

Regional Commute Atlas

NY-NJ-CT-PA Commuters Working in Manhattan and Other Key Business Districts

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Abstract

The Regional Commute Atlas is an interactive map visualizing each of over 2 million commuters working in Manhattan and other key business districts by the mode of transportation they chose on a typical day and by their trip origin.

Inspired by the Racial Dot Map¹ created by Dustin Cable, the Regional Commute Atlas adopted the dot density mapping approach, representing one commuter by one dot with six color-coded transportation modes such as car, commuter rail, subway/PATH, bus, ferry, and bike/pedestrian in a census tract level geography. Data displayed in the map is from CTPP.

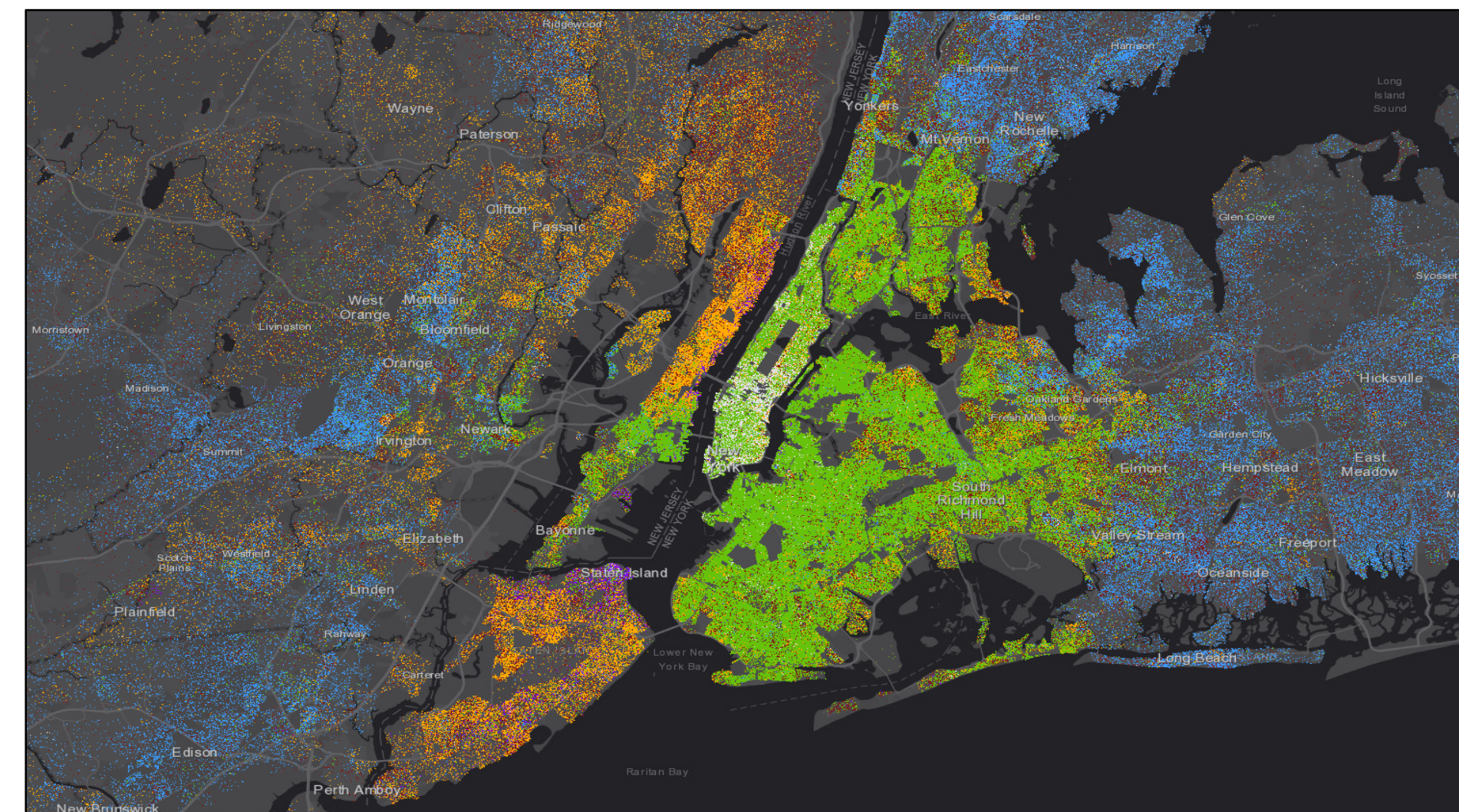


Figure 1. Commuters working in Manhattan by residence location and transportation modes in the New York and New Jersey metropolitan region (1 dot = 1 commuter)

