Bevorzugter Zitierstil für diesen Vortrag

Axhausen, K.W. (2007) Implementing UrbanSim in Zürich: Experiences and results, presentation at Nagoya University, July 2007.

Implementing UrbanSim in Zürich: Experiences and results

KW Axhausen

IVT
ETH
Zürich

July 2007

Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Team and sponsors

Collaborators:

- Prof. W. Schmid (IRL)

- Michaela Bürgle
- Michael Löchl
- Urs Waldner

Sponsor:

- ETH Zürich Research Fund

First: A bit about Switzerland

Some facts

- 7.5 mio residents (20% with foreign passports)

- 39'000 km^2 with about 2'800 tax-raising and planning authorities (1+26+2800) (Kyushu)

- 4 (5) official languages (1:3:9 for Italian, French, German plus Romanch Grisun and – unoffically - English)

- Administrative executives
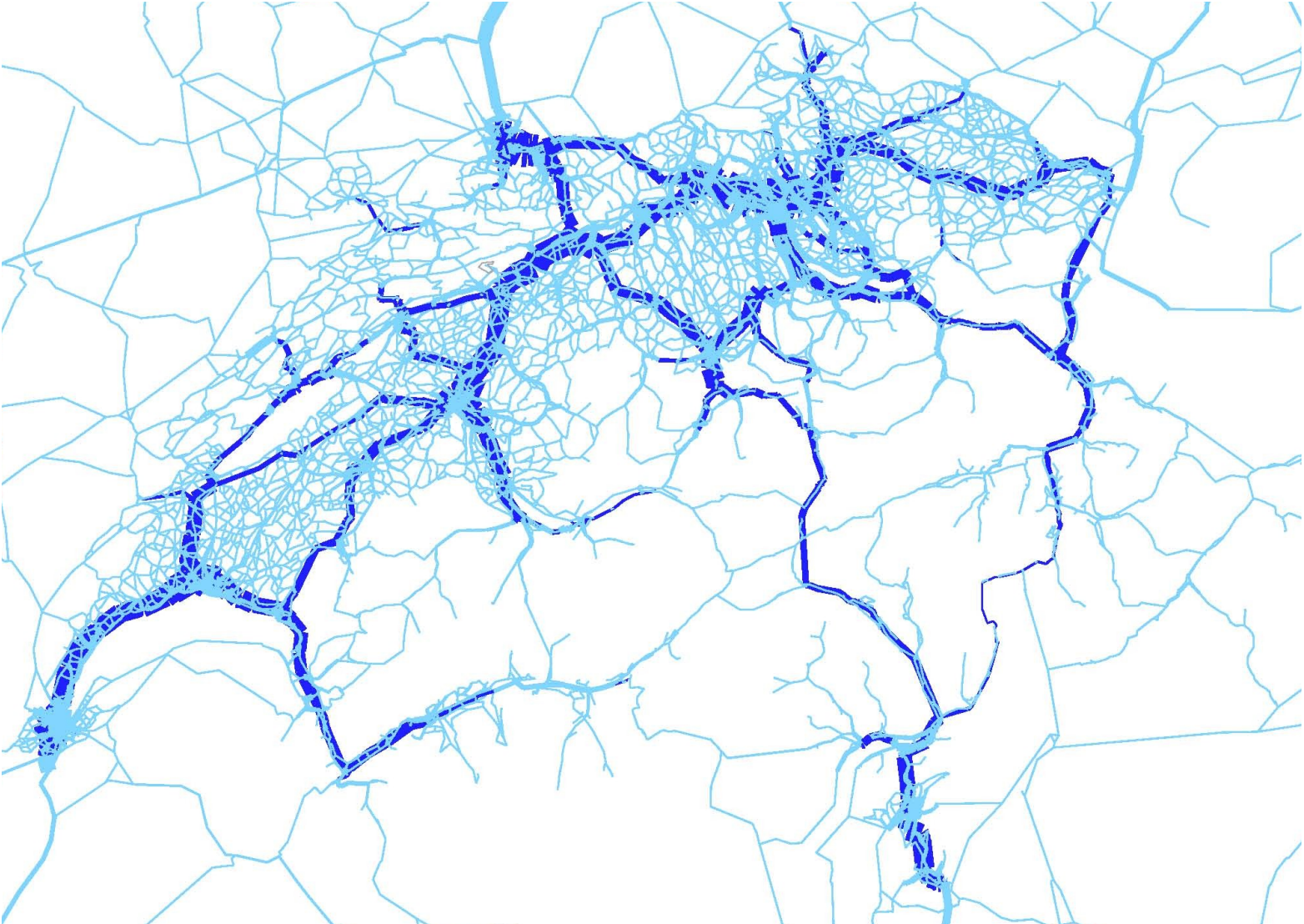- (Quarterly) referendum driven politics

