Agent Based Modeling in Transportation:
the example of MATSim

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MATSim at a glance

- Implementation of a fully **agent-based** approach as part of a transport modeling tool

- **Open source** framework written in **Java** (GNU License)

- Started ~10 years ago, **community** is **growing**

- Developed by Teams at **ETH Zurich**, **TU Berlin** and **Senozon AG**

- www.matsim.org

MATSim applications around the world
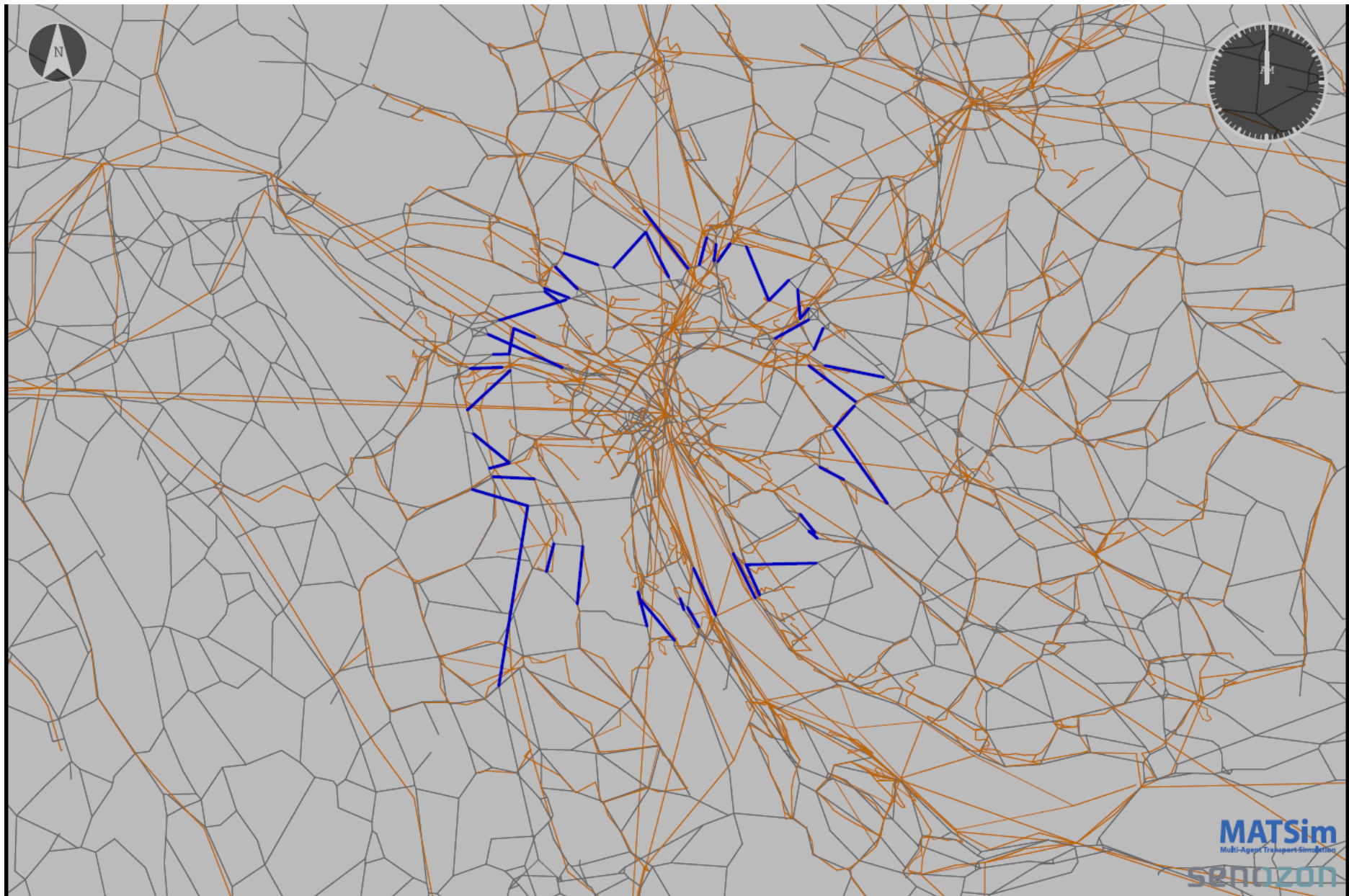
3

- MATSim Singapore 60FPS NEW TITLES.mkv
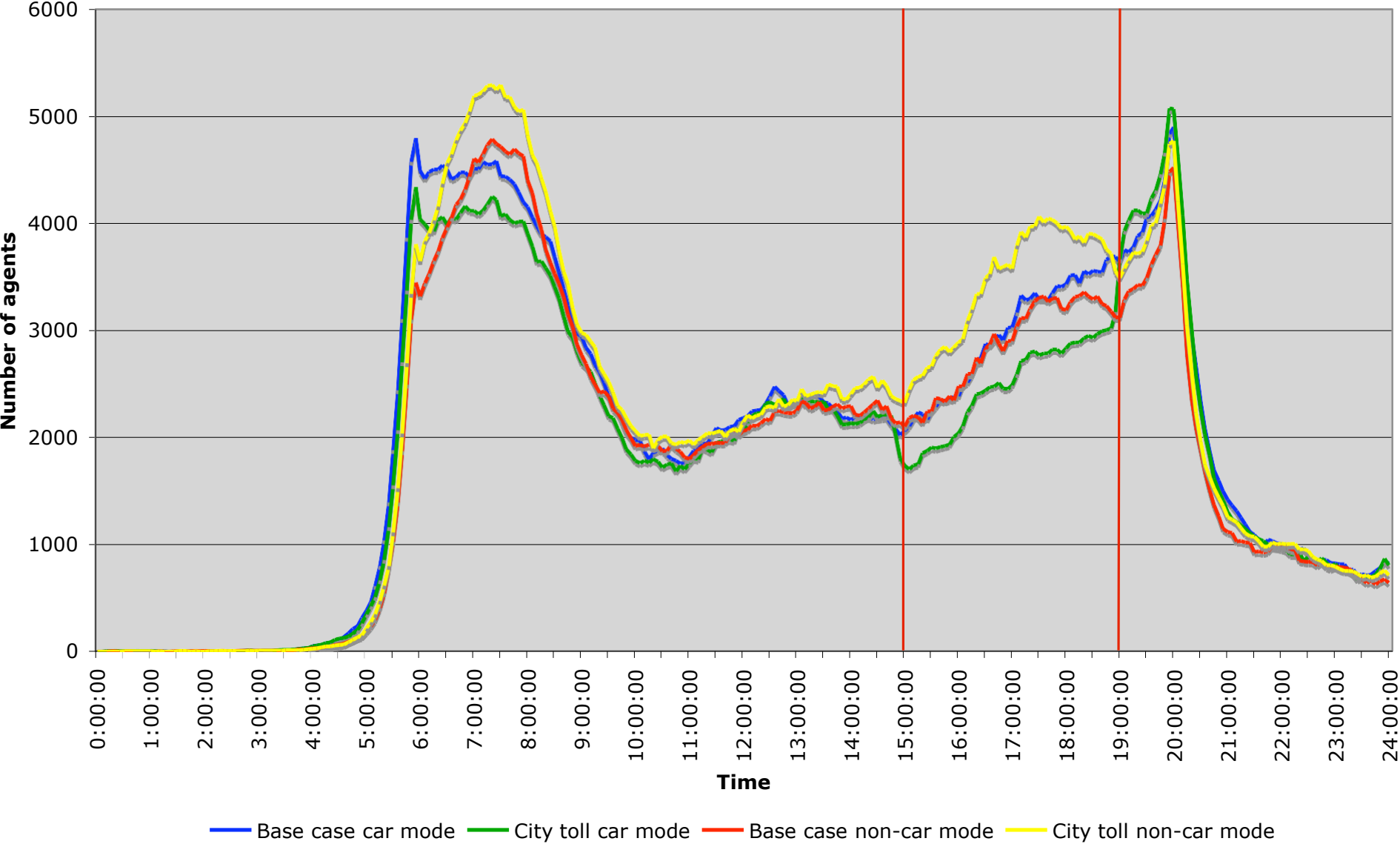
(author: Pieter Fourie)

Case Study 1 – Road Pricing

Evaluation of a road pricing policy in Zurich:

