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PREREQUISITES FOR ENSURING THE CONFIDENCE LEVEL IN GNSS OBSERVATIONS

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ABSTRACT: *According to the regulations in force, each newly determined point should have at least 3 independent position vectors. In this context, simulations can be made on the one hand by highlighting and extracting locations at the maximum reception range of distances from a permanent GPS station (80km), and on the other hand, in the context of checking, creating, or developing some networks, the new points should be determined having at least 3 independent vectors linked to the RNSGP (National Network of GPS Permanent Stations - NNGPS) within 75% of the maximum reception distance (to increase the confidence level of the measurements). Practically, based on these regulations, it should be checked whether and to what extent the requirement is met at the level of the determined point as the centroid of the researched area.*

Keywords: *GNSS, RNSGP, measurement, satellite availability, spatial analysis, GIS, geoprocessing*

Introduction

The topic addressed is related to the issue of the satellite geodesy, being linked to the establishment of ways that can provide accuracy in obtaining higher precisions through a rigorous planning and organizing of GPS observations. In other words, a correct informing that occurs at the right time can lead to the expected result. It has often been proved that improvisation, even if it is a level of creativity, based on intuition,

Fig.1. RNSGP distribution using GIS technology

it is dangerous in the engineering activity in general, and in topo-geodesic works in particular. Thus, a set of rules is required, which, although it seems unimportant at the beginning, it will prove to be useful both for efficiency and especially for achieving the expected result.

Scenario concerning the relationship of the RNSGP with the expected observations in the work area

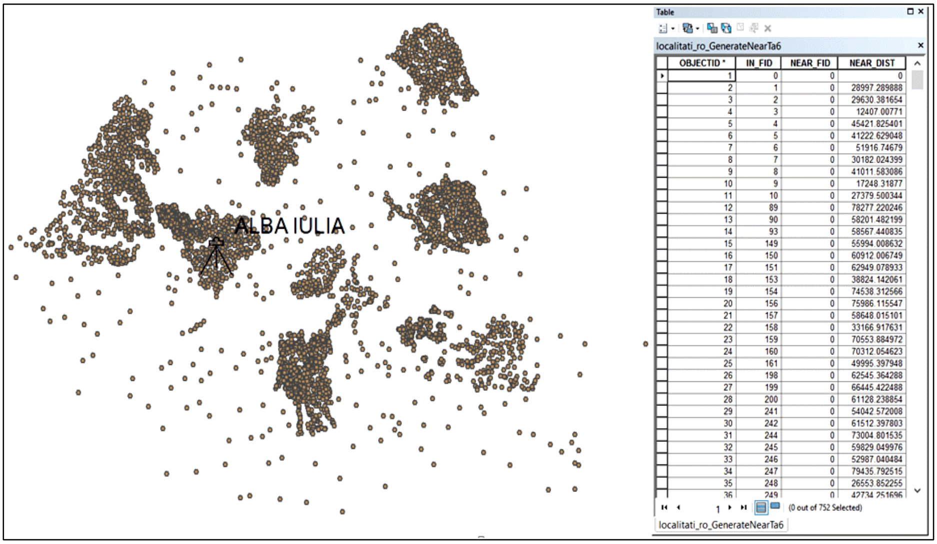
For the first case a cartographic map will be created with the spatial distribution of the GNSS permanent stations in Romania using the thematic layer LOCALITIES (fig. 1).

A new field, coded as STRING (text), is added to the corresponding layer attribute table, so that at the population database it can be specified this aspect in the right of the locality where GPS permanent stations are located. After validating the localities which present this attribute, the database is queried using the „ROMPOS” LIKE „DA” expression, followed by the export of entities in a new layer called RNSGP (contains 71 records of localities that possess GPS stations, fig. 2).

The vicinity is established between point entities in the LOCALITIES layer and the RNSGP layer that has been reduced to a single record based on the database query. Based on the analysis it can be observed that 752 locations can make use of differential corrections from SPGPS Alba over the maximum distance of 80km (fig. 3).

