OPPORTUNITIES TO WORK TOPOGRAPHY BASED GNSS TECHNOLOGY IN THE FORESTRY SECTOR

Crainic Ghiță Cristian*

**University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail:gccrainic@yahoo.com*

Abstract
Making topographical works in the forestry sector presents a number of features which are due mainly forest ecosystems. Following are a number of conditions of work, conditions which directly influences the establishment of technology work. If forest stands of deciduous vegetation season of broadies-leaved after folianeous system are the conditions in surveying works with GNSS technology. Given the technical condition imposed by GNSS technology can be carried out surveying works within massive forest using static and fast static method. In young forest stands can be achieved with topographic works Stop and Go method or kinematics methods to real-time RTK and ROMPOS system.
Choice of technology depends as a result of the logistics of which has the particularities of forest ecosystems and that the vegetation season.

Key words: GNSS technology, land measurement, forestry sector, static method, fast static method, Stop and Go method, kinematics methods, vegetation season.

INTRODUCTION

Evolution culmination of knowledge and achievements in technical areas including electronics and top computer that made possible a series of high technologies in the field of land measurements.

The appearance of various systems to investigate the remote and objective reality is to create multiple opportunities to solve problems that until recently were impossible to solve have a change of mentalities in terms of logistics on the ground measurements.

Were imposed following a series of techniques and technologies that provide efficient and accurate solutions to technical-economic and social conditions favorable.

Such global positioning technology, satellite remote sensing, digital photography, total stations, electronical theodolites, systems, etc.. are only part of that effort with a positive impact on the industry represented by ground measurements.

GPS is actually a part of the name NAVSTAR GPSIt stands for Navigation System with Time and Ranging Global Positioning System. The project was initiated by the U.S. government in the early 70s. The main goal is the possibility to determine the precise position of a cell at any point on Earth's surface at any time regardless of weather.

Due to technical peculiarities which it presents global positioning system technology - GPS that offers a range of possibilities of topographical survey.

Global positioning system geodetic network provides the opportunity of a national and international densing networks support and realisation networks lifting achievement details.

Can be achieved and some special lifting - Construction drawing elements, characteristic photogrammetric signs determination, tracking behavior in time of various constructions, etc..

Introduction of GPS technology in the forestry sector will be the future for a solution to problems relating to the introduction of forestry survey and forest management plan.

Considering the fact that survey photogrammetric will achieve further success with the development of technology to obtain digital photographs and related logistics respectively, following photogrammetric problem of determining the parts will be resolved in a certain measure of global positioning technology.

Also identify characteristic destroyed signs , principal may be made using GPS global positioning technology.

Given the particularities of relief and forest vegetation and GPS technology in most situations will adopt working methods with GNSS technology that meet the requirements.

MATERIAL AND METHODS

This case study was conducted in the management unit I Sâniob in the area of 1780.4 hectares which is managed by the Forest District Săcuieni of County Forest Administration Oradea.

Forest stands are located on the beam constituent communes Diosig, Sălard, Ciuhoi and Săcuieni in Bihor county.

Geographical management unit is found in the north-west of Bihor county.

To realize the case study have used a number of materials required as follows:

-Network support of Bihor county made with GNSS technology;

-Network support of Bihor County thicken, made with GNSS technology;

-Scale topographic map 1: 25 000;

-Forest planning map afferent U.P. I Siniob, O.S. Săcuieni, D.S. Oradea, scale 1: 20 000;

-Management plan of U.P. I Sîniob, O.S. Săcuieni, D.S. Oradea - general studies.

-4 GPS receivers R3 with accessories;

-GPS navigation Pocket LOOX N520 Fujitsu Siemens;

-Total Station Trimble 3605;

-Trimble Data Transfer;

-Trimble Total Control;

-Map Sys PDA 2.0;

-Terramodel 10.3;

-Topo Sys 5.0;

-Map Sys 7.0.

To carry out case studies to raise details of the forestry sector using modern technologies vector data collection were used several methods which are listed below.

Observation research method was used to identify the land (occupied by forest vegetation) which was the subject of study.

