



EUROPEAN FORUM FOR GEOSTATISTICS  
**SOFIA CONFERENCE 2013**  
23-25 October, Bulgaria



## PROTOTYPE OF BULGARIAN POPULATION GRID 2011

*Hybrid solution in producing grid statistics*

*Day 2, October, 24 / Established practices – Work Session 1*

NATIONAL STATISTICAL INSTITUTE  
OF THE REPUBLIC OF BULGARIA

*Mrs. Irena DUDOVA*  
*Mr. Arslan AHMEDOV*



## OVERVIEW



GEOSTAT 1B



Production Process



Specify needs, Analyze & Design



Data Collection



Geo-referencing Framework



Generating Population Grid



Analyzing, Testing & Dissemination



The Way Forward...



## GEOSTAT 1B



### GEOSTAT 1B Project

- ESS net project financed by European Commission
- Multi beneficiary project – Norway, Bulgaria, Czech Republic, Estonia, Portugal and Finland
- Started 2012, duration 24 months



### BNSI joins to GEOSTAT 1B as absolute beginner

- Bulgarian NSI has not practical experience in grid production and disaggregation methods
- No production of Grids at National level
- Not enough sources of high resolution Spatial data for whole territory of Bulgaria

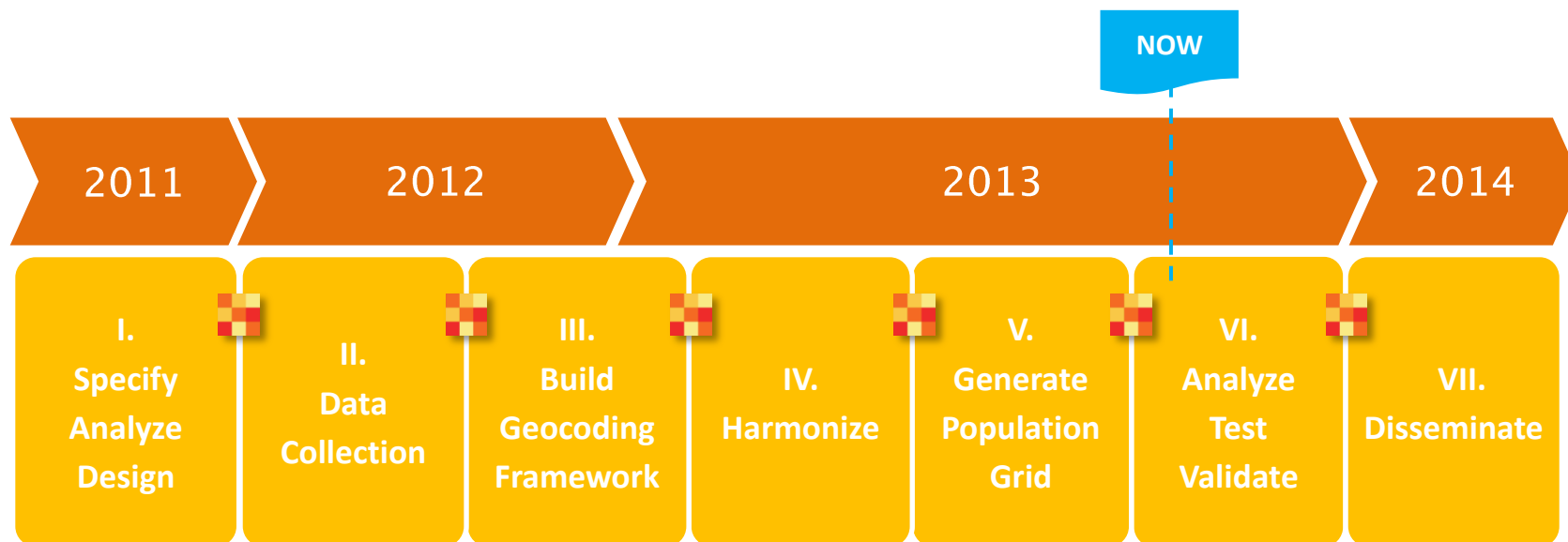


### Tasks of BNSI in the Geostat 1B Project

- Population distribution of Bulgaria per 1 sq. km grid net - **INSPIRE compliant**
- Geostatistics by Disaggregation or mixed methods
- Use case studies to illustrate the advantages with the use of datasets produced according to these methods



## PRODUCTION PROCESS





## SPECIFY NEEDS, ANALYZE & DESIGN



**Specify needs** according the tasks of the project and **available data sources**

- Census 2011 data
- Point-based data - in our case address locations
- Area-based data
- Methods for generating population grid



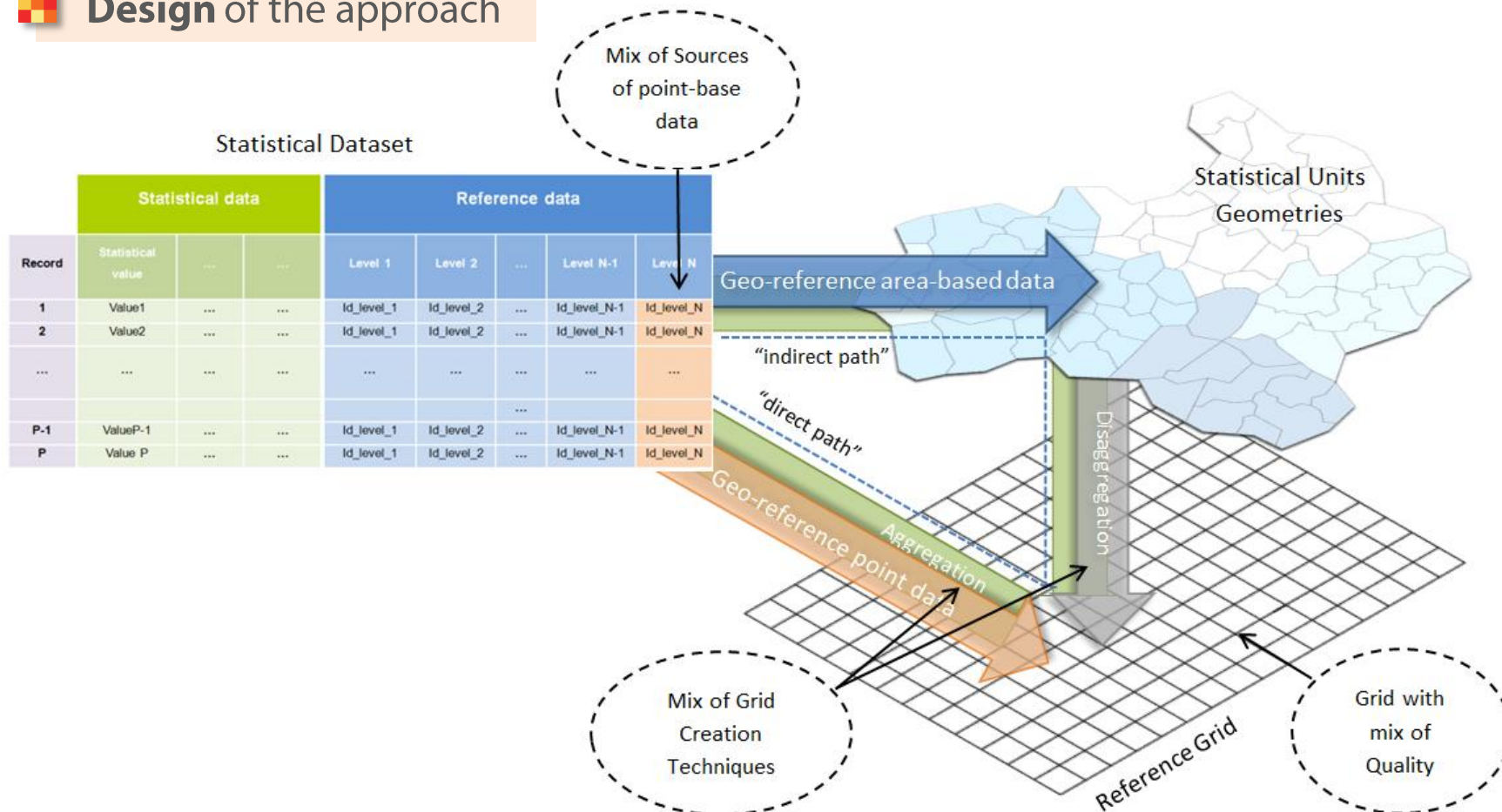
**Analyze** every available source for coverage and incompleteness



