METHODS FOR DIGITALIZING INFORMATION FROM ANALOGIC SUPPORT AND CREATING GIS DATABASES

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Abstract.*GIS is an acronym derived from Geographic Information System. A geographic information system (GIS) is a computerized system for capturing, storing, verifying, and displaying data related to positions on the Earth's surface. GIS can display several different types of data on a map, such as streets, buildings, and vegetation. This allows people to see, analyze and understand patterns and relationships more easily. There are two types of information used in a GIS: one graphical (and which can be raster or vector) that indicates the spatial distribution of the studied elements and another in the form of a database to store the attributes associated with these elements. Georeferencing is the process by which a scanned image (map) is aligned to a well-defined coordinate system. From a mathematical point of view, the coordinate system of the scanned map will be translated and / or rotated relative to the coordinate system in which the georeferencing process will be performed. Vector representation (digitization) of a map can seem like a very easy task for an uninitiated person. If the data is to be created in a very precisely defined structure and at the same time very correct from a geometric point of view, the problem is complicated. The result instead will be able to represent a very correct data structure that will be able to become a very solid base for all the types of analyzes that are wanted to be realized in the study area. In this paper was made the georeferencing of a map at a scale of 1: 25.000 with the code L-34-78-B-d based on the Transdat program of ANCPI Romania and ArcGIS v. 10.5. The projection system used was the National Stereographic System 1970. After georeferencing the map, a spatial database was created that includes elements such as point, line and polygon.*

Keywords: *gedatabase, GIS, georeferencing, maps, scale, transformation*

INTRODUCTION

GIS is an acronym derived from Geographic Information System (BEGOV UNGUR ET AL., 2016). A geographic information system (GIS) is a computerized system for capturing, storing, verifying, and displaying data related to positions on the Earth's surface. GIS can display several different types of data (HERBEI ET AL., 2015) on a map, such as streets, buildings, and vegetation. This allows people to see, analyze and understand patterns and relationships more easily.

There are two types of information used in a GIS: one graphical (and which can be raster or vector) that indicates the spatial distribution of the studied elements and another in the form of a database to store the attributes associated with these elements.

GIS systems generally consist of the following elements:

• Maps - Sharable maps that contain layers of geographic data.

• Data - spreadsheets, tables and images with a geographical component that links the data to a specific location (CALINA ET AL., 2020).

• Analysis - Spatial analysis improves decision making by providing information that gives users more confidence when interpreting and predicting situations.

• Applications - GIS is no longer tied to a desktop. Mobile applications allow the use of GIS data anywhere, anytime.

Although each application is different, GIS systems are generally similar in their operation. All GIS tools analyze and visualize spatial data (CĂLINA ET AL., 2018), which include location information, such as address, latitude, or longitude (Figure 1).

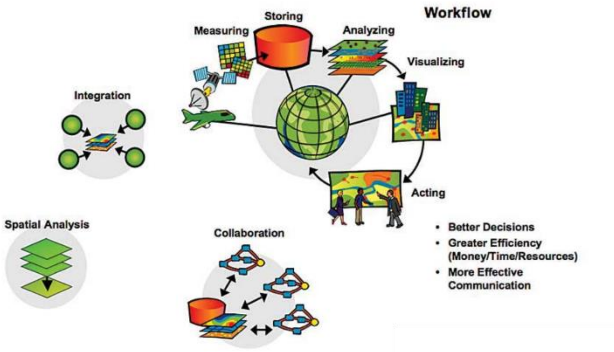


Figure 1. The principle of making and operating a GIS
(https://www.esri.com/news/arcnews/fall07articles/fall07gifs/p3p6-lg.jpg)

Geographic information systems GIS are closely related to our daily lives, based on geospatial information can make intelligent decisions about how we live on Earth (POPESCU ET AL., 2020). Based on a GIS system, geographic data is organized so that anyone reading a map can select the data needed for a particular activity. From routinely performing work-related tasks to scientifically exploring the complexity of our world, GIS offers people the geographic advantage of becoming more productive, more aware, and more receptive to planet Earth.

