OP KŽP

European Union
Cohesion Fund

MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC

SLOVAK ENVIRONMENT AGENCY

SLOVAK ENVIRONMENT AGENCY

is implementing an activity

INTERNATIONAL CONFERENCE
CONTAMINATED SITES
ZNEČISTENÉ ÚZEMIA
MEDZINÁRODNÁ KONFERENCIA

INTERNATIONAL CONFERENCE

CONTAMINATED SITES 2018

BANSKÁ BYSTRICA, SLOVAK REPUBLIC, 8 – 10 OCTOBER 2018

The activity has been implemented within the framework of national project
***Information and providing advice on improving the quality of environment in Slovakia**.*
The project is cofinanced by Cohesion Fund of the EU under Operational programme Quality of Environment.

www.op.kzp.sk *www.minzp.sk* *www.sazp.sk*

Specification of the methodology for the review of clues of contaminated sites obtained with the use of remote sensing

Zdeněk Suchánek, Jaroslav Řeřicha, Jan Krhovský

CENIA, Czech Environmental Information Agency, Czech Republic

zdenek.suchanek@cenia.cz

The activity has been implemented within the framework of national project ***Information and providing advice on improving the quality of environment in Slovakia****.*
The project is cofinanced by Cohesion Fund of the EU under Operational programme Quality of Environment.

OP KŽP

European Union
Cohesion Fund

MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC

SLOVAK ENVIRONMENT AGENCY

CENIA,
Czech Environmental Information Agency
www.cenia.cz

EVROPSKÁ UNIE
Fond soudržnosti
Operační program Životní prostředí

N!KM
národní inventarizace
kontaminovaných míst

Specification of the methodology for the review of clues of contaminated sites obtained with the use of remote sensing methods, and preliminary statistical data on the number and spatial distribution of these clues in the Czech Republic

Zdeněk Suchánek, Jaroslav Řeřicha, Jan Krhovský
CENIA, Czech Environmental Information Agency, Czech Republic

INTERNATIONAL CONFERENCE CONTAMINATED SITES 2018
BANSKÁ BYSTRICA, SLOVAK REPUBLIC, 8 – 10 OCTOBER 2018

Content

0. INTRODUCTION

- **The 1st stage of the NIKM project (metodological backgroud) 2009-2013**

- **The 2nd stage of the NIKM project (2018-2021) is focused on the inventory and evaluation of information on contaminated sites throughout the Czech Republic.**

- **The partial project task "Support of the Inventory by Remote Sensing Methods and Map Services" is taking place from January 2018 to April 2019 and it is provided by CENIA.**

0. INTRODUCTION

- **Inventory methodology includes analysis of raster data (aerial photomaps and satellite images). The supplier's mapping teams for the field inventory will obtain, among other data sources, a data layer containing information about location and the type of clue of the contaminated site.**
- **Used QGIS software**
- **As a mapping unit chosen regional districts - ORP (Municipality with extended competence = "small districts“, there are 206 in Czechia). Their areas are very different in size (the smallest is 45 km^2, while the largest is 1242 km^2)**

1. TYPOLOGY AND KNOWLEDGE BASES OF OBJECTS OF INTEREST

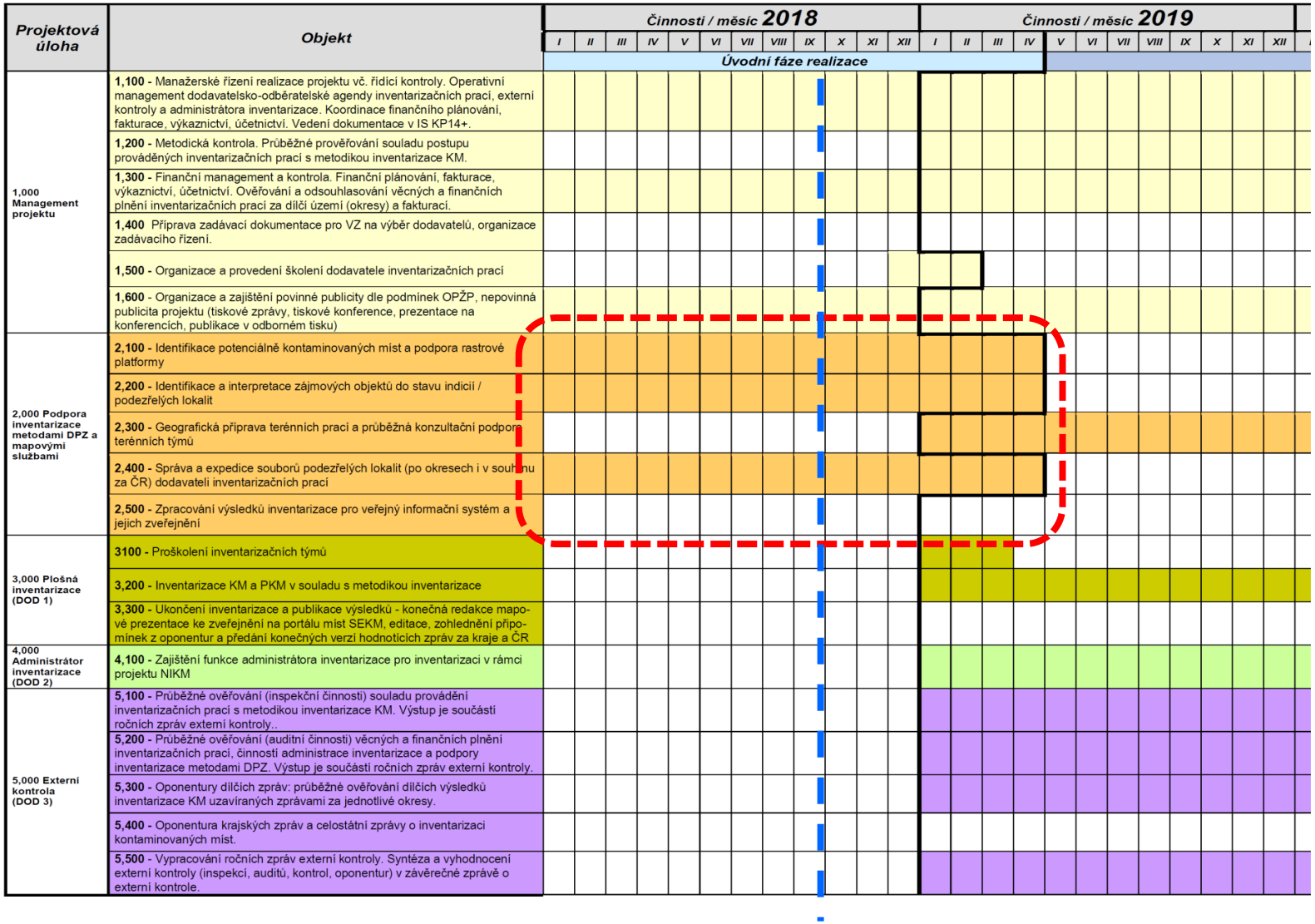
- Types already defined in NIKM I project
- February 2018 - slightly updated - completed with three new types ***b, t*** and ***r***
- The knowledge base - the methodical aid - the interpretative key (manual)

Code	Contamination type	Code	Contamination type
a	industrial park with an impact on the environment	***p***	suspicion of illegal dump site
b	industrial brownfield	***s***	a new clue linked to the site already included in SEKM database
c	illegal dump / landfill	***v***	scrapyard
h	dunghill	***z***	abandoned agriculture object/farm / agricultural brownfield
j	silage pit	***n***	unrecognized, other type of clue
l	abandoned quarry	***t***	waste dumps within the industrial area
o	abandoned property	***r***	object identified only in DMR (Hill Shaded Digital Terrain Model)

2. SCHEDULE AND STATE OF THE INTERPRETATION WORK

- **Work started in early 2018.**
- **In January / February - a preparatory phase: updating and optimization of the methodology for the interpretation of the clues in raster documents and the training of the team for the use of the QGIS software and the development of methodological instructions (interpretation key)**
- **Working standards were set so that the entire task of interpreting the clues would be completed by a set deadline of April 30, 2019.**

