Michael Balmer, balmer@ivt.baug.ethz.ch

“Westumfahrung Zurich”: Real World Study with MATSim

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

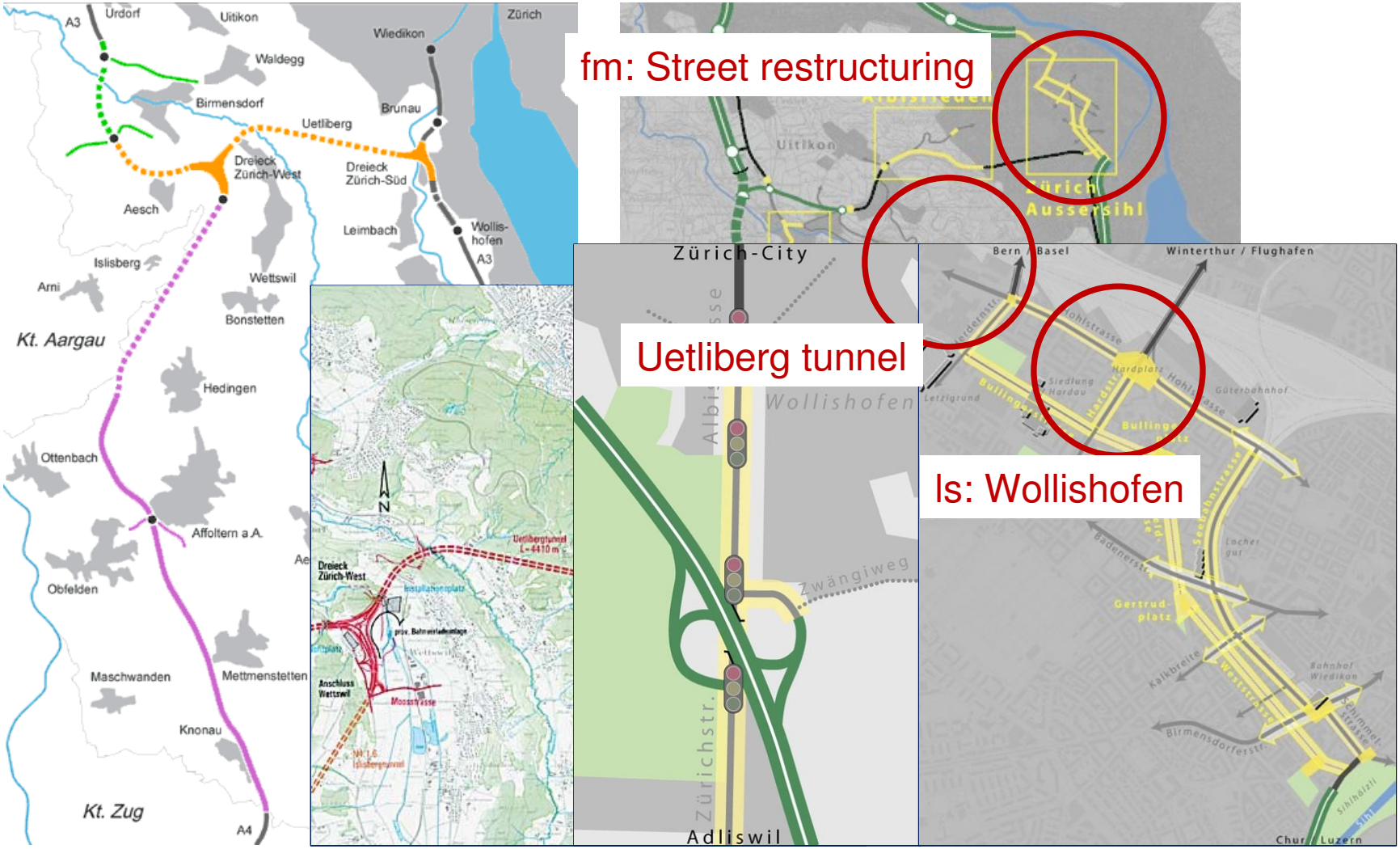
Technische Universität Berlin

MATSim
Multi-Agent Transport Simulation

Structure

- Target
- Case Study Process Steps with MATSim
- Project “Westumfahrung”
- Comparisons:
  - Actual State
  - Case Study I: Westumfahrung (WU)
  - Case Study II: WU & accompanying measures (AM)
  - Case Study III: WU & AM & traffic lights Wollishofen (TL)
- Conclusions / Summary & Outlook

Target



MATSim
Multi-Agent Transport Simulation

Target: Effects Measures

- Westumfahrung & Motorway A4 (Knonaueramt)
  - Traffic volumes
  - User of the WU
- Accompanying measures: Weststrasse / Seebahnstrasse ➔ called the “Westtangente” (WT)
  - Traffic volumes
  - Winners and loosers
- Brunau / Wollishofen
  - Effects of accompanying measures (traffic light)

Process Steps I: Initial Demand Creation

- Creating initial individual time-dynamic demand based on:
  - Census 2000
  - Micro census 2005
  - Commuter matrices 2000
  - Enterprise census 2000
  - National network model

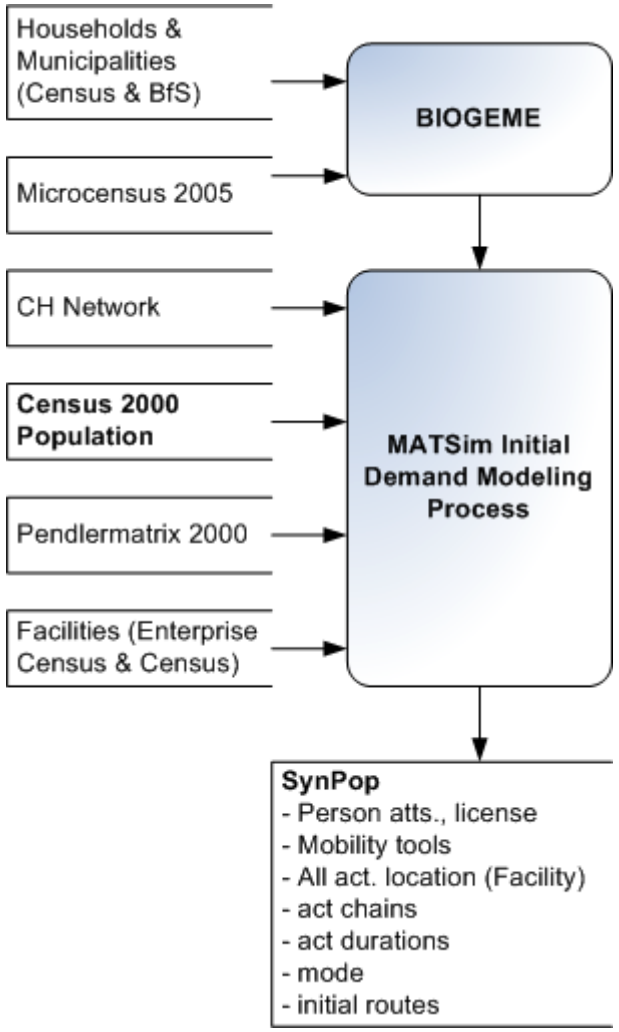
➔7.2 Mio Agents with demography

➔ca. 3.1 trips per agent

➔5 different activity types (h,w,e,s,l)