Concluding the above, it can be said that the Science of Geographic Information Systems has applicability in many areas of interest in our daily lives, such as: administration, agriculture (HERBEI ET AL., 2016), forestry, management, land planning (HERBEI AND SALA, 2020), various monitoring (CREȚU AND BĂDĂLUȚĂ-MINDA, 2007; ȘMULEAC ET AL., 2017; BADALUTA MINDA ET AL., 2011), environment (HERBEI ET AL., 2012), extractive engineering (DRAGOMIR AND HERBEI, 2012), evaluation and reclamation of agricultural lands (BERTICI ET AL., 2012; SALA ET AL., 2020; ȚĂRĂU ET AL., 2013; BERTICI ET AL., 2013) etc. Such applications are presented in many studies in the field of geomatics.

MATERIAL AND METHOD

ArcGis software description

ArcGis Software is a geographic information system (GIS) belonging to the Institute for Environmental Systems Research (ESRI), used in the management of maps and geographic information, creation and use of maps, compilation of geographic data, analysis of mapped information, distribution and finding of information, use of maps and geographic information in a variety of applications, management of geographic information in a database.

The system infrastructure allows maps and geographic information to be available both throughout the organization, in a community, and on the web.

ESRI applications can be used in conjunction with other GIS field tools, such as the Leica Zeno 20 with the ESRI Collector application, the workflow being similar to that in Figure 2.

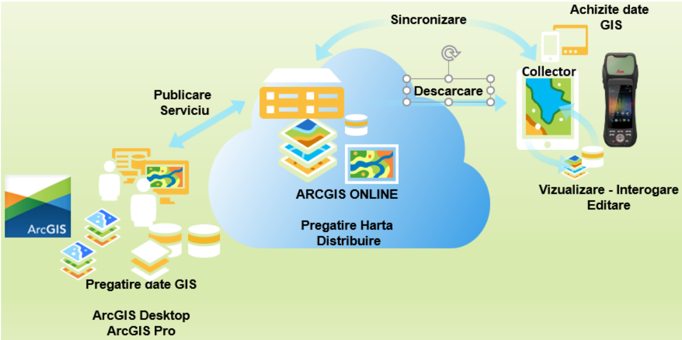


Figure 2. Workflow in a GIS

Georeferencing methods

Georeferencing is the process by which a scanned image (map) is aligned to a well-defined coordinate system. From a mathematical point of view, the coordinate system of the scanned map will be translated and / or rotated relative to the coordinate system in which the georeferencing process will be performed.

Any image (map) is composed of an array (lines and columns) of pixels that are numbered in its upper left corner (HERBEI ET AL., 2011). The georeferencing process applies a series of coefficients to each pixel that makes up the scanned image (map) to correspond to a well-defined geographical position through a pair (X, Y) of coordinates.

When geo-referencing raster data, define the location using the map coordinates and assign the coordinate system of the map frame. Raster georeferencing allows data to be viewed, queried, and analyzed along with other geographic data.

There are usually four steps to georeferencing data, they are:

1. Enter the raster data set (Figure3) to align with a specific projection system.
2. Use the georeferenced tab to create checkpoints so that you can connect your raster to known positions on the map.
3. View the checkpoints and errors again.
4. Finally, save the georeferencing result when you are happy with the alignment.

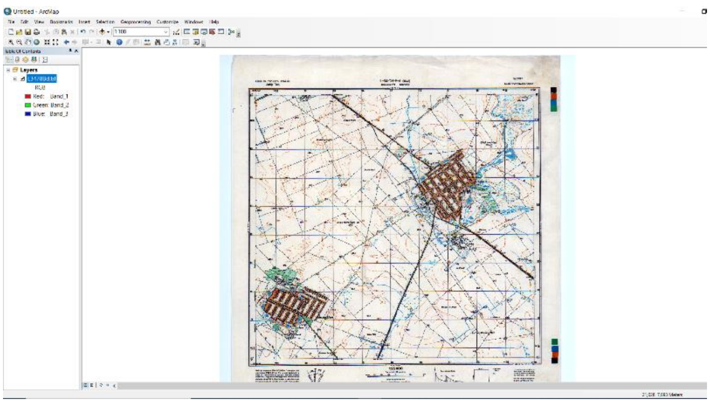


Figure 3. Map 1: 25.000 Nomenclature L-34-78-B-d

Create the database

Vector representation (digitization) of a map can seem like a very easy task for an uninitiated person. If the data is to be created in a very precisely defined structure and at the same time very correct from a geometric point of view, the problem is complicated. The result instead will be able to represent a very correct data structure that will be able to become a very solid base for all the types of analyzes that are wanted to be realized in the study area.

