Interim report

CLC2006 1st verification report, Bosnia and Herzegovina

CARDS Project 2007-2008

EEA Service Contract 3334-3601/B2007/EEA.53024

Prepared by:
G. Büttner

15.07.2008

Implementation of CLC2006 in the West Balkan Countries
EEA project manager: Tony Blagoev
Project manager, GeoVille Sàrl: Stefan Kleeschulte

ETC Land Use and Spatial Information

Universitat Autònoma de Barcelona
Edifici C – Torre C5
4ª planta
08193 Bellaterrra (Barcelona)
Spain

Contact:
Stefan Kleeschulte
GeoVille Environmental Services
7, rue du Parc, L-6684 Mertert

Email:
kleeschulte@geoville.com

European Environment Agency

TABLE OF CONTENTS

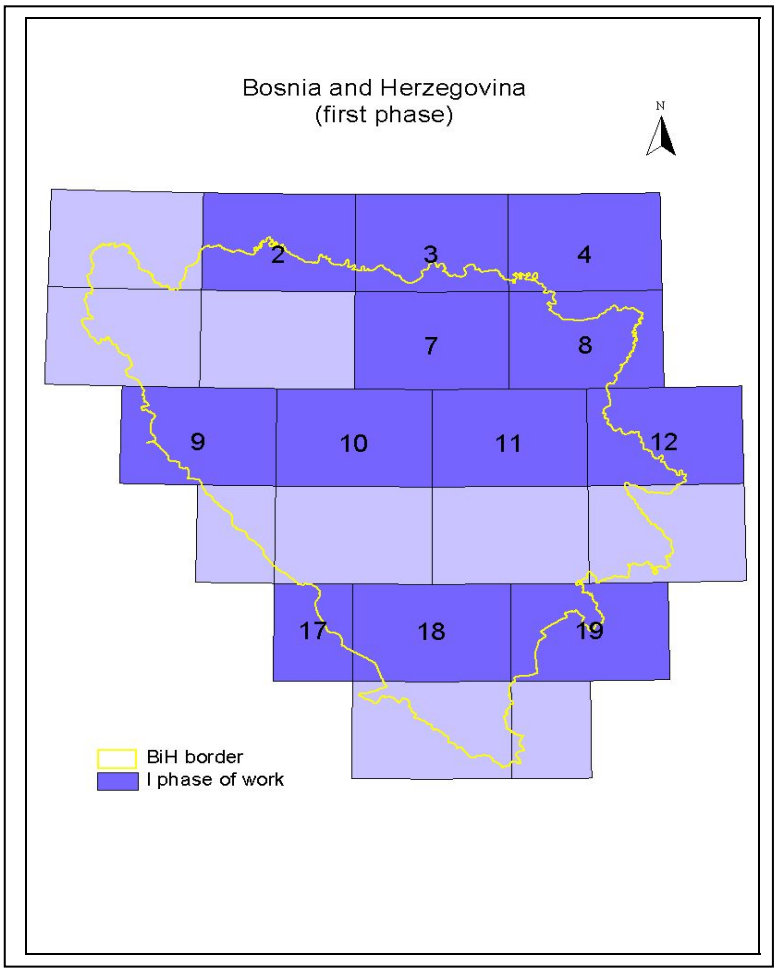
1 ACTIVITIES LINKED TO THE PREPARATION OF THE VERIFICATION

The CLC2006 update for Bosnia and Herzegovina is implemented by the University of Sarajevo, Faculty of Agriculture. Most of the experts in the national team also took part in the 1st CLC inventory in the country between 1999 and 2000. A training on CLC2006 (change mapping) was requested and conducted in December 2007. It was decided that before the first standard verification, a preliminary verification is to be carried out in FÖMI, within a so called 'remote' verification procedure, where about 12% of the country area has been checked. The 1st on-site verification was prepared jointly by the national technical project manager, Hamid Custovic and George Büttner, coordinator of the CLC Technical Team (TT). A bit more than 50 % of total country area has been prepared for the verification (Map 1).

1.1 VERIFICATION PROCEDURE

The objectives of the verification missions are manifold:

- To assist the national team in producing the CLC2006 databases and to assure a homogenous implementation across Europe.
- Corrective goal: reveal and discuss specific problems occurred during the production in order to correct databases if necessary, and hereby assure a harmonised European CLC database.
- Provide the EEA with information about the overall quality of the work performed by the country.



