

Fine Particulate Matter (PM_{2.5}) and Coal Mining in China

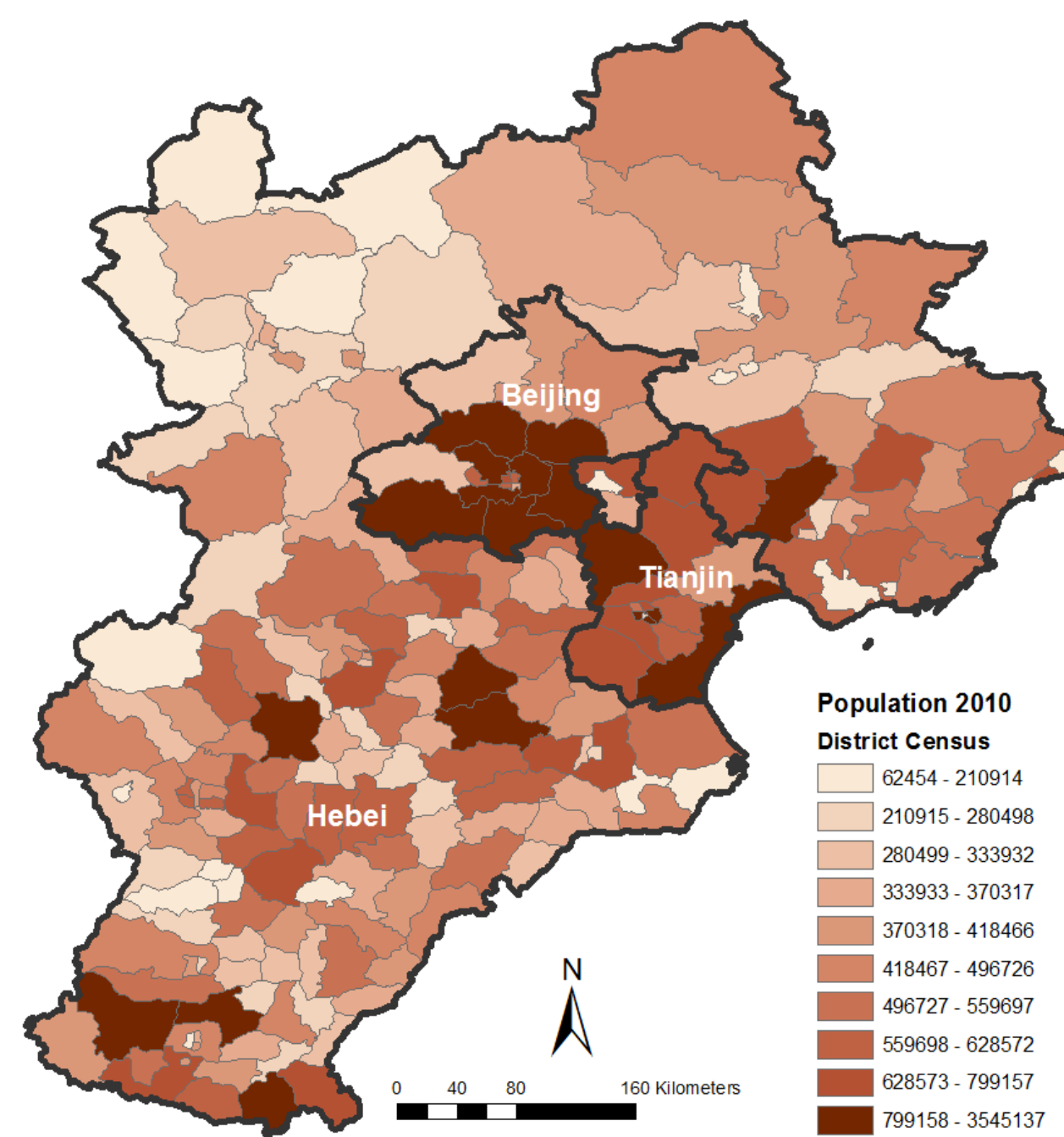
Spatial Analysis and Space-Time Analysis in Beijing-Tianjin-Hebei Region

