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Geol 495

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Homework 2

Lectures 4-5

Problem 1: The key physical constants related to gravitation and the gravity field of a planet are the gravitational contstant (or “big G”) and the forces that give a mass weight (or “little g”). Little g is a localized phenomenon, and so can be measured precisely. Big G, however, is not well known, or at least not constrained with total certainty. This goes along with Newton’s universal law of gravitation.

Problem 2: ***U = mV***, or the gravity potential; where V is the gravity potential, U is the potential energy, and m is the mass. ***ΔU = mgΔh*** where the potential energy changes relative to differences or changes in height. V = -\frac{GM}{x}, for the potential (V) at a distance (x) from a point mass (M). |\mathbf{a}| = \frac{GM}{x^2}. is the gravitational potential with a small moving body, and V(\mathbf{x}) = \sum_{i=1}^n -\frac{Gm_i}{|\mathbf{x} - \mathbf{x_i}|}. is the potential energy over a mass distribution. There are several more derivations of the equation depending on what you are trying to measure.

Problem 3: The Geoid can differ from the reference ellipsoid by up to +/- 100 meters, however with increasing advances in technology these differences can be minimized. The differences occur because the surface of the Earth is affected by gravity, and these gravity variations come from differences in the Earth below the crust, ie mantle convection, etc.

Problem 4: The origin of tides comes from the inter gravitational play between the Sun, the Earth, and the Moon. In more general terms, tides come from interacting gravitational forces of two or more free floating bodies.

Problem 5: We see ocean tides because of the same reason that we see any tidal forces or reactions. Ocean tides come slightly delayed to the forces acting upon them, however, due to different circumstances such as shape of ocean basins, friction along ocean bottoms, as well as the Earth’s rotation, etc.

Problem 6: As alluded to in the previous question, there is local variability in any location on the Earth’s surface. This includes short term variability (such as local climate and weather patterns) as well as longer term variability (such as shape of ocean basins, local topography, and local gravity field conditions). It also has to do with the rotation of the Earth and the distribution of its mass and rotational velocities from the equator to the poles.

Problem 7: The largest tides on Earth are Spring tides, because this is when the Moon and Sun occur in a straight line, causing the tidal bulges created by the Sun and Moon to interact constructively and creating a larger tide. The largest of the Spring tides occur in what is called proxigean spring tide, or when the Moon is closest to the Earth, which can cause the tides to be more than 20% larger than they would normally be.

Problem 8: The Moon keeps the same face towards the Earth because the tidal bulge inflicted on the solid Moon by the Earth has subsequently slowed the Moon’s rotation over time, and eventually the Moon became “locked” into place.

Problem 9: The tidal bulge of the Moon is greater than 50cm.

Problem 10: The main rotational eigenmodes of the Earth are the Chandler Wobble and the nearly diurnal free wobble. They are mainly attributed to the mantle and core of the Earth.