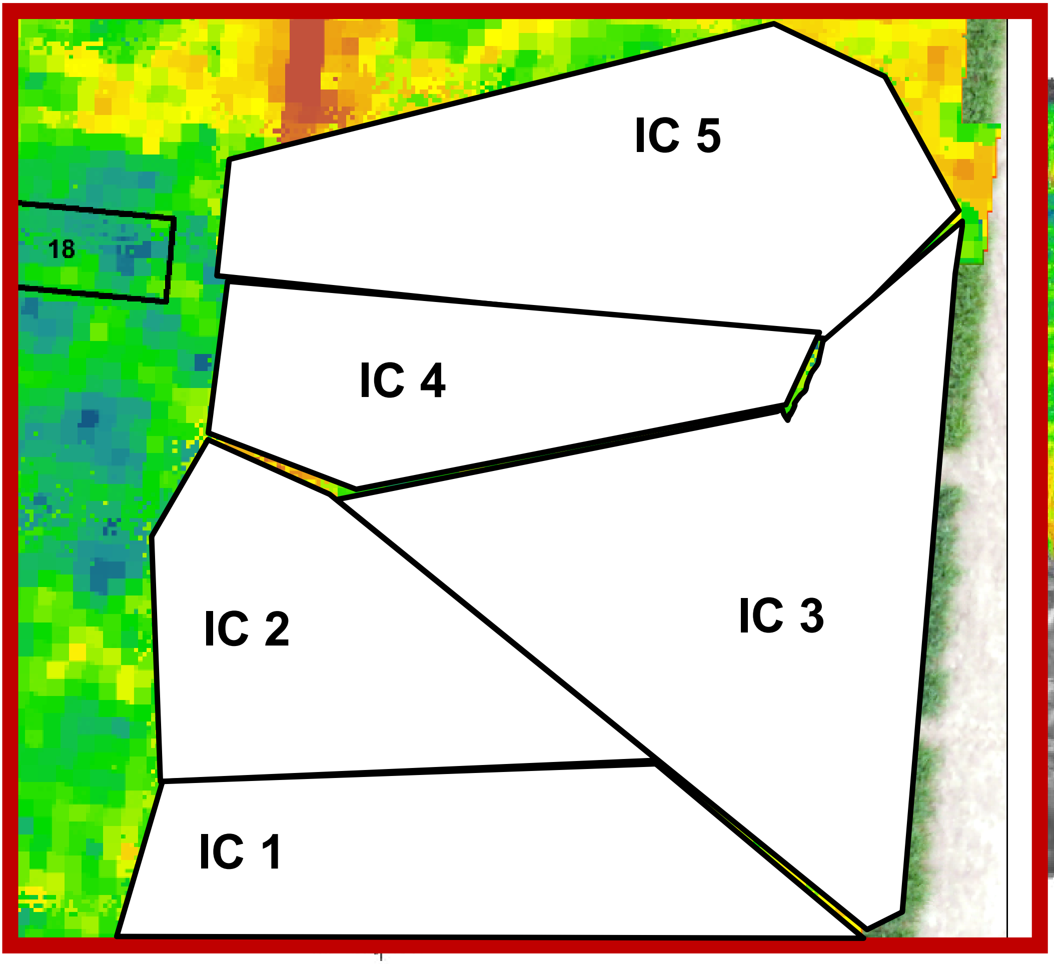
2D imager

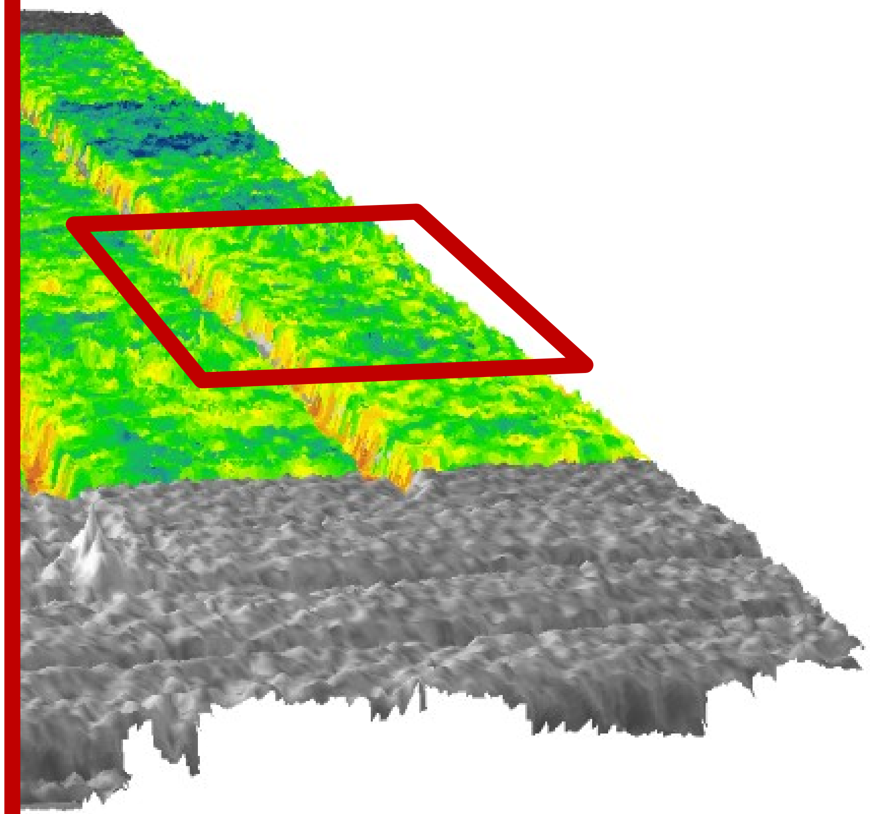


(Hagen et al., 2012)

Aasen, H., Burkart, A., Bolten, A., Bareth, G., 2015. Generating 3D hyperspectral information with lightweight UAV snapshot cameras for vegetation monitoring: From camera calibration to quality assurance.

