



Top-down Population Density Grid Based on European Land Monitoring Services

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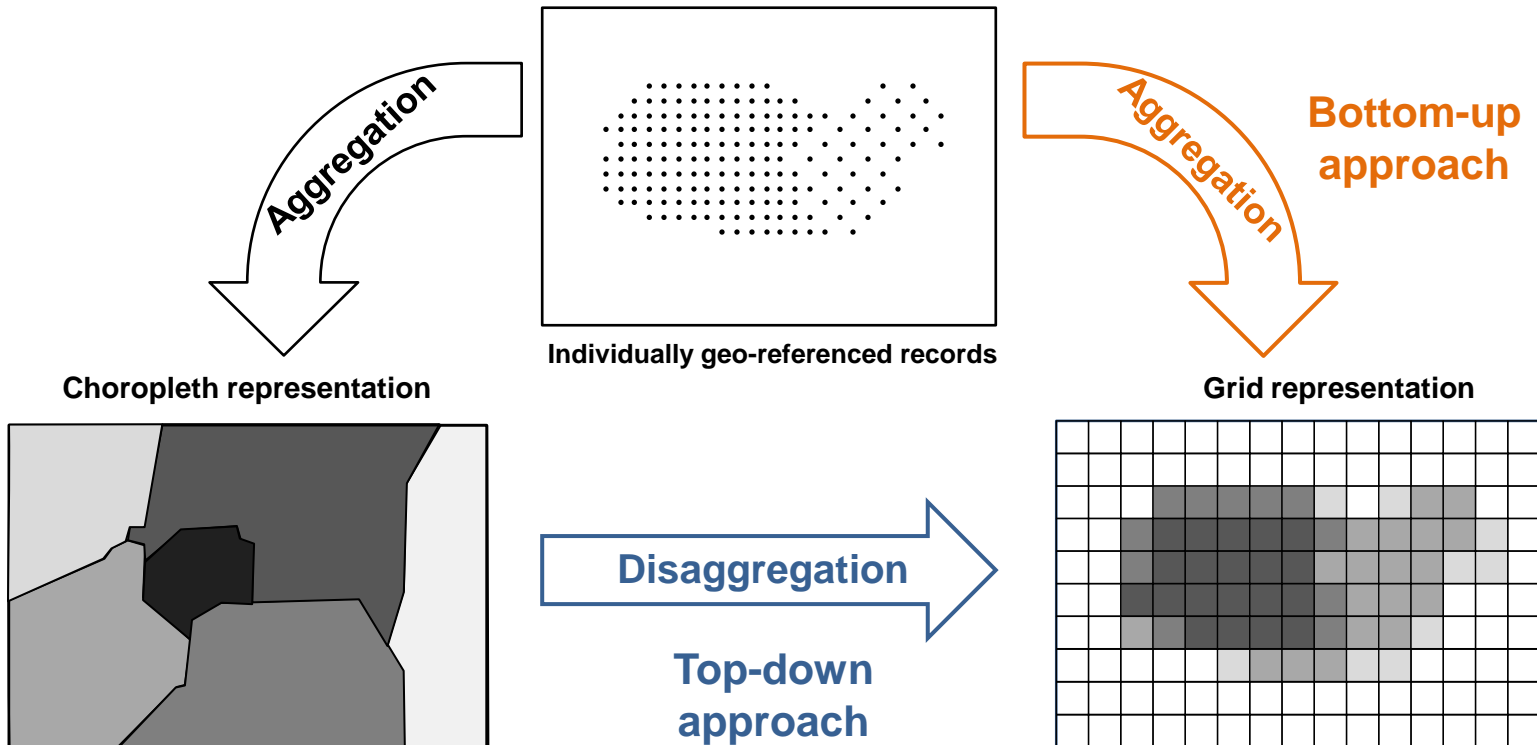
Pros of top-down approach

