

An Inventory and Assessment of Models Used to Predict Emergency Evacuation and Consideration of Increasing Policy Maker Involvement



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Research Objectives

- **Review Existing Evacuation Software and Match Strength and Limitations to Specific Conditions with Houston Area Focus**
- **Define Success for Houston Area Evacuations During Hurricanes Rita and Ike**
- **List Considerations for Decision Makers in Applying the Models**



Methods

- **Conduct Overview of Literature**
- **Review and Inventory Models**
- **Assess Models and Capabilities**
- **List Key Questions for Policy Makers**
- **Define Measure of Evacuation Success**



Models Overview

- **Network-based evacuation and traffic simulation models**
- **Challenge is one of realistic simulation of a likely evacuation event**
- **Models largely based on orderly, structured human responses**

Initial Highlights from Literature

- **Objective and subjective risk factors affect citizen decisions (NC Dept. Emergency Management, 2000)**
- **Decision-making/management insufficient for catastrophic event (US DOT, 2006)**
- **Micro, Meso and Macro Level Modeling**
- **Limited consistency between states in planning/design for evacuation (LSU, 2001)**
 - **Two Gulf Coast State DOTs Reported Use of Evacuation Model Outcomes**
 - **Extensive Use of Models in these States by Academia**

Initial Highlights from Literature (cont.)

- **Traveler behavior difficult to predict (Peacock et. al.,2007; Murray-Tuite and Mahmassani, January 2005)**



Keep in Mind

Tasks involved in effective emergency evacuation plans are complex.

Issues are increasingly important as incidence of extreme natural occurrences increases.

Evacuation modeling procedures do not incorporate all aspects of evacuation behavioral analyses

Keep in Mind

Some models do not contain dynamic traffic assignment.

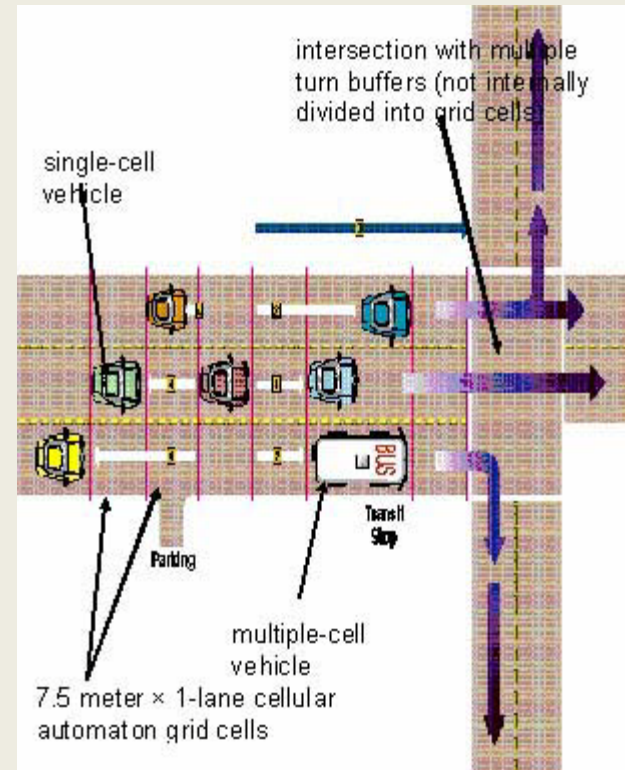
Model simulation facilitates investigation of effects of a mass evacuation on current transportation networks.



Primary Macro Level Models

Model	Special Focus
<i>Emme/2</i>	Planning Model
ETIS	Hurricanes
HEADSUP	Hurricanes
HURREVAC	Hurricanes
MASSVAC	Evacuation Management
NETVAC	Evacuation Management
OREMS	Traffic Simulation
PCDYNEV	Evacuation Management
REMS	Evacuation Management
TEDSS	Evacuation Management

Source: Modified from Evacuation Modeling Tool Inventory (Hardy and Wunderlich, p.25)