First of all, the purpose for which this work is considered necessary must be established from the beginning. If the goal is only to make a map with different graphical representations of the basic map, all this approach is not justified. It becomes cost-effective when the resulting data structures will be subjected to spatial analysis. As the analyzes and models become more complex, the production of data structures can be considered profitable and can be created.

Geospatial databases are nothing more than a container for spatial data and attributes (Figure 4). So are robust and extensible data models, taking advantage of the latest data storage technologies (www.gisgeography.com).

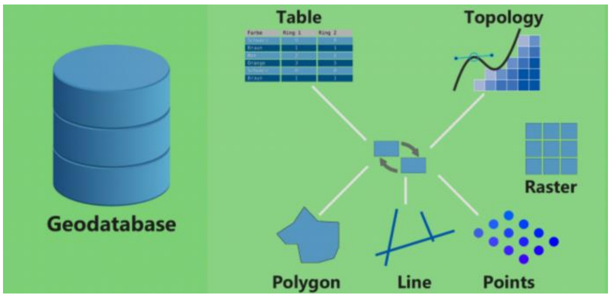


Figure 4. The structure of a Geodatabase

There are 2 types of geospatial databases: multi-user and single-user. Multi-user geospatial databases are intended for medium or large organizations, while single-user geospatial databases are intended for individual users.

RESULTS AND DISCUSSIONS

The georeferencing of a 1:25.000 map

In this paper a map (L-34-78-B-d) at 1:25.000 scale is georeferenced with the ArcGIS Software, following the following steps:

With the help of the TransDat program, the coordinates of the studied map will be transformed, from geographical coordinates into Stereo 70 coordinates (Figure 5) (HERBEI ET AL., 2013).

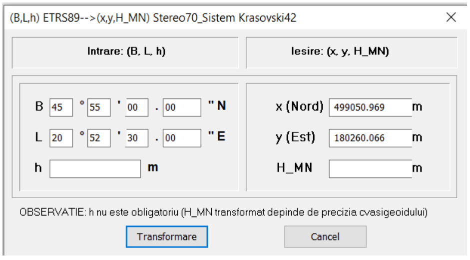


Figure 5. Transformation of geographical coordinates into Stereo 1970 coordinates

The following are the coordinates resulting from the transformation from the Transdat program to Microsoft Excel (Figure 6).

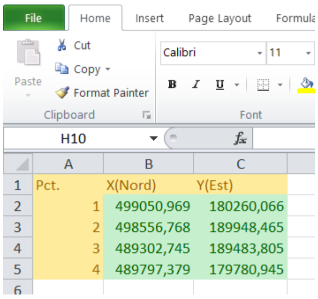


Figure 6. Save 1970 stereo coordinates to XLS file

The next step will be to establish the Stereo70 system (Figure 7) by right-clicking the Data frame Properties. Then further enter the coordinates of the 4 points written in Microsoft Excel through Add Data.

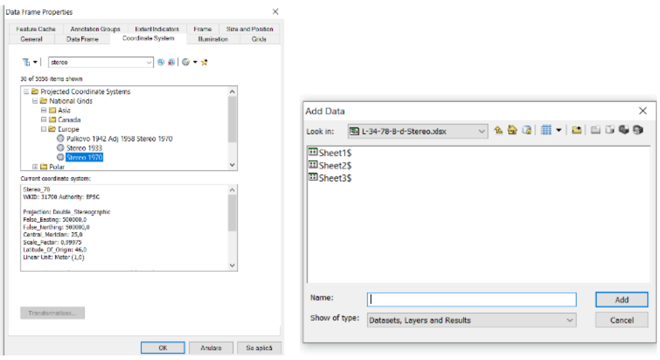


Figure 7. Data frame Properties (Stereo70) and Enter coordinates in Excel

After entering the coordinates through Add Data in the Table of Contents, the box “Sheet1” will appear where we will right click on it, then we will give on Display XY Data, where we will reverse (X North) and (Y East). The points of the 4 coordinates entered on the map will be obtained as a result.

