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data.covid.umd.edu

Measuring Mobility, Social Distancing, and Economic Impact with Anonymized Mobile Device Data

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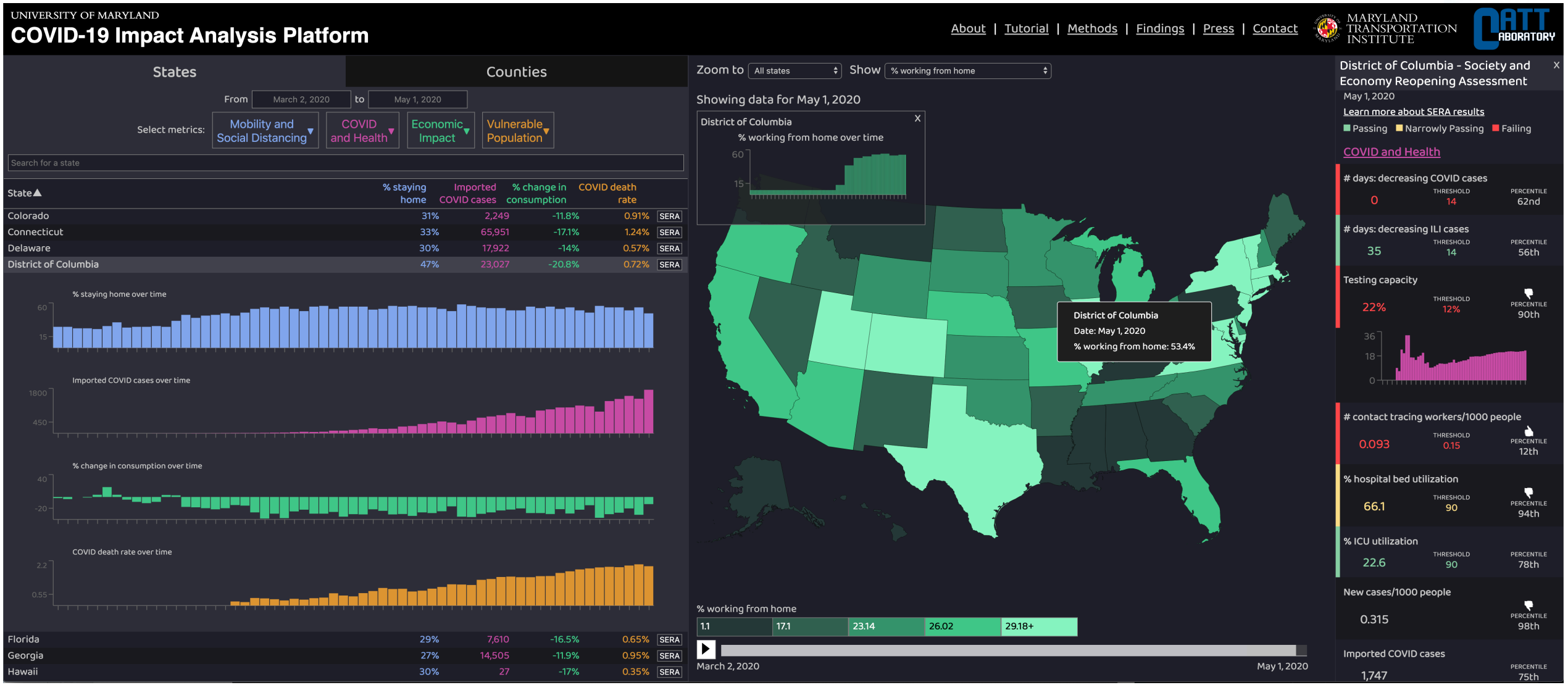
Public COVID-19 Platform: data.covid.umd.edu



Social Distancing Index based on Mobility Metrics

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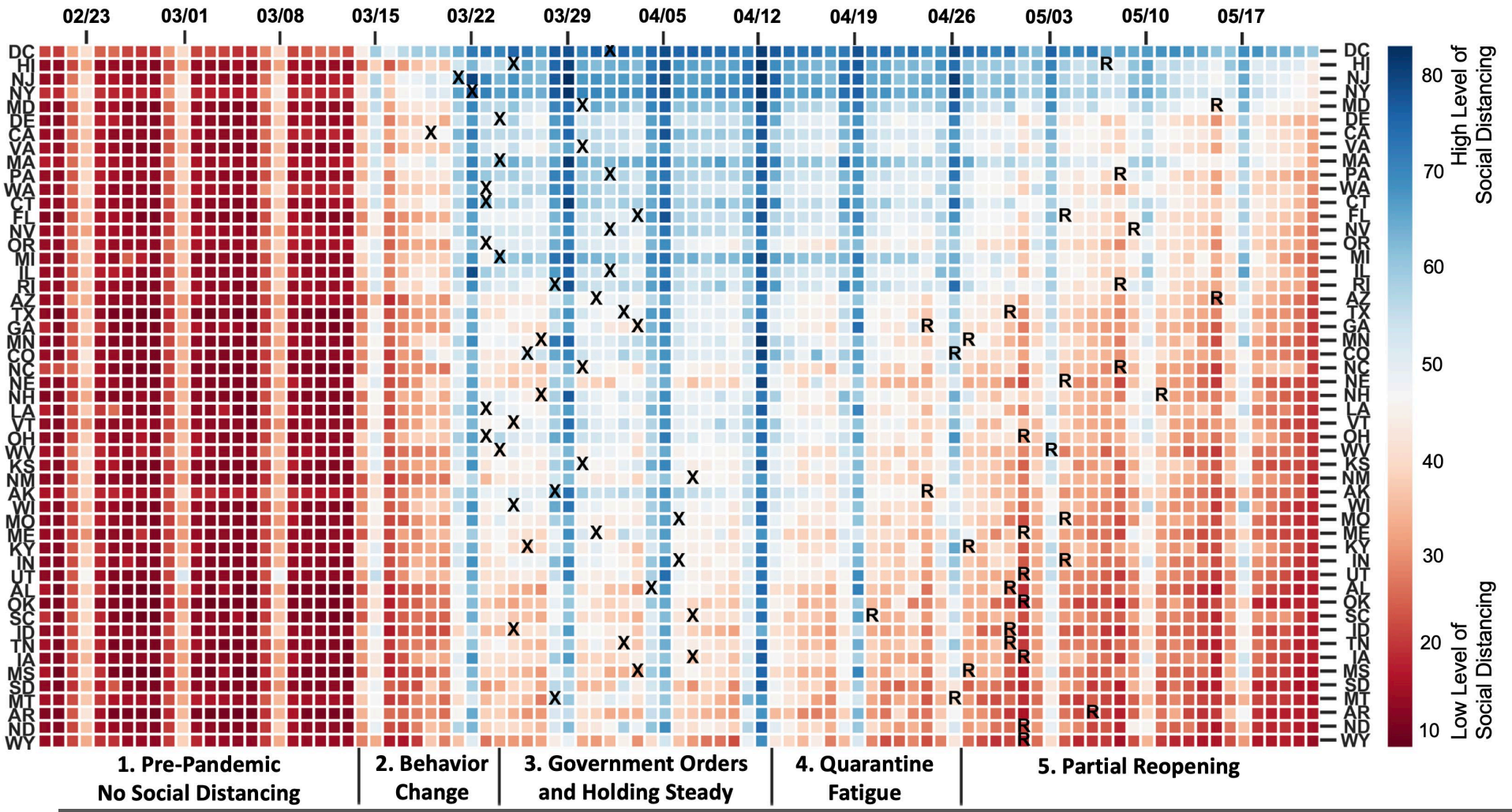
Social Distancing Index by State

February 20~May 22 data from: data.covid.umd.edu

"X" indicates statewide stay-at-home order date, "R" indicates phase 1 partially reopening date.