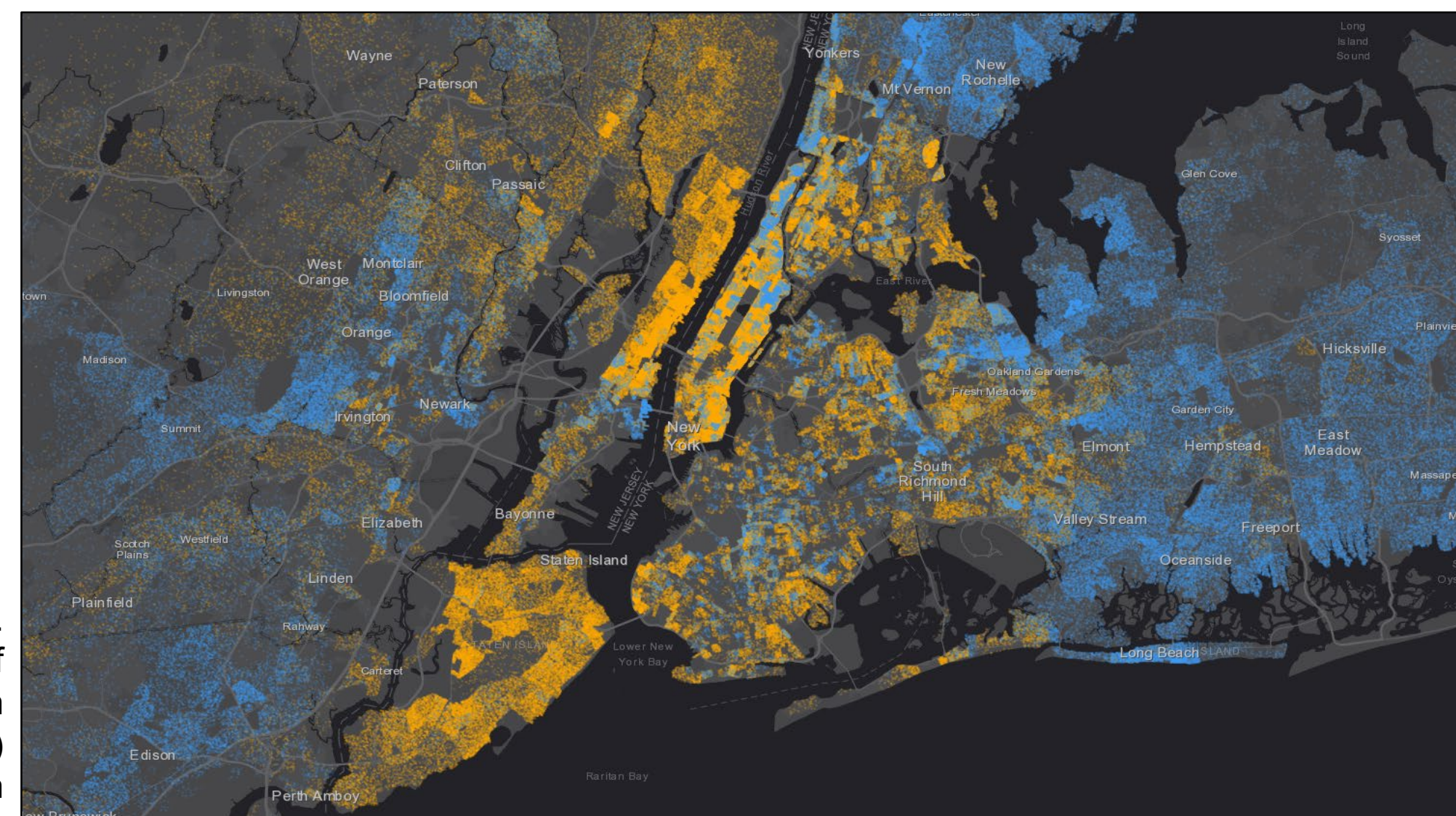


Figure 2. Geographic distribution of commuters working in Manhattan by commuter rail (in blue) and bus (in yellow) in the New York and New Jersey metropolitan region

Use of the Map

The Port Authority initially created a conventional commute dot map using CTPP2006-2010 to understand trans-Hudson transportation markets on all modes between the Outerbridge Crossing and the George Washington Bridge. On a typical day, this network carries over 1.7 million passengers by road, water, and rail, while handling more than 750,000 tons of freight.

