

Exploring New Model Workflows with OpenPaths

Atlanta Model Users Group Meeting



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OpenPaths Applications



Idea 1 - Explore integrated CUBE < > EMME model workflows

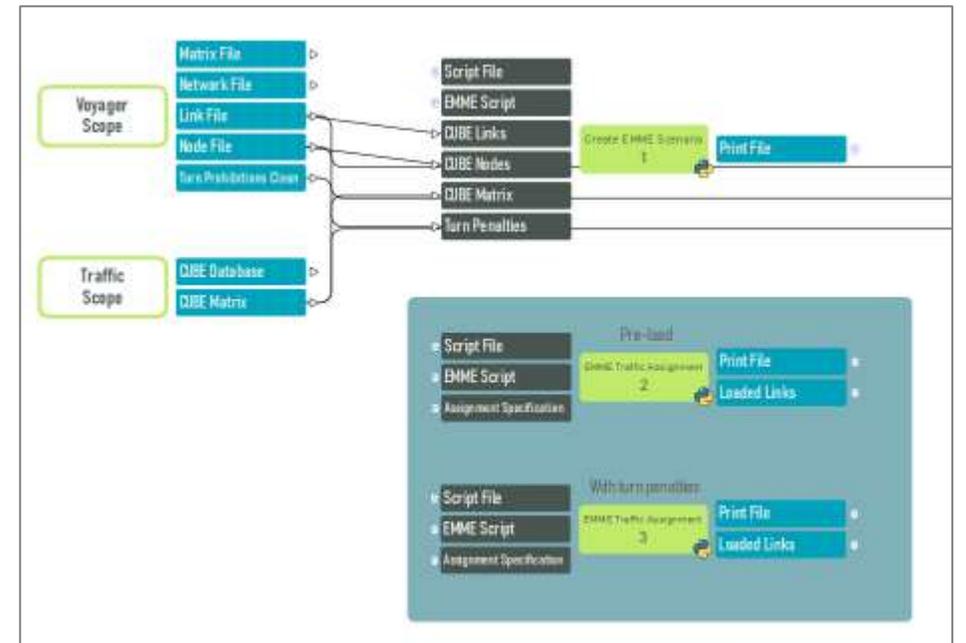
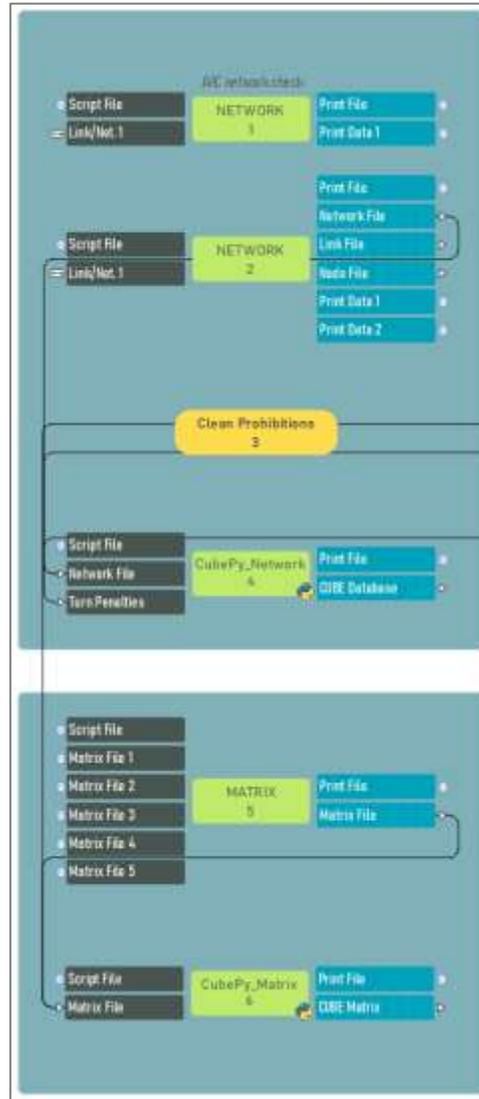
Possible to integrate EMME in CUBE workflows

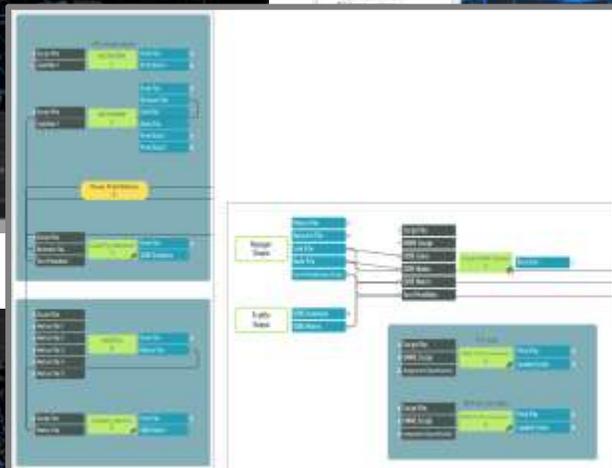
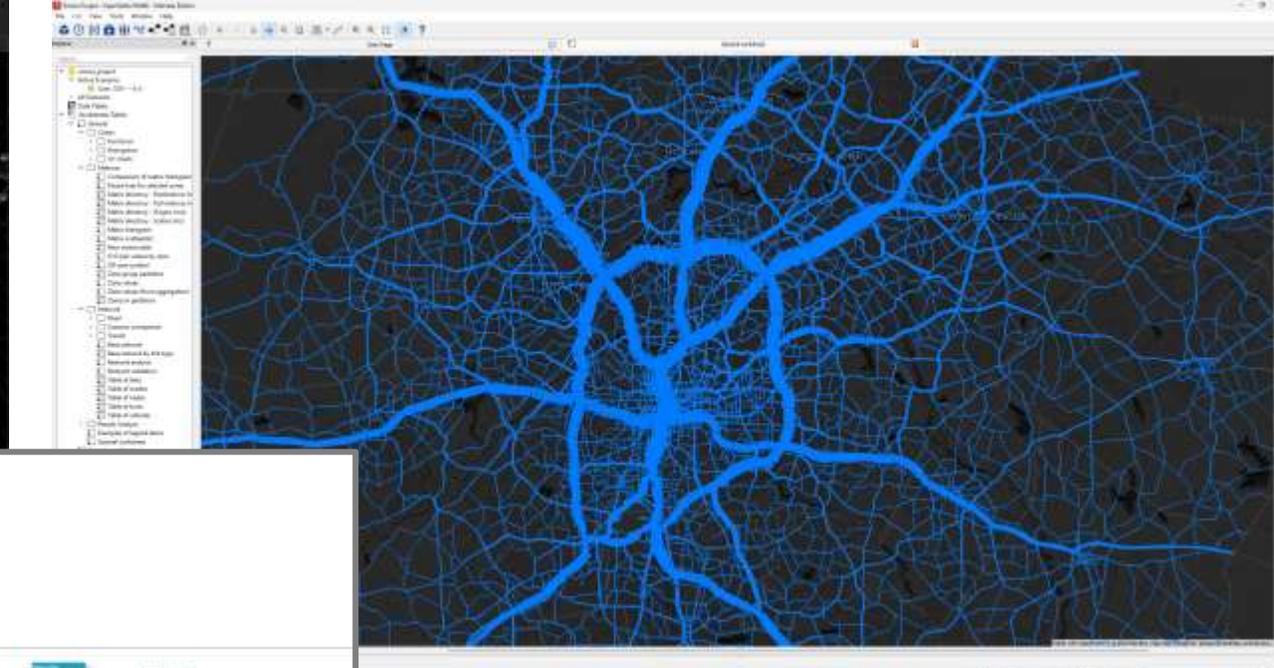
Data interoperability

1. Transfer CUBE data to EMME
2. Access EMME APIs from CubePy program box
3. Consolidate results in CUBE

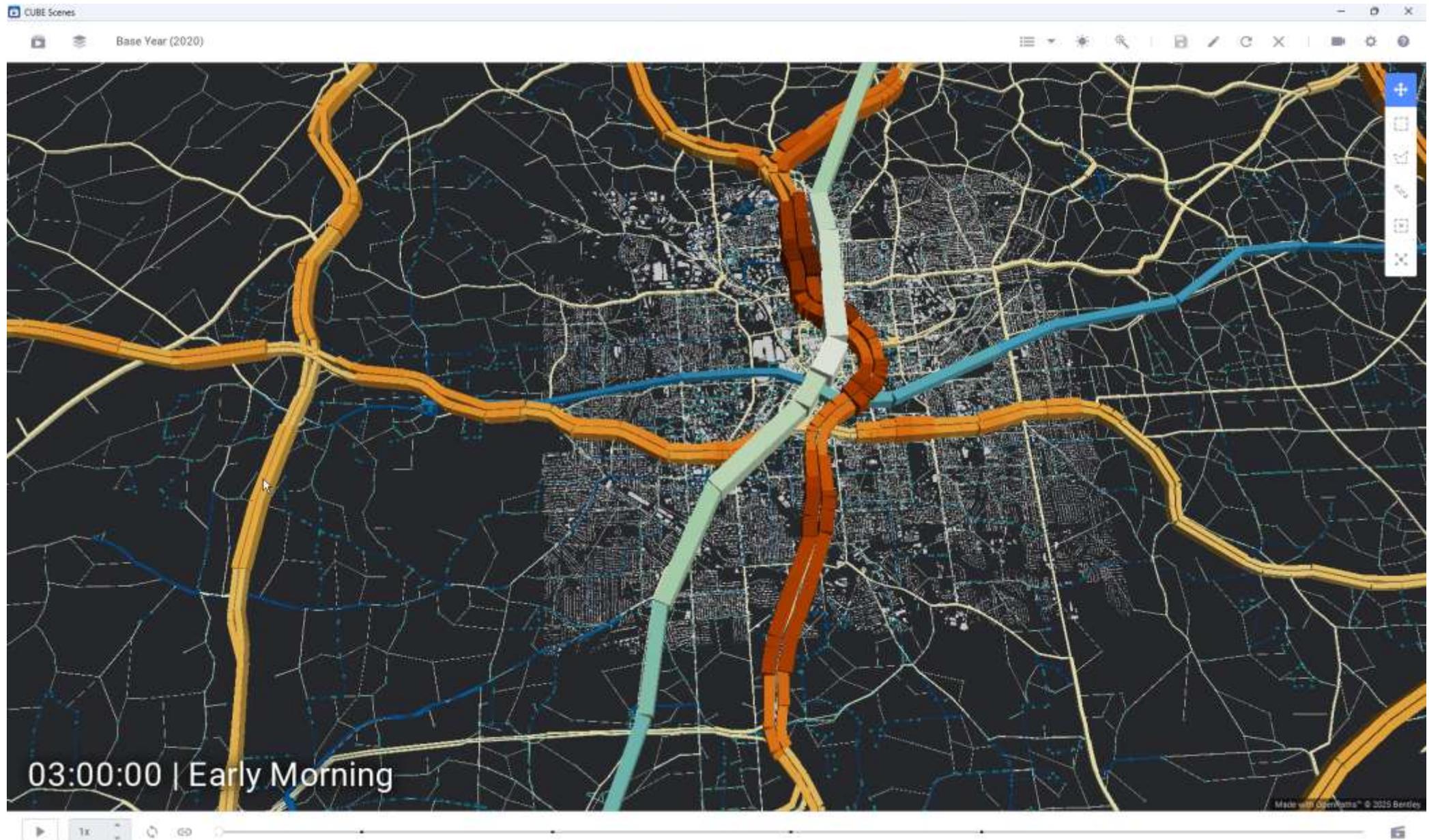
Works with CUBE Application Manager and batch scripts