- It allows for the production of:
 - Comparable international grids
 - National grids in countries, in which bottom-up approaches have not yet been applied (e.g. Slovakia)
 - Retrospective grids for years, in which bottom-up approaches have not yet been applied
 - Grids of alternative temporal population density conceptualizations (e.g. ambient, day-time, night-time, 24/7)
- No confidentiality issues

Cons of top-down approach

- Values are “only” estimates - it will never be possible to fully reconstruct the detail of the spatial structure from the aggregate commune data
- Appropriate ancillary data for disaggregation are not always available for the given moment in time
- Detailed validation data are not always available for the given moment in time
- Most disaggregated datasets represent population density; other demographic, social and economic variables are more challenging to estimate

Spatial aggregation and disaggregation



Types of disaggregation methods

- Simple – no ancillary spatial data used
 - Dasymetric – ancillary spatial data used
 - Mapping agencies data (e.g. buildings, roads, DTM)
 - Open source data (e.g. OpenStreetMap - OSM)
 - In situ sampled data (e.g. LUCAS)
 - Earth observation imagery (e.g. night time lights)
 - Land use/cover maps
 - CORINE Land Cover (CLC)
 - Soil Sealing Layer (SSL)
- } Free of charge
EU+ coverage
Consistent accuracy (?)

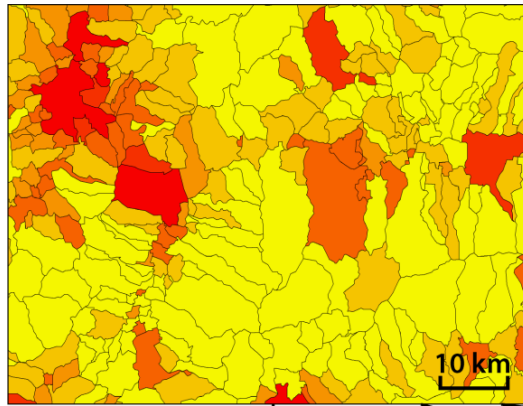
Dasymetric disaggregation methods used in some of the EU grids

- **JRC grid 2000 (F. J. Gallego)**
 - **CLC iterative**
 - **CLC-LUCAS simple**
 - **CLC-LUCAS logit regression**
 - **CLC expectation-maximization**
 - **CLC limiting variable**
- **AIT grid 2006 (K. Steinocher et al.)**
 - **CLC-SSL-OSM linear disaggregation**

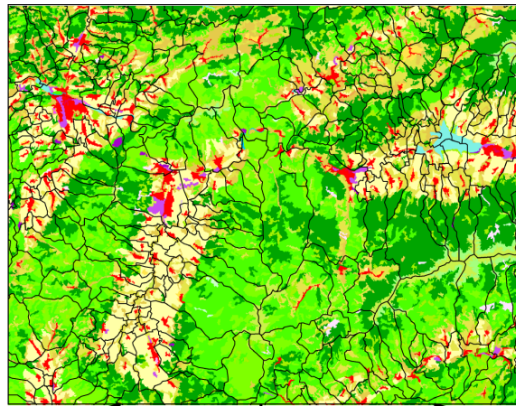
Methodology

- CLC-SSL iterative – i.e. modified CLC iterative method of Gallego & Peedell (2001) published by Rosina, Hurbánek & Atkinson (2012)
- Disaggregation of population data of 2920 communes in Slovakia into a 100 m grid
- Work in progress - future plans to further develop the iterative method and to employ more ancillary datasets with EU+ coverage available free of charge allowing for expansion of the study area to the whole of the EU+

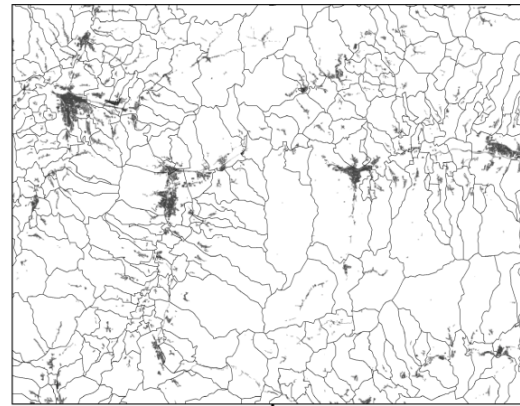
Commune boundaries (choropleth map)