## SPECIFY NEEDS, ANALYZE & DESIGN



### Design of the approach





## DATA COLLECTION

Dataset	Type	Coverage	Coordinate systems	Source
Census 2011	Statistical	FULL		BNSI
Census Enumeration Areas	Area-based	PARTIAL	1970, Sofia, 1950	BNSI
Grid 1 sq.km	Area-based	FULL	ETRS89_LAEA	Eurostat, EC
Points of the addresses	Point-based	PARTIAL	1970, Sofia, 1950	Bulgarian Cadastral Agency
Centroids of parcels	Point-based	PARTIAL	1970, Sofia, 1950	Bulgarian Cadastral Agency
Borders of Administrative Units	Area-based	FULL	WGS 1984 35N	Ministry of Agriculture and Foods
High resolution populated and build-up areas with land use and settlement codes	Area-based	PARTIAL (~95%)	WGS 1984 35N	Ministry of Agriculture and Foods
Urban Atlas	Area-based	PARTIAL	ETRS89_LAEA	DG Regional and Urban Policy, EC



### Difficulties



**Coverage and Incompleteness of the data**



**Formats of the datasets**



**Harmonization of the coordinate systems**



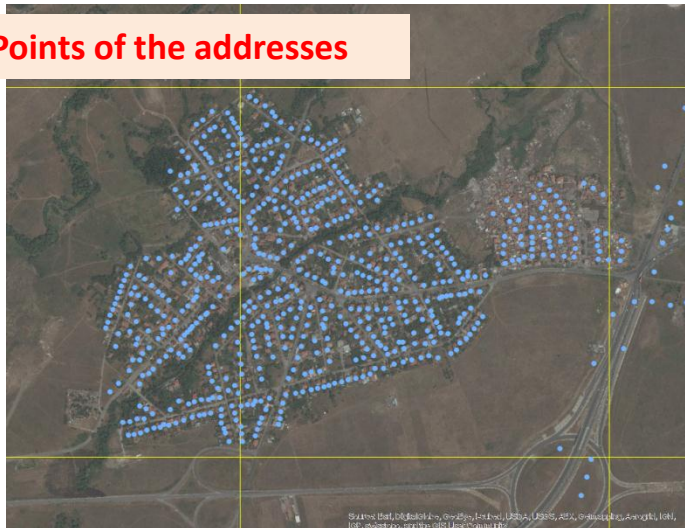
**Working infrastructure doesn't exist**



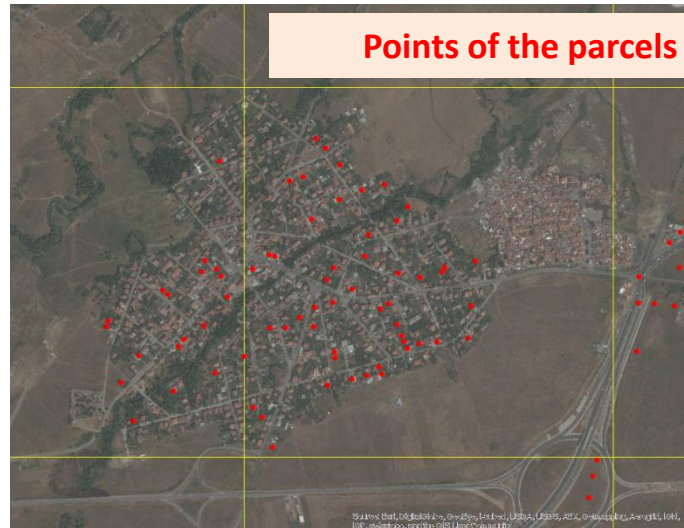


## DATA COLLECTION

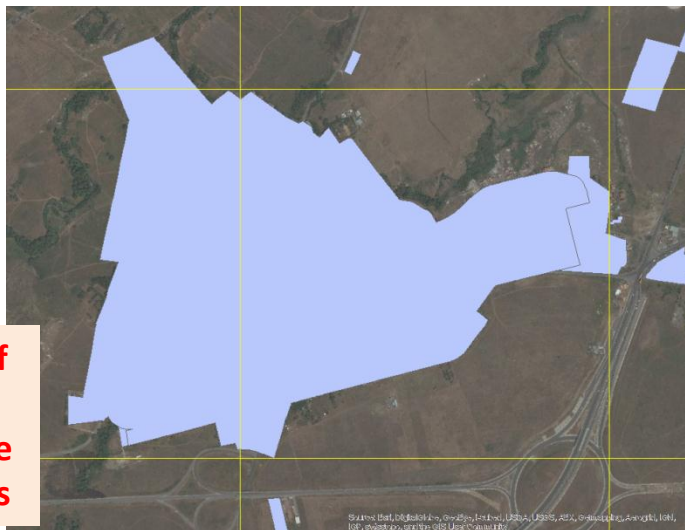
**Points of the addresses**



**Points of the parcels**



**Polygons of  
Populated  
Areas of the  
settlements**



**Urban Atlas  
Polygons**







## RESOLUTION OF STATISTICS

V1	V2	V3	V4	V5	V6	District	Municipality	Settlement	StreetCode	AddressC
1	1	2	3	2	2	24	2431	68850	08895	688500889500170
1	1	1	4	2	2	24	2431	68850	09069	688500906900620
1	1	1	4	2	2	24	2431	68850	01266	688500126601970
1	1	3	2	2	2	24	2431	68970	90001	68970900010006A
1	1	3	2	2	2	24	2431	68970	90001	68970900010006B
6	3	2	4	2	2	24	2431	70202	90023	702029002300040
1	1	1	3	2	2	24	2431	70202	90001	702029000100500
1	1	2	3	2	2	24	2431	70202	90009	702029000900020
1	1	1	3	2	2	24	2427	70586	04697	705860469700020
1	1	2	2	2	2	24	2427	70586	03277	70586032770034A
		3		2	2	24	2427	72824	90005	728249000500020

Districts



Municipalities



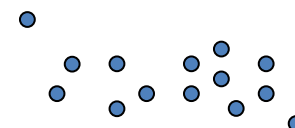
Populated Areas  
of the settlements



Unique Address Key  
Multilevel Locator

70586 03277 0034A

Addresses



Localization Units  
(Street, Boulevard, Square,  
Dwelling Complex, Neighborhood...)





## RESOLUTION OF STATISTICS



### “OBJECT”

Person  
Household  
Dwelling  
Building  
Address  
Census Tract  
Localization Unit  
Settlement  
Municipality  
Districts  
Country

V6	District	Municipality	Settlement	StreetCode	AddressC
24	2431	2431	68850	08895	688500889500170
24	2431	2431	68850	09069	688500906900620
24	2431	2431	68850	01266	688500126601970
24	2431	2431	68970	90001	68970900010006A
24	2431	2431	68970	90001	689709000100065
24	2431	2431	70202	90023	702029002300040
24	2431	2431	70202	90001	702029000100500
24	2431	2431	70202	90009	702029000900020
24	2427	2427	70586	04697	705860469700020
24	2427	2427	70586	03277	70586032770034A
24	2427	2427	72824	90005	728249000500020

