Using GIS and CTPP Data for Transit Ridership Forecasting in Central Florida

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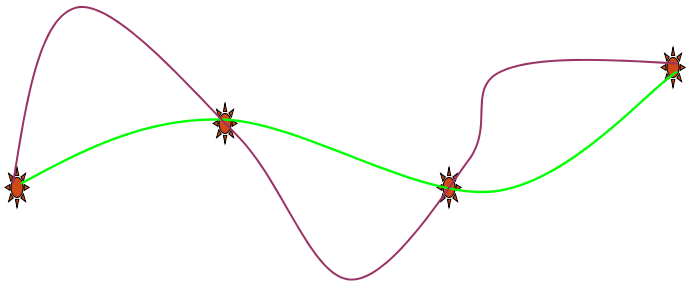
Aggregate Rail Ridership Forecasting Model

The Census Transportation Planning Package (CTPP)-Based Aggregate Rail Ridership Forecasting Model uses Journey-to-Work (JTW) flow data (all modes) occurring within specific distance buffers of rail stations and stratified by socioeconomic classification and/or worker density as the basis for forecasting the rail ridership.



Data source required

- GIS shape files
  - Station and rail line database
  - Census Geography layer
  - Hydro layer
- Census Transportation Planning Package (CTPP) data
  - CTPP Part 1 data
  - CTPP Part 2 data
  - CTPP Part 3 data

CTPP 2000 Data	Part 1 – Workers at home-end Part 2 – Workers at work-end Part 3 – Flows
CTPP1INC_TZ.exe, *CTPP1INC_BG.exe*, and *CTPP1INC_TR.exe* programs	Calculates proportion of households in low, medium and high income categories by geographic unit
CTPP2EMP_TZ.exe, *CTPP2EMP_BG.exe*, and *CTPP2EMP_TR.exe* programs	Calculates workers in each geographic unit and estimates employment density
CTPP3.exe program	Helps to extract tract-level data from region- or state-wide files
GIS info	Rail station points; Proportion of tracts/zones within range of stations
RailMarket.exe program	Calculates the number of workers who both live and work within particular distances of a rail station by income group and employment density category
Spreadsheet	Records service variables and *RailMarket* results; produces ridership potential estimate

From Dave Schmitt "Aggregate Rail Ridership Forecasting Model: Overview"

ARRF model development (1)

- Collecting and processing GIS data and CTPP
  - Point, plotlines, and polygons
- Determining socioeconomic characteristics of the geography

If Rail Line Service Area Lies Within…	Potential Geographic Units		Recommended
	MPO Level	State Level	Geographic Units
One MPO (number of states irrelevant)	TAZ or BG (only one is available)	State-County-Tract summary level	MPO data using TAZ or BG summary level
One MPO and non-MPO areas within one state	Consistent geographic level-of-detail not available	State-County-Tract summary level	State-wide data using State-County-Tract summary level
Multiple MPOs within one state			
Multiple MPOs and non-MPO areas within one state			
Multiple MPOs among multiple states	Consistent geographic level-of-detail not available	State-County-Tract summary level	State-wide data using State-County-Tract summary level from multiple state files
Multiple MPOs and non-MPO areas among multiple states			

ARRF model development (2)

- Extracting the household income distribution by different category from CTPP part 1
- Extracting estimated employment from CTPP part 2 by density
- Retrieve CTPP part 3 JTW flow data for the study area
- Determining relationships between rail stations and CTPP geography (TAZ or BG or Tract) for all rail stations
- Applying ARRF models

CR Model Equation

Commuter Rail Weekday Unlinked Trips =

Nominal Ridership x Demand Adjustment Factor

Nominal Ridership =

0.069*High Income CTPP PNR 6-to-1 JTW flows +

0.041*Medium Income CTPP PNR 6-to-1 JTW flows +

0.151*Low Income CTPP 2-to-1 JTW flows

Demand Adjustment Factor= (1+0.3*Percent Deviation in Average System Speed) x

(1+0.3*Percent Deviation in Train Miles per Mile) x

Rail Connection Index

CR Model Equation (2)

Percent Deviation in Average System Speed=

System Average Speed-35.7 mph / [System Average Speed+35.7)/2]

System Average Speed=

Annual Revenue Vehicle Miles/Annual Revenue Vehicle Hours

Percent Deviation in Train Miles per Mile=

Weekday Train Miles per Directional Route Mile-10.3 /

[(Weekday Train Miles per Directional Route Mile+10.3)/2]

