FLORIDA TRAFFIC ANALYSIS AND ROAD FLOOD RISK ASSESSMENT

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Objective

The original objective of this project was to explore the capability of ArcGIS to understand the underlying influences in a geo-spatial system. A secondary objective was to evaluate the possibility of using hydrology tools to traffic data. The intention was to take the city of Houston or Austin as a case study and evaluate the underlying influences of traffic congestion on Houston roads. The underlying factors that were to be considered were:

- Weather – precipitation, temperature
- Traffic impediments – accidents and work zones
- Traffic demand – population of the city, daily and seasonal variability
- Physical highway features - # of lanes
- Gasoline price

A detailed search for relevant data from the cities of Houston and Austin revealed that there was insufficient publicly accessible information to perform the analysis initially considered. The next step was a search of available GIS data from transportation departments from several states and cities. The state of Florida ranked highly as a source of organized traffic GIS data available to the public.

Modified Objective

The objectives of this project were modified as per the available data from the state of Florida. The available data from Florida and national databases included:

- Average Annual Daily Traffic (AADT)
- Traffic Signal Locations
- County Population Density
- NHDPlusV2

The objectives are:

- Visually inspect for correlation between traffic signal locations and traffic volume
- Visually inspect for correlation between county population and traffic volume
- Identify points of flood risk on roads based on traffic volume and stream locations

Methodology

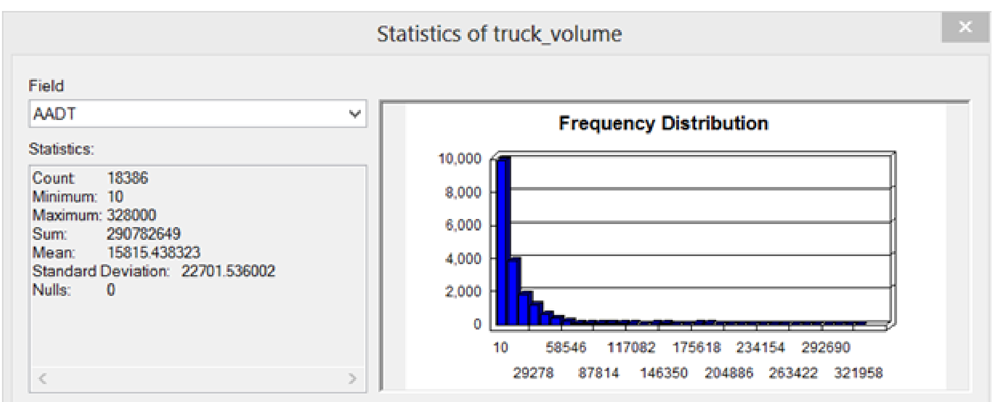
Traffic Volume

The traffic volume data was available in the form of AADT values on a polyline layer. Each line referred to a road. A consideration to be made here was to determine a method of visualizing traffic volume by region in Florida. Upon testing a few methods, a few observations were made.

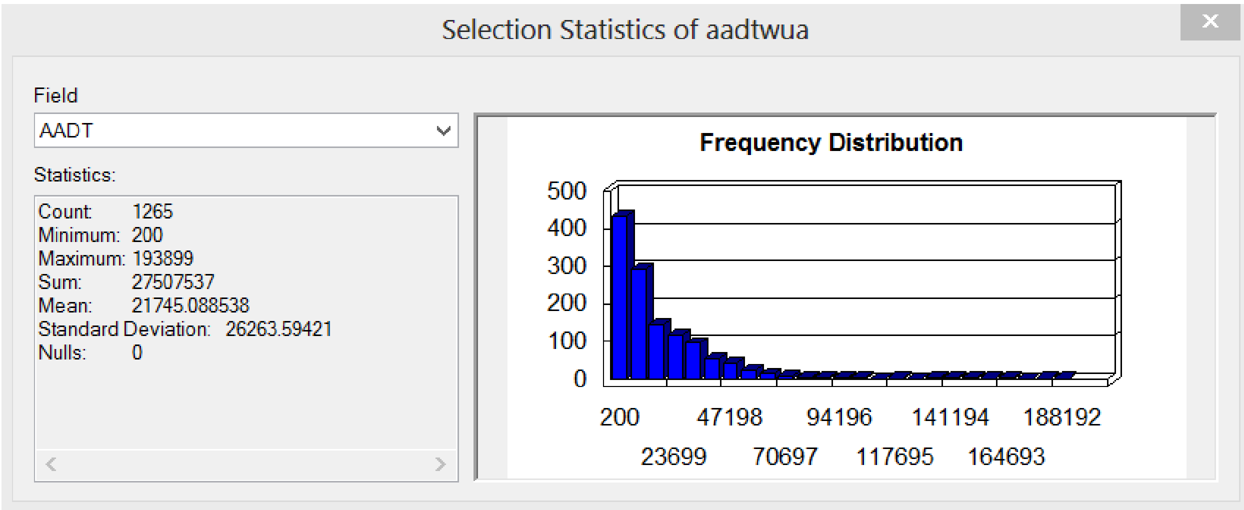
Firstly, due to the large number of roads that span the state, a map of the whole state with a colored gradient for traffic volume was overwhelming on the eye. This made it difficult to draw descriptive patterns about traffic volume and location. As majority of the variation in traffic volume happened closer to cities, the traffic volume layer was split by urban region for easier viewing and for highlighting the variation in traffic volume closer to the cities. Florida's urban region data used was a polygon layer entitled *ua2010*. A split of traffic volume by county did not prove useful in visualizing the flow of traffic. Figure 1 shows the map that was created based on splitting traffic volume data by urban region.

