Developing a Subregion Model Tool for the Southern California Association of Governments

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Outline

- **Goal of the Subregion Tool**
- **Subregion Tool Process**
- **Subregion Models**
- **Subregion Tool Demo**
- **Model Application – San Bernardino County**
- **Future Work**

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Goal of the Subregion Tool

- **Current SCAG Regional Model is 4000+ zones, 100,000+ links, and takes 24 hours to run**

- **SCAG region contains 170+ cities, 6 counties, and 17 subregions, many with modeling needs**

- **Very expensive and time consuming to build custom subregion models for each**

- **Tool designed to quickly use the regional model to create subregion models**

- **Models designed to focus on subregion, but be compatible with Regional Model**

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Typical Subregion Model Development

- **Subregion defined**
- **TAZs and network inside subregion disaggregated**
- **TAZs and network outside subregion aggregated**
- **Network, TAZs, demographics, other input manually re-configured**
- **Model inside subregion much more accurate**
- **Model outside subregion much less accurate**
- **Model is calibrated and validated for area inside subregion and model is ignored outside subregion**

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Subregion Tool Process

- **Main goal: automate and standardize conversion**
- **Subregion Conversion Steps**
  - **Define master subregion GIS layer with disaggregation inside subarea**
  - **Run a conversion utility which**
    - Auto-disaggregates and aggregates TAZs, demographics and other table inputs
    - Auto-disaggregates and aggregates matrix inputs
    - Auto converts network and creates new centroid connectors
  - **Run Subregion version of Regional Model**
    - Similar to Regional Model with exception in aggregation areas to ensure consistency
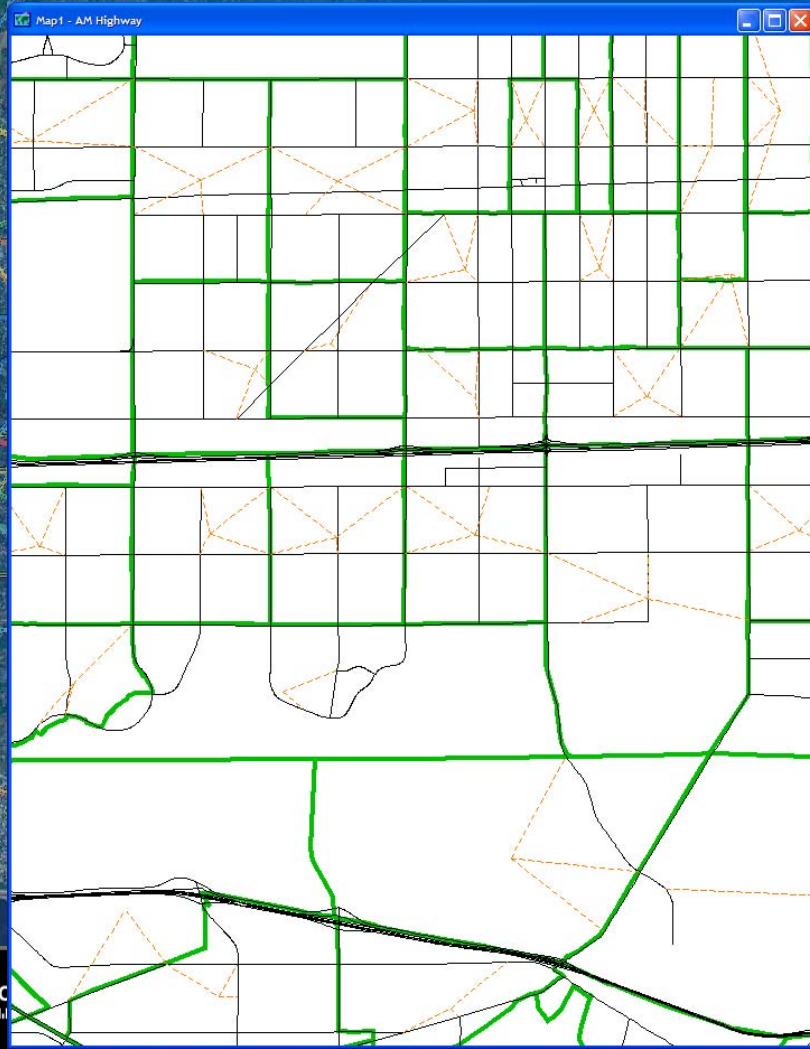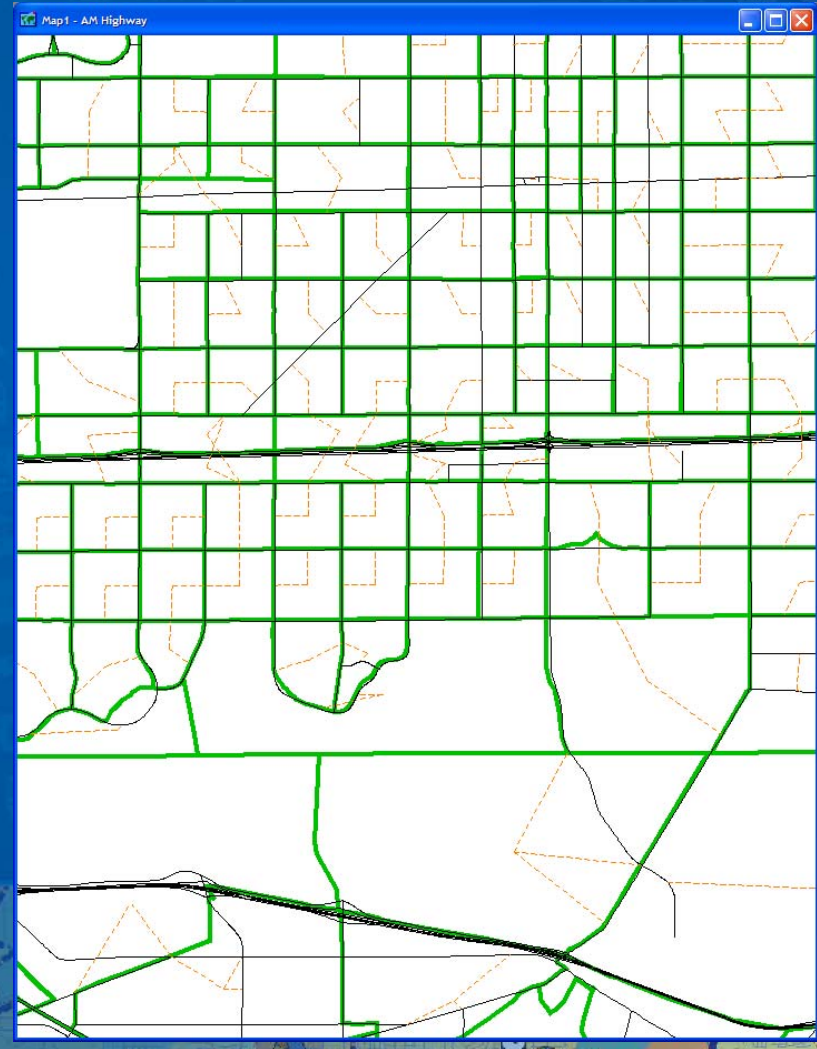
Inside Subregion

