Karabekov Ulugbek Abdukarimovich
Jizzakh Polytechnic Institute
Uzbekistan,

IMPROVED DATA RETRIEVAL METHODS FOR CREATING LARGE-SCALE DIGITAL MAPS.

Abstract: *The article discusses the creation of large-scale agricultural maps, data collection and improvement of the results obtained using remote sensing techniques. The use of geodetic survey methods for creating large-scale maps of agriculture is described. Mapping involves the use of ground survey methods and remote sensing materials. The generated digital maps are used to predict crop yields and agricultural growth, what to grow, when to plant and other issues.*

Key words: *Remote sensing, digital maps, tacheometric survey, GNSS, GPS, DGPS, aerial photography, dynamics.*

Карабеков Улугбек Абдукаримович
Джизакский политехнический институт
Узбекистан,

УЛУЧШЕННЫЕ МЕТОДЫ ПОЛУЧЕНИЯ ДАННЫХ ДЛЯ СОЗДАНИЯ КРУПНОМАСШТАБНЫХ ЦИФРОВЫХ КАРТ

Аннотация: *В статье рассматривается создание крупномасштабных сельскохозяйственных карт, сбор данных и улучшение результатов, полученных с помощью методов дистанционного зондирования Земли. Описано использование методов геодезической съемки для создания крупномасштабных карт сельского хозяйства. Картографирование предполагает использование методов наземной съемки и материалов дистанционного зондирования Земли. Созданные цифровые карты используются для прогнозирования урожайности и роста сельского хозяйства, определения того, что выращивать, когда сажать и других вопросов.*

Ключевые слова: *Дистанционное зондирование, цифровые карты,*

тахеометрическая съемка, GNSS, GPS, DGPS, аэрофотосъемка, динамика.

Introduction

Agriculture plays an important role in the economy of many countries in the world. This sector of the economy provides the population with vital products and is a very important area for the employment of the population. For Uzbekistan as a country where land resources for agricultural purposes occupy 45.08% of the total territory agriculture is the main source of income. For purpose, organizing of rational use and protection land resources, in order to quickly and efficiently obtain information on the land of specific administrative, territorial units maintain of continuous inventory, monitoring and mapping is required. According to Larson et al (1997), the importance of land data lies in its use as an object of inventory and monitoring.

In recent years Uzbekistan has paid special attention to the introduction of modern technologies in agriculture. In particular, the Decree of the President of the Republic of Uzbekistan from May 31, 2017 (PU-5065) directed to the use of remote sensing materials for monitoring and mapping of land resources was adopted [8]. In addition, Presidential Decree No. PP-4709 was adopted on 11 May 2020 [9]. The Decree defines measures to specialise certain regions of the Republic of Uzbekistan, in particular the districts of Jizzak region, in the cultivation of agricultural products.

Reddy et al (2016) states, natural, spatial, quantitative and qualitative information of land resources is prerequisite for their mapping, monitoring, and management on a sustainable basis. For a long time, different approaches, measuring methods and materials were used for land resources mapping purposes. Nowadays, the rapidly advancing geospatial technologies have immense potential in land resource mapping, monitoring and management more precisely and efficiently at different levels. These technologies are therefore being effectively used for precise mapping and judicious management of land resources. (Reddy et al., 2018).

Ground surveying methods

The State Committee for Land Resources, Geodesy, Cartography and State Cadastre of the Republic of Uzbekistan is the main competent authority for the creation of cartographic products of various scales in the country. Currently, the Committee uses images with very high spatial resolution of the KOMPSAT (Korean Multi-Purpose Satellite) spacecraft for the rational, targeted use and protection of land resources. Currently, the KOMPSAT-3 spacecraft provides images over five spectral channels (panchromatic, blue, green, red and near infrared) with very high spatial resolution (2.8 m in multispectral mode and 0.7 m in panchromatic mode). Using satellite images of very high spatial resolution KOMPSAT-3, were created agricultural maps of 1: 10000 scale of Tashkent, Bukhara, Andijan, Ferghana and other regions by the State Unitary Enterprise Geoinformkadastr under the the Committee.

