An Empirical Examination of Freeway Travel Reliability

Michael Mauch
UC Berkeley – ITS/PATH

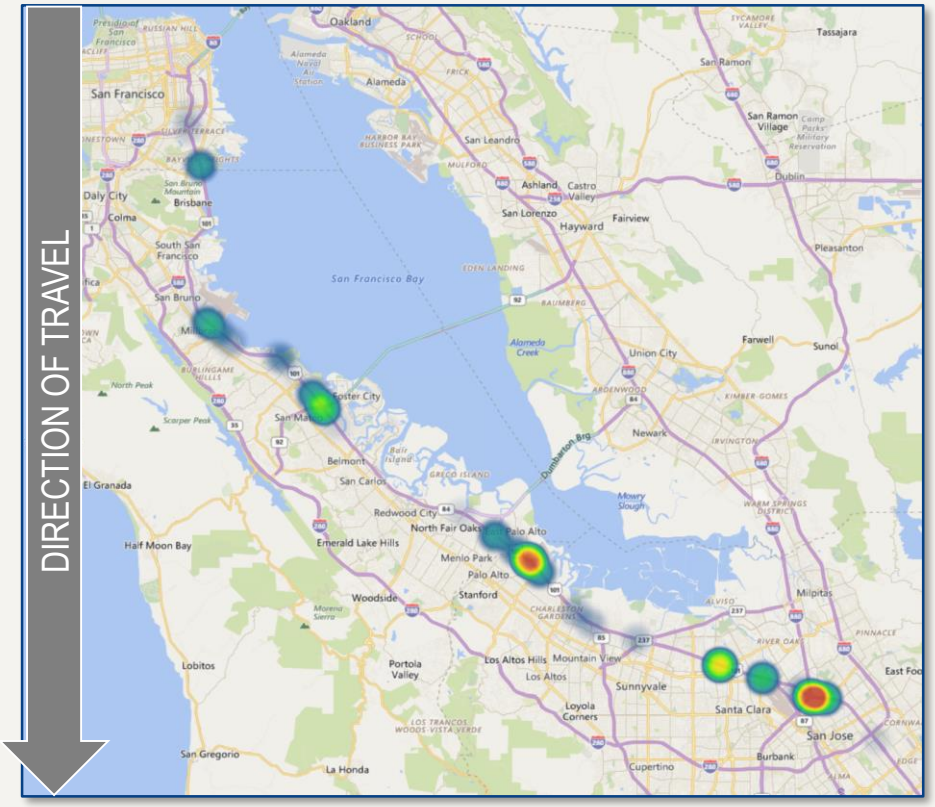
2017 ITE Western District Annual Meeting

