Google Earth

SWAC Module 7: GeoViewers

1. Introduction:

Google Earth is a free web-based geospatial data viewer maintained by Google in Mountainview, California. The program was developed under a different name by a company called Keyhole, Inc, prior to 2004 when Google acquired it. The program is essentially a globe similar to those found in classrooms across the country- the exception being that it is computer based, and much more flexible in terms of the data that it is able to represent. Users of the program are able to access hundreds of databases- some provided by default by Google Earth, others by what we call the "geoweb." This idea of the "geoweb" refers to the community of scientists who use open and closed source geospatial software like Google Earth to share their data publicly. A short list of groups and agencies that publish free data to the "geoweb" include NASA, NOAA, USGS, and many other private and public entities in the scientific community. Google Earth has been designed to allow anyone to upload and share their data using their software.

2. Theory:

Since the program is web-based, it relies on an Internet connection to load data. If there is no Internet connection, the application will still start, but the user will quickly see the program is unable to load any data. The theory behind Google Earth is simple: create a virtual earth similar to a classroom globe, but make it able to display more information.

Question: Why use a three-dimensional globe?

Because Google Earth uses a virtual sphere, it is able to accurately reproduce the Earth with little to no distortion. Remember that every two-dimensional map has some sort of distortion since it is impossible to perfectly fit a flat piece of paper over a ball. This problem of distortion is more or less eliminated* by using a three-dimensional representation of the Earth.

Question: How is the imagery displayed on the sphere?

To understand how data is displayed on this virtual earth, we need to understand the concept of the "layer". Let's pretend that we have a large white ball. We decide that we want to display all of the land and water surfaces of the Earth on it, so we paint those features onto the ball. This is one layer. Let's say that we then want to look at roads on the globe. We take a magic marker and draw all of the Earth's roads on the ball *over* the Earth Surface. These lines depicting roads are a *new* and *separate* layer from our initial painting. This "layering" of data is exactly what Google Earth does when we tell it to display data. The only difference is that unlike paint or pen that is permanent, we are able to activate and deactivate layers on our globe as we see fit.

The virtual sphere has hundreds of virtual lines of latitude and longitude that cover its surface. The intersections of these lines represent specific points on the

surface of the Earth. We can think of these as *X* and *Y* coordinates like those found on a Cartesian plane.

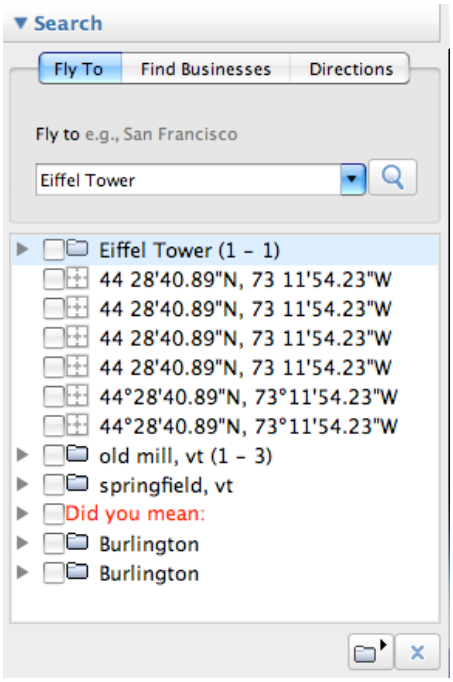
The imagery that is loaded into Google Earth is "*Georeferenced*," which means that somebody has made sure that a virtual place's coordinates in Google Earth actually correspond to its real life coordinates. This means that coordinates that we take at a place in real life (from a GPS or map) should bring us directly to that spot on our virtual globe. And since Google Earth's imagery in *georeferenced*, the image that we see on the screen should resemble the place that we took the measurements from.

Questions: Can Google Earth show relief in 3D?

In addition to displaying graphical data, Google Earth is also capable of displaying terrain data. Features from the highest of mountain ranges to the lowest of deep-sea trenches are found on the virtual sphere's surface. Google Earth contains three dimensions, so each point will have three numbers: an *X* (Longitude) *Y* (Latitude) and *Z* (Elevation). And since all of these points all conform to a universal scale, we can change that scale (usually to exaggerate the heights of mountains for easier viewing). This rescaling of elevations is called "*vertical exaggeration*" or "*elevation exaggeration,*" and is an option that we have control over in Google Maps.

3. Introductory Tutorial

In the upper left hand corner of Google Earth is the "***Search***" tab. This tab allows the user to enter locations (town names, coordinates, landmarks, etc.) that Google Earth will attempt to locate.



Type "Springfield" in the Search Box. Notice that results for Springfield in several different states pop-up.

