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TOMORROW TODAY

MATSIM MODEL VIENNA

Intermodal Traffic Simulation for Vienna, Austria

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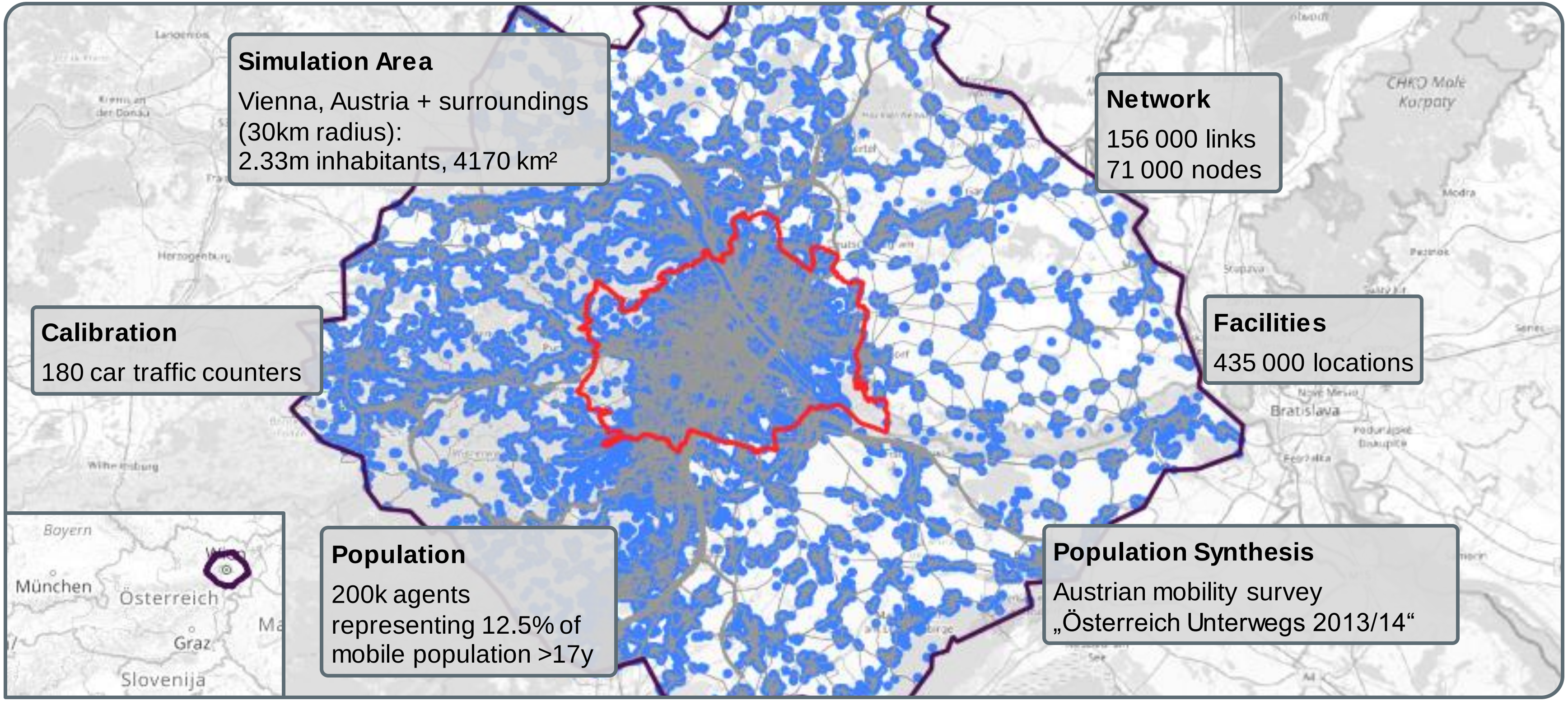
IN A NUTSHELL



