



Oregon Department of Transportation

Evaluating Streetlight AADT Data Product Northwest Transportation Conference 2020



Agenda

Agenda

Background

Data Quality Metrics

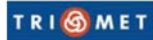
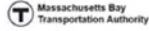
Streetlight Data and
Methods for AADT

ATR Comparison

Bend AADT Estimate
Comparison



Background: What's a Third Party Data Firm?



Project Goals

Gain Experience with New Data Sources

Test Evaluation Methodology

Determine Usefulness of Separate Products

Identify Potential Data Collection Cost Savings



Data Quality Metrics

Data quality is the fitness of data for all purposes that require them. Measuring data quality requires an understanding of all intended purposes for those data. (Turner 2008)

Sources:

- Department of Defense
- Computer Science
- Intelligent Transportation Systems

Rubric now in the Traffic Monitoring Guide (2016)

Data Quality	Characteristics Description	Example Metric
Accuracy	A quality of that which is free of error. A qualitative assessment of freedom from error, with a high assessment corresponding to a small error. (FIPS Pub 11-3)	when compared to the actual value. For example, the estimate of annual traffic compared to the actual value.
Completeness	Completeness is the degree to which values are present in the attributes that require them. (Data Quality Foundation)	Percent of data fields having values entered into them.
Validity	The quality of data that is founded on an adequate system of classification and is rigorous enough to compel acceptance. (DOD 8320.1-M)	Percent of recorded traffic count values that fall within operational expectations.
Timeliness	As a synonym for currency, timeliness represents the degree to which specified data values are up to date. (Data Quality Management and Technology)	Percent of data available within a specified threshold time frame (e.g., days, hours, minutes).
Accessibility (also referred to as usability)	Includes simple technical accessibility as well as ability to manipulate based on user needs. (Strong et al. 1997)	Percent of freeway centerline miles with sensor coverage and average sensor spacing.

*Adapted from Turner (2008)



Streetlight Data and Methods: AADT Estimate

Data

- Location-based service (apps)
- GPS navigation data
- Census population
- Vehicle counts data



Methods

- Machine learning using Random Forest
- Tried Ordinary Least Squares but less accurate



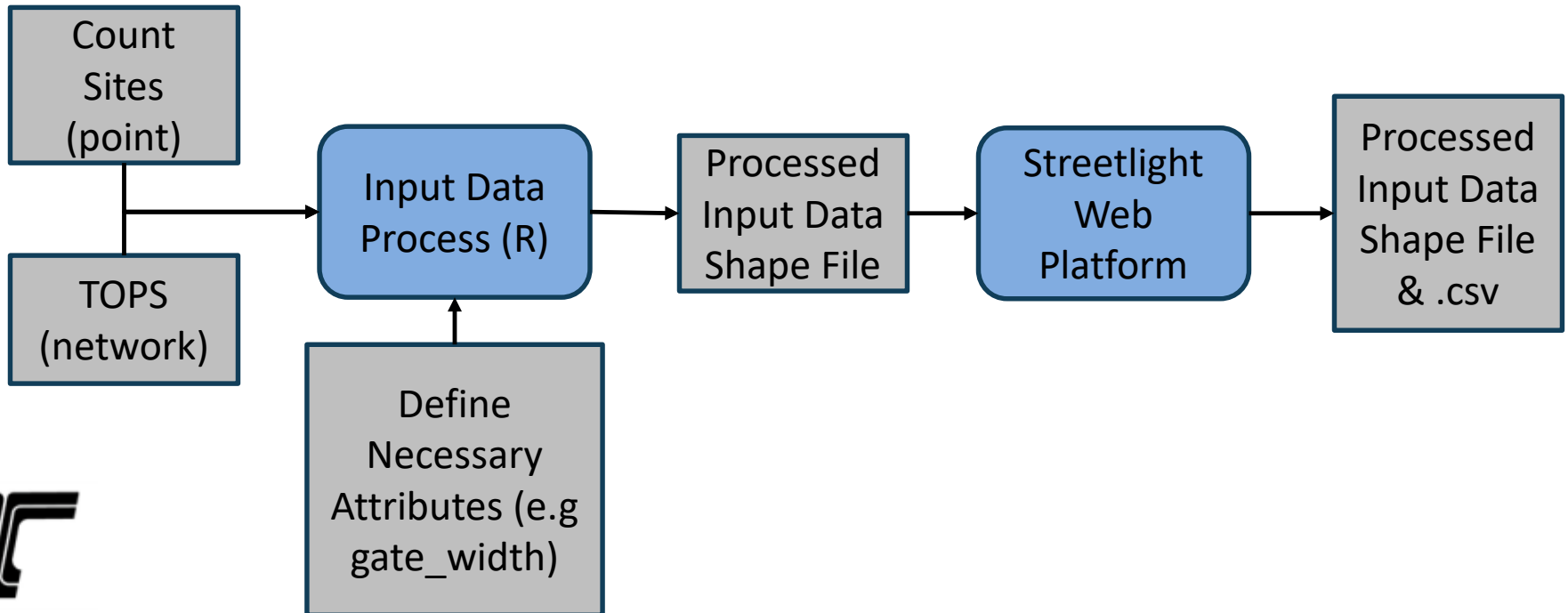
Streetlight Data and Methods: AADT Estimate

