

CENTER FOR URBAN
SCIENCE+PROGRESS

The Promise of Urban Science

Department of Energy

Computational Sciences Graduate Fellows Conference

July 26, 2013

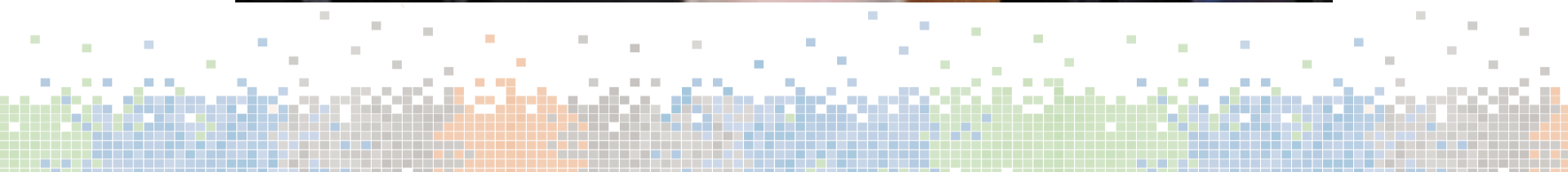
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<http://cusp.nyu.edu>



CUSP is Part of the NYC Applied Sciences Initiative Mayoral Announcement April 23, 2012



The CUSP Partnership



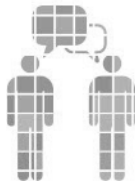
University Partners

- NYU/ NYU-Poly
- University of Toronto
- University of Warwick
- CUNY
- IIT-Bombay
- Carnegie Mellon University



National Laboratories

- Lawrence Livermore
- Los Alamos
- Sandia
- Brookhaven



Industrial Partners

- IBM
- Cisco
- Xerox
- Microsoft
- Con Edison, Lutron, National Grid, Siemens
- AECOM, Arup, IDEO



City & State Agency Partners

- City of New York
 - Transportation
 - Buildings
 - Sanitation
 - Citywide Administrative Services
 - Design and Construction
 - City Planning
 - Finance
- MTA
- Port Authority of NY & NJ
- Health and Mental Hygiene
- Environmental Protection
- Information Technology and Telecommunications
- Parks and Recreation
- Police Department
- Fire Department

A diverse set of other organizations have expressed interest in joining the partnership.

The CUSP vision includes New York City as its laboratory

The Center for Urban Science and Progress (CUSP) is a unique public-private research center that uses New York City as its laboratory and classroom to help cities around the world become more productive, livable, equitable, and resilient. Our ambition is to become the world's leading authority in the emerging field of "Urban Informatics."

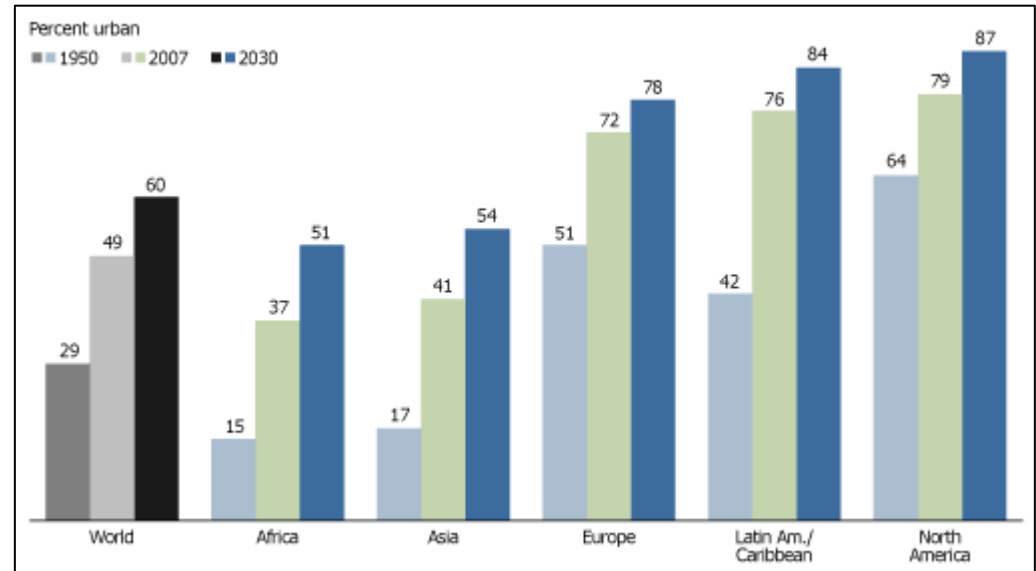
CUSP observes, analyzes, and models cities to optimize outcomes, prototype new solutions, formalize new tools and processes, and develop new expertise/experts.



Big Cities + Big Data

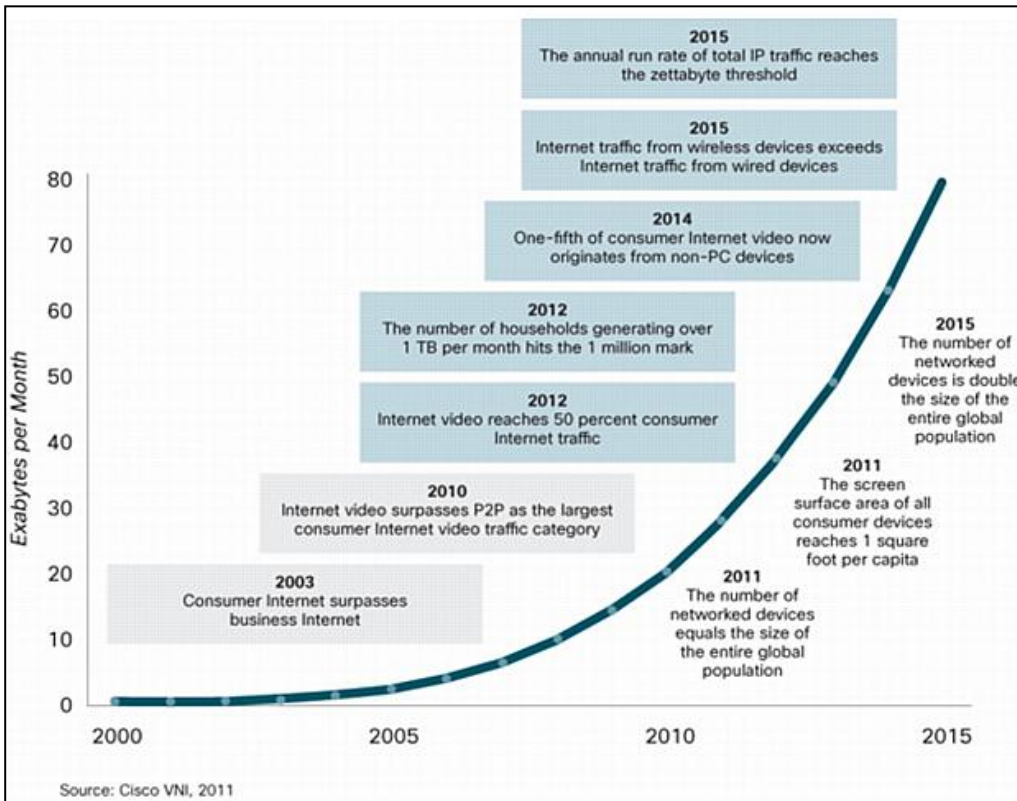
- The world is urbanizing
- Cities are the loci of consumption, economic activity, and innovation

