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Patterns of daily movement: An agent-based model of Switzerland

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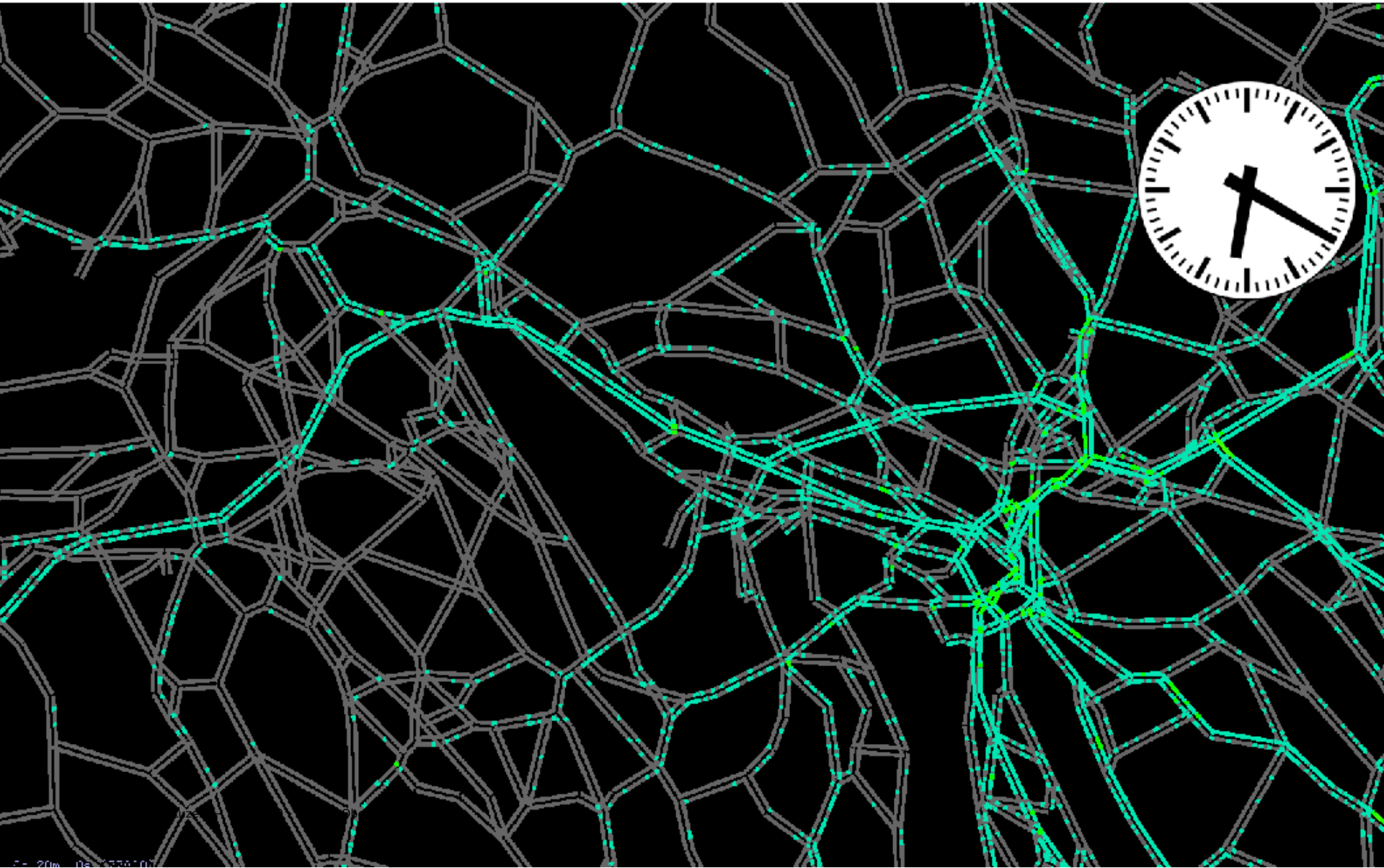
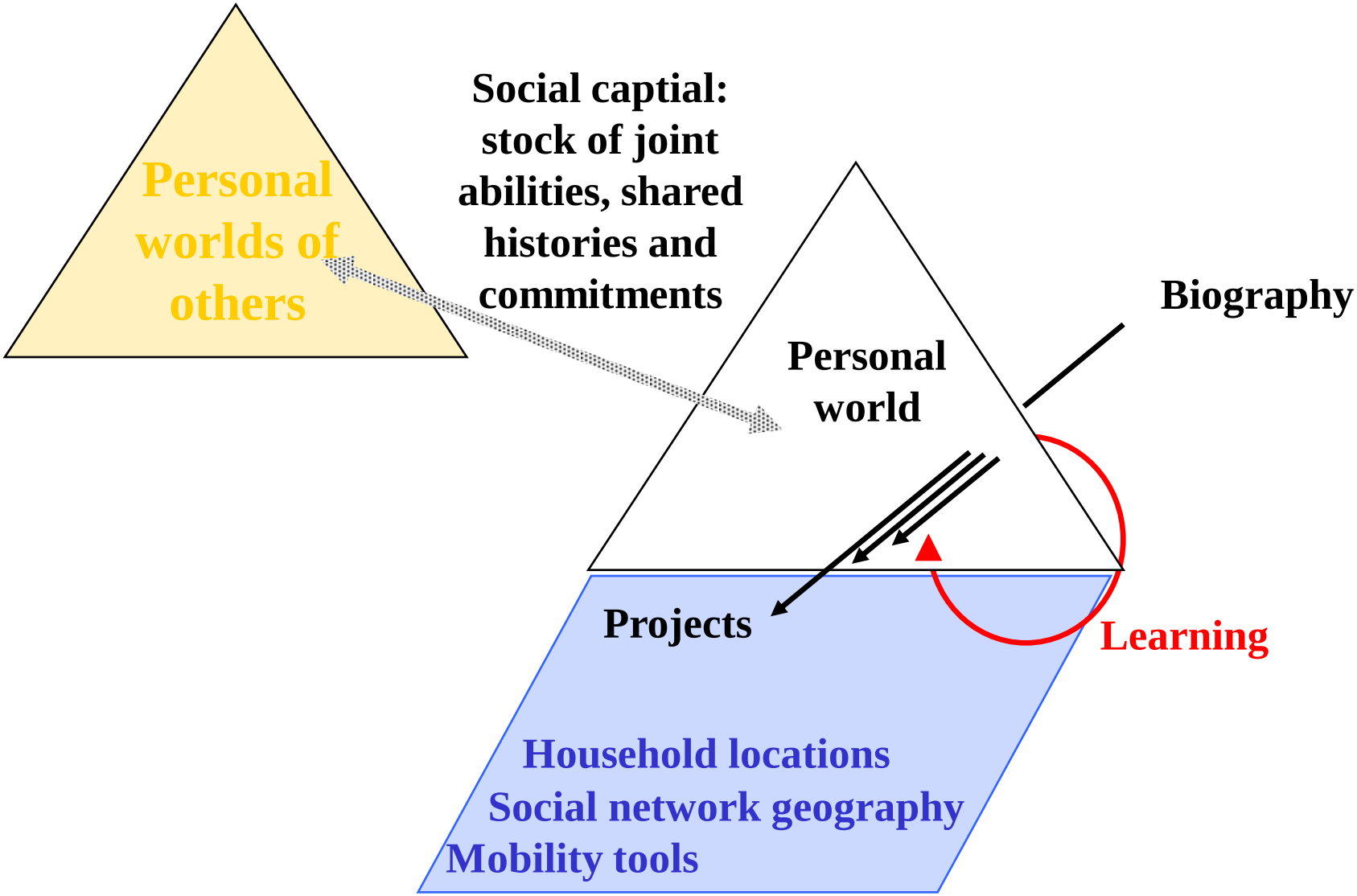
Why transport planning/traffic engineering ?