Allows to explore traffic and transit assignments and other licensed functionality



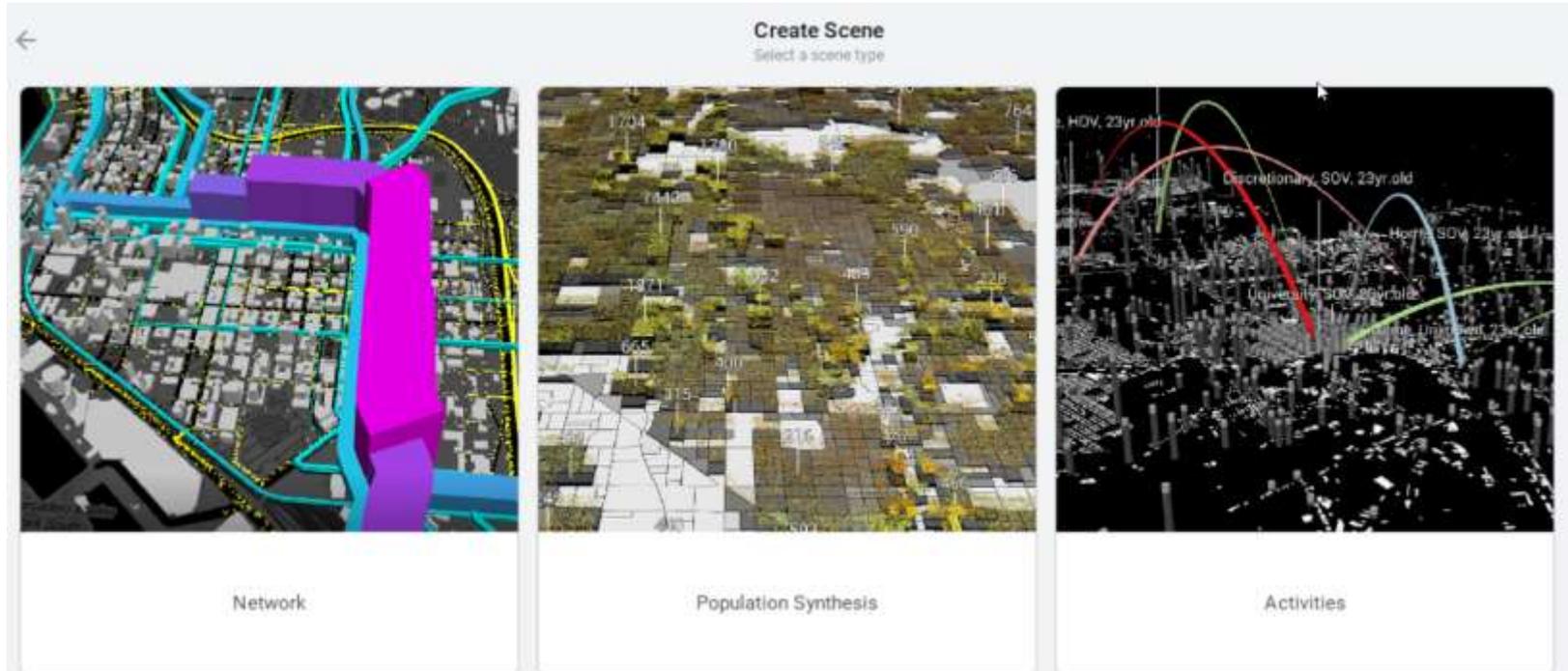


Idea 2 – Visualize Network Results with the Network Scene

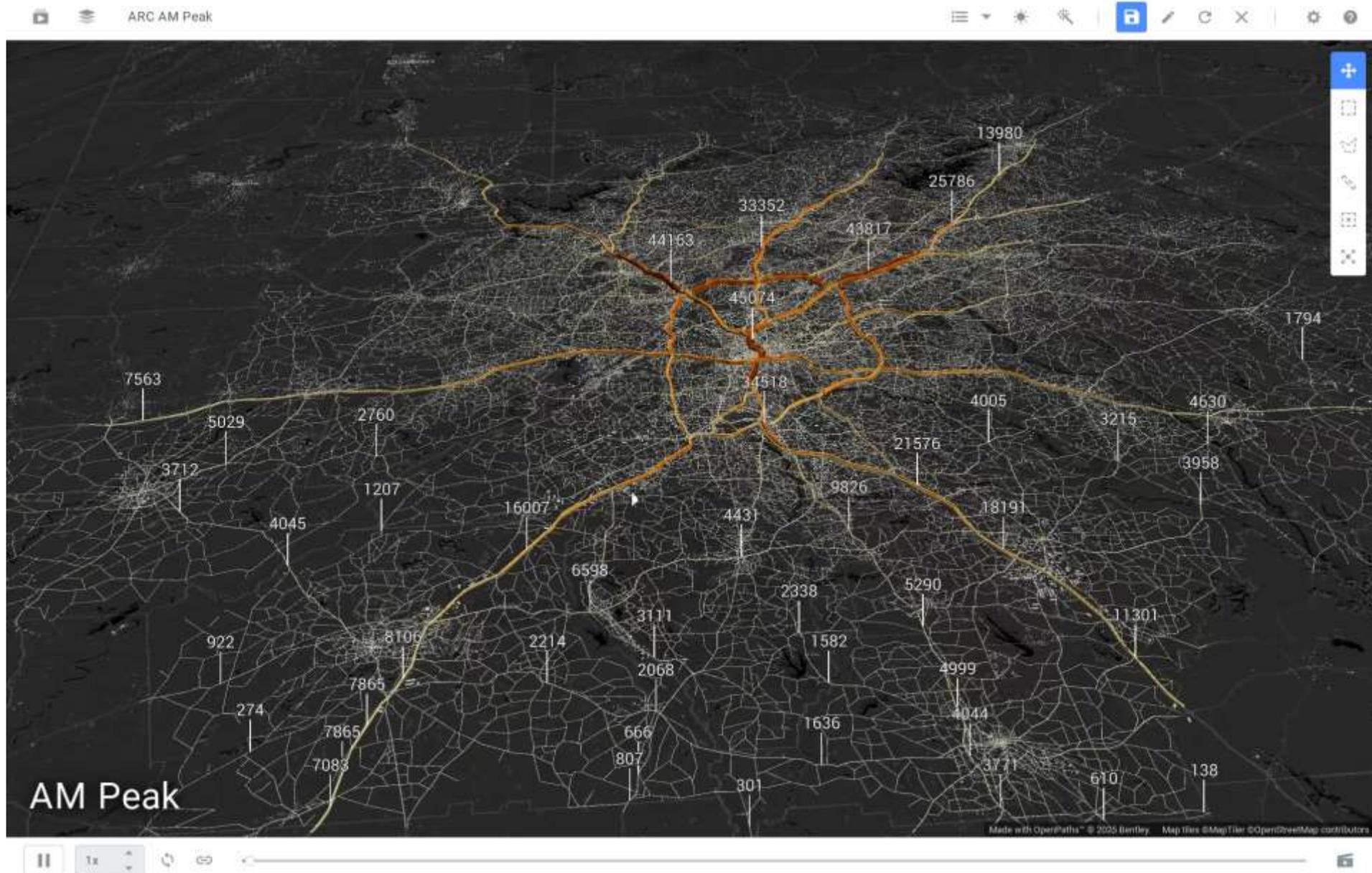


OpenPaths Scenes

Available on the CUBE and EMME Toolbar



Idea 2 – Network Scene (2)



Idea 3 - Import and Connect ABM Results

Full relational data model for ABM

Name	Last Modified
shp	12/5/2025 10:52 AM
ARC_2020.gdb	12/4/2025 9:14 AM
hhData.csv	12/2/2025 6:22 PM
indivTourData.csv	12/2/2025 1:48 PM
indivTripData.csv	12/2/2025 1:50 PM
personData.csv	12/2/2025 1:50 PM
tripData.csv	12/2/2025 3:47 PM
voyager_zones.csv	12/2/2025 5:55 PM
ZoneData.csv	12/2/2025 6:14 PM
ZoneData.DBF	12/2/2025 6:12 PM



ARC ABM

ARC ABM

Households

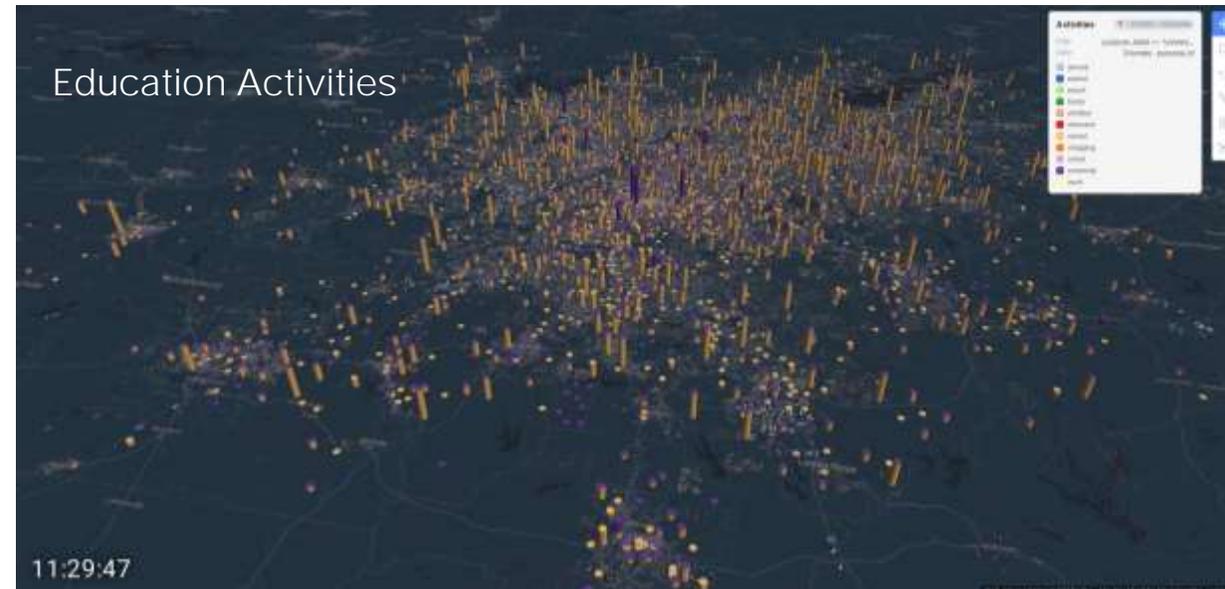
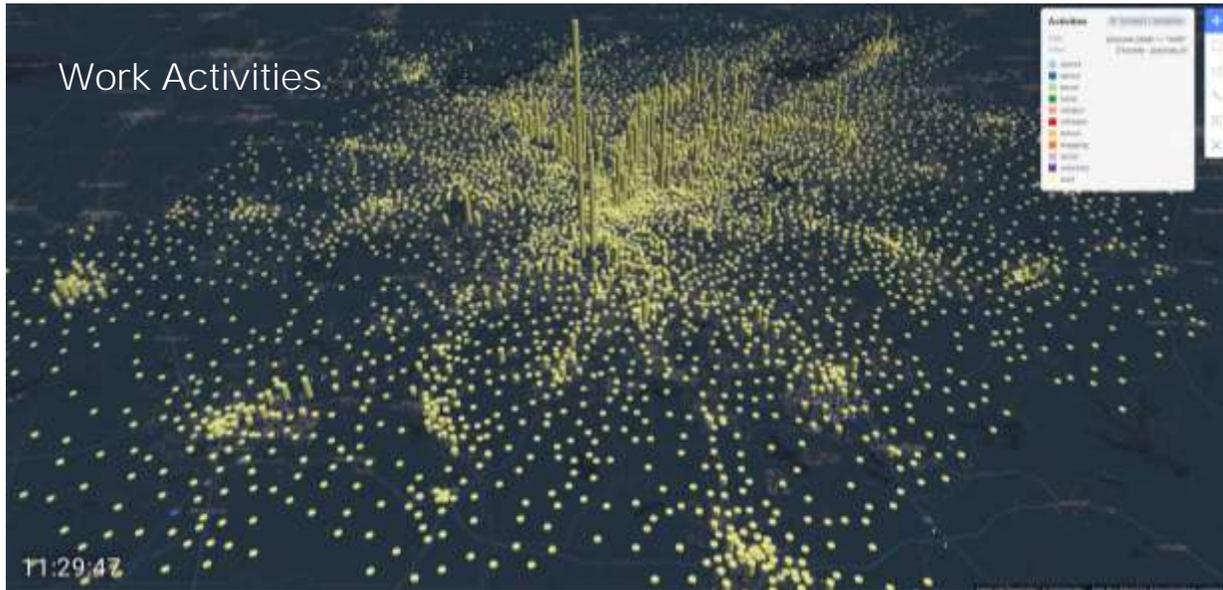
Displaying 2,257,252 of 2,257,252 rows