Input Data

- TOPS (Network links)
- Count sites (ATRs and AADT estimates)

Input Data Pre-Processed in R

Iterative Process for Gate Width Setting. More effort could be expended here.

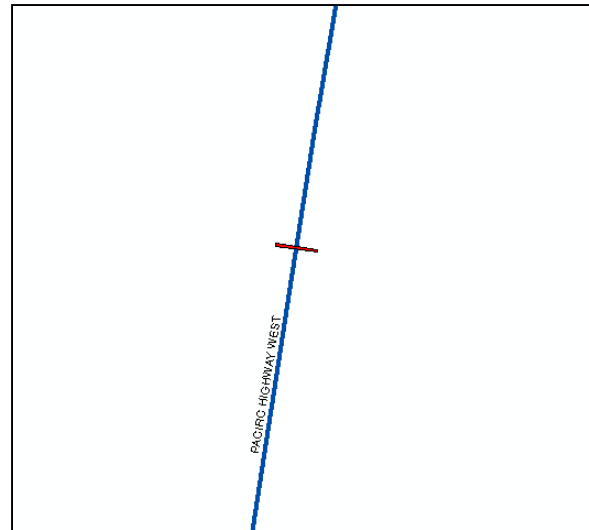


Streetlight Data and Methods: AADT Estimate

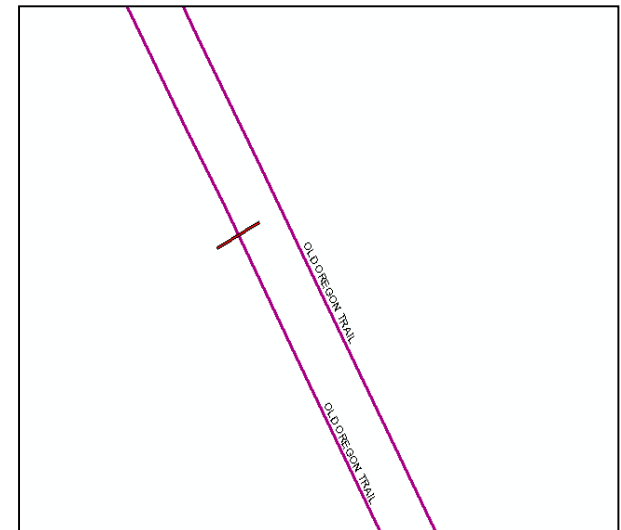
Gate Width and Location

- Used default – based on road classification
- Iterative process using high error values to pick out problems

Properly Defined



Improperly Defined

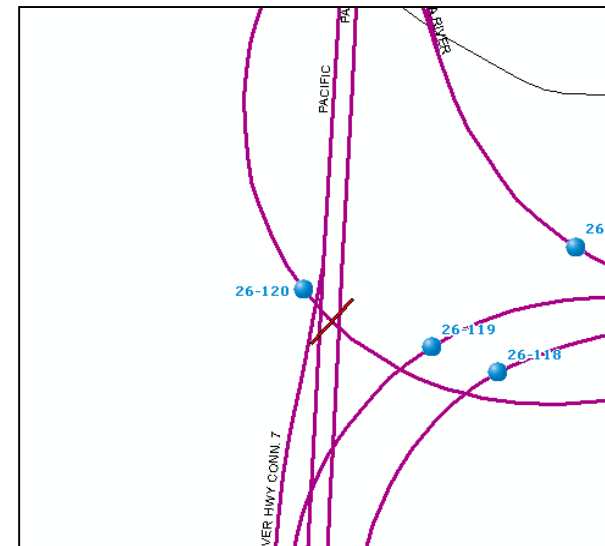


Streetlight Data and Methods: AADT Estimate

Gate Width and Location

- Gate created at mid-point of segment

Improperly Defined



ATR Comparison: Accuracy

$$Percent_Error = \frac{(AADT_{Streetlight} - AADT_{ODOT})}{AADT_{ODOT}}$$

$$Absolute_Percent_Error = \left| \frac{(AADT_{Streetlight} - AADT_{ODOT})}{AADT_{ODOT}} \right|$$