Prerequisites for determining a sufficient number of vectors in the case of gnss networks

For the second case, which should provide the confidence level of the measurements within some networks (ensuring at least 3 position vectors for each point determined when using the universal RINEX format for determining the coordinates of the new points by postprocessing, after the measurements are executed in a static manner according to the regulations in force), the layer that composes the ATUs (Administrative Territorial Units) in our country will be integrated, and we will stop on BUCIUM – the territory under research. We will submit the query database in order to reduce it to a single registration,



OBJECTID *	IN_FID	NEAR_FID	NEAR_DIST
1	0	0	0
2	1	0	28997.289888
3	2	0	29630.381654
4	3	0	12407.00771
5	4	0	45421.825401
6	5	0	41222.629048
7	6	0	51916.74679
8	7	0	30182.024399
9	8	0	41011.583086
10	9	0	17248.31877
11	10	0	27379.500344
12	89	0	78277.220246
13	90	0	58201.482199
14	93	0	58567.440835
15	149	0	55994.008632
16	150	0	60912.006749
17	151	0	62949.078933
18	153	0	38824.142061
19	154	0	74538.312566
20	156	0	75986.115547
21	157	0	58648.015101
22	158	0	33166.917631
23	159	0	70553.884972
24	160	0	70312.054623
25	161	0	49995.397948
26	198	0	62545.364288
27	199	0	66445.422488
28	200	0	61128.238854
29	241	0	54042.572008
30	242	0	61512.397803
31	244	0	73004.801535
32	245	0	59829.049976
33	246	0	52987.040484
34	247	0	79435.792515
35	248	0	26553.852255
36	249	0	42734.251696

Fig. 2. Displaying the Alba permanent station in the context of establishing new proximity indicators

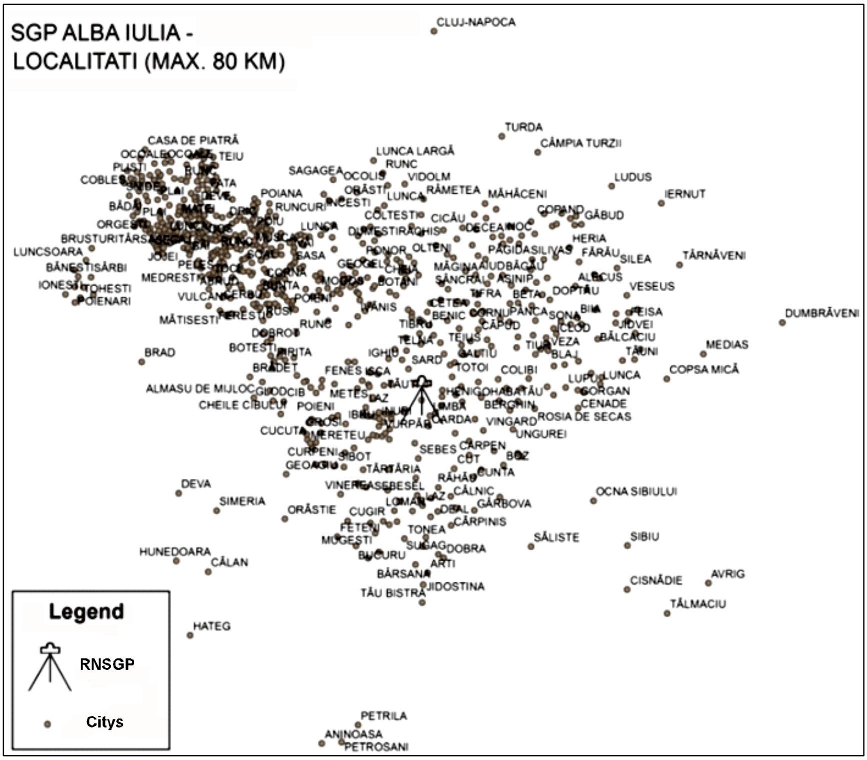


Fig. 3. Determining the 752 locations based on the maximum distance threshold

specifying the above ATU.

Next, we will calculate the centroid coordinates as the average of the coordinate values of the polygonal break points, as a representation structure for the ATU Bucium, and these calculated values will be the basis for generating the new point vector layer.

