Bevorzugter Zitierstil für diesen Vortrag

Axhausen, K.W. (2016) Autonomous vehicles: The next step in accessibility ?, presentation at the *Post-COTA International conference of transportation professionals 2016,* Zijingang Campus, Zhejiang University, Hangzhou.

Autonomous vehicles: The next step in accessibility ?

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July 2016

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Acknowledgements

C Weis for the estimates of the induced demand

J Meyer, H. Becker and P. Bösch for the first estimates of the AV
    induced demand and its impact

A Loder for the general accessibility map

Expected changes and challenges

Expected changes

Autonomous vehicles:

- Management of the transition until 2025-2040
- Reorganisation of public transport by new fleet operators
- Mobilisation of all current non-car users
- Accessibility gains and related urban sprawl

Behavioural changes:

- On-line shopping growth and its delivery services (drones, delivery robots, delivery points, autonomous delivery/pick-up)
- Timing and location of work
- (Scale of formal work)

Challenges

Making the Paris 2015 real:

- Electrification of regional traffic
- Continuing growth in long distance travel/freight

Balancing work/home locations:

- ‚Optimal' built density (m^3/km^2) and human density (m^2/head)
- Balanced road use (noise, emissions, quality of stay)

CBDs with radically fewer/other retail outlets

Aging of society

Potential loss of control of traffic flow

- What can the public still do ?

# Expected AV impacts

Some expected AV impacts

- New travellers in Switzerland:
    - Between 6 and 17: 2.3%
    - Between 65 and 80: 3.3%
    - Over 80: 3%

- Volume of empty trips: 18-53% of current car flows

- Additional capacity:
    - + 78% (Friedrich, 2015)
   - + 270% (Tientrakool et al., 2011)

Some expected AV impacts

- Lower per km costs:
  - Shared fleets (between 10-30% of the current Swiss fleet depending on service levels (See Bösch et al., forthcoming)
  - Market power in purchasing and servicing the fleet
  - Electrified fleet
  - Vehicle pooling, say doubling of the current car occupancy (see Dubernet, Rieser-Schüssler and Axhausen, 2013)

