

Lab 5: Exposure Assessment - Potential Health Risk Analysis

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GEOG 328 B03

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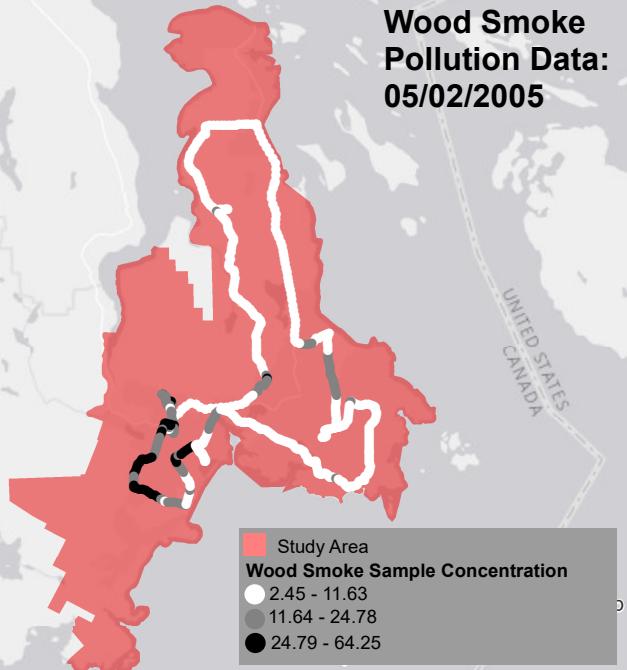
1.

Analyzing the distribution of wood smoke in the CRD is an inherently spatial problem. GIS platforms such as ArcGIS or QGis allow the analyst to take many spatial and socioeconomic factors into consideration such as elevation, wind speed and wind direction as well as mean income and percent low income. The information gained from the analysis can be passed down to decision makers to determine the highest risk areas. However, the quality of analysis is heavily dependant on quality of the input data. If the input samples are not distributed in a evenly or in a logical manner, there will be many areas of high interpolation and thus high uncertainty. In addition, using interpolation and advanced GIS methods can create a “false” sense of accuracy as a beautiful seemingly quantified surface is created, however, it is important to know the distribution of the data and which areas area interpolated to higher degrees then others.

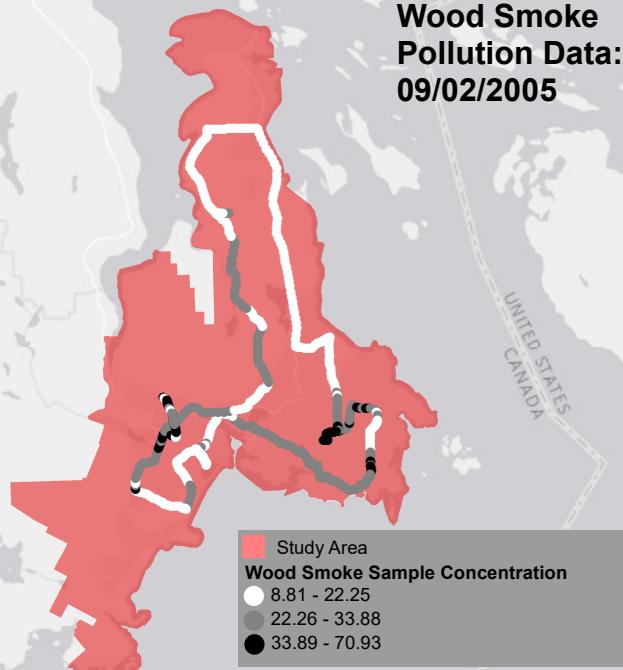
2.

The wood smoke pollution sample points from the Capital Regional District in 2005 are shown on the following page (Figure 1) with categorized symbol based on levels of concentration. This data provides semi-adequate coverage of the heavily populated areas in the CRD. The sample points suggest higher levels of wood smoke pollution in Victoria and Esquimalt regions, and lower wood smoke pollution in Saanichton, North Saanich and Sidney municipalities. It is important to note that there are very few samples in Saanich, and therefore this region will see high degrees of interpolation introducing error and uncertainty. Overall, the sample points and temporal data provide enough data to create a meaningful interpolated surface.