- Provide forecasts of the changes in use and impact of transport system change (short term to long term)
- Assess the economic viability of those changes (social benefit or individual/firm benefit)
- Provide input into the political assessment of projects and service changes
- Optimise the operation of the systems (social costs)

A peak hour



Conceptual understanding



Time horizons of transport planning

	System	Person
Long term	Slots	Home/work location
	Regulation	**Car ownership**
		Social networks
Medium term	Services offered	**Season tickets**
	Prices	Projects
	Awareness	
Short term	Operation	**Daily schedule**

Generalized cost function of the schedule

Risk and comfort-adjusted weighted sum of times, expenditures and social content of activities and travel:

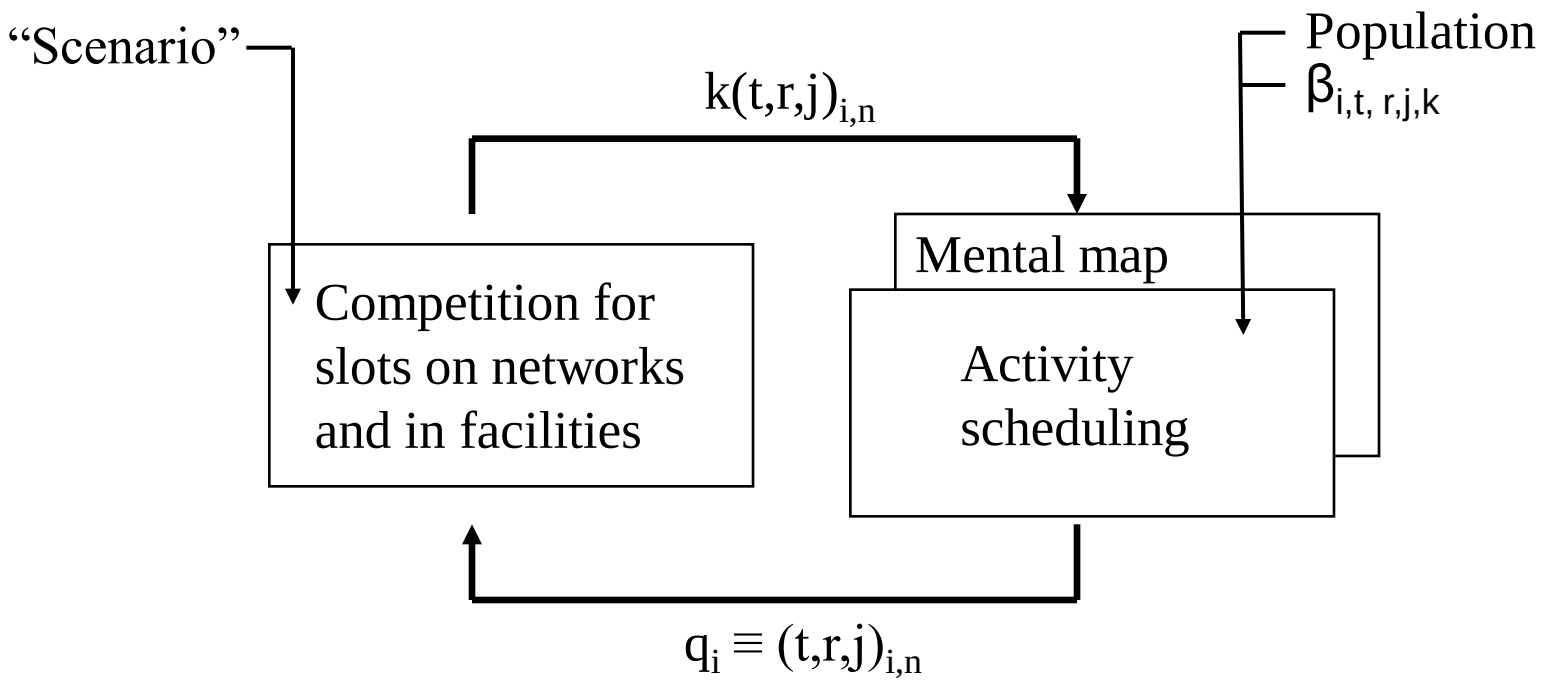
$$U_{plan} = \sum_{i=1}^{n} U_{act,i} + \sum_{i=2}^{n} U_{trav,i-1,i}$$

