Verification of
high resolution soil sealing
layer

- Qualitative assessment -

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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:

Expert name	Field of expertise	Institution
Elzbieta Bielecka	Training, interpretation, consultation	Institute of Geodesy and Cartography
Dariusz Dukaczewski	Interpretation	Institute of Geodesy and Cartography
Jedrzej Gasiorowski	Interpretation, GIS	Institute of Geodesy and Cartography
Ewa Laczynska	Interpretation, GIS	Institute of Geodesy and Cartography
Zenon Polawski	Interpretation	Institute of Geodesy and Cartography
Andrzej Skirmunt	Data down loading	Institute of Geodesy and Cartography

The average time needed for this verification is estimated at one person/day per 10.000 km^2. 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: Area: Please, select:

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

2. Aerial orthophotos

    ☐ No   ☒ Yes   Year: 2002-2005   Area: Subset

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

    Almost the whole country, except for areas located near national border

3. Very High Resolution satellite data

    ☐ No   ☒ Yes   Year: 2002-2005   Area: Subset

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

    IKONOS – 2 images for the Tatra Mountains, 1 image for Kozienice Forest
    Quickbird - 18 images located in the north, central and south parts of Poland

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):

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
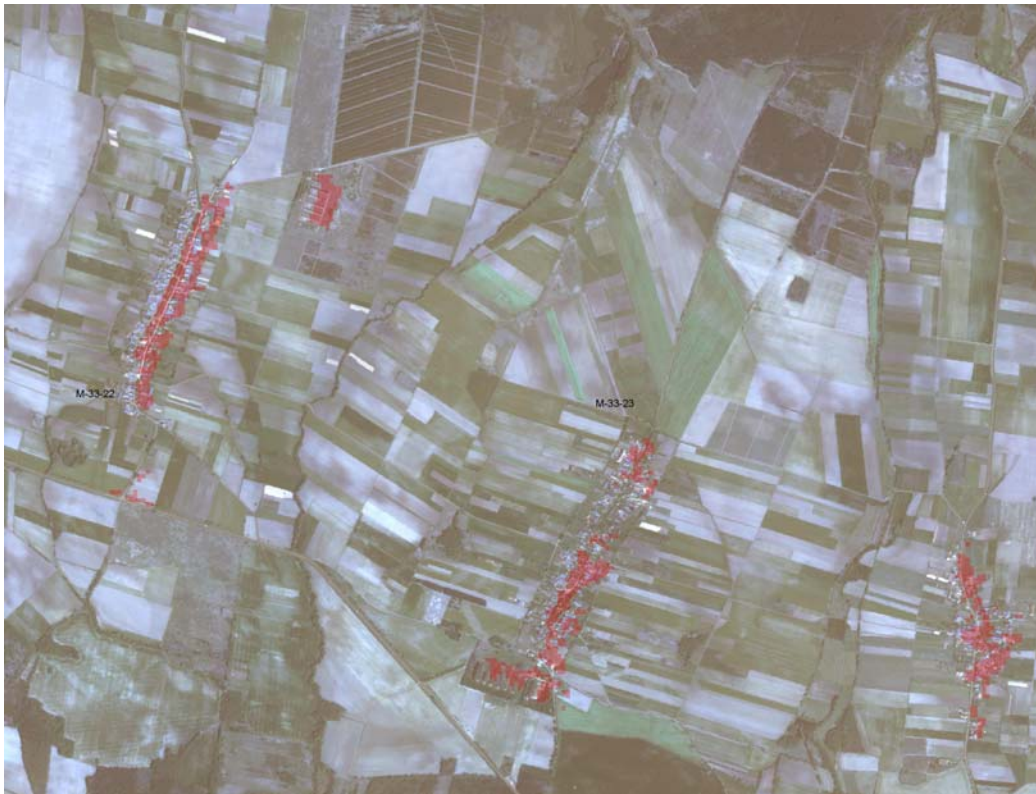
    If yes:

        a. Is there a systematic shift? ☐ Yes   ☒ No

        b. Is there a local shift?   ☒ Yes   ☐ No

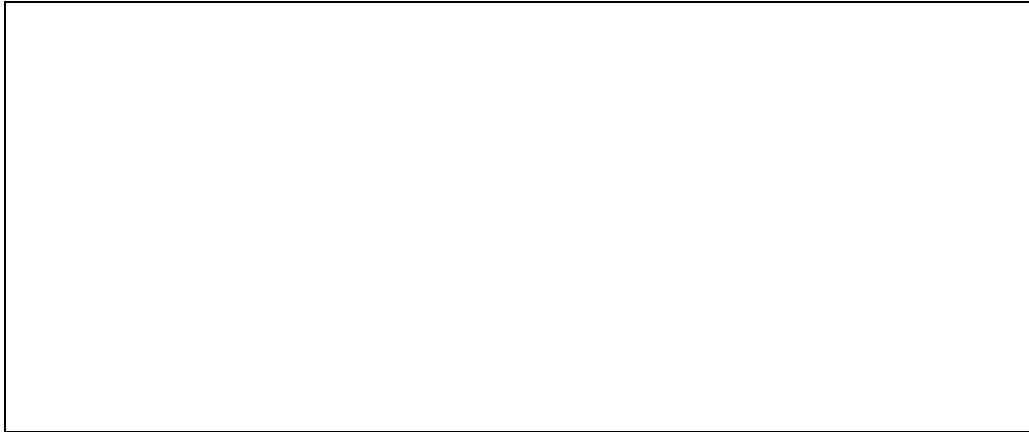   Where? NW x=359 551, y=398 885; SE x=373 555, y=384 629

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

    In general there is no shift, but in some regions HR soil sealing data is shifted about 50 -70 m (2-4 pixels).

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): buildings and associated areas are omitted in many cases, either in cities and towns or in villages. Sometimes soil sealing pixels are shifted and shadows of buildings were captured instead of buildings themselves.

