Presented to:

FDOT Central Office

LAND USE MODELING & FSUTMS




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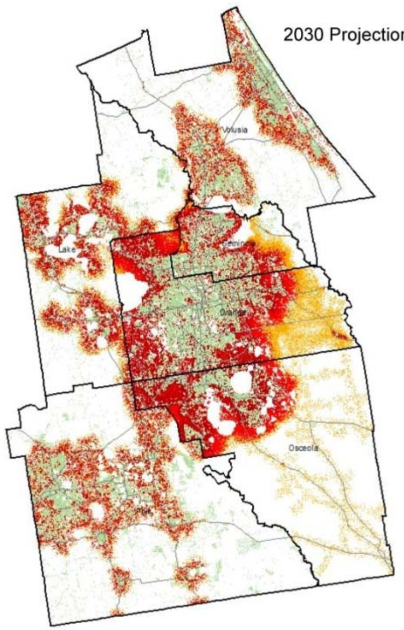
August 20, 2009

Presented by:

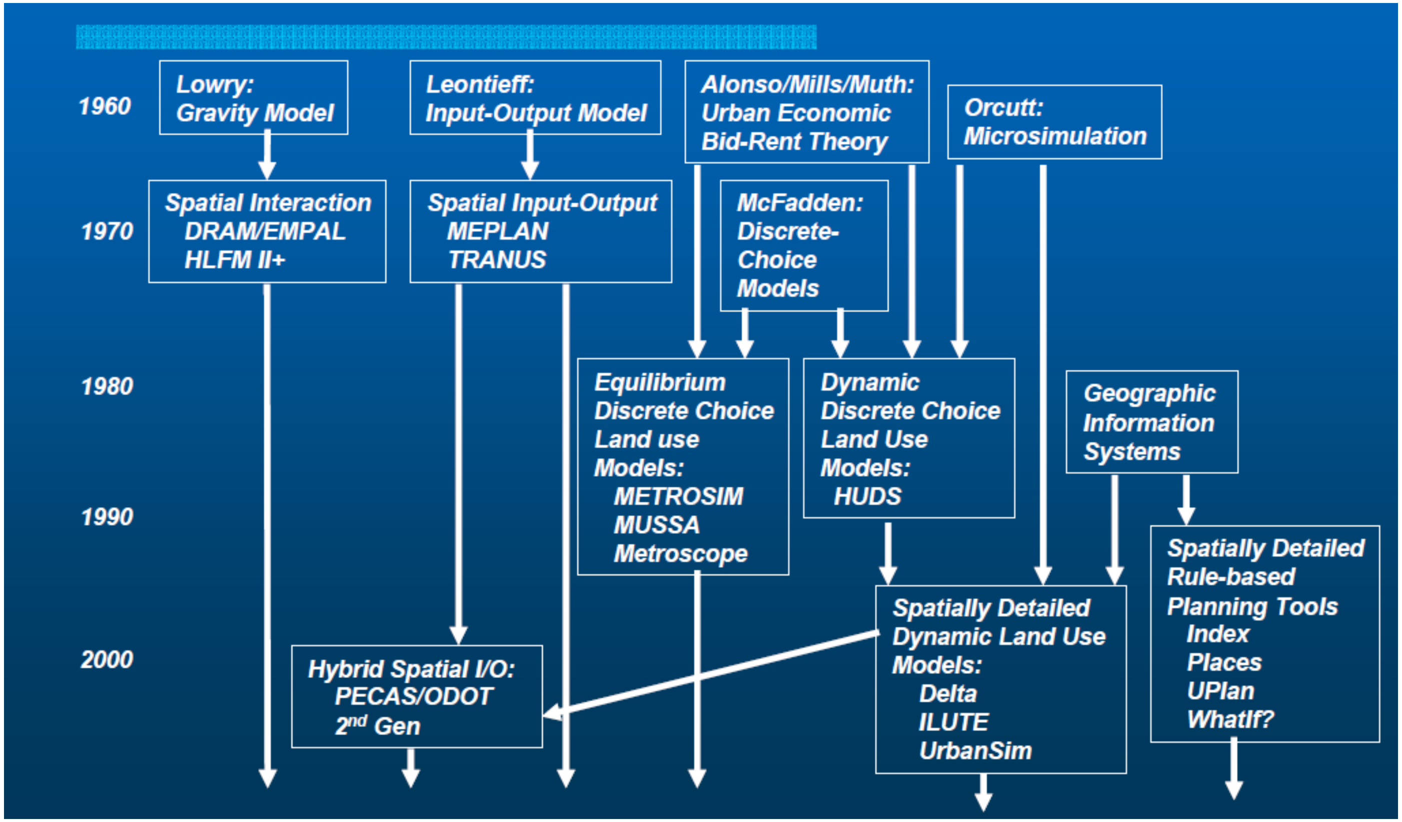
Whitehouse Group Inc.

Quick Rundown of Florida Land Use Modeling History



- SLAM
- DRAM/EMPAL
- ULAM
- Orlando Metroplan
- Turnpike's
- DELTASIM

Land Use Modeling Frameworks

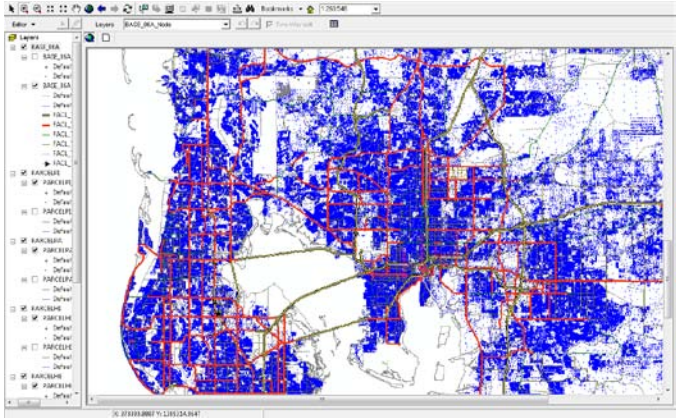


Waddell, TRB Workshop 162, January 2005

What's Making Agencies Revisit this Topic

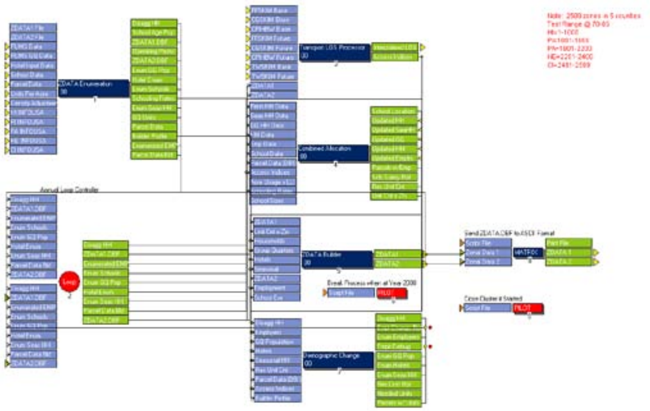
- Recognition that transport & land use interactions are complex and vary with major investment type
- Policy makers want to know what effect transport investments decisions will have on urban form, greenhouse gas emissions, etc.
- Redevelopment becoming more of an issue
- Push towards finer detail

