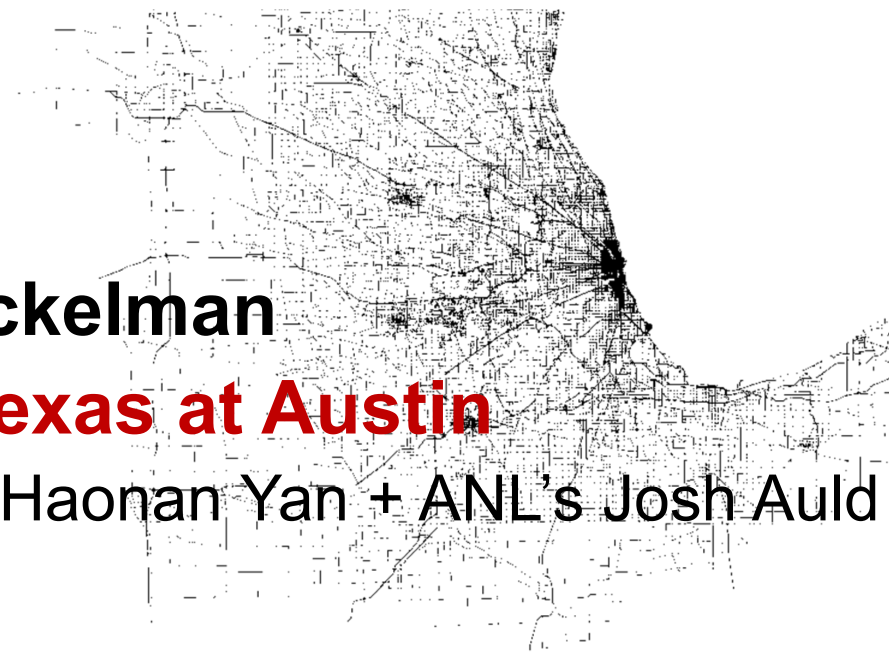
THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

Large-Scale Shared AV Simulations with Geofences, Stop Aggregation, & Parking Restrictions



