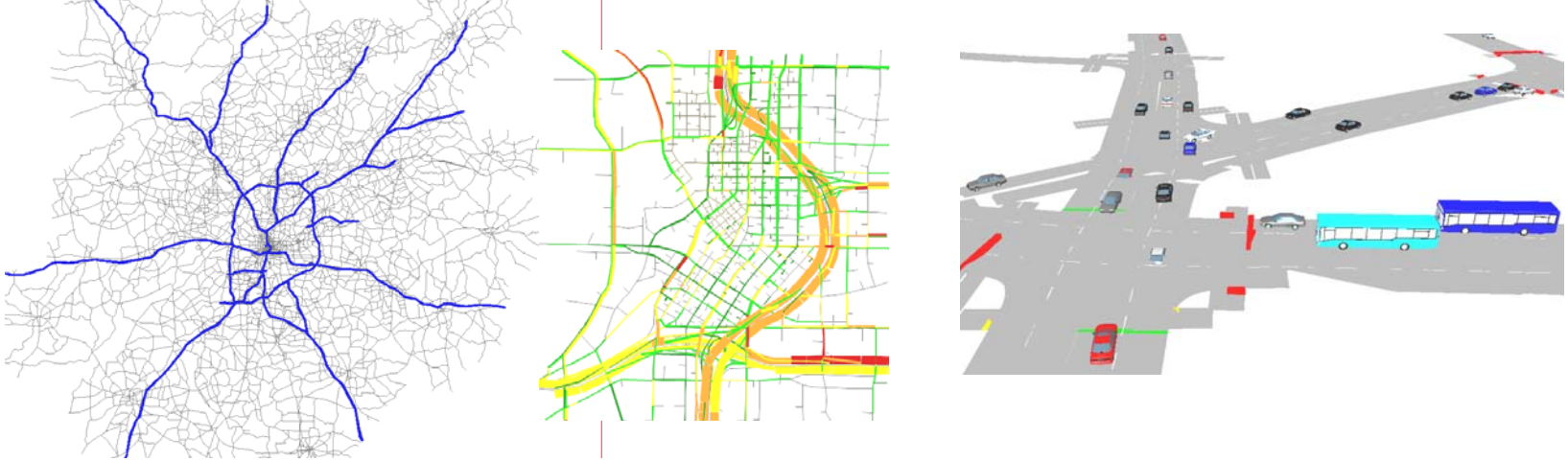

Linking Atlanta's Regional Transportation Planning Model with Microscopic Traffic Simulation

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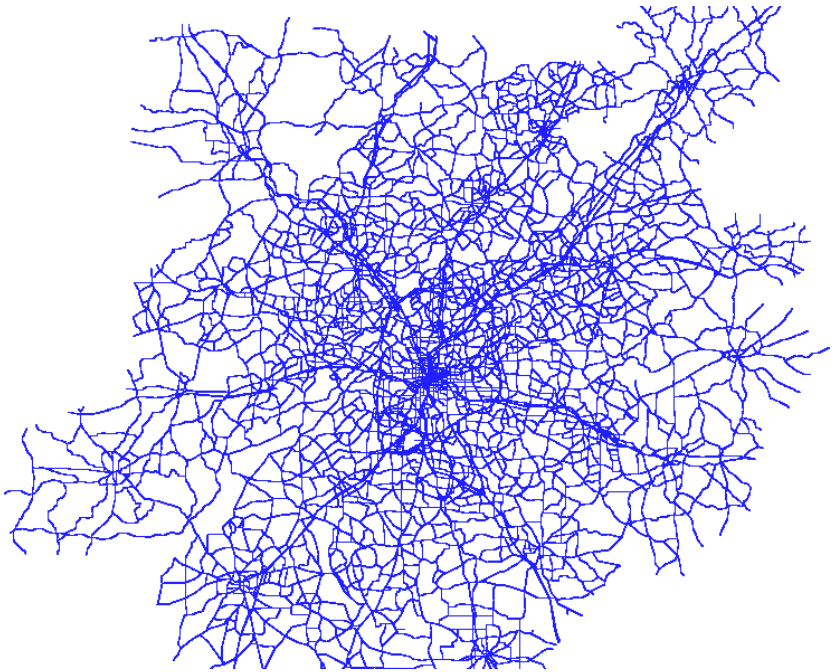
Outline of the Presentation

