

## Chapter 2

# Methodology and Research Techniques

**Abstract** In order to accomplish the proposed results, a series of modern research techniques were used. The DTM was generated by digitizing topographic plans scale 1:5000 (1979 edition), which was basically the base layer for other geospatial and archaeological data. Other maps from different years and scale were integrated in the study. Digital data was combined with data from the fieldtrips, GPS and geomorphological surveys. Finally, all the spatial data (geographical and archaeological) was integrated in a GIS database and, in this way, a high diversity of spatial analysis was possible (proximity analysis, viewshed analysis, 3D visualisation, etc).

**Keywords** Georeference • GPS • STEREO 70 • Topographic map • Total station

### 2.1 In Situ Identification of the GCPs (Ground Control Points) of Different Orders and Their Distribution in the Catchment

Following the analysis of the map that contains the distribution of the GCPs in the basin, it can be observed that a large amount of the area has been marked and surveyed. The presence of a total of 12 GCPs that cover a territory of 97 km<sup>2</sup> indicates that the undertaking of topographical measurements is easily covered (being that it is performed with a total station or the geodetic GPS). Thus, there are 2 GCPs of 2nd order, 3 GCPs of 3rd order, 6 GCPs of 4th order and one GCP of 5th order (Bălțați Orthodox Church) that it is just a reference and back sight ID for the measurements done with the total station (Fig. 2.1).

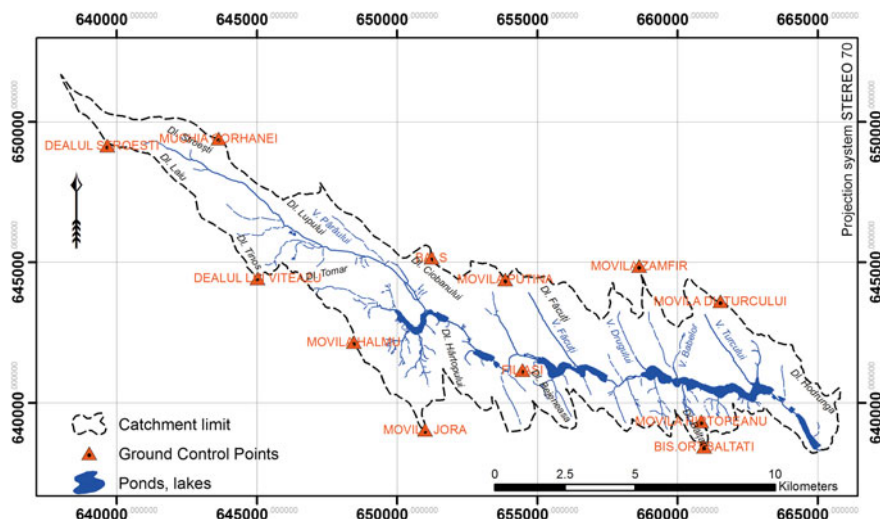


Fig. 2.1 Distribution of GCPs in the Valea Oii catchment

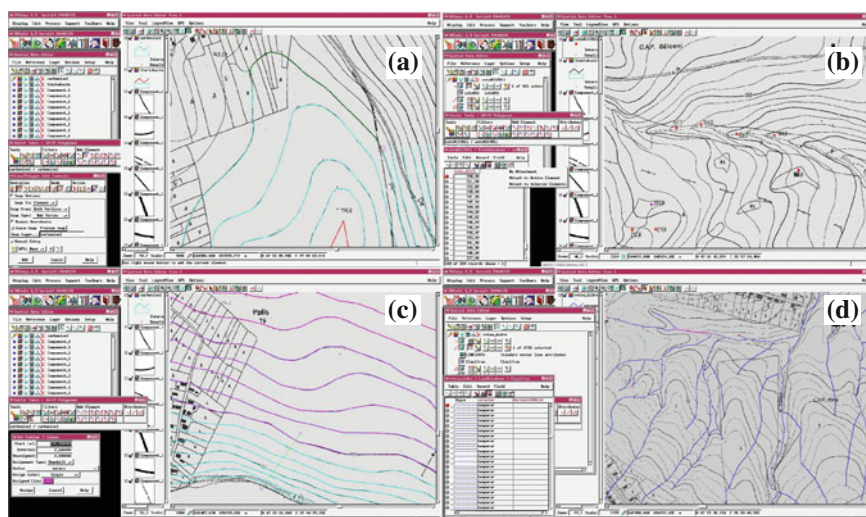
## 2.2 Utilisation of Old and New Maps (Austrian Maps, Historical Army Maps)