Map 1 Working units in Bosnia and Herzegovina. Wu-s submitted for the 1st verification are indicated with darker shade. Units 17, 18 and 19 have been subject to remote verification before.

2 AGENDA AND PARTICIPANTS

Place of the verification: University of. Sarajevo, Faculty of Agriculture and Food Science, Zmaja od Bosne 8, Sarajevo, Bosnia and Herzegovina

7 July 2008
13:45 – 15.00
Flight from Budapest to Sarajevo
16.30 – 19.00
Starting verification of CLC2006 databases produced by the BA team
8 July 2008
8.30 – 19.00
Verification of CLC2006 databases produced by the BA team
9 July 2008
8.30 – 20.00
Verification of CLC2006 databases produced by the BA team
10 July 2008
8.30 – 12.30
Discussion of results with the BA national team
15:30 – 17.00
Flight from Sarajevo to Budapest

The following experts participated:

From the Bosnia and Herzegovinan team:

- Hamid Custovic, project manager
- Melisa Ljusa, photointerpreter
- Sead Vojnikovic, photointerpreter
- Fahrudin Duza, photointerpreter

From the ETC-LUSI Technical Team:

- George Büttner

3 SUMMARY CONCLUSIONS

3.1 METHOD OF VERIFICATION

The InterCheck2.1 software running under ArcView 3.x was used as a support tool for verification. IMAGE2000 and IMAGE2006 data were available for each working unit. Topographic maps were used during discussion only. The environment of InterChange projects could be directly used in the verification, so the work could be started immediately.

The checking process was as follows:

a) Checking validity of codes and neighbouring polygons with the same code (merge errors) in CLC2000.
b) Checking size errors in CLC2000.
c) Checking CLC2000 statistics (to reveal non-relevant codes)
d) Checking validity of codes and neighbouring polygons with the same code (merge errors) in CLC-changes.
e) Checking size errors in CLC-changes.
f) Checking CLC-changes statistics (to reveal non-relevant codes).
g) Visual checking of minimum 10 % of polygons for all classes.
h) Visual checking of all change types.

Additionally the whole wu area was examined visually to find missing changes, if any. Verification units (vu) were not selected for the verification.

Results of the verification (remarks by the Technical team experts with coordinates) are included in ArcView point coverages, which are provided to the national team in order to load them into their GIS, used for photointerpretation. (InterChange2 software is capable to apply the remarks very easily.) Naming convention: Remark_r means: remarks for the revised CLC2000; Remark_c means: remarks for the CLC-Changes database.

3.2 GENERAL CONCLUSIONS CONCERNING THE RESULTS

About half of the country area has been prepared for the 1st verification. The summarised results of the verification are presented in Table 1. Working unit level details are presented in Table 2.

3.2.1 Technical quality

Satellite image quality was rather good regarding IMAGE2000 as well as IMAGE2006.

Technically the database is considered good. A very few size errors and some merge errors (neighbour polygons with the same code) in almost every working units have been found. 100 m width limit was well kept. CLC-Changes databases included some invalid polygons (with nil as the 2nd attribute).

3.2.2 Revised CLC2000

- 231 and 243 is locally overused, instead of 321 (especially in karstic region).
- In South part of the country 242 is used sometimes for built-up area.
- Sometimes 243 is used to map grasslands, abandoned not-long ago.
- 322 class (Moors and heathland) is not used consistently. This class can appear in BA only in high altitude (dwarf pine, Pinus Mugo).
- Codes 332 and 333 sometimes used for areas with more vegetation than described in the definition of these classes (karstic region).

- 411 class was incorrectly used sometimes for fish-ponds.
- Dammed section of rivers sometimes erroneously coded as 511.
- A few missing corrections have been found, some of them obviously being mistakes coming from mistyping in the first inventory.

3.2.3 CLC-Changes dataset

- Lots of non-real changes have been mapped, especially those related to internal changes in agriculture (changes between 2xx classes) and forestry (changes between 31x classes, see Figure 2).
- On some working units many omitted changes have been found (see Figure 3). Omitted changes are related both to new artificial surfaces and to changes in forestry and natural vegetation.
- Not always the real change code pairs have been given. Please note that the 2000 code of the change code pair can be different from the original polygon's CLC2000 code in order to describe the process properly.
- Non-changed parts (if larger than 5 ha) have not been cut and deleted from change polygons in a few cases.
- Changing water level of oxbow lakes sometimes interpreted as CLC change.
- Change polygons are delineated instead of correcting CLC2000 in a number of cases. This was especially significant in changes connected to settlements and agriculture (although many such changes were delineated properly).
- Complex changes have been rarely used.
- Technical changes have not been applied.