Session 9C: Bridges, Tunnels, and Freeways

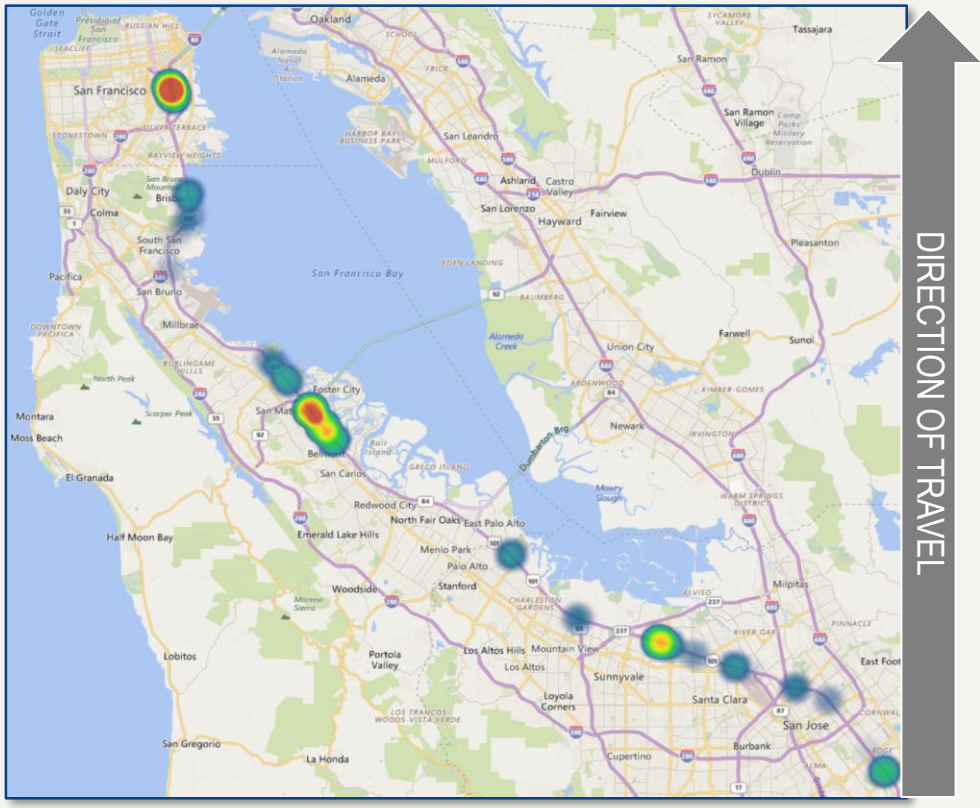
Wednesday, June 21, 2017

US-101 Study Corridor
San Francisco to San Jose

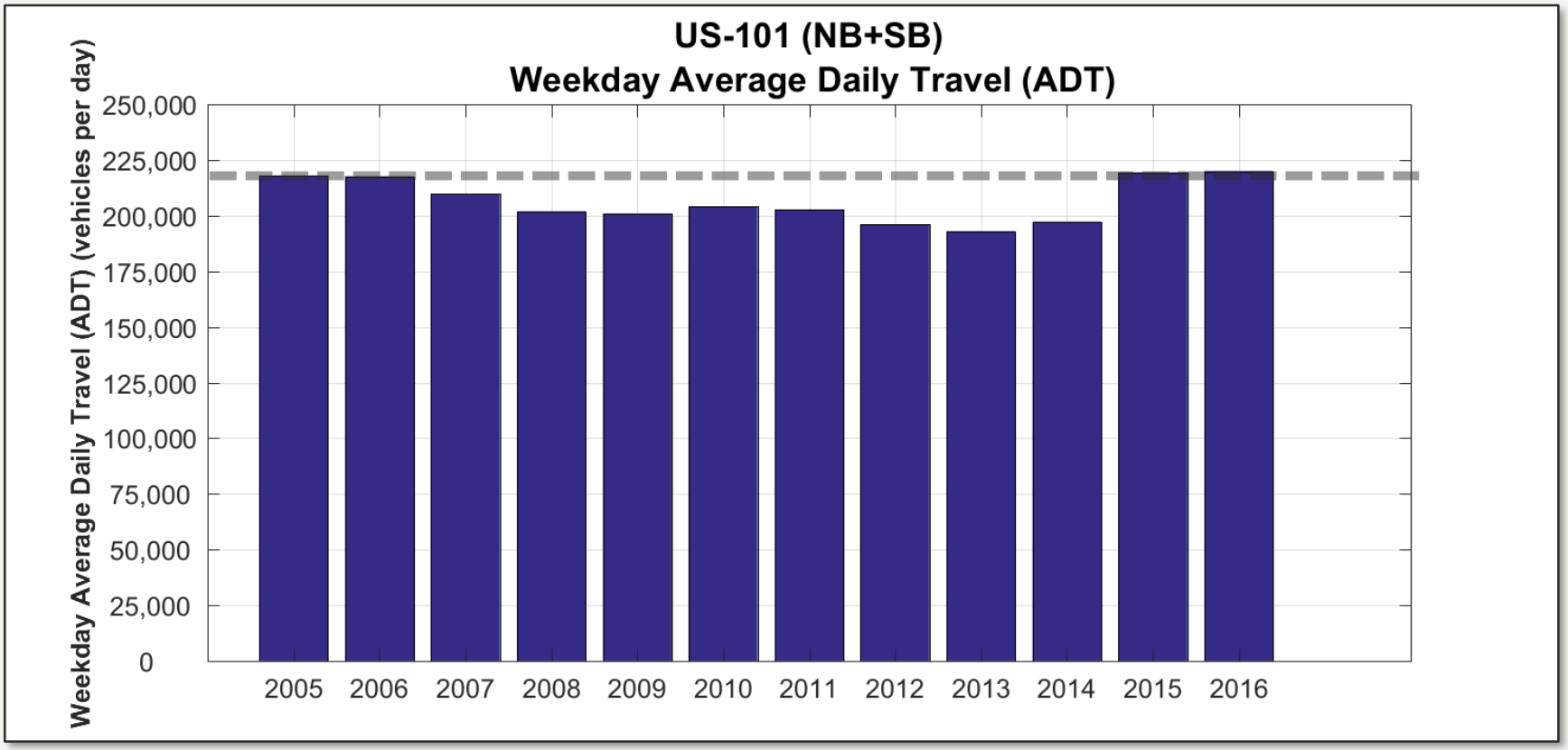
Southbound Bottlenecks



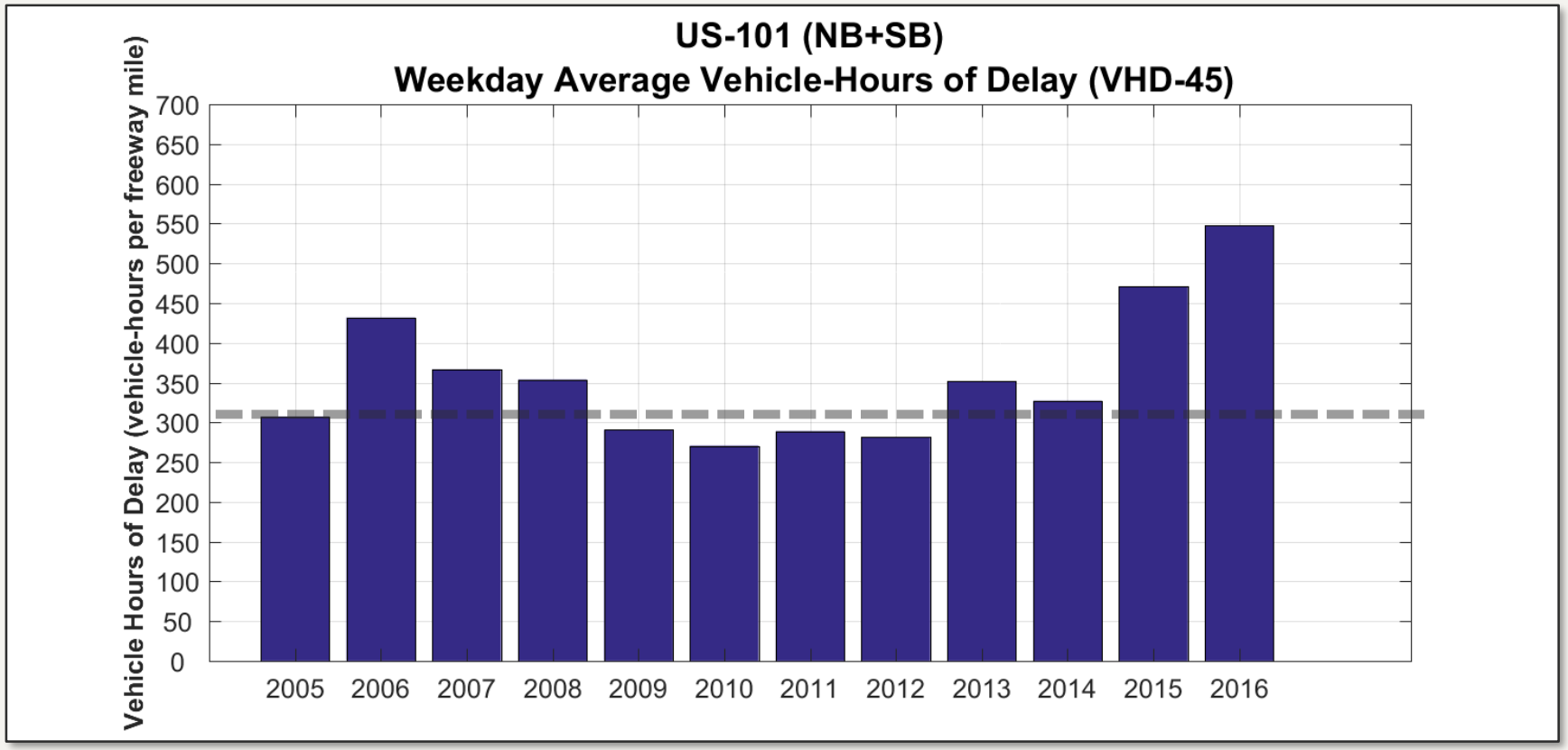
Northbound Bottlenecks



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