38 Metrics on Mobility, Health, Economy, and More

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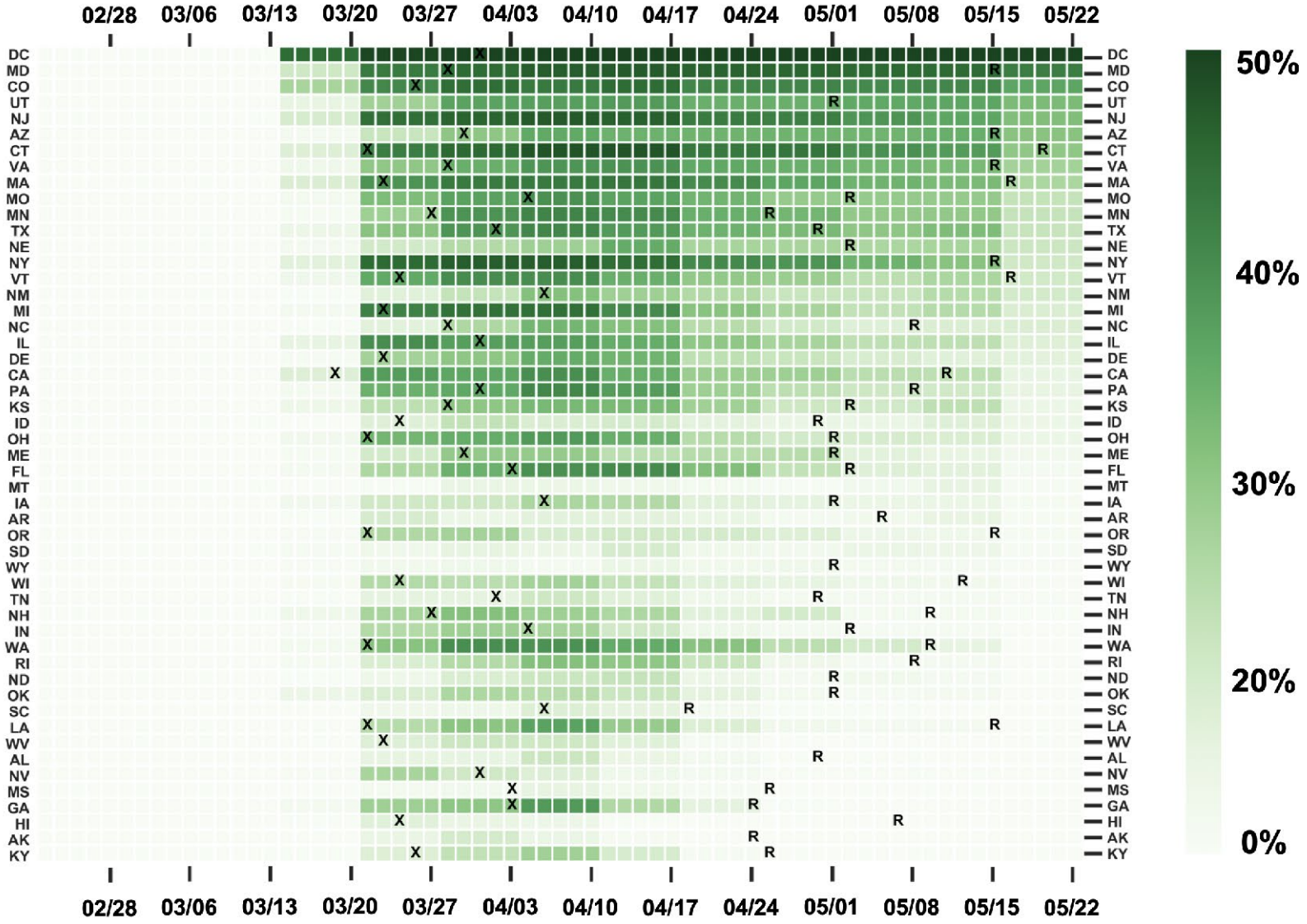
Percent of Workers Working from Home by State

February 24~May 22 data from University of Maryland COVID-19 Impact Analysis Platform
data.covid.umd.edu

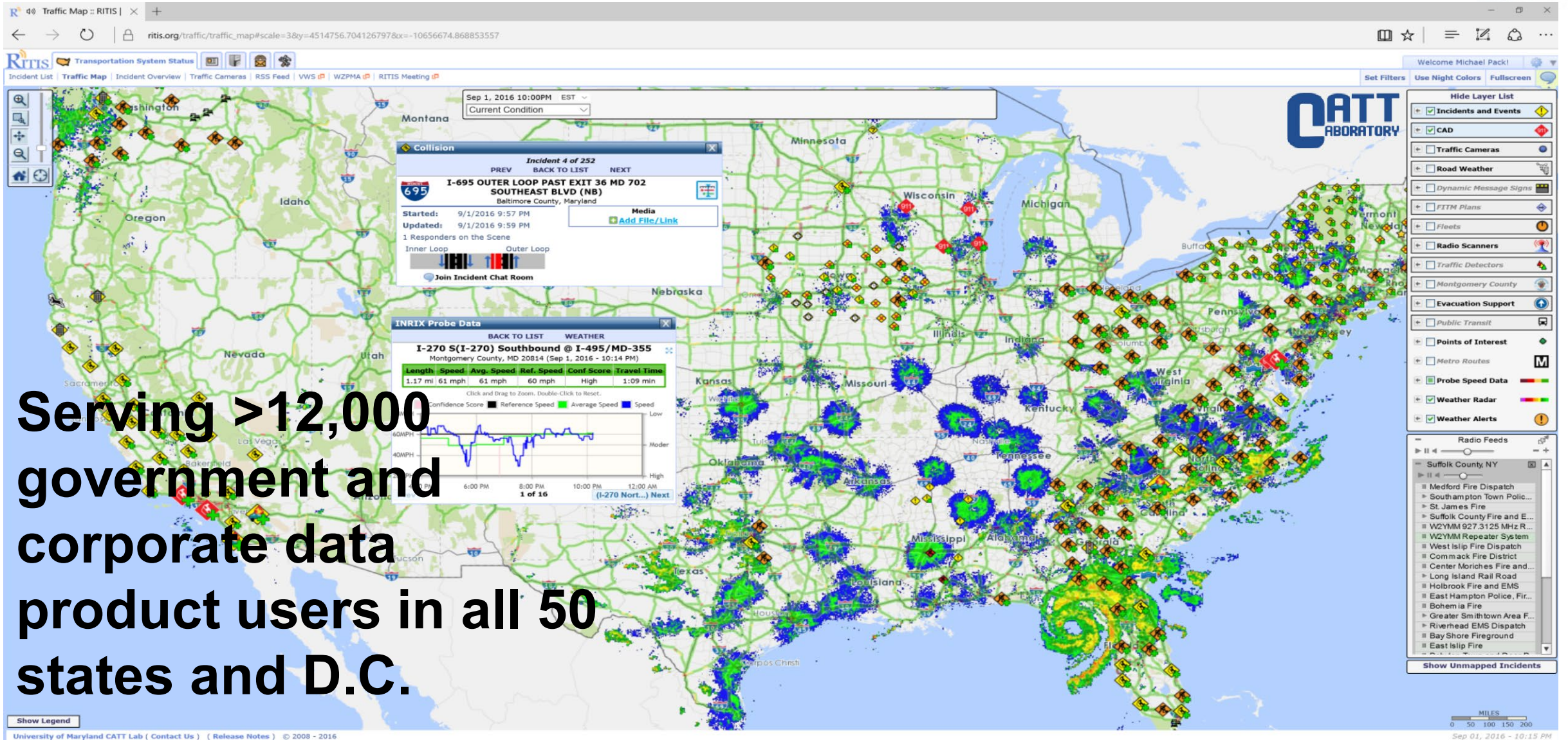
Graph displays workday data only for each state daily.

