IHDP Open Meeting 2009

7th International
Science Conference on the
Human Dimensions of
Global Environmental Change

26-30 April 2009
World Conference Center Bonn
UN Campus
Bonn, Germany

The Social
Challenges of
Global Change

IHDP Secretariat | Hermann-Ehlers-Str. 10 | D-53113 Bonn | P +49 (0)228 815 0600 | F +49 (0)228 815 0620
www.openmeeting2009.org | openmeeting@ihdp.unu.edu

Time: Monday 27 April, 14:00 - 15:30. Session: B070

New Directions for Urban Remote Sensing for Sustainability Science: Old Questions, New Approaches, and Remaining Gaps

Location: TNT Altestenrat

Convenors: Michail Fragkias and Lela Prasad, Arizona State University; Karen C Seto, Yale University, United States; and Maik Netzband, University of Leipzig, Germany

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. Major questions posed in the session include: 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?

Urban Sprawl Impact on Natural Resources

Presenter: Ramachandra T.V., Indian Institute of Science, India
Authors: Ramachandra T.V. (1), Uttam Kumar (1)
Indian Institute of Science, Bangalore, India (1)

Urban sprawl refers to the dispersed development along highways or surrounding the city and in rural countryside with implications such as loss of agricultural land, open space and ecologically sensitive habitats. Sprawl is thus a pattern and pace of land use in which the rate of land consumed for urban purposes exceeds the rate of population growth resulting in an inefficient and consumptive use of land and its associated resources. Sprawl is a consequence of unplanned urbanisation. Urbansiation process is very rapid with urban population growing at around 2.3 percent per annum. This unprecedented urbanisation trend consequent to unplanned developmental activities with burgeoning population has posed serious challenges in the city planning and management involving plethora of issues like infrastructure development, traffic congestion, and basic amenities, etc. In this context, to aid the decision makers in following the holistic approaches in the city and urban planning, the pattern, analysis, visualization of urban growth and its impact on natural resources has gained importance. This communication, analyses the urbanisation pattern and trends using temporal remote sensing data based on supervised learning using maximum likelihood estimation of multivariate normal density parameters and Bayesian classification approach. The technique is implemented for Greater Bangalore - one of the fastest growing city in the World, shows that there has been a growth of 466% in urban areas of Greater Bangalore across 35 years (1973 to 2007).

Monitoring the extent and intensity of urban impervious surface using the fusion of MODIS 500m resolution satellite imagery and ancillary data sources

Presenter: Annemarie Schneider, University of Wisconsin-Madison, United States
Authors: Annemarie Schneider (1), Mark Friedl (2)
University of Wisconsin-Madison, Madison, Wisconsin, United States (1), Boston University, Boston, Massachusetts, United States (2)

The human dimensions of global environmental change have received increased attention in policy, research, and even the media. However, the influence of urban areas in global change processes is still often assumed to be negligible. Although local environmental conditions such as the urban heat island effect are well-documented, little or no work has focused on cross-scale interactions, or the ways in which local urban processes cumulatively impact global changes. Given the rapid rates of rural-urban migration, economic development and urban spatial expansion, it is becoming increasingly clear that new ways to measure and monitor the footprint of cities are critical. Currently available datasets - often derived from census data) provide very poor estimates of urban impervious surface area, and virtually no information on geographic variations such as housing density or urban vegetation. Building on our early efforts with MODIS data, we have recently completed a new, validated map of the extent and intensity of global urban impervious surface at 500m spatial resolution using moderate to coarse resolution satellite imagery. A technique called boosting is used to improve classification accuracy and provides a means to integrate 500 m resolution MODIS data with ancillary data sources, while inter-annual and inter-year variability in 'greenness' are exploited to produce subpixel, continuous measures of urban "intensity". When compared against a global sample

of 150 cities that vary in population size, level of economic development, and spatial extent, our results show good agreement with the expected urban morphology in each region.

The 100 Cities Project - Sensing for Solutions, Bridging Cities and Science

Presenter: Lela Prashad, Arizona State University, United States
Authors: Lela Prashad (1), Phil Christensen (1)
Arizona State University, Tempe, Arizona, United States (1)

The 100 Cities Project at Arizona State University is a NASA-sponsored project and was initiated by ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) Team Member Philip R. Christensen in 2002 to collect daytime and nighttime ASTER data over 100 urban centers. The 100 Cities Project is a platform designed to bring policymakers and researchers together to apply urban remote sensing to the problems of urbanization, the environment, and sustainability.
We seek to create meaningful partnerships with cities internationally. Our goals are to:
• Make urban remote sensing products and processes useful and available to cities for planning and policy making through outreach and partnerships.
• Use mapping and modeling results of our urban remote sensing research to advance the understanding of urban development trajectories and urban "futures".
• Develop an international network of urban data providers, researchers, and end-users to rapidly disseminate and archive data, analytical approaches, and results.

We have collected data for all 100 Cities to compare effects of urbanization and supply the international community with standardized urban remote sensing datasets. This includes temperature, vegetation, land classification, and social data. We also provide timely and continuous monitoring of rapidly urbanizing regions using ASTER (and other) remotely sensed datasets. These remote sensing and GIS data for all cities will be available for public analysis on a web mapping interface at our website: http://100cities.asu.edu/.

Identifying the Poor in the Cities - How can Remote Sensing help to profile poverty (slum dwellers) in megacities?

Presenter: Maik Netzband, University of Leipzig, Germany
Authors: Maik Netzband (1), Ellen Banzhaf (1)
Helmholtz-Centre for Environmental Research Leipzig, Leipzig, Germany (1)

Addressing the question 'Is the world urbanizing in a context of poverty?' has been so far based on limited information. There is only poor scientific and operational knowledge of this process. Urban growth & land consumption patterns are poorly understood (i.e. costal cities are growing faster; they are disproportionately urban and with higher densities). Thus, the available information is inadequate for policy & 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 to document the 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 asses and evaluate intra-urban patterns as well as trends in slums across cities it is planned 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 laid on experiences in 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 giant and fast growing urbanized regions.

Urban Remote Sensing in the 21st Century: Challenges for Monitoring Rapidly Changing Landscapes

Presenter: Karen Seto, Yale University, United States
Authors: Karen Seto (1), Alexandre Boucher (2), Collin Cronkite-Ratcliff (2)
Yale University, United States (1), Stanford University, United States

Two of the biggest challenges in urban remote sensing are how to map urban growth dynamics and assess the accuracy of change detection results. Some cities are growing rapidly and require frequent acquisition of satellite data over short time intervals. For example, mapping the land-use dynamics of fast growing Chinese cities require the use of inter-annual images. Using only a few images to describe these cities' growth patterns will not adequately reflect the temporal and spatial patterns of change. Yet, most remote sensing urban change studies utilize only two or three satellite images because a majority of image processing algorithms are designed to analyze landscape change between two periods. Computationally, the same image processing algorithm can be applied to more than three images, but their repeated application can introduce errors. Therefore, it is important to use algorithms that process all the images simultaneously rather than sequentially or in a pair-wise fashion. Such algorithms do exist and more are currently being developed, but their use is limited to a small community of specialized researchers. With increasingly long time series of images, change detection accuracy should be evaluated not for two or time periods, but should include multiple time points. That is, one must ensure accuracy through time. Temporal accuracy becomes as important as spatial accuracy, especially when linking landscape changes with policy or socioeconomic data. In this paper, we discuss some of the challenges to identifying urban growth in fast changing landscapes and offer suggestions for future research.