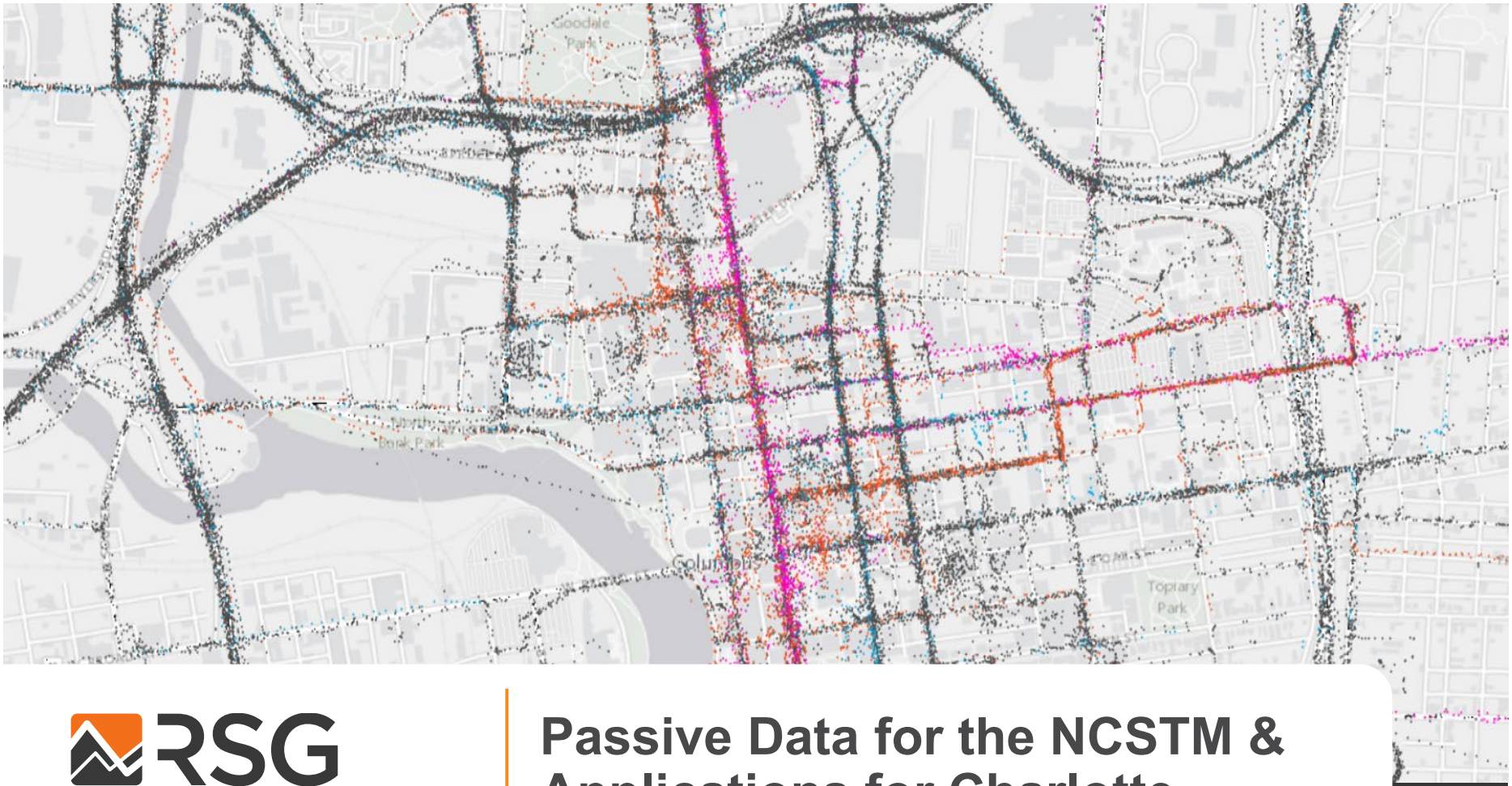


RSG
the science of insight

Passive Data for the NCSTM & Applications for Charlotte

Vince Bernardin, PhD

November 5, 2019

Projects

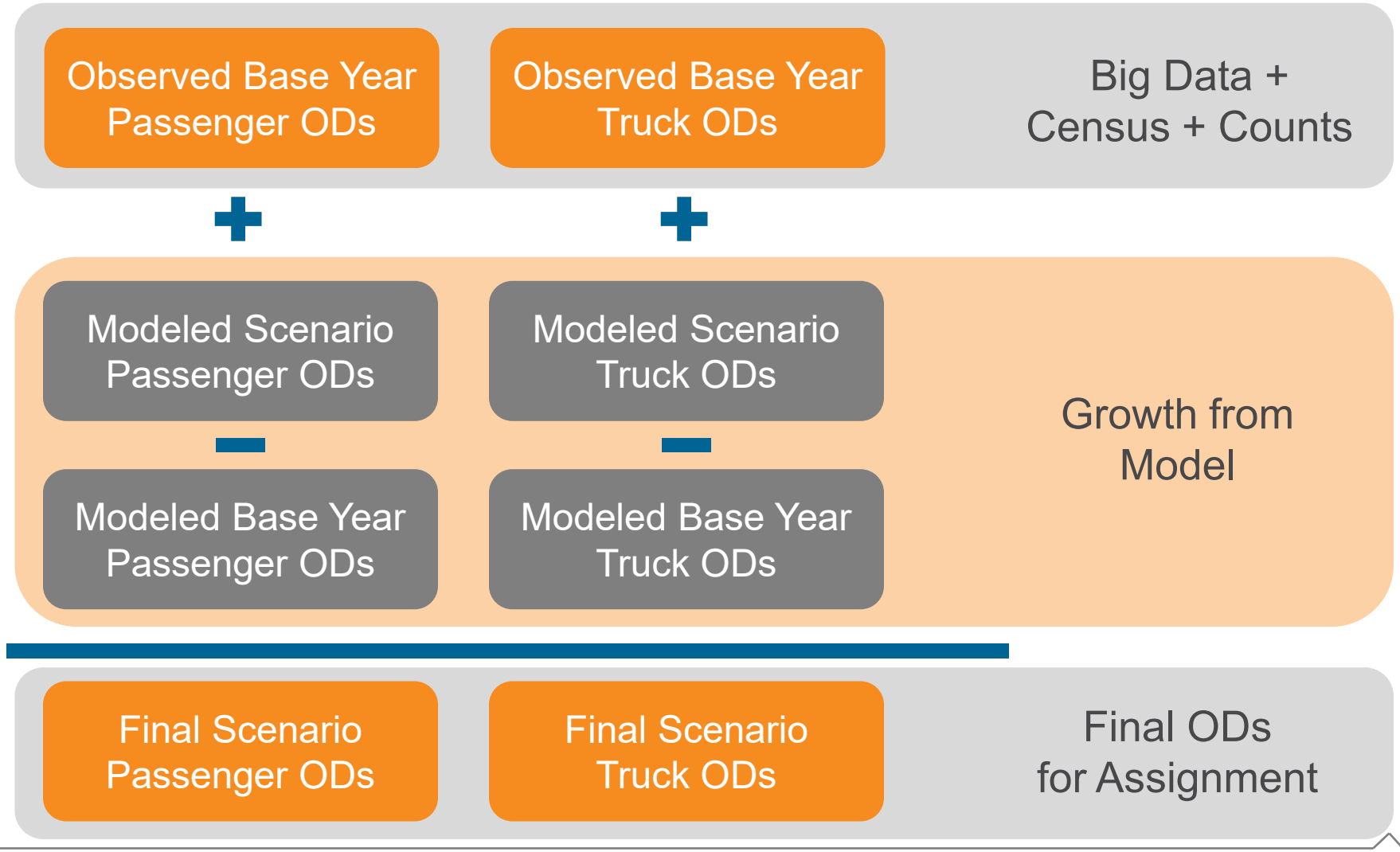
- NCSTM4 for P6
  - New Base Year: 2017
  - General Population & Truck-Specific Big Data
    - New data-driven, pivot point model architecture
  - Updated Passenger & Freight Models
    - NHB trips linked to HB trips
    - New visitor trips & Long-distance in GISDK
- Charlotte Big Data Analytics
  - General and Truck OD flows for the region
    - Metrolina zone system & times-of-day
  - Corridor specific ODs for I-77 and NC49

Data Acquired for NCSTM

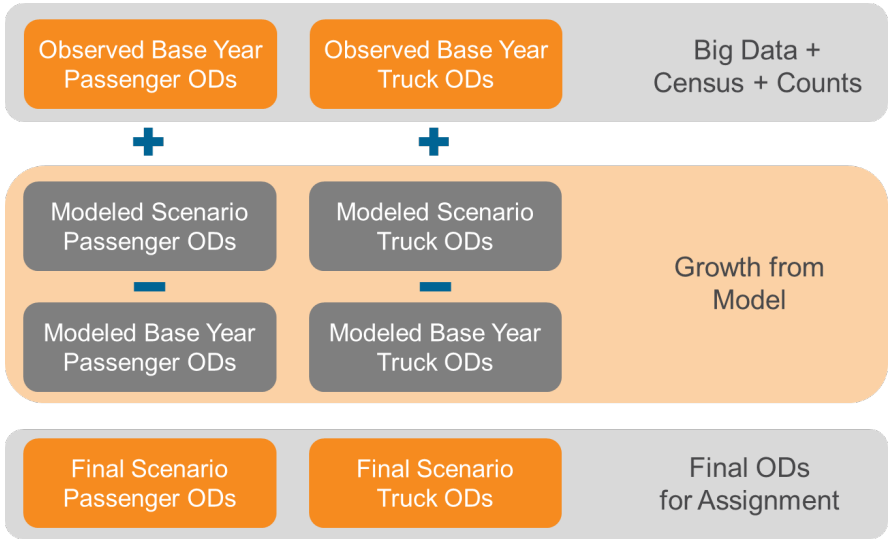
- NCSTM Passive Data
  - LBS data (from Safegraph)
    - 10-15% of devices on any given day and roughly half of all devices over the course of a month
      - May 6-12, 2018: 683,832,200 sightings from 2,555,873 devices
  - Truck GPS data from ATRI
    - Approaching 25% of all trucks
- Origin-Destination (OD) flows in new NCSTM zone system
- Truck ODs, trace data for Triad & Metrolina

One Day of LBS Data

Data-Driven Pivoting



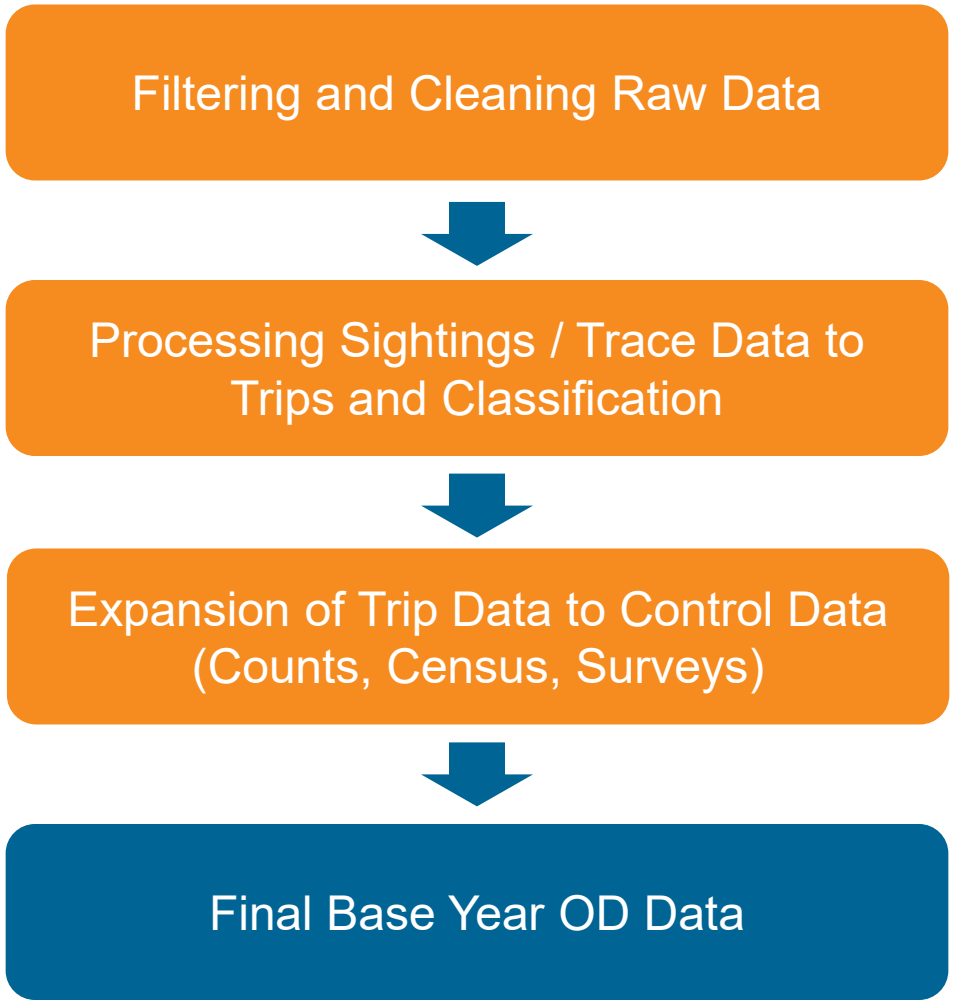
Data-Driven Pivoting



- Not done in past because no good OD data
- Allows base year updates without demand model recalibration
- Encourages shift in focus of model validation to dynamics / sensitivity and response properties
- Produces more accurate ODs than any “pure” model

Data Processing & Expansion

Stages of Data Development

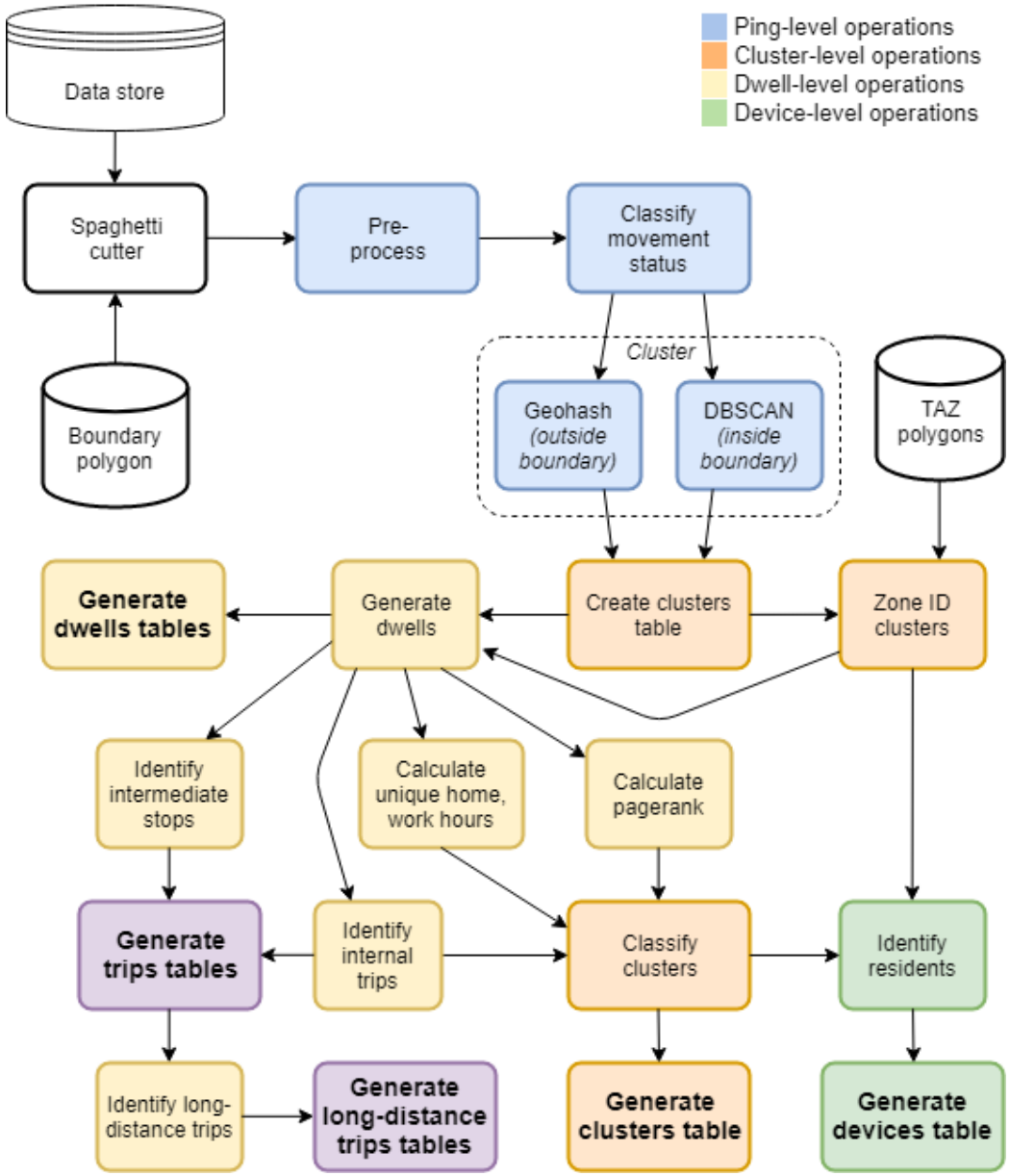


Data Filtering

- With big data, logically trivial queries can be computationally intense
- Filtering for study area and time period
  - North Carolina, October 2018
  - “Cookie cutting” vs. “Spaghetti cutting”
- Filtering devices for data quality
  - Minority of devices contain vast majority of information (sightings, trips)
  - At the scale of big data, better to have less, good data than more, bad data

Data Processing

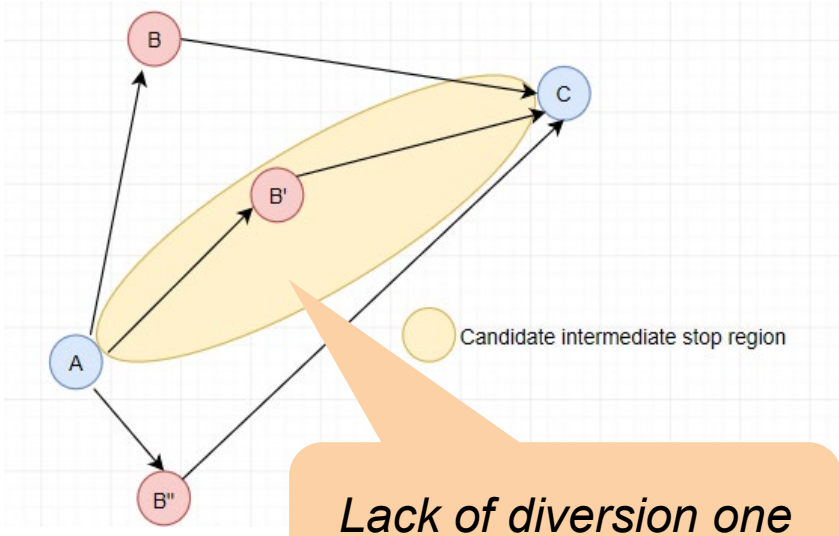
- Identifying stops
  - Best methods depend on data density
- With LBS, density based clustering allowing for noise is often best, but can sometimes augmented with heading, etc.



Graph Theory for Residence, Work Imputation

Topological centrality as primary indicator, overnighting secondary – higher confidence, multi-point fusion

Filtering Intermediate Stops on Long Trips



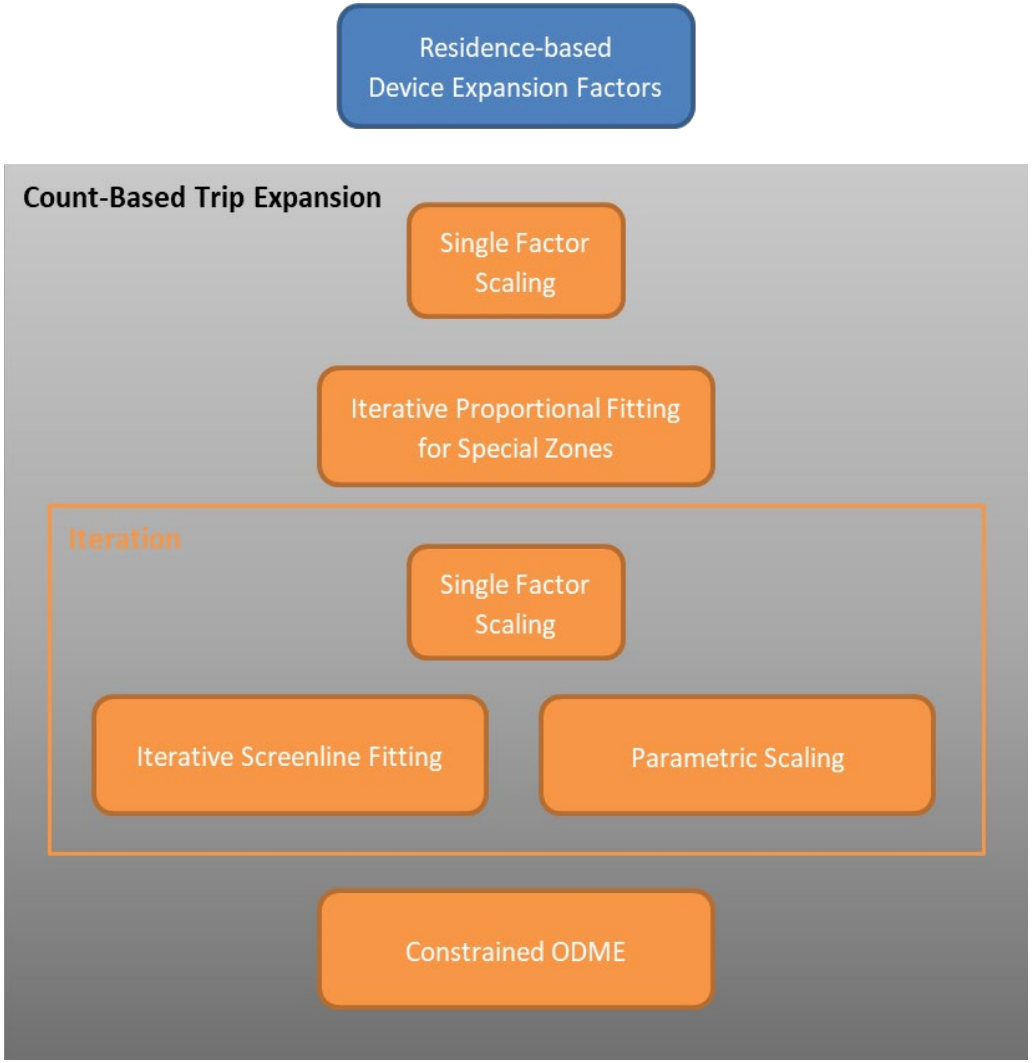
Lack of diversion one distinguishing mark

Geofencing around gas stations / truck stops, etc.

