MODERNIZATION OF GEOTOPOPHOTOGRAMMETRIC WORKS FROM THE FORESTRY CADASTRE – A MAJOR ISSUE OF THE FORESTRY SECTOR

MODERNIZAREA LUCRĂRILOR GEOTOPOFOTOGRAMETRICE DIN CADASTRUL FORESTIER - O PROBLEMĂ PRIORITARĂ A SECTORULUI FORESTIER

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***Abstract**: The execution of works of introducing the general cadastre and, implicitly, of the specialty cadastre related to the forestry sector represents a permanent preoccupation of the competent authorities, in order to achieve an infrastructure corresponding to the national real estate. From a technical point of view, the possibilities to execute the works of introduction of forestry cadastre are multiple, taking into account the diversity of technologies of gathering and processing data, obtaining the final products and, not the last, the creation of a data base containing space dates. Ensuring a modern logistical base for the accomplishment of works necessary to introduce the forestry cadastre and, respectively, to promote a corresponding management to this end represents a sure possibility in order to solve with maximum efficiency the issues related to the infrastructure of the national forestry fund.*

***Rezumat**: Realizarea lucrărilor de introducere a cadastrului general şi implicit a cadastrului de specialitate aferent sectorului forestier, reprezintă o preocupare permanentă a instituțiilor de resort, în vederea realizării unei infrastructuri corespunzătoare fondului funciar național. Din punct de vedere tehnic, posibilitățile de realizare a lucrărilor de introducere a cadastrului forestier sunt multiple, având în vedere diversitatea tehnologiilor de culegere a datelor, prelucrare a acestora, obținerea produselor finale şi nu în ultimul rând realizarea unor baze de date spațiale.Asigurarea unei baze logistice moderne pentru realizarea lucrărilor necesare introducerii cadastrului forestier şi respectiv promovarea unui management corespunzător în acest sens, reprezintă o posibilitate certă în vederea rezolvării cu maximă eficiență a problemelor referitoare la infrastructura fondului forestier național.*

Key words*: *forestry sector, GNSS technology, GPS receivers, durable development
Cuvinte cheie:sectorul forestier, tehnologie GNSS, receptoare GPS,dezvoltare durabilă,

INTRODUCTION

In the context of durable development of woods, the necessity of using the cartographic products is imperative.

The topogeodetics works within the forestry sector are characterized by a complexity and, respectively, by a high diversity and may be classified as follows:

-raisings on large surfaces;

-raisings on small surfaces

The raisings on large surfaces are performed in order to identify position and determine the forestry fund, aspects which are necessary in order to develop activities within the forestry household.

The raisings on small surfaces serve a series of specific activities, respectively the arrangement of woods, drafting the installations of collecting the wood material, drafting the transport installations, correction of torrents, improvement of deteriorated fields, arranging the hunting fields, scientific research, etc. In the context of applying the laws related to the

restoration of the property right over the fields covered with forest vegetation, in relation to a series of aspects, raisings are done on large surfaces, as well as on small surfaces.

The opportunity of modernization of topogeodetics works in the forestry sector presents a series of premises, such as:

-Necessity of updated plans, and of a corresponding quality, in order to accomplish the studies of arranging the woods in optimal conditions;

-Updating of photogrammetric plans and their execution in digital system, allowing an optimum administration, respectively their updating and the creation of data bases related to GIS systems, using software adequate for their execution;

-Accomplishment of clear and unitary evidences at a national level regarding the surfaces occupied with forestry vegetation which have been restored to their owners, in order to ensure the integrity of forestry fund, irrespective of the owners;

-Introduction of the general cadastre and, respectively, of the forestry cadastre in compliance to the Law 7/1996 if necessary, requires compulsory the drafting of modern cadastral plans, digital and, respectively, the accomplishment of GIS related to the general cadastre and, implicitly, to the forestry cadastre;

-The location of test surfaces within the forestry monitoring European and, respectively, national.

The geo-topo-photogrammetric works related to the forest sector are presented in fig.1.

In the same time with the accession of our country to the European Community, the necessity to implement modern technologies of achieving topogeophotogrammetric works is imperative.