Simulation Area

Vienna, Austria + surroundings (30km radius):
2.33m inhabitants, 4170 km²

Network

156 000 links
71 000 nodes

Calibration

180 car traffic counters

Facilities

435 000 locations

Population

200k agents representing 12.5% of mobile population >17y

Population Synthesis

Austrian mobility survey „Österreich Unterwegs 2013/14“

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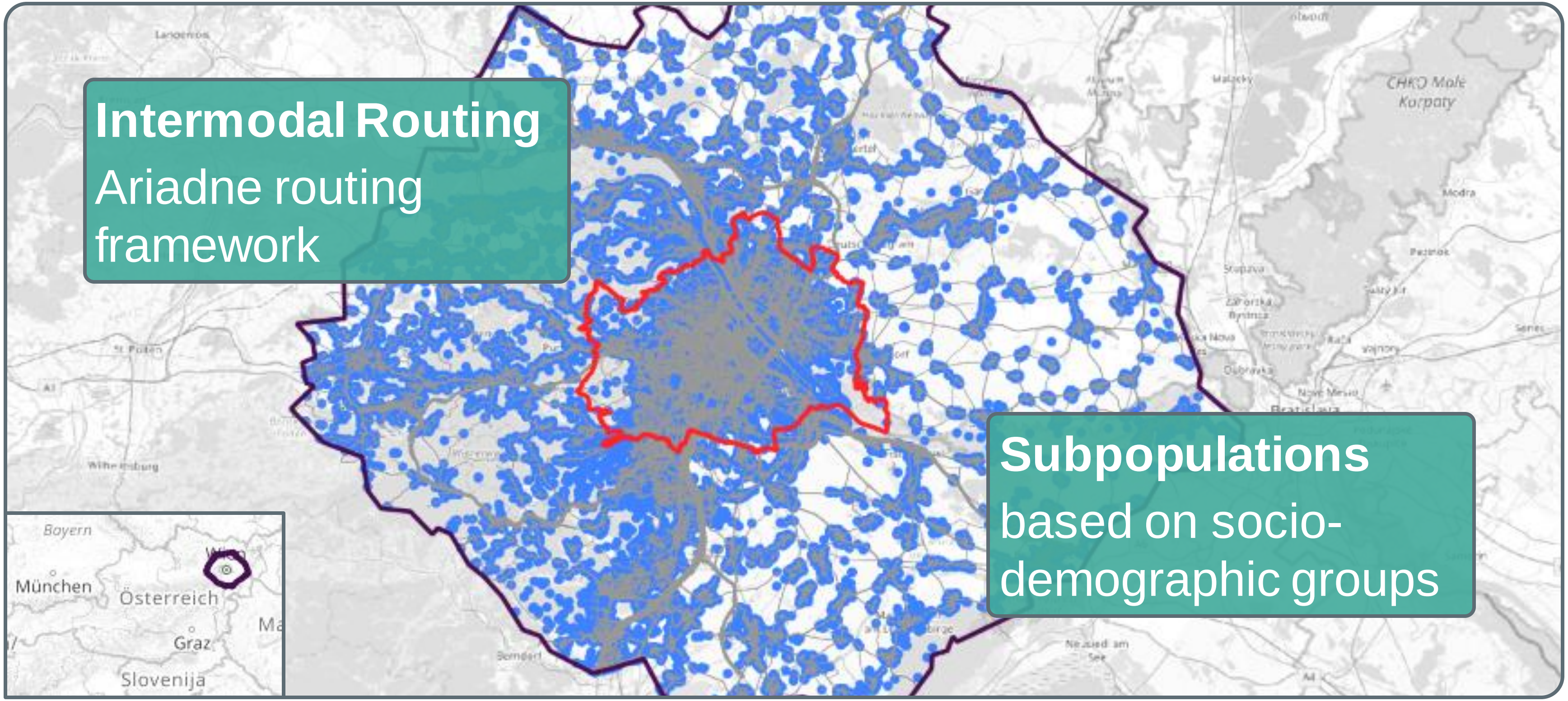
HIGHLIGHTS



