

Final

# **Guidelines for verification of high resolution soil sealing layer**

**- Qualitative assessment -**

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Version 1.0

European Environment Agency



## Introduction

This document provides the guidelines for the verification of the high resolution soil sealing layer, based on a qualitative assessment of the mapped area. As agreed at the Eionet workshop on quality control and validation of land cover data (Copenhagen, 12-13 November 2007), these guidelines should help National Reference Centres on Land Cover (NRCs) to support EEA in doing the verification of the soil sealing layer that is being produced in the frame of GMES land monitoring fast track service precursor.

The soil sealing data is produced by a consortium of European service providers under contract with EEA and is based on the classification of the IMAGE2006 satellite data. The overall objective is the production of a seamless European high resolution core land cover dataset of built-up areas, including degree of soil sealing, for the reference year 2006. Built-up areas are characterized by the substitution of the original (semi)-natural cover or water surface with an artificial, often impervious, cover. This artificial cover is usually characterized by long cover duration (FAO Land Cover Classification System, 2005). Impervious surfaces of built-up areas account for 80 to 100% of the total cover. A per-pixel estimate of imperviousness (continuous variable from 0 to 100 percent) will be provided as index for degree of soil sealing for the whole geographic coverage. The data will be produced in full spatial resolution, i.e. 20 m by 20 m, which provides the best possible core data for any further analysis. The classification accuracy per hectare (based on a 100 m x 100 m grid) of built-up and non built-up areas should be at least 85%, for the European product.

The verification task will run from end November 2007 (when the first country deliveries are expected) until October 2008 (deadline for the last country to be delivered by the contractor) and should support EEA in accepting or rejecting the delivery of the country datasets produced by the service provider.

This qualitative assessment supported by NRCs is part of the grant agreement between EEA and participating countries in the GMES project land monitoring fast track service precursor/CLC2006.

NRCs are invited to carry out this assessment and to give feedback to the Agency within 4 weeks after reception of the data. If it is not possible to perform the verification task within these 4 weeks, it is expected that it will be completed before the end of the grant agreement, according to Article I.2 (Duration).

If countries would like to do additional checks or a quantitative assessment based on statistical validation, they are welcome to do so and to share the results with EEA.

Guidelines are provided for the preparatory work, the inventory of reference data that will be used, the description of the geometric and thematic quality and the overall qualitative assessment. NRCs should use this document template to report on the verification of the data, by filling in the grey boxes: insert free text in the "Text Form Fields" ( ); tick the "Check Box Form Field" (); and select from "Drop Down Form Field" (Please, select). Feel free to add additional text or illustrations (e.g. examples from screenshots).

A quantitative assessment or final validation of the European dataset will be carried out by EEA in collaboration with Eionet during late 2008-2009 (project details to be confirmed during the second half of 2008). This European validation will be based as much as possible on the results of national validations. NRCs are invited to inform EEA about planned activities (if any) at national level. Preliminary recommendations for such a statistical validation (quantitative assessment) are attached in annex for information.

Note: After filling in the template save it as a word document: filename: countryISOcode.doc (e.g. AT.doc).

## 1. Preparatory work

1. Upload the data that will be made available by EEA via ftp server or sent by mail. Please inform EEA on reception of the data;
2. Check for available reference data that will be used during the verification;
3. List the experts/expertise that are involved in the verification task:

<b>Expert name</b>	<b>Field of expertise</b>	<b>Institution</b>
Sandra Radi Goljak	GIS specialist/Interpreter	Gisdata d.o.o.
Vladimir Kušan	GIS/RS specialist	Oikon d.o.o.

The average time needed for this verification is estimated at one person/day per 10.000 km<sup>2</sup>. Please note that this time can vary depending on the experience of the interpreter, the availability of the reference data and the complexity of the landscape. The table below gives an indicative estimate for the EEA member countries.

<b>Country</b>	<b>Area (km<sup>2</sup>)</b>	<b>Person days</b>	<b>Country</b>	<b>Area (km<sup>2</sup>)</b>	<b>Person days</b>
Austria + Liechtenstein	83.855	9	Lithuania	65.200	7
Belgium	30.520	3	Luxembourg	2.586	<1
Bulgaria	110.994	11	Malta	316	<1
Cyprus	9.251	1	Netherlands	41.526	4
Czech Republic	78.864	8	Norway	323.878	33
Denmark	43.075	4	Poland	312.683	31
Estonia	45.200	5	Portugal	88.935	9
Finland	338.145	34	Romania	237.500	24
France	543.965	55	Slovakia	20.251	5
Germany	357.028	36	Slovenia	49.035	2
Greece	131.957	13	Spain	504.782	51
Hungary	93.030	9	Sweden	449.964	39
Iceland	102.820	10	Switzerland	41.293	4
Ireland	70.282	7	Turkey	789.452	79
Italy	301.245	30	United Kingdom	244.082	25
Latvia	63.700	6			

## 2. Reference data

Please list the reference data that is used for this verification:

### 1. Topographic maps

No       Yes      Year: 1995-2006      Area: Subset

If only a subset, then please specify the area(s):

Topographic map scale 1:5000

### 2. Aerial orthophotos

No       Yes      Year: 2002-2006      Area: Subset

If only a subset, then please specify the area(s):

30% of the Northern part of the country and 25% of the southern part of the country

### 3. Very High Resolution satellite data

No       Yes      Year: 2003-2006      Area: Subset

If only a subset, then please specify the area(s):

SPOT-4, IRS LISS-3, IKONOS and QuickBird - northern part of the country, coastal area (about 10 km apart from the sea) and all islands

### 4. CLC2000

No       Yes

### 5. Other

Name:      Year:      Area: Please, select:

If only a subset, then please specify the area(s):

Name:      Year:      Area: Please, select:

If only a subset, then please specify the area(s):

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Name: Year: Area: Please, select:

