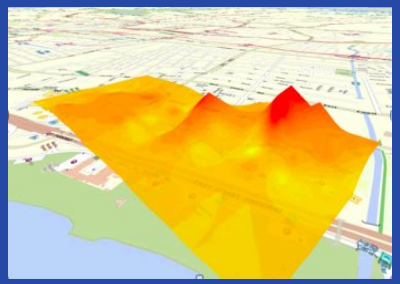
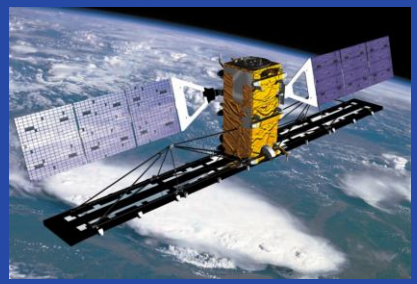
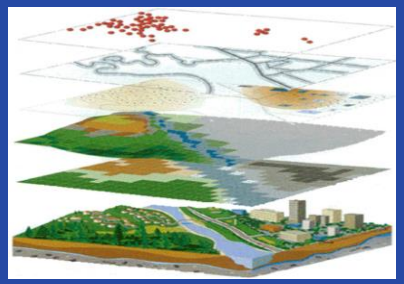
Using Location Information For Better Planning and Decision Support: Integrating Big Data, Official Statistics, Geo-information

Professor Paul Cheung
Professor of Social Policy and Analytics, NUS,
Chair, International Steering Committee for Global Mapping,
Former Director, United Nations Statistics Division

Integrating Geo-Information, Official Statistics, and Big Data

- Three communities operating with different analytical schemes and data structures, with minimal overlap;
- Distinct culture, languages and practices;
- Comfortable as distinct professional communities –
  - Geospatial Community – mapping, imageries;
  - Data Scientists Community – big data analytics;
  - Official Statistics Community – structured indicators;
- But now compelled by emerging trends to look for the common ground.

What is the Common Ground? How to get there??

White House Report on Big Data

- "Data fusion occurs when data from different sources are brought into contact and new facts emerge. Individually, each data source may have a specific limited purpose. Their combination, however, may uncover new meanings"

- "Policy attention should focus on Actual Uses of Big Data, and less on its collection and analysis"

1 May, 2014. White House

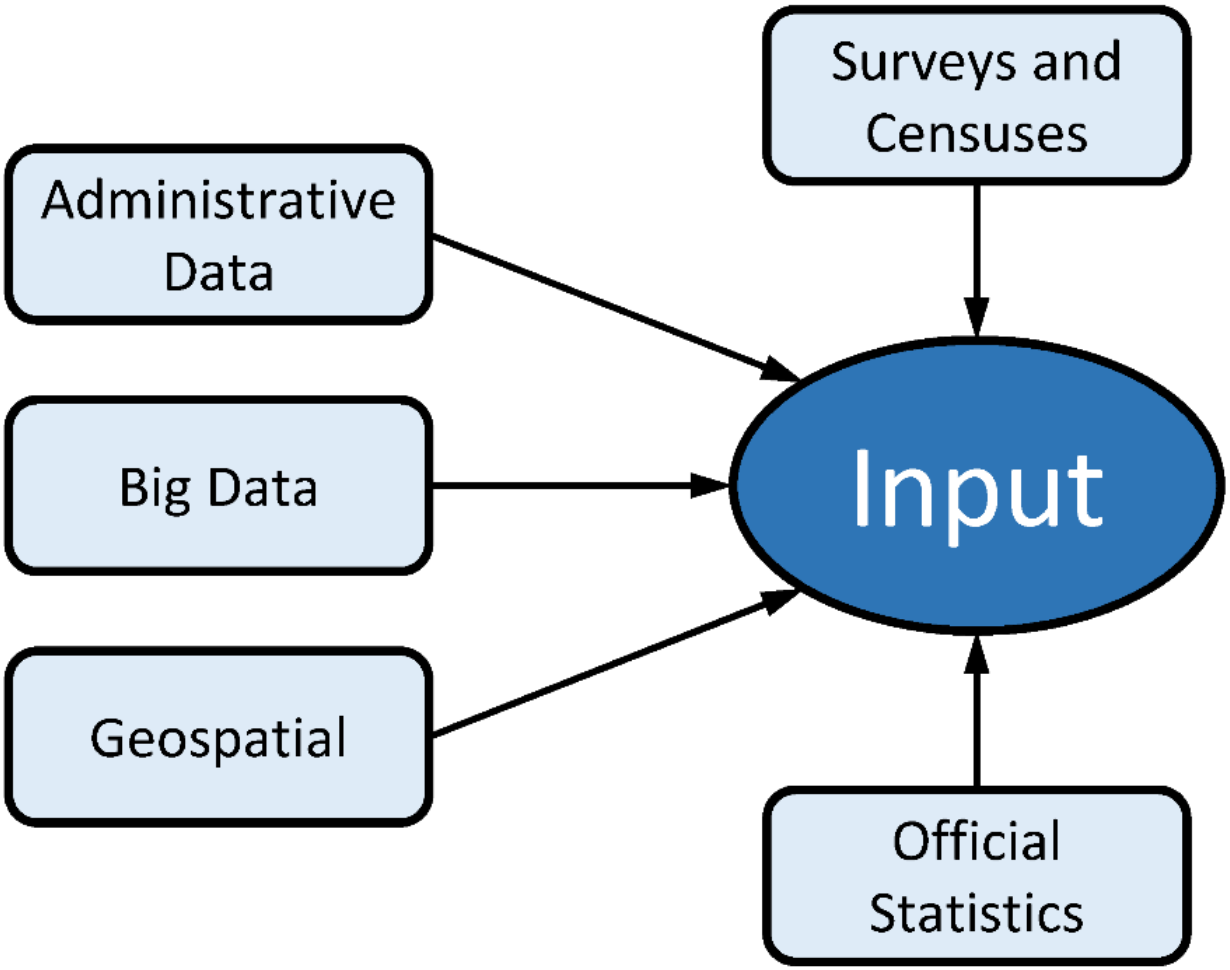
Promoting Global Data Fusion

- UNSD 2011 seminar in Korea explored integration of official statistics and geospatial information;
- UN Statistical Commission endorsed in 2013 ‘Statistical Spatial Framework’ – development continuing;
- UN Statistical Commission considered in 2014 integration of Big Data and Official Statistics;
- Data Fusion process continuing, and will bring in new sources in the future.

Information use for Public Policy

- Increasing demand for information in public policy
- Traditional surveys less emphasized. Too time consuming. Too slow. Users want quick data;
- Statistical community adjusting – using multi-mode approach: internet, call center, administrative source, fax, sms, sensors;
- Increasing use of administrative data;
- Back-end system integration important;

Integrating Multiple Data Sources for Decision Support



A New Era: Developing Location Information

- Rapid technological advancement overcoming security concerns, with innovative breakthroughs;
- Changing business model for the use, access and provisions of Geospatial (and related) Information;
- New business model gives rise to competition:
  eg: Google competes with government mapping agency;
- Data integration based on spatial framework gaining rapid pace (Location Information)

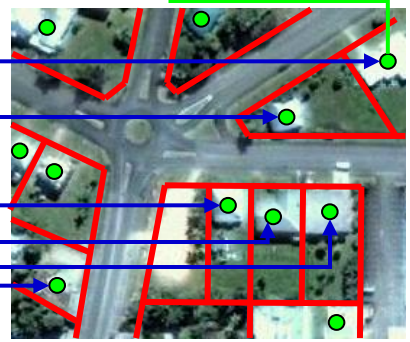
Location Information Framework

Aggregated to Local Government area or higher

Geocoded unit level data

25 Smith St = x,y: 35.5676, 135.6587

Aggregated to suburb or postcode

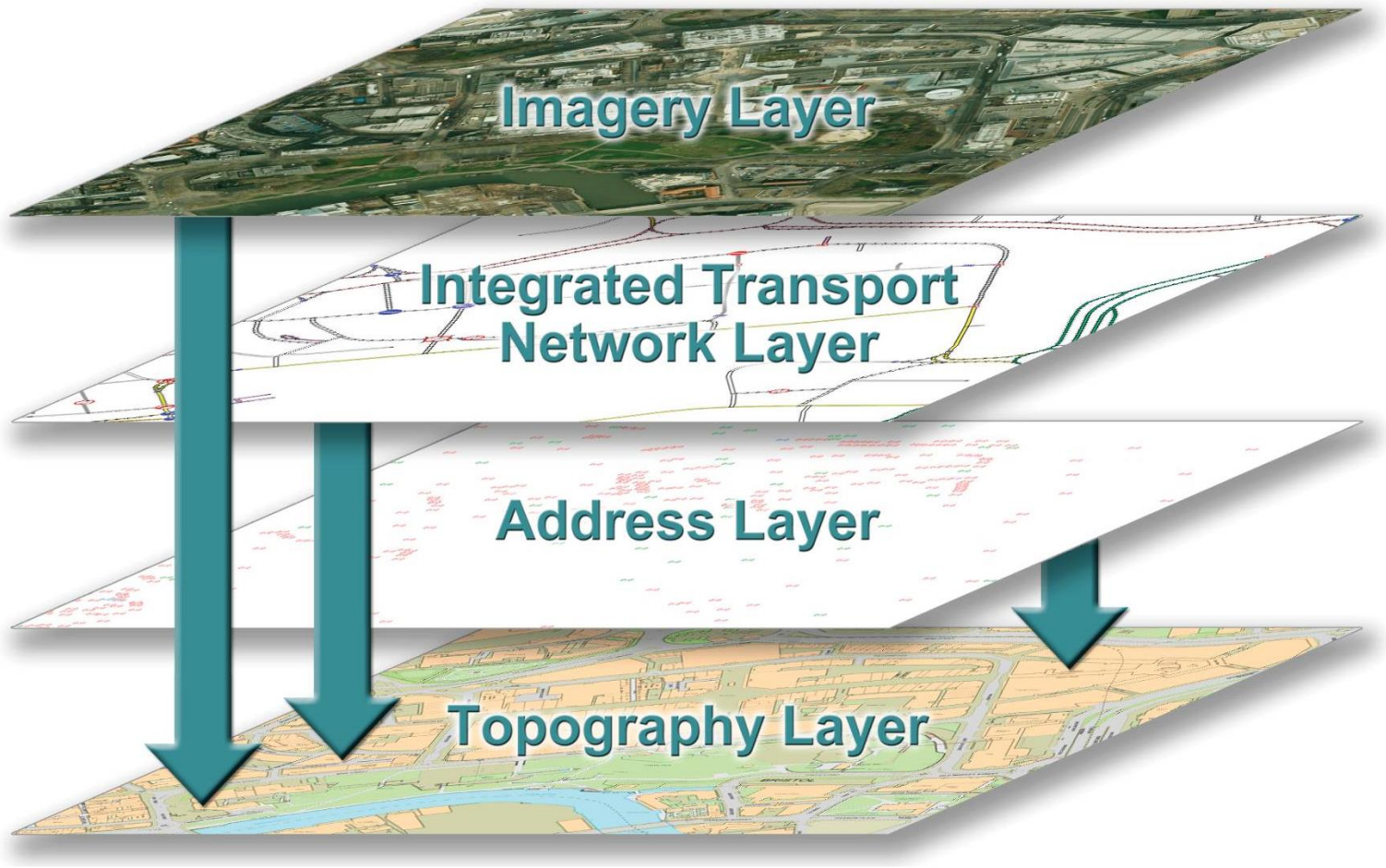


Location information at address level

Analysis and aggregation across geographies

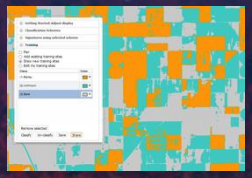
Source: Geoscience Australia

Mapping layers; Connecting Information



Source: Ordnance Survey International

Intelligent Imagery



New Sensors

- SPOT 6
- Landsat 8
- Pleiades
- DMCii
- Chinese (3)