- Introduction
- Macroscopic vs. Microscopic Models
- Needs for Macro-Micro Integration
- Method for Integrated Sub-area Analysis
- Examples
- Challenges of Macro-Micro Integration
- Conclusions and Recommendations

Introduction

- Who is ARC?
- ARC's Regional Travel Demand Model



- 6,402 sq mi
- 27,000+ nodes
- 57,000+ links (35 link attributes)
- 2115 zones

Introduction

- Who is ARC?
- ARC's Regional Travel Demand Model
- Motivations for Micro-simulations
- Projects from Marco to Micro Levels
  - Downtown traffic management
  - Downtown bus circulation
  - Detour analysis
  - Freeway analysis (I-285 ITS)

Macroscopic vs. Microscopic Models

Inputs:		
	- Land use - Socioeconomic demographical data - Travel behaviors - Highway and transit network (travel cost, geometry and capacity)	- Highway network (geometry) - Traffic control - Vehicle characteristics - Driver behaviors - Traffic demand
Outputs:		
	- Expected travel pattern and demand (time of day, current and future) - Aggregate traffic characteristics (e.g. VMT and hourly link volume)	- Individual vehicle trajectory and states (can be aggregated for any time interval) -Volume, speed, travel time, delay and queue length etc.
Applications:		
	- Transportation planning - Long-term forecasting - Impact study at regional or corridor level (e.g. new development)	- Engineering study focus on intersections - Short-term forecasting - Operational analysis (including ITS) - Visualization tool

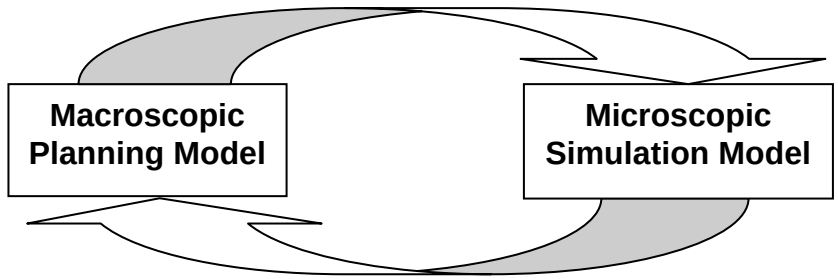
Macroscopic vs. Microscopic Models (contd)

Modeling Approach:		
	- Aggregation of vehicles (trips) - 4-step modeling process - Deterministic traffic flow models - Static equilibrium assumption	- Individual vehicles (trips) - Monte Carlo methods (stochastic) - Car following and lane changing logic - Signal control logic
Network Representation:		
	- Node and link topology - Simplification of intersections - Low level of details	- Links (curvature, gradient and lane use) - Intersection geometry (multiple objects) - High level of details
Traffic Representation:		
	- All trips are loaded simultaneously on a link (no queuing) - All trips share the same speed on a particular link and time period - Capacity is a model input and can be exceeded by the flow volume	- Individual vehicle loading and moving (queue building and spill back) - Vehicle speed varies in reaction to other vehicles and traffic control - Capacity is an implicit result of geometry constraints and vehicle behaviors

Needs for Macro-Micro Integration

- Complementary Tools
- (new) Model Development/Refinement (long run)
- Consistency of Data/Model Structure
- Better Communication
- Consistency of Analysis

- Basic Roadway Geometry
- Existing & Future Demands
- Initial Plan & Alternative Designs