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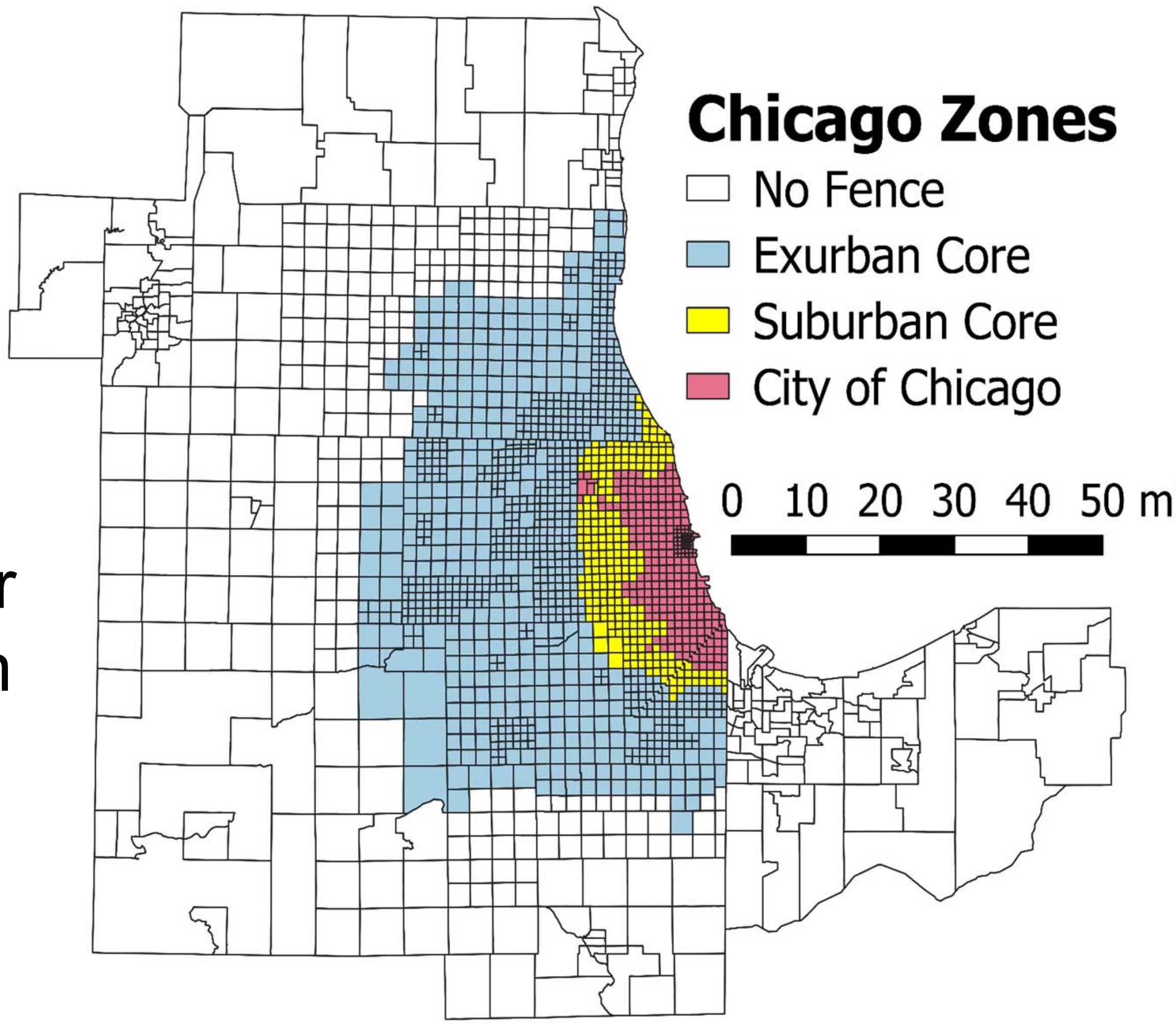