Filter

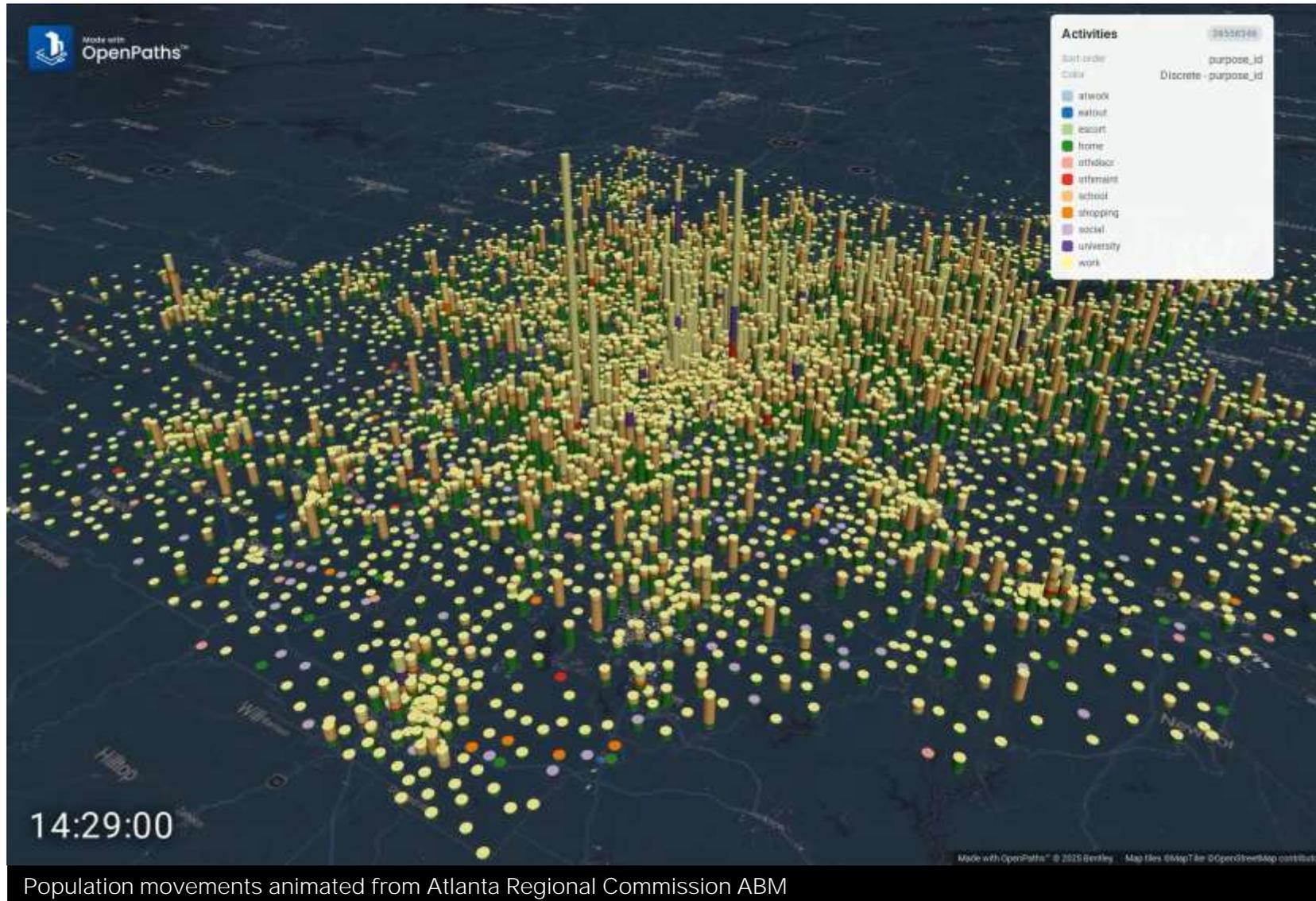
	hh_id	taz	walk_subzone	income	autos	jtf_choice	size	workers	auto_suff	av_choice
1	9	1	0	26174	1	-3	2	1	cars>=wkrs	1
2	209	1	0	507008	2	2	4	1	cars>=wkrs	1
3	201	1	0	308373	2	1	2	1	cars>=wkrs	1
4	53	1	0	164317	3	6	4	3	cars>=wkrs	1
5	13	1	0	82789	3	6	3	0	cars>=wkrs	1
6	43	1	0	301490	2	6	2	1	cars>=wkrs	1
7	72	1	0	114876	2	-3	2	2	cars>=wkrs	1
8	89	1	0	63982	3	-3	4	2	cars>=wkrs	1
9	77	1	0	125055	2	1	2	1	cars>=wkrs	1
10	85	1	0	164802	2	4	3	1	cars>=wkrs	1
11	86	1	0	77554	1	-2	1	1	cars>=wkrs	1

Query map, and model with a full relational data model for ABM

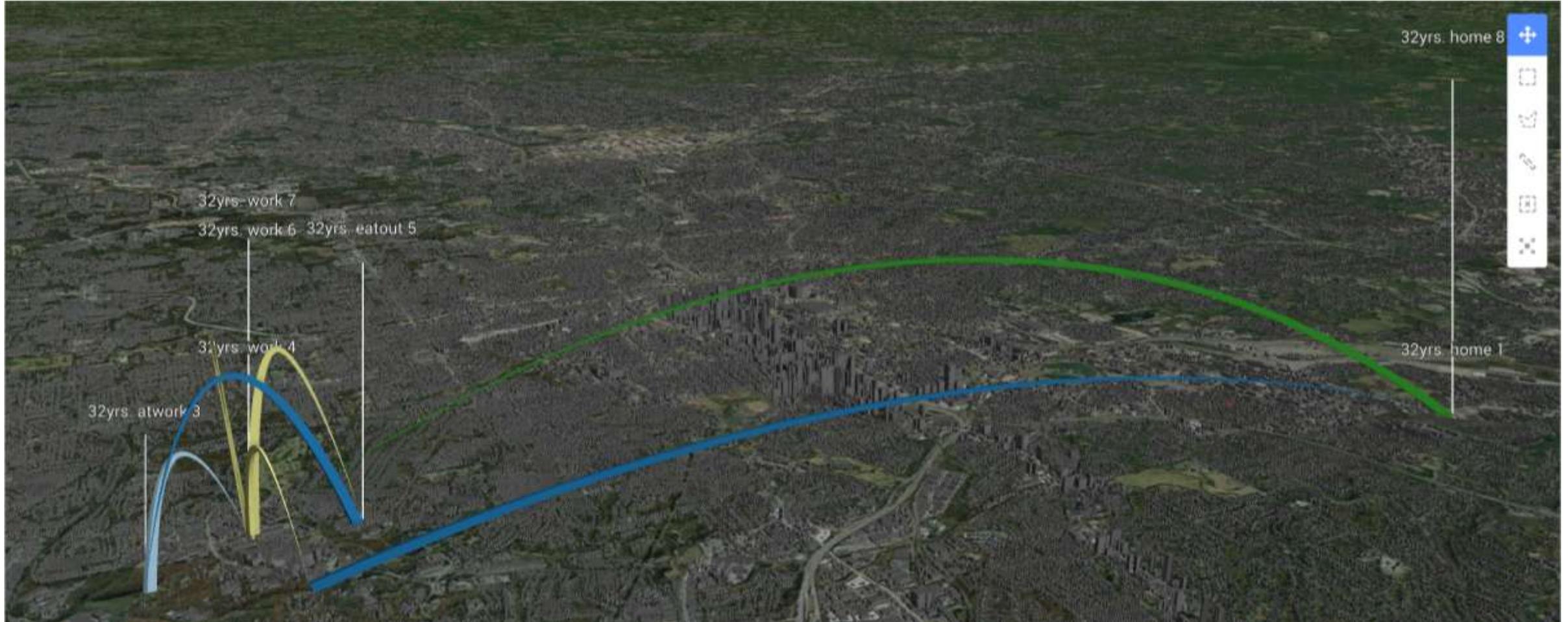
Idea 4 – Visualize ABM with the Activities Scene



Idea 4 – Visualize ABM with the Activities Scene (2)

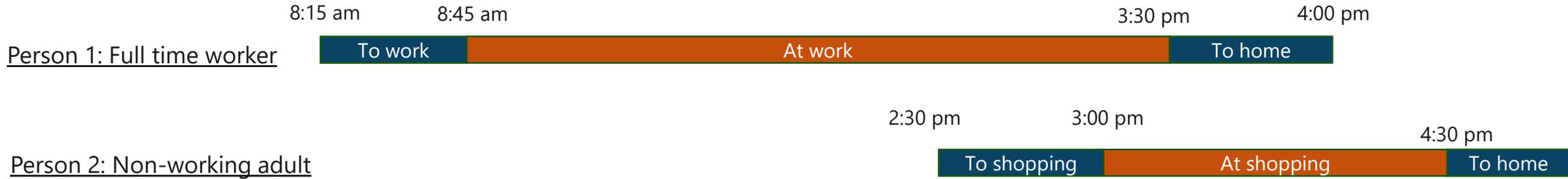


Idea 4 – Visualize ABM with the Activities Scene (3)



