

Modeling the Land-use Correlates of Vehicle Trip Lengths for Assessing Transportation Impacts of Land Developments

Siva Srinivasan

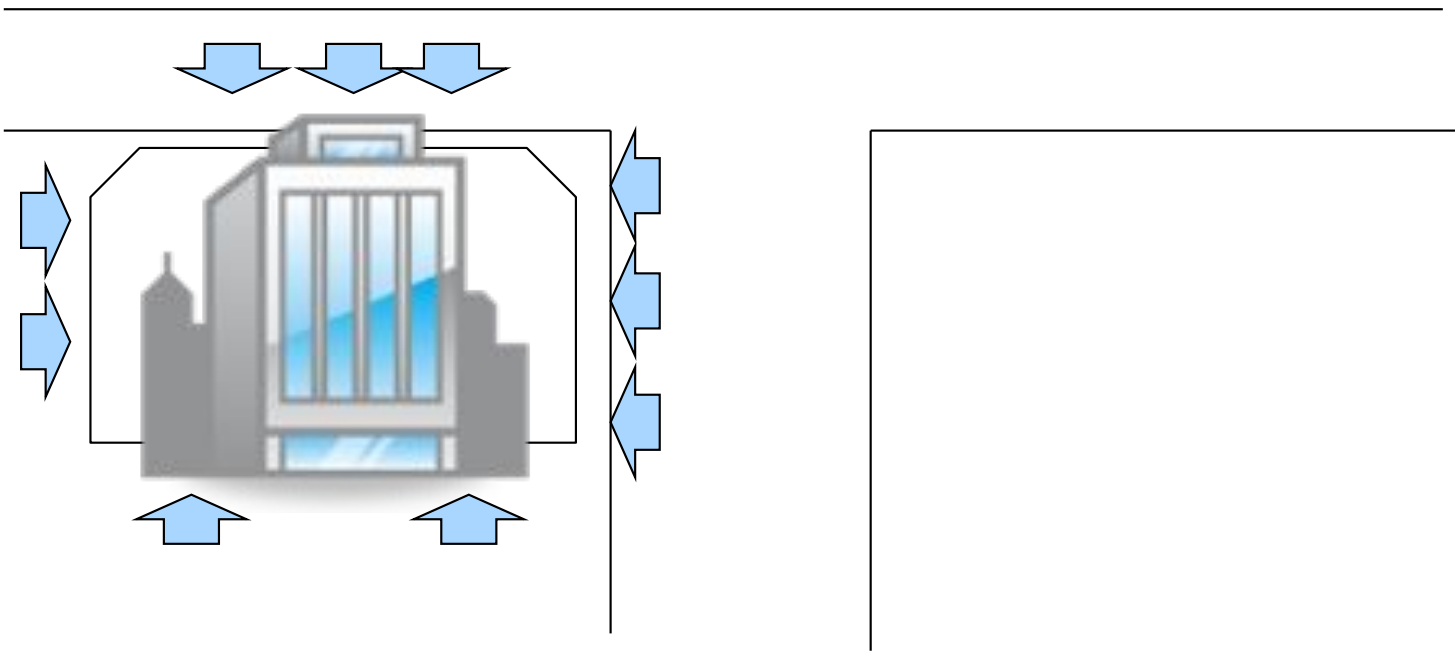
Ruth Steiner

Russell Provost

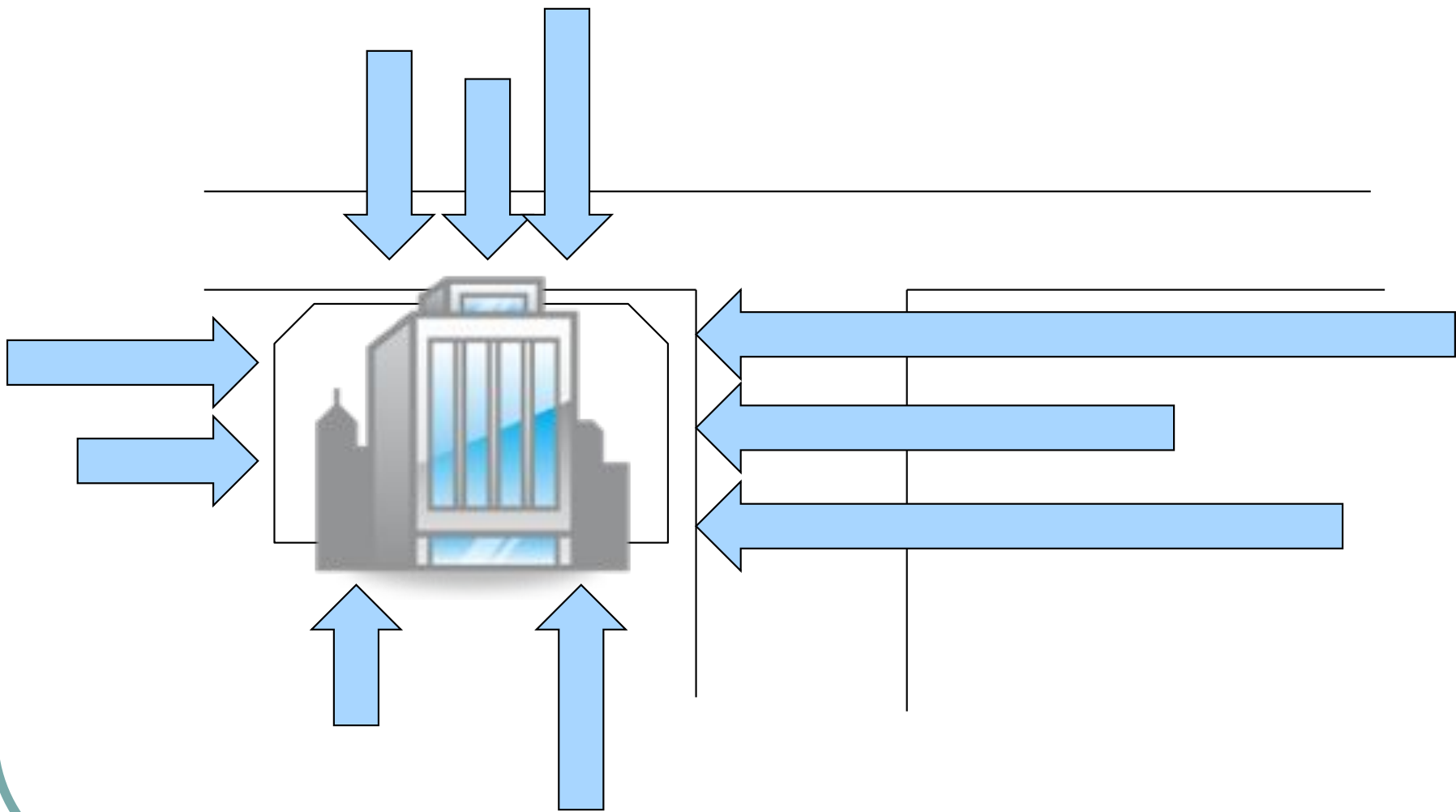
University of Florida, Gainesville



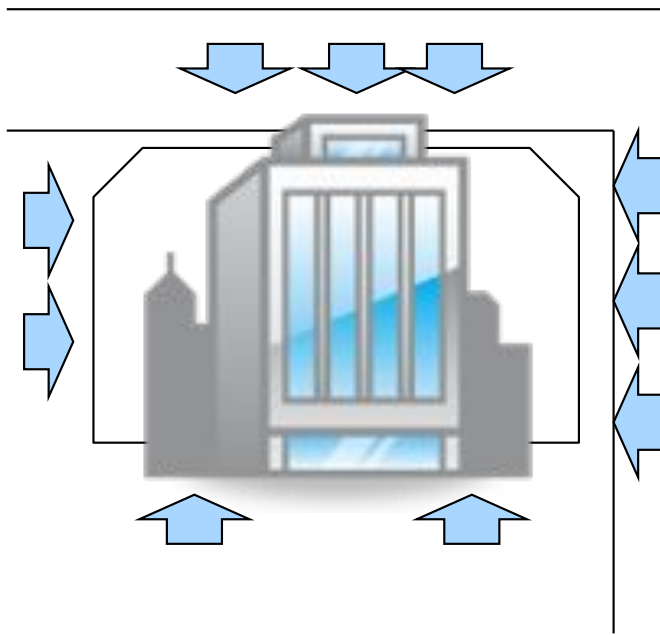
The Issue



The Issue



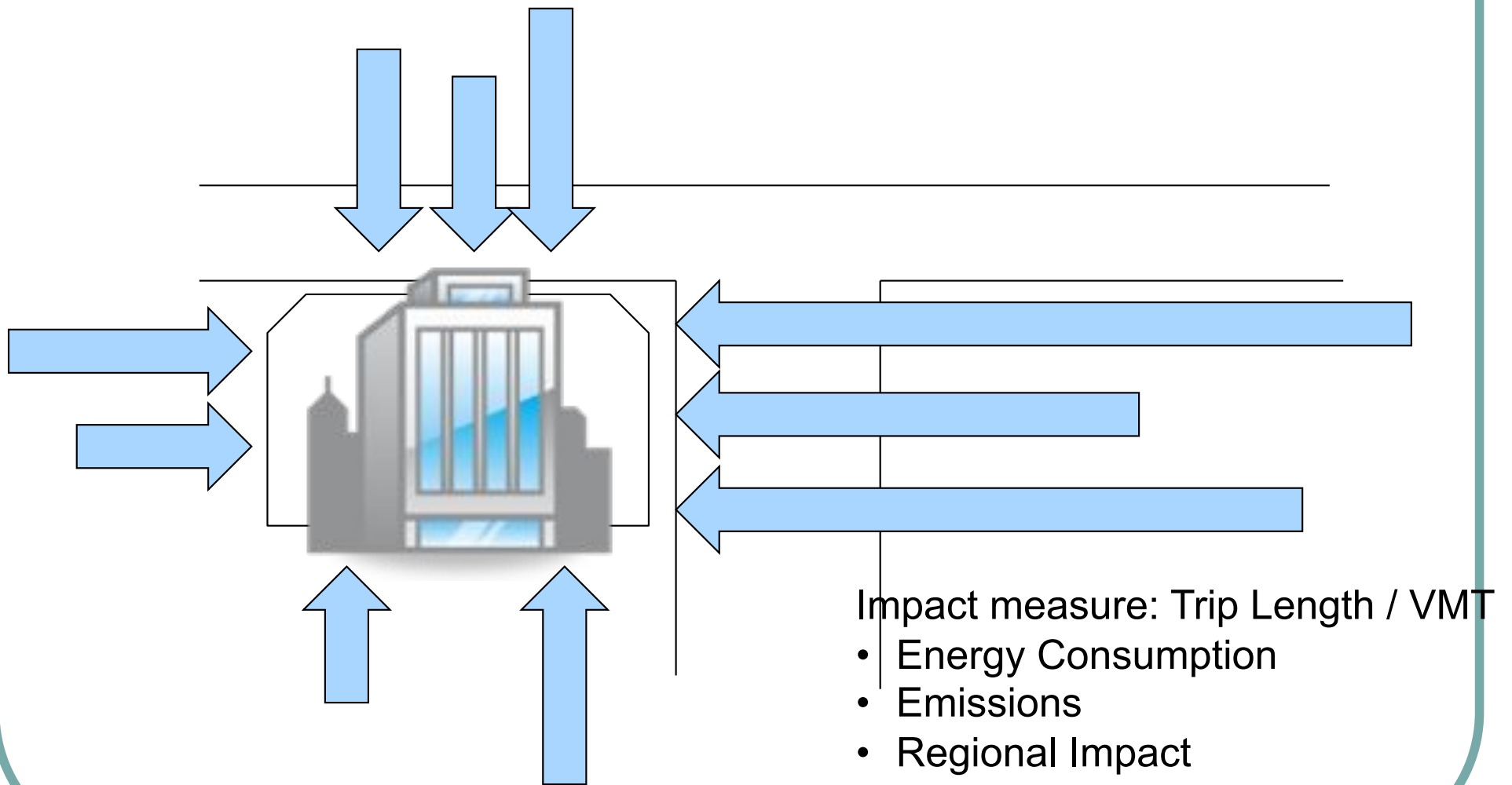
The Issue



Impact measure: #
Trips

- Intersection Control
- Parking Demand
- Localized Impact

The Issue



Study Objective

Develop a procedure to calculate vehicle trip lengths as a function of land-use to support transportation impact analysis:

- Fits within the conventional “trip based” travel forecasting paradigm
- “Development-centric” approach