Cities are the cause of our problems and the source of the solutions



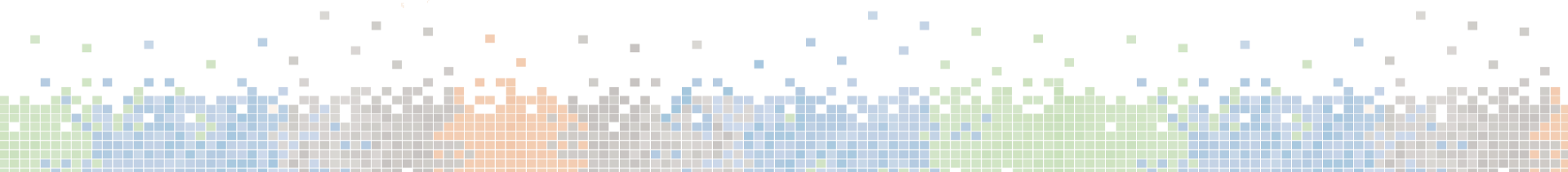
- All cities must be better for global issues
- Individual cities need to be “best” for competitiveness in talent, capital, ...
 - Be efficient, resilient, sustainable
 - Address citizen quality of life, equity, engagement

Big Cities + Big Data



- Informatics capabilities are exploding
 - Storage, transmission, analysis
- Proliferation of static and mobile sensors
- Internet of things

Global network traffic, 30% CAGR



What does it mean to instrument a city?

Infrastructure



Condition, operations

Environment



Meteorology, pollution,
noise, flora, fauna

People

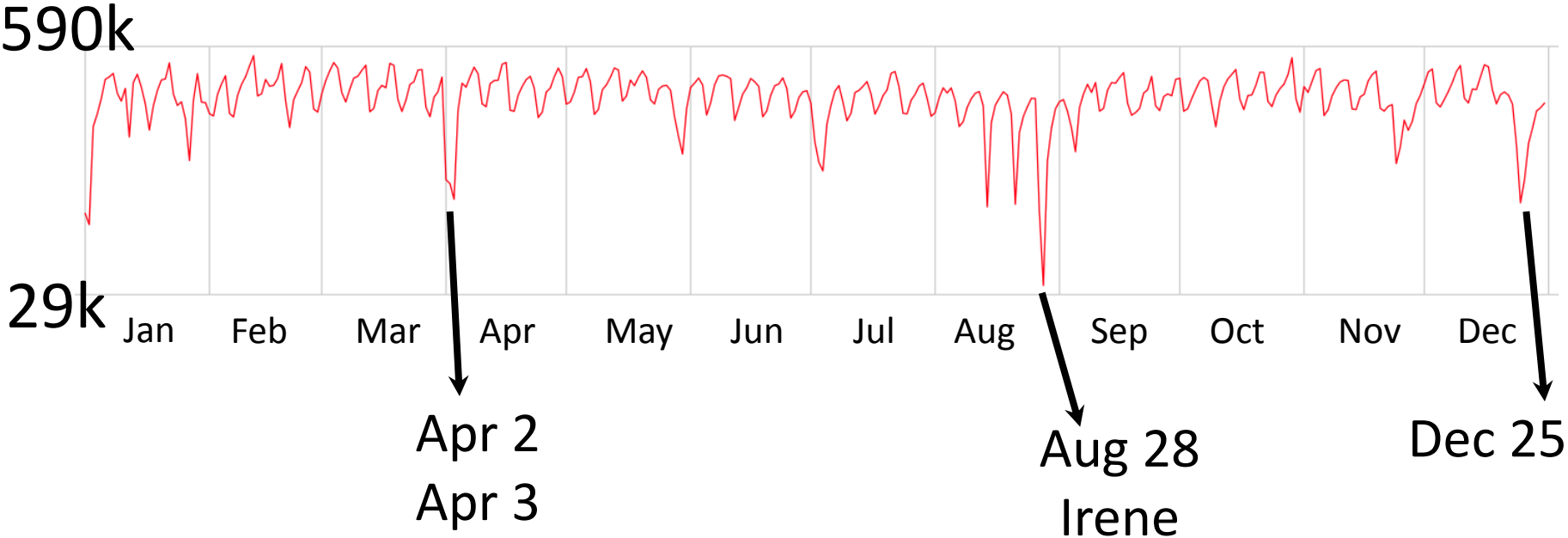


Relationships, location,
economic /communications
activities, health, nutrition,
opinions, organizations, ...

Properly acquired, integrated, and analyzed, **data can**

- Take government beyond imperfect understanding
 - Better (and more efficient) operations, better planning, better policy
- Improve governance and citizen engagement
- Enable the private sector to develop new services for citizens, governments, firms
- Enable a revolution in the social sciences