**Unique Address Key**  
**Multilevel Locator**

**Municipalities**

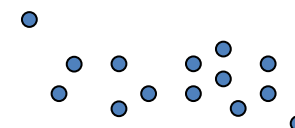


**Populated Areas  
of the settlements**



**70586 03277 0034A**

**Addresses**



**Localization Units**  
(Street, Boulevard, Square,  
Dwelling Complex, Neighborhood...)





## DATA INTEGRATION

### Statistics

#### Statistical dataset

Statistical data						Reference data			
V1	V2	V3	V4	V5	V6	D1	D2	D3	D4
1	1	1	4	2	2	24	2431	08850	08895
1	1	1	4	2	2	24	2431	68850	09069
1	1	1	4	2	2	24	2431	68850	01266
1	1	3	2	2	2	24	2431	68970	90002
1	1	3	2	2	2	24	2431	68970	90001
6	3	2	4	2	2	24	2431	70202	90023
1	1	1	3	2	2	24	2431	70202	90001
1	1	2	3	2	2	24	2431	70207	90009
1	1	1	3	2	2	24	2427	70586	04697
1	1	2	2	2	2	24	2427	70586	03277
1	1	1	3	2	2	24	2427	72824	90005
1	1	1	3	2	2	24	2427	72824	90006
1	1	1	3	2	2	24	2431	77431	00005
1	1	1	3	2	2	24	2431	77476	09216
1	1	2	4	2	2	24	2431	77476	08259
1	3	1	4	2	2	24	2431	77476	08228
1	1	2	2	2	2	24	2431	77476	07404
1	3	1	4	2	2	24	2431	77476	09799
1	1	1	4	2	2	24	2436	81414	07702
1	1	1	3	2	2	24	2436	81414	01119
1	1	1	3	2	2	24	2436	81414	06046
1	1	1	3	2	2	24	2436	81414	06029
1	1	2	3	2	2	24	2436	81414	04529
1	1	1	4	2	2	24	2436	81414	06001
1	3	1	3	2	2	25	2502	00518	00477
1	1	2	3	2	2	25	2502	00518	00477
1	1	1	4	2	2	25	2535	03037	00028
1	1	1	4	2	2	25	2535	03037	00031
1	1	2	6	2	2	25	2535	03037	00031
1	1	2	6	2	2	25	2535	03037	00028
1	1	2	6	2	2	25	2535	03037	00151
1	1	2	6	2	2	25	2522	03647	02155

District codes (UCATTU\*)

Municipality codes (UCATTU\*)

Settlement codes (UCATTU\*)

National Classification of  
Localization Units

National Classification  
of Addresses

### Geography

#### Map Features

Identifier  
codes

Geometries

Districts



Municipalities



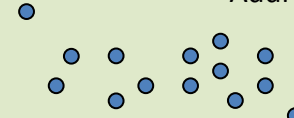
Populated places/  
Settlements



Street, Boulevard, Square,  
Dwelling Complex,  
Neighborhood...



Addresses



\* UCATTU – Unified Classification of Administrative-Territorial and Territorial Units

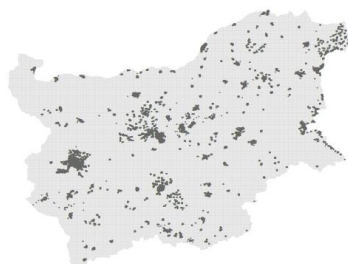
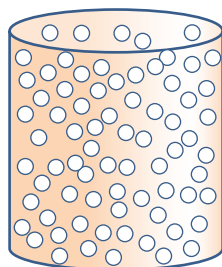


## STEP 1: AGGREGATION PHASE



### Matching Census with geocoded address mass

**Census dataset**  
**Aggregated by building**



**Geocoded Address  
Collection**

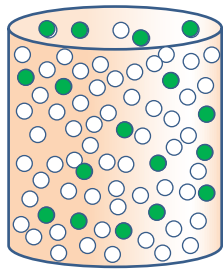


## STEP 1: AGGREGATION PHASE

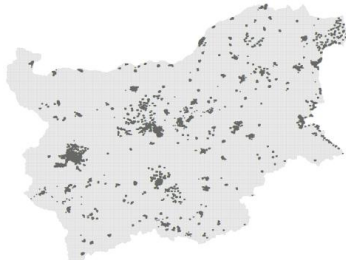


### Matching Census with geocoded address mass

**Census dataset**  
**Aggregated by building**



**Match  
address**



**Geocoded Address  
Collection**

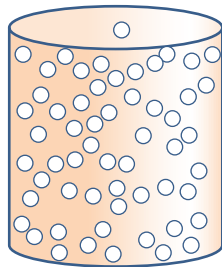


## STEP 1: AGGREGATION PHASE

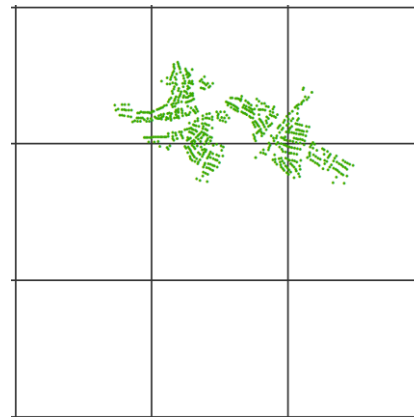


### Matching Census with geocoded address mass

Census dataset  
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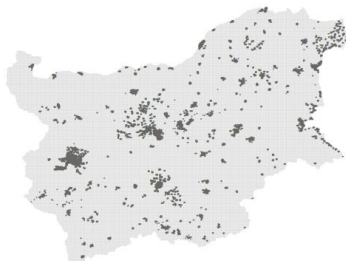


Geocoded census buildings to address points



Statistics aggregated by grids

186	1198	292
	371	289



Geocoded Address  
Collection

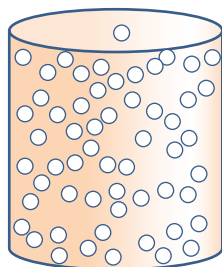


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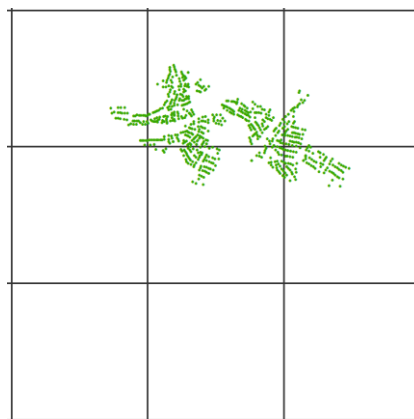


### Matching Census with geocoded address mass

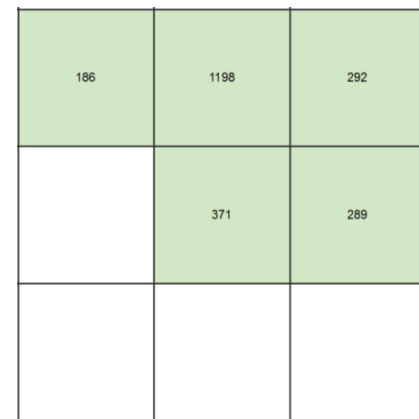
Census dataset  
Aggregated by building



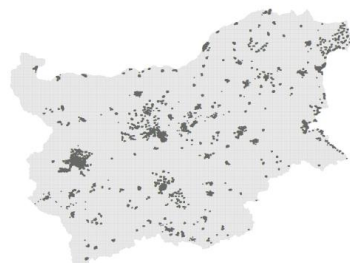
Geocoded census buildings to address points



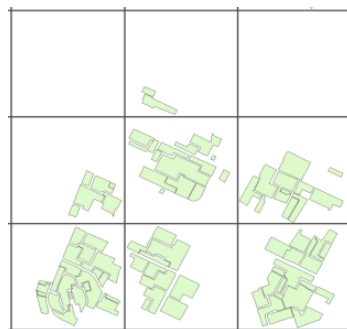
Statistics aggregated by grids



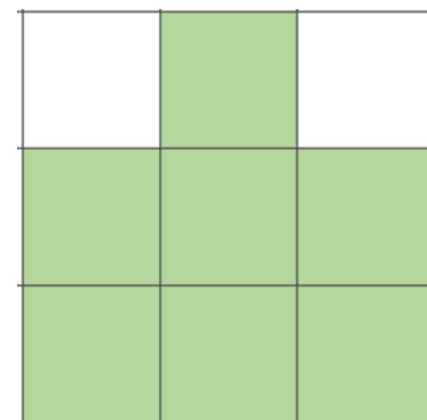
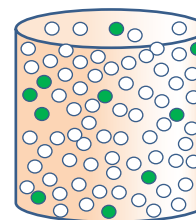
### Additional steps in Aggregation phase (Available census tracts geometries that are inside grid geometries)