- **TAZ attributes re-calculated based upon population/employment ratios, or input from subregion agency**
- **Centroid connectors redefined automatically, or based on previous definitions**
- **Additional network links automatically merged in**

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Inside Subregion Example

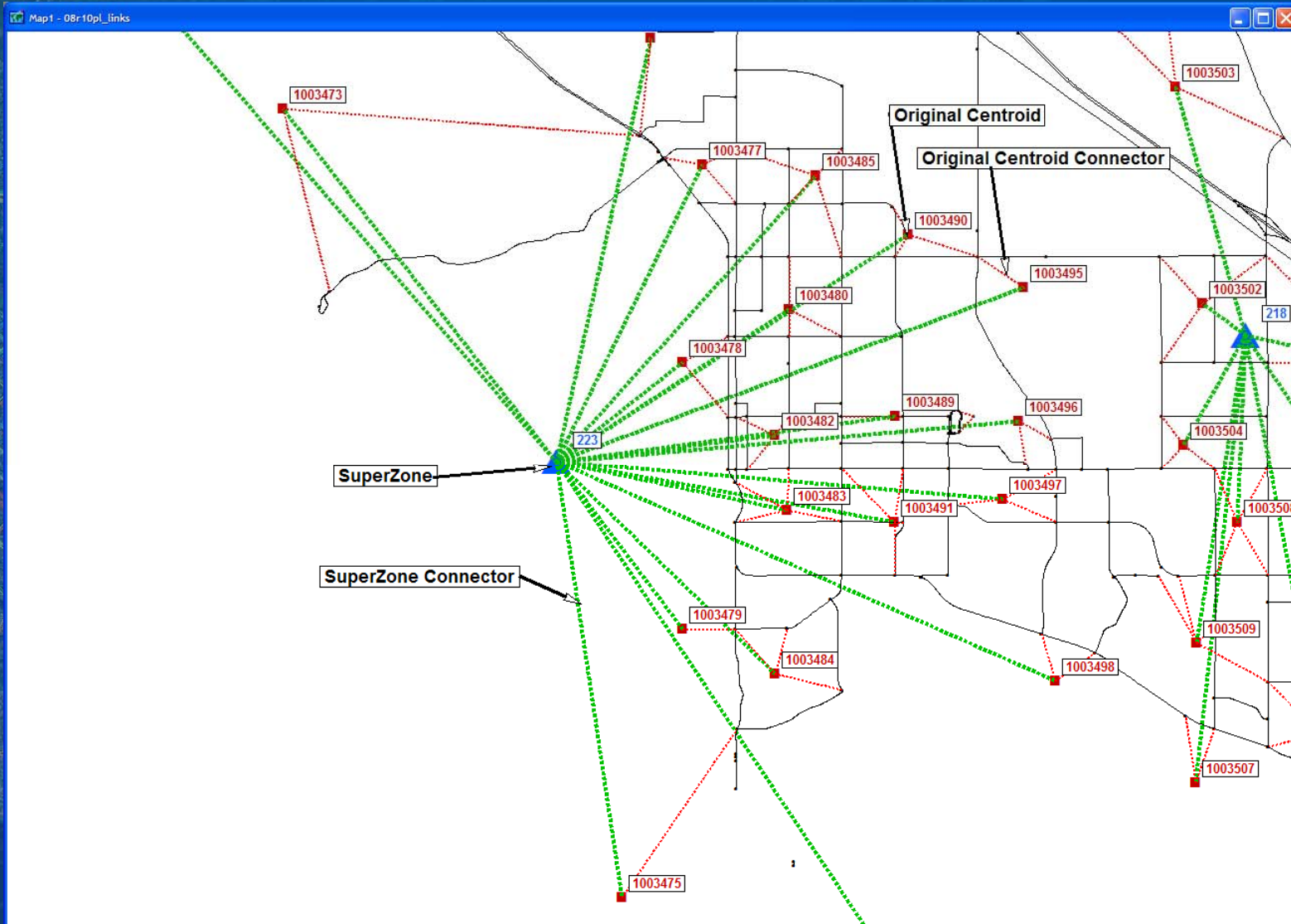Before Disaggregation

After Disaggregation

Outside Subregion

- **Centroid connectors preserved, but aggregated to higher lever**
- **Zonal aggregation models added to**
  - Account for aggregation bias
  - Account for trip loss during aggregation

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Centroid Aggregation Outside Subregion

What is Aggregation Bias?

- Model estimated based upon defined zone system
- Model evaluated based on different set of zones
- Solution: Keep original zone locations
- For each aggregate zone, pick a representative zone

