EXPLORING GLOBAL URBANIZATION USING NEW DATA
(EXTENDED ABSTRACT)

CHANDAN DEUSKAR & **EUGENIE BIRCH**
Penn Institute for Urban Research, University of Pennsylvania, United States of America
cdeuskar@upenn.edu

Paper prepared for presentation at the
"2017 WORLD BANK CONFERENCE ON LAND AND POVERTY"
The World Bank - Washington DC, March 20-24, 2017

Abstract

The understanding of global trends in urbanization has long been constrained by inconsistencies in the definitions of urban areas and a reliance on administrative boundaries as the units of analysis. However, advances in technology are now beginning to enable a more consistent approach to understanding the spatial form, scale, and pace of global urban development. In particular, the new Global Human Settlement data set allows an evidence-based approach to global urbanization. It combines a global map of built-up areas produced using earth observation data with a global population distribution layer, to which a standard definition of urban areas based on size, density, and contiguity of populations and built-up areas is applied. The result is a global map and catalogue of the changing populations and extents of all such urban clusters around the world (several thousand in total). This paper explores changes in all 'urban centers' (or 'high density clusters') from this dataset across the world during the 1990-2015 period. We calculate a range of metrics for all such clusters, and summarize the results by country, region, size category, and income group. We also discuss limitations of the data set.

Key Words:

comparative; global; spatial; urbanization; clusters

The following is an extended abstract for publication on the Land and Poverty Conference 2017 website. A full version of the paper is available upon request from the authors.

Researchers have struggled to provide the international community with a firm empirical basis on which to base agreements and policies on urbanization. Until recently, those concerned with global urbanization have relied on data drawn from the United Nation's Population Division's biennial publication, *World Urbanization Prospects* (United Nations Department of Economic and Social Affairs, 2014). The data on urbanization in this publication are derived from national census reports which vary not only in their timeliness and reliability, but also in the definitions they use to define what is "urban" (Deuskar & Stewart, 2016). The challenges associated with the use of incomparable definitions in this dataset have long been noted by researchers and international organizations (Dijkstra & Poelman, 2014; Satterthwaite, 2007; World Bank, 2009). Despite these shortcomings, the *World Urbanization Prospects* nevertheless offered the best available source of data on global urbanization from its inception in 1988 to the present. Increasingly, however, this resource is not fit for today's purposes, which are characterized by new demand for more accurate and universally comparable data. The sheer level of urbanization, the desire to understand its full extent as urban growth exceeds jurisdictional boundaries of places counted by the UN, as well as the growing monitoring requirements revolving around the UN agreements are all driving the quest for standardized urban definitions and data.

Until recently, there was no study or data set that involved a comprehensive mapping of all urban areas across the globe for more than one point in time, using a standard definition. There had been various studies that measured urbanization using comparable definitions across countries. These included studies of urbanization at the regional level using built-up areas or night-time lights data (World Bank Group, 2015; Ellis & Roberts, 2016), at the global level using representative samples of cities (Angel et al., 2005; Angel, Blei, Parent, Lamson-Hall, & Galarza Sánchez, 2016), or at the global level using a comprehensive mapping of urban areas (Uchida & Nelson, 2010). However, none of these allowed a globally comprehensive measurement of changes in urban areas defined in a standardized manner over time.

However, this changed with the release of the Global Human Settlement (GHS) dataset by the European Commission's Joint Research Center (JRC) at the Habitat III conference in October 2016. The GHS dataset uses satellite imagery, population data, and a standardized definition of urban areas to map and tabulate urbanization across the world over a relatively long time period. This paper uses this new dataset to examine changes in urban centers around the world between 1990 and 2015, classified by region, income group, and size in order to test commonly-held assumptions about global urbanization. It also assesses the opportunities and challenges associated with using this large new data set to characterize global urbanization.

The GHS dataset combines data on built-up areas from satellite imagery and population data from censuses. It starts with a global map of built-up areas in 1975, 1990, 2000, and 2015, called the Global Human Settlement Layer (GHSL), produced by JRC using earth observation data from the United States Geological Survey's LandSat satellite program. Population data from a global census database, produced by Columbia University's Center for International Earth Science Information Network (CIESIN), are then distributed to grid cells using the built-up area layer. A standard definition of urban areas, the 'Degree of Urbanization' developed by the European Commission (Dijkstra & Poelman, 2014), is then applied to this combined layer. The definition is based on size, density, and contiguity of populations and built-up areas, and is applied to the 2015 version of the population layer with a spatial resolution of 1km (European Commission, 2016). The result is a global map of the changing populations and built-up areas of all urban clusters around the world, several thousand in total, between 1975 and 2015 (within the 2015 extents). It allows the measurement and characterization of global urban growth, at various scales, in a comprehensive and comparable way.