Angular effects within the hyperspectral data

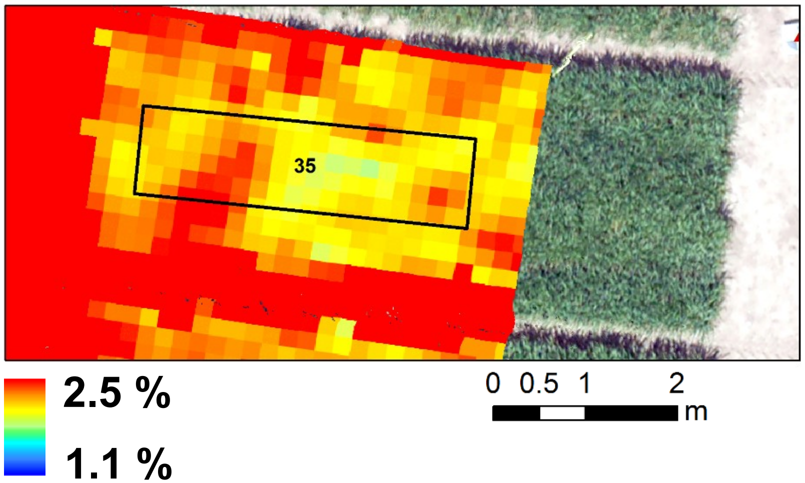


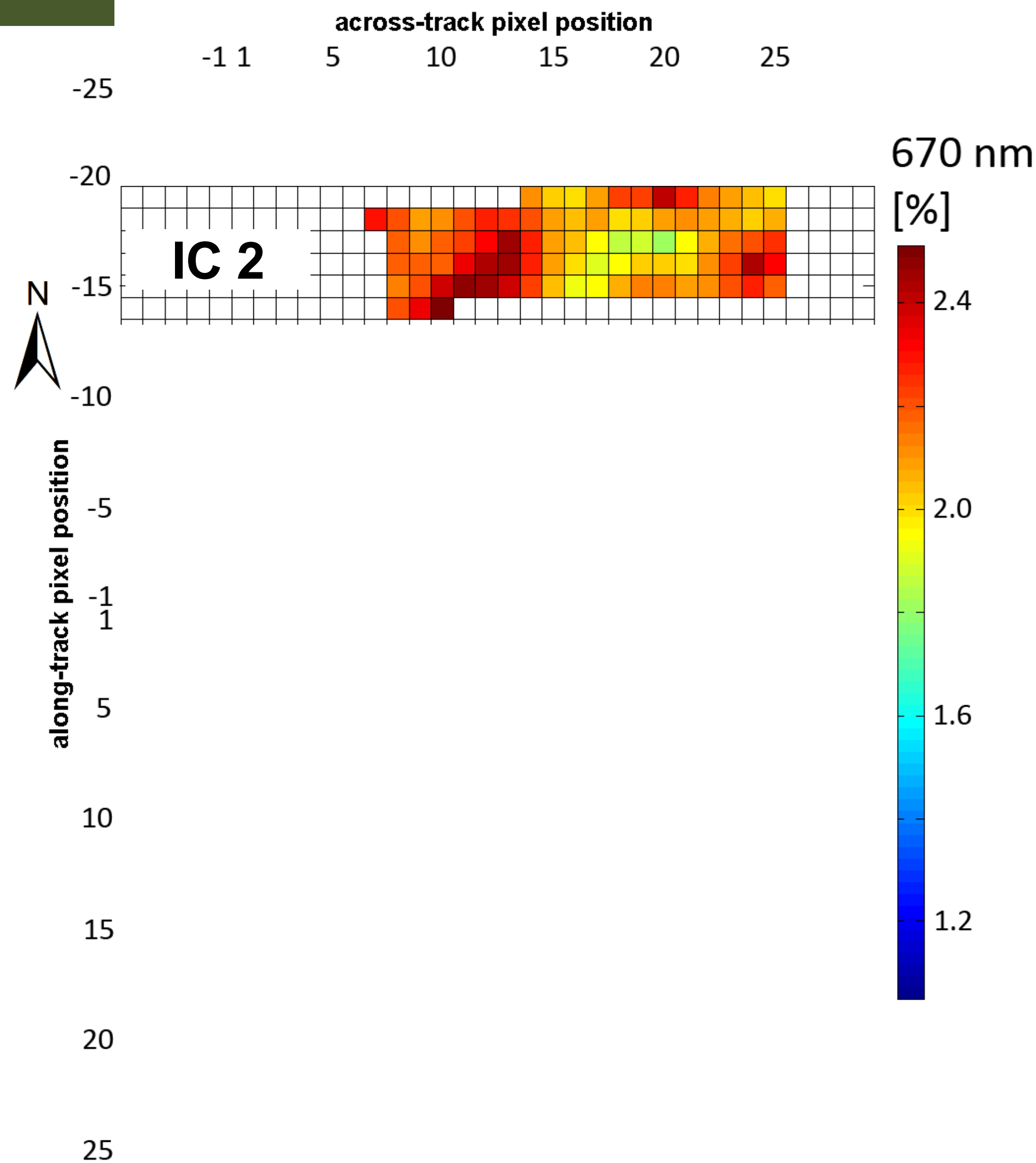


Aasen, H., Burkart, A., Bolten, A., Bareth, G., 2015. Generating 3D hyperspectral information with lightweight UAV snapshot cameras for vegetation monitoring: From camera calibration to quality assurance.