2. SCHEDULE AND STATE OF THE INTERPRETATION WORK

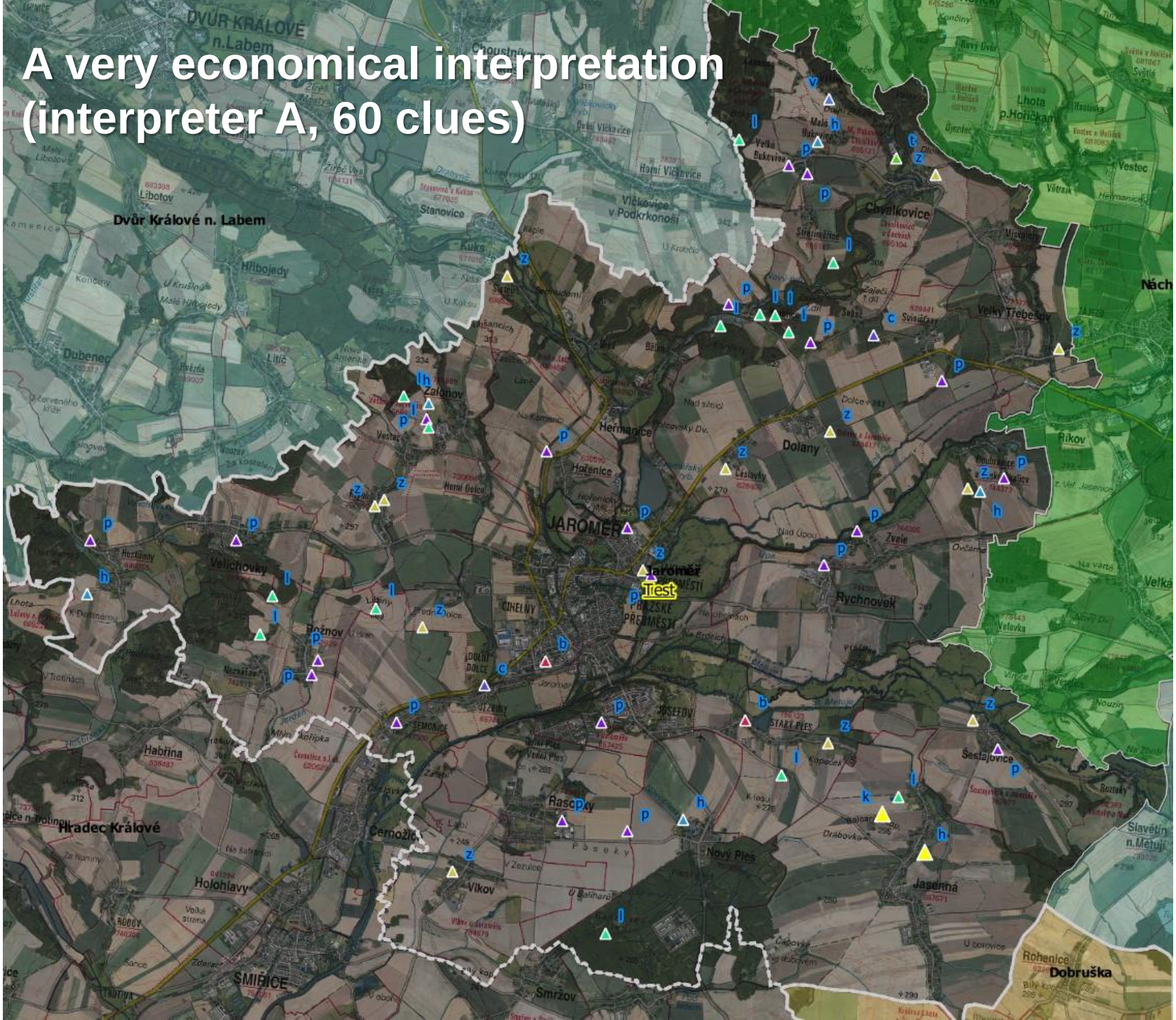


3. STANDARDIZATION OF PHOTOINTERPRETATION OF CLUES FOR USE IN THE REVIEW PROCESS

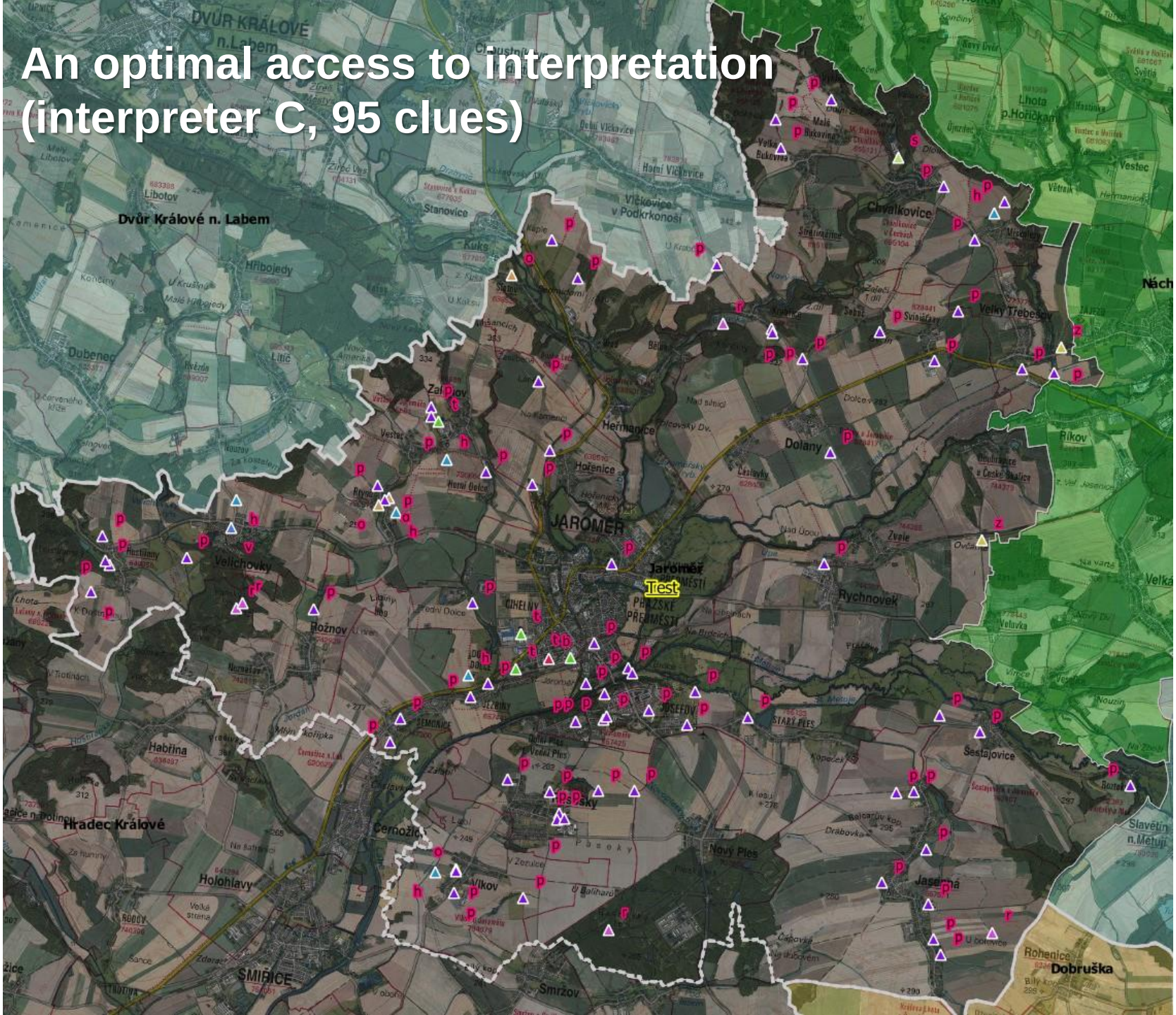
3.1 Simulation of inputs to interpretation and to the review process

- **Interpretation – 12 specialists,** different approaches to evaluations
- **Review - 4 leading reviewers**
- Simulation of different approaches to evaluations
- 4 reviewers carried out an independent interpretation of clues ORP Jaroměř (predominantly industrial and agricultural ORP, area of 139 km$^{2)}$.
- The goal: to homogenize and standardize the quality of the data acquired

