Analysis of spatial resolution impact on estimated biophysical parameters applying Proba-V and Sentinel-2 data

Radoslaw Gurdak[1,2], Maciej Bartold[1,2], Zbigniew Bochenek[2], Katarzyna Dabrowska-Zielinska[2],

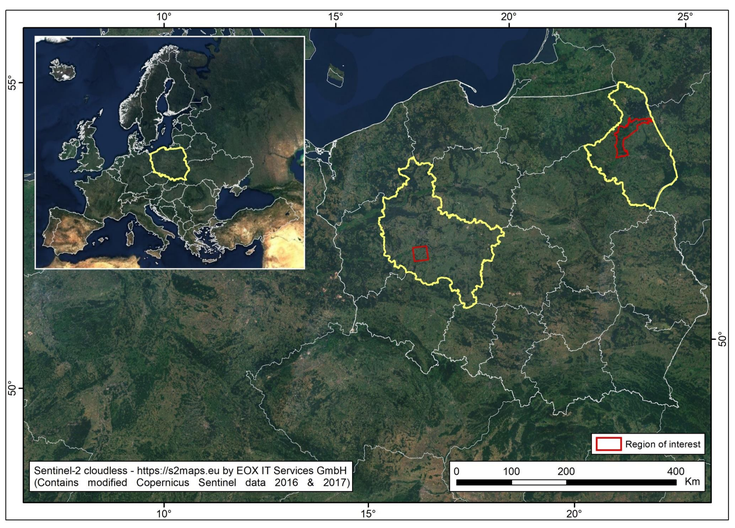
[1] University of Warsaw, Poland

[2] Institute of Geodesy and Cartography, Warsaw, Poland

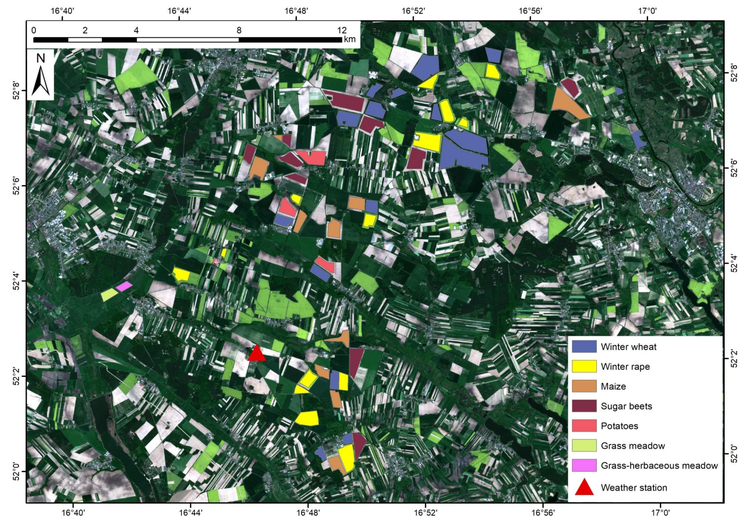
INTRODUCTION

During 2016-2017 growing seasons the series of ground measurements of biophysical parameters have been performed in Poland agricultural and wetland areas. The measurements were planned and carried out in coincidence with Proba-V and Sentinel-2 satellite overpasses with the goal to support the validation of land products derived from these optical sensors. The two study areas were: Poland-Wielkopolska cropland region in Western Poland (part of **Joint Experiment of Crop Assessment and Monitoring**) and Biebrza wetland site in North-Eastern Poland, which is characterized by various grassland plots.

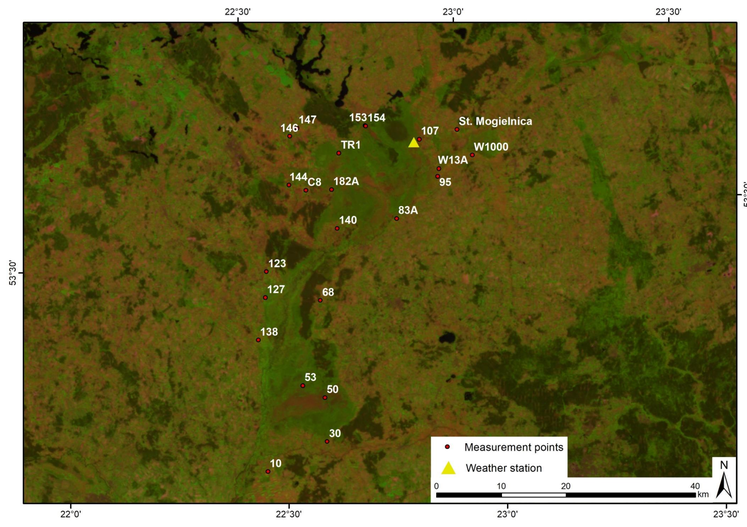
Test sites in Poland



Test fields in Poland– Wielkopolska JECAM
Sentinel-2 Image 2018-05-06 RGB432



Test fields in Biebrza wetlands/grassland area
Proba-V 100m Image 2016-06-09 RGB432