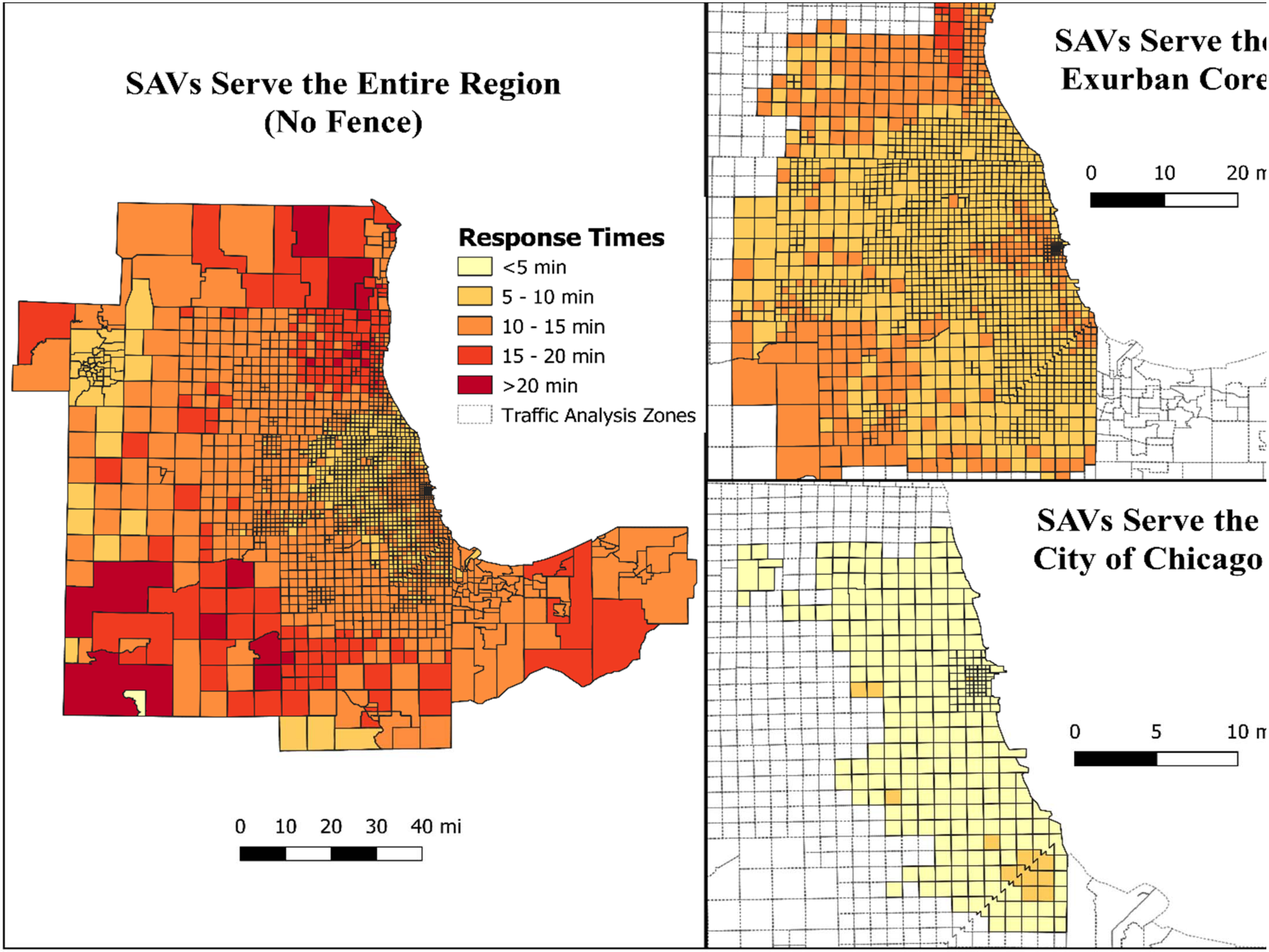
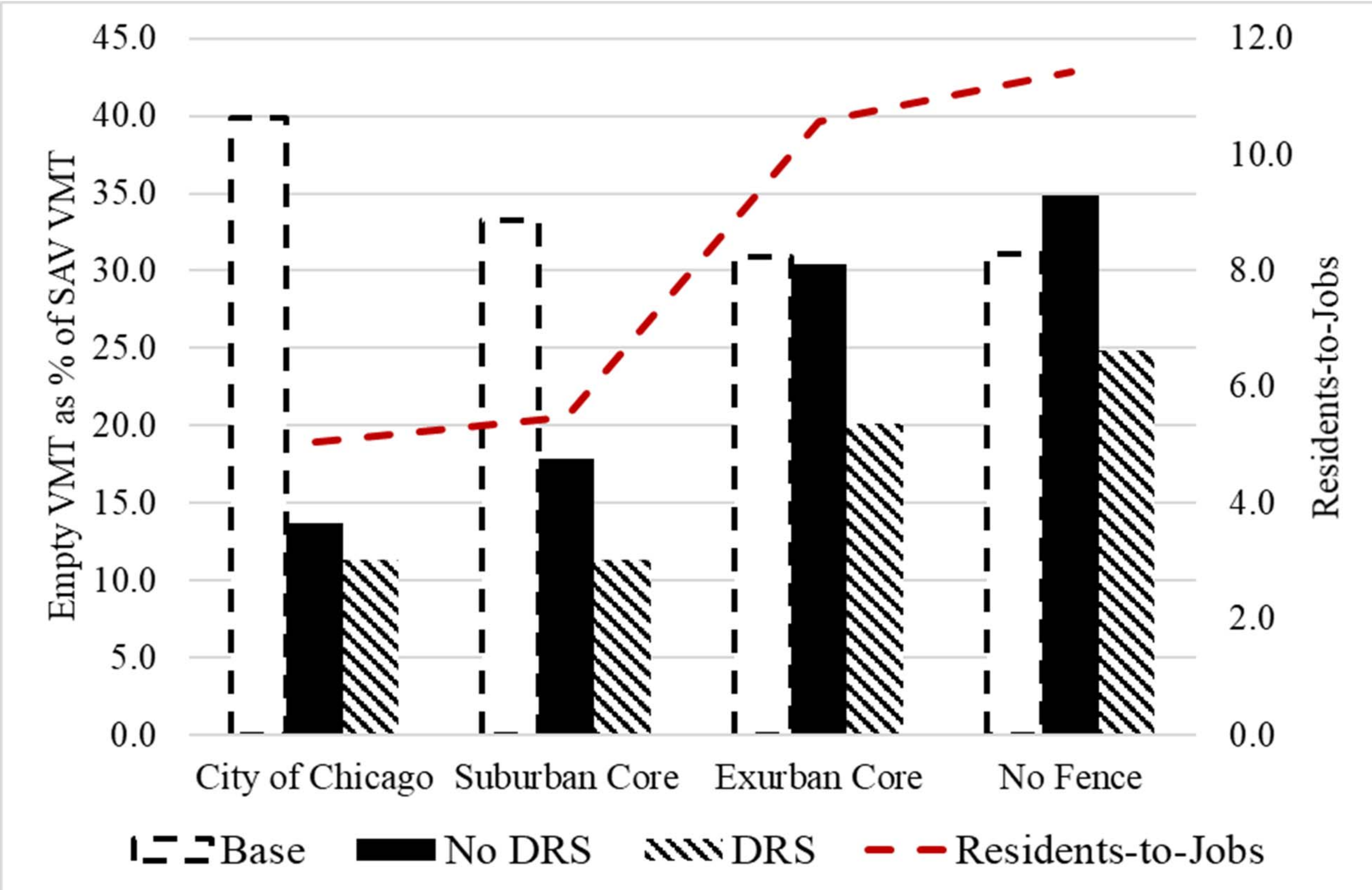
Case Study #1: 4 Chicago Geofences