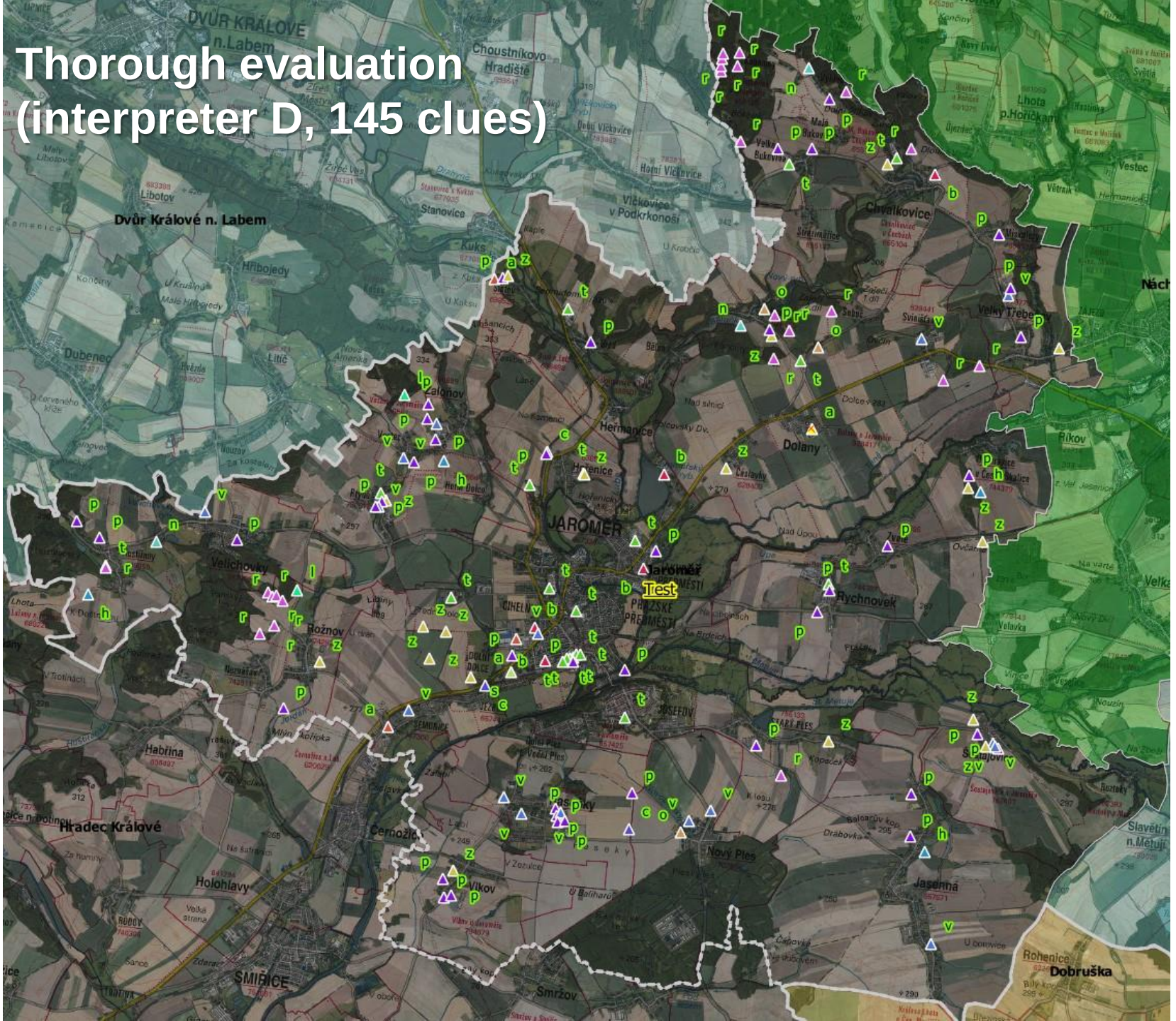
A very economical interpretation (interpreter A, 60 clues)

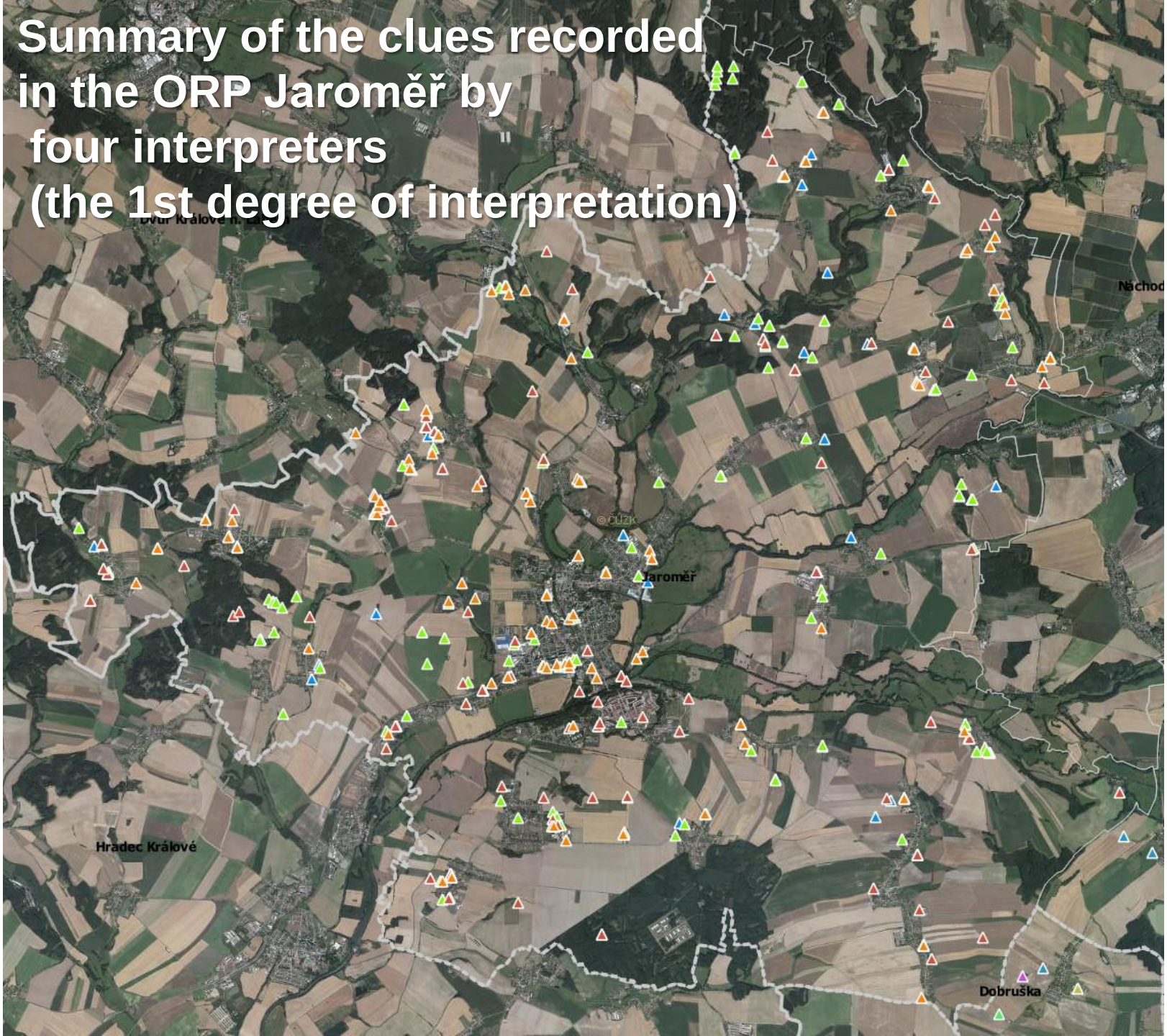


An optimal access to interpretation (interpreter C, 95 clues)



Thorough evaluation (interpreter D, 145 clues)




Summary of the clues recorded
in the ORP Jaroměř by
four interpreters
(the 1st degree of interpretation)
Jaroměř
Hradec Králové
Dobruška

3.2 Comparison of different approaches to the interpretation

The task to select from the collected records only those clues that have to be visited by field groups (economic reasons).
Comparison of the reviewers´ outputs in three steps:

1. **Aggregation of the results of the 1st degree evaluation into one common file in which multiplicities were solved.**

2. **Work on the merged first step output and a review of all recorded clues. A discussion above each record (type; inclusion; exclusion from the final set). Reassignment to a more appropriate type in some cases.**

3. **Merging primary interpretation and review. Removal of redundant and reassignment of misidentified clues (operations within the attribute table in the QGIS sw).**

3.2 Comparison of different approaches to the interpretation

Simulation and standardization of the performance of the 4 reviewers in the ORP Jaroměř