"X"s indicate statewide stay-at-home order dates.

"R"s indicate initial partially reopening dates.

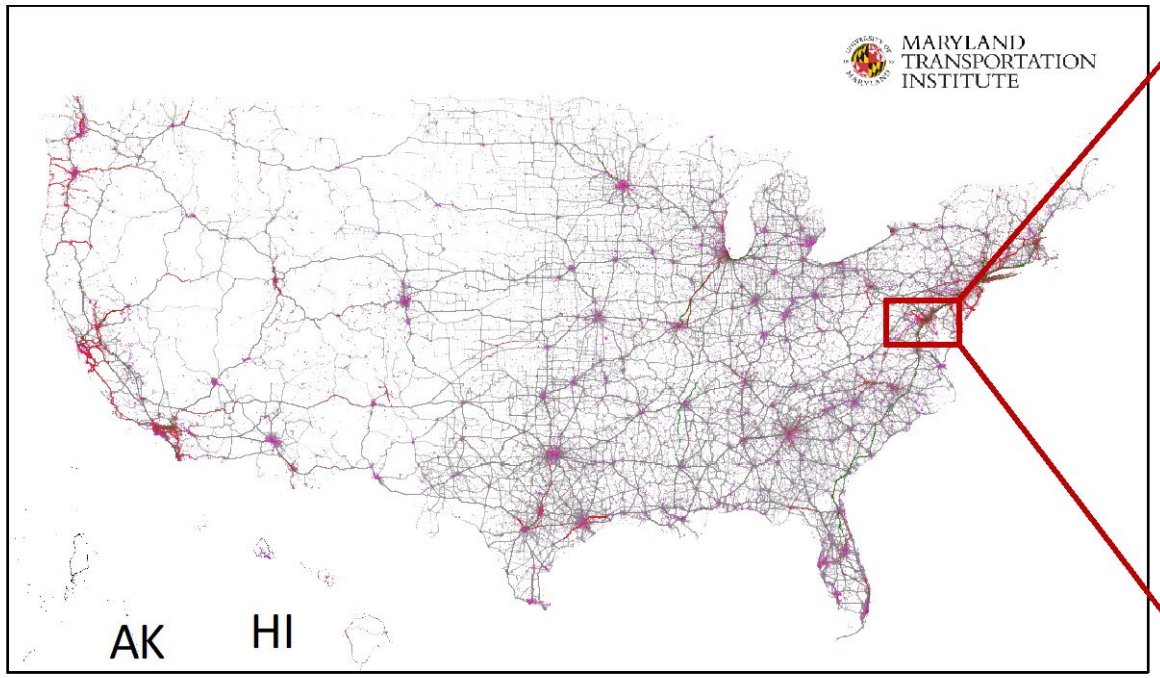


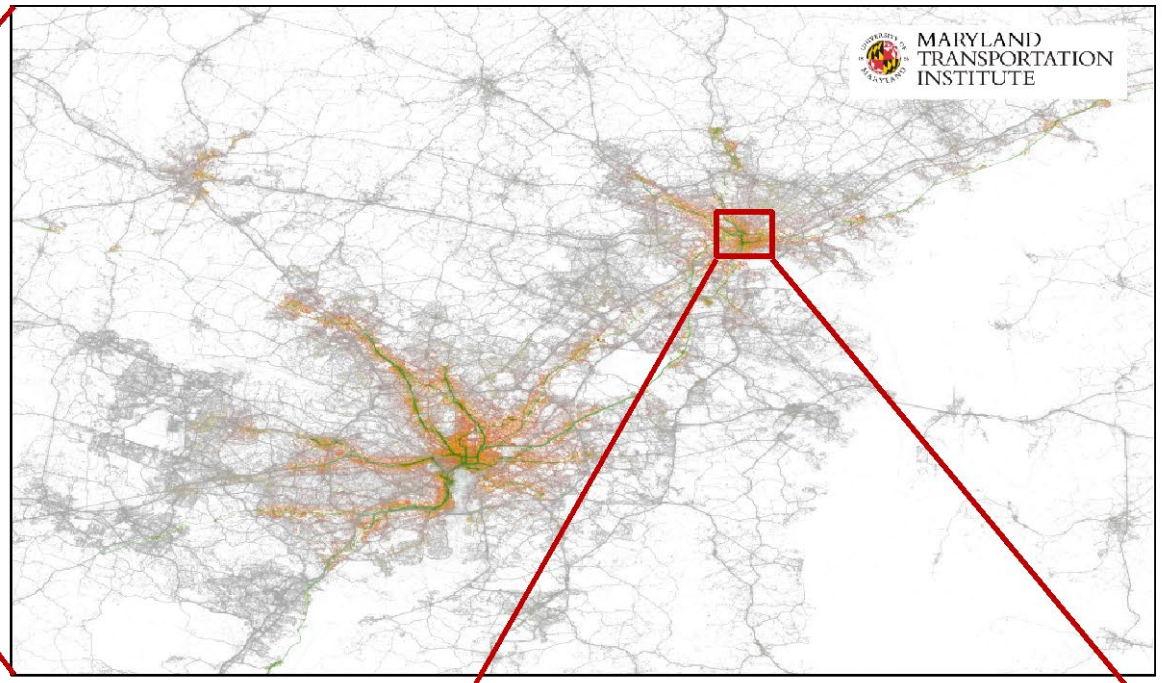
UMD: Leader in Transportation and Mobility Data

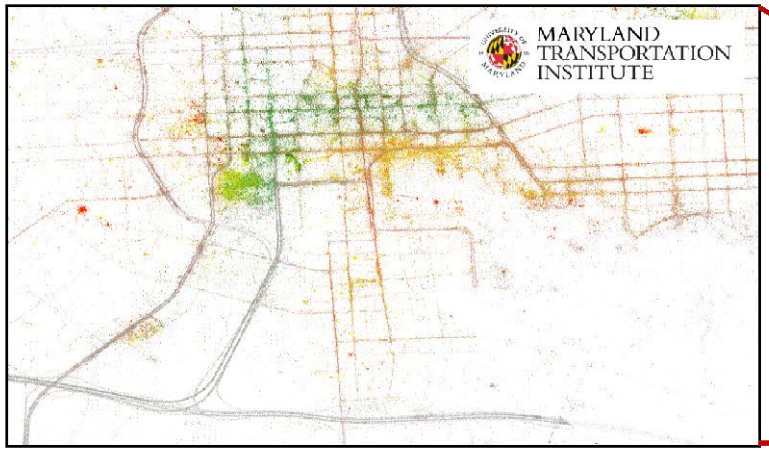


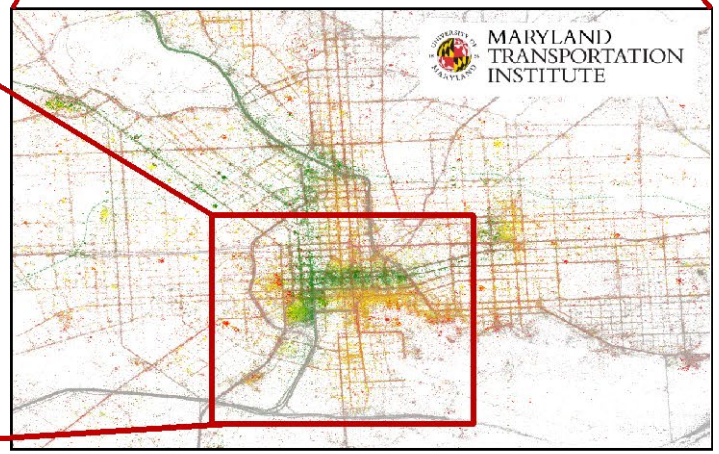
Serving >12,000 government and corporate data product users in all 50 states and D.C.