Experiment was used as a research method in this case study to facilitate the introduction of modern technologies to achieve geo-topo-photogrammetric works in forestry.

Following have experienced a number of possibilities to work in terms of removal in the forestry sector using various materials and technologies work, and that in pursuing the optimization of efficiency activities.

Simulation and modeling of the research methods were applied in the light use of specialized software endeavoring to obtain similar patterns of land and that objective reality abstraction some particular aspects of importance for forestry.

Therefore to obtain positive results, the achievement of a comprehensive case study which is subsequently generalized features of the final product that is applied on large areas.

Comparison - to compare results obtained with different technologies work.

To achieve these works have been used a number of points on the support network of Bihor county points were determined with modern technologies combined in several phases of work.

This case study analysis the opportunity of a topographical works in the forestry sector with GNSS technology. Following two methods will be tried lifting the details related to young stands of Acacia in the rest of vegetation and the vegetation season of the GNSS technology.

Static method. Static method is used frequently in current geodetic work. This method is the method for the creation of geodetic networks of support. It is enough to be at least two GPS receivers that receive signals from the same least 4 satellites visible and have a common time stationary.

As one of the two receivers is the point with known coordinates and other details determined by calculation. Number two receivers is minimal as the intersection before sufficient minimum two points with known coordinates of which are aimed at new point is used frequently at least three GPS receivers. The more receivers is greater the more increase safety determinations.

Static methods are commonly used when talking to achieving geodetic networks that require high precision.

Static method requires the existence of at least two GPS receivers located on two material points on the ground. The two receivers receive signals from 4 satellites have the same minimum downtime together. Maximum distance of visibility is linked to the four communication satellites. The wider spread greatly downtime is greater. As shown above, this minimum of 4 satellites is not sufficient to determine a point with sufficient accuracy (Hofmann J. et. al., 1997,Păunescu C. et. al., 2006).

In addition to getting a better yield and of better accuracy, the number of receivers is more than can be added to the permanent stations.

Kinematic measurement method. Kinematic measurement procedure is a method of determining the position of points with no time of observation in each point. Earlier measurements ambiguities need to be determined for measurements of phase with waves carry.

STOP and GO measuring method. Is used when you wish a quick determination of the coordinates, but with greater accuracy, downtime is minimal. Fast static method is similar except that by this method every stopping point between 30cc -- two minutes, instead of P code modulation of L1 and L2 relay used if static quickly, using only L1 spokeswoman code modulated L1. Movement receivers can be continuously, or to increase accuracy is a very short stays in the new points - fig. 1. It is a method of measuring post processing.

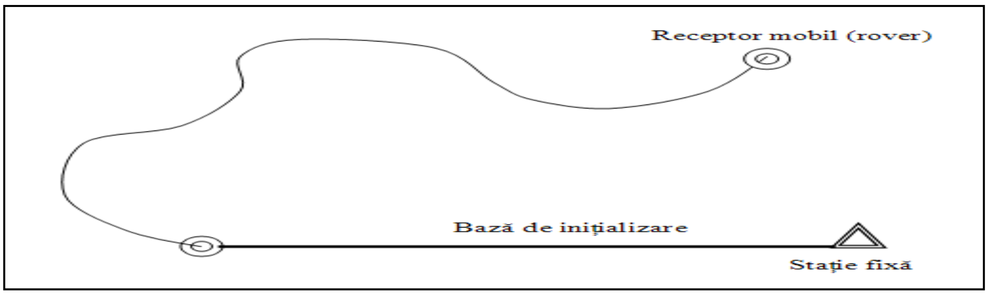

Fig. 1. Scheme to achieve kinematic observations in the method of measuring

Kinematic measurements can be achieved if we have two receivers: one used as a base station is fixed and the other as a mobile handset - rover.

To increase working efficiency can be entered into a number no matter how big the mobile handsets and base stations use additional.

Use of auxiliary base stations gives the following advantages:

-help eliminate problems related to the size range of clinical activity around base stations,

-measurement may take place within a larger,

-provides protection measurements in case you lost contact with satellites for base station,

-to collect additional information that you can use to verify the measurement results.