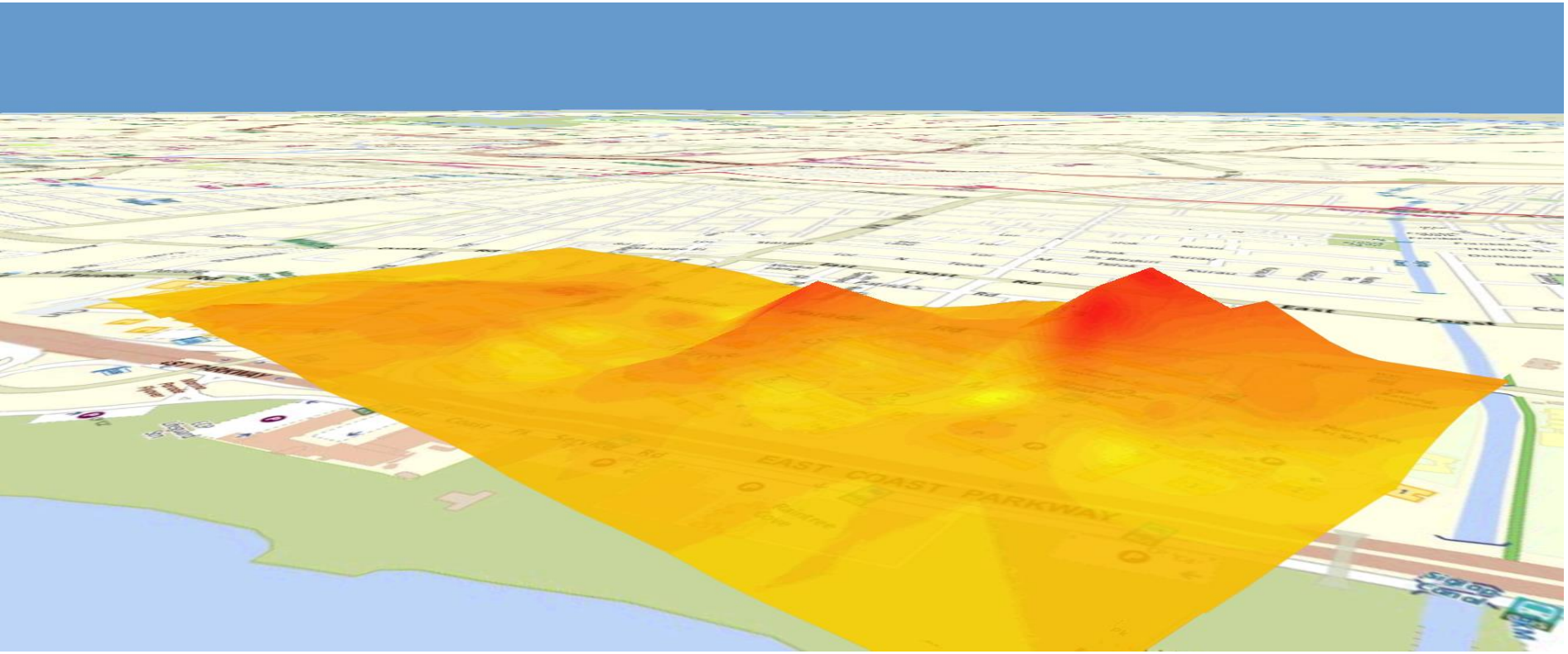
AccuWeather

RapidEye

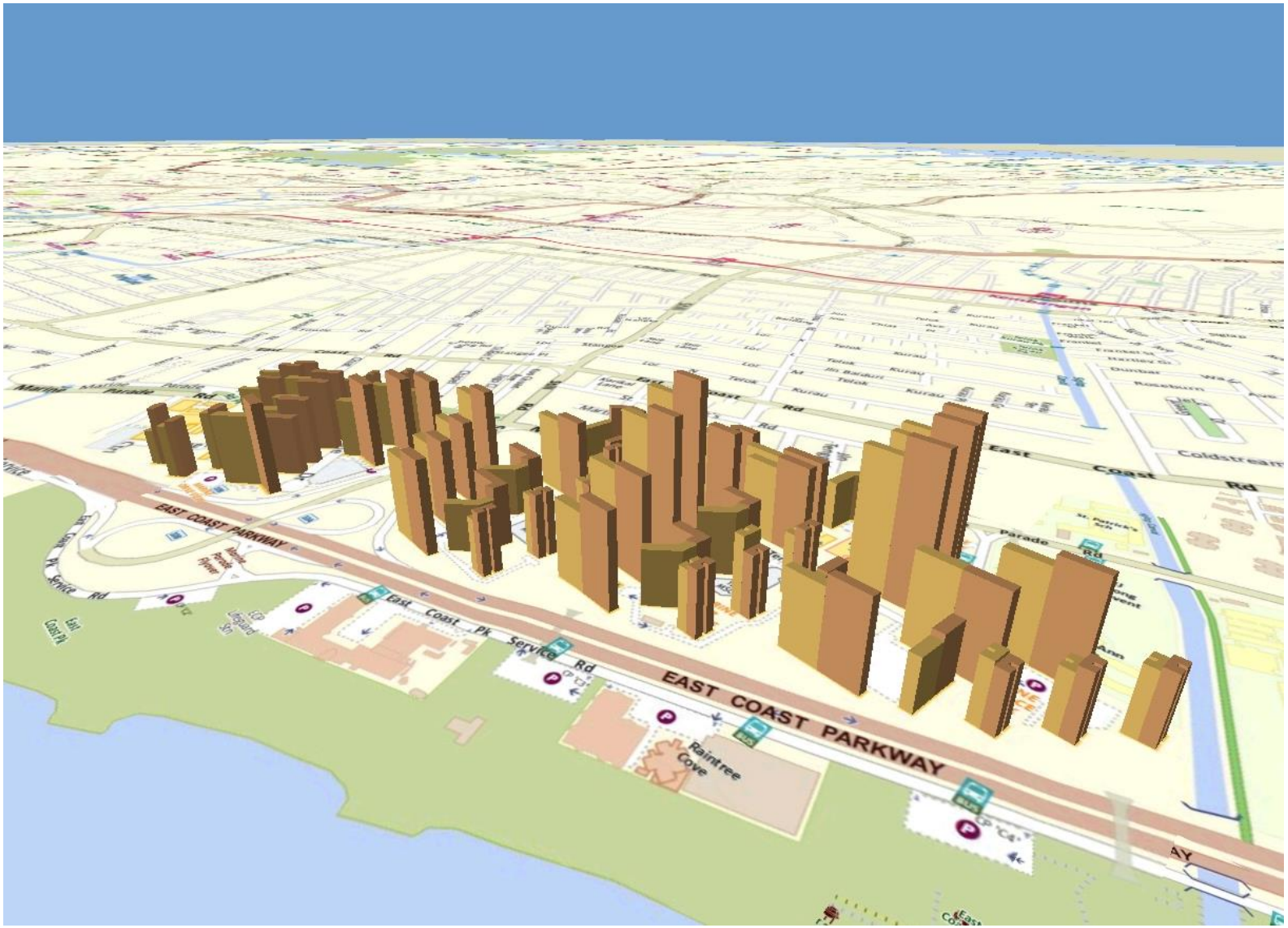
Digital Globe

Using Location Information

Many examples: Municipal and Urban Planning and Services



Current and Projected 65+, 2012-2022



Projected Elderly, 2022

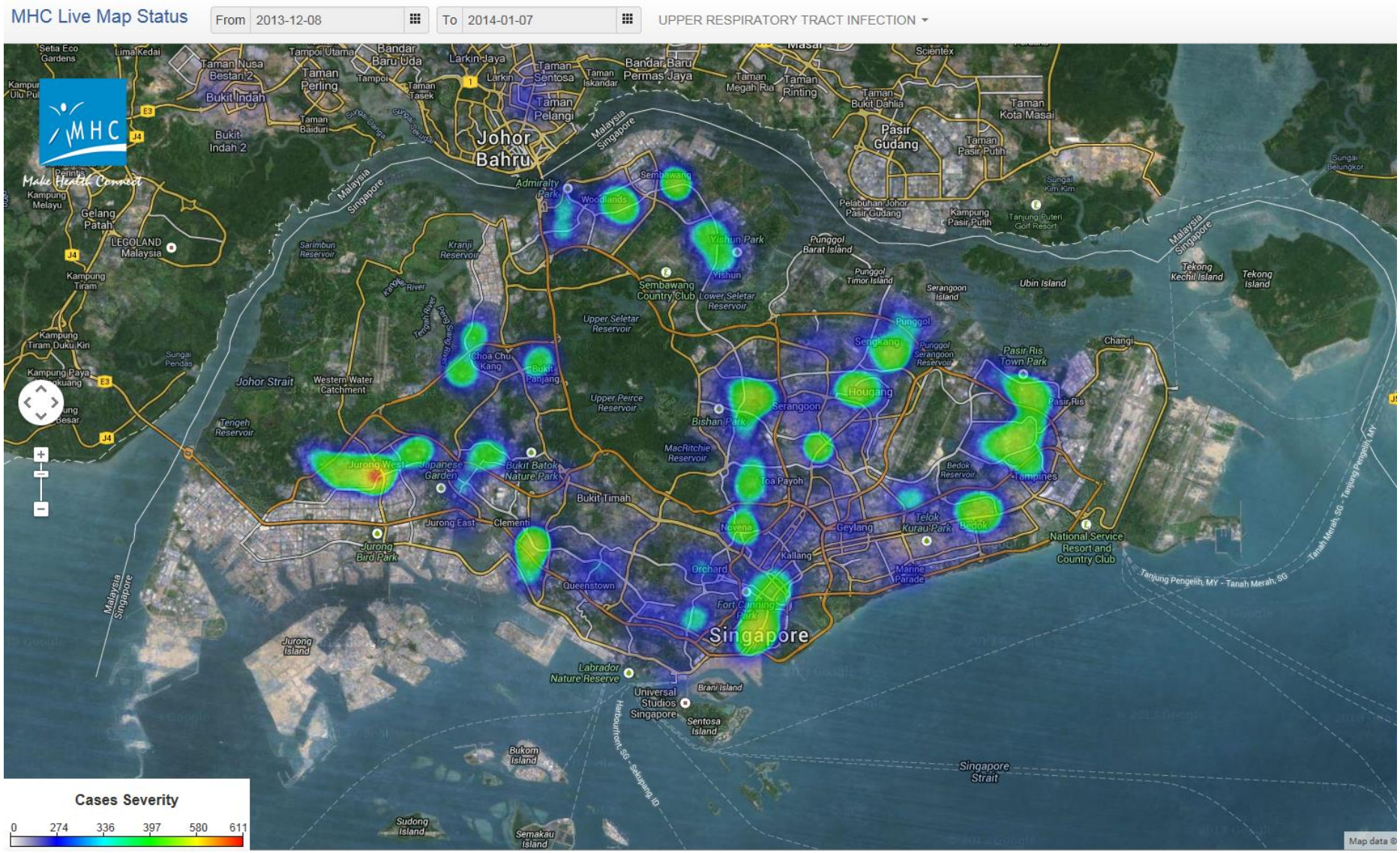
Elderly Residents (65+) in the Marine Parade Constituency (2012-2022)