IN-SITU MEASUREMENTS

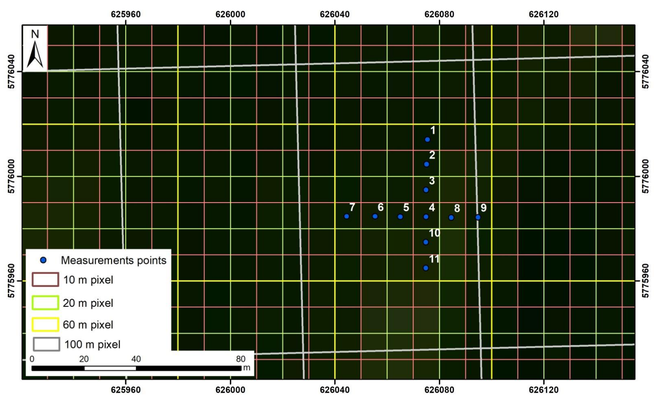
1) Spectral responses by the ASD FieldSpec4 Hi-Res
2) Chlorophyll fluorescence (with OSP5p+)
3) Leaf Area Index (with LAI 2200 Plant Canopy Analyser)
4) Soil moisture (with TRIME Field Measurement Devices)
5) APAR (with AccuPar 80 instrument)
6) Carbon balance (with chamber method)
7) Radiance temperature (with EVEREST AGRI-THERM II)
8) Chlorophyll (with FieldScout CM 1000 Chlorophyll Meter)
9) Wet and dry biomass, water content in (in a laboratory)
10) Type of vegetation cover and its development stage

1) 
2) 
3) 
4) 
5) 
6) 
7) 
8) 
9) 

All ground measurements have been collected during the satellite overpass. The size of the **Elementary Sampling Unit (ESU)** have been **10 m** for single measurements point.

In order to better characterize the whole field **the cross-transects** have been designed.

The scheme of cross-transect.



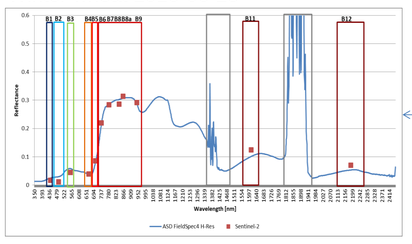
RESULTS

The ground sampling strategy focuses on specific agricultural and grassland fields, representative of the different vegetation cover and crop types in the area of interest. Within each elementary field, transect measurements were performed in order to assess the exactance of vegetation indices and then precision of LAI estimates, applying Proba-V data and Sentinel-2.

Vegetation indices were calculated on the basis of both types of satellite images and statistic values of Sentinel-2 based indices were computed within Proba-V pixels. This approach enabled to assess variability of S-2 based indices over larger area and to characterize differences between indices derived from various types of satellite data. The results of the biophysical parameters derived from the satellite were estimated using a model developed in IGIK and verified using in-situ measurements.

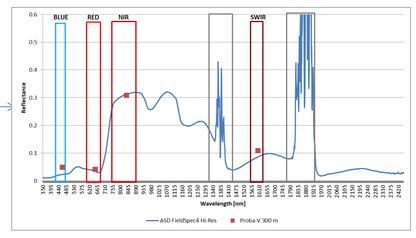
Reflectance by ground measurements and Sentinel-2

Winter wheat 2016-06-25

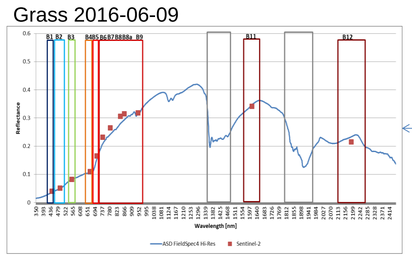


Milk ripening

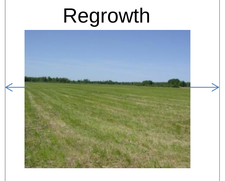
Reflectance by ground measurements and Proba-V Winter wheat 2016-06-25