- How would a toll to enter the city center between 3 and 7 pm affect daily traffic inside and outside the area?
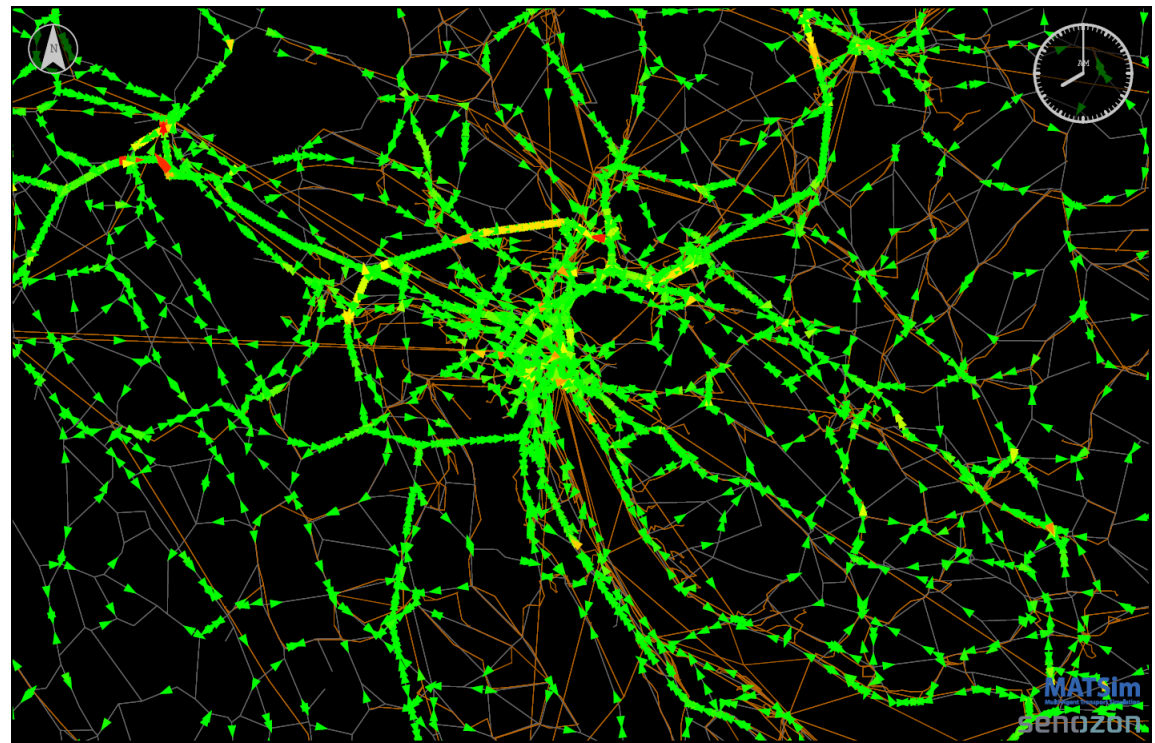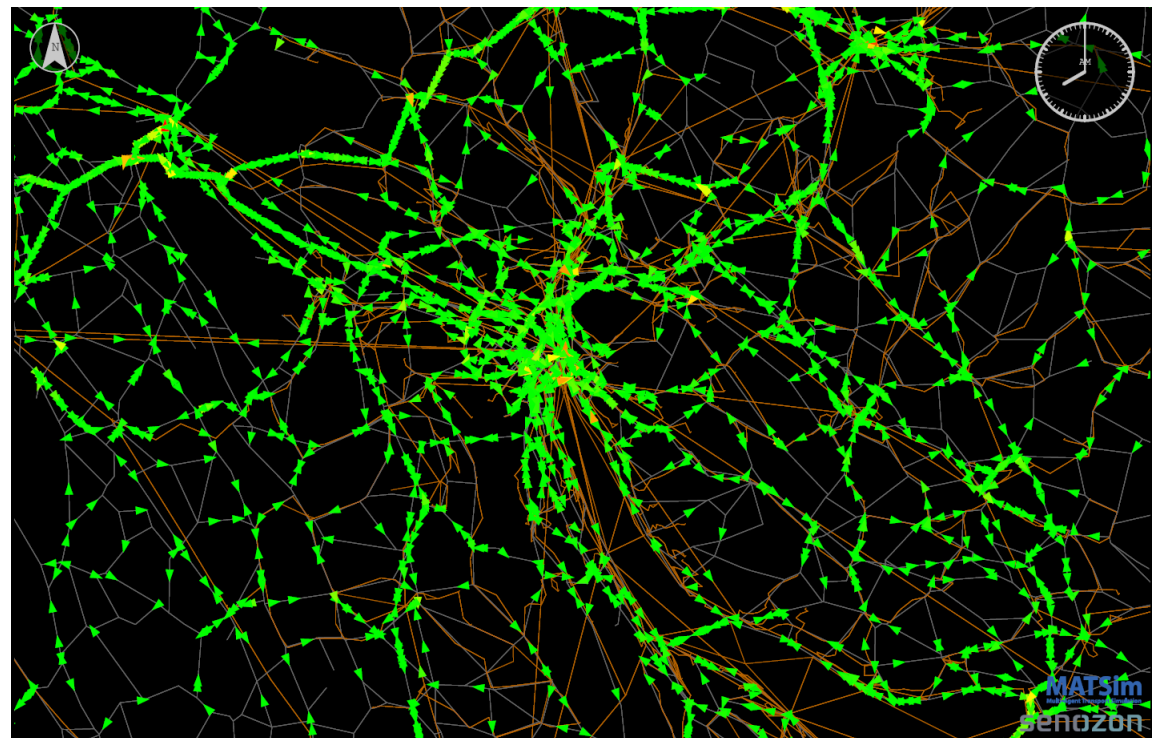
Toll links

Traffic over the day

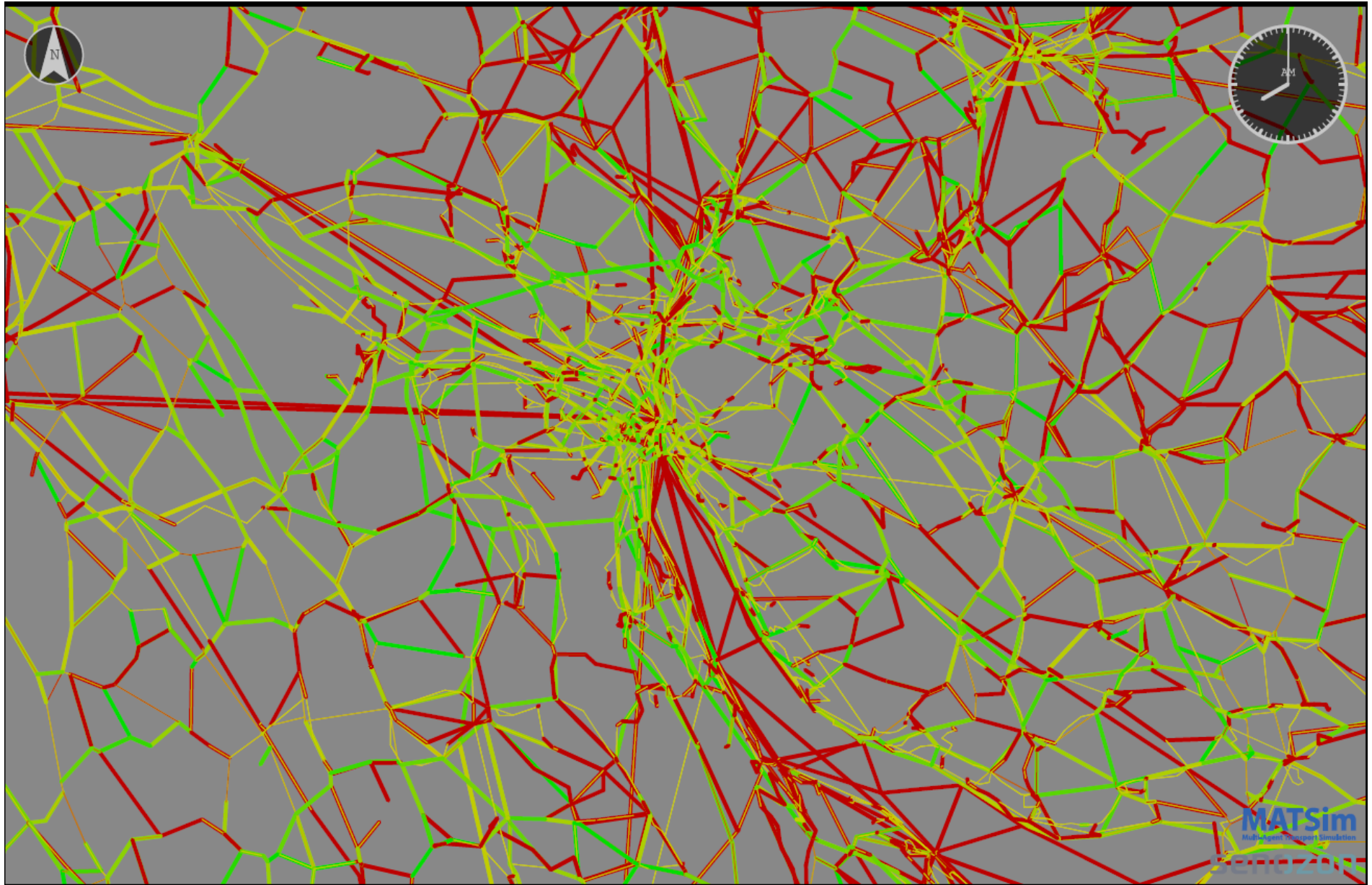

(author: Kai Nagel)

