

Transportation and COVID-19

Commute Flow from New York City and Boston City to other places within the same state and the local COVID-19 Confirmed Rate of the destination places

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Background

COVID-19 spread rapidly across the mainland China after the initial case reported in Wuhan, China in December, 2019. (Chinese Center of

Disease Control and Prevention, 2020) One great contributing factor for the rapid spreading was the large commute flow from Wuhan, the epicenter, to other cities driven by the Chinese Spring Festival—significant associations were found between the frequency and the traffic load of public transportation, like train, and the confirmed cases in the destination cities, (Zhao et al., 2020; Zheng et al., 2020) indicating that commute pattern could be an important determinant in the spread of COVID-19.

Now, the COVID-19 has become a pandemic. The total number of confirmed cases in the U.S. has reached 1,180,288 by May 4th, 2020, the largest in the world, and it is still rocketing. (Johns Hopkins Coronavirus Resource Center, 2020) Metropolitan areas like New York City and Boston are firstly and badly hit. (Johns Hopkins Coronavirus Resource Center, 2020), and they are now the epicenters within their own state. In this project, I will look at the commute flow from each epicenter to counties within the same state by commute methods. Also, since the MDPH released city/town-level COVID-19 data, I will also create map to show the COVID-19 confirmed cases and commute flow from Boston City to cities and towns within Massachusetts.

Methodology

The aggregated number of COVID-19 confirmed cases on

the county-level was obtained from the New York State Department of Health (NYSDH) and Massachusetts Department of Public Health (MDPH). The county-level and city/town-level data on commute flow from Boston/New York City to counties within the same state was obtained from the American Community Survey 2012-2016 5-year estimates. The commute flow by common public transportation methods-bus, subway and railroad were obtained separately from the ACS 2012-2016 5-year estimate. The aggregated number of COVID-19 confirmed cases on city/town-level was obtained from the MDPH. The number of confirmed cases will be normalized by the population size of the county/city/town using 2010 Census data. The commute flow and commute methods dataset and the COVID-19 confirmed cases are tabulated data. The tabulated data were joined with a shapefile by matching the county/city/town's name.

Reference:

Chinese Center of Disease Control and Prevention. (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Zhonghua Liu Xing Bing Xue Za Zhi*, 41(2), 145-151. <https://doi.org/10.3760/cma.j.issn.0254-6450.2020.02.003>

Fan, C., Liu, L., Guo, W., Yang, A., He, C., Jili, M., Ren, M., Xu, P., Long, H., & Wang, Y. (2020). Prediction of epidemic spread of the 2019 novel coronavirus driven by spring festival transportation in China: A population-based study. *International Journal of Environmental Research and Public Health*, 17(5). <https://doi.org/10.3390/ijerph17051679>

Johns Hopkins Coronavirus Resource Center. (2020). COVID-19 Map - Johns Hopkins Coronavirus Resource Center. <https://coronavirus.jhu.edu/map.html>

Massachusetts Department of Public Health. (n.d.). *Archive of COVID-19 cases in Massachusetts*. Retrieved April 13, 2020, from <https://www.mass.gov/info-details/archive-of-covid-19-cases-in-massachusetts#April-2020>

New York State Department of Health. (n.d.). *Workbook: NYS-COVID19-Tracker*. Retrieved April 13, 2020, from <https://covid19tracker.health.ny.gov/views/NYS-COVID19-Tracker/NYSDOHCOVID-19Tracker-DailyTracker?%3Aembed=yes&%3Atooltbars=no&%3Atabs=n>

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U.S. Department of Transportation. (2019, April 25). *Data Products - CTPP - Census Issues - Planning - FHWA*. https://www.fhwa.dot.gov/planning/census_issues/ctpp/data_products/

Zhao, S., Zhuang, Z., Ran, J., Lin, J., Yang, G., Yang, L., & He, D. (2020). The association between domestic train transportation and novel coronavirus (2019-nCoV) outbreak in China from 2019 to 2020: A data-driven correlational report. *Travel Medicine and Infectious Disease* (Vol. 33, p. 101568). Elsevier USA. <https://doi.org/10.1016/j.tmaid.2020.101568>