Idea 5 – ABM + AV Scenarios

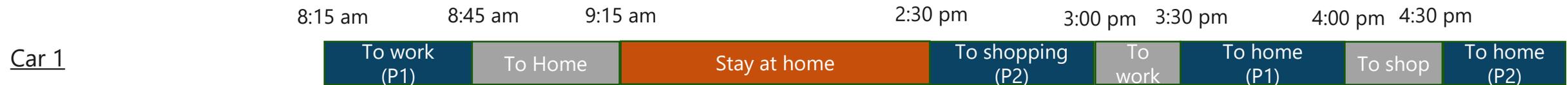
Schedule



With Car Coordinator: Regular Car



With Car Coordinator: AV



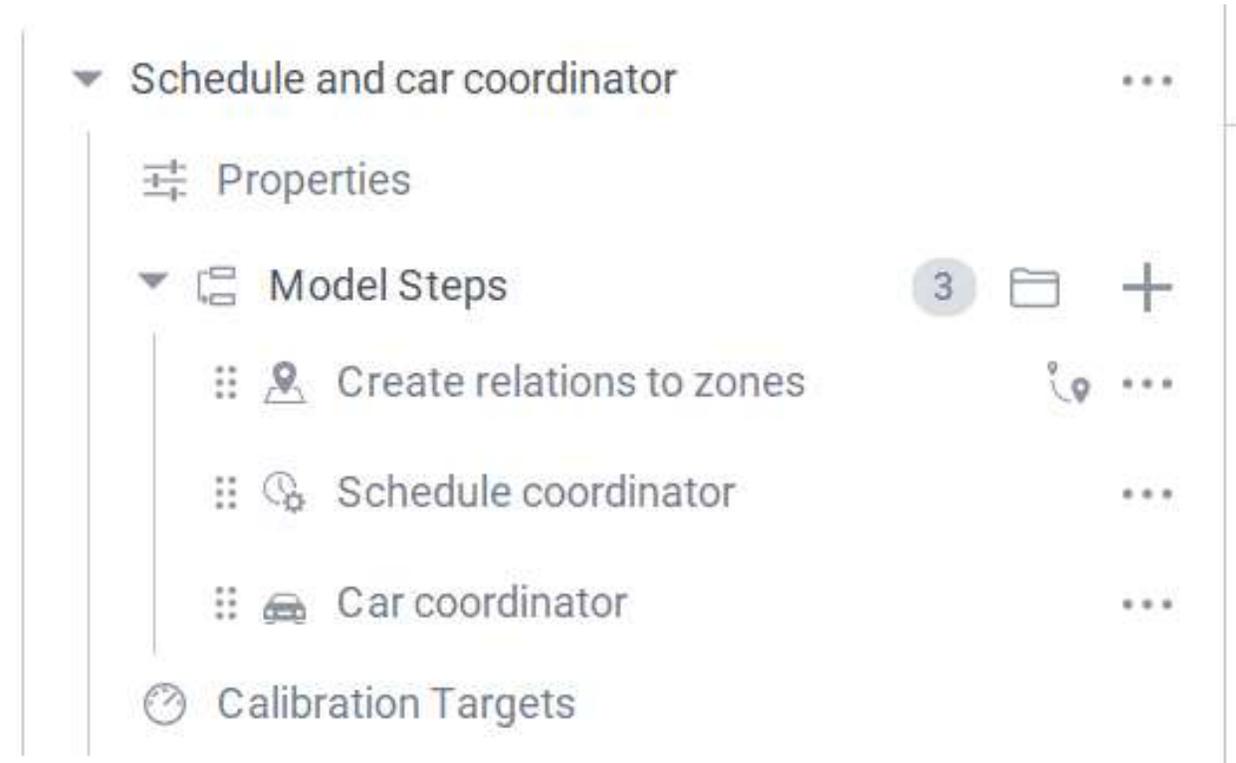
Idea 5 – ABM + AV Scenarios (2)

Explore AV scenarios with Car Coordinator:

- Allocation of household cars to car trips such that two cars cannot be present at two places at the same time
- Cars follow time-space constraints
- Handles intra-household car sharing for AVs
- Handles car repositioning to save parking cost/difficulty for AVs

Schedule Coordinator:

- Creates time-space consistent trip list
- Useful to prepare for Car Coordinator or DTA



Idea 6* – Dynamic Traffic Assignment

ARC Regional PoC

ARC Regional Model Proof-of-Concept

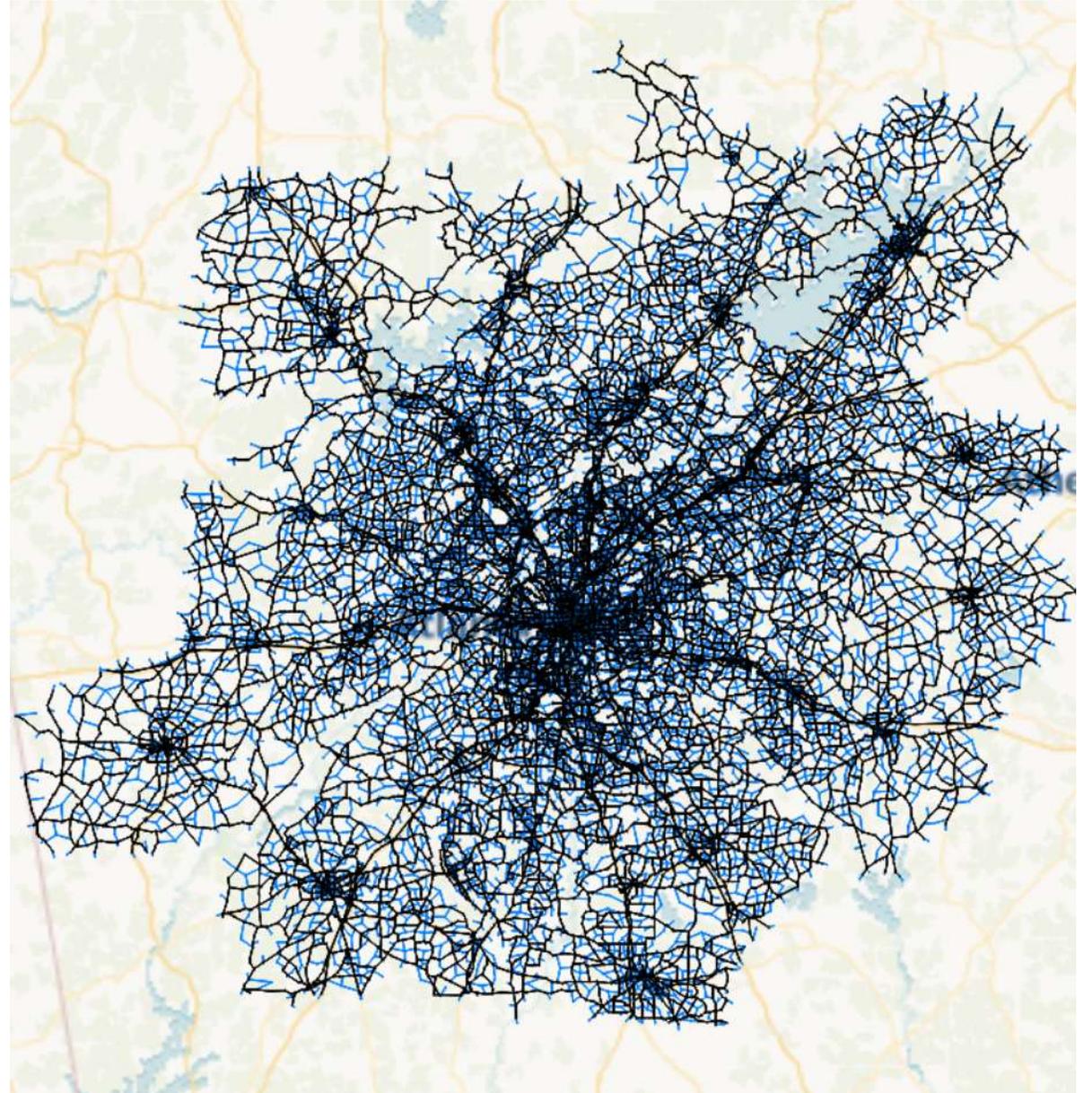
- 6,031 zones
- 150K links
- 66K nodes

Demand

- Total trips ~4.67M
- 3-7 PM
- 6 classes (SOV, HOV, HOV3, Commercial, Medium & Heavy Trucks)

Import Process

- **“Load from CUBE”** option in OpenPaths DYNAMIQ
- No other manual adjustments



Sample DTA applications

Portland (OR) Subarea



4 h demand = 396 K trips
2 h DTA (2 min / iteration)

Edmonton Citywide



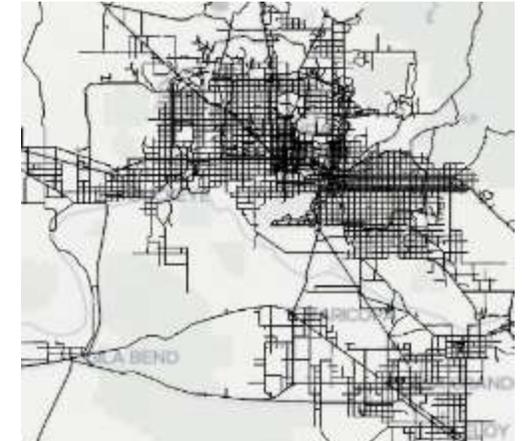
3.5 h demand = 902 K trips
2.5 h DTA (4 min / iteration)

York (Greater Toronto Area)

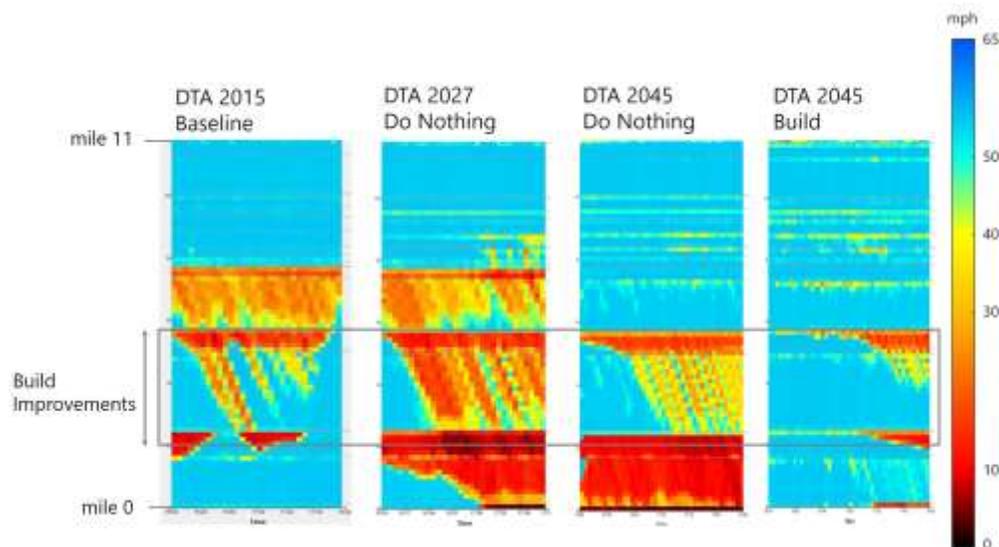


4 h demand = 1.81 M trips
6 h DTA (6 min / iteration)

