


Estimation of Suburbanization intensity of the Olomouc Region By Geographical Information Systems

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Introduction


- Part of project „Research of citizen movement between urban and suburban space in olomouc region“
 - Delimitation of suburban area – RS, statistics data, mental maps
 - Analysis of population movement
 - Analysis of urban processes
 - Synthesis of knowledges for prediction of future development and landuse optimization
 - Creation of Scenarios of regional development
- Urban planning – good cooperation with local government
- Visualization



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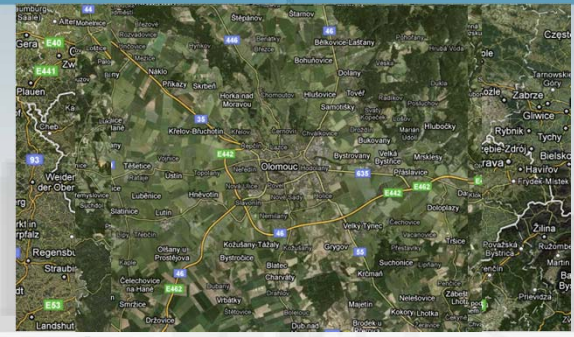

Geographical x GIS approach to suburbanization

- **Suburbanization**
 - Part of urban processes, moving people from city to suburbs
 - Commercial x residential suburbanization
 - Increasing of commuting, age structure changes, economical changes, creation of new urban plans, increase of housing, increase of industrial areas...
- Often based only on description (geographical approach) and not on analysis (GIS approach)
- Each factor decrbed or measured only as a separated topic
- No methodological approach how to estimate intensity of this process and how to predict it



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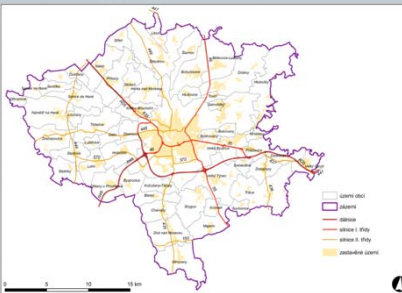

Olomouc region

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Localisation


- Olomouc city
 - 100 000 inhabitants
 - 5th larges city
- Olomouc region
 - 168 000 inhabitants

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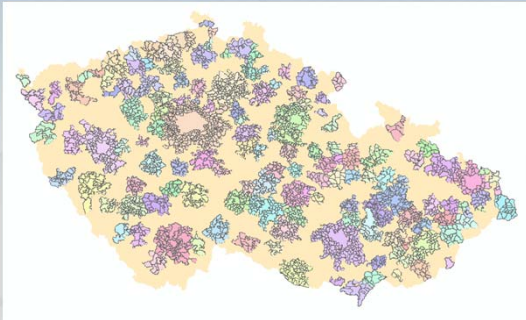
Procedure of determination of suburbanization intensity

1. Delimitation of area of urban processes (pre-delimitation)
2. Determination of period of suburbanization
3. Selection of criteria and determination of intensities
4. Determination of suburbanization intensity
5. Determination of suburbanization intensity – influence of Olomouc city



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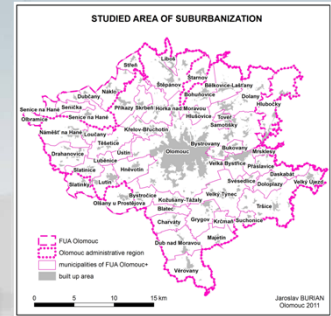
FUA (functional urban area)



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1. Delimitation of area of urban processes

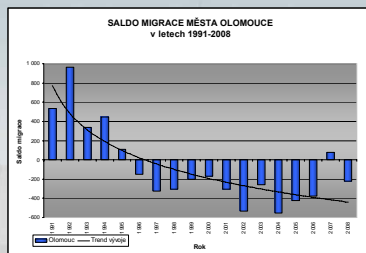
- Commuting to central city
- FUA - Functional Urban Area
 - More than 25% of people commuting to Olomouc
- Selected area – FUA + ORP Olomouc = FUA+
- 53 municipalities + Olomouc



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2. Determination of period of suburbanization

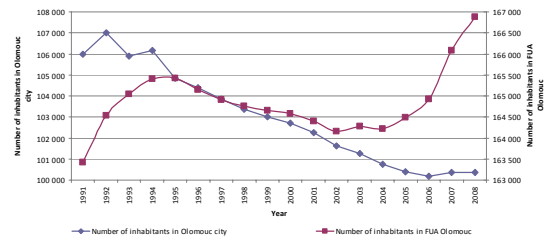
- Determination by migration balance
- Since 1996 to 2008 - decreasing
- Olomouc – decreasing nr. of inhabitants
- Olomouc + suburban area - increasing nr. of inhabitants