As a consequence, due to technical and economical reasons, it is necessary to observe a series of compulsory conditions, as follows:

- Ensuring the unity of geo-topo-photogrammetric works and rapid integration of subsequent one within the European geodetics network, generic denominated as EUREF through the national GPS geodetics network;
- The final products, plans and maps have to be achieved in numerical and digital format, aspect which allows an optimal administration of these matters;
- The quality of final products obtained, respectively the content and accuracy and maps and plans are superior in compliance with the present and future requests;
- Avoiding the superposition of works by implementing modern technologies regarding achieving topogeodetics works, in order to introduce the general cadastre and, implicitly, the forest cadastre, achieving a sustainable economic efficiency, thus eliminating a series of useless expenses.

MATERIALS AND METHOD

LOCALIZATION OF THE STUDY

The present study was achieved within the production unit I Sâniob, in the surface of 1780,4 ha, which is administered by the Săcuieni Forestry Circumscription within the Oradea Forestry Department.

The constituent brushes are located around the localities Diosig, Sălard, Ciuhoi and Săcuieni from Bihor County.

From a geographical point of view, the production unit is located in the North-West of Bihor County.

MATERIALS USED

In order to achieve the study case, a series of necessary materials were used, as follows:

-The support network of Bihor County achieved with GNSS technology;

-The support network of Bihor County thickened, achieved with GNSS technology;

-The topographical map at a scale of 1: 25 000;

-The arranged map related to U.P. I Sîniob, O.S. Săcueni, D.S. Oradea;

-The U.P. I Sîniob, O.S. Săcueni, D.S. Oradea placement – general study.

The support network of Bihor County achieved with GNSS technology may be used in digital format, in alphanumerical format – respectively accessible in analogical format - annex 1.

The topographical map at the scale of 1: 25 000 is accessible in screen format in file type BMP, which is georefered and serves mainly to obtain the related vector. In the study case presented two map sheets were used at a scale of 1:25 000, with the nomenclature L – 34033 – Aa color and L – 34033 – Ac color.

At the same moment with achieving the drafting of works and the establishment of work methods, the necessary logistics in order to perform this work will be proposed.

In order to achieve the thickening of the GPS support network, GPS receivers are necessary.

In order to efficiently identify the points from the support network, which are materialized in the train, a GPS navigation receiver is necessary, the model Pocket Loox N520 Fujitsu Siemens, equipped with the program MAPSYS PDA.

In order to process the dates gathered with the help of technologies used, it is necessary to use the electronic computer (PC), equipped with software and peripherals.

The positioning system with satellites used for the works in the present study is formed of a number 5 GPS receivers which present the following technical features:

-products of GEOTRONICS and SPECTRA PRECISION (Sweden) ;

-type of receivers

Type1)-GEODIMETER GPS Module L1: GEOTRACER 3140

Type 2)-GEOTRONICS GPS: GEOTRACER 2000 System L1

In order to achieve the objectives proposed, the screens of the map sheets through scanning, two common points were unified, obtaining an unified screen.

The unified screen was oriented by using four known coordinate points, placed relatively symmetrically in the four corners of the unified screen.

The software used for the transfer of registered data, for the processing of registered data, in order to obtain the final products, and, respectively, for their administration are varied.

In this study were used a series of software as it follows:

-TRIMBLE DATA TRANSFER - program specialized of transferring data (JOB) from the apparatus in the PC for the related processes;

-TOPO SYS 5.0 - program of calculation of coordinates in the space 3D or 2D +1D and of transformation of coordinates in various reference systems;

-MAP SYS 7.0 - program of planimetrical report of coordinates of determined points, of calculation of surfaces through the analytical method, of vectorization of screens, of unification of screens, of tracing the longitudinal and transverse topographical profiles, of transformations in various reference systems, of achieving the data bases and, respectively, of achieving the GIS, etc.

-TRIMBLLE TOTAL CONTROL - program used in order to process data registered with the GNSS technology, using GPS receivers, respectively to calculate new points on the ellipsoid WGS 84;

-ROMPLAN - program used in order to determine the nomenclature of various sheets of map used.

This program is used in order to ease the solving of issues related to the projections Gauss, Stereo70, calculation of geographical coordinates etc.

