Senozon Mobility Model: Analytics and Examples of microscopic and dynamic mobility data

Michael Balmer

MScIDS: MSc in Applied Information and Data Science
Domaine Experience: Geospatial Data Analysis for Smart Communities

HSLU

Senozon AG, Zürich

Dynamic Geo-Data in transport planning

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About…

Michael Balmer:

- PhD am IVT, ETH Zurich
- Focus: Development of the first MATSim Software (transport planning) in Java
- Founder of Senozon AG (ETH Spin-Off)
- Lecturer at IVT, ETH Zurich

Senozon:

- Application of research projects into mobility models, solutions and products
- Demand modeling, public transit optimization, location assessment

Overview

- What are (geo-)data?
- From data to geo-data
- What are projections?
- From (geo-)data to (geo-)analysis and (geo-)information
- What are (geo-)data in transport planning?
- What are dynamic (geo-)data?

What are (geo-)data

What are data? What are geo-data?

Survey:

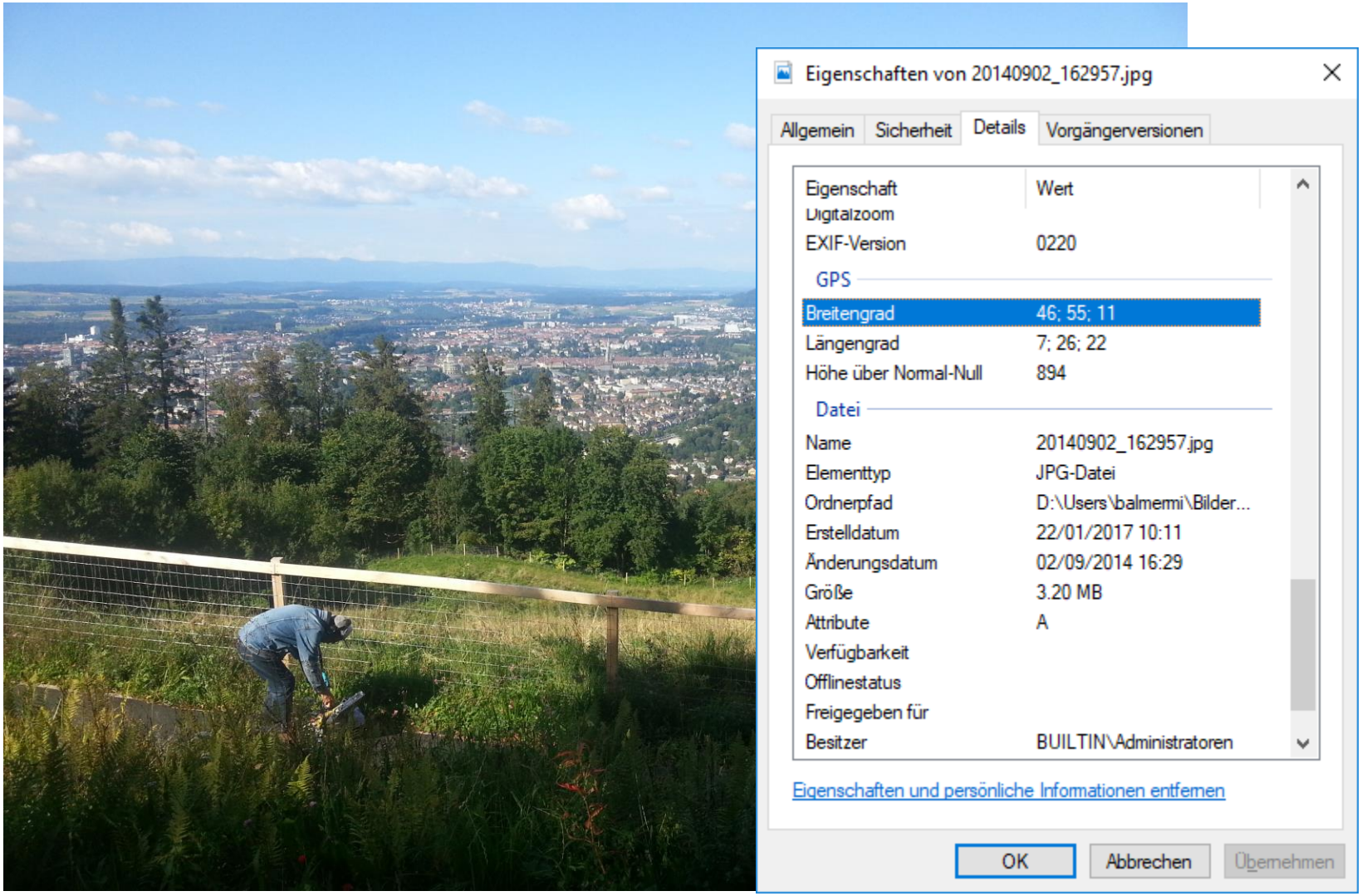
- schedules
- pictures
- 0/1
- etc…..

- Geo-data: It’s the same but with XYZ

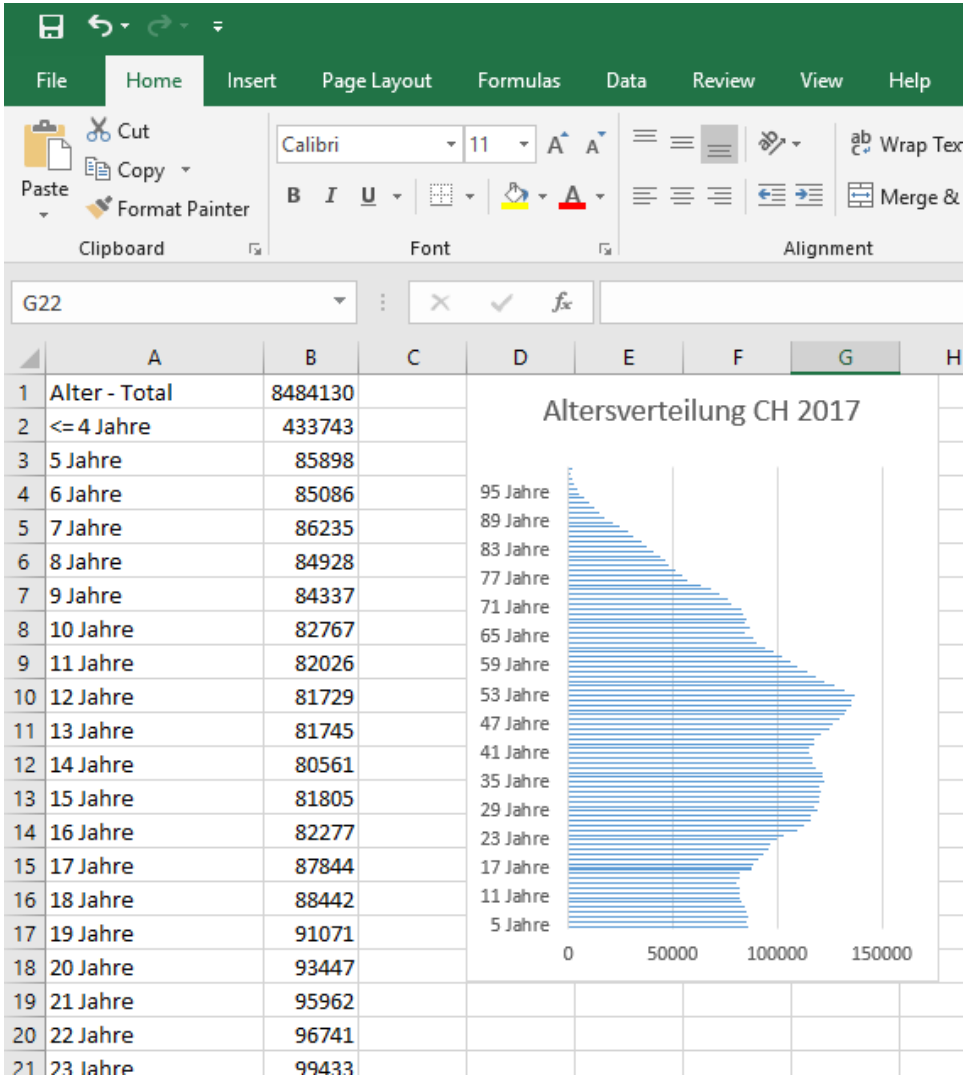
From data to geo-data

Data or Geo-Data?

Data or Geo-Data?



Data or Geo-Data?