The map has served as a powerful and informative resource as the Port Authority plans and implements significant infrastructure projects, including capacity expansion on its PATH rapid transit system and the replacement of its bus terminal in Manhattan.

The CTPP data as visualized in the map effectively demonstrated the geography of commuting from west of Hudson River to Manhattan in two important aspects:

- 1) West of Hudson area has multiple travel corridors with different mode orientations, and its mode choice varies considerably by trip origin; and
- 2) There is a unique bus dependence in trans-Hudson transit market

The Port Authority's map was featured on Citylab.com under the title of *Mapping How People Commute to Manhattan*².

As the 2012-2016 5-year CTPP became available, the Port Authority incorporated the new dataset and extended the map's geographic coverage in a user-friendly interactive mapping platform that allowed the display of changing commute patterns over time and distinct commute patterns to different business districts.

Snapshot of Interactive Web App Page

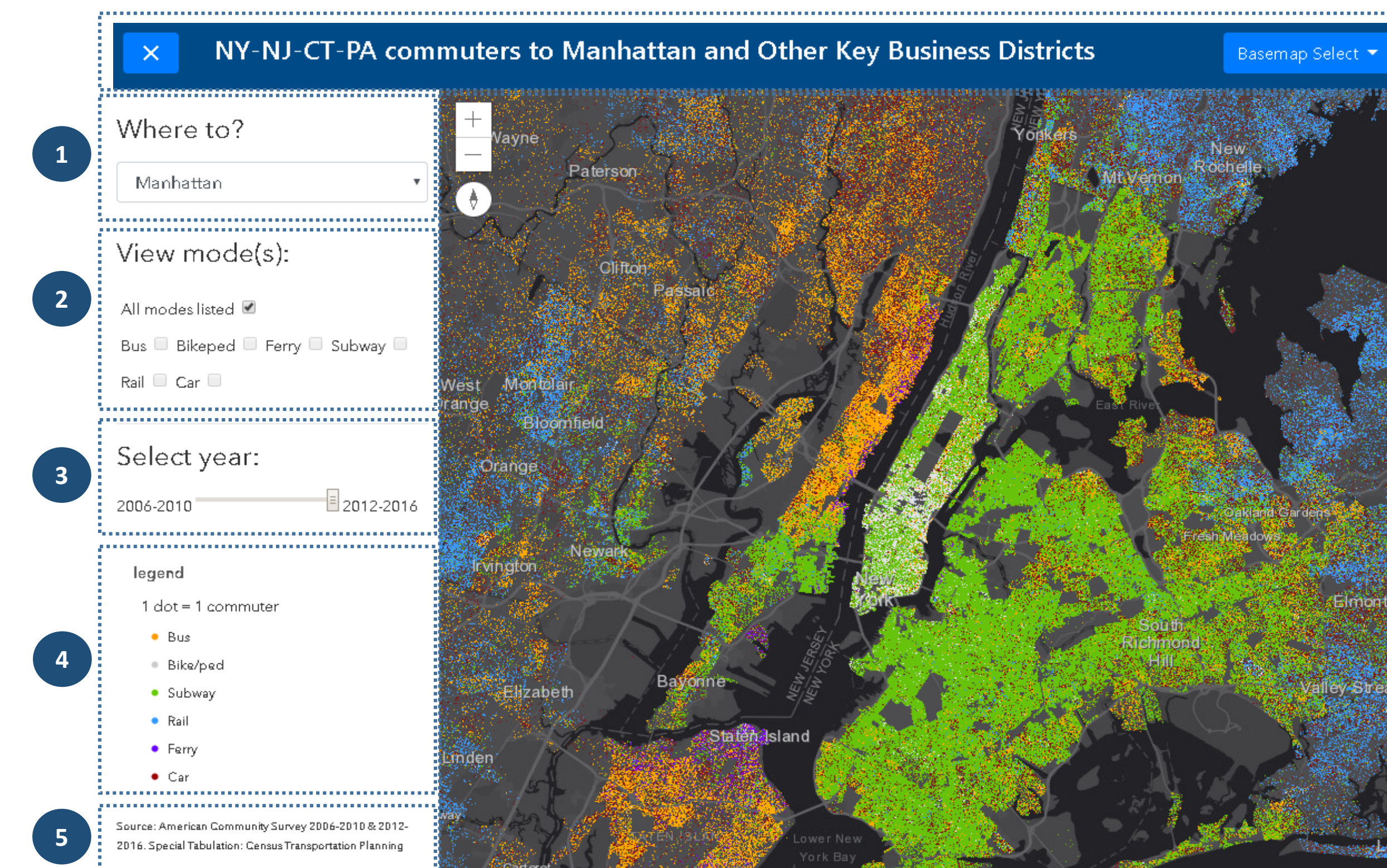


Figure 3. Snapshot of web app

1 15 Business Districts	2 6 Commute Modes	4 Legend
