CHAPTER 2
Location, Trigonometry, and Measurement of the Sphere

Practice: Work with Measurement in ArcGIS Online.
In this section, you will have the opportunity to measure units off of the graticule using a web-based GIS. Open a web browser and access ArcGIS Online: http://www.arcgis.com/home/.

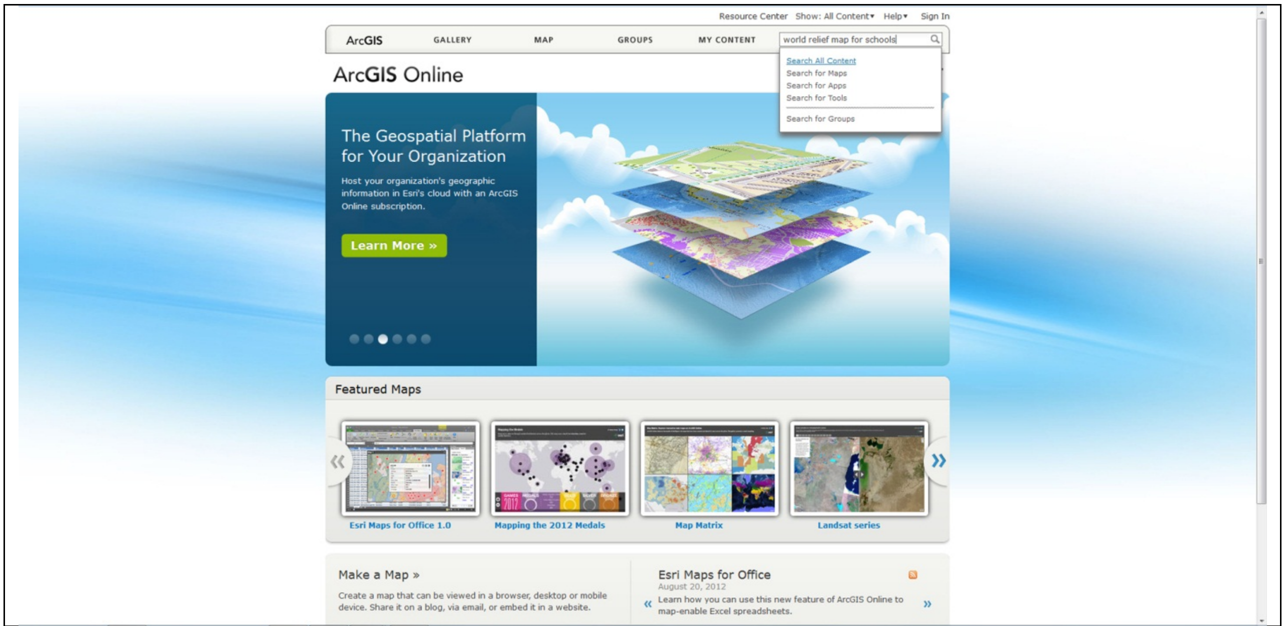

Figure 2.1. In the search box, enter (without quotation marks) "World Relief Map for Schools". The result of the search will appear as in Figure 2.2. Source: Esri software.

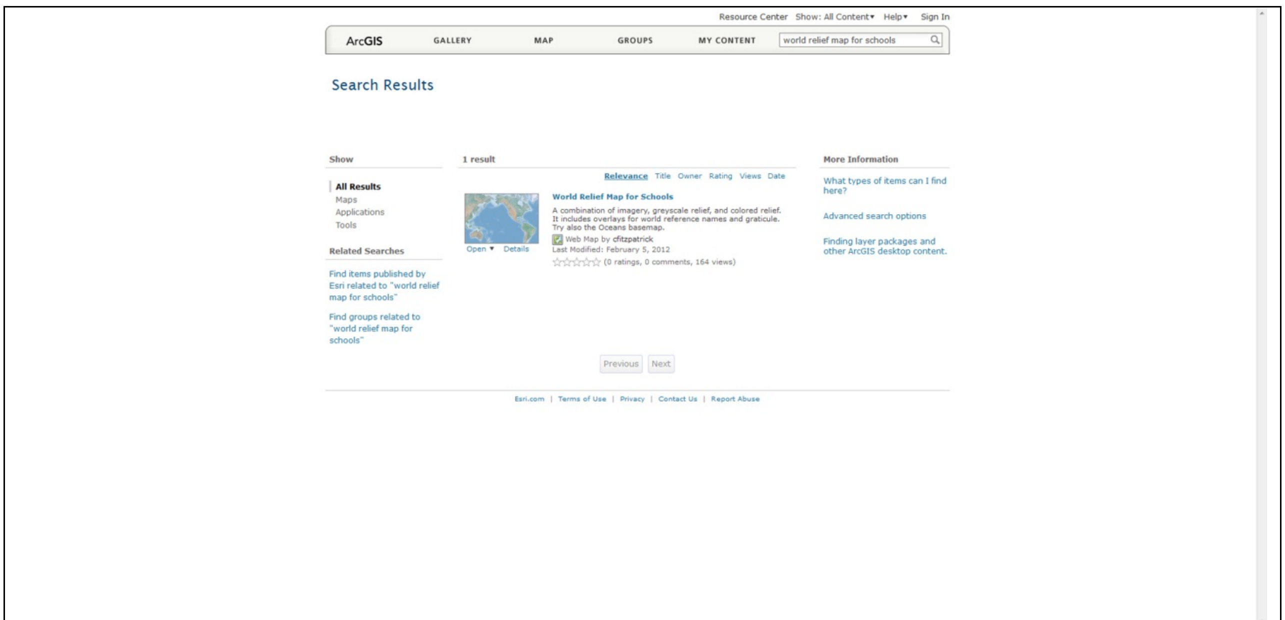

Figure 2.2. Open the map by clicking on the thumbnail image. Source: Esri software.