Accuracies that are obtained with this method lies in the field ± inches (1-3 cm).

Stop and go method is recommended for lifting details from distances of 5 to 6 km from base.

After conducting some kinematic GPS measurement method stop and go in cadastral survey in the villages were separated following aspects: -method of measuring stop and go ensure hight precision;

-measuring-time is much shorter because the number of stations is much lower than the total measurement stations;

-because there must be visible between the station and lifting points and distances can be great time for the measurements will be much lower than in the case of total stations;

Fig. 2. Location of young forest stands of Acacia in the experimental device will be positioned with GNSS technology

-kinematic GPS measurements stop and go method may be performed if it has a network of permanent stations distributed at distances of 30 to 50 km with GPS devices because fewer base stations will be taking the role of permanent stations (Păunescu C. et. al., 2006).

Acacia forest stands in which to be realized observations GNSS technology that the age of 6 and 4 years, marked by orthophotomap two polygons - fig. 2.

GNSS technology for effective analysis has been made remarks at the beginning of May when forest stands are in the rest of vegetation and in July in full season of vegetation. As a result of in-season rest vegetative observations were made fast static method and Stop & Go and vegetation season observations were made using only Stop and Go method.

To achieve these works have used as base points determined planimetric and altimetric GNSS technology - fig. 3, in the support network of experimental device that section 100 and section 125 located on the pier located inside the massive forest in plot 46, in regeneration area, which stand in the breast was removed after regeneration fellings.

Fig. 3. The planning works GNSS positioning technology

RESULTS AND DISCUSSION

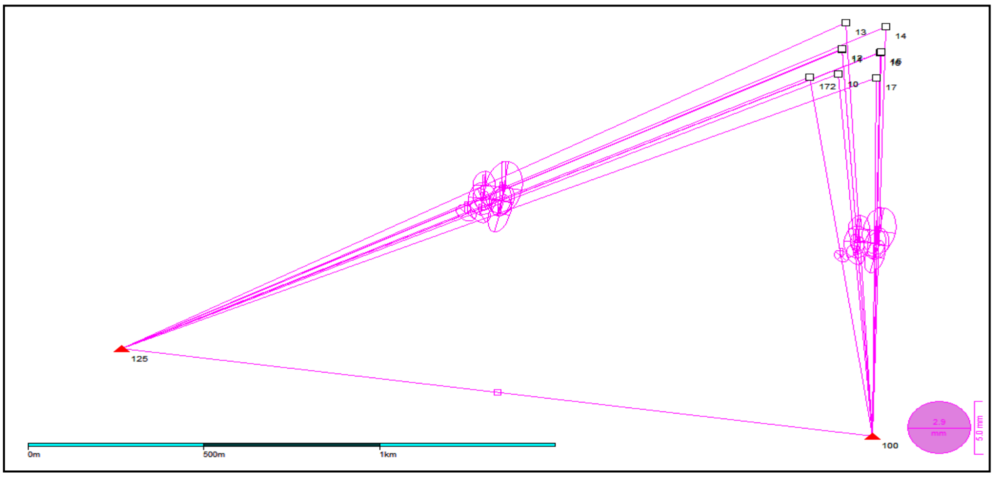

Fig. 4. Sketch the location of vectors to determine the details (young forest stands of acacia) GNSS technology, fast static method

