

Implementation of a Trip-based Time-of-Day Choice Model in FSUTMS

presented to
Advanced Model Structures Committee

presented by
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Objective



- Application of a trip-based time-of-day choice model in a congested region using FSUTMS



Test Model



- Central Florida region selected for test case.
- Test model based on CFRPM 5.0
 - 2005 Base Year
 - 4,549 zones
 - 9 standard trip purposes
 - HBW, HBSH, HBSR, HBO, NHB, LTK, HTK, Taxi, EI
 - 21 Special trip purposes
 - (Resident + Tourist + External) * (7 Major Attractions)

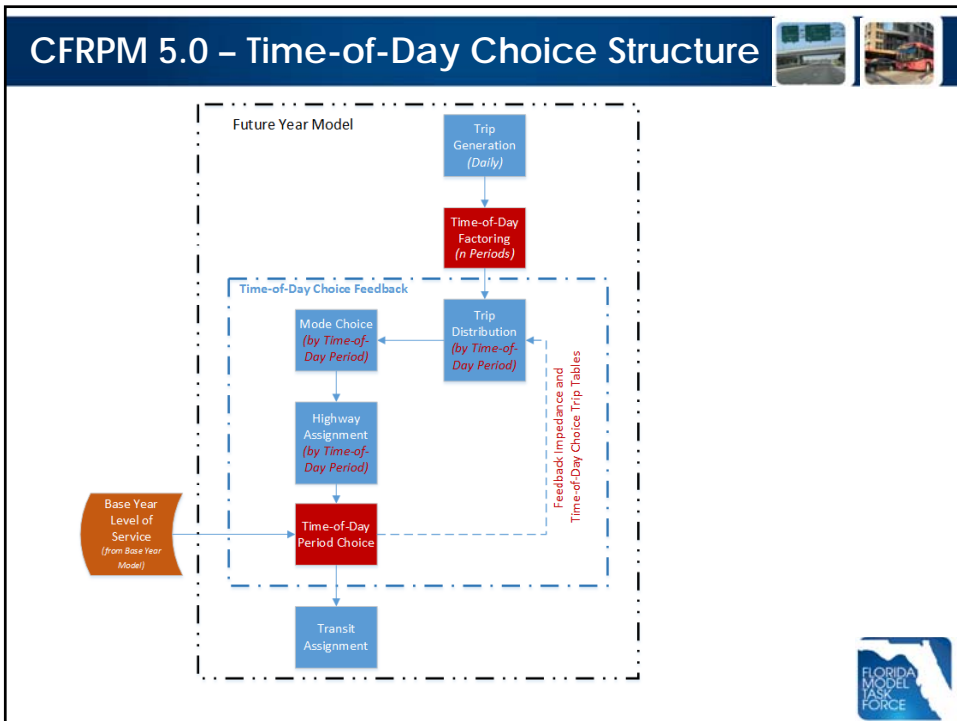
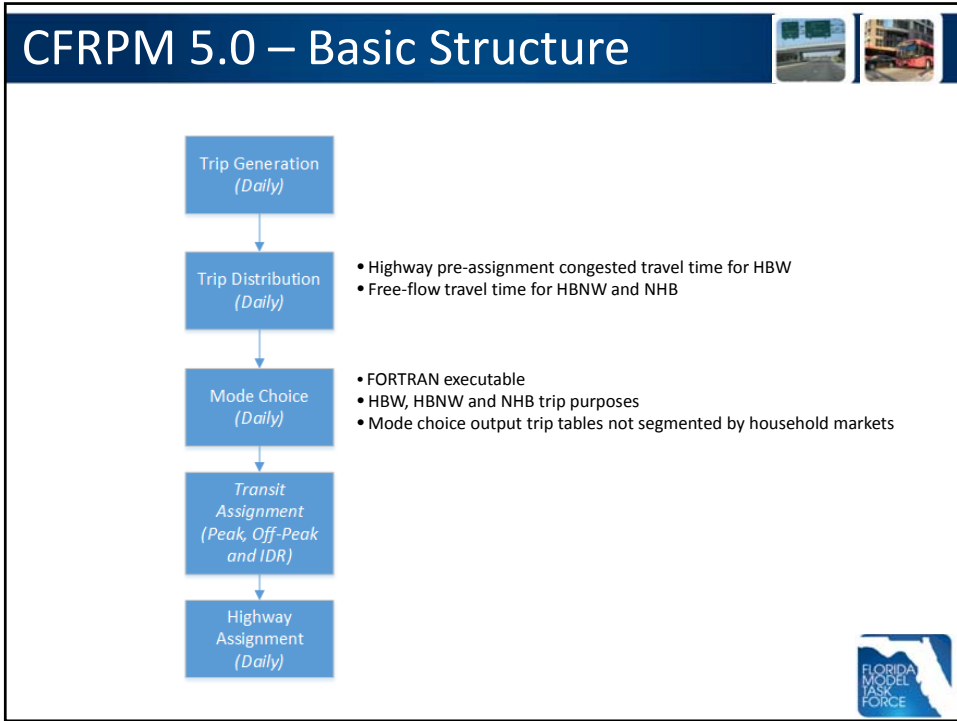