$$U_{act,i} = U_{dur,i} + U_{late.ar,i}$$

Choices currently modelled in MATSim-T

- *Number and type of activities*
- *Sequence of activities*
  - Start and duration of activity
  - Composition of the group undertaking the activity
  - Expenditure division
  - *Location of the activity*
    - Connection between sequential locations
      - Location of access and egress from the mean of transport
      - *Vehicle/means of transport*
      - Route/service
      - Group travelling together
      - Expenditure division

What does MATSim-T do ?



Demand q are the i^{th}movements of person p from the current location at time t on route (connection) r to location j. The resulting generalised costs k are used to adjust the schedules and to change the capacities C and prices P of facilities f

What does it return?

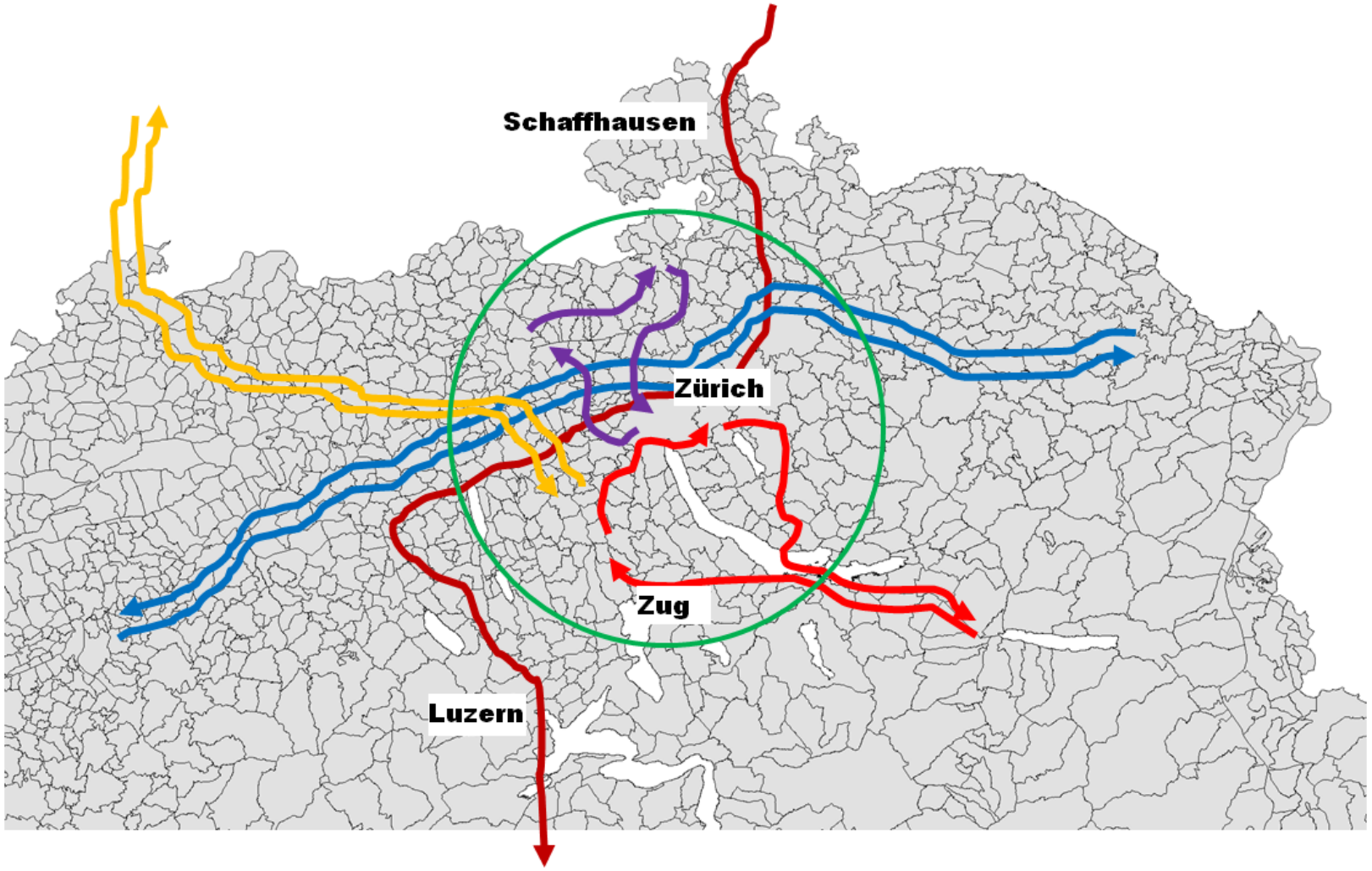
```
<person id="22018">
    <plan score="157.72" selected="yes">
        <act type="h" x="703600" y="236900" link="5757"
                                                    end_time="07:35:04" />
        <leg num="0" mode="car" dep_time="07:35:04" trav_time="00:16:31">
            <route>1900 1899 1897</route>
        </leg>
        <act type="w" x="702500" y="236400" link="5749" dur="08:12:05" />
        <leg num="1" mode="car" dep_time="16:03:40" trav_time="01:10:22">
            <route>1899 1848 1925 1924 1923 1922 1068</route>
        </leg>
        <act type="l" x="681450" y="246550" link="2140" dur="01:20:00" />
        <leg num="2" mode="car" dep_time="" trav_time="00:34:35">
            <route>1067 1136 1137 1921 1922 1923 1925 1848 1899</route>
        </leg>
        <act type="h" x="703600" y="236900" link="5757" />
    </plan>
</person>
```