Topography
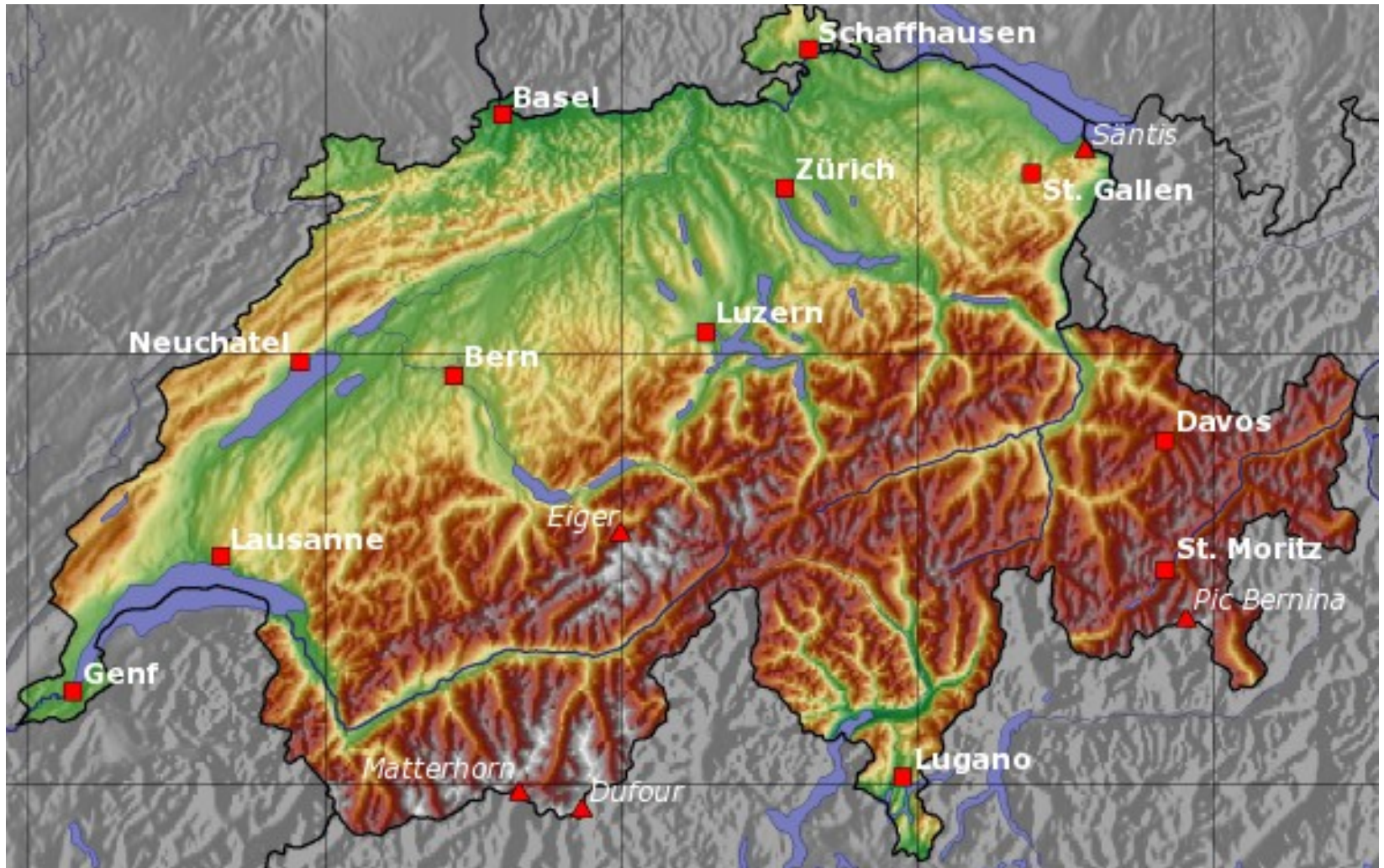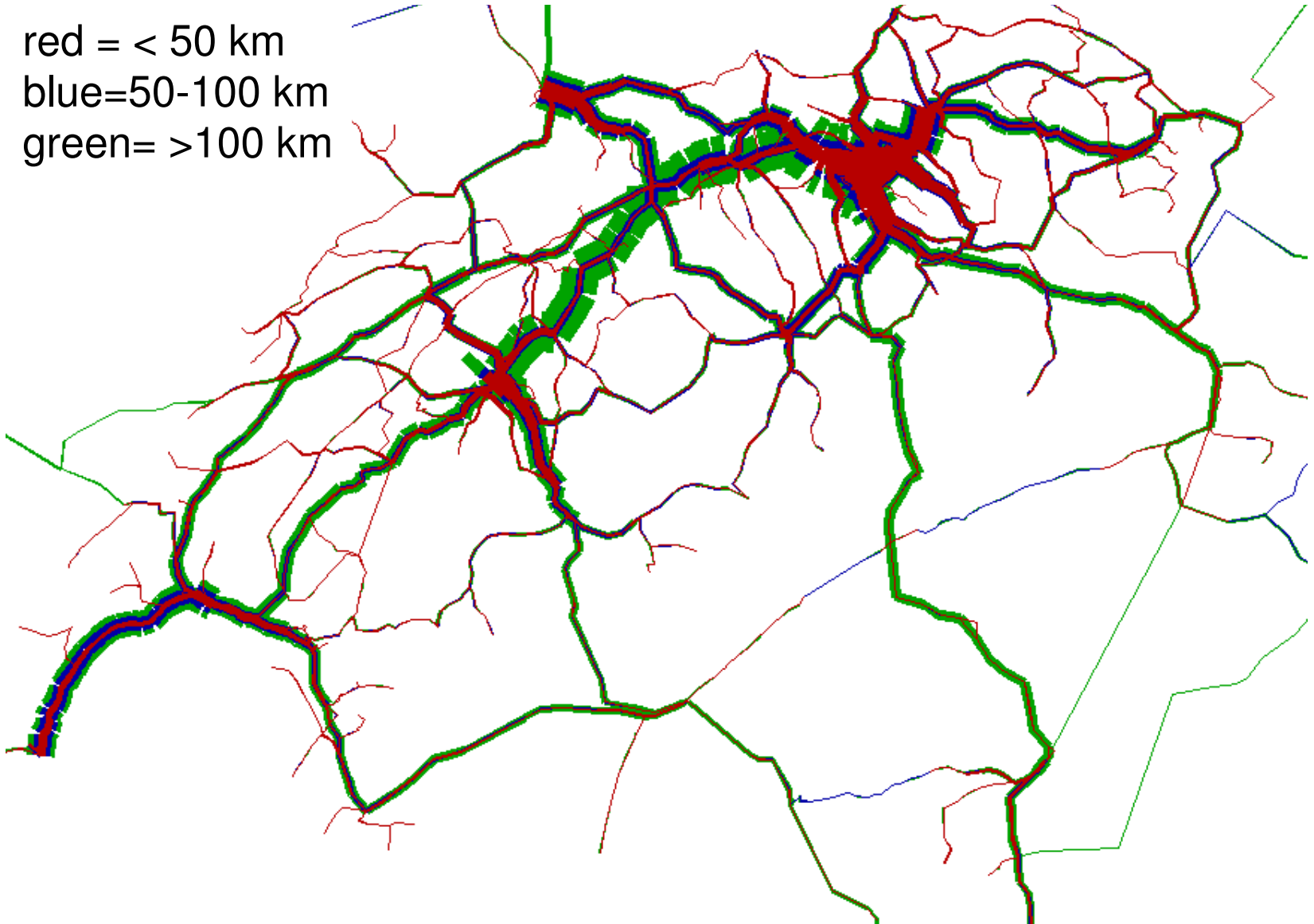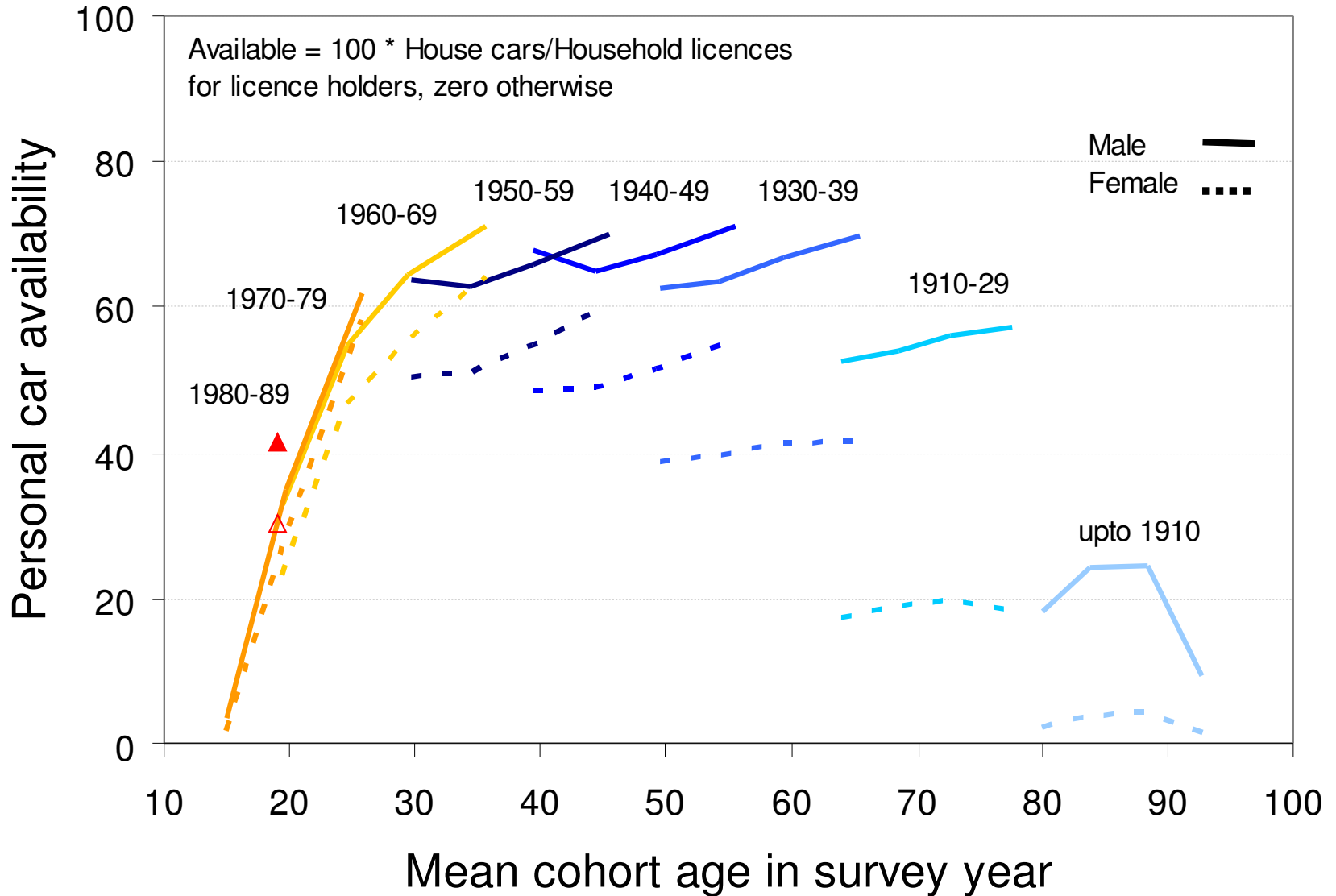
Population density
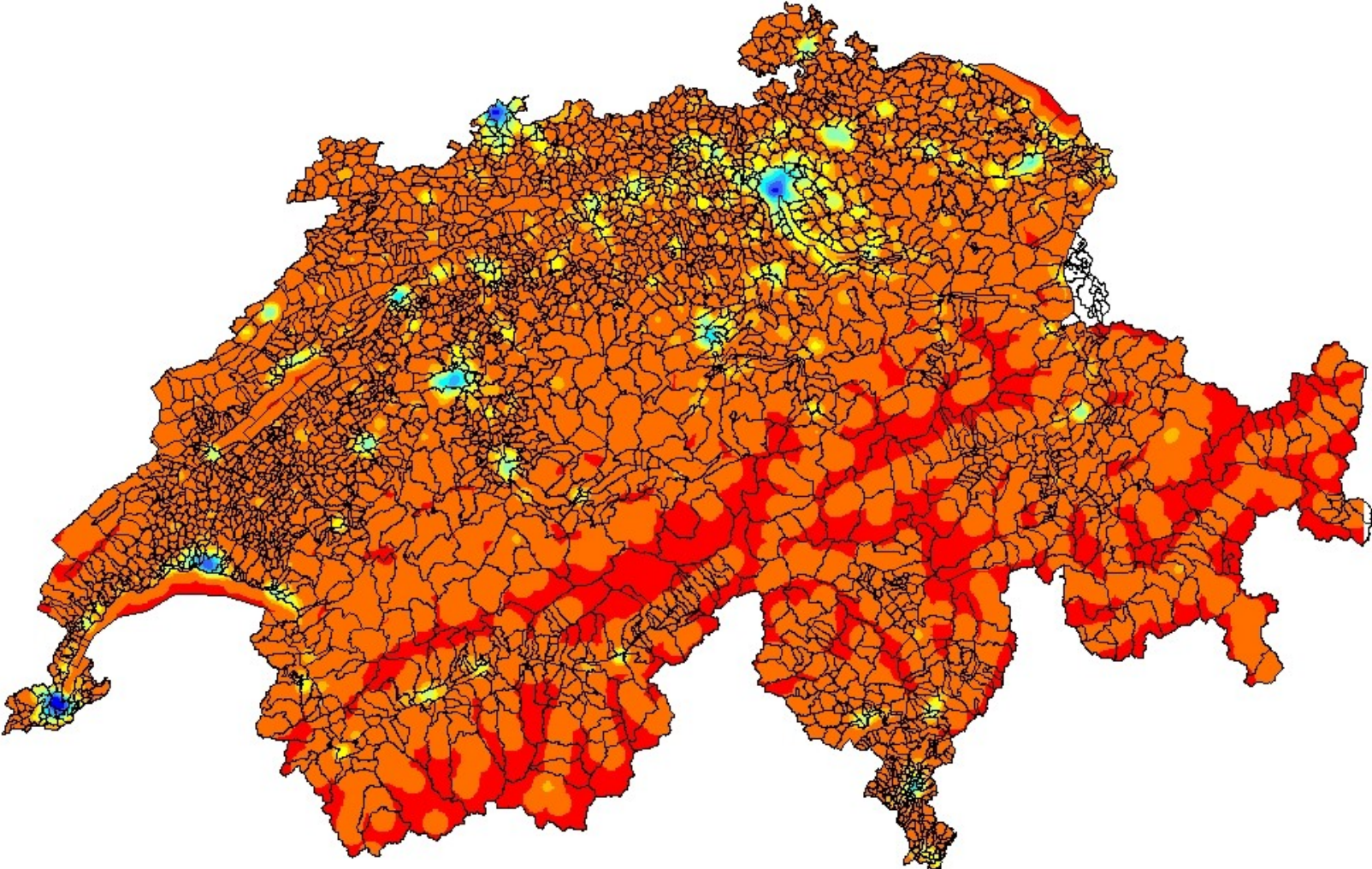
Road traffic volumes (2000)

Railway passenger flows by distance

red = < 50 km
blue=50-100 km
green= >100 km

Car availability

Available = 100 * House cars/Household licences for licence holders, zero otherwise

Mean cohort age in survey year

Personal car availability

Male
Female

1980-89
1970-79
1960-69
1950-59
1940-49
1930-39
1910-29
upto 1910

Season tickets and discount cards (MZ 2005)

Legend:
- □ None
- Only Halbtax
- Halbtax+Regional season
- ■ (yellow) Only regional season
- ■ (red) GA