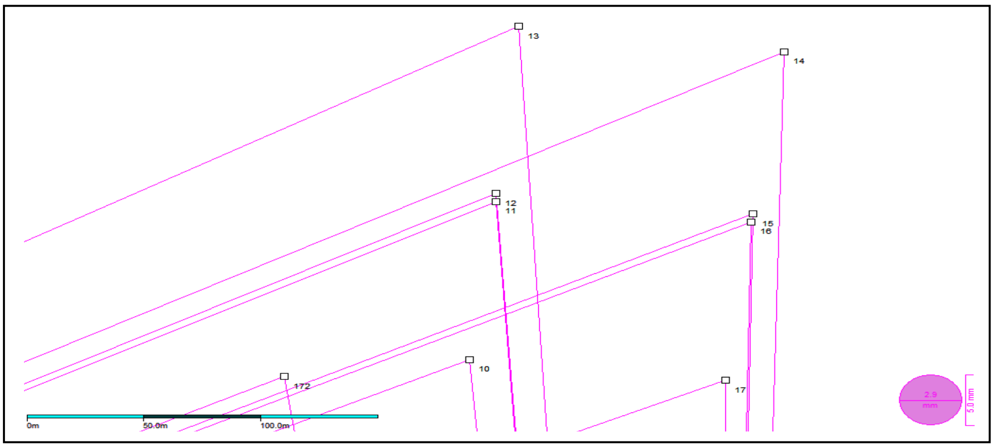

Fig. 5. Sketch the location of characteristic points delimiting forest stands of acacia to be determined with GNSS technology, fast static method

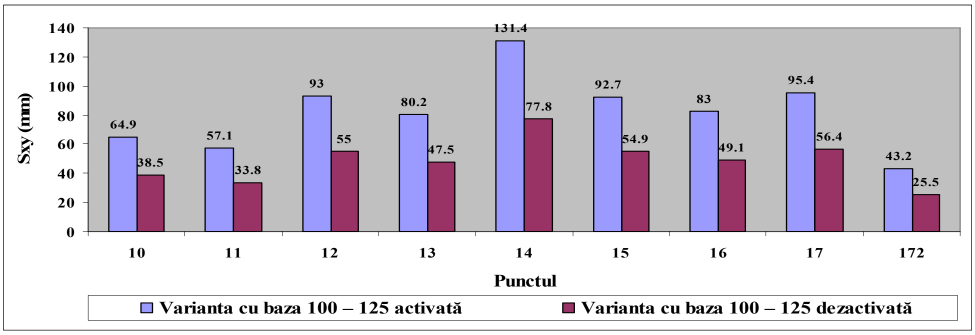

Fig. 6. Standard deviations determined by planimetry related items GNSS technology, fast static method, in two calcul variation

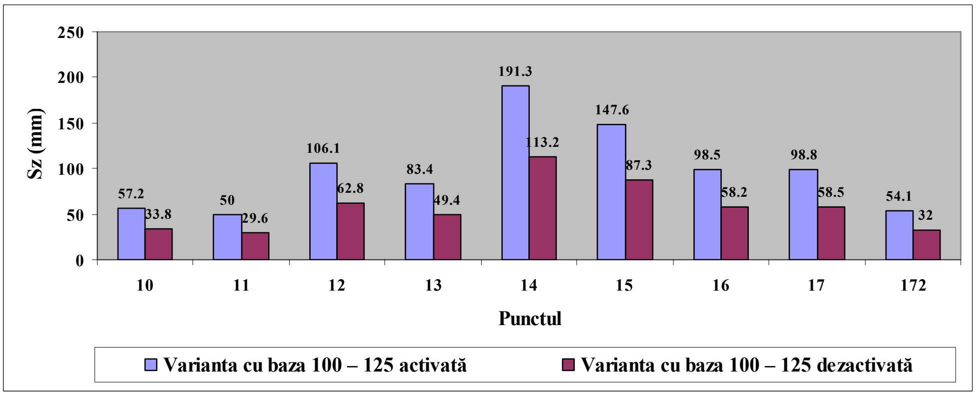

Fig. 7. Standard deviations determined by altimetry related items GNSS technology, fast static method, in two calcul variation

Table 1

Inventory coordinates determined by static method GNSS technology quickly, with the option of calculating 100 to 125 disabled

Point	X(m)	Y(m)	Z(m)
0	***1***	***2***	***4***
10	646222.528	281508.313	176.690
11	646306.920	281519.803	177.954
12	646311.143	281519.795	178.412
13	646400.383	281529.558	182.211
14	646386.827	281642.994	174.237
15	646300.140	281629.500	165.587
16	646295.852	281628.632	165.356
17	646211.343	281617.907	161.924
172	646213.432	281429.220	188.655