Types of Land Use Models



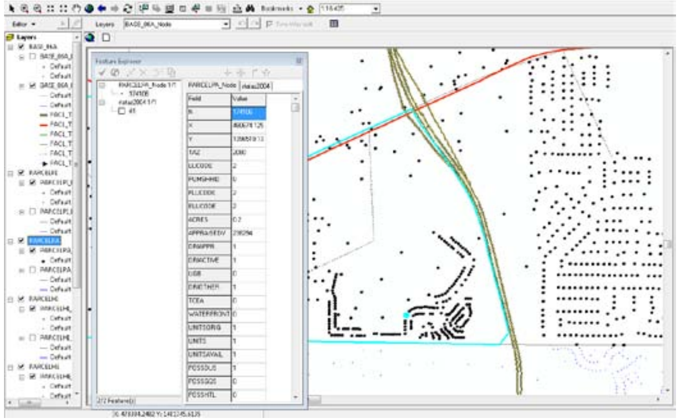
- Basic Types
  - Delphi
  - Rule-based/Gaming
  - Gravity
  - Input/output
  - Bid rent
- Geographic resolution
  - Region
  - TAZ
  - Grid cell
  - Parcel/sub-parcel

Quick Overview of DELTASIM



- Type- Competitive Monte Carlo Evaluation with Cohort Component Forecasting (Bid-rent possibly to be added)
- Resolution- Parcel/Agents

DELTASIM Data Sources

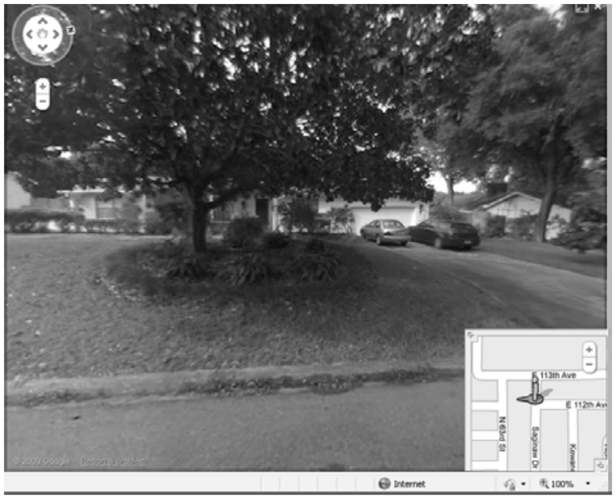


- Parcel- property tax appraisers
- Residential
  - ZDATA
  - Census special tabulations
  - PUMS
  - Jails/prisons, dorms, other (nursing, etc.)
  - Dept. of Business & Prof. Regulation
- Non-Residential
  – Employment
    - ZDATA (base year control totals)
    - InfoUSA (agents)

DELTASIM Agents- Schools

- Schools
  - 101 Public Preschool
  - 102 Public Elementary School
  - 103 Public Middle School
  - 104 Public High School
  - 105 Private Preschool
  - 106 Private Elementary School
  - 107 Private Elem-Middle School
  - 108 Private Elem-High School
  - 109 Private Middle-High School
  - 110 Private High School
  - 111 Pub/Priv Col,Univ,Voc

DELTASIM Agents- Households



- Households
  - 210 Permanent HH, Retired, 0 Car
  - 211 Permanent HH, Retired, 1 Car
  - 212 Permanent HH, Retired, 2 Car
  - 213 Permanent HH, Retired, 3+ Car
  - 220 Permanent HH, WNC, 0 Car
  - 221 Permanent HH, WNC, 1 Car
  - 222 Permanent HH, WNC, 2 Car
  - 223 Permanent HH, WNC, 3+ Car
  - 230 Permanent HH, WWC, 0 Car
  - 231 Permanent HH, WWC, 1 Car
  - 232 Permanent HH, WWC, 2 Car
  - 233 Permanent HH, WWC, 3 Car
  - 310 Seasonal HH, 0 Car
  - 311 Seasonal HH, 1 Car
  - 312 Seasonal HH, 2 Car
  - 313 Seasonal HH, 3+ Car
  - 401 Group Quarters, Dormitory
  - 402 Group Quarters, Jail
  - 403 Group Quarters, Nursing/Other
  - 501 Hotel, Business
  - 502 Hotel, Economy
  - 503 Hotel, Resort

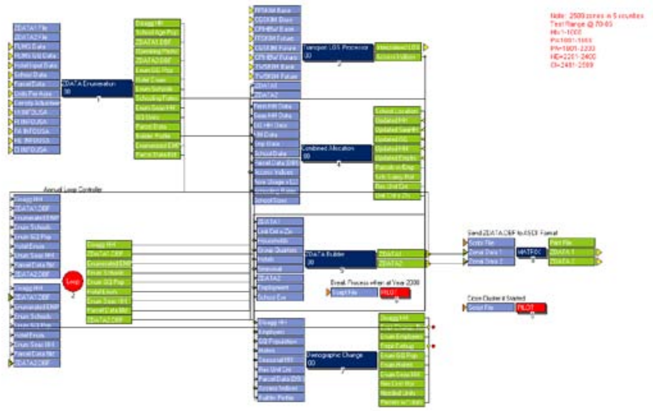
DELTASIM Agents- Employers

- Employers
  - 601 Employer, Industrial
  - 602 Employer, Regional Commercial
  - 603 Employer, Local Commercial
  - 604 Employer, Regional Service
  - 605 Employer, Local Service

