Magnetic Anomaly at Selected Region in Kufa City, Iraq

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ABSTRACT— ***In this work numerical simulation of the Earth's magnetic field at Kufa city, Iraq has developed using WMM model. The geodetic coordinates in this area in WMM2005 and WMM2010 programs are used. High anomaly value in all components of the Earth's magnetic field in the Jemaah blosh region is discovered. Typical results of the total magnetic field in this area found in the minimum magnitude (45708 NT) and maximum (45700 NT). This anomaly can be attributed oil or cracking in the Earth's. This area is examined for nine years (2005 to 2013). The results showed that the anomaly increased as linear relationship.***

Keywords—WMM 2005, WMM 2010, geomagnetic anomaly, contour maps

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1. INTRODUCTION

Jemaah blosh is vegetation and sandy region located between Al Sahla Mosque and the West Bank of Euphrates River in Kufa city of 180 km south-west of Baghdad, Iraq. It is situated between latitudes (32.02^o N, 32.05^o N) and longitudes (44.02^o E, 44.50^o E). The magnetic survey shows a sharp deviation of magnetic force lines. This anomaly may be attributed to the existence of iron or oil. Bilim and Ates (2004) found the gravity and aeromagnetic anomalies in a local area of North Turkey [1]. DI Chuan-Zhi et al. (2011) measured the magnetic field at 74 sampling sites in Philippines of duration 2001 to 2007 [2]. Vujic and Verbanac (2008) and Giuliana (2011) performed a ground survey of total magnetic field intensity and the behavior of geomagnetic field in Croatia [3, 4]. Zagar and Radovan (2012) presented a polynomial model of magnetic declination in Slovenia and this model is compared with the World Magnetic Model (WMM) [5]. In this paper, the region divided into grid points with same distances between two adjacent points. A magnetic survey in this region performed using the simulation model (WMM).

2. THEORY MODEL

The study area is surveyed using the World Magnetic Model (WMM). This model can be applied for magnetic survey in air, sea navigation systems, and ground. The WMM is a model of the Earth's magnetic field, that portion of the field generated in the Earth's core. The magnetic field is modeled as the negative gradient of a scalar potential V, which represented by

$$V(r,\theta,\emptyset,t) = a\sum_{n=1}^{N}\sum_{m=0}^{n}\left(\frac{a}{r}\right)^{n+1}[g_n^m(t)\cos m\,\emptyset + h_n^m(t)\sin m\emptyset] \times P_n^m(\cos\theta) \quad (1)$$

where a = the radius (6371.2 km), $(r,\theta,\emptyset)$= geographic coordinates, r = the distance from the center of Earth in km, θ = the co-latitude, $\emptyset$ = the longitude, P_n^m = the Schmidt Quasi-Normalized associated Legendre functions of degree (n) and order (m), the coefficients g_n^m and h_n^m = the Gauss coefficients, and N = the maximum degree and order of internal expansion, where N = 50 [6] [7] [8].

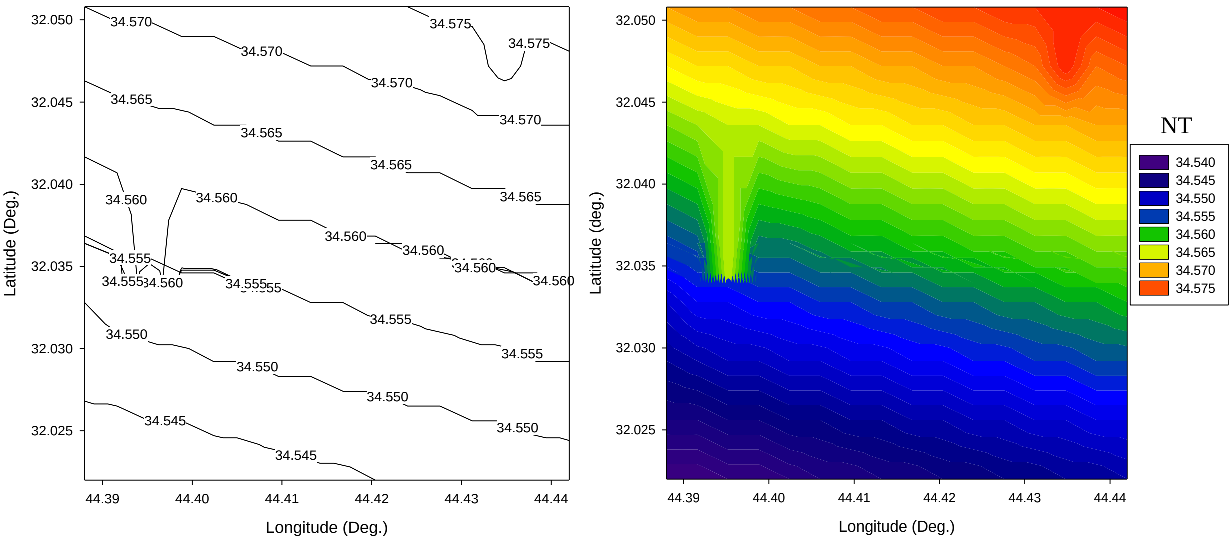
$$g_n^m(t) = g_n^m + \dot{g}_n^m \times (t - t_o) + \frac{1}{2}\ddot{g}_n^m(t - t_o)^2 \quad (2)$$