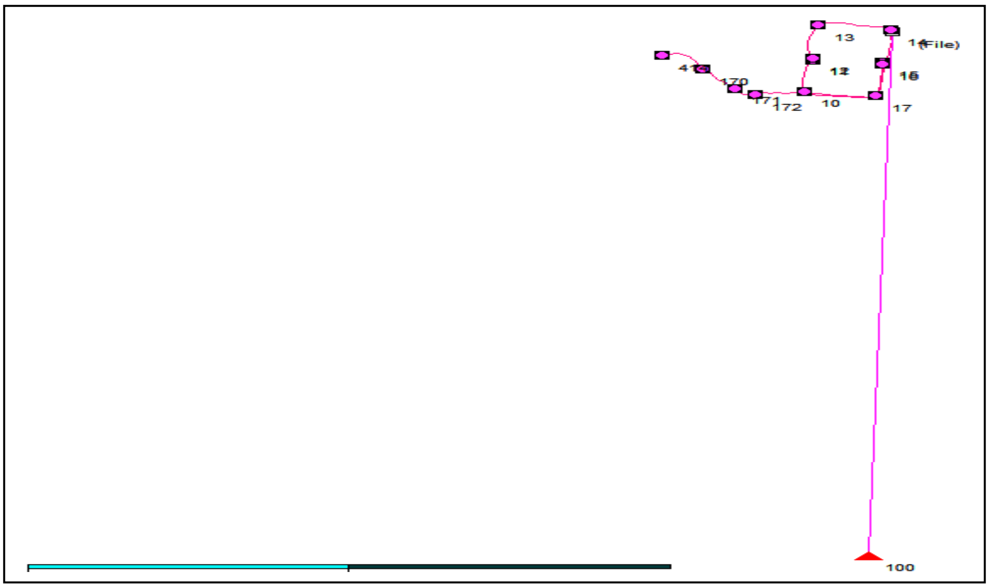

Fig. 8. Lifting details GNSS technology Stop and Go method

Considering the fact that the topography in the area of low hills and plains mostly has a rectangular shape parcel has studied a form.

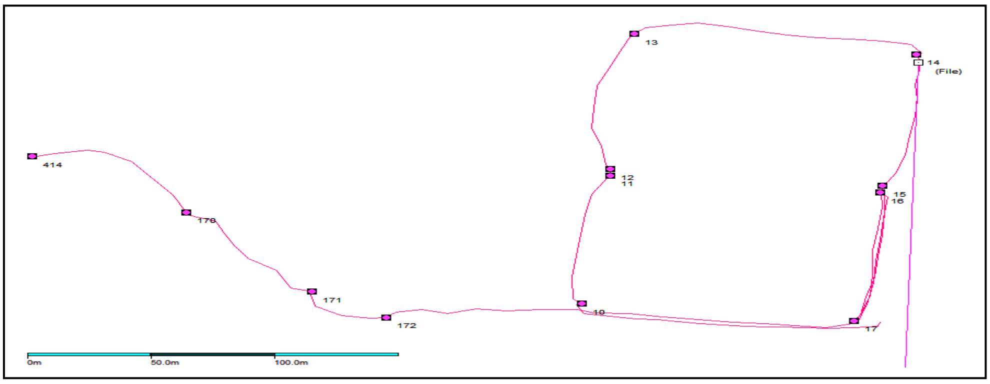

Fig. 9. Lifting details GNSS technology Stop and Go method

Table 2

Inventory coordinates determined by the technology GNSS and Stop and Go method

Point	**X (m)**	**Y (m)**	**Z (m)**	**H (m)**	**Observations**
0	***1***	***2***	***3***	***4***	***5***
100	644977.232	281606.991	185.469	143.164	Base
10	646222.528	281508.330	218.905	176.660	Rover registration
11	646306.902	281519.845	220.150	177.908	Rover registration
12	646311.129	281519.832	220.598	178.357	Rover registration
13	646400.408	281529.576	224.429	182.192	Rover registration
14	646386.820	281643.068	216.457	174.217	Rover registration
15	646300.135	281629.528	207.787	165.544	Rover registration
16	646295.838	281628.679	207.575	165.332	Rover registration
17	646211.336	281617.942	204.123	161.875	Rover registration
172	646213.425	281429.258	230.848	188.604	Rover registration
171	646230.389	281399.199	233.634	191.390	Rover registration
170	646282.703	281348.335	235.069	192.829	Rover registration
414	646319.622	281286.533	234.829	192.591	Rover registration
101	645476.984	281928.515	186.647	144.361	Rover registration