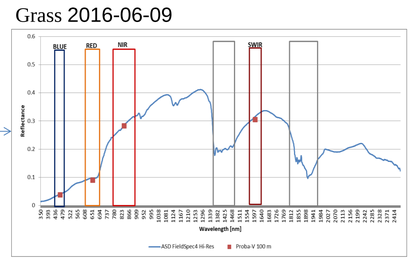
Grass 2016-06-09



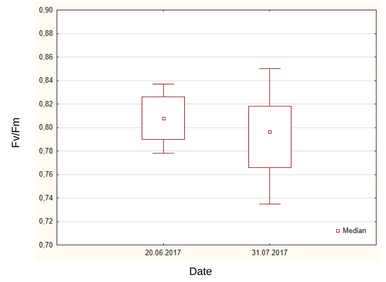
Regrowth



Grass 2016-06-09



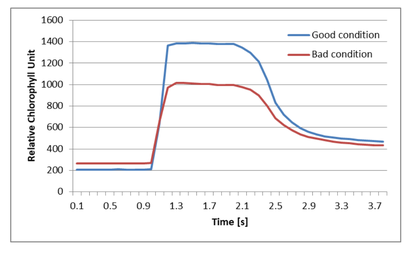
Chlorophyll fluorescence F_V/ F_M test by ground measurements for sugar beets



Sugar beets 2017-06-20

Sugar beets 2017-07-31

Sugar beets 2017-07-31 (leaves cover 90%)



Winter wheat

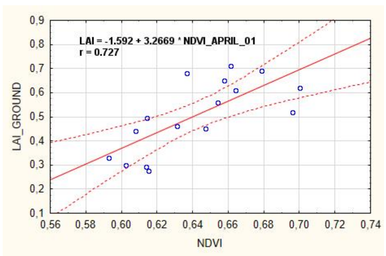
Results of correlation analysis (r coefficient) Sentinel-2

Date	Phase	NDVI	NDII	TVI	SAVI
April 01, 2017	Early tillering	0.727	**0.882**	0.839	0.862
May 01, 2017	Tillering	0.534	0.297	**0.706**	0.518
June 20, 2017	Milk ripening	**0.741**	0.606	0.588	0.652

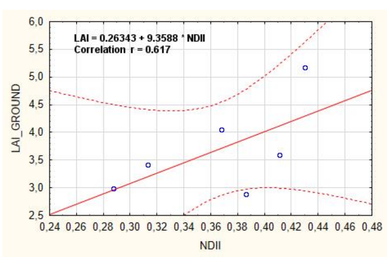
Proba-V

Date	Phase	NDVI	NDII
May 23, 2017	Heading	0.291	**0.617**
June 01, 2017	Heading	0.243	0.481
June 19, 2017	Milk ripening	0.416	0.332

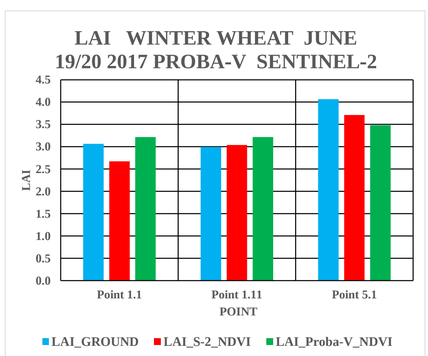
Results of correlation analysis between S-2 based NDVI and ground measured LAI in April



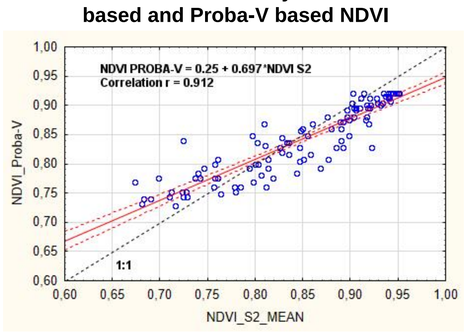
Results of correlation analysis between Proba-V based NDII and ground measured LAI in May



Compatibility of vegetation indices derived from Proba-V and S-2 images depends on phase of plant development. Vegetation indices derived from Proba-V images at 100 m resolution can be effectively used for LAI estimation when S-2 data are not available, with the assumption, that they are collected at the proper development phase – **heading stage for winter wheat, period is crucial for yield forecoast.** The relationship between S-2 based and Proba-V based NDVI is very high at this stage (correlation coefficient r = 0.912).



Results of correlation analysis between S-2 based and Proba-V based NDVI



Normalized Difference Vegetation Index

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

Normalized Difference Infrared Index

$$NDII = \frac{SWIR - NIR}{SWIR + NIR}$$

Soil Adjusted Vegetation Index

$$SAVI = 1.5 * \left[\frac{(NIR - RED)}{(NIR + RED)} + 0.5 \right]$$

Triangular Vegetation Index

$$TVI = 0.5 * \left[120 * (REDEDGE - GREEN) - 200 * (RED - GREEN) \right]$$

The presented work is performed and designed to be executed under the PhD studies. The work is application of the data for **ESA Project "Land Products Validation and Characterisation in support to Proba-V, S-2 and S-3 missions".**