OpenPaths AGENT

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OpenPaths™ AGENT

OpenPaths AGENT is a modern platform to assemble, calibrate and apply travel demand models. It includes everything needed for trip-based, tour-based and activity-based demand modeling.

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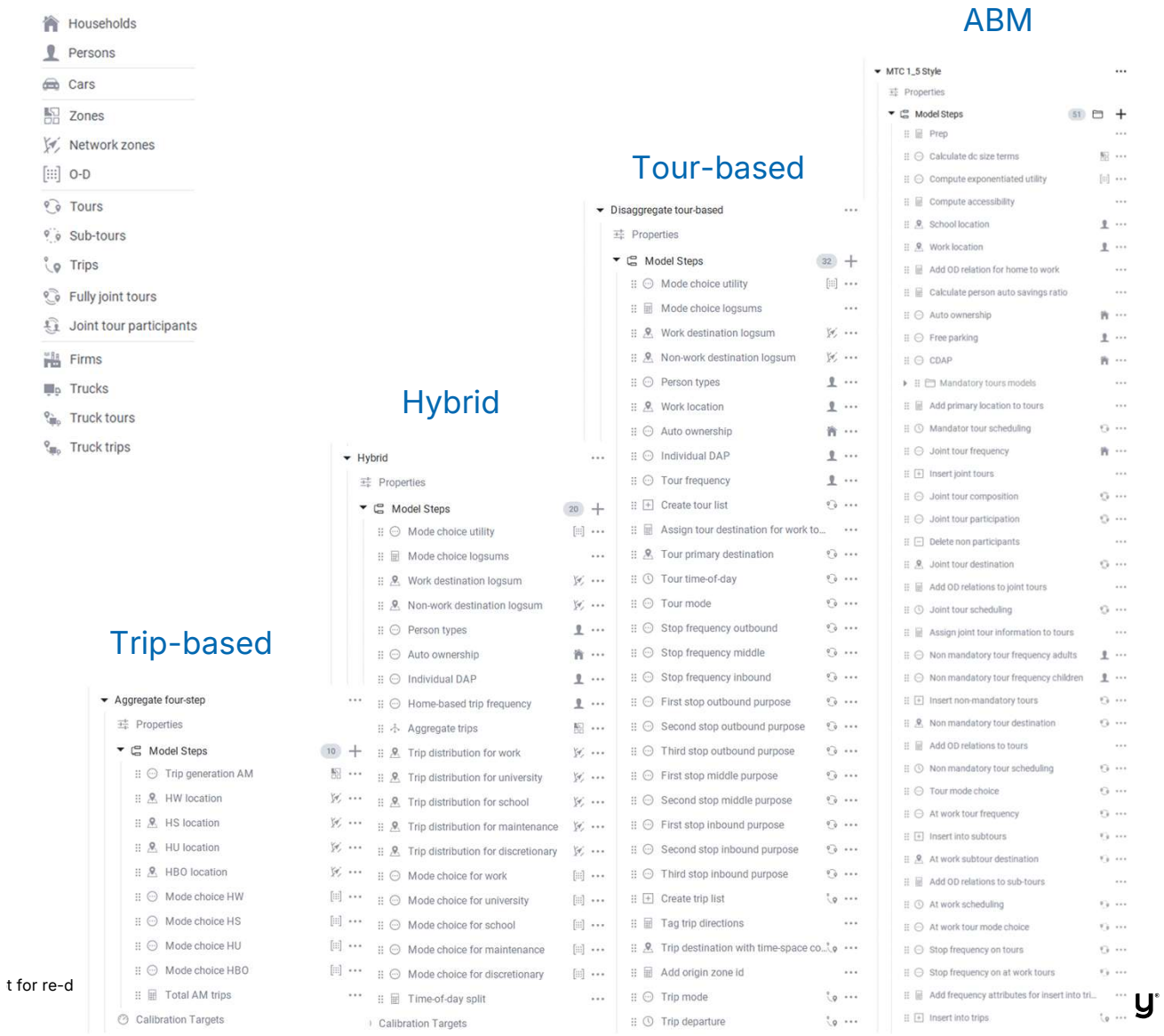
One Model Platform, Many Models

- Assemble virtually any travel demand model structure including trip-based, tour-based, hybrid and activity-based (ABM) models
- Maintain different models or versions in parallel
- Reduce time/effort to develop a new travel model
- Adapt or upgrade models with advanced features over time



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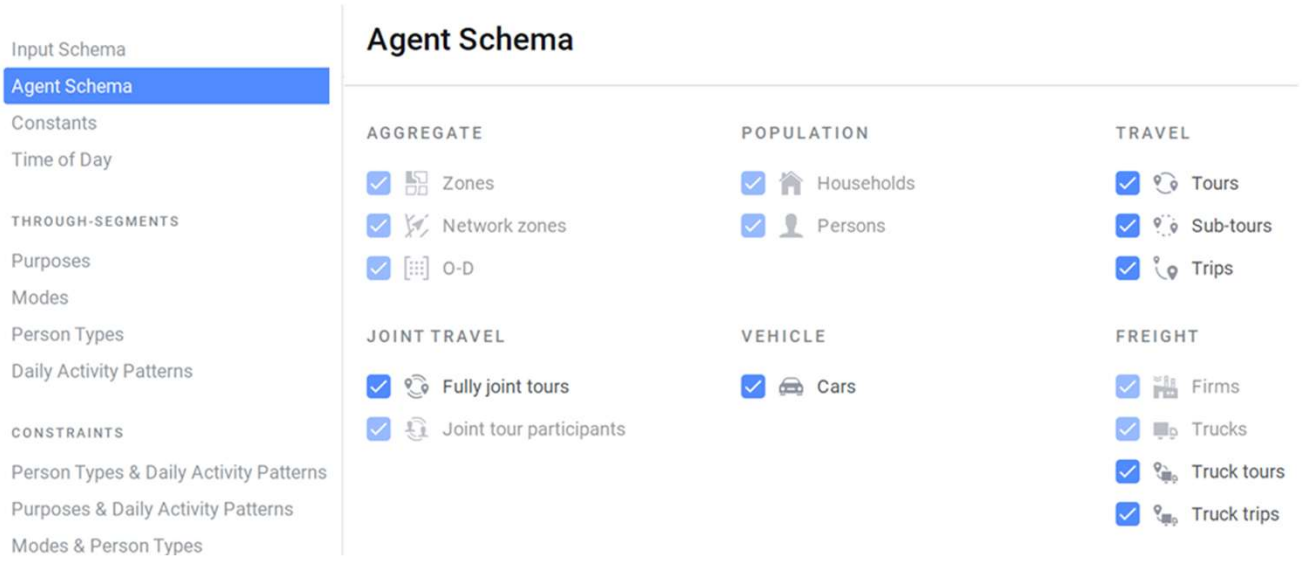