Table 3

Vectors determine the standard deviations associated with GNSS technology,
Stop and Go method

From	**to**	**ΔX(m)**	**S ΔX(mm)**	**ΔY(m)**	**S ΔY(mm)**	**ΔZ(m)**	**S ΔZ(mm)**
0	***1***	***2***	***3***	***4***	***5***	***6***	***7***
100	10	-769.0459	+- 4.3	-468.1178	+- 3.5	866.3640	+- 4.8
100	11	-829.0982	+- 4.3	-483.4343	+- 3.5	924.7599	+- 4.8
100	12	-831.6281	+- 4.3	-484.6439	+- 3.4	927.9548	+- 4.8
100	13	-892.6136	+- 4.0	-502.4444	+- 3.4	991.5309	+- 4.8
100	14	-934.0864	+- 7.2	-396.3556	+- 6.0	979.2838	+- 9.0
100	15	-876.3485	+- 6.3	-384.0715	+- 5.7	913.8167	+- 7.5
100	16	-873.2781	+- 5.5	-383.5694	+- 5.5	910.7273	+- 5.9
100	17	-814.8401	+- 4.1	-368.0643	+- 3.5	850.6417	+- 5.3
100	101	-461.1340	+- 5.0	139.6423	+- 2.4	347.6792	+- 7.1
100	170	-734.8158	+- 4.2	-629.1453	+- 3.2	915.0513	+- 6.4
100	171	-721.2605	+- 4.2	-566.7121	+- 3.2	879.7995	+- 6.2
100	172	-723.7631	+- 4.2	-534.6387	+- 3.3	867.0010	+- 6.1
100	414	-734.7818	+- 3.5	-697.2459	+- 2.6	938.3632	+- 5.4

Table 4

Inventory coordinates determined by the technology GNSS, method Stop and Go
on 04 07 2009

Point	**X (m)**	**Y (m)**	**Z (m)**	**H (m)**	**Observations**
0	***1***	***2***	***3***	***4***	***5***
100	644977.2320	281606.9910	185.4694	143.1640	Base
14	646386.7392	281643.4216	216.8967	174.6572	Rover
15	646300.0093	281629.9335	208.1854	165.9421	Rover
16	646295.7142	281629.0728	207.9667	165.7232	Rover
17	646211.1870	281618.3415	204.4538	162.2065	Rover
414	646281.4707	281347.7377	234.9188	192.6783	Rover

Table 5

Inventory coordinates determined by the technology GNSS, method Stop and Go on 04 07 2009

Point	X (m)	Y (m)	Z (m)	H (m)	Observations
0	*1*	*2*	*3*	*4*	*5*
100	644977.232	281606.991	185.469	143.164	Base
10	646222.533	281508.339	218.912	176.666	Rover
11	646307.019	281520.894	219.949	177.708	Rover
12	646311.144	281519.834	220.637	178.395	Rover
13	646400.412	281529.553	224.409	182.172	Rover
414	646319.645	281286.508	234.851	192.613	Rover

Table 6

Differences of coordinates for points determined with GNSS technology, Stop and Go method in data 06 05 2009 and 04-05 07 2009

Point	ΔX (m)	ΔY (m)	ΔZ (m)	ΔH (m)	Observations
0	*1*	*2*	*3*	*4*	*5*
10	-0.005	-0.009	-0.007	-0.006	Rover
11	-0.117	-1.049	0.201	0.200	Rover
12	-0.015	-0.002	-0.039	-0.038	Rover
13	-0.004	0.023	0.020	0.020	Rover
14	0.081	-0.354	-0.440	-0.440	Rover
15	0.126	-0.405	-0.398	-0.398	Rover
16	0.124	-0.394	-0.392	-0.391	Rover
17	0.149	-0.399	-0.331	-0.332	Rover