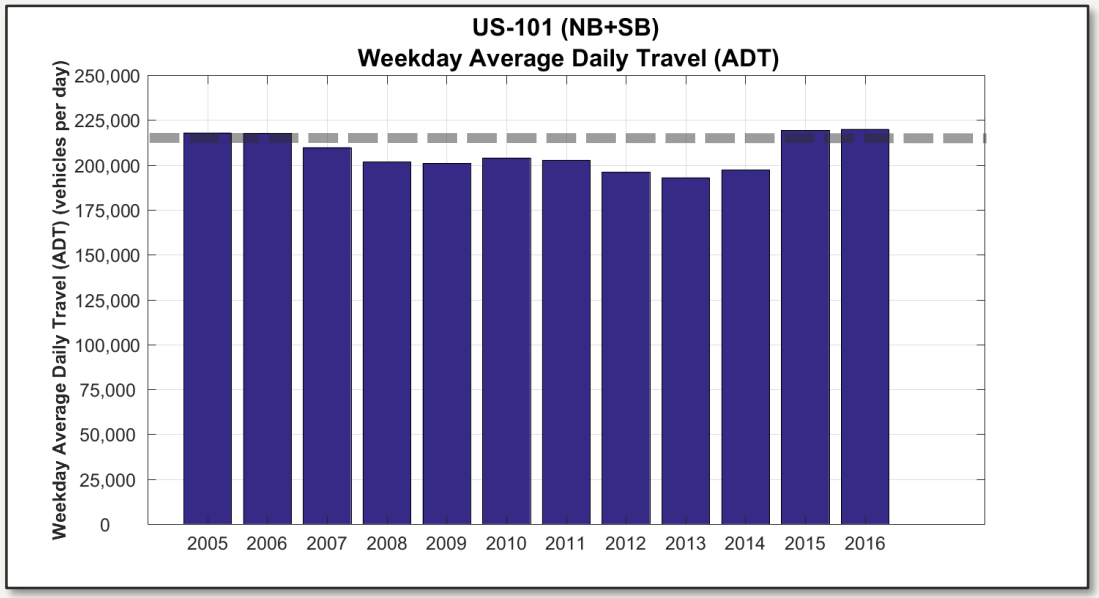


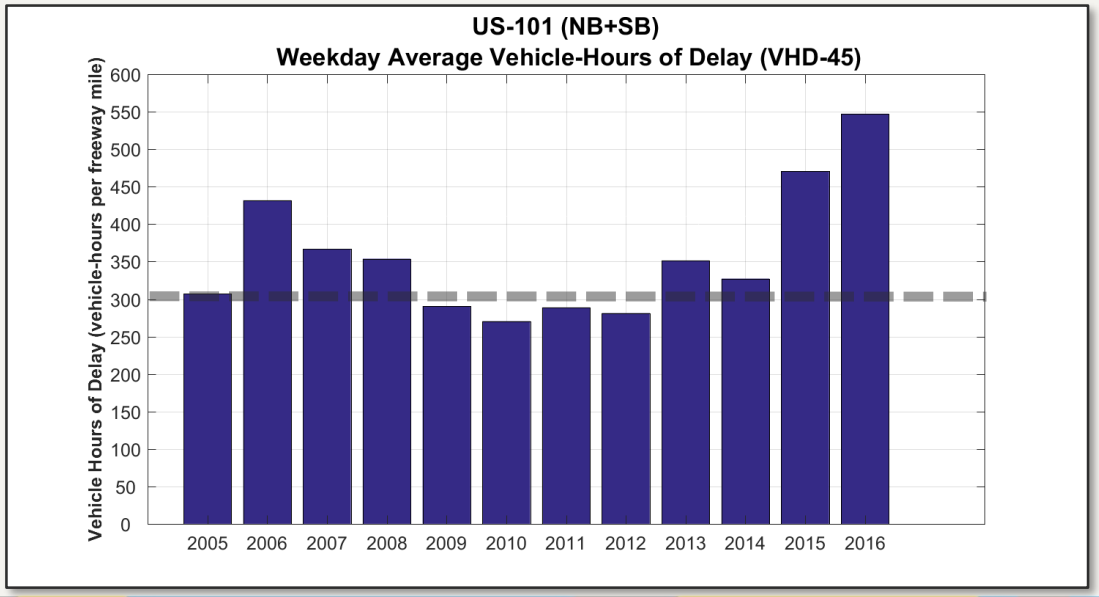
US-101 (Northbound + Southbound)
Average Weekday Vehicle Hours Delayed (VHD)



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.

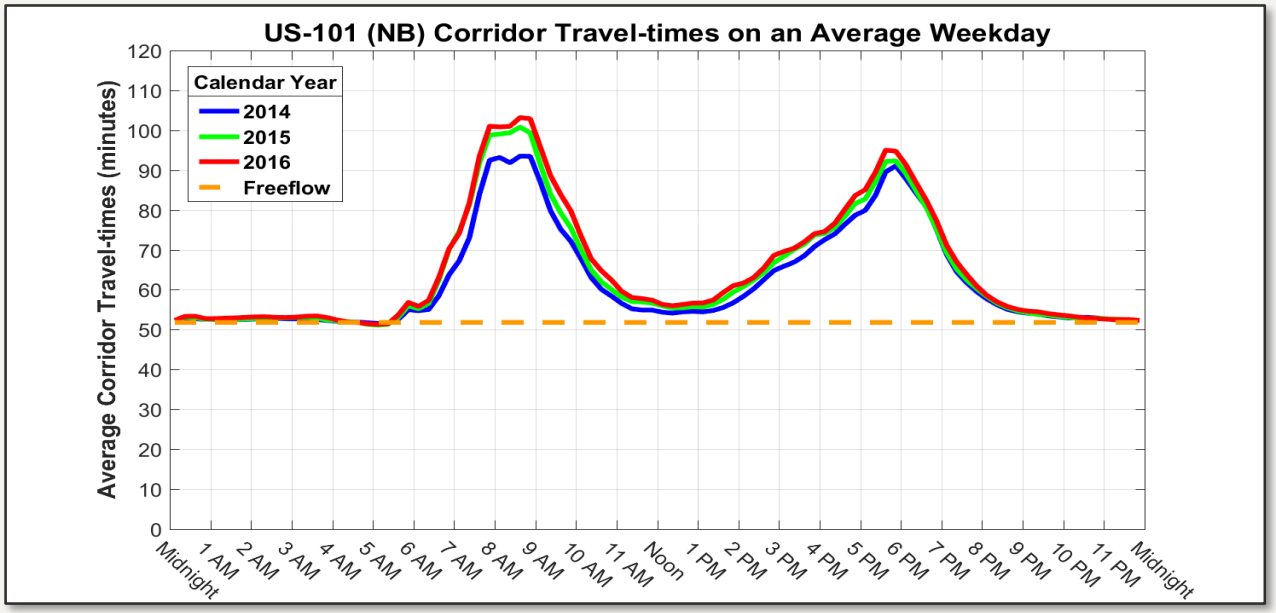


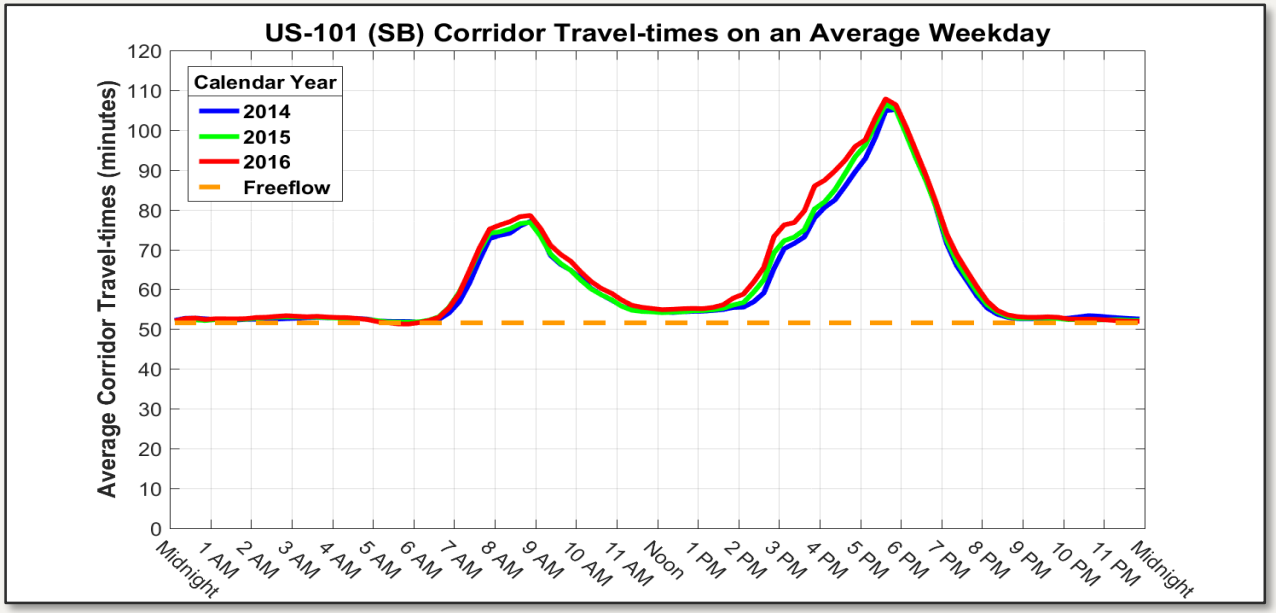


Corridor Traffic Growth Trends (2014-16)

