



# CORINE LAND COVER 2006

Final report on interpretation of CLC2006 in Denmark

---

Research Notes from NERI No. 257      2009



NATIONAL ENVIRONMENTAL RESEARCH INSTITUTE  
AARHUS UNIVERSITY



*[Blank page]*

# CORINE LAND COVER 2006

Final report on interpretation of CLC2006 in Denmark

---

Research Notes from NERI No. 257 2009

Michael Stjernholm



## Data sheet

Series title and no.: Research Notes from NERI No. 257

Title: CORINE Land Cover 2006  
Subtitle: Final report on interpretation of CLC2006 in Denmark

Author: Michael Stjernholm  
Department: Department of Freshwater Ecology

Publisher: National Environmental Research Institute ©  
Aarhus University - Denmark  
URL: <http://www.neri.dk>

Year of publication: 2009  
Editing completed: August 2009

Financial support: This project is jointly financed by the European Environment Agency, the Danish Ministry of Environment, Geological Survey of Denmark and Greenland, and National Environmental Research Institute.

Please cite as: Stjernholm, M. 2009 : CORINE Land Cover 2006. Final report on interpretation of CLC2006 in Denmark. National Environmental Research Institute, Aarhus University. 48 pp. - Research Notes from NERI No. 257. <http://www.dmu.dk/Pub/AR257.pdf>

Reproduction permitted provided the source is explicitly acknowledged

Abstract: CLC2006 is a joint European project aimed at mapping the Changes in Land Cover (CLC) from 2000 to 2006 according to the CORINE land cover nomenclature and methodology. The report describes the process and results of the interpretation of Denmark.

Cover photo: Hot air balloon ride over Silkeborg

Keywords: CORINE, land cover, change mapping, CLC2006

ISSN (electronic): 1399-9346

Number of pages: 48

Internet version: The report is available in electronic format (pdf) at NERI's website <http://www.dmu.dk/Pub/AR257.pdf>

# Contents

## Summary 5

## Sammenfatning 6

### 1 Background 7

### 2 Databases used in the project 8

- 2.1 Satellite imagery 8
- 2.2 Topographic data 8
- 2.3 Orthophotos 8

### 3 Organisation of work at national level 9

- 3.1 Overview of process 9
- 3.2 Basic specification 11
- 3.3 CLC nomenclature in Denmark 12
- 3.4 Processing methodology 13
- 3.5 Main difficulties and solutions 14

### 4 Results 18

### 5 Deliverables 30

### 6 Conclusions 31

### 7 References 32

### Annex 1 CLC-changes metadata sheet for Denmark 33

### Annex 2 CLC2006 metadata sheet for Denmark 41

National Environmental Research Institute

*[Blank page]*

## Summary

CORINE land cover is a European land use/land cover mapping project. In Denmark, land use/land cover has been mapped three times according to the CORINE methodology, with satellite images from the early 1990s (CLC90), from 2000 (CL2000) and from 2006 (CLC2006). This report describes the CLC2006 mapping, the applied methodology and the obtained results. The CLC2000 project was primarily an update of the land cover map, where the delineation of areas was updated if more than 5 ha of changes were identified. With the CLC2006 mapping the focus has shifted towards mapping changes. All changes in land cover above the threshold of 5 ha have been mapped (CLC-change2006). The CORINE land cover map for 2006 (CLC2006) was produced as a secondary product.

## Sammenfatning

“CORINE land cover” er en fælleseuropæisk kortlægning af arealanvendelse/arealdække. Arealanvendelse/arealdække er i Danmark kortlagt efter CORINE metode og klasseopdeling med satellitbilleder fra 3 forskellige tidsperioder, fra begyndelsen af 1990'erne (CLC90), fra år 2000 (CLC2000) og fra år 2006 (CLC2006). Denne rapport beskriver kortlægningen for 2006, den ændrede metode og de fundne resultater. Ved CLC2000 kortlægningen var fokus på en opdatering af CLC90. Afgrænsninger blev opdateret, hvis der var sket ændringer på mere end 5 ha. Med CLC2006 er fokus flyttet mod kortlægning af ændringer i arealanvendelsen. Hvor der er sket ændringer over 5 ha, er disse kortlagt (CLC-change2006). Der er efterfølgende også dannet et fuldt dækkende arealanvendelseskort (CLC2006).