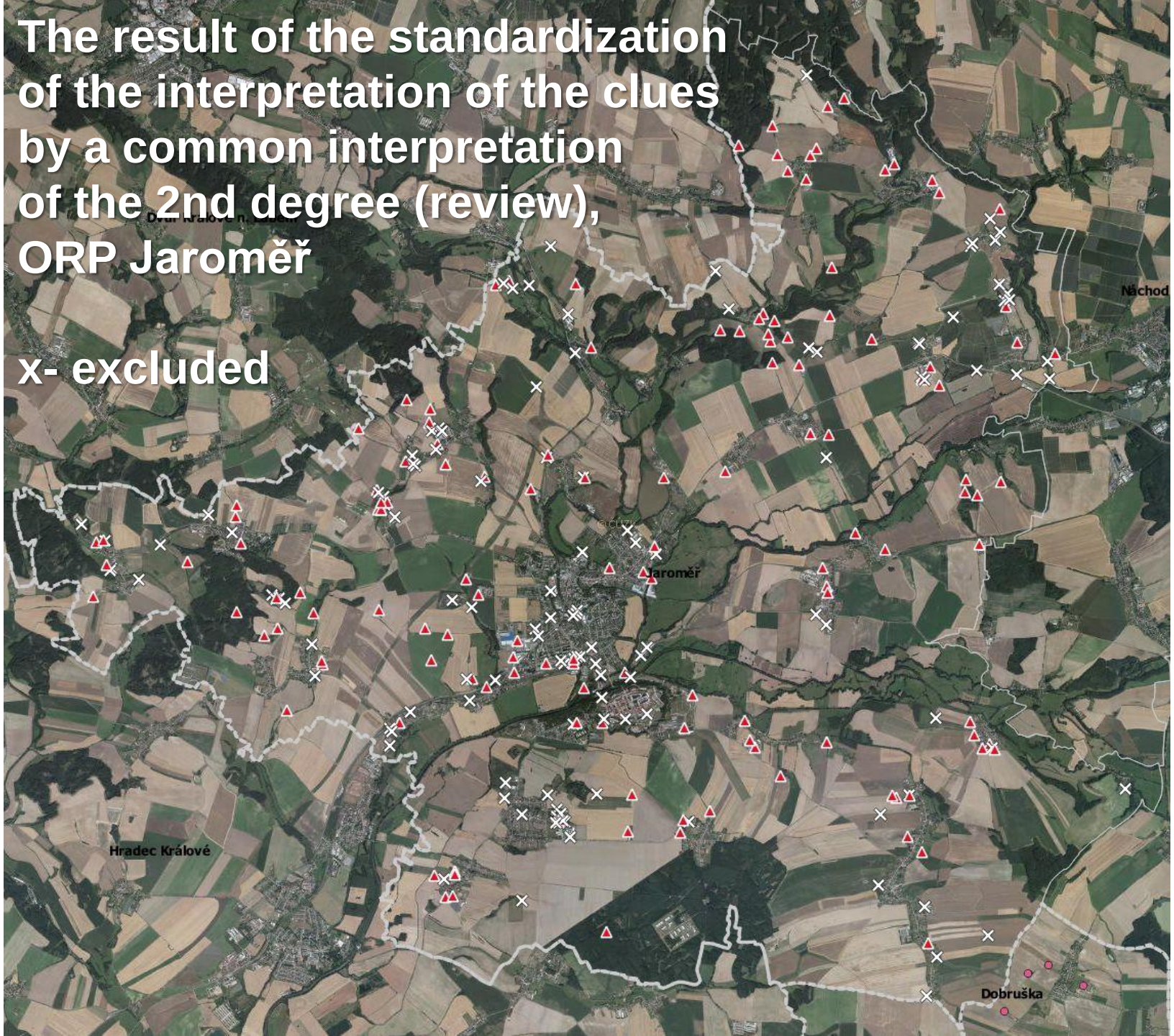
- **Out of the 385 clues (the sum of the interpretations of the 1st degree from 4 interpreters) 139 clues there remain for a mandatory, on-site visit and assessment within the future field survey - see Table.**

- **The result of the standardization of the interpretation** in graphical form. *The white crosses represent excluded clues and the clues prepared for subsequent field investigations are indicated by the red triangles.*

- **The result of the task - a collective, standardized review.**

Data and comments from common interpretation and review of clues in ORP Jaroměř

Type of clue	Interpreters and the signs of their clues in photomaps				No. of clues	Comments and recommendations for reviews
	A	B	C	D		
a	0	0	0	4	**7**	The “a” type includes also agricultural areas, specify in comments (e.g. incudes “p”, “t”, “v”).
b	2	2	1	5	**5**	Do not record individual houses / objects in destruction.
c	2	18	0	3	**3**	Mark only obviously operated landfill, which is not registered in the IPPC and SEKM
h	6	2	6	4	**8**	Mark only long-term and unsecured dunghill, from 100 m^2. Do not delete. Mark “d”.
j	0	3	0	0	**1**	Rare, if possible keep it.
l	14	2	0	2	**16**	Visible in the image even without DMR.
n	0	4	0	3	**3**	If it cannot be assigned to other types, keep it.
o	0	0	4	3	**2**	Do not record individual houses / objects in destruction.
p	21	33	71	41	**63**	The key to include in “p” is the size, which should be at least 20 m^3. Already recorded clues do not delete, just mark “d”. Do not record the earth from excavations and storages of bulk materials (gravel, sand, coal, peat, compost etc.).
r	0	0	5	23	**3**	From the DMR, to assess taking into account the neighbourhood, obvious old quarries mark directly “l”.
s	0	0	1	1	**1**	Mark only new superimposed clues to older SEKM sites.
t	1	17	4	20	**4**	Mark only individual "technological" landfills suspected to risk management, otherwise to mark the whole site as “a”.
v	1	3	1	16	**3**	An irrelevant scrapyard just mark ‚d‘. In case of a small number of up to 5 wrecks on private area do not record if manipulation is not apparent (e.g. dismantling).
z	13	3	2	18	**20**	Do not record individual houses / objects in destruction.
Sum	**60**	**87**	**95**	**143**	**385**	Total number of interpretations from interpreters and sum of all clues. The average number per interpreter is 96 clues.
Number of eliminated multiplicities					**120**	Fusion of the clues of the same type or of different but aggregatable type on one site or on one area.
Number of deleted clues (“d“)					**126**	The clues misinterpreted or non-conforming to size requirement .
Total of discarded clues					**246**	They are not the basis for field survey.
Final number of clues (=385-246)					**139**	Total number of clues after review. In subsequent field survey, they will be required to be visited and assessed. 36% of the original number of clues from the 1st degree of interpretation.


The result of the standardization
of the interpretation of the clues
by a common interpretation
of the 2nd degree (review),
ORP Jaroměř
x- excluded
Náchod
Jaroměř
Hradec Králové
Dobruška

3.3 Standardized output from discussion of interpretations

The exact match of the assessment of the same location even with experienced specialists is quite rare.

Some important insights:

- **Despite a different approach, many clues are placed relatively close to similar clues from another evaluator.**
- **The indices tend to concentrate on certain areas of which have favourable conditions for emergence.**
- **A too economic (“low-density”) approach leads to a lower number of indications from the 1st degree of the evaluation, but there is a risk of omission of significant clues.**

3.3 Standardized output from discussion of interpretations

Some important insights (cont.):

- **Review work with a higher number of clues is paradoxically faster (nearly no risk of significant clue omitting).**

- **Optimal approach - to make a record of medium-density, and then to evaluate each of them in a detailed view, usually above the actual photomap.**

- **The reviewer should no longer go through the whole ORP, but only assess the clues already recorded.**

3.4 Feedback to primary photointerpretation

- **In the case of a larger number of evaluators (12) their different individual approaches have to be taken into account.**

- **These differences are reflected in the collection of primary data, as there are not mathematically precisely defined requirements for data form, but rather the use of personal experiences and their projection into graphic and text recordings in a relatively free form.**

- **The task of the reviewer is to unify and optimize the records. The content of feedback from the reviewer to the primary evaluator is especially important and can help with the quality of input for review.**

3.4 Feedback to primary photointerpretation

The recommendations for evaluators are mainly:

1. **Accurately record the observed phenomena, but avoid obviously unnecessary records.**

2. **Not try to play a role of a reviewer, some important findings could be omitted.**

3. **In case of doubt it is better to record the clue instead of omitting it. If the clue is irrelevant, it will be eliminated in the review process.**

3.5 The procedure for 2nd degree interpretation (review) and the first data acquired from it

- **The process is paradoxically simpler in the case of a sufficient density of clues.**
- **It is enough to browse row by row through the attribute table in the QGIS software environment and display each clue in a scale of 1:1000.**
- **In the case when the reviewer decides to exclude an inappropriate clue, then fills the "d"(deprecated) character in the REV column in the attribute table.**

