An Empirical Examination of Freeway Travel Reliability

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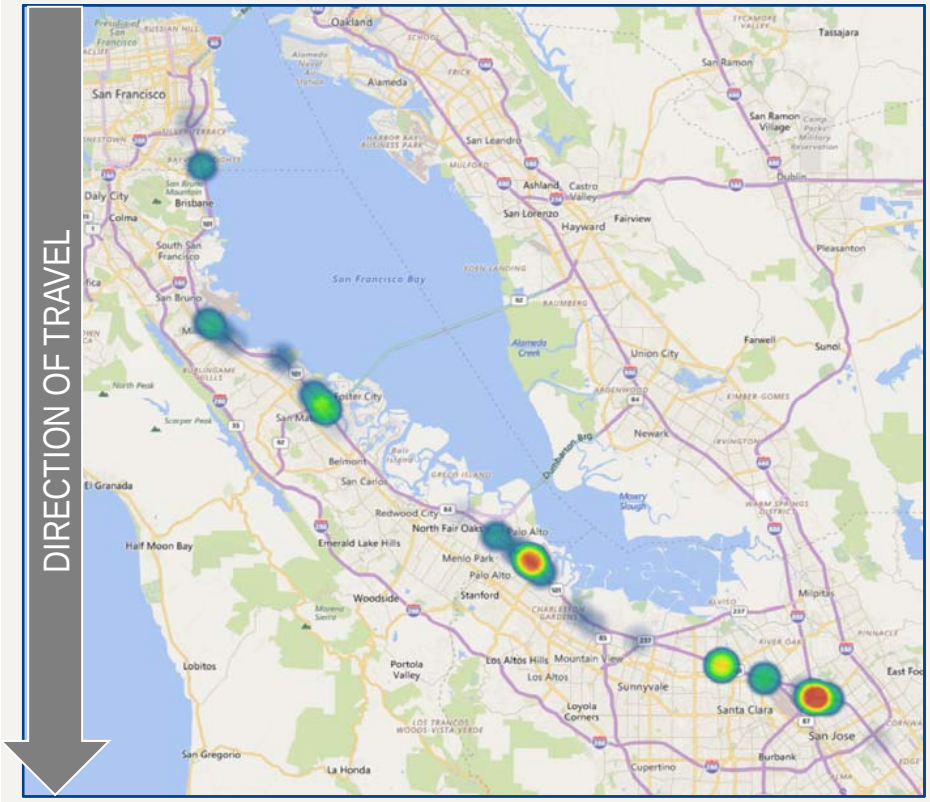
ITSCA
Intelligent Transportation Society of California

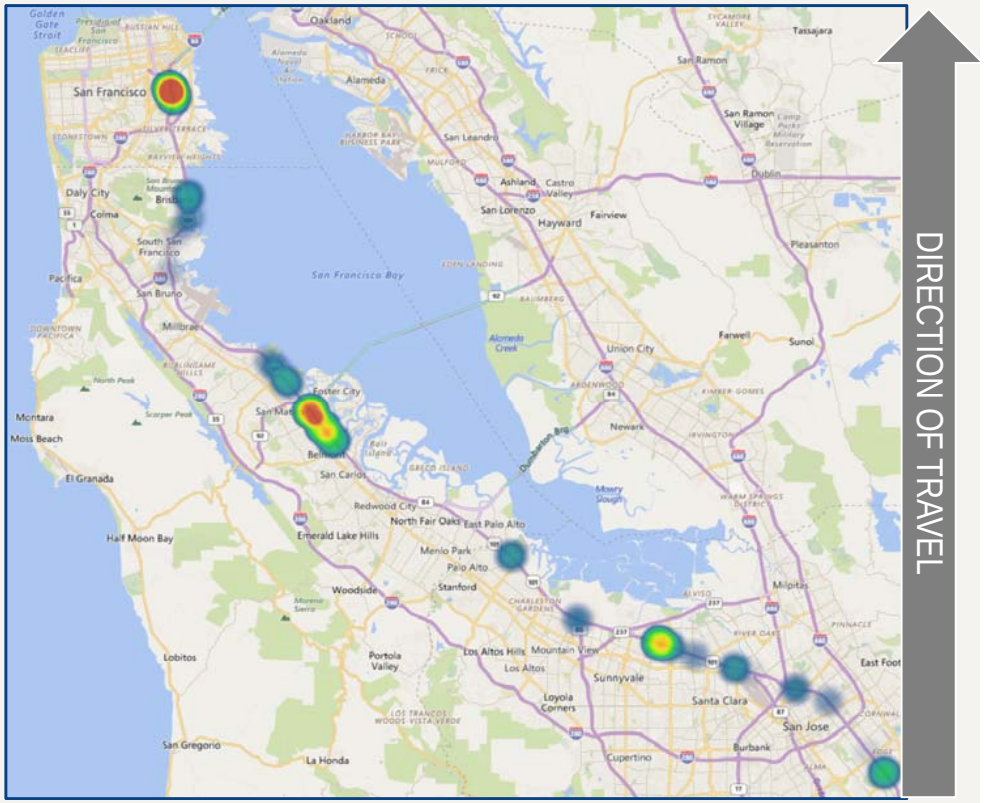
Session #9, Where the Rubber Meets the Road – Real Results in the Age of Performance-Based Operations