Total Residents aged 65 and above*: 4851

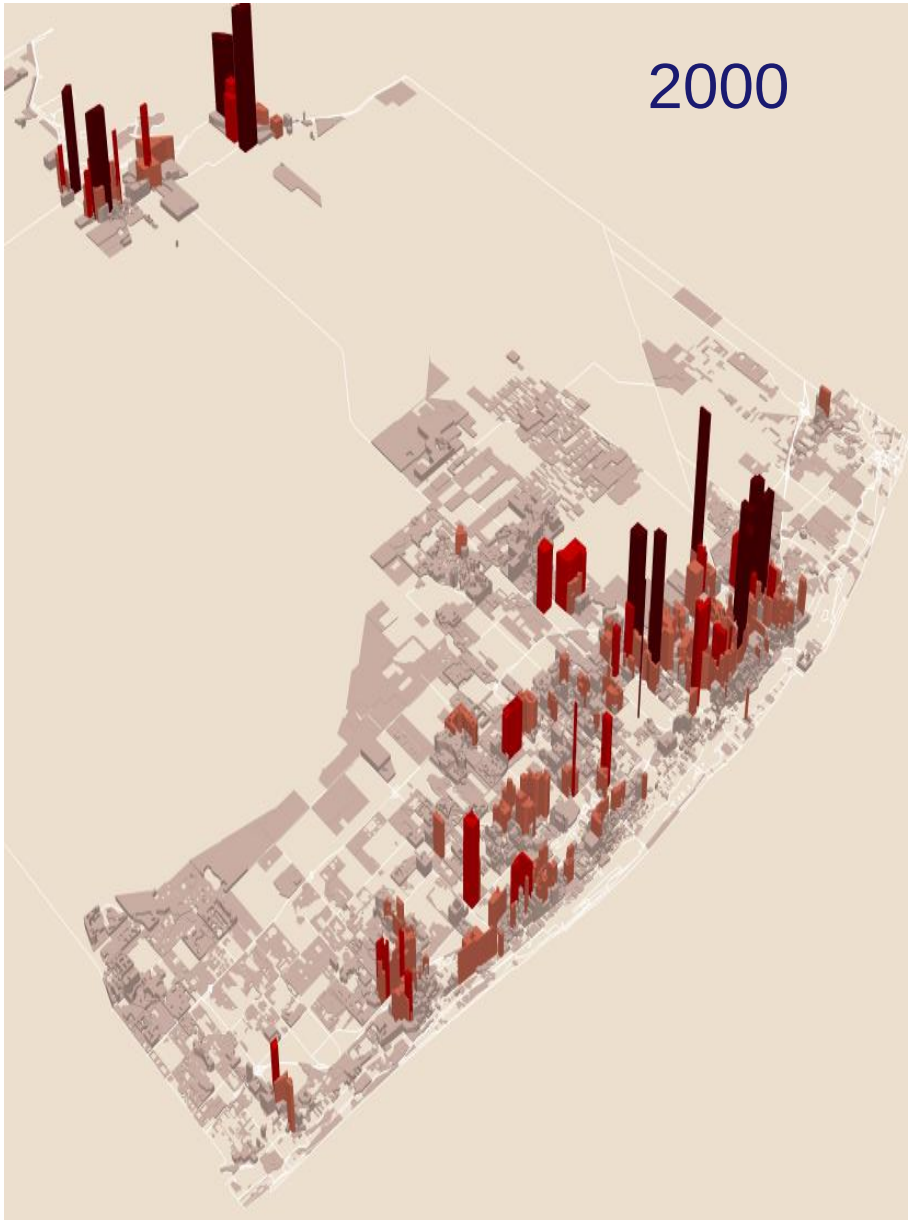
*Residents refer to Singapore Citizens & Permanent Residents "alive" as at end 2012

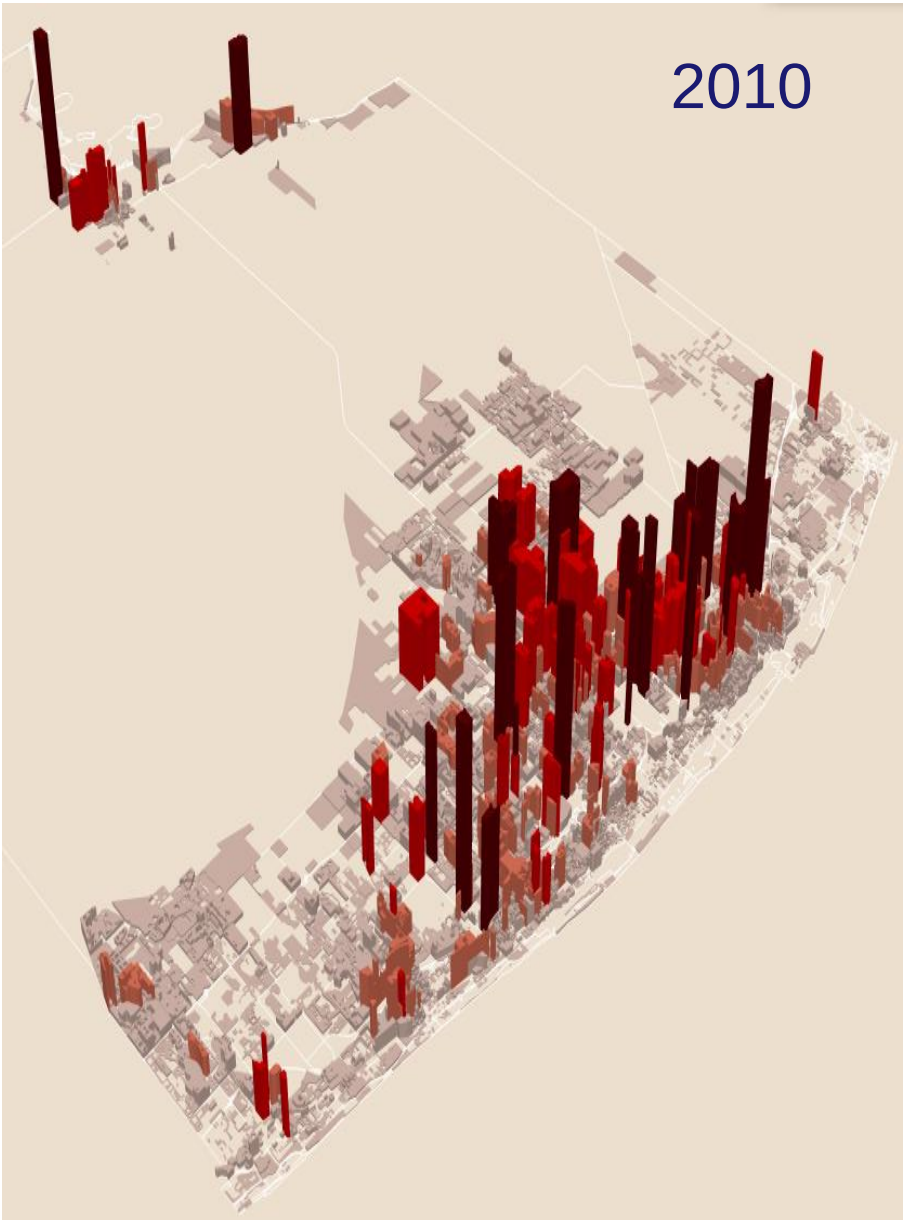
Projected Total Residents aged 65 and above (by 2022): 5635

