Determining Potential Fire Point of Ignitions in the Okanagan Shuswap Forest District

Sarah Campbell

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Abstract

Millions of hectares are destroyed by fire worldwide each year. In order to prevent this ecological and economic disaster, GIS models are used to predict fire characteristics such as rate of spread and point of ignition. Point of ignition is defined as the point in which an ignitable mixture automatically ignites due to sufficient oxygen vapor supply. There are a number of variables that contribute to igniting a fire at a specific location. Four different variables were used in this study. Using a Multi-Criterion Evaluation, factors were weighed according to their importance to produce a final output which will determine the potential fire point of ignitions within the Okanagan Shuswap Forest District.

Introduction

Forest fires have led to the disruption of houses, vegetation, and release of pollutants into the air. Therefore it is important to determine the initial point of ignition of a fire and to examine how this may affect human safety and changes to the environment. GIS models provide a look into the point of ignitions of fire and may be able to predict future fires.

My study focuses on potential areas susceptible to fire point of ignitions (POI) in the Okanagan Shuswap Forest District (DOS). The Okanagan Shuswap region lies in an area that is highly susceptible to forest fires. Important factors when considering point of ignitions include: proximity to campgrounds, proximity to roads (indicating settlement), proximity to previous POI (due to a re-ignition), fuel types (vegetation), moisture and aspect. I decided to use four of the above factors: proximity to roads, proximity to previous POI, aspect and fuel types.

Study Area and Data Sources

Located in the southern interior of British Columbia, the Okanagan Shuswap Forest District is one of 29 Districts in the Province.

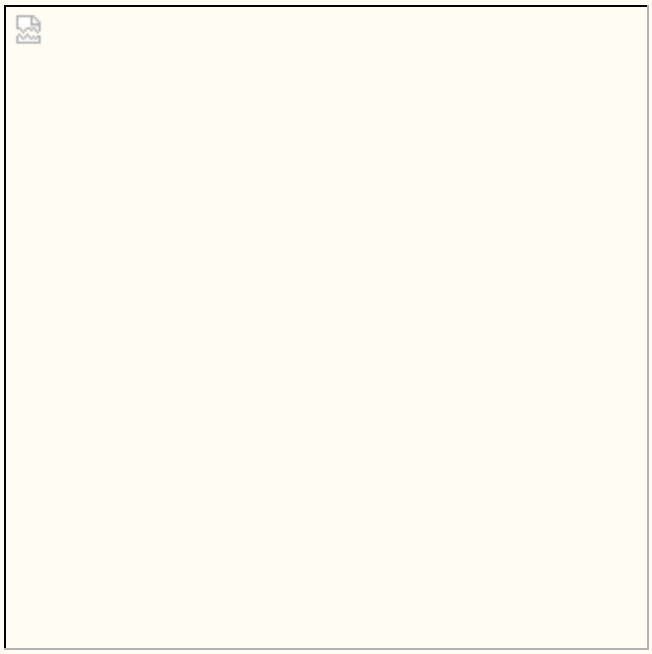


Figure 1: BC forest districts with higlighted Okanagan Shuswap District (http://www.for.gov.bc.ca/mof/maps/)

Five GIS datasets were used in this analysis including:

- 5 digital elevation model 1:250,000 sheets (82e, 82l, 82m, 92h, 92i)
- Road data (obtained from Mapplace.ca)
- Okanagan Shuswap Forest District boundary (obtained from BC Ministry of Forests)
- Forest Cover data (UNBC GIS lab)
- Previous Fire Point of Ignitions 2006 (obtained from BC Ministry of Forests)

Software used in this study included: ArcMap, ArcCatalog, Arc. In additon, a program called SAGA was used when dealing with the large DAM datassets and reprojecting them.

Data Manipulation

DEM
The Okanagan Shuswap Forest District covers 5 1:250000 map sheets. It crosses two different UTM zones and therefore needed to be reprojected into BC Albers. Due to the large area it covered ArcGIS proved to slow and unreliable to reproject so a program called SAGA was used instead. ArcGIS when then used to append all raster grids into one. The DEM was then clipped to DOS boundary. Aspect was then derived from the DEM.

DOS Boundary
DOS was reprojected to BC Albers.

Roads
Due to the large areas of this study, TRIM data would prove cause difficulties. Instead, road data was obtained from mapplace.ca. Road data was clipped to the DOS boundary.

Vegetation Data
Vegetation Data was converted from coverage to a shapefile. All 5 mapsheets were appended and then clipped to the DOS boundary. Vector data was then converted to raster data under the field of leading species.