A flexible data schema lets you work natively with tours, sub-tours, trips, households, persons and more

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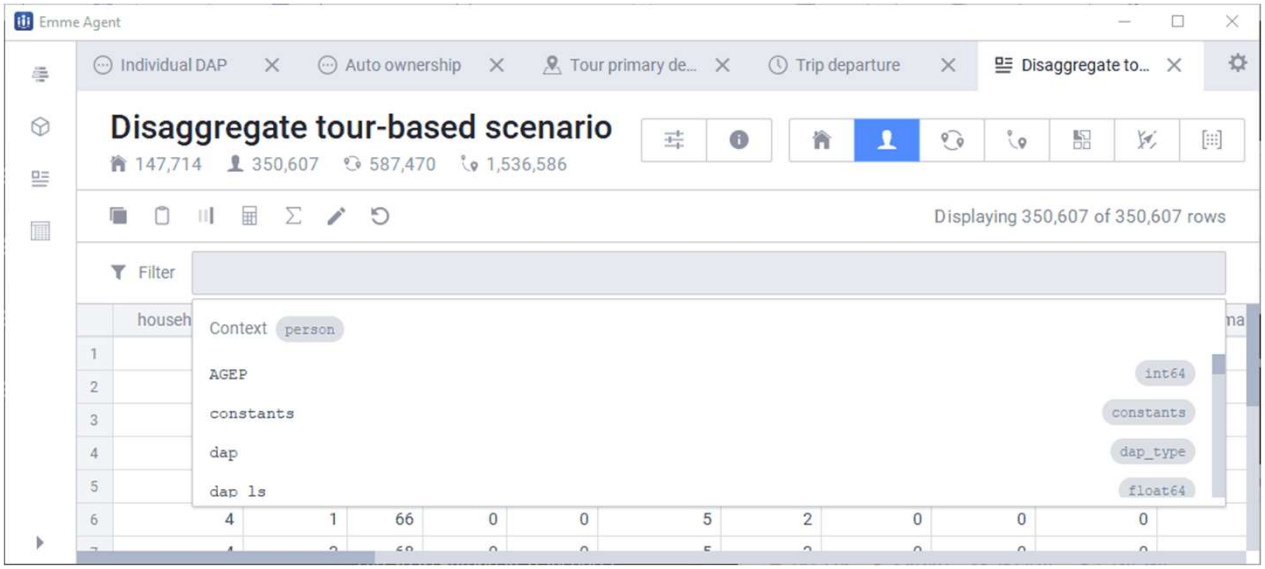

Expressions with auto-complete give context and relational data access for model configuration and analysis

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Automated Calibration for any model or data

- Machine learning approach for better calibration results than manual calibration
- Accelerates model calibration work
- Enables data fusion from multiple sources
- Modellers stay in control with transparency on the adjustments
- Equally applicable to four-step and ABMs

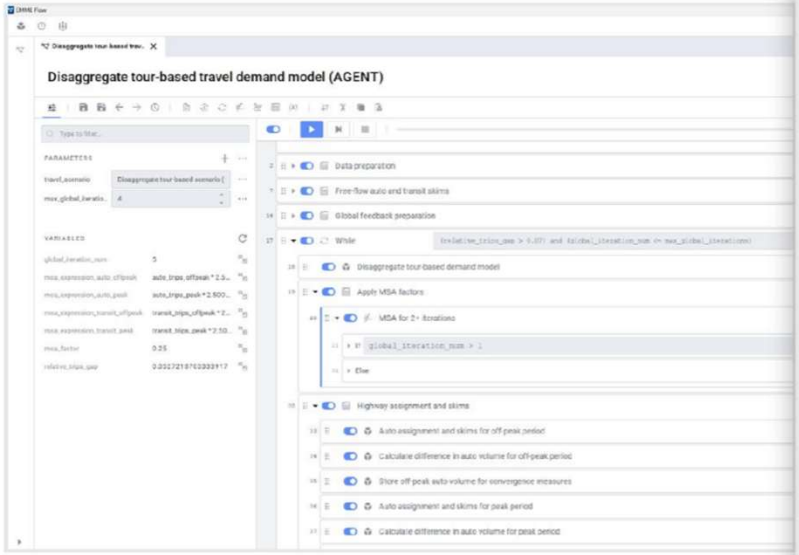
A simultaneous model calibration procedure fuses together disparate mobility data sources and considers the entire model system

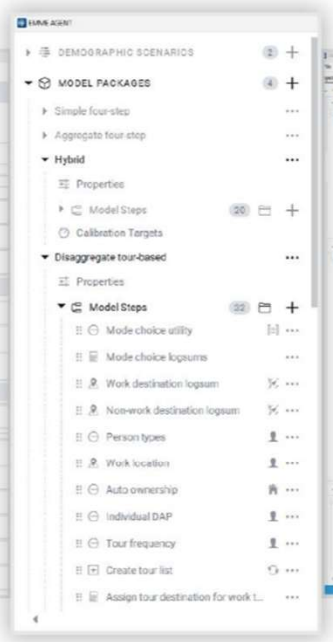
Harmonized Demand Modeling with OpenPaths

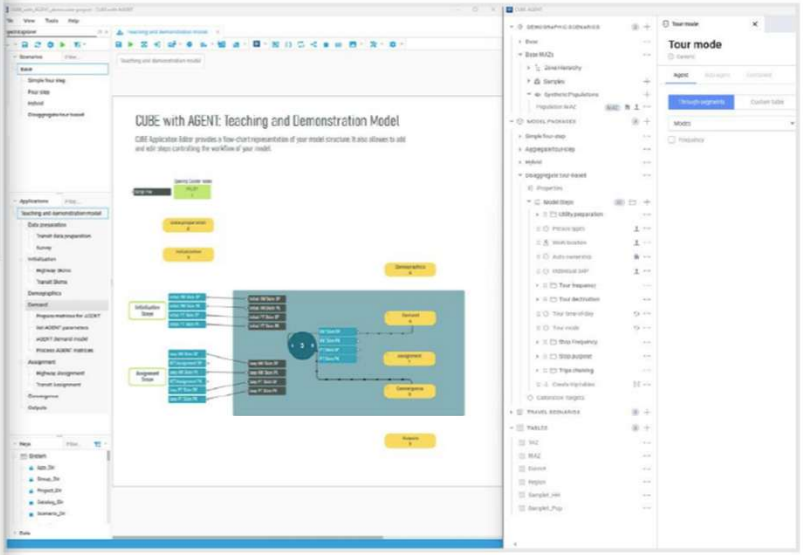
OpenPaths™ AGENT®

OpenPaths™ EMME®

OpenPaths™ CUBE™







Leverage EMME features like Modeler, APIs, Notebooks, Scenes, and Flow with AGENT.

