

# Some Personal Perspectives on the Evolution and Future of Global Change Research and Science

Tom Wilbanks  
Oak Ridge National Laboratory

Workshop on Frontiers of Global Change  
Science, Aspen Global Change Institute

Aspen, CO

August 2014



**Climate Change  
Science Institute**

AT OAK RIDGE NATIONAL LABORATORY



**OAK RIDGE NATIONAL LABORATORY**  
MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY

# The Questions Posed by This Workshop Are an Interesting Temptation to Reflect:

- Started graduate school fifty years ago interested in what we now call global sustainability: how society, nature, and technological change combine to shape human progress
- Found a lot of compelling places to start, e.g.:
  - Society and technological change: Lewis Mumford
  - Complex social systems: Talcott Parsons
  - Environment and economics: Howard Odum, Kenneth Boulding
  - Human responses to environmental stresses: Gilbert White
- Most were broad conceptual framings, not based on contemporary empirical research except for Gilbert White and his students and to some degree Odum



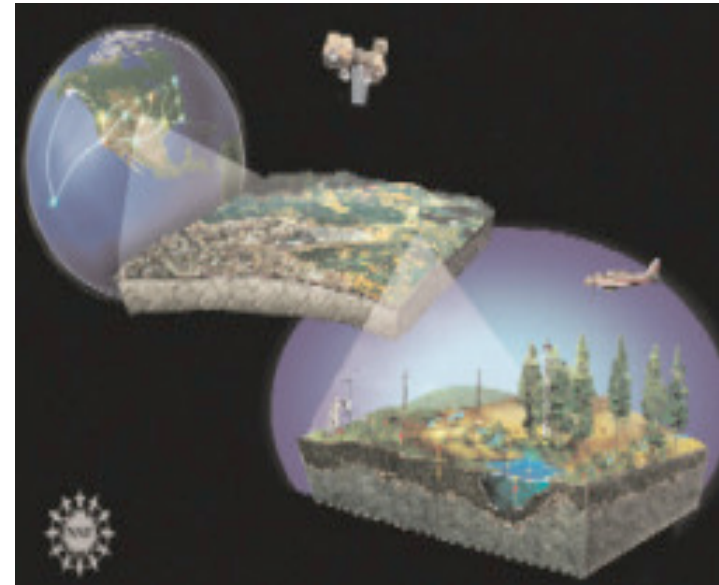
# Since That Time, What I Study and How I Work Have Been Transformed Almost Unimaginably:

- **Changes in how we view the systems that we care about**
- **Changes in the global processes that concern the society around us**
- **Changes in the tools available to us for data gathering and analysis**

**-- Even though the underlying concerns have not really changed...**

# Changes in How We View the Systems That We Care About:

- As we have dug deeper with our observations, we have found ever-greater complexities within and between systems
- Adding to what we know, what we know that we do not know, and more things that we are uncertain about
- The systems have not necessarily become more complex, but we have increased our appreciation for their complexities and the challenges of understanding them in comprehensive, integrated ways – often increasing uncertainties...
- More emphasis on large interdisciplinary team projects, from biocomplexity to IAM