- Different **population-to-jobs ratios** across geofences.
- **Pop/jobs ≈ 6** for City & Suburban Core.
- **> 11** for wider region




SAVs Serve the Entire Region
(No Fence)
Response Times
<5 min
5 - 10 min
10 - 15 min
15 - 20 min
>20 min
Traffic Analysis Zones
0 10 20 30 40 mi
SAVs Serve th
Exurban Core
0 10 20 m
SAVs Serve the
City of Chicago
0 5 10 m

%eVMT by Scenario



Note: Base Case = Ridehailing with conventional vehicles

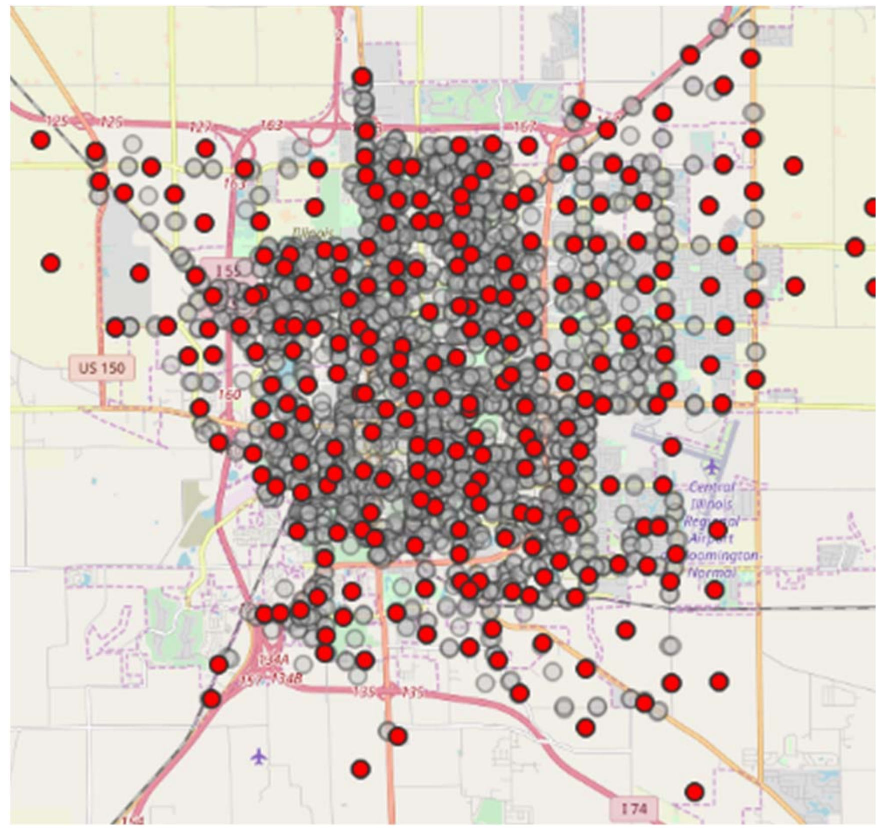
Fencing Results

Assuming fewer cars desired per household, **just 1 SAV per 100 residents**, & $0.50/mile SAV fares:

- ***Unfenced/full-region*** service has **11 min avg. response time** + **35%** (!) **eVMT**.
- **Geofences** help **lower response times & eVMT,** with **greatest reductions** within **(sub)urban core**.
- **City-wide fence** implies **smaller than 1:100 fleet** for comparable avg. trips served → non-linear fleet requirement.
- **Avg. response times** vary **linearly** with **proximity to CBD**.
- **Dynamic ride-sharing** (with strangers) lowers **%eVMT** by another **2-10%**.
- **Net VMT savings** up **to 5% (no DRS)** & **9% (DRS)** thanks to smaller fences.

Case Study #2: PUDOs in Bloomington

- **Bloomington**, Illinois
  - Just 74 sq. miles
  - **120,000** residents
  - **4,000** links **+ 2,500** nodes
  - About **2,800 unique locations**
- POLARIS **moves** travelers between all **O's & D's**.
- PUDO **stop clustering** using pre-defined **stop spacing, d_s** → **Equi-distant stops**



