

ESTIMATING DISAGGREGATED FREIGHT COMMODITY FLOWS USING PUBLIC DATA - A CASE STUDY IN FLORIDA

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Southeast Florida FSUTMS Users Group

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- More detailed freight movement data would better support freight demand modeling and planning.
- Data availability has been a major impediment:
 - (1) Freight companies generally view truck movement data as proprietary information.
 - (2) Public freight dataset only provides freight flows on regional level
- Project Goal: disaggregated flows using public datasets

Freight Analysis Framework (FAF)

Develop disaggregated flows using FAF data

Estimating first-, middle- and last-mile e-commerce flows

FREIGHT ANALYSIS FRAMEWORK (FAF)



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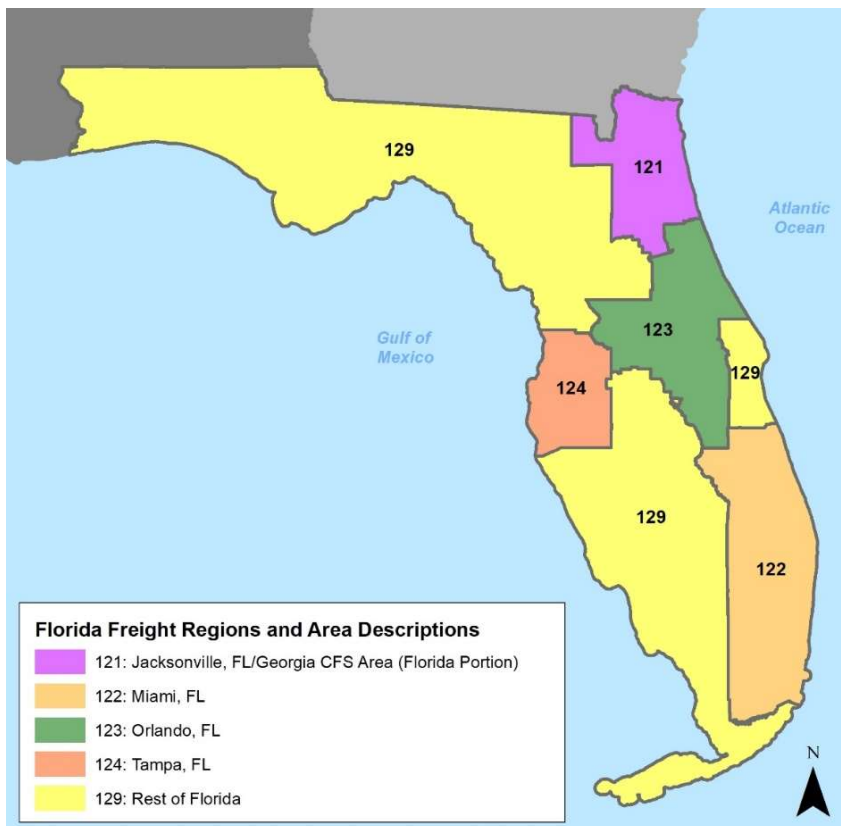


Table 4 FAF Foreign Regions

Code	FAF Region
801	Canada
802	Mexico
803	Rest of Americas
804	Europe
805	Africa
806	SW & Central Asia
807	Eastern Asia
808	SE Asia & Oceania

- FAF integrates data from the Commodity Flow Survey (CFS), international trade data from the Census Bureau, and data from agriculture, extraction, utility, and other sectors.
- FAF is produced by the Bureau of Transportation Statistics (BTS) with support from the Federal Highway Administration (FHWA).
- FAF 5 (current version) provides estimated freight flows (tonnage, value, ton-miles):
 - between FAF regions (132 domestic regions, 8 international regions)
 - by commodity (43) and mode (8),
 - for base year (2017), the recent years (2018-2022), and forecasts years (2023 - 2050).

FREIGHT ANALYSIS FRAMEWORK (FAF)

FAF Data Tabulation Tool

https://faf.ornl.gov/faf5/dtt_total.aspx

Custom Selection of FAF Data

Flow Type:

Measure:

Year: (Estimates for years after 2022 are based on forecasts.)
 2018
 2019
 2020
 2021
 2022
 2023
 2024
 2025
 2030
 2040
 2050

Forecast Scenarios: (2023-2050)
☐ Low Growth
☐ High Growth

Origin-Destination Geography:

Commodity:

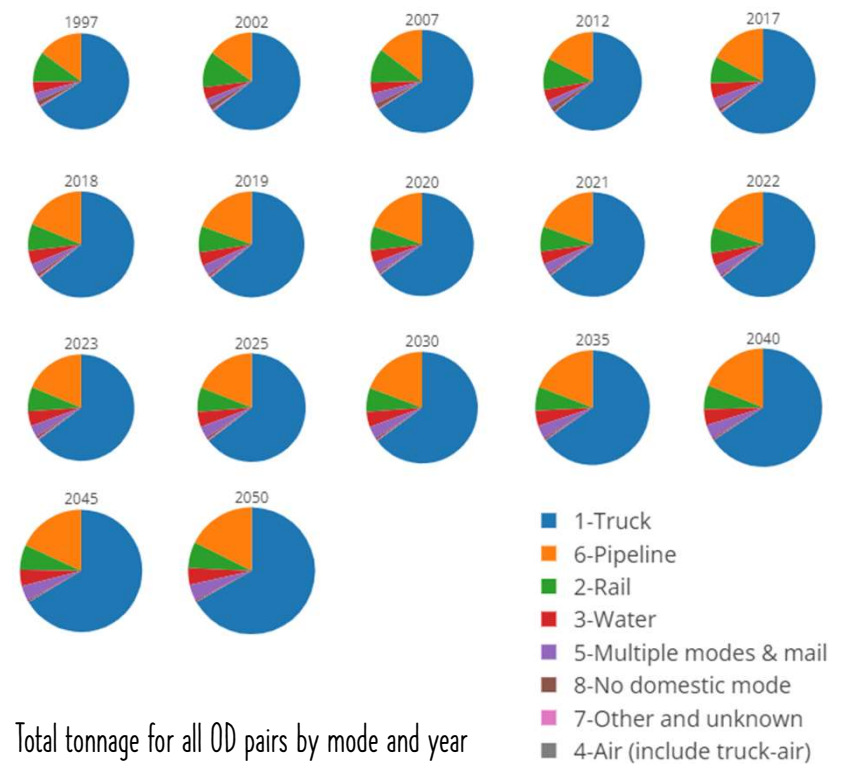
 The domestic destination is the FAF region or state where a freight movement ends the domestic portion of shipment. For exports, this is the US exit region where an export leaves United States.

Mode & Distance:

Display output labels as descriptive (e.g., descriptive: '1-truck' vs numeric: '1'): ☒

Generate Tables and Charts

Apply filters

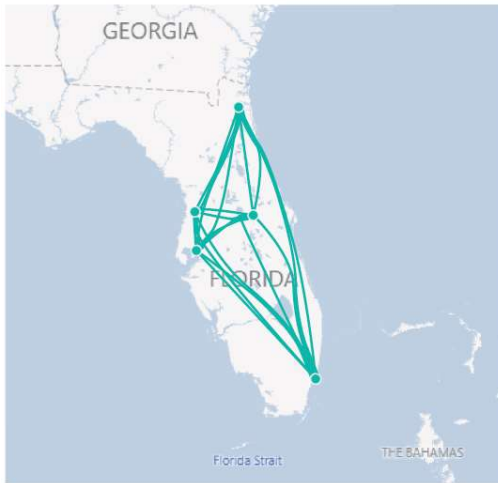


Total tonnage for all OD pairs by mode and year

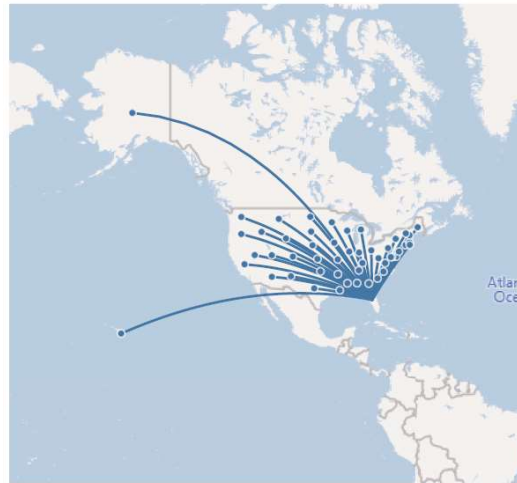
VISUALIZE FREIGHT FLOWS ON POWER BI

- Power BI is a data visualization software product developed by Microsoft.
- An interactive report was created using Power BI to visualize 2017 and 2050 FAF flows in Florida.

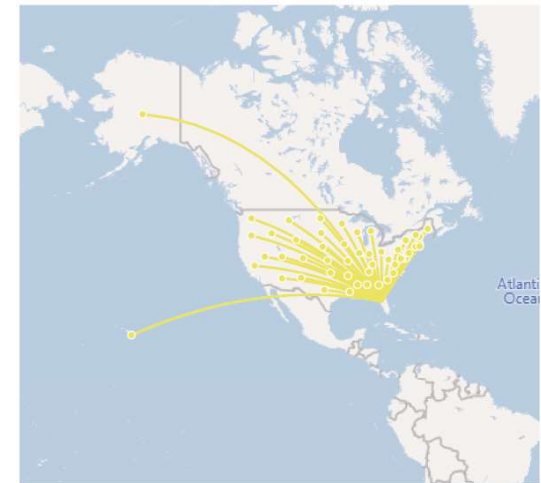
Within Florida (Tonnage/Value)