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Zonal Aggregation Models

- ## Intra-Superzone Trips Model
  - ### To account for underassignment of trips
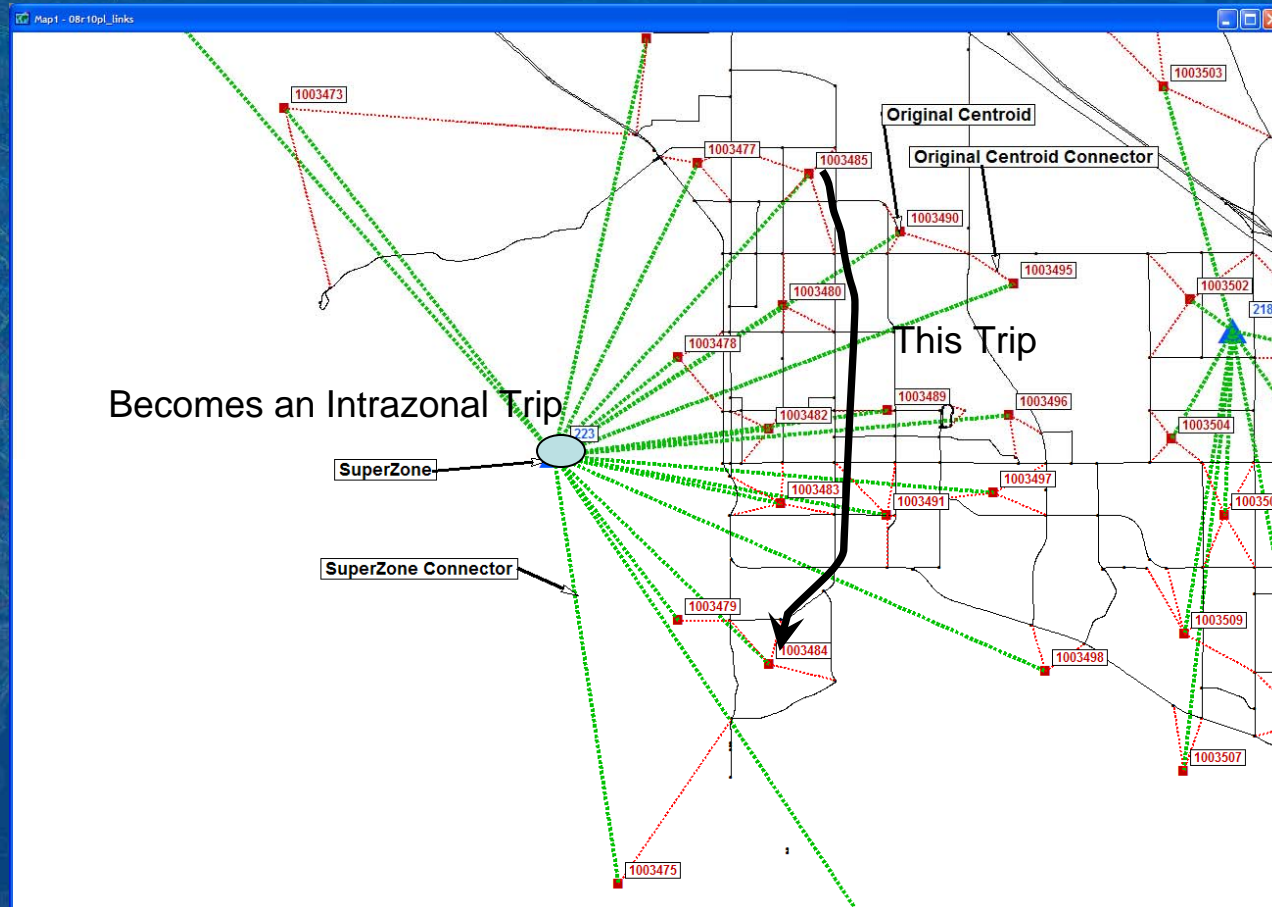
Zonal Aggregation Models

- **Intra-Superzone Trips Model**
  - **Take intra-superzone trips and load them onto the networks using original connectors**
  - **Combine with aggregate assigned trips**

Intra-Superzone Assignment Example

Aggregate OD Matrix

Intra-Superzone Trip

Inter-Superzone Trip

Matrix2 - AM Trip OD (DA)

	26	27	28	29	30	31	32	33	34	35	36	3
26	3554.24	274.07	1677.85	636.19	61.56	542.44	354.00	38.45	116.98	333.16	410.99	241.0
27	404.07	3093.66	324.14	423.37	47.03	584.28	160.09	34.77	66.84	464.34	334.86	390.8
28	3206.62	373.23	12523.15	3795.69	283.48	977.45	1155.94	54.15	117.23	349.22	432.32	326.7
29	722.22	234.49	1999.00	8097.06	404.30	1482.85	655.69	19.67	25.08	104.28	112.21	138.9
30	26.05	12.04	61.28	217.87	35.82	45.85	17.36	1.51	1.74	6.80	8.37	10.3