Filtering stops for fuel, food, etc., necessary for understanding actual long-distance OD demand for both passenger and freight flows

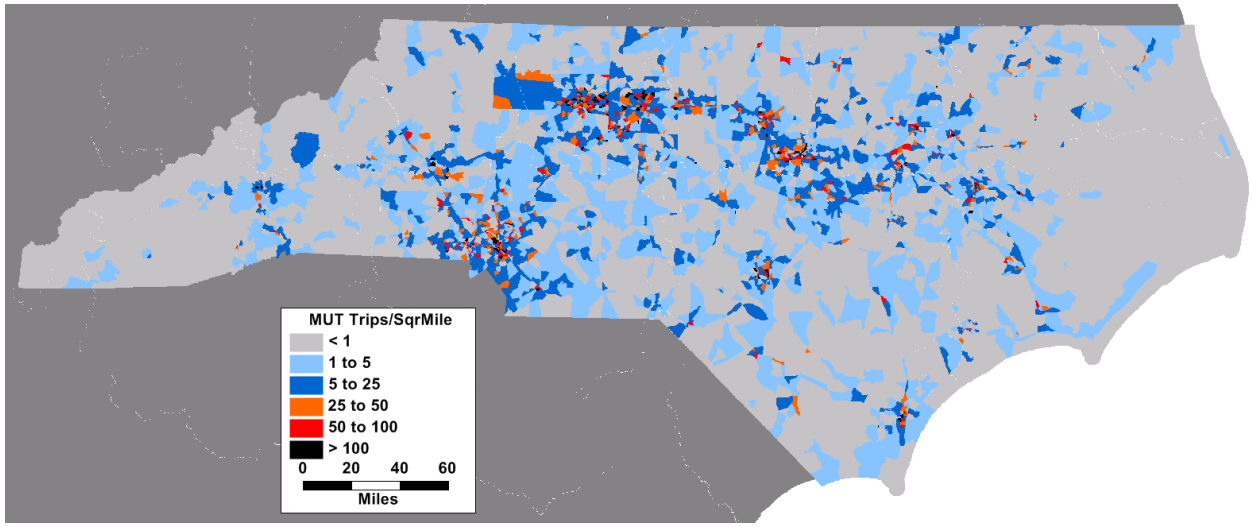
Data Expansion

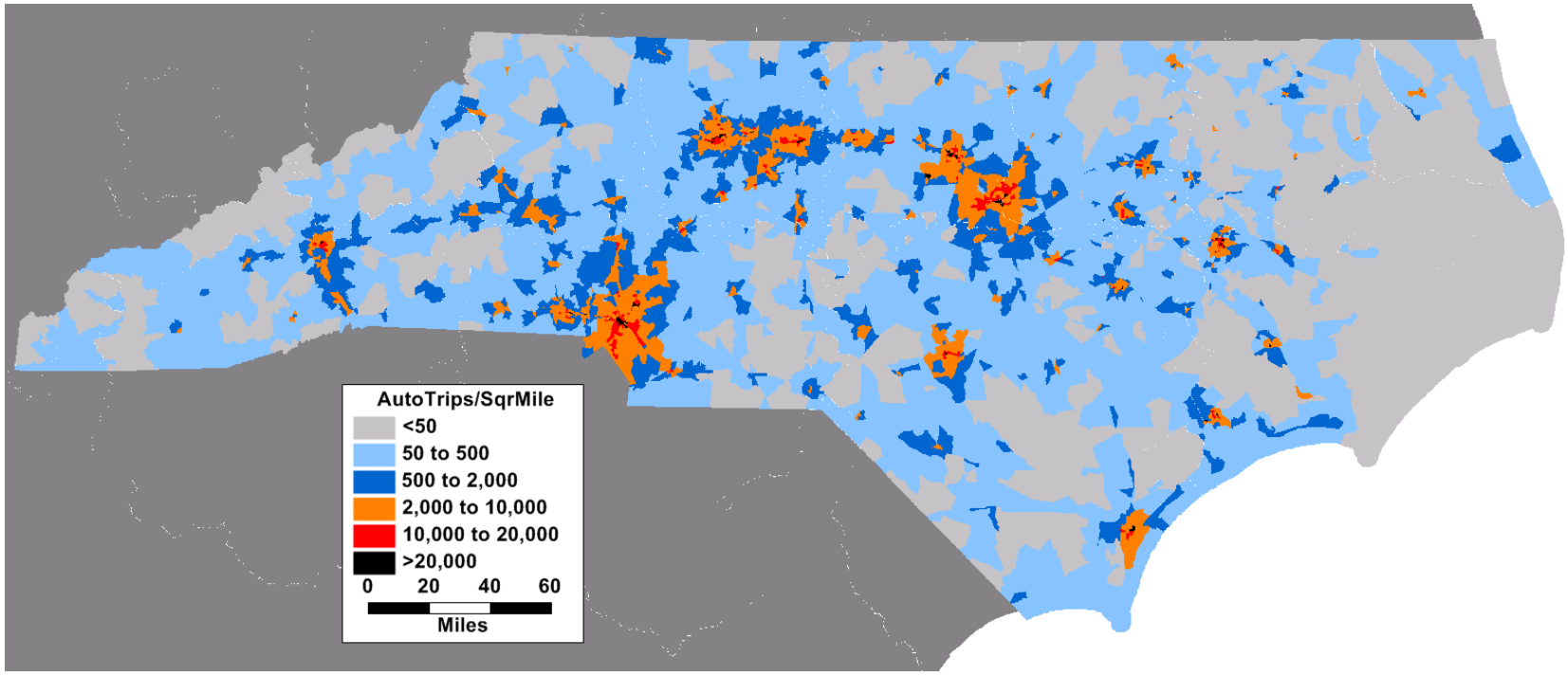
- Multi-step, ensemble method
- Starting with Census-based
- Followed by count-based



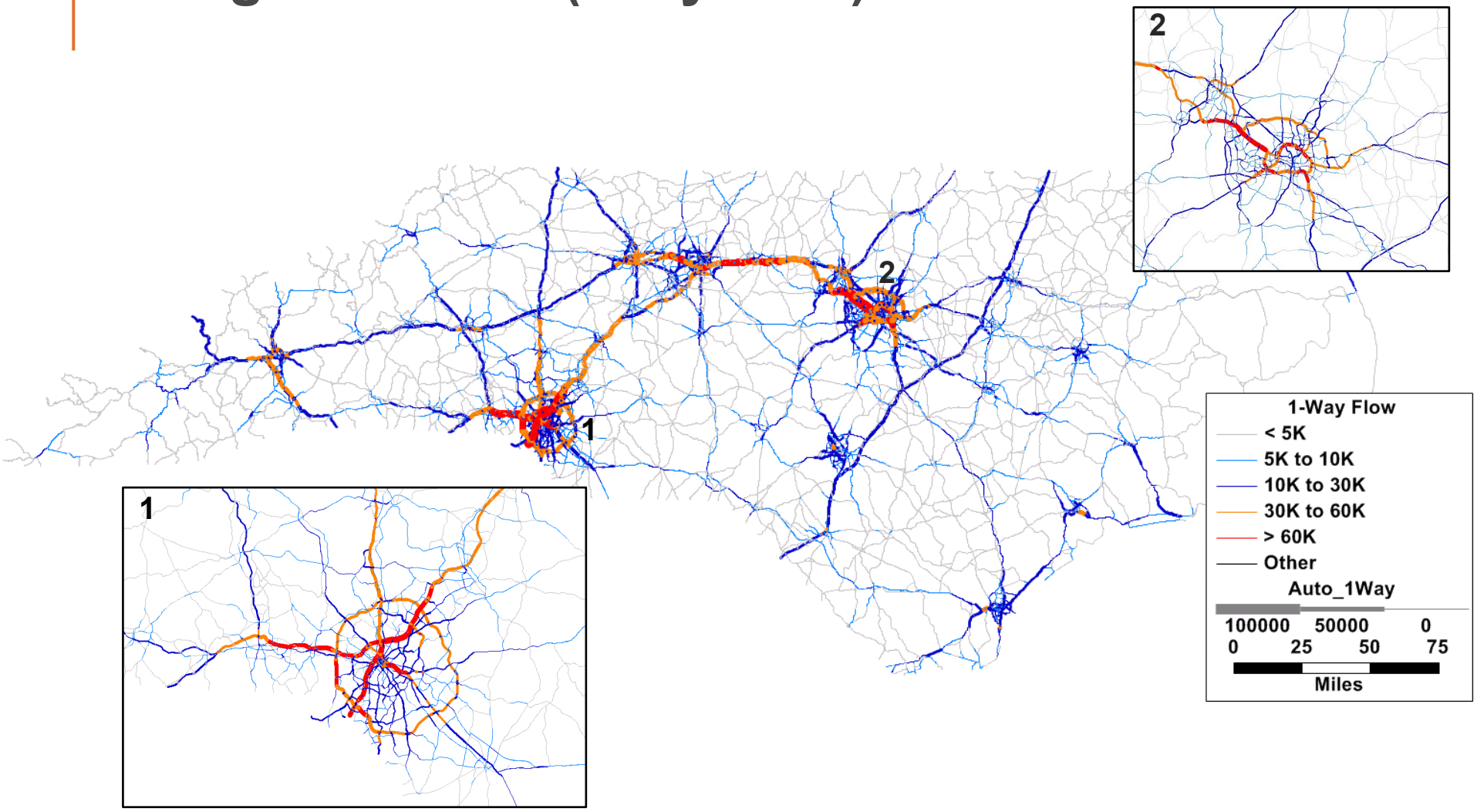
Results & Visualization

Auto & Truck Expansion

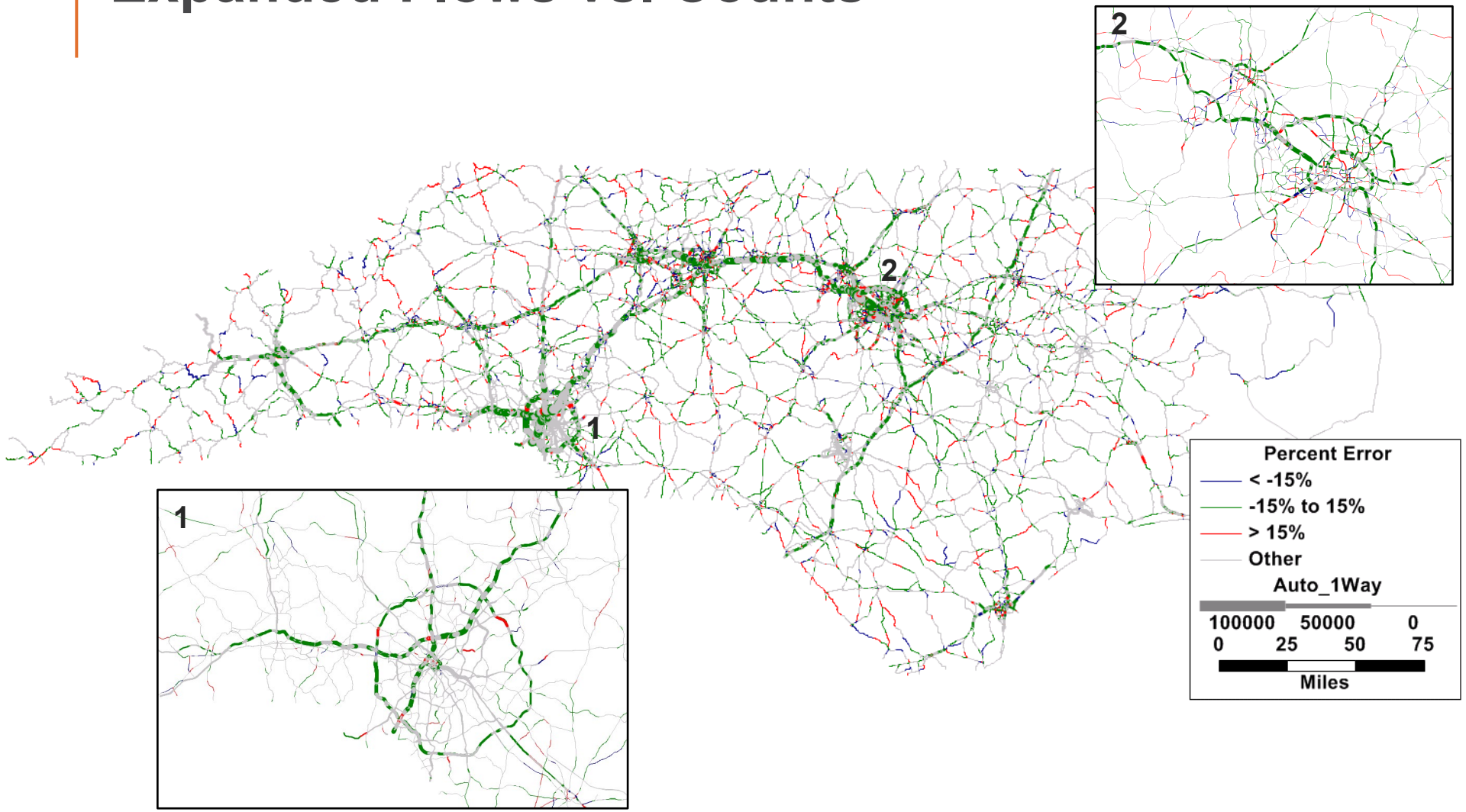




Assigned Flows (daily total)



Expanded Flows vs. Counts



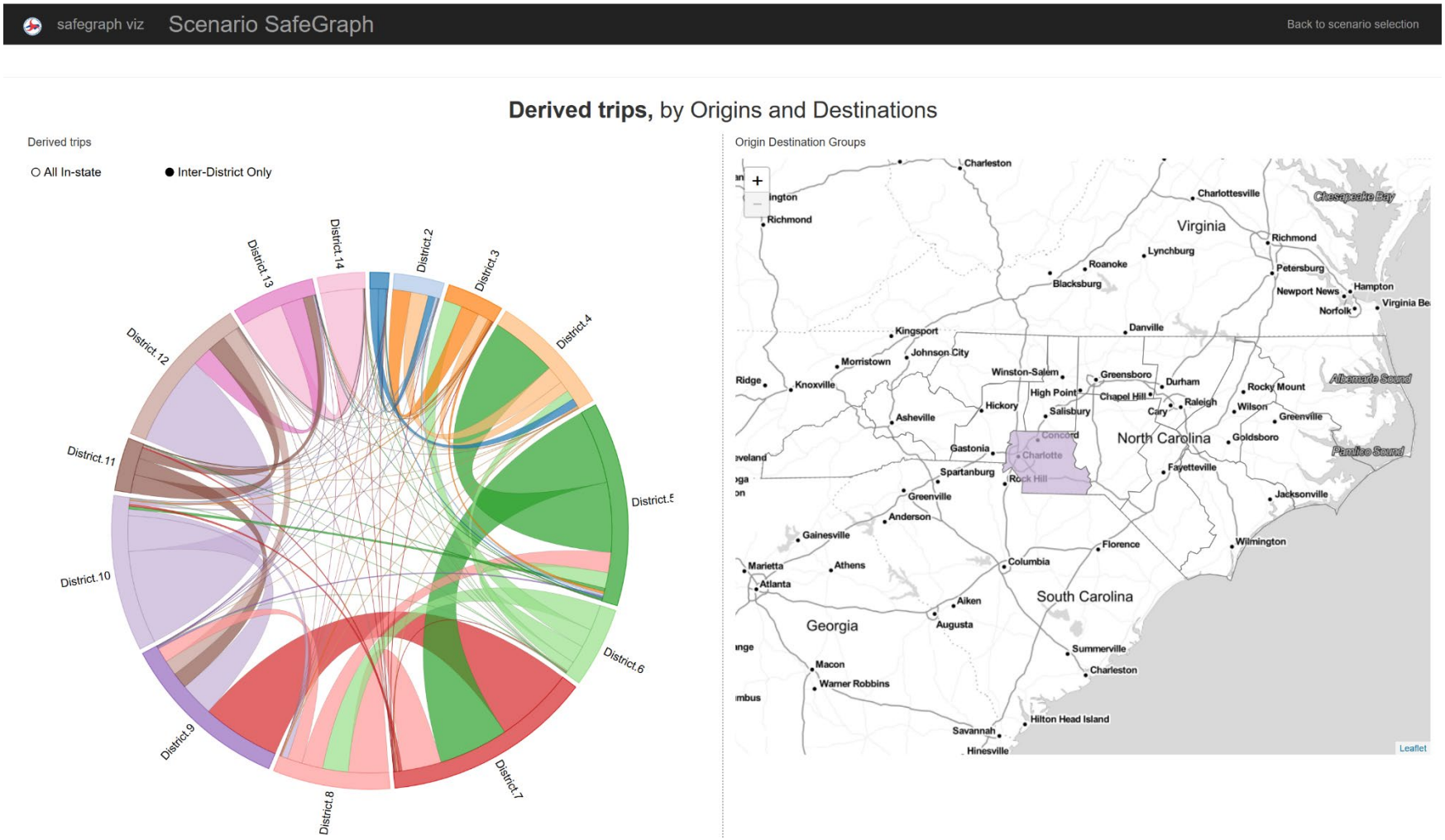
Expansion Validation

- Substantially better fit to counts than previous versions

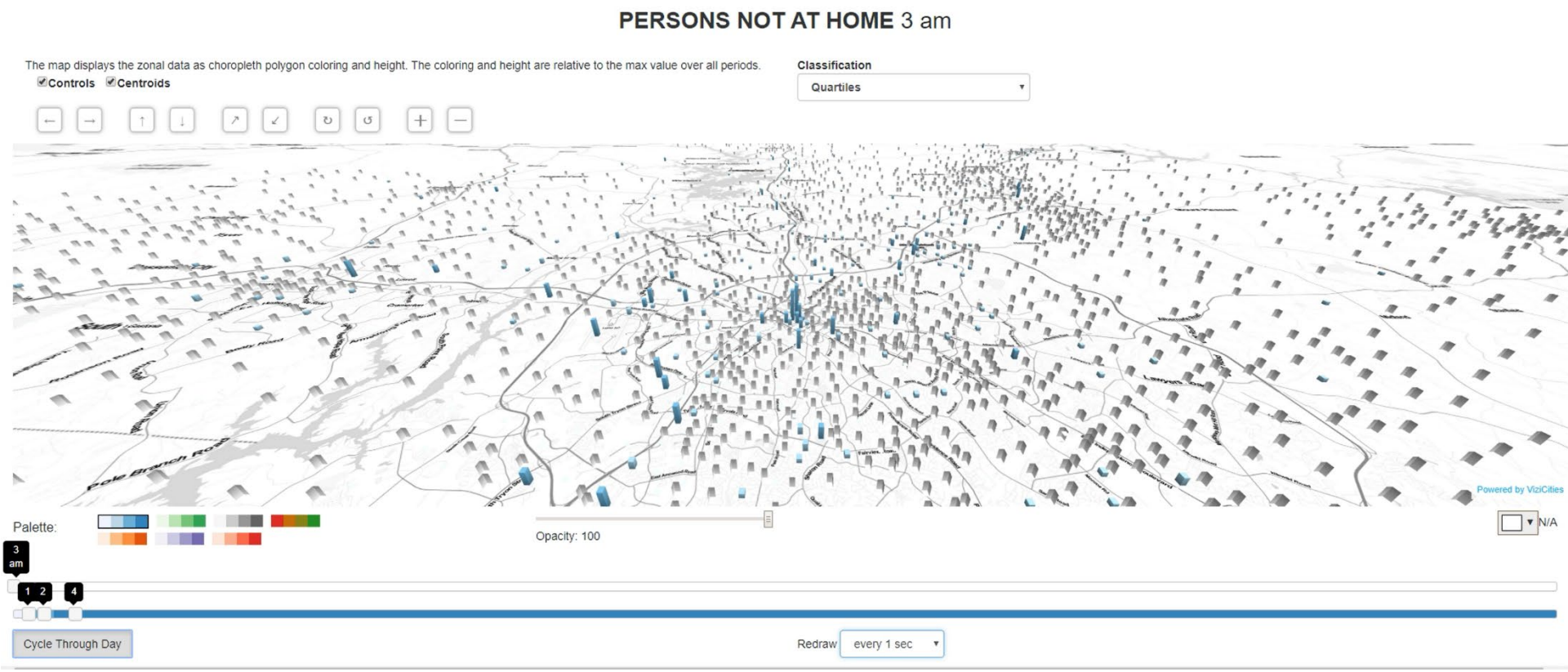
Volume Group	Number of Counts	Overall %RMSE	MU Truck %RMSE
<10K	5153	41.5%	99.6%
10K to 20K	2669	24.2%	62.6%
20K to 40K	1184	16.0%	37.8%
40K to 60K	259	10.4%	24.9%
>60K	175	7.2%	15.5%
Total	**9440**	**23.8%**	**56.4%**

Interstates & Freeways	Counts	Observed VMT	Model VMT	% Deviation
I-240	19	341,810	346,197	1.3%
I-26	27	1,694,770	1,671,445	-1.4%
I-277	19	302,789	282,958	-6.5%
I-40	346	15,617,968	15,821,143	1.3%
I-440	26	1,039,616	1,010,675	-2.8%
I-485	55	3,675,899	3,674,848	0.0%
I-540	26	1,497,812	1,554,591	3.8%
I-73	19	461,074	455,194	-1.3%
I-74	50	724,192	759,087	4.8%
I-77	71	2,955,802	2,998,491	1.4%
I-795	18	362,627	367,907	1.5%
I-85	211	8,277,974	8,314,057	0.4%
I-95	110	5,351,000	5,333,463	-0.3%
NC-147	32	442,181	474,416	7.3%
NC-295	7	285,268	285,358	0.0%
NC-54	7	59,746	50,736	-15.1%
NC-540	36	327,524	337,163	2.9%
NC-67	5	144,265	163,550	13.4%
SR-1728	8	125,152	118,016	-5.7%
SR-2085	5	109,624	87,190	-20.5%
SR-2254	10	149,049	154,311	3.5%
US-1	44	655,022	661,208	0.9%
US-17	21	279,752	295,607	5.7%
US-19	18	410,828	413,659	0.7%
US-29	23	425,601	409,414	-3.8%
US-311	33	523,278	565,107	8.0%
US-321	25	503,847	516,793	2.6%
US-421	26	299,205	293,225	-2.0%
US-52	53	886,225	904,412	2.1%
US-64	46	991,176	958,956	-3.3%
US-70	15	198,917	216,689	8.9%
US-74	30	320,525	318,832	-0.5%
Total	**1474**	**49,908,476**	**50,263,374**	**0.7%**

Inter-District OD Flows



Charlotte Out-of-Home Activity



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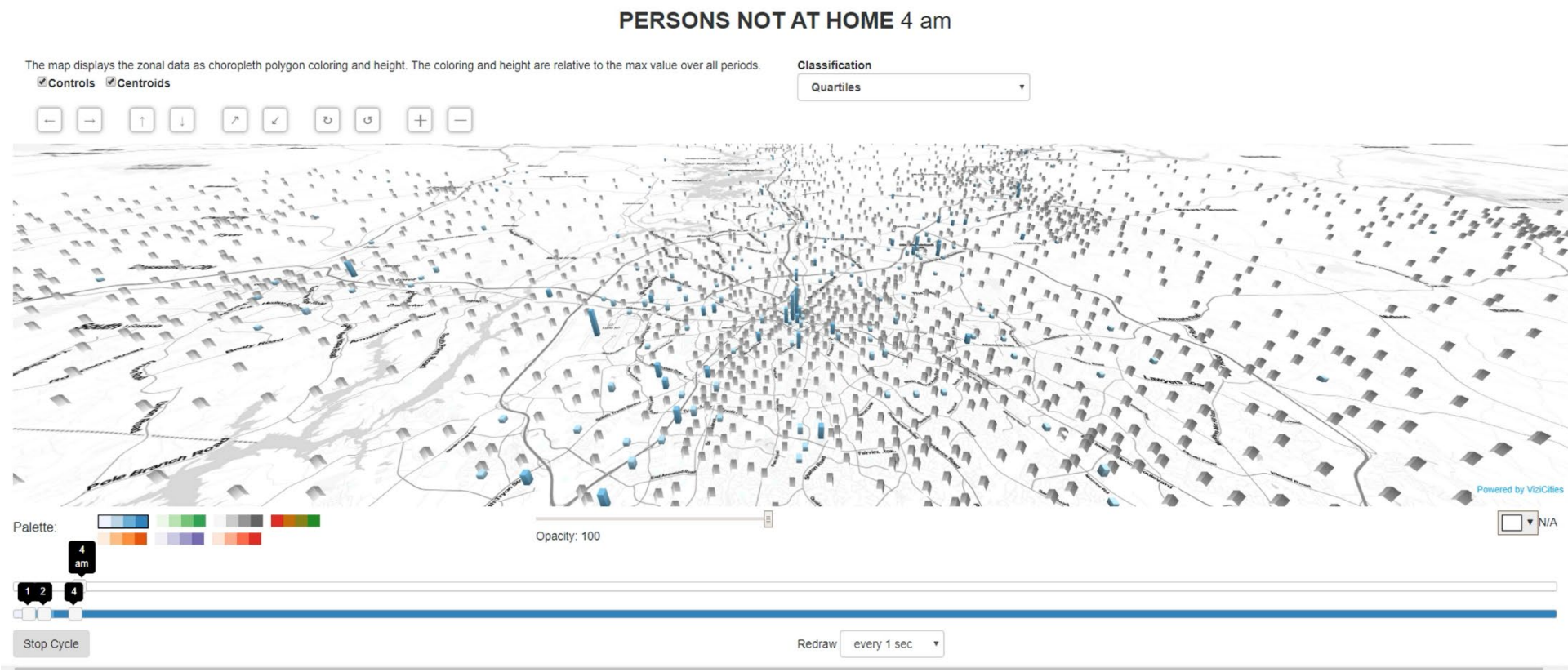

