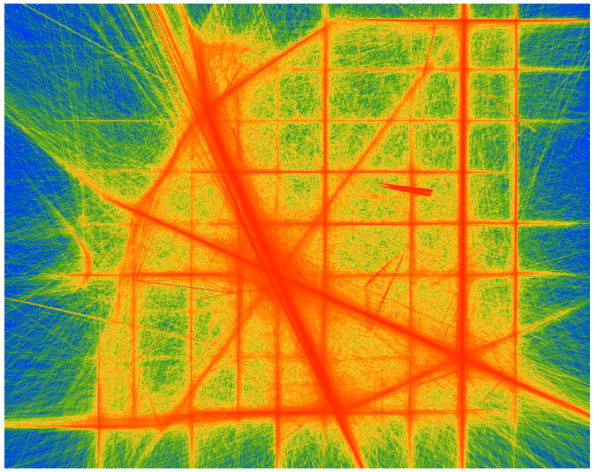
CENTER FOR GEOSPATIAL INFORMATION SCIENCE

# New opportunities through big mobility data analytics



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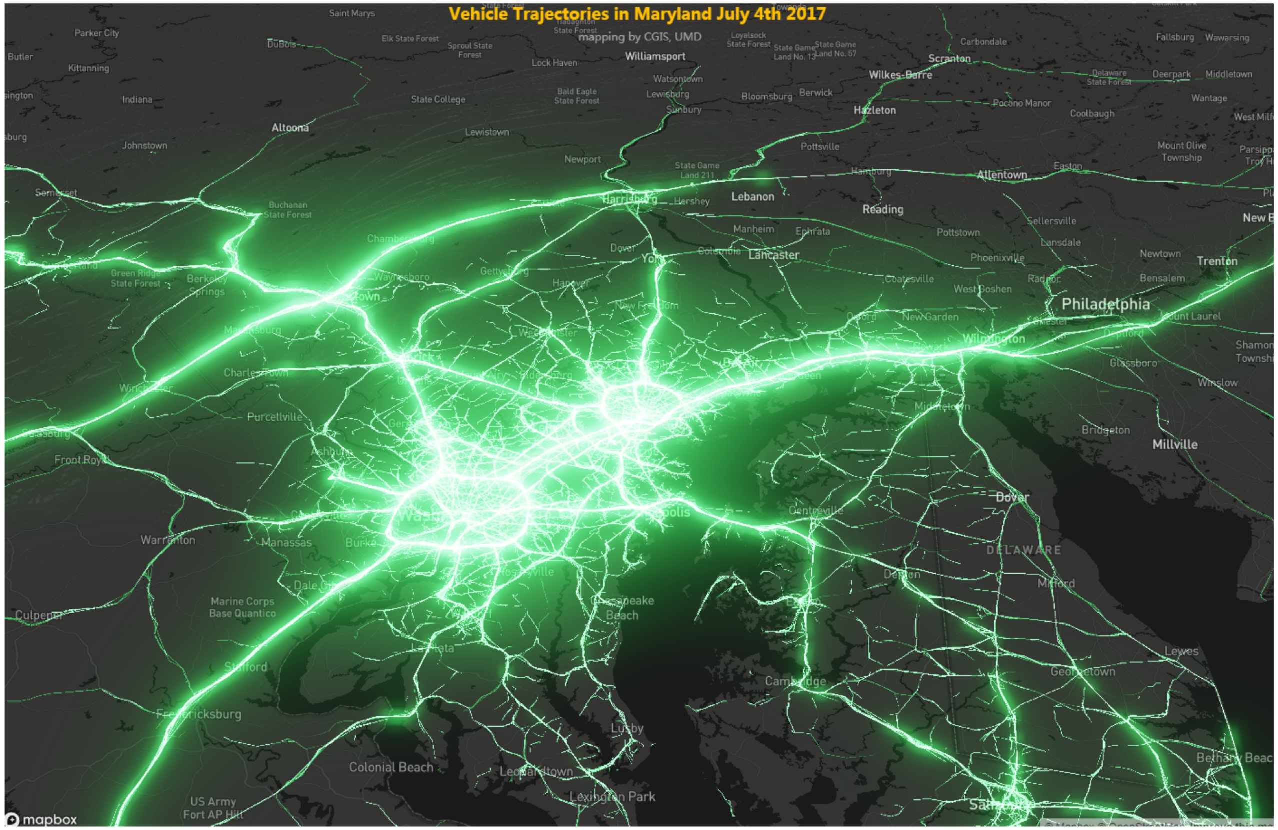
*Location Powers: Data Science Summit, November 13, 2019*

