

Final

Guidelines for verification of high resolution soil sealing layer

- Qualitative assessment -

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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:

Expert name	Field of expertise	Institution
Jackie Ulliyett	GIS	CEH Monks Wood
Nigel Brown	GIS / EO	CEH Monks Wood
Andrew Thomson	Land cover / EO	CEH Monks Wood
Geoff Smith	EO / land cover	CEH Monks Wood

The average time needed for this verification is estimated at one person/day per 10.000 km². 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.

Country	Area (km ²)	Person days	Country	Area (km ²)	Person days
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: **04/05** Area: **Subset**

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

4 regions of the UK representing around 25 %.

2. Aerial orthophotos

☒ No ☐ Yes Year: Area: Please, select:

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

3. Very High Resolution satellite data

☐ No ☒ Yes Year: **2006** Area: **Subset**

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

As in section 1.

4. CLC2000

☒ No ☐ Yes

5. Other

Name: **LCM2000** Year: **2000** Area: **Subset**

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

**A set of subsets were used in this analysis, but the whole of UK will
be used in quantitative analysis.**

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):

Name: Year: Area: Please, select:

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

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):

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): **The estimation of soil sealing is only consistent on major roads.**

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:

- 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): **Quarries areas are consistently included in the sealed area.**

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:

- 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:

- 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:

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

Salines:

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

Intertidal flats:

- 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:

- 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.):

Overall the quality of the data was pretty good.

The soil sealing layer was found to be consistent between across the UK in general terms. Most urban areas were well represented with good variation between heavily urban and suburban districts.

The main issue was the depiction of mineral extraction sites, old quarries etc. They are generally 'rocky' because they have had the soil removed and some have had soils put back and are regenerating a vegetation cover. The soil sealing in such areas seems inconsistent, perhaps because the source data/images predate the vegetation growth?

Roads are rather inconsistently represented, even where substantial enough to be recorded. There were also a number of construction sites which may be mostly bare ground rather than 'sealed' ground . There were a few areas where soil sealing had been identified but when looking at the reference data there didn't appear to be anything there other than bare ground.

An area of extensive upland and coastal landscape areas with a scattering of small towns and villages, mainly on the coast was selected to discover if false positive false soil sealing data occurred in upland and coastal areas with exposed natural rock surfaces but it did not.

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:

The overall portrayal of built-up land surfaces by soil sealing values was generally good. The highest soil sealing values occurred only in the densest urban areas; medium values are needed to cover residential urban areas.

The main exception to this was the inclusion of gravel pits and quarries in the high soil sealing class.

Stray clouds such as aircraft contrails on the imagery can introduce false data. Although only a small percentage there are some large contiguous areas with no data due to cloud cover.

There was one fault in the documentation where the wrong location map was used in the figure in section 4.2.

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:

We considering a quantitative assessment via a full cross comparison with the Land Cover Map 2000. There are obvious timing and minimum mappable unit issues, but it may identify any systematic offsets between the two data sets. The time scale and exact methodology are not finalised at the moment.

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 **Geoff Smith**

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Date: **21st July, 2008**

Thank you!