Spatial analysis of routine vegetation management around electric infrastructure: a resource for utility asset maintenance

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Introduction

Trees and other woody stemmed vegetation growing too close to power lines can cause extensive power outages, damage to power lines as well as pose serious fire and safety hazards to the public. Utility providers patrol and prune vegetation in their service territory to maintain compliance according to a routine pruning cycle (Figure 1). Mid-cycle patrols are conducted, especially on the onset of the rainy or wind seasons, for trees that might cause outages and in areas forecasted to be within the storm radar.

Figure 1. *Types of tree pruning performed for vegetation growing close to power lines*

Methodology

After data were acquired, necessary data attributes were marked. The analysis was done using the Utilities and Mapping Clusters Spatial Statistic Tools. Kriging as form of raster interpolation was performed and results visualized using ArcScene to extrapolate the Kriging results.

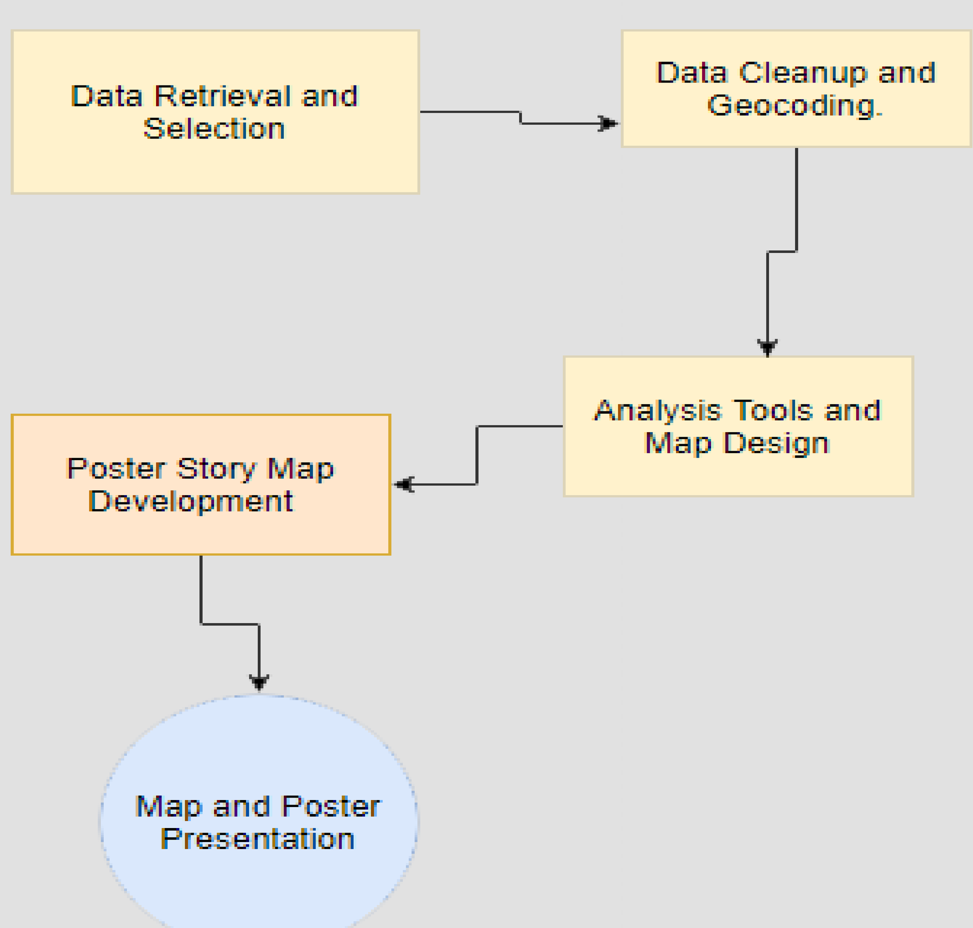

Figure 2. *Methods Flowchart*

Data and Data Sources

Data points representing pruning locations over a 5-year period in 5 cities were obtained from a contact in the utility consulting industry and provided in Microsoft Excel Format.