# 1 Background

The CLC2006 project is a joint European effort to evaluate the changes in and status of the land cover in Europe. The evaluation of the changes in land cover is based on the previous CORINE Land Cover (CLC) interpretations with reference dates in the early 1990's (CLC90) and 2000 (CLC2000).

The basic methodology has over the years been based on:

- Interpretation of land cover based on satellite imagery supplemented with other information
- A common nomenclature with 3 levels and 44 classes at the 3<sup>rd</sup> level
- A complete coverage with a minimum mapped unit in the land cover map of 25 ha
- In 2000 the land cover map was updated and changes were thus mapped. The criterion for when to update was set to changes above 5 ha with a width broader than 100 m.

With the project in 2006 the focus concerning methodology and deliverables has been on the interpretation of changes (CLC-Changes) irrespective of whether these would result in changes in the resulting land cover map (CLC2006).

The CLC2006 project is performed in Denmark at the request of EEA and the European Commission. The project is considered a (voluntary) national contribution to the European environment and regional planning policies by the Danish Ministry of the Environment.

The CLC2006 interpretation was performed by the National Environmental Research Institute (NERI) on behalf of the Ministry of the Environment. NERI also performed the CLC2000 interpretation.

Project agreements were negotiated by the Strategic Board of the Ministry (Board of Deputy Directors) in 2006 when the Ministry was composed of the following main institutions:

- Environmental Protection Agency (MST)
- Forest and Nature Agency (SNS)
- National Survey and Cadastre (KMS)
- Geological Survey of Denmark and Greenland (GEUS)
- National Environmental Research Institute (NERI)

The national financing was split evenly among institutions. Several organisational changes have occurred since the arrangements were made:

- NERI is now part of Aarhus University
- GEUS is part of the Ministry of Climate and Energy
- A new institution, 'Agency for Spatial and Environmental Planning (BLST)', now undertakes some of the tasks previously assigned to MST and SNS.

## **2 Databases used in the project**

### **2.1 Satellite imagery**

In Denmark the CLC2006 project is based on satellite images from Image2000 and Image2006. DMC constellation images were not included.

The Danish Image2000 consisted of a mosaic of Landsat 7 ETM images basically with single date coverage.

The Image2006 coverage is composed of both SPOT-4/5 images and IRS images. The images have been acquired as dual date coverage, basically within 2 acquisition periods: a spring /early summer period and a late summer / early autumn period. A given area may, however, be covered by several images from different dates.

Further details on image coverage may be found in the metadata of the working units (see annexes).

### **2.2 Topographic data**

Topographic data from the national mapping agency (KMS) were applied as supporting layers. These are revised in 5 year cycles, implying that the information is not necessarily from the reference years 2000 and 2006. The topographic data consist of a raster map (DTK) similar to traditional paper maps and as vector representation (Kort10) of the individual feature types.

The two versions of the topographic data applied were DTK1999 and DTK2006/Kort10\_2006.

### **2.3 Orthophotos**

An orthophoto composite from 1999 (DDO99) has been used as an ancillary layer for the main part of the interpretation phase. The orthophoto layer is from COWI and was acquired in spring 1999. DDO99 has a resolution of 40 cm in ECW compression.

In the phase following the first validation of data, orthophotos from the topographic map production was made available and used in parts of Jutland. The orthophoto acquisitions are from the period 2004-2007 and have a resolution of 40 cm and 20 cm (uncompressed).

### 3 Organisation of work at national level

The CLC2006 project in Denmark was (as the previous CLC2000 project) undertaken solely by NERI, Department of Freshwater Ecology. The project team consisted of:

Michael Stjernholm	Project-leader, photo-interpreter
Inge-Lise Madsen	Photo-interpreter
Ane Kjeldgaard	Photo-interpreter

#### 3.1 Overview of process

The CLC2006 project followed the same process as CLC2000, with a few modifications.