In the map that resembles Figure 2.3, zoom out, if necessary, until you see the lines of latitude and the lines of longitude represented in a spacing of 15 degrees apart. On a map in the Mercator projection, such as this, notice that the lines of latitude and longitude are represented as straight lines. Notice how the lines of longitude are spaced evenly while the lines of latitude get farther apart as one approaches the North Pole and the South Pole.

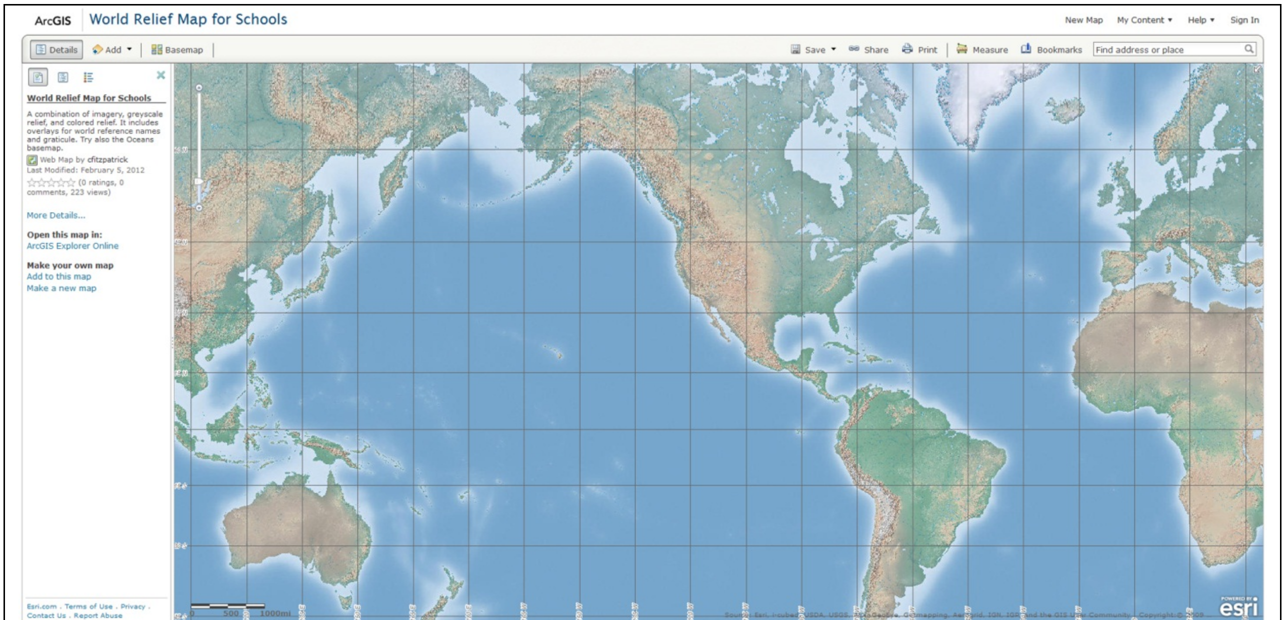

Figure 2.3. The map that comes up as the "World Relief Map for Schools." Source: Esri software.

Verify the numeric value of the latitude and longitude lines by clicking on each of them Figures 2.4 and 2.5).

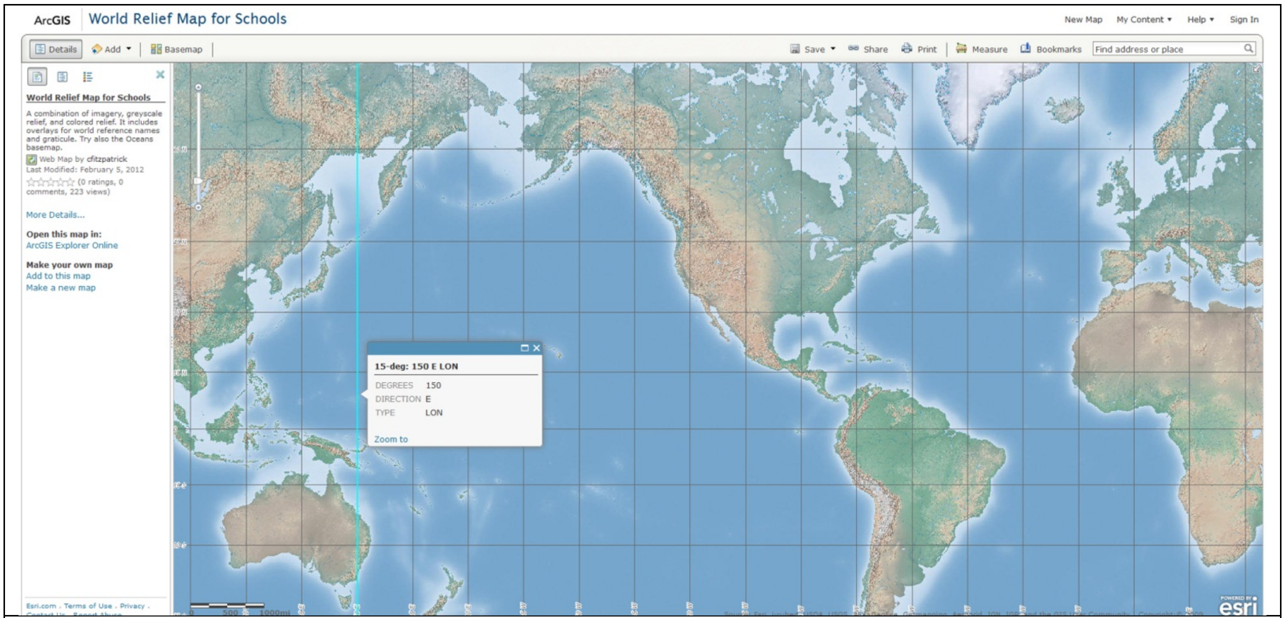

Figure 2.4. Longitude 150 E. Source: Esri software.

