THE WAISTLINE OF ROTATION

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A decrease in the rotational rate of the earth is expected to increase the equatorial radius of the earth. This postulate can be demonstrated by two different methods. The first of these examines the kinetic energy and inertial momentum of the earth as it relates to differentials, and the second will examine the problem from the viewpoint of conservation of angular momentum. It can be shown that the results expected are similar in each case, where a change of one second per year in the rotational rate of the earth leads to an expected increase in the earth's radius of approximately 4 to 8 inches. Greater changes in the rotational rate (current observations support a change of 12 seconds per year) result in correspondingly greater changes in the equatorial radius of the earth.

In conjunction with anomalous variations in time that are currently being reported, there is the recollection of a popular science article published by CNN on August 7, 2002 entitled, *Earth's Waistline Could Be Expanding*. This account summarizes an article published in Science magazine in that same week, where the following excerpts from the CNN article are provided as follows:

"The Earth's gravity field has bulged more in the middle in the past four years and scientists suspect that the same is true for the planet itself."

"The researchers say neither rising global sea levels nor faster glacial ice melting could produce such a sharp change in the gravity field measurements. Something else is moving mass from the high latitudes to the low latitudes nearer the Equator, causing a suspected bigger bulge around the middle".

"While understanding the precise shape of our planet and its gravity field may seem like esoteric endeavors, the data could have a profound impact on everything from weather forecasting to agriculture to making sure there is enough fresh water to support life."

It will be of further interest to examine the magnitude of this change within contemporary ellipsoid models that incorporate this latest data, and as it is reported in the Science journal. It is also of interest that the earth change recorded is noted primarily within the last four to five years; readers may also wish to be aware of the anomalous time measurements over this same period as recorded in the earlier articles, Time, Time To Start Watching Time and Time, Energy and Earth Changes.

The question of rotational rate change as it corresponds to earth shape changes is to be equally considered, as there now is observational data available to support the existence of both. In addition to these considerations, a discussion has been provided on the expected tremendous kinetic energy changes (and expected geophysical changes that result) associated with small changes in the earth's rotational rate, i.e., time.

Additional fields that are under further examination include the magnetic field of the earth, either natural or affected artificially, the gravity field and the atmospheric pressure of the earth. The current work assumes a homogeneous sphere as a first approximation to the problem.

The remainder of this article is mathematical in nature, and will be provided below to those with a further interest.

Let us examine the differential method first.

The kinetic energy of the rotating earth can be approximated as[1]:

$$KE_r \text{ (approx)} = (1/5) * m * R^2 * w^2$$

where KE_r represents the kinetic energy of the rotating earth in Joules, m represents the mass of the earth in kilograms, R is the radius of as assumed spherical earth in meters, and *w* is the rotational rate of the earth in radians per second.

Let us solve this form for R:

$R^2 = (5 * KE_r) / (m * w^2)$

or

$R = ((5 * KE_r) / (m * w^2))^{1/2}$

therefore:

$dR / dw = (1 / 2) * ((5 * KE_r) / (m * w^2)^{-1/2} * (-2) * ((5 * KE_r) / m) * w^{-3}$

or in differential form:

$dR = ((-5 * KE_r) / (m * w^3)) * ((5 * KE_r) / (m * w^2))^{-1/2} * dw$

and substituting the values previously established[2], where

The mass of the earth is approximately 5.98E24 kg.

The mean radius of the earth is approximately 6371km.

The rotational rate of the earth, *w* (approx) = 7.272E-5 rad / sec.

KE_r (approx) = 2.567E29 Joules.

and d*w* in this case will the rotational rate change corresponding to a time change (decrease) of one second in one year:

d*w* = -(1 / 365) * (1 / 86400) * 7.272E-5 rad /sec.

or

d*w* = -2.306E-12 rad / sec.

this results in:

dR = -5.581E17 * (1.57E-7) * -2.306E-12 rad /sec.

leads to

dR = .202 meters

or

dR = 8 inches (approximate) increase corresponding to a one second time differential within one year.

Increases in time differentials beyond one second per year will lead to corresponding increases in the earth radius. Note: current observations indicate a time differential of approximately 12 seconds per year.

For the second method of estimating the increase in the radius of the earth that corresponds to a decrease in the rotational rate, let us use the principle of conservation of angular momentum. The reader is referred to problem number 341 of Fogiel[3] for the necessary background in the formulation of this approach.

In our case, we are led to:

$$w_f = w_o / (1 - (dx\% / 100))^2$$

where w_f is equal to the decreased angular velocity, w_o is the original angular velocity, and dx% is the change in the radius of the earth in terms of per cent.

or

$$dx\% / 100 = 1 - (w_o / w_f)^{1/2}$$

And if we again let dw correspond to a change of one second in one year, we have

$$w_f = w_o - dw$$

where w_o = 7.272E-5 rad / sec.

and

w_f = 7.272E-5 rad/sec - 2.306E-12 rad /sec.

then

w_f = 7.27199769E-5 rad / sec.

then

dx% / 100 = 1.59E-8

and the change in the radius of the earth will be:

dR = R * (dx% / 100) = 6371E3 meters * 1.59E-8 = .101 meters = 4 inches (approximate).

We are therefore led to a similar result as with the differential approach, with an estimated range of 4 to 8 inches increase in the equatorial radius per second per year. Any corrections will be made to this paper as is appropriate in the future.

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References:

1. Clifford E Carnicom, *Time, Energy and Earth Changes*, http://www.carnicom.com/time3.htm, 2003.
2. Carnicom, 2003.
3. Dr. M. Fogiel, *Problem Solvers Physics*, (Research and Education Association, 2000), 344.

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