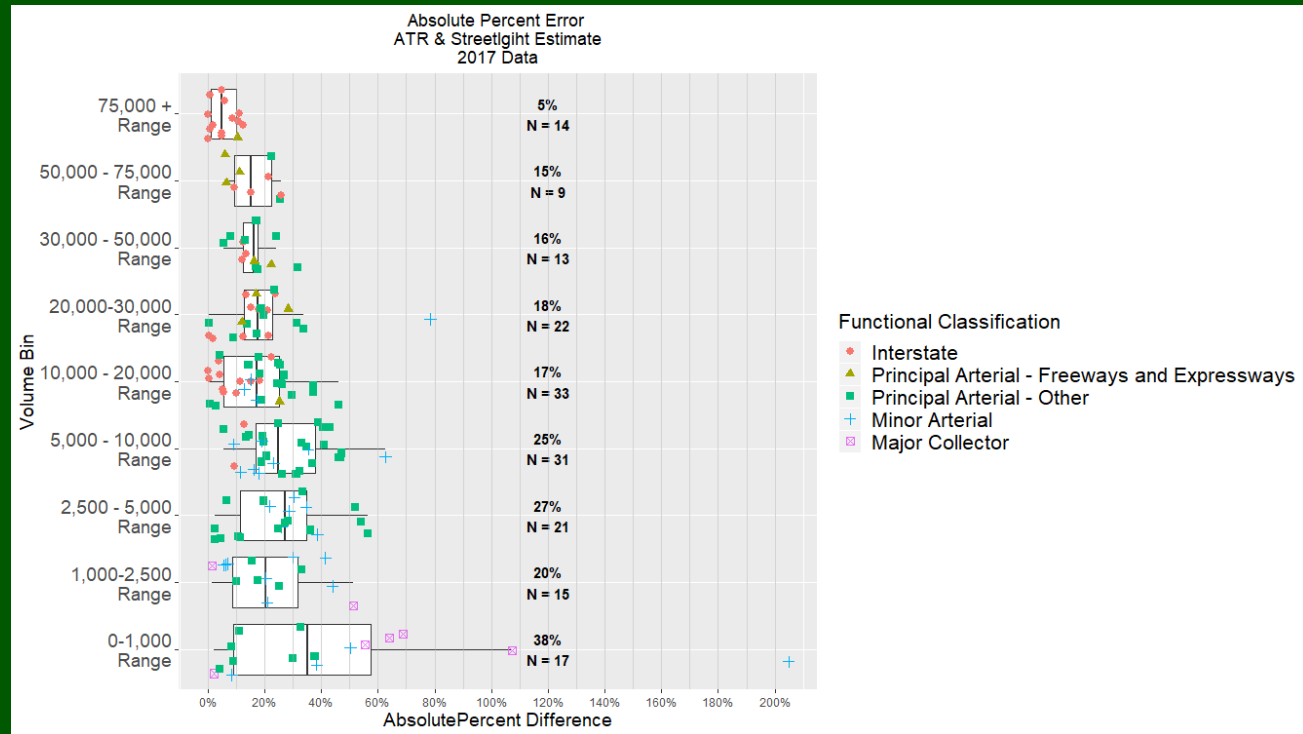
Where:

$AADT_{Streetlight}$ is the annual average daily traffic estimate from Streetlight

