



Urbanization and Global Environmental Change

AN IHDP CORE PROJECT

INTRODUCTION

Understanding the Linkages between Urbanization and Global Environmental Change (UGEC)

Global environmental change (GEC) is defined as the biophysical transformation of the environment through human activities and natural processes (i.e., climate change, natural disasters, loss of biodiversity, freshwater ecosystem decline, desertification, and land degradation).

GEC occurs both as a driver and outcome of economic, political, cultural, social and physical processes in urban areas.

Currently, more than half of the world's population lives in cities; by 2030 the world will advance to the 60% urbanization threshold and nearly one out of every three urban residents will reside in either China or India.

Approximately one out of three urban dwellers worldwide lives in slum conditions and this ratio is expected to increase in the future.

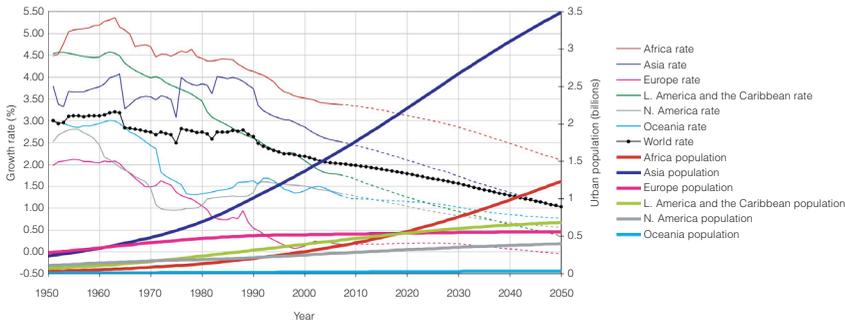
Worldwide, urban expansion is one of the primary drivers of habitat loss and alteration, and of plant and animal species extinction.

Rapid urbanization effects will not only be present within the immediate locations (cities and their metropolitan areas), but will be experienced regionally and globally.

Cities are agents of rapid change across a wide range of environmental, economic, and social systems and offer many advantages and opportunities for sustainability.

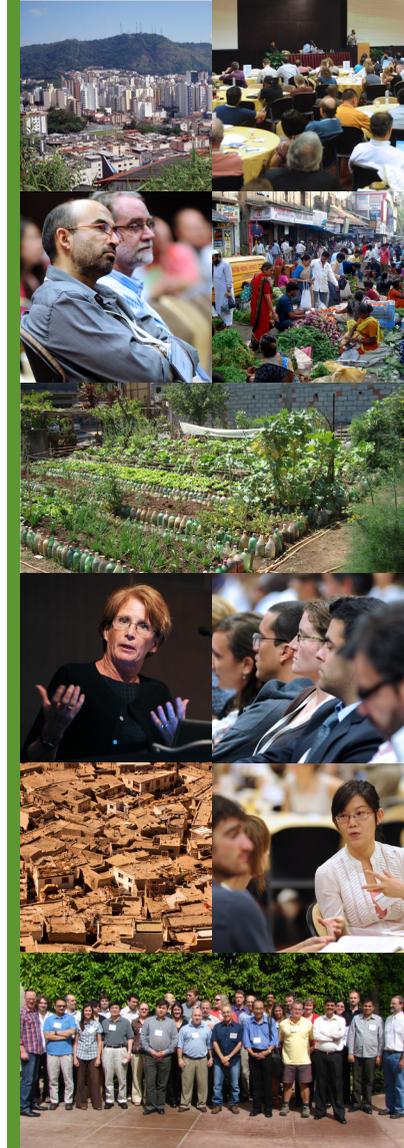
Contemporary urbanization fundamentally differs from historic patterns in its scale, rate, geographic reach, form, and function, and it is characterized by its many interconnected dimensions. Contemporary perspectives on and agendas for sustainability need to explicitly incorporate new projections over future urbanization patterns and trends (Seto et al., 2010).

ANNUAL URBAN POPULATION GROWTH AND GROWTH RATE BY WORLD REGION. Thin lines denote rates of change; thick lines represent magnitudes. Dashed lines represent UN projections.