Phoenix Region



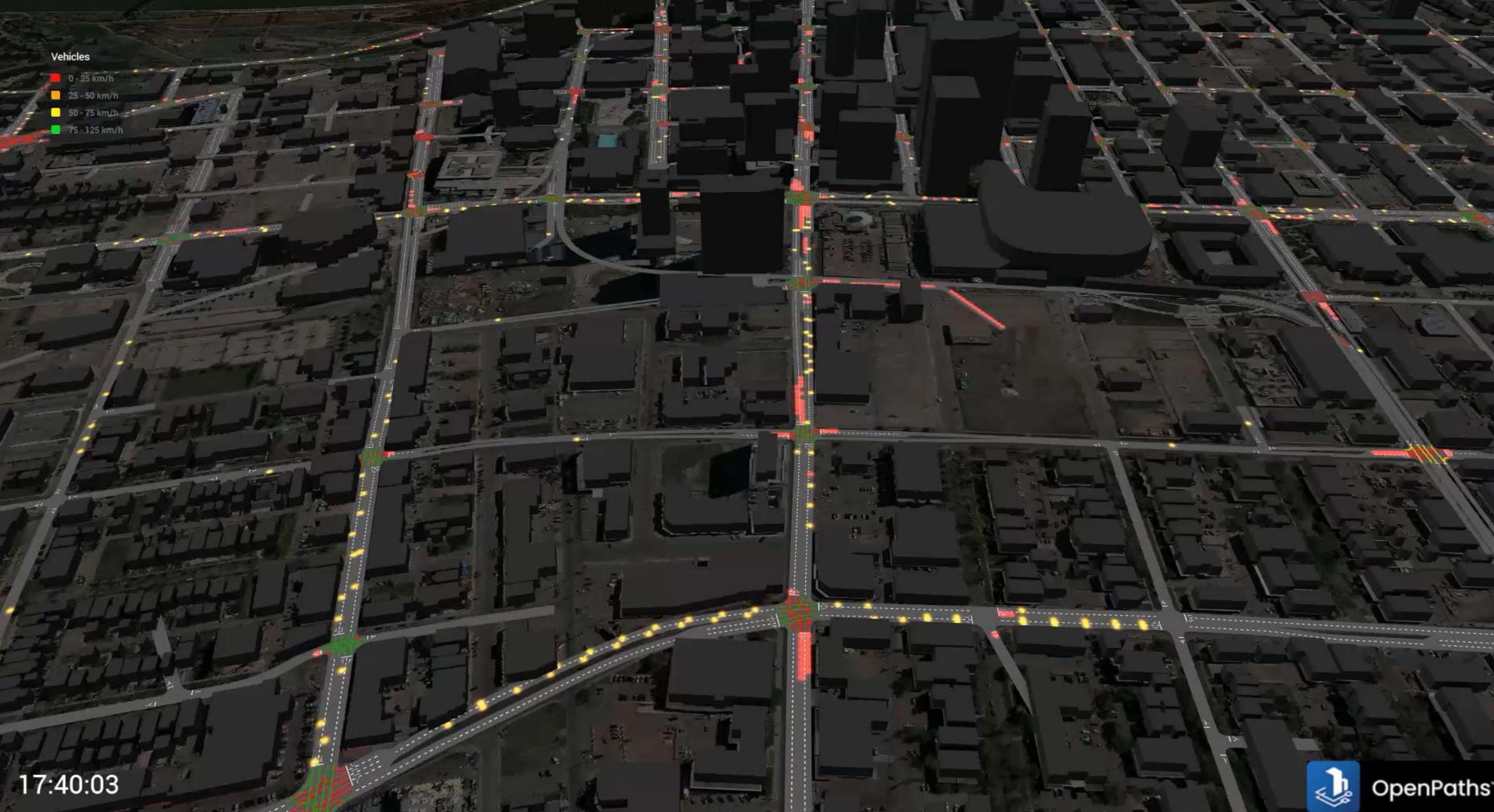
24 h demand = 20 M trips
~ 60 min / iteration *



“ The DTA model allows the project team to more accurately capture the benefits of the proposed infrastructure improvements and toll schedules on reducing congestion and diversion relative to the No Build
Peter Bosa | Oregon Metro

Vehicles

- 0 - 25 km/h
- 25 - 50 km/h
- 50 - 75 km/h
- 75 - 125 km/h



17:40:03



OpenPaths

Idea 6* - ARC Regional DTA

Proof-of-concept

ARC Regional Model Proof-of-Concept

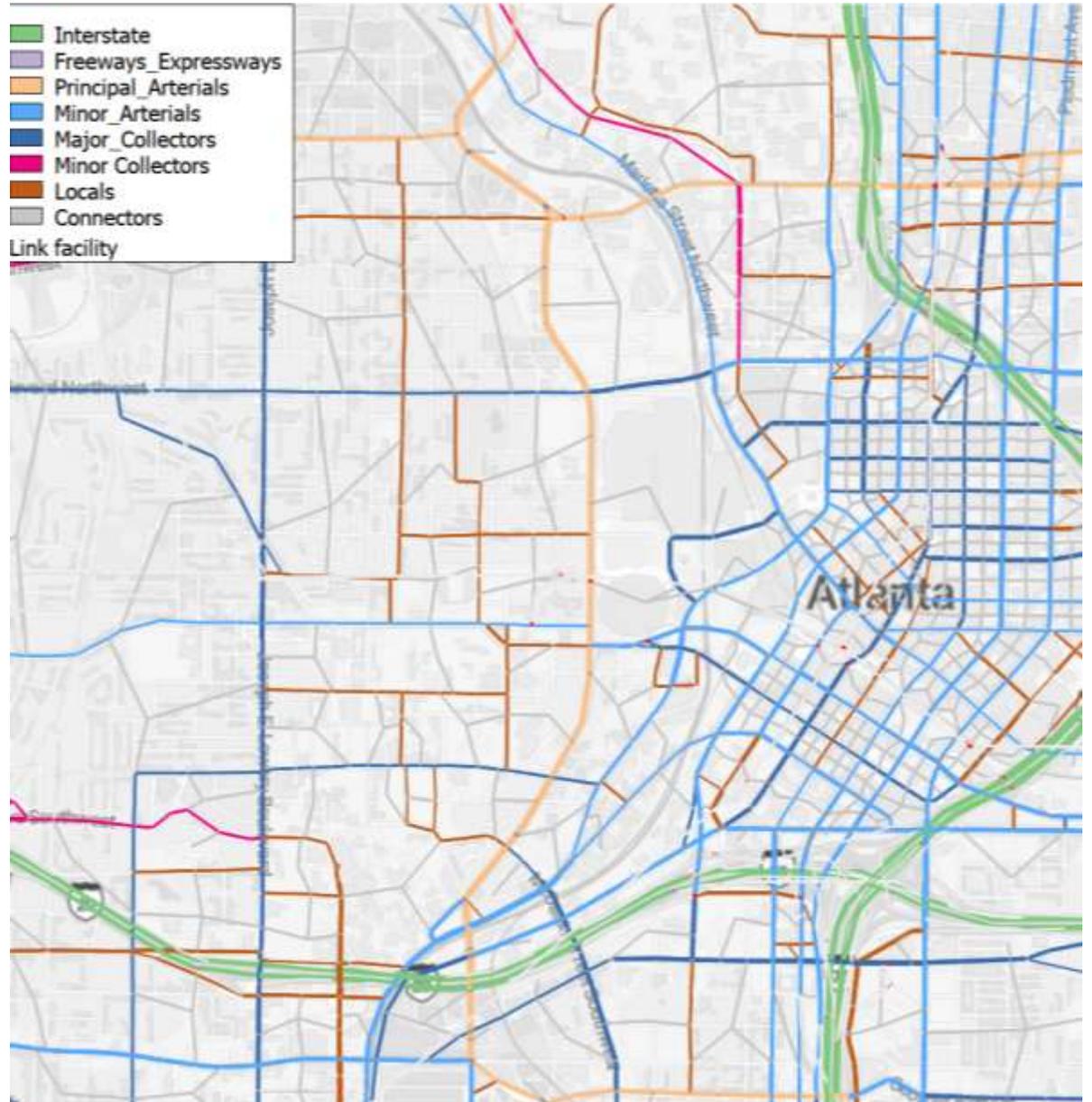
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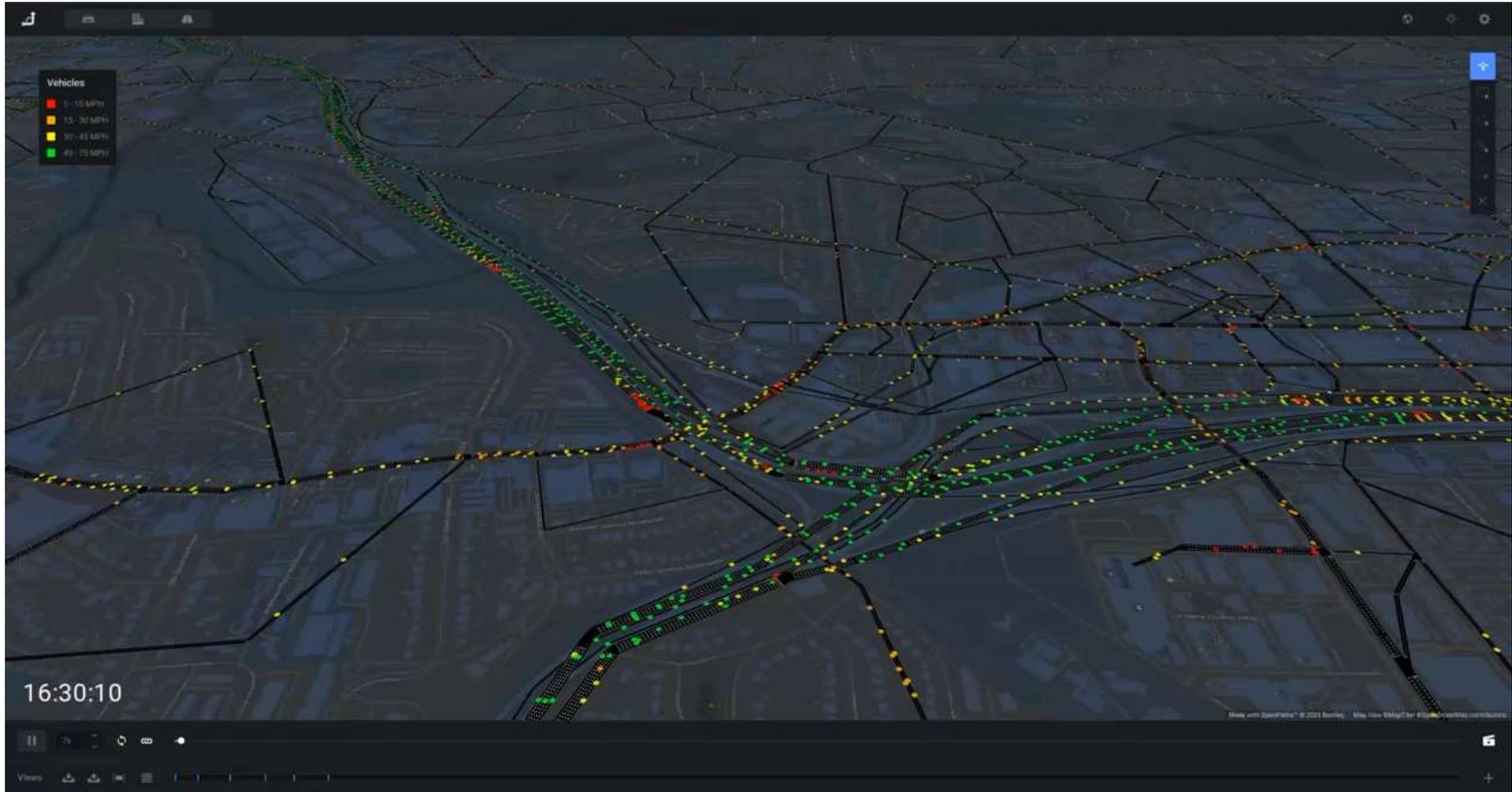
Import Process

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Idea 6* - ARC Regional DTA PoC

Simulation playback



Technology Preview

All subsequent slides refer to roadmap items and are subject to the below disclaimer

Release plans and timelines are forward-looking estimates and projections only. There can be no assurance that Bentley will be able to meet such estimates or projections by the dates specified, or at all. Do not make purchase decisions based on forward looking roadmaps.

