

## Preferred citation style for this presentation

---

K.W. Axhausen (2005) Changes in Swiss Accessibility Since 1850, presentation at the international conference *Economic Impacts of Changing Accessibility*, Edinburgh, October 2005.

# Changes in Swiss Accessibility Since 1850

KW Axhausen

IVT

ETH

Zürich

October 2005

 *Institut für Verkehrsplanung und Transportsysteme*  
*Institute for Transport Planning and Systems*

**ETH**

Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich

# Questions

---

- Why bother with accessibilities ?
- What are the trends for Switzerland ?

# The mistaken logic of public capital

---

The literature since Aschauer (1989) assumes:

$$\Delta y(t) = f(\Delta p(t), \Delta x(it))$$

with

- $\Delta y(t)$  : GNP, productivity change
- $\Delta p(t)$  : Road or other transport capital change
- $\Delta x(it)$  : Change in other relevant variables

## Does this work ?

---

Implicit assumption:

$$\Delta p(t) \sim \Delta \text{Network services}(t)$$

but this implies constant proportionalities for each of the following:

$$\Delta p(t) \sim \Delta \text{Lane miles}(t)$$

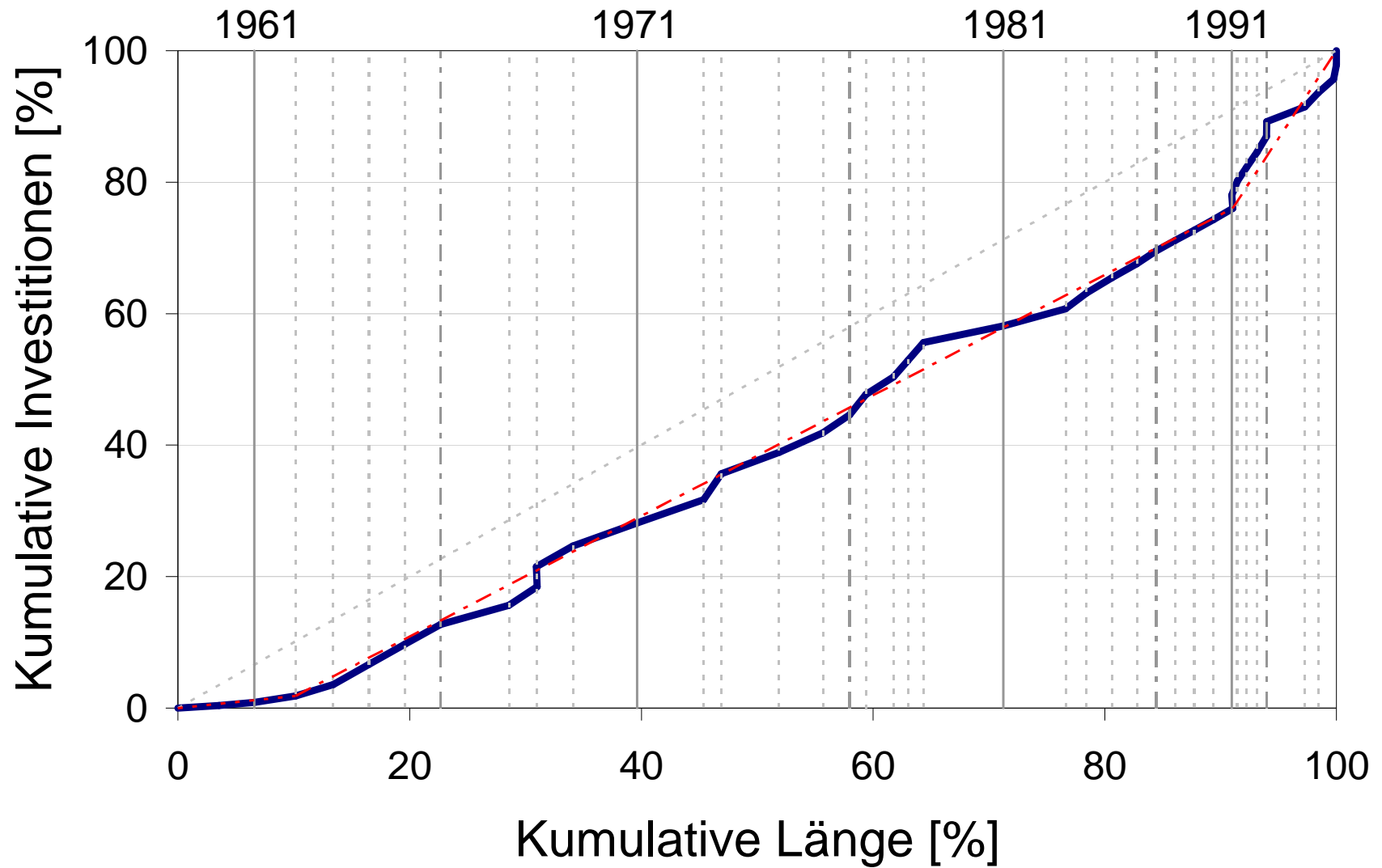
$$\Delta \text{Lane miles}(t) \sim \Delta \text{Capacity}(t)$$

$$\Delta \text{Capacity}(t) \sim \Delta \text{Speed}(t)$$

$$\Delta \text{Speed}(t) \sim \Delta \text{Accessibility}(t)$$

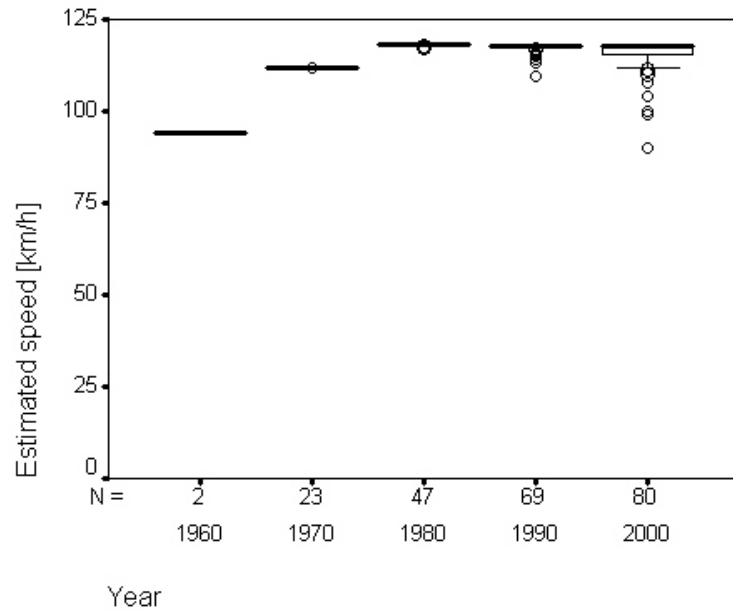
$$\Delta \text{Accessibility}(t) \sim \Delta \text{Network services}(t)$$

