Toponym mapping: a case for distribution of ethnic groups and landscape features in Guangdong, China

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**ABSTRACT**

Toponyms serve as symbols of regional culture and thus reflect the history, habitat and environment of a place. This study aims to (1) visualize the distributions of the four ethnic groups and landscape features in Guangdong of China using a toponym mapping method, of which results were presented at 1:6,400,000 scale and (2) to explore the changes by comparing contemporary data, of which results were presented at 1:3,200,000 scale. These maps provide a toponymic aspect to explore the historical evolution of ethnic groups and landscape features.

**1. Introduction**

Toponyms, also known as place names, are the names of certain geographical regions (Chu, Yin, & Sun, 2009) and represent a subjective interpretation of the living environment by the local inhabitants at the time of naming (Conedera, Vassere, Neff, Meurer, & Krebs, 2007). In this respect, three types of information can be extracted from toponyms: spatial locations, temporal information and landscape (Calvo-Iglesias, Díaz-Varela, Méndez-Martínez, & Fra-Paleo, 2012). Many landscape features can be reflected by toponyms, such as topography, settlement of ethnic groups (Situ, 1992), migration of people, religious and cultural traditions and local language (Evereet-Health, 2000). Toponyms also remain relatively consistent over time, and many have survived transformations of the external environment (Rose-Redwood, Alderman, & Azaryahu, 2010). The Chinese city of ‘Xianyang’, for example, was named 2000 years ago, and its name is still in use today. ‘Xianyang’ means the location south of the mountain and north of the water. The landscape features of this city still exist today. A toponym is thus a useful tool to identify variation and trends in cultural and natural landscape features over time.

Research has been conducted to reconstruct past land use (Conedera et al., 2007), to identify the role of toponyms in soil classification (Siderius & de Bakker, 2003), to explore former floodplain connectivity using toponyms and to discuss the possibility of using toponyms as indicators of historical landscape features that have been transformed (Calvo-Iglesias et al., 2012; Sousa & García-Murillo, 2001). These studies view toponyms as cultural and geographical characteristics and are based on the deconstruction of toponym structure. A toponym is composed of both a specific name and a generic name, and the latter describes the landscape in more detail (Seidl, 2008). By classifying generic names, toponyms associated with different ethnic groups can be identified in our work. Based on these classifications, some research has been conducted (Wang, Hartmann, Luo, & Huang, 2006; Wang, Wang, Hartmann, & Luo, 2012) on the migration of ethnic groups in southern China using geographical information systems.

The concept of ‘toponym mapping’ proposed in this paper refers to the use of toponyms as original thematic data, employing spatial analysis and cartographic methods to show the complex rules and characteristics of toponyms in an intuitive way on a map of the region (Slingsby, Wood, & Dykes, 2010). Toponym mapping puts emphasis on revealing landscape features (Ni, 1988). Some research that interpret concepts in toponym maps has been conducted by Japanese scholars, but more practical research is still lacking.

Guangdong province is part of an ancient area of land called Lingnan, which encompasses a region of the country between the Five Rides and the South China Sea. This geographical feature creates a relatively closed environment, which facilitates the preservation of local toponyms. There are four ethnic groups in Guangdong, including Cantonese, Hakka, Hoklo and Zhuang (Situ, 2001; Tan, 1999; Wang, Huang, & Situ, 2012). Each ethnic group has its own toponym features that are reflected in generic names.

Based on the classification of generic names of the four ethnic groups, there are two main aims in this...
paper. The first is to study spatial patterns and migration trends through toponym mapping. The second is to explore the characteristics and variations of the four ethnic groups in geomorphology and land use. Floating catchment area (FCA), trend surface analysis and spatial clustering (Bailey & Gatrell, 1995; Brown, 2004; Wang, 2010) are employed in toponym mapping to obtain accurate results. Eventually, results are displayed in a series of thematic maps.

