e-Planning at MIT:

Urban Information Systems for Responsive Cities

Prof. Joseph Ferreira, Jr.
Head, Urban Information Systems
MIT Urban Studies & Planning Department

MIT Department of Urban Studies and Planning

- Part of School of Architecture and Planning
  - ~65 MCP and ~8 PhD each year
  - 75th Anniversary this year
  - Physical and social consequences of development
- Areas of Interest
  - City design, housing and communities, environment, and international development
  - Urban information systems, transportation, and regional planning
  - Distributional impacts of development
- Multi-disciplinary faculty
  - Architecture, urban planning, social science, engineering

E-Planning

- Impacts of new Information and Communication Technologies (ICT) on planning and development of metro areas
- Increasingly important due to problems with global warming, sustainability, urbanization
- 25-year history at MIT
  - Planning Support Systems
  - Geographic Information Systems (GIS) and spatial data infrastructure
  - Technology-aided public participation (PPGIS)
  - e-Planning seminars in 2003 (organized by Pedro)

ePlanning Scope

- ePlanning is more than eGovernment
  - Beyond office automation
    - ICT has broad social impacts & ripple effects
  - ePlanning Goal is ***not*** 'automation'
    - Example: **permitting** (*what development to allow*)
    - Illuminate consequences of choices
    - Discover interests, values, alternatives
    - Facilitate evaluation and (self) governance
    - Protect public interest and public goods
- Restructuring urban planning to utilize ICT
  - Making cities more ***responsive*** via ICT

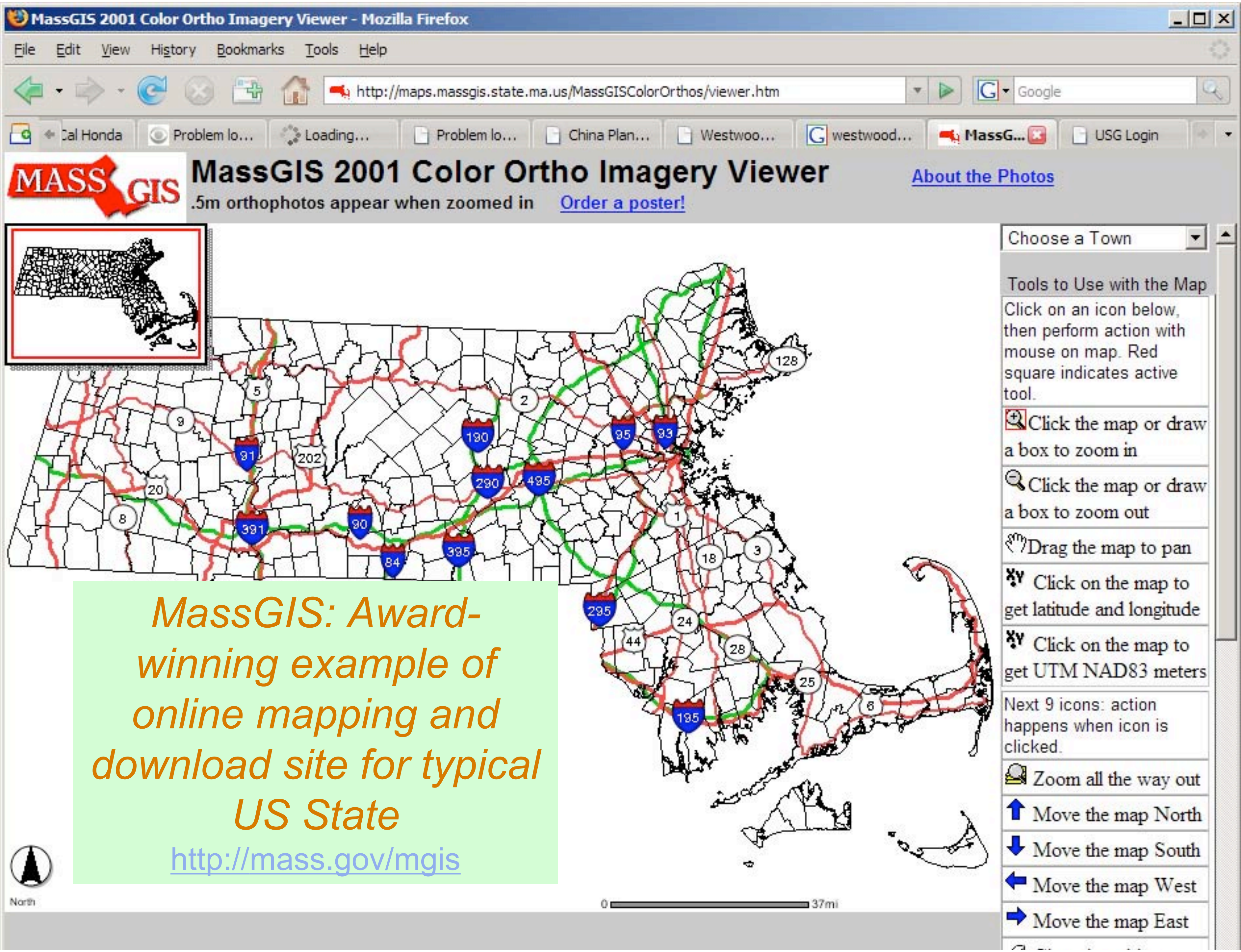
Example: ePlanning Opportunities and Challenges for Urban Transportation