Weekday Train Miles per Directional Route Mile=

Annual Revenue Vehicle Miles/250/Average Train Length

LRT Model Equation

Total Weekday Unlinked Rail Trips =

Weekday Unlinked Drive Access to Work Rail Trips +

Weekday Unlinked Other Rail Trips

Weekday Unlinked Drive Access to Work Rail Trips =

0.030 * CTPP PNR 6 -to-1 Mile JTW Flows (<50K Den) +

0.202 * CTPP PNR 6 -to-1 Mile JTW Flows (>50K Den)

Weekday Unlinked Other (Non-Drive Access to Work) Rail Trips =

0.395 * CTPP 2 -to-1 Mile JTW Flows (<50K Den) +

0.445 * CTPP 2 -to-1 Mile JTW Flows (>50K Den)

Calibration of the ARRF Models

- Base data for LRT model
  - Rail Ridership as a function of mileage
  - Rail Ridership as a function of corridor JTW trips
  - Home-to-Work Rail Ridership by mode of access as a function of corridor JTW flows
  - Home-to-Work Rail Ridership by mode of access as a function of corridor JTW flows by socioeconomic class
- Commuter Rail Model
  - Adjustment for Operational characteristics

CTPP Flow Data for Commuter Rail Systems

Production Buffer - 2 miles and Attraction buffer - 1 mile

Income Group	Employment Density	Baltimore	Dallas	Los Angeles	Miami	San Diego	San Francisco	San Jose	Seattle	Virginia
Low	50,000+	6,127	535	1,661	-	1,349	2,262	-	2,677	2,372
Medium	50,000+	13,614	1,257	3,702	-	2,594	5,925	-	5,187	7,300
High	50,000+	15,945	1,337	4,394	-	3,167	11,981	-	4,807	14,630
Low	<50,000	9,828	1,066	24,196	8,175	2,528	13,018	2,424	2,126	2,787
Medium	<50,000	29,844	2,712	67,066	18,968	6,109	48,292	6,478	5,527	10,843
High	<50,000	45,866	2,471	78,695	15,110	8,604	136,648	13,799	5,377	24,430
All	All	121,224	9,378	179,714	42,253	24,351	218,126	22,701	25,701	62,362

PNR Production Buff - 6 miles and Attraction buffer - 1 mile

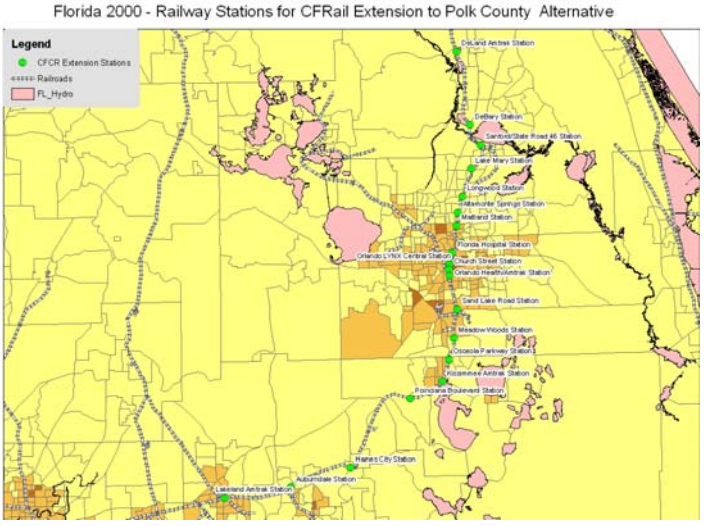
Income Group	Employment Density	Baltimore	Dallas	Los Angeles	Miami	San Diego	San Francisco	San Jose	Seattle	Virginia
Low	50,000+	14,189	2,836	5,702	-	4,865	3,892	-	7,549	8,111
Medium	50,000+	38,735	6,981	12,721	-	10,800	12,500	-	21,382	25,612
High	50,000+	54,896	8,409	17,594	-	13,188	33,060	-	32,385	49,391
Low	<50,000	19,259	4,318	52,916	20,439	7,090	19,856	6,153	6,046	7,758
Medium	<50,000	63,225	11,060	155,003	53,085	18,476	77,599	20,600	19,626	29,306
High	<50,000	108,700	10,869	222,689	48,694	26,341	249,163	53,376	26,690	63,601
All	All	299,004	44,473	466,625	122,218	80,760	396,070	80,129	113,678	183,779

