

# UGEC 2010 ABSTRACT BOOK

## Oct. 10th, 2010

[The Abstract Book is a supporting document to the conference program; conference participants are advised to check both for details regarding our conference sessions and presentations.]

### PLENARY SESSION ABSTRACTS

**Friday, October 15, 2010**

#### **Building Sustainability: Addressing vulnerability and adaptation to climate change in the context of urban development**

Plenary description

Topics to be addressed in this session include: social and urban vulnerability and adaptation responses to climate change; lessons from current responses in developed and developing countries; emerging challenges and how they are linked with development and sustainability planning, main governance issues; the connection between climate change and other environmental challenges in cities, e.g., cities still need to deal with “traditional” challenges of urbanization and now climate change is adding another dynamic; and the efforts of the science community to work on adaptation issues with local decision-makers and other stakeholders.

#### **Sustainability through rapid urban and population growth: the role of rates, scale, location, form and function**

Plenary description

The geography of urbanization is rapidly changing and in multiple dimensions. These changes in the characteristics of contemporary urbanization are fundamentally transforming the relationship between cities and the global environment. We have now entered the Century of the City—and urbanization will be a defining social, economic, and environmental characteristic of the new millennia. The Century of the City presents both global environmental challenges and opportunities. Contemporary urbanization differs from historical patterns of urban growth in terms of their scale, rate, location, form, and function. This session will explore the role of urban planning, multi-level governance, agglomeration and globalization forces in driving and shaping the relationship between urbanization and global environmental change. Worldwide, the physical structure and character of urbanization is increasingly similar to Western cities, but at larger scales and with greater rapidity. These characteristics are most evident in developing country cities and if they continue over the next forty years, will have significant implications for local and global sustainability. Based on this assessment, the session will focus on the challenges of current conceptual frameworks for sustainability in the context of rapid urbanization, and opportunities for triple-win solutions where urban planning for urban development can be aligned with mitigation of and adaptation to climate change. It will also explore the role of urban planning, multi-level governance, agglomeration and globalization forces in driving and shaping the relationship between urbanization and global environmental change.

**Saturday, October 16 2010**

## **Institutions, governance, planning, and sustainability**

### Plenary description

This session will showcase regional perspectives on the cross-scale design of effective institutions, governance structures and strategies promoting sustainable urban futures. It will focus on an institutional view of new alliances and networks, decentralization processes, international agreements/collaborations and development pathways towards sustainability. In particular, it will also focus on the role of national- and city-level authorities and non-governmental actors in the formulation of a variety of responses to global environmental change. Globally, cities have increasingly become the main arena for interactions and responses to global environmental change through new policies, programs, and projects. How can we judge the relative value of the responses based on their design? But more importantly, how are these initiatives being designed and through which processes do they materialize? What are the politics behind the policies? What is the urban governance context within which new action emerges? This session will explore different theories of urban governance and draw on empirical evidence to examine how, why and with what implications cities globally are assessing, planning, and implementing responses to global environmental change.

## **Local action for biodiversity – building resilience from the roots up**

### Plenary description

There is increasing recognition of the fact that city-level resilience to global environmental change will be affected by the manner in which ecosystems and the services they provide are protected and managed at the local level. This session will take the form of a series of presentations highlighting current initiatives (at both the global and local scale) to address the biodiversity challenge in the urban context. It will also address the critical issue of ecosystem services and the role of these services in ensuring local and global level sustainability. The participants are internationally recognized experts: one from a global level local government organization responsible for championing the biodiversity issue at the local level; one with in-depth experience in local government; one with experience in developing an index to monitor local level biodiversity; and one who has been engaged in the analysis of ecosystem services at the global level. After the presentations the chairperson will summarize the key themes emerging from the session. The session will bridge the gap between the academic enquiry into biodiversity and ecosystem services and the manner in which global and local government policy, and grassroots action are required to ensure the sustainable planning and management of biodiversity in cities. It specifically addresses conference theme 3 (biodiversity, habitat conservation and urban areas).

## **Sunday, October 17- Joint UGEC/GLP Day, Sustainable Land Systems in the Era of Urbanization and Climate Change**

### **Urban land systems for sustainability**

#### Plenary description

The shift from rural to urban living has been a defining global trend of the last 100 years, and urban areas are emerging as the most common form of human settlement worldwide. Globally, urban population is expected to increase by 2 to 5 billion over the next forty years. The rate, magnitude, and patterns of contemporary urbanization presents both opportunities and challenges to sustainability. Today's urban transition is a myriad of trends that can be described as either the biggest, fastest, or the first in history: the size and number of cities; the rate at which populations and landscapes are urbanizing; the changing geography of urbanization in developing countries; and depopulation in manufacturing cities. It is the

confluence of these trends that presents both opportunities and challenges to the sustainability of Earth's life support systems.

The changes in the characteristics of contemporary urbanization are fundamentally transforming the relationship between cities and the global environment. This new era of urbanization—as both a demographic and land change process—has characteristics that differentiate it from other periods in history. A major challenge humanity faces is how to change the current scale, form, and rate of urbanization to build opportunities for sustainability in both developed and developing countries. The scale of urbanization is extraordinary; cities are bigger than any other time in terms of their physical extents, population sizes, economic importance, and environmental impacts. The rate at which populations and land cover are becoming urban is faster than any other time in history. The location of urbanization is changing; urban growth in the coming decades will take place primarily in Asia and Africa and expand into agricultural lands, forests, and other natural land covers; urban function is increasingly specialized and this in turn has differentiated effects on the urban labor force, urban lifestyles, and the environment. These characteristics suggest a significant break from periods of rapid urbanization in the past; together, they represent a profoundly new era of urbanization.

## **Sustainability of desert urbanization**

### Plenary description

Many of today's fastest growing cities are in arid regions. Faced with limited water availability, growing populations, and rising demand for energy, desert urbanization creates unique challenges to sustainability. Provision of adequate quantity and quality of water to feed this growth is emerging as an important challenge. Cities in dry regions are particularly critical since climate change projections indicate an increased frequency of climatic extreme events and a progressive decline in rainfall in these regions. In the global south, cities are already struggling with providing access to potable water supplies to their growing populations and seem scarcely equipped to deal with the uncertainties due to climate change. In this session, a panel of experts on desert urban ecosystems will discuss the links between science and policy, the challenges of urban growth and water management, and the decision-making processes that are central to achieving sustainability in arid urban regions.

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## **PARALLEL SESSION ABSTRACTS**

### **FRIDAY, OCTOBER 15 PARALLEL SESSIONS - GROUP A**

#### **A1 Between Institutions and Innovation: Equitable Governance and Urban Climate Action**

Municipal authorities and non-governmental actors are increasingly viewing the city as a means through which to engage in climate action, both to mitigate greenhouse gas emissions and adapt to projected climate impacts. As new policies, programs, and projects take root in cities around the world, more often than not, the emphasis is on the designs of these initiatives rather than the ways in which decisions are made and the processes through which climate action is initiated and sustained. Academic research has tended to examine the factors that have led to the development of particular policies or initiatives, rather than attending to the politics of such processes, the urban governance contexts within which they are emerging, and the implications

for public and private authority. In the first of two sessions on this theme, we engage with different theoretical perspectives and empirical contexts to examine how state and non-state actors in cities are responding to the challenges of mitigation and adaptation, focusing in particular on the emerging challenges in relation to social and environmental justice. Through their contributions, the papers suggest new ways for conceptualizing and researching urban climate governance.

## **A2 Carbon Footprints and Dynamics of Greenhouse Gas (GHG) Mitigation in Urban Areas**

In the last six decades, atmospheric CO<sub>2</sub> concentrations increased by about 20%, methane by about 45%, and global average annual temperature by about half of a degree Celsius. At the same time, the amount of the world's population living in urban areas grew from 2.5 billion to about 6 billion. In an era of rapid anthropogenic global (environmental) change - most of the observed climate change in the past 100 years is attributed to anthropogenic activities - and severe potential impacts of global environmental change on urban areas, it is critical that urbanization is examined in parallel with GEC.

Small, medium and large urban areas in the world continue to grow - but now increasingly in less developed regions of the world. From an Earth system perspective, this is significant not only with respect to the sustainability issues associated with rapid urbanization in poorer vs. richer economies, but also in terms of the emissions associated with differing economies and because of the shift in the geographic location of the cities – e.g. from mid-latitude to tropical/sub-tropical regions and to/from cities in coastal regions vs inland cities. In rapidly growing urban areas in developing countries it is especially difficult to establish the infrastructure and enforce the regulations needed for mitigation of atmospheric emissions, due both to lack of economic resources and because of differences in the way in which urbanization is occurring. In many mega-cities in the developing world, a large fraction of cities' populations live in the urban periphery in poverty and environmental degradation. These high density settlements are often extremely polluted owing to the lack of urban services, resulting in atmospheric pollutants which are not only significant but that differ characteristically from pollutants stemming from industry, power generation, or agricultural sources. Higher concentrations of atmospheric particulate pollution and aerosols with a higher fraction of trace metals, toxins and black carbon (soot) have implications for both human health and climate in the affected region.

The teleconnections of urbanization are also very significant. In many instances, urbanization and wealth generation that follows urbanization has led to land use change in forests and prime agricultural land. For instance, the reduction of rice paddy area due to urban development (and eating habits of new urbanites) may alter the surface albedo and fluxes of water vapor, methane, N<sub>2</sub>O, etc. It is also likely that there will be an increased number of crops grown expressly for biofuel (e.g., sugarcane) production. The emission changes associated with these shifts are poorly understood and would need to be accounted for in future greenhouse gas and aerosols projections. Climate change itself is likely to influence the patterns and nature of urbanization. If past natural and socio-political 'disasters' are any indicator, climate refugees are likely to preferentially migrate to urban areas. Efforts to mitigate climate change will also influence the planning of future energy systems and transportation, and in this sense climate change and urbanization are closely linked from carbon management perspective.

## **A3 Urban Responses to Climate Change: Linking Mitigation, Adaptation and Development**

This session will explore how cities respond, fail to respond, or could better respond to climate change. Cities are considered the locus of action in responding to the challenges of climate change. An increasing number of cities around the world have begun to respond to climate

change through mitigation actions but fewer cities have created comprehensive responses through climate change adaptation initiative and combined (mitigation and adaptation) action.

The session will focus on the institutional drivers of current responses to climate change; the role of different actors and institutions (in public, private, social, informal sectors, and international organizations), their role and relationships in the responses to climate change in urban areas; the deficiencies and resistance of institutions to respond to climate change; the windows of opportunities to overcome them and; how cooperation/collaboration between actors could effectively establish better measures, solutions, and responses to climate change.

Critical questions that the session seeks to address include: What are the strengths and weaknesses of current institutions to respond to climate change? How can we adapt local institutions to the challenge of climate change? What institutions can take a leading role in those responses and at which administrative levels? How can mitigation and adaptation be best a part of local strategies in response to climate change? What is the level of compatibility and coherence of mitigation and adaptation actions with the local urban development agenda? What steps need to be taken to foster urban sustainability through responses to climate change?

#### **A4 Sustainable Urban Infrastructure in Developing Regions**

Infrastructure development is critical to the achievement of the Millennium Development Goals (MDG). The unmet demand for infrastructure to support the delivery of housing, transportation, energy and water services limits economic opportunity and is therefore a major barrier to the achievement of MDG1 (poverty and hunger reduction).

Patterns of infrastructure development determine the environmental sustainability of economic growth (MDG7 - ensure environmental sustainability). In turn, eco-efficiency is a key criterion for the development of sustainable infrastructure, and therefore a key objective in developing, planning and building more sustainable cities. More eco-efficient infrastructure delivers higher-quality services with less use of resources and low negative environmental impact, as well as lower vulnerability to natural disasters. Eco-efficiency can be measured using indicators that relate environmental impact (such as emissions of pollutants) or resource use (such as water or energy), to the service or economic benefit provided (such as passenger kilometers, in the case of transportation infrastructure).

In an era of rising natural resource prices and scarcity and increasing vulnerability to natural disasters and climate change, infrastructure eco-efficiency has long-term and significant impacts on both economic and environmental sustainability in all countries, but in developing and least-developed countries in particular. In the context of climate change, eco-efficient infrastructure development is also essential to the development of "low-carbon" economies. It also expands financing opportunities through the Clean Development Mechanism (CDM), on the basis of avoided greenhouse gas emissions.

The panel will present and discuss the findings and policies proposals of the ongoing research project on eco-efficiency in infrastructure development in Asia and Latin America. The project is being developed by UN-ESCAP and UN-ECLAC and seeks to promote the application of eco-efficiency as key criterion for sustainable infrastructure development and as a basis for expanding infrastructure financing opportunities. It also promotes social inclusiveness (including gender responsiveness) as a key requirement for developing eco-efficient and sustainable infrastructure. The project will develop the capacity of decision-makers, policy-makers and planners from developing countries in Asia and Latin America to assess the eco-efficiency of their infrastructure in an integrated manner and to take action to improve this.

## **A5 Conflicting Principles of Water and Sanitation Management in the Context of Rapid Urbanization, Growing Inequalities, and Climate Change**

Megacities of the Global South have emerged as major economic powerhouses, yet universal provision of basic services - such as water and sanitation - in these cities remains an elusive goal. It is increasingly being realized that the core of the problem does not lie in budgetary constraints, proper pricing, or appropriate technologies alone but in the capacity of the State, community actors, and institutions in these countries to negotiate and resolve the increasingly complex conflicts introduced by competing claims to scarce resources. The rapid pace of urbanization and population growth - coupled with ecological constraints and climate uncertainties - has posed new risks and vulnerabilities that call for innovative holistic approaches.

This session brings together scholars working on water and sanitation management in cities of the developing world (such as Delhi and São Paulo). The session presents a unique opportunity to engage in cross-comparative analysis across cities to: a) relate the structure and pattern of urbanization in these cities - particularly, the growth of informal settlements - to the spatial distribution of access to water and sanitation services; b) examine what new risks and vulnerabilities are emerging with rapid urbanization and how these are likely to be exacerbated by climate change; c) unravel new arenas of conflict that are emerging and how these are being negotiated and resolved (or not) through formal and informal institutions, legal structures, and policy; and d) finally to explore some of the cross-comparative lessons, particularly in the form of innovative approaches towards multi-use arbitration and citizen participation.

The session meets the conference objectives of fostering dialog among researchers from different countries to develop innovative integrated approaches to basic service provision, particularly from a governance standpoint, in light of the new risks and opportunities from rapid urbanization and climate change.

## **FRIDAY, OCTOBER 15 PARALLEL SESSIONS - GROUP B**

### **B1 Cities, Networks and Multi-level Governance: Experimenting with Urban Climate Responses**

Municipal authorities and non-governmental actors are increasingly viewing the city as a means through which to engage in climate action, both to mitigate greenhouse gas emissions and adapt to projected climate impacts. As new policies, programs, and projects take root in cities around the world, more often than not, the emphasis is on the designs of these initiatives rather than the ways in which decisions are made and the processes through which climate action is initiated and sustained. Academic research has tended to examine the factors that have led to the development of particular policies or initiatives, rather than attending to the politics of such processes, the urban governance contexts within which they are emerging, and the implications for public and private authority. In the second of two related sessions on this theme, contributors seek to understand the multilevel contexts within which the possibilities of governing climate change in cities are forged, and the roles of cities as 'test-beds' and sites of experimentation in climate governance. In so doing, they offer new ways of conceiving of the relationship between different levels and actors in the governing of climate change in the city.

### **B2 Exploring the Underlying Drivers of Vulnerability of Water across Cities**

Changes in the hydrologic cycle will play a significant role in driving the impacts of global climate change on cities. In particular, long-term changes in water availability or water quality could affect

a city's ability to supply safe, reliable, affordable and environmentally-responsible water service to its inhabitants. Climate-driven changes in water availability and water demand also could fuel conflicts between the city and other users of the water resource. In addition, expected increases in the intensity of precipitation events, are likely to exacerbate flooding hazards, while sea-level rise poses both inundation hazards and threats to the quality of coastal aquifers. Last but not least, new modes of governance, are leading to redistributions of functions and responsibilities (e.g. decentralization, privatization of water services and commoditization of water resources). By so doing they are defining new options and constraints to a resilient and sustainable management of water. This session will draw together case studies that explore the vulnerabilities and adaptation strategies of particular cities to the possible hydrologic impacts of climate change, as well as the interplay of vulnerability and adaptive capacity with new modes of water governance. Through comparative analysis of different urban settings, these cases will highlight some of the underlying drivers of different types of vulnerabilities and the likely effectiveness of different adaptation pathways. Our goal is to identify lessons for priority-setting and adaptation-planning approaches that can be applied in other urban settings.

### **B3 Cities, Climate Change and Sustainability: Local and Regional Perspectives**

This session explores the interface of major global changes that have been dominant for at least the last half of the 20th century, namely urbanization and climate change, characterized by their accelerating and eventually rapid pace across different world regions. At the forefront of GEC realities lie the global warming trends connected with progressive sea level rise, increased intensity (and maybe frequency) of climatic extreme episodes leading to (natural) disasters. Today we know that "warming in the climate system is unequivocal" and that "most of the observed increase in globally averaged temperatures since the mid-20th century" is very likely (90-99% chance) due to human activity (IPCC 2007). Expected temperature increases range across scenarios from 1.1 - 6.4 °C with a best estimate of 1.8 °C (3.2 °F) – a variation that spreads from mild to catastrophic impacts. Due to thermal expansion and loss of mass from glaciers and polar ice caps, sea-level rise is expected between 18-59 cm in the 21st century (ibid.). Frequency of natural catastrophes since 1960 shows a threefold increase in the 1990s and a nine-fold increase in economic losses in real terms (ibid). Other predictions brought forward by the IPCC AR4 SPM suggest that it is very likely that hot extremes, warm spells and heat waves will continue to become more frequent over most land areas; that heavy precipitation events will become more frequent - frequency (or proportion of total rainfall from heavy falls) will increase over most areas. Also, it is likely that the area affected by droughts will increase, that future tropical cyclones will become more intense, with larger peak wind speeds and heavier precipitation (but we have less confidence in the estimates of change of total number). Clearly, these predictions have significance for human security, safety, and health in the next 100 years, and in particular for urban areas.

This session will explore the complexities present at the intersection of urban areas, climate change and sustainability through perspectives that vary from the local context to the regional scope.

### **B4 Micro-Climatic and Heat Island Effects of Urban Areas I**

In the last decade, we have experienced an increased understanding of the relationship between urbanization and climate. Though the effects of anthropogenic greenhouse gases have been the focus of prevailing climate change inquiry, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) noted the emerging interest in understanding the role of urban landuse on the climate system. The built environment characterized by urbanization is a significant forcing function on the weather-climate system because it is a heat source, a poor storage system for water, an impediment to atmospheric motion, and a source of aerosols (e.g. pollutants).

Such attributes significantly alter surface energy budgets, the hydrological cycle, and biogeochemical cycles related to carbon and nitrogen. Further, it is increasingly clear that the impact of urban land-use extends from local to global scales. The most well-studied and familiar manifestation of urban climate modification is the urban heat island (UHI). Recent research shows that it is spatially correlated with regional land-use and land-use change. A landscape during the early phases of urban development is a patchwork of multiple land-covers, with bare land, vegetated areas, agricultural plots, and built-up areas in close proximity with one another. In non-desert environments, urbanization increases the contiguous urban extent and reduces the vegetated surfaces, and the spatial pattern of the urban heat island correspondingly becomes less scattered and more intense. In desert cities, the urbanization process often increases vegetation. The role of the urban heat island on regional and global climate has been the subject of numerous investigations. However, the role of urban land-use on climate extends well beyond the UHI.

Human activities associated with urban land-use (e.g. transportation, energy, and industrial processes) produce a clearly discernible association with 'urban' aerosols or pollution, and have been associated with elevated greenhouse gas emissions. Carbon dioxide concentrations in urban centers are significantly higher than in nonurban, rural areas, but per capita greenhouse gas emissions for urban dwellers may be lower than for country averages]. Efforts to inventory greenhouse gas emissions in urban areas are made more difficult by a lack of data to attribute both direct and indirect emissions to urbanization. Back of the envelop calculations suggest that if greenhouse gas emissions were attributed to the producer rather than the consumer, cities emit between 30 and 40% of all greenhouse gas emissions, a figure that is significantly lower than the widely cited statistic that cities generate 75–80% of all greenhouse gas emissions.

#### **B5 Urban Climate Change Research Network, First Assessment Report on Climate Change in Cities (ARC3): Research Inventory, Opportunity for Engagement, and the Science-Policy Linkage**

The objective of this session is to situate an ongoing researcher collaborative network (Urban Climate Change Research Network [UCCRN]) and its soon-to-be-published assessment report (First Assessment Report on Climate Change in Cities [ARC3] ) within the larger context of promoting effective and meaningful climate scientist-stakeholder partnerships in cities. The goal of the ARC3 work is to present a comprehensive assessment of the current understanding of climate change impacts on cities and associated ongoing urban adaptation strategies and mitigation activities. The volume includes contributions from more than 90 authors – several of which make up the session panel. The session discussion will focus on the Assessment summary results, their implications for climate change science and cities, and successful mechanisms to integrate the findings into on-the-ground decision-making within cities through enhanced science-policy linkages. Connections and synergies between the ARC3 and UCCRN efforts with other ongoing, large-scale climate change and cities report projects will be highlighted.

### **SATURDAY, OCTOBER 16 PARALLEL SESSIONS - GROUP C | 11:00a.m. – 1:00p.m.**

#### **C1 Ecosystem Services on an Urbanizing Planet: What 2 billion New Urbanites Means for Climate and Water**

For the first time in history, a majority of people live in cities, and urbanization is expected to add almost 2 billion new urban residents by 2030. While there is growing awareness that cities affect almost every ecosystem on Earth 2-5 and are increasingly vulnerable to environmental change, there are few global estimates of urbanization's impact on key ecosystem services. This is particularly true for freshwater availability and global climate, which may be massively impacted

by urbanization and may be key future vulnerabilities for urban residents. This panel consists of researchers working on this theme. Several participants who collaborate in sub-groups focusing on the themes of water and air will discuss preliminary findings from recent workshops sponsored by the National Center for Ecological Analysis and Synthesis (NCEAS) and The Nature Conservancy.

## **C2 Spatial Urban Planning and Climate Change**

Mankind is increasingly facing the challenges of an urbanizing world. In 2008 the world will be predominantly urban and within the next 15 years 93% of the urban growth will be occurring in developing countries whereby Asia alone will account for more than half the world's urban population. More than half of the world's urban population lives in cities of less than 500,000 inhabitants.

How urban areas develop — whether expansive or compact, with multifamily residential complexes or single family homes, automobile dependent or enabling multiple forms of transportation, with mixed-use or single-use zoning — affects transportation choices and travel behavior, and determines infrastructure needs and energy consumption. Once in place, urban infrastructure is difficult to reverse, and their longevity leads to a path dependency with regard to energy use and may limit adaptation strategies to climate change and associated effects such as heat waves. Where urban areas develop — whether on the coast, in agricultural areas, in forested regions, or near existing urban centers — determine their vulnerability to climate change impacts such as sea level rise and storm surges, the need to expand agricultural production into other areas, and the resources required to provide urban services such as water, energy, and transportation infrastructure. In short, environmental impacts of urban form are indisputable.

This session discusses the role of spatial planning for urban sustainability in the 21st century.

## **C3 Coastal Zones and Urbanization**

This session will exemplify cutting edge research on global environmental change risk assessment for human settlements and the vulnerability of populations in the world's low elevation coastal zones (LECZ). The 13% of the world's urban population that lives in low elevation coastal zones is spatially highly concentrated; the ten countries with the most people living in LECZs account for about 73% of those who live in the zone globally. New research shows that vulnerabilities of populations in LECZs to GEC are largely affected by levels of economic development, and the vast majority of the countries that have the largest share of their populations in LECZs belong to the most at-risk low or lower-middle income group requiring special attention. Existing research has shown that localized assessments of vulnerabilities improve understanding of higher environmental hazard risks facing global cities of the coastal zone. Combining climate change scenarios, physical characteristics and social vulnerability data helps identify unique stress bundles for individual cities. Research on vulnerabilities to environmental hazards for global cities identifies several sets of stress bundles that consist of environmental factors (such as extreme rainfall and flooding; sea level rise and temperature increases; temperature increases and drought) and their interaction with sets of physical characteristics (terrain topography, geology, percent of wetlands and flood-prone areas, sub-standard urban planning and infrastructure, elaborately designed but inefficient management plans), and socio-economic characteristics (population growth and poverty levels) that create environments of increased the vulnerability of urban populations

There is an evolving nature in the perception of risks and vulnerability of city populations. Storm surges, for example, have embedded a notion of existing severe dangers in local culture. Altered storm patterns, stronger winds and rise of mean sea level, increasing the height of storm surges, obviate the risk of anthropogenic global environmental change. Utilizing present or in-the-works

coastal defense measures makes short-term predictions of change "well manageable"; the longer term predictions will require "alternative adaptation strategies" if realized. Paradoxically, although state-led adopted measures reduce actual risk levels, vulnerability of populations increased by the changes in perceptions of risk (as unforeseen paths and speeds of storms can still lead to dangerous storm surges) and by the sheer inflow of population with little experience and awareness of the severity of the risk in the urbanized area. Research also prescribes some form of attention to the three "Ms" - mitigation, migration and modification as future responses and adaptation to the environmental change risks present in coastal settlements. Particular importance is placed on the roles and relative importance of formal and informal institutions as coping mechanisms. For the developing world, financing institutions will be critical for the creation of infrastructure in response to global environmental change. Infrastructure (repair) projects often do not move forward due to lack of resources (totally missing or devoted to post-disaster uses). While all countries face inappropriately designed infrastructure, which often results in the paradox of false perceptions of risk, the problems are exacerbated in the developing world. New or retrofitted (if possible) climate-change-risk-conscious urban infrastructure designs and plans have to be efficiently designed; although learning about resilience at the state level can be a hard task, the possibility of success exists on both structural (technological, resource management) and non-structural (insurance etc.) aspects. Countries can learn from each other's experiences and societal safety can be reached through increased cooperation and knowledge sharing.

This session focuses on the implications of GEC, vulnerabilities and natural disasters on human security in urban coastal zones areas. GEC places urban coastal areas at high risk; the identification and implementation of mitigation and adaptation programs lies at the forefront of integrated urban planning and coastal management. Moving forward requires the assessment and, eventually, increased awareness, education, and training on the interrelationships between social and environmental urban coastal processes involving topics of sea level rise, population growth, environmental degradation and economic development. Specific themes that emerge include: an added value in the coupling of global perspectives on population vulnerabilities with local place-based studies; the use of technological advances in several scientific fields together with local community action and democratic participatory systems; the consideration of a multiplicity of interacting contributors to socio-environmental stress that act at different spatial and temporal scale; and the combination of distinct analyses that expose differing social science view points (as in the case of political economy/ecology contrasted to the more traditional managerial approaches).

#### **C4 Rapidly Urbanizing World Regions – Processes and issues**

The UN has estimated more than half of the human population is living in urban areas, and that urbanization will continue at a rapid pace, particularly in developing countries. Development challenges in these areas such as infrastructure and basic services provision for the growing population are likely to be intensified. The satellite semi-rural landscapes at the fringes of such urban areas showcase significant changes in soils, the diversity of plant and animal species, impacts on fringe ecosystems but also human health. Apart from these, natural hazards and their impacts have always been a challenge to streamline with development. As urban areas are sprawling they are expected to experience adverse impacts related to climate change. Local governance is crucial to deal with such issues and subsequent challenges due to climate change. Monitoring of these cities at various spatio-temporal scales is critically needed to understand the drivers and impacts of such changes. Comprehensive policies fostering urban resilience that better address development and population vulnerabilities are vital.

This session will offer the opportunity to discuss urban expansion in the context of local issues and linkages with climate change with a special emphasis on Asia. Participants include researchers, practitioners and stakeholders in the areas of urban development and climate change. The sharing of research findings and experiences aims at enhancing the understanding not only of the imminent challenges but also of the opportunities and necessary changes for

achieving sustainable urban development, considering the environmental and social aspects and the role of good local governance.

### **C5 A Special Panel on UGEC research and the 2014 IPCC 5th Assessment Report (AR5)**

This dialogue event will focus on the role of UGEC research within the context of the Fifth Assessment Report (AR5) of the IPCC. In the previous landmark report, published in 2007, urban areas were but a tiny part of the content – mainly within a single chapter in Working Group II report. While this is no longer the case for AR5, as urban areas will be featured more prominently, questions remain on whether the allocation of attention to cities and peri-urban areas is adequate. Very importantly, are the right mechanisms in place to address the multidimensional linkages of urban processes with global environmental change (such as the one between urban development, adaptation and mitigation)? The panelists along with the audience will jointly explore what urban issues can and should be addressed in the context of different planned chapters of the AR5 report.

The event will begin with a review of how urban issues were dealt with in AR4. Understanding the structure of the previous report and the procedures that led to it can become a reference point for where progress needs to be made and how AR5 can become a truly major advancement in knowledge synthesis. Panelists will then make a short introduction of the structure of the IPCC AR5, and provide a general overview of the working groups and relevant individual chapters. The discussion will focus on the chapters most relevant to the UGEC community. The panel participants have been active in the IPCC process in multiple roles in the past: they have all participated in the expert meetings on human settlements and infrastructure but as authors in different chapters of AR5, they will be providing distinct perspectives.

The session seeks to shed light into the several issues: what questions should the scientific community on UGEC focus on in the next two years in order to fill significant gaps in the existing literature? Peer reviewed publications up to 2013 can potentially inform AR5 - what can the UGEC community do better so that new and important research is reflected in the urban chapters? Which methodological advances are needed presently in the field? AR4 faced criticism on issues of openness and error-proneness. How can the UGEC community better assist the chapter authors in meeting the goals of a salient, credible and legitimate AR5?

Finally, one the biggest question mark with AR5 continues to be how to deal with non-formally peer reviewed material, especially government documents and the so-called “gray literature”. This question is bound to loom even larger than was the case with AR4 especially vis-à-vis urban issues because so much of the material of cities is coming out from practitioner communities (city and regional government reports). The envisioned dialogue is expected to generate a better understanding of how different types of literature should be viewed, processed and integrated in AR5 – what safeguarding methods and parameters should be in place ensuring a uniform treatment of different types of information and the resulting credibility of the knowledge generated. This discussion could potentially lead to a formal statement from the UGEC community pushing the issue forward in the next few years.

The dialogue event will help the UGEC community to better understand what research is already taking place in relation to the IPCC AR5, taking stock of urban knowledge from existing methodological frameworks, what are the existing gaps and necessary advances, what are some previously unrecognized synergies among UGEC scientists and what are the possible pathways of moving forward.

### **SATURDAY, OCTOBER 16 PARALLEL SESSIONS - GROUP D**

#### **D1 Micro-Climatic and Heat Island Effects of Urban Areas II**

In the last decade, we have experienced an increased understanding of the relationship between urbanization and climate. Though the effects of anthropogenic greenhouse gases have been the focus of prevailing climate change inquiry, the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) noted the emerging interest in understanding the role of urban land use on the climate system. The built environment characterized by urbanization is a significant forcing function on the weather-climate system because it is a heat source, a poor storage system for water, an impediment to atmospheric motion, and a source of aerosols (e.g. pollutants).

Such attributes significantly alter surface energy budgets, the hydrological cycle, and biogeochemical cycles related to carbon and nitrogen. Further, it is increasingly clear that the impact of urban land-use extends from local to global scales. The most well-studied and familiar manifestation of urban climate modification is the urban heat island (UHI). Recent research shows that it is spatially correlated with regional land-use and land-use change. A landscape during the early phases of urban development is a patchwork of multiple land-covers, with bare land, vegetated areas, agricultural plots, and built-up areas in close proximity with one another. In non-desert environments, urbanization increases the contiguous urban extent and reduces the vegetated surfaces, and the spatial pattern of the urban heat island correspondingly becomes less scattered and more intense. In desert cities, the urbanization process often increases vegetation. The role of the urban heat island on regional and global climate has been the subject of numerous investigations. However, the role of urban land-use on climate extends well beyond the UHI.

Human activities associated with urban land-use (e.g. transportation, energy, and industrial processes) produce a clearly discernible association with 'urban' aerosols or pollution, and have been associated with elevated greenhouse gas emissions. Carbon dioxide concentrations in urban centers are significantly higher than in nonurban, rural areas, but per capita greenhouse gas emissions for urban dwellers may be lower than for country averages]. Efforts to inventory greenhouse gas emissions in urban areas are made more difficult by a lack of data to attribute both direct and indirect emissions to urbanization. Back of the envelope calculations suggest that if greenhouse gas emissions were attributed to the producer rather than the consumer, cities emit between 30 and 40% of all greenhouse gas emissions, a figure that is significantly lower than the widely cited statistic that cities generate 75–80% of all greenhouse gas emissions.

## **D2 Adapting Border Cities to Climate Change: Practices, Options and Constraints**

Even as some cities and municipalities within the U.S.-Mexico borderlands are gradually becoming more mindful of the unusual risks that climate change creates – prompting greater recognition that mitigation and adaptation measures are urgent – most border communities are failing to take sufficient steps to prevent climate instability from presenting even larger dangers in the future. While large U.S. metropolitan areas like San Diego and El Paso are taking action, other urban areas on both sides of the border are falling behind even in adopting basic commitments to protect people and property from climate variability. National policies toward the border area create an even more complex scenario for climate action in this region.

In this session we would like to explore the following issues: the various forms of mitigation and adaptation being adopted by cities on both sides of the border; the distinct conceptualizations of vulnerability to climate change in a binational context; the emergence of new forms of collaboration and governance being proposed or developed in the region to adapt to climate change; the role of non-governmental entities in promoting local and cross-border responses to climate change; the institutional responses to climate change; the role of borders and border policy in curtailing or promoting adaptation efforts.