Out of Florida (Tonnage/Value)



Into Florida (Tonnage/Value)



Select flow type



2017 Base Year and 2050 Future Year FAF Flows -- Tonnage (unit: thousand tons) (Within Florida by Commodity and by Mode)

Commodity
(click to select one or more commodities)

Mode
(click to select one or more modes)

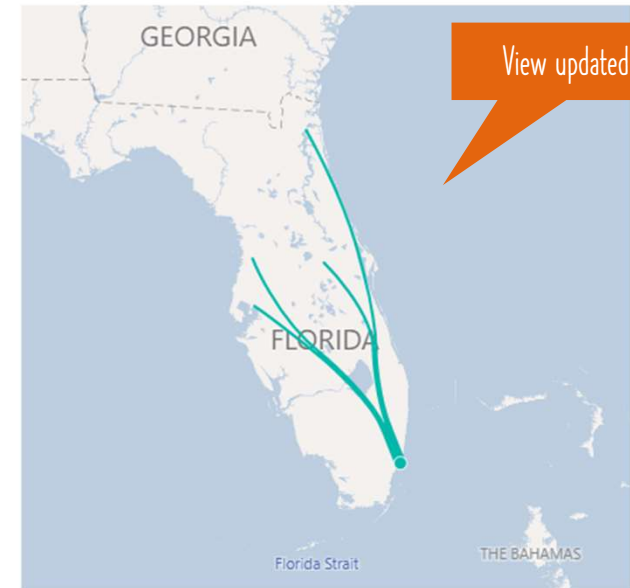
All

All

Apply filters

Highlight OD pairs of interest

Links	Origin	Destination	Tons 2017	Tons 2050
129_122	Rest of FL	Miami FL	17,975.54	49,347.20
129_123	Rest of FL	Orlando FL	39,636.52	22,313.47
129_124	Rest of FL	Tampa FL	28,700.29	37,473.47
129_129	Rest of FL	Rest of FL	167,636.44	231,849.46
123_121	Orlando FL	Jacksonville FL-GA CFS...	1,591.26	5,283.92
123_122	Orlando FL	Miami FL	3,937.76	7,730.65
123_123	Orlando FL	Orlando FL	39,381.74	80,048.00
123_124	Orlando FL	Tampa FL	10,834.00	9,148.79
123_129	Orlando FL	Rest of FL	5,923.64	18,594.10
122_121	Miami FL	Jacksonville FL-GA CFS...	2,535.52	4,521.77
122_122	Miami FL	Miami FL	159,521.63	212,371.15
122_123	Miami FL	Orlando FL	3,441.03	8,213.73
122_124	Miami FL	Tampa FL	11,193.06	8,325.44
122_129	Miami FL	Rest of FL	12,724.34	38,697.31
121_121	Jacksonville FL-GA CFS...	Jacksonville FL-GA CFS...	27,718.79	54,873.92
121_122	Jacksonville FL-GA CFS...	Miami FL	4,859.12	7,292.55
121_123	Jacksonville FL-GA CFS...	Orlando FL	3,114.69	5,836.39
121_124	Jacksonville FL-GA CFS...	Tampa FL	2,222.52	4,605.35



View updated map

VISUALIZE FREIGHT FLOWS ON POWER BI

WHAT IS NEW? (FAF 4 VS FAF 5)

- Mode Assignment

2017 CFS (the main data source for FAF 5) estimated transfer points based on commodity, volume, and distance. Commodity type was not considered in estimating the transfer point in 2012 CFS (the main data source for FAF 4).