NYC Taxi Rides by Day in 2011

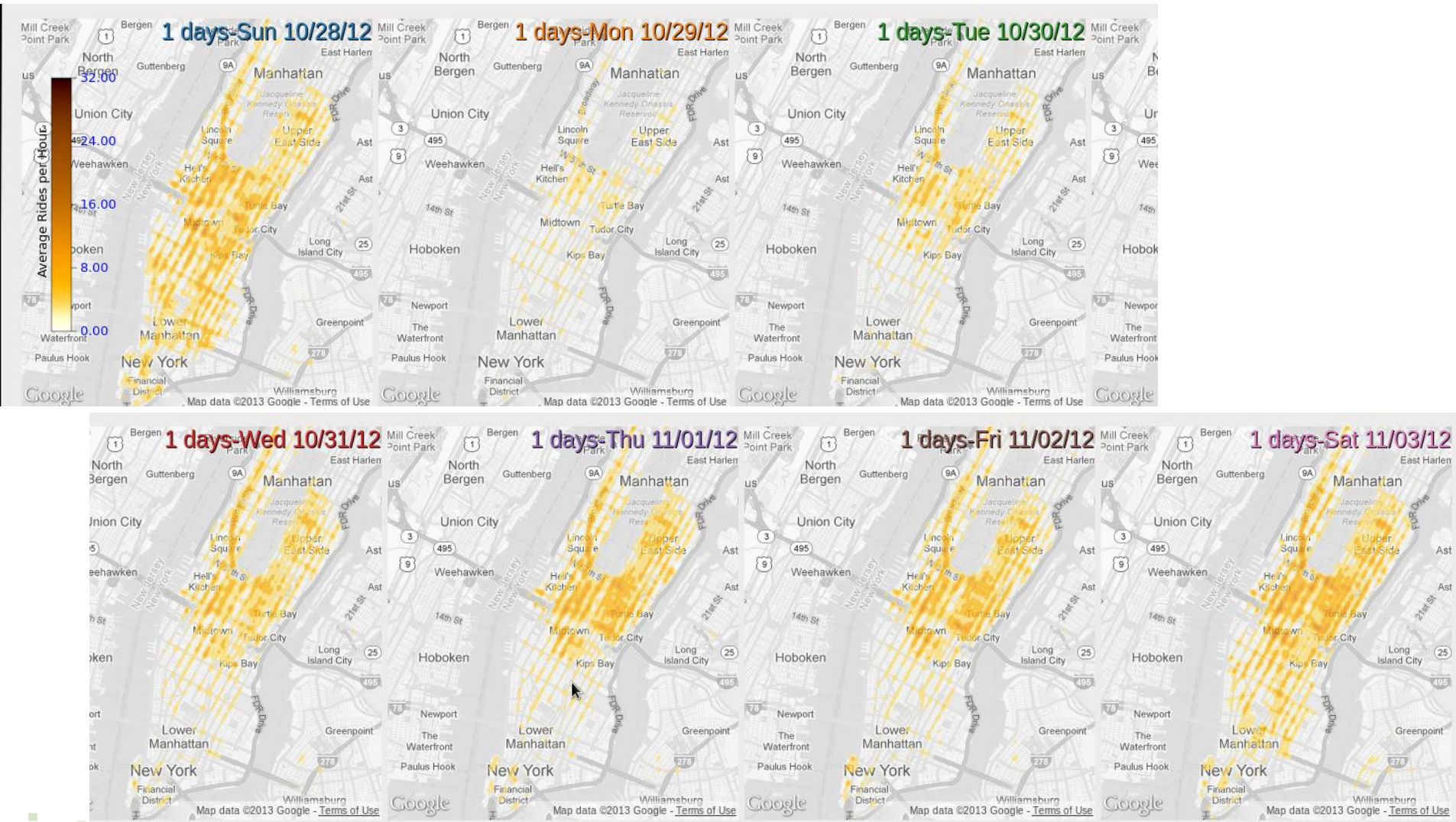


Lauro Lins, Fernando Chirigati, Nivan Ferreira, Claudio Silva, and Juliana Freire, NYU- Poly
(Data obtained from TLC on June 6, 2012)



Taxi Rides in Manhattan, October 28 – November 3, 2012

(Superstorm Sandy)



Juliana Freire, Claudio Silva, et al, NYU-Poly

Looking South from the Empire State Building



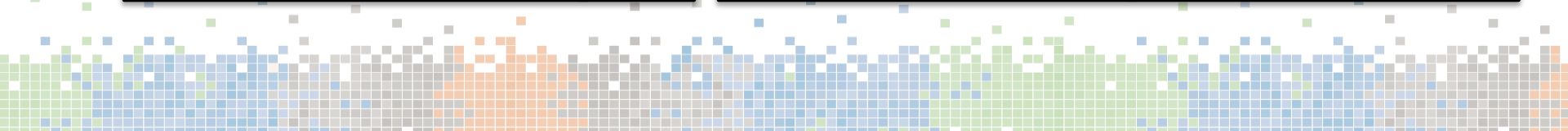
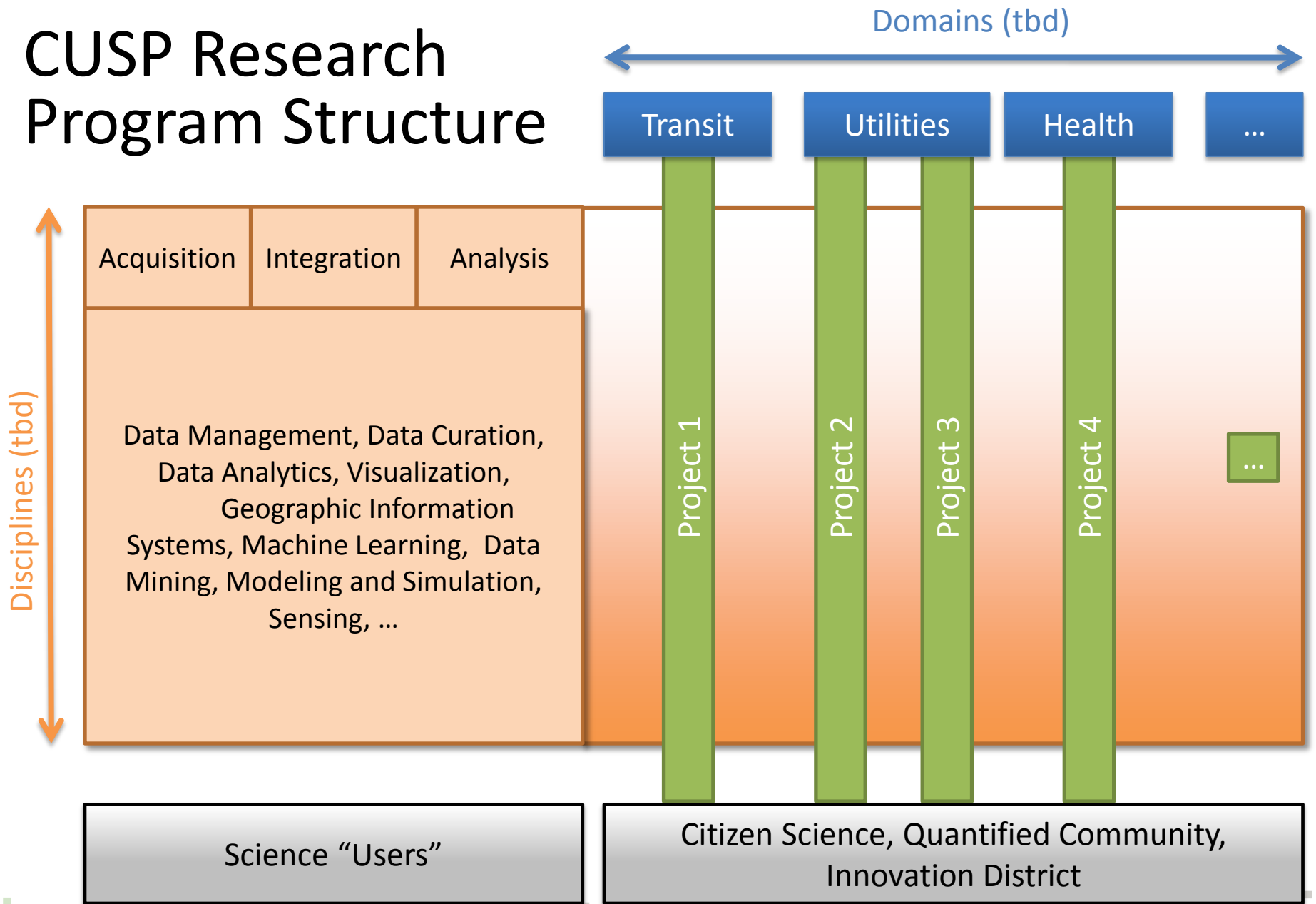
Manhattan in the Thermal IR



