Map Production from Google Earth Snapshot

Mohamed Hosny, Hosam Elhabrouk, Aly M. El-naggar[1], Sameh Abdel Wakeel

[1]aly_m_gad@yahoo.com
Transportation Department, Faculty of Engineering, Alexandria University

ABSTRACT

The ubiquitous Google Earth service is arguably the most popular and the most commonly used internet service that offers a free access to the global collection of satellite and aerial imagery. It provides an easy access to cost free image data collected from several sources which aims to produce maps benefit the community. This contemporary high-resolution archive of the Earth's landmass represents a rapidly expanding, significant and largely unexploited resource for scientific inquiry. Therefore, many individuals and researchers still use Google Earth as a reliable and accurate data source for mapping applications. This issue raises questions about the expected positional accuracy of Google Earth and the impact of height of the scene on the planimetric accuracy, which is the main interest of the current research. In this context, the positional accuracy assessment was not carried out directly on the Google Earth imagery, but on a selected scene for a certain study area that resulted in a corresponding non georeferenced image. Then, it is georeferenced with the aid of some control points in order to be compared with a base ground-surveying map, on which the accuracy assessment will depend on the coordinates' discrepancies of some selected well-defined check points. The results have a significant accuracy to derive planimetric maps of different scale.

Keywords - Google Earth; Root Mean Square Errors; Planimetric Accuracy

INTRODUCTION

Google Earth is the most worldwide software that enable people to get an access to high-resolution imagery for anywhere on earth surface. Unfortunately, given the popularity of Google Earth, many users think it is a source of accurate information and rarely tend to verify its trustiness (Flanagin; Metzger, 2008). Moreover, the practice of Google Earth for reporting coordinates does not satisfy the required scientific accuracy of the specialized users such a fact is support by the Google representatives' statement "coordinates provided by Google are just a kind of approximation." ((Goodchild et al., 2012). However, Ground Truth project is invented by Google in 2008 for increase the accuracy of their geographic products by

gathering data from authoritative sources such as the USA National Geospatial-Intelligence Agency and the Mexican National Institute for Geography and Statistics (Google, 2012).

As a result of its popularity, the scientific community in their projects commonly uses Google Earth. Google Earth has been used, for example, to assess visualize the output of scientific experiments, urban vegetation cover, map landslides and evaluate land cover datasets, in addition to some other applications. In most of the scientific applications mentioned above, the concerned scientists have exercised some caution related to the accuracy of Google Earth. Therefore, in order to reduce and understand the suspicions correlating with the use of Google Earth in various applications, accuracy assessments of Google Earth's imagery are demand (Potere, 2008; Yu; Gong, 2012).

Consequently, different researchers have undertaken a series of accuracy assessments of Google Earth's imagery. Google Earth positional accuracy of 436 control points was tested by (Potere, 2008), this control points were located in 109 cities worldwide. The study concluded that those control points had a positional accuracy of 39.7 meters RMSE (error magnitudes range from 0.4 to 171.6 meters). The accuracy of control points in more-developed countries is 24.1 meters RMSE, which is significantly more accurate than the control points in developing countries such as KSA (44.4 meters RMSE). (Becek, et al., 2011) tested the Google Earth positional accuracy of more than 1900 control points located in five continents worldwide. The study concluded that the error could reach 1.5 km in some cases. In Khartoum state, Sudan, Google Earth positional accuracy of 16 control points was tested by (Mohammed, N et al., 2013). This was carried out by comparing reference ground coordinates these points which measured by Global Positioning System (GPS) with online Google Earth coordinates. Root Mean Square Errors (RMSE) for horizontal and height coordinates were found to be 1.59m & 1.7m respectively. (Elgohary et al., 2011) tested the Google Earth positional accuracy of (20) points Related coordinates North and Eastern (E, N) existing within a city Karbala and find amount where error after comparing Google Earth coordinates these points with reference ground coordinates . Root Mean Square Errors (RMSE) magnitudes range from 14.57 to 27.59 meter. (Ragheb.E.A. Ragab.F,.A,. 2015) the horizontal positional accuracy of online Google Earth imagery for a certain study area located in Cairo was tested by (Ragheb.E.A. Ragab.F,.A,. 2015). the study concluded that the error magnitudes range from 5.89 to 15.68 meter.