MATSIM-T: Steady-state version

- Scale:
  - 7.5 mio agents,
  - 2 mio homes
  - 1 mio facilities
  - 1 mio links and nodes

- Continuous time resolution: Seconds
- Spatial resolution: Address (individual facilities)

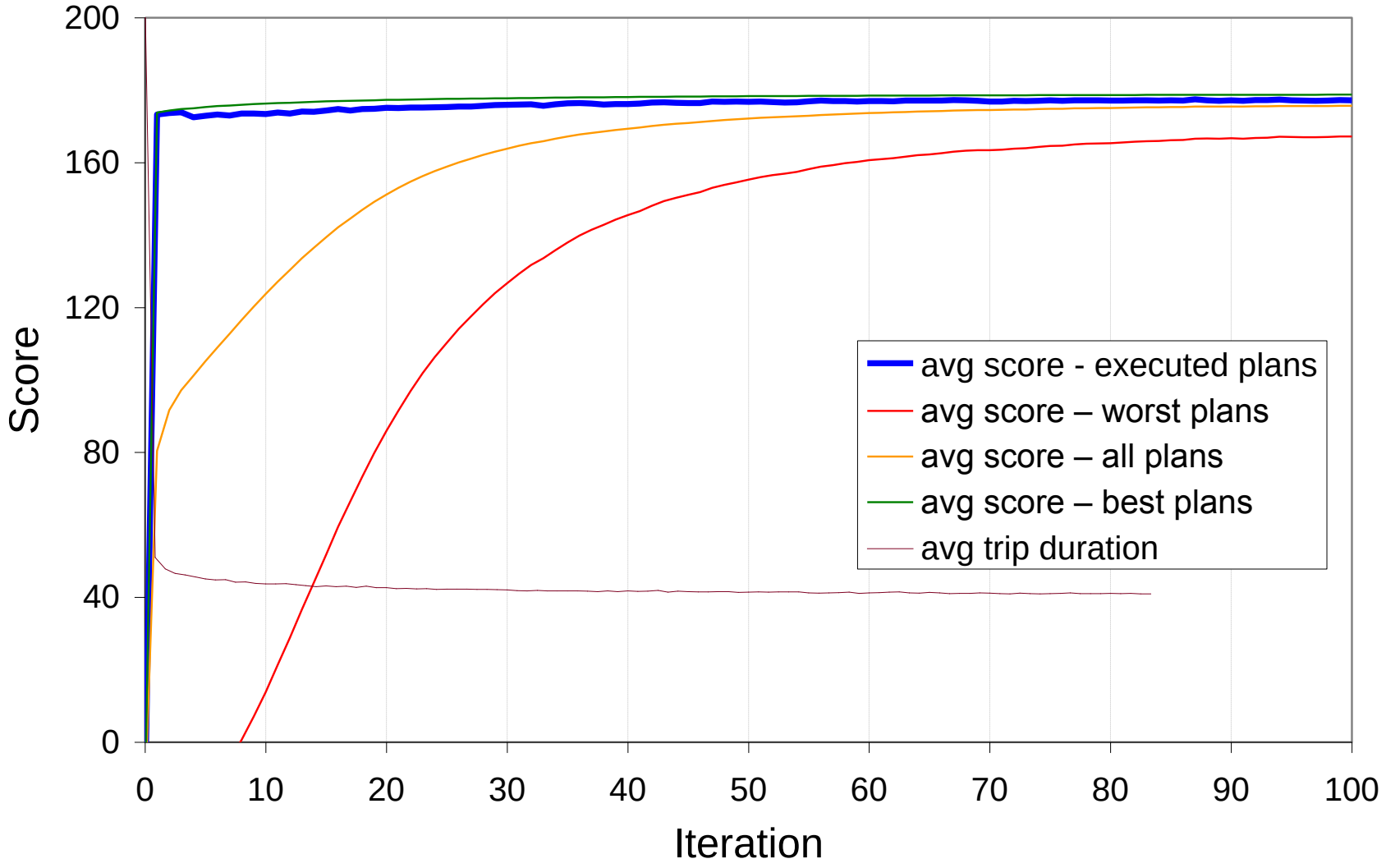
Example: 3% of Swiss population



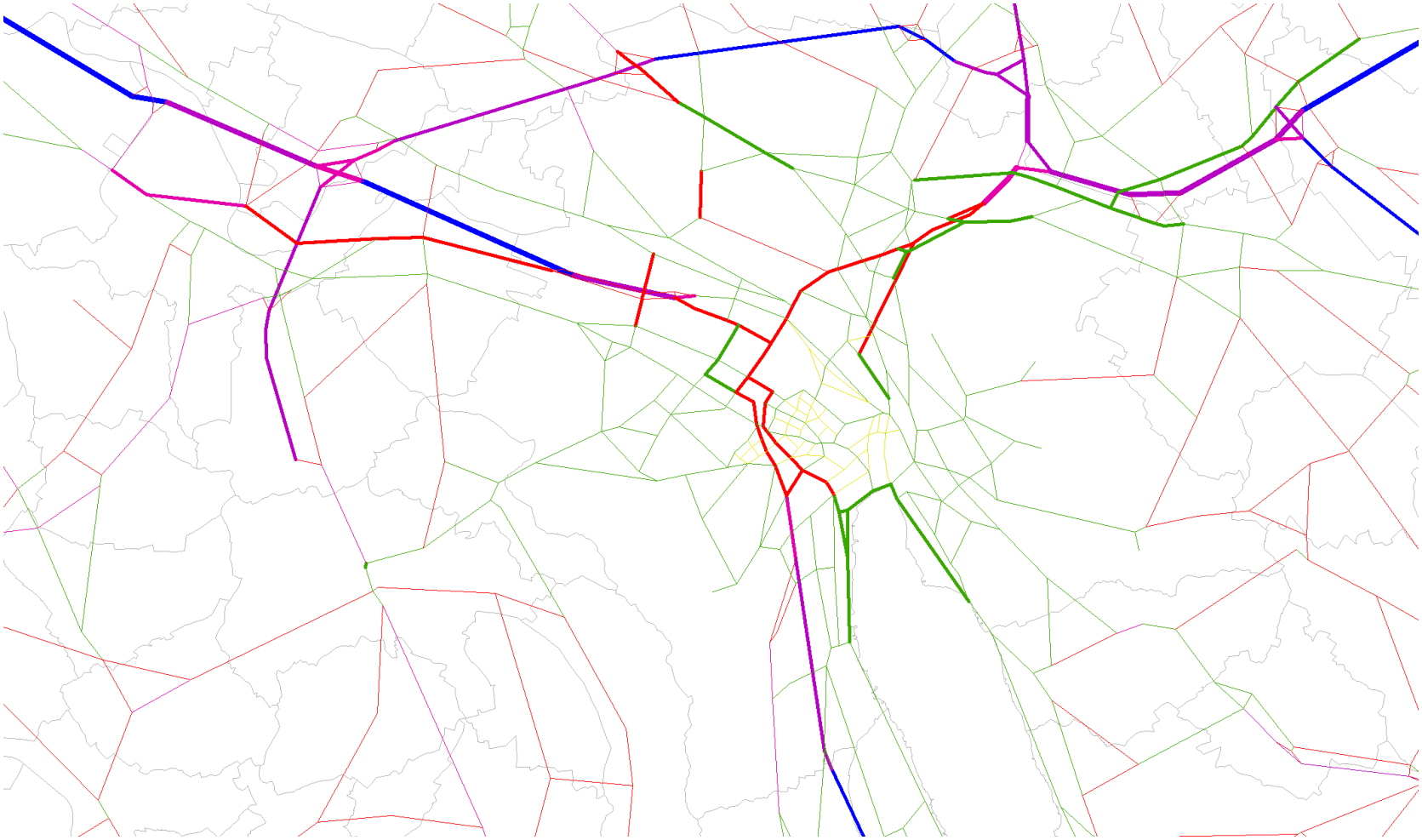
Example: Computing times by step

