



October 10, 2017

AirSage Background - Cell Tower Based Mobility Information

AirSage pioneered the transformation of wireless network signaling data into powerful mobility information soon after their founding in 2000. Early research led to unique developments that enable AirSage to provide more accurate location information, ubiquitous traffic coverage of roadways, and time-of-day traffic patterns.

AirSage collects and analyzes mobile signals to produce **over Billions of anonymous locations every day**. This data is passively gathered and stored based on the device interactions with the cell phone towers of major wireless carriers nationwide in the US.

Highlights:

- Patented *Population Analytics*
- ~15 billion location data points per day
- ~100 million mobile devices
- Consumer privacy protection



Methodology

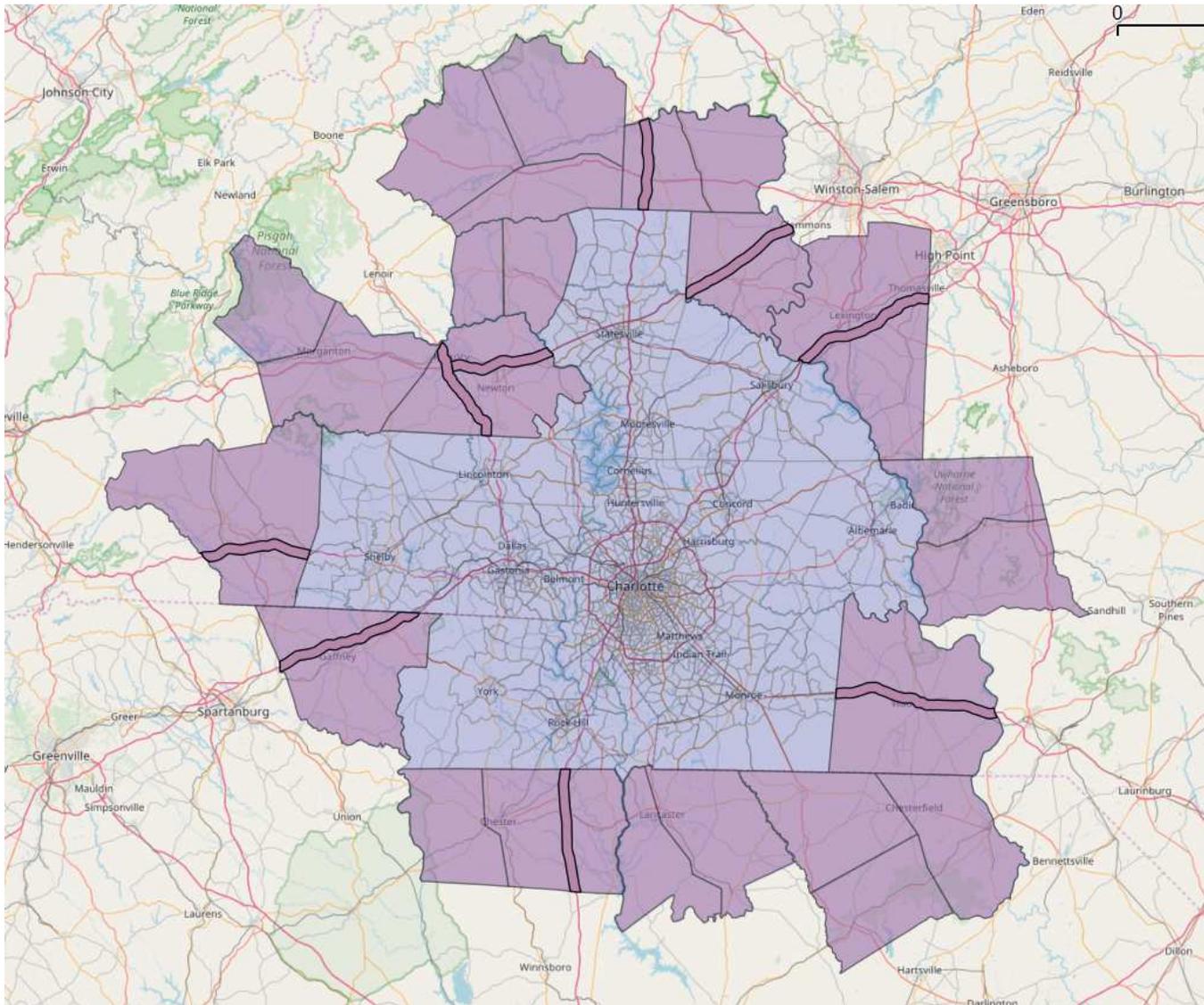
Devices remaining at the same location (over 5 minutes - 300 meters) create “Activity Points” whose location is refined and then analyzed for: Arrival time at location, Departure time from location and Activity duration

Activity Patterns for each device are summarized by frequency and schedule to determine the most common nighttime location. This is deemed the “Home Location”

A penetration analysis is done at the Census Block Group level to determine the extrapolation factor for each device. The sample is then scaled to represent the movements of 100% of the Population of the Census Block Group.