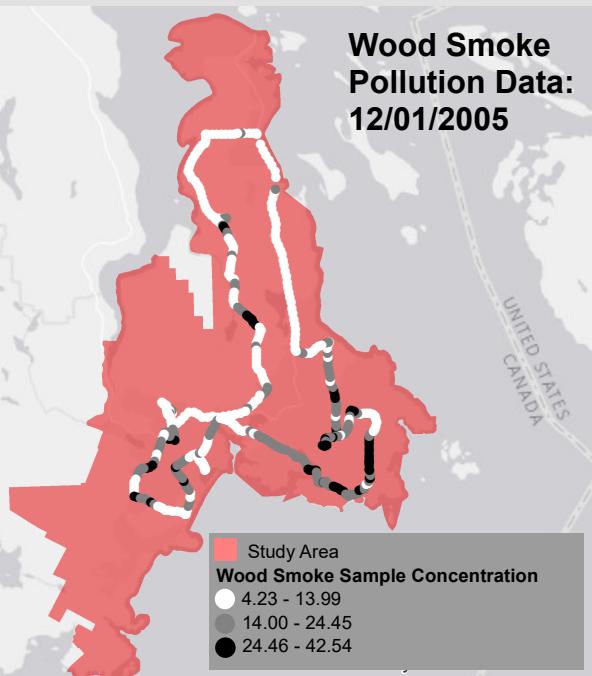
**Wood Smoke
Pollution Data:
05/02/2005**



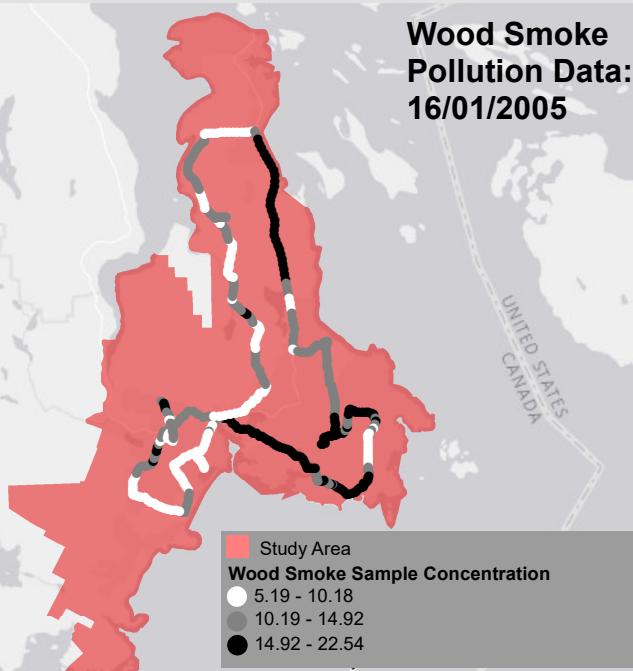
**Wood Smoke
Pollution Data:
09/02/2005**



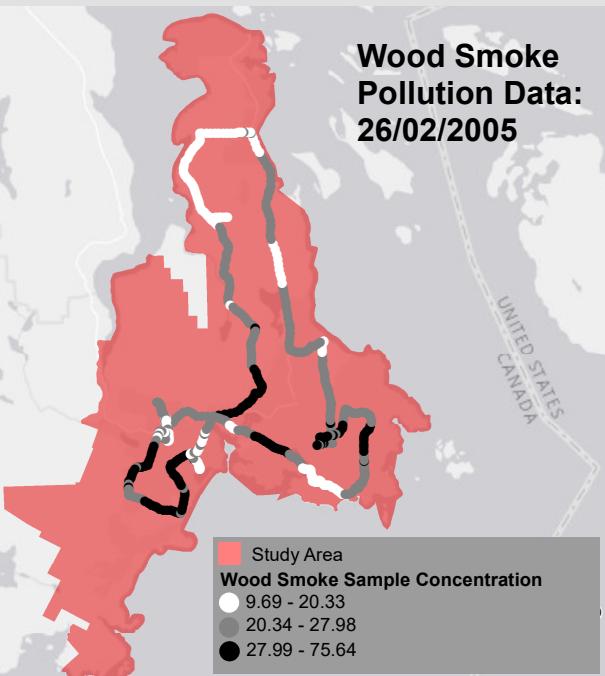
**Wood Smoke
Pollution Data:
12/01/2005**