Intermodal Routing

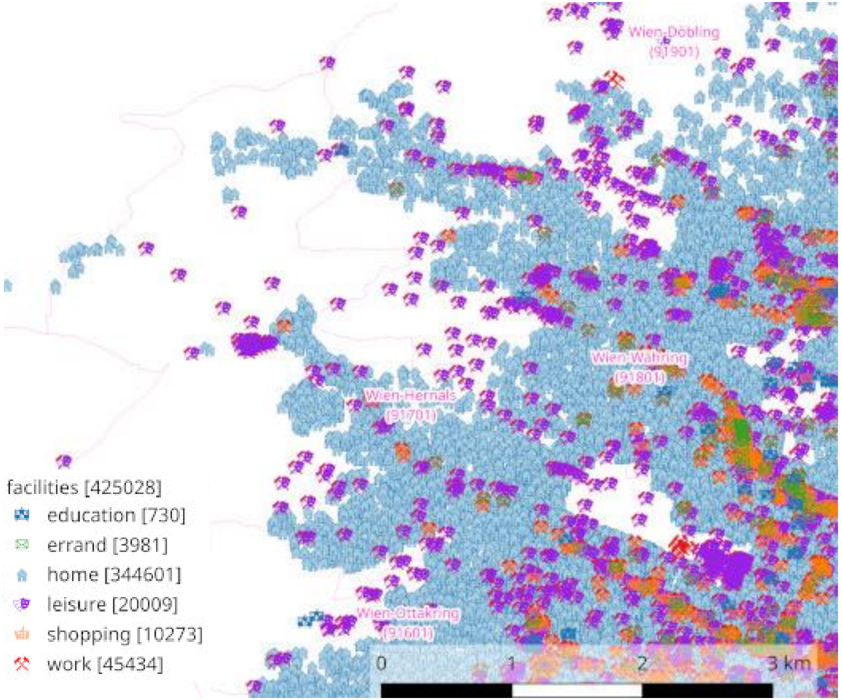
Ariadne routing framework

Subpopulations

based on socio-demographic groups

FACILITIES

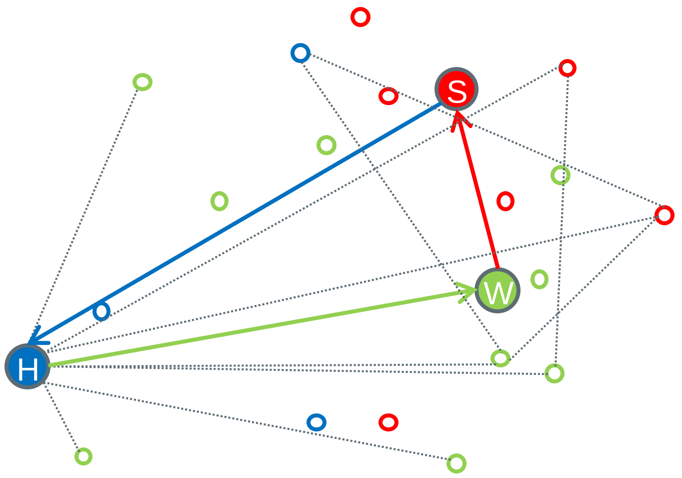
- **Education, errand, leisure, shopping**
  - OSM POIs
- **Home**
  - Geostat 1km² population grid
  - OSM residential areas
- **Work** (statistics by WKO*)
  - **71% service**: same facilities as errand, leisure, shopping
  - **25% production**: OSM industrial landuse
  - **4% agriculture**: ignored



* Austrian Federal Economic Chamber

POPULATION SYNTHESIS

- Data source: Austrian mobility survey „Österreich unterwegs 2013/14“
  - **resolution: municipal districts**

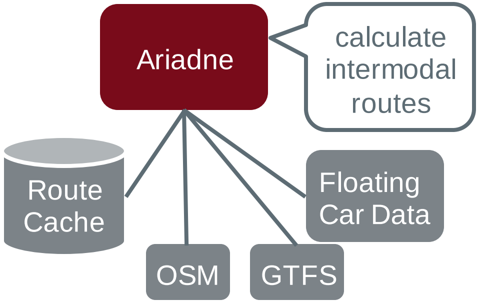


optimization: find best match of travel times

- **Synthesis by weighted resampling**
  - based on survey person-day weights
  - of mobile population on **workdays**
- Activity **location distinctness** classification
- Spatial **disaggregation** of distinct locations
  - Utilizing facility distributions
  - **Optimize** journey **facility locations to match reported travel time** (publication upcoming)

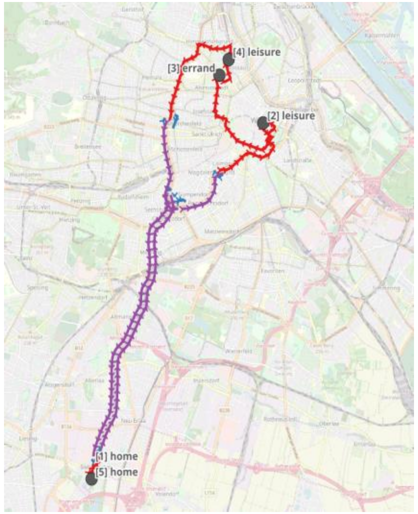
ARIADNE INTERMODAL ROUTER

- Modes of transport
  - Walk
  - Bike (including topography)
  - Public transport
  - Car
  - Combinations: P+R, Bike+Ride,…