US-101 Study Corridor
San Francisco to San Jose

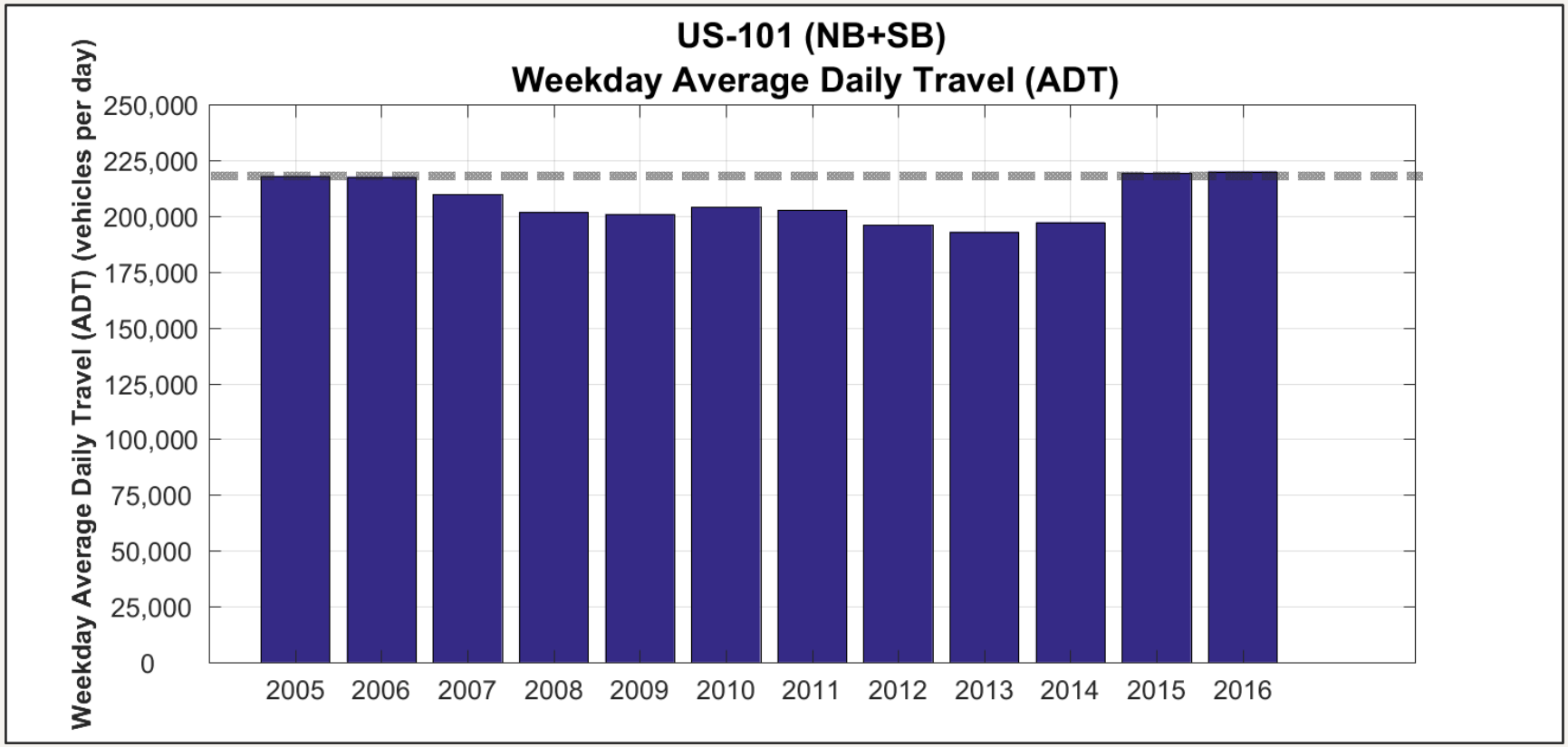
Southbound Bottlenecks



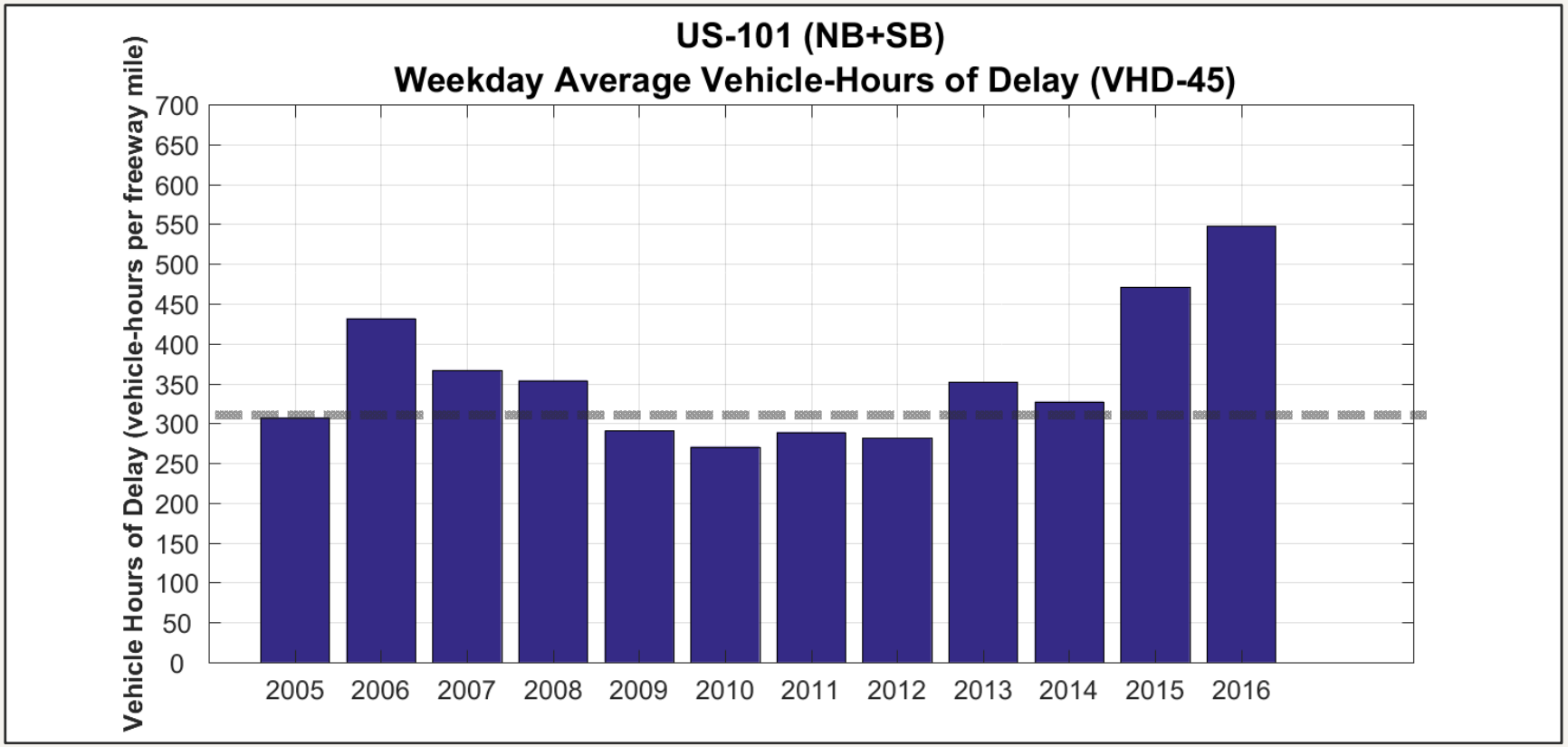
Northbound Bottlenecks



US-101 (Northbound + Southbound)
Average Weekday Average Daily Travel (ADT)

