Region-wide Microsimulation-based DTA

Results and Findings at the NFTPO

presented by
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Caliper Corporation

May 6, 2015

Context: Technical Motivation

- Dynamic Traffic Assignments are helpful for analyzing capacity improvements, and essential for analyzing pricing and ITS strategies
- Appropriate congested travel times are crucial for planning model estimation
- Operational fidelity necessary for traffic engineering studies
- Many projects and traffic management measures have impacts that require lane-level behavioral resolution for proper evaluation

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Context: Practical Motivation

- Effective deployment hinges on usability, robustness, and manageable run times
- DTA potentially lends itself better to visualization and animation
- A more compelling tool for engaging stakeholders and the public at large

Approach: Key DTA Elements


- Dynamic shortest paths based upon departure times
- Potentially more realistic route choice and driver behavior
- Queue build-up and dissipation
- Short time intervals for travel time measurement
- Dynamic User Equilibrium condition - a temporal extension of Wardrop's principle
- Iterative computation required to achieve convergence

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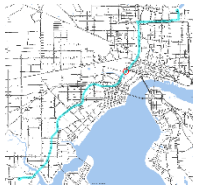
Approach: Microscopic DTA

- Microscopic in level of detail
  - Referenced to ground truth with accurate geometry
  - Lane level and intersection area representation
  - Temporal dynamics (as low as 0.1-sec)

- Microscopic in modeling accuracy
  - Microscopic (car following, lane changing)
  - Employs realistic route choice models
  - Handles complex network infrastructure (signals, variable message signs, sensors, etc.)
  - Simulates multiple modes, user classes, vehicle types



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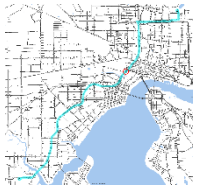

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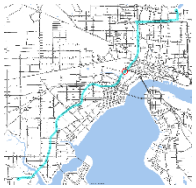

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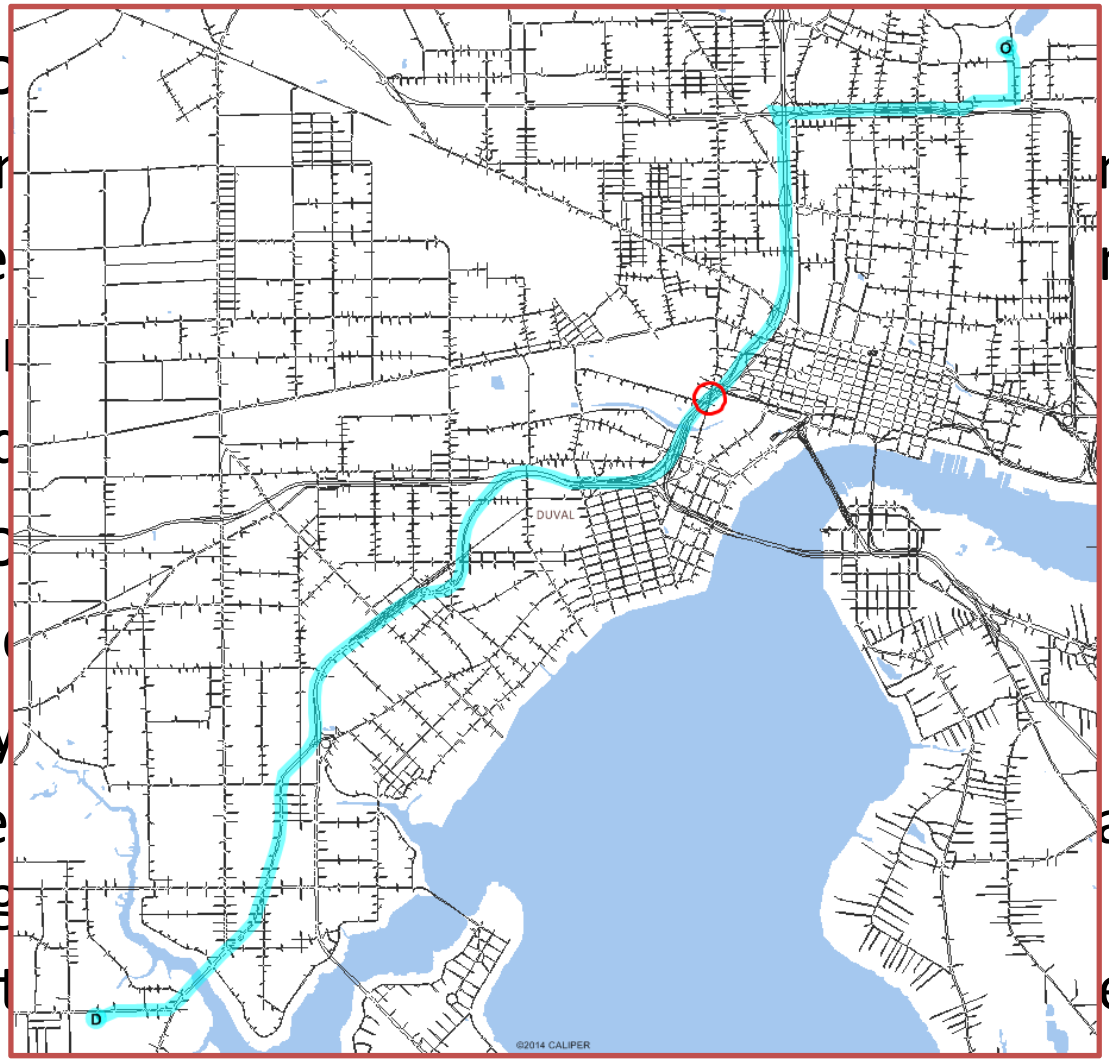

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Implementation: North Florida TPO

Region-wide, Six-county coverage

NASSAU
HAMILTON
MADISON
BAKER
COLUMBIA
SUWANNEE
FLORIDA
UNION
ST. JOHNS
CLAY
LAFAYETTE
BRADFORD
TAYLOR
GILCHRIST
ALACHUA
PUTNAM
DIXIE
FLAGLER
LEVY
MARION