Figure 1. Aerial survey and mapping services

Mainly, electronic land-use maps are created using a variety of sources, including cartographic, statistical data or using various surveying methods (Stupen et al., 2018). Data for large-scale land use mapping for agricultural purposes can be acquired in two ways. With direct field measurements or remote sensing. Remote sensing technology can significantly contribute to land use mapping since they provide timely and detailed land-use information over large areas due to their synoptic coverage and high revisiting frequency (Bellon et al., 2017). Although the almost all mapping projects covering large areas now use remote sensing materials. Ground surveys are still commonly used in preparing large-scale maps of smaller areas (Ghilani et al., 2012). In ground survey spatial positions of features of agriculture can be obtained using different types of measuring equipment such as theodolites, total stations, GPS receivers. Depending on the measuring instruments used, can be chosen the appropriate survey methods. Location of planimetric features and contours can be accomplished by one of the following field procedures: (1) radiation by total station instrument, (2) coordinate squares or “grid” method, (3) offsets from a reference line, (4) use of portable GNSS units, or (5) a combination of these methods. For example, in surveying a situation (agricultural land parcels) with theodolites or total stations, we can use the method of radiation by total station instrument. The essence of the method is the measurement of distances and horizontal angles relative to the reference direction (Figure 1). In this manner, all other objects can be measured. After field works, obtained results are processed using special software products and the spatial positions (x, y coordinates) of the features of agriculture are found. After processing, large-scale maps is created.

Acquiring high-quality spatial data. After processing them, orthophotos and digital models are built which are ideal for cadastral accounting, creating maps and plans with 1:500, 1:1000 and 1:2000 scales.

Using Geoscan technologies you can take advantage of high-resolution orthophotos, raster and TIN surface models. These data help our clients reveal dry and soggy areas, create soil moisture maps and plan irrigation procedures. Every Geoscan suit for agriculture comes with 3D GIS software Sputnik. It gives you convenient tools for accurate measurements of volumes, profiles, distances and areas. For instance, you can in few minutes determine the amount of earthworks for paddy fields construction or maintenance. Wide choice of export formats allows advanced 3D modelling in CAD software and deep spatial analysis in GIS.

Another the most effective ground surveying method is GNSS based methods using GNSS receivers. Global navigation satellite system (GNSS) has revolutionized research in the areas of surveying, engineering, monitoring positions, and navigation (Noviline et al., 1993). As far as mapping and monitoring of land resources are concerned, GNSS applications have immense potential and handy to the surveys to increase the positional accuracy over the conventional surveying techniques. Let us consider GPS positioning system. Modern high- precision GPS receivers using differential technique called DGPS allow finding the spatial position of a point with centimeter accuracy, in some cases even millimeter. DGPS is a method to improve the positioning or timing performance of GPS using one or more reference stations at known locations, each equipped with at least one GPS receiver (Sickle, 2008). The essence of the GPS measurements is to determine the position of points on the earth's surface by satellite. Depending on the required accuracy, positioning methods can be chosen. Positioning with GPS can be performed by either of two ways: point positioning or relative positioning. Point positioning, also known as autonomous positioning, is considered a less accurate method that provides meter accuracy measurements. The method is mainly used for navigation purposes. In this method, one receiver must simultaneously track four or more satellites and ultimately determine its location in the WGS-84 coordinate system. So, what does the spatial distribution of vertical change for the 3D transform between NAD83 and WGS84 look like? I ran a one-degree grid for the Northwest quadrant of the world through the NOAA/NGS HTDP program to have a look. That program is really meant to do a lot of other cool things related to the velocities of tectonic plates, but I used it for a simple change of coordinates without a time difference. Figure 2 shows the height in WGS84 coordinates for the zero elevation in NAD83 coordinates. (Figure 2).