Leverage CUBE features like Application Manager, Scenario Manager, and Voyager with AGENT.

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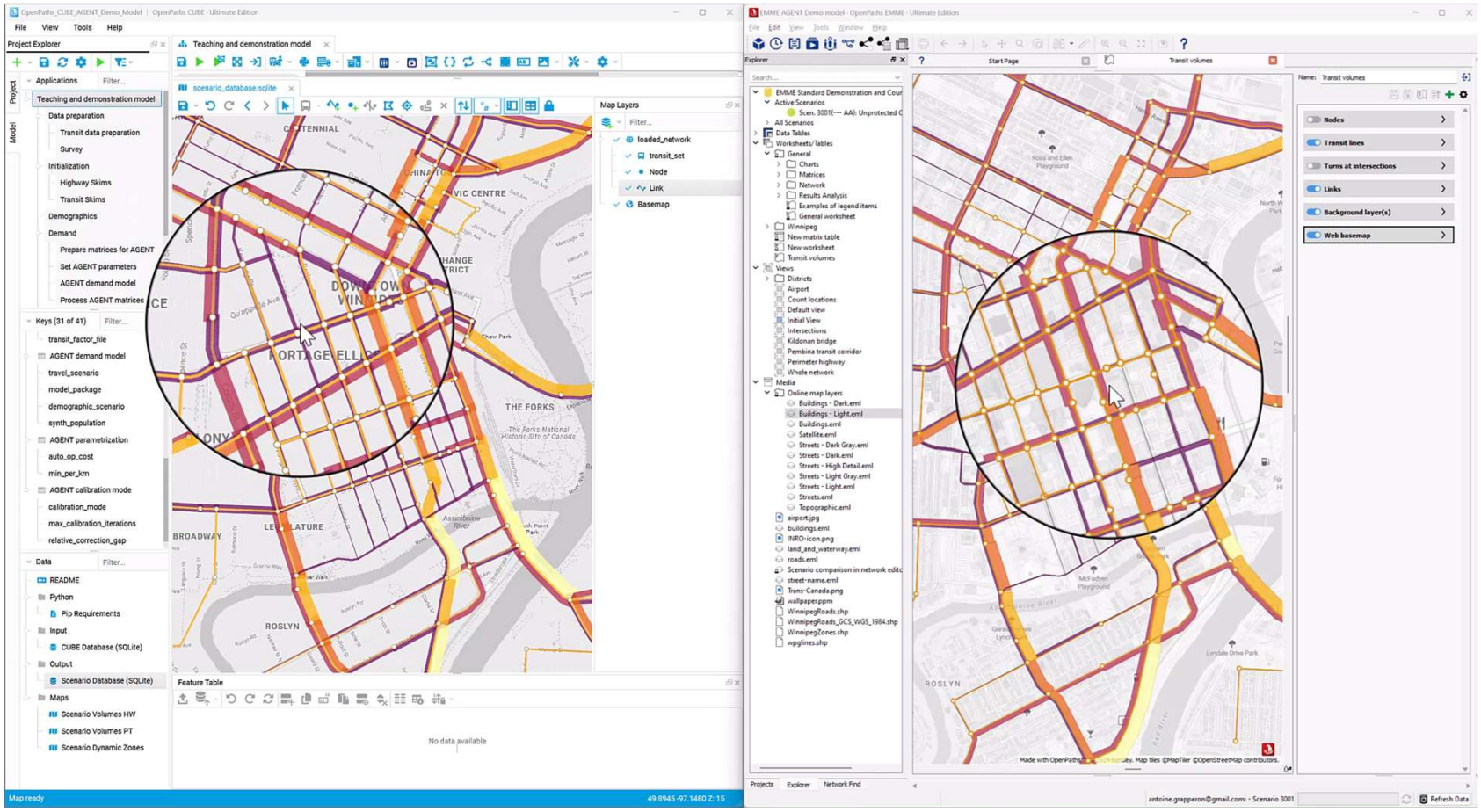
Harmonized Demand Modeling with OpenPaths

OpenPaths CUBE ***OpenPaths EMME***



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Selected recent applications

MAG Weekend Model Model type: State-of-practice ABM Population: 5M Runtime*: 70 mins	**Houston-Galveston Area Council** Model type: Four-step Population: 7M Runtime*: 26 mins	**Ottawa Model** Model type: Disaggregate hybrid Population: 1.4M Runtime: 7 mins
Edmonton PTM Model type: Data-driven tour-based Population: 1.3M Runtime: 25 mins	**Perth ABM** Model type: State-of-practice ABM Population: 2M Runtime: 25 mins	**Perth TB-STEM** Model type: Simplified tour-based model Population: 2M Runtime: 15 mins
Quebec City Model type: Aggregate trip-based Population: NA (0.56M) Runtime: 1 min	**Singapore** Model type: Disaggregate tour-based Population: 5M Runtime: 35 mins	**Jerusalem** Model type: Hybrid trip-based Population: 4M Runtime: 2 mins
Queensland STM** Model type: State-of-practice ABM Population: 4M Runtime: 40 mins	**Chattanooga**** Model type: ABM Population: 450K Runtime: 4 mins	**Brighton** Model type: Disaggregate four-step Population: 3M Runtime: 7 mins

Runtime for 1 demand model run with 100% population on Intel® 2.4GHz, 20 cores, 32 GB RAM

* Intel® 2.8GHz, 32 cores, 128 GB RAM

** *PoC*

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Common Data Sources in Model Development

Household travel survey (HHTS) data

- Main source of disaggregate estimation
- But large-scale HHTS is expensive and difficult to recruit
- Even 3,000 – 5,000 households are becoming increasingly problematic

Other data sources include

- Traffic counts
- Transit ridership (APC, e-ticketing / smartcard, on-board survey)
- Primarily only used for model validation and manual calibration

“Big data” as a replacement?