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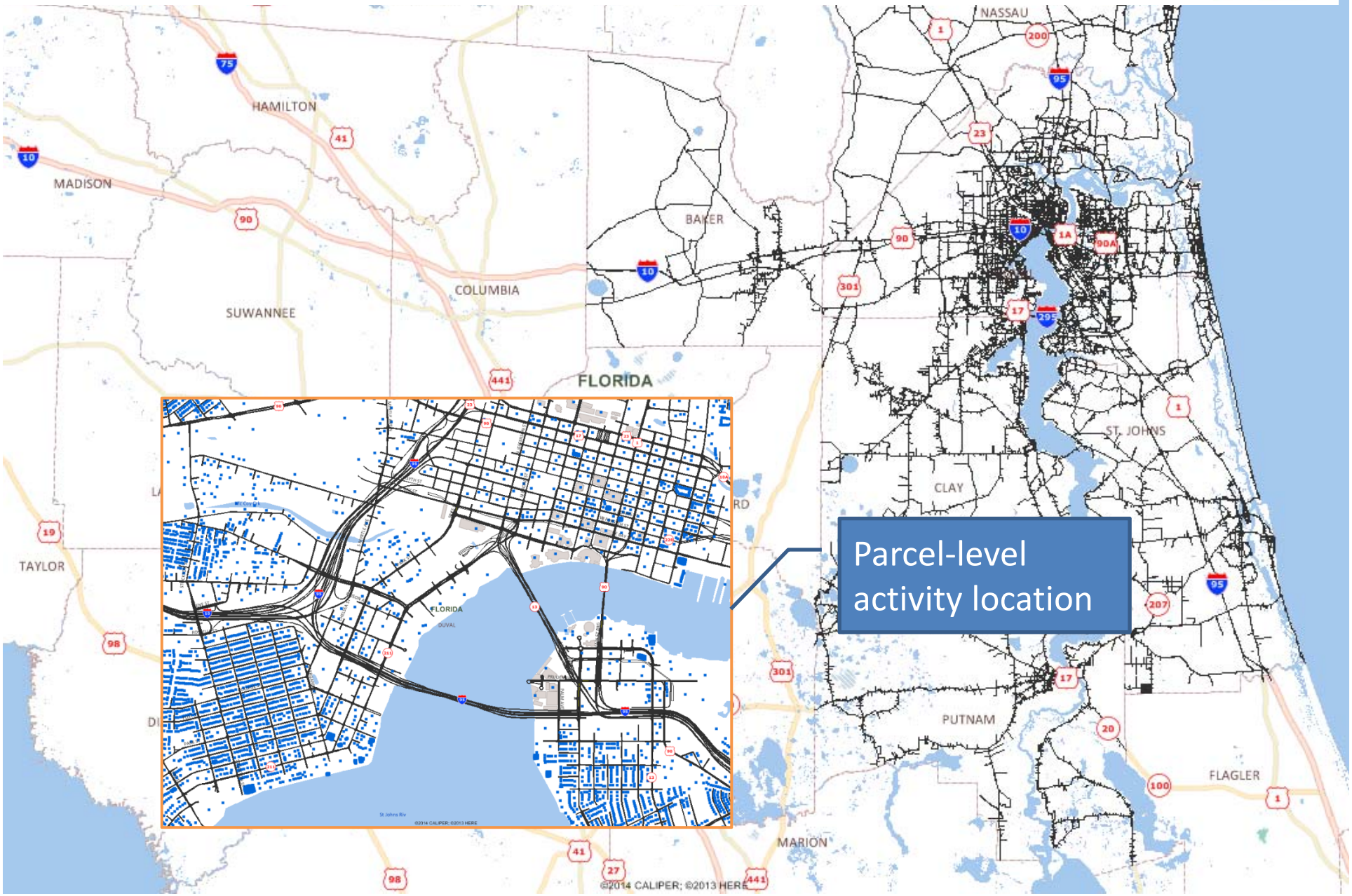
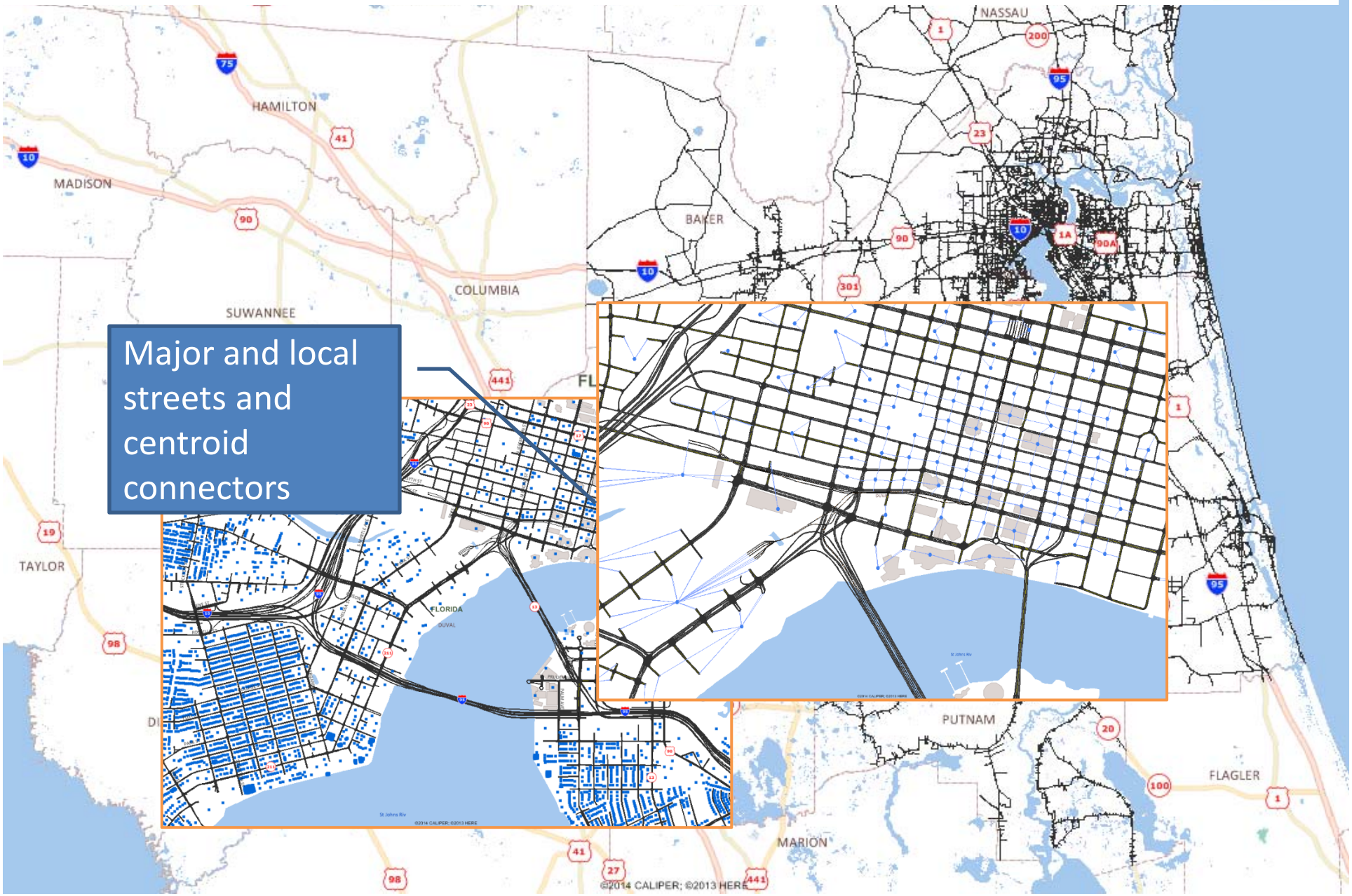
Implementation: North Florida TPO



Implementation: North Florida TPO



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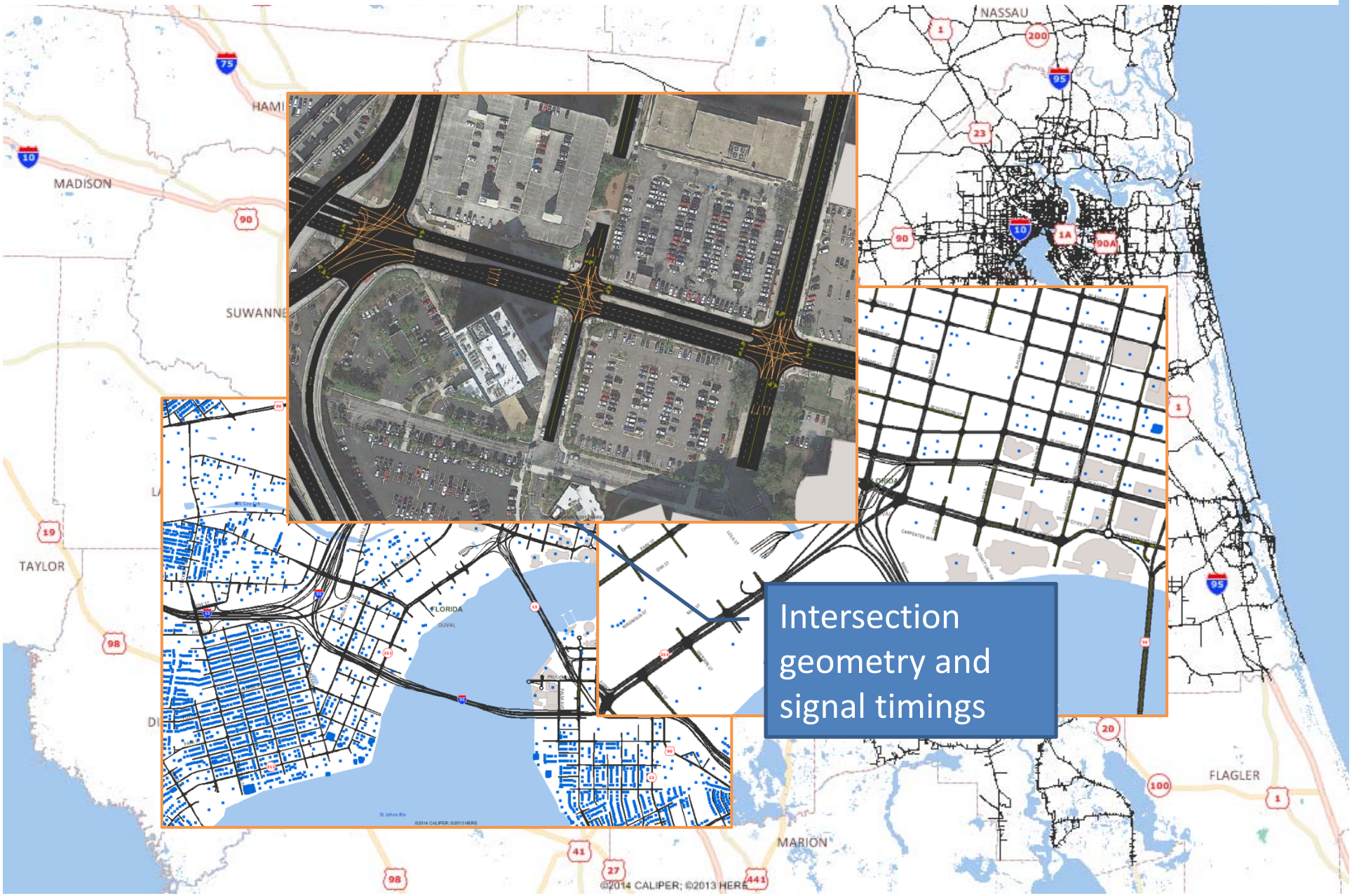