Table 1: Summary of 1st verification in Bosnia and Herzegovina

Technical features, revised CLC2000 (25 ha, valid codes, 100 m width, etc)	Good in general; some merge errors and small polygons in CLC2000.
Technical features, CLC-Changes (5 ha, valid codes, 100 m width, etc)	Good in general; some change polygons with 0 attribute.
Consequent applications of the CLC nomenclature	Good. Application of 322 class needs harmonisation considering all interpreters.
Geometrical precision	Good
Correction of CLC2000 in view of IMAGE2000	Not fully sufficient
Have the majority of changes found?	Yes
Is the area of change polygons realistic?	Usually yes (considering real changes only).
Are the attributes of change polygons describing properly the evolution processes?	Not always. False changes in almost all dominant processes: urbanisation, internal changes in agriculture and forestry.
Overall evaluation	Corrections are needed

Table 2 Working unit level summary of 1st CLC2006 verification in Bosnia-Herzegovina

Working unit no.	A, CA or R	Explanation
Photointerpreter: Jazmin Taletovic		
4	A	242-211 changes are false; 231-512 change is not a real LC change; 112-512 is impossible.
8	R	242-112 changes are overestimated, seasonal differences are interpreted as 242-243 and 231-243; most of 211-243 are omitted corrections and no change.
12	A	Some false 311-324, omitted changes in forestry
16	CA	Some non-real changes in forestry because of the autumn date of IMAGE2006.
Photointerpreter Fahrudin Đuza		
9	CA	Highly questionable internal changes in forestry (312-313, 311-313); seasonal / sensor differences are often interpreted as clear-cut (313-324, 312-324); 242-211 changes are false; 411-231 changes are not true, CLC2000 has be corrected.
10	R	False 313-312 changes in forestry, overestimation of 242-112, complex changes are not applied, several missing changes (mines, forests)
Photointerpreter: Melisa Ljuša		
2	R	242-243 changes relate to seasonal differences and usually not CLC changes; 243-242 and 211-243 changes are not real also, but usually CLC2000 has to be corrected; missing / misunderstood important changes.
3	CA	Many false changes between agriculture classes. Some of them to be “converted” into corrections in CLC2000.
7	R	Extreme number of false change polygons (especially 242-243). Many false 231-243, 243-242 and 211-243. Frequently instead of change correction of CLC2000 has to be applied. Missing changes.
Photointerpreter: Sead Vojnikovic		
17	CA	In addition to remarks of the remote verification (not corrected): some of the 242 polygons in CLC2000 have to be corrected as 112.
18	R	Very few of the remarks of the remote verification have been corrected, still many omitted changes.
19	CA	Remarks of the remote verification have not been corrected
Total verified: 12	**A: 2 CA: 5 R: 5**	

A (accepted) means: smaller mistakes only (but should be corrected)

CA (Conditionally accepted) means: the database includes mistakes that are relatively easy to correct. Following corrections the database will be accepted.

R (rejected) means: the database includes more serious/numerous mistakes that need more efforts to correct.

