

Homework Assignment #5 (Due in Class February 19)

- 1) Tides are most affected by the moon, which is very close to the Earth, and the sun, which is much further away, but very massive. Using the information below, what would be the effect (either the net tidal force, or a percentage of the moon's force) if Mars, Jupiter, Saturn and the sun all lined up with Earth (this is frequently cited as a "doomsday" time when the massive pull of the aligned planets will rip apart the earth...), such that their net force was additive.

Body	Distance from Earth	Mass
Moon	384,835 km	7.3×10^{19} metric tons
Earth	--	5.98×10^{21} metric tons
Mars	56.3×10^6 km	0.11x Earth
Jupiter	588×10^6 km	318x Earth
Saturn	1.2×10^9 km	95x Earth

- 2) Waves from separate sea areas (A and B) meet outside of Santa Cruz harbor. If the waves from area A are 1.5 m, and the waves from area B are 2.5 m, what would the resulting height be if the wave patterns were subject to constructive interference? What would the height be if they were destructive? If the wavelength of the resulting constructive wave were 15 meters, at what depth would the wave go from a deep-water to transitional wave? At what depth would it become a shallow-water wave?
- 3) Explain the difference between the PDO and ENSO. What happens when these two oscillations align, such as occurred in 1997 (in other words, do they interact, and if so, how?)
- 4) In 2004, the Banda Aceh tsunami was calculated (based on satellite altimetry) as having a wavelength (L) of 430 km, and a period (T) of 37 minutes. Based on that information, is this wave likely to be a deep- or shallow-water wave? What is the speed (C)? If you assume that it is a deep-water wave, what would its speed be if you only used the wavelength (L) and one of the formulas from the chapter or notes? If there's a difference between the two numbers, explain why the speeds do not match.
- 5) After the tsunami event in Southeast Asia, there has been renewed interest in developing a warning system for the world's oceans, similar to what exists in the Pacific. Based on your understanding of tsunamis and waves in general, describe how you would go about designing this warning system. As part of your answer, describe a tsunami using the terms we covered in class (so what is its approximate expected wavelength, speed, etc)? Would your warning system also predict the occurrence of rogue waves?

Extra Credit (2+2 points):

For 2 points, draw a picture of the surface circulation of the North Atlantic ocean, with the major currents labeled. Describe the difference (if any) between the eastern and western boundary currents. For an extra 2 points, draw a cross-section of the surface height of the Atlantic, at roughly 40° N (east coast to Portugal). Explain in terms of geostrophic balance, coriolis, and vorticity why you drew it the way you did, and make sure that it matches how you described the surface circulation.