2. Materials and methods

Guangdong province exhibits a complex and diverse culture due to its location in Lingnan (the mountains in the south). During the pre-Qing Dynasty (before 221 BC), aboriginals occupying the region were mainly Naiyue, Luoyue and Minyue people who were collectively known as Baiyue people. These were the ancestors of the subsequent subgroups of Han Chinese. After the Qing Dynasty (1636–1912 AD), Han migrants from the north continuously entered Lingnan and, because of different migration routes and regional environments, formed three subgroups of Han Chinese. Immigrants who first entered the Xi River Corridor integrated with Nanyue and Luoyue people during the Dang and Song Dynasty (618–1279 AD) and formed a new subgroup called Cantonese. During the Song and Yuan Dynasty (960–1368 AD), migrants from the north entered the southern and northeast Guangdong province and formed a subgroup called Hakka. During the Song Dynasty (960–1279 AD), many Min people migrated to the Chaoshan-Shantou area under the strain of increasing population in the southern Fujian province, which allowed the culture in this area to merge with Min culture (Xie, 2013). After the Cantonese occupied western Guangdong, some of the Baiyue people migrated to Huaiji and the Lianshan Zhuang and Yao Autonomous County, which now constitutes Zhuang (Wang, Wang, et al., 2012).

These differences in ethnic groups result in a diverse linguistic culture in Guangdong province, for example, Zhuang people speak the Zhuang language, while Cantonese, Hakka and Hoklo people speak Cantonese, Hakka and Hoklo dialects, respectively. After the Cantonese became the dominant ethnic group in western Guangdong, the Cantonese dialect was popularized in the Xi River Corridor and the Pearl River Delta. However, the Zhuang language of the Baiyue people remained intact due to their deeply ingrained culture (Wang, Wang, et al., 2012). Hakka dialects are common in eastern and northeastern Guangdong, while the Hoklo dialect is spoken in the Chaoshan-Shantou area. A distinctive toponymic landscape of linguistic culture and cultural meanings was generated.

Just as a generic name indicates the category of a geographic entity (Pang, Liu, & Tian, 2010), toponyms can be classified according to generic names (Chu et al., 2009). Some generic names are unique to an ethnic group and have a specific meaning, which allows us to identify the ethnic group according to generic names. Similarly, generic names in one ethnic group always have the same meaning, so we can identify a type of landscape feature through classification of generic names. Therefore, in this study, toponyms were classified according to ethnic groups and landscape meanings to present both the spatial patterns of the four ethnic groups as well as man-made and physical landscape features. Landscape features were then divided into landforms and land use.

To reconstruct both the distribution of ethnic groups and landscape features as shown in Main Map, toponyms were selected from The New Century Atlas in Guangdong Province (Guangdong Map Publishing House, 2010), which covers detailed toponyms in Guangdong province at the township level. Table 1 shows the generic names we selected and the classification results. The toponyms containing these generic names are pure, which means that one generic name belongs to only one ethnic group or is associated with only one landscape feature. Furthermore, the origins of generic names date back to the Song Dynasty and its historical characteristics.

2.1. Mapping ethnic groups based on toponyms

The historical settlement patterns can be reconstructed from toponyms on the condition that a place named by an ethnic group has been unchanged. To visualize the distribution of ethnic group toponym, a common spatial smoothing method called the FCA method was applied. As described by Wang (2010), FCA can calculate the ratio of place names of a specific ethnic group among all other place names. When calculating the ratio of place names in an ethnic group, a binary variable was used to classify these names (1 for the ethnic group needing to be examined and 0 for the other three ethnic groups). Experiments with various radii show that using a circle with a 10-km radius as the filtering window not only highlights general trends but also maintains local variability. Trend surface analysis, a global spatial interpolation method, was then used to generate a continuous surface for the entire study area. Trend surface modeling assumes that known values (ratios of name places) at any location can be expressed

