GIS FOR PRECISION FARMING – SENZOR MONITORING AT MOARA DOMNEASCA FARM, UASVM OF BUCHAREST

Doru MIHAI[1], Nicoleta-Daniela SÂRBU[1], Radu MUDURA[1]

e-mail: sarbun@yahoo.com

Abstract

Precision farming is an intelligent way of approaching agricultural activities, which involves the use of advanced machines and technologies to streamline the agricultural process and ensure the control of agricultural production. Practicing precision farming represents, for Romanian farms, the best step towards progress, based on the technologies in the field, from automatic GPS systems to soil sensors, helping farmers to obtain the best results in a more efficient way, efficient and simpler, without wasting energy and resources. Part of modern technology is represented by sensors that can monitor different parameters related to soil and atmosphere. The obtained values must be monitored and processed in some agricultural applications, as well as of the Geographic Information Systems (GIS) that allow the spatialization of the data and the creation of specific thematic maps, which come to the support of the farmers for optimal decisions.
For the monitoring of the agricultural land, images taken with a drone (eBee Classic UAV) were used, which were the basis for making the maps needed to place the Teralytic sensors for monitoring the following soil parameters: Humidity, Salinity, Soil temperature, pH, Nitrates, Potassium, Phosphorus, at three different depths (15 cm, 45 cm and 91 cm). The research has shown the importance of using GIS techniques in spatializing the data obtained from these sensors and developing specific thematic digital maps that support farmers to make decisions regarding the programming of various agricultural works depending on the type of crop.

Keywords: precision farming, GIS, UAV, ground sensor, digital map

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MATERIAL AND METHOD

The concept of precision farming is relatively new in Romania, compared to western Europe, where farmers have reached a high level of use of this concept. Precision farming offers support for farmers who use:

- data collection using satellite images from the Copernicus operational service using Sentinel data https://land.copernicus.eu/global/themes/vegetation
- crop analysis using remote sensing and multispectral analysis that generates an early report on the health status of the crop, monitoring crop yield, soil moisture, controlling the occurrence of pests;
- UAV technology, on the plane or helicopter platform on which a multispectral camera is installed that can give us real-time information about the crops that are inspected;
- agricultural equipment and machines equipped with GPS technology, variable nozzles (for seeders, fertilization equipment and application of treatments);
- sensors that monitor various operating parameters of agricultural equipment and machinery as well as grain flow in the case of harvesting;
- sensors for monitoring various chemical parameters, temperature and soil moisture.

At the Moara Domneasca Farm School, near Bucharest, belonging to the University of

[1] University of Agronomic Sciences and Veterinary Medicine of Bucharest

Agronomic Sciences and Veterinary Medicine of Bucharest, we proposed the creation of an application based on GIS technology that will allow the monitoring of agricultural crops. In this sense, a digital map of the agricultural farm had to be made based on a photogrammetric flight made with a UAV (eBee Classic) drone (https://www.sensefly.com/drone/ebee-mapping-drone/). Based on the obtained images, the orthophotoplan and the Digital Land Model were made, which were the basis for the digital map of the farm. Also, other older analogue maps were used from which information was extracted regarding the organization of agricultural land, pedology of plots, etc.*(*Zufferey J.C. *et al*, 2010; Zhang C.**,** Kovacs J., 2012*).*

Figure 1 - **UAV eBee and GPS SOUTH S82-V**

For information on soil properties we have proposed the use of eight Teralytic sensors. These sensors are specially designed for soil monitoring and can determine soil moisture, salinity, soil temperature, pH, nitrates, potassium and phosphorus. The sensors are of wireless type transmitting the measurements made at three different depths (15 cm, 45 cm and 91 cm) (https://teralytic.com).

RESULTS AND DISCUSSIONS

The flight was carried out with the eBee Classic drone, resulting in a mosaic of images, which, after specific processing, led to the production of the orthophotoplan and the Digital Land Model (*figure 2, 3 and 4*). Based on these images, the vegetation stage of the various agricultural crops can be traced and can visually assess the areas in which to intervene in order to improve the vegetation stage situation. To be eloquent for the different vegetation stages of agricultural crops, the flight should be repeated at least once a month during May-September.

After processing the images taken by the drone with the Postflight Terra 3D software, we could see the new constructions built up in the last years and who are not on the initial maps. Some of the old buildings were demolished in order to build the new one.

Within the GIS application developed on the ESRI platform - ArcGIS 10.3, the images obtained with the drone were stored and processed, as well as the various vector maps previously made with the plan of culture and pedology and the chemistry of the parcels within the farm.