Anonymized Data from 150 million+ Mobile Devices









Travel Modes

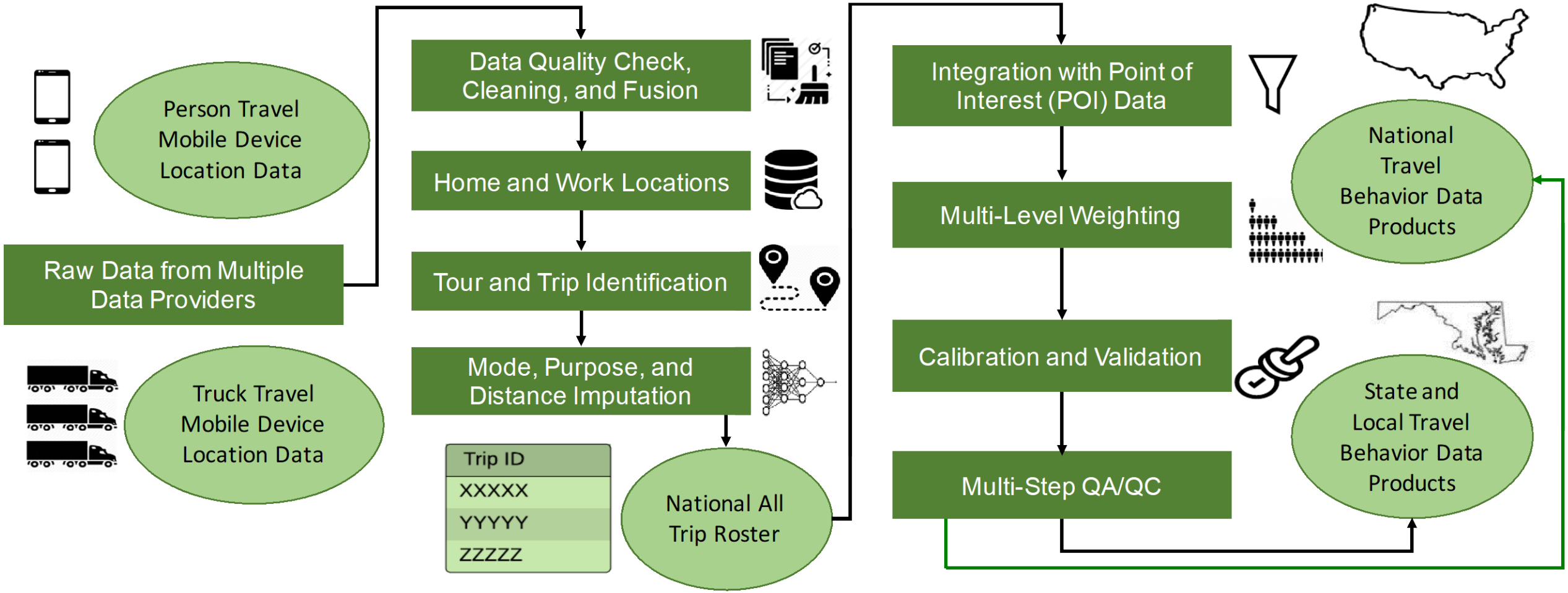
Gray: Driving
Green: Rail
Purple: Air
Red: Bus
Yellow: Bike/Walk

Mobile Device Location Data Quality Standard

A possible national mobile device location data quality standard is defined by the best quality metric values observed in any single raw dataset from any data provider (e.g., "best" values in the table below). In other words, the national "raw data panel" after data fusion must have higher quality than any original raw datasets from individual data providers based on ALL quality metrics.

Selected Raw Data Quality Metrics	Raw Dataset 1	Raw Dataset 2	Raw Dataset 3
DAU population coverage (%)	1.76	8.82	13.08 (best)
MAU population coverage (%)	6.31	53.05 (best)	28.01
Geographical representativeness (0~1)	0.13	0.09 (best)	0.12
Frequency (median #points per device per day)	57	75	190 (best)
Temporal consistency (days per device)	10.18	12.90	14.67 (best)
Device representativeness (0~1)	0.71	0.67 (best)	0.81
Hourly temporal coverage (0~1)	0.67	0.64	0.249 (best)
Daily temporal coverage (0~1)	0.24	0.05	0.03 (best)