	A	B
1	Alter - Total	8484130
2	<= 4 Jahre	433743
3	5 Jahre	85898
4	6 Jahre	85086
5	7 Jahre	86235
6	8 Jahre	84928
7	9 Jahre	84337
8	10 Jahre	82767
9	11 Jahre	82026
10	12 Jahre	81729
11	13 Jahre	81745
12	14 Jahre	80561
13	15 Jahre	81805
14	16 Jahre	82277
15	17 Jahre	87844
16	18 Jahre	88442
17	19 Jahre	91071
18	20 Jahre	93447
19	21 Jahre	95962
20	22 Jahre	96741
21	23 Jahre	99433

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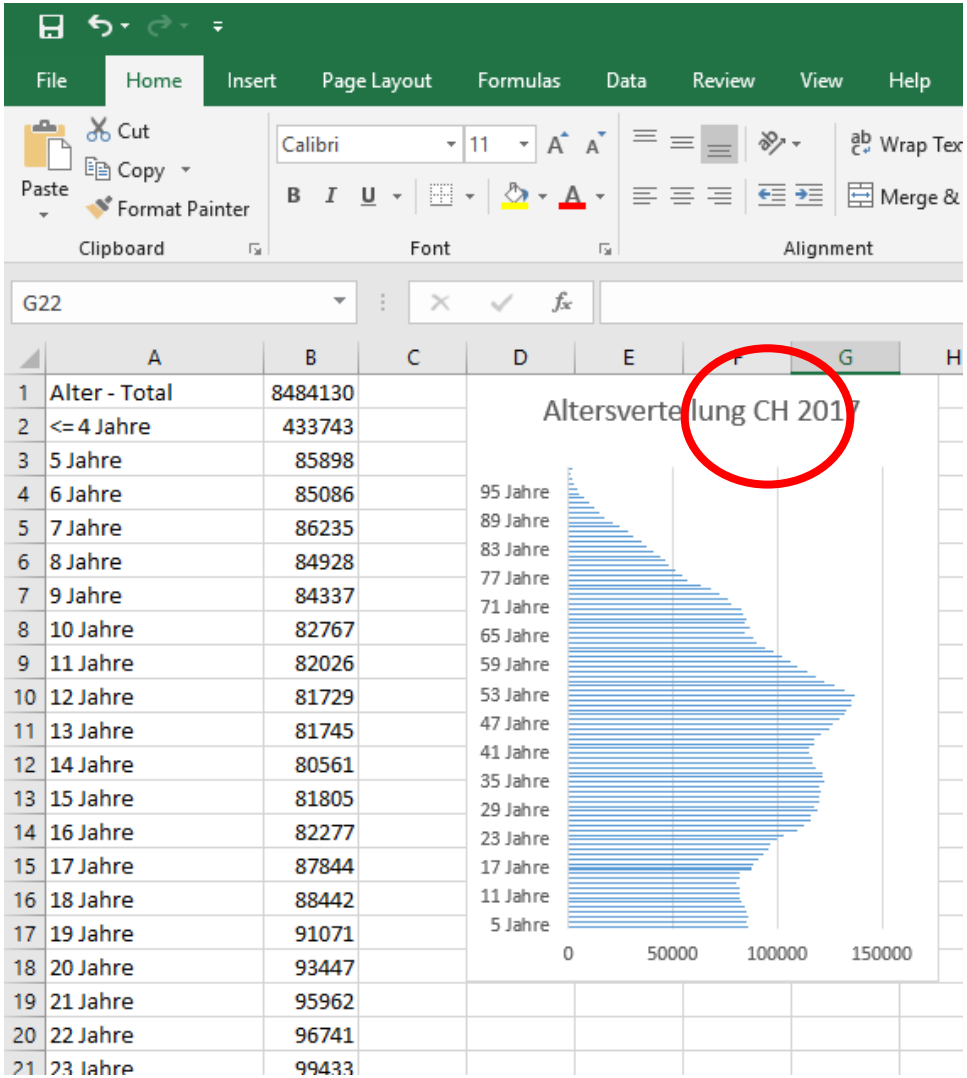

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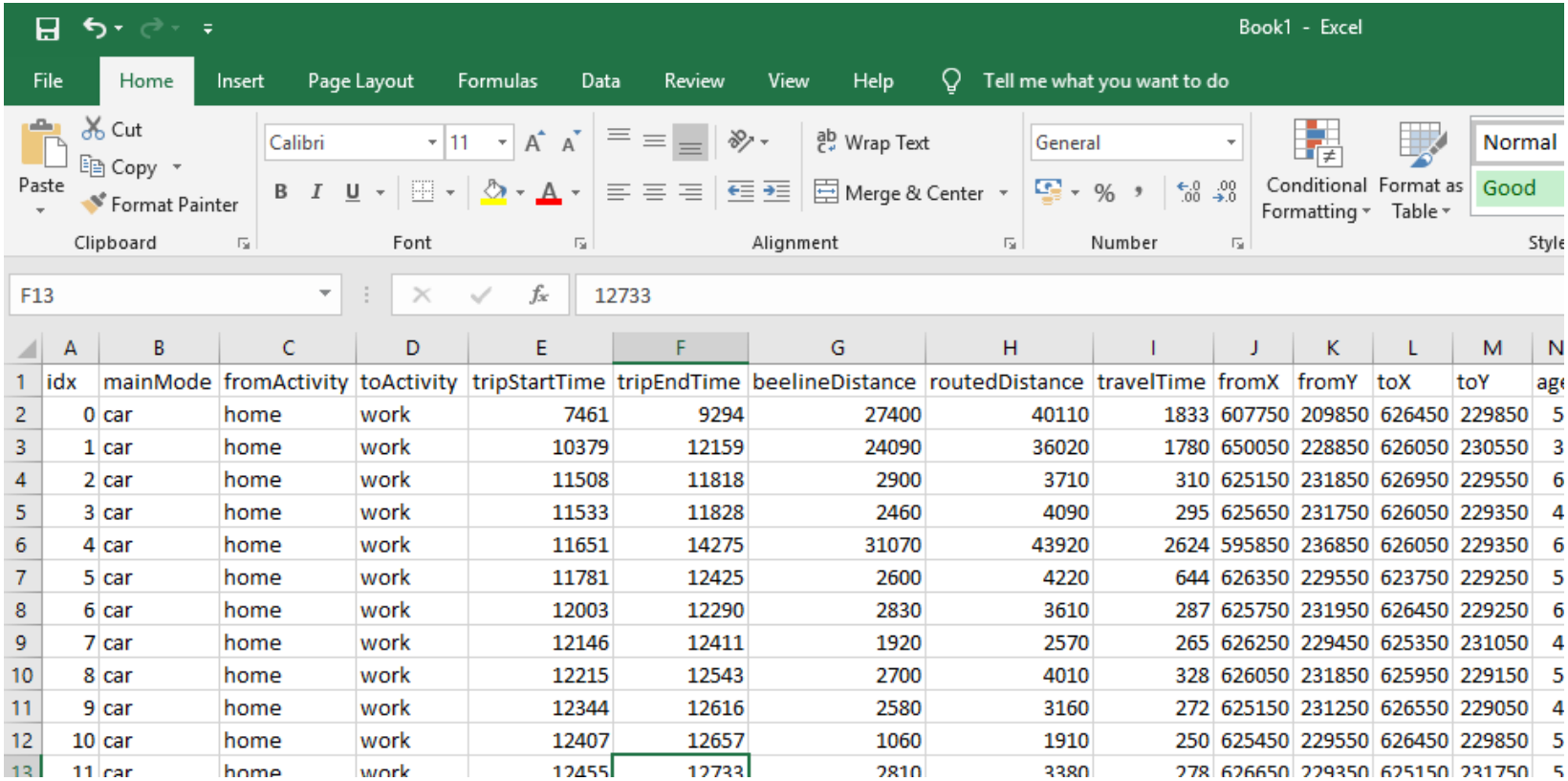

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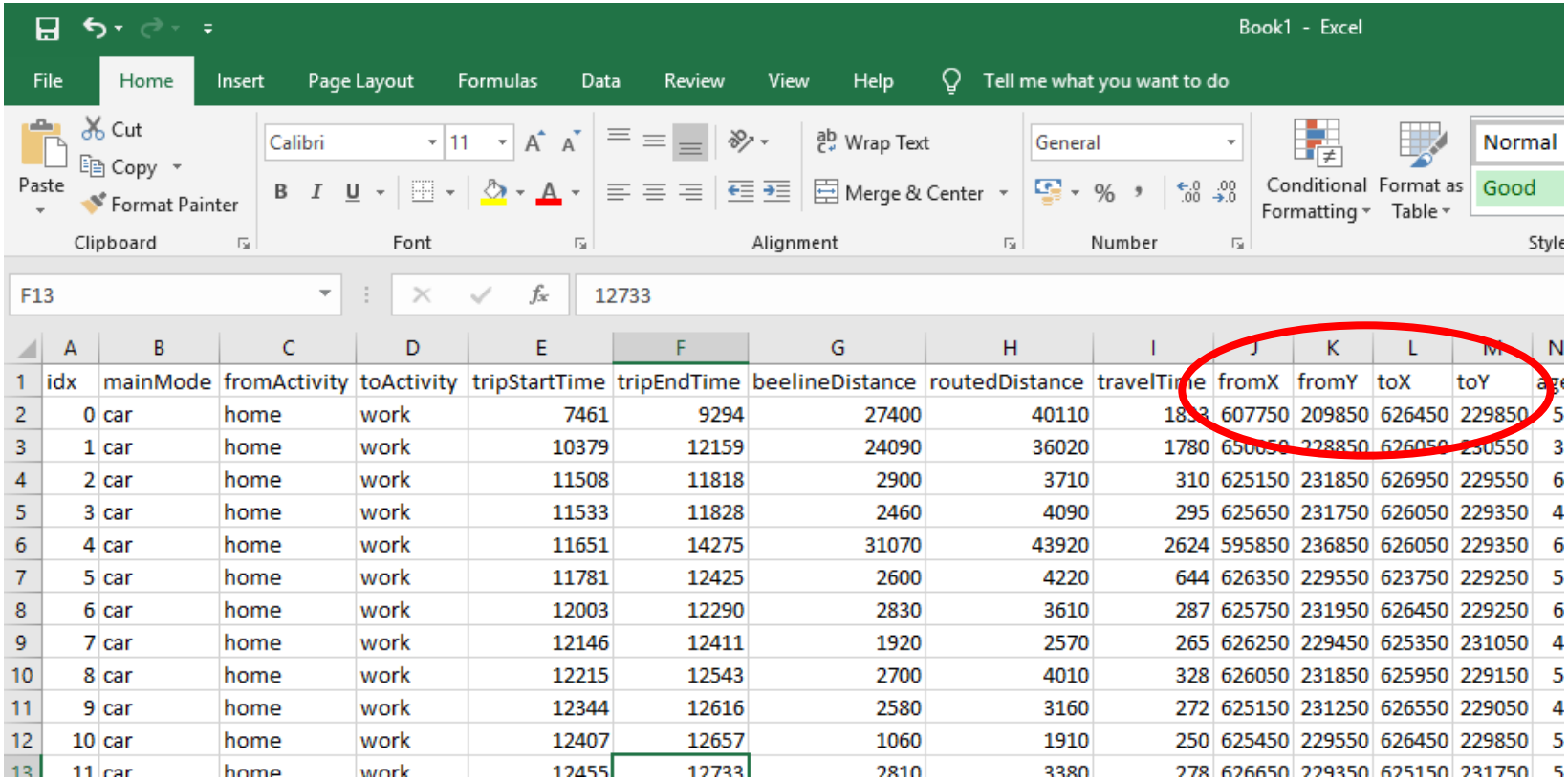