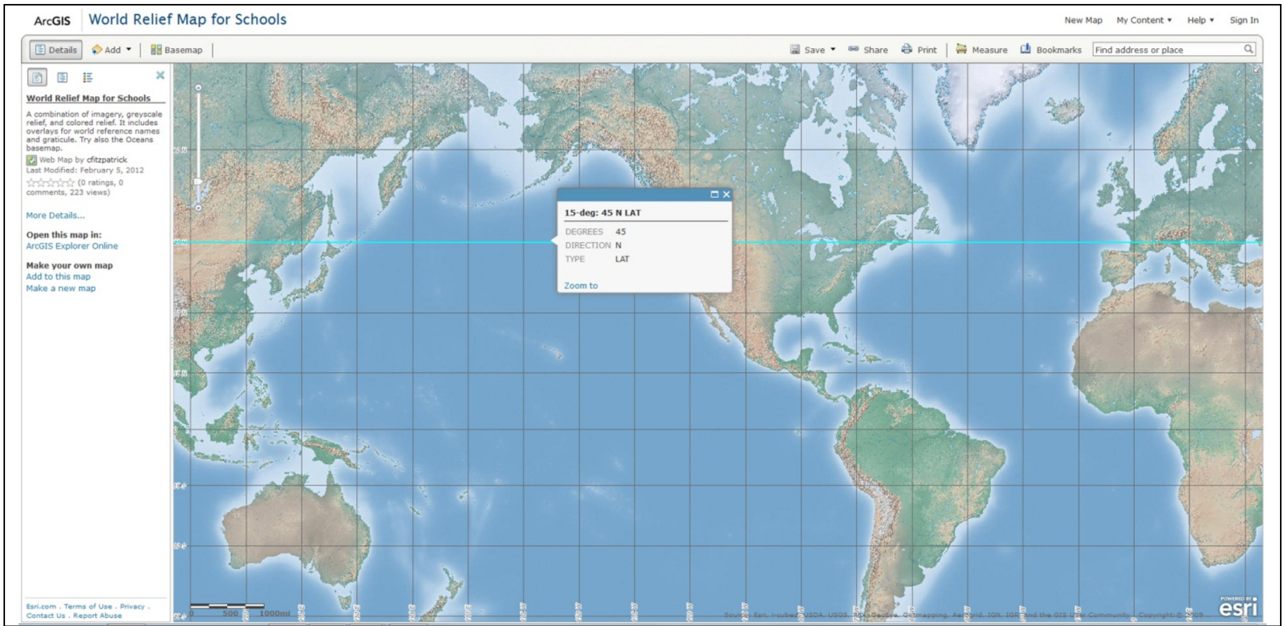

Figure 2.5. Latitude 45 N. Source: Esri software.

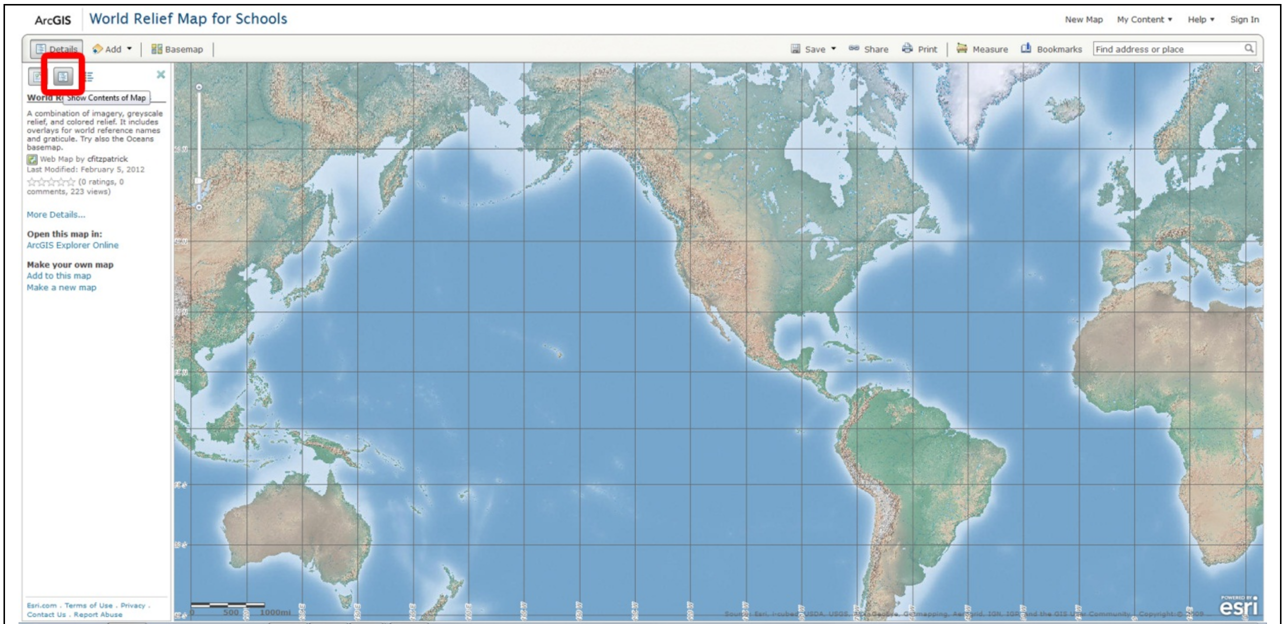

Figure 2.6. Select the tool that shows the individual map layers that make up your map (Figure 2.6). Source: Esri software.

