Multi-Scale estimates of ecosystem traits: a meta-model approach

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1. Objectives

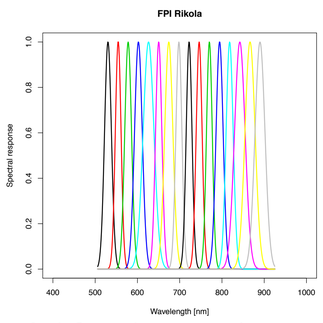
To test the potential of UAV-borne hyperspectral observations for evaluating satellite data.

To derive ecosystem traits from multiple platforms and to provide insights on scaling effects.

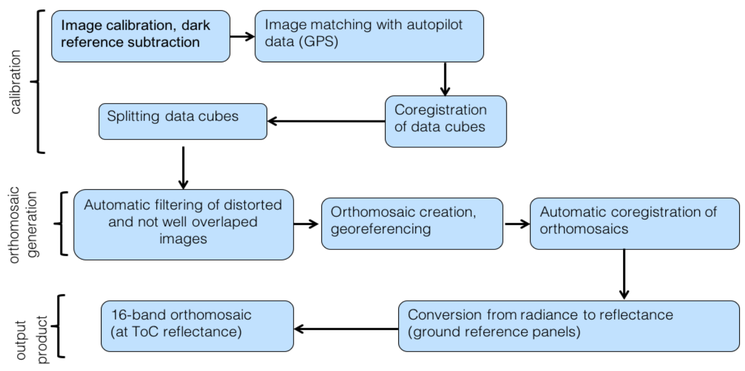
2. Data

UAV-borne: Fabry-Pérot Interferometer (FPI)

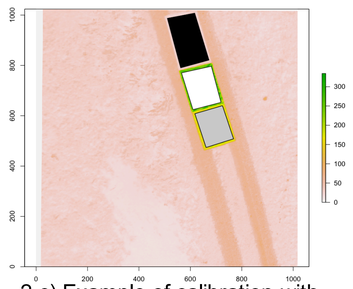
Horizontal FOV	36,5°	Date of acquisition	**21/08/2015**
Vertical FOV	36,5°	Solar Zenith	30°
F-number	~ 2,8	Solar Azimuth	220°
Focal Length	~ 9 mm		
Default Spectral Range	500-900 nm		
FWHM >10 nm			
Spectral Step	1 nm		
Spectral Bands	30 max		
Image Sensor	CMOS		
Image Dimensions	1010x1010 Pixels		



2.a) Gaussian spectral response functions for the FPI



2.b) Workflow for processing FPI mosaics



2.c) Example of calibration with ground reference panels

Satellite: Sentinel-2

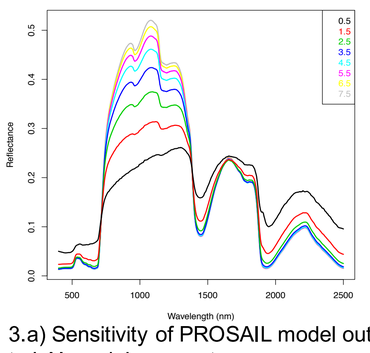
Date of acquisition	**26/08/2015**
Orbit	65
Solar Zenith	37°
Solar Azimuth	160°

2.d) Spectral response functions in VNIR for the MSI sensor

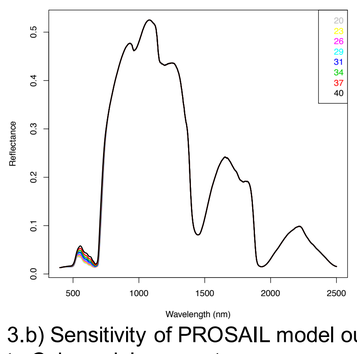
Ground Truth

The study area is located in the Matscher Valley, South Tyrol, Italian Alps. The ecosystem is an alpine pasture. During the flight campaign, biomass samples were collected and field spectra measured over the area of interest. LAI was quantified by means of planimetry (measured range 0.79-2.89 m^2/m^2).

