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INTRODUCTION

Transport network has become one of the important ways to explore urban spatial network. It is surprising to find that previous studies on intercity transportation network are mainly based on a single mode of transportation, such as high-speed railway, highway or aviation. However, there exist multiple transport modes in many regions. Many studies has shown that these modes are potential substitutes.

This paper investigates and compares the connectivity of multi-mode intercity passenger transport in the Yangtze River Economic Belt.

DATA AND METHODS

Based on intercity passenger rail, road and air day shift data, we construct weighted connection models. Due to the limitation of road passenger traffic data, we can only directly replace intercity links with shift data. We also did not obtain passenger traffic data between train station, but there were large differences in railway passenger traffic between cities of different sizes. It is worth noting that different trains also have different speeds (Shanghai to Nanjing high-speed rail only takes 90 minutes, ordinary train takes about 240 minutes), which also affects the strength of intercity connections. Thus, we defined *rail capacity discount* based on population, economy and intercity distance. Meanwhile, *rail time discount* is defined according to the train running time. Moreover, we defined *air capacity discount* based on air traffic data.
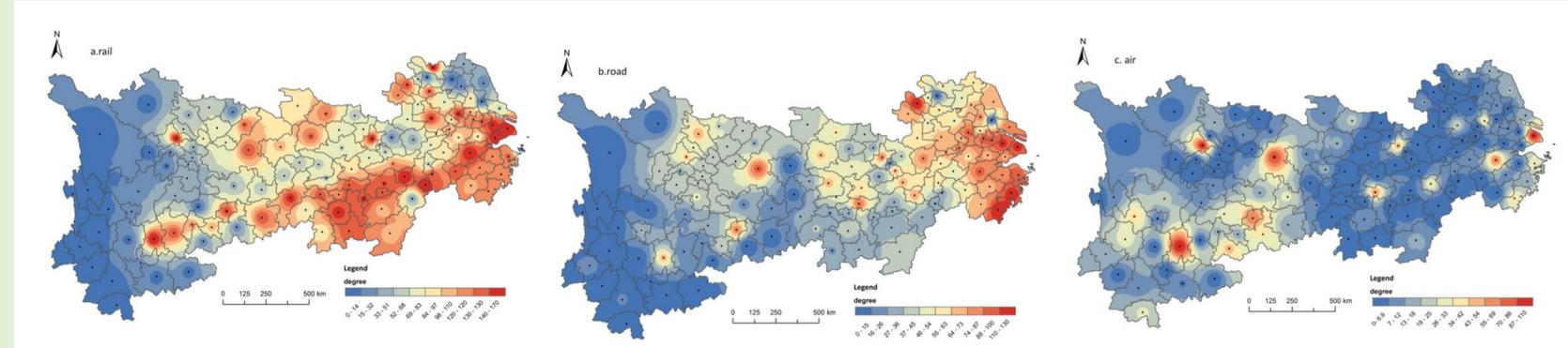
RESULTS

Figure 1. The urban degree based on rail, road and air

The higher urban degree based on rail passenger is mainly concentrated in Shanghai and provincial capital cities. Its spatial distribution coincides with the height of railway network lines, and it also shows the uneven development of the eastern and western regions. Moreover, there is also a difference between the northern and southern. The higher urban degree based on road passenger is mainly concentrated in Yangtze River Delta region, with Shanghai as the leading divergent diffusion to the western part of the Yangtze River. The urban degree of the central and western regions is generally lower besides provincial capital cities and Cheng-Yu area. Unlike rail and road, the higher urban degree of airline are mainly distributed in Shanghai, Hangzhou and other big cities located western region. Limited by terrain and location, Yunnan and Guizhou, centered around Kunming and Guiyang, are highly dependent on aviation.
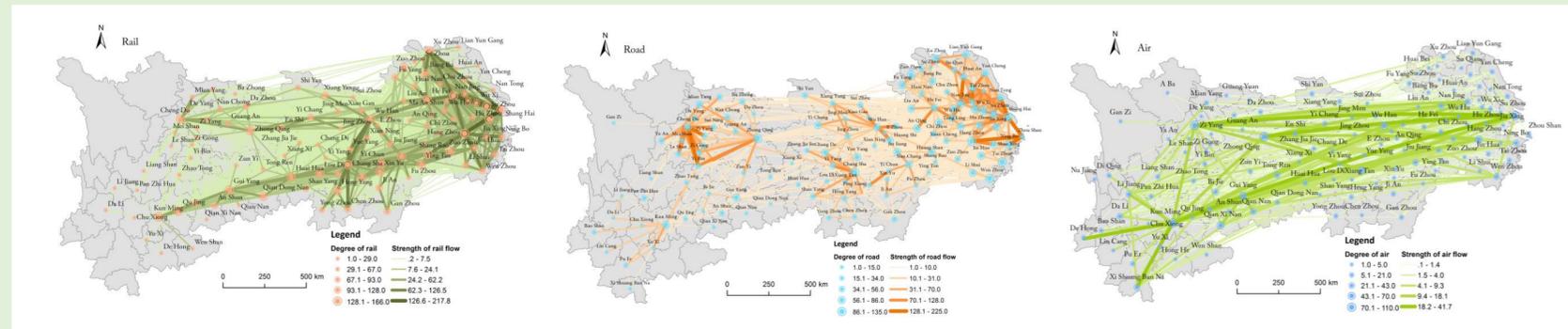