Approach for Trip-based TOD Choice Model




- Static TOD model after Trip Generation
 - Fixed TOD factors for initial stratification
 - TOD factors developed from observed local data
- TOD choice feedback model
 - Incremental logit model
 - Estimate TOD period choice after Highway Assignment
 - Feedback of TOD choice to Trip Distribution







Time-of-Day Factors



- Provides initial temporal stratification
- Adopted from work done previously by CSI
 - 2009 NHTS Florida Add-on data
- Developed for four time periods
 - AM Peak: 6:30 AM – 8:59 AM, 2.5 hours
 - MD: 9:00 AM – 3:29 PM, 6.5 hours
 - PM Peak: 3:30 PM – 6:29 PM, 3.0 hours
 - NT : 6:30 AM – 6:29 PM, 12.0 hours
 - More periods were tested (and preferred) but increased runtime and exposed caused hardware issues
- Stratified by trip purpose and direction



TOD Choice Feedback Model




- Incremental logit model
- Driven by difference in travel impedance
 - Forecast year compared to base year
- Applied for each trip purpose independently
 - For all Time-of-Day periods
- Estimates switch in trips for each Time-of-Day period
- Feedback through trip distribution, mode choice and assignment:
 - Estimated TOD period trip tables
 - Travel impedance
 - Provides consistency in supply and demand assumptions and final forecast

$$Z_{ij}^{u\beta}(n+1) = \frac{Z_{ij}^{u\beta}(n=0) \times \exp(\lambda^u \times \Delta L_{ij}^\beta)}{\sum_{\beta} \left(\frac{Z_{ij}^{u\beta}(n=0)}{Z_{ij}^{u\beta}(n=0)} \times \exp(\lambda^u \times \Delta L_{ij}^\beta) \right)}$$

Where,

- $i, j \in I$ = Origin and destination TAZs
- u = Trip purpose from 1 through 9
- β = TOD period from 1 through 4
- n = Global iteration with TOD choice feedback.
- $Z_{ij}^{u\beta}(n=0)$ = Trips by TOD period, before the first global iteration
- $Z_{ij}^{u\beta}(n=0) = \sum_{\beta} Z_{ij}^{u\beta}(n=0)$ = Total daily trips, before the first global iteration
- $Z_{ij}^{u\beta}(n+1)$ = TOD choice trips by TOD period,
- ΔL_{ij}^β = Difference in LOS impedance between the current iteration and the base-year scenario
- λ^u = Estimated/calibrated dispersion coefficient (peak spreading elasticity)



