**Introducing Google Earth Pro**

During the course of the quarter the instructors hope to familiarize you to several different visualization systems for observing geographic information. In laboratory 1 Google Earth Pro will be utilized to introduce students to some of the basic geography of Puget Sound, as well as some of the different types of data that can be presented using the Google Earth platform. We will also introduce some of devices and techniques that are used to acquire the data that is used to create the layers we will observe.

Google Earth Pro is computer software system that allows the display and manipulation of Geographic Information Systems (GIS) data using a web browser. Many of you may already be familiar with the free version of Google Earth. The Pro version will give us several important capabilities over the free software, including the ability to import and create GIS data layers (in kml or kmz file format), print higher resolution images, and make movies. In this instance we would like to introduce a system that you will likely be dealing with in your future, as a student, professional or in your personnel life. For your information and use, the link to Google Earth’s help/user guide is: <http://earth.google.com/support/bin/static.py?page=guide_toc.cs>. Additional basic information on Google Earth can be found at: <http://en.wikipedia.org/wiki/Google_Earth>.

Many “layers” of geographic information have been prepared in advance for our labs. We will use Google Earth Pro to mix-and-match various views of the Puget Sound Ecosystem and to study its properties.

Due to the number of computers available in SAL, we will divide the class into teams of two, however, each individual student will be responsible for turning in a lab assignment with responses that indicate you worked independently. You should see the Google Earth Pro icon on your desktop. Click on the icon to launch Google Earth Pro. For further help, refer to the “Help/User Guide” link provided above, or click the “Help” button in the upper right corner on the toolbar at the top of the screen.

**Getting Started With Google Earth Pro**

**The following is an introduction to using the basic components of the Google Earth Pro interface.**

# From the desktop, click on the Google Earth Pro icon, the system should launch, providing you with a view of the globe in a large window to the right, toolbars at the top of the screen and a left column with three windows.

## The left column contains all the links you will use for studying the GIS data. It contains three windows that may be collapsed as the browser window opens. Open the “Places” (center) window by clicking on the triangle at the right of the bar containing the label. Under the “My Places” folder click on the yellow place-mark titled Puget Sound Basin. You will automatically fly to a view that looks down upon Puget Sound.

## You will notice a series of folders will be available in the “Places” window as well as the “Layers” window. The folders in the “Layers window are provided with the Google Earth Pro software. The “Places” window contains layers that have been built for this lab (notice the folder marked Lab 1 Ocean260 Fall 2010), as well as imagery updates and any files that you download or import into Google Earth Pro. By clicking the box next to each folder, additional sub-categories or folders can be made available. Quickly open each folder and scan the list of categories to see the lists of data and information available for visualization.



## Clicking on an empty box to the left of a sub-category will cause these data to appear on the map in the large window to the right. From the “Layers” window, open the folder “borders and labels,” open the folder “labels” and check the box to make “Populated places” visible.

### Move the cursor across the screen and take note of the data appearing at the bottom. You will notice that latitude, longitude and elevation data for are presented and change as the cursor is moved. The elevation at which the image is being viewed from is available in the lower right hand corner.

### On the right hand side of the image window you will notice the slider for magnification. Drag the slider and click on the buttons to zoom in or out. Next, use your cursor to double click near the city of Seattle, it should automatically zoom in on your area of interest.

### As you scroll across the image take note of your cursor. Move the cursor directly over the dot that marks Seattle. Did you notice it changed from a little hand to an arrow. This indicates that you can click on the item for attribute information, in the case of this data layer, a wide variety of information about Seattle becomes available.

### If you have a scroll wheel on your computer mouse, place the cursor over the map, scroll it one way, and wait. Then scroll the other way and wait. What do you observe?

### If you click the mouse and hold (the hand cursor draws in its fingers), you can drag the map around (pan).

### Click on the circular tool directly above the zoom slider tool (it has a hand in the middle surrounded by four arrows that point out). Press on the arrows and you will observe that this tool can be used to pan.

### Click on the circular tool above the “pan” tool. This tool has a couple of important functions. Clicking on the arrows to the right and left causes the image to rotate (notice that the “N”, indicating the direction of the North Pole, also rotates). Clicking on the arrows at the top and bottom will cause the image to tilt. Zoom in on an area of interest, use both the rotate and tilt functions to explore imagery.

