Preferred citation style for this presentation

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Zöllig Renner, C.

K. Müller

Integrated Transport LandUse Simulation on the Canton of Zurich

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Integrated Transport LandUse Simulation
on the Canton of Zurich

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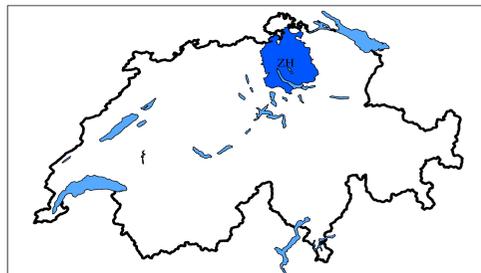Funded under Socio-economic Sciences & Humanities

Introduction – Simulation area and time period

Parcel level

Simulation start: 2000

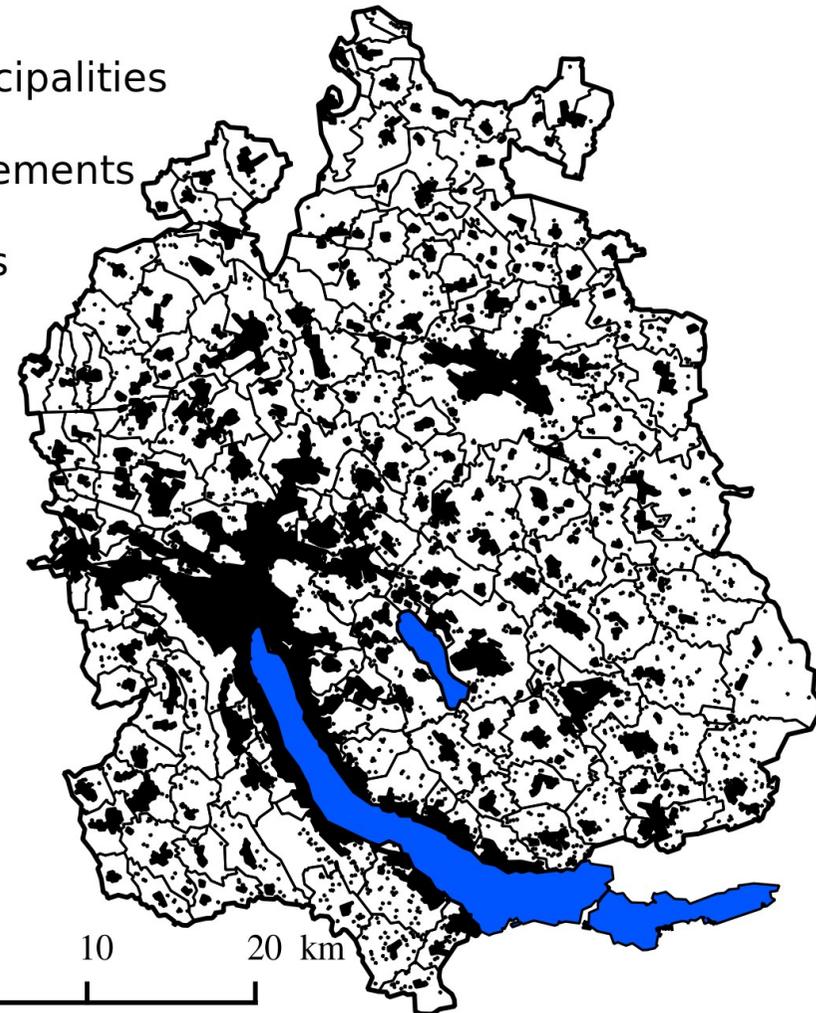Evaluation period: 2000-2010

(Simulation period: 2010-2030)

Municipalities

☐

Settlements

■

Lakes

■

0   10   20 km

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Introduction – City of Zürich

- 370.000 inhabitants in 2007
- 180 vacant apartments = 0.09% of stock (01.07.2007)
- 46'551 persons moved into the city
- 42'108 persons have changed their residence within the city
- 2'263 new dwellings have been built
- 40'437 persons moved out of the city, 3'480 persons died

=> almost ⅓ of the population has moved! Source: Thalmann (2010)
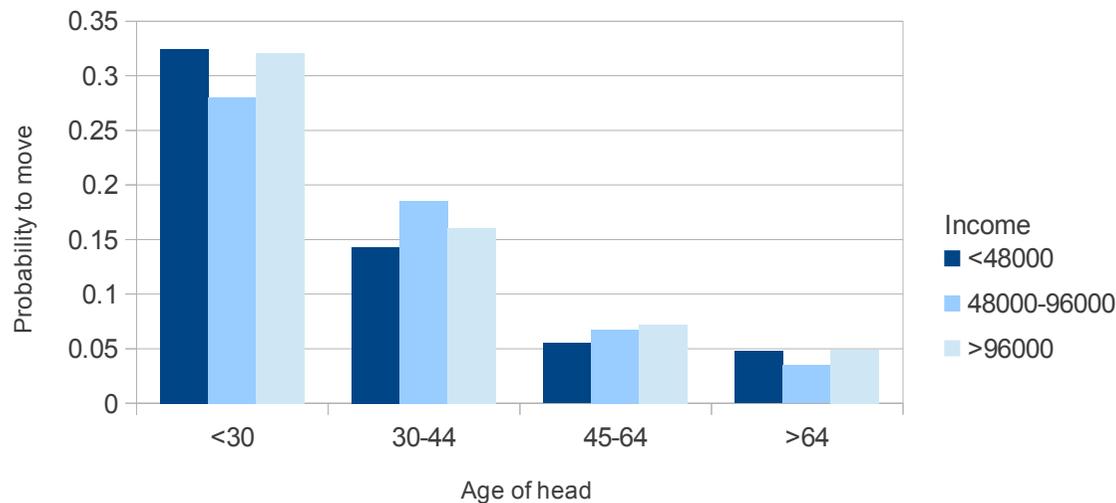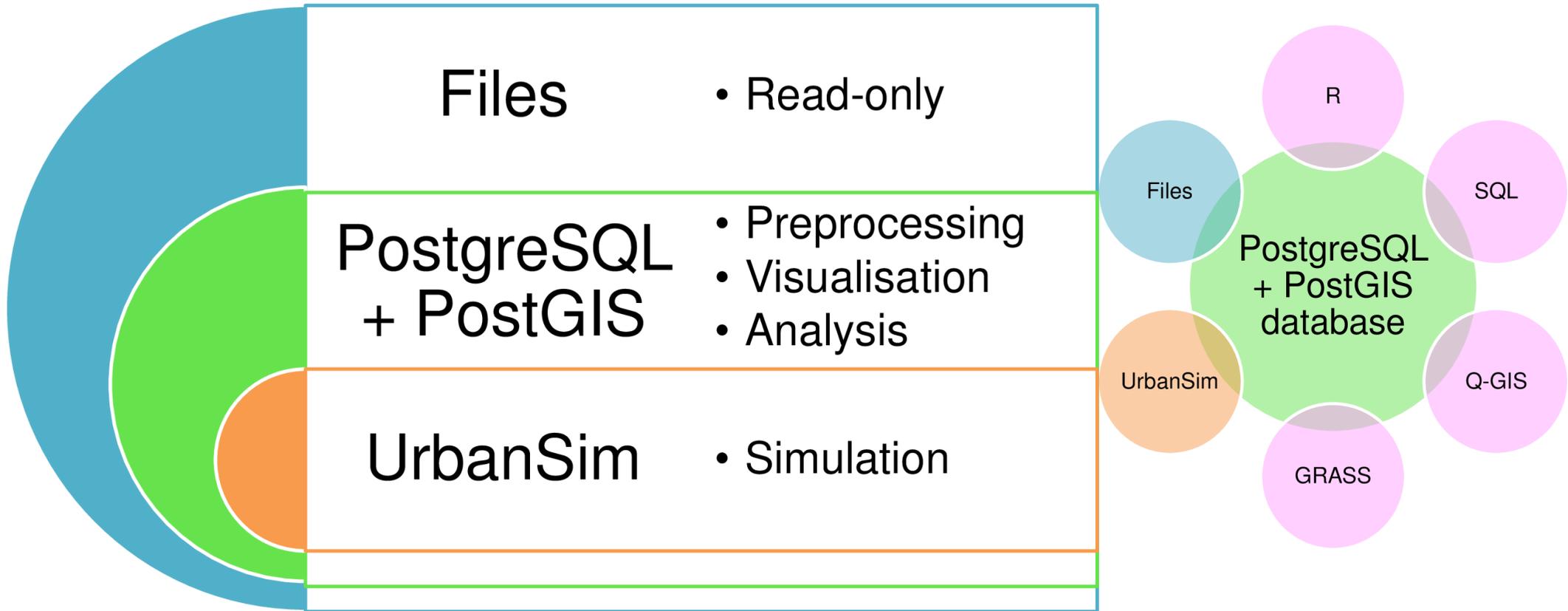
Introduction – Data model SustainCity
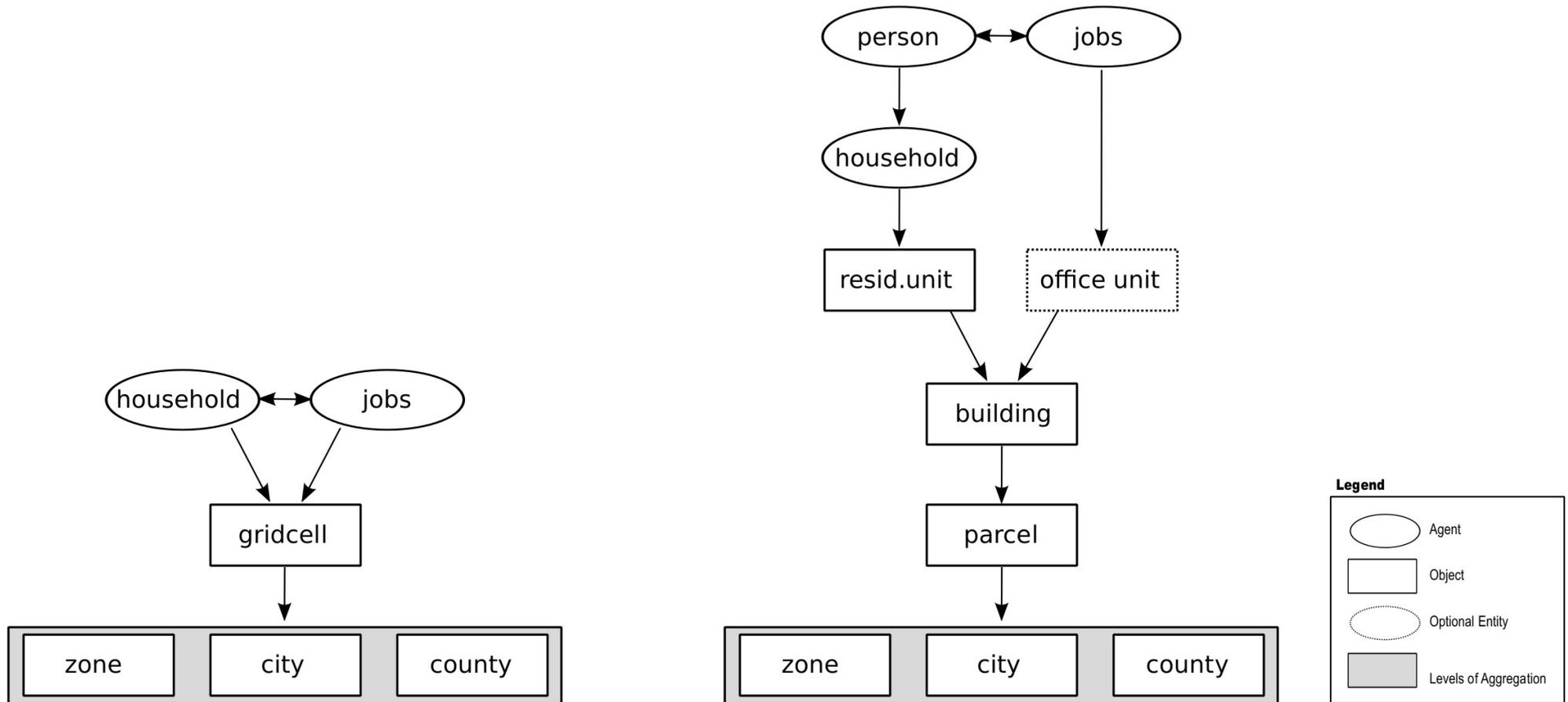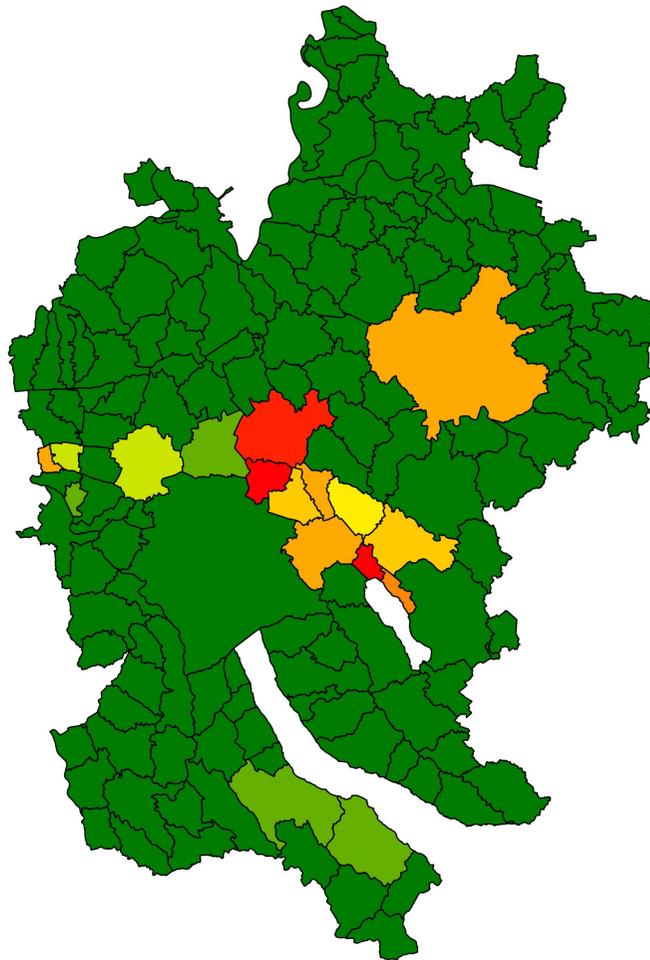
Data processing – spatial matching

