STATISTICAL ANALYSIS ON THE ACCURACY OF DETERMINING THE COORDINATES OF THE POINTS WITH GPS EQUIPMENT IN FORESTRY SECTOR

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Abstract

The purpose of this paper is to perform a statistical analysis based on many factors that influence accuracy of determining the coordinates of the points in the forestry sector, points determined by GPS technology, the method used is Stop-and-go. Factors influencing the accuracy of determining the points are: composition stands, consistent, age, land orography, exhibition etc. This paper aims forests that are under the administration of RPLP PC Zarnesti, area where there is already a GIS project, which includes the observations on the factors that influence accuracy, listed above, and coordinates obtained from measurements made by GPS technology. The conclusion resulting from the statistical analysis performed is that the accuracy of determining the coordinates of the points by GPS technology is greater on heights and much weaker on valleys with North-South exhibition.

Key words: accuracy, forestry sector, GPS, land orography, composition

INTRODUCTION

Global positioning systems are composed of several constellations of satellites orbiting the Earth, constantly transmitting ground receiver position, with waves radio.On TOA (time of arrival) basis, after the needles have received satellite signals, receiver calculates the 3 dimensional elements of the globe position (longitude, latitude and altitude) according to the transmission time of messages and the position of at least four satellites in orbit. The best known is the GPS positioning system (Glove Positioning System) - American system was developed as a military application but, in present, is free provided for civilians.

The data analyzed in this paper were collected with GPS equipment in dual frequency (L1, L2) using Stop-and-go method, and beeing post-processed using the corrections from a reference station nearby. The studied zone is in the upper basin of Birse, near Zarnesti. Statistical analysis was performed only for spruce forests from the study area.(the study area is represented in Figure 4).

Figure 1. An image taken from a graphic artist to Terra suggesting positioning of one of the satellites of the GPS system

MATERIALS AND METHODS

The data obtained from the measurements were taken over several days with GPS equipment (two types of receivers in dual frequency-Trimble Proxrt, Trimble Proxh). In order to analyze the accuracy of their determination based on certain criteria, I used an existing GIS which contained information about relief,

exposition , crown density of the stand, composition, age, etc. .. Further, various combinations were made from two criteria reaching up to five criteria. (eg two criteria: spruce forest on valley, spruce forest with crown density of the stand 0.7-0.8, spruce forest age 81-100 years, spruce forest on southern exposition, ex. 3 criteria: spruce forest on valley with crown density of the stand 0.9-1, spruce forest age 1-20 years on Eastern exposition, ex. 4 criteria: spruce forest on slope age 81-100 years, crown density of the stand 09-01; ex .5 criteria: spruce forest on slope age 101-120 years crown density of the stand 07-08 and on North exposition. The analyse were performed for each one of these combinations regarding the points precision and to achieve it have been established certain thresholds: the orography have been divided into valley, slopes and ridge, the crown density of the stand have been divided in crown density >=0.6, 0.7-0.8 and 0.9-1.0, age in thresholds of 20 to 20 years (1-20, 21-40, 41-60, 61-80, 81-100, 101-120, 121-140) and exposition in Northern(N), Southern(S), Eastern(E), Western(W), N-E, N-W, N-S, S-E, S-V, NE-SV, NV-SE.

RESULTS AND DISCUSSIONS

After I relized all possible combinations on the accuracy of determining the coordinates of the points in the forestry sector (especially the spruce forest) with GPS equipment, were calculated averages of all the points that define each combination in hand, but before I calculated the coefficient of variation which shows if the community is homogeneous or inhomogeneous.If coefficient of variation is lower than 30% it means that the community is homogeneous and the arithmetic mean can be used.Otherwise, must calculate other parameters, such as:quartile, percentile, median etc.which helped getting the final result. In the analysis were obtained the results that are represented in Figure 2.

As we can see, the precision of determining the point with GPS equipment is higher on ridge (on average 0.3 m) and lower on valley. Analyzing combinations of 2 criteria at a time, the accuracy in spruce forest will be higher when crown density of the stand is lower than 0.6, when the exhibition is EV and age is

between 1 and 20 years and obviously, as shown above when measurements are made on the ridge. The accuracy will be lower on valley, slopes with northern exposition, age between 121 and 140 years or in forests with crown density of the stand 09-1.
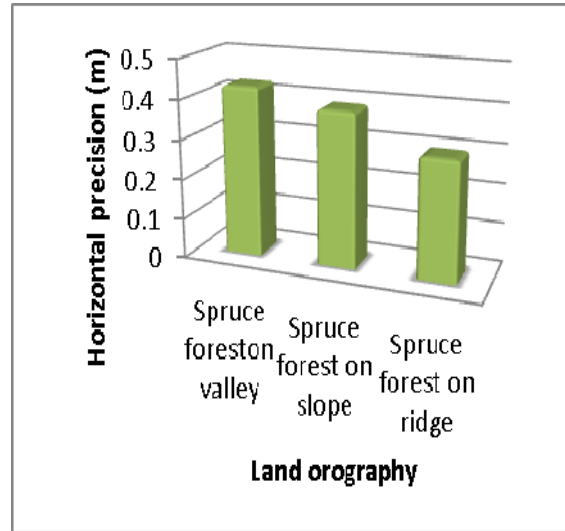