In order to obtain a scientific approach, a varied cartographic background with a different representation scale will be used. 1:50,000 (1894 edition), scale 1:25,000 (1984 edition), topographic plans scale 1:5000 (1979 edition), historical army maps scale 1:20,000 (1942–1945 edition), topographic plans scale 1:2000 (1973 edition) but also orthophotomaps (taken during the flights of 2005 and 2008), satellite images.

T period 1970–1993, was realized the topographical plan of Romania with about 90 % of the countries territory, as follows: scale 1:2000 on 12 %, scale 1:5000 on 75 % (thus explaining the lack of 9 topographic plans from the study area), scale 1:10,000 for 3 % (Mihăilă et al. 1995). Using a detailed cartographic background, allows the realisation of complex analysis, both in terms of natural elements, evolution, and for economic transactions.

### 2.2.1 Methodological Staging

In the fulfilment of the geographical database, GIS software was used: TNTmips, AutoCAD 2008, Global Mapper, and ArcGIS. In the execution of the DTM, the topographical plans at a 1:5000 scale was used, with the following stages: collection and selection of the cartographic support from the ANCPI (National Agency for Cadastre and Land Registration) Iasi, scanning, importing in GIS, georeferencing



**Fig. 2.2** The workflow for obtaining a DTM. **a** Contour lines digitisation. **b** Adding altitudinal points. **c** Assigning Z value for contour lines. **d** Drainage network classification

raster cartographic objects in STEREO 70 projection system (for a precise overlay of the topographic surveys over the topographic plans), manual digitisation (Fig. 2.2a); in order to obtain a more accurate modelling of the relief, altitudinal points have been added (Fig. 2.2b), numerical classification by assigning geographic information to objects (Fig. 2.2c, d). STEREO 70 cartographic system is based on the same mathematic principles established and applied for the old projection system from 1930. Besides, this projection system belongs to the ones which distorts radial lengths, but still retains the values of the angles (Mihăilă et al. 1995).

In the upper basin, where topographic plans are missing tracks of the area were taken, using GPS Leica RTK Rover 1200. The tracks were then embedded in the same file with the altitudinal points from the topographic plans. Out of several methods of contour lines and altitudinal point's interpolation (Kriging, Topo to Raster, IDW), was chosen Topo to Raster method, being the most suitable for the present case, resulting in a DTM with  $5 \times 5$  m pixel size. It can be observed a faithful reproduction and high quality of the reality in the field, and can be used for both analysis of the location of the known settlements and the location of new archaeological sites on the basis of the characteristics of the terrain (Fry et al. 2004). It can be combined successfully with orthophotoplans, satellite imagery, LANDSAT images, and 3D views (Katsianis et al. 2008).

In the last years, modelling and 3D reconstruction are used more often in the capitalisation and presentation of research results in geography, and also in archaeology. From habitat reconstruction, the evolution of relief and reconstruction of objects, 3D modelling constitutes an indispensable tool in the interdisciplinary research.

### 2.2.2 Database Integration in GIS

Ghilardi and Desruelles (2008) and Ghilardi et al. (2008) shows the importance of integrating a geographical database (connected to the mapping and conversion of the in situ data in digital format, realisation of spatial analysis, 3D visualisation, analysis through statistic methods of the distribution of settlements, paleogeographic reconstructions, all offering a better interpretation of the relationships of sites, their structure and their formation), with an archaeological one (placement of sites) in a GIS.

Within the 1990s, archaeological studies were based only on a 2D perspective. With the advancement of new technologies, which improved the quality and efficiency of the digital analysis (satellite images, aerial photographs along with in situ observations, detailed topographical measurements), the transition toward a tridimensional study took place. With the help of this tool, a multitude of surveying (visibility, proximity, etc.) could lead to solving the proposed premises and to better understand the archaeological sites placement in certain locations, in accordance with certain factors derived from GIS analysis (altitude of relief, soil type, and proximity toward water resources).

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