# The opportunities: Vehicle travel patterns

50,282 trips for the 4th of July, 2015

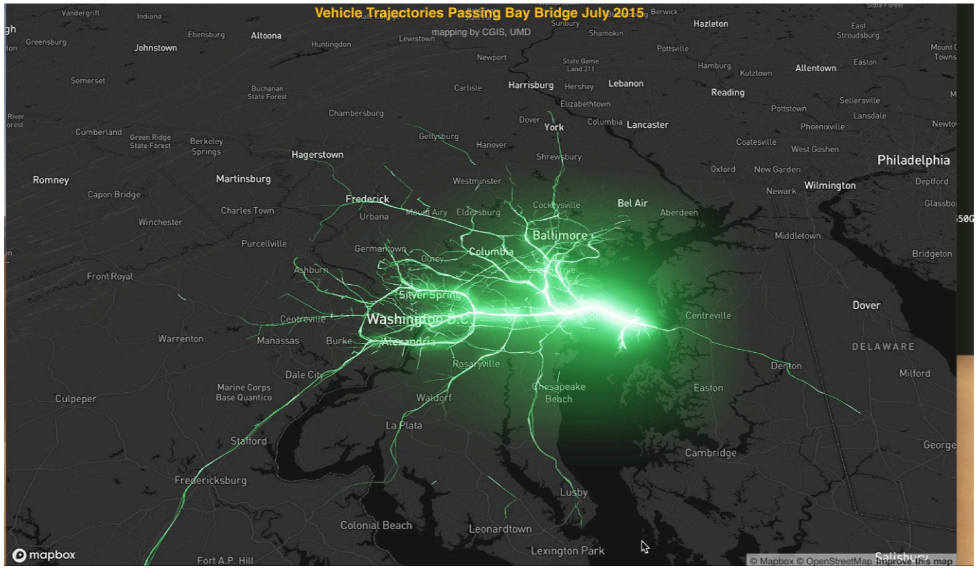


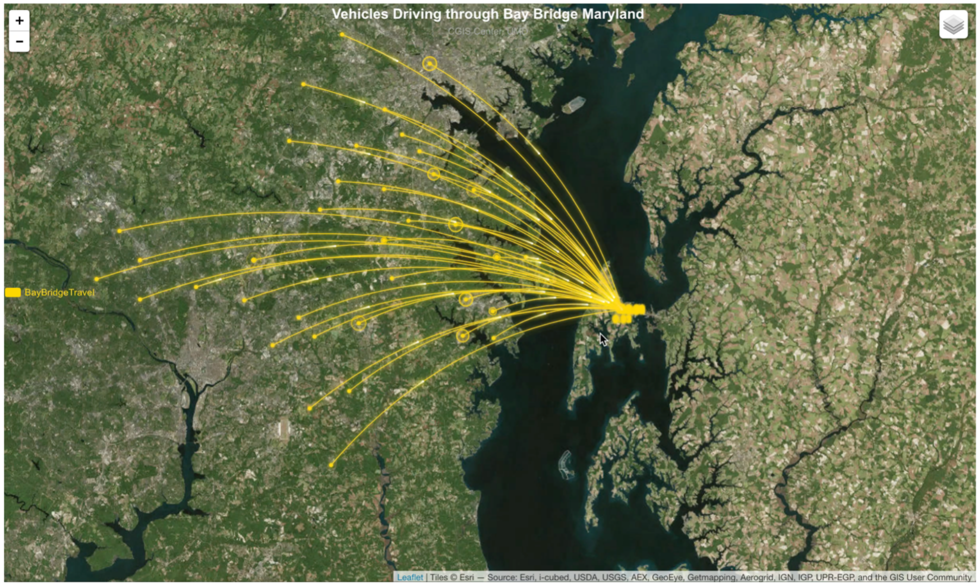

**J. Fan**

Especially useful for **critical or significant locations** such as a **key bridge** at a **key time (July 4th...)**

