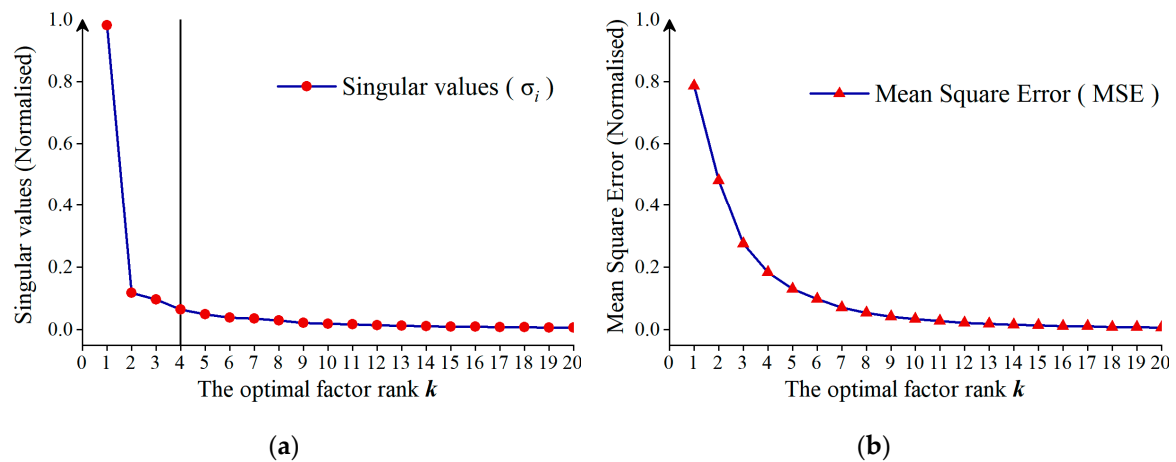


# Supplementary file

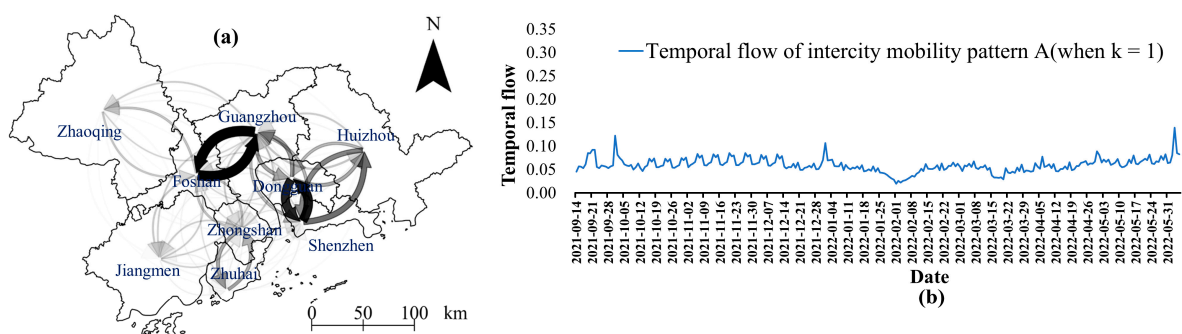
This document provides a sensitivity analysis for the effect of the optimal factor rank  $k$  on the results of intercity mobility patterns when using the Non-negative Matrix Factorization (NMF).

Figure S1(a) shows the results of singular values related to the optimal factor rank  $k$ . We found that the maximum singular value is much larger than other singular values, and the singular value decreases rapidly. Singular values keep a small change amplitude after the fourth item. Figure S1(b) shows an analysis of the Mean Square Error compared with the origin matrix related to the optimal factor rank  $k$ . We found that the values of Mean Square Error gradually decreased with the increase of the optimal factor rank  $k$ . The descending speed gradually slows down.

