GIS of crop monitoring remote sensing system

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Abstract: *We aim to develop a GIS to provide agricultural crop monitoring based on heterogeneous data. The GIS integrates multi-source data (space, air-born and ground-based data, meteorological, plant and soil agrochemical data and other data) as well as up-to-date research on crop modelling to support decision making in the management of crop status. Various geospatial input data are taken a view of as a source of information for crop monitoring system. The structure of the GIS, the components and their relations of crop monitoring system based on remote sensing data are described in this paper.*
KEYWORDS: *CROP MONITORING, GIS, REMOTE SENSING, HETEROGENEOUS DATA, CONCEPTUAL MODEL*

1. Introduction

Up-to-date digital technologies and technological basis for obtaining and data processing are widely used in monitoring systems. Remote sensing data and ground-based observations of high-level accuracy are integrated into the crop monitoring systems and agricultural lands state monitoring systems.

Application of heterogeneous data improves the quality of agricultural lands monitoring and accuracy of criterion assessments of parameters of crop condition growth and development.

2. Prerequisites and means for solving the problem

Agricultural monitoring systems aim to provide up-to-date information regarding agricultural crop status, food production, soil quality and soil conservation. Many monitoring systems now exist. An overview of the main global and some regional scale agricultural monitoring systems and mapping cropping practices is presented in [1-5]. These papers show input data and models used, and the outputs produced. Despite improvements in access to multi-source remotely sensed data, the use of numerous remote-sensing based products by the different systems as well as monitoring systems are still to be improved, in particular spatial knowledge of cropping systems and agricultural practices. The increasing availability of various geospatial data and remote sensing data, the emergence of new data processing techniques foresees to improve designing of GIS structure for the crop monitoring system.

The purpose of the study is to substantiate the conceptual model of the GIS crop monitoring system using heterogeneous data to improve the efficiency of decision-making management of crop growth and development.

The development of the monitoring system involves a systematic analysis of the aim and purpose, types of input and output data, components of the system and functions. Conceptual modelling of GIS is performed using both the structural-functional method and a unified modelling language (UML).

3. Results and discussion

When monitoring crops, it is necessary to process heterogeneous data and perform geoinformation analysis and modelling to manage their productivity. In many researches, scientists argue that high-quality monitoring of crops should be performed based on heterogeneous data. Accordingly, the applied crop monitoring GIS should integrate spatial and non-spatial data of different data models and formats, be able to import and export data of various information systems, perform complex analysis and visualize data from ordinary tables to complex reports. Figure 1 shows the proposed structural and functional model of the GIS crop monitoring remote sensing system.

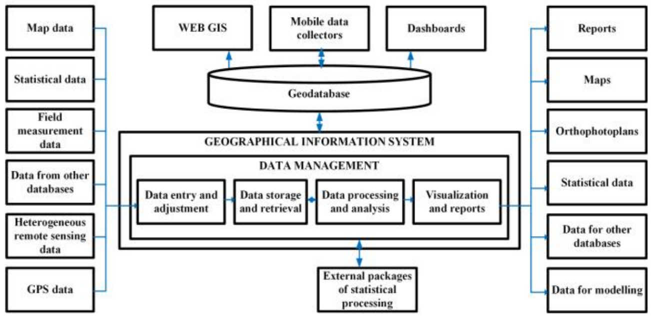

Fig. 1. *Structural-functional model of GIS crop monitoring remote sensing system*

It is proposed that GIS will process data in several stages:
• collection and quality control of heterogeneous data;
• the ability to optimally store and quickly search for data;
• data preprocessing and thematic processing and geoinformation analysis;
• data visualization and creation of various reports.

The input data of the proposed GIS should be: cartographic data from external databases and historical cartographic and statistical data within the fields; data of current field measurements, data of external databases (meteorological, agrometeorological, soil quality data, information on biological properties of crop cultivar etc.); heterogeneous remote sensing data and GPS measurements. Since part of the data is expected to be obtained within the field, the use of mobile GIS is proposed. Such a GIS will allow to link the input data to the sampling points, identify problematic zones, connect to the Internet, and immediately transfer to the server.

For the functioning of the system, the creation of a geospatial database is provided. This database will allow to integrate data into a single environment and quickly exchange data between different information systems and web services.

Figure 2 shows the proposed structure of the GIS crop monitoring remote sensing system in the form of a UML deployment diagram of its components.

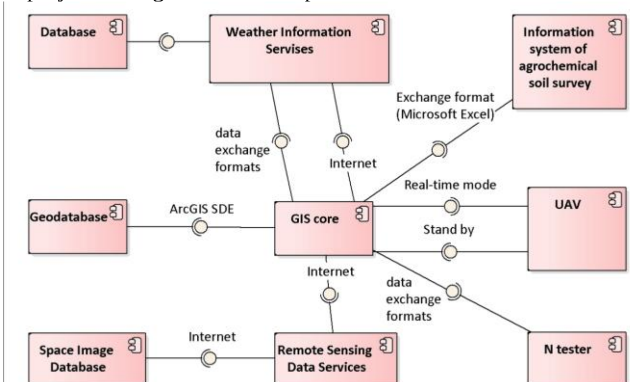

Fig. 2. *Structural model of system components*

The central constituent of the system is GIS, which is implemented using modern technologies. The GIS core consists of a server and a desktop part and it also can support mobile and web GIS. The basic part of the geospatial data is created in the following components. Weather data are obtained through Meteorological Data Services via exchange data formats or, preferably, online. Data of different imagery of remote sensing satellites are downloaded via the Internet. UAV data are also used, where, depending on the model of the vehicle, they are loaded into the GIS in real-time or after flights. Ground control of crop state is carried out using N-tester data. And accordingly, the data of agrochemical soil properties are uploaded through exchange formats. In the future, the structure of the system will expand due to new components. Figure 3 shows the proposed data structure of GIS.

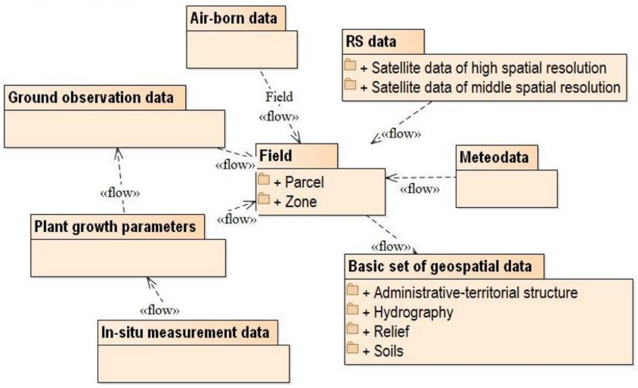

Fig. 3. *GIS Data structure*

First of all, the data structure consists of a basic data set for the area where the agricultural land is located. It is formed by data on the administrative structure, hydrography, relief and soils. Within the territory, the data of the boundaries of the fields where the products are grown are determined. Other data are used for geoinformation analysis and modelling of crops.

4. Conclusions

The study reflects the approach of decision-making to develop an applied GIS crop monitoring remote sensing system. A number of tasks that could be performed by GIS to support decision-making to monitor the conditions of growth and development of crops and yield prediction are observed. Also, the structure of input and output data for analysis of the state and development of prognostic models of crops is shown. Conceptual models of GIS structure have been developed, which allow to understand how heterogeneous data will be integrated in system.

5. References

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