$$h_n^m(t) = h_n^m + \dot{h}_n^m \times (t - t_o) + \frac{1}{2}\ddot{h}_n^m(t - t_o)^2 \quad (3)$$

where $\dot{g}_n^m$ and $\dot{h}_n^m$ represent the Gauss coefficients for the secular variation, the time is given in year and t_0 = the epoch of the main-field model, and t = the required time ($t_0 \leq t \leq t_0 + 5$) [9][10].

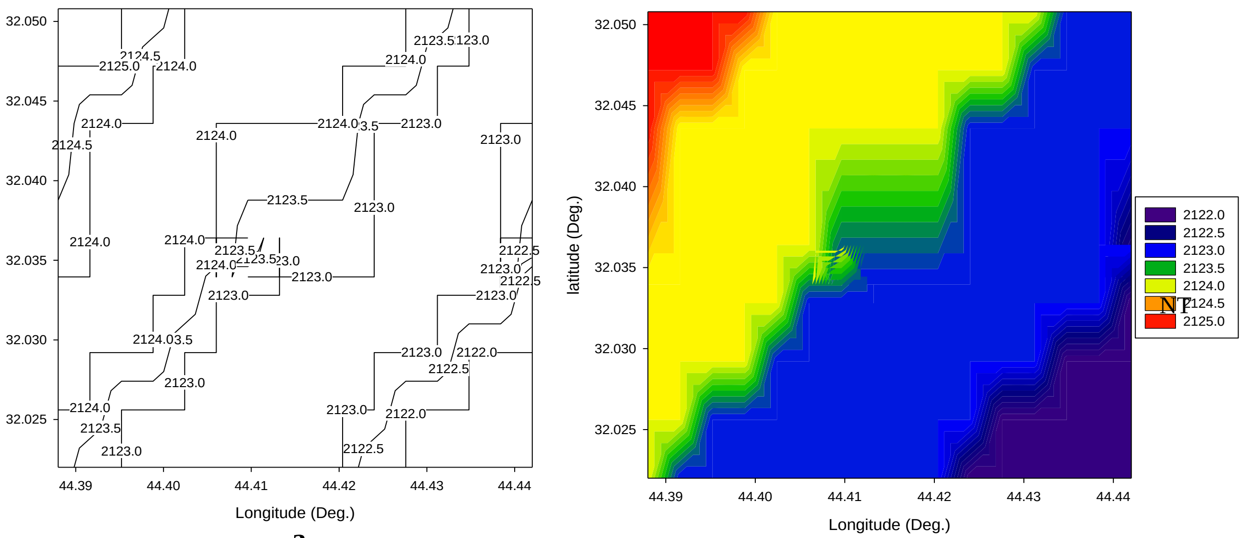
3. RESULTS AND DISCUSSION

In this paper the results obtained in the form of contour map for each component of the Earth's magnetic field. The WMM 2005 and WMM 2010 Programs used to calculate the magnetic field parameters (total intensity, horizontal field strength, north, east, downward components, declination, and an inclination with the coordinates (longitude, latitude, above mean sea level, and the time zone)). Fig. 1a shows the downward component (Z) of the geomagnetic field. Fig. 1a appears a sharp deviation of two lines of isomagnetics fields values (34560 NT and 34555 NT). Similar results can be found in Fig. 1b, where the contour map shows the anomaly. Fig. 2a shows the anomaly in East component in the same area. Fig. 