Table 7

Differences of coordinates for points determined with GNSS technology, fast static method (03 05 2009) and Stop and Go method (06 05 2009)

Point	ΔX (m)	ΔY (m)	ΔZ (m)	ΔH (m)
0	*1*	*2*	*3*	*4*
10	0.000	-0.020	0.030	0.030
11	0.018	-0.045	0.045	0.046
12	0.014	-0.042	0.055	0.055
13	-0.025	-0.016	0.019	0.019
14	0.007	-0.078	0.019	0.020
15	0.005	-0.028	0.044	0.043
16	0.014	-0.049	0.025	0.024
17	0.007	-0.032	0.049	0.049

Table 8

Differences of coordinates for points determined with GNSS technology, fast static method (03 05 2009) and Stop and Go method (04 - 05 07 2009)

Point	ΔX (m)	ΔY (m)	ΔZ (m)	ΔH (m)
0	*1*	*2*	*3*	*4*
10	-0.005	-0.029	0.023	0.024
11	-0.099	-1.094	0.246	0.246
12	-0.001	-0.044	0.016	0.017
13	-0.029	0.007	0.039	0.039
14	0.088	-0.432	-0.421	-0.420
15	0.131	-0.433	-0.355	-0.355
16	0.137	-0.443	-0.367	-0.367
17	0.156	-0.432	-0.282	-0.282

CONCLUSIONS

Making measurements of GNSS technology by any method for lifting details of the forest is recommended to achieve in the rest of vegetation.

You should use methods which ensure a high efficiency following method using Stop and Go outside vegetation season in young forest stands is appropriate.

Difference coordinates of points determined by different methods of working with GNSS technology is relatively low.

Following either of the two methods can be applied successfully.

It is recommended that the distance base-rover to be up 2-3 km for the accuracy of determining the points with Stop and Go method to be maxim.

REFERENCES

1.Boş N., Iacobescu O., 2007, Topografie modernă, Editura C H Bek, Bucureşti;

2.Boş N., 2003, Cadastru general, Editura ALL BECK, Bucureşti;

3.Boş N., 2003, Cartea funciară şi expertiza tehnică topo-cadastrală, Editura ALL BECK, Bucureşti;

4.Boş N., Chiţea Gh., 2005, Ridicarea în plan a pădurilor din România în etapa actuală, Revista pădurilor, nr.1/2005, pag. 28 - 31, Bucureşti;

5.Dragomir P. I., 1992, Topografie generală, Institutul de Construcţii Bucureşti;

6.Hofmann – Wellenhof B., Lichtenegger H., Collins J., 1997, Global Positioning System - Theory and Practice, Springer Verlag Wien New York;

7.Neuner J., 2000, Sisteme de poziţionare globală, Editura Matrix Rom, Bucureşti;

8.Păunescu C., Mocanu V., Dimitriu S. G., 2006, Sistemul Global de Poziţionare G.P.S. – curs, Editura Universităţii din Bucureşti;

9.Tămâioagă Gh., Tămâioagă D., 2007, Automatizarea lucrărilor de cadastru, Editura Matrix Rom, Bucureşti;

10.Vorovencii I., 2006, Topografie, Editura Universităţii Transilvania din Braşov;

***Amenajamentul Ocolului Silvic Săcuieni, Direcţia Silvică Oradea, Studiul General;

***Amenajamentul Unităţii de Producţie II Sîniob, Ocolului Silvic Săcuieni, Direcţia Silvică Oradea, Studiul General;

***Norme tehnice pentru introducerea Cadastrului general aprobate prin Ordinul MAP nr.534/01.10.2001;

Programe utilizate

Programe culegere date

1.TRIMBLE TOTAL CONTROL;

Programe transfer date

2.TRIMBLE DATATARNSFER

Programe prelucrat date şi raportare grafică

3.TERRAMODEL 10.3

4.MAPSYS 7.0

Adrese utilizate

1.www.trimble.com, 2.www.geotop.ro