- Lots of ICT Impacts on urban transportation
  - Direct changes in urban transport efficiency
    - Productivity: fare collection, vehicle location, ...
    - Incentives: Congestion pricing, realtime adjustment, …
  - Indirect changes in behavior & land use
    - New economics of place
    - New choices for facility location, public space, …
- We need
  - More than transportation data
    - land use, buildings, safety, demographics, …
  - More than logistical analysis
    - Urban design: digital cities, public spaces
    - Data management privacy, personal freedom, net neutrality

ePlanning Opportunities and Challenges for Urban Transportation – Part II

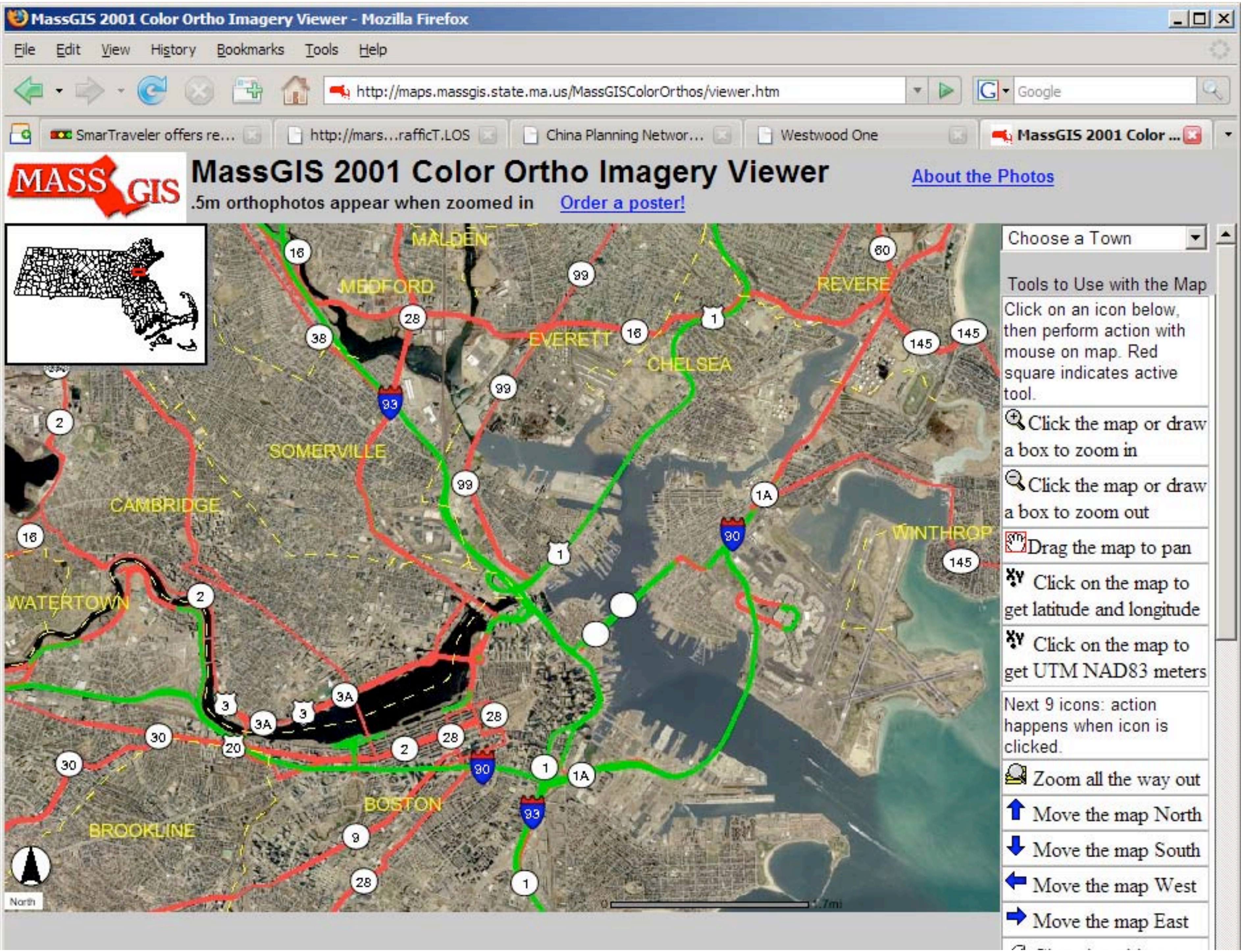
Illustrate key points:

- New Information infrastructure requirements
  - Base of ‘City Knowledge’ as ‘public good’
  - Distributed, flexible, loosely-coupled architecture
    - To allow public/private value-added
    - Using chained web services (not isolated models)
- Traditional urban models need rebuilding
  - To tap ‘City Knowledge’ base
  - To be part of continual planning process
  - To support useful citizen participation



MassGIS: Award-winning example of online mapping and download site for typical US State