Real Time: Upper Respiratory Tract Infection Map

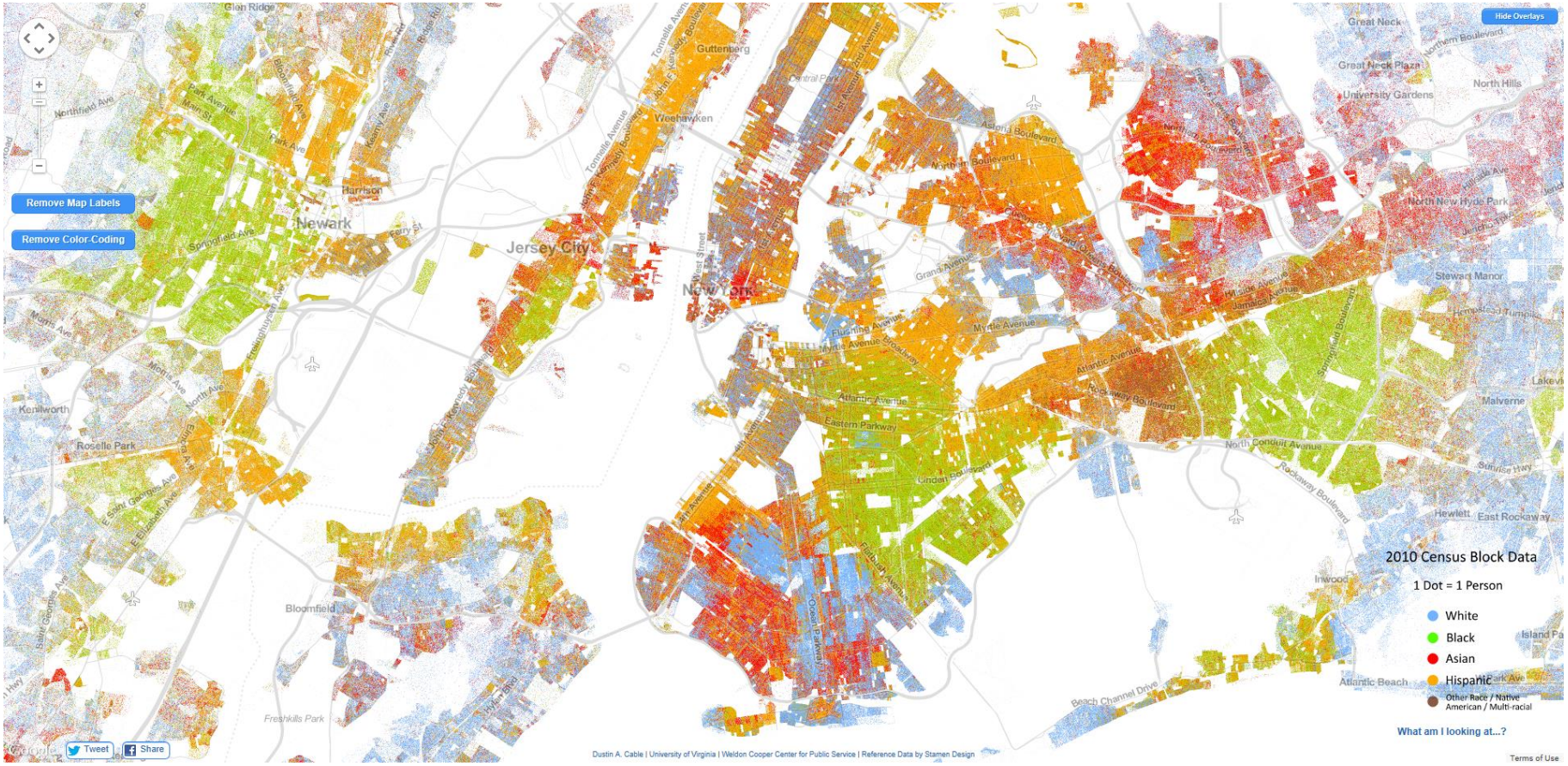


3-D Sub Population Analysis

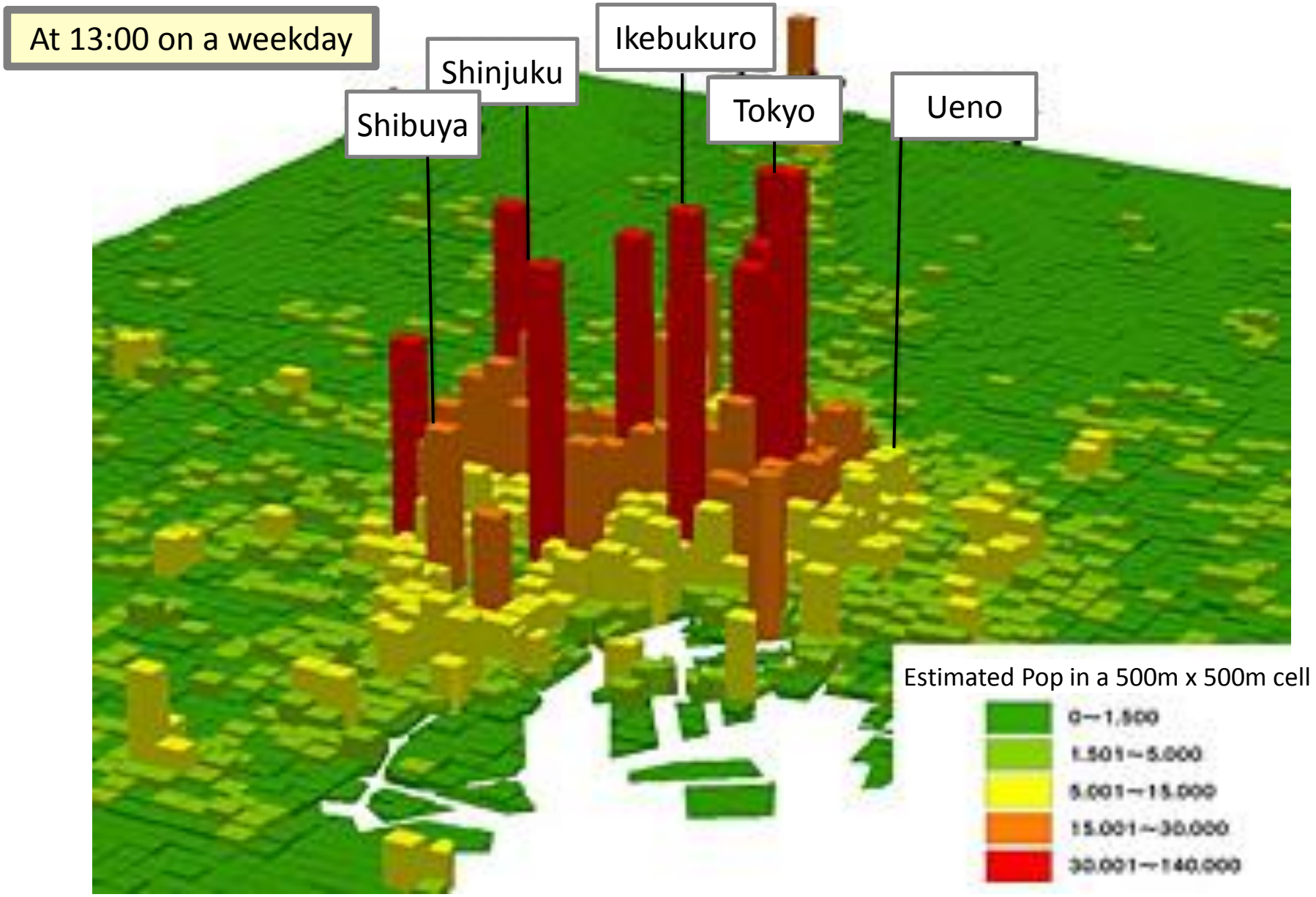




Modelling Racial Diversity in New York

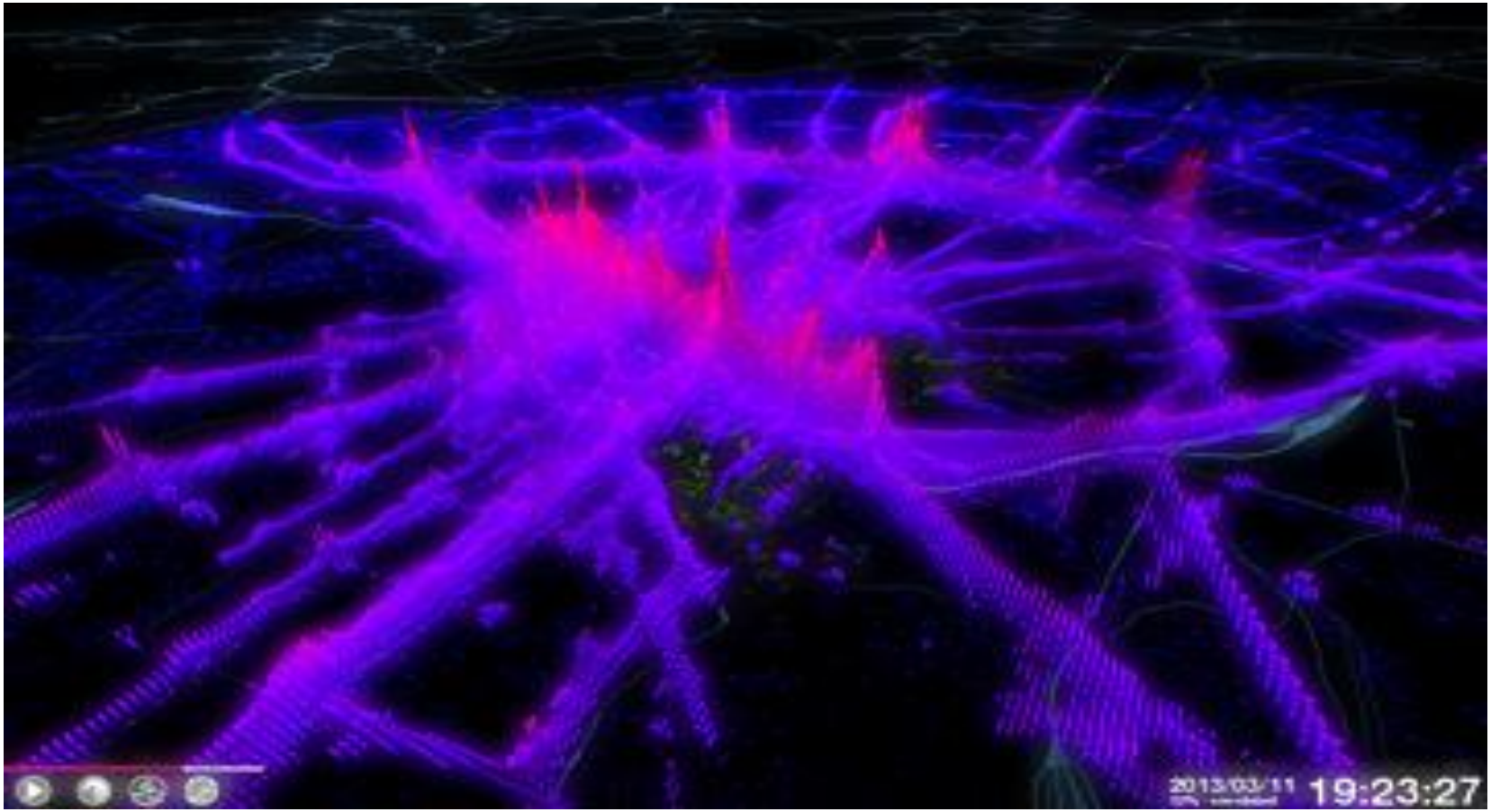


Sample image of Mobile Geospatial Statistics:
Population Distribution of Central Tokyo (23 Wards)



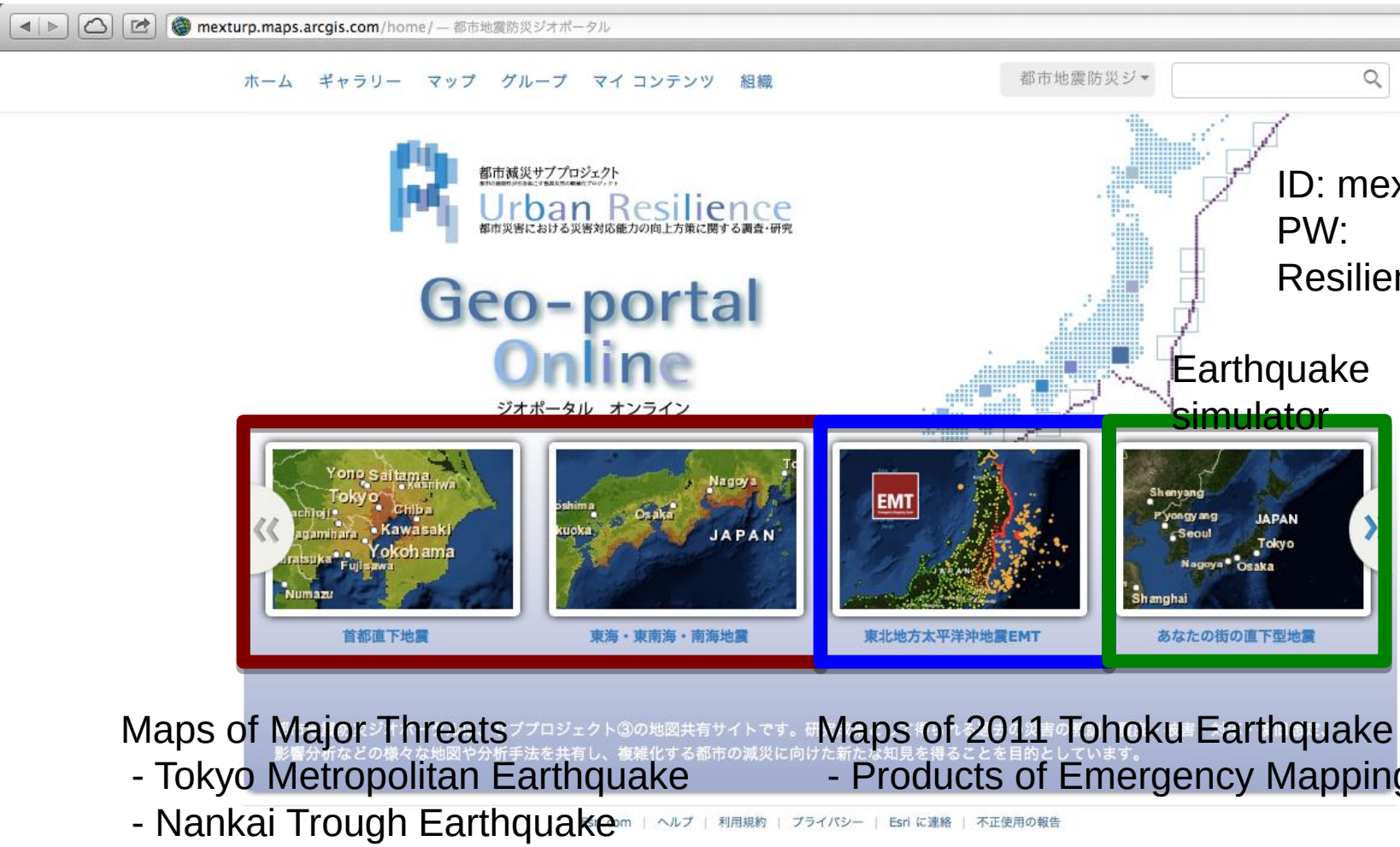
Taken from NTT docomo website

Traffic Pattern Location Information



Tokyo Traffic Pattern- Congestion Heatmap, derived from mobile phone data, March, 2013, 7:23 pm