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Geo-Data

- «geographically localized»
- Coordinates (XY or XYZ)
- Data with reference to geographically localized data

- [https://what3words.com/ausweiten.abbildbar.kinos]

What are projections?

Projections

- Interactive projections
  https://www.jasondavies.com/maps/transition/
- Mercator → Shape retaining (not surface retaining)
  https://geopuzzle.org/puzzle/easy/
- Gall-Peters: → surface retaining
  https://de.wikipedia.org/wiki/Peters-Projektion
- Mollweide → somewhat both
- Dymaxion → land connecting
  https://en.wikipedia.org/wiki/Dymaxion_map
- Gnomonik → shortest distance as a straight line
  https://bl.ocks.org/mbostock/3795048

- Spatial Reference
  http://spatialreference.org/ref/epsg/

Projections – Tips

- Standards versus «self made»
- Geo-data are always subject to a projection
- Geo-data are only complete if the projection is included!

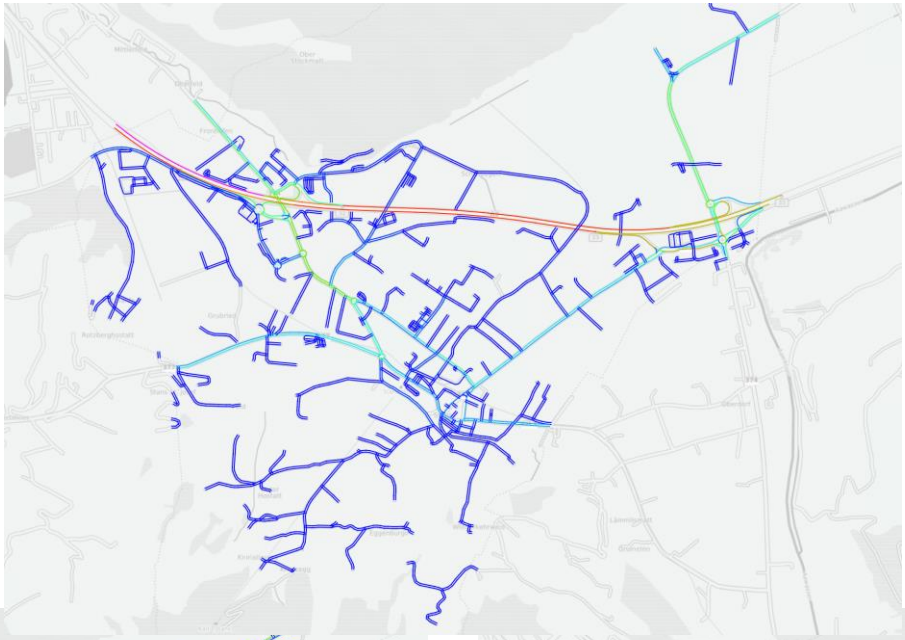
From (geo-)data to (geo-)analysis and (geo-)information

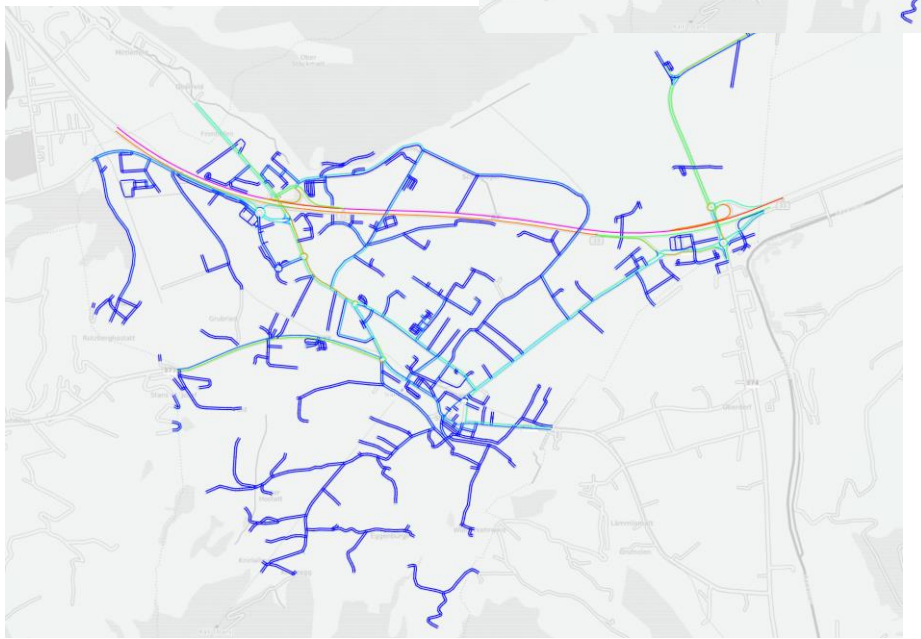
Examples

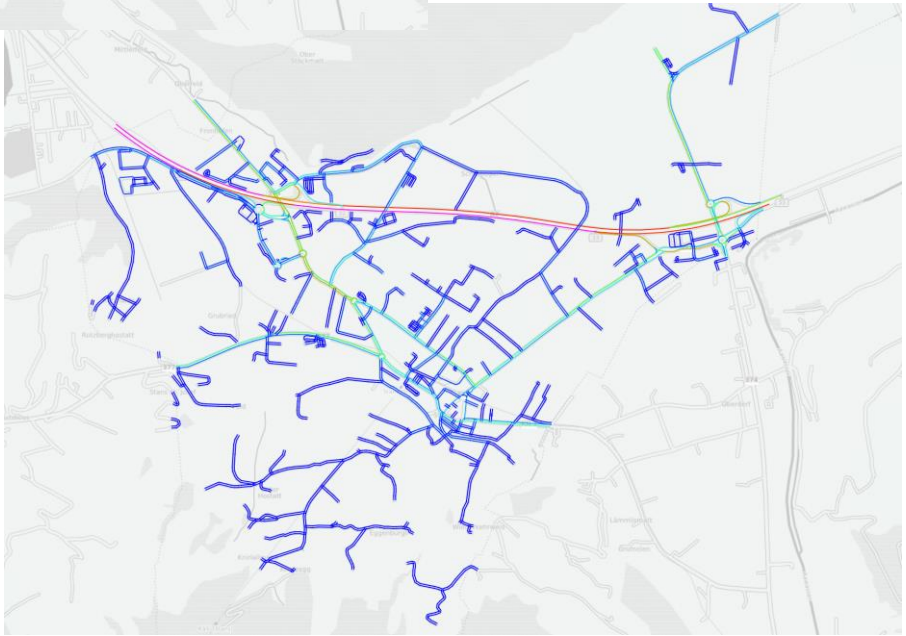
- GPS Tracks
- Maps
- Transport demand
- http://apps.senozon.com
  → Einfach Registrieren
- https://maps.senozon.com
  → U:public / P:EnjoyOurMaps
- https://online.tableau.com
  → U:insights@senozon.com / P:SenozonInsights2019!

What are (geo-)data in transport planning?