Results

The purpose of this applied research project was to conduct an analysis of vegetation management data over a five-year period to understand the varied pruning needs in the cities included in the study area. The research results will be part of a project that will include the cities' regulatory authorities, collaborating with the utility provider to pursue ways to improve the effectiveness of vegetation management through safe, efficient planning, scheduling and compliance requirements.

Data points representing coincident events for years 2011 to 2015 were combined to create weighted point data through a Collect Event (CE) analysis. This added a field named ICOUNT to hold the sum of all incidents at each unique location. The weighted points created from the CE analysis were used to perform a Hot Spot analysis (Getis-Ord Gi*).This identified significant spatial clusters of high values (hot spots) and low values (cold spots).The new output feature class has a z-score, p-value, and confidence level bin (Gi_Bin) for each feature in the input feature class. Point data were interpolated using Kriging and visualized using ArcScene to illustrate the geospatial phenomenon.

Collect Events Analysis

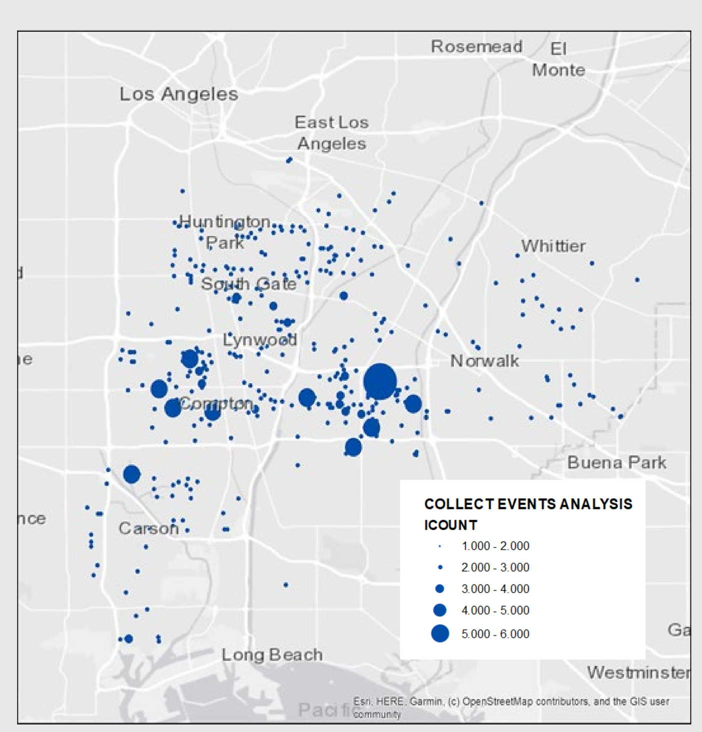

Figure 3. *Map with a new field named ICOUNT to hold the sum of all incidents at each unique location*

Hot Spot Analysis (Getis-Ord GI*)