-MAPSYS PDA 2.0 – working schedule of the GPS navigation receiver;

The corresponding arranging map related to U.P. I Sîniob, O.S. Săcueni, D.S. Oradea at a scale 1 20 000 in analogical format A4, which was scanned, obtaining the related screens saved in files of type BMP or JPG.

METHODS OF STUDY

In order to achieve the study case, several cases were used, as follows:

-observation, experiment, comparison, simulation, modeling, reasoning.

The observation as a research method was used to identify the field (occupied with forest vegetation) which represented the object of study.

Observations were done on the itinerary, especially to establish the placement spot of various characteristic points (points of thickening the support system, points of the network of raising the details, etc.) used subsequently in achieving the study case.

Also, observations were made in stationary from the points determined (by various methods) which were materialized on the field.

The experiment was used as a research method within the present study case in order to facilitate the introduction of modern technologies in the accomplishment of geotopophotogrammetric works from the forestry sector.

As a consequence, a series of possibilities of work were tested regarding the raisings from the forestry sector, using various materials and work technologies, in order to improve and, respectively, to grant efficiency to the respective activities.

The simulation and modeling as research methods were applied by using specialty software, trying to obtain similar methods to the objective reality from the field, and, respectively, abstracting some particular features, important for the forestry sector.

The reasoning shapes in a certain manner the results and, respectively, the conclusions resulting from the application of methods of research used.

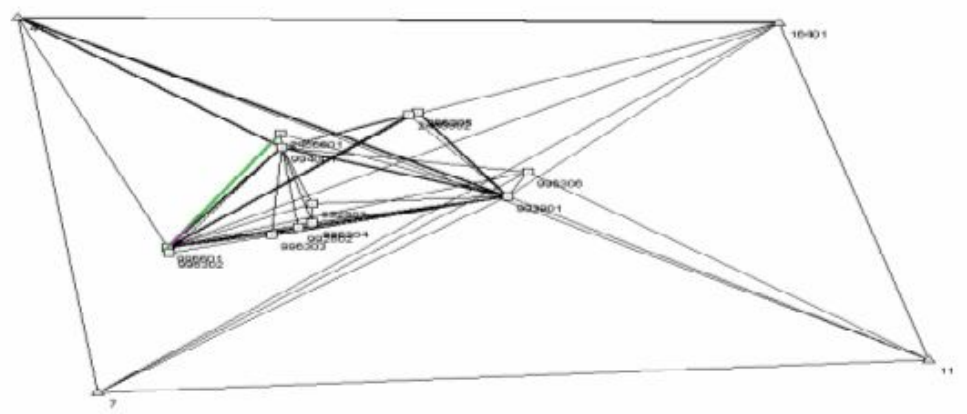

Fig. 1 – The geometrical configuration of the experimental system

As a consequence, in order to obtain certain positive results, it is necessary to accomplish a complex study case, which, subsequently may be generalized in relation to the characteristic features of the final products which is requested, on large surfaces.

In order to achieve the case study, several variants of processing of registrations made with GNSS technology were analyzed, variants which considered, after case, the points of coordinates already known, used for the calculation of coordinates of new points fig. 1. As a consequence, nine variants of calculation for the couple of newly determined points were achieved, the results obtained being presented in tables no. 1,2,3,4.

RESULTS AND DISCUSSION

From the analysis of the dates mentioned in table 1 we notice the fact that for variant 5 of calculation the standard deviations of the coordinates related to the analyzed point (993901) are minimum.

Table 1

Calculation variants of the coordinates of the point 993901
In the system of geocentric coordinates on the ellipsoid WGS 84

Variant	X (m)	Sx(mm)	Y(m)	Sy(mm)	Z(m)	Sz(mm)
1	4017030.671	9.0	1632105.447	7.5	4662152.934	9.2
2	4017030.672	8.1	1632105.440	7.0	4662152.919	9.0
3	4017030.673	8.8	1632105.451	7.4	4662152.934	9.2
4	4017030.671	5.8	1632105.446	5.1	4662152.923	6.8
5	**4017030.676**	**5.5**	**1632105.437**	**4.7**	**4662152.921**	**6.2**
6	4017030.670	6.7	1632105.470	6.4	4662152.930	9.6
7	4017030.639	8.2	1632105.455	5.9	4662152.957	7.7
8	4017030.657	11.1	1632105.403	7.8	4662152.914	9.5
9	4017030.647	9.5	1632105.440	6.8	4662152.949	8.3