3.5 The procedure for 2nd degree interpretation (review) and the first data acquired from it

- **If the reviewer finds that the finding is correct but differs from the type of clue, he will enter the correct type of clue in the REV column.**

- **If one of the primary evaluators applies a very restrictive approach with a small number of clues, it is necessary to go through the entire ORP at least briefly, or randomly, for example, on every 10th square (4x4 km), and by a new interpretation to check that obvious clues are not systematically neglected.**

- **The first set of data from the review works is provided in Table.**

3.5 The procedure for 2nd degree interpretation (review) and the first data acquired from it

Summarization of the data from reviews in 4 ORPs (1,8 % of the inventory area of Czechia) by September 10, 2018

ORP	Area in km²	Number of clues			
		1st interpretation	2nd interpretation (review)	Difference	Reduction in %
Jaroměř	138,6	143	139	-4	97
Kutná Hora	643,1	362	171	-191	47
Nepomuk	308,7	139	119	-20	86
Nové Město na M.	292,8	148	104	-44	70
Říčany	377,3	388	271	-117	70
Total	**1 760,5**	**1180**	**804**	**-376**	**67**

3.5 The procedure for 2nd degree interpretation (review) and the first data acquired from it

Summarization of the data from reviews in 15 ORPs (8,5 % of the inventory area of Czechia) by October 1, 2018

ORP	Area in km²	Number of clues			
		1st interpretation	2nd interpretation (review)	Difference	Reduction in %
Benešov	690,01	299	146	-153	49
Bučovice	170,88	67	41	-26	61
Dobruška	279,19	316	75	-241	24
Dobříš	318,41	340	60	-280	18
Hl. m. Praha	496,17	903	445	-458	49
Jaroměř	138,58	143	139	-4	97
Kaplice	484,67	238	116	-122	49
Kutná Hora	643,09	362	171	-191	47
Mladá Boleslav	810,46	452	274	-178	61
Nepomuk	308,73	139	119	-20	86
Nové Město na M.	292,81	148	104	-44	70
Říčany	377,31	388	270	-118	70
Šlapanice	343,12	138	104	-34	75
Tábor	1002,33	521	300	-221	58
Turnov	247,20	218	165	-53	76
Total	**6602,96**	**4672**	**2529**	**-2143**	**54**

SUPPORT FROM STATISTICAL MODELS

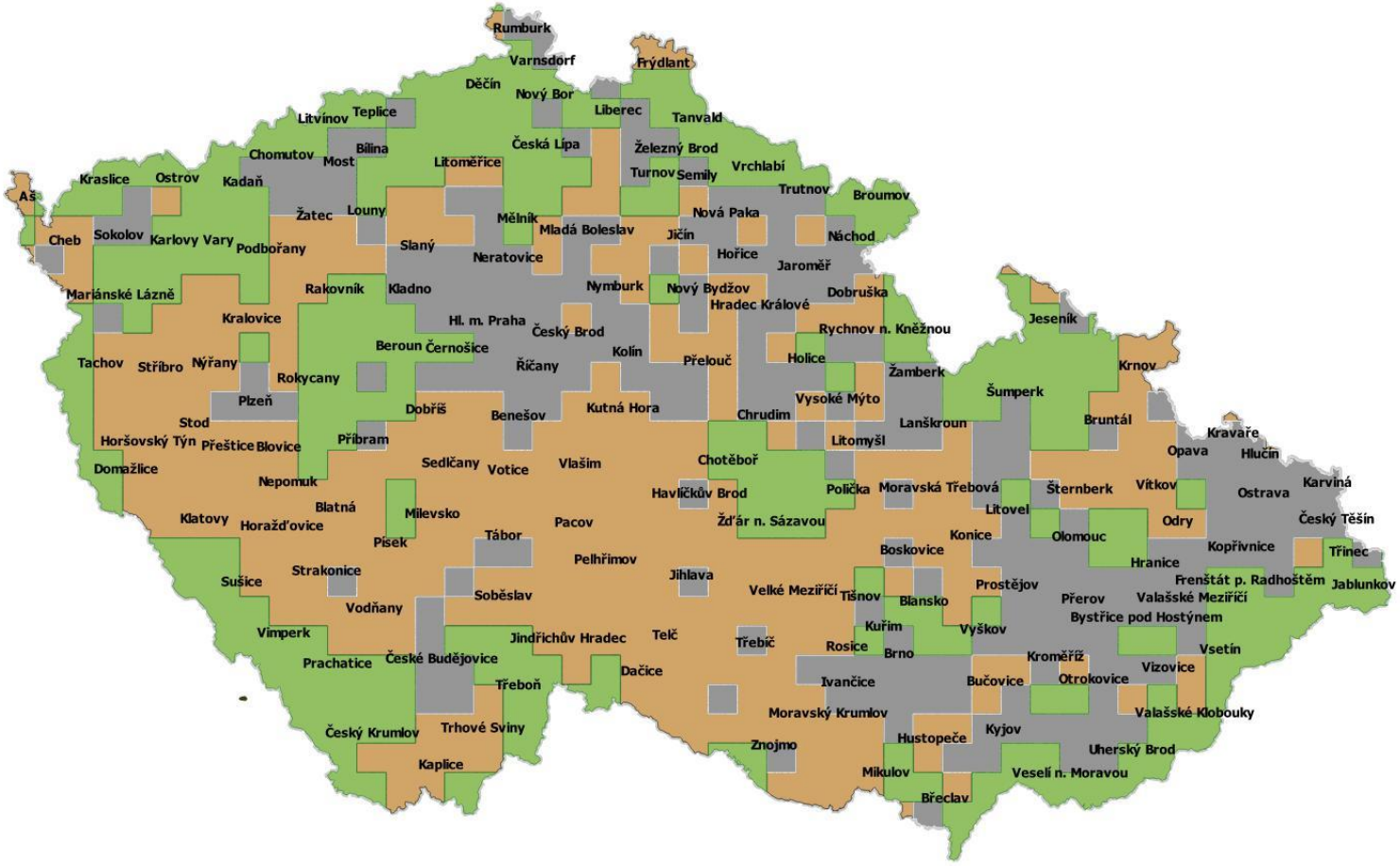
- **Need of planning tools for field works to reflect different types of areas**
- **In the 1st stage of NIKM project we evaluated 3 basic types of areas (industrial, nature, agricultural) in constructed grid 10x10 km for selection of 3 test areas (50x50 km).**

Legend:

- **Industrial areas – grey**
- **Nature areas – green**
- **Agricultural areas - orange**