**Wood Smoke
Pollution Data:
16/01/2005**



**Wood Smoke
Pollution Data:
26/02/2005**



Meta-Data:
Cartographer: Connor Schultz
Coordinate System: NAD 1983 BC Environment Albers
Projection: Albers
Classification: 3 Class, Equal Interval

Note: Classes are different for each figure due to the classification.

Figure 1: Maps of Capital Regional District showing the distribution of wood smoke pollution sample points

3.

A 250 meter spatial resolution was used to interpolate the wood smoke pollution points. This was chosen because of the distribution of the points relative to each other. There are areas that have a higher density of points and greater interpolation would reduce accuracy.

The 25m, 500m, 1000m and 3000m IDW surfaces for February 5th, 2005 are shown on the following page (Figure 2). The 250m resolution IDW surface “appears” to have a higher accuracy as it creates sharper lines and more distinct boundaries, however it is only more accurate in the high density areas. As the resolutions increases, details are lost. The centre area of the “loop” of points shows a highly concentrated wood smoke area in the 250m resolution surface. As the resolution is increased, the details on this area begin to be smoothed and generalized.

**05/02/2005 250m
IDW Interpolation Surface**



**05/02/2005 500m
IDW Interpolation Surface**



Samples

- 2.46 - 11.63
- 11.64 - 24.78
- 24.79 - 64.25

Cartographer: Connor Schultz
Coordinate System: NAD 1983 Albers
Projection: Albers
Classification: 3 Class, Natural Breaks

**05/02/2005 1000m
IDW Interpolation Surface**



**05/02/2005 3000m
IDW Interpolation Surface**



4.

A map showing physical variables (wind direction, wind speed, elevation) and the concentration of wood smoke pollution is shown on the following page. The wood smoke and wind speed layers were over-layed in red and blue as transparent layers. The high wind speed and high concentration areas will thus be shown in purple. The DEM is layered as a base layer to provide elevation details.

The map shows a relationship between high wind speed, north facing winds, lower/flatter elevations and the levels of wood smoke concentration. This is to be expected as the high winds tends to “trap” smoke in lower elevation valleys. The smoke will accumulate in these areas causing higher pollution. The areas with lower wind speeds typically see less accumulation.

Wind Direction, Wind Speed and Elevation, and their combined effects on wood smoke pollution data from the CRD in 2005.