Implementation: Framework

- Parcel-level origins and destinations
  - 492,684 parcels
  - Point-to-point route choice
  - Trips produced by DAYSIM
- Zonal truck and external traffic
  - 2,578 TAZs
  - Zone-to-zone route choice
  - Initial Matrices produced by Cube
- Integration/Linkage
  - DAYSIM
  - Cube

FLORIDA MODEL TASK FORCE

Implementation: Challenges

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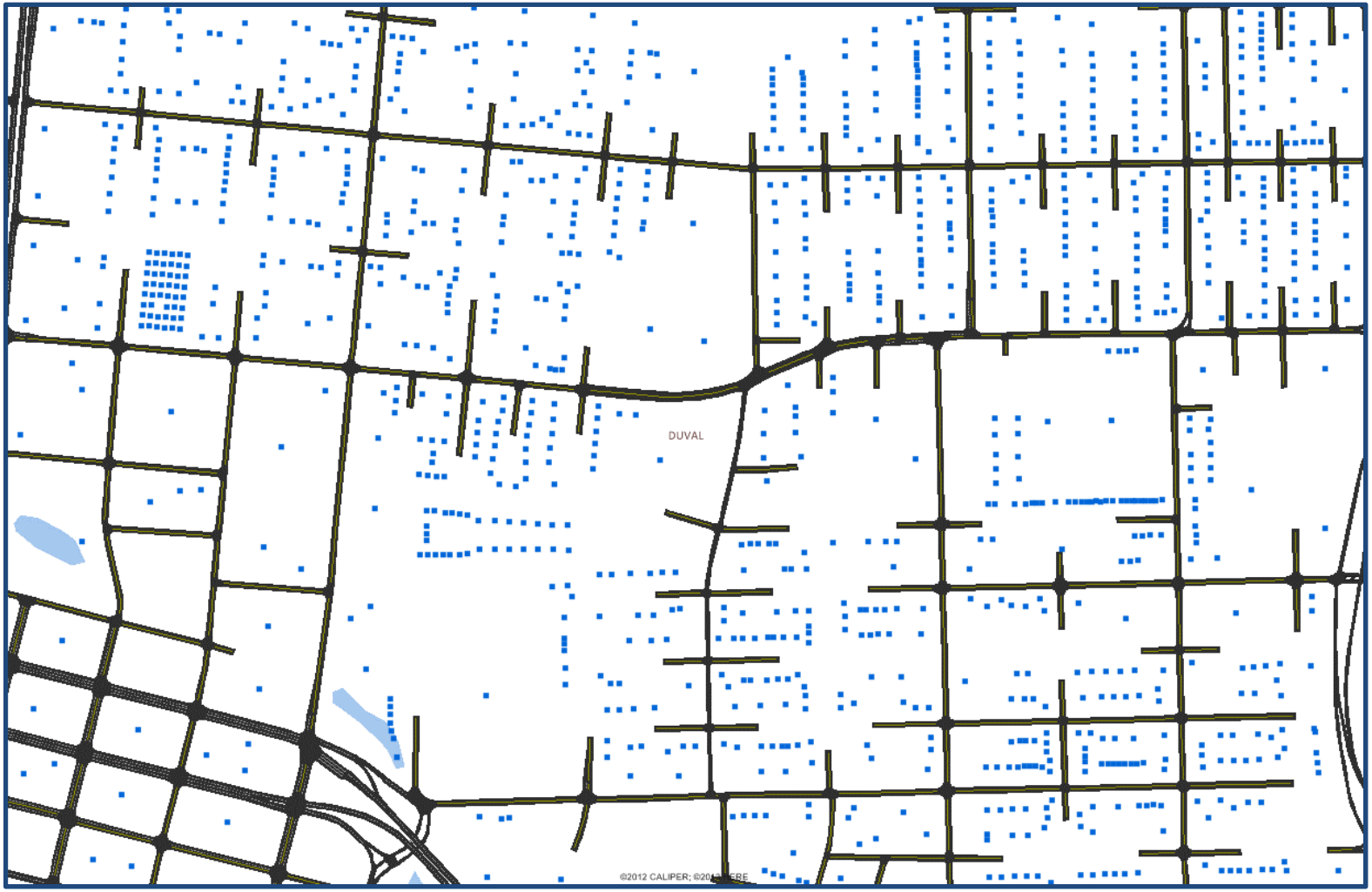

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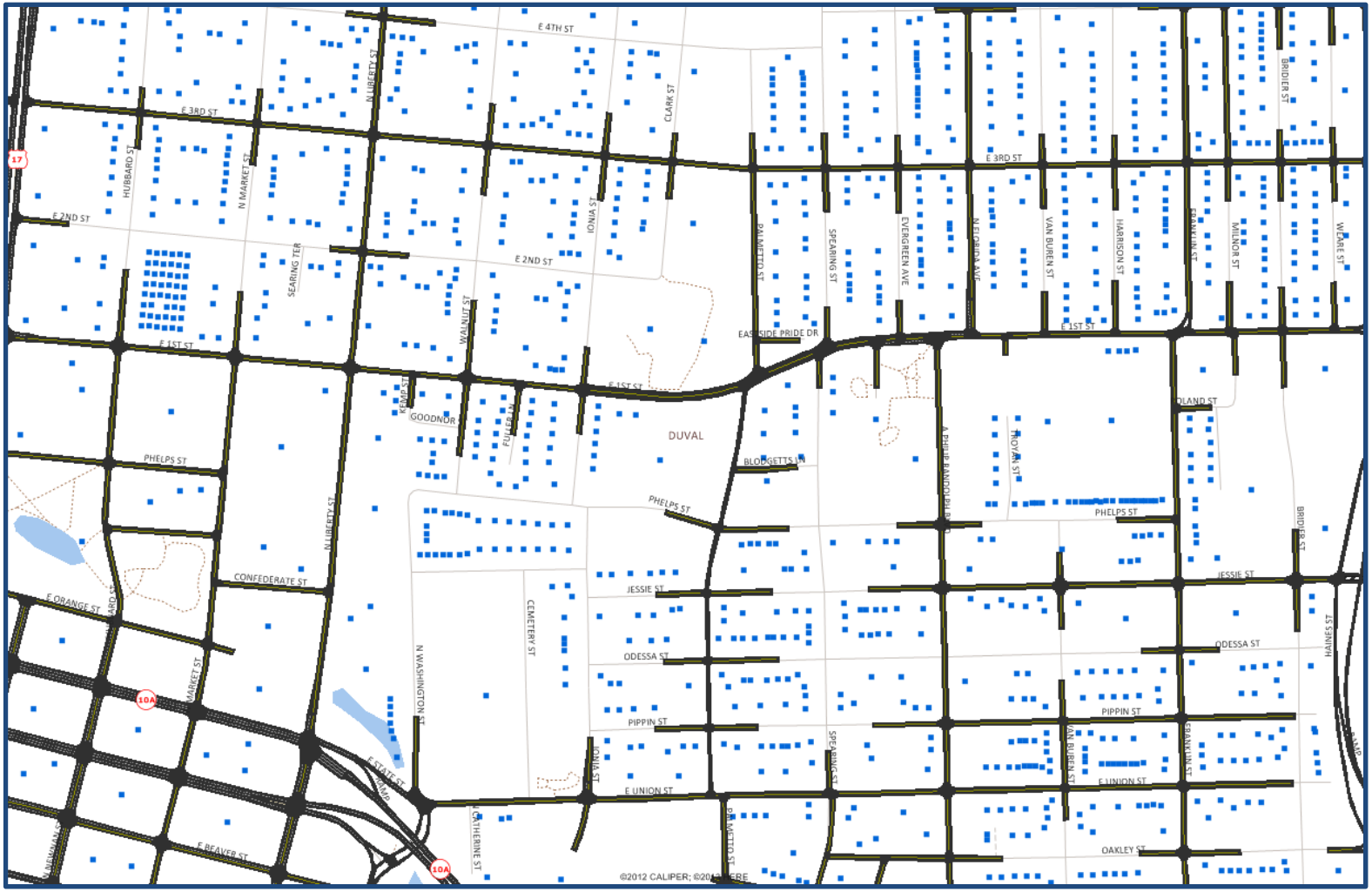