http://mass.gov/mgis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Order a poster!
About the Photos
MALDEN
MEDFORD
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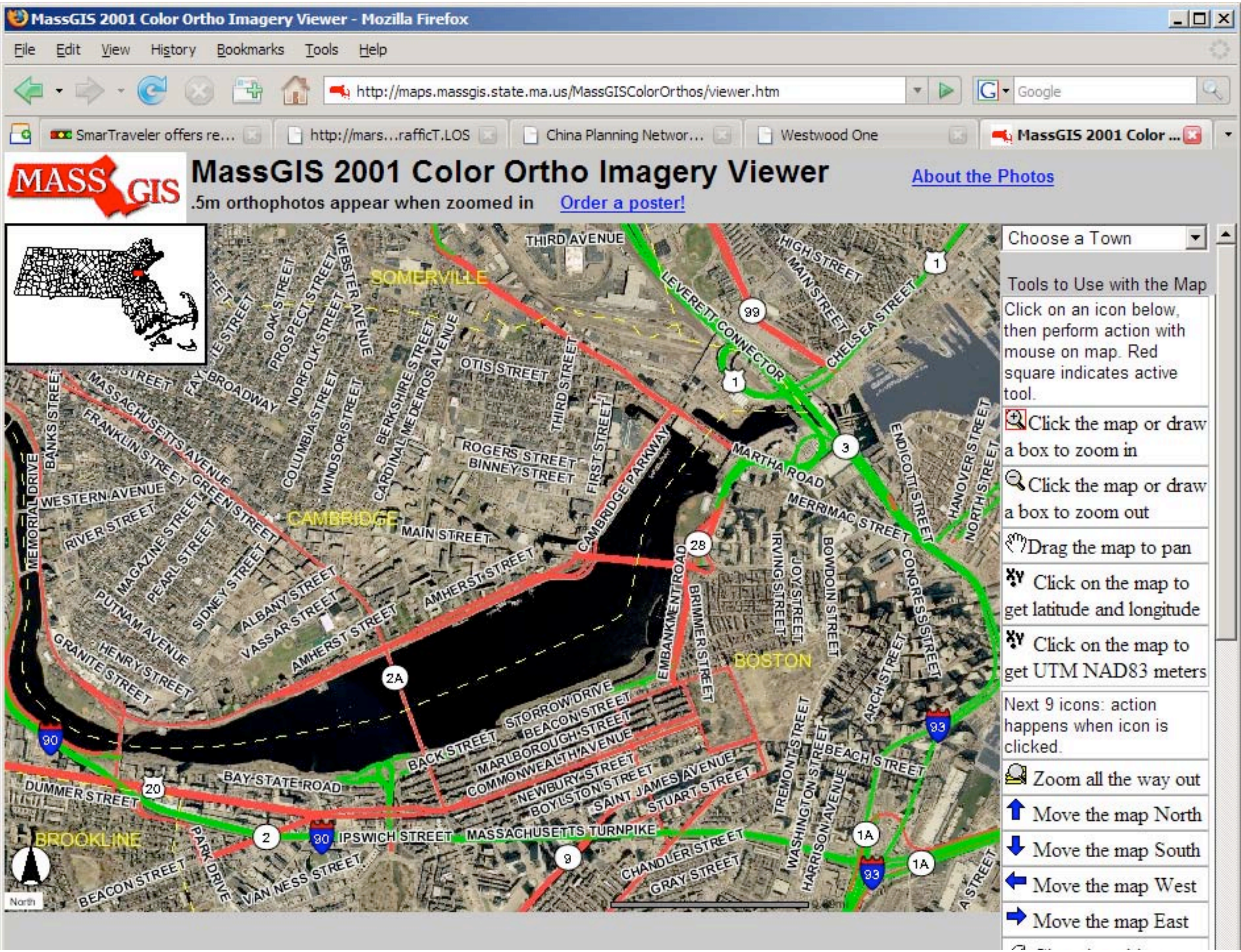
CHELSEA
REVERE
SOMERVILLE
CAMBRIDGE
WINTHROP
WATERTOWN
BOSTON
BROOKLINE
North
Choose a Town
Tools to Use with the Map
Click on an icon below, then perform action with mouse on map. Red square indicates active tool.
Click the map or draw a box to zoom in
Click the map or draw a box to zoom out
Drag the map to pan
Click on the map to get latitude and longitude
Click on the map to get UTM NAD83 meters
Next 9 icons: action happens when icon is clicked.
Zoom all the way out
Move the map North
Move the map South
Move the map West
Move the map East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Click on the map to get latitude and longitude
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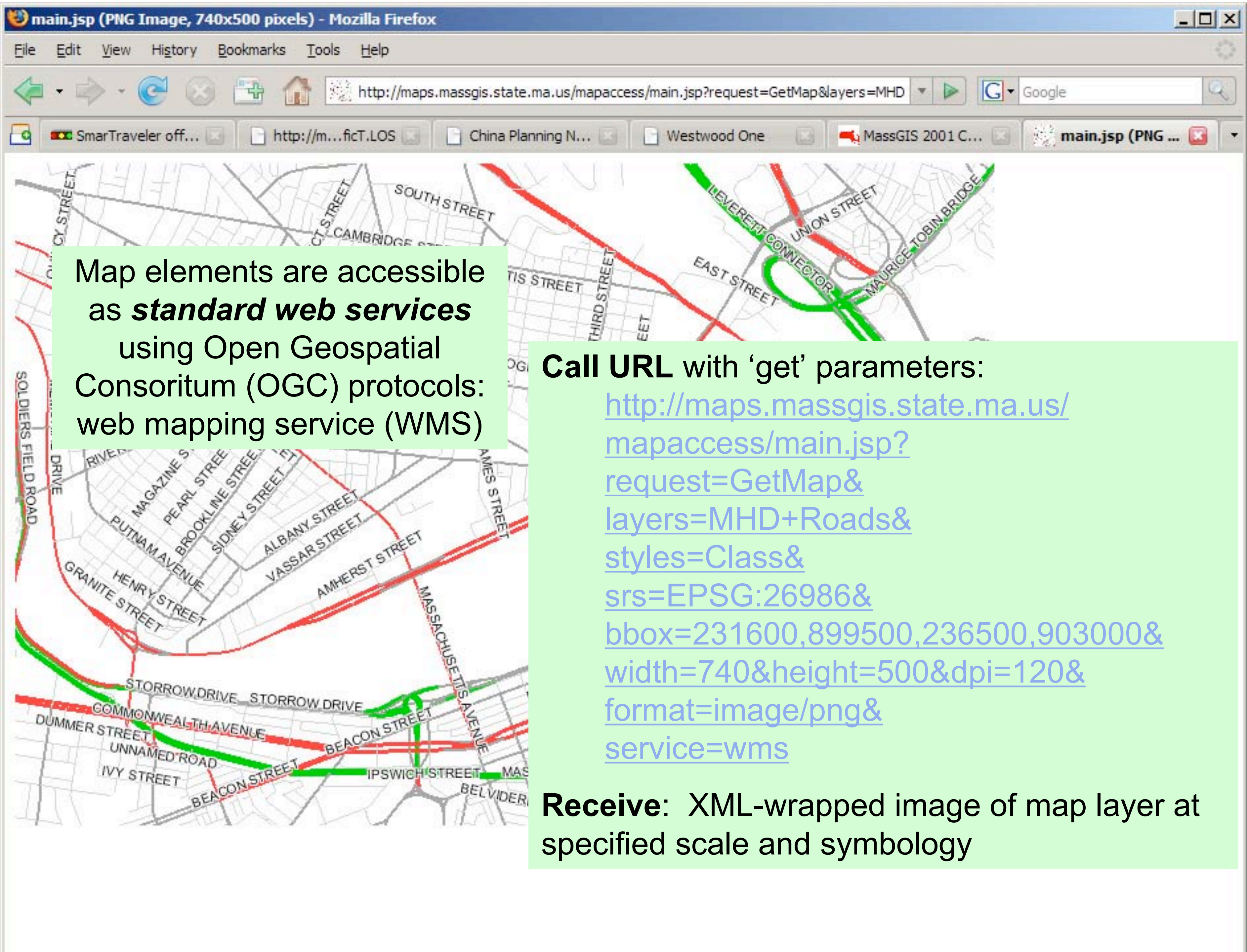
Next 9 icons: action happens when icon is clicked.
Zoom all the way out
Move the map North
Move the map South
Move the map West
Move the map East
SOMERVILLE
CAMBRIDGE
BOSTON
BROOKLINE
THIRD AVENUE
HIGH STREET
MAIN STREET
LEVERETT CONNECTOR
CHELSEA STREET
WEBSTER AVENUE
OTIS STREET
BROADWAY
MASSACHUSETTS AVENUE
FRANKLIN STREET
WESTERN AVENUE
RIVER STREET
MEMORIAL DRIVE
ROGERS STREET
BINNEY STREET
CAMBRIDGE PARKWAY
MARTHA ROAD
MERRIMAC STREET
MAIN STREET
AMHERST STREET
STORROW DRIVE
BEACON STREET
MARLBOROUGH STREET
COMMONWEALTH AVENUE
NEWBURY STREET
BOYLSTON STREET
BACK STREET
BAY STATE ROAD
DUMMER STREET
IPSWICH STREET
MASSACHUSETTS TURNPIKE
SAINT JAMES AVENUE
STUART STREET
CHANDLER STREET
GRAY STREET
VAN NESS STREET
BEACON STREET
PARK DRIVE
EMBANKMENT ROAD
BRIMMER STREET
CONGRESS STREET
BEACH STREET
TREMONT STREET
WASHINGTON STREET
HARRISON AVENUE
North