Geocoded Address  
Collection



Geometries of census tracts



Statistics aggregated by grids



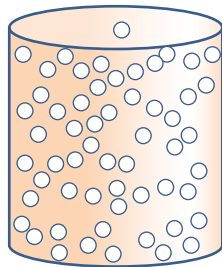


## STEP 1: AGGREGATION PHASE

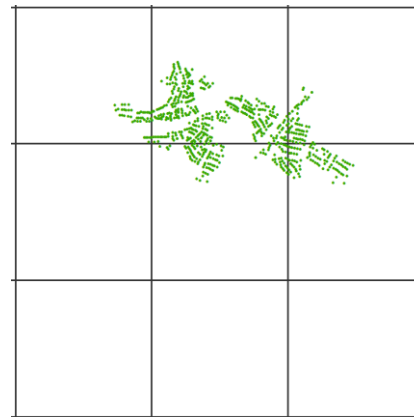


### Matching Census with geocoded address mass

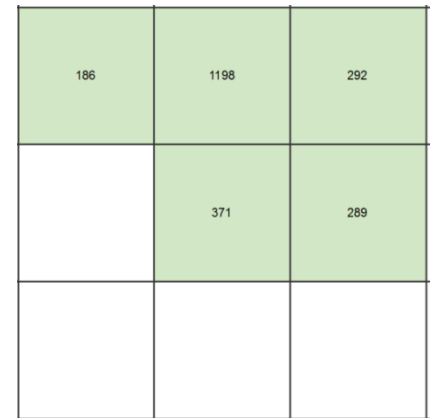
Census dataset  
Aggregated by building



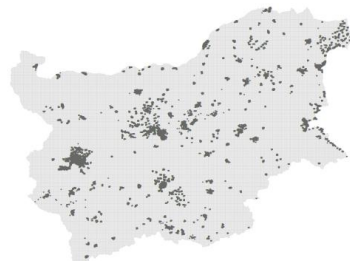
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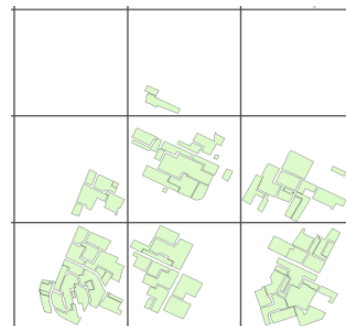
Statistics aggregated by grids



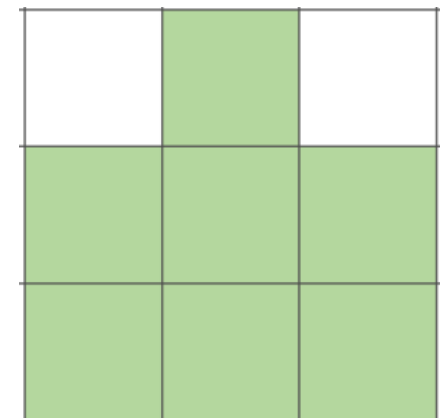
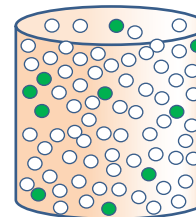
**Additional steps in Aggregation phase**  
(Available census tracts geometries that are inside grid geometries)



Geocoded Address  
Collection



Geometries of census tracts



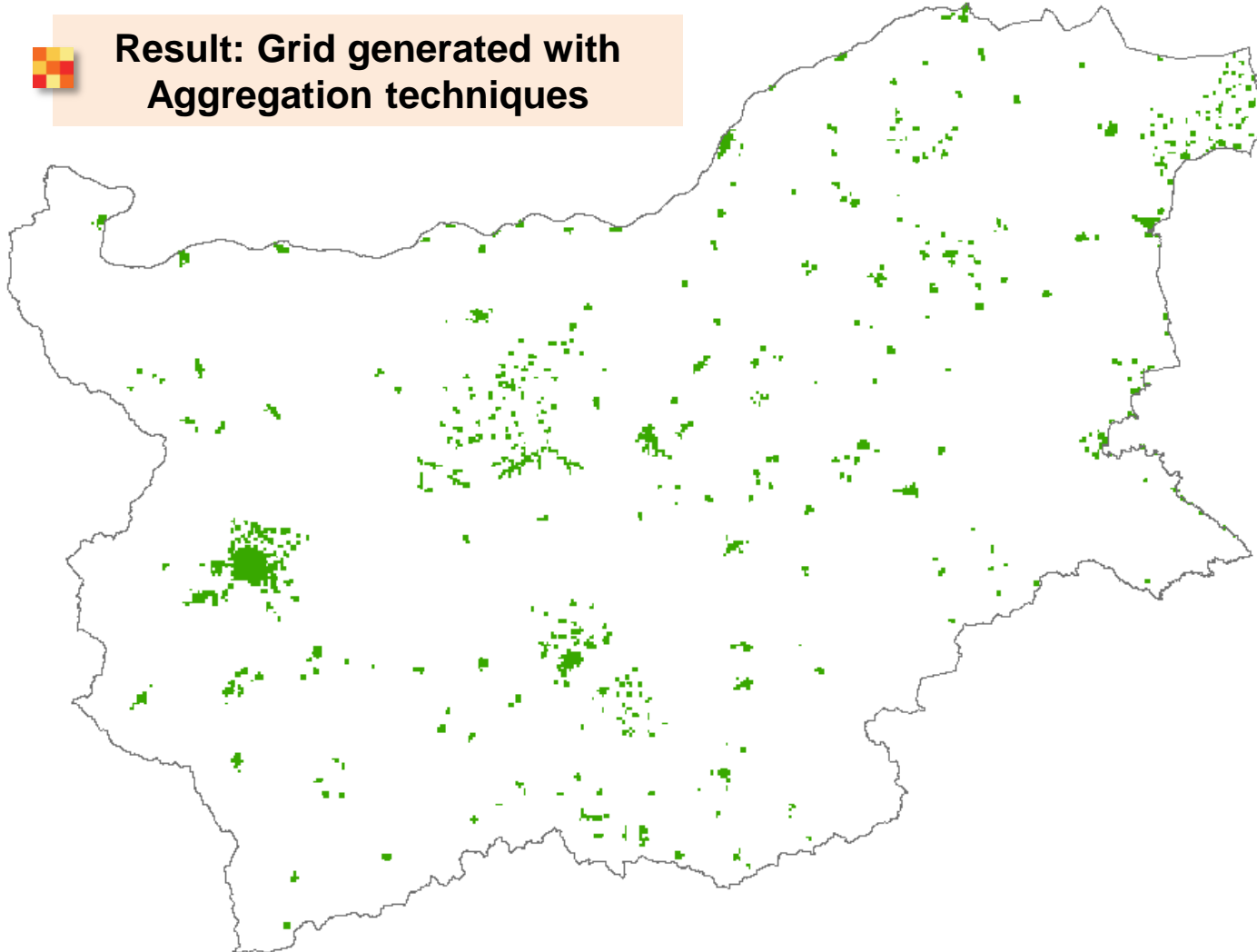
Statistics aggregated by grids



## STEP 1: AGGREGATION PHASE



**Result: Grid generated with  
Aggregation techniques**



**Statistics aggregated by grids**

186	1198	292
	371	289






## STEP 2 & 3: DISAGGREGATION PHASE



**Matching Census “objects”  
with map feature of the “object”**



**Localization Units**

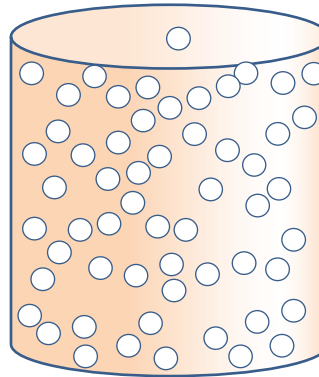


**Urban Atlas**



**Populated Areas  
of the settlements**

**Census dataset  
Aggregated by “object”**



**Binary Dasymetric  
(Populated Areas/Unpopulated Areas)**



**Assuming uniform density inside the “object”**



## STEP 2 & 3: DISAGGREGATION PHASE



**Matching Census “objects”  
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**Localization Units**



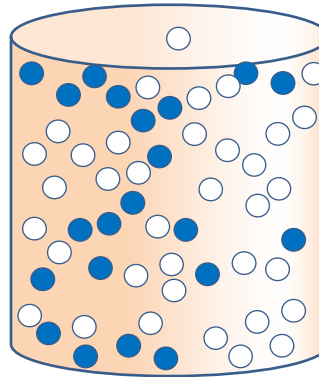
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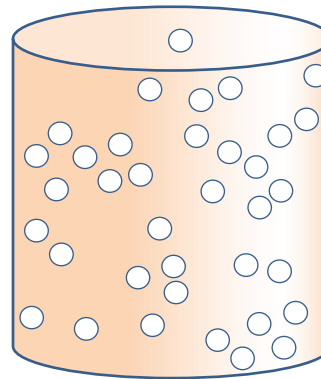