DELTASIM Agents- Builders

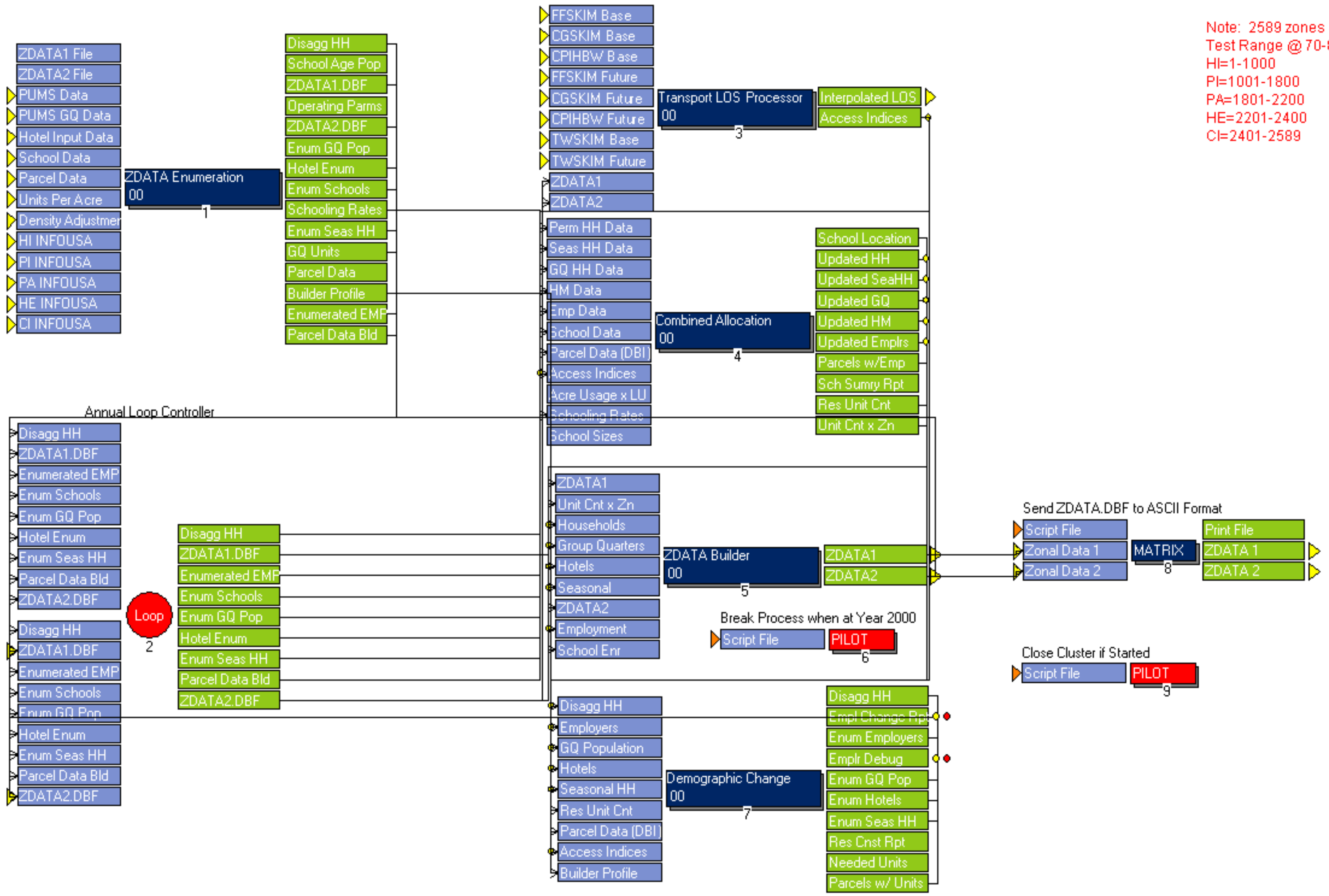
- Builders
  - 701 Builder, SF Dwellings
  - 702 Builder, MF Dwellings
  - 703 Builder, Commercial/Ind
  - 704 Builder, Commercial/Retail
  - 705 Builder, Commercial/Service
  - 706 Builder, GQ Jail
  - 707 Builder, GQ Dormitory
  - 708 Builder, GQ Nursing/Other

DELTASIM Overview



- Operates in 1 Year increments
- Generally
  - Transport accessibility calculated
  - Agents select (priority order)
  - Population evolves
  - Market assessed
  - Builders respond
  - Next year repeat

DELTASIM Architecture



Note: 2589 zones in 5 counties
Test Range @ 70-85
HI=1-1000
PI=1001-1800
PA=1801-2200
HE=2201-2400
CI=2401-2589

DELTASIM Transport Accessibility

- Measures
  - Free-flow time
  - Congested travel time
  - Composite impedance (log sum)
  - Walk-to-transit peak
- Accessibility to
  - Population
  - Employment (total and by type)

DELTASIM Life Events

- Births
- Deaths
- Household dissolution
- Children moving out
- Household formation
- Auto ownership changes
- Move from current location
- Net in-migration
- Income (not yet but would like to build in)

DELTASIM Types of Outputs

```
SCHOOL AGE REPORT- DELTASIM VERSION 1.0001
----------------------------------------------------------------------
  MALES AGE  5=  5,338    FEMALES AGE  5=  5,107  TOTAL AGE  5= 11,174
  MALES AGE  6= 15,516    FEMALES AGE  6= 14,678  TOTAL AGE  6= 30,208
  MALES AGE  7= 16,132    FEMALES AGE  7= 15,500  TOTAL AGE  7= 31,639
  MALES AGE  8= 17,029    FEMALES AGE  8= 15,236  TOTAL AGE  8= 32,267
  MALES AGE  9= 16,570    FEMALES AGE  9= 15,751  TOTAL AGE  9= 32,323
  MALES AGE 10= 17,093    FEMALES AGE 10= 17,109  TOTAL AGE 10= 34,202
  MALES AGE 11= 18,261    FEMALES AGE 11= 15,969  TOTAL AGE 11= 34,230
  MALES AGE 12= 17,007    FEMALES AGE 12= 16,922  TOTAL AGE 12= 33,929
  MALES AGE 13= 18,473    FEMALES AGE 13= 17,751  TOTAL AGE 13= 36,224
  MALES AGE 14= 17,527    FEMALES AGE 14= 16,658  TOTAL AGE 14= 34,185
  MALES AGE 15= 18,409    FEMALES AGE 15= 18,852  TOTAL AGE 15= 37,261
  MALES AGE 16= 19,662    FEMALES AGE 16= 17,553  TOTAL AGE 16= 37,215
  MALES AGE 17= 18,746    FEMALES AGE 17= 19,158  TOTAL AGE 17= 37,904
  MALES AGE 18= 17,360    FEMALES AGE 18= 17,398  TOTAL AGE 18= 34,758
----------------------------------------------------------------------
   TOTAL MALES=233,123     TOTAL FEMALES=223,642         TOTAL=457,519
```