- Car Travel: base case

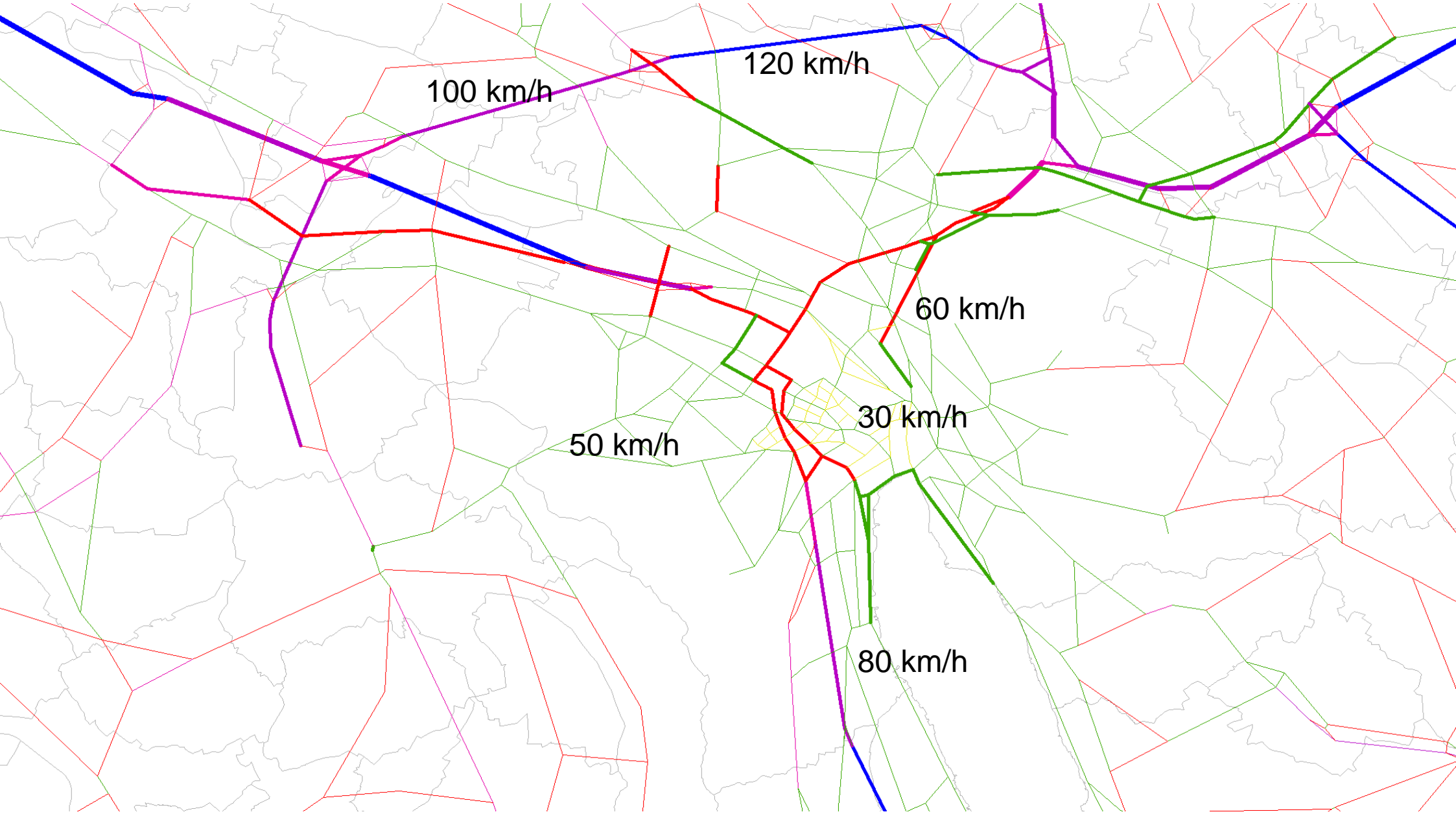- Car Travel: city toll

Toll vs. no-toll

Case Study 2 – A new bypass
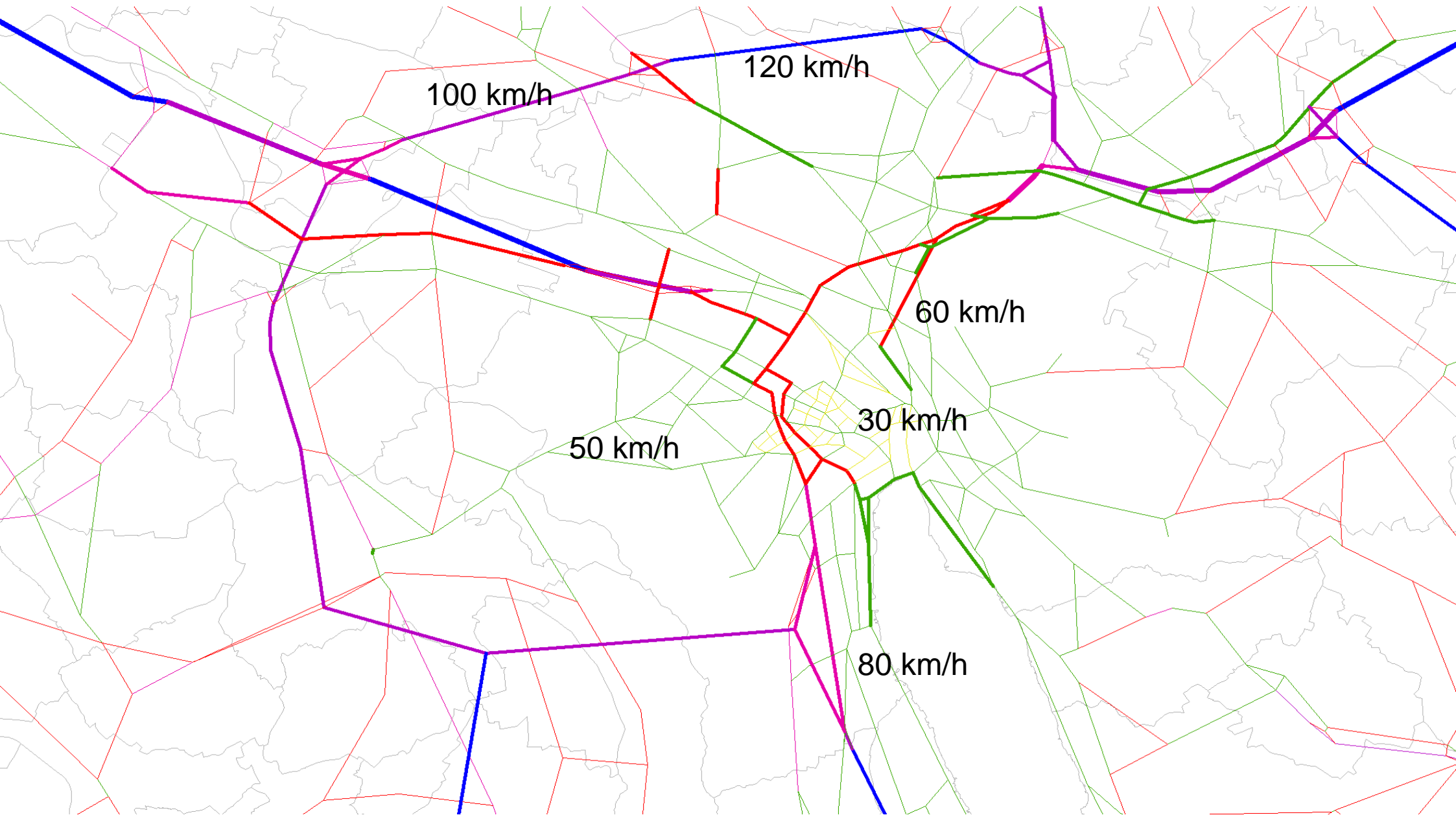
Evaluation of a new bypass in Zurich's west side:

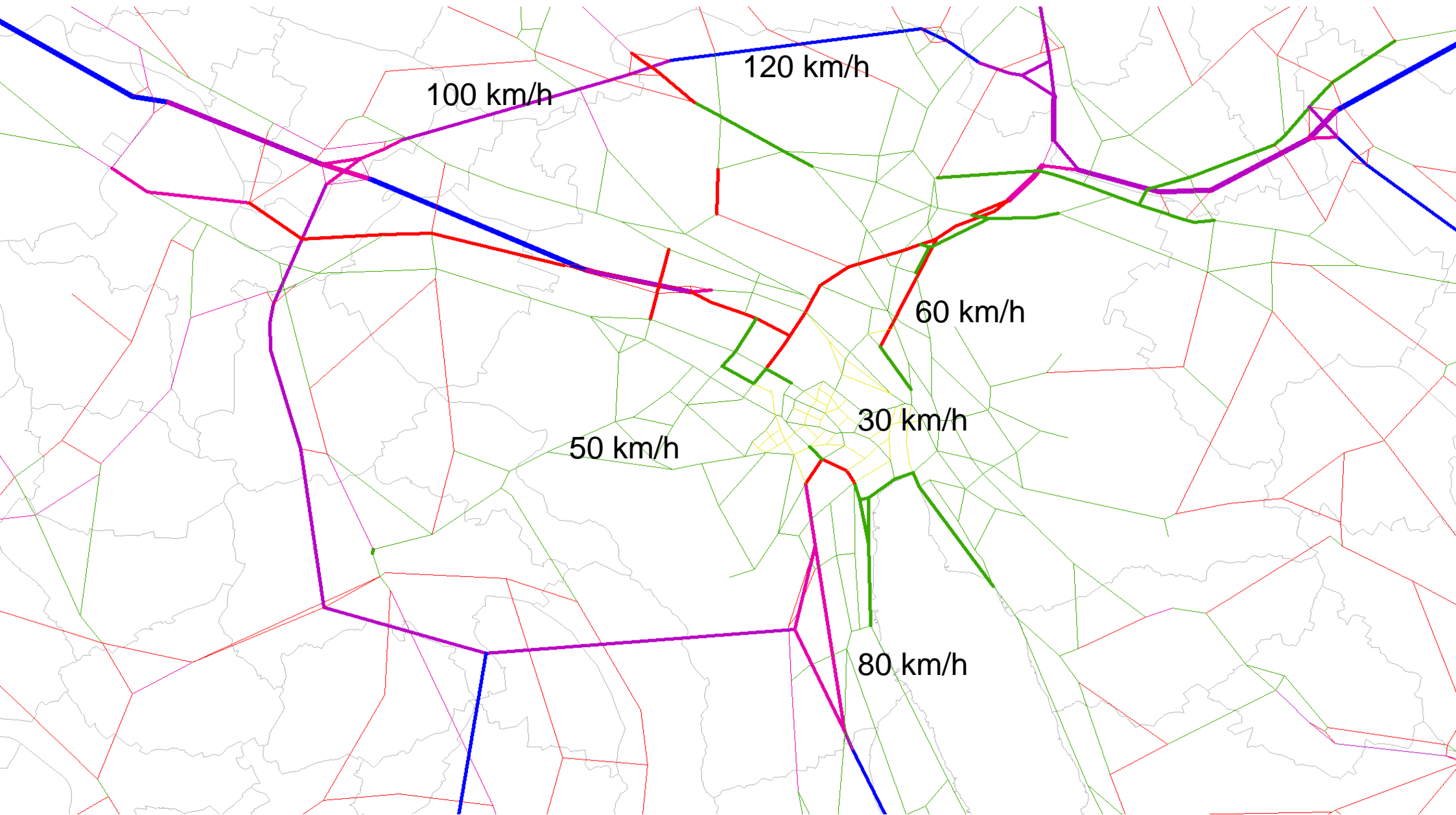- Who would win and lose with the new infrastructure?