- Simplified spreadsheet-based implementation

What we did

The screenshot displays a spreadsheet interface for a Trip-length Calculation Tool. The spreadsheet is organized into several sections with red boxes highlighting specific input and output cells. A diagram of a road layout is visible in the lower right quadrant of the spreadsheet area.

Section	Item	Value
Input/Assumptions	Estimated 100'	1
	Estimated 200'	1
	Officer 100'	1
	Estimated 200'	1
	Estimated 300'	1
	Officer 200'	1
Input/Assumptions	Number of 'random' segments per mile	1
	Number of 'random' segments per mile	1
Input/Assumptions	Estimated per 100'	10,000
	Estimated per 200'	10,000
	Officer per 100'	10,000
	Estimated per 200'	10,000
	Estimated per 300'	10,000
	Officer per 200'	10,000
	Estimated per 300'	10,000
Input/Assumptions	Number of 'random' segments per mile	1
	Number of 'random' segments per mile	1
	Number of 'random' segments per mile	1
Input/Assumptions	Length of random 100'	10,000
	Number of random 100'	10,000
	Officer per 100'	10,000
Input/Assumptions	Number of 'random' segments per mile	1
	Number of 'random' segments per mile	1
	Number of 'random' segments per mile	1

Estimated trip length by length (miles)

Length (miles)	Estimated	Actual
100'	10,000	10,000
200'	10,000	10,000
300'	10,000	10,000

Trip-length Calculation Tool

Analysis

Travel
Survey

Roadway
network

Parcel
data

GIS Analysis

GIS Analysis

Distance
(for each trip)

Land-use Descriptors
(at each trip end)