Time-of-Day Choice Model



- Difference in LOS (ΔL), forecast year compared to base year
 - Mode choice log sums, or
 - Destination choice utilities, or
 - Generalized cost
- Generalized cost used as impedance for test model
 - Travel time + Toll Plaza Delay + Toll Equivalent Time
- Mode choice log sums essential when evaluating rail and fixed guideway transit
- Dispersion coefficient (λ)
 - Requires data from Panel survey or “Before and After” survey for estimation/calibration
 - Default values used for test model
 - May be calibrated for local conditions



Effects of Changes



- Temporal stratification of all model components (except trip generation)
- Home-based trips by direction
 - Outbound (O) – from home
 - Inbound (I) – to home
- Period-specific networks and congested travel times for all model components (except transit)
 - Transit Peak: AM Peak period network and travel time
 - Transit Off-Peak: MD period network and travel time
- Model sensitivity to change in LOS



Effects of Changes



- Internal trip purposes by direction maintained in all model components, except transit
 - HBWO, HBWI, HBSHO, HBSHI, HBSRO, HBSRI, HBSRO, NHB
- Requires greater calibration/validation effort
 - More time-of-day periods
 - Time-of-Day choice model
 - Panel data for calibration
- Longer model run time
 - More time periods
 - More trip purposes
 - Feedback loop



Issues for Consideration



- Consistency in TAZ structure across all model scenarios (Required)
- Trip Distribution
 - Destination choice mode vs. gravity model
- Mode Choice
 - Same trip purpose as TOD choice model
 - Output trips by household markets



Issues for Consideration



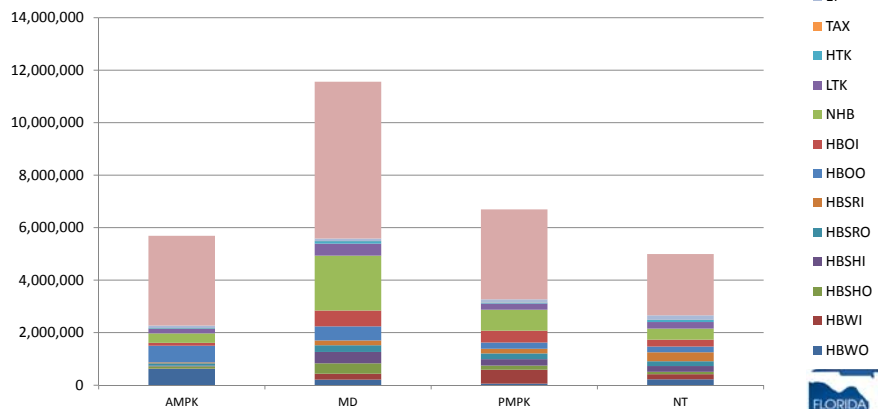
- No trip-chaining information
- No disaggregate household/person/trip variables
- Trip-based model with time-of-day choice vs. activity-based model



2005 Base Year Forecast: Time-of-Day



- Time-of-day Factoring
- Four Time-of-Day periods



Time-of-Day Results: 2035 No-Build



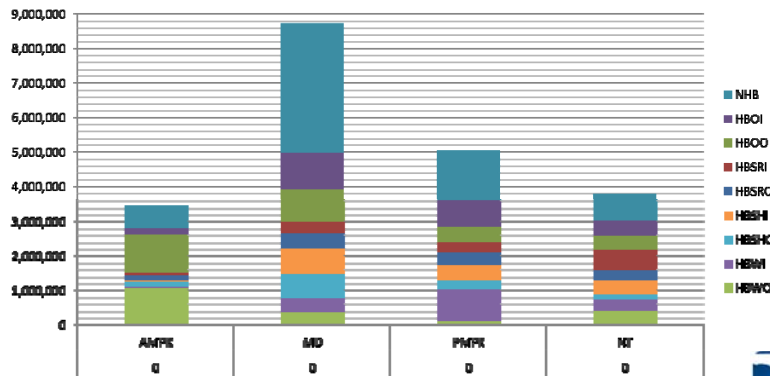
- 2035 No-Build Future Year
 - 2005 highway and networks
 - 2035 socioeconomic data