Source. United Nations. 2008. *World Urbanization Prospects: The 2007 Revision*. New York: United Nations

Seto, K., Sánchez-Rodríguez, R., & Fragkias, M. (2010). The new geography of contemporary urbanization and the environment. *Annual Review of Environment and Resources*, 35, 167-194. doi: 10.1146/annurev-environ-100809-125336



OVERVIEW

Towards a better understanding of the regional and global implications of urbanization and the complex dynamic systems of urban areas that affect and are affected by global environmental change

What is the UGEC PROJECT?

A **core science project** of the International Human Dimensions Programme on Global Environmental Change (IHDP) since 2006, steered by an international scientific committee which provides strategic direction and oversees the project's development and implementation of the UGEC Science Plan.

A **multidisciplinary programme** that coordinates and facilitates new research on the bi-directional interactions and feedbacks between global environmental processes and urban societies at the local, regional, and global levels.

A **coordination platform** for thematic and regional **networks** of international research projects and practitioners.

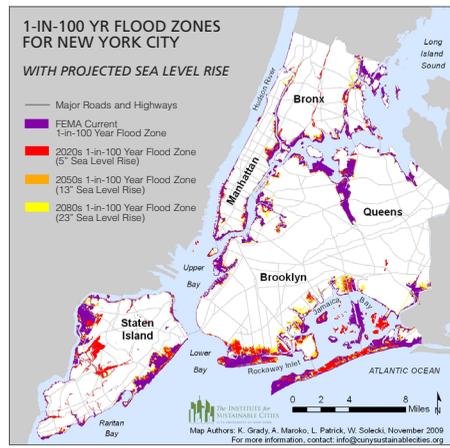
A **repository of knowledge** aiding cooperation and close interaction between practitioners, decision-makers and researchers.

A **gateway for communication and exchange** of cutting-edge research and innovative practice in the field of urbanization and global environmental change.



Coastal cities face a specific set of challenges that require a unique set of adaptation strategies due to their concentration of people and critical infrastructure in low-lying coastal zones, inability to easily shift locales, overlapping regulatory jurisdictions, and especially the variety and complexity of infrastructure and the population's dependence on it. While specifically designed for New York City, the comprehensive approaches, methods, and tools developed here can be modified and applied to many urban areas both coastal and non-coastal. These approaches, methods, and tools include a multi-jurisdictional stakeholder-scientist process, state-of-the-art scientific projections and mapping, and development of a range of types of adaptation strategies based on an overarching risk-management approach (Rosenzweig et al., 2011).

AREAS POTENTIALLY AT-RISK TO THE 1-IN-100 YEAR FLOODS IN NYC DUE TO SEA LEVEL RISE PROJECTIONS DERIVED FROM GLOBAL CLIMATE MODELS



Note. This map is subject to limitations in accuracy as a result of the quantitative models, datasets, and methodology used in its development. The map and data should not be used to assess actual coastal hazards, insurance requirements, or property values or be used in lieu of Flood Insurance Rate Maps issued by FEMA.

Interpretation. The floodplains delineated in no way represent precise flood boundaries but rather illustrate three distinct areas of interest: 1) areas currently subject to the 1-in-100 year flood that will continue to be subject to flooding in the future, 2) areas that do not currently flood but are expected to potentially experience the 1-in-100 year flood in the future, and 3) areas that do not currently flood and are unlikely to do so in the timeline of the climate projection scenarios used in this research (end of current century).

Source. Solecki, W., Patrick, L., Brady, M. (2010). Climate protection levels. In: C. Rosenzweig and W. Solecki (Eds.) *New York City Panel on Climate Change, 2010. Climate change adaptation in New York City: Building a risk management response*. Prepared for use by the New York City Climate Change Adaptation Task Force. *Annals of the New York Academy of Science* 2010. New York, NY, pp 291-351.