- More comfort and time usability during the ride

Expected AV impacts on accessibility

Switzerland: current general accessibility
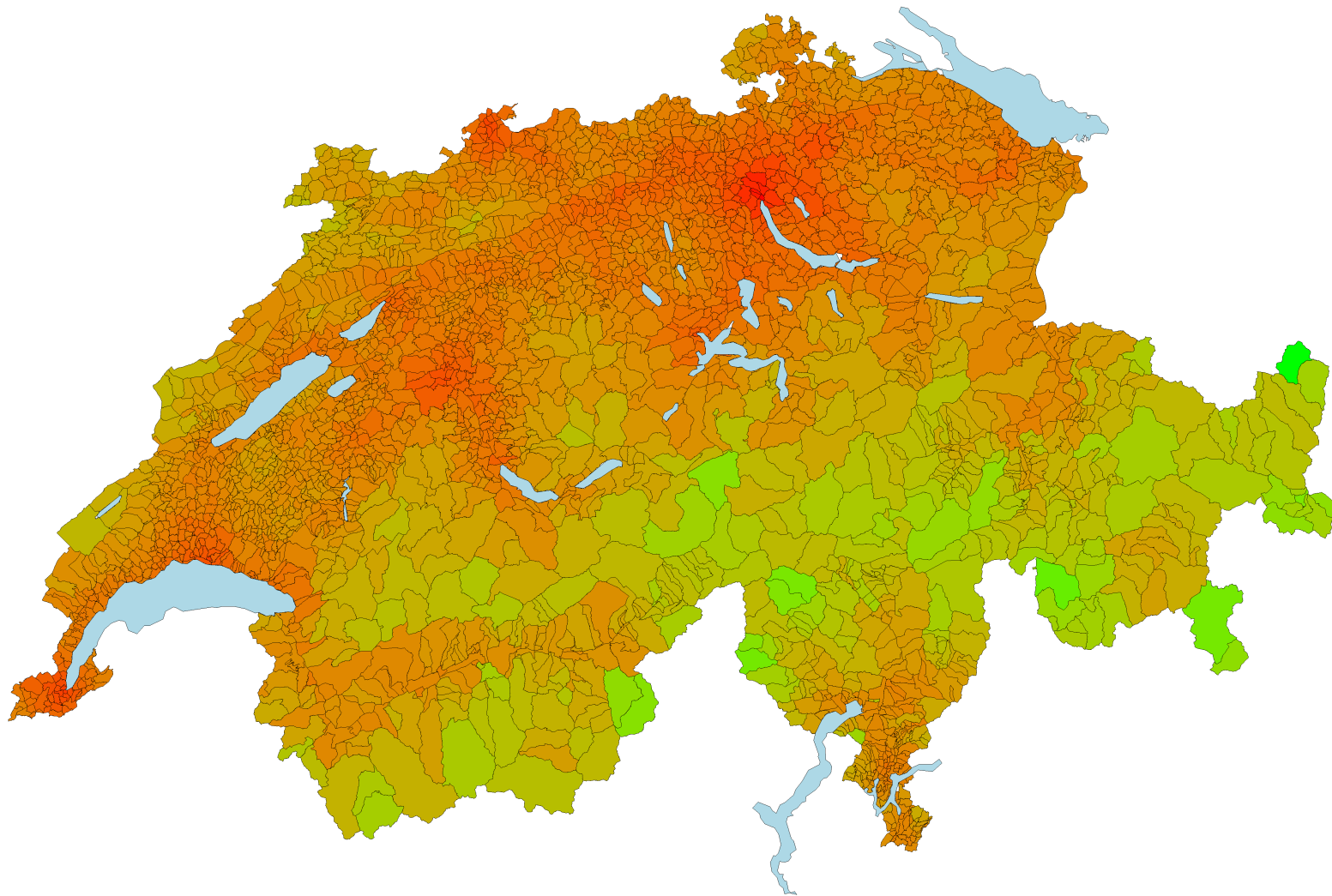
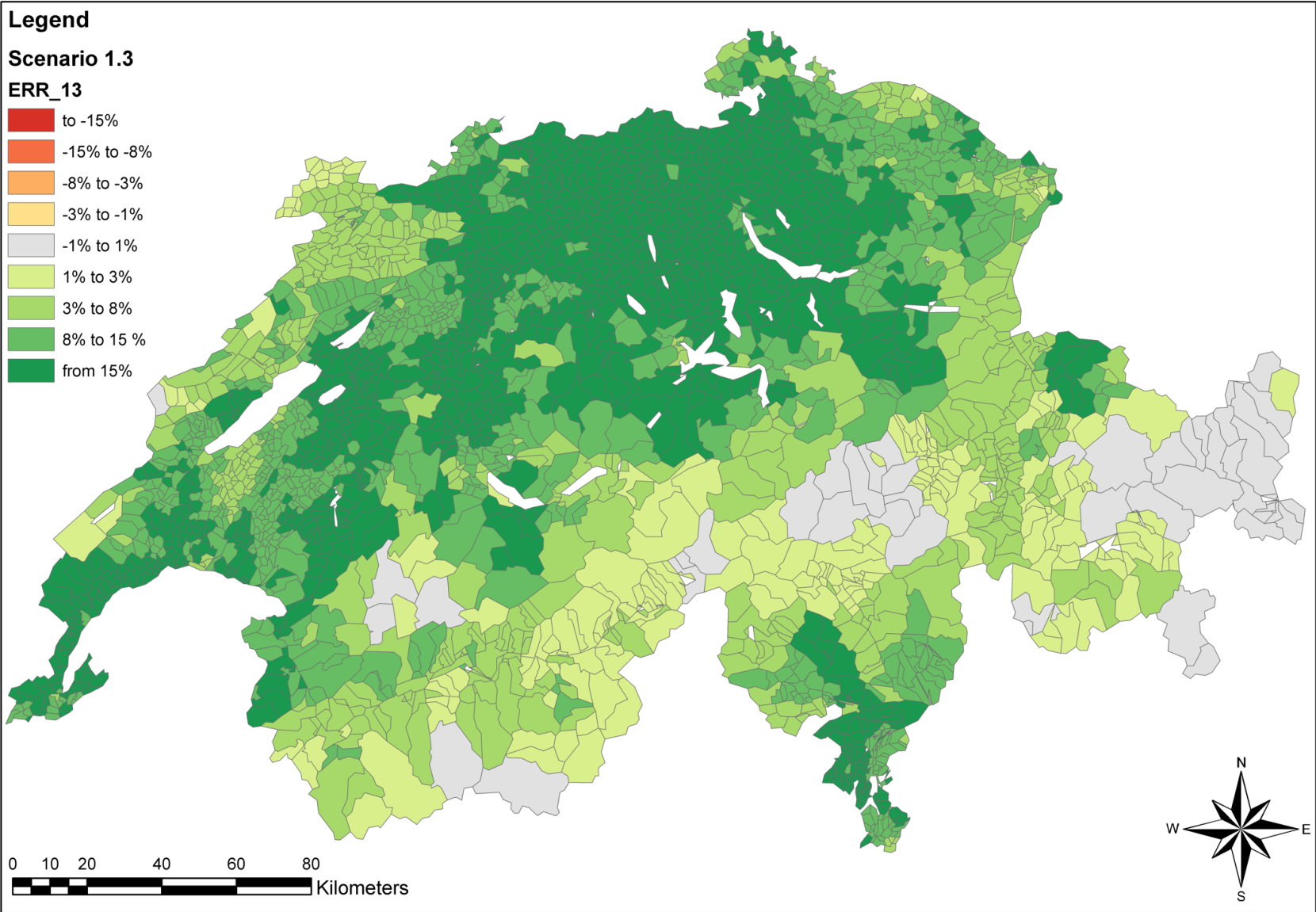