For each Project: Activity Points for each device are then Linked to generate Trips by Daypart and by Type (Home, Work, Other), Time of Day Information (Minimum 3hr bracket) Resident Classifications (Resident Worker, Home Worker, Inbound Commuter, Outbound Commuter, Short-Term Visitor, Long-Term Visitor)



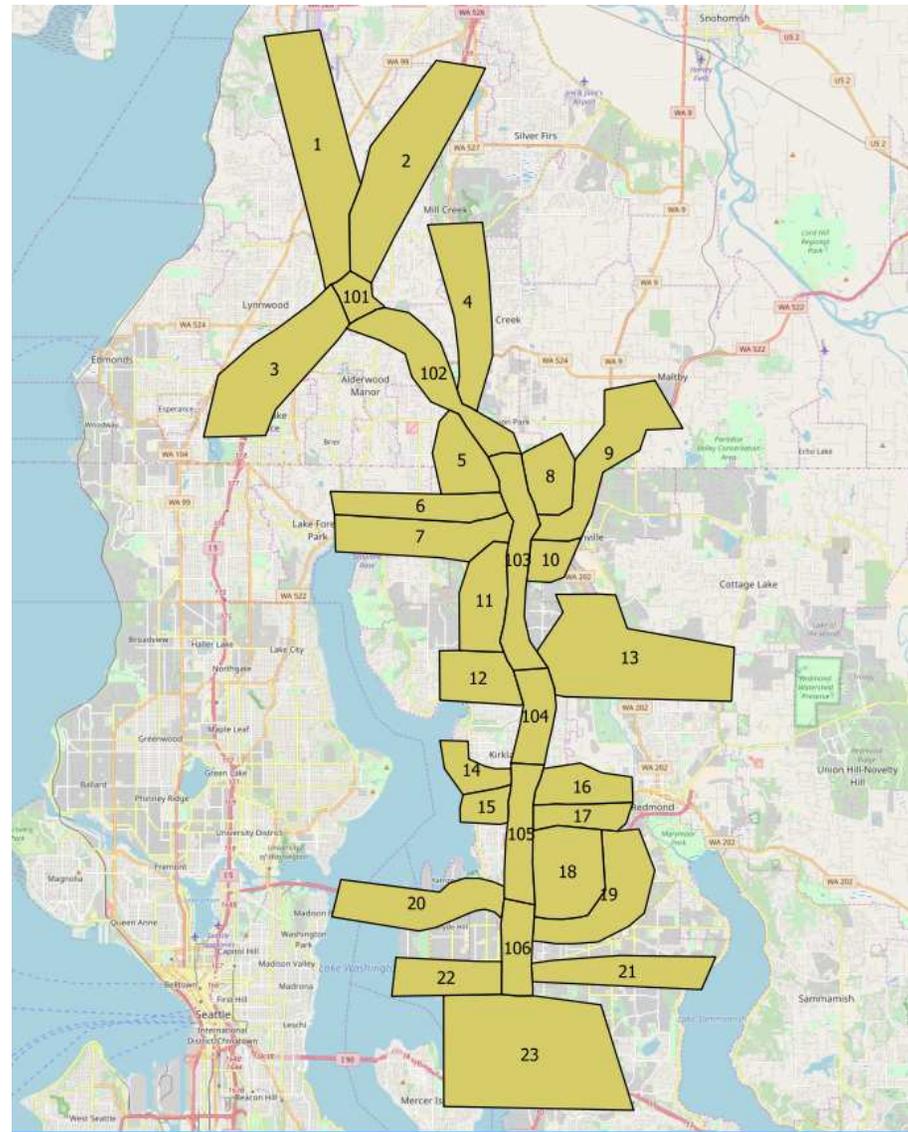


Typical Metro Traffic Analysis Zone Structure for a Regional Model

Light blue region would be subdivided into the Model TAZ's

Outer Zones are for capturing entry and exit trajectories of trips entering and exiting the internal zones.

Typical Traffic Analysis Zone Structure for a Corridor Model using passively collected cellular data.



Zones labeled 101-106 are used to filter the trips. For example a trip from Zone 3 to Zone 20 is of no interest if it does not pass through the corridor of interest and can be filtered out.