# Switzerland: Changing costs of one km motorway

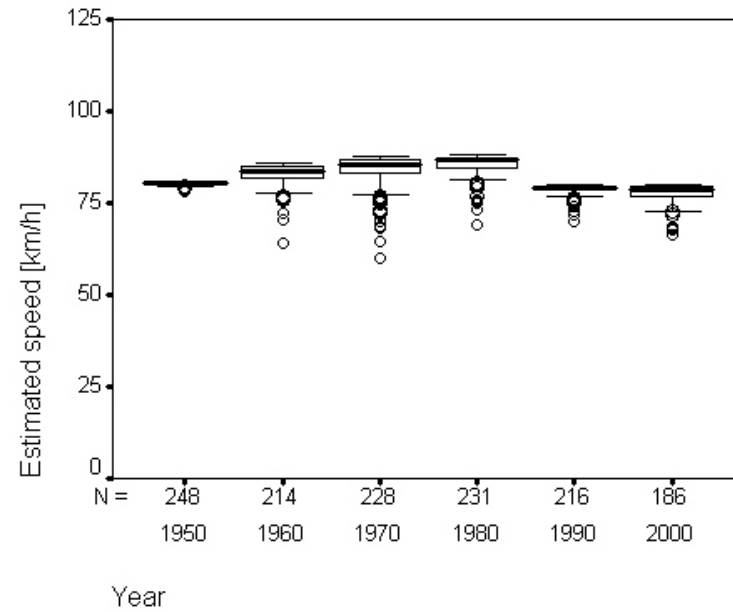


# Switzerland: Changing speed gain of capacity expansion

Axhausen und Fröhlich, 2004

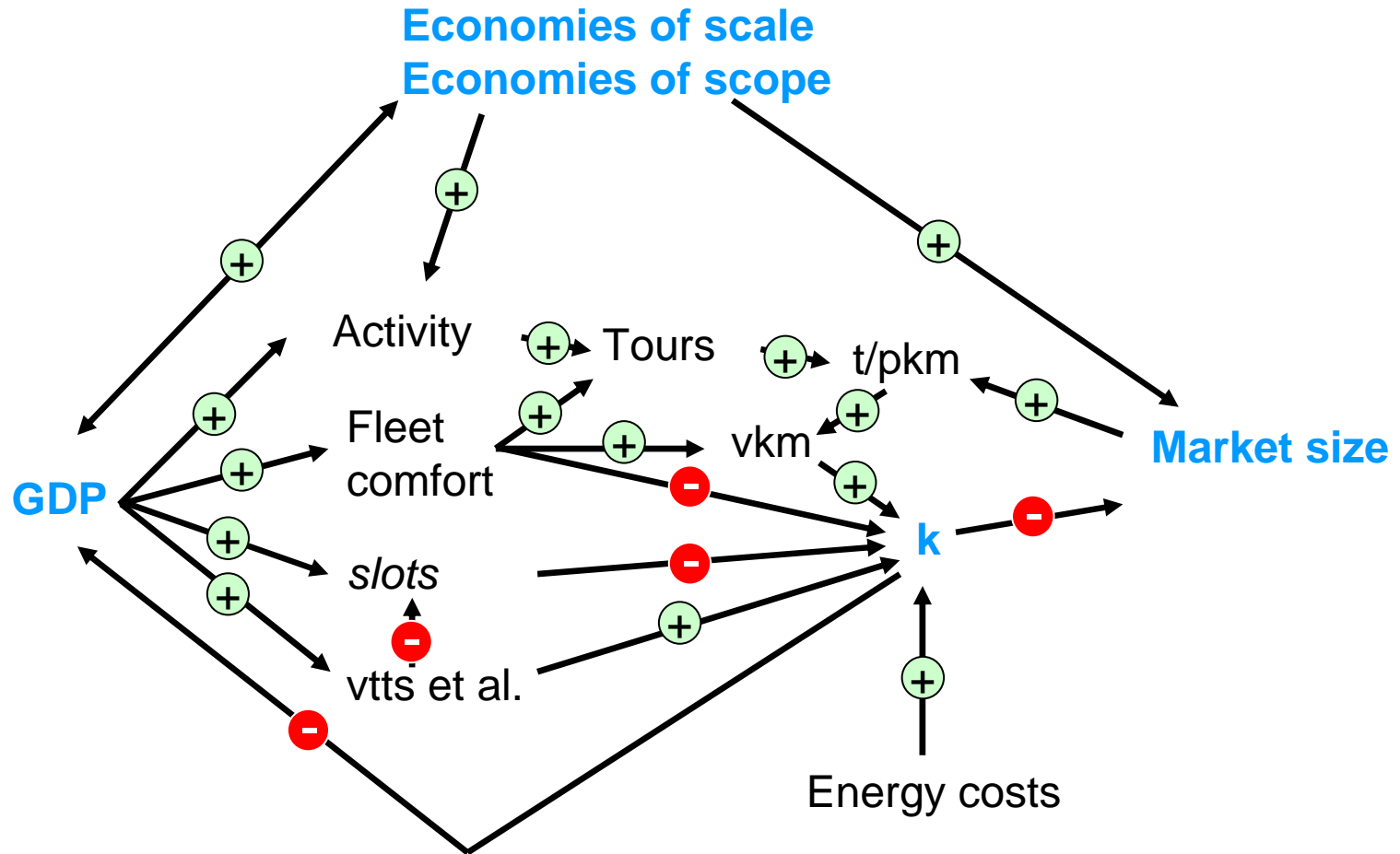


Two-lane motorways



Trunk roads

# Size of goods markets and productivity: A hypothesis



⊕ Elasticity > 0

⊖ Elasticity < 0

Slots: possibilities to move goods or people  
 For a given infrastructure and commercial and private fleet



## Accessibility as the log-sum term of a choice model

---

In line with the literature we use:

$$Acc_i = \ln \sum_{\forall ij} X_j e^{-\beta c_{ij}}$$

Using:

- Weighting parameter ( $\beta$ ) of 0.2
- Travel time as the only generalised cost element ( $c_{ij}$ )
- Population as number of opportunities ( $X_j$ )

## Description of Elements: Overview

---

Study area:	Switzerland and surrounding jurisdictions in a 350 km band
Spatial resolution:	Municipality equals one zone/Bezirk Larger municipalities are subdivided Zones outside Switzerland on regional or county level
Intrazonal travel times:	Dependent on equivalent radius of the size of the built up area

## Description of Elements: Road transport

---

Network resolution: All major road developments inside Switzerland and motorway development outside

Link description: Assumed mean speeds by 51 link types based on a detailed historical review

Centroid connectors: Fixed speeds

Travel time calculation: Shortest-time paths

## Description of Elements: Public transport

---

- Timetables: Detailed time tables for all regular interurban trains (without S-Bahn)  
Coaches and interurban buses, where relevant
- Station connectors: Fixed speeds
- Travel time calculation: Shortest-time paths (including transfer times)

## Description of Elements: Years

---

Matching the census the reference areas are:

- 1850, 1888, 1910, 1930      Only Bezirke
- 1950 and then each decade      Municipalities and Bezirke

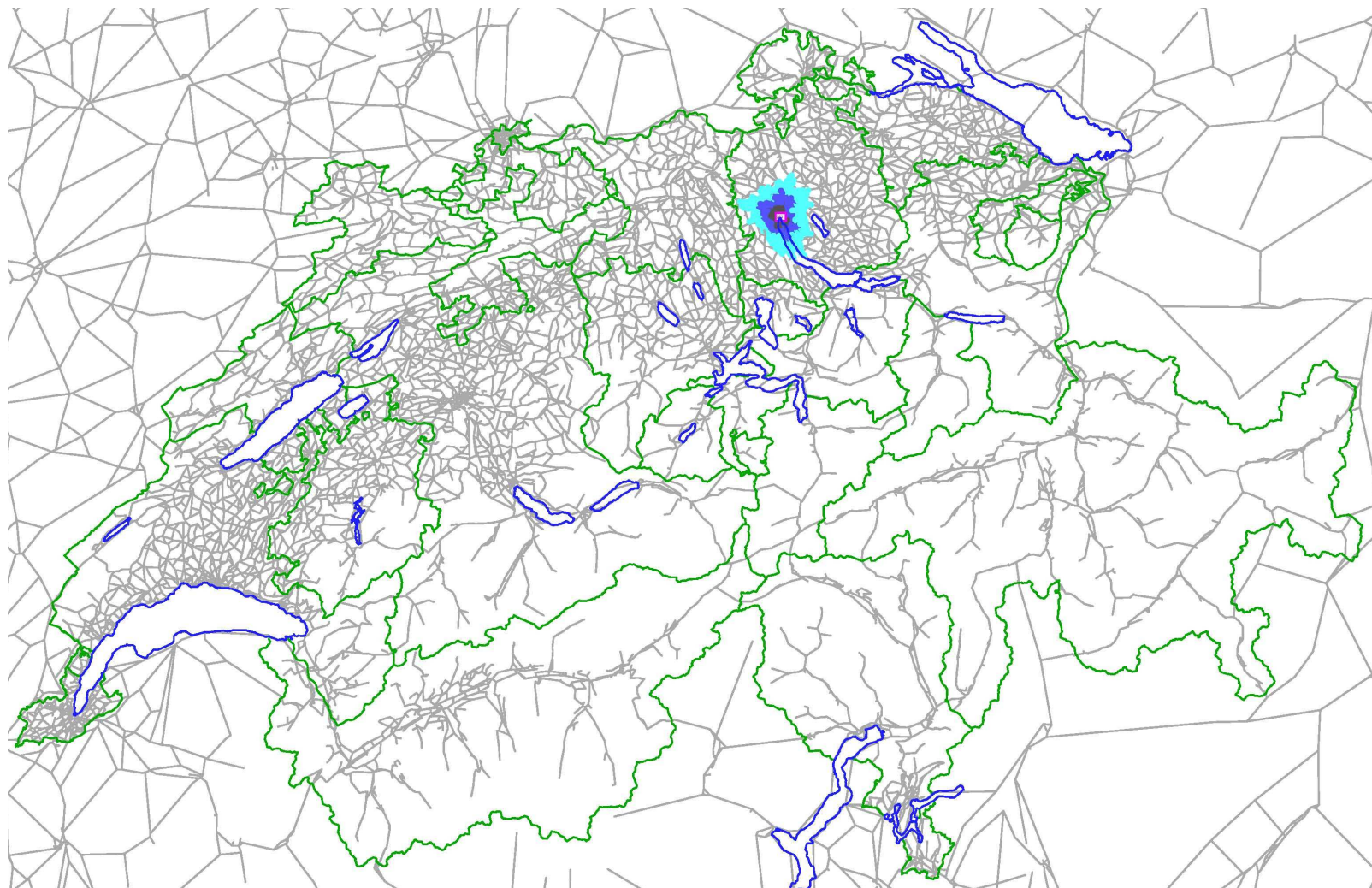
## Road network models

---

Year	mod. Links CH	Total CH Links CH	mod. Links EU	Total Links EU
1950	3'527	17'698	136	29'248
1960	3'589	17'760	195	29'307
1970	4'147	18'318	422	29'534
1980	4'810	18'981	747	29'859
1990	5'215	19'386	896	30'008
2000	-	19'700	-	30'053