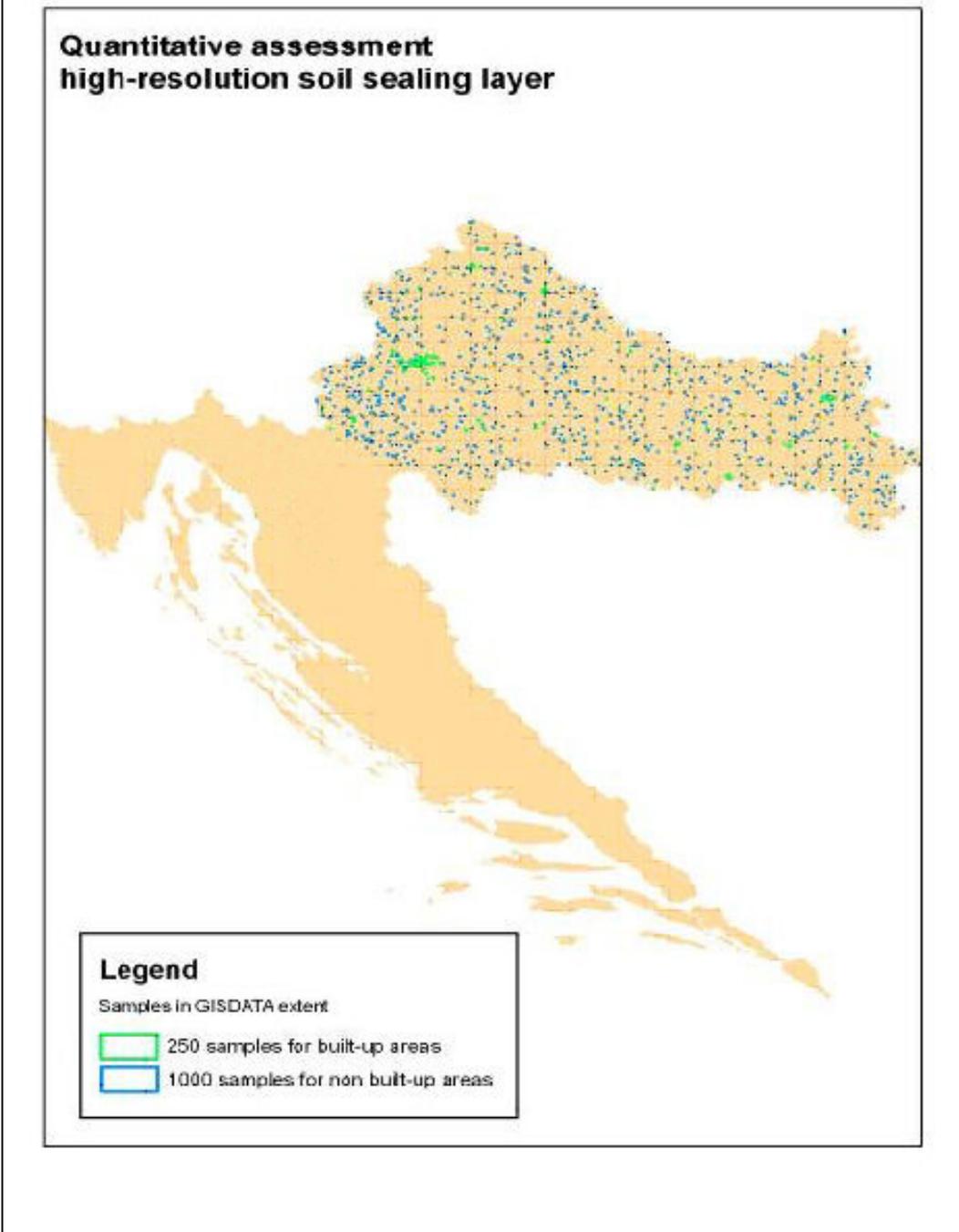
If only a subset, then please specify the area(s):

Name: Year: Area: Please, select:

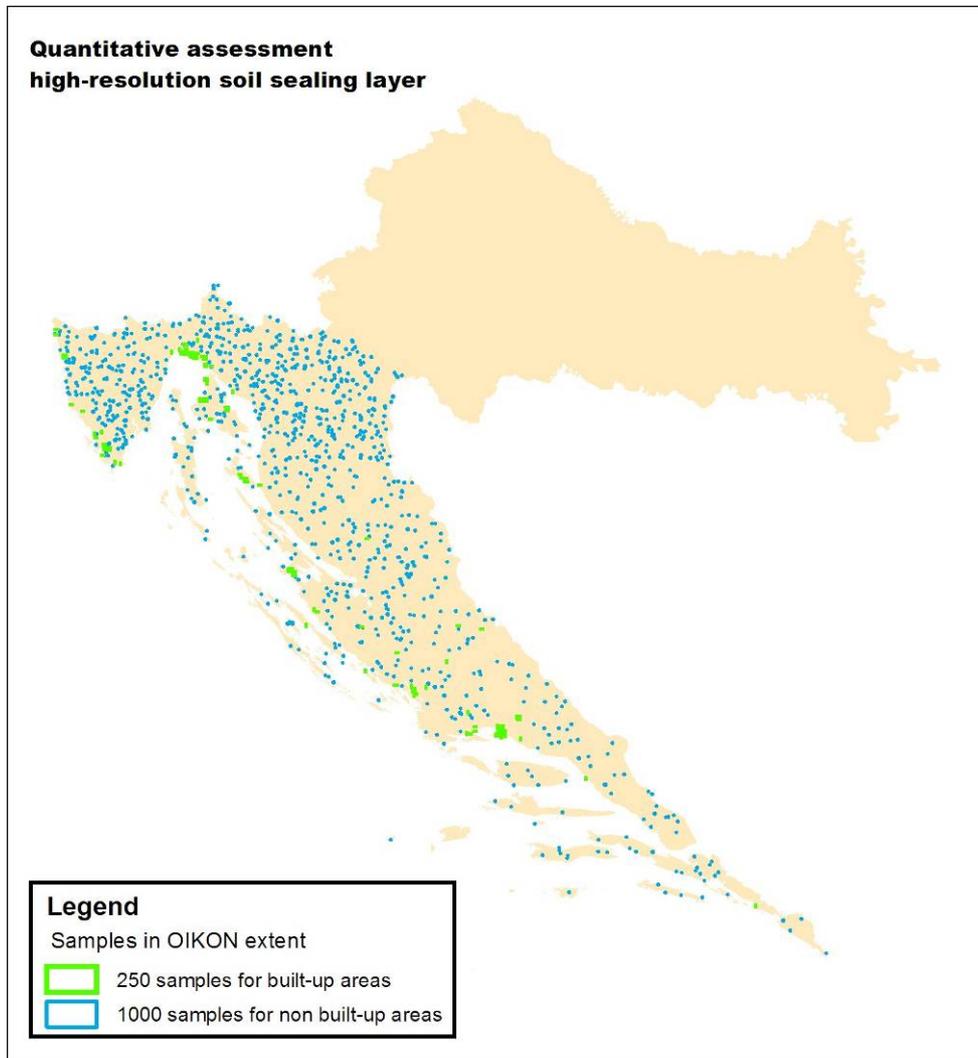
If only a subset, then please specify the area(s):

GISDATA has performed qualitative assessment of the quality of the high resolution soil sealing layer for 50% of the country (Figure 1). The other 50 % is done by OIKON (Figure 2).

**Figure 1:** Illustration of a sealed and non-sealed sample cell for Gisdata extent  
Cell size: 100x100 meters



**Figure 2:** Illustration of a sealed and non-sealed sample cell for Oikon extent  
Cell size: 100x100 meters



Comments concerning the reference data used (if any):

**B. Geometric quality**

Please provide your qualitative assessment of the geometric quality of the data. The objective of this task is to perform a visual analysis of the soil sealing dataset concerning its co-registration when put in overlay with other reference datasets.

1. Check geometric accuracy:

Is there a visible shift?  Yes  No

If yes:

a. Is there a systematic shift?  Yes  No

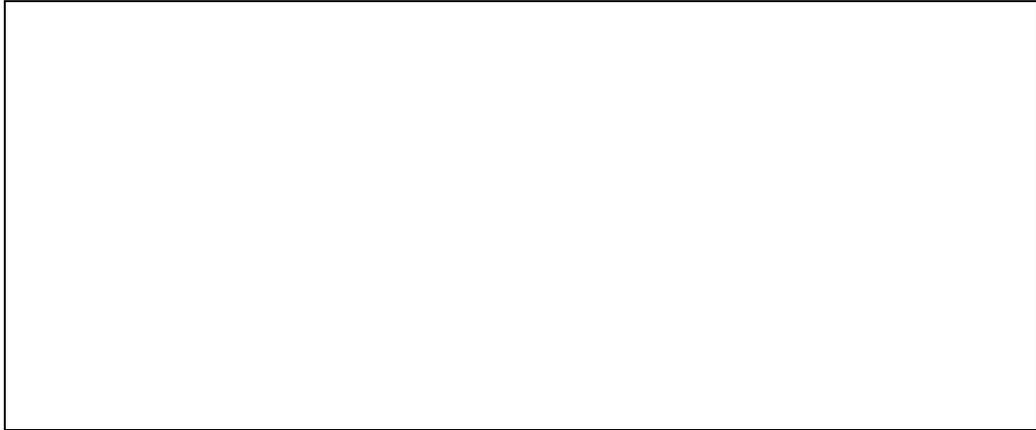
b. Is there a local shift?  Yes  No

Where?