Operation	Unit	Units/sec
Initial demand		0.12h
Scheduling (fixed components)		14.40h
Scheduling (planomat)	Agent	100
Scheduling (routing)	Agent	1000
Time-step based traffic flow simulation	Agent	300
Learning	Agent	250’000
Total iteration (with I/O)		0.22h
Total run (with I/O) (100 iterations)		23h

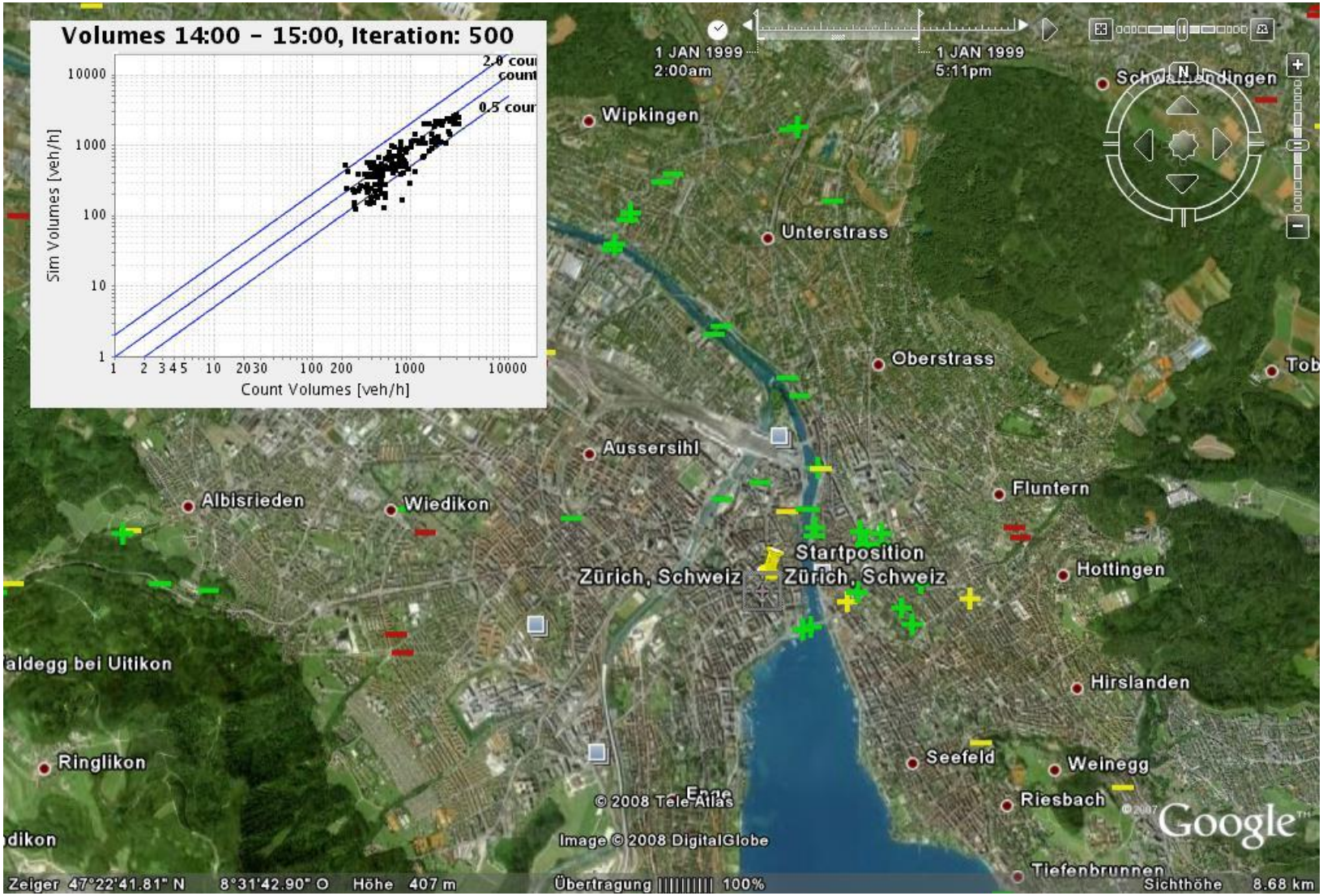
Example: Score/generalised costs by iteration



