SMS-303: Integrative marine sciences III.

Assignment #2

Homework:

Login to the Boston Globe to an article published last Sunday:
http://www.boston.com/news/local/massachusetts/articles/2005/10/23/mass_among_states_backing_tidal_power_study/

This article discusses a study commissioned for the feasibility of using the tides of the Bay of Fundy to produce electricity.

1. What is the difference between the new method proposed to harness the tidal energy from that already in use for one power station in the Bay?

The old method involves damming a certain part of the bay. The new one involves current vanes much like wind mills on land. The effect on the currents in the vicinity is much reduced in the new approach.

2. Which of the two approaches is most likely to change the geometry of the basin when done in large scale? How can changing the geometry of the basin affect its tides (think about what we discussed in the wave lecture)?

The 'old' approach changes the geometry in the basin. Since the matching of frequency between the basin mode and the tides depends on the geometry of the basin (much like the size of a musical instrument) one risk changing the resonance interaction and thus the amplitude of the tide when dams are built.

3. Given (from the last class) that the flux of energy due to a wave per unit length of beach is given by the product of the group velocity (c_g) and the wave energy $\{(\rho g a^2)/2\}$, calculate the maximal amount of energy per tidal period for the one meter of beach (for the group velocity assume the length of the basin to be 270km and that it takes about 12hrs to propagate the whole length of the basin). Use a realistic amplitude based on what you found during today's class. How many 100W light bulbs can you light up per 1m of beach assuming you can convert all the tidal energy into electricity (conversion efficiency are usually only several percents)?

First let us establish the units we are working with Energy and work have units of Joules which is equal to Force [N=kg m s^{-2}] times distance [m] and thus J= kg m^2 s^{-2} (J stands for Joule). The units of c_g($\rho g a^2$)/2- m s^{-1} Kg m^{-3} m s^{-2} m^2 = kg m s^{-3} = J s^{-1} m^{-1}= W (watt) m^{-1} ← energy per unit time per 1m (of coast or wate).*

c_g=270km/12hr=6.25m s^{-1}.
Assuming a=5m, g=9.81m s^{-2}, ρ=1030kg m^{-3}, ($\rho g a^2$)/2=1.26e5.

$\rightarrow c_g*(\rho g a^2)/2 = 7.9x10^5 W\ m^{-1}$

$c_g*(\rho g a^2)/2$ ** 1m of beach/ 100W = 7.9 x10*^{3}*, about 8,000 100W bulbs.*

This page was last edited on 11/10/2005