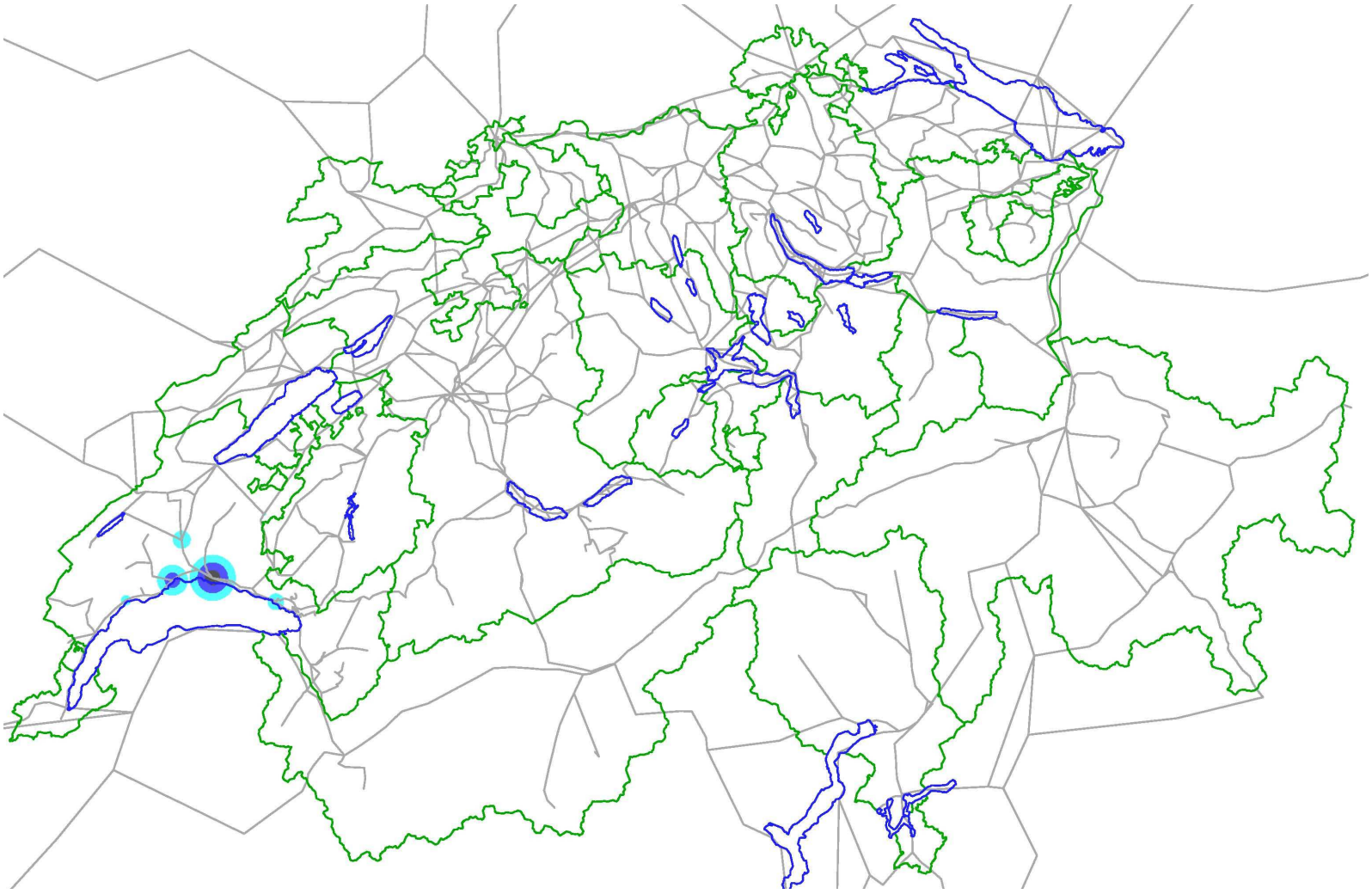
# Road travel times from Zürich (1850)