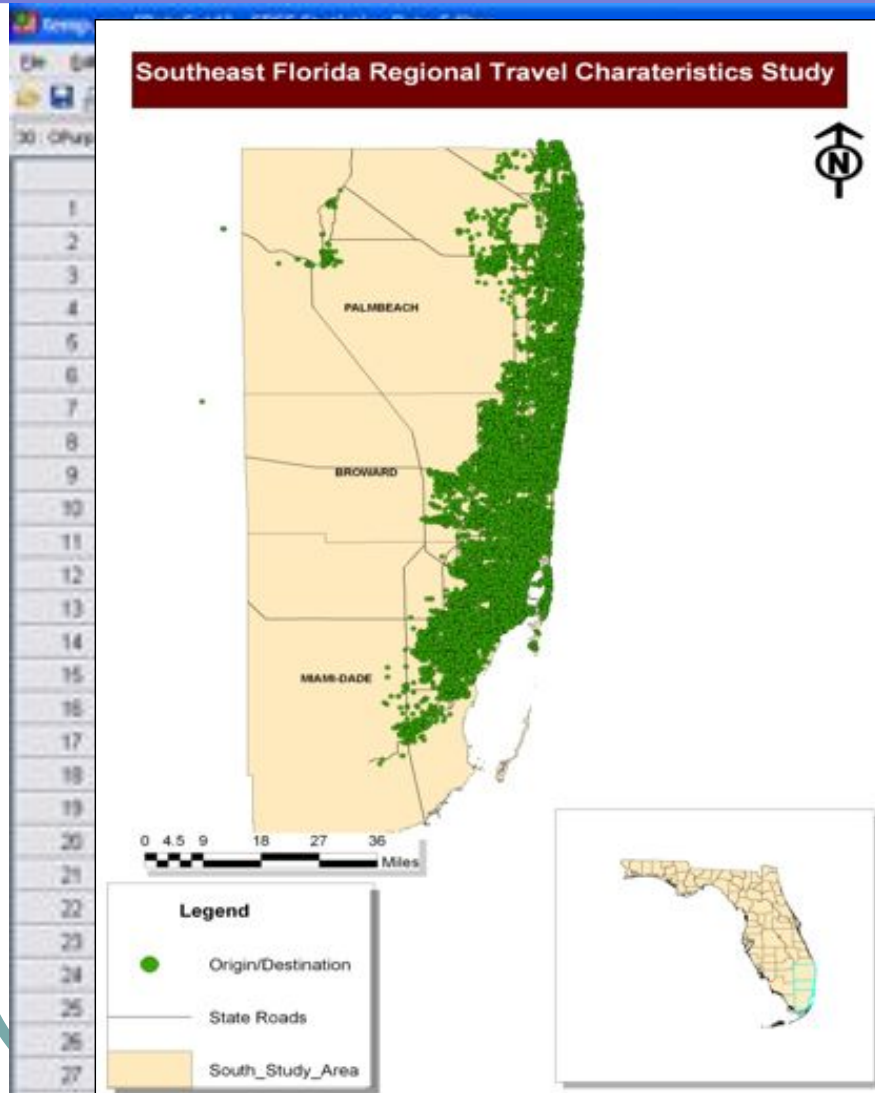
Statistical Analysis

Formula to calculate trip distance for
different types of land use

Data

- | Travel Characteristics
 - | South-East Florida Household Travel Survey (2000)
- | Land-Use
 - | Department of Revenue Parcel Files
- | Transportation System
 - | Roadway Network Characteristics

Data: Travel Characteristics



2000 South-East Florida Household Travel Survey

STime	ETime	OLong	OLat	DLong	DLat
360	300	-80.075207	26.653334	-80.100766	26.709041
365	410	-80.105765	26.759041	-80.102264	26.926435
705	710	-80.102264	26.926435	-80.081663	26.934135
760	765	-80.081663	26.934135	-80.086553	26.967635
900	960	-80.086553	26.967635	-80.075207	26.653334
600	680	-80.075207	26.653334	-80.070563	26.790640
900	1000	-80.070563	26.790640	-80.075207	26.653334
600	630	-80.217054	26.348054	-80.202493	26.677400
-1	750	-80.202493	26.677400	-80.217054	26.348054
720	750	-80.217054	26.348054	-80.071495	26.871443
-1	765	-80.071495	26.871443	-80.217054	26.348054
870	885	-80.217054	26.348054	-80.077015	26.844479
900	915	-80.077015	26.844479	-80.217054	26.348054
375	405	-80.131870	26.696969	-80.122811	26.540437
670	-1	-80.122811	26.540437	-80.090090	26.547064
-1	-1	-80.090090	26.547064	-80.122811	26.540385
-1	-1	-80.122811	26.540385	-80.131870	26.696969
700	800	-80.131870	26.696969	-80.089464	26.655644
1060	1080	-80.089464	26.655644	-80.089464	26.655644
1120	1130	-80.089464	26.655644	-80.089464	26.655644
1230	1250	-80.089464	26.655644	-80.131870	26.696969
375	390	-80.716057	26.665334	-80.714538	26.662037
1060	1065	-80.714538	26.662037	-80.716057	26.665334
225	237	-80.270038	26.671959	-80.201767	26.691543
300	312	-80.201767	26.691543	-80.270038	26.671959
480	485	-80.270038	26.671959	-80.259535	26.669361
510	515	-80.259535	26.669361	-80.270038	26.671959