| Table 1. Statistics of general names used by ethnic groups. |
|------------------------------------------------------------|
| Mountainous/hilly areas | Zhuang | Cantonese | Hoklo | Hakka |
| Water | Dong | Zhang, Bei, Lang | | |
| Paddy/irrigated field | Chong, Lai, Yong, Li | She | |
| Towns | Na, Luo | Xu | | |
| Plain | Liang | Sha | Qian | Duan |
by a polynomial equation, such as
\[ z_i Y_{xi}, \; y_1 Y = z_i Y_{xi}, \; y_1 Y + e_i, \]
where \( z_i Y_{xi}, \; y_1 Y \) is the observed value, \( z_i Y_{xi}, \; y_1 Y \) is the theoretical value and \( e_i \) is the residual value (Xu, 2006). The method of least squares is used to minimize the sum of the squares of the errors made when obtaining the results of each equation. The estimated polynomial equation is then used to estimate unknown values at any location.

Maps for distribution of ethnic group using a toponym mapping method show the distribution of ethnic groups toponym using trend surface analysis, and reveal different concentrations of ethnic groups in the past. The concentration of Zhuang is highest in the Leizhou Peninsula and locations close to the intersection of Guangxi province. Cantonese is widely distributed in the Pearl River Delta and northern Guangdong province, close to Guangxi and Hunan province. Hakka is concentrated in two areas: the larger area spans Chaoshan and Shantou (two cities of eastern Guangdong), whereas the smaller area is an island-shaped region on the Leizhou Peninsula. Hakka mainly clusters in the northern region of Guangdong province, especially in Heyuan and Meizhou.

2.2. Mapping ethnic groups in contemporary times
Place names in a town level are stable to some extend and the ways of naming places remain unchanged when different ethnic groups occupied. Therefore, the distribution of the four ethnic groups in the past is usually different from those in the present time.

To map the distribution of ethnic groups after the 1980s, we collected demographics of the Zhuang, Cantonese, Hoklo and Hakka people from The distribution of Min Dialect in Guangdong Province and its similarities and differences of phonology, distribution of dialects in Guangdong and History of Hakka in Guangdong (Gan & Jian, 2010; Lin, 1994; Tan, 2010). Maps for distribution of ethnic group population in the 1990s show the population proportion using dialects by county in the present time.

2.3. Migration of ethnic groups
To examine the immigration and emigration of ethnic groups, population proportion in the 1990s and toponyms ratio were subtracted using a raster calculator to compute increases and decreases of population. Furthermore, centrographic analysis was applied to visualize the movements of the centroid. Maps for the change of ethnic groups’ distribution show the migration of the four ethnic groups. A negative value denotes immigration of an ethnic group, while a positive value indicates immigration of an ethnic group. Because spatial interpolation errors exist and the demographics of ethnic groups in the 1990s were limited within counties, a difference between −10% and 10% was regarded as no migration.

The differences between ethnic group using the toponym mapping method and data in the 1990s demonstrate the migration of ethnic groups, and centrographic analysis helps one to visualize this evolution. Zhuang people migrated from Leizhou Peninsula to Huaiji and the Lianshan Zhuang and Yao Autonomous County. Cantonese tend to have migrated from north to south, and the centroid of Cantonese moved to the Pearl River Delta. The Hoklo migrated from the Chaoshan-Shantou area to Leizhou Peninsula, but some Hoklo live in the east, which results in the centroid moving to the Pearl River Delta. Hakka people expanded to the Pearl River Delta and some places in the west while the population in the north increased and the centroid moved south.

2.4. Mapping landscape features based on toponyms
As mentioned previously, toponyms were classified according to generic names to reconstruct past landscape features and view changes over time. The landscape features were then divided into two types: landforms and land use. Plains and mountainous and hilly area were characterized as landforms, while paddy and irrigated land, water and towns exemplify land use. To visualize the distribution of landscape features, the FCA method and Kriging interpolation method were again applied. Kriging interpolation reveals local patterns, which is lacking in the global interpolation method.

To identify types of regional landforms, the ratios of plain and mountainous and hilly area toponyms were compared, and each region was assigned the ratio with the larger value of landform type. Map for elevation using the toponym mapping method shows that mountainous and hilly land in the Hakka residential zone are the dominant landform, while the largest plain is in the Pearl River Delta where Cantonese people lived.

