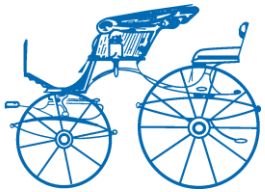

Simulating household location choice at different geographical levels with UrbanSim

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Contents

1. The aim of the study

The UrbanSim dilemma:

- need for disaggregate data (Hunt *et al*., 2005; Duthie *et al*., 2007)
- need to apply a powerful modelling potential

Zone-based approach:

- zone version of UrbanSim might be helpful?
- application at the zonal level: the Paris Region (de Palma *et al*., 2005; de Palma *et al*., 2007)?

1. The aim of the study

Which zone level is appropriate in the Lyon application:

- ILOT (block)?
- IRIS (TAZ)?
- commune (municipality)?

Motivation – unsatisfactory prediction results with ILOTs

1. The aim of the study

Reasonableness of simulation results given historical data (Waddell, 2002, Waddell *et al*., 2007):

- overall correlation between simulated and actual values
- differences between simulated and actual change by spatial unit

Additional benchmark for the HLCM

(the alternative method) –

evenly split population growth

1. The aim of the study

Criterion for an appropriate spatial unit:

- predictions are closer to actual values in comparison with other spatial units
- predictions are better than the alternative method for this spatial unit

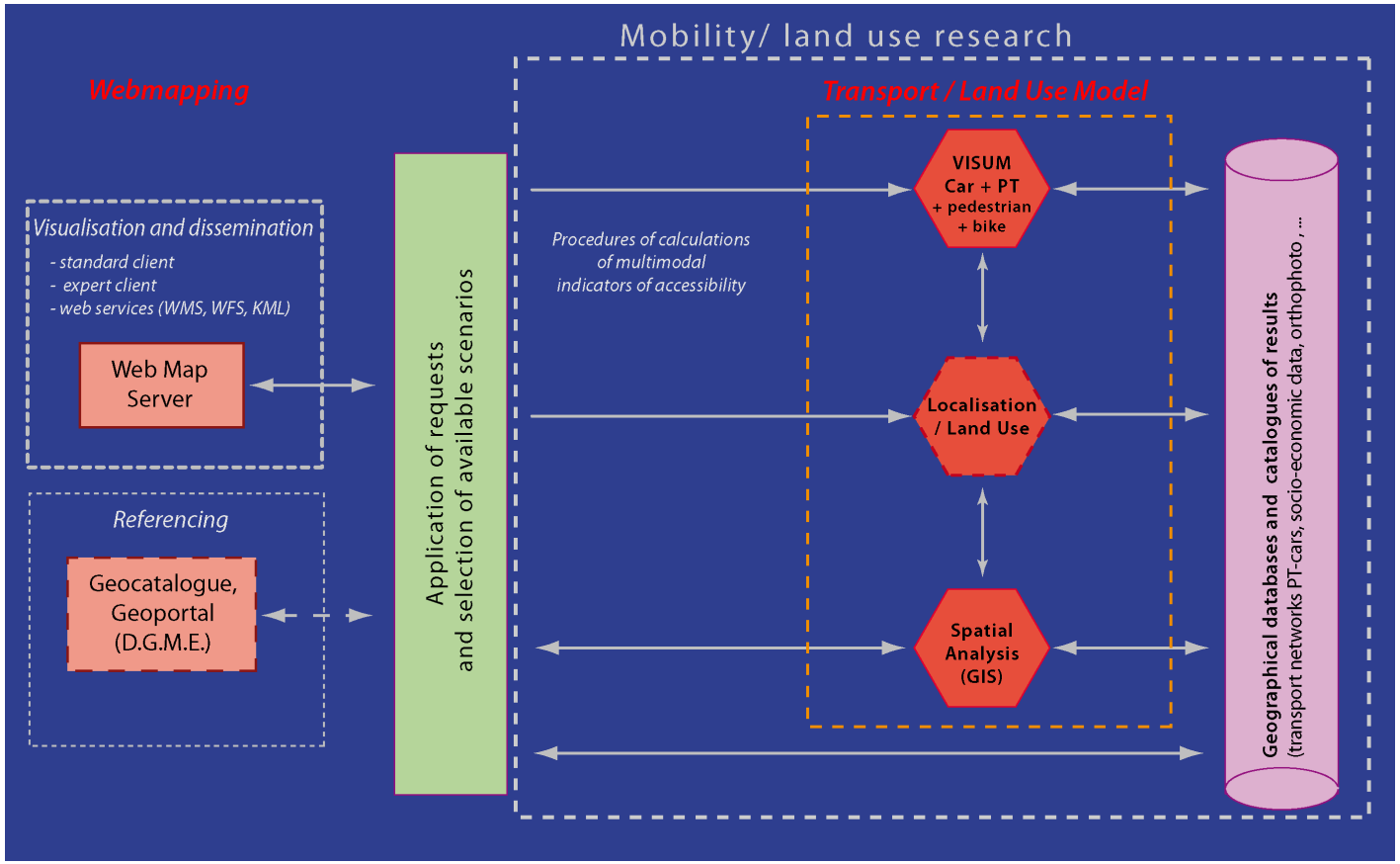
2. The Lyon UrbanSim application

- Project PLAINSUDD (Innovative Numerical Platforms of Urban Simulation for Sustainable Development) sponsored through French ANR

- Numerical platform MOSART (Modelling and Simulation of Accessibility to Networks and Territories): data, perspective building of a transportation-land use model

