



I-95 Corridor Coalition

I-95 Corridor Coalition Vehicle
Probe Project: Validation of
INRIX Data
Monthly Report
Maryland



May 2009

I-95 CORRIDOR COALITION VEHICLE PROBE PROJECT: VALIDATION OF INRIX DATA APRIL 2009

Monthly Report

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Evaluation Results for the State of Maryland

Summary

Travel time samples were collected along just over 19 miles of freeways in Maryland from Monday, March 2, 2009 to Wednesday, March 11, 2009 and compared against travel time and speed data reported by INRIX as part of the I-95 Vehicle Probe project. The validation data represents approximately 1015 hours of observations along nine freeway segments in Maryland. The table below summarizes the result of the comparison between the validation data and the INRIX data for the same period. Both the absolute average speed error and the speed error bias as measured against the SEM band are within the acceptable limits of the contract specifications. These validation results from Maryland set a benchmark for both overall quality of data, and quantity of data observed during severely congested periods.

Maryland Evaluation Summary						
State	Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples	Hours of Data Collection
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean		
0-30 MPH	4.20	5.10	1.80	2.10	356	29.7
30-45 MPH	4.20	6.20	1.30	2.20	529	44.1
45-60 MPH	1.60	3.50	0.20	0.60	3371	280.9
> 60 MPH	1.60	3.90	-1.40	-2.90	7935	661.3
All Speeds	1.79	3.92	-0.75	-1.56	12191	1015.9

Based upon data collected in March 2009

Data Collection

Bluetooth sensor deployments in Maryland started on Monday, March 2, 2009. The actual deployments in Maryland were performed with the assistance of Maryland State Highway Administration (MDSHA) personnel. Sensors remained in the same position until they were retrieved the following week on Wednesday, March 11, 2009. This round of data collection in Maryland was designed to cover segments of the highways along which both recurrent and non-recurrent congestions could be expected during both peak and off-peak periods.

Figure 1 presents snapshots of the roadway segments over which Bluetooth sensors were deployed in Maryland.

Table 1 presents a list of specific TMC segments that were selected as the validation sample in Maryland. In total, results of validation on nine freeway TMC segments are reported in this document. These segments cover a total length of over 19 miles. The coordinates of the locations at which the Bluetooth sensors were deployed throughout the state of Maryland are reported in Table 2 which also presents the distances that have been used in the estimation of Bluetooth speeds based on travel times.

Analysis of Results

Table 3 summarizes the data quality measures obtained as a result of comparison between Bluetooth and all reported INRIX speeds. In all speed bins INRIX data passes the data quality measures set forth in the contract when errors are measured as a distance from the 1.96 times the standard error band.

Table 4 shows the percentage of the time intervals that fall within 5 mph of the SEM band and the mean for each speed bin for all TMCs in Maryland. Tables 5 and 6 present detailed data for individual TMC segments in Maryland in similar format as Tables 3 and 4 respectively.

Figures 2 and 3 show the overall speed error bias for different speed bins, and the average absolute speed errors for all segments in Maryland, respectively. These figures correspond to Table 3.