Maps for the area of paddy and irrigated land, water, and town toponyms using the toponym mapping method show different concentrations of land use type in past time. Paddy and irrigated land toponyms are concentrated in the Leizhou Peninsula and scattered throughout the north and northeast of Guangdong province. The concentrations of water toponyms are mainly around rivers: the primary toponym is in the northern part of the region through which the Bei River and Xi River flow, and the secondary toponym is to the east where the Dong River runs. Clusters of town toponyms are scattered in the Pearl River Delta and Chaozhou-Shantou area.
2.5. Mapping landscape features in contemporary times

Historical landforms were then compared with the digital elevation model (DEM) data to observe the historical evolution of landscape features, which was obtained from the SRTM 90 m DEM Database (http://srtm.csi.cgiar.org/). Additionally, historical land use was compared with land use in the 1980s, which was obtained from data sharing infrastructure of Earth System Science (http://www.geodata.cn/). The land use types were expressed using raster and the value means percentage of the land use type within 1 km \( \times \) 1 km grid.

Maps for elevation using digital elevation data in 2000 shows the elevation obtained through the Digital Elevation Database. Maps for the area of paddy and irrigated land, water and town in the 1980s show the distribution of land use type in the present time.

2.6. Historical evolution of landscape features

A comparison of elevation using the toponym mapping method and digital elevation data shows that landforms deduced from toponyms correspond with elevation. Because elevation is relatively stable, using toponyms can accurately reflect the physical landscape in Guangdong province.

To understand the changes of land use among each ethnic group, land use types in the 1980s and ratio of land use toponym were subtracted using the raster calculator to compute the increase and decrease in land use. A negative value denotes a decrease in the land use type, while a positive value indicates increase in the land use type. Because spatial interpolation errors exist, a difference between $-10\%$ and $10\%$ was regarded as invariability.

Maps for the area changes of land use demonstrate the change of land use throughout history. Regional divisions help identify differences in land use among ethnic groups. Use of paddy and irrigated land in the ancient Zhuang area has decreased. As Han Chinese people entered Lingnan, they started farming in the northern and eastern Guangdong province. In the meantime, Zhuang people migrated to Huaiji and the Lianshan Zhuang and Yao Autonomous County. After the Ming Dynasty, Cantonese and Hakka people continuously migrated to the Pearl River Delta and farmed in the area. Migration prompted the expansion of agricultural areas from the west to the entire study area, especially the Pearl River Delta. Water in the 1980s reflect areas with rivers or lakes, whereas toponyms with water-related meanings reflect ancient places near water. The largest area in which towns have increased is the Pearl River Delta. The ancient town name ‘Xu’ originated from the Yue language and extended to the entire Guangdong province as the commodity economy boomed after the Ming dynasty. To some extent, the appearance of ancient towns reflected the development of the economy.

3. Conclusion

Toponyms serve as symbols of regional culture and thus reflect the history, habitat and environment of a place. Toponymic studies examine the origin and development of an ethnic group, present the spatial patterns of a certain culture and reveal both man-made and physical environmental features of a region. Both migration policy and a distinctive geographical environment in Lingnan contribute to a complex and unique culture in Guangdong province.

The spatial patterns of Zhuang, Cantonese, Hoklo and Hakka toponyms were displayed using spatial smoothing and spatial interpolation methods. Immigration and emigration of ethnic groups were examined through centrographic analysis and comparisons of toponym ratios associated with populations in the 1990s.

To visualize the distribution of landscape features, both the FCA method and Kriging interpolation were applied. A comparison of landscape toponyms and landscape features in the 1980s shows the variations in landscape among the four ethnic groups.

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Software

ESRI ArcGIS 10.2 was used for spatial analysis and statistical analysis. ArcGIS 10.2, Adobe Photoshop CS6 and CorelDRAW X6 were used for cartography.

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