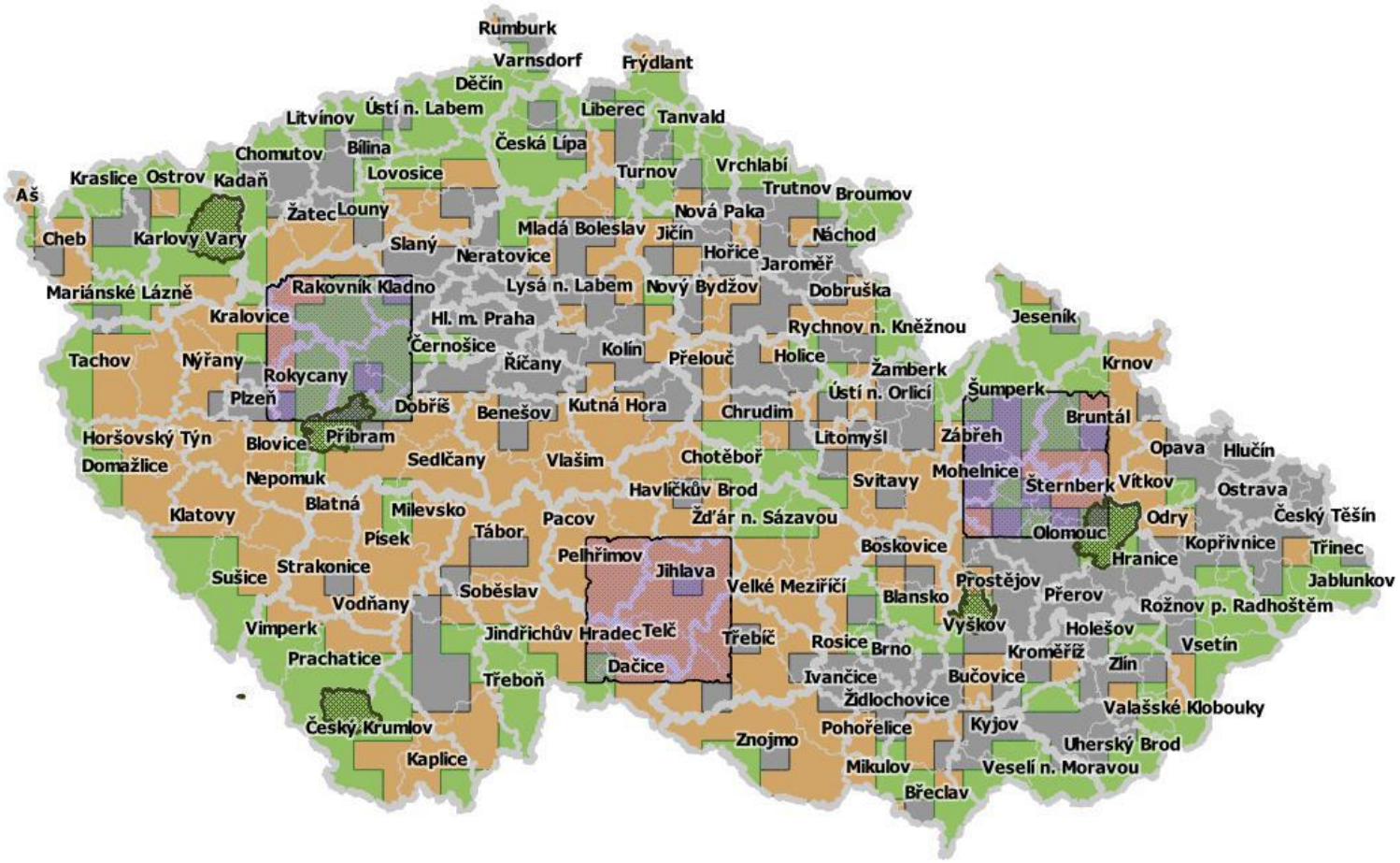
SUPPORT FROM STATISTICAL MODELS

- 3 basic types of areas (industrial, nature, agricultural)



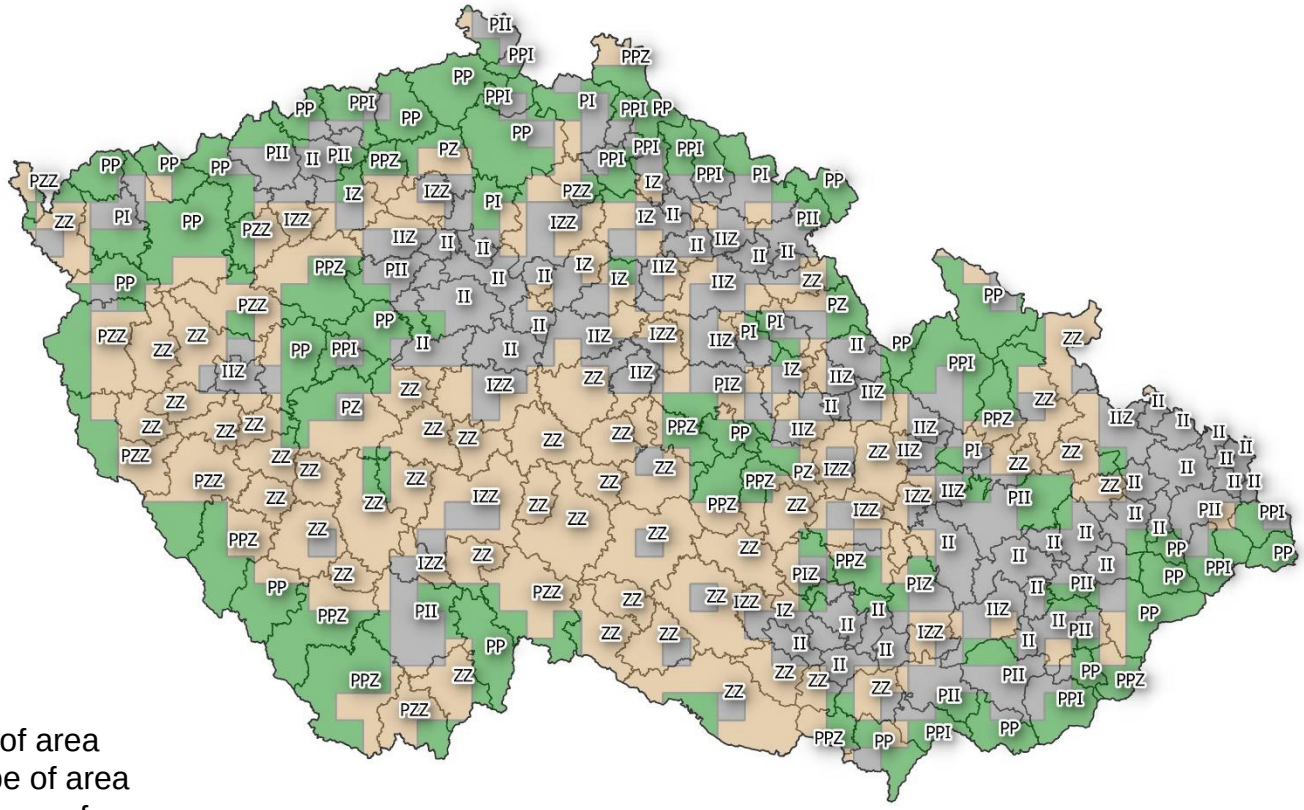
SUPPORT FROM STATISTICAL MODELS

3 basic types of areas (industrial, nature, agricultural)
+ military areas + test areas



SUPPORT FROM STATISTICAL MODELS

Combination of basic area types in ORPs



Legend

P - Nature type of area
I - Industrial type of area
Z - Agricultural type of area

SUPPORT FROM STATISTICAL MODELS

Combination of basic area types in ORPs

SUPPORT FROM STATISTICAL MODELS

Number of clues

	Number of clues in ORP in various combinations of area types													
Clue type	II	IIA	IA	IAA	NI	NII	NIA	NN	NNI	NNA	NA	NAA	AA	total
a	213	35	1	12	5	0	0	0	2	0	1	7	45	321
b	210	24	4	32	5	10	0	17	26	5	5	11	21	370
c	119	12	8	62	0	15	0	59	26	52	29	4	147	533
h	161	130	34	207	29	32	0	63	52	54	18	71	391	1242
j	41	38	5	77	2	8	0	8	11	7	2	32	149	380
l	66	27	59	4	3	42	0	31	41	25	18	1	146	463
n	72	9	1	67	0	44	0	15	17	19	3	5	22	274
o	89	42	4	67	13	5	0	7	6	3	7	23	74	340
p	1448	230	167	647	124	654	0	454	354	608	243	286	1143	6358
r	275	17	4	95	0	5	0	9	1	4	9	0	115	534
s	41	0	2	17	0	1	0	1	15	5	0	4	21	107
t	246	160	20	152	37	78	0	99	49	56	54	31	228	1210
v	352	80	20	192	40	33	0	25	21	25	15	54	271	1128
z	113	47	31	133	17	21	0	18	29	29	15	29	161	643
Total	3446	851	360	1764	275	948	0	806	650	892	419	558	2934	13903
Area	4845,2	1962,49	753,15	3747,17	680,25	2673,37	0	2740,36	1630,12	2534,4	1222,69	2290,09	6608,93	31688,22
													per 100 km^2	43,87

Legend
I - Industrial type of area
N - Nature type of area
A - Agricultural type of area