## **D3 Higher Education as a Catalyst for Urban Sustainability**

The objective of this session is to examine how institutions of higher education are taking-on an even greater leadership role in putting sustainability concepts into practice. As the world has become an ever more urban society, it is appropriate for urban-based colleges and universities to more actively become catalysts for sustainability efforts in cities. Sustainability is a complex issue that requires detailed examination and testing to determine which techniques and approaches will be most useful for bringing its goals to reality. In the past few years, researchers and practitioners have been actively working to develop and test new ideas on sustainability science and practice. Many of these ideas are being considered for the urban context. Numerous city governments have developed plans to make their cities more sustainable. Colleges and universities also have taken on the call to promote sustainability science and practice. Together these efforts represent an ambitious attempt to highlight the need for sustainability and pathways to enhance its potential.

Putting sustainability into place demands a further expansion and coordination of the efforts between institutions of research and education and the communities in which they are located. Through providing sites of creative expression and experimentation, skill development and workforce training, and continuing education, the institutions directly serve their localities. With respect to the transition to sustainability, institutions of higher education have at least four roles to play: 1) Education and curriculum development; 2) Promotion of pure research; 3) Promotion of applied research and development; and 4) Retrofit of facilities and materials procurement.

#### **D4 Rethinking Integrated Assessments and Management Projects**

Science and management agencies have promoted interdisciplinary integrated assessment and management projects to address the potential threats to vulnerable water supplies, populations and environments posed by climate variability and change. At the core of these projects are scientist-practitioner research partnerships that seek to target solutions and enhance the exchange of information. This session will illustrate and evaluate such efforts. Abstracts address topics such as co-development of science; decision support, and knowledge networks to address socio-environmental challenges; urban vulnerabilities to climate change; challenges to effective resource management posed by tensions related to the multilevel nature of governance structures.

#### **D5 Peri-Urban Development and Environmental Sustainability I : Examples from Asia**

Large-scale urban development is likely to be one of the primary sources of environmental change in Asia over the next decades, and more of this development will take place in India and China than in any other two countries. Rapid urban growth can have severe consequences for environmental sustainability creating an urgent need for alternative pathways to development. This panel presents in part preliminary findings from the first systematic comparative analyses of development on the urban fringe and its environmental consequences in these two countries. The presentations analyze local and regional variations in developmental trajectories and sustainability among a number of urban regions within each country. The focus of each is on land use, ecosystems and environmental. This project has been funded by the US National Science Foundation administered by the Asia-Pacific Network for Global Change Research.

### **SUNDAY, OCTOBER 17 PARALLEL SESSIONS - GROUP J-A**

#### **J-A1 Direct and Indirect Interactions of Urban Areas and Land Use Changes**

Urban function and form are the physical manifestations of the interactions and conflicts among global, regional, and local forces in the urban space. Urban function and form also define the positive and negative bi-directional interactions with regional and global environmental change. Examples of these interactions are the impacts of different land uses within the urban

areas on the creation of microclimates; the health consequences of climate variability and climate change in urban areas; the lack of adaptation of architecture and urban design to local climatic conditions; aggravating energy demand and index of comfort for their inhabitants. There are extended causal chains created by these changes in urban function and urban form that affect the interactions between urban areas and global environmental change.

The size, scale, and form of cities and their likely future growth trajectories will be critical to global environmental change. The environmental challenges posed by the spatial configuration of urban land use have been and will continue to be enormous: infrastructure requirements of extensive versus compact cities, energy implications of commuting patterns, impact of urban expansion on global food security. The conversion of natural and agricultural ecosystems to urban uses has massive implications for Earth system functioning, and while there exist numerous regional and local case studies, the global rate and extent of urbanization as a transformation of the landscape are poorly documented. Even less understood are the impacts of urban form in the 'global south'. For example, many of the existing studies on urban heat islands have been conducted in temperate zones, and yet most of the future urban growth will occur in the global south. These are also regions of the world with economies that rely heavily on dirty technologies. Hence, more studies are needed in semitropical and tropical areas.

### **J-A2 Urban Vegetation and Socio-Ecological Contexts: Heterogeneity, Trends and Implications**

With the rapid and overwhelming spatial scope of contemporary urbanization, the role of urban areas and ecologies in local, regional and global environmental change has received increasing scientific attention. Land change science, long term ecological research and urban geography/political ecology have variously investigated aspects of human-environment interactions and processes in urban systems. The heterogeneous patterns, trajectories and dynamics of urban vegetation have significant implications for ecosystem structure and function, are fundamentally tied to particular socioeconomic and political dynamics, and hold differential implications for urban dwellers.

In this session, we highlight the results of empirical research on urban vegetation distribution, its fundamental driving dynamics and socio-ecological implications across a diversity of urban sites in the United States, and in Brazil. These sites represent various stages of historical urban development, urban size, regional biophysical regimes, and socio-political and institutional contexts. The analyses and case studies highlight critical patterns and processes of urbanization dynamics in order to understand their social and environmental interfaces, and implications for local and regional sustainability.

### **J-A3 Urban Ecology, Environmental Justice and Global Environmental Change**

This session focuses on the intersection of questions on how to deal with limited resources and ecosystem services and how to increase equity and establishing social cohesion at various levels in an era of global environmental change. Scholars have recently started exploring complex links between ecology environmental justice through new integrated, collaborative, transdisciplinary and synthetic research on the dynamics of socio-ecological systems. Despite the increasing intellectual acceptance of the links between ecological and social systems, scientists are just beginning to make the empirical connections between environmental justice and ecological structure and function as both fields have devoted enormous resources to developing robust metrics and models. This session will capitalize on these efforts and pinpoint new research, datasets and methods at the intersection of ecology and environmental justice for urban areas that help address the following overarching questions: How does the distribution of environmental

inequities, measured by the uneven distribution of ecosystems services, affect the vulnerability and resilience of urban social-ecological systems to regime shifts? And in turn, how do social and ecological regime shifts affect the distribution of ecosystems services and environmental justice patterns in urban areas?

#### **J-A4 Peri-Urban Development and Environmental Sustainability II : Examples from Asia & Europe**

Large-scale urban development is likely to be one of the primary sources of environmental change in Asia over the next decades, and more of this development will take place in India and China than in any other two countries. Rapid urban growth can have severe consequences for environmental sustainability creating an urgent need for alternative pathways to development. This panel presents in part preliminary findings from the first systematic comparative analyses of development on the urban fringe and its environmental consequences in these two countries. The presentations analyze local and regional variations in developmental trajectories and sustainability among a number of urban regions within each country. The focus of each is on land use, ecosystems and environmental. This project has been funded by the US National Science Foundation administered by the Asia-Pacific Network for Global Change Research.

#### **J-A5 Sustainable Cities in Arid Areas**

Many of today's fastest growing cities are in arid regions. Faced with limited water availability, growing populations, and rising demand for energy, desert urbanization creates unique challenges to sustainability. Provision of adequate quantity and quality of water to feed this growth is emerging as an important challenge. Cities in dry regions are particularly critical since climate change projections indicate an increased frequency of climatic extreme events and a progressive decline in rainfall in these regions. In the global south, cities are already struggling with providing access to potable water supplies to their growing populations and seem scarcely equipped to deal with the uncertainties due to climate change. In this session, a panel of experts on desert urban ecosystems will discuss the links between science and policy, the challenges of urban growth and water management, and the decision-making processes that are central to achieving sustainability in arid urban regions.

#### **J-A6 Market Mechanisms in Land-Use Change Models**

Papers in this session model the effects of local markets on land values and land-use change. Topics covered include land markets (agricultural, urban fringe, and urban), biofuels markets, with emphasis on the environmental and social impacts of markets.

#### **J-A7 Global Land-Use and Land-Cover Datasets - Status, Challenges, and New Opportunities**

While remote sensing and earth observation driven advances in global land cover products has been remarkable, knowledge on important land use parameters globally remains patchy, of heterogeneous quality and often difficult to access. We aim at summarizing the status in land cover datasets (briefly) before discussing new developments, challenges and opportunities for key land use parameters.

#### **J-A8 Modeling Dynamic Urban-Environmental Interactions**

The spatial configuration of the urban landscape is a path dependent process reflecting past decisions and actions as well as a manifestation of today's socioeconomic and political interactions. The urban spatial structure constitutes a snapshot of various economic, social, political, and technological factors that have influenced –and continue to do so– land-use

decisions – (e.g., transportation costs, agglomeration economies and diseconomies, construction of built environment, and land-intensiveness of productive activities). The urban systems are also complex adaptive systems, hierarchically structured entities at several levels, following power law in their distributions of populations in national urban systems and clusters in intrametropolitan urban systems.

Today, the importance and usefulness of integrated, systemic analyses of urban areas is nearly uncontested. This interdisciplinary consensus needed for such analyses has been in the works for more than a century within the fields of urban planning, economics, geography, and sociology and “on the shoulders” of foundational work on spatial land-use theory and models. Especially since the 1960's, the work on urban growth and morphology has been an important subject of interest for geographers and economists, but also natural scientists and especially physicists. The measurement and forecasting of urban land change and its environmental impacts can occur through a wide variety of methods such as urban land-use change models, statistical techniques, and process-based empirical investigations. New approaches and variations of existing ones are also constantly being developed in part due to advances in computing and epistemology. Different models and methods approach the issue of spatial explicitness and urban morphology in alternative ways. This session focuses on recent modeling and other methodological advances in the analysis of urban-environmental dynamics.

### **J-A9 Advances in Urban Remote Sensing**

Urban Remote Sensing (URS) has proved to be a useful tool for cross-scale urban sustainability research as humankind increasingly facing the challenges of an urbanizing world. It can track rapid changes in physical characteristics of human environments – local, regional and global and can allow scientists to gather important information in the context of human environment interactions such as the environmental consequences of various social, economic, and demographic processes and phenomena.

But studies concentrating on the challenge of world urbanization and its interconnections to global environmental change still claim an unmet need for linked spatial and socio-demographic information. The well documented gap between social science and remote sensing research arises from a lack of correspondence in nature or landscape units to grids or even small-scale administrative units and an imperfect coupling of URS information with social science data streams. The potential benefits of bridging that gap are great and voices in support of cross-disciplinary advances in URS methods and techniques and their integration with social science are multiplying as the social value of such an effort becomes obvious.

This session seeks to better understand how urban remote sensing can best be utilized by both researchers and practitioners in urban models, planning, and policy formulation. Two major questions posed in the session are: What is the potential of URS for an integrated interdisciplinary social science with a focus on urban sustainability?; How can URS fill the gaps in scientific information best for the needs of integrated spatial social science?

## **SUNDAY, OCTOBER 17 PARALLEL SESSIONS - GROUP J-B**

### **J-B1 Sustainability Challenges Related to Urbanization in Phoenix, Arizona: Past, Present, and Future**

In many ways, urbanization in Phoenix creates a crucible of socio-ecological issues relating to sustainability. Cities have thrived in the Sonoran Desert through the ages despite the environmental challenges such as water scarcity and extreme heat. Positioned near the Mexican border and the American Sunbelt, Phoenix has an heritage of immigration and in-migration that is reflected in an eclectic and transient demography. The coupling of an extreme biophysical environment with demographic pressures has lead to conflicts that challenge the sustainability of

urban life in the Desert. This panel will explore past, present, and future sustainability challenges related to urbanization in Phoenix. Panelists will present research tracing challenges related to urbanization from early Sonoran civilization to contemporary landscapes and future pathways. Furthermore, the panelists are members of the Integrative Graduate Education and Research Training (IGERT) in Urban Ecology at Arizona State University and the case studies reflect integrative perspectives that draw upon interdisciplinary knowledge including anthropology, archeology, ecology, geography, planning, and sustainability science. The goal of the panel is to identify common themes amongst case studies and novel insights stemming from the integrative perspectives.

### **J-B2 Modeling and Forecasting Urban Land-Use Change: An Earth System Science Perspective - A Networking Event**

This networking event is the first phase of a two-part international workshop that is planned for March 2011 by the IHDP Urbanization and Global Environmental Change project (UGEC), sponsored by NASA. The event focuses on contrasting methods of forecasting of urban land-use change and Earth system responses. In this session, participants will discuss, compare, and contrast current urban growth modeling efforts with an eye towards improving their application to developing country cities, and by developing new models that better capture the interactions between the physical expansion of urban space and global environmental change. The goals of the workshop are fivefold:

(1) to assess the state-of-the-art methodological advances in modeling and forecasting urban land-use change with satellite data; (2) to synthesize current understanding and conceptualizations Earth system responses to urban land-use change, including impacts on human (e.g., agriculture) and natural (e.g., climatic, ecological) systems; (3) to evaluate the utility of current urban land change models for policymakers, scientists, and other stakeholders who have an interest in the urban land cover interface; (4) to identify research and knowledge gaps in urban land change modeling and forecasting efforts; (5) to evaluate the performance of models as applied in the developing country city context

The workshop thus addresses a key UGEC theme: what are the pathways by which urban land use and land cover change affects global environmental change? During the UGEC/GLP joint day, the planned workshop leaders and selected participants will present preliminary findings on the above themes while through a dialogue with the conference participants, other themes will be identified for incorporation to the March 2011 workshop.

### **J-B3 Land System Dynamics: Chinese Perspectives I**

As one of the research theme of Global Land Project, Land System Dynamics responds to the geophysical process and socioeconomic development while being directly influenced by human activities. Exploration on the rationale and development of the methodologies to research the land system dynamics will definitely need to start from case-based studies. China, with a rich and varied geographical and societal environments, could supply appropriate places to identify the factors shaping the land changing pattern, explore the mechanism of land system dynamics, assess the suitability of land uses and evaluate the consequences of land use changes, which are indicated by the endeavours made by the presenters for this session.

### **J-B4 Forest Transitions in a Global Economy**

The rural and urban worlds are increasingly connected by trade in natural resources. This is illustrated by new trends in forest-cover change. While forests are still being converted at a rapid rate globally, a few countries have managed a transition from net deforestation to net reforestation. What factors led to this forest transition? How are these land-use dynamics

associated with global economic forces? How are urban markets influencing the fate of tropical forests? This set of talks by some of the most active researchers in the field will illuminate these questions and provide new insights of high significance for new policies aimed at controlling deforestation, such as REDD. Urban consumers may hold part of the solution.

### **J-B5 Globalizing the Case Study: Advantages and Opportunities**

Local and regional case studies are the most powerful approach to investigating cause and effect in coupled human-environment systems (CHANS). To understand CHANS as agents of global change, global synthesis of observations and models from existing local and regional case studies should therefore be the primary strategy, coupled with highly efficient global sampling strategies designed to observe the most globally-significant local and regional CHANS that still remain unstudied. Global synthesis of case study observations and models is challenged by tremendous variation in social and environmental conditions, interactions and dynamics that vary so much at every spatial scale and from place to place, as do the methods used to study them, which it is a supreme challenge to "move beyond the variance of place". This session will present and discuss conceptual, methodological, computational, and social networking approaches aimed at advancing and accelerating global synthesis of local and regional case study observations and models.

### **J-B6 Coupled Human and Natural Systems (CHANS) in China and Nepal**

Research on coupled human and natural systems (CHANS) has recently emerged as an exciting and integrative frontier of cross-disciplinary scientific inquiry. However, most research in this field has been conducted through the traditional mechanism of individual site-based projects. Although these site-based projects have generated many important insights, it is essential to compare processes across sites. This session highlights CHANS research from complementary sites in China and Nepal.

### **J-B7 Evolving Urban Spatial Structure and the Environment**

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### **J-B8 Suburban and Exurban Land Use Change Processes, Patterns and Ecological Impacts**

Peri-urbanization refers to a highly dynamic process where rural areas, both close to but increasingly also distant from, city centres become enveloped by, or transformed into, extended metropolitan regions. These changes generally are not sudden or uniform, but rather piecemeal and ongoing processes. In the most general sense, the development of peri-urban areas involves a complex adjustment of social and ecological systems as they become absorbed increasingly into the sphere of the urban economy. Peri-urban areas fulfil key functions for urban areas, from the supply of inputs (e.g., food, energy, water, building materials), to biodiversity and the provision of ecological services (e.g., wildlife corridors). They also suffer the negative consequences of urban areas (e.g., pollution, urbanization pressures and land use changes, degradation of natural resources). This session capitalizes on the significant opportunities for collaboration between UGEC and GLP in this particular area. It emphasizes land transformation processes, the competition on productive land utilization and the management of land resources. Questions addressed range from the aggregate impact of conversion of land to urban uses affect regional and global hydrological cycles, ecosystem structure and habitat disturbances, drivers of

periurbanization and the effects of urban agriculture.

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## ORAL & POSTER PRESENTATION ABSTRACTS

**0003**

### **Integrated Urban Water Management in São Paulo Macro-Metropolitan Area: Planning and Operation Restructuring in the Perspective of Environmental Change**

Presentation type: Oral

Ricardo Toledo Silva

*University of São Paulo, São Paulo, Brazil*

In late May 2005, a very severe frontal rain lasting more than 12 hours flooded most of the densely occupied eastern region of the State of São Paulo; 140.4 mm of rain fell during what was supposed to be the dry season. Because flooding safeguards were undergoing scheduled maintenance, both human and material losses were high. This event forced upon the sector policies of water, energy and urban infrastructure the reality of the negative impacts of environmental changes. Since this time, design pattern and operational routines have been challenged by a sequence of atypical events including very wet rainy seasons and unexpectedly dry wet seasons; these events suggest a new standard of typicality regarding environmental variables, rather than a very improbable succession of anomalies.

This presentation aims to discuss how recent changes in weather and climate affect the practices of planning, design and operation of the macro-metropolitan water and sanitation infrastructure in São Paulo. It focuses on the new strategic guidelines now considered by the State of São Paulo to face the escalation of socio-environmental damages. These guidelines include: (a) a macro-metropolitan approach to the multiple use of water resources in a context of growing water stress, associating non-structural measures and demand control as tangible components of a comprehensive regional supply; (b) adaptation of urban regulations at the municipal level to address flood control and water conservation, along with a clear-cut quantification of potential benefits from non-structural measures on urban drainage (e.g. infiltrating pavements, sidewalks and landscape); (c) organization of an integrated operational center for real time support of decision concerning dams and pumping stations of the metropolitan macro-drainage complex; (d) emergency circuits and new priorities for electricity re-connection in a case of energy blackout for macro-drainage control structures (information network, pumping stations and electromechanical appliances of dams).

**0013**

### **Social Adaptation to Climate Change: Coping with Floods in Dhaka's Informal Settlements**

Presentation type: Oral

Boris Braun, Tibor Aßheuer

*University of Cologne, Cologne, Germany*

Many megacities in the world - including Dhaka - are regularly threatened by natural hazards. Risks associated with these natural hazards (mainly floods and cyclones) are expected to increase in the future due to the impacts of global climate change and rapid urbanization. Today, the sprawl of slums and informal settlements in Greater Dhaka is primarily taking place in wetlands, swamps and other high-risk areas, with little attempt being made to limit the environmental impairments. In the past, Dhaka has proven that it is able to deal with external shocks. However, an increase of precipitation extremes and tropical cyclones, together with a growing vulnerability of the urban population, is likely to put considerable stress on the adaptability and resilience of the social and economic system.

Our paper will present findings of an extensive field survey undertaken in informal settlements. We have found that the dwellers of informal settlements are especially vulnerable to floods due to their poor access to physical and financial capital. At the same time, they may have profound

access to social capital and are very experienced with floods and other kinds of setbacks and show a relatively high degree of resilience. A major aim of our research is to understand which assets are fundamental for this resilience and whether the access to these assets will be disturbed by future effects of climate change.

**0016**

**Urban Growth and its Impact on Biodiversity, Food & Livelihood Security in High Mountain Ecosystems: An Empirical Study in Kumaon Himalaya, India**

Presentation type: Oral

Prakash Chandra Tiwari

*Kumaon University, Nainital, Uttarakhand, India*

In Himalaya, owing to constraints of terrain, climate forest based subsistence agriculture and biodiversity constitute the main source of rural livelihood. During recent years, the region has experienced rapid urbanization mainly due to population increase, growth of tourism, improved road connectivity and the resultant improved access to markets. Consequently, there has been tremendous increase in density, intensity and complexity of urban settlements resulting in expansion of urban land use in forests and prime agricultural land. This has disrupted the hydrological system, depleted biodiversity, and undermined food and livelihood security of rural poor and marginalized communities in Himalaya.

The paper attempts to analyze the urban growth and assess its impacts on biodiversity, food productivity and rural livelihood with a case illustration of selected urbanized areas in Kumaon Himalaya. The study used remote sensing and field-based techniques along with qualitative and quantitative empirical methods. The results indicated that besides the emergence and growth of a large number of new urban centers, the existing towns are rapidly increasing in size and area.

This has brought about rapid land use changes in the peri-urban zone decreasing cultivated land, forest and biodiversity respectively by 26%, 7% and 15%, and increasing built up area by 39% during 1991-2009. Moreover, there is regional shift from traditional crop-farming and animal husbandry to fruit, vegetable, flower and milk production for growing urban markets, thus transforming agricultural land use, occupational patterns as well as resource demand and traditional rural resource utilization in the peri-urban zone. The study revealed that 75% of cultivated land has been diverted from traditional crop farming to vegetable and fruit production, and 21% of the regional population has abandoned agriculture. As a result, food productivity has declined by 25%, and peri-urban zones have recorded a 17% and 21% decline respectively in biodiversity and agricultural based livelihood opportunities.

**0017**

**Identifying the Poor in the Cities - How can Remote Sensing Help to Profile Poverty (Slum Dwellers) in Megacities?**

Presentation type: Oral

Maik Netzband

*Ruhr-University Bochum, Bochum, Germany*

Addressing the question 'Is the world urbanizing in a context of poverty?' has been thus far based on limited information. There exists only poor scientific and operational knowledge of this process. Urban growth and land consumption patterns are poorly understood (i.e. coastal cities are growing faster; they are disproportionately urban and with higher densities). Thus, the available information is inadequate for policy and planning. Due to their microstructure, irregularity and direct adaptation to local conditions and the terrain, a generically applicable mapping of these settlements is difficult.

Hence, sophisticated data and methods of image analysis are necessary. High resolution remotely sensed data sets allow the documentation of growth of the urban area interactively, both quantitatively and – in combination with auxiliary data sets – qualitatively. Using Geospatial Technology to identify vulnerable groups and their concrete living conditions (i.e. measuring the real access to improved water in cities) could enhance the search for equity in megacities. In order to assess and evaluate intra-urban patterns as well as trends in slums across cities, the goal is to work at different levels of the planning process and incorporate whatever socio-economic

information is available. The focus of the proposed paper will be on the experiences of identifying slums and informal settlements in Megacities in different parts of the world (Indian Subcontinent, Latin America) by means of high resolution remote sensing in order to help spatially profile poverty in very complex (cluttered) and partly hard to control, very large and fast growing urbanized regions.

**0025**

### **Quantification of Urban Carbon Sinks: Producer and Consumer Perspectives**

Presentation type: Oral

Eugene Mohareb, Christopher Kennedy

*University of Toronto, Toronto, ON, Canada*

As municipal governments plan transitions to low carbon economies, inventorying of greenhouse gas (GHG) emissions has become increasingly common at the urban scale. While this should remain the principle focus of policy makers, a comprehensive effort to quantify carbon sinks that are under municipal domain has not been undertaken. In meeting the long-term goal of carbon neutral settlements, knowledge of annual carbon sequestration can provide a means to measure whether the carbon cycle within a region is balanced. Additionally, there are many indirect benefits associated with enhancing carbon sinks, including reduction of urban heat island (urban canopy expansion) or increased soil quality (conservation agriculture). It is the purpose of this research to identify consumer- and producer-side carbon sinks, assess their magnitude and determine what policy measures could enhance their capacity. The Greater Toronto Area (GTA) has been used as a regional case study to explore these items, using 2005 as an inventory year.

Producer-side carbon sinks, those which result from direct sink management, are identified as biomass (urban forests, regional forests and perennial crops) and agricultural soil. Of these, regional forests are shown to be the greatest carbon sink, sequestering 160,000 tC yr<sup>-1</sup>. Consumer-side carbon sinks, those which result from consumption activities within a municipality, are identified as harvested wood products, concrete and landfilled waste. Landfilled waste exhibited the greatest capacity to store carbon, however it should be stated that all items noted above are carbon sources when using a life-cycle perspective. This emphasizes potential flaws in avoiding a life-cycle approach in any GHG inventory, whether sources or sinks. Quantification of the producer-side sinks demonstrates that municipal action to protect and increase woody biomass will have the greatest effect in reducing net carbon emissions in the GTA, especially when coupled with indirect benefits associated with urban greenery.

**0027**

### **Water Access in the Context of Global Environmental Change in the Metropolitan Area of Merida, Yucatan, Mexico**

Presentation type: Oral

Mauricio Dominguez-Aguilar

*Centro de Investigacion y de Estudios Avanzados, Cinvestav-Merida, Merida, Yucatan, Mexico*

The interactions between urbanization and global environmental change are complex and involve bidirectional processes among the social and biophysical systems (Sánchez, 2007). Some of the most important vulnerabilities that human settlements face with respect to global environmental changes are those that affect their capacity to satisfy the growing necessities of water access within their populations, which in turn, threatens social and economic development. Since access to water is strongly influenced by social processes (IPCC, 2008), the strategies to cope with the related vulnerabilities and adaptation to global environmental change should consider aspects such as poverty, social inequalities and the political economy of water. On the other hand, although there are important contributions from water access studies at the local and global levels that incorporate the global environmental change perspective, it is well known that there is a dearth of knowledge about the regional level. The case of the Metropolitan Area of Merida (MAM), Yucatan, Mexico aims to reduce the breach in the deficit of regional studies about vulnerability and adaptation to global environmental change, particularly on the topic of water access. The work approaches this phenomenon from a multidimensional perspective (Sánchez, 2009) and takes advantage of advances developed by Sullivan et al. (2003) with a water poverty index, and Hahn et al. (2009) with a livelihood vulnerability index; two useful concepts that along with the social ones mentioned before, will be used as a starting point for the analysis of the MAM case - the most important urban system in the Yucatan Peninsula, Mexico.

0029

**Field-Level Adaptation to Floods and Sea Level Rise in Coastal Peri-Urban Areas in Monsoon Asia: Comparative Case Studies between Continental Bangkok and Insular Metro Manila**

Presentation type: Oral

Yuji Hara<sup>1</sup>, Danai Thaitakoo<sup>2</sup>

<sup>1</sup>*Wakayama University, Wakayama, Japan*, <sup>2</sup>*Chulalongkorn University, Bangkok, Thailand*

Many large Asian cities are located on alluvial lowlands. Before urbanization, such lowlands were mainly treated as wet rice cultivation. Cultivation patterns were influenced by hydro-geographical conditions, resulting in a wide range of agricultural land uses: from floating rice areas in the continental delta to small-scale gravity irrigated rice fields in insular lowlands. Local people have adapted their daily life to such natural environments and have tried to maximize its ecological services, thereby forming various agricultural landscapes. Although these landscapes have been transformed with the development of agricultural engineering as well as expansion of urban land uses, local inherent responses to environmental changes are still recognizable in the current urbanization period.

This research aims at extracting local people's responses to recent flooding, which are derived from historical and cultural development processes of the past agricultural landscapes. To achieve this, two cities with contrasting agricultural landscapes were selected for case studies: the continental delta of Bangkok and the insular lowlands of Metro Manila. Through spatial analyses using geographic data and field investigation into local people's responses to the recent water level changes, we identified local people's inherent adaptation measures. Moreover, comparison between the results of the two different cities supports our view that we need site-specific flexible countermeasures to mitigate flood hazard. Our results may have useful implications for the future of land-use planning in Asian coastal urban areas impacted by global warming and sea level rise.

0030

**Cities, Services and Changing Contexts: Examining the Role of Institutions in Responding to Changing Environmental Risk**

Presentation type: Oral

Sara Hughes

*University of California, Santa Barbara, United States*

Cities everywhere have developed complex and varied institutional arrangements that govern the production and provision of services such as water supply, waste disposal, transportation, and public space. Such services rely on environmental resources, and institutional arrangements determine, in part, the degree to which urban services are sustainable and equitable. However, the context of decision making by cities is shifting rapidly due to changes in their environments, leading to variation in the level of risk associated with different service options. How do cities respond to such shifts in environmental risk in their decision making for basic services? What role do institutional features play in mediating these responses? This paper presents results from an ongoing study of decision making by local urban water agencies in California, an arid state in the western U.S. The study uses a unique, 18-year data set to examine the interactive effects of changing risk contexts and institutional arrangements on water production decision making. The hypotheses tested assume that the differences in agency specialization, authority, and insulation levels determine an urban agency's sensitivity to changes in risk. Preliminary results show that highly specialized agencies are more likely to continue purchasing water from wholesalers, despite increasing risk. The results are translated to reflect a growing demand for urban flexibility and adaptation, enhanced local resource development, and the institutional arrangements that appear to support such qualities.

0032

**Land Use Change and Urbanization in Anambra State, Nigeria**

Presentation type: Poster

Chizoba Chinweze, Gwen Abiola-Oloke, Chike Jideani

*Nnamdi Azikiwe University, Awka, Anambra State, Nigeria*

Land use/cover changes from the concept of urbanization and environmental change has stimulated a lot of concerns from the point of earth system sustainability. Growth in human population and increases in industrial/commercial activities that fuels urbanization translates to natural resource consumption, depletion and environmental change. Human activities of urbanization leads to land use/cover changes that impacts climate, biodiversity, biogeochemistry, water availability and the sustainability of earth's life support systems. Sustainability is the primary concern of international institutions such as the UN Framework Convention on Climate Change, UN Convention to Combat Desertification and UN Convention on Biological Diversity.

We found by analysis that the driving forces of land-use/land-cover changes in Anambra State is largely due to demographic factors and the need for urbanization. A 44% increase in land-use has been recorded for the state between 1999 - 2009. The demand steams from the conversion of farmland/forests to residential settlements and for economic/infrastructural development. The population of the state rose from 2,796,475 people in 1991 to 4,182,032 in 2006 (NPC, 1991; 2007) a 66.86% increase. Anambra with a population density of 863 persons per km<sup>2</sup>, has one the highest population density in Nigeria and the sub-Saharan Africa. It is projected that the population will triple within the next 50 years, particularly in the commercial cities of Awka, Onitsha and Nnewi, with an envisaged pressure on the land use. The natural ecosystem services in the area shall be significantly altered as the rate of urbanization increases.

This paper gives an in-depth analysis of the magnitude of urbanization activities in the area and its implication for biodiversity, subsistence agriculture and environmental change which threatens the sustainability of the life-support system in the zone. It should be noted that ecological balance is the primary key to sustainable development.

**0034**

#### **Impacts of Urbanization on Ecosystems: Integrated Urban Footprint Accounting**

Presentation type: Poster

David Vackar

*Charles University in Prague, Environment Center, Prague, Czech Republic*

Urban systems gained increasing attention with regard to their rapid growth, their impacts on the environment and contributions to global changes. Urban areas have considerable impacts on land use, biogeochemical cycles, hydrological flows and biodiversity. Cities appropriate the share of planetary resources and integrated resource accounting can contribute to lessening the impacts of cities on ecosystem services.

To account for the role of urban areas on global environmental changes, we adjusted an Ecological Footprint methodology to account for land, carbon and water appropriation and biodiversity. Land accounting is based on the methodology of European Environment Agency and follows land and ecosystem accounting. We calculated the carbon footprint for selected urban areas and accounted for the amount of net primary production (in carbon flow units) appropriated by cities. We were also interested to quantify water flows induced by urban metabolism, based on the water footprint methodology.

Our aim was to find what share of resources is appropriated by cities, using selected middle-sized cities of the Czech Republic as a pilot sample. We devised accounting framework for quantifying impacts of urban socio-environmental metabolism on ecosystems. Moreover, we were interested in whether there are patterns in ecosystem appropriation and biodiversity levels. We detected positive spatial coincidence between human population density and biodiversity. We found that the ecological footprints of urban lifestyles are comparable to national averages. However, cities appropriate a considerable share of net primary productivity and water flows. Urban areas also contribute to rapid land conversion, with implications for ecosystem services and biodiversity. Integrated accounting framework can contribute to the awareness about impacts of cities in the broader global context, the adoption of strategies to reduce urban footprints and the development of consistent accounting at the level of cities.

**0035**

#### **Growing Buildings in Maize Fields: The Role of Household Maize Production in the Rural-Urban Interface of the Toluca Valley, Mexico**

Presentation type: Poster

Amy M. Lerner

*University of California, Santa Barbara, Santa Barbara, CA, United States*

The rates of urban growth continue to rise globally, especially in and around small and intermediary cities of the developing world. This is particularly the case in Latin America, where growth in primate cities has given way to the urbanization of the countryside and urban periphery. What is currently seen in much of the former countryside is a mix of both agricultural and urban land-uses, exemplary of the rural-urban interface. In Mexico, a traditional culture of land reform and maize production still exists alongside rapid urban and industrial growth, which could provide significant competition for agricultural land-use and livelihoods. This issue is of particular importance because of the dependence that Mexico has on maize for the basis of its culture and diet. Additionally, the campesino (peasant) movement in Mexico remains strong, despite economic and political policy making it increasingly difficult to be a small-scale producer. This phenomenon begs the questions: What is the role of agriculture, specifically maize production, in expanding urban areas? At what point do households abandon food production altogether? How does peri-urban and urban food production contribute to sustainable urban growth and household livelihood structure? This paper discusses a study of household land-use and livelihood strategies in the Toluca Metropolitan Area, outside of Mexico City. The Toluca Valley was a traditional maize growing region, mostly for Mexico City and regional consumption until industrial growth expanded in the 1980s. Although maize plantings still persist among urban growth, this paper will discuss the role of maize production in the rural-urban interface and potential scenarios for the future of agriculture in the ever-sprawling metropolis.