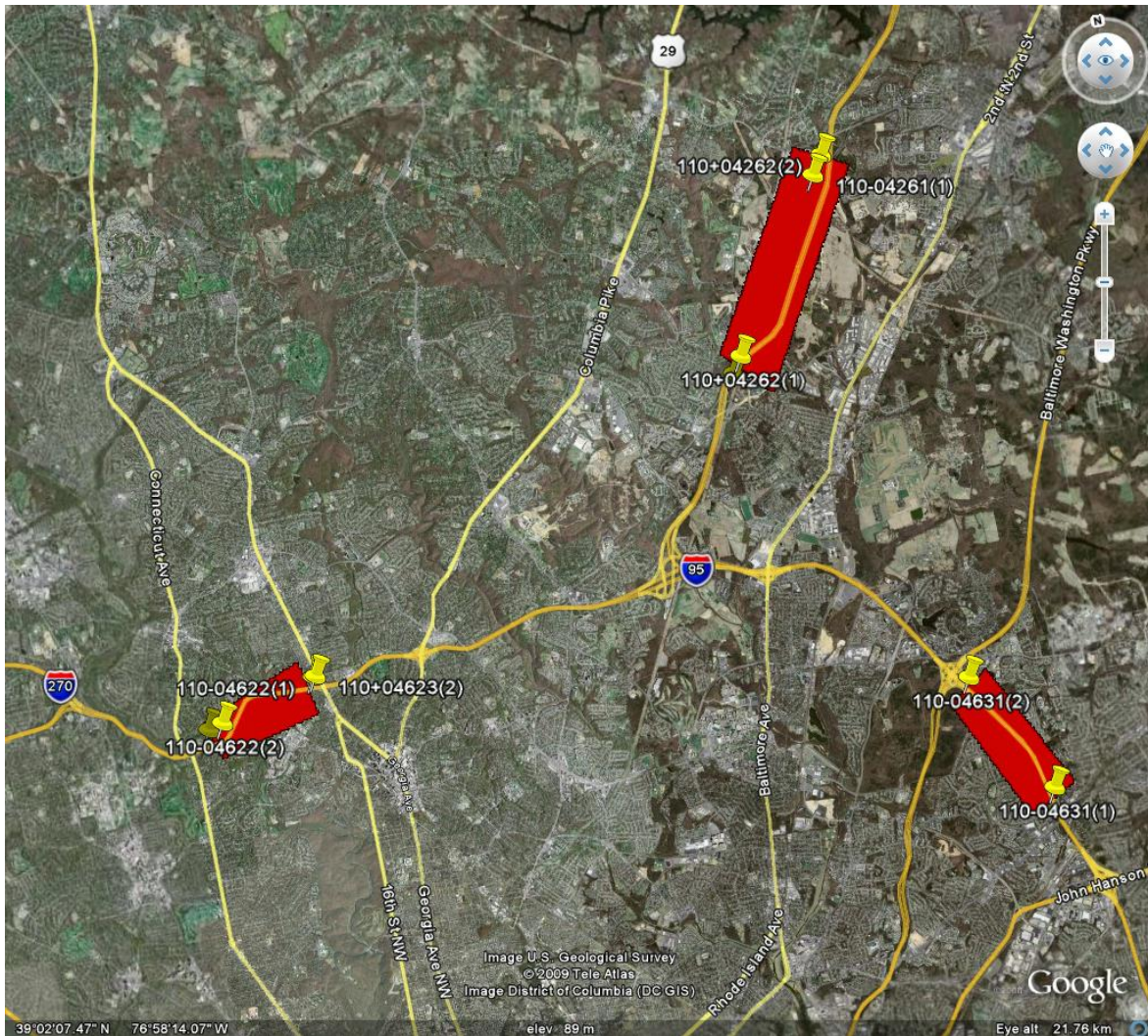


Figure 1
TMC segments selected for validation in Maryland



Figure 1 (Cont'd)
TMC segments selected for validation in Maryland

Table 1
Traffic Message Channel segments picked for validation in Maryland

TYPE	TMC	HIGHWAY	STARTING AT	ENDING AT	COUNTY	DIRECTION	LENGTH (mile)
Freeway	110+04623	I 495	HWY 185/CONNECTICUT AVE/EXIT 33	HWY 97/GEORGIA AVE/EXIT 31	MONTGOMERY	CLOCKWISE	1.8
Freeway	110-04622	I 495	HWY 97/GEORGIA AVE/EXIT 31	HWY 185/CONNECTICUT AVE/EXIT 33	MONTGOMERY	COUNTERCLOCKWISE	1.6
Freeway	110-04261	I 95	HWY 198/EXIT 33	HWY 212/EXIT 29	PRINCE GEORGE'S	SOUTHBOUND	2.9
Freeway	110-04418	I 95	HWY 32/EXIT 38	HWY 216/EXIT 35	HOWARD	SOUTHBOUND	2.4
Freeway	110-04631	I 495	HWY 450/ANNAPOLIS RD/EXIT 20	HWY 193/HWY 295/EXIT 22	PRINCE GEORGE'S	COUNTERCLOCKWISE	1.9
Freeway	110+04262	I 95	HWY 212/EXIT 29	HWY 198/EXIT 33	PRINCE GEORGE'S	NORTHBOUND	3.0
Freeway	110-04419	I 95	HWY 175/EXIT 41	HWY 32/EXIT 38	HOWARD	SOUTHBOUND	1.8
Freeway	110-04421	I 95	I 895/EXIT 46	HWY 100/EXIT 43	HOWARD	SOUTHBOUND	2.1
Freeway	110+04419	I 95	HWY 216/EXIT 35	HWY 32/EXIT 38	HOWARD	NORTHBOUND	1.9
TOTAL							19.4

Table 2
TMC segment lengths and distances between sensor deployment locations in the state of Maryland