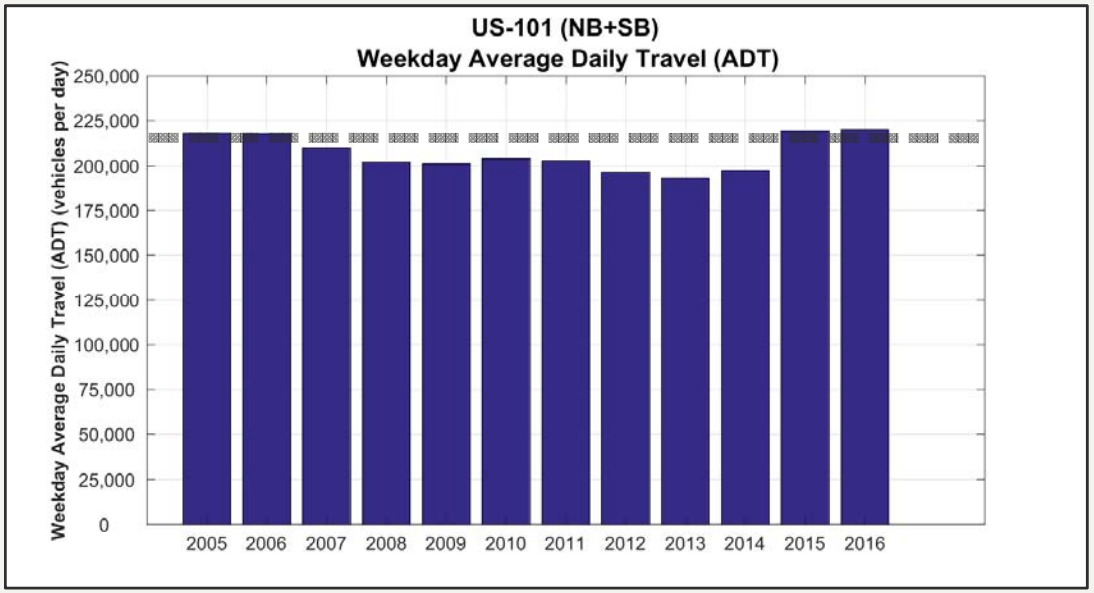


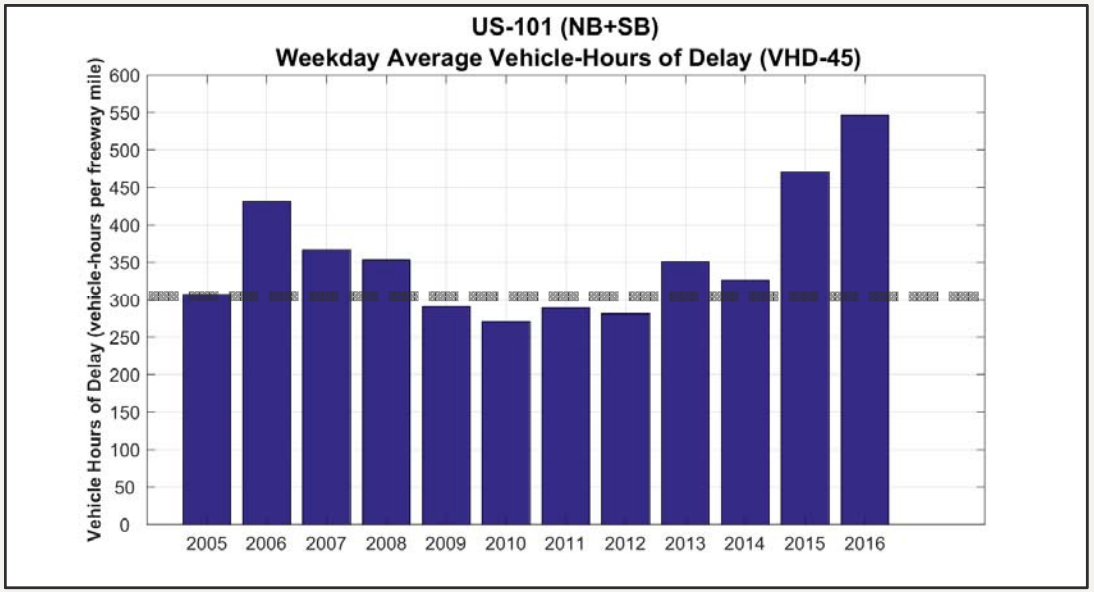
US-101 (Northbound + Southbound)
Average Weekday Vehicle Hours Delayed (VHD)



US-101 Corridor - Corridor Demand & Congestion Trends

In heavily congested corridors, moderate changes in demand can bring about large impacts to travel delays & levels of congestion.

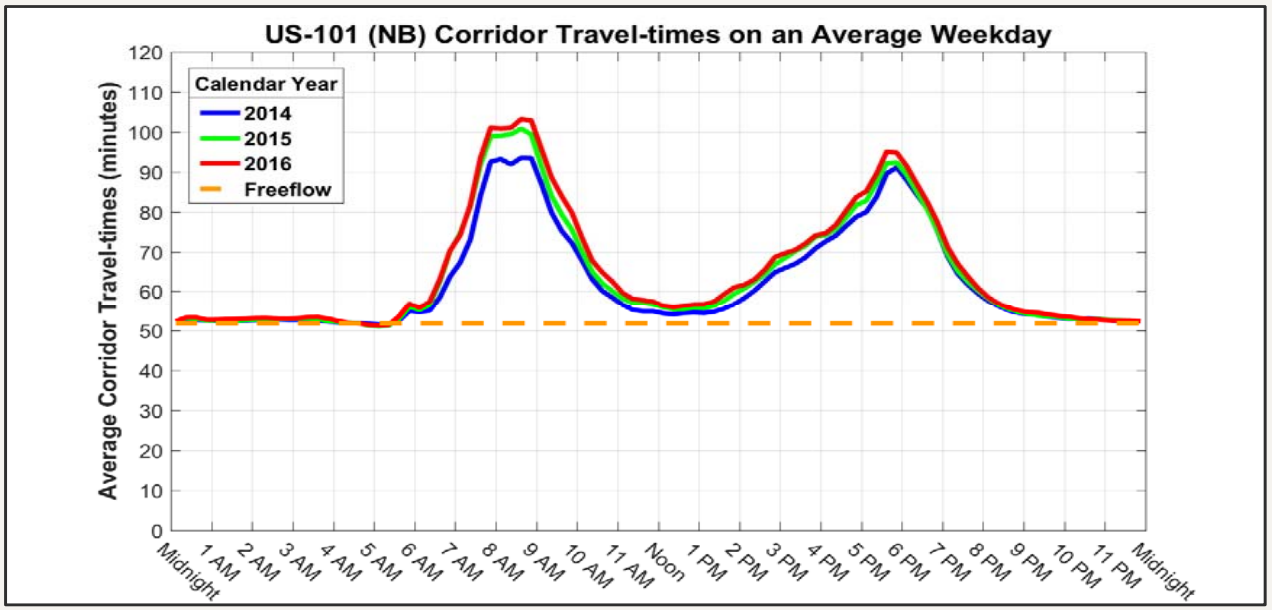


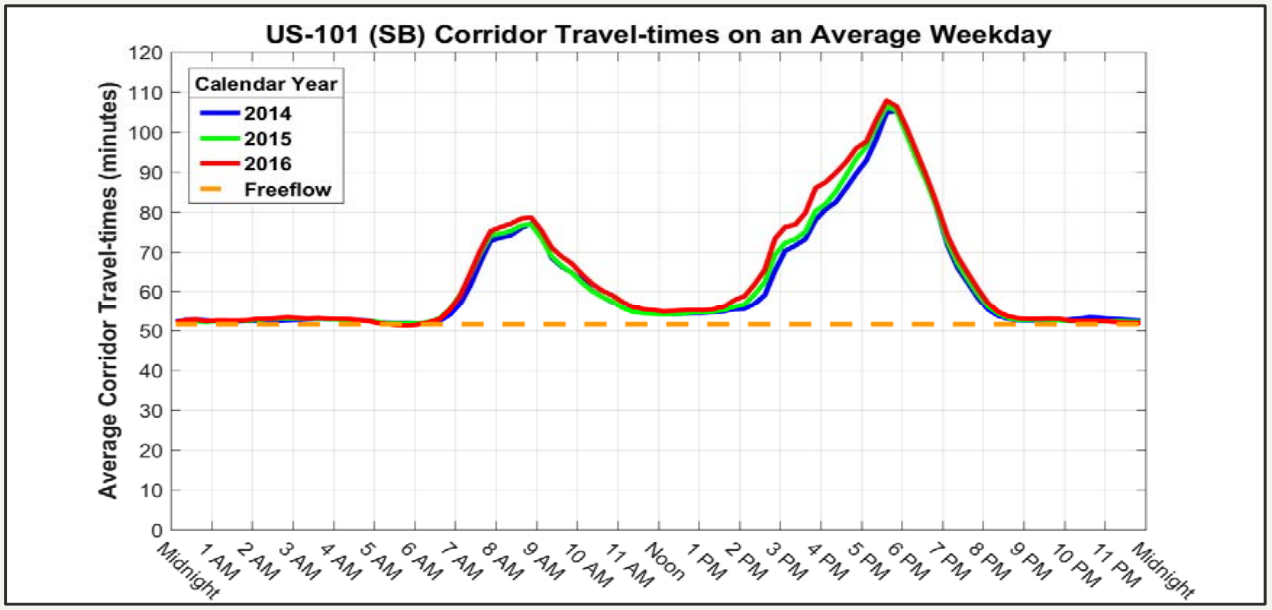


Corridor Traffic Growth Trends (2014-16)