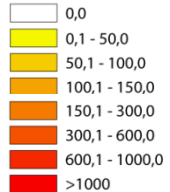
Corine Land Cover (44 land cover classes)



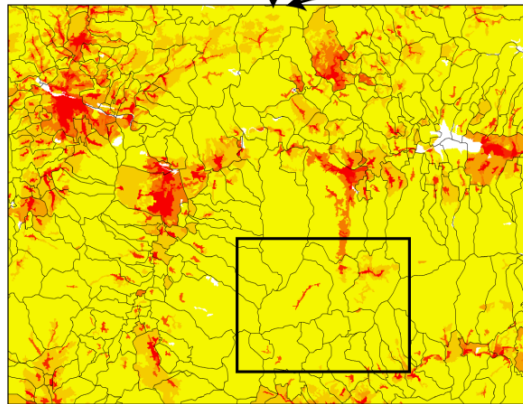
Soil Sealing Layer (0-100% sealed area)



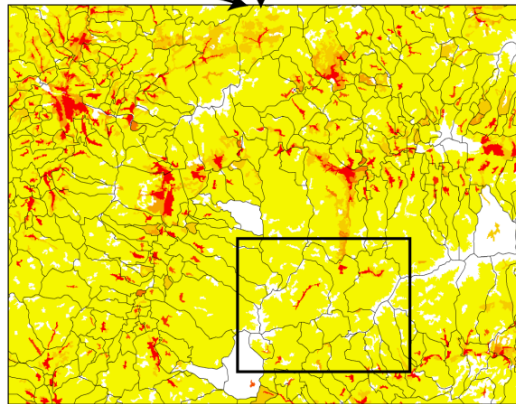
Population density



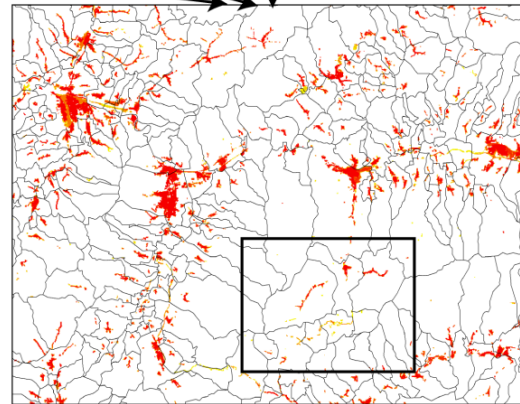
Sealed area per pixel (%)



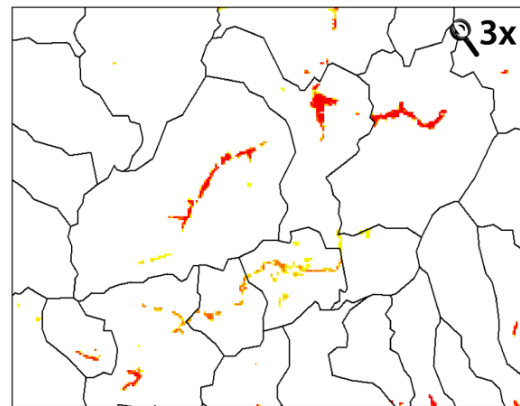
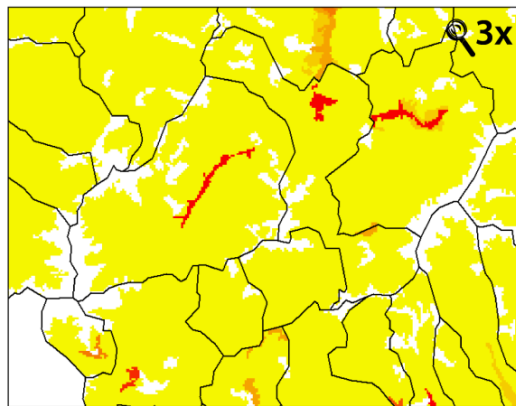
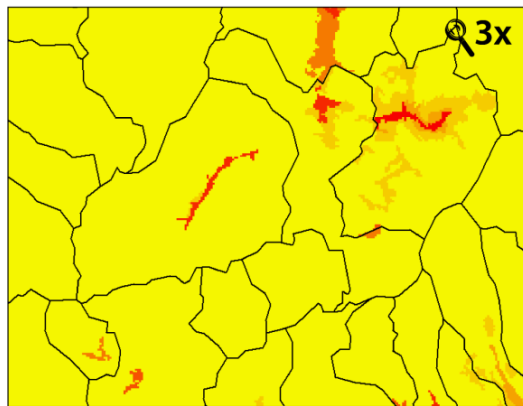
JRC population density grid version 3