---



# Public transport travel times from Lausanne (1850)

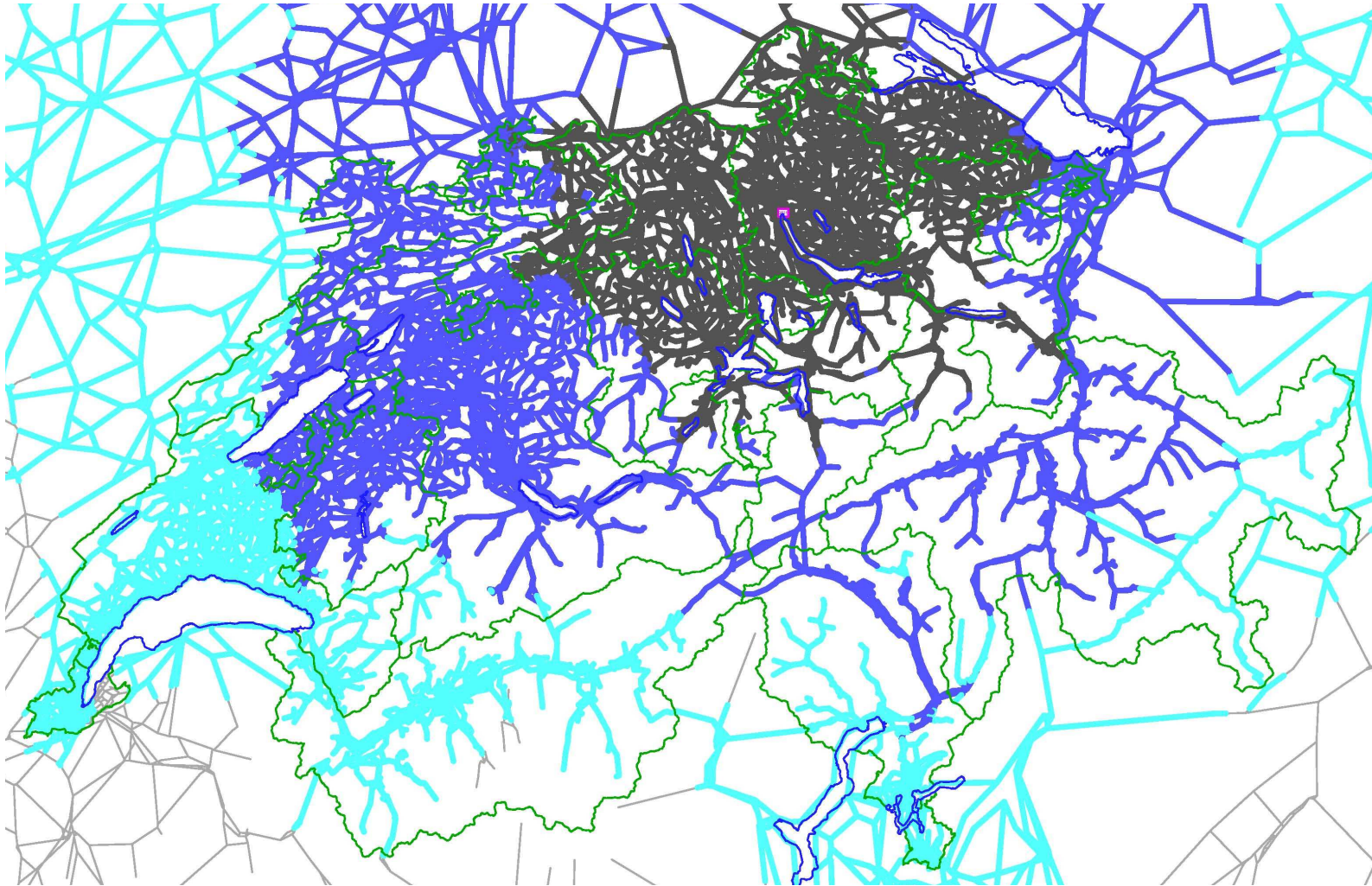
---





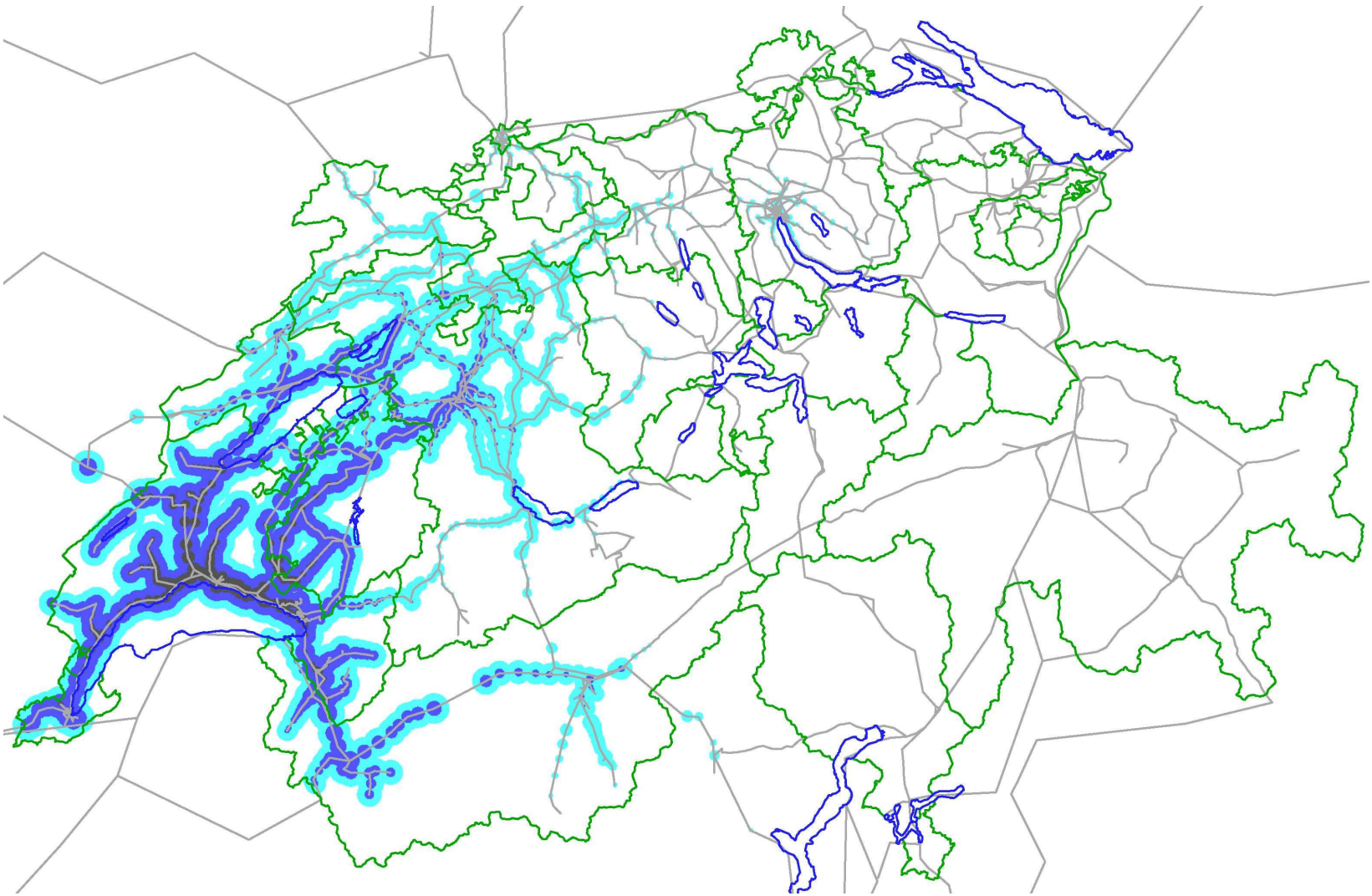
## Road travel times from Zürich (2000)

---



# Public transport travel times from Lausanne (2000)

---





# Road travel time-scaled map of Switzerland 1950



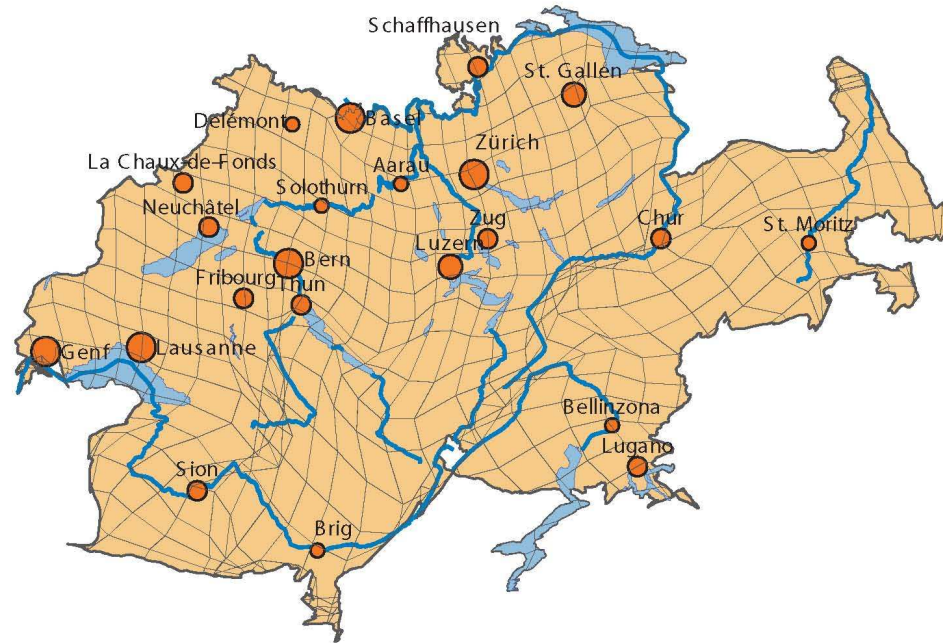
© IVT, ETH Zürich

1 Stunde

10km x 10km Raster

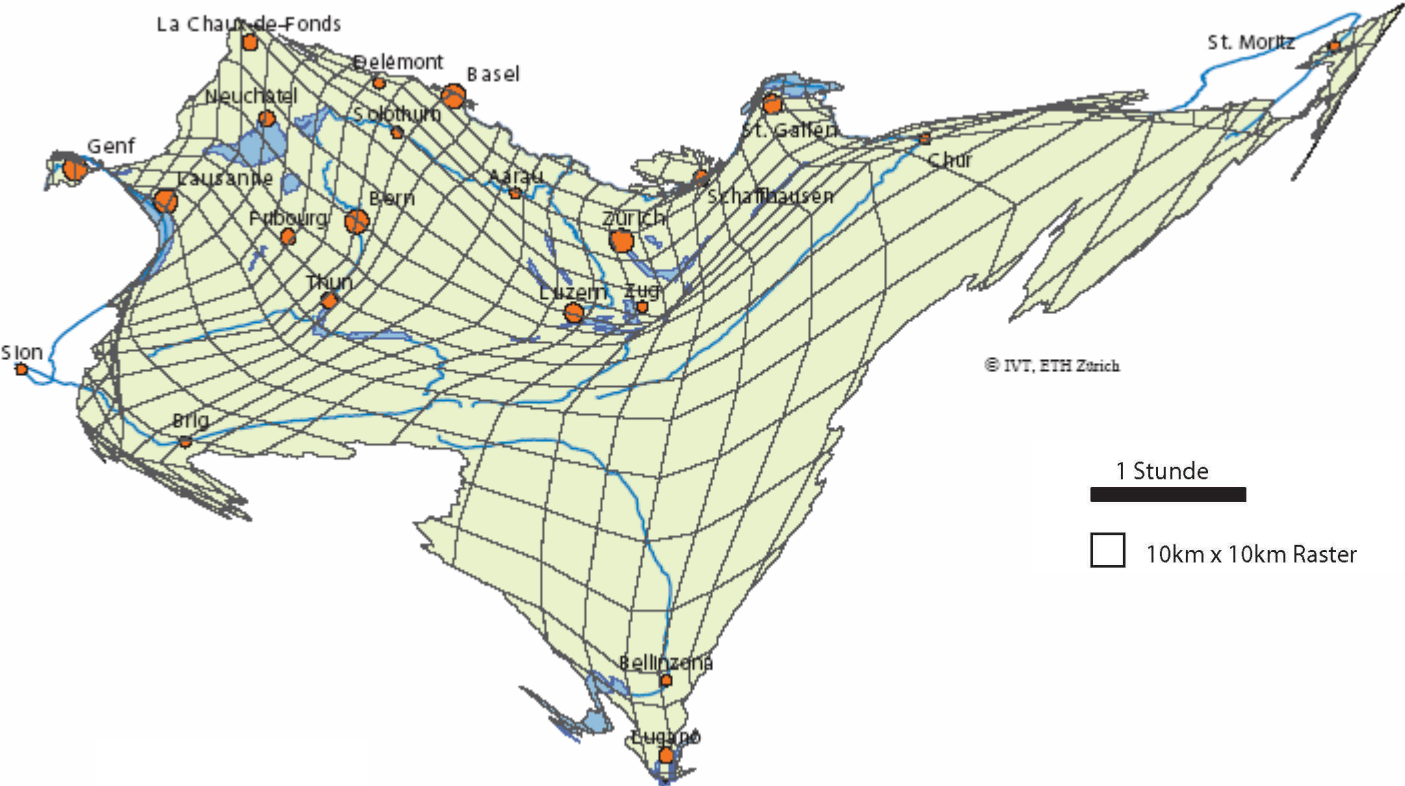
# Road travel time-scaled map of Switzerland 2000

