ATLANTA REGIONAL COMMISSION · ARIZONA STATE UNIVERSITY

# Reproducing a Regional Assignment Workflow in GMNS

*What we tested, what we reproduced, and what still requires agency review*

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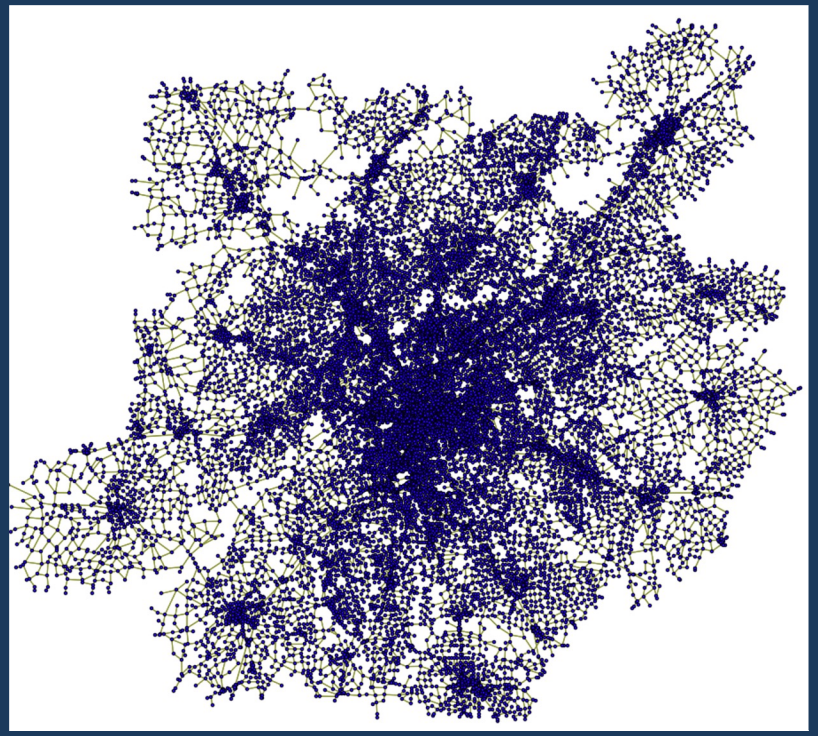
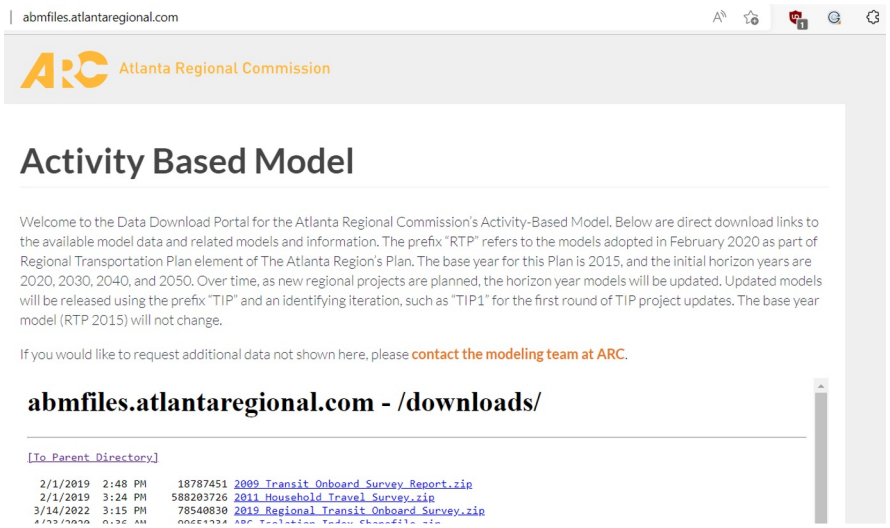


*ARC regional network as converted to GMNS*

Zephyr Learning Session: GMNS+ and Assignment · 20 August 2026

# From published files to a runnable model




*ARC publishes the model, shapefiles and Section 7 documentation openly. The whole case starts from public files.*

**150,255** source link records

**145,971** directed links after conversion

## ARC is a large, multimodal activity-based model

ARC's model is a CT-RAMP activity-based microsimulation model forecasting typical weekday travel by households and persons.

It integrates resident passenger travel with separate truck, airport, external-internal, and external-external models.

The model covers 21 metro Atlanta counties using 5,922 traffic analysis zones.

Activities are scheduled at 30-minute resolution, while skimming and assignment use five periods: Early AM, AM Peak, Midday, PM Peak, and Evening.

The model represents 16 passenger-trip modes, including toll/non-toll automobile classes, walk, bicycle, TNC, school bus, and several transit-access combinations.

# ARC needs more than a network export

Model conversion cannot preserve only lines and points. Every assumption below changes assigned volume, and each one must arrive with the network or be re-derived by hand.