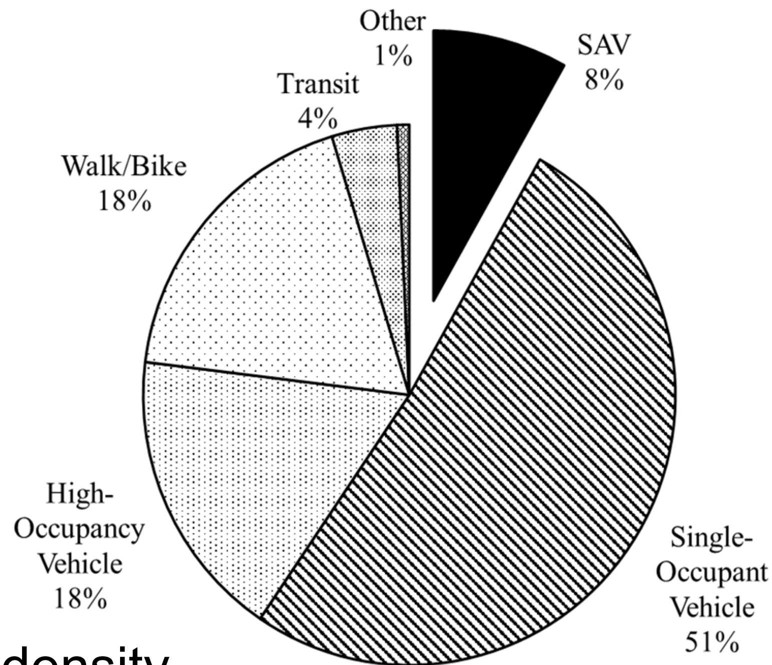
d_s = 0.25 mi = 400 m

Scenarios

- **Trip intensities**: **100%, 500%, & 2500%** to approximate a major city.
  - 25x provides about 15M trips/day or **8,500 person-trips per hour per sq. mile**.
  - **Travel times rise too**, so mode splits need to be unchanged for ideal comparison.
- Fleet sizes scaled up, so **each SAV serves 70 person-trips per day**, on average.
- SAVs considered for match if **< 10 min** away.
- **All** travelers assumed **willing to use DRS**.
- **DRS** matching ends if **> 5 min** or **5% delay** (vs. direct travel time).
- PUDO stop **spacings** of **d_s = 0, 0.25, & 0.5 mile** tested.

