

Application of GIS technologies in the methods of geodetic work in the mapping of demographic processes

S Abdurakhmonov^{1*}, D Berdiyev³, Sh Gulov³, S Hazatqulov³, and M Bozorov²

¹“TIAME” National research university 39 Qori Niyoziy, Tashkent, Uzbekistan

²Karshi Institute of Engineering Economics, Karshi Uzbekistan

³Karshi Institute of Irrigation and Agrotechnology, Karshi, Uzbekistan

Abstract. Analytical work on rapid data identification based on modeling spatial analysis of data based on geographic information systems (GIS) and technologies is required. As a result, with the help of GIS technologies, the population density in the regions; natural population growth dynamics; a histogram with respect to species; the dependence of the location of the population on the terrain; it is possible to carry out analytical work through spatial analysis of data describing demographic processes such as employment. The study focuses on the ways of geolocation of data from the GPS navigator and the software "Geodesist" in the automatic remote transmission of various demographic processes in the field, including population-related information online to the GIS technology database.

Keywords: geographic information systems, GPS, population, database.

1 Introduction

Enter coordinates and coefficient corrections of the central meridian in the GPS navigator database. Geolocation process - using the GPS navigator to determine the actual geographical location of the object, as well as to obtain the necessary information about the location, indicating the latitude and longitude coordinates of a particular area [1-4].

Modern geodetic devices manufactured by the world's leading companies are of great importance in the field of geodesy and cartography. Modern optical-electronic devices and navigators are produced in conjunction with electronic digital levels. Today, manufacturing enterprises and organizations use modern geodetic instruments, including GPS receivers [5, 6].

Today, many manufacturing organizations use Magellan (Ashtech) single-frequency GPS navigators. These navigators will carry out large-scale reforms to inspect agricultural land by land users and determine the nature of land accounting [7, 8].

The Magellan navigator is activated and the settings are adjusted based on the coordinate zone where the navigator is located. Adjustments to the navigator settings are made in the following sequence [9-11].

*Corresponding author: s.abdurakhmanov@gmail.com

In our thoughts above, we adopted Magellan Pro Mark 3 GPS navigators as an effective method for the remote transmission of demographic data. When collecting demographic data in this area, it is necessary to purchase this device from the regional authorities and specialists. While the average cost of a Magellan Pro Mark 3 GPS navigator is \$ 6,000 (US \$), there are 14 districts in Kashkadarya Province alone when one device is installed for each district, making it worth \$ 84,000 [12-14]. While there are a total of 167 districts across the country, it takes around \$ 1 million to provide officials in all districts with a Magellan Pro Mark 3 GPS navigator. From this point of view, it was found expedient to use the Android application "Geodesist" in conducting this research using modern techniques and technologies (Figure 1).

Geodesist software regularly enters demographic data (population, age structure, sex, etc.) for a given location in a GIS technology database remotely online [15-20]. For example, in the event of a threat of natural disasters (floods, avalanches, storms) in the area, it guarantees the identification of all information about the population and the rapid development of evacuation measures and various other targeted actions. This will be discussed in more detail in the next section [21-25].



Fig. 1. Geolocation process.

According to geographical location, the Republic of Uzbekistan is located in 4 zones and 4 columns, zones 10 N, 11 N, 12 N, and 13 N (North-North) columns are located between columns 40, 41, 42, and 43. The central meridian along the Mercator is 100 for the 10 N zone, 630 for the 11 N zone, 690 for the 12 N zone, and 750 for the 13 N zone.

Taking into account the superiority of the region 41 and 42 in the southern region (Kashkadarya and Surkhandarya regions), the coefficient corrections of the 11 N and 12 N zones will be introduced in the high-precision equalization of geolocation data obtained using GPS navigators. 11 N Zone Corrections Coefficients of value 630 for the central meridian of the Mercator and 690 for the 12 N zone are given.

Due to the fact that the geographical location of the Surkhandarya region is located in the full 12 N zone, the adjustment was made based on the value of the central meridian (Mercator) 690. The part of the Kashkadarya region at a distance of 143 km 831.07 meters to the west from the 690 true meridians is in the zone of the 11 N zone, and the part of the Kashkadarya region at a distance of 190 km 204.43 meters is located in the zone of the 12

N zone. In the Kashkadarya region, it is recommended to make adjustments to the navigator settings according to the change of zones.

2 Materials and methods

Adjustments to the navigator's zone settings are made in the following sequence (Figure 2).