2. The Lyon UrbanSim application

MOSART: Numerical Platform of Modelling

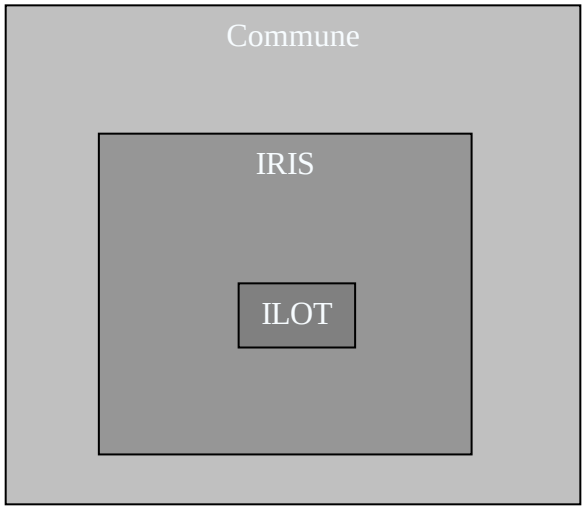


2. The Lyon UrbanSim application

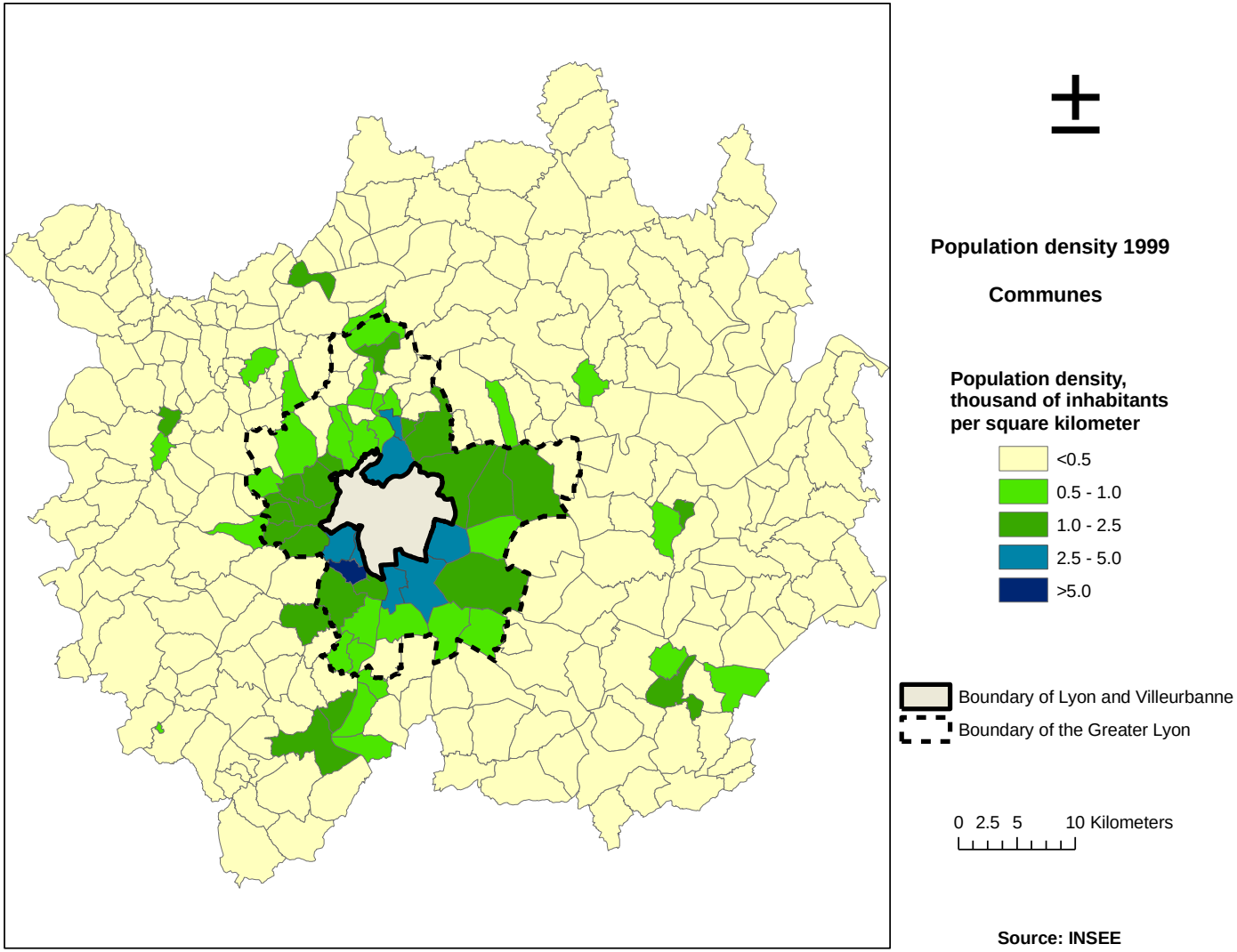
- version 4.2.2 (GUI)
- framework created for gridcells
- gridcell size 100 m * 100 m
- each spatial unit is analysed as one “gridcell”
- “gridcells” are located in centroids of spatial units
- irregular network of “gridcells”

2. The Lyon UrbanSim application

Attribute	ILOT	IRIS	Commune
Territory covered	The Greater Lyon	The Lyon Urban Area	The Lyon Urban Area
Total number of spatial units	5,296	743	304
Number of spatial units with dwellings	4,662	742	304
Area, km^2:			
Minimum	0.00002	0.01280	0.40235
Maximum	14.14738	39.99089	39.99089
Mean	0.09272	4.47694	10.94199
Std. dev.	0.54107	6.36776	6.52716
Population 1999:			
Minimum	0	1	96
Maximum	7,951	7,960	116,653
Mean	210	2,124	5,184
Std. dev.	422	1,288	12,033