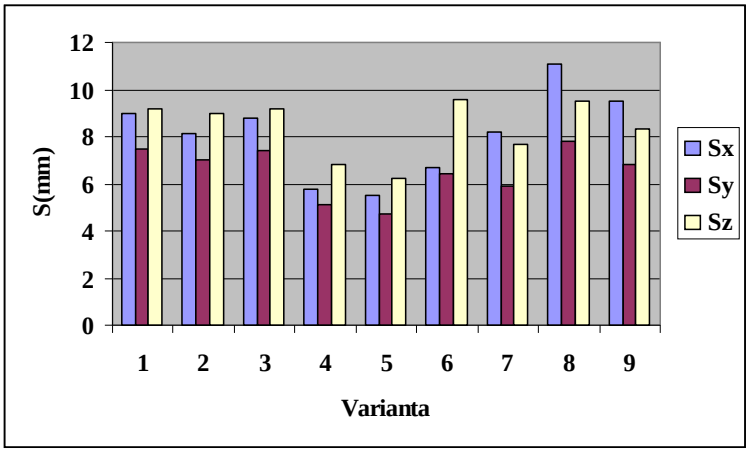

Fig. 2 - The values of standard deviations of the coordinates of Point 993901 in connection to the calculation variants

Analyzing the diagram in fig.1, we notice the fact that for variant 5 of calculation, the standard deviations of the coordinates related to the point analyzed (993901) is minimum.

In table 2, the inventory of coordinates on variants for the point 993901 is presented in the projection system STEREO 70 and reference system for quotas Black Sea 75 on the ellipsoid KRASOVSKI

Table 2

The calculation variants of the coordinates of point 993901 in the projection system STEREO 70
And reference system for quotas Black Sea 75 on the ellipsoid KRASOVSKI

Variant	X (m)	Y(m)	Z(m)
1	644977.743	281607.108	115.023
2	644977.735	281607.102	114.997
3	644977.741	281607.112	115.012
4	644977.737	281607.109	115.001
5	**644977.735**	**281607.098**	**114.999**
6	644977.734	281607.129	115.026
7	644977.778	281607.128	115.023
8	644977.752	281607.074	114.974
9	644977.771	281607.112	115.003

Table 3

Calculation variants of the coordinates of point 996306
in the geocentric coordinates system on the ellipsoid WGS 84

Variant	X (m)	Sx(mm)	Y(m)	Sy(mm)	Z(m)	Sz(mm)
1	4016570.746	14.6	1632244.784	10.5	4662499.605	11.2
2	4016570.753	13.4	1632244.776	10.1	4662499.588	11.2
3	4016570.751	14.7	1632244.795	10.7	4662499.607	11.3
4	4016570.753	9.8	1632244.789	7.5	4662499.593	8.5
5	**4016570.757**	**8.7**	**1632244.778**	**6.7**	**4662499.590**	**7.6**
6	4016570.752	9.3	1632244.811	7.7	4662499.599	10.5
7	4016570.724	9.7	1632244.797	6.8	4662499.627	7.9
8	4016570.743	11.6	1632244.746	8.1	4662499.583	9.9
9	4016570.732	11.3	1632244.780	7.8	4662499.618	8.9

From the analysis of the dates from table 3 we notice the fact that for variant 5 of calculation, the standard deviations of coordinates related to the point analyzed **(996306)** are minimum.

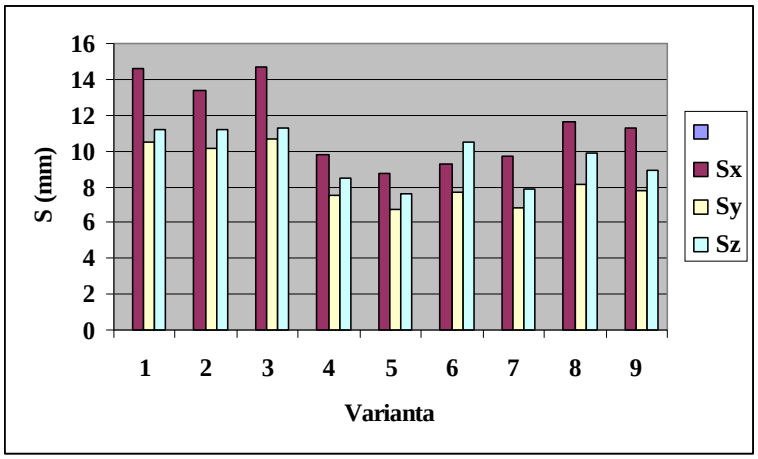

Fig. 3 – The values of standard deviations of the coordinates of point (996306) in connection to the calculation variants