Introduction

As far as we know, air pollution has been one of the biggest environmental issues in China. Currently, the government of China has started to impose the tougher environmental standards and interventions to reduce PM_{2.5}. Air pollution generated from burning conventional coal is ten times higher than from cleaner sources. Based on current data provided by Greenpeace, there were almost 49% of PM_{2.5} emissions coming from coal burning in China. One of the reasons was northern region relied on burning coal for heating during winters. Beijing-Tianjin-Hebei (BTH) Region had higher density of emissions from coal burning than other areas. This study is going to focus on the distribution of PM_{2.5} in BTH Region, estimate the population exposed to PM_{2.5}. By analyzing the time change of coal mining location and value of PM_{2.5}, this study will compare different air quality in Beijing with in Tianjin, and discuss how recent policies impact those difference.



Population in BTH Region



Methodology

ArcMap

- 1. Census Map:** Quantile map of population in BTH Region.
- 2. Space-Time Analysis:** I used *Create Space Time Cube by Aggregating Points* and *Emerging Hot Spot Analysis* to get the results and patterns of coal mining location's time change.
- 3. ESDA & Interpolation:** *Geostatistical Analysis* on PM_{2.5} dataset. I used *Geostatistical Wizard* to do *kriging* on my dataset → Raster of PM_{2.5}.