**0036**

**Sea Level Rise and Flood Risk in Rio de Janeiro City: Challenges of Global Climate Change**

Presentation type: Oral

Andrea Young

*State University of Campinas, Campinas, São Paulo, Brazil*

This study of the vulnerability to flood and sea level rise was essentially concentrated in Rio de Janeiro city. Assessing vulnerability consisted of taking into account the risk of flooding, considering the environmental aspects of spatial organization (i.e. basin conditions, land use, urban expansion, deforestation and areas of protection). In the following methodology, satellite images were used to identify the urban expansion of the city. A data base was built serving as support for an analysis between different aspects related to flood areas in order to provide scenarios with the identification of vulnerable areas. For the analysis, Geographic Information System (GIS) tools were employed for the building of scenarios by the integration of environmental and urban data. The idea was to recognize the relationship between urban sprawl and the socio-environmental vulnerability, for example, people living in areas of flooding or landslides as a result of urban expansion. The results of the analysis clearly demonstrated the presence of many conflicts caused by landscape changes. It was possible to verify the importance of the size and distribution of vegetation and areas of protection. This study has demonstrated how climate changes associated with changes in the landscape, without taking into consideration the ecological dimension, can affect the urban spatial structure (i.e. local services, facilities and infrastructure) by the increasing of flood risk. It has shown how the rapid population growth and urban development trends within the city compete with sensitive environmental areas such as municipal parks and areas of conservation. This provides a new direction and research opportunity for evaluating the environmental goals for social-economic development on the agendas of policy makers, especially because the study has highlighted the fact that not only the physical attributes of landscape but also their spatial configuration were important determinants for vulnerability zones.

**0038**

**Land Use Changes in the Context of Urbanization and Environmental Vulnerability in Baixada Santista Metropolitan Region**

Presentation type: Oral

Andrea Young

*State University of Campinas, Campinas, São Paulo, Brazil*

The aim of this study was to analyze the connection between the socio-spatial inequalities of residential location (caused by urban expansion) and socio-environmental vulnerability in Baixada Santista. This region is located along the coast of São Paulo State (Brazil) and is facing important social challenges affected by global environmental changes associated with urbanization. This region is experiencing significant population density and increasing pressures on the environment. The research sought to recognize the relationship between urban sprawl and socio-environmental vulnerability (i.e., people living in areas of flooding or landslides as a result of urban expansion). It was important to distinguish the processes that provoked significant transformations in the land use patterns caused by socioeconomic and political decisions that might have led the coastal population to be at risk. For the analysis, Geographic Information System was used for the creating maps based on the integration of environmental and urban data. The purpose was to identify the relationship between urban sprawl and socio-environmental vulnerability. The results have demonstrated that the metropolitan expansion brings not only increasing urban complexity with nucleus de-concentration and peripheral extension, but also evidences of the socio-spatial dissimilarities that can be observed by the stratification of space in different social layers (i.e., poor classes were pushed to distant and less desirable locations without any infrastructure). Many forested areas were converted to non-forest land for urban and industrial use without considering any ecological criteria. This region has experienced a significant destruction of its wetlands, Atlantic forests and restingas occupied mainly by residential and industrial expansion.

**0040**

#### **Urban Growth and Long Range Pressure on Natural Systems**

Presentation type: Oral

Christopher Doll

*United Nations University, Yokohama, Japan*

The long term sustainability of cities lies in part, in their ecological context. Whilst resources can be imported locally or internationally, there is a need to characterize the local resource base as a means of supply. In this paper, spatial analysis is employed to assess the magnitude of both short and long term urbanization and its stress on the surrounding environment. City growth over 15 years has been analysed through investigating the growth of light emissions from night-time light satellite imagery. These growth rates are then placed in the context of the supplying river basin and ecological biome. A second long term assessment uses spatially disaggregated projected increases in population and economic activity modelled according to a number of IPCC scenarios to 2100. Of note is the relative change in rank of river basins based on these projections. The results are suggestive for planners at both the city government level and international level since many river basins straddle political boundaries. This research also aids in our understanding of the relative stress certain natural systems will experience over this century.

**0041**

#### **San Juan ULTRA-Ex: Social-Ecological Systems Change, Vulnerability, and the Future of a Tropical City.**

Presentation type: Oral

Tischa A. Munoz-Erickson, Maria Luz Cruz-Torres, Carlos Garcia-Quijano, Diana Garcia-Montiel, Juan Giusti, Myrna Hall, Charlie Hall, Maria Juncos-Gautier, Ariel E. Lugo, William H. McDowell, Elvia Melendez-Ackerman, Elvia Melendez-Colom, Pablo Mendez-Lazaro, Jorge Ortiz-Zayas, Robert Pontius, Alonso Ramirez, Olga Ramos, Luis E. Santiago, Jose Seguinot-Barbosa, Jess Zimmerman

*San Juan ULTRA-Ex, San Juan, Puerto Rico, United States*

In this presentation we discuss efforts in the development of an Urban Long Term Research Area (ULTRA) Exploratory site in San Juan, Puerto Rico, as part of a new initiative to establish a network of urban socio-ecological research in the United States. The San Juan ULTRA-Ex was developed to address the exacerbating social and environmental risks that city residents face - reduction of forest cover, diminishing stream quality, vulnerability to flooding and pollution risks,

decreased access to local natural resources, and droughts - as a result of pervasive urban development and susceptibility to potential perturbations of the global oil market and climate change. Our objective is to analyze the interactions and changes of the biophysical, economic, and social sources of vulnerability over the last 70 years for the city's main watershed, the Rio Piedras River Watershed (RPRW), and evaluate to what degree they influence the city's potential for sustainability. We also seek to understand the organizational networks involved in land-use decision-making, and what alternative future scenarios are envisioned by city stakeholders, including citizens and experts alike. To address these objectives, our interdisciplinary team developed an integrated conceptual framework that combines (a) social science vulnerability theory, (b) physical laws such as conservation of mass and thermodynamics and their relation to development and economic activity, and (c) the ecological focus that explains the biodiversity of the city and the functioning of ecosystems to its inhabitants. In addition, we developed a participatory research approach in which local stakeholders are involved in the framing of the research questions, as well as have the opportunity to collaborate in other aspects of the research process to facilitate links between science and decision-making. We will present our conceptual framework as well as initial outcomes of the collaboration process in the development of San Juan ULTRA-Ex.

**0042**

### **Growth and Water in Hermosillo, Sonora, Mexico: The Problem Structuring, Challenges for the Future and Policy Implications**

Presentation type: Oral

Nicolas Pineda-Pablos, Jose Luis Moreno-Vazquez, Alejandro Salazar-Adams

*El Colegio de Sonora, Hermosillo, Sonora, Mexico*

Since the early 1990s, Hermosillo water authorities realized that the city was running out of water. This was also made visible when the reservoir used to supply water to the city dried out in 1995. The city population was then just over one half million and was growing at an annual rate of almost 2%. Something had to be done to solve the problem. The solutions to the problem concerned supplying more water to the city. Since then, a series of grandiose projects have been proposed. Some of them have failed while others have been carried out.

The carried out projects include: the purchase of agricultural water rights from farmers and an aqueduct to bring water from a dam on the Sonora River. Among the failed projects have been new wells, an aqueduct from a dam in the Yaqui River, and a desalination plant in the Gulf of California Coast. On the other hand, the demand-oriented solutions have been lagging behind. Water is not fully metered; the loss of water has been reduced but remains at around 35%. Free-riders include about 30% of customers. A rationing scheme has been implemented in different years. Also, the city lacks a wastewater treatment plant.

Currently, Hermosillo's population is 750,000 and will see more growth. The State Government is proposing an ambitious state-wide Hydraulic Plan to bring water for Hermosillo from the Yaqui and Mayo rivers basins. In the meantime, the city's water management department has not improved its efficiency. This paper will review the different ways in which the city's water problems have been understood and the different solutions that have been proposed during the last 15 years. Also, some attention will be given to challenges for future growth as well as the implications for policy and planning.

**0043**

### **Global Multi-Scale Urban Land Cover Modeling**

Presentation type: Oral

Michael Reilly

*Association of Bay Area Government, Oakland, CA, United States*

A combination of both substantial and methodological changes has made the spatial modeling of urban land cover change over large regions increasingly feasible and relevant. Over the recent decade, transportation and communications innovations, along with increasing globalization, have expanded the range of urban interconnections to the national, continental, and global scales.

During this same period, remote sensing and geospatial technology have improved rapidly allowing the analysis of large regions and the globe. However, the movement to larger urban systems has led to uncertainty regarding the appropriate modeling approach. In previous work (Reilly, Güneralp, and Seto, 2009), the authors proposed a Coupled System Dynamics Spatial

Logit (CSDSL) framework that combined an econometric systems approach at the higher (county) level with a probabilistic logit approach at the lower (remotely-sensed pixel) level. A wide range of urbanization drivers were modeled at the theoretically appropriate scale for the Pearl River Delta metropolitan area, generally agreed to be the world's largest integrated urban system. In the current work, the CSDSL framework will be applied on the global level. National- or provincial-level drivers relating to economic level, growth, and composition; population growth; and transportation and land use policy will be used to model the rate of urban land cover expansion within an econometric systems framework. Pixel-level information relating regional accessibility; prior non-urban land cover; and physical factors such as topography will be applied within a logistic regression model to evaluate pixel-level urban land cover transition. Such an approach combines the best aspects of two different methodological approaches, treats drivers of urbanization at the appropriate spatial scale, and allows the integrated modeling of urbanization at the global scale. The presentation concludes with limitations of the approach and suggests a Monte Carlo simulation approach to policy application of the model.

**0044**

### **Governing Climate Change in the City**

Status: Accepted Presentation type: Plenary

Author's preference: Oral

Harriet Bulkeley<sup>1</sup>, JoAnn Carmin<sup>2</sup>

<sup>1</sup>*Durham University, Durham, United Kingdom,* <sup>2</sup>*MIT, Boston, United States*

Municipal authorities and non-governmental actors are increasingly viewing the city as a means through which to engage in climate action, both to mitigate greenhouse gas emissions and adapt to projected climate impacts. As new policies, programs, and projects take root in cities around the world, more often than not, the emphasis is on the designs of these initiatives rather than the ways in which decisions are made and the processes through which climate action is initiated and sustained. Academic research has tended to examine the factors that have led to the development of particular policies or initiatives, rather than attending to the politics of such processes, the urban governance contexts within which they are emerging, and the implications for public and private authority. In this session, we seek to engage with different theories of urban governance and draw on empirical evidence to examine how, why and with what implications cities in developed and developing countries are assessing, planning, and implementing climate mitigation and adaptation programs. Individually, the papers in this session each focus on a specific dimension of governing climate change in urban centres. Through diverse examples, consideration of emerging trends in mitigation and adaptation initiatives, and assessments of both innovations and critical issues, the papers collectively suggest new theoretical frameworks for assessing and advancing urban climate governance.

**0045**

### **Accomplishing Urban Low Carbon Transitions: Government by Experiment?**

Presentation type: Oral

Harriet Bulkeley, Vanesa Castan Broto

*Durham University, Durham, United Kingdom*

For over a decade, research has drawn attention to the fundamental ways in which infrastructures construct and are constructed through the politics and practices of urban governance, captured in the debates over the nature, extent and purchase of the 'splintering urbanism' thesis in cities across the world. However, despite drawing attention to the socio-technical nature of governing in the city, these debates "mostly ignore the fact that networked infrastructures constitute a - if not the - central interface between nature and society" (Monstadt 2009: 12). This is a critical omission, for recent evidence suggests that a new politics of reconfiguring urban infrastructures underpinned by logics of sustainable development and 'carbon control' (While et al. 2009) are emerging.

In this paper, we argue that in the case of climate change this politics is being pursued through the development of 'experiments' - initiatives that seek to intervene in the socio-technical fabric of the city in order either to reduce GHG emissions or vulnerability to climate impacts. Drawing on a database of over 450 examples of such experiments in 100 cities, together with preliminary analysis of case-studies conducted in India, Mexico and the UK, the paper will examine how governing urban infrastructures is conducted through experiments, the roles of public and private

authority, and the consequent implications for issues of social and environmental justice. In conclusion, we reflect on the implications of our findings for theorising the governance of climate change in the city.

#### 0046

##### **Getting to Carbon Neutral: A Guide for Cities**

Presentation type: Poster

Christopher Kennedy<sup>1</sup>, David Bristow<sup>1</sup>, Sybil Derrible<sup>1</sup>, Eugene Mohareb<sup>1</sup>, David Rulff<sup>1</sup>, Sheyda Saneinejad<sup>1</sup>, Robert Stupka<sup>1</sup>, Lorraine Sugar<sup>1</sup>, Ryan Zizzo<sup>1</sup>, Bernie McIntyre<sup>2</sup>

<sup>1</sup>*University of Toronto, Toronto, ON, Canada,* <sup>2</sup>*Toronto and Region Conservation Authority, Toronto, ON, Canada*

This paper presents a guidebook and on-line strategic planning tool, which assist cities down the path to becoming carbon neutral (i.e., emissions from the municipality minus sequestered carbon and offsets sum to zero).

The first phase of the project entailed collecting and analyzing best case practices and strategies in sustainable urban design and planning. The review included over 70 case studies in areas of transportation, buildings, energy systems, waste management, water infrastructure, carbon sequestration and integrated community design. The case studies included information on costs, barriers to implementation, GHG reductions, and other benefits. The second stage involved developing best practice strategies for reducing urban GHG emissions. For each strategy the guide provides simple, generic rules for estimating the reductions in GHG emissions that can be achieved. For example, the formulae can be used to estimate GHG reductions from: installing X km of light-rail; or servicing Y% of homes in a municipality with district energy. The rules of estimation typically calculate changes to intermediary quantities, such as energy use and vehicle kilometers travelled, from which GHG emissions are subsequently determined. The guide does not seek to be prescriptive in how the GHG reduction strategies are selected; it offers a menu of choices. The final section shows how the integration of a range of strategies can substantially reduce a city's overall emissions. The inventory process, estimation guidelines and other data tables in this guide have been developed in a consistent fashion, so that they can be used together to quantitatively develop, or assess, a municipality's master plan for GHG reductions. An example shows how Toronto's GHG emission could be reduced by over 70% by 2031.

#### 0050

##### **Urbanisation, Global Environmental Change and Impacts on Coastal Urban Areas in Pacific Island Countries: Challenges and Opportunities**

Presentation type: Oral

Manoranjan Mohanty

*University of the South Pacific, Suva, Fiji*

Urbanisation and Global Environmental Change (UGEC) are intricately linked in a two-way process. Urbanisation is a socio-demographic phenomenon and a physical transformation of landscapes. Climate change is one of many global environmental changes affecting urban areas, and is influenced by, urbanisation. On the one hand, cities are net contributors to greenhouse gas emissions, global warming and climate change; on the other, climate change and extreme weather events such as cyclones, droughts and floods cause population displacement and migration to cities, and contribute significantly to urbanisation. Beyond the negatives, urbanisation also provides opportunities that help mitigation and adaptation to environmental changes and for sustainability.

Cities are affected by both global (macro) climate change, and local (micro) climatic variability. Urbanization has aggravated vulnerability to environmental change especially in the coastal urban areas. Pacific Island Countries (PICs) with wide regional social, economic and environmental diversities are more vulnerable to climate change and urbanisation. Rapid urban sprawl, poverty, solid wastes, poor drainage, and lack of urban planning are some aggravating factors to environmental challenges in these countries. The paper examines the linkages between urbanization and global environmental change, explores the effects of GEC on urban areas and vice versa, the responses of urban areas to those effects and also identifies challenges and the

benefits of urbanization that help mitigation and adaptation to global environment change and opportunities for sustainability in the coastal cities of the Pacific Islands.

**0052**

**Impact of Urban Planning Decisions on Urban Energy Use: An Integrated Simulation Model for Vienna**

Presentation type: Oral

Veronika Gaube<sup>1</sup>, Markus Heinz<sup>1</sup>, Paul Pichler<sup>2</sup>, Alexander Remesch<sup>1</sup>, Julia Steinberger<sup>1</sup>, Helga Weisz<sup>2</sup>

<sup>1</sup>*Institute of Social Ecology, Vienna, Austria*, <sup>2</sup>*Potsdam-Institute for Climate Impact Research, Potsdam, Germany*

Interest in sustainability assessment for urban areas has increased notably, with additional attention generated due to the fact that by now half the world's population lives in cities. In conceptualizing the biophysical inputs and outputs of a city, the analysis of urban metabolism provides valuable insights into the energy and resource requirements of a given urban area. Within the FP7 project on Sustainable Urban Metabolism for Europe (SUME), an urban metabolism model will be developed by focusing on the dynamics between stocks and flows of energy and combining this with agent-based modelling in order to enable scenario analysis and thus allow for the simulation of potential impacts of decisions made in urban planning. We have chosen the strategy of focusing on key urban processes and their metabolic consequences. In particular, we model processes which involve both buildings and transport to determine their use of energy, material and land. To do this we have to understand the spatial distribution of activities within cities and how decisions concerning place of residence and transportation (e.g. destinations, modal split) are made. Currently, urban planning does not take into account the necessity of the reduction of energy and material throughput for sustainable urban development. The goal of the integrated model presented here is not to quantify exactly the change in energy and material throughput resulting from changes in urban structure, but to estimate the plausible differences that decisions in urban development can make. The specific goal of the agent-based model component is to generate a better understanding of the relevance of decisions taken by different actors with regard to stocks and flows defined in the urban metabolism model on the one hand and on the other hand, the framework conditions (governance and institutions) which influence these decisions.

**0053**

**Insect Biodiversity Patterns of Social-Ecological Systems in the Mediterranean: A Preliminary Assessment**

Presentation type: Poster

Luis Mata<sup>1</sup>, Marta Goula<sup>2</sup>, Josep Gordi<sup>3</sup>, Antonio Monleón<sup>4</sup>, Christian Oltra<sup>5</sup>

<sup>1</sup>*Department of Animal Biology, University of Barcelona, Barcelona, Catalonia, Spain*, <sup>2</sup>*Biodiversity Research Institute (IRBio), Barcelona, Catalonia, Spain*, <sup>3</sup>*Laboratory of Landscape Analysis and Management, University of Girona, Girona, Catalonia, Spain*, <sup>4</sup>*Department of Statistics, University of Barcelona, Barcelona, Catalonia, Spain*, <sup>5</sup>*Center of Sociotechnic Research (CIEMAT), Barcelona, Catalonia, Spain*

Social-ecological systems (SESs) are dynamic complex adaptive systems where biophysical and social factors interact reciprocally. Processes taking place within SESs, like land use change and habitat conversion, are the primary cause for reduction of biological diversity, which is among the most pervasive effects of the human domination of Earth's ecosystems. One of the most relevant challenges of both biophysical and social sciences is to develop interdisciplinary research approaches and conceptual tools to understand patterns and processes of SESs. Insects are a logical taxon to study because they are diverse, abundant, easy to sample, represent a spectrum of trophic levels, have short generation times and are fundamental in agriculture, horticulture and gardening.

The Mediterranean basin is a biodiversity hotspot, in which biodiversity patterns of SESs of some insect taxa have been studied to some extent; however, heteropteran [Insecta: Heteroptera] biodiversity patterns in the Mediterranean biome remains an open unexploited line of research.

As a preliminary assessment to a projected interdisciplinary long-term socioecological research of the Metropolitan Region of Barcelona, Catalonia, Spain, this study will report on findings of a natural snapshot experiment that will take place between spring and summer of 2010. The study will evaluate heteropteran biodiversity patterns of 15 SESs embedded in 10 Mediterranean basin cultural landscape patches. These patches will be selected identifying demographic, physical, landscape, social and economic measures and metrics according to landscape ecology frameworks. The aims of this preliminary assessment of SESs in the Mediterranean basin is to begin to understand how socioecological patterns and processes drive insect biodiversity patterns, how these feedback to SESs to generate future change, and how resilience to disturbance emerges. Knowledge of SESs patterns of insect biodiversity is also essential to efficiently plan models of human development that facilitate biological conservation, restoration and reconciliation.

**0054**

**Reducing Contemporary and Future Community Vulnerability to Hurricane Storm-Surge by Injecting Climate Scenarios into Long-Range Comprehensive Plans: A Sarasota County, Florida Case Study**

Presentation type: Oral

Brent Yarnal<sup>1</sup>, Tim Frazier<sup>2</sup>

<sup>1</sup>*Pennsylvania State University, University Park, PA, United States*, <sup>2</sup>*University of Idaho, Moscow, ID, United States*

Long-term planning requires local decisionmakers to balance pressures for growth and development with needs for hazard resilience and climate change adaptation. The challenge is especially difficult in coastal zones where growth and development are exceptionally strong, yet natural hazards are prevalent and increasing because of climate change and associated sea level rise.

This case study addresses these conflicting demands via two goals: (1) examining the potential effect of sea level rise on community vulnerability to future hurricanes, and (2) presenting the results of a collaborative spatial decision-making and participatory mapping exercise aimed at helping the community confront its increasing vulnerability. To reach the first goal, we assessed variations in socioeconomic exposure of Sarasota County, Florida to contemporary hurricane storm-surge and to storm-surge enhanced by sea level rise. Analysis indicated that significant portions of the population, economic activity, and critical facilities are in contemporary and future hurricane storm-surge risk zones, and the addition of sea level rise significantly increases the area of these risk zones. Analysis of the 2050 comprehensive land-use plan suggested that efforts to manage future growth in residential, economic and infrastructure development in Sarasota County are increasing societal exposure to hurricane storm-surge hazards. The daylong collaborative spatial decision-making and participatory mapping exercise reflected the varied political agendas and socioeconomic interests of five local domains: business, emergency management and infrastructure, environment, government, and planning. Participants compared the local 2050 comprehensive land-use plan to maps of contemporary storm surge and projected storm surge enhanced by sea level rise. The results demonstrate that despite very different agendas and interests, all stakeholders agreed that the community must act to increase resilience to today's hurricane hazards and to adapt to tomorrow's sea level rise-enhanced storm surge. Dissemination of results from both research components is causing local officials to reconsider the 2050 land-use plan.

**0056**

**Modelling of Urban Expansion of Greater Hyderabad Metropolitan Region in India – Scenarios for 2030**

Presentation type: Oral

Gowtham Gollapalli, Rajan Krishnan Sundara

*IIIT-H, Hyderabad, India*

Urbanization in developing countries like India is rampant and an outcome of policy changes in industrial and economic sectors. There is a need to analyze and model this urbanization process,

so as to provide insights for managing the changes and its impacts. Developing and employing spatially explicit models help in elucidating the locational spread along with other parameters like quantum of growth in economy and population. This work employs AGENT LUC (Anthropogenically Engineered Transformation of Land Use and Land Cover) model to capture the urbanization process and simulate the future scenarios of land use for the region of Greater Hyderabad in India at one square kilometre resolution grids. The model incorporates policy changes as events and simulates the related spatial changes. Greater Hyderabad has recorded a doubling of urban population in the last 1.5 decades and an overall increase of 30% over the study area encompassing administrative regions of Hyderabad and surrounding three districts, largely propelled by liberalization policy of both the National and State Governments. This study will help in understanding the effect of globalization on land use changes at the sub-regional level and can be extended to other regions in developing countries like India. Modified versions of the model can be employed to study the effect on sub sector events like service sector growth and population migration on land use changes. The simulations used IPCC SRES A1 and B2 estimates of economy starting from 1990 and national population growth rates for the simulation. Results showed a population of 15.75 and 16.16 million respectively in 2001 against the census figure of 16.62 million. By 2030, it will grow to 19.05 and 18.85 million respectively, with the Northern and North-western parts of the city contributing the most.

**0057**

### **Mapping the State of City Systems Based on Remote Sensing: Exergy and Sustainability of Urban Form**

Presentation type: Oral

Anastasia Svirejeva-Hopkins<sup>1</sup>, Yuri G. Puzachenko<sup>2</sup>, Robert B. Sandlerkiy<sup>2</sup>

<sup>1</sup>PIK (Potsdam Institute for Climate), Potsdam, Germany, <sup>2</sup>A.N. Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russian Federation

Urbanization is considered as a Global Ecological Process, which means that city, or urban area, could be viewed as an open thermodynamic system, maintaining its structure through the conversion of energy. There are both autotrophic (vegetation in open spaces and in parks) and heterotrophic (humans) components of the urban system, as well as non-living ones - buildings, constructions etc. In the process of its evolution - growth (increase in size) and structural development (increase in the system's organization) - the system-city fluctuates from one state to another. Exergy could describe and measure the sustainability of the system and is used to determine how far the system is from thermodynamic equilibrium with its surroundings. Exergy grows in the process of self-development of the complex system and is the highest when the system is farthest from an equilibrium state with the local maximum of entropy. Namely this distance (and the degree of non-equilibrium) can be estimated by the difference of entropies, or by Kullback entropy (Joergensen and Svirezhev, 2004). Based on this information-thermodynamic approach, the spatial and temporal variations in energy conversion are described using remote sensing (Sandlerkiy, Puzachenko, 2005). This method, originally used for vegetation dynamics, also allows for the construction of maps of exergy at the regional level, occupied by cities and their surroundings, using the standard Landsat data.

**0060**

### **Peri-Urbanization, Ecosystem Service Evaluation, and Integrated Modelling: PU-GEC Project**

Presentation type: Oral

Shu-Li Huang, Szu-Hua Wang, Li-Fang Chang, Yu-Hwa Chen  
*National Taipei University, San Shia, Taiwan*

Peri-urban areas are valuable environments that provide ecosystem services for urban residents. The PU-GEC project proposed studying the effect of global environmental change and land use change on ecosystem services in peri-urban areas, using the Taipei-Taoyuan area as a case study. The Taipei-Taoyuan area is the most populated and fastest growing region of Taiwan. First, this project investigated the spatial pattern of land conversion in the study area by interpreting the 1990 and 2006 SPOT images for comparison with the land cover map of 1971. A

comparison of landscape metrics between urban planned districts and non-urban planned districts indicates that urban sprawl in non-urban planned districts is much more severe than in urban planned districts, and the landscape in non-urban planned districts is highly fragmented. For assessing the effect of land cover change on ecosystem services in peri-urban areas, an emergy approach is applied for evaluating ecosystem services. By converting all stocks and flows into common emergy units, an impact matrix is constructed to analyze the systemic role of ecosystem components by classifying their status of being active, reactive, critical or indifferent. The analytical results indicate that the soil component of forest ecosystems, upstream rivers and agricultural productivity are critical components of ecosystem services in the study region. The effect of land cover change during 1971 to 2006 in the study region on ecosystem services is also analyzed.

An integrated model that links a stock-flow model with an agent-based model is also developed to enhance our understanding of the interactions among land use, human decision-making, and environmental change. The land cover change from agricultural landscape to an urbanized system and the consequential effects on ecosystem services in the study areas are simulated. The resilience of ecosystem services in the study area is also analyzed.

**0063**

### **Challenges to Adaptation for Risk-Prone Coastal Livelihoods in Tumaco, Pacific Coast (Colombia)**

Presentation type: Oral

Andrea Lampis

*Universidad de Los Andes, Bogotá, Colombia*

The challenges posed by the two-way relationship between climate change and urban settlements require responses from a multi-disciplinary range of scientific fields as well as more developed inter-disciplinary frameworks. Over the next two decades, the production of new knowledge to unwind a number of interlocking environmental and developmental processes will be a key factor in providing added-value towards the fostering of the adaptive capacities of urban communities and local institutions in the face of climate change.

This paper presents fieldwork research undertaken in October 2008, which aimed to bridge knowledge between vulnerability and asset-based research, local organizations from the communities and institutions and available scientific hard knowledge about local hazards and risks. This cross-cutting issue is central considering that no adaptation process is viable unless both communities and institutions participate, feedback into and have the power to assess the usefulness of research that concerns them. Evaluating existing constraints to people's livelihoods towards adaptation to climate change is of the uttermost importance to produce local knowledge following the call of the international scientific community and to engage local research and policy-making institutions with the issue. Colombia is a rich, but at the same time, fragile combination of ecosystems. It will be fully exposed to the intensification of extreme events and to the risk of natural disasters over the next decades, as recently stated by research carried out by the National Institute of hydrology, meteorology and environmental research (IDEAM, 2007), which produced a set of modeled scenarios of climate change impacts on the broad regions of the country.

**0065**

### **Urban Environment Governance in Indonesia: Challenges to Address Flooding in Jakarta**

Presentation type: Oral

Laely Nurhidayah

*Indonesian Institute of Sciences, Jakarta, Indonesia*

Jakarta faces complex problems in regard to urban environmental problems. These include flooding, water pollution, air pollution, lack of green space, and waste problems. Flooding is an annual and major problem during the rainy season. The impacts are not only damaging to the people and their property and the economy, but cause health problems and create unliveable cities. The cause of the problem is complex. Climate change and sea level rise are at fault, as is the mismanagement of the environment - namely deforestation upstream, a lack of green space, blockage of the rivers and waterways due to domestic waste and illegal settlements, and the construction of housing and settlements within the mangrove areas. The government cannot solve the problem effectively for a variety of reasons, some of which include: a lack of a

comprehensive policy and framework to address the issue, overlapping laws and legislation, a lack of enforcement and government coordination and cooperation with other stakeholders within the watershed region, a lack in the capacity of government to respond to the disasters, and difficulties concerning the completion of canal infrastructure. Thus, the solution to the problem is not easy, but it should be one that is comprehensive and integrates all involved stakeholders. This paper will examine urban environment governance in Indonesia and its challenges using the case study of Jakarta.

**0066**

### **Land and Resource Use Efficiency for Built-up Environment**

Presentation type: Oral

Burak Güneralp<sup>1</sup>, Karen Seto<sup>2</sup>

<sup>1</sup>Texas A&M University, College Station, TX, United States, <sup>2</sup>Yale University, New Haven, CT, United States

Urbanization is a land change process as well as a demographic and economic process of concentrating people and resources. The construction and operation of building stock - the central manifestation of urban expansion - drives energy demand and carbon dioxide (CO<sub>2</sub>) emissions through the extraction and use of raw materials as well as energy used for building construction and operation.

In this paper, we evaluate, in the context of urban development, i) whether there is an increase in urban land use efficiency and related material and energy intensities in building construction and operation, and ii) if so, whether or not the efficiency gains are high enough to counter increasing demand for these resources. Our case study is Pearl River Delta, a rapidly urbanizing region in China. We combine remotely sensed images and official statistics on floor area and population to quantify urban land expansion and evaluate both urban population and building density from 1988 to 2008. As indirect impacts of urban land use change, we track the changes in material and energy demands and the resulting CO<sub>2</sub> emissions using concrete and heating/cooling as proxies for building construction and operation, respectively. Both density measures indicate that urban land becomes less dense for about 15 years until the early 2000s; from then on trends are towards more densification while urban land continues to increase (more than 20% since 2003). Structural changes and efficiency gains ensure that material and energy demand due to building construction and operation reach lower levels than they would have otherwise. Nevertheless, the demands for these resources lead to significant increases in the CO<sub>2</sub> emissions per capita. CO<sub>2</sub> emissions elsewhere due to energy demand in the metro area increase more than five fold while those that are co-located with the metro area first decline and then stabilize.

**0067**

### **Cities' Contribution to Global Warming: Exploring the Relationship between Urbanization, Energy Consumption and CO<sub>2</sub> Emissions in Transitional China (1979-2009)**

Presentation type: Oral

Lijian Xie, Suhong Zhou

*School of Geography and Planning, Sun Yat-sen University, Guangzhou, China*

Since the reform in 1978, urbanization in China has been ongoing and at an amazing speed during which China has made great progress in political, economical, social matters. However, the urbanization process has given rise to many kinds of problems, such as widened disparities in affluence, social polarization, cultivated-land loss, environmental degradation, heavy pollution, etc. At the same time, China - as the largest developing country and the largest CO<sub>2</sub> emitter in the world - is facing more and more pressure and challenges from the world, especially western developed countries that claim China should take more environmental responsibility in the economical and the political sense. So in context of urbanization and environmental change, it is meaningful and necessary to identify the temporal and spatial relationship between urbanization and energy consumption and CO<sub>2</sub> emissions in transitional China.

The first step of the exploration is to construct a comprehensive urbanization assessment model, by which one can evaluate the actual urbanization process in different regions. There are great differences between levels of urbanization, especially in volume and speed. The next step is to calculate the regional energy consumption and CO<sub>2</sub> emissions resulting from human behavior during the process of urban growth. Based on the aforementioned two steps, this article quantitatively analyzes the relationship between urbanization and energy consumption and CO<sub>2</sub>

emissions, identifies the temporal relationship between the urbanization processes and the volume of energy consumption and CO<sub>2</sub> emissions to find differentiated periods and important turning points, and explores the spatial configuration differences of urbanization, energy consumption and CO<sub>2</sub> emissions to find spatial laws of the three. As a result, we find that highly urbanized territories in transition play an important role in energy consumption and CO<sub>2</sub> emissions, while other regions act as small contributors.

**0068**

### **Rapid Urbanization and Land Fragmentation in the US Southwest: A Socio-ecological Gradient Analysis**

Presentation type: Oral

Milan Shrestha, Abigail York, Sainan Zhang, Christopher Boone  
*Arizona State University, Tempe, Arizona, United States*

Rapid urbanization in the Southwestern United States over the last five decades has led to extensive, low-density developments commonly characterized as sprawl, suburbanization, exurbanization, and 'leap-frog' developments. These types of urban growth have significantly altered the regional land-use trajectories, resulting in land fragmentation with many social and ecological consequences. Some of these consequences include the loss of the connecting corridors important for ecological processes, reduced efficiency in public services, increased commuting times and fuel consumption, decreased ability to use lands for agricultural or forest production, and loss of culturally relevant open spaces and natural amenities.