### Using your mouse, scroll to the middle of the image window. Make sure that the open hand is visible (not the arrow for selecting attributes). Right click on the mouse and hold, circle the mouse and observe how your view adjusts.

## Use the zoom and pan tools to make the Puget Sound region fill the center panel of the viewer.

### Turn off “Populated Places” and check the “Western WA Major Water Bodies” layer that can be found in the places window under the folder “Water Bodies, Rivers/Streams.”

### Use the clicker to identify one of the features (i.e., one of the water bodies) on the map. Note that the cursor will show an arrow over major water bodies (rather than an open hand), indicating attribute information is available.

### Note that the attribute information is displayed in a pop-up window. What attribute information is available for water bodies?

## Now turn off the “Western WA Major Water Bodies” layer and click on both the “Western WA Major Rivers” and “King County Rivers” layers.

### How can you tell the difference between these 2 layers in the map?

### How can you get information about features in these data layers?

### Note that directly below the “My Places” window there is a horizontal slider bar. Move this slider back and forth. What do you see? Keep in mind that this function can be very useful when comparing similar data layers, for example historical photos with the latest satellite imagery. You may find this tool helpful later in Lab 1.

### Select the “Ruler” tool from the icons on the tool bar at the top of the screen, note the instruction window that opens. Turn the “Populated Places” layer on again and measure the distance between Seattle and Everett according to the map. How many miles? How many kilometers?

**Introducing the Puget Sound Watershed**

# Now that we have familiarized ourselves with some of the navigation tools we can begin the lab exercise. Begin by un-checking the data layers that you have opened. **Remember to only have layers necessary for each question open. Too many layers opened slows down the program significantly!!**

# **Puget Sound Basins** (2.25 pts.) Make the “Western WA Major Water Bodies” layer visible to compare the view in Google Earth Pro to the map of Puget Sound salt-water sub-basins on the page below. This map considers “greater” Puget Sound to include all of the inland salt water of Washington State. By left clicking on a water body, or any other object, you will obtain information about that object. This will be useful for answering the following questions:

## (0.25 pts.) What water body of greater Puget Sound does the Google Earth Pro identify as “Puget Sound?”

## *Main Basin*

## (0.5 pts.) What does Google Earth Pro call the waters immediately north of the San Juan Islands? Immediately south of the San Juan Islands?

## *Strait of Georgia, “Straight” of Juan de Fuca*

## (0.5 pts.) List the names of the four largest major water bodies in Google Earth Pro that are part of the Whidbey Basin.

## *Port Susan, Possession Sound, Saratoga Passage, Skagit*

## (0.25 pts.) What is the name of the large bay that connects to the northwest side of Hood Canal?

## *Dabob*

## (0.5 pts.) List 5 of the 6 major inlets in Google Earth Pro that are part of the Southern Sound.

## *Carr, Case, Henderson, Eld, Totten, Hammersley/Oakland*

## (0.25 pts.) What is the name of the bay off downtown Seattle?

## *Elliot Bay*



# **Puget Sound Rivers** (2.75 pts.) Make the “Western WA Major Rivers” layer visible and active.

## (0.25pts.) Identify 2 of the three major rivers flowing into the Strait of Juan de Fuca.

*Dungeness, Elwha, Hoko*

## (1 pts.) Identify 4 of the 5 major rivers feeding into Hood Canal.

*Tahuya, Dosewallips, Duckabush, Hamma Hamma, Skokomish*

## (1 pt.) In the table below, identify 8 major US rivers that feed the **eastern shore** of greater Puget Sound north of Tacoma, and give the Google Earth Pro name from the “Western WA Major Water Body” layer into which each flows.

|  |  |
| --- | --- |
| Major US River | Major Water Body |
| *Nooksack* | *Lummi & Bellingham Bay, Strait of Georgia* |
| *Samish* | *Samish Bay or Strait of Georgia* |
| *Skagit* | *Skagit or Whidbey Basin* |
| *Stillaguamish* | *Port Susan or Whidbey Basin* |
| *Snohomish* | *Possession Sound or Whidbey Basin* |
| *“Stream” (L. Washington Ship Canal)* | *Puget Sound or Main Basin* |
| *Duwamish* | *Puget Sound or Main Basin or Elliot Bay* |
| *Puyallup* | *Puget Sound, Main Basin, Commencement Bay* |
| Major US River | Major Water Body |

## (0.5 pts.) Identify 3 rivers flowing into the Southern Sound (south of Tacoma Narrows).

## *Nisqually, Deschutes, Black*

# **Puget Sound Terrain** (5 pts.) Make the “Snoqualmie USGS Topo Map” layer visible. Zoom to view the area between Seattle and the crest of the Cascade Mountains (note this data layer only covers a small area of western Washington that includes a region between Seattle and the Cascades).