Origin_Zone	Destination_Zone	Start_Date	End_Date	Aggregation	Subscriber_Class	Purpose	Time_of_Day	Count
9	17	20150101	20150129	WD	Long Term Visitor	OW	H1030:H1400	1.43
17	7	20150101	20150129	WD	Long Term Visitor	WH	H14:H19	2.6
2	101	20150101	20150129	WD	Long Term Visitor	OO	H1030:H1400	247.67
102	102	20150101	20150129	WD	Long Term Visitor	OO	H14:H19	87976.5
102	102	20150101	20150129	WD	Short Term Visitor	OO	H1030:H1400	23609.67
102	102	20150101	20150129	WD	Short Term Visitor	OO	H14:H19	20301.46
102	102	20150101	20150129	WD	Short Term Visitor	HH	H1030:H1400	6188.85
101	101	20150101	20150129	WD	Short Term Visitor	OO	H14:H19	17632.51
7	10	20150101	20150129	WD	Long Term Visitor	OO	H1030:H1400	48.7
10	7	20150101	20150129	WD	Long Term Visitor	OO	H1030:H1400	54.2
102	102	20150101	20150129	WD	Long Term Visitor	WW	H05:H10	828.18
102	102	20150101	20150129	WD	Long Term Visitor	WW	H1030:H1400	1435.39
102	102	20150101	20150129	WD	Long Term Visitor	WW	H14:H19	1217.78
102	102	20150101	20150129	WD	Long Term Visitor	OO	H1030:H1400	93819.8
1	3	20150101	20150129	WD	Resident Worker	OO	H14:H19	16.89
102	102	20150101	20150129	WD	Short Term Visitor	OO	H05:H10	13109.5
101	101	20150101	20150129	WD	Short Term Visitor	OW	H14:H19	1749.14
6	6	20150101	20150129	WD	Home Worker	HH	H05:H10	1298.23
6	6	20150101	20150129	WD	Home Worker	HH	H1030:H1400	1221.12
7	19	20150101	20150129	WD	Long Term Visitor	HO	H1030:H1400	3.6
19	7	20150101	20150129	WD	Long Term Visitor	OO	H14:H19	62.77
5	5	20150101	20150129	WD	Home Worker	HH	H1030:H1400	176.03
101	101	20150101	20150129	WD	Short Term Visitor	HH	H05:H10	19756.39
101	101	20150101	20150129	WD	Short Term Visitor	HH	H14:H19	28741
19	19	20150101	20150129	WD	Long Term Visitor	HO	H1030:H1400	8.76
19	19	20150101	20150129	WD	Long Term Visitor	OH	H14:H19	23.7
2	2	20150101	20150129	WD	Home Worker	HH	H14:H19	2234.69
40	101	20150101	20150129	WD	Short Term Visitor	OO	H1030:H1400	3.64
1	101	20150101	20150129	WD	Long Term Visitor	OO	H14:H19	327.18
101	1	20150101	20150129	WD	Long Term Visitor	OH	H14:H19	153.72

Typical deliverable: Comma delimited ASCII text file
Pricing based on the number of records in the dataset.
Count is “Person trips”



Pricing Calculator (Trip Matrix, Select Zone & Arrivals and Departures) Typical Origin - Destination Matrix

Product	Trip Matrix
# of Zones	100
# of Months Covered per Report	1
# of Reports *	1
Population Covered	1,500,000
Long Distance Trip Filter	No

Internal & External Zones Options:	
Internal Zones Only	No
Internal & External (Include all I-I, E-E and E-I-E trips)	Yes
Internal & External (Include only I-I and E-I-E Trips)	No

Day Aggregation Options:	
Average Weekdays (T-Th)	Yes
Average Weekend Day (Sat-Sun)	No
Average Full Week (Sun-Sat)	No
Total Weekdays (M-F)	No
Total Weekends (Sat-Sun)	No
Total Full Week (Sun-Sat)	No
Avg. Specific Day of Week*	No
All Individual Days* (enter #)	0
Total Specific Day(s)* (enter #)	0
Total	1

Day Part Aggregations (3 hr min*)	
Early AM	No
AM Peak (6am-9:30am)	Yes
Mid-Day	No
PM Peak (3pm-6:30pm)	Yes
Late PM	No
24 hour Total	Yes
Total	3

Trip Purpose Attributes	
3-Class (Home-based Work, Home-based Other, Other-based Other)	Yes
9-Class (HBW, HBC, WBO, WBH, WBW, HBH, OBO, OBH, OBW)	No
Total	3

Residence Class Attributes	
2-Categories (Residents, Visitors)	Yes
6-Categories (Res Worker, Home Worker, In-Commuter, Out-Commuter, Short-Term Vis, Lg-Term Vis) <i>Requires Int/Ext Zone option</i>	No
Total	2

Demographic Attributes	
Bundle includes the 3 below:	No
Annual Household Income (census bins) (Or customer-specific bins*)	
Age (census bins) (Or customer-specific bins*)	
Autos (census bins) (Or customer-specific bins*)	
Total	0

Optional Add-on Reports	
Home-Work Matrix Report	
County to County	No
Use Study Zones	No

Home Location Report	
Home Locations Only Within Study Area *	No
Home Locations Nationwide *	No

Quote Summary	
# of Zones/Pairs	10,000
# of Day Aggregations	1
# of Day Part Aggregations	3
# of Trip Purpose Attributes	3
# of Res Class Attributes	2
Total # of Records	180,000
Base Report Calculation	\$ 15,448

Adjusted for Min Price (\$10k)	\$ 15,448
Population Adjustment	\$ -
Subtotal	\$ 15,448