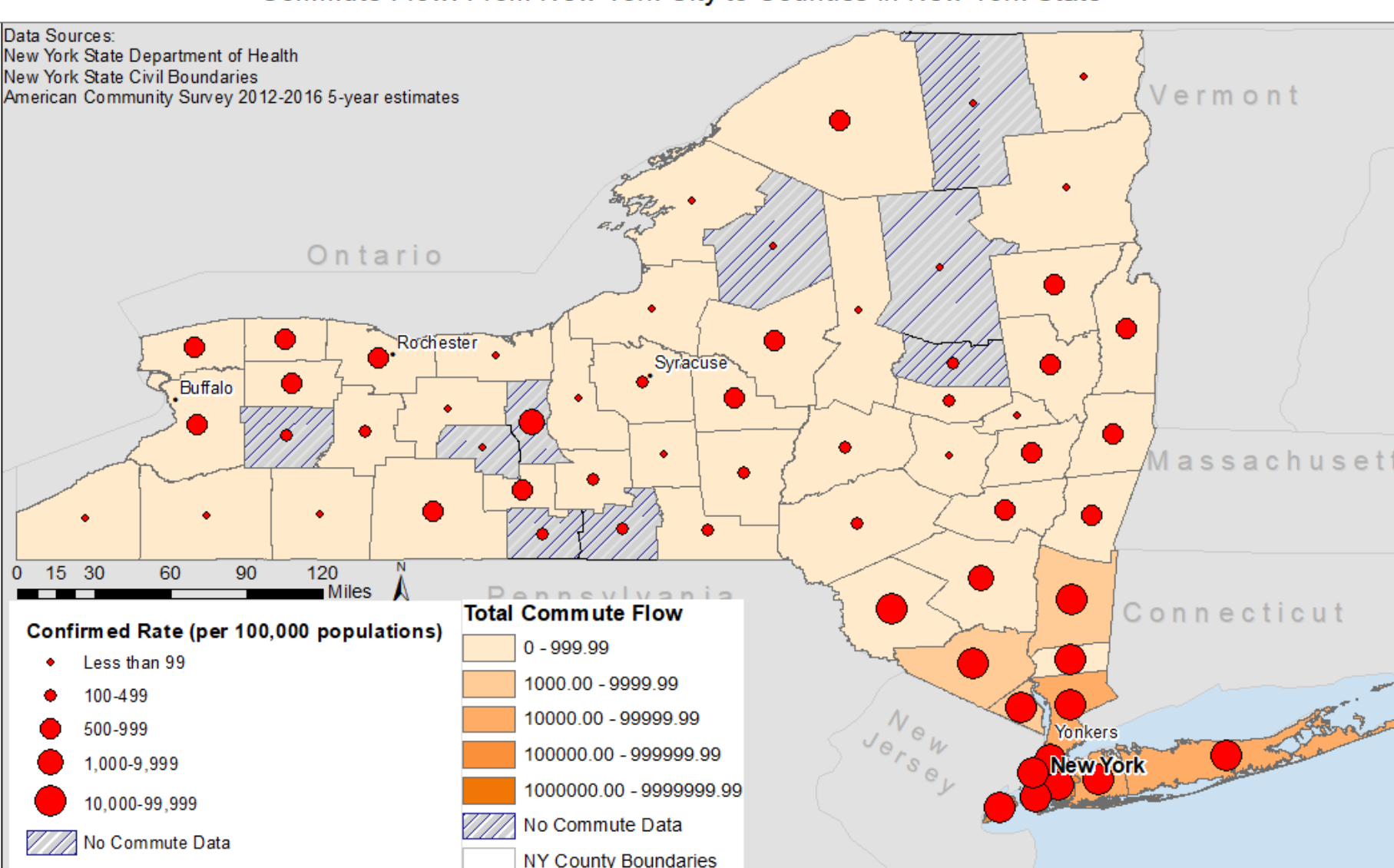
Zheng, R., Xu, Y., Wang, W., Ning, G., & Bi, Y. (2020). Spatial transmission of COVID-19 via public and private transportation in China. *Travel Medicine and Infectious Disease*, 101626. <https://doi.org/10.1016/j.tmaid.2020.101626>