JRC population density grid version 5



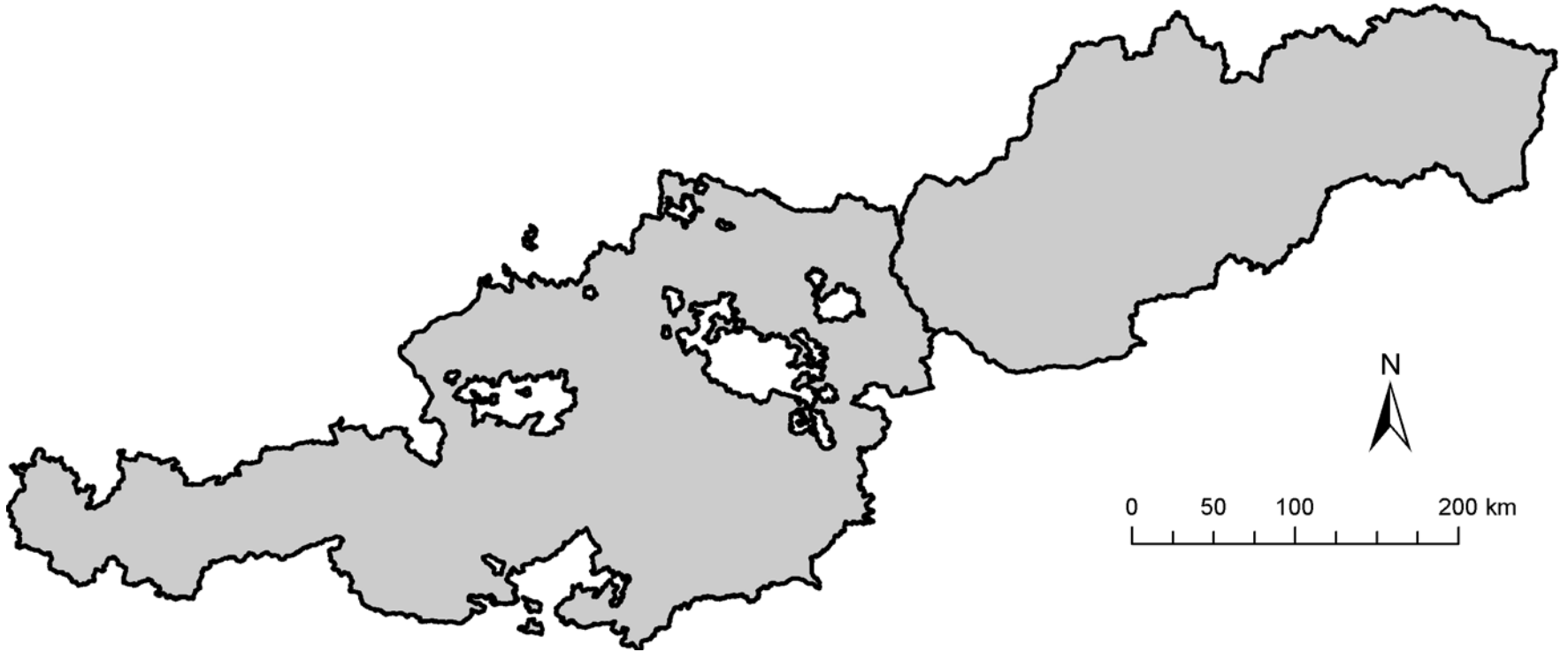
CLC + SSL population density grid



Study area and validation

- Slovakia 2001 – using CLC2000 & SSL2006
 - Primary focus
 - No cloud cover in SSL
 - Unavailability of proper validation data
 - No bottom-up grid available
 - 6864 Basic Settlement Units (BSU) used for validation, but 1976 (out of 2920) communes consist of just one BSU
- Parts of Austria 2006 – using CLC2006 & SSL2006