Categories (y-axis): All, Vehicle available, No vehicle available

X-axis: 0%, 20%, 40%, 60%, 80%, 100%

Share of population
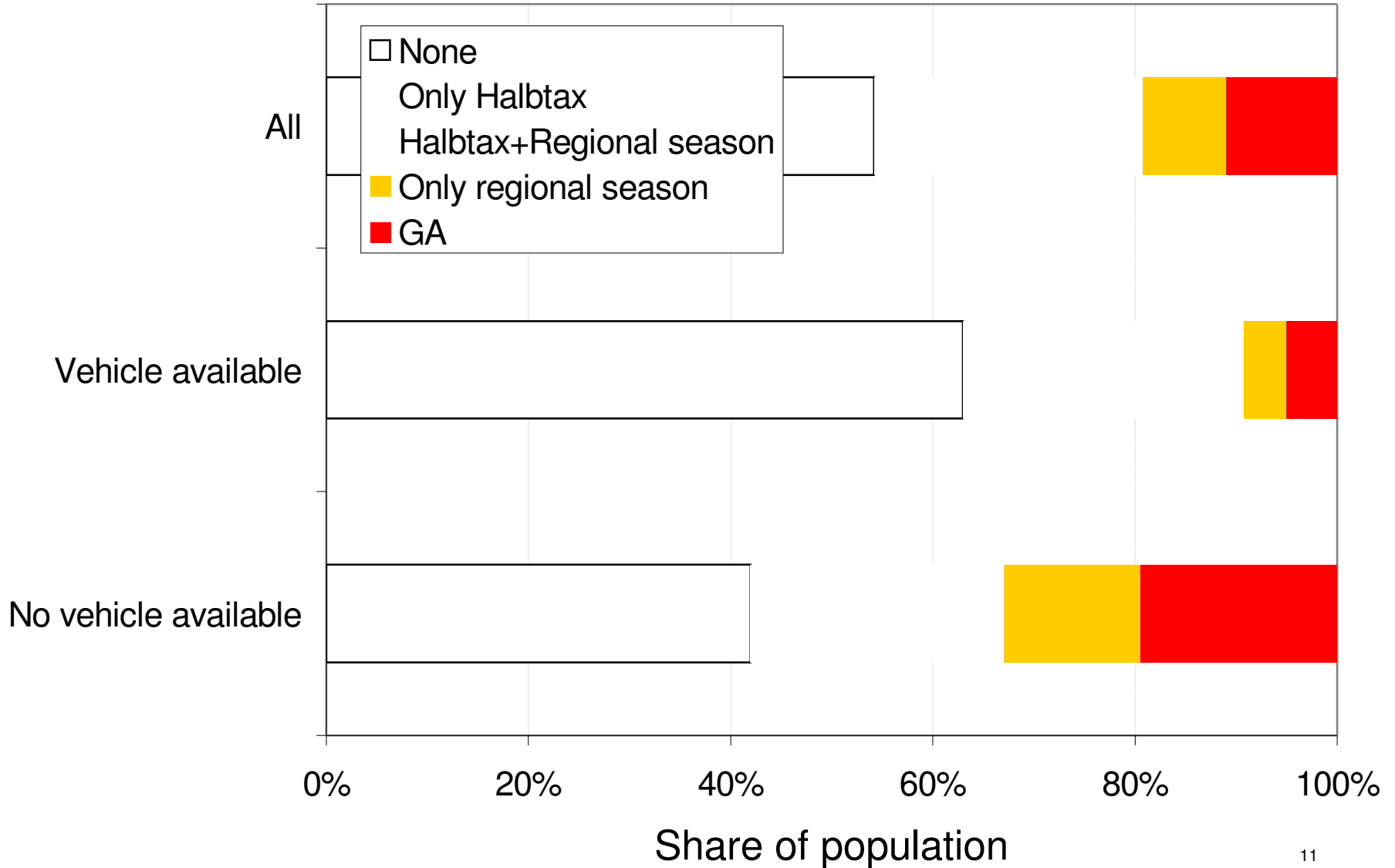
Mobility tools and model split (CH 1984-2000)
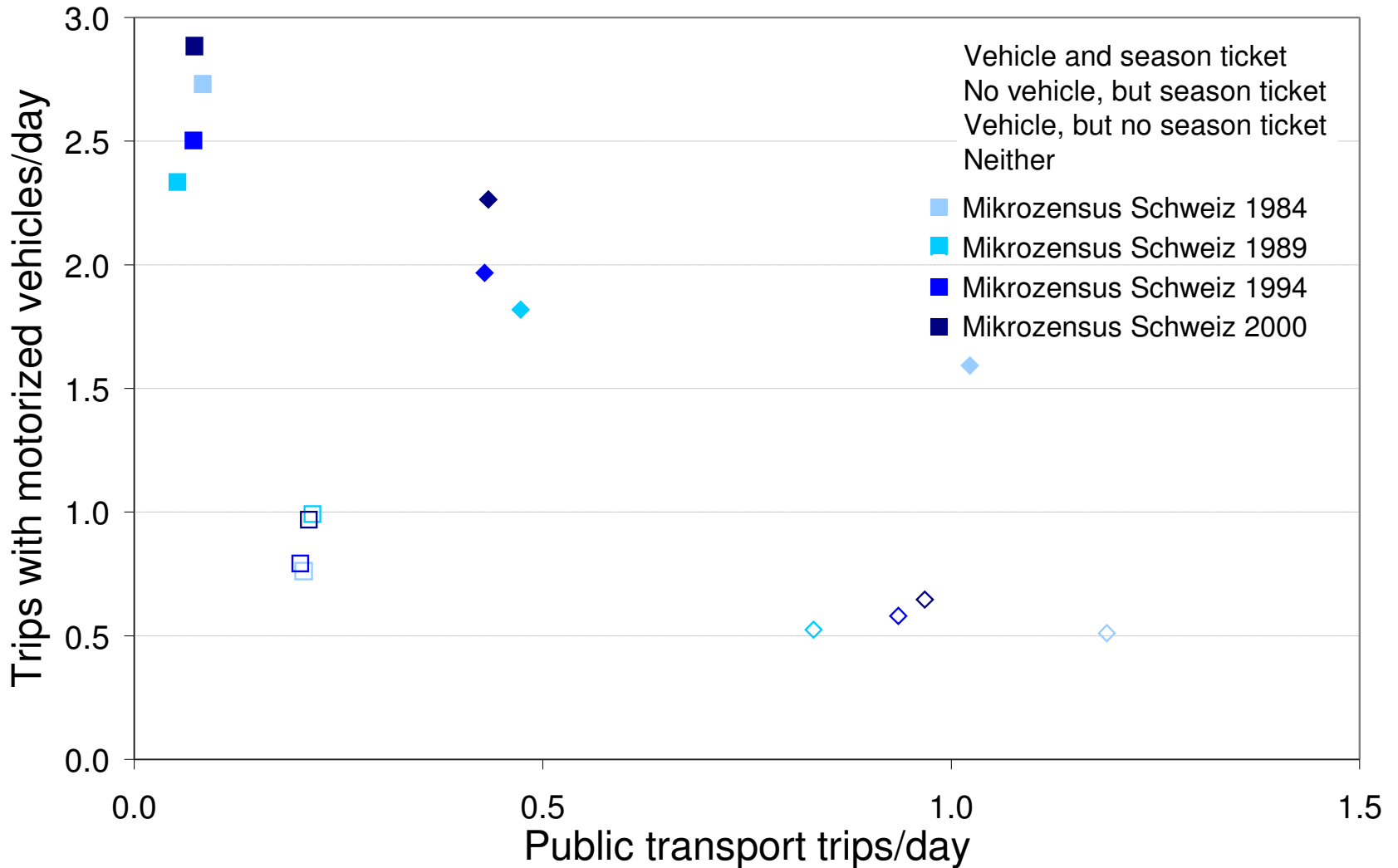
Why UrbanSim ?

Why ?

- GNU Open source
- Fast on single CPU machines

- Good backup and documentation (www.urbansim.org)
- Active development

- Worldwide user community

- Incremental modelling approach
- Quasi-agent driven

Known applications

UrbanSim basics

Inputs/Outputs

Exogenous
Given for forecast period

- land use plan
- transport network characteristics
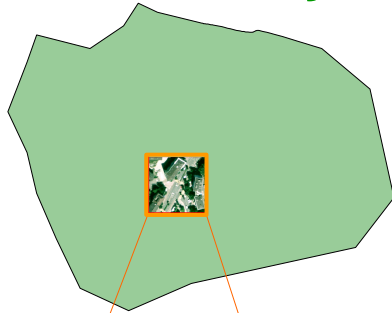- economic forecasts
- population forecasts

Endogenous
Modelled for forecast period

- households
- jobs
- built floorspace
- land prices
- traffic flows

Elements

Traffic analysis zone

Accessibility (road, public transport)