Rosenzweig, C., Solecki, W., Blake, R., Bowman, M., Faris, C., Gornitz, V., Horton, R., Jacob, K., LeBlanc, A., Leichenko, R., Linkin, M., Major, D., O'Grady, M., Patrick, L., Sussman, E., Yohe, G., & Zimmerman, R. (2011). Developing coastal adaptation to climate change in the New York City infrastructure-shed: process, approach, tools, and strategies. *Climatic Change*, 106(1), 93-127. doi: 10.1007/s10584-010-0002-8

OBJECTIVES

Foster **transdisciplinary research** and develop innovative **conceptual and methodological frameworks** to expand and improve our knowledge of the interactions between urban areas and global environmental change;

Develop and expand **networks of scholars** with common geographic or thematic interests in the emerging field of urbanization and global environmental change;

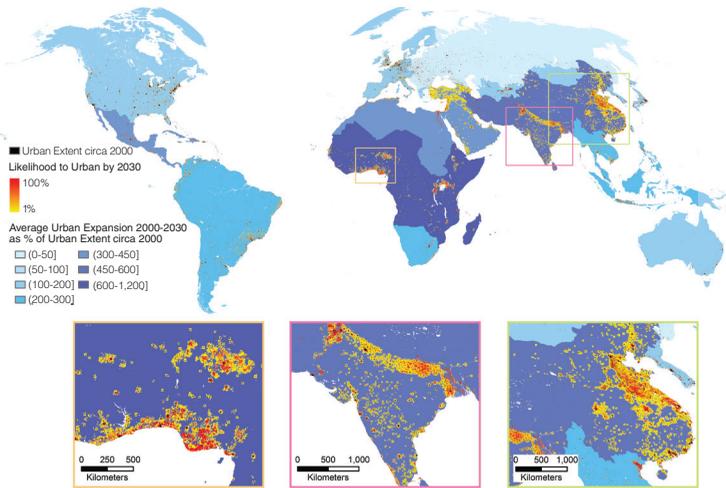
Connect **science and policy**, thus making UGEC research more policy-relevant;

Promote **cooperation** and the **exchange of knowledge** among researchers, decision-makers, practitioners, and other end-users at the international, national and local levels with respect to theories, models and methods, policies, and initiatives related to UGEC;

Build **capacity** where capacity does not exist; and,

Strengthen our role as a **central node** in the network of urban sustainability scientists and practitioners.

We expect massive urban expansion concentrated in a few world regions. These hotspots of urban land change are spread across the developing world and they may become even larger megapolitan areas than those in the U.S. and Western Europe. Three of the largest of these projected hotspots exist in and around the Niger Delta in Africa, across the Indo-Gangetic plain, and across eastern and central China in Asia. Our findings at continental and global scales will help us develop a better understanding of both urban vulnerability to various natural hazards and vulnerability of certain ecosystems to urban expansion in the near future (Seto and Güneralp, in prep.).



URBAN FOOTPRINT IN YEAR 2030 ACROSS THE WORLD. The map shows the most likely places to urbanize across the World according to a study on urban expansion conducted by Burak Güneralp and Karen Seto. The urban extents *circa* 2000 are shown as black and are based on the MODIS Land Cover product version 5. The probabilistic simulations generated an ensemble of predicted urban expansion magnitudes and patterns by 2030. Those pixels with a likelihood from 1% to 100% to become urban by 2030 are shown with shades that range from yellow to red; average magnitude of urban expansion in each region as a percentage of the region's urban extent *circa* 2000 are shown with shades of blue.

Source: Burak Güneralp and Karen C. Seto.



IMPLEMENTATION

The UGEC project is a leader in developing:

Original, high impact research publications;

International and national assessment reports;

Research syntheses;

Meta-analyses;

Comparative case studies;

Research, training, and science-practice workshops;

International conferences and fora including panels, sessions, special side-events, and networking events;

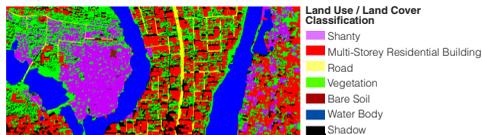
Policy briefs, white papers, and newsletters;

Resources and tools for knowledge integration, synthesis, and dissemination; and,

Listservs, website(s), and electronic newsletters.