Please indicate the region, place name, coordinates or other description of location:

2. Is the used projection correct?  Yes  No

3. Comments concerning geometric issues (if any), or in case the geometric quality could not be checked, please provide a short explanation:



### C. Thematic quality

Please provide your qualitative assessment of the thematic quality of the data. The objective of this task is to perform a visual comparison between available reference data and the soil sealing dataset. You are requested to verify for a number of land cover classes (similar to the CLC classes at levels 2 or 3) to check if any errors in the data can be identified. Please note that many land cover classes can include sealed surfaces, especially for features <25 ha.

For this part of the verification, it is recommended to use a binary mask (built-up/non-built-up area) that can be used in overlay with the reference data:

1. Apply a lookup table to map all pixels > 80% degree of soil sealing as built-up area;
2. Perform the checks on pixels > 80% degree of soil sealing by screening for each of the land cover classes if built-up or non built-up areas are correctly mapped. Feel free to add screenshots with examples to illustrate the quality judgement.

For your qualitative assessment, following examples of check boxes can be ticked:

- “excellent” meaning that you expect that the accuracy of the built-up data is reaching almost 100%; no errors could be found in the areas that were verified.
- “good” meaning that you are confident that the classification results are at least 85 % correct; only sporadic errors were encountered in the areas that were verified.
- “acceptable” meaning that you estimate that in most of the verified areas the classification results will probably reach an accuracy of 85 %; some minor errors could be detected in the areas that were verified.
- “insufficient” meaning that you do not expect that the classification results will reach the minimum of 85 % accuracy; you encountered several errors in different regions.
- “very poor” meaning that you are confident that the classification results are bad with regard to presence of built-up area; most of the areas verified are wrongly mapped.

#### Urban fabric:

a. Did you check if built-up/non built-up areas are correctly mapped within urban fabric (e.g. houses, buildings, streets, etc.)?

- Yes       No       Not possible

b. How would you assess the quality of the mapped built-up area within the urban fabric?

- very poor     insufficient     acceptable     good     excellent

- a. Short description of errors found (if any): Some of the areas in towns presented with > 80% degree of soil sealing as built-up area are not correct (Figure 3)

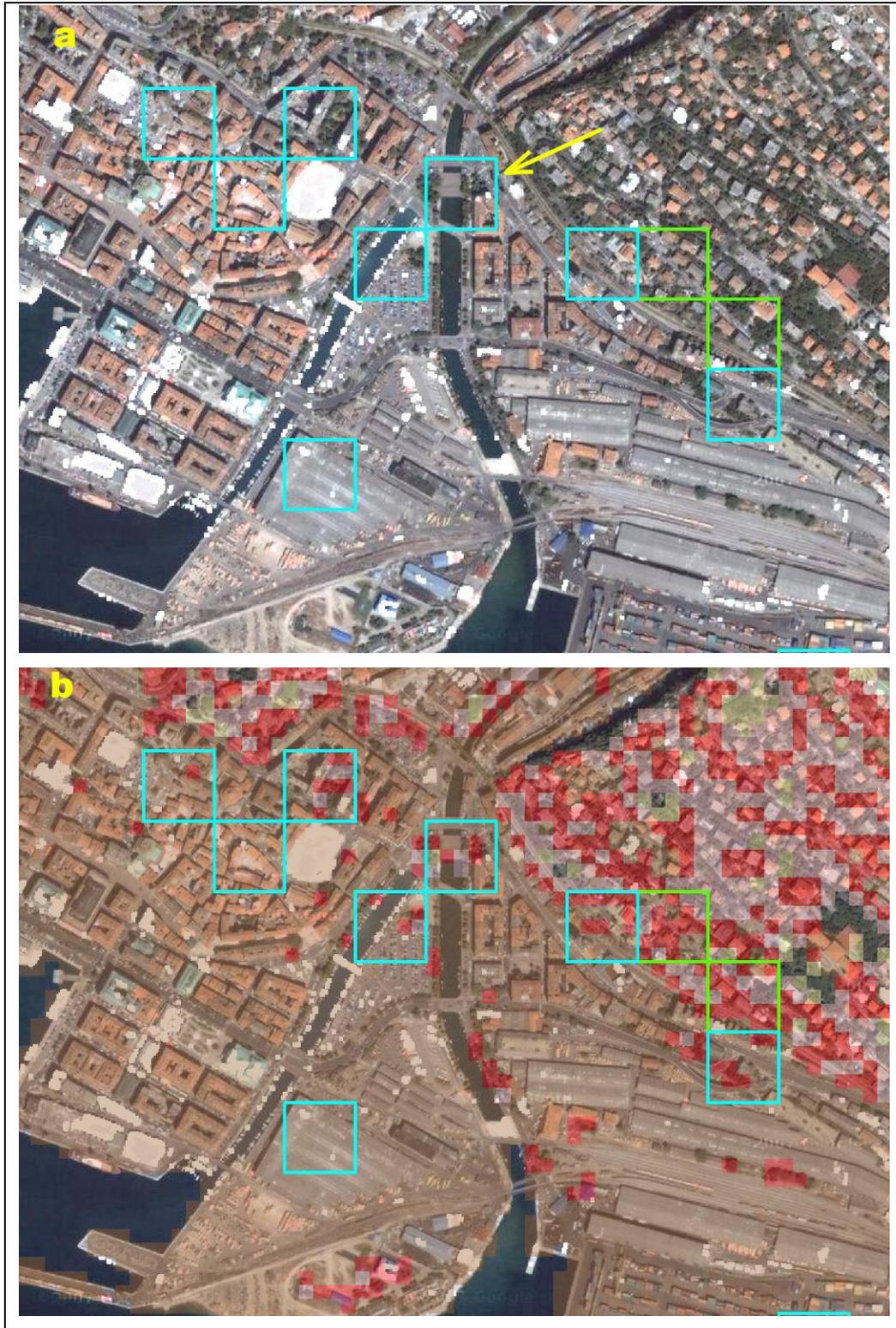


Figure 3: Squares 100x100 m of built-up samples with > 80% degree of soil sealing as built-up area (figure b) are marked in cyan. The square sample pointed with arrow (figure a) has less than 80% degree of soil sealing (water, trees, grass).