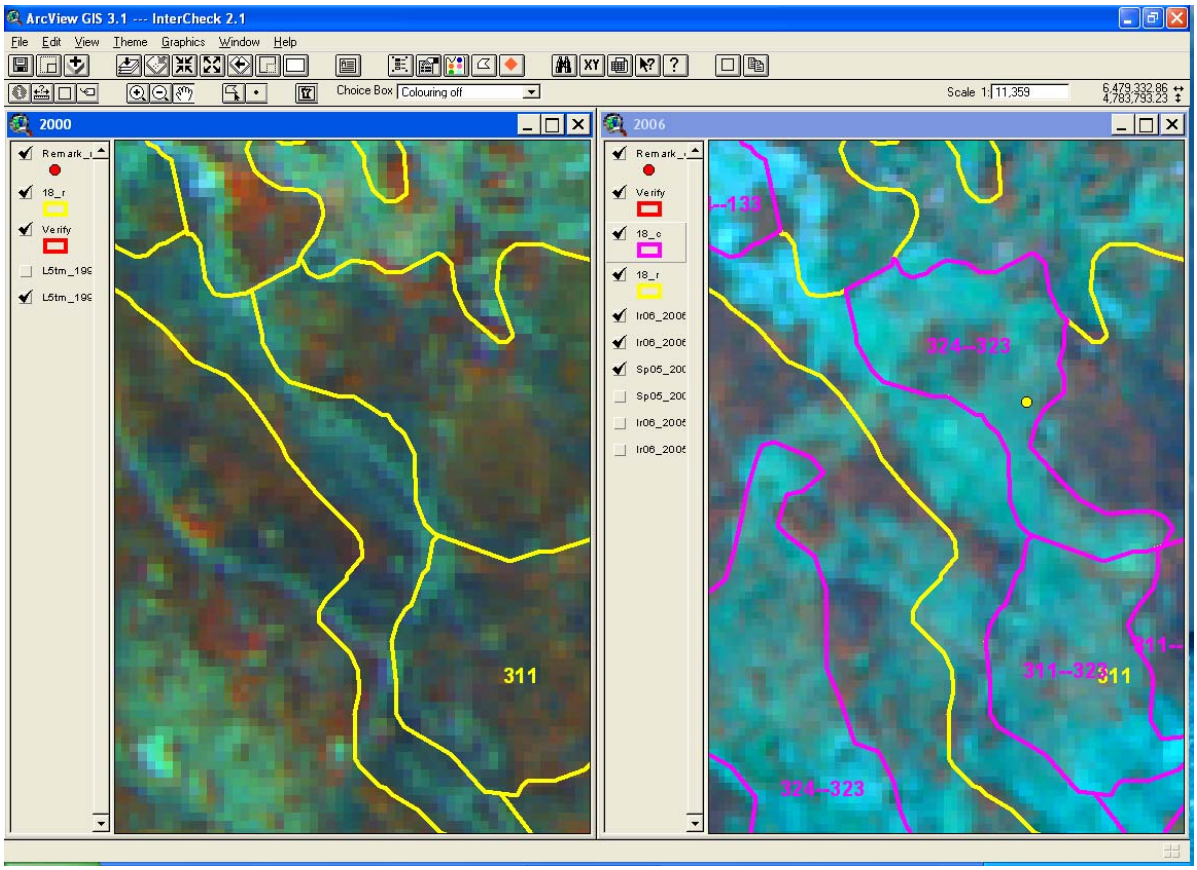


Figure 1 Forests (311, 324) after burning on the sub-Mediterranean area are naturally replaced by schlerophyllous shrubs.

