GEOL 695-Environmental Geodesy
Assignment #2 - Lectures 4-5
Resubmittal for Problems 9 & 7

Jay Goldfarb
3/31/11

(9.) To compute maximum equilibrium lunar tidal potential due to earth, in the equation

$$V = GM_b\left(\frac{1}{d} - \frac{1}{s} - \frac{r\cos\psi}{s^2}\right)$$

we must have

M_b = mass of earth

d = distance between earth and moon centers minus lunar radius

s = distance between earth and moon centers

r = radius of moon

ψ = geocentric zenith angle

(The last term in brackets above is counterintutive to me, but it will be negligible, so I will omit it from the calculations. It would make more sense to me if the cosine were replaced by a sine, or if the zenith angle were really an altitude.)

From http://www.ksc.nasa.gov/facts/faq04.html

6371 km (6400) -- Mean radius of Earth
1738 km (1700) -- Mean radius of Moon
3.986e14 m^3/s^2 (4e14) -- Gravitational constant times mass of Earth
4.903e12 m^3/s^2 (5e12) -- Gravitational constant times mass of Moon
384401 km (4e5) -- Mean Earth-Moon distance (s)

Inserting these values into the formula and neglecting the (counterintutive) last term, we get

$$V_{tide}^{moon} = 3.986\times 10^{14}\left(\frac{1}{384\,401\,000 - 1\,738\,000} - \frac{1}{384\,401\,000}\right)\frac{m^2}{s^2}$$

We'll compute the mean lunar gravity as

$$g_0^{moon} = \frac{GM_{moon}}{(\bar{r}_{moon})^2} = \frac{4.903\times 10^{12}}{(1\,738\,000)^2}\frac{m}{s^2}$$

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Putting these quantities together we get

$$\delta N_{tide}^{moon} = \frac{V_{tide}^{moon}}{g_0^{moon}} = 2\,900\,m$$ which seems quite large!!!

(7.) For the equilibrium tides on earth, we substitute the appropriate quantities:

$$V_{tide}^{earth} = 4.903 \times 10^{12} \left(\frac{1}{384\,401\,000 - 6\,371\,000} - \frac{1}{384\,401\,000} \right) \frac{m^2}{s^2}$$

$$g_0^{earth} = 9.807 \frac{m}{s^2}$$

$$\delta N_{tide}^{moon} = \frac{V_{tide}^{moon}}{g_0^{moon}} = 22\,m$$