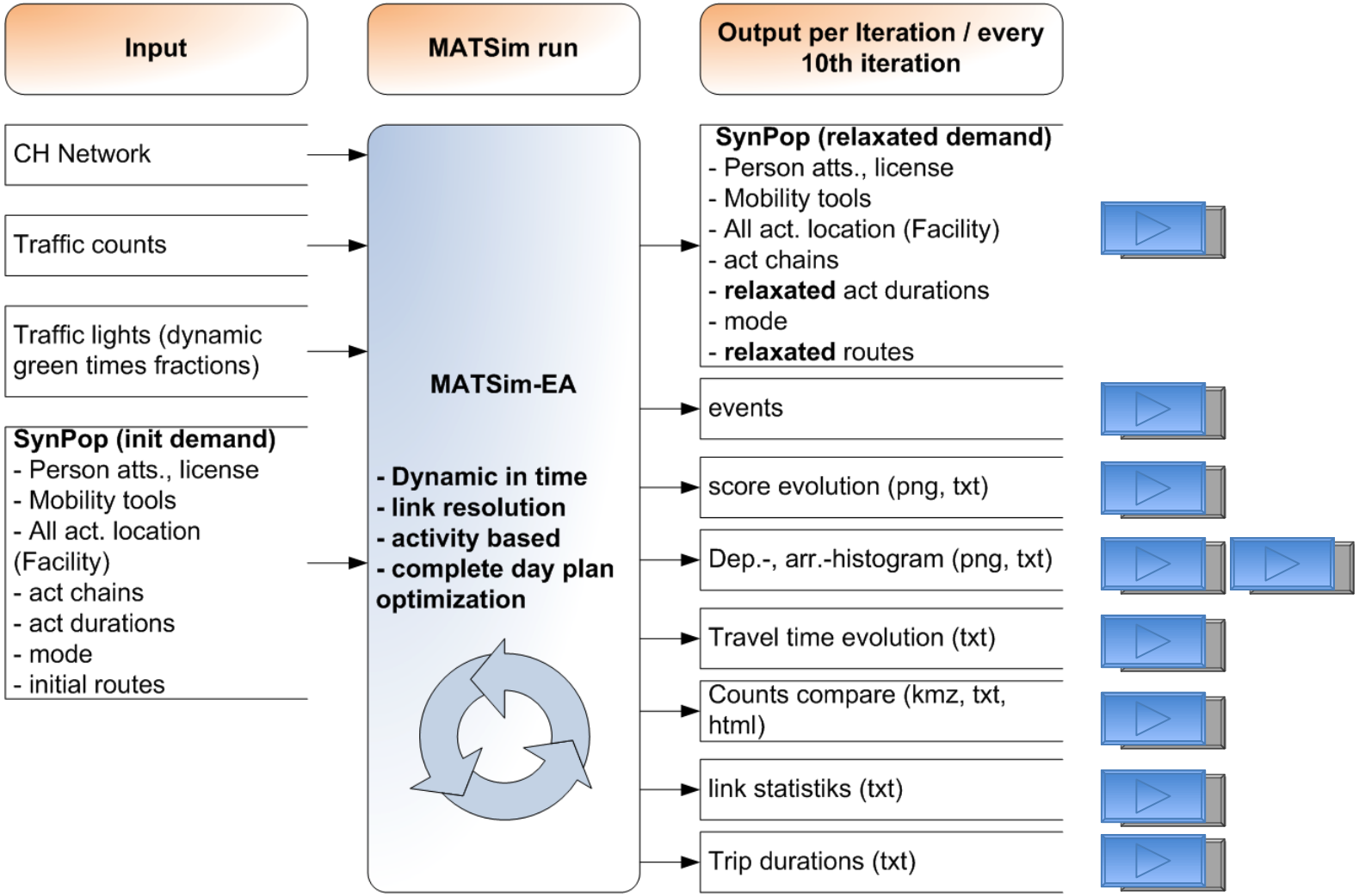
➔Mobility tools

➔Mode choice



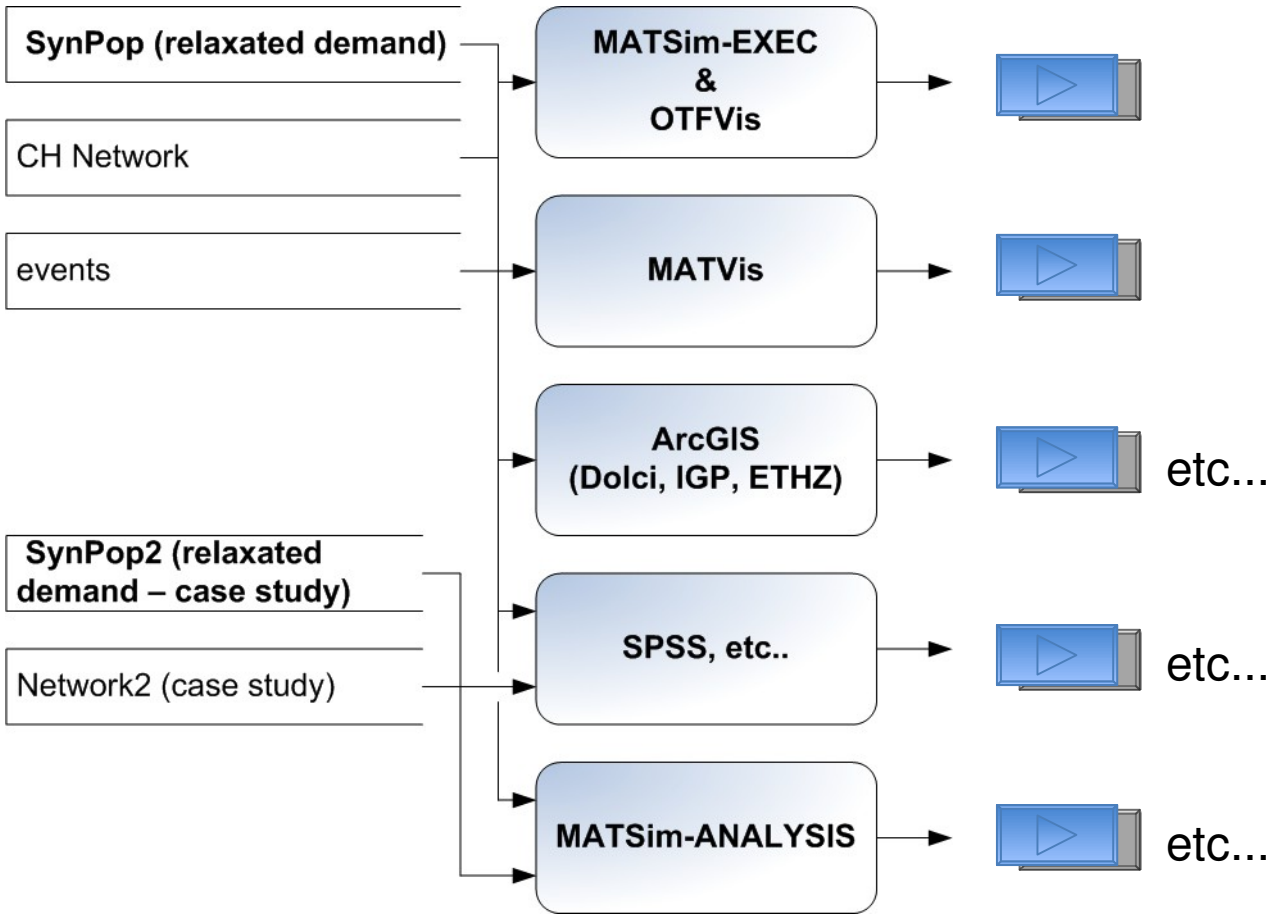
MATSim
Multi-Agent Transport Simulation

Process Steps II: relaxation → actual state

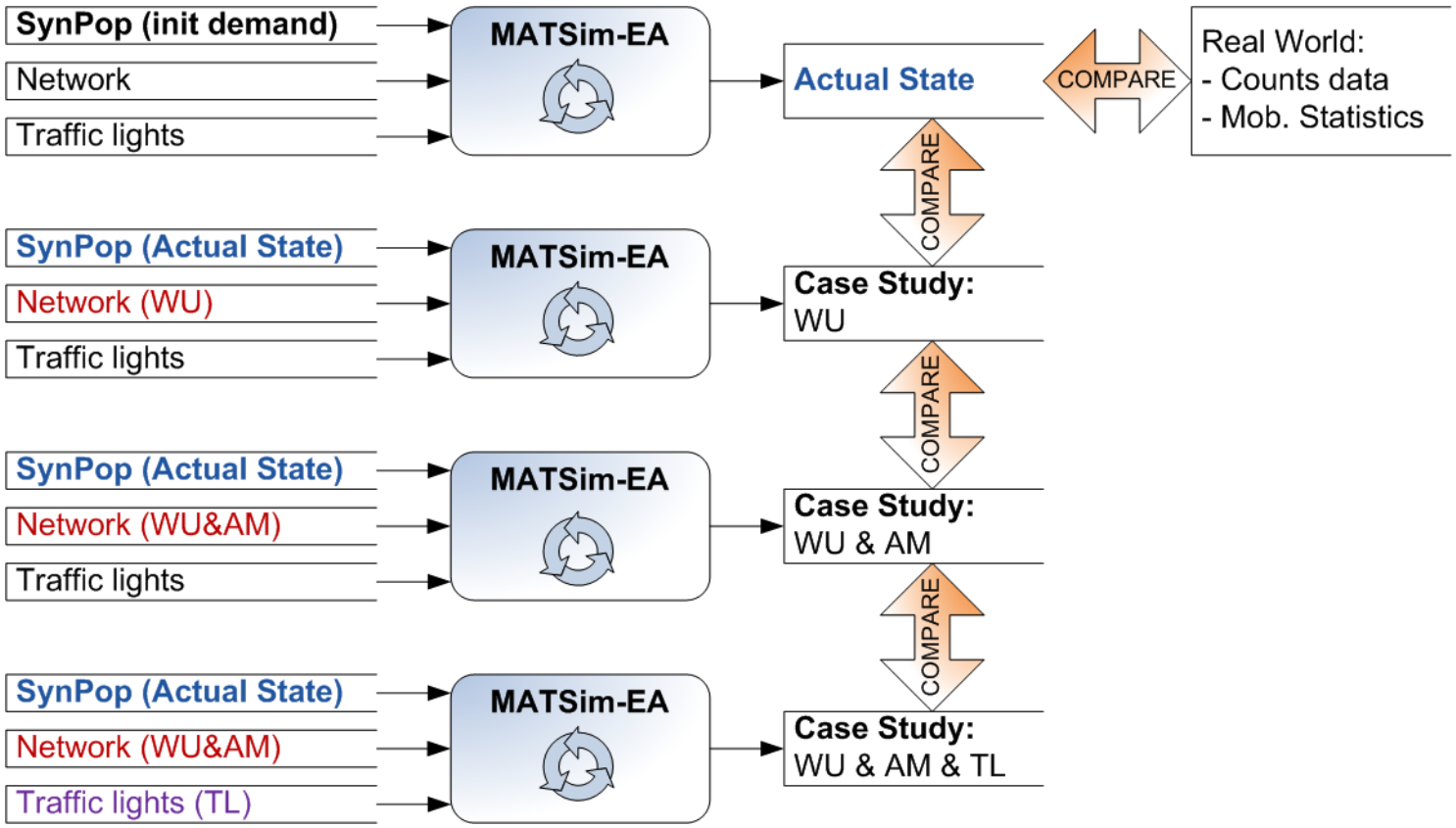


MATSim
Multi-Agent Transport Simulation

Process Steps III: post process analysis



Project “Westumfahrung”: process steps



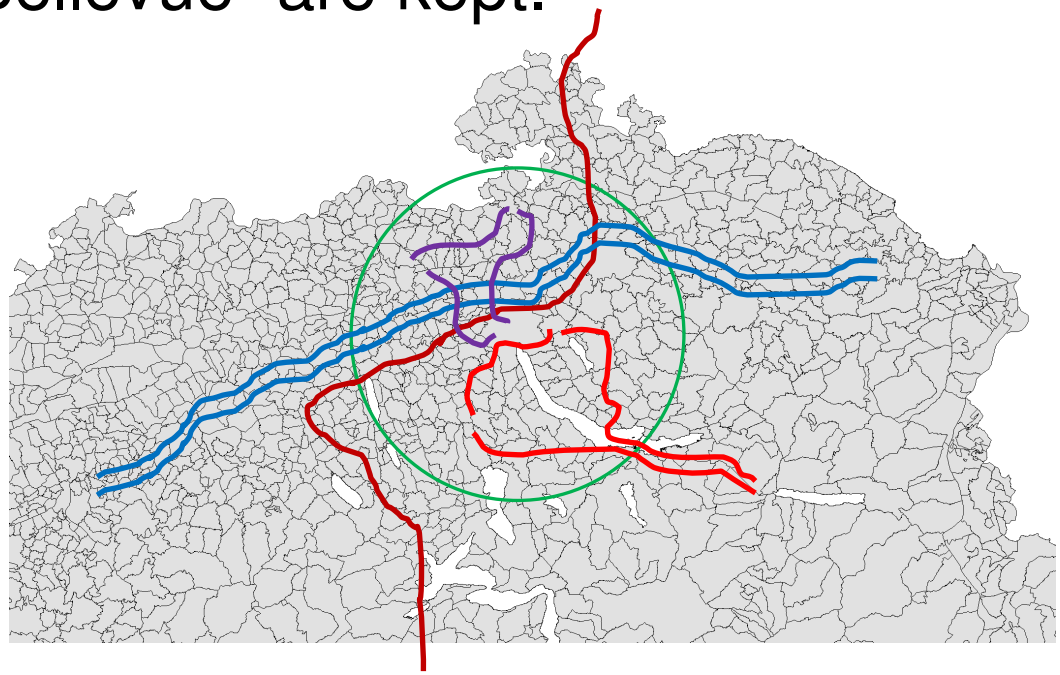
MATSim
Multi-Agent Transport Simulation

Project “Westumfahrung”: Initial demand

- ~7.2 Mio. agents of Switzerland (~22 Mio. trips)
- Additional ~570‘000 agents / ~870‘000 trips (Swiss border crossing traffic)
  - Commuters
  - Shopping / leisure traffic
  - Transit traffic
  - ➔ motorized individual transport only

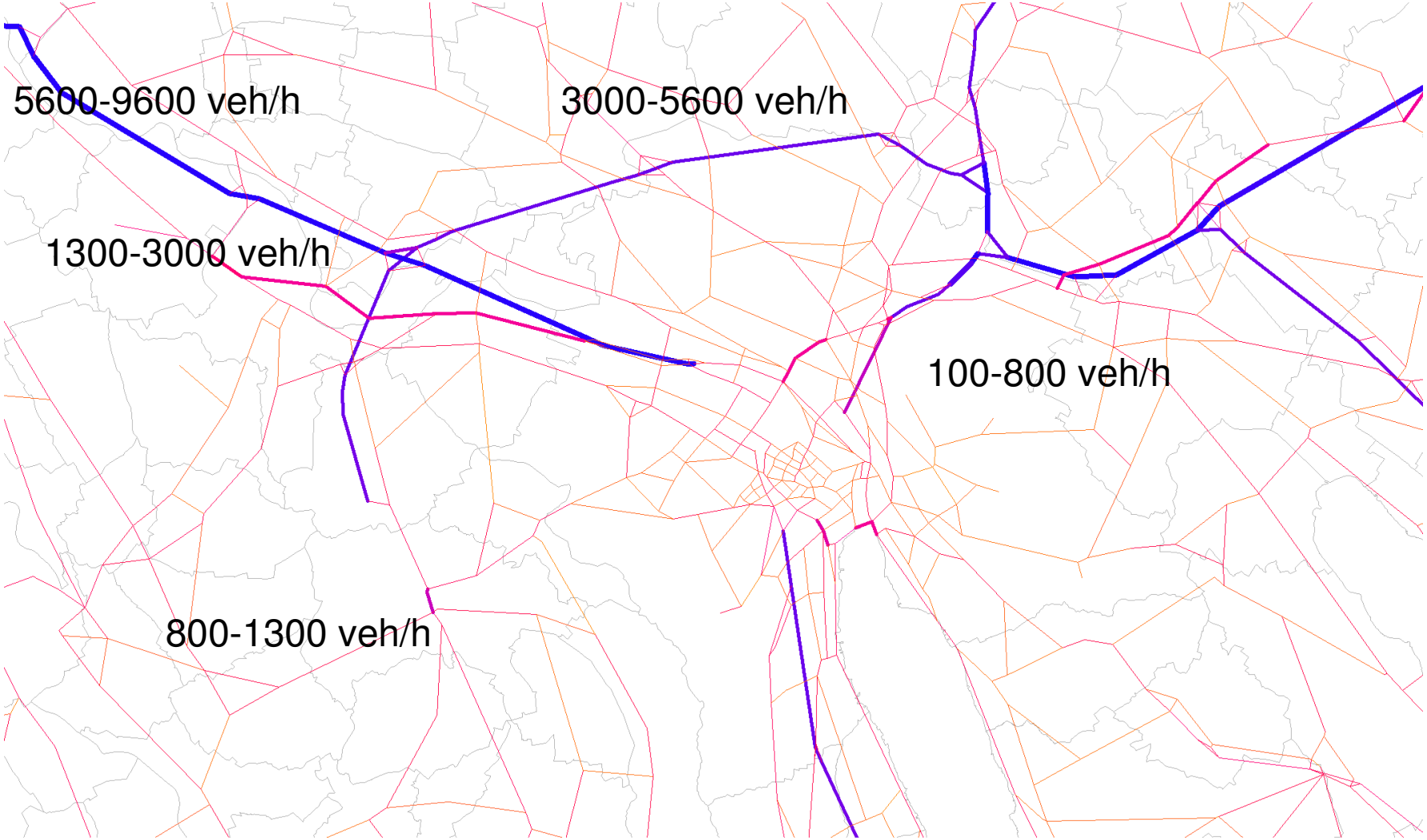
Project “Westumfahrung”: Region of Zurich

Agents which pass the Area of circle := 30km radius around „Bellevue“ are kept.



➔ 673’706 agents / 2’173’235 trips (MIT)

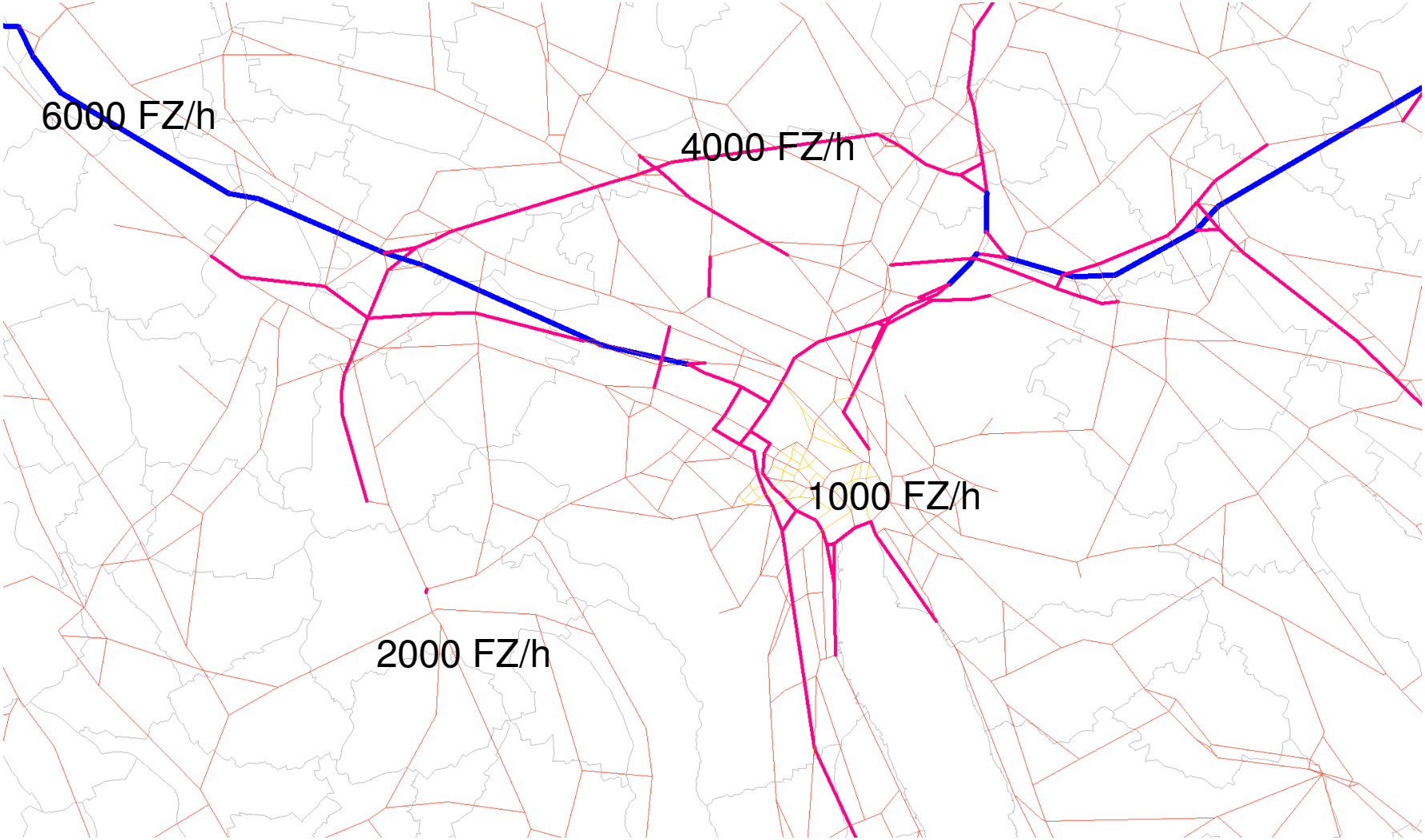
Project “Westumfahrung”: network (basis)



colors: capacities, thickness: # lanes

MATSim
Multi-Agent Transport Simulation

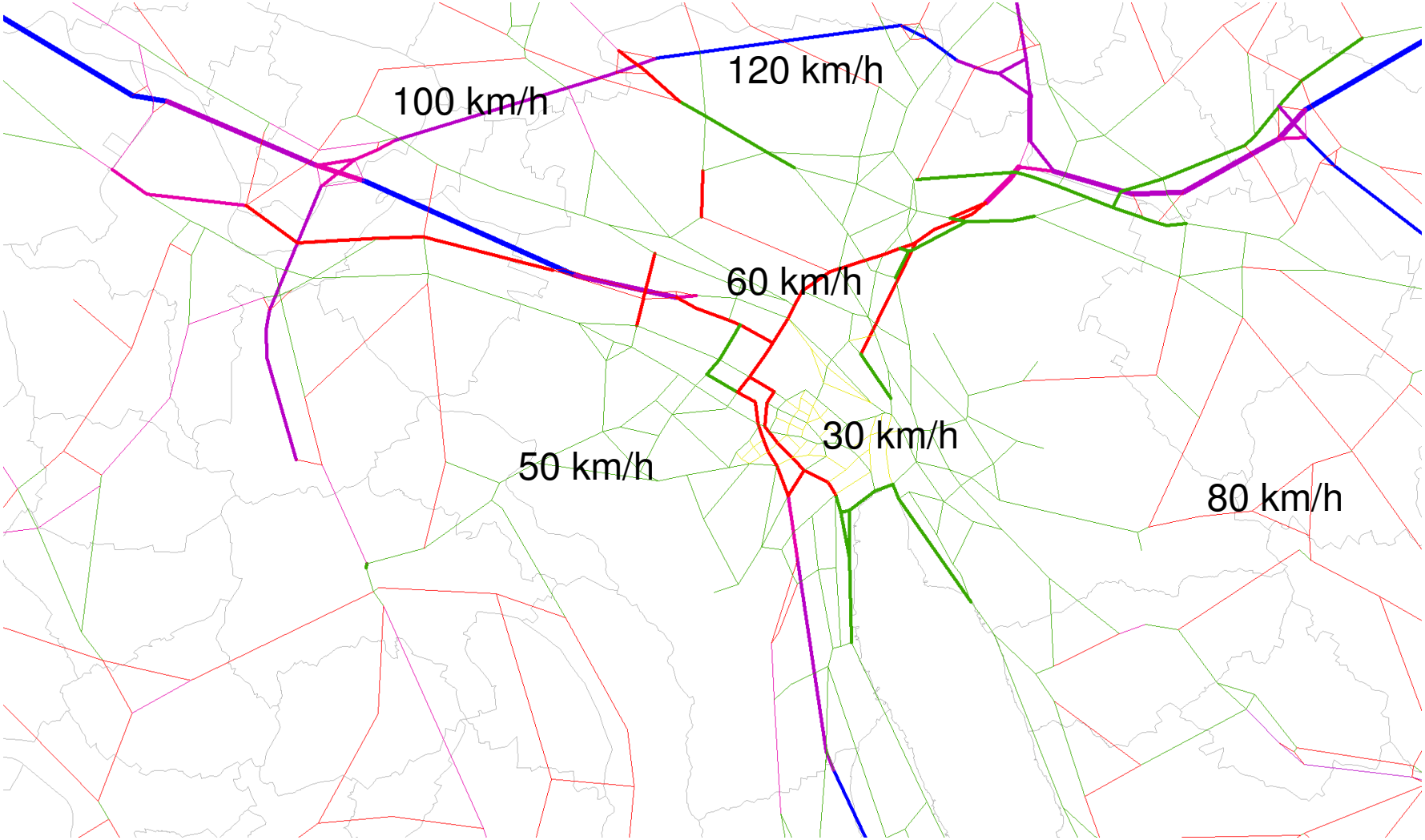
Project “Westumfahrung”: network (adaption)