Current network

100 km/h

120 km/h

60 km/h

30 km/h

50 km/h

80 km/h

Colours: Allowed Speed; Thickness: # of Lanes

New network with bypass

100 km/h

120 km/h

60 km/h

30 km/h

50 km/h

80 km/h

Colours: Allowed Speed; Thickness: # of Lanes

New network with bypass and additional measures

120 km/h

100 km/h

60 km/h
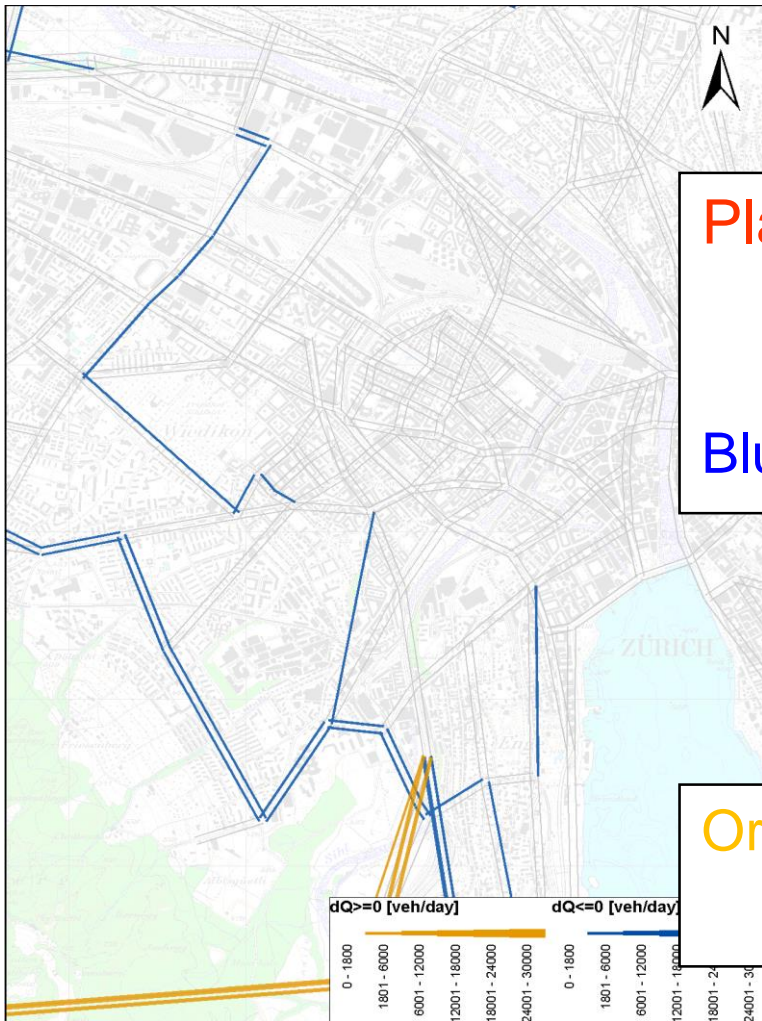
30 km/h

50 km/h

80 km/h

Colours: Allowed Speed; Thickness: # of Lanes

Simulation results bypass

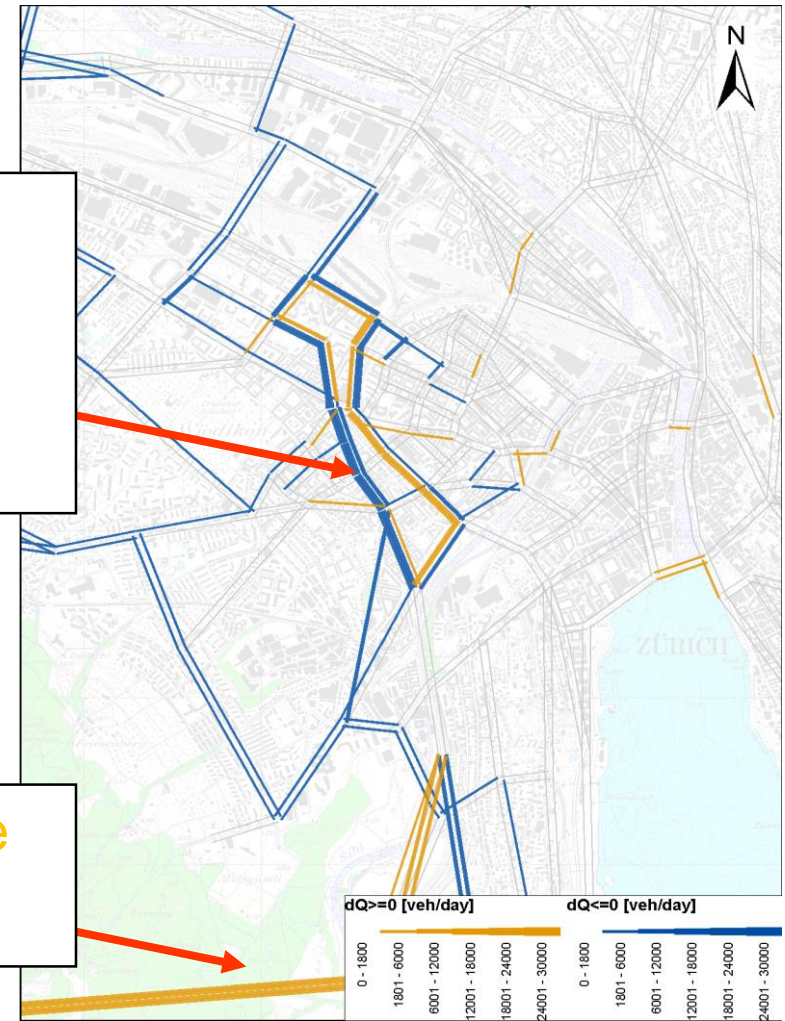Daily Volumes: Difference with current situation