This issue presents an assessment study of the planimetric accuracy of Google Earth within a certain area in Alexandria. It differs from other previous investigations that the assessment will not be carried out upon directly derived Google Earth coordinates, but on a

georeferenced scene that is captured from Google Earth imagery. Accordingly, the paper starts with a clear identification and explanation of the undertaken methodology. This will be followed by the description of the field experiment along with an illustration of both selected control and check points upon which the georeferencing and assessment will be discussed. Moreover, the obtained results will be manipulated, statistically analyzed and compared with other related researches. Finally, the main conclusions along with some appropriate recommendations are presented.

METHODOLOGY

As stated before, the planimetric accuracy of Google Earth will not be assessed upon the directly derived coordinates from the online image. Instead, a selected scene is captured as an image of the tested area that will be compared with the corresponding base map produced by ground surveying techniques. This test region area is part of Faculty of Engineering, Alexandria University. Studying the influence of height of scene on planimetric accuracy. The same scene for study area was taken from Google Earth in different heights at 3, 2.5, 2, 1.5, 1 and 0.5 km. This area was surveyed by total stations. The process involved Georeferencing of the images obtained by Google Earth for Faculty of Engineering, Alexandria University to 20 well defined and sharp reference ground control points. These reference points are selected from the AutoCAD file for Faculty of Engineering, Alexandria University. Figure (1) shows the selected test area along with the used 20 common points. For each experiments, The PCI Geomatica 2013 software is used for Georeferencing the image. The geometric model used is the first order Rational function model and the resampling method used is the Nearest Neighbor to obtain the rectified images.

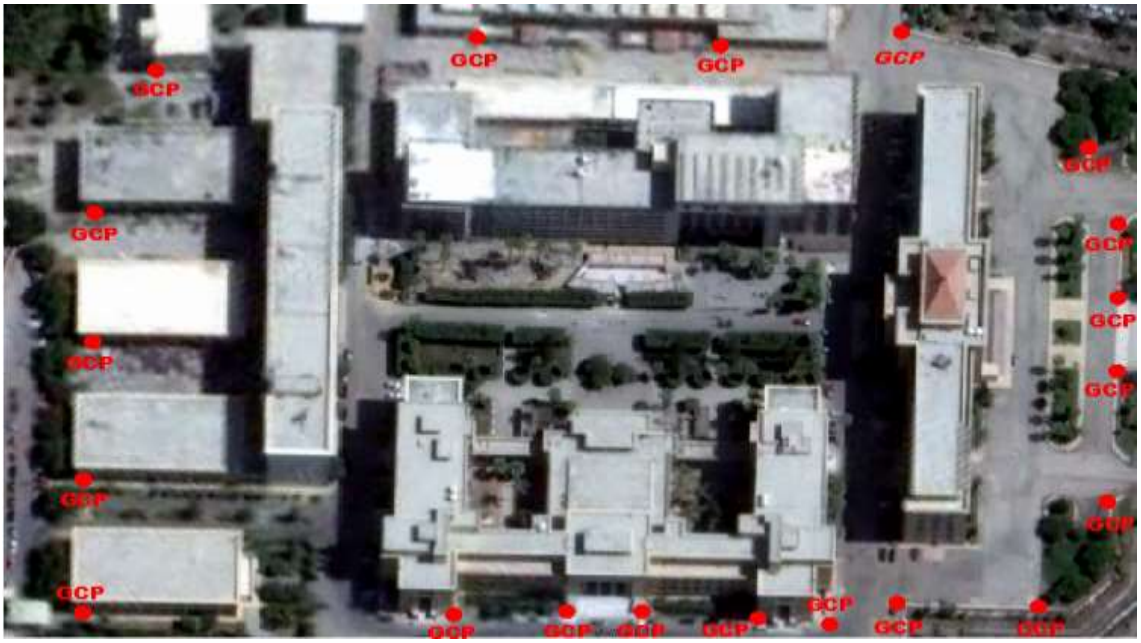

Figure (1): Applied test region along with reference ground control points.

