
THE EARTH GRAVITY BETWEEN REGION OF NAJAF AND KUFA CITY IN IRAQ

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ABSTRACT: *In this paper had study the earth gravity between Najaf and Kufa city/ Iraq (latitude $32.5 - 33.5^0$), and calculated the earth gravity for altitude (30-60 m) for troposphere layer (60-1030m) above sea level. the result explained the earth gravity in this region was less then comparing with sea level, and found new model for earth gravity with altitude was very agreement with the paper words.*

KEYWORDS: The Earth gravity, Najaf and Kufa city

INTRODUCTION

Historically, gravity has played a central role in studies of dynamic processes in the Earth's interior and is also important in exploration geophysics. The concept of gravity is relatively simple, high precision measurements of the gravity field are inexpensive and quick, and spatial variations in the gravitational acceleration give important information about the dynamical state of Earth [1]. Tracking data from some tens of satellites at different altitudes and orbit inclinations have over the last three decades gradually improved the knowledge of the Earth's gravity field[2]. The limitations are due to the attenuation of the gravitational signal with altitude, the sparse tracking data coverage and the difficulties in modeling the non-gravitational forces for most of the satellites [3]

However, the study of the gravity of Earth is not easy since many corrections have to be made to isolate the small signal due to dynamic processes, and the underlying theory although perhaps more elegant than, for instance, in seismology is complex[2,4]. The gravitational field of the Earth has been mapped by several techniques, including analyses of satellite tracking data, terrestrial measurement campaigns, and satellite altimetry of the ocean surface [5]. Recently, the Earth gravity has been a significant subject of studies about its impact on the topography of the Earth in which there are several hypotheses determine the Earth gravity Such as study at Syowa Station, Antarctica, Nigeria and The North American[6,7,8].

Theory of the Earth gravity:

The gravity on the ellipsoid can be derived from the gravitational potential U:

$$U = \frac{GM}{r} + \frac{GMa^2}{r^3} J_2 \left[\frac{3}{2} \sin^2 \phi - \frac{1}{2} \right] - \frac{1}{2} \omega^2 r^2 \cos^2 \phi \dots \dots \dots (1)$$

Where: G, M, ω are the gravitational constant, mass of the earth and the angular speed of the earth rotation respectively. The second term in equation (1) is due to spheroidal shape of the earth. J_2 is a constant determined by the distribution of mass and the term in bracket is the second degree harmonic giving the spheroidal shape. The third term is the centrifugal potential and r is the radius of the spheroid and varies with geographic latitude, ϕ according to:

$$r(\phi) = a(1 - f \sin^2 \phi) \dots \dots \dots (2)$$

a is the radius of the earth and f is represented the flattening of the earth.

So the ellipsoidal model can now be written for GRS30, GRS1967, GRS80 and WGS84. Thus,

$$g_o = 9.78049(1 + 0.0052884 \sin^2 \phi - 0.0000059 \sin^2 2\phi) \dots \dots \dots (\text{GRS30}) \dots \dots \dots (3)$$

$$g_o = 9.78031846(1 + 0.0053024 \sin^2 \phi - 0.0000058 \sin^2 2\phi) \dots \dots \dots (\text{GRS1967}) \dots \dots \dots (4)$$

$$g_o = 9.7803267714 \left\{ \frac{1 + 0.00193185138639 \sin^2 \phi}{\sqrt{1 - 0.00669437999013 \sin^2 \phi}} \right\} \dots \dots \dots (\text{GRS80}) \dots \dots \dots (5)$$

$$g_o = 9.7803185(1 + 0.00527889 \sin^2 \phi + 0.000023462 \sin^4 \phi) \dots \dots \dots (\text{WGS84}) \dots \dots \dots (6)$$

where g_o is called normal gravity. The variation due to Earth's rotation is on the order of $\pm 0.03 \text{ m/s}^2$ [7,9,10].

The inverse-square law of gravitation provides an expression for (g) as a function of altitude with sufficient accuracy for most model-atmosphere computations [11]:

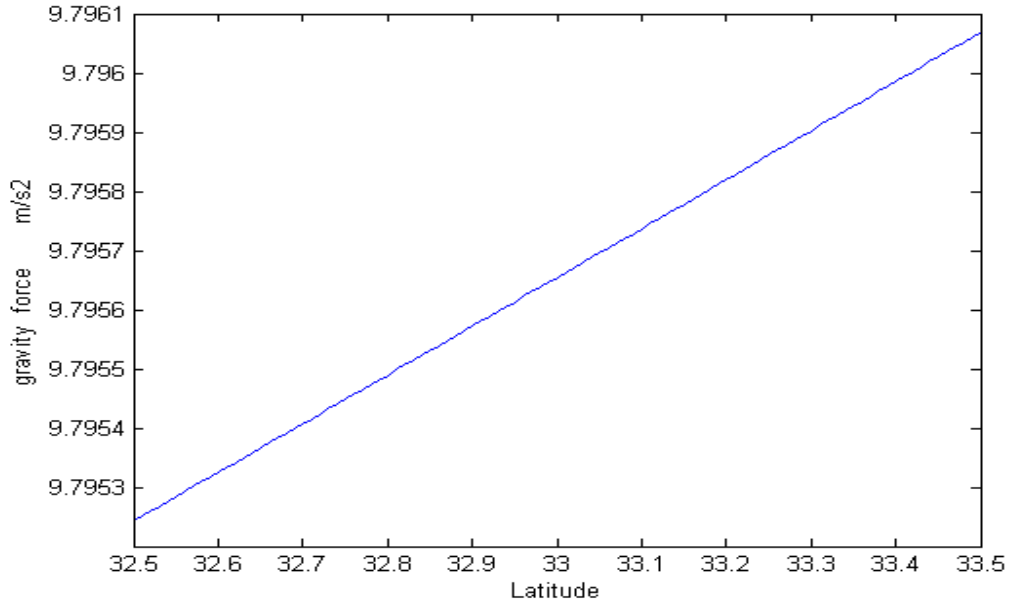
$$g = g_o \frac{r}{r+a} \dots \dots \dots (7)$$

where a is altitude

RESULTS AND DISCUSSION

In this paper calculate The Earth gravity between region of Najaf and Kufa city in Iraq (latitude 33.5^0 - 32.5^0 , longitude 44.5^0 - 45.5^0 and altitude 30m in Kufa and 60m in Najaf city above sea level) by using matlab program where found the earth gravity between this reign (latitude 33.5^0 - 32.5^0) from 9.7953 m/s^2 to 9.793 m/s^2 see fig.(1). and the Earth gravity calculated from altitude 30m to 1030m in tropospheric layer in the same region see fig.(2) also we found the gravity for altitude from 30 to 60m (between region of Najaf and Kufa city) from 9.806562 m/s^2 to 9.8064665 m/s^2

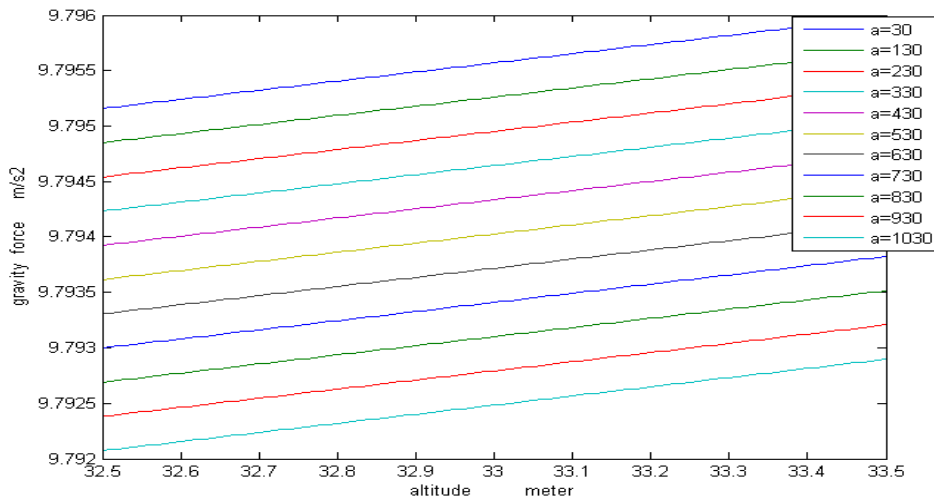
see fig. (3). From this study we found the gravity is less than the earth gravity in sea level fig.(4). The earth gravity is effect on the topography of earth so the study of the gravity is very important



in geographic earth.