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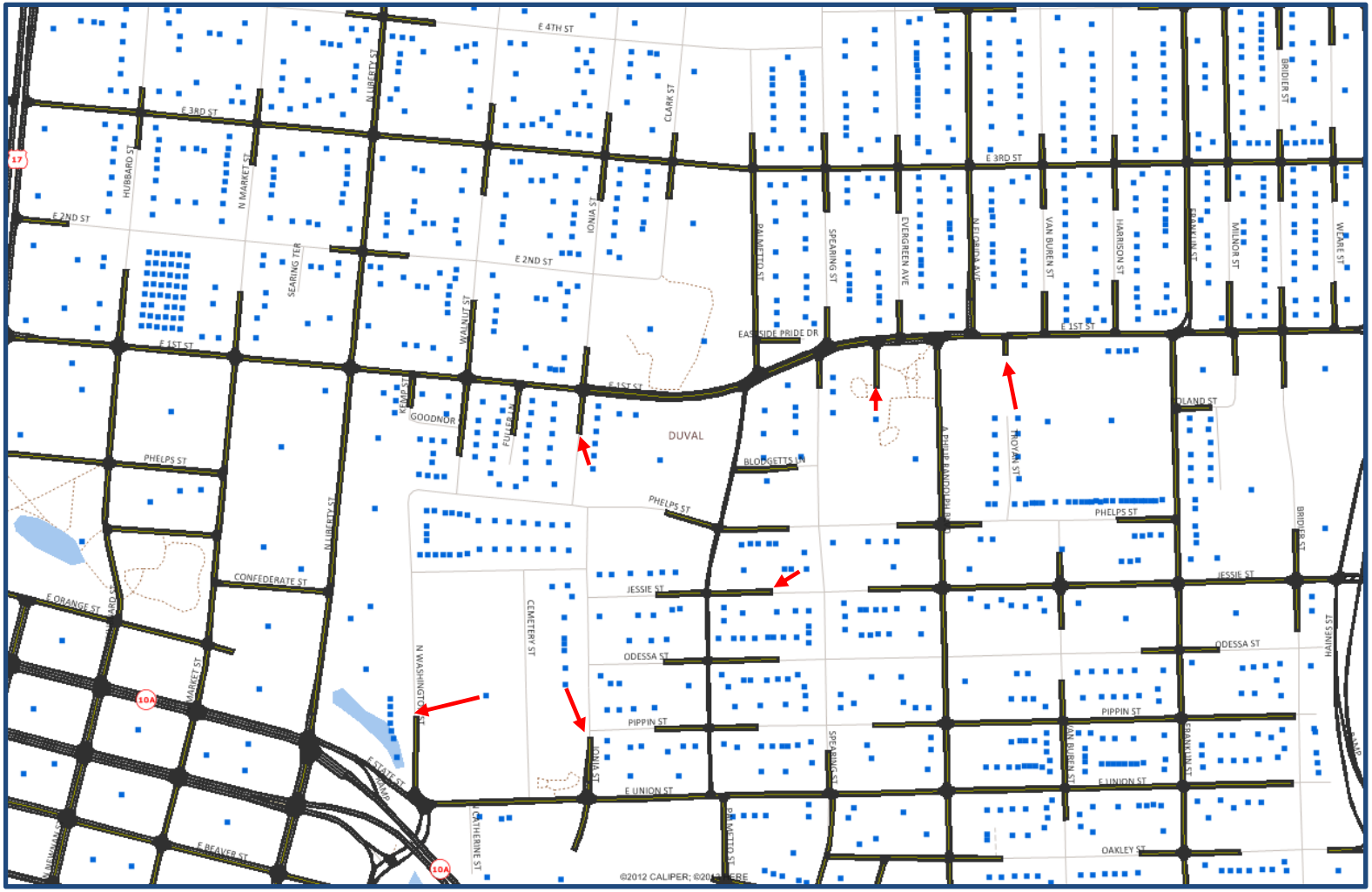

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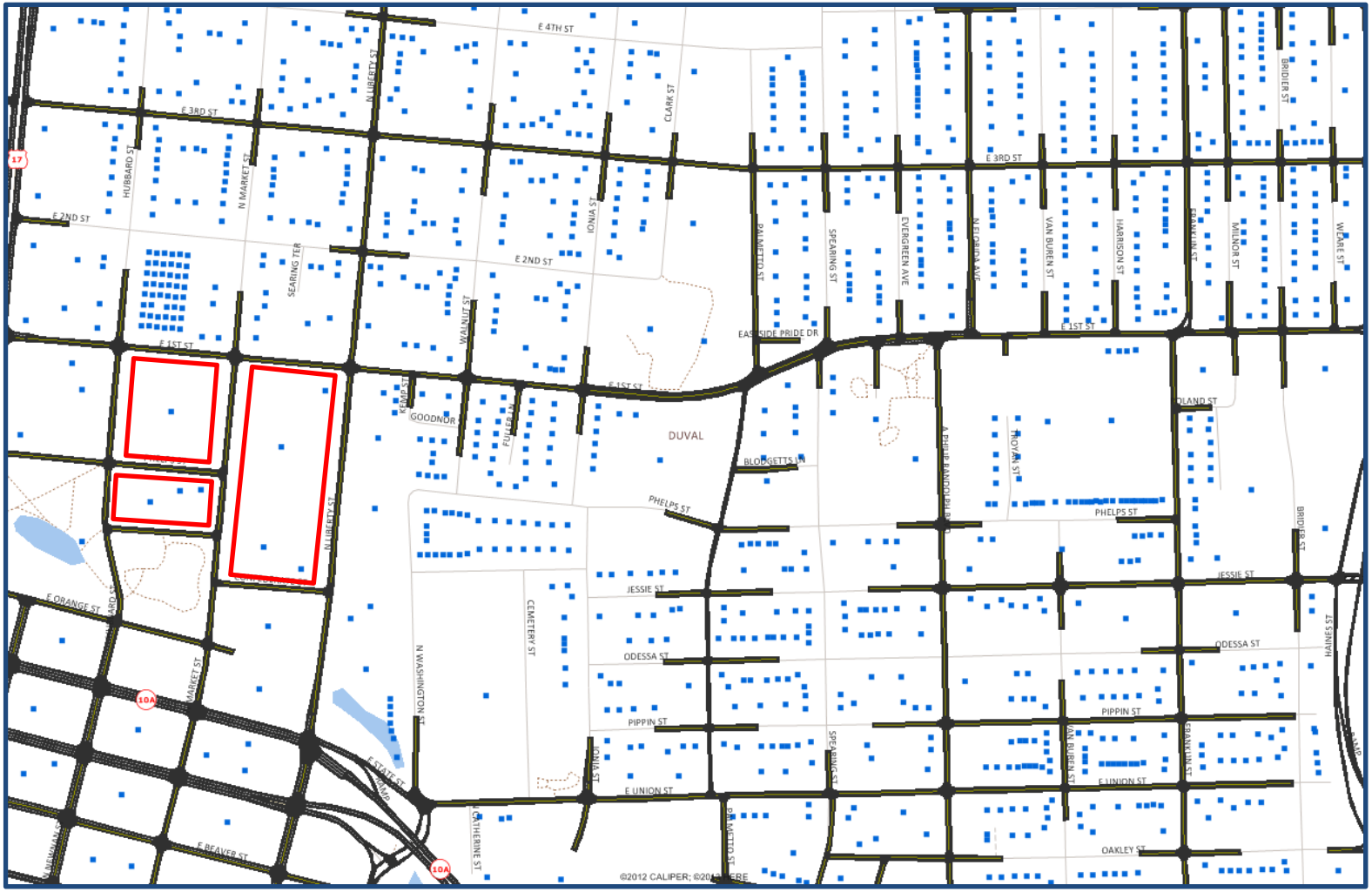

