Inquiring and visualizing large-scale space: Placing China's changing urban hierarchy from 1985 to 2010 into spatial system

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Inquiring and Visualizing Large-Scale Space:
Placing China's Changing Urban Hierarchy from 1985 to 2010 Into Spatial System

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Research Rationale and Research Questions

For the past decades, anthropologists and sociologists have increasingly emphasized the importance of space. However, for most of them, "space" is a kind of analytical approach to identify "material culture, kinship systems, house form, and social institutions" and they concerned "space" with finding ways to integrate the results of traditional anthropological inquiry, which tends to be small-scale and personal (Aldenderfer & Maschner, 1996: v). Different from their perspectives, my aim of the project is to find what inside the space based on a large scale of locations, attributes, and relationships of features in spatial data. My case study is China, a giant country of 1.3 billion people. China's urbanization started to accelerate since the 1980s and continues with fast-paced and wide scale in human history. I argue that finding out the urban hierarchy changes in China and inquiring its economic transformation, the public policies and regional internal structural impacts on hierarchy change could enable us to comprehensively understand the spatial structure of China's urban system, and contribute to the theoretical development of "space".

My research design is, first I select the Chinese urban growth in 1985 to 2010, which fits with a large-scale analysis. After examining the growth via Rank Mobility Index (RMI), I transform this urban growth information into visual maps to construct the vivid large-scale space. Then I inquire my visual maps with four questions step by step: "what kind of phenomenon does each map present?" "What are the driven forces behind these phenomena, politically and economically?" "What kind of elements actually inside a large-scale urban space, based on Chinese urban growth?" "How do these structural elements embedded in space interacted between and within the urban system?"

Data Source and Data Management

[Data Source]
The data comes from the United Nations Online Database "World Urbanization Prospects: The 2009 Revision Population Database" and National Bureau of Statistics of China Online Database. I adopt the 1985, 2005, and 2010 city ranks and population information (see figure 1).

[Data Management and the Unbalanced Issue]
When preparing (merging) the address table for geocoding, there are 28 unmatched values , which leads to missing values of 28 cities in 2010. I translate these city's coded -pinyin names into Chinese characters and recheck their location information (figure3). I confirm they are entirely different places and values only in 2010 which could be cleaned as 28 real missing values rather than misspelling-lead-errors. Thus my research is based on the rest 109 cities (urban agglomerations equal or more than 750,000) in the database regarding a strong balanced data structure.

Figure 1. Primary data with Access

Figure 1. Holistic Trend of RMI

Figure 3. Data Cleaning
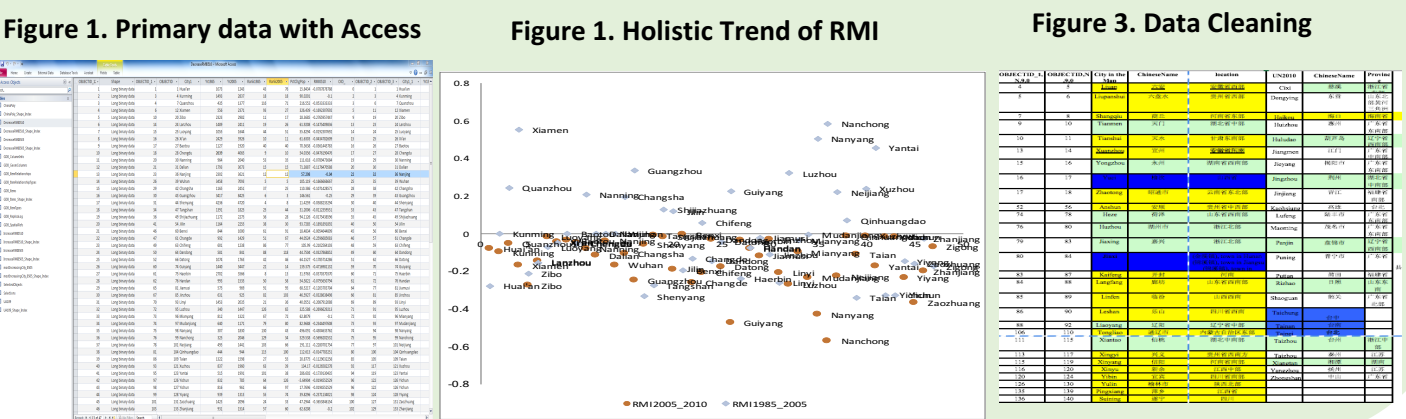
RMI Index and GIS Analysis

