Determining the Spatial Structure of Shenzhen, China

An Analysis of Commuter Flows and Centers of Activity

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Background

In the United States and throughout the world, cities are becoming more polycentric (Vasanen, 2012). Rather than having one main core of activity, cities are developing viable nodes around the central core. These polycentric cities are decentralized, yet still clustered in various areas (Yang et al., 2012). While numerous studies have been conducted on polycentricity within American cities, there is room for exploration when it comes to analyzing the spatial structures of Chinese cities. The goal of this study is to determine where the major nodes of activity within Shenzhen, China are located as well as analyze the commute patterns within the city and implications that come along with them.

Research Area

Shenzhen is a major city within the Guangdong Province of China with a population of over 12.5 million. The city is located in Southeastern China, connecting Hong Kong to China's mainland.

Traffic Analysis Zones (TAZs) containing simplified home and work locations of residents within the city as well as an origin-destination (OD) table summarizing commuter flows were acquired from the City of Shenzhen to aid in our analysis.

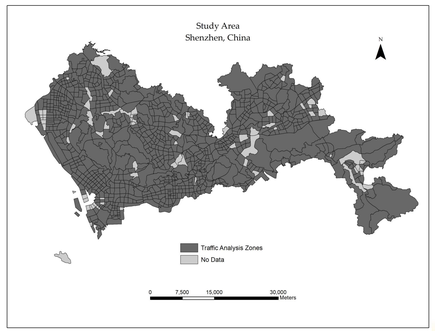

Figure 1. The study area—Traffic Analysis Zones (TAZs) within Shenzhen, China.

Clusters at a Glace

Initially, density maps were created to visualize clusters of residents and workers throughout the city.

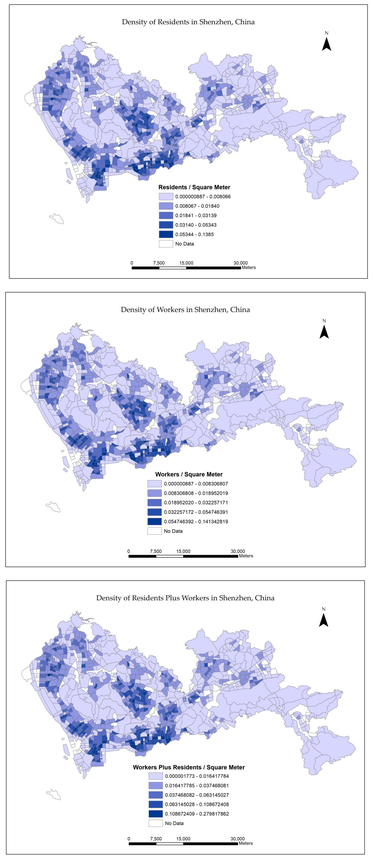

Figure 2. Map series showing density of residents, workers, and residents plus workers in Shenzhen, China.

As can be seen in Figure 2, there do seem to be multiple centers of activity found throughout the city. Higher densities of residents, workers, and residents plus workers also appear to be found in the same areas.

Further Analysis

In order to gain a deeper understanding of where clusters of activity are found within Shenzhen, we completed a Hot Spot Analysis (Getis-Ord Gi*), shown in Figure 3, on the resident plus worker density in order to identify statistically significant hot spots and cold spots using the Getis-Ord Gi* statistic.

A Cluster and Outlier Analysis (Anselin Local Moran's I), Figure 4, was also completed on resident plus worker density to locate nodes within the city. The Cluster and Outlier Analysis identifies statistically significant hot spots, cold spots, and spatial outliers using the Anselin Moran's I statistic.

For both analyses, fixed distance band was used for the conceptualization of spatial relationships parameter, meaning that each feature is analyzed within the context of neighboring features within the distance specified—neighboring features inside of the specified critical distance receive a weight of one and exert influence on computations for the target feature while features outside the specified distance hold no influence. The distance method used for both analyses was Euclidean distance.

To choose the critical distance, the spatial autocorrelation tool was run on the resident plus worker density values at six different distance thresholds; it was determined that clustering was least likely to be random at a distance of 5000 meters, so a 5000 meter distance threshold was used for all analyses.