### Identity & topology

- Original node and link IDs
- From / to node, direction
- Zone and connector structure

### Supply

- Facility and area type
- Lanes
- Hourly per-lane capacity
- Free-flow speed

### Behavior & cost

- Volume-delay function and coefficients
- Value of time, operating cost
- Tolls by class

### Period & demand

- Time-period window
- Period (peak-load) factor
- Demand by user class

### Restrictions

- HOV and truck prohibitions
- Turn and access rules

### Validation basis

- ARC AM reference volumes
- Observed speeds and counts

*Anything on this list that is not declared becomes a silent assumption made by whoever runs the model next.*

# ARC's full model, and the subset this test reproduced

## ARC's full modeling system

- Activity-based demand generation
- Five time periods (EA / AM / MD / PM / EV)
- Full user-class and truck structure
- Highway and transit assignment
- Agency validation, review, and adoption process

## What this test covered

- AM roadway assignment only (6:00–10:00)
- SOV, HOV2, HOV3 demand as supplied by ARC
- GMNS handoff of network, settings, and demand
- Validation against ARC's published AM volumes
- Corridor congestion comparison vs. INRIX speeds

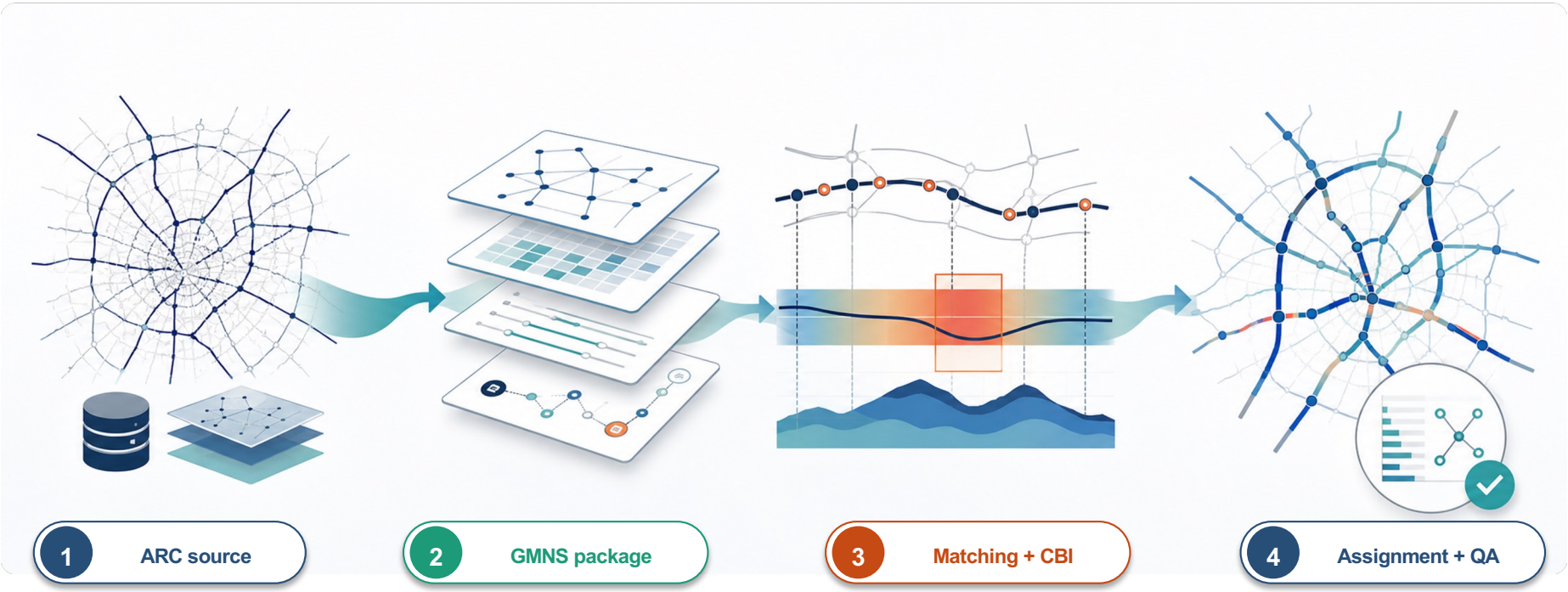
# ARC highway assignment is technically sophisticated

- Highway assignment uses a standard equilibrium methodology with the bi-conjugate Frank–Wolfe algorithm.
- Convergence is defined as a relative gap below $10^{-4}$ for three consecutive iterations.
- Route choice is based on generalized cost:
- Cost=(time×VOT)+toll+(distance×operating cost)
- Each of the five time periods includes 10 assignment classes:
  - 6 SOV/HOV2/HOV3+ toll and non-toll classes
  - Commercial vehicles
  - Medium trucks
  - Two heavy-truck classes
- Congested travel time is represented using modified BPR volume-delay functions, with different calibrated parameters for freeways, weaving sections, expressways, ramps, arterials, and collectors.