$AADT_{ODOT}$ is the annual average daily traffic estimate from ODOT ATR

ATR Comparison: Accuracy

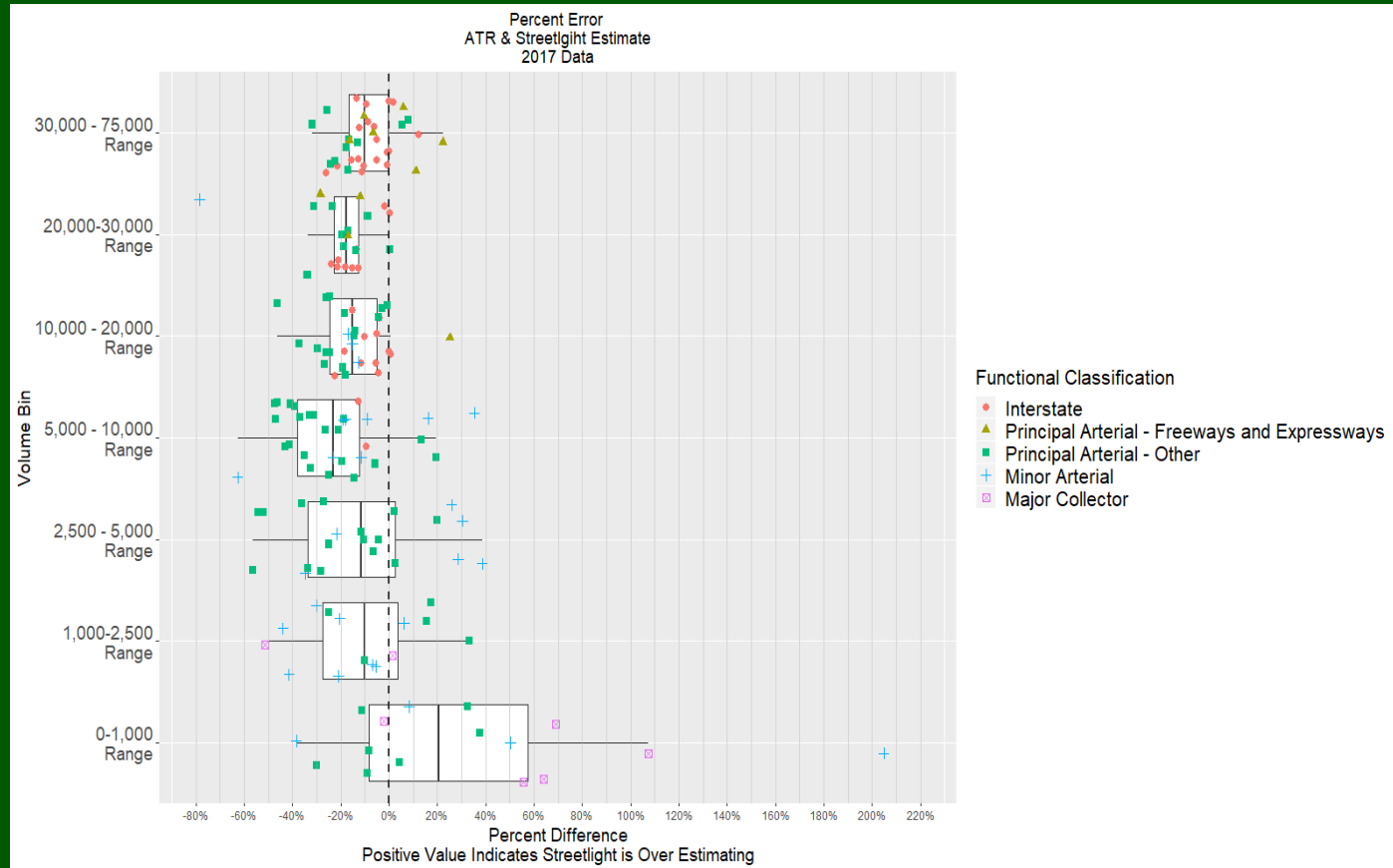
- Mean error: 27%
- Median error: 18%
- More error at low volumes
- Error increased with new model -



Bin	Absolute Percent Error				Count
	Median	Mean	Min.	Max	
75,000 +	5%	6%	0.02%	12%	14
50,000 - 75,000	15%	16%	5.9%	26%	9
30,000 - 50,000	16%	16%	5.6%	32%	13
20,000-30,000	18%	20%	0.4%	78%	22
10,000 - 20,000	17%	17%	0.1%	46%	33
5,000 - 10,000	25%	28%	5.7%	63%	31
2,500 - 5,000	27%	26%	2.3%	56%	21
1,000-2,500	20%	22%	1.4%	51%	15
0-1,000	38%	88%	2.2%	758%	17
All Sites	18%	27%	0.02%	758%	175

ATR Comparison: Accuracy

- More error at low volumes
- Streetlight mostly under-estimating (67% ATRs higher compared to SL)



ATR Comparison: Accuracy

- New confidence boundary output
- 81% of evaluated sites were within the boundary

ATR Sites					
Bin	Confidence Interval Bounds		Total Sites	Streetlight AADT Within Interval	
	Mean Lower Bound	Mean Upper Bound		Count	%
75,000 +	-31%	25%	14	14	100%
50,000 - 75,000	-30%	31%	9	7	78%
30,000 - 50,000	-31%	35%	13	13	100%
20,000-30,000	-29%	33%	22	16	73%
10,000 - 20,000	-32%	39%	33	27	82%
5,000 - 10,000	-36%	44%	31	20	65%
2,500 - 5,000	-41%	52%	21	16	76%
1,000-2,500	-47%	71%	15	14	93%
0-1,000	-56%	98%	17	15	88%
All Sites	-37%	47%	175	142	81%

ATR Comparison: Accuracy

- 55% of sites gave 20% error or less
- Five urban areas APE below 20%,
- Portland lowest error, due to high volume sites
- Small Urban didn't do bad

