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## Delimitating functional zones at municipal or county level in China based on a spatial optimization and simulation coupling approach

Dan Li, Jigang Qiao, and Yihan Zhang

Guangdong University of Finance & Economics, School of Geography and Tourism, China (danli@gdufe.edu.cn)

Territory spatial planning is a guide and blueprint for future territorial development in China. It means to form a scientific, rational, intensive, and efficient spatial protection and development pattern in territory space. The first task according to the government is to delimitate the functional zones of ecology, agriculture, urban zones, and delineation of ecological protection red lines, permanent basic farmland boundaries, and urban development boundaries ("three zones and three lines"). Currently China used a resource and environment carrying capacity and land space development suitability evaluation ("double evaluations") to complete the delimitation task. However, the process of these evaluations and demarcation is relatively complicated, high-level human intervention, and the operability is not strong, therefore it is not practically at municipal or county level. We proposed a new delineation framework, methods, and software tools for the delimitation work, based on a spatial optimization and simulation coupling approach, and is verified by an example in Guangzhou, a super metropolis city in China. It shows that this method can rapidly and efficiently delimit urban ecological and agricultural zones based on regional geographic background conditions, by using an ant colony intelligent optimization algorithm, and using a cellular automata model to delineate compact urban zones. Compared with the "three zones" division plan in the "Guangzhou Land and Space Master Plan (2018-2035) Draft" which is published by local government, the delimited functional zones by proposed method can meet the quantitative requirements of the draft, while providing more detailed and realistic spatial pattern of the three functional zones, which can be very useful for municipal and county level territory spatial planning work.