**Urban Atlas**

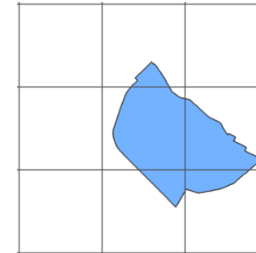


**Populated Areas  
of the settlements**

**Census dataset  
Aggregated by “object”**



**Map features  
of “the objects”**



**Disaggregation  
by grids**

	21	
210		124
38		44



**Binary Dasymetric  
(Populated Areas/Unpopulated Areas)**



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## STEP 2 & 3: DISAGGREGATION PHASE



**Matching Census “objects”  
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**Urban Atlas**

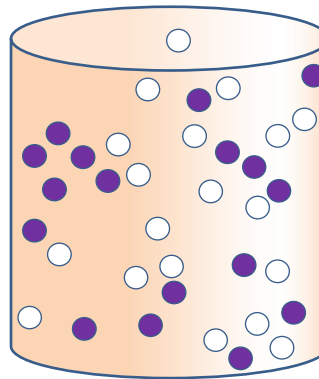


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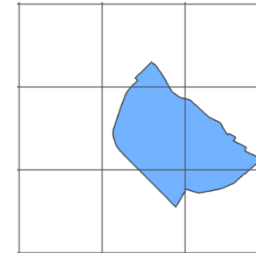
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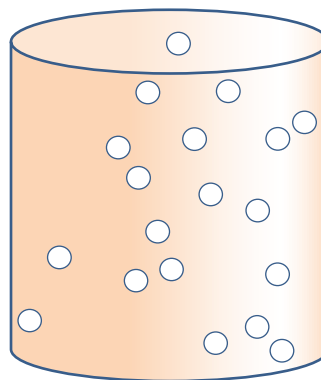


**Urban Atlas**

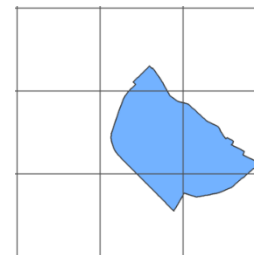


**Populated Areas  
of the settlements**

**Census dataset  
Aggregated by “object”**

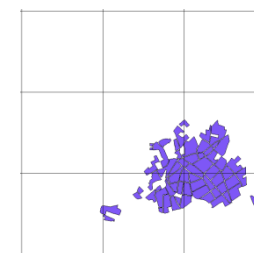


**Map features  
of “the objects”**



**Disaggregation  
by grids**

	21	
	210	124
	38	44



	110	236
2	156	205



**Binary Dasymetric  
(Populated Areas/Unpopulated Areas)**



**Assuming uniform density inside the “object”**





## STEP 2 & 3: DISAGGREGATION PHASE



**Matching Census “objects”  
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**Localization Units**



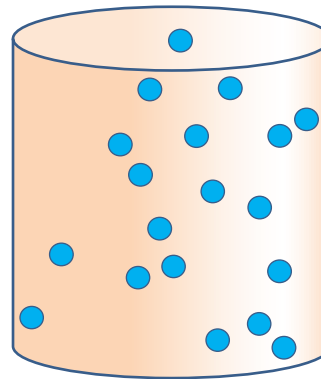
**Urban Atlas**



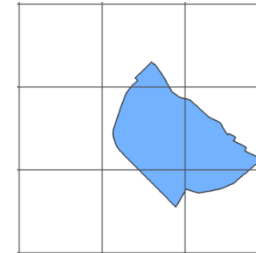
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**Match  
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**Census dataset  
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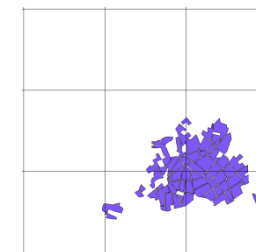


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## STEP 2 & 3: DISAGGREGATION PHASE



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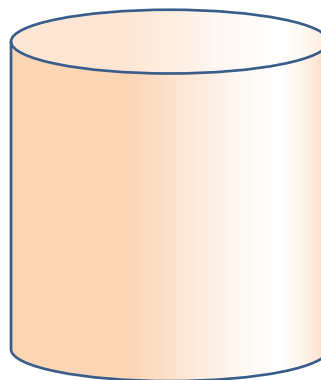


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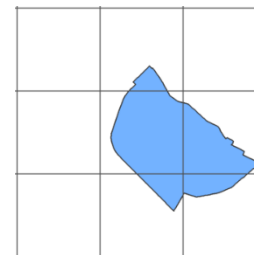


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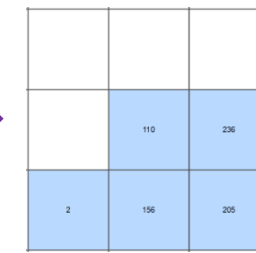
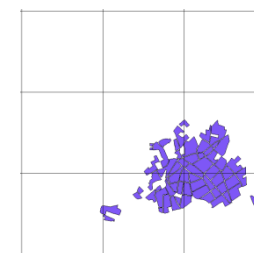
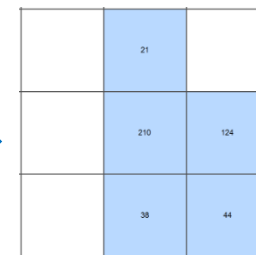
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**Map features  
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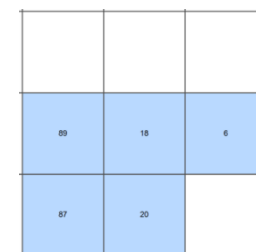
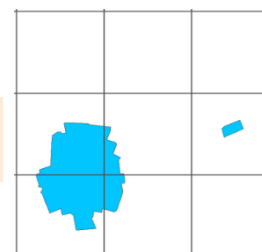
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## STEP 2 & 3: DISAGGREGATION PHASE



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with map feature of the “object”**



**Localization Units**

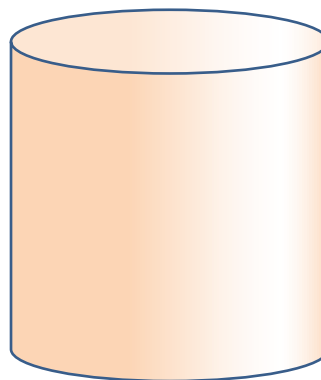


**Urban Atlas**



**Populated Areas  
of the settlements**

**Census dataset  
Aggregated by “object”**

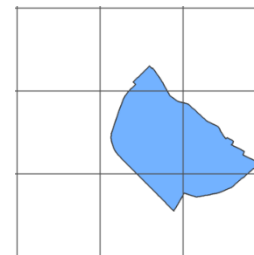


**Binary Dasymetric  
(Populated Areas/Unpopulated Areas)**

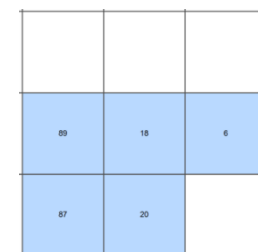
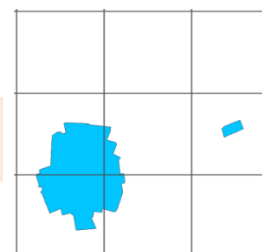
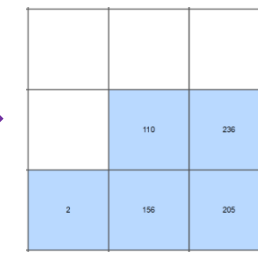
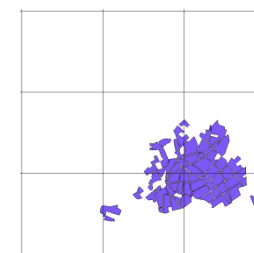
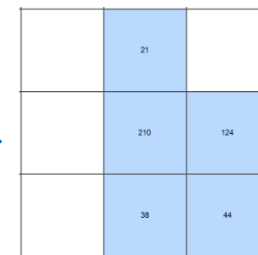