**Exposes different travel patterns over space and time**

**These 2 visualization tell different stories...**



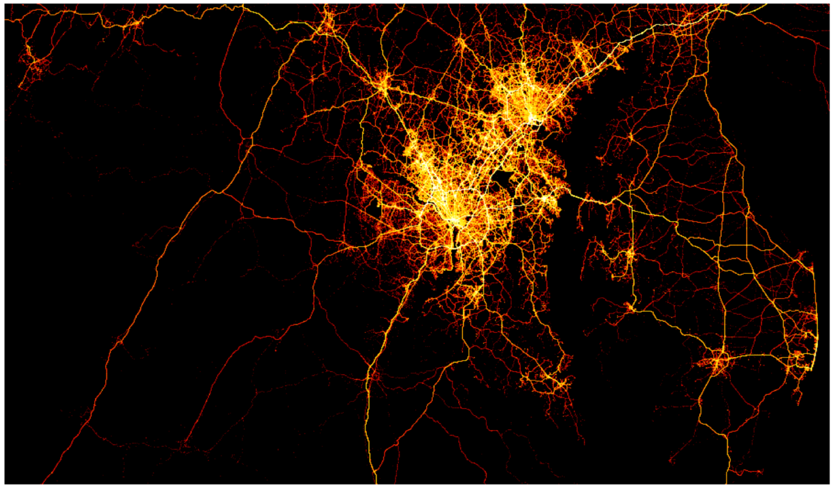
# Space-time patterns are important…

Data that give rise to such patterns are available from different data sources… **GPS waypoint** data, **cell phone** data, **location-based app** data, as well as **other sensors (fitness trackers)**…..

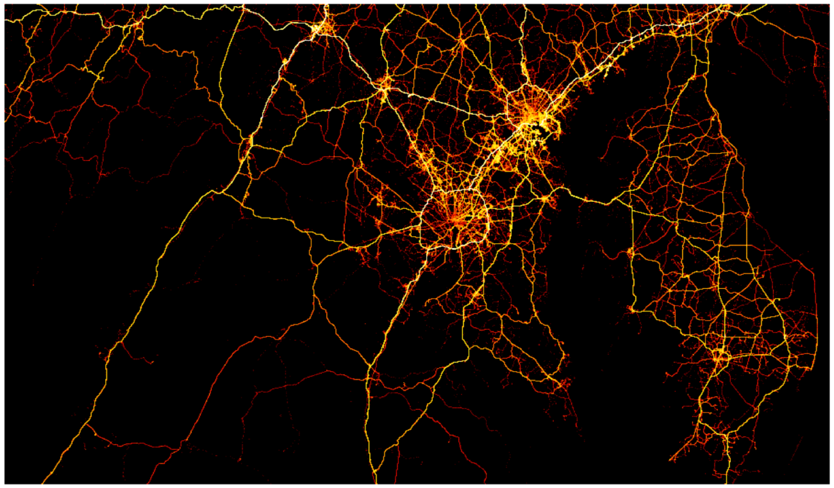
Here we see **big trajectory data** (GPS waypoints transformed into trajectories) useful for highlighting travel behaviors of different groups

We want to **expose different dynamic behaviors** over **space and time**

Important for:
- understanding urban/rural differences
- risk exposure
- Evacuation
- Multi-scale



Passenger vehicle trajectories, Maryland, 2015



Truck fleet trajectories

GPS data from in-vehicle sensors, Maryland, 2015
100 million waypoints, 5 million trajectories

## However, big GPS trajectory data comes with its own challenges…

- **Hundreds of millions** of **GPS trajectory data** have to be **matched** back to the underlying road network in order to determine the traffic volume pattern on different segments of the road network
- **Irregular GPS sampling intervals** and **gaps** exist for vehicles travelling on the road network derived perhaps from the fixed sampling intervals that can vary between devices

```
b4ba00bd9748981fc74c19afe5bacfc0,0,2015-06-01T10:53:00.000Z,40.1307,-77.0202,,
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b4ba00bd9748981fc74c19afe5bacfc0,9,2015-06-01T11:29:04.000Z,39.7181,-77.3079,,
```

