LUCAS and CORINE Land Cover

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If our environment and natural heritage are to be properly managed, decision-makers need to be provided with both an overview of existing knowledge, and information on changes in certain features of the biosphere which is as complete and up-to-date as possible.

To this end, the three aims of the CORINE (Coordination of information on the environment) programme of the European Commission are:

- to compile information on the state of the environment with regard to certain topics which have priority for all the Member States of the Community;
- to coordinate the compilation of data and the organization of information within the Member States or at international level;
- to ensure that information is consistent and that data are compatible.

In 1985 the CORINE programme started as a prototype project working on many different environmental issues. One important product is an inventory of land use and land cover in 44 classes in 3 hierarchical levels, and presented as a geographic database, at a scale of 1:250 000.

This CORINE Land Cover (CLC) database not only contains the status for the specific reference year, but also the changes between the different inventories. While the status is mapped using a minimum mapping unit of 25 ha, the threshold for detection of changes is set to five hectares in order not to lose many significant, but small scale changes.

This database on the status and the changes is operationally available for most areas of Europe for the reference years 1990, 2000 and 2006 and is currently updated for 2012 within the framework of the Copernicus Land Monitoring Service, coordinated by the EEA. From 1990 on the geographic coverage has increased, starting with 25 countries for CLC 90, 29 countries for CLC2000 and in 2012 it will cover 39. (Source: http://www.eea.europa.eu/publications/COR0-landcover)

CORINE Land Cover is traditionally based on computer assisted visual interpretation of the ortho-rectified satellite images. Some countries apply advanced semi-automatic methodology. The project is implemented in a decentralised approach in the EEA member counties, i.e. each country produces the national database contributing specific regional knowledge and building a national land cover mapping capacity. The individual country data sets are later joined into one seamless spatial data set, including the matching of land cover objects (polygons) across borders.

The database has been in the top three of the EEA data downloads from the first day of publication in November 2004. The popularity of the data and the first time availability of land cover change information have created a market for a wide range of applications. A survey among some 500 projects from about 6000 registered data users showed that the initial investment cost of roughly 13 Million Euro has generated revenues in the range of 250 Million Euro through underpinning downstream applications of the data and services. Application areas range from environment (34

percent), agriculture (14 percent) and forestry (9 percent) to research and education (22 percent), transport (3 percent), and physical planning (5 percent).

LUCAS data plays a crucial role be it in the production process, be it during validation, as LUCAS data is the only information that is available for a European wide validation which fulfils the criteria of validation data: being of high geometric accuracy and having a mostly coincident acquisition window. Clearly, when LUCAS is used for production and validation, then different points are used for the different purposes. LUCAS data can support the production of the CORINE land use and land cover information through the LUCAS land use and land cover point information as well as through the LUCAS photos taken at each point.

The production of CLC2012 for example consist in two parts: (1) mapping CLC changes between 2006 and 2012 and (2) generating CLC2012 by adding together CLC2006 and CLC-Changes(2006, 2012).

Change mapping in most of the countries is made by computer assisted photointerpretation. CLC2006 is displayed on top of IMAGE2006, while changes are delineated on top of IMAGE2012. Some changes are obvious for the photointerpreter (e.g. clear-cutting of forest), while other changes are not so evident to interpret. E.g. arable land replaced by fruit tree plantations or pasture replaced by arable land. In such a case in-situ data such as LPIS (land parcel identification system) or LUCAS are necessary. LUCAS LU/LC codes are proper in situ data. As the LUCAS sample size is a 3 meters radius, while CLC has 25 ha MMU, the field photographs are needed to bridge the gap between these different mapping units.

The validation of the CLC2000 database will be presented in some detail as example of the validation process for CLC (extracted from Maucha and Büttner; 2006). The validation was based on the re-interpretation of the field photographs in combination with the LUCAS codes and the original satellite images. The consideration of the field photographs had the advantage of being able to consider the different minimum mapping units respectively observation units of CLC (25 ha) and LUCAS (circle of 3 m). The validation consisted of 2 different methods.