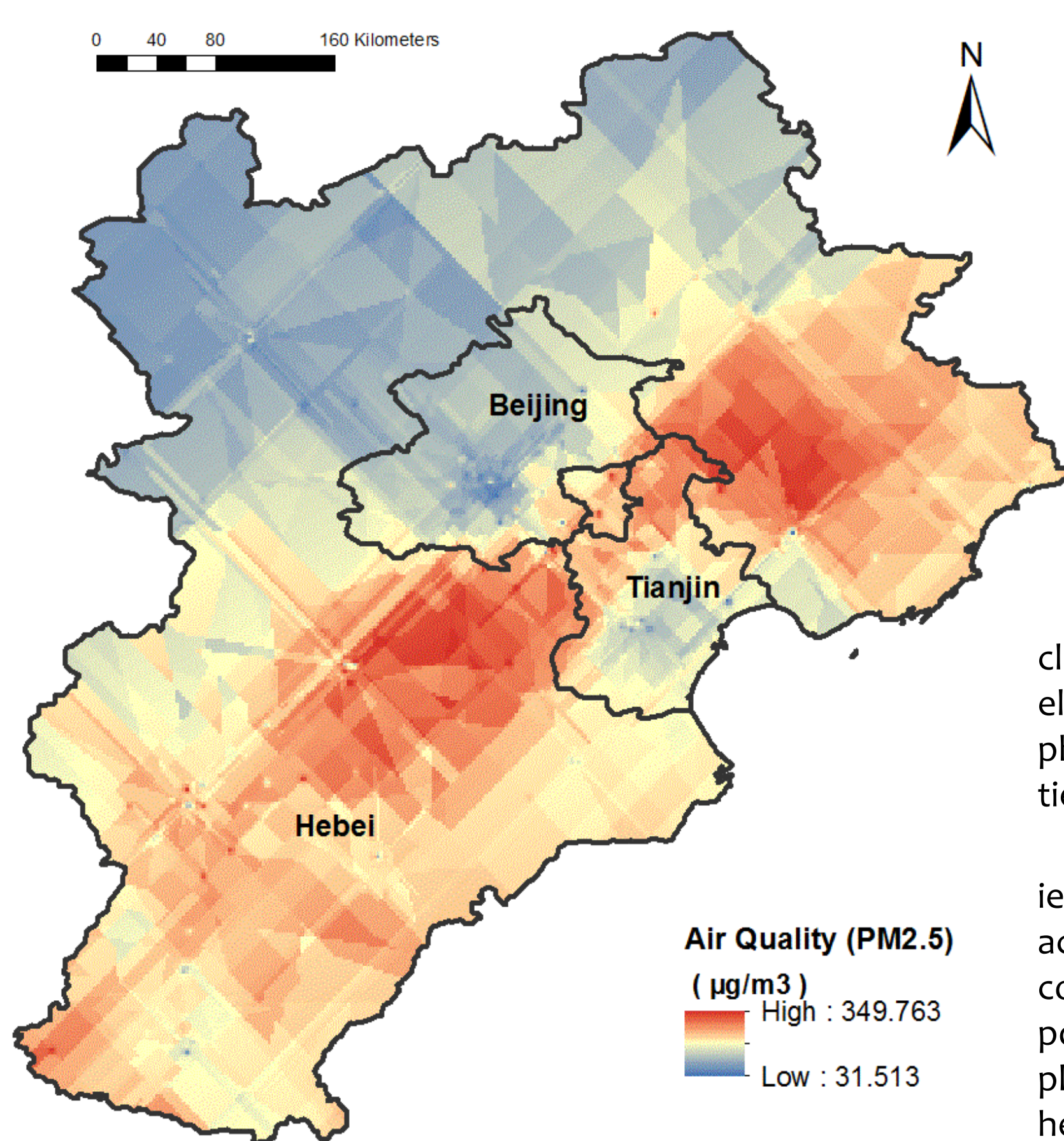
Geoda

ESDA & Spatial Analysis
Clustered map of PM_{2.5} and population by using *Bivariate local Moran's I* (based on queen's contiguity).



Results & Analysis

Spatial Distribution of PM_{2.5}



The map showed that over half of BTH Region had medium and even higher value of PM_{2.5}. According to the standard of PM_{2.5} in China, the area with value of PM_{2.5} over 150 µg/m³ would be seemed as moderate polluted, and the area with value of PM_{2.5} over 250 µg/m³ would be the heavily polluted. Above, the overall area of Beijing-Tianjin-Hebei Region were in medium-heavy polluted area.