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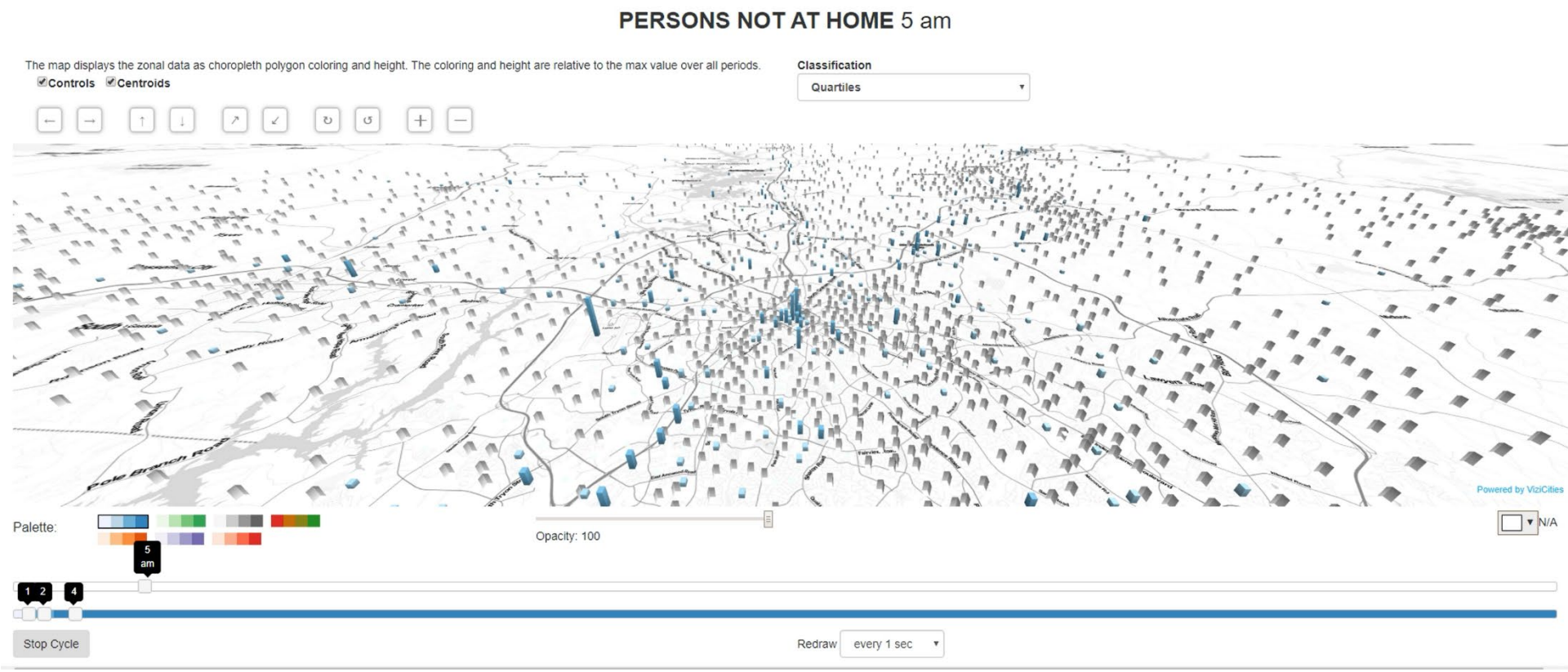

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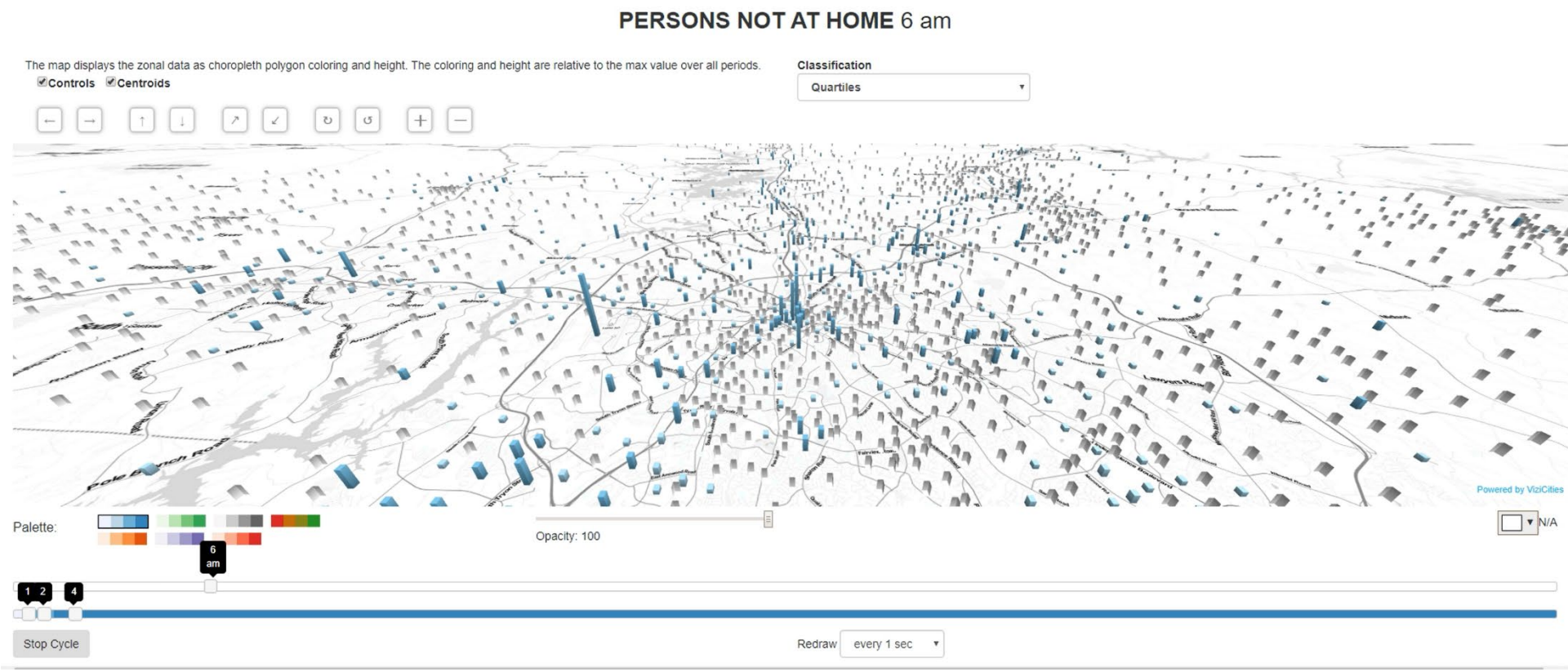

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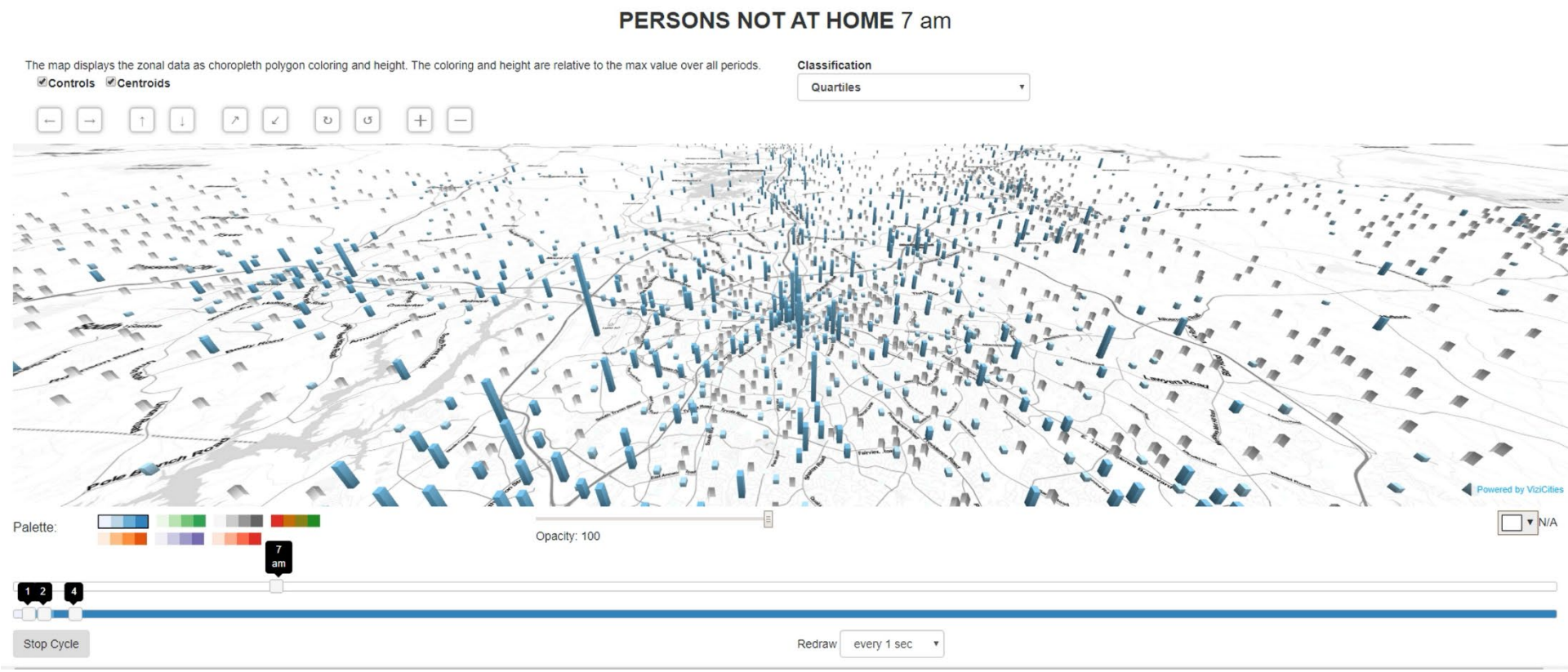

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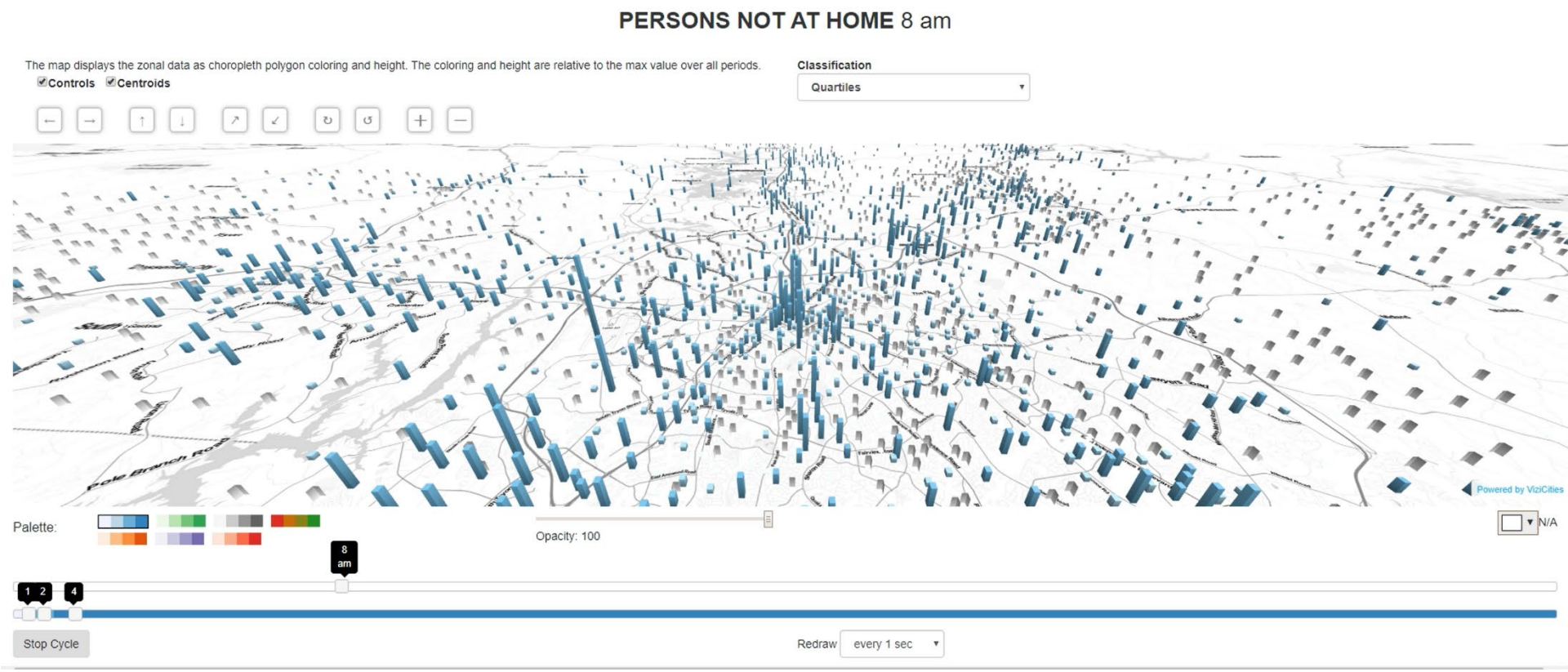

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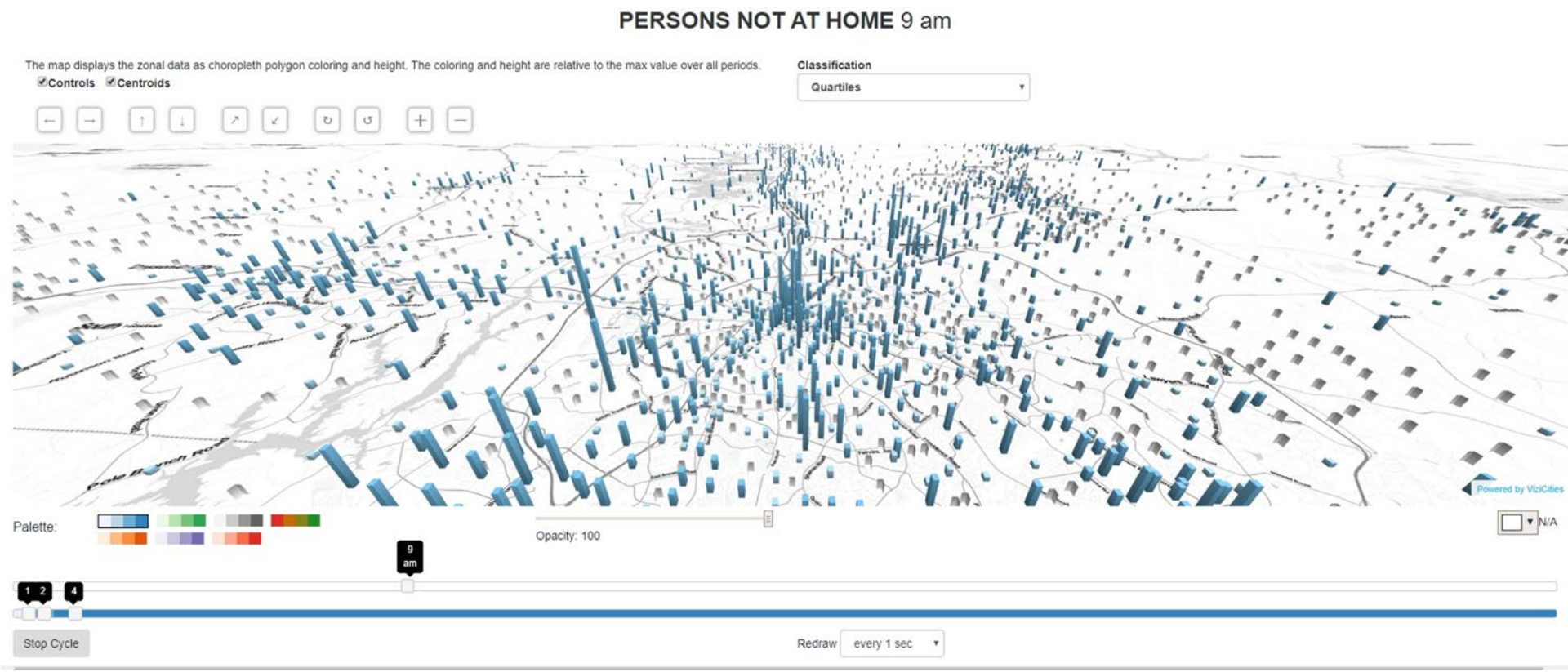

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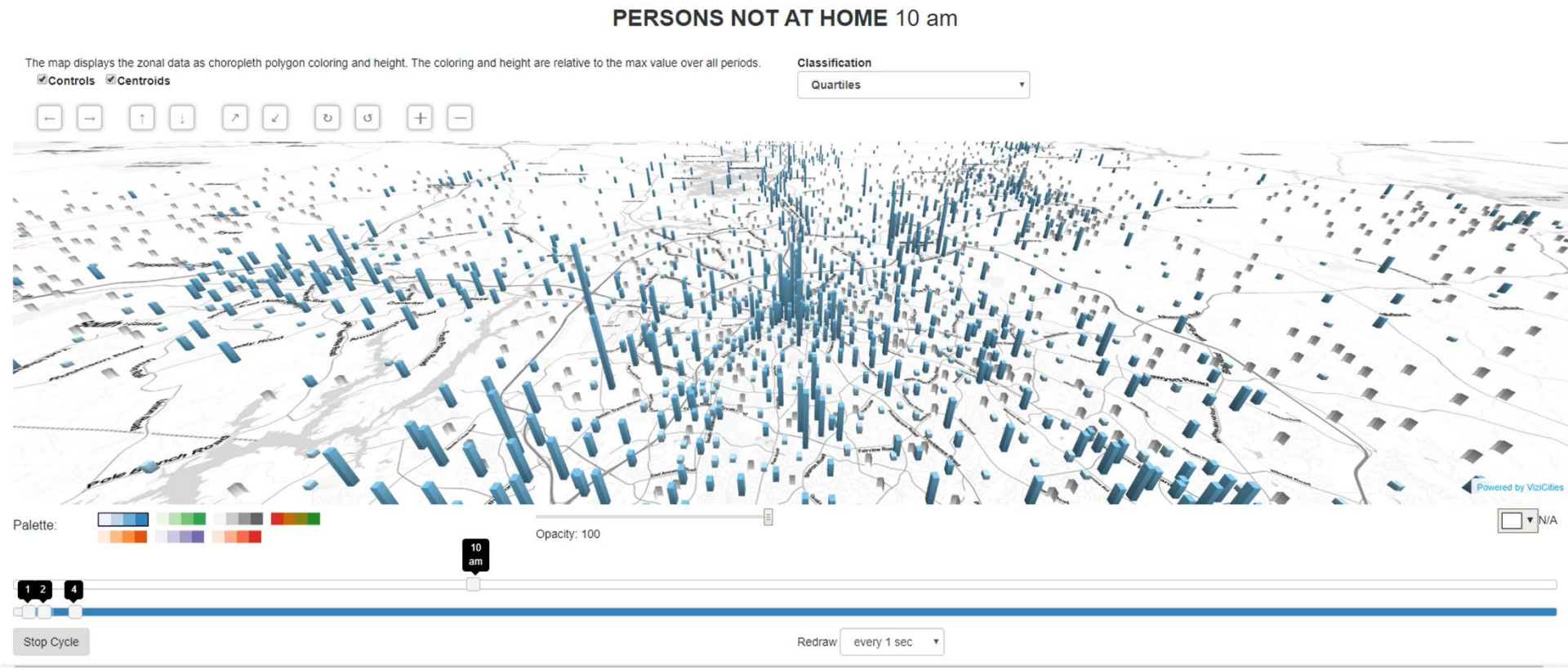

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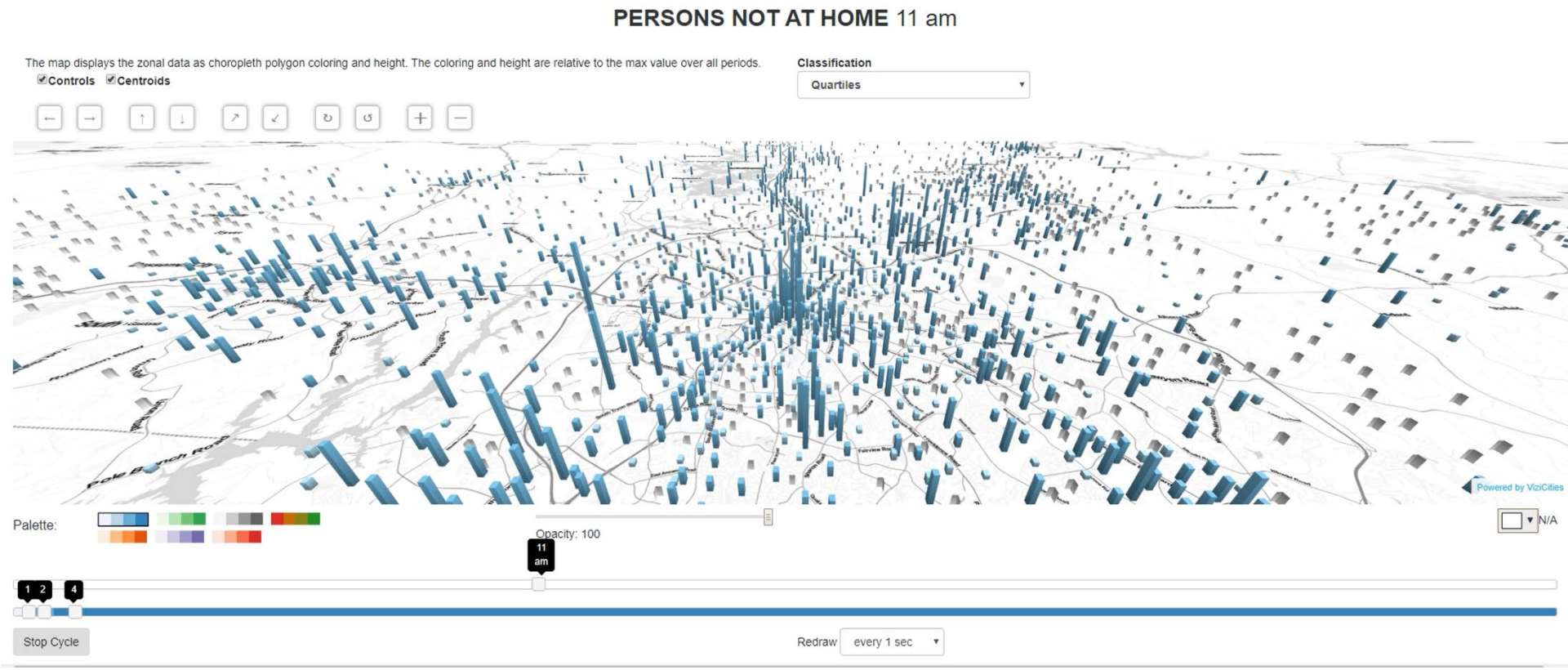

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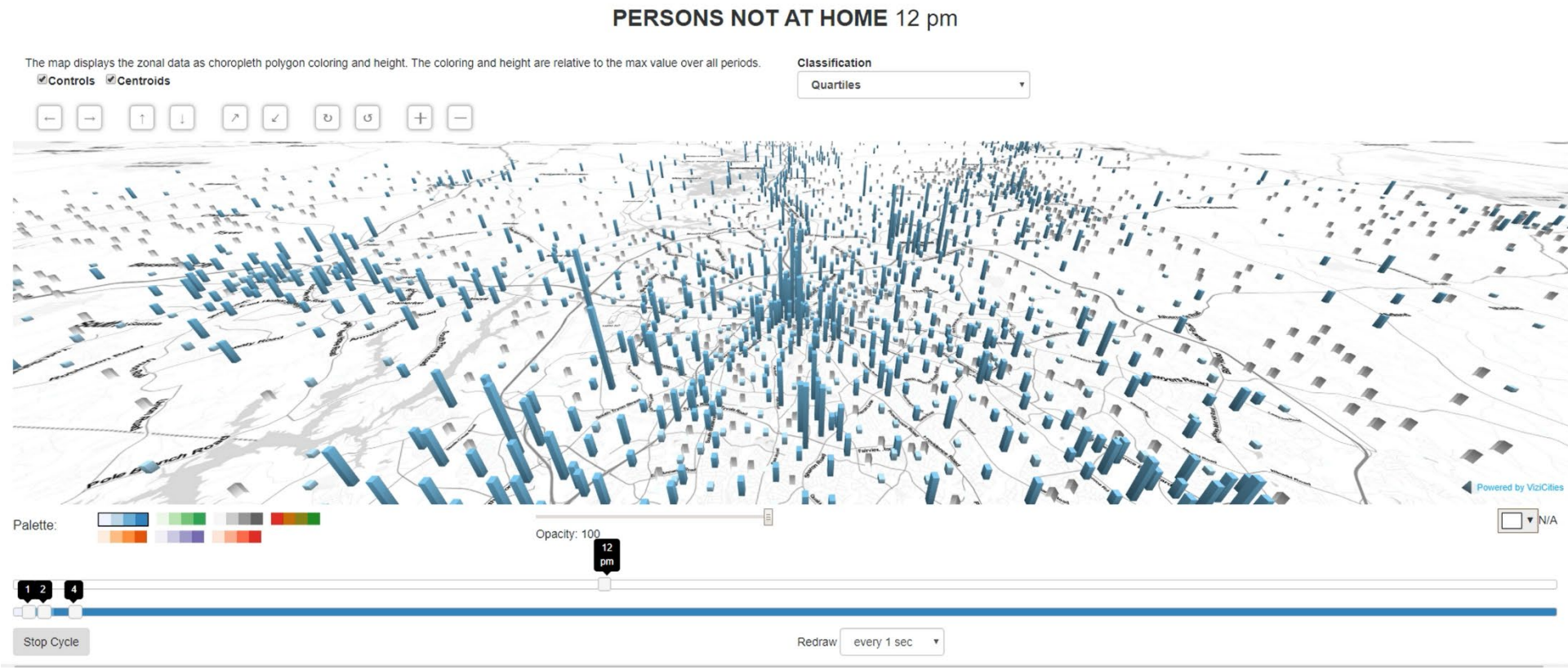