Influence of the viewing geometry

Plot 35, 670 nm, IC 2





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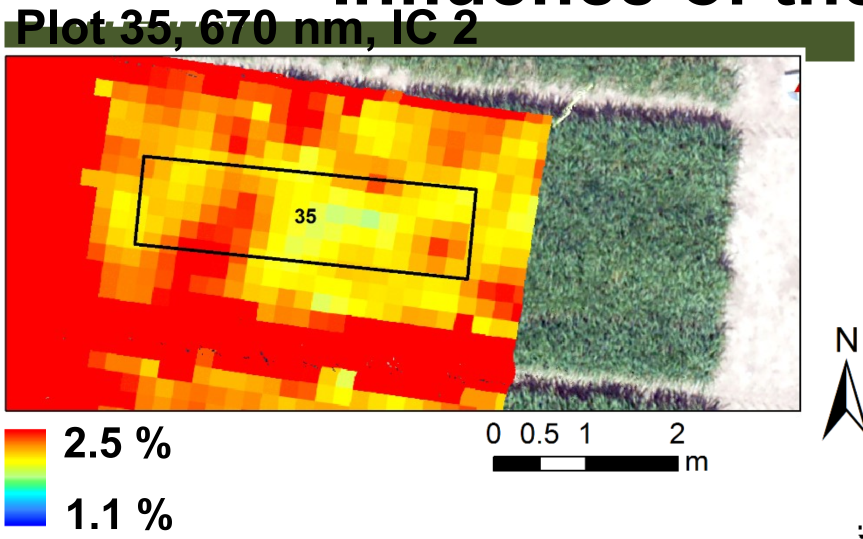
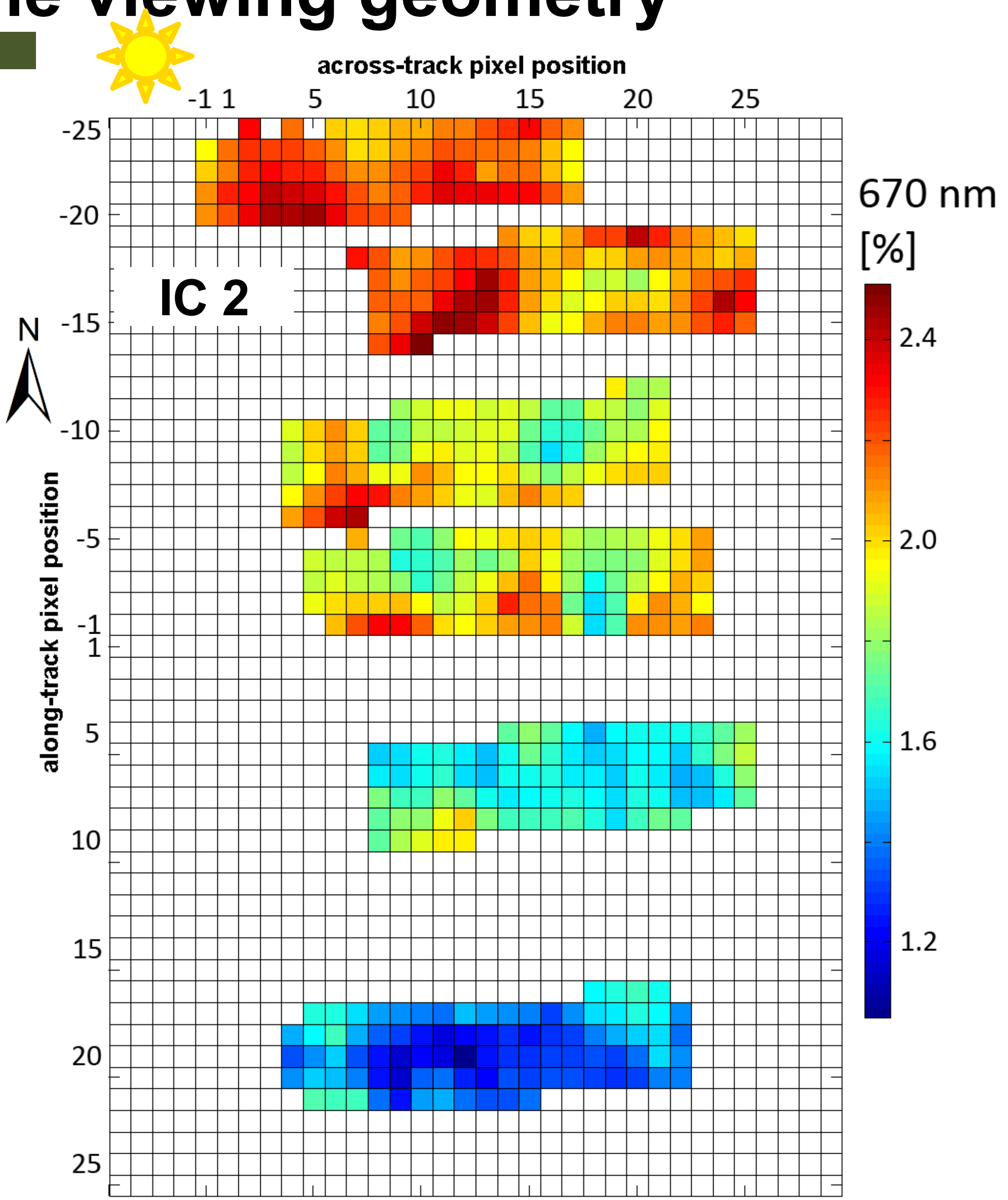
Influence of the viewing geometry