Dataview5 - model_sed+TAZEQCOUNTY

[seq #]	CSA	HH	Tot_emp
1369	29	53	3579
1375	29	681	208
1376	29	1391	256
1378	29	1202	2544
1379	29	189	20263
1382	29	1506	122
1388	29	2651	1184
1390	29	1059	401
1393	29	955	484
1399	29	1812	7205
1400	29	2517	5681
1401	29	2847	3485
1402	29	1282	927

Matrix1 - Output Matrix (CAR Intra)

	1369	1375	1376	1378	1379	1382	1388	1390	1393	1399
1369	42.48	0.37	0.25	6.52	48.17	0.20	1.86	0.47	0.53	12.76
1375	28.74	18.20	2.29	45.14	79.31	2.26	5.59	2.80	4.86	18.79
1376	33.06	2.35	30.06	24.05	234.79	3.11	32.17	4.01	3.25	58.09
1378	58.05	8.46	3.60	138.60	152.40	4.19	10.63	4.86	8.66	40.16
1379	45.51	0.79	1.19	16.00	472.89	0.70	10.12	1.62	1.40	64.65
1382	45.99	5.80	8.64	64.76	191.35	22.83	19.27	16.36	8.67	49.05
1388	59.83	3.11	13.34	37.80	451.41	3.65	98.04	8.46	5.29	139.64
1390	29.38	2.44	2.97	26.39	128.87	5.59	15.26	24.13	7.18	43.47
1393	34.02	2.85	1.90	31.34	105.21	1.89	8.64	5.76	28.09	36.85
1399	62.11	1.20	2.00	22.45	422.19	1.03	16.43	3.05	2.76	210.03
1400	55.67	2.46	1.39	31.95	356.00	2.29	26.52	6.41	6.74	154.90
1401	66.27	4.10	5.36	45.41	309.60	4.68	25.02	15.79	15.77	125.42
1402	38.74	2.86	2.04	31.06	135.62	1.76	9.30	4.85	11.57	51.28

Correspondence Table

Disaggregate Intra-Superzone Trip

Demo of Subregional Model
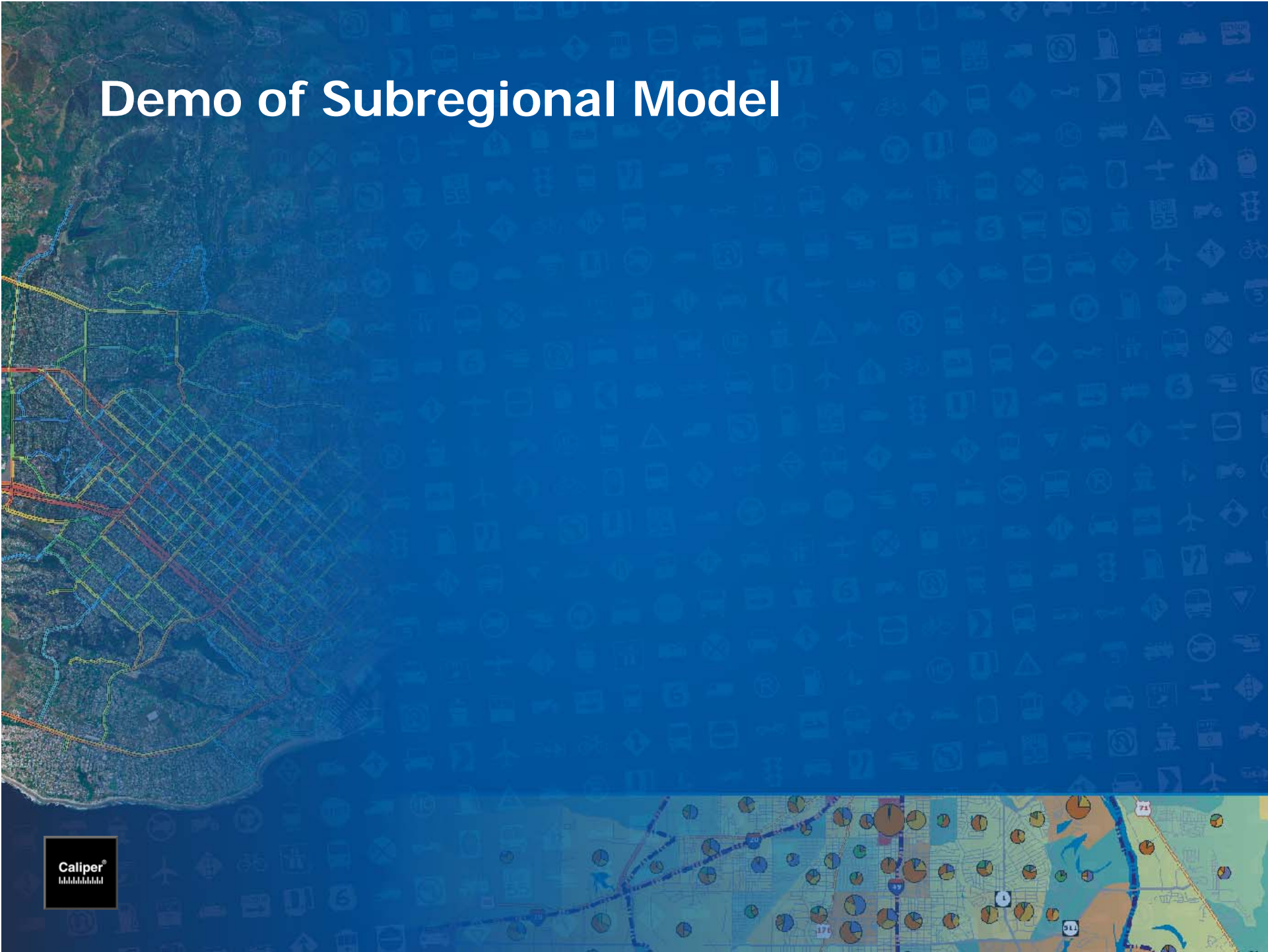
Verification Results-San Bernardino