Using GPS and GIS technology you can accurately determine the location of crops and then record information on the quality and chemistry of the cultivated land, so that the quantities of nutrients are used only on the land that needs them in order to increase the production increase;

In order to improve the information regarding the soil properties, we chose a homogeneous plot on which we installed the eight Teralytic sensors (*figure 6*). These sensors provided information on soil properties: moisture, salinity, temperature, pH, nitrates, potassium and phosphorus. The measurements were made at three different depths: 6 " (15 cm), 18" (45 cm) and 36 "(91 cm).

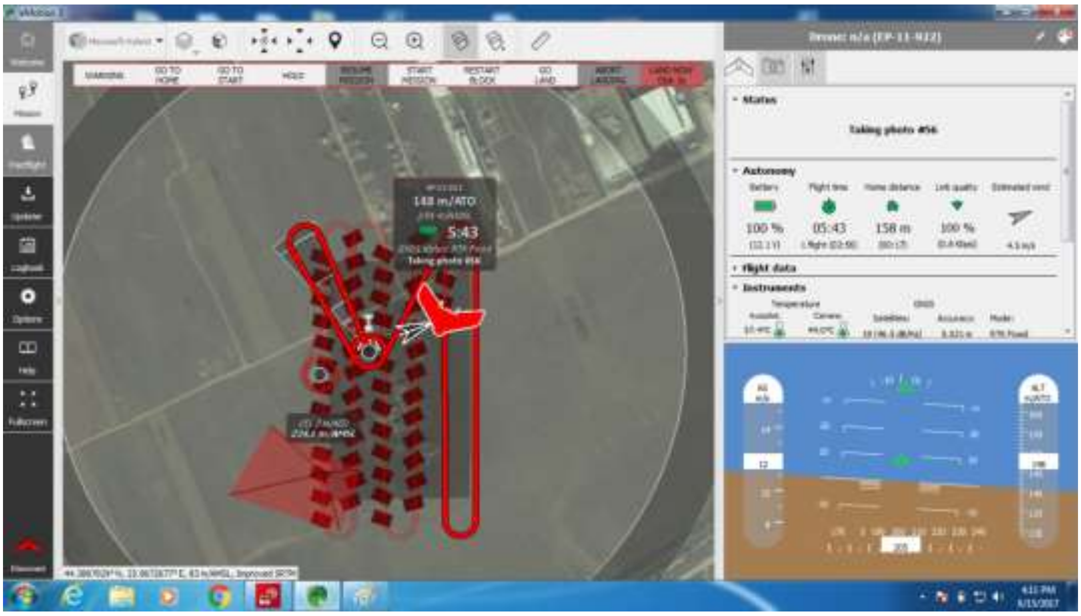


Figure 2 **Image recording and drone route**

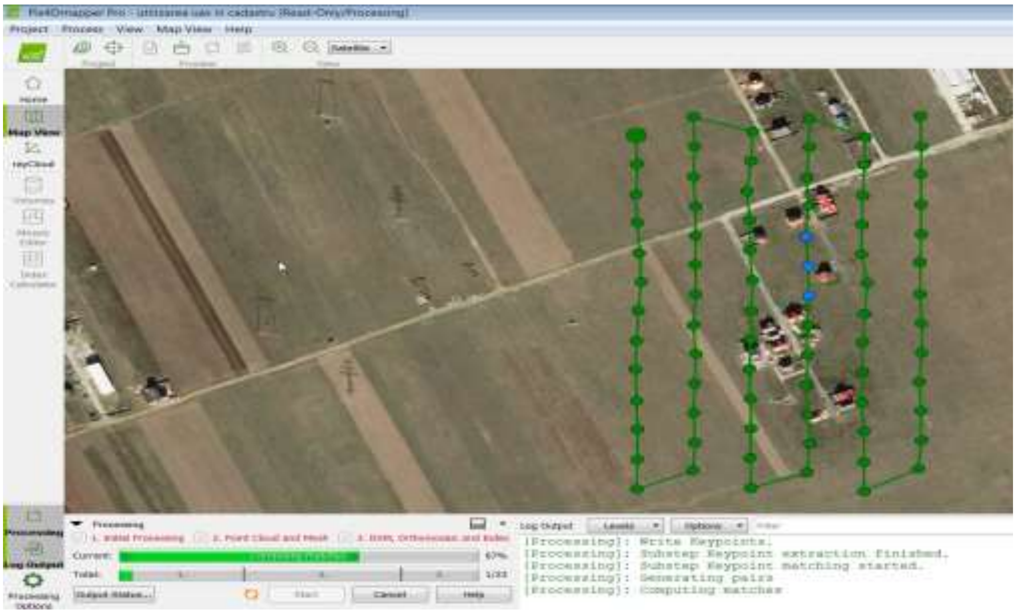
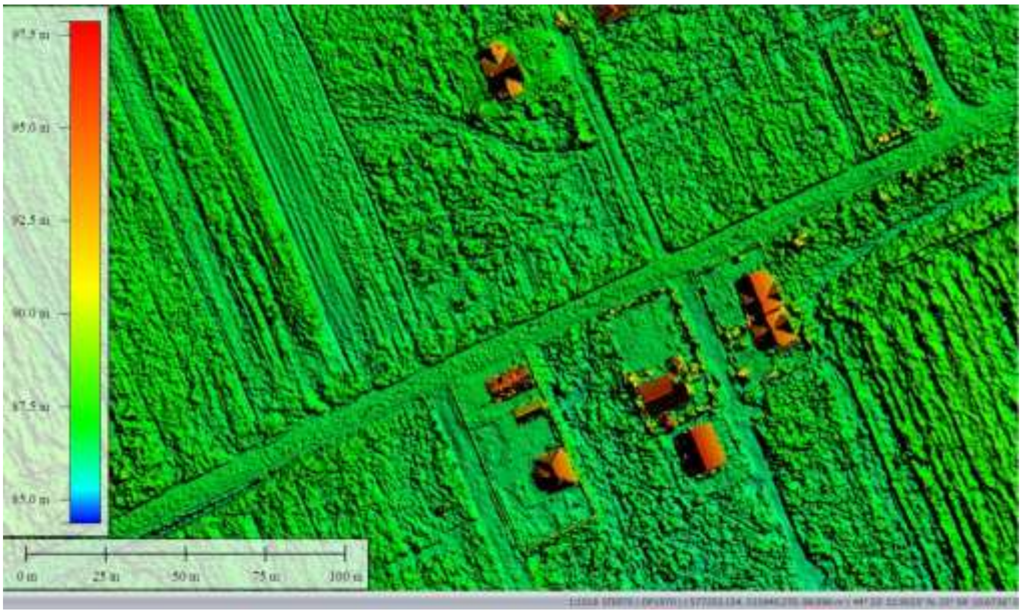