Urban Resilience Geo-portal Online Developing Prototype Home Page



ID: mext
PW:
Resilience2012

Earthquake simulator

Maps of Major Threats
- Tokyo Metropolitan Earthquake
- Nankai Trough Earthquake

Maps of 2011 Tohoku Earthquake
- Products of Emergency Mapping Team

URL:
http://mexturp.maps.arcgis.com/

Building geo-portal
gathering data and utilizing them

Static Information

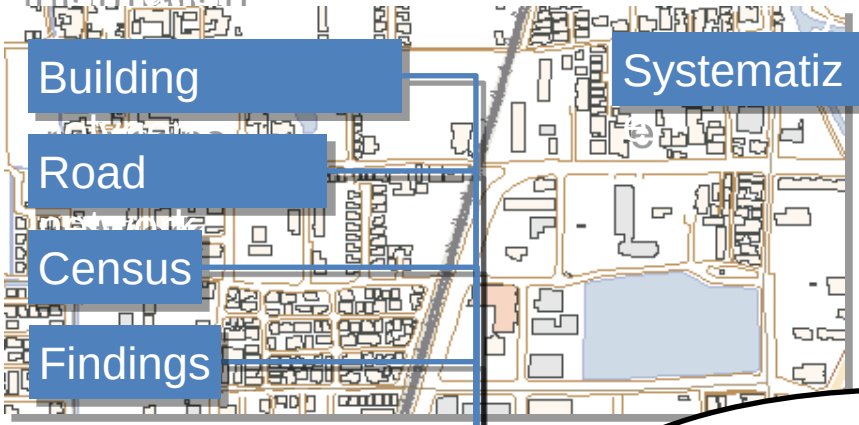
Building

Road

Census

Findings

Systematiz e



Information for BIA

Utilize

Seismic

Damage

Lifeline

Business continuity

Urban Resilience Geo-Portal Online

Dynamic Information

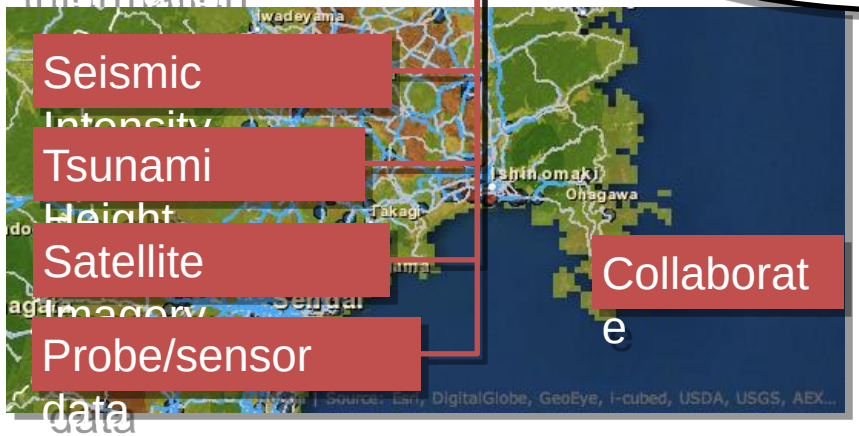
Seismic Intensity

Tsunami Height

Satellite Imagery

Probe/sensor data

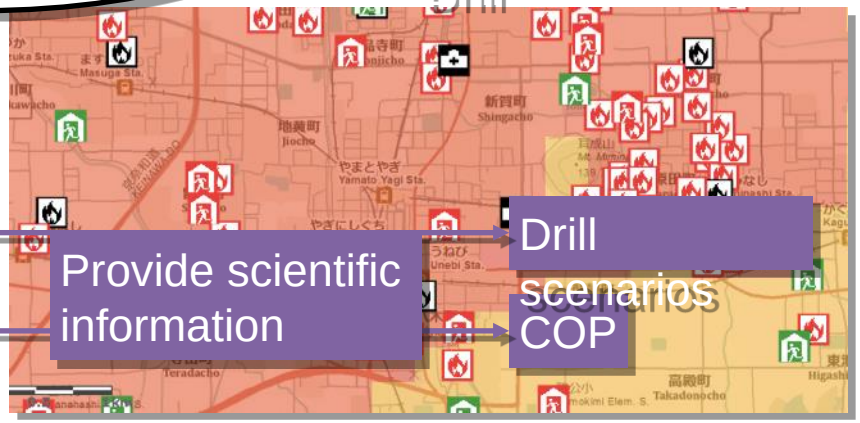
Collaborat e



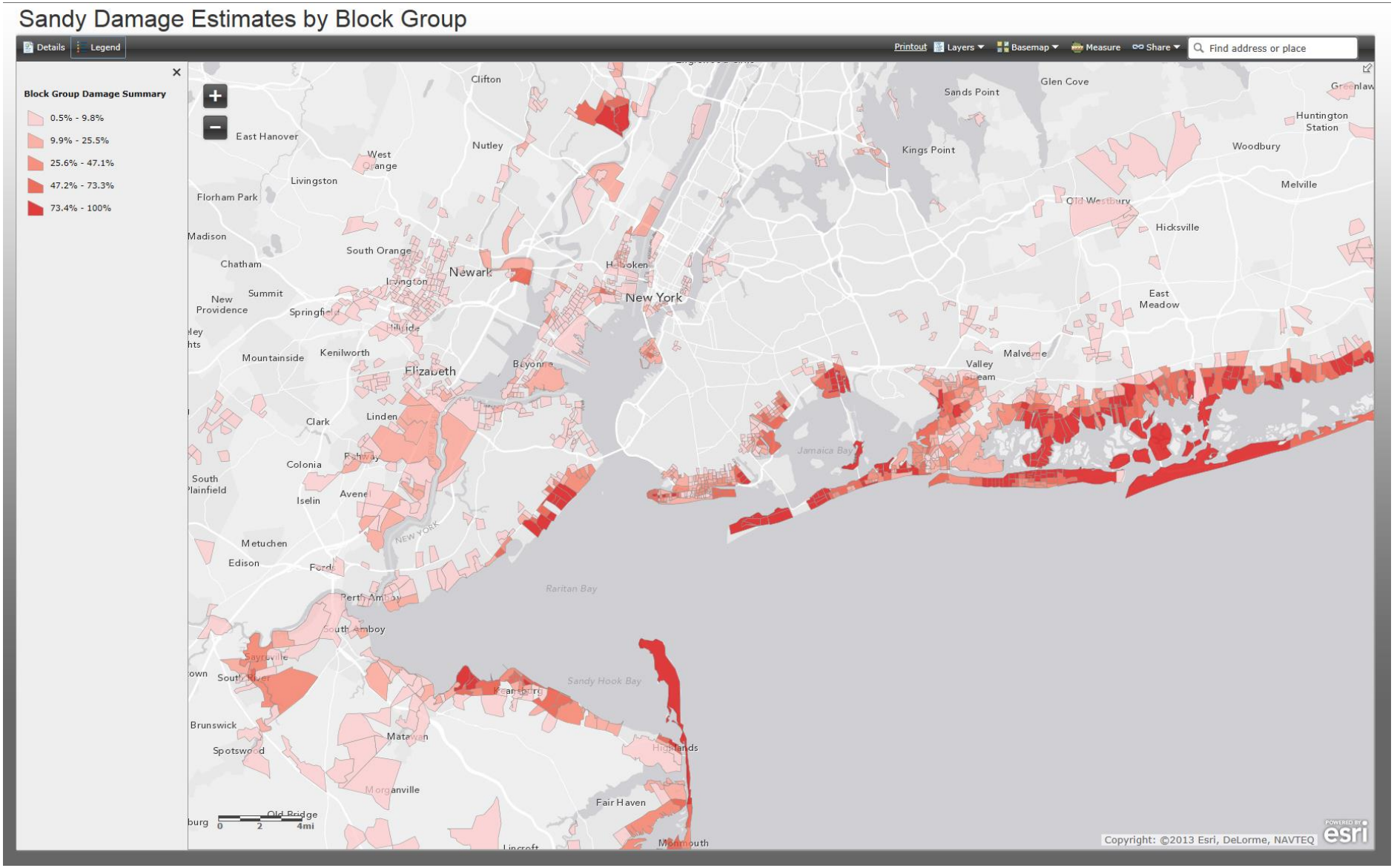
Information for Drill Scenarios

Provide scientific information

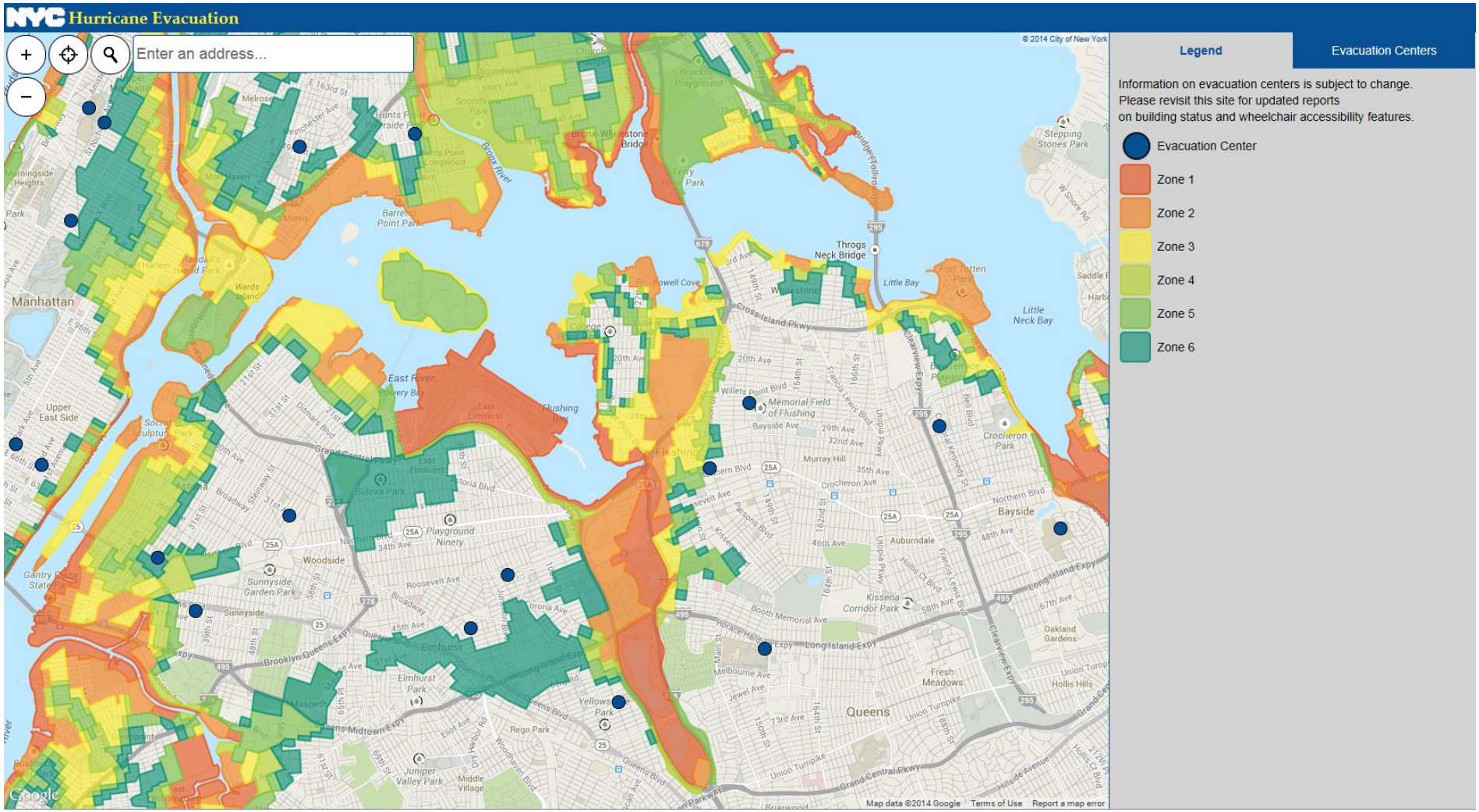
Drill scenarios COP



Hurricane Sandy Damage Estimates



Hurricane Evacuation Zones (New York City)



Australian Bureau of Statistics

Statistical Spatial Framework

Statistical Community

Socio-economic datasets

- **Core NSO datasets** — Census, Demographics, Agriculture, Building, Labour Force, etc.
- **Tax** — Income and business tax
- **Electoral**
- **Human Services** — Medicare, Pharmaceuticals
- **Land Use and Value**
- **Payments** — Unemployment, Disability, Family Support
- **Others …**

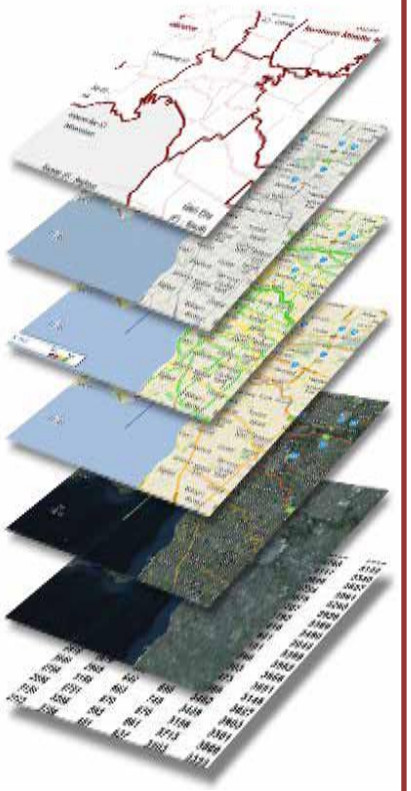
SSF bridge

Spatial Community

Spatial Data Frameworks – Fundamental Elements

Themes:

- Admin. & statistical boundaries
- Addressing, Place Names
- Transport, Water
- Land and Property