Computation of Demand Adjustment Factor and CTPP Calibration Ridership

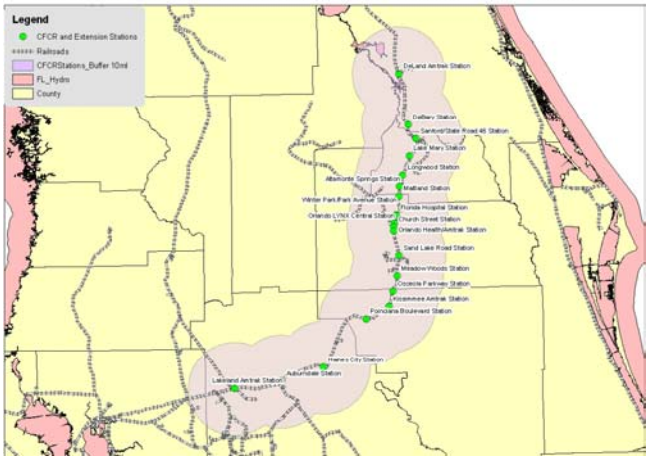
Attribute	Baltimore MARC	Dallas TRE	Los Angeles MetroLink	Miami Tri-Rail	San Diego Coaster	San Francisco Penn. JTP	San Jose ACE	Seattle Sounder	Virginia VRE	Average
Avg Speed	40.1	18.9	41.3	35.1	43.2	32.1	37.4	39.3	33.8	35.7
Ann Vehicle Miles/ RouteMile	12,152	6,289	8,422	12,794	12,880	27,798	2,560	935	8,705	10,281.7
Base:Peak Ratio	0.71	0.29	0.43	0.67	0.50	0.91	0.00	0.00	0.00	0.4
Passengers/Car	35.29	20.37	39.54	36.88	31.97	44.40	51.06	40.98	43.76	
Assumed Train Length	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
Weekday Trn Miles/Route Mile	12.2	6.3	8.4	12.8	12.9	27.8	2.6	0.9	8.7	10.3
Service Adjustments										
Speed vs Avg	11.8%	-61.7%	14.6%	-1.7%	19.2%	-10.6%	4.7%	9.5%	-5.5%	
Adjusted Demand Factor	1.04	0.81	1.04	0.99	1.06	0.97	1.01	1.03	0.98	
Weekday Trn Miles/Mile	16.7%	-48.2%	-19.9%	21.8%	22.4%	92.0%	-120.3%	-166.7%	-16.6%	
Adjusted Demand Fact	1.05	0.86	0.94	1.07	1.07	1.28	0.64	0.50	0.95	
Rail Connection Index	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	
Total Demand Adjustment Factor	1.09	0.70	0.98	1.06	1.13	1.24	0.65	0.26	0.93	
CTPP Calibration Demand	19,180	6,066	26,795	6,965	3,834	24,782	12,646	4,355	8,621	

Proposed Rail Alternatives

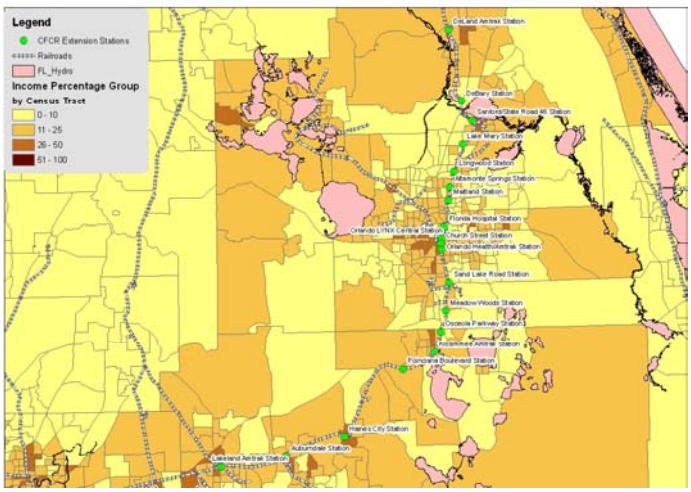
- CSX Corridor Regional Rail Alternative
- I-4 Corridor Regional Rail Alternative to Orlando Airport
- I-4 Corridor Regional Rail Alternative to Orlando CBD
- Tampa to Polk County Rail Alternative
- ***CFRail Extension to Polk County ALternative***



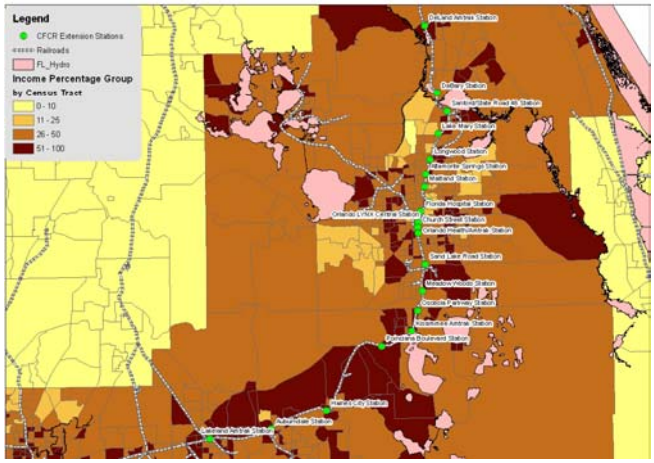
Florida 2000 - The Counties Covered by CFRail Extension to Polk County Alternative