[Rank Mobility Index (RMI)]
I employ the Rank Mobility Index (RMI) to measure one city's change in population rank among a group of cities. The calculation of RMI= $(R1-R2)/(R1+R2)$, where R1 = city's rank at time point 1 and R2 = city's rank at time point 2. An RMI value must be between −1 and 1, and RMI=0 indicates no change of the city rank. I use the RMI of 1985-2005 and RMI of 2005-2010 in my research and such measurement provides me a quick insight into the changing urban hierarchy of China and enables me to identify urban growth's change over time and space.
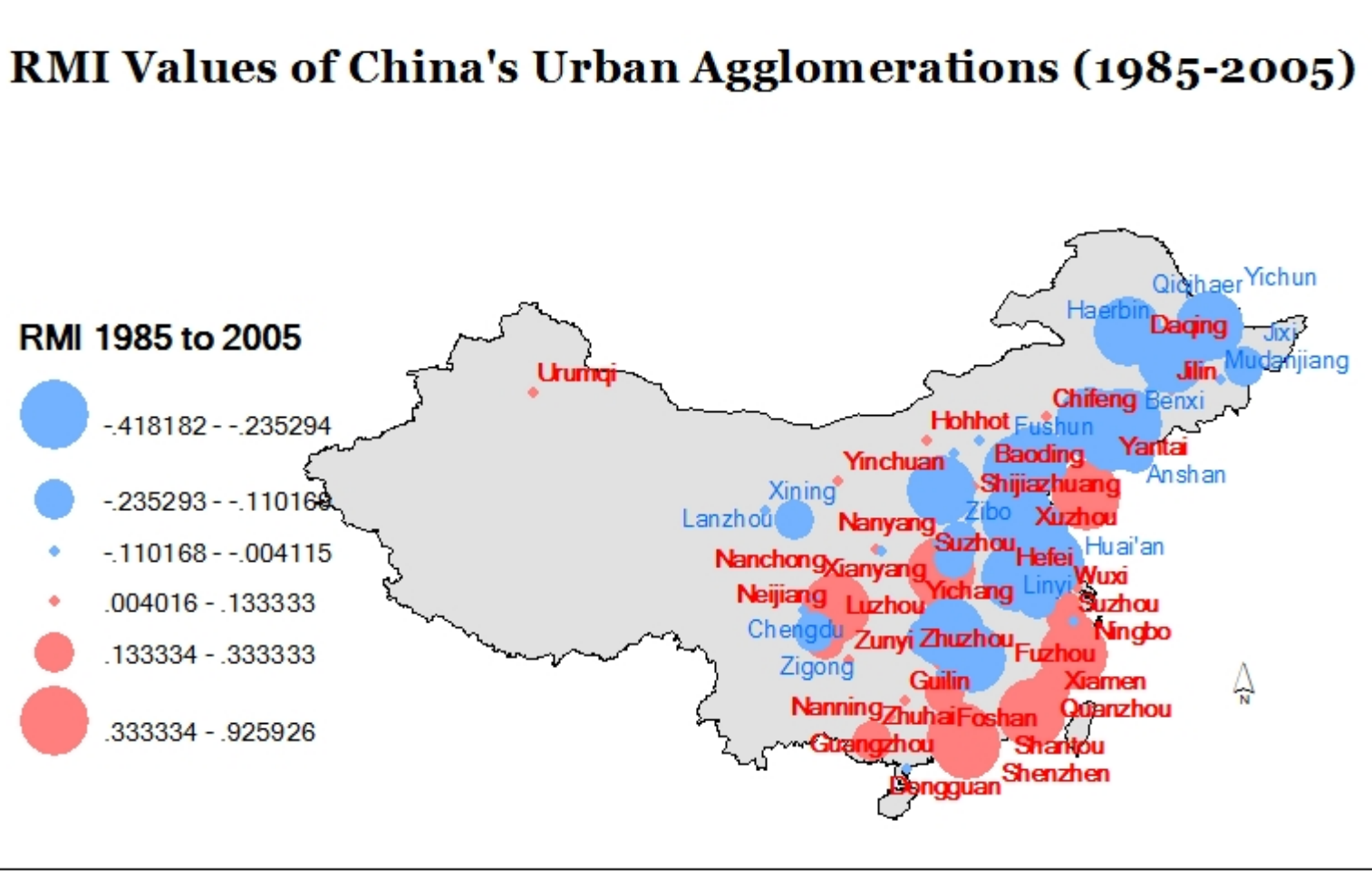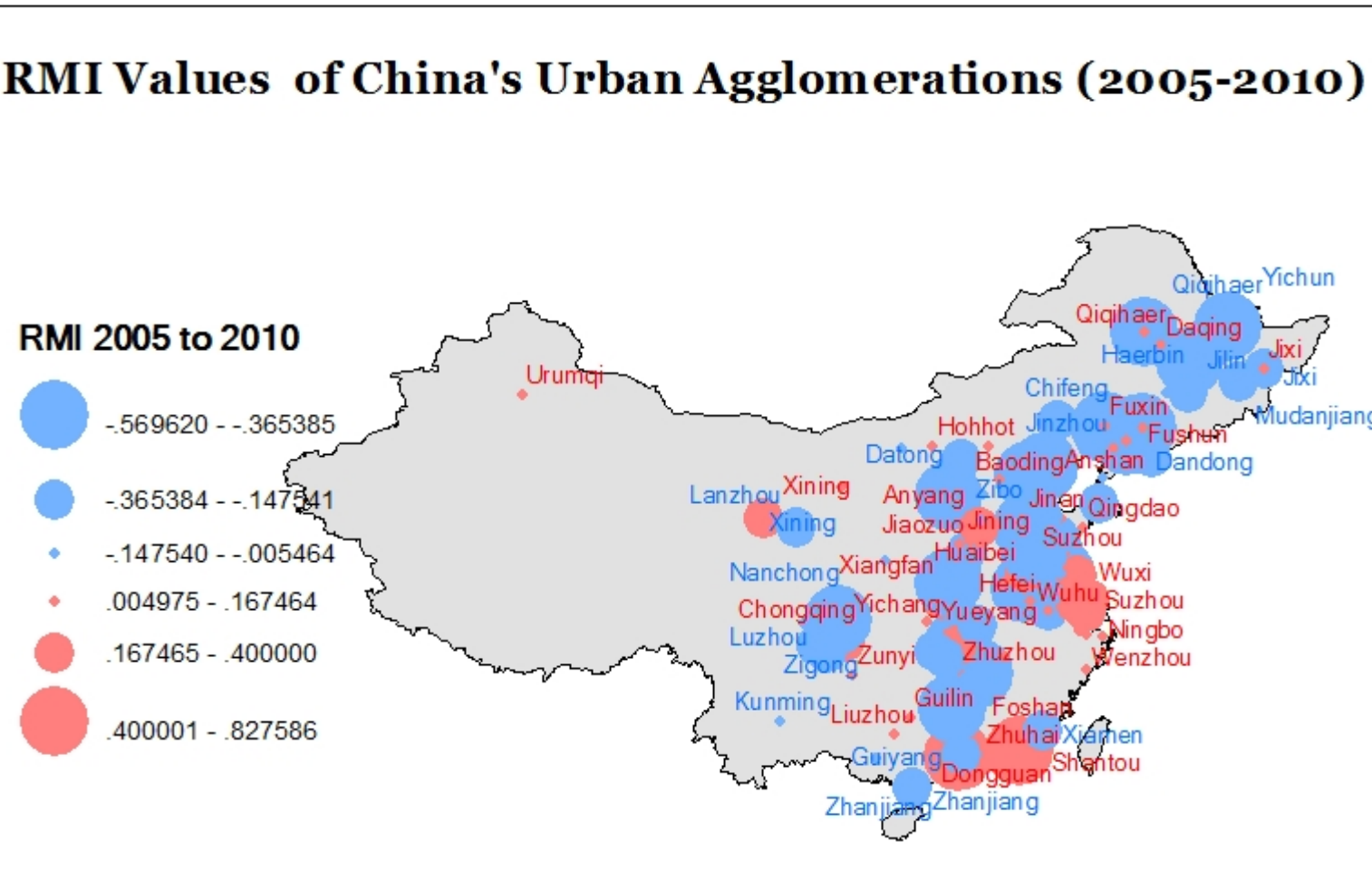
[Spatial Analysis]
I use ArcGIS 10.3 version. The coordinate system is GCS_WGS_1984 in my maps. There are two spatial-analysis steps. First, when identifying the RMI value, I add "field" into the data table, calculating "fields" of the RMI value, and using "selection by attribution" to find the most decreasing and increasing RMI values cities and the RMI=0 cities. Second, when presenting the result visually, my cartography steps include creating a graduated symbol map and composing a map with more than one data frame (multiple frames), which helps me to compare the change of 1985-2005 RMI and 2005-2010 RMI values visually.