Pros

- Becoming increasingly available from vendors
- “Big data” trip tables can be used to support aggregate 4-step models in practice

Cons

- Not behavioral (no details about trip purposes or individual attributes)
- No person ID to identify individual activity patterns
- Gap between aggregate data structure and disaggregate ABM structure

Reality of transportation industry

Enable the use of new data sources for model development

Central question
How can big data be used for model calibration?

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How is Big data used for manual calibration in practice so far?

Pre-processing of O-D level data to create sub-model specific targets:

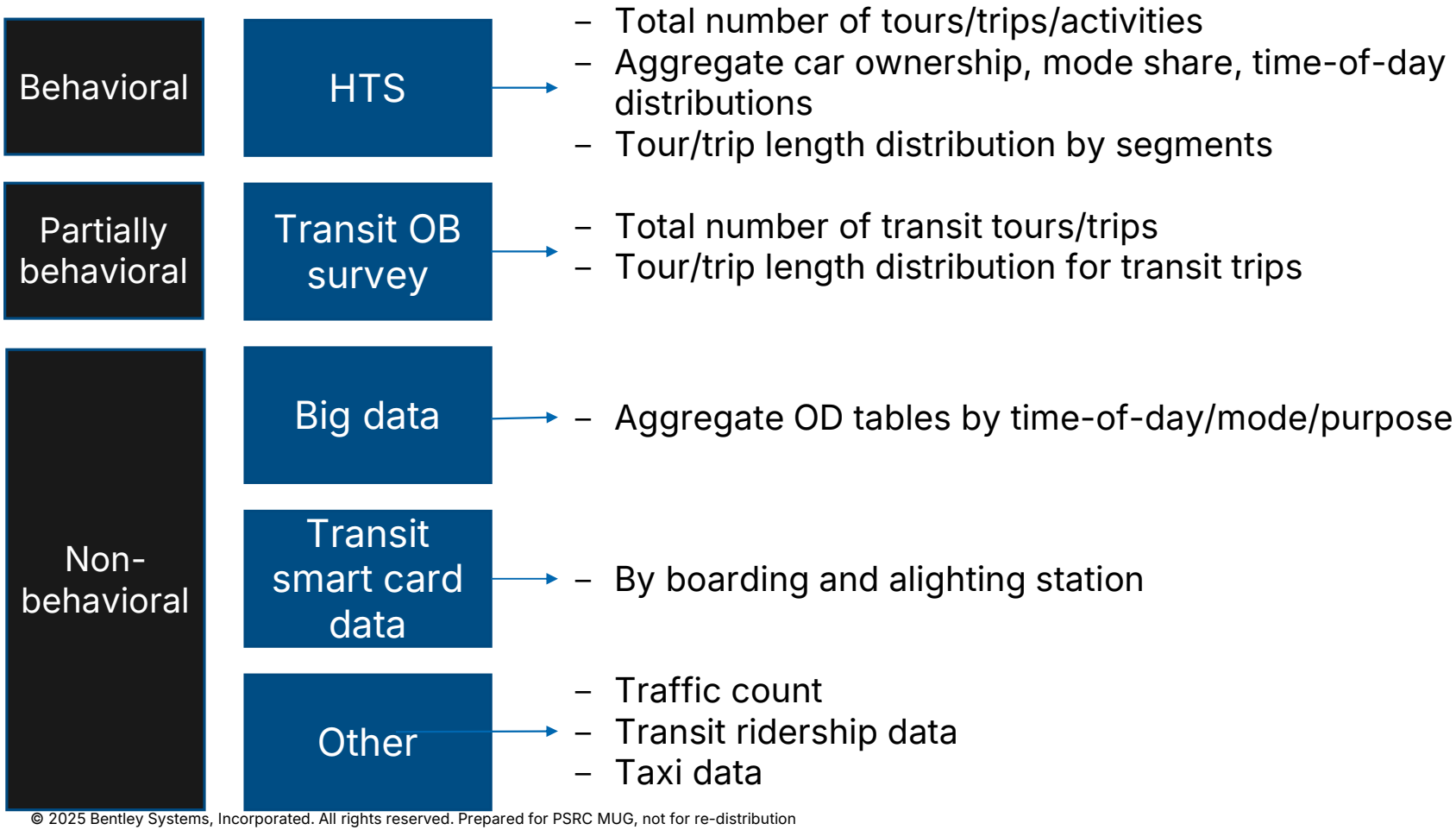
- For example: O-D total trips is typically processed to calculate target for trip destination model

No systematic approach to identify outliers

Our approach

- Use of O-D data directly for model calibration
- Data and model output are endogenously brought to common denominator
- No need to pre-process the data

Data Fusion



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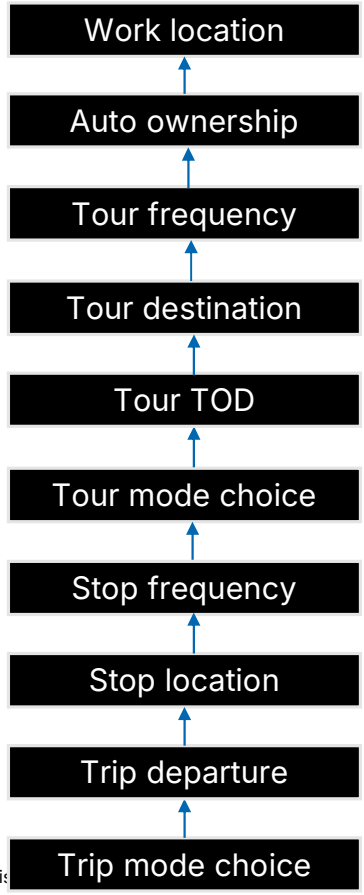
Calibration Instrumentation

Parameters

Q: Which parameter(s) should we adjust and how?