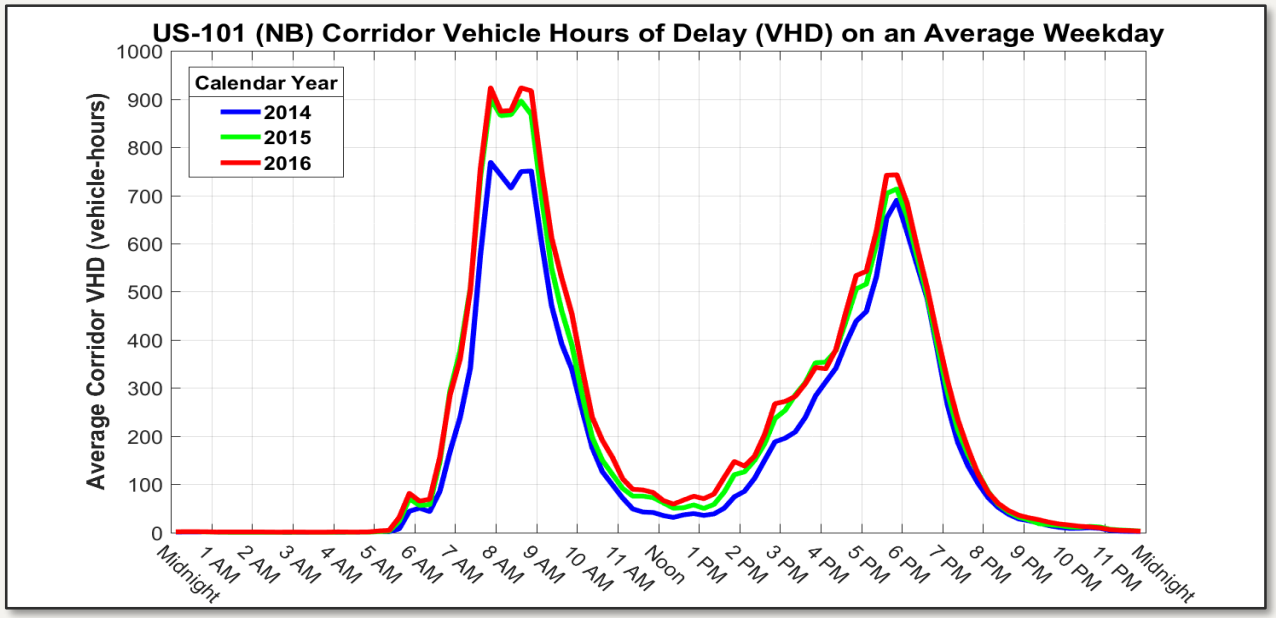
Day(s) of Week	Corridor Performance Metric	US-101 Northbound	US-101 Southbound
Non-holiday Weekday	VMT	3.2%	4.6%
	VHD	12.4%	12.4%
Saturday	VMT	6.5%	8.0%
	VHD	28.0%	29.5%
Sunday	VMT	5.4%	7.2%
	VHD	32.2%	43.4%

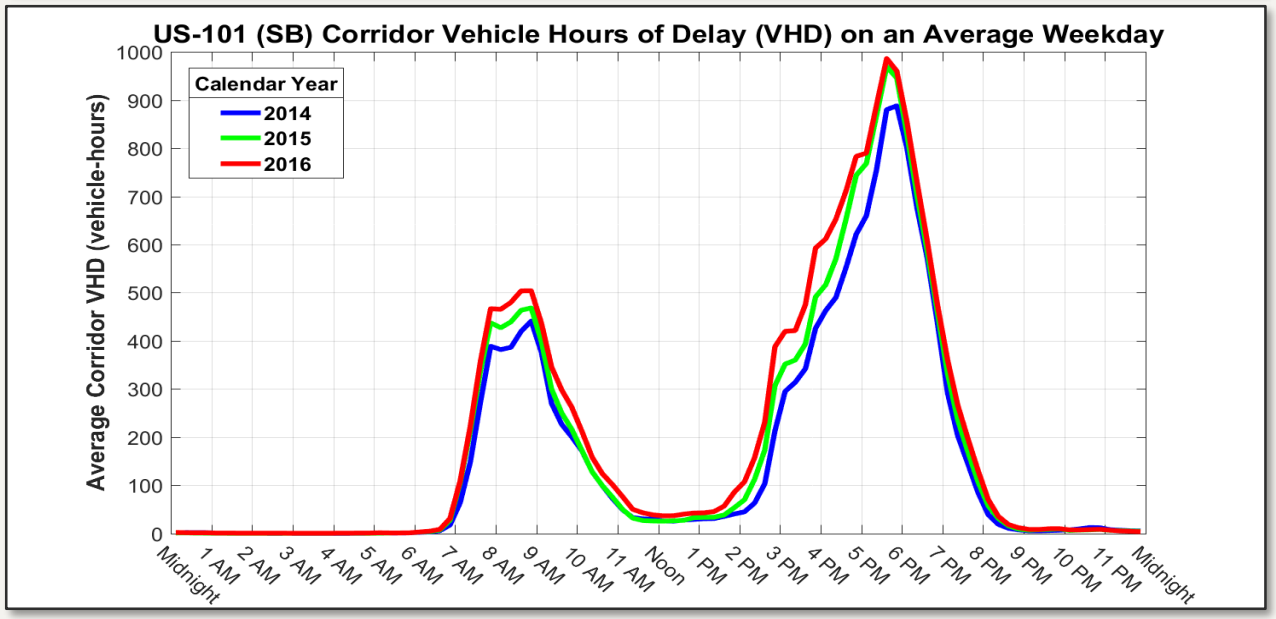
US-101 Corridor - Weekday Average Travel-times





US-101 Corridor – Weekday Average Vehicle-Hours Delayed





Travel Time Reliability – Buffer Index

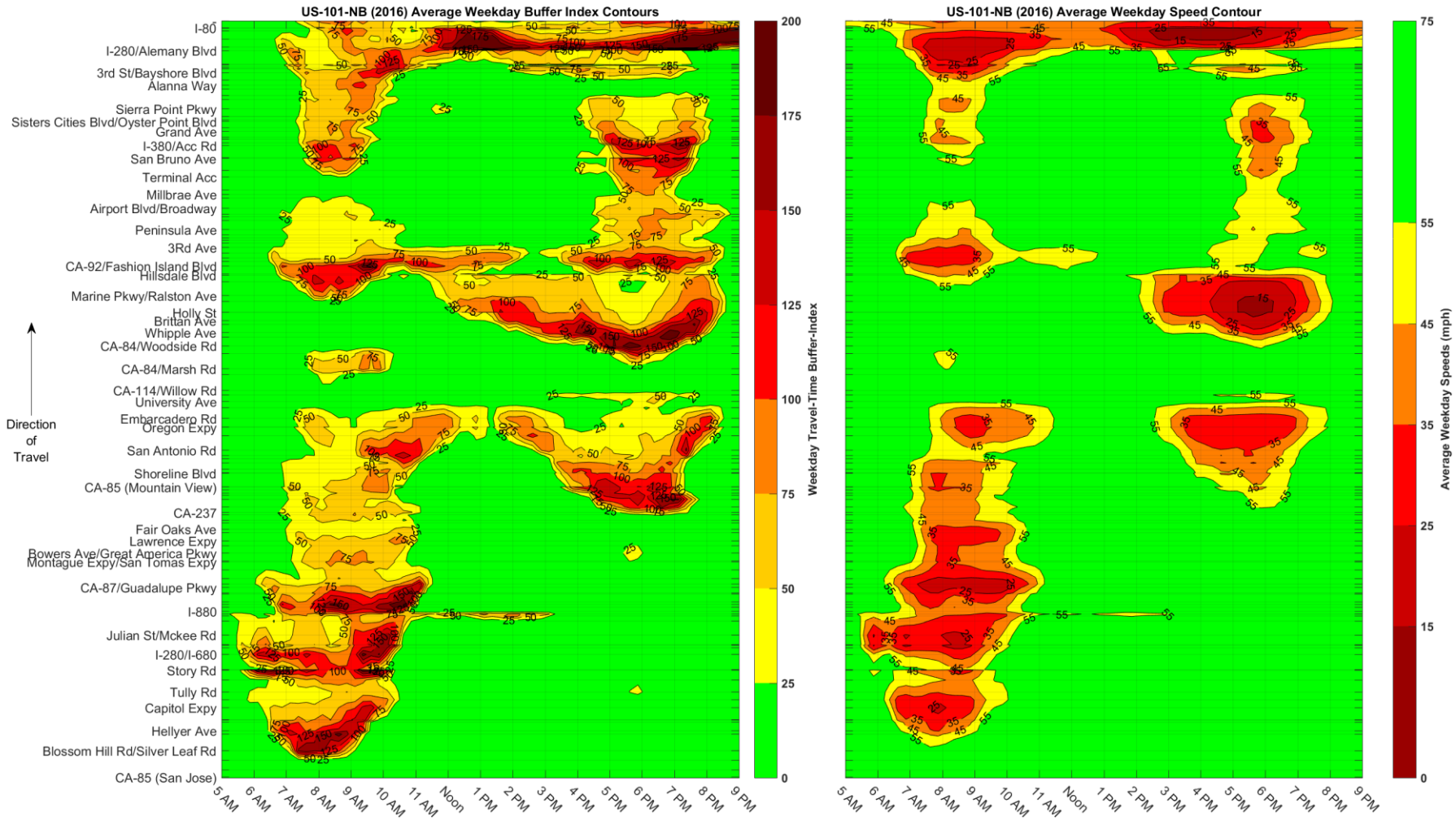
Buffer Index (BI) is a very commonly used travel-time reliability metric.

