It's Time for an Urbanization Science

by William Solecki,
Karen C. Seto, and Peter J. Marcotullio

Today, urban areas generate more than 90% of the global economy, are home to more than 50% of the world population, consume more than 65% of the world's energy; and emit 70% of global greenhouse gas emissions.[1] The science and policy communities increasingly recognize that cities, urban areas, and the underlying urbanization process are at the center of global climate change and sustainability challenges. Policymakers need facts, empirical evidence, and theories on how to plan and manage cities and urbanization during the contemporary era of rapid change and environmental uncertainty.

Air pollution over Sao Paulo, Brazil.

Scholars spanning from the humanities to social and physical sciences have engaged in the study of cities over the past century and have generated numerous discoveries about urban places and processes that drive their creation and development. While some research has concluded that cities are sources of environmental degradation, there is also evidence that cities and the lifestyles they engender can be potential solutions to current and future environmental and sustainability challenges.

A residential area of Singapore shows huge buildings stretching into the horizon.

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As a sign of confidence in our understanding of cities, the recent Rio + 20 conference recognized "the need for a holistic approach to urban development and human settlements" and called for "an integrated approach to planning and building sustainable cities and urban settlements" to create livable places as a way to solve our local, regional, and even global environmental problems. The idea is simple and enticing: Acting locally within cities can solve our global environmental problems.

Compelling as this may be, it leaves out half of the equation. Scholarship on cities is extensive,[2] but our knowledge of urbanization is fragmented. Cities are places. Urbanization is a process, one of simultaneous transformation of places, populations, economies, and the built environment that creates an urban society. Despite a panoply of researchers studying cities, research on urbanization has not focused on the process and its intersection with other environmental systems. Consequently, contemporary urban studies are unlikely to deliver the information and knowledge required to help urban areas become the meaningful catalysts for sustainability solutions. Why is this the case? Part of the problem is that each discipline approaches the city and uses its own analytical lenses and tools to examine the processes of interest to that discipline: population growth in cities, ecology within cities, migration to cities, the economy of cities, climate within cities.

As a result, we have a smorgasbord of information and data about cities as places and lack a coherent understanding of the underlying urbanization processes that create urban places and interaction of these processes with other systems. Yet it is exactly this process that is currently unfolding at a scale and rate that has never been matched in history. Urban areas will expand by more than 29,000 soccer fields every day for the next 18 years and the world is adding 1 billion more urban dwellers every 13 years, a rate twice as fast as just 30 years ago.[3]

This lack of coherent understanding will result in sustainability policies—be it climate, carbon, equity— that are merely stop-gaps at best, and mistakes at worst. Contemporary solutions do not reach to underlying urbanization processes and contexts, but rather continue to address symptoms of problems. If we continue with this piecemeal approach, we will not define meaningful global sustainability solutions. For example, creating more bike lanes in North American cities is a great idea; however, its impact meeting the global sustainability challenge may be offset by many of these same cities continuing to spread outward, becoming more automobile dependent and less useful for reaching places easily by bicycle.

In order to address this lacuna we must take a good, hard, and inspired look at what we are missing. We need a science of urbanization. This science would focus on the fundamental laws of the urbanization process: its origins, development, organization, emergent properties, and connections to other

