TESTING SENTINEL-2 VEGETATION INDICES FOR THE ASSESSMENT OF THE STATE OF WINTER CROPS IN BULGARIA (TS2AGROBG)*

The *TS2AgroBG* project is motivated by the idea that the Bulgarian agriculture sector can benefit significantly from the wider application of remote sensing technology. While aerial photographs have been used in this sector for a decade for agricultural parcels identification, the full potential of satellite applications for crop growth assessment and crop mapping is to be further explored.

The innovative Sentinel-2 sattelite mission, of the European Comission's *Copernicus* programme, will expand the possibilities by providing free imagery with high spectral and spatial resolution suitable for crop state monitoring at field level. In addition to that, the PROBA-V acquires 100 m spatial resolution satellite data at high temporal frequency enabling crop mapping based on image time series. In this context, it is an opportunity to raise awareness of Bulgarian policy makers and other agricultural stakeholders for the capability of these advanced contemporary technologies. This project could also promote the development of applications and services for this emerging market in Bulgaria.

For effective crop management it is important to have timely information about the distribution and areas of different crops and about their growth status and potential yield. To acquire this information, satellite imagery from Sentinel-2 and PROBA-V seems to be of great benefit. In this project, data from these two satellites will be used to generate agriculture-relevant products, including: raster layers with crop biophysical variables, crop state assessment maps, crop masks, and national crop map. Because this is a pilot study, the project will focus on the most important winter crop in Bulgaria – winter wheat. In addition to the common bio-physical variables like Leaf Area Index (LAI), fraction of Absorbed Photosynthetically Active Radiation (fAPAR) and Canopy Chlorophyll Content (CCC), the project will investigate the possibility to retrieve total nitrogen (N) content, fresh and dry above ground biomass (AGBf and AGBd), and fraction vegetation cover (fCover) from Sentinel-2 data. Vegetation indices calculated from Sentinel-2 data will be used to develop empirical regression models for computation of biophysical variables. Dedicated field campaigns will be conducted to obtain consistent ground-truth dataset for the regression models' calibration and validation. The Institute of Soil Science, Agrotechnologies and Plant Protection "Nikola Poushkarov" will provide valuable support during the field campaigns and laboratory analyses of plant samples. Based on these bio-physical variables a crop

state assessment map will be generated. Other type of product will be the crop mask, which will be developed by the Belgian project partner – VITO. To facilitate the generation of crop masks in operational context an extension of the software SPIRITS is proposed to handle and process Sentinel-2 data. In addition, a sub-pixel crop map at national level will be produced through classification of PROBA-V 100 m time series data. Classifications of Sentinel-2 imagery over two training/test areas will be used to calibrate the national level PROBA-V classification. Finally, the possibility to improve the winter wheat yield prediction based on crop-growth model and Sentinel-2 derived biophysical variables will be examined.

The main objectives for the project are to:
1. Accomplish series of field campaigns in a selected test site and to provide geo-database containing ground measured biophysical variables and semi-synchronous remote sensing imagery;
2. Calibrate and validate regression models for retrieval of different biophysical variables using Sentinel-2 vegetation indices applicable to winter wheat grown in Bulgaria; making use of this information to generate crop state assessment map;
3. Extend the capability of the software SPIRITS to assess the crop state using Sentinel-2 data. In absence of long Sentinel-2 time series, the capability of the software will be demonstrated by creating crop masks in the studied region;
4. Produce a crop map at national level using sub-pixel classification of PROBA-V 100 m time series;
5. Assess the possibility for improving WOFOST crop-growth modelled yield by using Sentinel-2 derived biophysical variables.

Project web site: http://www.rse-sri.com/index.php?l=352
Partners:

Space Research and Technology Institute – Bulgarian Academy of Sciences (SRTI-BAS) – leading partner

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