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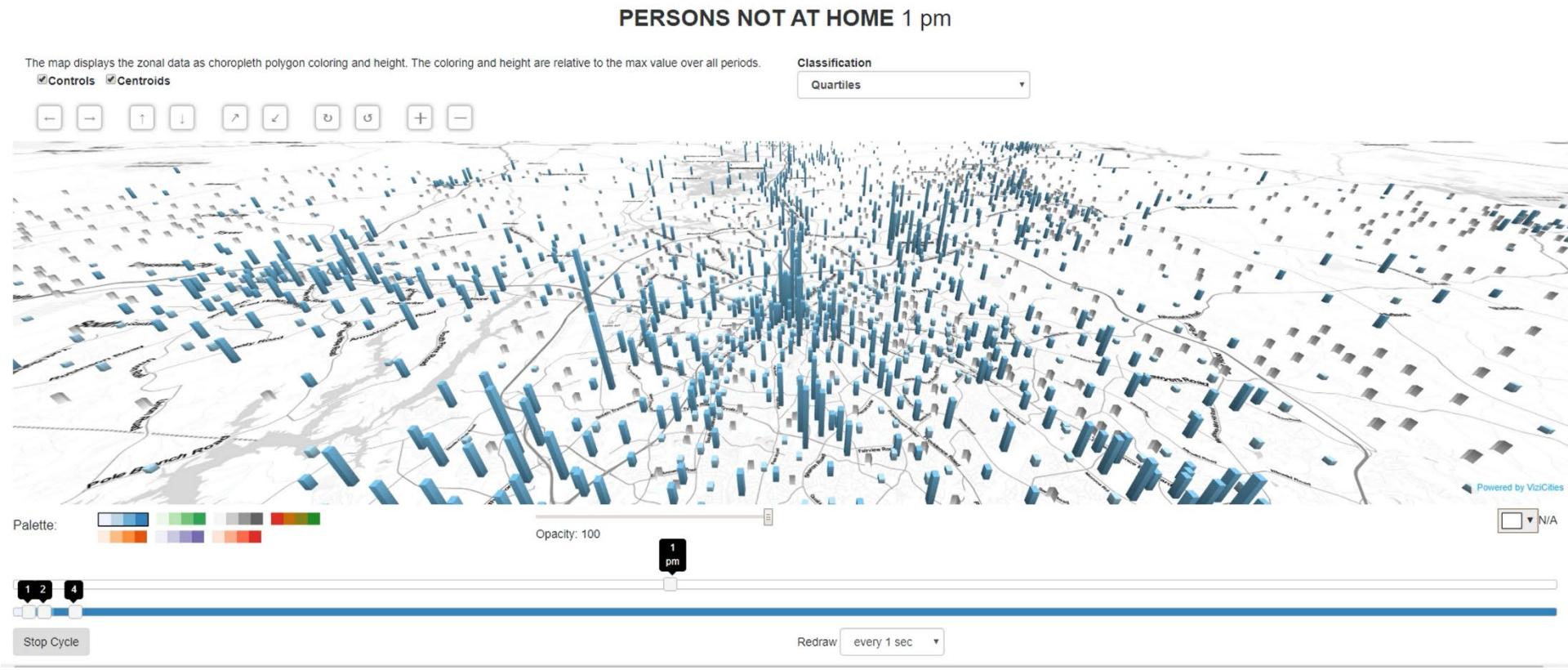

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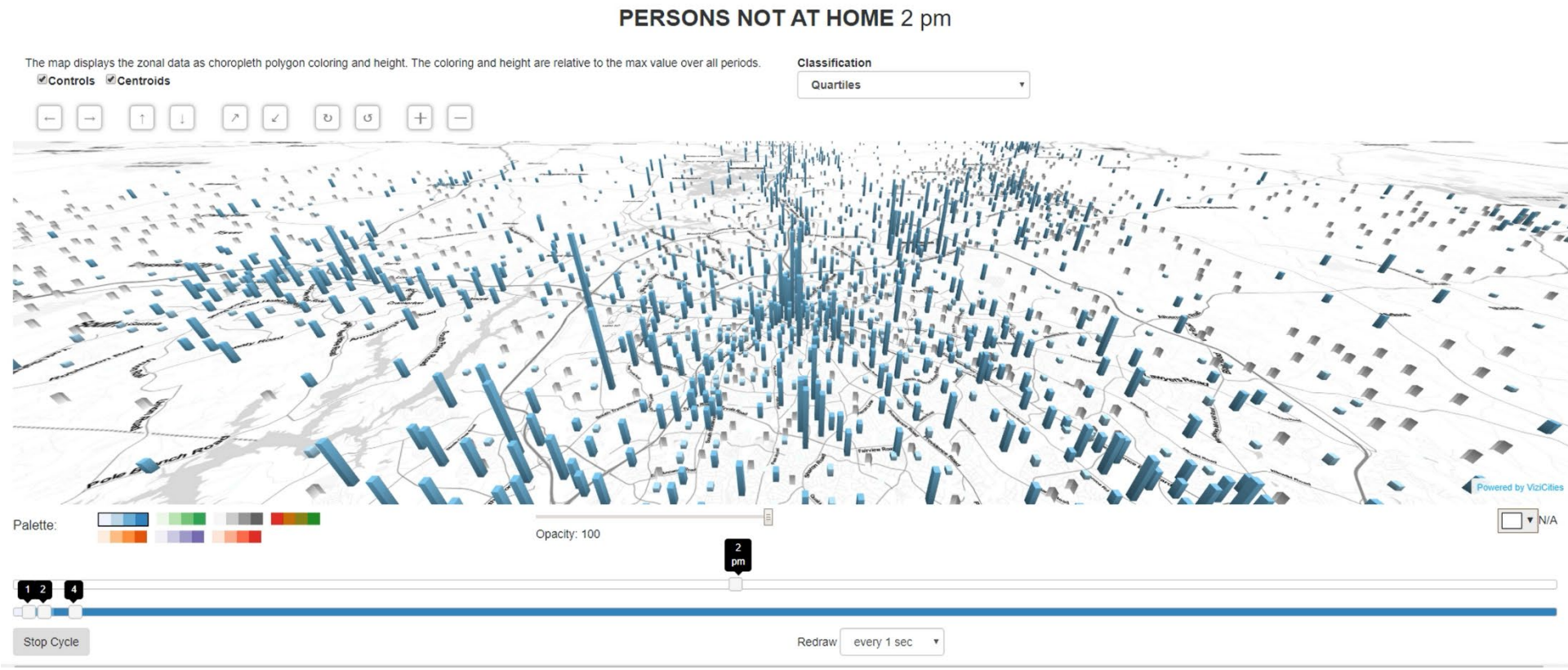

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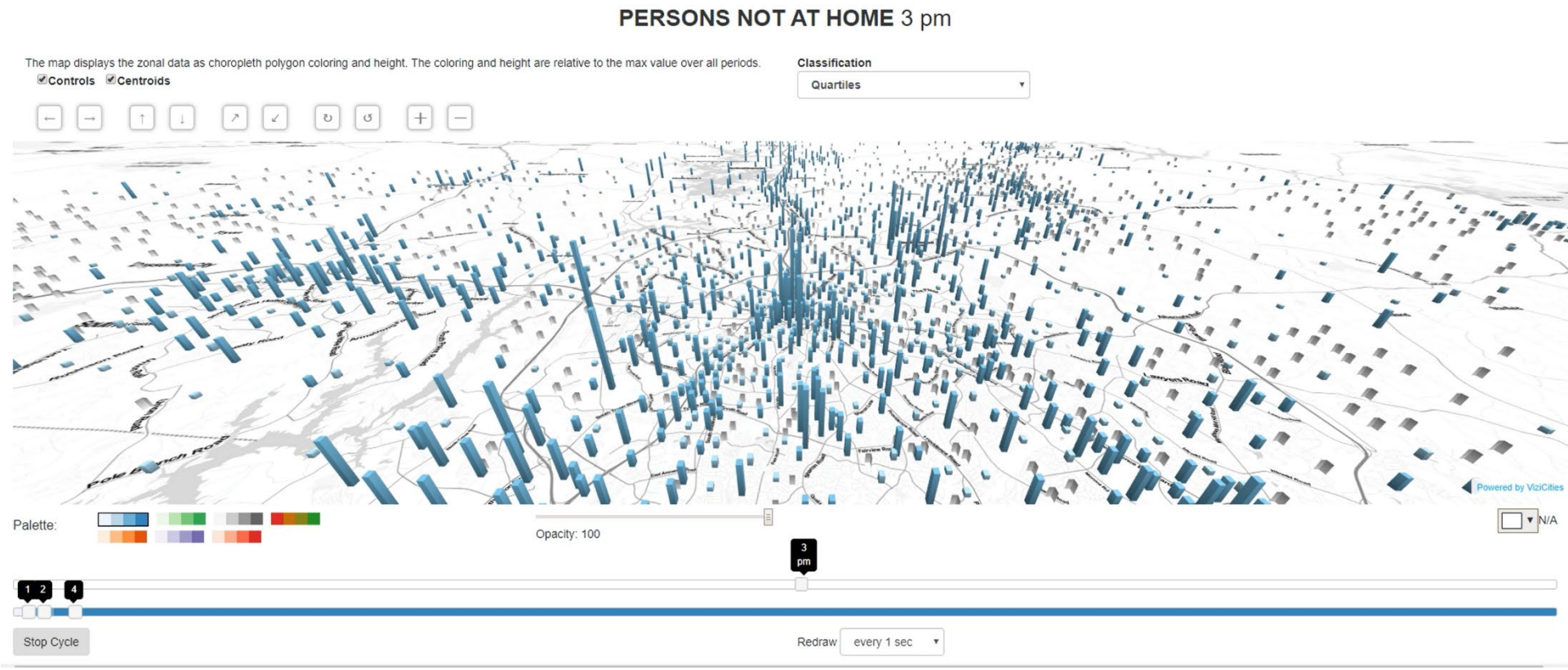

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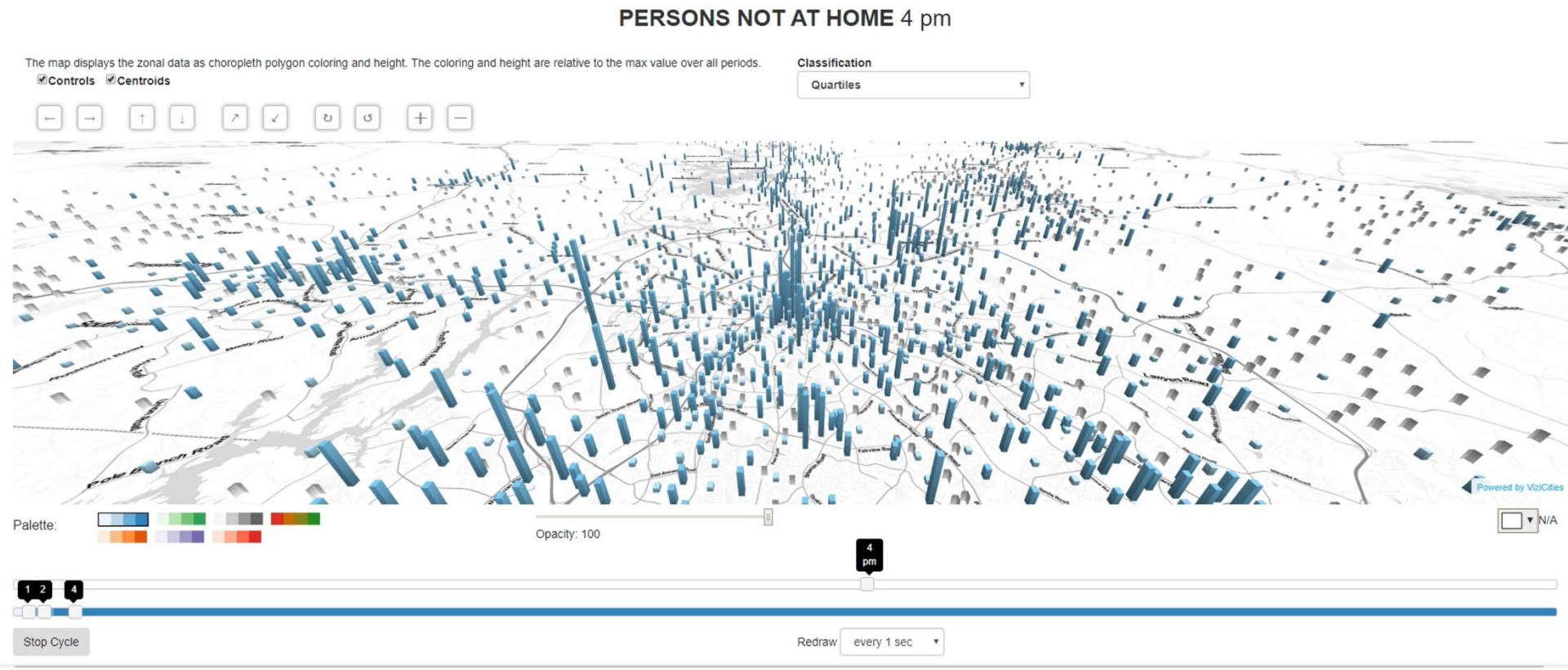

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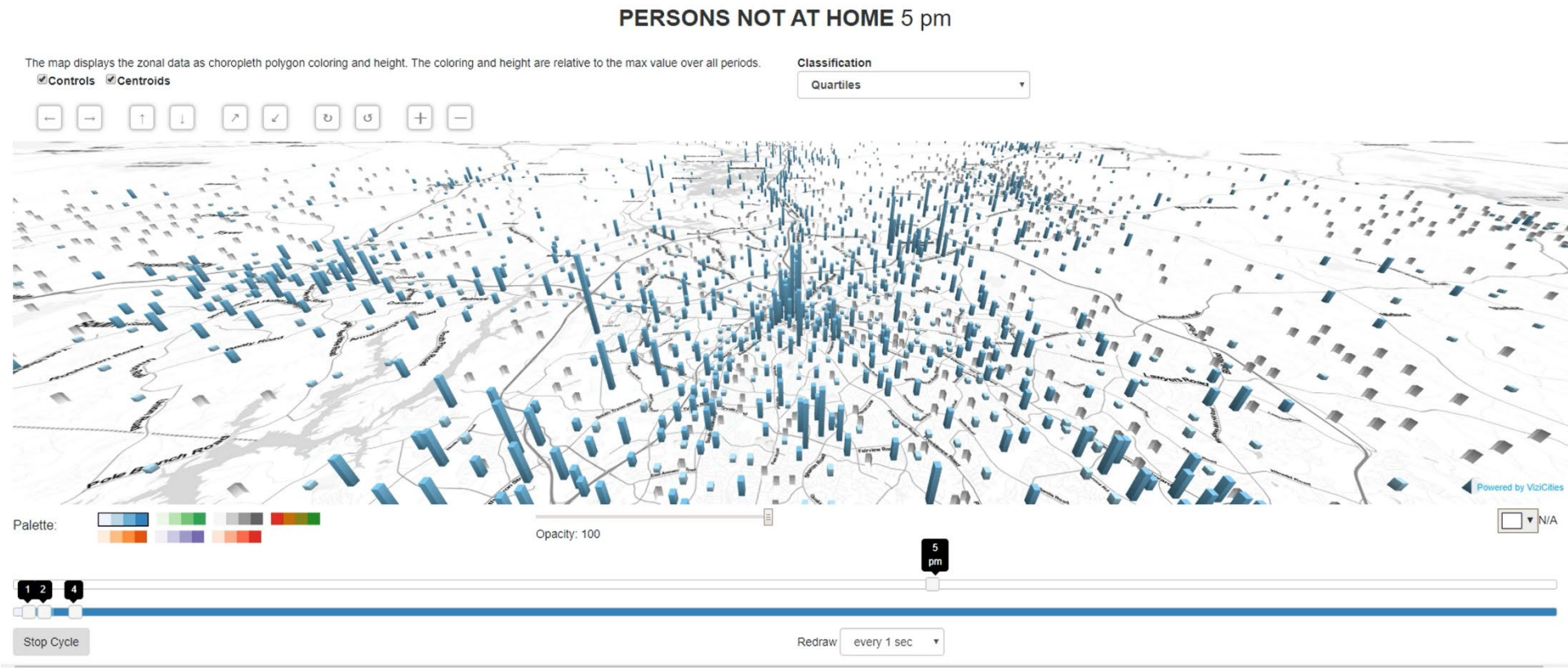

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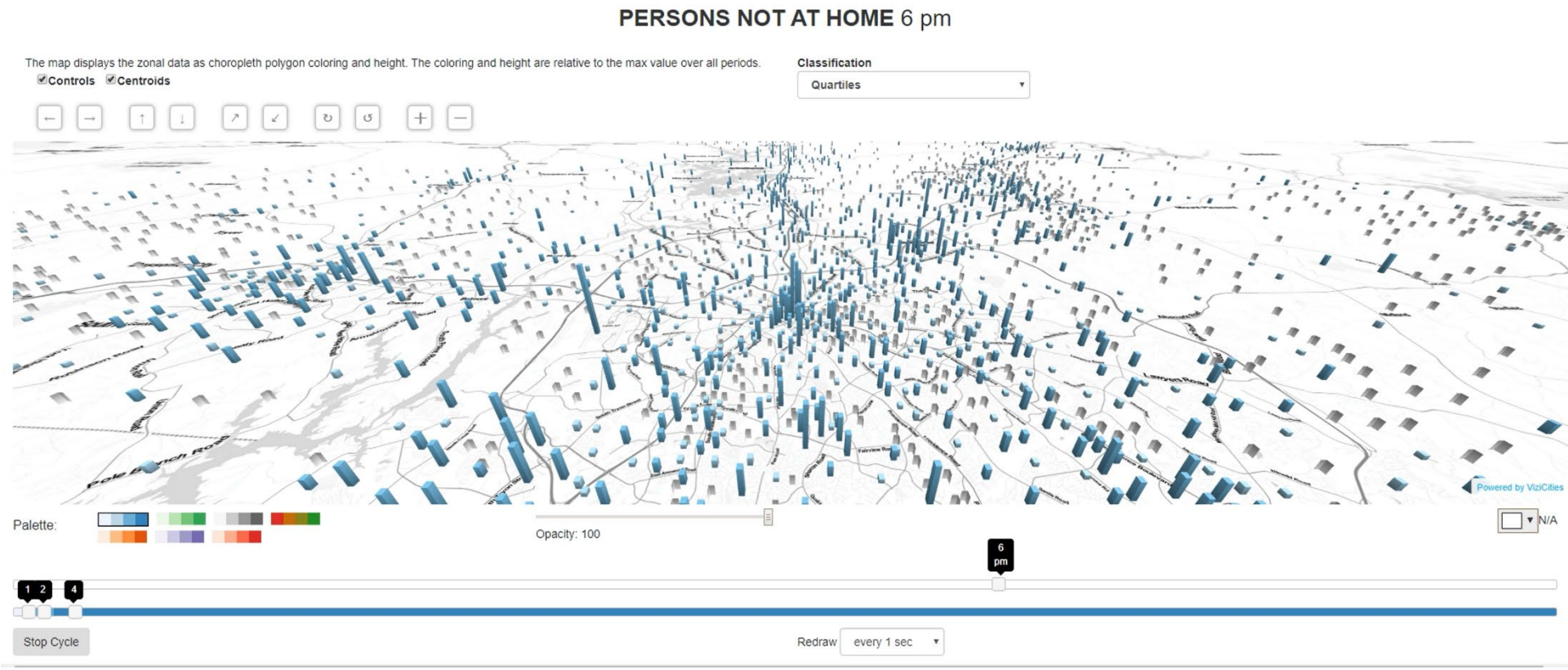

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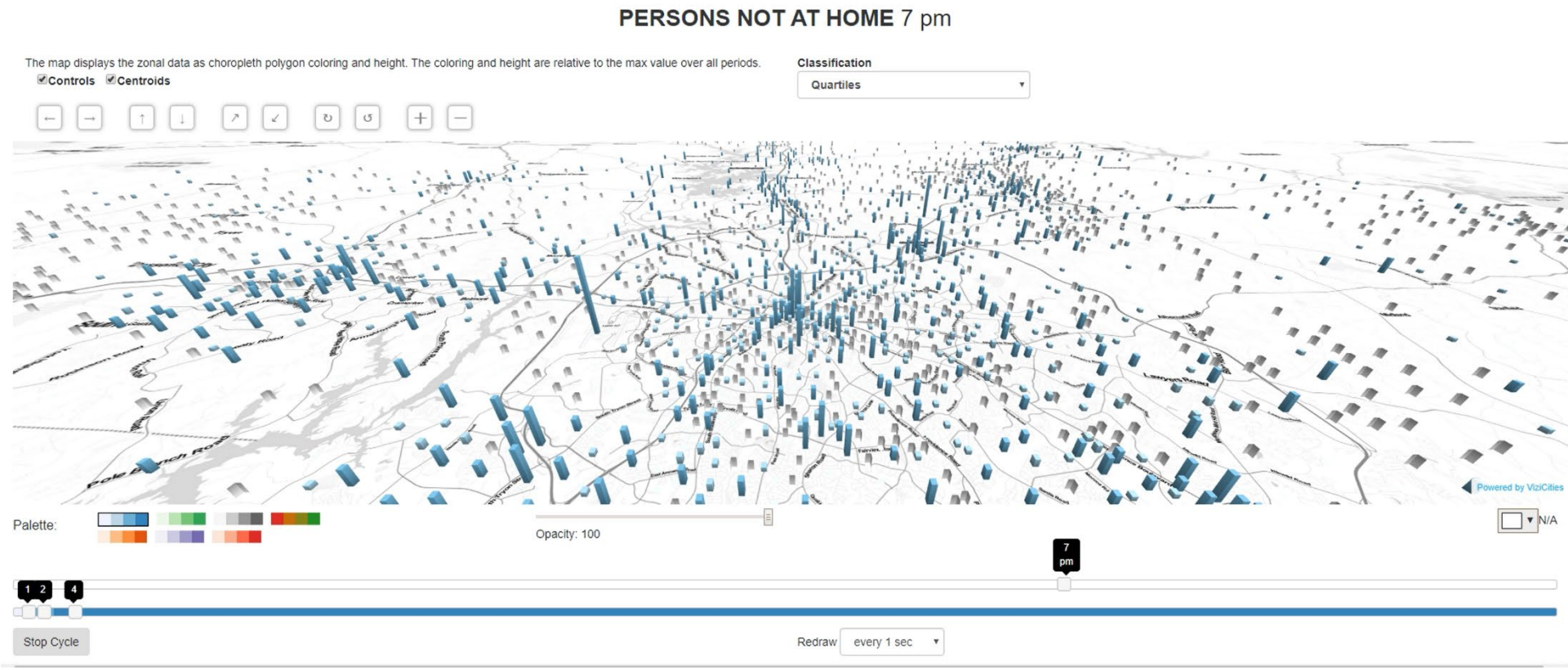