- Simulation Results
- Visualization
- Validated Assumptions
- Refined Network

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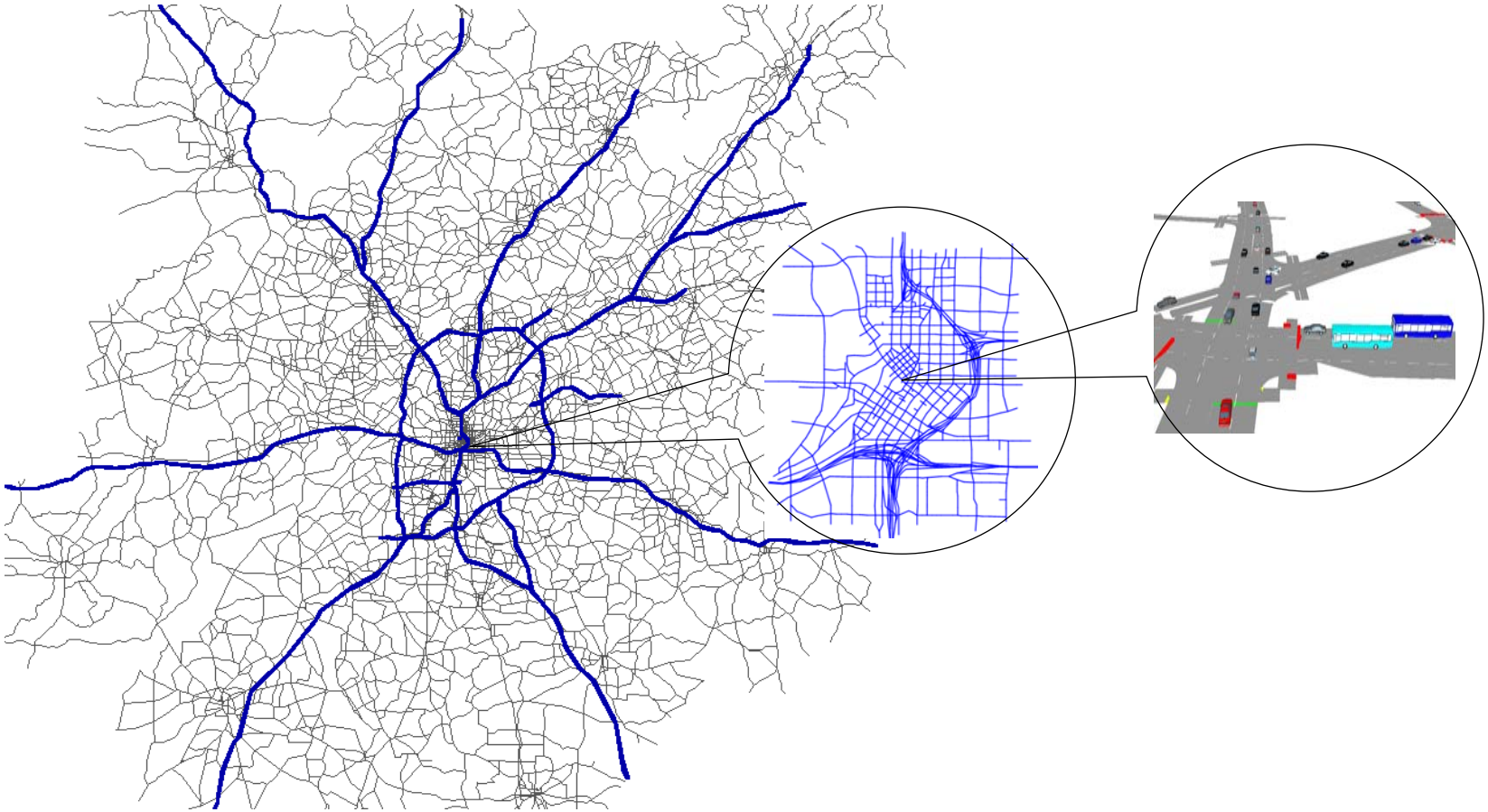
Example - Integrated Subarea Model