100 Meter

100 Meter

Hektar

Number of households by type
Workplaces
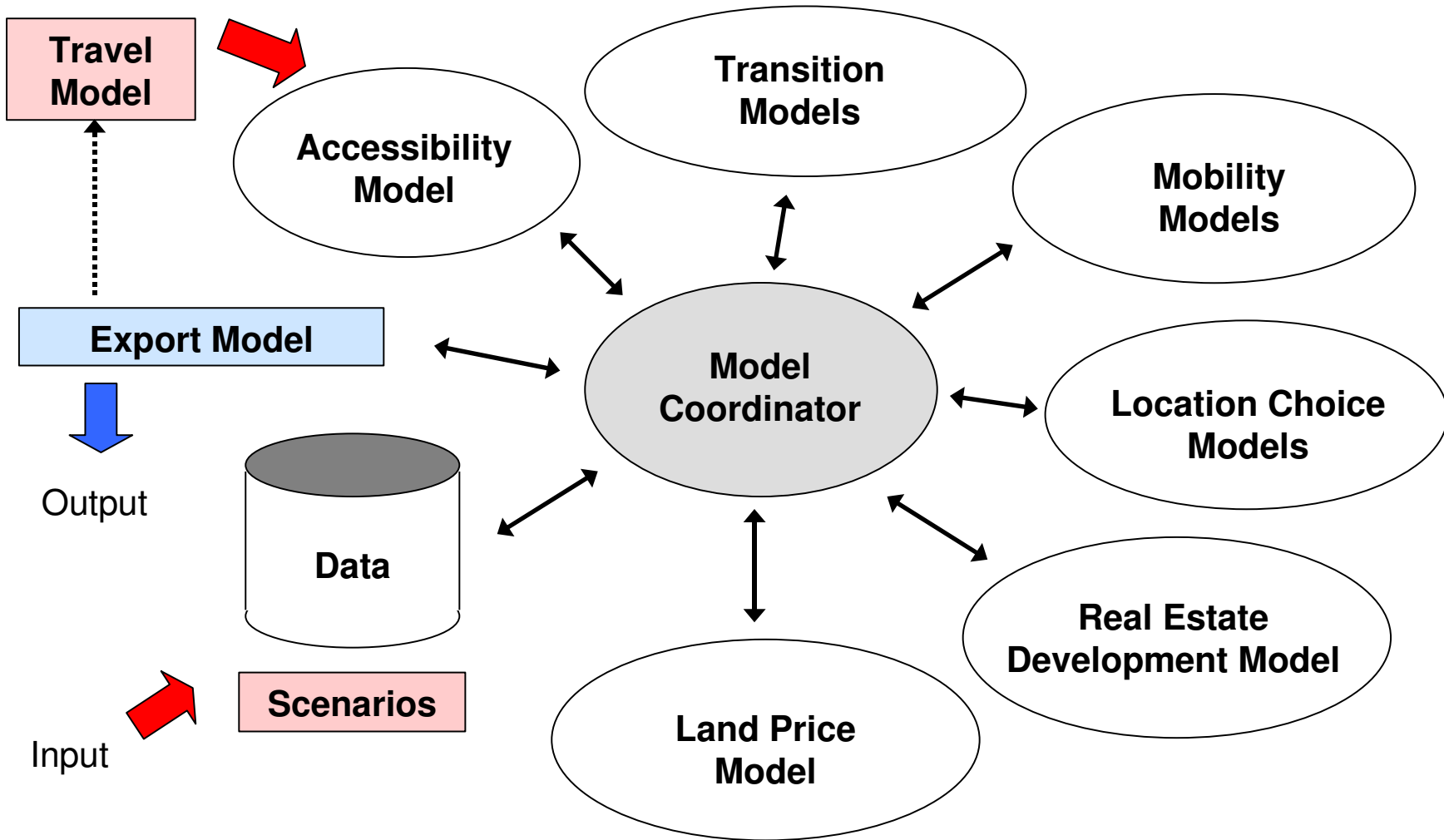Floor area
Flats
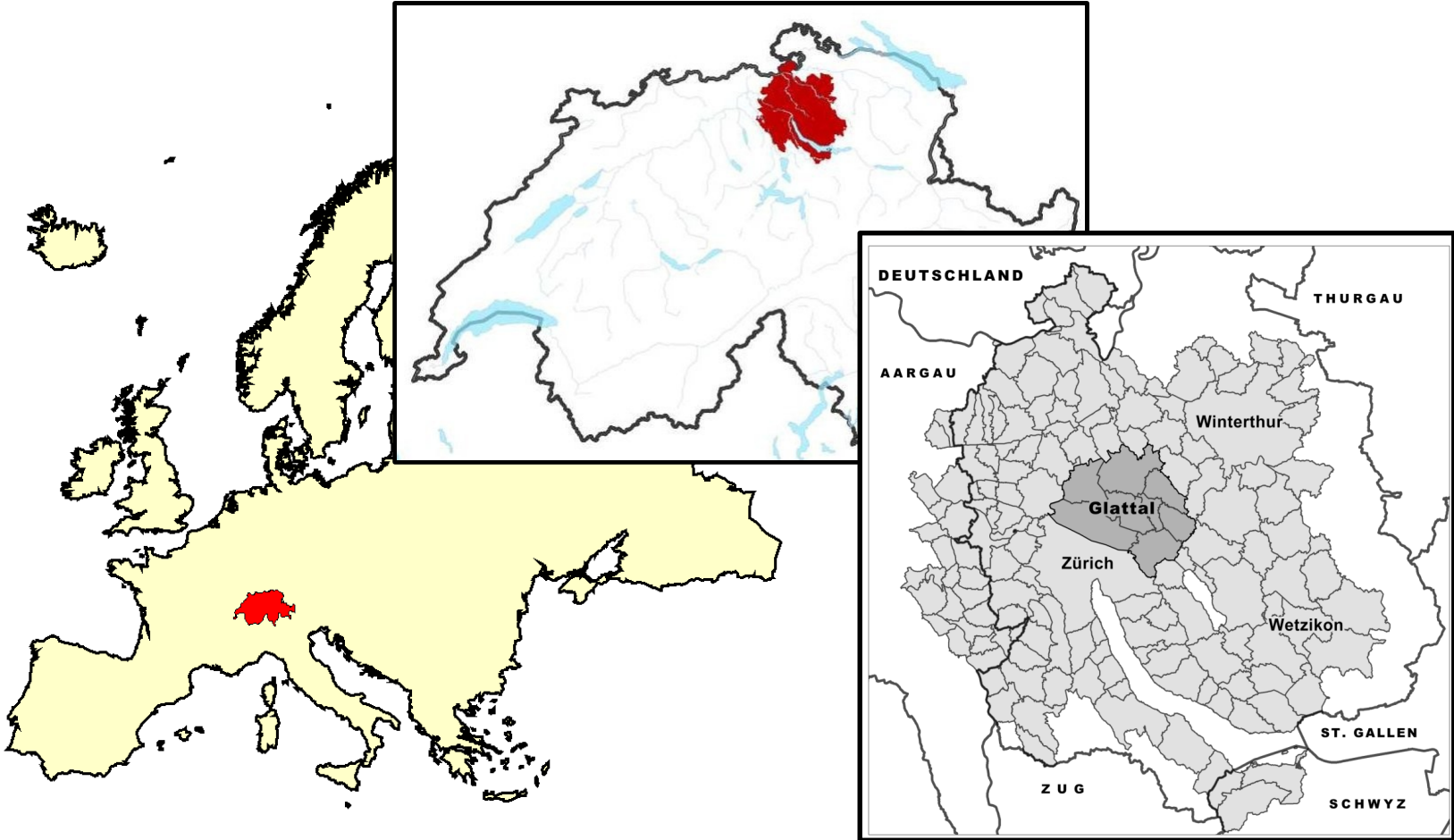Land price index
Maximum use & use regulations

Structure

Data needs & sources

Study area

Items and providers

Issue	Provider
Topographical maps	Swiss Topo
Digitial terrain model	Swiss Topo
Vector maps 1:25000	Swiss Topo
Census data by hectare	BfS
Census of work places by hectare	BfS
Building volumes, floor area	Cantonal fire insurance
Land use regulation	Canton Zürich

Items and providers

Issue	Provider
Public transport stops	ZVV
Road noise	Canton
Rail noise	IVT
Aircraft noise	Unique Airport
Road accessibilities	IVT (Cantonal model)
Public transport accessibilities	IVT (Cantonal model)

Models

Hedonic models for land values

Probability to move (households, firms)

Residential location choice
Employment location choice

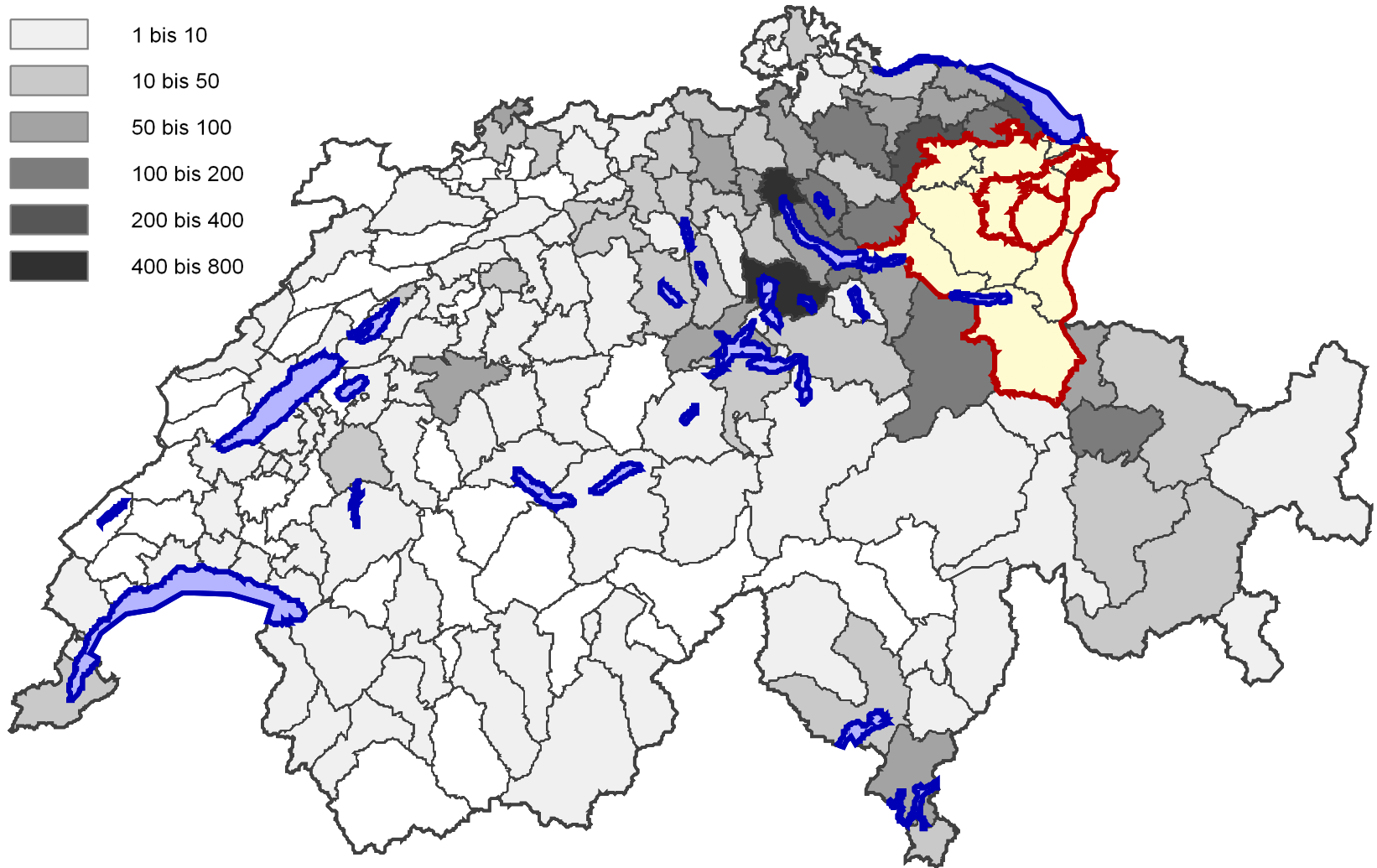Development decision choice

Firmographics

Data

Sources:

- Official business register
- Census of places of employment

Area:

- St. Gallen
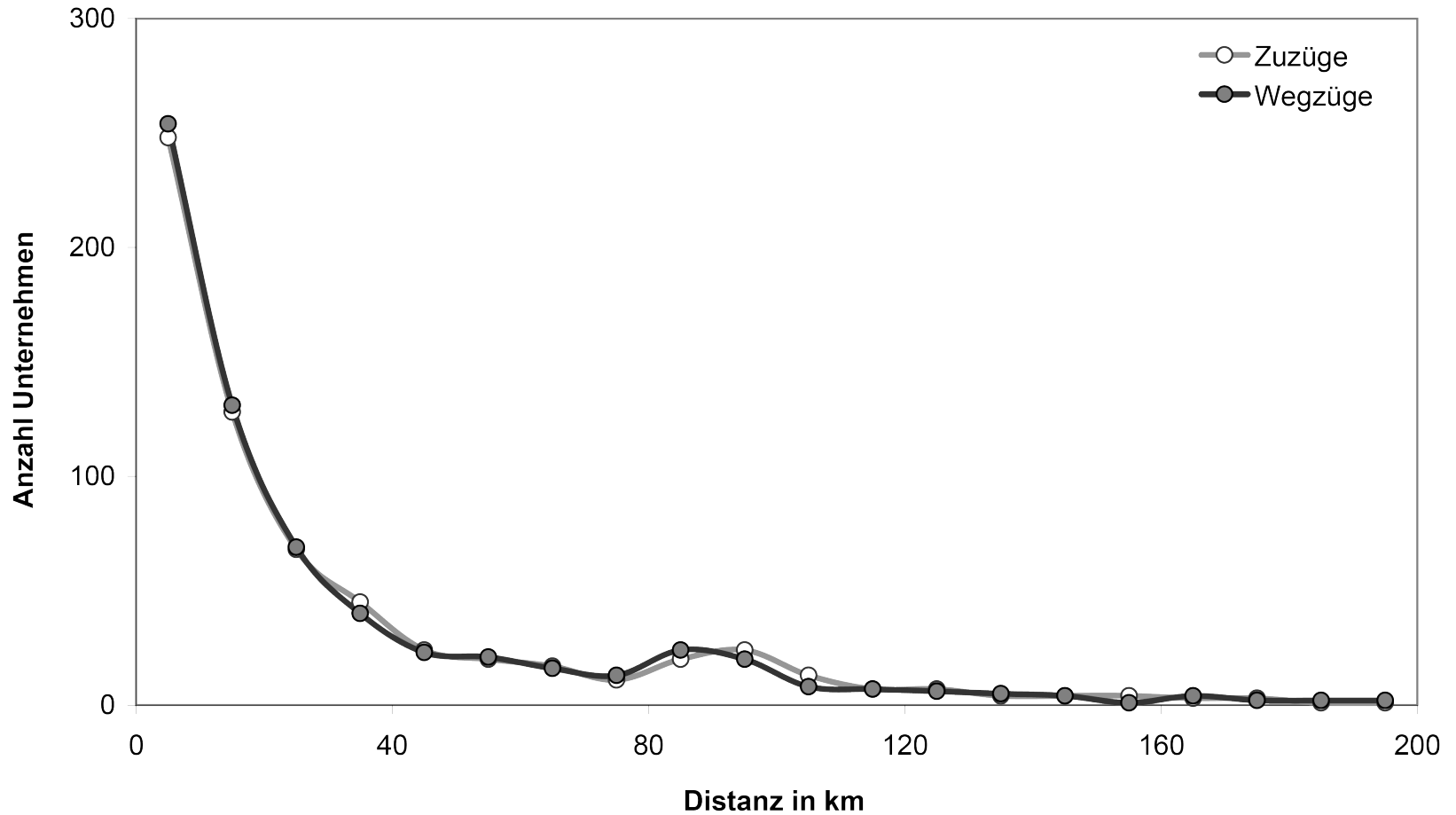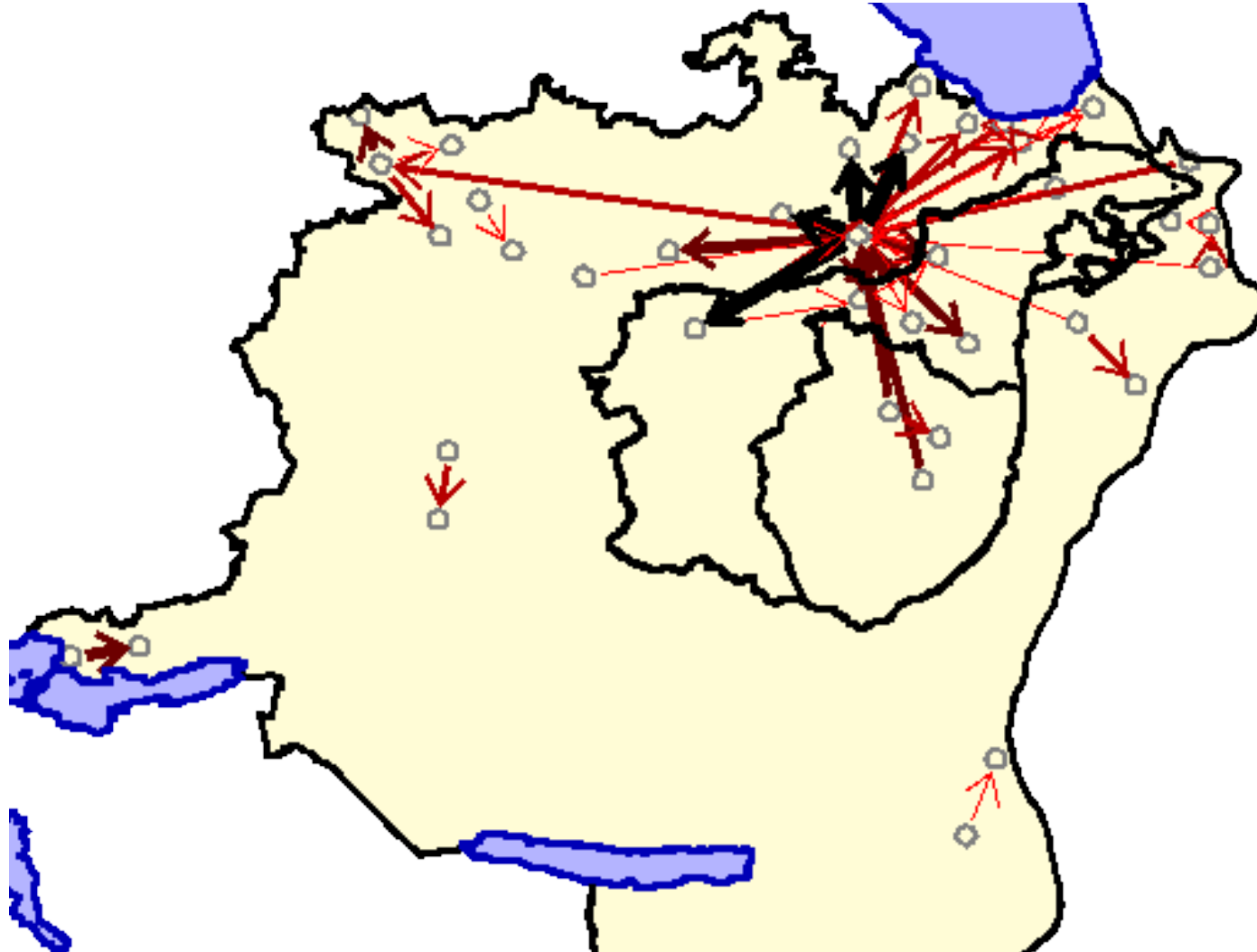- Appenzell

Distribution of the moves

Legend:
- 1 bis 10
- 10 bis 50
- 50 bis 100
- 100 bis 200
- 200 bis 400
- 400 bis 800

Distance distribution of the moves

Pattern of the moves

Annual chance of moving (within/without the municipality)

Anteil der Unternehmen mit Sitzverlegung (pro Jahr) vs **Alter**

Legend:
- Sitzverlegungen innerhalb der Gemeinde
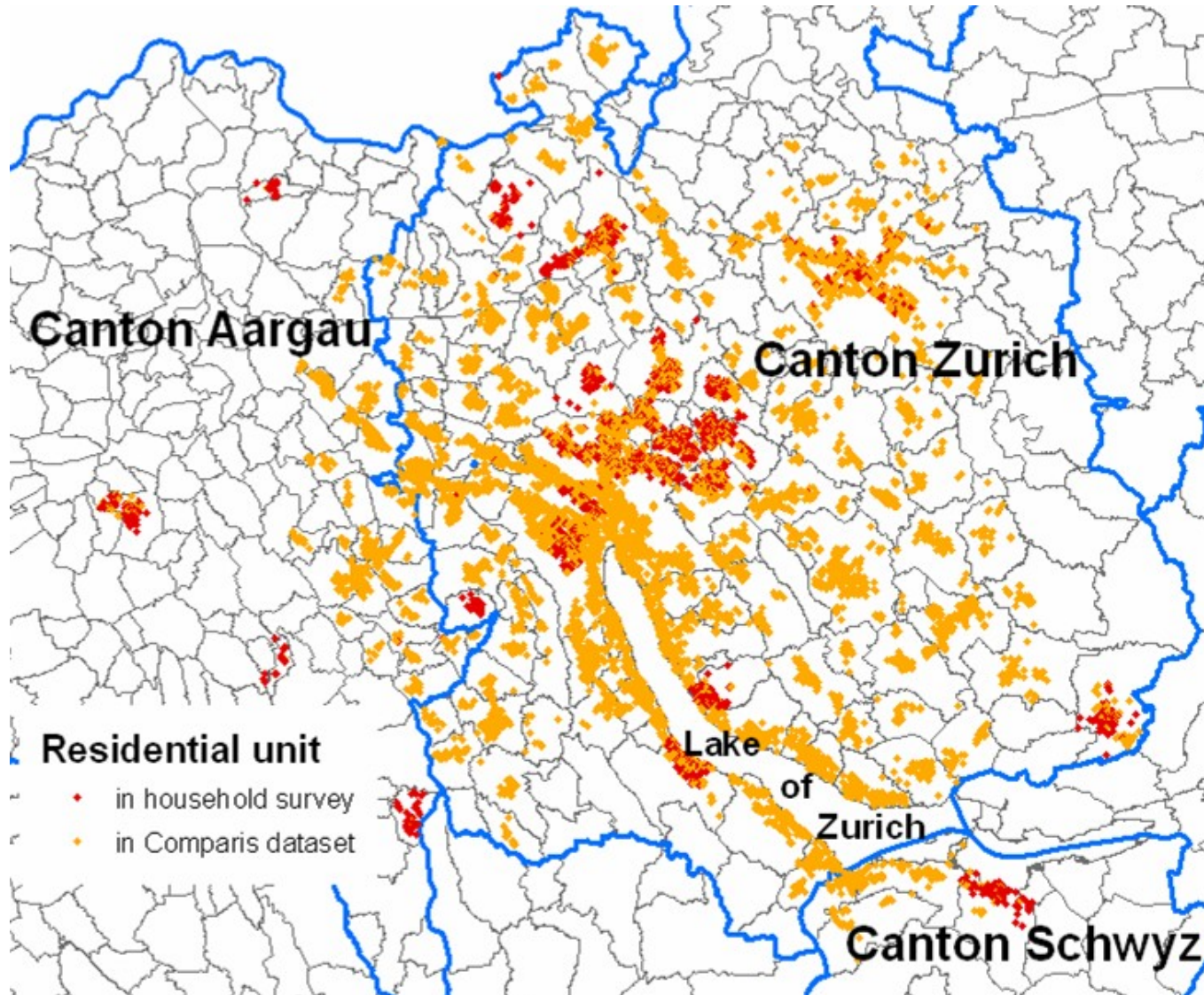- Sitzverlegungen über Gemeindegrenze hinaus
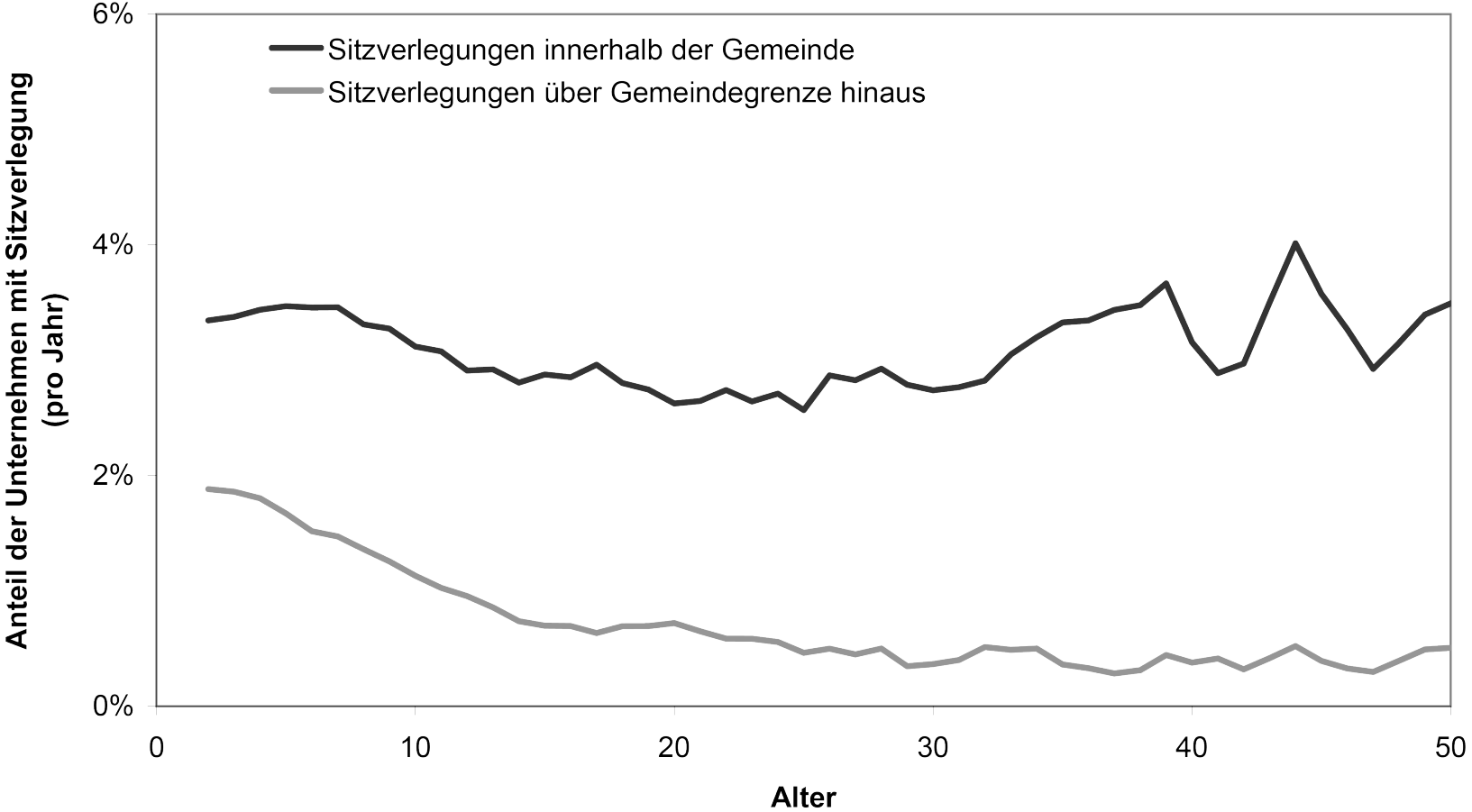
Residential location choice and hedonic model