Fig.1 Lodz city, (central part of Poland, x=526 668, y=436 538), a lot of buildings (CLC112) are not classified as sealed

Fig.2 Tomaszow Mazowiecki town (central part of Poland, x=569 035, y=408 489) some buildings (CLC112) are not classified
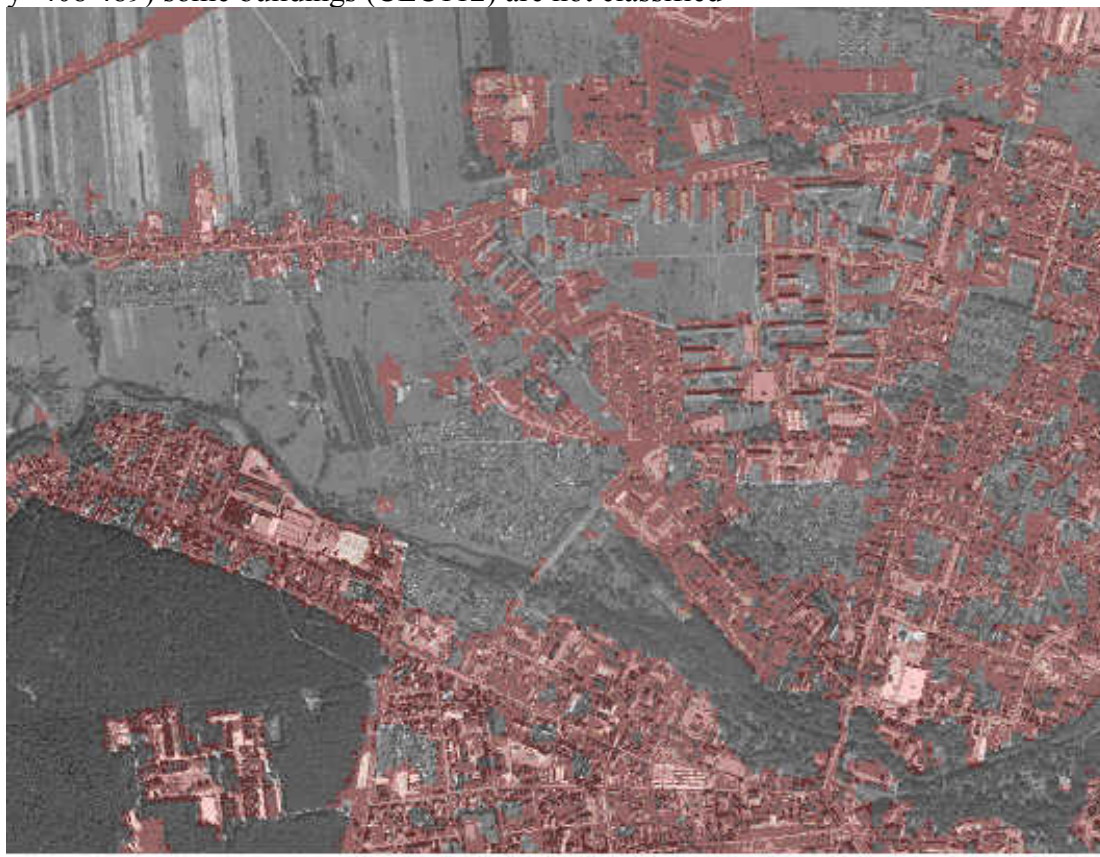

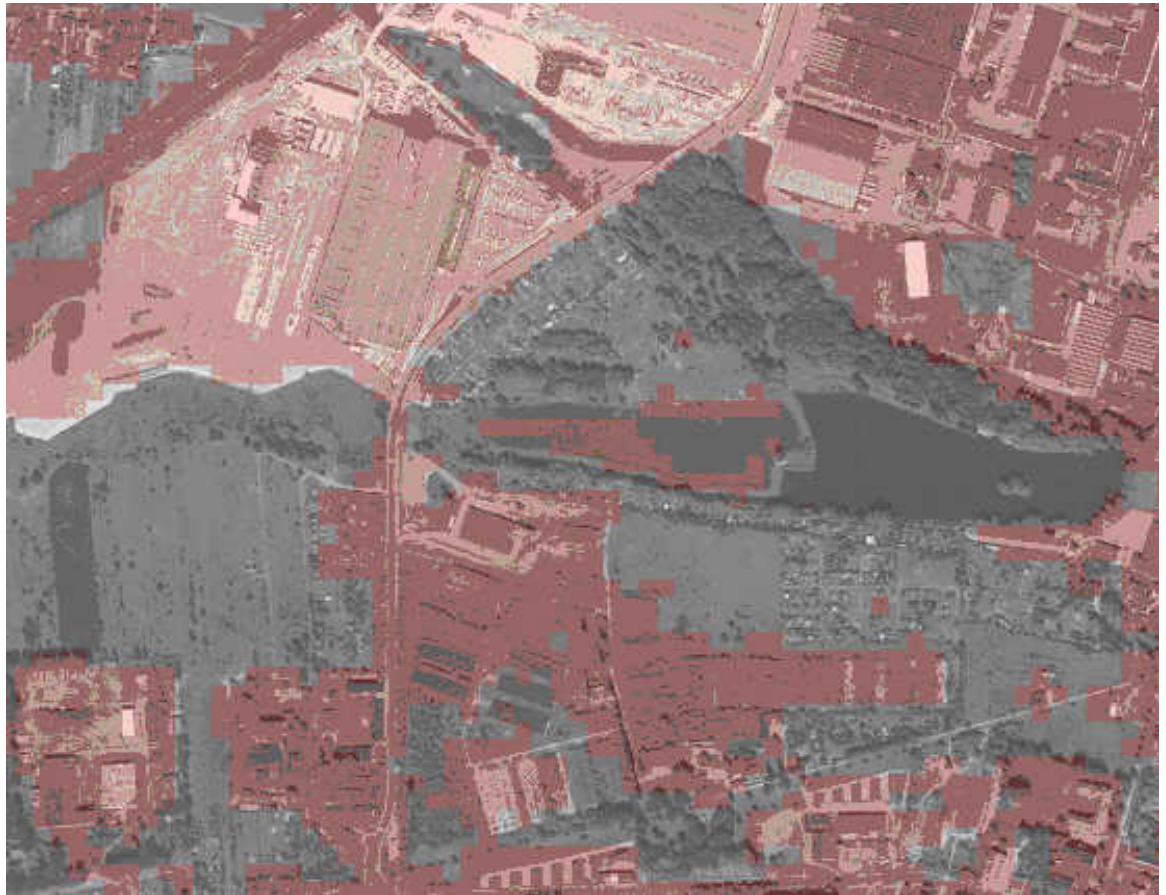Fig. 3. A lot of buildings are omitted (x=573 891, y=404 587)

Fig.4. A lot of omitted houses (x=530 029, y=284 919)

Fig.5 Upper Silesia (x=524 150, y=291 018)

Fig.6 water classified as urban (central part of Poland, x=569 776, y=409773)

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): some industrial areas are not classified as urban, in the other cases non vegetated industrial areas are classified as urban

Fig.7. Big industrial area is omitted (x=572 898, y=408542)

Fig. 8. Industry not classified (x=283 913, y=698 595)