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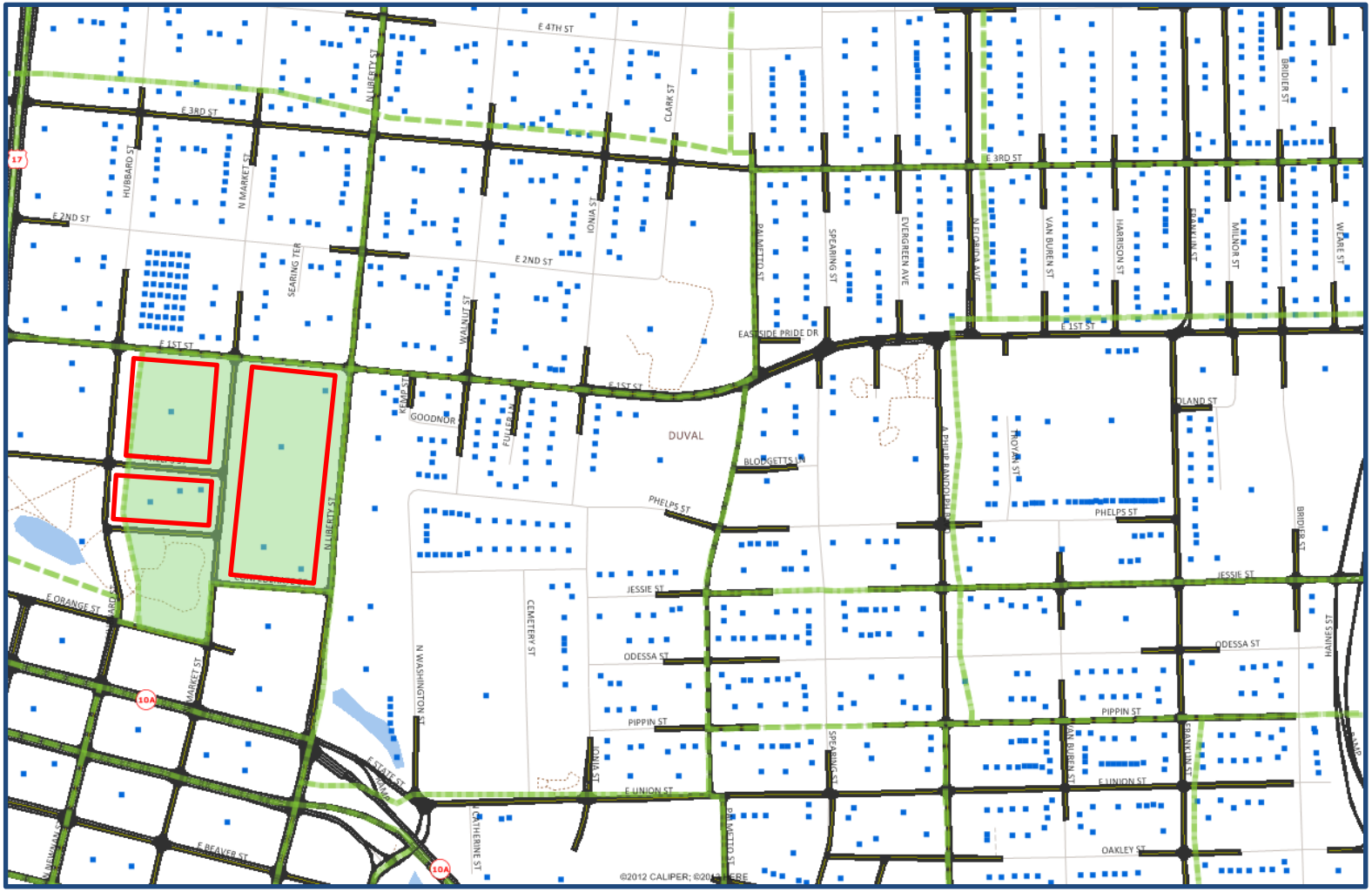

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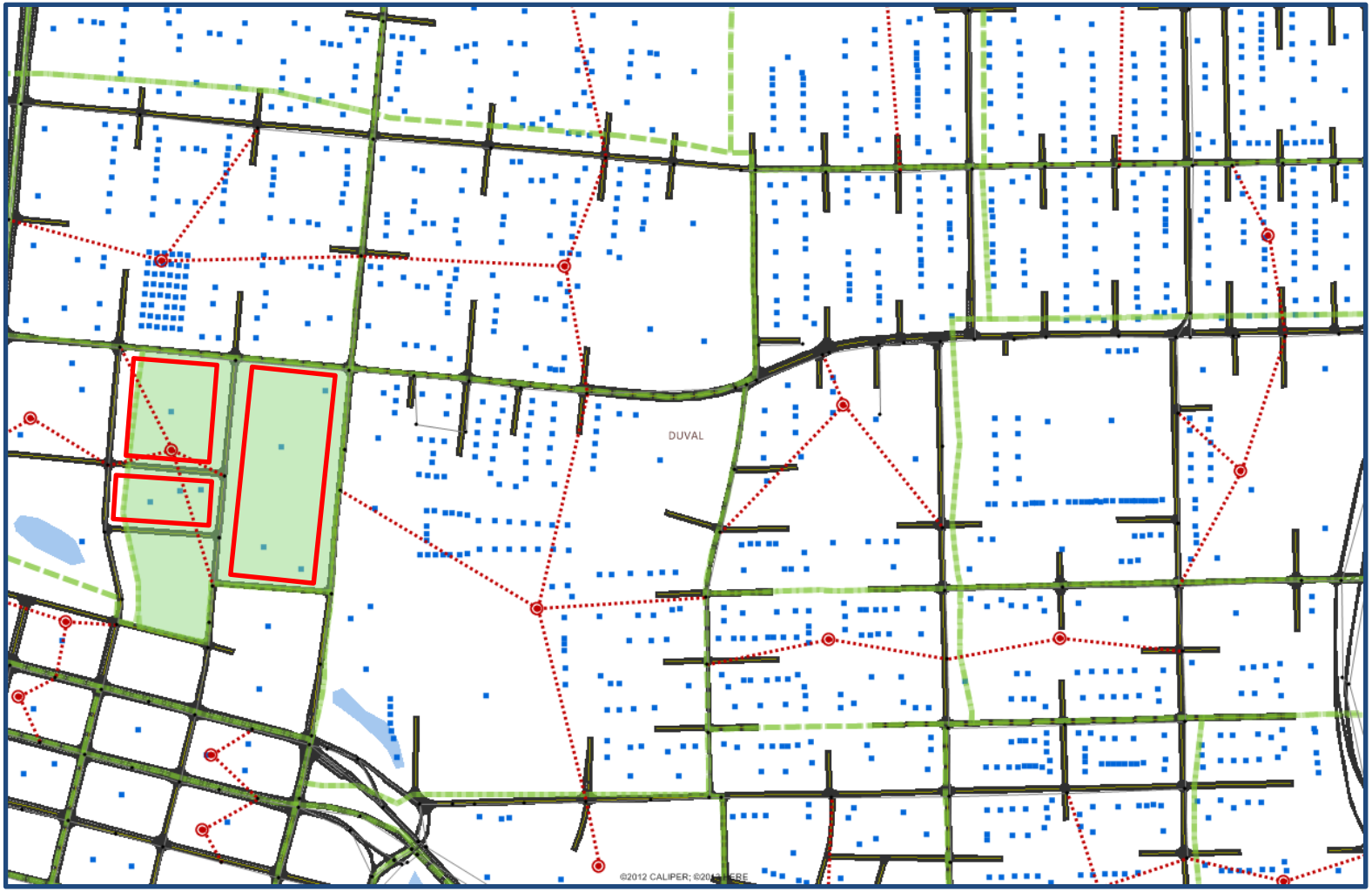