Demographic Attributes Option	\$ -
External Zone Adjustment	\$ 7,724
Time Frame Adjustment	\$ -
Long Distance Adjustment	\$ -
Total Base Price (1 report)	\$ 23,172
Total Base Price (all reports)	\$ 23,172

Home-Work Matrix	\$ -
Home Location Report	\$ -
Total Price with Optional Reports	\$ 23,172

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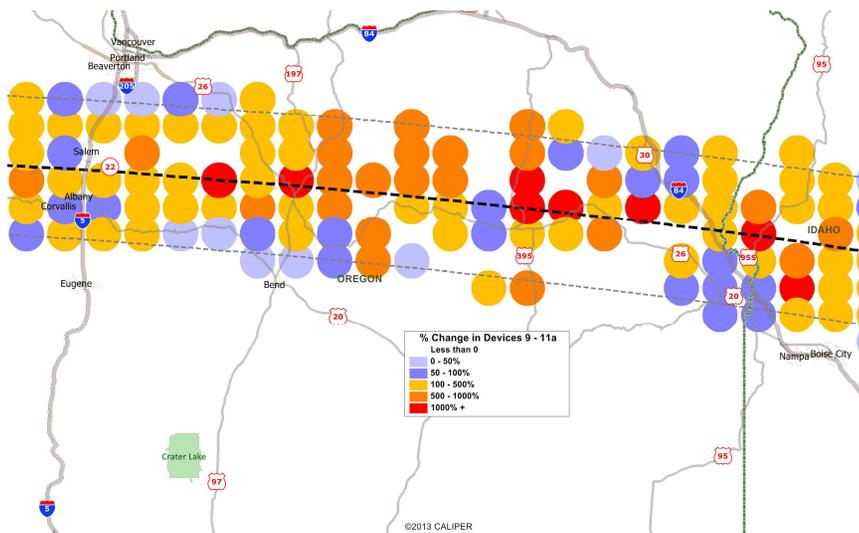
Introduction of AirSage GPS Data

- Given that the Quality of location traces generated by mobile apps has better accuracy than cell-based data
- The Quantity of devices providing location based data sources has been growing to the point that GPS volume is reaching acceptable levels similar to that of cell-based
- New GPS data has been collected and archived nationwide since July 1, 2017. Data in Canada is available upon request but is not a part of the current archive.
- We still have Cell Data and our O-D products in the USA. Current GPS work is in parallel to provide the same products with smaller zones possible due to increased accuracy.
- Initial case studies presented in the next few slides from AirSage GPS based data source - BETA PHASE