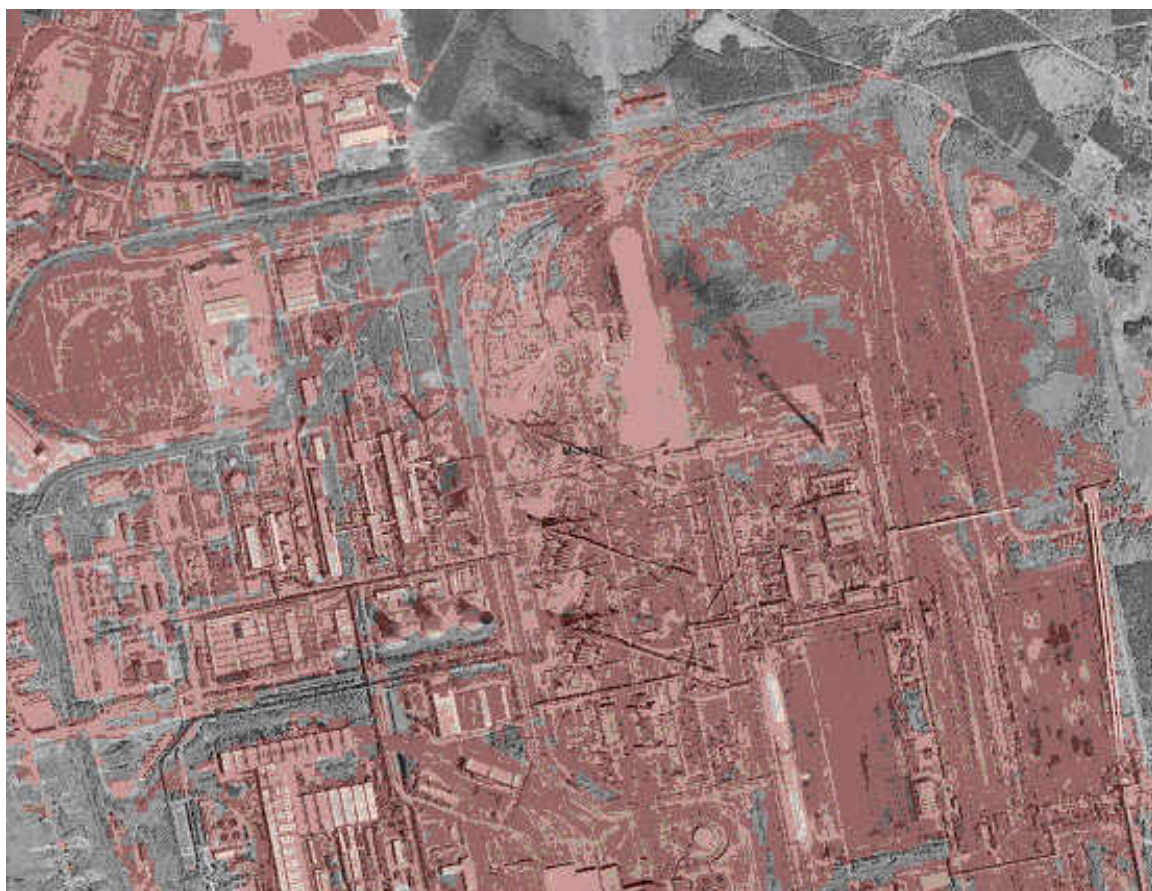Fig. 9. Katowice steelworks: vegetated area is classified as urban (x=521 363, y=276 498)

Fig. 10. Only a part of buildings is classified as urban (x=727 314, y=674 487)

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): railway stations and associated areas are partly omitted, roads are discontinuous, sometimes trees with shadows are classified as urban

Fig. 11. Discontinuity of a road, in the left-upper part classified pixels are shifted (x=607 068, y=347 105)
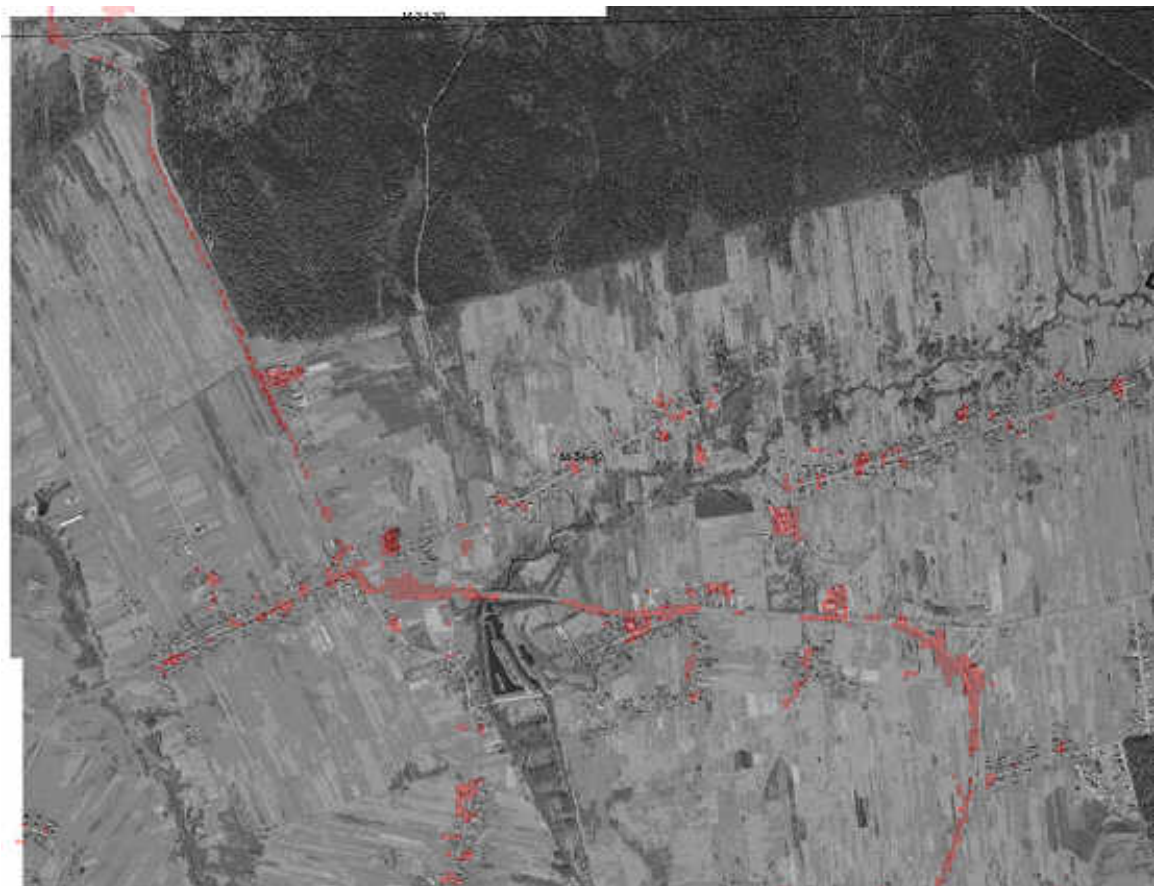
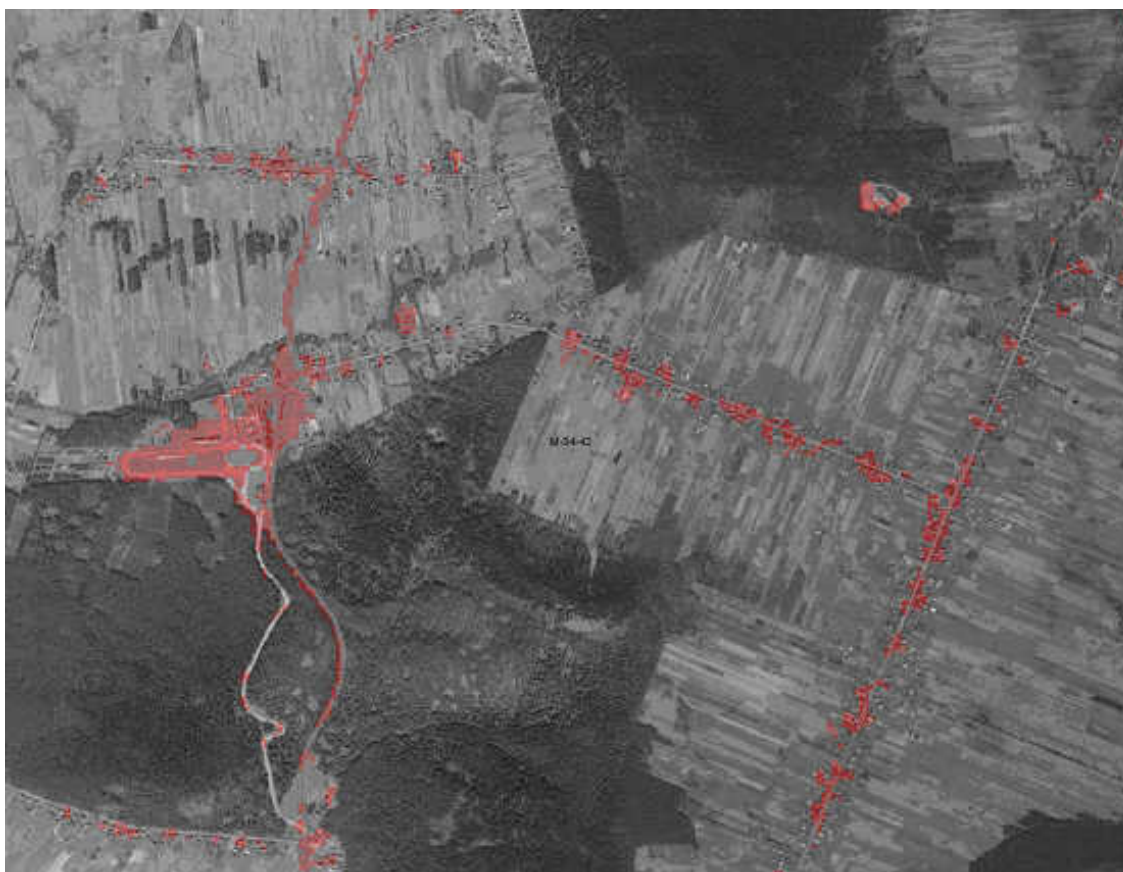Fig. 12. Discontinuous and shifted road (x=608 437, y=345 371)