Data sources

Comparison of the two data sets

	Household survey data (N=1488)			Comparis data (N=9764)		
	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.
Rent abs. (CHF)	1426.92	1375.00	563.11	1857.19	1667.00	901.81
Rent per sqm (CHF)	16.73	16.50	4.97	20.56	19.34	5.68
Floor space in sqm	88.84	85.00	34.52	92.54	90.00	37.53
Number of livable rooms	3.48	3.50	1.13	3.68	3.50	1.23

GIS enrichment of the geocoded objects (1)

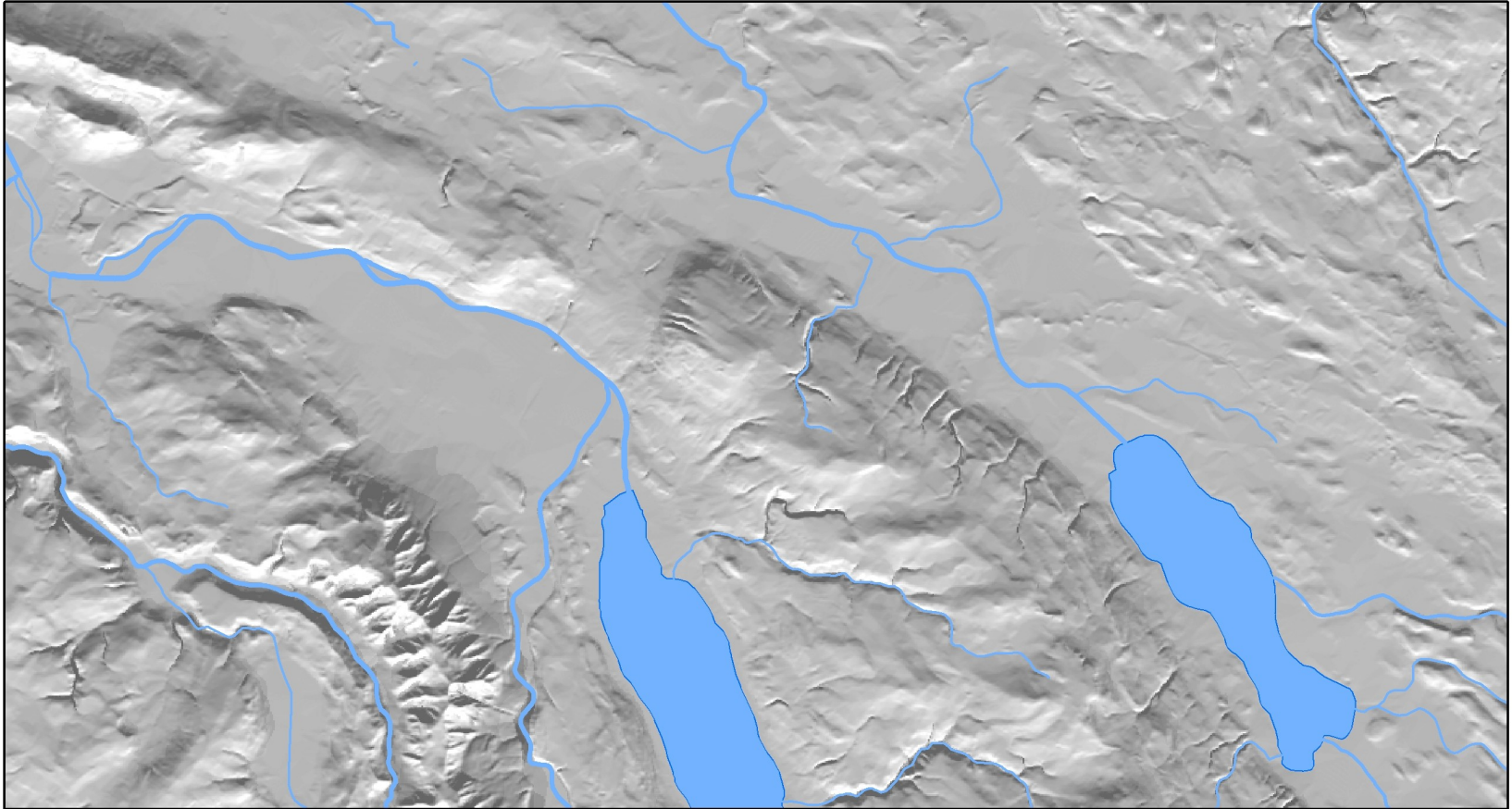**Total lake surface visibility in sqkm**