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Development of population

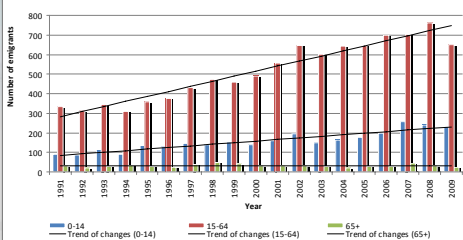
CHANGES IN NUMBER OF INHABITANTS IN OLOMOUC CITY AND FUA OLOMOUC in 1991-2008



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Age structure of the emigrants

AGE STRUCTURE OF EMIGRANTS FROM OLOMOUC CITY TO FUA OLOMOUC in 1991-2009



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3. Selection criteria and determination of Intensities

- Statistical selection – multi criterial evaluation

Criteria	Migration balance	Housing intensity	Commuting intensity	Build-up areas intensity
Fuller triangle	0,484	0,172	0,016	0,328
Geometric mean	0,343	0,243	0,140	0,275
Saaty method	0,343	0,243	0,140	0,273
Average value	0,390	0,219	0,098	0,292
Final value	0,4	0,2	0,1	0,3



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Selected criterias

Criteria:

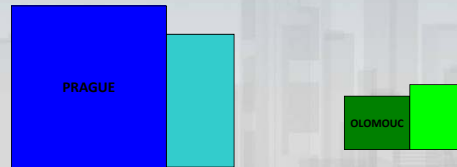
- **Migration intensity** – migration balance
- **Build-up areas intensity** – increase of build-up areas
- **Housing intensity** – increase of number of finished flats and houses
- **Commuting intensity** – number of people commuting to Olomouc from all commuting people



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3. Selection criteria and determination of Intensities

- Absolute x relative values
- Original value/number of inhabitants * 1000

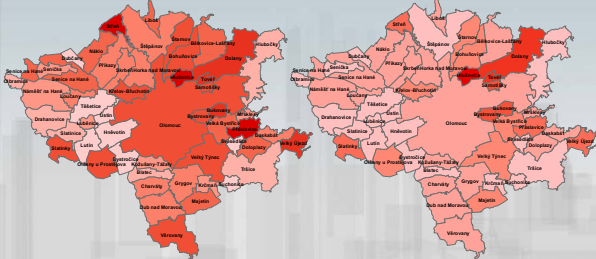


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Housing Intensity

Absolute

Relative



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4. Determination of suburbanization intensity

- Reclassification of intensities (relativisation of original values of intensities)
- **Weighted overlay** of 4 main intensities
 - Migration intensity - 0,4
 - Housing intensity - 0,2
 - Commuting intensity - 0,1
 - Built-up intensity - 0,3



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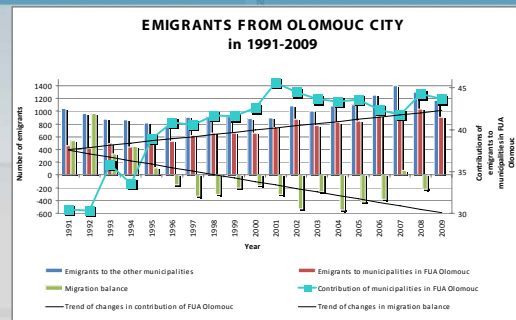
5. Determination of suburbanization intensity – influence of Olomouc city

- Influence of all cities
- Influence of Olomouc city only
 - accumulated number of immigrants from Olomouc/accumulated number of all immigrants
 - Since 1992 to 2001 the percentage of emigrants from Olomouc to communities in suburban area is increasing from 30 to 45 %

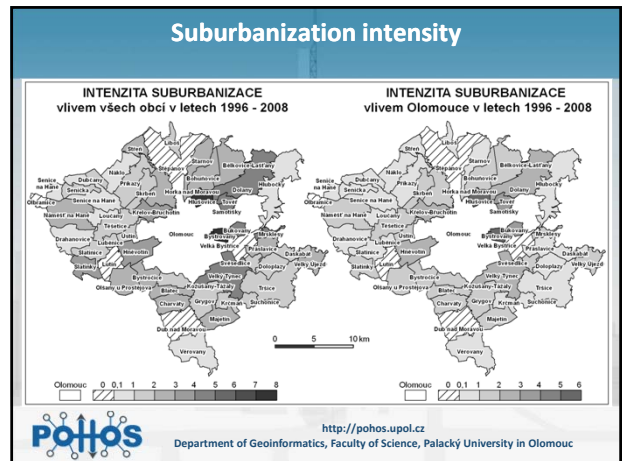
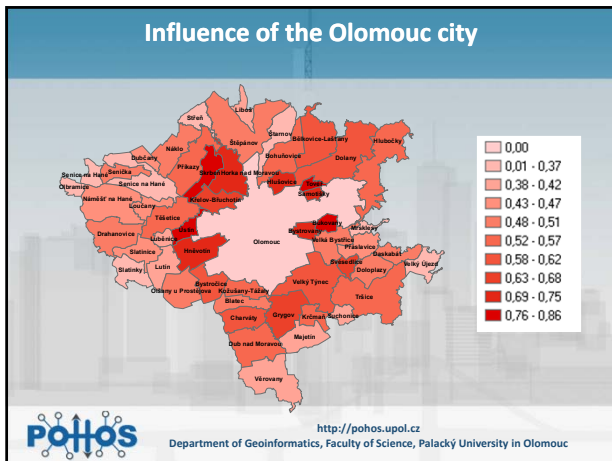