Point of Ignition
Co-ordinates were obtained from the Ministry of Forests site and inputed and converted in Excel. The data was exported into ArcGIS and then reprojected to BC Albers.

Methods / Procedure

All 4 factors needed to be generated into raster format.

Factor 1: Aspect

-Fires tend to ignite on south facing regions. Therefore aspect was weighted with south being rated 3, east, west and flat ares were 2 and north facing areas were rated as 1.

Factor 2: Forest Cover

-Different tree species will result in more or less fuel for ingiting fires. Fuel types are very important when determining the point of ignition Therefore Black Spruce (SB) was rated as 4, Pine species (PLI, PL, PW) was rated as 3, Douglas Fir (FD, FDI) as 2 and all other tree species were rated as 1.

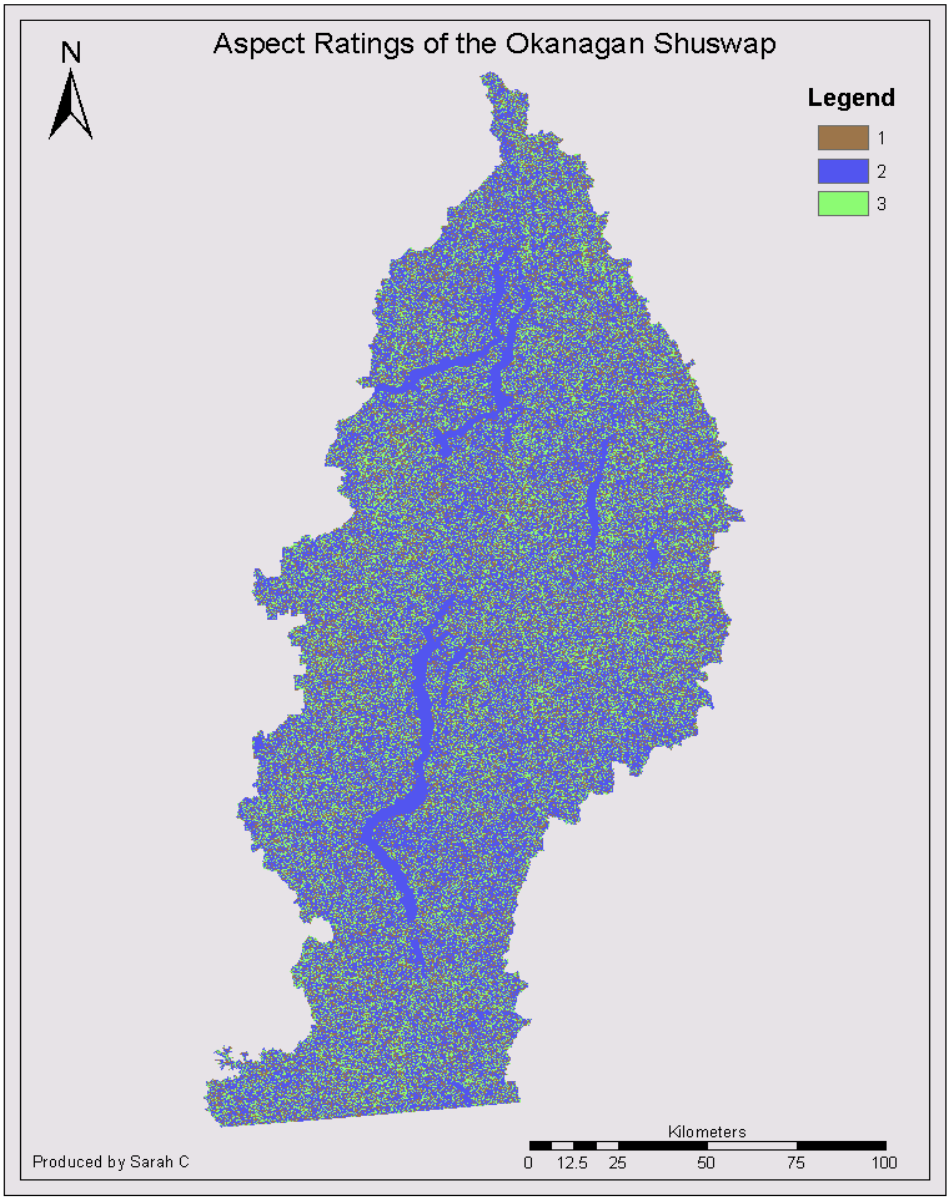
Factor 3: Proximity to Roads

-distance was derived from roads. Values of 100m or less from the roads were rated as 4, 200m from roads was rated as 3, 300m from roads was rated as 2 and distances of 400m was rated as 1. Distances of 400m or more were classfied as 0 because they did not have any impact.