# Accessibility of Swiss Bezirke since 1850
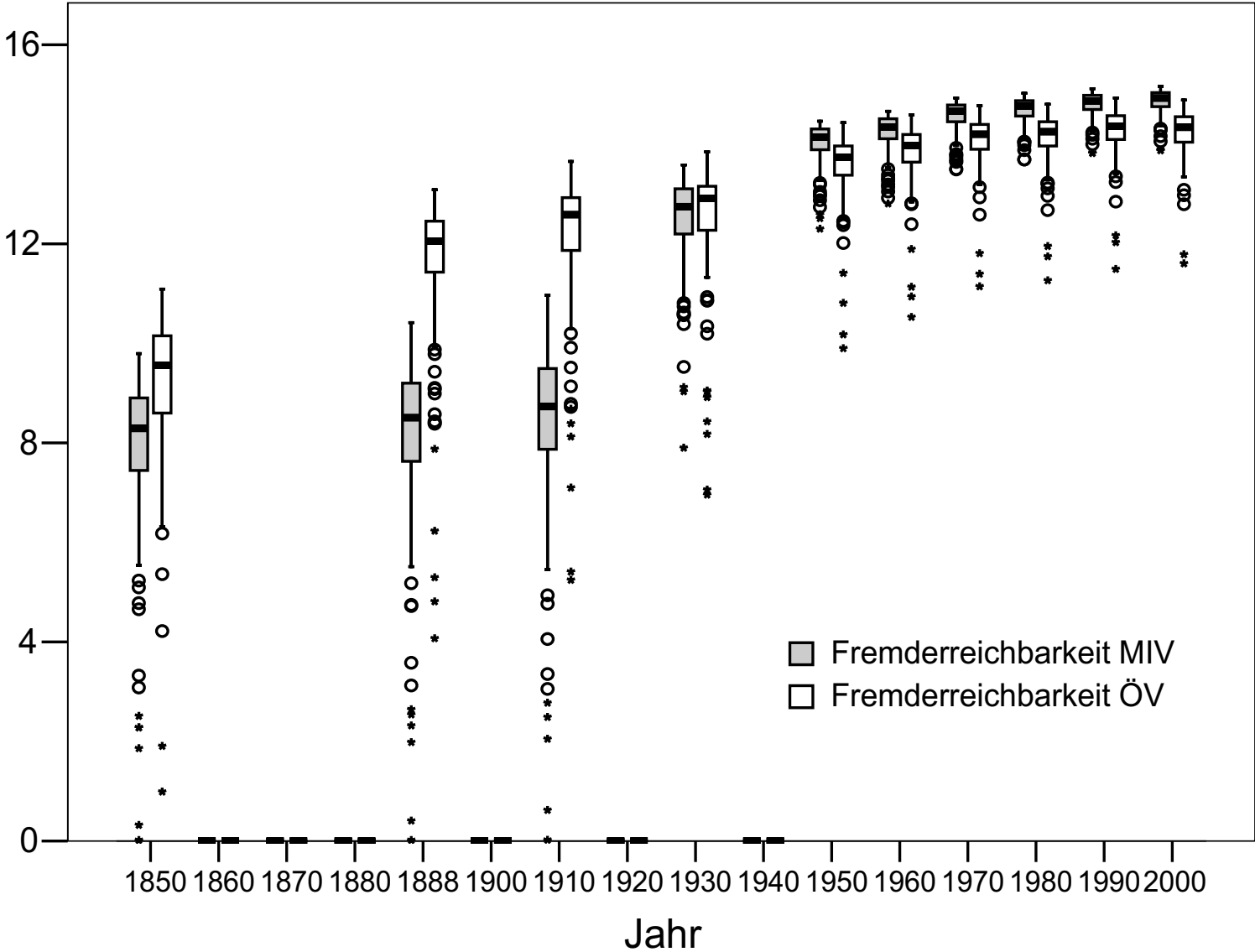
Yes, but