By installing the Mobile Mapper Office program on your computer, it is necessary to determine the corrections of the central meridian coefficients of the zones relative to Mercator and enter them in the navigator setting, for which the following steps are performed:

- First, click on the "Settings" command in the main menu, then select "Select system coordinates" from the resulting menu. The result is a window in the working window. In the window, select the row "New" (Figure 3) [4].

- In the window created under the name "Select system coordinates", select the line "New" and select "Master coordinate system settings - Welcome!" the correction window appears (Figure 4).

- In this window, select "Select pre-installed system" and click "Next". The RUSSIA-PULKOVO 1942-RUSSIA / PULKOVO 1942 / Gauss-Kruger CM 69E line is selected based on the work area and the Gotovo button is pressed (Figure 5) [6].

- From the Select System Coordinates window, press the button in the form of a circle in the image and display the central meridian corrections along the Mercator (Figure 6) [7].

- The "comparing system" window provides corrections in several groups of items (Figure 7).

According to the first paragraph, the corrections are entered in the "Datum" corrections after entering the "System Coordinates" line from the settings menu of the navigator [11].

The introduction of the Datum amendments is given in the table below with a description of the amendments that need to be made in detail. All the work to be done in this table is shown in the pictures.

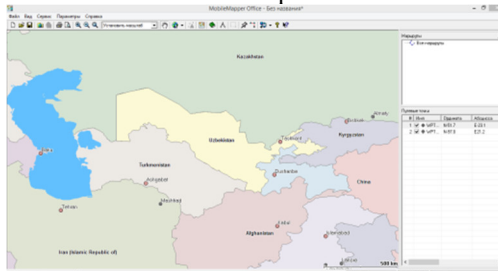


Fig. 2. Mobile Mapper Office work window.

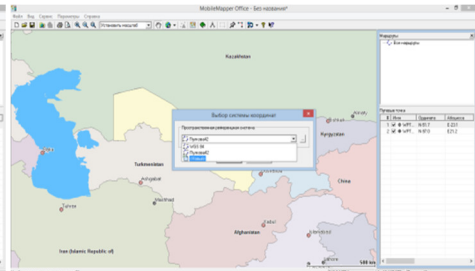


Fig. 3. Coordinate selection window.

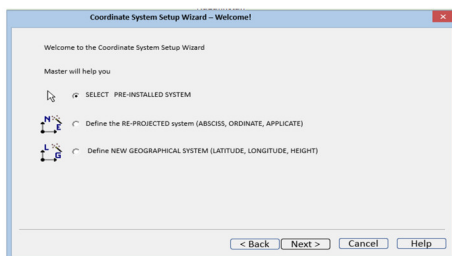


Fig. 4. Coordinate unit selection window.

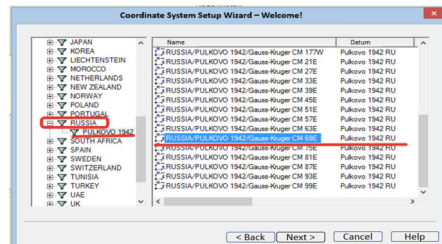


Fig. 5. The window of the "Master settings system coordinates-Selection".

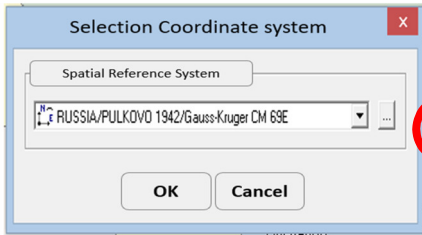


Fig. 6. Choosing System Coordinate window.

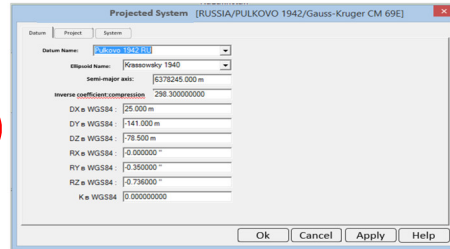

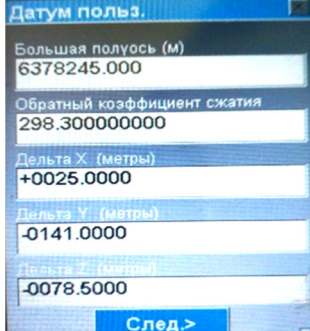


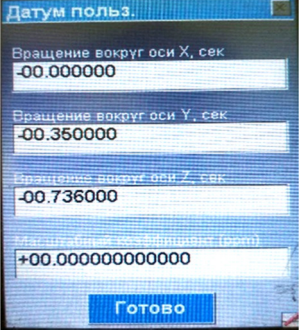
Fig. 7. Datum group of "Sproetsirovannaya sistema".