For comparison, I obtained statistics for AADT in the urban regions of Orlando and Miami using 'Select by Attribute' on the aadtwua attribute table and using the statistics drop down option. The statistics obtained are shown below.

Florida AADT Statistics:



Orlando AADT statistics:



Miami AADT statistics:

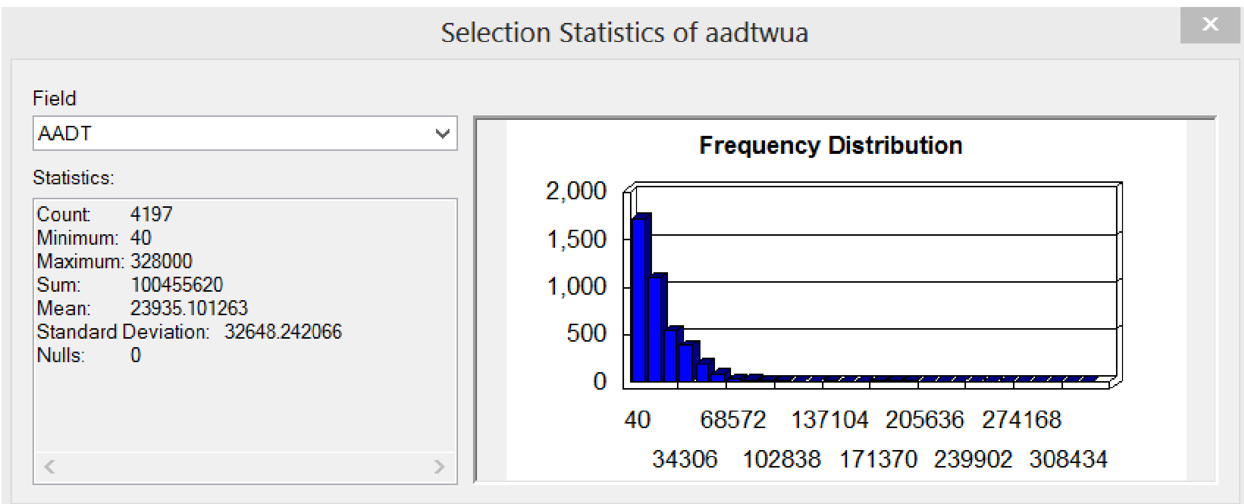


Figure 1. Urban Regions and Average Annual Daily Traffic

Traffic Volume and Traffic Signal Locations

The traffic signal locations layer is a point layer with each point referring to the location of a traffic signal. In order to visually identify patterns between traffic volume and traffic signal locations, two techniques were tested: higher resolution view of AADT and traffic signals in a city, and a lower resolution view of AADT density and traffic signal density.

In the first case, more traffic signals could be observed on roads that had higher AADT values. The yellow roads, with lower AADT, were less likely to have traffic signals on them. The traffic signals are the red points in Figure 2 below.