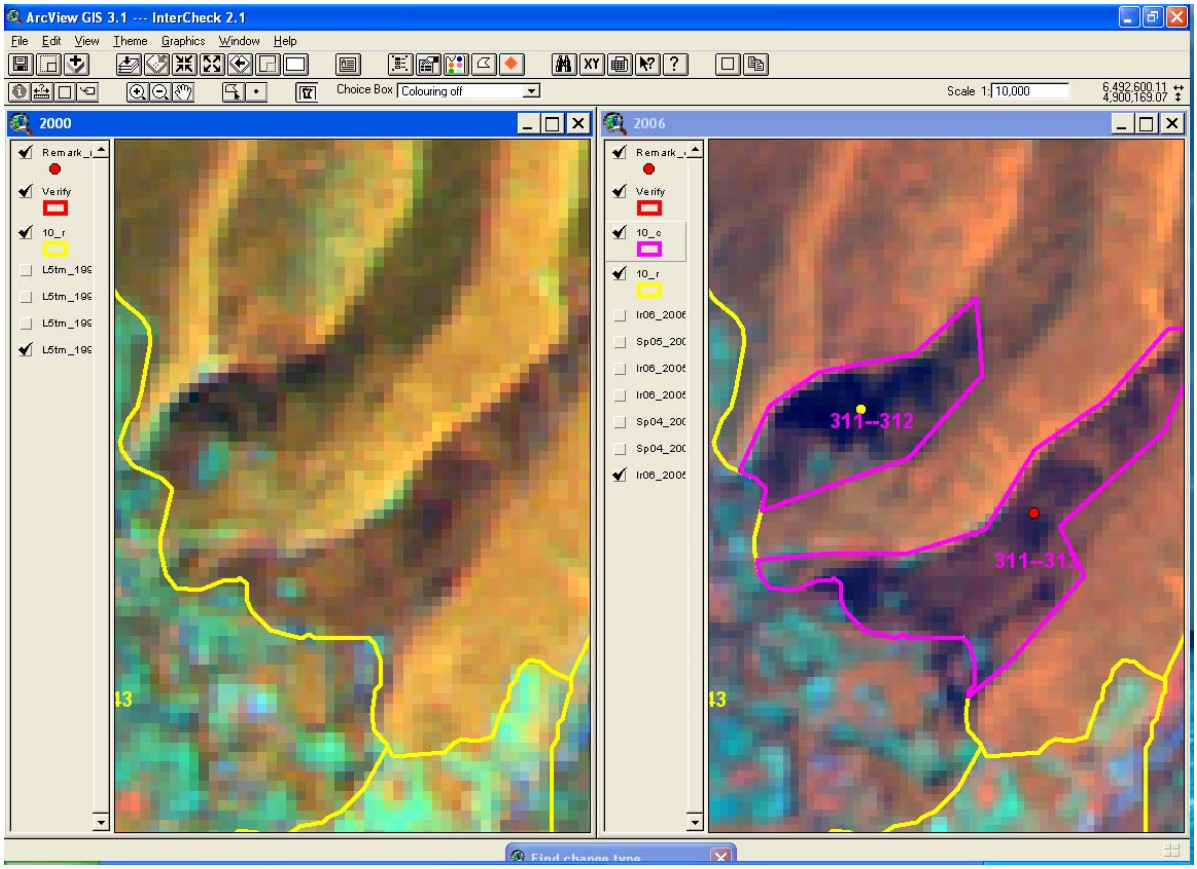


Figure 2 Seasonal differences and enhanced topographic effect on an autumn image are misinterpreted as change