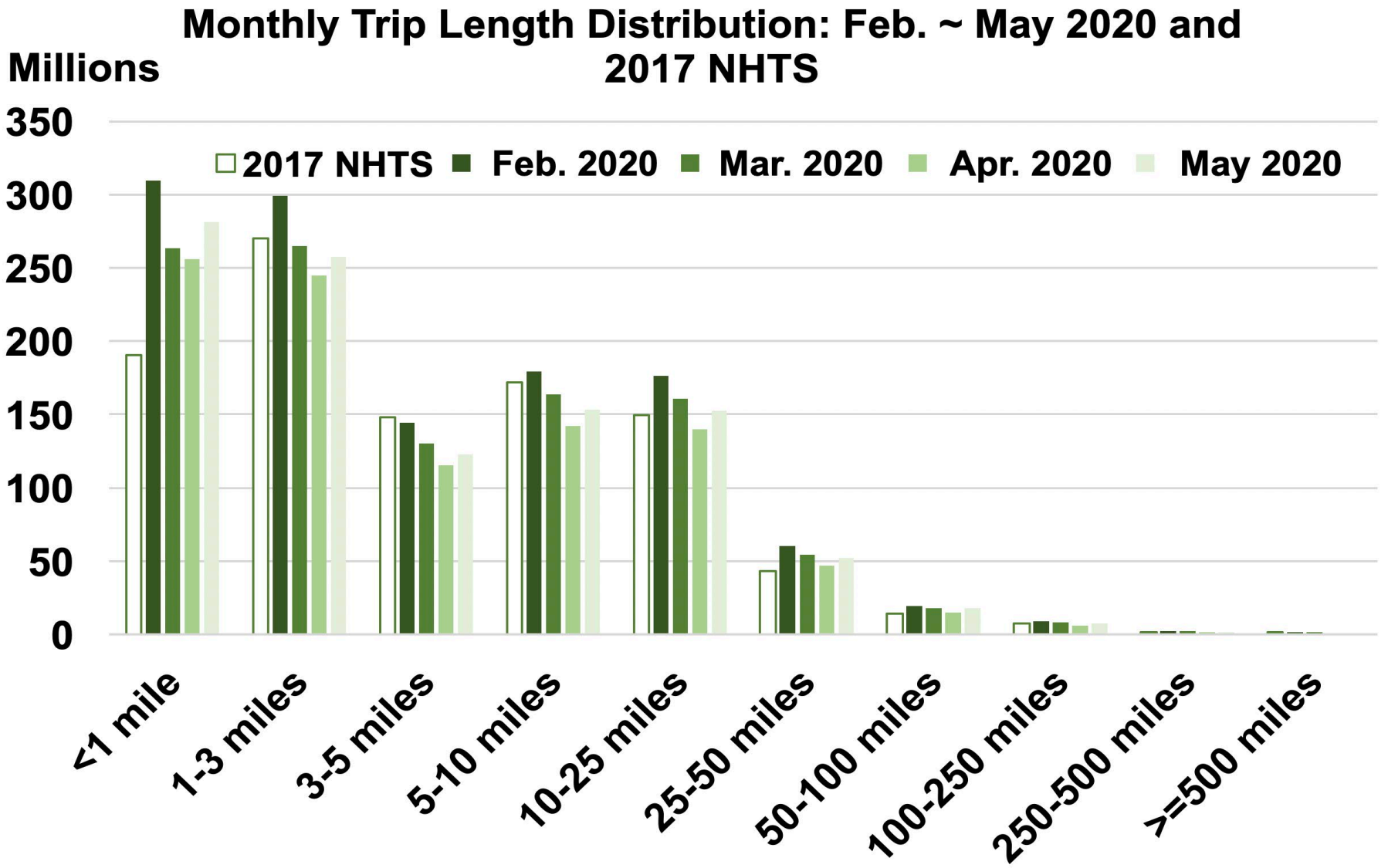
Methodology



Sample Use Cases at U.S. Federal Governments

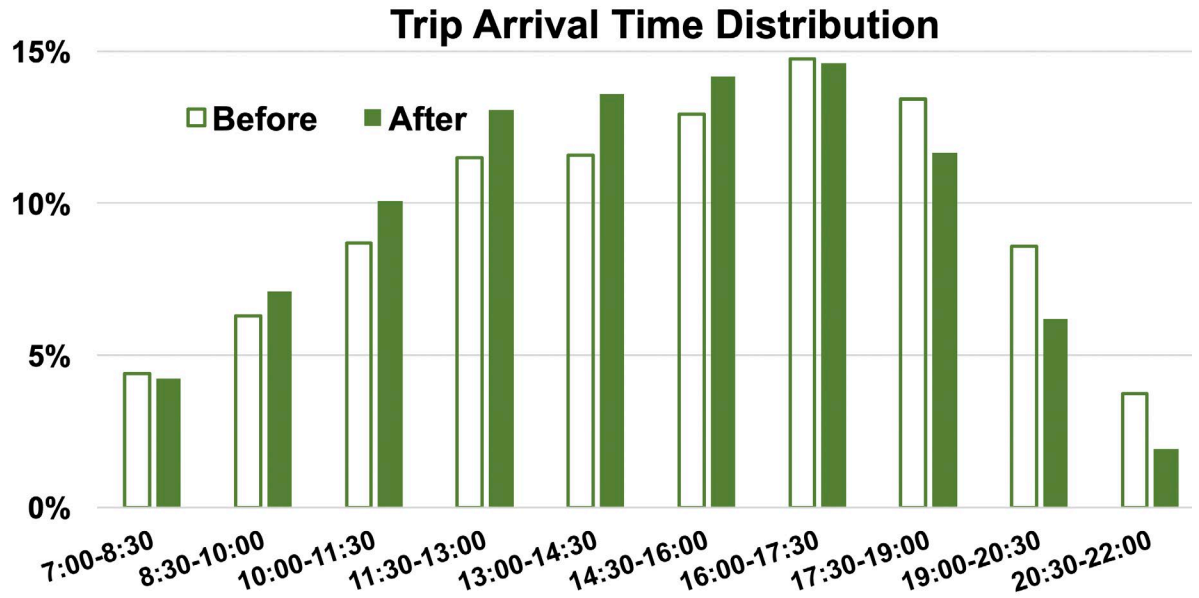
- **Department of Transportation**
  Travel monitoring: daily #trips by distance bands by state and county.
- **Center for Disease Control**
  Integrate mobility and social distancing data into epidemic models for prediction of future cases and death.
- **Department of Veterans Affairs**
  Use SERA tool and its metrics to help determine when to reopen certain VA facilities in specific states and counties.
- **Department of Treasury and Federal Reserve Bank**
  Use mobility and economic metrics on platform for economic and financial impact analysis.