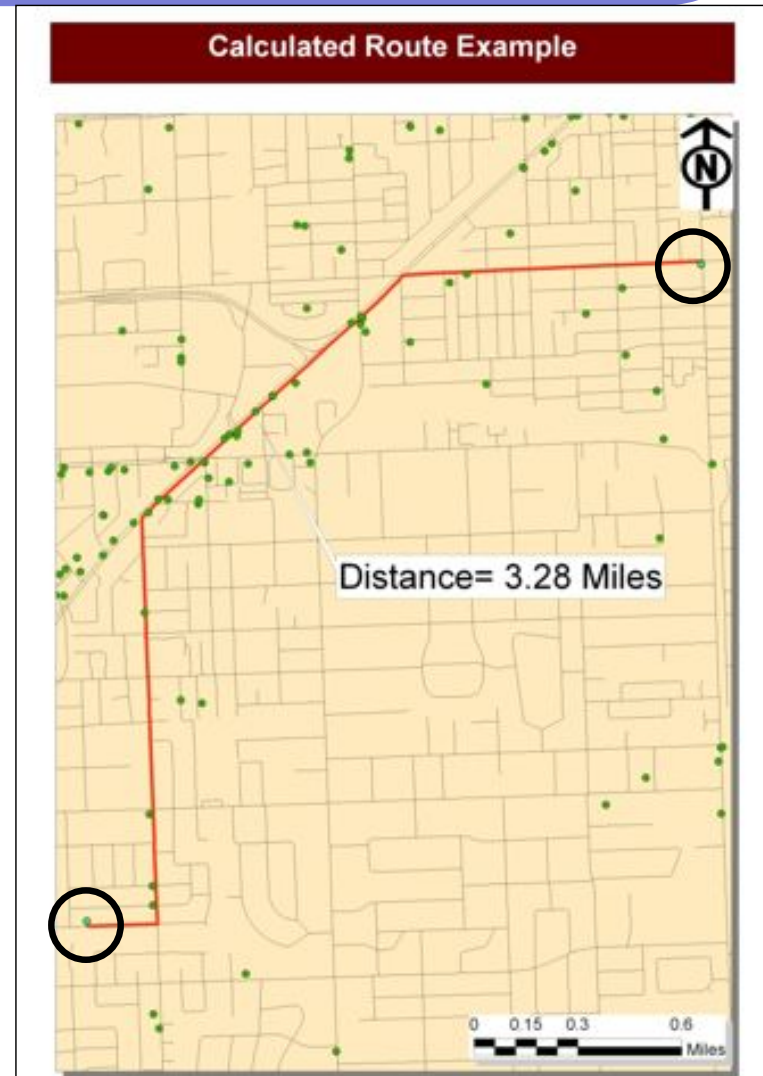
Data: Travel Characteristics

Trip-end
locations

Roadway
network

GIS Analysis

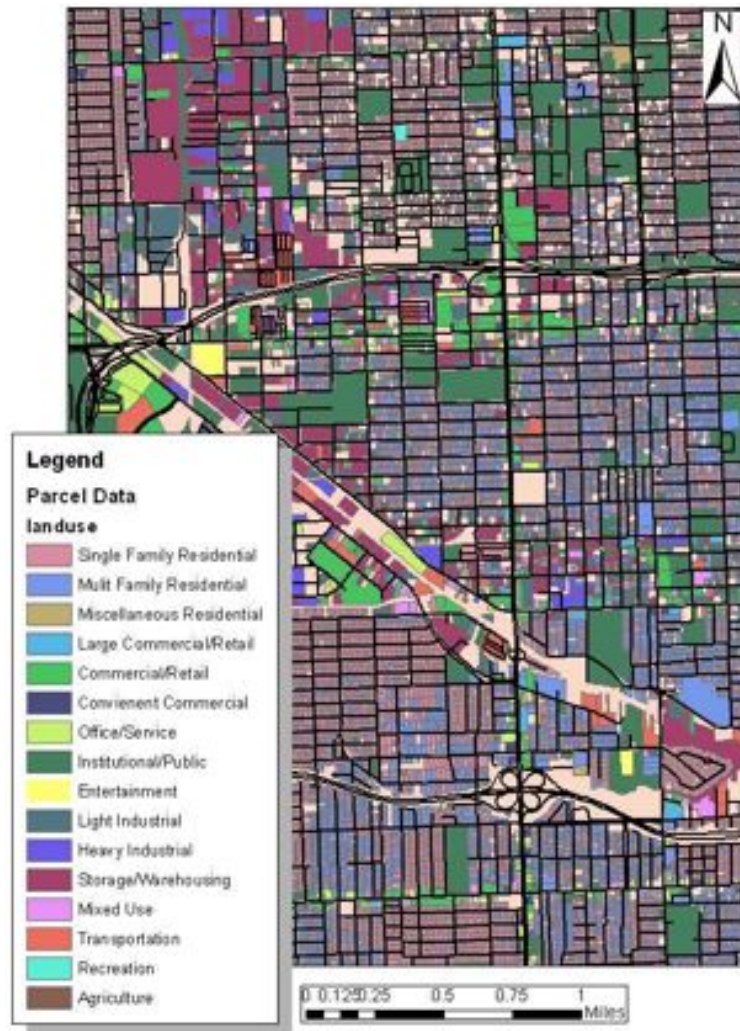
Trip Distance
(*shortest distance*)



Data: Travel Characteristics

	Home-based Work (HBW)		Home-based Other (HBO)		Non-Home Based (NHB)	
	Trip Length	LN (Trip Length)	Trip Length	LN (Trip Length)	Trip Length	LN (Trip Length)
Number of trips	5327	5327	8257	8257	4796	4796
Mean	10.31	1.93	5.42	1.16	6.14	1.26
Median	7.70	2.04	3.30	1.19	3.92	1.37
Variance	93.04	0.98	39.79	1.17	48.77	1.31
Minimum	0.10	-2.28	0.10	-2.29	0.10	-2.28
5 Percentile	1.09	0.09	0.49	-0.71	0.43	-0.83
10 Percentile	1.91	0.65	0.76	-0.27	0.76	-0.28
90 Percentile	21.20	3.05	12.79	2.55	14.15	2.65
95 Percentile	27.99	3.33	17.11	2.84	18.94	2.94
Maximum	97.75	4.58	85.00	4.44	82.62	4.41