---



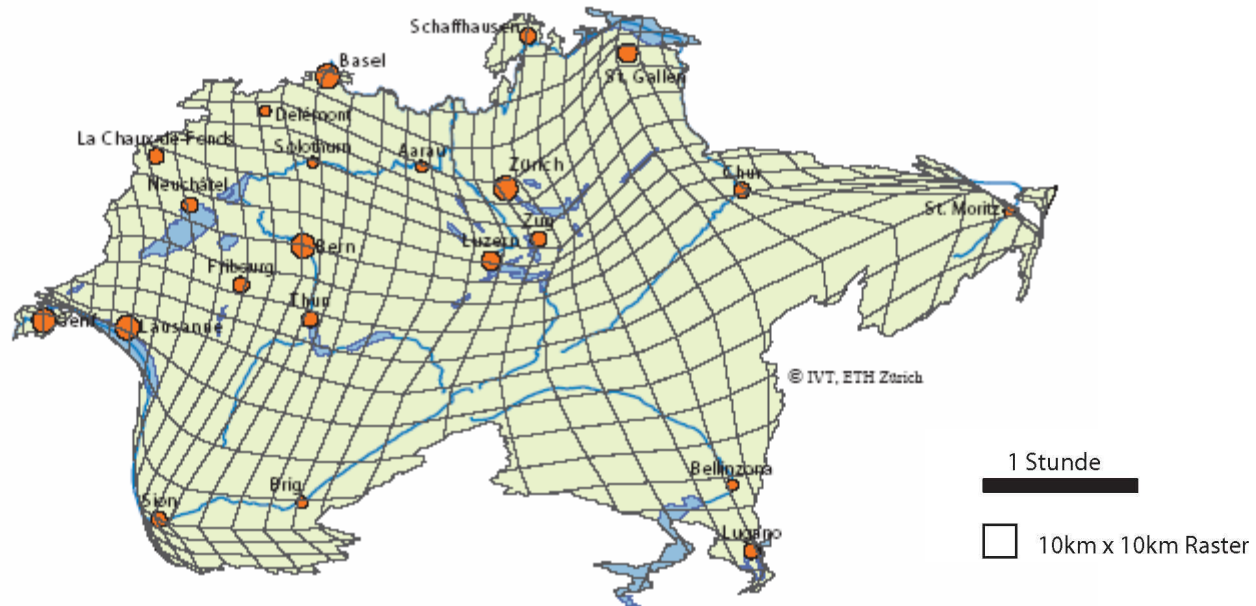
1 Stunde  
10km x 10km Raster

# Rail travel time-scaled map of Switzerland 1950

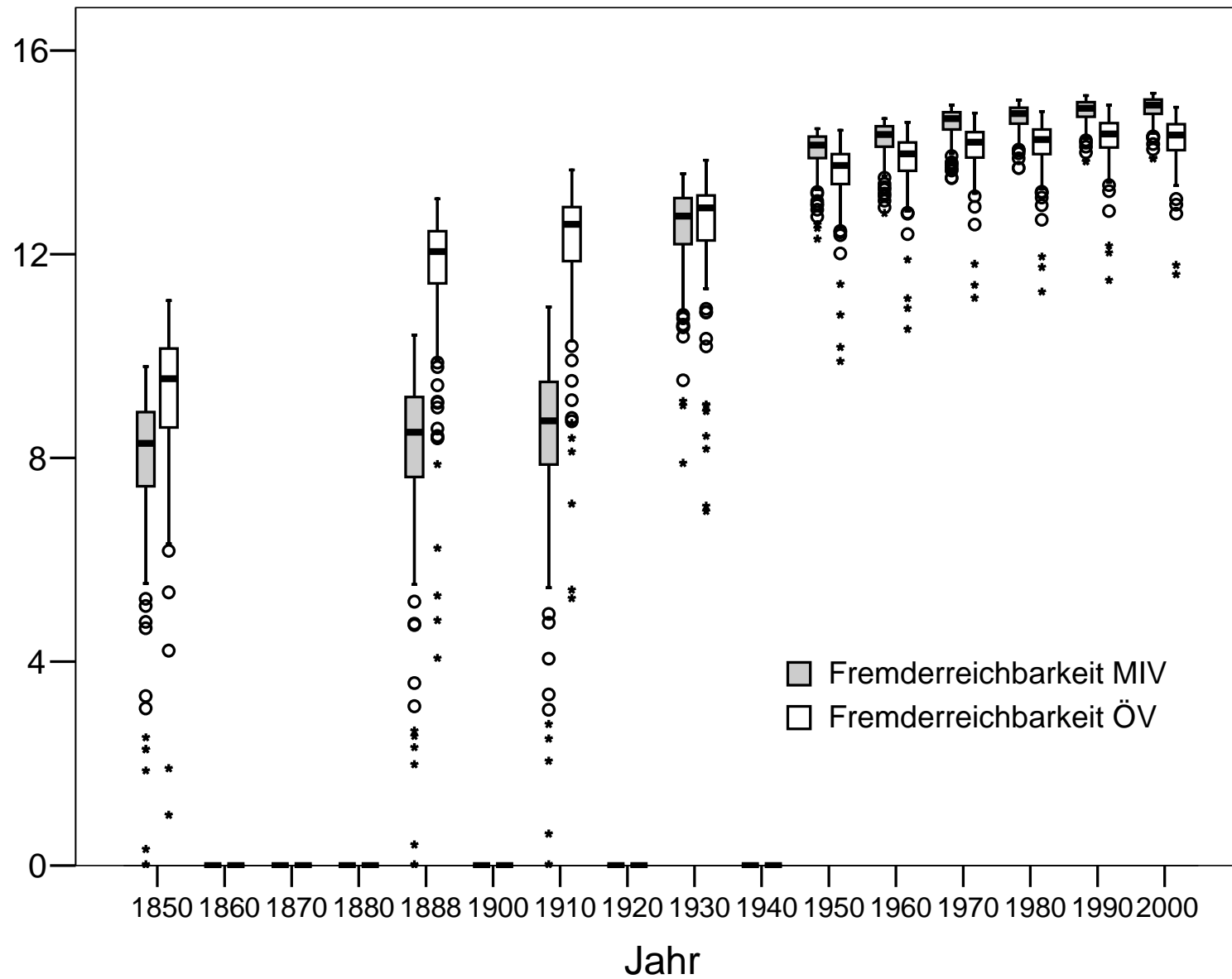


# Rail travel time-scaled map of Switzerland 2000

---

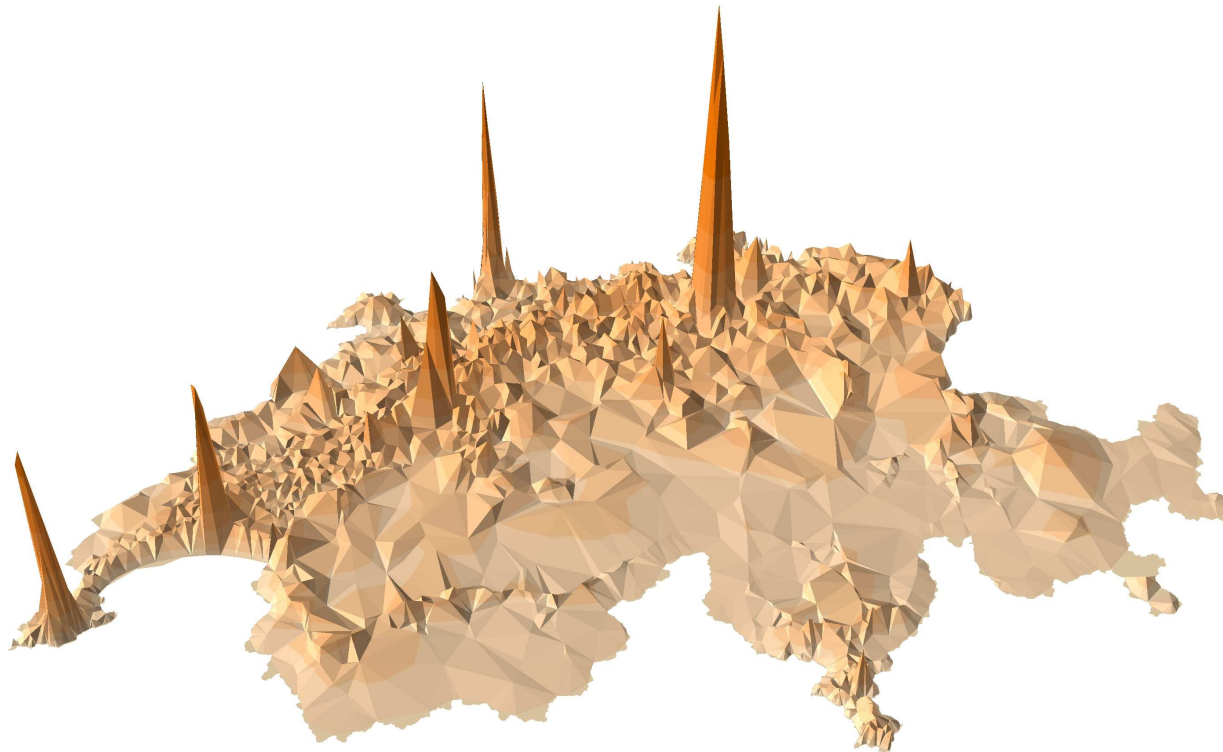