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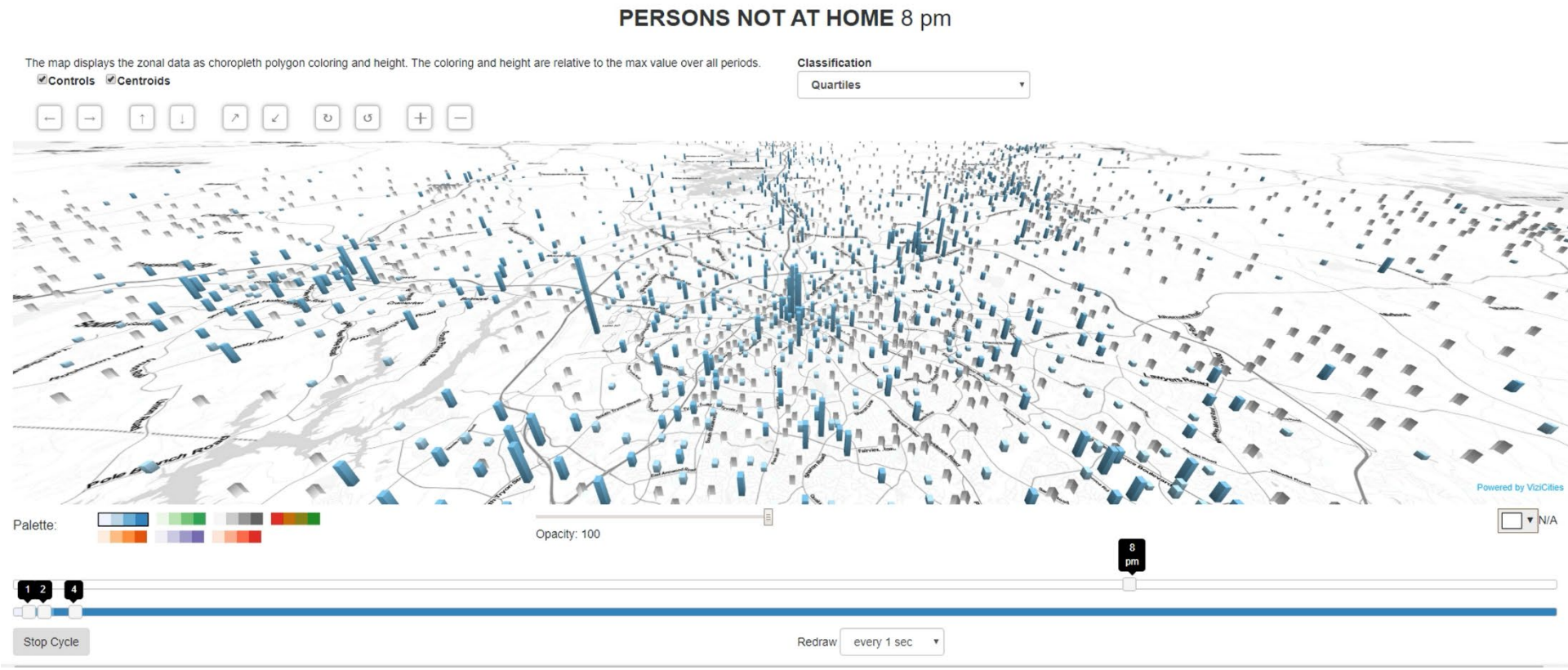

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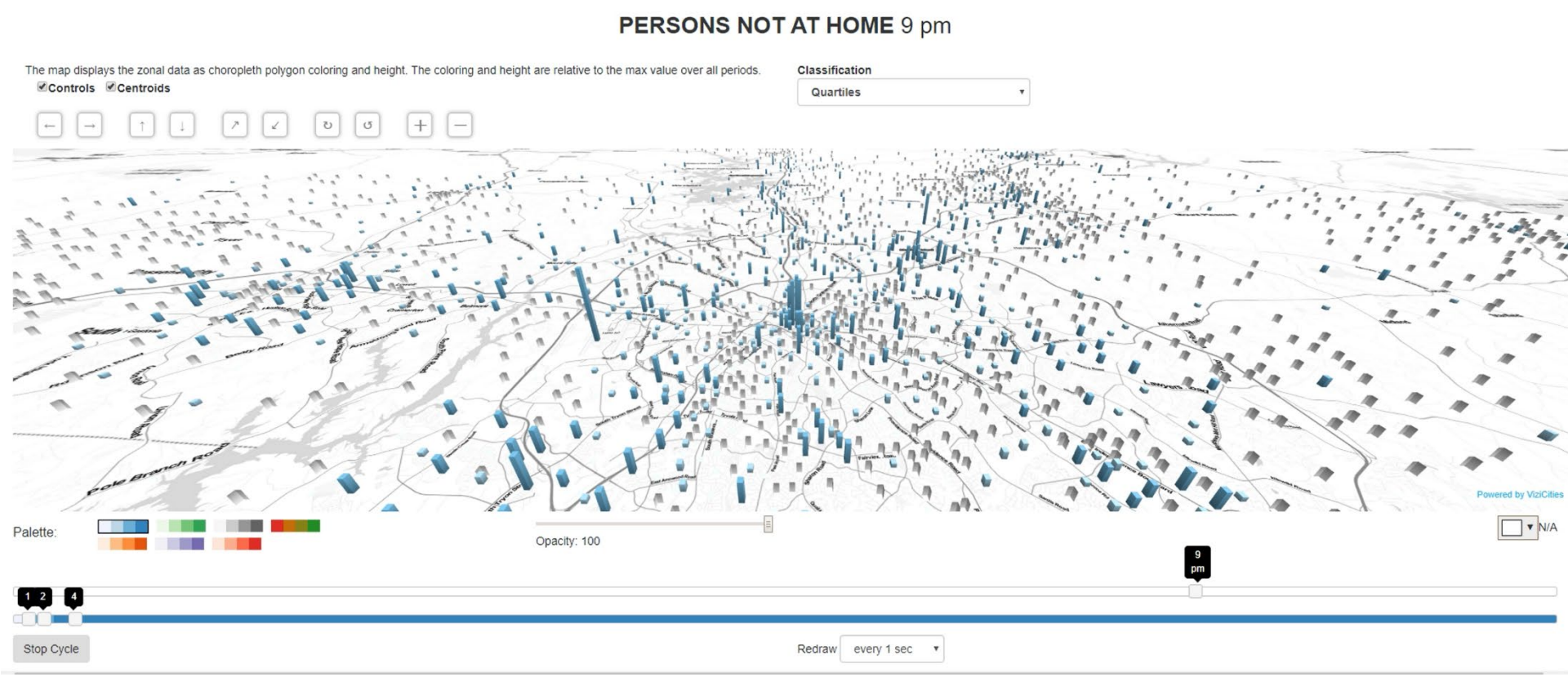

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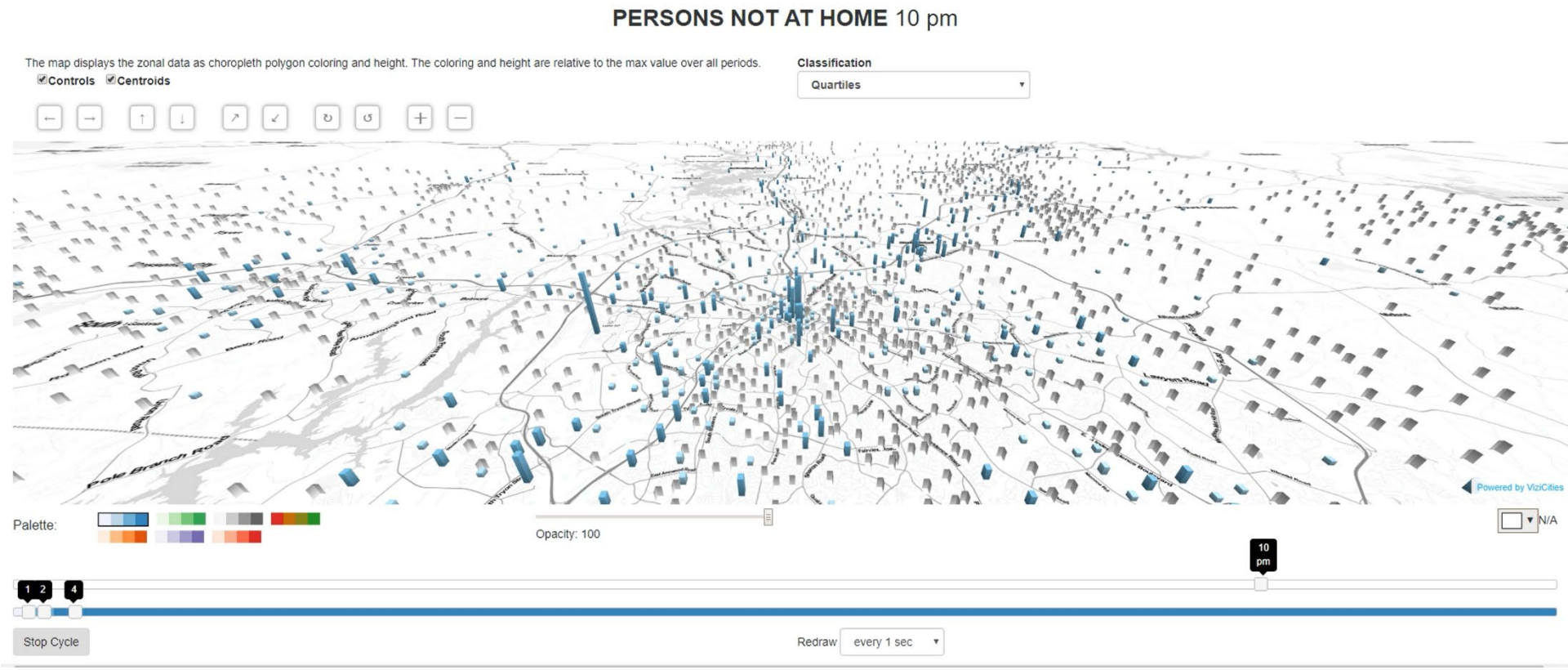

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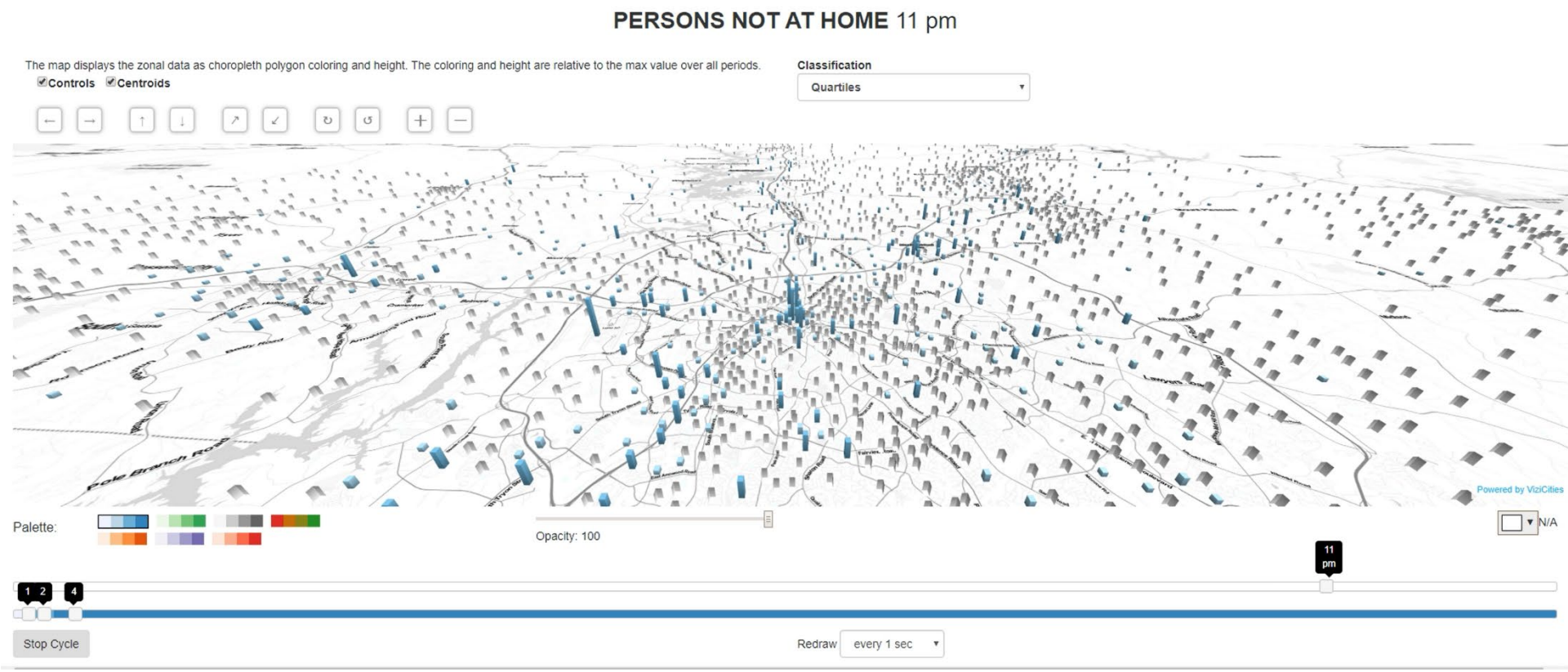

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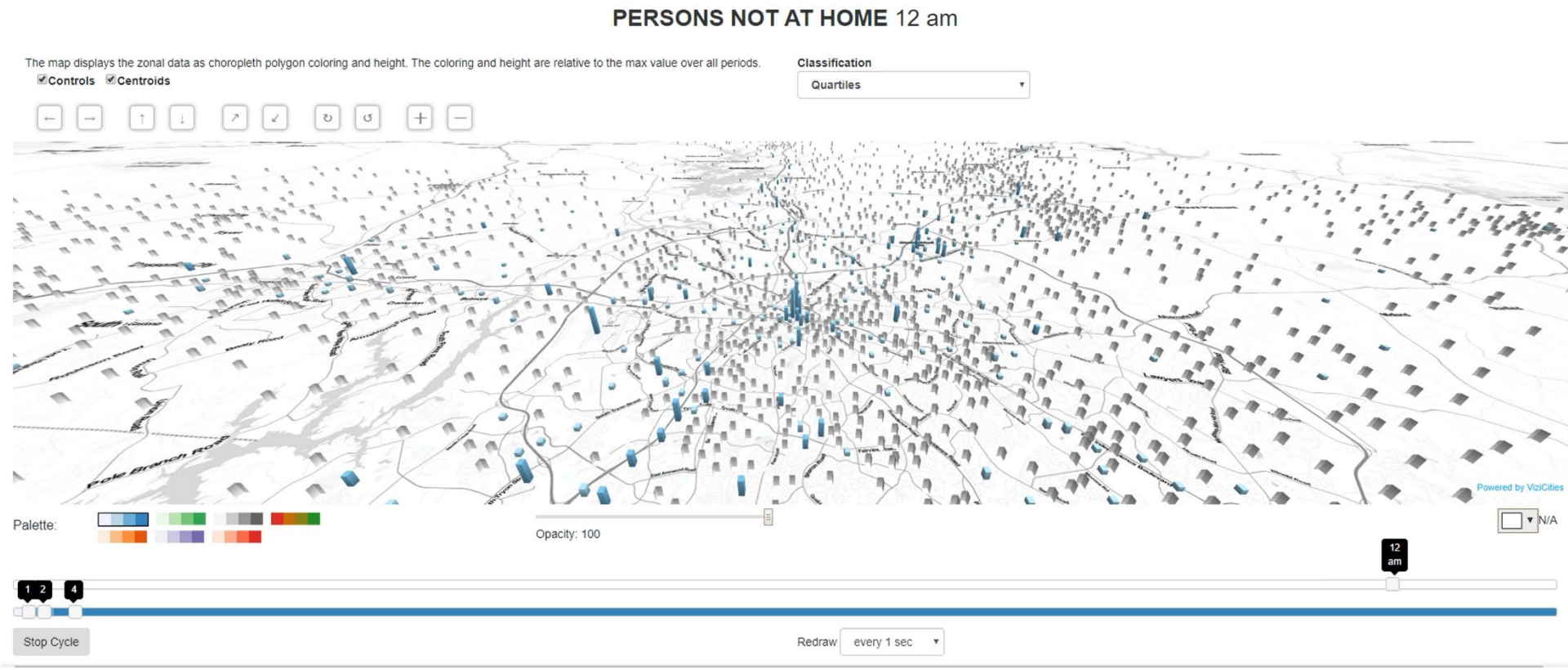

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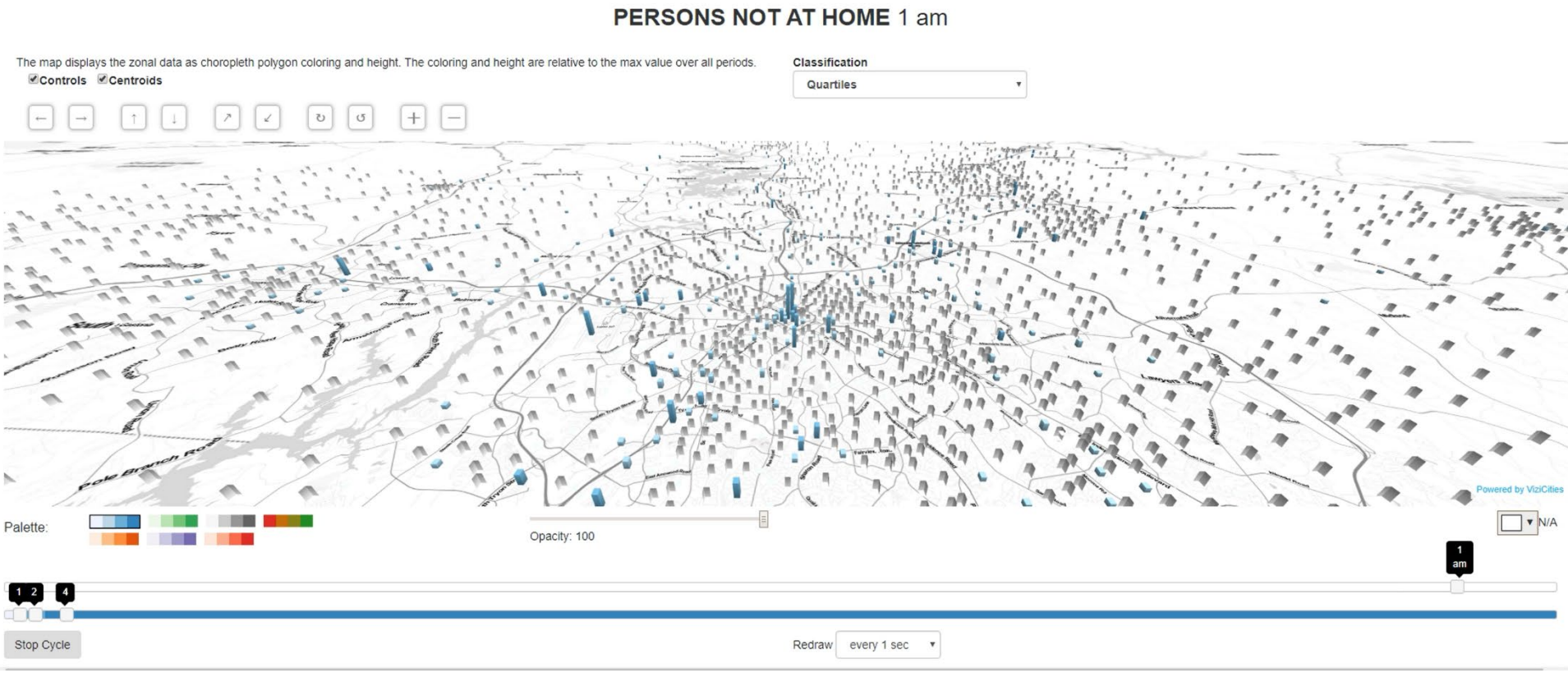

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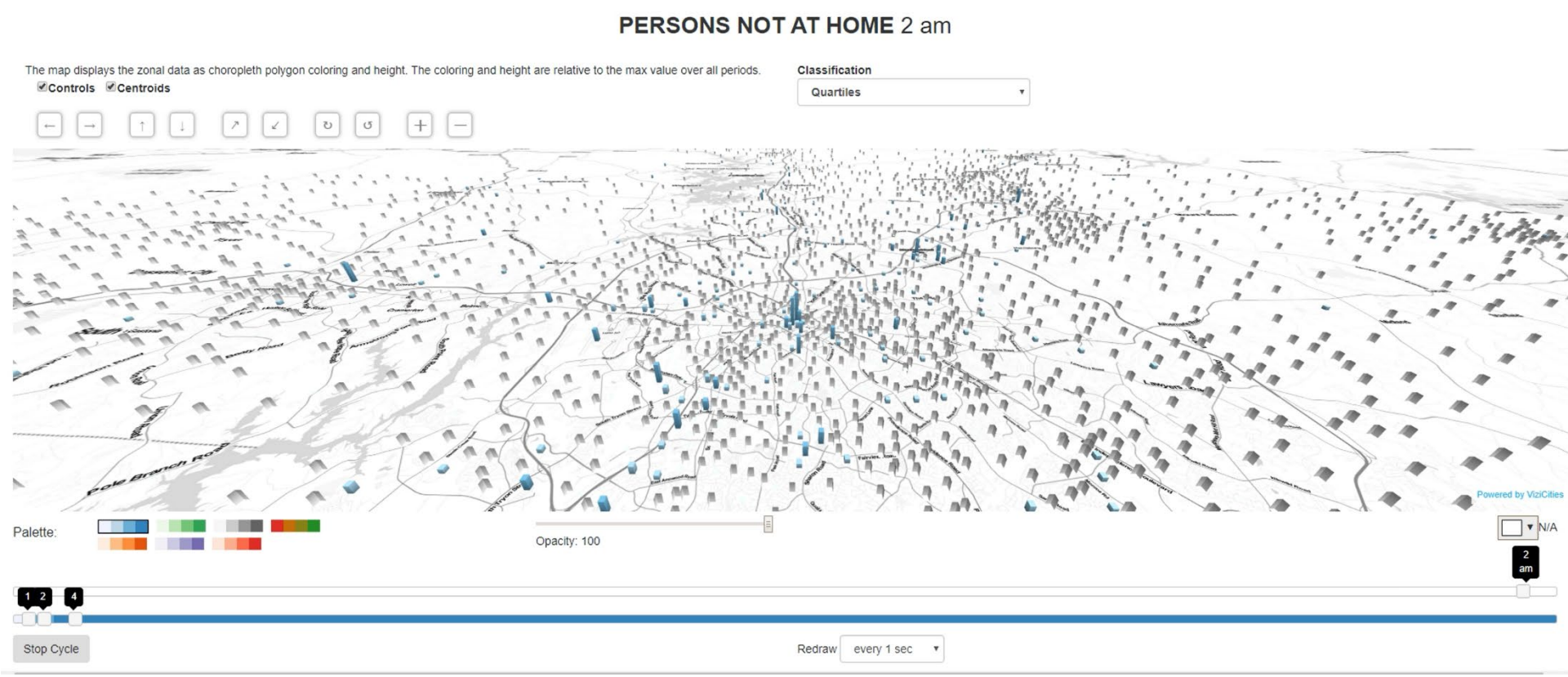


I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting between 7-8am, weekday