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.

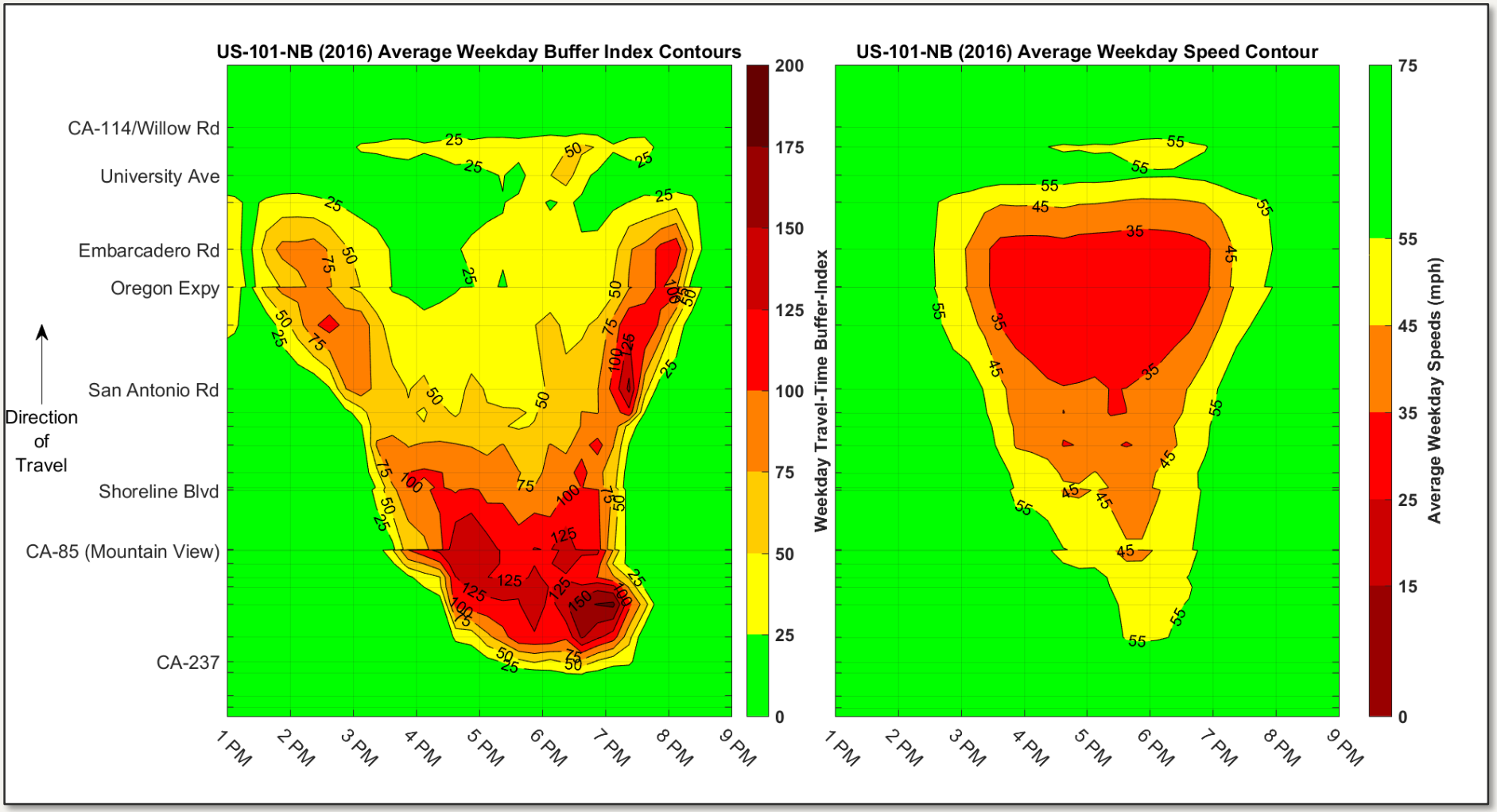
$$BI\ (\%) = 100\% * \frac{95th\ \% - ile\ travel\ time\ (minutes) - average\ travel\ time\ (minutes)}{average\ travel\ time\ (minutes)}$$