DELTASIM Types of Outputs

```
DELTA-SIM VERSION 1.0001
SUMMARIES OF COHORT ANALYSIS
ALL PERMANENT RESIDENT HOUSEHOLDS
BASE YEAR=2000  TARGET YEAR=2006

STARTING POPULATION  = 2,469,677
NEW BABIES           =    30,381
FUNERALS             =    46,864
NET MIGRATION        =    74,090
---------------------------------------
UPDATED POPULATION   = 2,527,284
CHANGE IN POP        =    57,607

AGE Cohort= 1 Deaths=     84 Population- M= 22,341 F= 22,135 Total= 60,893
AGE Cohort= 2 Deaths=     18 Population- M= 70,593 F= 66,281 Total=137,629
AGE Cohort= 3 Deaths=     32 Population- M= 88,377 F= 84,425 Total=172,802
AGE Cohort= 4 Deaths=    107 Population- M= 92,569 F= 89,625 Total=182,194
AGE Cohort= 5 Deaths=    198 Population- M= 89,148 F= 83,869 Total=173,017
AGE Cohort= 6 Deaths=    158 Population- M= 68,095 F= 66,982 Total=135,077
AGE Cohort= 7 Deaths=    215 Population- M= 70,851 F= 74,290 Total=145,141
AGE Cohort= 8 Deaths=    360 Population- M= 84,667 F= 91,000 Total=175,667
AGE Cohort= 9 Deaths=    584 Population- M= 93,879 F=104,617 Total=198,496
AGE Cohort=10 Deaths=    874 Population- M= 96,738 F=113,697 Total=210,435
AGE Cohort=11 Deaths=  1,230 Population- M= 91,824 F=115,270 Total=207,094
AGE Cohort=12 Deaths=  1,910 Population- M=100,826 F=119,890 Total=220,716
AGE Cohort=13 Deaths=  2,274 Population- M= 85,157 F=100,280 Total=185,437
AGE Cohort=14 Deaths=  2,849 Population- M= 74,087 F= 93,029 Total=167,116
AGE Cohort=15 Deaths=  5,251 Population- M= 99,175 F= 97,429 Total=196,604
AGE Cohort=16 Deaths=  7,864 Population- M= 90,832 F=106,198 Total=197,030
AGE Cohort=17 Deaths=  8,174 Population- M= 70,651 F= 74,293 Total=144,944
AGE Cohort=18 Deaths= 14,682 Population- M= 70,591 F= 68,447 Total=139,038

COUNTY=1 BIRTHS=13,375 DEATHS=14,478
COUNTY=2 BIRTHS=10,401 DEATHS=18,940
COUNTY=3 BIRTHS= 4,001 DEATHS= 7,591
COUNTY=4 BIRTHS= 1,540 DEATHS= 3,153
COUNTY=5 BIRTHS= 1,064 DEATHS= 2,702
COUNTY=6 BIRTHS=     0 DEATHS=     0
SCHOOL AGE POP(5-18)= 457,519
  KIDS MOVING OUT   =  58,141
  ADULTS SEPARATING =  74,750
```

DELTASIM Types of Outputs

TAZ	COUNTY	SERIALNO	DRAWNO	EMPCLASS	EMPLOYEES	PARCELNUM	CHANGETYPE
1	1	20	24650	4	2	274	Contraction
1	1	28	34260	4	1	328	Contraction
1	1	37	5423	5	11	315	Contraction
1	1	39	19147	3	3	344	Contraction
1	1	51	14551	1	5	583	Constant
1	1	53	32394	1	1	595	Contraction
2	1	61	9574				
2	1	68	19070				
2	1	71	20878				
2	1	81	32000				
2	1	83	33273				
2	1	87	11440				
2	1	91	15843				
2	1	93	14564				
2	1	94	35445				
3	1	105	10364				
3	1	109	19963				
3	1	112	25664				
3	1	113	25753				
3	1	119	29600				
3	1	124	33218				
3	1	125	33965				
3	1	134	9422				
3	1	143	26264				
4	1	148	7190				
4	1	153	15619				
4	1	154	18856				
4	1	158	30868				
4	1	165	25473				
4	1	167	23382				
5	1	179	19068				
5	1	180	27194				

TAZ	COUNTY	SERIALNO	DRAWNO	EMPCLASS	EMPLOYEES	PARCELNUM	CHANGETYPE
0	0	364889	0	5	2	0	Birth
0	0	364890	0	5	1	0	Birth
0	0	364891	0	5	1	0	Birth
0	0	364892	0	5	1	0	Birth
0	0	364893	0	5	21	0	Birth
0	0	364894	0	5	7	0	Birth
0	0	364895	0	5	3	0	Birth
0	0	364896	0	5	7	0	Birth
0	0	364897	0	5	1	0	Birth
0	0	364898	0	5	1	0	Birth
0	0	364899	0	5	8	0	Birth
0	0	364900	0	5	2	0	Birth
0	0	364901	0	5	1	0	Birth
0	0	364902	0	5	12	0	Birth
0	0	364903	0	5	3	0	Birth
0	0	364904	0	5	3	0	Birth
0	0	364905	0	5	2	0	Birth
0	0	364906	0	5	7	0	Birth
0	0	364907	0	5	1	0	Birth
0	0	364908	0	5	1	0	Birth
0	0	364909	0	5	3	0	Birth
0	0	364910	0	5	1	0	Birth
0	0	364911	0	5	1	0	Birth
0	0	364912	0	5	2	0	Birth
0	0	364913	0	5	2	0	Birth
0	0	364914	0	5	2	0	Birth
0	0	364915	0	5	2	0	Birth
0	0	364916	0	5	18	0	Birth
0	0	364917	0	5	2	0	Birth
0	0	364918	0	5	3	0	Birth
0	0	364919	0	5	113	0	Birth
0	0	364920	0	5	37	0	Birth