Adjustments are made to the navigator's coordinate system settings using the above sequence. The above corrections ensure that the navigator performs alignment operations perfectly when obtaining geolocation data [12].

In the study of demographic data, the coordinates of the location are determined by geolocation using a navigator [10], and a geolocation in the form of a defined point is formed and transmitted by means of integrated communication with the database (server).

Table 1. Functions such as the navigator's settings menu, fixing the ellipsoid, and visualization.

#	Screen	Notes
1		Overview of ProMark MAGELLAN (Ashtech) GPS navigator
2		ProMark MAGELLAN (Ashtech) GPS Navigator Configuration Menu Adjustment of Ellipsoid Window 1

3		ProMark MAGELLAN (Ashtech) GPS Navigator Configuration Ellipsoid Adjustment Menu Window 2
---	---	--

3 Results and discussion

In the results of the study, we consider the process of modeling densely populated areas. First of all, it is necessary to clearly define the function of the created model. For example, this system provides ample opportunity to identify many issues, such as the study of the geographical location of territorial boundaries. To do this, the study of the geographical location of territorial boundaries is determined using the necessary geodetic devices and formed in the form of a vector. Statistical data belonging to the population in the settlements of the region are identified and geocoded. Detected data is attributed using special programs. The generated data is sent to the database online. Vector geocodes received nationwide are imported into ArcGIS. Using the Model Builder window, the themed layers are connected to the toolbar commands in a series or chain (Figure 8).

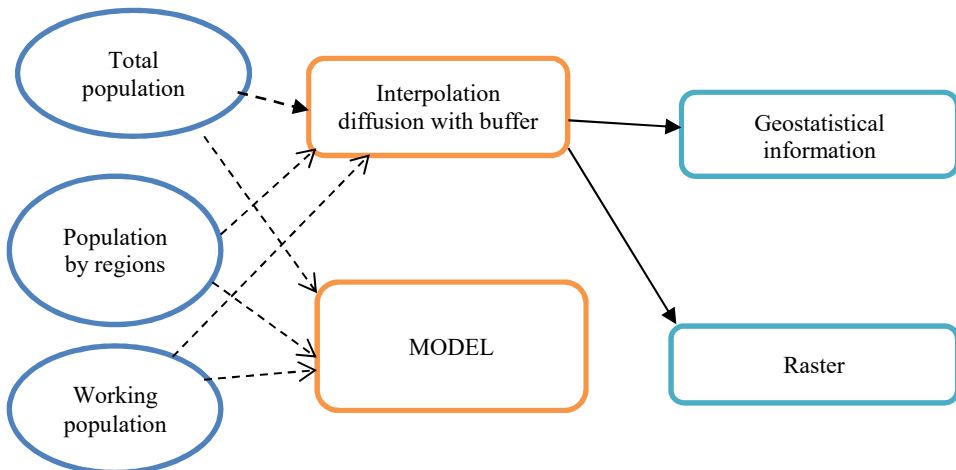


Fig. 8. The working mode of the Model Builder window.

Using the Start button, the created model is checked and a command is given to start the process. As a result, the analysis is visualized in the program's working window. There are several types of analyzes and they are:

- Density in the regions relative to the total population;
- population growth or decline dynamics;
- Histogram of species;
- Dependence of the location of the population on the terrain;

- Spatial analysis describing all demographic processes, such as identification of able-bodied population zones.

In addition, with the help of the command "Geostatistical analyst" we can visualize the flow of population and observe the process of urbanization of areas (Figures 9 and 10).