colors: capacities, thickness: # lanes

MATSim
Multi-Agent Transport Simulation

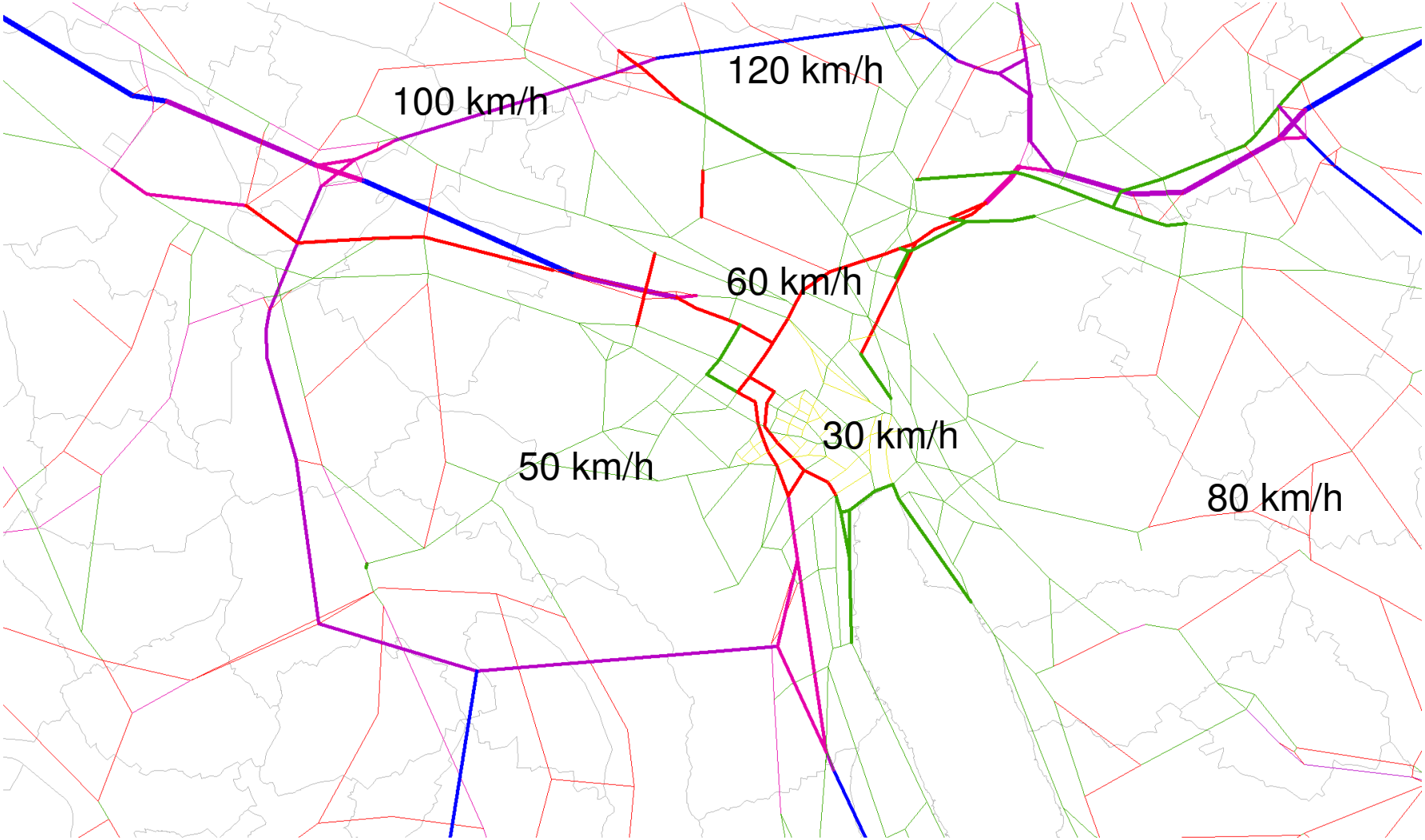
Project “Westumfahrung”: network (adaption)



colors: free speed, thickness: # lanes

MATSim
Multi-Agent Transport Simulation

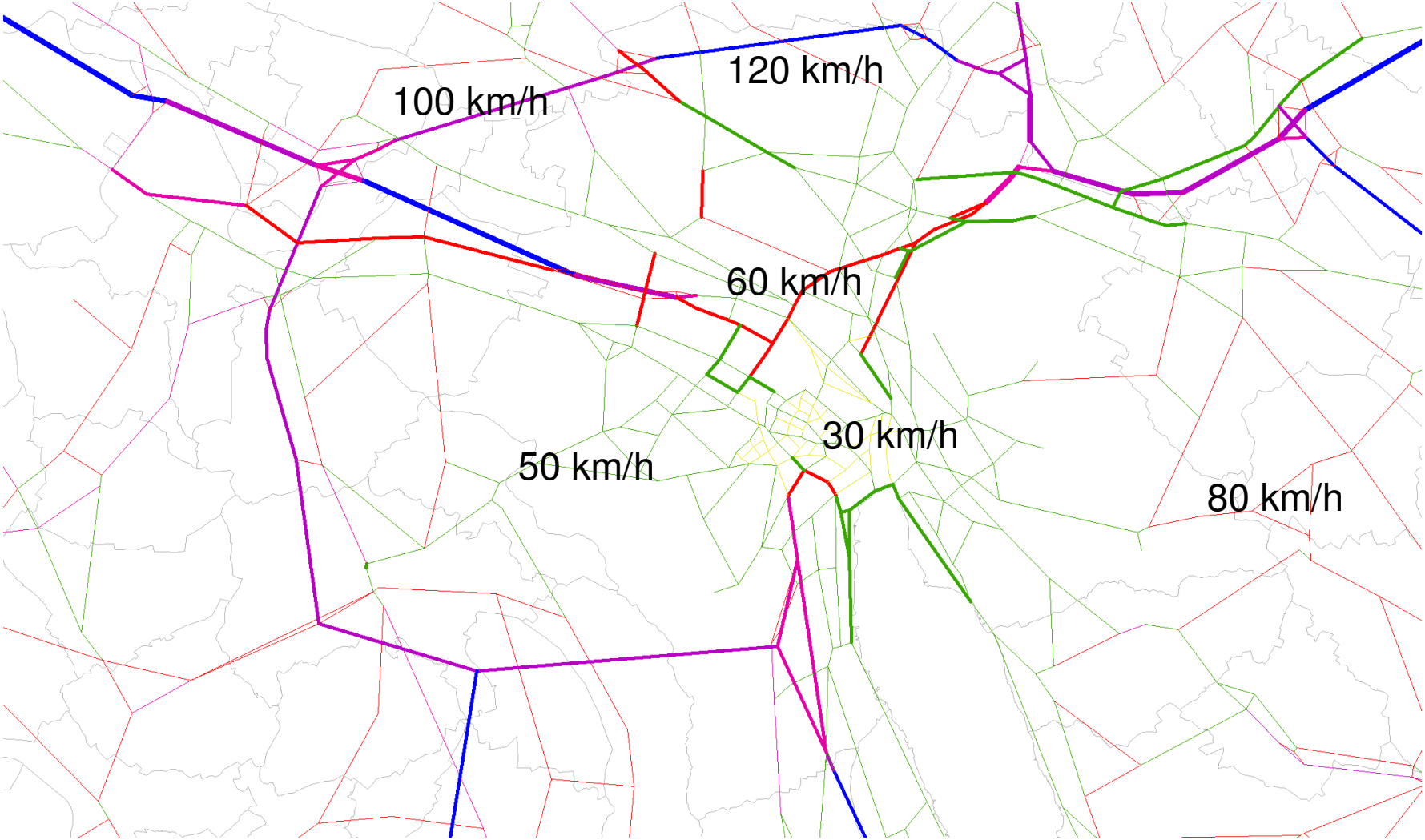
Project “Westumfahrung”: network (WU)



colors: free speed, thickness: # lanes

MATSim
Multi-Agent Transport Simulation

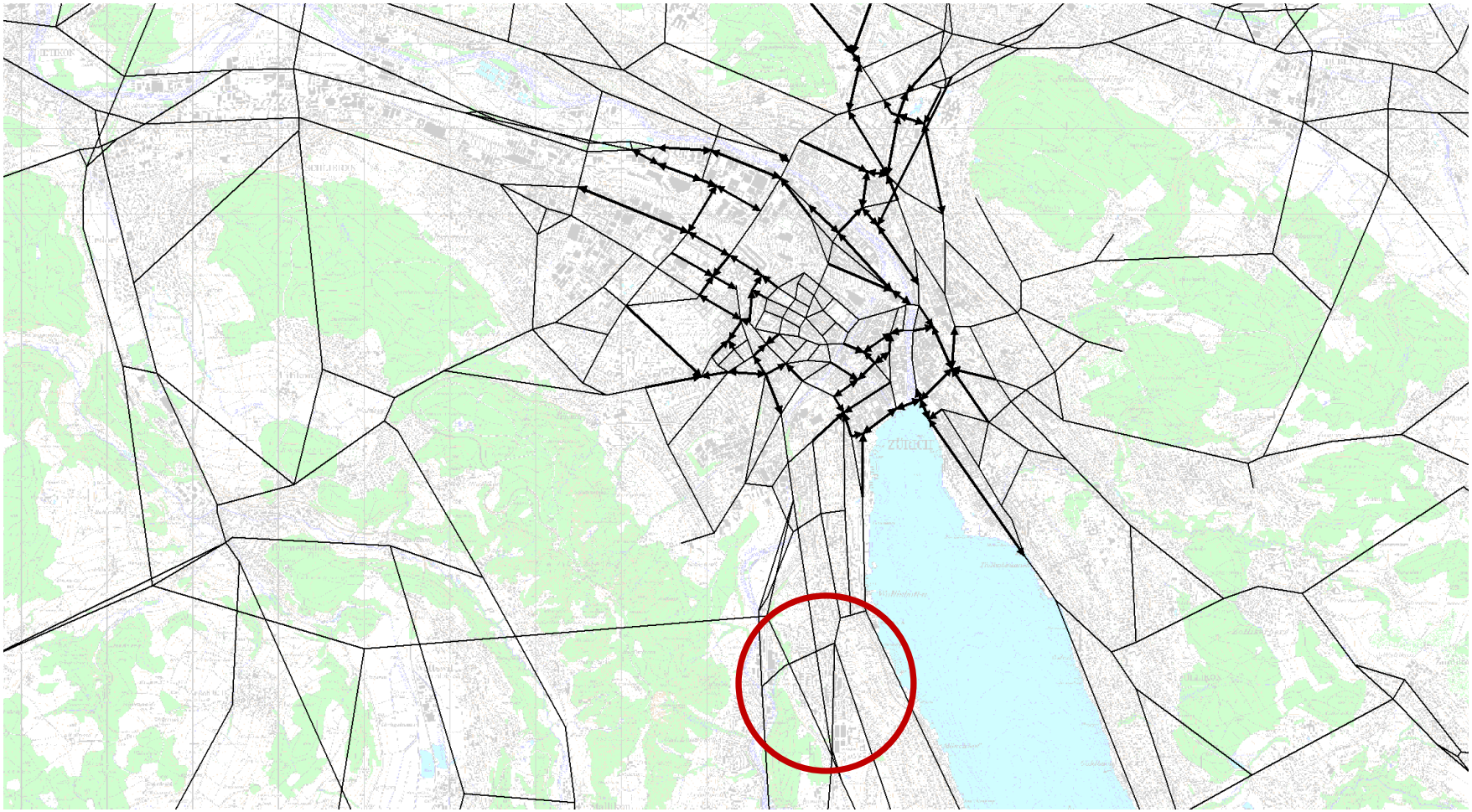
Project “Westumfahrung”: network (WU&AM)



colors: free speed, thickness: # lanes

MATSim
Multi-Agent Transport Simulation

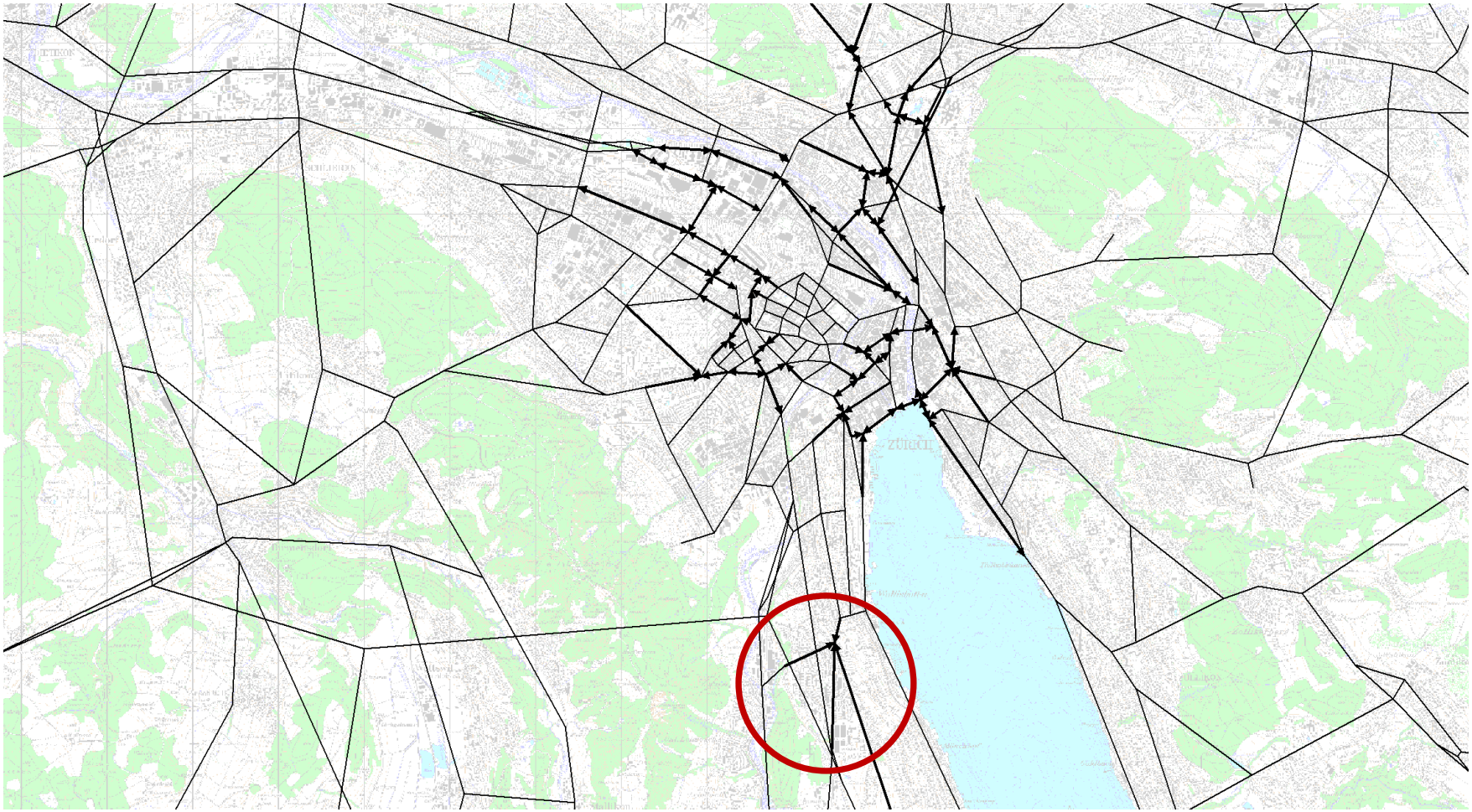
Project “Westumfahrung”: traffic lights



arrows: links with traffic lights

MATSim
Multi-Agent Transport Simulation

Project “Westumfahrung”: TL Wollishofen



arrows: links with traffic lights

MATSim
Multi-Agent Transport Simulation

Reality vs. Actual State

Reality vs. Actual State

- Dynamic traffic volumes
- Counts comparison 

Comparisons: Statistics

Actual State vs. CS I (WU)

- Statistics

Border crossing agents	Actual State	Case Study I (WU)
av. daily utility	64,84	69,31
av. trip travel time	02:13:14	02:06:40
av. trip distance [km]	189,77	189,40

Census population	Actual State	Case Study I (WU)
av. daily utility	183,72	185,61
av. trip travel time	00:16:22	00:14:23
av. trip distance [km]	12,35	12,36

Population WT ==> WU	Actual State	Case Study I (WU)
av. daily utility	158,26	165,08
av. trip travel time	00:48:20	00:39:10
av. trip distance [km]	45,61	46,69

Population WT	Actual State	Case Study I (WU)
av. daily utility	164,68	166,04
av. trip travel time	00:21:54	00:18:57
av. trip distance [km]	8,57	8,50

CS I (WU) vs. CS II (WU&AM)

- Statistics

Border crossing agents	Case Study I (WU)	Case Study II (WU&AM)
av. daily utility	69,31	67,78
av. trip travel time	02:06:40	02:10:04
av. trip distance [km]	189,40	189,66

Census population	Case Study I (WU)	Case Study II (WU&AM)
av. daily utility	185,61	184,91
av. trip travel time	00:14:23	00:14:41
av. trip distance [km]	12,36	12,34

Population WT ==> WU	Case Study I (WU)	Case Study II (WU&AM)
av. daily utility	182,50	181,16
av. trip travel time	00:32:55	00:32:42
av. trip distance [km]	31,06	32,28

Population WT	Case Study I (WU)	Case Study II (WU&AM)
av. daily utility	166,04	164,02
av. trip travel time	00:18:57	00:18:38
av. trip distance [km]	8,50	8,45

CS II (WU&AM) vs. CS III (WU&AM&TL)