*Part 2 begins on the next slide.*

# GMNS carries agency meaning across a reusable tool chain

ARC is the worked case: one declared exchange connects matching, congestion analysis and assignment—while each tool remains replaceable.

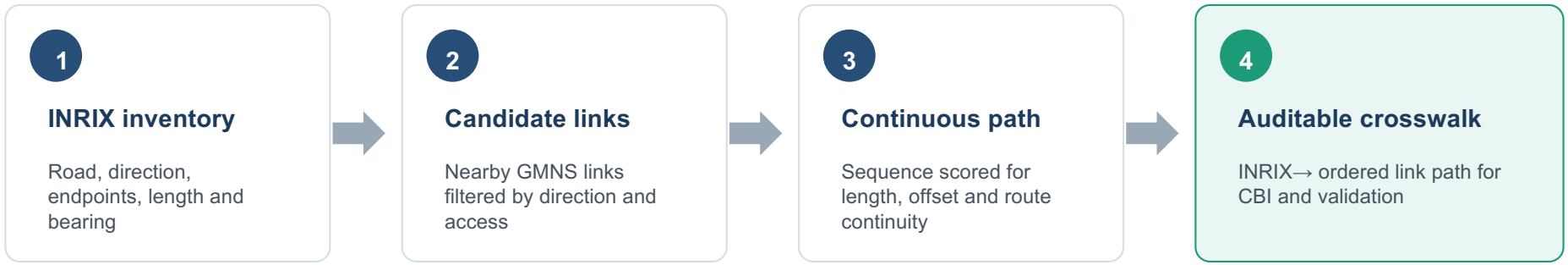



**CBI: Congestion and Bottleneck Identification tool:**

**Source:** Congestion and Bottleneck Identification (CBI) Tool Software Download | FHWA

# Map matching connects observed TMCs to the GMNS network

The matcher builds a continuous, auditable path—not a nearest-link shortcut.




FINAL BATCH

**17,012**
TMC geometry versions

**15,928**
QA-passing paths

**1,084**
review / no path

4,378 source INRIX TMCs · 375 corridors
104,889 ordered TMC → link rows

** 99.8% obtained a network path; accepted coverage after QA is 93.6% (32 versions have no path).*

# CBI converts matched speeds into assignment-ready boundaries

The tool chain is explicit: observe → detect → parameterize → hand off.

1 **Align observations**

Attach TMC speed profiles to ordered GMNS paths.

2 **Detect transitions**

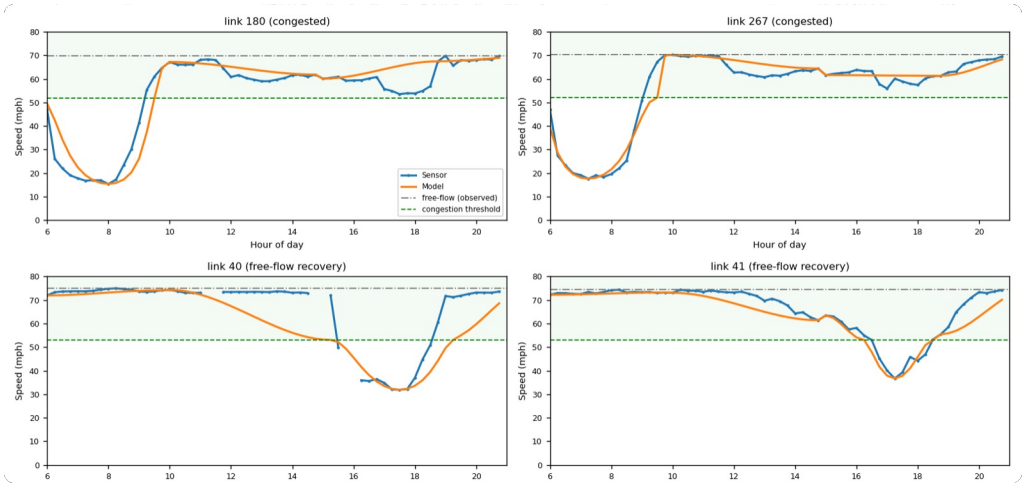
Identify candidate t0 / t2 / t3 congestion episodes.

3 **Estimate parameters**

Fit VDF and boundary fields with explicit screening.

4 **Publish the handoff**

Write link-level fields, provenance and QA for assignment.




*I-20 westbound example: observed vs QVDF-reconstructed speed; AM and PM each passed 7/7 diagnostic gates.*

**REGIONAL BATCH** 361/361 corridors completed · 354 produced calibration rows · 585/987 period fits passed ≥6 of 7 diagnostics.