At this moment the map is not georeferenced, this process being done with the help of the Georeferencing bar. Next for the georeferencing of the map we will select the Add Data button, in which we will add the map, and then we will right-click on it -Zoom To Layer. In the Georeferencing bar we will uncheck Auto Adjust, and then we will select Add Control Points. Then enlarge the upper left area as much as possible and point with the mouse in the upper left corner of the trapezoid, then point to the corresponding point from the 4 points related to the previous step. In the same way proceed for the next 3 points (Figure 8).

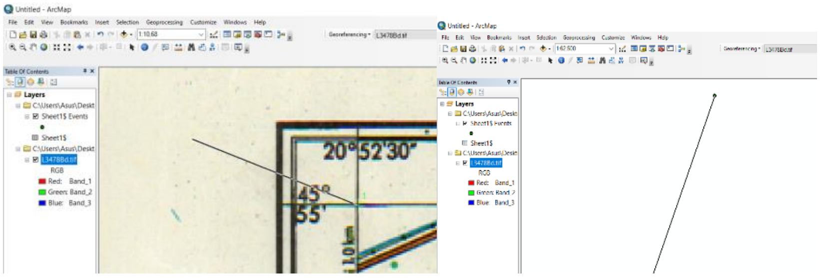


Figure 8. Align the map to the stereographic coordinates of the trapezoidal corners

After establishing the 4 points, the Auto Adjust option is checked from the Georeferencing bar and the scanned map will be brought over the 4 known coordinate points, and thus it is georeferenced. The last step is to save it, with the TIFF extension. From the Georeferencing menu, choose the Rectify…(Figure 9) option and save the map with the desired name and location. At this moment the saved map is georeferenced, it can be used in any GIS or CAD software, in the Stereo 70 projection, at a scale of 1: 25,000.

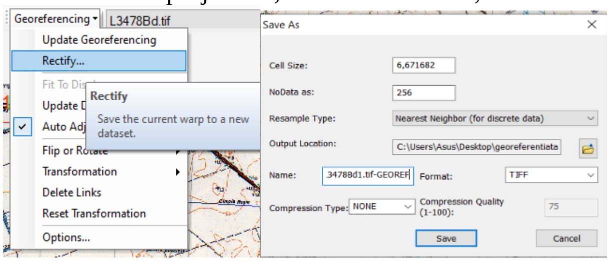


Figure 9. Saving the georeferenced map in GeoTIFF format

Creating the Geodatabase

Below is presented the way of creating a geodatabase that contains shapefile files of point, line, and polygon type with the characteristic attributes of each element.

The first step in creating a Geodatabase is to select the Catalog button, and we will choose the folder we created to create them. After selecting the folder, right click on it, then select New - File Geodatabase (Figure 10). Value domains can also be defined in the database properties (Figure 11), to help the digitization process when values of an attribute can be chosen from a predefined list. In this case it is an example of value fields for Type Locality (village, commune, city or municipality) and for Type Orchard (apple, plum, apricot, cherry, etc.).

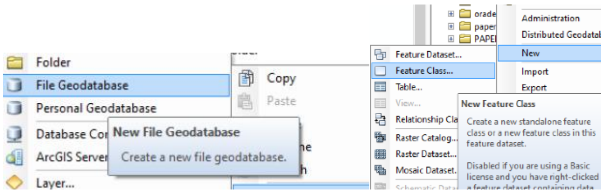


Figure 10. Create Geodatabase and popular with point, line or polygon feature classes