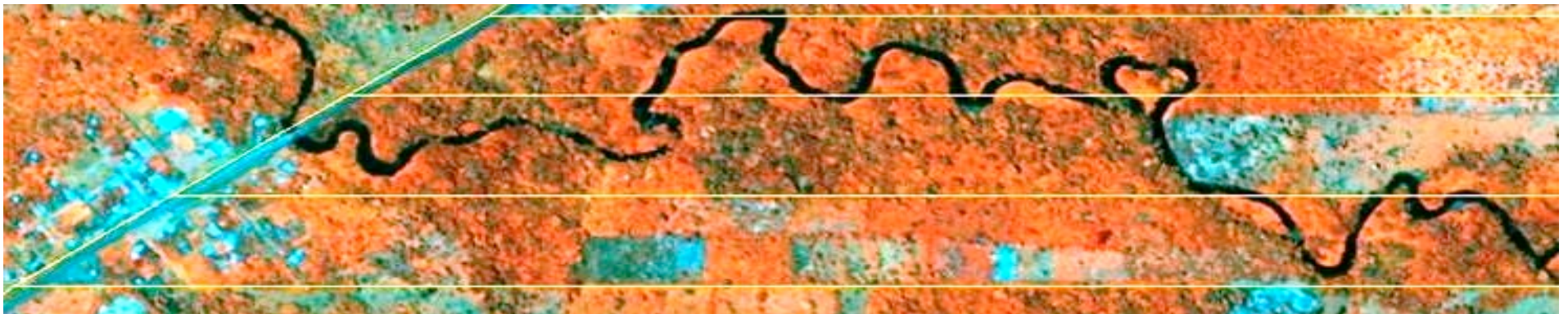
# Changes in the Global Processes That Concern the Society Around Us:

- **Changes in the global processes that matter:**
  - Globalization of economic systems
  - Globalization of threats to security other than from nuclear war
  - Globalization of threats to health: e.g., HIV, influenza, Ebola
  - Globalization of environmental threats: climate change...
  - Globalization (and acceleration) of science and technology development
- **Implications of these changes:**
  - Expansion of options for livelihoods and lifestyles
  - Expansion of awareness of information and events, including both things we can find out about to things we worry about
  - Heightened sense of regional differences in comparative advantages for job creation and well-being



# Changes in the Tools Available to Us for Data Gathering and Analysis:

- New capacities for gathering information: remote sensing, sensors
- New capacities for recording and storing information
- New capacities for analyzing information: the computing/IT revolution
- New paradigms and terminologies for addressing our topics
- New capacities for communicating information, from television to social media



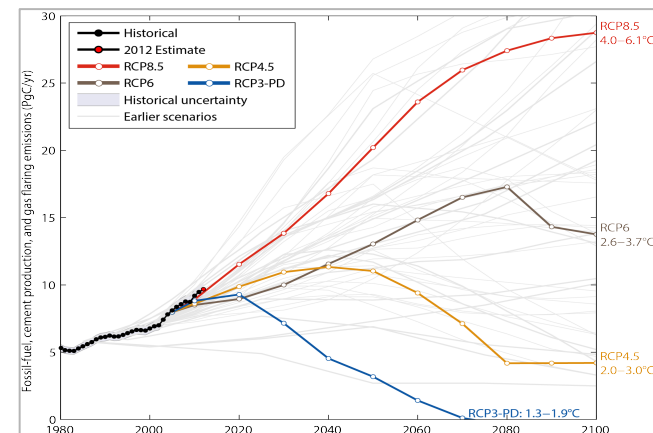
# Where My Parts of Global Change Science Are Going Over the Next Generation or Two:

- **Changes in driving forces that shape support for and uses of our science**
- **Further changes in the assets available to us to support scientific progress**

**-- Even though the underlying concerns are not really changing...**

# Changes in Driving Forces That Shape Support for and Uses of Our Science (I):

- **Event-driven agendas, focused on societal attention to big issues related to our science: e.g., how bad is climate change becoming? Is it time for geoengineering? What is happening with global population growth: pressures on resources, waste generation, institutional performance, equity? Where are resources and their services facing limitations in abundance, reliability, and affordability? What are emerging crises related to security, health, well-being?**





# Changes in Driving Forces That Shape Support for and Uses of Our Science (II):

- Accelerating emergence of advanced IT/computational technologies and capacities
- Issues related to science as a threat: e.g., genetic engineering, privacy, nanobiology
- Demands and potentials for linking process paradigms with spatial paradigms, related to increasing expectations of visualization for both heuristics and communication
- Chronic budget constraints: e.g., facing increasing questions about the value from and priorities for investments in our science, with relevance more important as a priority for funding – “if it’s not contributing to making the world better, what’s the payoff?” – “don’t obsess about uncertainties, give us useful advice” – maybe a shift away from a focus on reducing uncertainties toward developing robust strategies for action given uncertainties