- 0
- 1 - 100
- 101 - 200
- 201 - 400
- 401 - 1000
- Lake
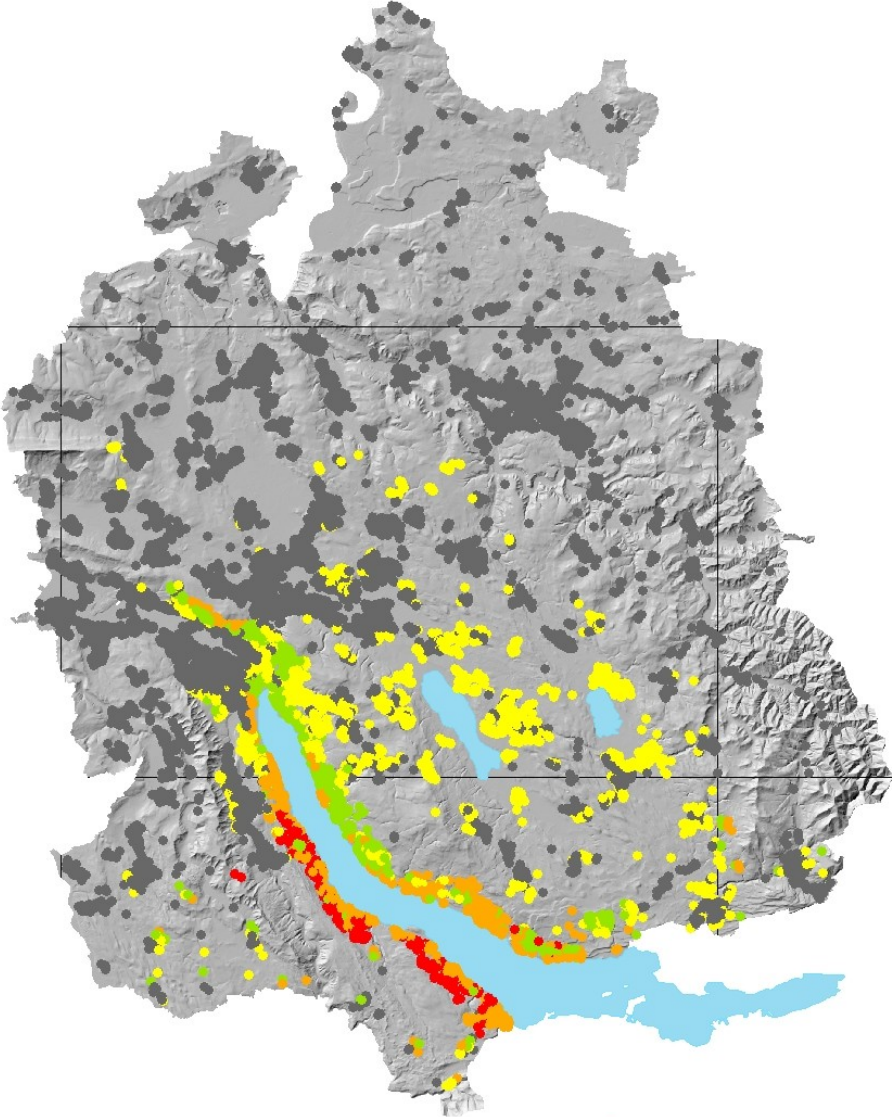
GIS enrichment of the geocoded objects (2)
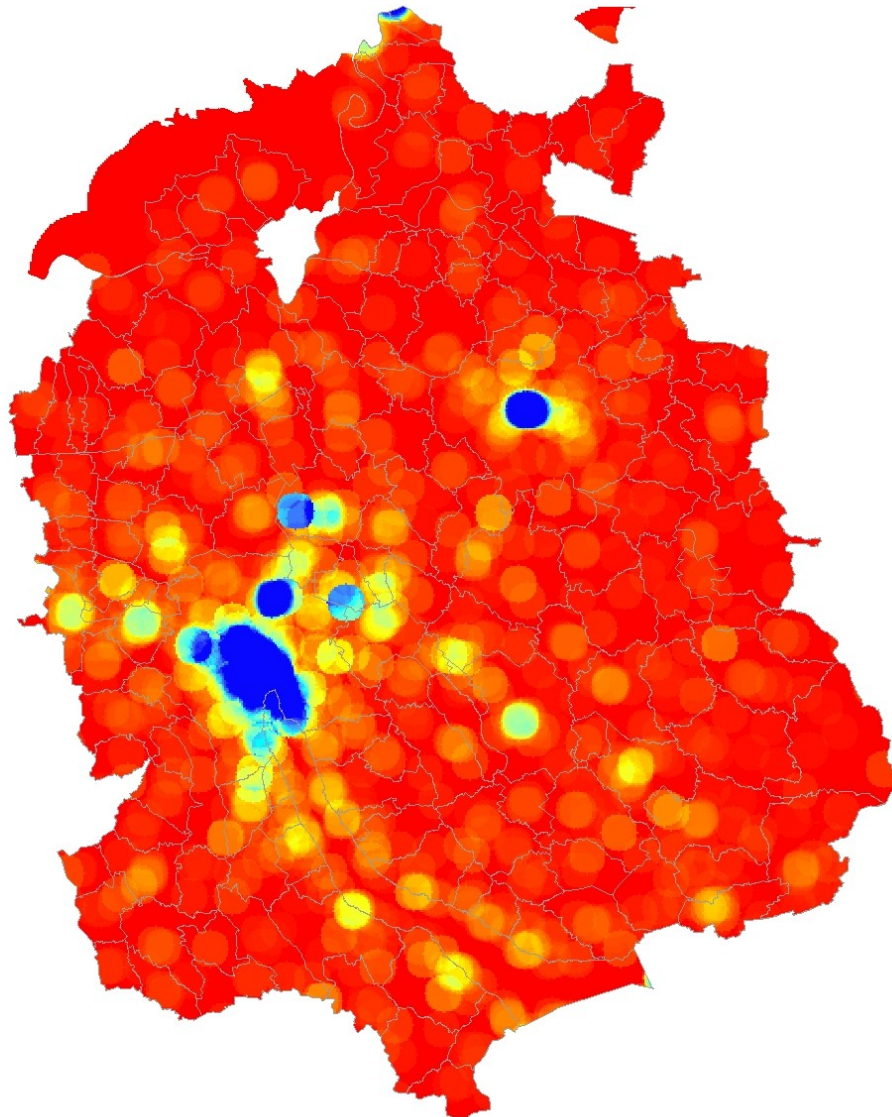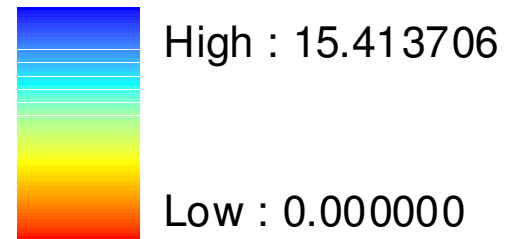

Sunshine Index: Shade and shadow situation for 9 typical sun
positions (summer, spring, winter; morning, midday, evening)

Density of employment in restaurants, bars and cafes (1 km)
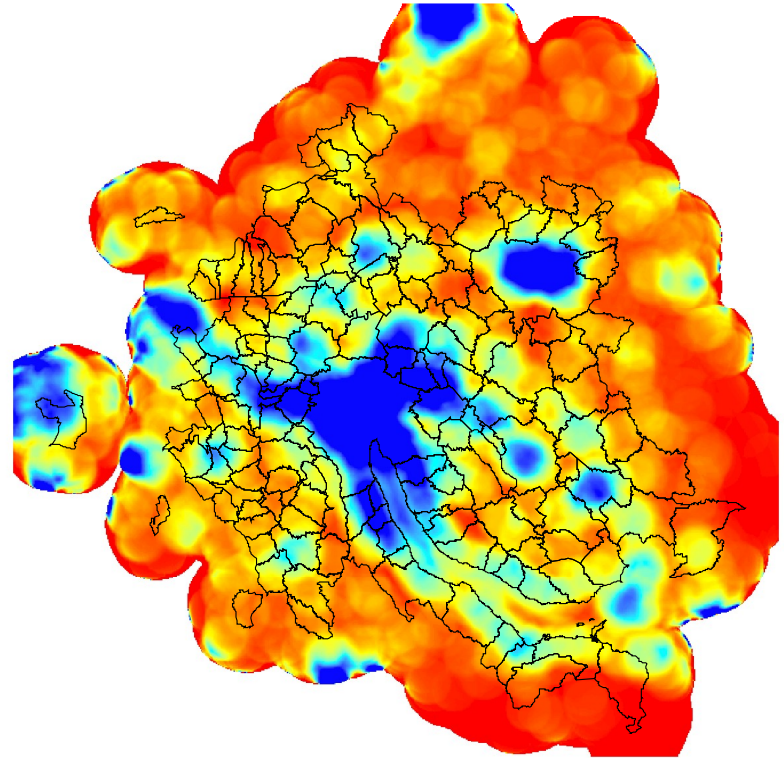
High : 15.413706

Low : 0.000000

GIS enrichment of the geocoded objects (4)
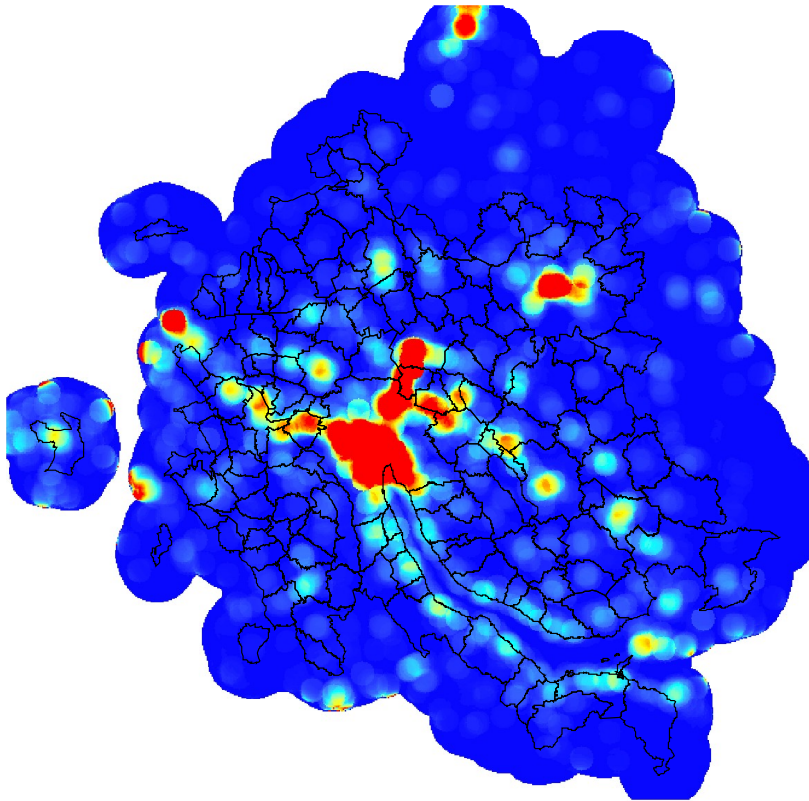
Employment density (1km radius)   Open space density (2 km radius)

Location choice versus hedonics (1)

Variable	m² - rents		Location choice	
	Standard-ized	Non-Standardized	Best model	Urban-Sim
Constant		27,327[***]		
Accessibility				
Ln (car travel time to Zürich CBD)	-0,349[***]	-5,580[***]	0,018[***]	-3,335[***]
Ln (transit accessibility) for non-car owners			0,570[***]	0,600[***]
Distance to work [km]			-5,459[***]	
Power of distance to work			0,167[***]	
Ln (Distance to next motorway ramp [km])	0,080[***]	0,581[***]		0,119[**]
Ln (Distance to next station [km])	-0,033[***]	-0,242[***]		-0,115[***]
Railway line within 50m	-0,027[***]	-0,878[***]		-0,933[***]
Motorway within 100m	-0,017[**]	-0,702[**]		-0,400[*]
Increased noise level			-0,236[***]	

Location choice versus hedonics (2)

Variable	m² - rents Standardized	Non-Standardized	Location choice Best model	Urban-Sim
Local socio-demographics				
Density of young households				0,006***
Household of same size within 1km			0,0004***	0,0001**
Jobs in hotels&restaurants within 1km [10^{-3}]	0,193***	1,289***		
Environment				
Ln (distance to next lake [km])	-0,101***	-0,447***		
Sunshine index	0,090***	0,081***		
Slope (%)	0,064***	0,111***		
Municipal socio-demographics				
Federal income tax take per head [10^{-3} CHF]	0,169***	0,977***	-0,026***	1,037***
Share of buildings built before 1971 (%)	0,146***	0,049***		0,041***
Share of empty units (%)			-0,224***	-0,110***

Location choice versus hedonics (3)

Variable	m² - rents		Location choice	
	Standard-ized	Non-Standardized	Best model	Urban-Sim
Share of empty units (%)			-0,224***	-0,110***
Share of college graduates (%)				-3,073***
Household variables				
Ratio of rent to household income			-0,546**	
Rent per m² [CHF]				-0,600***
Size (m²)/ Squareroot of household size			-0,289***	
	n = 9199; adjusted R^2 = 0,454; F = 695,883		n = 877, rho^2=0,26	n = 1356 rho^2=0,08

Very latest hedonic results

Variable	Impact on rent price
Travel time to Zurich CBD by car	-
Income per capita in municipality	+
Viewshed of lake surface (only lakes larger 1sqkm considered)	+
Number of workers in bars and restaurants within 1 km radius	+
Average aircraft noise above 52dB (dummy)	-
Percentage of buildings built before 1971 in municipality	+
Next autobahn ramp within 2km crow-fly-distance distance (dummy)	-
Evening sunshine index	+
Number of inhabitants in hectare of property	-
Crow-fly distance to next rail station	-
Slope	+
Autobahn within 100m linear distance (dummy)	-
Rail line within 50m linear distance (dummy)	-
Power line within 200m linear distance (dummy)	-
Share of foreigners in hectare of property	-
Public transport accessibility (to employment)	+