Now type "Springfield, Vermont" in the Search Box. Google Earth finds the location "Springfield, Vermont" in its database and "brings" us to it. Using town names is just one of the ways that we can use Google Earth to locate places.

Now type: 44 28'40.89"N, 73 11'54.23"W

Google Earth brings us to Old Mill at the University of Vermont. These are the specific geographic coordinates of our computer lab. Google Earth will understand any geographic coordinates provided they are properly entered. The easiest format (and the one that is generally used with handheld GPS devices is the **Degrees (º) Minutes (') Seconds (")** format: **---º -- ' --.--"**

Since the º character is difficult to enter for Windows users, Google Earth allows it to be omitted ***so long as*** a space is entered in its place.

Thus 44º28'40.89" becomes 44 28'40.89"

Now type: "Eiffel Tower" in the Search Box. Google Earth takes us to the Eiffel Tower in Paris, France. Not that a series of advertisements appear in the Search Window. These advertisements are how Google is able to support development on such a costly endeavor without charging the users for money.

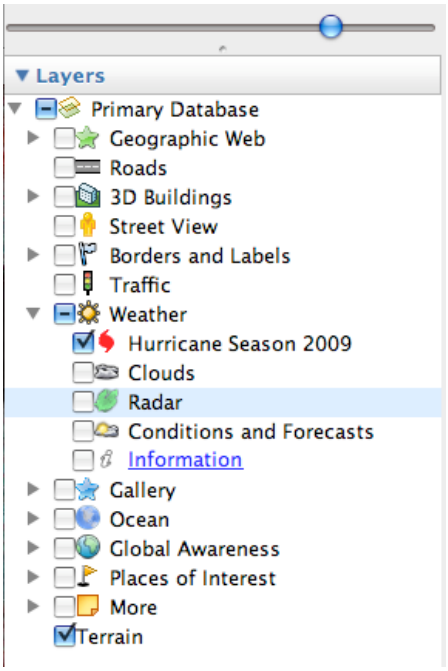
Notice that if you hover the mouse over the map, you see a **Hand tool** like the one that we saw with the GeoMapApp. This tool also allows the user to navigate like GeoMapApp, with the exception that Google Earth has a built in "flying" mechanism that "spins" the model.

Take a look at the buttons in the upper left of the screen. The TOP button controls the 3D angle of the view. **Take a minute to explore its functionality.**

The MIDDLE button controls the PAN of the view, which simply moves the scene ***without*** adjusting the ***view angle***. **Take a minute to explore its functionality.**

The BOTTOM slider controls the zoom of the view. **Take a minute to practice zooming in and out.**

Notice the box in the lower left of the screen entitled "***Layers***." (If it is not expanded, expand it now.) Notice the "***Primary Database***" checkbox. (If it is not expanded, do so now.) Contained within the Primary Database are several data layers similar to those that we saw in the GeoMap App.



Click on the "*Roads*" checkbox. Now zoom in. Notice that the closer we zoom to the surface, the more roads appear. This strategy of rendering less information at greater distances is what allows Google Earth to load and browse so quickly.

Un-check the "*Roads*" box and collapse the "*Weather*" menu. Notice that we have several choices. **Click on the "*Radar*" box.** Notice that it takes a few seconds for the Radar image to load. This is because of the fact that, like the GeoMapApp, Google Earth is a web-based viewer that loads data on demand.

Notice the sliding bar above the ***Layers*** menu. This is the ***opacity*** bar. **Drag the slider to the left so that you can see the land beneath the precipitation.**

Type your address in the Search Box and press "Enter". Google Earth brings you to the exact coordinates of your home. Let's say that you want to share this location with your family members without having to tell them exactly which steps to take to arrive there. **Right-click the blue highlighted address in the Search Box Window and click "*Save Place As*".** This will allow you to save your location as a .Kmz or .Kml file. **Accept the default .kmz format and save the file to the Desktop.**

Shut down Google Earth. Navigate to the Desktop, and double click on the file that you just created. The file reopens Google Earth (shutting down isn't always necessary, it was just to illustrate what the file can do in this case…), and brings you to your address.

Notice that the Address file has been added to the 'Temporary Places" folder in the Search Menu.

4. Integrating GeoMapApp and Google Earth

Now let's see how we can integrate the GeoMapApp and Google Earth. Restart the GeoMapApp if it is not already running.

Create a map with information *different* from the example that we worked on earlier.

Choose to save the map, but this time, select the .kmz format and save it to the desktop after giving it a meaningful name.

Close GeoMapApp and navigate to the desktop. Open your new file.
Now you can see the image that was saved from the GeoMapApp on Google Earth. Notice that like the Address layer, your new layer is also added to the ***Temporary Places*** folder. If you wish to save these two layers together for further use, you can right click the ***Temporary Places*** folder and save the file as a .Kmz just like what we did for the Address layer.