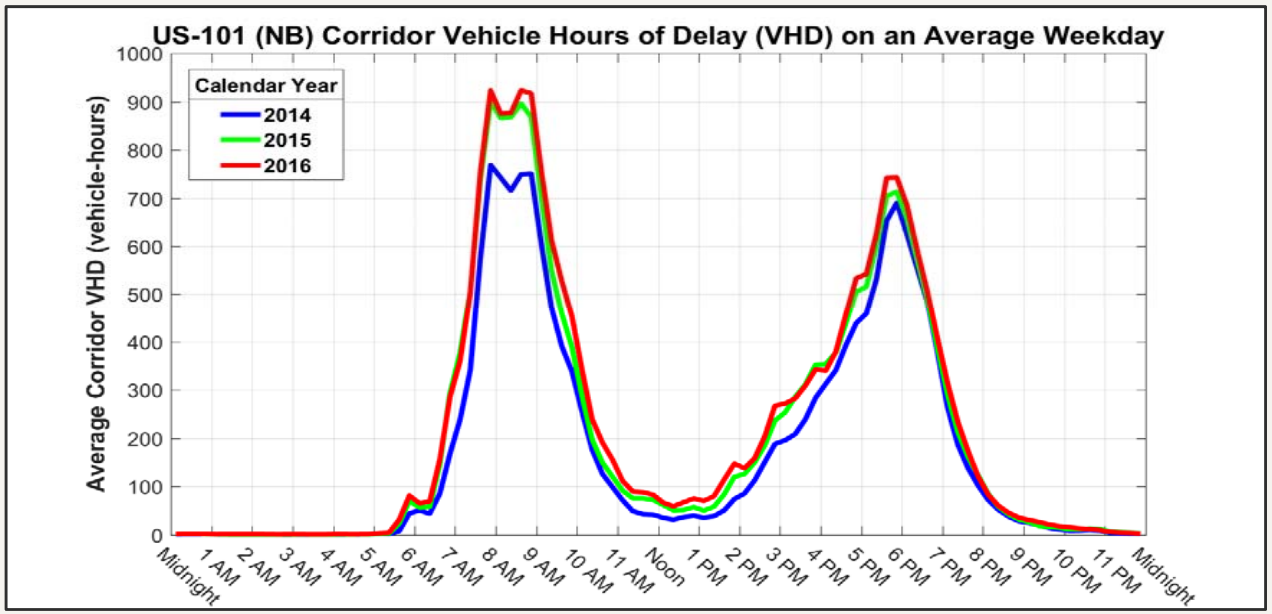
Day(s) of Week	Corridor Performance Metric	US-101 Northbound	US-101 Southbound
Non-holiday Weekday	VMT	3.2%	4.6%
	VHD	12.4%	12.4%
Saturday	VMT	6.5%	8.0%
	VHD	28.0%	29.5%
Sunday	VMT	5.4%	7.2%
	VHD	32.2%	43.4%

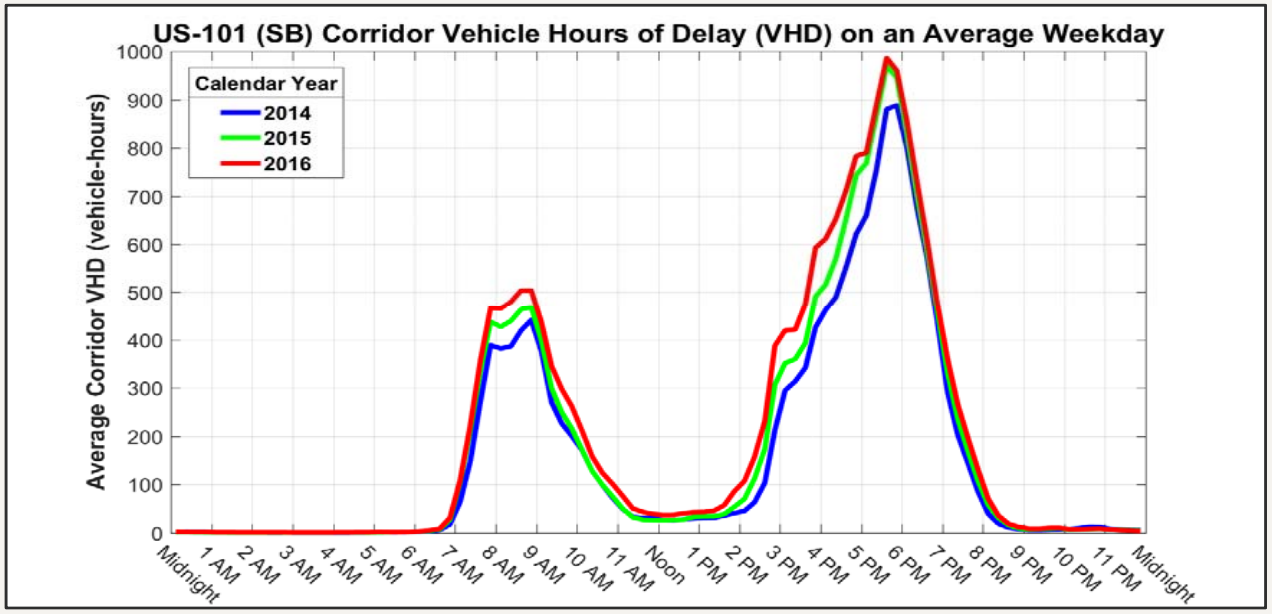
US-101 Corridor - Weekday Average Travel-times