SEGMENT TYPE	TMC	STANDARD TMC					SENSOR DEPLOYMENT					ERROR IN SEGMENT LENGTH (%)
		Endpoint (1)		Endpoint (2)		Length (mile)	Endpoint (1)		Endpoint (2)		Length (mile)	
		Lat	Long	Lat	Long		Lat	Long	Lat	Long		
Freeway	110+04623	39.00635	-77.07464	39.01272	-77.04557	1.81	39.00544	-77.07510	39.01316	-77.04350	1.96	8.4%
Freeway	110-04622	39.01260	-77.04612	39.00716	-77.07094	1.57	39.01378	-77.04540	39.00650	-77.07160	1.66	6.0%
Freeway	110-04261	39.09001	-76.89804	39.05493	-76.92729	2.91	39.08751	-76.89660	39.05565	-76.92880	2.89	-0.8%
Freeway	110-04418	39.15578	-76.83280	39.12973	-76.86164	2.44	39.15639	-76.83500	39.13000	-76.86240	2.38	-2.1%
Freeway	110-04631	38.96302	-76.86815	38.98748	-76.88398	1.93	38.96304	-76.86680	38.98893	-76.88320	2.02	4.9%
Freeway	110+04262	39.05800	-76.92473	39.09357	-76.89507	2.96	39.05882	-76.92480	39.09209	-76.89180	2.98	0.8%
Freeway	110-04419	39.17590	-76.79411	39.16203	-76.82276	1.84	39.17620	-76.79370	39.16031	-76.82350	1.95	6.2%
Freeway	110-04421	39.21820	-76.72760	39.20090	-76.75980	2.09	39.21896	-76.72650	39.20109	-76.76050	2.20	5.4%
Freeway	110+04419	39.13575	-76.85498	39.15587	-76.83269	1.90	39.13431	-76.85470	39.15589	-76.83160	2.00	5.1%
TOTAL						19.44					20.05	

Table 3
Data quality measures for freeway segments greater than one mile in Maryland

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
0-30	1.8	4.2	2.1	5.1	356
30-45	1.3	4.2	2.2	6.2	529
45-60	0.2	1.6	0.6	3.5	3371
60+	-1.4	1.6	-2.9	3.9	7935

Table 4
Percent observations meeting data quality criteria for freeway segments greater than one mile in Maryland

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SE Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-30	15%	72%	0%	67%	356
30-45	19%	67%	0%	53%	529
45-60	45%	91%	0%	78%	3371
60+	46%	90%	0%	72%	7935

Table 5
Data quality measures for individual freeway segments greater than one mile in the
state of Maryland

TMC	Standard TMC length	Bluetooth distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SE Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
110+04262	2.96	2.98	0-30					98
			30-45	0.1	2.0	0.3	3.7	47
			45-60	1.5	2.4	3.2	4.8	555
			60+	-0.7	1.0	-2.0	3.5	
110+04419	1.90	2.00	0-30	5.7	7.0	10.3	12.0	7
			30-45	1.4	7.2	9.0	16.4	13
			45-60	1.1	3.7	4.5	7.9	30
			60+	-1.5	1.6	-3.3	3.9	1090
110+04623	1.81	1.96	0-30	1.0	3.3	1.2	4.2	252
			30-45	0.7	4.0	1.5	5.7	284
			45-60	0.3	1.4	0.7	3.4	1989
			60+	-2.0	2.2	-4.0	4.8	281
110-04261	2.91	2.89	0-30					
			30-45					
			45-60	1.2	1.2	1.7	2.6	4
			60+	-0.9	1.3	-2.1	3.4	620
110-04418	2.44	2.38	0-30					
			30-45	3.7	3.7	26.6	26.6	4
			45-60	0.6	0.6	11.6	11.6	9
			60+	-1.7	1.9	-3.6	4.6	838
110-04419	1.84	1.95	0-30					
			30-45	23.3	23.3	27.2	27.2	1
			45-60	2.7	3.5	3.9	6.1	21
			60+	-1.3	1.6	-2.6	3.6	1405
110-04421	2.09	2.20	0-30					
			30-45	4.5	6.9	4.6	8.3	6
			45-60	2.1	2.6	4.8	5.6	25
			60+	-1.0	1.2	-2.4	3.2	1158
110-04622	1.57	1.66	0-30	7.7	8.5	8.0	9.0	43
			30-45	2.5	4.9	3.0	5.9	101
			45-60	-0.2	1.7	-0.1	3.2	1145
			60+	-1.8	2.1	-3.2	4.2	800
110-04631	1.93	2.02	0-30	0.4	4.5	0.5	5.3	54
			30-45	5.5	11.1	5.8	12.9	22
			45-60	0.4	3.0	1.1	4.9	101
			60+	-1.7	1.9	-3.3	4.2	1188