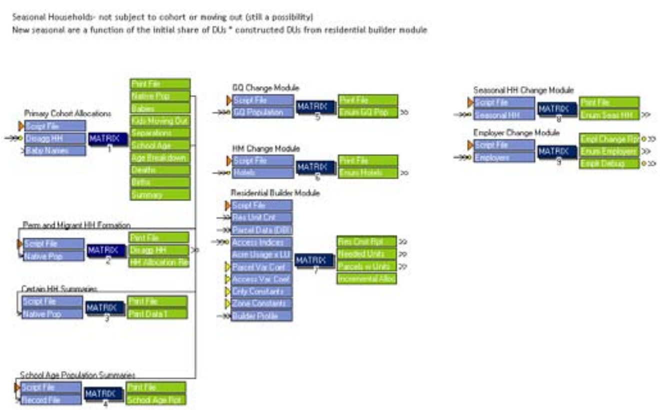
DELTASIM Types of Outputs

TAZ	1
COUNTY	1
NEWHH	0
SELECTID	84170
KNTHH	1
LIFESTYLE	1
AUTOS	2
INCOME	15600
PERSONS	2
P1AGE	74
P1SEX	1
P1EMP	0
P2AGE	77
P2SEX	2
P2EMP	0
P3AGE	0
P3SEX	0
P3EMP	0
P4AGE	0
P4SEX	0
P4EMP	0
P5AGE	0
P5SEX	0
P5EMP	0
P6AGE	0
P6SEX	0
P6EMP	0
P7AGE	0
P7SEX	0
P7EMP	0
P8AGE	0
P8SEX	0
P8EMP	0
P9AGE	0
P9SEX	0
P9EMP	0
PARCELNUM	303
UNALLOCATE	0
YEAR	2000

DELTASIM Types of Outputs

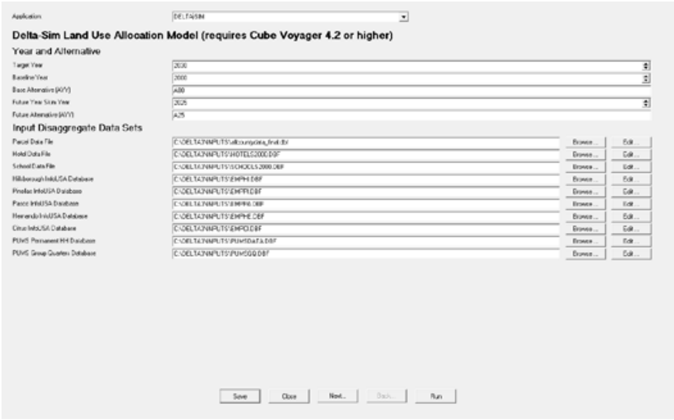
COUNTY	DISTRICT	ZONE	DUS	VNP	VAC	PERMPOP	RET0	WNC0	WWC0	RET1	WNC1	WWC1	RET2	WN
1	7	188	811	0.01	0.04	2067	0.02	0.02	0.02	0.18	0.09	0.1	0.08	
1	7	189	593	0	0.07	1430	0.01	0.01	0.01	0.22	0.09	0.06	0.1	
1	7	190	367	0	0.07	883	0.01	0.01	0.01	0.21	0.07	0.07	0.11	
1	7	191	289	0	0.07	669	0.01	0.01	0.01	0.22	0.09	0.07	0.1	
1	7	192	1271	0	0.06	3520	0	0.02	0.02	0.08	0.09	0.13	0.04	
1	7	193	776	0	0.08	2098	0.01	0.01	0.01	0.08	0.12	0.13	0.05	
1	7	194	768	0	0.08	2115	0.01	0.02	0.01	0.08	0.1	0.12	0.04	
1	7	195	0	0.05	0.05	0	0.06	0.05	0.05	0.05	0.26	0.14	0.03	
1	7	196	433	0	0.05	1155	0.01	0.02	0.03	0.1	0.1	0.11	0.04	
1	7	197	1694	0	0.09	4325	0.01	0.01	0.01	0.09	0.11	0.1	0.04	
1	7	198	753	0	0.09	1901	0	0.01	0.01	0.1	0.14	0.09	0.04	
1	7	199	2016	0.01	0.08	5089	0	0.02	0.02	0.11	0.12	0.09	0.04	
1	7	200	657	0.01	0.06	1711	0	0.01	0.02	0.1	0.11	0.09	0.05	
1	7	201	257	0.01	0.06	698	0	0.01	0.02	0.11	0.1	0.07	0.04	
1	7	202	163	0.01	0.06	441	0	0.01	0	0.13	0.16	0.07	0.03	
1	7	203	875	0	0.12	2363	0	0.01	0.02	0.06	0.1	0.15	0.03	
1	7	204	637	0	0.06	1764	0	0.01	0.02	0.09	0.1	0.11	0.05	
1	7	205	346	0	0.3	732	0	0.02	0.03	0.1	0.06	0.1	0.05	
1	7	206	900	0	-0.07	2706	0	0.01	0.01	0.08	0.11	0.11	0.04	
1	7	207	2266	0	0.12	5622	0	0.02	0.02	0.08	0.12	0.09	0.04	
1	7	208	726	0	0.07	1832	0.01	0.01	0.02	0.16	0.13	0.07	0.08	
1	7	209	1137	0	-0.08	3274	0.01	0.01	0.01	0.17	0.12	0.08	0.06	
1	7	210	416	0	0.06	1040	0.02	0.02	0.02	0.14	0.09	0.07	0.08	
1	7	211	400	0.01	0.12	997	0.01	0.01	0.02	0.07	0.11	0.12	0.03	
1	7	212	0	0.05	0.05	0	0.06	0.1	0.01	0.13	0.2	0.07	0.06	
1	7	213	395	0.02	-0.19	1377	0	0.02	0.03	0.08	0.12	0.14	0.03	
1	7	214	0	0.05	0.05	0	0.06	0.1	0.01	0.13	0.2	0.07	0.06	
1	7	215	284	0.01	0.12	713	0	0.01	0.03	0.06	0.1	0.1	0.04	
1	7	216	1496	0	0.13	4055	0	0.01	0.02	0.07	0.09	0.13	0.03	
1	7	217	601	0	0.06	1518	0.01	0.01	0.01	0.14	0.1	0.08	0.06	
1	7	218	468	0	0.1	1114	0	0.01	0.01	0.14	0.1	0.06	0.06	

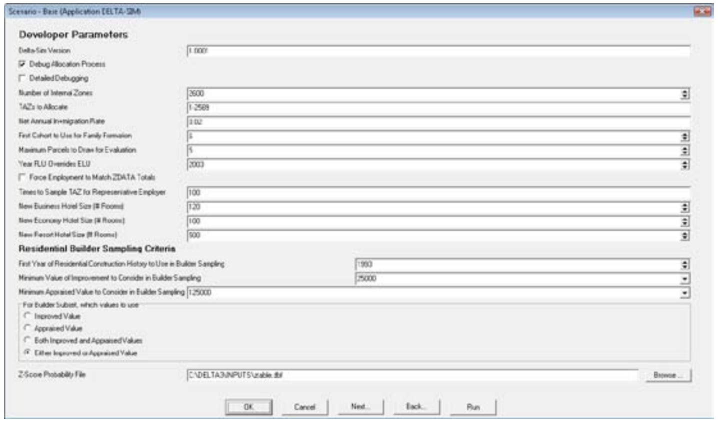
DELTASIM Current Efforts



- Collect AWI employer transition data
- Assemble final estimation data set
- Validate allocation process (other procedures validated)
- Document final results