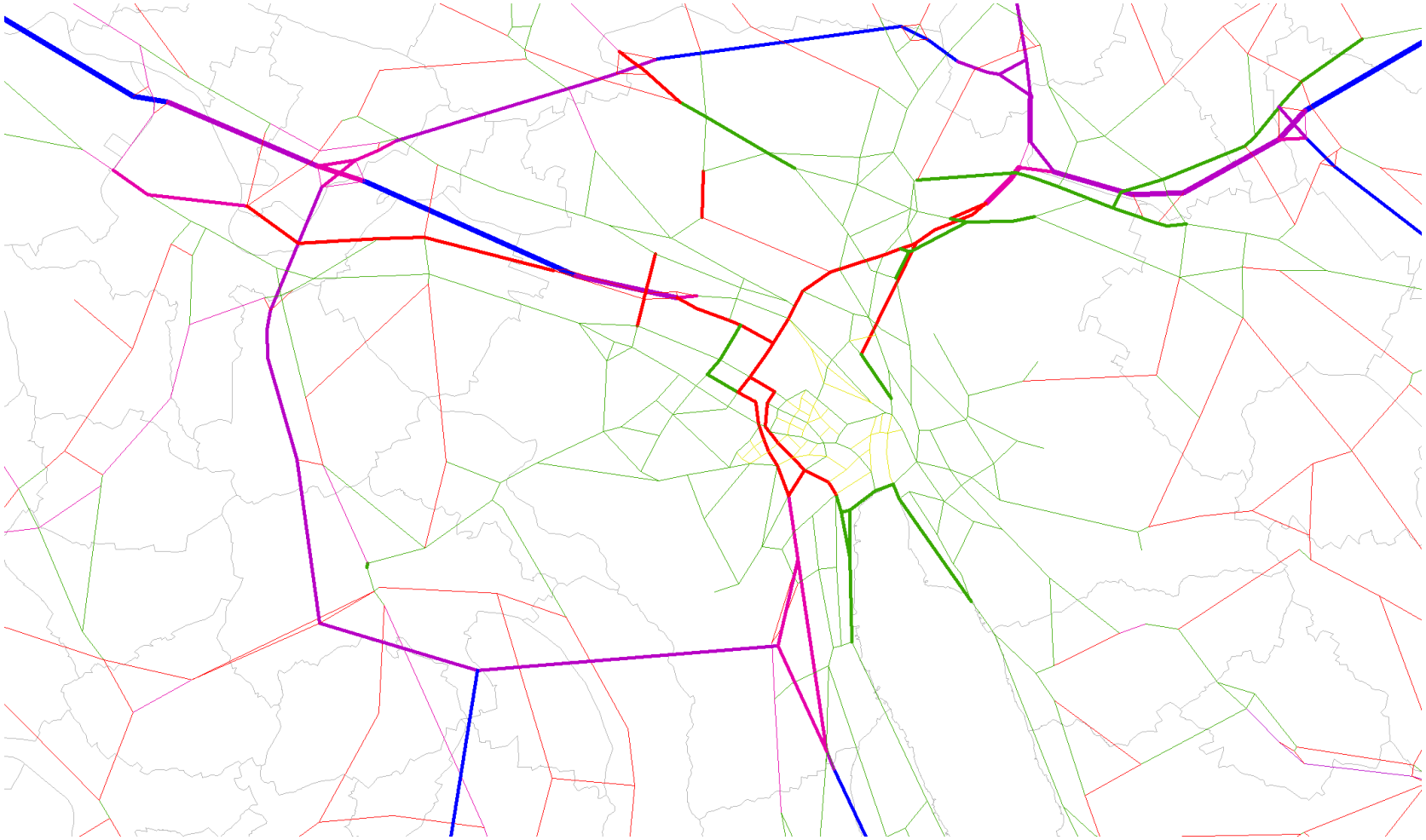
Westumfahrung Zürich: Before



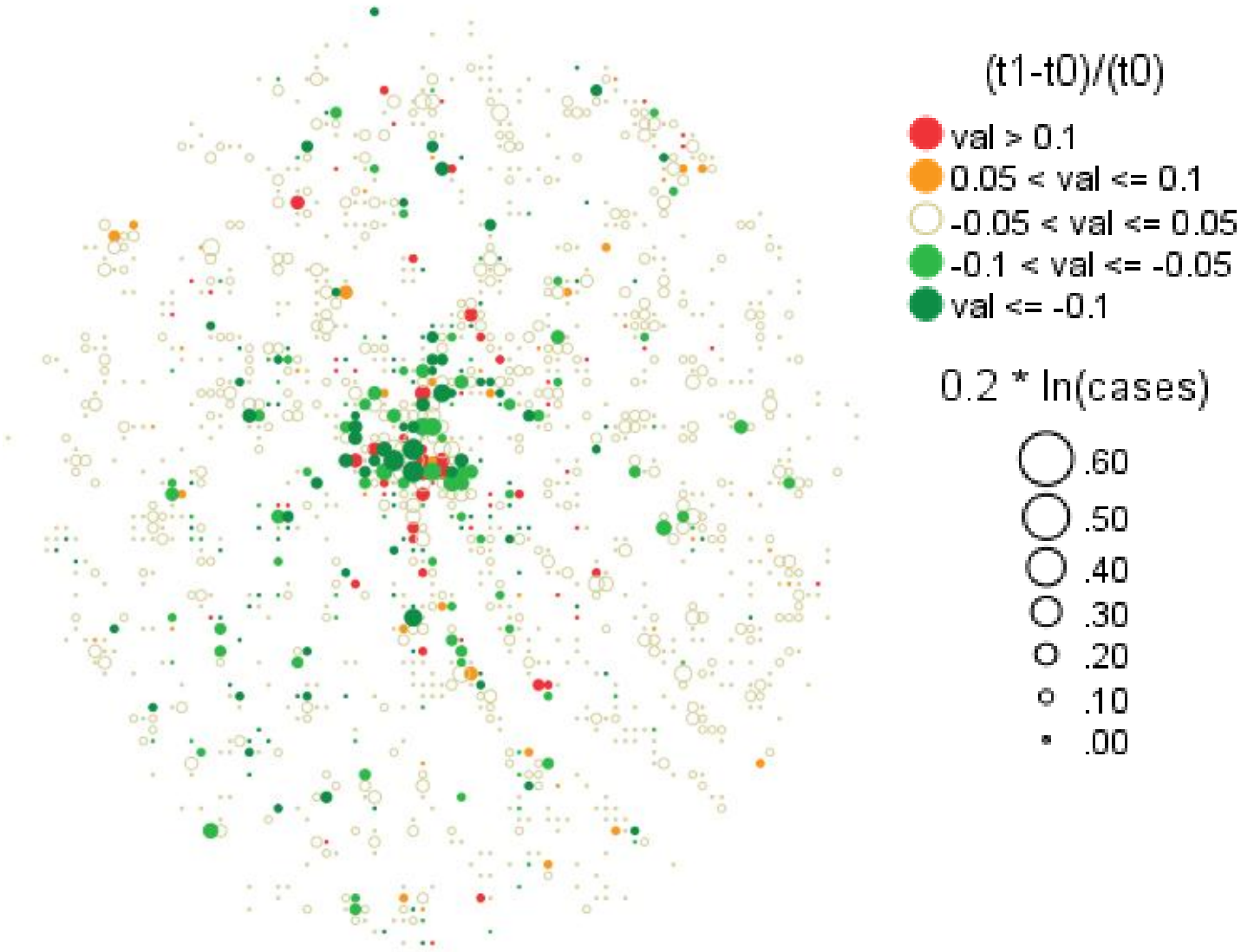
Validation of status-quo



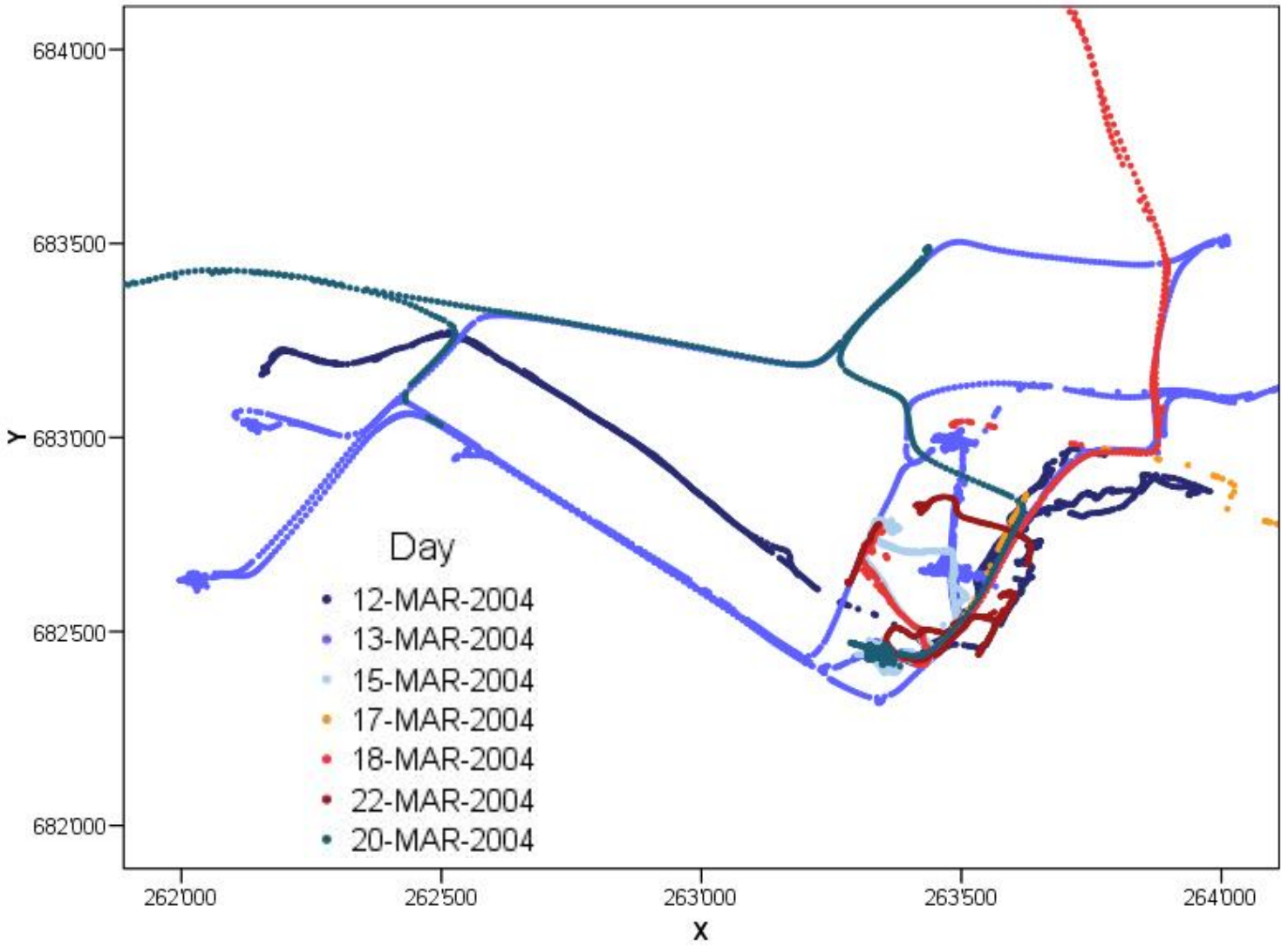
Westumfahrung Zürich: After