SUPPORT FROM STATISTICAL MODELS

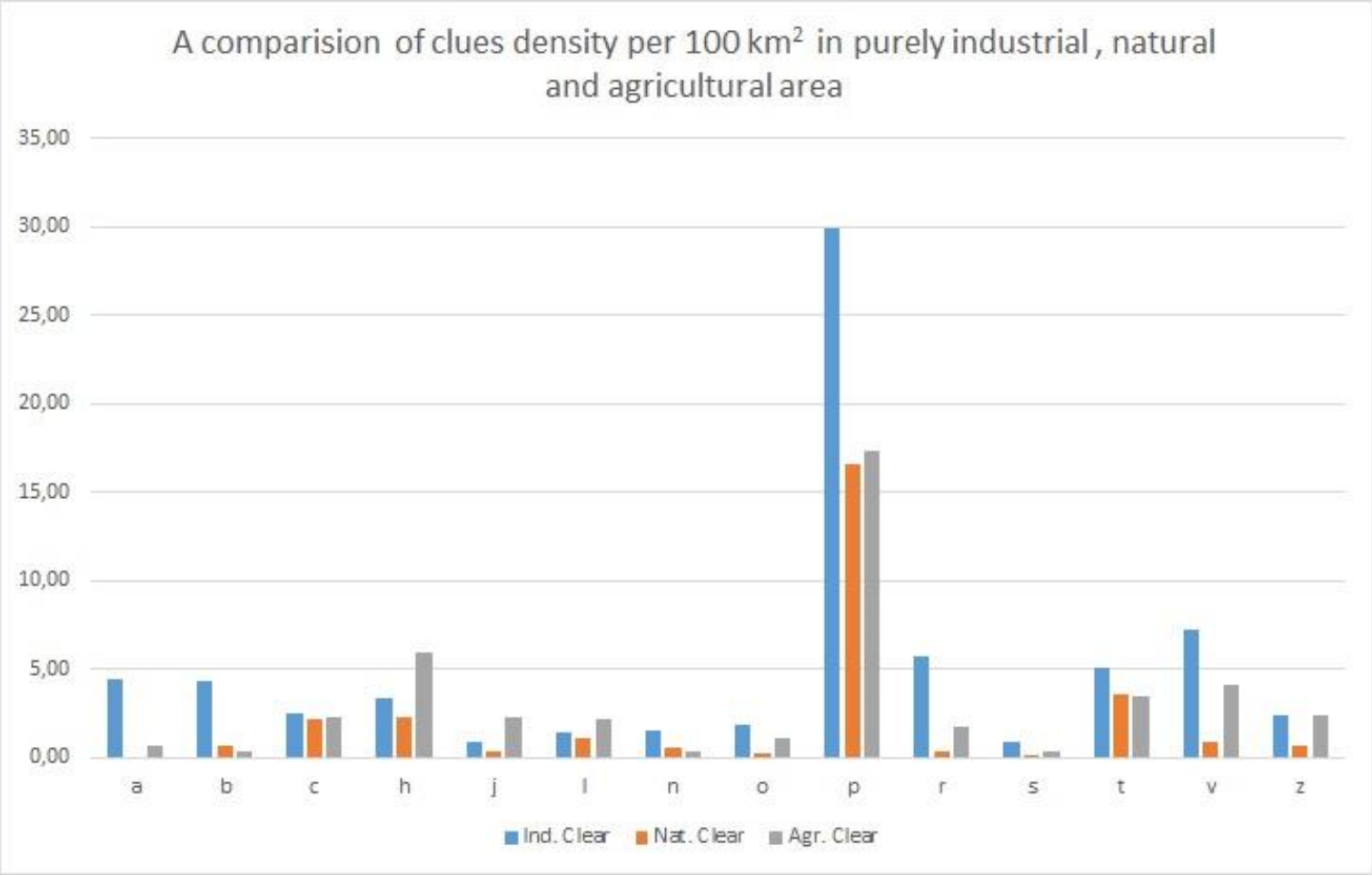
Clues density

	Clue density per 100 km2 in various combinations of area types												
Clue type	Ind. Clear	IIA	IA	IAA	NI	NII	NIA	Nat. Clear	NNI	NNA	NA	NAA	Agr. Clear
a	4,40	1,78	0,13	0,32	0,74	0,00	0,00	0,00	0,12	0,00	0,08	0,31	0,68
b	4,33	1,22	0,53	0,85	0,74	0,37	0,00	0,62	1,59	0,20	0,41	0,48	0,32
c	2,46	0,61	1,06	1,65	0,00	0,56	0,00	2,15	1,59	2,05	2,37	0,17	2,22
h	3,32	6,62	4,51	5,52	4,26	1,20	0,00	2,30	3,19	2,13	1,47	3,10	5,92
j	0,85	1,94	0,66	2,05	0,29	0,30	0,00	0,29	0,67	0,28	0,16	1,40	2,25
l	1,36	1,38	7,83	0,11	0,44	1,57	0,00	1,13	2,52	0,99	1,47	0,04	2,21
n	1,49	0,46	0,13	1,79	0,00	1,65	0,00	0,55	1,04	0,75	0,25	0,22	0,33
o	1,84	2,14	0,53	1,79	1,91	0,19	0,00	0,26	0,37	0,12	0,57	1,00	1,12
p	29,89	11,72	22,17	17,27	18,23	24,46	0,00	16,57	21,72	23,99	19,87	12,49	17,29
r	5,68	0,87	0,53	2,54	0,00	0,19	0,00	0,33	0,06	0,16	0,74	0,00	1,74
s	0,85	0,00	0,27	0,45	0,00	0,04	0,00	0,04	0,92	0,20	0,00	0,17	0,32
t	5,08	8,15	2,66	4,06	5,44	2,92	0,00	3,61	3,01	2,21	4,42	1,35	3,45
v	7,26	4,08	2,66	5,12	5,88	1,23	0,00	0,91	1,29	0,99	1,23	2,36	4,10
z	2,33	2,39	4,12	3,55	2,50	0,79	0,00	0,66	1,78	1,14	1,23	1,27	2,44
Total density	71,12	43,36	47,80	47,08	40,43	35,46	0,00	29,41	39,87	35,20	34,27	24,37	44,39

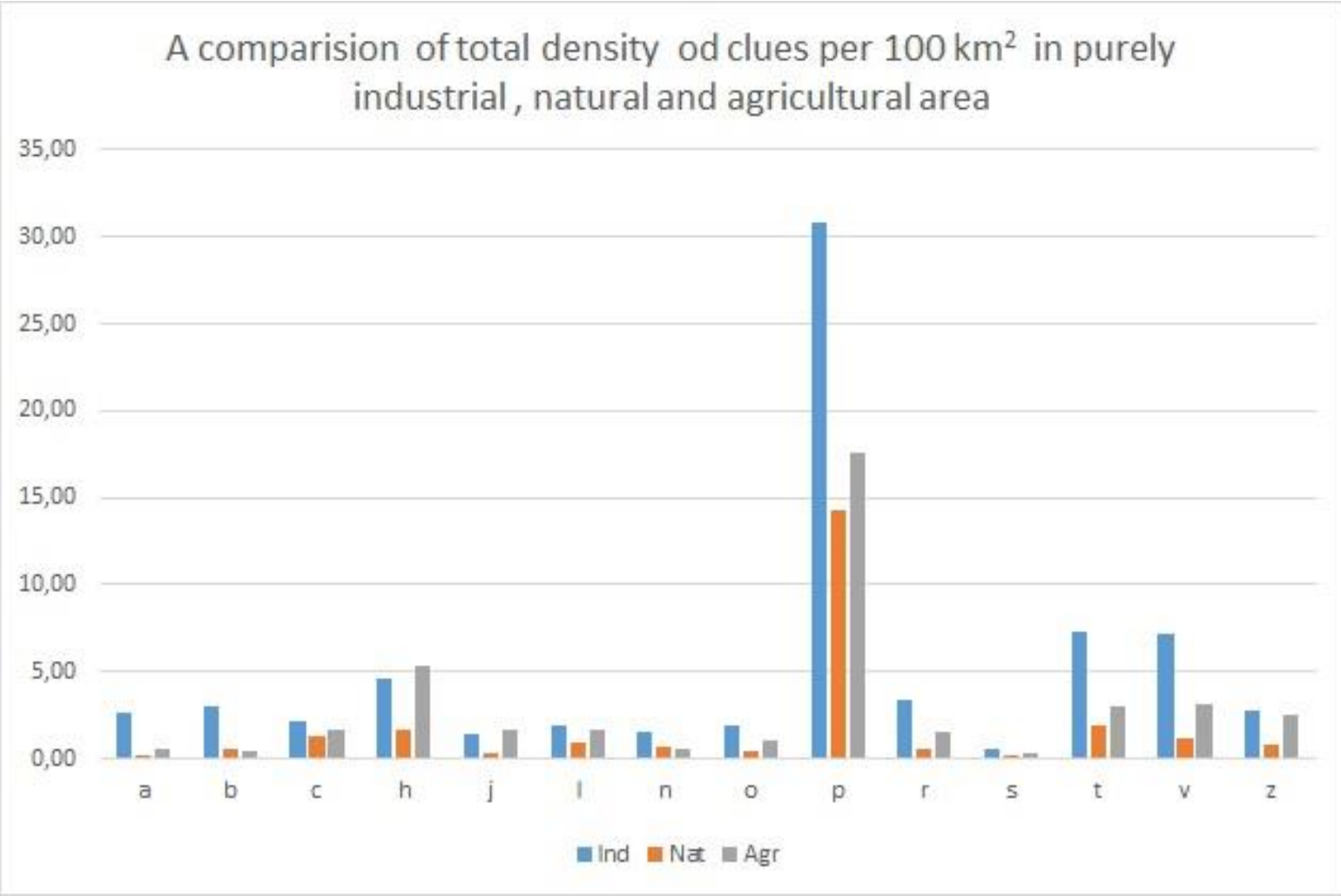
Statistic data for clue types vs area type