# Accessibilities of the Bezirke since 1850



# Road based accessibilities 1950 (without log)

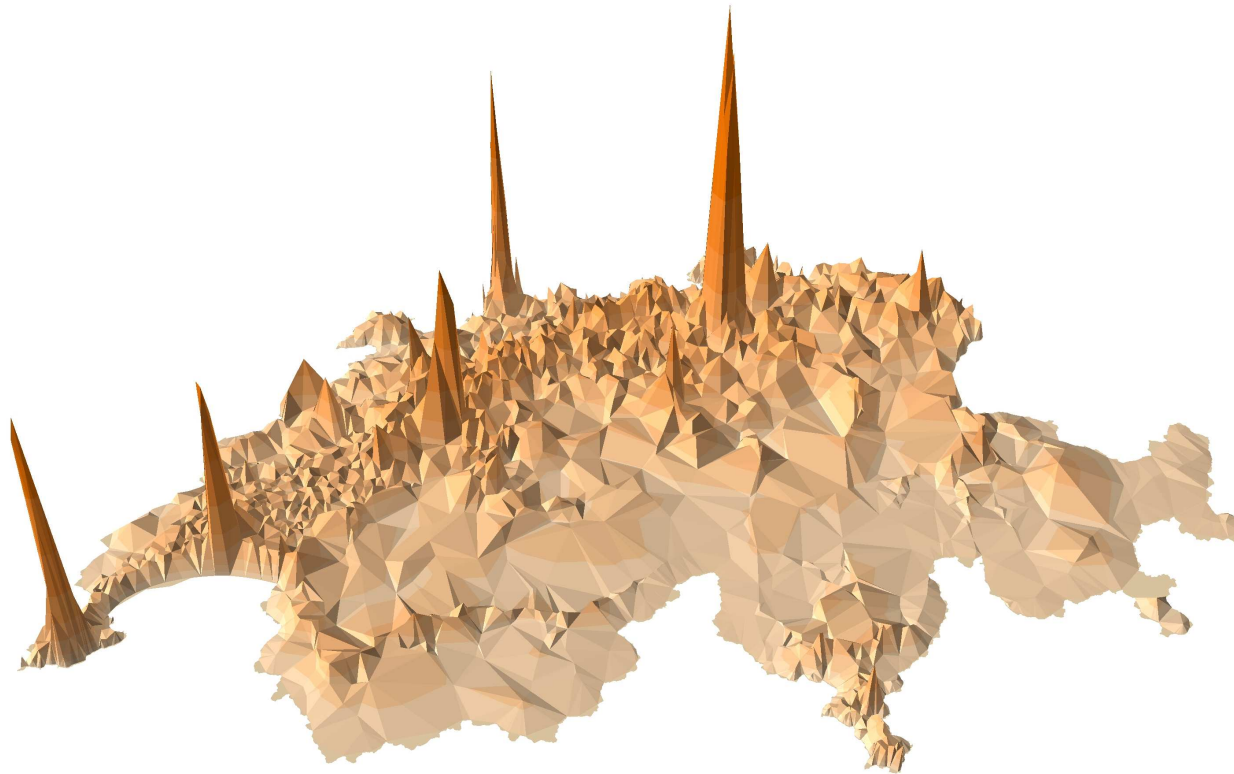
---





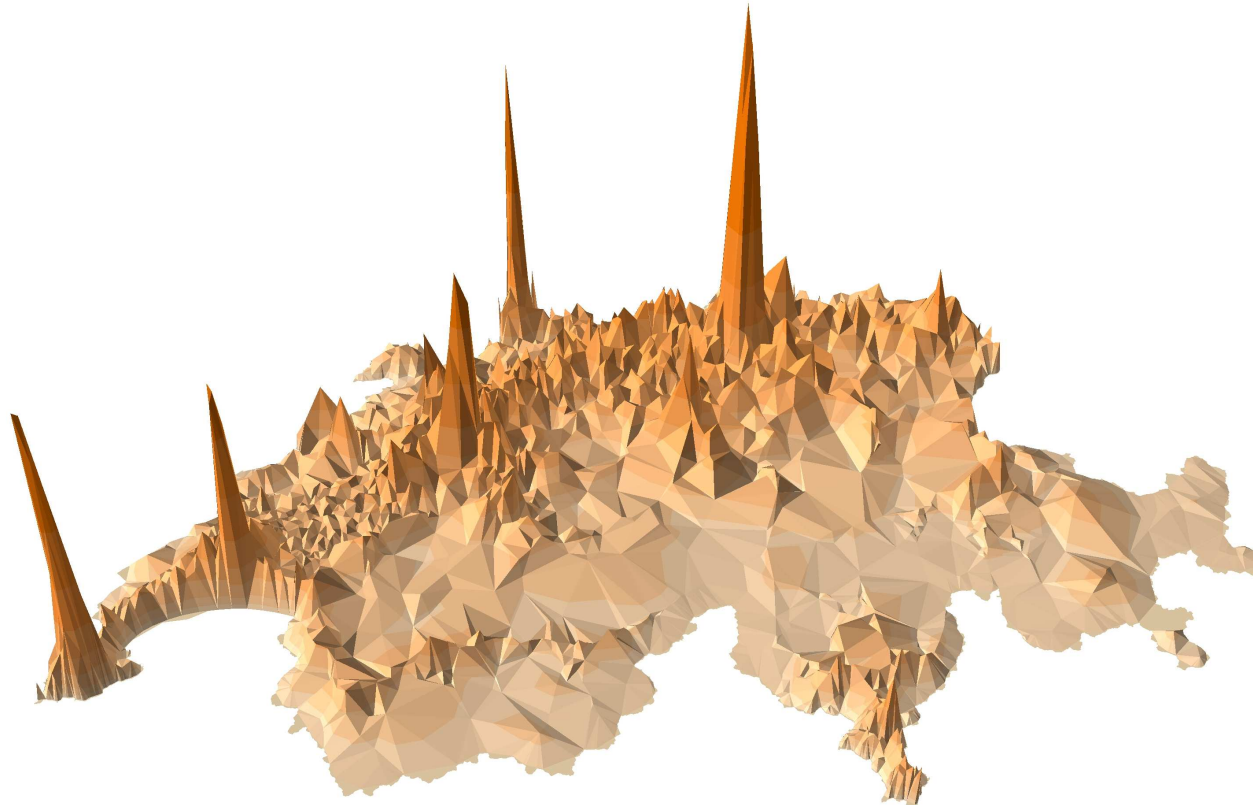
# Road based accessibilities 1960 (without log)

---



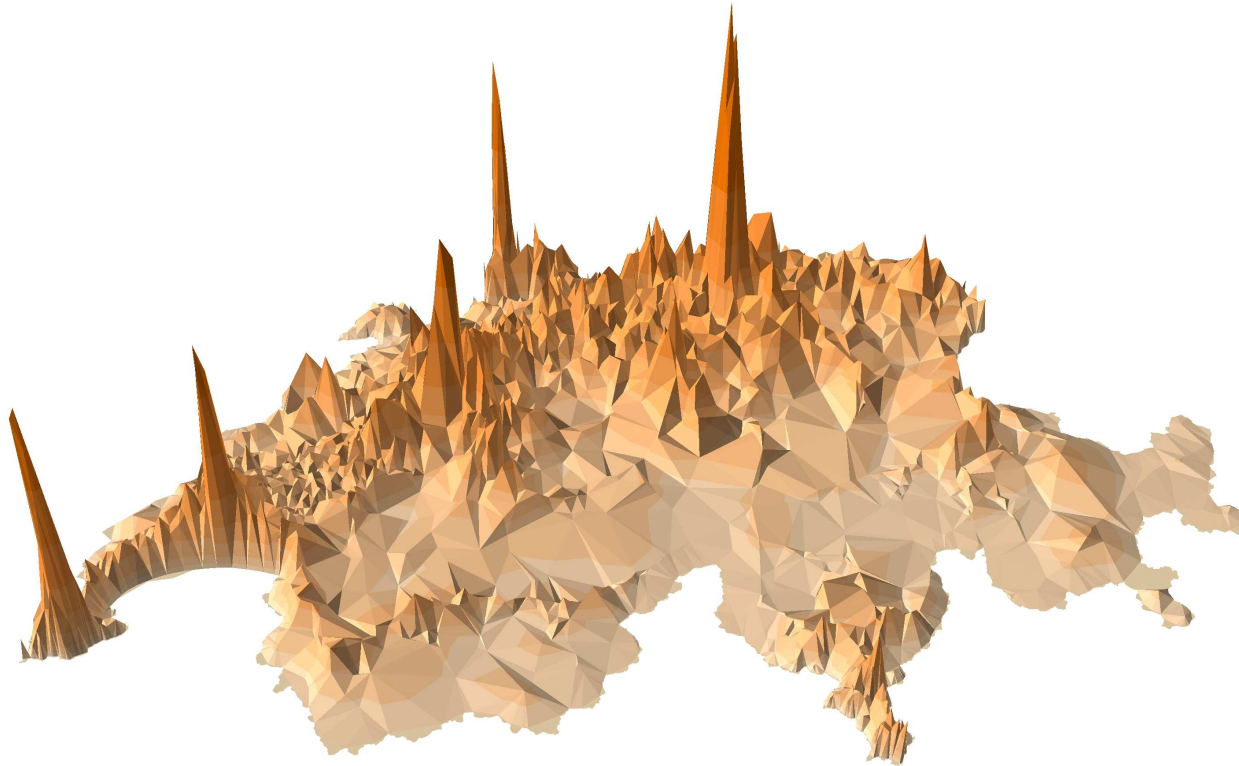
# Road based accessibilities 1970 (without log)

