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GEOGRAPHY 328 Lab 3: Terrain Analysis

Introduction:

Weather stations are an essential facility on land to help gather useful data information for the purpose of predicting future forecasts. These stations are devices that collect ongoing data that is related to the weather and the environment, by using many different instruments. Each of these individual stations contains sensors such as a thermometer (for temperature measurements), a barometer (for measuring atmospheric pressure), as well as others (such as measuring rain, wind, and humidity). (WeatherUnderground.2015) The temporal data collected can be further analyzed and studied to determine the local climate and the possible upcoming weather sequence. This information is critical to understanding how precipitation can influence the watershed. The main objective of this lab is to determine the best suitable location for the new weather station in the Sooke Watershed area under the contract by Environment Canada. This can be determined by constructing a Digital Elevation Model with the provided data files to imitate the watershed region.

Data and Study Area:

The main study location for this lab assignment is the Sooke Watershed area. Most of the population living in the Greater Victoria area's drinking water comes from this site. Sooke Lake Reservoir has been the primary water source for the region since 1915, and in 2010 over 320,000 citizens depend on this supply of water (CRD,1998-2015). This water reservoir is located in the Sooke Hills area, which is about thirty kilometers northwest of the City of Victoria. The Sooke Lake Watershed area is made up of 27,240 acres of land and at its full capacity; it can contain up to 20.4 billion liters of water and is equivalent to 31 million Olympic-sized pools (CRD. (CRD,1998-2015).

In the lab file, it is provided with two types of data files and required to create the third type. Most of the data files provided by the lab material is limited to discrete data of points, lines, and polygons that are either in vector or raster format. The raster files associated with the provided Sooke Watershed are in a 20m resolution. The provided discrete line vectors files are, "scontour," "sroad," "sstream," and "sutility." Files such as "sforest," "slake," and "ssoil" are discrete polygon vectors and the single discrete point vector file provided is the "sallysm" file. The second type of data files provided are continuous data; the variables presented by the data files change continuously over the surface area (Fowler.J,2015). However, the only provided continuous raster file for this lab is the "sooke_dem" file. This provided continuous raster file is used to generate two other same types of files "sooke_slope%" and "aspectsooke." The “sooke_dem” continuous raster file can also be used to create discrete raster files, “Viewshed_sooke” and “above_500.” After the performance of “reclassify” most of the continuous raster files are converted into discrete raster files.

Lastly, the lab is required to construct a third type of data model known as TIN, Triangulated Irregular Network, using the provided line and polygon vector files. The created TIN file represents the entire Sooke Watershed area using non-overlapping and contiguous triangles. These triangles create a 3D model, which helps the visualization of the area’s elevation.

Methods:

To be able to understand the climate behavior, it is essential to monitor the climate variables with the help of weather stations. The acquired data can be used as a guidance to help direct the capacity of watershed. The objective of this lab is to construct a Digital Elevation Model of the Sooke Watershed region that represents the best placement location for the new weather station. There are four main criteria that needs to be follow first to limit down the best possible location. The first criteria stated the new location must be visible from the existing stations. This could be determined by performing the view-shed analysis, but first, the four existing weather stations must be located. The view-shed analysis help identified the visible surface areas from the four stations and transformed the continuous raster, “sooke_dem”, file into discrete raster file with the separation of “visible” and “not visible.” A further step needed to be taken to reclassify the values in this image to simple “1” and “0” (“1” meaning acceptable location and “0” vise versa). This reclassification step allows the performance of raster calculator to incorporate the four criteria image into a final product due to its new value classification.

The second criteria suggested that the slope cannot be greater than 15%. To able to determine this criteria, the slope raster continuous file needed to be constructed first using the “sooke_dem” file. A crucial step for this process was to convert the degree values into percentage. The newly created slope file needed to be reclassified in order to determine the slopes that are less than 15%. This can be done by using the reclassify tool and manually changing the old values to the desired range and limiting the new values into two categories; no greater than 15% = “1” and greater than 15%= “0”. The third criteria limited the new weather station to be only facing east downslope direction. This can be performed with the help of the aspect tool, which “identifies the steepest downslope direction from each cell to its neighbors” (Fowler.J,2015). Similar to the steps before for the reclassifying procedure, the numbers of the old value were manually changed to the desired range of 40-140 degree and the new values of “1” was given to this range. The ranges that were below 40 and above 140 degree were given the new value of “0” indicating that this information is unnecessary.