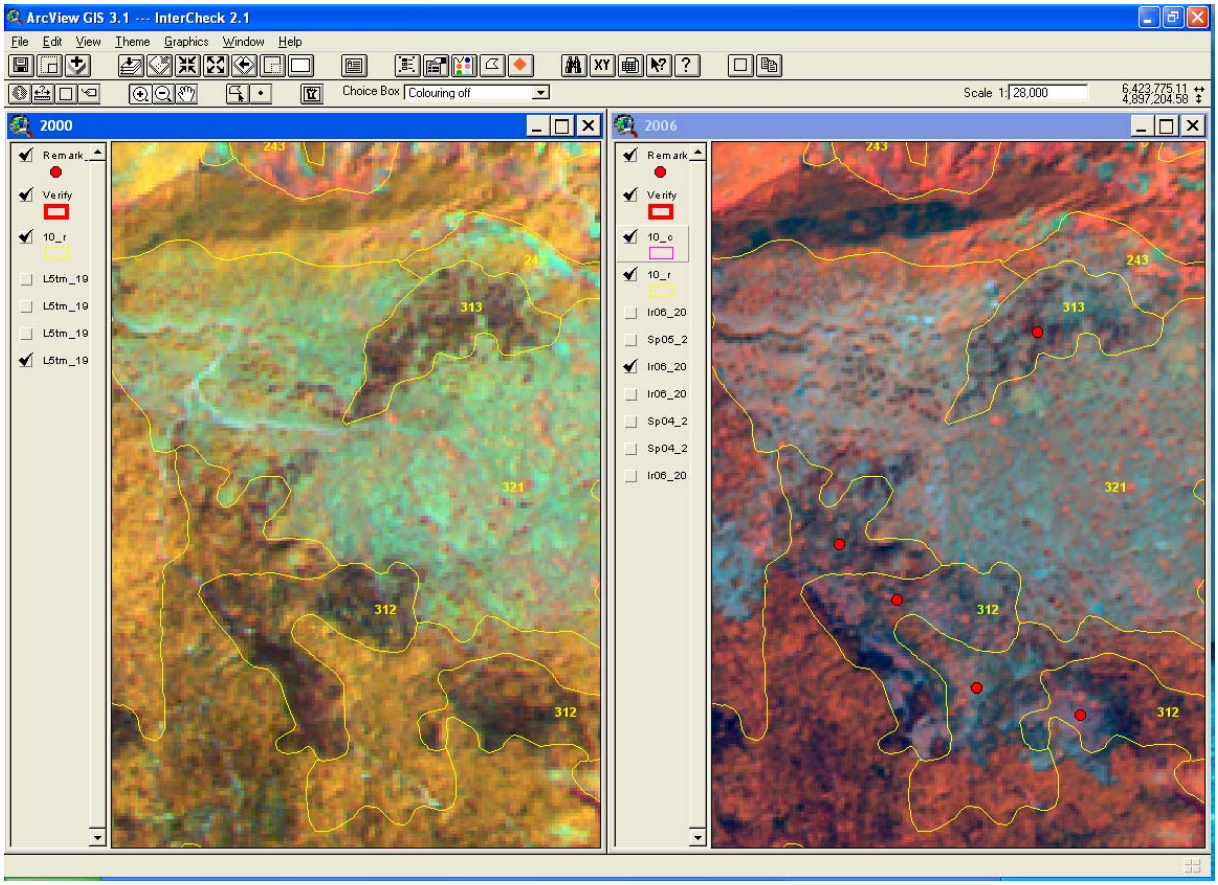


Figure 3 Several missing forest loss areas (31x-324, around red dots).

3.3 METADATA

Metadata are not yet available. It was discussed that working-level metadata should be filled in for each working unit, preferable in parallel with the mapping process. Metadata will be checked during the 2nd verification. The blank metadata sheet can be found in Annex 1 of the CLC2006 Technical Guidelines.

4 RECOMMENDATIONS CONCERNING CONTINUATION OF CLC2006 IN THE COUNTRY

Study the remarks of the Technical Team using the remark_r.shp and remark _c.shp files (attached). Corrections should be implemented before starting the second phase of the project. Corrections should be applied not only for the polygons with remarks, but all the completed working units have to be revised, especially in order to reveal still missing changes. Working unit evaluated with rating "A" (accepted) should also be corrected according to remarks.

4.1 METHOD OF INTERPRETATION

Based on the discussions with national team, it seemed important to summarise some important features of the CLC2006 interpretation methodology:

- Production of the CLC-Changes database should rely basically on satellite image interpretation with using some other materials (aerial photos, topographic maps, etc.) as ancillary information. Consequently: interpreters should work basically with IMAGE2000 and IMAGE2006 and the existing CLC2000 (CLC1998). Only in the case that something is not possible to decide this way, interpreters should consult ancillary data.
- If the production relies mostly on aerial photographs (no orthophotos are available), it will slow down, and wrong decisions might be taken (photo date is not known or different from satellite image, there are no photos available from 1998, etc).
- Topographic maps (old and new) should be made accessible more easily; otherwise this valuable material will not be used.
- Arial photographs (single date) are valuable for general orientation, but not good for mapping changes.
- The aim of mapping CLC-Changes is to map the real evolution process between the previous inventory (1998) and 2006. The "evolution process" is determined by interpreting remotely sensed data. E.g. if IMAGE2000 shows forest, and the corresponding area in 2006 shows no-forest (and the area is minimum 5 ha), than the process is forest loss (31x-324).
- Always use the latest image for 2006 in delineating changes, as some changes could happen very rapidly (e.g. construction, forest clear-cut, forest-fire).
- Check as many as possible IMAGE2006 images in order to understand the ongoing process better. Spring time and autumn images can be misleading in interpreting forests.
- The forestry expert of the team (SV) proposed to advise other team members in revising all the 322 polygons and – in case of need – also other polygons of natural vegetation.
- Regular project meetings are important to discuss problems and exchange experiences between team members.
- An internal quality control is mandatory before checking results by the CLC2006 TT by the most experienced interpreter of the national team (JT).

4.2 REVISED CLC2000

- 2006 images might help to reveal possible mistakes of CLC2000 data. These should be corrected if significant (> 100 m displacement; change in 1st level code)

and in the cases listed in chapter 3.2.2, otherwise mistakes will be inherited by CLC2006 database.