<ul style="list-style-type: none">ManhattanCBDManhattan DowntownManhattan ValleyManhattan MidtownManhattan UptownDowntown Brooklyn, Navy Yard and Waterfront AreaLong Island CityHudson Waterfront AreaDowntown NewarkNewark Airport and PortsJFK AirportLaGuardia AirportHowland Hook	<ul style="list-style-type: none">Car (Red)Commuter Rail (Blue)Subway/PATH (Green)Bus (Yellow)Ferry (Purple)Bike/Pedestrian (White)All Modes	Shows 6 color-coded modes.
3 2 Data Sets	5 Data source	6 Title bar including:
<ul style="list-style-type: none">CTPP2006-2010CTPP2012-2016		<ul style="list-style-type: none">TitleToggle to remove menu paneOption to choose from various background mapsAbout page describing the map
	7 Main map page	
	Provides 15 detailed zoom-in levels and panning function.	

Discussion on Data

The map uses Part 3 Residence-to-Workplace flow tables from 2006-2010 5-year CTPP and 2012-2016 5-year CTPP in a Census tract level geography.

These efforts addressed initial concerns about the completeness of the 2012-2016 CTPP tract-level flow data by limiting the use of the dataset to visualization tools and geographic and modal distributions (rather than absolute flow volumes).

Time serial comparison between two maps (see below) that show commute to Downtown Brooklyn, Navy Yard and Waterfront Area captures the changing patterns and trends, especially for the bike/walk mode as color-coded in white.