🔴 **GWR/GVZ**

Housing units

Construction year

Value

…..

⬛ **Soil coverage zones (A**V)

surface information

buildings footprints

.....

⬜ **Parcel**

size

FAR covered

.....

🔲 **Land use zone**

planning constraints

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Data storage

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SustainCity Conference on
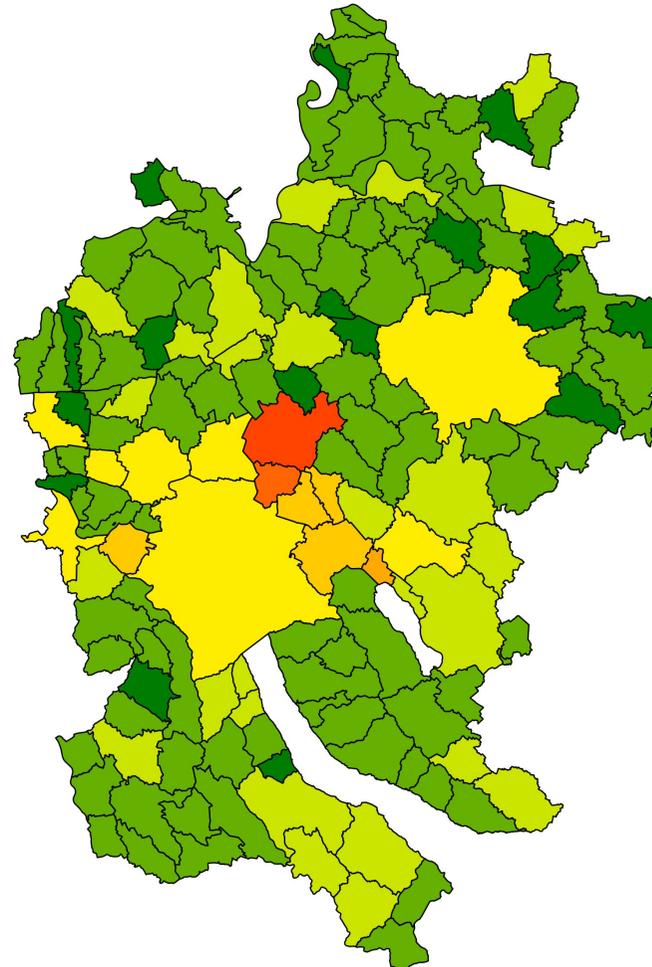Integrated Land-Use and Transport Simulation, 18.04.2013

7

Data processing – import quality

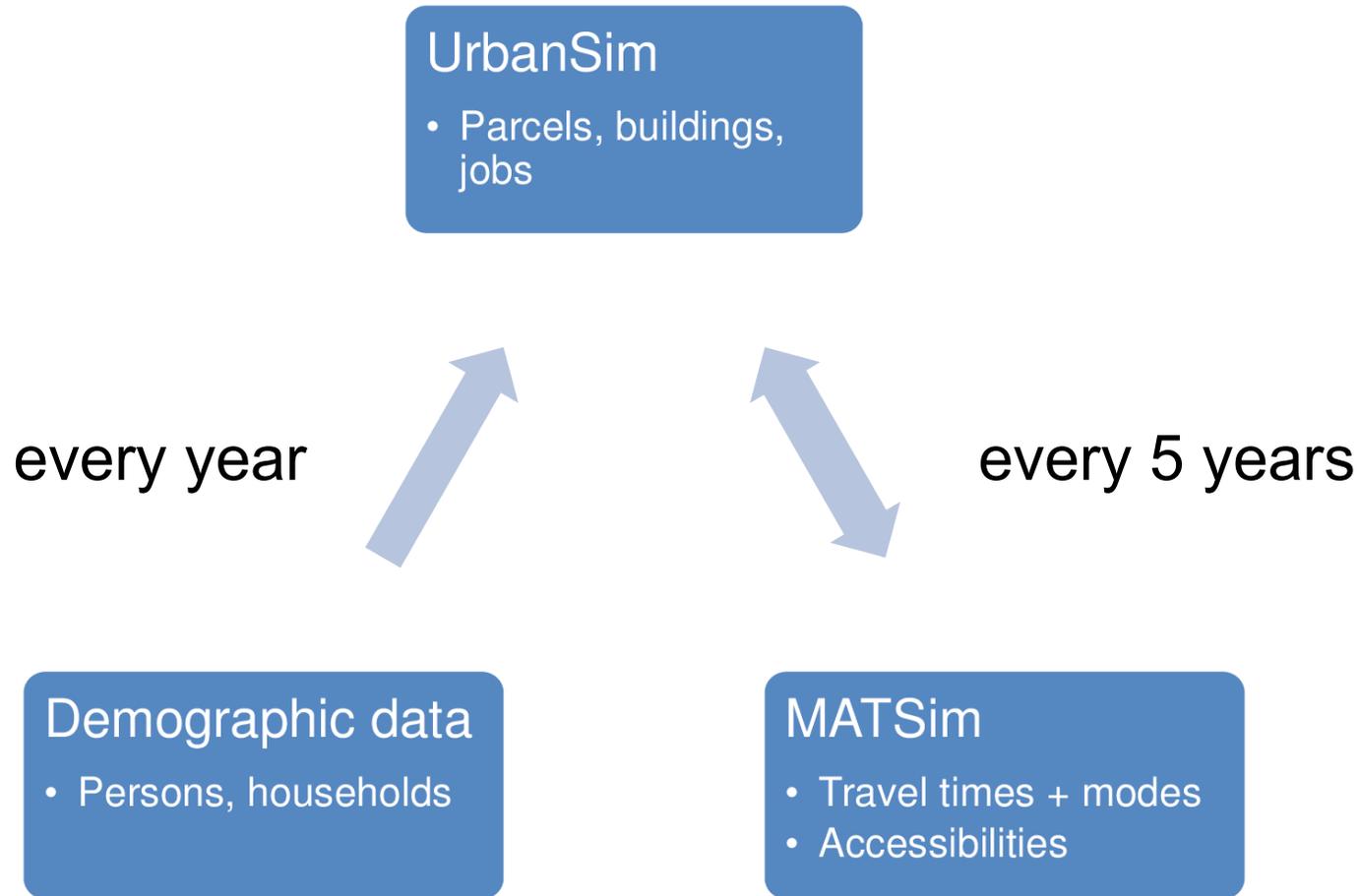Quality of matching jobs to buildings (%)

Quality of all data-processings (%)

Legend

quality

- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95
- 95 - 100

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General structure of the model system