Demand Model



Target

Total walk trips

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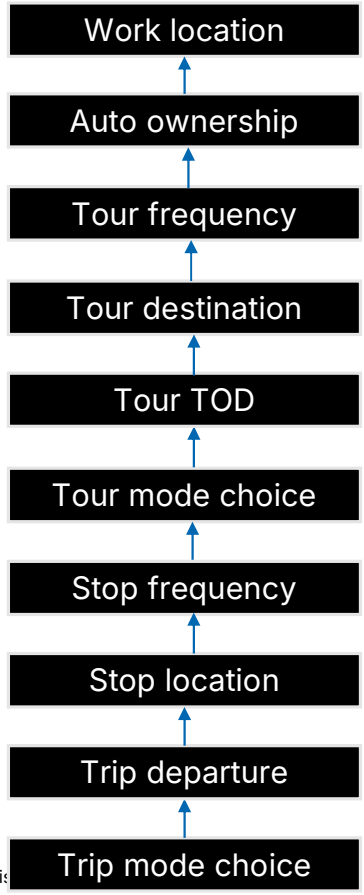
Calibration Instrumentation

Parameters

- Auto ownership constants
- Tour frequency constants
- Dispersion coefficient
- Mode choice constants
- Dispersion coefficient
- Mode choice constants

Demand Model



Target

Total walk trips

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Examples of OpenPaths AGENT Automated Calibration Application

Application	Types of data sources			
	Big data	Transit ridership or counts	Household Travel Survey	Traffic counts
Phoenix AZ, weekend model + truck model	X			X
Singapore regional model	X	X	X	X
Swedish National and regional models			X	
Lima, OH regional model	X		X	X
Romania National model		X	X	
Nanaimo, BC regional model			X	
Ottawa, ON regional model			X	X
Edmonton person travel model		X		X
Perth ABM			X	
Perth TB-STEM		X	X	X
HGAC regional model			X	X
Yorkshire Travel Model			X	
Queensland regional model		X		
Quebec City travel model		X		
Auckland, NZ	X	X		

Selected application examples

MAG Weekend Model

CT-RAMP1 model structure

Calibration targets

- Weekend activity rates
- Big data O-D tables
- Traffic counts by time-periods

Chattanooga ABM PoC

DaySim model structure

Calibration Targets

- Household travel survey
- OpenPaths Patterns Big data

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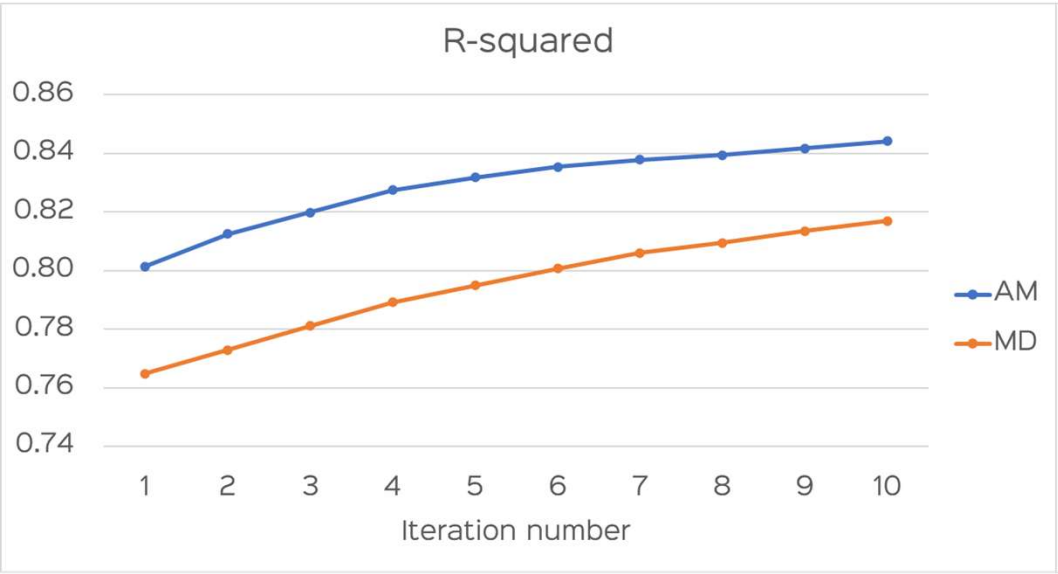
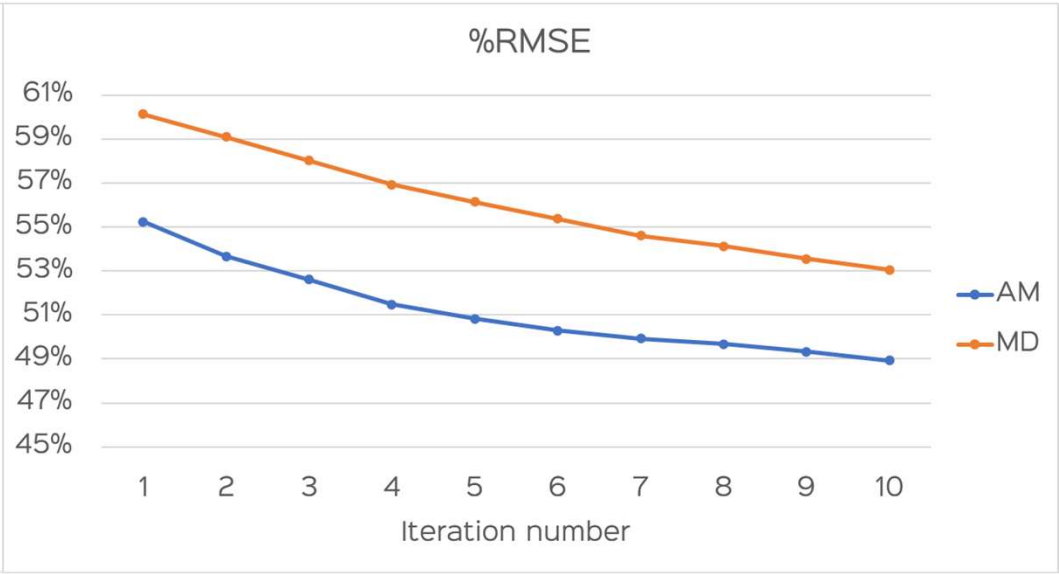
MAG Weekend model: Comparison of Link Level Traffic Counts