Results

Map 1

COVID-19 Confirmed Rate* and Commute Flow** from NYC to Counties in New York State

Confirmed Rate: Standardized cumulative number of confirmed cases by county population size from January to April
Commute Flow: From New York City to Counties in New York State

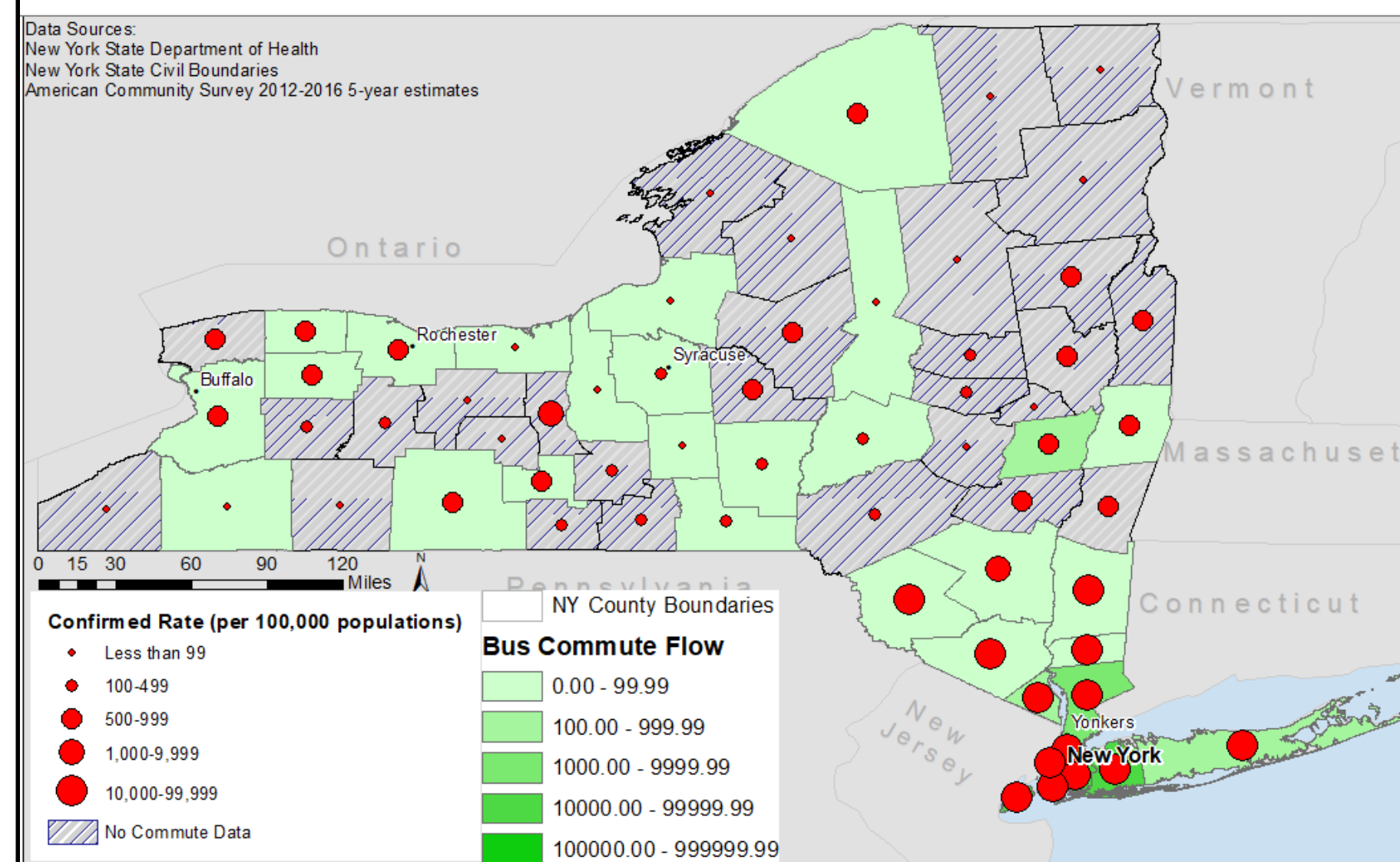


As shown on Map 1, counties in NY that didn't have commute data from NYC are always with less confirmed cases

Map 2

COVID-19 Confirmed Rate* and Bus Commute Flow** from NYC to Counties in New York State

Confirmed Rate: Standardized cumulative number of confirmed cases by county population size from January to April
Commute Flow: From New York City to Counties in New York State