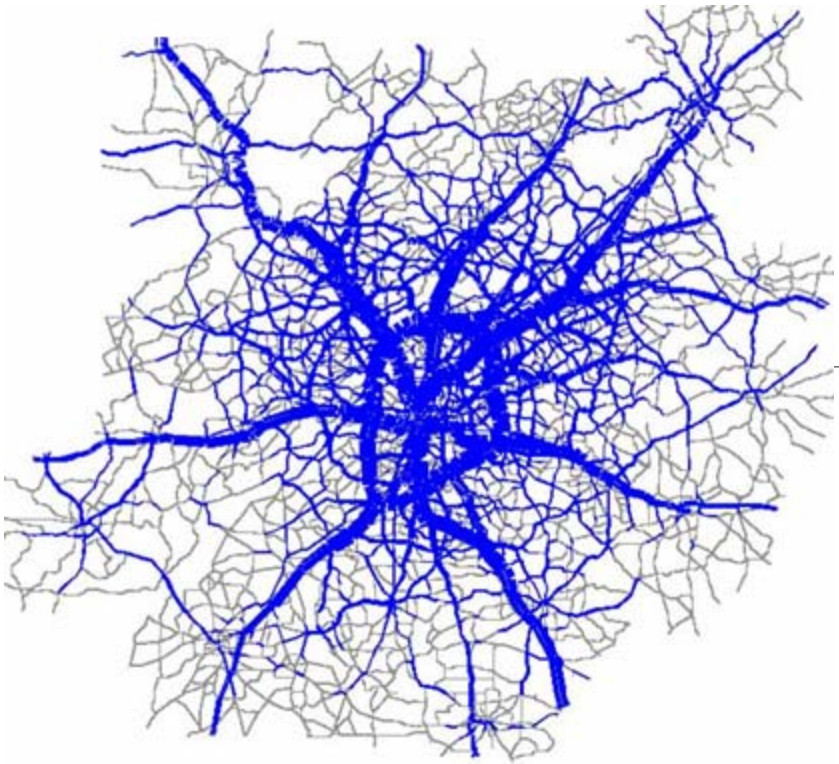


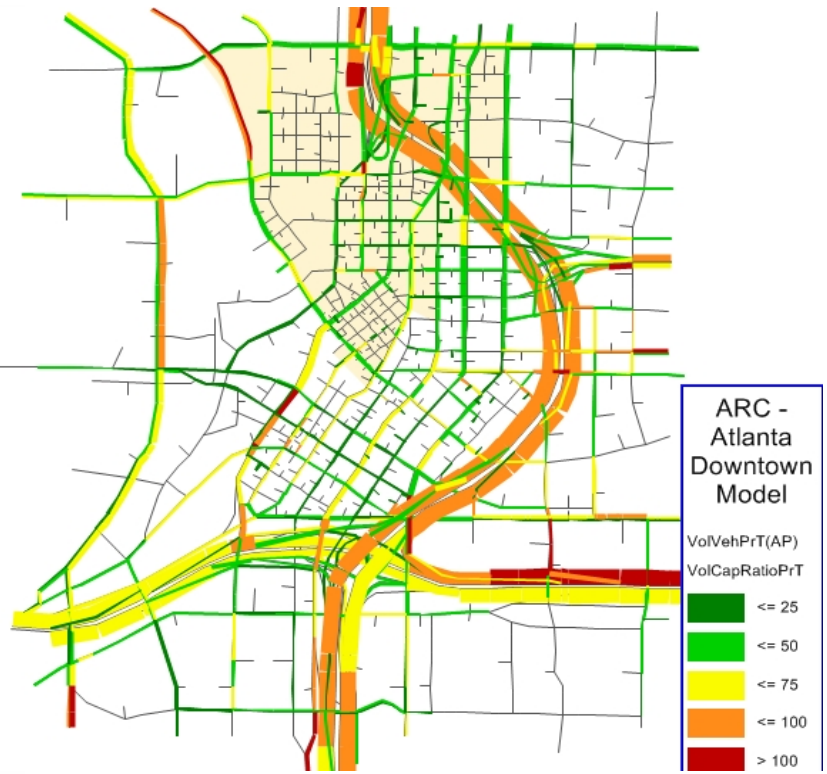
Example - Integrated Subarea Model (continued)

	Regional Model (CUBE)	Downtown Macro-Model (VISUM)	Downtown Micro- Model (VISSIM)
Model Area (sq mi)	6402	4	1
Number of Links	57726	3332	1658
Number of Zones (internal/total)	2024 / 2115	45 / 95	30 / 76
Number of Intersections Modeled with Control (total / signal)	None	392 / 121	392 / 121