- Elevation and Depth
- Imagery
- Positioning



Issues in Integrating Official Statistics and Geo-information

A. Treating Location as Basic Unit of Observation;

B. Full Integration of NSDI and NSDS:

NSDI: National Spatial Data Infrastructure

NSDS: National Strategy for Development of Statistics

C. Governance and Institutional arrangement

D. Evolving new National Information Management Infrastructure (NIMI)

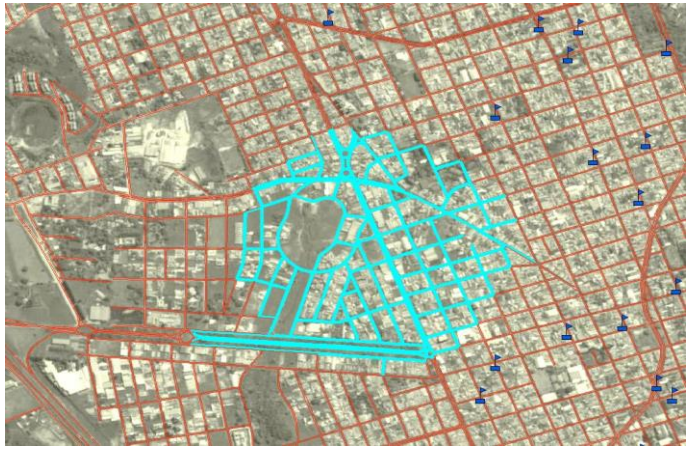
Hierarchical Data Structure : Location as Basic Unit of Observation

25 Smith St, Town Z x,y: 35.5676, 135.6587

Address / Geocode

Cadastral property parcels

Census Districts/Postal codes

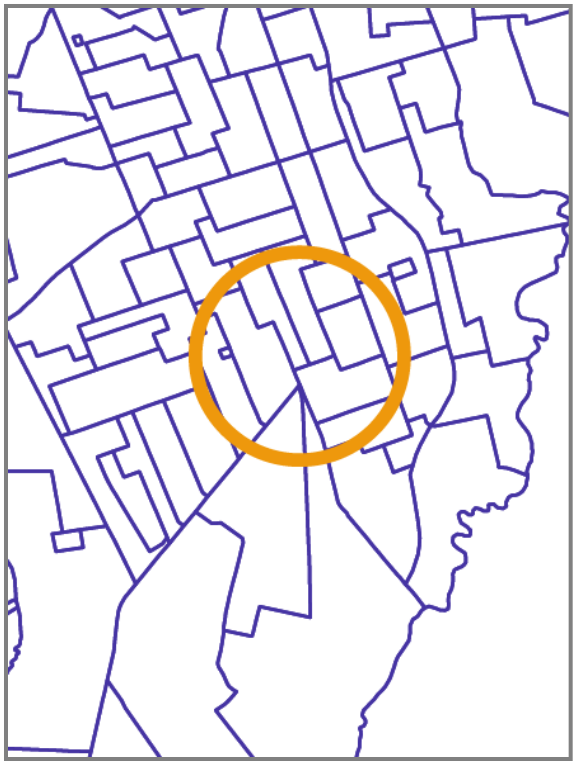


Block Face

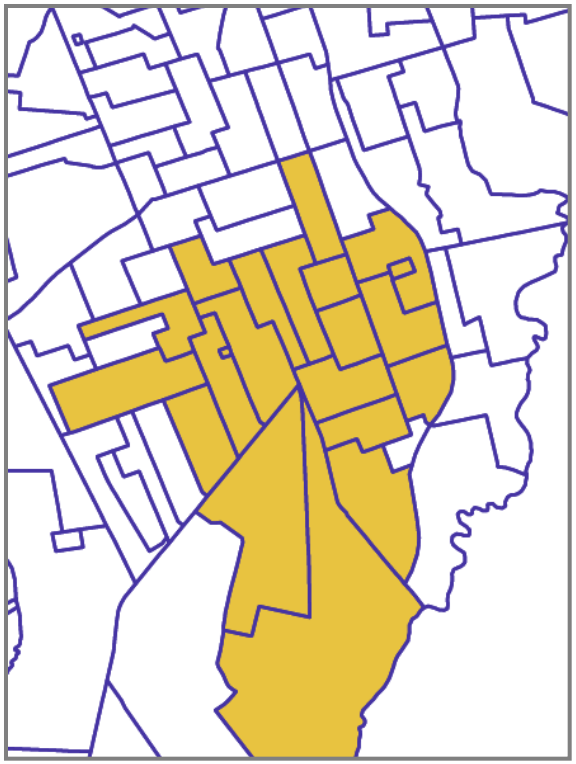
From Polygons to Points of Relevance (POR)

Users demand increasing precision.

What is the smallest spatial unit possible??



area of interest

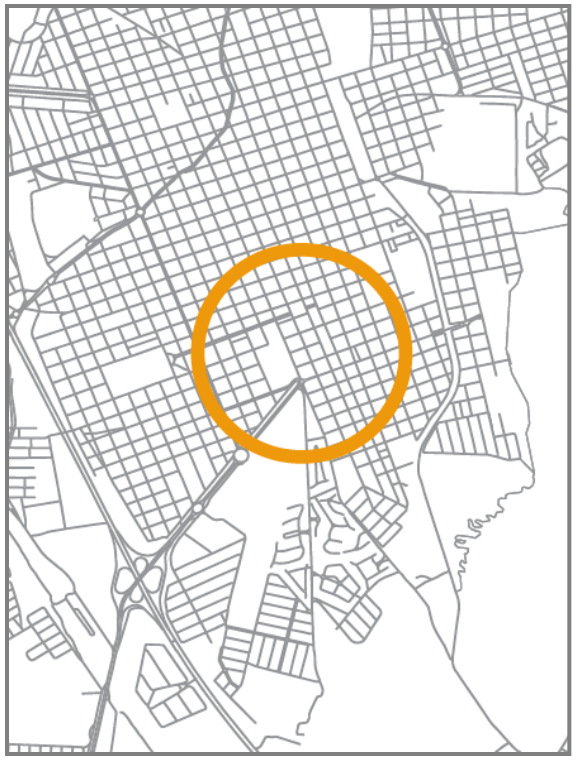


intersection result

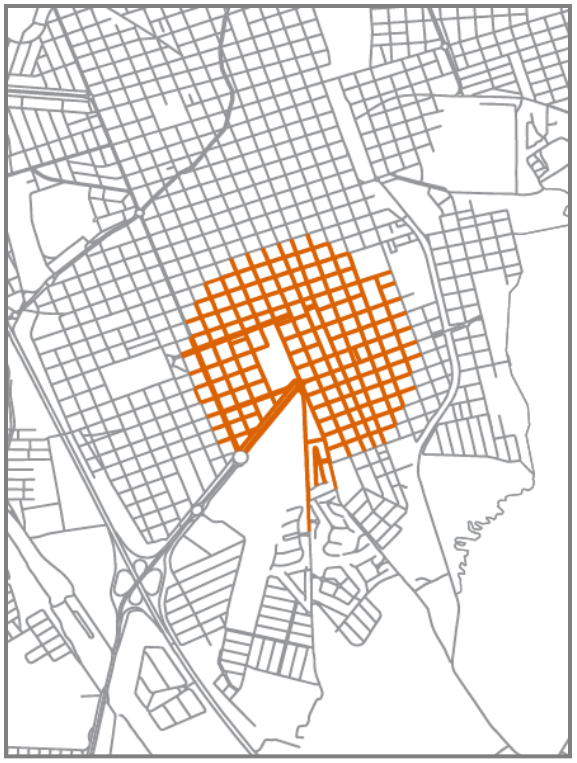
Smaller Polygons, More Precise Data

Confidentiality the key constraint

But users demand (and will supply) POR data



area of interest



intersection result

From Polygons to Point-Based Information

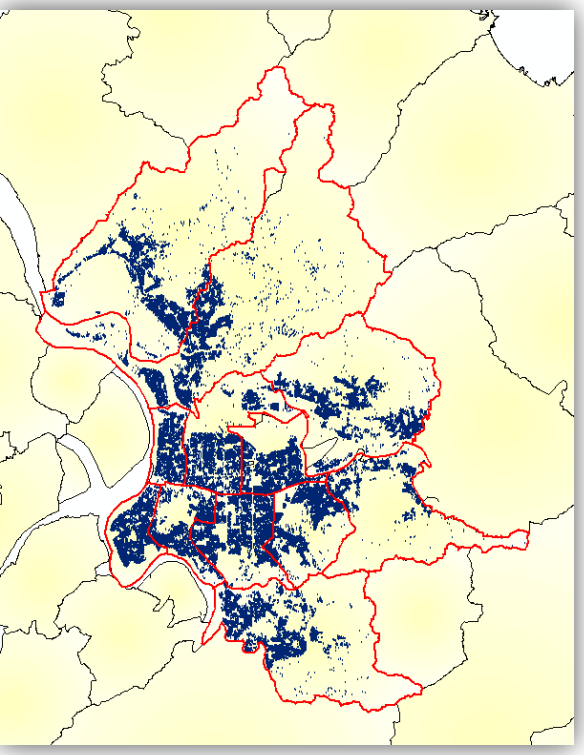
- Points likely to complement Polygons as the organizing framework for data integration, providing location-specific Information;
- The dynamic movement from Point to Point will pull out packets of Point-of-Relevance information on a string;
- Point-based information will be able to facilitate the convergence of information from multiple sources for a particular location;
- Points identified by Geocodes or Addresses.