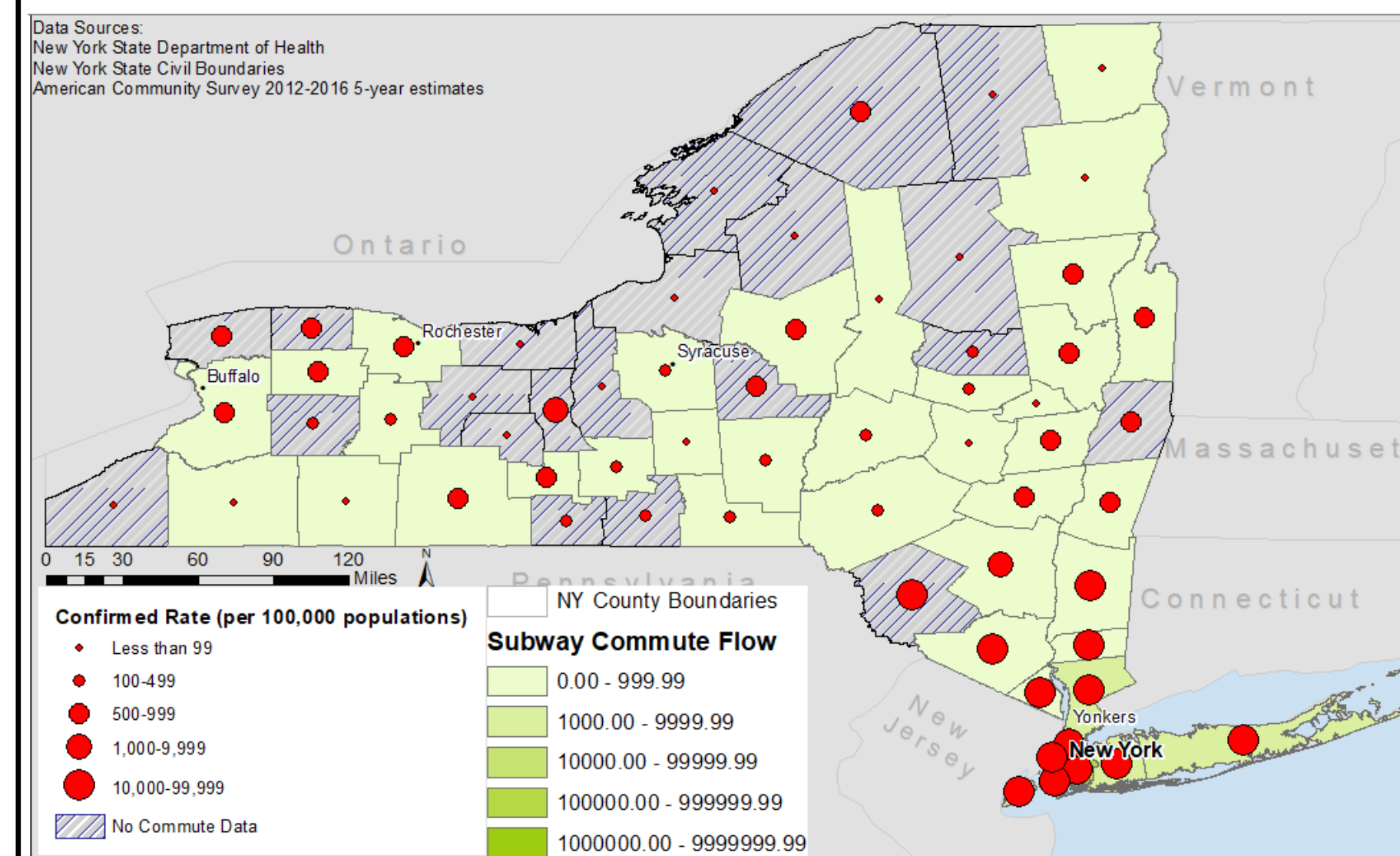


As shown on Map 2, compared with counties that are far away from the NY down state, the COVID-19 confirm rate were more related with commute flow by bus.

Map 3

COVID-19 Confirmed Rate* and Subway Commute Flow** from NYC to Counties in New York State

Confirmed Rate: Standardized cumulative number of confirmed cases by county population size from January to April
Commute Flow: From New York City to Counties in New York State