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What is needed?

- Solid understanding on instruments and their properties
- Instrument characterization and calibration
- Well established, robust and transparent (ideally standardized)
  - Measurement protocols
  - Processing methods
  - Retrieval methods
- Transferability between different instruments and scales

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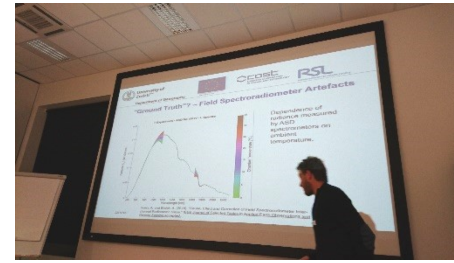
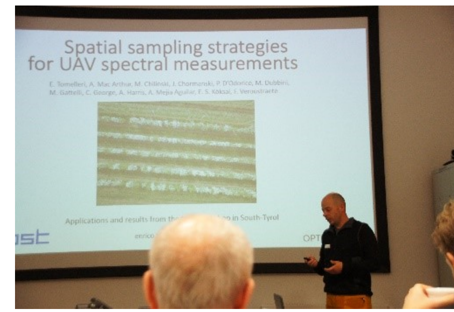
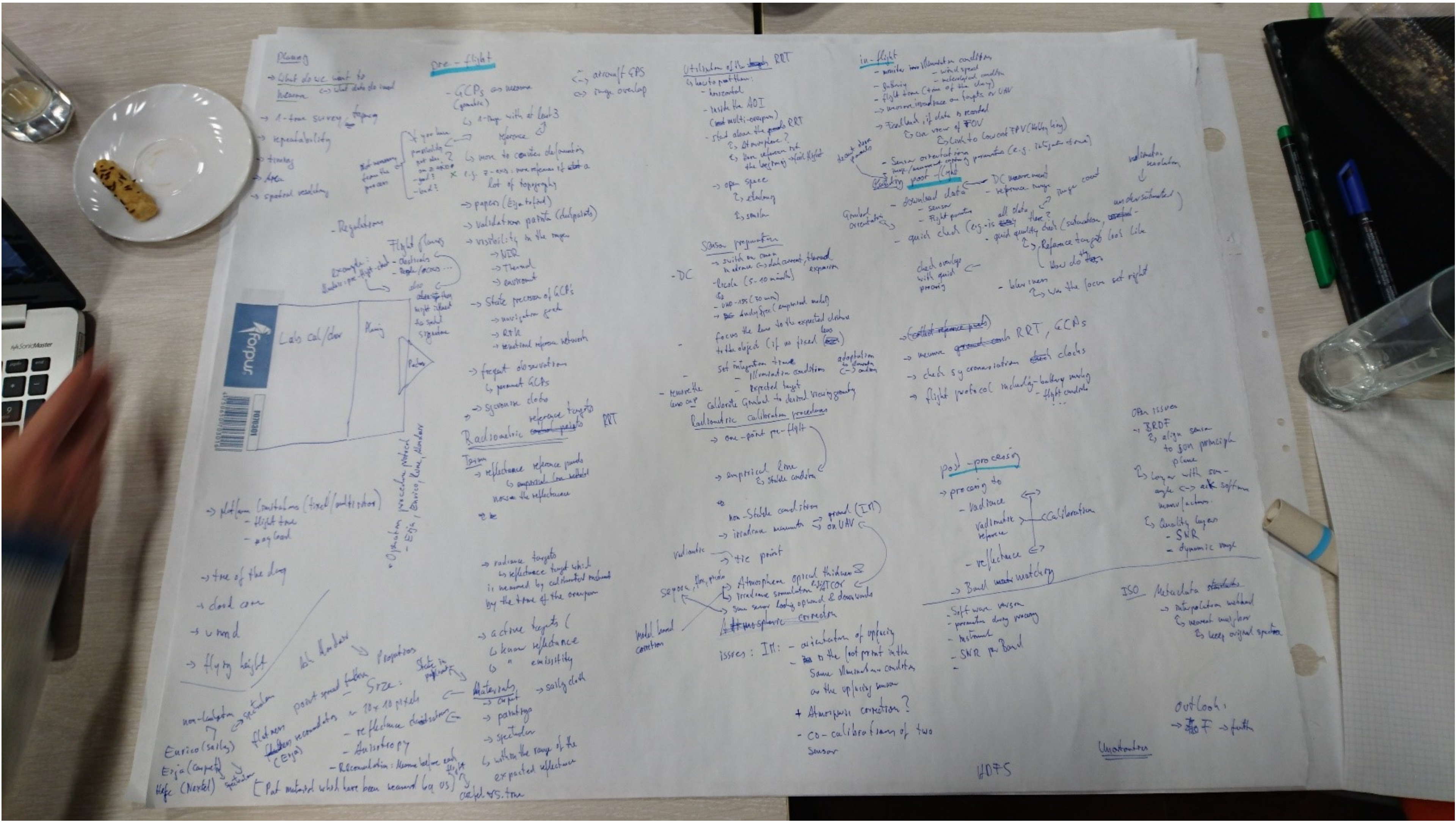
Workshops on BUS