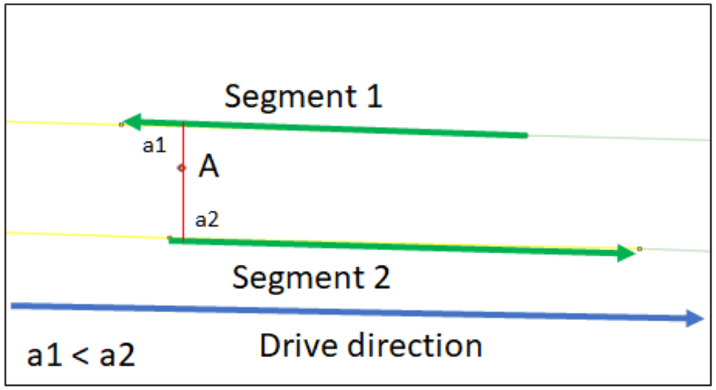
# Requires trajectory reconstruction algorithms

**Snap way-points of a trip to road segments**

- Find the K-nearest neighbors (k=10, and distance within 100 meters) as the candidates
- Select the candidate with largest cosine

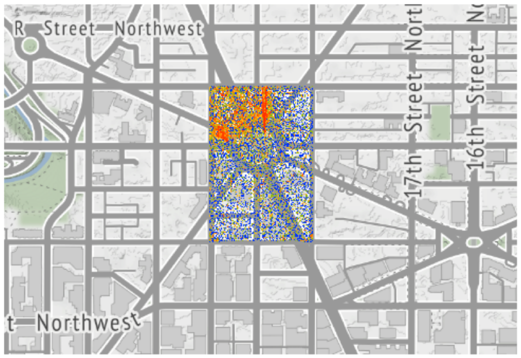
**Fill segment gaps by heuristic algorithms**

- Due to large time interval between two waypoints (1~2mins or longer), intermediate segments may be missing
- Use road network topology
- **Need to use a [shortest path] algorithm** to fill the gaps between two segments
    - This assumes that drivers take the shortest path between the two recorded waypoints…

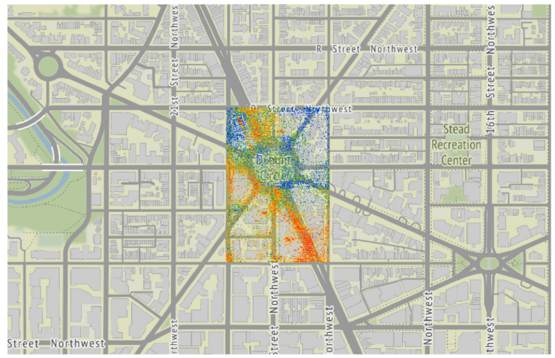



*Due to the uncertainty of GPS positioning, we cannot always employ the nearest segment to snap the waypoint*

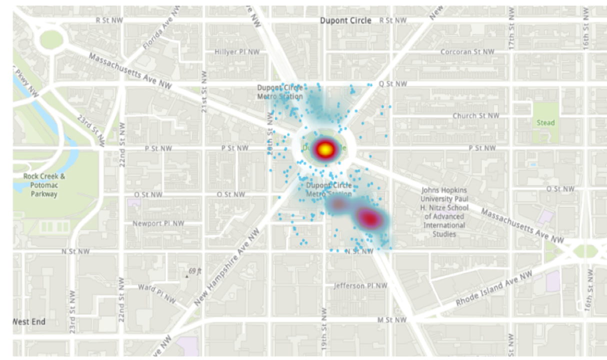
# Mobility data now comes from numerous different data sources….