Lastly, the final criteria proposed that the weather station must be located at elevation that are greater than 500m. This could be determined with the help of raster calculator tool by performing the written algebra expression. This process was as simple as entering “sooke_dem” >500m in the expression box and the output result classified the image into the area with elevation that are greater than 500m and area that are not. The reclassify process was performed to make the values to “0” and “1” just like the previous criteria image to enable the creation of the final product.

The four final reclassified images were combined into the concluding image that shows the best possible locations for the placement of new weather station. This process can be done by using the Raster Calculator. However, after following the four main criteria, the placement of the station needs to follow a specific guidelines presented by the Environment Canada. This would be further discussed in the Discussion Section.

Results:

The location of the new weather station at the Sooke Watershed Area is presented in Figure 1, (attached to the following page). This location falls under the 4 criteria that were given and carefully follows the specific guidelines given by the Environment Canada.

Table 1. Reclassify view-shed

reclass_view

Rowid	VALUE	COUNT
0	0	138000
1	1	91286

(0 out of 2 Selected)

Table 2. Reclassify slope (< 15%)

reclassslo

Rowid	VALUE	COUNT
0	0	130505
1	1	98781

(0 out of 2 Selected)

Table 3. Reclassify aspect

Reclass_aspect

OBJECTID *	Value	Count
1	0	154870
2	1	74416

(0 out of 2 Selected)

Table 4. Reclassify 500m

500

Rowid	VALUE	COUNT
0	0	161565
1	1	67721

(0 out of 2 Selected)

Discussion:

The placement location for the new weather station is the essential step for monitoring the climate variables. Informations collected by the station can be analyzed along with the nearby weather stations. This analyzation can help to draw conclusion about the climate behaviors of the local region. The city of Victoria is a great example; With the School-Based Weather Station Network spread all over the city, it can help to understand the influences of temperature, precipitation, humidity, windspeed and other variables on the local climate. The behavior of local climates can effectively influence the watershed capacity and the information gathered by these stations are critical for monitoring the watershed. With that being said, the placement of the new weather station is crucial.

The Environment Canada provided a specific guidelines to follow enable to locate the best fit area for the placement of new weather station. It is required to be in an open area of level ground with available space of at least 90m by 90m (EnvironmentCanada,2005). The given raster resolution is 20m by 20m so the available space for the weather station on the model has to be at least four pixels in size. Such location should also be a distance from topographic features or possible vertical obstructions to maintain a correct results (EnvironmentCanada,2005). Obstruction and features can affect the climate variables and lead to a false conclusion. The placement of the new station should also be easily accessible for maintenance and with that being said, the weather station needs to be placed close to the roads (EnvironmentCanada,2005). The placement should avoid being on top of hills or near any steep hills, isolated ponds and streams due to the possibility of influencing the data. However, the new placement should also avoid from being too close to the roads due to snow removal equipment can affect the site (EnvironmentCanada,2005). Weather station need to be placed away from shadows, reflective surfaces, and any source of artificial radiation due to the potential blockage/alteration of the measurement accuracy (CampbellScientific,Inc.1997).

In Figure 1. the chosen location has a flat elevation with space of at least 90m by 90m. It can be accessible from two nearby roads for maintenance, but it is not close enough for the possibility of mankind vandalism or alteration from snow removal equipment. The placement also avoided being on top of the hill, or nearby topographic features that could lead to the possibility of discourage misleading climate results. However, the potential error of this placement is the missing given contour lines. It appeared that part of the contour lines has been cut out and could potentially be a very steep hill where it would be unsuitable location based on the specific guidelines from Environment Canada.

Conclusion:

The placement of weather station is critical to understand the relationship between climate and the watershed. With over 320,000 citizens depending on the Sooke Watershed for the clean supply of water (CRD,1998-2015). The management of the watershed is crucial for people's safety. With that being said, the information gathered by these weather stations can be used to help monitor and understand the watershed. Using the given data files, a model that represented the four criteria was created with the best possible locations of the new station. The provided specific guidelines by Environment Canada helps narrow down all the possible locations into the one best fit location for the new weather station. A possible improvement is to have the full contour lines to improve the justification of this best fit location.

References:

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