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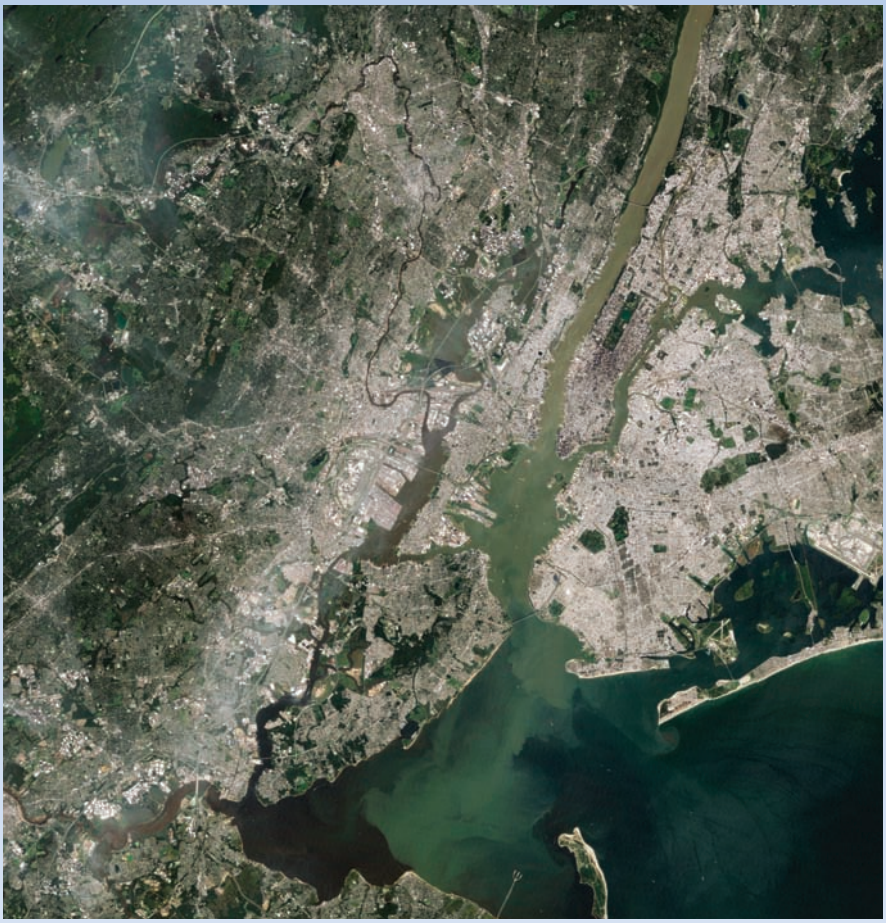
A chaotic street in Dhaka, Bangladesh, shows many people and rickshaws with obsolete residential buildings.

social and biophysical processes. What might urbanization science look like? At minimum, it would address three fundamental aspects of urbanization that to date have been only partially answered. First, there is no consensus on the basic components of urbanization. What is missing is a framework that focuses on urbanization as an object of study both within one city and more importantly across cohorts and populations of cities. Generally, axiomatic conditions on the relationship between the population share in urban centers and income generation, or the space for time substitution models associating urban land use and ecosystem service degradation, also have been undertheorized. These statements taken together suggest that we need to explore what makes up the most fundamental aspects of urbanization, across space, place, time, and cultures. In order to take a proactive approach to urbanization and the complex set of socioecological systems interactions within and across urban areas, we need a much better understanding of all system components.

Second, we need to explore and critically examine the empirical evidence that presents the urbanization system (meaning the set of components and process of changing urban centers) in and of itself as unique among systems (at any scale) and ask how the associated elements and processes influence other systems. Can we identify a theory of urbanization with fundamental and unique components that can withstand scientific scrutiny and produce valuable universal laws and theories? A more critical review of the evidence on urbanization as a process and not on cities as places could lead to systemic solutions that address the whole rather than separate components.

The importance of a scientific understanding of urbanization is underscored by recent weather events, such as Hurricane Sandy

Finally, can we then find relationships between urbanization and other aspects of the Earth System? We argue that a science is needed to understand how urbanization unfolds so that we can develop generalities to larger scales and with that understand how this process interacts with local and global environments. For example, while there have been studies of how biodiversity changes in urban to rural gradients and statements on the increasing homogeneity of urban biota, there has not been a study that examines whether and how urbanization has affected, for example, the latitudinal gradient in biodiversity or any of the ecogeographic rules of biodiversity. Is global urbanization resulting in a typology of cities that can be useful in understanding impacts and responses to climate change? How does urbanization affect land use transitions? How does urbanization affect poverty across urban–rural gradients? To answer these questions we need a firm grasp on



NASA/Landsat 5

In the wake of heavy rains from Hurricane Irene, sediment filled New York's Hudson River and estuary.

what urbanization is and how it interacts with other systems. The answers to these questions will lead to a better understanding of how, when, where, and at what scale urbanization connects to laws and principles in other sciences.

The science emerging from these fundamental questions can contribute to the goals of sustainability practice. If we better understand the local, regional, and global urbanization processes, these insights could be brought to the city (re)building process now underway via changes in policy shifts and market incentives. The importance of a scientific understanding of urbanization is underscored by recent weather events, such as Hurricane Sandy, which hit coastal urban areas in New York and New Jersey in October 2012. The storm's impacts, which are predicted to be among the most costly in U.S. history, highlight the great need for better understanding of urbanization and its relationship to larger processes, such as climate change, just at a time when greater attention is being paid to these processes. The result of not developing a science on such fundamentals is to continue scholarly fragmentation and lack of scientific consensus on which to build evidence-based policies.