Table 6
Observations meeting data quality criteria for individual freeway segments greater than one mile in the state of Maryland

TMC	SPEED BIN	Data Quality Measures for								No. of Obs.
		1.96 SE Band				Mean				
		Speed Error Bias		Average Absolute Speed Error		Speed Error Bias		Average Absolute Speed Error		
		No. falling inside the band	% falling inside the band	No. falling within 5 mph of the band	% falling within 5 mph of the band	No. equal to the mean	% equal to the mean	No. within 5 mph of the mean	% within 5 mph of the mean	
110+04262	0-30									
	30-45	28	29%	89	91%	0	0%	69	70%	
	45-60	14	30%	41	87%	0	0%	29	62%	
	60+	341	61%	526	95%	0	0%	413	74%	
110+04419	0-30	0	0%	4	57%	0	0%	2	29%	
	30-45	2	15%	6	46%	0	0%	3	23%	
	45-60	13	43%	22	73%	0	0%	9	30%	
	60+	469	43%	1002	92%	0	0%	773	71%	
110+04623	0-30	47	19%	197	78%	0	0%	183	73%	
	30-45	55	19%	190	67%	0	0%	154	54%	
	45-60	998	50%	1847	93%	0	0%	1545	78%	
	60+	113	40%	240	85%	0	0%	165	59%	
110-04261	0-30									
	30-45									
	45-60	2	50%	4	100%	0	0%	3	75%	
	60+	325	52%	575	93%	0	0%	488	79%	
110-04418	0-30									
	30-45	3	75%	3	75%	0	0%	0	0%	
	45-60	7	78%	9	100%	0	0%	2	22%	
	60+	403	48%	721	86%	0	0%	552	66%	
110-04419	0-30									
	30-45	0	0%	0	0%	0	0%	0	0%	
	45-60	7	33%	15	71%	0	0%	10	48%	
	60+	633	45%	1273	91%	0	0%	1044	74%	
110-04421	0-30									
	30-45	0	0%	4	67%	0	0%	3	50%	
	45-60	8	32%	18	72%	0	0%	11	44%	
	60+	581	50%	1108	96%	0	0%	920	79%	
110-04622	0-30	2	5%	22	51%	0	0%	21	49%	
	30-45	12	12%	63	62%	0	0%	51	51%	
	45-60	437	38%	1042	91%	0	0%	948	83%	
	60+	316	40%	699	87%	0	0%	523	65%	
110-04631	0-30	5	9%	33	61%	0	0%	32	59%	
	30-45	0	0%	2	9%	0	0%	1	5%	
	45-60	33	33%	81	80%	0	0%	66	65%	
	60+	499	42%	1034	87%	0	0%	799	67%	