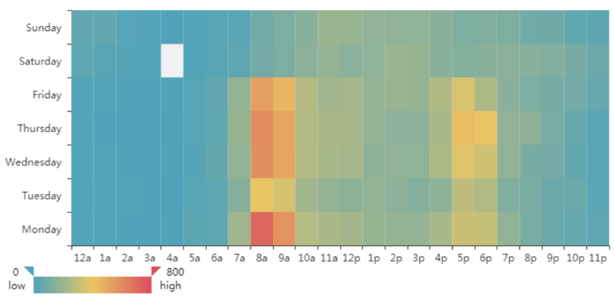

Cell phone data – ~23,775 sample points, ~14,000 devices

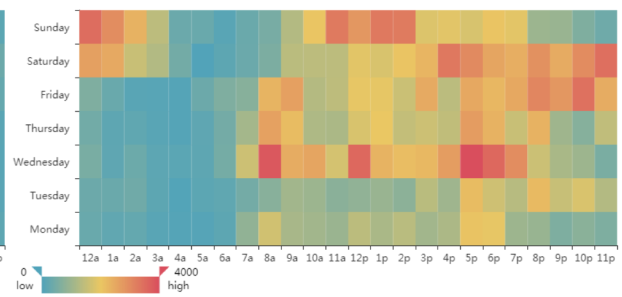


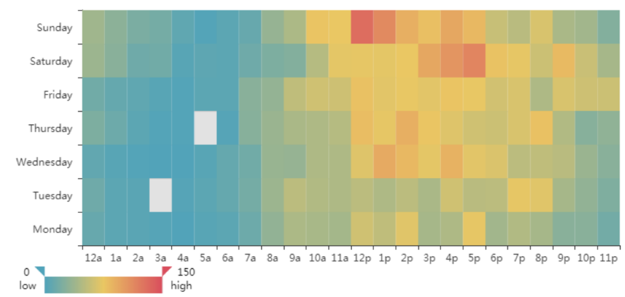

LBS data – ~240,000 sample points from ~7,300 devices




Geo-tagged tweets – ~7,000 sample points from ~2,600 individuals, 2017

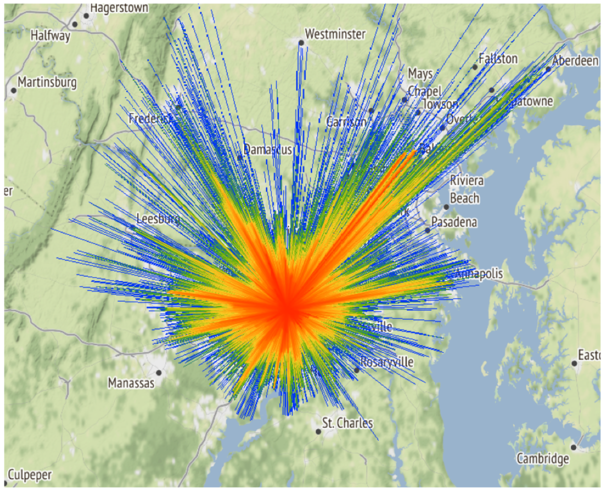


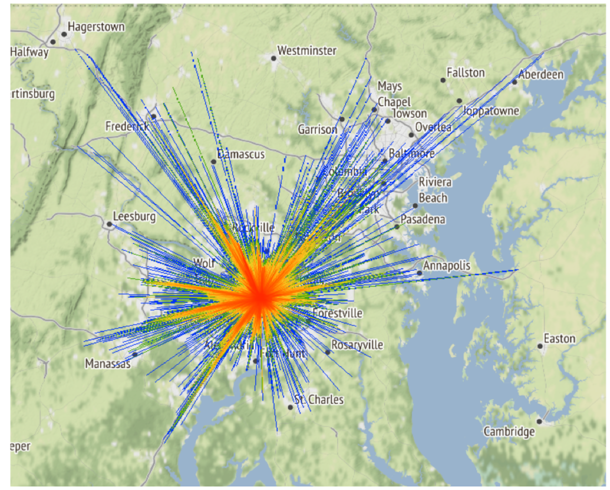

Dupont Circle, Washington, DC