US-101 Corridor – Weekday Average Vehicle-Hours Delayed





Travel Time Reliability – Buffer Index

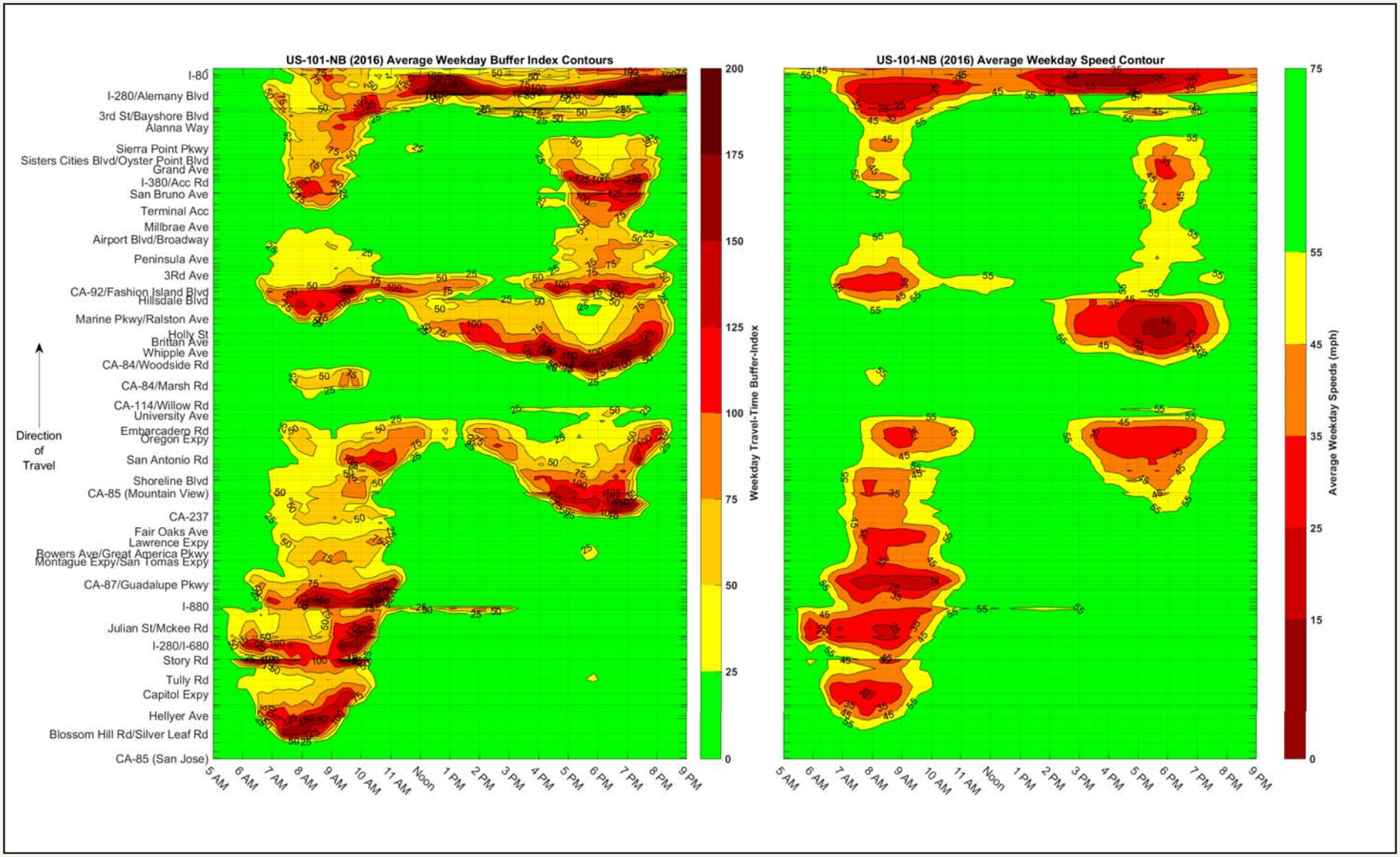
Buffer Index (BI) is a very commonly used travel-time reliability metric.

The buffer index represents the extra time (or time cushion) that travelers must add to their average travel time when planning trips to ensure an on-time arrival.

$$BI\ (\%) = 100\% * \frac{95th\ \% - ile\ travel\ time\ (minutes) - average\ travel\ time\ (minutes)}{average\ travel\ time\ (minutes)}$$

- The 95th percentile travel time is a reasonable upper bound for expected travel time – on very heavily congested days.