**Industrial or commercial units:**

- a. Did you check if built-up/non built-up areas are correctly mapped within industrial or commercial units (e.g. parking lots, buildings, etc.)?  
 Yes       No       Not possible
- b. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- b. Short description of errors found (if any):

**Road and rail networks and associated land:**

- a. Did you check if built-up/non built-up areas within road and rail networks and associated land are correctly mapped (e.g. railway stations, highways >20 m width, etc.)?  
 Yes       No       Not possible
- b. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- c. Short description of errors found (if any):

**Port areas:**

- a. Did you check if built-up/non built-up areas in port areas are correctly mapped (e.g. installations, dykes, etc.)?  
 Yes       No       Not possible
- b. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- d. Short description of errors found (if any):

**Airports:**

- c. Did you check if built-up/non built-up areas in airports are correctly mapped (e.g. runways, buildings, etc.)?  
 Yes       No       Not possible
- d. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- e. Short description of errors found (if any):

**Mine, dump and construction sites:**

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- a. Did you check if built-up/non built-up areas in mine, dump and construction sites are correctly mapped (e.g. buildings, infrastructure, etc)?
- Yes       No       Not possible
- b. How would you assess the quality?
- very poor     insufficient     acceptable     good     excellent
- f. Short description of errors found (if any): There is no built-up areas in mine area as shown in Figures 4-6

