Featured graphic. How mixed is Beijing, China?
A visual exploration of mixed land use

The combination of a legacy of socialist urban planning and the more recently established market economy in Beijing, China, is likely to create a mismatch between urban land-use plans and actual land use. Before China's economic reforms of 1978, Beijing's landscape reflected a more egalitarian premise and was dominated by large parcels and single-purpose zoning. In contrast, the city's recent economic success, as evidenced by mushrooming financial districts, retail malls, and technology centers, might be expected to have resulted in more mixed development than was planned (Yang et al, 2013).

In order to capture this mismatch, we compute a mixed land-use index (Frank et al, 2004) to try to address the question: "will the zoning plan and the actual land use reveal different levels of mixed development in Beijing?" The mixed index (M) of a land lot is calculated as $M = -\Sigma p_i \ln p_i (i = 1, ..., n)$, where n denotes the number of land-use types under consideration, and p_i is the proportion of the lot that is characterized by land-use type i. This index has been used before to better understand evolving travel mode choice and public health outcomes, as well to study changing senses of community (Manaugh and Kreider, 2013).

Our study shows city-wide planned land use for 21 922 parcels obtained from Beijing Institute of City Planning, while actual land use is measured by three datasets:
(1) 22 027 current land parcels identified from remote sensing images;
(2) 84 541 Points-of-Interest (PoIs) crawled from a leading Chinese social media—Sina Weibo (the Chinese equivalent of Twitter) which catalogs 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).

To produce this graphic central Beijing is divided into 2272 km² cells, and for each cell the mixed land-use index is computed following Frank et al (2004). Overall the amounts of land-use mixing revealed by each of the different data sources are rather consistent. This might confirm the continued effectiveness of urban planning implementation (Long et al, 2012): for example, land-use mixing remains higher in the city center and much lower in the periphery; geographic extents of planned and actual urban activities largely overlap; and there exists a lack of residential and commercial activities (ie, blank grids) along several axes in the city periphery. Moreover, land-use patterns captured by check-in and PoI data are more mixed than those revealed by parcel-level observations.

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References
Frank L, Andresen M, Schmid T, 2004, "Obesity relationships with community design, physical activity, and time spent in cars" *American Journal of Preventive Medicine* **27** 87–96
Long Y, Gu Y, Han H, 2012, "Spatiotemporal heterogeneity of urban planning implementation effectiveness: evidence from five urban master plans of Beijing" *Landscape and Urban Planning* **108** 103–111
Manaugh K, Kreider T, 2013, "What is mixed use? Presenting an interaction method for measuring land use mix" *Journal of Transport and Land Use* **6** 63–72
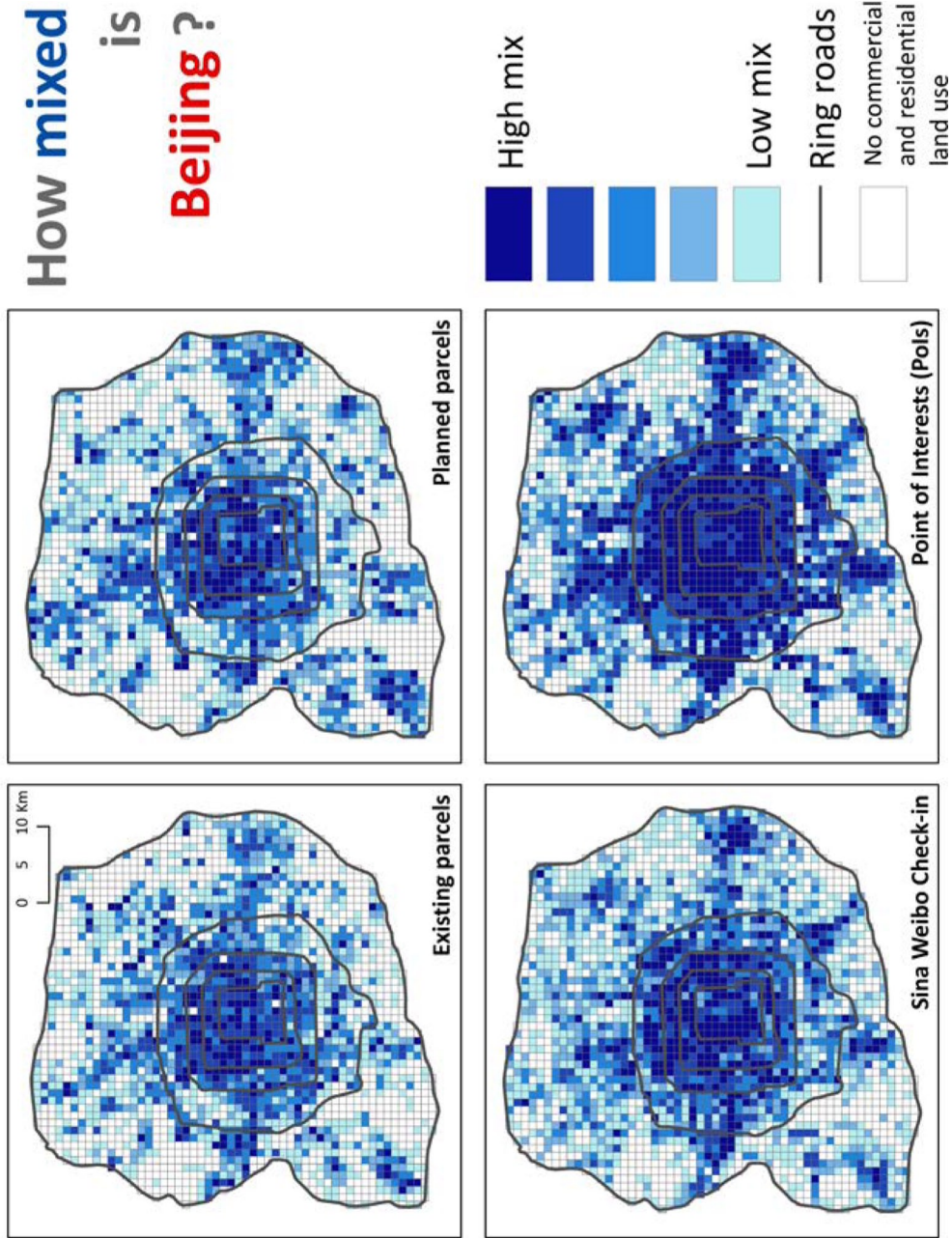Yang Z, Cai J, Ottens H, Sliuzas R, 2013, "Beijing" *Cities* **31** 491–506

How mixed is Beijing?

High mix

Low mix

Ring roads

No commercial and residential land use

Planned parcels

Point of Interests (PoIs)

Existing parcels

0   5   10 km

Sina Weibo Check-in

Figure 1. [In color online.] How mixed is Beijing, China? A visual exploration of mixed land use.

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