Finally, 20 check points were selected in order to assess Google Earth planimetric accuracy. The assessment depends on the discrepancies in the 2D planimetric ground coordinates (E, N) of all selected check point, which is simply the difference between the computed coordinates from both used Google Earth images and the actual reference ground coordinates. In addition and for instance, the discrepancies of the position at any point will be also computed, since it is generally the most important parameter used to estimate the quality of any data. Moreover, the efficiency of the output results will be evaluated by analyzing the root mean square error RMS of the 2D and positional discrepancies at all selected check points for the whole image, since it is the most widely and popular index for error measurements. The distribution of used 20 check points is shown in Figure (2).

Figure (2): Distribution of ground check points.

RESULTS AND DISCUSSIONS

This section is devoted to the manipulation and analysis of the obtained results, concerning the output measured coordinates from Google Earth imagery. Figure (3) shows the relationship between RMS (p) errors for 20 GCPs and 20 CKs at different height of the scene and position accuracy requirements for different maps according to (ASPER 2013). As shown in figure (3), the RMS (p) error for CKs at height of the scene = 3 km was found to be 3.47 m. The RMS (p) error for CKs at height of the scene = 2.5 km was found to be 3.27 m. The RMS (p) error for CKs at height of the scene = 2 km was found to be 2.5 m. The RMS (p) error for CKs at height of the scene = 1.5 km was found to be 2.36 m. The RMS (p) error for CKs at height of the scene = 1 km was found to be 1.82 m. The RMS (p) error for CKs at height of the scene = 0.5 km was found to be 1.39 m. the horizontal accuracy requirement for "Class 1" 1:10,000 maps =3.53 m, 1:5,000 maps =1.77 m and 1:2,500 maps = 0.88 m.