2b shows three lines of forces deviated from mean values of 2124.0 NT and 2123.5 NT. Fig. 2b shows lines of latitude 32.035, longitude 44.395, and altitude 56 m. Figs. 3a, b explain the North component and anomaly in the values of 29842 NT and 29840 NT. Figs 4a, b show the horizontal component, where the values 29918 NT and 29916 NT are limited. This area is the same inclination components of 49.00125^o and 49.00120^o as shown in Figs. 5a, b. Fig. 6 shows the declination component (D). From Fig. 6 noticed that there is no noticeable change in the lines of force. The total component of magnetic field appears in the Fig. 7a, b and in the same study area at values of 45708 NT and 45700 NT. The estimated anomalies in the study area plotted for nine years (2005 to 2013), as shown in Fig. 8. It found that there is a linear increase of anomaly with increasing time intervals. This can be attributed to the solar and geomagnetic activities in the study area.



a b

Figure 1: Dawn component (Z)



a b

Figure 2: East component (Y)

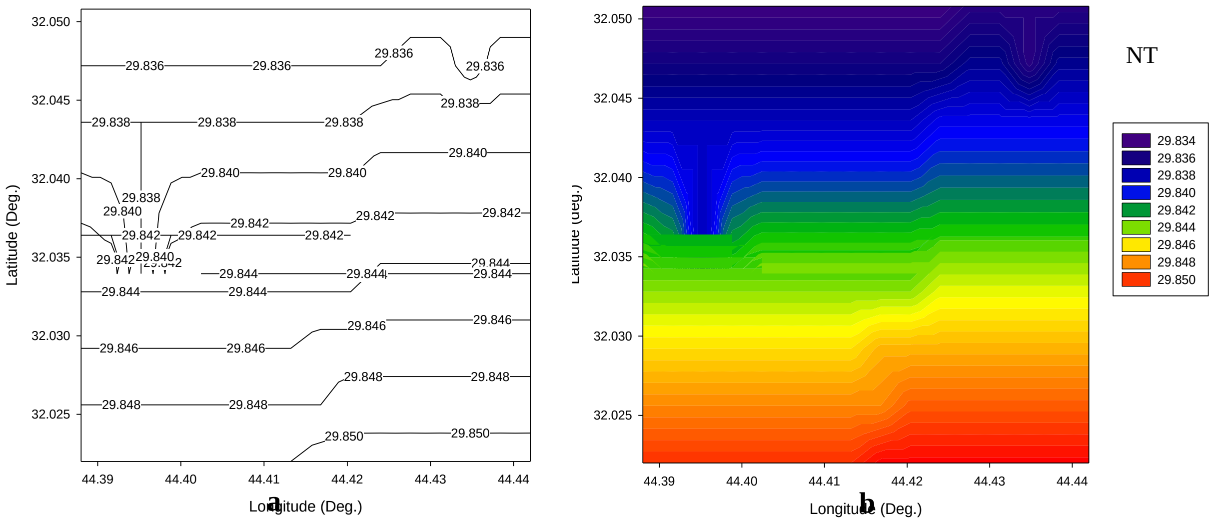


Figure 3: North component (X).