Map elements are accessible as ***standard web services*** using Open Geospatial Consoritum (OGC) protocols: web mapping service (WMS)

Call URL with ‘get’ parameters:

http://maps.massgis.state.ma.us/mapaccess/main.jsp?request=GetMap&layers=MHD+Roads&styles=Class&srs=EPSG:26986&bbox=231600,899500,236500,903000&width=740&height=500&dpi=120&format=image/png&service=wms

Receive: XML-wrapped image of map layer at specified scale and symbology

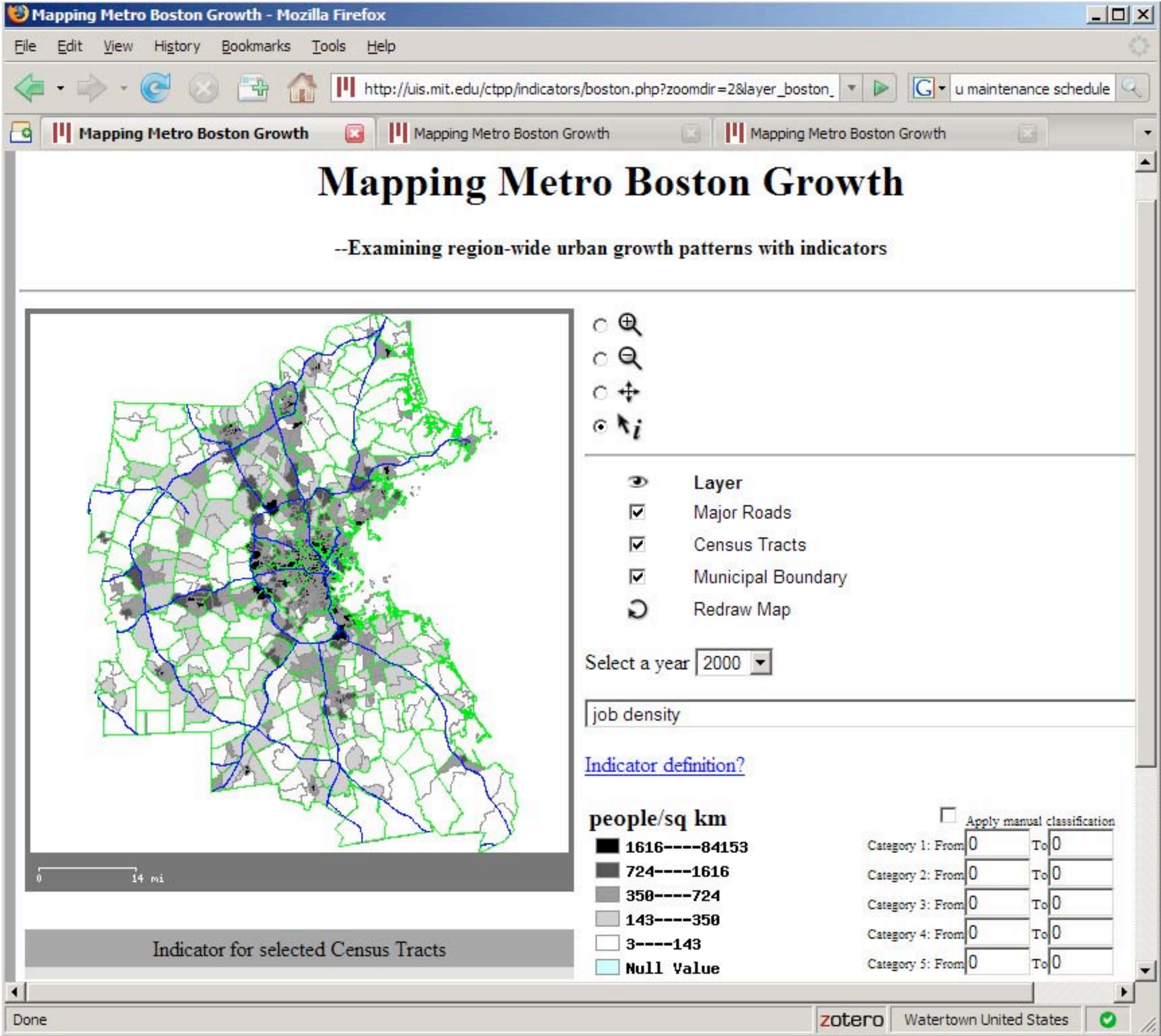
Job-Housing Balance and Commuting Patterns (with Yang Jiawen)

- Study journey-to-work data in Atlanta and Boston for 1980, 1990, and 2000
  - US Census survey of 5% of households
    - identify residence, workplace, and commuting mode/time
  - Aggregate to census tract and publish (free)
  - 2 million workers & 900 census tracts in Atlanta & Boston
    ➔ 900x900= 810,000 commuting possibilities
- Compare commuting patterns as residences and jobs decentralized

Job-Housing Balance and Commuting Patterns:
Examine UIS Implications of Study

Facilitate exploratory data analysis by

- Putting journey-to-work data on **Web**
  - Worker counts for 900x900 resident/job pairs
- With tools to **visualize** spatial patterns
  - In relational database (Postgres)
  - Use PHP and MapServer to provide online mapping of job density, commute sheds…