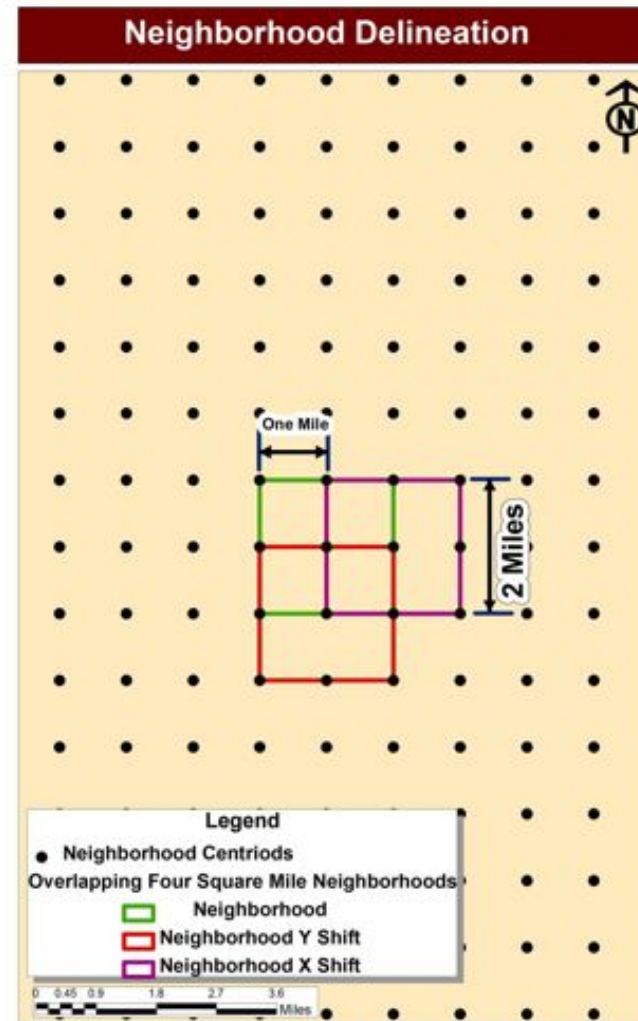
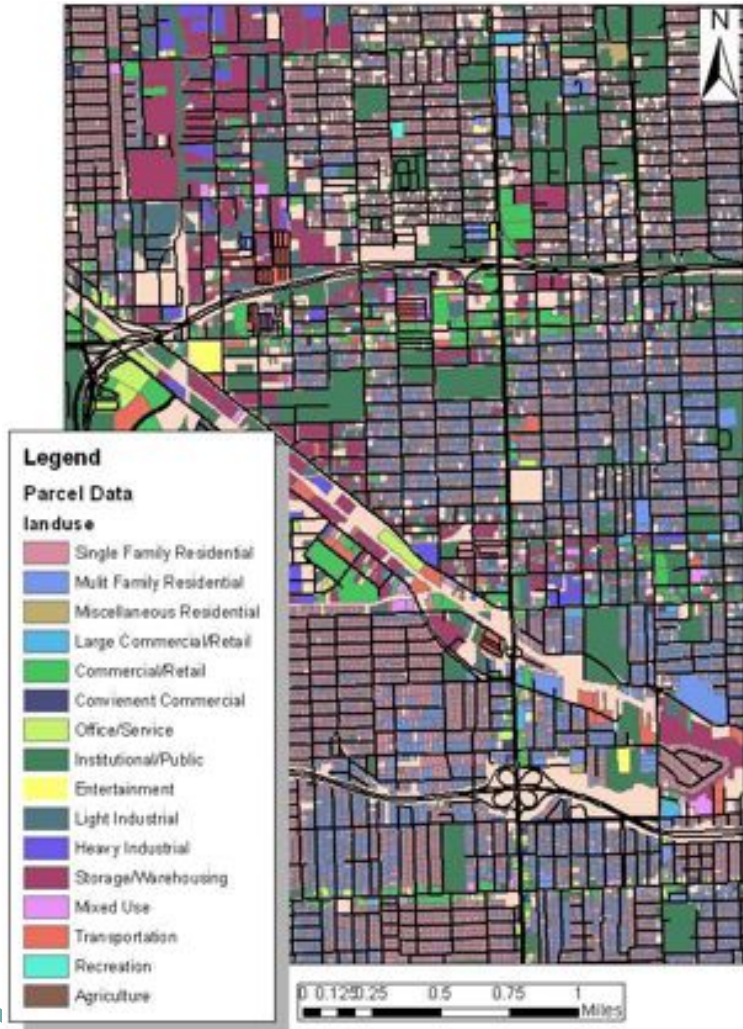
Data: Land Use