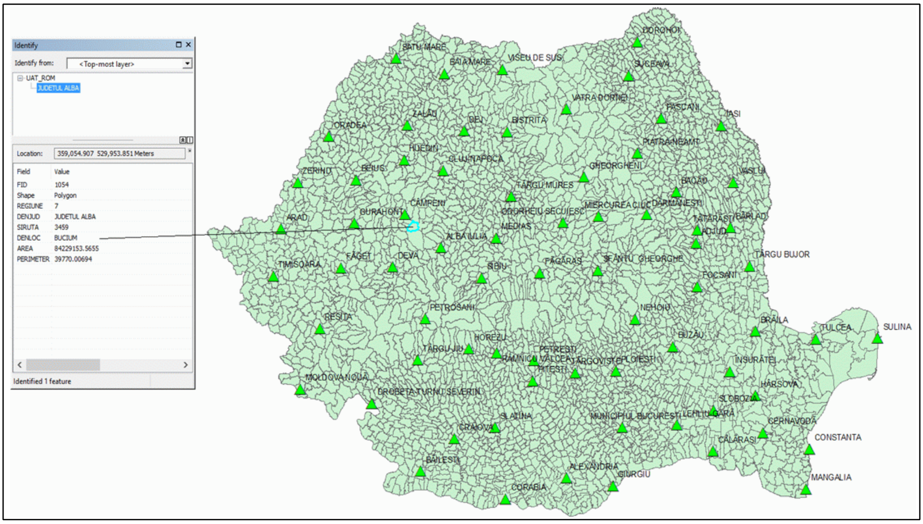


Fig. 4 Displaying ATUs in Romania and identifying ATU Bucium

In order to verify the fulfilment of the requirement for obtaining at least 3 independent vectors within 75% of the maximum reception distance (i.e. 60km) between the considered point (centroid) and the permanent GPS stations, a new analysis is carried out based on the toolsets Analysis Tools, Proximity subset, Point Distance function. Basically, this required distance is justified by the fact that on the one hand it strengthens precision, and on the other hand, wherever the measurements are located within ATU Bucium, differential corrections could be received without exceeding the maximum distance threshold (fig. 5).

In order to find out the name of the permanent GPS stations that may have emission quality in the context of the relationship with the selected point, a table link will be created by setting the spatial layer reference (RNSGP). In other words, the attribute table corresponding to the RNSGP layer will be linked to the table resulting from applying the Point Distance function on the primary keys (fig. 6).

In order to simplify the table corresponding to the RNSGP layer, the database will be queried by cancelling permanent stations that do not show values at the calculated field level, DISTANCE, the

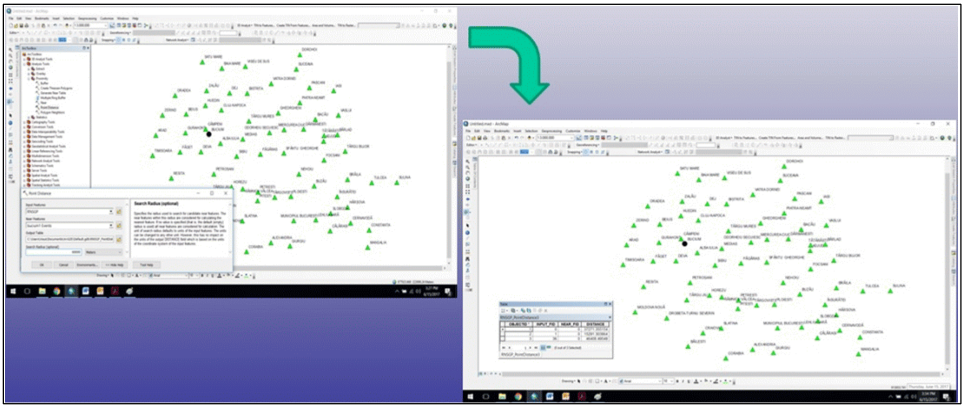


Fig. 5. Applying the Point Distance function and determining the resulting distances

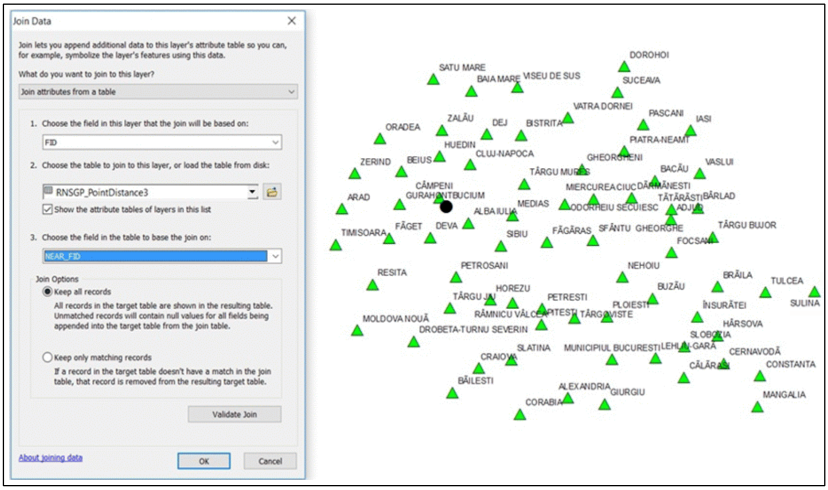


Fig. 6 Linking the resulting table to the RNSGP layer table

syntax being presented as „bucium1_ Features_PointDistan. DISTANCE” IS NOT „NULL”. In this way we have verified that the requirement is fulfilled, highlighting the optimum emission parameters of the Câmpeni, Alba Iulia and Deva permanent stations in relation to the point from Bucium area (fig. 7).