- Commodity codes

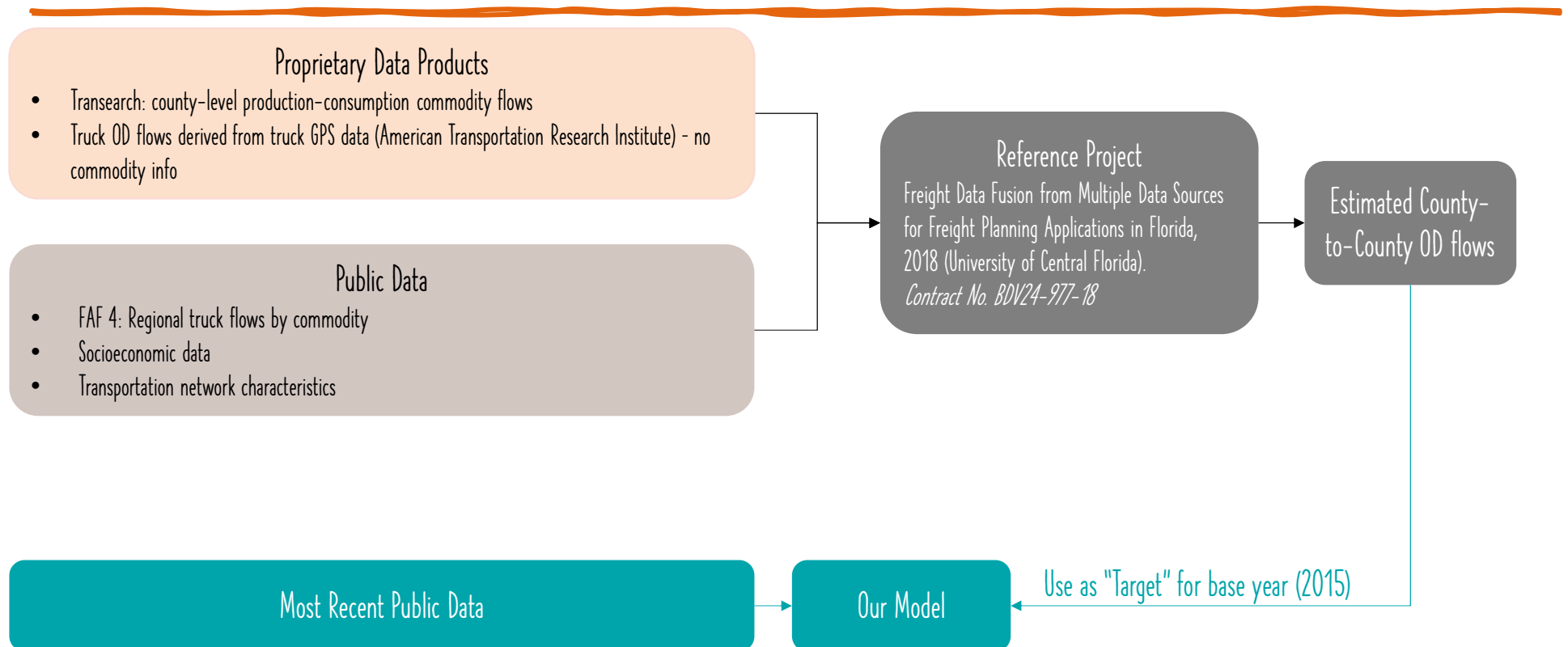
A machine-learning technique was utilized to input commodity codes, where the respondent provided a description of the product, but not an actual Standard Classification of Transported Goods (SCTG) code. With this SCTG input effort, the 2017 CFS, and consequently the associated FAF 5 data, contain more shipment data for some commodities in their records than prior FAF data.

Mode	FAF 4 (Year 2045) Mid-Range Estimates		FAF 5 (Year 2050) Mid-Range Estimates	
	Tonnage (thousand tons)	Value (million dollars)	Tonnage (thousand tons)	Value (million dollars)
Grand Total	760,877	844,813	948,390	950,813
Air (includes Truck-Air)	79	9,998	57	3,449
Multiple Modes & Mail	5,076	40,222	26,609	140,712
Other and Unknown	202	3,554	277	3,625
Pipeline	1,353	1,482	44,335	11,314
Rail	23,805	2,445	35,039	9,218
Truck	715,564	769,909	840,376	778,343
Water	14,798	17,204	1,697	4,153