# Trips originating from Dupont Circle (origin-destination analysis)



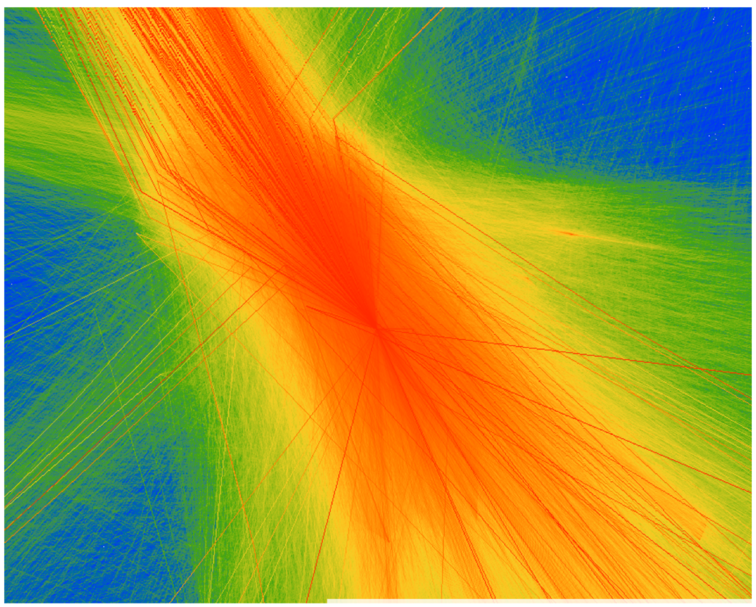

Cell phone data trips

More than 2,400,000 individuals



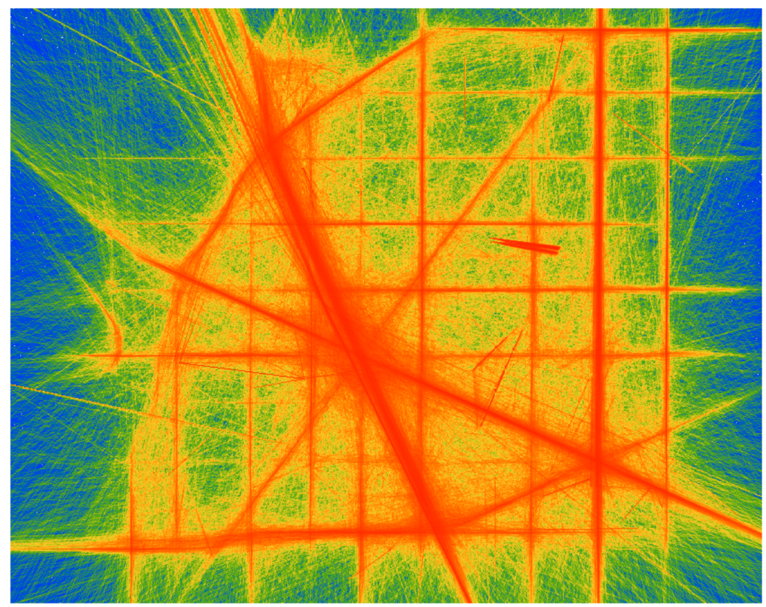

LBS data trips

More than 300,000 individuals



Median trip duration 28 mins

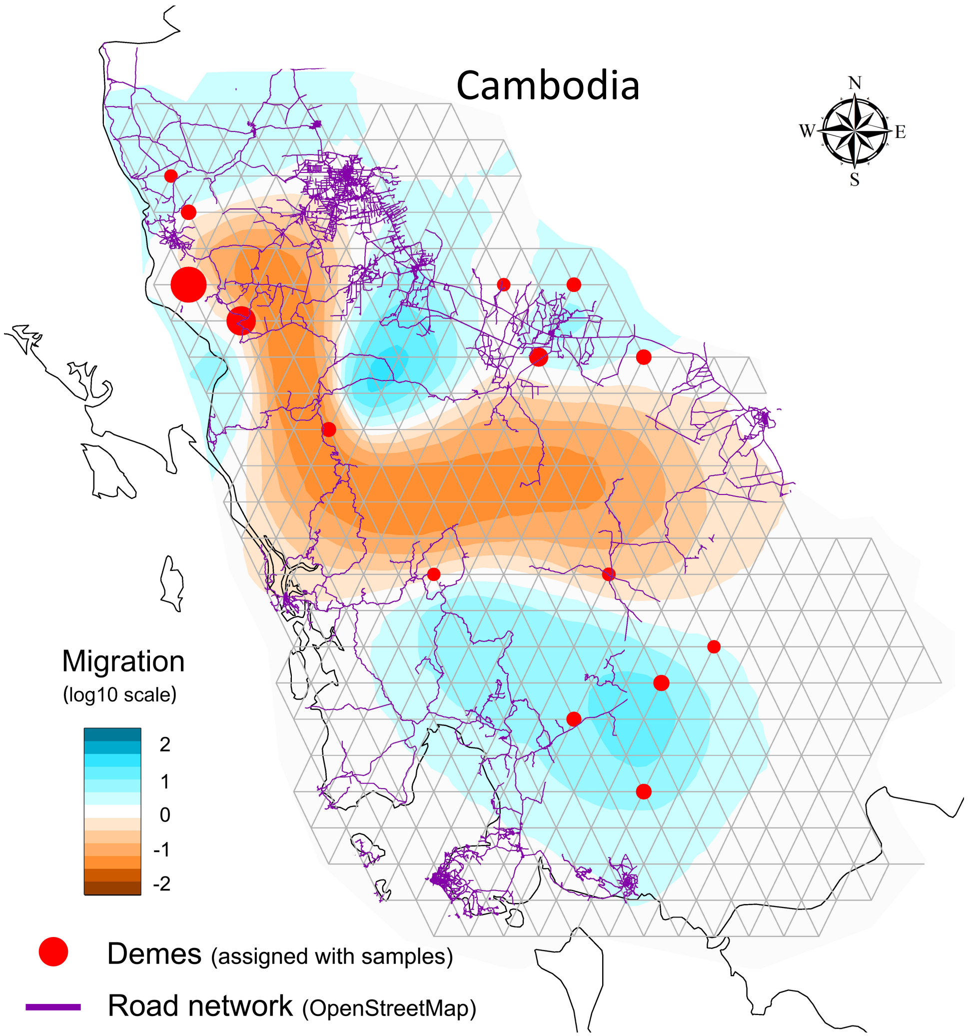
Median trip distance 1.8 mile



Median trip duration 2 mins

Median trip distance 0.2 mile