What are the patterns and drivers of land fragmentation in the rapidly urbanizing southwestern US? This paper presents the results of a cross-site comparative study involving five sites that are part of the Long Term Ecological Research (LTER) network: Central Arizona-Phoenix, Sevilleta, Jornada Basin, Konza Prairie, and Shortgrass Steppe. Together, the five southwestern sites provide an interesting and useful gradient for examining social and ecological drivers and consequences of land fragmentation in relatively dry and fast growing urban areas. Using a socio-ecological framework, we explored the complex, interrelated processes of land change and land fragmentation. We used National Land-cover Dataset and reclassified its land-cover categories into seven classes: developed (higher intensity), developed (lower intensity), agriculture, forest, undeveloped, grass/shrubland, and water. The land-use maps developed with these classes were subsequently used in the analysis of fragmentation patterns based on several landscape metrics: Patch Density, Edge Density, Interspersion and Juxtaposition Index, Contagion, Landscape Shape Index, and Shannon's Diversity Index. We calculated these metrics for each site and compared the fragmentation patterns across all study sites. We identified three fragmentation patterns: 1) riparian, 2) polycentric, and 3) monocentric, and analyzed the effects of five drivers on these patterns -water, urban population dynamics, transportation, institutions, and topography.

**0069**

### **Climate Change Impacts and Adaptation at City Scale: illustrations in Paris, Copenhagen and Mumbai**

Presentation type: Oral

Stephane Hallegatte

*CIREAD, Nogent-sur-Marne, France; ENM, Meteo-France, Toulouse, France*

This presentation discusses the design of adaptation strategies at the city scale by first investigating climate change impacts at this scale, and then possible adaptation strategies. Illustrations and results for three case studies are discussed here which include heat waves in Paris, coastal floods in Copenhagen, and river floods in Mumbai.

These studies first illustrate a methodology to assess the economic impacts of climate change at the city scale. The approach is a simplified risk assessment, to calculate the direct costs of floods, coupled to an economic input-output model in the Copenhagen and Mumbai cases. The output is a risk assessment of the direct and indirect economic impacts of extreme events, including, for example, production and job loss and reconstruction duration. This approach makes it possible to assess the benefits of investment in new urbanism rules, of upgraded sea defences, of drainage systems, of insurance and of increased reconstruction capacity.

It is found that, in absence of adaptation, unmitigated climate change would increase natural risks

in a significant manner. In Paris, urban-scale climate simulations show that specific adaptation measures can have a significant effect to reduce the negative consequences of heat-waves. In Copenhagen, coastal flood risk is currently, negligible. With sea level rise, however, mean annual losses could reach hundreds of millions Euros in absence of adaptation. Upgraded protections are relatively cheap to implement, if this is incorporated into urban planning. In Mumbai, flood risks are extremely large and could more than likely triple because of climate change. Adaptation options could reduce this risk, and even make it lower in the future than it is today. These results call for the introduction of adaptation in urban planning, as one part of a comprehensive strategy to manage climate change.

**0072**

**Impact of Landuse Changes on Rainfall Pattern and Runoff Characteristic in the City of Yogyakarta, Indonesia**

Presentation type: Oral

Sudarmadji Sudarmadji, Emilia Nurjani

*Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia*

Global climate changes have been argued to change rainfall pattern and even runoff in an urban area. Rainfall becomes greater than usual and similarly, runoff also increases significantly. In the city of Yogyakarta and its surrounding area, covering an area of about 40 km<sup>2</sup>, this situation has been observed since the 1970's when land used started to change significantly from agricultural to urban. This research aims to identify the changes of rainfall pattern and hydrological characteristics caused by the land use changes. The hydrological changes were represented by runoff characteristics in the urban area. Over the last 30 years, data of rainfall was collected from the rainfall station in the city of Yogyakarta and the surrounding area, while data on runoff was collected by measuring the river channel within the urban area. Data on rain water quality was also collected. Serial aerial photographs and satellite imagery was used to evaluate the land use changes of the study area. Simple analysis was used to correlate rainfall patterns and land used change, and was used to estimate runoff. The study shows that monthly rainfall and frequency of rainy days per month in the urban area is higher than those in the surrounding area. The urban rainfall area tends to experience higher daily rainfall events, and the same amount of rainfall. In the urban area, the temperature is higher than the surrounding area, indicating an urban heat island. Some rain samples show pollutants in rain water. This indicates that urban transportation may influence the rainfall. The land used changes has caused runoff to increase markedly in some rivers, accompanied by high concentrations of TDS, TSS as well as some other pollutants.

**0073**

**An Urban Integrated Assessment Facility to Analyse Adaptation and Mitigation Strategies under Global Environmental Change**

Presentation type: Oral

Richard Dawson

*Newcastle University, Newcastle upon Tyne, United Kingdom*

There is a growing awareness of the important role of urban areas, particularly their form, function and development trajectories, in arbitrating the sustainability of urban areas. The urgent need to reconfigure urban areas so their greenhouse gas emissions are drastically reduced, are more resilient to the impacts of climate change, and are more sustainable in general, is widely recognised. A wide variety of measures are being considered and piloted, including schemes to transform urban energy systems, reduce transport emissions, retrofit buildings, conserve water, build resilience to flooding and prepare for heat waves. These individual policies need to be implemented as part of an integrated strategy that can steer cities towards low carbon and well adapted futures. To do so requires understanding of the processes that are driving long term change in cities and the ways in which they interact. Demographic, economic, land use, technological and behavioural changes are all drivers, which alongside climate change, will shape the future of cities. With this in mind, we have developed an Urban Integrated Assessment Facility (UIAF). The UIAF is driven by global and national scenarios of climate and socio-economic change, which feed into models of the regional economy and land use change. Simulations of climate, land use and socio-economic change inform analysis of carbon dioxide

emissions (focussing upon energy, personal transport and freight transport) and the impacts of climate change (focussing on heat waves, droughts and floods). An integrated case study, developed with stakeholders in the Greater London Authority, Transport for London, Thames Water and the Environment Agency will be presented. Amongst many findings, the UIAF application highlights the rate at which infrastructure must change, the balance of different adaptation and mitigation measures and the importance of spatial planning in mediating vulnerability to climate impacts and mitigating greenhouse gas emissions.

**0075**

**Long-Term Trends of Maximum, Minimum and Mean Annual Air Temperature over Northern and Southern Nigeria.**

Presentation type: Poster

Ojo Joseph, Oladosu Olakunle Rufus

*Federal University of Technology, Akure, Ondo State, Nigeria*

This study analyzes the surface air temperature data from Northern and Southern Nigeria, West Africa over 30-years (1975-2004). Both graphical and statistical techniques were used to evaluate recent trends in the minimum, maximum and mean air temperatures. The results show that there is a significant rise in air temperature by about 1.2 °C in Northern Nigeria over the last three decades, with the dry season warming at a faster rate. The coastal area of the country (Southern Nigeria) also shows an increase of about 1 °C over the decades. Conforming to the global trends in temperature rise, the study confirms evidence of strong warming and cooling in the West African sub-region (WASB) over the last three decades.

**0076**

**Satoyama Woodland Conservation in Urban Areas: A GIS-Based Analysis on Local Strategies**

Presentation type: Poster

Kazuaki Tsuchiya, Kazuhiko Takeuchi

*The University of Tokyo, Yayoi1-1-1, Bunkyo-ku, Tokyo, Japan*

*Satoyama*, coppice woodlands in traditional Japanese agricultural landscapes, provide biodiversity and multiple ecosystem services in today's extended urban areas. In the last decades wide variety types of policies for the conservation of *satoyama* have been developed in many of the municipalities in the Tokyo metropolitan area. The quantity and quality of the conserved areas will significantly relate to the policy types and implementation of the municipalities, however, there are few empirical studies which deal with the conservation strategies of different municipalities. Special importance in *satoyama* conservation is to consider not only land acquisition but also the costs of traditional management.

This paper aimed to provide a framework to clarify the relationship between different *satoyama* conservation policies and those conservation costs and adapt it in the research sites in the southwest part of the Tokyo metropolitan area to understand the conservation process of different municipalities. We investigated how each municipality has developed policies under limited conservation budgets through the cross-border approach with geographic information system (GIS) analysis, archival research and interviews. Maps of conserved areas of each municipality have been collected by archival research in local government offices and later combined in GIS with the distribution maps of *satoyama*. Interviews were conducted with local officials to understand the actual implementation process of each of the local policies and local conservation strategies. The results showed that each municipality has developed policies differently and this could be explained by the differences in the available budget, implementation strategies and development history of municipalities. The results also showed that the area managed by citizen groups is significantly higher than the results of former studies which estimate it at the national scale. This result supports the importance of promoting public participation in the *satoyama*

management within urban areas.

**0077**

**Assessing Urban Vulnerability In a Peri-Urban Area Using Emergy Indices: Taiwan's Western Coastal Plain**

Presentation type: Poster

Li-Fang Chang, Shu-Li Huang

*Graduate Institute of Urban Planning, NTPU, San Shia, Taipei, Taiwan*

The rapid economic and population growth in Taiwan during the past decades occurred in its cities along the western coastal plain, which are considered at high risk from sea level rise and climate change. The densely populated coastal urban areas coincide with the "key societal hotspots of coastal vulnerability" as described in the IPCC 4th Assessment Report. Furthermore, peri-urban areas are often characterized by valuable natural environments that provide essential life-support functions and ecosystem services for urban systems. Global environmental change has raised concerns over how urbanization, land use and land cover change affect ecosystem services.

Currently, over 90% of the population of Taiwan are concentrated in the western coastal plain. Owing to urban sprawl, land use and land cover change in the peri-urban areas of the major cities of Taiwan tends to affect biophysical processes and ecosystem services, increasing the vulnerability of cities to climate change. For the purpose of identifying the spatial heterogeneity of urban vulnerability in Taiwan's western coastal region, a framework for assessing urban vulnerability is established using emergy indices. The type of ecosystem services and characteristics of urban vulnerability influenced by climate change in the study area are identified. Land use change between 1995 and 2005 are also analyzed using GIS to study its effect on urban vulnerability in the study region.

**0078**

**The Impact of a Carbon Tax on the Paris Metropolitan Area and Its Population**

Presentation type: Oral

Vincent Viquié, Stéphane Hallegatte

*CIREN, Paris, France*

After decades of urban sprawl, many voices advocate for a densification or re-densification of cities. To do so, different economic policy tools can be used, and one often-discussed tool is a tax on transportation. A specific form of transport tax is the carbon tax, and this approach has been regularly discussed in the public and policy debate in the last years.

This paper aims at informing public-policy decision-making on this issue. We have first investigated and modeled the structure of the Paris urban area, in particular the distribution of population, rents and building heights across the metropolitan area, by applying classical tools of urban economics and calibrating a urban economy model on the Paris urban area using a broad range of detailed socio-economic data. We find that the model reproduces fairly faithfully the available data on the Paris area, suggesting that this tool can be used to inform policy decisions. Then, we used the calibrated model to assess the impact of a 100 €/tC carbon tax on the urban area, and especially on its population densification. We analyzed the tax impact over three timescales: the immediate impact, the medium term impact after rents and household location have adjusted, and the long-term impact after the urban structure has adjusted. We find that the 100 €/tC carbon tax has a limited effect on the densification of the agglomeration, measured by the decrease in the average distance of households from the center of Paris, even on the long term. Moreover, it is found that the tax has significant redistributive impacts on households and landowners, and that these impacts vary with the considered timescale. We conclude with a discussion of the consequences of pro-densification policies on climate vulnerability and the link with adaptation policies.

**0079**

**Scenario Exercises as Synthetic Decision-Making Environments for Urban Vulnerability to Climate Change**

Presentation type: Oral

Timothy Lant, Sharon Harlan

*Arizona State University, Tempe, Arizona, United States*

We will present ongoing research from our Urban Vulnerability to Climate Change project, which studies the coupled human-natural systems of climate variability and change, heat-related health outcomes, urbanization and urban form, and social adaptation and mitigation in Phoenix, Arizona. We are developing scenario exercises that present the risks and vulnerabilities from extreme-heat events as synthetic decision-making environments. The exercise will present multiple parallel narratives of a heat wave using both quantitative and qualitative inputs. These scenarios are grounded in the physical, social, and decision sciences to allow participants to explore the consequences of their choices and actions in addition to providing better understanding of the feedbacks of human decision-making to the social and physical environment. Participants in these exercises (our research subjects) will include public officials, community representatives, and experts. The scenario exercises will be conducted at the Decision Theater at Arizona State University.

This research framework enables us to study the theoretical constructs of human vulnerability, adaptation, and risk-management through synthetic decisions taken by groups and individuals during our exercises. Collectively, we aim to study the adaptive capacity of the population to respond to the scenarios in a reactive mode. We also will study prospective planning processes that can influence the environment in the face of potential environmental risk. These reactive and prospective decision dynamics will be studied from multiple perspectives including the social, institutional, and organizational structures that develop and guide coupling dynamics. We will discuss methods used during the development of scenario materials and analysis for human subjects research, media development, model integration, informatics, and visualization.

**0080**

### **Exploring the Underlying Drivers of Vulnerability of Water across Cities**

Presentation type: Plenary

Patricia Romero Lankao, Kathy Miller

*NCAR, Boulder, CO, United States*

Changes in the hydrologic cycle will play a significant role in driving the impacts of global climate change on cities. In particular, long-term changes in water availability or water quality could affect a city's ability to supply safe, reliable, affordable and environmentally-responsible water service to its inhabitants. Climate-driven changes in water availability and water demand also could fuel conflicts between the city and other users of the water resource. In addition, expected increases in the intensity of precipitation events, are likely to exacerbate flooding hazards, while sea-level rise poses both inundation hazards and threats to the quality of coastal aquifers. Last but not least, new modes of governance, are leading to redistributions of functions and responsibilities (e.g. decentralization, privatization of water services and commoditization of water resources). By so doing, they are defining new options and constraints to a resilient and sustainable management of water.

This session will draw together case studies that explore the vulnerabilities and adaptation strategies of particular cities to the possible hydrologic impacts of climate change, as well as the interplay of vulnerability and adaptive capacity with new modes of water governance. Through comparative analysis of different urban settings, these cases will highlight some of the underlying drivers of different types of vulnerabilities and the likely effectiveness of different adaptation pathways. Our goal is to identify lessons for priority-setting and adaptation-planning approaches that can be applied in other urban settings.

**0081**

### **The Relationship of Urban Form and Urban Heat Island in Europe**

Presentation type: Oral

Nina Schwarz, Ralf Seppelt

*Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany*

Climate change challenges cities with rising mean temperatures as well as more heat-related extreme events. In Europe, the share of urban population that is exposed to the urban heat island effect is already high and still rising. What is more, demographic change in Europe increases the share of elderly people, who are more vulnerable to heat. Fortunately, cities will have more options for action because of an overall decreasing population and possibly vacant land within

cities that could be transformed into cooling green and water areas.

The question is where to best create new urban green and water areas in order to decrease the urban heat island. Therefore, this paper presents an investigation of the relationship between urban form (including urban green and water) and the extent of the urban heat island. A statistical analysis of about 200 European cities is currently being carried out. Urban form and size are quantified with remote sensing data and official statistics, using a) CORINE land cover data from the European Environment Agency, and b) socio-economic statistical data collected by the Urban Audit initiative of Eurostat. The urban heat island is quantified with remote sensing data (MODIS land surface temperatures).

The presentation will provide quantitative results on the relationship between urban form and urban heat island. It will show whether or not the spatial configuration of built-up area versus urban green and water areas has an influence on local climate (as opposed to the sheer size of these areas). Out of this, conclusions for adapting European cities to global change will be drawn. Results will also be discussed in the context of the compact city as an overall planning concept.

## **0082**

### **The Impact of Man-Made Features and Natural Landscapes on Urban Warming**

Presentation type: Oral

Soe Myint, Elizabeth Wentz, Anthony Brazel

*Arizona State University, Tempe, Arizona, United States*

Different land-use and land-cover characteristics can alter thermal energy in urban areas. In situ measurements of air and skin temperatures have traditionally been used to explore surface energy balance that has an impact on urban warming. However, these measures typically represent a local-scale analysis that covers small areas with a limited number of point observations instead of continuous records. Moreover, point measurements of air and surface temperatures may not represent urban warming over a sizable area when dealing with the interactive nature of different landscapes within complex urban settings. We have investigated the direct relation between detailed land-cover classes derived from Quickbird 2.4 m spatial resolution data and surface temperature (Celsius) generated from ASTER data in Phoenix, Arizona.

This study reveals that urban buildings have little or no influence on urban daytime temperature. Surprisingly, there was either a negative relation or no relation between buildings and nighttime temperature in both winter and summer. This implies that buildings do not alter thermal energy and can even lower nighttime temperatures. In contrast, other paved materials increase daytime and nighttime surface temperatures regardless of whether the temperature is measured in the summer or winter. Results from this study suggest that trees can lower skin temperature more effectively than grass. However, trees do not have any influence on nighttime temperature during winter. Water bodies generally are negatively correlated to skin temperatures. Unexpectedly, unmanaged soil significantly increases daytime temperature, and it can even elevate temperatures more drastically than impervious surfaces in the winter. We would like to conclude that the built environment as a whole is not the explanation for the urban heat island but different covers contribute differently. In particular, there is a perception that buildings contribute to the urban heat island effect but they are instead providing a cooling component.

## **0083**

### **Environmental Drivers of Urbanization: Footprints Bound for Town?**

Presentation type: Oral

Lezlie Morinière

*University of Arizona, Tucson, AZ, United States, Stockholm Environment Institute, Oxford, United Kingdom*

Humans are intricately connected to the environments in which they live. The connection is bi-directional: humans influence the environment and the environment affects humans. This connection is explored by focusing on the portrayal of human mobility and urbanization within scholarly literature. The Web of Science was queried to identify all pertinent documents and 147 articles were studied to determine the direction of the link and the inclusion (or not) of urbanization.

The results demonstrate that equal attention is paid to both directions of the environment-mobility

link. Forty percent of the articles identify urbanization as important, but 93% of those portray urbanization as a forcing on the environment, rather than a consequence of environmental degradation. The visible lack of scholarly exploration of environmentally influenced urbanization can be explained by academic silos that prevent transdisciplinary research and the disinterest of nation states to recognize the environmentally mobile. Understanding these relationships is paramount to the promotion of adaptation without eroding resilience or further degrading environments.

**0086**

### **Dynamics of Urban Water Consumption**

Presentation type: Poster

Christina Wong, Nancy Grimm

*Arizona State University, Tempe, AZ, United States*

Freshwater provisioning is a key ecosystem service for all cities. Global analyses of water consumption typically occur at the country level, yet city behavior, particularly for cities in the developing world, can differ greatly from national norms. The transition to sustainable water management will require improved understanding of how differing social, economic, and environmental conditions in cities influence urban water use. For 103 international cities, we assessed the influence of biophysical conditions, urban population size, urban population growth rate, city wealth, and national development context on urban water use. City wealth was the most important determinant of urban water consumption. Population size was not significantly correlated to urban water use. Precipitation and runoff were negatively correlated to urban water consumption. Water availability minimally affected water use in low and middle income cities, and was inversely related to water use in wealthier cities. In low and middle income cities water consumption is likely limited by economic scarcity not physical scarcity. However wealthier cities respond to environmental conditions by increasing water use under increased aridity. Lastly, consumption behavior at the city level differed from national expectations. Rapidly industrializing cities consumed water at quantities similar to cities in the United States, whereas water use in European cities resembled that of cities in low and middle income nations. As urbanization continues into the future, achieving sustainable urban living will require accurate evaluation of the dynamic relationship between cities and their regional environments.

**0088**

### **Climate Change, Globalization, and Urban Sustainability: Evidence from Coastal New Jersey**

Presentation type: Oral

Robin Leichenko

*Rutgers University, Piscataway, NJ, United States*

Climate change and globalization present significant challenges for efforts to achieve urban sustainability. Both processes are enhancing connections across space and time, such that actions taken in one part of the world have increasingly visible impacts in other parts of the world. The two processes are also magnifying risks and uncertainties, exacerbating vulnerabilities, and undermining resilience to many types of shocks and stresses. While much research has looked at the separate impacts of climate change and globalization, relatively little work has examined how these two processes intersect and interact within specific regions and sectors. This paper explores how climate change and globalization are influencing sustainability in urbanized coastal zones with particular emphasis on coastal New Jersey. While coastal zones have long confronted a multitude of development-related stresses including reductions in quantity and quality of freshwater supplies into estuaries, destruction and infill of wetlands, and dredging and development of inlet areas, climate change and globalization represent new and interconnected sources of stress. Under climate change, altered temperature regimes, shifts in the variability and seasonality of precipitation, increases in the frequency and magnitude of extreme events, and sea level rise, are together transforming the environmental baseline of coastal areas. At the same time, processes of globalization are contributing to expansion of port facilities, growth of shipping traffic, intensification of coastal property investment, and changes in the availability of

public funds needed to manage these complex, coupled systems. Drawing from a recently completed study of the economic impacts of climate change across a range of sectors in New Jersey, the paper examines how interacting stresses associated with climate change and globalization are affecting New Jersey's coastal zones and considers implications for efforts to promote sustainability.

**0090**

**Assessing Changes in Ecosystem Services Due to Land Use Change in Peri-Urban Areas: A Case Study in Taiwan**

Presentation type: Poster

Ying-Chieh Lee, Shu-Li Huang

*Graduate Institute of Urban Planning, National Taipei University, San shia, Taipei, Taiwan*

Ecosystem services include various provisioning, regulating, and cultural services provided by unmanaged natural or domesticated agricultural land. The agriculture land in peri-urban areas has substantially declined during the past decades in Taiwan, mainly because of the expansion of cities and infrastructure development. The impact of the decrease of peri-urban agriculture land on the entire urban environment by altering ecosystem services is enormous. In addition to food provisioning, the peri-urban agriculture land provides other significant ecosystem services, such as mitigating risks associated with climate change in urban areas.

To study the effect of land use change on ecosystem service of peri-urban agriculture, this research presents the results of emergy synthesis to evaluate ecosystem service changes in a sprawled landscape in the peri-urban area from 1995 to 2005. The western coastal plain of Taiwan is divided into grids of 1 km × 1 km to reveal the spatial variation of ecosystem services in the study area. The results indicate that the decline of provisioning services of agricultural land in the peri-urban area was particularly dramatic in paddy rice field. The diminished hydrologic regulating services of agricultural land also decreased infiltration during the study period and increased surface runoff. The emergy index for evaluating the declining cultural services is also developed and discussed.

**0091**

**Patterns of Urbanization and Vulnerability of Ecosystems in Lagos**

Presentation type: Oral

Peter Elias, Olatunji Babatola, Ademola Omojola

*University of Lagos, Lagos, Nigeria*

Catastrophic physical disasters in the geo-climatic past destroyed and disrupted ecosystems globally. Recent ecosystem disturbance and disruption are to a great degree attributable to human activities in the environment. The increasing concentration of human populations in urban centers has resulted in the increasing demand for natural resources and consequent transformations of the earth's systems without control and proper monitoring, especially in developing countries.

Lagos, with a population of over 14 million inhabitants, ranks among the fastest growing cities in the world. The issue really is not so much with the quantum of people but the pattern of consumption of natural resources. The fact that the city lies within the coast makes it unique and vulnerable with the influence of global warming. The main issues revolve around the linkages between social and ecological systems and the trade offs. How does land use patterns affect global environmental change and vice versa? How are these consequences being perceived, measured evaluated and managed? These research questions are the bases for the assessment of ecosystems' vulnerability in the coastal city of Lagos.

The study will determine the stock and depletion of environmental resources in Lagos due to increasing human populations using remotely sensed data and population censuses between 1960 and 2009. It will employ a geo-statistical technique to correlate population growth and ecosystem vulnerability. The study will also identify the impact of global environmental change, the most vulnerable groups and resources, and evaluate the ecological imprints of land use patterns and land use change. The study will show the nature, extent, magnitude and implications of land use patterns and land use change over the period with increasing human populations in Lagos to unravel the human dimensions of global environmental change in relation to the nature, future directions and implications for environmental management strategies and sustainability.

**0092**

**Understanding Urban Heat Risks: A Comprehensive Analysis of Heat-Related Mortality in Phoenix, Arizona (USA) 2000-2008**

Presentation type: Oral

Sharon Harlan, Gerardo Chowell, Juan Deplet, Emmanuel Morales, Diana Petitti, Darren Ruddell  
*Arizona State University, Tempe, AZ, United States*

Exposure to excessively warm weather is a significant threat to human health and well-being in cities around the world. The process of urbanization is strongly linked to increasing temperature through the formation of heat islands and these local effects are likely to intensify with future trends in global warming. Our research addresses the interplay between urban climates and socio-ecological systems that amplify or mitigate heat-related hazards for different socioeconomic and racial/ethnic groups in Phoenix, Arizona (USA). Phoenix is a Southwestern desert city where the average daily summer temperature is 105°F. Twentieth century human adaptations to climate, such as large-scale water projects, landscape transitions, and air conditioning, created a habitable environment for most of today's 4.5 million metropolitan area residents. Access to heat adaptative capacity, however, is unevenly available in the population due to historical and current inequalities in quality housing, education, income-generating employment, and associated differences in residential neighborhoods. This presentation will demonstrate greater vulnerability to chronically hot weather among certain population groups through an analysis of deaths in the Phoenix region over a nine-year period. It will summarize the incidence of deaths that are attributable directly to heat exposure and that may be indirectly related to behavior and underlying diseases during the warm season. Using geospatial analysis techniques, we also estimate the probability of dying from heat exposure in specific urban places. The study is innovative in probing all possible causes of heat-related deaths and predicting heat risks as a result of neighborhood-specific environmental and population variables, such as air temperature, land cover, percent living in poverty and percent Latino, as well as decedent characteristics, such as race/ethnicity, education, age, and gender. Using statistical models and spatial techniques, our analysis addresses large gaps in understanding the distributive impacts of climate and climate change at a sub-city or neighborhood scale.

**0095**

**Making Low Carbon England**

Presentation type: Oral

Mike Hodson

*SURF, University of Salford, Manchester, United Kingdom*

This paper addresses the question: What kind of low carbon England is currently being made? Specifically, its focus is on low carbon experimentation – with energy priorities and plans, with projects, with places and with governance – the importance of understanding how these different aspects of experimentation are negotiated and organised and the extent to which they coalesce to produce more deep rooted systemic change. In doing this, confluences of contemporary pressures are examined for the ways in which they create the conditions for experimentations that contribute, but do not determine fundamental societal, economic, environmental, spatial and governing transformations. Yet experiments – whether it is in how we are governed, how we are kept warm, or how the lights are kept on - are often designed, developed and undertaken by a variety of different social interests for a wide range of motivations from different positions and in physically different locations.

The paper examines the ways in which state intervention seeks to shape low carbon experimentation and uses examples from a global city, an old industrial region, and a medium-sized city to examine what these cases tell us about what a future low carbon England would look like. This is done to provide a way to assess the extent to which contemporary pressures may be understood as providing a context for fundamental transformation or a continuation of existing practices.

**0096**

**Climate Change Demands that We Work Co-Operatively: Fostering Multiscalar Collaboration and Co-Operation for Effective Urban Governance of Climate Change**

## **Adaptation and Mitigation**

Presentation type: Oral

David Simon, Hayley Leck

*Royal Holloway, University of London, Egham, Surrey, United Kingdom*

The UNFCCC Copenhagen summit (COP 15) fomented widespread disappointment due to the lack of binding and progressive commitments for curbing global greenhouse gas (GHG) emissions and facilitating adaptation in developing countries. Nevertheless, international co-operation and collaboration are widely emphasised as crucial ingredients for reaching critical global GHG emission reduction targets and facilitating adaptation to the unavoidable impacts of global environmental change (GEC), or more narrowly climate change. While such relations are vital, it is equally important to foster collaborative relationships at the regional, national and local government levels if GEC mitigation and adaptation measures are to be successfully and sustainably implemented. Insufficient attention has been paid to relational dynamics between multiple levels of governance as well as to related learning networks outside formal government structures with regard to addressing the myriad challenges associated with GEC.

This paper addresses these issues by exploring relations among neighbouring local authorities in South Africa's eThekweni metropolitan region and between these local authorities and higher levels of government and other non-governmental networks in the context of GEC and urbanisation. To date, most progressive climate change initiatives implemented by local government bodies and non-governmental agencies have largely been implemented autonomously without sufficient collaboration at the local level as well as in the absence of adequate provincial or national instruction and support. Moreover, national level focus is still predominantly mitigation-orientated, whereas local initiatives have emphasised the importance of both mitigation and adaptation. The likely implications for adaptation and mitigation actions are thus considered. Effective urban governance and the promotion of sustainability in the context of GEC and urbanisation require genuine collaboration and co-operation between multiple scales of governance, especially in terms of optimal social-ecological system functioning. The nurturing of productive relations between smaller governance scales could ultimately drive international level relations and climate change negotiations.

**0097**

## **Canadian Public Health Renewal in the Wake of SARS**

Presentation type: Poster

Lisa Gorman

*Carleton University, Ottawa, Canada*

Following the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak in Ontario, scathing criticism of Canada's health units emerged. SARS had tested our public health systems and had shown them to be woefully inadequate. All three major reports commissioned after the outbreak spoke of major shortcomings and proposed lengthy recommendations for reform. In the years after SARS, many changes were made at all three levels of government.

In just a few years, new initiatives that had been introduced in the wake of SARS were put to the test. In 2008 and 2009-2010, Canada suffered two more public health emergencies: the listeriosis outbreak that began at a food production facility in Toronto and the H1N1 novel influenza pandemic. Yet again, Canada's public health systems were chastised for serious deficiencies, forcing critics to conclude that this country had not yet learned its hard lessons from 2003. SARS was to be the great focusing event for public health in Canada and the one major opportunity to ensure vital systems were up to the task. Instead, this wake up call was never answered.

In addition to chronicling the weaknesses of the reforms introduced in the wake of SARS, this paper considers the role of federalism in the context of public health reform. In Canada, authority for public health management is shared between all three levels of government. This essay analyzes the political factors that have created a very particular, and very challenging, public policy context. Developing effective intergovernmental relationships and clear lines of jurisdiction should, at minimum, be a key theme for public health policy in the coming years. Further, effective public health reform requires a significant reassessment of the federal role in emergency public health response. Evidence from these three emergencies signifies a need for increased

federal leadership and oversight in public health emergencies.

**0098**

**Urban Growth Hotspots and Loss of Agricultural Land in China**

Presentation type: Oral

Li Jiang, Qingling Zhang, Karen Seto

*Yale University, New Haven, CT, United States*

China has experienced a rapid urban growth after the economic reforms and it is anticipated that China's urban growth will accelerate in the future (Liu et al., 2005). Despite the magnitude of the undergoing urban land transformation throughout the country, little is known about patterns of urban land use change at national and regional scales. By far, most research efforts have been devoted to studying the growth of individual cities. Nevertheless, many processes of environmental changes driven by urban growth may go beyond the boundaries of individual cities. This study examines the emergence and growth of urban clusters at the national scale. One of the goals of the analysis is to set the basis for discussion about the relationships among the physical expansion of urban clusters, agricultural land loss, and agricultural land conservation.

**0099**

**Off the Sand and onto the Asphalt: Does the Urban Heat Island Impact Desert Reptiles?**

Presentation type: Poster

Jeffrey Ackley

*Arizona State University, Phoenix, AZ, United States*

Lower per-capita energy use in cities may reduce the impacts of human activities at a global scale, but many environmental consequences of urbanization are concentrated at the local scale on humans, animals, plants, and ecosystem services within areas like Phoenix. The warming predicted by global climate change has already been exceeded in some cities by the urban heat island for over 50 years, and evolutionary thermal adaptation has been documented in urban populations of ants and fungi. Lizards are another group of cold-blooded organisms that are highly sensitive to changes of only 1-2 °C, and could serve as models for investigating the ecological ramifications of climate change. A seasonal tradeoff exists in that the UHI may broaden the times and locations a lizard can be active in winter, but the stress of rising summer temperatures may exceed their adaptive capacity. Predicted changes of lizard populations in warmer urban areas include: local extinctions of less heat-tolerant species, shorter hibernations, altered daily activity periods, and skewed sex ratios. This proposed research project will integrate socioeconomic data, the NSF Phoenix CAP-LTER climate research on the urban heat island, infrared satellite maps of Phoenix, and surgically implanted body temperature loggers used in reptile thermal ecology.

Exposure to biodiversity of all types has been shown to result in a number of psychological benefits. Reptiles also provide ecosystem services in the form of "green" pest control that reduces our need for insecticides. This study will include low-income neighborhoods in high population density areas of Phoenix with limited greenspace. Here, the UHI is strongest and both reptiles and humans with limited coping mechanisms are inequitably subjected to potentially lethal heat stress. Thus UHI mitigation will have multiple benefits for reptiles, and poor neighborhoods in Phoenix that have become almost entirely disconnected from the natural world.

**0100**

**Terrestrial Carbon Dynamics across Gradients of Urbanization**

Presentation type: Oral

Lucy Hutyra

*Boston University, Boston, MA, United States*

Most of our global population and its CO<sub>2</sub> emissions can be attributed to urban areas. The process of urbanization changes terrestrial carbon stocks and fluxes, which, in turn, impact ecosystem functions and atmospheric CO<sub>2</sub> concentrations. The relationships between urbanization and ecosystem function are governed by complex interactions and feedback mechanisms between human choices and ecological processes. Most research to date has

focused on urban carbon emissions, or separately on urban vegetation carbon exchange. Thus, we are currently lacking the empirical data and evidence of mechanisms linking urban patterns and ecosystem function that are critical to advance urban sustainability efforts. Using the Seattle, WA and Boston, MA regions as contrasting case studies, this work explores the relationships between terrestrial carbon exchange and land cover across urban to rural gradients. Micrometeorological, biometric, and remote sensing methods are combined to characterize the relationships between urban land covers and vegetation across gradients of urbanization.