Multiresolution DTA

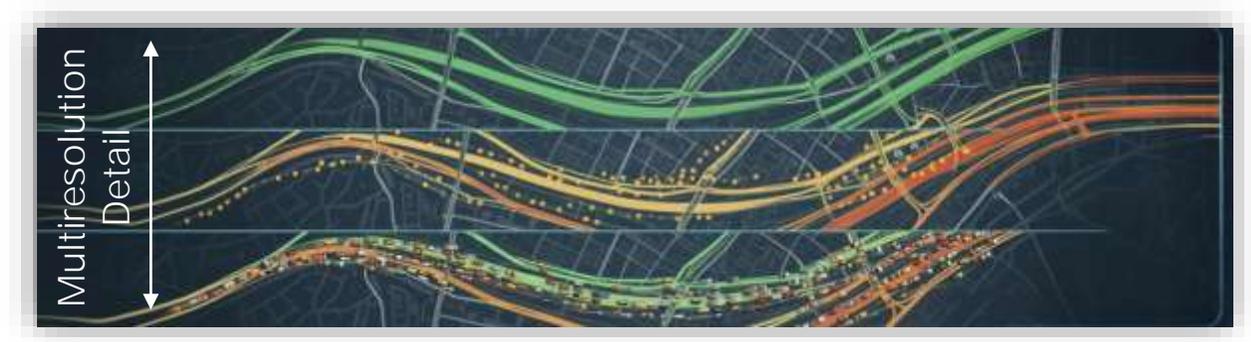
Multi-resolution DTA*

- A single model solved at different levels of resolution
- Optionally fed with a fraction of total demand
- Simulation is scaled so that model outputs approximate those obtained with a regular simulation run
- Scaling applies to *all components* of the simulation: car following, lane changing, gap acceptance, etc...

Advantages

- Lower resolutions may yield dramatic reduction in run times
- Results may be compared to full resolution (100%) results
- Model remains internally consistent -> no boundary conditions
- No additional user intervention required

Accelerating DTA for Large-Scale Applications with a Multiresolution approach, *Modeling Mobility 2025*, Mahut, Juran, Vovsha, Hicks (Bentley Systems), Zhu, Dutta (Maricopa Association of Governments)



Multiresolution DTA

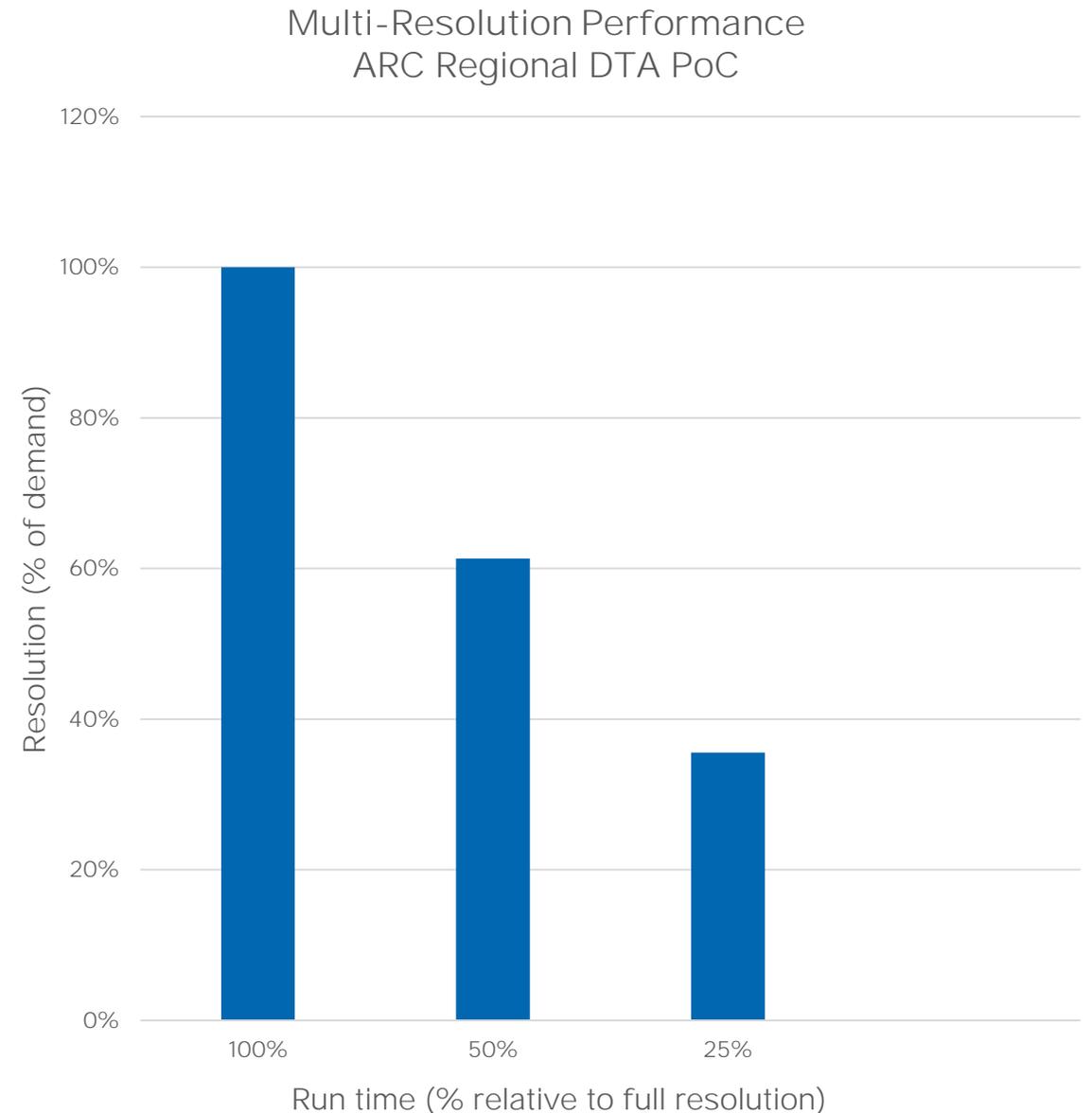
Multi-resolution DTA*

- A Single model solved at different levels of resolution
- Optionally fed with a fraction of total demand
- Simulation parameters are scaled so that model outputs approximate those obtained with a regular simulation run with 100% demand
- Scaling applies to *all components* of the simulation: car following, lane changing, gap acceptance, etc...

Advantages

- Model remains internally consistent -> no boundary conditions
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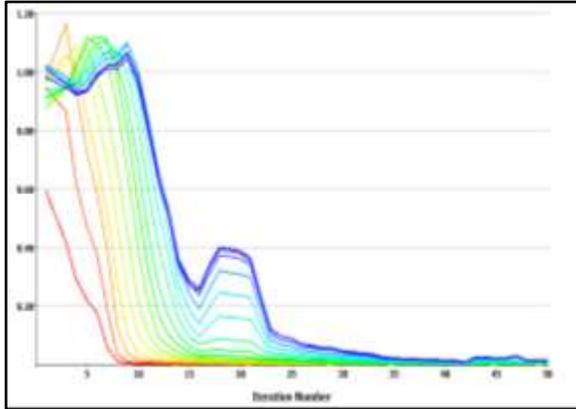
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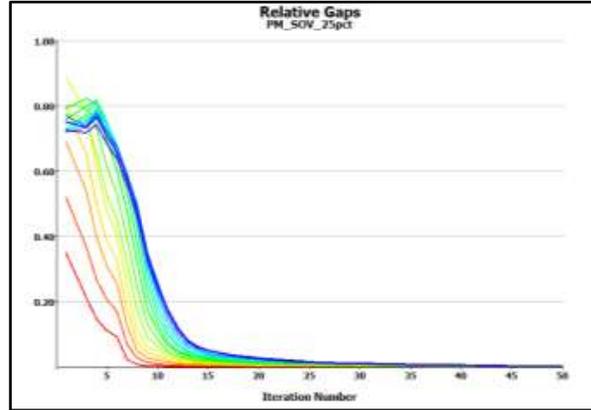
Multiresolution Convergence and Runtime*

ARC Regional DTA PoC

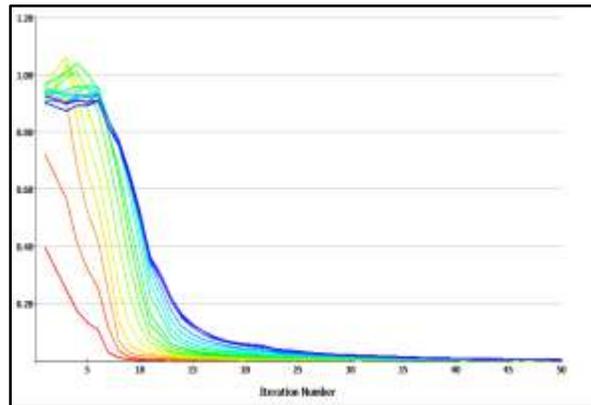
100% Sample (



50% Sample



25% Sample



ARC Regional Model PoC

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- 150K links
- 66K nodes

Demand

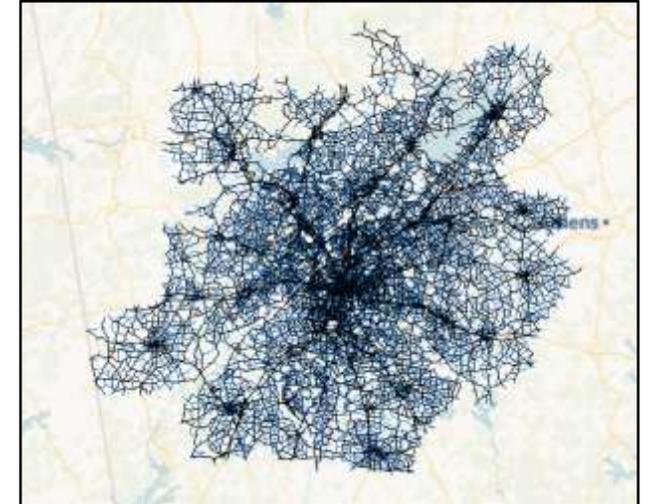
- Total trips ~4.67M
- 3-7 PM
- 6 classes