Factor 4: Proximity to Previous POIs

-distance was derived from POIs. Values 100m or less from previous POI were rated as 1 whereas anything over 100m was given a rating of 0.

All 4 factors were reclassified and generated into new rasters. Weights were applied on each factor rating to achieve a final dataset.
A weight of 0.5 was applied to aspect, 0.3 on fuel types, and a weight of 0.1 for both proximity to road and proximity to previous POI.


Aspect Ratings of the Okanagan Shuswap
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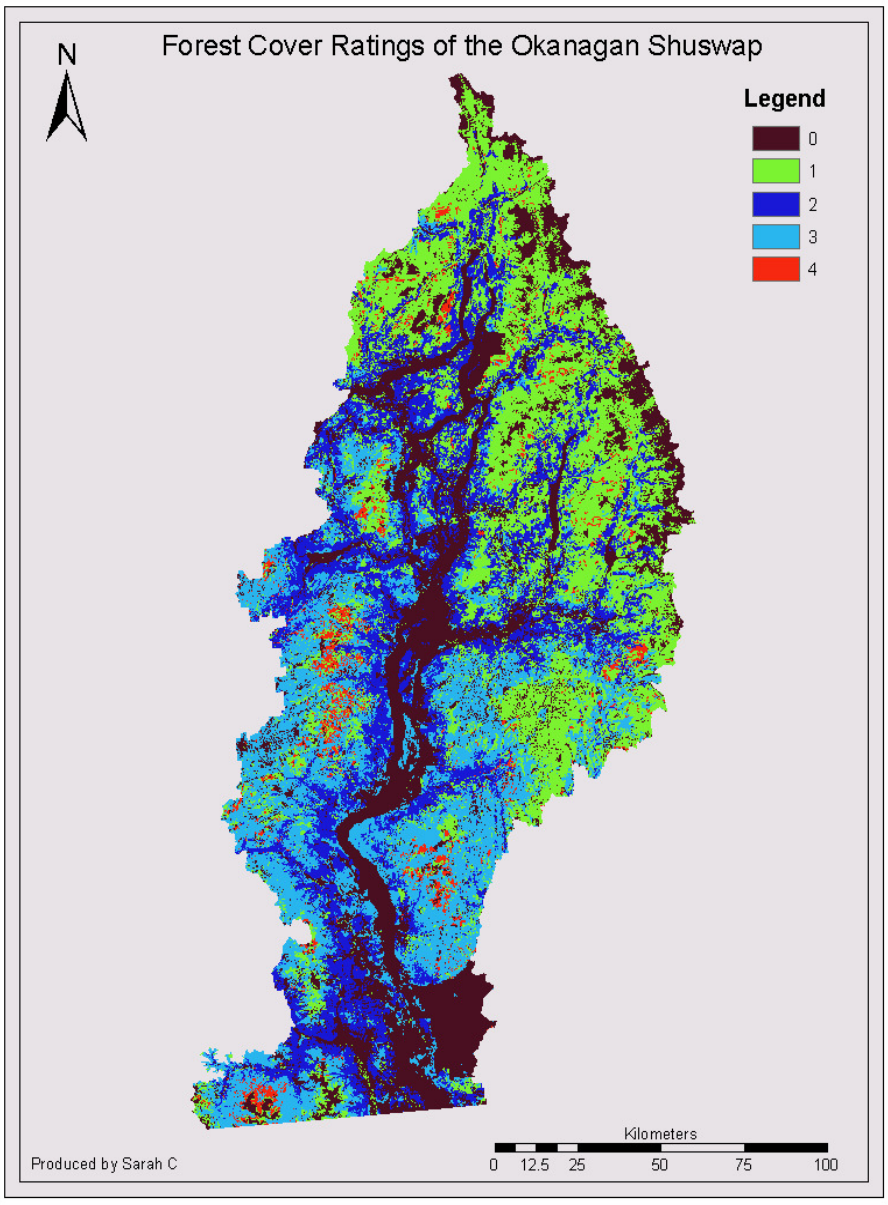
Legend
1
2
3
Kilometers
0 12.5 25 50 75 100
Produced by Sarah C