Error	# Sites	Proportion of To
0-10%	44	25%
10-20%	53	30%
20-30%	34	19%
30-40%	22	13%
40-50%	9	5%
50%+	13	7%
Total	175	100%

Urban Area	Absolute Percent Error			# Sites
	Median	Mean	Max	
Albany	21%	21%	32%	2
Bend	18%	16%	26%	4
Eugene-Springfield	17%	17%	26%	6
Grants Pass	37%	37%	37%	1
Medford	21%	21%	33%	6
Milton-Freewater	26%	26%	26%	1
Portland	9%	9%	25%	21
Rural	21%	33%	758%	110
Salem	14%	18%	28%	3
Small Urban	18%	20%	78%	21
All Observations	18%	27%	758%	175

ATR Comparison: Summary

Data Quality Metrics

- Completeness - Good
- Validity – N/A
- Timeliness – Good
- Accessibility – Good
but requires some
data manipulation skill

Questions

- How best to consider
the accuracy results?

Data Quality	ATR Comparison
Accuracy	Median APE 18% ; 55% of the comparison sites exhibited 20% error or less
Completeness	Vendor AADT estimates available at 99% of required sites
Validity	Not Assessed
Timeliness	Reasonable currency, as up to date as agency data
Accessibility (also referred to as usability)	Relatively accessible platform, with some moderate data processing tasks for input and output data which benefits from R