UrbanSim
- Parcels, buildings, jobs

every year

every 5 years

Demographic data
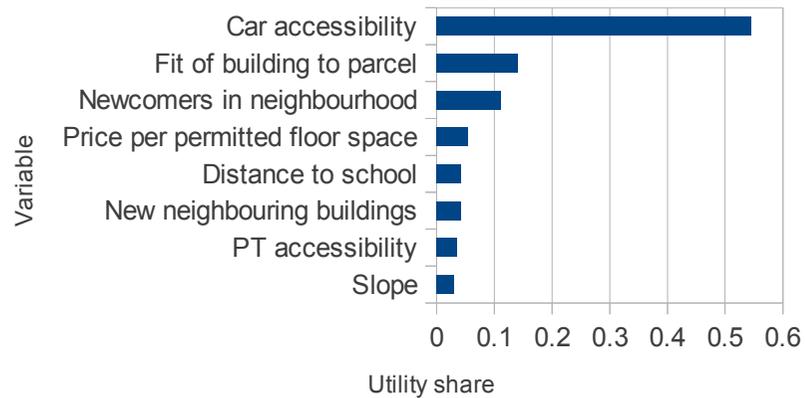- Persons, households

MATSim
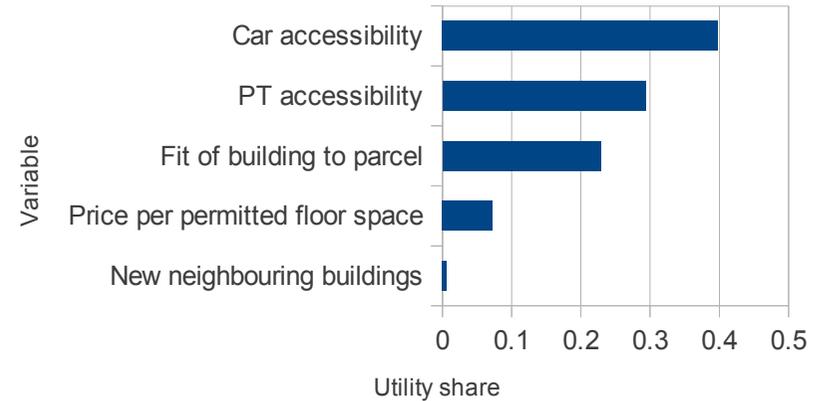- Travel times + modes
- Accessibilities
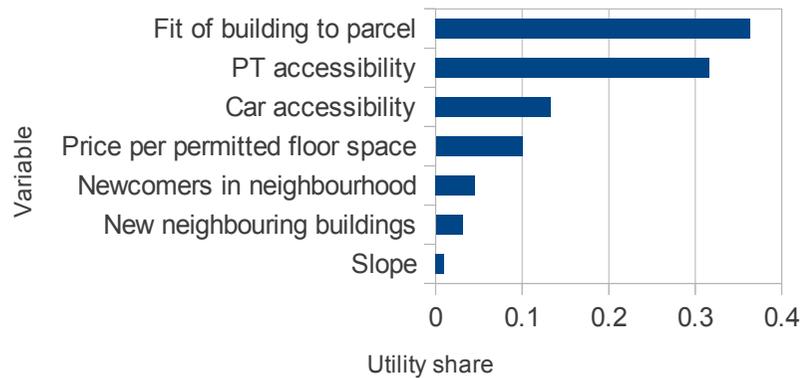
Run order of simulated models
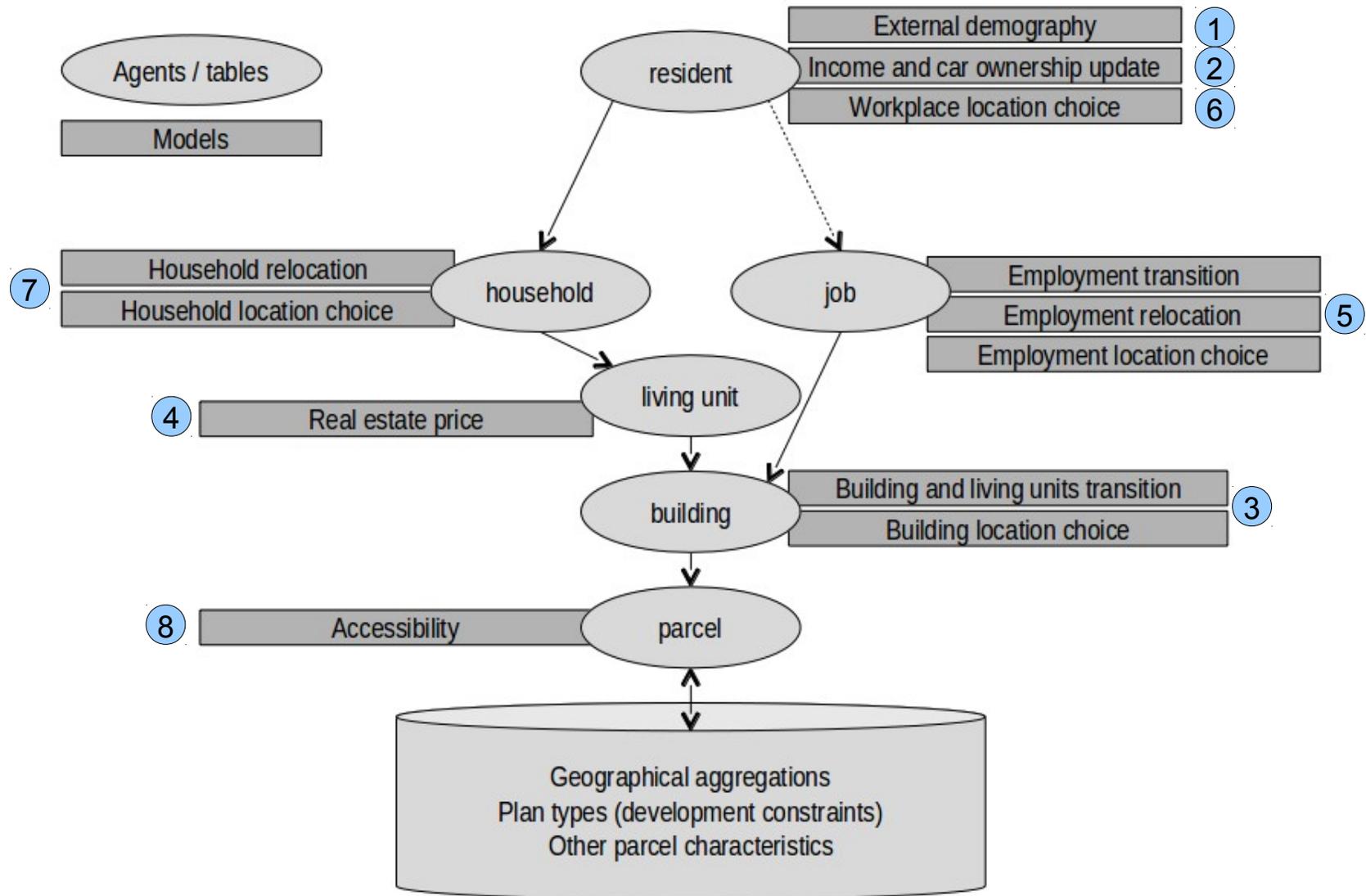
Models- Building Location

Single Family Housing

Mixed Use
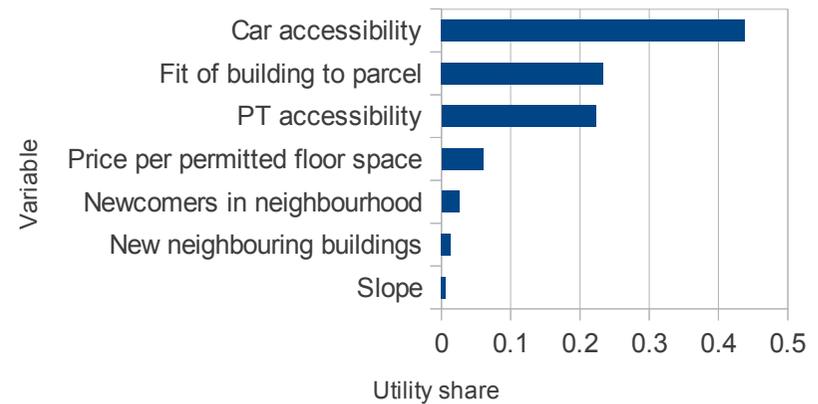
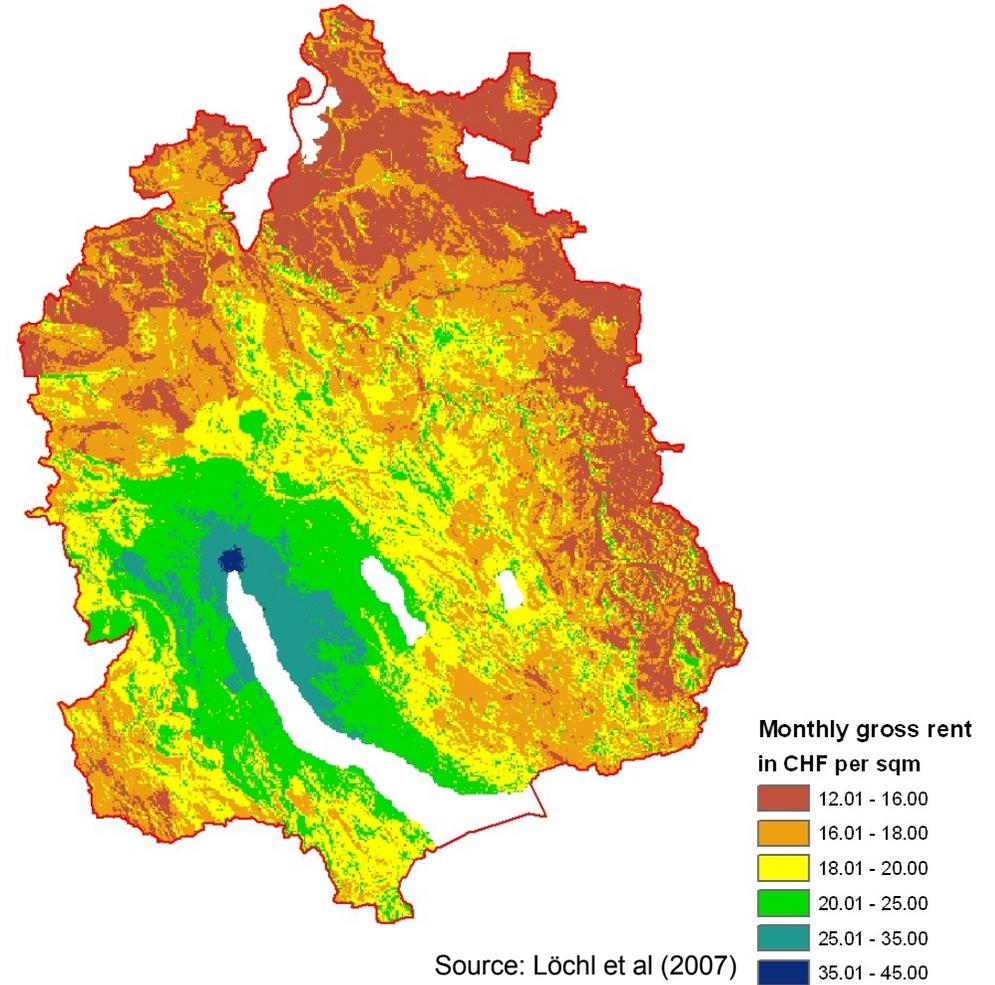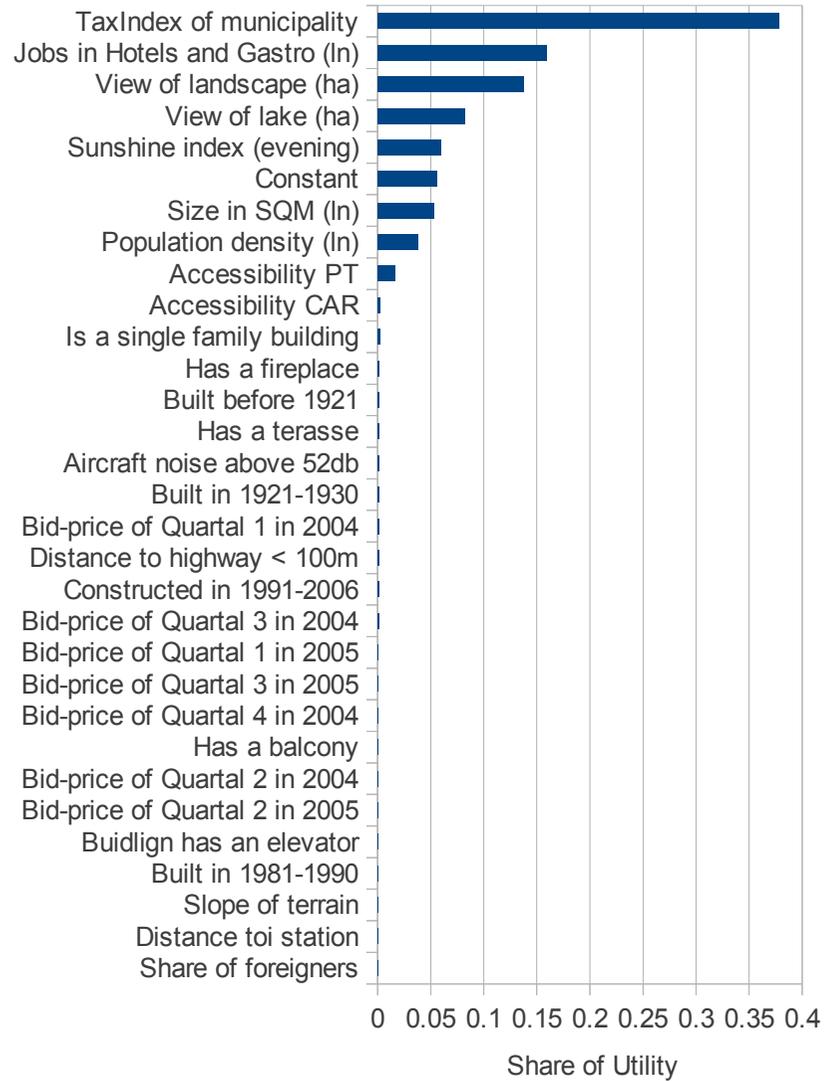Multiple Family Housing

Non-Residential

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Models – Real estate price

Bar chart — "Share of Utility" (horizontal axis from 0 to 0.4):