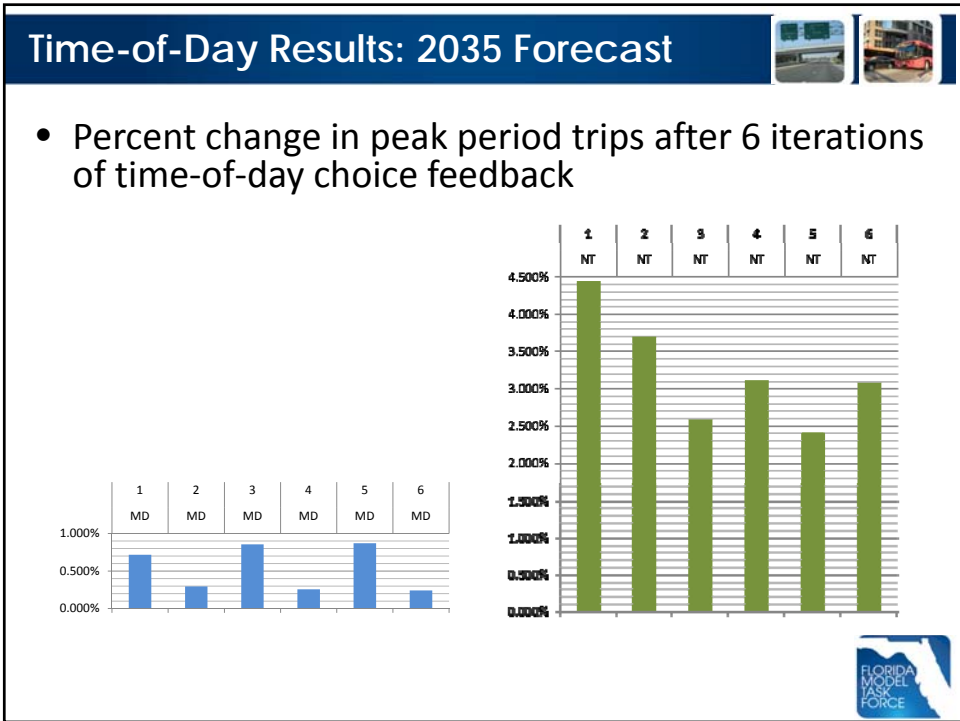
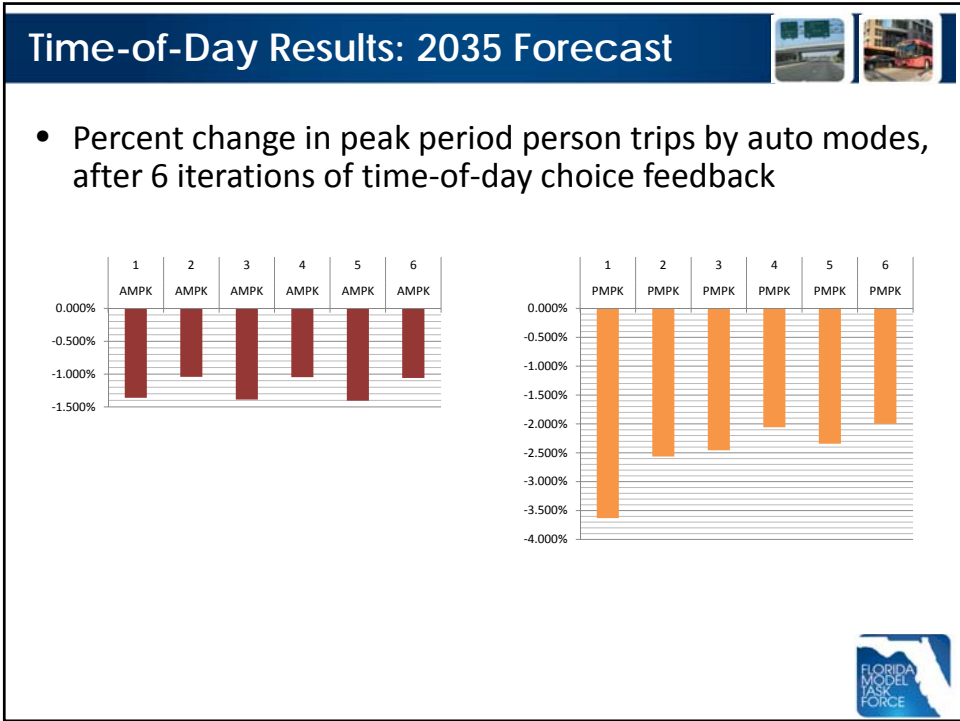