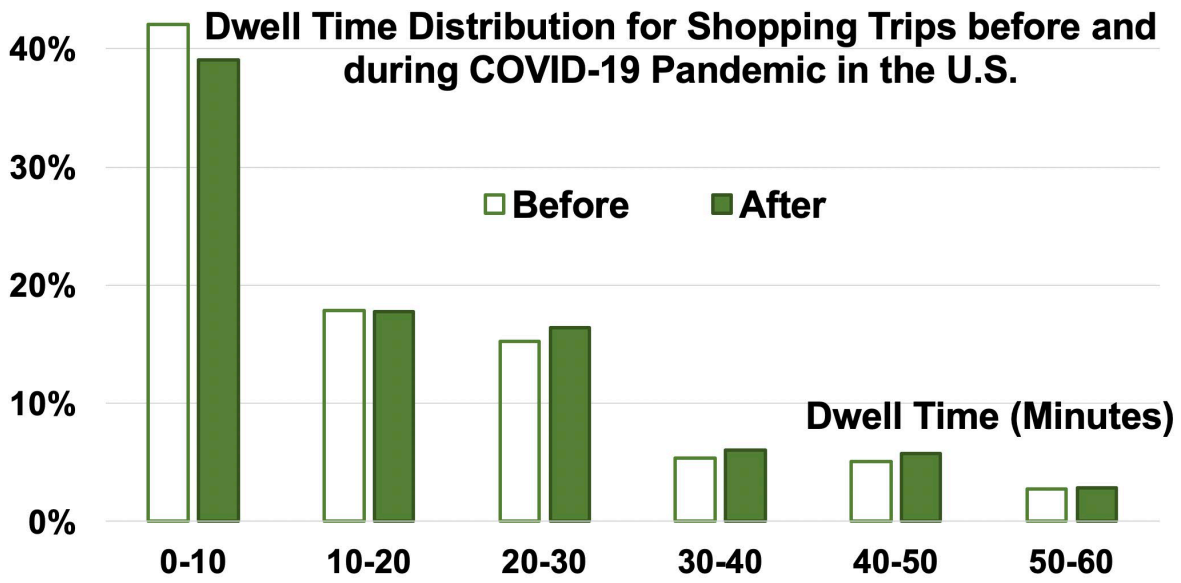
Trip and Travel Distance Trends



Activity Duration and Time Use Trends

- **Arrival time and activity duration distributions for shopping trips**

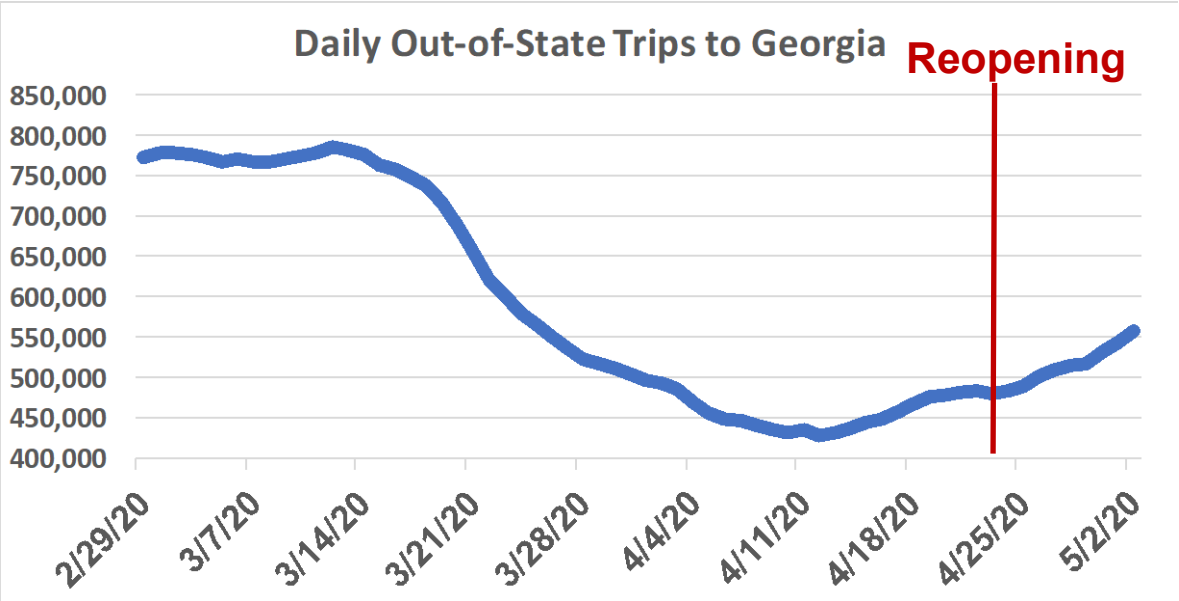




Origin-Destination Tables and External Trips

Example: Following 4/24 partial reopening in Georgia

% staying home: down by 32%.
Distance traveled/person: up by 19%.
non-work trips: up by 24%.
Out-of-state trips to GA: up by 13%.



Travel to Georgia by State: Top 10 States		
State	Daily Trips After Reopening	% change
AL	140,910	14%
SC	135,707	12%
TN	118,606	11%
FL	97,483	17%
NC	27,748	11%
KY	5,217	10%
MS	3,962	10%
VA	2,768	11%
TX	1,599	10%
IL	1,446	-4%
All States	546,159	13%

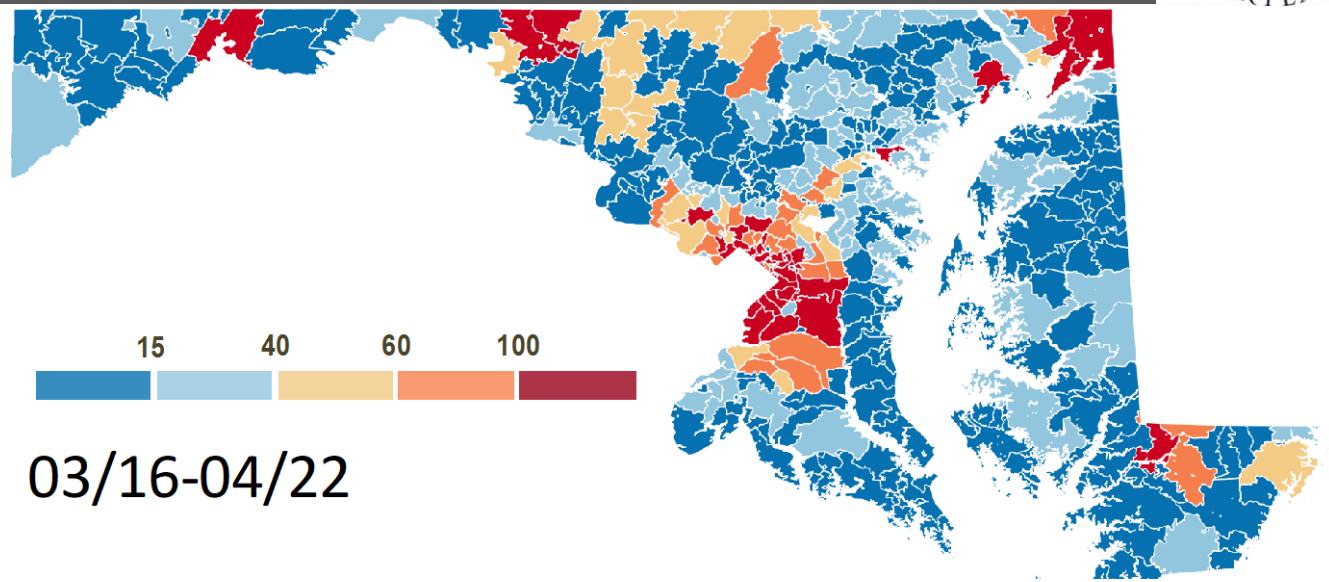
Correlation b/w Imported Cases and COVID Cases

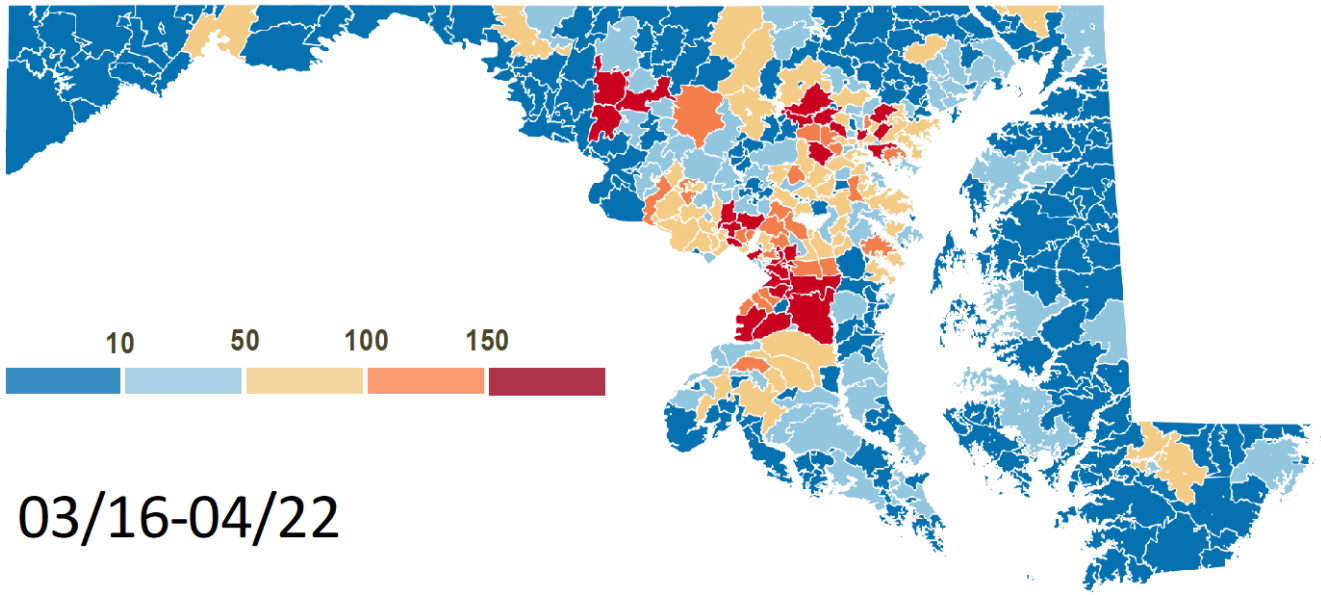
Number of Imported Cases by Out-of-State Travel to Maryland