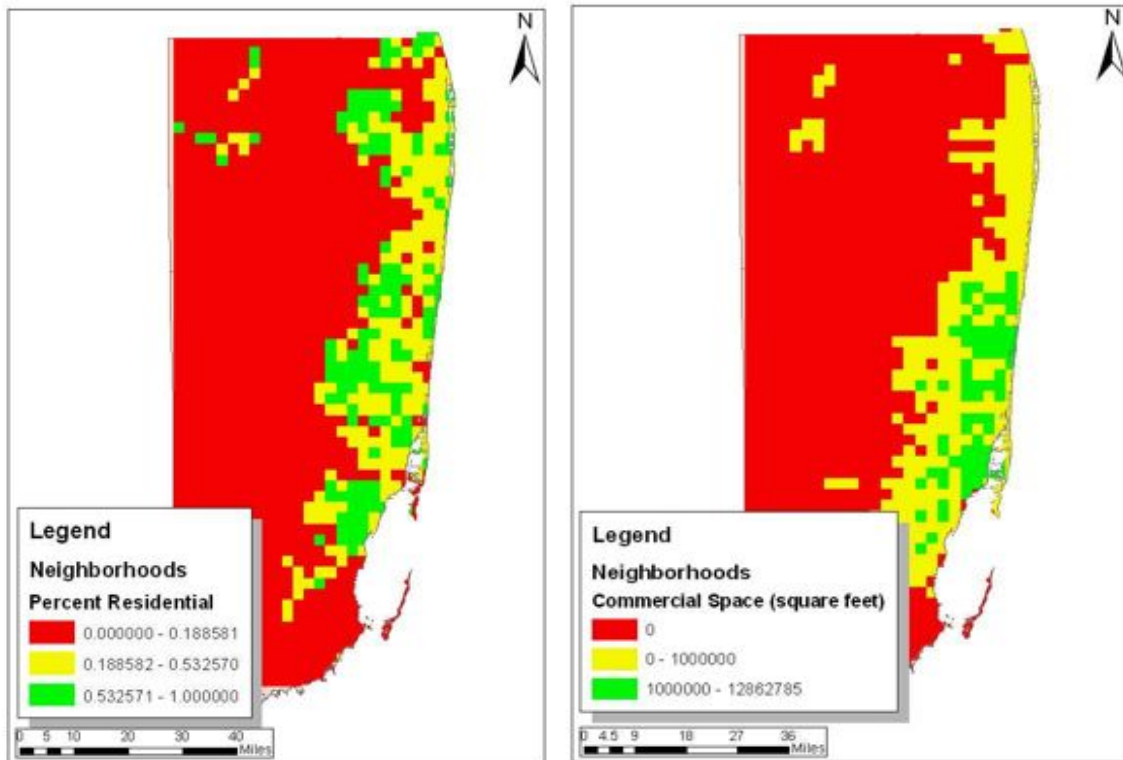
Parcel Attributes

- Land Use Characterization (90 categories aggregated to about 6 major categories)
- Parcel Area
- Bldg. Area
- Number of Residential Units

Data: Neighborhoods



Data: Land Use



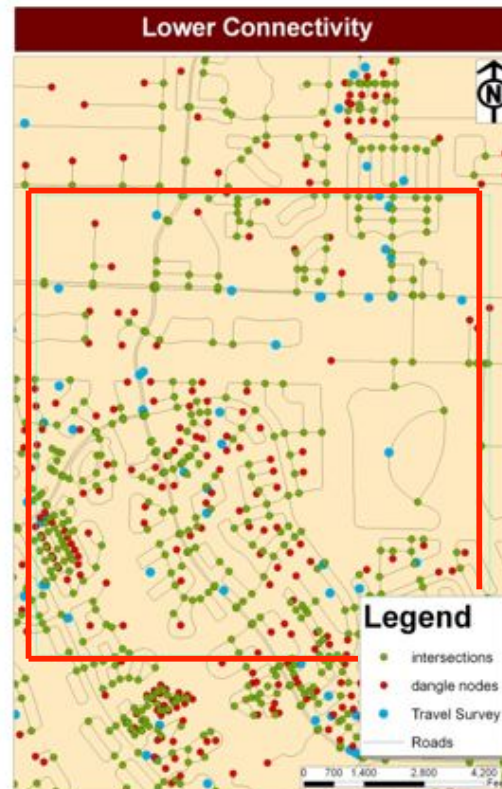
Neighborhood Attributes

- Four square miles
- Developed Area (total and by land use type)
- Number of Residential Units
- Bldg. Area (by land use type)
- Number of parcels with “convenient commercial” land use

Data: Transportation System



CNR = .96



CNR = .72

Neighborhood Attributes

- Road miles
- Number of intersections
- Number of Cul De Sacs
- Connected Node Ratio (CNR)

Data: Location within Region



Location within Region

- Distance to nearest Regional Activity center
- Distance to farthest Regional Activity center
- Centrality of Location

Statistical Analysis

Home-based Work	Production-end Model	Aggregate Model Disaggregate Model
	Attraction-end Model	Aggregate Model Disaggregate Model
Home-based Other	Production-end Model	Aggregate Model Disaggregate Model
	Attraction-end Model	Aggregate Model Disaggregate Model
Non-Home Based	Production-end Model	Aggregate Model Disaggregate Model
	Attraction-end Model	Aggregate Model Disaggregate Model