## Further Changes in the Assets Available to Us to Support Scientific Progress:



- Large-scale computational modeling of complex issues not amenable to experimentation – virtual disappearance of limits to computational capacities; new capacities for examining multiple drivers, complex feedbacks, non-linearities, discontinuities (e.g., tipping points), multi-criteria optimization, increasing potentials for linking different forms of data
- Advances in observational data gathering: e.g., NYC Center for Urban Science and Progress (CUSP)
- Increased democratization/participation in global change analysis: linked with the IT revolution, with a much more widespread awareness of issues, knowledge, and who is doing what – more co-production of knowledge?

# A Few Final Reflections:

- **A danger that growing quantitative data sources and growing quantitative analytical capacities will move science even farther away from global change issues that cannot be fully captured by quantitative metrics**
- **The possibility (likelihood?) that increasingly complex issues and their societal importance will continue to move more of global change science and research in the direction of work by large multidisciplinary teams**



# A Few Ideas for AGCI Workshops:

- **Large-scale computational simulation of geoengineering interventions and their implications**
- **Improving the capacity to anticipate tipping points in earth and human systems**
- **Frontiers in visualization for global change science, from heuristics to communication**
- **Incorporating qualitative issues and data in global change science**
- **Improving the understanding of process linkages that cross geographical scales**

# A Few Added Perspectives on Where Research on Urban Areas and Processes Fits into This Picture

Tom Wilbanks  
Oak Ridge National Laboratory

Workshop on Frontiers of Global Change  
Science, Aspen Global Change Institute

Aspen, CO

August 2014



**Climate Change  
Science Institute**

AT OAK RIDGE NATIONAL LABORATORY



**OAK RIDGE NATIONAL LABORATORY**

MANAGED BY UT-BATTELLE FOR THE U.S. DEPARTMENT OF ENERGY



# For Decades, Urban Areas and Processes Were at the Margins of Attention to Core Issues in Global Change:

- Traditionally, largely overlooked as priorities for global change research as a scattering of localized phenomena: not a sector, not a discipline, rather untidy to study, more engineering than science, lacking sustained sources of research support....
- But they are often at the heart of the kinds of vulnerabilities and impacts that most people care most about: comfort, convenience, mobility, labor productivity, security, ....
- For example, “Urban” was not defined as a chapter topic in IPCC Working Group II until the Fifth Assessment Report, 2014, or of a US National Climate Assessment until the third NCA, 2014