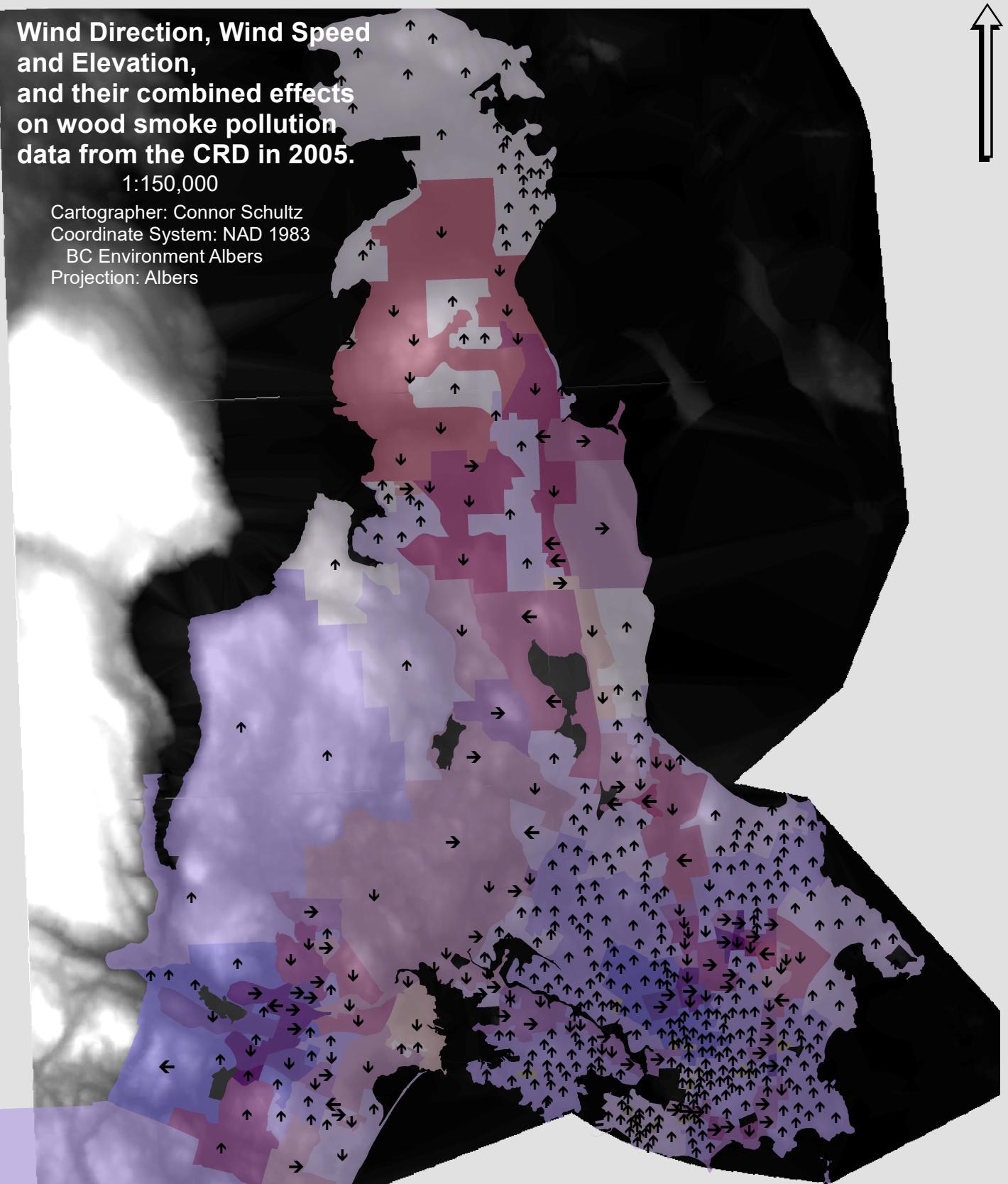
1:150,000

Cartographer: Connor Schultz

Coordinate System: NAD 1983