3. Methods



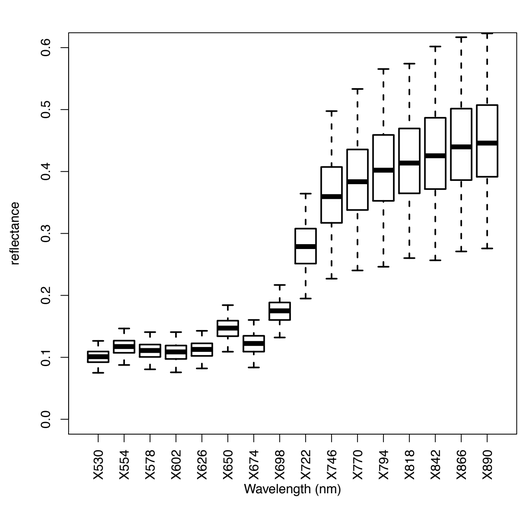
3.a) Sensitivity of PROSAIL model output to LAI model parameter



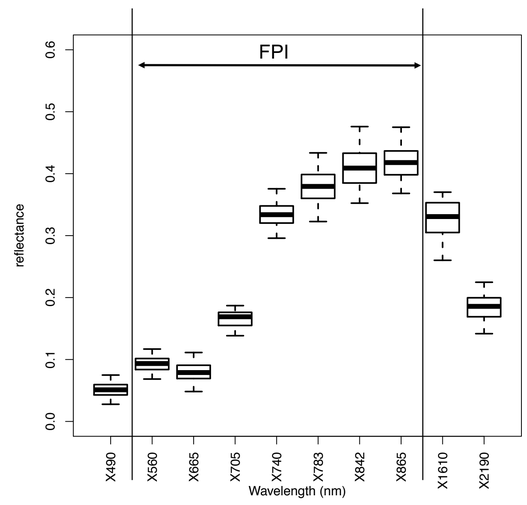
3.b) Sensitivity of PROSAIL model output to Cab model parameter

1. N reflectance spectra were generated by randomly varying the PROSAIL model parameters LAI (range 0-7 m^2/m^2) and Chlorophyll content (range 20-40 ug/cm^2).
2. The simulated spectra were convoluted with the spectral response functions of the Fabry-Pérot Interferometer and Sentinel-2 sensors and used to train random forests (RF).
3. RF were used to retrieve the model parameters from UAV-borne and Sentinel-2 acquisitions.

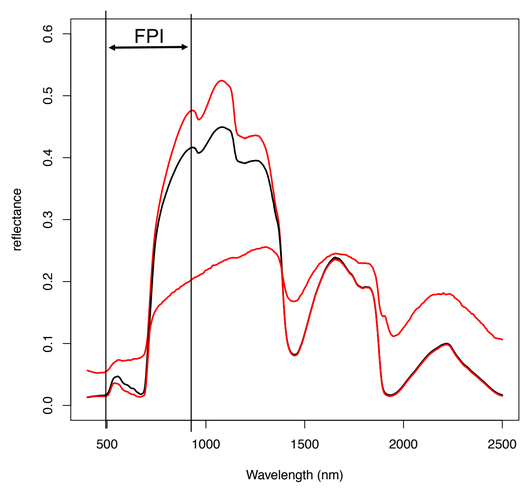
4. Spectral comparison



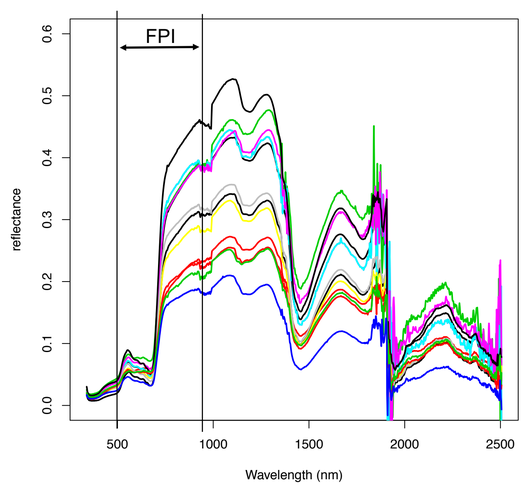
4.a) Calibrated reflectances from FPI within the study area