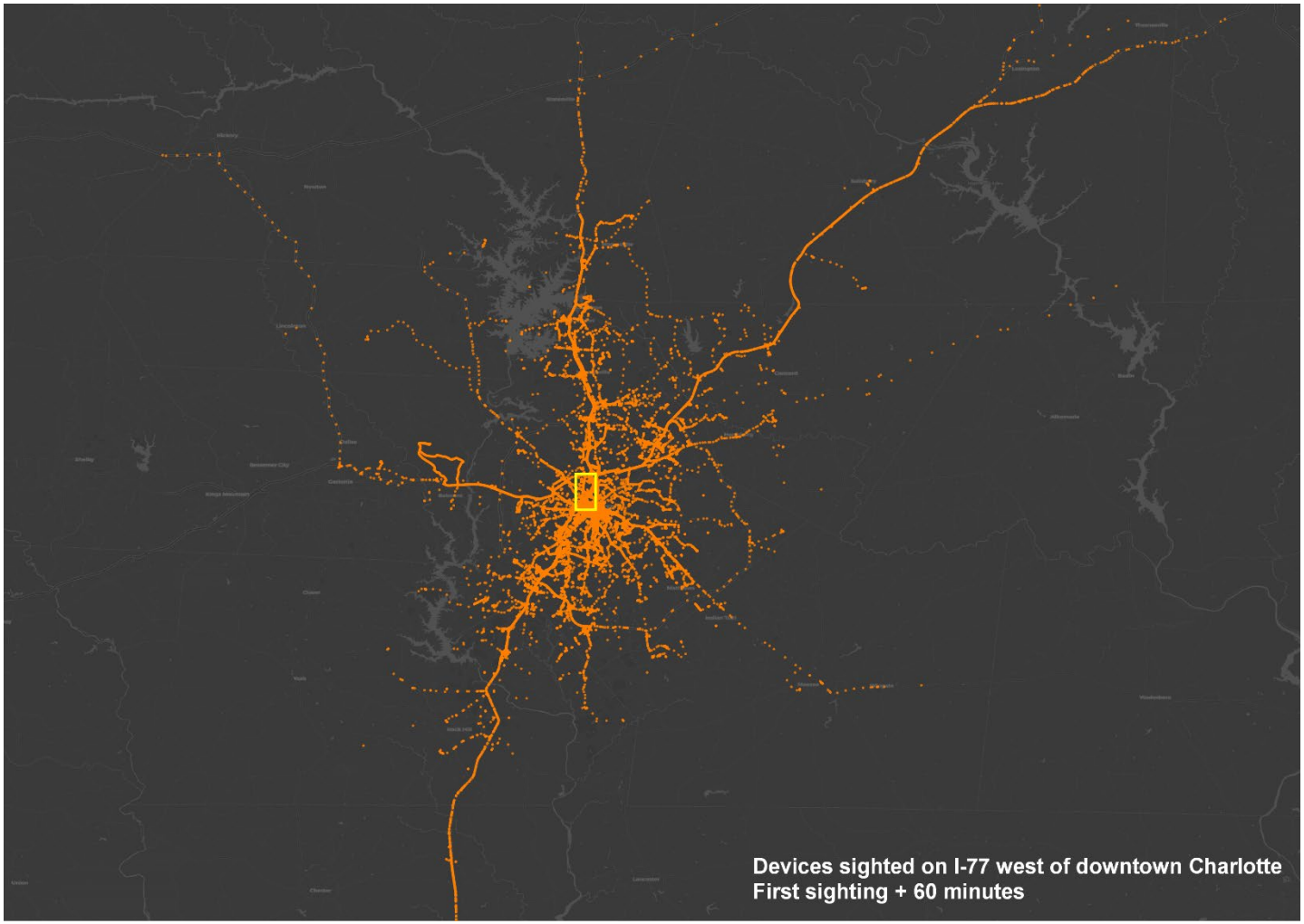
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 15 minutes

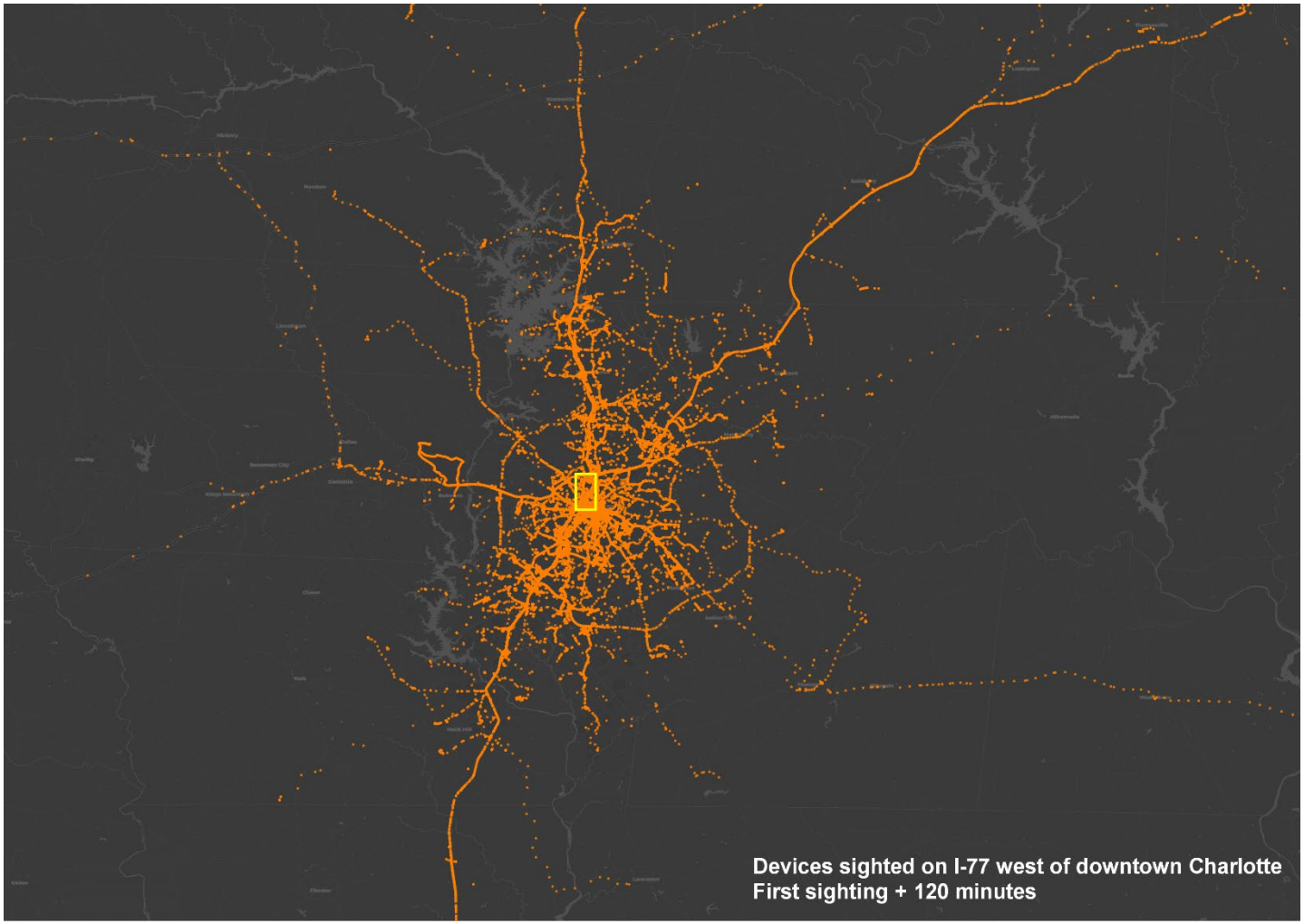
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 30 minutes

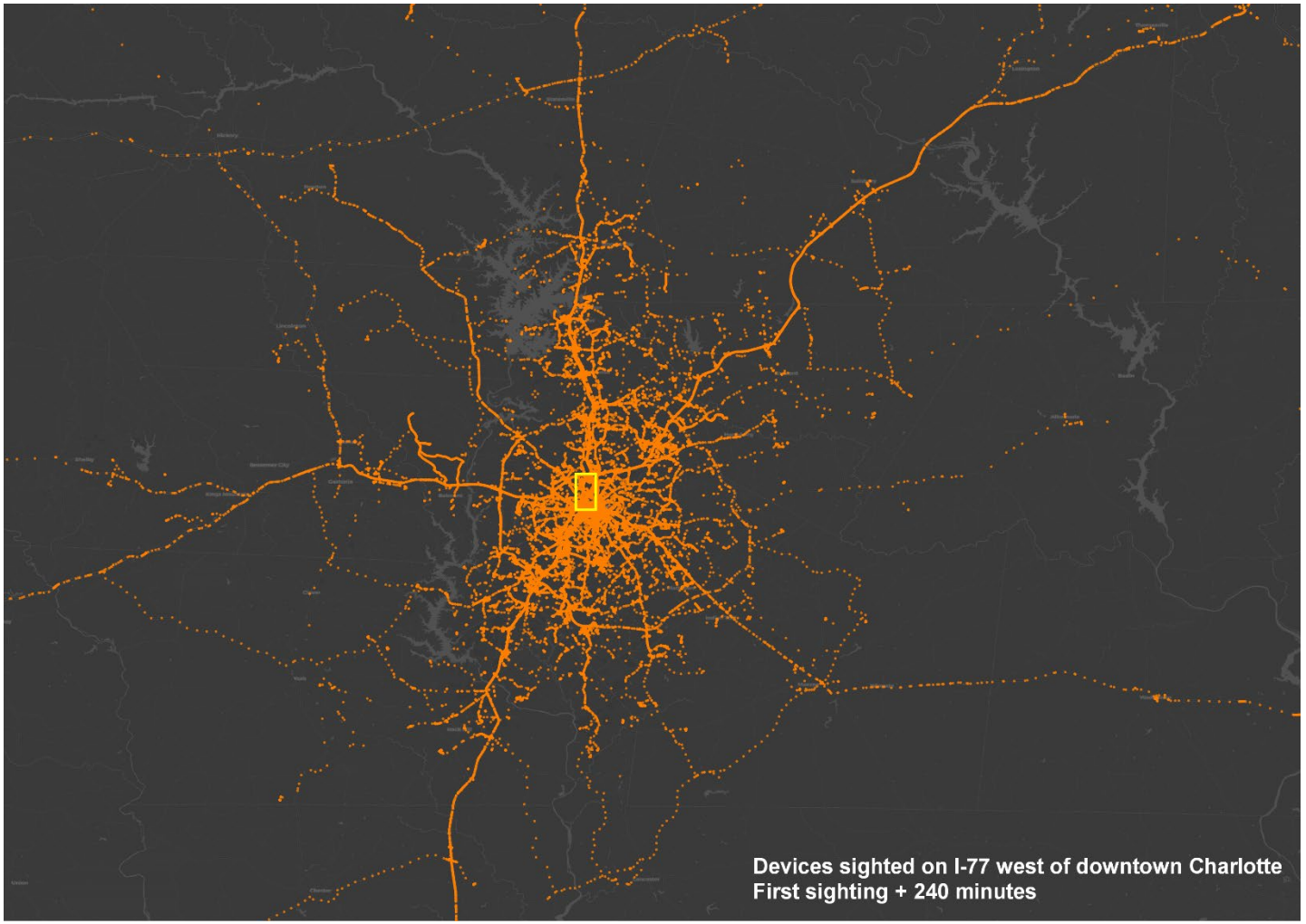
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 60 minutes

I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 120 minutes

I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 240 minutes

I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 360 minutes

I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 480 minutes

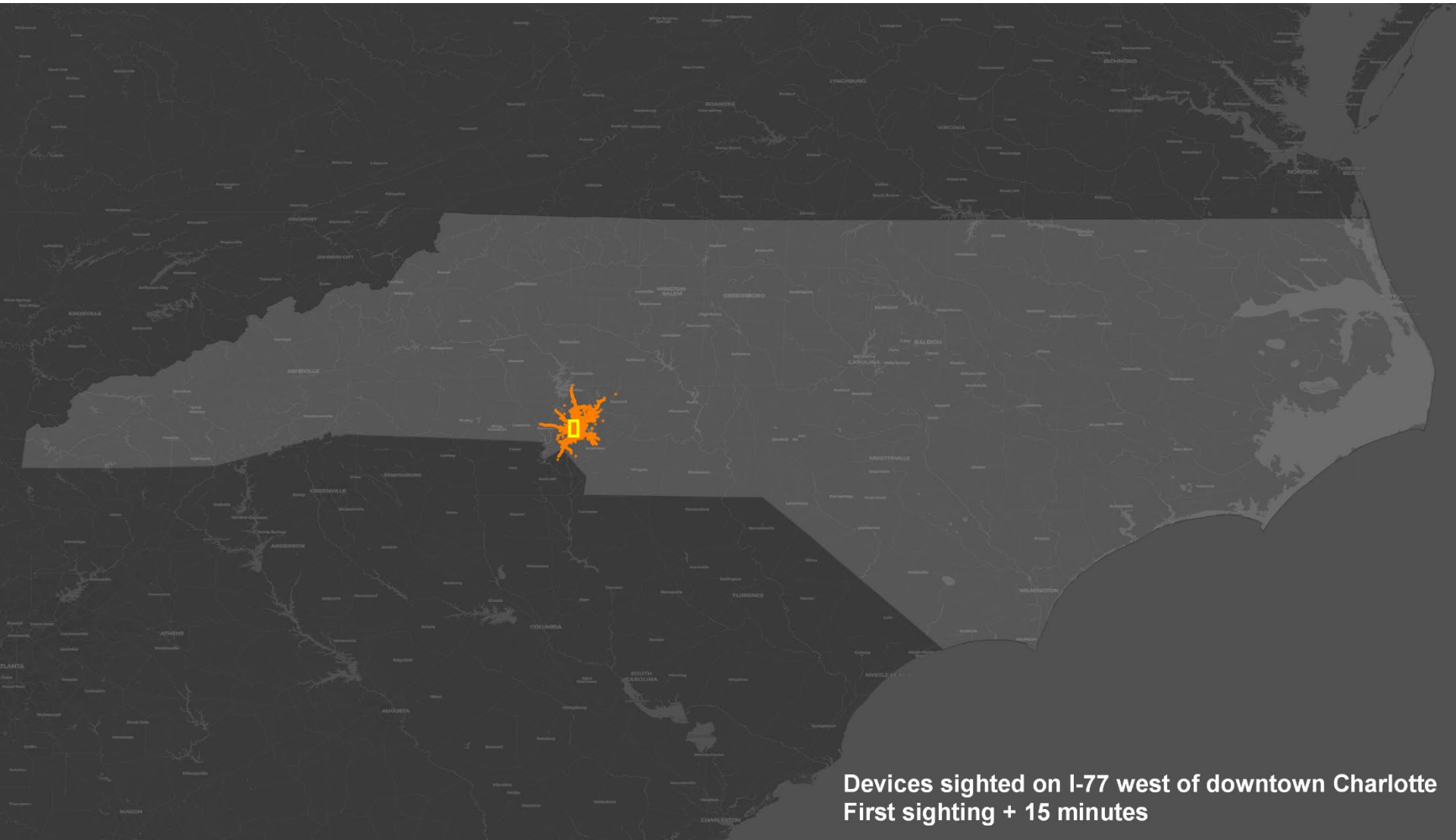
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 600 minutes

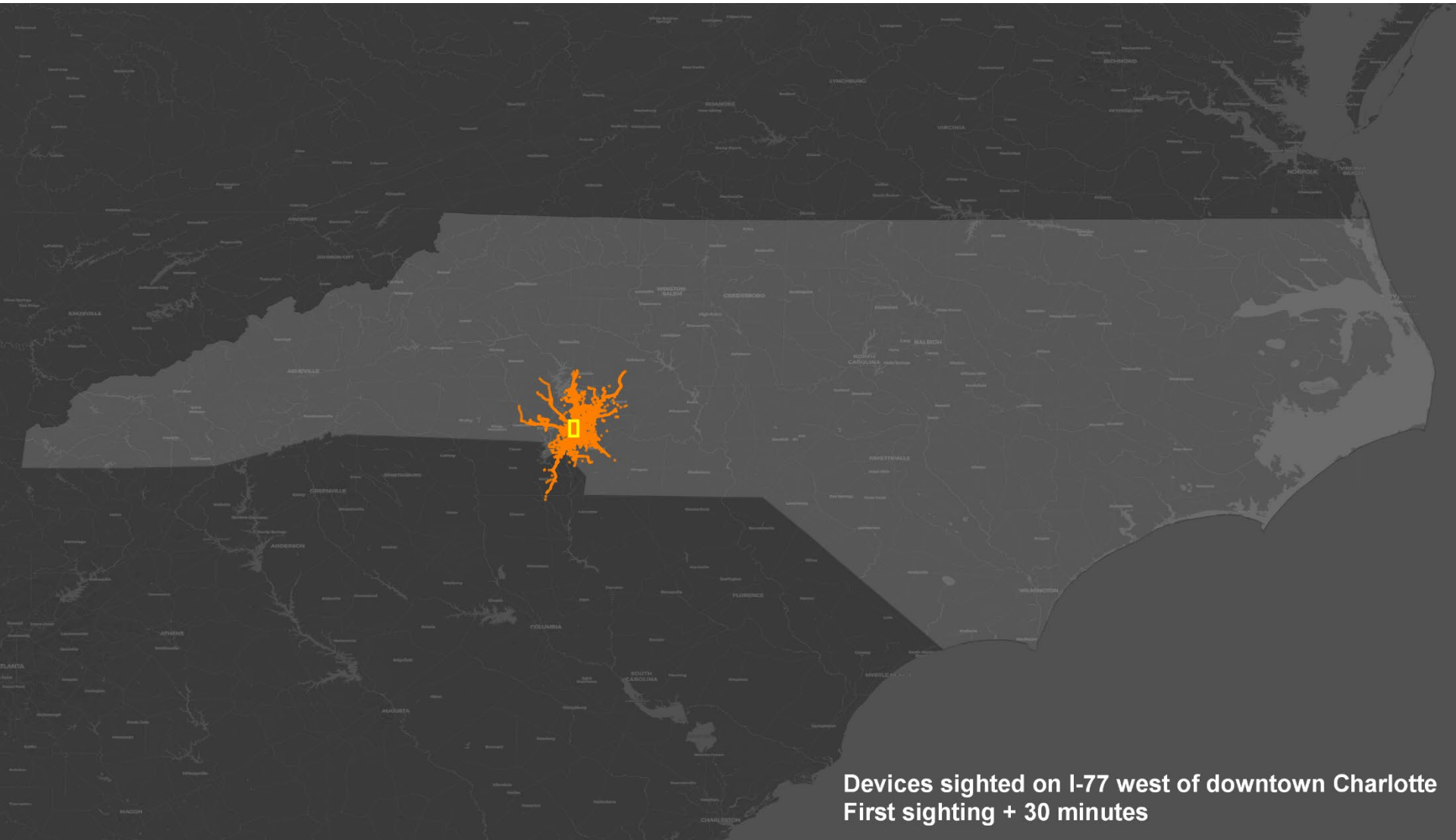
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting between 7-8am, weekday

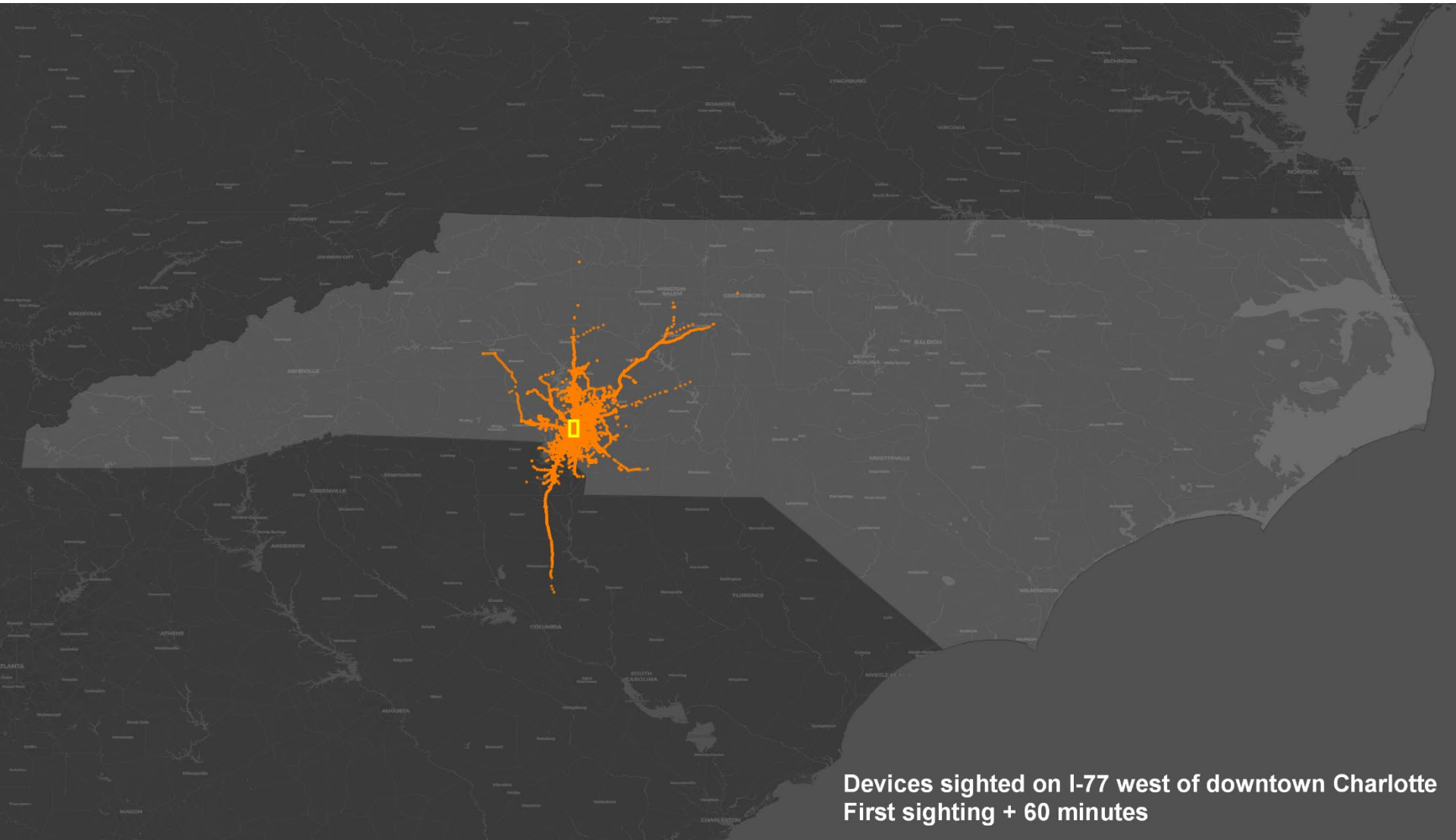
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 15 minutes

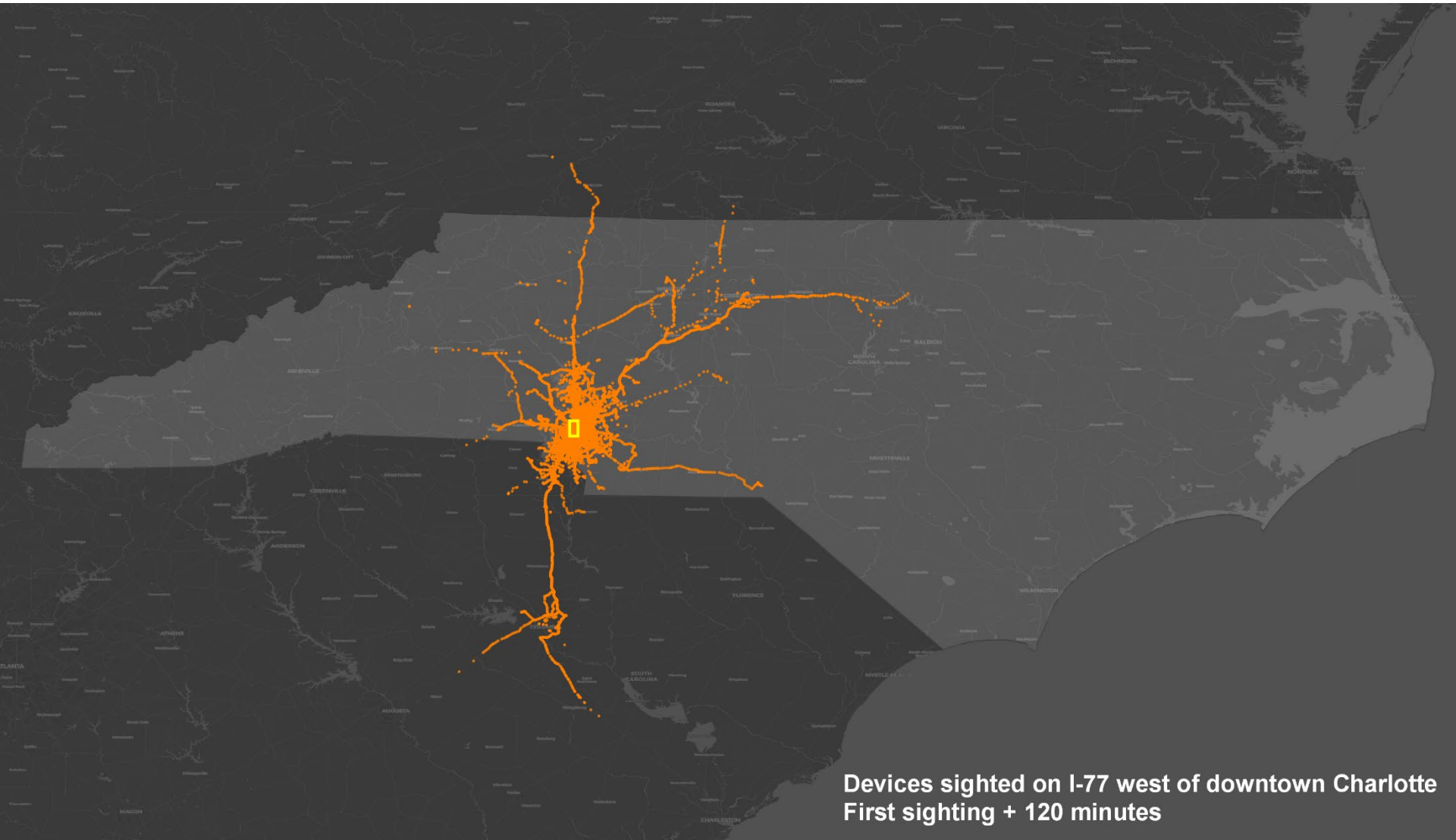
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 30 minutes