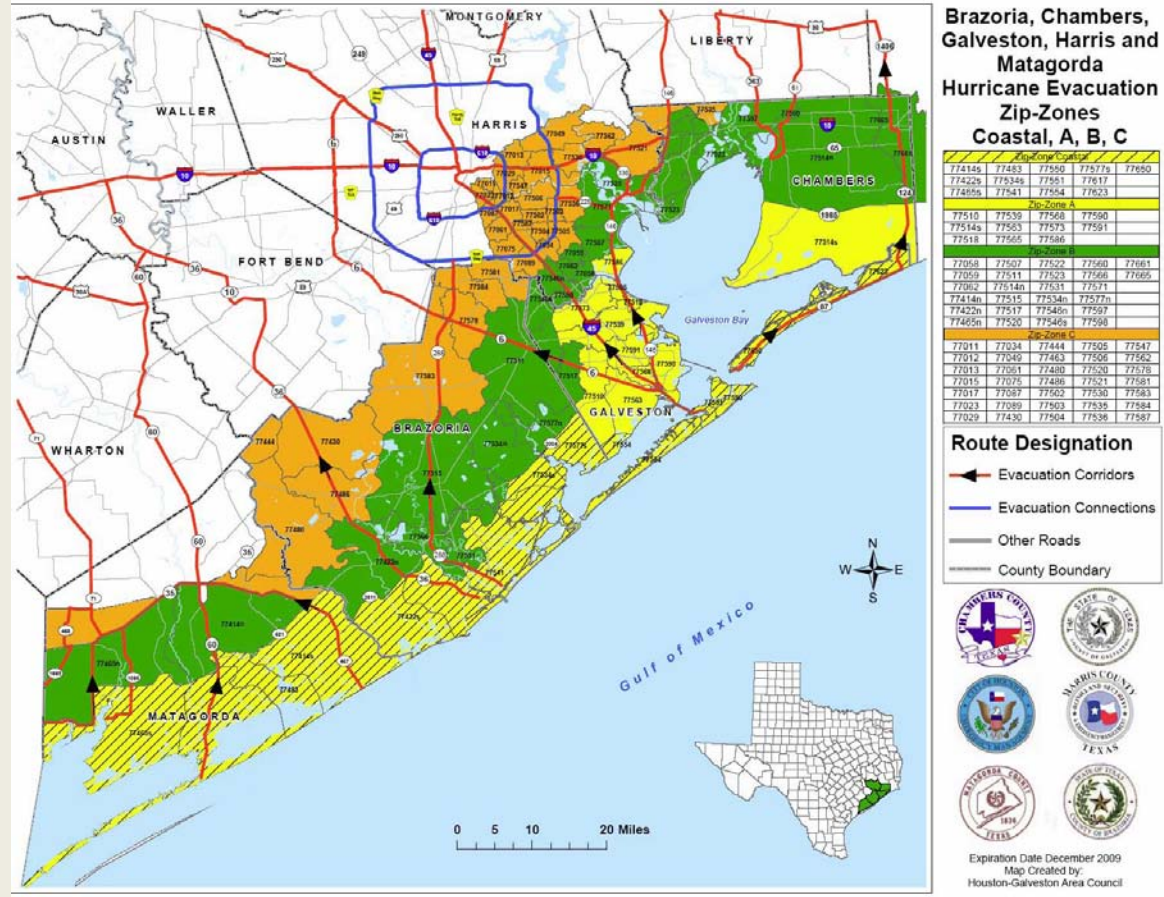
Source: http://tmip.fhwa.dot.gov/community/user_groups/transims/background.htm#procedures

Primary Meso Models

Model	Special Focus
Simulex	Evacuation Management
Cube	Traffic Simulation
DYYNASMART	Traffic Simulation
Transmodeler	Planning Simulation
TRANSIMS	Planning Simulation

Source: Modified from Evacuation Modeling Tool Inventory (Hardy and Wunderlich, p.25)

Defining Evacuation Success



Houston Galveston Area Evacuation Zones

Defining Success

Hurricane Rita 2005



Hurricane Ike 2008



- ***Command, Control and Communication***
- ***Evacuation of People with Special Needs***
- ***Fuel Availability***
- ***Flow of Traffic***
- ***Public Awareness***

Defining Evacuation Success

Comparison of Normal Traffic Volume to Hurricane Rita
Volume at One Location

Hours into Evacuation	Average Weekday Volume	Volume Sept. 21, 2005	Volume Sept. 22, 2005	Index: Evacuation Aver. to Hurricane Aver.
5	1667	1906	1000	.87
10	4613	5280	1024	.68
15	5403	2419	1502	.36
20	3445	2184	1166	.48
Total all hours	87,995	67,129	31,050	.55

Defining Evacuation Success cont.

Comparison of Normal Traffic Volume to Hurricane Ike Volume at One Location in Houston

Hours into Evacuation	Average Weekday Volume	Volume Sept. 11, 2008	Volume Sept. 12, 2008	Index: Evacuation Aver. to Hurricane Aver.
5	1132	1623	1569	1.40
10	3407	5103	3787	1.30
15	4676	3389	1877	0.56
20	2557	2334	435	0.54
Total all hours	65431	68697	42,124	0.85

Note: Shaded cells show when travel time was better than for the average rush hour.

Questions for Policy Makers

- **What information do we need to make a proper decision?**
 - **Anticipated number of evacuees**
 - **Available routes and alternative routing scenarios**
 - **Variables affecting individual decisions**
 - **Potential bottlenecks and delay locations**
 - **Possible traffic control strategies**
 - **Projected length and duration of congestion; estimated travel speeds**
 - **Quantity of public transportation needed**
 - **What constitutes a successful evacuation?**

Questions for Policy Makers cont.

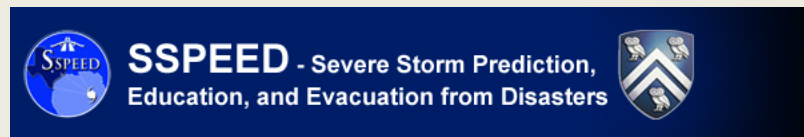
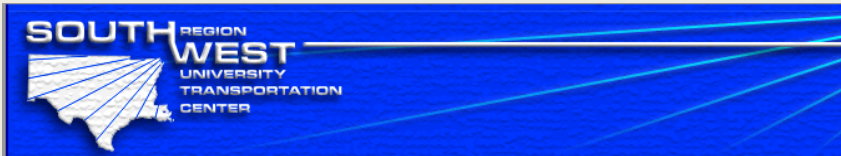
- **What are necessary skill sets and finances and what professionals are available to conduct the work?**
- **Are we interested in neighborhood/route level or regional scale outputs?**
- **Would there be an advantage to using a static model over a dynamic model?**
- **Do we want a model specifically designed to address hurricane evacuation, or would a general planning or traffic model better suit our needs?**
- **By what measures will we claim evacuation success?**

Research Outcomes

- **Improved application of existing software**
- **Guidance to assist locale officials in selecting and applying appropriate software**
- **Measurement for Gauging Traffic Flow Success**

Research Acknowledgments

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Selected References

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