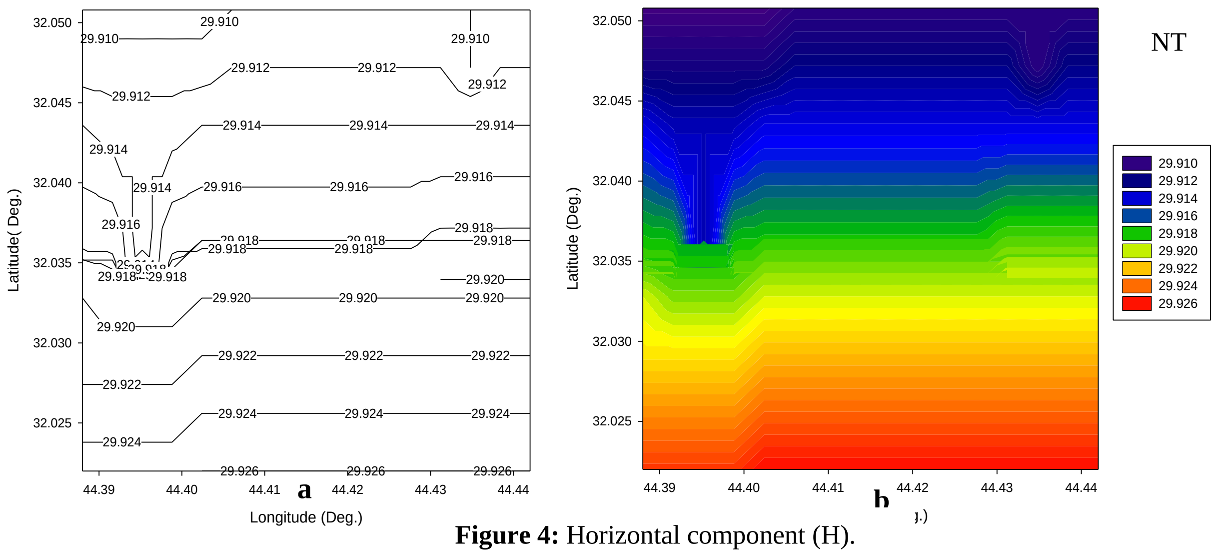


Figure 4: Horizontal component (H).

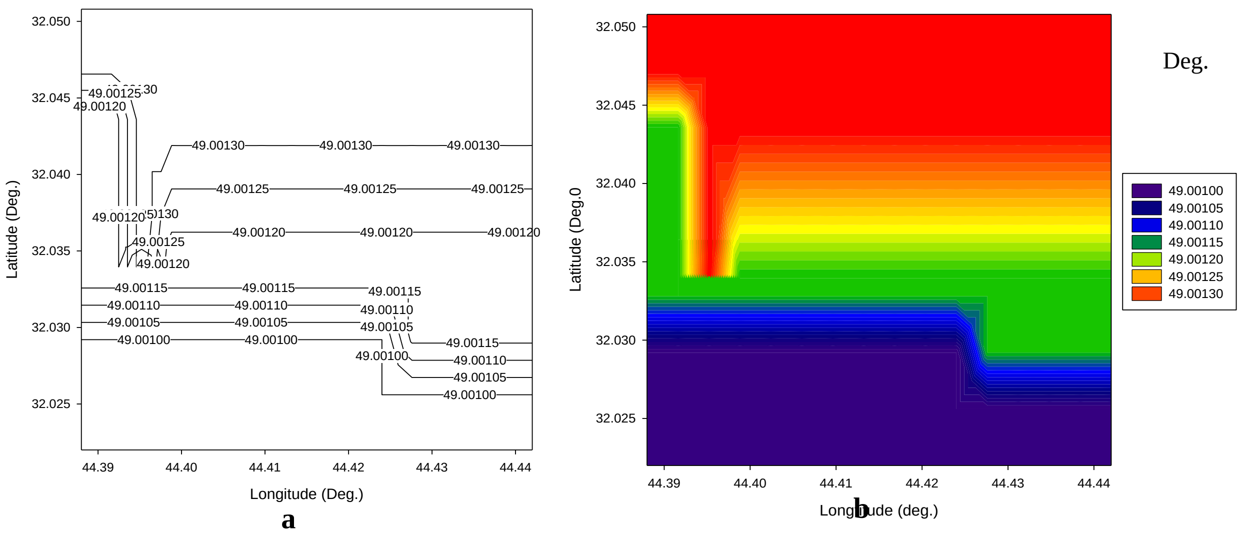


Figure 5: Inclination component (I)

