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Editorial

Perspectives on "Earth Observation and GIScience for Agricultural Applications"

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Current and future scenarios for global agricultural systems under a changing climate require innovative approaches, novel datasets, and methods for improving environmental resource management and better data-driven decision-making. Recent technological advancements, such as unprecedented and free Earth Observation (EO), open-source geospatial tools and technologies, unmanned aerial vehicles (UAVs), and the Internet of things (IoT) have boosted our knowledge about agricultural systems and interactions at natural, social, and economic levels. These have assisted in resource collection, analysis, monitoring, and simulation in the agricultural area. Yet, they have provided decision-making tools that support sustainable intensification, production systems and supply chains, and natural resource management, among others.

We are facing the data deluge era with free and open data policies for several satellite platforms and geospatial data originating from a wealth of human and electronic sensors along with a growing set of powerful tools and algorithms (e.g., machine learning and web 4.0) for data management and processing. It's timely to harness the potential of geospatial data, tools, and services for making value-added products and services to serve a wide spectrum of stakeholders in agricultural monitoring and supporting a climate-resilient, climate-neutral, and environment-friendly agriculture.

EO data and GIScience will certainly be pivotal in ensuring the implementation of European Union (EU) and global policies such as the Sustainable Development Goals (SDGs) or the EU's Green Deal. Therefore, the use of EO technologies and GIScience in agricultural applications is expected to further increase in the future, overcoming many of the challenges that are still faced.

This Special Issue includes seven papers covering various aspects related to agricultural application based on EO and geospatial data collectively processed by using different algorithms.

In the first paper, Gonzalez and Arsanjani [1] uses a Danish case study and provides data-driven insights about future water level changes based on different climate change scenarios using diverse machine learning algorithms. Their study resulted in simulating the future water level across Denmark and its implications for the water management sector as well as comparing the performance of different machine learning methods. The choice of input data and the implemented methodical approach alongside the discussions borne from the study are of interest to the farming sector and drinking water suppliers as well as the climate change impact assessment domain. The paper by Zan et al. [2] deals with the assessment of lodging risk for different maize in Northern China by using a joint probability model. They used a joint probability distribution of distinct environmental variables (i.e., wind speed and precipitation) to assess the lodging risk, the typology, and its spatial distribution and frequency in the study area. This approach allows to exploit the synergistic effect of multiple factors outperforming the single/multi-factors independent methods usually employed in the classical lodging risk models. Handling the lodging risk is important for the detection of lodging resistance and to select properly the input factors (i.e., fertilization) in view of better sustainable management.

Soil erosion is an important issue that needs to be properly addressed by assessing its spatio-temporal characteristics considering vegetation cover and agricultural management. Mukharamova et al. [3] demonstrated the use of remotely sensed data for estimating the C-factor (tied to vegetation and agricultural management) used in classical soil erosion modeling. The authors used the MODIS satellite imagery with machine learning methods to automatically identify the main crop groups in a vast area of the European Russian territory. Crop maps were validated with official statistics reporting a high level of accuracy and were used to compute the C-factor. MODIS data were complemented with Copernicus FCover, VIIRS satellite, and climatic data to consider vegetation cover, phenological phases, and seasonality of precipitation.

Monitoring the intensity of cropping is of great importance for food security, planning of land resources, and sustainability of natural resources. Free multispectral data (i.e., Copernicus Sentinel-2), free cloud-based processing platforms such as Google Earth Engine along with proper algorithms are the ideal ingredients for producing high spatio-temporal resolution on crop intensity for evaluating grain production. Guo et al. [4] demonstrated how to produce 10 m spatial resolution cropping intensity products with a phenological-based algorithm in the Henan Province (China). Ten-day composite vegetation indices were computed and accuracy assessments of the products were carried out with independent datasets reporting very good performances. The study shows good potential in estimating cropping intensity in heterogeneous areas, and provides quantitative information on farming systems and improved capacity in grain yield forecast.

Nitrogen is an essential inorganic mineral that affects vegetative growth and plant development. Therefore, it is essential to investigate its content in the soil for improving field management efficiency and the economic benefit of agricultural production. Pechanec et al. [5] evaluated the suitability of airborne hyperspectral imaging for determining soil nitrogen content and producing a soil nitrogen map on a pixel-wise basis usable for precision agriculture. The authors performed hyperspectral and visible near-infrared analysis (ASI-1500 and SASI-600 sensors), field spectrometer measures, and soil analysis. The study results confirm the potential of remote sensing methods in predicting soil properties.

Ground-based imagery and modeling approaches can be used to monitor yield prediction for fruits high perishable, such as strawberry, to improve labor and marketing management. Abd-Elrahman et al. [6] used high-resolution ground-based imagery, yield, and weather data for yield prediction throughout the season at different time intervals. Orthorectified mosaics and digital surface models were generated to measure canopy features (e.g., area, height, volume) and to count visually flowers and fruits. Data collected at the plot level were used to develop prediction models by using also weather and previous yield data. Results show good accuracy and great potential in predicting yield by exploiting various sources of data, geospatial models, and high temporal ground-based imagery.

Paddy fields in Indonesia are important for sustaining urban dwellers, but they are constantly threatened by the expansion of settlement areas. Arjasakusuma et al. [7] employed Google Earth Engine (GEE) platform and satellite data for mapping paddy fields in West and Central Java Provinces, Indonesia. Time series of Landsat 8 OLI, Sentinel 1, DEM, and ancillary data were used to generate the temporal spectral indices used as the input for classification. The study highlighted the usefulness of the combination of Landsat 8 and Sentinel-1 monthly time-series data for mapping paddy fields. The authors stressed the importance of future studies integrating deep learning methods for time-series satellite imagery data. We hope that the readers of the ISPRS International Journal of Geo-Information find these articles of interest and that they may help in the development of further applications of EO and GIScience within the agricultural domain.

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