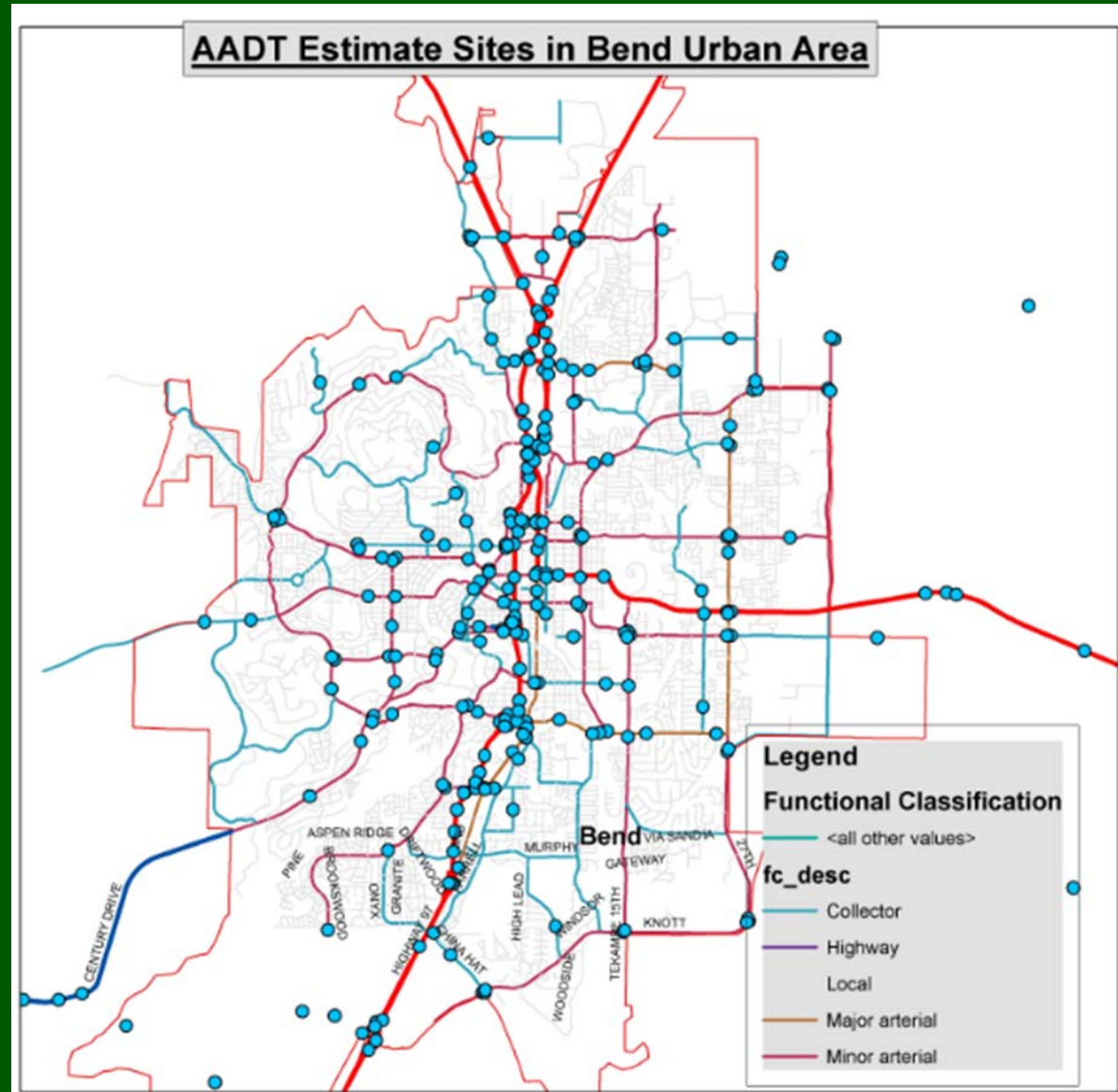
ATR Comparison: Accuracy

- Error in rural counties higher
- 19 (41%) counties have median ape less than 20%

County	Absolute Percent Error			# Sites
	Median	Mean	Max	
Baker	11%	136%	758%	6
Benton	35%	29%	44%	5
Clackamas	20%	19%	47%	12
Clatsop	26%	26%	33%	2
Columbia	29%	29%	29%	1
Coos	39%	37%	46%	3
Crook	27%	27%	34%	2
Curry	28%	28%	31%	2
Deschutes	11%	14%	37%	12
Douglas	20%	26%	52%	6
Gilliam	79%	79%	107%	2
Grant	11%	15%	30%	3
Harney	20%	62%	205%	4
Hood River	13%	13%	25%	2
Jackson	22%	19%	33%	9
Jefferson	37%	37%	47%	2
Josephine	37%	35%	54%	3
Klamath	19%	23%	69%	9
Lake	8%	18%	38%	3
Lane	21%	25%	51%	13
Lincoln	20%	18%	26%	5
Linn	19%	21%	32%	7
Malheur	5%	7%	17%	4
Marion	32%	32%	56%	8
Morrow	12%	11%	20%	3
Multnomah	9%	11%	64%	15
Polk	23%	23%	37%	4
Sherman	1%	1%	2%	2
Tillamook	15%	15%	15%	1
Umatilla	15%	21%	78%	10
Union	18%	24%	56%	5
Wasco	26%	26%	35%	2
Washington	23%	27%	63%	6
Yamhill	21%	21%	25%	2

Bend MPO AADT Comparison: Accuracy

- AADT – Annual Average Daily Traffic (for vehicles)
- 229 sites in Bend urban area – rolling survey every 3 years
- Some sites as old as 6 years
- Short term counts of 48 hours factored to represent annual
- Extrapolation known to produce error:
 - 12% error (Kockelman 2007)
 - 11% - 95% error (Sharma et al. 1996)



Bend MPO AADT Comparison: Accuracy

All Bend AADT Sites

- Mean Error: 59%
- Median Error: 32%
- Less predictable error result in relation to volume bin

“Quality” Sites Only

- Reduced to about ¼ of initial sites
- Mean Error: 46%
- Median Error: 22%

All Bend AADT Sites					
Bin	Absolute Percent Error			Count	
	Median	Mean	Max		
50,000 - 75,000	22%	29%	52%	4	
30,000 - 50,000	12%	13%	27%	7	
20,000-30,000	9%	11%	30%	16	
10,000 - 20,000	24%	24%	95%	62	
5,000 - 10,000	35%	40%	127%	79	
2,500 - 5,000	69%	83%	196%	31	
1,000-2,500	98%	100%	183%	16	
0-1,000	223%	311%	786%	14	
All Sites	32%	59%	786%	229	

Bin	Absolute Percent Error				Count
	Median	Mean	Min.	Max	
20,000-30,000	10%	9%	2%	15%	6
10,000 - 20,000	15%	16%	0.2%	45%	15
5,000 - 10,000	21%	23%	1%	84%	20
2,500 - 5,000	37%	47%	9%	107%	9
1,000-2,500	67%	71%	6%	151%	9
0-1,000	153%	178%	82%	278%	7
All Sites	22%	46%	0.2%	278%	66