2. The Lyon UrbanSim application



2. The Lyon UrbanSim application

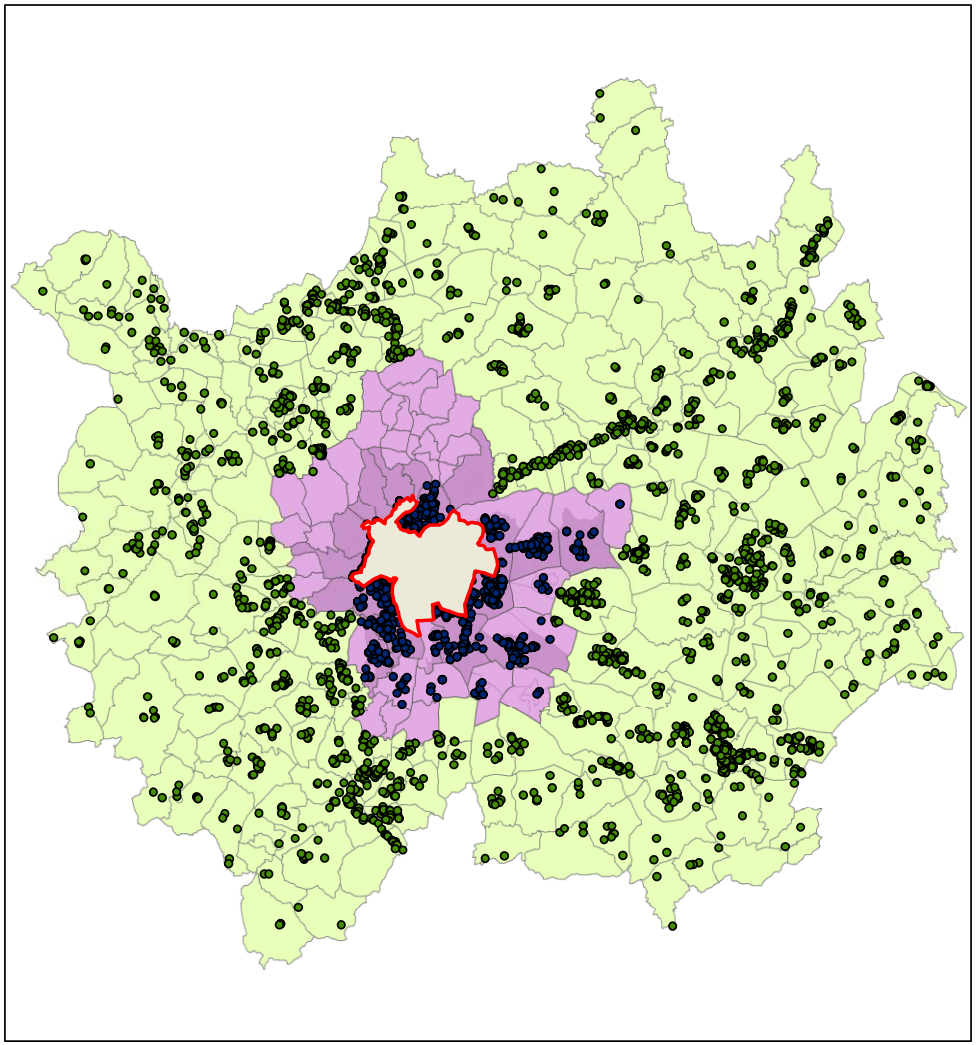
Households:

- population 1999: 1.58 million
- population 2005: 1.74 million
- 3 income groups
- number of cars
- annual relocation rate for household: 0.076

TAZs or communes:

- travel time by car, morning peak (O-D matrix)
- number of residential units
- average real estate price per square metre