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Emigrants from Olomouc city



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Hněvotín



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Bukovany



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Chomoutov, Hněvotín, Velký Újezd, Bystrovany



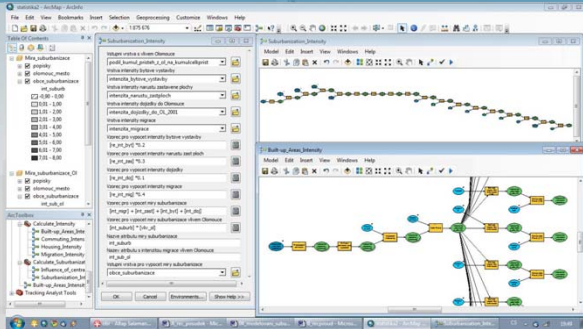
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Automatization of the process by ArcGIS Model Builder



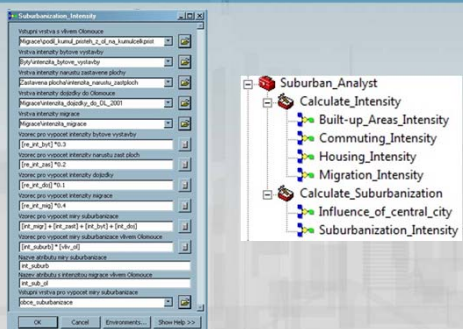
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Suburban Analyst



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Suburban Analyst



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Built-up Areas Intensity

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Built-up Areas Intensity

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Analysis of land suitability and of optimal landuse

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Optimal software solution

dr. Jaromír Kolečka

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OPTIMAL SOFTWARE SOLUTION

- 1. Module for data input
- 2. Module for GIS analysis
- 3. Module for data outputs and results visualization
- Extension for ESRI ArcGIS 9.3 (licence ArcView, Spatial Analyst), Python 2.5 and higher

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Urban Planner

Component 1: Evaluation of landscape potential (land suitability)

Settings

Help

Component 2: Optimal landuse analysis

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Evaluation of landscape potential

Urban Planner - Land suitability

Land suitability: Residential

1. Physical-geographical factors | 2. Physical-geographical factors | 3. Weights setting

Factor	Factor weight	Rating
<input checked="" type="checkbox"/> Relief (slope)	2	Setting X
<input checked="" type="checkbox"/> Flood hazard	10	Setting X
<input checked="" type="checkbox"/> Protective areas of water resources	6	Setting X
<input checked="" type="checkbox"/> Protective areas of natural healing resources	4	Setting X
<input checked="" type="checkbox"/> Geology	4	Setting X
<input checked="" type="checkbox"/> Main protective areas	10	Setting X
<input checked="" type="checkbox"/> System of ecological stability	10	Setting X
<input checked="" type="checkbox"/> Forest	2	Setting X

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Evaluation of landscape potential

Urban Planner - Land suitability

Land suitability: Residential

1. Physical-geographical factors | 2. Physical-geographical factors | 3. Weights setting

Factor	Factor weight	Rating
<input checked="" type="checkbox"/> Distance of residential areas	2	Setting X
<input checked="" type="checkbox"/> Distance of industrial areas	6	Setting X
<input checked="" type="checkbox"/> Distance of recreational areas	2	Setting X
<input checked="" type="checkbox"/> Distance of services	4	Setting X
<input checked="" type="checkbox"/> Distance of networks	10	Setting X
<input checked="" type="checkbox"/> Distance of roads	6	Setting X
<input checked="" type="checkbox"/> Distance of railway junctions	0	Setting X
<input checked="" type="checkbox"/> Noise	2	Setting X
<input checked="" type="checkbox"/> Protective areas of sewage water treatment plants	2	Setting X
<input checked="" type="checkbox"/> Protective areas of electricity	2	Setting X

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Evaluation of landscape potential

Pláčeby systém: Rating - Relief (slope)