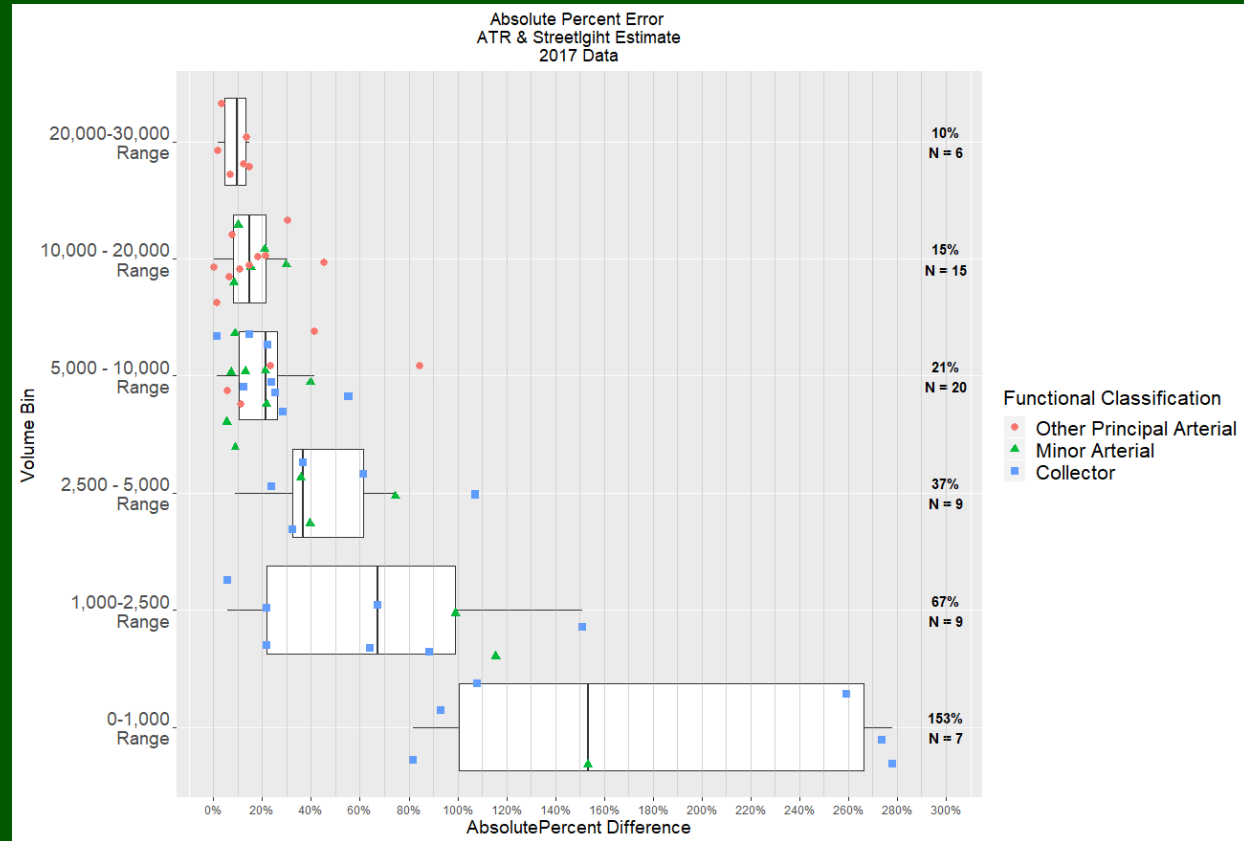
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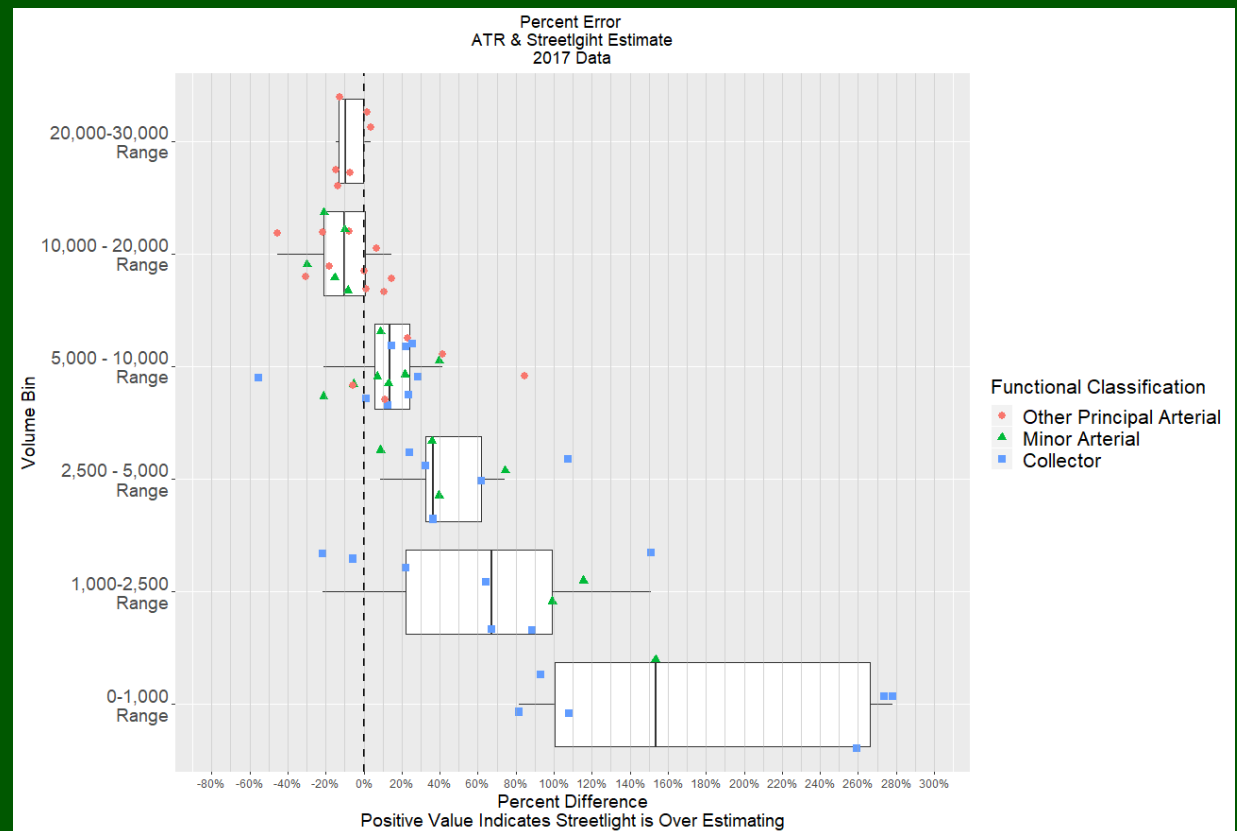
“Quality” Sites Only