Photo by Tyrone Turner/National Geographic

Other synoptic modalities: Hyperspectral, RADAR, LIDAR, Gravity, Magnetic, ...

CUSP Research Program Structure



CUSP Facilities Being Developed

- **Data access policies, technologies, infrastructure**
- **Urban Observatory**
- **“SimCity for real”**
- **Quantified Community**



Urban Observatory

Provisioned urban vantage point(s)

- Downtown Brooklyn
- Midtown Manhattan
- Governors Island

Suite of bore-sighted instruments

- Photometric and colorimetric optical imaging
- Broad-band IR imaging (SWIR, MWIR, and thermal)
- Hyperspectral imaging (trace gases)
- LIDAR (building motions, pollution)
- RADAR (building /street vibrations, building motion, traffic flow)



Correlative data on the urban scenes

- Meteorology (temperature, winds, visibility)
- Scene geometry (distances, directions, identities of features visible)
- Parcel and land use data, building characteristics and activities, building utility consumptions, and real estate valuation data
- *In situ* pollution data and location/nature of major sources
- *In situ* vehicle and pedestrian traffic for the streets visible
- Demographic and economic data



Capability to archive, process, and analyze data acquired

- Image processing chains
- Data warehouse, GIS, Visualization tools
- Software and procedures to enhance privacy protection

Personnel and funding to create and operate the above



Visible imagery tests

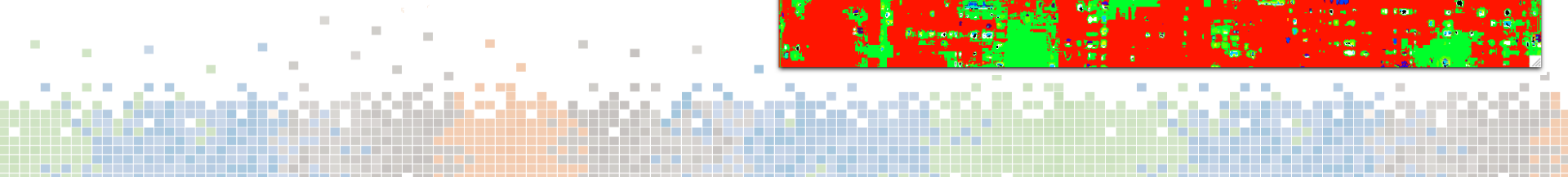
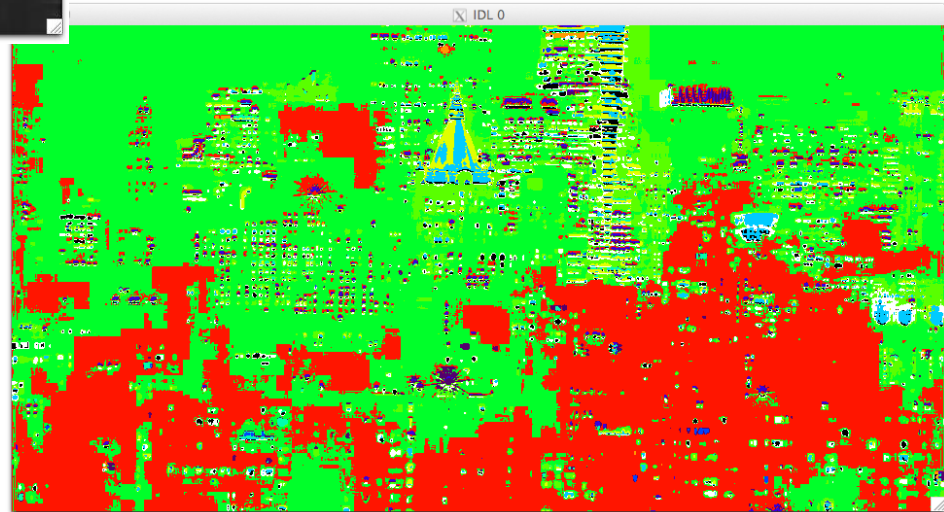
- 8M pixel visible camera
- Frame interval = 25 seconds
- Duration = 15 hours
- Lunar phase = $\frac{3}{4}$