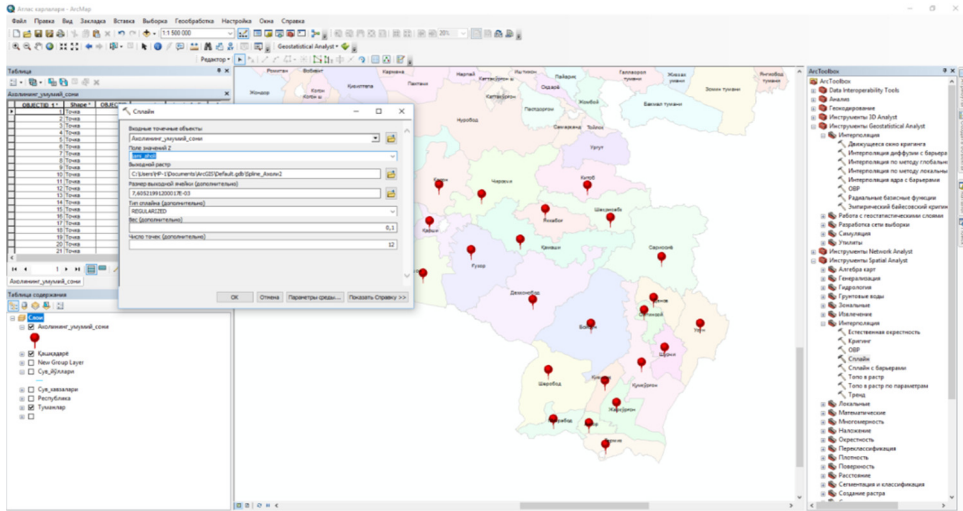


Fig. 9. The process of geocoding of residential centres.

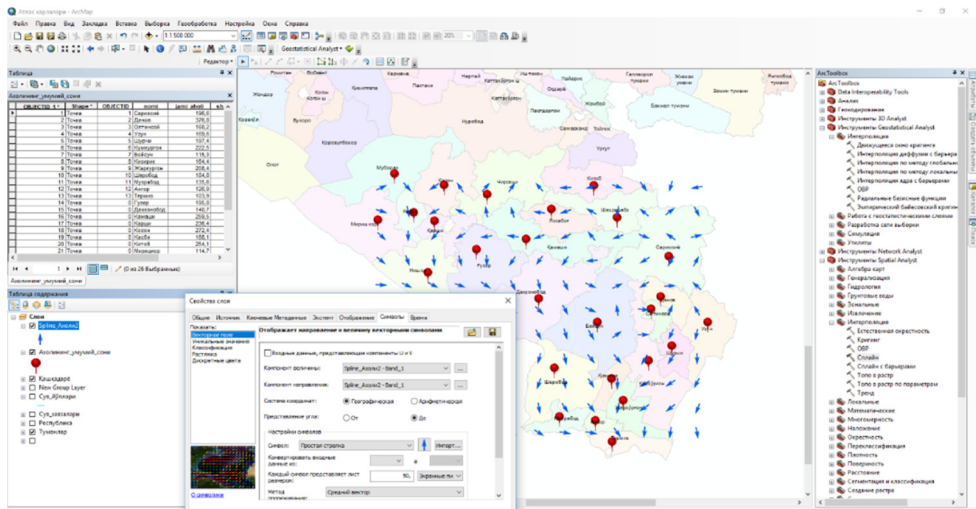


Fig. 10. Population flow.

The finished model algorithm is named separately. Models are usually stored in the Tools section. For ease of use, it should be included in the main menu.

We enter the values for the population according to the condition specified in the window under the conditions under consideration and click OK. As a result, a window will appear on the screen showing the analysis processes. This indicates that the model is working. If an error is observed during the analysis, red warnings will be displayed in the window.

4 Conclusions

Adjustments are made to the navigator's coordinate system settings, and these adjustments perfectly align the navigator when retrieving geolocation data. The coordinates of the site were determined by geolocation. By integrating with a digital demographic database (server), high-precision modern data transmission is possible.

Electronic digital maps today provide an opportunity to identify promising measures to address demographic challenges. At the same time, GIS technologies provide the basis for rapid data collection and database formation.

With the introduction of innovative technologies, it will be possible to continuously monitor and regulate demographic processes by receiving statistical information online from local officials or experts on the basis of new data on the ground and integrating it with a geodatabase.

Analytical work on rapid data identification based on the modelling of spatial analysis of data on the basis of geographic information systems and technologies was carried out. As a result, with the help of GIS technologies, the population density in the regions; natural population growth dynamics; a histogram with respect to species; the dependence of the location of the population on the terrain; it is possible to carry out analytical work through spatial analysis of data describing demographic processes such as employment.