- 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



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

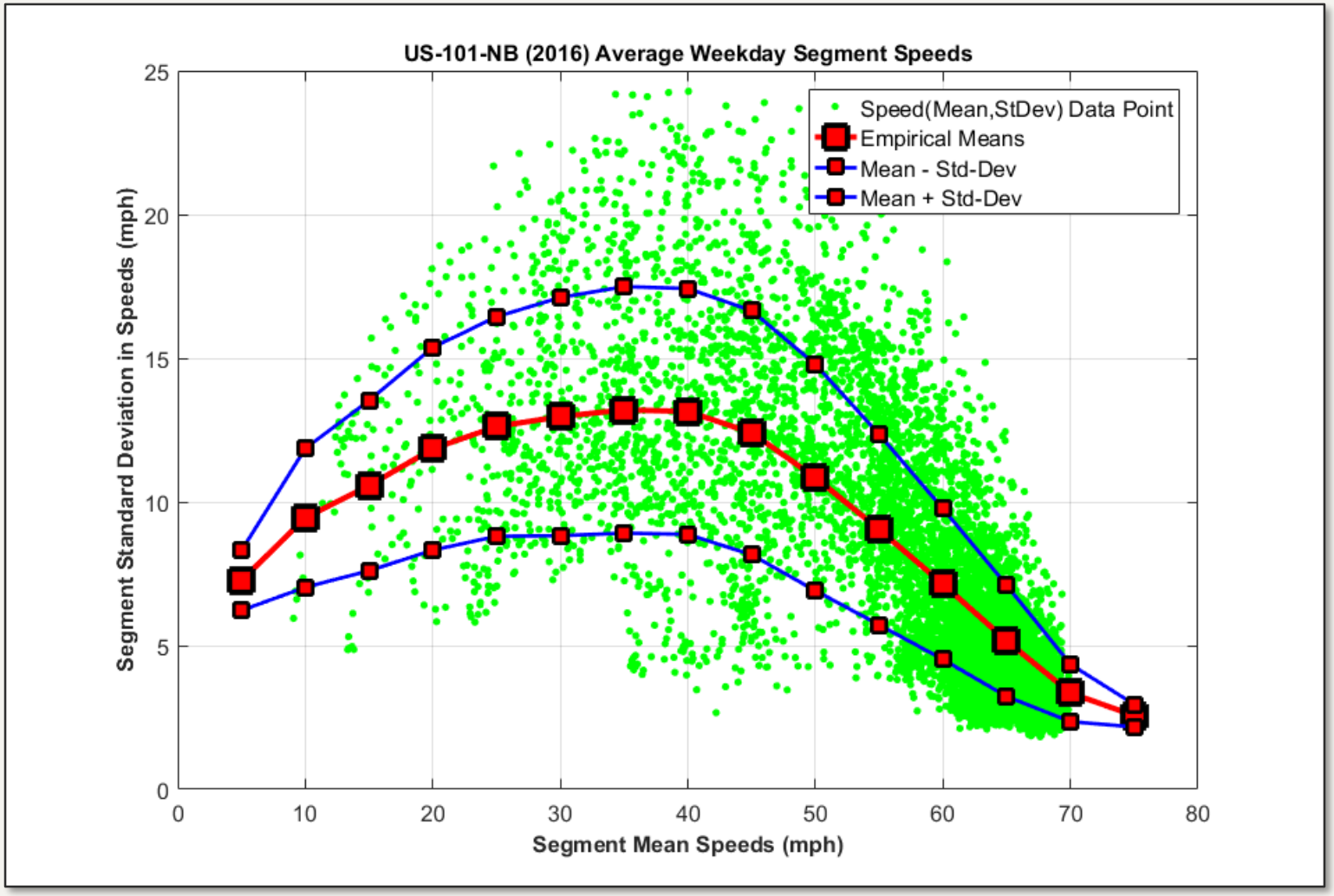


INRIX data: Mean speeds & reliability

Unreliable Speeds

Moderate Reliability

Stable Speeds

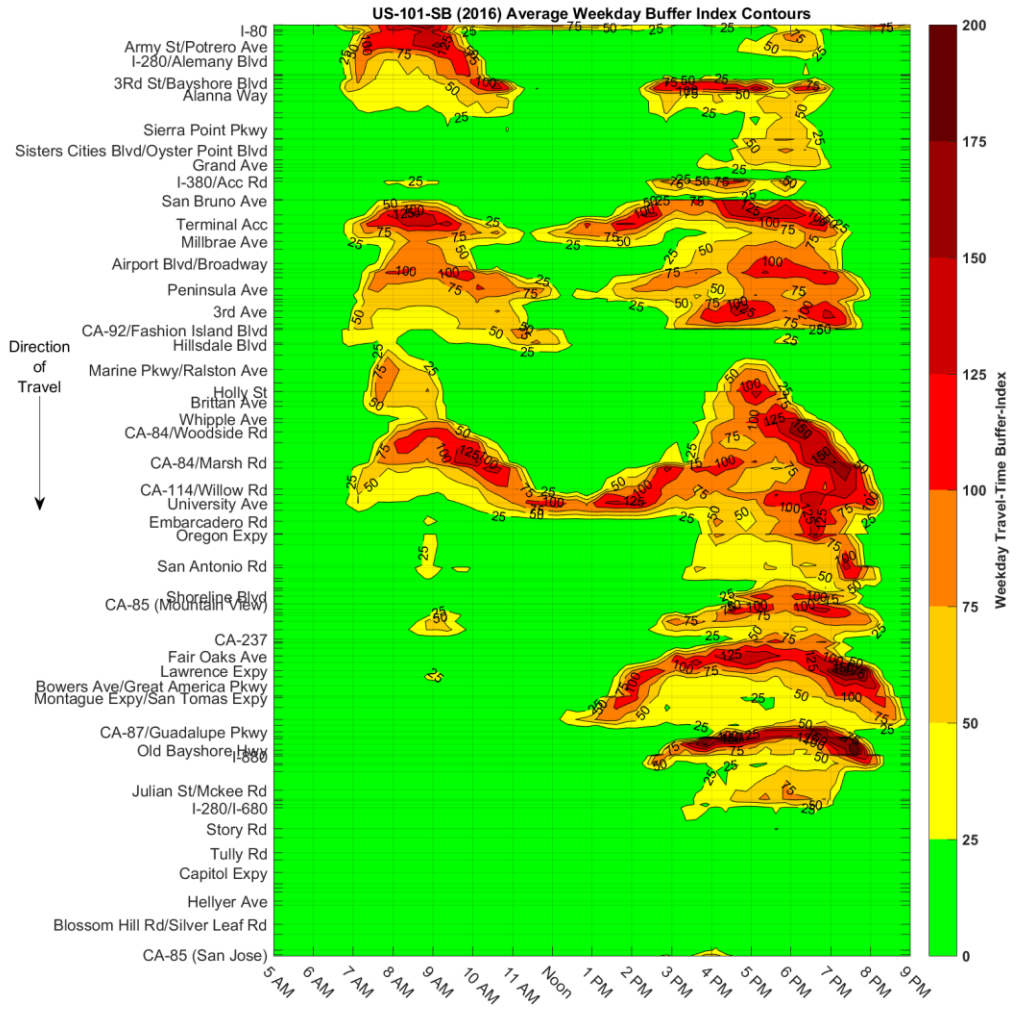


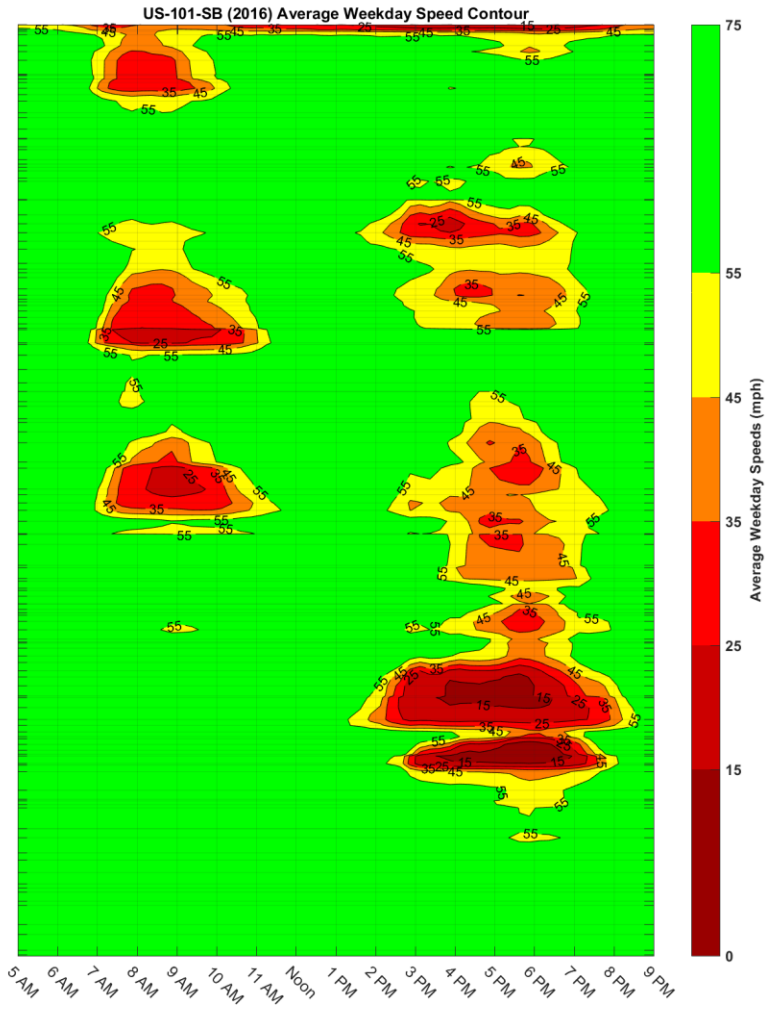
Highly Congested

Moderate Congestion

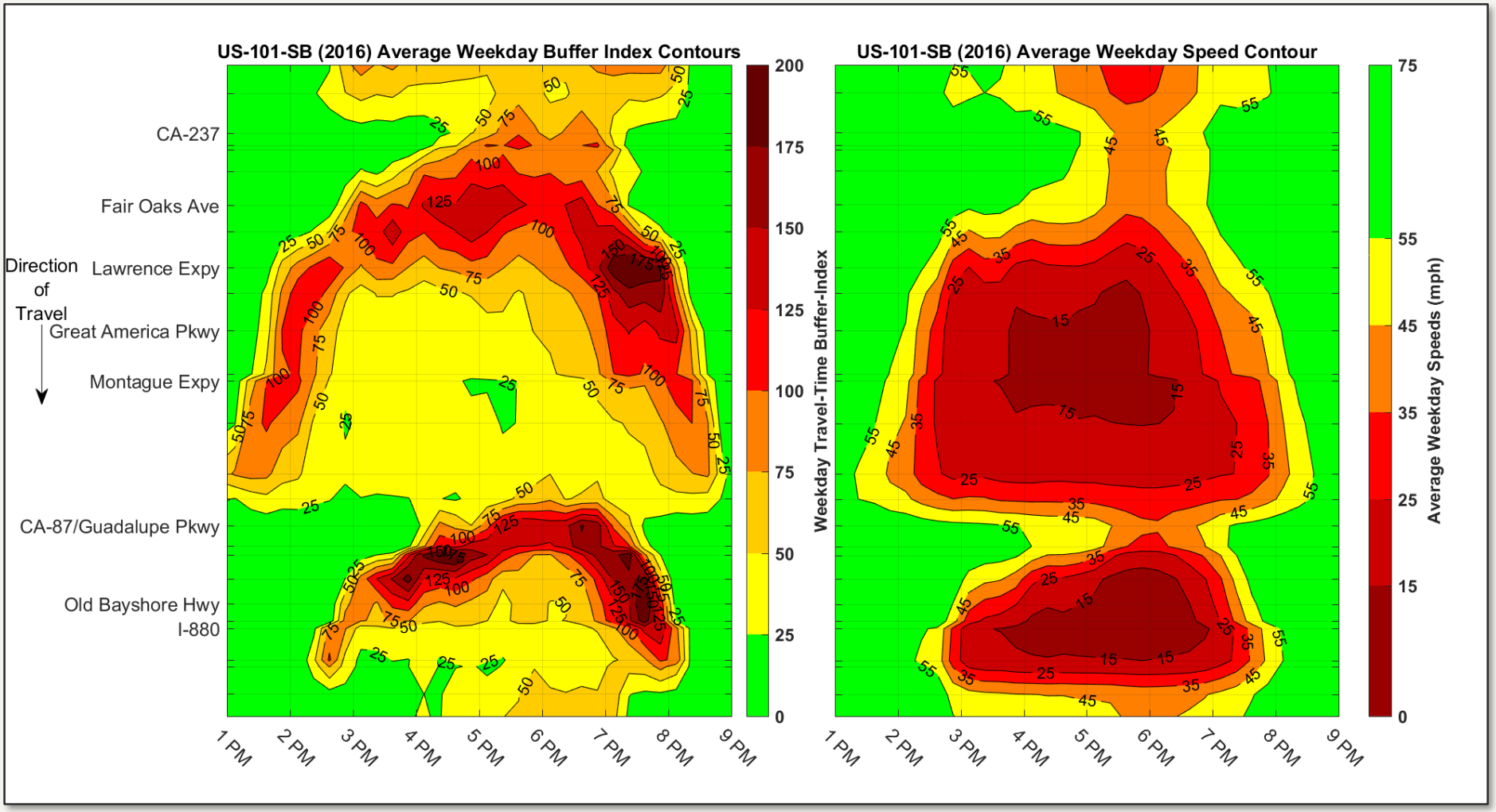
Freely Flowing

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





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

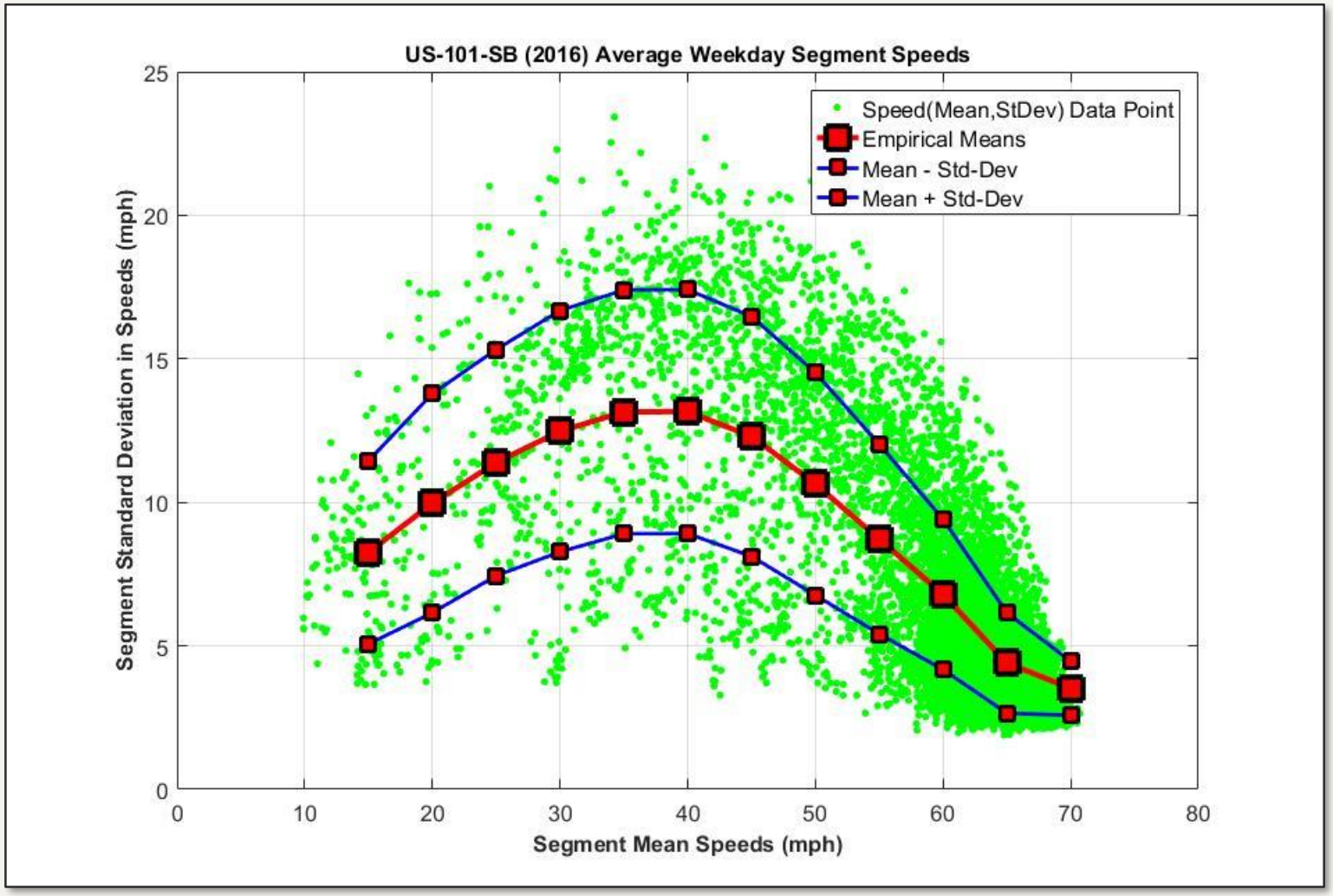


INRIX data: Mean speeds & reliability