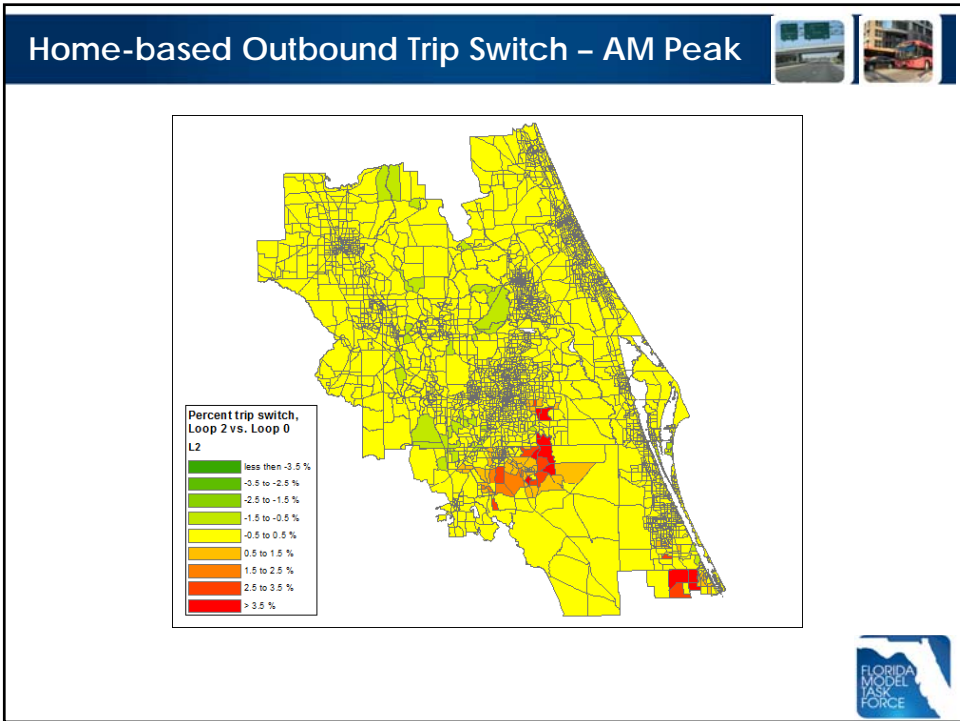
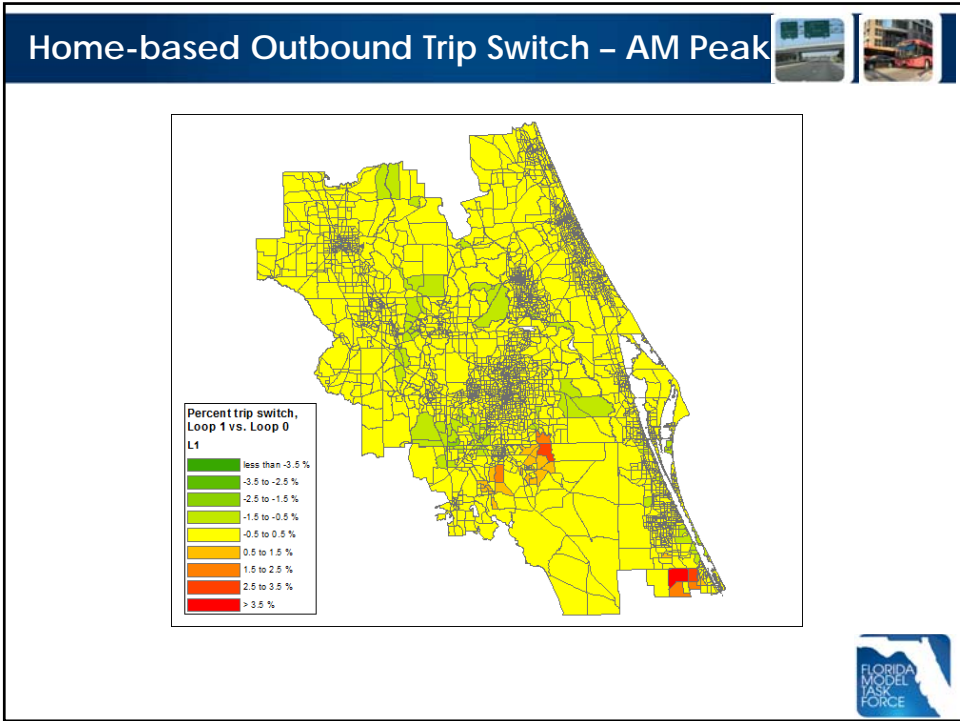
Time-of-Day Results: 2035 No-Build