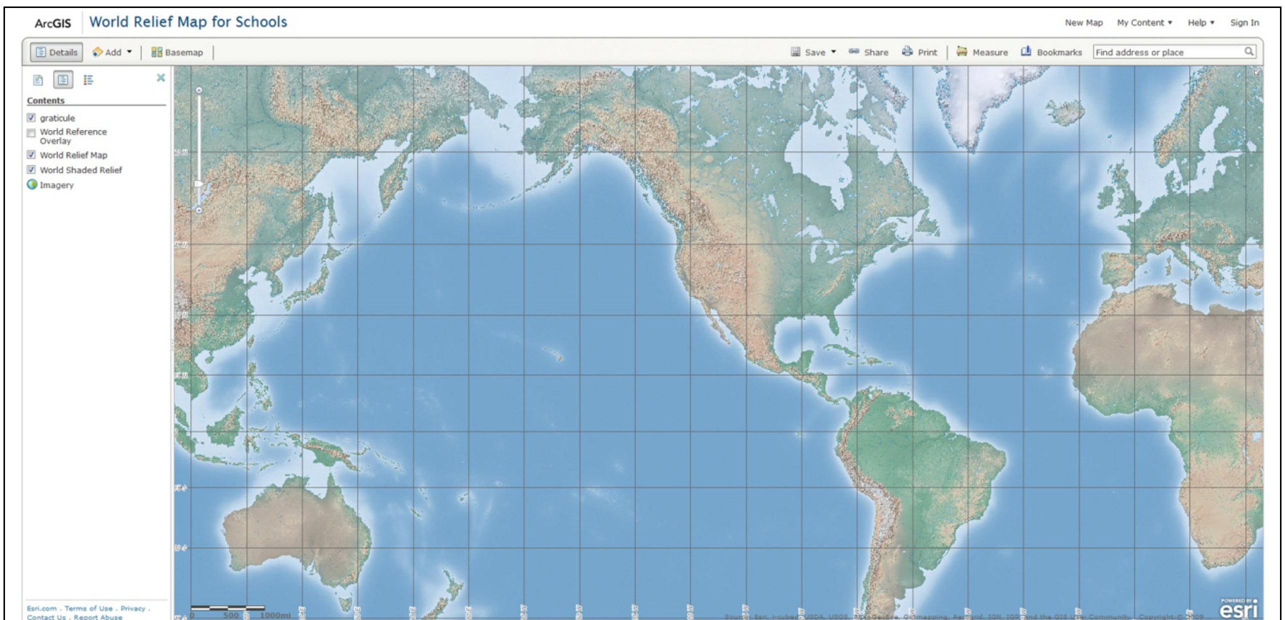

Figure 2.7. Now the left hand column shows the content of the map: the layers of which it is composed. Source: Esri software.

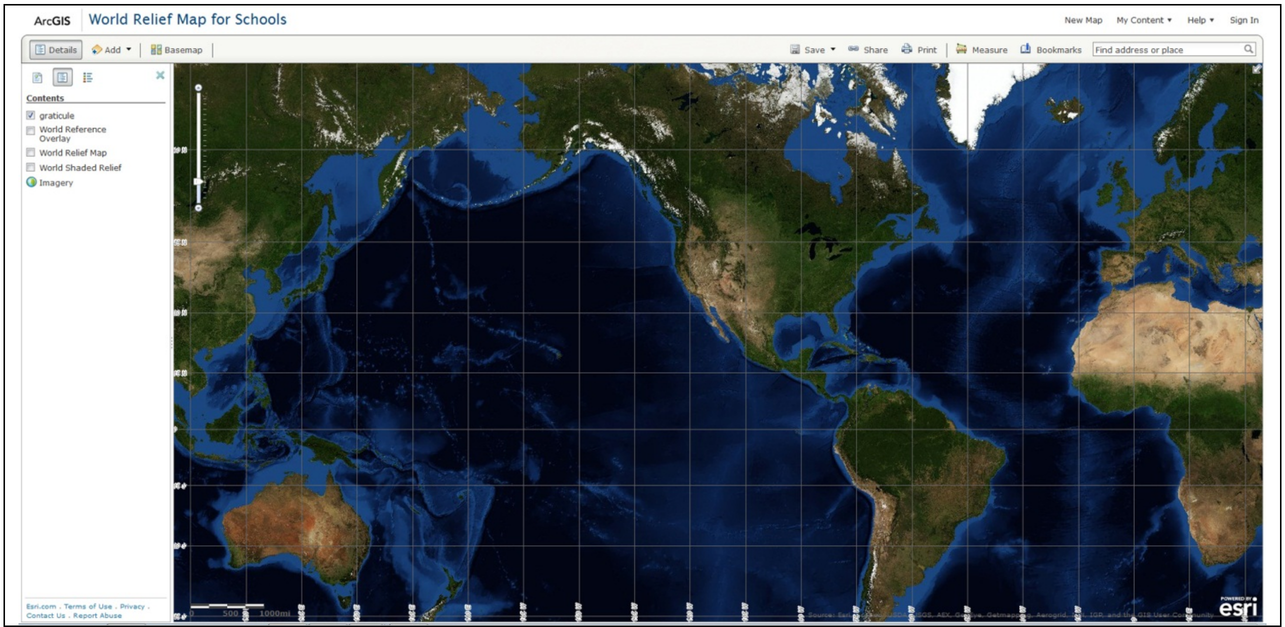

Figure 2.8. Look at some of the content by switching layers off and on. Source: Esri software.