Figure 2. The results on analysis performed based on land orography

Continuing with the combination of 3 criteria, were obtained following results (as you can see in Figure 3):
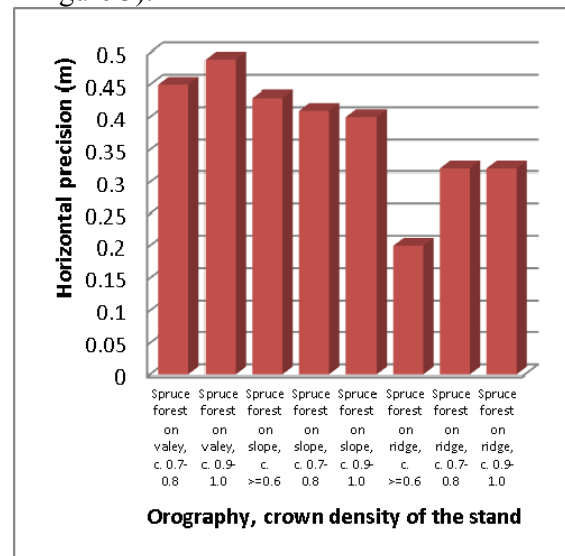

Figure 3. The results on analysis performed based on land orography and crown density of the stand

In combinations that were used criteria related to orography and crown density of the stand, the best accuracy is reached in spruce forests located on the ridge with crown density lower than 0.6, the weakest precision is touched on valley with crown density 0.9-1 (as you can see

in the chart above). When using orography criteria and age, the best accuracy resulted is in the forests on the ridge between the ages of 1 and 20 years and the worst in the valley between the ages of 61 and 80 years. Taking into consideration topography and exposition accuracy resulted the highest precision on ridge and exhibition Northern Eastern-Southern Western (NE-SW) and the weakest on the Northern exposition on slopes.

In the statistical analysis conducted in combinations of 4 criteria, there were 109 combinations analyzed in spruce forest and the result is that the best accuracy will be found in combination: spruce forest with crown density of the stand lower than 0.6 located on ridge with NE-SW exhibition with an age of 1 to 20 years. Obviously, the worst precision will be in the combination that contains spruce forest on slope with Northern exposition, with crown density of the stand 0.9-1.0 and an age between 61-80 years.
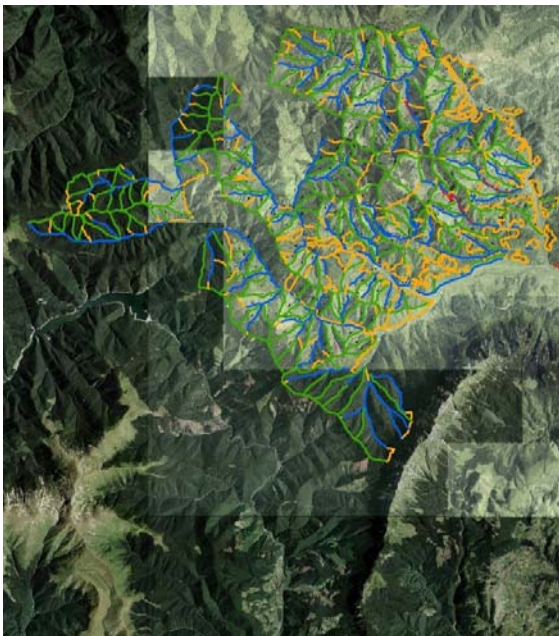

Figure 4. The study area

CONCLUSIONS

The conclusion resulting from achieving statistical analysis on the accuracy of determining the coordinates of the points in the forest (spruce forest) with GPS equipment is one obvious as it is logical that on the ridge will be the highest accuracy of determining the coordinates of the point because the sky is relatively free, on the valley the signal of the satelites is blocked by the slopes that surround the valley or on the slopes with Northern exposition where the signal will be very weak because the direction of the satellites is also EV.Also, the accuracy will be much better in young forests where canopy cover is not consistently affect accuracy.It is obviously that the crown density of the stand will also influence the precision and the accuracy will be better on a forest with lower crown density.

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