Findings and Discussion

My findings suggest that the China's exported and market oriented parts--south and southeast--have dominant roles regarding the urbanization process after the Reforming and Opening-up Policy 1980s (see map1). However, the map 2005-2010 displays the decreasing urban process of these regions (see map3). The main reasons are the global economic crisis and regional economic structural adjustment. Meanwhile, due to China's "Open Up the West Program" there is an explicit increasing trend of urban agglomeration in central and western China (see map2). Additionally, Beijing and Shanghai could hardly overtake an increasing RMI formerly and maintain the value equals 0 for both 1985-2005 and 2005-2010 (see map4).

These sets of findings present the change of China's urban hierarchy spatially, economically and politically. They support three key elements: in a longitudinal observation, there is contingency but a balance of large-scale space system under urban agglomerations; in a cross-sectional observation, the heterogeneity embedded in the spatial structural, like the gap between China's eastern part and the western; third, in a bird-eye view, the co-evolution of China's urban spatial system becomes more complex within and between globalization such as the decline of the eastern part urban growth rank caused by crisis internally and externally.

Map 1
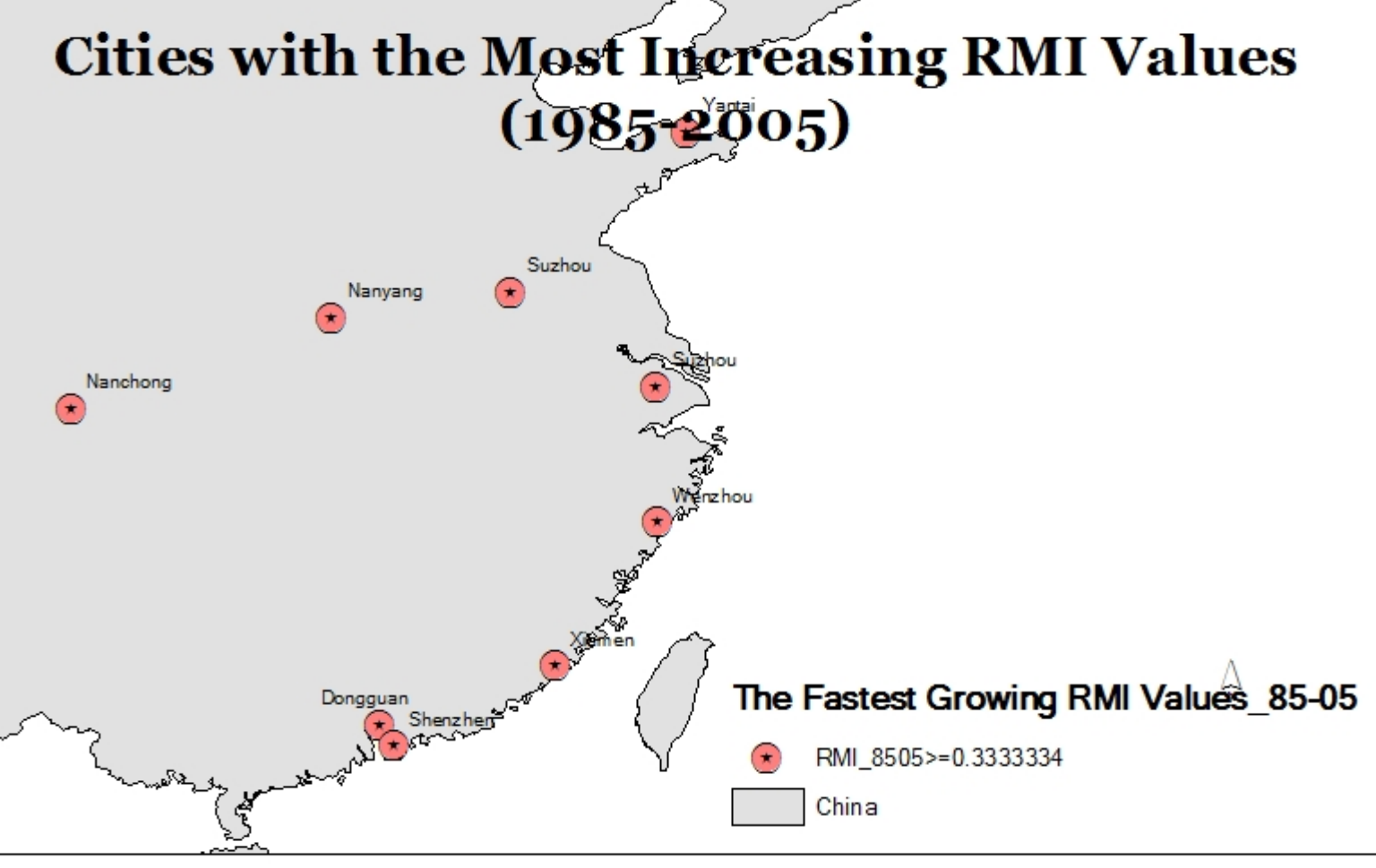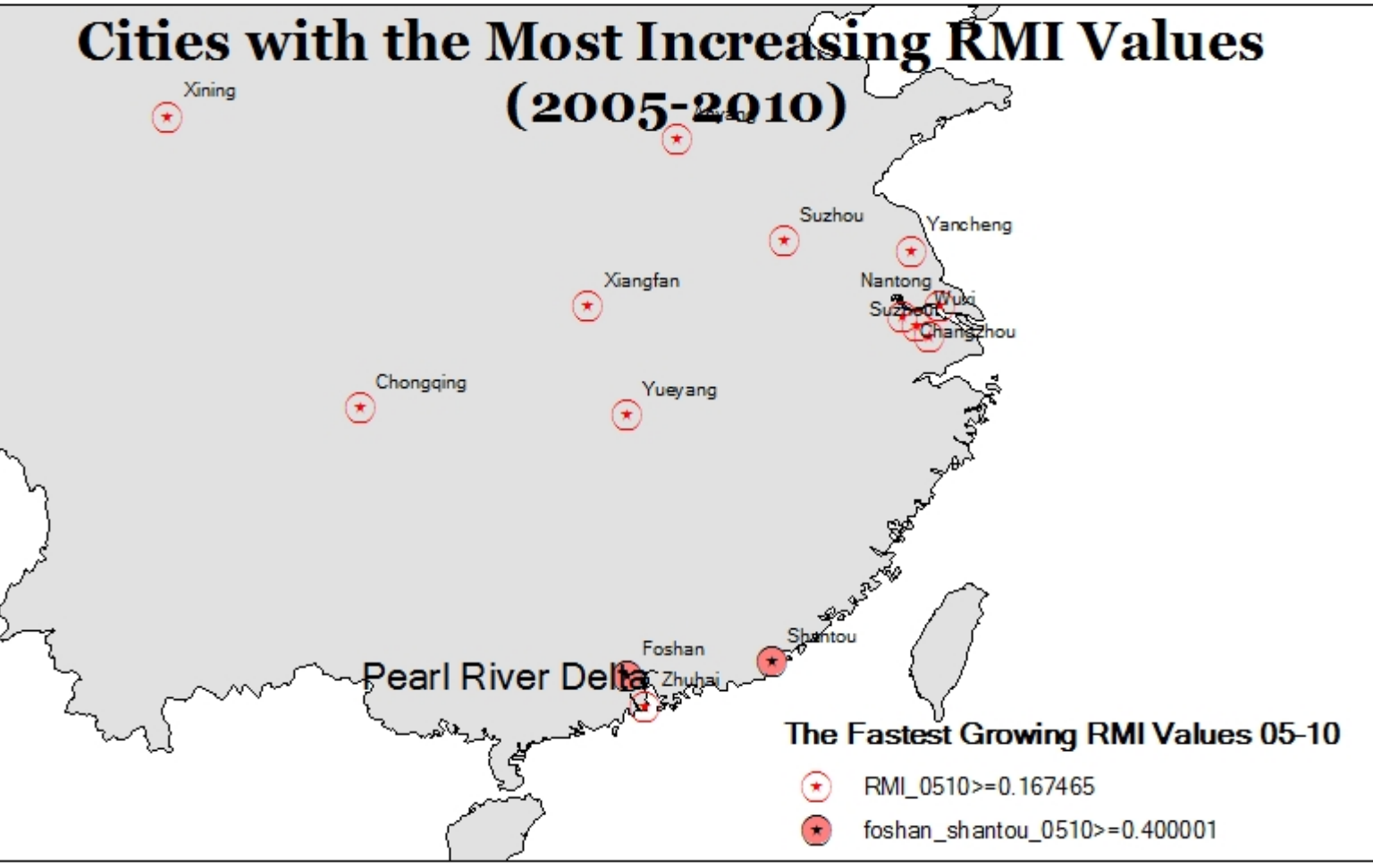