Bypass **without** additional measures

Bypass **with** additional measures

Planned additional measures are impactful

Blue: Traffic reduction

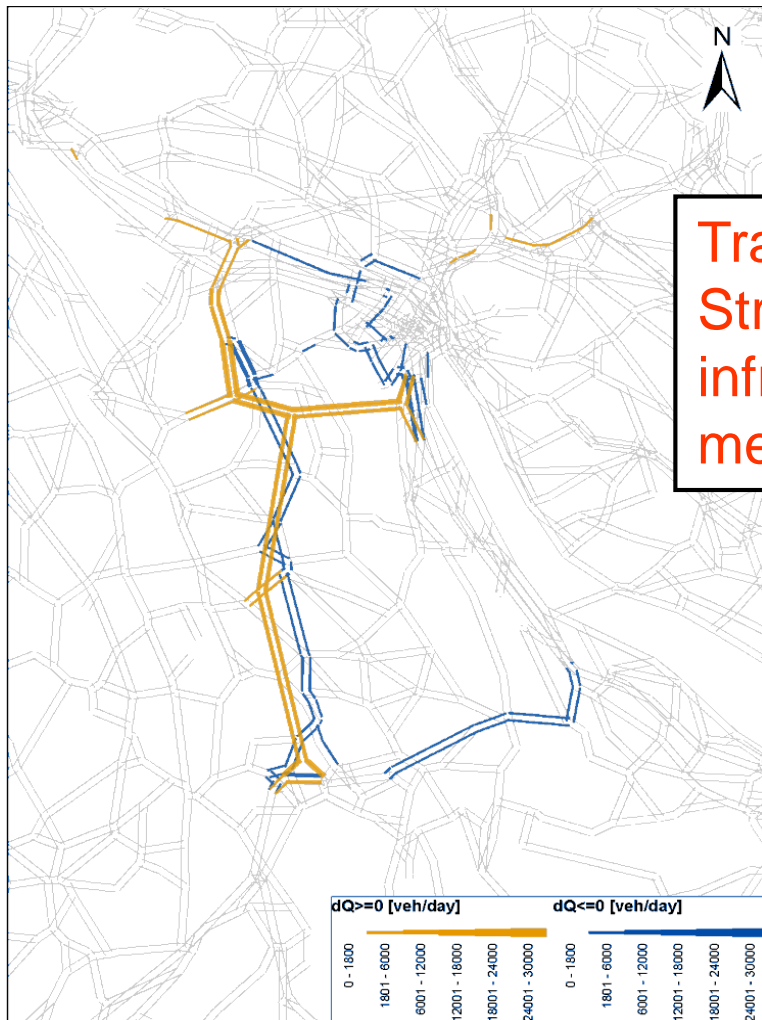Orange: Traffic increase on the Bypass
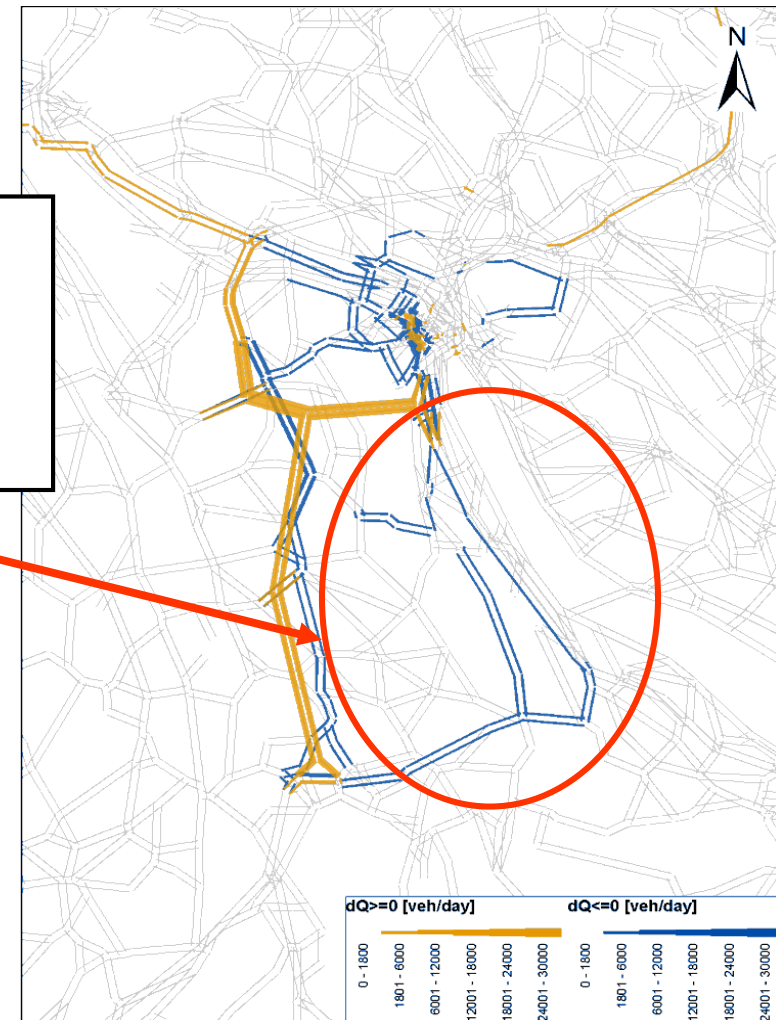
Simulation results bypass

Daily Volumes: Difference with current situation

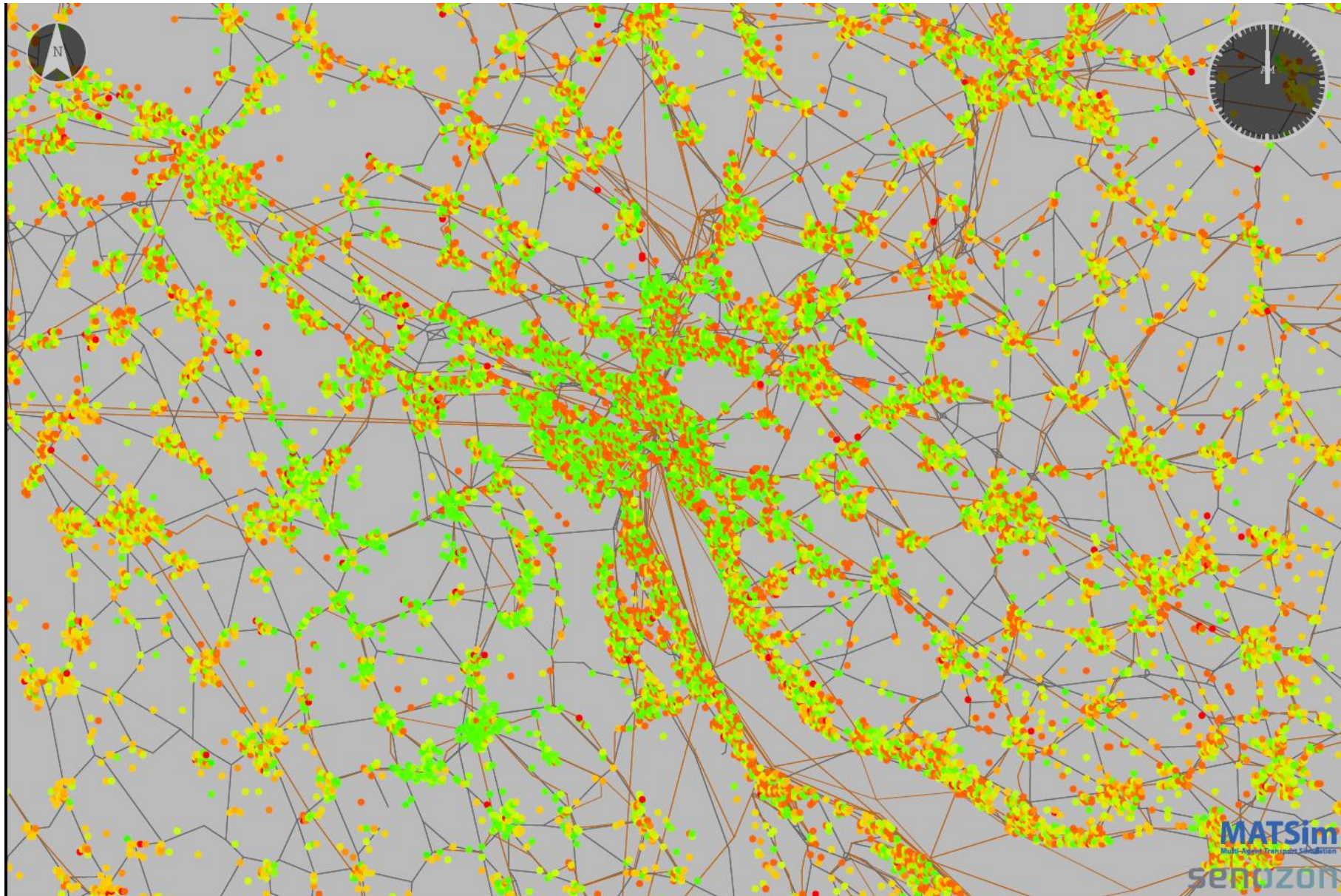Bypass **without** additional measures
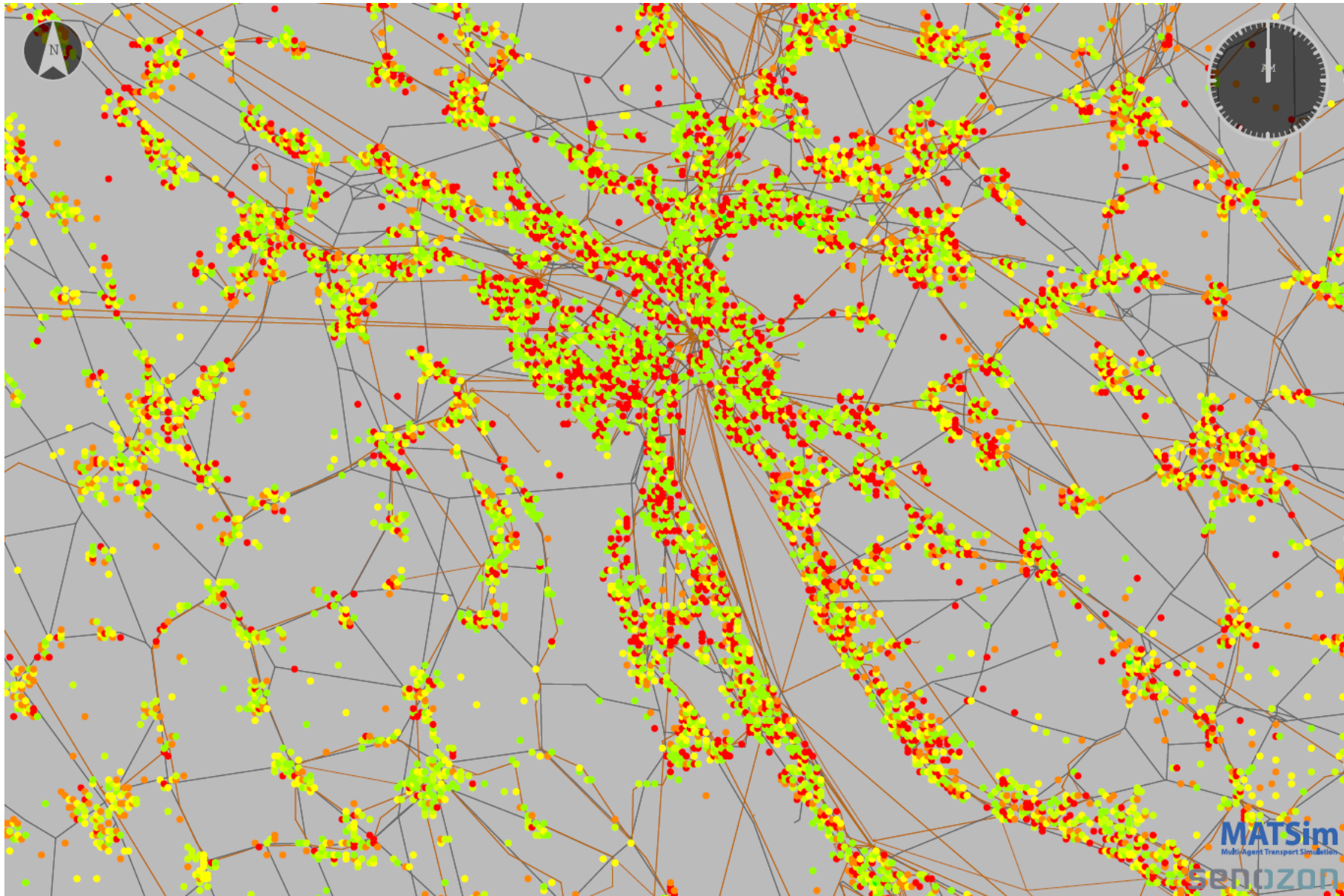
Bypass **with** additional measures

