



According to geophysicist Richard Gross at NASA's Jet Propulsion Laboratory in Pasadena, California, the March 11, 2011 Japan Quake caused the rotation of Earth to speed up by about 1.8 millionths of a second (that's 0.0000018 seconds). This doesn't sound like much, but in today's high-tech world where time is regularly measured in billionths of a second, this is a huge change!

The reason this happens is similar to a spinning ice skater pulling in her arms during a spin. The mass in her hands brought closer to her spin axis causes her to spin faster in order to conserve momentum. Earthquakes may move mass, like the island of Japan, slightly closer to the center of Earth and so it will also spin up to conserve momentum. Japan was moved around by nearly 4 meters, which changed the way matter was distributed in Earth's crust (the ice skater's hands) in a significant way. How does this work? Here is a simple model.

**Problem 1** - The formula for the angular momentum of a uniform sphere is just

$$J = \frac{2}{5}Mr^2\omega$$

If the mass,  $M$ , is conserved and the angular momentum,  $J$ , is conserved, what is the formula for the initial radius,  $r$ , and angular velocity,  $\omega$ , compared to the final radius and angular velocity?

**Problem 2** - If the Earth rotates  $2\pi$  radians in exactly 24 hours, with a radius of 6378.00 km, what will its final angular velocity be in radians/sec, after it has shrunk by 1.00 kilometer?

**Problem 3** - What will be the difference in its rotation period in seconds?