RMI Values of China's Urban Agglomerations (2005-2010)

RMI 2005 to 2010
- -.569620 - -.365385
- -.365384 - -.147541
- -.147540 - -.005464
- -.004975 - .167464
- .167465 - .400000
- .400001 - .827586

RMI Values of China's Urban Agglomerations (1985-2005)

RMI 1985 to 2005
- -.418182 - -.235294
- -.235293 - -.110168
- -.110168 - -.004115
- -.004016 - .133333
- .133334 - .333333
- .333334 - .925926

0 850 1,700 3,400 Kilometers
Author: ShanShan

A Longitudinal Observation
A Cross-sectional Observation
A Bird-eye View

MAP 1: The discrepancy of China's inland and coastal areas still exists, but the gap gradually decreases with the rise of the central and the western part of China.

In a longitudinal observation, there is contingency but a balance of large-scale space system as the gap between the East and West gradually decreases in terms of urban hierarchy; in a cross-sectional observation, the heterogeneity embedded in the spatial structural, like the gap between China's east part and the west; third, in a bird-eye view, the co-evolution of China's urban spatial system becomes more complex within and between globalization.
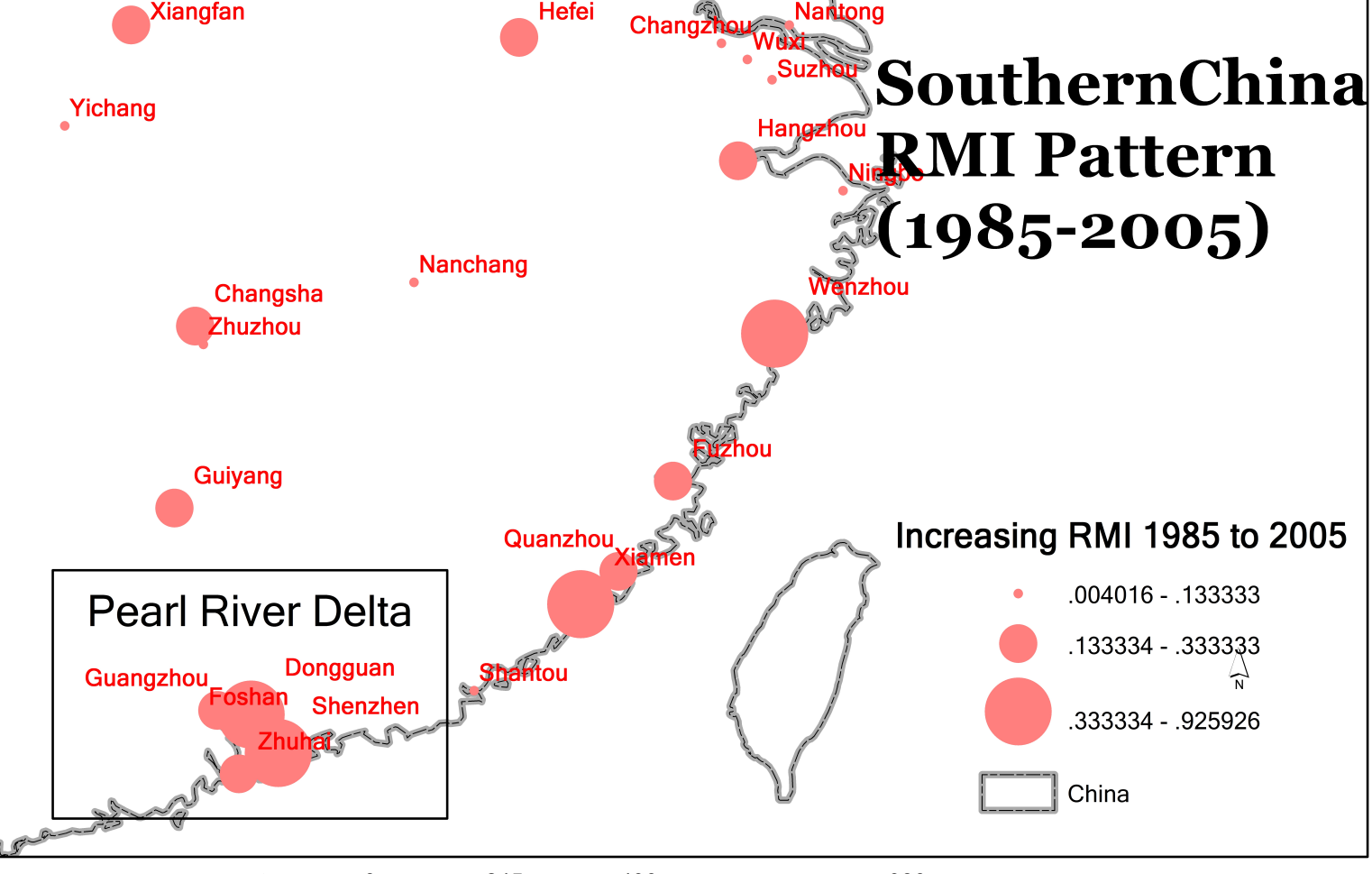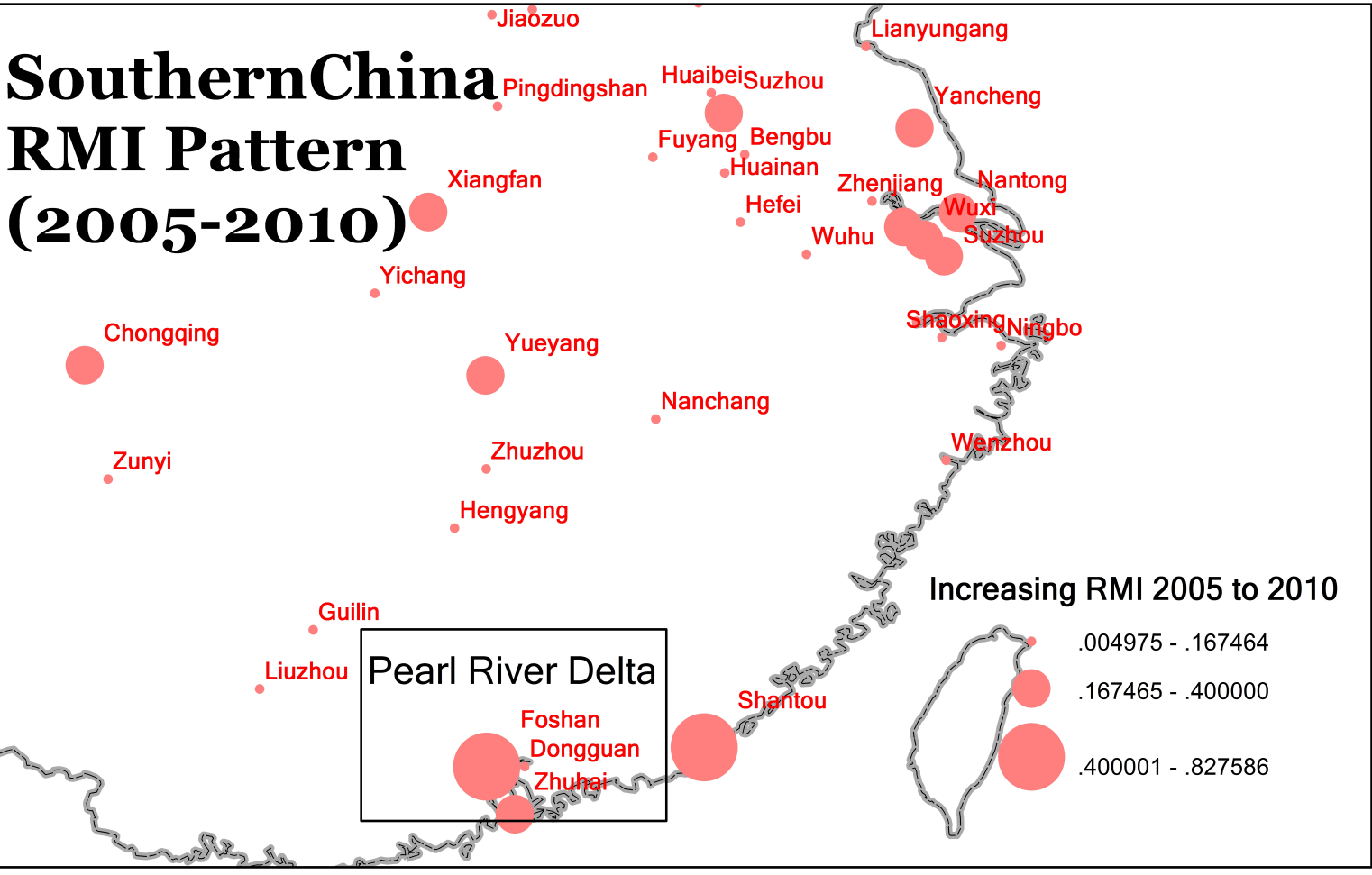
Map 2

Cities with the Most Increasing RMI Values (2005-2010)

Pearl River Delta

The Fastest Growing RMI Values 05-10
- RMI_0510>=0.167465
- foshan_shantou_0510>=0.400001

Cities with the Most Increasing RMI Values (1985-2005)

The Fastest Growing RMI Values _85-05
- RMI_8505>=0.3333334
- China

0 360 720 1,440 Kilometers
Author: ShanShan

The Rise of the Central and Western China

MAP 2: The gap gradually decreases with the rise of the central and western part of China. The case in points are Chongqing in the central China and Xining in the western. The policy impetus could be the "Open Up the West Program".