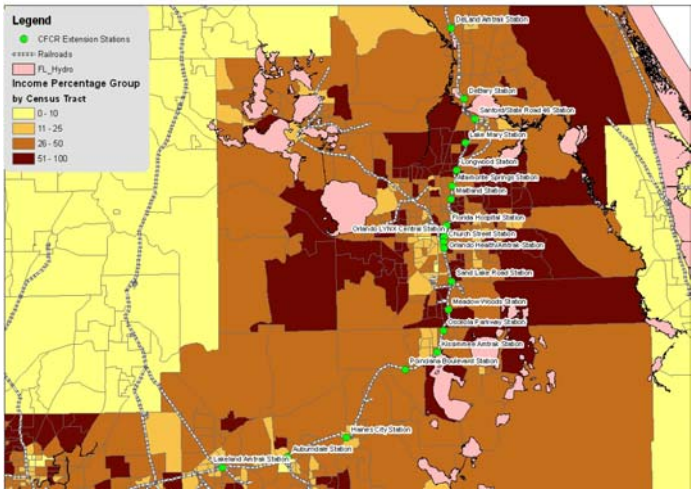
Florida 2000 - Percent of people in income group < 25k



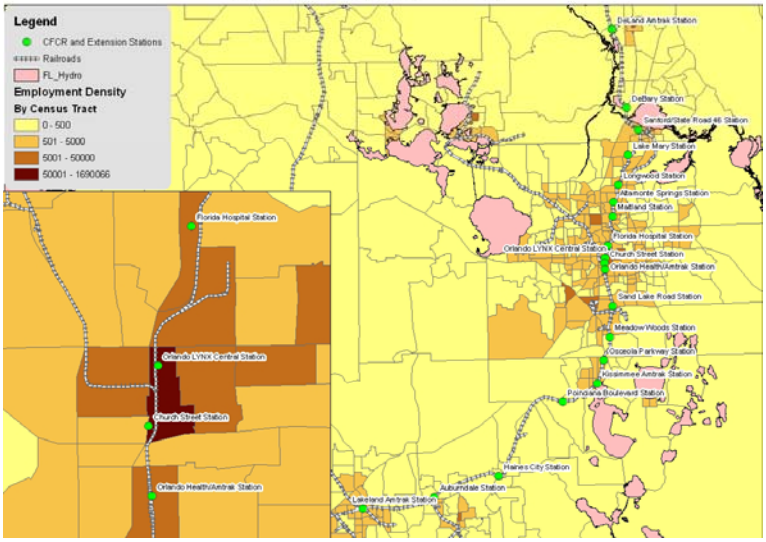
Florida 2000 - Percent of people in income group 25k < 60k



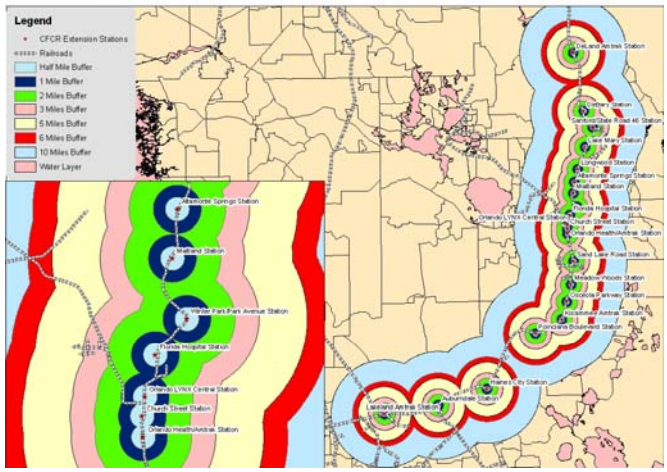
Florida 2000 - Percent of people in income group > 60k



Florida 2000 - Employment Density



Florida - Buffers around CRRail Extension Alternative All Stations



Reliability of ARRF Model

- New new start transit line
- Access mode
- Other transportation mode connection
- Discrepancy of ARRF and Regional Planning Model due to demand projection and mode split
  - New rail line btw CBD and suburban with existing service
  - CBD connections where each CBD has transit system
  - New commuter rail line connecting to commuter bus services

Questions:

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