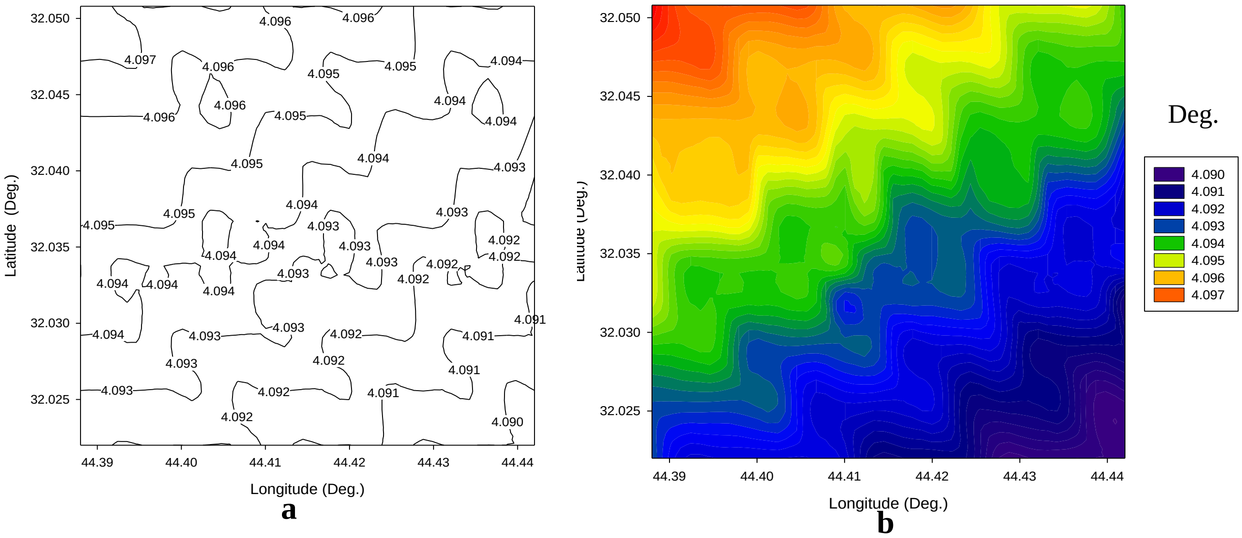
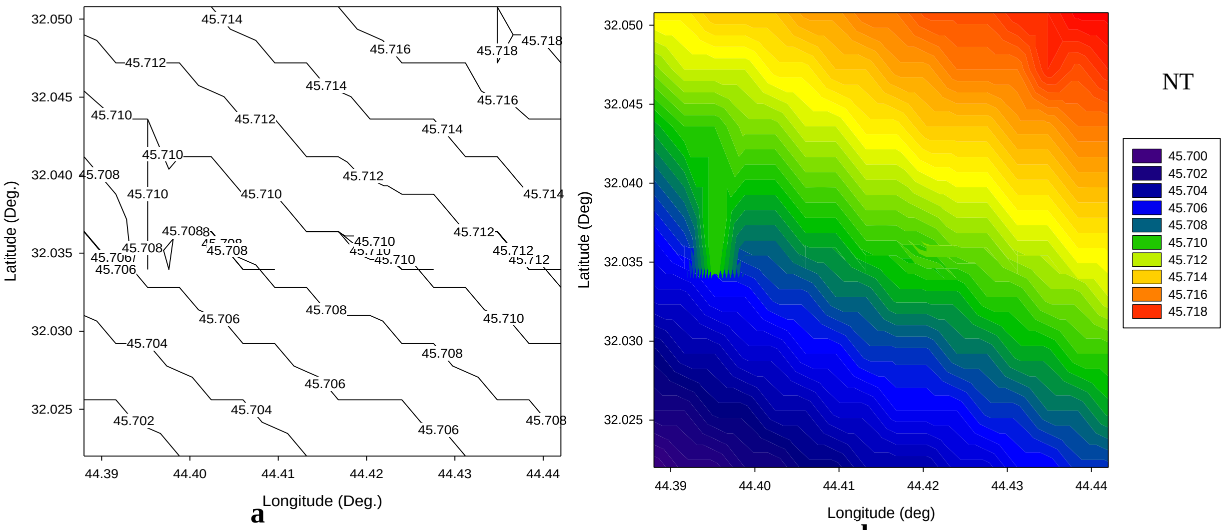


Figure 6: Declination Component (D)



b

Figure 7: The total component (F)