Fig.13. Discontinuity of express road Warsaw-Gdansk (x=571 712, y=636 563)

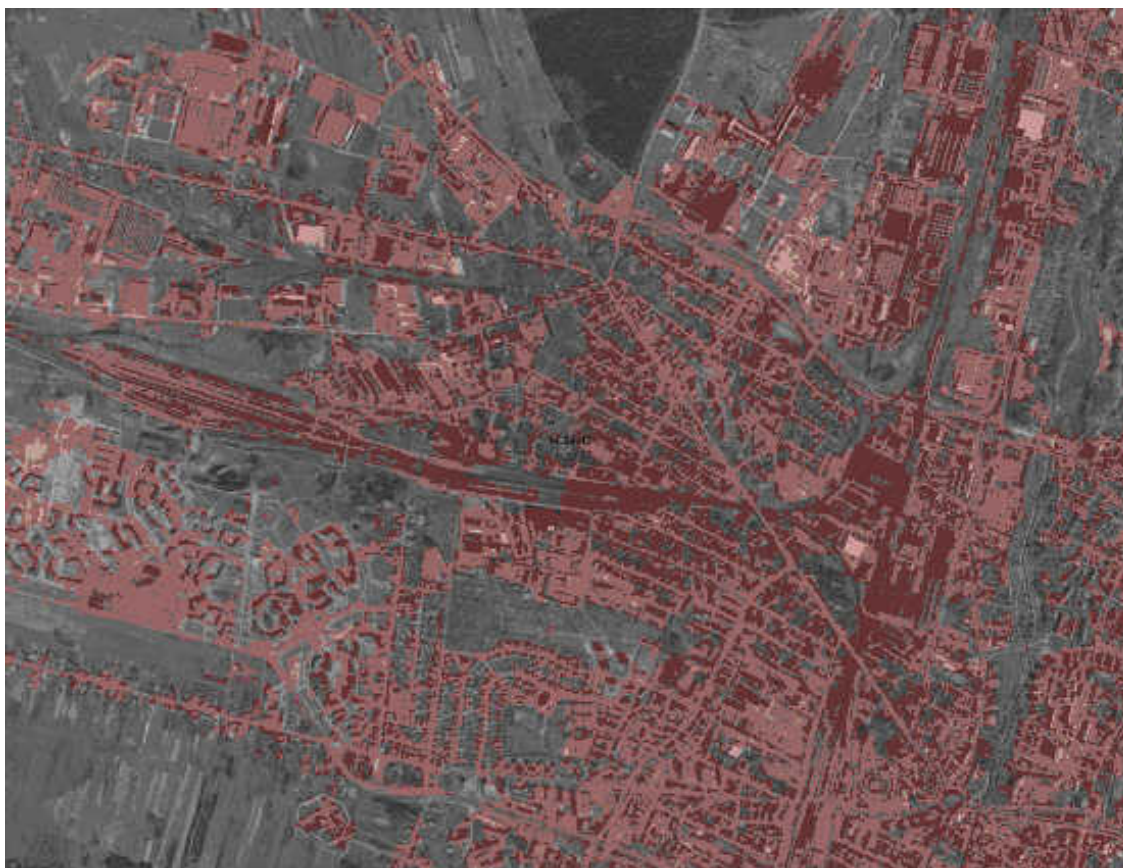Fig.14. Discontinuity of railway station (x=530 029, y=284 919)

Fig.15. Completely omitted railway station (x=602 635, y=697 473)

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):