- A BI of zero means that the 95th percentile travel time and the average travel time are the same; there are no differences (or variability) in the travel times between an average day and a heavily congested day.
- A BI of 50 means that the travel times on heavily congested days are 1.50 times (or 50%) greater than on average days.

US-101 Northbound
Average Weekday Buffer-Index & Speed Contours



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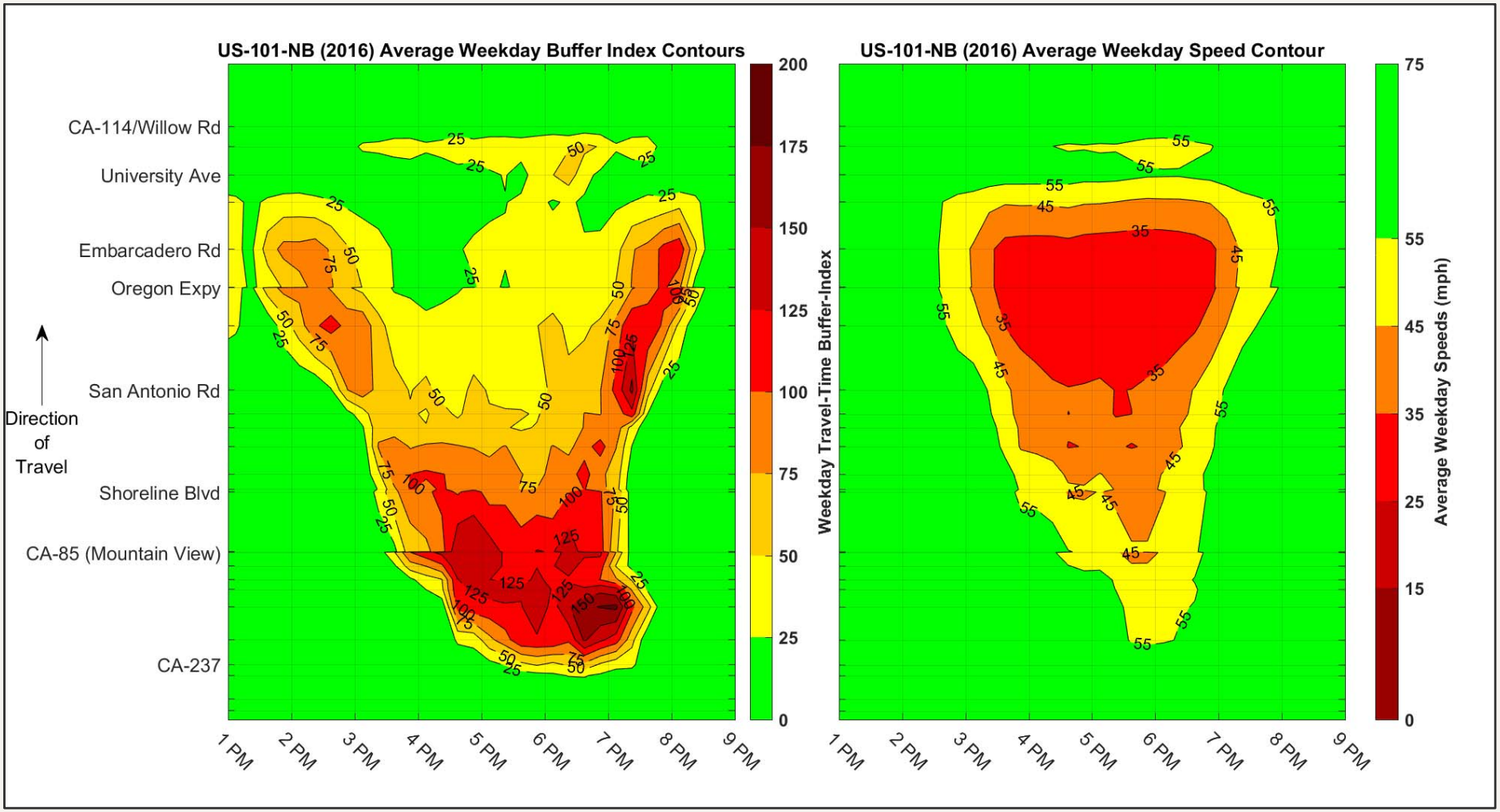
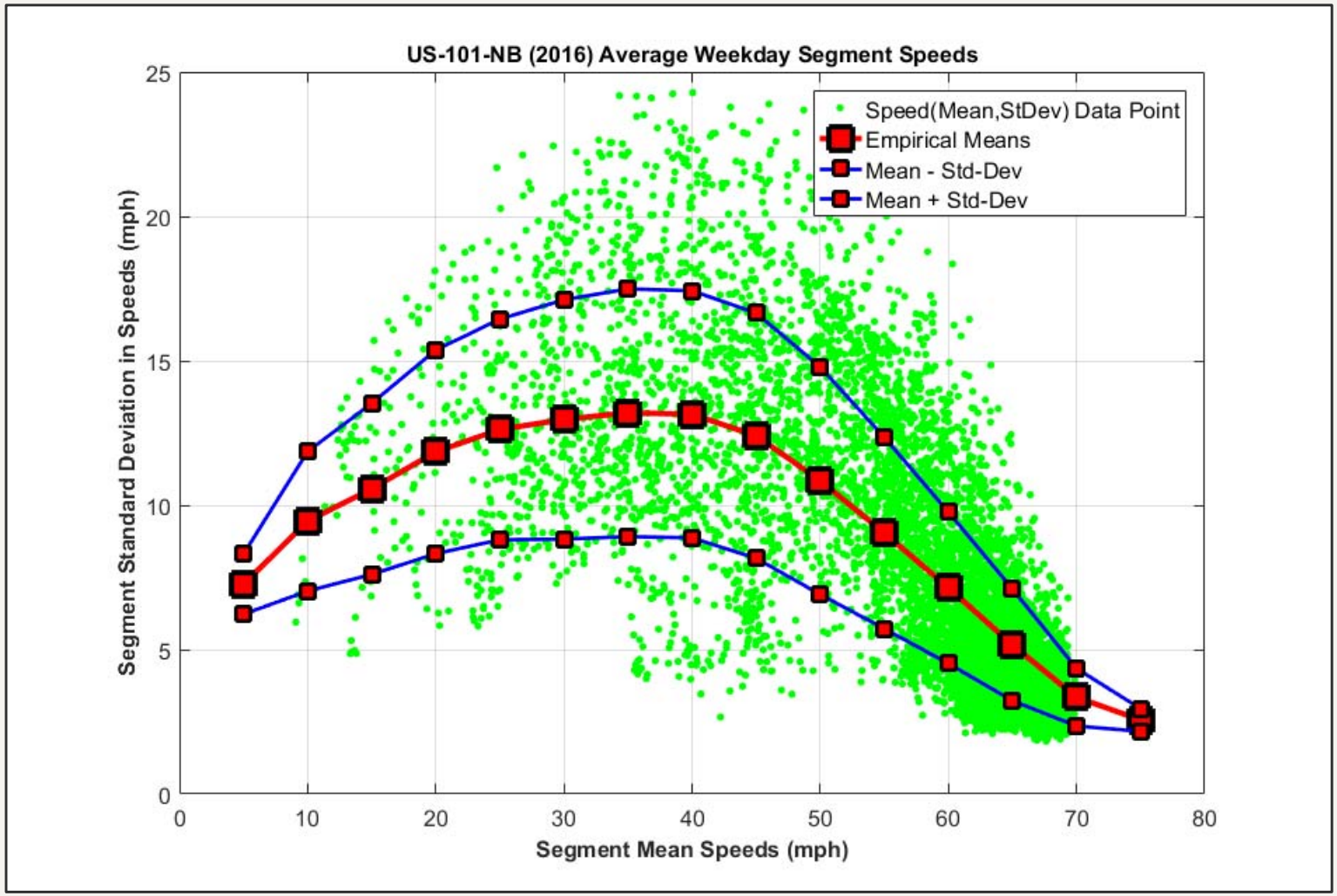