## (0.5 pts.) What physical property does this layer represent? How do you think the data for this layer were originally obtained?

## *Topography = elevation, from land-based surveying*

## (0.5 pts.) How does this layer depict the data is represents? Zoom in very close to view the layer if necessary.

## *Contour lines of elevation*

# Turn off the Snoqualmie USGS Topo Map. From your DEM folder, find and make visible the “Seattle Bathymetry w/ DEM (hillshade)” layer along with the “Seattle USGS Topo Map” layer.

## (0.5 pts.) What does the DEM layer add to the data view? Why does this layer improve your view of the physical property represented?

## *It shades the eastern slopes of the terrain as if the sun were shining from the west. This makes the terrain appear much more realistic than it does from contour lines alone.*

## (0.5 pts.) What physical property does the DEM layer represent? How are these data obtained? If you are unsure, consult <http://en.wikipedia.org/wiki/Digital_elevation_model>.

## *Digitized elevation model = topography derived from aerial & satellite photography and radar and digitization of historic topographic maps. The computer then adds shading.*

## (0.25 pts.) Turn off the “USGS Topo Maps” layer. Why is the DEM layer alone not as useful as the two layers combined?

## *The loss of color makes some features such as lakes less evident.*

# Make “Seattle Bathymetry w/ DEM (hillshade)” as the only visible layer. Zoom so that this layer fills the center panel.

## (0.5 pts.) Once again this data layer has been cut from a larger layer and we are visualizing a more limited extent due to the large size file size. There are not any blank spots that represent missing data for this sub-section of the Western WA Bathymetry w/ DEM layer, but if we could show the entire layer for Washington you would notice large areas missing. Why do you think the layer that represents the entire state does not cover all of Washington?

## *The data are obtained mostly by aerial & satellite photography and radar and only portions of western Washington have been surveyed so far.*

## (0.5 pts.) Zoom in to view Seattle and Bainbridge Island. What do you notice about the difference in detail between terrain above and below sea level? How would you explain this difference?

## *The data are more detailed on land, because the underwater terrain can’t be surveyed aerially & most be constructed from sonar data.*

## (0.5 pts.) What do you notice about the compass orientation of the terrain features (i.e. hills) on land? How would you explain this pattern?

## *The hills are elongated in a north-south direction because of the travel of the glaciers during the last Ice Age.*

# Make the “Seattle LIDAR DEM” layer visible.

## (0.5 pts.) How does this layer display elevation data compared to the “Seattle Bathymetry with DEM” layer?

## *It uses color to indicate elevation, red at low elevation to yellow, green, blue, and red again at higher elevation.*

## Close the “Seattle LIDAR DEM” and open both the “LIDAR – Discovery Park/West Point” and “Seattle Bathymetry with DEM” layers. Compare the two layers by sliding the fade bar.

## (0.5 pts.) See “About LIDAR” at the UW site <http://pugetsoundlidar.ess.washington.edu/> (on lab page). How is LIDAR data collected versus more conventional DEMs such as the “Seattle Bathymetry with DEM” layer?

## *The data are obtained by aerial laser photography, which is much more sensitive than visible light photography or radar, and can penetrate tree cover (“virtual deforestation”).*

## (0.25 pts.) By comparing the “LIDAR – Discovery Park/West Point” and “Seattle Bathymetry with DEM” layers, what can you see about the quality of LIDAR images compared to conventional topo maps and DEM images?