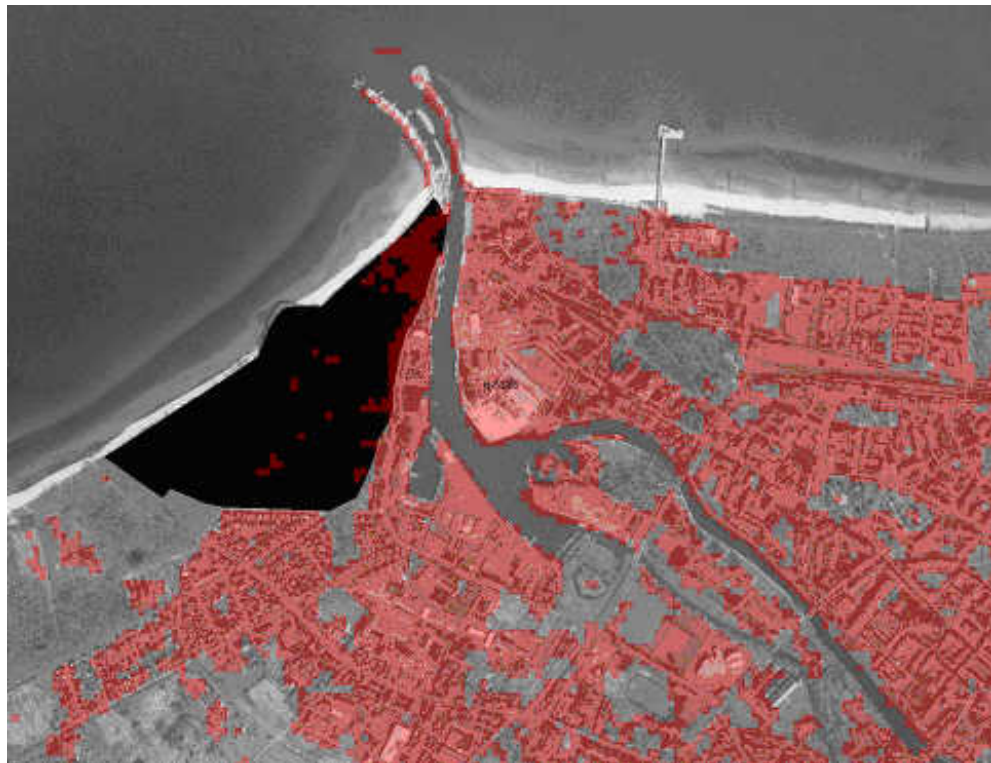Fig.16. Port area in Kolobrzeg (x=282 689, y=708 997), some parts of sealed seashore are omitted

Fig. 17. Completely omitted (x=191 986, y=670 853)

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): runways are discontinuous, some buildings are omitted.
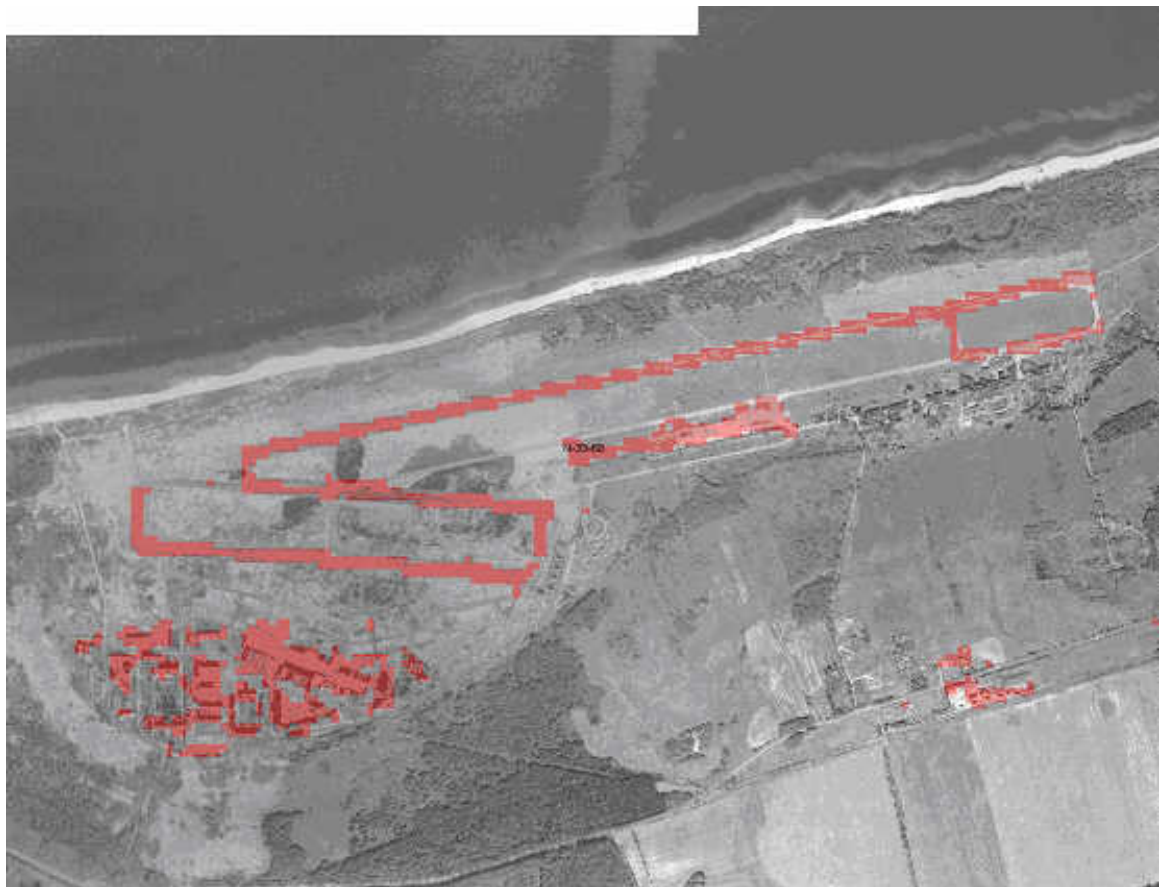
Fig.18. (x=282 689, y=708 768)

Fig.19. (x=377 160, y=736 338)

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): small opencast mines are omitted, sometimes recultivated areas are classified as sealed