Method for Integrated Subarea Analysis

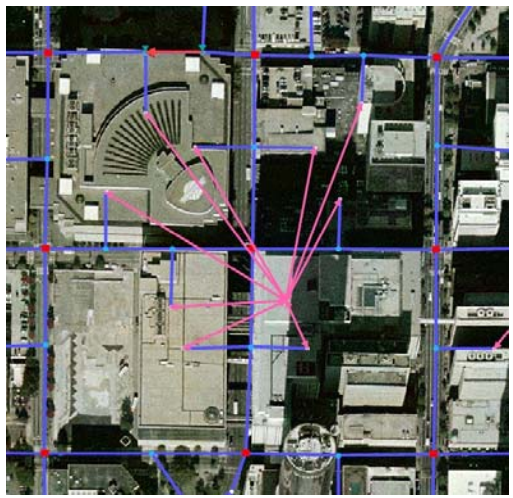
- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix

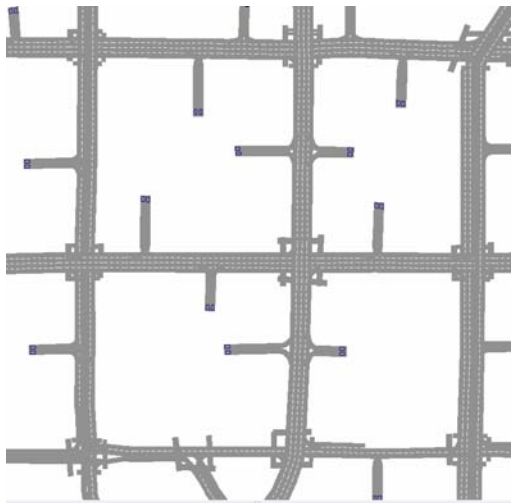




Method for Integrated Subarea Analysis

- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Subarea Network
  - Node-link network (e.g. NAVTEQ tile, aerial photos)
  - Zone-connector structure (e.g. driveways and parking facilities)