Intermodal plans of an agent

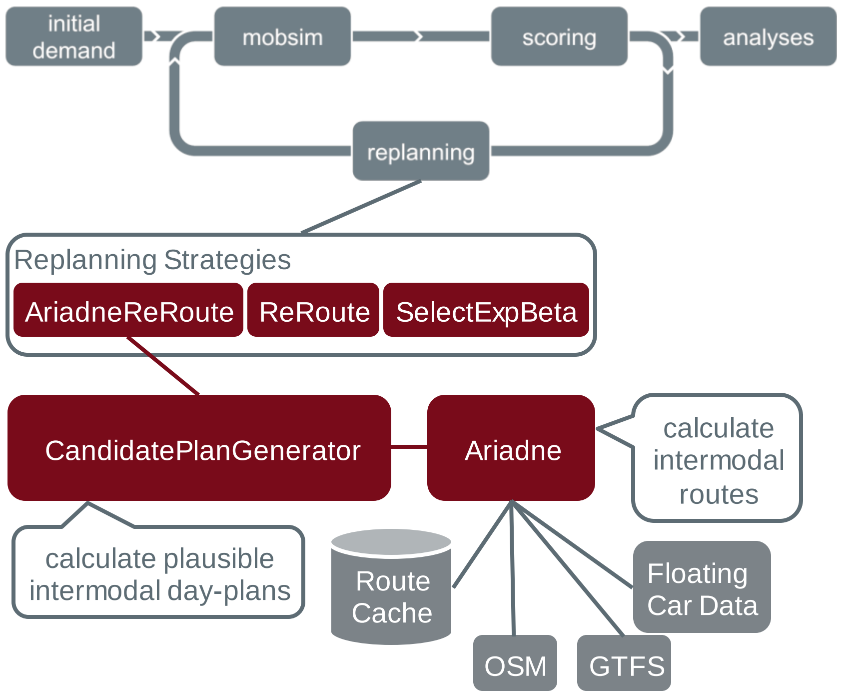
Car



P+R, DRT in the city center

REPLANNING WITH INTERMODAL TRAFFIC

- Replanning in MATSim
  - co-evolutionary algorithm
  - random mutation
  - **For intermodal plans**
    - **combinatorial explosion**
- Approach (similar to Hörl et al, 2018*)
  - **Limit alternative day plans to plausible ones**
  - **Pre-calculation and caching**
- Simulation
  - Car + DRT: on the MATSim network
  - Other: teleportation with the previously calculated travel time



* Pairing discrete mode choice models and agent-based transport simulation with MATSim.

MODE CHOICE MODEL: SUBPOPULATIONS

I. Parameter estimation for two latent classes

SP/RP Survey
BOKU / WU

→

	VTTS_bike	*VTTS_car*	…	*performing*	*< 35 yrs*	…
Class 1						
Class 2						

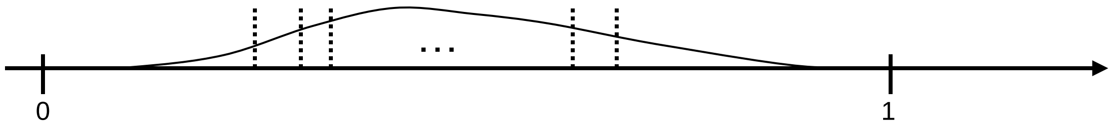
II. Calculation of Class Membership Probability

	sex	*Age below 35*	*Age above 55*	*Kids in household*	…
Agent 1					
…					
Agent n					