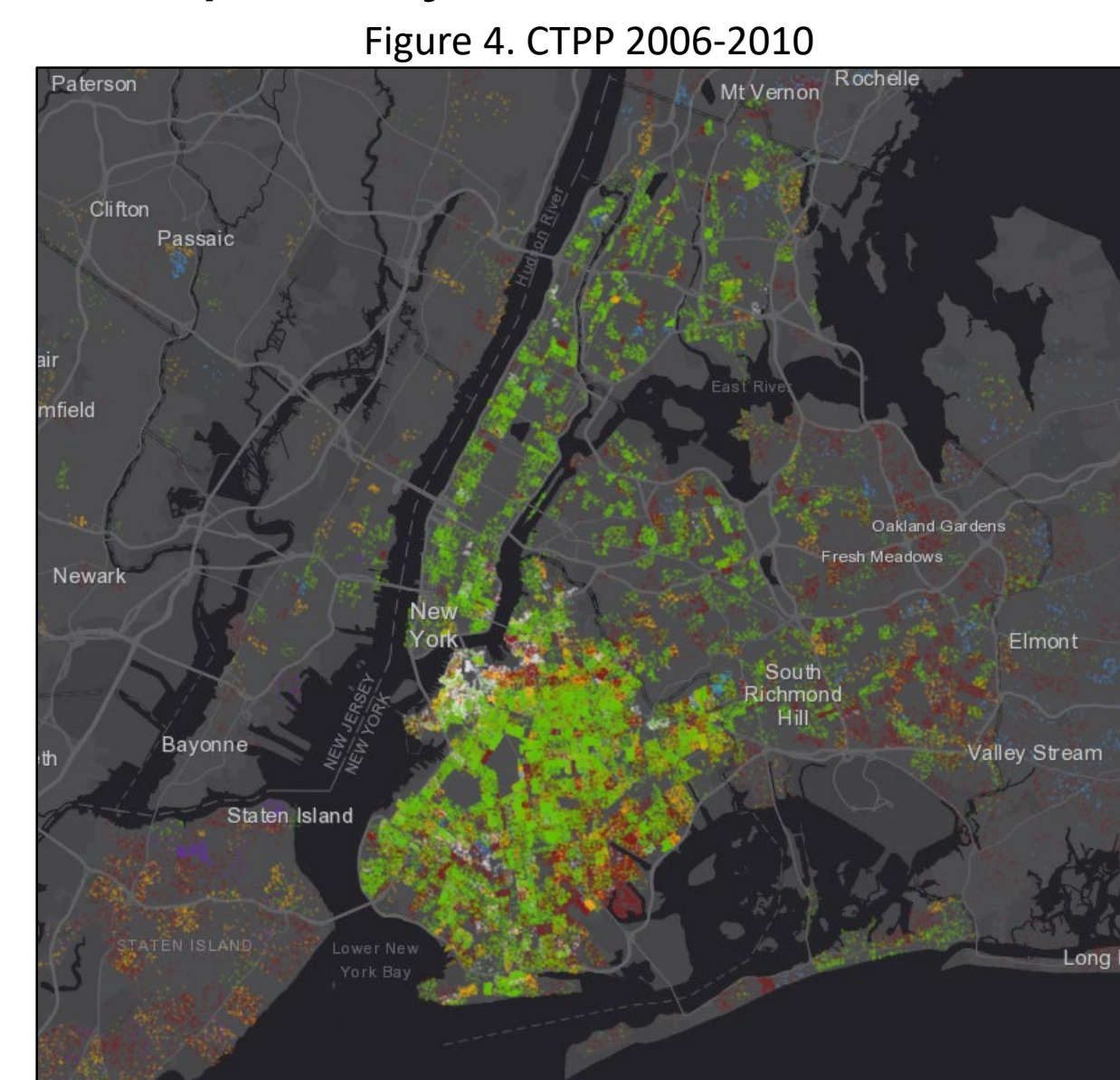


Figure 4. CTPP 2006-2010

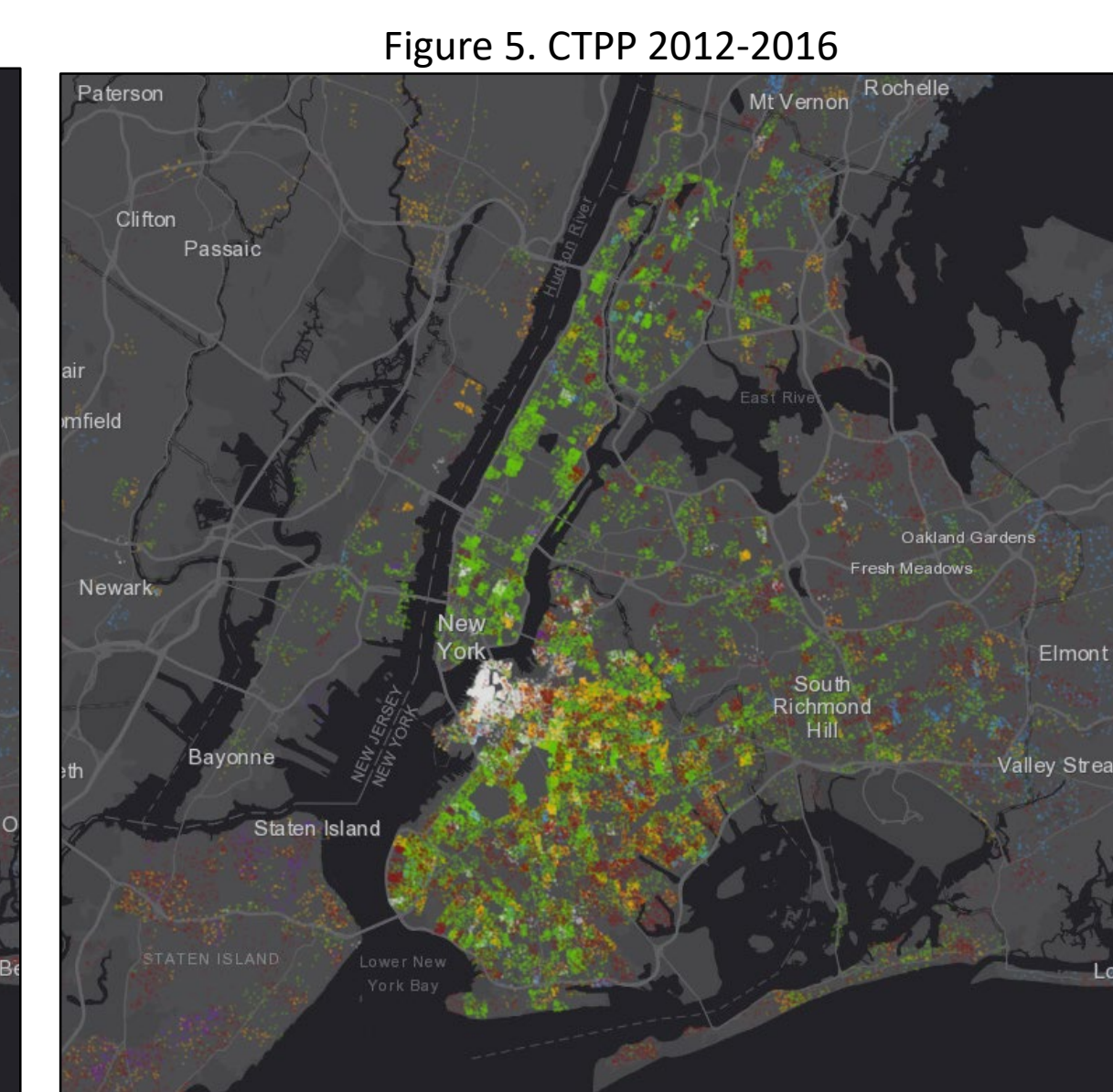


Figure 5. CTPP 2012-2016

Methodology

Creating map data - R was used to process the CTPP Part 3 data and to summarize Origin and Destination pairs by the unit of Census tract with commuter counts by modes for mapping. From the processed CTPP database, ArcGIS Pro was used to create random points by setting the constraining extent as Census tract using shapefiles.

Visualizing map data - The ArcGIS Pro is used to process Census tract Shapefiles and create vector and raster tiles. The most detailed zoom level of the tiles is 15.

Creating web app - Web development languages were used to build the web app.

- Bootstrap was used to carve out the user interface.
- jQuery was used to wire the buttons to trigger events and the ESRI JavaScript API for the map.
- HTML, CSS, and JavaScript were used to read the tile images as well as for the web development.

Hosting website - The Port Authority's internal web server hosts the files (HTML/JavaScript/CSS) needed for the application.

The Regional Commute Atlas can be accessed through a link or QR Code:

http://52.186.84.233:3838/Atlas/Map1.0/map_index.html

The interactive map is best viewed with Google Chrome.