 - Additionally included to test the estimates of the same disaggregation method with proper validation data – 1 km bottom-up data from GEOSTAT grid
 - Only communes without cloud cover in SSL validated

Study area



Validation results

- Slovakia

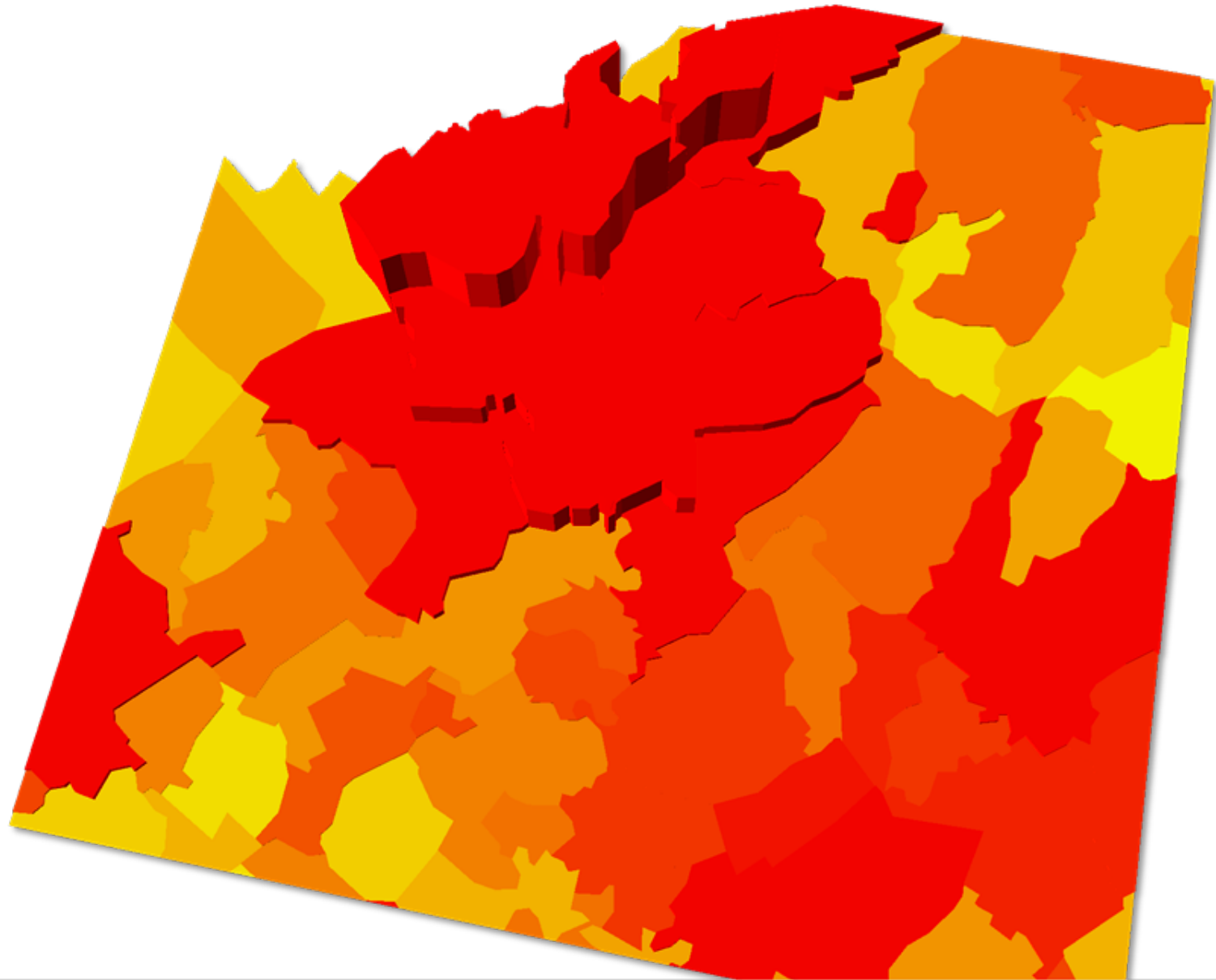
Year	Validation		Sum of absolute errors (SAE)	
	Units	Data source	The best result of CLC-SSL iterative method	Comparison dataset JRC grid (CLC limiting variable method)
2001	BSU	STAT-SK	2,488,171	< 2,598,599