# Other new sources of data, e.g., genomic data also bring important opportunities to understanding mobility in new ways

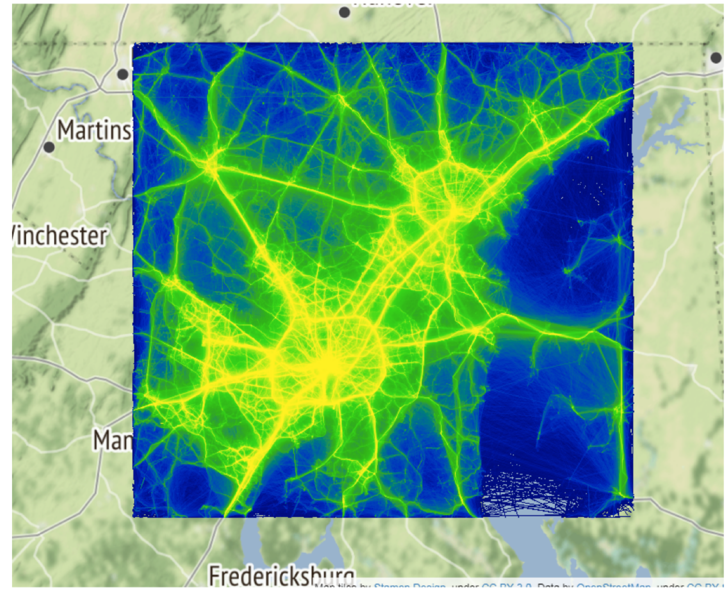



**Malaria elimination in the Greater Mekong Subregion**

Use big data techniques to simulate and estimate patterns of **parasite gene flow** with a **human mobility travel network**

Y. Li

# Contact:

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