Pixel light curves grouped into 12 clusters



Work by Steve Brumby, LANL

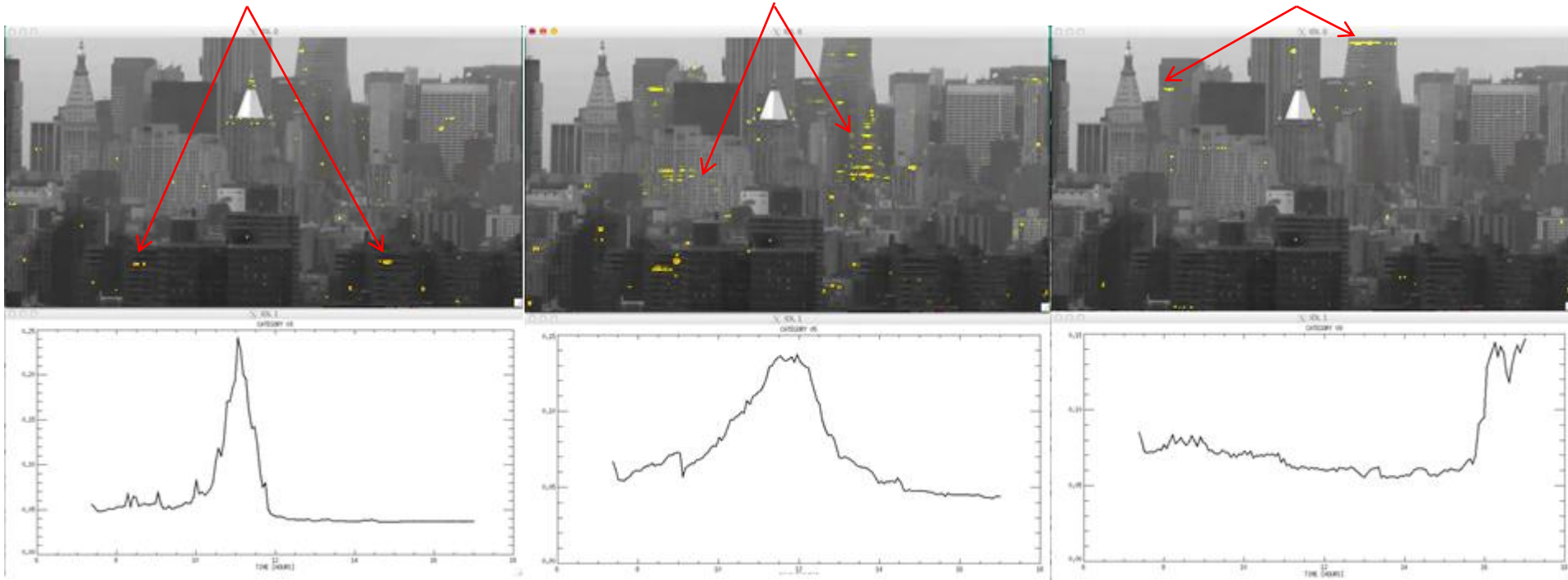


Selected cluster light curves

11 o'clock news?

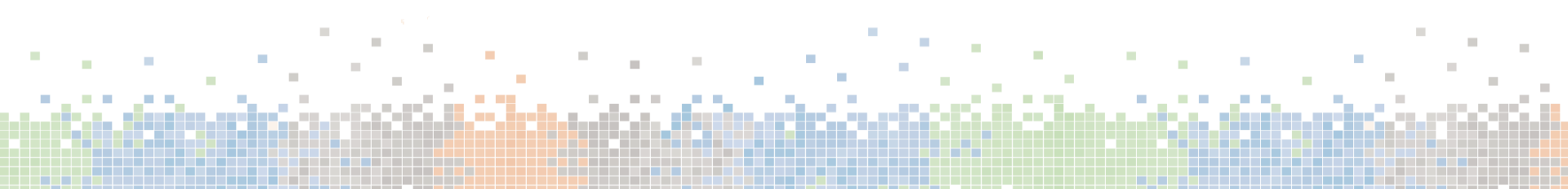
cleaning crews?

trading floors?



Quantified Community

- **Fully instrument a slice of the city**
 - 10-100k people within 20 blocks of MetroTech or a new development
 - Create a well-characterized test bed for technologies/policies and behavioral interventions
- **What constitutes “complete instrumentation”?**
 - *In situ* vs. choke points vs. synoptic?
 - Economic data? Physiological data? Nutrition? ...
- **How to fully engage people who live/work in the community to provide data, participate in citizen science, create educational opportunities, ...?**
 - Foster improved quality of life: “cleanest/greenest/healthiest/most livable /...”
 - “I’ll show you the parking spaces ...”
 - ???
- **What might we expect to learn?**



QC Opportunities

Buildings

Resource consumption;
indoor air quality;
productivity, health
measures

Safety and Security

Network security;
situational awareness;
emergency management
integration; event
forecasting

Environment

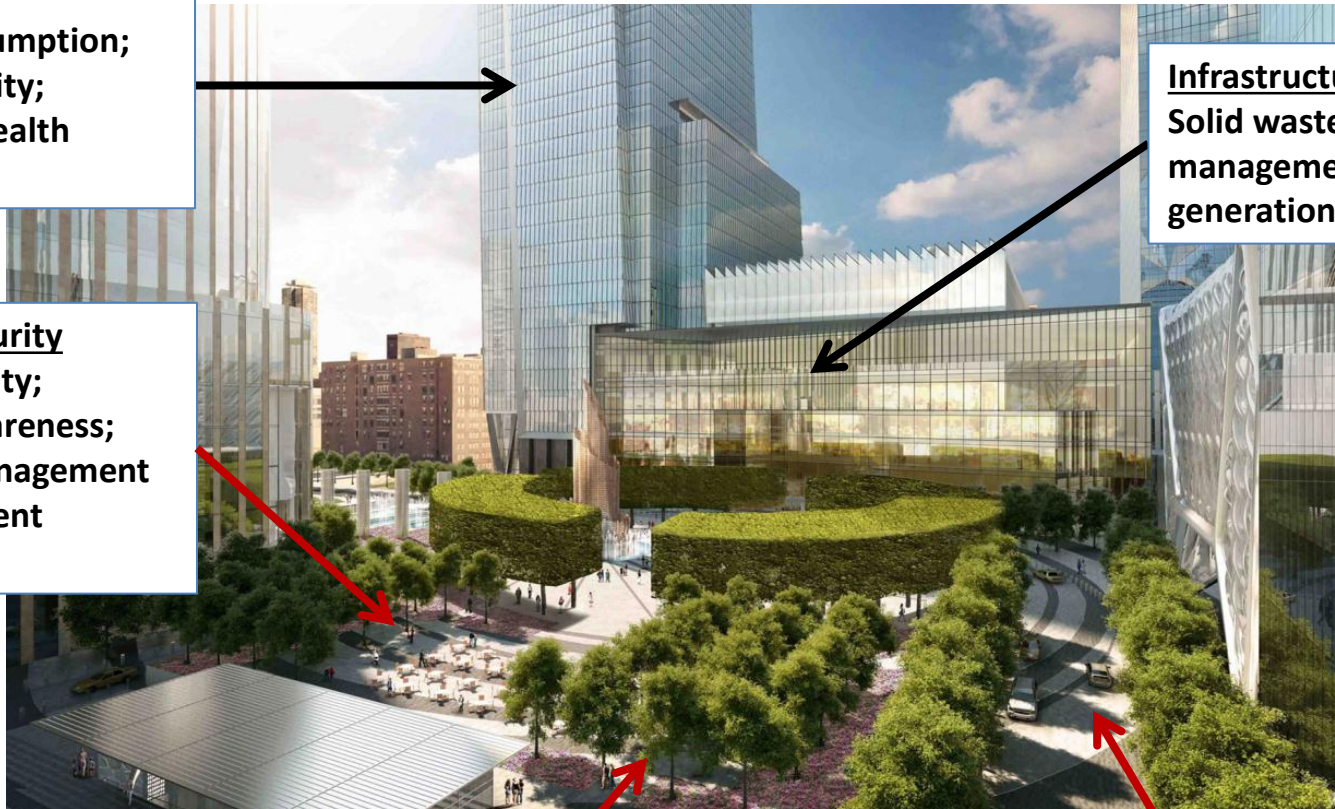
Carbon emissions; air
pollution and particulates;
noise; climate