- Statistics

Border crossing agents	Case Study II (WU&AM)	Case Study III (WU&AM&TL)
av. daily utility	67,78	68,02
av. trip travel time	02:10:04	02:08:26
av. trip distance [km]	189,66	189,54

Census population	Case Study II (WU&AM)	Case Study III (WU&AM&TL)
av. daily utility	184,91	184,82
av. trip travel time	00:14:41	00:14:48
av. trip distance [km]	12,34	12,35

Population WT ==> WU	Case Study II (WU&AM)	Case Study III (WU&AM&TL)
av. daily utility	181,98	182,88
av. trip travel time	00:33:29	00:33:54
av. trip distance [km]	30,98	31,71

Population WT	Case Study II (WU&AM)	Case Study III (WU&AM&TL)
av. daily utility	164,02	165,03
av. trip travel time	00:18:38	00:20:14
av. trip distance [km]	8,45	8,32

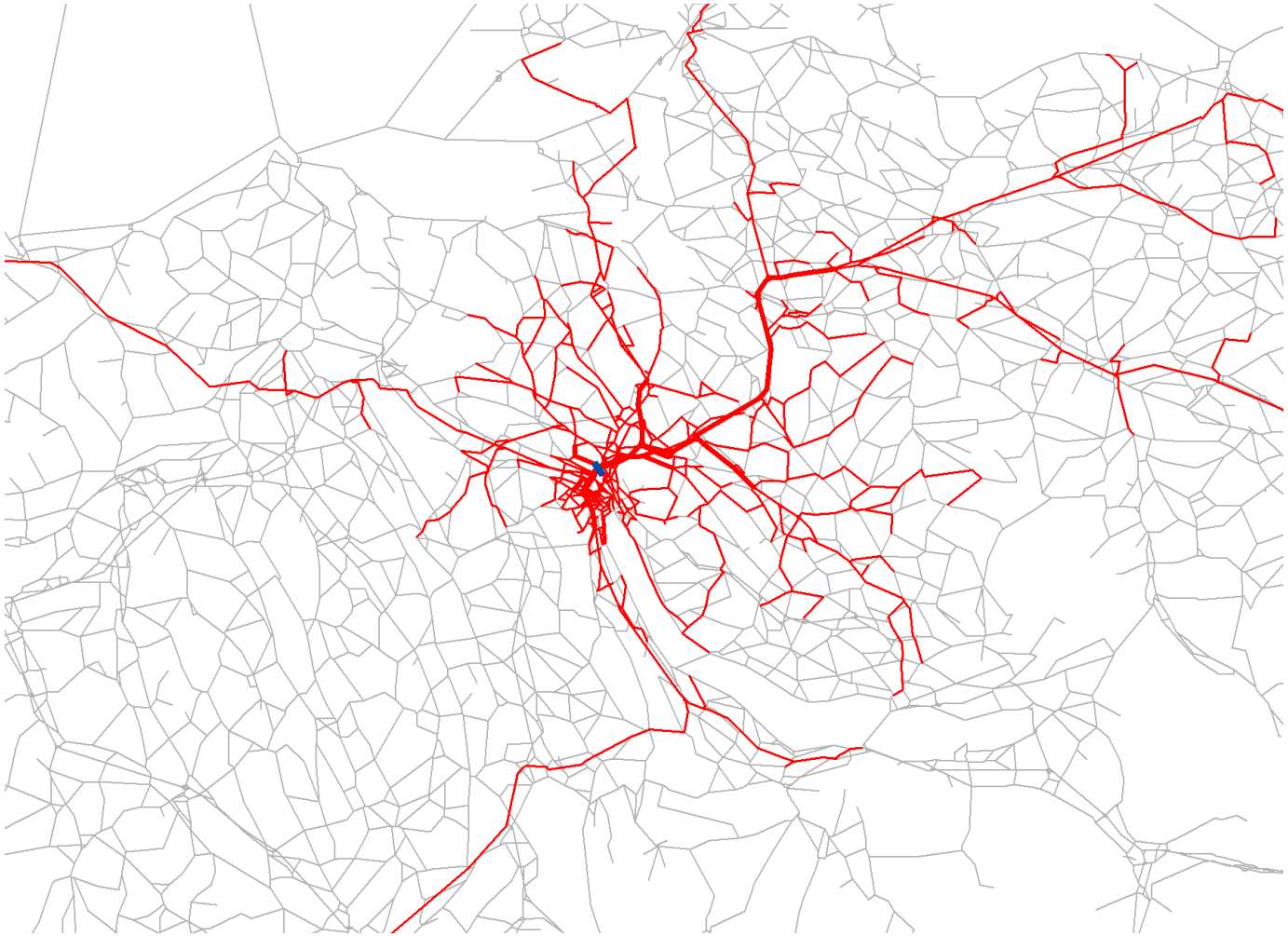
Volume comparison

Volume comparison

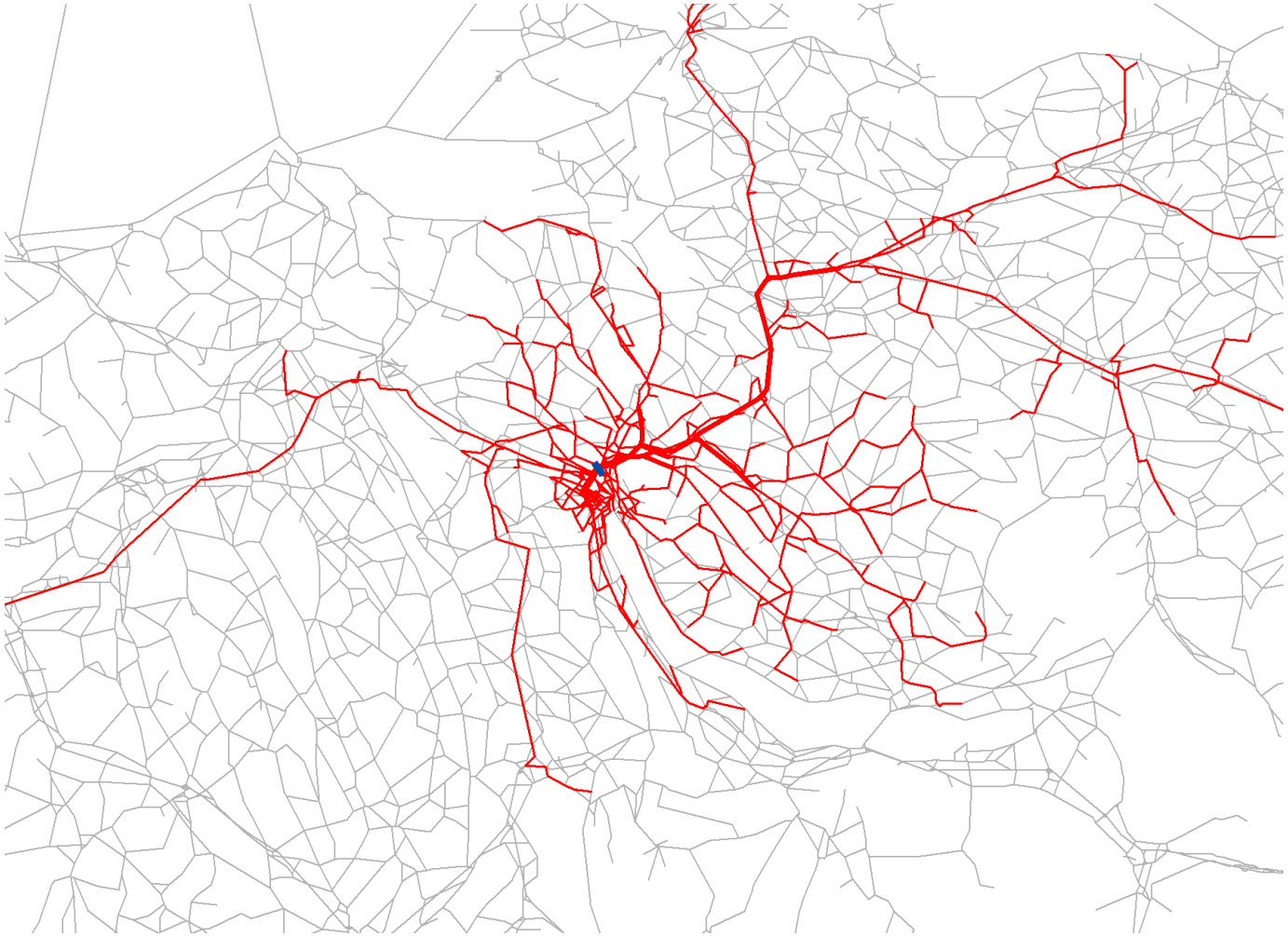
- Actual State vs. CS I (WU)
- CS I (WU) vs. CS II (WU&AM)
- CS II (WU&AM) vs. CS III (WU&AM&TL)