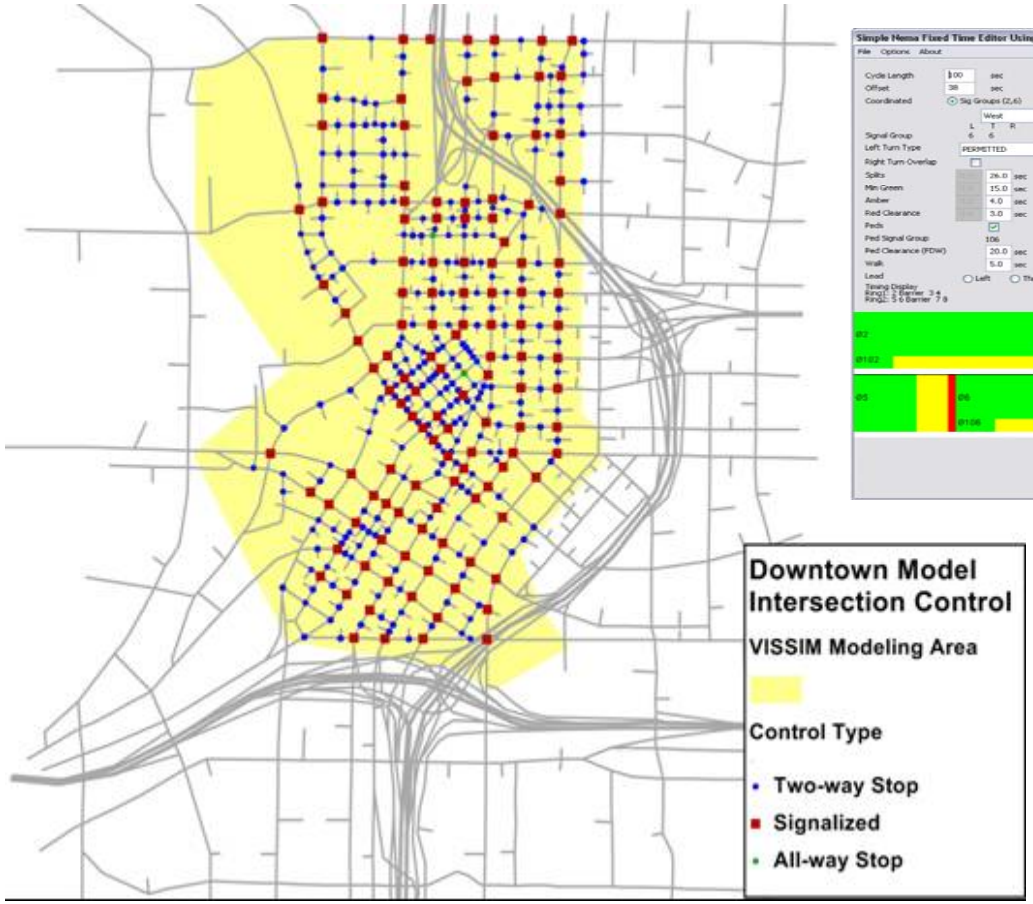


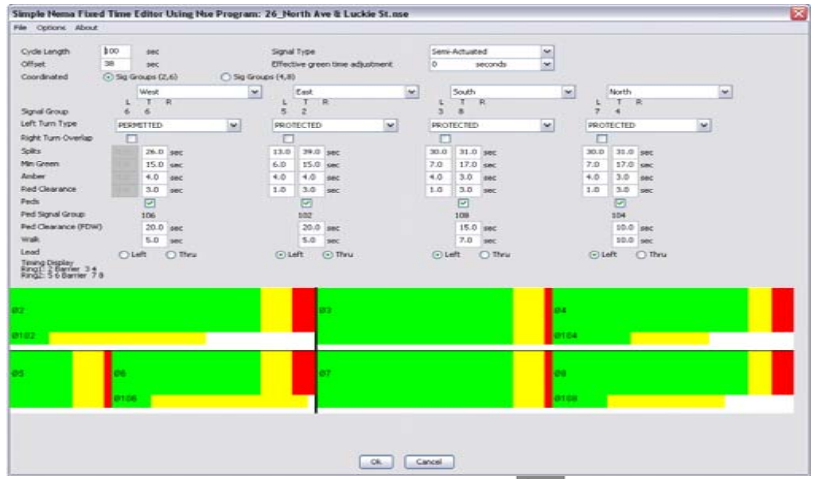


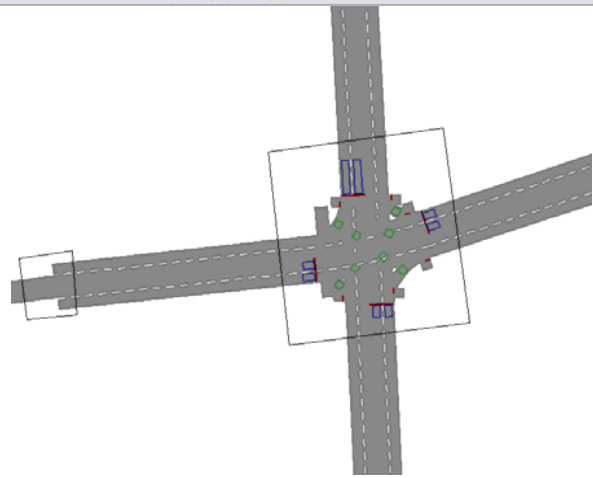
Method for Integrated Subarea Analysis

- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Subarea Network
- Add Intersection Data (geometry and control)