- TaxIndex of municipality
- Jobs in Hotels and Gastro (ln)
- View of landscape (ha)
- View of lake (ha)
- Sunshine index (evening)
- Constant
- Size in SQM (ln)
- Population density (ln)
- Accessibility PT
- Accessibility CAR
- Is a single family building
- Has a fireplace
- Built before 1921
- Has a terasse
- Aircraft noise above 52db
- Built in 1921-1930
- Bid-price of Quartal 1 in 2004
- Distance to highway < 100m
- Constructed in 1991-2006
- Bid-price of Quartal 3 in 2004
- Bid-price of Quartal 1 in 2005
- Bid-price of Quartal 3 in 2005
- Bid-price of Quartal 4 in 2004
- Has a balcony
- Bid-price of Quartal 2 in 2004
- Bid-price of Quartal 2 in 2005
- Buidlign has an elevator
- Built in 1981-1990
- Slope of terrain
- Distance toi station
- Share of foreigners

Share of Utility

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

Source: Löchl et al (2007)

Models – Real estate price

	UrbanSim		Löchl (2007)	
	Effect	Sign.	Effect	Sign.
Constant	+	**	+	**
Car accessibility	+	**	n.a.	n.a.
PT accessibility	+	**	+	**
Built in 1921 to 1930	+	**	+	**
Built in 1981 to 1990	+		+	**
Built after 1991	+	**	+	**
Built before 1921	+	**	+	**
Distance to station	-	**	-	**
Proximity to highway (< 100 m)	-	**	-	**
Is a single family house	+	**	+	**
Jobs in hotels and gastronomy	+	**	+	**
View of lake (ha)	+	**	+	**
Population density (ln)	-	**	-	**
Size in m² (ln)	+	**	+	**
Slope of terrain	+	**	+	**
Sunshine index (evening)	+	**	+	**
Foreigners within 300 m	+	**	(-)	(**)
Adj. Likelihood ratio index:	0.78173		0.85	
Number of observations:	6497		8592	

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Models – Employment location choice

Type	1	2	3	4	5	6	7	8
Average zonal income	– **	– **	– **	– **	– **	– **	– **	– **
Car accessibility	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
PT accessibility	+ **	+ **	+ **	+ **	+	+	+ **	+
Distance to motorway access	– **	– **	– **	– *	+	– **	+ **	+ **
Distance to station	– **	– **	– **	– **	– **	– **	– **	– **
Distance to Zürich CBD	+ **	+	+ **	+ **	+	+ **	–	– **
Household density (km²)	– **	– **	– **	– **	– **	– **	– **	– **
Job density (km²)	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
Share of same jobs (zone)	+ **	+ **	+ **	+ **	+ **	+ **	+ **	+ **
Adj. likelihood ratio index:	0.17	0.11	0.23	0.18	0.13	0.26	0.21	0.17
Number of observations:	15714	9187	11895	10143	7038	14390	33170	12382

Type 1 = Manufacturing (NOGA-code C - E)
Type 2 = Construction (NOGA-code F)
Type 3 = Wholesale Trade (NOGA-code G 45, G46)
Type 4 = Retail Trade (NOGA G47)
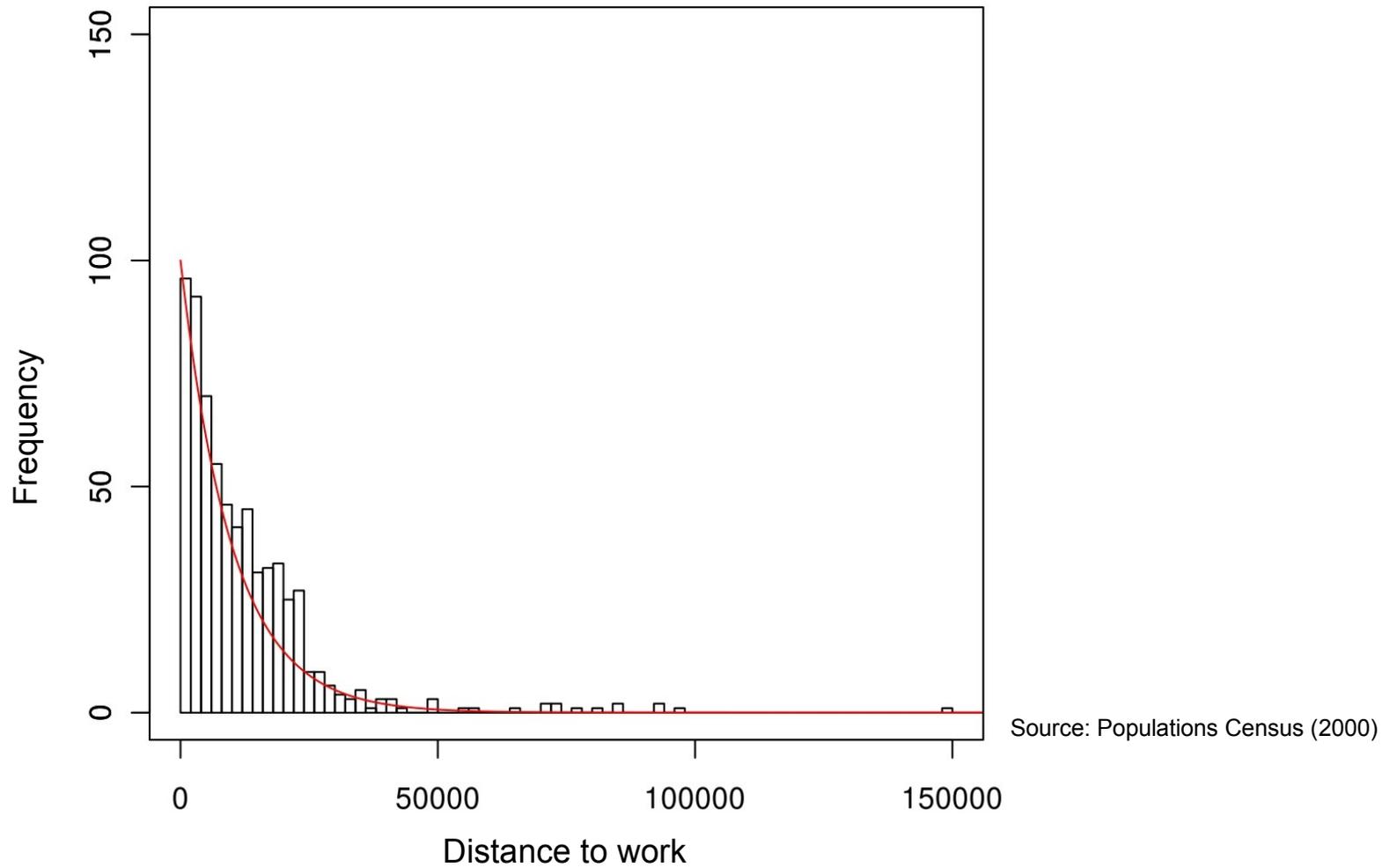
Type 5 = Hotel & Gastronomie (NOGA-code I)
Type 6 = Transport & Communication (NOGA-code J)
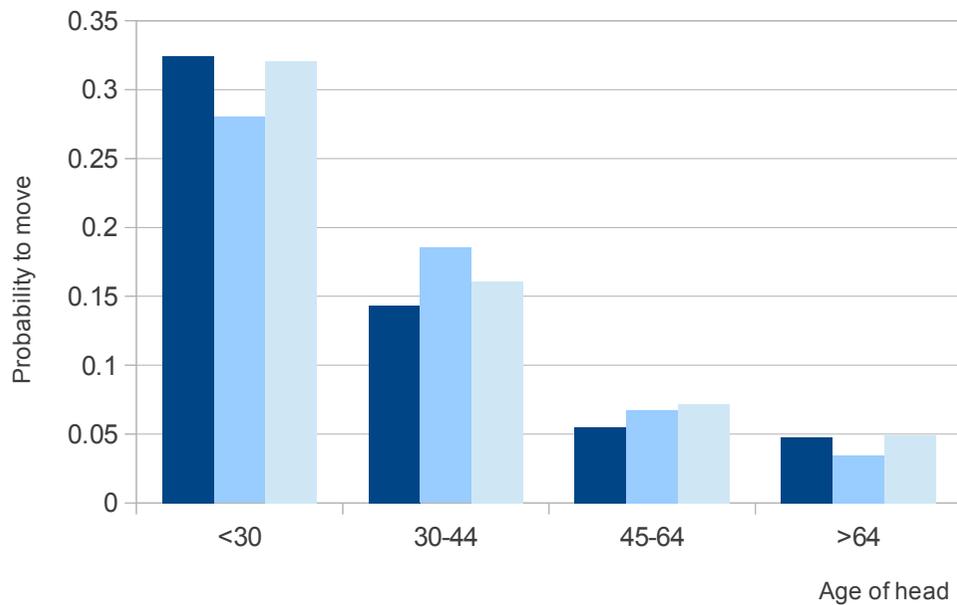Type 7 = Service & Finance (NOGA-code K - N)
Type 8 = Health (NOGA-code Q)

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Models – Workplace location choice

Source: Populations Census (2000)

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Models – Household transition and relocation

Relocation probability

Probability to move

| Age of head | <30 | 30-44 | 45-64 | >64 |

Income
- <48000 (dark blue)
- 48000-96000 (medium blue)
- >96000 (light blue)

Source: Beige (2005)

Reason to move

- Other reason
- Change in relationship-status
- Buying residential property
- Quality of residence/environment
- Job
- Family
- No reason given

Number of households

Survey: Belart (2010)

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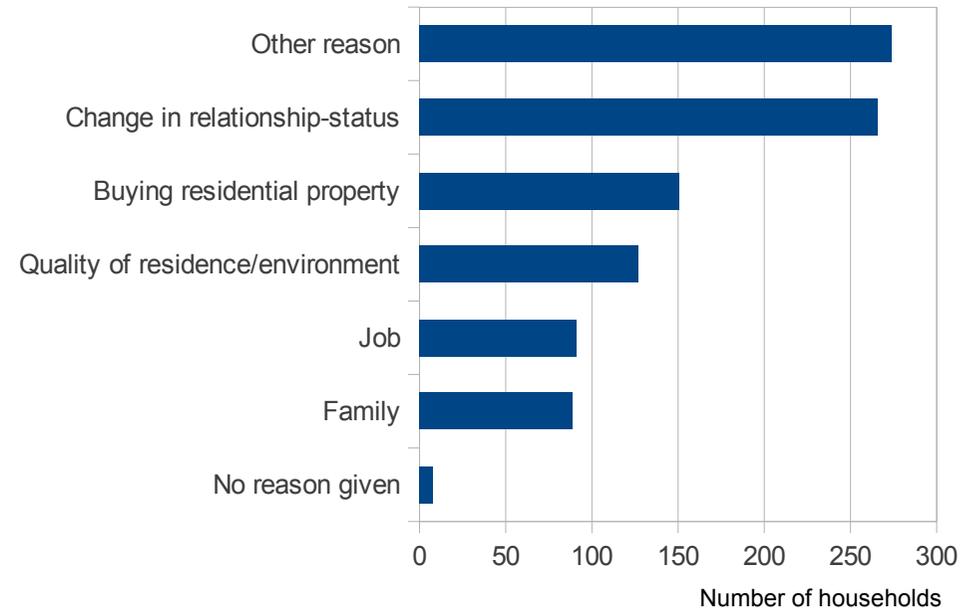
Models – Household location choice

	Effect	Sign.		Effect	Sign.
Building age	+	**	Proximity to main road and railway (noise)	-	*
Building is new build (dummy)	+	**			
Share of rent to income	-	**			
Rooms per person	-	**	Distance to Zurich CBD	+	**
Space per room (m²)	+	**	Distance to motorway on-ramp (car owners)	-	*
Distance to previous location (beta *dist ^eta)	-	**	Distance to station (car non-owners)	-	
Distance to workplace (beta *dist ^eta)	-	**	Denisty of retail jobs	-	**
			Distance to school	+	**
			Density of service jobs	-	**
Car accessibility	-	**	Share of households in same age	+	**
PT accessibility	+	**			