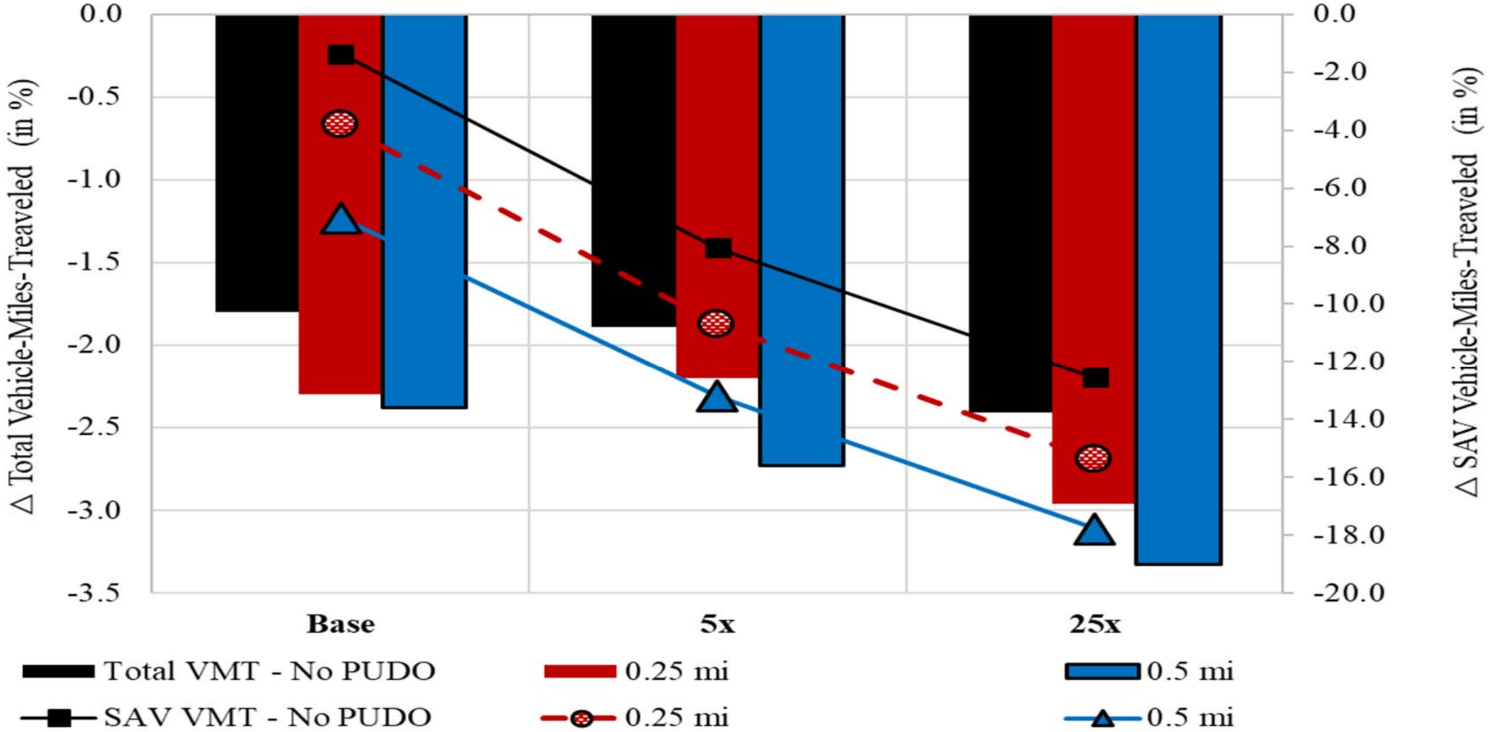
Results

- **7-8% of trip-makers** choose **SAVs.**
  - Between **48k** (1x) **to 1.2M** (25x) trips served each day.
- **With*out* DRS & PUDO Stops:**
  - Average SAV serves **65 trips/day**.
  - Travels approx. **430 mi/day** (!)
  - **% eVMT** about **34%** (!)
  - **2-5% lower eVMT** with 5x & 25x trip density.
- ***With* DRS (but no PUDOs):**
  - **5 more trips/**SAV/day, **19% eVMT,** & **2% less** *total* **SAV VMT**.
  - But **longer response** & **travel times**.



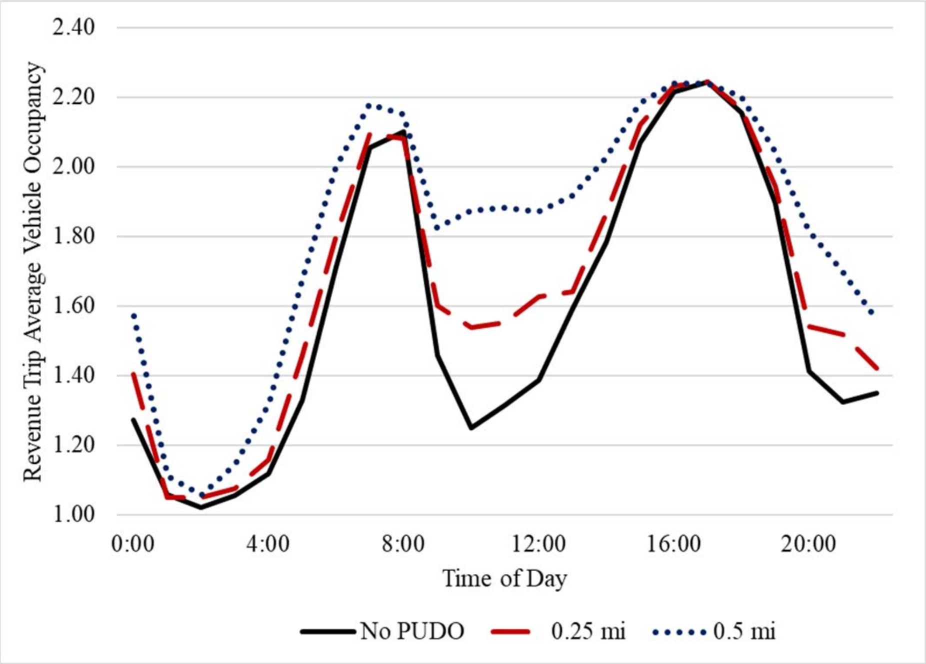
DRS + Stops

- ***Total VMT falls*** *by* ***1 to 3%.***
- **SAV VMT** savings of **10-20% possible**, with more savings from **5x & 25x** trip density **than from stops**.