BC Environment Albers

Projection: Albers

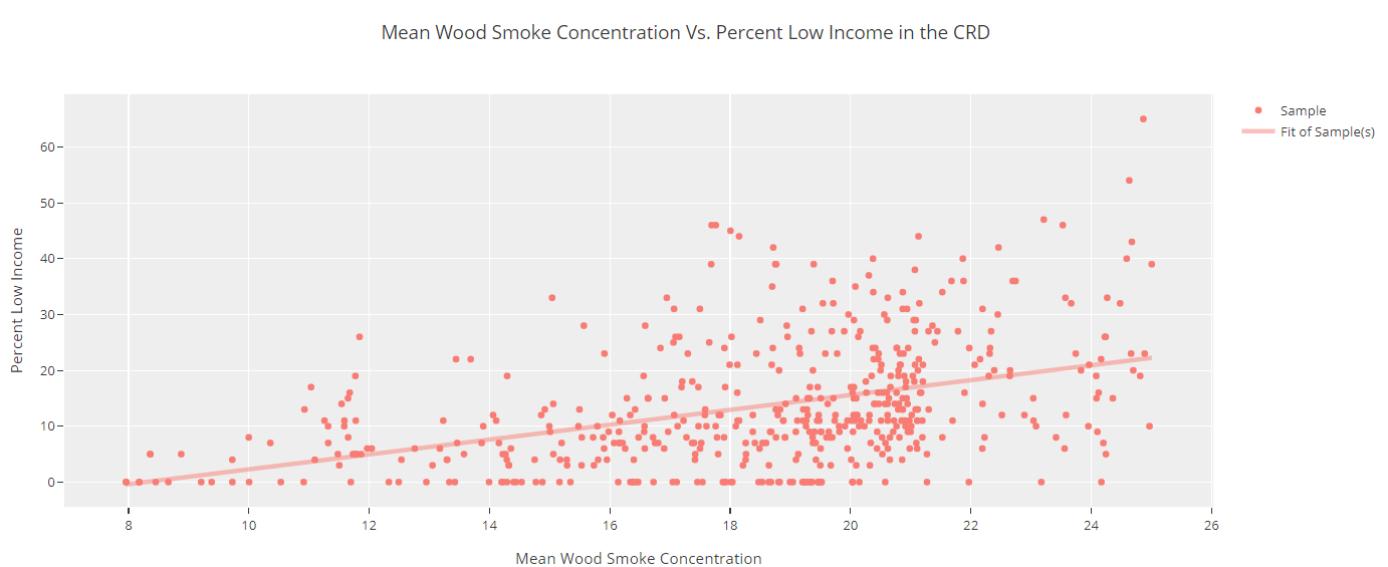
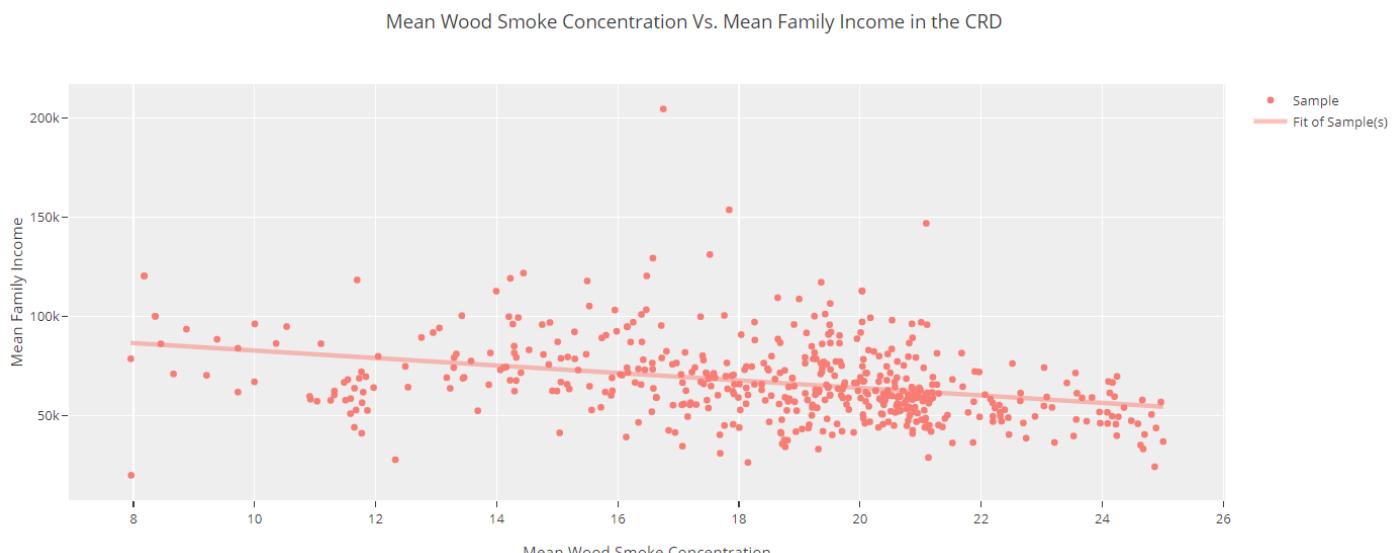