- September 2016: ITC
- October 2016: Bolzano
- November 2016: Tartu

- Upcoming:
- March 2017: Bucharest






pre - flight
in-flight
post - flight
Sensor preparation
Radiometric calibration procedures
post - processing
Open issues
BRDF
outlook
HDF5

OPTIMISE

Current status

- Summary document of state-of-the-art procedures general (MaPi, Javier, Helge)
  - Instrument characterization
  - Field protocols
  - SIF retrievals

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Paper on Top Of Canopy Sun Induced Chlorophyll Fluorescence measurements: from instruments to protocols

Yves, Helge, Andy, Javier, Micol, Tommi, Luis, Andreas, MaPi, Petya, Alasdair, Dan Sporea….

The idea is to divide the manuscript into 3 section. i) instrument characteristics; ii) retrieval methods; iii) field protocol.

Section 1. Instrument characteristics.

This section refers to all the instrumental characteristics considered important in a perspective of achieving high quality SIF estimates.
Key aspects of radiometry and field spectroscopy are reported. Particular attention is paid to determine the sources of measurement uncertainties in order to define the procedures for characterizing the instrumental uncertainty sources of a spectrometer.
This section has been divided distinguishing instrument characteristics into

- optical characteristics
- operational characteristics.

1.1 Optical characteristics

1.1.1 Bit resolutions, Dynamic range and radiometric resolution

1.1.2 Integration time (sampling time)

Define IT and dark current measurement interval.
How often should I change integration time? ~ different integration veg and standard

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Current status

- Summary document of state-of-the-art procedures general (MaPi, Javier, Helge)
  - ➢ Instrument characterization
  - ➢ Field protocols
  - ➢ SIF retrievals

- Document of state-of-the-art of UAV spectral sampling
  - Procedures, best practices, technological background
  - Questionnaire