Spider analysis

Spider: actual state: 7-8am, N→S



Spider CS I (WU): 7-8am, N→S

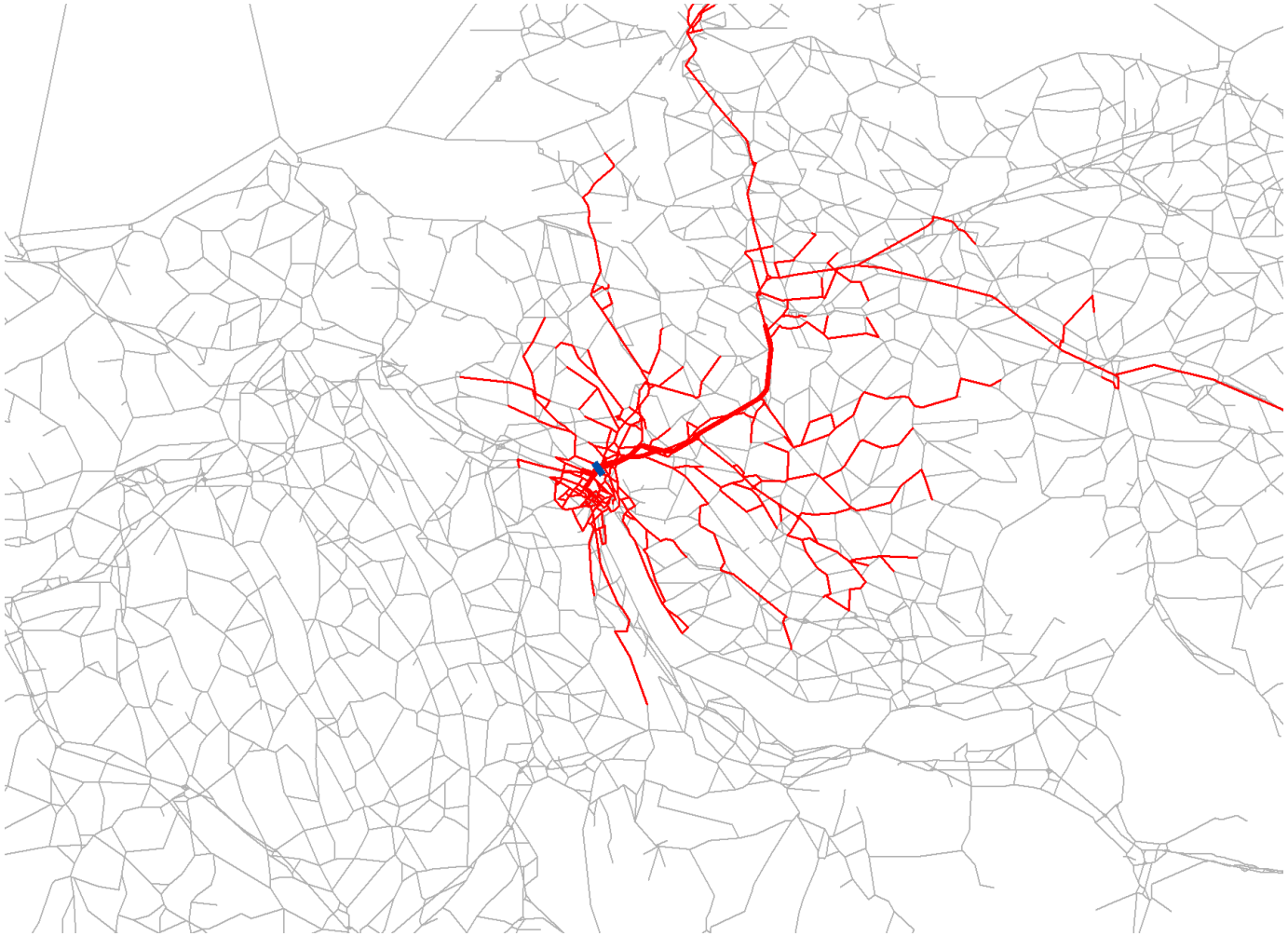


MATSim
Multi-Agent Transport Simulation

Spider CS II (WU&AM): 7-8am, N→S

MATSim
Multi-Agent Transport Simulation

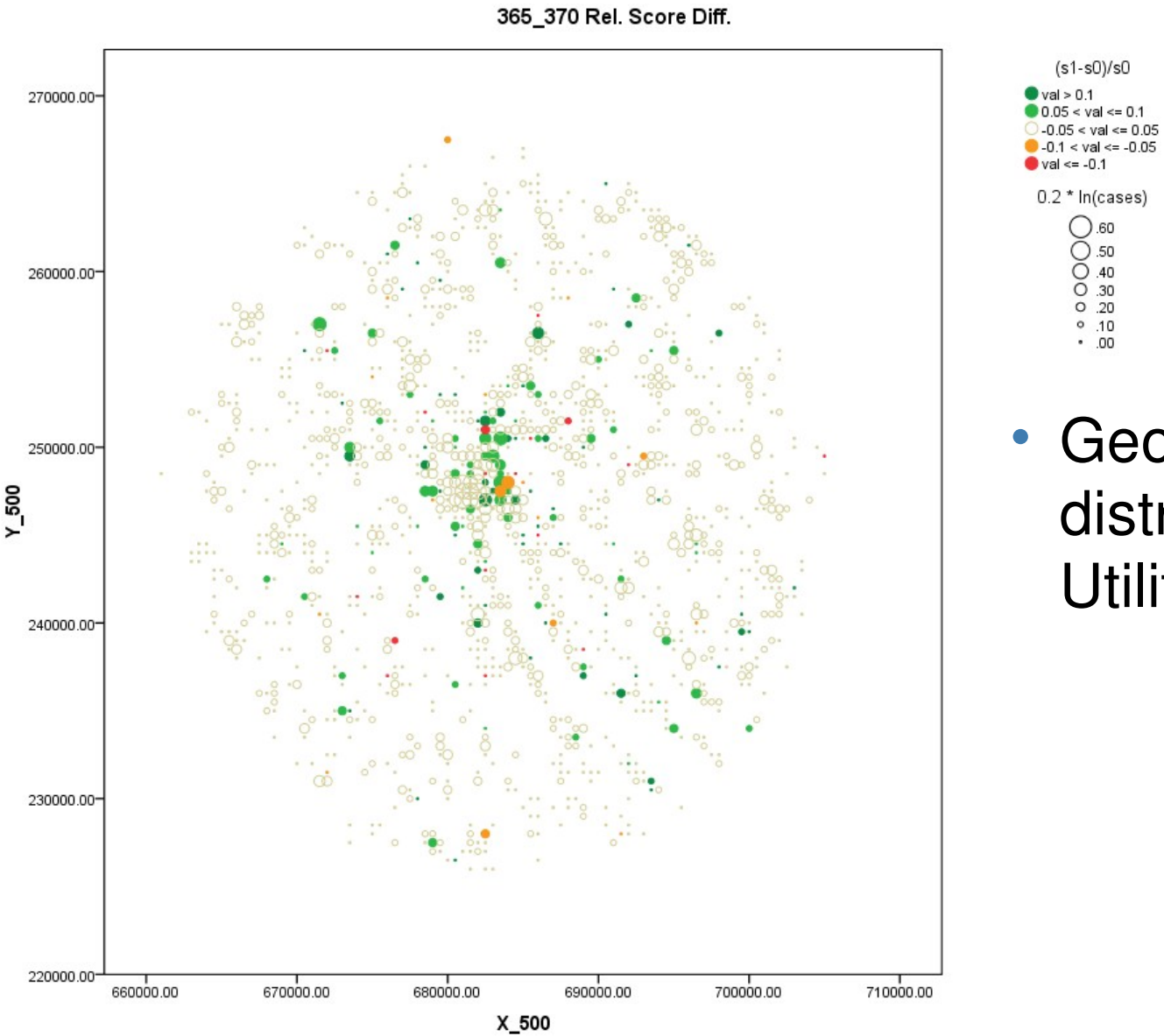
Spider CS III (WU&AM&TL): 7-8am, N→S



MATSim
Multi-Agent Transport Simulation

Winner / Looser: Utility

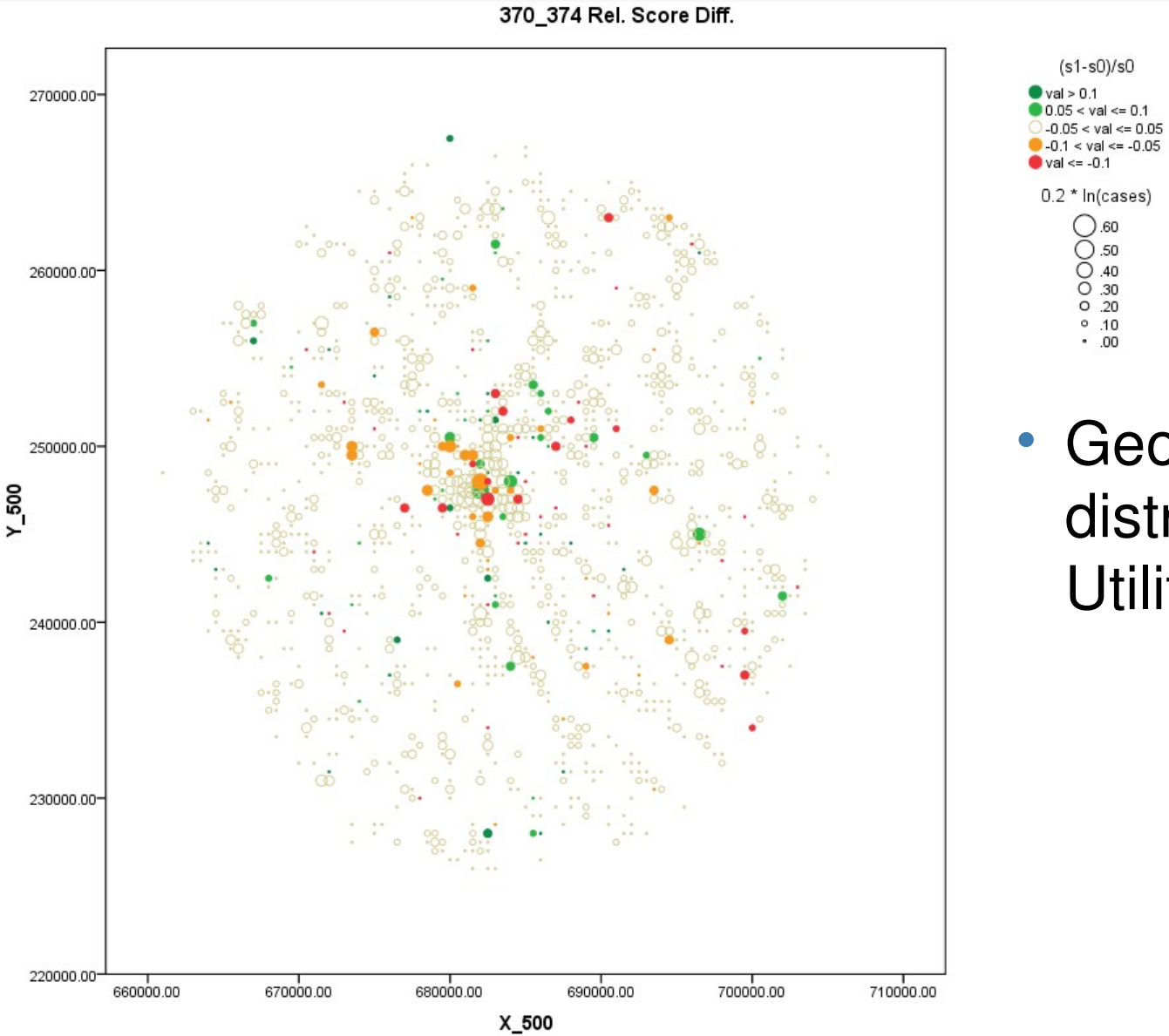
Actual State vs. CS I (WU)



- Geographical distribution: Utility

MATSim
Multi-Agent Transport Simulation

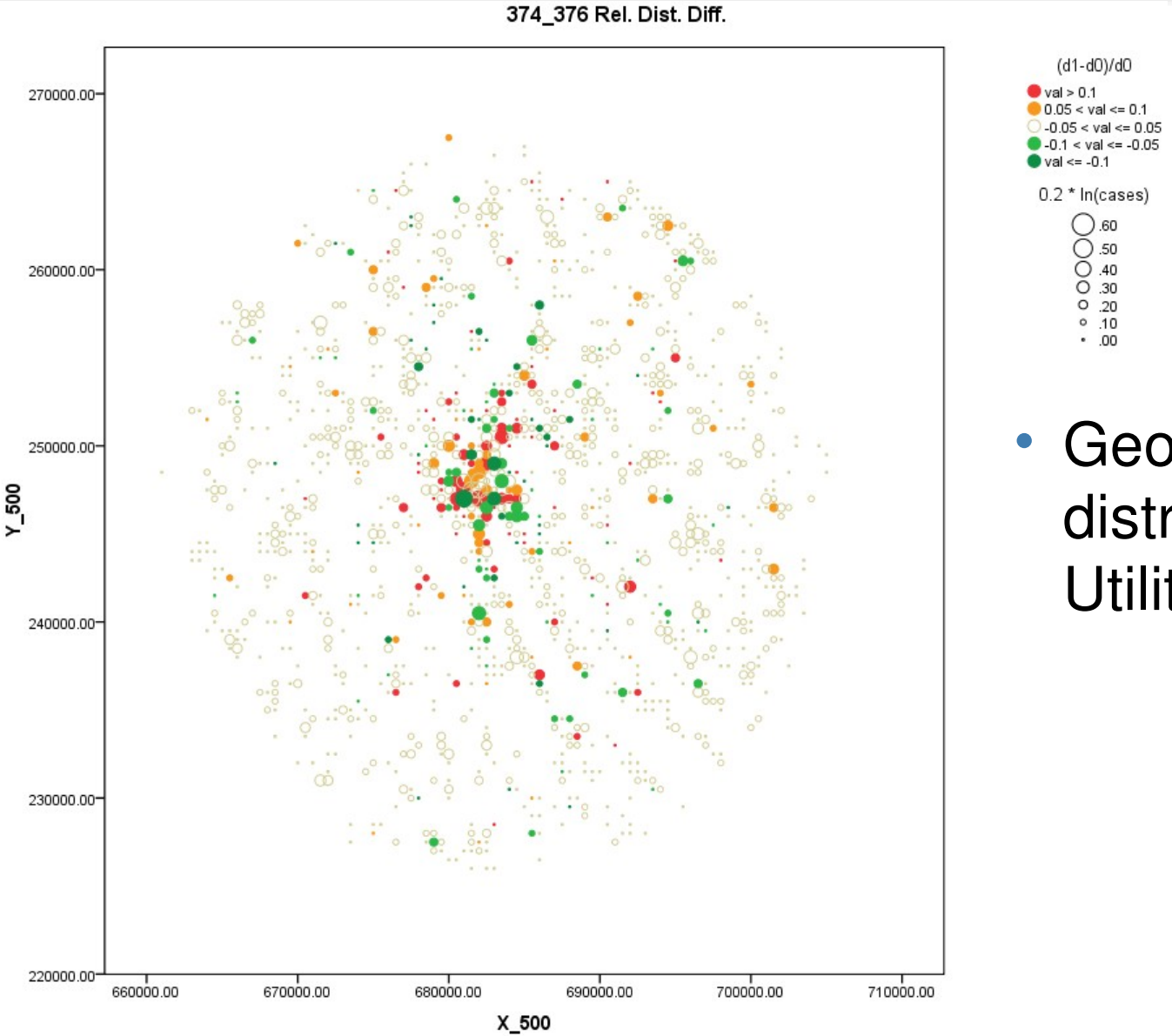
CS I (WU) vs. CS II (WU&AM)



- Geographical distribution: Utility

MATSim
Multi-Agent Transport Simulation

CS II (WU&AM) vs. CS III (WU&AM&TL)

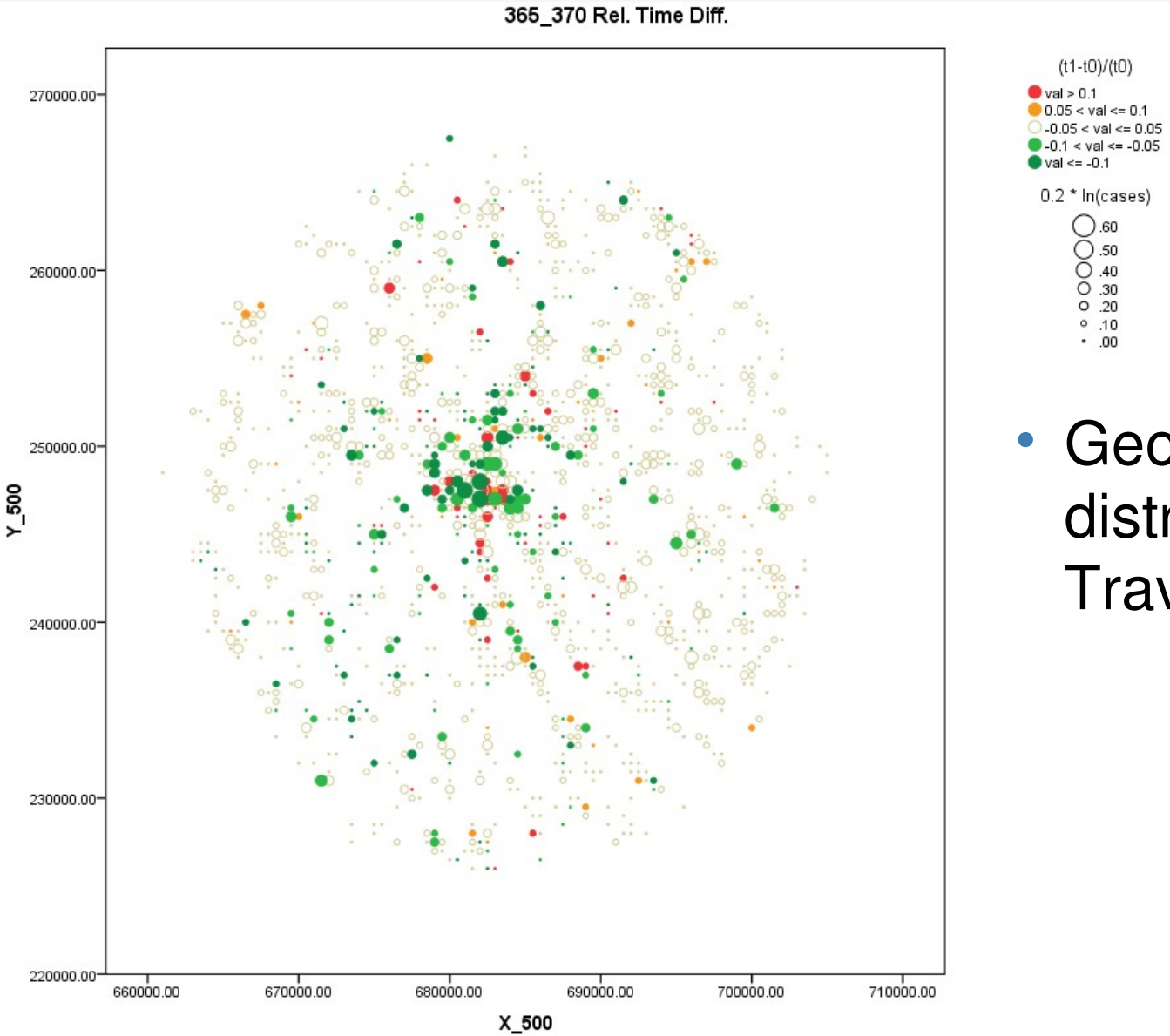


- Geographical distribution: Utility

MATSim
Multi-Agent Transport Simulation

Winner / Looser: Travel Times

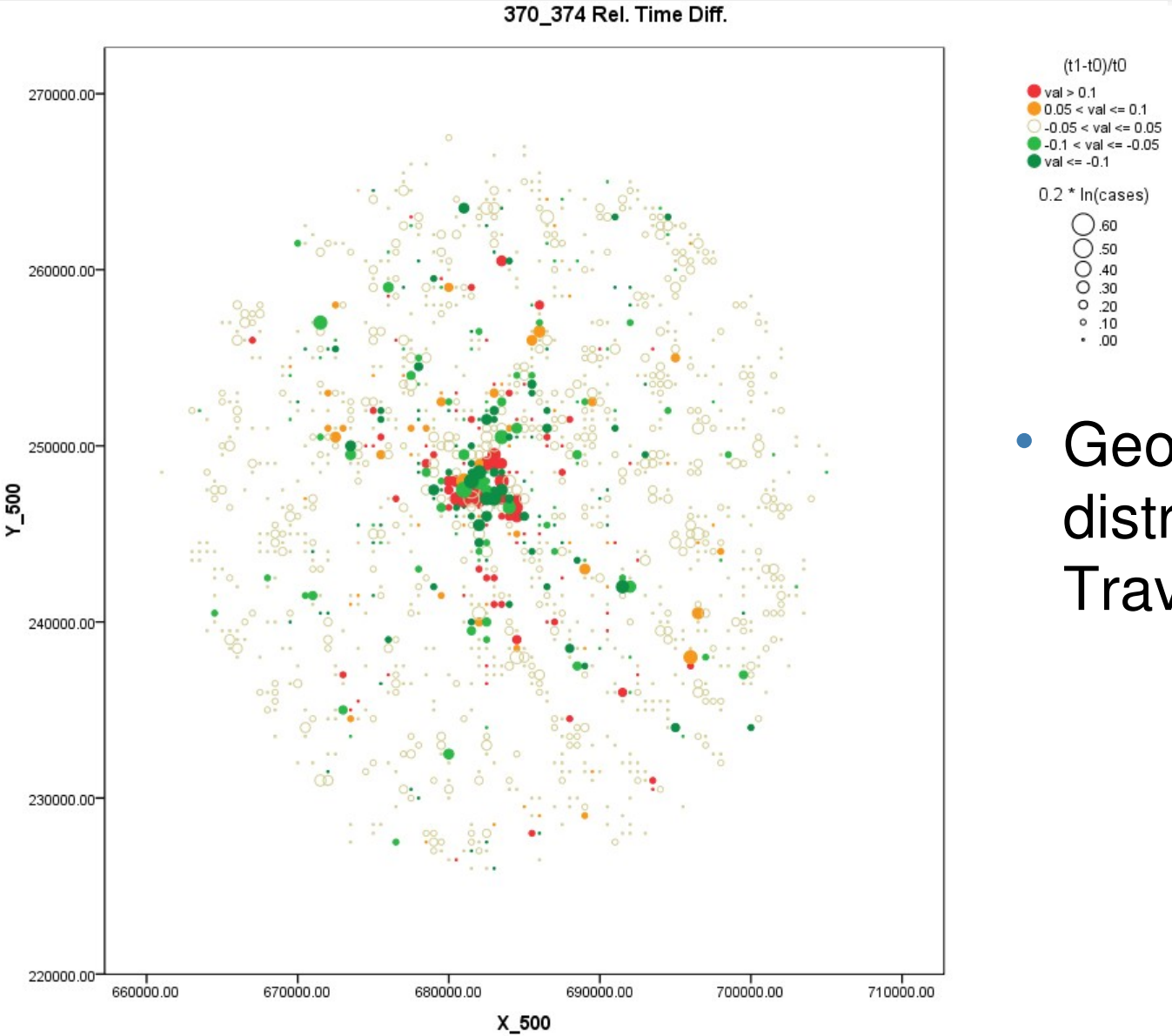
Actual State vs. CS I (WU)