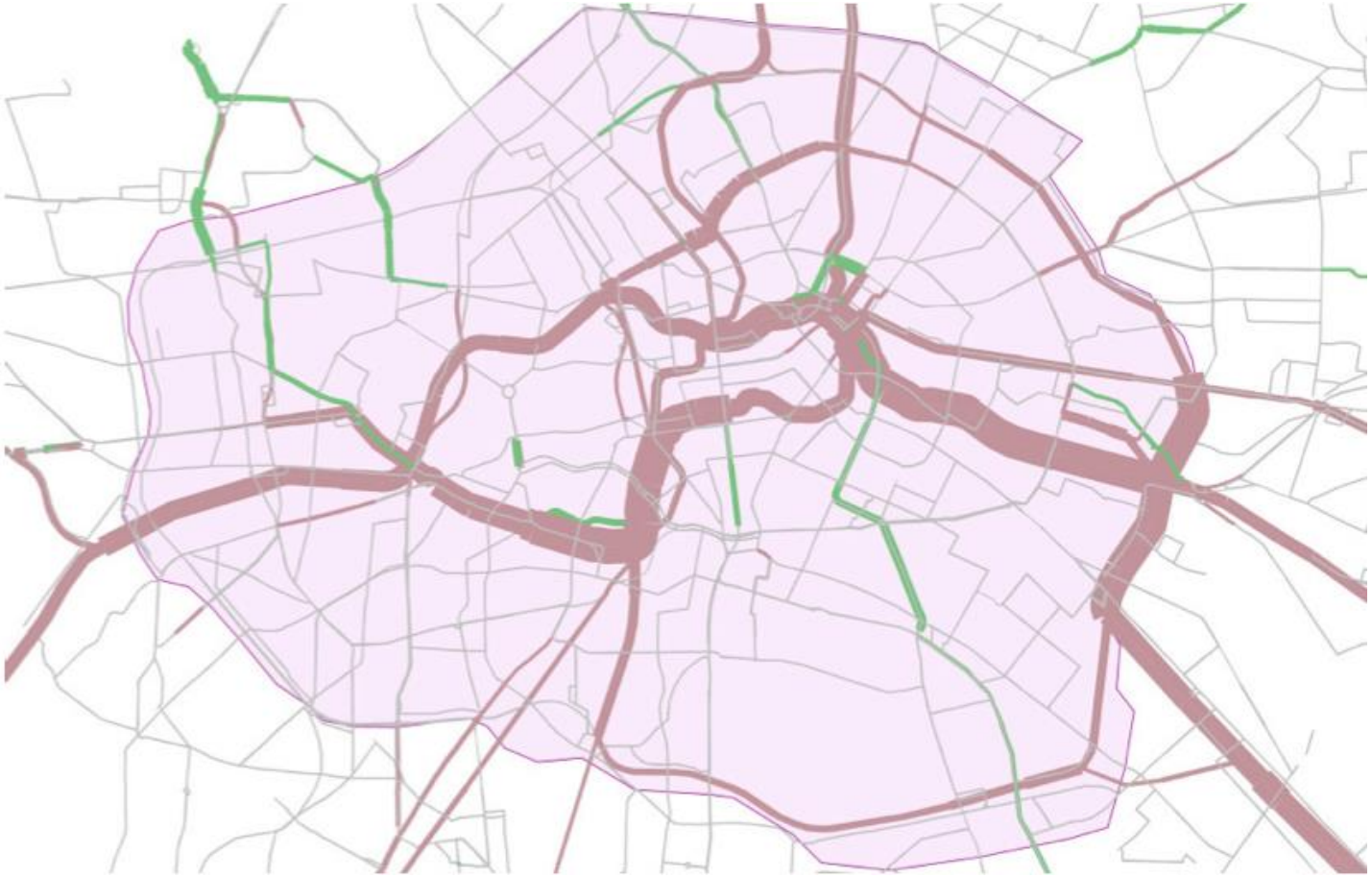
Traffic volumes







Changes in public transit demand 2015 versus 2008



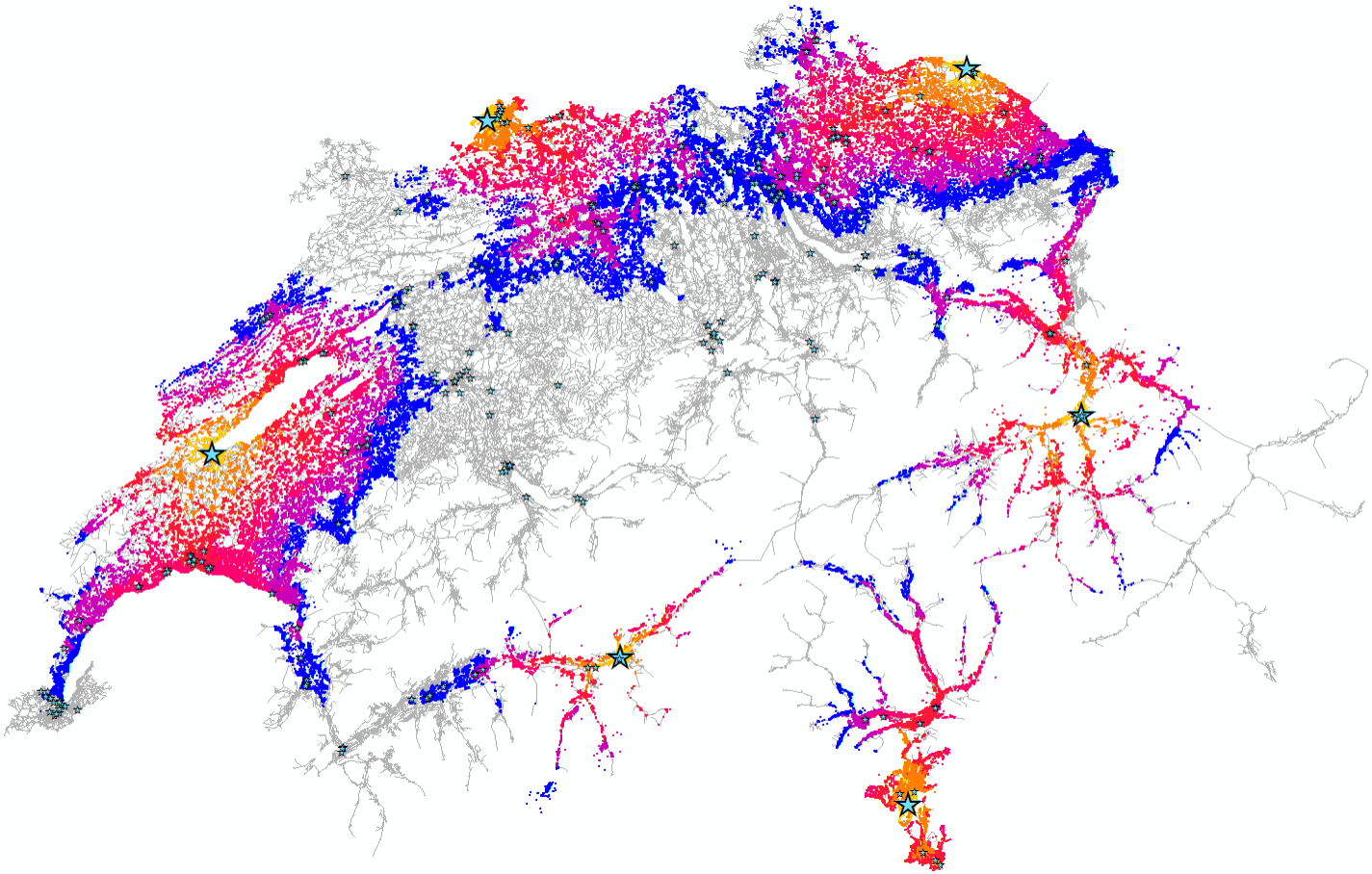
Pedestrian frequencies

Passantenströme, alle Aktivitäten

Passantenströme, von / nach Einkauf

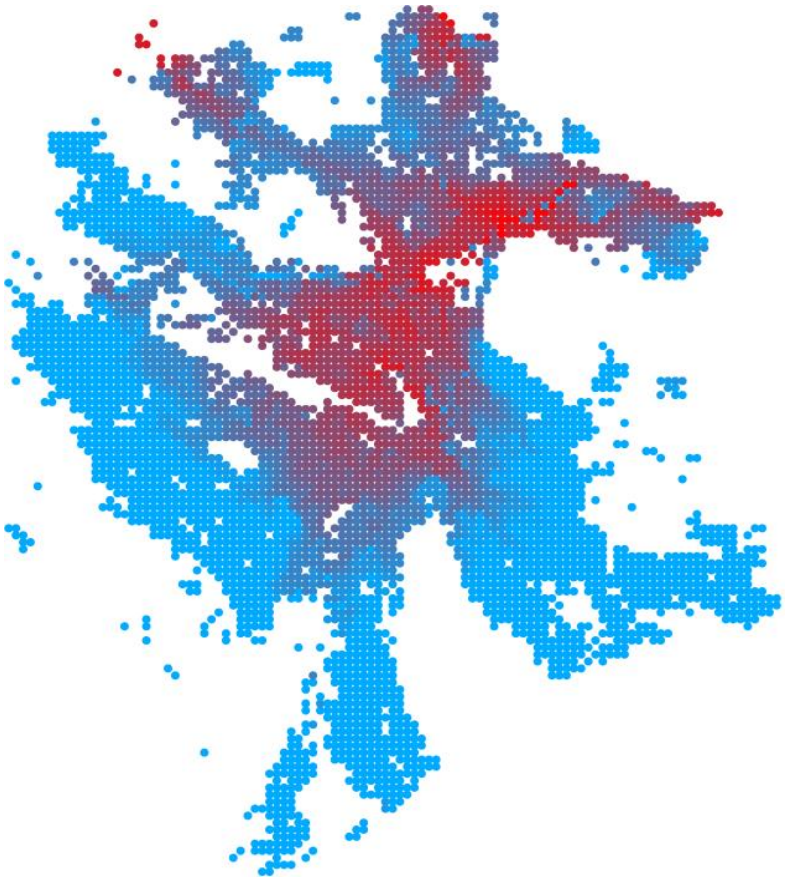
Travel times

Travel times of shopping malls (by car, 60 Min.)