**Assuming uniform density inside the “object”**

**Map features  
of “the objects”**



**Disaggregation  
by grids**

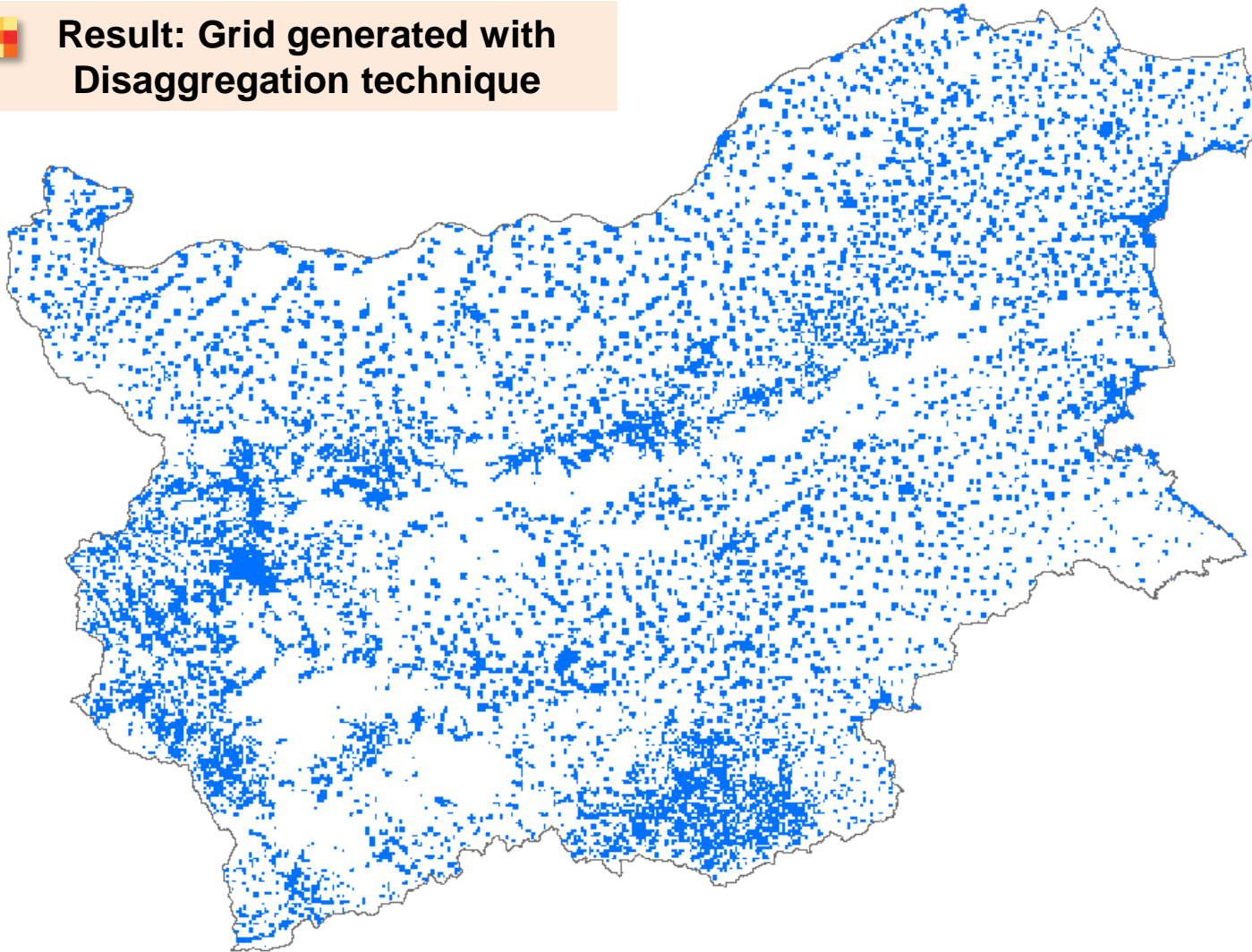




## STEP 2 & 3: DISAGGREGATION PHASE



**Result: Grid generated with  
Disaggregation technique**



	21	
	210	124
	38	44

+

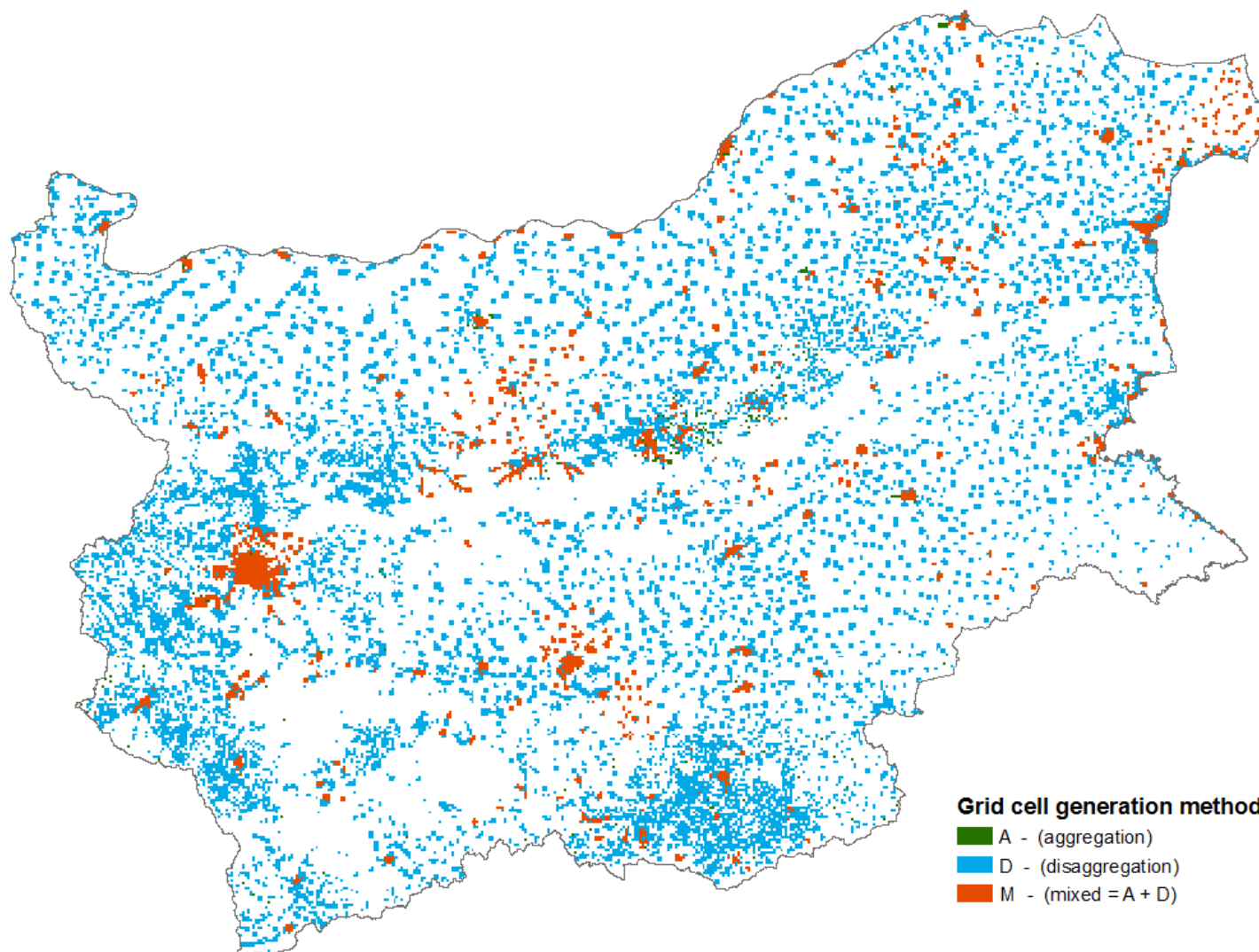
	110	236
2	156	205

+

89	18	6
87	20	

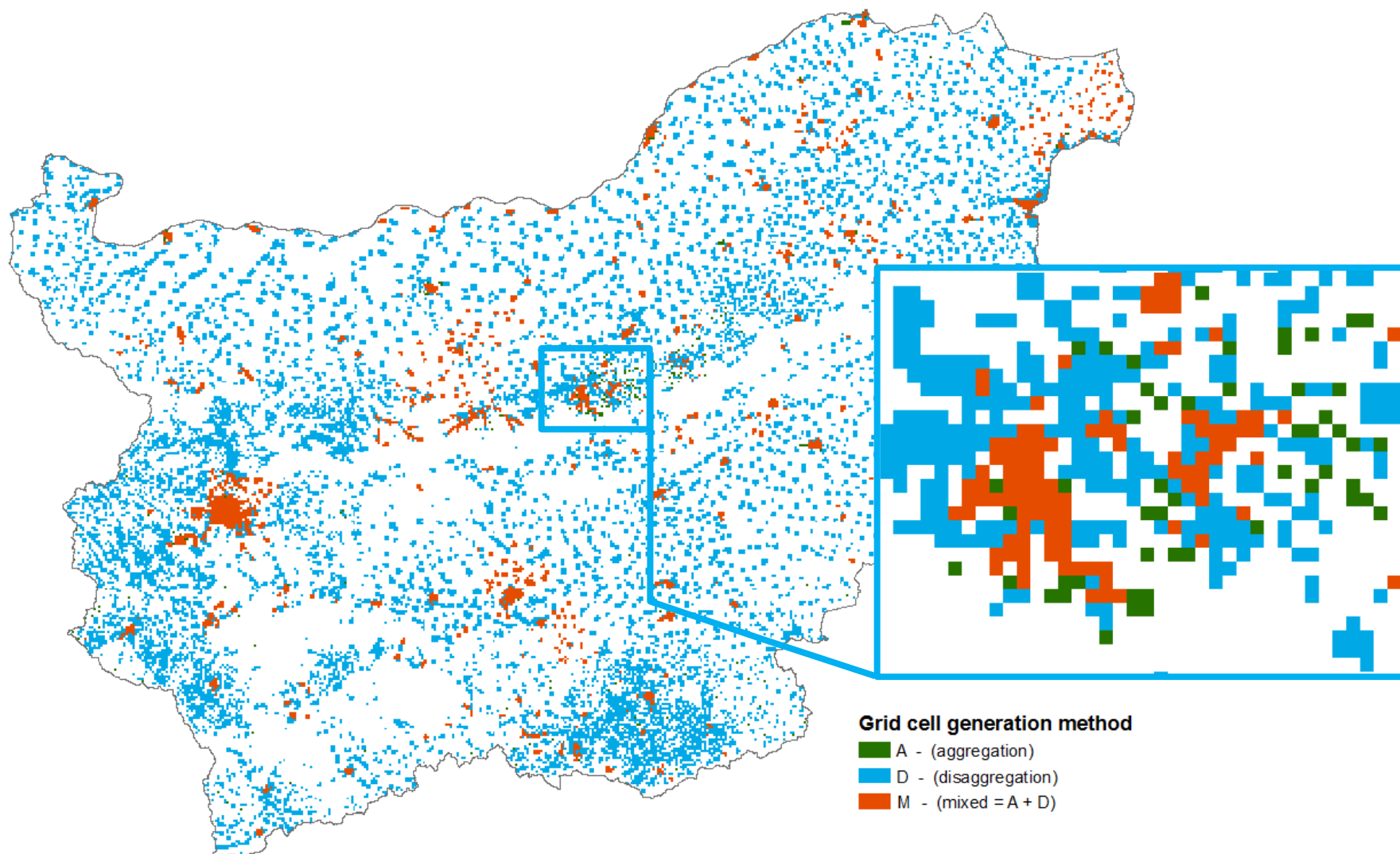


## POPULATION GRID BY GENERATION METHOD

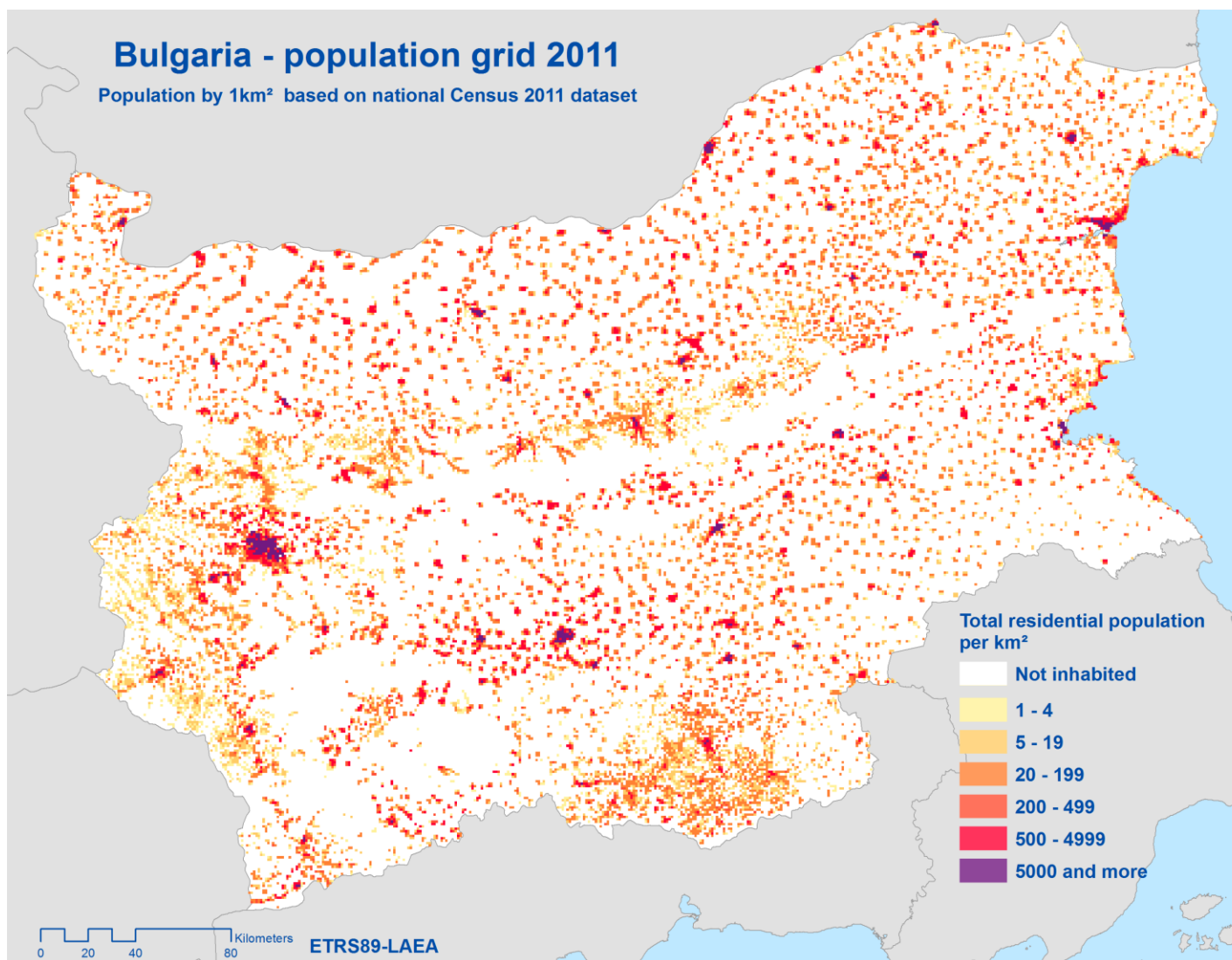




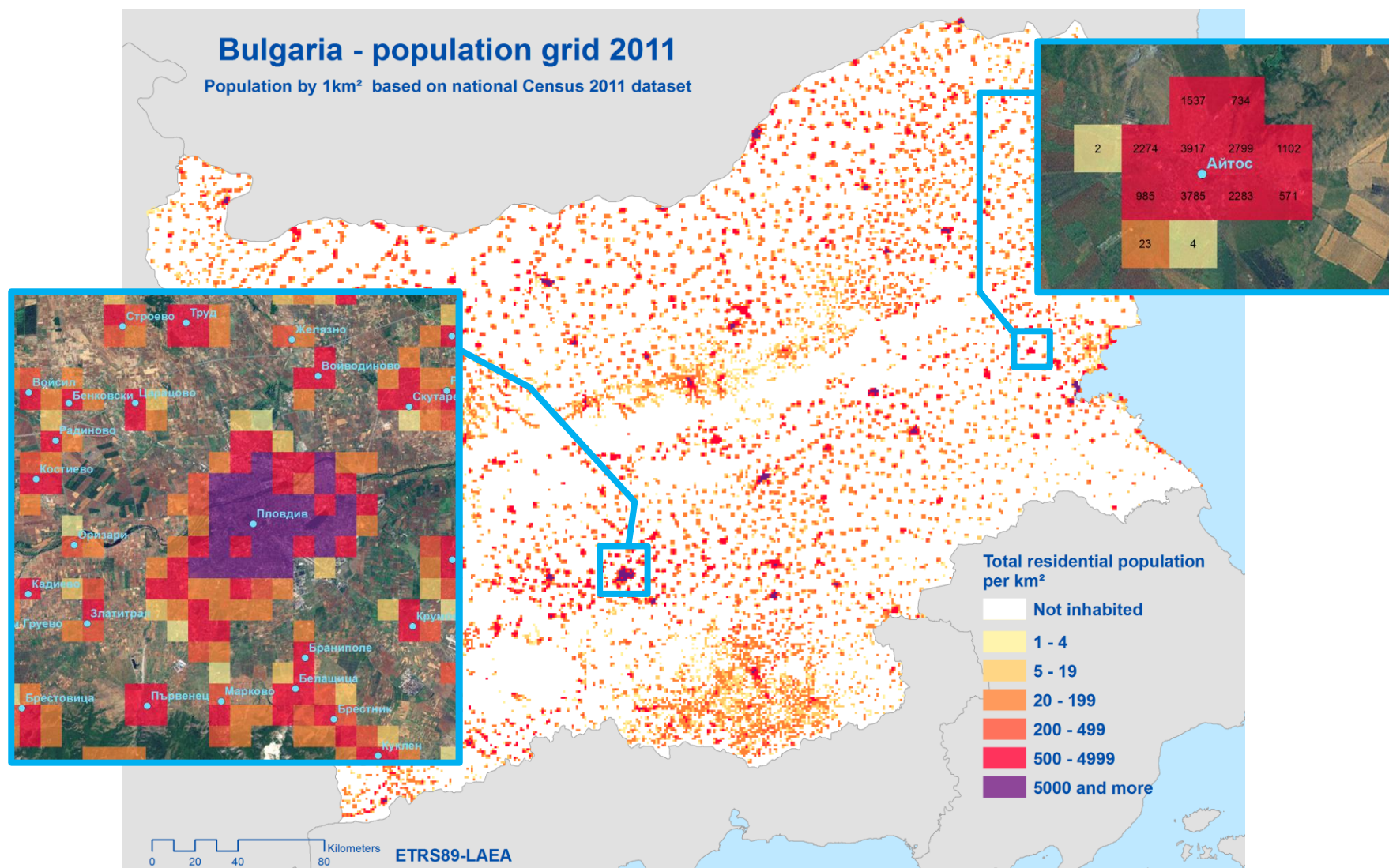
## POPULATION GRID BY GENERATION METHOD













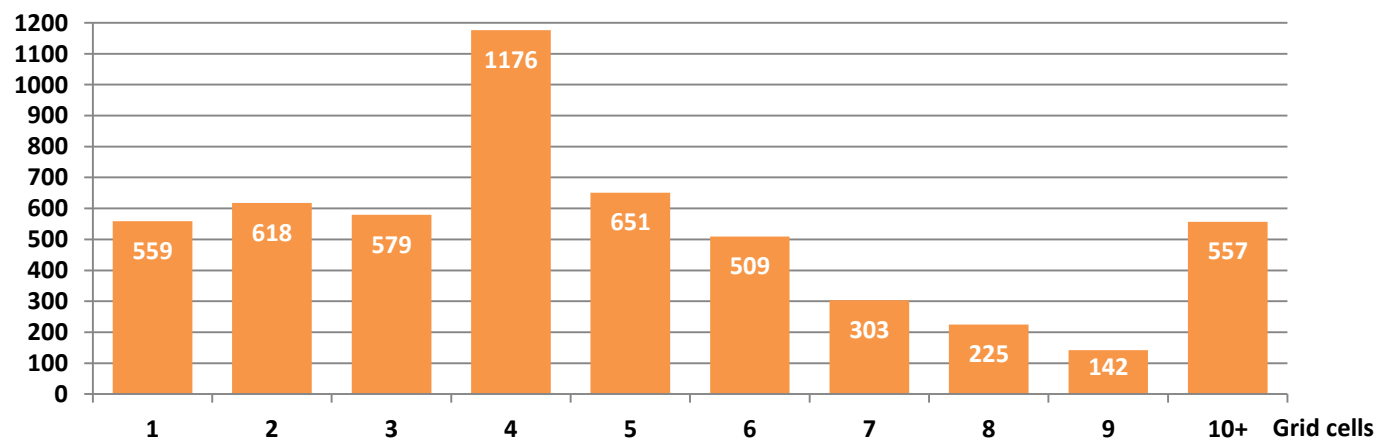