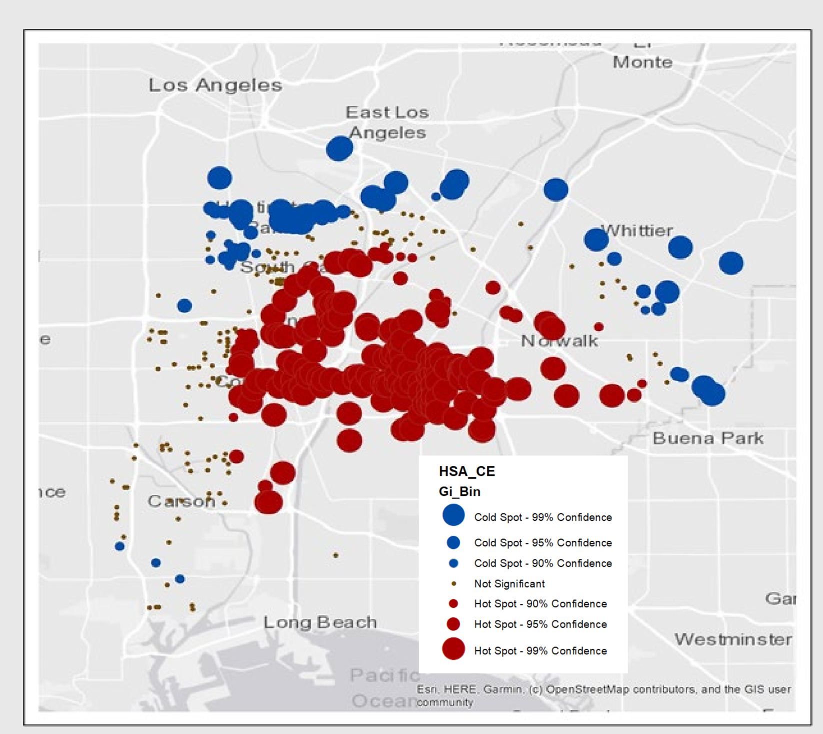

Figure 4. *Illustrating the significant clusters of points ready for modeling*

Kriging Results

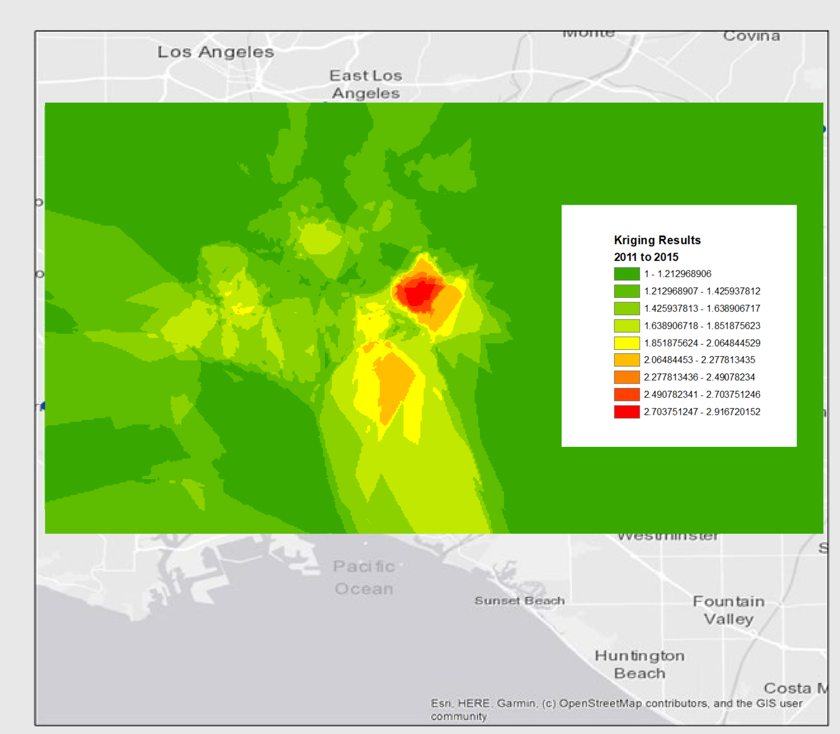

Figure 5. *A visualization of the Kriging results clearly identifying the hot spots based on the spatial distribution of events*

Discussion

The data used in this analyses were from Planned Inspections over a period of 5 years and did not include mid-cycle reports for Vegetation Management Activity (VMA) that was done as an emergency due to a storm or auto accident. This was one of the limitations of the analysis.

