SMS-303: Integrative marine sciences III.

Assignment #4

1. (Total points 36, 12pts for each subsection)
In the small tanks you sloshed water with water depths of 1.5cm and 6cm back and forth and found the number of sloshes as function of time.

a) Translate your results into the wave speeds (how fast did crest move from one side to the other). How did they compare with theory?

b) Was the ratio of the waves speed with 6cm depth and 1.5cm depth consistent with theory?

c) What is the natural (or intrinsic) period of the tank (1^{st} mode) at each depth? (hint: you should be able to calculate it using only the length of the tank (30.5cm) and the wave speeds computed above). This is analogous to a Seich.

d) (extra credit, 5pts) What is the intrinsic period of the North-South oriented Seich in Pushaw lake given an average depth of 20feet and a length of 4miles? Would the rotation of the Earth be an important factor for this Seich (how does the period of this seich compare with 1/f, where f is the Coriolis frequency from last week)?

2. (Total points 64. a. 14pts. b. 30pts and c. 20pts)
The effect of the sun on the tides in the Gulf of Maine (GOM).

The sun and the moon both contribute to the tides in the GOM, with the moon being the major contributor. For simplicity we will consider only two tidal components (M2-lunar and S2-solar) which often have the largest amplitude of all tidal components and which will be the major contributor were the moon, sun and earth all on the same plane perpendicular to the axis of rotation of the earth.

The elevation (in m) near Rockport, ME for the two tidal wave components is given by:
Lunar (M2): $1.2\cos(28.984t)$
Solar (S2): $0.3\cos(30t)$

Where t is in **hours** and the frequencies (28.984 & 30) are given in **degrees per hour** (not radians). At time t=0 the sun and the moon are at the same side relative to the earth (new moon).

a) Which component dominates the tidal amplitude?

b) Add the two components together on a spreadsheet and plot the resulting amplitude as function of time for a 28day lunar month (remember, t has to be in hours, 1 day = 24hours). Time step for the plot should be no longer than 3hours.

Annotate on your plot the different arrangement of the planets every 3.5 days. For example:

t=0

Pay attention to units and to the fact that programs such as excel assume radians in the argument of trigonometric functions.

c) Add the two tidal components using a trigonometric relationship for the addition of two sines (sin(A)+Sin(B)), by first breaking the lunar component to two parts one of which as the same amplitude as the solar component (you can find the appropriate formula at: http://www.sosmath.com/trig/Trig5/trig5/trig5.html). The phenomena you are describing is called beating, the interaction of two waves with slightly different frequencies. Explain your results in section b in light of what you have found.

d) (Extra credit, 5pts): What is the name of this phenomenon (the wave beating of lunar and solar tides) when applied to ocean tides?

Reference:
Applet on seich: http://www.coastal.udel.edu/faculty/rad/seiche.html
Applet on beating: http://www.surendranath.org/Applets/Waves/Beats/BeatsApplet.html
Tides: http://en.wikipedia.org/wiki/Tide

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