Forest Cover Ratings of the Okanagan Shuswap
N
Legend
0
1
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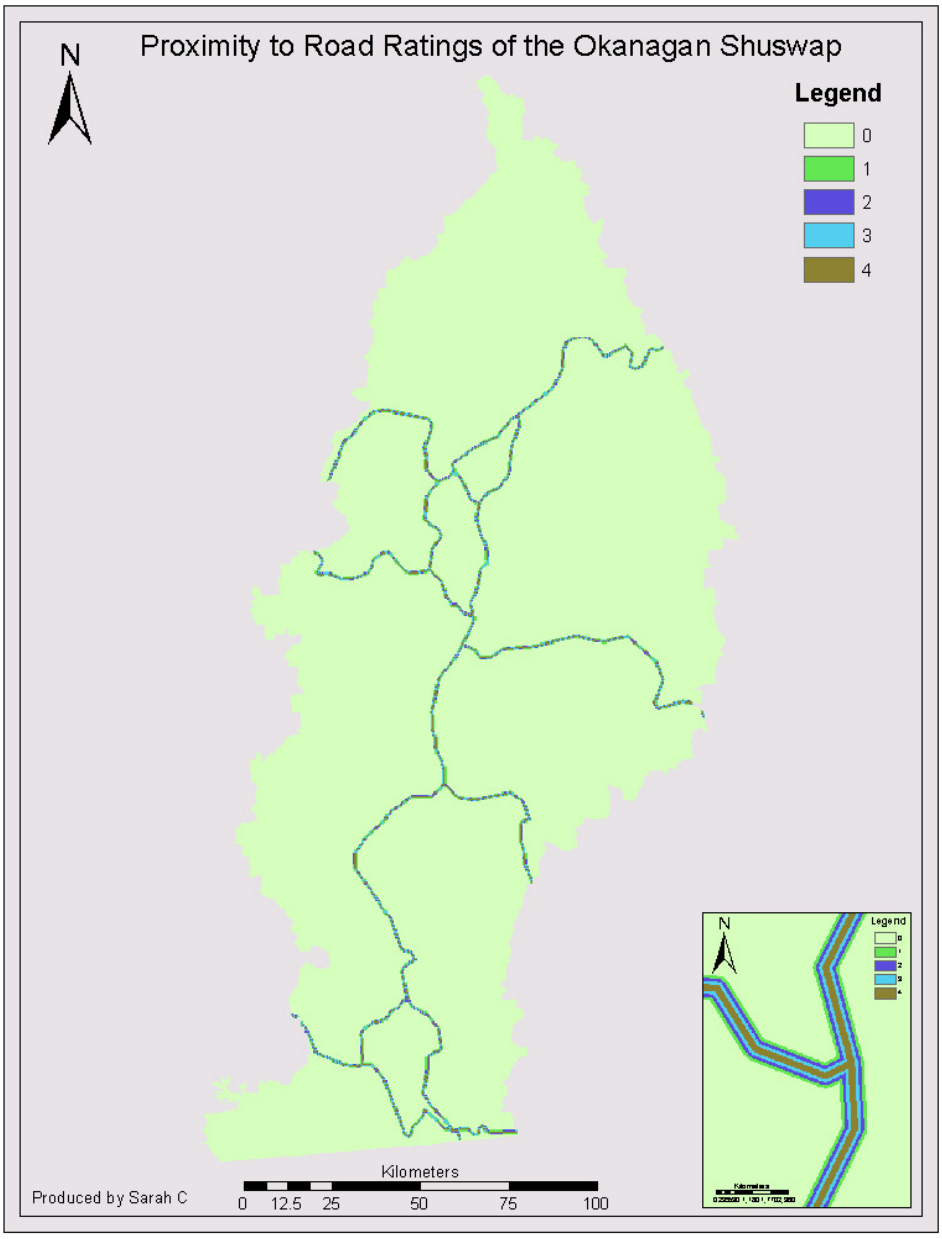
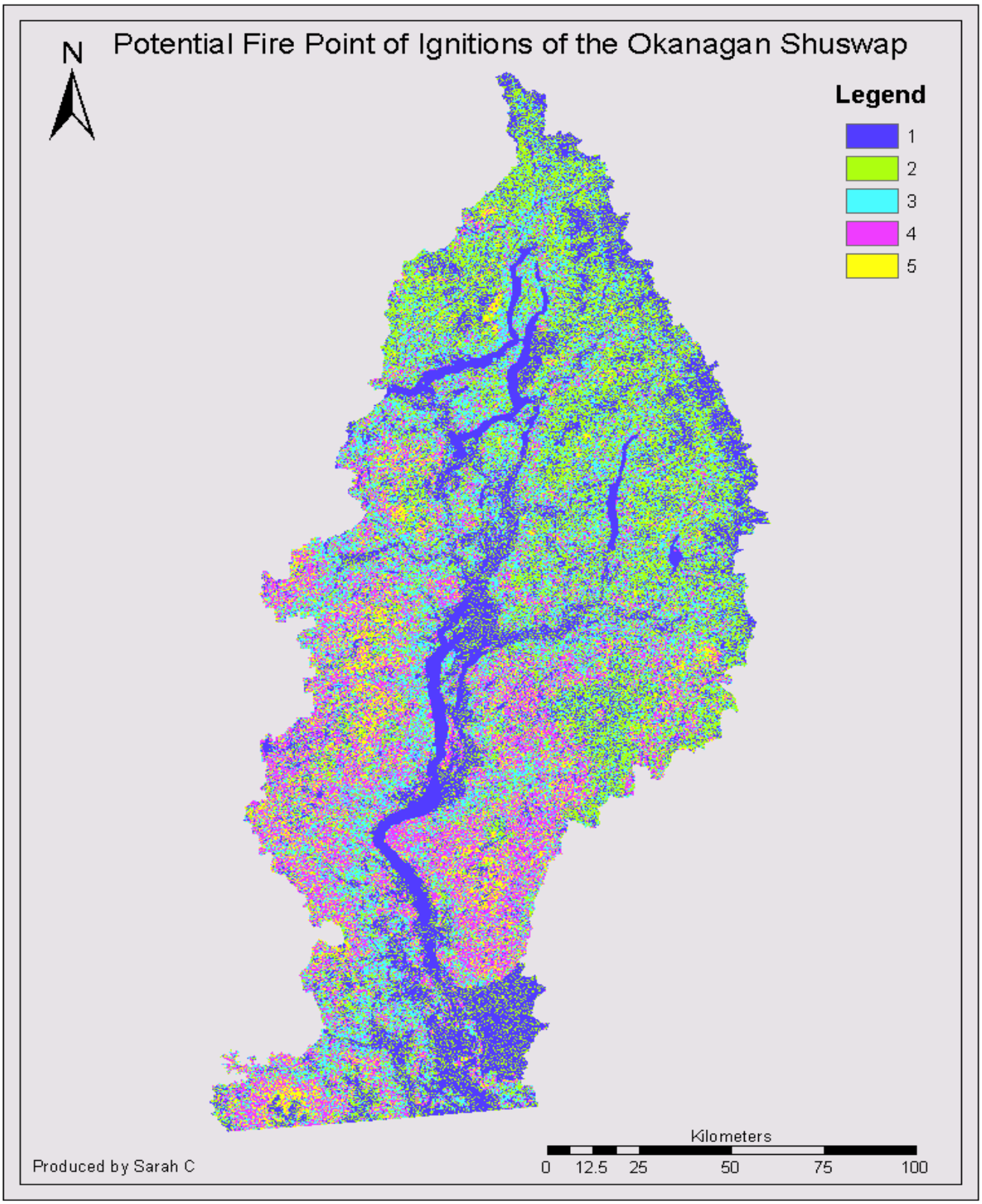
4
Kilometers
0 12.5 25 50 75 100
Produced by Sarah C



