Google Earth, Topographic Maps, and Remote Sensing

Goals: After completing this lab, you will be able to:

- Differentiate among various remote sensing images and data and determine how such images and data apply to problems that are investigated within physical geography.
- Carry out navigation and measurement activities within Google Earth.
- Use mapping skills within the virtual globe of Google Earth.
- Select and use data layers within Google Earth to solve physical geography problems with USGS topographic maps.

Key Terms and Concepts:

- digital elevation model (DEM)
- Doppler radar
- Google Earth
- Google Earth toolbar, sidebars, sidebar layers, navigation panel, geographic grid coordinates and elevation, eye altitude, historical imagery, and contour lines
- LiDAR (light detection and ranging)
- radar
- remote sensing
- sonar

Required Materials:

- Calculator
- Google Earth tutorials (if needed): http://www.google.com/earth/learn/
- High-speed Internet connection (for all modules) and Google Earth (free download at http://www.google.com/earth/download/ge/agree.html)
- Textbook: *Living Physical Geography,* by Bruce Gervais
- When opening Google Earth, your computer may show the image presented in Figure 1–1. If you see this, simply wait while the selected file is loaded.

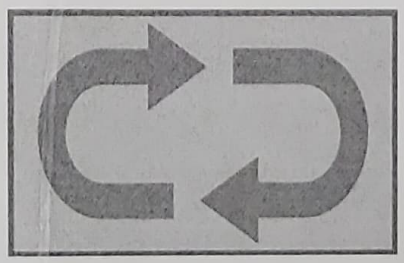

FIGURE 1–1

Problem-Solving Module #1: Google Earth and Topographic Maps

Download the following file from the *Living Physical Geography* book companion site and open it within Google Earth:

- Liberty CO Topographic Layers.kmz (Note: This is a large file and may take a few minutes to download. Please be patient.)

1. The kmz file will open with the Liberty, Colorado topographic map boundaries layer already turned on. Fly to marker A by double-clicking A in the Places Sidebar. What is the name of the national forest identified by marker A?

   Rio grande national forest

2. Fly to marker B by double-clicking B in the Places Sidebar. Describe how the boundary of the national forest looks.

   The boundary of national forest looks inclined.

3. In the Places Sidebar, right-click on "Liberty CO Boundaries" and select "Properties." Use the "Transparency" sliding bar to manipulate the map layer. What happens to the map layer when you slide the bar all the way to the left?

   The hills are pretty visible in map layer when slided to left.

4. In the Places Sidebar, turn off the following map elements: Liberty CO Boundaries, markers A and B. Turn on the following map elements: Liberty CO Hydrography, markers C, D, and E. Fly to marker C by double-clicking C in the Places Sidebar. What is the name of the water source demarcated by marker C?

   Sand creek is the name of water source demarcated by marker C.

5. Fly to marker D by double-clicking D in the Places Sidebar. What is the name of the water source demarcated by marker D?

   Coldcreek is the name of water source demarcated by marker D

6. Fly to marker E by double-clicking E in the Places Sidebar. Is marker E at a higher or lower elevation then markers C and D, and how do you know?

   Marker E is at lower elevation than marker C and D because elevation of C and D are higher than D.

7. Use the elevation indicator at the bottom of your Google Earth screen and record the elevation of marker E.

   7860 FT

8. Use the elevation indicator at the bottom of your Google Earth screen and record the elevation of marker D.

   10950 FT

9. If you walked from marker E to marker D, how many vertical feet would you travel?

   3090ft

10. Use the Ruler on the Toolbar to measure the straight-line distance between markers E and D. How many miles (map length) exist between these two markers?

    5.53 miles

11. Use the Ruler on the Toolbar to measure a path from marker D, downslope, following the curving line of the river. Proceed to a distance of approximately 3.6 miles. At the end of your path, what happens to the map's graphic element that represents the water source, and what does this mean?

The ephemeral river is flowing towards old creek.

12. In the Places Sidebar, turn off the following map elements: Liberty CO Hydrography, markers C, D, and E. Turn on the following map elements: Liberty CO Contours, markers F, G, 1, 2, 3, and 4. Fly to marker F by double-clicking F in the Places Sidebar. What is the value of the contour line upon which marker F is located?

12440

13. Fly to marker G by double-clicking G in the Places Sidebar. What is the value of the contour line upon which marker G is located?

7800

14. Double-click marker 1 in the Places Sidebar. Notice that this view has both markers 1 and 2 visible and that both are located on an index contour line. According to the contour lines, how many vertical feet separate marker 1 from marker 2?