Traffic Lights
Strengthen the impact of the infrastructural additional measures

Winners and Losers: Travel Time

Winners and Losers: MATSim Score (Utility)

Case Study 3 – Free-floating Carsharing in Zürich

Evaluation of a new free-floating carsharing service:

- How would different pricing strategies affect demand for a newly introduced free-floating carsharing?
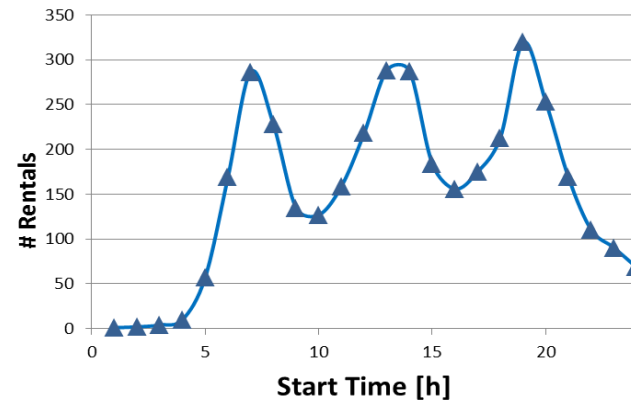
Scenario

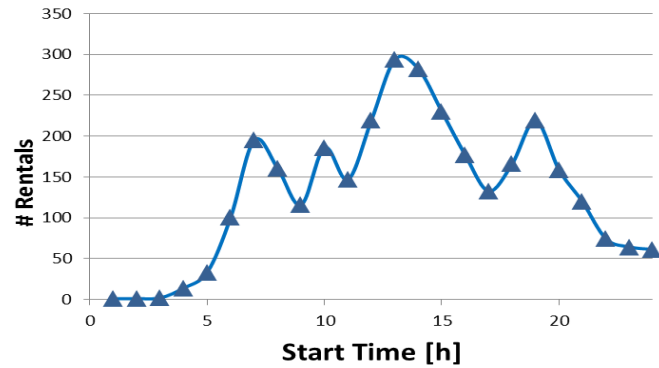|	Scenario I	Scenario II	Scenario III	Scenario IV	Scenario V
SB Time Fee	2.80 SFr./h	2.80 SFr./h	2.80 SFr./h	2.80 SFr./h	2.80 SFr./h
SB Distance Fee	0.60 SFr./Km	0.60 SFr./Km	0.60 SFr./Km	0.60 SFr./Km	0.60 SFr./Km
FF Time Fee	-	0.37 SFr./min	0.185 SFr./min	0.185 SFr/min (10-16) 0.37 SFr/min (rest of day)	0.185 SFr/min (16-10) 0.37 SFr/min (rest of day)