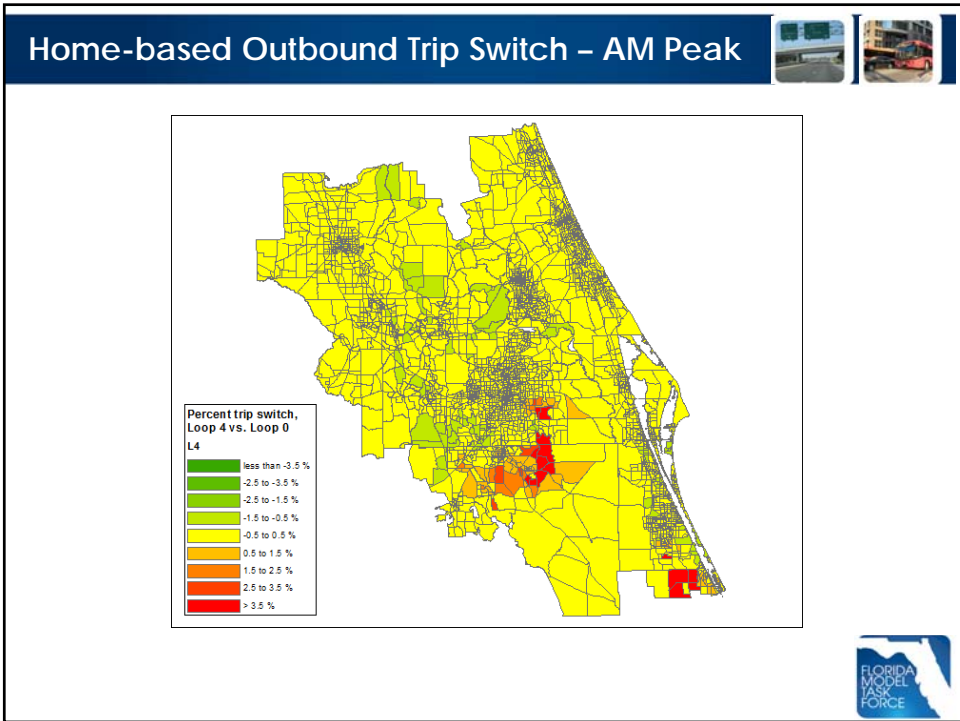
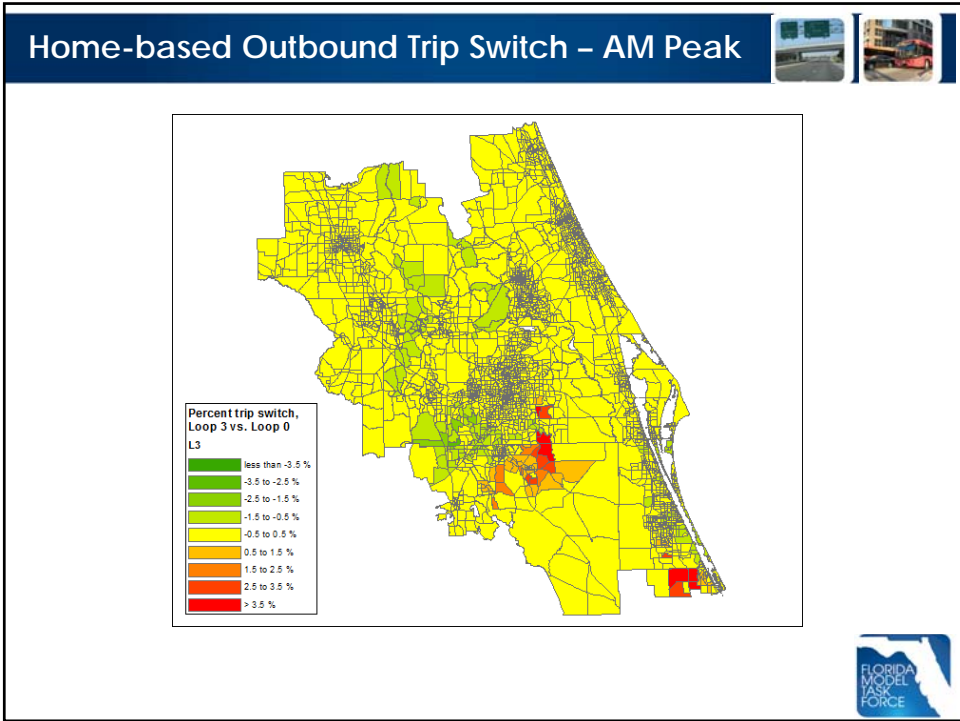