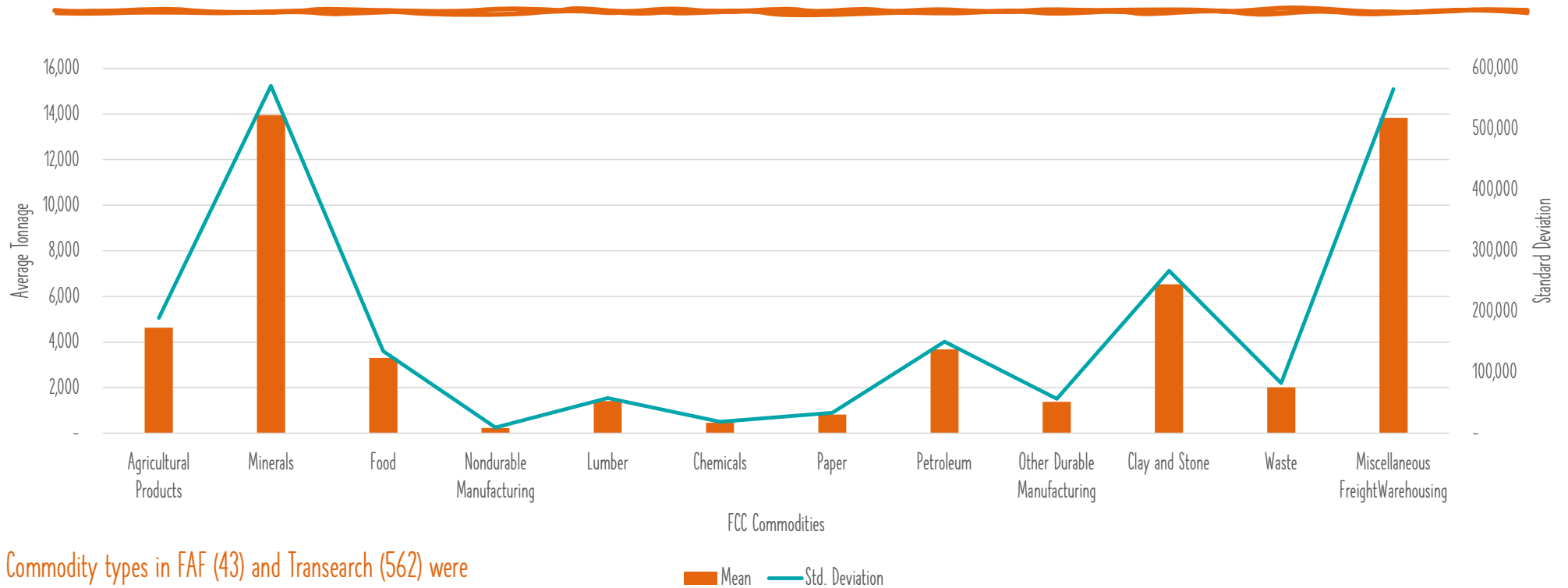
DEVELOP DISAGGREGATED FLOWS USING
FAF DATA



OUR MODEL



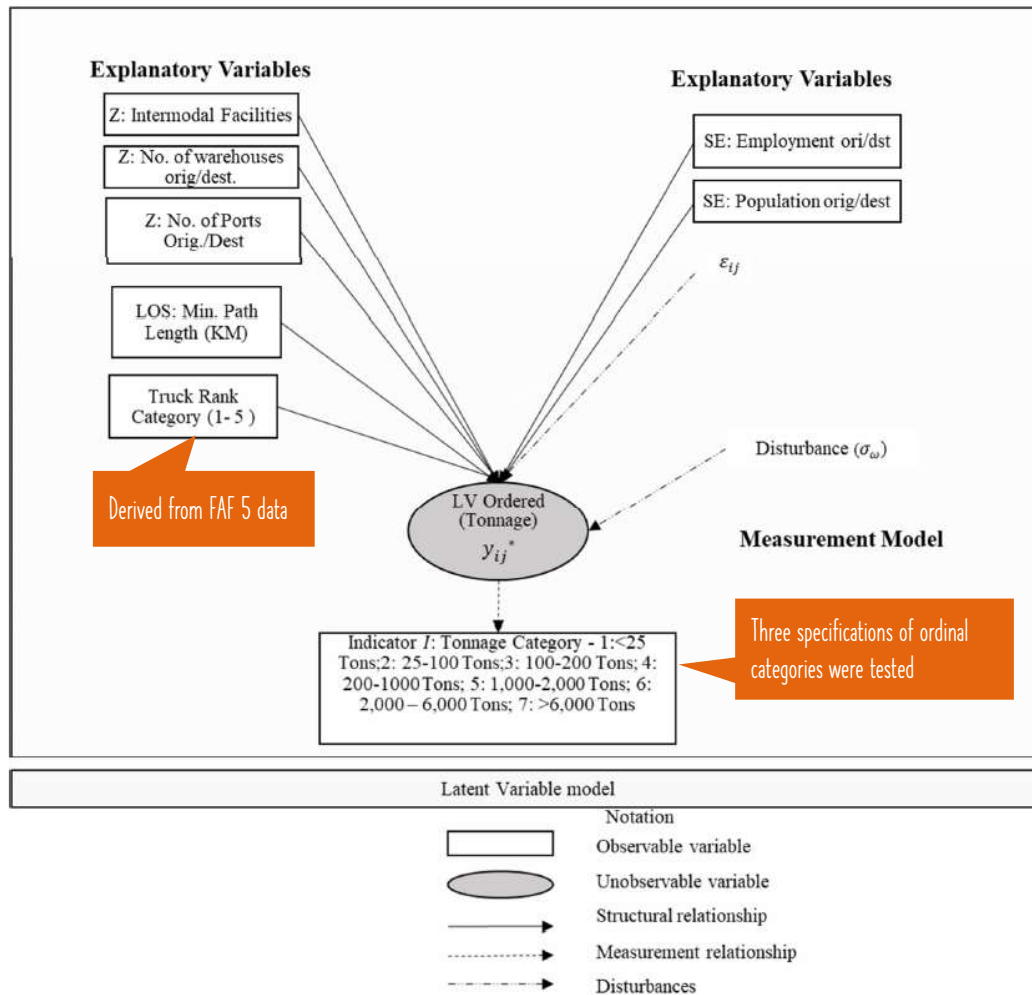
DISTRIBUTION OF TARGET DATA



Commodity types in FAF (43) and Transearch (562) were converted into comparable classifications.