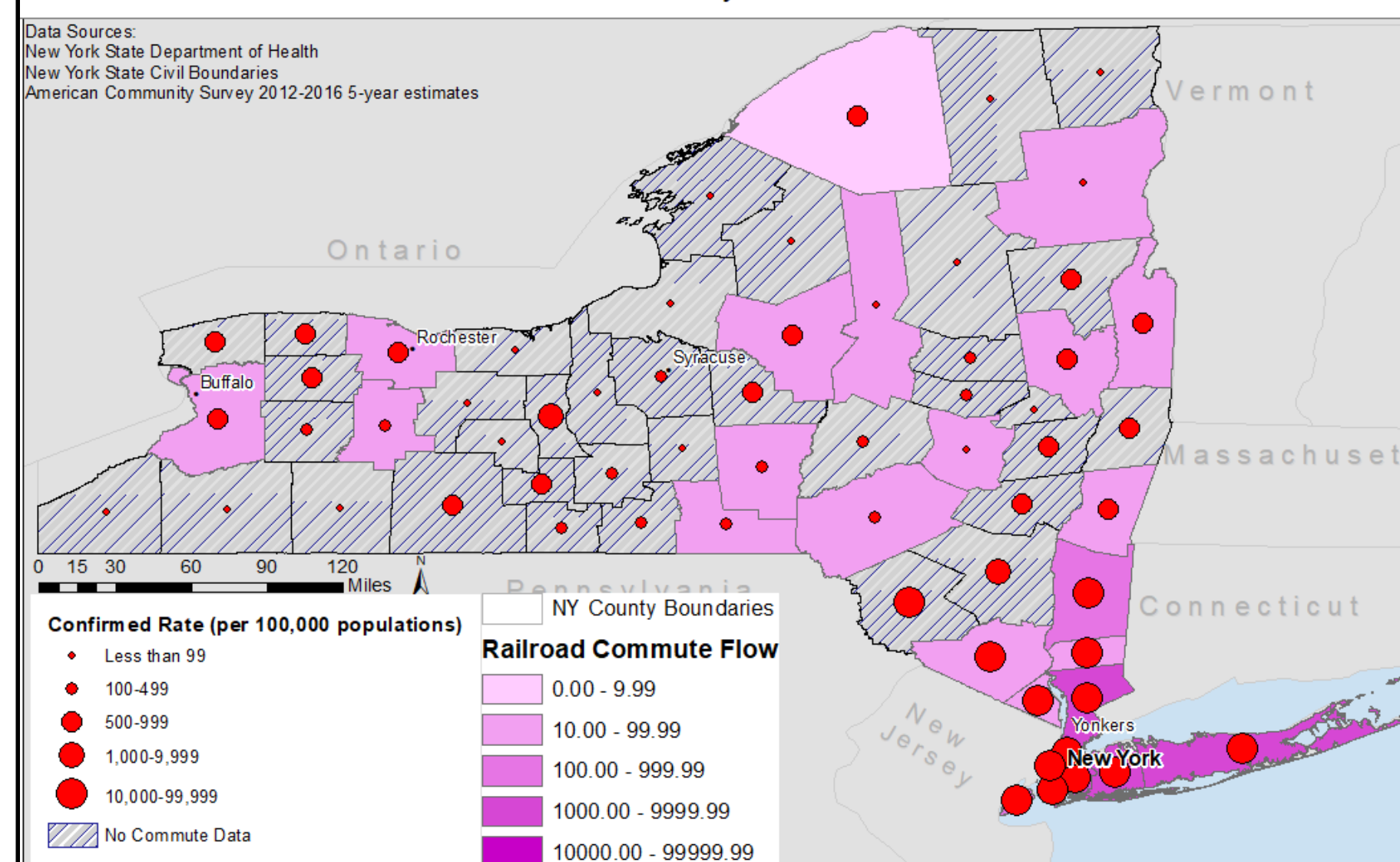


As shown on Map 3, compared with counties that are far away from the NY down state, the COVID-19 confirm rate were more related with commute flow by subway, which is similar to what showed on Map 2

Map 4

COVID-19 Confirmed Rate* and Railroad Commute Flow** from NYC to Counties in New York State

Confirmed Rate: Standardized cumulative number of confirmed cases by county population size from January to April
Commute Flow: From New York City to Counties in New York State