---



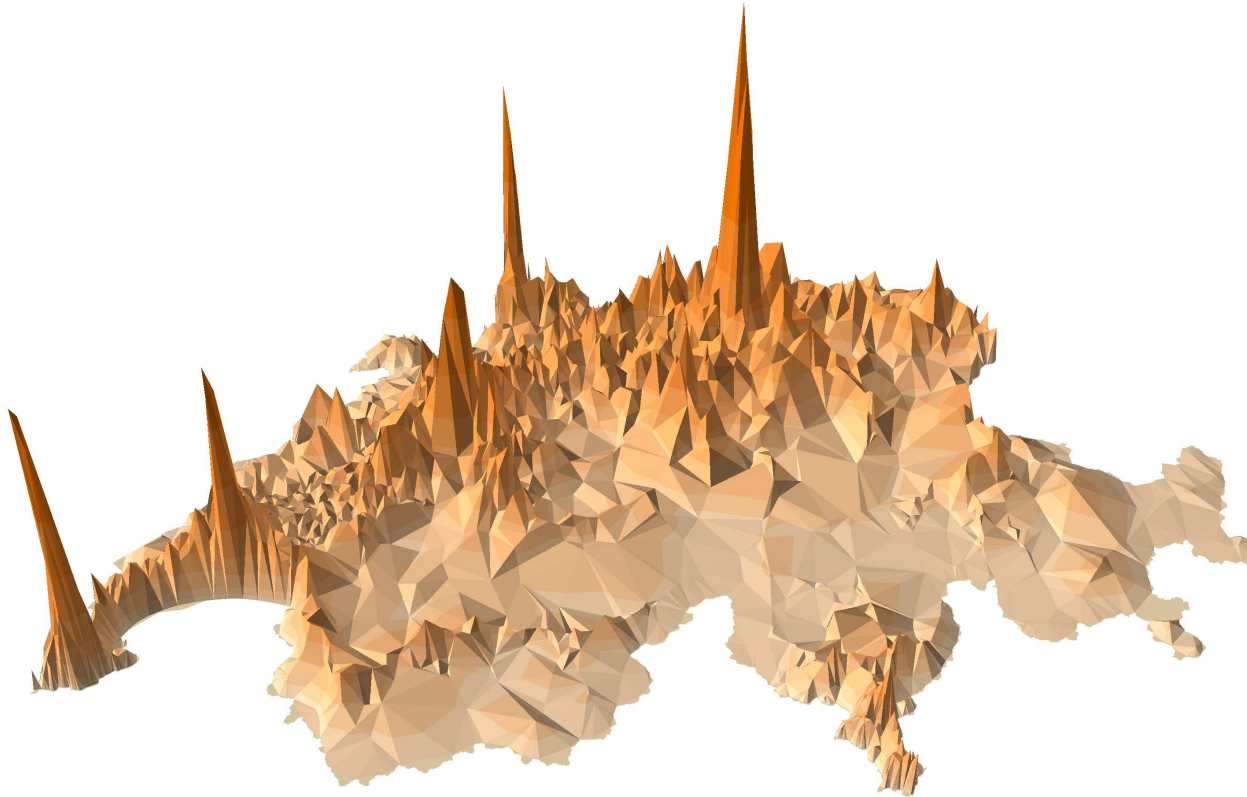
# Road based accessibilities 1980 (without log)

---



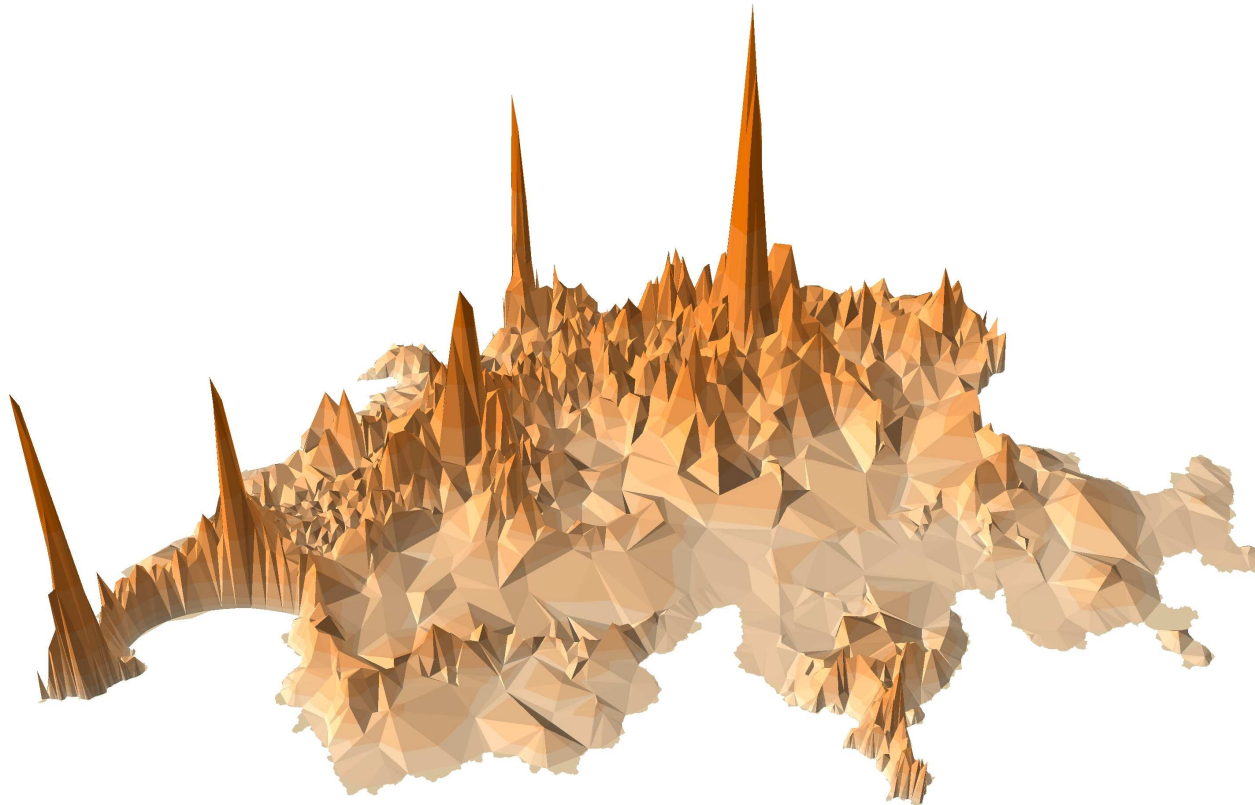
# Road based accessibilities 1990 (without log)