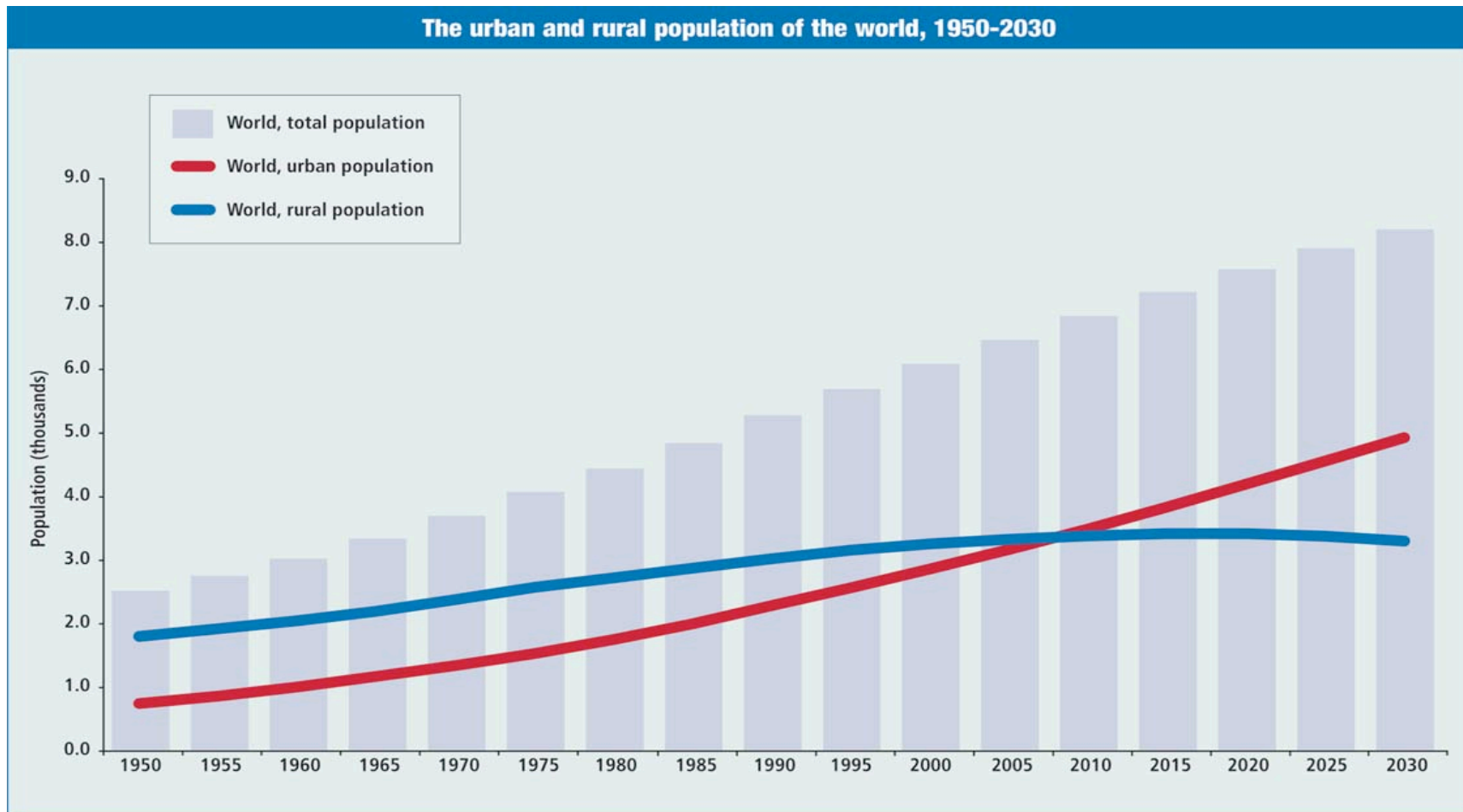


# Why Are Urban Areas a Topic of Particular Interest (I):

- Where most of the earth's population live
  - Urban population growing rapidly
  - In 2008, for the first time more than half of the world's population is living in cities and towns
  - Most of the growth in urban areas in developing countries: UN: world urban population from 1.9 billion in 2000 to nearly 4 billion in 2030; Africa and Asia urban proportion growing from 39% in 2000 to 54/55% in 2030