Infrastructure

Solid waste; stormwater
management; power
generation/distribution

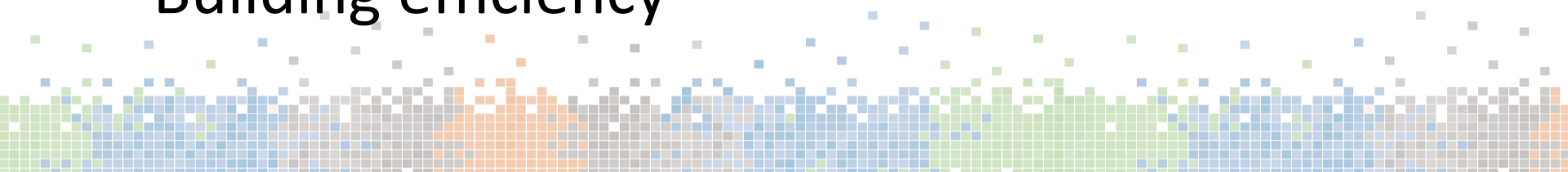
People

Behavior; mobility;
health; activity;
social networks,
metagenomics



Among the Projects We're Working On

- Normalization, interoperability of city data sets
- Multi-data correlations to improve city resource allocation
- Noise / Temperature / Pollution
- Mobility
- Novel sensing of public health
- Building efficiency



Noise Project

Overview

- Noise the biggest 311 complaint
- Significant public health issue
- Noise code enforcement is difficult

Objective and Goals

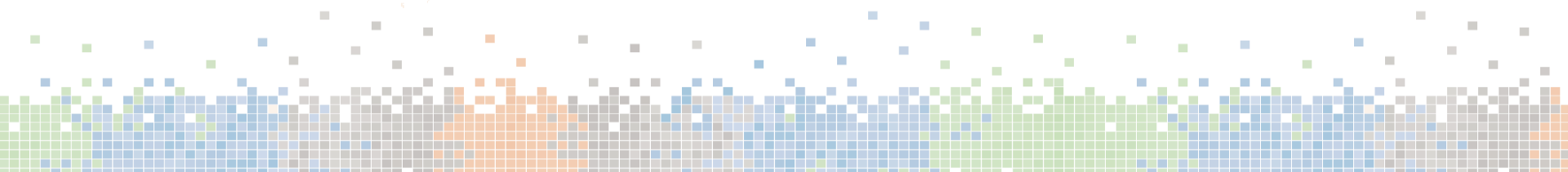
- Characterize the “soundscape” of the City
- Inform policy makers
- Build an archive of sound around the city that can be used for research

Project Plan

- Initial phases underway
- Will likely start instrumenting the Union Sq. area

Data

- Audio measurements throughout the City via phones or fixed microphones
- Panel on ethical, legal, and social implications will be convened and led by CUSP Chief Data Officer



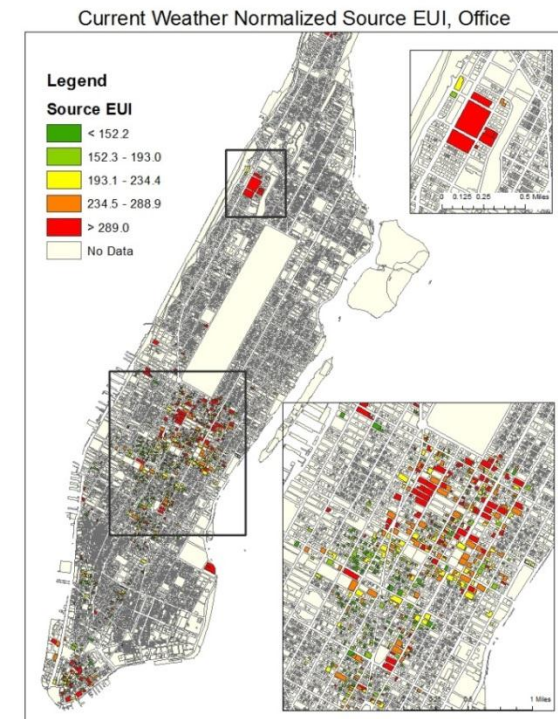
Building Informatics Program

Overview of Projects Underway

- Local Law 84 Data Analysis (with OLTPS)
- Using LiDAR and Aerial Imagery to Estimate Building Size (with OLTPS, DoITT)
- Understanding the Impact of Energy Disclosure on Market Behavior
- Responses to Transparency and Reporting (with OLTPS, ULI, and NCREIF)
- Price Effects in Commercial Markets (with CoStar, NCREIF)
- ‘Tenant Star’ Energy Performance Rating and Benchmarking (with NRDC, CBRE)
- The Building Quality Index (BQI)
- Solid Waste Benchmarking (potentially with DSNY, OLTPS)

Data

- Local Law 84 Database
- PLUTO Database (DOF, DCP, DOB)
- CoStar Group
- Urban Land Institute Greenprint Center
- NCREIF
- 311 Data
- LiDAR files (2010/2011 flyover)