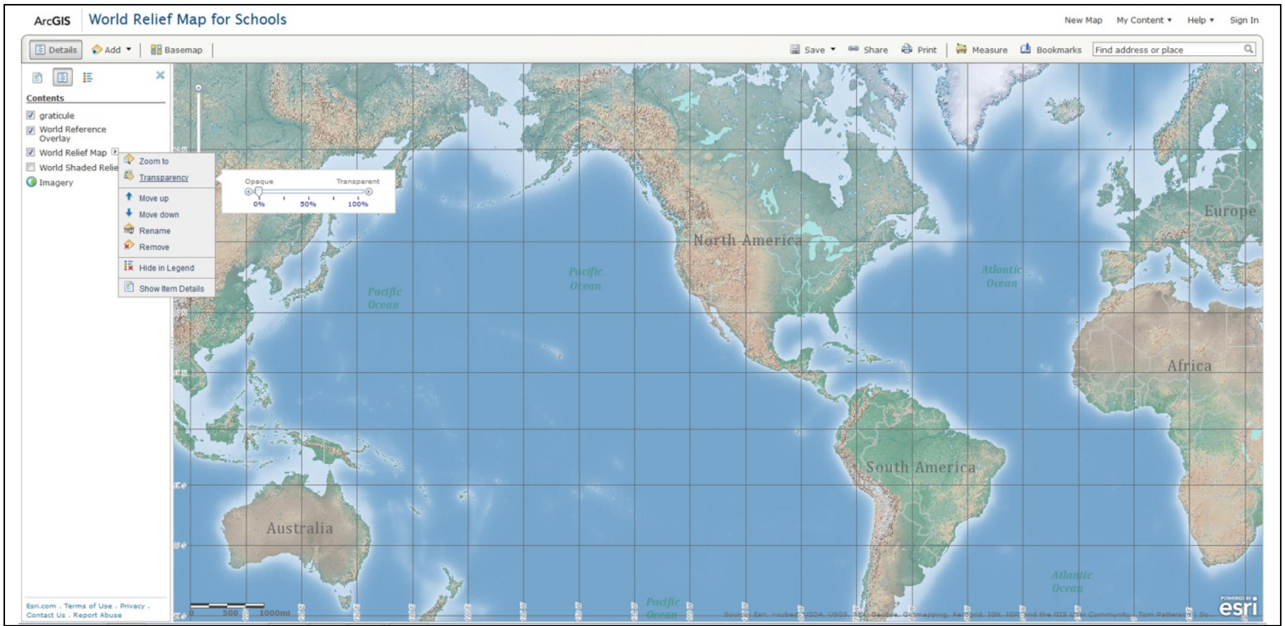

Figure 2.9. Notice that there are pull-out menus on some of the layers. Here, there is one where layer transparency can be modified. "Transparency" is a powerful tool available in digital mapping that is not available in conventional mapping. Source: Esri software.

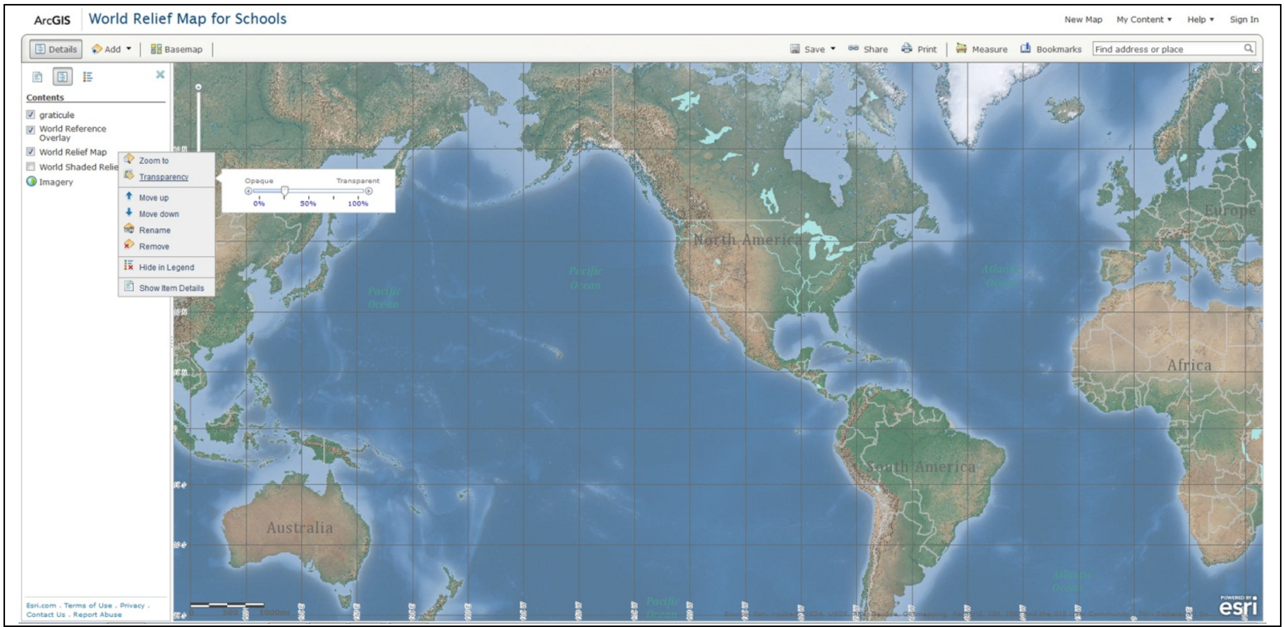

Figure 2.10. The result of setting transparency to 25%--accentuates inland lakes. Source: Esri software.

These layers are scale dependent. As you zoom in, a finer, higher resolution mesh of latitude and longitude lines appears.