In 2000, China's western development plan started to help the western China to catch up with the Eastern. The strategy includes the development of infrastructure, enticement of foreign investment, environmental protection, education, etc. These changes not only help residents to obtain job opportunity without migrating to the east but also attract the eastern workers to seek fortune in the central (like Chongqing) and the western (like Xining).
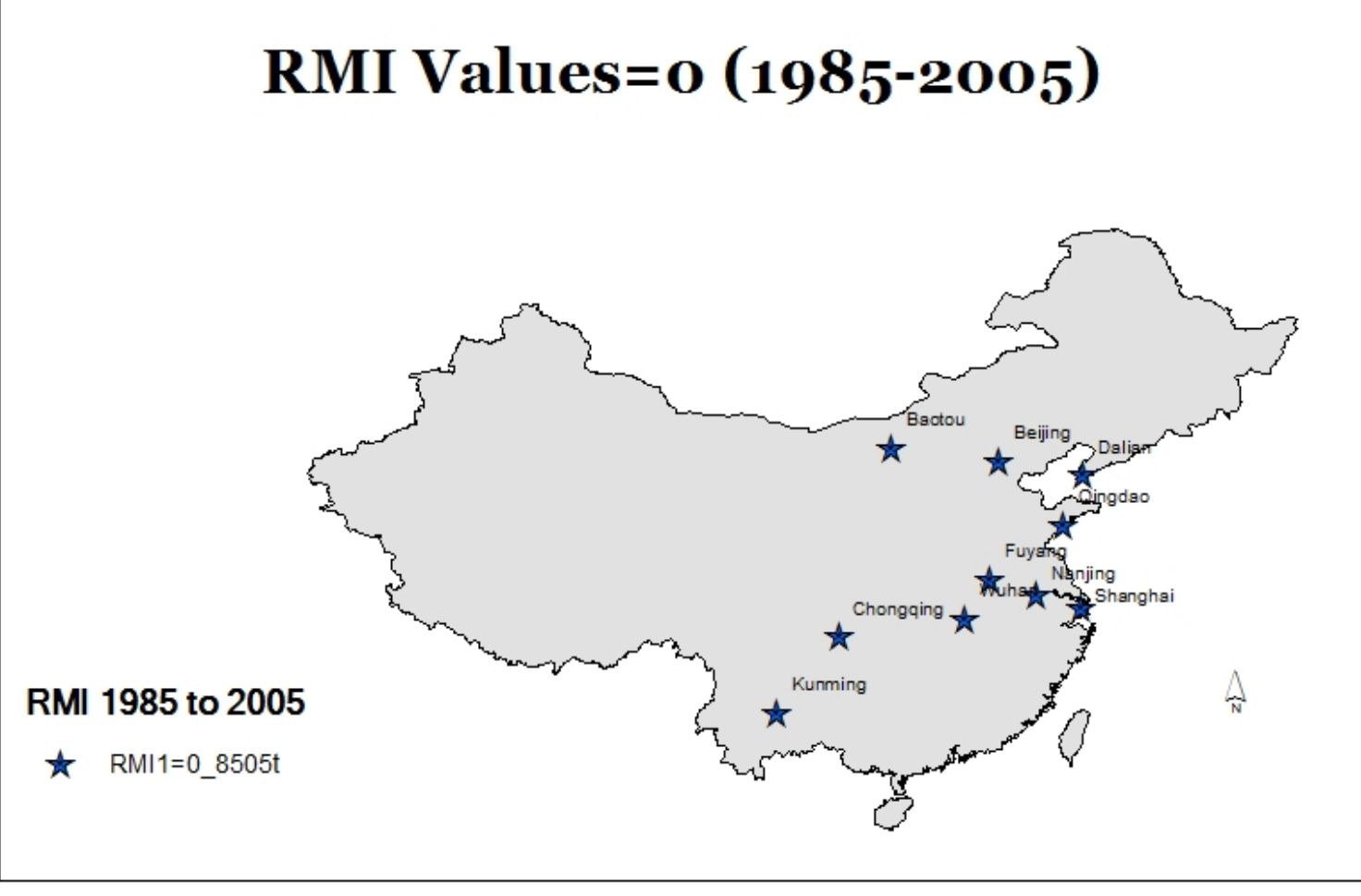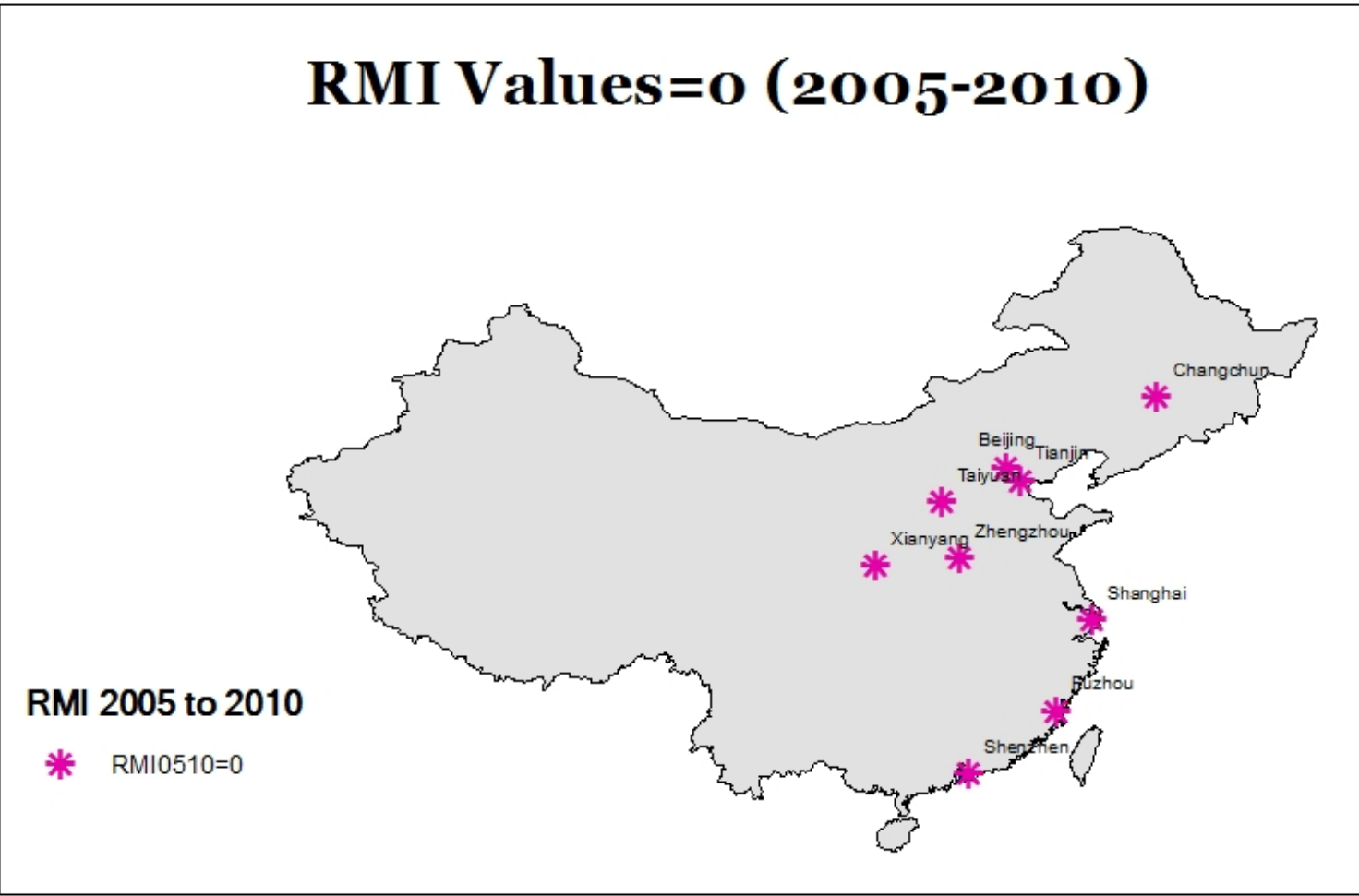
Map 3