MEAN AND STANDARD DEVIATION PER FLORIDA COMMODITY CLASSIFICATION (FCC)

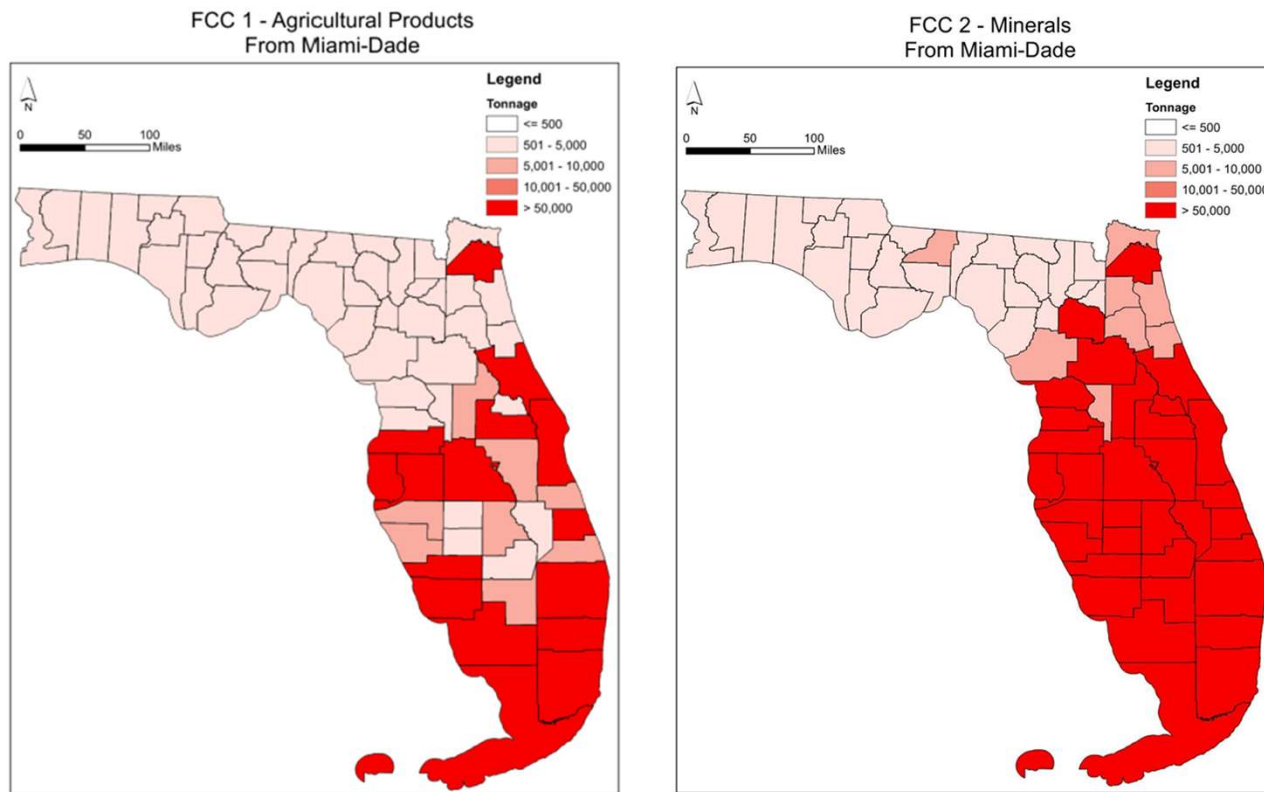
ANALYTICAL FRAMEWORK



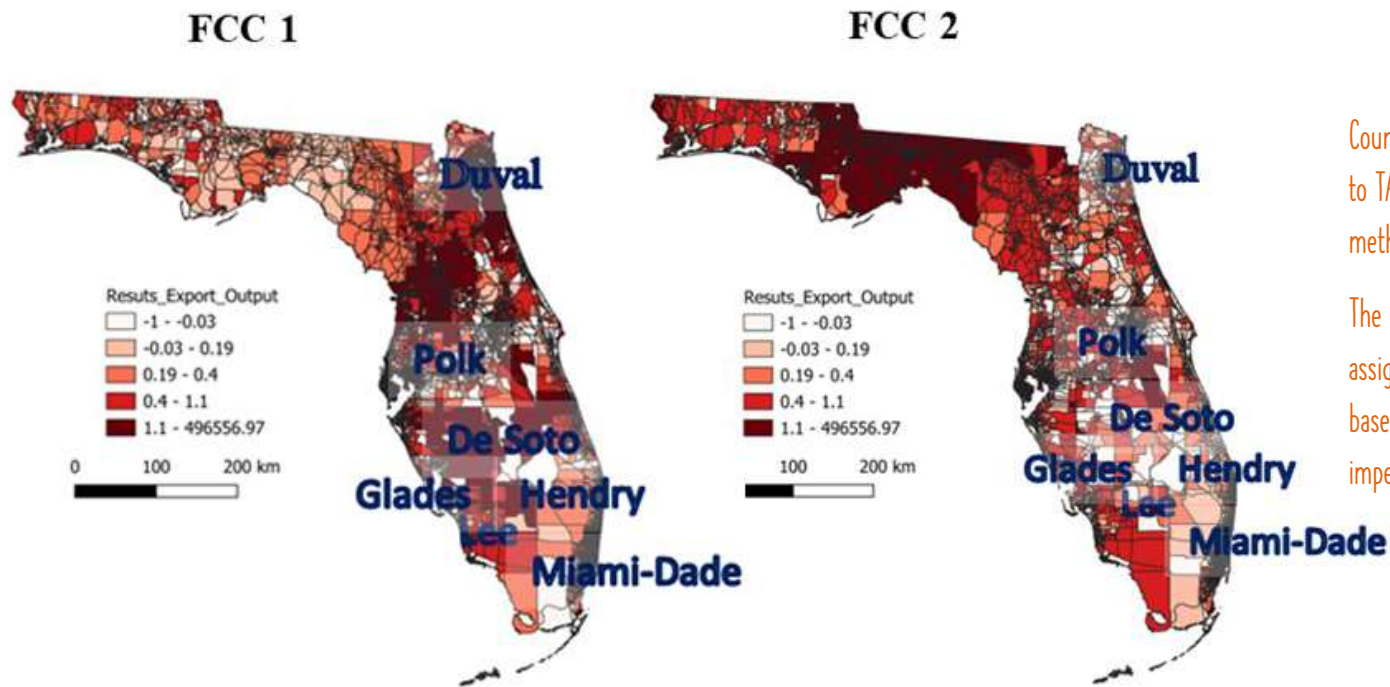
LATENT ORDERED MODEL

- A latent ordered model contains latent variables with ordered-categorical (ordinal) indicators. Latent variables can only be inferred indirectly through a mathematical model, based on observable variables.
- Model was estimated using Biogeme - a Python package designed for various models using maximum likelihood estimation (MLE). MLE is a method of estimating the parameters of a statistical model, by finding the parameter values that maximize the likelihood of making the observations.

ESTIMATED COMMODITY FLOWS BY ORIGIN/DESTINATION COUNTY



ESTIMATED COMMODITY FLOW CHANGE (2020-2050) BY TAZ



County-to-county flows were disaggregated to TAZ level using fractional split estimation method from the reference project.

The fraction of county-to-county flow assigned to each TAZ OD pair was estimated based on population, employment, and travel impedance.