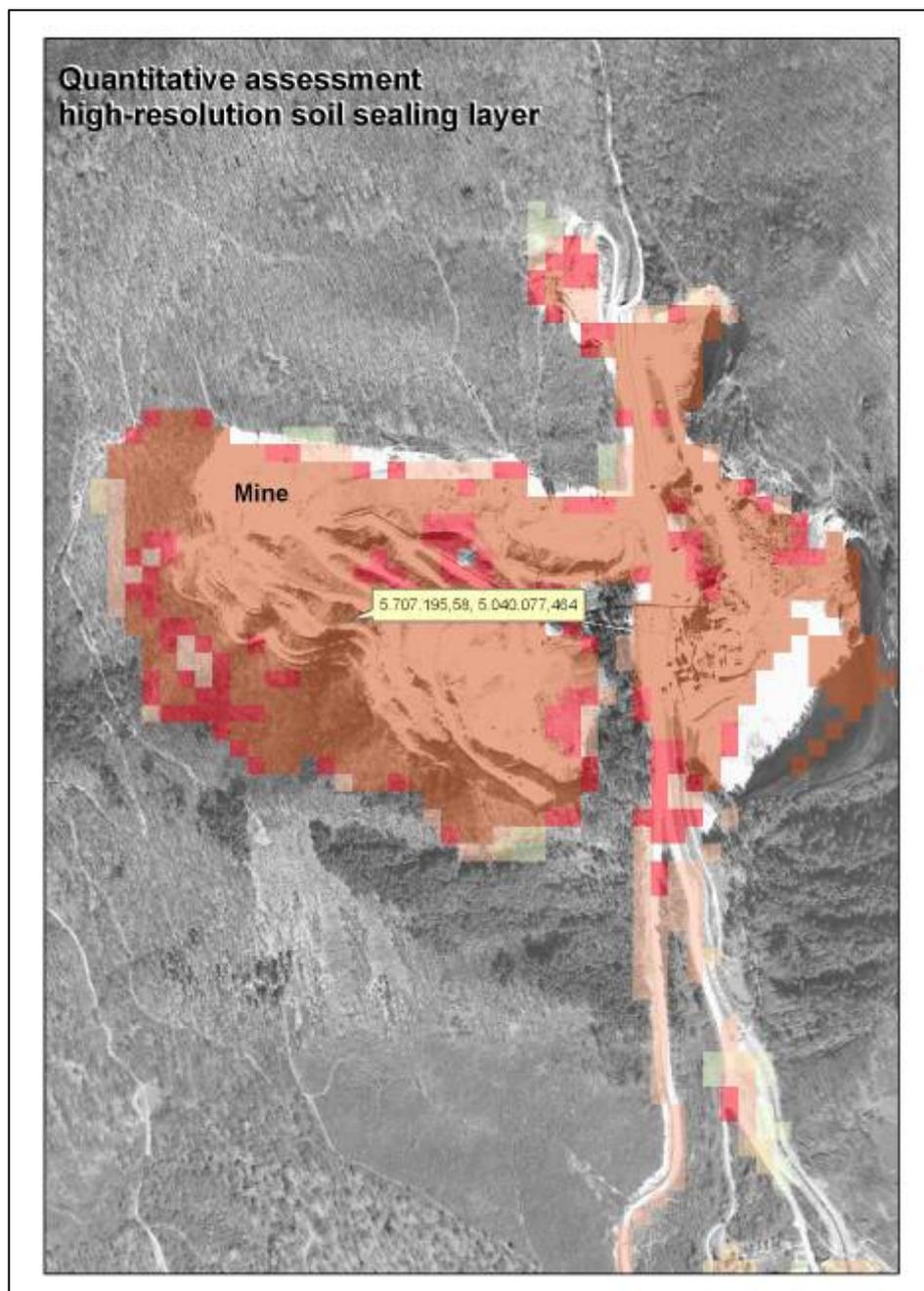


Figure 4: Mine in Nature park Papuk

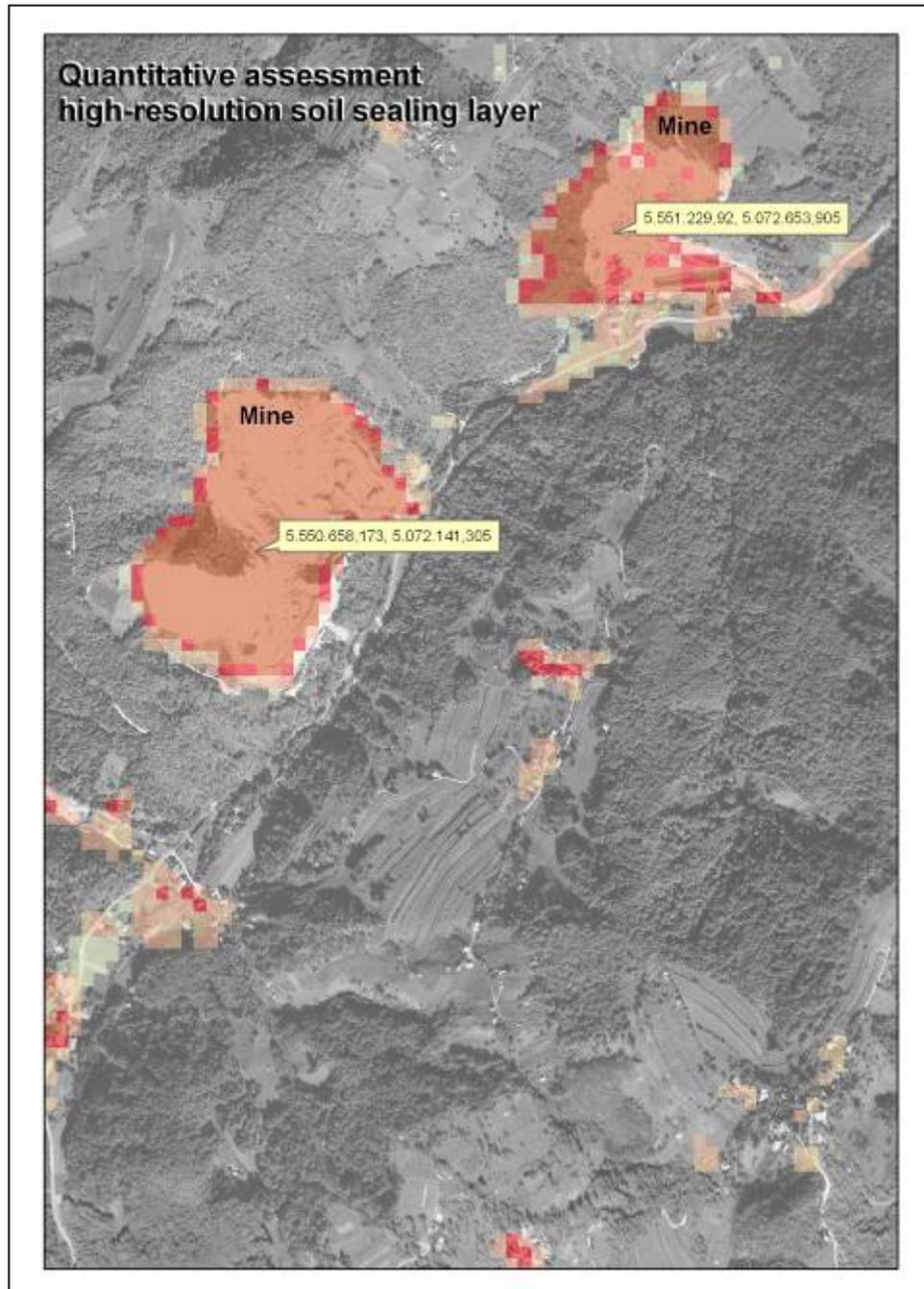


Figure 5: Mine in Nature park Zumberak

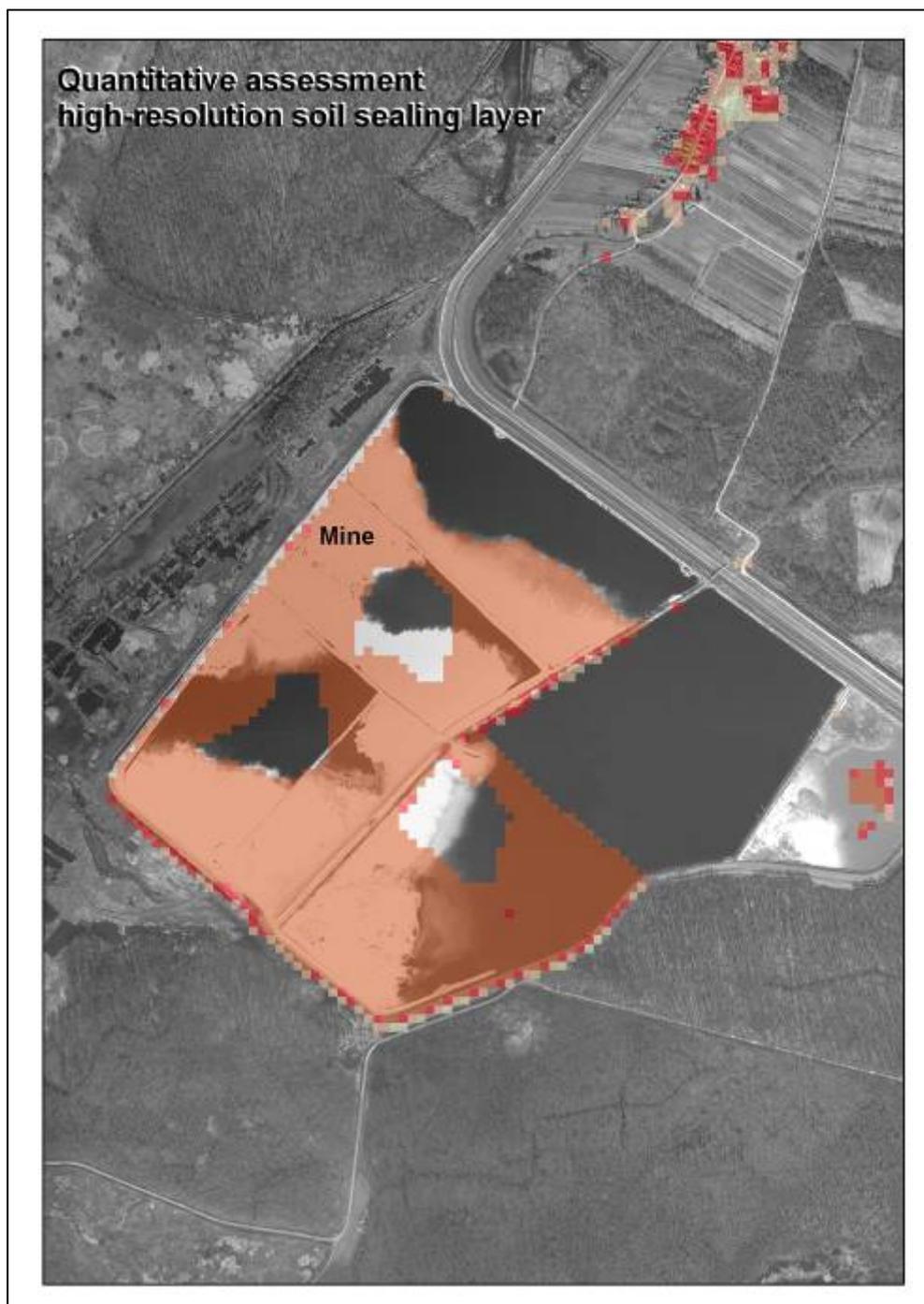


Figure 6: Mine in Nature park Lonjsko polje

**Arable land:**

a. Did you check if built-up/non built-up areas in arable land are correctly mapped (e.g. bare soil, large farm houses, roads >20m width, etc)?

Yes       No       Not possible

b. How would you assess the quality?

very poor     insufficient     acceptable     good     excellent

g. Short description of errors found (if any):

**Heterogeneous agricultural areas:**

- a. Did you check if built-up/non built-up areas in heterogeneous agricultural areas are correctly mapped (e.g. buildings, roads >20m, etc)?
- Yes       No       Not possible
- b. How would you assess the quality?
- very poor    insufficient    acceptable    good    excellent
- h. Short description of errors found (if any):

**Forest:**

- a. Did you check built-up/non built-up areas in forests are correctly mapped (e.g. clear-cuts, roads, etc.)?
- Yes       No       Not possible
- b. How would you assess the quality?
- very poor    insufficient    acceptable    good    excellent
- i. Short description of errors found (if any):

**Scrub and/or herbaceous vegetation associations:**

- a. Did you check if built-up/non built-up areas in scrub and/or herbaceous vegetation areas are correctly mapped (e.g. dry vegetation, rock outcrop, etc.)?
- Yes       No       Not possible
- b. How would you assess the quality?
- very poor    insufficient    acceptable    good    excellent
- j. Short description of errors found (if any):

**Beaches, dunes and sands:** *There are very few areas in this category that are too small and not covered by samples.*

- a. Did you check if built-up/non built-up areas in beaches, dunes and sand areas are correctly mapped?
- Yes       No       Not possible
- b. How would you assess the quality?
- very poor    insufficient    acceptable    good    excellent
- k. Short description of errors found (if any):

**Bare rocks:**

- a. Did you check if built-up/non built-up areas in bare rock areas are correctly mapped?  
 Yes       No       Not possible
- b. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- l. Short description of errors found (if any):

**Sparsely vegetated areas:**

- a. Did you check if built-up/non built-up areas in sparsely vegetated areas are correctly mapped?  
 Yes       No       Not possible
- c. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- m. Short description of errors found (if any):

**Glaciers and perpetual snow:** *category doesn't exist in Croatia*

- a. Did you check if built-up/non built-up areas in glaciers and perpetual snow areas are correctly mapped?  
 Yes       No       Not possible
- b. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- n. Short description of errors found (if any):

**Inland wetlands:** Did you check if built-up/non built-up areas in inland wetlands are correctly mapped?

- Yes       No       Not possible
- a. How would you assess the quality?  
 very poor    insufficient    acceptable    good    excellent
- o. Short description of errors found (if any):

**Salines:**

- b. Did you check if built-up/non built-up areas in saline are correctly mapped?  
 Yes       No       Not possible
- c. How would you assess the quality?

very poor  insufficient  acceptable  good  excellent

p. Short description of errors found (if any):

**Intertidal flats:** *There are very few areas in this category that are too small and not covered by samples.*

a. Did you check if built-up/non built-up areas in intertidal flats are correctly mapped?