Import Process

- "Load from CUBE" option in OpenPaths DYNAMIQ
- No other manual adjustments

CPU

- i9-9920X CPU @ 3.50GHz
- 12 cores / 24 threads

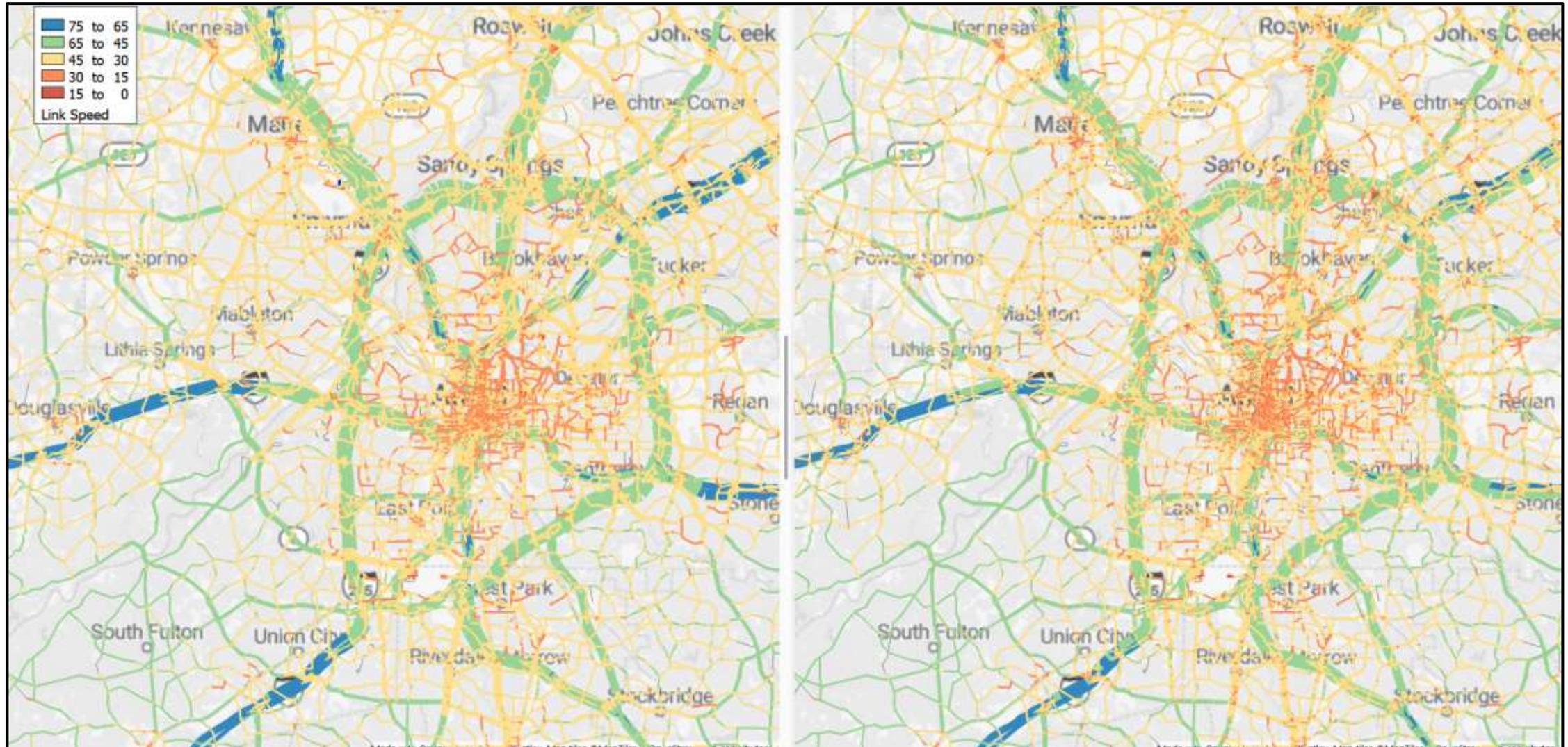


Multiresolution Flows and Speeds (Peak Hour)*

ARC Regional DTA PoC

100% Sample

25% Sample

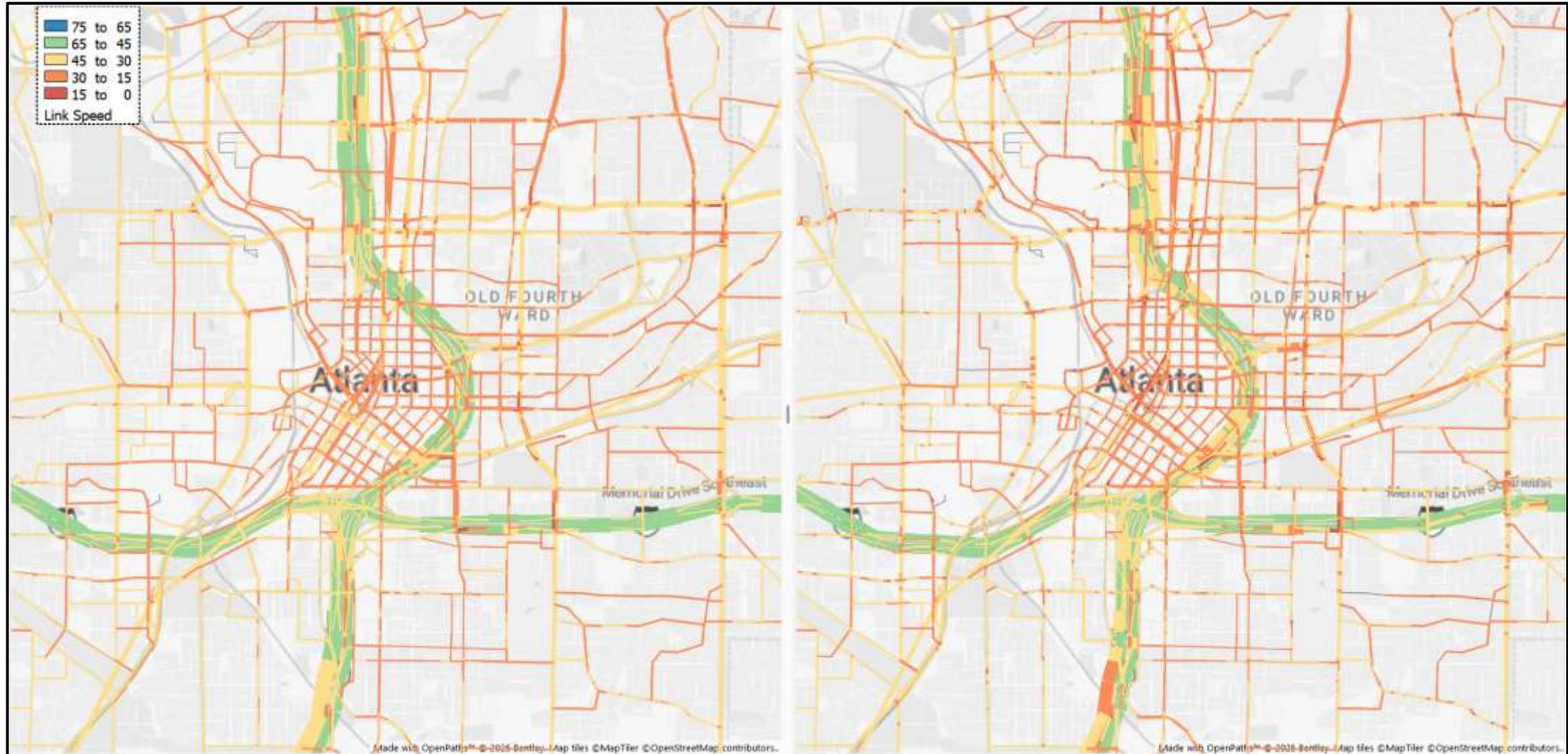


Multiresolution Flows and Speeds (Peak Hour)*

ARC Regional DTA PoC

100% Sample

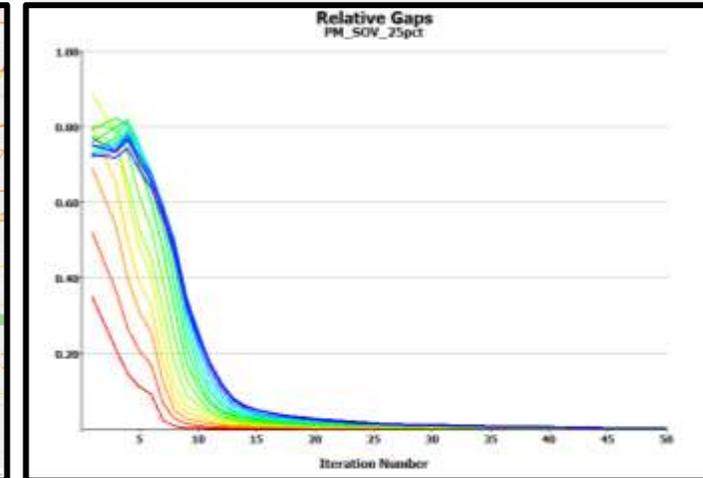
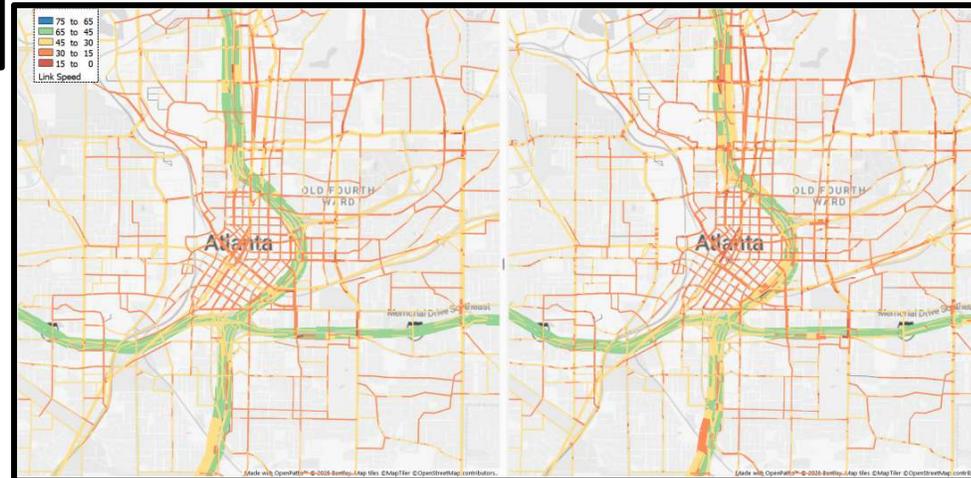
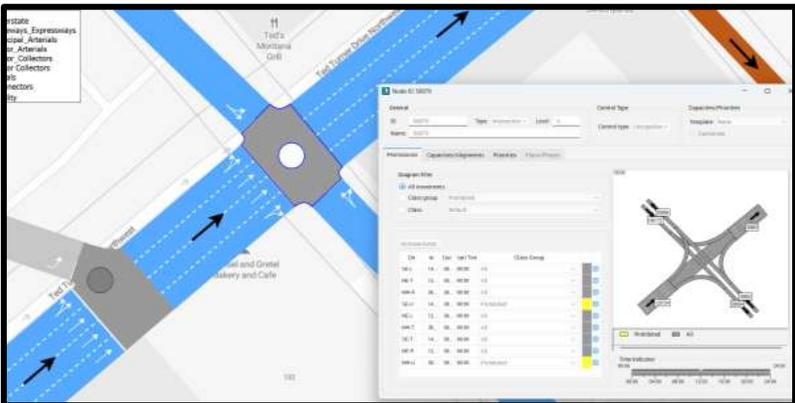
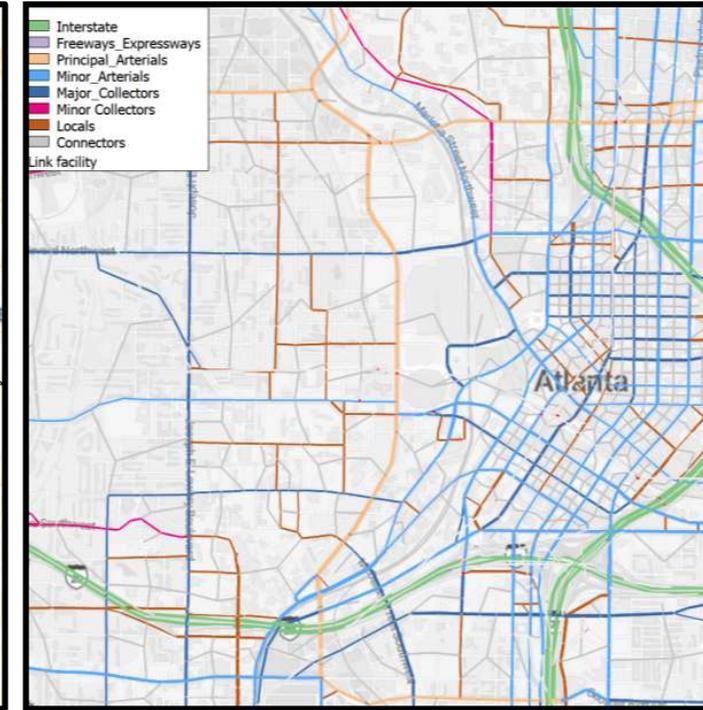
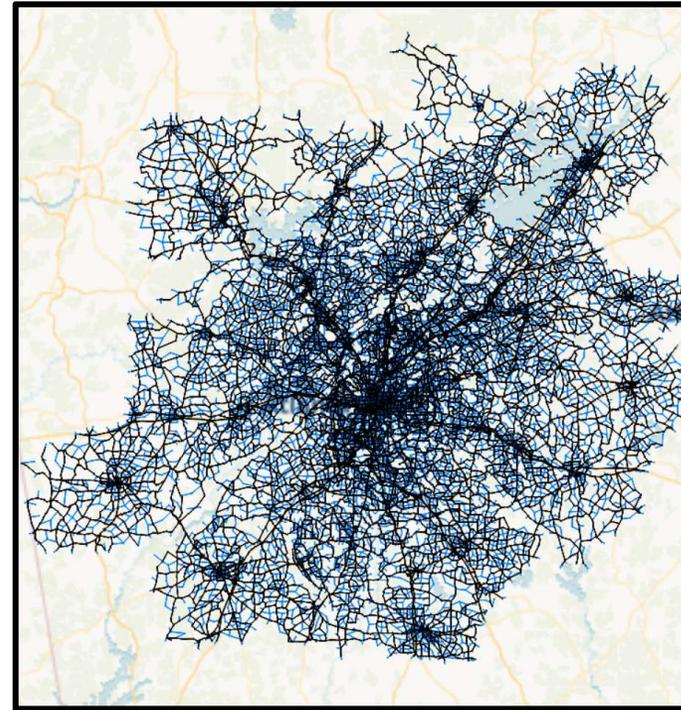
25% Sample