Preliminary results
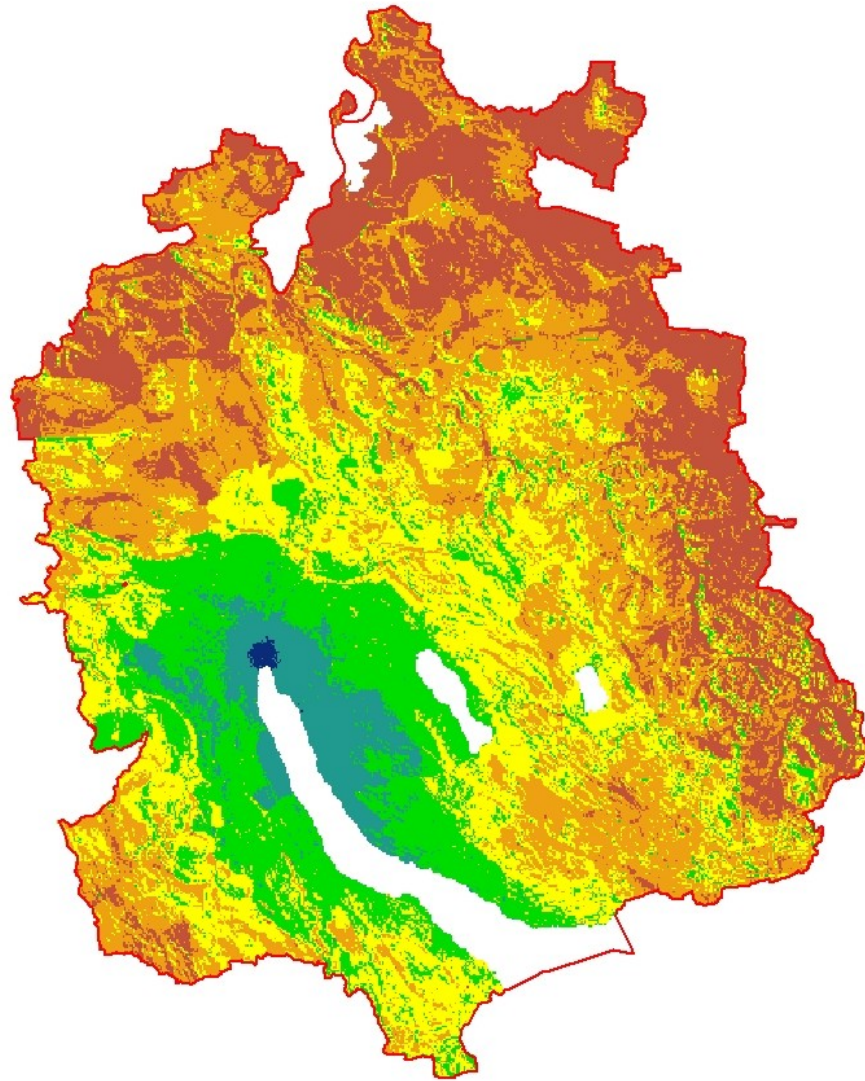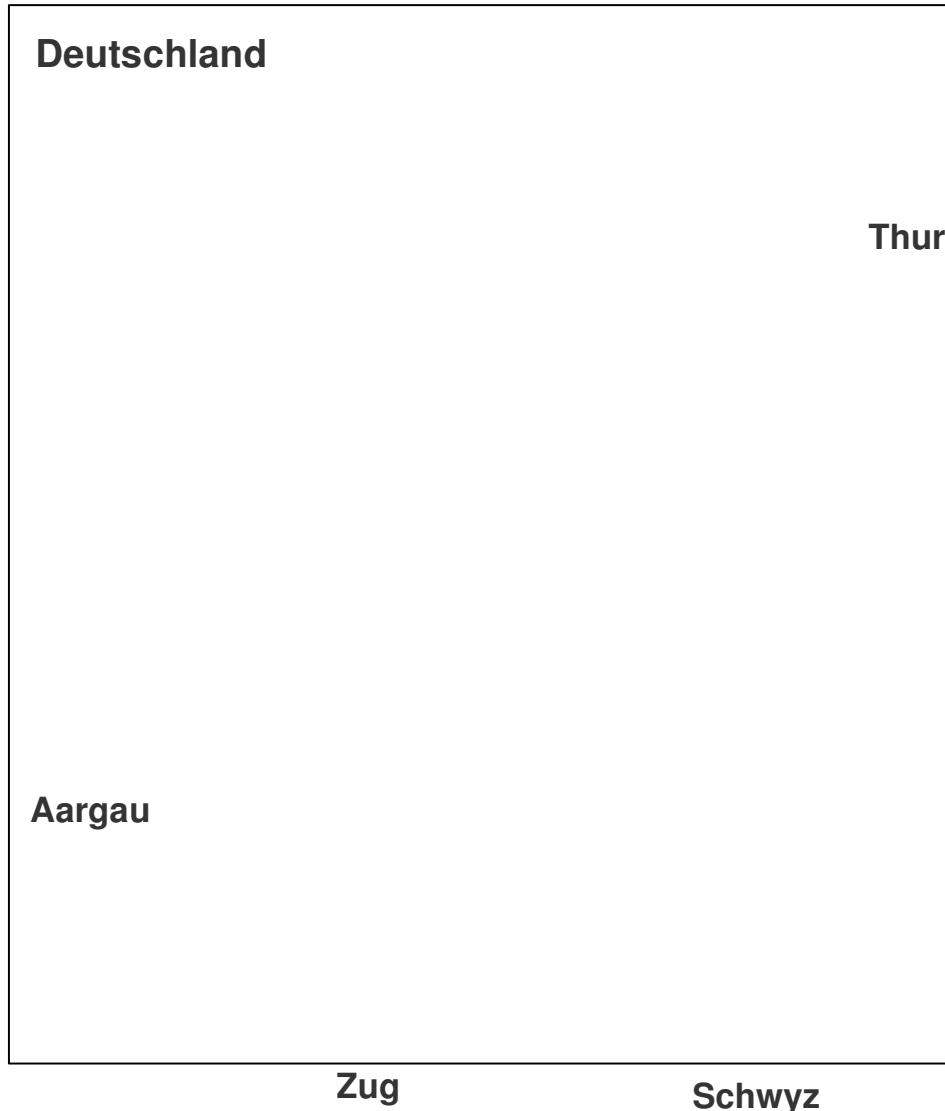

Monthly gross rent in CHF per sqm

- 12.01 - 16.00
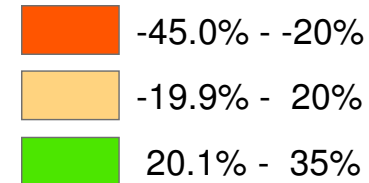- 16.01 - 18.00
- 18.01 - 20.00
- 20.01 - 25.00
- 25.01 - 35.00
- 35.01 - 45.00

First experiences

Running the model for four years (1996 – 2000)

Deutschland

Thurgau

Aargau

Zug

Schwyz

Deviation of households per municipality: Simulation 1996 to 2000 in comparison to Census 2000

🟧	-45.0% - -20%
🟨	-19.9% - 20%
🟩	20.1% - 35%

Administrative Units:
GG25 © 2007 swisstopo
(DV33492.2)

Next steps

Research

- Next generation of UrbanSim: OPUS

- Moving to a full agent approach (parcel, household)

- Coupling MATSIM/UrbanSim

- Adding supply-side agents to MATSIM-T

Application

- Full calibration

- Better integration of the transport model

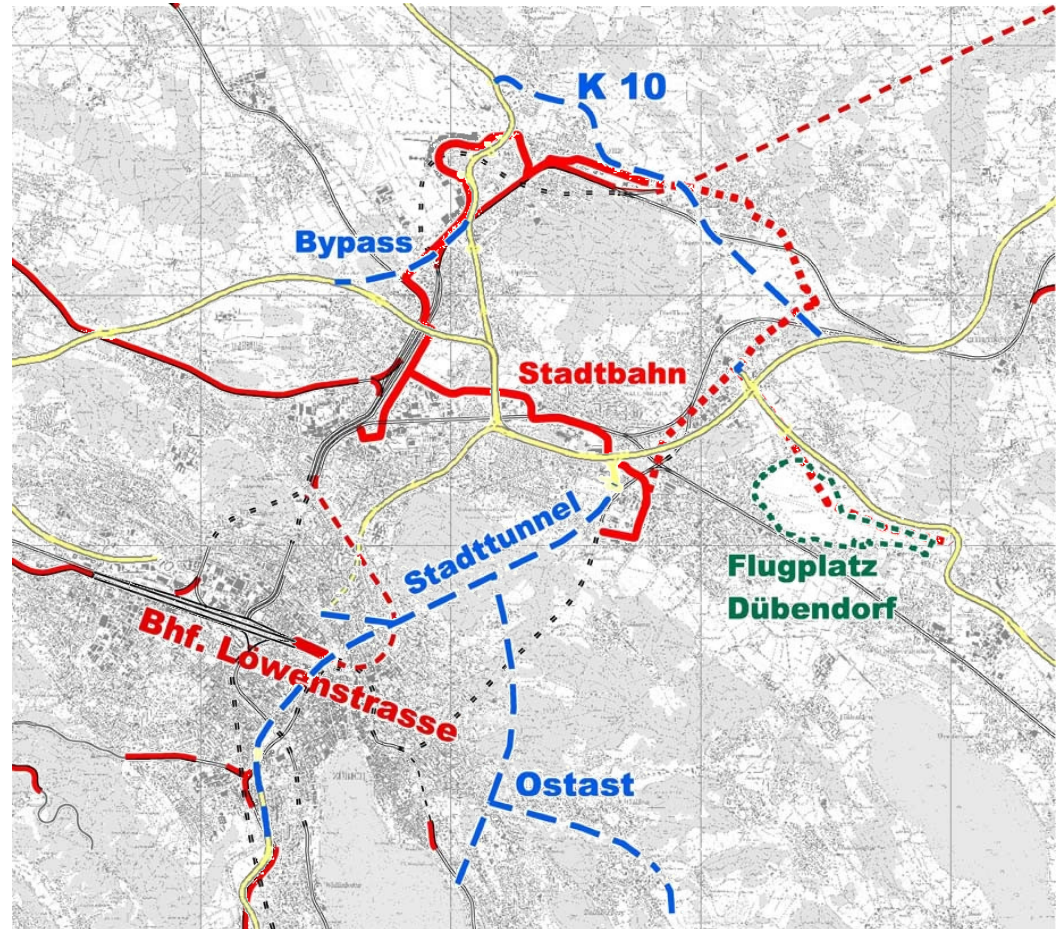- Policy analyses

Case studies

Light rail system Glattal

Underground rail station
Löwenstrasse

S-Bahn extension

Autobahn extensions

Future use of military
airport Dübendorf

Sources at

www.ivt.ethz.ch