GRAVITY CAUSES WEIGHT

Unit 8, Dr. John P. Cise,
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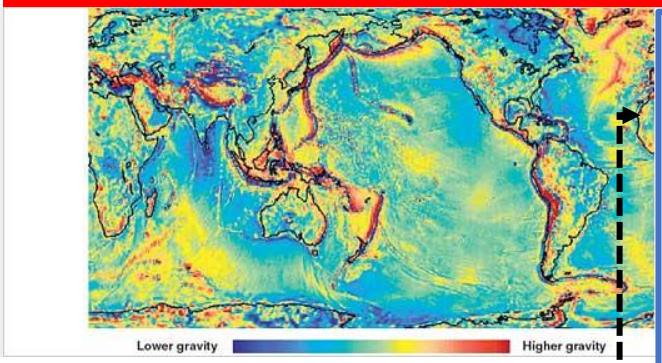
Before the '04 Tsunami, an Earthquake So Violent It Even Shook Gravity



GRAVITY'S RAINBOW Fluctuations in gravity occur across the planet. This map shows variances (less than one-thousandth percent of the Earth's total gravity) detected by Grace.

INTRODUCTION: With gravity (as stated here) dropping 1.5 X 10^{-6} % the goal is to verify article statement that a 150 lb. person would loose 1/25,000 oz.

HINTS: Percentage change in gravity: $[\Delta g/g]\ 100 = 1.5 \times 10^{-6}$ %

Change in weight: $\Delta W = \Delta g\ m$ where $W = m\ g$ or $m = W/g$

$\Delta W_{IN\ OUNCES} = [\Delta W_{POUNDS}]\ [16\ oz./lb.]$

g = 32 ft./s.^{2} , 16 oz./lb.

QUESTIONS: see below

The giant earthquake that set off a devastating tsunami across the Indian Ocean in December 2004 disrupted the earth enough to change gravity and to deflect satellites passing hundreds of miles above. Two identical satellites, collectively known as the Gravity Recovery and Climate Experiment, or Grace, travel one behind the other in a polar orbit separated by about 130 miles. By recording small changes in the distance between them when their orbits are deflected, the satellites provide data used to calculate variations in the earth's gravitational field. In a report in the current issue of the journal Science, scientists at Ohio State University and the University of California, Santa Barbara, report that in the aftermath of the **magnitude 9.1 earthquake, the largest in four decades,** Grace recorded **sudden drop in gravity near the quake's epicenter off Sumatra.** The rupture raised thousands of square miles of the seafloor, reducing the density of rocks in the earth's crust and diluting their gravitational pull. The data, combined with models of the earth's interior, indicate that the density changes extend hundreds of miles. "It really gives an insight of the earth's interior down to the mantle area," said Shin-Chan Han, an Ohio State research scientist and an author of the Science paper. It was the first time that the gravitational effect of an earthquake had been observed from space. **(((The gravity at the earth's surface decreased by as much as about 0.0000015 percent, meaning that a 150-pound person would experience a weight loss of about one-25,000th of an ounce.)))** In other places, where the force of the earthquake compressed rocks, gravity increased by a similar amount. The force of gravity is changing in other areas of the earth, too. In Hudson Bay, Canada, which was crushed downward by the weight of ice during the last ice age, the ground is still rebounding upward. That change adds about one-400,000th of an ounce to the weight of a 150-pound person every year.

QUESTIONS: (a) Find Δg (in ft./s.^{2}) when stated g is reduced 0.0000015 % (1.5 X 10^{-6} %) ? , (b) Find mass m of 150 lb. person? Mass units in English system are in slugs., (c) Find ΔW (in pound units) of a 150 lb person due to a 0.0000015 % decrease in gravitational attraction?, (d) Find ΔW in ounce units ?, (e) Convert the article stated weight loss of 1/25,000 ounce in fraction units to decimals?, (f) How well does your computed decrease in weight (due to less gravity) compare to article stated loss of 1/25,000 of a ounce for a 150 lb. person?

ANSWERS: (a) $\Delta g = -0.48 \times 10^{-6}$ ft./s.^{2} , (b) m = 4.68 slugs , (c) $\Delta W = -2.25 \times 10^{-6}$ lb., (d) $\Delta W = -36 \times 10^{-6}$ oz., (e) $\Delta W = -[1/25{,}000\ oz.] = -40 \times 10^{-6}$ oz. , (f) Wow! Quite close……good comparison. Dr. Cise, 2018