Why Now?

There are several emerging opportunities that steel our resolve for such an effort to fully specify urbanization science, beginning with the increasing amount of available data that can help us address previous modeling barriers. There are also a growing number of research communities calling for such a science, including long-term ecological researchers, the urban modeling community, the remote sensing community, land change scientists, and the urbanization and global environmental change research community, as well as those who are attempting to apply physical laws to cities.[4] These scholars have the expertise to develop such a sci-

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The French Quarter in New Orleans is flooded in the wake of Hurricane Katrina in 2005.

ence. Finally, a greater sophistication in analysis, availability of large-scale data, and hardware can be brought to bear on this analysis.

More important than the data, expertise, and technologies is the urgent need for the development of this science. We endorse the sentiment that came out of the Rio + 20 meeting that "cities" can be effective catalysts for sustainable development. They are, however, necessary but not sufficient actors in sustainability efforts. Urbanization unfolds on multiple scales and needs to be addressed at these scales. While there are all too few examples of regional and national urban programs that address urbanization, there is nothing at the global scale. A research effort on urbanization, similar to that of climate change science, is necessary to support policy development at these larger scales.[5] Certainly, policymakers at multiple levels of governance can positively influence the externalities associated with urbanization, but only if they have the scientific evidence and understanding of how the system works. Given the growing importance of urbanization and the concentration of populations and economies in cities, urbanization is now of global interest to researchers and policies, which both should be directed toward this goal. We believe that the moment has arrived for the development of an urbanization science that will provide the basis for and stimulation of local, national, and international laws, regulations and agreements.

William Solecki is a professor of geography at Hunter College and director of the City University of New York, Institute for Sustainable Cities. He is also co-chair of the New York City panel on Climate Change, and a member of the Scientific Steering Committee of the Urbanization and Global Environmental Change Project (UGEC) of the International Human Dimensions Programme on Global Environmental Change (IHDP). **Karen C. Seto** is an associate professor of the urban environment at the Yale School of Forestry & Environmental Studies. She is also co-chair of the Urbanization and Global Environmental Change Project (UGEC) of the International Human Dimensions Programme on Global Environmental Change (IHDP). **Peter J. Marcotullio** is an associate professor of geography at Hunter College, co-deputy director of the City University of New York, Institute for Sustainable Cities, and program associate with the Urbanization and Global Environmental Change Project (UGEC) of the International Human Dimensions Programme on Global Environmental Change (IHDP).

NOTES

1. IEA, *World Energy Outlook 2008* (Paris, OECD/IEA, 2008); UNFPA, *State of the World Population: Unleashing the Potential of Urban Growth* (New York, NY: United Nations Population Fund, 2007); and United Nations, *National Accounts Main Aggregates Database* (New York, NY: United Nations, Statistics Divison, 2011), available at http://unstats.un.org/unsd/snaama (accessed March 21, 2012).

2. See, for example, M. R. Montgomery, R. Stren, et al., *Cities Transformed, Demographic Change in its Implications in the Developing World* (Washington, DC: National Academies Press, 2003).

3. K. Seto, M. Fragkias, et al., "A Meta-Analysis of Global Urban Land Expansion," *PloS One* 6, no. 8 (2011).

4. M. Batty, "The Size, Scale, and Shape of Cities," *Science* 319 (2008): 769–771; L. Bettencourt and G. West, "A Unified Theory of Urban Living," *Nature* 467 (2010): 912–913; N. Grimm, S. H. Faeth, et al., "Global Change and the Ecology of Cities," *Science* 319, no. 5864 (2008): 756–760; and K. C. Seto, A. Reenberg, et al., "Urban Land Teleconnections and Sustainability." *Proceeding of the National Academy of Sciences of the United States of America* 109, no. 18 (2012), available at www.pnas.org/cgi/doi/10.1073/pnas.1117622109

5. C. Rosenzweig, W. D. Solecki, et al., eds., *Climate Change and Cities, First Assessment Report of the Urban Climate Change Research Network* (Cambridge, UK: Cambridge University Press, 2011).

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