Assignment Speed, VMT, VHT, Delay

Regional Model	AM PEAK	PM PEAK	MIDDAY	NIGHT	TOTAL
			Time Period		
Average Speed (mph), ALL	30.9	26.9	35.8	43.8	32.1
Vehicle Miles Traveled ('000), ALL	79,792	133,369	117,306	64,827	395,294
Vehicle Hours Traveled ('000), ALL	2,583	4,956	3,279	1,481	12,298
Vehicle Hours Delay ('000), ALL	755	1,823	610	86	3,273

Subregion Model	AM PEAK	PM PEAK	MIDDAY	NIGHT	TOTAL
			Time Period		
Average Speed (mph), ALL	30.4	27.4	33.7	41.7	31.7
Vehicle Miles Traveled ('000), ALL	78,453	127,763	117,554	69,276	393,046
Vehicle Hours Traveled ('000), ALL	2,580	4,667	3,492	1,662	12,402
Vehicle Hours Delay ('000), ALL	704	1,526	690	115	3,035

Difference	AM PEAK	PM PEAK	MIDDAY	NIGHT	TOTAL
			Time Period		
Average Speed (mph), ALL	-2%	2%	-6%	-5%	-1%
Vehicle Miles Traveled ('000), ALL	-2%	-4%	0%	7%	-1%
Vehicle Hours Traveled ('000), ALL	0%	-6%	6%	12%	1%
Vehicle Hours Delay ('000), ALL	-7%	-16%	13%	34%	-7%

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Sensitivity Results

VMT, VHT and Delay Scenario Comparisons

	VMT	VHT	Delay
Base Scenario	393,046	12,402	3,035
10 min CR Headways	389,881	12,222	2,929
1 Extra Lane on all Freeways	403,079	12,245	2,791
15% Higher Freeway Speeds	399,037	12,082	3,061
Doubling Households and Employment	659,835	29,110	12,181
High Auto Operating Cost	337,881	10,228	2,146

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Future Work

- **Rollout: San Bernardino, North Los Angeles, Imperial County**
- **Better methods to handle aggregation bias**
- **Add highway-only and transit-only component**
- **Add more subregion-specific parameters**
- **Additional optimization**

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Thank You

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