4.b) Calibrated reflectances from S2 within the study area

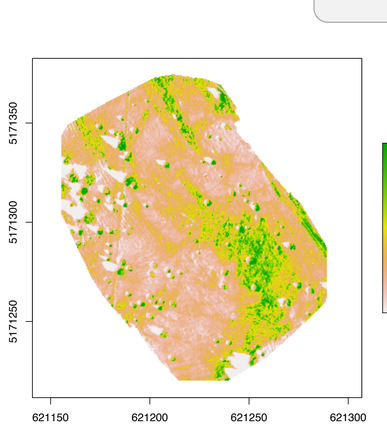


4.c) PROSAIL runs: 0.1 and 0.99 percentiles (red), 0.5 percentile (black)

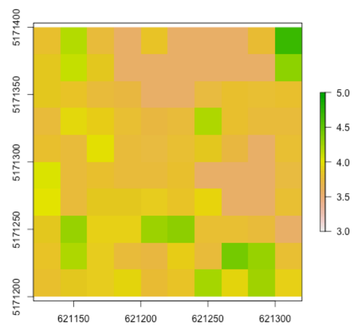


4.d) Field spectromery measurements in the study area (SVC HR1924i)

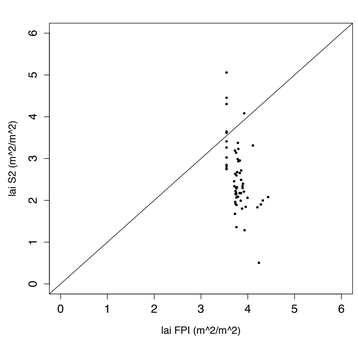
5. Biophysical parameters



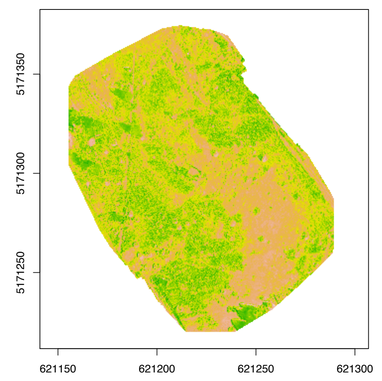
5.a) LAI retrieved from FPI data



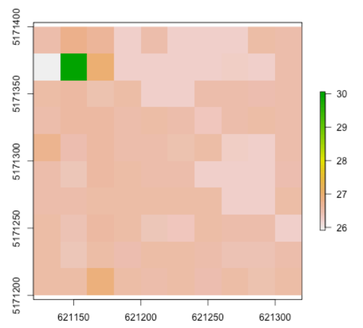
5.b) LAI retrieved from S2 data



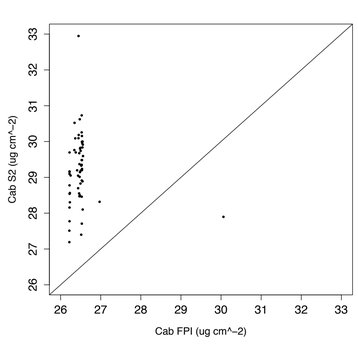
5.c) LAI retrived from FPI and S2 data



5.d) Cab retrieved from FPI data



5.e) Cab retrieved from S2 data



5.f) Cab retrived from FPI and S2 data

Conclusions

UAV can provide very high spatial resolution data, while satellite spatial and temporal coverage. UAV data can be easily calibrated with ground measurement because of scale affinity. Therefore UAV-borne measurements can be used for linking satellite data and field spectrometry. Our preliminary results show that FPI retrievals of herbaceous vegetation is consistent with LAI ground measurements. Even if FPI and S2 spectra are consistent, respective model parameters retrievals show inconsistencies. This might be linked to the different spectral resolution. We conclude that UAV measurements have a potential for evaluation of satellite data over homogeneous areas but proper retrieval algorithms are fundamental due to the different spectral and spatial resolution. Further work for understanding the mismatch is necessary. Different retrieval approaches will be tested. The workflow will be applied to multiple UAV acquisitions over study area during summer 2015 to develop a comparison dataset for various satellite sensors.

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