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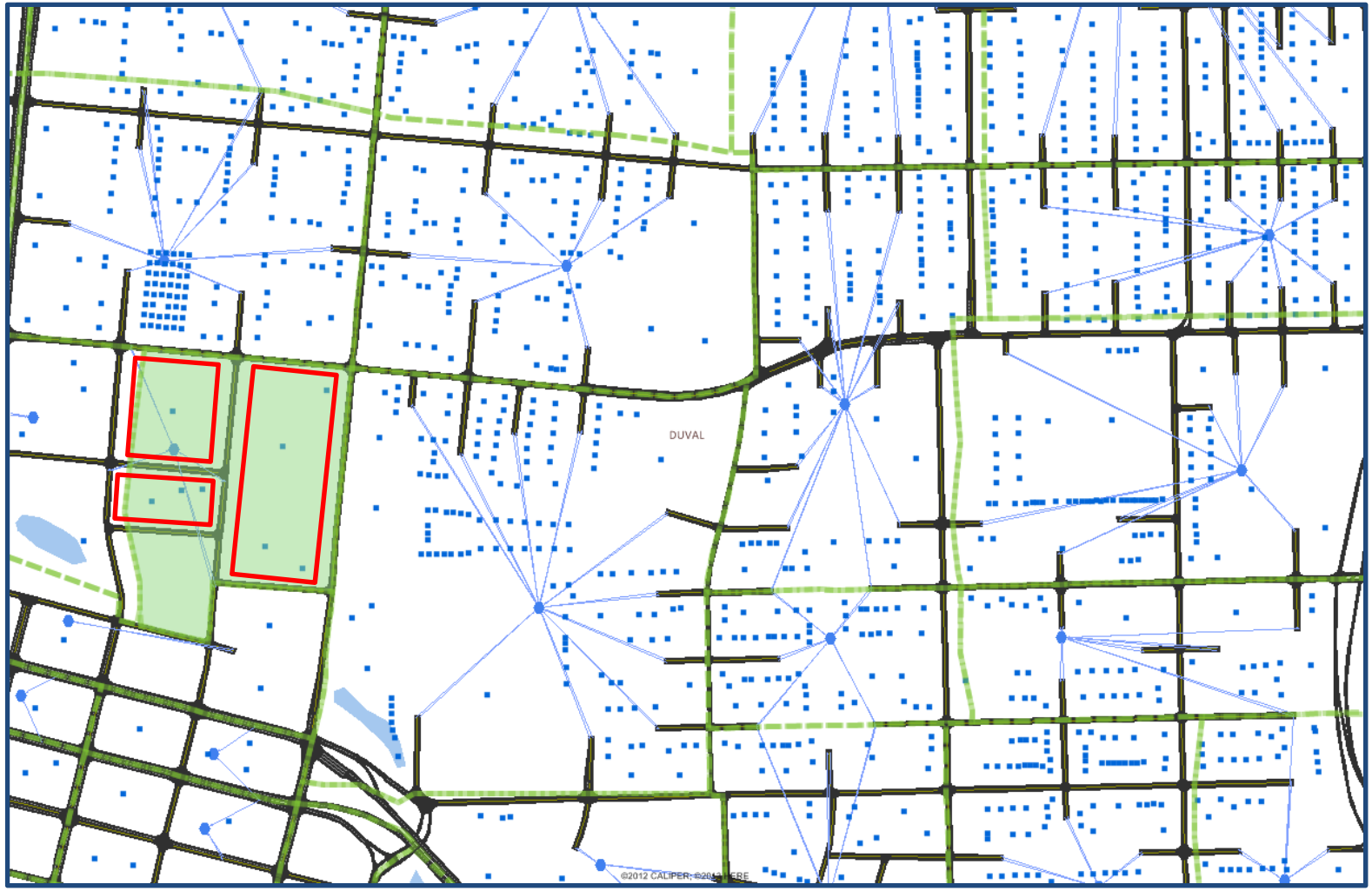
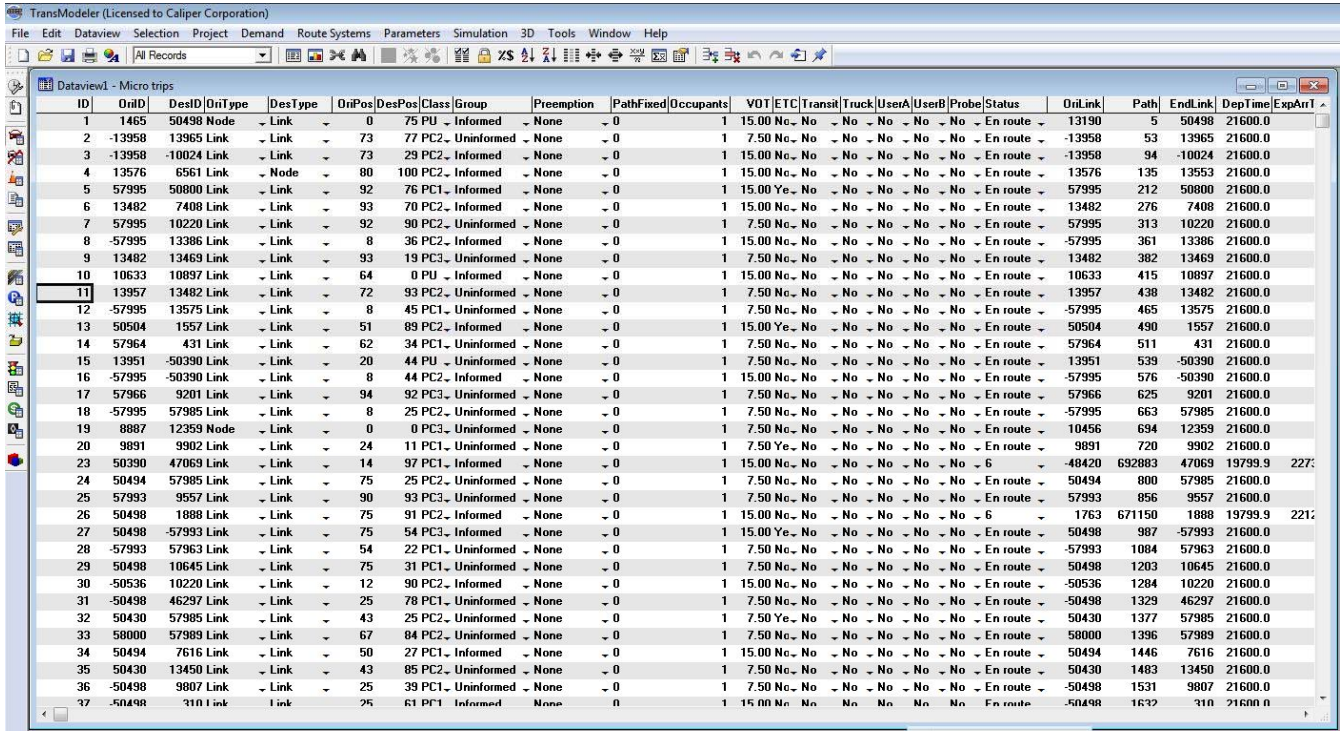


Implementation: Features

- Read DAYSIM trips without temporal aggregation
- Handle parcel locations without spatial aggregation
- Use dense street network
  - Realistic accessibility, connectivity
- Simulate multiple travel modes
- Possess practical running times

Implementation: Input

- Demand: Disaggregate trip tables
  - Detailed demographic and trip information
  - Approximately 650K trips in 3-hour AM peak [6:00-9:00]



TransModeler (Licensed to Caliper Corporation)