Results

The final output rating for potential fire point of ignitions. A factor of 5 will have the highest potential of a fire starting whereas a factor of 1 will have the lowest potential of a fire igniting.



Conclusions / Discussion

Highest POI potentials were scattered through the DOS area. However, a higher occurance does appear in the southern region. Lowest potentials were located on water sources. Advantages to using MCE methods is that it can provide information as to where settlements should and should not exist as well as where high damage to ecosystems could occur.

Management and prevention techniques could use this knowledge to decrease the risk to humans and animals.

The limitations of this method are: it only takes into account a handful of factors that affect fire point of ignitions and discards a great deal of information that may or may not prove to be important. To provide a more precise model other variables including moisture data and proximity of campgrounds could be included as criteria. However using too many parameters in a model doesn't nessessarily increase the precision of the model and can sometimes make the model very unreliable. In addition models of fire data are highly unpredictable. GIS cannot account for all factors therefore not making it entirely accurate. In addition, determining the factor weight may not always be entirely accurate and may differ among literature and studies.

Problems arose with such a large dataset. Increasing the cell size, would make proccesses go faster however, the detail needed for aspect and forest cover would be lost. However, decreasing the cell size made processes go extremely slow but there would be adequate detail.

Future Works / Developments

One suggestion to this study is to find a smaller region within the Okanagan Shuswap District and perform analysis on the smaller region instead of the full district. Processes would run more smoothly and results would most likely be more precise. In additon, more variables may be incorporated into a smaller area.

References

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Anderson, K. et al. Operational Forest Fire Growth Predictions for Canada. Canadian Forest Service. 2007.

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The Vital Role of Geographic Systems to Fight Forest Fires. IFFN. No. 33. July-December 2005, 93-98.

All datasets for this project are located on the UNBC Ninkasi Server: N:\campbe5\geog413\term_project_fast

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TOP