Mapping Metro Boston Growth - Mozilla Firefox
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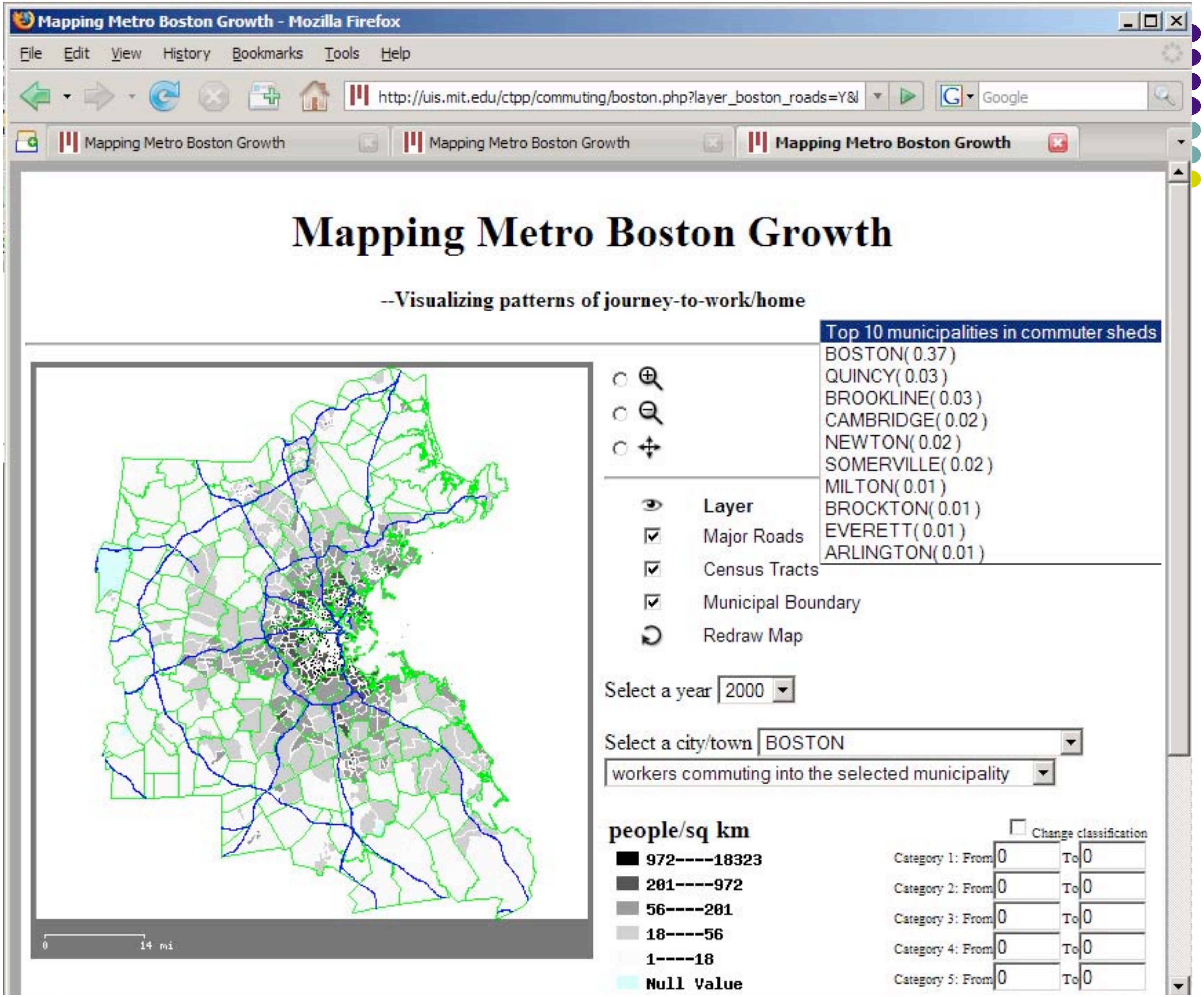
Mapping Metro Boston Growth
Mapping Metro Boston Growth
--Examining region-wide urban growth patterns with indicators
0
14 mi
Layer
Major Roads
Census Tracts
Municipal Boundary
Redraw Map
Select a year 2000
job density
Indicator definition?
people/sq km
1616----84153
724----1616
350----724
143----350
3----143
Null Value
Apply manual classification
Category 1: From 0 To 0
Category 2: From 0 To 0
Category 3: From 0 To 0
Category 4: From 0 To 0
Category 5: From 0 To 0
Indicator for selected Census Tracts
Done
zotero
Watertown United States