- Automatic comparison of CLC2000 and LUCAS LC/LU codes

The percent total agreement between the 2 sources shows to what extent CLC2000 reflects the reality, which is modelled by LUCAS LC and LU codes. Benefits of this method are fast, automatic computation and the inclusion of a large number of points (around 100 000 SSUs).

– Visual reinterpretation of IMAGE2000 with the help of LUCAS data (LU & LC codes and photographs) following interpretation rules of CLC.

The main advantages of this method are that the CLC generalisation rules and complex class definitions can be considered; the LUCAS LC and LUCAS LU codes in the 1200 × 300 meter area surrounding the central SSU (where the photos were taken) provide the spatial context and LUCAS field photographs provide a valuable “ground truth” for re-interpretation. Results provided by this method can be considered as thematic reliability figures of CLC2000, as national CLC2000 data are compared to an independent CLC2000 interpretation.

Sampling sites, having stable location in time, are of great value for mapping change. If we have LUCAS data for 2006 and 2012 for the same set of locations this is a valuable dataset both for mapping and for validating CLC-Changes.

For the year 2000 LUCAS data exist for approximately 10.000 locations in eighteen European countries and records independent land cover (fifty-seven classes) and land use (fourteen classes) information for each of the observations as well as landscape photographs in four compass directions.

The result of the reinterpretation approach was that the total reliability of CLC2000 is 87.0 ± 0.8 percent, which leads to the conclusion that the 85 percent accuracy requirement specified in the Technical Guidelines of CLC2000 has been correctly fulfilled. Details about LUCAS and the validation approach are described in EEA, 2006a. The two main sources of mistake were misclassification and not enough detailed interpretation. Delineation accuracy was a less important source of error.

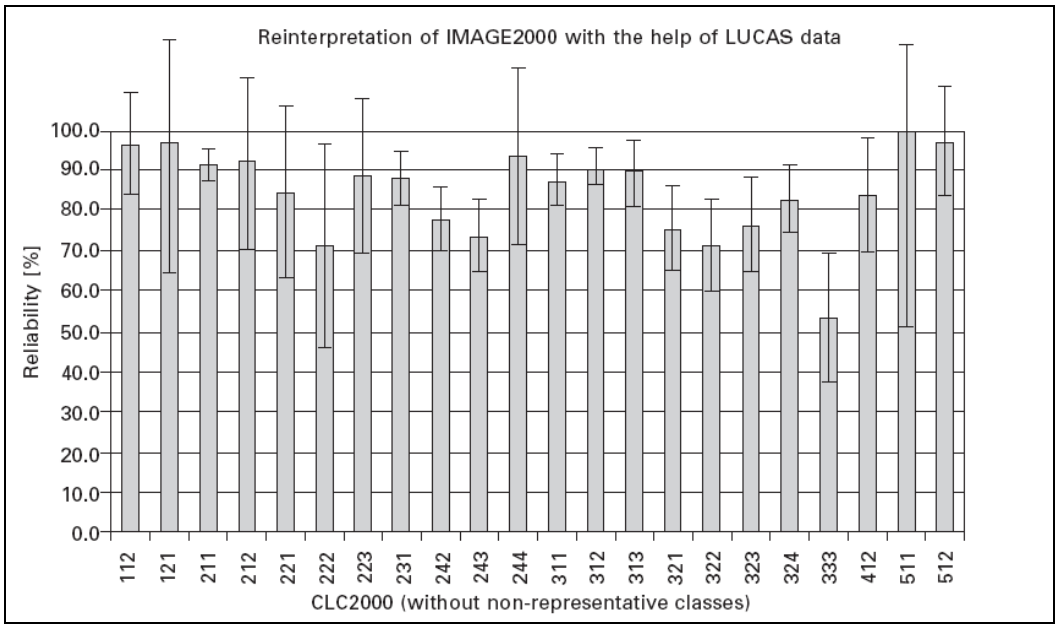

Figure 1: Re-interpretation of IMAGE2000 with the help of LUCAS data: class-level accuracies (reliability and confidence intervals) (Maucha and Büttner; 2006)

The automatic comparison proved to be an appropriate method to estimate the correspondence between CLC interpretation and the reality. According to this study, the CLC2000 database approximates the reality with 75.6% ± 0.5% average accuracy.

References

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