Temporal Distribution of AVO

- **PUDOs increase AVO** & **lower total VMT** by aggregating **low-density trips** at **off-peaks**.
- Aggregating trips at **off-peak times may be** wise for benefits.
  - This **minimizes walking disutility** at other times of day to **maintain** overall **SAV attractiveness.**

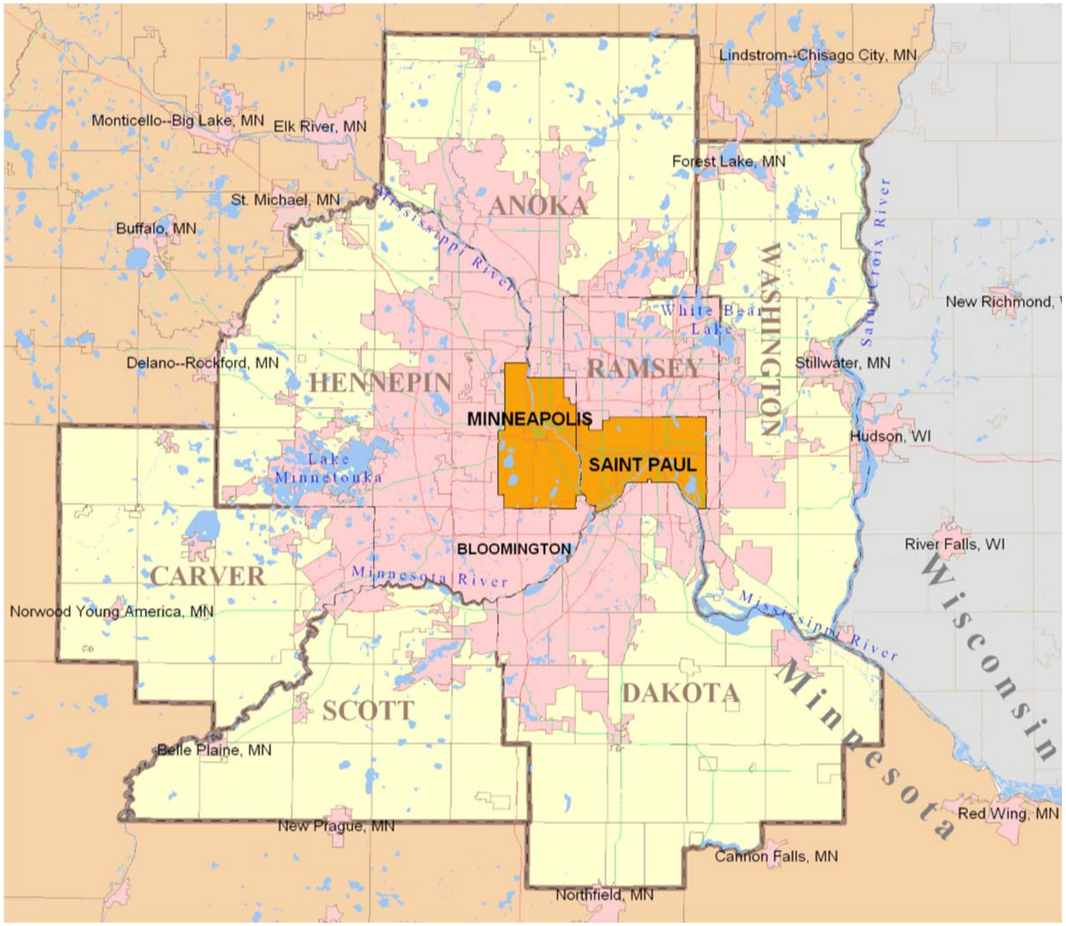


Stop Aggregation Takeaways

- **DRS** does help **lower congestion** – but really depends on travelers' **willingness to be delayed**.
- Higher trip density settings **can lower total VMT**.
- **High parking prices** can **shift mode shares** to **SAVs & transit** → boosting savings!
- **Stops** help marginally **increase AVO** & **lower VMT** – assuming **no disutility** from **walking**.
- **Dedicated infrastructure** may be needed to accommodate **SAVs at stops.**
- **Link characteristics** (larger **capacity & walkability**) may be important for **stop placement**.

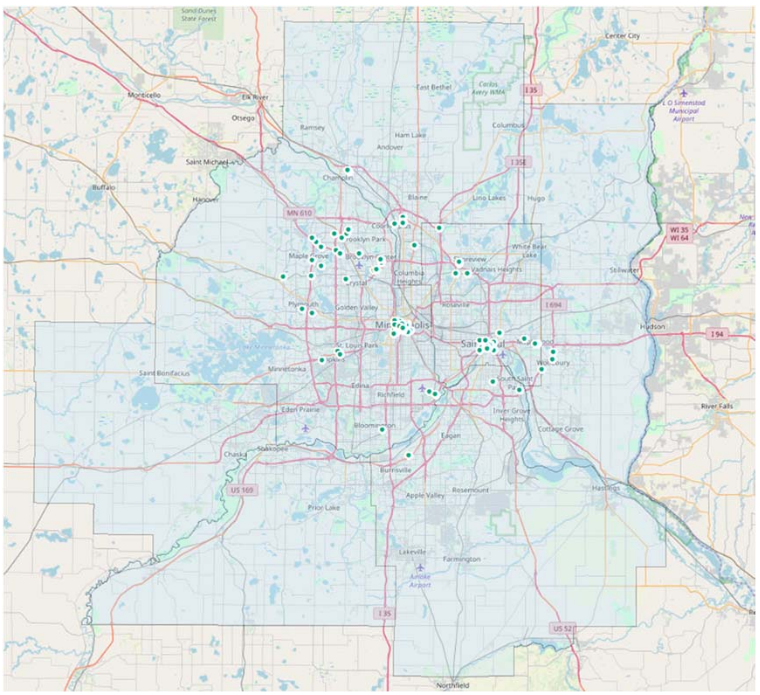
Case Study #3: SAV Parking Restrictions in the Twin Cities