References

1. S. Kortov, A. Terlyga, N. Terlyga, *Role of the University in city agglomerations sustainable development*, J. E3S Web Conf., **6**, 01011 (2016)
2. B. Szulczyński, T. Dymerski, J. Gębicki, J. Namieśnik, *Instrumental measurement of odor nuisance in city agglomeration using electronic nose*, J. E3S Web Conf., **28**, 01012 (2018)
3. B. Korwel-Lejkowska, *Transformation of the Landscape Structure of the Selected Testing Grounds in the Tri-city Agglomeration in the Years 1985–2012*, J. Quaest. Geogr., **39** (2020)
4. L. Inostroza, J. H. Tábbita, *Informal Urban Development in the Greater Buenos Aires Area: A Quantitative-Spatial Assessment Based On Households' Physical Features Using GIS and Principal Component Analysis*, J. Procedia Eng., **161**, 2138-46 (2016)
5. C. Otioma, A. M. Madureira, J. Martinez, *Spatial analysis of urban digital divide in Kigali Rwanda*, J. GeoJournal, **84**, 719-41 (2019)
6. S. O. Dekolo, L. Oduwaye, *GIS in Urban and Regional Planning* (2005)
7. L. N. Kantakumar, S. Kumar, K. Schneider, *Spatiotemporal urban expansion in Pune metropolis, India using remote sensing*, J. Habitat Int, **51**, 11-22 (2016)
8. M. Batty, M. Dodge, B. Jiang, A. Smith, *GIS and Urban Design Cent*, J. Adv Spat Anal., **31** (1998)
9. A. Aibinu, U. Mapping Expert, K. Urban Planning, *GIS Application in urban planning and urban management: Utilising GIS in Kigali urban planning and city management Aderemi AIBINU*, J. Corp, 93-6 (2001)
10. S. Lahoti, M. Kefi, A. Lahoti, O. Saito, *Mapping Methodology of Public Urban Green Spaces Using GIS: An Example of Nagpur City, India*, J. Sustainability, **11**, 2166 (2019)
11. D. K. Brearcliffe, A. Crooks, *Creating Intelligent Agents: Combining Agent-Based Modeling with Machine Learning*, 1-20 (2019)

12. M. van Maarseveen, J. Martinez, J. Flacke, *GIS in Sustainable Urban Planning and Management* (2019)
13. R. P. Poyil, A. K. Misra, *Urban agglomeration impact analysis using remote sensing and GIS techniques in Malegaon city, India*, *Int. J. Sustain. Built Environ.*, **4**, 136-44 (2015)
14. I. H. Sarker, *Machine Learning: Algorithms Real-World Applications and Research Directions*, *J. SN Comput Sci.*, **2**, 160 (2021)
15. S. Mahmudova, *Machine Learning for Software*, *Int. Conf. Tech. Technol. Educ.*, 251-5 (2019)
16. S. Amershi, A. Begel, C. Bird, R. DeLine, H. Gall, E. Kamar, N. Nagappan, B. Nushi, T. Zimmermann, *Software Engineering for Machine Learning: A Case Study*, *Proc. - 2019 IEEE/ACM 41st Int. Conf. Softw. Eng. Softw. Eng. Pract. ICSE-SEIP 2019*, 291-300 (2019)
17. M. Barenkamp, J. Rebstadt, O. Thomas, *Applications of AI in classical software engineering*, *J. AI Perspect*, **2**, 1-15 (2020)
18. T. S. Bajirao, A. Elbeltagi, M. Kumar, Q. B. Pham, *Applicability of machine learning techniques for multi-time step ahead runoff forecasting*, *J. Acta Geophys.* (2022)
19. P. Mohammad, A. Goswami, S. Chauhan, S. Nayak, *Machine learning algorithm based prediction of land use land cover and land surface temperature changes to characterize the surface urban heat island phenomena over Ahmedabad city, India*, *J. Urban Clim.*, **42**, 101116 (2022)
20. C. Murphy, G. Kaiser, M. Arias, *An approach to software testing of machine learning applications*, *19th Int. Conf. Softw. Eng. Knowl. Eng. SEKE 2007*, 167-72 (2007)
21. V. Balázsik, Z. Tóth, I. Abdurahmanov, *Analysis of Data Acquisition Accuracy with UAV*, *Int. J. Geoinformatics*, **17** (2021)
22. S. Abdurakhmonov, I. Abdurahmanov, D. Murodova, A. Pardaboyev, N. Mirjalolov and A. Djurayev, *Development of demographic mapping method based on GIS technologies InterCarto, InterGIS*, **26**, 319-28 (2020)
23. M. Lehoczky, Z. Abdurakhmonov, *Present software of photogrammetric processing of digital images*, *J. E3S Web of Conferences*, **227** (2021)
24. S. Khasanov, R. Oymatov, R. Kulmatov, *J. IOP Conf. Ser.: Earth Environ. Sci.* **1142**, 012109 (2023)
25. S. Egamberdiev, M. Kholmurotov, E. Berdiev, T. Ochilov, R. Oymatov, Z. Abdurakhmonov, *J. E3S Web Conf.* **284**, 03015 (2021)