Applications and Challenges of Using Geographical Information System (GIS) in City-scale Traffic Simulation Research

Presented by: Bingyu Zhao, Postdoc, Department of Civil Engineering, UC Berkeley, bz247@berkeley.edu

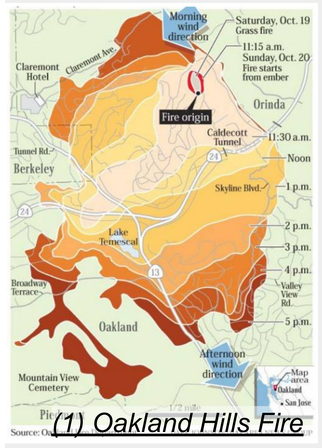
Introduction

GIS & spatial analysis are crucial for city & regional-scale traffic studies. Typical use cases vary from mapping & visualization to joining disparate data spatially & intuitive results validation. This poster presents four examples of using GIS in the traffic context. Our goal is:

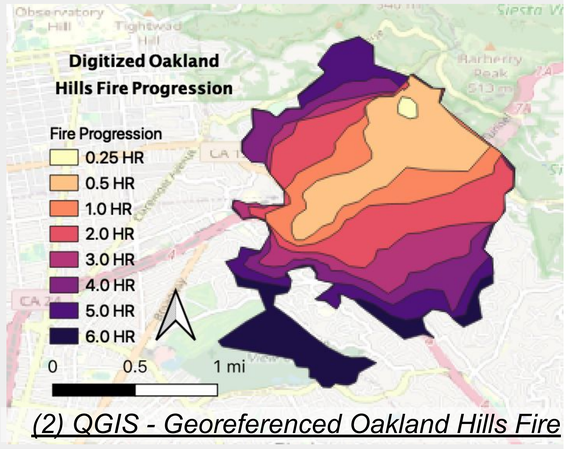
- Demonstrating applications of GIS & spatial data analytics in transportation research;
- Welcoming advice & feedback from GIS experts in improving our current usage of GIS tools.

Application 1. Information Acquisition

Traffic data are sourced from diverse inputs. Fortunately, they can often be merged based on their spatial relationships. For example, for wildfire evacuation planning, the hazard zone or time-stamped fire-frontier can be geo-referenced to determine vehicles and households that need to be evacuated.



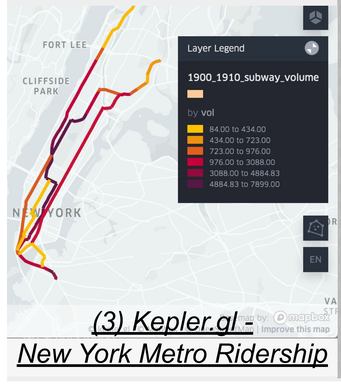
(1) Oakland Hills Fire



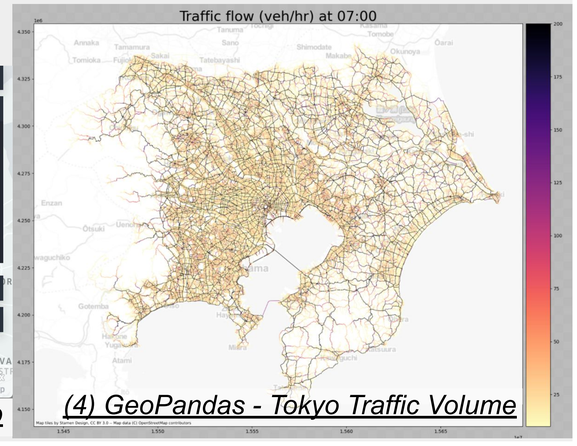
(2) QGIS - Georeferenced Oakland Hills Fire

Application 2. Results Presentation

GIS is routinely used in presenting traffic study results, e.g., the traffic speed map. (3) is an example of an interactive subway ridership map generated in Kepler.gl, and (4) is a batch-made static map of traffic volume in the Tokyo area. The network has over 2 million features. Rendering in QGIS is quite slow.



(3) Kepler.gl - New York Metro Ridership

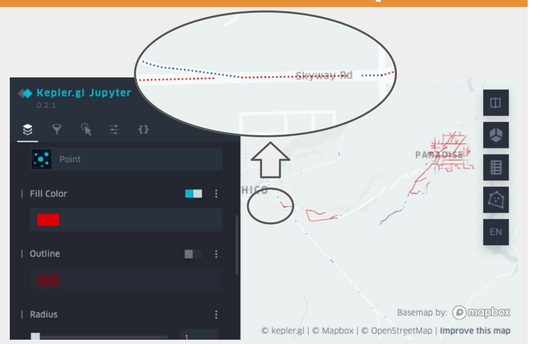


(4) GeoPandas - Tokyo Traffic Volume

Challenge 1. Interactive Programmable Tool for Developers

Debugging traffic simulation code is labor intensive. Good geospatial visualization software can greatly assist in this process, for example, by allowing developers to trace the movement of individual vehicles over multiple time frames.

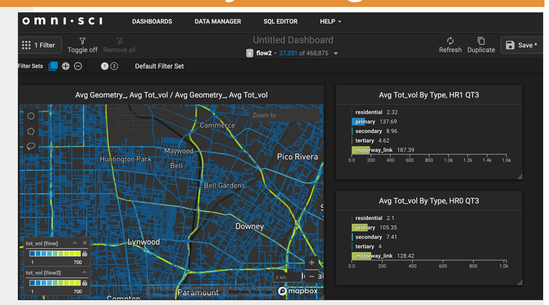
Problem: developer friendly, interactive, lightweight in memory & storage tools.



(5) Kepler.gl - Camp Fire Evacuation Traffic via Browser-based Interactive Map

Challenge 2. Versatile Platform for Story Telling

Maps & charts can be used to convey a compelling story, e.g., congested areas, emission hotspots. The OmniSci platform allows this to be done efficiently using GPU-based rendering plus integrated PostGIS functionalities.



Problem: efficient map rendering, numerical and spatial analytics in a single post-processing engine.

(6) OmniSci (provided by HP) - Los Angeles Traffic

Summary

GIS tools can greatly benefit traffic engineering research. However, use cases that require high efficiency and flexibility can still be deterring. Through this poster, we hope to convey our struggles, as well as creating an opportunity of discussion of suitable or cutting-edge techniques that we could adopt in transportation analysis.

Acknowledgements

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References

Oakland Hills Map: http://djjr-courses.wikidot.com/soc128:project13-fires