Statistical Analysis

- | Complementary land-uses, number of “convenient-commercial” parcels, network connectivity, distance to regional activity centers, ... all affect trip lengths
- | Time of day of travel and vehicle occupancyaffect trip lengths
- | Age, employment status, presence of children, car ownership, income, affect trip length

Trip Length Calculation Tool

Proposed Lead Line Characteristics		Proposed Lead Line Characteristics	
Estimated (ft)	1	Building area - Estimated (sq ft)	1,000,000
Estimated (ft)	1	Building area - Office (sq ft)	200,000
Office (ft)	1	Building area - Industrial (sq ft)	200,000
Industrial (ft)	1	Building area - Retail (sq ft)	200,000
Other (ft)	1	Building area - Other (sq ft)	200,000
Building area - Estimated (sq ft)	1	Number of "vertical column" joints	1
Proposed Lead Line Characteristics		Proposed Lead Line Characteristics	
Estimated (ft)	10,000	Length of lead line (ft)	10,000
Estimated (ft)	10,000	Number of joints (ft)	10,000
Office (ft)	10,000	Other (ft)	10,000
Industrial (ft)	10,000	Number of Proposed vertical Joints	1,000
Estimated (ft)	10,000	Number of vertical joints (ft)	10,000
Office (ft)	10,000	Number of vertical joints (ft)	10,000
Industrial (ft)	10,000	Number of vertical joints (ft)	10,000
Number of vertical joints	10,000		
Proposed Group by Length Index			
	Index	Value	
	100	10,000	
	100	10,000	
	100	10,000	

Applications

HBW: 19.61
HBO: 8.68



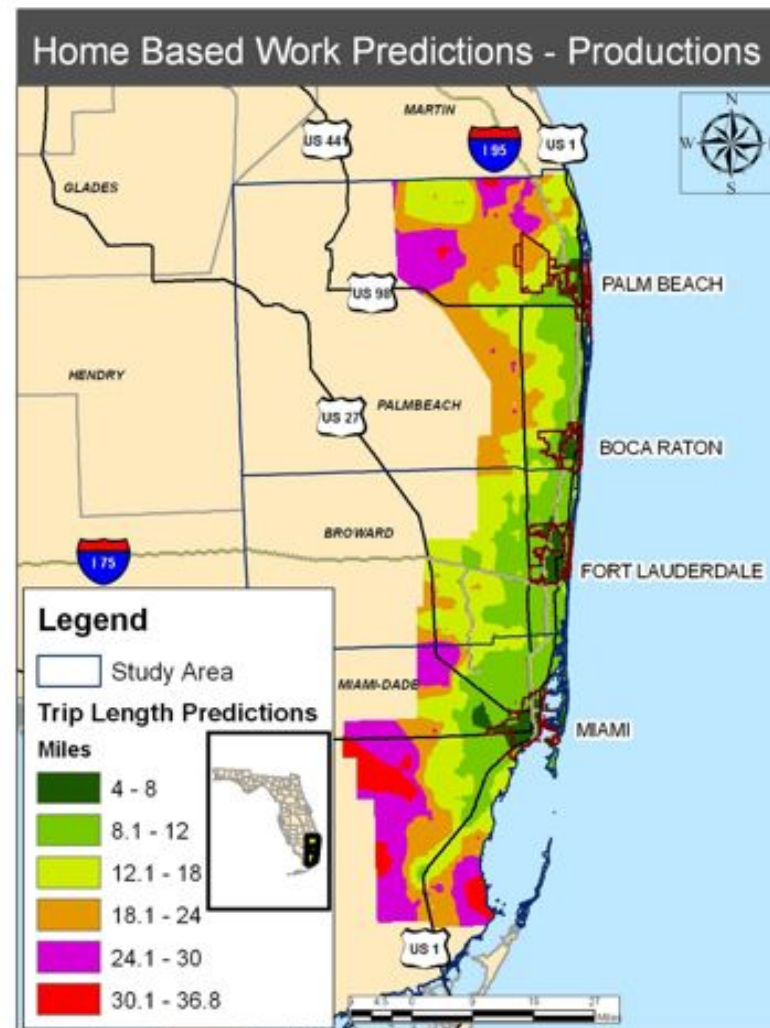
HBW: 6.72
HBO: 3.85



HBW: 4.21
HBO: 2.23



Applications



Summary

- | Trip-volume is not an adequate traffic-impact measure
- | Developed a procedure to determine the length of trips associated with different types of land uses
- | Used Florida-specific data for analysis
- | Implemented procedure in easy to use spreadsheet

Next Steps

- | Models explain no more than 10% of the variation in the logarithm of trip lengths
 - | Disaggregate trip purposes
 - | Further characterization of land use
 - | Beyond log-linear specifications
 - | Better treatment of space
 - | Trip chaining effects

Documentation

CMS Project Final Report (on CMS web site)

http://cms.ce.ufl.edu/research/Steiner_CMS_2008-007_final.pdf