Urban Microbiome Project

Overview

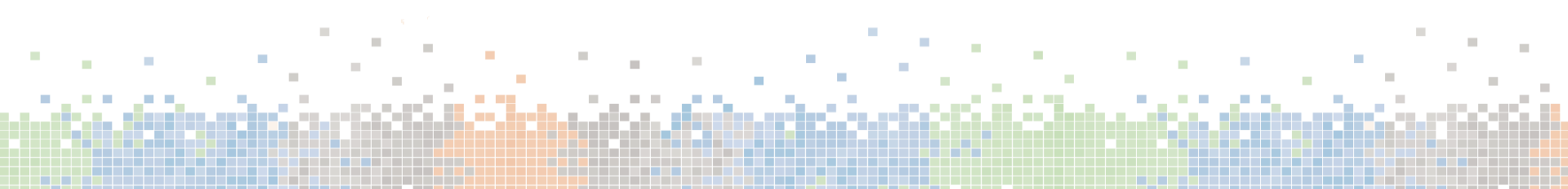
- Microbes are a significant and important part of the City ecosystem
- The characteristics of the City microbiome and its implications to public health are unknown

Objective and Goals

- A metagenomic study of the City microbiome
- Will study the variations over time and across different locations (residential vs. industrial vs. commercial)
- Sewers aggregate material from many people, so representative of large areas
- Understanding the microbial milieu could potentially lead to effective bioremediation of DEP's grease problem

Data

- Analysis of DNA would identify antibiotic resistant strains
- Results would greatly assist the mitigation of pathogens



Privacy & Confidentiality Book

Confidentiality and Data Access in the Use of Big Data: Theory and Practical Approaches

The book will identify ways in which vast new sets of data on human beings can be collected, integrated, and analyzed to improve urban systems and quality of life while protecting confidentiality. It will provide theoretical and practical foundations cities across the world can draw from to establish data access rules and data security procedures. Sponsored by CUSP, the American Statistical Association, its Privacy and Confidentiality subcommittee, and the Research Data Centre of the German Federal Employment Agency.

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CUSP Data Sources: Existing and In Acquisition Agency

Source	Description	Status
NYC Department of Information Technology & Telecommunications (DoITT)	NYC Open Data	In process
NYC Mayor's Office / Office of Analytics	100 TB data warehouse covering dozens of City agencies, ~1TB/day update	In process
NYC Office of Long-Term Planning & Strategy (OLTPS)	3D Model of NYC from LIDAR Topography	On hand
NYC Taxi & Limousine Commission (TLC)	NYC Taxi Rides: start and stop location, tip, fare, time (3 years)	On hand
NYC Bike Share		In discussion
NYC Department of Health & Mental Hygiene	Public health, through collaboration within NYU	In discussion
NYC Department of Education	Through collaboration within NYU	In discussion
NYC Department of Transportation	Camera and traffic volume sensor data	In discussion

CUSP Data Sources: Existing and In Acquisition

CUSP-Generated & Private

Source	Description	Status
Urban Land Institute		On hand
TomTom	Real-time traffic data feed for the NY region, updated once/minute	In process
AT&T	Call Data Records (CDRs)	In discussion
Xtify	Billions of cellphone location data points	In process
Gnip	API to major social data feeds, such as Facebook and Twitter	In process
Twitter	Geo-tagged and historical feeds	In discussion
Metagenomics Project	DNA sequence data from metagenomic studies of NYC sewers	In development
Noise Project	Audio measurements through the City and associated metadata	In process
Quantified Community	Diverse data from a full instrumentation of a small neighborhood	In discussion
Urban Observatory	Imagery data from vantage points in several modalities (visible, infrared, etc.)	In process

GRADUATE PROGRAMS IN APPLIED URBAN SCIENCE AND INFORMATICS

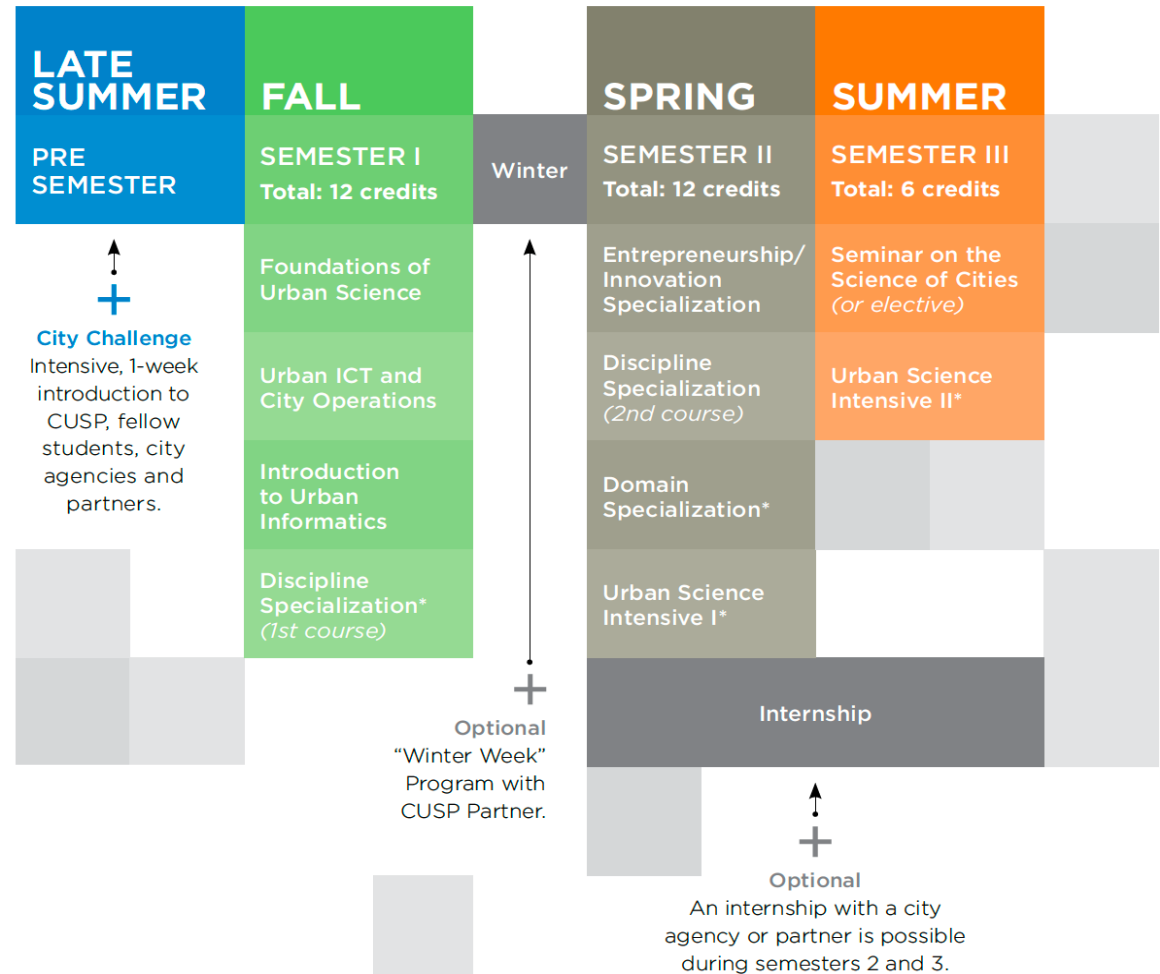
DEGREE
Master of Science

LENGTH
One Year, 3-semester
(Full-time)