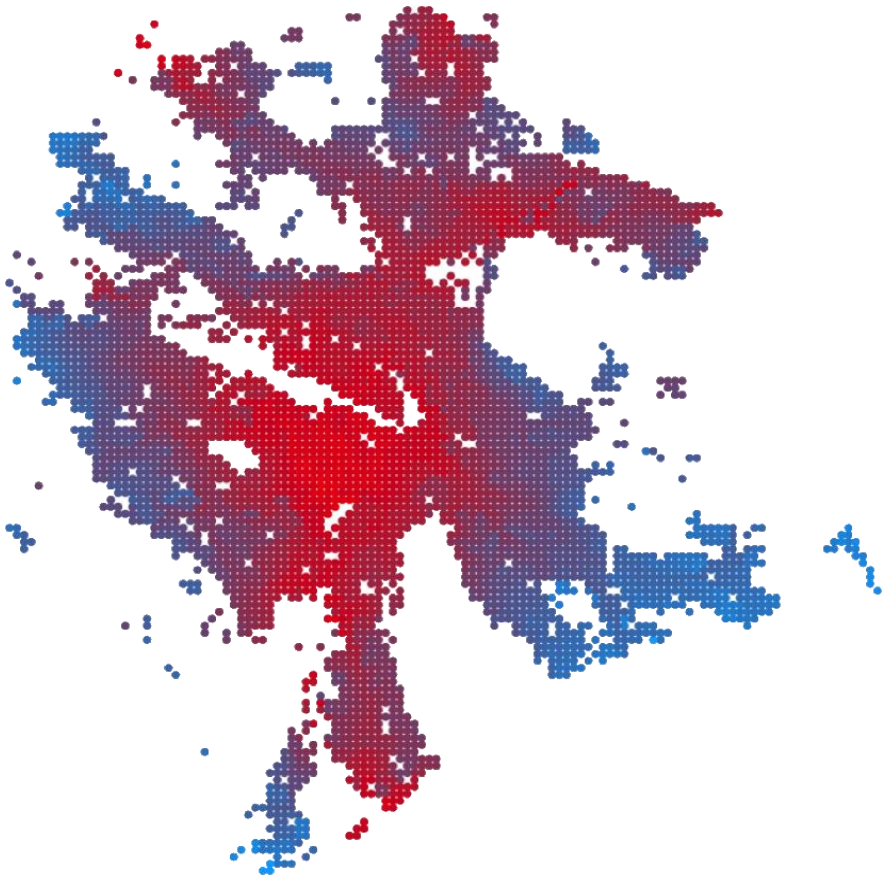


Reachability of people

Number of persons, car, 20 min

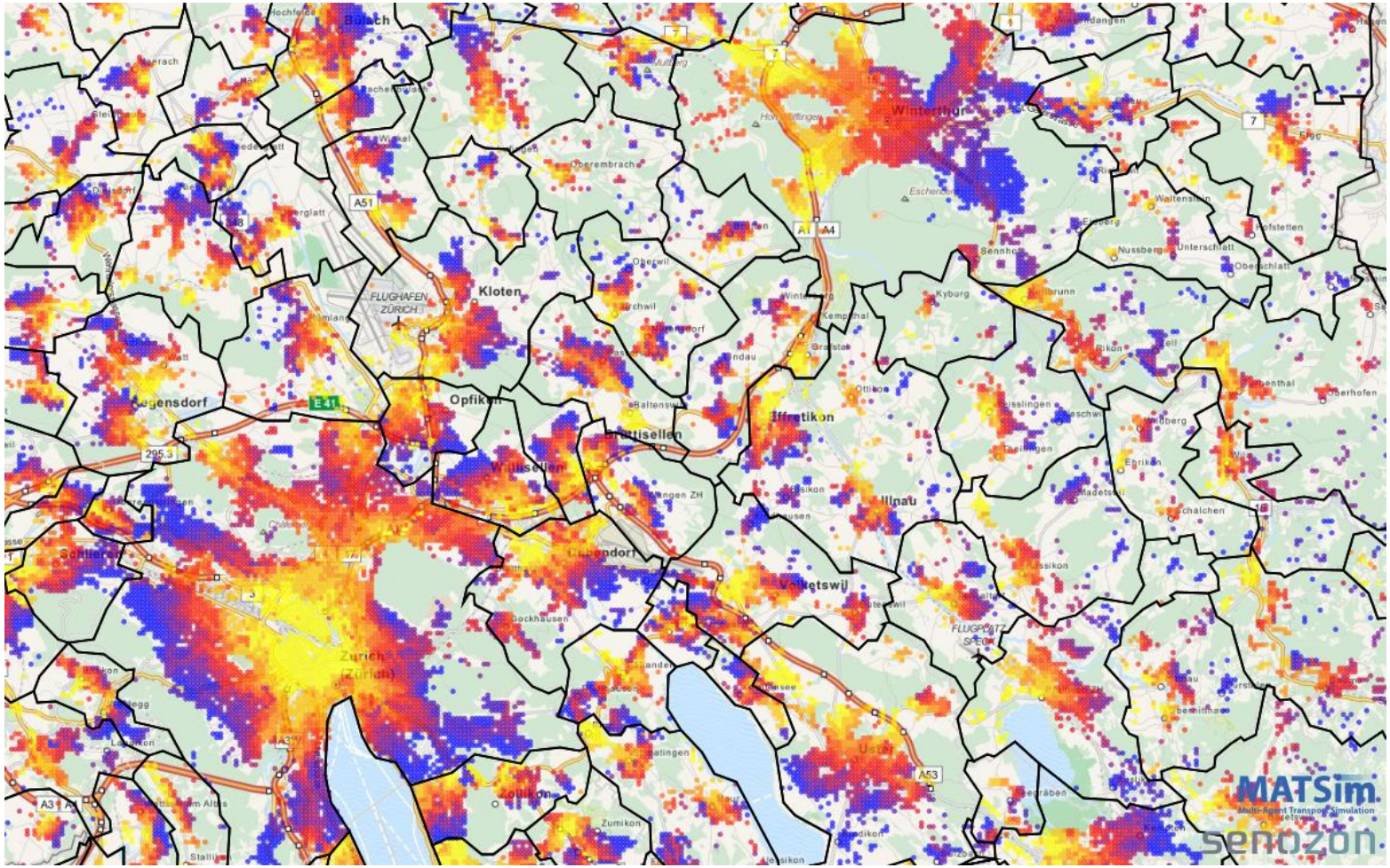


Number of persons, car, 40 min



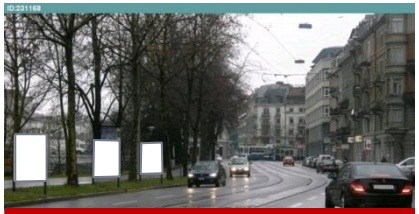
Reachability of people

Reachability at hectare level of details per municipality



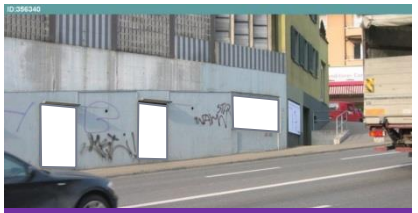
Location Assessment: Billboards

Merkurstrasse



Kasernenstr.

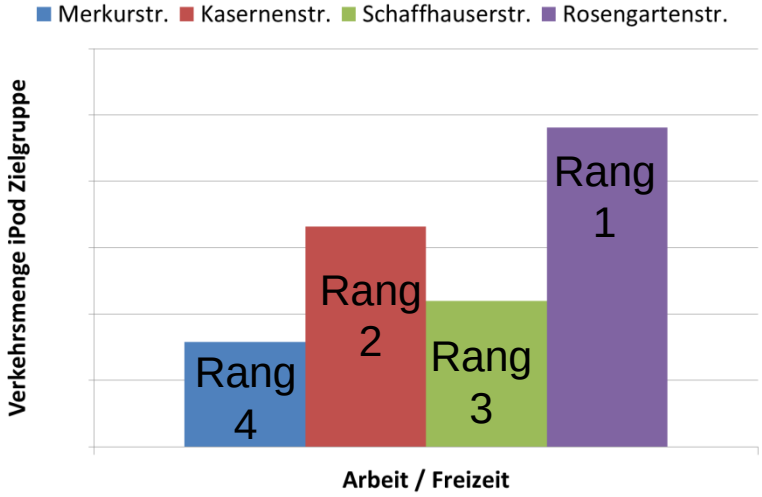
Schaffhauserstr.

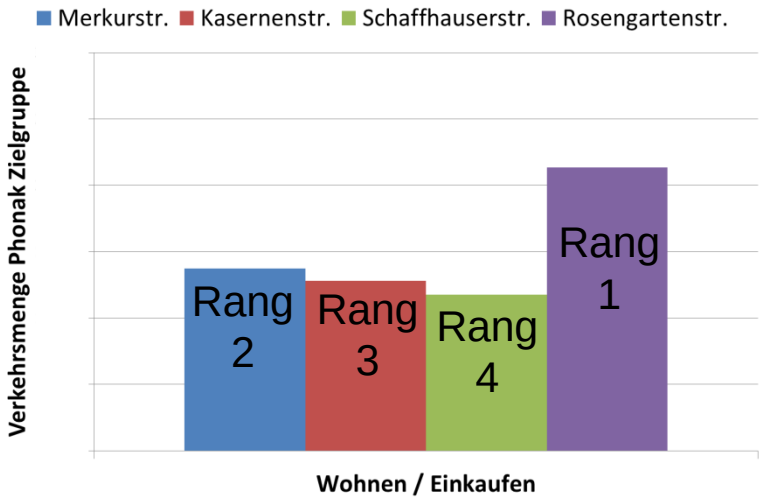


Rosengartenstr.