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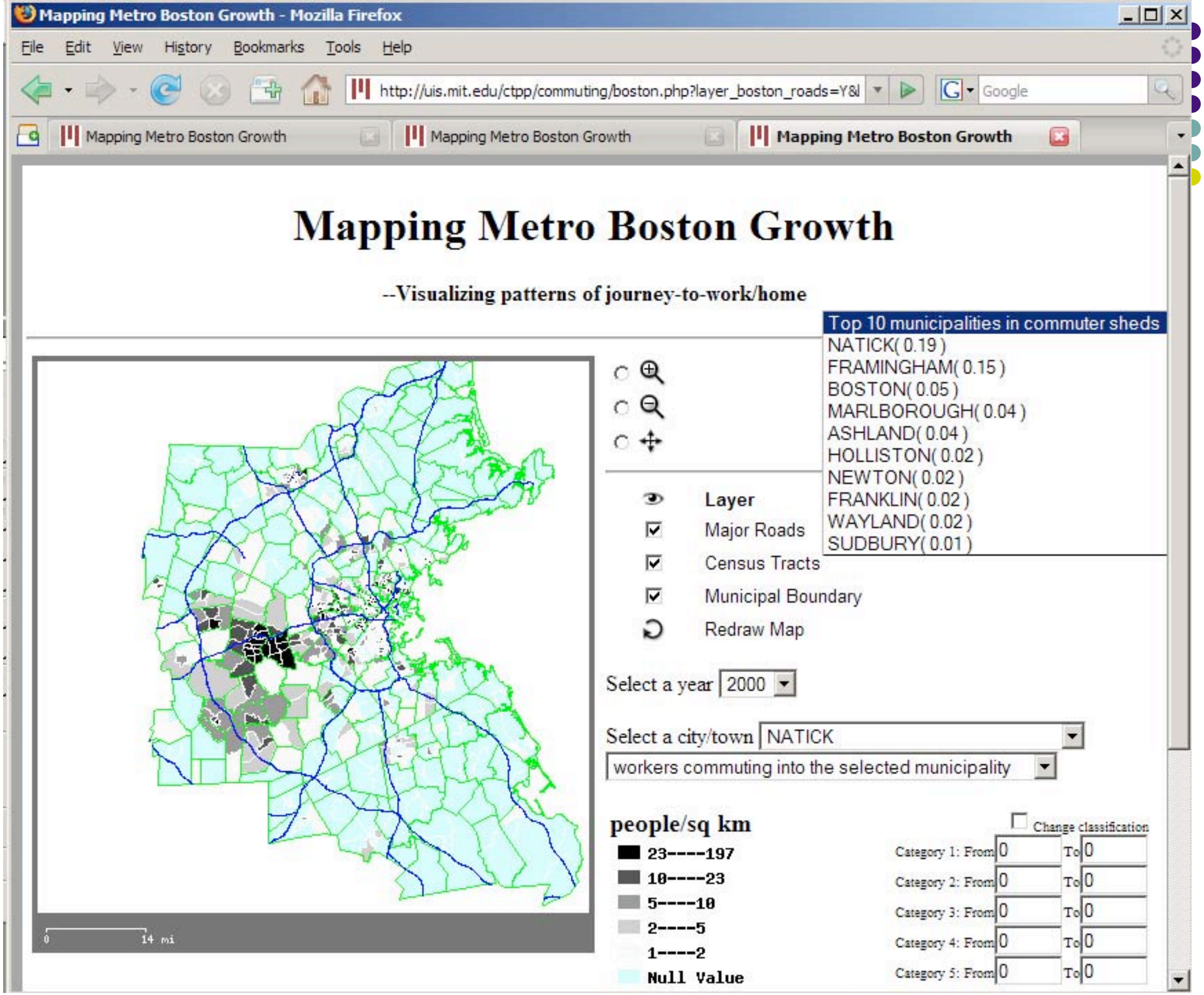
Google
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
--Visualizing patterns of journey-to-work/home
Top 10 municipalities in commuter sheds
BOSTON(0.37)
QUINCY(0.03)
BROOKLINE(0.03)
CAMBRIDGE(0.02)
NEWTON(0.02)
SOMERVILLE(0.02)
MILTON(0.01)
BROCKTON(0.01)
EVERETT(0.01)
ARLINGTON(0.01)
Layer
Major Roads
Census Tracts
Municipal Boundary
Redraw Map
Select a year 2000
Select a city/town BOSTON
workers commuting into the selected municipality
people/sq km
972----18323
201----972
56----201
18----56
1----18
Null Value
Change classification
Category 1: From 0 To 0
Category 2: From 0 To 0
Category 3: From 0 To 0
Category 4: From 0 To 0
Category 5: From 0 To 0
0
14 mi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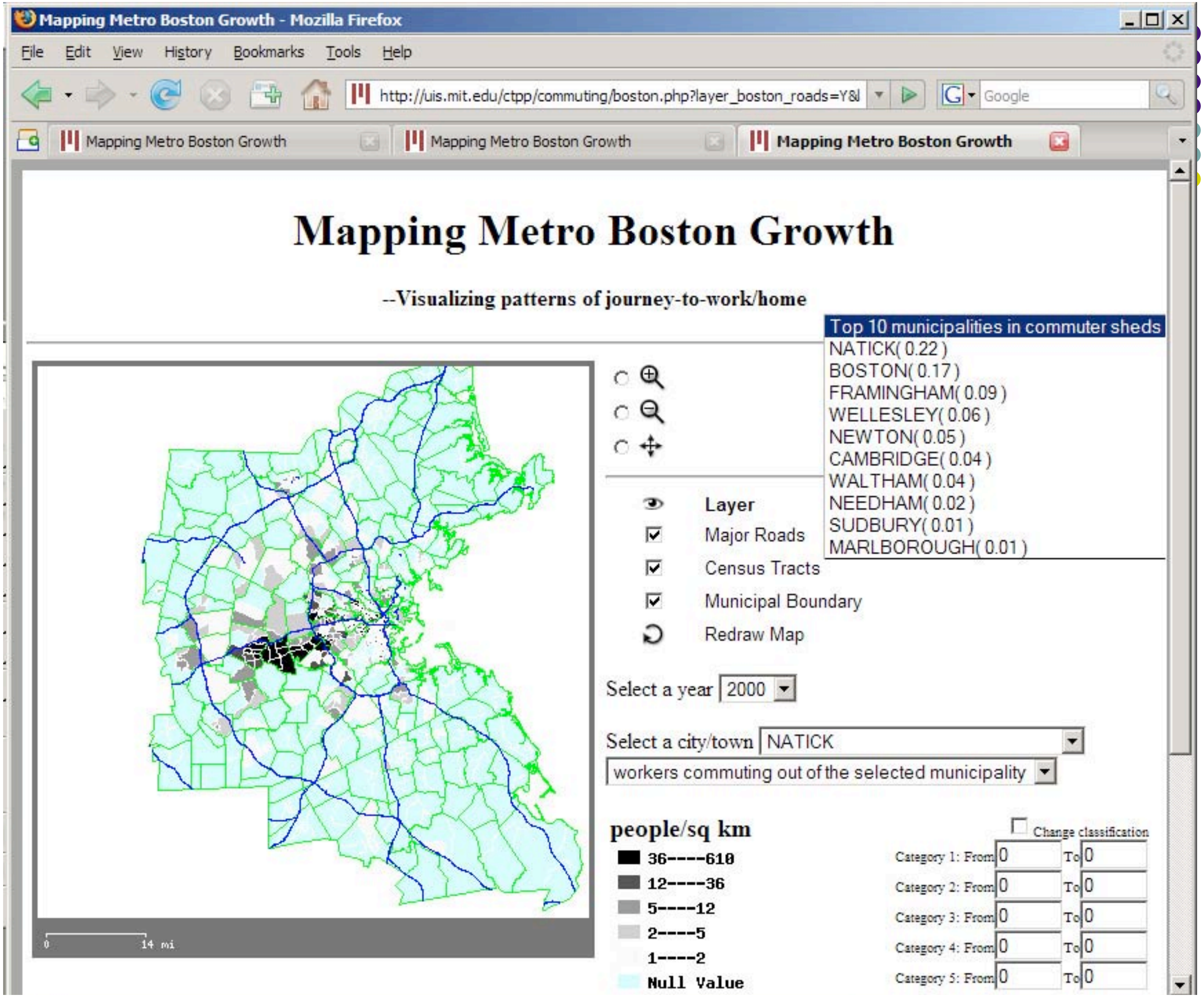
Google
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
--Visualizing patterns of journey-to-work/home
Top 10 municipalities in commuter sheds
NATICK(0.19)
FRAMINGHAM(0.15)
BOSTON(0.05)
MARLBOROUGH(0.04)
ASHLAND(0.04)
HOLLISTON(0.02)
NEWTON(0.02)
FRANKLIN(0.02)
WAYLAND(0.02)
SUDBURY(0.01)
Layer
Major Roads
Census Tracts
Municipal Boundary
Redraw Map
Select a year 2000
Select a city/town NATICK
workers commuting into the selected municipality
people/sq km
23----197
10----23
5----10
2----5
1----2
Null Value
Change classification
Category 1: From 0 To 0
Category 2: From 0 To 0
Category 3: From 0 To 0
Category 4: From 0 To 0
Category 5: From 0 To 0
0
14 mi