# ARC assignment starts with a declared contract

Source conventions are converted by configurable Python tools; the C++ kernel runs the assignment.

| ARC source of record | GMNS declaration |
|---|---|
| Cube-exported shapefile + IDs | node.csv · link.csv |
| ATYPE × FACTYPE · AMCAPACITY | link type · capacity · VDF fields |
| AM period and demand matrices | settings.csv · demand_<class>.csv |
| **PROHIBIT + toll lookups** | **allowed_use (access) + toll (cost)** |
| ARC AM assigned volumes | ref_volume for comparison |

**Conversion record** Every field mapping, exception and source hash is reviewable before the engine runs.

COMPLETED RUN CONTRACT

## TAPLite C++ kernel

*Open-source reproducibility testbed*

**Static TA → analytical bridge → DTA**

- 66,810 nodes · 146,377 directed links
- 39,181 lane-miles
- 7 vehicle classes · 3.27 M AM trips
- AM period: 06:00–10:00
- ARC class costs, access, tolls and VDF
- 20 Frank-Wolfe iterations

**RUN COMPLETE** Full seven-class regional equilibrium completed on one desktop; validation and known demand-scope caveats follow.

# ARC results are measurable—and the misses are traceable

Completed-run evidence is scored against ARC's comparable demand scope; known gaps stay explicit.

**6,031 centroids** **146,377 directed links** **7 vehicle classes** completed run

1 **Can it run at regional scale?**

Full network, 3.27 M AM trips and seven vehicle classes loaded.

2 **Does it preserve ARC meaning?**

ARC VDF, class costs, access and toll semantics carried through the exchange.

3 **Does it reproduce the assignment?**

Comparable class volumes reproduce closely; HOV-only access is exact.

**COMPLETED-RUN EVIDENCE**

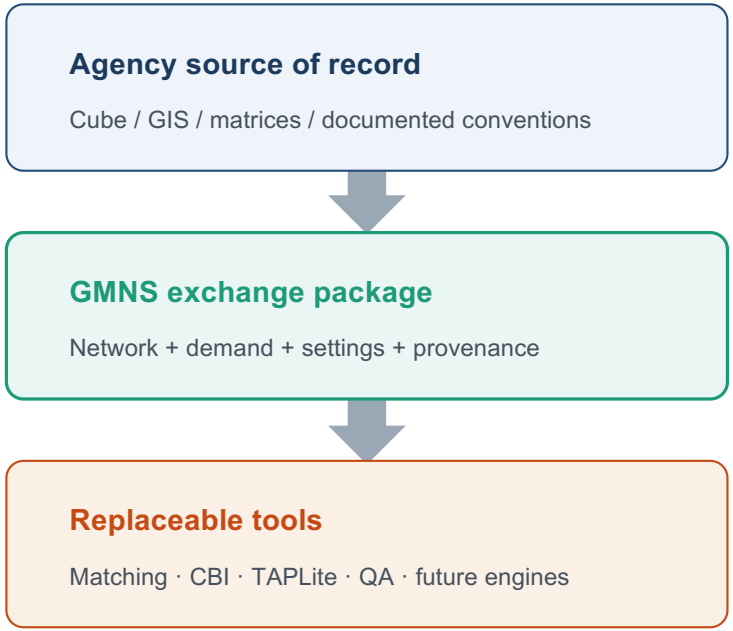
| | |
|---|---|
| HOV2 / HOV3 volume ratio | 1.000 / 1.003 |
| Comparable total / $R^2$ | 0.879 / 0.952 |
| HOV-only QA (820 links) | SOV = 0 |
| Gap · runtime | 0.08% · 20.5m |
| Memory · speedup | 23.3GB · 46% |

*Scope caveat: commercial, truck and PNR/KNR demand are absent (17% of network volume).*

**Where recovered demand is exact, class volumes match within 0.3%; remaining misses trace to known demand scope.**

# GMNS makes the ARC workflow portable without replacing it

The completed Atlanta runs show one exchange layer carrying agency meaning between replaceable tools.




WHAT THIS ENABLES

1. **Repeatability across MPOs**
   Reuse the same declare → convert → check → run → validate sequence.
2. **Auditability**
   Assumptions live in named fields, settings and manifests—not operator memory.
3. **Tool choice**
   Matching, CBI, assignment and QA can improve independently around one exchange.
4. **Lower switching cost**
   Test an open tool without abandoning the agency's established environment.
5. **Community compounding**
   Converters, test cases and fixes from one agency can accelerate the next.

**GMNS is not the model—it made 17,012 TMC versions, 361 CBI corridors and a seven-class ARC run auditable together.**

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IMMEDIATELY FOLLOWING
THE LEARNING SESSION!

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An Online Community Built by Travel Modelers

zephyrtransport.org/
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