#### 0102

##### **The Influences of Urbanization on the Thermal Environment and Residents' Life Styles in Jakarta, Indonesia**

Presentation type: Oral

Akinobu Murakami<sup>1</sup>, Shinji Kurihara<sup>2</sup>, Koji Harashina<sup>3</sup>, Shin Muramatsu<sup>4</sup>

<sup>1</sup>*University of Tsukuba, Tsukuba, Ibaraki, Japan,* <sup>2</sup>*Nihon University, Fujisawa, Kanagawa, Japan,* <sup>3</sup>*Iwate University, Morioka, Iwate, Japan,* <sup>4</sup>*Research Institute of Human and Nature, Kyoto, Kyoto, Japan*

In this study, we analyzed the features of urbanization in a suburban area of Jakarta, Indonesia and evaluated the impact on the thermal environment by using numerical simulation. First, land use change was analyzed by using aerial photos and satellite images during the last 25 years. Second, information on building shapes and materials, and in which year each house had been built, was collected in the study area. Third, the 3D-CAD model, to which the material and physical property data were added, was developed, and the surface temperature distribution was calculated through numerical simulations. Furthermore, two indices were used to evaluate the impact on the thermal environment: Heat Island Potential (HIP) was an index of the sensible heat flow rate on all surfaces in the area, and Mean Radiant Temperature (MRT) was one of the indices for the evaluation of thermal comfort. The results of analysis revealed that the land use conversion from a paddy field to urbanized land resulted in the mixture of urban and agricultural land uses in these 25 years. The materials and structures had gradually changed. The HIP value increased significantly as the land conversion proceeded and the housing materials were changed. The area of locations in an outdoor environment with low MRT value, which determined the comfort for human activities, had been decreased. Then, the residents in the study site were interviewed to understand their daily behavior. A field survey was conducted in order to understand the thermal comfort at the locations they used. The observation showed that the newly moved-in residents' life style was determined by the ill thermal condition. This indicated that the study site had caused urban heat island phenomenon and it had become an uncomfortable area through urbanization and landscape changes.

#### 0104

##### **Urbanization and Cultivated Land Changes in China**

Presentation type: Oral

Xiangzheng Deng, Qunou Jiang, Jiyuan Liu, Quanqin Shao

*Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China*

There have been growing debates on the impacts of urbanization on cultivated land changes in China. Intuitively, the fast growth of cities induced by the rapid urbanization would be a cause of cultivated land loss although cities have had the higher potential to inhabit and create more jobs for people than rural areas. Empirical and case-based studies have also shown that urban land expansion is highly related to the spatial heterogeneity of cultivated land changes. The widespread controversies over the impacts of urbanization on the loss of cultivated land have begun in recent years to make exploration of the relationship between urbanization and cultivated land changes a great concern of academics, land use planners, and decision makers in China. The objective of this study is to explore the relationship between the urbanization and cultivated land changes using the econometric model. Remotely sensed estimates show that built-up area in China increased by 3.43 million hectares from 1989 to 2005. In our study, patterns of four kinds of built-up areas, villages, small towns and middle-sized "cities" within county boundaries have

been recognized by over 2200 counties of China. The rates of built-up area expansions, however, are not spatially even. The sizes of villages in the rural area grow fast and the small towns grow slower. The middle-sized cities continue expanding at an even slower speed. The results indicate that the effects of the built-up expansion over various scales on cultivated land changes differ from each other. With the effects of other factors controlled, growth of "cities" larger than county seats use much less cultivated land than does the expansions of small towns or the rural residences, implying that urbanization may even slow down the declining trend of and save more cultivated land in China.

#### **0105**

##### **Augmentative Urban Heating Effect with the Rapid Urbanization in China**

Presentation type: Oral

Jiyuan Liu, Quanzhen Shao, Jianfeng He, Chaoyang Sun

*Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China*

The environmental effects of urban land expansion attract more and more concerns in China, among which the augmentative urban heating effect is one of the most important aspects. Intuitively, urban land expansion would increase the amount of impervious surface and consequently result in the underlying surface changes, and then destroy the balance of water and heat balance on the land surface. The urban heat island effect is the typical impact of urbanization on the climate in urban area, which is identified by the erratic rising of surface temperature inside and around the urban core areas. Our descriptive statistics have shown that the average temperature of large cities with significant expansion has risen by 2°C~3°C. The objective of this study is to explore and measure the augmentative urban heating effect with the rapid urbanization in China. The average urban heat island effect is calculated by subtracting the reference temperature from the records of surface temperature from the stations in the urban areas. The reference temperature is generated according to the observation from the stations in the rural area. The results show that the maximal average urban heating island effect intensity (HI) appears after the year 2000, and reaches the peak value (HI=1.167) in winter, 2007. HI in winter shows an obvious rising trend with an increase rate of 1.9 percent and keeps stable in other seasons, and the urban heat island effect in northern China is more evident than it is in southern China. The empirical research results provide a significant reference on which to clarify the feed-back mechanism and measure the magnitude of the effects of urban land expansion on climatic changes in China.

#### **0106**

##### **Building Urban Community Resilience to Climate Change that Couples with Development**

Presentation type: Oral

Shuaib Lwasa

*Makerere University, Kampala, Uganda*

Rapid urbanization in East Africa has brought forth both opportunities of new urban developments as well as challenges for ensuring quality of life and acceptable environmental conditions. Climate change has added another layer to urban challenges, exposing urban populations to various vulnerabilities to disasters, impacts on infrastructure, impacts on housing, water and energy. Increased urban hazards have subsequently led to a reduction in ecosystem services such as flood control, air quality control and influence of the micro-climate. These risks are adding another dimension to the urban development challenge and require renewed efforts in coupling development with climate change responses. In response, spatial planning is yet to fully embrace these challenges to mainstream vulnerability assessments and adaptation at the community level for out scaling. Such urban planning and development needs to be matched with the capability of the urban natural resource base of locales to mitigate the problems of extreme and variable climate-change driven events such as flooding and the management of the urban heat island. But it also needs to draw upon the experiential knowledge and various technologies, long referred to as coping mechanisms, which can provide entry points for mediation between development and climate change. This paper attests to the nexus between spatial urban planning

and its responsiveness to climate change by looking at practical strategies of building community based resilience that cascades to the city-wide scale.

**0107**

### **Institutions for Urban Governance and Adaptation to Climate Change in Kampala**

Presentation type: Oral

Shuaib Lwasa

*Makerere University, Kampala, Uganda*

In the realms of decentralizing urban governance lies the devolution of powers to local leaders who play a vital role in guiding decision making. Since 1997, when the decentralization policy in Uganda was launched, urban local councils have guided programs and policies with specific interventions to address development needs of the urban population. Due to decentralization, the urban governance space has widened to include a diverse group of actors, institutional arrangements and regulations for taking actions. Recently, global environmental change, particularly climate change, has added another layer to the already persistent challenges of poverty, urban environment and spatial development. Whereas none of these challenges can wait, the urgency of climate change responses is exerting pressure on urban councils that are unprepared, considering the dearth of knowledge that exists on climate change mitigation and adaptation. Actors in urban governance are inadequately knowledgeable about what climate change is, its impacts on cities, the future trends, mitigation and adaptive responses. Merging results of an action-research project and the recently concluded urban vulnerability assessment in Kampala, this paper attests to the complexities of governance by examining the Kampala City Council's response to climate change. Good lessons and practices of urban actor engagement to assess climate change risks and to develop local level strategies for climate change adaptation are emerging. Scalable neighborhood-level adaptation measures, valuable for policy responses at a city-wide scale, are also emerging. Actors including communities, municipal managers, policy makers, civil society organizations and researchers have demonstrated practical approaches in designing adaptation solutions that would bolster outcomes of urban policies. Although the impacts of climate change are manifest, political processes tend to be divergent on climate change action. There is at present, no policy addressing climate change despite initial steps to establish an institutional framework for climate change adaptation and mitigation.

**0108**

### **An Elemental Approach to Understanding Human Environment Interactions**

Presentation type: Poster

Jessica Corman<sup>1</sup>, Elizabeth Cook<sup>1</sup>, Rebecca Hale<sup>1</sup>, David Iwaniec<sup>2</sup>, Genevieve Metson<sup>2</sup>

<sup>1</sup>*School of Life Sciences, Arizona State University, Tempe, Arizona, United States,* <sup>2</sup>*School of Sustainability, Arizona State University, Tempe, Arizona, United States*

Humans alter urban biogeochemistry by deliberately changing material inputs and outputs, by inadvertently altering air, water, and soil conditions, and by changing material accumulation. Urban biogeochemistry can affect human activity by controlling city-wide policy regulations (i.e., pollution control), by regulating costs of manufacturing, agriculture, and transportation, and by affecting individual health and quality of life. Feedbacks between human activity and biogeochemistry are influenced by the relationship between elements (e.g. carbon (C) and phosphorus (P)) in the system components (e.g. building materials, foods, biota, soil). The relative amounts of elements in each component may have a unique elemental signature or stoichiometry. As technologies, regulations, built structures, values, preferences and economies change and develop, so does the stoichiometry of the city.

Here we present our initial work to construct an urban phosphorus budget and to couple it with two other biogeochemically important elements, C and N, to create the first stoichiometric budget of an urban system. Using the Central-Arizona Phoenix ecosystem as our case study, we suggest a framework to couple existing C and N budgets to our preliminary P budget. Our integrated Urban Stoichiometry Framework is important for understanding urban biogeochemical processes and cross-scale interactions. We are especially interested in exploring whether the biological

concepts of stoichiometry and nutrient budgets can be transferred to human-dominated systems. We suggest potential entry points for interdisciplinary applications with hope to motivate feedback and collaboration.

**0109**

**Environmental Tradeoffs in a Desert City: An Investigation of Water Use, Energy Consumption, and Local Air Temperature in Phoenix, AZ**

Presentation type: Oral

Darren Ruddell, Anthony Brazel, Juan Deplet, Patricia Gober, Susanne Grossman-Clarke, Sharon Harlan, Scott Kelley, Elizabeth Wentz  
*Arizona State University, Tempe, AZ, United States*

Three environmental challenges in an urban desert environment are temperature regulation, water scarcity, and energy demands. Phoenix, AZ, a naturally dry and hot region, has experienced rapid urban growth over the last fifty years which has strained environmental systems and raised the importance of water resource management. For example, studies have identified a pronounced urban heat island (UHI) effect which observes higher nighttime temperatures and generally higher but more variable daytime temperatures in the urban corridor compared to nearby native areas. A second challenge is water scarcity. Related to the UHI effect, research indicates that temperatures vary significantly within metropolitan Phoenix and that vegetation plays an important role in mediating temperature. Water intensive landscapes, such as turf grasses and trees, mitigate against warm temperatures through evapotranspiration in some areas of Phoenix, while soils of drought resistant landscaping store heat, exacerbating high temperatures in other metropolitan areas. A third challenge is energy demand because generating electricity for indoor cooling in Arizona requires a significant amount of water. This study examines 16 diverse census blocks groups within the city of Phoenix to investigate the complex relationship between water consumption, energy use, and local air temperature at the urban microclimate scale. Research hypotheses are: 1) drought-resistant landscaping uses more energy and at higher demands compared to irrigated landscapes; and 2) it is more efficient to use local water resources to support irrigated landscapes rather than drought-resistant landscaping when considering the indirect costs of energy generation, transmission, and consumption. This study utilizes four datasets for the year 2005 at the census block group level, which are: monthly water consumption; monthly residential and commercial energy use; vegetation fraction calculated via the Object-Based Image Analysis (OBIA) classification; and surface air temperature, which was simulated using the Weather Research and Forecast (WRF) climate model.

**0110**

**The Roles of Coupled Land and Water Institutions in Land System Change**

Author's preference: Oral

Sainan Zhang, Abigail York, Christy Mercer  
*Arizona State University, Tempe, Arizona, United States*

In desert cities, water and land institutions play an important role in shaping urban patterns and causing land system change. In this study, we explore the coupling of land and water institutions and their impact on land-use and land-cover (LULC) change in the metropolitan Phoenix area. Metropolitan Phoenix is one of the fastest growing cities in the US with 26 jurisdictions ranging from urbanized cities to rural towns. Through history, access to water has greatly influenced growth and land use decision-making in Phoenix. Water from northern Arizona and neighboring states, especially from the Colorado River, facilitated a rapid conversion from agriculture to urban land over the last six decades. We aim to answer three questions: (1) What types of land and water policies exist in the Phoenix area? (2) How are these policies coupled? (3) How do these policies affect LULC change? To address the first question we categorize and code institutional data from archival documents found at city clerk's offices, public websites, Municode, and the ASU Local Government Archives. We present a conceptual framework to highlight the range of potential connections between the land and water institutions within the socio-ecological framework, and then highlight the framework with cases from our institutional analysis. Finally, we link LULC from Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) historical

land use database to the institutional data. We conduct a spatial statistical analysis to evaluate the relationship between institutions to land system change. Our study enhances our understanding of influence of coupling and decoupling land and water institutions on land use decision-making and growth through space and time.

#### **0111**

##### **Rethinking Integrated Assessments and Management Projects**

Presentation type: Plenary

Robert Varady, Patricia Romero Lankao, Gregg Garfin, Maria Carmen Lemos  
*Udall Center, Tucson, Arizona, United States*

Science and management agencies have promoted interdisciplinary integrated assessment and management projects to address the potential threats to vulnerable water supplies, populations and environments posed by climate variability and change. At the core of these projects are scientist-practitioner research partnerships that seek to target solutions and enhance the exchange of information. Papers in this session will illustrate and evaluate such efforts, addressing topics such as co-development of science; decision support, and knowledge networks to address socio-environmental challenges; urban vulnerabilities to climate change; and challenges to effective resource management posed by tensions related to the multilevel nature of governance structures.

#### **0112**

##### **Constructing an UrCHIN: The Urban Climate/ Heat Island Network Project**

Presentation type: Oral

Nicholas Rajkovich, Larissa Larsen, Paul Coseo  
*University of Michigan, Ann Arbor, MI, United States*

Collecting a fine level of microclimate data allows us to determine how neighborhood design elements (density, impervious surface area, albedo, building configuration, presence of vegetation) contribute to variations in the urban heat island effect and suggest how specific design and urban planning strategies can reduce residents' exposure to elevated temperatures. Urban microclimate measurement poses substantial challenges (Oke, 2004). For example, the sampling methodologies utilized by the climatology and meteorology communities do not have the resolution necessary to support studies of neighborhood design. Fixed weather stations are expensive, require permission for installation, and are subject to vandalism and theft. Also, fixed stations cannot be deployed quickly to capture data from a heat wave or other unique climate events. While remote sensing can provide data on ground surface temperatures and albedo, timing, cost and resolution remain as significant limitations.

In an effort to overcome these measurement limitations, we have designed and constructed an Urban Climate/ Heat Island Network (UrCHIN) mobile measurement cart. This cart allows us to move from space to space within a city and assess the thermal and physical properties of different spaces. The construction of the mobile measurement cart builds on investigations of indoor climate at U.C. Berkeley (Benton, Bauman, and Fountain, 1990), and transitional space research at the University of Oregon (Rajkovich and Kwok, 2001; 2002; 2003). This piece of equipment should greatly enhance our understanding of urban microclimates. This paper describes the history of measurement assessment carts, design and construction of the UrCHIN comfort cart, the testing and validation procedures, and presents the results from a field trial in Ann Arbor, Michigan and Chicago, Illinois. Results from the field trials and recommendations for future versions of the cart are also presented.

#### **0113**

##### **Green Alley Assessment: Evaluating the Impact of Sustainable Infrastructure on Urban Heat Islands in Chicago Neighborhoods**

Presentation type: Oral

Paul Coseo  
*University of Michigan, Ann Arbor, MI, United States*

The paper investigates the impacts of urban heat island (UHI) mitigation techniques and how these efforts influence heat vulnerability. The purpose of this research is to identify and quantify

the most effective techniques to retrofit existing urban landscapes to reduce UHIs. Chicago's compact settlement form is often viewed as a desirable form from a sustainable development perspective. Yet, compact settlements contribute to UHIs which increase ozone levels, increases unwanted heat extremes and can produce dangerous impacts to residents' health and daily well-being. This phenomenon has been shown to more adversely affect low-income neighborhoods than resource-rich neighborhoods. Chicago's *Green Alley Program* is an example of a design intervention to mediate between the interactions of neighborhood scale human-climate systems. This research looks at how green transportation infrastructure programs affect neighborhood heat levels and how future green alley projects could target neighborhoods with greater UHI and more vulnerable residents. A quasi-experimental case control study methodology is used to investigate both the physical and social components of green alleys on Chicago's human-climate system. Six (6) different neighborhoods are used as case studies and locations to collect social and weather observations in one (1) green alley and (1) control (non-green) alley in each of those six (6) neighborhoods (a total of twelve (12) alleys for the study). Both quantitative measures and qualitative observations are used to better understand the human-climate system. This research is an important contribution to a growing body of knowledge about UHI mitigation strategies and will help quantify the impacts of Chicago's innovative program. It also contributes to our understanding of urban climate, especially in light of the consequences of climate change and variability growing as an important urban issue.

**0114**

**Urban Strategic Eco-Governance of Coastal Areas under Rapid Urbanization: A Case Study of Lianyungang, Jiangsu Province, China**

Presentation type: Poster

Yangfan Li<sup>1</sup>, Xiaodong Zhu<sup>1</sup>, Qiang Zhou<sup>2</sup>

<sup>1</sup>Nanjing University, Nanjing, Jiangsu, China, <sup>2</sup>University of Wisconsin-Milwaukee, Milwaukee, WI, United States

During the last three decades, China has witnessed a surge of urbanization, which leads to radical socio-spatial transformation in its coastal regions. Recently, such rapid urbanization increasingly challenges the environmental capacity of many China's coastal cities. On the basis of the theories of governance and urban ecology and the application of environmental Pressure-Status-Response model, we propose a conceptual framework of urban strategic eco-governance (USEG), which specially concentrates on policy/decision-making integration, capability building, and the mechanism of harmonious development. Through the case of Lianyugang, one of most important port cities in China with prominent wetland loss and urban sprawl, we explain how the framework can be applied to regional governance to help generate practical plans to integrate urban development with coastal wetlands ecosystem management. Finally, we examine how it works by examining some preliminary evidence.

**0115**

**Synergies and Conflicts between Mitigation and Adaptation: Reflecting on Real World Evidence from Cities in Europe, South East Asia and Australia**

Presentation type: Oral

Darryn McEvoy

RMIT University, Melbourne, Victoria, Australia

Responding to climate change has traditionally tended to be dichotomised between the two camps of mitigation and adaptation. Early emphasis was placed on the need to mitigate, i.e. reduce GHG emissions, with little consideration of adaptation objectives. However, recent influential reports have emphasised the need to recognise that even with mitigation efforts some degree of climate change is inevitable, and as such, societies need to be planning for adaptation to changes that are unavoidable. Moves towards considering both types of response as part of a more coherent and integrated strategy represent an explicit acknowledgement by decision makers that both mitigation and adaptation are important in seeking to reduce climate risks. However, academic debate continues on the potential (or even desirability) of such a marriage of agendas. Understanding the linkages, synergies and conflicts between adaptation and mitigation

measures therefore poses a considerable challenge for decision makers. The presentation will illustrate the main conceptual differences between the two approaches, including detailing some of the key synergies and conflicts as manifested in the context of the urban environment. Using this conceptual framework as a foundation, analysis will then turn to a consideration of what this actually means in practice; using evidence from urban conurbations in Europe, South East Asia, and Australia to showcase where synergies and conflicts can arise. The concluding strand of commentary will then comment on the comparative analysis of cities in the different world regions in order to illustrate that an already complex picture is further complicated when differing climate regimes, exposure to hazards, governance structures, planning systems, and even population dynamics, are all thrown into the mix.

**0116**

**Assessing the Impacts of Urban Expansion on Net Primary Productivity of Terrestrial Vegetation in China from 1992 - 2008**

Presentation type: Oral

Chunyang He

*College of Resource Sciences & Technology, Beijing Normal University, Beijing, China*

China has undergone massive urban expansion due to steady population increase and fast economic increase since 1978. Although urban land still accounts for a small fraction of China's land surface, it induces dominant disturbances to the natural ecosystem in China. This paper tries to assess the impacts of urban expansion on the ecosystem by using multi-resource remotely sensed data and the ecological model. First, the urban expansion information in China from 1992 - 2008 was obtained from the global Defense Meteorological Satellite Program's Operational Linescan System (DMSP/OLS) Nighttime Lights Time series data (version 4). Second, the Net Primary Productivity (NPP) was used as an indicator to reflect the ecosystem functioning with the average annual NPP in China calculated by using one ecological model. Finally, the losses of the NPP in the expanded area from 1992 - 2008 were assessed. The results showed that the DMSP/OLS Nighttime Lights Time series data (version 4) is helpful to understand urban expansion in China over the last two decades. It also suggested that massive losses of NPP in China have already been induced by the fast urban expansion in China. It is time for China to start the transformation from past "urban sprawl" to future "smart growth" to maintain its ecological security and food security.

**0122**

**Water and Climate Change in Border Cities: Binational Collaboration toward Adaptive Governance**

Presentation type: Oral

Margaret Wilder

*University of Arizona, Tucson, AZ, United States*

Both theoretical and empirical advances are necessary to understand the role of collaboration in developing adaptive water governance in a binational context. This paper presents preliminary findings from a series of five linked case studies in the U.S.-Mexico border region on urban water vulnerability and adaptive governance. From 2008 to 2010, a binational and multidisciplinary team of researchers (University of Arizona, Colegio de Sonora, Universidad de Sonora, National Center for Atmospheric Research, among others) has worked in fivesites within the Arizona-Sonora region to assess urban water vulnerabilities in the context of climate variability and climate change. The project's objective has been to identify major vulnerabilities affecting water in urban areas and—working with water managers and disaster relief planners through a series of stakeholder workshops—to promote and develop institutional capacity for more adaptive management of water resources via increased incorporation of “climatic thinking” in institutional operations and practices. The project also examines the particular challenges of collaboration toward adaptive governance within a binational context. Research was funded by a NOAA Sectoral Applications Research Program grant, the Inter-American Institute for Global Change Research, and the NOAA Climate Assessment of the Southwest Program.

**0123**

## **Urban Ecotone: Habitat Functions of an Urban River - Study Case in Megacity Taipei, Taiwan**

Presentation type: Oral

Yu-Fang Lin

*Department of Environmental Planning, Leibniz University of Hanover, Hanover, Germany*

In the last decade many studies on urban areas focus on integrated river basin management (IRBM) to evaluate and simulate the ecological services of urban rivers. Under the pressure of rapid urbanisation and climate change, uncertainty and flooding risk seem to be the core issues in coastal urban areas. Taipei, which is located in the subtropical zone, has typical developing characteristics of many of the world's mega-cities.

As a dynamic open ecosystem, cities face uncertain factors and disturbances that may influence river ecosystems and urban environments through natural changes and human activities. Climate change and related hazards such as floods and storms occur easily and have many negative consequences (i.e., threaten resources and infrastructure). However, the traditional techniques for flood prevention have established water control works (e.g. embankment, straightened river channel), but have not helped to prevent the flooding and raises economic costs.

Consulting the theories of landscape ecology and river management, this study aims to explore the habitat functions of urban rivers with the concept of "urban ecotone". The research establishes an evaluative framework and simulation of flood prevention incorporating landscape structure and land uses. The criteria may not only contribute to the flood directive and river management, but also to the sustainable development indicators in coastal urban areas. The main findings of this study may help to indicate the condition of habitats, which reflect the health of biodiversity in Taipei City. Accordingly, strategic rehabilitation may contribute to maintaining and improving ecosystem services.

**0124**

## **Factors Shaping Responses to Climate Change in Three Latin American Cities**

Presentation type: Oral

Patricia Romero Lankao, Mercy Borbor Cordova, Georgelina Hardoy, Griselda Günther  
*NCAR, Boulder, CO, United States*

Cities are already responding to climate change. Yet, the research is lagging behind this new trend, and has tended to focus on cities from the North and on 'leaders', those cities which have been first-movers on the issue of climate change (e.g. London, New York, Durban) with the result that we know little about the particular challenges in 'ordinary' cities and in cities from the South. This paper covers the gap by presenting results of a project exploring a) how Buenos Aires, Mexico City and Quito, three cities from Latin America that have not necessarily been first movers, are responding to climate change both on the mitigation and adaptation domains; b) the institutional factors (i.e. knowledge, institutional capacity) shaping their ability to respond; and c) how these factors play out in developing country contexts, characterized by centralized control by the national governments and institutional fragmentation of local structures and political participation.

**0125**

## **Has "Ecological Modernization" Improved the Sustainability of Non-Market Values?**

Presentation type: Oral

Patricia Romero Lankao, Griselda Günther  
*NCAR, Boulder, CO, United States*

This paper will draw on evidence from Mexico City and Buenos Aires to explore whether the neoliberal reform and the theories it draws from (ecological modernization, neoclassical economics), **have helped improve both sustainability, including the sustainability of non-market values, and resilience of urban water systems.**

**0126**

## **Anthropogenic Afforestation and Ecosystem Services: How Urban Vegetation Affects Ecosystem Structure and Function**

Presentation type: Oral

Nancy Golubiewski

*LCR, Palmerston North, New Zealand*

The non-built component of urbanization -the landscaped plantings or green infrastructure -can

impose major ecological changes in terms of transforming land cover structure and ecological function. This is especially true when landscape preferences draw on biomes markedly different from the local environment. Moreover, when the resource base of the ecosystem under transformation is more limited than the originating ecosystem, material and energy flows can undergo radical shifts. One such example occurs in the semi-arid grasslands of the Front Range of Colorado (USA), which constitutes the largest area of human settlement adjacent to the Rocky Mountains; it extends southward from Cheyenne, Wyoming and Fort Collins, Colorado through Denver and Colorado Springs to Pueblo along the eastern edge of the Southern Rocky Mountains (~40°N, ~105°W). Since the mid 1800s, dryland and irrigated farming have transformed much of the region's natural grasslands. Urbanization followed in the early twentieth century and increased markedly mid-century. Throughout the Denver-Boulder metropolitan area (the largest conurbation of the Front Range), landscaping decisions in the built environment have transformed the ecology of this former semi-arid grassland. A matrix of lawns and planted trees carpet the once rolling plains at the base of the Rocky Mountains. What are the structural and functional characteristics of this introduced forest? This presentation characterizes the structure and composition of the introduced multi-strata urban forest. It further considers the resultant shifts in ecological function, including requirements and provisioning of ecosystems services, with a focus on carbon, water, and energy.

**0127**

### **Spatial Distribution and Socio-Economic Contexts of Urban Tree Canopy Cover in Bloomington, Indiana, USA**

Presentation type: Oral

Sarah Mincey, Michael Cox, Richard Thurau, Rinku Roy Chowdhury, Mikaela Schmitt-Harsh  
*Indiana University, Bloomington, IN, United States*

Increasing urban populations and development have resulted in a decline of urban forests. This is problematic given that residents depend upon urban forests' ecosystem services for maintenance of livable urban environments where globally, most people reside. Urban political ecologists and urban planners have addressed urban land use and land cover change with a focus on urban tree canopy cover (UTCC), finding influential factors to be socio-economic and demographic characteristics of urban residents (with reference to environmental justice issues), institutional factors, such as zoning, and biophysical factors, including stream density and slope. This research has generally addressed large, first-class cities as case studies or specified models based on large sample sizes. Therefore, exploration of factors influencing urban forest structure in mid-sized municipalities is warranted for conservation management and policy implications. This paper addresses research to develop and implement a replicable methodology to classify UTCC in addition to explaining its extent and pattern in Bloomington, Indiana, USA. Thus we ask, what is the spatial distribution of UTCC in this mid-sized, Midwestern city? What factors influence the extent of UTCC at multiple spatial scales in Bloomington? What is the relative influence of institutional zoning in the context of social and biophysical variation on UTCC at different spatial scales in the city? To determine UTCC, we utilized ERDAS IMAGINE 9.2 software to conduct a maximum likelihood supervised classification of the 2008 aerial photographs of the city from the National Agricultural Inventory Program (NAIP). The 2008 NAIP imagery includes for the first time an infrared band; additional benefits for replication include high spatial resolution of one meter and free availability to the public. Once classified, UTCC's extent and pattern in Bloomington is explored through correlation analysis with exogenous variables including socio-economic, biophysical, and institutional factors with emphasis on the influence of zoning.

**0128**

### **An Interdisciplinary, Multi-Scalar Framework for Understanding the Social-Ecological Dynamics of Residential Landscapes**

Presentation type: Oral

Kelli Larson, Elizabeth Cook, Sharon Hall, Colleen Strawhacker  
*Arizona State University, Tempe, United States*

Human management of land is a primary cause of environmental change and ecosystem functioning. The maintenance of turfgrass lawns in residential and other areas now constitutes the largest irrigated crops in the U.S., contributing to high rates of water and fertilizer use. Our

ongoing project in Central Arizona -Phoenix aims to advance integrated knowledge about residential landscapes as important components of urban ecosystems by examining how cognitive factors (cultural values, beliefs, and norms) and structural forces (social attributes, institutions, and urban form) drive various yard management practices, which in turn, affect the ecological structure, functioning, and benefits of yards. Applying a multi-scalar framework, we employ a case study approach to examine and explain how cultural, social, and political-economic forces operate at the household to regional scales to affect urban ecological structure and the ecosystem services derived from them. Our integrated analysis of social survey and observational field data from diverse neighbourhoods addresses: how do assorted human values, ecological worldview, and landscaping priorities affect multi-faceted landscaping practices, and how does the ecological structure of yards impact water and chemical applications? While personal values most influenced land cover and herbicide use, the extent of 'mesic' grass was negatively related to pesticide use, challenging the notion of the lawn as environmentally detrimental compared to alternatives such as 'xeric' rock yards. However, the influence of environmental and other values was limited, partly due to the pre-existing structure of yards (e.g., no to all grass) as well as other constraints on individuals' decision, including legacy effects from past land-use decisions and social norms codified by Homeowner Associations at the neighborhood scale. As a whole, this ongoing research reveals the complex dynamics involved in the production of residential landscapes and their ecological and social consequences for current and future generations.

**0129**

**Is there a metabolism of an urban ecosystem? An ecological critique**

Presentation type: Oral

Nancy Golubiewski

*LCR, Palmerston North, New Zealand*

The energy and material flows of a city are often described as urban metabolism by ecological economists, industrial ecologists, and engineers. This concept draws parallels to the biology of individual organisms, yet the analogy is not necessarily clear or accurate. The concept of urban metabolism is examined for what it does-and does not-offer to a comprehensive, integrated understanding of urban ecology. The research questions pursued include: How well do these frameworks integrate the socioeconomic and ecological processes of a city? Does the analogy offer appropriate scale of reference, or do ecosystem ecology and the concept of the urban ecosystem offer something more? Through a close reading of the literature, the analogy is examined using the scientific principles it invokes. The need for and possibilities of achieving an integrative framework for modern studies of the urban environment are considered, and the audience is welcome to participate in an interactive discussion about problems of semantics as well as to explore appropriate ways forward.

**0133**

**Multiple Time Scales Analysis of Temperature and Numerical Simulation of Urban Meteorological Element Changes in Shanghai**

Presentation type: Oral

Jiong Shu<sup>1</sup>, Qianqian Shen<sup>1</sup>, Ying Gu<sup>1</sup>, Chi Zhang<sup>1</sup>, Xingheng Wang<sup>2</sup>

*<sup>1</sup>Key laboratory of Geographic Information Science, Ministry of Education, Shanghai, China,<sup>2</sup>The computer Center, East China Normal University, Shanghai, China*

We use statistics and numerical simulations for understanding how is climate affected by human activities in Shanghai. Using a Mexican hat form wavelet transformation we investigate yearly average temperature from 1873 to 2008, in order to gain oscillating structure and periodic characteristic of the Shanghai climate at multiple scales. The results show that, there is an

obvious increasing trend in Shanghai annual temperature, especially after 1980s as it rose faster than ever before. The warm period of 1940s and the cold period of 1960s constitute the main features of temperature changes in 20th century in Shanghai. The influence of temperature variations between urban and suburb areas caused by urbanization is significant to a certain extent.

To gain a further understanding of above results, a numerical simulation was then performed to evaluate the impact of urbanization caused by land-use change and energy consumption on meteorological factors. We use the urban land cover state in 1993 and 2006 to represent two time periods of urban development. As the urban area expanded, the function of urban canopy model and the emission of anthropogenic heat were considered as the typical characteristics of metropolis; four sensitivity analysis experiments were designed, accordingly, with WRF-UCM modeling system finally simulated three episodes. Results showed that urbanization not only produced the obvious heat island and dry island effects, but also decreased wind speed at urban site. Data shows the daily average temperatures in downtown area and rural area were increased by 3.5°C and 2.3°C, respectively, while daily average relative humidity were reduced by no less than 20% and 14%. Meanwhile a decrease of daily average wind speeds was also found by a maximum of 1.5m/s.

**0134**

**Toward More Nuanced Urban Climate Governance: Analyzing the Terrain of Interstitial Spaces**

Presentation type: Oral

Pamela Robinson, Christopher Gore  
*Ryerson University, Toronto, ON, Canada*

Ongoing efforts by local governments to mitigate greenhouse gases are often tracked through a milestone process. In Canada, a new and similar milestone process is being developed for climate adaptation. Yet research into Canadian local government response reveals that activities and actions are underway which the milestone process neither identifies nor tracks. Our central argument is that political and bureaucratic decision-making and the relationship and network building that takes place in these interstitial spaces between milestone progress must be identified, traced and understood because of their important implications for urban climate governance. The milestones' reporting tells us what is happening and when but it is the answers to the how, why and by whom questions from which our understanding of urban climate governance is more meaningfully informed.

This delineation and analysis of the interstitial space will be explored in the context of Canadian local government response to climate change. In 1999, the first Canada-wide survey of municipal mitigation action was conducted surveying all municipalities with populations greater than 10,000 people (392 local governments). In spring 2010, this survey is being repeated and expanded to include adaptation activities as well. Using data from this second survey this paper proposes a new governance framework for understanding municipal action.

Actions will be subject to two forms of classification that shed light on activities in between milestone completion. By classifying actions as initiatives, outputs and outcomes, we are able to shed light on the politics and processes that lead to the actions taken by local government.