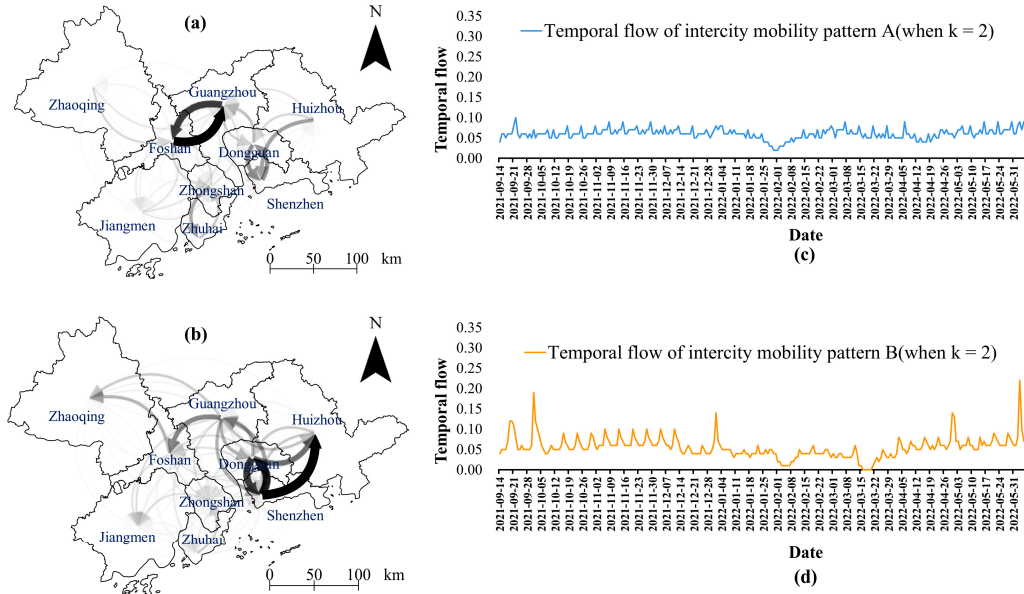


**Figure S1.** Changes of singular values and Mean Square Error related to  $k$ . (a) Changes of singular values. (b) Changes of Mean Square Error compared with the origin matrix.

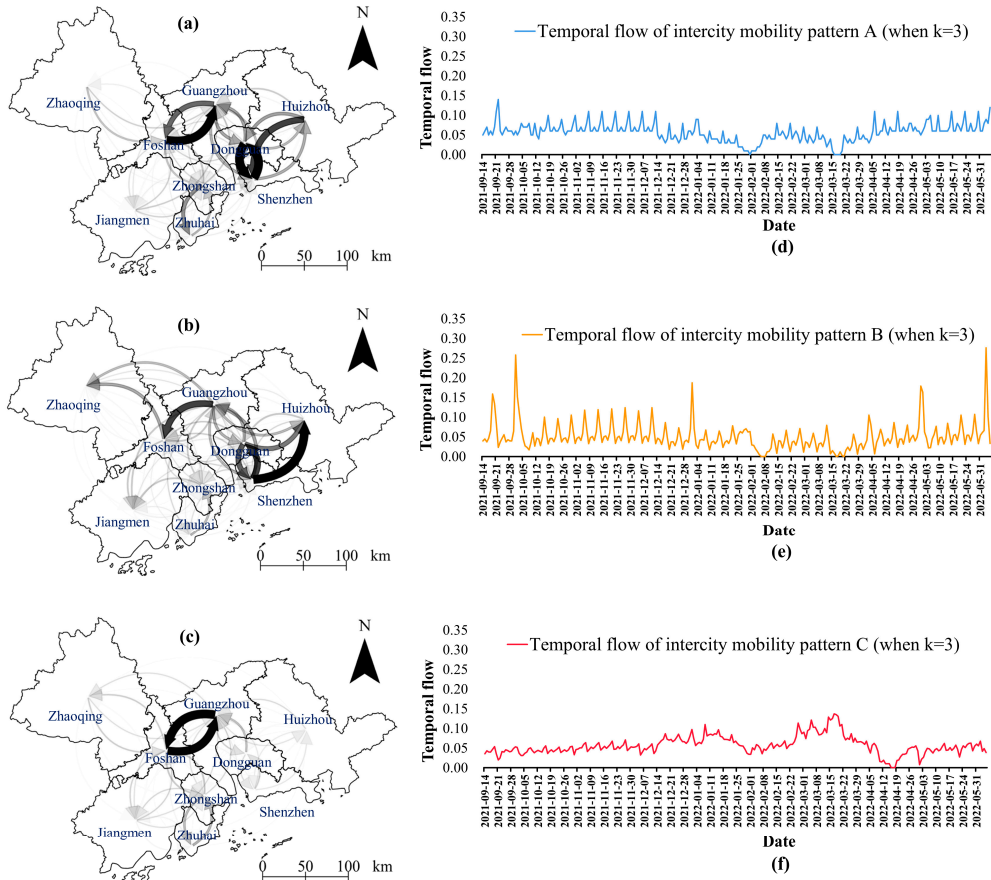
Figures S2-S4 show the decomposed intercity mobility patterns when setting  $k$  with 1, 2, and 3. We can see that a smaller optimal factor rank  $k$  only extracts partial information. With the increase of the value of  $k$ , the decomposed intercity mobility patterns become more detailed. Importantly, it remains an important topic to investigate the determination of the optimal factor rank  $k$  when using the method of NMF.



**Figure S2.** The intercity mobility pattern in the GBA when  $k=1$ . (a) Spatial flow of intercity mobility pattern A. (b) Temporal flow of intercity mobility pattern A.



**Figure S3.** The intercity mobility patterns in the GBA when  $k=2$ . (a) Spatial flow of intercity mobility pattern A. (b) Spatial flow of intercity mobility pattern B. (c) Temporal flow of intercity mobility pattern A. (d) Temporal flow of intercity mobility pattern B.



**Figure S4.** The intercity mobility patterns in the GBA when  $k=3$ . (a) Spatial flow of intercity mobility pattern A. (b) Spatial flow of intercity mobility pattern B. (c) Spatial flow of intercity mobility pattern C. (d) Temporal flow of intercity mobility pattern A. (e) Temporal flow of intercity mobility pattern B. (f) Temporal flow of intercity mobility pattern C.