determined point when using the RINEX universal format for determining the coordinates of the new points by postprocessing, after the measurements are executed in a static manner according to the regulations in force) and last but not least the non-existence or the partial existence of the GSM signal for the transmission of

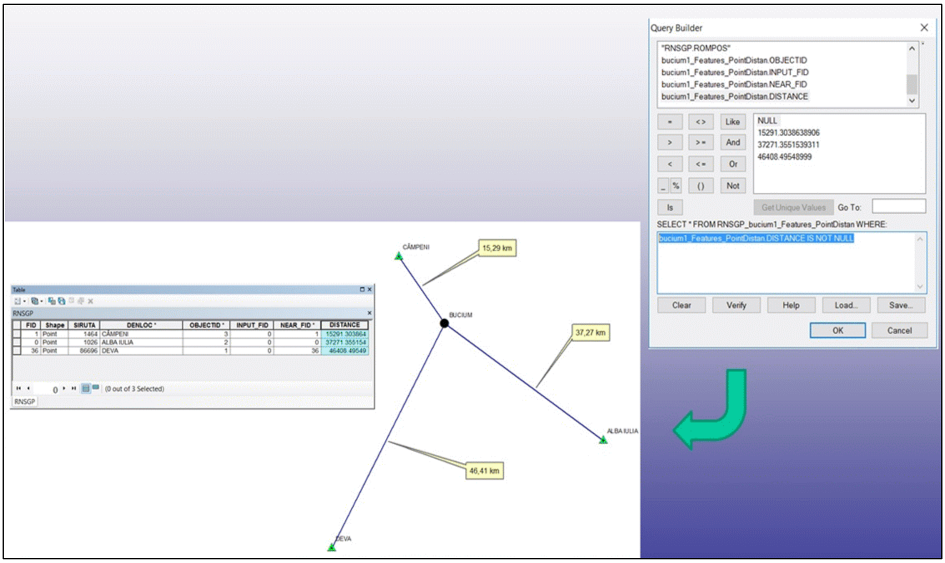


Fig. 7. Distribution of stations and generation of at least 3 independent vectors

Conclusions

In the present paper we have customized the planning of satellite observations according to several criteria, namely the use of proximity factor on the basis of GPS RTK measurements (proximity of the receivers in relation to permanent GPS stations, which can ensure the diffusion of differential corrections in real time), the confidence level of the measurements within some networks (ensuring at least 3 position vectors for each differential corrections (in which case we can make use of the radio transmission of corrections using the relative positioning method). All these analyses that can optimize the planning and organization of works with GPS instruments have been carried out in the GIS environment, an environment that targets all the equipment, programs, methods and norms, with the aim of capturing, storing, checking, integration, analysis and visualization of geographic data.

References

1. Boş, N.; Iacobescu, O.; *Topografie Modernă*, Editura C.H. Beck, Bucureşti, 2007;
2. Borşan, T., *Sisteme Informaţionale Geografice – Fundamente teoretice şi practice*, Seria Didactica, Alba Iulia, 2013;

3. Borşan, T.; Hila, A.; Ferencz, Z., *Organizarea lucrărilor de observaţii GPS prin metoda statica. Studiu de caz – staţiunea arheologică Budureasca, jud. Prahova*, revista Pangeea, nr. 15, Alba Iulia, 2015;
4. Borşan, T., *Topografie arheologică şi GIS. Fundamente teoretice şi aplicaţii practice*, Editura Risoprint, Cluj Napoca, 2015;
5. Dragomir, P.; Rus, T.; Avramiuc, N., *Aspecte privind utilizarea ROMPOS în Cadastru*, RevCAD, Alba Iulia, 2009;
6. Grecea, O.; Herban, S.; Alionescu, A., *Architectural and Tourism potential of Timisoara, Romania highlighted by WebGIS solutions,* 15th International Multidisciplinary Scientific GeoConference SGEM 2015, ISBN 978-619-7105-34-6 / ISSN 1314-2704, Book2 Vol. 1, 495-502 pp;
7. Grecea, C.; Ienciu, I.; Dimen, L.; Bala, A. C.; Oprea, L.: *Impact of Surveying Engineering on the Environmental Protection Problems,* Journal of Environmental Protection and Ecology, 13 (1), 2012, pp. 352-360;
8. Gregory T. French, *Understanding the GPS – An introduction to the Global Positioning System, What it does and how it works* , GeoResearch, Inc, 1996;
9. Oprea, L.; Ienciu, I.; Tudorascu, M.; Filip, L.; *Implications of topography and cadastre in tourism planning and sustainable development of Alba Carolina Vauban Citadel*, Journal of Environmental Protection and Ecology, 16 (3), 2015, pp. 1016-1023;