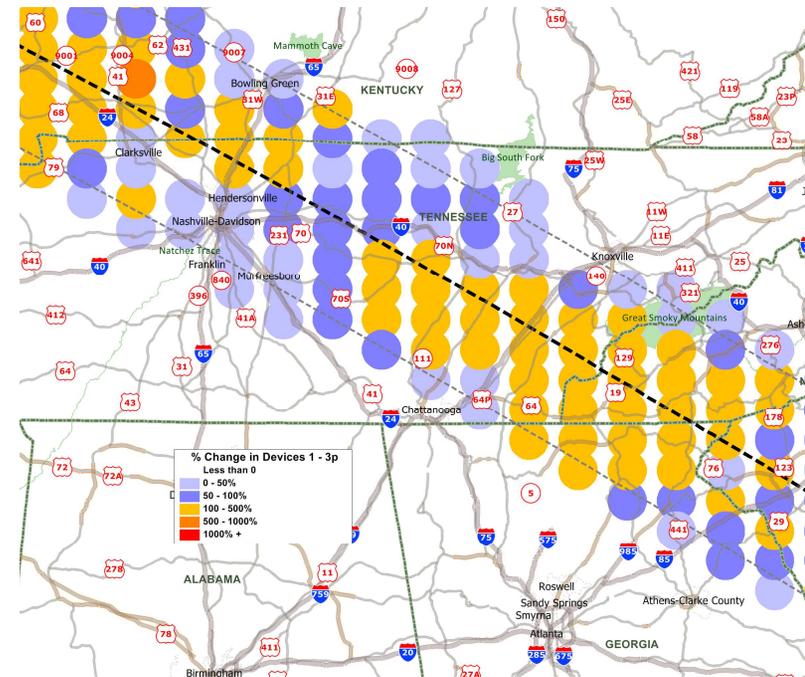


Solar Eclipse - August 21 Device Density

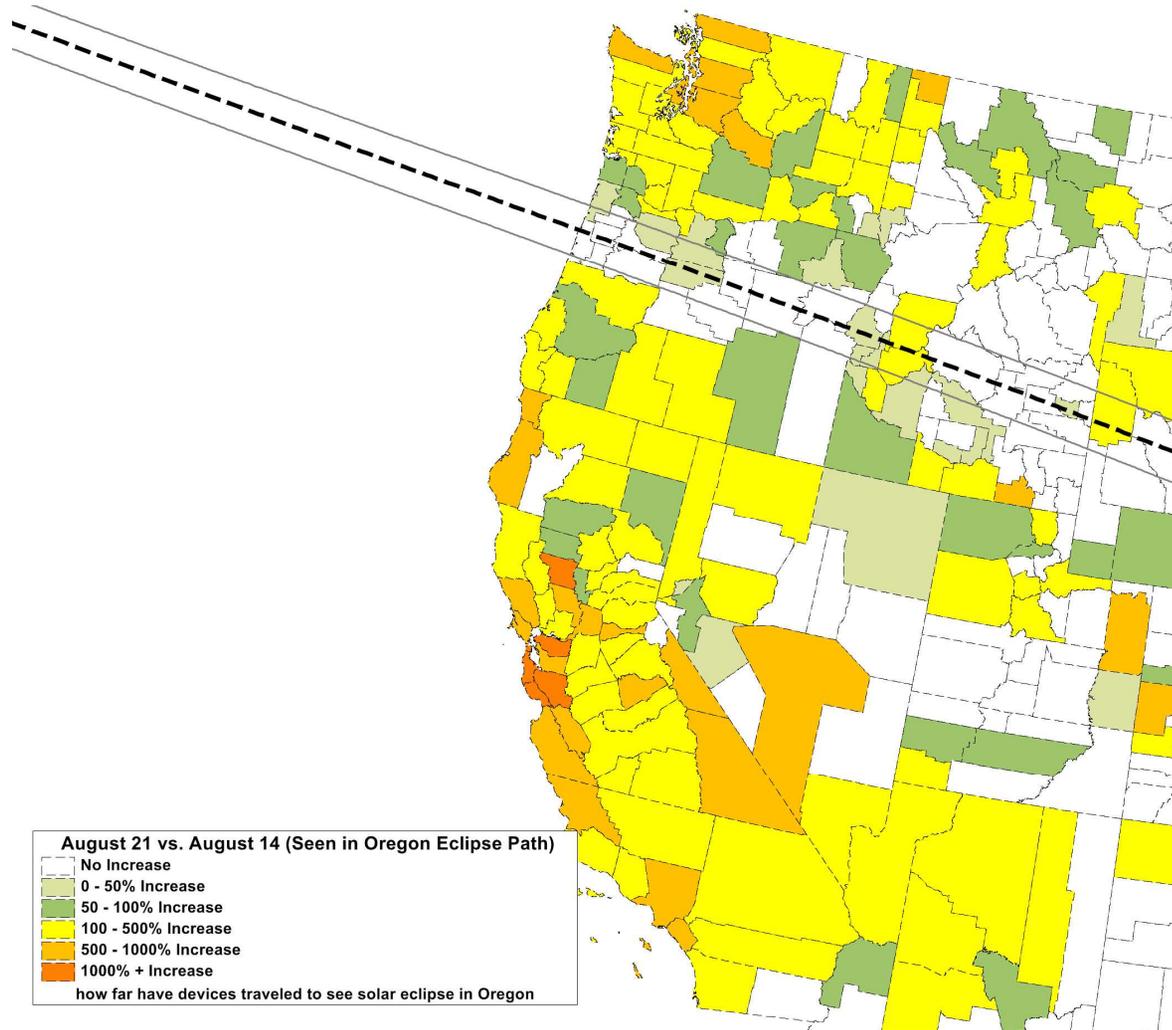
- Northern Georgia and Eastern Tennessee also saw 100% - 500% increase in device activity during totality compared to the same time a week before (1:00 and 3:00 PM)



- Sparsely populated places like Madras, Oregon and rural Idaho saw over 1000% increase in device activity during totality compared to the same time a week before (9:00 to 11:00 AM)