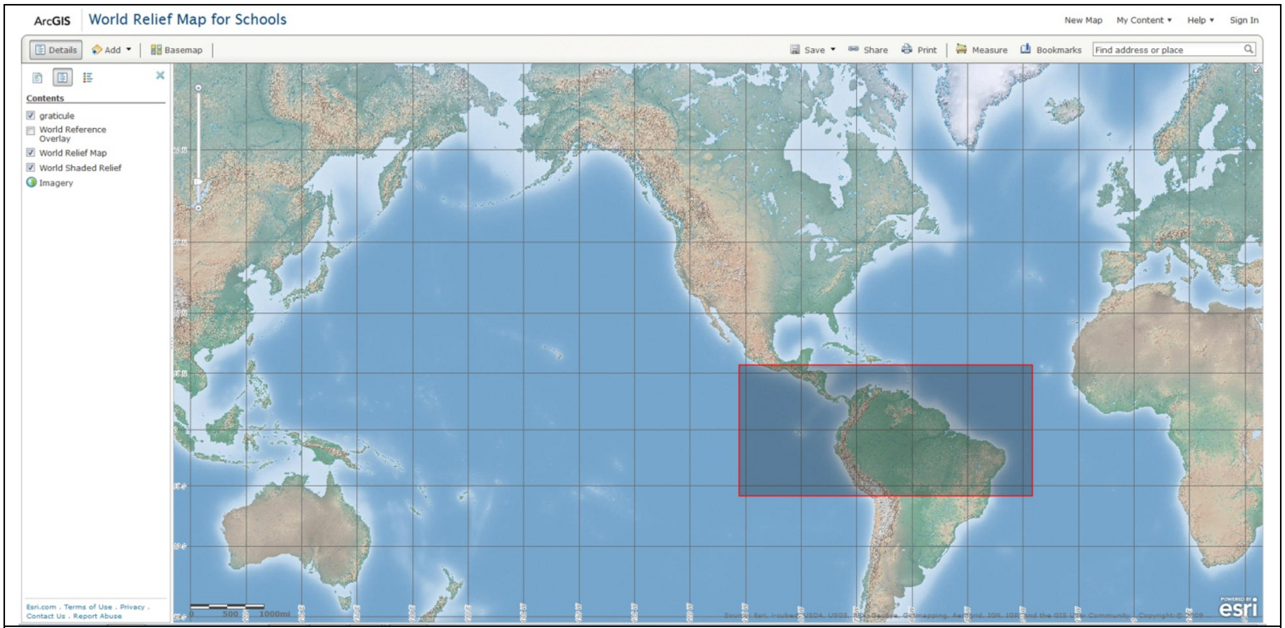

Figure 2.11. Zoom to the Equator in South America by holding the Shift key and simultaneously dragging a box with the mouse. Source: Esri software.

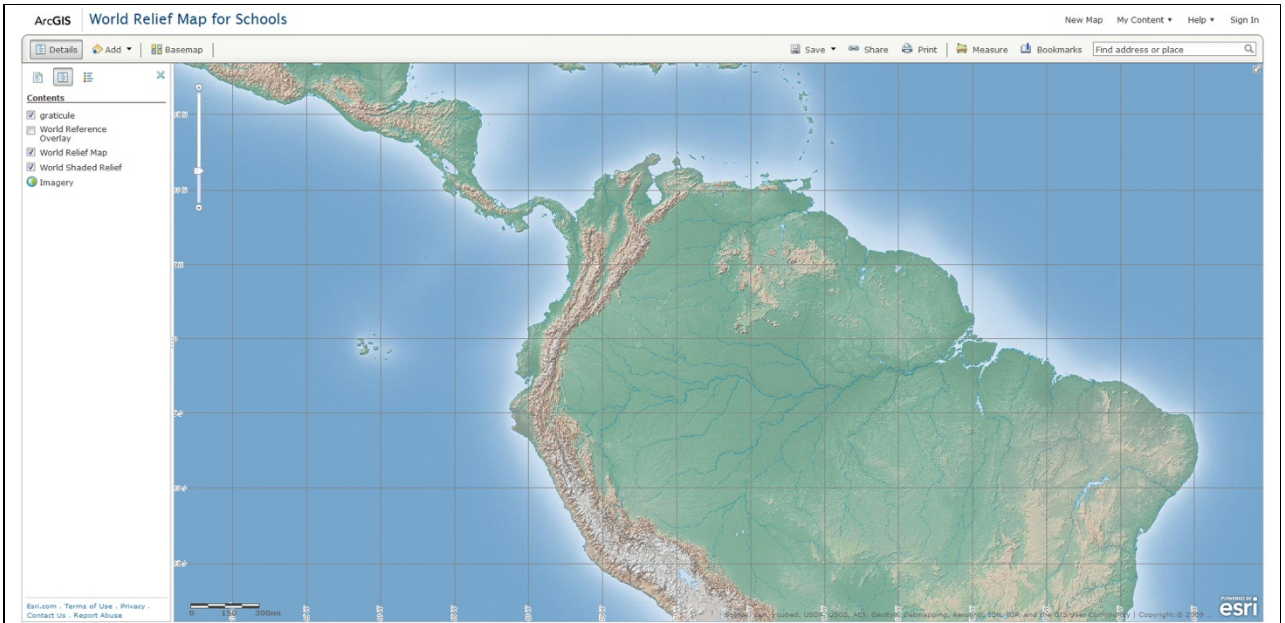

Figure 2.12. Results of the zoom. Search for Quito, Ecuador, and find the Equator nearby. Source: Esri software.

Figure 2.13 shows the results of searching for Quito. Compare Figure 2.13 to 2.14 to see that at this level of zooming in there is a one degree mesh of latitude and longitude lines. Experiment with more zooming to discover if this mesh is the finest one available in the online software. In theory, there are an infinite number of finer graticules that could be generated; for example, a half-degree, 10 minute, or even a 1 second mesh. The number is in fact infinite because no matter how small the numerical entity, it can always be cut in half producing an even finer mesh.