Wind Direction	Wind Speed	Elevation (m)	Wood Smoke Concentration
↑ Up	0.000000 - 0.133440	High : 610	7.956240 - 13.687511
→ Right	0.133441 - 0.411322	Low : 1	13.687512 - 18.148504
↓ Down	0.411323 - 0.851744		18.148505 - 21.526527
← Left	0.851745 - 2.388000		21.526528 - 25.006142

5.

The plots shown below show a relationship between levels of socioeconomic hardship and levels of wood smoke pollution. The first plot shows wood smoke pollution versus mean family income. The plot and line of best fit generated from the data show a weak inverse relationship between mean family income and wood smoke pollution.

The second plot shows wood smoke pollution versus percent of low income population. The plot and line of best fit generated from the data show a moderate relationship between percent of low income population and wood smoke pollution levels.

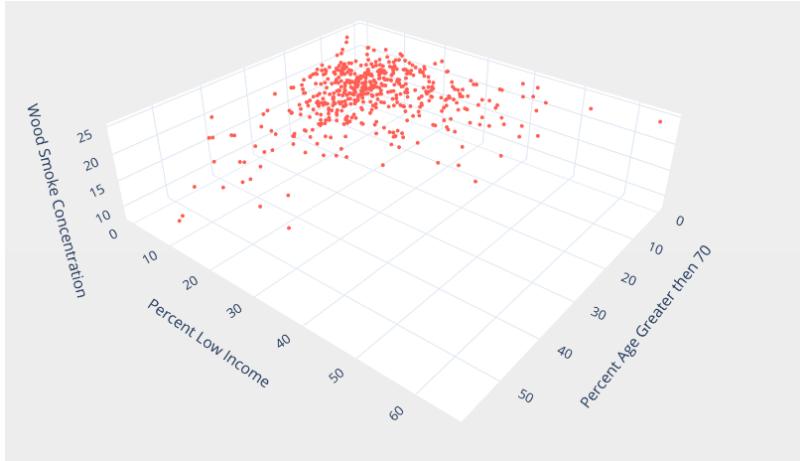


6.

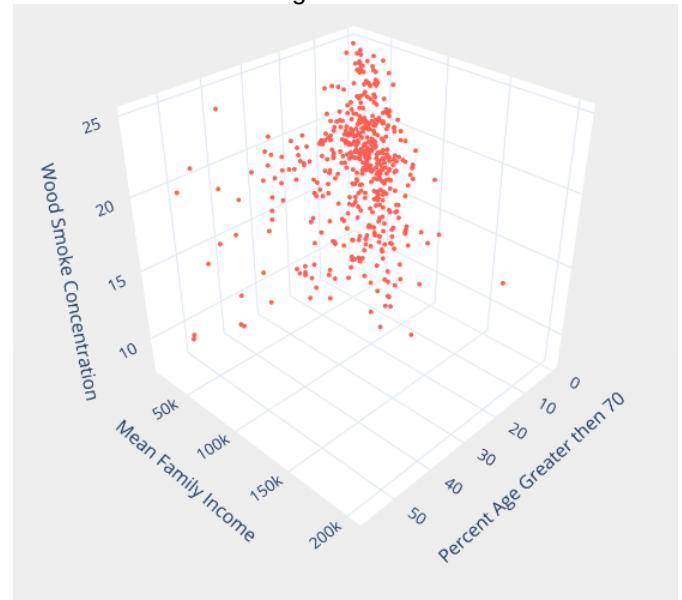
The regions that were determined to be most susceptible to wood smoke pollution were lower income areas with higher rates of poverty. These areas are suspected to mostly have residents over the age of 5 (less young families) and less than 70 (less elderly residents).