2. The Lyon UrbanSim application



±

- apartment prices
- housing prices

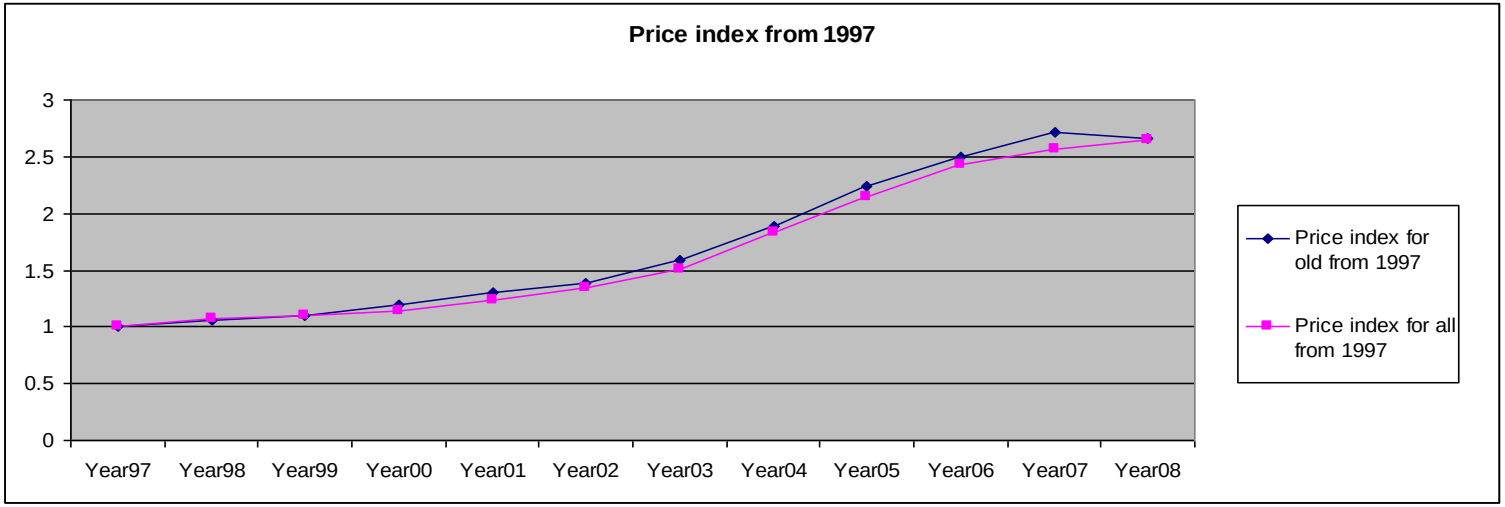
0 2.5 5 10 Kilometers

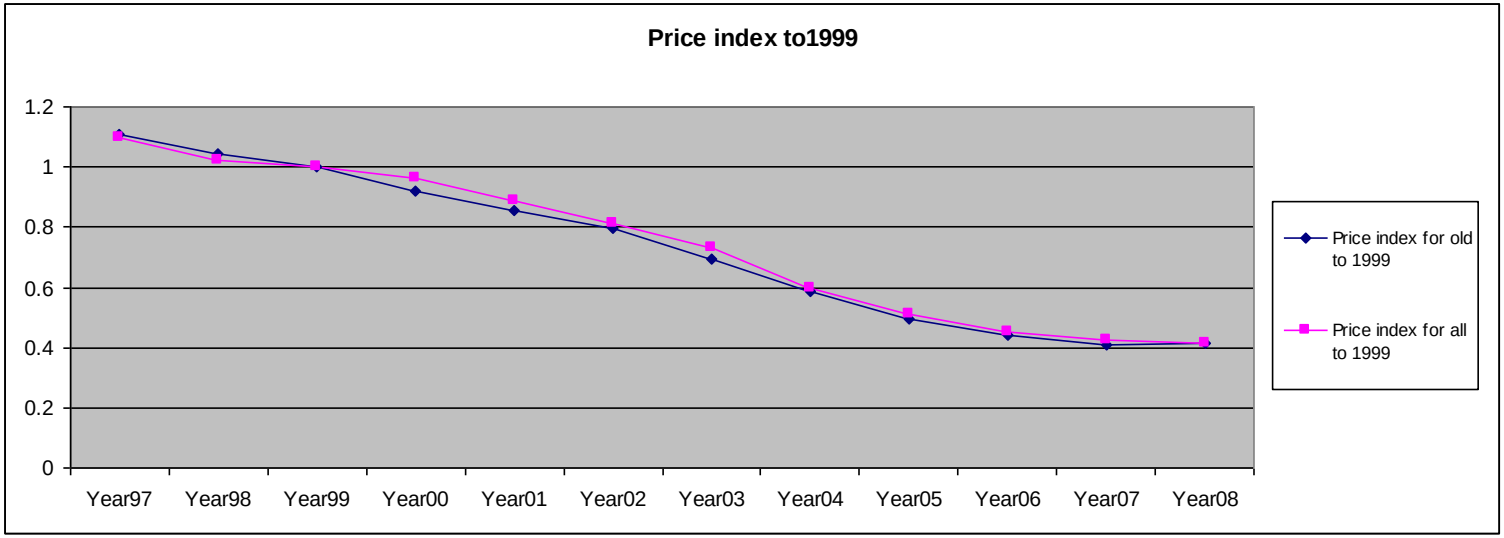
2. The Lyon UrbanSim application

Real estate prices:

- data: sales 1997-2008
- hedonic model for old apartments, Péguy (3100 observations, 41 variables, adj. R^2=0.82)
- hedonic model for all apartments, Kryvobokov (4308 observations, 43 variables, adj. R^2=0.88)
- amalgamate apartments and houses: 11407 observations
- recalculate prices to 1999
- interpolate to raster, zonal statistics

2. The Lyon UrbanSim application





3. Model estimation

HLCM:

- synthetic population
- 10,000 randomly selected households
- 1 + 29 alternatives

Selection of variables:

- parsimonious model
- based on fundamentals of urban theory
- avoid the “within walking distance” concept
- avoid scale variables

3. Model estimation

Number	Variable	Coefficient (*t-value*)		
		ILOT	**IRIS**	**Commune**
1	Log of average real estate price if high income household	0.505 (8.59)	0.526 (9.66)	0.247 (3.94)
2	Log of average real estate price if middle income household	0.138 (5.36)	0.127 (4.93)	-0.284 (-9.01)
3	Log of average real estate price if low income household	-0.338 (-9.96)	-0.638 (-18.59)	-0.973 (-20.56)
4	Log of residential vacancy rate	0.016 (4.24)	-0.144 (-18.62)	0.165 (17.31)
5	Log of index of employment access if household has a car	-0.599 (-32.53)	-0.310 (-23.67)	0.434 (29.54)
6	Log of index of employment access if household does not have a car	0.969 (28.93)	1.491 (53.64)	2.227 (68.97)
Null log-likelihood		-168400.085	-225244.297	-225244.297
Log-likelihood		-167289.676	-222899.831	-220769.638
Likelihood ratio test		2020.818	4688.932	8949.318
Number of observations		49512	66225	66225
Number of location choices		4662	742	304