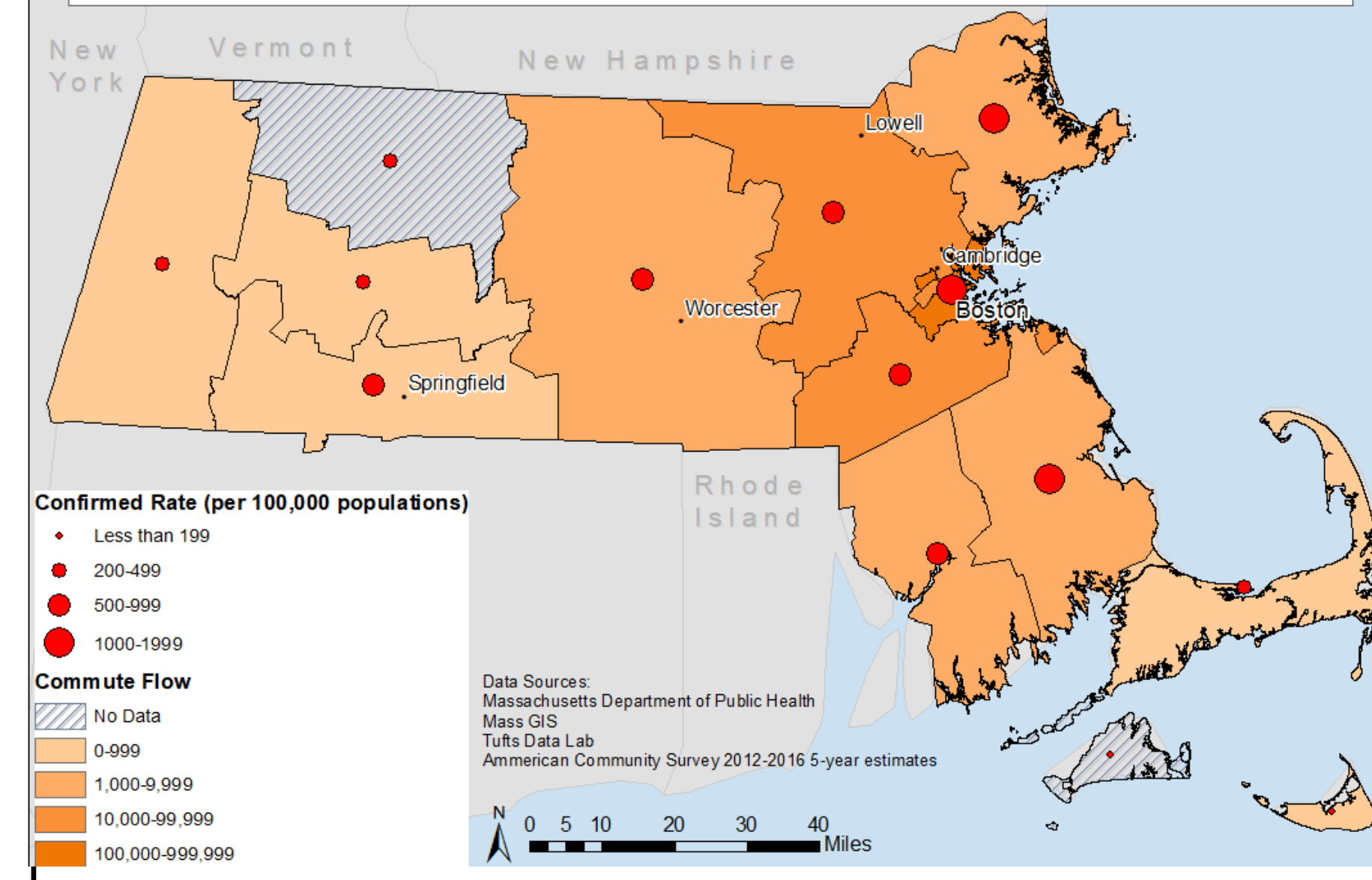


As shown on Map 4, among counties that are far away from NYC, counties that don't have commute flow from NYC overlapped well with counties that have less COVID-19 confirmed rate.

Map 5

COVID-19 Confirmed Rates* and Commute Flow** from Boston City to Counties in MA

*Cumulative confirmed COVID-19 cases normalized by 100,000 populations in MA counties by May 1, 2020
**Total Commute flow estimate from Boston city to counties in MA