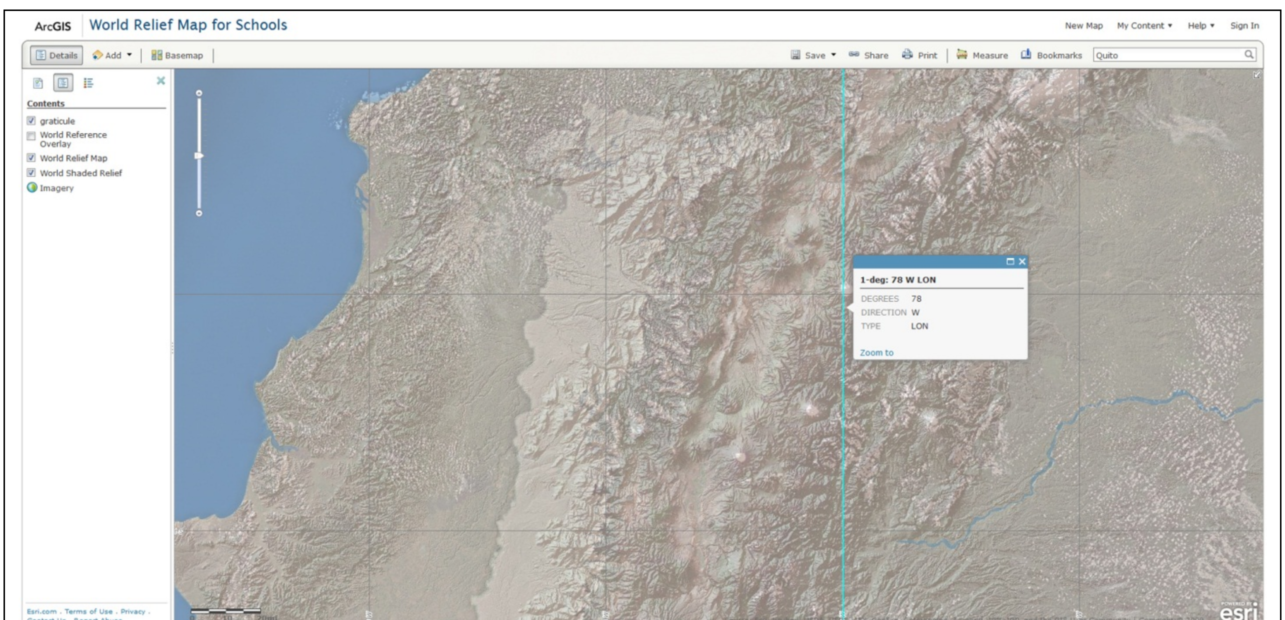

Figure 2.13. 78 W longitude. Source: Esri software.

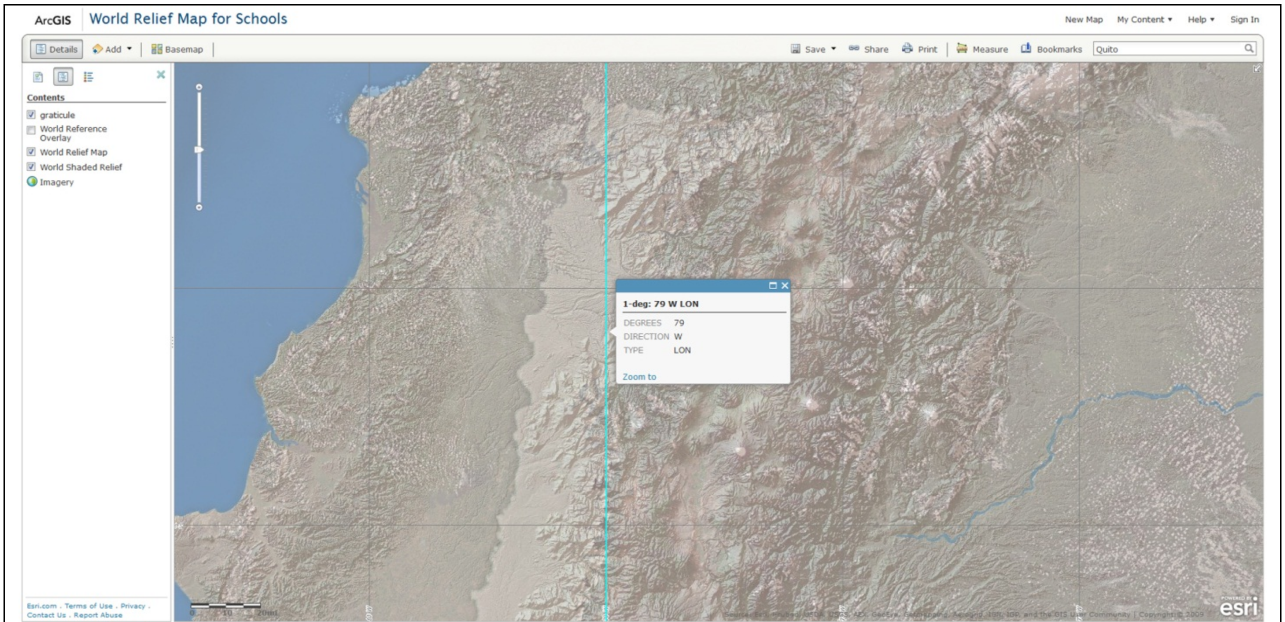

Figure 2.14. 79 W. longitude. Source: Esri software.

Use the measure tool to find the distance between one degree of longitude and the next degree of longitude to the east or west. Indicate the units chosen Figure 2.15).

