World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:14, No:05, 2020

Explanation of Sentinel-1 Sigma 0 by Sentinel-2 Products in Terms of Crop Water Stress Monitoring

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Abstract : The ongoing climate change affects various natural processes resulting in significant changes in human life. Since there is still a growing human population on the planet with more or less limited resources, agricultural production became an issue and a satisfactory amount of food has to be reassured. To achieve this, agriculture is being studied in a very wide context. The main aim here is to increase primary production on a spatial unit while consuming as low amounts of resources as possible. In Europe, nowadays, the staple issue comes from significantly changing the spatial and temporal distribution of precipitation. Recent growing seasons have been considerably affected by long drought periods that have led to quantitative as well as qualitative yield losses. To cope with such kind of conditions, new techniques and technologies are being implemented in current practices. However, behind assessing the right management, there is always a set of the necessary information about plot properties that need to be acquired. Remotely sensed data had gained attention in recent decades since they provide spatial information about the studied surface based on its spectral behavior. A number of space platforms have been launched carrying various types of sensors. Spectral indices based on calculations with reflectance in visible and NIR bands are nowadays quite commonly used to describe the crop status. However, there is still the staple limit by this kind of data - cloudiness. Relatively frequent revisit of modern satellites cannot be fully utilized since the information is hidden under the clouds. Therefore, microwave remote sensing, which can penetrate the atmosphere, is on its rise today. The scientific literature describes the potential of radar data to estimate staple soil (roughness, moisture) and vegetation (LAI, biomass, height) properties. Although all of these are highly demanded in terms of agricultural monitoring, the crop moisture content is the utmost important parameter in terms of agricultural drought monitoring. The idea behind this study was to exploit the unique combination of SAR (Sentinel-1) and optical (Sentinel-2) data from one provider (ESA) to describe potential crop water stress during dry cropping season of 2019 at six winter wheat plots in the central Czech Republic. For the period of January to August, Sentinel-1 and Sentinel-2 images were obtained and processed. Sentinel-1 imagery carries information about C-band backscatter in two polarisations (VV, VH). Sentinel-2 was used to derive vegetation properties (LAI, FCV, NDWI, and SAVI) as support for Sentinel-1 results. For each term and plot, summary statistics were performed, including precipitation data and soil moisture content obtained through data loggers. Results were presented as summary layouts of VV and VH polarisations and related plots describing other properties. All plots performed along with the principle of the basic SAR backscatter equation. Considering the needs of practical applications, the vegetation moisture content may be assessed using SAR data to predict the drought impact on the final product quality and yields independently of cloud cover over the studied scene.

Keywords : precision agriculture, remote sensing, Sentinel-1, SAR, water content
Conference Title : ICATPA 2020 : International Conference on Agricultural Technology and Precision Agriculture
Conference Location : Rome, Italy
Conference Dates : May 04-05, 2020