The 3D scatter plots shown below show a relationship between these variables. As the percent of elderly or young residents increases along with mean family income, wood smoke population decreases. Similarly, as the percent of elderly or young residents decreases and the percent of population low income increases, wood smoke pollution appears to increase from the plots shown below.

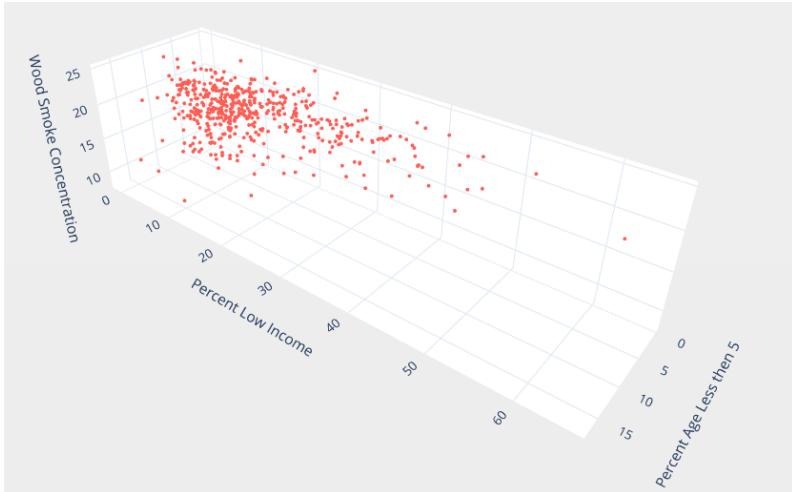
3D Plot 1: Wood Smoke x Percent Low Income x Percent Age Greater than 70



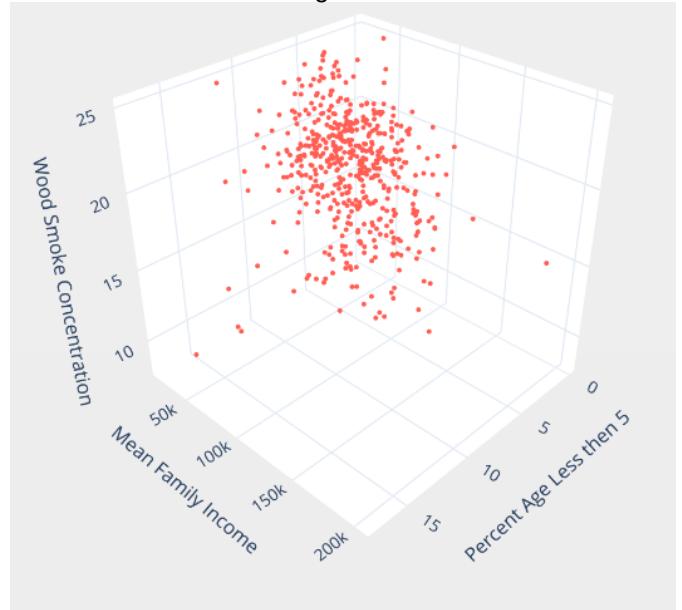
3D Plot 2: Wood Smoke x Mean Family Income x Percent Age Greater than 70



3D Plot 3: Wood Smoke x Percent Low Income x Percent Age Less than 5



3D Plot 2: Wood Smoke x Mean Family Income x Percent Age Less than 5



7.

In conclusion, the figures and cumulative wood smoke pollution determined from the 2005 samples show that non-elderly and non-adolescent residents are at the highest risks in the lower income areas of the CRD. The data also suggest the highest pollution levels are typically located in the densely populated regions such as the municipality of Victoria. In order to make an accurate decision as a policy maker, more recent data as well as much more data distributed over the entire CRD would need to be considered to determine an accurate assessment in the region. The data suggests a relationship between certain physical and socioeconomic factors and levels of wood smoke pollution, however, there is not enough information and high levels of interpolation in the created surfaces. These surfaces are not enough to make decisions concerning the entire CRD.