Demand facets	Elasticity wrt accessibility	Elasticity wrt price index
Share out-of-home	0.61	-0.06
Number of trips	0.44	-0.19
Number of trips per journey	0.24	-1.66
Time out-of-home	0.10	-0.84
Daily VMT	1.14	-1.95

Source: Weis und Axhausen, 2013

Hangzhou 16

Accessibilities after 100% AV introduction

+78% capacity, current demand with 100% private AV

Legend

Scenario 1.3

ERR_13

- to -15%
- -15% to -8%
- -8% to -3%
- -3% to -1%
- -1% to 1%
- 1% to 3%
- 3% to 8%
- 8% to 15 %
- from 15%

0 10 20 40 60 80 Kilometers

+78% capacity, pooling only, 15% more + 100% of transit

Legend

Scenario 3.30
ERR_330

🟥	to -15%
🟧	-15% to -8%
🟧	-8% to -3%
🟨	-3% to -1%
⬜	-1% to 1%
🟩	1% to 3%
🟩	3% to 8%
🟩	8% to 15 %
🟩	from 15%

0 10 20   40   60   80
Kilometers
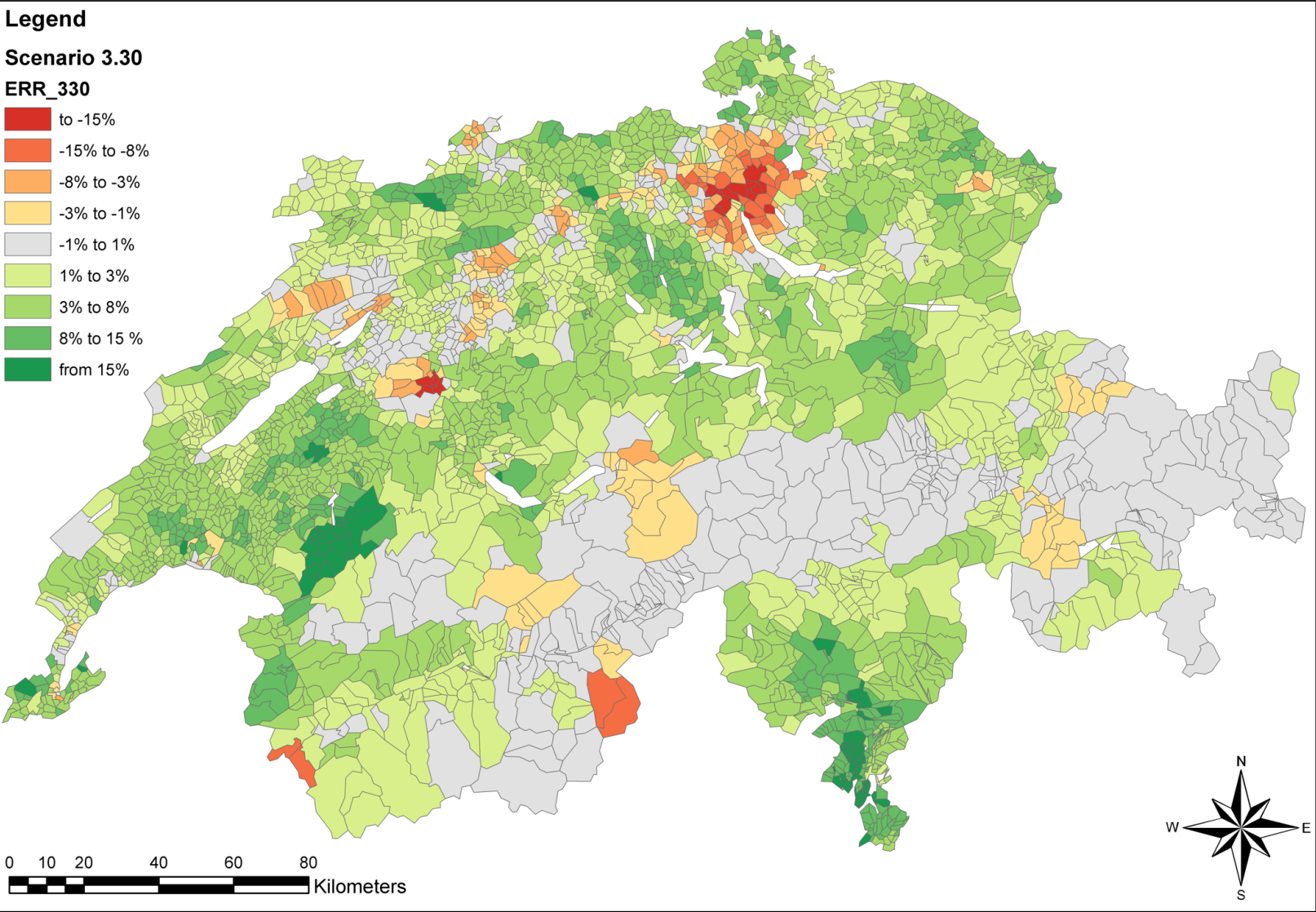
Summary of the very first assumption-driven results

- The future of transit hangs in the balance

- The gains need to be translated into a new balance :
  - More street space for pedestrians and cyclists
  - More street space for pick up/delivery points
  - Rethinking urban form

- New price systems for public transport and low income residents

Questions ?

www.matsim.org

www.ivt.ethz.ch
www.futurecities.ethz.ch

www.senozon.ch

References

Axhausen, K.W., P. Fröhlich and M. Tschopp (2011) Changes in Swiss accessibility since 1850, *Research in Transportation Economics,* **31** (1) 72-80.

Bösch, P.M., F. Ciari and K.W. Axhausen (forthcoming) Required autonomous vehicle fleet sizes to serve different levels of demand, *Transportation Research Record*.

Dubernet, T., N. Rieser-Schüssler and K.W. Axhausen (2013) Using a multi-agent simulation tool to estimate the car-pooling potential, paper presented at the *92nd Annual Meeting of the Transportation Research Board,* Washington, D.C., January 2013.

Friedrich, B (2015) Verkehrliche Wirkung autonomer Fahrzeuge, in M. Maurer, J. –C. Gerdes, B. Lenz and H. Winner (eds.) *Autonomes Fahren - Technische, rechtliche und gesellschaftliche Aspekte,* Springer Vieweg, Heidelberg.

Tientrakool, P., Y-C. Ho and N.F. Maxemchuk (2011) Highway Capacity Benefits from Using Vehicle-to-Vehicle Communication and Sensors for Collision Avoidance, Department of Electrical Engineering, Columbia University, New York.

Weis, C. and K.W. Axhausen (2009) Induced travel demand: evidence from a pseudo panel data based structural equations model, *Research in Transportation Economics,* **25** (1) 8-18.