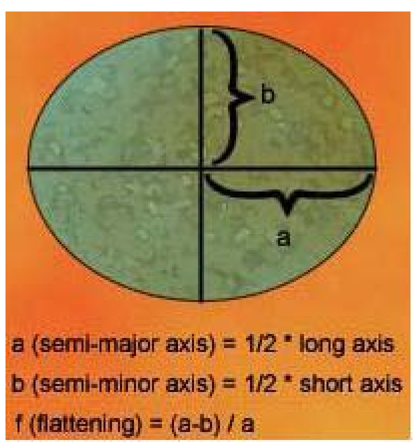
Are You Oblate?

As some of you know, I had the opportunity to spend about 8 years in St. Louis, Missouri working for what was then called the Defense Mapping Agency Aerospace Center (DMAAC). This was of course during the Reagan years, and I thought at the time that it was a great idea to pick up additional cartographic skills by working for the Defense Department. (They are now known as the National Geospatial-Intelligence Agency … and many of my friends there are either retired or about to, which makes me wonder why I left.)

One of the things I was exposed to in greater depth was this science of geodesy, which was not well covered at the undergraduate or graduate level in those days of manual cartography. There are a number of excellent resources that will define the science of geodesy, but essentially it is the measurement and representation of the Earth and its gravitational field. Sounds a lot like cartography!

One of the things I decided to do with my introductory physical geography courses was to spend a portion of one lab building the basic representative ellipsoid, or the mathematical model of the Earth's shape. Nothing too complex, just simple "flattening" mathematics and application of the concept to introduce Earth shape modeling.

As geographers know, the actual shape of the Earth is something more irregular than a simple spheroid. Creating a model of the Earth shape, one will use the three parameters of the reference ellipsoid (a,b,f). With two known parameters, the third missing parameter can be determined mathematically. Flattening can be computed by taking the difference between the semi-major axis (a) and the semi-minor axis (b):



One of my issues was trying to relate the concept to students in my introductory courses to make it interesting to non-geo majors. I came up the "Oblate Professor" who was larger or more rotund then he was tall. (The image I had in mind was an undergraduate professor with a thick German accent I once had in an Earth Science course many years ago). Professor Oblate would expound on flattening and ask the students to complete a few simple exercises.

There have been numerous refinements for the Earth semi-major and semi-minor axis over the years, but for my purposes we would use the information in the textbook. From Pole to Pole, the length given was 12,714 km, while the equatorial bulge measures 12,756 km, a difference of only 42 km (but enough to take into account in modern day computer cartography and GIS applications!). Applying the information as per the previous diagram, first we will divide the two axis' in half to compute the semi-major and semi-minor axis.

$$a = 12{,}756 / 2 = 6378 \text{ km} \quad \text{and } b = 12{,}714 / 2 = 6357 \text{ km}$$

$$\text{flattening (f)} = \frac{6378 \text{ km (a)} - 6357 \text{ km (b)}}{6378 \text{ km (a)}}$$

$$\text{flattening (f)} = 0.0032926$$

The next step for my students was to apply flattening they computed to a globe that is 100 centimeters (about 3.3 feet) along the equatorial axis. How "tall" would our polar axis for our oblate model Earth model?

100 centimeters x 0.0032926 (flattening) = .32926

100 centimeters - .32926 = 99.6707 centimeters, from Pole to Pole.

Doesn't seem like very much, yet as GIS professionals, most of us are using some similar configuration. Next time you open ArcMap and look at a layer, click → properties → source and check the datum. For Lancaster County, we see D_GRS_1980. Use ArcGIS DeskTop Help and take a look for GRS80. This is very basic to the concept of location and our modeling of the Earth. As Professor Oblate might say, *"datums are not dat dumb"*.

(If you read these and think they are worthwhile; or if you have any ideas for the Armchair Geographer, drop him a note: srobinson@lancaster.ne.gov)

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