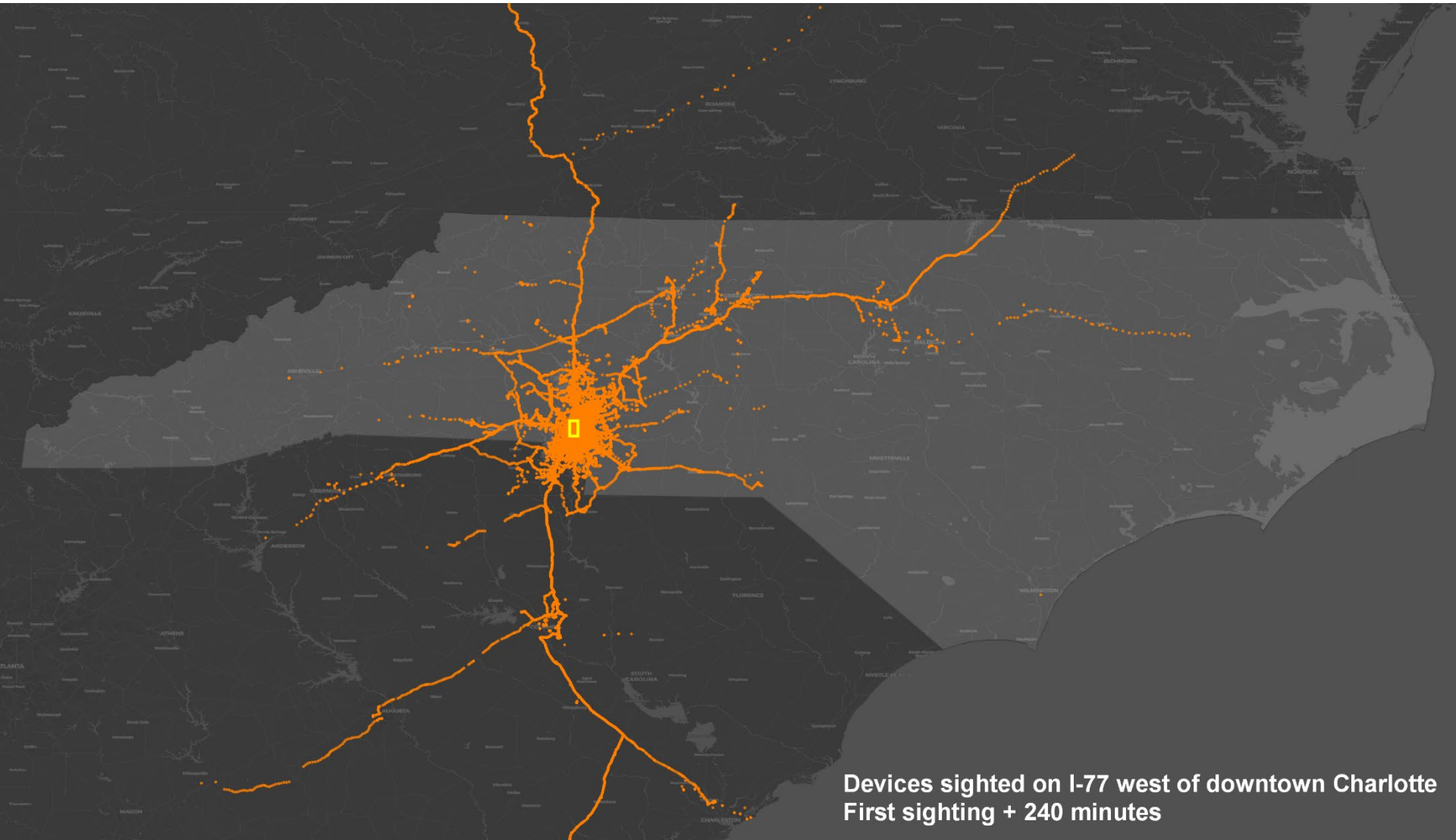
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 60 minutes

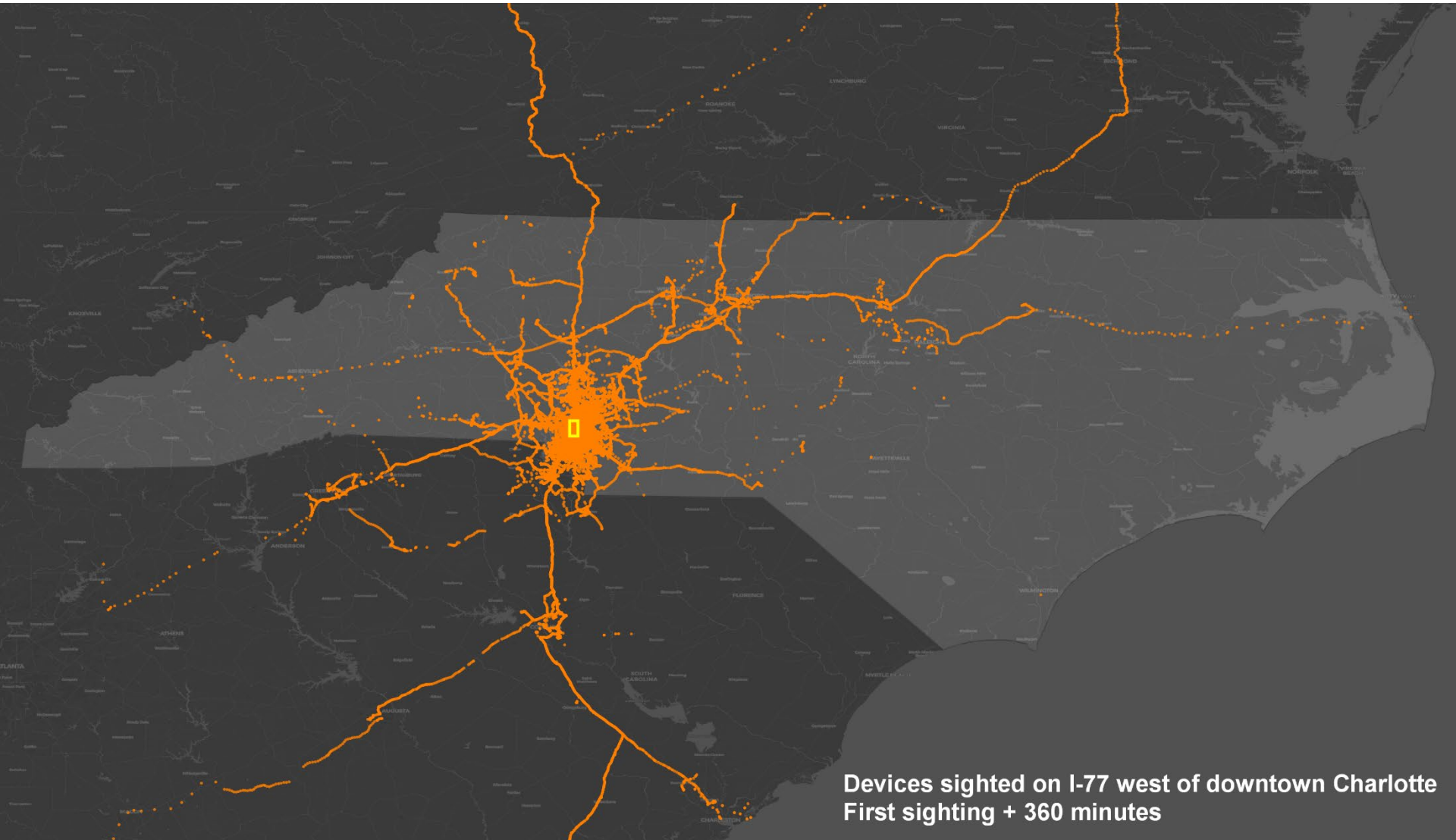
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 120 minutes

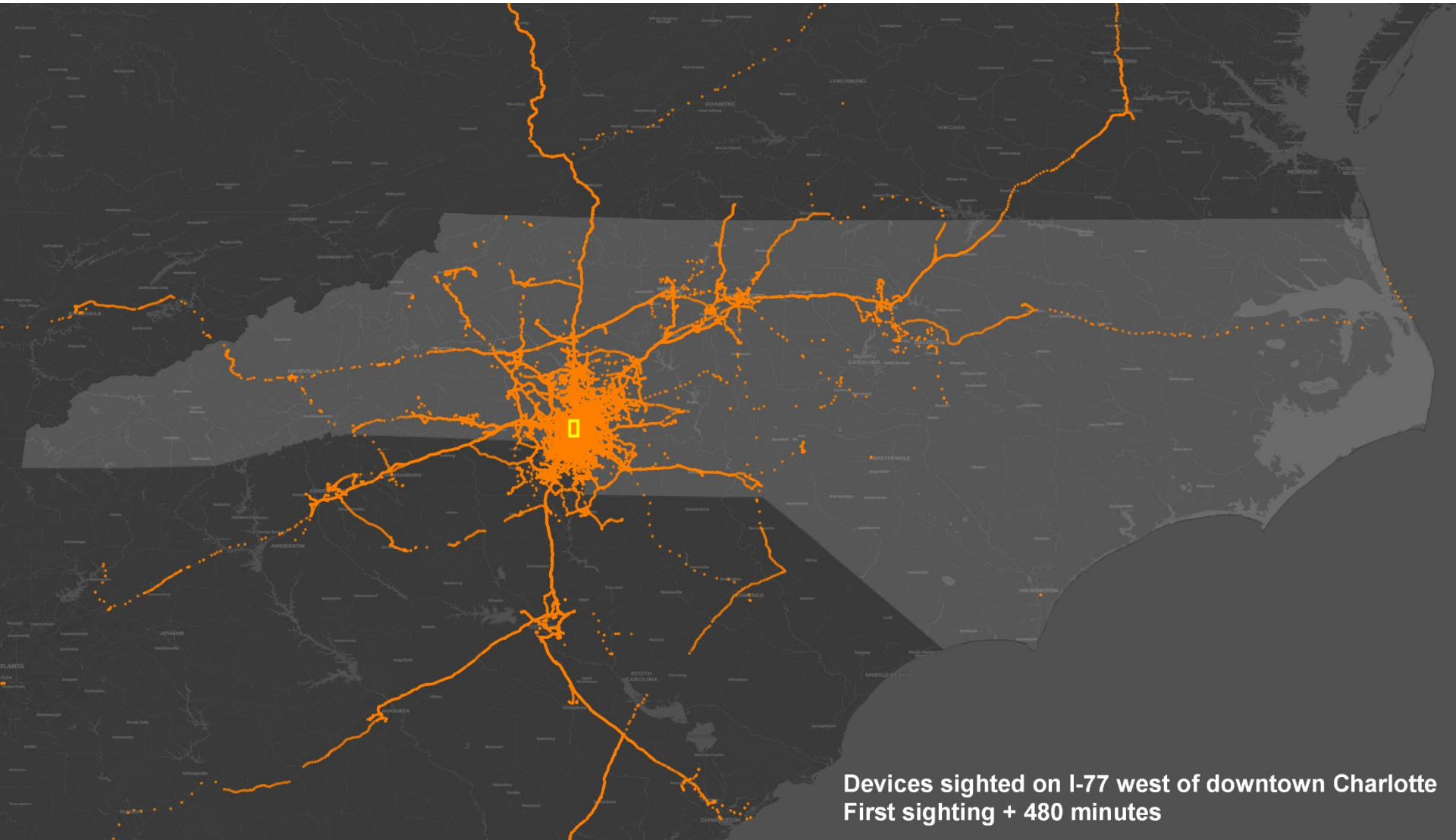
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 240 minutes

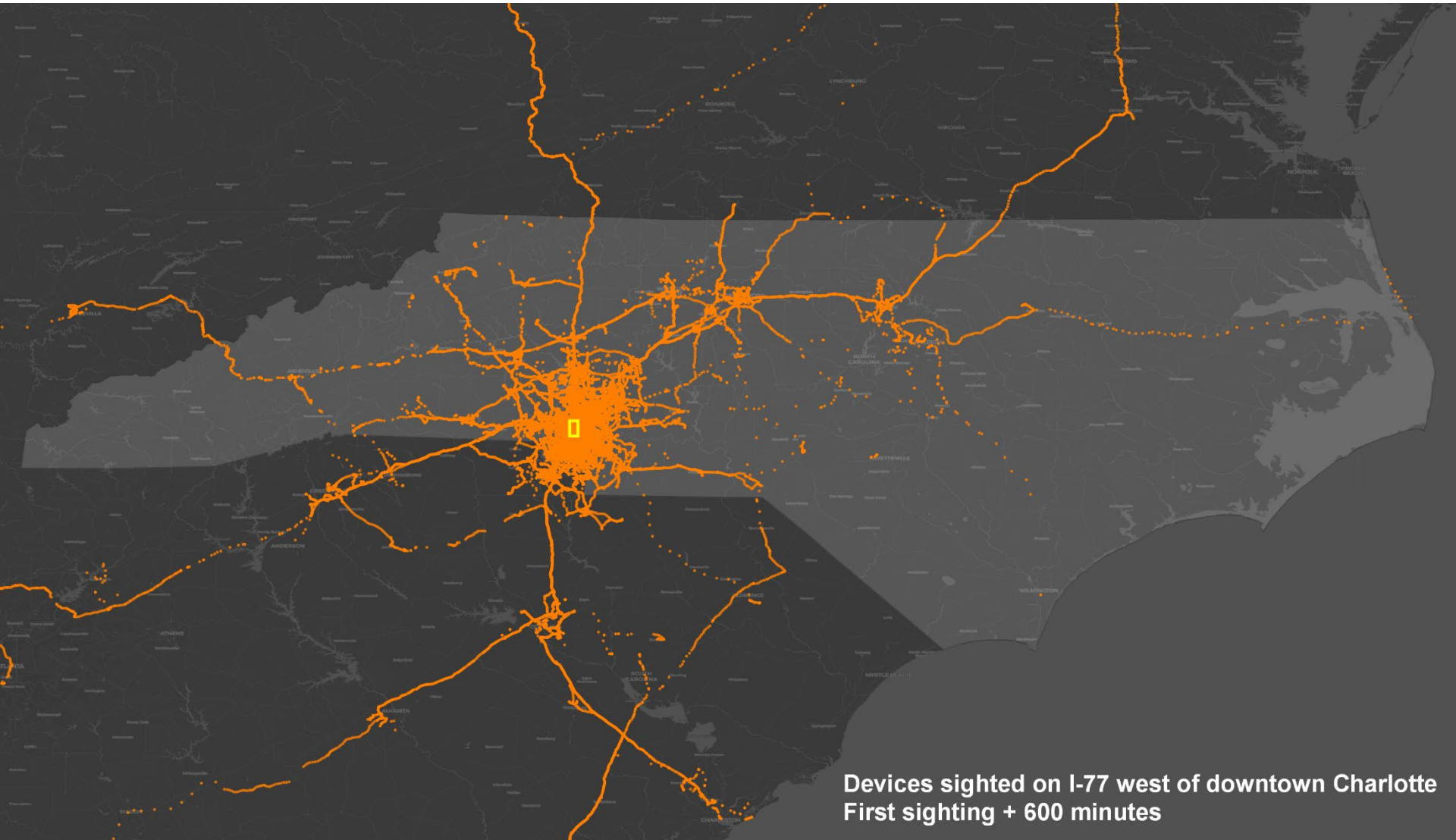
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 360 minutes

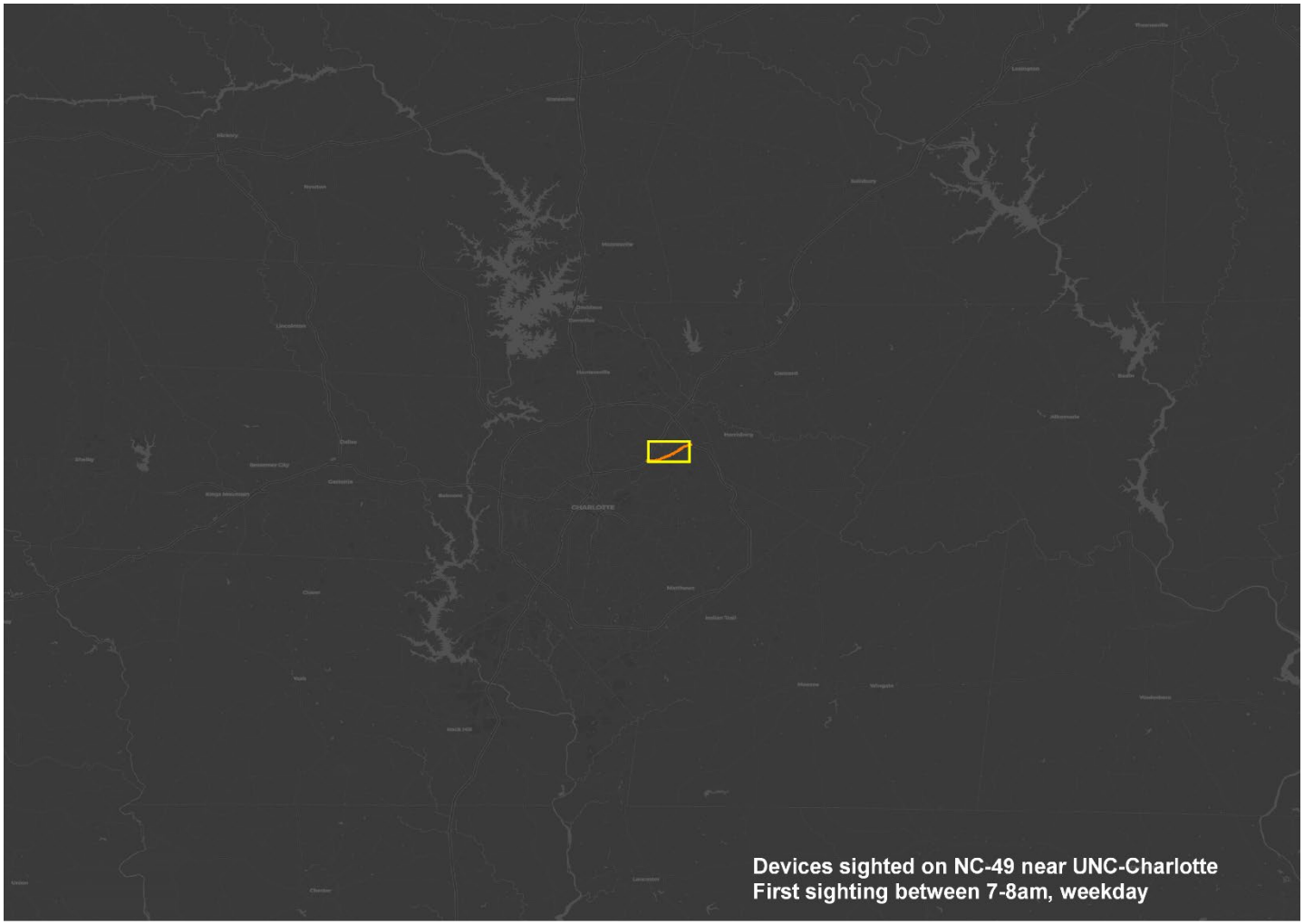
I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 480 minutes

I-77 Flows


Devices sighted on I-77 west of downtown Charlotte
First sighting + 600 minutes

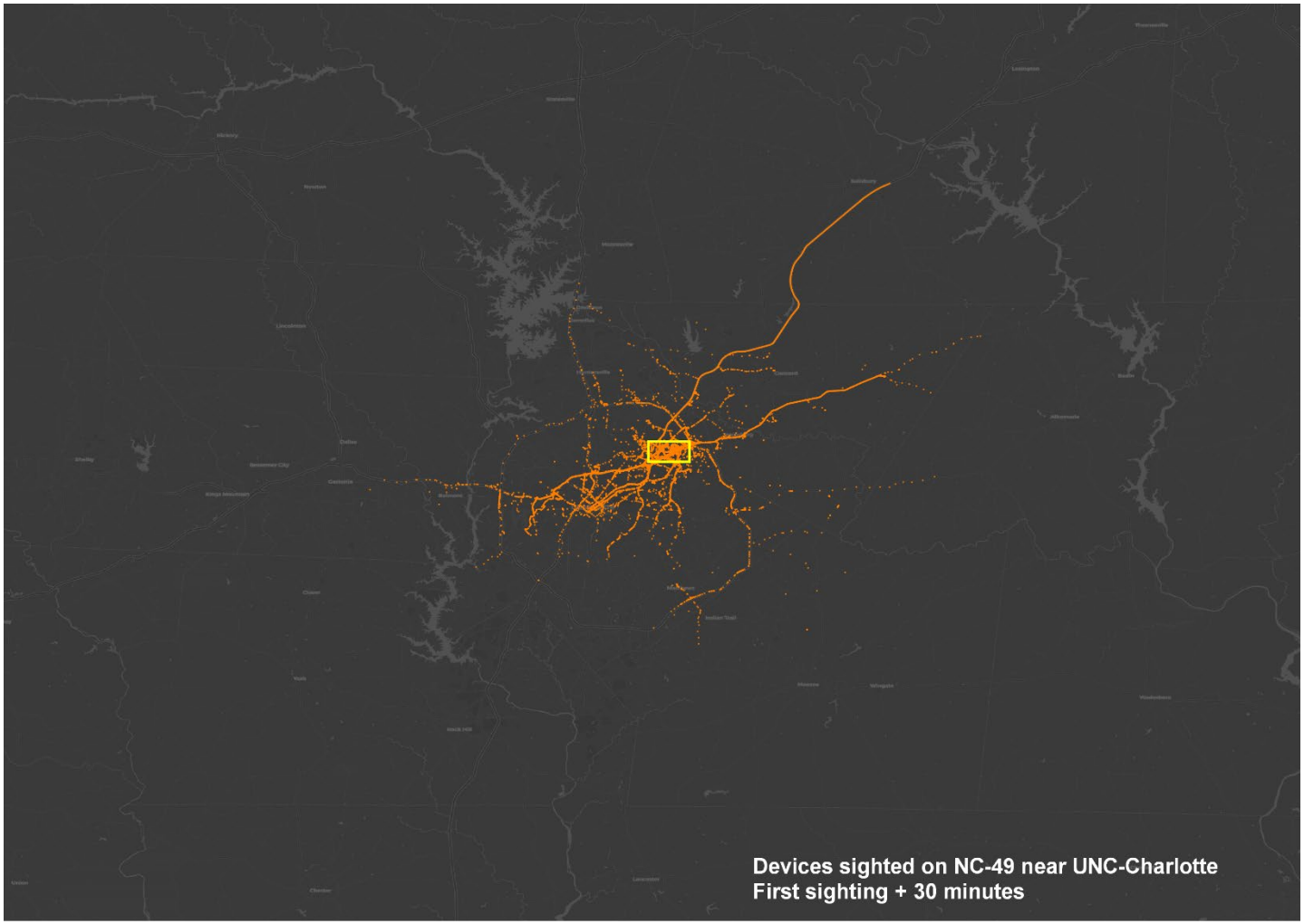
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting between 7-8am, weekday