200

15. Use the Ruler on the Toolbar to measure a line between markers 1 and 2. How many feet (in map length) are between markers 1 and 2?

6623.73ft

16. Double-click marker 3 in the Places Sidebar. Notice that this view has both markers 3 and 4 visible and that both are located on an index contour line. According to the contour lines, how many vertical feet separate marker 3 from marker 4?

200

17. Use the Ruler on the Toolbar to measure a line between markers 3 and 4. How many feet (in map length) are between markers 3 and 4?

330.76ft

Copy and paste the following coordinates into the Search window on the sidebar and then click the Search button: **37° 41′ 23″ N 106° 06′ 52″ W**

Use the above coordinates to answer questions 18–24.

18. What anthropogenic evidence is visible on the landscape?

It is a farming field

19. What is the imagery date? *Hint: See the bottom of the Google Earth screen.*

9/8/2016

20. What is the elevation of this location?

7663ft

21. What is the eye altitude?

10944ft

In the Toolbar, click the icon that looks like a clock with a green arrow wrapping around it in a counterclockwise direction.

22. What is the new imagery date? *Hint: See the bottom of the Google Earth screen.*
1985

23. In the historical imagery slider, slide the marker all the way to the left. What is the new imagery date?
12/1985

24. How does the 10/22/2005 image differ from the 8/30/2006 image?
The farming field contains and it's less greenary

25. In the Layers Sidebar, click the "photos" box to turn on pictures posted by Google Earth users. Now double-click "Liberty CO Topographic Layers.kmz" in the Places Sidebar. Investigate the pictures by clicking the photo icons. What is a common desert landscape feature that many people have taken photographs of in this area?
Great sand dunes

Problem-Solving Module #2: Google Earth and Digital Elevation Models (DEM)

Download the following file from the *Living Physical Geography* book companion site and open it within Google Earth:

- NOAA New Orleans DEM.kmz

1. In the Places Sidebar, expand all the menu items within the Temporary Places folder. Single-click the following layer within the Places Sidebar:
   - NOAA Coastal Digital Elevation Models

   List three things that NOAAs DEMs can be used for.

   Conserving and managing coastal and marine resource
   Modelling of coastal process, ecosystem management etc
   Building and distributing high-resolution coastal digital elevation models

2. Fly to marker A by double-clicking A in the Places Sidebar. Use the map's legend in the lower left and describe the location of marker A.

   Dryland near or below sea level.

3. In the Places Sidebar, right-click on "Path from A to B" and select "Show Elevation Profile." Move the cursor right and left within the elevation profile window. Notice that as you move the cursor within the window, a red arrow indicates that location on the path. Within the elevation profile window, move your cursor to 1 mile (see the bottom of the elevation profile window for distances). What is the elevation at this place?

   0 ft

4. Within the elevation profile window, move your cursor to 2.50 miles (see the bottom of the elevation profile window for distances). What is the elevation at this place?

   8 ft

5. Notice that marker B is on the Mississippi River. If you lived in New Orleans near marker A and walked to the Mississippi River along Path A to B, would you walk uphill or downhill to the river?

   uphill

6. Click the small X in the elevation profile window and then fly to marker C by double-clicking C in the Places Sidebar. Use the map's legend in the lower left and compare the location of marker C with the location of marker D.

   Marker C is located in shallow water and location of marker D is in dryland near sea level.

7. In the Places Sidebar, right-click on "Path from C to D" and select "Show Elevation Profile." Notice that a wall exists at about 0.45 miles. This is a man-made levee that keeps Lake Pontchartrain (where marker C is located) from pouring into New Orleans (where marker D is located). According to the elevation profile, how high is the highest point on the levee?

   11 ft

8. In the Places Sidebar, turn off the layer named "NOAA Coastal Digital Elevation Models" (this layer is below marker J). Zoom in to marker D. What do you see?

Suburb is seen

9. Turn the "NOAA Coastal Digital Elevation Models" layer back on. Click the small X in the elevation profile window and then fly to marker E by double-clicking E in the Places Sidebar. Use the map's legend in the lower left and describe the location of marker E.

Marker E is located in deep water

10. Fly to marker F by double-clicking F in the Places Sidebar. Use the map's legend in the lower left and describe the location of marker F.

Shallow water is the location of marker F.

11. Fly to the Path from G to H by double-clicking that path in the Places Sidebar. In the Places Sidebar, right click on "Path from G to H" and select "Show Elevation Profile." If you traveled from marker G to marker H, would you travel uphill or downhill?