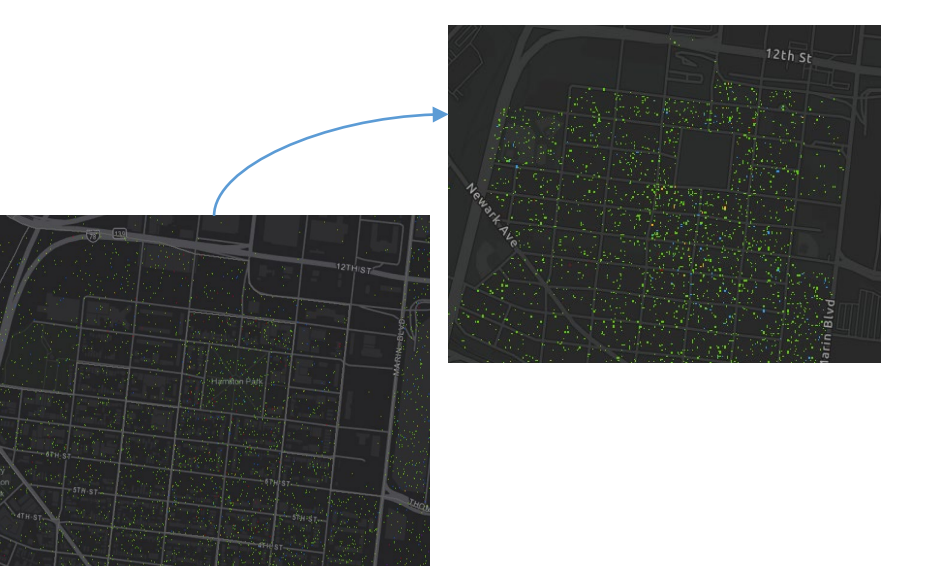
Technical Challenges and Solutions

Port Authority tackled a number of technical challenges in developing this tool, including increasing the geographic accuracy and realism of dot placement, ensuring a realistic visual impression of the dominant transit modes, and achieving efficient loading times despite the large datasets.

1) Geographic Accuracy

Problem: Commuter's residence was located in parks and lakes when Census tract boundaries include them.

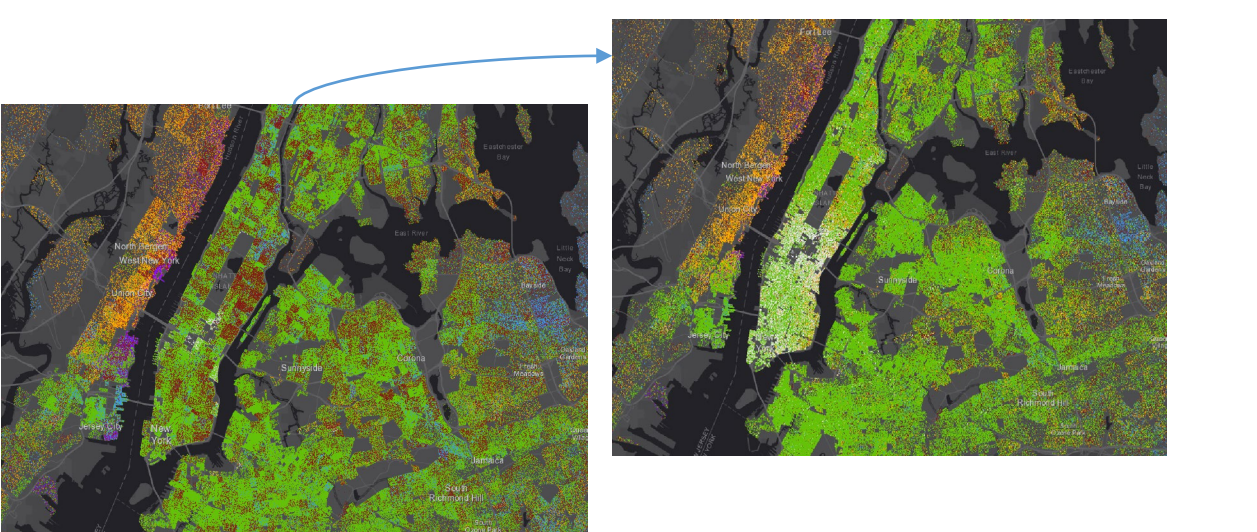
Solution: Recreated census tract shapefiles by excluding census blocks with zero-population.



2) Realistic visual impression

Problem: Dots of one mode stacked on top of other modes in dense areas such as Manhattan (e.g. cars vs subway)

Solution: Randomized the drawing order of database records.



3) Big data issue

Problem: ArcGIS online mapping tool didn't load massive amount of geographic data at a reasonable speed.

Solution: Explored ways of displaying big data and chose an approach using map tiles. We converted the millions of dot data to tiles of pre-defined/ pre-loaded images using "vector tile" for single mode layers and "Raster tile" for multi-mode layers. It loads fast.

4) Web app platform

Problem: The standard widgets of the user-friendly ArcGIS web app builder did not equip some features such as the tabs and drop-down menu. There was no mapping platform for interactive display of map tiles.

Solution: Undertook an in-house web app development. We learned about Html & JavaScript coding and the webserver to host the web app site.

Contact

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Reference

1. The racial dot map is available on <https://demographics.coopercenter.org/racial-dot-map>.
2. The article is available on <https://www.citylab.com/transportation/2016/09/manhattan-commutes-port-authority-bus-terminal-capacity-study/501515/>.