INRIX data: Mean speeds & reliability

Unreliable Speeds

Moderate Reliability

Stable Speeds

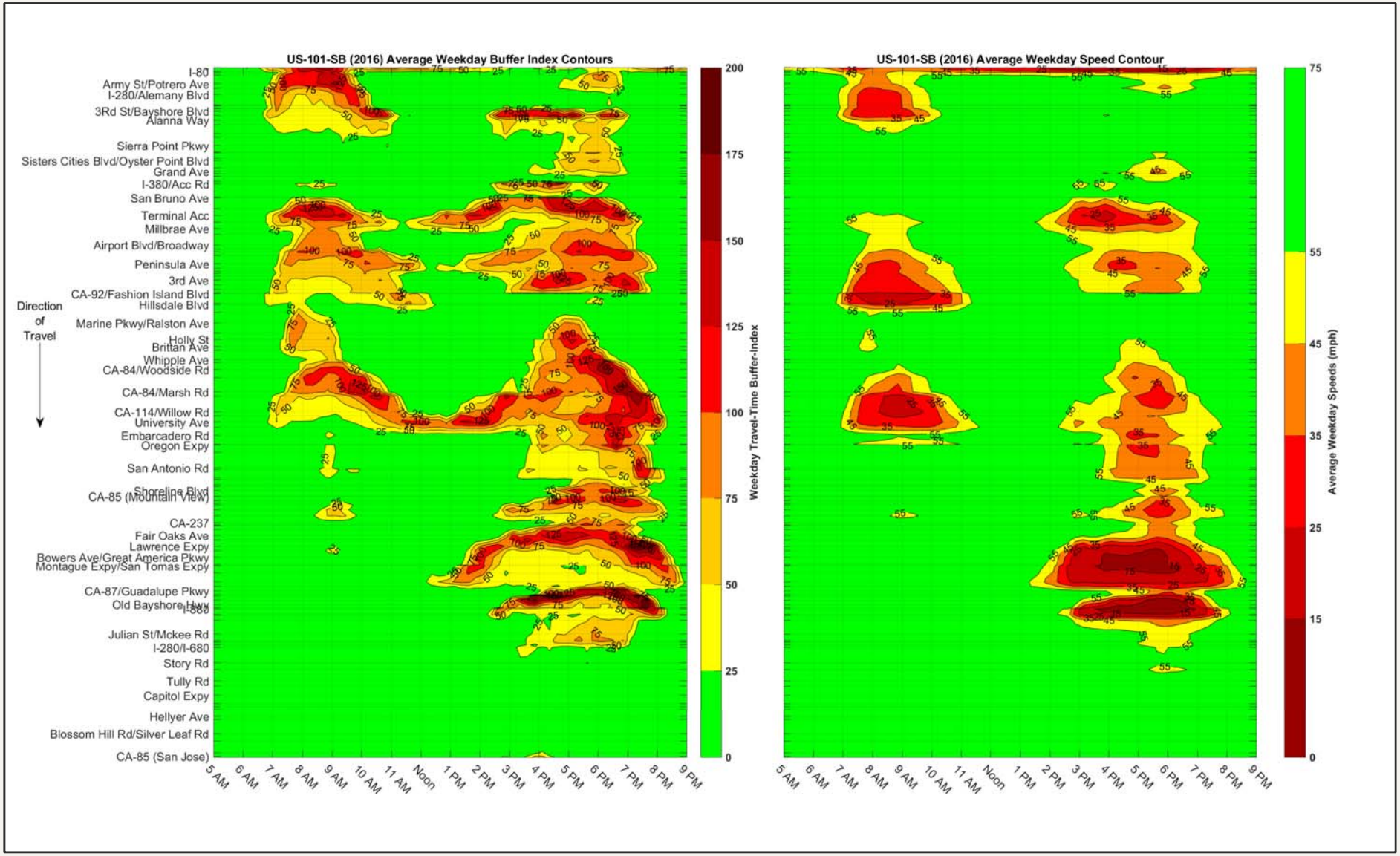


Highly Congested

Moderate Congestion

Freely Flowing

US-101 Southbound
Average Weekday Buffer-Index & Speed Contours



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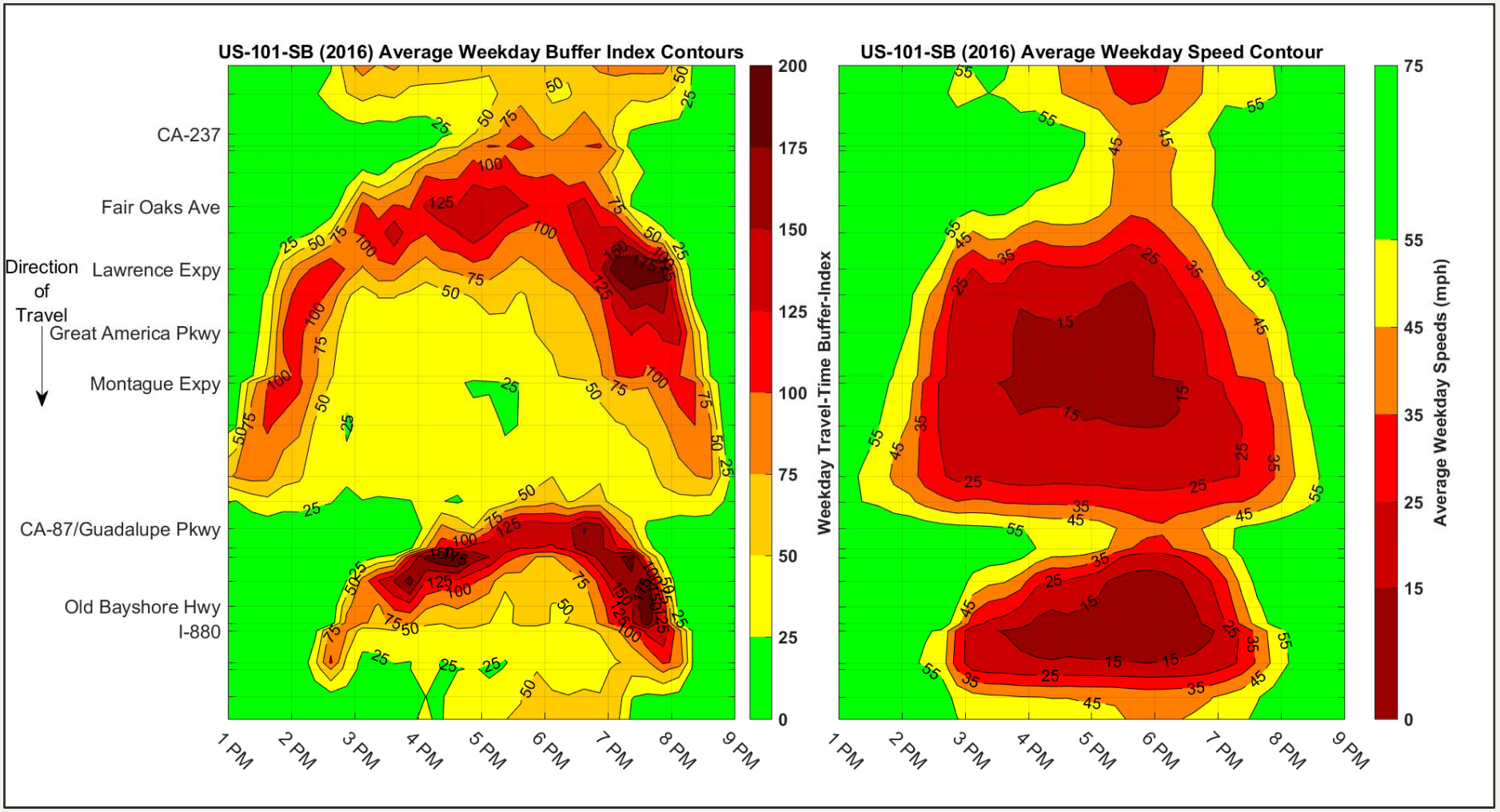

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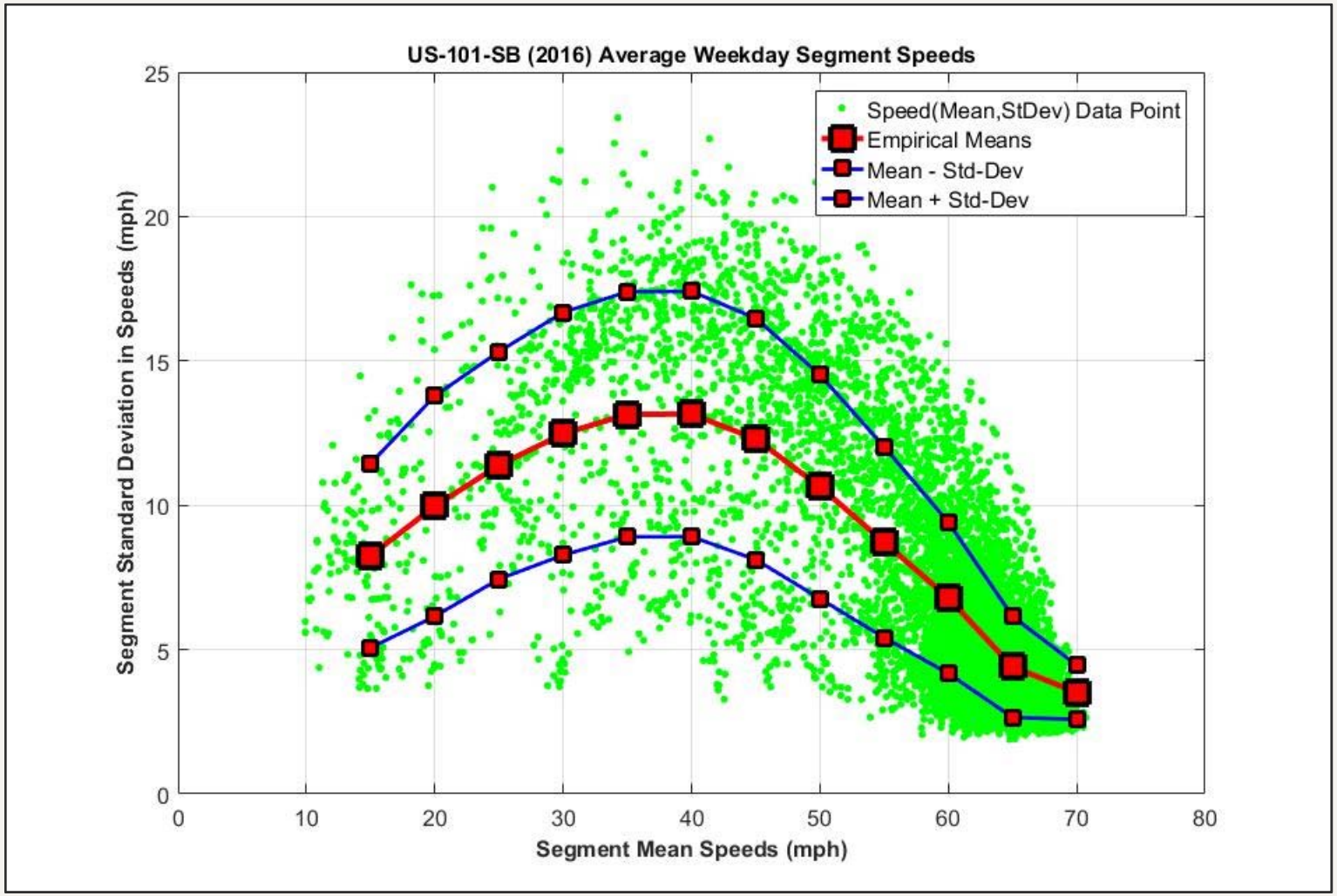