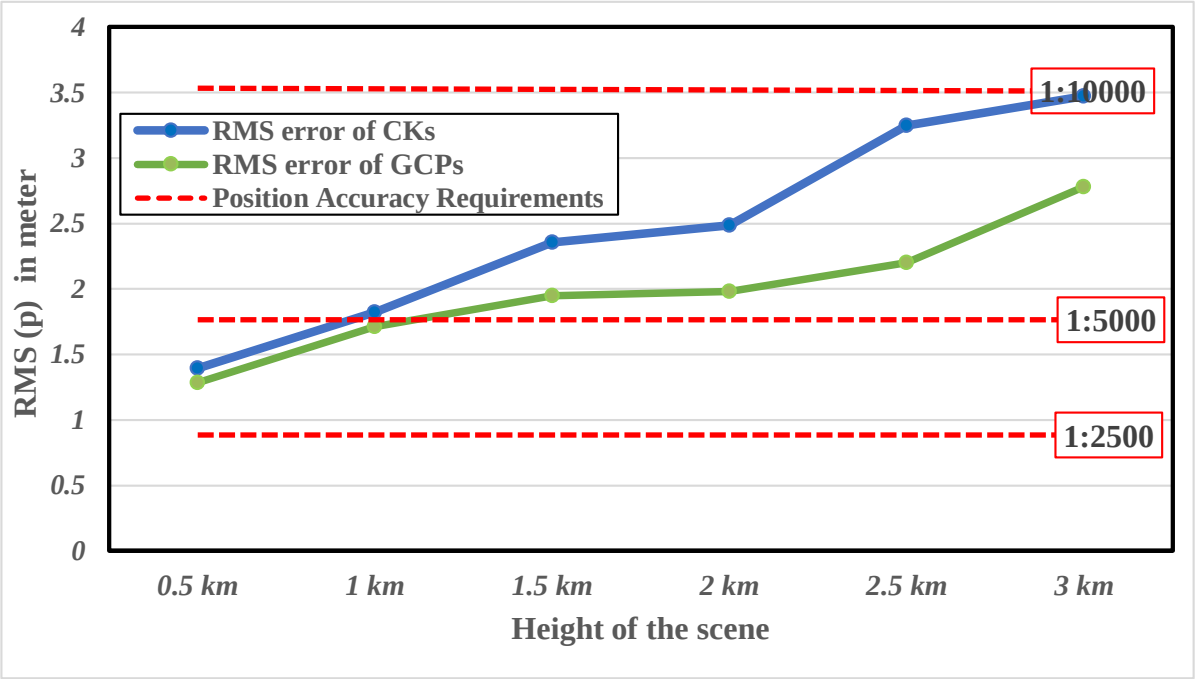

Figure (3): The relationship between RMS error at different height of the scene and position accuracy requirements for different maps

CONCLUSIONS

This issue presents an overall evaluation of the planimetric positional accuracy of Google Earth imagery in a certain study area. These images were taken from different height of the scene. According to the obtained results and analysis; some conclusions can be summarized and enumerated as:

- Google Earth represents a huge and effective source of positional data that can be used for implementing and initiative studies with convenient accuracy and low cost.
- The planimetric accuracy gets worse with increasing the height of the scene.
- The planimetric positional accuracy of Google Earth imagery for a certain study area, located in Alexandria, leads to a corresponding accuracy of 3.47 m. This accuracy can successfully be used to derive planimetric maps of scale of 1: 10000 when taking image from Google Earth at a height of scene less than 3 km.

REFERENCES

[1] Flanagin, A, J; Metzger, M, J., (2008). The credibility of volunteered geographic information. GeoJournal, 72, 137-148.

[2] M.F.Goodchild ; H.Guo;A.Annoni ; L.Blan ; K.Debie ; F.Campbell ; M.CRAGLIA ; M.Ehlersg ; J.Van Genderen ; D.Jackson ; A.J. Lewis ; M.Pesaresi ; G.Remetey – FÜLÖPP ; R. Simpson ; A.Skidmore ; C.Wang ; P. Woodgate ,(2012). Next generation Digital Earth. Proceedings of the National Academy of Sciences of the United States of America, 109 (28), 11088–11094.

[3] American Society for Photogrammetry and Remote Sensing (ASPRS) (2013), ASPRS Accuracy Standards for Digital Geospatial Data (DRAFT), PE&RS, December 2013, pp 1073-1085.

[4] Potere, D., (2008). Horizontal positional accuracy of Google Earth's high-resolution imagery archive. Sensors, 8, 7973-7981.

[5] YU, L.; Gong, P., (2012). Google Earth as a virtual globe tool for Earth science applications at the global scale: progress and perspectives. International Journal of Remote Sensing, 33(12), 3966-3986.

[6] Ragheb.E.A. Ragab.F.A, (2015) "Enhancement of Google Earth Positional Accuracy" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181. IJERTV4IS010732

[7] Elgohary, .Z. (2011).Assessment Of Horizontal Positional Accuracy of Google Earth Imagery. Journal of Babylon University/Pure and Applied Sciences/ No.(2)/ Vol.(19): 2011 http://repository.uobabylon.edu.iq/journal.aspx?dpp=175

[8] Becek, K.; Ibrahim, K. (2011). On the positional accuracy of the Googleearth® imagery. TS05I - Spatial Information Processing Ipaper no. 4947. In: FIG Working Week 2011, Marrakech, Morocco, 18-22 May 2011.

[9] Mohammed, N; Ghazi, A and Mustafa, H (2013) "Positional accuracy testing of Google Earth", International Journal of Multidisciplinary Sciences and Engineering, Vol. 4, No. 6.