Prince George's County

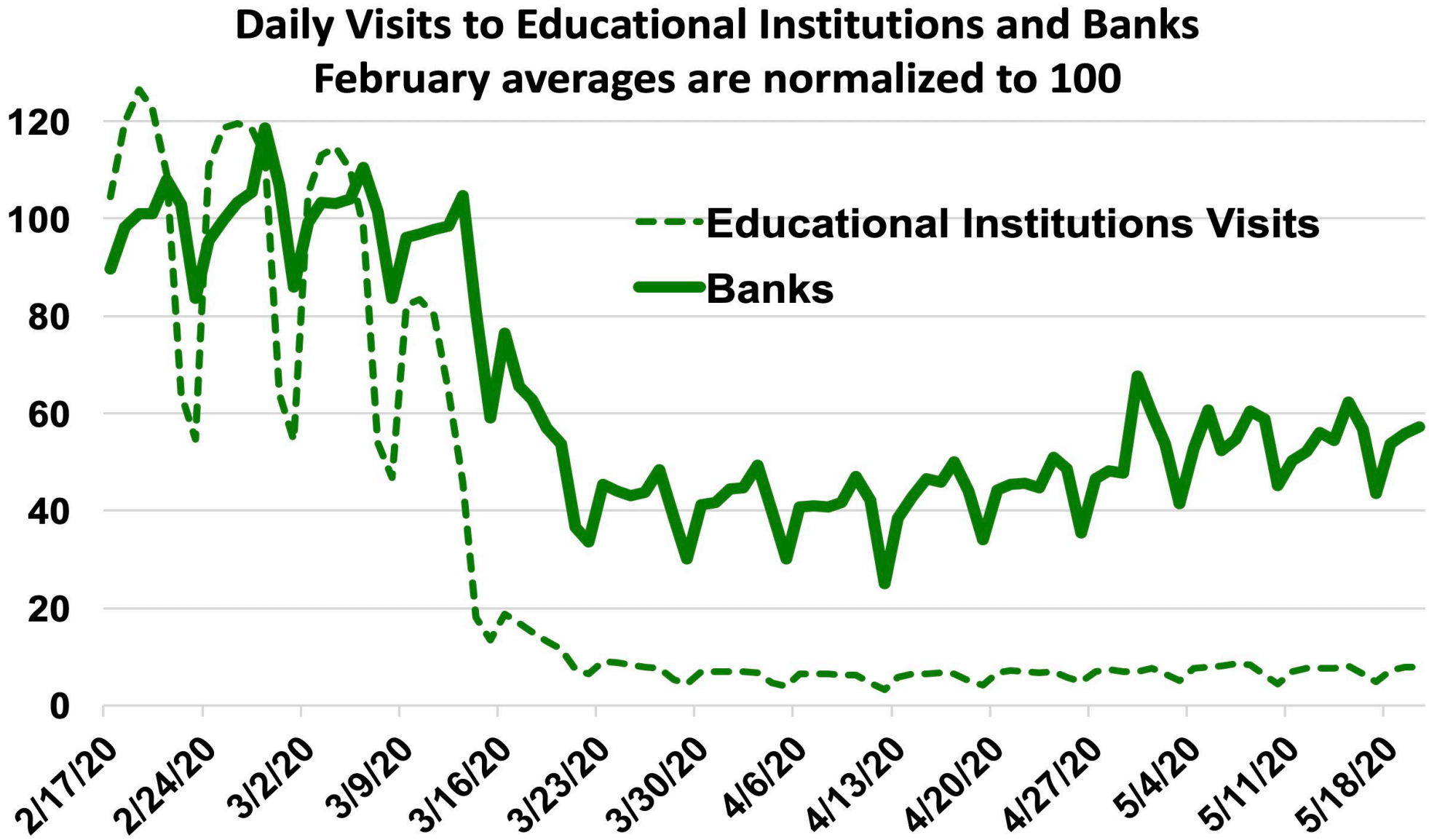
County	Imported COVID cases
Prince George's County, Maryland	22,635
Baltimore County, Maryland	16,551
Baltimore city, Maryland	12,989
Montgomery County, Maryland	11,702
Anne Arundel County, Maryland	10,256
Howard County, Maryland	7,133
Harford County, Maryland	4,056
Frederick County, Maryland	3,956
Cecil County, Maryland	3,285
Carroll County, Maryland	3,242
Charles County, Maryland	2,998
Washington County, Maryland	2,724
Wicomico County, Maryland	1,778
Calvert County, Maryland	1,490
St. Mary's County, Maryland	1,263
Queen Anne's County, Maryland	1,198
Worcester County, Maryland	1,111
Caroline County, Maryland	946
Talbot County, Maryland	850
Dorchester County, Maryland	769
Allegany County, Maryland	679
Somerset County, Maryland	518
Kent County, Maryland	513
Garrett County, Maryland	401