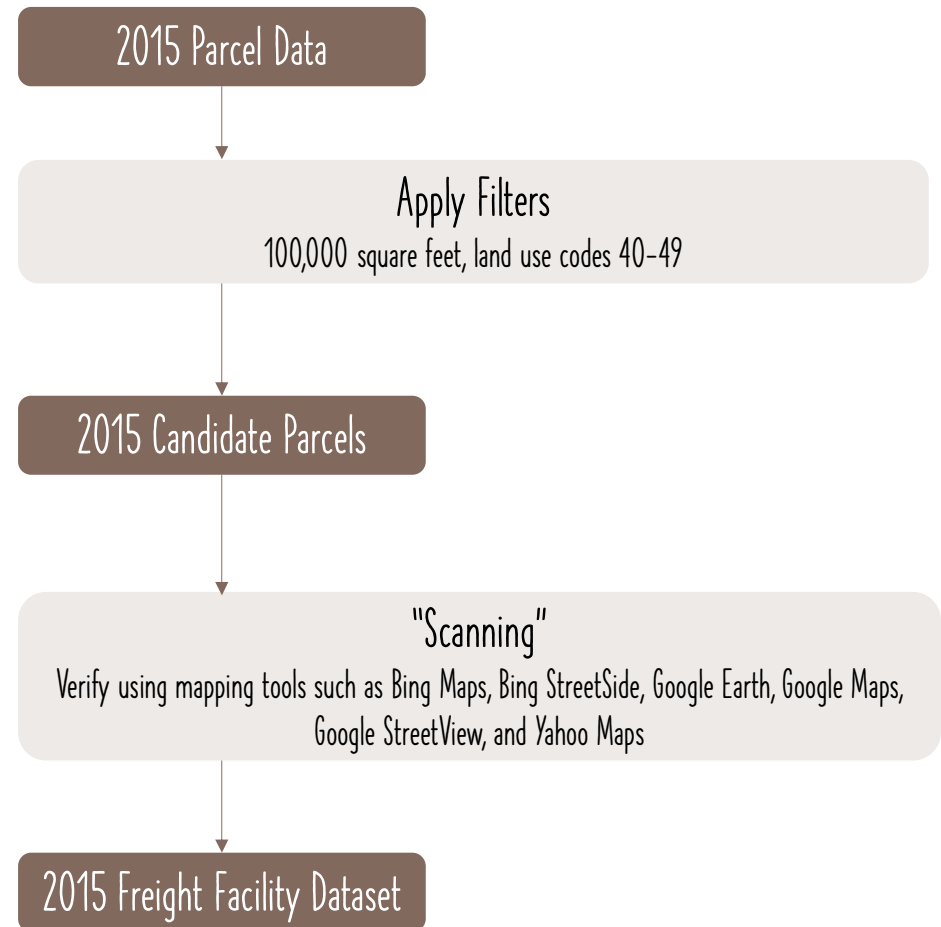
DATA GAPS FOR ESTIMATING FIRST-
MIDDLE- AND LAST-MILE E-COMMERCE
FLOWS



IDENTIFY ORIGINS/DESTINATIONS

The FDOT Freight Facility Dataset is a statewide dataset of large-scale freight facilities developed by the Transportation Data and Analytics Office. This dataset identifies large freight facilities used in the "distribution of consumer and other goods that generate moderate to high levels of truck traffic", thus could be used to identify primary origins and destinations for freight flows.

Freight Facility Dataset 2015 is the current dataset, but it can be updated using the latest parcel data.

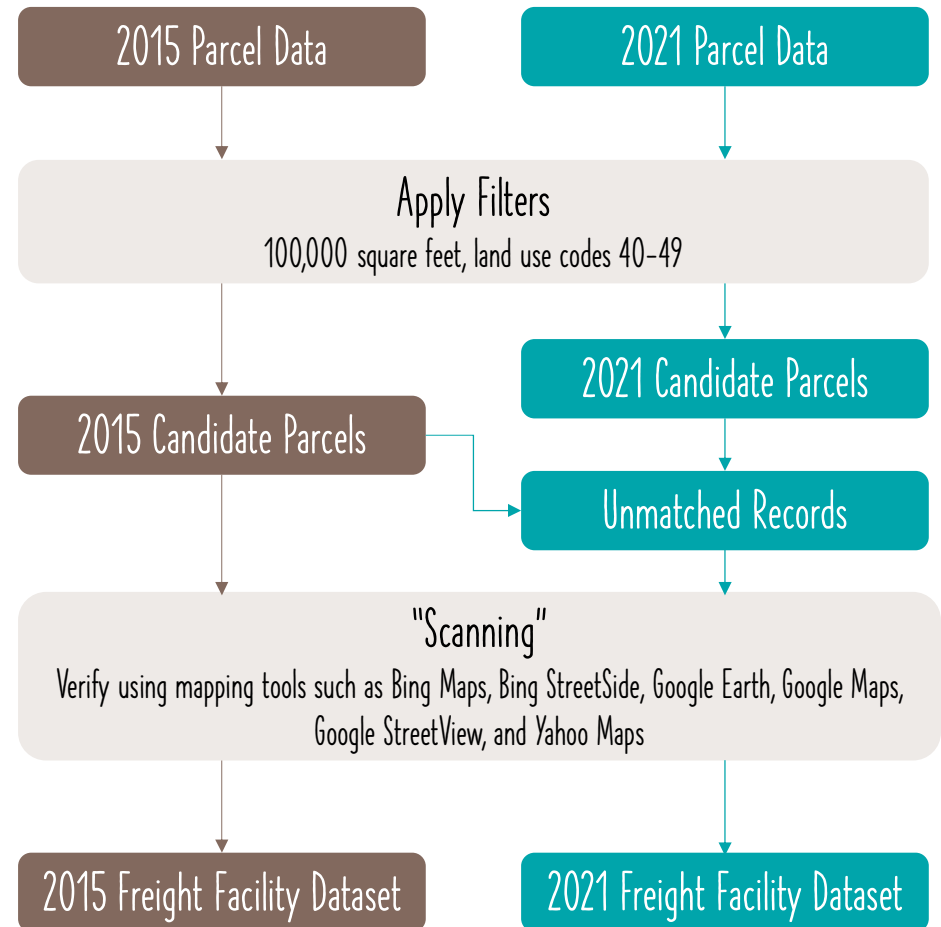


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Public data sources identified



TRUCK MOVEMENT DATA

FAF/CFS Data (Public):

- Disaggregating regional flows to local level is not feasible
- Used for validation or as supplementary input data

Truck GPS Data (e.g., ATRI):

- American Transportation Research Institute (ATRI) data is from freight shipping companies, and **proprietary**.
- Can be used to develop truck OD trips (e.g., 2014 Project: BDK84-977-20)
- To provide confidentiality of data, ATRI does not provide information such as commodity carried, weight or volume carried, purpose of travel, and the type of truck. Thus, other data sources are also needed, e.g.: Truck counts at FDOT TMSs, Weight-in-Motion data, FAF/CFS.

THANK YOU

Presented by



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