➢ This afternoon

https://goo.gl/imLAS4 (case sensitive)
https://de.surveymonkey.com/r/uav-bus

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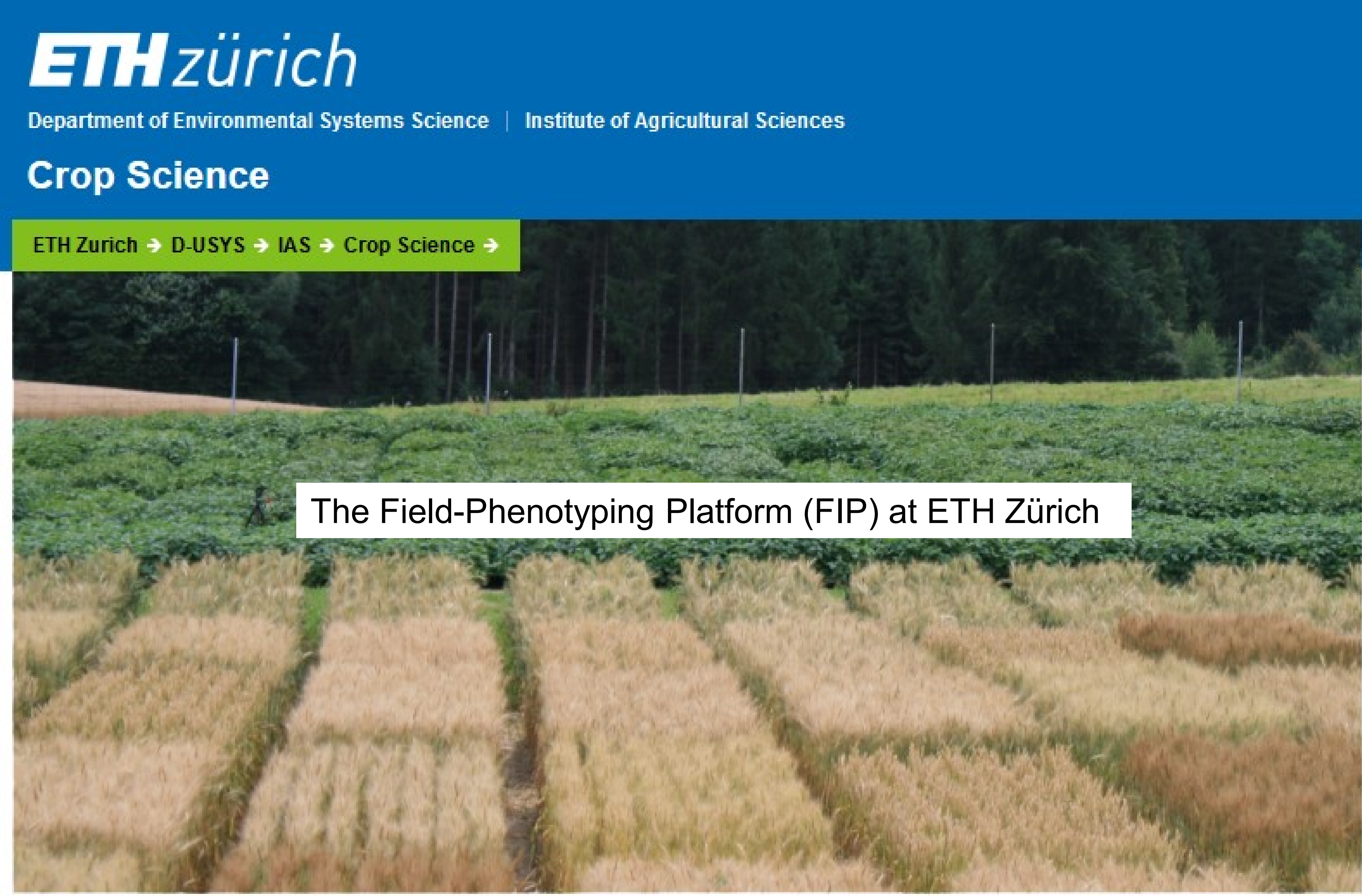