Idea 6* - ARC Regional DTA PoC

Summary

Computational PoC of ARC Regional DTA. Demonstration of a) model import, b) model convergence, c) runtime and d) potential speed-up with multiresolution DTA*.



Idea 7* - New OpenPaths Common Traffic Assignment ~2.5x speedup vs Voyager Highway

ARC assignment benchmark

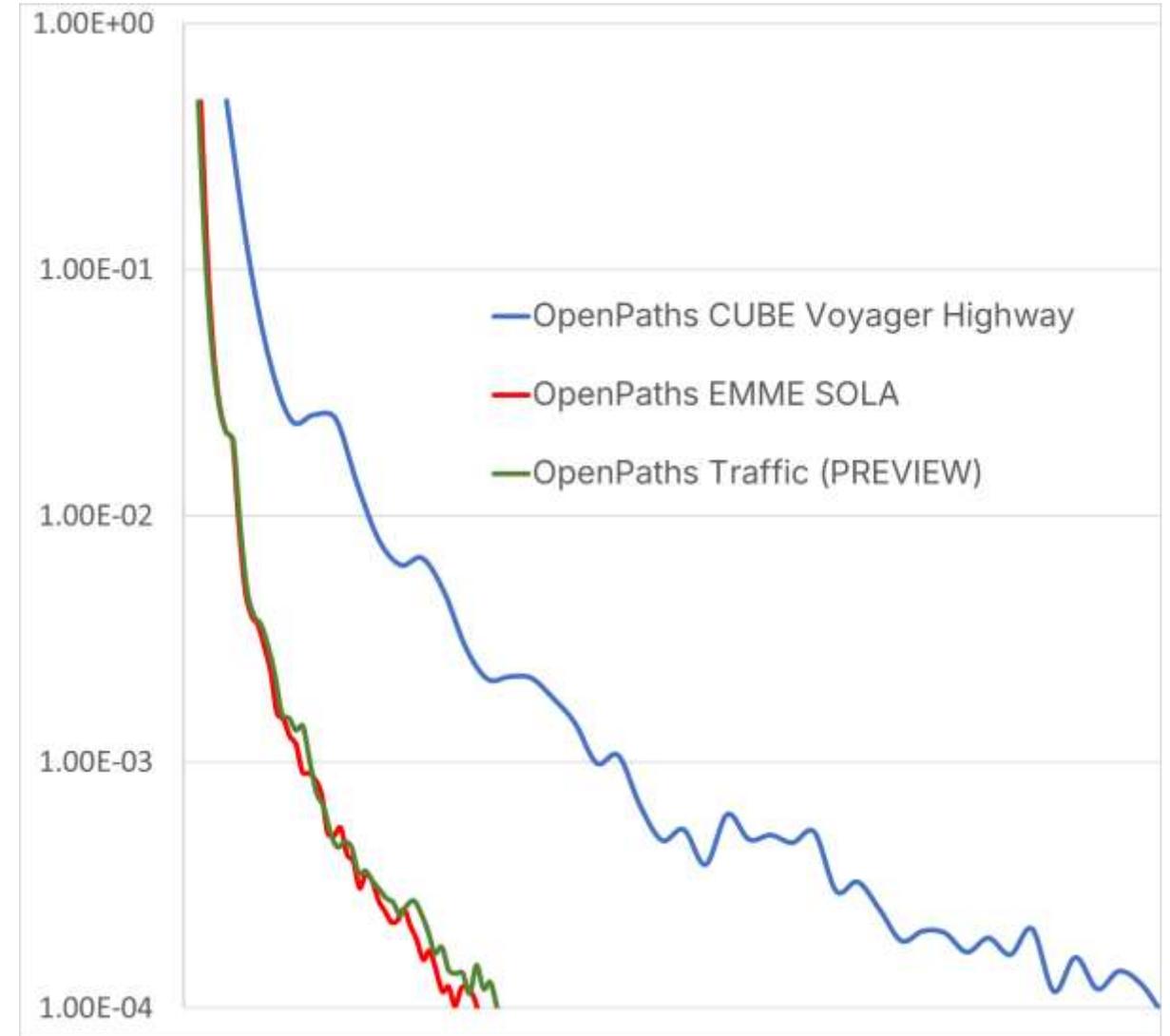
- 6,031 zones
- 150K links
- 66K nodes
- 15 classes + 2 classes background traffic

Tested on Intel Xeon Platinum 8573C (2.1GHz base/4GHz boost, 32 threads)

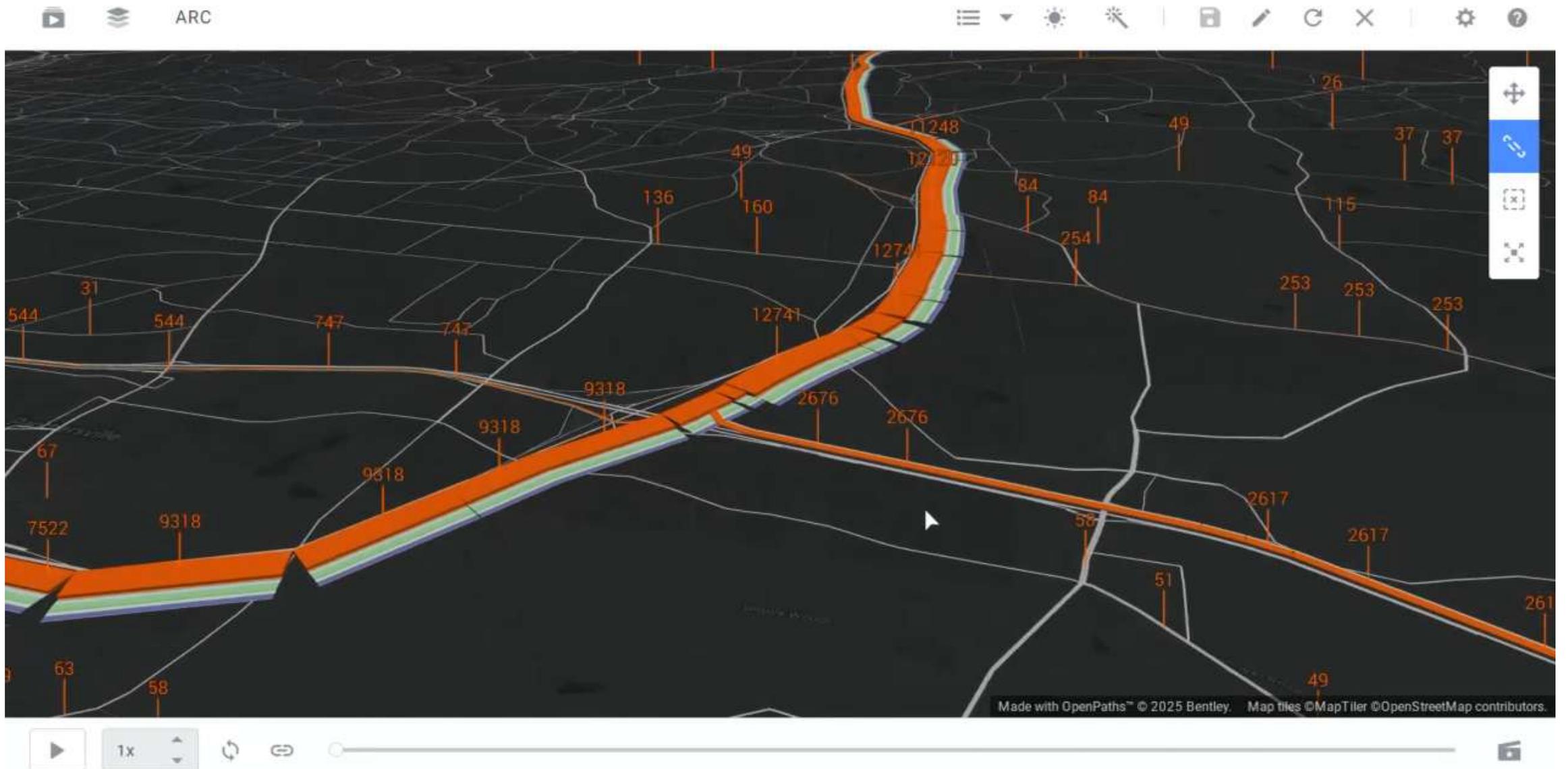
~2.5x speed up to 10^{-4}

Supports proportionality, user-defined functions, analysis capabilities

Harmonized assignment for OpenPaths CUBE and OpenPaths EMME



Idea 8* - Interactive Select-Link Analysis



Idea 9* ABM <> Network Analysis

Traffic Analysis

Link ID	415-423
< \$30k	245.1
\$30k-\$50k	222.63
\$50k-\$70k	213.66
\$70k-\$100k	235.99
\$100k-\$200k	285.23

Select Link Analysis

Analyze flows by ABM segment.

Use Assignment Classes

Use ABM Bins

ABM Bin Definitions

Label	Expression
< \$30k	tour.person.hh.HINCP < 3
\$30k - \$50k	tour.person.hh.HINCP > 4
\$50k - \$70k	tour.person.hh.HINCP > 5
\$70k - \$100	tour.person.hh.HINCP > 6
\$100k - \$20	tour.person.hh.HINCP > 7

Add ABM Bin

Apply Workflow

Thank you!

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michael.mahut@bentley.com

filippo.contiero@bentley.com

gaurav.vyas@bentley.com

For general queries

openpaths-info@bentley.com

Summary

Idea 1 – Integrated CUBE<>EMME Model Workflows

Idea 2 – Visualize Results with the Network Scene

Idea 3 – Import and Connect ABM results

Idea 4 – Visualize ABM with the Activities Scene

Idea 5 - ABM + AV Scenarios

Idea 6* – DTA / Multi-resolution DTA

Idea 7* – New OpenPaths Traffic Assignment

Idea 8* - Interactive Select-Link Analysis

Idea 9* - ABM<>Network Analysis

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