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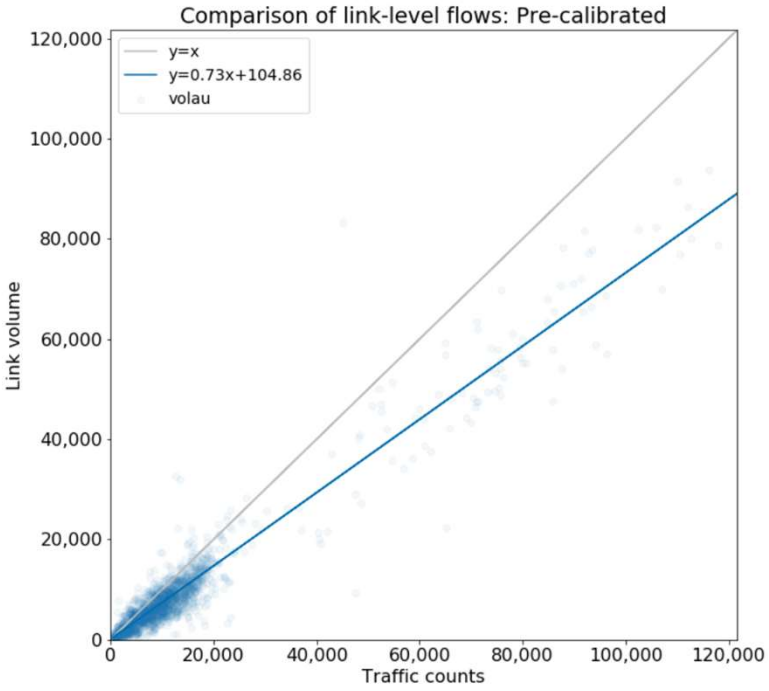
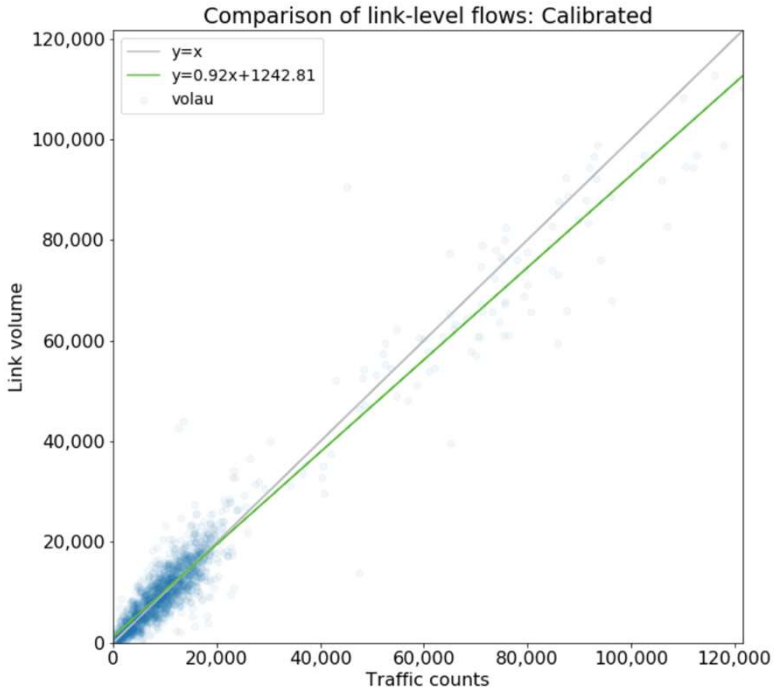
MAG Weekend model: Validation at link level
Target: Daily Traffic counts



Slope: 0.73, Rsq: 0.83, %RMSE: 50%



Slope: 0.92, Rsq: 0.93, %RMSE: 32%

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MAG Weekend model: Example of calibration coefficients

Traffic counts were connected to non-mandatory tour frequency model

- Configured to affect the coefficient on number of tours by purpose

Calibrated coefficients

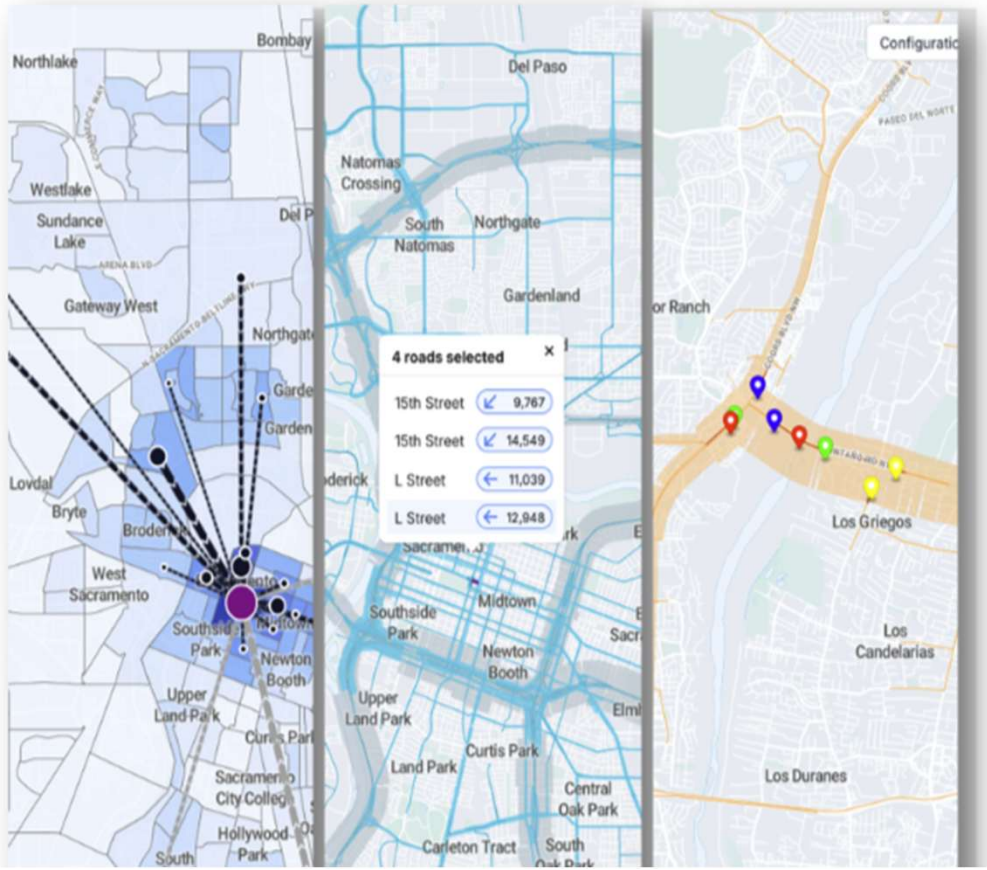
Tour purpose	Coefficient
Shopping	0.077
Maintenance	0.069
Eat-out	0.129
Visiting	0.124
Discretionary	0.100

Chattanooga ABM PoC: Calibration to OpenPaths Patterns

OpenPaths Patterns
Mobility Data and Analytics

OpenPaths Patterns is a web-based mobility data and analytics application for transportation analysts to harness the power of big-data for better decision-making.

Understand where, when, and how people travel anywhere in the United States.