Unreliable Speeds

Moderate Reliability

Stable Speeds



Highly Congested

Moderate Congestion

Freely Flowing

Freeway travel-time reliability

Reliability = Consistency

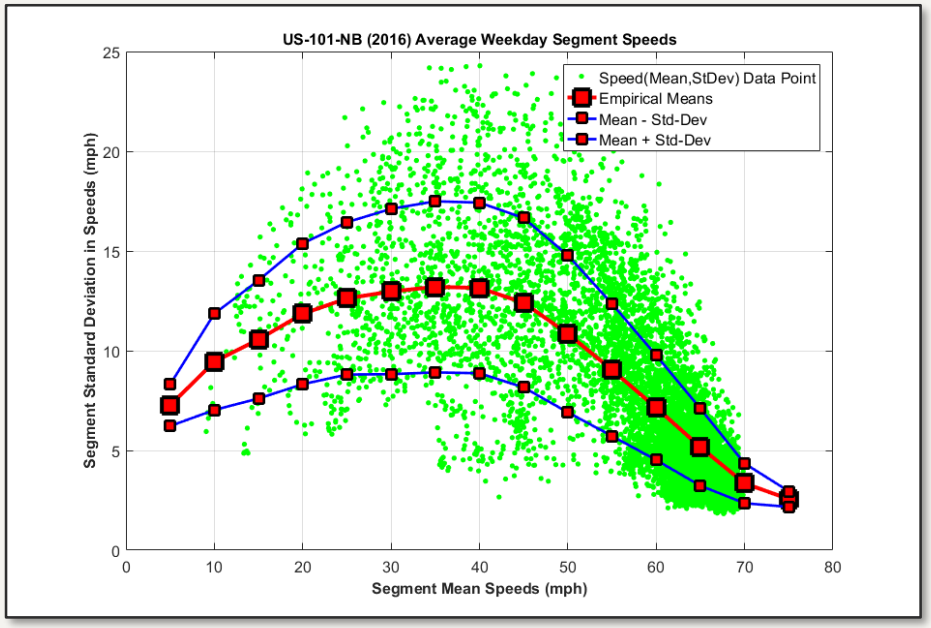
Travel times tend to be reliable or consistent on freeway segments (and time-of-day) when traffic is always freely flowing – no congestion.

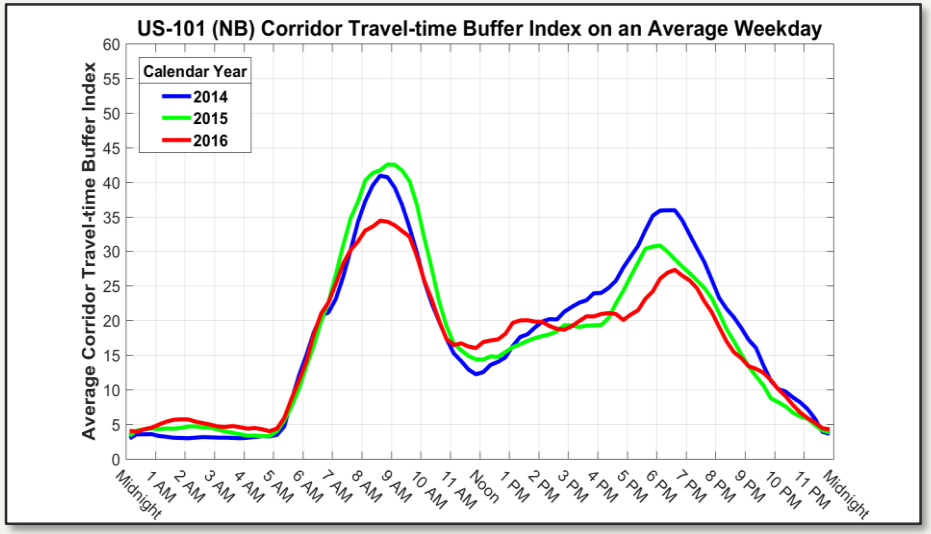
Travel times tend to be fairly reliable on heavily congested stretches – segments and times that are congested every day – not just occasionally congested.

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.





Freeway travel-time reliability