Fig. (1): The earth gravity between the latitude 33.5^o-32.5^o

Fig.(2): The Earth gravity from altitude 30m to 1030m in tropospheric layer



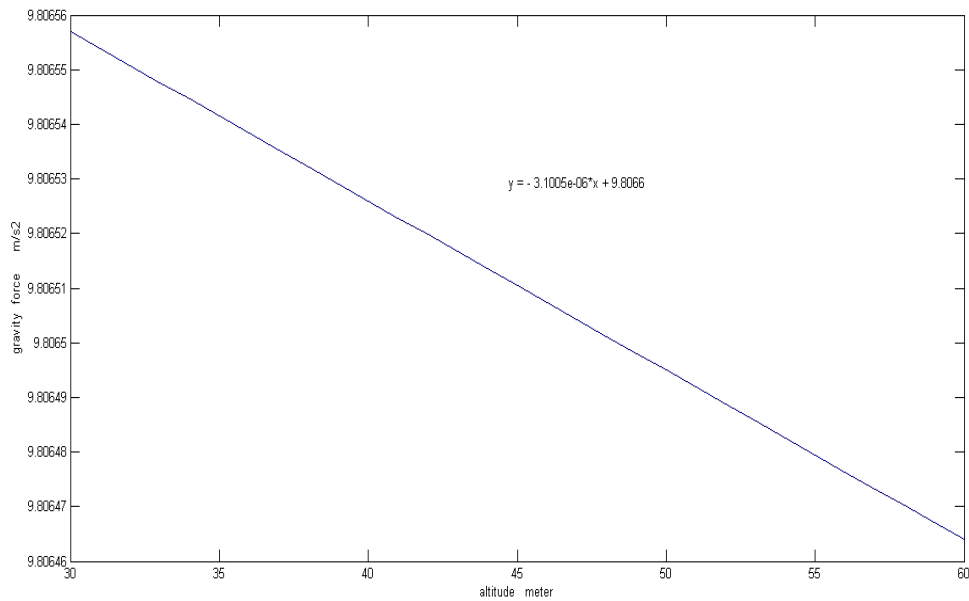


Fig. (3): The gravity for altitude from 30 to 60m between region of Najaf and Kufa city

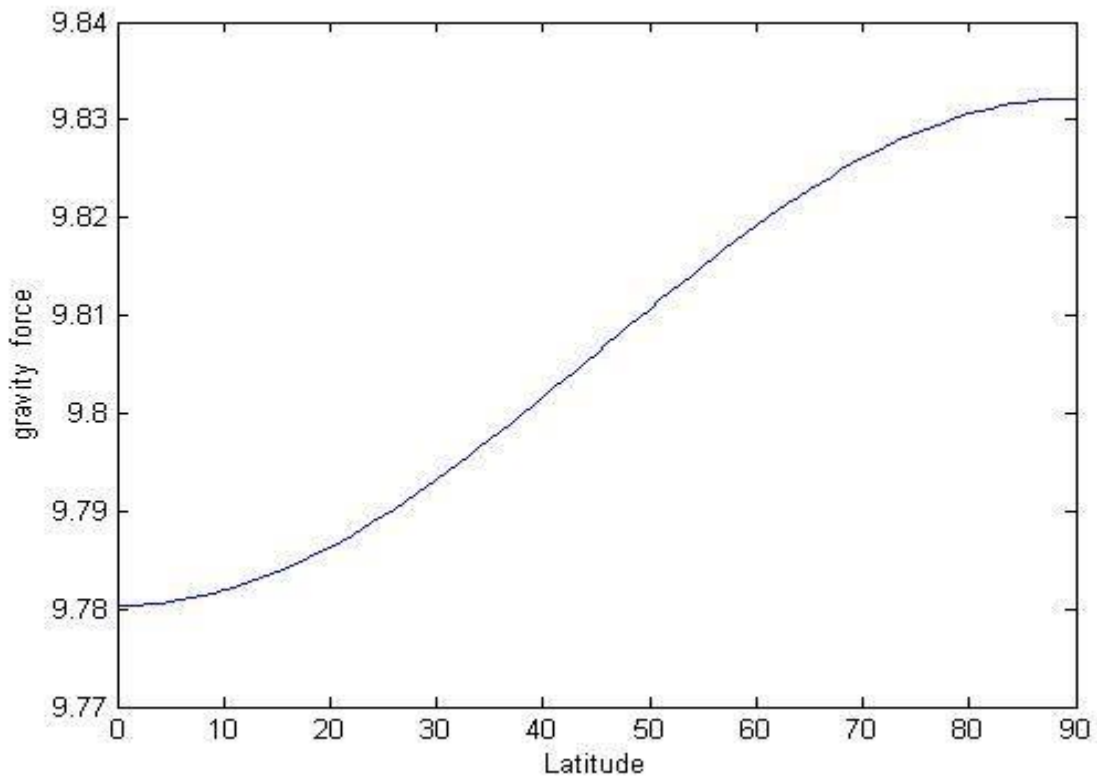


Fig.(4): The earth gravity in sea level

In this study found the new model:-

$$g_0 = 9.80665 (-3.1616 * 10^{-7}a + 1) \dots\dots\dots (8)$$

To calculate the gravity force where this eq. was very agreement with result of eq.(7).

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