4. Model simulation

Base year: 1999

Simulation period: 2000-2005

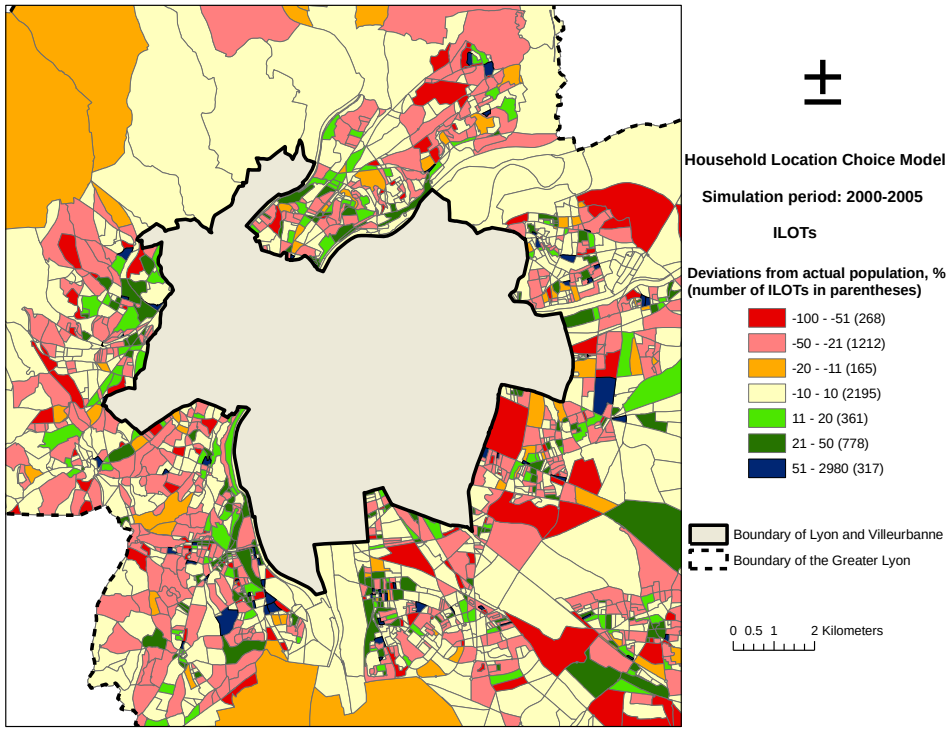
Year for comparison: 2005

No new real estate development

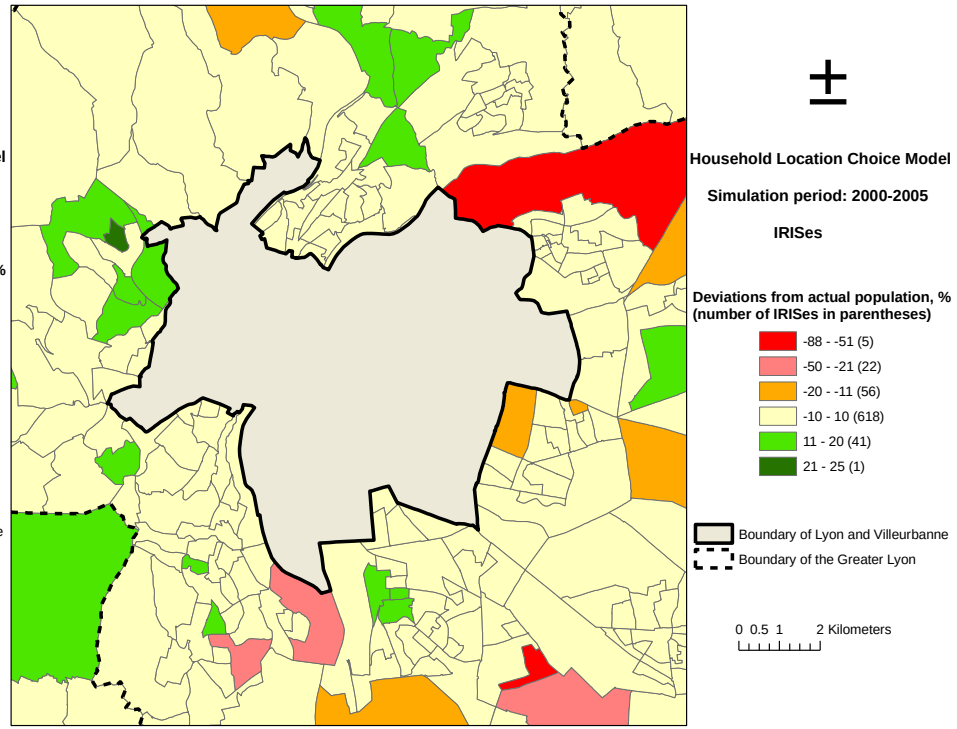
4. Model simulation

Deviations from actual population 2005

ILOTs (6% of population unplaced)