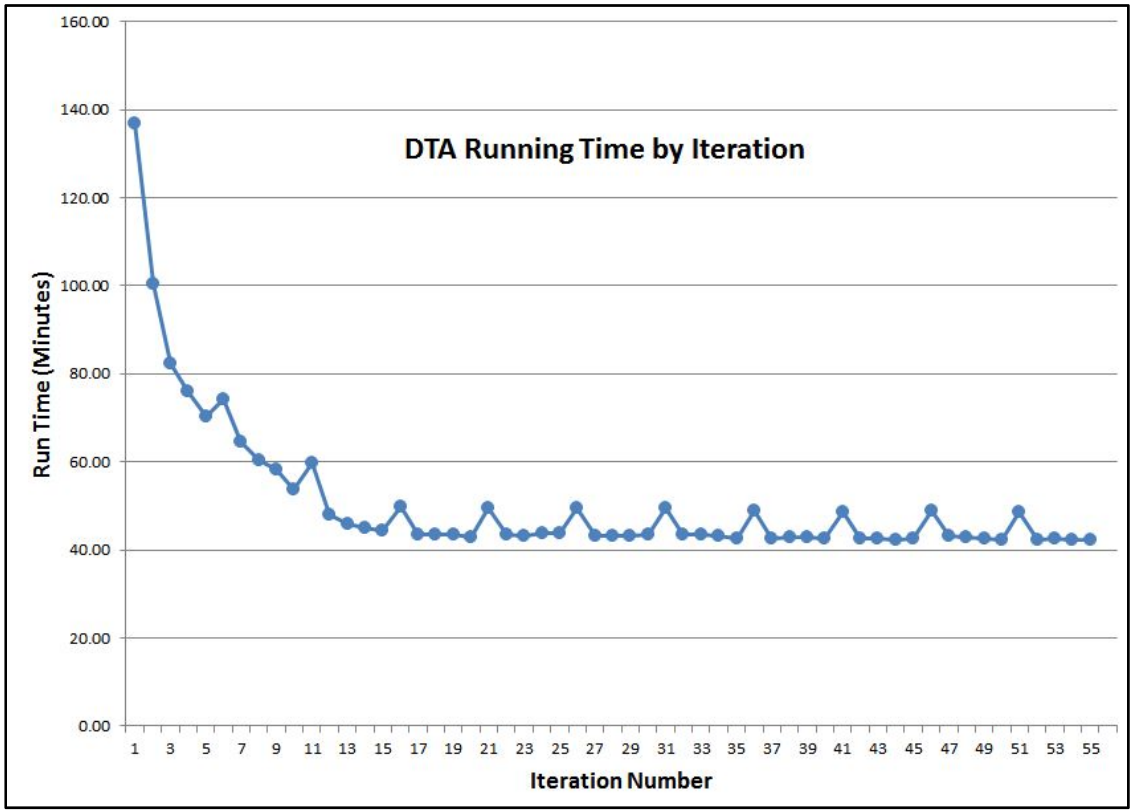
File Edit Dataview Selection Project Demand Route Systems Parameters Simulation 3D Tools Window Help

Dataview1 - Micro trips

ID	OrilD	DesID	OriType	DesType	OriPos	DesPos	Class	Group	Preemption	PathFixed	Occupants	VOT	ETC	Transit	Truck	UserA	UserB	Probe	Status	OriLink	Path	EndLink	DepTime	ExpArrT
1	1465	50498	Node	Link	0	75	PU	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	13190	5	50498	21600.0	
2	-13958	13965	Link	Link	73	77	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-13958	53	13965	21600.0	
3	-13958	-10024	Link	Link	73	29	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	-13958	94	-10024	21600.0	
4	13576	6561	Link	Node	80	100	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	13576	135	13553	21600.0	
5	57995	50800	Link	Link	92	76	PC1	Informed	None	0	1	15.00	Ye	No	No	No	No	No	En route	57995	212	50800	21600.0	
6	13482	7408	Link	Link	93	70	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	13482	276	7408	21600.0	
7	57995	10220	Link	Link	92	90	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	57995	313	10220	21600.0	
8	-57995	13386	Link	Link	8	36	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	-57995	361	13386	21600.0	
9	13482	13469	Link	Link	93	19	PC3	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	13482	382	13469	21600.0	
10	10633	10897	Link	Link	64	0	PU	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	10633	415	10897	21600.0	
11	13957	13482	Link	Link	72	93	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	13957	438	13482	21600.0	
12	-57995	13575	Link	Link	8	45	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-57995	465	13575	21600.0	
13	50504	1557	Link	Link	51	89	PC2	Informed	None	0	1	15.00	Ye	No	No	No	No	No	En route	50504	490	1557	21600.0	
14	57964	431	Link	Link	62	34	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	57964	511	431	21600.0	
15	13951	-50390	Link	Link	20	44	PU	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	13951	539	-50390	21600.0	
16	-57995	-50390	Link	Link	8	44	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	-57995	576	-50390	21600.0	
17	57966	9201	Link	Link	94	92	PC3	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	57966	625	9201	21600.0	
18	-57995	57985	Link	Link	8	25	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-57995	663	57985	21600.0	
19	8887	12359	Node	Link	0	0	PC3	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	10456	694	12359	21600.0	
20	9891	9902	Link	Link	24	11	PC1	Uninformed	None	0	1	7.50	Ye	No	No	No	No	No	En route	9891	720	9902	21600.0	
23	50390	47069	Link	Link	14	97	PC1	Informed	None	0	1	15.00	No	No	No	No	No	No	6	-48420	692883	47069	19799.9	227
24	50494	57985	Link	Link	75	25	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	50494	800	57985	21600.0	
25	57993	9557	Link	Link	90	93	PC3	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	57993	856	9557	21600.0	
26	50498	1888	Link	Link	75	91	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	6	1763	671150	1888	19799.9	221
27	50498	-57993	Link	Link	75	54	PC3	Informed	None	0	1	15.00	Ye	No	No	No	No	No	En route	50498	987	-57993	21600.0	
28	-57993	57963	Link	Link	54	22	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-57993	1084	57963	21600.0	
29	50498	10645	Link	Link	75	31	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	50498	1203	10645	21600.0	
30	-50536	10220	Link	Link	12	90	PC2	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	-50536	1284	10220	21600.0	
31	-50498	46297	Link	Link	25	78	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-50498	1329	46297	21600.0	
32	50430	57985	Link	Link	43	25	PC2	Uninformed	None	0	1	7.50	Ye	No	No	No	No	No	En route	50430	1377	57985	21600.0	
33	58000	57989	Link	Link	67	84	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	58000	1396	57989	21600.0	
34	50494	7616	Link	Link	50	27	PC1	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	50494	1446	7616	21600.0	
35	50430	13450	Link	Link	43	85	PC2	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	50430	1483	13450	21600.0	
36	-50498	9807	Link	Link	25	39	PC1	Uninformed	None	0	1	7.50	No	No	No	No	No	No	En route	-50498	1531	9807	21600.0	
37	-50498	310	Link	Link	25	61	PC1	Informed	None	0	1	15.00	No	No	No	No	No	No	En route	-50498	1632	310	21600.0	

Implementation: Running Time

- DTA running time per iteration
  - Approx. 50 minutes overall
  - 3.1 GHz Intel Xeon Dual-Core 64-Bit CPU, 64 GB RAM



Implementation: Calibration

Link Flows vs. Counts: Percent RMSE by time period and facility type

		N		%RMSE		w/i Acceptable Error		w/i Preferable Error		Sum of Counts/ Sum of Flows	
Peak Period	Road Class	DTA	Static	DTA	Static	DTA	Static	DTA	Static	DTA	Static
AM	All	554	447	50%	57%	--	--	--	--	1.36	1.28
	Major Arterials	182	136	50%	56%	40%	41%	17%	20%	1.33	1.27
	Freeways	14	7	16%	20%	64%	71%	29%	14%	0.94	0.94
Midday	All	555	448	55%	55%	--	--	--	--	1.47	0.97
	Major Arterials	183	137	55%	50%	29%	44%	9%	15%	1.47	0.96
	Freeways	14	7	18%	20%	64%	57%	29%	43%	1.05	0.94
PM	All	555	448	51%	51%	--	--	--	--	1.40	1.05
	Major Arterials	183	137	48%	45%	38%	40%	17%	21%	1.35	1.00
	Freeways	14	7	18%	35%	71%	43%	43%	14%	0.95	0.80