The European Commission's 'Degree of Urbanization' approach classifies grid cells in the population distribution grid into three categories. Urban centers (also known as 'high-density clusters') are made up of contiguous cells with a population density of at least 1,500 inhabitants per sq. km., or a density of built-up land greater than 50% of the cell, such that the total population of the cluster as a whole has a minimum of 50,000 inhabitants. These represent cities or large urban areas. 'Urban clusters' are made up of contiguous cells with a population density of at least 300 inhabitants per sq. km., such that the total population of the cluster is at least 5,000 inhabitants. The urban clusters add towns and suburbs to the urban centers. Cells that do not meet the criteria of the urban clusters are 'rural areas'.

For the purpose of this analysis, we use only the urban centers. The total population in urban centers is roughly half of the global total population in 2015, whereas the total population in urban clusters adds up to 85%. This means that, between the two, the population in urban centers is closer to the estimate of the world's urban population based on census definitions, 54% in 2015 (United Nations Department of Economic and Social Affairs, 2014), which has been widely accepted. Additionally, the data on urban clusters are tabulated by JRC in spreadsheet format, which is not the case with urban clusters, making it more practical to work with urban centers for an initial exploratory analysis such as this.

Prior to analyzing the list, we cleaned the data by removing urban centers that were extremely small or which appeared to have unreasonably high densities, to filter out potential errors of commission. The original list of urban centers prepared by JRC included 13,844 entries, each representing an urban center. The resulting list has 9,269 urban centers. The removals were disproportionately in South Asia, from which 63% of the original urban centers were removed, and Sub-Saharan Africa (40%). As a result, 90% of all

removed urban centers were in low or lower-middle income countries. While the original GHS data set includes data for four time points – 1975, 1990, 2000, and 2015 – the 1975 data are less reliable due to missing LandSat imagery, and were therefore not included in this analysis.

We proceed to present and discuss the populations and population densities of the urban centers, broken down by region and income group, along with the change in these metrics over the 1990-2015 period. We use the dataset to calculate the 'land use efficiency', which the United Nations intends to use to measure global progress towards one of its Sustainable Development Goals. We discuss the limitations of this metric in characterizing land use efficiency, arising from the fact that it only represents change and not absolute values. We also use the data to examine changes in urban concentration within nations over time, and adherence of national urban systems in select countries (Brazil, China, India, and the United States) to Zipf's Law.

We discuss several limitations of the dataset and precautions required while using it. For example, the change, the measurement of changing population density, i.e. the changing relationship between population and built-up areas, is complicated by the fact that in this dataset population is in fact distributed using built-up areas. Also, the fact that changes are only recorded within the 2015 urban center extents means that if urban extents reduced in size between previous years and 2015 (e.g. due to a reduction in density at the periphery), some areas that would have qualified as part of urban centers in previous years are neglected.

References

Angel, S., Blei, A. M., Parent, J., Lamson-Hall, P., & Galarza Sánchez, N. (2016). *Atlas of Urban Expansion: The 2016 Edition*

Angel, S., Chabaeva, A., Gitlin, L., Kraley, A., Parent, J., & Perlin, M. (2005). *The Dynamics of Global Urban Expansion*. Washington, D.C.: World Bank, Transport and Urban Development Department.

Deuskar, C., & Stewart, B. (2016). *Measuring Global Urbanization using a Standard Definition of Urban Areas: Analysis of Preliminary Results.*

Dijkstra, L., & Poelman, H. (2014). *A harmonised definition of cities and rural areas: the new degree of urbanization.* (Regional Working Paper).

Ellis, P. D., & Roberts, M. (2016). *Leveraging urbanization in South Asia: Managing Spatial Transformation for Prosperity and Livability*. Washington, DC: World Bank.

European Commission. (2016). Global Human Settlement.

Satterthwaite, D. (2007). *The transition to a predominantly urban world and its underpinnings.* London: International Institute for Environment and Development (IIED).

Uchida, H., & Nelson, A. (2010). *Agglomeration index: towards a new measure of urban concentration.* Helsinki: WIDER.

United Nations Department of Economic and Social Affairs. (2014). *World Urbanization Prospects.* New York:

World Bank. (2009). *Reshaping economic geography*. Washington, D.C.: World Bank.

World Bank Group. (2015). *East Asia's Changing Urban Landscape : Measuring a Decade of Spatial Growth*. Washington, DC: World Bank Group.