Figure 3 **Exemple of flight plan**



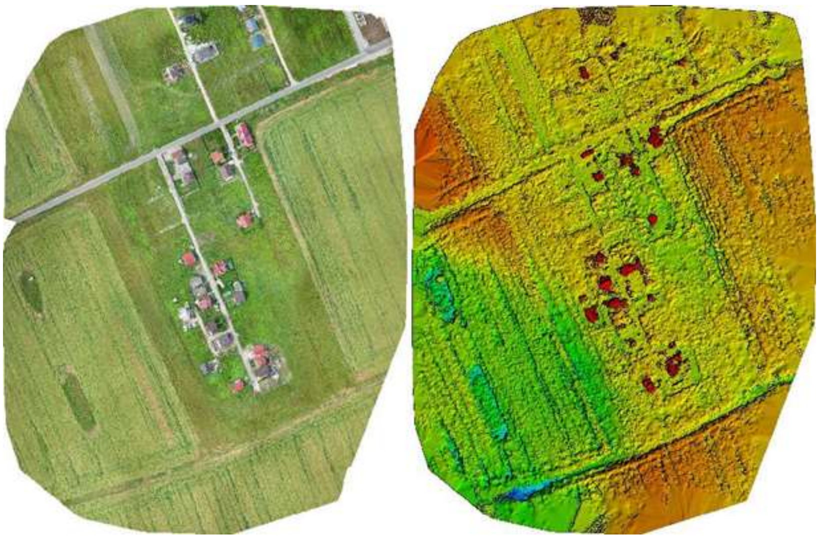


Figure 4 **Orthophotomozaic and Digital Land Model**

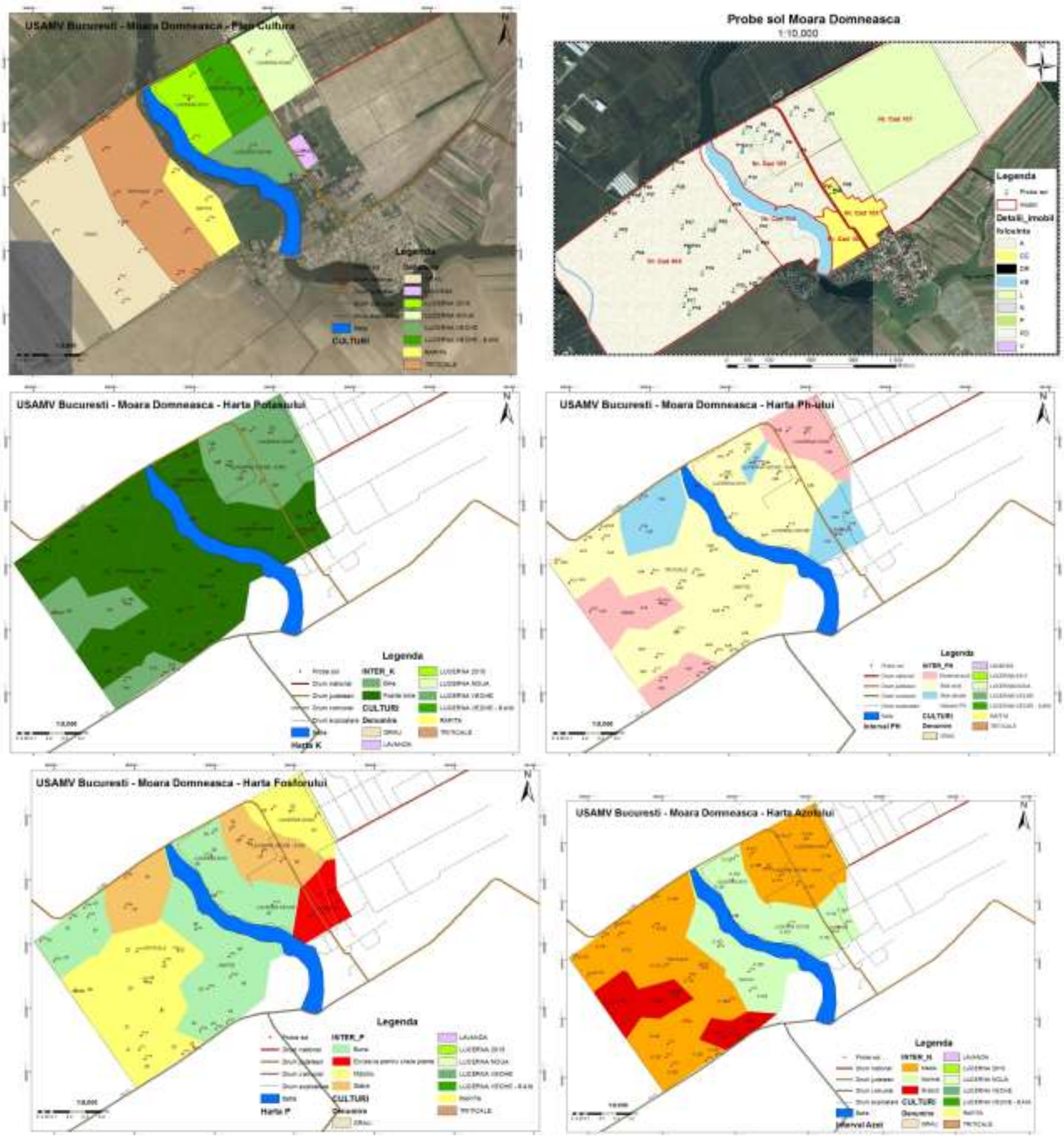


Figure 5 **Vector maps with ancient measuremnts**

Figure 6 **Orthophotomozaic and Digital Land Model**

CONCLUSIONS

A software that uses accurate data from the field must be developed step by step and we consider that it must be started of course with the mapping of the land, without a precise cartographic support we cannot develop a complete GIS (Geographic Information System). Precision farming means measuring and keeping track of all the data resulting from the measurements you make, and for this you need an integrated system that uses a data management application to help us get the most out of it. decisions. We know at every moment what happens to our plants, if they have sufficient humidity, if they need treatments or we can estimate, with 90% accuracy, the production that we are going to harvest at the end of the vegetation period.

In conclusion we recommend the use of UAV / Drone equipment in order to perform information updating. The eBee drone can be equipped with different camera sensors, RGB, thermal, infra-red. This gives the opportunity to capture images that can be used also for vegetation monitoring, moisture level, etc.

With less equipment and with only one day in the field we succeeded to gather enough information to update the maps and to build a GIS for the Moara Domneasca Farm School.

ACKNOWLEGMENTS

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