Feature Class: Contour (Interval 5 m)

Abstrakce: Elevation [m] | WRT_M

Vhodnost	Slope [°]
1 - Lowest	1300 - 9999
2 - Very low	1050 - 1300
3 - Low	900 - 1050
4 - Below average	750 - 900
5 - Average	600 - 750
6 - Above average	450 - 600
7 - High	300 - 450
8 - Very high	150 - 300
9 - Highest	0 - 150
0 - Elevation	

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Evaluation of landscape potential

Urban Planner - Land suitability

Land suitability: Residential

1. Physical-geographical factors | 2. Physical-geographical factors | 3. Weights setting

Physical-geographical factors | Social-economical factors

25 % | 75 %

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Optimal landuse analysis

- input: rasters of landscape suitability, actual landuse
- output: vector layer of optimal landuse

	0	0 % - 30 %	30 % - 50 %	50 % - 70 %	70 % - 85 %	85 % - 100 %
Category	Very unsuitable	Unsuitable	Low suitability	Average suitability	High suitability	Very high suitability
Abbreviation	NUL	UNS	LOW	AVE	HIG	VER

• conflict areas – NUL, UNS, LOW X actual land use

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Optimal landuse analysis

Urban Planner - Optimal land use

1. Land suitability | 2. Function structure | 3. Categorization | 4. Preferences | 5. Permissions

Raster - Land suitability of residential areas

Raster - Land suitability of industrial areas

Raster - Land suitability of sport and recreation

Raster - Land suitability of public services

Raster - Land suitability of commercial services

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Optimal landuse analysis



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Optimal landuse analysis



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Optimal landuse analysis



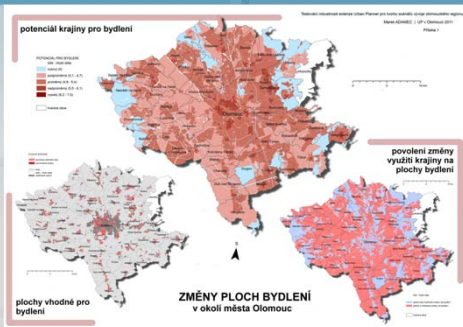
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Optimal landuse analysis



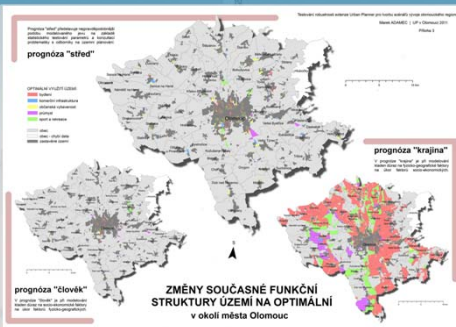
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Landscape suitability for housing

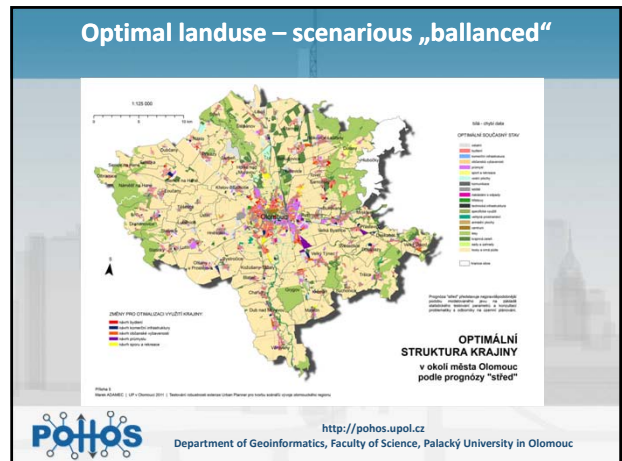
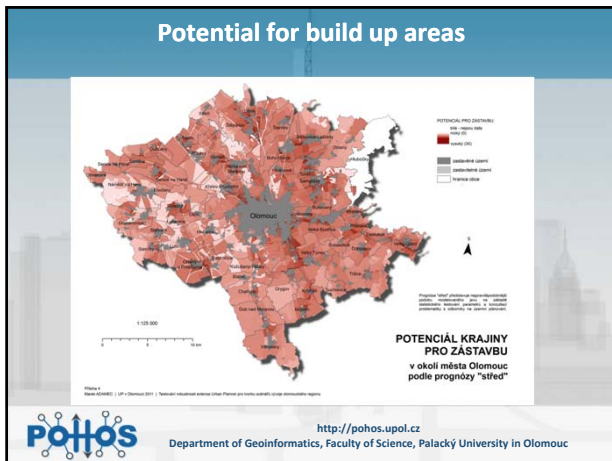


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Changes of actual landuse – 3 scenarios



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