Policies Analysis & Conclusions



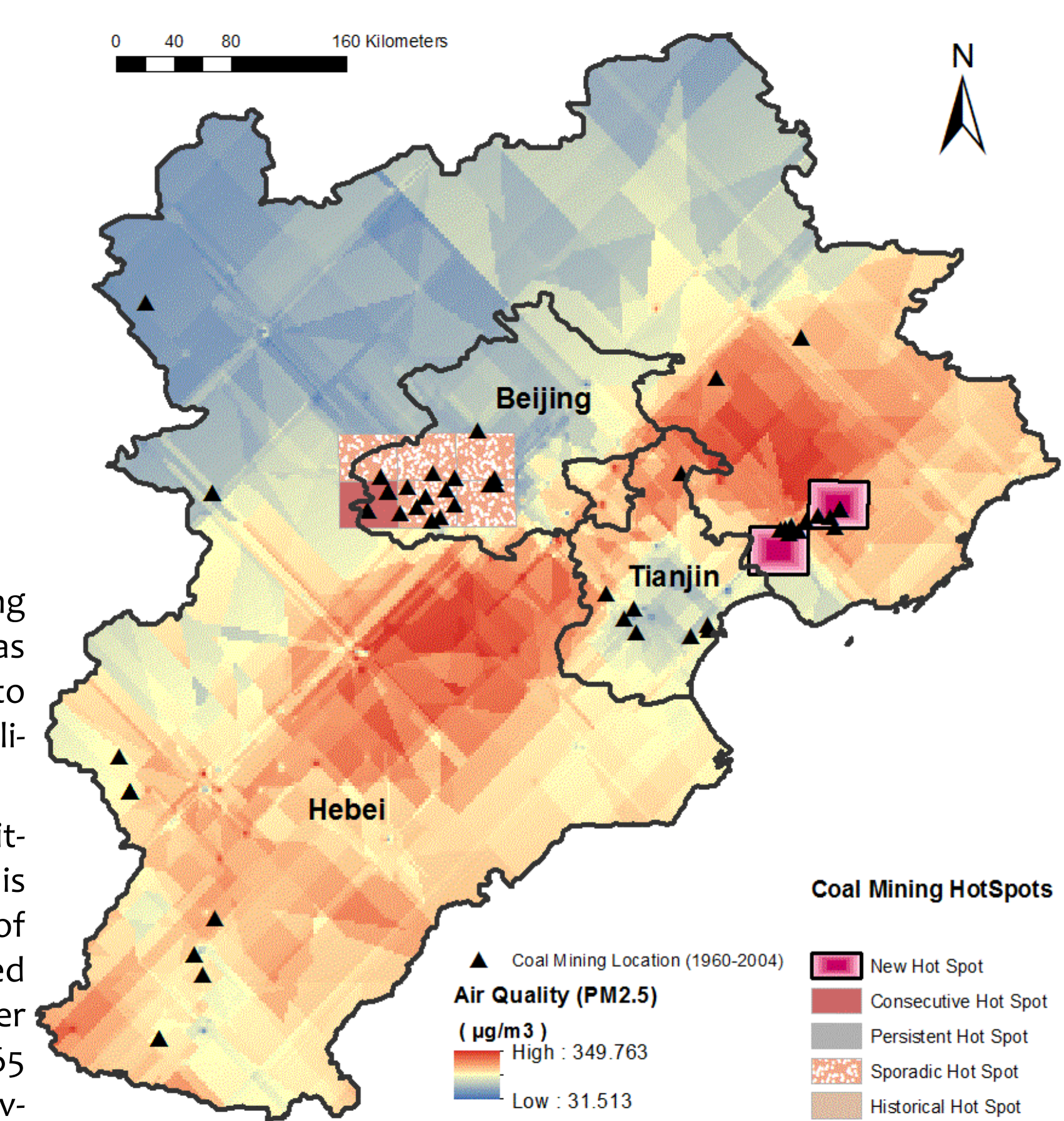
According to the Clean Air Asia's Report 2016, both total consumption control and using clean coal were adopted to reduce the pollution from coal in 2015. One of the measures was eliminating industrial coal-fired boilers, it was also implemented in Beijing and Shanghai to phase out coal consumption. Most importantly, the installation rate of desulfurization facilities in coal fired unit increased during the 12th Five-Year Plan Period in China.

BTH Region had multiple policies and different goals for reducing PM_{2.5} in different cities. In Beijing, one of the related policies was shutting down all coal-fired units in 2017. This action could reduce 9.2 million tons of coal use. Another policy was cutting 2 million tons of coal from industrial boilers which would reduce 0.5 million tons of coal. In Tianjin, the related policies like switching coal-fired units to gas in Chentang, Jinhai and Junliangcheng power plants or shutting down the Jianchang power plants. (CAAC) Tianjin aimed to switch 465 heating boilers to gas by the end of 2016, which equaled to 13,733 tons of coal. Hebei Province aimed to shut down 29 thermal power units in order to reduce 2.76 million tons of coal use.

By comparing different policies in BTH Region, we could learn that Chinese government have paid more attention to Beijing and set up a series of stricter policies to reduce the coal production and consumption in Beijing. In terms of the spatial distribution of PM_{2.5}, although the average value of PM_{2.5} was still high, the value of PM_{2.5} around Beijing was lower than the value around Tianjin in 2016. The stricter policies like shutting down all coal-fired units was practicable for saving the air quality.