- Geographical distribution: Travel time

MATSim
Multi-Agent Transport Simulation

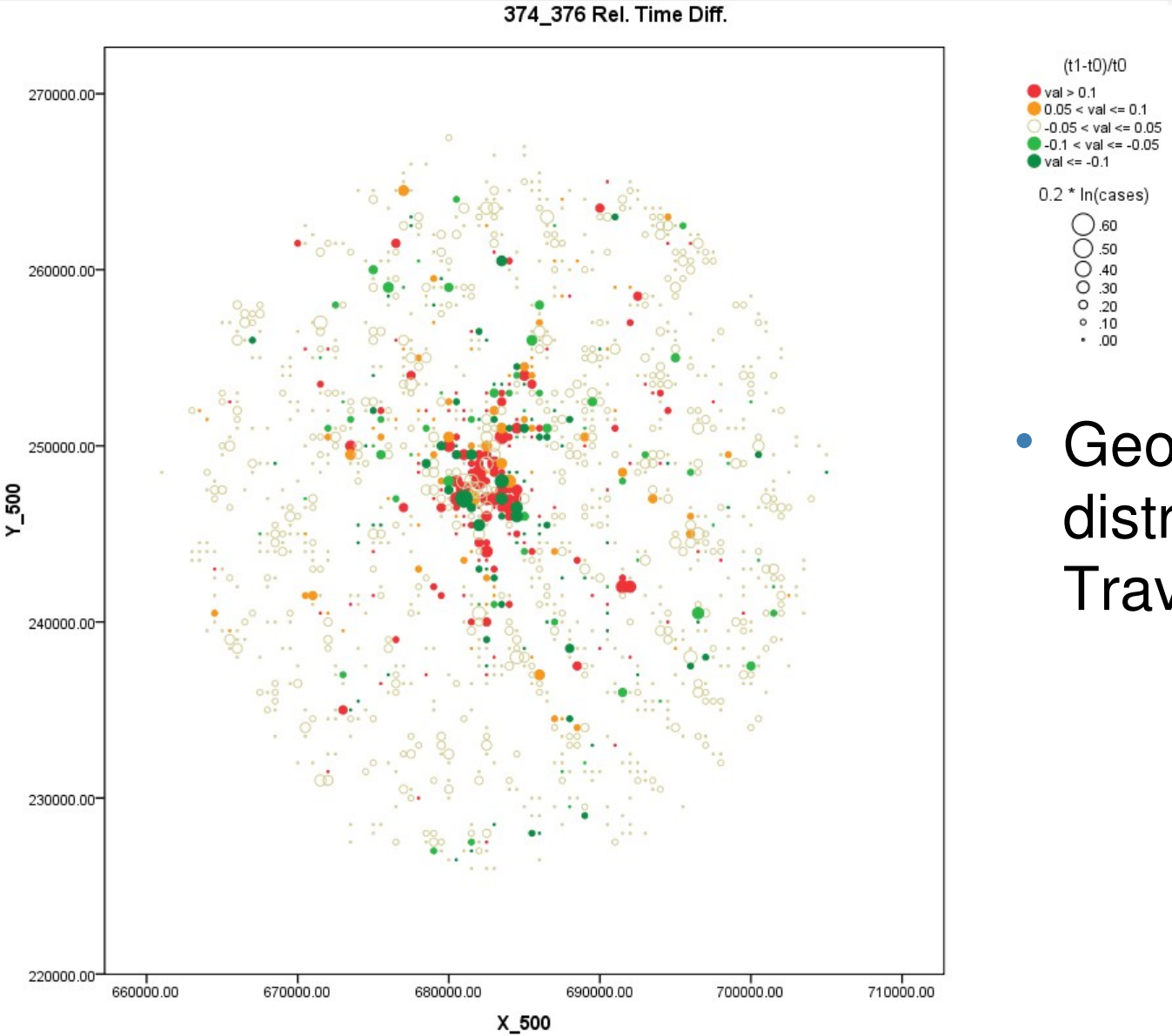
CS I (WU) vs. CS II (WU&AM)



- Geographical distribution: Travel time

MATSim
Multi-Agent Transport Simulation

CS II (WU&AM) vs. CS III (WU&AM&TL)

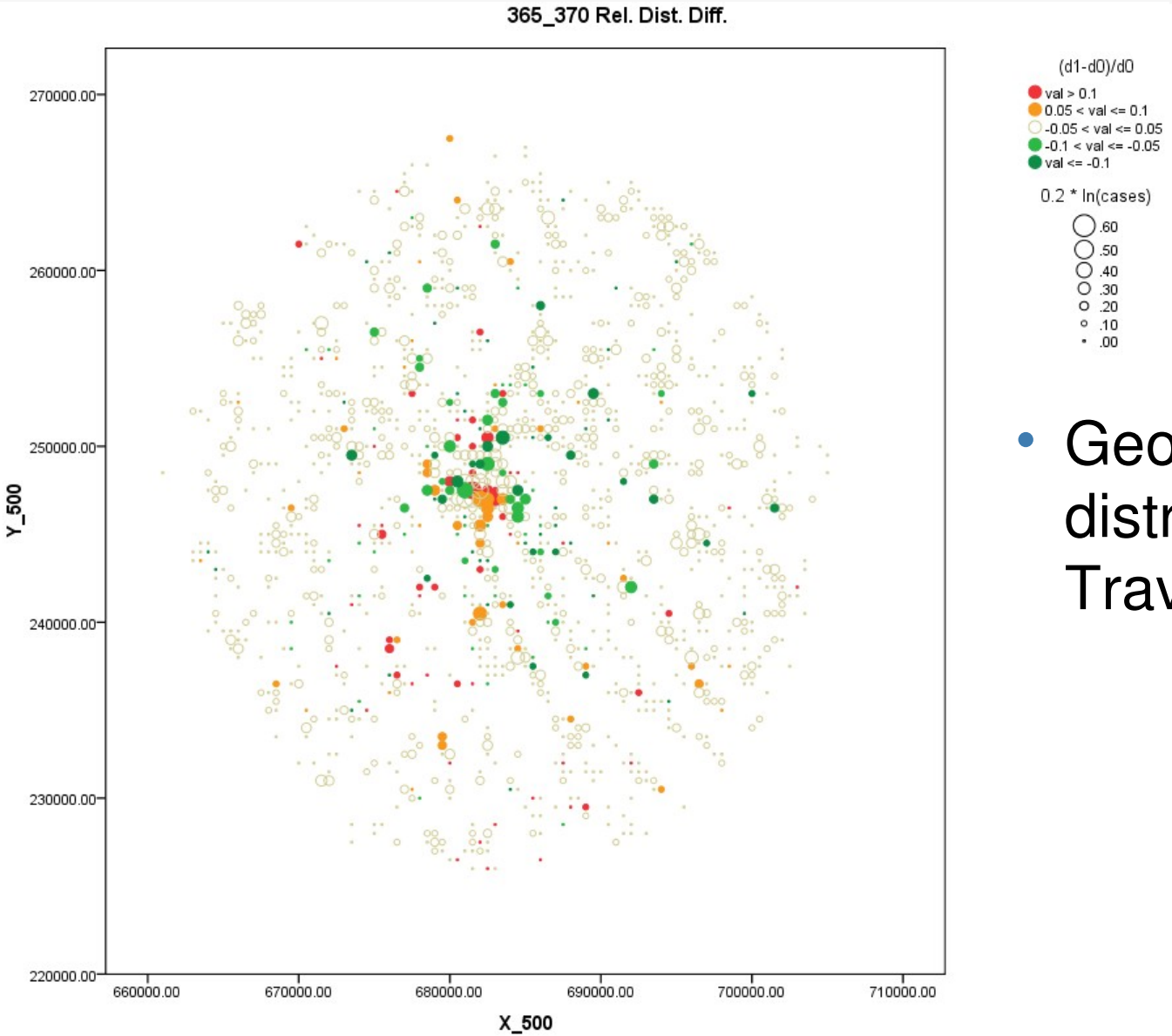


- Geographical distribution: Travel time

MATSim
Multi-Agent Transport Simulation

Winner / Looser: Travel Distances

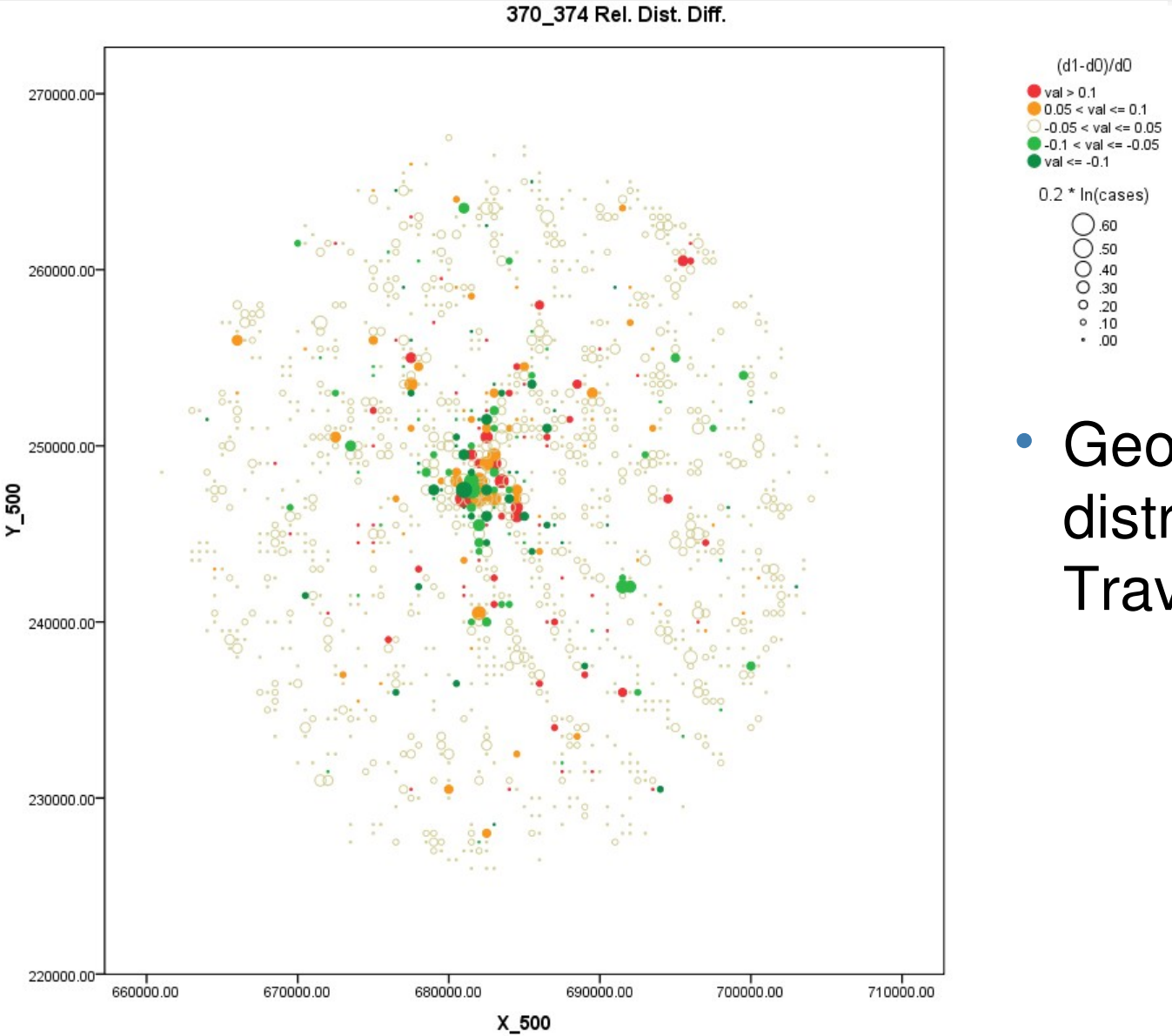
Actual State vs. CS I (WU)



- Geographical distribution: Travel distances

MATSim
Multi-Agent Transport Simulation

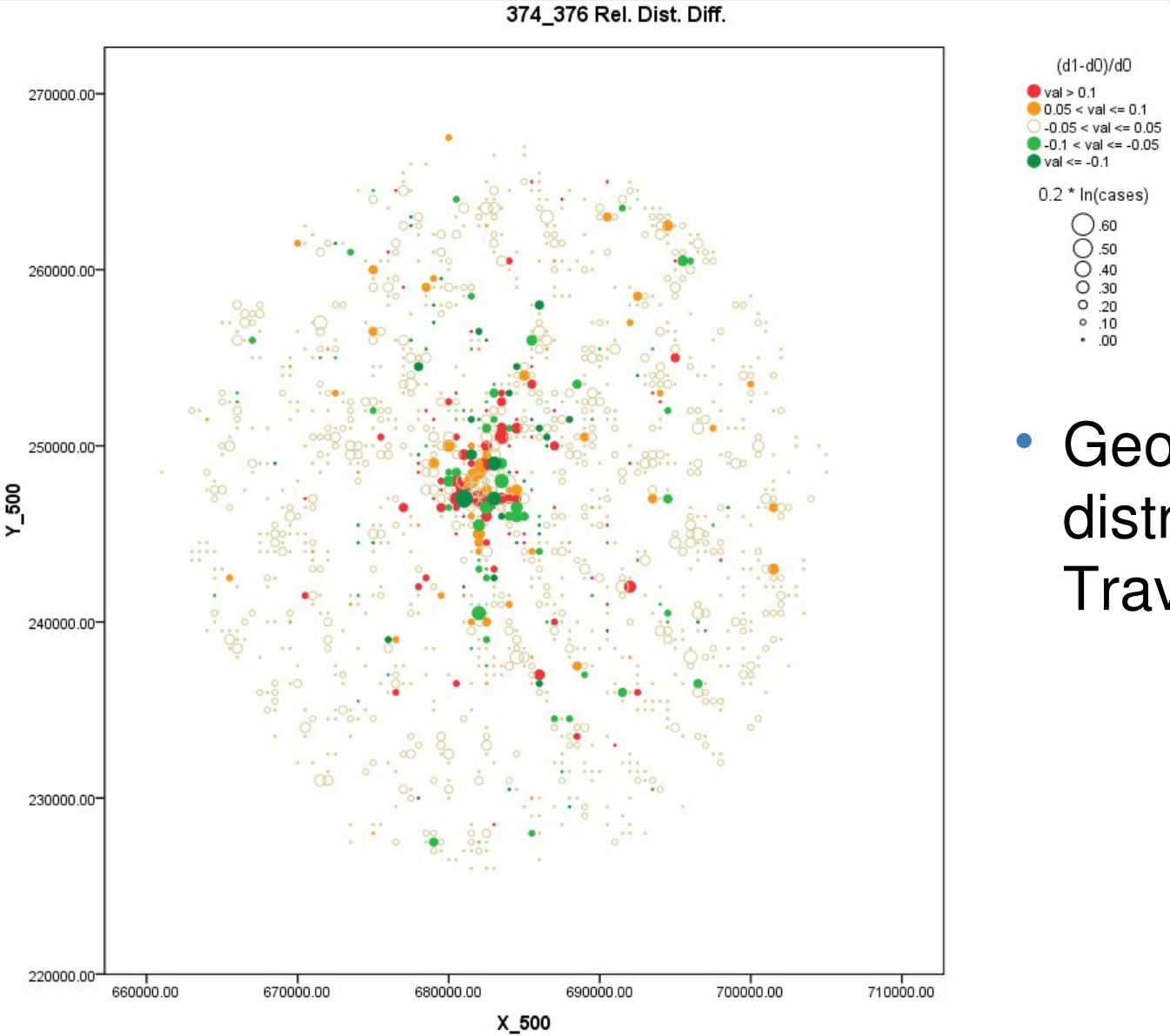
CS I (WU) vs. CS II (WU&AM)



- Geographical distribution: Travel distances

MATSim
Multi-Agent Transport Simulation

CS II (WU&AM) vs. CS III (WU&AM&TL)



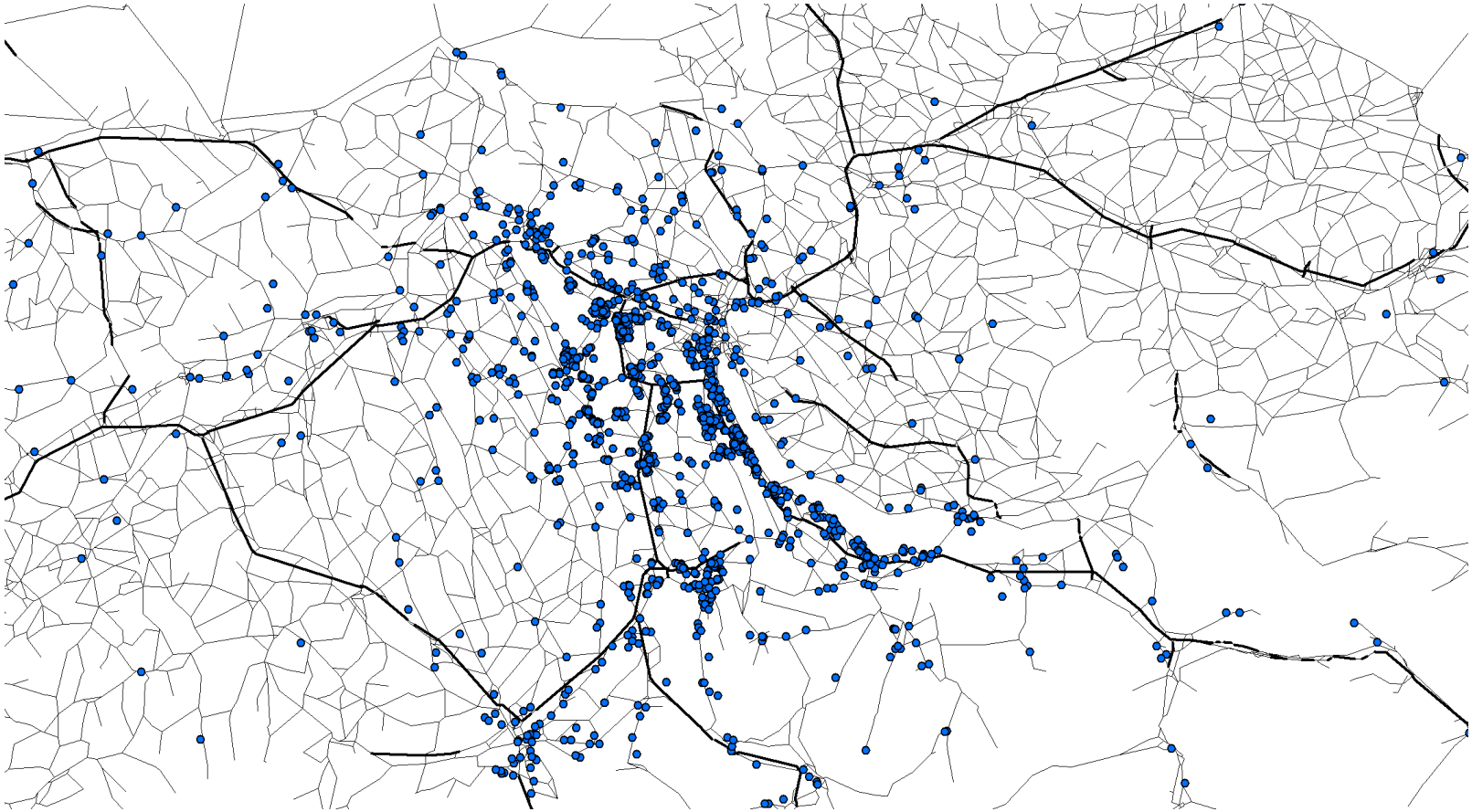
- Geographical distribution: Travel distances