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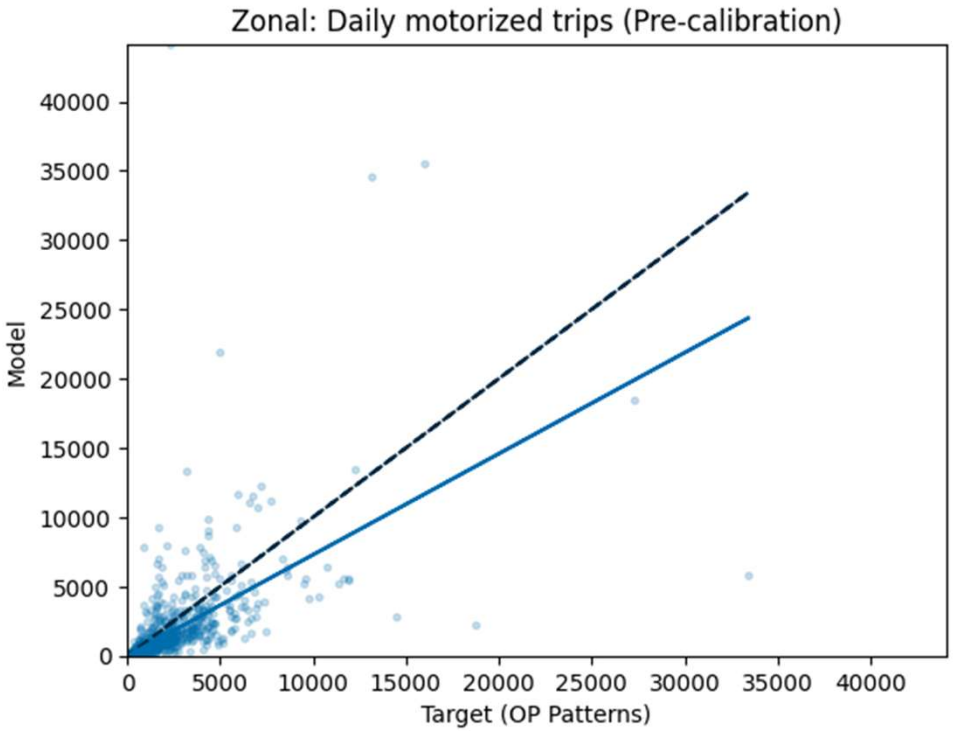
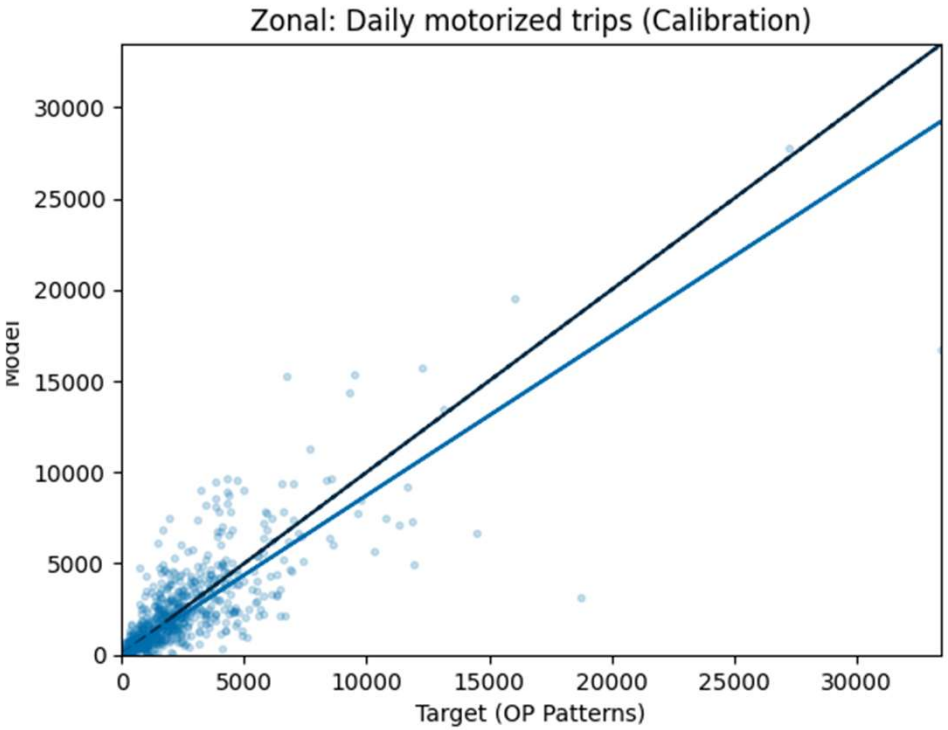
Chattanooga: Zonal attraction comparison with OP Patterns



Y = 0.73x, Rsq = -0.15



Y = 0.87x, Rsq = 0.59

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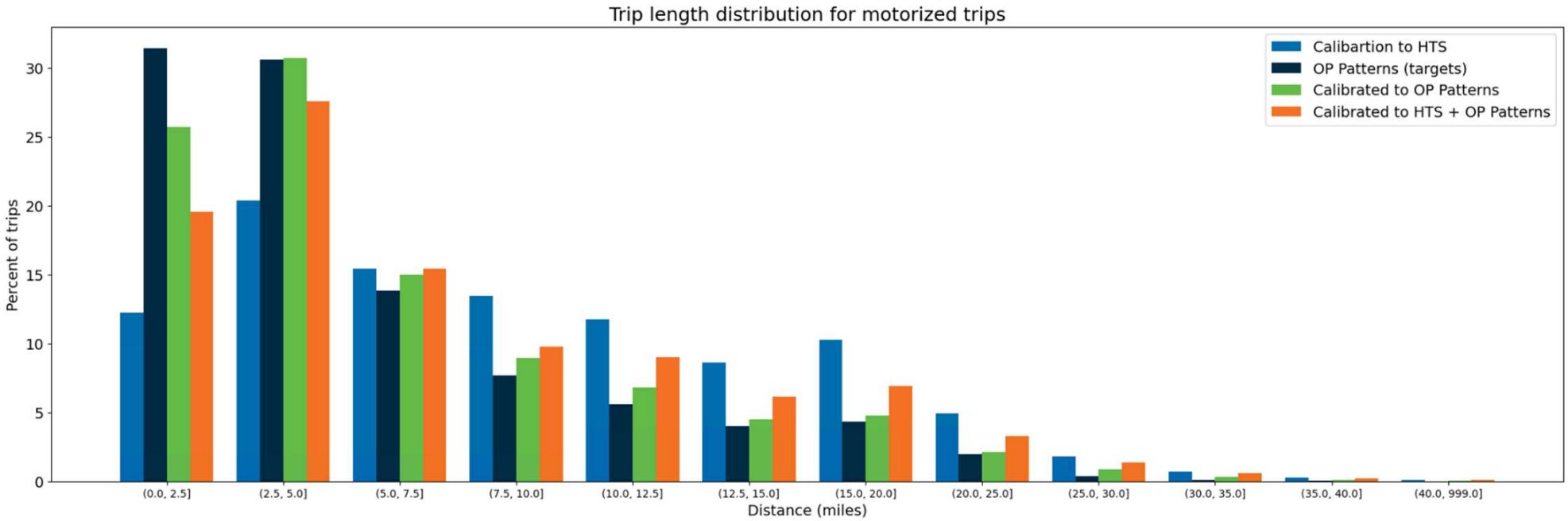
Chattanooga: Trip length distribution - Calibration to HTS + OP Patterns