Fig. 20. Recultivated (vegetated) areas captured as sealed (x=619 958; y=341 816)
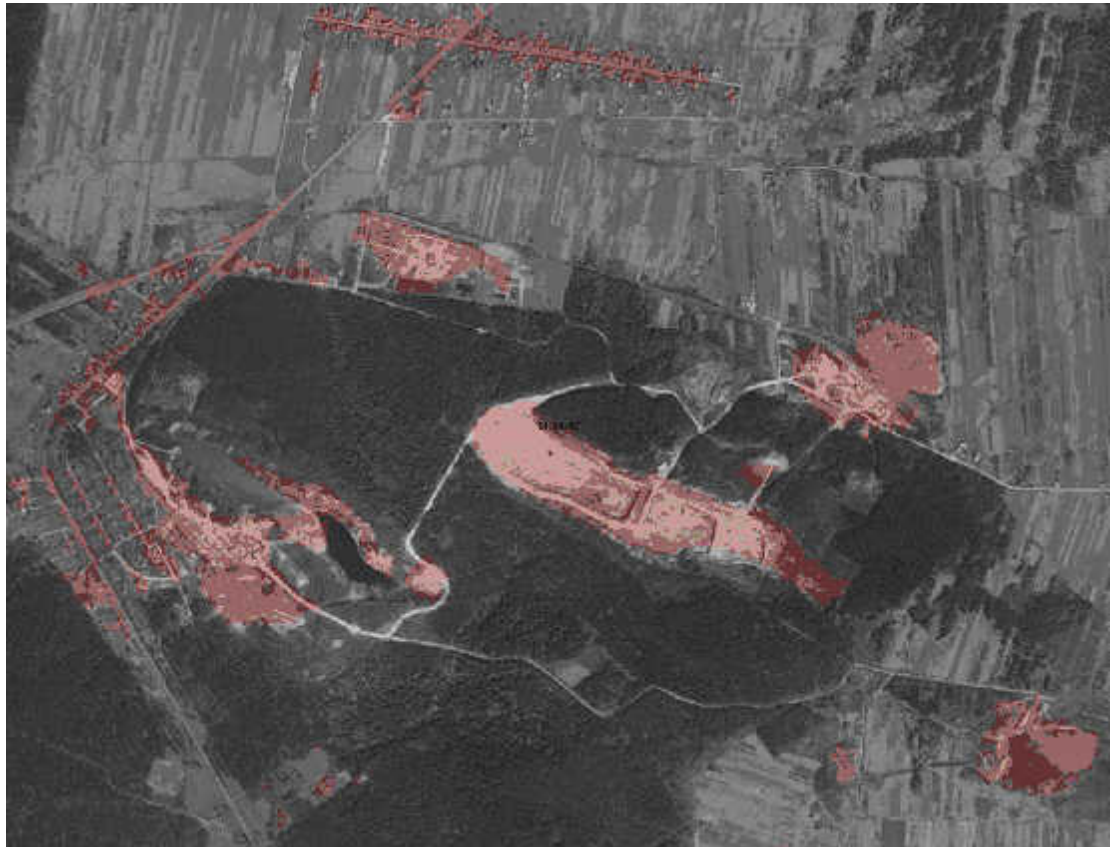

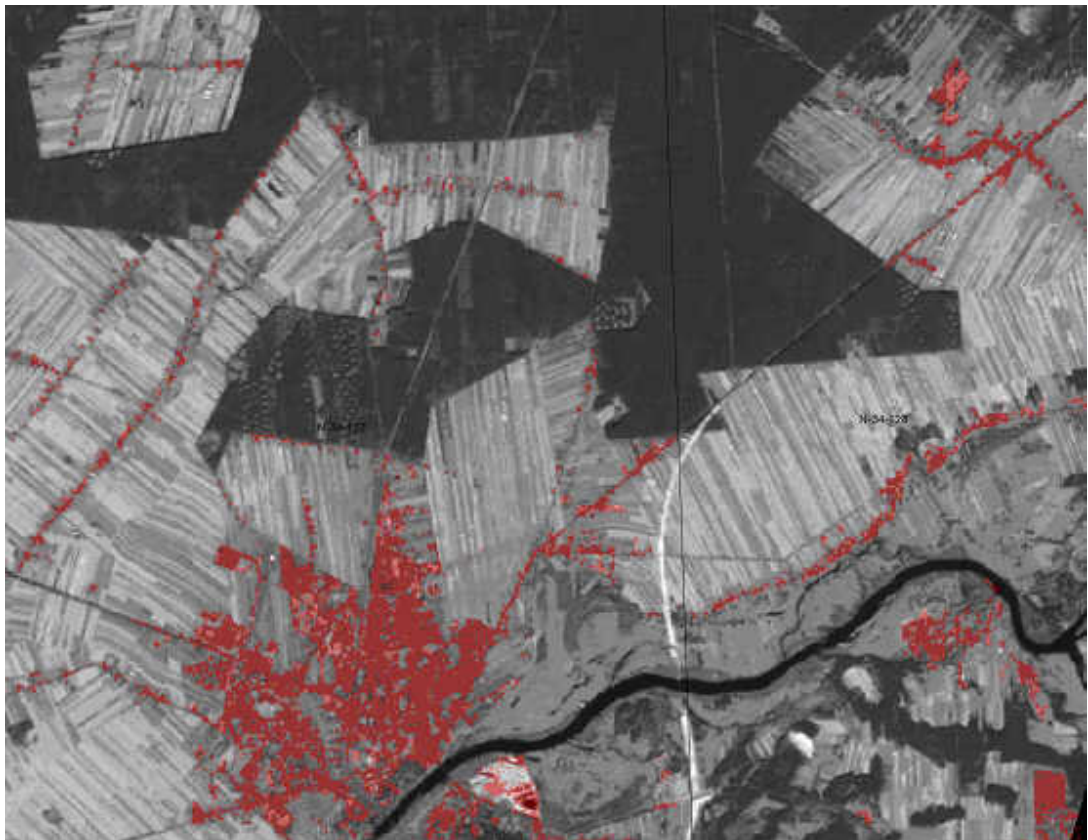Fig.21. Road under construction not classified (x=668 894, y=530 230)

Fig.22. Opencast mine not captured as sealed soil (x=570 653, y=623 253)