Furthermore, by also evaluating whether actions taken are land-use planning; technical; relationship building or independent institutional responses, we are able to delineate how the politics of implementation vary across this range of mitigation and adaptation actions and thus offer a new framework for understanding urban climate governance.

**0135**

**What current vulnerability challenges hold for the future in Latin American cities. Results from ADAPTE in four Latin American Cities**

Presentation type: Oral

Patricia Romero Lankao, Mercy Borbor Cordova, Olga Wilhelmi  
NCAR, Boulder, CO, United States

Urban populations in Latin America play a crucial role, not only as sources of atmospheric emissions, but also as epicenters of risk from exposure to such hazards as weather and air pollution, which climate change is expected to aggravate. I will present results from ADAPTE an IAI-funded study that investigates the mortality effects of vulnerability and exposure to weather-related stresses and air pollution in Buenos Aires, Bogota, Mexico City, and Santiago. The populations of these cities are already at risk from exposure to high levels of pollution, exceeding WHO standards. Although a relationship exists between air pollution and weather, the way in which both correlate to affect the health of urban populations differs by city and changing weather conditions. Health impacts, which are also the result of a multidimensional set of factors defining population's vulnerability, differ across and within cities. Combining the *relative risk* with a *multi dimensional vulnerability index* we show for instance that a) populations with lower levels of socioeconomic status lack the assets and access to information to cope with hazards; b) yet because of factors such as age and the high levels of air pollution at the city level, wealthy districts are not spared from the impacts of those hazards. The presentation will shortly focus on some achievements and challenges. For instance it has been difficult for us to work with the multiple and mismatching scales inherent to hazards and social processes. The project is integrated only in that the disciplinary teams addressed diverse angles of the same research questions. The created knowledge emerged from the interplay between theory and local contexts. However, we did not have the resources to fully learn and take advantage of each other's concept, language and local contexts.

**0136**

**Rethinking Sustainability Indicators in Building Codes: The Case of The Leadership in Equity and Design**

Presentation type: Poster

Sonay Aykan

New Jersey Institute of Technology, Newark, New Jersey, United States

The last two decades have witnessed the emergence of "sustainability" as a critical concept in decision-making processes in architecture, urban planning and energy use. Most recent definitions of sustainability refer to the synergetic interactions among economic, social and environmental aspects. Different indicators have been developed to measure sustainability by looking at each of these aspects. Building codes in different countries, however, generally incorporate indicators of environmental aspects only. These codes adopt a delimited set of indicators to measure environmental sustainability by mostly focusing on energy unit consumption and ignoring the broader scale of the environment, such as aggregate energy use of buildings, buildings' location in the city, use of infrastructural services and access to public transportation. These codes usually omit basic design elements that regulate size and volume of rooms, and promote multipurpose spaces; while they adopt a technological fix as their basic tool for attaining sustainability. Many building codes also fall short of addressing the synergetic relationships among social, economic and environmental indicators, by not addressing criteria of affordability, public access and effects on the social environment.

To address these weaknesses in building codes, this paper adopts Lutzenhiser's definition of energy consumption and argues that a different set of indicators can be integrated into building codes based on three major approaches: life-style analysis, compact city approach and life-cycle analysis. I will investigate the Leadership in Equity and Design (LEED) to determine the kinds of indicators it includes and excludes and to suggest additional indicators that would measure features of the environment at the scale of interior spaces and the city.

**0138**

**Vulnerability to Climate Variability on the US-Mexico Border**

Presentation type: Oral

Bernardo J. Marquez Reyes

*Arizona State University, Tempe, United States*

Cities have become a focus for adaptation and vulnerability research for two reasons: (1) most big cities are located in coastal areas exposed to sea-level rise, and (2) half of the world population already lives in urban areas. The vulnerabilities and capabilities of cities in the interior have not been explored adequately in the climate change literature. And, while cities in developed countries have initiated mitigation and adaptation responses to climate change, most cities in developing countries have not. In this article, I explore the vulnerability to climate variability of the US-Mexico border by using the cities of Nogales, Arizona and Nogales, Sonora as a case study. I focus on the following questions: What is the spatial distribution of vulnerability, and what is the role of the border in decreasing or increasing vulnerability? How can adaptation policy support the current priorities of the local governments? What kind of coordination should occur to address hazards resulting from climatic variability? I use a Geographic Information System to analyze the distribution of flood exposure and to evaluate the socioeconomic characteristics that define sensitivities to loss and capacities to minimize risk. The result is a vulnerability index that estimates flood vulnerability using a set of indicators that are comparable between cities on both sides of the border. Planners and local government officials were interviewed to validate the vulnerability model and to assess collaboration efforts between the cities. This research contributes to the field in two ways: (1) it provides a framework for assessing and comparing vulnerabilities at the city level between nations, overcoming issues of data incompatibility, and (2) it sheds light on the institutional arrangements of border cities and their role in affecting vulnerability. The results of this research can inform efforts to address climate hazards in other cities around the globe.

**0139**

**Changing Ecosystem Services by the Invasion of Alien Species in the Coastal Zones. Case Study "Rosa rugosa Invasion on the Island of Sylt"**

Presentation type: Poster

Tatiana From<sup>1</sup>, Karsten Reise<sup>2</sup>, Felix Mueller<sup>1</sup>, Benjamin Burkhard<sup>1</sup>, Wilhelm Windhorst<sup>1</sup>  
*1Christian-Albrecht University, Kiel, Schleswig-Holstein, Germany, 2Wadden Sea Station AWI, List, Sylt, Germany*

The Wadden Sea ecosystem, forming the largest unbroken belt of tidal sand and mud flats, is one of the world's most outstanding coastal regions with its natural dynamic processes, high primary and secondary production and diverse coastal and marine communities of flora and fauna. It provides rich and diverse habitats for migratory water birds, as well as important nursery and spawning area for many migrating fish between marine and fresh waters.

Recently, the Wadden Sea ecosystem experienced increased pressure by biological invasions of non-indigenous species. Together with climate change and world trade intensification new processes are now rapidly restructuring Wadden Sea communities (Reise 2008). Research in the framework of the Coastal Futures Project was conducted on one of the Wadden Sea islands where the Japanese rose (*Rosa rugosa*), planted first in urban areas, spread vigorously to the dunes and coastal grassland. For assessing the effects of the Japanese rose invasion the concept of ecosystem services was used. The application of the ecosystem services concept implies the study of invasive species' impact on the provisioning of the services by assessing the type, quality and state of the services. Compared was the state with no or little impact of the alien species taken as a reference state of the ecosystem with changes of the system's indicators under the influence of invasive species. Relevant groups of services were selected and reference

state of the ecosystem reconstructed. From the results it is concluded that the invasion of alien species in the Wadden Sea ecosystem is associated not only with negative effects on the quality and structure of the ecosystem services provided, but also with certain positive changes in the ecosystem.

**0140**

**Suburbanization Extension of Beijing's Mass Rapid Transit System: Social Equity and Sustainability Implications**

Presentation type: Poster

Liou Xie

*Arizona State University, Tempe, AZ, United States*

Suburbanization is an ongoing and accelerating process in China, changing rapidly in its characteristics. In the case of Beijing, suburbanization has been fueled by land/property market reforms, surging housing prices in the center, rapidly increasing car ownership, private developers' behavior and recent intensive development of the Mass Rapid Transit (MRT) system catalyzed by the "Olympic Shock" and a follow-up "Beijing's Public Transport City 2015" plan. My study aims to better understand the relationship between suburban extension of MRT lines and suburban access and sustainability issues. In particular, the middle classes in Beijing are, by financial circumstances, settling in the suburbs, creating new dynamics. I will explore the impacts of rapid transit accessibility on the middle-class suburban communities in terms of: i) built form; ii) mode share; iii) travel behavior, and evaluate the magnitude of sustainability benefits generated by rapid transit accessible suburban communities versus non rapid transit accessible suburban communities.

**0144**

**Composting Toilets, Urban Infrastructure, and Sustainability: Complement or Contradiction?**

Presentation type: Poster

Diane Austin, Francisco Trujillo

*Bureau of Applied Research in Anthropology, School of Anthropology, University of Arizona, Tucson, AZ, United States*

The purpose of this presentation is to explore the role of composting toilets in the effort to address serious infrastructure shortages in arid urban areas under conditions of climate change and in an era of "sustainability." The presentation will center on the first three-years of a research and outreach initiative to develop, install, and evaluate composting toilets as an alternative for residents of marginal colonias in Nogales, Sonora that lack water and sewer services. The presentation will describe the origins of the initiative within Nogales; the initial framing and ongoing reframing of the initiative by and for local residents, U.S. and Mexican federal government officials, non-governmental organizations, and academic institutions; and the interactions among residents, program leaders, and policymakers during the three-year period. The presentation will include materials developed throughout the project, monitoring data and results, and a review of lessons learned. It will end with a discussion of implications for other urban areas along the U.S.-Mexico border, in the interior of each country, and elsewhere.

**0151**

**Urbanization and Extreme Weather: Vulnerability of indigenous people to windstorms in Ibadan, Nigeria**

Presentation type: Oral

Ibidun Adelekan

*University of Ibadan, Nigeria, Ibadan, Oyo state, Nigeria*

The urban form is a reflection of processes which reproduce risks in new contexts, amplifying their magnitude and intensity in addition to increasing the numbers of vulnerable places and people (Hogan and Marandola, 2007). Changing urban forms combined with exposure to greater frequency and intensity of natural hazards consequently modify risk and vulnerability patterns. Although globally and in sub-Saharan Africa much attention is placed on major extreme events such as droughts, floods, and tropical storms; severe local winds are one manifestation of extreme weather events that have become more frequent and increasingly important to human security. It is projected that with global warming windstorms will become more extreme and frequent. Increasing occurrence of severe winds associated with rainstorms generated by line squalls and local thunderstorms is becoming an increasing threat to communities across Nigeria. The paper examines the vulnerability of indigenous urban populations to wind hazards in relation to changing patterns of urbanization, land use and wind climate in Ibadan, the largest traditional urban centre in sub-Saharan Africa. Assessment of wind-induced damage to buildings in eight affected districts and the vulnerability characteristics of residents of wind-damaged houses were undertaken through field survey and administration of a purposely-designed questionnaire following a major windstorm event in March 2008 which induced widespread social and economic damage to mostly indigenous population of the high-density traditional core area of the city. Findings of the study provide insights into changing climate risk patterns and emerging vulnerabilities of indigenous urban populations in traditional cities. The role of risk perception by indigenous population and local institutions in adaptation planning and risk management is also examined

**0153**

**Built-up Land-cover Change Monitoring by Remote Sensing of Urban Area in the Pearl River Delta Based on GIS**

Presentation type: Poster

Weiping Hu<sup>1</sup>

*1School of Geography, Guangzhou, Guangdong, China, 2School of Geography and Earth Sciences, Hamilton, Ontario, Canada*

The urbanization of the PRD in South China developed greatly in the past decades. We use Landsat imagery and CBERS-02 imagery to monitor the built-up land-cover change from 1988 to 2008. The methods of extracting built-up land-cover change information were discussed. The results showed that the built-up land-cover changed greatly. The spatial features were analysed in detail. The inner circle and outer circle spatial structure kept relatively stable. The core-oriented development and transportation-oriented development are significant. And the spatial distribution of the growth amount of built-up area differs from the spatial distribution of the growth speed of the built-up area greatly. The paper finally discusses the main driving force of urban built-up land-cover change in the PRD.

**0154**

**Cultivating plant biodiversity in user maintained green space: The case of community gardens in Los Angeles, CA**

Presentation type: Poster

Lorraine Weller, Darrel Jenerette

*University of California Riverside, CA, United States*

Community gardens, urban spaces gardened by a group of people, provide important ecosystem services to urban residents, such as food production and recreational space. Biodiversity, an indicator of ecosystem functionality, has been poorly researched in user managed urban green space, and no clear urban mechanisms for diversity have been established. We asked, "What environmental and socioeconomic mechanisms impact community garden plant species diversity?" Thirteen gardens throughout the County of Los Angeles were visited for a complete plant species survey between July-September 2009 and January-March 2010. All purposefully planted species were recorded in each individually owned garden plot. Information on garden age, ethnicity, and socioeconomics was also collected. Over 500 unique species were recorded, and each garden had an average of 85-140 species with a few exceptions. The number of planted species in each garden had a slight negative or no relationship with area. In other words, species density in city habitat islands may not be as closely tied to area as island biogeography theory suggests. Rarefaction curves based on plot diversity in fully inventoried gardens did not reach an asymptote in two gardens in the highest income neighborhoods, but consistently reached an asymptote in low income gardens used primarily for food. Since no further species can be identified, this analysis indicates an abundance of unique species and high  $\beta$  diversity in gardens not focused exclusively on food production. An ordination plot based on the Sorensen's similarity matrix grouped all Hispanic gardens together, indicating that cultural identity may also be a key driver of plant species diversity. The results of our study highlight the importance of income, cultural identity, and local plant uses on  $\alpha$  and  $\beta$  plant diversity in urban community gardens and has implications for production of urban ecosystem services in user managed urban space.

**0155**

**Recycling and Reuse of Hazardous Waste is Practical?: A Case Study of Waste Pickers in Phnom Penh, Cambodia**

Presentation type: Poster

Gina Chhun, Chuthatip Maneepong  
*Arizona State University, Tempe, AZ, United States*

The handling of waste including recycling, collection, treatment and disposal is crucial to providing a cost-effective waste management system that is able to reduce public health and environmental risks. Proper handling of hazardous waste remains severely limited in urban cities if the industries and hospital producing it does not take responsibility in developing countries.

Recycling and reuse in Phnom Penh is an active industry in Cambodia, driven by an informal network of waste pickers, waste collectors, and waste buyers.

This paper examines an environmental situation of hazardous waste in Phnom Penh, and socio-economic background of waste pickers and their current practices on handling hazardous waste through observations on children and adult waste pickers at the dump site and other sites, and surveys done with waste pickers, and interviews with governmental officials, local non-government organization agencies and other key stakeholders in Phnom Penh.

This paper reports the factors contributing to or hindering safe and cost-effective management and disposal hazardous waste, and health, economic and social impacts from current practices, in the context of a wider literature review in developing countries. The paper describes key factors (e.g. limited awareness on health impacts, lack of proper health protection tools and lack of health guidelines) and impacts (e.g. chronological sickness, risks to serious communicable diseases and disability). However, the government and other related agencies put an effort to establish sanitation handling, treatment, and disposal system. The paper raises the question of whether handling of hazardous waste by informal waste pickers is practical or whether it increases health risks and environmental degradation, such as burdening local governments with communicable diseases, disability and financial burdens.

0160

**Moving beyond predictions: an integrative approach to downscaling and robust decision making**

Presentation type: Oral

Katja Brundiers<sup>1</sup>, Gregg M. Garfin<sup>2</sup>, George Basile<sup>3</sup>, Rosalind Bark<sup>4</sup>, Ray Quay<sup>5</sup>  
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The Phoenix Metropolitan Area has experienced a combination of sustained drought, rapid population growth, and a burgeoning heat island that puts it at 'ground zero' for climate change impacts on water supplies. For scientists, questions related to climate change, adaptation and governance present formidable sustainability challenges - conglomerates of complex issues calling for innovative problem-solving processes that lead to robust solutions. For practitioners, acceptance of hydroclimatic non-stationarity prompts interest in exploring alternatives to the 'predict-plan-build' paradigm, in order to build the adaptive capacity needed for decision-making under uncertainty. For practitioners and scientists to motivate this paradigm shift requires moving beyond deterministic predictions and embracing uncertainty through the exploration of scenarios, understanding how they are constructed (e.g., modeling), what they mean (plausible futures), and how to use them for operational management and long-term planning (backcasting). We present a project to co-produce science and policy, called Collaborative Planning for Climate Change: An Integrated Approach to Water-Planning, Climate Downscaling, and Robust Decision-Making. We highlight the roles of boundary organizations, and focus on design principles that ensure co-construction of knowledge accounting for credibility, legitimacy, and salience. These include (1) co-leadership by representatives from water management entities and the science community, mediated through a team of science-translators; (2) a purposeful and functional approach to collaboration; (3) commitment to an iterative approach of scientific data and information production, mutual discussion of implications and future needs, and application of knowledge by water managers; (4) dissemination of the process and its results, to raise awareness and foster acceptance by various constituencies, such as managers in other cities (replication), water management policy constituencies (policy making), and the broader public (engagement). Finally, promoting urbanization as an opportunity for sustainability requires embedding long-term water-planning in a sustainability perspective to account for the systemic feedbacks between cities and their arid environments.

0161

**Urban Expansion Modeling Based on Logistic Regression and Cellular Automata: A Case Study in Wujiang**

Presentation type: Oral

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Since the Chinese Reform and Opening Up from 1978, Wujiang, a typical region in the core areas of Lower Yangtze River Delta, has experienced a rapid population growth and urban expansion during the last 30 years. The measurement, analysis and modeling of the urban growth in Wujiang are much more significant to reveal the underlying urban development mechanism. In this study, based on the land cover classification and change detection results of series' Landsat MSS and TM images, a novel urban expansion modeling framework which integrates the comprehensive influence of three aspects, such as macro controls, local impacts and micro dynamics, are designed to simulate the urban expansion scenario of Shenze Town, Wujiang in

1978-2004. Firstly, in the facet of macro controls, a Boolean logic is used to calculate the land use type transformation probability, which can be used to detect the affective of macro factors, such as land use master planning and wetland protection etc. Secondly, in the facet of local impacts, a Logistic regression model is used to incorporate several local impact factors, such as the distance to main roads, the distances to general roads, the distance to river , the distance to the central downtown, the distance to the city boundary etc. , to calculate the transformation probability .Thirdly, in the facet of micro dynamics, Cellular Automata (CA) is used to calculate the transformation probability , which can simulate the spontaneous bottom-up urban growth mechanism. Finally, simulation results evaluation are implemented by point-to-point comparison methodology. The results reveal that the highest simulation accuracy from 1993 to 2000 is 78.63%, and lowest one is from 1978 to 1986, 52.47%. Simulation results show that such a methodology considering the macro controls, local impacts and micro dynamics can be effectively used to model the urban expansion in Wujiang.

**0162**

**Spatial patterns and socio-ecological context of land use and vegetative cover in south Florida's suburbanization frontier**

Presentation type: Oral

Rinku Roy Chowdhury<sup>1</sup>, Nicholas Vaughn<sup>1</sup>, Laura Ogden<sup>2</sup>, Jeffrey Onsted<sup>2</sup>  
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Processes of decision-making and landscape change in urban socio-ecological systems are multi-scalar, entailing household residential parcels, formal and informal institutions at the neighborhood-scale, and town/municipal and state regulatory structures, including land use zoning. In south Florida, over a century of wetland drainage, land conversion, and the implementation of a highly-engineered regional water management system, has profoundly altered the historic natural system, and enabled urban growth that now encompasses over seven million people in the 16 county Everglades region. The Florida Coastal Everglades Long-Term Ecological Research (FCE-LTER) project study site includes the rural southernmost region of Miami-Dade County, south of the City of Miami. This region has undergone (and continues to experience) significant land conversion in the past few decades, primarily from agricultural and undeveloped land uses to residential development. The economic, social and ecological impacts of this land conversion are of particular concern, as historically these rural lands have served as a "buffer" between urban Miami-Dade and two national parks (Everglades National Park to the west and Biscayne National Park to the east). This paper presents ongoing research on the spatial patterns of current land use and vegetative cover relative to extant socioeconomic characteristics of the region's neighborhood and land parcels, and highlights in particular the role of land use zoning institutions in shaping those patterns.

**0163**

**Urban vegetation and socio-ecological contexts: Heterogeneity, trends and implications**

Presentation type: Oral

Rinku Roy Chowdhury  
*Indiana University, Bloomington, IN, United States*

With the rapid and overwhelming spatial scope of contemporary urbanization, the role of urban areas and ecologies in local, regional and global environmental change has received increasing scientific attention. Land change science, long term ecological research and urban geography/political ecology have variously investigated aspects of human-environment interactions and processes in urban systems. The heterogeneous patterns, trajectories and dynamics of urban vegetation have significant implications for ecosystem structure and function, are fundamentally tied to particular socioeconomic and political dynamics, and hold differential

implications for urban dwellers.

In this proposed session, we highlight the results of empirical research on urban vegetation distribution, its fundamental driving dynamics and socio-ecological implications across a diversity of urban sites in the United States, and in Brazil. These sites represent various stages of historical urban development, urban size, regional biophysical regimes, and socio-political and institutional contexts. The analyses and case studies highlight critical patterns and processes of urbanization dynamics in order to understand their social and environmental interfaces, and implications for local and regional sustainability.

**0164**

**In the eye of climate change: Urbanization in Bangladesh**

Presentation type: Oral

Mehdi Azam

*University of Freiburg, Freiburg, Germany*

The paper critically analyze how climate change and human induced changes in local environment creates conflict and influencing people to landward movement in the urban areas from the coastal region of Bangladesh. The increased risk of cyclone, tidal surges, river erosion, changes in weather pattern and salinity ingression is expected to link with climate change as per scientific prediction, however human intervention are also causing significant threat to survival of poor people in that areas. Livelihood and food insecurity are forcing people to move to urban areas for work and putting more pressure on using common pool resources and social services especially in the Dhaka city, the capital of Bangladesh. The study is based on intensive discussion (qualitative approach) with vulnerable people of coastal Bangladesh about their perception of present trend of changing local environment and causes of migration to urban areas. The study also review the situation of the migrated people in the urban areas with a prime question whether migration reduces the vulnerability or not? The study finally makes a critical analysis of present policy strategies and suggests a new policy action to address the local problem to keep the migrating people in touch with their origin place.

**0165**

**Collaborative Work for Flash-Flood Forecasting at Ambos Nogales**

Presentation type: Oral

Laura M. Norman<sup>1</sup>, Floyd Gray<sup>1</sup>, James Callegary<sup>1</sup>, Hans Huth<sup>2</sup>, Francisco Gastelum<sup>3</sup>, Claudia Zulema Gil Anaya<sup>4</sup>, David Goodrich<sup>5</sup>, Gary Woodard<sup>6</sup>, Jesus Quintinar<sup>7</sup>, Jose Nunez<sup>8</sup>, Gilberto Oliveros<sup>9</sup>, Roberto Molina<sup>10</sup>, D. Phillip Guertin<sup>1</sup>, Eduardo Canizales Curiel<sup>11</sup>  
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The KINEROS2 (K2) model has been developed and implemented to evaluate the watershed of Nogales, Arizona and Nogales, Sonora, Mexico and assess flood vulnerability as a part of a larger project to develop an "Early Warning Hazard System" for the region. In a collaborative effort, K2 is being expanded to incorporate real-time rainfall data input and compute volumes of runoff, peak flow, and watershed discharge rate. An existing gage network is being adapted in

Nogales, Sonora to measure precipitation and provide hard-wired precipitation measurements straight to an online rainfall monitoring network for Arizona (Rainlog). Community gages have been positioned using a well-distributed sampling regime in the upper watershed at Nogales, Sonora, drawing on collective local knowledge and support. Local residents who have Internet access and safe locations for which the equipment have set up instrumentation to start receiving data. Live data will be streamed into the existing K2 model to support the pilot flood warning system. The model estimates both rain gage-derived rainfall and predicted associated runoff. The runoff graph shows stage of flows and equivalent discharge rate in streams, and indicates the peak stage (discharge) and time of peak. An alarm capability is included to alert the forecaster or other designees when the maximum predicted stage level exceeds the critical stage or stages designated by the operator. The K2 model will also be used to evaluate future flood hazard across the watershed under alternative land-use scenarios. Rain gage data will be used to calibrate the K2 model for advanced flood modeling and to help inform land use planning for future scenarios. Rain gage data will also be used in a demonstration project to locate most advantageous sites for larger more extensive weather equipment that will provide emergency managers with the most reliable alert system.

**0166**

**(Re)regulating city-regions in Chile: maximising the role of spatial planning instruments in climate change adaptation**

Presentation type: Oral

Jonathan Barton

*Pontificia Universidad Católica de Chile, Santiago de Chile, Chile*

The challenges of climate change adaptation in Latin America are closely related to urban areas and their hinterlands - city-regions - given the high concentration of population in urban settlements. This is especially the case of Chile, where over 80 per cent of the population is urban. However, most of the national climate change discourse has been related to productive sectors, and mitigation in particular, reflecting concerns about the wider economic impacts to trade. To date there is little work on how city-regions should respond to the expected climate changes. Nevertheless, the 2009 National Action Plan stipulates that regulatory plans should contemplate these changes. The research presented here will reflect on the current regulatory plans of the largest city-regions in the country: Santiago Metropolitan Area, Concepción Metropolitan Area, Valparaiso-Viña del Mar Metropolitan Area, Greater La Serena and Antofagasta. Each of these city-regions has different challenges due to topography, land use, morphology, socio-economic conditions and institutional arrangements. The work reviews the opportunities and limitations of introducing climate change into regulatory plans and development plans, with a view to searching out common aspects of city-region planning and specific local dimensions that should be engaged with.

The argument put forward is that existing regulatory plans serve the purpose of fulfilling aims of meeting housing demand, basic infrastructure provision and commercial interests. With little appreciation of long-term and short-term risks, and how these can be incorporated into land use, urban design and public consciousness, they have inherent weaknesses that should be remedied. Without effective incorporation of climate change considerations into spatial planning instruments, there is a likelihood that risk will be enhanced for many groups and associated health and financial costs will rise.

**0168**

**Adaptation to Climate Change and the Diffusion of Innovations in Slums in Bangladesh**

Presentation type: Oral

Manoj Roy<sup>1</sup>, David Hulme<sup>1</sup>, Simon Guy<sup>2</sup>

*<sup>1</sup>Brooks World Poverty Institute (BWPI), University of Manchester, Manchester, United*

*Kingdom, 2 Manchester Architecture Research Centre (MARC), University of Manchester, Manchester, United Kingdom*

While much of the literature on adaptation to climate change assumes that external expertise is required this is not the case: poor people are doing it for themselves. By adjusting their lifestyle, living environment, huts and common areas to the stresses and strains of climate change through innovation and the diffusion of innovative practices. This paper draws on case studies of such innovative practices from two slums in Bangladesh to highlight: how innovative poor people's adaptive practices are; the contexts that promote innovative practices; the ways in which innovations are diffused; and the significance of these practices in poor people's adaptive capacity. The slums are: *Beltola*, in the capital city Dhaka; and *Rishi Putty* in Bhairab, a secondary city. The former is in a fast growing megacity with problems of security of tenure, air pollution, heat stress, and access to basic services. The latter in a slow growing secondary city with exposure to impacts of sea level rise, e.g. flooding and cyclones adding to problems of tenure security and access to basic services, and limited livelihood opportunities. Our analysis reveals a number of innovative practices in both contexts. There are household-level innovations to adapt to environmental problems, such as construction techniques to protect roofs being blown away by cyclones and use of green infrastructure both as a source of food and for cooling of indoor air temperature. At the community level, we see the formation of a collective identity as an innovative strategy to access NGO support and to reduce eviction threats. We observe that tenure security makes a big difference in people's innovative capacity; when this is secured, people tend to be more innovative. The paper concludes that building on poor people's responses to climate change is the key to effective adaptation at the micro level.

**0170**

**Scale issues in the design and implementation of climate change mitigation and adaptation policies: a case of the forestry sector in Uganda**

Presentation type: Oral

Charlotte Nakakaawa

*Norwegian University of life sciences, Norway*

Climate change attributed to the increasing level of greenhouse gas (GHG), in particular, carbon dioxide (CO<sub>2</sub>) emissions presents a global social dilemma which requires global collective action. Efforts to address this challenge through an international treaty negotiated as part of United Nations Framework Convention on Climate Change (UNFCCC) have thus been dominated by several actors focused at the global level but actual decision making occurs at a local level. While global treaties are part of an effective governance framework, local institutions are also required for achieving effective environmental policy outcomes. Within the international treaty, one of the important strategies for reducing (CO<sub>2</sub>) emissions is developing policies for protecting ecosystem services, particularly those related to carbon sequestration. An innovative policy response which has become increasingly popular involves providing Payments for Environmental Services (PES). In this regard, the forest sector has received increasing attention in the recent negotiations on a post 2012 climate change regime as a cost effective option for reducing emissions from deforestation and forest degradation (REDD). Such efforts to reduce GHG generate multiple benefits at diverse scales. The benefits are enjoyed by multiple actors at different scales. Although negotiations on an international REDD regime acknowledged the need to include local institutions/actors involved in the use and management of forest/tree resources, recent negotiations still excluded local actors. Under such circumstances, scale mismatches are bound to occur resulting in conflicts and inefficiencies in the use, management and delivery of intended ecosystem services. This paper analyzes outcomes in three case study carbon sequestration projects in Uganda negotiated and implemented at different scales and under differing institutional arrangements. The implications of the outcomes for the design and implementation of future carbon mitigation and adaptation policies within the forestry sector are

also discussed.

**0171**

**Heat Waves in Phoenix: High Impact Events?**

Presentation type: Poster

Doug Green<sup>1</sup>, Paul Iniguez<sup>1</sup>, Jon Skindlov<sup>2</sup>

*<sup>1</sup>National Weather Service, Phoenix, Arizona, United States, <sup>2</sup>Salt River Project, Phoenix, Arizona, United States*

Hot temperatures are routinely observed over the lower desert of far southeast California and southwest Arizona during the summer: average daytime highs exceed 38 C (100 F) from early June through mid-September, with warmest average daytime highs of 41 C (105 F) or higher observed during July and early August. The daily maximum actual and/or apparent temperature frequently exceeds 41 C (105 F). Plentiful sunshine and late afternoon breezes exacerbate the heat and its impact.

Given the typical hot summertime conditions, relatively small difference between average and record temperatures, a trend toward warmer nighttime lows (especially in urban areas), and the less-than-desirable quality/availability of useful heat-health statistics, development of practical excessive heat watch/warning guidance for local National Weather Service (NWS) Phoenix customers has been challenging. Prior to 2000, heat thresholds for the lower desert were so high that heat advisories/ warnings were never issued. Kalkstein's high heat-health model, first applied to the Greater Phoenix area in 2000, was the first serious attempt to address the heat-health issue at NWS Phoenix. NWS Phoenix has modified the heat watch/warning guidance provided by Kalkstein's model to place more emphasis on highlighting periods when anomalously high maximum and/or minimum temperatures are forecast. Though this method successfully captures extreme temperature events, it may not fully account for the effects of apparent temperature on the human body.

This talk will focus on describing the current heat watch/warning guidance employed by NWS Phoenix and suggest a modification that places greater emphasis on apparent temperature.

Persistent excessive heat is a major health concern; to that end, a 'heat wave' definition for the lower desert is proposed, and recent heat wave events for the Greater Phoenix area are highlighted.

**0172**

**Climate Change and Urban Water Planning: Efforts to Develop and Apply a Structured Decision Analytic Approach**

Presentation type: Oral

Kathleen Miller

*NCAR, Boulder, CO, United States*

While the general characteristics of future changes in the global water cycle are beginning to emerge from climate modeling efforts, the specific regional details of changes in precipitation, flood hazards, water availability and water quality are far from clear. This leaves water users, resource managers, and policy makers in the uncomfortable position of knowing that future water resource conditions are likely to be very different from those of the past, but not knowing the magnitude, or perhaps even the direction of those changes. Despite this high level of uncertainty, a number of major urban water suppliers in the United States have begun to explore methods for considering climate change in their long-range planning processes. This paper describes a project aimed at developing and applying a structured decision-analytic approach for evaluating planning alternatives in light of uncertain climatic change. While one cannot credibly calculate probability distributions for the local-scale impacts of global-warming on water resources, it is possible to derive useful information on the range of uncertainty from downscaled climate model

output. Utilities can use such information to identify strategies that are robust to a wide range of possible future conditions, adaptable to evolving information, and resilient to surprise. The planning approach focuses on facilitating this exploration. Each of the utilities that participated in the project followed a similar methodology, but came to the table with different planning needs, and different levels of system complexity. As a result, there were significant differences across the cases in how far the utilities chose to take the analysis, and the questions they explored. The paper will describe the results of a subset of these analyses and draw lessons that could be applied by other cities seeking to identify useful planning approaches for dealing with the potential impacts of climate change on their water resources.

**0174**

**Mapping Vulnerability on the Peri-urban Areas of Mexican Border Cities: Case Studies of Northern Mexico.**

Presentation type: Oral

Rolando Díaz-Caravantes, Erick Sánchez-Flores, Luis Bravo-Peña  
*Universidad Autónoma de Ciudad Juárez, Chihuahua, Mexico*

The urban/peri-urban phenomenon is frequently studied as a territorial landscape for urban expansion, and a good deal of scholarship chronicles aspects of land annexation, housing construction, and infrastructure, but the question of how peri-urban livelihoods and natural resources have been reconfigured by urban needs has not received sufficient scholarly attention. Particularly, peri-urban water reallocation demands examination in arid regions where water is a critical resource. In Mexico, for example, in 2005 there were 34 human settlements with more than 500,000 inhabitants. 20 of these cities are located in states with a strong pressure on the water resources, and 8 out of them are located in border states, which belong to a semi-arid region with low annual precipitation levels. Based on the study cases of Hermosillo, Sonora and Cuauhtémoc, Chihuahua, in the present paper we map social and environmental vulnerability of peri-urban areas. Social vulnerability is examined through the question of how the transfer of natural resources from the peri-urban to urban areas affects peri-urban livelihoods, particularly livelihoods depending of agriculture and livestock. In order to examine environmental vulnerability this work evaluates the land use/cover change dynamics and their effects in the peri-urban areas. This study demonstrates that urban expansion causes several types of land use/cover changes (LUCC) due to water transfers from peri-urban communities to the city that are not usually considered in the traditional approach of LUCC studies.