Yes  No  Not possible

b. How would you assess the quality?

very poor  insufficient  acceptable  good  excellent

q. Short description of errors found (if any):

**Coastal lagoons:** *There are very few areas in this category that are too small and not covered by samples.*

a. Did you check if built-up/non built-up areas in coastal lagoons are correctly mapped?

Yes  No  Not possible

b. How would you assess the quality?

very poor  insufficient  acceptable  good  excellent

r. Short description of errors found (if any):

3. Comments concerning thematic content check (if any). Please indicate which part of the data was verified (full coverage or partial coverage, etc.):

GISDATA has performed qualitative assessment of the quality of the high resolution soil sealing layer for 50% of the country (Northern part as shown in Figure 1). The other 50 % is in competence of OIKON (Southern part of the country).

**Short description of the methodology:**

The data were validated at 1 ha resolution (100x100m or 5x5 pixels).

First, aggregation of the individual cells to blocks of 1 ha was performed.

Only cells that are more than 80% sealed were used for preparation of a vector layer containing the randomly distributed 100x100 meter cells.

For entire country 500 samples were distributed inside the sealed area, and 2000 samples were distributed outside the sealed area (Recommendations

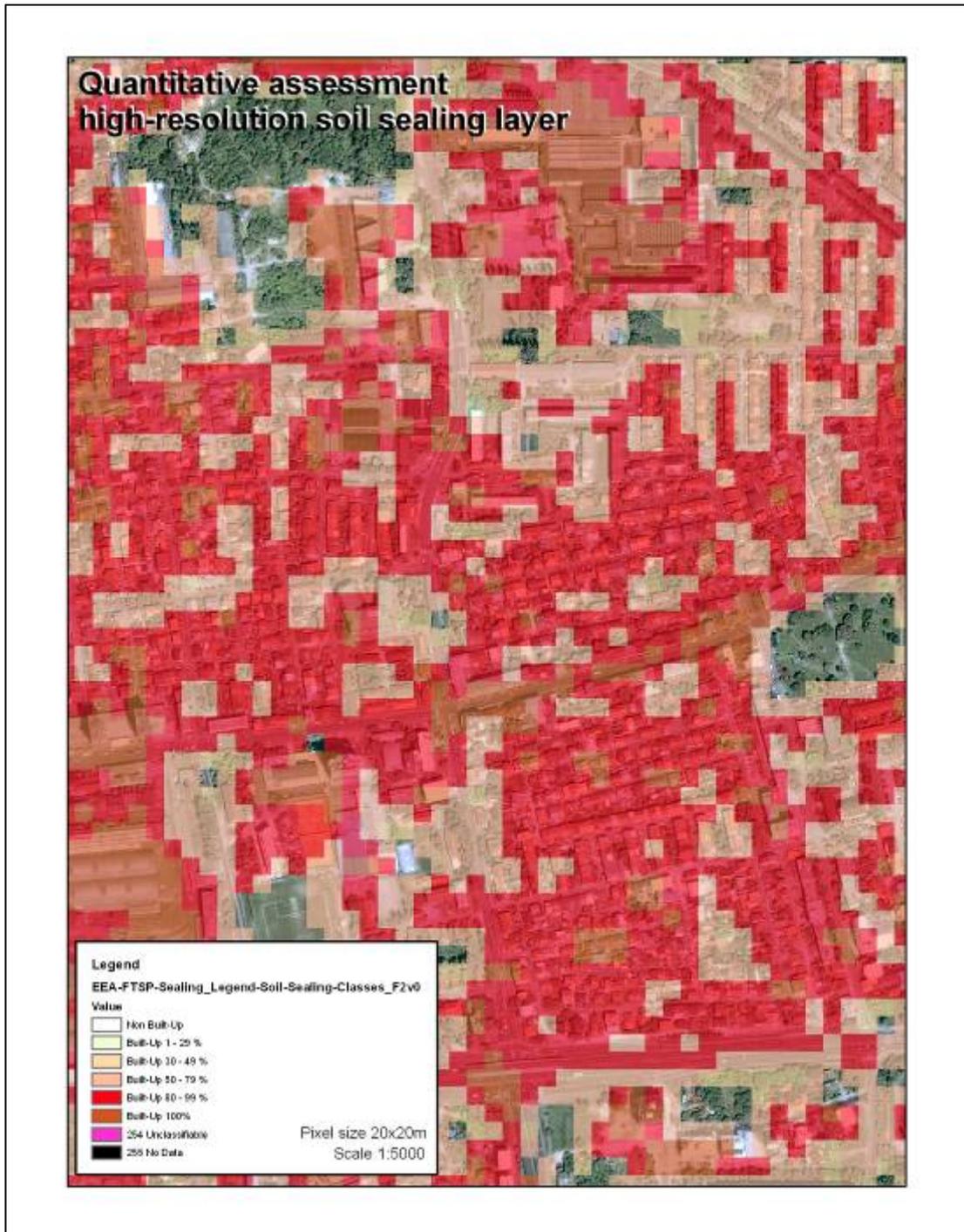
Quantitative assessment high-resolution soil sealing layer, G. Maucha and G. Büttner, 2007).

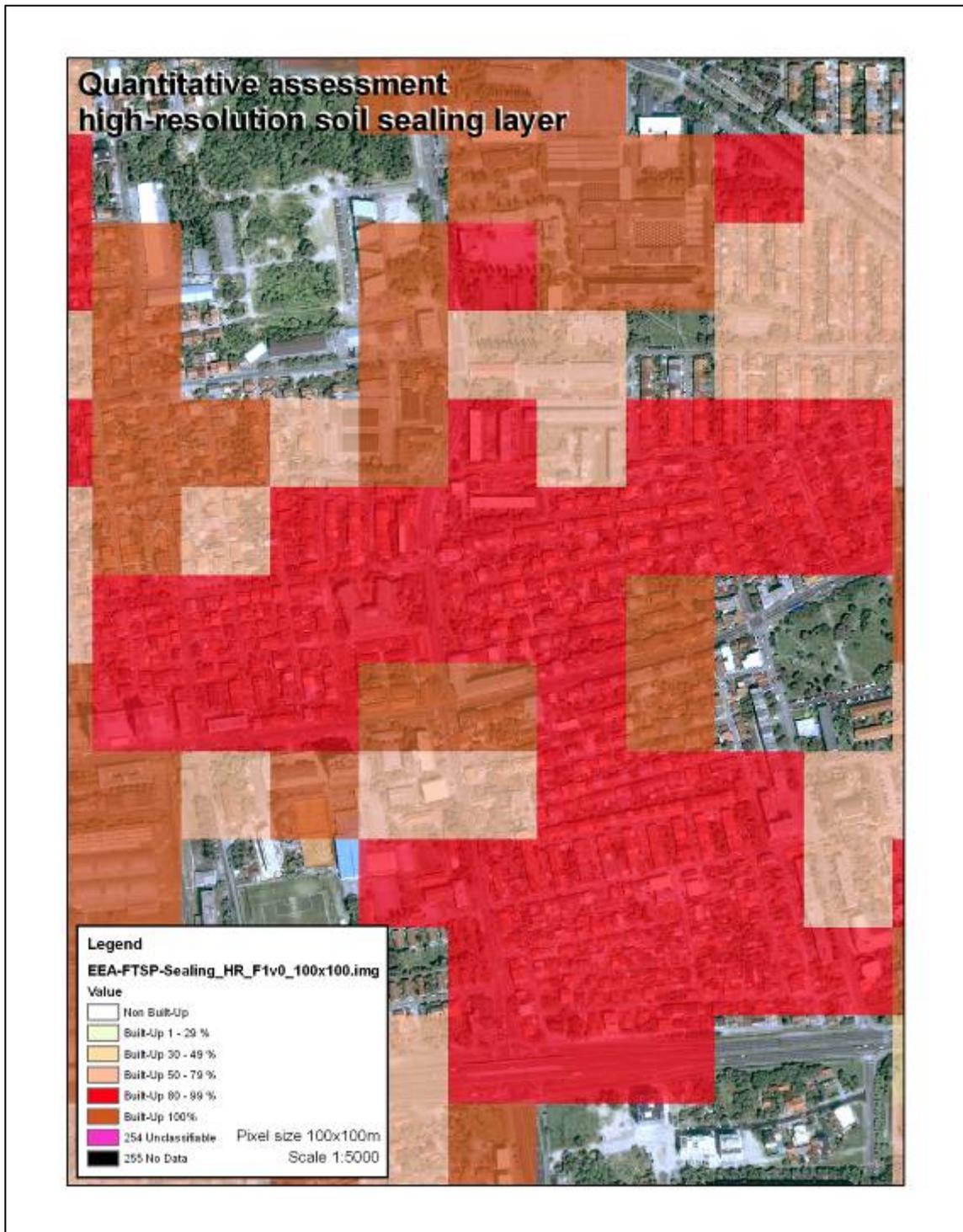
GISDATA validated 250 samples for built up area and 1000 samples for non built-up area. The same amount of samples was validated by OIKON (Figure 1 and 2).