- Austria

Year	Validation		Sum of absolute errors (SAE)	
	Units	Data source	The best result of CLC-SSL iterative method	Comparison dataset AIT grid (CLC-SSL-OSM linear method)
2006	1 km cells	GEOSTAT	2,592,965	> 2,032,987

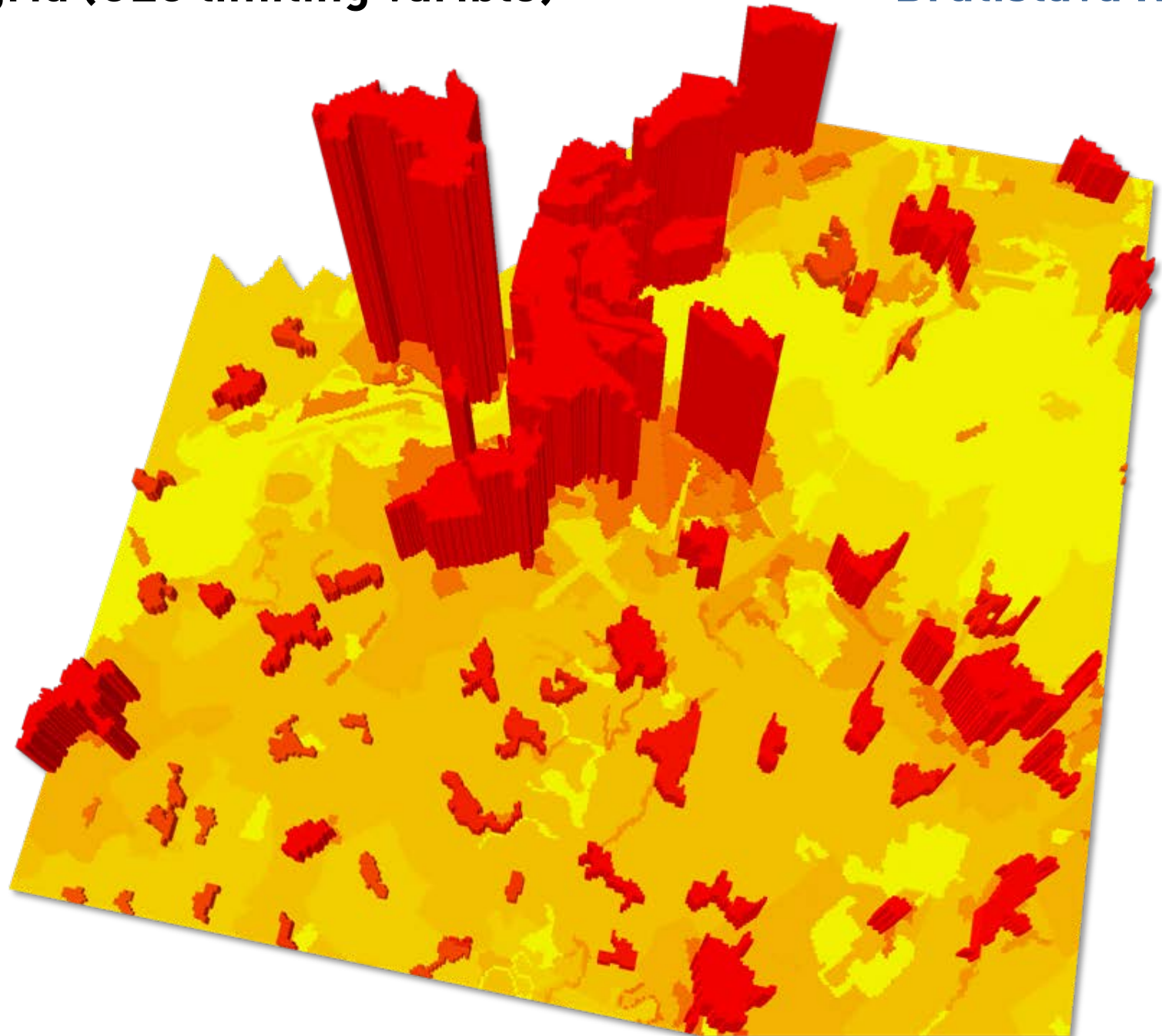
Commune Choropleth Map

Bratislava Region



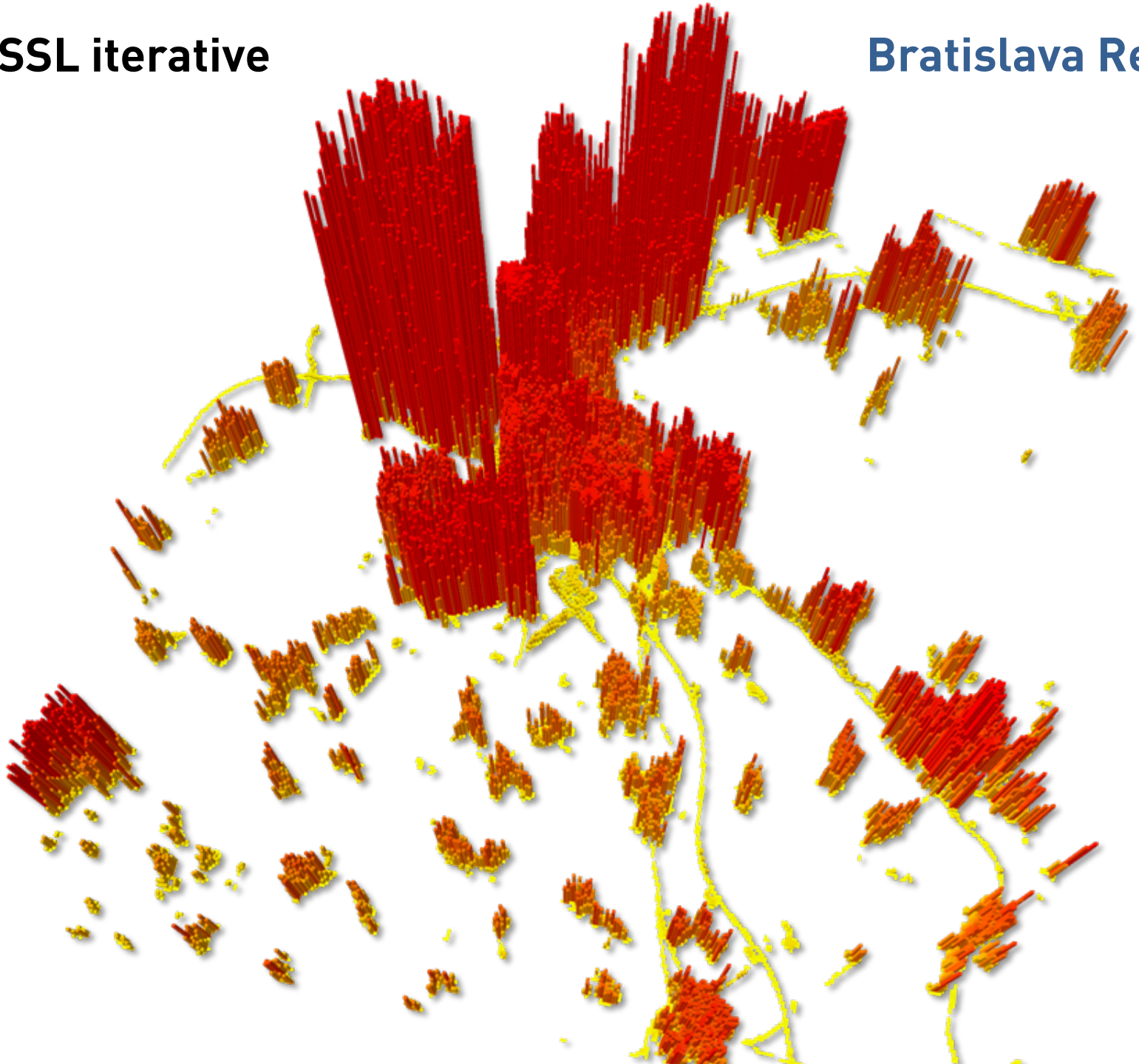
JRC grid (CLC limiting variable)