	Number of clues in area types				Clue density per 100 km2		
	Type of area				Typ území		
Clue type	Industry	Nature	Agriculture	total	Industry	Nature	Agriculture
a	231	19	71	321	2,70	0,18	0,56
b	256	61	53	370	3,00	0,58	0,42
c	188	132	213	533	2,20	1,26	1,69
h	390	175	677	1242	4,57	1,68	5,36
j	126	38	216	380	1,47	0,36	1,71
l	165	92	206	463	1,93	0,88	1,63
n	132	66	76	274	1,55	0,63	0,60
o	164	46	130	340	1,92	0,44	1,03
p	2635	1498	2225	6358	30,84	14,34	17,61
r	292	54	188	534	3,42	0,52	1,49
s	52	19	36	107	0,61	0,18	0,28
t	621	205	384	1210	7,27	1,96	3,04
v	610	125	393	1128	7,14	1,20	3,11
z	236	88	319	643	2,76	0,84	2,52
total	6098	2618	5187	13903	71,38	25,07	41,05
area	8542,75	10442,8	12634,5	31620,05			
per 100 km2		Average density		43,97			

Clues density in all areas with various combinations of area type



Clues density in areas with dominancy of one area type



SUPPORT FROM STATISTICAL MODELS

Conclusion

- **Each area type is characterized with own patern of density parameters.**
- **„Pure“ industrial, natural and agricultural areas (dominancy of one area type) have a very similar distribution of clues densities belonging to individual clues types as it is in sum of all combinations of area types.**
- **For planning tasks, the „pure“ areas are sufficiently representative.**
- **Final „models“ of number and types of clues (and of assignment of logistic and personal budget for different ORPs reflecting type of area) will be based on data resulted from reviews.**

5 PRELIMINARY STATISTICAL DATA

on the number and spatial distribution of clues in Czechia

Interpretation of clues (before review) by 1st October, 2018

- **14 789 clues in 91 ORP (44 % from total number 206)**
  31 674 km^2 – 40,7 % of the area of Czechia

Review

- **2 529 clues in 15 ORP (7,2 % from total number 206)**
  6 603 km^2 – 8,5 % of the area of Czechia

Projection of expected final number of clues

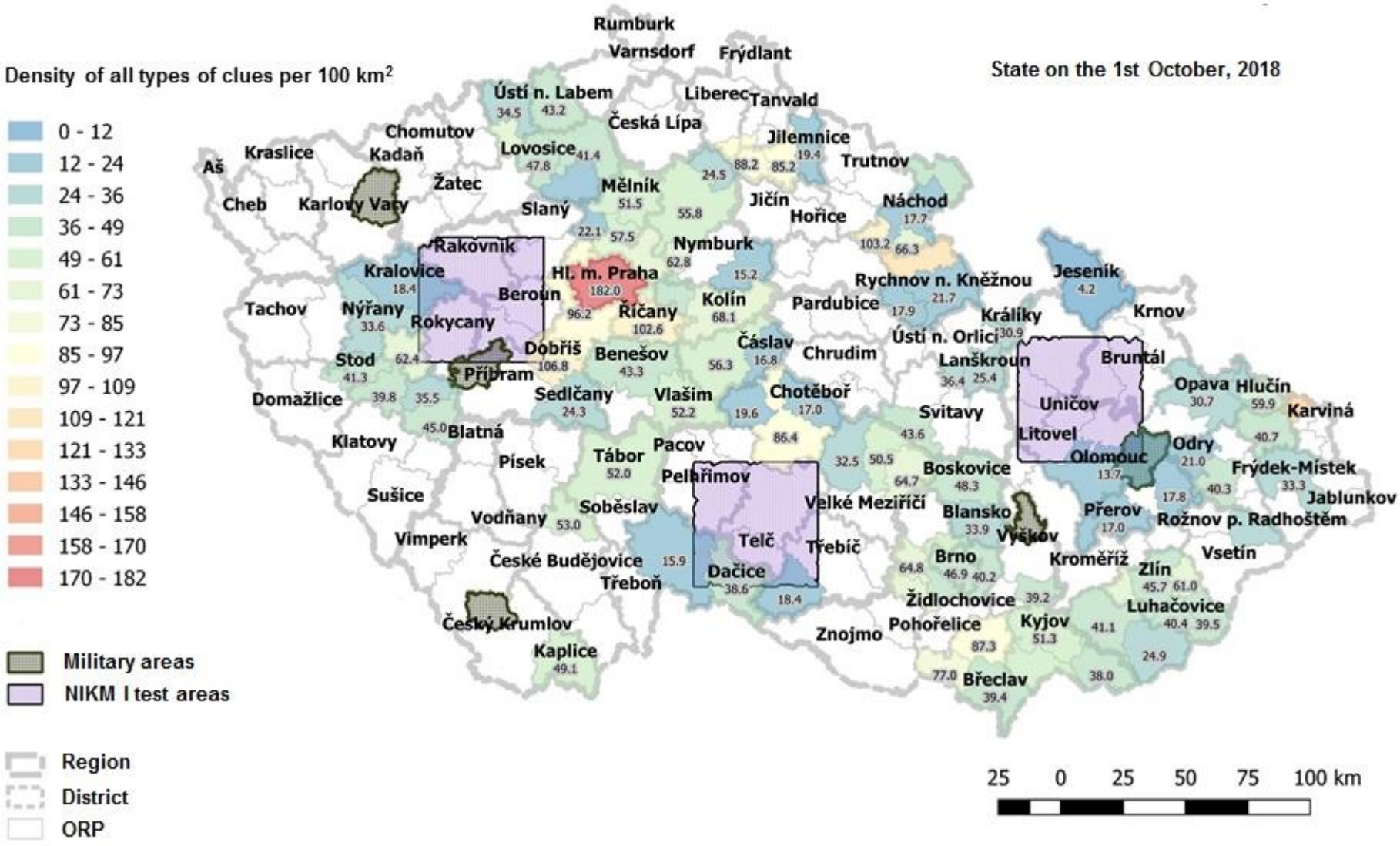
After interpretation (before review) : 36 340

After review : 29 875

Number of clues estimated in project documentation:

24 000 – 26 000

Density of clues per 100 km^2
(before reviews)



6. CONCLUSIONS

- **According to preliminary findings, we are on the way to achieve the optimal coverage of the territory subjected to inventory using the established review procedure.**

- **The monitored parameters are the numbers, respectively density of clues and their importance.**

6. CONCLUSIONS

- **The standardization of interpreters' performance and the optimization of quantity and credibility of recorded clues is crucial to streamline financial and logistically demanding field surveys within the NIKM 2nd stage project.**

- **As planning tool for field works (for scheduling and assigning of logistic and personal budget for different ORPs reflecting type of area) certain „models" of number /density and types of clues will be used, based on data resulted from reviews.**

cenia

NIKM
národní inventarizace
kontaminovaných míst

Acknowledgement

Project NIKM – 2nd stage (National Inventory of Contaminated Sites) is co-financed from European Union Funds - the Cohesion Fund - in the frame of the Operational Programme of the Environment 2014-2020, the area of intervention 4.2. - The Rehabilitation of Old Environmental Burdens“.

EVROPSKÁ UNIE
Fond soudržnosti
Operační program Životní prostředí

EVROPSKÁ UNIE
Fond soudržnosti
Operační program Životní prostředí

cenia

N!KM
národní inventarizace kontaminovaných míst

Thank you for your kind attention!

Contacts:

Zdeněk Suchánek (zdenek.suchanek@cenia.cz) , **Jaroslav Řeřicha** (jaroslav.rericha@cenia.cz), **Jan Krhovský** (jan.krhovsky@cenia.cz)

CENIA, Czech Environmental Information Agency

Vršovická 1442/65, 100 10 Prague 10, Czech Republic

EVROPSKÁ UNIE
Fond soudržnosti
Operační program Životní prostředí

N!KM
národní inventarizace kontaminovaných míst