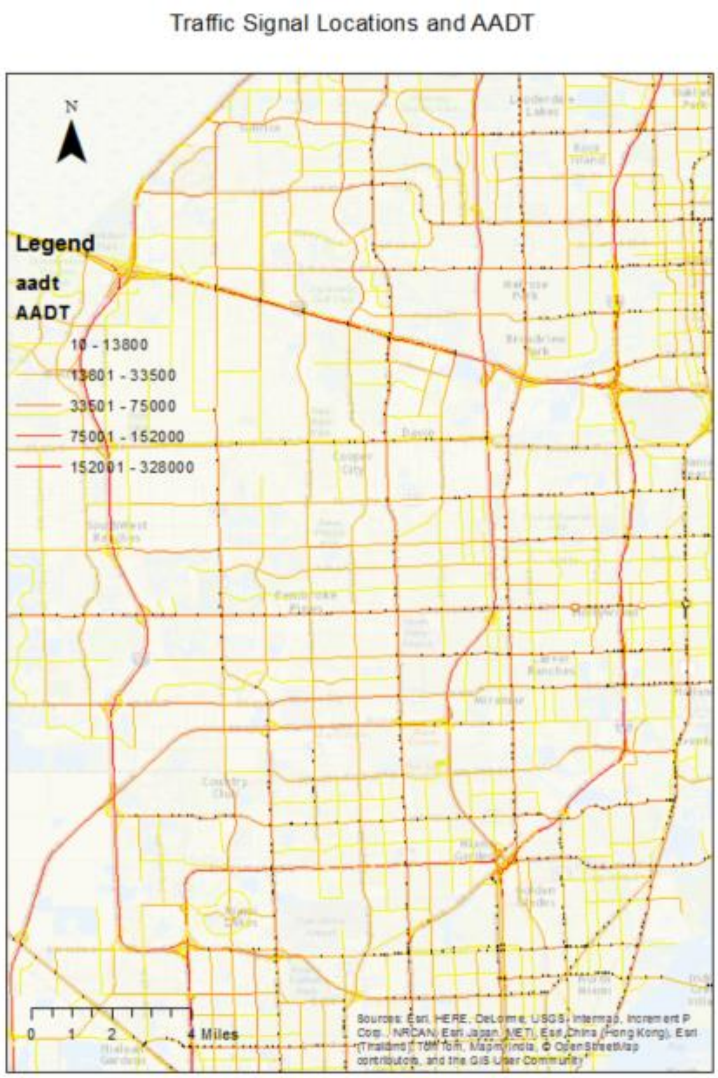


Figure 2. Traffic Signal Locations and AADT

In the second case, the AADT layer and traffic signal layer were converted to density layers. The 'Line to Density' and 'Point to Density' tools from the Spatial Analyst toolbox were used to make these conversions. The resulting layers were then viewed for the whole state of Florida. While the density layer does not represent accurate traffic signal locations and cannot be used to make scientifically accurate inferences, the correlation between traffic signal density and traffic volume was easy to observe. The density of county population was also presented to show patterns between traffic volume, traffic signal density and population density. The lower degree of resolution of county population density (at the county level) rendered visualizations on the city level to be of no value. Figure 3 shows the AADT intensity and the traffic signal density maps for the state of Florida. The county colors refer to population per square mile.