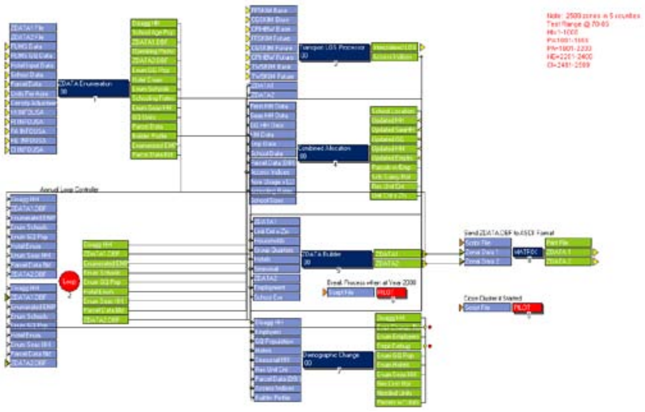
DELTASIM & FSUTMS Direction





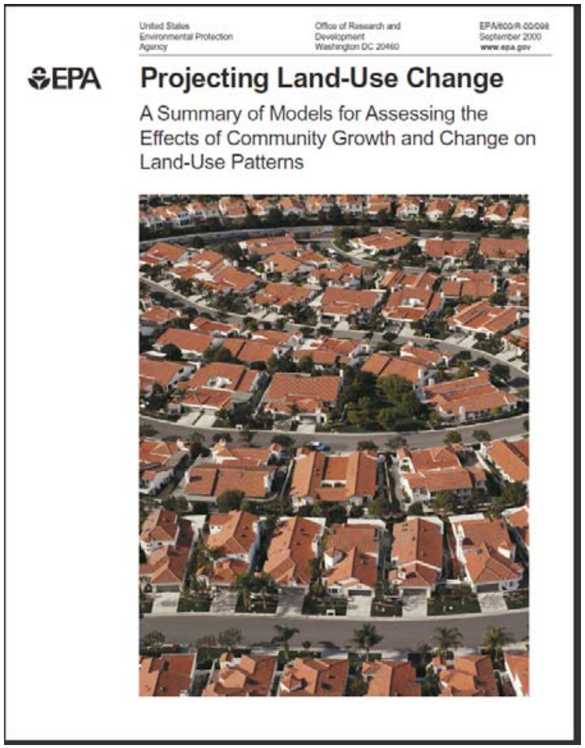
- Fully Cube Voyager scripted (i.e. changeable)
- Produces individual household/person characteristics that are "rolled up" for standard 4 step model
- 100% compatible with activity-based models (by design)
- Fixed or random seed Monte Carlo-based (menu driven)

DELTASIM Possible Improvements



- Integrate household surveys to estimation
- Add income as a variable in allocation (0 coefficient now)
- Forecast property values (exogenous now)
- Expand use of Cluster (due to Monte Carlo), bid process possibly allows better exploitation

For Your Reading Pleasure



United States Environmental Protection Agency

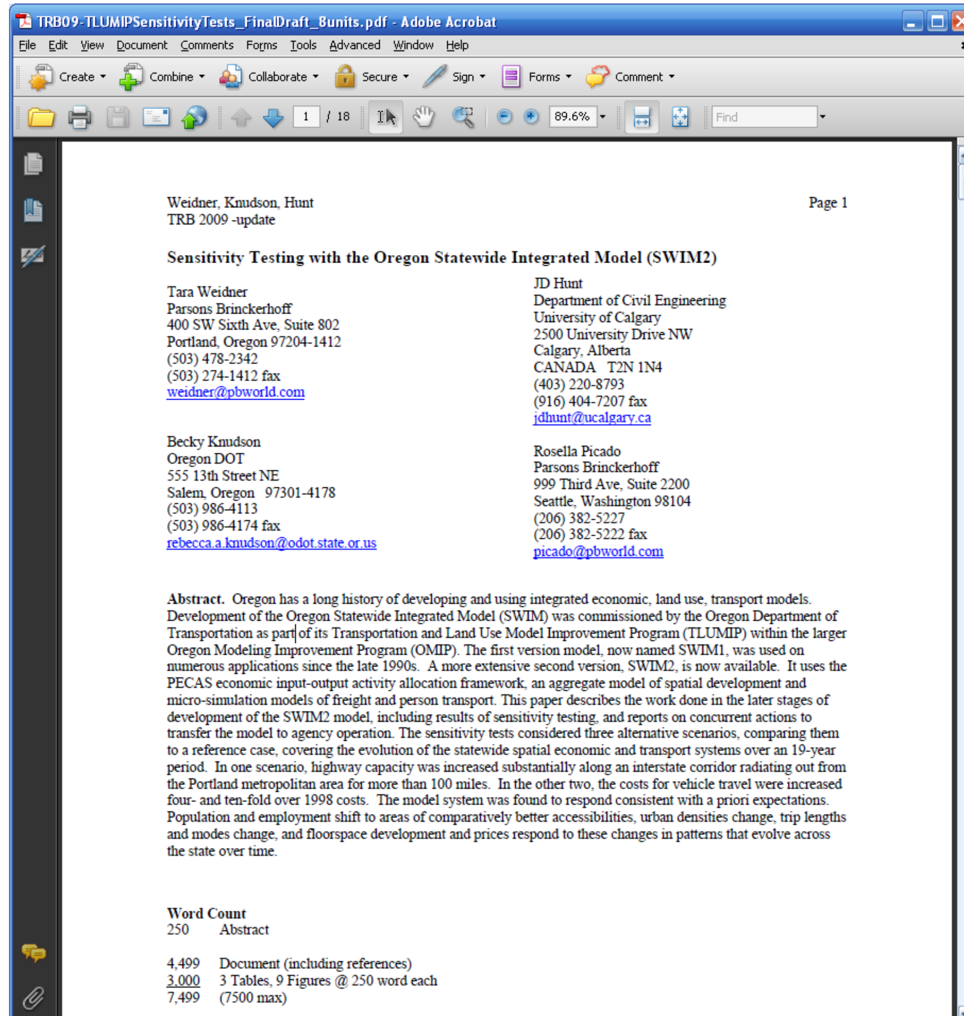
Office of Research and Development Washington DC 20460