http://www.kp.ethz.ch/

Current levels of remote sensing at the ETH crop science lab

High altitude

Low altitude

Close range

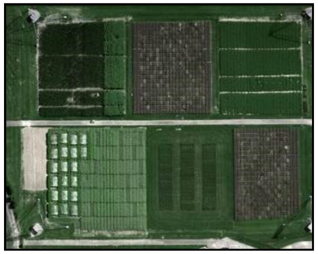
Proximal

➢ **Multi-scale field-phenotyping for breeding and precision agriculture**

Leaf, plant, plot

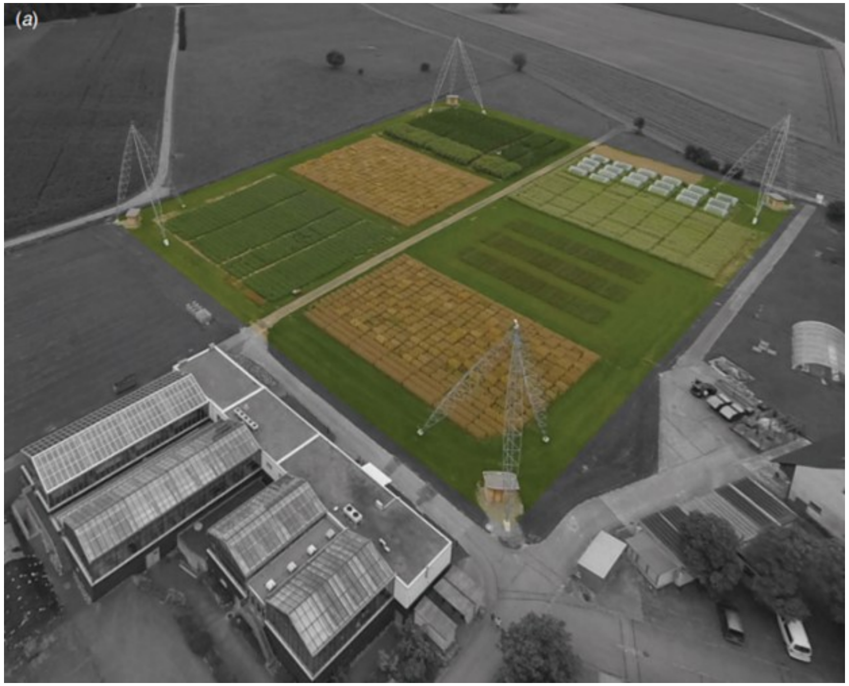
Plot to field

Field to region



ETH zürich

The field-phenotyping platform (FIP)



Sensors

HS point	Ocean Optics USB2000+	Ocean Optics NIR Quest	
RGB and IRGB	Canon EOS 5D Mark II	Canon EOS 5D Mark II NIR, Maxmax	
HS 2D imager	Gamaya 2 CMOS 40 band sensor	Infratec Variocam Head	**Thermal imager**
Laser scanner	Faro Focus 3D		

- Kirchgessner et al. (2016): The ETH field phenotyping platform FIP: a cable-suspended multi-sensor system

Questionnaire

https://goo.gl/imLAS4 (case sensitive)

https://de.surveymonkey.com/r/uav-bus

cost
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

COST is supported by the EU Framework Programme Horizon 2020

OPTIMISE
Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

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Output B: Questionnaire

- Aims:
  - Figure out the current status of UAV spectral sampling (community)
  - Rise awareness for the topic
- Content:
  - Questions related to the workshop content
  - Connected to Eija et al. s work in 2009, but adapted to the new situation
- Target audience
  - researchers, companies and ‘consumers’ e.g. farmers
  - channels: ISPRS, OPTIMISE, EARSeL, DLG …?

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Questionnaire

- Sections:
  - 1) User profile: who is filling out the form
  - 2) Experience level
  - 3) Most used sensing system – specifications
  - 4) Platform, in-flight procedures and flying conditions
  - 5) Post processing
  - 6) Application and outlook

Do it – try it, it's a beta test

- Please:
  - Take a peace of paper or document and write down anything that comes into your mind
  - What is unclear
  - What you would add
  - …
  - And the time it takes you (should take less than 15 min)

https://goo.gl/imLAS4 (case sensitive)
https://de.surveymonkey.com/r/uav-bus

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