**0175**

**Socio-ecological dynamics and urban vegetation in Baltimore, Maryland**

Presentation type: Oral

J. Morgan Grove<sup>1</sup>, Christopher Boone<sup>2</sup>, Geoffrey Buckley<sup>3</sup>, Austin Troy<sup>4</sup>, Jarlath O'Neil-Dunne<sup>4</sup>  
*1USDA Forest Service, Baltimore, Maryland, United States,2Arizona State University, Tempe, Arizona, United States,3Ohio University, Athens, Ohio, United States,4University of Vermont, Burlington, Vermont, United States*

City governments are increasingly developing goals and strategies to promote urban sustainability. The list of urban sustainability strategies invariably includes the need to increase urban tree canopy without addressing the fact that most urban tree canopy resources are not on public lands, but on private lands. More importantly, the ability to achieve an urban tree canopy goal depends upon increases to urban tree canopy on private lands. Current sociological and geographical theories of social stratification and power are not sufficient for explaining the current distribution of urban tree canopy nor the mechanisms for increasing urban tree canopy on private lands. Advances in theory and data are needed to address these issues. First, we introduce the concept of an Ecology of Prestige, building upon reference group behavior theory. Second, we

describe how consideration of temporal and hierarchical dynamics - legacies and lags, and parcel to municipal interactions - improve our ability to understand the current distribution of urban tree canopy and to formulate policies, plans and practices to increase urban tree canopy. Finally, we illustrate how improvements in hi-resolution social and ecological data and the development of long term social and ecological data are necessary for advances in both social ecological theory and urban sustainability practice.

**0176**

**Poverty and Climate Change: Reducing the Vulnerability of Mexican Border Cities**

Presentation type: Oral

Francisco Lara

*Arizona State University, Tempe, AZ, United States*

Mexican cities bordering the United States currently face many environmental and development challenges with significant impacts on their livability, equity, ecosystems and economic competitiveness. In this context, climate change impacts are likely to aggravate existing socio-environmental vulnerabilities, particularly in poor urban neighborhoods. For thousands of residents of slums and other informal settlements, most of the risks of climate change are the result of development and planning shortcomings. This aim of this paper is to contribute to the limited body of knowledge regarding climate change, cities and the urban poor in the border region, and to inform how local institutions and planning can be retrofitted to reduce the vulnerability of the urban poor through adaptation.

**0177**

**Adapting border cities to climate change: practices, options and constraints**

Presentation type: Parallel Session

Francisco Lara-Valencia<sup>1</sup>, Margaret Wilder<sup>2</sup>

*<sup>1</sup>School of Geographical Sciences and Urban Planning, Arizona State University, Tempe, Arizona, United States, <sup>2</sup>Center for Latin American Studies, University of Arizona, Tucson, Arizona, United States*

Even as some cities and municipalities within the U.S.-Mexico borderlands are gradually becoming more mindful of the unusual risks that climate change creates - prompting greater recognition that mitigation and adaptation measures are urgent - most border communities are failing to take sufficient steps to prevent climate instability from presenting even larger dangers in the future. While large U.S. metropolitan areas like San Diego and El Paso are taking action, other urban areas on both sides of the border are falling behind even in adopting basic commitments to protect people and property from climate variability. National policies toward the border area create an even more complex scenario for climate action in this region.

In this session we would like to explore the following issues:

- The various forms of mitigation and adaptation being adopted by cities on both sides of the border
- The distinct conceptualizations of vulnerability to climate change in a binational context
- The emergence of new forms of collaboration and governance being proposed or developed in the region to adapt to climate change
- The role of non-governmental entities in promoting local and cross-border responses to climate change
- The institutional responses to climate change
- The role of borders and border policy in curtailing or promoting adaptation efforts.

0178

**Governance, Cities and Global Changes: Co-benefits to Face the New Challenges in the Developing World**

Presentation type: Oral

Jose Antonio Puppim de Oliveira  
*UNU-IAS, Yokohama, Japan*

As populations concentrate in the world's cities, the future growth of urban centers is of particular concern for planners and policy makers in both the developed and developing world. However, the challenges are quite different.

On the one hand, the sustainability challenges of cities in the developed world are more related to "over-development" (or green agenda) caused by over-consumption of energy and natural resources, urban sprawl and emission of greenhouse gases. Many of them have also a stable population and have solved the past local environmental problems, such as local air and water pollution (or brown agenda). Moreover, these cities are more prepared to adapt to the impacts of global change.

On the other hand, cities in the developing world face a triple challenge to sustainability. Firstly, those cities are growing rapidly, particularly in Asia and Africa. Second, there is a growing degradation of the local environmental quality because of the lack of environmental protection. Thirdly, they need to tackle both mitigation and adaptation to global changes. Those cities will be key to achieve worldwide stabilization in the emissions of greenhouse gases. They will also be the most vulnerable urban population to the effects of global change.

However, there are a lot of opportunities to have win-win situations, or co-benefits, in tackling the different environmental problems, and avoid both the environmental "Kuznets" curve and the over-development faced by many cities in the now developed countries. This research analyzes the case studies of successful co-benefits situations in several Asian cities to understand the governance structures that allowed them to be implemented. Based on those lessons, a series of policy implications were identified such as a need of a much stronger participation of civil society and integration among the different levels of government and other governance structures both horizontally and vertically.

0179

**Suburbanization, Lawns, & Water: Multi-scale Dynamics in Suburban Boston, USA**

Presentation type: Oral

Colin Polsky<sup>1</sup>, Wil Wollheim<sup>2</sup>, Charles Hopkinson<sup>3</sup>, R. Gil Pontius<sup>1</sup>  
*<sup>1</sup>Clark U., Worcester, MA, United States, <sup>2</sup>U. of New Hampshire, Hanover, NH, United States, <sup>3</sup>U. of Georgia, Athens, GA, United States*

Human alterations of the earth's surface are widely recognized as one of the planet's most significant cumulative global environmental changes. Increasing population and per capita income suggest that this trend will continue in coming decades. In countries such as the US this process manifests principally as suburbanization. Yet our understanding of the specific causes of US suburbanization and associated consequences is limited because we also lack a systematic baseline description of the location, extent, timing, and rates of land use- and -cover changes where the process is suspected to be important. This presentation reports on a project to examine the causes, patterns, and consequences of suburbanization in the northern Boston suburbs. The presentation will focus on how the project's core dataset - a <1m parcel-level classification emphasizing the various types of lawn-cover - can be used to catalyze analysis of the social and environmental dimensions of the presence and management of suburban lawns.

**0180**

**Linking ecological methods to local land use law to guide land development**

Status: Accepted Presentation type: Oral

Alexander Felson

*Yale University, New Haven, CT, United States*

Ecologists have recognized human accelerated environmental change, particularly land use change, as a leading cause of ecological degradation and worldwide species declines. Motivated by these concerns, ecologists have analyzed mechanisms and interactions underlying biodiversity and ecosystem function. Most recently, this analysis has resulted in a shift in perspective from the notion that biodiversity develops as a response to the abiotic environment, to the idea that biodiversity is fundamental in regulating ecosystem processes. This discovery has implications on land use practices. Yet, after two decades of rigorous research and verification, these perspectives remain peripheral to policy and planning approaches guiding most land use practices. Federal endangered species law does apply scientific understanding, monitoring and long term assessment through habitat conservation planning. However, for sites and species that are not threatened or endangered, the current legislation does not adequately reflect scientific understanding or evolve responsively to reflect emerging scientific evidence. Further compounding these matters are the issues, which inhibit the development of a responsive legal framework to effectively integrate ecological sciences especially in respect of habitat conservation and land use in the United States. Taken together these influences create substantial challenges for conservation efforts especially in anticipation of continued land development coupled with limited regulations. To explore and address these challenges, a transdisciplinary research project was implemented focusing on amphibian populations and their terrestrial and aquatic lifecycle to guide a large-scale masterplanning process and to inform the location of roadways, houses and engineered stormwater systems. In this way the ecological research was integrated in practical and effective way relying on the local land use legal framework to address unregulated habitats.

**0181**

**Dry rangelands ecosystem degradation, migration, uncontrolled urbanization and urban health in Mongolia**

Presentation type: Poster

Davaanyam Surenjav, Bayantur Myagmar

*Institute for Dryland Sustainability, Ulaanbaatar, Mongolia*

Mongolia faces two major interrelated problems in its path towards sustainable development: a dry rangelands ecosystem degradation and uncontrolled urbanization - with severe implications for urban health. Mongolia is one of the most vulnerable regions to climate and land use change. A fragmentation of the cultural landscapes in arid lands, loss of traditional knowledge and tragedy of the commons increases vulnerability and reduces resilience and the adaptive capacity to climate variability of pastoral systems that have evolved over thousands of years.

Inappropriate ratio of herder, herd and pastureland reaches to pastureland ecosystem degradation and desertification have been occurring since the transition from socialism to a market economy. For example, herders have been migrating to Ulaanbaatar city from rural areas because of animal loss resulting from overgrazing and natural disaster such as drought. Because of unpredicted migration, rapid and uncontrolled urbanization and bad governance, the country has seen a rise in unemployment and poverty rates, an inadequacy of infrastructure and services, and air pollution its urban areas.

Ulaanbaatar is the coldest and the most air polluted capital city in the world. Coal burning for winter survival in the city has reached critical levels and it is causing serious health problems. All the above changes are making the coupled social-environmental systems of Mongolia more vulnerable to global change. Ulaanbaatar is an ideal place to introduce innovative technologies

for efficient energy use with reduction of carbon emission and quality of life locally. A complex approach on regional development policy supporting remote areas and cities and sustainable rangeland management is needed in order to decrease rural-urban over migration and to develop satellite towns of Ulaanbaatar city.

**0182**

**Urban growth in the U.S.-Mexico border region: Meeting the environmental and socio-cultural development needs with new paradigms**

Presentation type: Oral

Andrea Garfinkel-Castro

*Arizona State University, Tempe, Arizona, United States*

For a century and a half, a pattern of mutual benefit and exchange has been routine for the U.S.-Mexico border region. Repeatedly, cities' fates become intertwined, sharing labor pools, markets, natural resources and ecosystems and public services (Arreola & Curtis, 1993). Labor ties, especially, remain strong today. This continuum of Mexican immigrant labor has long been recognized as a "key factor in the economic development of the U.S. southwest and border region" (Ganster et al, 2000, p. 76). Jorge G. Castañeda (1995) maintains that the benefits of this longstanding labor relationship extend not only to the economy of the U.S. but also to Mexican individuals and the Mexican economy, as well. Whether distribution of these benefits have been equitable remains highly debatable, however, as suggested by the contention that "Tijuana is subsidizing the San Diego economy with affordable housing" (Goodno, 2003, p. 21). While specific dynamics vary, the explosive growth in population and commercial activity in recent decades have brought development challenges common to the whole region. For example, inadequate water, waste and transportation infrastructure and a lack of affordable housing place heavy pressures on the environment-urban and rural, with costs often the limiting factor. Planning paradigms that promote compact, transit-oriented development can reduce infrastructure costs, helping precious development funds go further. They also promote planning processes that encourage community input and socio-cultural relevance. This paper explores how these development paradigms are well-suited to the growth needs of U.S.-Mexico border region and how planning policy supports them.

**0183**

**Conflicting principles of water and sanitation management in the context of rapid urbanization, growing inequalities, and climate change: A comparative analysis of India, Brazil, and South Africa**

Presentation type: Plenary

Rimjhim Aggarwal<sup>1</sup>, LaDawn Haglund<sup>1</sup>, Amitabh Kundu<sup>2</sup>, Roberto Do Carmo<sup>3</sup>, Pedro Jacobi<sup>4</sup>  
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Megacities of the Global South have emerged as major economic powerhouses, yet universal provision of basic services - such as water and sanitation - in these cities remains an elusive goal. It is increasingly being realized that the core of the problem does not lie in budgetary constraints, proper pricing, or appropriate technologies *alone* but in the capacity of the State, community actors, and institutions in these countries to negotiate and resolve the increasingly complex conflicts introduced by competing claims to scarce resources. The rapid pace of urbanization and population growth - coupled with ecological constraints and climate uncertainties - has posed new risks and vulnerabilities that call for innovative holistic approaches. This session brings together scholars working on water and sanitation management in three of the major megacities of the developing world: Delhi, São Paulo, and Johannesburg. The session

presents a unique opportunity to engage in cross-comparative analysis across these megacities to: a) relate the structure and pattern of urbanization in these cities - particularly, the growth of informal settlements - to the spatial distribution of access to water and sanitation services; b) examine what new risks and vulnerabilities are emerging with rapid urbanization and how these are likely to be exacerbated by climate change; c) unravel new arenas of conflict that are emerging and how these are being negotiated and resolved (or not) through formal and informal institutions, legal structures, and policy; and d) finally to explore some of the cross-comparative lessons, particularly in the form of innovative approaches towards multi-use arbitration and citizen participation.

The session meets the conference objectives of fostering dialog among researchers from different countries to develop innovative integrated approaches to basic service provision, particularly from a governance standpoint, in light of the new risks and opportunities from rapid urbanization and climate change.

**0184**

**Crafting Sustainability Visions for Phoenix 2050**

Presentation type: Oral

David Iwaniec, Arnim Wiek

*School of Sustainability, ASU, Tempe, AZ 85007, United States*

The absence of a systemic approach to analyzing the long-term future is one of the critical barriers to sustainability research and connecting long-term goals to practical action. Goals of the research to be presented include: bringing visioning into the fold of rigorous methods to analyze our futures; incorporating sustainability core concepts into the visioning process; and applying this sustainability visioning framework to shape and analyze the long-term future of urban systems. Our research addresses shortcomings and gaps in current visioning approaches by integrating sustainability principles in the visioning process to create useable goals that deal with the nuances of complex social-ecological relationships and dynamics, intergenerational needs, heterogeneity of needs and values, and high uncertainty. Navigating sustainability challenges from an anticipatory solution-oriented approach, this research focuses on the development and collaborative implementation of a sustainability visioning process in Phoenix, AZ, USA. We present using Phoenix, AZ, USA as a case study and highlight a broader collaborative sustainability endeavor between Arizona State University and the City of Phoenix. We will present participatory components of the visioning process which include community hearings to identify community values and preferences. We will also present stakeholder engagement workshops which were used to further clarify and develop coherent systems maps of sustainable visions. Additionally, we explore how to evaluate envisioned future states using backcasting and systems modeling approaches and analyses.

**0186**

**Peri-Urban Development and Environmental Sustainability: Examples from China and India**

Presentation type: Oral

Jefferey Sellers

*USC, California, United States*

Large-scale urban development is likely to be one of the primary sources of environmental change in Asia over the next decades, and more of this development will take place in India and China than in any other two countries. Rapid urban growth can have severe consequences for environmental sustainability creating an urgent need for alternative pathways to development.

This panel presents preliminary findings from the first systematic comparative analyses of development on the urban fringe and its environmental consequences in these two countries. The

presentations analyze local and regional variations in developmental trajectories and sustainability among a number of urban regions within each country. The focus of each is on land use, ecosystems and environmental. This project has been funded by the US National Science Foundation administered by the Asia-Pacific Network for Global Change Research.

**0188**

**Ecosystem services on an urbanizing planet: What 2 billion new urbanites means for climate and water**

Presentation type: Parallel Session

Peter Marcotullio

*Hunter College, New York, United States*

For the first time in history, a majority of people live in cities, and urbanization is expected to add almost 2 billion new urban residents by 2030. While there is growing awareness that cities affect almost every ecosystem on Earth 2-5 and are increasingly vulnerable to environmental change, there are few global estimates of urbanization's impact on key ecosystem services. This is particularly true for freshwater availability and global climate, which may be massively impacted by urbanization and may be key future vulnerabilities for urban residents. This panel represents a sub-group of those working on such a project. We have had funding from the National Center for Ecological Analysis and Synthesis (NCEAS) and The Nature Conservancy, for workshops that have brought us together twice over the past year. We will convene our final working group early in 2011. Those presenting are from both the water and air sub-groups and discuss preliminary findings to date.

**0190**

**Urban carbon footprints and mitigation responsibilities of cities- insights from analyses of Tokyo**

Presentation type: Oral

Shobhakar Dhaka<sup>1</sup>, Shinji Kaneko<sup>1</sup>, Lavinia PORUSCHI<sup>1</sup>

*<sup>1</sup>Global Carbon Project, National Institute for Environmental Studies, Tsukuba, Japan, <sup>2</sup>Graduate School for International Development and Cooperation, Hiroshima University, Hiroshima, Japan, <sup>3</sup>Global Carbon Project, National Institute for Environmental Studies, Tsukuba, Japan*

Emission of GHGs within territorial boundary and mitigation responsibilities are two different aspects. The former is physical but the later is an attribution or allocation. City governments account mitigation responsibilities for out-of-boundary GHG emissions associated with electricity consumption in cities but do not do the same with other goods and services. How much mitigation responsibility a city takes, defined by how much emission a city attributes to itself for mitigation, is subject to the definition of its chosen system boundary. Delineating this system boundary for carbon responsibility is not an easy task. These complexities needs better understanding but also it has important but differential policy implications for commercial and industrial cities from production and consumption perspectives. Policy community has been debating the issue of emission responsibility for some time now. ICLEI's revised guideline has some elements of embedded emissions and UNEP-Habitat-World Bank released a Draft International Emission Reporting Protocol for Cities with some elements of embedded emissions in March 2010. In this context, this paper will analyse the case of Tokyo- the first city in the world to start city-wide cap-and-trade system for CO<sub>2</sub> starting 2013. We will first present the territorial emissions (direct emission) and show how issues such as inter-city-mobility, electricity import-export, location of waste treatment, aviation, marine transport etc affect such numbers. We will also show how different definitions of Tokyo yields different carbon emission numbers. Then we will estimate embedded emissions in goods and services that Tokyo import and exports using economic Input-Output tables. We will frame multiple definitions of Tokyo's carbon footprints and

analyze how Tokyo's footprints vary depending on such definitions. Lastly, we will discuss the policy implications of multiple definitions of footprints (this essentially reflects mitigation responsibilities) for Tokyo.

**0191**

**Catching the long tail of urban green activism**

Presentation type: Poster

Rohit Nayak

*Clean Earth Movement, Pune, Maharashtra, India*

Pune is the eighth-most populous city in India. Unbridled urban growth has eaten considerably into its large green cover and adversely affected its mild climate. The politician-builder nexus, the corruption and lack of government will combined with citizen apathy have fueled this rampant destruction of Pune's biodiversity.

Pune has a fairly vibrant activist culture with several dedicated individuals and civil society organizations, many in the area of urban growth, traffic and environmental action. Unfortunately many of the groups work within silos and the impact they have stays limited. Among the population there is a great awareness of climate change related problems and its global context. While there is despair and skepticism among citizens that these negative trends can be reversed there is a large section who are interested in making a difference. As yet, they do not believe sufficiently in the "cause" as to make a big change in their schedule and lifestyle.

We believe that engaging this "long tail" of the population is the key to increasing biodiversity in Pune. The Clean Earth Movement ([cleanearthmovement.com](http://cleanearthmovement.com)) is an attempt to create a platform to involve these citizens. Working since 2006 in Baner, a division of Pune, it does tree plantation, restoration of natural water bodies and environmental awareness education. Combining a very hands-on approach, best practices in forestry and water treatment, use of the internet and media, community breakfasts and word-of-mouth publicity we have been able to get a significant involvement from the local population. Several cities in India and indeed all over the world are facing similar issues or will soon do so as forces of urbanization proceed at a rapid pace. We feel that this model of participative green activism needs to be nurtured and replicated if we are to reverse the trends of global climate change.

**0193**

**Spatial Distribution of Access to Water and Sanitation in Megacities of Developing World: A Comparative Analysis of Conflicting Principles, Policy Dilemmas, and Institutional Innovations**

Presentation type: Oral

Rimjhim Aggarwal, LaDawn Haglund

*Arizona State University, Tempe, AZ, United States*

In spite of their growing economic power, megacities around the developing world struggle to provide their populace with basic services, such as water and sanitation (W&S). In this paper we situate these struggles in terms of multiple (and often conflicting) framings of W&S with reference to economic, social, ecological, and human rights. The basic premise underlying this work is that understanding these conflicts is key to addressing not only current problems in access but also emergent risks and vulnerabilities- particularly in the context of climate change - and opportunities for social learning and institutional innovations.

Taking the case of three major megacities in the global South - Delhi, Johannesburg, and São Paulo we use census data to first examine the spatial distribution of household access to W&S and its correlation with socio-economic, demographic, hydrologic, and bio-physical variables. Previous studies have looked at the issue of water and sanitation in isolation. Our integrated analysis reveals how access to these services is correlated quite differently with the underlying

socio-economic and demographic variables both within and across these cities. The second part of the analysis uses spatial clustering techniques to identify hot spots where these problems with access to W & S converge. Interestingly, we find that these hot spots are also areas where conflicts arising from unmet human needs (such as inadequate housing), ecological threats, and economic constraints are particularly acute. The third part of the paper uses a cross-comparative approach to understand what these conflicts are, how these have been addressed (or not) through the formal and informal legal structures, policy instruments, and governance mechanisms at play in each context. The paper concludes with comparison of outcomes through the lens of human rights and sustainability, analyzing the efficacy and generalizability of attempted solutions, mechanisms, and strategies across these contexts.

**0194**

**Urbanization and Water in the São Paulo Metropolitan Region: conflicts and management with the climatic change perspective**

Presentation type: Oral

Roberto Carmo

*University of Campinas, Campinas, São Paulo, Brazil*

The population of the São Paulo Metropolitan Region is already 20 million inhabitants. Water availability is relatively small considering the specificity of an upstream watershed of the Tietê River basin. Growing demand is pushed by several factors besides population growth, such as system losses and growing per capita consumption (despite continuing social inequality). Urban expansion--and with it, impervious surfaces--has led to increased flooding. The lack of water in some areas of the metropolitan region during the dry season is also a problem for poor populations. All these factors will be exacerbated by climate change in the next few decades. At the same time, few developments are being made in terms of management of these new sets of risks. This paper explores these factors and the conflicts that arise from this situation, as well as the arenas in which these conflicts are discussed, especially the river basin committees ("comitês de bacia"). It first presents data on population growth and spatial distribution of the population across the metropolitan area, the growing demand for water and the composition of this demand, and the basic characteristics of the water system of the region. It then presents and analyzes the role of institutional mechanisms and social arenas in addressing these problems, given the increasing risk of harm due to incidences of extreme climate events.

**0197**

**The Environmental Impact of Vegetable Consumption in São Paulo Metropolitan Region**

Presentation type: Poster

Tatiana Gadda

*UTFPR, Curitiba, Paraná, Brazil*

While during the last three decades São Paulo Metropolitan Area has been facing changes in its GDP its food consumption patterns has also been changing. We analysed the consumption of vegetables in the Region by looking at data from the larger wholesale market in South America. While the per capita vegetables appropriation from nature increased 60% from 1986 to 2006, the household consumption rate decreased about 40%. Results suggests that people from São Paulo has been appropriating more vegetables than they actually consumes. This may indicate an increasing inefficiency in reducing the waste from the production site to the tables.

**0198**

**Interdependencies among datasets for global climate change analysis**

Presentation type: Oral

Jochen Albrecht

*Hunter College CUNY, New York, NY, United States*

Most datasets for global change analysis are so expensive to compile that this effort is typically not replicated by other research groups. A number of high resolution (0.1 degree) model outputs are therefore unique within their domain. Examples include EDGAR greenhouse gas emissions, CIESIN gridded population estimates, and IIASA gridded national gross product estimates. As each of these are dependent on their own set of determinants, any attempt to link these datasets runs risk of circular reasoning. The purpose of this paper is two-fold: first to reveal the reasoning chains in three commonly used global model datasets, and second to outline the realm of research questions that could possibly be answered using these datasets.

**0199**

**Local Policy Responses to Urban Air Pollution and Ecosystem Stress**

Presentation type: Oral

Andrea Sarzynski

*George Washington Institute of Public Policy, Washington, DC, United States*

This paper aims to map urban ecosystem stress and response strategies with respect to global urban air pollution. It will briefly summarize the state of the science on urbanization and air quality, with a focus on the most important factors responsible for recent change in urban air quality. It will next identify urban areas already stressed by air pollution (such as from ozone or fine particulate matter), compile predictions regarding future population change and its air quality impact, and compile information regarding locally-adopted sustainability strategies to deal with coming air pollution stress. It will also highlight response strategies that appear most promising with respect to maintaining or improving urban air quality in the face of rapid urbanization. Finally, the paper will conclude with a summary of current research gaps and an agenda for future research oriented towards local sustainability efforts.

**0200**

**The global extent of urban land: current monitoring and future forecasts**

Presentation type: Oral

Annemarie Schneider<sup>1</sup>, Mark Friedl<sup>2</sup>

*<sup>1</sup>University of Wisconsin-Madison, Madison, WI, United States, <sup>2</sup>Boston University, Boston, MA, United States*

Despite the growing importance of urban land in regional to global scale environmental studies, it remains extremely difficult to map urban areas at coarse scales due to the heterogeneous mix of land cover types in urban environments, the small area of urban land relative to the total land surface area, and the significant differences in how different groups and disciplines define the term "urban". In this talk, we present results from recent efforts to produce a new global map of urban land based using remotely sensed data in association with a global stratification of "urban ecoregions." This work builds on our past work using Moderate Resolution Imaging Spectroradiometer (MODIS) data at 1-km spatial resolution in coordination with the MODIS Collection 4 Global Land Cover Product. The goal of producing this new map is to address problems in our earlier map arising from confusion between built-up areas, bare ground and shrublands, as well as begin development of a database of urban land surface characteristics for multiple time periods. To this end, the new dataset is produced using newly released Collection 5 MODIS data circa 2001-2002 with increased spatial resolution (500 m). An accuracy assessment based on sites from a stratified random sample of 140 cities shows that the new map has an

overall accuracy of 93 percent ( $k = 0.65$ ) at the pixel level and a high level of agreement at the city scale ( $R^2 = 0.90$ ). In this talk, we will also discuss our ongoing efforts to (1) monitor urban land for 2005 and 2010; (2) analyze the drivers of global urban land use change by linking the spatial pattern of urban areas to data on demographic, socio-economic, and biophysical variables; and (3) develop and validate a spatial model to explain observed joint changes in population distribution and urban expansion.

**0202**

**Planning for Evolution of Cities**

Presentation type: Oral

Sudhira HS

*Gubbi Labs, Gubbi, Karnataka, India*

The evolution of human-social organization to live in large urban agglomerations has posed new and complex challenges for planning and governance in meeting the necessary demands of infrastructure and amenities, while minimizing the implications on environment and resources. In the process of organic urbanization, despite the city-size distributions conforming to the scaling laws (Zipf's law) resulting in hierarchical organization of societies, the urban primacy is continuously increasing. As a consequence, only a few cities are growing rapidly resulting in urban sprawl that is often unplanned and uncoordinated outgrowths beyond the geometrically laid out land-use plans and governed by idealized zoning regulations. Thus, cities self-organise and continuously adapt to find newer ways of managing its resources and meet the perpetually increasing demands. In other words, cities evolve. Planning has until now restricted to preparation of idealised geometric land-use plans that grossly ignored the interactions among different sub-systems and the ensuing dynamics. Two key sub-systems that demand integration are land-use and transportation models in forecasting future urban growth. Although national urban transport policy and several research stress the need for integration of land-use and transportation planning, no methods exist for them in the Indian context. It is this motivation that entails the design of a spatial planning support system coupled with integrated land-use and transportation models and robust forecasting abilities. The paper outlining the design and development of such a planning support system, demonstrates that such tools can be used for 'planning for evolution of cities'.

**0203**

**Urban Land and Governance: An Analysis of *Akrama-Sakrama* and TDR as Instruments of Land Regularisation and Resettlement in Bangalore, India.**

Presentation type: Poster

Sudhira HS

*Gubbi Labs, Gubbi, Karnataka, India*

In the course of a city's evolution, land becomes central in its evolution. Although many instruments and forms are employed for regulation of land during the city's evolution, often 'land' gets embodied in different claims and contestations. With metropolitanisation, the outskirts are agglomerated into the larger urban local body as in the case of several Indian cities, adds an additional dimension to the nature of claims and consequent regulation. Spatial planning by way of state-backed Master Plans often fails to capture the underlying dynamics and contestations. Thus, such practices have been a miserable failure with respect to guiding and regulating urban growth. A case in point here is the State Government's initiative called as 'Regularization of Unauthorized Development and Constructions', popularly called as *Akrama-Sakrama*. Colloquially, *Akrama-Sakrama*, means legalizing the illegal. The entire process of this scheme is captured on a Mindmap in order to analyse the genealogy and the interconnections among multiple realms (legislative, political, judiciary and public). Additionally, the map also notes the

issues that entail in the conceptualization, mechanisms, and implementation of the scheme. This approach enables us to analyse how divides of income, infrastructure and services have significant institutional correlates, rather than being simply a natural outcome of rapid urban growth. It also allows for an analysis of the Constitutional reforms in local governance embodied in the 73rd and 74th Amendments as they get materialised in particular institutional locations and practices. The analysis while revealing the legal pluralism points out that the current instrument of land regularisation actually leads to a loss of power by local groups - shaped by their declining claims to land and reworked tenure situations.

## **0204**

### **Rapidly Urbanizing World Regions - Processes and Issues**

Presentation type: Plenary

Pawan Kumar Joshi

*TERI University, New Delhi, India*

The UN estimated more than half of the human population is living in urban areas, and the urbanization will continue to grow, particularly in developing countries. Development challenges in these areas such as infrastructure and basic services for the growing population are likely to be intensified. The satellite semi-rural landscapes at the fringes of such urban areas show changes in soil, human health, the diversity of plant and animal species and further impact on fringe ecosystems. Apart from these, natural hazards and their impacts have always been a challenge to streamline developments. The urban areas are sprawling and are expected to experience adverse impacts related to climate change. Local governance is crucial to deal with such issues and subsequent challenges due to climate change. Monitoring of these cities at spatio-temporal scale is critically needed to understand the drivers, passengers and impacts of such changes. Comprehensive policies fostering urban resilience and that better address the development and vulnerability are vital.

This session will offer the opportunity to discuss the issue of urban expansion, local issues and linkage with climate change with a special emphasis on Asia, among researchers, practitioners and stakeholders in the area of urban development and climate change. The sharing of research findings and experiences aims at enhancing the understanding; not only of the imminent challenges but also of the opportunities and necessary changes for achieving sustainable urban development, considering the environmental and social aspects and the role of good local governance.

The session will count with researchers, scientists, academicians, policy makers, experts and stakeholders from developing countries, specifically Asia.

## **0205**

### **Plenty water from Asian water tower? Climate change, land use transition and urbanization in Asia**

Presentation type: Oral

Jianchu Xu

*World Agroforestry Centre, China Program, Kunming, Yunnan, China*

The quality and flow of water resources is largely determined mostly by climate and land use. The Asian highlands contain the most extensive areas of glaciers and permafrost outside high latitudes. The region is often referred to as the 'Asian water tower': the source of Asia's ten largest rivers the waters of which sustain over 1.3 billion people.

During recent decades, economic growth, urbanization and climate change have taken place so intensely and so rapidly that traditional water resource management are losing their efficiency.

The region is failing to act as an ecological mediating system between India and the China.

The supply of freshwater, or the snow and ice meltwater component, in large river basins is

projected to increase over the following decades as perennial snow and ice decrease. Later, however, most scenarios suggest a decrease, even of catastrophic proportions, by the 2050s. The pace, magnitude, and spatial reach of land-use changes in highlands have increased over the last half century as a result of land reclamation. Land-use changes are the primary source of water and land degradation. Land-use decisions is also water decision. Land use intensification including afforestation has significantly reduced stream flow and increased evapotranspiration, all have hydrological consequences.

As urbanization rates in Asia rise rapidly, stress on the region's water resources is intensifying. The urbanized population has often negative feedback to watersheds and river systems due to poorly established sewage system.

Climate change together with urbanization is expected to worsen the water security significantly. Experts agree that increased demand and reduced access to freshwater will lead to a cascading set of consequences, including impaired food production, health risk, the loss of livelihood security, large-scale migration within and across borders, and increased economic and geopolitical tensions and instabilities. Over time, these effects will have a profound impact on security throughout the region.

## **0209**

### **Sustainable Urban Infrastructure in Developing Regions**

Presentation type: Parallel Session

Ricardo Jordan, Roberto Sanchez Rodriguez, Jonathan Barton  
*Sustainable Development and Human Settlements Division ECLAC United Nations, Santiago, Chile*

Infrastructure development is critical to the achievement of the Millennium Development Goals (MDG). The unmet demand for infrastructure to support the delivery of housing, transportation, energy and water services limits economic opportunity and is therefore a major barrier to the achievement of MDG1 (poverty and hunger reduction).

Patterns of infrastructure development determine the environmental sustainability of economic growth (MDG7 - ensure environmental sustainability). In turn, eco-efficiency is a key criterion for the development of sustainable infrastructure, and therefore a key objective in developing, planning and building more sustainable cities. More eco-efficient infrastructure delivers higher-quality services with less use of resources and low negative environmental impact, as well as lower vulnerability to natural disasters. Eco-efficiency can be measured using indicators that relate environmental impact (such as emissions of pollutants) or resource use (such as water or energy), to the service or economic benefit provided (such as passenger kilometers, in the case of transportation infrastructure).

In an era of rising natural resource prices and scarcity and increasing vulnerability to natural disasters and climate change, infrastructure eco-efficiency has long-term and significant impacts on both economic and environmental sustainability in all countries, but in developing and least-developed countries in particular. In the context of climate change, eco-efficient infrastructure development is also essential to the development of "low-carbon" economies. It also expands financing opportunities through the Clean Development Mechanism (CDM), on the basis of avoided greenhouse gas emissions.