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): it has happened that arable fields were classified as soil sealing. Many small CLC112 villages and disperse settlements (CLC242) were omitted in HR soil sealing data.
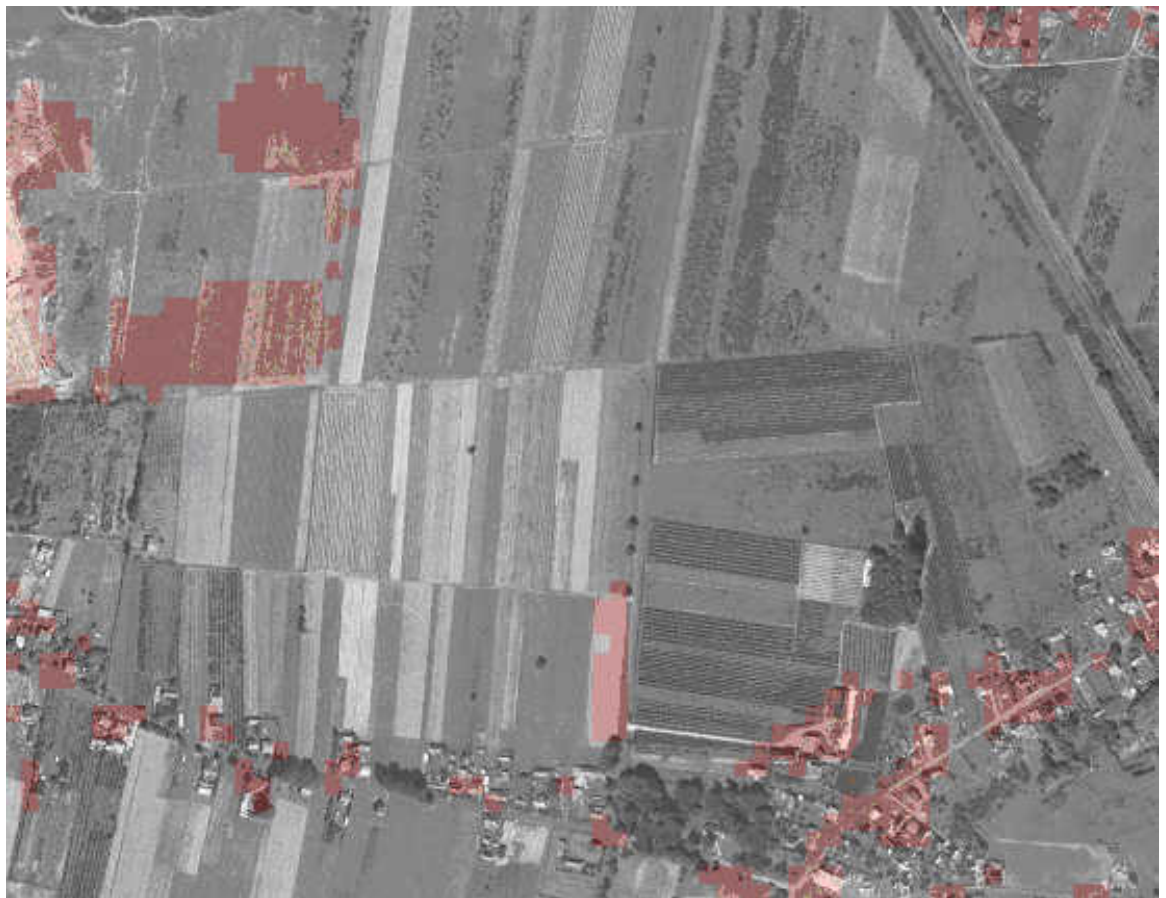
Fig.23. x=569207, y=405711

Fig.24. x= 524 150, y=292 018

Fig.25. x=566 264, y=620 693

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): built-up areas within heterogeneous agricultural areas were omitted very often

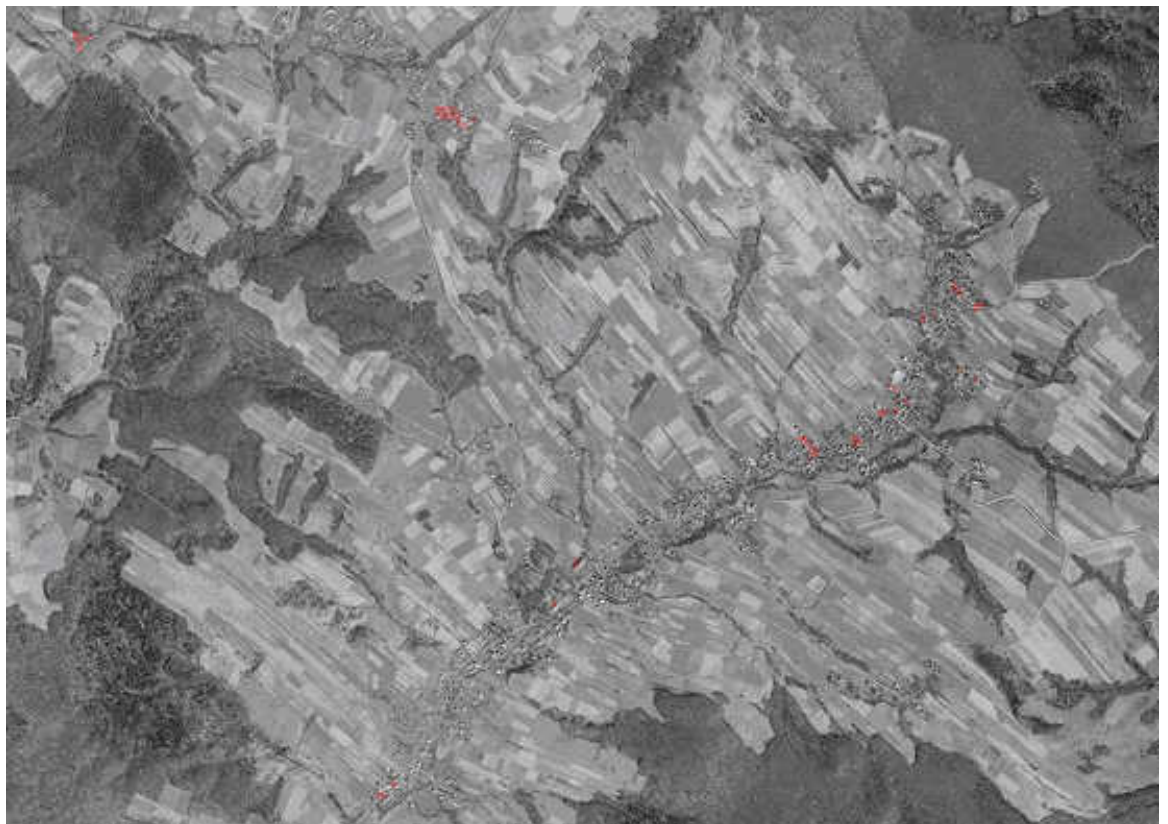Fig. 26. Completely omitted (x=729 129, y=201 209)

Fig.27. A lot of omitted buildings (x=689 830, y=605 927)