Bratislava Region



CLC-SSL iterative

Bratislava Region



Conclusions

- The analysis confirmed that the use of more ancillary datasets results in better estimates:
 - SAE of **CLC** limiting variable >
 - > SAE **CLC-SSL** iterative >
 - > SAE of **CLC-SSL-OSM** linear
- Therefore, additional ancillary datasets (Urban Atlas, OpenStreetMap, etc.) should be employed
- Of course, the type and parameters of disaggregation method also influence the accuracy of the estimates – therefore further development of the iterative method should be examined
- The used ancillary datasets allow for expansion of the study area to the EU+ (once the cloud issue is resolved)

Thank you for your attention

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Further reading:

- HURBÁNEK, P., ATKINSON, P. M., PAZÚR, R., ROSINA, K. & CHOCKALINGAM, J. (2010): Accuracy of built-up area mapping in Europe at varying scales and thresholds. In: Tate, N. J. & Fisher, P. F. (eds.): *Accuracy 2010, Proceedings of the Ninth International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences*, 20-23 July 2010, University of Leicester, International Spatial Accuracy Research Association (ISARA), 385-388.
Available at: <http://www.spatial-accuracy.org/HurbanekAccuracy2010>
- ROSINA, K. & HURBÁNEK, P. (2012). An iterative method for dasymetric mapping of population density based on European land monitoring services / Iteratívna metóda dasymetrického mapovania hustoty zaľudnenia na báze európskych služieb pre monitoring krajiny. *Cartographic letters / Kartografické listy*, 20(2). ISSN 1336-5274 (In Slovak)
- ROSINA, K., HURBÁNEK, P. & ATKINSON, P. M. (2012). Spatial disaggregation of population data using maps of land cover and imperviousness / Priestorová dezagregácia populačných dát s využitím máp krajinej pokrývky a nepriepustnosti povrchu. In: *Symposium GIS Ostrava 2012 proceedings*. ISBN 978-80-248-2558-8 (In Slovak)
Available at: http://gis.vsb.cz/GIS_Ostrava/GIS_Ova_2012/sbornik/papers/rosina.pdf
- GALLEGO, F. J. & PEEDELL, S., (2001). Using CORINE Land Cover to map population density. In: *Towards Agrienvironmental indicators*. Topic report 6/2001 European Environment Agency, Copenhagen, 92-103.
- GALLEGO, F. J. (2009). Population density grid of EU-27+, version 5. European Environment Agency.
Available at: <http://www.eea.europa.eu/data-and-maps/data/population-density-disaggregated-with-corine-land-cover-2000-2>
- GALLEGO, F. J. (2010). A population density grid of the European Union. *Population and Environment*, 31, 460-473.