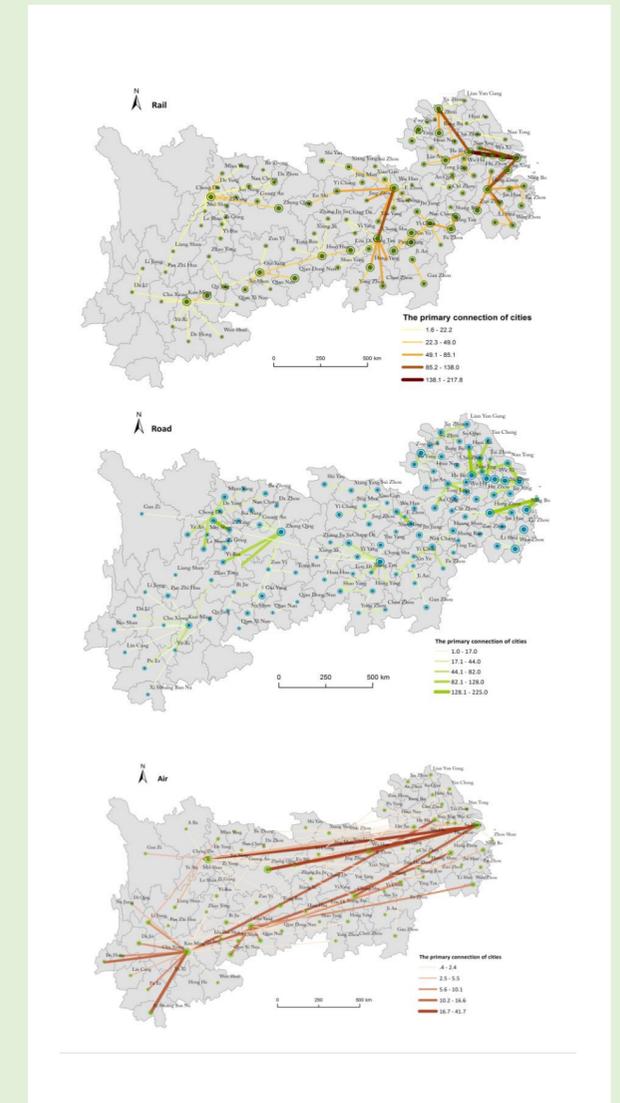Figure 2. The strength of intercity flows based on rail, road and air

Figure 3. The largest intercity flow based on rail, road and air

As shown in Figure 2, we can find that railway flow is mainly concentrated among adjacent provincial capitals and Yangtze River Delta, western network performance is poor. The road network shows a clear close-range provincial network, especially in Jiangsu and Sichuan. The aviation network is characterized by medium-to-long-distance connections, especially the links between the Yangtze River Delta region with Shanghai as the core and the provincial capitals of the western region (such as Chengdu and Kunming).In order to show the relationship between nodes more clearly, we preserve the maximum connection of each node, as shown in Figure 3. The railway maximum connection flow network shows regional network and geographical proximity. The highway maximum connection flow shows strong same-province effect and geographical proximity. The aviation maximum connection flow is mainly the East-West long-distance inter-city connection and the intra-provincial city connection of Sichuan and Yunnan.

Different modes of transportation undertake the function of intercity connection at different distances. Highway mainly undertakes the inter-city passenger flow within the province, railway undertakes the inter-city passenger flow between regions, while air is responsible for the inter-city transportation in long-distance and complex terrain areas.