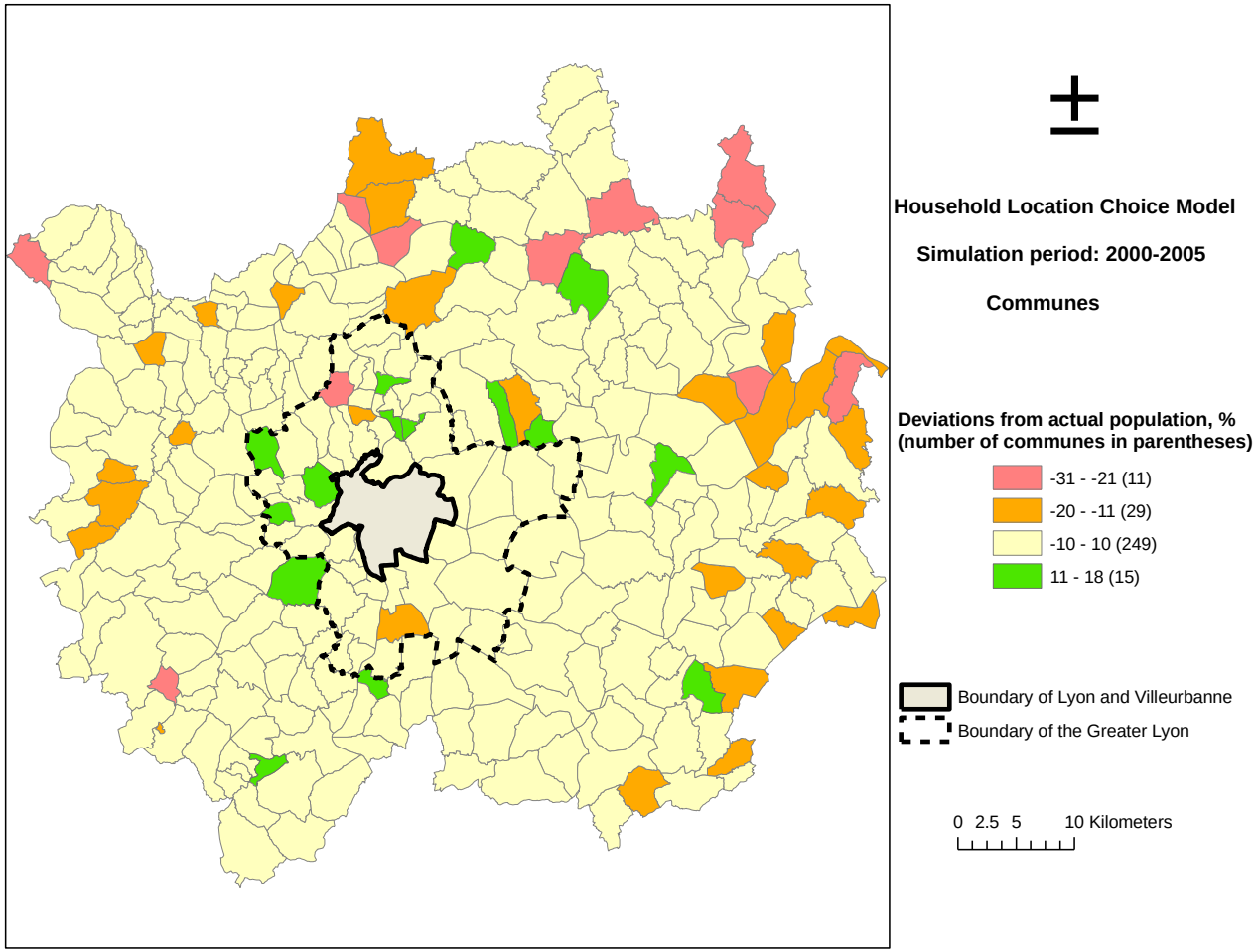


IRISes (no unplaced population)



