International Journal of Remote Sensing ›

Volume 40, 2019 - Issue 22

Articles

An estimation of housing vacancy rate using NPP-VIIRS night-time light data and OpenStreetMap data

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Pages 8566-8588 | Received 17 Sep 2018, Accepted 21 Apr 2019, Published online: 19 May 2019

Cite this article https://doi.org/10.1080/01431161.2019.1615655 Check for updates

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ABSTRACT

As an informative proxy measure for a range of socio-economic variables, satellite-derived night-time light (NTL) data have been widely used to investigate the diverse anthropogenic activities and reveal urbanization development. Due to the rapid increase of Chinese urbanization rate, from 25.3% in 1987 to 58.5% in 2017, and 'crazy expansion' of city space, the sick phenomenon – 'Ghost Town' – has been brought out, generally defined as places with high housing vacancy rate (HVR), which will cause the huge waste of the limited land source in China. To investigate the HVR of urban areas in China, this study attempts to establish a hybrid model combining data derived from National Polar-Orbiting Partnership–Visible Infrared Imaging Radiometer Suite (NPP-VIIRS) NTL sensors with OpenStreetMap (OSM) data. By distinguishing non-residential

areas and introducing detailed residential building information, we proposed a novel HVR estimation model, thus realizing the estimation of HVR in 31 Chinese provincial cities with different development levels (Tier 1–Tier 3). The results showed the average HVR of Tier 2 cities (0.204) was higher than that of Tier 1 cities (0.189) and Tier 3 cities (0.233). The model was proven more accurate (root mean square error of approximation (RMSE) = 0.022) when compared with previous models. To explore the reasons causing different HVRs in these provincial cities, the relationship between HVR and typical socio-economic factors – gross domestic product (GDP), population, and housing price – was also revealed. Through correlation verification and built of a regression model, HVR was found positively correlated with housing price (0.409), however, negatively correlated with population (−0.829) and GDP (−0.356). The research is an indication of the applicability of using data derived from NPP-VIIRS NTL sensors in reflecting HVR and an exploration to distinguish socio-economic factors influencing HVR in different cities. The model we proposed can potentially provide guidance for urban planners to formulate better land-use plan and rental measures.

Author Contributions

Wang Luyao and Fan Hong conceived and designed the main idea and experiments; Wang Luyao and Wang Yankun performed the experiments; Wang Luyao wrote the paper.

Disclosure statement

No potential conflict of interest was reported by the authors.

Additional information

Funding

This research was supported by the National Natural Science Foundation of China (Grant Nos. 41471323, 91746206, and 41661086), the National Key Research and

Development Program of China (2017YFB0503500) and the Science and Technology Development Project of Guizhou Province Tobacco Corporation of China National Tobacco Corporation (Contract No. 201407).