GC8-Hydro-103, updated on 29 Mar 2024
https://doi.org/10.5194/egusphere-gc8-hydro-103
A European vision for hydrological observations and experimentation

Assessment of UAV-based LiDAR and photogrammetry data in crop morphology monitoring for advanced irrigation

Attila Nagy, Erika Buday-Bódi, Andrea Szabó, Zsolt Zoltán Fehér, and János Tamás
University of Debrecen, Faculty of Agricultural and Food Sciences and Environmental Management, Institute of Water and Environmental Management, Debrecen, Hungary (attilanagy@agr.unideb.hu)

Most of the climate scenarios forecast increased water scarcity in semi-arid and arid areas, such as Hungary. Since only 2% of Hungary's agricultural land is irrigated where mostly outdated irrigation technology is applied, there is a huge need for act to enhance advanced irrigation. The general aim of the present research was to develop the basis of variable rate irrigation for a water-saving precision sprinkler irrigation system on an maize site (85 ha) located in the reference area of the Tisza River Basin. There are limited available water resources at the site, therefore alternative water sources utilization system was set up for irrigation to adapt to climate change and reduce fertilizers. As the alternative water resource for irrigation, inland excess water, treated wastewater, and biogas fermentation sludge are collected in a water reservoir with a capacity of 114,000 m^3. For proper irrigation scheduling, heterogeneity of topography, hydrological, soil and crop conditions have to be explored and monitored. For this reason, UAV-based surveys were carried out with high spatial and temporal resolution by which DEM, DSM, multispectral vegetation data was conducted both on irrigated and non-irrigated parts of a maize field in Hungary this site. Supplementing these data with physically based modelling of the soil and crop status, and the water balance surveying is tested to use for accurate irrigation scheduling.

In the surveys we used a DJI Matrice 300 RTK UAV drone equipped with a Zenmuse L1 LiDAR payload with integrated RGB Surveying Solution and a DJI Zenmuse H20T thermal camera, which measures in the spectral range from 8000 to 14,000 nm. A DJI Mavic 2 Zoom drone equipped with a Sentera Double 4K sensor that can calculate NDVI (Normalized Difference Vegetation Index) and NDRE (Normalized Difference Red-Edge Index) by filtering out red and NIR wavelengths was used for the multispectral research. These data enables the monitoring of crop height and biomass and the assessment of the thermal properties and the photosynthetic activity of the crop, respectively. A crucial work phase is the data management of these remotely sensed data by which we gain point-cloud and raster from semi-raw formats and photogrammetry analysis can commence. For validation, the results of field measurements for crop height, general status and chlorophyll content were applied by virtue of the high spatial resolution provided by the sensors. Based on the results, the considerable relation was found between the field and RS based data to survey the surface, the height and health status of the maize, which contributes to the mapping of a proper vegetation patterns fostering variable rate irrigation prescription maps.

The abstract was funded by European Union's Horizon 2020 "WATERAGRI Water retention and nutrient recycling in soils and steams for improved agricultural production" research and innovation programme under Grant Agreement No. 858375. This research was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences