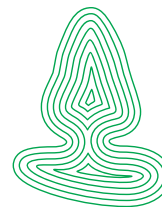


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11/2010



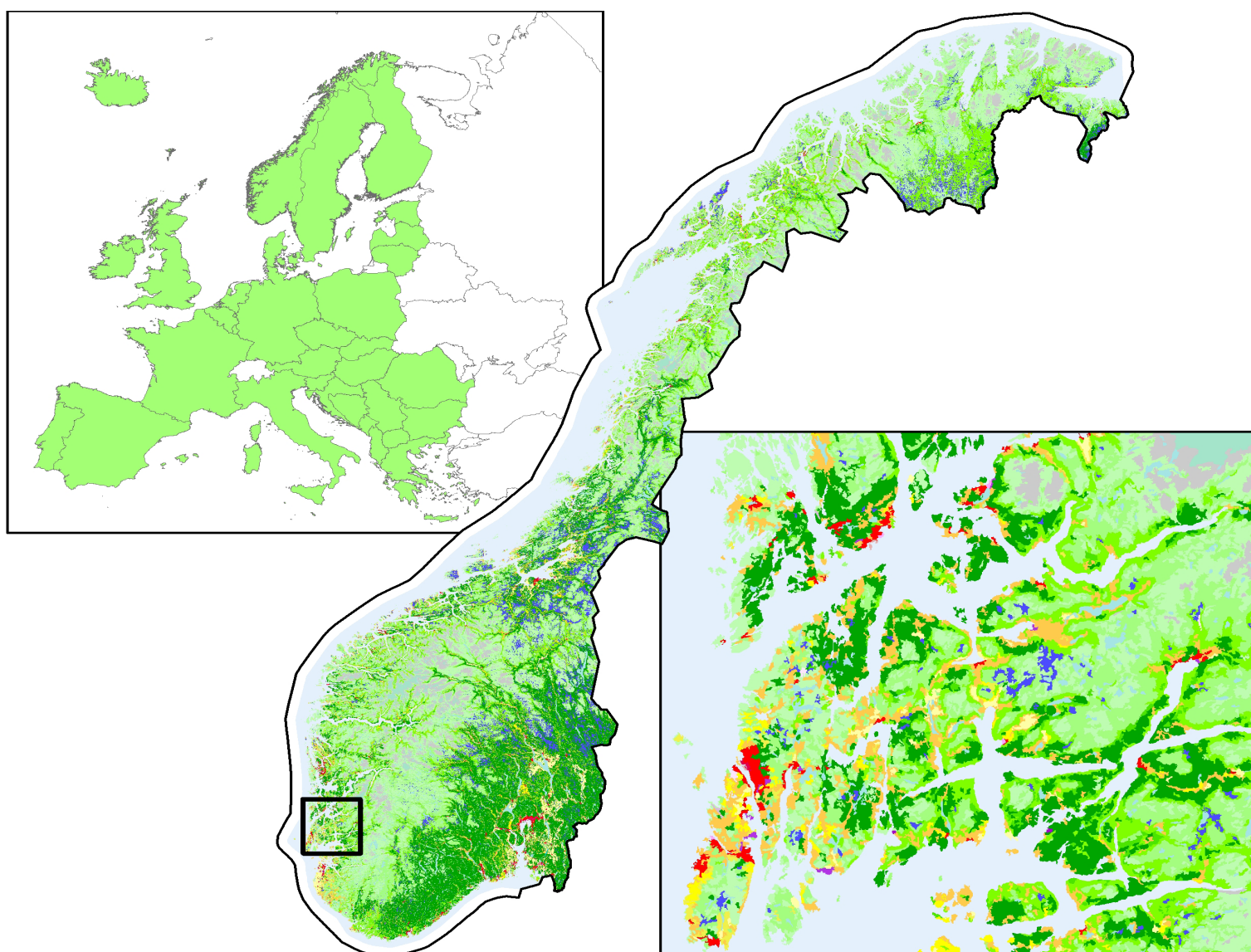
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NORSK INSTITUTT FOR
SKOG OG LANDSKAP

CORINE LAND COVER 2006

The Norwegian CLC2006 project

Linda Aune-Lundberg and Geir-Harald Strand



Rapport 11/2010

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SUMMARY

CORINE Land Cover (CLC) is a seamless European land cover vector database. The Norwegian CLC for the reference year 2006 (CLC2006) was completed by the Norwegian Forest and Landscape Institute (*Skog og landskap*) in 2009 and was produced according to CLC2006 technical guidelines (EEA 2007).

CLC has a common nomenclature with 44 classes that is used throughout Europe. 31 of these classes are found in the Norwegian dataset. A coordinating Technical Team from the European Topic Centre on Land Use and Spatial Information (ETC-LUSI) is coordinating the mapping efforts ensuring that the classification is applied in a similar fashion in each country.

CLC is a small scale map showing build up areas, agriculture, forest and semi-natural areas, wetlands and water bodies. CLC has a minimum mapping unit of 25 ha and can be used for visualization of the general land cover patterns in Norway at a scale 1:250 000 or smaller. CLC2006 represents the land cover situation close to year 2006. A similar map has previously been produced for the reference year 2000 (CLC2000).

This report presents the Norwegian CLC2006 project and the methods and automatic generalization processes that were used in the project. While the methodology in the Norwegian CLC2000 project was automated generalization of data from existing databases, CLC2006 has been created by updating CLC2000 using satellite images and aerial photographs. Auxiliary data from other projects and public maps and registers were, however, applied in order to identify areas where change was most likely and to concentrate efforts on these areas.

CORINE Land Cover is one of four land cover maps (AR5, AR50, AR250 and CLC) published by *Skog og landskap*. CLC was produced with support from the European Environmental Agency (EEA) who has joint ownership to the product.

WARNING

The Norwegian CLC2006 data should not be used to assess the land cover of a particular location in Norway. Neither should it be used to compile statistics for Norway or parts of Norway.

CLC2006 is a generalized and simplified land cover dataset. Its purpose is to complete the EEA CORINE Land Cover database of Europe in order to serve the EEA, European institutions and the research establishment with a homogeneous European land cover dataset as input to pan-European and wider regional studies.

Statistics compiled from CLC2006 will always be biased due to the generalization involved in the production of the dataset. They will therefore be different from official statistics obtained from registers, unbiased point samples and high resolution maps.

Norwegian official statistics are published by Statistics Norway (www.ssb.no). Land use and land cover statistics for agricultural, forest and mountain areas are published by *Skog og landskap* (www.skogoglandskap.no).

CLC2006 can be used for visualization of the general land cover patterns in Norway. More accurate land cover and land use maps for Norway are published by *Skog og landskap* and distributed through Norway digital – the national geographical infrastructure (www.norgedigitalt.no).

Nøkkelord:	CORINE Land Cover, kart, arealressurser, arealdekke, generalisering
Key words:	CORINE Land Cover, map, land resources, land cover, generalization
Other relevant documents from the project:	“CORINE LAND COVER 2000. The Norwegian CLC2000 project” “CORINE LAND COVER CLASSES. Examination of the content of the CLC classes in Norway”

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1. INTRODUCTION

The European Environment Agency (EEA) is an agency of the European Union. The main task of EEA is to provide independent information on the environment in Europe. The Norwegian Forest and Landscape Institute (*Skog og landskap*) is the Norwegian “National Reference Centre on Land Cover” for the EEA.

The CORINE (Coordination of information on the environment) programme of EEA, dating back to 1985, is a European commission which compiles information on the state of the environment. CORINE Land Cover (CLC) is a compilation of national land cover data sets, which are integrated into a seamless land cover map of Europe. The production is based on agreed methodology and a common nomenclature.

The Norwegian CLC dataset for the reference year 2000 was completed by *Skog og landskap* in 2008 (Heggem and Strand 2010). The purpose was simply to complete EEA’s CLC2000 database, since more detailed national land cover data already were available in Norway. CLC2000 for Norway was therefore produced by generalization and merging of data from existing sources.

In November 2006, EEA decided to update the CLC database with a new CLC2006 data set portraying the situation in 2006. The methodology required a CLC-Changes dataset created by comparing CLC2000 data with satellite imagery obtained close to the year 2006. The satellite images (IMAGE2006) were provided by the EU and partly funded by EEA, with national co-funding from the Norwegian Ministry of Environment.

The work was carried out in 2009 and CLC-Changes and CLC2006 for Norway was accepted by EEA in February 2010.

1.1 The Norwegian CLC2006 project

The “CLC2006 Technical Guidelines” consisting of “Part I General project description” and “Part II Interpreting land cover changes and producing CLC2006” formed the methodological basis for the project. The Norwegian approach generally followed the guidelines but auxiliary data (described in detail in chapter 2 below) from existing sources (documented in chapter 2 below along with the description of the aforementioned auxiliary data) were also used (for purposes described in chapter 3 below).

The principal workflow of the Norwegian CLC2006 project was:

Task 1: Verification of high resolution data

Carrying out the verification of high resolution soil sealing layer based on a qualitative assessment of the mapped area. This was completed in 2008.

Task 2: Preparation (Identification of areas where CLC-Changes are expected)

Maps identifying areas with potential changes were prepared and available by the end of 2008. A map of forest areas logged between 2000 and 2006 was initially produced in 2008 and further refined in 2009. The Cadastre information was used to identify areas where buildings had been constructed between 2000 and 2006. Registers¹ of dump sites and roads were also used to target the areas most likely² for change.

This task also included documentation and archiving of the satellite images (IMAGE2006).

¹ These included the register of dump sites (maintained by the Norwegian Climate and Pollution Agency), and the National Road Database (maintained by the Norwegian Public Roads Administration).

² “Most likely” in this context means that locations where buildings had been constructed, dump sites created, roads constructed or other large, physical development projects initiated between 2000 and 2006 were thought to be more likely to show signs of land cover change than locations where none of these activities took place.

Task 3: Creating the CLC-Changes dataset (based on CLC-Changes)

The changes in the CLC2000 dataset between year 2000 and year 2006 were mapped manually following the instructions in the CLC2006 technical guidelines (EEA 2007). The changes were stored as a new dataset called CLC-Changes.

The entire country was visually inspected for land cover changes. Areas identified through task 2 as more likely to show signs of change did, however, receive more attention than other areas.

IMAGE2006 was the basis for change mapping, as described in the technical guidelines, but the operators also extensively used the online access to the Norwegian orthophoto database through a Web Map Service integrated into the CLC-Changes working environment. Topographic maps and other auxiliary data were also available online.

Task 4: Creating the CLC2006 dataset (based on CLC-Changes)

The production of CLC2006 was done by combining CLC2000 and CLC-Changes using software developed by MLOG Instruments Ltd. (www.mlog.hu).

Task 5: Metadata

Metadata for each working unit (see chapter 3.2) has been compiled. These metadata were part of the delivery to EEA.

Task 6: Verification of the CLC datasets

The datasets were checked by the Technical Team from ETC-LUSI throughout the entire project.

Task 7: Delivery of the CLC datasets to EEA

The datasets, documentation and metadata were submitted to the central data repository of EEA according to the CLC2006 technical guidelines.

1.2 Overview of data used

The major datasets used in the project are mentioned here:

1. IMAGE2006; the main source for the CLC2006
2. IMAGE2000; compared with IMAGE2006
3. Topographic maps available in several scales (1:5 000, 1:50 000 and 1:250 000)
4. Cadastre information; buildings constructed between 2000 and 2006
5. The Norwegian orthophoto database; Norge i bilder (lit. "Norway in pictures")
6. Forest mask; possible clear cuts between 2000 and 2006

1.3 Timeliness

CLC2006 represents the land cover close to year 2006. IMAGE2006 for Norway is obtained from June 2005 to June 2008. The deviation from year 2006 is probably not critical. Only 3 % of Norway is agricultural land and only 1 % is "urban" in any sense. Land cover changes are therefore a slow process in most of Norway. The CLC methodology, designed to measure changes in areas with much greater human activity and impact may therefore not be optimal as a tool for detecting changes over a time-span of only six years.

2. DATA SOURCES

2.1 Digital vector data

2.1.1 TOPOGRAPHIC MAPS

Topographic maps were available in several scales (1:5 000, 1:50 000 and 1:250 000). The topographic maps were available as seamless, georeferenced digital raster images as a WMS-service. See also www.norgedigitalt.no.

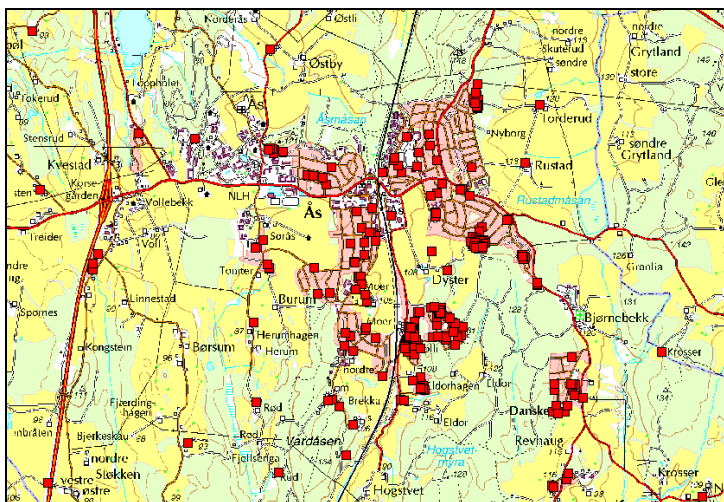


Figure 1. The figure shows buildings constructed in the period 2000–2006 (from the national database of buildings) drawn on top of a digital topographic map N50. © Norway digital.

2.1.2 CADASTRE INFORMATION

The Cadastre information (GAB) is the official register of ground property, address and buildings in Norway. GAB is a national index and information system for all the Norwegian landed properties, owners, addresses and buildings.

A database with all new building completed in the period between 31 December 2000 and 1 January 2007 was extracted from GAB. The data included a classification of the buildings and information about their size. This database was used to assist the detection of CLC changes.

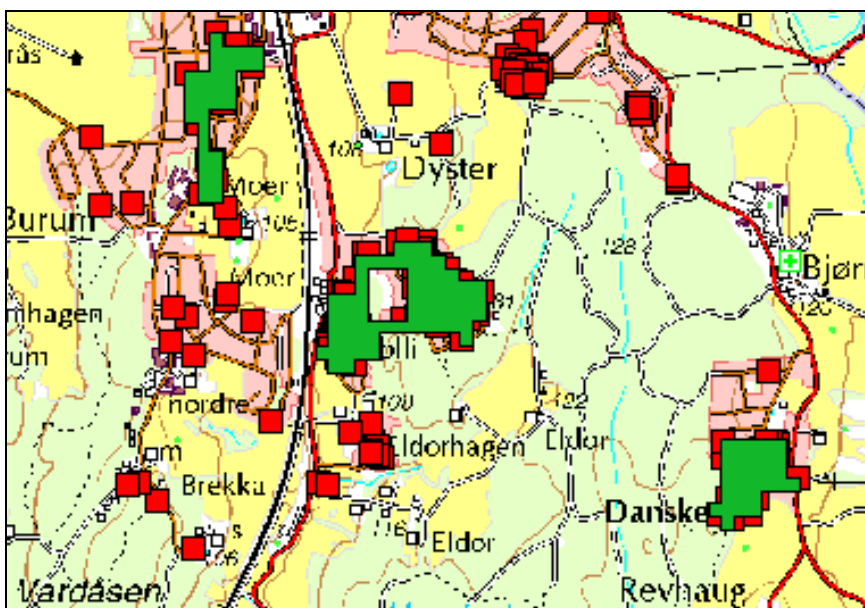


Figure 2. The figure shows areas where clusters of new buildings is likely to have caused CLC-Changes between 2000 and 2006. The clusters are here drawn on top of a digital topographic map N50. © Norway digital.

2.2 Remote sensing

2.2.1 ORTHOPHOTO (NORGE I BILDER)

The Norwegian orthophoto database *Norge-i-bilder* (lit. "Norway in pictures") is a seamless, multi-layered, online database containing a very large number of digital orthophotos acquired by major public institutions in Norway. The database was linked to the GIS software through a WMS and thus available to the interpreters. They could zoom into any area and select photo layer from an appropriate year. A public service can be viewed at www.norgebilder.no. Notice, however, that the resolution used in this public service is lower than the resolution available to the interpreters.



Figure 3. An example of the public service version of the Norwegian orthophoto database used as support by the analysts while performing CLC change mapping. © Norway digital.

2.2.2 IMAGE2000

The satellite Landsat 5 and 7 provided the imagery for IMAGE2000. IMAGE2000 consisted of 42 satellite images obtained over a three years period from 30 July 1999 to 8 September 2002. Some of the images were prepared for two UTM zones. The most applicable satellite images (time of day, time of year, cloudiness, snow cover, atmospheric conditions) were geometric corrected by the Czech company GISAT (www.gisat.cz).

2.2.3 IMAGE2006

Three different satellites provided the imagery for CLC2006; SPOT4, SPOT5 and IRS P6. The scenes were obtained over a three year period from 30 June 2005 to 11 June 2008.

European Space Agency (ESA) was in charge of the selection of satellite images for the national coverage and the geometric correction. IMAGE2006 was delivered the Norwegian team with overlapping scenes. Most locations in Norway were covered by at least two satellite images. The IMAGE2006 delivery consisted of two packages. The main delivery consisting of 57 IRS P6 images and 70 SPOT4 and 5 images had the highest quality. The second delivery contained 165 images, mainly SPOT4, with lower quality (more shadows and clouds). The interpreters had access to all these images and selected the image with the best quality (by subjective judgement³) for interpretation.

³ Criteria involved image clarity, absence of shadows, absence of snow, development of the vegetation and closeness to year 2006.

The SPOT4 images have a pixel size of 20 m X 20 m, using 5 bands (green, red, near-infrared, middle infrared and panchromatic). The IRS P6 images have pixel size of 23 m x 23 m using 4 bands (green, red, near-infrared and middle-infrared).

The acquisition window recommended for the IMAGE2006 was between June and September.

The IMAGE2006 was delivered in UTM zones 31 to 36. Some scenes were therefore transformed to the standard UTM zones used in Norway (32, 33 and 35).

Further information about the imagery is provided in the metadata included in the CLC2006 delivery.

2.2.4 FOREST CHANGE

A map was produced showing productive forest areas (according to the AR5 land resource data base) where the land cover was likely to have changed CLC class between 2000 and 2006 (based on automatic interpretation of remote sensing images assisted by data from the National Forest Inventory (NFI)). The approach was to classify forest land into 1) clear cut or recently clear cut areas (open areas and young forest) and 2) tree covered areas. The first category corresponds to the CLC class for “temporary open areas where reforestation has started or is expected to start soon”. The second category corresponds to the CLC classes for forest.

The remote sensing images were first clustered into spectrally homogeneous multi-pixel segments. It was expected that clear-cut areas would have a sharp contrast to the surrounding wooded landscape, because the spectral signature of satellite images is closely linked to the amount of green vegetation (Lillesand et al 2007) and therefore show up as separate segments. A dichotomous classification of the segments (again based on spectral content) was used to group the segments into the two categories described above.

The exercise was carried out with both IMAGE2000 and IMAGE2006 data. A GIS overlay of the two results produced a new dataset (for the productive forest areas) with the following categories: 1) forest in 2000 and forest in 2006, 2) forest in 2000 and clear cut in 2006, 3) clear cut in 2000 and clear cut in 2006, and finally 4) clear cut in 2000 and forest in 2006. The categories 2 and 4 correspond to a (possible) change of forest state and used as a guide for the manual interpretation and change detection. The raster version was also saved as a vector dataset for later visual control and correction.

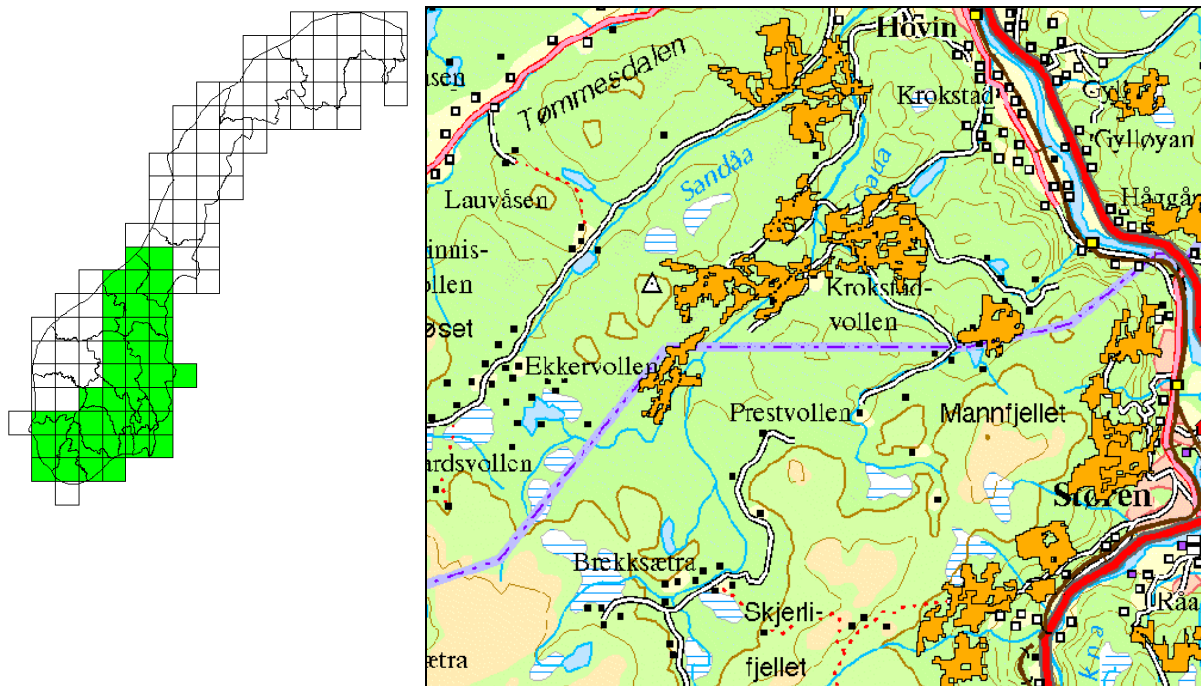


Figure 4. The figure shows areas where forest may have been logged between 2000 and 2006. The clusters are here drawn on top of a digital topographic map N250. © Norway digital.

3. GENERATING CLC2006

3.1 Data preparation

A total of 292 satellite images from IMAGE2000 and IMAGE2006 were renamed and categorized and consequently incorporated in the satellite image base at *Skog og landskap* with a documentation of coverage and quality. Since IMAGE2006 were delivered in UTM zone from 31 to 36, many (approximately 20 %) of the images had to be transformed to another UTM zone fitting the Norwegian standards. This procedure was performed using the Norwegian software GIS/LINE-raster.

A three band composition of the satellite images was used as a basis for the visual detection of CLC-Changes. This is in agreement with the recommendations from EEA (EEA 2007). In addition image enhancement was performed on the images in order to make them brighter/clearer.

Recommended colour composites for photo interpretation.

Band/sensor	Landsat 7	SPOT-4	IRS P6	Spectral range
Red (R)	4	3	3	Near-infrared (NIR)
Green (G)	5	4	4	Middle-infrared (SWIR)
Blue (B)	3	2	2	Red (VIS)

3.2 The mapping of CLC-Changes

The CLC-Changes database is according to EEA the primary and most important product from the CLC2006 project (EEA 2007). The aim of the CLC-Changes is to have a European coverage of land cover changes that are a) larger than 5 ha; b) wider than 100 meters, c) occurred between 2000 and 2006 and d) detectable on satellite images.

Two different changes in the land use were mapped:

1. Real changes; differences in land use between 2000 and 2006
2. Technical changes; corrections of the CLC2000 database.

For logistical reasons, Norway was divided into 112 tiles (working units), each measuring 75 km x 75km. All satellite images, CLC2000 and other data sources (see chapter 0) were organized according to these working units.

Each working unit was systematically checked for both real and technical changes. Priority and extra attention was given to areas with expected changes (according to the data extracted from GAB and the results of the forest change exercise). The work was carried out using InterChange 2.0 software running under ArcView 3.3® developed by MLOG Instruments Ltd. (www.mlog.hu).

The CLC-Changes mapping was carried out by comparing the IMAGE2000 and the CLC2000 database with IMAGE2006. The images were compared using a dual window-setup as illustrated in Figure 5. Only changes visible in the satellite images were included in the CLC-Changes database.

All the polygons drawn in the CLC-Changes database were manually interpreted and each "Changes-polygon" was given two codes: code₂₀₀₀ and code₂₀₀₆. The codes represent the actual land cover each of the two years. The scale for the manually interpretation of the CLC-Changes were between 1:25 000 and 1:30 000. Larger scales were used in cases where actual land use was difficult to detect.

The GAB data and forest change mask guided the interpreters to easier detection of changes.

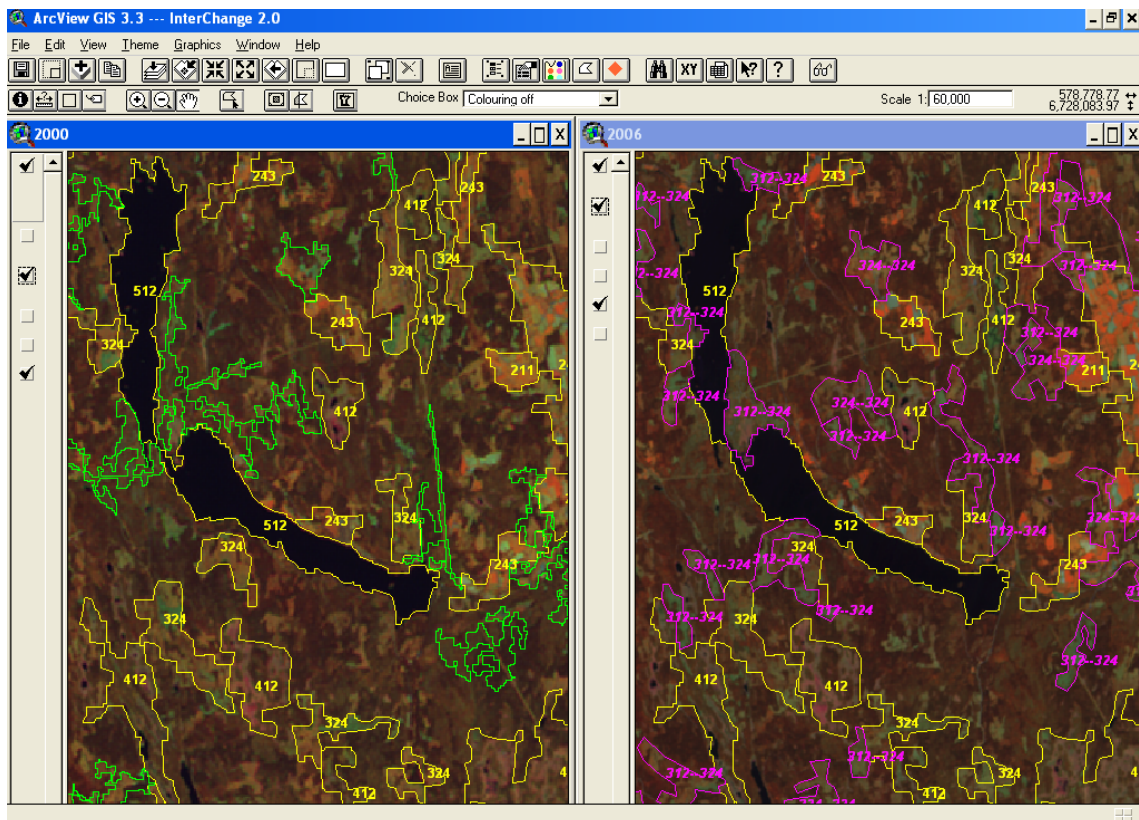


Figure 5. Print screen of the InterChange 2.0 in use. Scale 1:60 000.

The Web Map Services, *Norge-i-bilder* and topographic maps, were regularly used, especially when making decisions about the classification of artificial surfaces and agricultural areas. *Norge-i-bilder* was used to calibrate the interpreters to separate clear cuts and young forest from other land use areas on the satellite images.

Three different interpreters were involved in the CLC2006 project. The interpreters frequently coordinated their work and special cases were discussed for consensus. To make a uniform database all the working units were finally checked by the project leader for missing changes and differences regarding how the EEA instructions were interpreted.

The technical team from EEA evaluated the work carried on by the national team twice during the project period. These verifications were accomplished to assure a common implementation of CLC across Europe, and to control the quality of the national work and assist the national team.

3.3 The generating of CLC2006

Finally all 112 working units were assembled in a seamless database including all the CLC-Changes for the entire country. Errors in the database like invalid codes or polygon errors (too small or too narrow polygons) were corrected at this stage.

The CLC2006 was assembled using ArcInfo Workstation 9.3® software. A union was made between CLC2000 and CLC-Changes before an ArcInfo macro program developed by ETC-LUSI Partner FÖMI (Pataki 2008) was applied to merge all the CLC-Changes polygons < 25 ha with neighbouring polygons according to a priority table set by EEA.

CLC2006 = CLC2000 + CLC-Changes

- CLC2006 = CLC database for 2006 (polygon larger than 25 ha and wider than 100 m)
- CLC2000 = the original CLC database for 2000 (polygon larger than 25 ha and wider than 100 m)

- CLC-Changes = changes (larger than 5 ha and wider than 100 m) between year 2000 and 2006 and corrections of the CLC2000 database
- + indicates a GIS process, including automatic generalization and some actions taken by a photo interpreter

Finally topology specification given in the CLC2006 technical guidelines were checked, attribute table defined and the datasets were prepared.

3.4 The generating of revised CLC2000

The revised CLC2000 was generated using the same approach as in the production of the CLC2006, except that only technical changes in the CLC-Changes database were merged with the existing CLC2000.

Revised CLC2000 = CLC2000 + CLC-Changes_{technical}

- CLC2000 = the original CLC database for 2000 (polygon larger than 25 ha and wider than 100 m)
- CLC-Changes_{technical} = technical changes (code errors in original CLC2000 were corrected)

3.5 Delivery

The CLC2006 project was delivered in accordance with the CLC2006 technical guidelines and included the following products:

- CLC-Changes
- Revised CLC2000
- CLC2006
- Metadata on working unit level for CLC-Changes
- Metadata on country level for CLC-Changes and CLC2006

4. PARTICULAR CONDITIONS IN NORWAY

Some particular cases or challenges for Norway are discussed in this chapter.

4.1 Clear cuts and young forest

Approximately 90 % of the time used for visual interpretation of CLC-Changes was to eliminate occurrences of the CLC class 3.4.2 “Transitional woodland/shrub” (interpreted as clear cut or recently clear cut areas in Norway). Most of the clear cuts are small in acreage and create mosaic patterns of forest at different development stages.

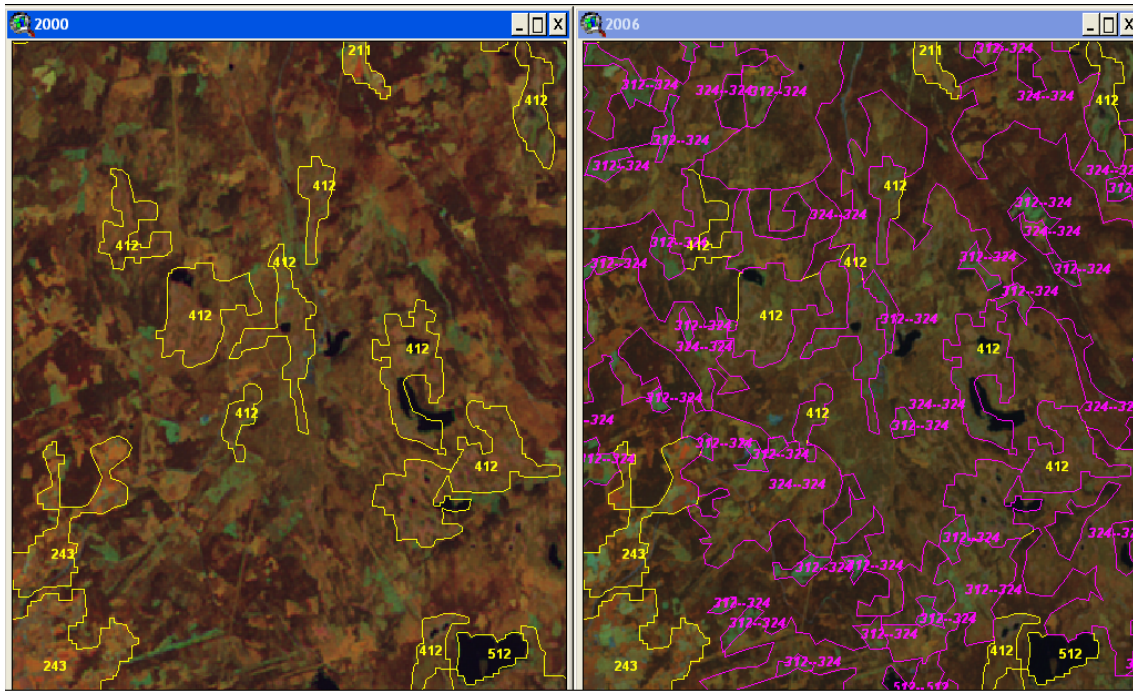


Figure 6. Clear cuts and regrowing forest. In the right window: polygons with cerise outline are CLC-Changes (both real and technical changes) .Location: Gran municipality in Oppland County.

4.2 Glaciers and perpetual snow

For the CLC2000 database, the CLC class 3.3.5 “Glaciers and perpetual snow” were generated from the topographic map N50. In the visual review for the CLC2006 a general overestimation of the glaciers were detected. As a result, all polygons labelled 3.3.5 in the CLC2000 database was thoroughly examined. It was not possible to distinguish between real and seasonal changes because the satellite images spanned a period of several years and were obtained during a wide acquisition window. All changes within the class 3.3.5, were therefore labelled as technical changes.

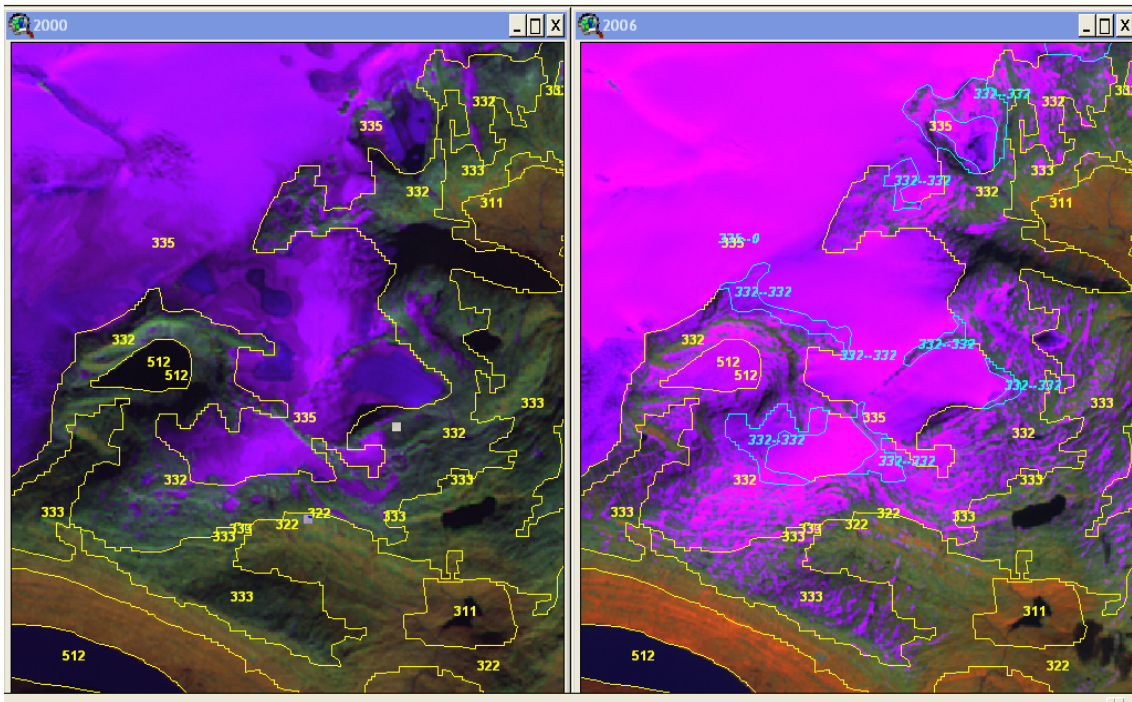


Figure 7. In satellite images band combination 453/324 draw attention to glaciers and snow cerise. To the right: Technical changes shown with blue outlines.

4.3 Ski areas

In CLC2000 ski areas/ski resorts were not classified as 1.4.2 “Sport and leisure facilities”. This was corrected in CLC2006. All ski areas with facilities producing artificial snow were included in 1.4.2 since the slopes are heavily influenced by machinery and prolonged cover by artificial snow.

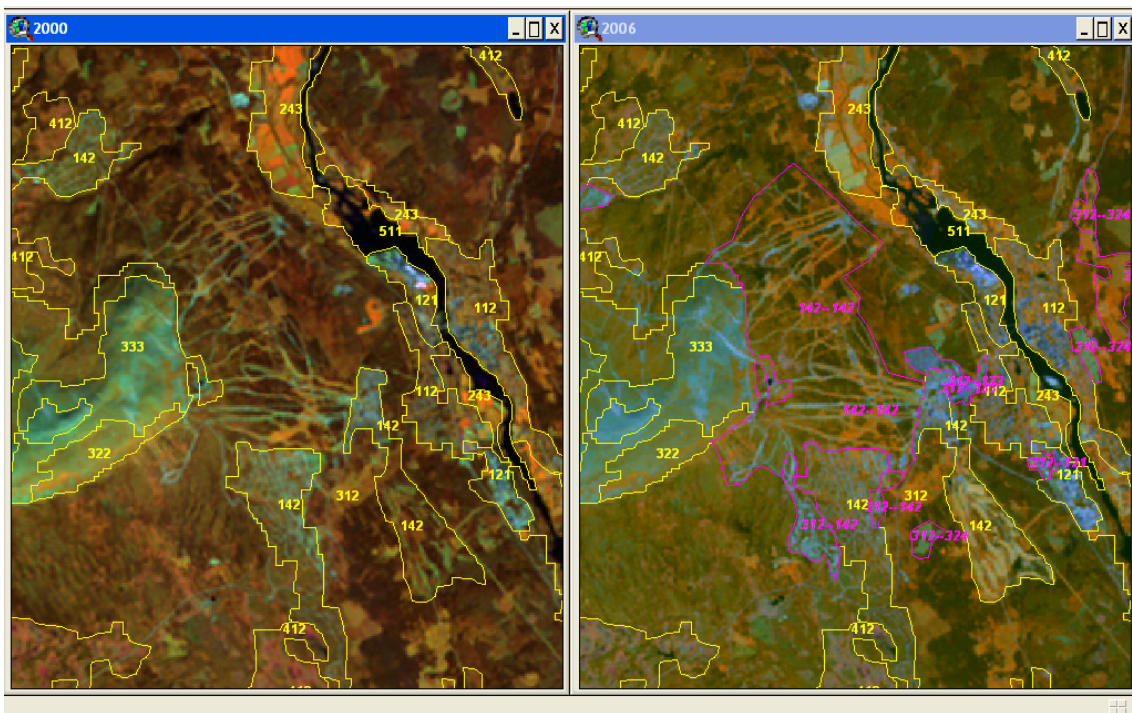


Figure 8. Ski resort in Trysil, Hedmark county.

4.4 Airports

Small airports missing in the CLC2000 database were located and added to the CLC-Changes database as a technical change.

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6. APPEN DIX

6.1 National project team

Norwegian Forest and Landscape Institute

Geir-Harald Strand, Director of Land resource surveys, EEA steering committee member

Hanne-Gro Wallin, Head of remote sensing, high resolution data control

Barbi Nilsen, Project coordinator

Linda Aune-Lundberg, Project leader, image interpretation

Eva S. F. Heggem, GIS methodology and software development

Arnt-Kristian Gjertsen, Image analysis and software development

Michael Angeloff, Image analysis

Finn-Arne Haugen, Image interpretation and field surveys

Kristian Berg, Image interpretation

Britt Lindstad, High resolution data control

Marit Johannessen, High resolution data control

Gunnar Engan, CLC2006 verification

6.2 Workflow

2008 Jun.: The general contract and first Specific Agreement with EEA was signed

2008 Dec.: High resolution verification/receiving satellite scenes (IMAGE2006)

2008 Dec.:The second Specific Agreement with EEA (3601/B2007.EEA.53085) was signed

2009 Jan.: Mapping of the CLC-Changes started

2009 Feb.: Verification in *Skog og landskap*'s regional office in Andselv by EEA technical team on preliminary results

2009 May:The third Specific Agreement with EEA (3601/B2008.EEA.53337) was signed

2009 Sep.: Second verification in *Skog og landskap* regional office in Andselv by EEA technical team on preliminary results

2009 Nov.:CLC-Changes work finished. CLC06 and revised CLC00 created.

2009 Dec.:CLC2006 data and final report submitted to EEA

2010 Jan.:Final revised CLC-Changes and CLC2006 data submitted to EEA

2010 Feb.:Final delivery verified by EEA

6.3 The Norwegian CORINE Land Cover nomenclature

The Norwegian class names are based on a list suggested by a project group established by the Norwegian Ministry of Environment (NIJOS report 11/1997 part 4), but revised according to the experience from the Norwegian CLC2000 project and input from the EEA technical team. Categories marked "No" are not found in Norway. A number of other categories are present in Norway but individual occurrences are too small to be included in the Norwegian CORINE Land Cover map (marked "Ts" – Too small).

CLC level 1

Class		
1	Bebyggd og annet opparbeidet areal	Artificial surfaces
2	Jordbruksareal	Agricultural areas
3	Skog og annen fastmark	Forests and semi-natural areas

4	Myr og våtmark	Wetlands
5	Vann	Water bodies

CLC level 2

Class		
1.1	Tettbygd areal	Urban fabric
1.2	Industri, handels- og transportområde	Industrial, commercial and transport
1.3	Massetak, deponi og byggeplass	Mine, dump and construction sites
1.4	Anlagt grøntområde	Artificial non-agricultural vegetated areas
2.1	Fulldyrka mark	Arable land
2.2	Frukt- og bærhage	Permanent crops
2.3	Eng og beite	Pastures
2.4	Heterogent jordbruksareal	Heterogeneous agricultural areas
3.1	Skog	Forests
3.2	Åpen fastmark med vegetasjon	Shrub and/or herbaceous vegetation associations
3.3	Fastmark med sparsom eller ingen vegetasjon	Open spaces with little or no vegetation
4.1	Myr	Inland wetlands
4.2	Salt- og brakkvannsvåtmark	Coastal wetlands
5.1	Ferskvann	Inland waters
5.2	Hav	Marine waters

CLC level 3

Class			
1.1.1	Bymessig tettbebyggelse	Continuous urban fabric	
1.1.2	Tettbygd areal med åpen struktur	Discontinuous urban fabric	
1.2.1	Industri og handelsområde	Industrial or commercial units	
1.2.2	Veg og jernbane	Road and rail network and associated land	
1.2.3	Havn	Port areas	
1.2.4	Flyplass	Airports	
1.3.1	Gruver og massetak	Mineral extraction sites	
1.3.2	Deponi	Dump sites	
1.3.3	Byggeplass	Construction sites	
1.4.1	Grønt tettstedsareal	Green urban areas	
1.4.2	Idretts- og rekreasjonsområde	Sport and leisure facilities	
2.1.1	Fulldyrka mark	Non-irrigated arable land	
2.1.2	Permanent vannet jordbruksareal	Permanently irrigated land	No
2.1.3	Rismark	Rice fields	No
2.2.1	Vingård	Vineyards	No
2.2.2	Frukt- og bærhage	Fruit trees and berry plantations	Ts
2.2.3	Olivenlund	Olive groves	No
2.3.1	Eng og beite	Pastures	
2.4.1	Jordbruksareal med blanding av ett-årige og flerårige vekster	Annual crops associated with permanent crops	No
2.4.2	Blandet jordbruksareal	Complex cultivation	
2.4.3	Spredt jordbruksareal	Land principally occupied by agriculture, with significant areas of natural vegetation	
2.4.4	Agroforestry	Agro-forestry areas	No
3.1.1	Lauvskog	Broad-leaved forest	
3.1.2	Barskog	Coniferous forest	
3.1.3	Blandingsskog	Mixed forest	
3.2.1	Gras og urterik mark	Natural grassland	Ts
3.2.2	Hei og lyngmark	Moors and heath land	
3.2.3	Sklerofyll vegetasjon	Sclerophyllous vegetation	No
3.2.4	Hogst- og gjengroingsflater	Transitional woodland/shrub	

3.3.1	Strand og sanddyner	Beaches, dunes and sand plains	
3.3.2	Bart fjell	Bare rock	
3.3.3	Sparsomt vegetert areal	Sparsely vegetated areas	
3.3.4	Brannflate	Burnt areas	
3.3.5	Varig is og snø	Glaciers and perpetual snow	
4.1.1	Ferskvannsvåtmark	Inland marshes	
4.1.2	Myr	Peat bogs	
4.2.1	Strandsump	Salt marshes	Ts
4.2.2	Saline	Salines	No
4.2.3	Tidevannsflate	Intertidal flats	
5.1.1	Elv	Water courses	
5.1.2	Innsjø	Water bodies	
5.2.1	Lagune	Coastal lagoons	Ts
5.2.2	Elvemunning	Estuaries	Ts
5.2.3	Hav	Sea and ocean	

No = the class is not present in the Norwegian dataset, Ts = occurs in Norway, but they represent too small continuously areas to be included.