## *Much finer resolution revealing smaller-scale features.*

# **Puget Sound WRIAs** (1 pt.) Make the “Western WA WRIAs” layer active and visible.

## (0.25 pts.) What does the acronym WRIA stand for, and what physical entity does a WRIA represent? If you are stuck, check [www.ecy.wa.gov/apps/watersheds/wriapages/index.html](http://www.ecy.wa.gov/apps/watersheds/wriapages/index.html)

*Water Resource Inventory area; major watershed basins*

## (0.5 pts.) Zoom in on WRIA 7 (Remember, you can find info about a layer by left clicking on it). What is the name of the hydrologic feature that this WRIA represents? What are the names of the WRIA’s immediately to the north and south of WRIA 7?

*Snohomish watershed; Stillaguamish, Lake Washington (cedar-sammamish)*

## (0.25 pts.) The river system in WRIA 7 contains 3 major sub-units shaped like a letter Y, with the base of the Y entering salt water in Everett. Use the layers available to you to figure out the names of each of the three legs of the Y.

*Snohomish , Skykomish. Snoqualmie*

# **Puget Sound Land Cover / Land Use** (1 pt.) Zoom and make layers active, visible and invisible as appropriate so that you can study the “Washington Land Cover/Land Use” layer in the vicinity of WRIA 7.

## (0.25 pts.) What type of Land use / Land cover appears to cover the largest amount of area outside of urban areas? Hint: Expand the “Land Use” menu for the legend.

## *Conifer forest, maybe also Mixed deciduous forest*

## (0.25 pts.) What dominant type(s) of Land use / Land cover occur(s) at the highest elevations?

## *Snow/rock/ice*

## (0.25 pts.) What dominant type(s) of Land use / Land cover surround/follow(s) major US rivers?

## *Mixed deciduous forest*

## (0.25 pts.) Where do most urban Land use / Land cover areas occur?

## *Near Puget Sound*

# **Puget Sound Land Ownership** (1.25 pts.) Zoom and make layers active, visible and invisible as appropriate so that you can study the “Western WA Land Ownership” layer in the vicinity of WRIA 7.

## (0.25 pts.) Which entity is the largest single landowner in this region? Which branch of this entity is the primary owner/manager?

## *Federal government—Dept. Agriculture U.S. Forest Service*

## (0.25 pts.) Who owns the region north of Everett and the mouth of the Snohomish River?

## *Tulalip indian*

## (0.25 pts.) What is the large area owned by “City or Municipal Government” southeast of Seattle?

## *Cedar River Watershed*

## (0.25 pts.) Who owns area around the mouth of the Puyallup River?

## *The Puyallup Indian tribe*

## (0.25 pts.) What is the area owned by the state government near the center of Seattle?

## *University of Washington*

# **Puget Sound Political Boundaries** (2.75 pts.) Use the Google Earth Pro tools as appropriate so that you can answer the following questions.

## (0.5 pts.) What do you observe about the correspondence between WRIA boundaries and the northern & southern boundaries of counties along the east shore of Puget Sound (the counties layer can be found in the “Layers” window, in the borders folder under “2nd level Admin Regions”)?

*The county boundaries mostly follow roughly east-west lines, which cross watershed (WRIA) boundaries. The King-Pierce and Pierce-Thurston lines follow the river courses in mid-watershed.*

## (0.5 pts.) In what counties does WRIA 7 reside?

*Snohomish & King*

## (0.25 pts.) What WRIAS (name & number) lie all or partly within King County?

## *7 Snohomish, 8 Cedar-Sammamish, 9 Green-Duwamish, 10 Puyallup*

## (0.5 pts.) What kinds of difficulties might this cause for land-use managers?

## *Have to coordinate & negotiate with managers in multiple counties to manage a single watershed consistently*

## (0.5 pts.) What do you observe about the correspondence between WRIA boundaries and the eastern boundaries of counties along the east shore of Puget Sound?

*The eastern boundaries of the counties generally follow the WRIA boundaries.*

## (0.5 pts.) How would you explain your observation?

*Both boundaries follow the crest of the Cascade Mountains because that is the watershed boundary between eastern & western Washington.*

# **Puget Sound Population** (2 pts.) Use the Google Earth tools as appropriate so that you can answer the following questions.

## Turn on the “Population – Census tract centroids” layer. Here centroids points from census tract polygons (the points directly in the center of census tracts) are visually represented. Tract size/areas are roughly correlated to population density. To answer the following questions zoom out enough to see Western WA.