---



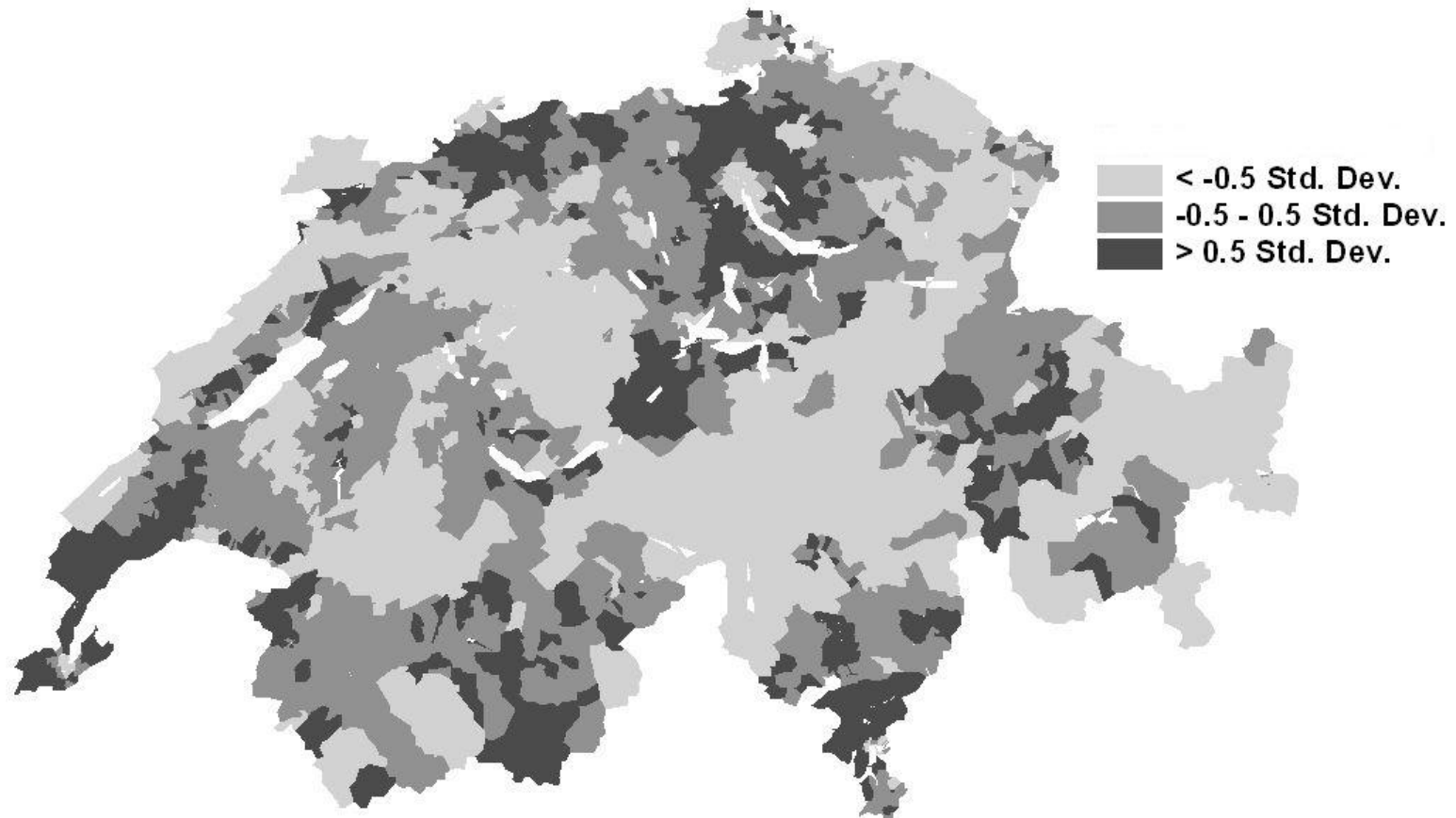
# Road based accessibilities 2000 (without log)

---



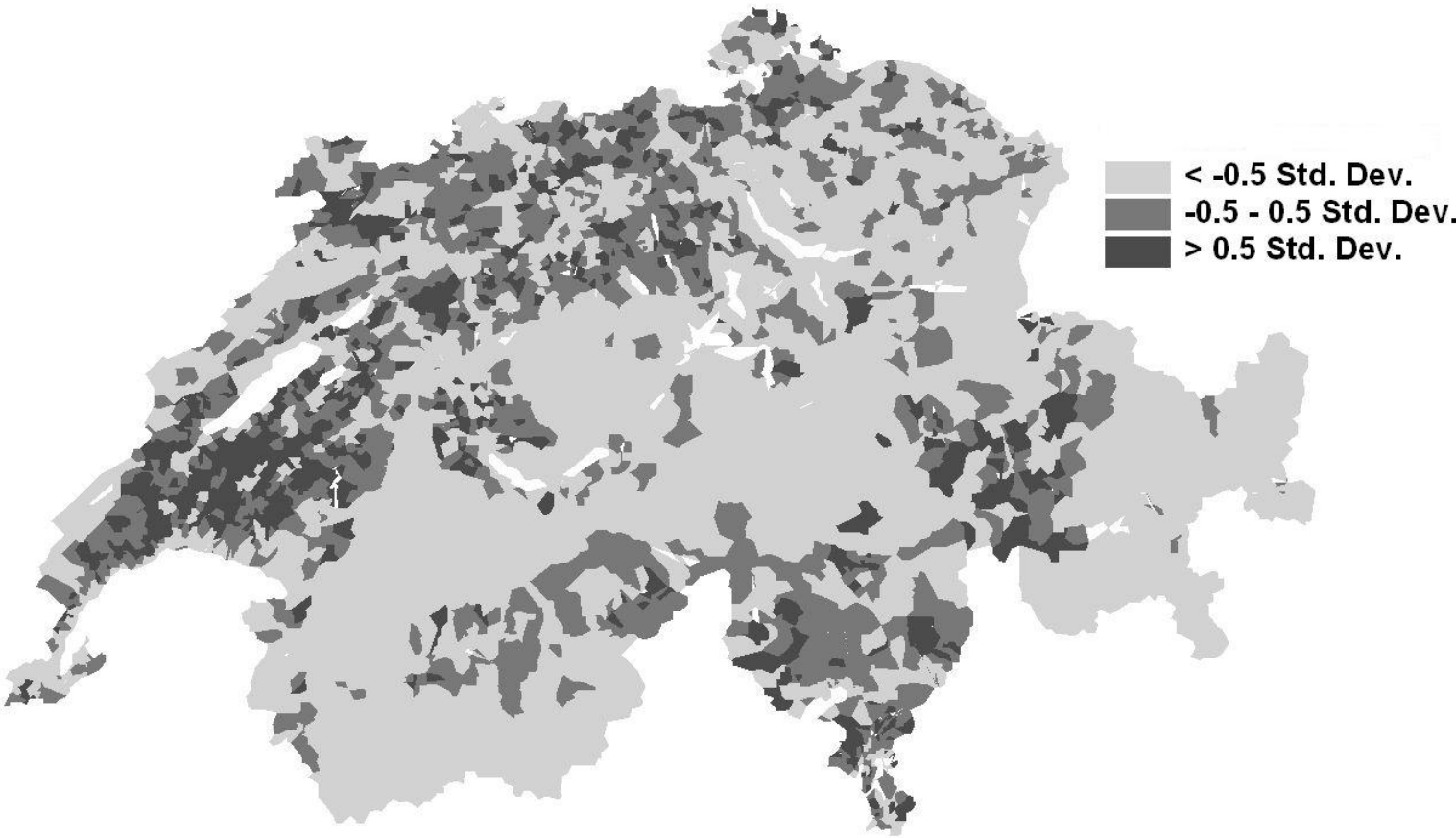
# Growth of the road based accessibilities 1950 to 2000

---



# Ratio of road to public transport accessibilities 2000

---



# Conclusions

---

Tracking the road-based accessibility changes is possible over a long period of time.

It seems advisable to concentrate only on the developments of the motorways and similar high capacity roads.

Public transport requires full timetables.

Public transport accessibilities underestimated due to the omissions of schedule delay effects (headways)



# Conclusions

---

Need to track not only infrastructure, but also regulations and the vehicle fleet.

Policy impetus to the equalisation of speeds

Winners are the suburban municipalities between the major centres

Saturation effects visible

# Literature

---

- Aschauer, D. (1989) Is public expenditure productive?, *Journal of Monetary Economics*, 23 (2) 177 –200.
- Axhausen, K.W. und P. Fröhlich (2004) Public investment and accessibility change, in P. Marti und A. Müller (Hrsg.) *Festschrift Schalcher*, vdf, Zürich.
- Fröhlich, Ph. and K.W. Axhausen (2004) Sensitivity of accessibility measurements to the underlying transport network model, *Arbeitsberichte Verkehrs- und Raumplanung*, **245**, IVT, ETH Zürich, Zürich.
- Fröhlich, P. and K. W. Axhausen (2002) Development of car-based accessibility in Switzerland from 1950 through 2000: First results, *Arbeitsberichte Verkehrs- und Raumplanung*, 111, Institut für Verkehrsplanung, Transporttechnik, Strassen- und Eisenbahnbau (IVT), ETH, Zürich.
- Gätzi, M. (2004) *Raumstruktur und Erreichbarkeit*, Diplomarbeit, IVT, ETH Zürich, Zürich.
- Tschopp, M., P. Fröhlich and K. W. Axhausen (2004) Accessibility and spatial development in Switzerland during the last 50 years: A multilevel regression approach, conference paper *Access to Destinations Conference*, University of Minnesota, Minneapolis, 8-9.11.2004, *Arbeitsberichte Verkehr- und Raumplanung*, 260, Institut für Verkehrsplanung und Transportsysteme (IVT), ETH Zürich, Zürich.

# Appendix

---

## Mean ratios of road to public transport accessibility

---

	<b>1950</b>	<b>1960</b>	<b>1970</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
<b>Mean</b>	<b>1.31</b>	<b>1.33</b>	<b>1.38</b>	<b>1.38</b>	<b>1.37</b>	<b>1.36</b>
<b>Median</b>	<b>1.28</b>	<b>1.30</b>	<b>1.33</b>	<b>1.33</b>	<b>1.32</b>	<b>1.32</b>
<b>Std. Dev.</b>	<b>0.19</b>	<b>0.21</b>	<b>0.23</b>	<b>0.24</b>	<b>0.23</b>	<b>0.22</b>
<b>25% percentil</b>	<b>1.16</b>	<b>1.17</b>	<b>1.19</b>	<b>1.19</b>	<b>1.19</b>	<b>1.19</b>
<b>75% percentil</b>	<b>1.43</b>	<b>1.46</b>	<b>1.53</b>	<b>1.53</b>	<b>1.51</b>	<b>1.50</b>

Based on municipal accessibilities, with their own-accessibility included