## Why Are Urban Areas a Topic of Particular Interest (II):



Urban & rural population of the world, 1950-2030. Source: UN Population Division

## Why Are Urban Areas a Topic of Particular Interest (III):

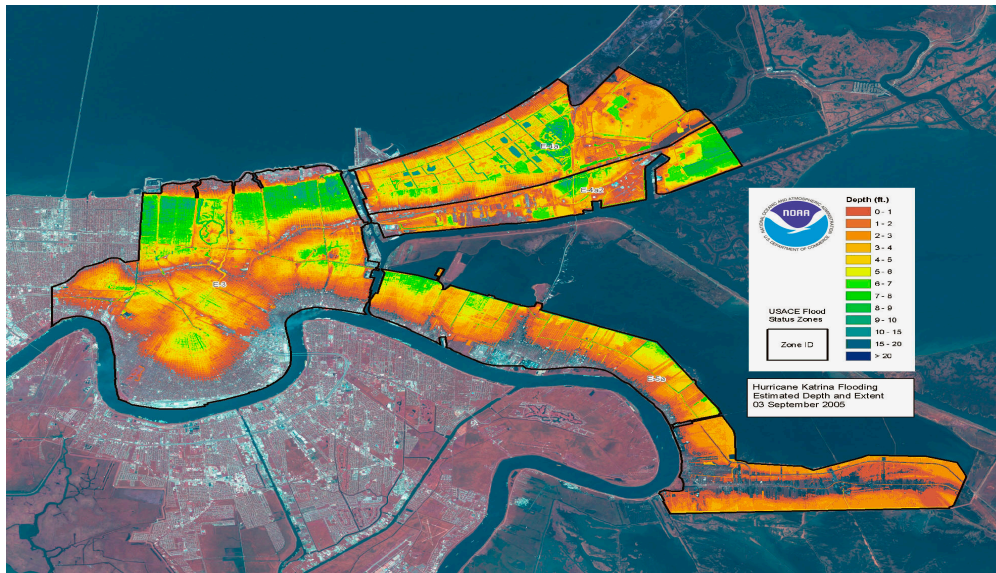
- Population concentrations present special risks of human system catastrophes from major global change events
- Often are the location of a large share of a nation's most disadvantaged citizens





# Why Are Urban Areas a Topic of Particular Interest (IV)?

- Often located in areas vulnerable to climate change impacts
  - Coastal areas and river valleys
  - Areas where regional climate-related resources face increasing competition with population and economic growth
  - Areas where the economic base is rooted in climate-sensitive sectors



*Flood depths in New Orleans on September 3, 2005, five days after flooding from Hurricane Katrina, in feet (0.3 meter) (Source: [www.katrina.noaa.gov/maps/maps.html](http://www.katrina.noaa.gov/maps/maps.html)).*

# Why Are Urban Areas a Topic of Particular Interest (V)?

- A focus of many driving forces for global change responses at regional and national scales
  - Financial centers
  - Industrial centers
  - Media centers
  - Innovation centers
  - Democratic decision-making: one person/one vote





# So Urban Areas Matter, and a Number of Significant Institution-building Initiatives Are Under Way:

- **Including:**
  - IHDP Urbanization and Global Environmental Change Project (UGEC)
  - Urban Climate Change Research Network (UCCRN)
  - NSF Urban LTER Sites: Phoenix and Baltimore, plus ULTRA since 2009
  - IIED, London: major programs, including the journal *Environment and Urbanization*
  - ICLEI: Local Governments for Sustainability
  - Rockefeller Foundation's Asian Cities Climate Change Resilience Network
  - START – Cities at Risk: Developing Adaptive Capacity for Climate Change in Asia's Coastal Megacities
  - NYU Center for Urban Science and Progress (CUSP)
  - Development of a number of urban area climate change adaptation strategies
  - Recent US agency interests in vulnerabilities of urban areas to disruptive extreme weather events – and strategies to increase their resilience
- **AGCI was an early player in this arena:**
  - The 1997 initial National Climate Assessment meeting at AGCI identified as the highest research priority for impact-related climate science: “integrating human and natural systems to understand climate change,” with a particular focus on “urban services”
  - Led to a 1999 AGCI workshop on “Integrating Human and Natural Systems to Understand Climate Change Impacts on Cities” – well ahead of its time, led directly to such initiatives as the Boston CLIMB assessment (Lakshmanan, Kirshen, Ruth)

## Stimulated by a Succession of Disruptive Events in Recent Years:

- Extreme weather events, such as Hurricanes Irene and Sandy, regional droughts, and wildfires – and growing concerns about such vulnerable areas as densely-populated Asian mega-deltas and the US Gulf Coast
- Failures of aging urban infrastructures under stress, combined with challenges (at least in the US) in finding public sector funding to address such problems
- Terrorism and other forms of urban conflict
- Epidemics
- Severe economic downturns