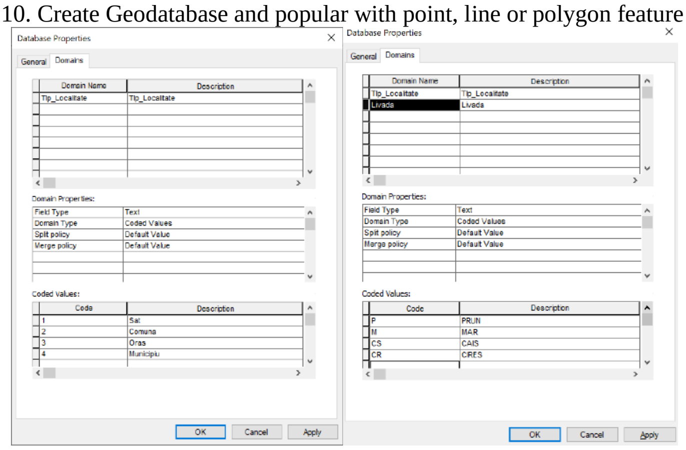
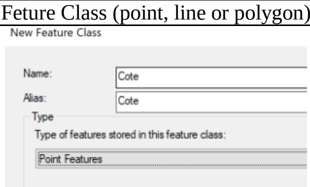
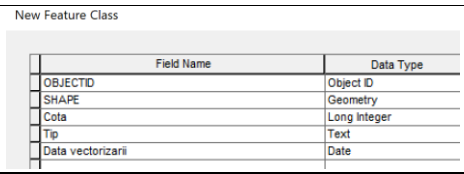
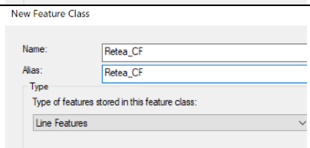
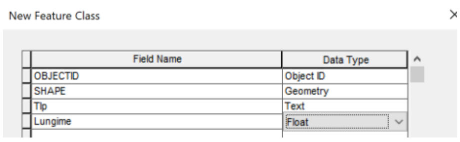
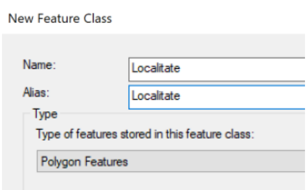
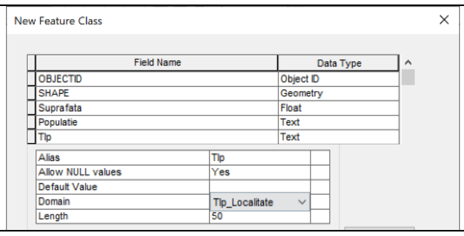
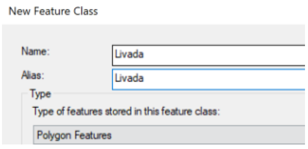
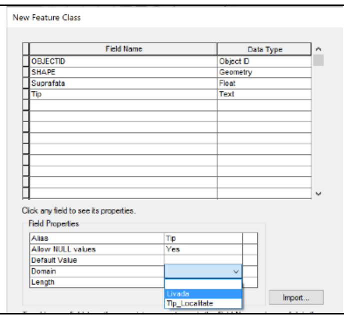


Figure 11. Defining Domains

Table 1

Creating the feature classes

	Feture Class (point, line or polygon)	Database for feature classes
1		
2		
3		

4		

In the Table of contents were added the existing shapefiles in the previously created database (Figure 12).

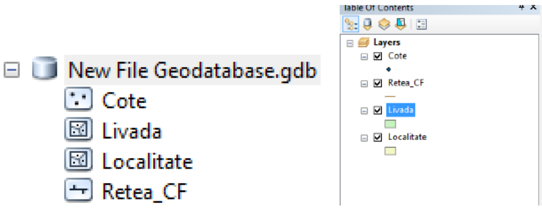


Figure 12. Viewing the elements created in Geodatabase

CONCLUSIONS

A GIS is a computer system capable of holding and using data that describes places on the Earth's surface. It is a powerful set of tools for collecting, saving, transforming, and visualizing real-world spatial data. This study aims to present how to georeferenced in ArcGis a 1: 25.000 scale map by one of the known methods. Some advantages would be: Awareness of the usefulness and importance of geographic information systems, Understanding the essential concepts needed to use a GIS program, The advantages of using geographical databases and their capitalization, The maps are made according to the user's specifications.

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