Reliability = Consistency

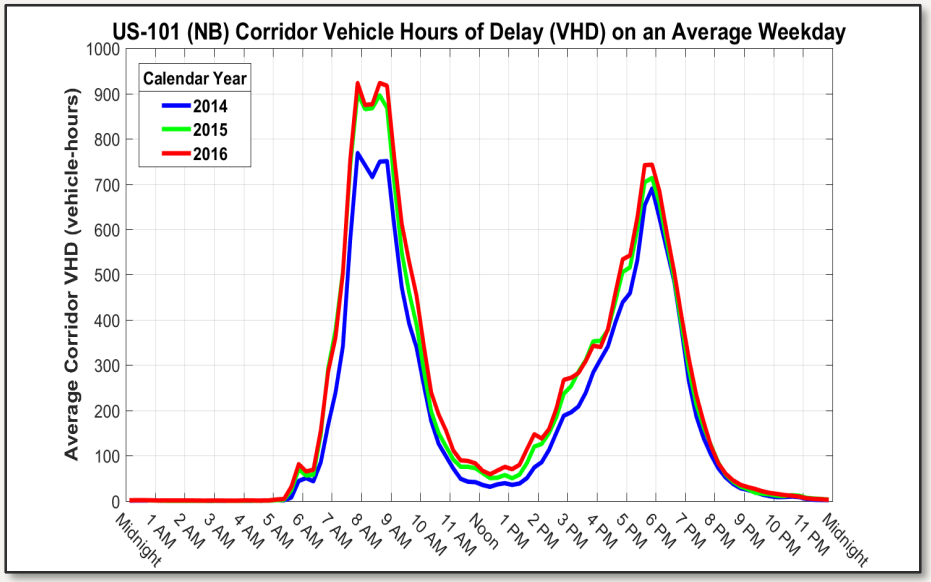
Travel times tend to be reliable or consistent on freeway segments (and time-of-day) when traffic is always freely flowing – no congestion.

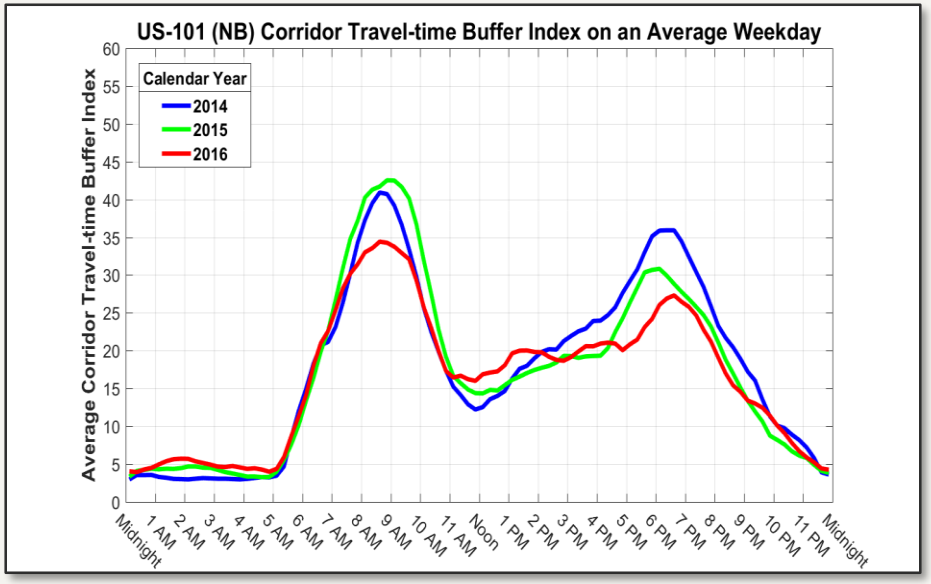
Travel times tend to be fairly reliable on heavily congested stretches – segments and times that are congested every day – not just occasionally congested.

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.





ITS Berkeley
Institute of Transportation Studies

CALIFORNIA PATH

Thank You

Questions & Comments

ITE SAN DIEGO
2017 Western District Annual Meeting