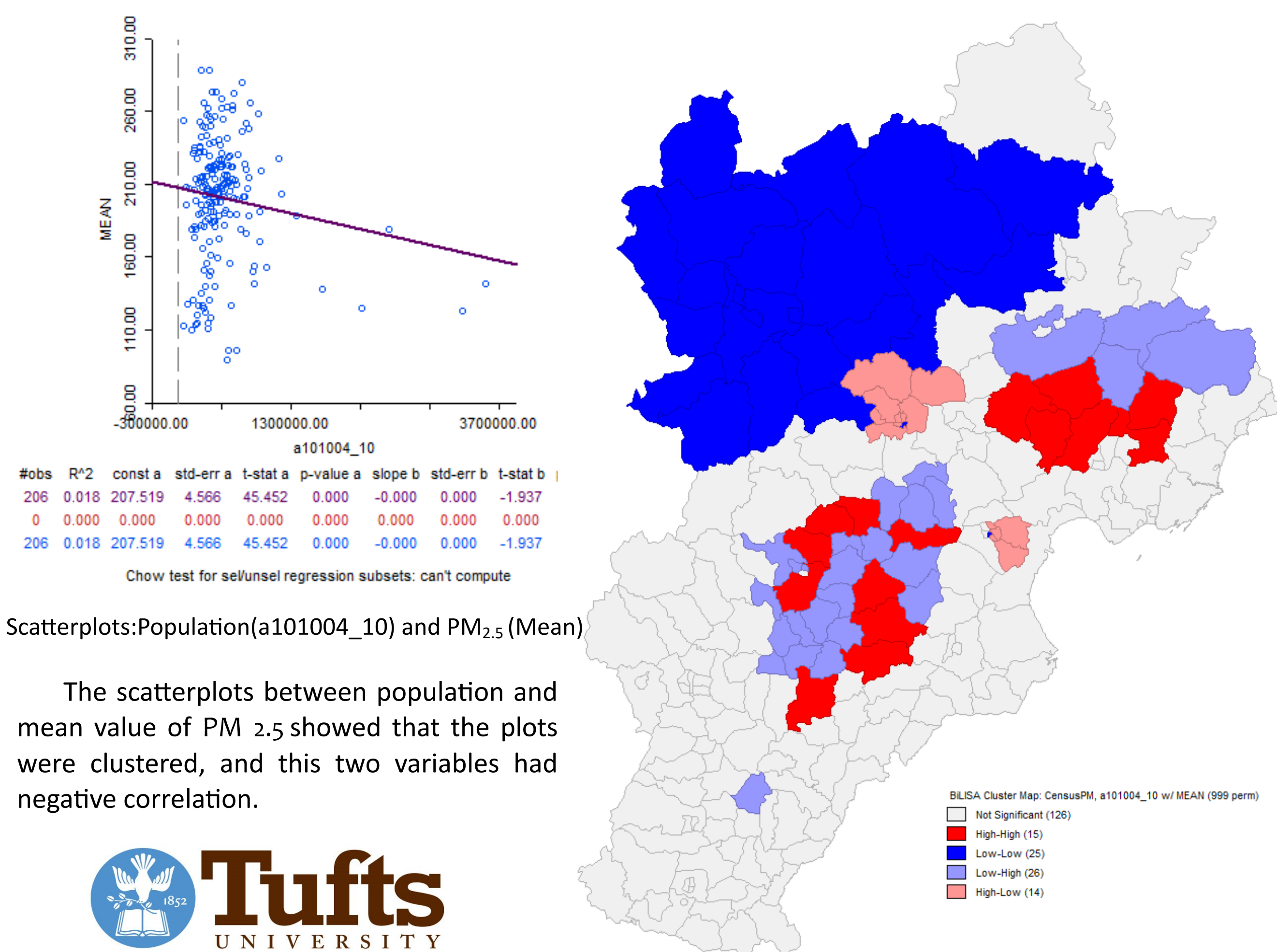
Overall, the new hotspots of coal mining were located in Hebei that near Tianjin, which also surrounded by high concentration of population and high value of PM_{2.5}. Compared with Beijing and other area in Hebei, the new hotspots area near Tianjin should be paid more attention to.