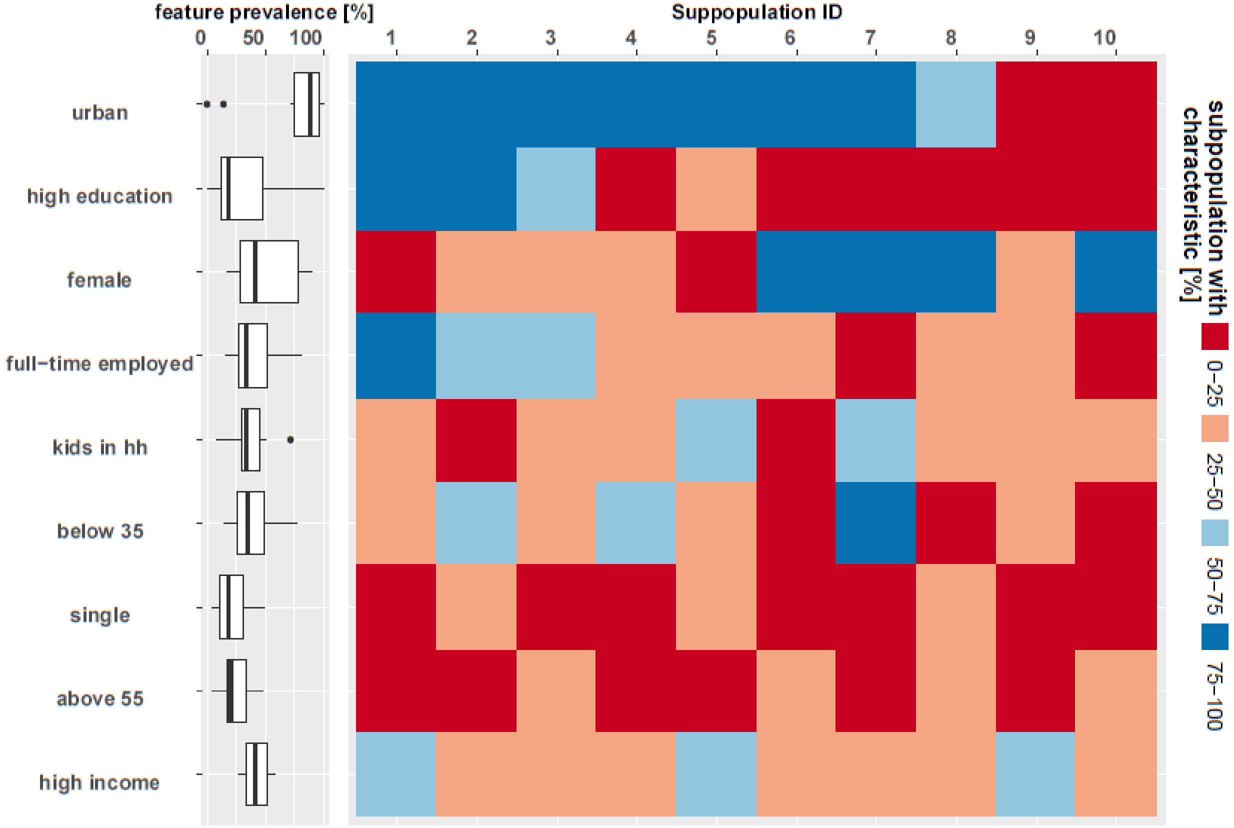
→

Membership prop for class 2

III. Assigning agents to a group according to class membership probability



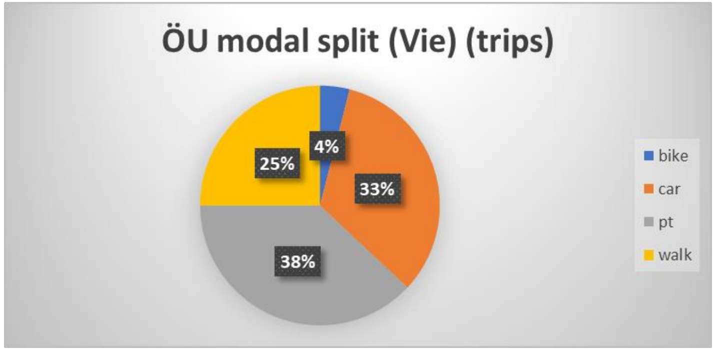
MODE CHOICE MODEL: SUBPOPULATIONS

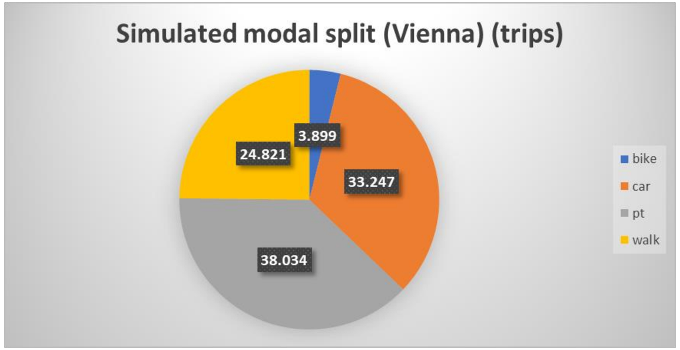


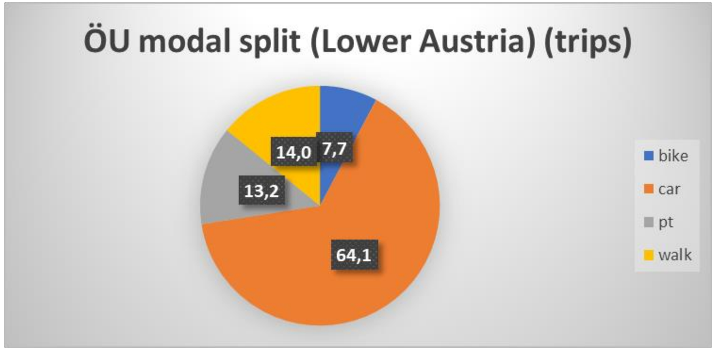
PARAMETERS FOR MODE CHOICE

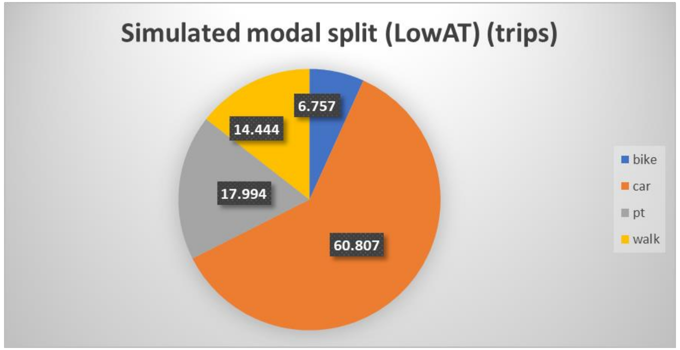
Subpopulation	c_{bike}	c_{car}	c_{pt}	β_{bike}	β_{car}	β_{pt}	β_{walk}	$\beta_{lineSwitch}$	β_{dur}
1	2.55	0.85	0.14	-9.38	-12.20	-5.29	-11.06	-0.71	10.71
2	2.72	0.80	0.13	-10.50	-12.29	-5.47	-11.39	-0.75	9.34
3	2.85	0.76	0.12	-11.38	-12.36	-5.61	-11.65	-0.78	6.75
4	2.94	0.74	0.12	-11.99	-12.40	-5.70	-11.83	-0.80	9.11
5	3.04	0.71	0.12	-12.65	-12.45	-5.81	-12.03	-0.83	7.35
6	3.18	0.67	0.11	-13.53	-12.52	-5.95	-12.28	-0.86	9.99
7	3.28	0.64	0.10	-14.20	-12.57	-6.05	-12.48	-0.88	13.02
8	3.42	0.59	0.10	-15.15	-12.64	-6.20	-12.76	-0.92	7.28
9	3.66	0.52	0.09	-16.73	-12.76	-6.45	-13.23	-0.97	6.23
10	4.09	0.39	0.07	-19.58	-12.97	-6.90	-14.07	-1.08	5.92