SouthernChina RMI Pattern (2005-2010)

Pearl River Delta

Increasing RMI 2005 to 2010
- .004975 - .167464
- .167465 - .400000
- .400001 - .827586

SouthernChina RMI Pattern (1985-2005)

Pearl River Delta

Increasing RMI 1985 to 2005
- .004016 - .133333
- .133334 - .333333
- .333334 - .925926
- China

0 245 490 980 Kilometers
Author: ShanShan

The Shrink of the Pearl Delta River Region RMI

MAP 3: China's special economic zones (SEZ) policy in the 1980s boosted the development of the coastal cities (Shenzhen, Zhuhai, Xiamen, Shantou etc.), locates in the Pearl River Delta (PRD) during this period, more foreign-invested factories were built in PRD alongside more job opportunities and the migration wave.

In the year 2005-2010, RMI of PRD has shrunk greatly. The impact is the crisis of industrialization in PRD began in 2008. This crisis is a combined result of global economic slowdown and structural problems of local labor-intensive export production mode. Such crisis led PRD region to a sharp decline in export demand and a large-scale closure of labor-intensive Small and Medium Enterprises (SMEs) with massive lay-off of migrant workers.

Map 4

RMI Values=0 (2005-2010)

RMI 2005 to 2010
- RMI0510=0

RMI Values=0 (1985-2005)

RMI 1985 to 2005
- RMI1=0_8505t

0 850 1,700 3,400 Kilometers
Author: ShanShan

The "big brothers"--Beijing and Shanghai

MAP 4: "The larger the urban agglomeration, the more difficult it is to overtake" (Chen and Greene (2012), the consistent of the highest rank of these two cities indicates their economic, geographic and social advantages in the whole country.

In both periods (1985 to 2005, and 2005-2015), the RMI value for Beijing and Shanghai maintains 0. The attribution of the rank table supports this conclusion as Shanghai rank 1 and Beijing rank 2 for the examined time points. Namely, both cities maintain their "big brothers" roles in China's urban hierarchy system.

Reference: Aldenderfer, Mark, and Herbert DG Maschner, eds. Anthropology, space, and geographic information systems. Oxford university press, 1996.
Chen, Xuwei, and Richard Greene. "The spatial-temporal dynamics of China's changing urban hierarchy (1950–2005)." Urban Studies Research 2012 (2012).
Greene, Richard P., and James B. Pick. Exploring the urban community: A GIS approach. Prentice Hall, 2012.