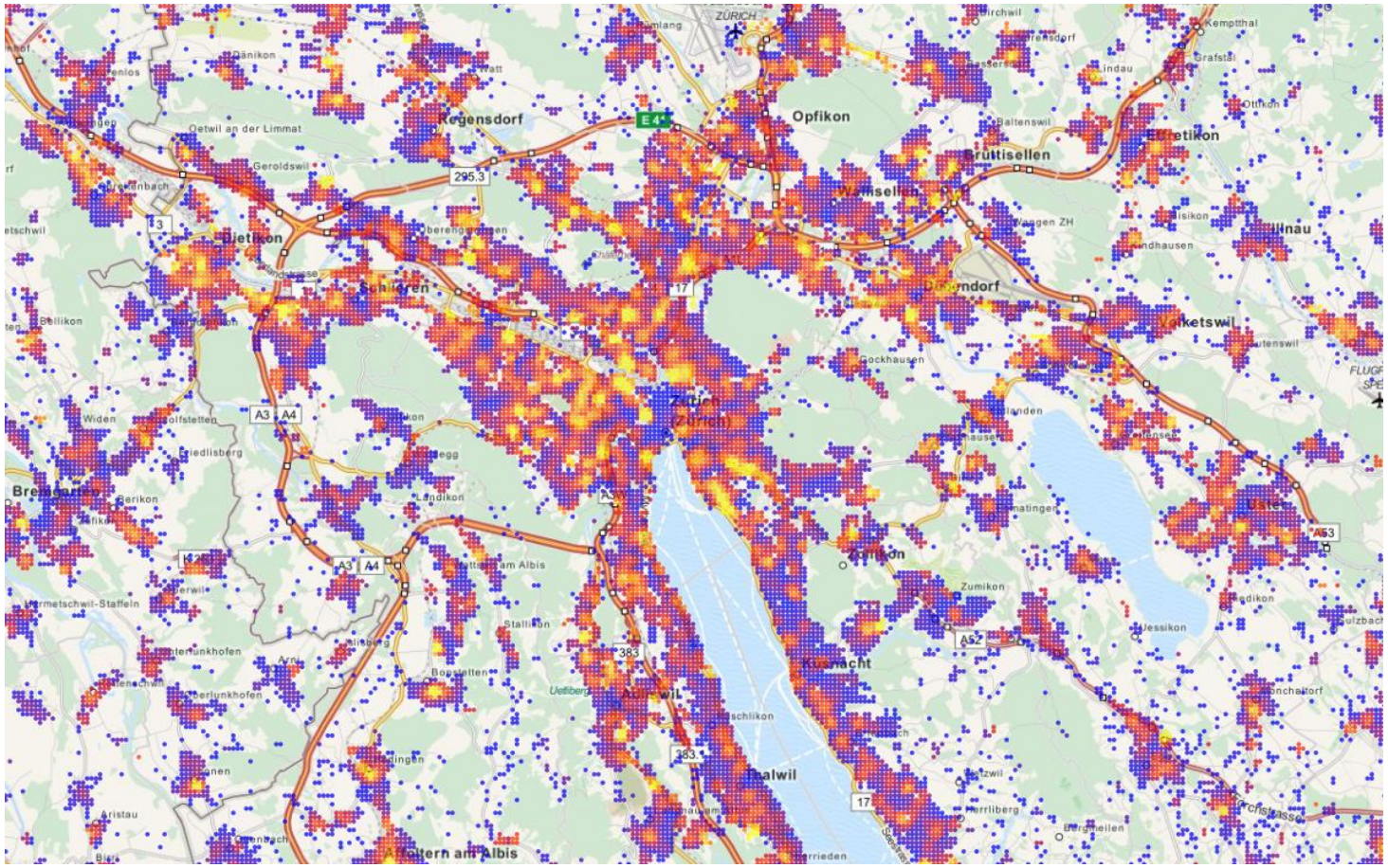
iPod Touch
Target group:
Age 15-34, towards work or leisure