4. Model simulation

Deviations from actual population 2005, communes



4. Model simulation

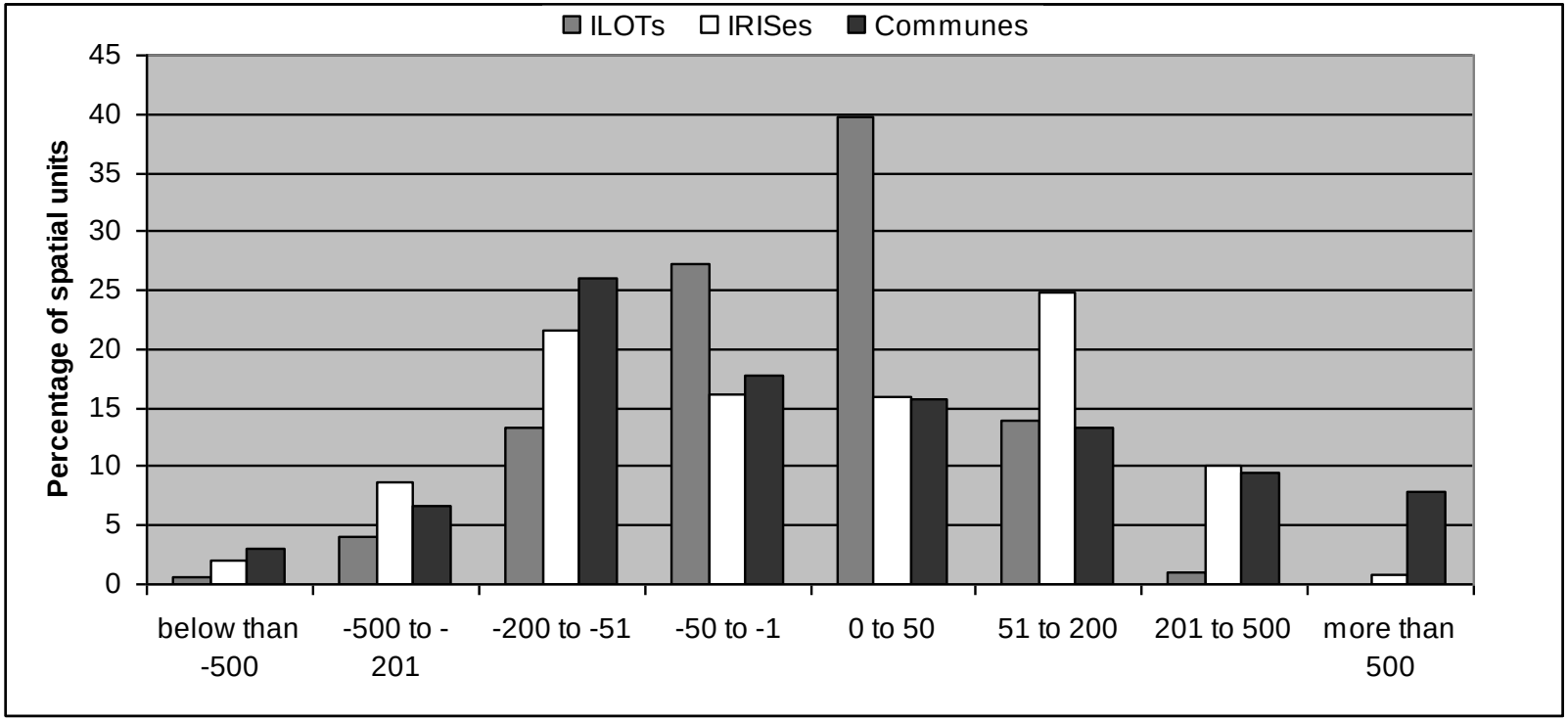
Analysis of simulated population 2005

Parameter	ILOT			IRIS	Commune
	ILOT	Aggregation to IRIS	Aggregation to commune		
Correlation coefficient	0.972	0.946	0.995	0.990	0.999
Within ±5% of actual population*	19 (36)	27 (25)	13 (24)	60 (57)	63 (54)
Within ±10% of actual population*	31 (41)	44 (41)	67 (52)	87 (83)	93 (82)
Within ±20% of actual population*	50 (51)	83 (79)	97 (86)	99 (96)	>99 (96)
Moran's I for difference	0.04	0.30	0.12	0.19	0.12
Moran's I for deviation	0.03	0.24	0.24	0.16	0.17

* Percentage of population and percentage of spatial units (in parentheses) are presented

4. Model simulation

Differences between simulated and actual population 2005 by spatial unit (the same interval as in Waddell, 2002)



5. Evenly split population growth

Population increase with average growth rate in each spatial unit

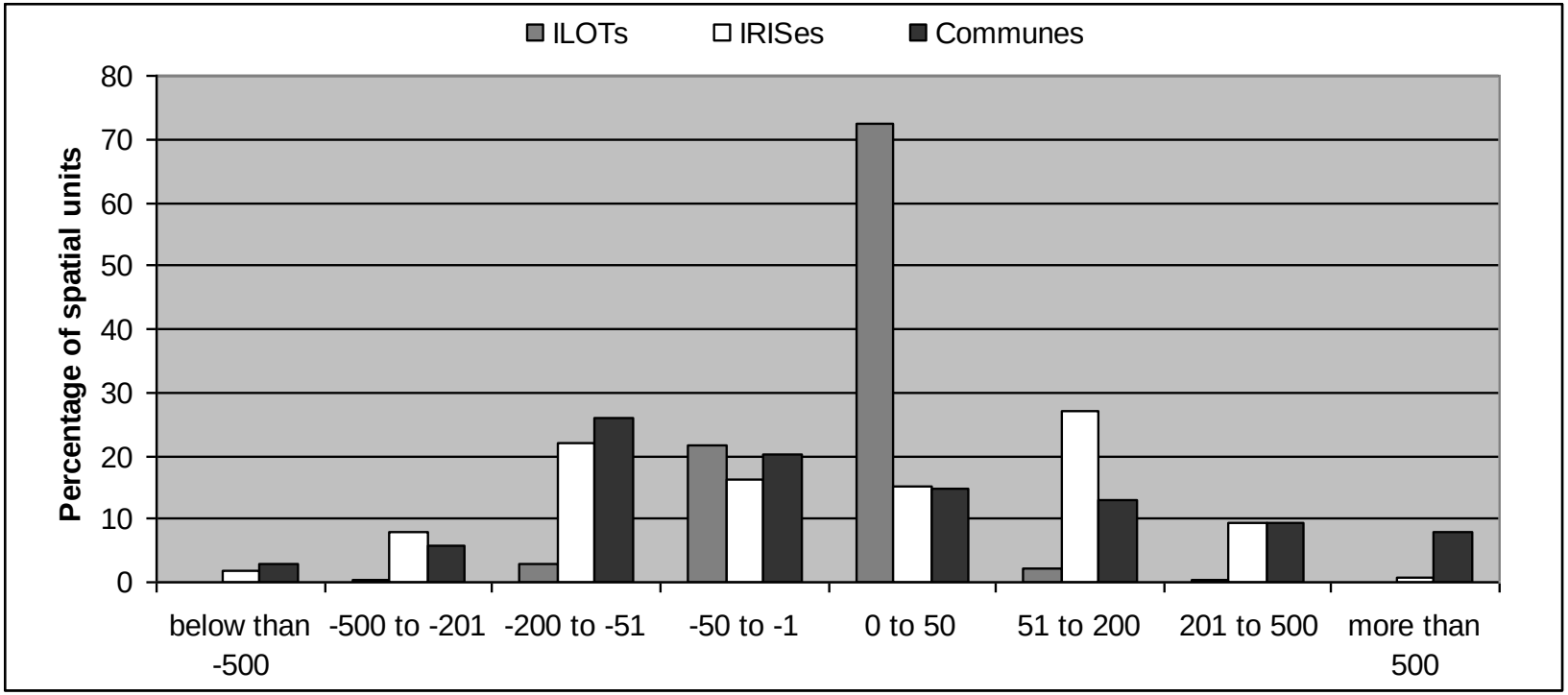
Analysis of calculated population 2005

Parameters	ILOT	IRIS	Commune
Correlation coefficient	0.993	0.991	0.999
Within ±5% of actual population*	66 (82)	60 (57)	63 (53)
Within ±10% of actual population*	88 (93)	88 (84)	94 (84)
Within ±20% of actual population*	96 (97)	99 (97)	>99 (97)
Moran's I for difference	0.01	0.18	0.08
Moran's I for deviation	0.04	0.16	0.18