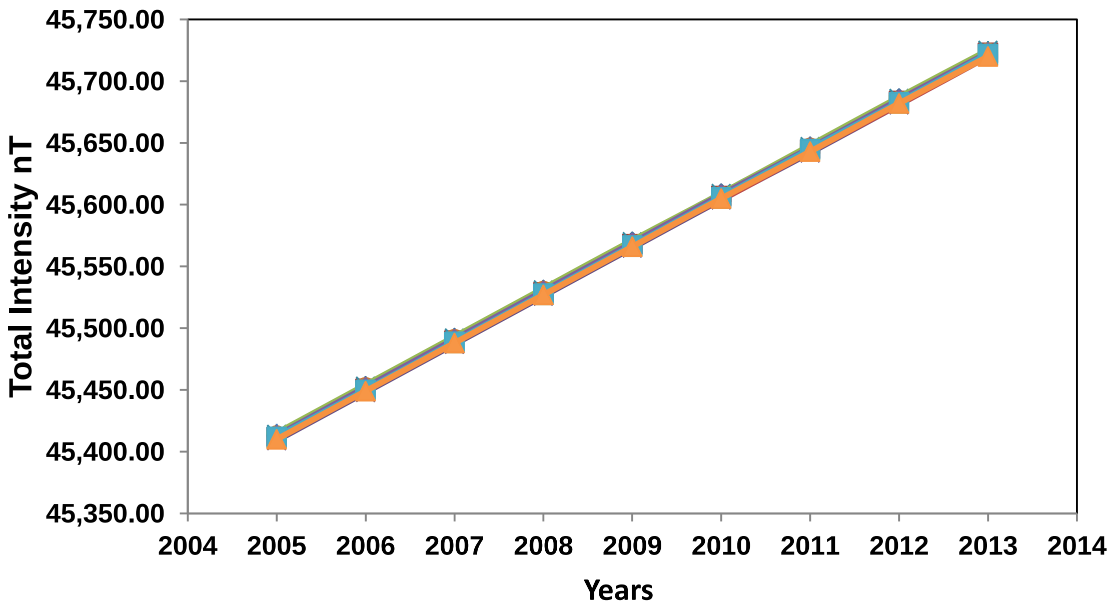


Figure 8: The total intensity versus years

4. CONCLUSIONS

Contour maps for each component of the Earth's magnetic field in study area plotted. The results show that the magnetic anomaly in this area has minimum (45700 NT) and maximum (45708 NT) fields. These anomalies may be attributed to the existence of ferromagnetic rocks or oil. However, this area needs further experimental and theoretical works.

5. ACKNOWLEDGEMENT

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6. REFERENCES

[1] Bilim F., A. Ates, “Estimation of the paleopole positions from potential field anomalies of a local area in northern central Turkey’’, Journal of Balkan Geophysical Society, 7, 2, 12 – 22, 2004.
[2] DI Chuan-Zhi, GU Zuo-Wen, B. M. Soriano, C. Bin Carina G. Lao, Zhang Yi, XIN Chang-J., GAO Jin-T, “The study of magnetic field models for Philippines and its neighboring regions’’, Chinese Journal of Geophysics, 54, 4, 508-515, 2011.
[3] Vujic E., Verbanac G., “Geomagnetic Field in Croatia – The New results’’, MGB, 101-109, 2008.
[4] Giuliana V., “Modeling the geomagnetic field over Croatia’’, Geofizika, 28, 2011.
[5] Zagar T., D. Radovan, “The model of magnetic declination of Slovenia. Geodetski vestnik’’, 56/2, 2012.
[6] Mohammad Nizam Filipski, Renuganth Varatharajoo, “Earth magnetic field model for satellite navigation at equatorial vicinity’’, Jurnal Mekanikal, 23, 31 - 39, 2007.
[7] Mohammad Jafar Al-bermani, Jamal Nasser Al-Obeidi, Amer Atyah Laftah, “Simulation of earth geomagnetic field at an-Najaf governorate by using IGRF model’’, Asian Transactions on Basic and Applied Sciences (ATBAS ISSN: 2221-4291), 2, 6, 2013.
[8] Benoit Langlais and Mioara Mandea, “An IGRF candidate main geomagnetic field model for epoch 2000 and a secular variation model for 2000-2005’’, Earth Planets Space, 52, 1137-1148, 2000.
[9] Julio C. Gianibelli, Jacqueline Köhn, Marta E. Ghidella, “Testing geomagnetic reference field models for 1990-2000 with data from the Trelew geomagnetic observatory, Argentina’’. Geofísica Internacional, 42, 4, 635-639, 2003.
[10] Vincent Lesur, Susan Macmillan, Alan Thomson, “The BGS magnetic field candidate models for the 10th generation IGRF’’. Earth Planets Space, 57, 1157–1163, 2005.