MATSim
Multi-Agent Transport Simulation

“Route Switchers (WT→WU)”

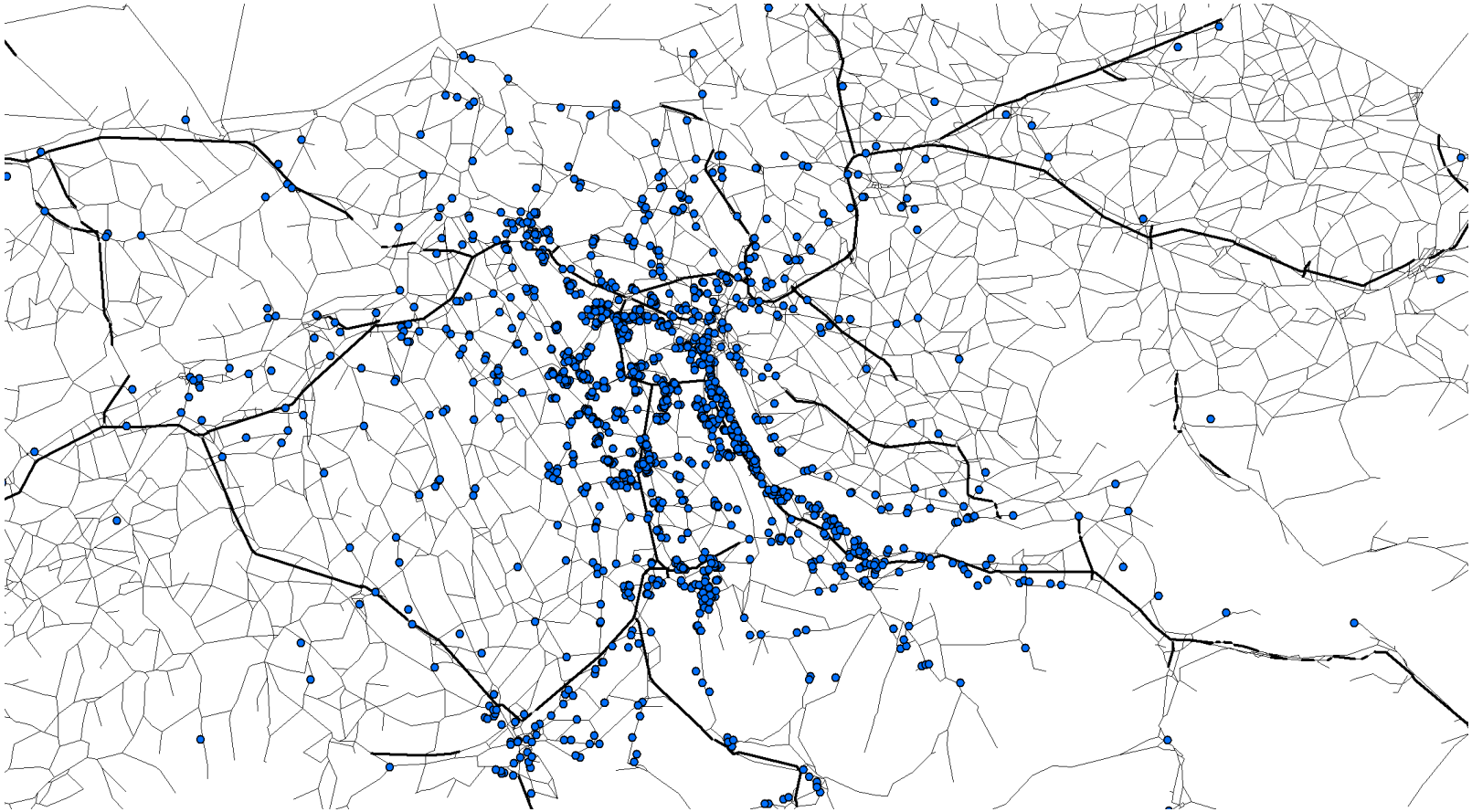
Actual State vs. CS I (WU)

Geographical distribution: „Route switchers“ WT→WU



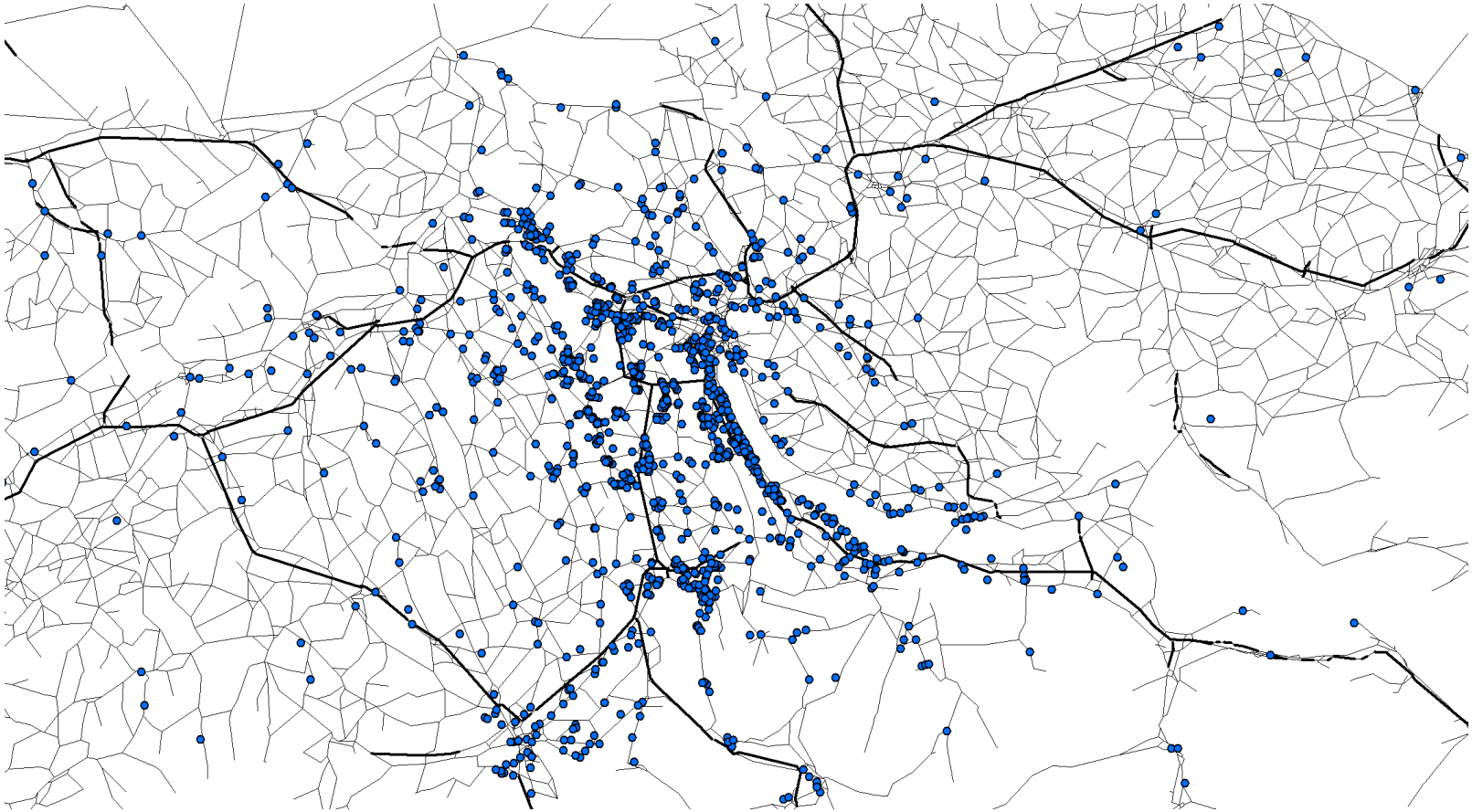
CS I (WU) vs. CS II (WU&AM)

Geographical distribution: „Route switchers“ WT→WU



CS II (WU&AM) vs. CS III (WU&AM&TL)

Geographical distribution: „Route switchers“ WT→WU



Conclusions

- Effect measures of the case studies approve the expected effects; no new consolidated findings

➔MATSim produces similar results than previous expertises.

Advantages:

- Detailed statistics possible on disaggregated level (individuals, activities, activity-chains, links)
- Complete time dynamic results for a whole day

„For each agent, we know—at any time of the day—where it is, and what it is doing“

Notes

- Static landuse ➔ results only useful for short term predictions
- Mode choice as a preprocess (no optimization)
- „Low“ resolution network

Acknowlegment

- Volkswirtschaftsdirektion Kanton Zürich, Verkehr und Infrastruktur Strasse
- Stadt Zürich, Dienstabteilung Verkehr, Regelung + Entwicklung
- Bundesamt für Statistik
- ETH Zürich
- IVT

- Prof. K.W. Axhausen
- David Charypar
- Francesco Ciari
- Andreas Horni
- Konrad Meister

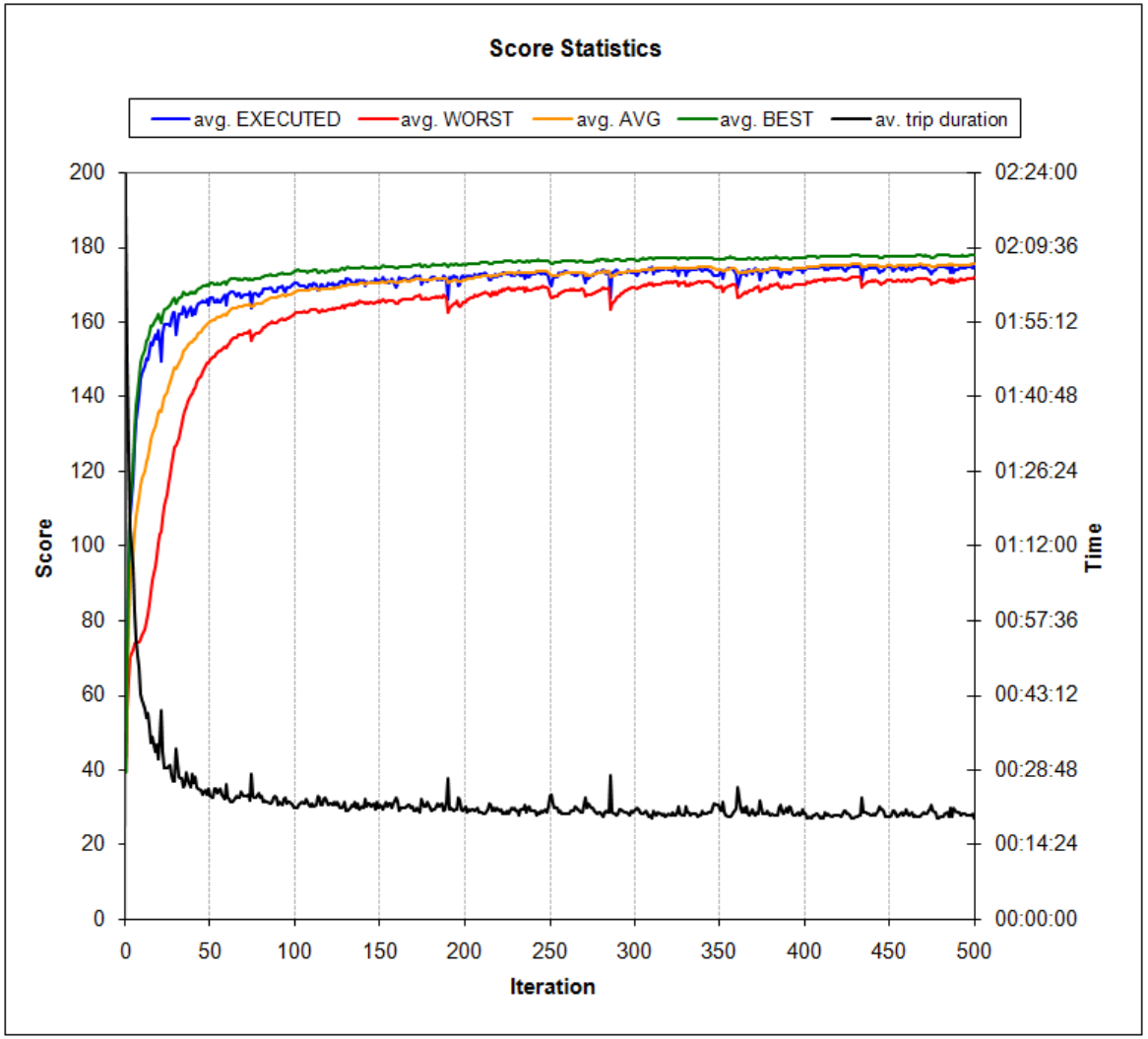
- VSP, TU Berlin

Special Thanks to

- Claudia Dolci

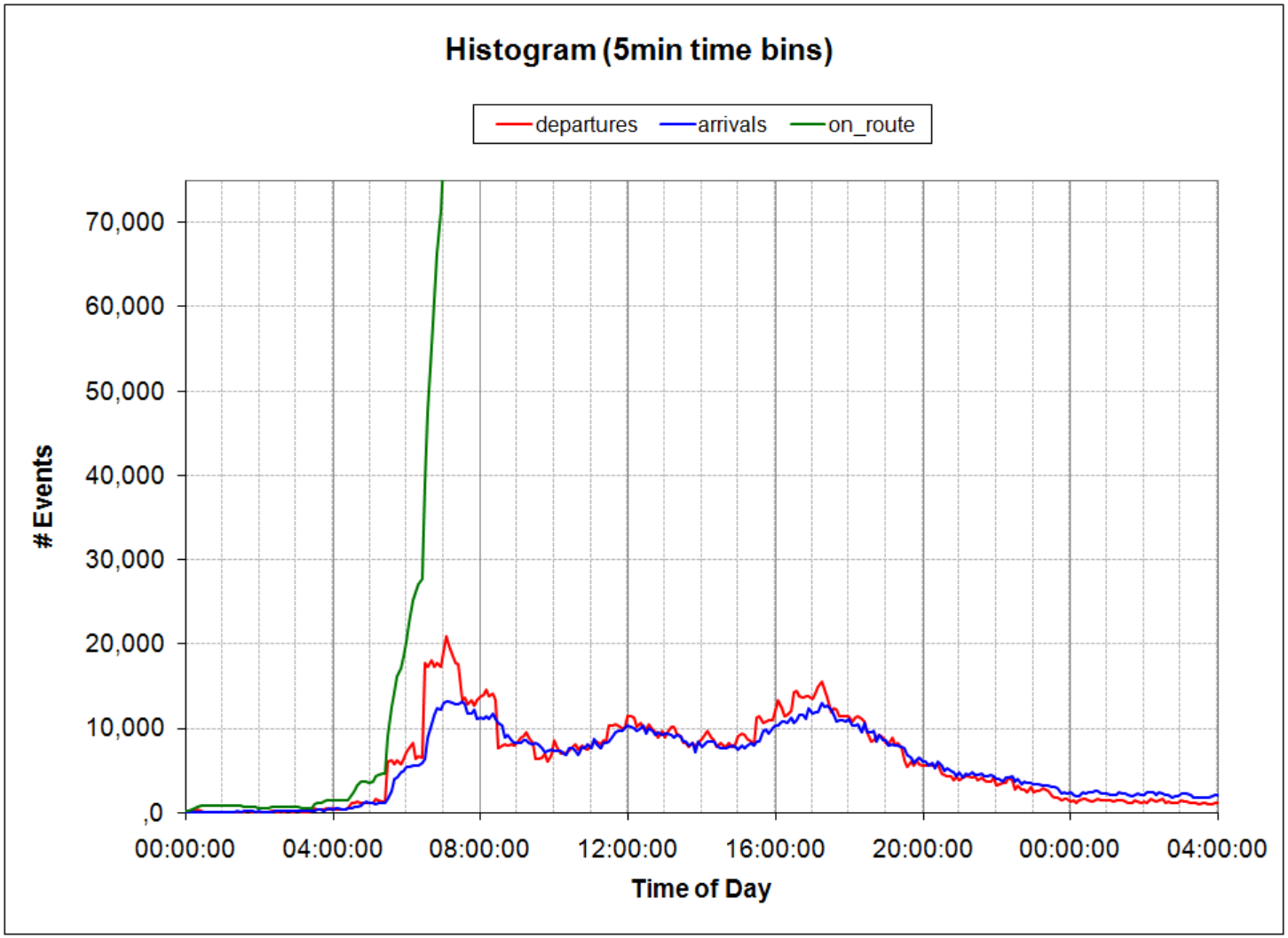
Thank you for your attention!