- Reduced to about ¼ of initial sites
- Mean Error: 46%
- Median Error: 22%



Bend MPO AADT Comparison: Accuracy

- Streetlight mostly over estimating (46 of 66 sites higher than ODOT AADT)
- Over estimate in all lower bins (5,000 and less) Streetlight
-



Bend MPO AADT Comparison: Accuracy

- 32% of AADT sites have 20% error or less
- 50% of bend sites fall into confidence boundary thresholds

Data Quality	ATR Comparison
Accuracy	Median APE 22% ; 41% of the comparison sites exhibited 20% error or less
Completeness	Vendor AADT estimates available at 100% of required sites
Validity	Not Assessed
Timeliness	Reasonable currency, as up to date as agency data
Accessibility (also referred to as usability)	Relatively accessible platform, with some moderate data processing tasks for input and output data which benefits from R

Bin	Confidence Interval		Total Sites	Sites within Interval	
	Mean Upper Bound	Mean Lower Bound		Count	%
20,000-30,000	30%	-9%	6	6	100%
10,000 - 20,000	33%	-13%	15	12	80%
5,000 - 10,000	38%	-15%	20	10	50%
2,500 - 5,000	45%	-20%	9	2	22%
1,000-2,500	40%	-30%	9	3	33%
0-1,000	38%	-32%	7	0	0%
All Observations	37%	-19%	66	33	50%

Bend FAUB Comparison: Summary

Data Quality Metrics

- Completeness - Good
- Validity – N/A
- Timeliness – Good
- Accessibility – Good
but requires some
data manipulation skill

Data Quality	ATR Comparison
Accuracy	Median APE 22% ; 41% of the comparison sites exhibited 20% error or less
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Validity	Not Assessed
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Other Evaluations

MN DOT

- Firm: Streetlight
- 1st round: Initial testing of 2017 AADT product
 - 61% Mean APE
- 2nd round – Not done but looking at all ~34,000 sites

LA DOT

- Firm: Citilabs – Streetlytics
- Accuracy: 18%

CDOT

- Firm: In-house
- Accuracy: 18% (CO)
- Accuracy: 25% (FL)

Conclusion & Discussion

- Future evaluations should evaluate costs of third party vs. traditional data collection
- Streetlight Platform could likely be improved with Oregon data feeding machine learning, but evaluation would then be problematic
- How to weigh accuracy of Streetlight with unknown accuracy issues in short term count derived AADT?
- Is an application of the data needed to understand usefulness. (Crash, emissions, travel model calibration)
- Other Streetlight Data products could be explored?
 - 2018 AADT
 - Origin-Destination
 - Bike/Ped data (NITC Pooled Fund)
- National Efforts
 - FHWA Pooled Fund – ODOT is a participant
 - National Labs building big data fusion platforms
- Report on Research Section website
- Would we ever grow something of our own?
- How to protect privacy?

Thanks



"After careful consideration of all 437 charts, graphs, and metrics, I've decided to throw up my hands, hit the liquor store, and get snocked. Who's with me?!"

Contact

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