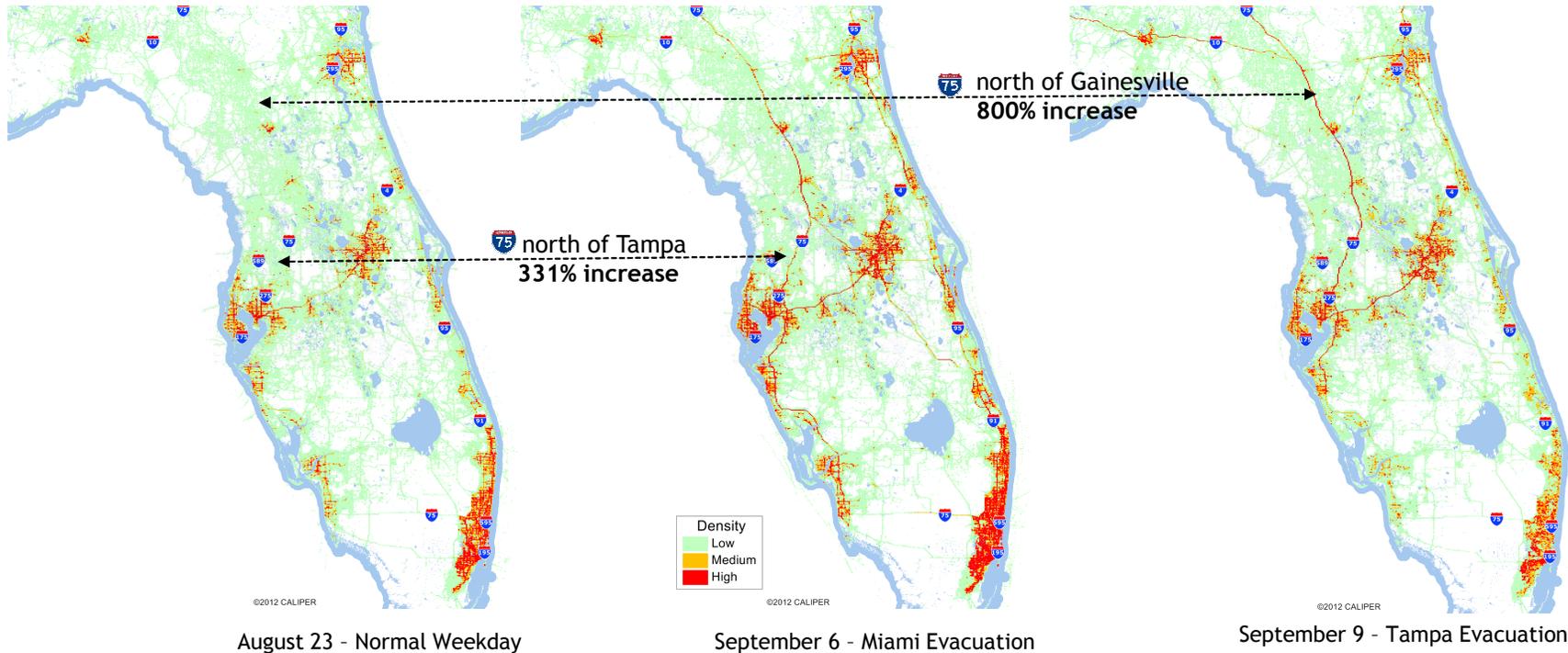
Solar Eclipse - County “Home Locations”



- 1000% more devices visited from the bay area to view totality in Oregon compared to a week before August 21 (24 HR Totals)
- 500% - 1000% more devices visited from southern California to view totality in Oregon compared to a week before August 21