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Moderate Congestion

Freely Flowing

Freeway travel-time reliability

Reliability = Consistency

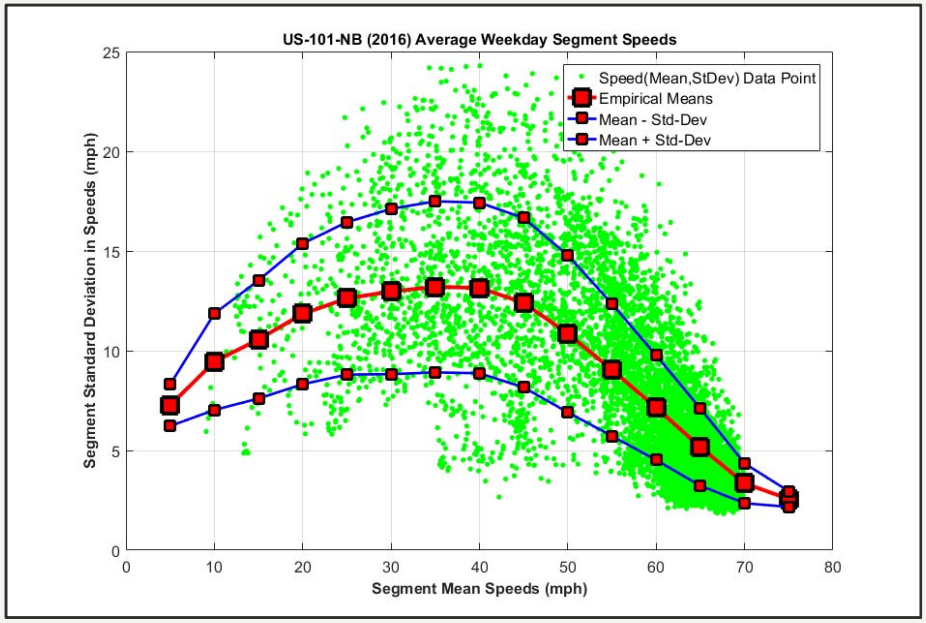
Travel times tend to be reliable or consistent on freeway segments (and time-of-day) when traffic is always freely flowing – no congestion.

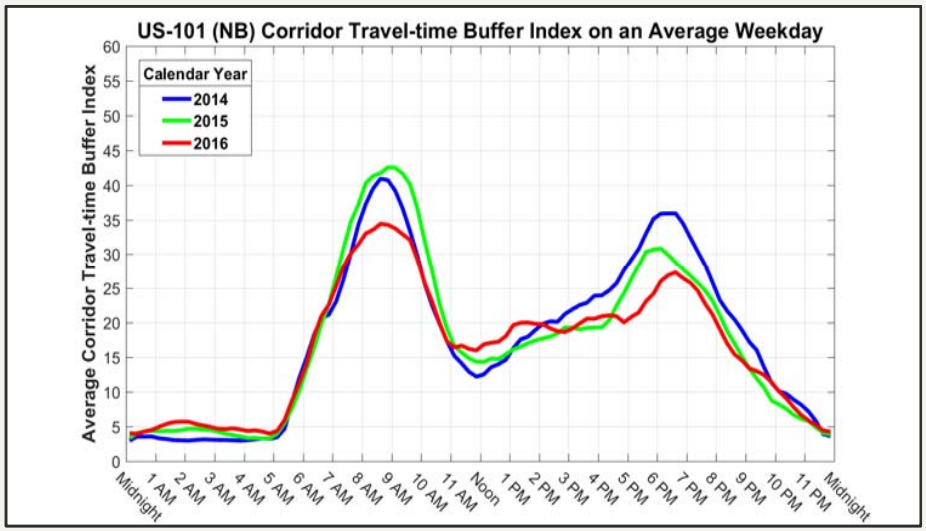
Travel times tend to be fairly reliable on heavily congested stretches – segments and times that are congested every day – not just occasionally congested.

Travel times tend to be the most unreliable on freeway segments that are congested on some days and not congested on other days – some good days & some bad days → not consistent.

Reliability gets worse as corridors transition from uncongested to moderately congested.

Reliability gets better as corridors transition from moderate to severe congestion.





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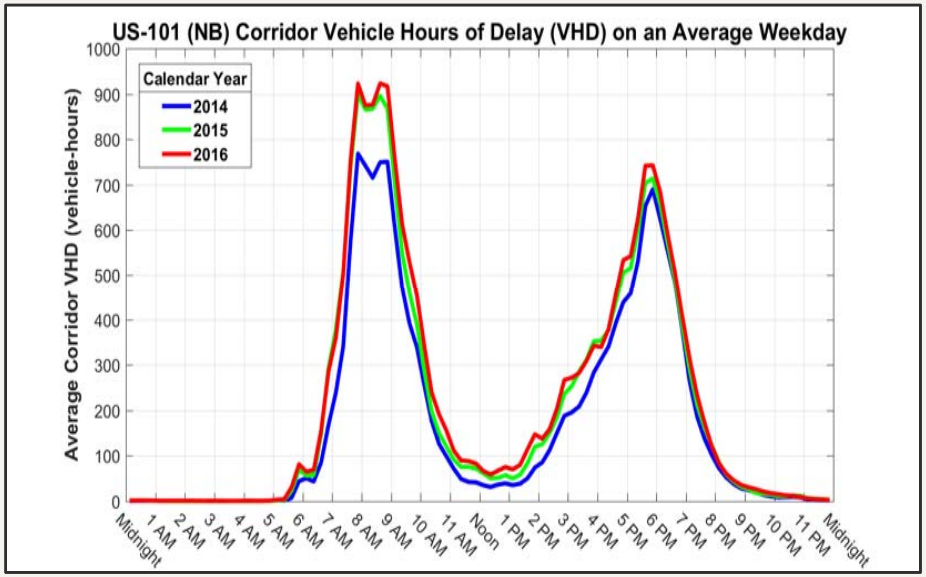

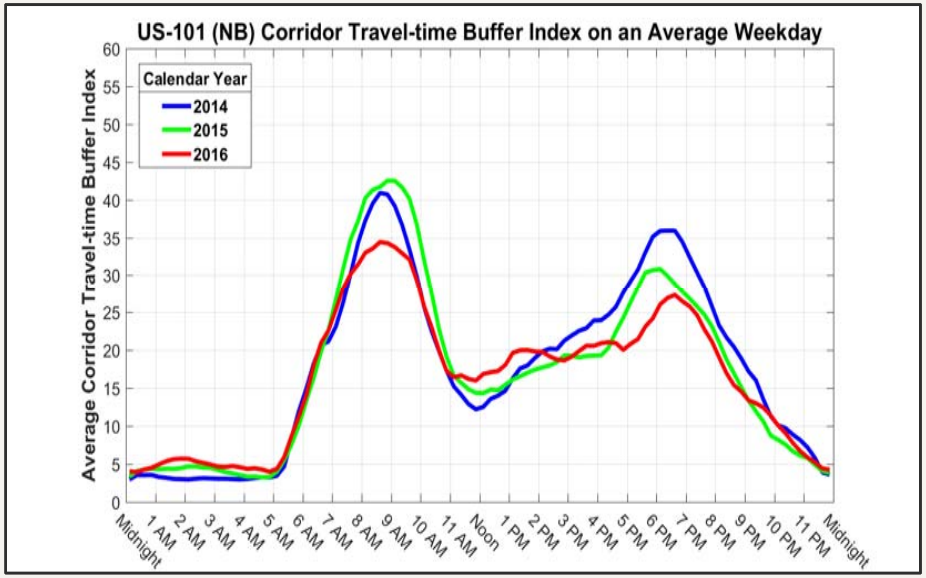

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Thank You

Questions & Comments