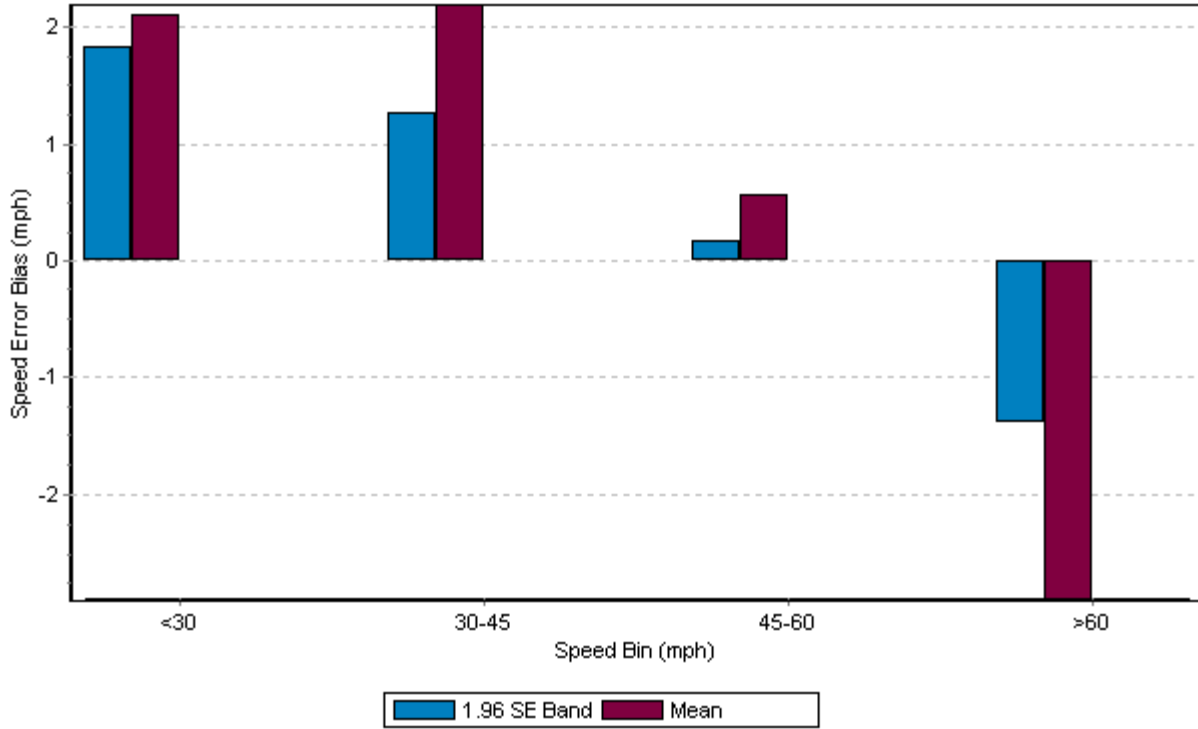


Figure 2
Speed error bias for freeway segments greater than one mile in Maryland

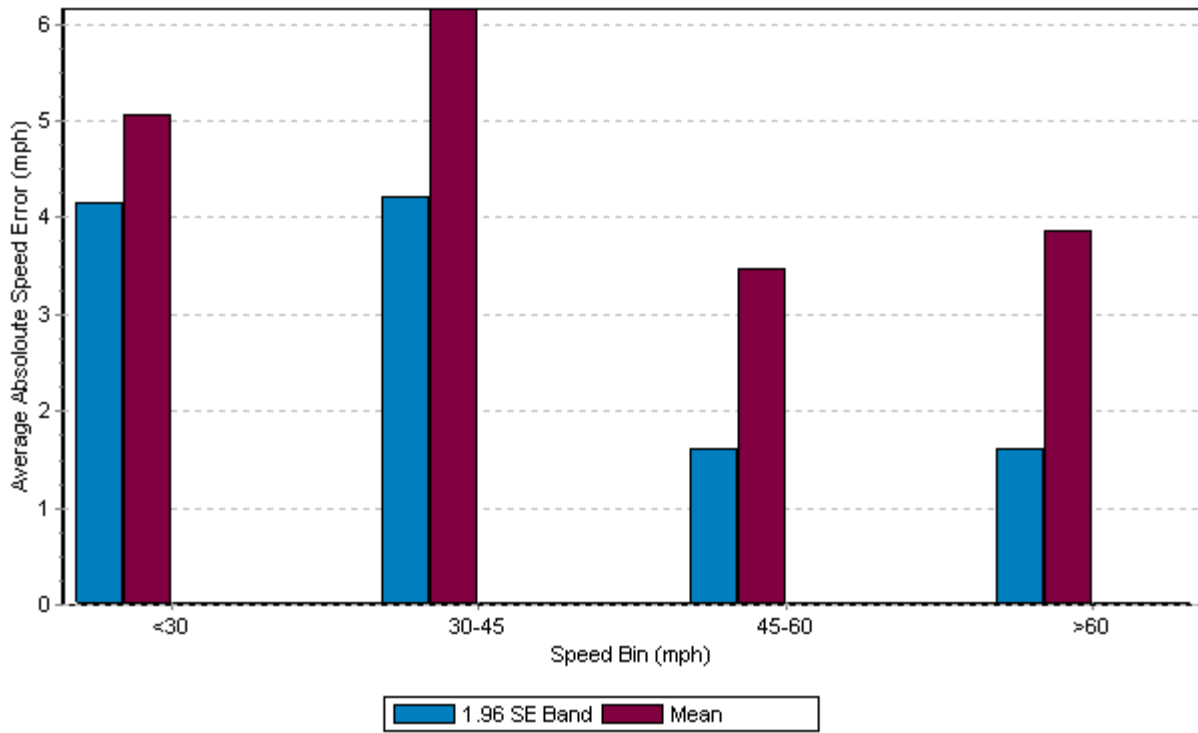


Figure 3
Average absolute speed error for freeway segments greater than one mile in Maryland