The Hot Spot Analysis shows over 90 % Hot Spot Confidence in 5 Cities in the study area for the Planned Vegetation Management Activity (PVMA) over a 5 year period. With this results, there is definitely room for the cities regulatory authorities to support the Utility Provider. Passing legislation and approving funding to convert all Overhead to Underground Infrastructure could be a long term consideration especially if the aesthetic effect from the woody stemmed vegetation is of value to the city and the residents. Funding and doing the VMA themselves, approving power shutoff requests during routine VMA, lower if any work permit fees, night time work allowances, efficient traffic control routines especially during Mid-cycle Vegetation Management Activity (MVMA) in collaboration with an inspector can also ease the burden on the Utility Provider while making it safer for the residents in the said cities

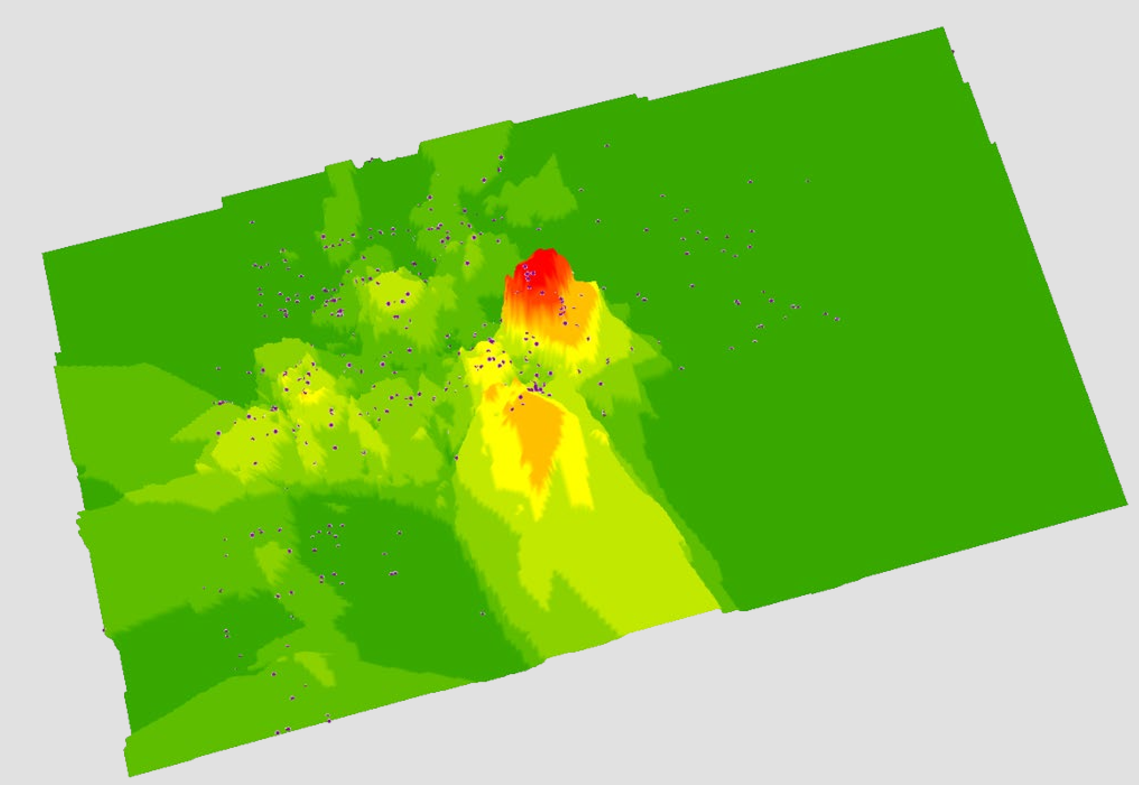

Figure 6. *A visualization of the Kriging results represented as a color-coded surface.*

Conclusion

Gaps and opportunities can be understood backwards by reviewing them now and defining what we want the future to look like. Meeting with stakeholders to discuss, collaborate and action process change is what the consumer wants for a safer, power friendly environment.

Submitted in partial fulfillment of the requirements of the Master of Science in Geographic Information Science (MSGISci), August 9, 2019.

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Maps available on the CSULB ArcGIS Online Organization site at csulb.maps.arcgis.com.