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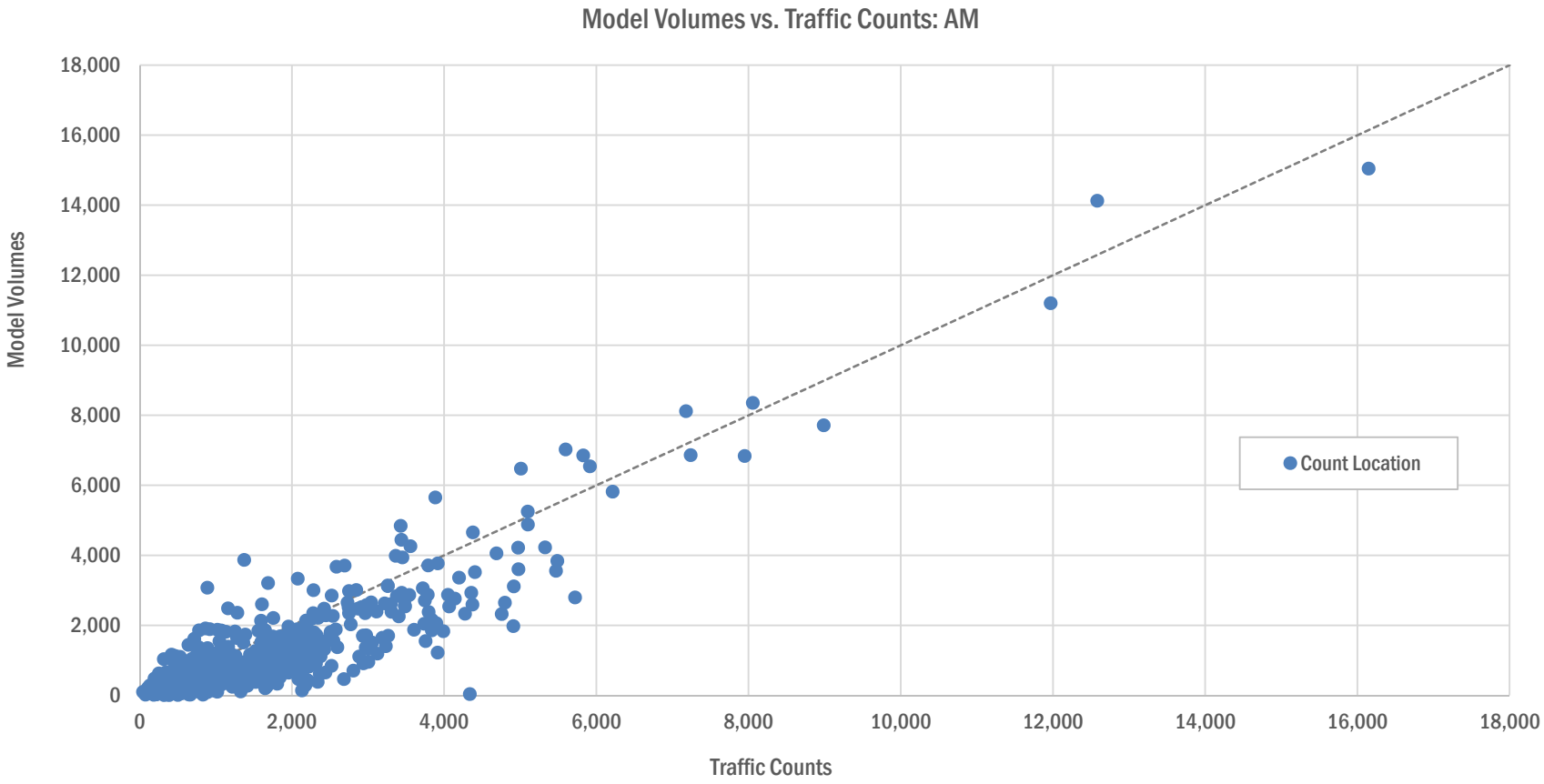
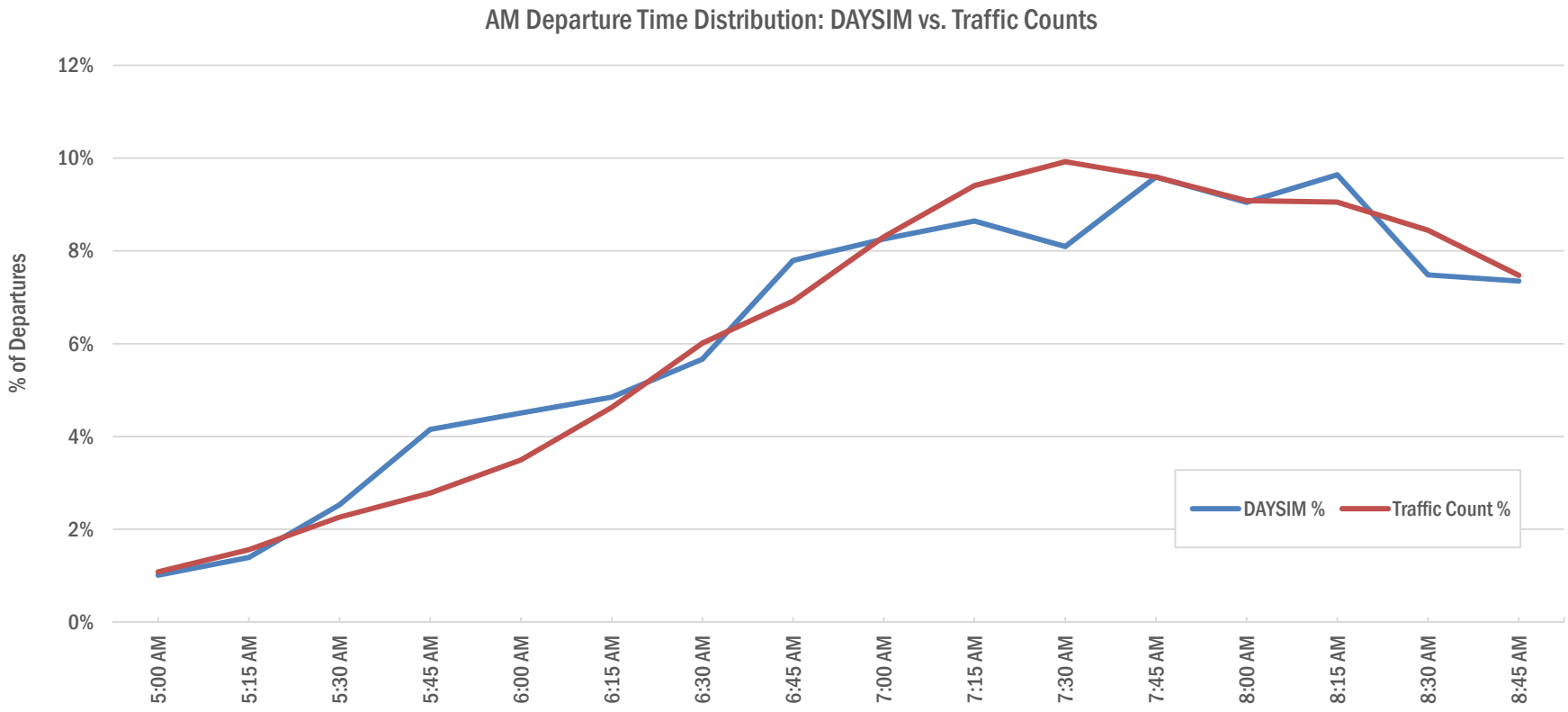
Implementation: Calibration

Link Flows vs. Counts: Scattergram for AM Period



Implementation: Calibration

Departure Times: DAYSIM vs. Count Data



Conclusion

- DTA approach is necessary for analyzing projects with lane level concerns
- DTA is a feasible approach for regional applications
- There is a reasonable interface with both ABM and trip-based approaches
- Significant calibration effort is necessary to replicate link-level queue lengths, and travel times, and link flows, however it is not insurmountable
- Ideally, signal timing and other operational data to replicate complex dynamics

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Thank you for your time

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