CALIBRATION AND VALIDATION









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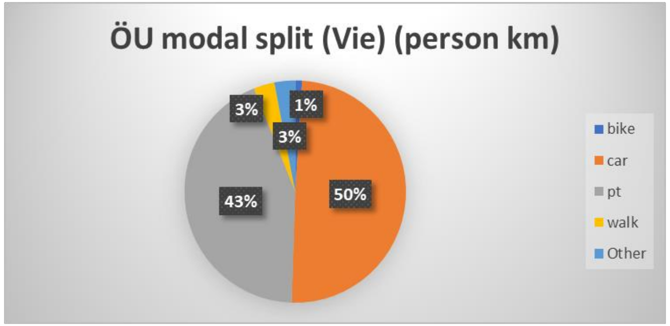
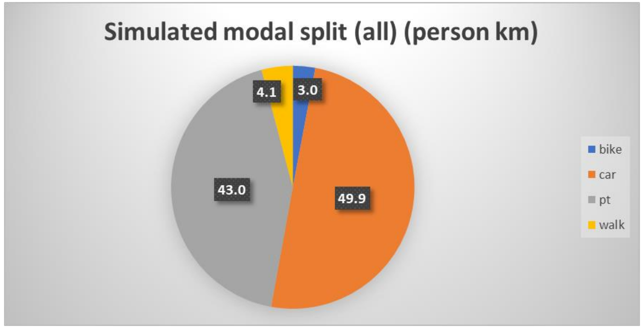
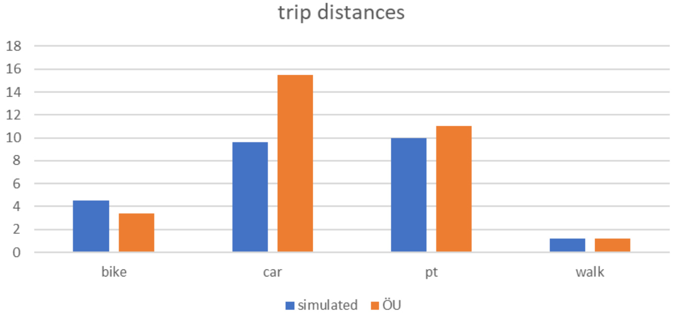
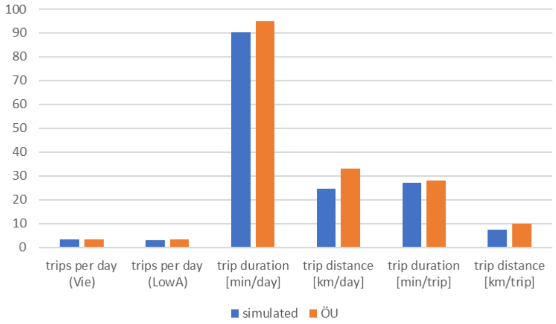








180 traffic count stations (95 in Vienna)

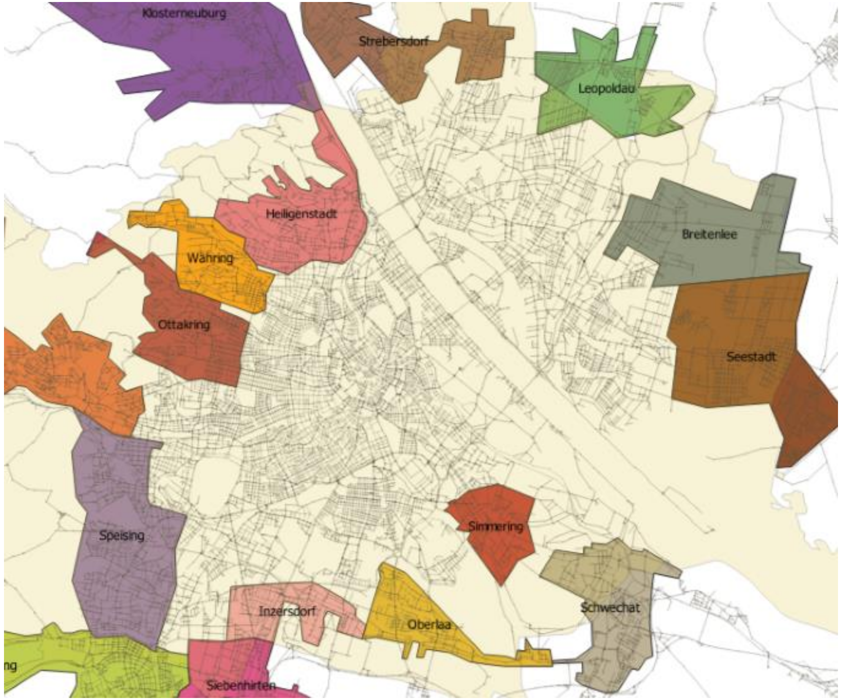
mean relative error for peak hours (6-9h,15-18h), city count stations: 0.34