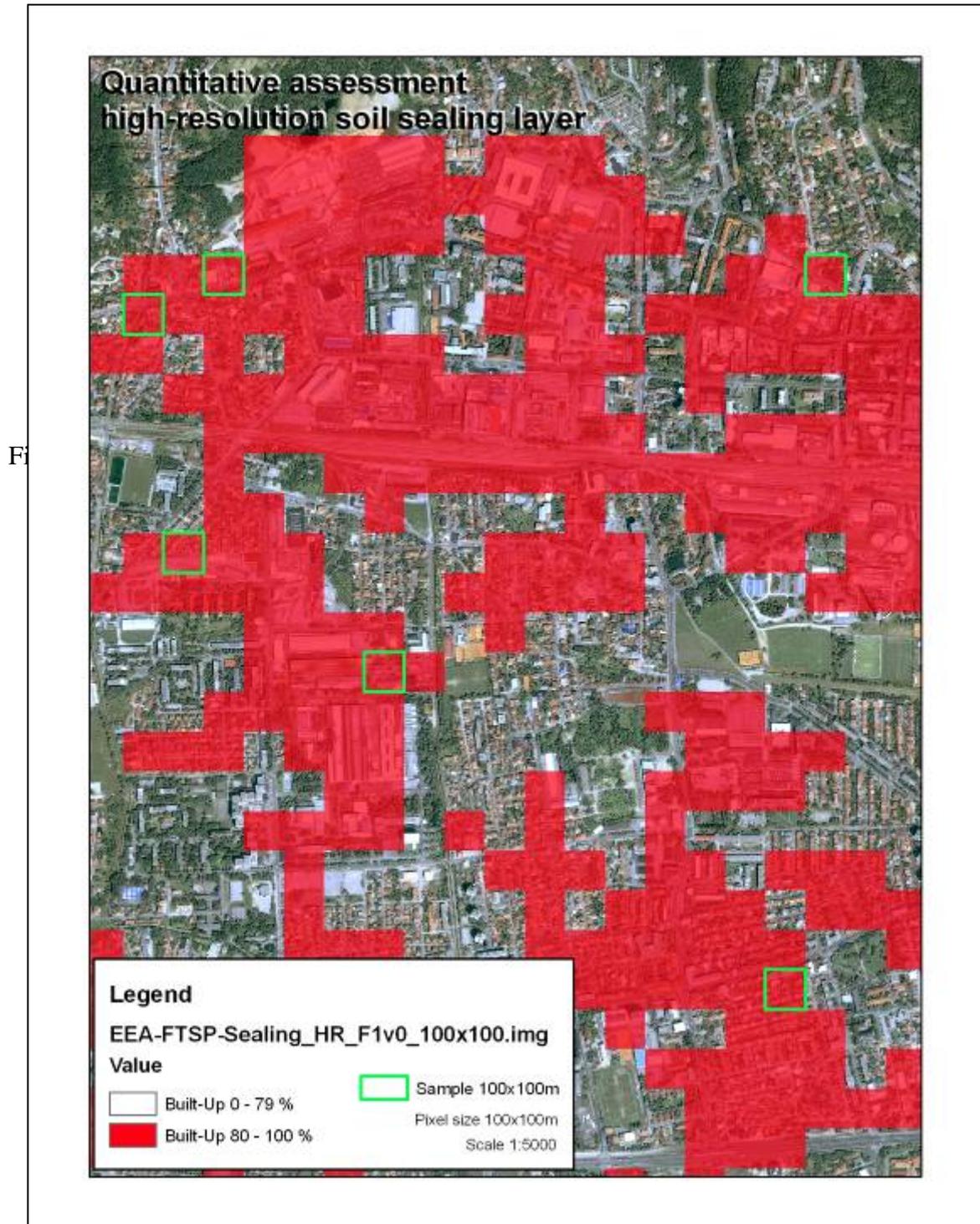
All sampling cells were evaluated and qualified as sealed/not sealed and percentage of sealed/not sealed were determined.

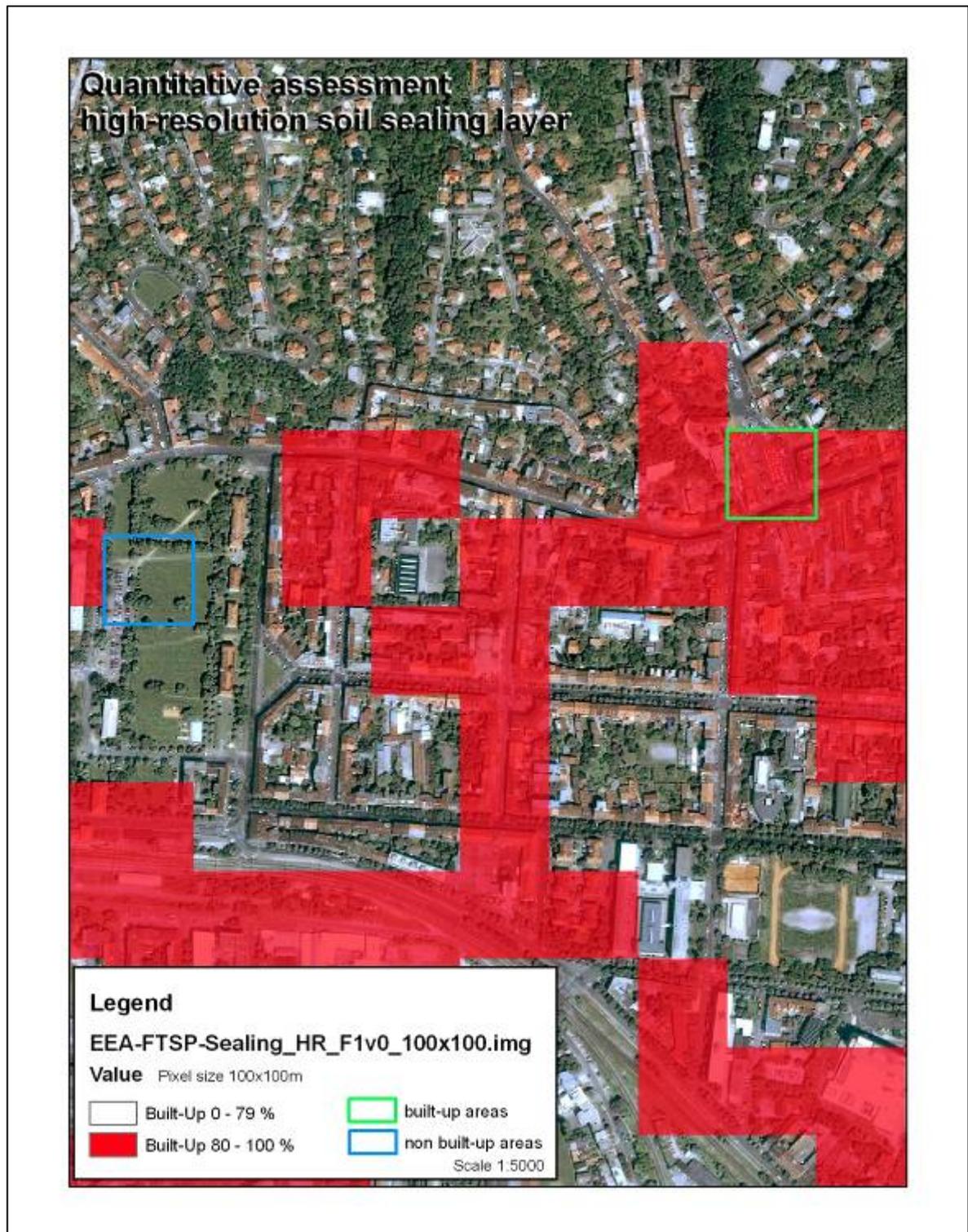
**Figure 7-12** presents short description of the metrology.