Analyzing the diagram from fig. 3 we notice the fact that for variant 5 of calculation the standard deviations of coordinates related to the point analyzed (996306) are minimum.

In table 4, the inventory of coordinates on variants of calculations for the point 996306 is presented in the projection system STEREO 70 and the reference system for Black Sea quotas 75 on the ellipsoid KRASOVSKI

Table 4

The calculation variants of the coordinates of point 996306 in the projection system STEREO 70 and the reference system for Black Sea quotas 75 on the ellipsoid KRASOVSKI

Variant	X (m)	Y(m)	Z(m)
0	***1***	***3***	***5***
1	645476.104	281927.845	116.152
2	645476.090	281927.835	116.133
3	645476.099	281927.854	116.149
4	645476.088	281927.847	116.139
5	**645476.088**	**281927.835**	**116.136**
6	645476.087	281927.866	116.158
7	645476.128	281927.865	116.158
8	645476.103	281927.811	116.114
9	645476.123	281927.848	116.142

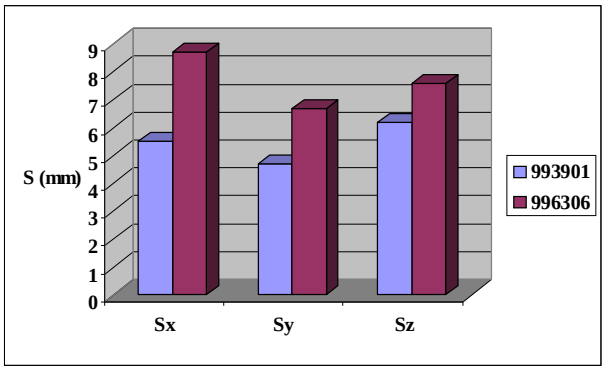

Fig. 4 - Comparative values of standard deviations related to coordinates of studied points, within the variant 5 of calculation

CONCLUSIONS

Following the execution of the study case, the following may be concluded:

-The application of GNSS technology by using methods based on measures achieved with GPS receptors offer clear advantages regarding the configuration of networks which will be obtained;

-The configuration of the networks, respectively the number of known points do not influence in a significant manner the determination accuracy of new points – the case of variant 5 of calculation, when processing the data was performed by using only a point of known coordinates;

-In order to obtain accurate coordinates, it is necessary that in the points where it is stationed, the signal must not suffer disturbances;

-The accomplishment of thickening of support network in order to raise the details from the forestry fund, in the situation of present study case may be achieved in the best conditions;

-The establishment of planimetric position of thickening points is not conditioned by the visibility towards other points, the condition which must respected aim at the possible disturbances of the signal owed to the reflection; the materialization of points determined with

GNSS technology within the present study case was achieved with wood terminals, with dimensions of 1000 mm x 100 mm x 100 mm, at which the axes were materialized with the help of metallic nails. The placement of concrete or stone terminals was not possible due to the position of legal owners of fields where they where supposed to the placed.

-When placing the determined points with GNSS technology, we must take into account the fact that they must be placed in pairs of minimum two, with mutual visibility between them, in order to be used as support points with orientation for the works which will be performed subsequently using the conventional technology (raisings with total station);

-In the present case study, couples of pairs in two points were placed, being determined with GPS technology between which there is a very good visibility.

-For the forestry sector the thickening of the support network, the accomplishment of the networks of raising the details with the technology GNSS, using GPS receivers presents a series of characteristic features, in the case of compact massifs, the use of these technologies being limited;

-In order to ensure high accuracy of coordinates on newly determined points, regional parameters of transformations will be used in the national system of reference, respectively within the support network of Bihor County.

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