EPA/600/R-00/098 September 2000 www.epa.gov

EPA

Projecting Land-Use Change

A Summary of Models for Assessing the Effects of Community Growth and Change on Land-Use Patterns



Weidner, Knudson, Hunt
TRB 2009 -update

Page 1

Sensitivity Testing with the Oregon Statewide Integrated Model (SWIM2)

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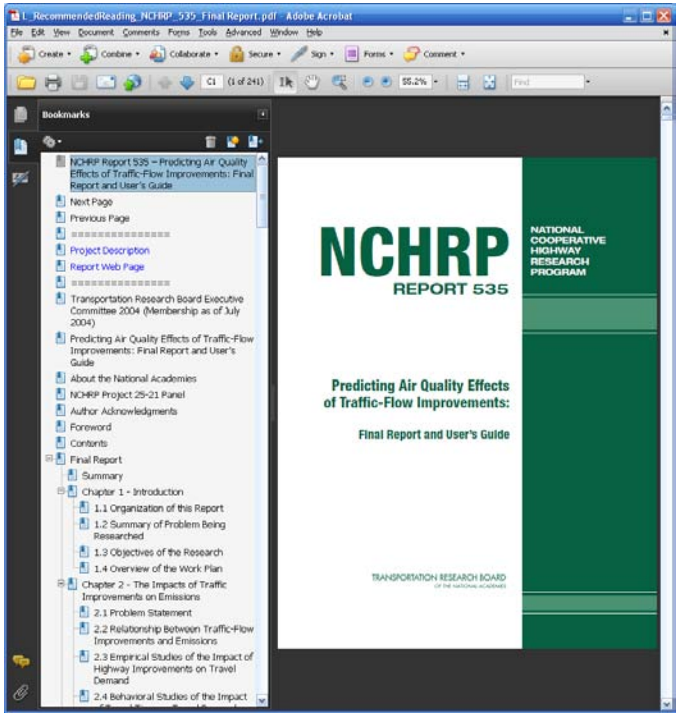
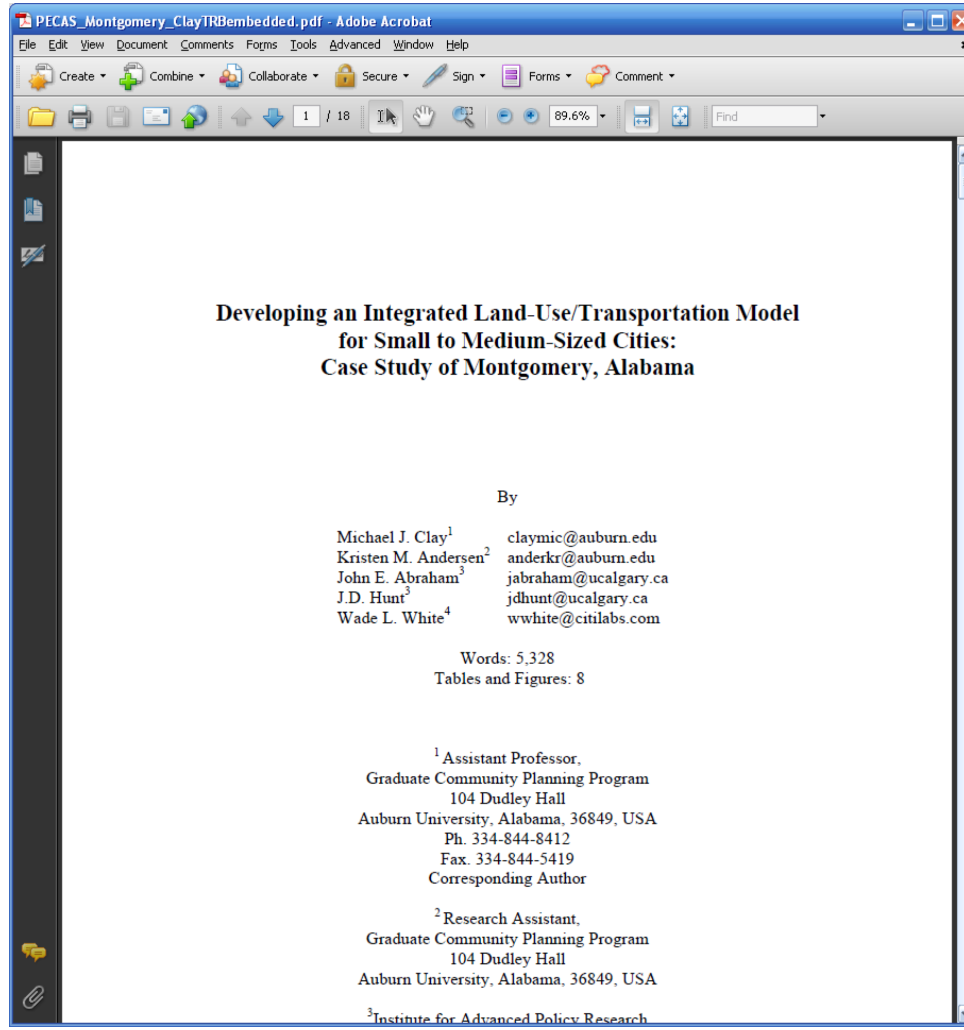
Abstract. Oregon has a long history of developing and using integrated economic, land use, transport models. Development of the Oregon Statewide Integrated Model (SWIM) was commissioned by the Oregon Department of Transportation as part of its Transportation and Land Use Model Improvement Program (TLUMIP) within the larger Oregon Modeling Improvement Program (OMIP). The first version model, now named SWIM1, was used on numerous applications since the late 1990s. A more extensive second version, SWIM2, is now available. It uses the PECAS economic input-output activity allocation framework, an aggregate model of spatial development and micro-simulation models of freight and person transport. This paper describes the work done in the later stages of development of the SWIM2 model, including results of sensitivity testing, and reports on concurrent actions to transfer the model to agency operation. The sensitivity tests considered three alternative scenarios, comparing them to a reference case, covering the evolution of the statewide spatial economic and transport systems over an 19-year period. In one scenario, highway capacity was increased substantially along an interstate corridor radiating out from the Portland metropolitan area for more than 100 miles. In the other two, the costs for vehicle travel were increased four- and ten-fold over 1998 costs. The model system was found to respond consistent with a priori expectations. Population and employment shift to areas of comparatively better accessibilities, urban densities change, trip lengths and modes change, and floorspace development and prices respond to these changes in patterns that evolve across the state over time.