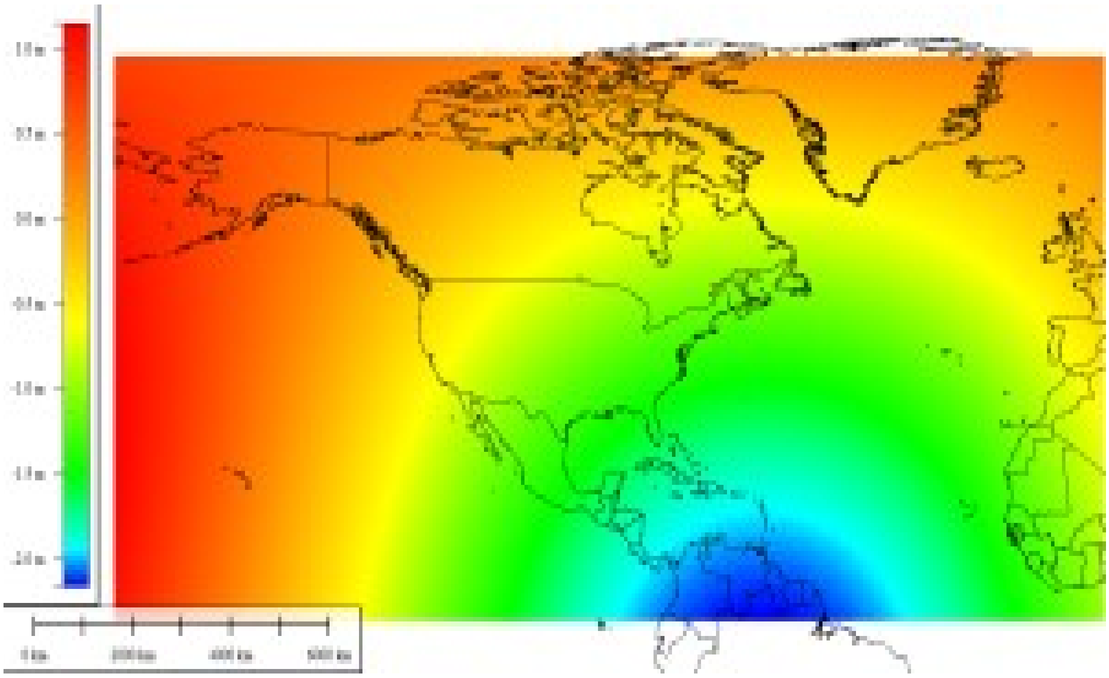

Figure 2. WGS84 ellipsoid heights at zero NAD83 (equivalent to WGS84 minus NAD83).

In practice, relative positioning is performed in several modes depending on the required accuracy: static, fast static, stop-and-go, kinematics, RTK (real time kinematics). For the purposes of mapping agriculture, it is advisable to use the RTK GPS mode.

The use of ground methods of measurements for mapping agricultural needs makes it possible to obtain the required results with the necessary accuracy. However, as noted above these methods are only suitable for fine-scale mapping for relatively small areas.

It is difficult to achieve effective farming without a knowledge of accurate area and location of each field. It is hard to overestimate the value of up-to date high resolution aerial imager. It brings information about crop health, soil conditions and even the current state of drainage tile system to the table. Our cutting edge technologies will provide you with vital data for efficient decision making, reducing expenses and raising yields.

Actual size data for every field is the key for successful costs management. Every miscounted hectare leads to erroneous seeds, fertilizers, pesticides and fuel cost assessment. This will also end up with inaccurate yield estimation. Aerial surveying with UAV is much more productive than traditional land observations. You can obtain thousands of hectares of highly accurate imagery of your fields per day, just at a fraction of a manned services cost. Our UAV systems provide images with spatial resolution better than a satellite can offer. You will always get great results despite any cloud cover. The level of image detalization (fine image quality) allows detection of accurate fields shape and area, real land use and land cover, crop types and patterns, erosion, tillage issues and even plant height.

Remote sensing data

The use of satellite imagery, aerial images or data from unmanned aerial vehicles is a priori reliable and displays a real picture of the state of agricultural land and vegetation. These technologies enable direct observation of the land surface at repetitive intervals, and therefore it allows mapping of the extent, monitoring of the changes, and management of the resources (Reddy et al., 2018).

Despite the fact that agriculture is the leading sector for Uzbekistan, the existing material and the technical base does not meet modern requirements to ensure regular monitoring of lands used for agricultural purposes and requires the implementation of modern technologies. Recently attempts have been made to apply digital technologies for these purposes using materials from remote sensing of the earth. However, at this stage, this question does not have any theoretical and experimental basis.

The generation orthophotoplan using the coordinates of ground control points and the satellite images with the ortho-ready level was performed by the

PHOTOMOD digital photogrammetric station in PhotoMOD Lite 6. 2 software package in the following order: • determination of the location of control points in satellite images; • photo triangulation; • satellite image orientation; • orthomosaic generation; • orthophotoplan generation. The last and complex step in creating the large scale map of the study area is the interpretation of satellite images. Interpretation of satellite images was carried out strictly in accordance with special instructions [10]. In the process of interpreting remote sensing materials, terrain objects were identified and marked with appropriate symbols. Interpretation or analysis of remote sensing data was carried out by visual method. At the same time, terrain objects, the reliability and correspondence of which are beyond doubt, were interpreted from space images using the Panorama 11 program of the Racurs company, and terrain objects that could not be identified by space objects were identified directly in the field. It should be noted that one of the most important objects of interpretation is the boundaries of land use and land ownership, settlements and lands of the state reserve. Boundaries, in terms of interpretation, refer to special objects.

Conclusions

This paper focused to give a general review of geospatial technologies of creating large scale land use maps for agricultural purposes. Geospatial technologies individually as well as jointly play a significant role in mapping, monitoring, and management of land resources (Reddy et al., 2018). Although remote sensing approach has significantly developed over the few decades for mapping and monitoring natural resources but ground-based methods are still using for surveying and mapping relatively small areas. However, for large-area mapping, remote sensing materials are considered more appropriate data sources. Data sets from Landsat, Sentinel, MODIS can be used for mapping and monitoring purposes but the spatial parameters of this data in some cases do not meet the requirements, but images with very high spatial resolution are expensive sources. Thus, airborne remote sensing, especially materials obtained from UAVs, can be used as relevant data. In

Uzbekistan, the implementation of the use of UAVs for agricultural purposes is carried out on a national scale. However, these attempts require the appropriate practical and theoretical support.

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