- **9.5M person-trips/day** across **7 MPO counties**.
- **MATSim** used across 325k links & 131 nodes, ignoring external + trucks trips.

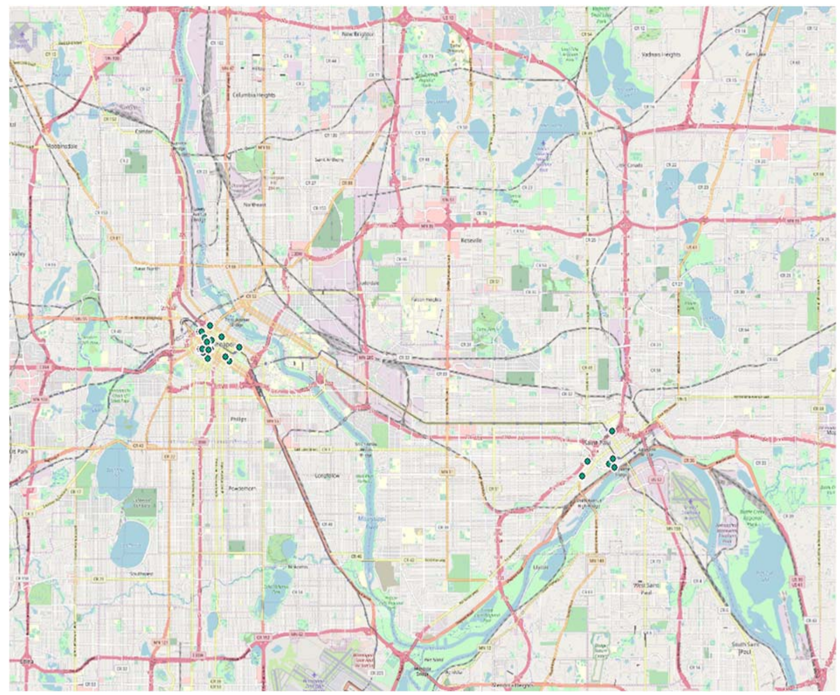


Restricting Curb Idling

- **134 parking lots with 500-vehicle capacity** along links with **> 400 trip stops (O's & D's) per curb per day**.
- **SAVs** dropping off pax at those curbs, seek **closest parking lot**. If no spaces are available at closet 2 lots, SAVs will idle at the curb.



Locations of Parking Lots across 7 Counties



Locations of Parking Lots across Twin Cities

MSP Parking Results

- **Curb parking restrictions** across 7 counties generated **8% more SAV VMT** & **7% more eVMT** on average.
- **SAV work durations**/run times **rose 15%.**
- **# DRS trips fell 5%.**
- **Curb parking restrictions** decreased **DRS trips** by **0.5%**, while increasing wait times by **11% & 19%** in the **7-county & Twin Cities** scenarios, respectively.

More Twin Cities Results

- **Using 1:5 SAV-to-traveler fleet**, **eVMT** averaged **7.2% to 14%** of **total VMT**, with each SAV **working 4.0 to 8.9 hours per day.**
- **Smaller fleet of 1:15** had higher **eVMT 17 to 23%** & running times ranging from **7.2 to 18 hr/day**.
- Once **DRS** is offered, **average response times fall 10%.**
- Relative to the **7-county service area**, **Twin Cities simulations** averaged **25% more DRS trips** & **19% shorter wait times.**
- **eVMT** occurred **mostly** in **neighborhoods** with **lower trip-end density** & **dispersed directions.**
- **Most SAV VMT & eVMT occur** on **freeways & highways** across MSP region.
- Interestingly, MSP **response times are similar across the region!**

Thank you!

Questions & Suggestions?

30+ CAV papers & reports at www.caee.utexas.edu prof/kockelman