Urbanization: An influence on EarthCube

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The overall concept of the EarthCube CyberInfrastructure for Geophysics should recognize that a very small percent of the surface area of the earth has a disproportionately large human population and a disproportionately large impact on the global geosphere. This disproportion will have an effect on the amount of data to be managed, resolution requirements, simulation tools, and analysis refinements.

The unifying EarthCube architecture will constantly be adjusted based on inputs from not only the users, developers and data providers but also from the stakeholders who have a vested interest in the positive outcomes resulting from its development. It is the responsibility of the scientists and engineers who are intimately involved with the creation of the EarthCube to engage in stakeholder interactions with the broader community to both educate them and be educated by them regarding EarthCube's architectural vision. This sort of "out of the cube" procedure is very

important considering the sensitive role of human activity to global change. In this manner, EarthCube's construction will be molded with a burgeoning society's interest in mind in order to be effectively utilized by risk aware decision makers.

The United Nations estimates that about half the world's population now lives in urban areas and about 70 percent will be city dwellers by 2050. This will require the doubling of city infrastructures. It also estimates that the number of "megacities" with over 10 million people will increase from 19 to 27, while the number of people, living in non-urban environments will continue to decline over the next 40 years [1]. The current urban population is estimated to produce about 75% of all greenhouse gases, yet occupies only about 3% of the earth's surface area [2]. Most megacities are located in environmentally sensitive coastal zones [3], which are also subject to flooding due to global warming and rising sea levels.

Urbanized areas have received increased attention in the area of environmental research due the growing challenges urbanized areas face [4,5,6,7,8,9,10,11,12]. The findings of these researchers suggest a much broader range of structural and functional relationships than is often assumed for urban ecological systems where surprising relationships emerge. Additional factors that require attention are the suitability of land-use models, the diversity of soils, the potential for urban carbon sequestration as well as lags between social patterns and vegetation, the biogeochemistry of lawns, ecosystem nutrient retention, and social-biophysical feedbacks. Consequently, urban environmental research is shifting focus from understanding isolated processes embedded within cities to integrative studies of urban areas as biophysical-social-and ecological complexes [13, 14, 15, 16, 17]. The complex interaction between urban and the supporting non-urban buffer areas necessitates nested analyses on multiple spatial domains, where traditional Earth System representation provides boundary conditions.

The New York City Metropolitan Area was the first acknowledged mega city in the world with a population in 1950 of 12,463,000 [18]. Its current population is estimated to be 22,262,000 people [19]. In 2006, Mayor Michael R. Bloomberg challenged New Yorkers to generate a plan for achieving key goals for a sustainable future. The result was PlaNYC, a comprehensive plan focused on five factors: land-use, air quality, water quality, transportation systems, and energy efficiency. Key goals were to identify actions to be taken to ensure a higher quality of life for future generations of New Yorkers, build the infrastructure to support an additional one million inhabitants, and reduce energy consumption and global warming emissions by 30% over the next twenty years. An equally important goal was to define a model for 21st Century planning to be used by other mega cities around the world. This research requires a multi-disciplinary approach that brings together economists, urban planners, ecologists, hydrologists, sociologists, as well as political scientists to fully understand the mechanisms and interactions of the various physical and social actors in this arena.

The City University of New York (CUNY) is the largest urban university in the United States with approximately 260,000 students in degree programs and another 250,000 in non-degree programs. A major research thrust at CUNY is the study of the impact of urban human activity on the global, regional, and local environments. CUNY researchers are leaders in the study of the impact of human activities on the metropolitan ecosphere. Their activities include the acquisition

and analysis of fine-scale data on land use, hydrology, solar radiation, energy consumption, atmospheric conditions, and the land-ocean-atmospheric interface. They are the developers and stewards of many unique sensor and data acquisition systems required for obtaining the fine-scale data required for creating and making use of improved models of the impact of human activity on the ecosystem. The increasing amount of high resolution micro-scale environmental information available from dense sensor networks coupled with regional and global surveying systems enables investigators to simultaneously look across multiple scales to uncover patterns and develop scientific methods that can be applied to advance urban systems engineering and urban science. CUNY researchers have extensive collaborations and share data with the following organizations:

- NYC Government Offices
- NASA Goddard Institute for Space Studies
- National Oceanographic and Atmospheric Administration
- National Aeronautics and Space Administration
- United States Geological Survey
- Geophysical Fluid Dynamics Laboratory
- Center for Maritime Systems, Stevens Institute of Technology
- NOAA CREST Institute (CUNY, Columbia University, University of Wisconsin, Bowie State, University of Maryland, University of Puerto Rico-Mayaguez, Hampton University, California State Los Angeles)
- University Transportation Research Center (UTRC)
- Raytheon
- Northrup Grumman
- Earth Networks
- Earth Resources Technology

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