Hearing aid
Target group:
Age 55-84, towards home or shopping

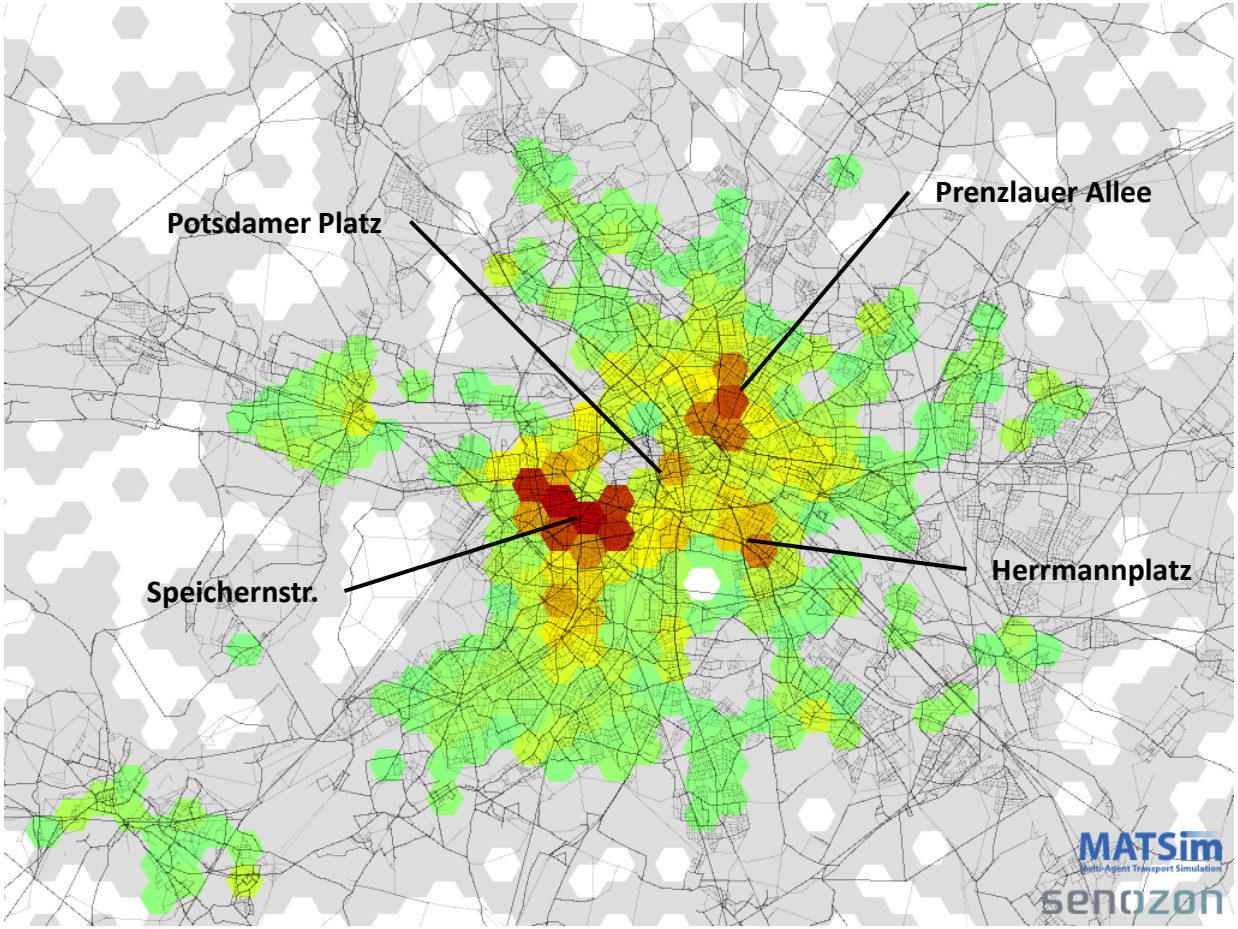




Hotspot / Whitespot Analysis

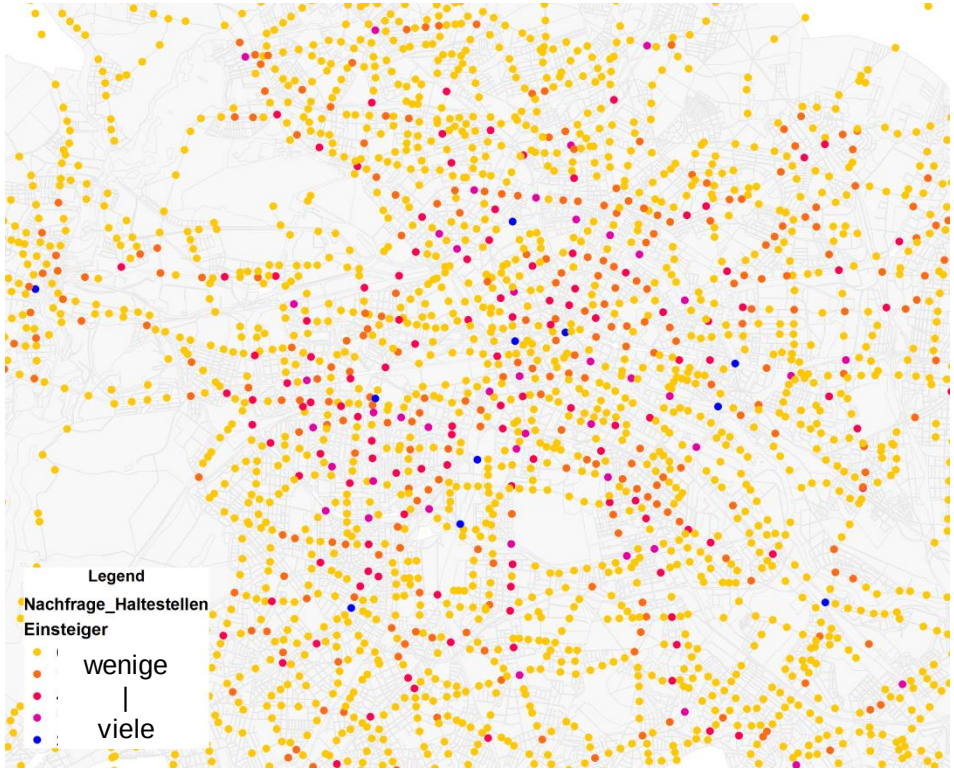


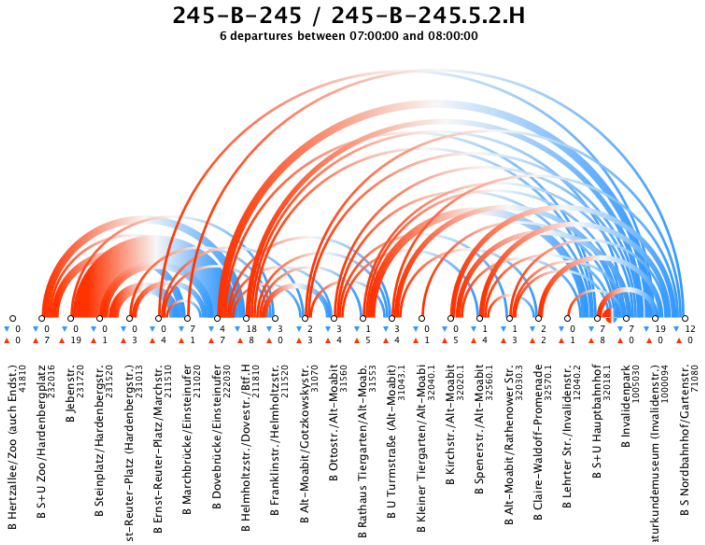
Target group assessment – and where they are

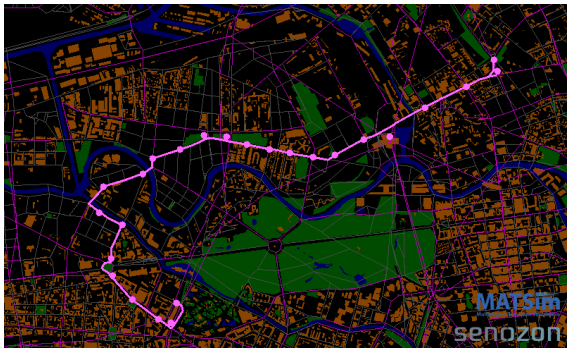


#Trips from origin [in % of maximum]

Public transit analysis



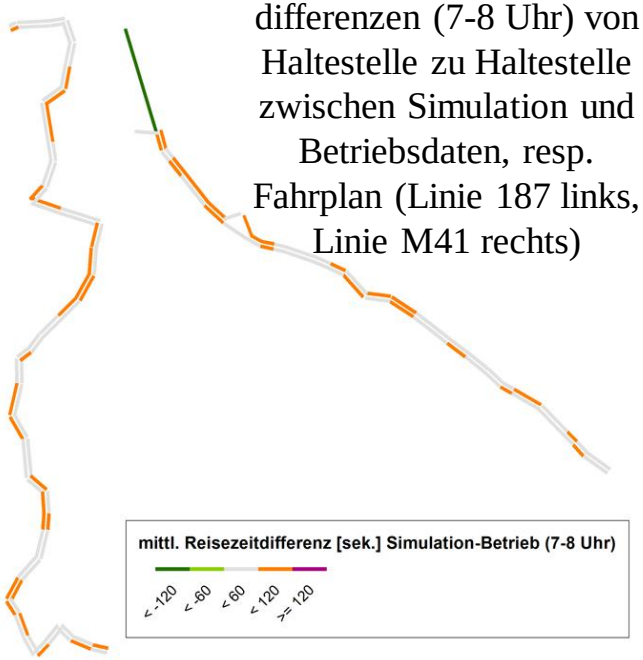




Übersicht

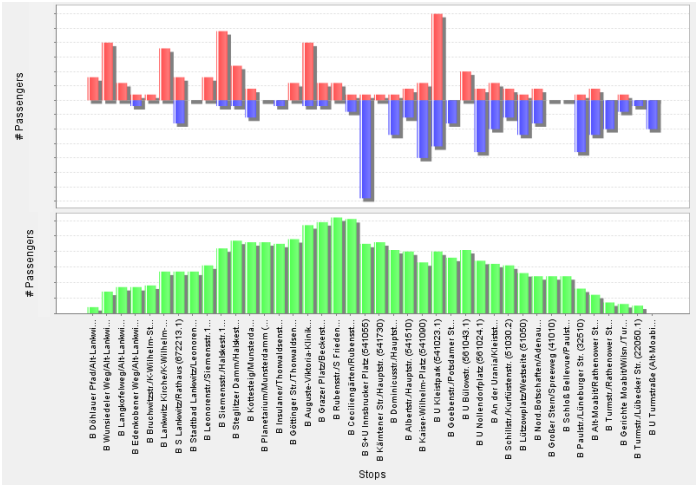
Public transit – passenger counts (“pax”)

Mittlere Reisezeit-differenzen (7-8 Uhr) von Haltestelle zu Haltestelle zwischen Simulation und Betriebsdaten, resp. Fahrplan (Linie 187 links, Linie M41 rechts)