## **0213**

### **Crisis, Transition, and Urban Environmental Change**

Presentation type: Plenary

William Solecki  
*Hunter College of the City University of New York, New York, United States*

The process of urban environmental change often includes a set of conditions associated with

rapid transformations during which the structure and organization of the systems in questions enter into a phase change and are recalibrated. These moments in cities respond to demands and pressures emerging during their growth, and over time increasingly act as impediments to the continued development and viability of the community. The identification, management and potential prediction of these critical transitions is a key element in the theoretical and policy understanding of resilience and sustainability. Rapid critical transitions within natural and human systems have emerged in a variety theoretical and conceptual contexts including complexity theory, adaptive management theory, urban transition theory, and theories urban/regional spatial development.

The session invites papers that examine the role of system transitions, phase changes, and tipping points in sustainability science and practice in cities. The session papers in part address the following issues: 1. Can tipping points and associated early warning signals in urban systems be identified?, and 2. What are the connections between natural components and human component tipping points of urban systems?

#### **0214**

##### **Higher Education as a Catalyst for Urban Sustainability**

Presentation type: Parallel Session

William Solecki

*Hunter College of the City University of New York, New York, United States*

The objective of this session is to examine how institutions of higher education are taking-on an even greater leadership role in putting sustainability concepts into practice. As the world has become an ever more urban society, it is appropriate for urban-based colleges and universities to more actively become catalysts for sustainability efforts in cities. Sustainability is a complex issue that requires detailed examination and testing to determine which techniques and approaches will be most useful for bringing its goals to reality. In the past few years, researchers and practitioners have been actively working to develop and test new ideas on sustainability science and practice. Many of these ideas are being considered for the urban context. Numerous city governments have developed plans to make their cities more sustainable. Colleges and universities also have taken on the call to promote sustainability science and practice. Together these efforts represent an ambitious attempt to highlight the need for sustainability and pathways to enhance its potential.

Putting sustainability into place demands a further expansion and coordination of the efforts between institutions of research and education and the communities in which they are located. Through providing sites of creative expression and experimentation, skill development and workforce training, and continuing education, the institutions directly serve their localities. With respect to the transition to sustainability, institutions of higher education have at least four roles to play: 1) Education and curriculum development; 2) Promotion of pure research; 3) Promotion of applied research and development; and 4) Retrofit of facilities and materials procurement.

#### **0215**

##### **Assessment of Urban Growth using Entropy Approach: A case Study of Jaipur, India**

Presentation type: Poster

Milap Punia, Laxman Singh

*Jawaharlal Nehru University, New Delhi, India*

In India the last 30 years had witnessed a radical transformation of urban scene. In particular, during this period, small and medium-sized cities (one lakh - 100 thousand people - and more than one million people) began to grow rapidly. In this study, urban growth Jaipur city in the last 31 years (1975- 2006) is being assessed. Jaipur ranks 11th with a total population of 2.3 million and has shown a consistent increase in the past 50 years. It is one of the fastest growing mega

cities of the country with an annual average growth rate of 4.5% which is quite high from the national urban growth rate. Remote sensing and GIS have been used to extract the information related to urban growth, built up area and its spatial and temporal variation. The Shannon's entropy at two levels (city as a whole and wardwise) is computed in order to quantify the form and patterns of urban growth using built up area as spatial phenomena. Further, multivariate statistical techniques have been used to establish the relationship between the urban growth and its causative & determining factors. Results reveal that the growth rate of built up in Jaipur has outstripped the rate of population growth. Shannon's entropy quantifies as dispersed form of urban growth till 2000 while post-2000 there is relative compactness by 2006.

**0217**

**Integral Sustainability on the trans-border region of Tijuana - San Diego. Basis for the creation of a common agenda**

Presentation type: Oral

Alejandro Mungaray - Moctezuma, Michael Schorr, Julio Calderon  
*Universidad Autonoma de Baja California, Mexicali, Baja California, Mexico*

The cities of Tijuana and San Diego form the most important trans-border region between Mexico and USA. With more than 4.7 millions of residents, the economical interactions that occur among their urban groups, on an exogenous and endogenous way, develop complex systems of human activities that constantly influence processes of territorial transformation of different types. These transformations, must be integrally visualized as reaching balances of regional sustainability that strengthen the relationship between the natural and built environment; for as much as the small or excessive inflexibility of the border links with the typology of its environment.

The city is recognized as a system that generates impacts on a regional and global level. For this reason, the processes of transformation are attended through a local and regional vision, integrating two types of systems: dynamics, contemplating human mobility, and durable, as changes in territory. In this matter, several stages of urban growth allow a chronological analysis that set two structuring processes with different pace connecting causes, insisting on a unique regional trans-border development, and effects, transcending on the natural conditions of the territory. The border is perceived as a delimitation that presents specific opacities, the same that happens in other trans-border spaces of the world. Therefore, its understanding approaches through a global comparative framework that provides feedback to the sustainable development cores on a local and regional level. It unravels its discontinuous phenomena, direct and indirect, measuring the guidelines that are generated on multi directional flows and observing its relation with the natural and built networks. While establishing criteria to evaluate the contribution of the urban environment to the climatic change, the definition of a common agenda between the several public administrations involved must be balanced by environmental rules, soil legislation and strategic land-use planning.

**0218**

**Coping with energy challenges in the peri-urban town of Epworth, Zimbabwe: Lessons from the poor**

Presentation type: Poster

Innocent Chirisa  
*University of Zimbabwe, Harare, Zimbabwe*

This paper examines how the poor in Epworth, a peri-urban town of Harare in Zimbabwe, are coping with the "energy crisis" they face as a daily challenge. More than fifty percent of the people living in Epworth live illegally, as it were. Efforts to upgrade this peri-urban town have been limited and ineffective; it continues to receive a new horde of illegal settlers who have to fend for themselves in order to make do with life including access to energy. Epworth has,

consequentially, so much been subjected to all forms of environmental degradation, deforestation ranking high in the list. With diminishing firewood, the poor peri-urban dwellers have embarked on finding sawdust from various source markets including Mbare in Harare and Ruwa, a sister peri-urban town with a host of timber and furniture manufacturing companies. With this sawdust and some firewood brought from the surrounding farms with just one piece of firewood is put together with some compressed sawdust and the fire is quite strong to do all the cooking and heating. Combustion efficiency may be high at the way households perceive it but the pollution effects of this technology remain unknown in terms of human health and the general environmental sanity. Through use of observation, and interviews with the poor in the peri-urban, the content of this article was constructed. One key lesson learnt is that the poor always find means to survive life pressures and that sounds quite work for them in their context. If only the same technologies could be applied, say in rural areas, that are suffering massive deforestation and its disastrous effects, then the problem of climate change due to indiscriminate cutting down of the trees might be put at bay.

**0219**

**Land use dynamics and their carbon footprints in the megacities of the monsoon Asia**

Presentation type: Oral

Chandrashekhar Biradar, Xiangming Xiao  
*University of Oklahoma, Norman, Oklahoma, United States*

Unprecedented urban and economic growth rates have occurred over the last 30 years in the monsoon Asia, and will continue as more and more people are moving from rural areas to megacities for jobs, access to city services, cultural and educational opportunities. The land use change in and around the megacities will have direct impact ecological footprint. The global average ecological footprint is likely to grow beyond Earth's carrying capacity. Long term monitoring of the megacities at spatio-temporal scale is critically needed to understand its impact and drivers. Satellite remote sensing plays an important role in quantifying land cover dynamics and their impact on the carbon footprint of the megacities and their fringe zone. The MODIS images enable multi-temporal analysis of the optical images for land use characterization at landscape level of the megacities of monsoon Asia. The research will address two key questions of land cover and land use change (LCLUC) such as; what is the magnitude of urban sprawl and vegetation in the megacities from 2000 to 2010? And how much vegetation productivity the megacities have? We also link human population dynamics associated with urban land-use changes, its magnitude and direction. The outcomes of the research will demonstrate the potential of time-series satellite images in understanding vegetation and carbon dynamics in the megacities in the monsoon Asia and the world.

**0220**

**Sustainable Urban Infrastructure in Developing Regions**

Presentation type: Parallel Session

Jonathan Barton  
*Instituto de Estudios Urbanos y Territoriales, UC, Santiago de Chile, Chile*

Infrastructure development is critical to the achievement of the Millennium Development Goals (MDG). The unmet demand for infrastructure to support the delivery of housing, transportation, energy and water services limits economic opportunity and is therefore a major barrier to the achievement of MDG1 (poverty and hunger reduction). Patterns of infrastructure development determine the environmental sustainability of economic growth (MDG7 - ensure environmental sustainability). In turn, eco-efficiency is a key criterion for the development of sustainable infrastructure, and therefore a key objective in developing, planning and building more sustainable cities. More eco-efficient infrastructure delivers higher-

quality services with less use of resources and low negative environmental impact, as well as lower vulnerability to natural disasters. Eco-efficiency can be measured using indicators that relate environmental impact (such as emissions of pollutants) or resource use (such as water or energy), to the service or economic benefit provided (such as passenger kilometers, in the case of transportation infrastructure).

In an era of rising natural resource prices and scarcity and increasing vulnerability to natural disasters and climate change, infrastructure eco-efficiency has long-term and significant impacts on both economic and environmental sustainability in all countries, but in developing and least-developed countries in particular. In the context of climate change, eco-efficient infrastructure development is also essential to the development of "low-carbon" economies. It also expands financing opportunities through the Clean Development Mechanism (CDM), on the basis of avoided greenhouse gas emissions.

The panel will present and discuss the findings and policies proposals of the ongoing research project on eco-efficiency in infrastructure development in Asia and Latin America. The project is being developed by UN-ESCAP and UN-ECLAC and seeks to promote the application of eco-efficiency as key criterion for sustainable infrastructure development and as a basis for expanding infrastructure financing opportunities.

## **0221**

### **Climate variability and urban floods in Bangui, Central African Republic**

Presentation type: Oral

Cyriaque-Rufin Nguimalet

*University of Bangui, Bangui, Central African Republic*

Bangui is located in perish-forest zone where the average annual rainfall is 1,500 mm, and its topography predispose to a runoff concentration in its marshy and plain area. This physical context shows the site's precariousness where the town was established before human occupation, then the growth led by the forms of spatial conquest. Urbanization, a social phenomenon, induces a physical transformation of landscapes, tidy or untidy. Last case convenes to the studied urban dynamics posing societal constraints. This work would like to determine rain risk and its interrelations with urbanization and/or climate variability in Bangui. Annual (1964-2009) and daily maximum (1964-1999) rainfall data were analyzed to follow/capture temporal variability and to calculate events' frequencies (GEV, Gumbel and Log Pearson III distributions). They were appreciated according to the *impluvium*, hydraulic networks in the exposed districts and the local resilience vis-a-vis floods. GIS considering the affected district's boundaries allowed the exhibition of flooding fields, exposure levels etc. at urban scale. So rainfall indexes more describe drier years (1967-1974 and 1980-1997) than humid (1975-1979); this rhythm did not affect the production of catastrophic rainy episodes leading to flooding in Bangui. This shows that climate variability has not modified the phenomenon occurrence although rainfall decline observed ( $r = 0.3$ ). In addition, maximum daily episodes of one (61-76 mm), two (86-88 mm) or fifty (169-175 mm) years' recurrences generate floods. That would be due to first the stormy character of events, then to deficit of urbanization reinforced by the site's precariousness. Moreover, GIS recalling the exposed districts in their anarchistic forms for some recorded events in Bangui (2005, 2007 and 2009) spread out the vulnerability of inhabited spaces (marshy zones depressed, flooding beds). These results translate the rain risk impact reinforced by the deficit of urbanization and the modifications of the urban soil use.

## **0222**

### **Towards Sustainable Water Resources for Arid Land Cities The Case of Riyadh**

Presentation type: Poster

Assaf Alhawas

*King Saud University, Riyadh, Saudi Arabia*

The Arabian Peninsula is a vast platform of ancient rocks. Structurally, it is composed of crystal-rock Arabian shield in the west, and a sequence of sedimentary formations of varying hydrologic characters named the Arabian shelf underlying the eastern parts. Owing to the aridity prevailing in the region, the peninsula is very poor in renewable water resources. Internal renewable water resources are estimated at 1577 m<sup>3</sup> yr<sup>-1</sup> per inhabitant. The total withdrawal of water is greater than the total actual renewable water resources. This applies great deal of stress on planning water resources and water use for development sustainability. Fortunate for the city of Riyadh water resources, it is located on the Arabian shield. Ground water sources are a major source of city potable and irrigation waters. Deep ground water sources supply the city more than 40% of its daily water consumption. But the recharge rate is way below the withdraw rate, annual PPT average 100 mm. However, the fast growth of the city is imposing serious challenges on water supply planning. The ground water sources by the city are exhausted, and their 40% share in city water supply is not tenable. The city planners are directed towards depending on an increasing share of desalinated seawater for the city supply. Expected city daily consumption of water in 2020 is 2343264 m<sup>3</sup> day<sup>-1</sup>, of which the current ground water supply is 20%. The rest is to be supplied from other sources. It is concluded that all other potential sources should be fully utilized in order to reduce pressure on ground and desalinated water sources, including cloud seeding, rain harvesting and water reuse. It is also recommended that huge amounts of water can be saved by maintaining the city distribution net, and by other means like water conservation propaganda to raise public awareness.

### **0223**

#### **Peri-urban expansion in China and India: A Comparative Analysis**

Presentation type: Oral

Jefferey M. Sellers, Jingnan Huang, T.V. Ramachandra  
*University of Southern California, California, United States*

Studies of their spatial expansion have been confined to one or at most a small number of cities.

As a result, little is known about how patterns of urbanization in different countries compare.

This study undertakes the first comparative overview of changing urban spatial patterns in the two largest urbanizing nations, China and India. The analysis examines patterns in parallel samples of ten cities in each country, ranging from the largest urban regions down to mid-sized cities with populations of one million. The data is processed from Landsat images of urban form at four time intervals from the end of the 1970s to the late 2000s. In both countries, the data shown an acceleration of urban expansion following periods of liberalization and decentralization, but this process began in the 1970s in China and in the 1990s in India. The territorial expansion of Chinese cities has also been much more dramatic in the fastest growing urban regions than the parallel processes in Indian cities. Further analysis of urban form shows that this greater expansion is also linked to denser urban development through large blocks of land, in contrast with the more piecemeal, more fragmented development of Indian cities. The analysis concludes with an examination of the national economic, institutional and other differences that help to account for the differences between urban forms in the two countries.

### **0224**

#### **Chinese Urban Form in the Past Three Decades: Pattern and Process**

Presentation type: Oral

Jingnan Huang, Jefferey Sellers, X.X. Lu  
*School of Urban Design, Wuhan University, Wuhan, Hubei Province, China*

With the growing acceptance of sustainable development, researchers have refocused on the old

topic of urban form. A "good city form" or "sustainable urban form" are believed to enhance economic vitality and social equity, and reduce the deterioration of the environment. Recent discussions of "urban sprawl" in the United States and the "compact city" in Europe have lent credence to this renewed issue. However, most of the urban form studies were limited to developed countries while in the developing countries with dynamic setting, researches about urban development pattern and its changes have been lacking. In the past three decades, China has undergone rapid urbanization and great socio-economic transition from planned economy to market economy, causing a intensive and radical urban form change. However, there is no a general, systematic and complete understanding of China's urban form change. Limited studies centered on individual cities or cities in the coastal regions, while inland cities were largely ignored. Moreover, most of the studies were traditionally qualitative rather than quantitative analyses. This research employs four time-series Landsat images, including late 1970s, late 1980s, late 1990s, and present to investigate the pattern and process of Chinese urban form in the past three decades. The chosen ten big cities include five cities in the coastal regions and the other five inland cities. A selection of spatial indicators are defined and computed in order to draw insights into Chinese cities' urban form. Comparisons of spatial metrics between coastal and inland cities and among four time periods are carried out. Socio-economic dynamics and mechanism are explored.

**0225**

**Sprawl and Urban Expansion in Indian Cities Since the 1970s**

Presentation type: Oral

T.V. Ramachandra, Uttam Kumar  
*Indian Institute of Science, Bangalore, India*

Indian cities are rapidly expanding, but up to now studies of their spatial expansion have been confined to one or at most a small number of cities. This study undertakes the first comparative overview of changing urban spatial patterns throughout urban India. The analysis examines data processed from Landsat images of urban form at four time intervals from the end of the 1970s to the late 2000s. Up until the liberalization and decentralization of the 1990s, the images point to a process of limited urban expansion in forms that remained largely centralized. Since 2000, and in some cities since 1990, the spatial expansion of built up areas has accelerated. These processes have concentrated in larger Indian cities. Although some cities have experienced an increasing consolidation of urban concentrations, others have sprawled along transportation corridors or extended the existing urban fringe. The patterns can only partly be explained by clear differences in foreign direct investment like those that distinguish Chinese urban regions. In some urban regions, planning and land transfer restrictions in the rural areas may have effectively limited urban sprawl.

**0226**

**Urban Expansion and Vulnerable Populations in the Chinese Context: A Pilot Research in Guangzhou**

Presentation type: Oral

Guo Chen  
*Michigan State University, East Lansing, United States*

The rapid outward expansion of urban space is one of the most visible changes in Chinese cities over the last two decades. Such rapid urban growth has been characterized by a restructuring of city centers and a major shift of people and economic activity toward outer city zones. At the same time, city economies and rural-urban migration have continued to grow at unprecedented rates. This has created tremendous strain on the environments surrounding cities. The growing importance of city fringes in absorbing the forces of industrial production, urbanization, and

migrant and city-born populations is accompanied by the specter of increasing inequality and deepening environmental degradation. In general, urban environmental degradation has the most immediate effects on poor urban residents. The urban poor in China are increasingly faced with social economic uncertainties and environmental problems due to the following two trends: (1) more and more low-income residents are pushed to the outer zones of cities due to raised property prices in the core, and (2) the fringes continue to absorb most of the rural-urban migrants to cities. Recent assessments by the World Bank (2005) have called for further analysis of urban expansion in the context of policies that affect rural-urban migration, the distribution of populations, and the process of urban development in individual cities and metropolitan areas. Understanding the factors that impact the livelihoods of populations living on city fringes is a critical policy priority. Specifically, this pilot case study in Guangzhou aims to describe the spatial patterns of vulnerable groups' locations and frequent land use change locales in a large metropolitan setting, based on the analyses of Remote Sensing images and population survey data collected in Guangzhou. The study concludes the findings with a discussion of potential drivers of land use conversions and their inauspicious impacts on the poor.

**0227**

**Urbanization and the changing nature of urban renewal policy of Lagos State Government 2007-2009**

Presentation type: Oral

Suraju Adebayo Adebowale, Gbenga Amos Oyenuga  
*SGBM Heritage Project Limited, Lagos, Nigeria*

Urbanization is increasingly having unprecedented impacts in most contemporary societies of the world. The accelerated effects of this social transformation have been linked to the increasing integration of economies of developing nations into the global capitalist system. As cities with million-plus number are multiplying, so also are their socio-economic predicaments increasingly daily. Slums and floods remain a few of the several problems they are facing causing loss of lives and property sometimes when the problems are not properly handled. Of all African cities today, Lagos is the only city that has attained the mega city status amidst underdevelopment problems such as insecurity of lives and property, urban violence, politically motivated killings, and poverty in the slum areas of the city. Since the end of Nigeria's independence in 1960, the city of Lagos has witnessed rapid urbanization feasible in her high level of population size, cultural heterogeneity, and intense internal and external migration. The consequences of all this, is that, today, the city of Lagos has continued to be a melting pot for most African people and Nigerians of different background. However, Fashola's urban renewal's policies have been received with mixed feelings. In order to capture these feelings, this study shall embark on an assessment of these policies using a cross sectional survey of 500 samples to be selected from the five geo-political divisions of the state. SWOT analysis shall be used in constructing and analysing the instruments so that we can determine the strengths, weaknesses, opportunities and threats of the government urban renewal programmes. Findings from this research is expected to help government strengthened her current efforts at actualizing the Lagos State Mega city projects in line with vision 20:2020

**0229**

**Harnessing the power of the invisible majority: The potential role of small- and medium-sized businesses in urban greenhouse gas management**

Presentation type: Oral

Sarah Burch, Heike Schroeder  
*Environmental Change Institute, Oxford University, Oxford, United Kingdom*

Cities are increasingly viewed as key players in responding to climate change, as they have both

direct control of critical sources of emissions and are the scale at which the potentially catastrophic impacts of climate change will play out. Nascent sub-national climate change policies are addressing urban emissions through awareness-based programs aimed at individuals and residential building stocks, transportation, regulatory measures targeting large industrial emitters, and a host of other strategies.

While large industrial emitters are the first to be required to report on their greenhouse gas (GHG) emissions, the invisible majority of commercial emitters are small- and medium-sized enterprises (SMEs) for which legislated GHG reductions are extremely unlikely. Novel partnerships and networks are emerging however, which align the goals of SMEs, municipal governments, and regional authorities in support of GHG management in cities. This paper attempts to map the landscape of these SMEs, unpack their varied engagement with climate change and examine the networks and partnerships in which they operate.

Based on this analysis, the paper argues for an expansion of the urban climate change research agenda that includes an examination of the drivers of these emerging partnerships. Rooted in an understanding of multi-level governance, and the role of non-state actors (such as municipal governments and the private sector) in climate change action, this new research agenda will facilitate a greater understanding of socio-technical transitions toward resilient, low-carbon development pathways in cities.

In expanding urban climate change research to explore partnerships that include SMEs, we will attempt to situate SMEs within the following questions: what are the political and legislative triggers of these emerging private/public sector partnerships? How can these arrangements help to manage or alter institutional path dependence in cities? What is the long-term potential for ongoing entrepreneurship supporting GHG management, and ultimately the mitigation of climate change?

**0230**

### **Governance and Institutions of Climate Change at National and Local Level: The Case of Zambia**

Presentation type: Oral

Jacob Chishiba

*Kaizen Consulting International, Lusaka, Zambia*

This paper aims to take stock of new national and local governance arrangements in the climate change domain emerging within Zambia. In focus are mechanisms for public participation, deliberation and network governance on the local level. The paper looks at the extent new governance arrangements such as climate change networks within and between communities may spur effective and legitimate climate policies which could provide opportunities to address issues of climate change adaptation, mitigation and advancing a green economy.

Governance challenges as a barrier to the implementation of REDD+ relate particularly to the centralised system of managing forest resources. Inadequate participatory forest management systems, including benefit-sharing mechanisms, may lead to conflicts that may hinder the implementation of REDD+. The challenges include matters of land tenure and land uses that are not easily resolved.

The large scale and cross-cutting nature of interventions required to implement REDD+ will necessitate high level government support and large scale cross-sectoral reforms. Preparation for REDD+ will require a specific set of interventions including inter alia:

- developing capacity from community to government level;
- strengthening of institutional, policy and legislative frameworks;
- strengthening the implementation of policy and enforcement of legislation;
- widespread sharing of knowledge on REDD+; and
- developing incentives for the adoption of alternative livelihoods and energy sources.

Stakeholder engagement analysis will be critical for the sustainability of the success of National REDD+ programme. Sustainability will depend on equitable and transparent benefit-sharing mechanisms. The benefits received by local communities will need to, at least, match the costs incurred by them in not undertaking deforestation and forest degradation. Its goal is to prepare Zambian stakeholders and institutions for effective future nationwide implementation of REDD+.

**0232**

**Climate Change in the Greater Toronto Area (GTA) Canada**

Presentation type: Oral

Monirul Mirza, Tanzina Mohsin, Adam Fenech  
*Environment Canada, Toronto, Canada*

Since 2007, more than half of the world population live in urban areas and within next two decades, more than three quarters of the world population will be living in urban areas and in Canada it would be more than 80%. As urban areas are expanding, climate of the cities are becoming very important for its growing population.

This paper is based on the recently concluded study on the climate change in the Greater Toronto Area (GTA) in Canada. The study considered climatological data for 10 meteorological stations in the GTA for the period 1971-2000. The stations have been classified into urban, sub-urban and rural stations. Analysis shows a consistent increase in annual mean temperature in the stations in these three settings. The study also examined a range of indicators for temperature related extremes. Average number of *warm extremes* based on maximum temperature has increased at the urban and suburban stations. *Cold extremes* based on minimum temperature have decreased at the urban and suburban stations. Annual precipitation in the urban areas shows a decreasing trend while it demonstrates in general an increasing trend in sub-urban and rural areas. *Heavy precipitation extremes* (e.g.20 mm) have increased in rural stations but decreased overall in urban and sub-urban stations. No observed trend found in *short duration extremes*. The *urban heat island* (UHI) at Toronto has been analyzed from a number of different perspectives. Annual mean temperature data from seven stations in the GTA are considered which show the influence of UHI at different distance from the city core. An important observation associated with the temperature change due to urbanization is that the local climate modifications that have occurred in large cities over the past century show similarities in terms of the expected change with projected future climate changes (IPCC, 2007).

**0233**

**Inter Local-Government Partnership for Environmental Management Under Indonesia's Rapid Decentralization: From Below or Above? Kartamantul (Greater Yogyakarta) and Jabodetabek (Jakarta Metropolitan Area) Compared**

Presentation type: Oral

Tommy Firman  
*Institute of Technology, Bandung, Bandung, Indonesia*

Under the new decentralization policy, local governments in Indonesia tend to be inward looking in orientation. Many local governments have exploited the local resources even more intensively, and they are not concerned with socio-economic conditions of the larger region in which they are located. Within the context of metropolitan areas, there has been almost no effective cooperation among the bordering districts and municipalities to promote the sustainable environmental development. There is a need to establish an effective metropolitan collaboration institution to improve regional competitiveness. Again this background, the paper will examine and compare

the institutional partnership and governance in two Indonesia's metropolitan areas, namely kartamantul (Greater Yogyakarta) and Jabodetabek (Greater Jakarta).

**0234**

**Quantifying short- and long-term climatic implications of urbanization: Multi-scale modeling of Atlanta and Phoenix urban environments**

Presentation type: Oral

Matei Georgescu, Mohamed Moustouai, Alex Mahalov  
*Arizona State University, Tempe, AZ, United States*

The local and regional-scale hydro-climatic impacts of land use and land cover change (LULCC) that result from urbanization require attention in light of future urban growth projections and related concerns for environmental sustainability. We address this matter via two examples. First, we illustrate consequences that result from long-term landscape change in a semi-arid urbanizing area (Greater Phoenix metropolitan area). Second we present immediate, short-term, impacts that result from the presence of an urban complex (Atlanta metropolitan area).

High-resolution (2km) numerical modeling experiments focused on the climatic effects of observed, multi-decadal, LULCC driven by the urbanization of Phoenix reveal a 0.12°C increase in regional-scale July 2m-temperatures for today's landscape relative to that of the early 1970's. Maximum local increases in 2m-temperature due to LULCC from the early 1970's through today, and separate from all other forcings, are in excess of 1°C and are found to occur over those regions of greatest urbanization. An enhancement of downwind precipitation is noted and the physical mechanisms involved (e.g., interplay between turbulent, meso-, and large-scales; precipitation recycling), related to the region's specific pattern of landscape change, are discussed.

On shorter time-scales, urbanization may modify the structure and/or impacts (i.e. enhance or diminish) of existing storms with potentially significant socioeconomic implications. We present one example of the short-term impact of the urban complex by means of high-resolution (2km) simulations focused on the disastrous 2009 Atlanta (Ga.) floods, a series of extreme rainstorms responsible for considerable loss of life and extensive damage. Our results indicate that the presence of the built environment of the Atlanta metropolitan area played a significant role in the enhancement of this catastrophic event.

**0235**

**The geography of greenhouse gases released from urban areas: A preliminary global analysis**

Presentation type: Oral

Andrea Sarzynski, Peter J. Marcotullio, Jake Garcia, Jochen Albrecht, Niels Schulz  
*Peter J. Marcotullio, New York, United States*

This research project estimates the urban share of global greenhouse gas emissions from 14 different sources and 6 pollutant categories over time (1990-2005) and presents the spatial distribution of these emissions. We also present a preliminary analysis of several explanatory variables for variations in emissions during the year 2000 amongst urban extents. Explanatory variables include urban form (urban population size, density) and socio-economic (GDP per capita and development status) characteristics. Results have both theoretical and policy implications.

**0236**

**Powering Accra: Projecting Electricity Demand for Ghana's Capital City**

Presentation type: Oral

Tyler Frazier<sup>1</sup>, Quang Bao Le<sup>2</sup>, Paul L.G. Vlek<sup>3</sup>

*1Technische Universität Berlin, Berlin, Germany, 2ETH Zürich, Zürich, Switzerland, 3Center for Development Research (ZEF), Bonn, Germany*

The purpose of this research was to create an agent-based urban simulation based on land use at the plot level for projecting the disaggregated electricity demand of the Greater Accra Metropolitan Area (GAMA). A simulation system comprised of location choice, regression, and simple models were used to project household, employment and land development decisions.

Households, persons, and jobs tables were synthetically generated from GLSS5 (Ghana Living Standards Survey 2005) data using Stata, built in a MySQL database and incorporated for use in the Open Platform for Urban Simulation (OPUS). Electricity demand was projected for each of the simulation years based on a regression model. Numerous geospatial datasets were projected and edited in ArcGIS which describe the physical composition of Accra in its totality, including buildings, roads and electricity infrastructure. Household mobility was estimated from a modified Cox Regression of residential mobility in Accra (Bertrand et al.) and applied to the GLSS5 for use in the location choice model, while employment coefficients and parameters describing land value were derived from literature (Buckley et al.). The model has been applied for projecting the electricity demand of the Korle Bu district in terms of high, medium and low economic and population growth rates for the time period 2006 until 2025, based on monthly electricity consumption per meter. An additional phase of this research envisions including all 12 GAMA districts (using data which has been obtained); infrastructure models to project demand for transportation, water & sewer, and solid waste facilities; as well as comparing weak and strong sustainability scenarios with the business-as-usual development path for cost-benefit analysis of proposed public policies.

**0237**

**Comparison of Greenhouse Gas Emissions from Urban and Peri-urban Areas in India and China**

Presentation type: Oral

Peter Marcotullio

*Hunter College, New York, United States*

This research examines the trends in GHG emissions (in CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub> and SF<sub>6</sub> from 14 sources aggregated to six: agriculture, transportation, industry, energy, residential and waste) released from cities in China and India. It presents comparisons to national rates (per capita) and by city size, growth rate and density. The research also examines GHG emissions in peri-urban areas (defined by areas surround major metropolitan centers) and compares release rates.

**0238**

**Global change and strategy for urban sustainability-- A case of Shanghai, China**

Presentation type: Oral

Xiangrong Wang

*Fudan University, Shanghai, China*

Global change has been no doubt a world wide focus for governments, international organizations and scientists in recent years, especially after Copenhagen Climate Conference in 2009. The fourth assessment report of the IPCC (2007) stated that globally, average surface temperature has been increased 0.56 to 0.92°C throughout the past century. This makes the 20th century possibly the one with the most obvious temperature increase in recent centuries. Global warming will bring tremendous impact on global ecosystems. As a unique natural

ecosystem, estuaries have abundant nutrients, high biodiversity and varied ecological environment. The impact of global climate change on such areas is most directly and severe, and at the same time, with the most obvious change, which makes the research here especially important and urgent, it is the foundation to understand estuary eco-vulnerability under global climate change.

On the basis of analyzing the impact of global climate change and strategy of some estuary cities and regions in the world, the strategies for sustainable estuary city were studied by taking the city of Shanghai as an example in this paper. Shanghai is the economic center of China with population over 20 million, and is located at the largest continent (Eurasian) and at the mouth of the largest river (Yangtze) into the largest ocean (Pacific). The special location has endowed it with perfect combination of continental and oceanic characteristics. We identify the spatiotemporal distribution features of climate change and potential impacts caused by a variety of climate change scenarios, key factors affecting the Yangtze estuary city of Shanghai and analyze its eco-vulnerability zoning and strategy for urban sustainability.

**0239**

### **Sustainable Infrastructure in North America - Lessons for Latin America**

Presentation type: Oral

Roberto Sanchez-Rodriguez

*El Colegio de la Frontera Norte, Mexico and UC Riverside, USA*

There is an impressive array of green and sustainable infrastructure initiatives in the U.S. and Canada. The business community has been a major actor in the development of green technology for urban infrastructure through the development of technologies, products, and services. But despite this array of initiatives, the majority of cities and municipalities in the two countries have fragmented approaches for the development of green infrastructure, or they have not incorporated this concept as part of their development strategies. Green infrastructure has been adopted as an ad hoc basis for only specific issues, but not as part of an integrated plan towards sustainability. Only few cities have achieved a coherent integration of green and sustainable infrastructure in their plans for urban growth and the efforts to build a sustainable future for their communities and promote green infrastructure.

**240**

### **Implications of fast urban growth for freshwater provision**

Rebecca Hale

Arizona State University

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**241**

### **Visualizing carbon footprints for travel behavior at the household level**

Subhrajit Guhathakurta<sup>1</sup>, Sebastian Petsch<sup>2</sup>, and Hans Hagen<sup>2</sup>

<sup>1</sup>Arizona State University, <sup>2</sup>Technische Universität Kaiserslautern

This paper presents a novel approach for calculating carbon footprints for household travel behavior in an urban region. We use Maricopa County, Arizona, USA as our study area to demonstrate this approach. By incorporating travel behavior, we extend our previous work in estimating relevant carbon emissions from household consumption and energy needs (Petsch et al. 2009). The travel related CO<sub>2</sub> emissions would be the third and last component for measuring the total carbon footprint at the level of individual households in Maricopa County. Based on data from the Maricopa Regional Household Travel Survey from 2001 and an underlying street network data for Maricopa County, we provide information on travel behavior, such as travel time and distances, for different categories of households, depending on income levels and race/ethnicity. In addition, we are able to show the spatial distribution of CO<sub>2</sub> emissions

depending on these different household attributes. We then use novel visualization techniques to represent the results in three-dimensions, which allow for highlighting the spatial component of our carbon footprints (Petsch et al. 2008). The ultimate objective is to derive parameters for simulating carbon footprints for future scenarios of growth in Maricopa County under different planning approaches.

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