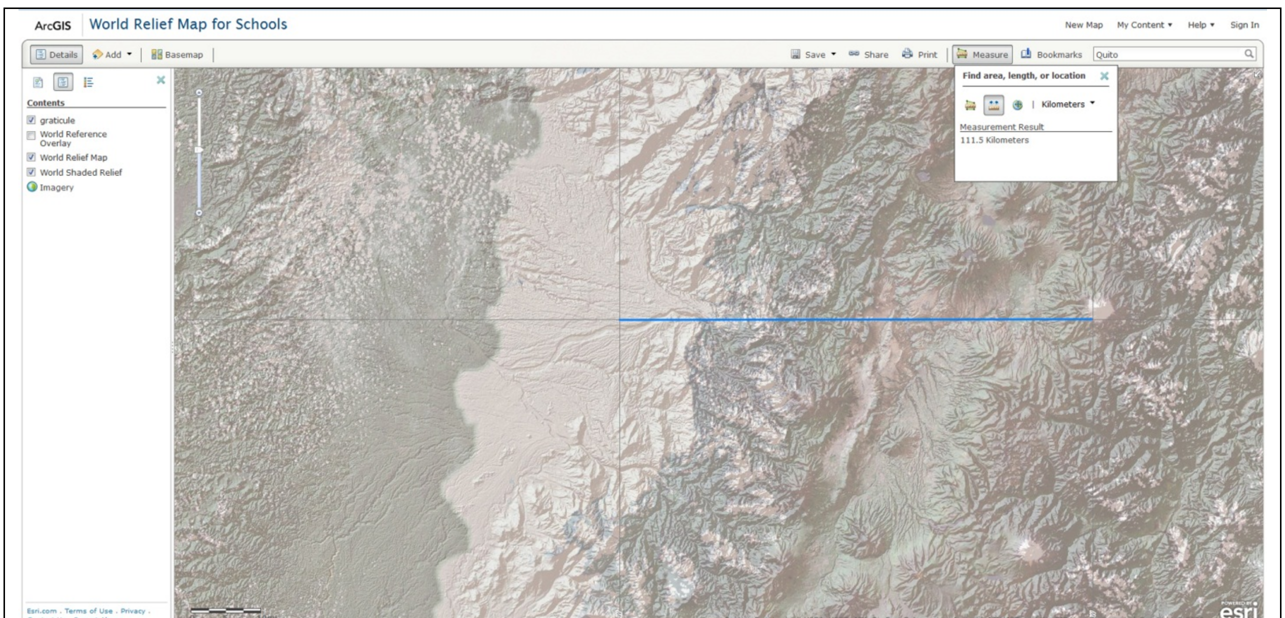

Figure 2.15. Distance between 79W and 78 W measures about 111.5 km. Source: Esri software.

The accepted value discussed earlier in the text was 111.319 km. What are a few reasons why the value from from Figure 2.15 does not match the accepted value? It depends on where you click with your mouse, which is in itself an imperfect science, and the map projection used on this map. Repeat the process as suggested in the text.

CHAPTER 3
Transformations: Analysis and Raster/Vector Formats

Geodesic versus Euclidean Buffering

Buffers fundamentally depend on the mathematics behind them, and specifically, on the shape of the Earth. Geodesic buffers account for the actual shape of the Earth as an oblate spheroid in their calculations. Euclidean buffers measure distances in a two-dimensional Cartesian plane. Euclidean buffers work best when analyzing distances around features that are concentrated in a relatively small area, in a projected coordinate system. Using a web browser, access the Geodesic Buffering web GIS application on:
http://help.arcgis.com/EN/webapi/javascript/arcgis/demos/util/util_geodesic_buffering.html.

Click anywhere on the map to generate a line. The short line segments that you generate create buffers that are oval in shape, because they represent shapes that enclose areas within 1,000 kilometers of the line segments. The geodesic buffer appears in red; the Euclidean buffer appears in blue. The two buffers are most similar near the Equator and are quite different near the poles. The sequence of images in Figures 3.1, 3.2, 3.3, 3.4 illustrates visually the change in relative buffer sizes as one moves away from the Equator.

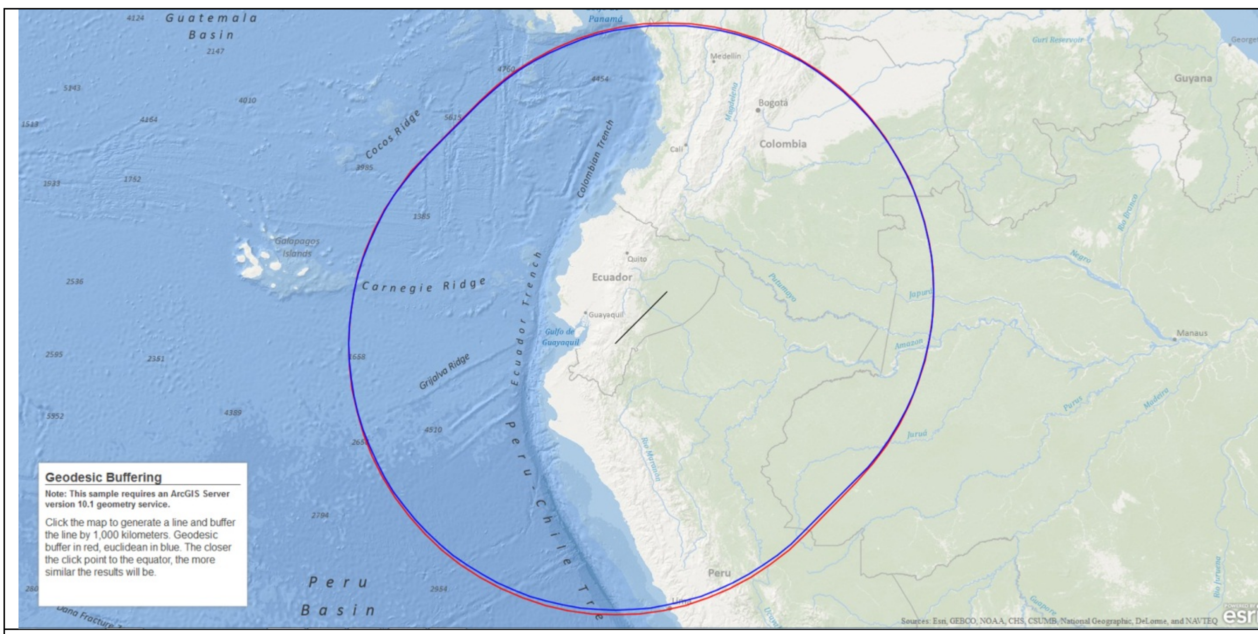

Figure 3.1. Geodesic and Euclidean buffers are close to identical when centered on Ecuador, close to the Equator. Source: Esri software.