Adj. likelihood ratio index	0.522
Number of observations	1065

Schirmer, van Eggermond and Axhausen (2013)

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Models – Household location choice
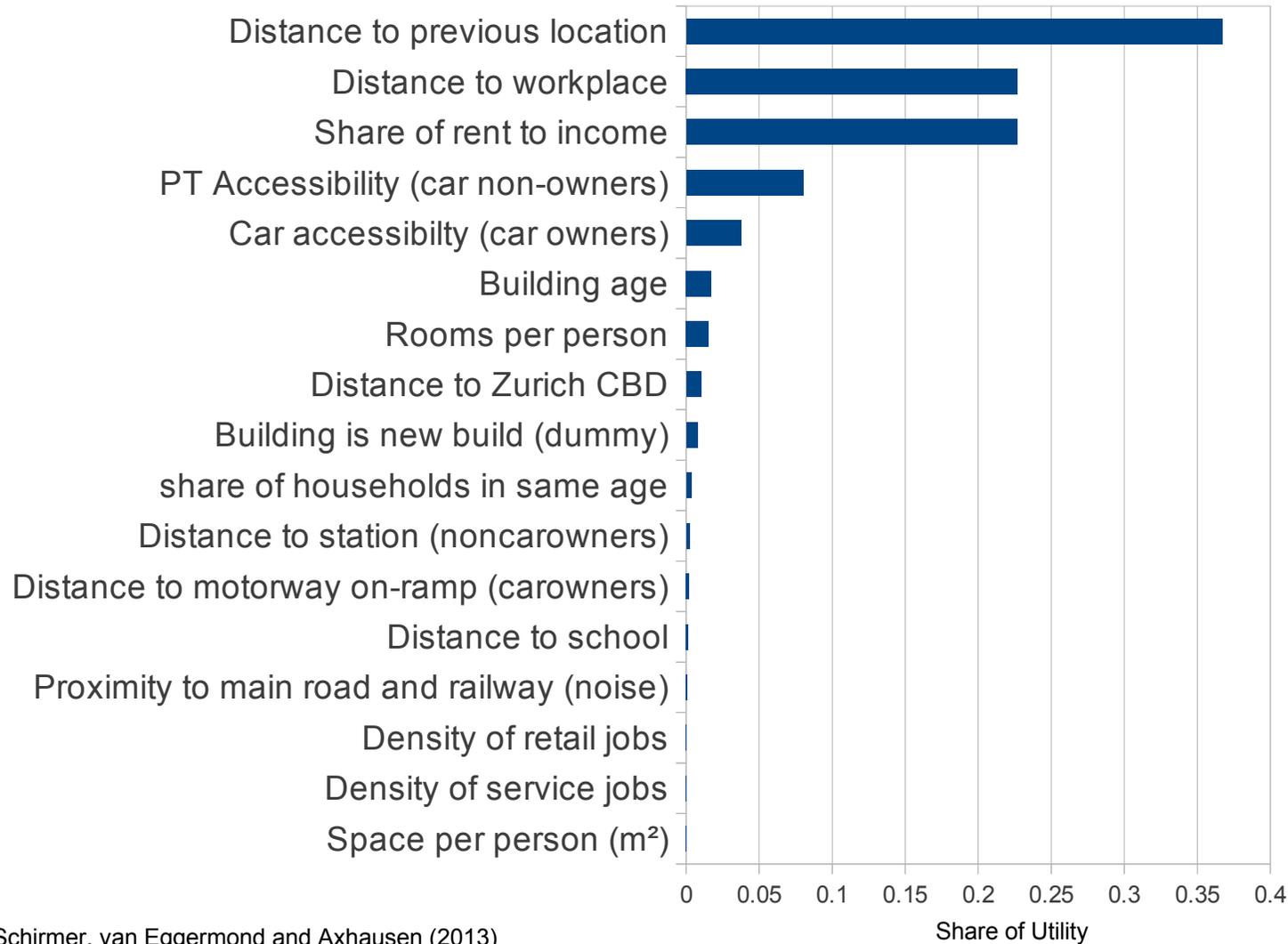
Source: Schirmer, van Eggermond and Axhausen (2013)

Choice sets – Household location choice

	UrbanSim (mean)	Survey (mean)	Diff (%)	
Car accessibilty (car owner)	9.89	9.07	9.03	
PT accessibility (car non-owner)	11.97	11.16	7.33	
Building is new build (dummy for	0.10	0.24	-55.96	(1)
Building age (log)	3.46	3.03	14.25	
Distance to motorway on-ramp (c	2147.81	2333.57	-7.96	
Distance to school	420.50	446.98	-5.93	
Distance to station (car non-owne	800.86	723.72	10.66	
Distance to Zurich CBD	10299.55	12104.99	-14.91	
Proximity to main road and railwa	0.02	0.08	-76.38	(2)
Density of retail jobs	83.82	16.46	409.24	(3)
Density of service jobs	255.84	61.10	318.75	(3)
Share of rent to income	0.00	0.24	-98.92	(4)
Rooms per person	1.93	1.89	1.90	
Share of households with age (<4	0.38	0.37	1.30	
Share of households with age (40	0.37	0.46	-20.91	
Share of households with age >6!	0.21	0.20	7.07	
Space per person (m²)	26.48	28.32	-6.52	

(1) recent movers of survey are located in new buildings
(2) recent buildings are at peripherical areas and closer to highway
(3) recent buildings are at peripherical areasn and have a low density of other uses
(4) corrected error: income categories and log(rent_price)

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Models - Summary

Achievements

Combining 6 main datasets (census data, cadastral data and register data)

Interaction of:

- 5 discrete-choice-models (12 submodels)
- 2 regression models
- 5 rate based models

Current limitations

all: estimation on distribution, vs. estimation on RP/SP

BLCM: templates can include mixed use (no link to job type)
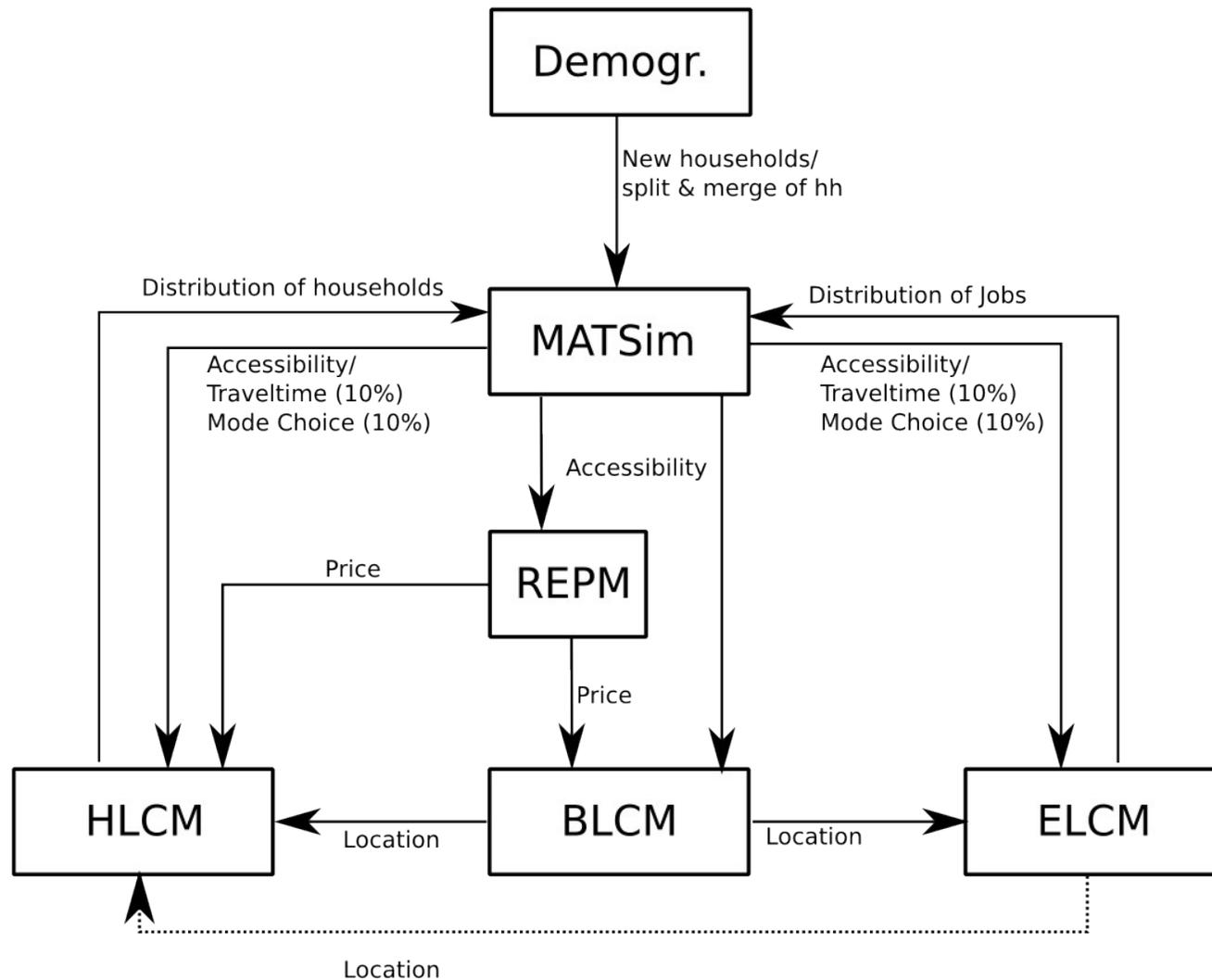
ELCM: needs to include taxes
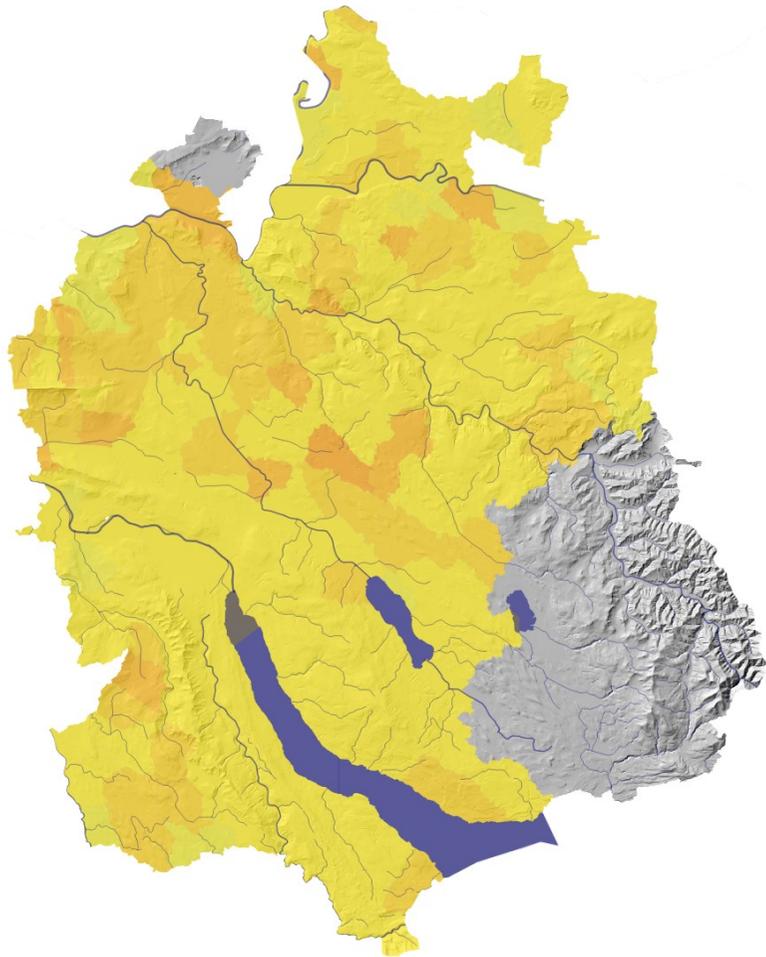
HLCM: no social groups; no bidprices