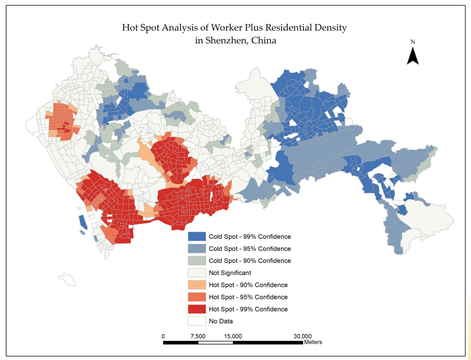

Figure 3. Results of the Hot Spot Analysis conducted on resident plus worker density values.

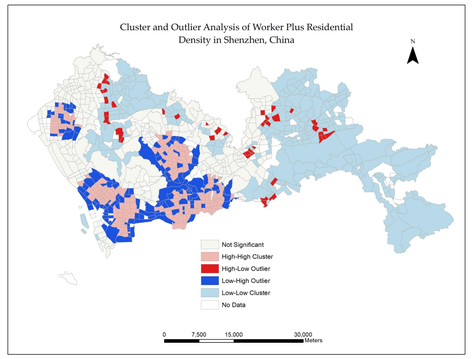

Figure 4. Results of the Cluster and Outlier Analysis conducted on resident plus worker density values.

Determining Clusters

Given that the Cluster and Outlier Analysis provides a more detailed result, such as low values among high values and other outliers, the cluster-outlier results were used to delineate six clusters of high activity within the city.

TAZs were then assigned Cluster IDs ranging from 0-9. A value of 0 indicates that the TAZ was insignificant in the cluster-outlier analysis. Values from 1-6 indicate the TAZ is in one of the 6 high-high clusters. 7 indicates the TAZ is low-high (a low value grouped with high values), 8 indicates the TAZ is low-low (a low value grouped with other low values, and 9 indicates the TAZ is high-low (a high value near low values).

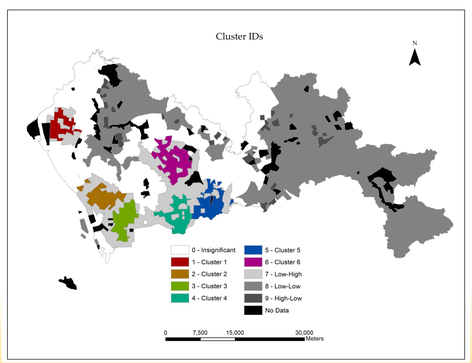

Figure 5. Map of clusters within Shenzhen and corresponding Cluster IDs derived from Cluster and Outlier Analysis results.

Conclusion

After assigning Cluster IDs, we were able to join the IDs to TAZs within the OD table, allowing us to summarize the 151,509 commute flow records for the entire city. In the end, we came up with a new OD table showing 100 different commute patters that we were then able to rank in terms of total commuters.

Figure 6 shows the top ten commute flows in the city. The greatest amount of people travel from a statistically insignificant area to another statistically insignificant area. Inter-cluster commutes also make up a great number of the 151,509 commutes.

Commute	Count	Total Commuters
Insignificant to Insignificant	13009	2284824
Low-Low to Low-Low	7454	1258524
Cluster 6 to Cluster 6	1370	764692
Cluster 5 to Cluster 5	1549	643461
Cluster 4 to Cluster 4	1492	588653
Cluster 3 to Cluster 3	966	544189
Cluster 2 to Cluster 2	1117	466179
High-Low to Low-Low	2111	364929
Low-Low to High-Low	2076	361300
Insignificant to Low-Low	4754	309101

Figure 6. The top ten commute flows within Shenzhen, China.

While we have located major centers of activity within Shenzhen, there is much more research to be done. Analyzing commute distances, how land use has changed in the city, and the impacts of commutes on the environment are only a few of the topics we aim to add to this study.

References

Vasanen, Antti. "Functional Polycentricity: Examining Metropolitan Spatial Structure through the Connectivity of Urban Sub-centres." *Urban Studies Journal Unlimited* 49.16 (2012): 3627-3644.

Yang, Jiawen, et al. "Measuring the Structure of U.S. Metropolitan Areas, 1970-2000. *Journal of the American Planning Association* 78.2 (2012): 197-209.

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