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How Mixed is Beijing, China? A visual exploration of mixed land use

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The legacy of socialist urban planning and recently established market economy in Beijing, China often create a mismatch between urban land use plans and actual land use: Before China's opening and reforming in 1978, Beijing's landscape reflects egalitarian premise and is dominated by large parcels and single-purpose zoning. Yet the city's recent economic success, as evidenced by mushrooming financial districts, retail malls, and technology centers, has surely spurred up mixed development (Yang et al. 2013).

In order to capture this mismatch, we compute a mixed land use index (Frank et al. 2004) and ask "will the zoning plan and the actual land use reveal different levels of mixed development in Beijing?" Furthermore, such index has often been used to understand evolving travel mode choice, public health outcomes, as well as the sense of community (Manaugh and Kreider 2013).

Nevertheless, quantifying the degree of mixed-use has proven difficult. Conventional methods (e.g., remote sensing and survey) have focused on the proportion of different land use types at (aggregated) parcel level, rather than different land use of individual establishments (e.g., residential building, restaurants, and retail stores) within parcels.

Our study therefore employs land use data at multiple spatial scales. More specifically, city-wide planned land use for 21,922 parcels is obtained from Beijing Institute of City Planning (BICP), while the actual land use is measured by three datasets: (1) 22,027 current land parcels identified from remote sensing images; (2) 84,541 Point-of-Interests (PoIs) crawled from Sina Weibo (the Chinese equivalent of Twitter) which catalogues business establishments and housing options throughout the city; and (3) 6,555,529 check-ins for all PoIs in (2), reflecting land-use intensity. All parcels, check-in points, and PoIs are associated with one of the eight commercial and residential land use types (Long et al. 2012)

As our data sources reveal – planned as well as actual – mixed land use in Beijing at various geographical scales, a consistent geographic framework is constructed for comparison: central Beijing (Figure 1) is divided into 2,272 square km grids, and for each grid the mixed land use index is computed following Frank et al. (2004).

Figure 1 reveals a consistent pattern of mixed land use in Beijing computed from different data sources, and reflects the effectiveness of urban planning implementation (Long et al. 2012): the mixing of land use is higher in the city center and much lower in the periphery; the spatial extents of planned and actual urban activities largely overlap; and there exists a lack of residential and commercial activities (i.e., blank grids) along several axes in the city periphery. Moreover, central-city land use captured by check-in and PoI data are more mixed, as check-ins and PoIs entail additional information about heterogeneous land use within parcels. We therefore suggest that, check-in and PoI data – with fine-grained locational information – would be supplement to conventional ways of measuring urban land use.

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