CLASS SIZE
Approx. 60 students

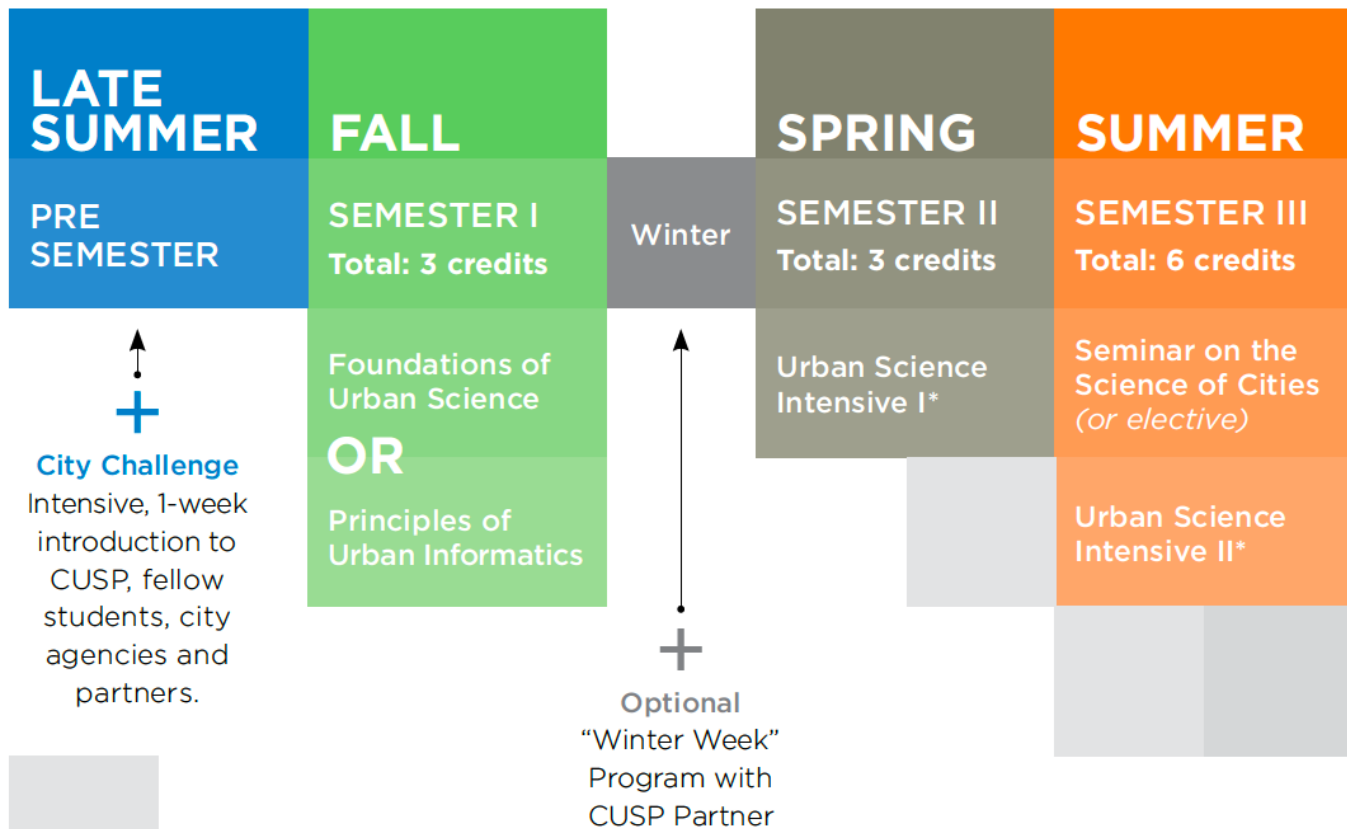
START
Fall 2013

CURRICULUM (1 YEAR)



ADVANCED CERTIFICATE IN APPLIED URBAN SCIENCE AND INFORMATICS

CURRICULUM (1 YEAR) 



DEGREE
Advanced Certificate

LENGTH
1 Year (FT and PT options)

CLASS SIZE
Approx. 60 students


START
Fall 2013

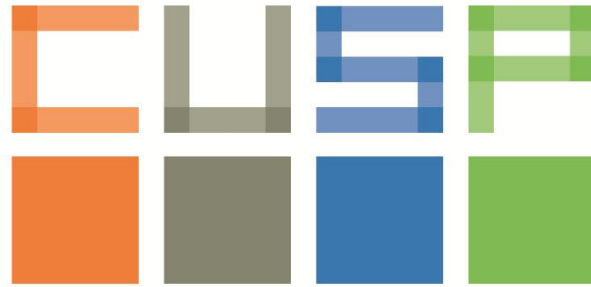
In 5-10 Years, CUSP will be a major center for research and education in Urban Informatics



- 50 full-time senior researchers
 - 30 faculty, 20 industrial
- 30 Postdocs
- 430 Masters students and 100 PhD candidates
- Located in Downtown Brooklyn
 - 60,000 ft² leased in 1 MetroTech
 - 150,000 ft² + 40,000 ft² incubator post-2017 in 370 Jay Street
- Government (esp. Federal), corporate, philanthropic, academic funding to \$70M/yr

What's success after 5 years?

- Define and elaborate “Urban Science”
 - A vibrant world-class center pursuing such
 - Nucleate an NYU/NYU-Poly community
 - Implement CUSP facilities
 - Projects that impact the City and its Citizens
 - CUSP established as a trusted partner to NYC
 - Support public understanding and engagement
 - Train several hundred people in this new field
 - Commercialization of CUSP technologies
 - Bring new tools to the social sciences
 - Begin to franchise the brand globally
- 



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Questions/Comments?

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