Method for Integrated Subarea Analysis





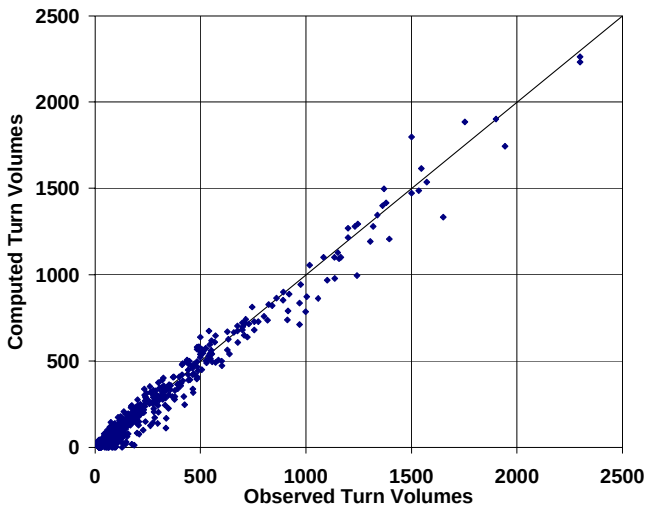


Method for Integrated Subarea Analysis

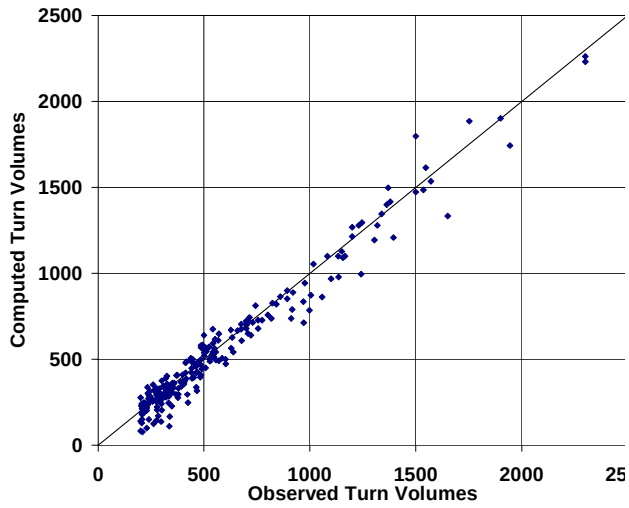
- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Subarea Network
- Add Intersection Data (geometry and control)
- Calibrate flow (assignment and OD matrix)

Method for Integrated Subarea Analysis

All AM turn counts:
R^2=0.98, %RMSE=22, N=667



All AM turn counts above 200:
R^2=0.96, %RMSE=14, N=229



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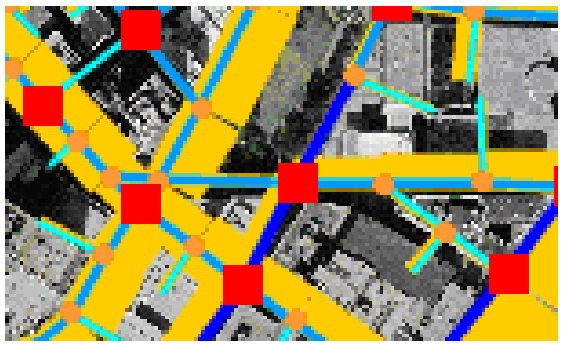
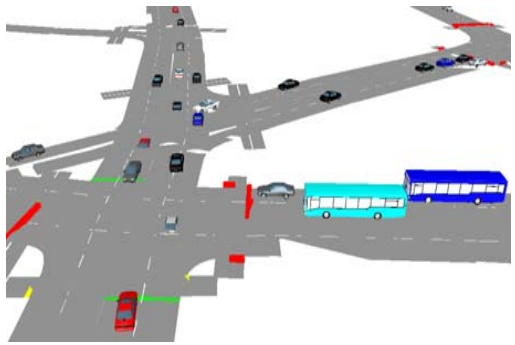
Method for Integrated Subarea Analysis

- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Subarea Network
- Add Intersection Data (geometry and control)
- Calibrate Flow (assignment and OD matrix)
- Export to Micro-simulation