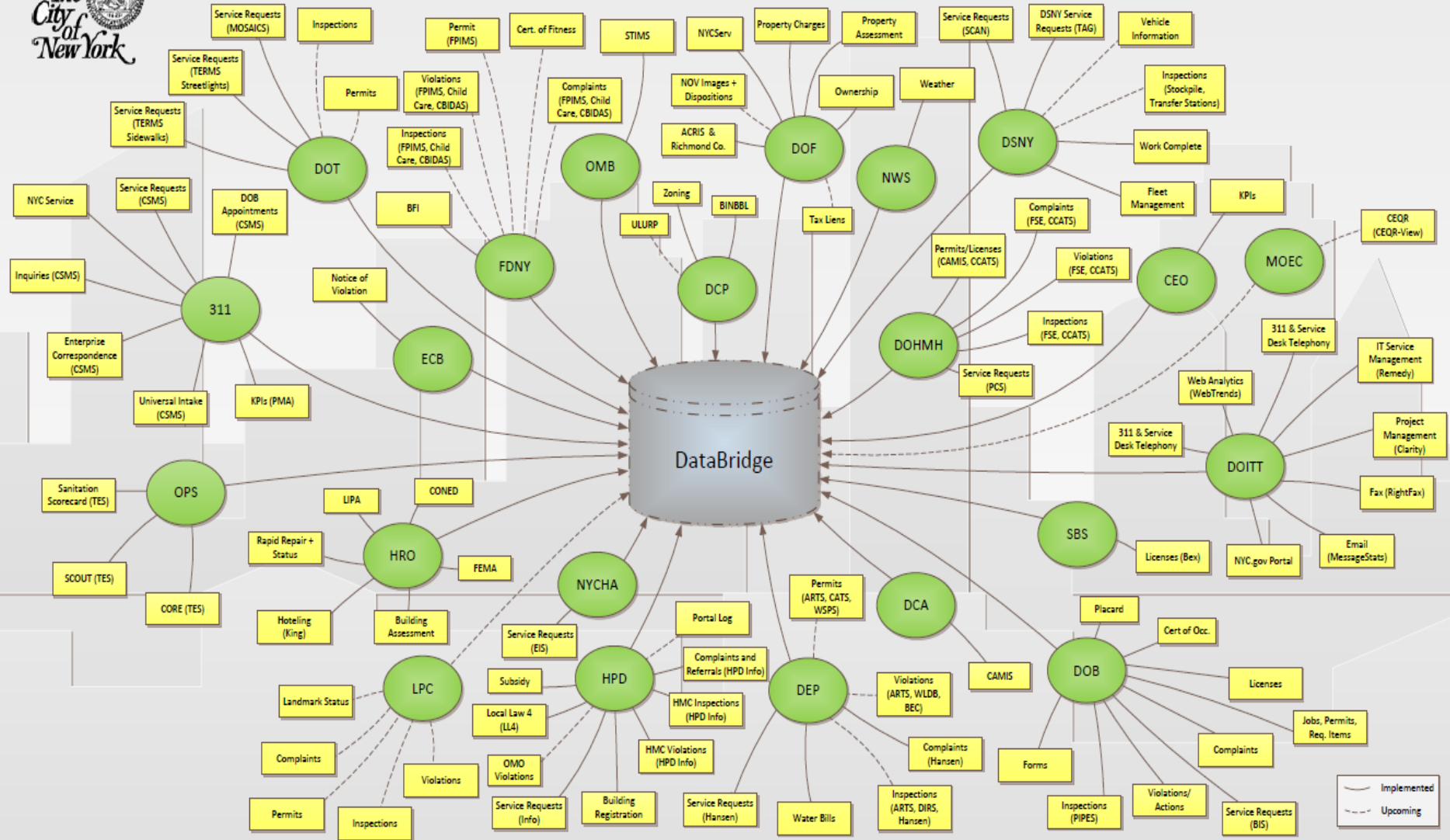
# Among the High-priority Directions for Urban Research in the Next Several Decades Are:

- Vastly improving the understanding of resilience as an attribute of urban areas and urban infrastructures – and how to enhance it
- Improving the understanding of complex linkages among urban systems and infrastructures and potentials for cascading impacts of disruptions
- Pursuing synergies between climate change adaptation and mitigation in urban areas
- Considering possible requirements for transformational changes in urban areas facing threats that probably cannot be addressed by incremental changes
- Monitoring adaptation/resilience actions and their effectiveness – and spreading the word about success experiences
- Modeling urban microclimates to inform responses to climate and weather risks and costs
- Linking improved sensor capabilities with real-time resilience enhancement and quality of life improvement



# Office of Analytics – DataBridge Store

May 2013  
v 1.4



## Agency Applications

311 Customer Service Systems (CSMS)  
Asbestos Reporting and Tracking System (ARTS)  
Automated City Register Information System (ACRIS)  
Building Information System (BIS)  
Business Explorer Tool for Licenses (Bex)  
CEQR-View - City Environmental Quality Review System (CEQR)  
Childcare Automated Tracking System (CCATS)  
Clean Air Tracking System (CATS)  
City-Wide Agency Management Information System (CAMIS)  
Coordinated Building Inspection and Data Analysis System (CBIDAS)

Daily Inspection Reporting System (DIRS)  
DEP Complaint System (HANSEN)  
Electronic Fax System (HighFax)  
Email Service (MessageStats)  
Fire Prevention Information Management System (FPIMS)  
Food Service Establishment (FSE)  
Hotel System (King)  
HPD System (HPD Info)  
IT Service Management (Remedy)  
Local Law 4 (LL4)

Management Oriented Street Attribute Information Control Systems (MOSAICS)  
New York City On-Line Payment Services (NYC Service)  
NYC.gov Portal  
Performance Management and Analysis (PMA)  
Pest Control System (PCS)  
Project Management (Clarity)  
Sanitation Control and Analysis Network System (SCAN)  
The Uniform Land Use Review Procedure (ULURP)

User Navigation data for reporting - Web Analytics (WebTrends)  
Water and Sewer Forms Online Permitting System (WSPS)  
Workload Database (WLDB)

## Mayoral City Agencies/Units

Center for Economic Opportunity (CEO)  
Dept. of Buildings (DOB)  
Dept. of Consumer Affairs (DCA)  
Dept. of City Planning (DCP)  
Dept. of Environmental Protection (DEP)  
Dept. of Finance (DOF)  
Dept. of Health and Mental Hygiene (DOHMH)  
Dept. of Housing, Preservation and Development (HPD)  
Dept. of Information Technology and Telecommunications (DOITT)  
Dept. of Sanitation (DSNY)

Dept. of Transportation (DOT)  
Environmental Control Board (ECB)  
Fire Dept. of New York (FDNY)  
Housing Recovery Office (HRO)  
Landmarks Preservation Commission (LPC)  
Office of Operations (OPS)  
Mayor's Office of Environmental Coordination (MOEC)  
National Weather Service (NWS)  
New York City Housing Authority (NYCHA)  
Office of Management and Budget (OMB)  
Small Business Services (SBS)

## Non-Mayoral City Agencies/Units, External

Federal Emergency Management Agency (FEMA)  
Long Island Power Authority (LIPA)  
Consolidated Edison Company of New York (CONED)

# THANK YOU !

**Thomas J. Wilbanks**

Phone: (865) 574-5515

E-mail: [wilbankstj@ornl.gov](mailto:wilbankstj@ornl.gov)