REPM: not including market; not including taxes

WLCM: choice only distance based, due to missing observations

Models – Interaction (influence of transport)

Simulation – Persons

Observed development 2001 - 2008:
Persons per km2 of municipality
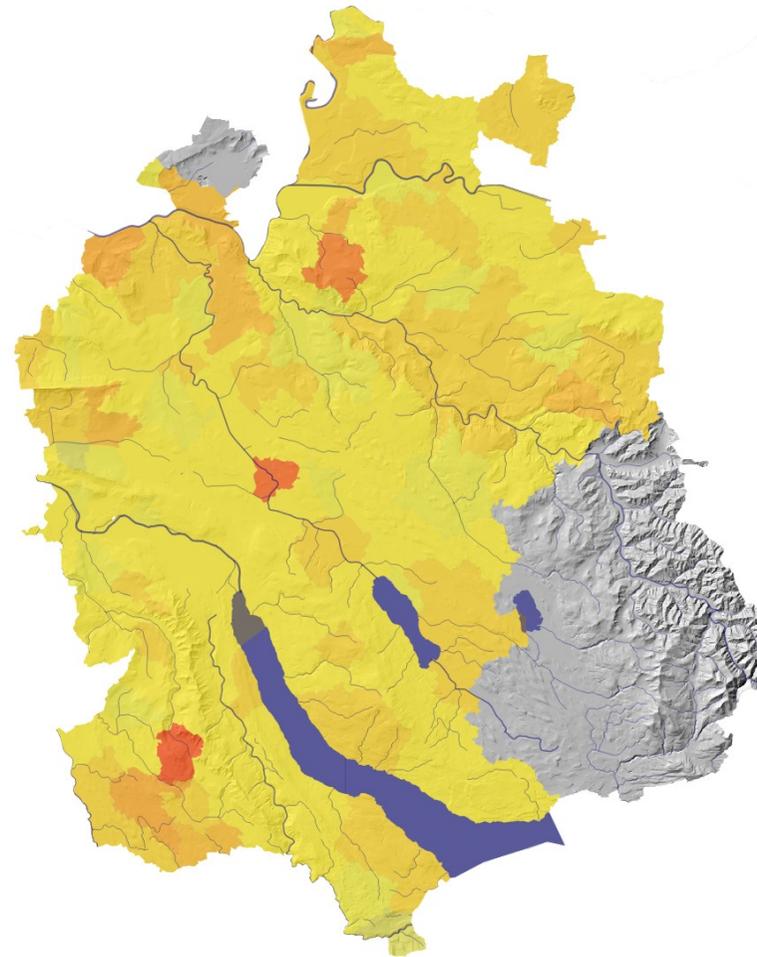
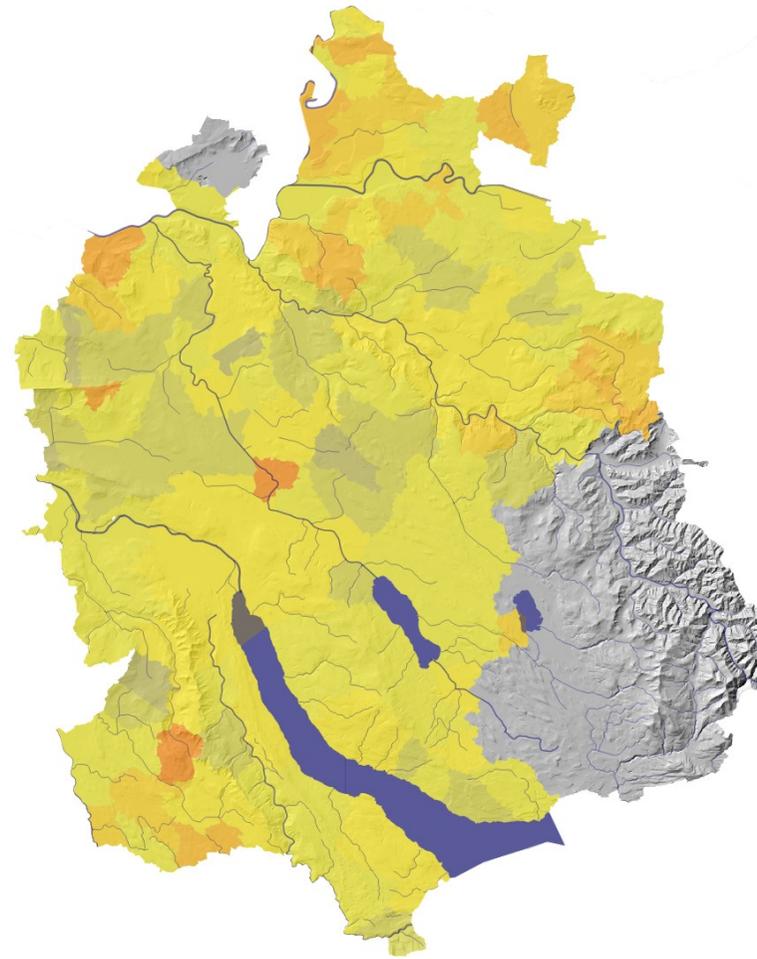Simulated development 2001 - 2008:
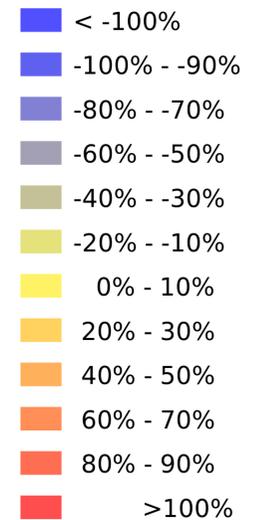Persons per km2 of municipality

Legend

- ■ < -100%
- ■ -100% - -90%
- ■ -80% - -70%
- ■ -60% - -50%
- ■ -40% - -30%
- ■ -20% - -10%
- ■ 0% - 10%
- ■ 20% - 30%
- ■ 40% - 50%
- ■ 60% - 70%
- ■ 80% - 90%
- ■ >100%

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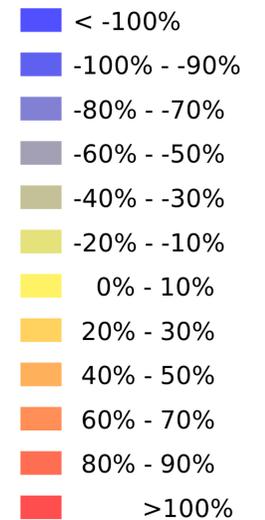
Simulation – Persons
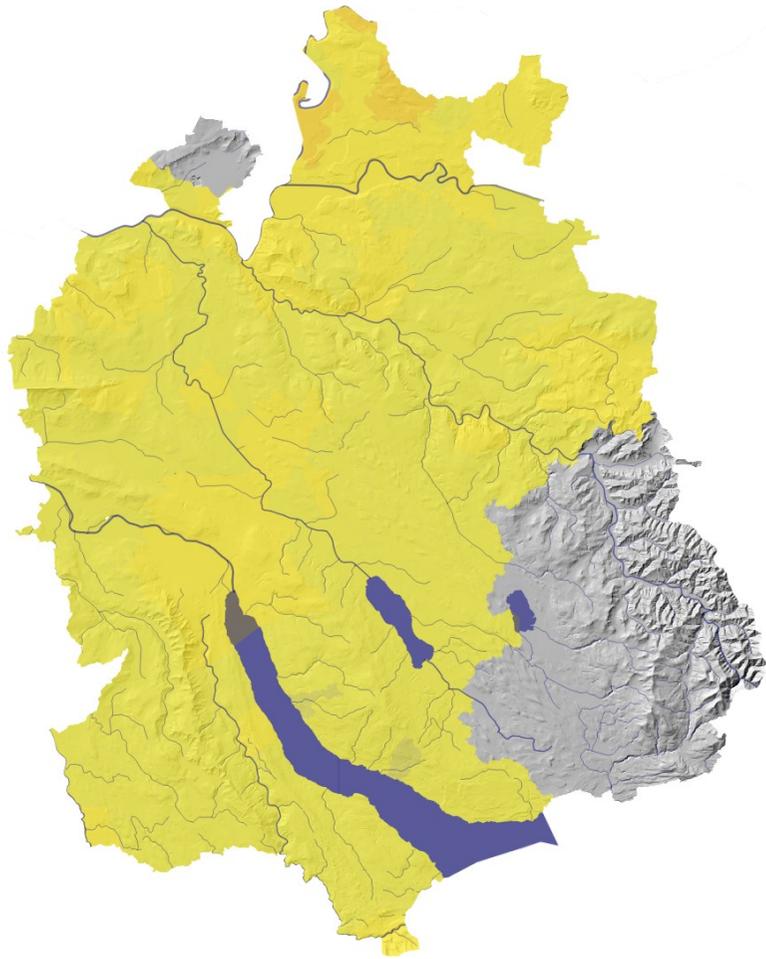
Difference of simulation to validation 2001:
Persons per km^2 of municipality

Difference of simulation to validation 2008:
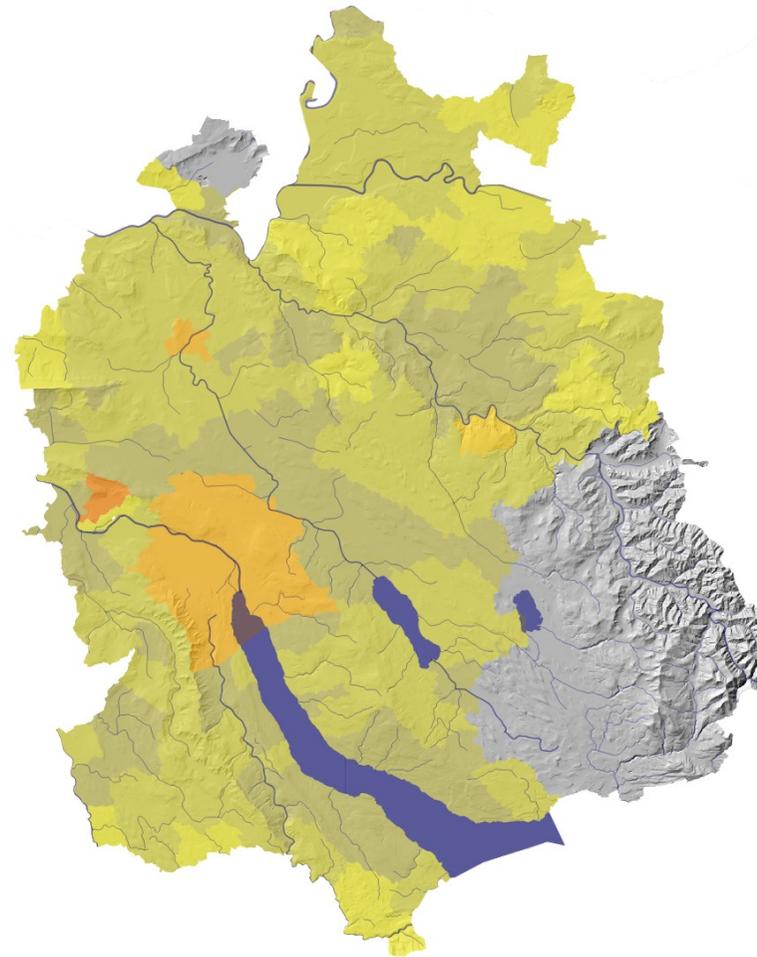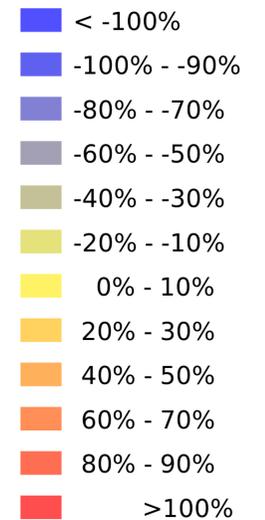Persons per km^2 of municipality
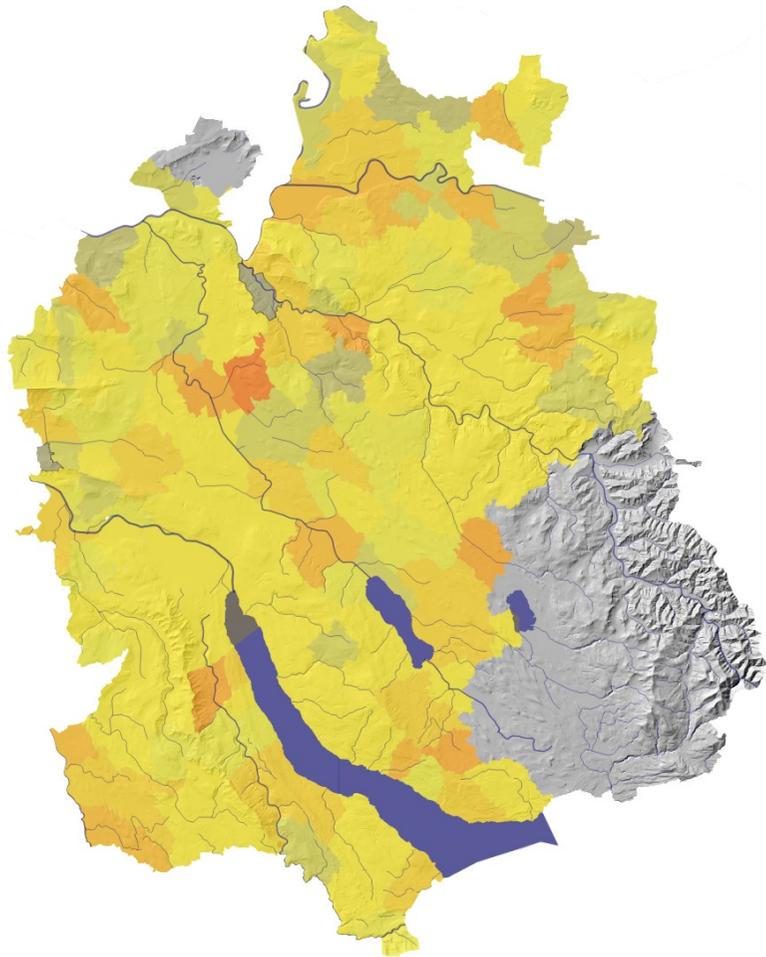
Legend