Carsharing Vehicles in Motion
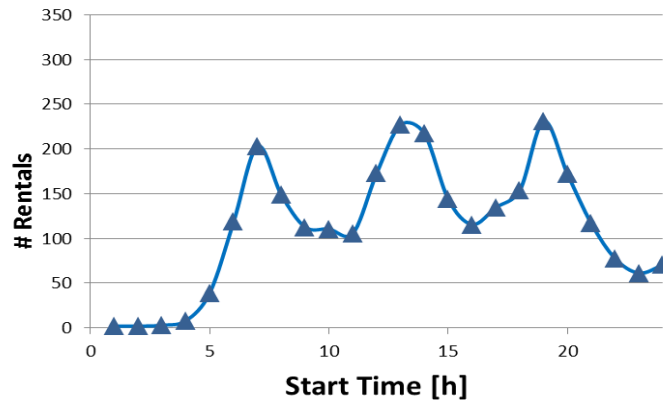
Rentals spatial patterns
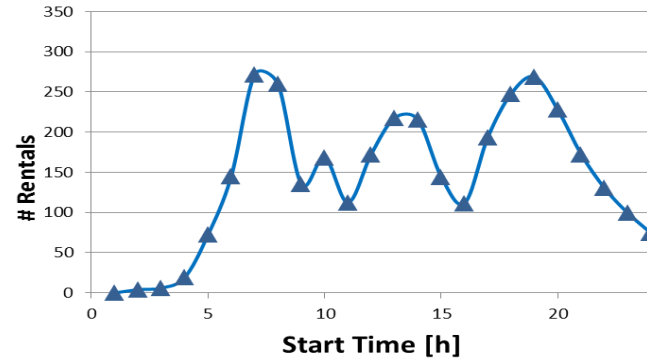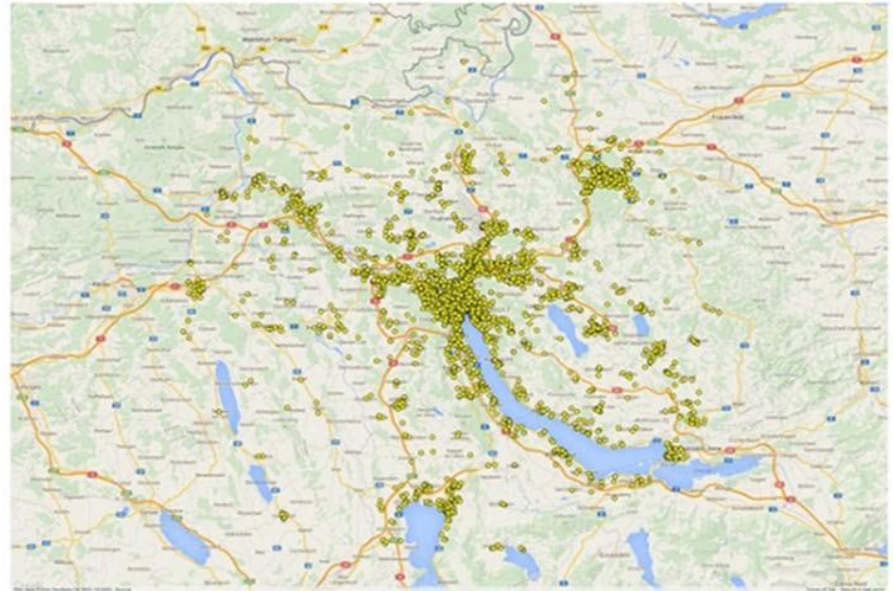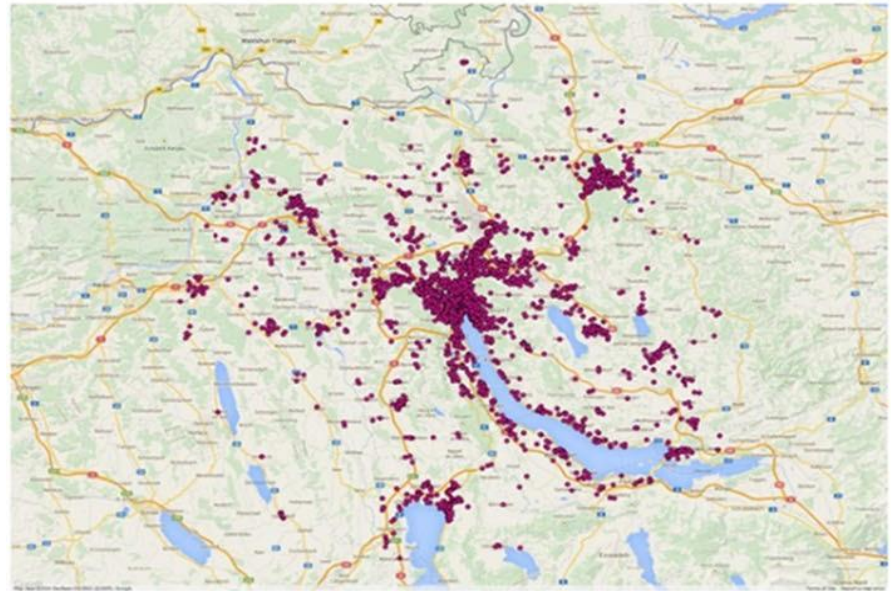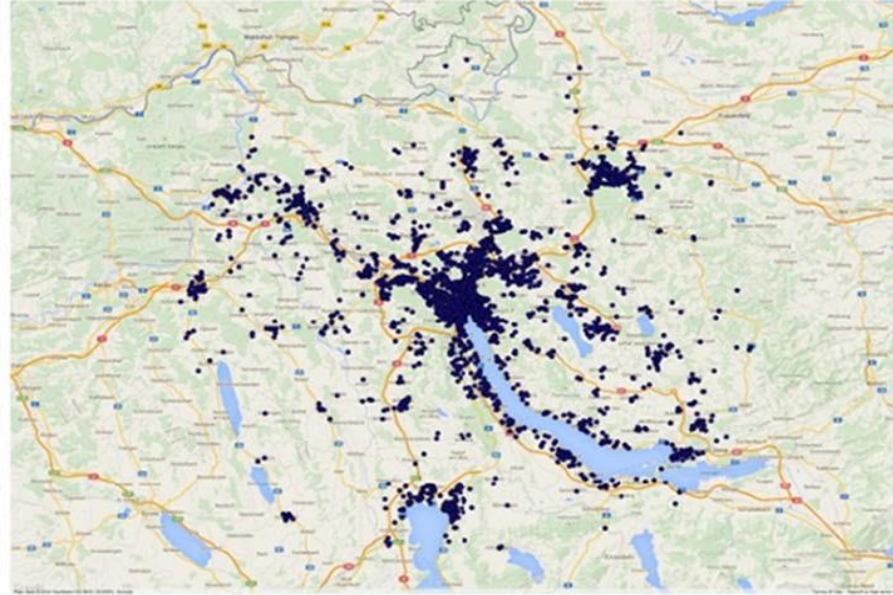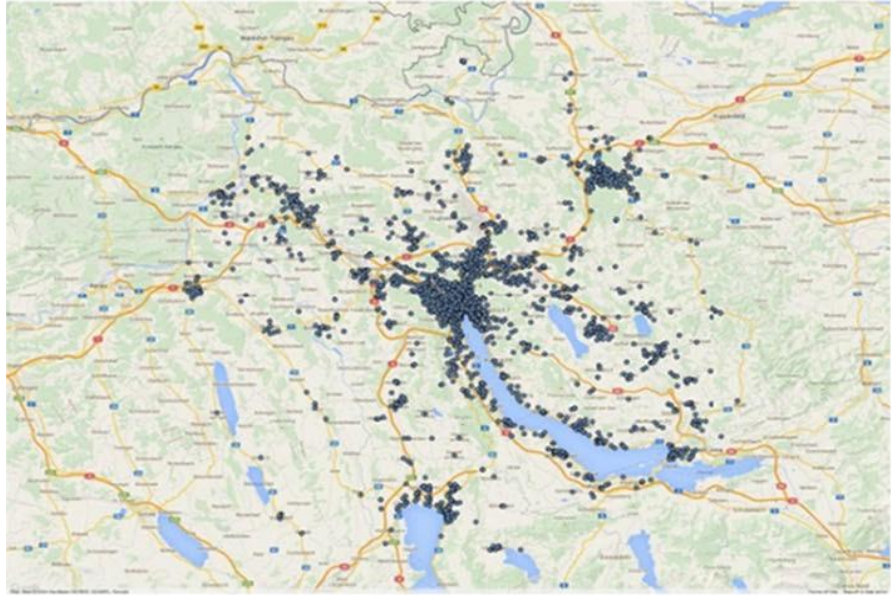
Purpose of the rental
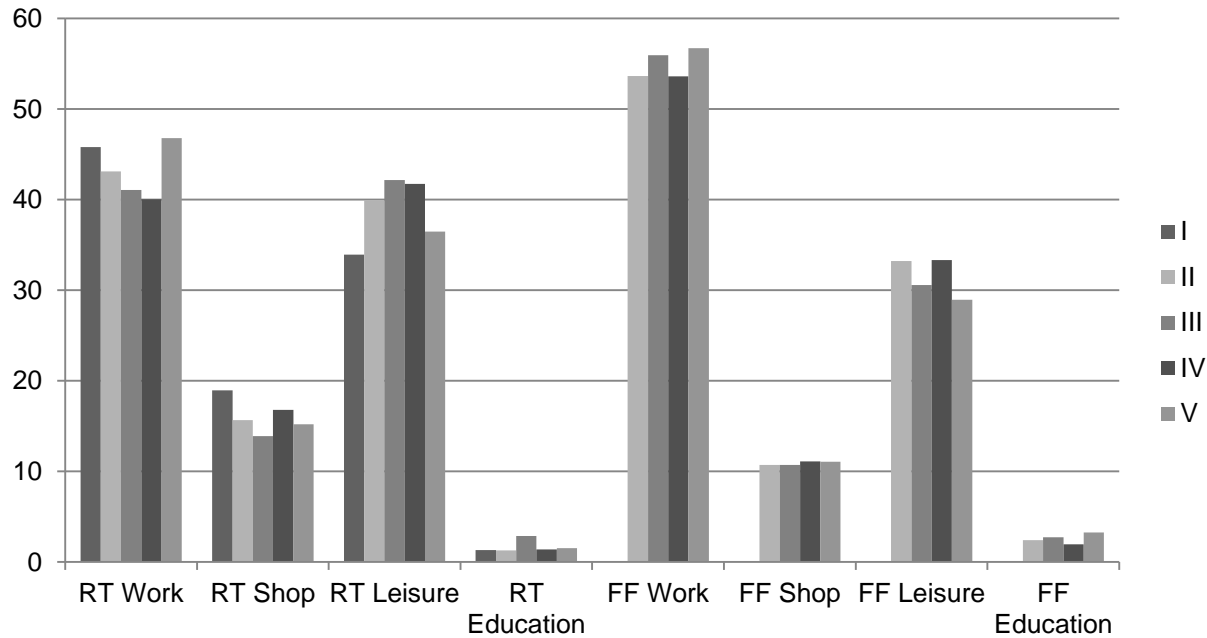
	Scenario I	Scenario II	Scenario III	Scenario IV	Scenario V
RT CS	3h14'57"	3h29'36"	3h07'49''	3h37'12''	3h21'22''
FF CS	-	6h21'10"	6h40'43"	6h09'14"	6h52'02"
Car	5h37'16"	5h37'24"	5h37'32"	5h37'59"	5h37'25"

Questions?

MATSim @ ETHZ, TU Berlin, FCL, Senozon (present)

Prof. Kay Axhausen
Milos Balac
Dr. Michael Balmer
Henrik Becker
Patrick Bösch
Artem Chakirov
Dr. Francesco Ciari
Dr. Christoph Dobler
Thibaut Dubernet
Dr. Alexander Erath
Dr. Gunnar Flötteröd
Pieter Fourie
Prof. Kai Nagel
Kirill Müller
Dr. Andreas Neumann
Benjamin Kickhöfer
Sergio Ordonez
Dr. Marcel
Rieser
Lijun Sun
Michael Van Eggermond
Dominik Ziemke
Michael Zilske

The Multi-Agent Transport Simulation MATSim

edited by
Andreas Horni, Kai Nagel, Kay W. Axhausen

initial demand — mobsim — scoring — analyses — replanning

MATSim
Multi-Agent Transport Simulation

home → work → leisure → home

Agent ◄ (red)
Cars ◄ (gray)
Pt vehicles ■
Home ● (blue)
Working ● (cyan)
Education ● (magenta)
Shopping ● (yellow)
Leisure ● (green)

