CROP YIELD MODELING APPLYING LEAF AREA INDEX ESTIMATED FROM SENTINEL-2 AND PROBA-V DATA AT JECAM SITE IN POLAND

Katarzyna Dąbrowska-Zielińska1, Maciej Bartold2, Radosław Gurdak2, Martyna Gatkowska2, Wojciech Kryła1, Zbigniew Bochenek1, Alicja Maliniska1

1 Institute of Geodesy and Cartography, Jacka Kaczmierskiego 27, 02-679 Warsaw, Poland
2 University of Warsaw, Faculty of Geography and Regional Studies, Krakowskie Przedmieście 26/28, 00-927, Warsaw, Poland

INTRODUCTION

The aim of the project was to examine the applicability of vegetation parameters calculated from Sentinel-2 and PROBA-V satellite data for crop yield prognosis. The extensive field measurements have been carried out parallel to Sentinel-2 and Proba-V satellite overpasses in order to elaborate the best relationship between satellite data and in-situ measured LAI. Finally, the prognosis model based on meteorological data with the periodic input of LAI for wheat yield prognosis has been applied. Additionally classification of crops over JECAM site in Wielkopolska district was performed for 2016 and 2017 to choose the fields with wheat and with other crops for further research.

IN-SITU MEASUREMENTS

1) Leaf Area Index
   (with LAI 2000 Plant Canopy Analyser)
2) Spectral responses
   by the ASD FieldSpec4 Hi-Res
3) Chlorophyll fluorescence (with OSP5p+)
4) Soil moisture
   (with TRIME Field Measurement Devices)
5) APAR (with AccuPar 90 instrument)
6) Carbon balance (with chamber method)
7) Radiation temperature
   (with EVEREST AGRI-TERM 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

RESULTS

Correlation analysis between ground measured LAI and LAI derived from the selected S-2 and Proba-V based vegetation indices has been done separately for each phase of the growing season and for particular vegetation indices. The aim of analysis was to study temporal variation of precision of LAI estimation and to determine, which indices are most suited to remote sensing based LAI estimation.

The PROBE model simulates the daily plant growth. The inputs to the model are basic meteorological data and LAI derived from the best correlation with satellite derived indices. The model calculates the Total Above Ground Mass with the high precision of 95% compared with the laboratory measurements.

Separate analysis was done for estimating precision of LAI determination from Sentinel-2 data with the use of SNAP software (Sent2Agri). LAI values derived applying this software were compared to ground measured ones. LAI from SNAP software is overestimation compare to ground measurements LAI value.

Compatibility of vegetation indices derived from Proba-V and S-2 images depends on phase of plant development. The results of the work point out, that application of both types of satellite data - Sentinel-2 and Proba-V, is justified while keeping proper time of data acquisition and applying appropriate vegetation indices derived from original satellite data and the proper sampling strategy for LAI ground-based measurements. 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 which is crucial for yield forecast.

Comparison of LAI derived from Sentinel-2 NDVI and LAI produced from Proba-V approach (by Stephan J. Mass)

The scheme of LAI measurement

The scheme of cross-transects

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