Studies concentrating on the challenge of world urbanization and its links to global environmental change often refer to a need for combined spatial, physical and socio-demographic information. Geospatial technology and Remote Sensing (RS) can help to fill some of these gaps. For example, RS can help identify vulnerable groups and their spatial urban environment, which if acted upon, could promote equity in megacities (Netzband & Rahman, 2011).

URBAN REMOTE SENSING APPLICATIONS, A: CENTRAL DHAKA, BANGLADESH; B: LO BARNECHEA, SANTIAGO DE CHILE. This High resolution remotely sensed data sets (e.g., IKONOS, Quick Bird and Cartosat 1 and 2) help to document the growth of urban areas, both quantitatively and, in combination with ancillary data sets, qualitatively. In order to analyze and evaluate intra-urban patterns as well as trends in slums across cities, such data must be taken throughout the various levels of planning processes and must incorporate all existing and documented socio-economic information and environmental issues.



A 0 200 400 800 Meters



B 0 100 200 400 Meters



THEMATIC RESEARCH AREAS

Changes in urbanization patterns and their implications for global environmental change

– build a better understanding of the opportunities, challenges, and actions needed to build sustainability and resilience according to the diverse paths of urbanization in regions.

Triple win solutions: adaptation, mitigation and development – opportunities and constraints of triple win solutions to climate change; merge urbanization via urban design, land use with adaptation and mitigation potential.

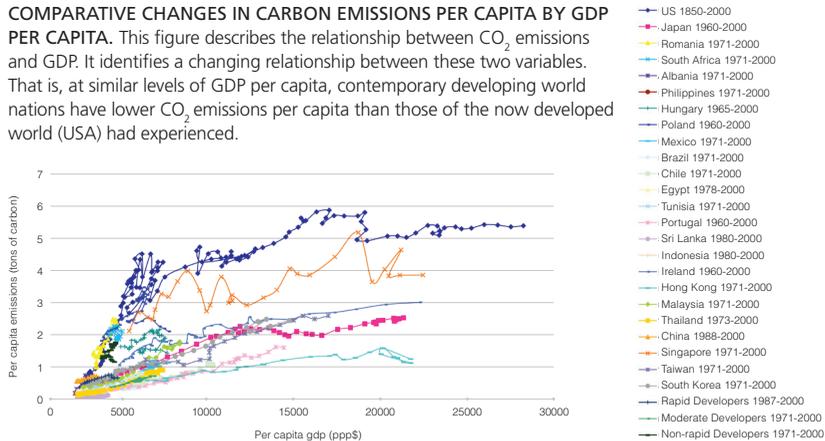
Critical urban environmental transitions – review and refine the methods to identify and evaluate conditions under which transitions take place.

Linking urban ecology and environmental justice in an era of rapid urbanization and global environmental change – connect important themes on urban sustainability that remain largely separate but have great potential for intellectual synergies.

The urban ecosystem services/well-being link – review and refine the methods to identify, classify and value urban ecosystem services.

All countries do not follow similar patterns of income growth and environmental impact. For developing countries, contemporary economic growth is arguably accompanied by more energy efficiency and therefore has less systemic global impact than was experienced by the United States. Indeed, despite rapid increases in GDP, developing countries experience lower levels of energy usage than would have been expected using developed Western world history as a guide (Marcotullio & Schulz, 2007).

COMPARATIVE CHANGES IN CARBON EMISSIONS PER CAPITA BY GDP PER CAPITA. This figure describes the relationship between CO₂ emissions and GDP. It identifies a changing relationship between these two variables. That is, at similar levels of GDP per capita, contemporary developing world nations have lower CO₂ emissions per capita than those of the now developed world (USA) had experienced.