Westumfahrung Zürich: Winners/Loosers



Outlook: Exploit the existing (coming) data wealth

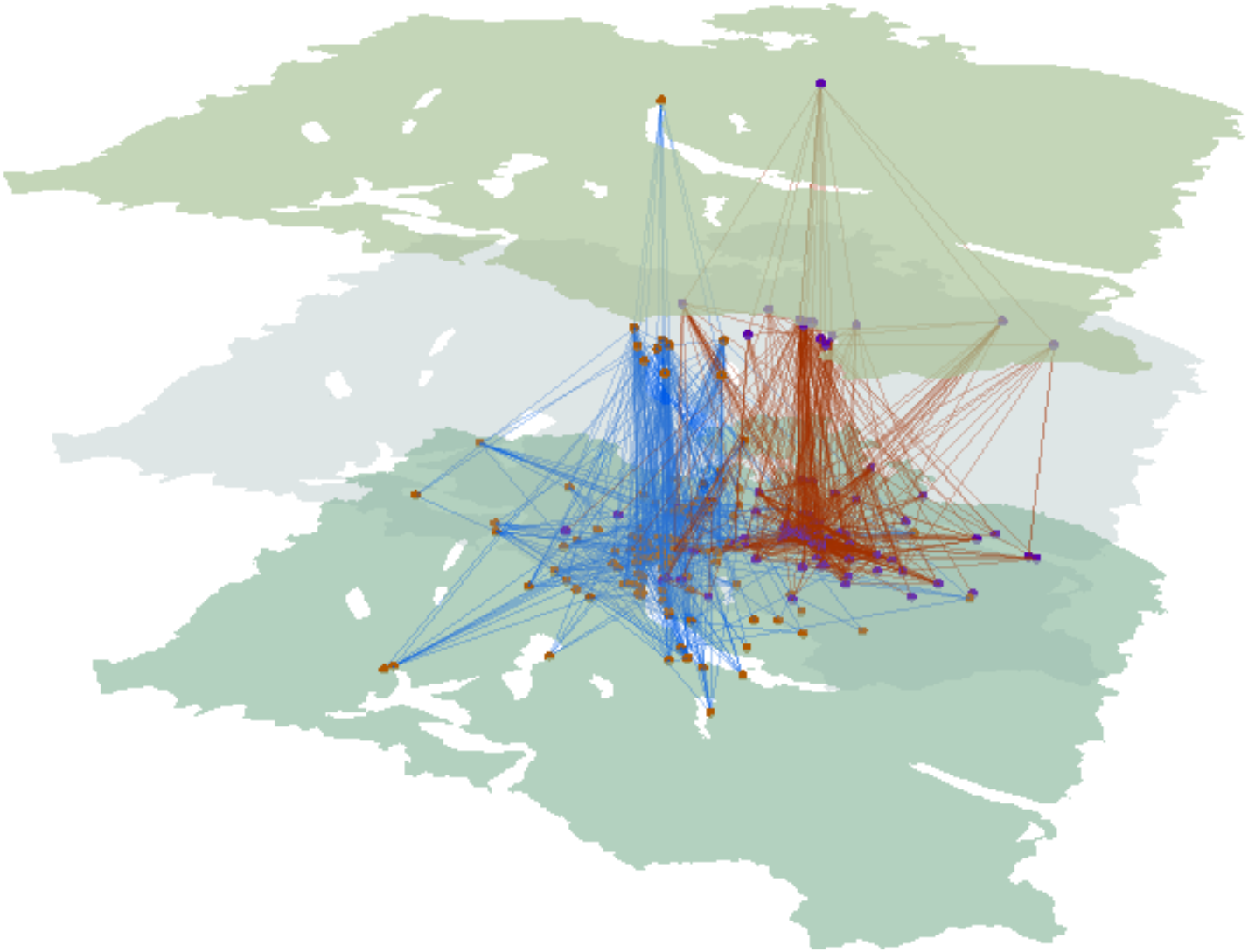


Adapted from Botte, 2003

Outlook: Integration of supply side actors

Adapted from Botte, 2003

Outlook: Joint choice and information flow



Outlook

- Stability of simulation with multiple actor types

- Path dependence
- Development of crisis

- Validation
- Computing times

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