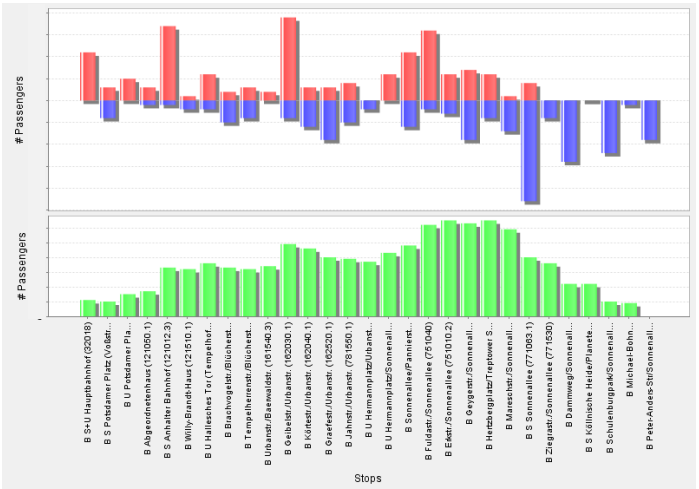


Übersicht

Linie 187 – Fahrgäste – 7-8 Uhr

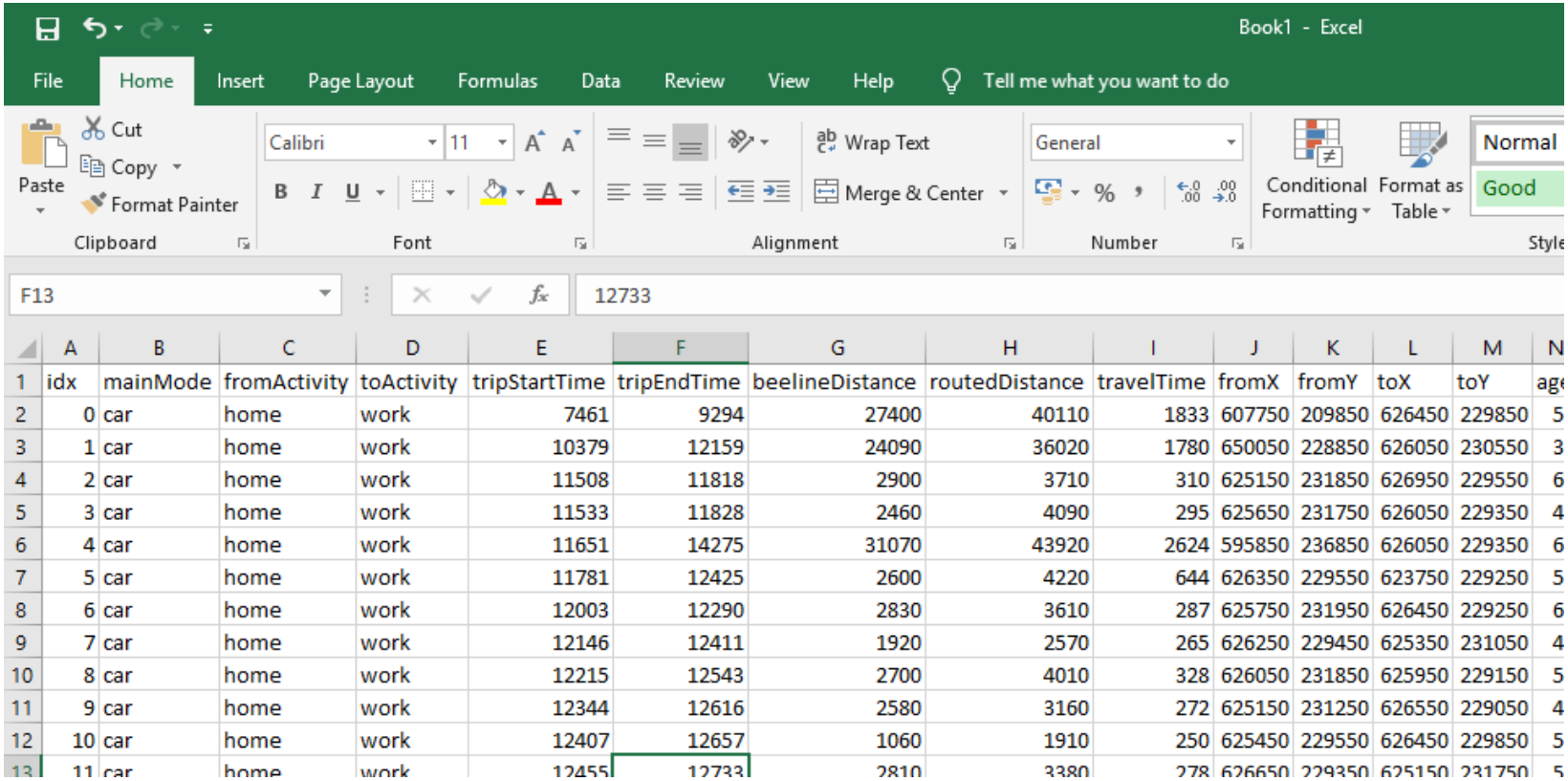


Linie M41 – Fahrgäste – 7-8 Uhr



What are dynamic (geo-)data?

Dynamic geo-data?



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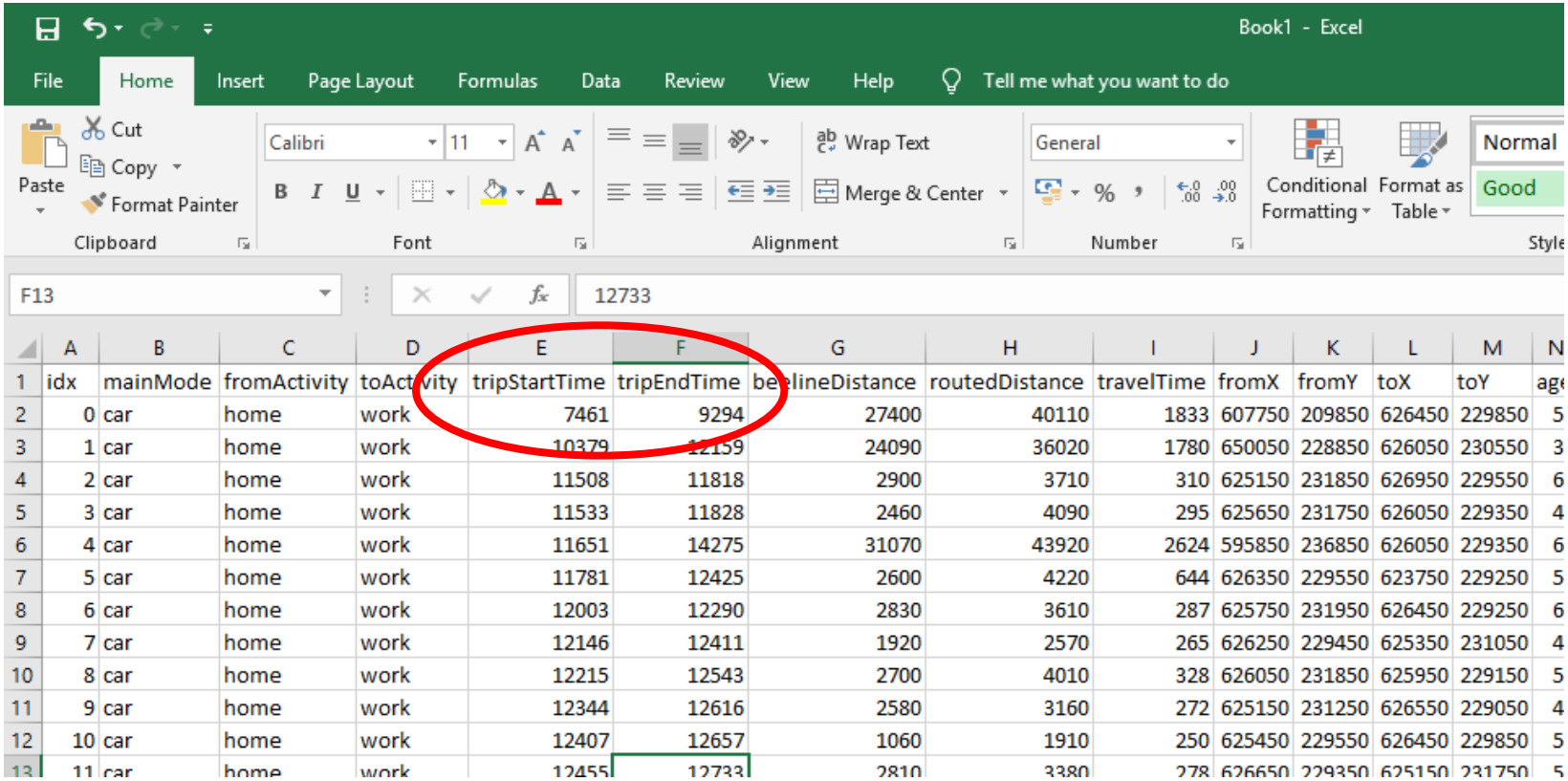
Dynamische Geodaten?



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Dynamic Geo-Data

- «geographically localized»
- Coordinates (XY or XYZ)
- Data with reference to geographically localized data
- AND: time information

Network

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        <node id="2" x="80.0" y="0.0" />
        ...
   </nodes>
   <links capperiod="01:00:00">
        <link id="100" from="1" to="2" length="90.0" freespeed="7.5"
                capacity="1800.0" permlanes="1" oneway="1" />
        <link id="101" from="2" to="3" length="90.0" freespeed="7.5"
                capacity="1800.0" permlanes="1" oneway="1" />
        <link id="102" from="3" to="4" length="90.0" freespeed="7.5"
                capacity="1800.0" permlanes="1" oneway="1" />
        ...
   </links>
</network>
```

Travel demand

„plans“:

```
<person id="1" sex="f" age="20" license="yes"
   car_avail="never" employed="yes">
   <plan>
        <act type="home" link="110" start_time="00:00:00"
               dur="08:00:00" end_time="08:00:00" />
        <leg num="0" mode="car"> <route> 12 1 </route> </leg>
        <act type="shop" link="100" start_time="08:00:00"
               dur="04:00:00" end_time="12:00:00" />
        <leg num="1" mode="car"> <route> </route> </leg>
        <act type="work" link="100" start_time="12:00:00"
               dur="04:00:00" end_time="16:00:00" />
        <leg num="2" mode="car"> <route> 2 3 </route> </leg>
        <act type="home" link="102" start_time="16:00:00"
               dur="04:00:00" end_time="20:00:00" />
        <leg num="3" mode="car"> <route> 4 9 10 11 </route>
   </leg>
        <act type="home" link="110" start_time="20:00:00"
               dur="04:00:00" end_time="24:00:00" />
   </plan>
</person>
```

«Events»

```
<event time="26303.0" type="actend" person="101" link="1112" actType="h"  />
<event time="26303.0" type="departure" person="101" link="1112" legMode="transit_walk"  />
<event time="26938.0" type="arrival" person="101" link="11" legMode="transit_walk"  />
<event time="26938.0" type="actstart" person="101" link="11" actType="pt interaction"  />
<event time="26938.0" type="actend" person="101" link="11" actType="pt interaction"  />
<event time="26938.0" type="departure" person="101" link="11" legMode="pt"  />
<event time="27023.0" type="PersonEntersVehicle" person="101" vehicle="tr_1"  />
<event time="27253.0" type="PersonLeavesVehicle" person="101" vehicle="tr_1"  />
<event time="27253.0" type="arrival" person="101" link="12" legMode="pt"  />
<event time="27253.0" type="actstart" person="101" link="12" actType="pt interaction"  />
<event time="27254.0" type="actend" person="101" link="12" actType="pt interaction"  />
<event time="27254.0" type="departure" person="101" link="12" legMode="transit_walk"  />
<event time="27550.0" type="travelled" person="101" distance="NaN"  />
<event time="27550.0" type="arrival" person="101" link="2333" legMode="transit_walk"  />
<event time="27550.0" type="actstart" person="101" link="2333" actType="w"  />
<event time="63642.0" type="actend" person="101" link="2333" actType="w"  />
<event time="63642.0" type="departure" person="101" link="2333" legMode="transit_walk"  />
<event time="63924.0" type="arrival" person="101" link="32" legMode="transit_walk"  />
<event time="63924.0" type="actstart" person="101" link="32" actType="pt interaction"  />
<event time="63924.0" type="actend" person="101" link="32" actType="pt interaction"  />
<event time="63924.0" type="departure" person="101" link="32" legMode="pt"  />
<event time="64017.0" type="PersonEntersVehicle" person="101" vehicle="tr_1"  />
<event time="64249.0" type="PersonLeavesVehicle" person="101" vehicle="tr_1"  />
<event time="64249.0" type="arrival" person="101" link="11" legMode="pt"  />
<event time="64249.0" type="actstart" person="101" link="11" actType="pt interaction"  />
```