## STATISTICS ABOUT THE RESULTS

METHODS			SETTLEMENTS COVERED BY THE METHOD	POPULATION DISTRIBUTED BY THE METHOD	
AGREGATION	Address Points + census tracts		569	4205641	57.1%
	Settlements Points		361	450	
DISAGGREGATION	Localization Units	Binary	3	200490	42.9%
	Urban Atlas	Binary	376	399630	
	Populated and Build-up Areas	Binary	4562	2558359	
				<b>7 364 570</b>	<b>100%</b>



### Number of settlements by number of grid cells they cover

Number of settlements



**Total Population of Bulgaria  
according Census 2011**



## ANALYZING & DISSEMINATION



### Analyzing

- Generated grid
- Validation
- Test



### Dissemination

- Metadata – INSPIRE compliant
- Licenses policy
- Confidentiality issues
- Disclosure control
- Dissemination by internet (downloadable dataset) and users requests



## THE WAY FORWARD...

*The work beyond the project GEOSTAT 1B*



Working on the address collection



Development of Spatial Units Dataset



Disaggregation Methods



Producing a grids with higher resolutions



Population Grids as official statistics



Merging statistics with geography



Involvement in National activities for building and harmonization of Spatial Infrastructure of Bulgaria



*Thank you for your attention!*



**Mrs. Irena DUDOVA**

E-mail: [ldudova@nsi.bg](mailto:ldudova@nsi.bg)



**Mr. Arslan AHMEDOV**

E-mail: [aahmedov@nsi.bg](mailto:aahmedov@nsi.bg)