Example from Chinese Taipei

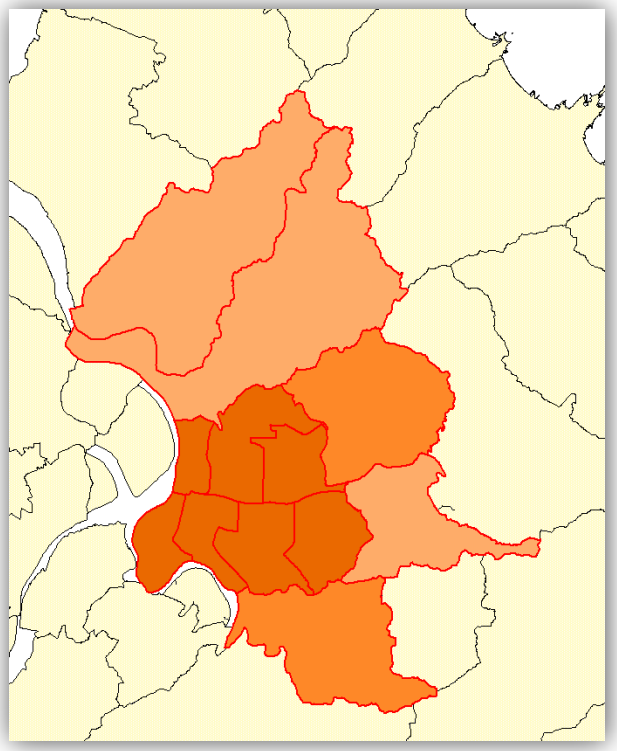
Problems

- Jurisdictional units is usually too large to provide detail information on local area of interest