MATSIM MODEL VIENNA

Application Example

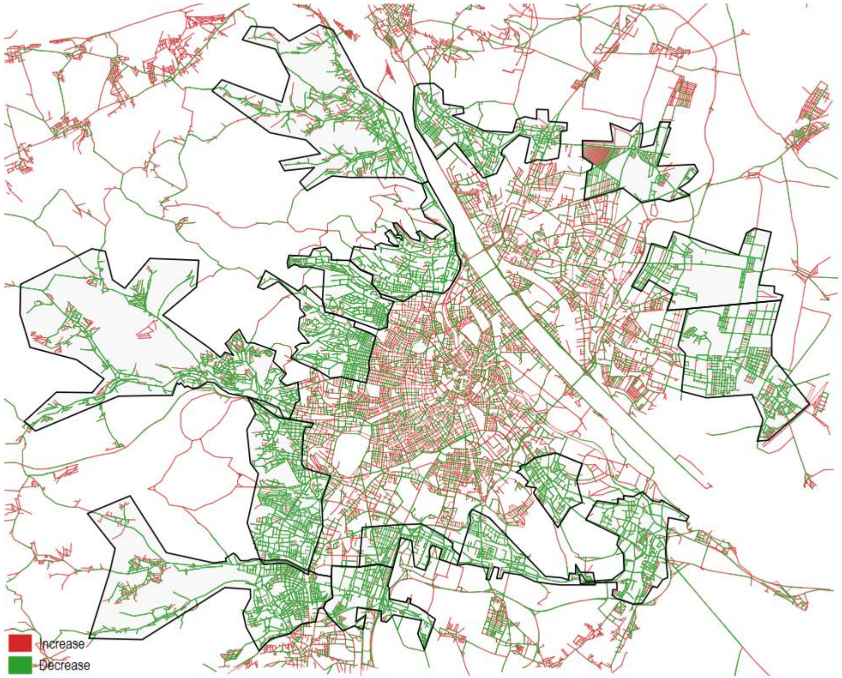
SHARED AUTONOMOUS ELECTRIC VEHICLES FOR THE FIRST AND LAST MILE

- **Concept:** SAEVs can only be used in the suburbs of Vienna
  - Fixed and separated areas, each with a metro station
- **Research question:** what is the environmental & socio-economic impact of SAEVs?
- MATSim modules
  - **drt** – demand responsive transport
  - **dvrp** – dynamic vehicle routing problem
  - **ev** – electric vehicles



IMPACT OF SAEVS

- Numbers of SAEV rides
  - correlate with price level
- Waiting times
  - decrease with higher fleet size
- **CO2 reductions**
  - only sufficient **if private car ownership is reduced**
- **Mode shifts**
  - towards SAEVs (and without additional policies): **expected to come from active modes** (walk, bicycle)



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OPEN ACCESS

- Open access release of the MATSim Model Vienna
  - **Full population (including subpopulations)**
  - Network
  - Facilities

- Excludes: Ariadne routing

https://github.com/ait-energy/matsim-model-vienna

RELATED LITERATURE

- Prandtstetter, M., M. Straub, and J. Puchinger, On the way to a multi-modal energy efficient route. In IECON 2013-39th Annual Conference of the IEEE Industrial Electronics Society, IEEE, 2013, pp. 4779–4784.
- Hössinger, R., F. Aschauer, S. Jara-Díaz, S. Jokubauskaite, B. Schmid, S. Peer, K. Axhausen, and R. Gerike, A joint time-assignment and expenditure-allocation model: value of leisure and value of time assigned to travel for specific population segments. Transportation, Vol. 47, No. 3, 2020, pp. 1439–1475.
- Schmid, B., S. Jokubauskaite, F. Aschauer, S. Peer, R. Hössinger, R. Gerike, S. R. Jara-Diaz, and K. Axhausen, A pooled RP/SP mode, route and destination choice model to investigate mode and user-type effects in the value of travel time savings. Transportation Research Part A: Policy and Practice, Vol. 124, 2019, pp. 262–294.
- Greene, W. H. and D. A. Hensher, A latent class model for discrete choice analysis: contrasts with mixed logit. Transportation Research Part B: Methodological, Vol. 37, No. 8, 2003, pp. 681–698.
- Hörl, S., Balac, M., Axhausen, K. (2018). Pairing discrete mode choice models and agent-based transport simulation with MATSim.
- **Müller, J., Straub, M., Naqvi, A., Richter, G., Peer, S., & Rudloff, C. (2021). MATSim Model Vienna: Analyzing the Socioeconomic Impacts for Different Fleet Sizes and Pricing Schemes of Shared Autonomous Electric Vehicles. Proceedings of the 100th Annual Meeting of the Transportation Research Board**

THANK YOU!

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