Word Count

250	Abstract
4,499	Document (including references)
3,000	3 Tables, 9 Figures @ 250 word each
7,499	(7500 max)

For Your Reading Pleasure (continued)





Developing an Integrated Land-Use/Transportation Model for Small to Medium-Sized Cities: Case Study of Montgomery, Alabama

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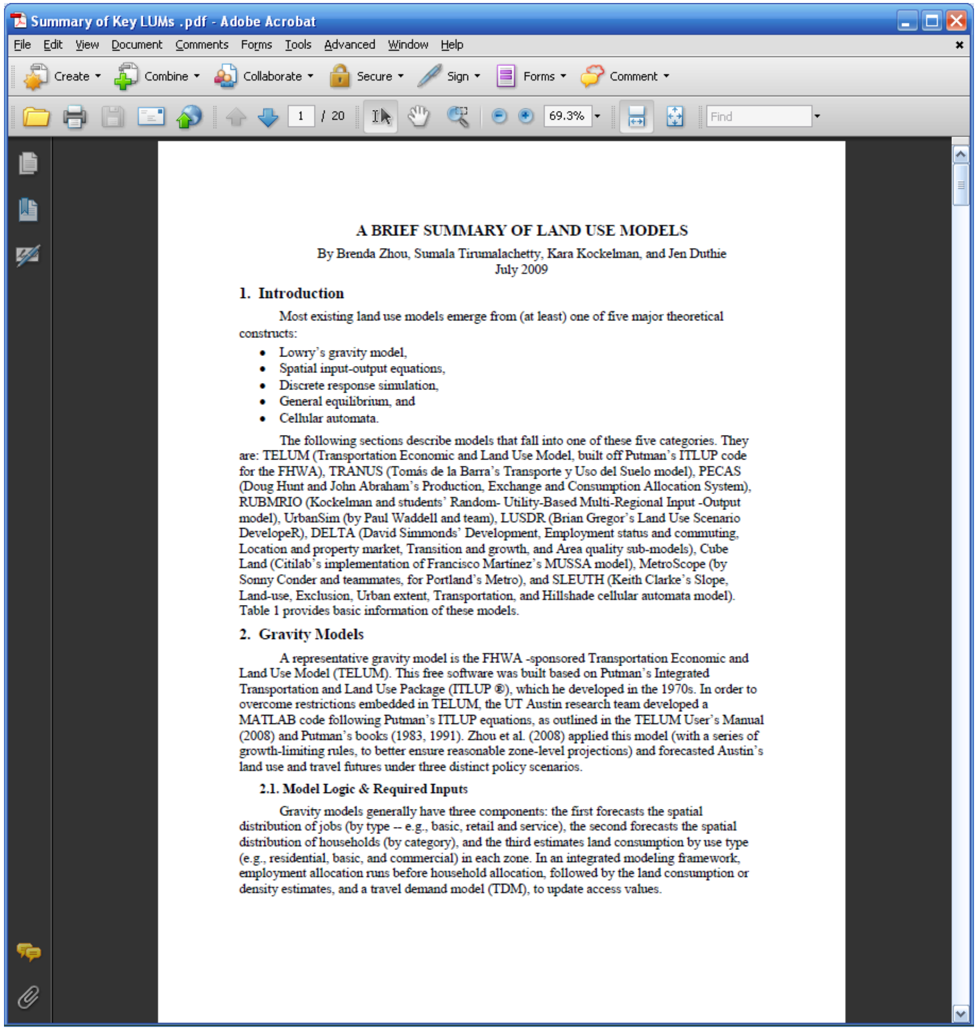

A BRIEF SUMMARY OF LAND USE MODELS

By Brenda Zhou, Sumala Tirumalachetty, Kara Kockelman, and Jen Duthie
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1. Introduction

Most existing land use models emerge from (at least) one of five major theoretical constructs:

- Lowry's gravity model,
- Spatial input-output equations,
- Discrete response simulation,
- General equilibrium, and
- Cellular automata.

The following sections describe models that fall into one of these five categories. They are: TELUM (Transportation Economic and Land Use Model, built off Putman's ITLUP code for the FHWA), TRANUS (Tomás de la Barra's Transporte y Uso del Suelo model), PECAS (Doug Hunt and John Abraham's Production, Exchange and Consumption Allocation System), RUBMRIO (Kockelman and students' Random- Utility-Based Multi-Regional Input -Output model), UrbanSim (by Paul Waddell and team), LUSDR (Brian Gregor's Land Use Scenario DevelopeR), DELTA (David Simmonds' Development, Employment status and commuting, Location and property market, Transition and growth, and Area quality sub-models), Cube Land (Citilab's implementation of Francisco Martinez's MUSSA model), MetroScope (by Sonny Conder and teammates, for Portland's Metro), and SLEUTH (Keith Clarke's Slope, Land-use, Exclusion, Urban extent, Transportation, and Hillshade cellular automata model). Table 1 provides basic information of these models.

2. Gravity Models

A representative gravity model is the FHWA -sponsored Transportation Economic and Land Use Model (TELUM). This free software was built based on Putman's Integrated Transportation and Land Use Package (ITLUP ®), which he developed in the 1970s. In order to overcome restrictions embedded in TELUM, the UT Austin research team developed a MATLAB code following Putman's ITLUP equations, as outlined in the TELUM User's Manual (2008) and Putman's books (1983, 1991). Zhou et al. (2008) applied this model (with a series of growth-limiting rules, to better ensure reasonable zone-level projections) and forecasted Austin's land use and travel futures under three distinct policy scenarios.

2.1. Model Logic & Required Inputs

Gravity models generally have three components: the first forecasts the spatial distribution of jobs (by type -- e.g., basic, retail and service), the second forecasts the spatial distribution of households (by category), and the third estimates land consumption by use type (e.g., residential, basic, and commercial) in each zone. In an integrated modeling framework, employment allocation runs before household allocation, followed by the land consumption or density estimates, and a travel demand model (TDM), to update access values.

Possible Discussion Topics

- What are the desirable characteristics for a FSUTMS-based land use modeling process?
- What are the "least common denominator" data requirements? Are the data available everywhere?
- What is the appropriate level of geography?
  - Parcel (DELTASIM)
  - Grid (URBANSIM- note moving towards parcel)
  - Zone (Cube Land)
- What resources can/are agencies willing to commit to land use modeling?

Possible Discussion Topics (continued)

- How does this compete with other priorities?
- What sort of “talent pool” is out there to estimate and calibrate such tools?
- What are the potential roles of the university research talent pool in the process?
- What sort of policies should the model be sensitive to?
- How do you determine “success”?
- What is acceptable error in a land use model (hint: academic and practitioners have differing expectations)?
- Should it be micro-simulation (with some random noise)?

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