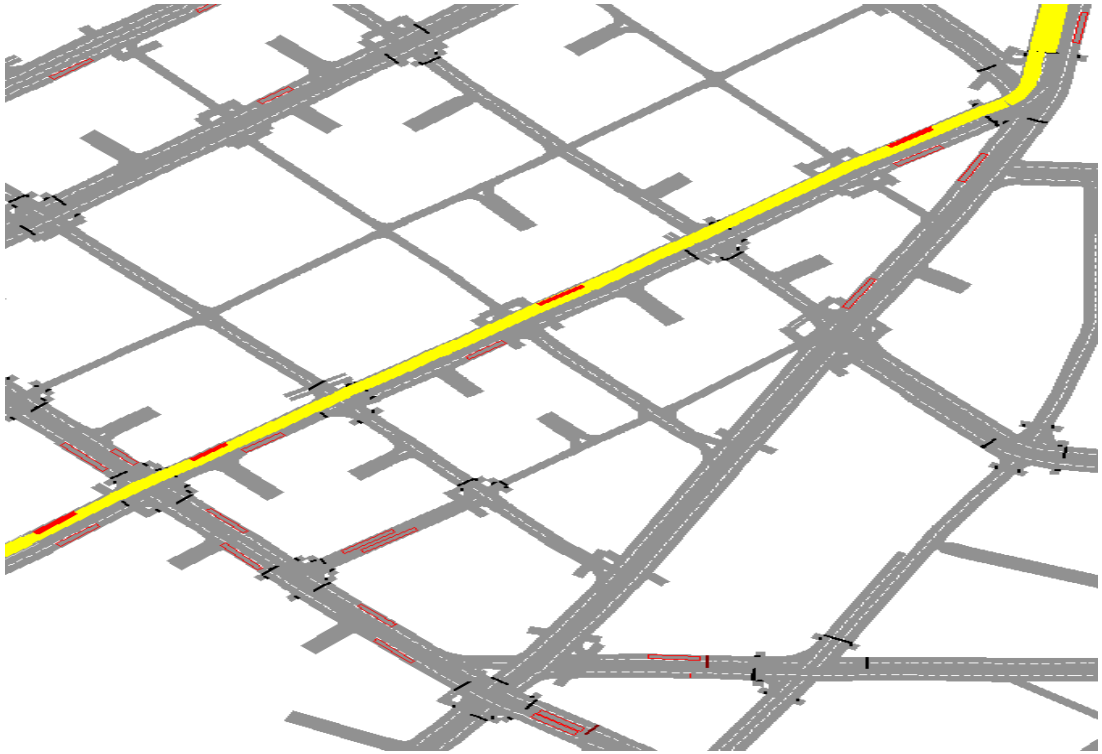


Method for Integrated Subarea Analysis

- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Macro Network
- Add Intersection Data (geometry and control)
- Calibrate Flow (assignment and OD matrix)
- Export to Micro-simulation
- Calibrate Micro-simulation

Method for Integrated Subarea Analysis

- ✓ Travel time
- ✓ Volume
- ✓ Intersection
- ✓ Driver behaviors



Method for Integrated Subarea Analysis

- Identify Subarea Boundary
- Cut Subarea Network and Traversal Matrix
- Refine Macro Network
- Add Intersection Data (geometry and control)
- Calibrate Flow (assignment and OD matrix)
- Export to Micro-simulation
- Calibrate Micro-simulation
- Feedback from Micro to Macro
- Transfer Flow for Future Forecasts to Micro-simulations

$$Trips_{OD}^{2015} = CalibratedTrips_{OD}^{Exist} + (ForecastTrips_{OD}^{2015} - ForecastTrips_{OD}^{Exist})$$

Challenges of Macro-Micro Integration

- Data Gap
- Graph Consistency and Correspondence
- Different Goodness of Fit Requirements in Macro and Micro
- Combination of Right Skills
- Communications

Conclusions and Recommendations

- A general methodology for integrated subarea analysis has emerged over the last 10 years and has been applied in many urban areas.
- In recent years ARC has been increasingly involved with microscopic traffic simulation projects.
- ARC's major challenge is to make sure that the data and assumptions used in such studies are consistent with the regional model.
- ARC has found that the integrated approach of linking its macroscopic model with microscopic ones has helped to address that challenge.
- In cooperation with the City of Atlanta and the Atlanta Airport, ARC will make an effort to maintain integrated models like the Atlanta Downtown Model, and keep them updated to contribute to integrated and consistent micro analysis in the region.