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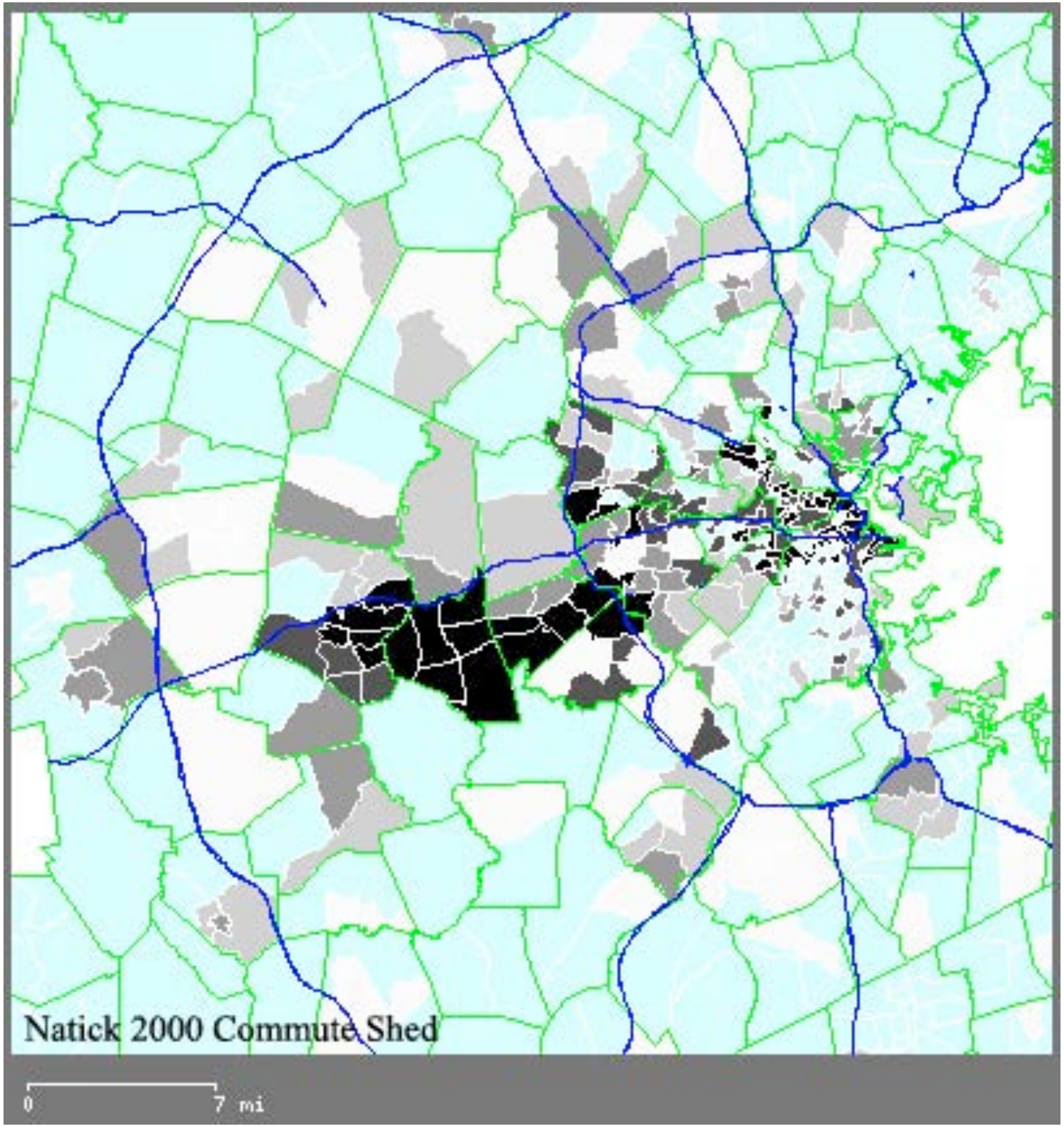
Google
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
Mapping Metro Boston Growth
--Visualizing patterns of journey-to-work/home
Top 10 municipalities in commuter sheds
NATICK(0.22)
BOSTON(0.17)
FRAMINGHAM(0.09)
WELLESLEY(0.06)
NEWTON(0.05)
CAMBRIDGE(0.04)
WALTHAM(0.04)
NEEDHAM(0.02)
SUDBURY(0.01)
MARLBOROUGH(0.01)
Layer
Major Roads
Census Tracts
Municipal Boundary
Redraw Map
Select a year 2000
Select a city/town NATICK
workers commuting out of the selected municipality
people/sq km
36----610
12----36
5----12
2----5
1----2
Null Value
Change classification
Category 1: From 0 To 0
Category 2: From 0 To 0
Category 3: From 0 To 0
Category 4: From 0 To 0
Category 5: From 0 To 0
0
14 mi