scores & times



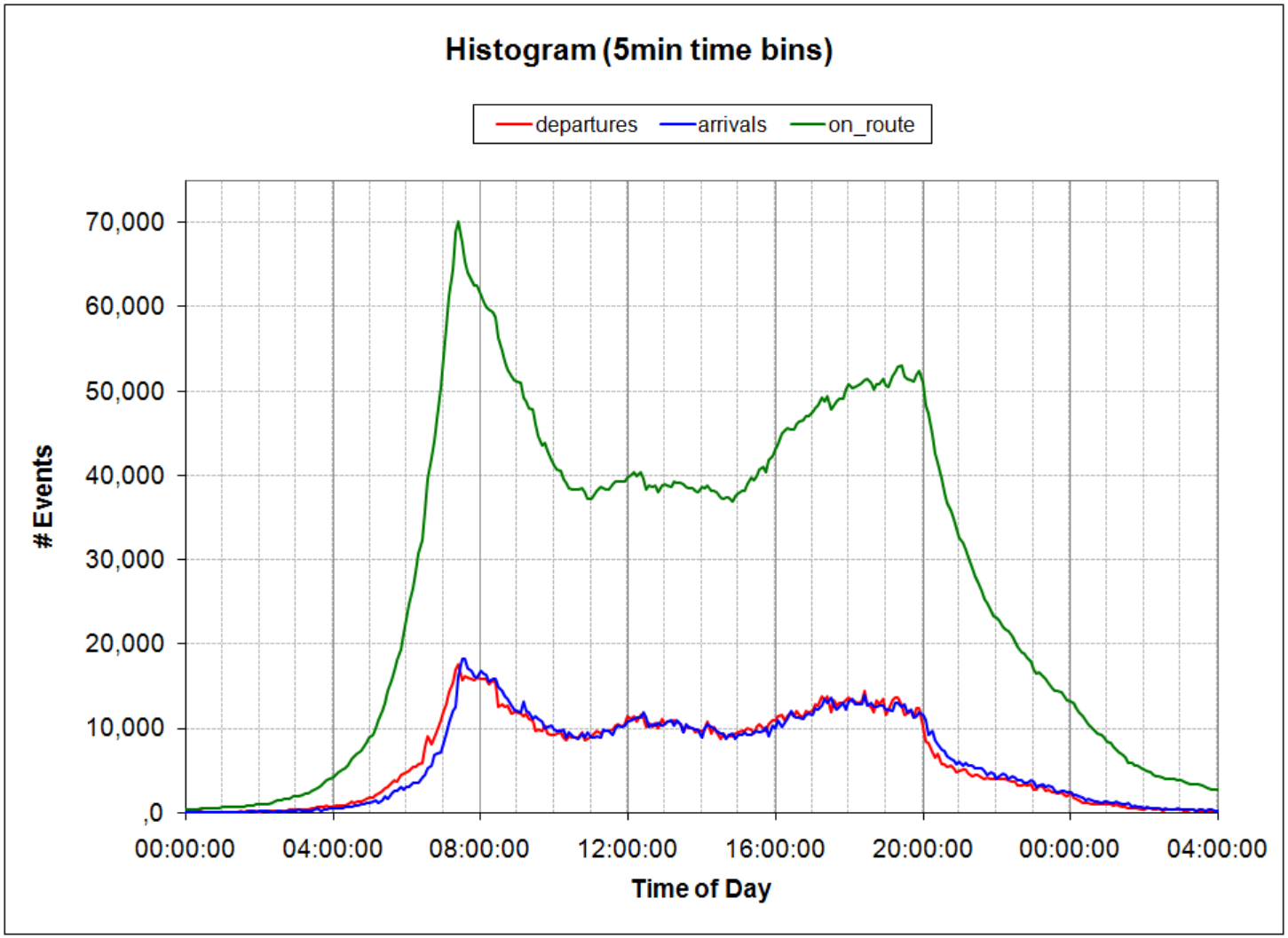
MATSim
Multi-Agent Transport Simulation

histogram (iteration 0)



MATSim
Multi-Agent Transport Simulation

histogram (iteration 150)

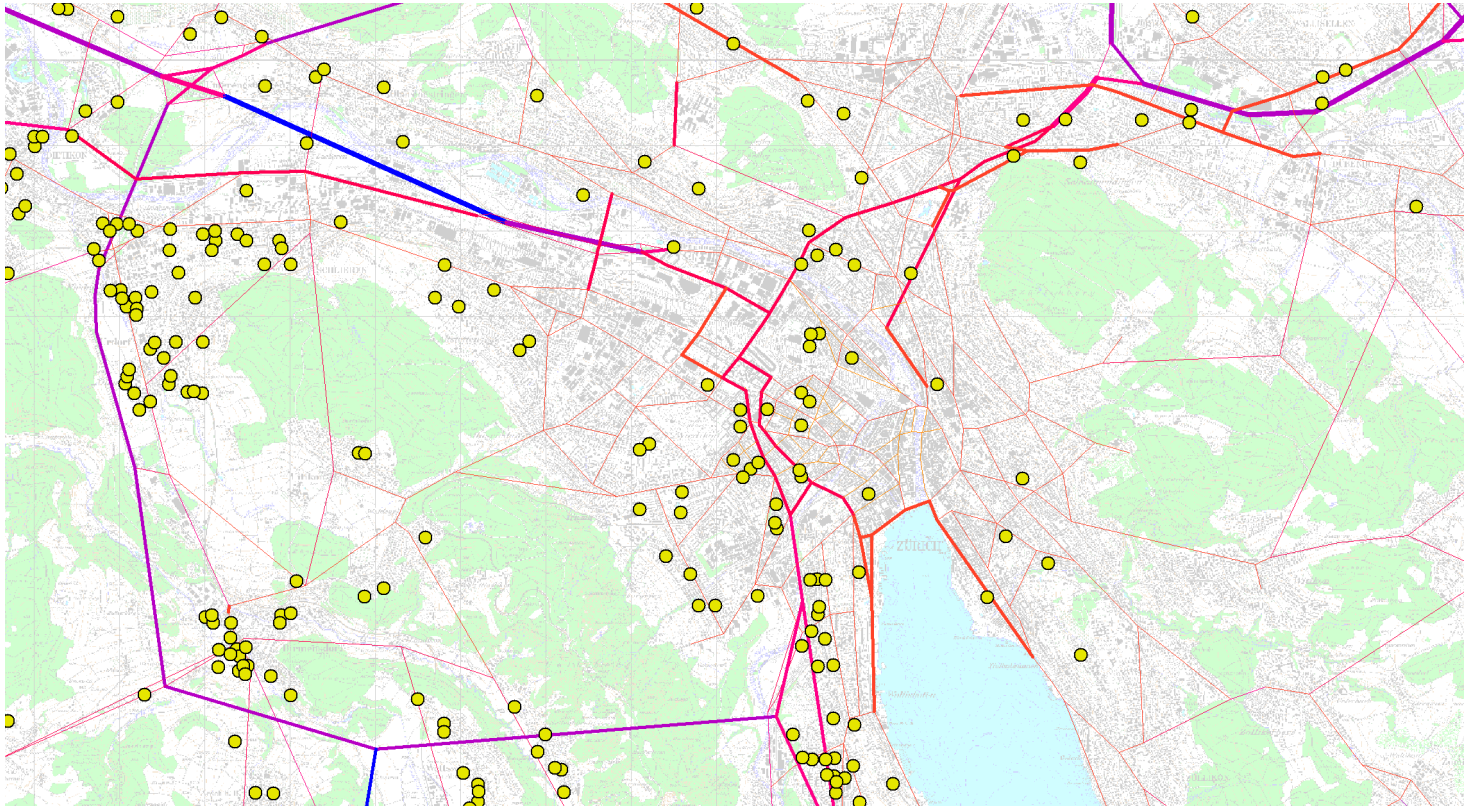


MATSim
Multi-Agent Transport Simulation

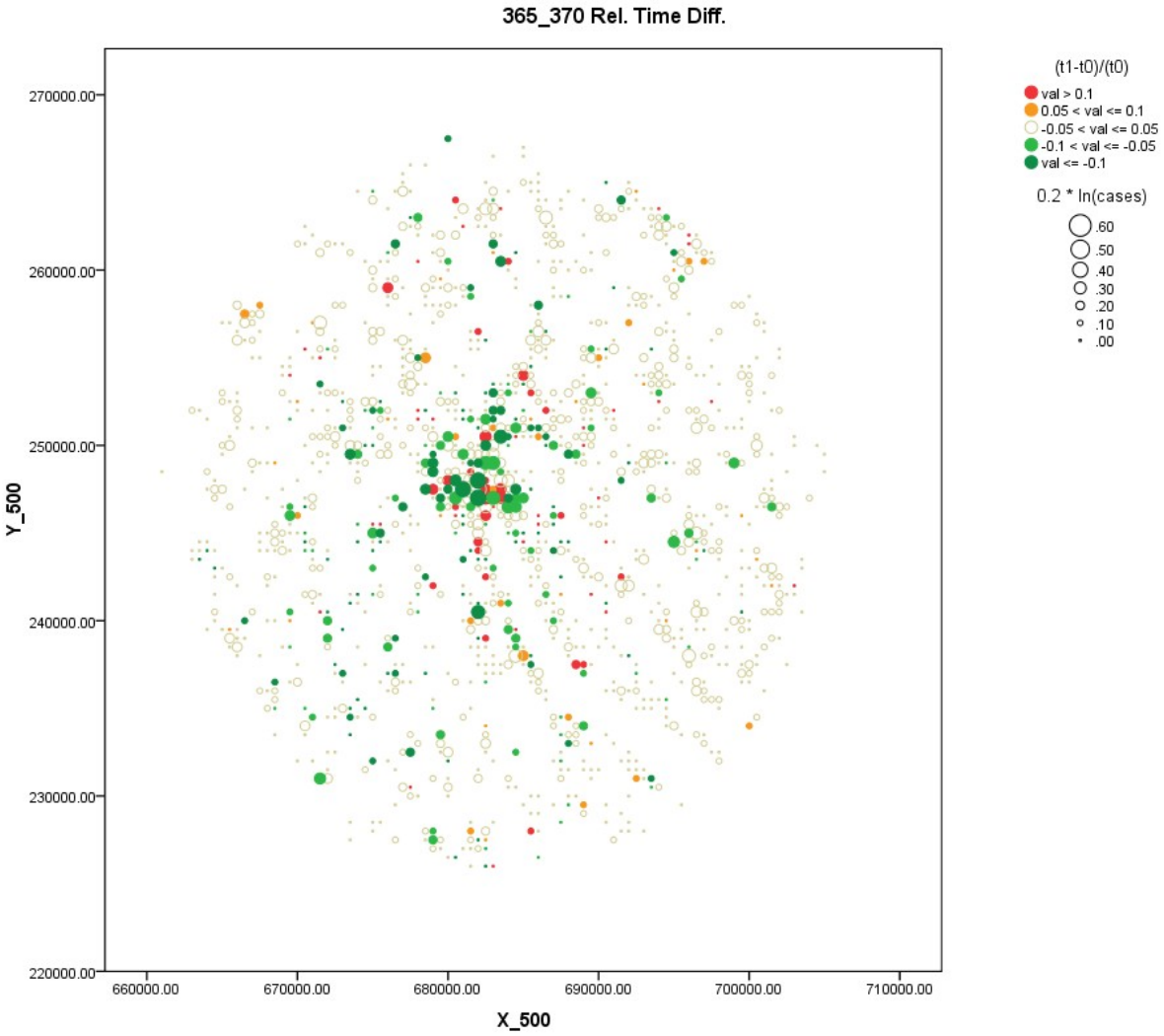
OTFVis

MATSim
Multi-Agent Transport Simulation

MATSim-ANALYSIS: route switchers (WT→WU)

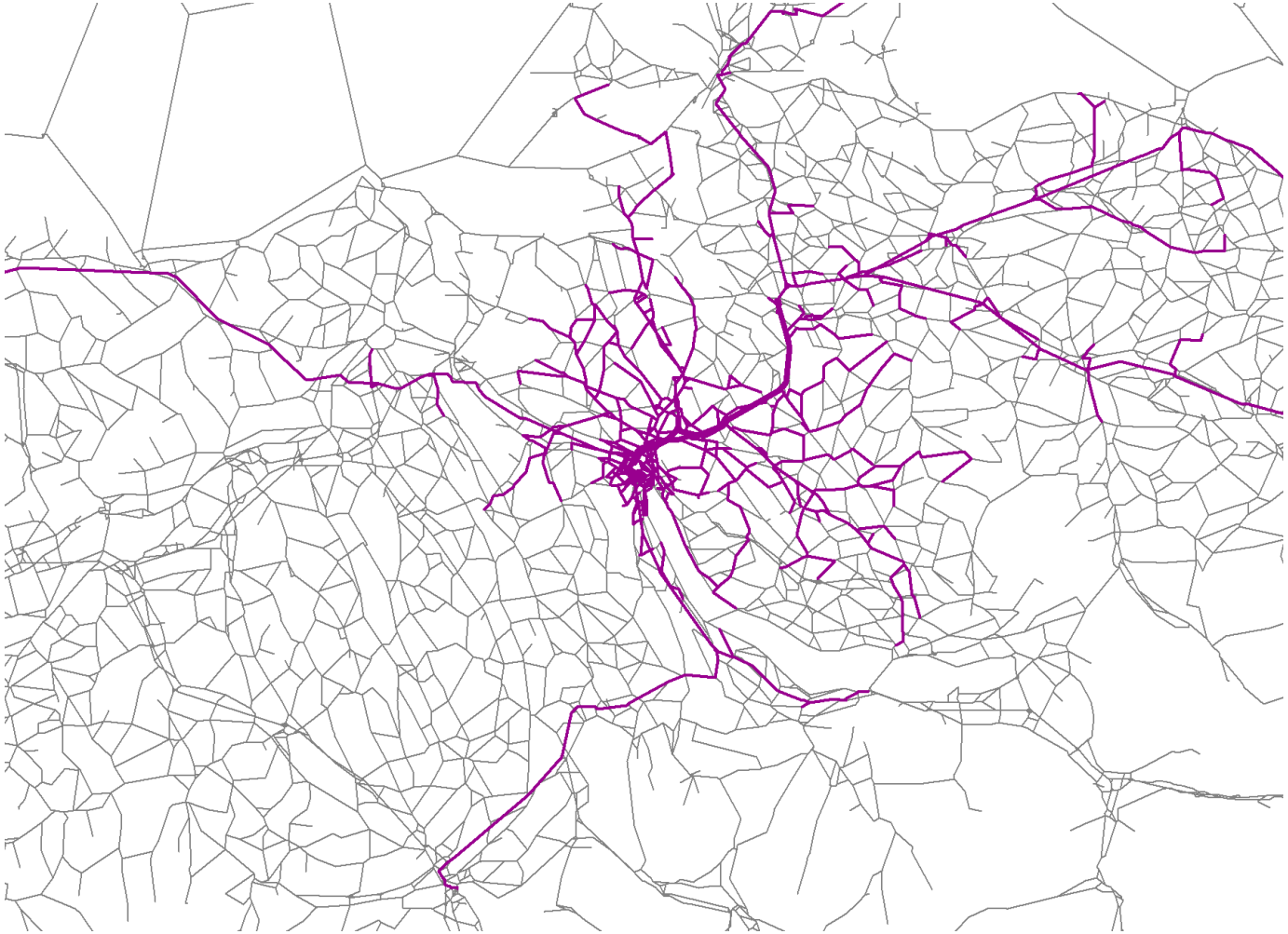


MATSim-ANALYSIS: winner-looser



MATSim
Multi-Agent Transport Simulation

MATSim-ANALYSIS: spider analysis



MATSim
Multi-Agent Transport Simulation

?