■ (blue)	< -100%
■ (blue)	-100% - -90%
■ (blue-gray)	-80% - -70%
■ (gray)	-60% - -50%
■ (gray-green)	-40% - -30%
■ (olive)	-20% - -10%
■ (yellow)	0% - 10%
■ (gold)	20% - 30%
■ (orange)	40% - 50%
■ (orange)	60% - 70%
■ (red-orange)	80% - 90%
■ (red)	>100%

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Simulation – Jobs

Observed development 2001 - 2008:
Jobs per km² of municipality

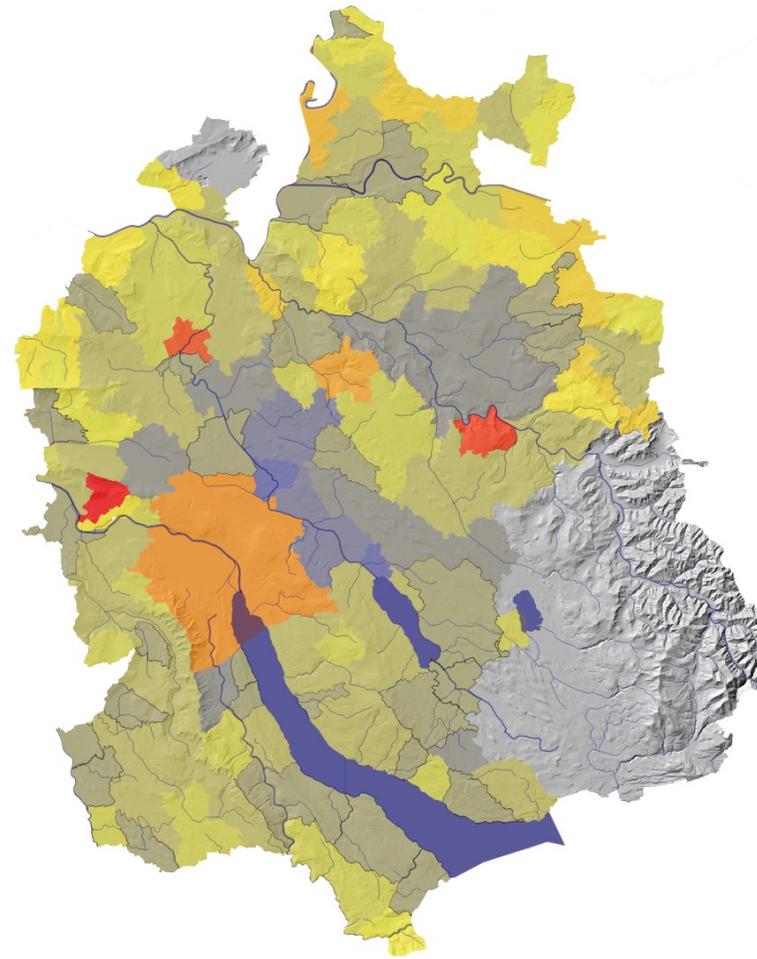Simulated development 2001 - 2008:
Jobs per km² of municipality

Legend

- ■ < -100%
- ■ -100% - -90%
- ■ -80% - -70%
- ■ -60% - -50%
- ■ -40% - -30%
- ■ -20% - -10%
- ■ 0% - 10%
- ■ 20% - 30%
- ■ 40% - 50%
- ■ 60% - 70%
- ■ 80% - 90%
- ■ >100%

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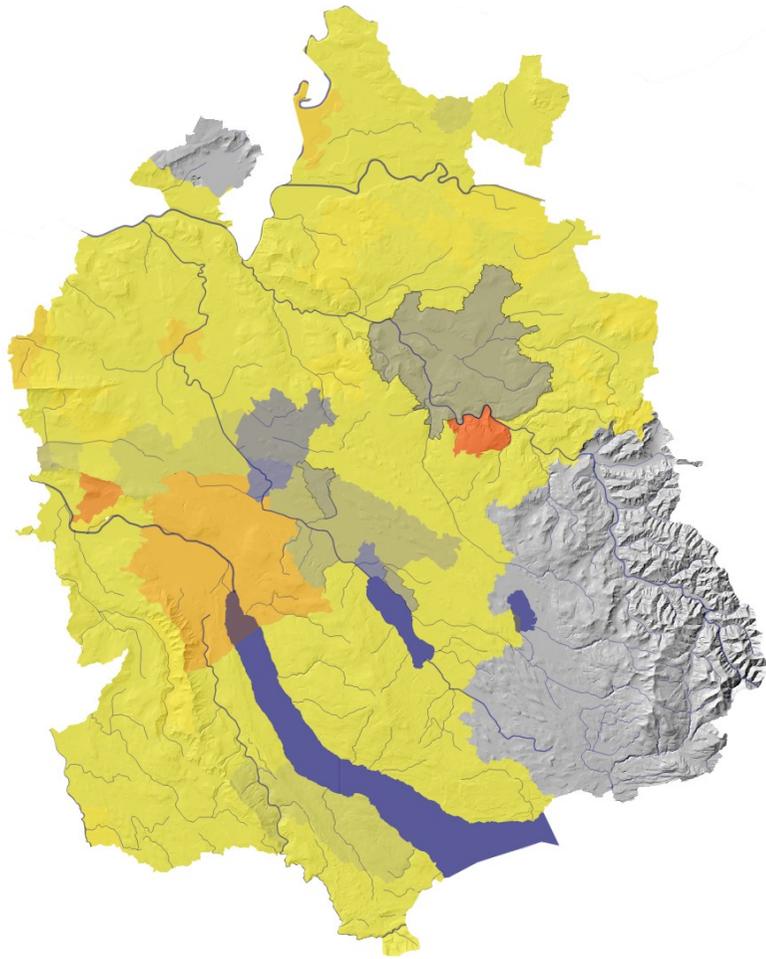
Simulation – Jobs

Difference of simulation to validation 2001:
Jobs per km^2 of municipality

Difference of simulation to validation 2008:
Jobs per km^2 of municipality

Legend

- ■ < -100%
- ■ -100% - -90%
- ■ -80% - -70%
- ■ -60% - -50%
- ■ -40% - -30%
- ■ -20% - -10%
- ■ 0% - 10%
- ■ 20% - 30%
- ■ 40% - 50%
- ■ 60% - 70%
- ■ 80% - 90%
- ■ >100%

Findings

Methodological

Reproducible research with big data?

Harmonised data / Synthetisation

Estimation of model in UrbanSim (base year)

Estimation of model using surveys (RP and SP)

Simulation of households fits to observation

Simulation of employment reflects limited data quality

Evaluation of scenario effects

Calibration and correlation of models

Simulation – Persons

Movie persons

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Scenario: Densification

Topic

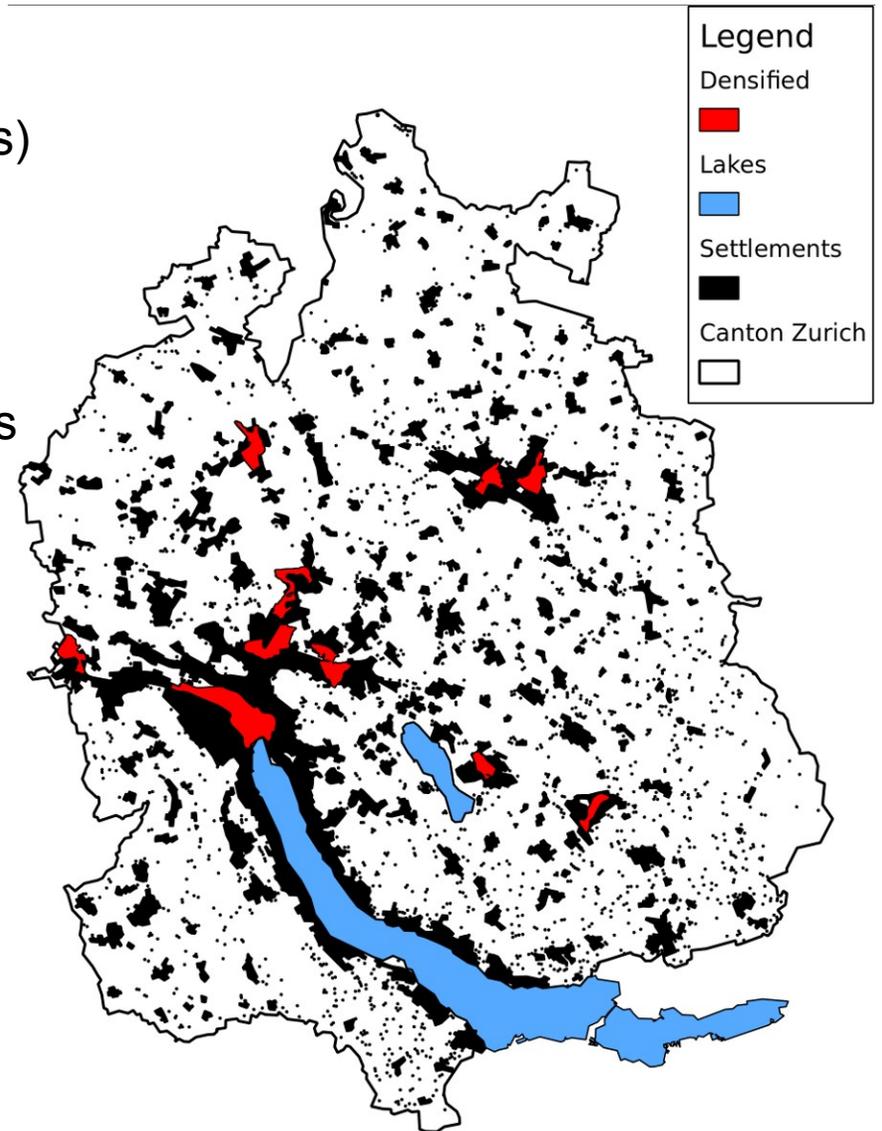Cantonal directive plan (11 densification areas)