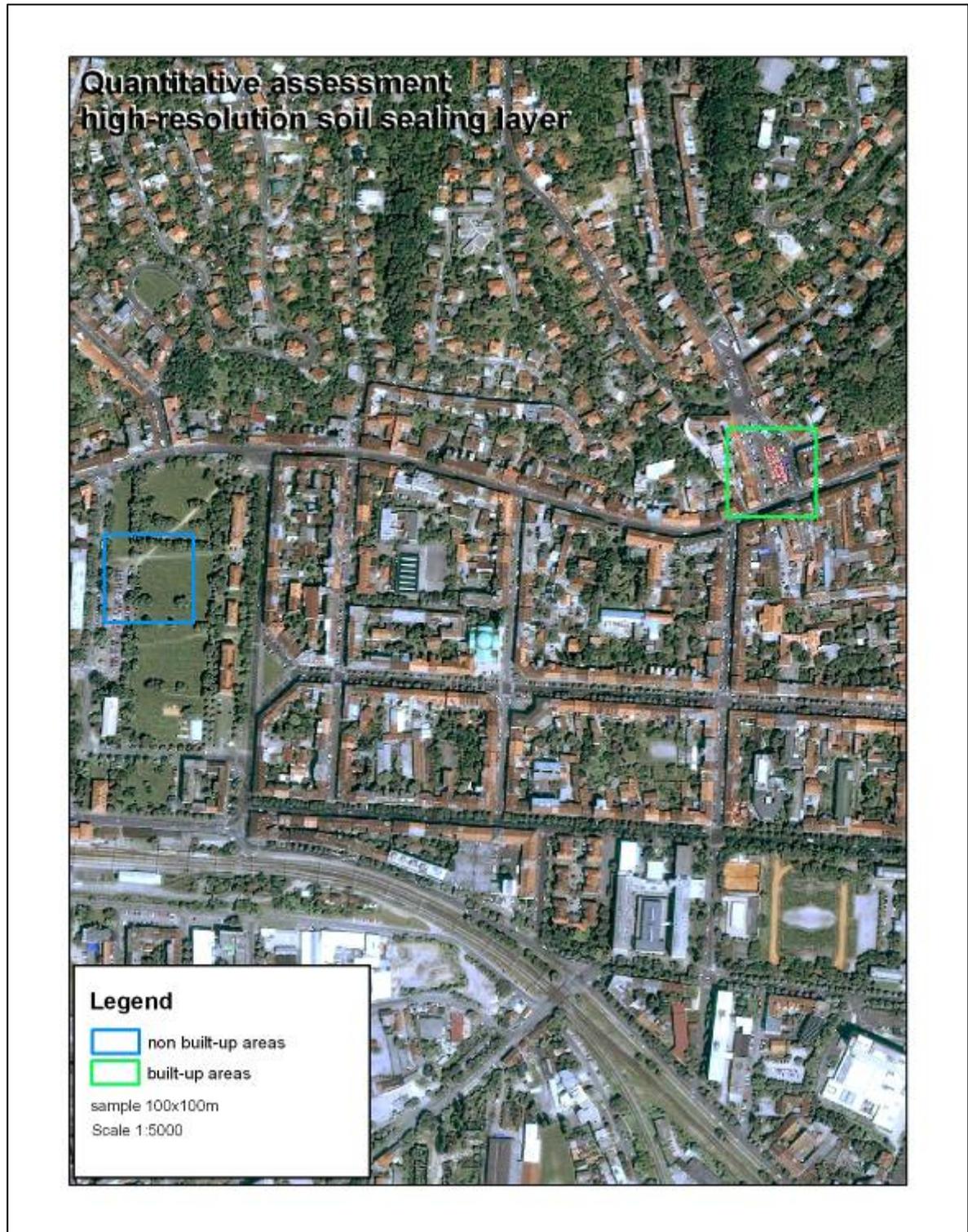












#### D. Overall qualitative assessment of the dataset

The overall qualitative assessment is meant to support EEA in our contractual procedures with the service provider regarding the acceptance of the dataset. While the previous thematic quality assessment was looking at class by class, this section should provide your assessment of the quality for the whole territory.

How would you assess the overall quality of the mapped built-up/non built-up areas for the dataset provided?

very poor  insufficient  acceptable  good  excellent

Please provide your final comments and additional remarks concerning overall qualitative assessment (e.g. difference in quality between regions e.g. mountains, agglomerations, coastal zones, etc), if any:

Due to that GISDATA validated 50% of the country conclusion is that overall quality of the mapped built-up/non built-up areas for the northern part of the dataset (Figure 1) is excellent.

In 250 samples used for validation of built up areas only 11 cells were classified as not built up with accuracy less than 80%.

In 1000 samples used for validation of not built areas only 9 cells were classified as built up with accuracy less than 80%.

In southern part of the country validated by OIKON (Figure 2) overall quality of the mapped built-up/non built-up areas is good.

In 250 samples of built-up areas 123 cells were found to have less than 80% accuracy.

In 1000 samples used for validation of not built areas 81 cells were found with soil sealing >80% and classified as built-up areas.

In spite of that overall quality of the mapped built-up/non built-up areas for the dataset provided is assessed as good.

### E. Quantitative validation

Are you planning to carry out a statistical validation (quantitative assessment) of the national dataset?

Yes       No

If yes, it would be helpful to provide us information about the timing, methodological approach or any other additional information which might be available:

It depends of situation in Croatia and new plans for project.

Are you willing to contribute to the final validation of the European dataset (actions scheduled from the second half of 2008 onwards)?

Yes       No

Filled in by Sandra Radi Goljak

Telephone number: 0038513667666

Email: sandra.radi@gisdata.com

Date: 01.04.2008.

Filled in by Vladimir Kušan

Telephone number: 0038515507131

Email: svkusan@oikon.hr

Date: 03.04.2008.

*Thank you!*