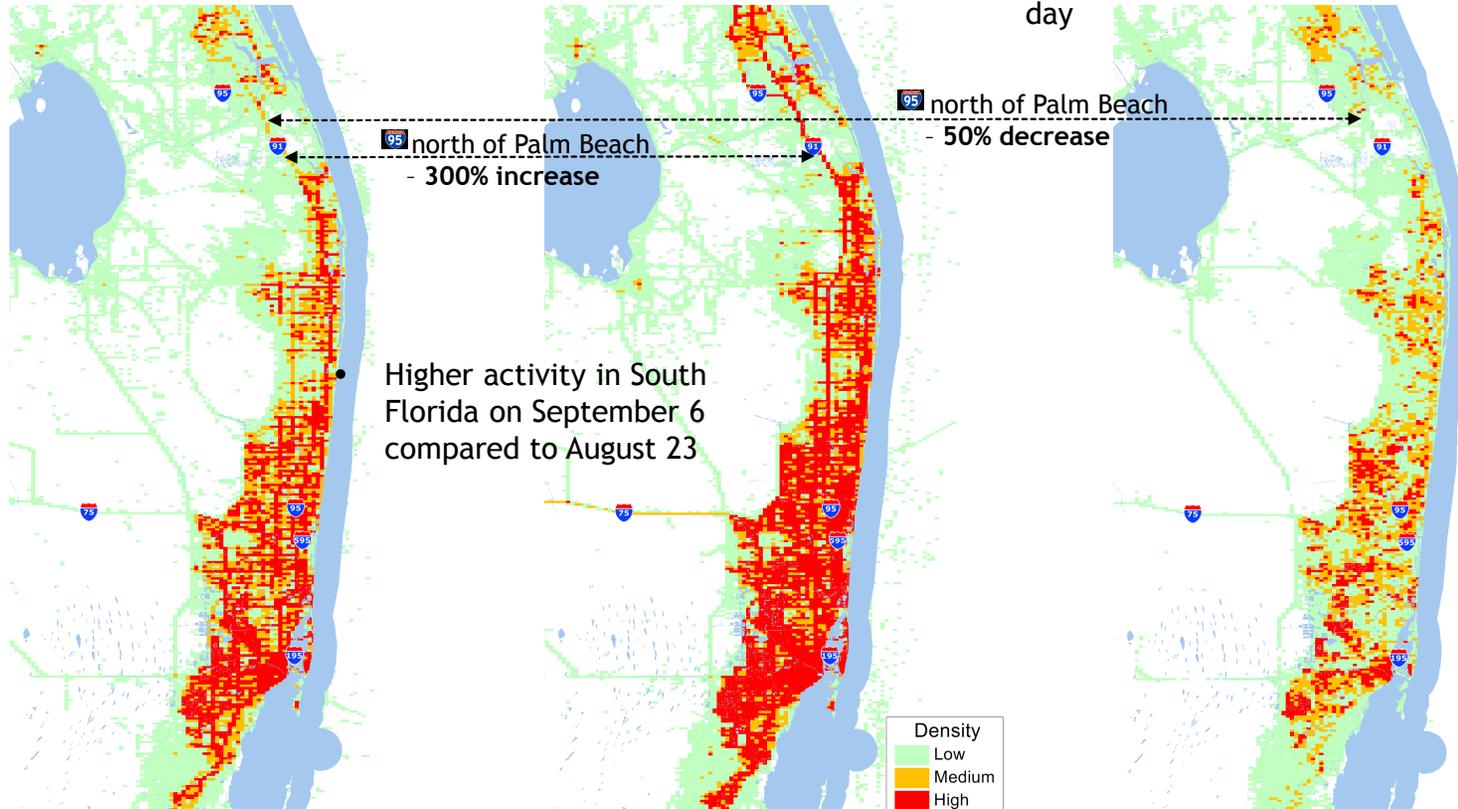
Hurricane Irma - Florida

- Higher activity along I-75 and I-95 in Florida on September 6. Miami ordered evacuations on September 6
- Higher activity along I-75 in Florida on September 9. Tampa ordered evacuations on September 8 and 9.



Hurricane Irma - South Florida

- Lower activity on September 10, the day Irma made landfall compared to normal day