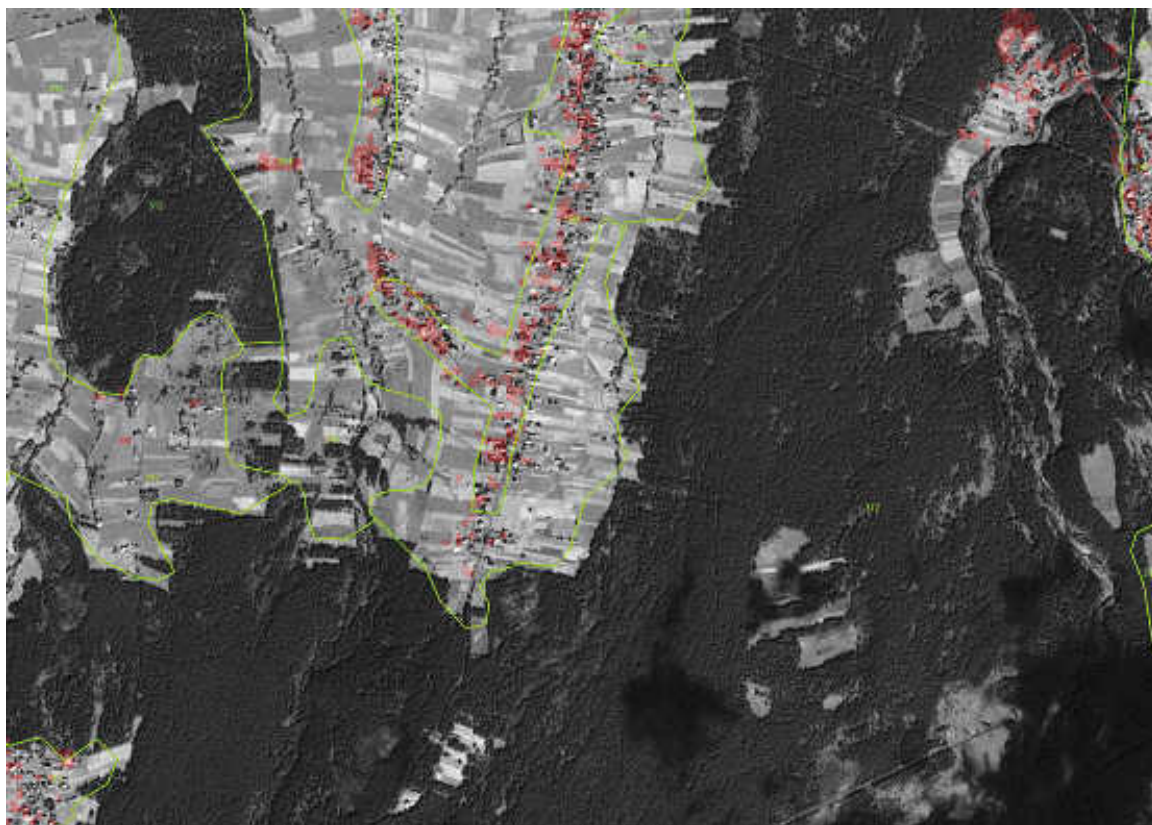Fig.28. A lot of not classified buildings (x=575 675, y=159 847)

Fig. 29. x=573 719, y=407 934

Fig.30. x=565 561. y=619 566

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): individual buildings and small groups of buildings were omitted.

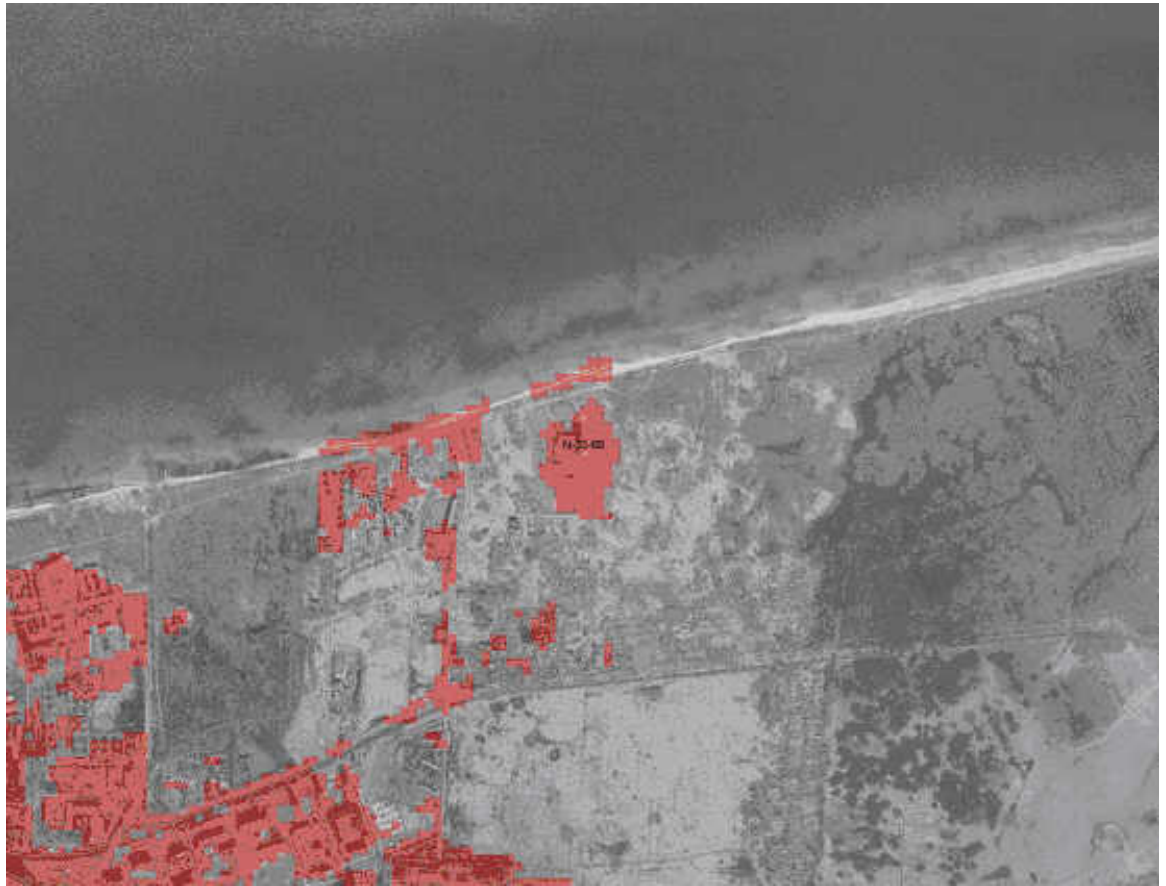**Scrub and/or herbaceous vegetation associations:**

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): there are no buildings in clc322 category , because in Poland it includes only subalpine dwarf mountain pine.

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): some parts of beaches were classifies as sealed.

Fig. 31. x=278 761, y=708 269

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.):

> About 10% of the Poland territory was checked. Areas for checking were distributed all over the country. We tried to choose areas located in different geographical regions (seaside, postglacial areas, lowlands, foothills, hills, mountains) as well as in different types of landscape (urban, industrial, agricultural, forested).
>
> Verification was based on aerial ortophotomaps, as well as HR satellite data such as IKONOS and Quickbird. Each of the CLC class was checked.

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 quality of HR soil sealing data in big cities and towns is generally good. Only in few cases buildings were omitted. But in small towns and villages a lot of buildings were not classified as urban. So finally our evaluation of correctness of the classification in urban fabric CLC classes is acceptable. In the countryside (forests, agricultural areas, small villages...) the scattered settlements are insufficiently classified. Also roads and railways are mapped insufficiently, generally they lost continuity, even then when a road is more than 20 m in width.
> Globally the quality of the mapped build-up/non built-up areas is assessed as "acceptable". Even though some minor classes have been assessed as "insufficient", the most important classes reached the acceptable level of quality.

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:

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 Elżbieta Bielecka

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Date: 23.07.2008

Thank you!