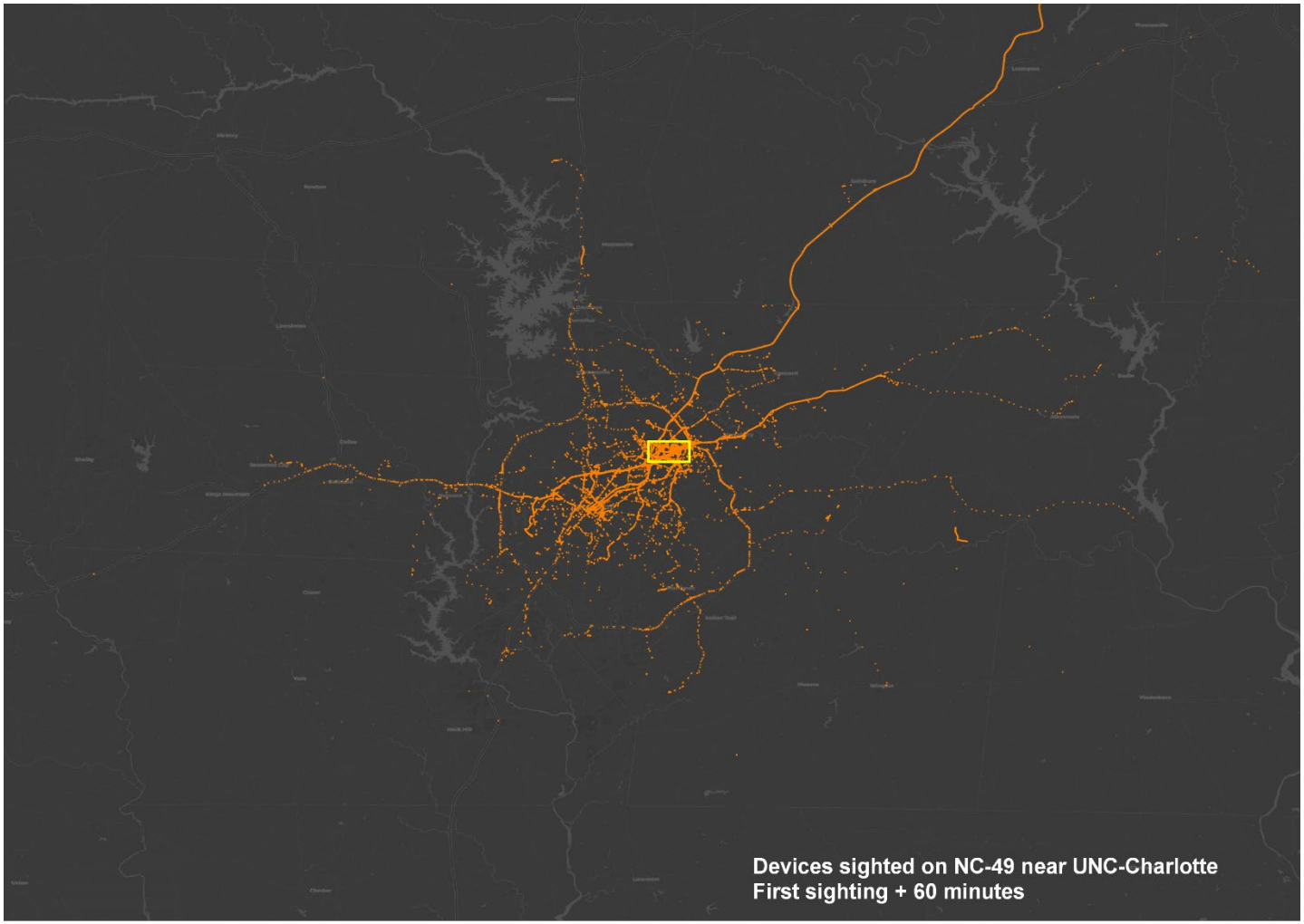
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 15 minutes

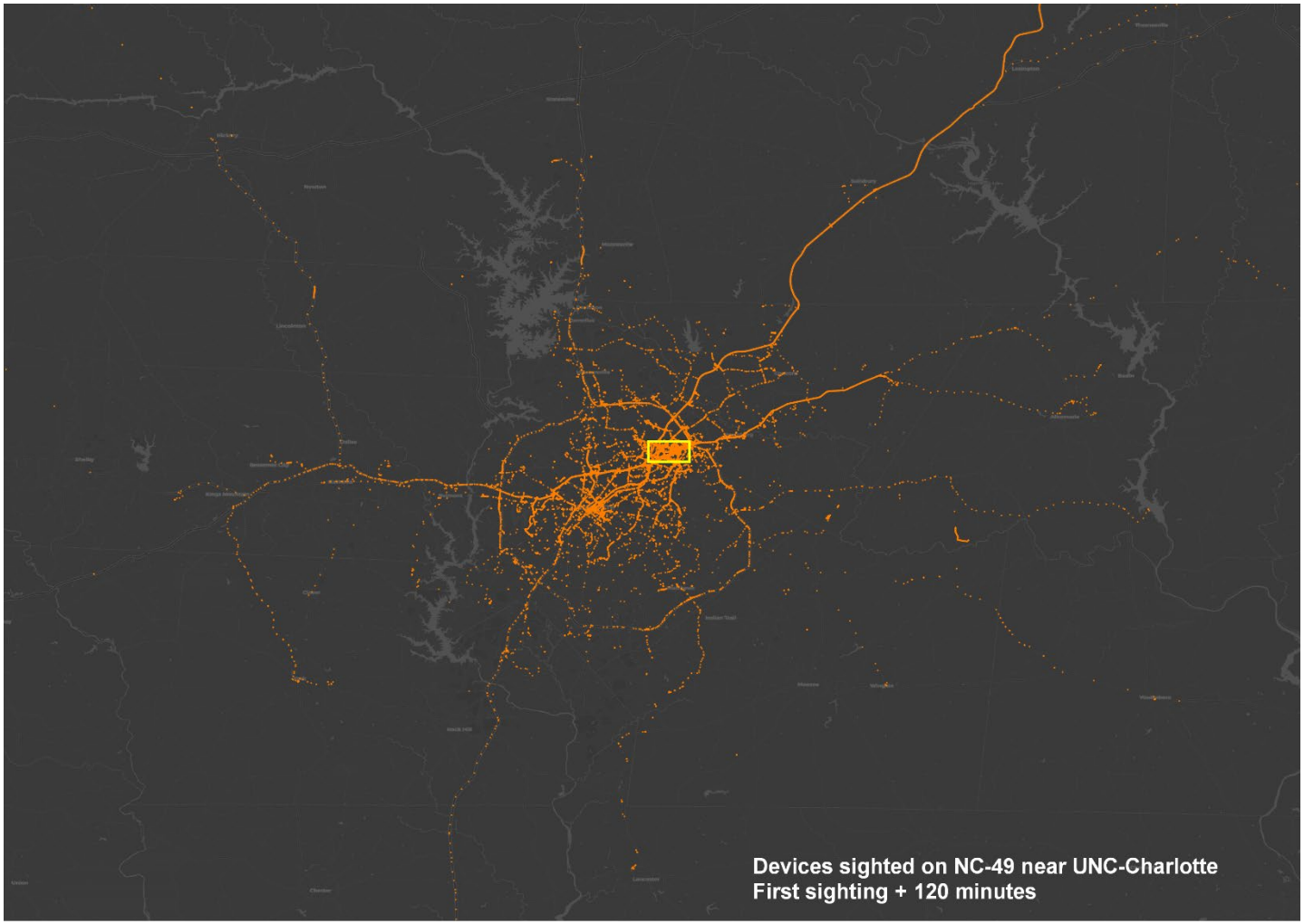
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 30 minutes

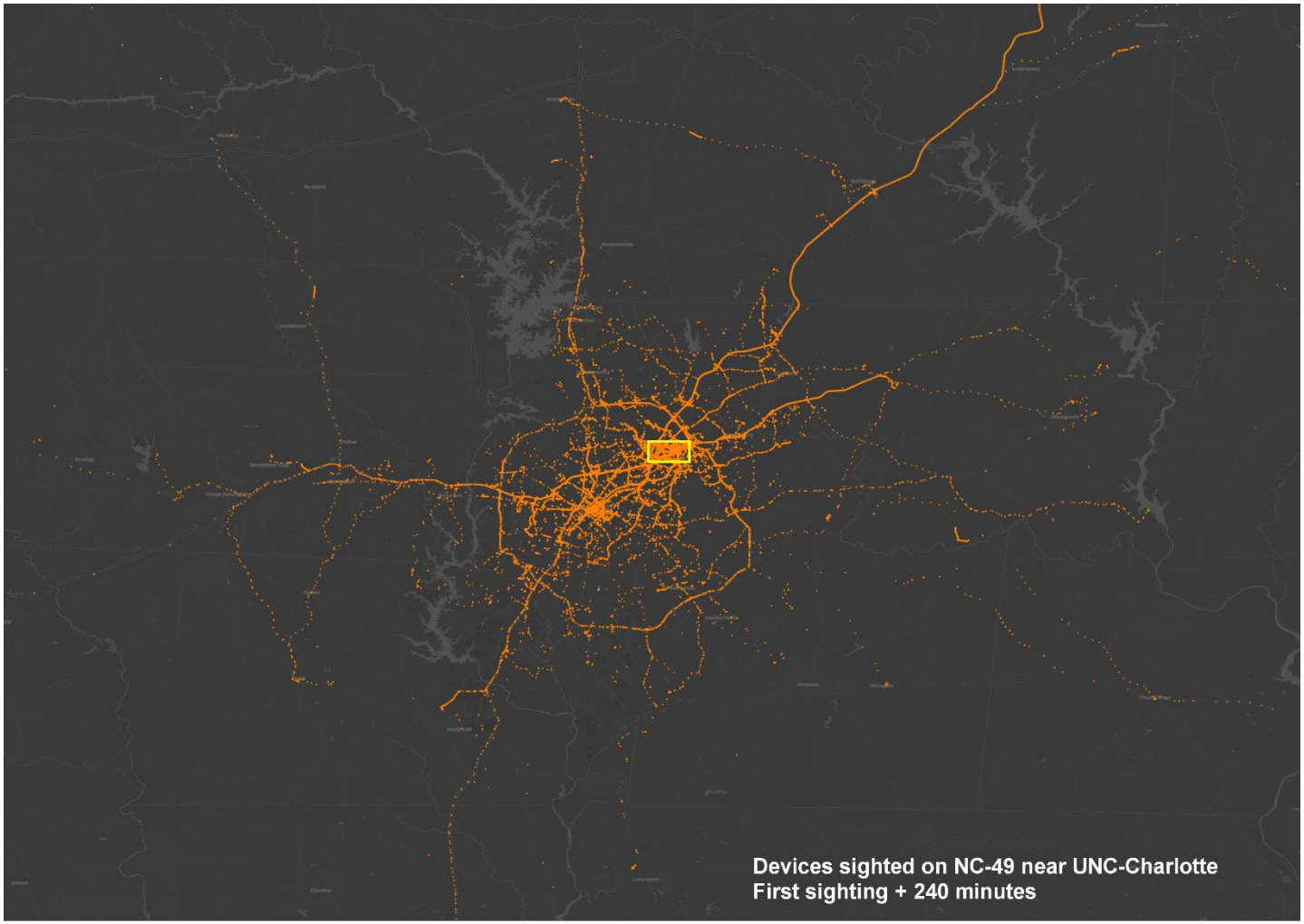
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 60 minutes

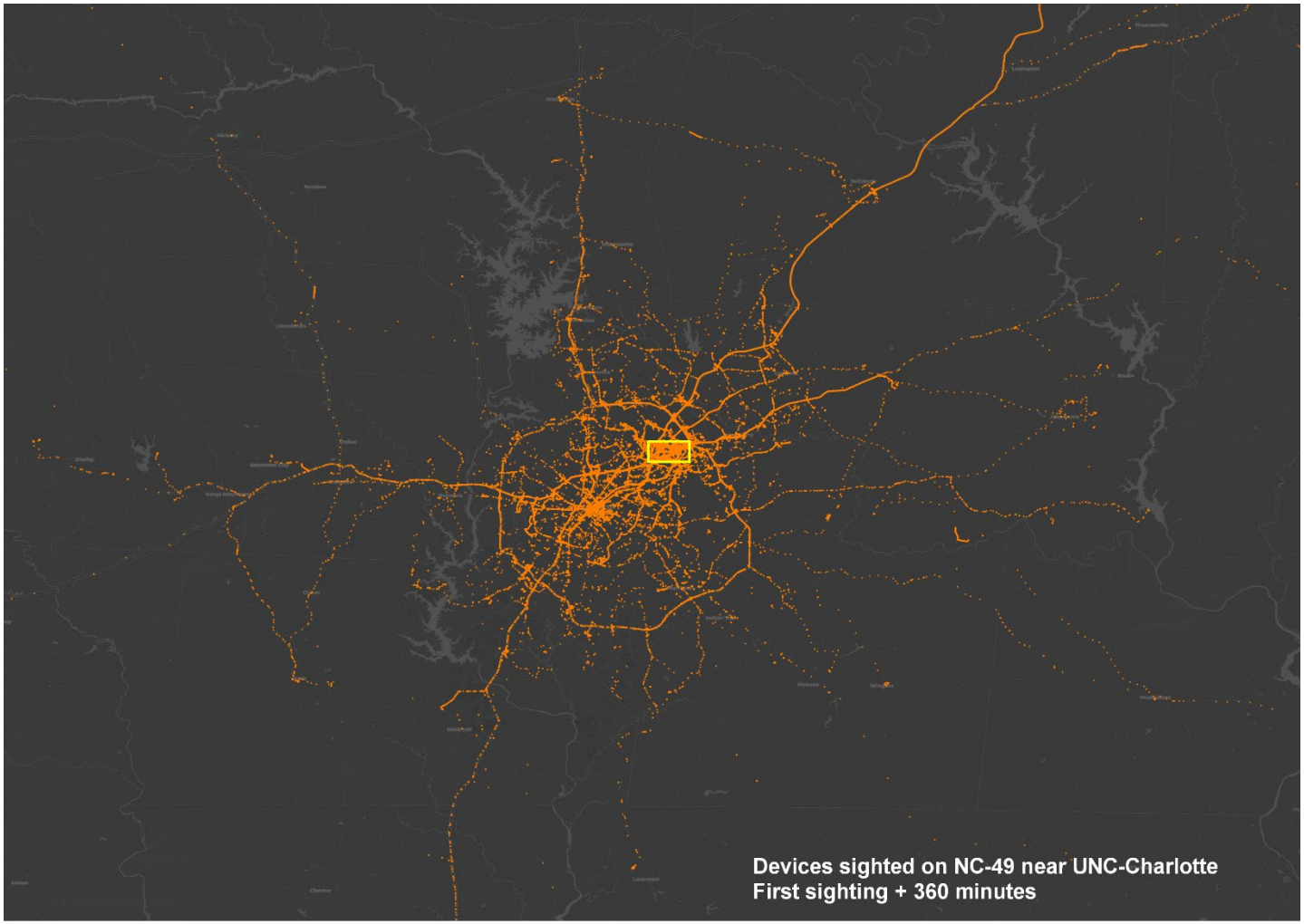
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 120 minutes

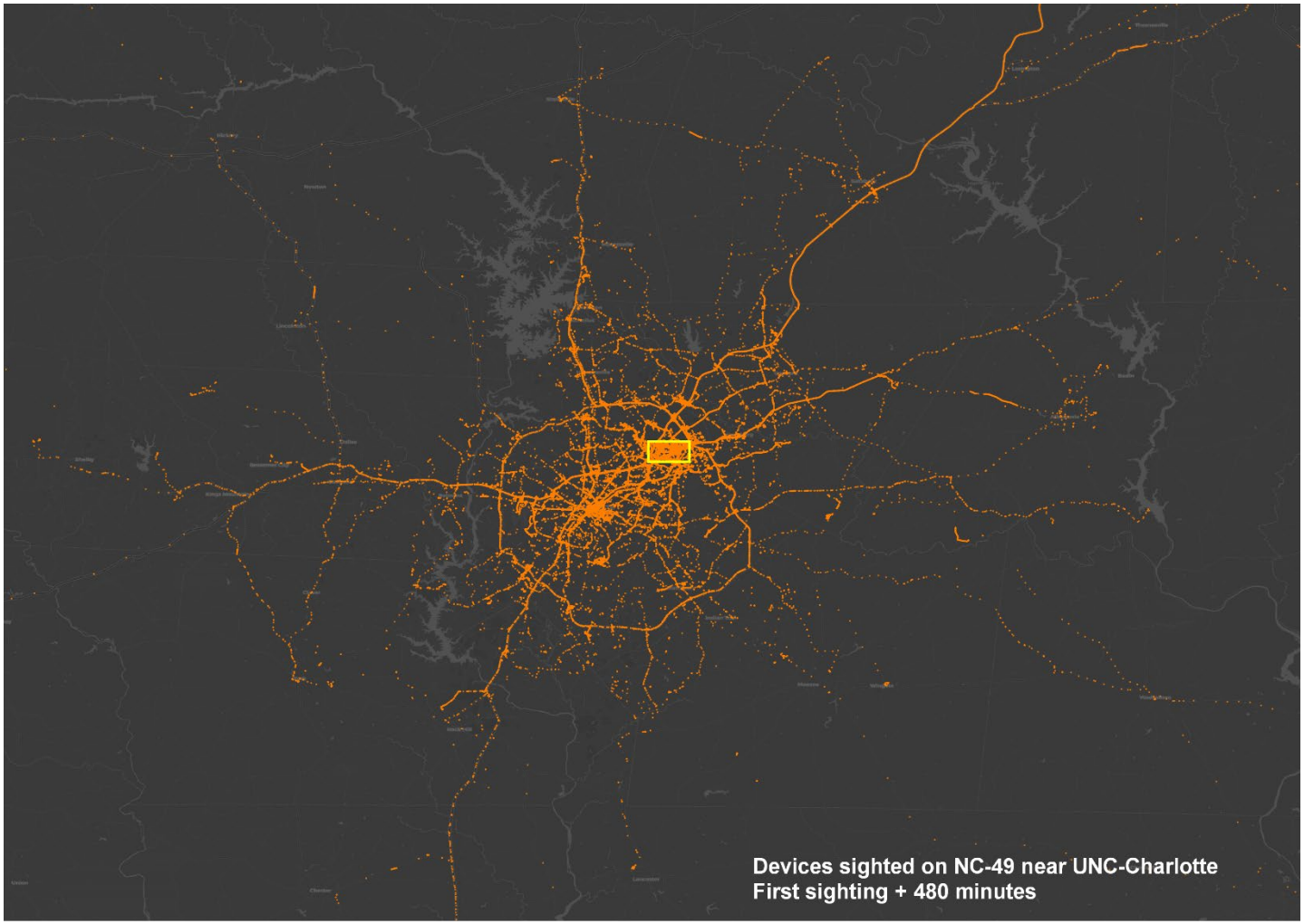
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 240 minutes

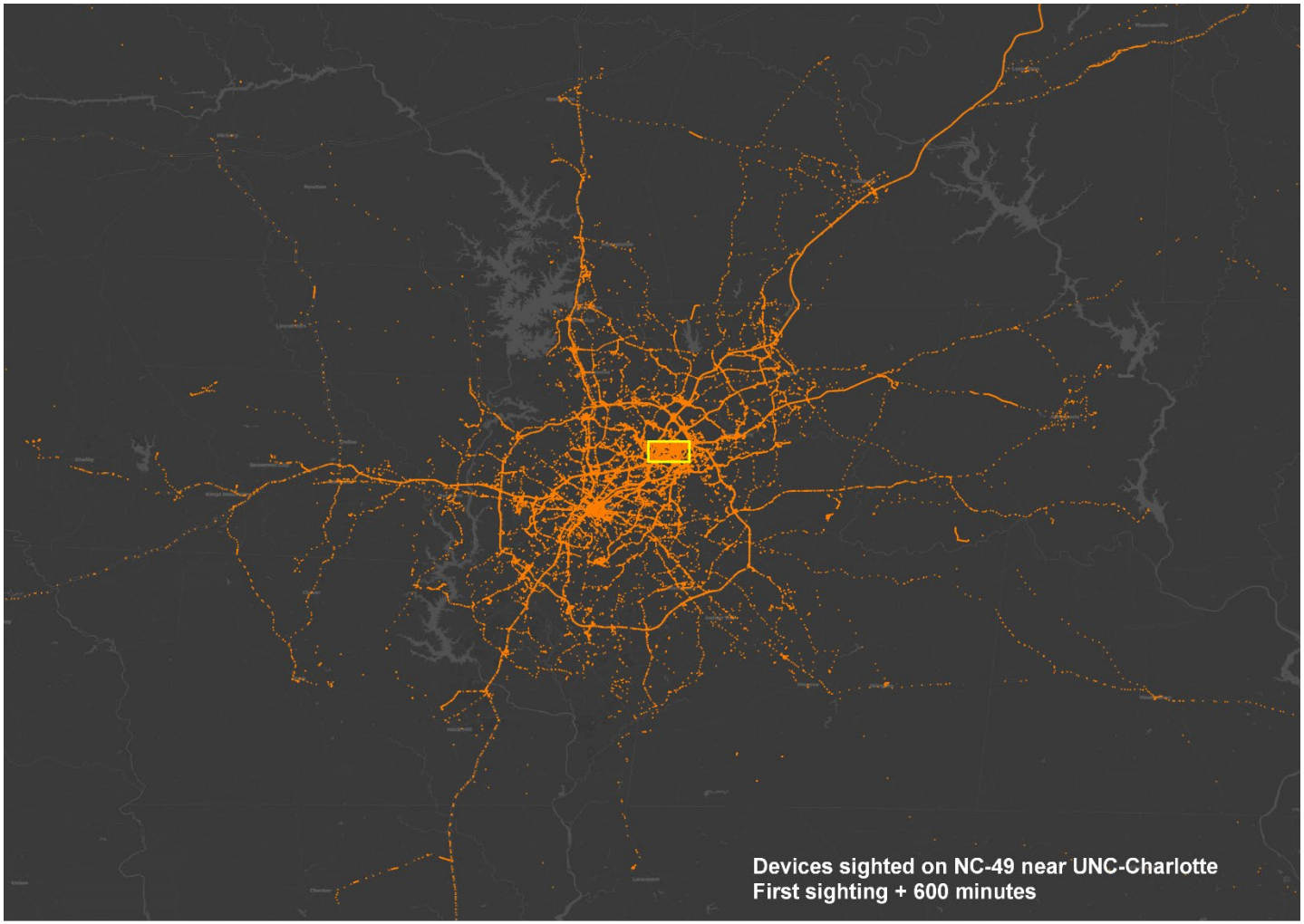
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 360 minutes

NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 480 minutes

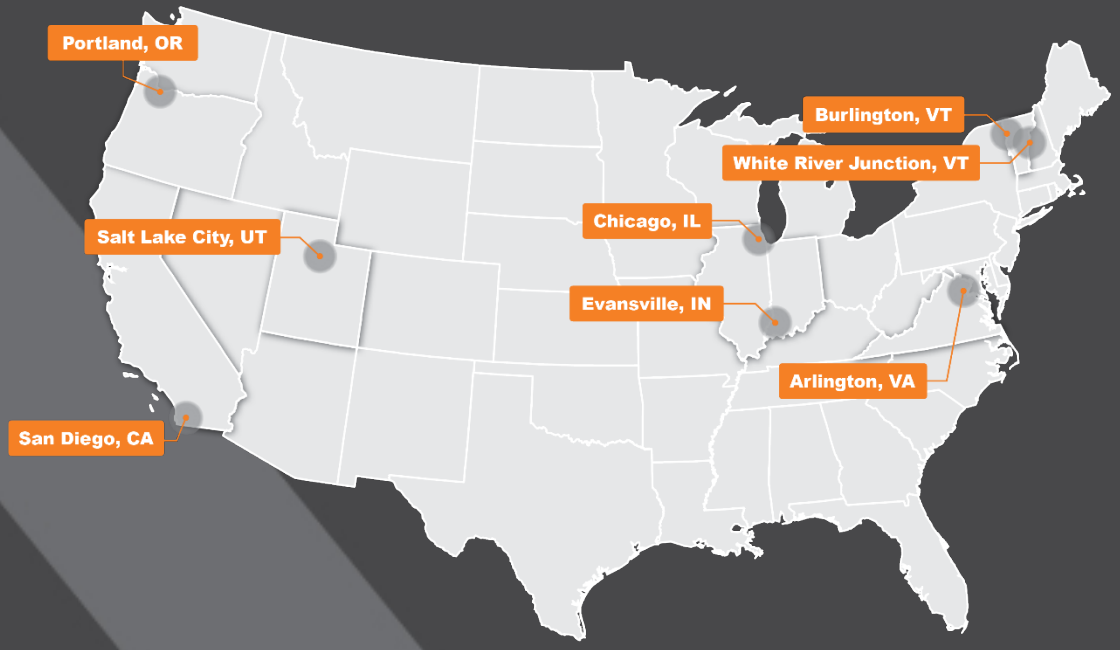
NC49 Flows


Devices sighted on NC-49 near UNC-Charlotte
First sighting + 600 minutes

Summary & Takeaways

Summary

- Passive (big) data is available for 2018, but processing & expansion is necessary (and non-trivial)
- NCSTM gen 4
  - Incorporates new OD data in a new data driven pivot point design
  - More accurate ODs and better fit to counts, easier to update going forward
- Charlotte using data for I-77 and NC49 corridor studies, model update, etc.



Contact

Vince Bernardin, Jr, PhD
DIRECTOR OF FORECASTING
Vince.Bernardin@rsginc.com
812.459.3500

www.rsginc.com