Source: Marcotullio, P. J., & Schulz, N.B. (2007). Comparison of energy transitions in the United States and developing and industrializing economies. *World Development*, 35(10), 1650–1683. doi: 10.1016/j.worlddev.2006.11.006



GETTING INVOLVED

The project is continuously developing a network of affiliates who will provide a broader diversity of scientific (thematic and regional) expertise in various disciplines and sub-disciplines as well as practical expertise (practitioners and decision-makers).

UGEC Project Associates

Are researchers, including young and early career scientists, and practitioners who collaborate closely with the UGEC project and are interested in issues related to urbanization and global environmental change.

Have a unique opportunity to define and shape the UGEC project.

Actively participate in, propose, or lead UGEC activities, which include but are not restricted to:

- Developing regional and thematic research networks, co-authoring scoping reports and other publications;
- Engaging in outreach and synthesis activities;
- Coordinating and convening panels and workshops;
- Seeking funding for UGEC-related research and activities;
- Reporting on UGEC activities and their own UGEC-related research at international conferences;

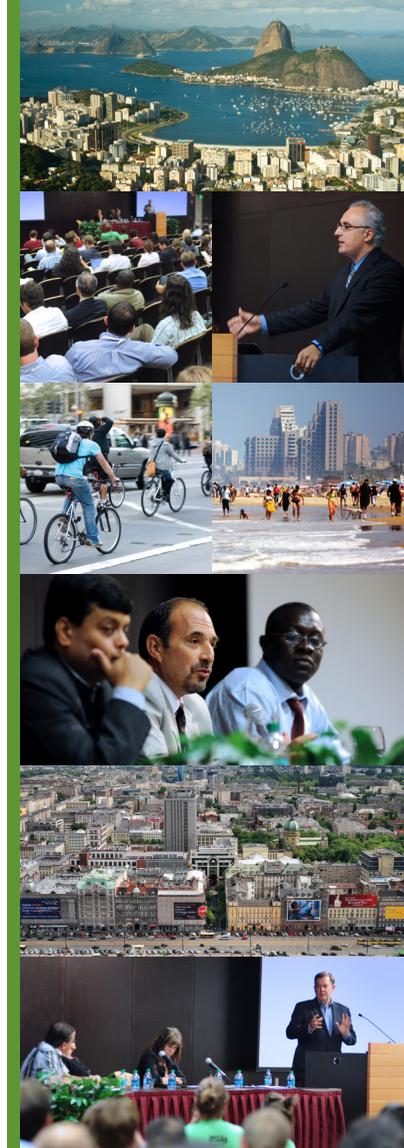
- Cultivating partnerships with research and practitioner communities and organizations; and,
- Mentoring young or newly emerging scholars in UGEC-related research, and leading training workshops.

Endorsed Projects

Include projects from research groups, institutions, and agencies worldwide that connect to the UGEC community;

Are part of the activities of the respective UGEC Regional Network and are integrated into its portfolio of activities, publication and outreach initiatives; and,

Gain access to the UGEC network of projects, programs (including various international and regional workshops) and potential funding initiatives through the various correspondences of the UGEC International Project Office (IPO).



INTERNATIONAL PROJECT OFFICE (IPO)

The UGEC IPO is hosted by the Global Institute of Sustainability (GIOS) at Arizona State University

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The UGEC International Project Office (IPO) has been hosted since its establishment in 2006 by the Global Institute of Sustainability at Arizona State University. Our partnership with GIOS has been critical for the development of the UGEC network internationally. The Global Institute of Sustainability is the hub of Arizona State University's (ASU) sustainability initiatives. The Institute advances research, education, business practices, and the University's operations for an urbanizing world. Its School of Sustainability, the first of its kind in the US, offers transdisciplinary degree programs that explore and advance practical solutions to environmental, economic, and social challenges.

With over 30 years of environmental research conducted by ASU's Center for Environmental Studies, in 2004, it evolved into the Global Institute of Sustainability established by Julie A. Wrigley. In 2007, the School of Sustainability was formed, offering undergraduate and graduate degrees in sustainability.

The Institute has a comprehensive sustainability research portfolio with a special focus on urban environments. More than half of the world's population lives in cities: global sustainability cannot be achieved without making cities sustainable.





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