work
leisure
home

MATSim
Multi-Agent Transport Simulation
senozon
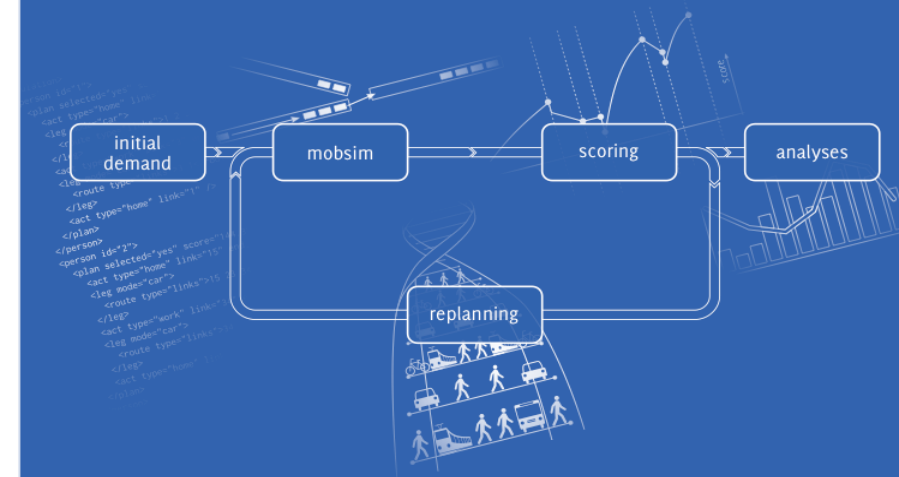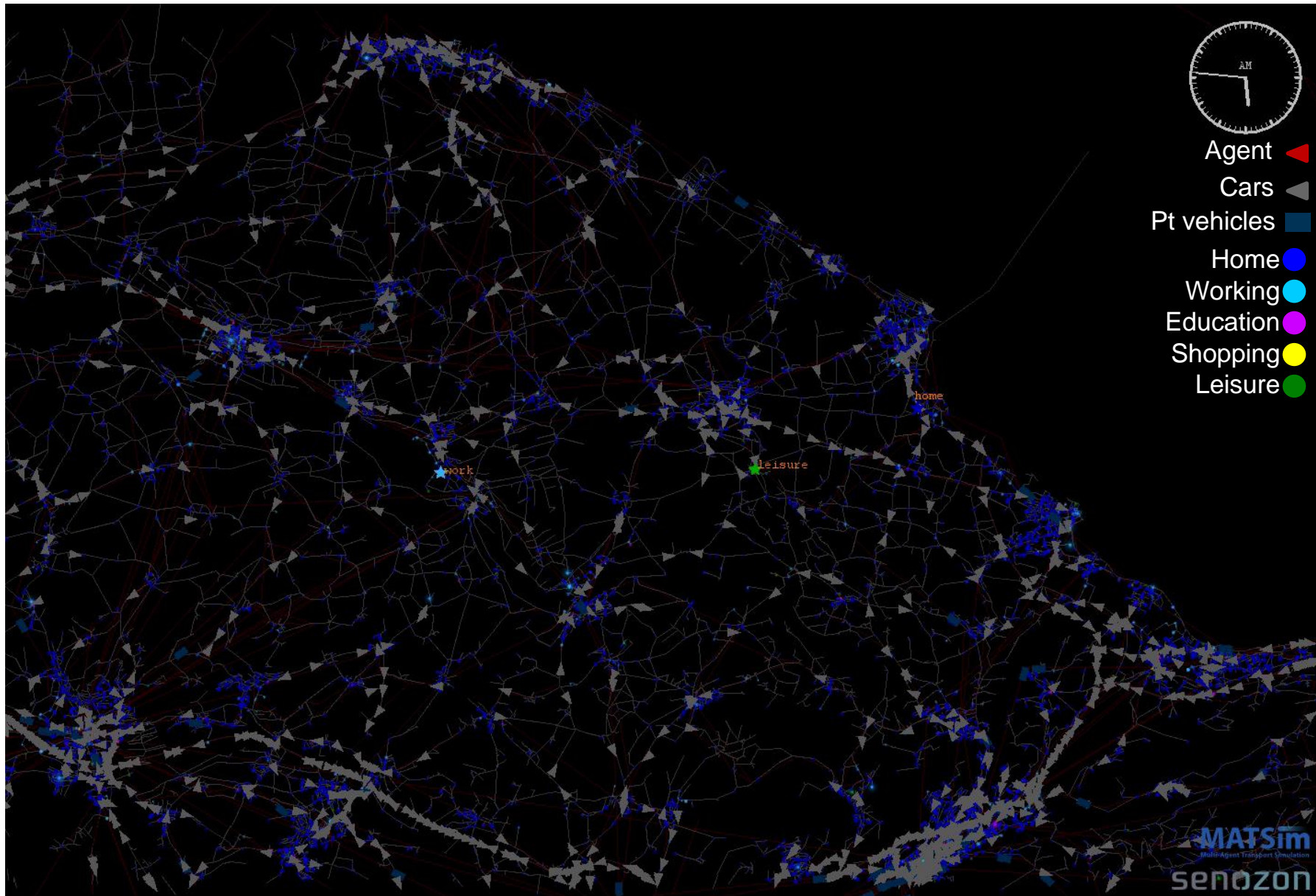
Macro-Simulation vs. Micro-Simulation

- Macro-Simulation
  - Based on aggregated data
  - Flows instead of individual movement
  - Often planning networks

- Micro-Simulation
  - Population is modeled as a set of individuals
  - Traffic flows are based on the movement of single vehicles (or agents) and their interactions
  - Various traffic flow models, e.g. cellular automata model, queue model or car following model
  - Often high resolution networks (e.g. in navigation quality)

MATSim - Scenario creation

- A MATSim scenario contains some mandatory as well as some supplementary data structures

- Mandatory
  - Network
  - Population

- Supplementary
  - Facilities
  - Transit (Schedule, Vehicles)
  - Counts

Speed vs Resolution

Resolution (vertical axis), Speed (horizontal axis)

- physical (VISSIM)
- CA (TRANSIMS)
- Q (Cetin)
- Q event (MATSIM)
- parallel Q event (MATSIM)
- meso (METROPOLIS)
- macro (VISUM)
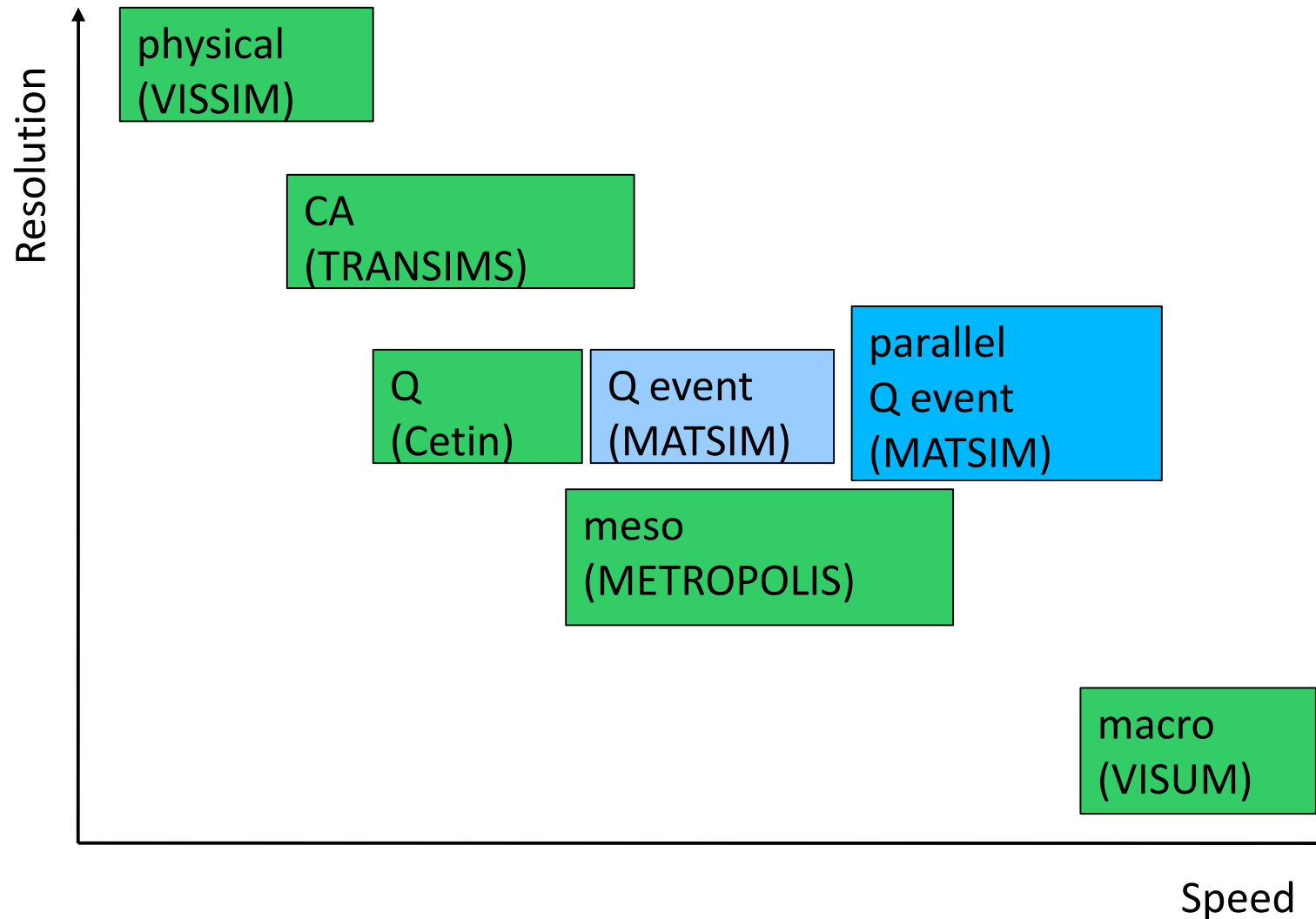
Performance - Scenario

- Transportation system in Switzerland
- 24 h of an average Work-day

- 5.99 Mio Agents
- 1.6 Mio Facilities for 1.7 Mio Activities (5 Types)
- Navigation network with 1.0 Mio Links
- 4 Modes (others optional → i.e. shared modes)
- 22.2 Mio Trips
- Routes-, Time-, (Subtour-)Mode- und „Location"-Choice

→ One Iteration in ca. 4.5 hours