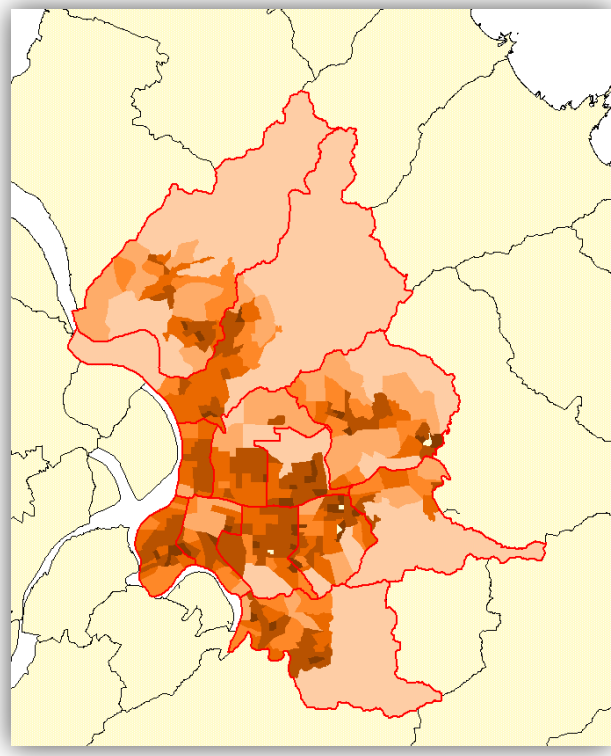
Original individual data

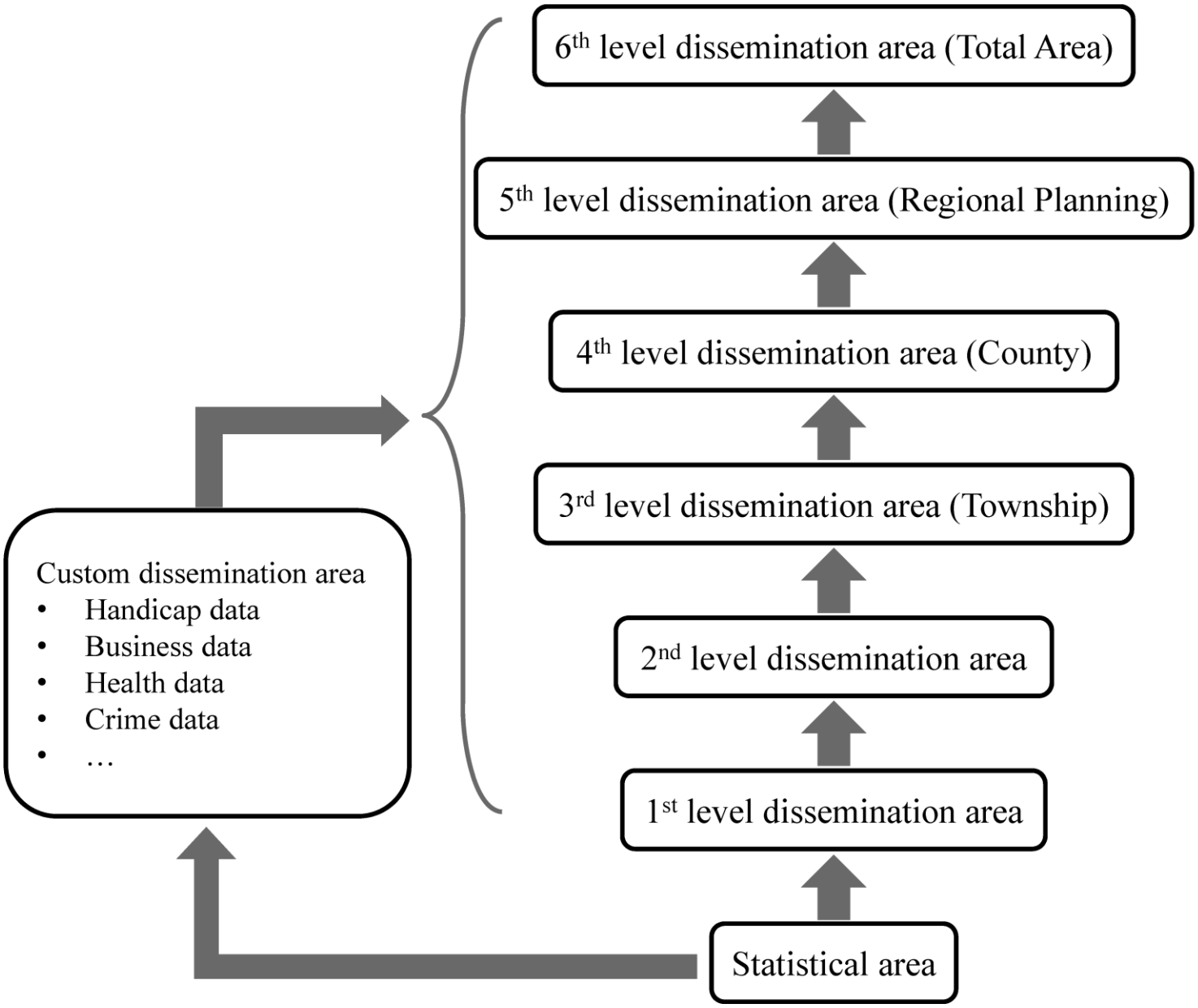


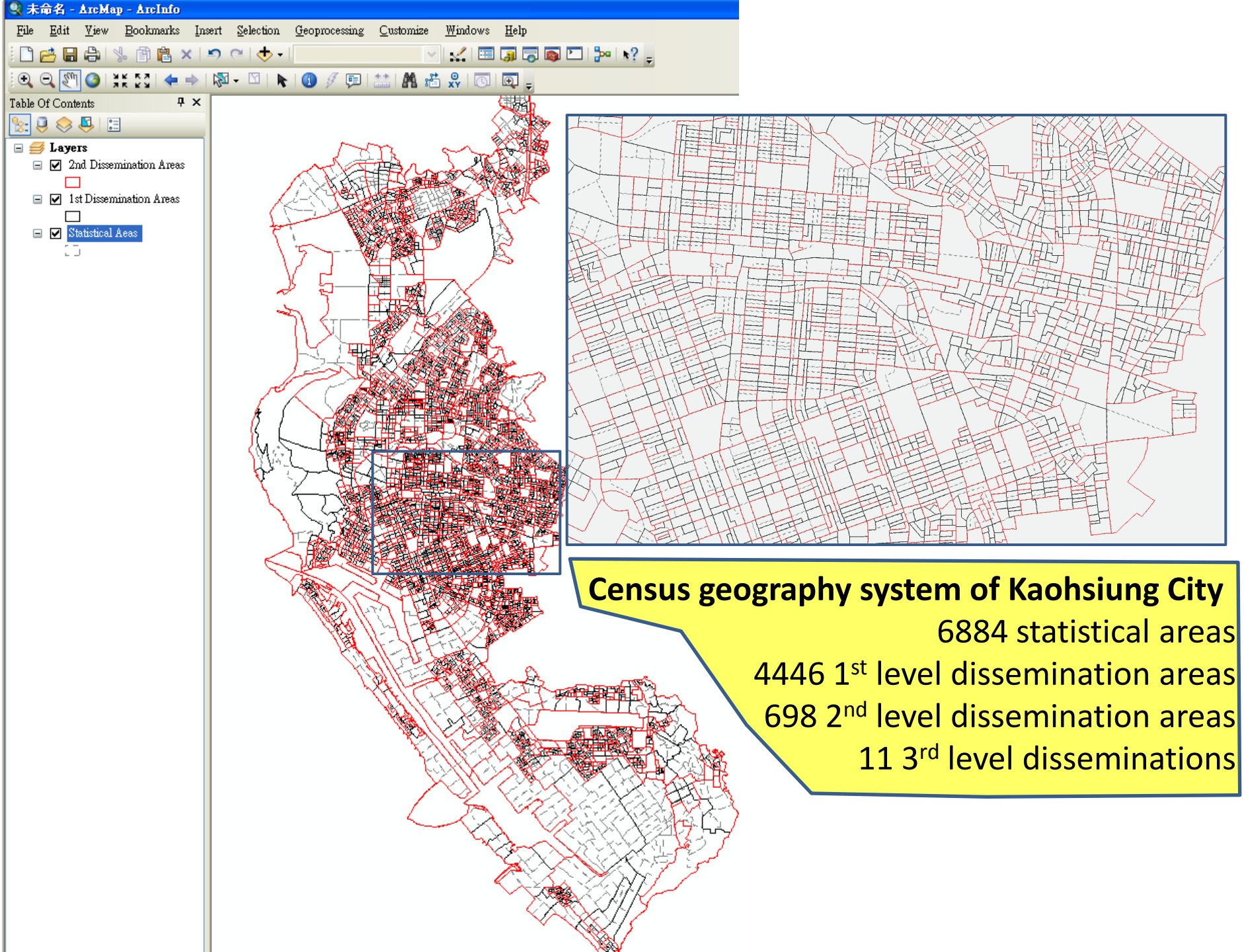
Aggregated by township level boundaries



Aggregated by village level boundaries



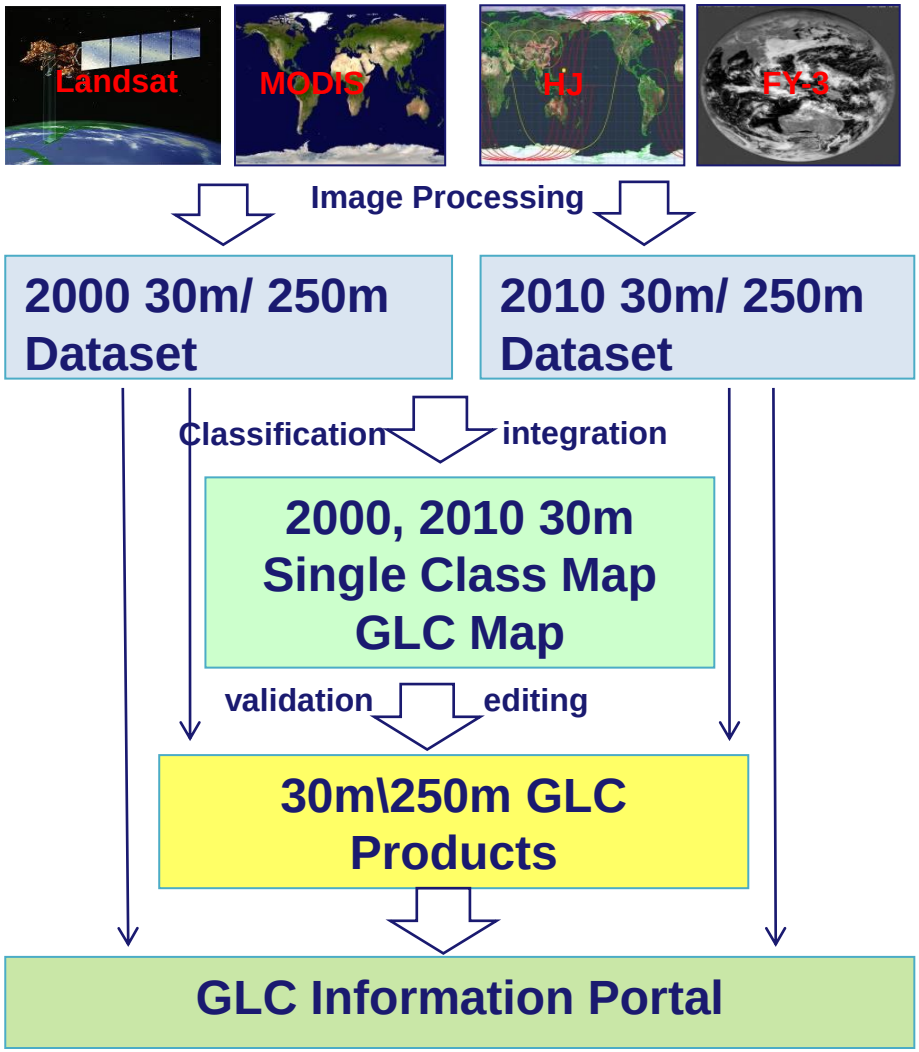

6th level dissemination area (Total Area)
5th level dissemination area (Regional Planning)
4th level dissemination area (County)
3rd level dissemination area (Township)
2nd level dissemination area
1st level dissemination area
Statistical area
Custom dissemination area
• Handicap data
• Business data
• Health data
• Crime data
• …


未命名 - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
2nd Dissemination Areas
1st Dissemination Areas
Statistical Aeas
Census geography system of Kaohsiung City
6884 statistical areas
4446 1st level dissemination areas
698 2nd level dissemination areas
11 3rd level disseminations

Building Location-Based Data Structure

- No consistent Geocode to link statistical data to Location;
- Many countries working on National Address Management Framework to define an unique geocode data structure;
- Urgently need location-based data management practices with multiple databases linked through geocode;
- Statistical-Spatial Metadata Interoperability, Integrating SDMX/DDI (statistics) with ISO-19115;
- Need enabling policies and protocols.

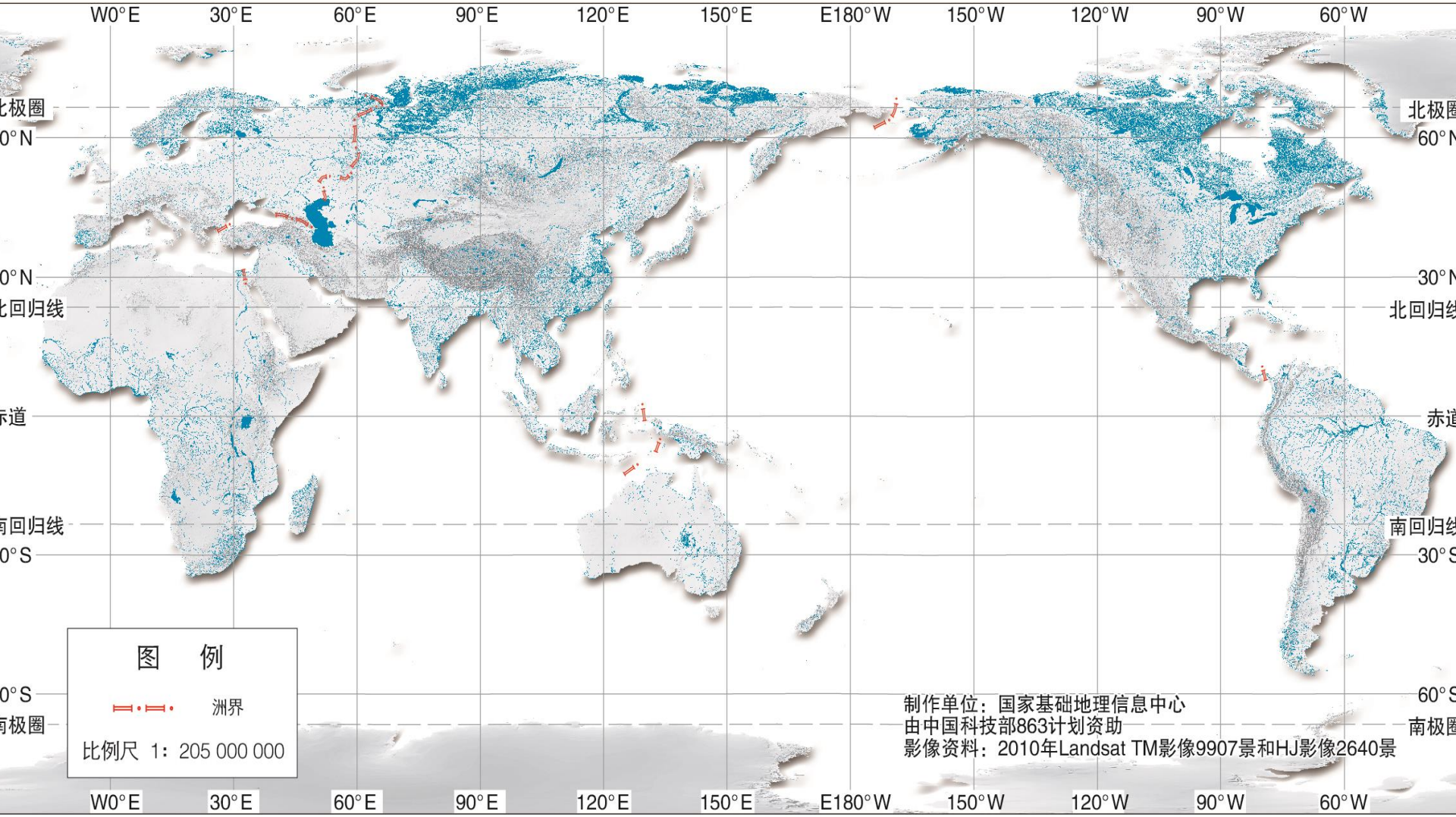
Global Location Information: China's Global Land Cover Mapping



- **Mapping land cover of the whole globe at 30 m and for two baseline years (2000 and 2010)**
- **The first time in the world**

From Prof Chen Jun, NASG

Global Land Surface Water



From Prof Chen Jun, NASG

Assessment of Land Surface Water Areas

	Area of Surface Water (in 10,000 sq km)		Change (in 10,000 sq km)	% change
	2000	2010		
Asia	125.00	124.28	-0.72	-0.58%
Europe	32.58	31.59	-0.99	-3.12%
Africa	28.61	27.19	-1.42	-5.22%
North America	153.23	153.02	-0.21	-0.14%
South America	28.79	26.78	-2.01	-7.49%

From Prof Chen Jun, NASG

Coordinating NSDI and NSDS

- Now NSDI and NSDS two independent processes;
- NSDI sets norms for sharing spatial information;
  - Specifying the technology, policies, criteria, standards and people necessary to promote geospatial data sharing
- NSDS sets strategy for statistical development;
  - No reference to location information in NSDS
- Greater cooperation will allow the full implementation of Statistical Geospatial Framework

Governance and Institutional Arrangement

- Mapping agency and Statistical agency under different jurisdictions and with different mandates;
- Coordination needs to be further enhanced;
- Mapping agency primary responsibility is the base map and the geographic and cadastral layers;
- Statistical agency adds layers of information from their pool of official statistics, but also produce census maps;
- Coordination and collaboration based on mutual respect is important

The Road Ahead: Developing a National Information Management Infrastructure (NIMI)

- Need a National Spatial Data Infrastructure (NSDI) to coordinate all meta data and information layers;
- Need a core data system linking all agencies and new tools in information integration;
- Need new thinking on how to use information;
- Need a new national governance arrangement to manage the process of gathering and using information;
- Need cross-border coordination as well such as borderlands information systems or global thematic mapping.

Developing a NIMI through CDO leadership

- Governments and enterprises have established ‘Chief Data Officers’ (CDOs) to have the business responsibility to capture and exploit for decision-making purposes;

- CDO’s role will become more important in future, as decisions are based not on single source, but through data fusion and aggregation;

- CDO will also manage the location of central database and the coordination of information layers to enhance efficiency;

- The new NIMI will be critical for national competitiveness, as it enhances problem-solving capabilities through better information flow and management.

THANK YOU

paul.cheung@nus.edu.sg