* Percent of population and percent of spatial units (in parentheses) are presented

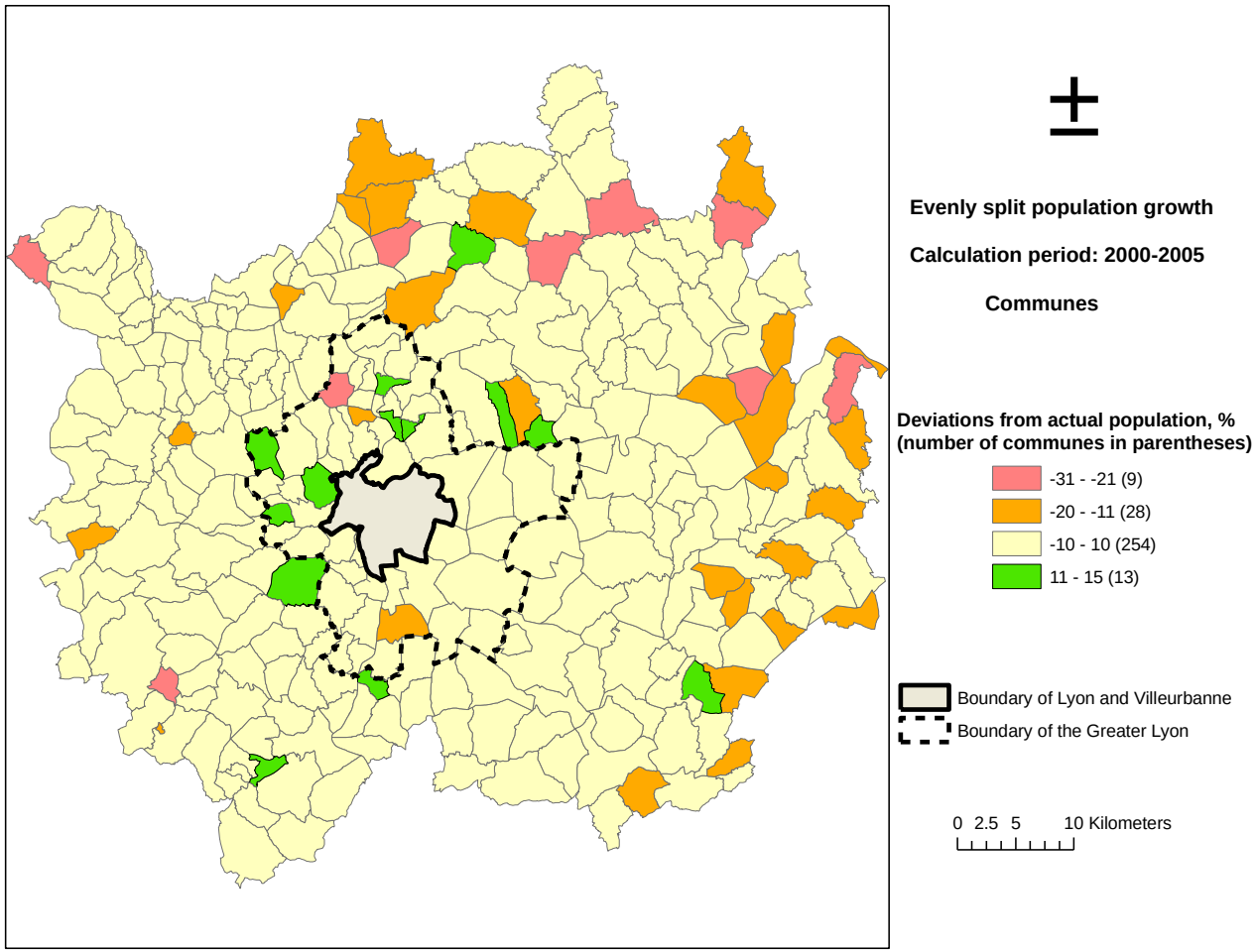
5. Evenly split population growth

Differences between calculated and actual population 2005 by spatial unit



5. Evenly split population growth

Deviations from actual population 2005, communes



6. Conclusion

With larger spatial units the predictability of the HLCM gradually improves:

- multinomial logit works better with less alternatives
- data (disaggregation) errors and prediction errors are compensated

However at the lower spatial level

spatial autocorrelation is lower

6. Conclusion

The criterion for an appropriate spatial unit:

- not satisfied for ILOT
- close to being satisfied for IRIS and commune

The best prediction is obtained with commune

Spatial distribution of predicted population is in line with an even population increase, there are no extreme differences in the centre

7. Questions

Methodological:

- How to measure multicollinearity in MNL model?
- In a zone model, is a number of observations sufficient for regression (the LPM, the REPM, the RLSM)?
- Is the Paris Region model in de Palma et al. (2005) a zone-based? The commune level is mentioned (1300 communes). What about gridcells?

7. Questions

Technical:

- How to work with scenarios?
- How to save the list of variables in a model for a consequent estimation?
- Is it worth switching to a zone model?
- If we use 4.2.2 GUI and want to try a zone model, do we need some additional installations?
- There are the zone .xml files (for Eugene, PSRC, and Durham) in https://svn.urbansim.org/project_configs/, but we do not see the zone data (in particular, pseudo_buildings table) neither in https://svn.urbansim.org/data/ nor in the file opus-4-2-2.zip at http://www.urbansim.org/Download/DownloadingSampleDataAndSourceCode. Where the zone data can be found?
- How to work with a household synthesizer with non-US data?