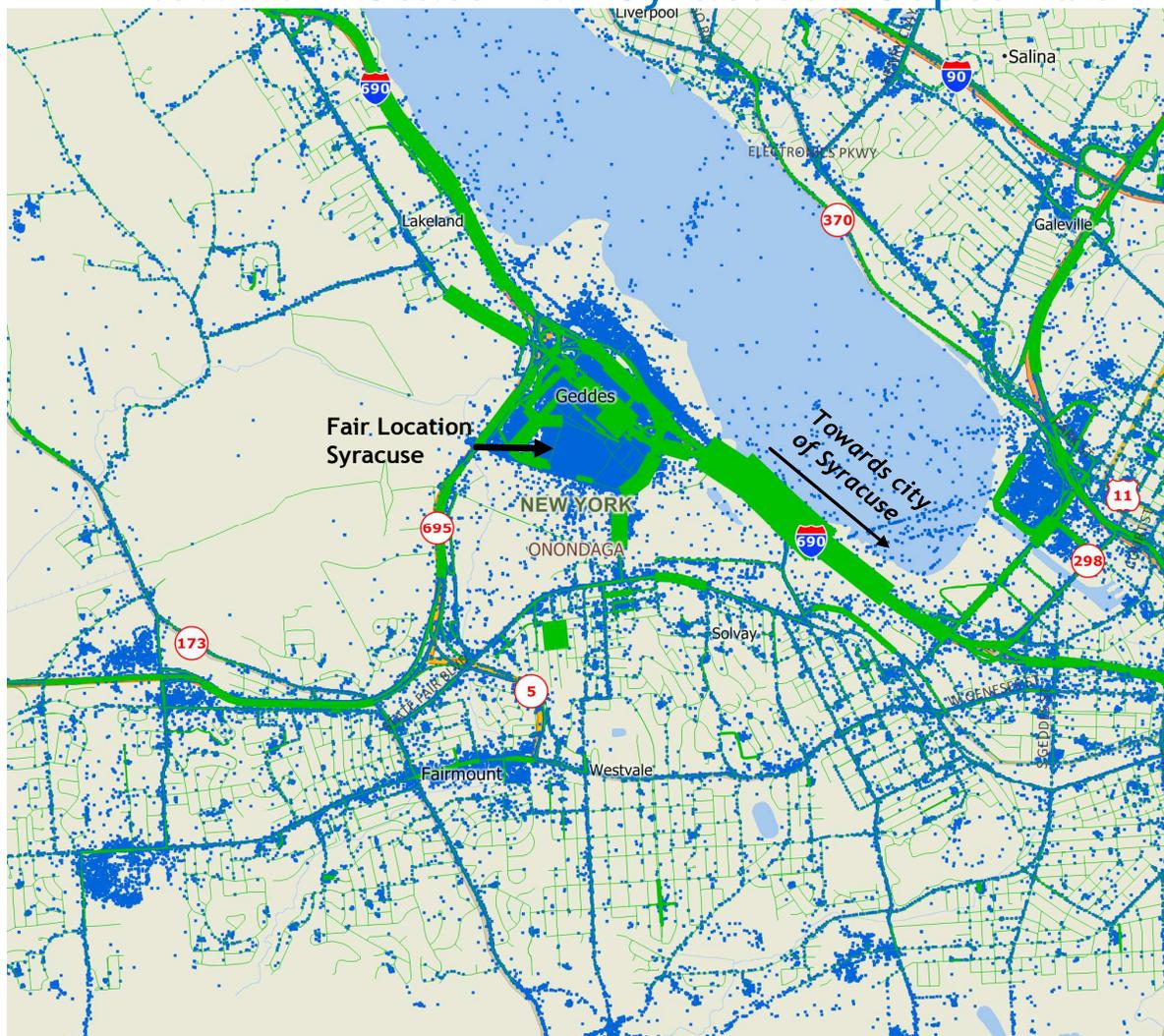


August 23 - Normal Weekday

September 6 - Miami Evacuation

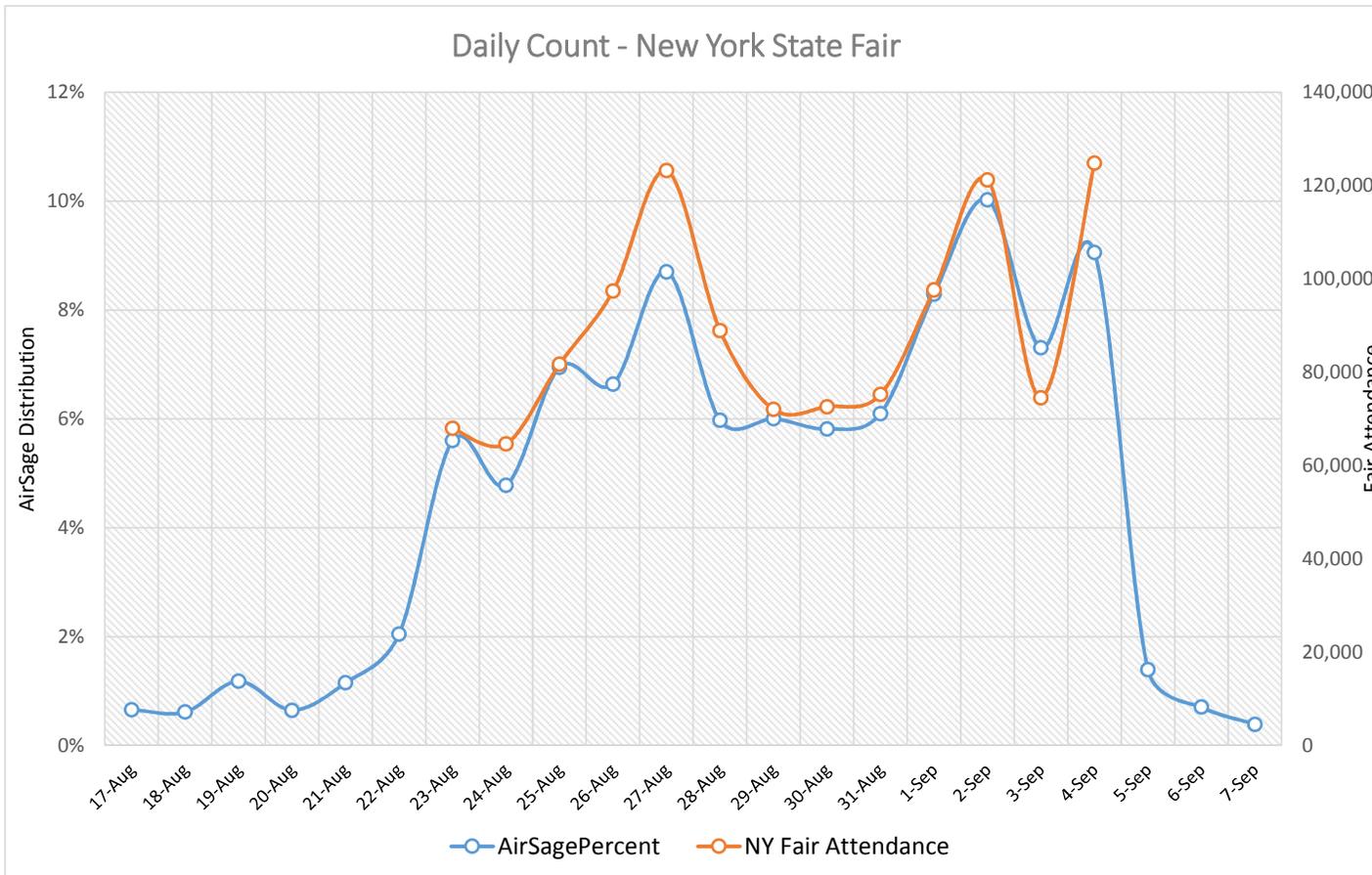
September 10 - Irma Landfall

New York State Fair Syracuse - September 2 Select Zone/Link



- Devices seen at the State Fair on September 2
- Green Line width represents density along roadways (10 Meters of center)
- Dots represent activities

New York State Fair Syracuse - August 23 to September 4, 2017



- The plot shows State Fair attendance (right axis) and AirSage sample distribution (left axis) by day (x-axis)
- As can be seen, AirSage sample follows fair attendance distribution very closely.





AirSage GPS Introduction

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