- In case houses are closer to each other than 300 m, or the density of sealed surface is higher than 30% (see Addendum 2000) the area should be classified as 112 (and not 242), even if between houses there is agricultural activity.
- Use of 231 (sometimes 243) must be revised in the sub-Mediterranean region. Large-extent, low-productivity grasslands in dry areas should be coded as 321 even if some agricultural use is present (extensive grazing).
- Not-long ago abandoned grasslands, which are not used intensively, but the natural succession process is not yet visible should be coded as 231 (and not 243).
- The use of the 322 class (Moors and heathland) should be harmonised. This class can appear in BA only in high altitude (dwarf pine, Pinus Mugo). The forester member of the NT is requested to advise other colleagues: where 322 can appear in the country and how to handle (keep or reclassify) existing 322 polygons.
- Try to distinguish better classes 332 (bare rock) and 333 (sparsely vegetated areas). 332 areas could contain maximum 10% of vegetation, while 333 can contain noticeable amount of natural vegetation (between 10 and 50 %).
- Fishponds are always classified as 512 (water body), even if the lake (or parts of the lake) is temporarily empty.
- Dammed section of rivers (511) should be classified as water body (512).
- A few missing corrections have been found, some of them obviously being mistakes coming from mistyping in the first inventory.

4.3 CLC-CHANGES DATASET

- Internal changes in agriculture (242-211, 242-243, 243-242, 211-243, 231-243, etc) should be interpreted with care. Apply such changes only if you are 100% sure in the process. Always raise the question: “what happened?” E.g. 242-211 means: the former mosaic (arable land, pastures, vineyards, etc) has became homogeneous arable land. Colours on satellite images depend on many factors: season of the image, soil moisture, sensor type, resolution, image processing, etc. During interpretation not only colours but also texture inside the polygons should be considered. All the identified polygons should be revised, based on instructions in the Remarks-file. In several cases the solution is “no change” i.e. deletion of the change polygon. In other cases instead mapping a change (i.e. deleting the change), CLC2000 has to be corrected.
- Internal changes in forestry (e.g. 312-313, 311-313, 313-312, 311-312) can hardly happen in the reality within a short period (8 years). These polygons reflect simply seasonal differences an / or enhanced effect of topography shown by autumn images (see Figure 2). These false change polygons have to be deleted.
- Regarding forest clear-cuts (31x-324) not only the colours but also the image texture should be considered to avoid mapping false changes. It helps to improve the consistency of delineation of 31x and 324, if polygon boundaries are removed help.
- On wu9 a large, non-typical (dark) forest loss area can be seen. If a forest fire took place this change should be classified as 31x-334). Check with official data on forest fires what happened.
- Try to find omitted changes (see Figure 3). by examining the entire working unit at scale 1:40.000. All the completed working units should be revised in order to find omitted changes.
- Try to use the real change code pair in change polygons. Please note that the 2000 code of the change code pair can be different from the original polygon’s CLC2000 code in order to describe the process properly. E.g. If a small coniferous

patch inside a 311 polygon has been cut, the right process is 312-324 and not 311-324.

- If a delineated change polygon includes > 5 ha of non change parts, these have to be cut and deleted from change polygon in order to map the real-change area.
- Oxbow lakes show usually strong seasonal changes depending on precipitation. These are not CLC changes. Oxbow lakes are classified as 512 or 411 (in case of advanced sedimentation).
- Never mix up CLC-Changes and corrections of CLC2000. E.g. 242-112 changes are often false, because of the resolution differences between Landsat TM and SPOT XI sensors. If you recognise that the built-up area (112) existed already in 1998, but was recognised only through the better resolution of SPOT XI, CLC2000 has to be corrected and no-change is to be mapped.
- Technical change should be applied with the only aims to avoid mistakes in CLC2006 database (to be created by combining revised CLC2000 and CLC-Changes). Technical change should have identical attributes and area between 5 and 25 ha. Regarding details see: CLC2006 Technical Guidelines

5 OTHERS

5.1 DIFFICULTIES ENCOUNTERED DURING THE WORK AND SOLUTIONS APPLIED

No difficulties were encountered during the mission.

5.2 SUMMARY OF ACTIONS TO BE UNDERTAKEN

None.

5.3 NEXT FORESEEN MISSION IN THE COUNTRY

The date of the next mission (2nd standard verification) in Bosnia and Herzegovina is planned for middle of October 2008 and should cover the total area of the country. Some of the working units of the 1st verification will be re-checked in order to see how the remarks have been considered by the national team.

5.4 MATERIALS COLLECTED

A few screen shots.

5.5 ANNEXES

Detailed remarks (shape files).