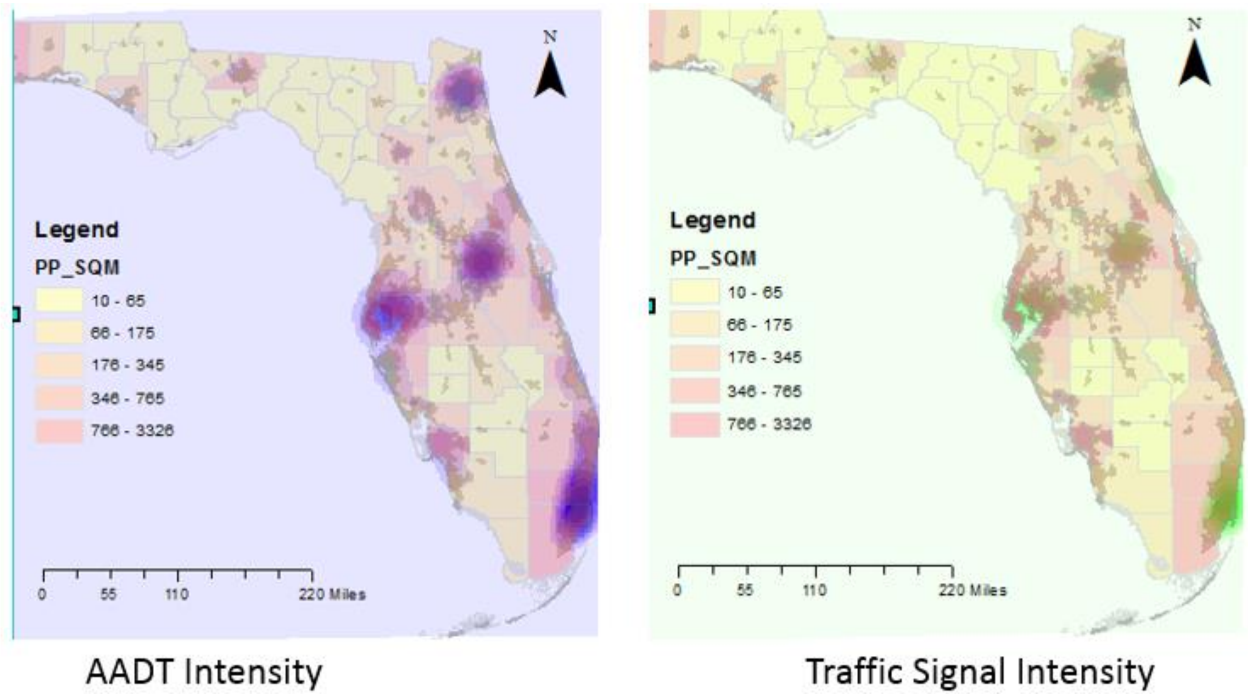


Figure 3. AADT Intensity and Traffic Signal Intensity

Identification of Flood Risk Areas on Roads

Floods pose a challenge to planners as they try to identify regions of higher flood risk. Risk may be evaluated on a variety of factors. For the sake of this study, risk to traffic was associated with the proximity of a stream to the road, and the volume of average annual traffic prevalent on that road. The higher the traffic, the higher the possibility of damage to human lives, hence the described calculation for risk. Traffic planners would benefit from being able to visualize the points of flood risk on the road network.

The stream network was obtained using NHDPlusV2 data set. The stream flow lines were specifically used to determine their proximity to Florida roads. The AADT layer was used for the road network. The next step was to determine locations where the road network intersected with the stream network considering that these points would be those of closest proximity of the roads to flooded streams.

Due to the size of the NHDPlusV2 flowline data set for the state of Florida, ArcGIS was unable to perform an intersection of the stream network with the road network. So, Broward County was chosen as a sample region to test in this project. The following steps were followed to obtain the points:

1) A select operation was done to extract the stream network for the Broward County alone
2) A new layer of the stream network was created to filter out stream flow lines that did not have flow information such as Gage Adjusted Flow readings. The reason for this choice is that for future flood risk calculations, a more accurate determination could be made based on the flow associated with each stream segment.
3) The Intersect tool was used to intersect the AADT network and the stream network to provide a layer of risk points in Broward County.
4) The risk points were allocated a risk value based on the AADT value of the intersection road.

The result can be seen in Figure 3 below. The level of risk associated with each of these points is shown in degrees of red, the darkest being points of highest risk. The stream lines are in blue and the AADT network is colored in an ascending order of traffic from yellow to red.

Florida: Points of Flood Risk in Broward County

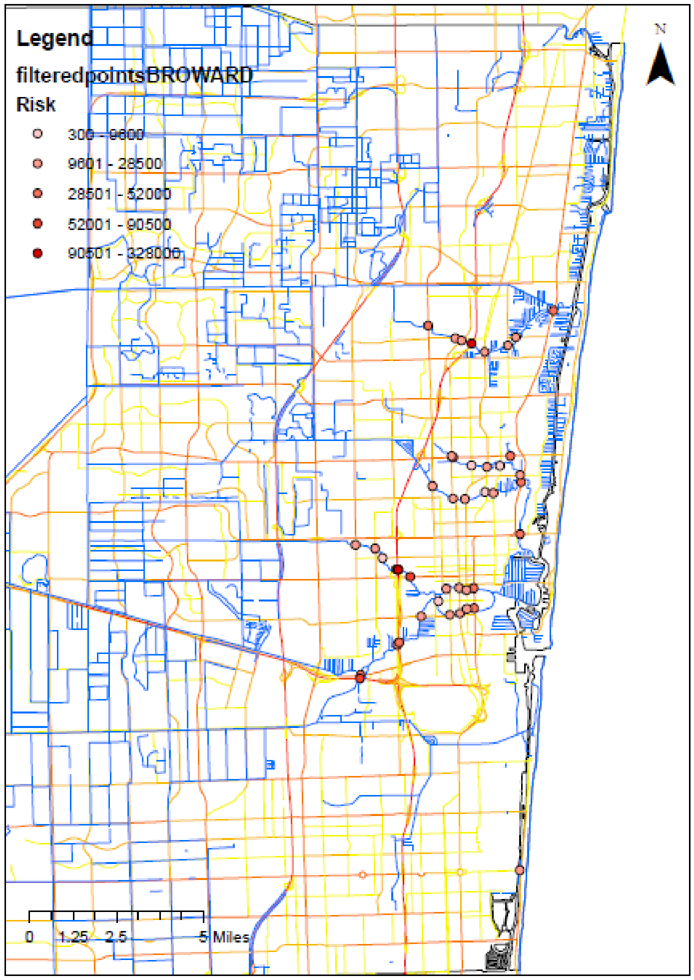


Figure 3. Points of Flood Risk in Broward County

Final Observations

Hydrology tools could not be used on traffic data and data availability was a major issue

There was a slight verifiable correlation between traffic signal density and traffic volume within urban regions. A closer look at the data revealed that bridges tended to have higher AADT. Truck traffic volume was higher on freight routes. A correlation was observed between county population and traffic volume as well as traffic signal density.

From the flood risk map, the fairly high density of flood risk points can be observed. A point of consideration for safety is the proximity of high traffic roads to streams. A possible next step is to assign risk values based on both traffic volume and mean annual flow of intersecting streams. .