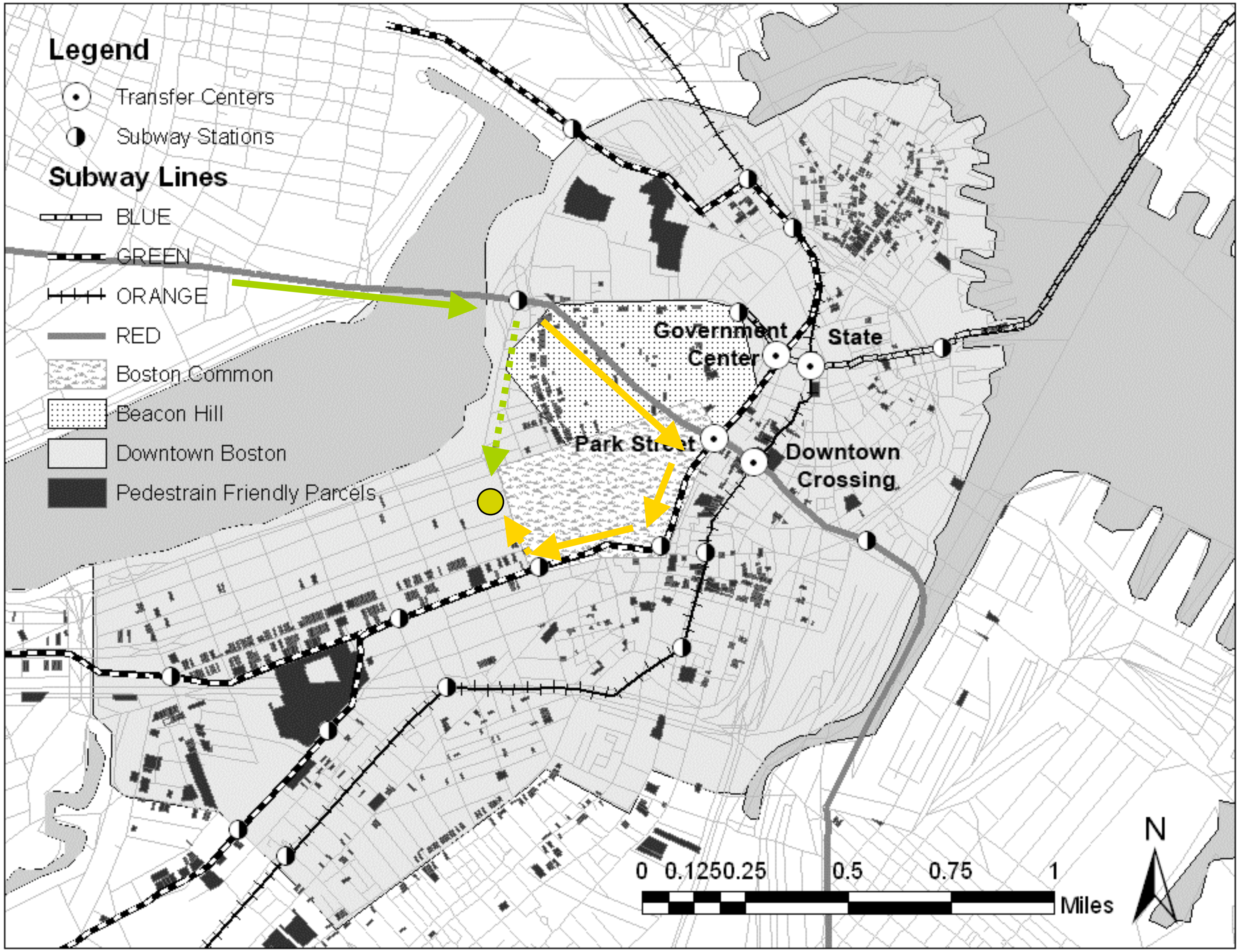
Natick commute shed 1990-2000 [workplaces of Natick residents]

Trend: Spreading outward along ***non-toll*** highways

Effects of Transfers and Pedestrian Environment on Transit Riders (with Guo Zhan)

- Use another travel survey – 3000 transit trips into downtown Boston
- Identify transit riders with multiple paths to work
  - with/without transfer, long walk, …
- Measure characteristics of each path
  - Transfer convenience (stairs, long walk, …)
  - Pedestrian friendliness (sidewalk width, cafe and shop density, …)

Subway System in Downtown Boston



Modeling Transit Rider Behavior

- Fit discrete choice model
  - path choice = function of path characteristics
- Use results to understand effects of station design and land use patterns on transit riders
  - Transfer inconvenience is high – equivalent to 10 minutes of walking time savings
    - But 70% is controllable (transfer distance, escalator, …)
  - Pedestrian attractiveness matters
    - riders exit sooner and walk further if land use is attractive

UIS Lessons from Modeling Transit Rider Behavior

Predicting transit rider behavior requires

- Spatially detailed journey-to-work data (again)
- Parcel-level land use data
- Extensive spatial analysis using GIS and algorithms
  - Identify path options
  - Measure geography and land use along paths
  - Compute path characteristic indicators for discrete choice model

Quality of UIS limits transit analysis capacity

Urban Transportation Planning Implications: UIS Lessons from Examples

- ICT complicates urban planning and modeling
  - Because ICT makes future ≠ past
- ICT provides new data and tools
  - However, traditional GIS is not enough
  - Need spatial analysis tools and data management
- Metropolitan Spatial Data Infrastructure
  - Beyond centralized ‘enterprise GIS’
  - Share distributed geospatial services (not data sets)
  - Realtime city monitoring and planning will require even more…

Urban Transportation Planning Implications
(Continued)

Metropolitan Information Infrastructure

- More than ‘intelligent transportation systems’ (ITS)
- Needs base of ‘City Knowledge’ as ‘public good’
- Distributed, flexible, loosely-coupled architecture
  - To allow public/private value-added
  - Using chained web services (not isolated models)
  - And interoperable, open geospatial standards

Traditional urban models need rebuilding

- To build web services on ‘City Knowledge’ base
- To enable continuing planning processes
- To support useful citizen participation

ePlanning Scope

- ePlanning is more than eGovernment
  - Beyond office automation
    - ICT has broad social impacts & ripple effects
  - ePlanning Goal is ***not*** ‘automation’
    - Example: **permitting** (*what development to allow*)
    - Illuminate consequences of choices
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    - Protect public interest and public goods
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Thank you

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jf@mit.edu