Number of Confirmed COVID-19 Cases in Maryland





Point of Visit Trends by POI Category and Location

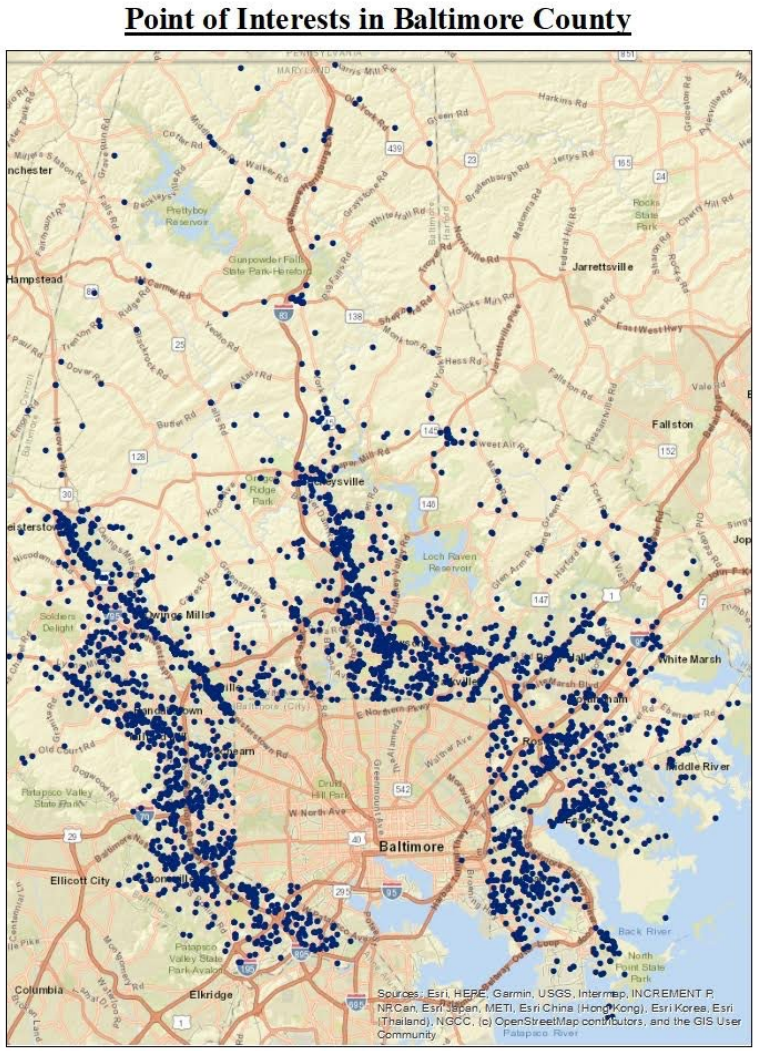


Hotspot Monitoring and Outbreak Warning

Baltimore County, MD

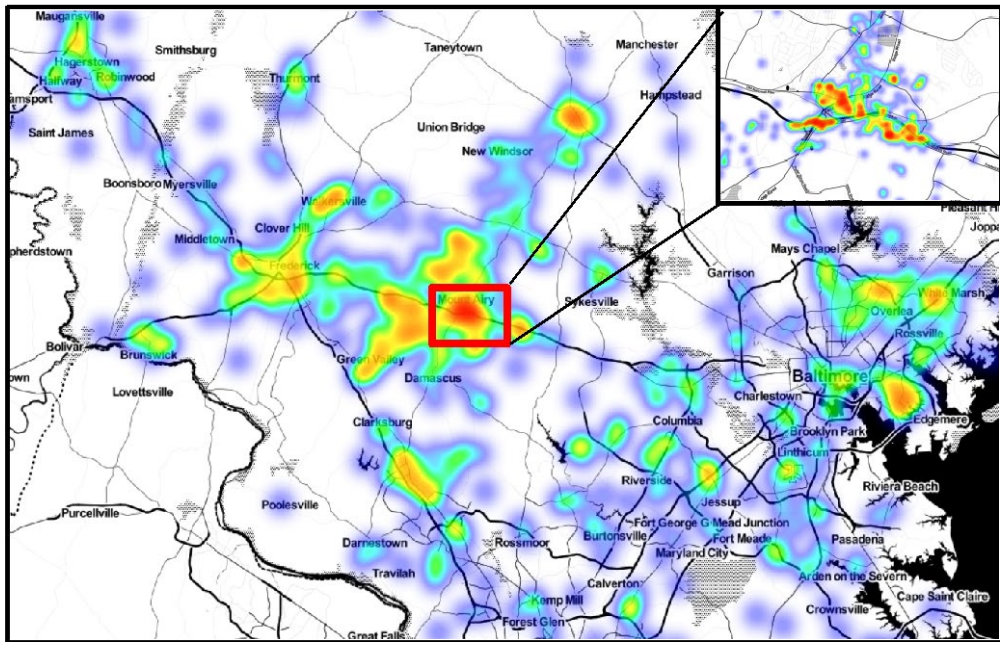
- For hotspot monitoring, the platform uses anonymized data to automatically monitor daily visits to more than 6,000 locations.

- For outbreak risk prediction, the platform uses number of visits, origins of visits, and COVID infection rates at origins together to predict high-risk locations for new outbreaks and suggest preventative measures.



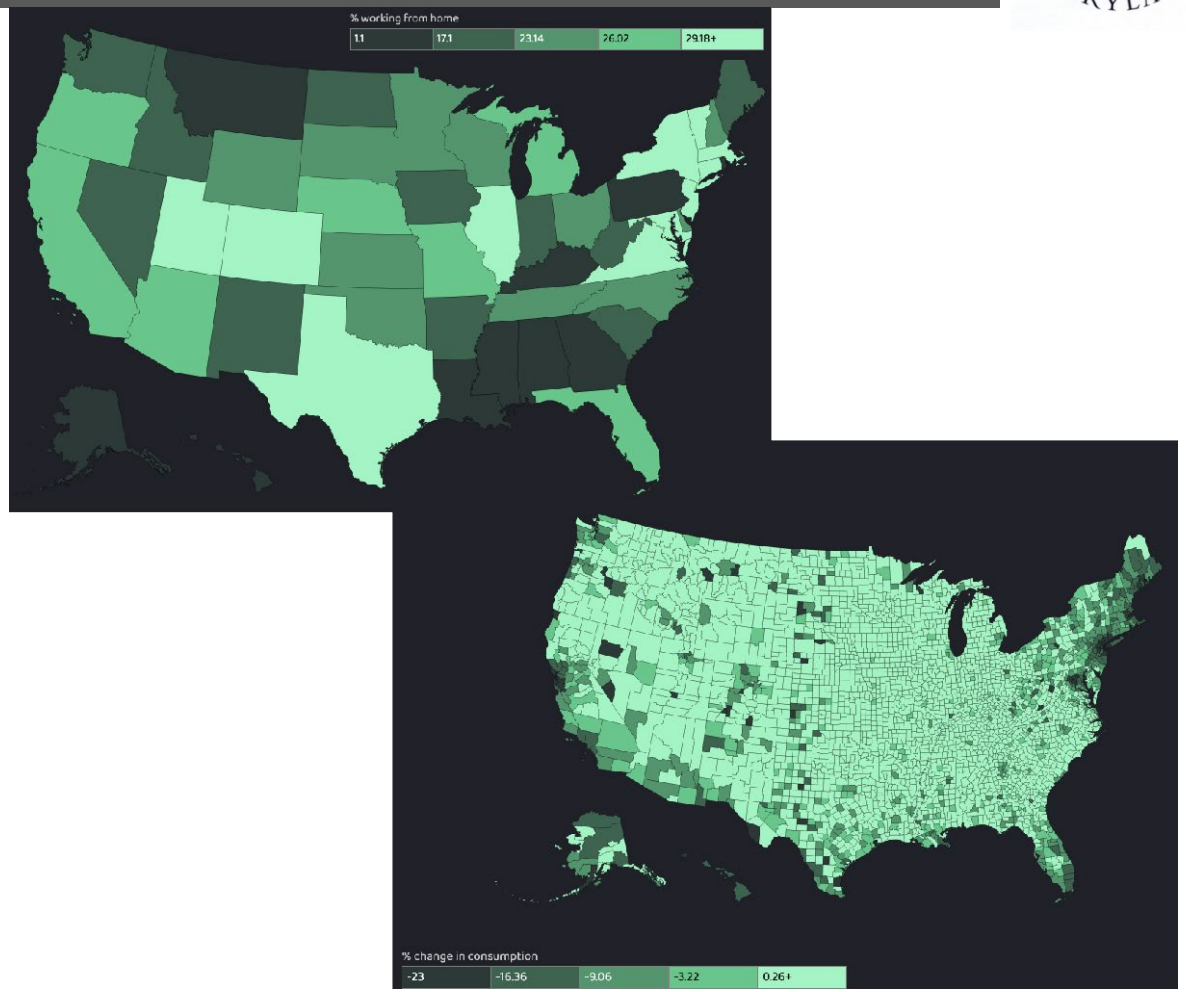
Contact Tracing and Local Containment

- Minutes after a new outbreak, we can use privacy-protected mobile device data to conduct aggregate, community-level contact tracing and recommends localized quarantine areas. This complements traditional, individual-level contact tracing that takes much longer to complete.
- For instance, the pleasant view nursing home outbreak appeared to be correlated with non-employee visits 10 days before the outbreak.



Economic/Job Impact and Policy Decision Support

- Change in consumption, % working from home, and number of visits to individual business types.
- Weekly estimates of job gain and loss by economic sector at the county level.
- Guide the design and implementation of economic recovery policies and practices.



Top: % working from home by state and county-level
Bottom: impact of COVID-19 on retail trade, hotel, food and drink, entertainment, and recreation businesses.

Research Questions related to Spatial Indicators

- How can we best define mobility and spatial behavior indicators that can serve as inputs for traditional epidemic models?
- How to integrate mobility data, travel model, and epidemic model for public health policy analysis, reopening scenario analysis, and decision support?
- How should the research community work together to best leverage the ability to measure person-level spatial behavior continuously for a large sample of anonymized individuals?
- How can we ensure privacy protection and responsible data use while seeking scientific discovery?