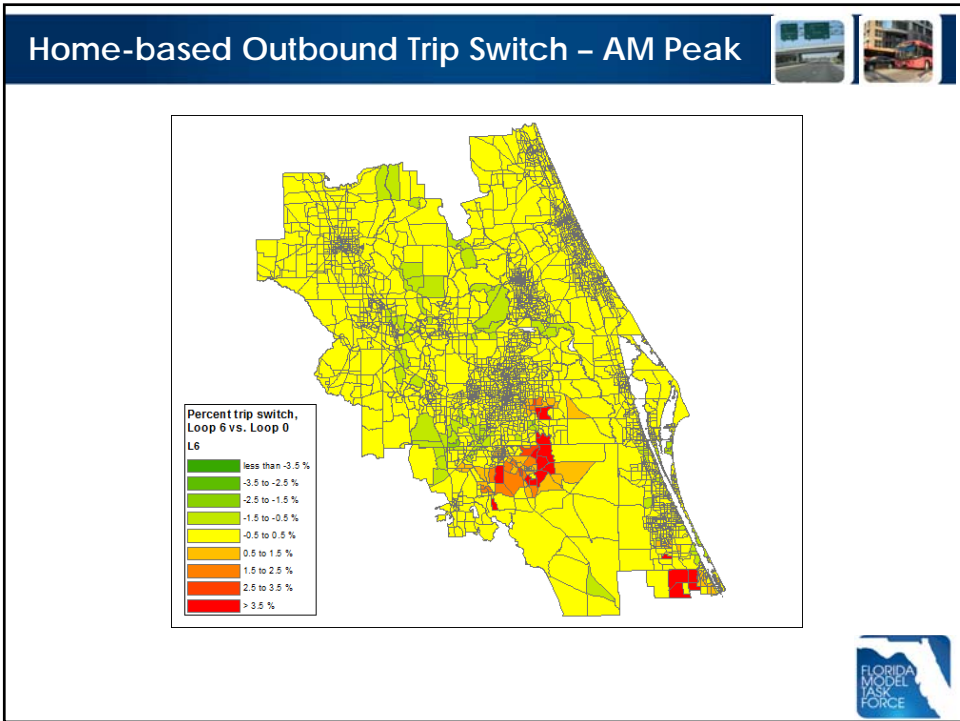
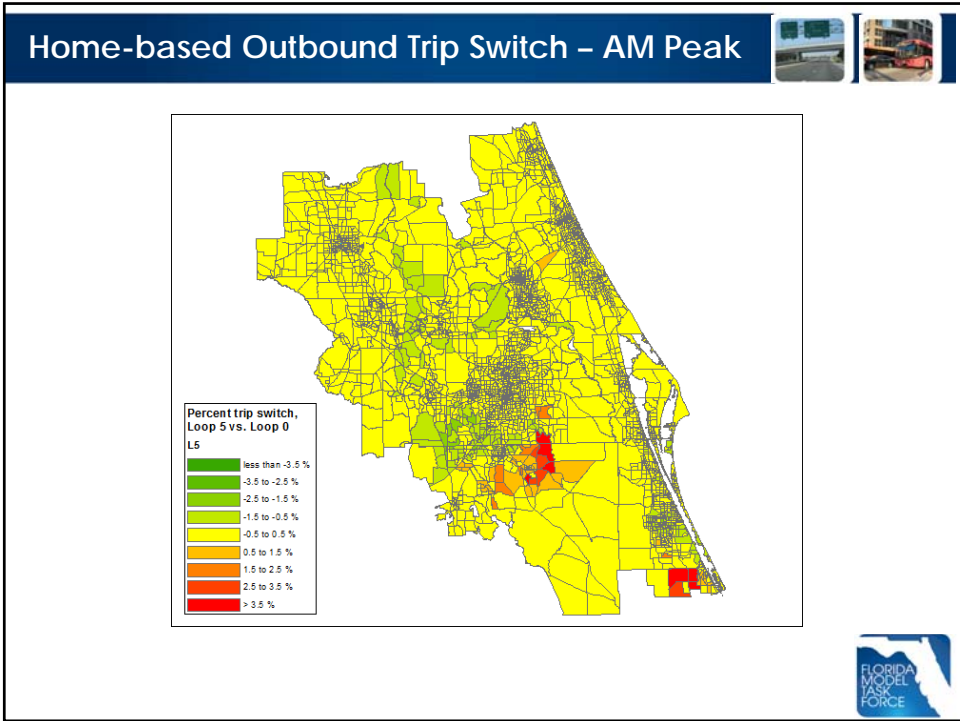
- Initial Mode Choice estimate of person trips by auto modes
 - Not including, taxi, trucks or special trips











Time-of-Day Modeling Toolbox



- Static Time-of-Day Model
 - Fixed Time-of-Day factors
 - Relatively easy to implement
 - Assumes travel patterns will remain the same in the future
 - Not sensitive to change in LOS ☹
 - Adequate for regions with limited or negligible congestion growth



Time-of-Day Modeling Toolbox



- Trip-based Time-of-Day Choice Model
 - Dynamic model
 - Predicts shifts in time-of-day period of travel
 - Can model peak spreading
 - Sensitive to trip purpose and changes in LOS
 - May be sensitive to household markets
 - Useful in regions where peak period congestion is significant and growing
 - Aggregate ☹



Time-of-Day Modeling Toolbox



- Activity-based Travel Models
 - Disaggregate Time-of-Day Choice is built-in



Questions?



- Thank you.