Densification of centers

Implementation

Increase FAR of parcels in densification zones

Expected effects

Increased building activity

Less vehicle miles travelled

Legend

Densified

Lakes

Settlements

Canton Zurich

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Scenario: New infrastructure

Topic

New infrastructure facilities from
cantonal directive plan

Implementation

Adaptation of MATSim network

Expected effects

Locally increased accessibility
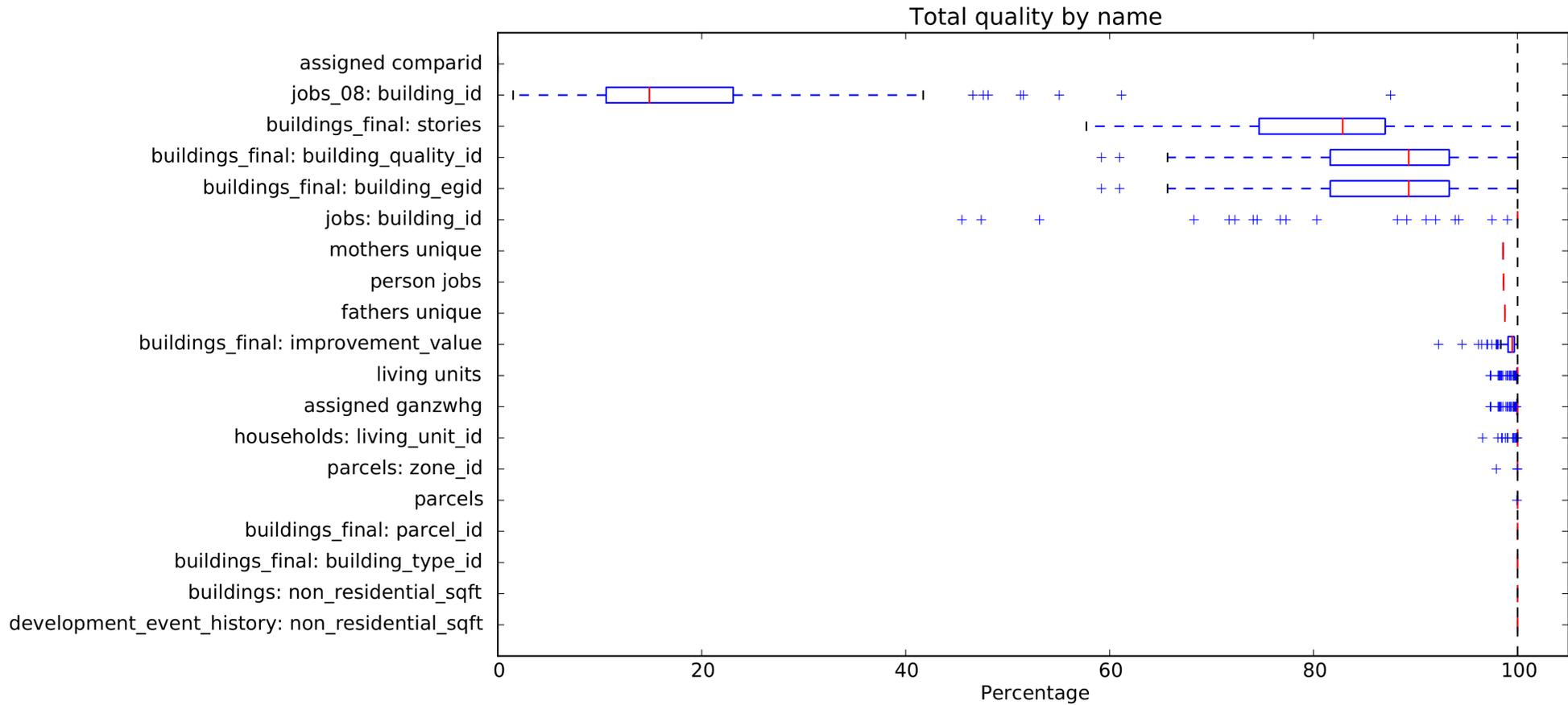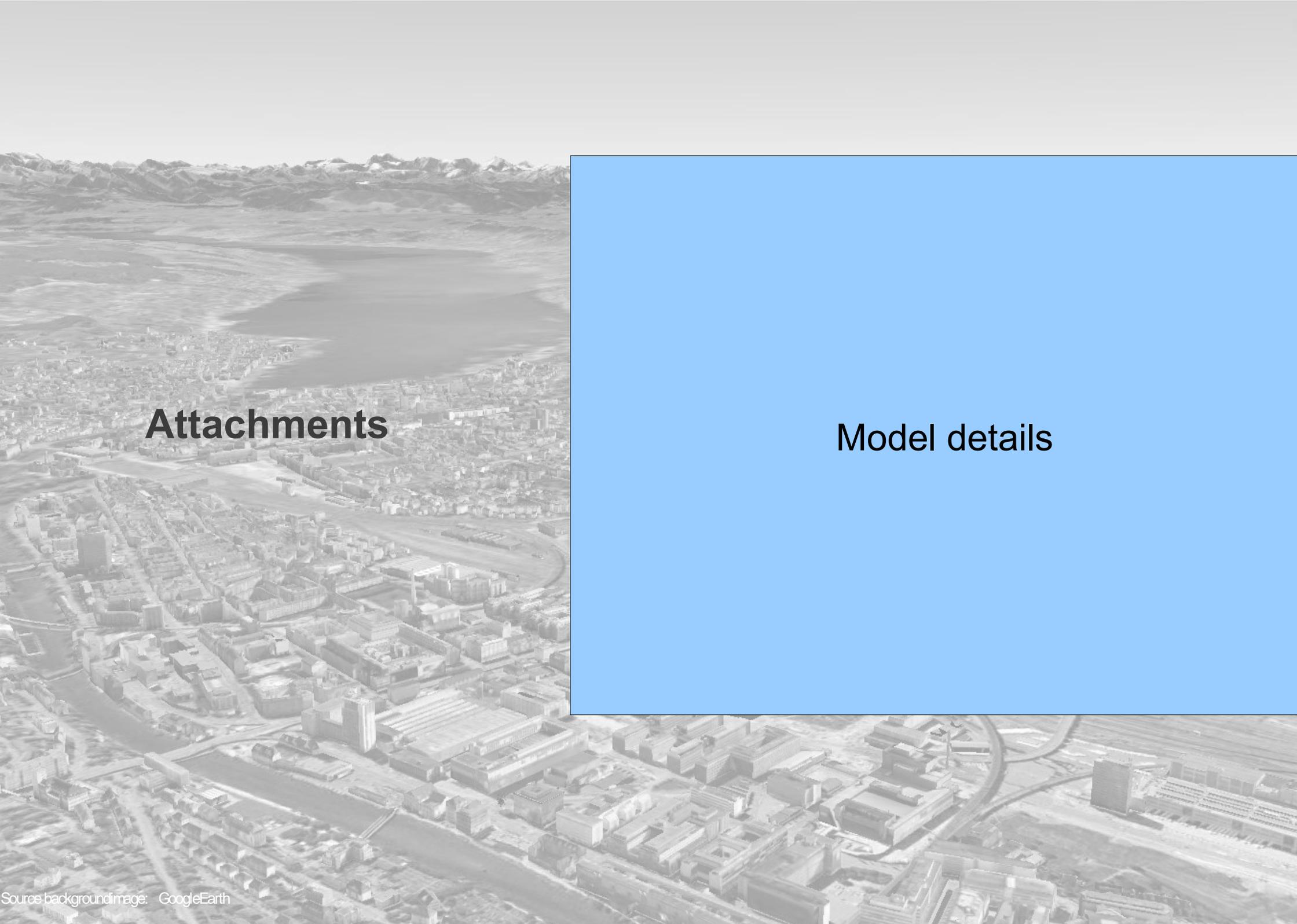
According local growth
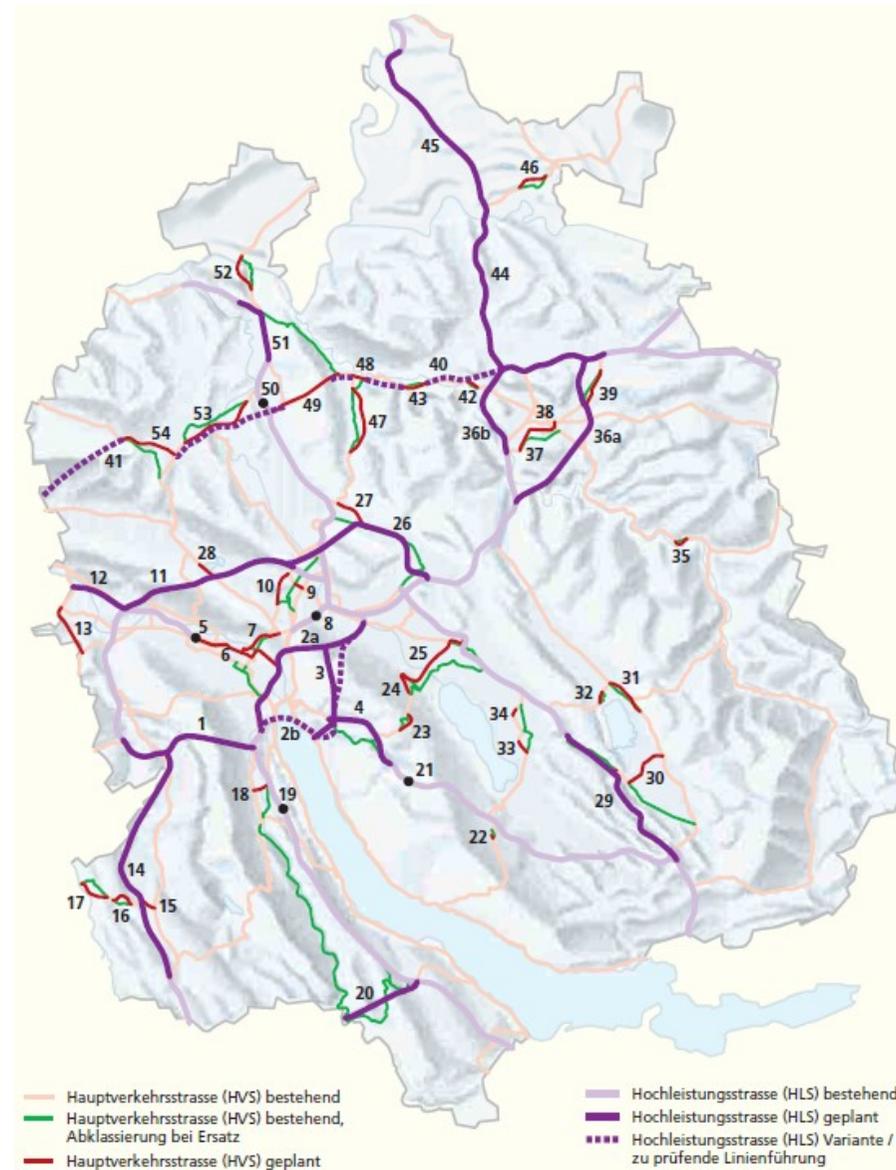
Legend:

— Hauptverkehrsstrasse (HVS) bestehend
— Hauptverkehrsstrasse (HVS) bestehend, Abklassierung bei Ersatz
— Hauptverkehrsstrasse (HVS) geplant
— Hochleistungsstrasse (HLS) bestehend
— Hochleistungsstrasse (HLS) geplant
···· Hochleistungsstrasse (HLS) Variante / zu prüfende Linienführung

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Attachments

Data processing

Total quality by name

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Integrated Land-Use and Transport Simulation, 18.04.2013

Attachments

Model details