Distribution of Coal Mining Hot Spots



Although there was large amount of coal mining locations around Beijing and Tianjin, most of them around Beijing were in sporadic hotspots area. Only one small area across Beijing and Hebei was in consecutive hotspots area. However, there were two new hotspots appearing near Tianjin. The value of PM_{2.5} around those two new hotspots near Tianjin were higher than the value around the sporadic hotspots in Beijing.

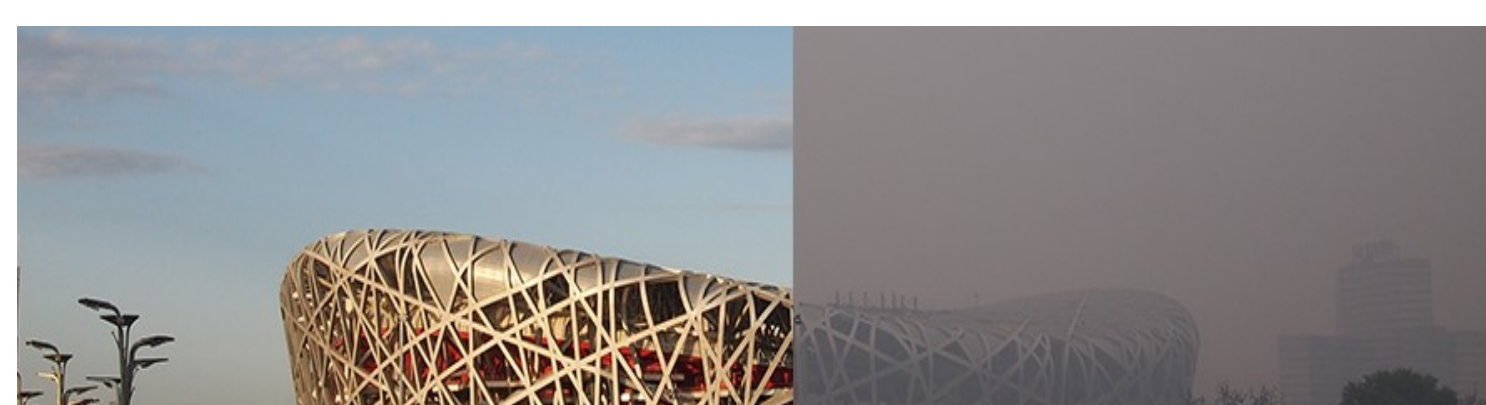
Clustered Map (Population & PM_{2.5})



The clustered map (left) showed that the locations in red were both high concentration of population and were surrounded by high value of PM_{2.5}. Those locations in pink were the high concentration of population but surrounded by low value of PM_{2.5}. The light blue ones were the area in low concentration of population surrounded by high value of PM_{2.5}. And the dark blue ones were the low concentration of population and surrounded by low value of PM_{2.5}.

Beijing was located at both pink (high concentration of population but surrounded by low value of PM_{2.5}) and dark blue area (low concentration of population but surrounded by low value of PM_{2.5}). But parts of Tianjin area were located at the red area. Also, the LH and HH clustered area were concentrated in Hebei.

Furthermore, the sporadic and consecutive hotspots of coal mining were surrounded by HL clustered area (high concentration of population but surrounded by low value of PM_{2.5}), but the new hotspots of coal mining were surrounded by one of the HH clustered area.



Limitations

The dataset of coal mining didn't have the closing date of some mining area that had already closed. Also, since there were not any valid data of the coal mining location from 2004 to present, this might impact the accuracy of this analysis.

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Data Source: China Data Online ; AQI Air Pollution Data: PM_{2.5} (2016).
Image Source: climatechangenew.com; CNN.com; Beijing Kids.com
Citation: Clean Air Asia Org (CAA) ; Clean Air Alliance of China (CAAC)