Downhill

12. According to the elevation profile, what is the highest elevation along path G to H?

153ft

13. If you wanted to live in Louisiana and were worried about flooding, why would you likely choose location G over location D? (Use both the key as well as the elevation indicator at the bottom of your Google Earth screen to answer this question.)

location G is above the sea level compared to location D so, I would like to live in location G than location C

14. Click the small X in the elevation profile window and then fly to marker I by double-clicking I in the Places Sidebar. Use the elevation indicator at the bottom of your Google Earth screen and record the elevation of marker I.

21ft

15. Use the elevation indicator at the bottom of your Google Earth screen and record the elevation of marker J.

38ft

16. If you wanted to live in Louisiana and were worried about flooding, why would you likely choose location J over location I? (Use both the key as well as the elevation indicator at the bottom of your Google Earth screen to answer this question.)

location I is just 21feet above the sea level where as location J is 38ft above so. I would live in location J compared to location I.

Problem-Solving Module #4: Google Earth and Radio Detection and Ranging (Radar)

Download the following file from the *Living Physical Geography* book companion site and open it within Google Earth:

- Radar.kmz (Note: This is a large file and may take a few minutes to download. Please be patient.)

The map's legend in the lower-left corner is a graphic reference key for radar reflectivity data. Radar reflectivity is measured in units called "decibels of Z" (dBZ), with higher dBZ values indicating increased amounts of signal that return to a radar dish.

Larger dBZ values indicate stronger rainfall. When light rainfall happens, radar dBZ is typically between 20 and 25, which is colored green on the key. When heavy rainfall happens, radar dBZ is typically between 50 and 55, which is colored red on the key. No rainfall reveals no radar signal, thus no colors on the map.

Markers A, B, C, and D are placed at these cities within Georgia:

- A: Atlanta, Georgia
- B: Augusta, Georgia
- C: Athens, Georgia
- D: Macon, Georgia

Note: Radar image data is displayed most clearly when only one radar image layer at a time is turned on.

1. In the Places Sidebar, notice that the 1:00 p.m. U.S. radar image overlay is already turned on. At this time, what kind of precipitation is Macon experiencing, and how do you know?

   Macon is experiencing heavy rainfall as it is coloured red

2. Keeping the 1:00 p.m. U.S. radar image overlay turned on, what kind of precipitation is Augusta experiencing, and how do you know?

   Augusta is experiencing no rain as there is no colour on the key

3. Turn off the following image overlay: U.S. Radar 1:00 p.m. Turn on the following image overlay: U.S. Radar 1:10 p.m. What happened to the rainfall over Macon over these 10 minutes, and how do you know?

   As the colour changed from red to yellowish it shows decreased in rainfall

4. In what direction (N, E, S, or W) did the band of heavy rainfall move between 1:00 and 1:10 p.m.?

   At East direction the band of heavy rainfall move between 1:00 and 1:10pm

5. Between 1:00 and 1:30 p.m., what happened to the weather in Augusta, and how do you know?

   At 1:10 pm, It started raining lightly and at 1:20 pm the rain started to fade but at 1:30pm, It started raining heavily.

6. Between 1:00 and 1:50 p.m., what happened to the weather in Atlanta, and how do you know?

   From 1:00pm to 1:50pm, the rain went from 30-35 to 15-20 dbz

7. Between 1:00 and 1:50 p.m., what happened to the weather in Athens, and how do you know?

   From 1:00pm to 1:50pm, the rain went from 35-45 dbz to 30-35 dbz

Summary of Key Terms and Concepts:

- Digital elevation models (DEMs) are three-dimensional digital representations of surface topography.
- Doppler radar is radar that uses microwave energy to measure velocity of particles of rain or hail within a cloud.
- Google Earth is a virtual globe that provides information about Earth's surface features and allows users to examine spatial relationships among features.
- Google Earth sidebar layers are activated to display different kinds of data, including borders, places, photos, roads, and research activities about oceans, the atmosphere, and water and mineral resources.
- LiDAR (light detection and ranging) operates on the same principle as radar but uses optical light (in the form of a laser) rather than radio or microwave energy.
- Radar is a remote sensing technology that uses radio waves or microwaves to determine the distance, shape, and altitude of surface topography.
- Remote sensing collects information about Earth's physical features without being in direct contact with them. Imaging from satellites, radar, and sonar are examples of remote sensing technologies.
- Sonar works by sending a pulse of sound from a transmitter. The echo of the sound is received and used to create a map of the features of the seafloor.