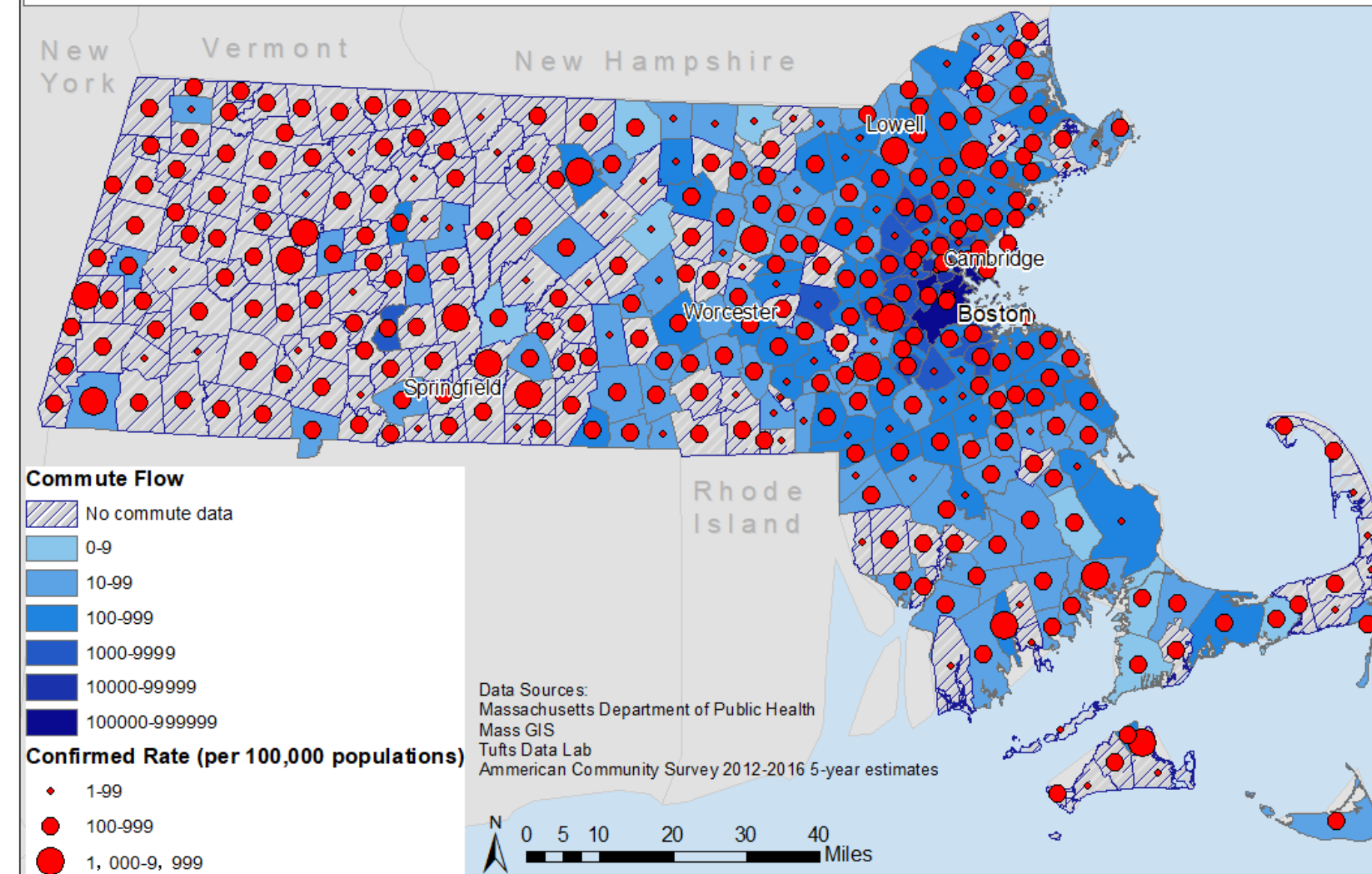


As shown in Map 5, in MA, overall, among counties that are not around the Boston City, the less commute flow from Boston, the less COVID-19 confirmed rate.

Map 6

COVID-19 Confirmed Rates* and Commute Flow** from Boston City to Cities or Towns in Massachusetts

*Cumulative confirmed COVID-19 cases normalized by 100,000 populations in MA towns and cities by Apr 22, 2020
**Total Commute flow estimate from Boston City to towns and cities in MA



It's hard to tell a story between commute flow and COVID-19 confirmed rate directly from Map 7. However, noticeably, the COVID-19 confirmed rate in Boston is not among the highest across MA, which suggesting that Boston City may no longer be the epicenter in MA.

Discussion

Currently the stay-at-home order has been extended to May 18th in MA. Although the longer we stay at home, the better for outbreak control. However, the economic can not wait until the virus die. It is likely that some places will return to work in the close future. Since this spatial analysis suggested that commute flow to be potentially associated with COVID-19 spread according to maps of the New York State. The association was not clear in the maps of MA, since Boston is no longer the epicenter in MA according to Map 7, but there are more "local epicenters" emerging in MA. To prevent the second outbreak of COVID-19 due to returning to work, besides asking individuals to practice social distancing and good hygienic, from a public health perspective, having restricted commute flow or restrict transportation to certain domestic place may also be considered as a strategy to control the spreading of COVID-19. This is a potential implementation of this analysis. A great limitation of this analysis is that it only looked at commute from one place to another within the state, which possibly omit the impact of between state travelling, which could lead to underestimate the influence of travelling on COVID-19 spread.

Locator Map



Data Source:
Massachusetts Department of Public Health
New York State Department of Health
American Community Survey: 2012-2016 5-year estimate
MassGIS Community Boundaries
New York GIS Clearinghouse Civil Boundaries
Geographic Coordinate System:
GCS_North_American_1983