## (0.5 pts.) Where are the most densely populated areas in the Puget Sound region?

*Along Puget Sound, especially the eastern shore, and in the river valleys*

## (0.25 pts.) Do these densely populated areas coincide with political or natural boundaries?

*Not really political, but natural, yes*

## (0.25 pts.) In general, what is the spatial relationship between population density and water bodies (salt water, lakes, rivers) in WRIA 7, i.e. where do most of the census points show up? It may also be useful to look at the Land Use layer to see where the most developed areas are.

*The densest populations are in Everett & Marysville near salt water. In suburban & rural areas, population & small towns are concentrated along lakes (Lake Stevens) and rivers.*

## (0.5 pts.) What might account for this population density distribution, i.e. why would people historically settle in these areas?

*Water bodies once were a means of transportation; river valleys were easier to traverse & settle than slopes; farming along river valleys was an earlier means of livelihood. River valleys also offered flat land, which was easier to farm than hillsides & mountains. Largest cities grew along salt water because of ports.*

## (0.5 pts.) How might this population density distribution impact salmon?

*Human impacts are concentrated near water bodies, causing degradation in stream conditions*

## **Bonus** (0.5 pts.) Find the building where you are now sitting using aerial photos. Show the TA or instructor and get this question checked off or print the image and attach it to your lab assignment.

## **Bonus** (0.5 pts.) In the layers window turn on the “3D buildings” layer. Find the space needle in downtown Seattle. Tilt the view until you are looking in the window. Show the TA or instructor and get this question checked off, or print the image and attach to your lab assignment.

# **Snoqualmie Valley Land Alteration** (2.0 pts.) This Google Earth Pro project includes several layers created from data collected at different times in recent history. This information was taken from the Puget Sound River History website. Additional information may be found by visiting the River History website at <http://riverhistory.ess.washington.edu/index.html> and clicking on the “data” link. The different types of layers we will look at today are as follows:

* GLO Plat maps – The General Land Office (GLO) mapped the Puget Lowland between about 1850 and 1890.
* Aerial photos – taken at various times in the past. These photos have been orthorectified (corrected to be true representations of the earth’s surface) prior to inclusion here.

# Navigate Google Earth Pro to find the confluence of the Snoqualmie and Skykomish Rivers to form the Snohomish River in WRIA 7. We will use Google Earth Pro to examine the landscape changes that have occurred in this area over time. Hide the layers on Rivers & Streams and DEM, which depict recent conditions. We will use these layers later for comparison.

## (0.5 pts.) Make the “GLO Plat Maps–Confluence Snoqualmie and Skykomish Rivers” layer visible and active. What do you think the stippled areas on either side of the Snoqualmie River represent? Turn on and off all of the “Historical Photos and Maps” layers to help answer this question, keeping in mind land alterations between the times of the GLO maps and the first aerial photos.

*Wetlands (“swamps”) formed by flooding, some of which have been converted to farms by the 1930s.*

## (0.5 pts.) Turn layers on and off as necessary to compare the latest Google Earth imagery with the GLO maps. How do the modern Snoqualmie river course and the land cover in the surrounding valley differ today? Hint: Using the slider for fading images at the bottom of the “Places” window may be helpful.

*The river course is about the same. The wetlands are nearly completely converted to farmland, with just traces of “Crescent Lake” and a pond with a small creek course where a large wetland southwest of the river once was.*

## (0.5 pts.) Turn layers on and off as necessary to use the Snohomish/Snoqualmie DEM (hillshade) layer to study the terrain in this region (look in the Snoh Snoq DEM HS folder). What do you notice about the shape of the terrain immediately on either side of the Snoqualmie River? What do you think accounts for this shape? To help understand the processes that create this terrain, make the two “Flood Hazard” layers visible.

*The areas flanking the river are very flat. They are frequently flooded and river sediment is laid down. The flood hazard area exactly matches the flat terrain in the river valley.*

## (0.5 pts.) How does the shape of the terrain immediately on either side of the Snoqualmie River relate to the natural features visible in the GLO maps and to the land alterations visible in the recent aerial photos? *I'm looking for you to spot the locations on the DEM terrain layer, and to say why the riverside terrain fostered human conversion of the land from its prior land cover to its present land use.*

*The flat areas created by flooding retain water to become wetlands. They were converted to farmland because of the rich soils, ample water, and level terrain for easy cultivation.*