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Chattanooga: Model Steps Affected by OP Patterns

Type of Step	Model Step	Total Daily Daily	Daily Periods
Mode Choice & Generation	Calculate mode utilities	☐	☐
	Calculate non-mandatory size terms	☐	☐
	Calibrate mandatory size terms	☑	☐
Location Decisions	School and university location	☑	☐
	Work location	☑	☐
Tour & Trip Structure	Auto ownership	☑	☐
	Individual day pattern	☑	☐
	Exact number of tours	☑	☐
	Other tour destination	☑	☐
	Work based sub-tour generation	☑	☐
	Tour mode choice	☑	☐
Time of Day & Scheduling	Tour time-of-day	☑	☑
	At-work destination	☑	☐
	At-work mode choice	☑	☑
	At-work scheduling	☑	☑
	Stop frequency outbound	☑	☐
	Stop frequency inbound	☑	☐
	Stop frequency outbound at-work	☑	☐
	Stop frequency inbound at-work	☑	☐
	Trip destination	☑	☐
	Outbound trip scheduling	☑	☑
	Inbound trip scheduling	☑	☑
	Outbound trip scheduling at-work	☑	☑
	Inbound trip scheduling at-work	☑	☑
	Trip mode	☑	☑

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Automated Calibration: Outcomes

1. All travel model simulation results are consistent with the data used in the automated calibration process

2. All data sets are validated against a common travel model structure
   - Fuse various data sources together, including O-D targets, traffic counts, and others

3. Because the modellers select the coefficients to adjust, the calibrated model is applicable even for forecasting

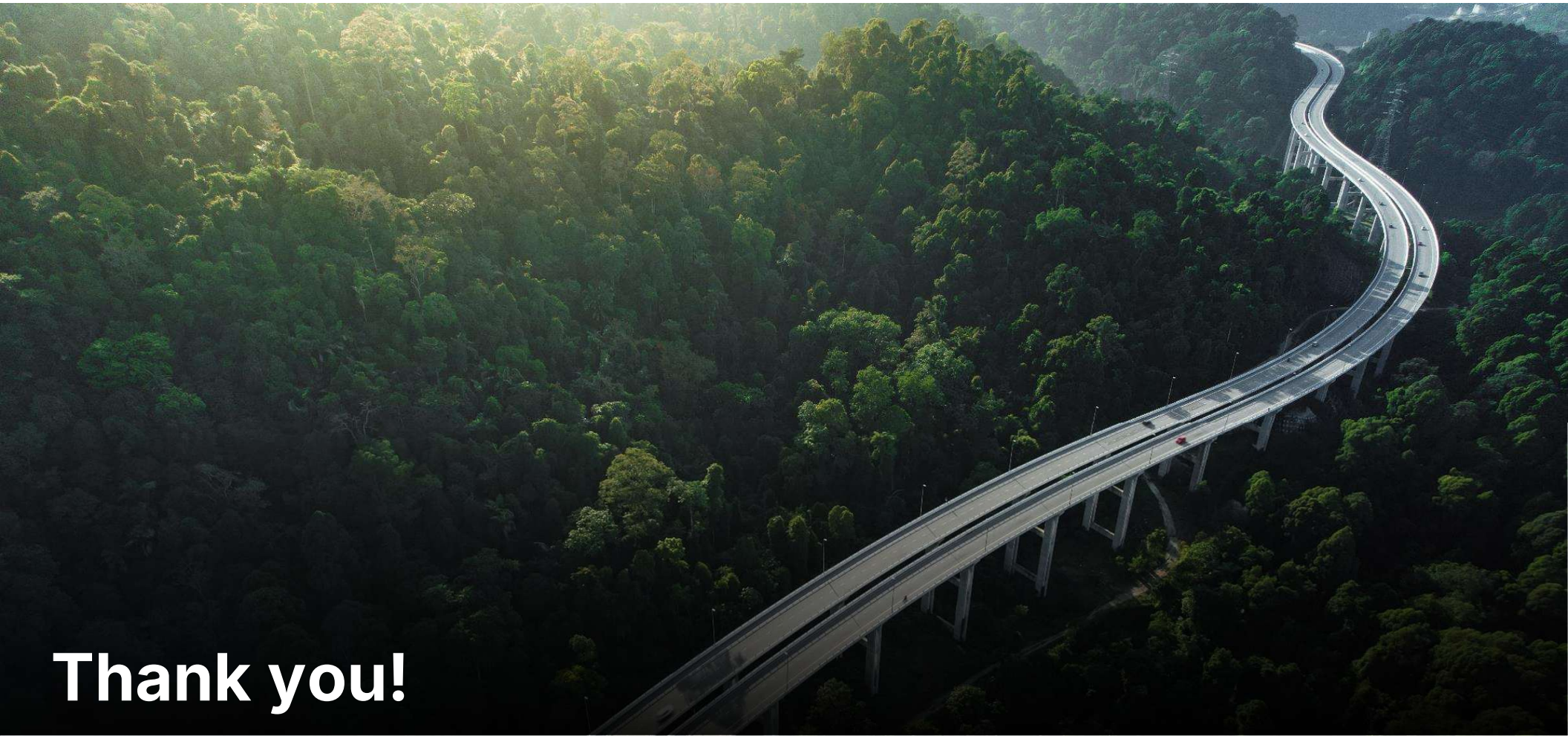
4. Transferring model from one region to another is made easier by automated calibration using local data

Transferability

Three options to get started:

1. Choose a pre-configured model in OpenPaths AGENT and transfer it to your region
2. Re-configure your regional model to OpenPaths AGENT
3. Assemble an entirely new model using OpenPaths AGENT

Calibrate the travel demand model using local targets using automated calibration procedure



Thank you!

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