Preparatory phase:

- Pre-processing of satellite imagery – contrast-stretching of images in false colour composite
- Modification of previous ArcView 3.1 application
- Selection of ancillary data

Interpretation phase:

- The interpretation process was sub-divided into 6 regions (working sheets). As the image coverage of Image2006 is far more complex than that of Image2000, the sub-division was based on a combination of natural regions (the islands) and a practical split of the main part of Jutland (see figure 3.1).
- During the interpretation 3 main elements were considered in the same process:
  - Potential revision of CLC2000
  - Potential changes at 5 ha scale from Image2000 to Image2006 CLC-Change2006
  - Potential changes in CLC2006 as a result of real changes. If a change was identified, the LC codes were interpreted both within a 5 ha context – “real change” from 2000 to 2006 and in a 25 ha context (resulting CLC2006 polygons).

Review phase:

Following the first verification mission a complete review of the entire country was performed, taking the verification results and recommendations into account.

Finalisation phase:

After a second verification mission involving acceptance of interpretation results with a few minor recommendations, these were implemented and the final products were generated.



Figure 3.1. CLC2006 Working units

## 3.2 Basic specification

The CLC specifications were defined during the CORINE programme (Heymann et al., 1994).

The three determining elements of the CLC Project are:

- The mapping scale is 1 : 100 000. Boundary accuracy is at least 100 m for national and European products.
- The minimum unit for inventory is 25 ha (at scale 1 : 100 000 it is represented by a 5x5 mm square or a circle with a 2.8 mm radius; minimum width of unit is 100 m – at scale 1 : 100 000 it is 1 mm). Only area elements (polygons) are identified. Areas smaller than 25 ha are allowed in the national land cover database as additional thematic layers, but should be aggregated into the European database.
- The CLC nomenclature is hierarchical and distinguishes 44 classes at third level, 15 classes at second level and 5 classes at first level.

The nomenclature was developed in order to map the whole Community territory (CORINE Land Cover. Technical Guide by Heymann et al., 1994; Addendum 2000 by Bossard et al., 2000), including the foreseen extension to Phare accession countries. Use of the CLC nomenclature with its 44 classes at three hierarchical levels is mandatory. Additional national levels can be mapped but should be aggregated to level 3 for the European data integration. No unclassified areas should appear in the final version of the data set.

The specification for the workflow in CLC 1990 anticipated that satellite imagery should be printed at scale 1:100.000 and interpretation should be performed on overlaid transparencies, later to be digitized and interpreted. The Danish CLC 1990 did not, however, fully follow this workflow, as the interpretation and digitization were performed directly on the computer screens. Satellite imagery was available in 1:100 000 print-outs to provide an overview of the region to be interpreted.

### 3.2.1 Novelties I&CLC2000

Based on the lessons learnt from the first CLC inventory (CLC90), novelties of the I&CLC2000 were:

- The updated CLC inventory was more time-consistent. For all participating countries the satellite images of the Image2000 part of the project were from year 2000 +/- 1 year.
- Minimum change area for existing polygons was 5 ha, isolated changes were mapped when above 25 ha. The boundary displacement was minimum 100 meter and the changes for a contiguous area were minimum 5 ha.
- The interpretation and digitization were performed directly on the computer screen without intermediate hard-copy printing.
- The documentation of the data and production process occurred in a standardised form.
- The production of the I&CLC2000 was monitored more closely by the Technical team from the EEA Topic Centre for Terrestrial Environment. The visits from the technical team ensured homogeneity and quality and helped resolve interpretation issues.

### 3.2.2 Novelties in CLC2006 specification

- With the CLC2006 specification the focus was shifted fully towards the generation of land cover change data (CLC-Change2006 - changes between 2000 and 2006); thus all changes > 5 ha were to be mapped and labelled according to the real change process.
- The CLC2006 feature layer (the country-wide land cover layer) should be produced either semi-automatically by the technical team by combining the (revised) CLC200 layer and the CLC-Change2006 or by the country. See also “ Processing methodology“ below.

### 3.3 CLC nomenclature in Denmark

In Denmark 30 classes out the 44 European classes are represented.

Table 3.1. CLC classes relevant for Denmark

Level 1	Level 2	Level 3
1 Artificial areas	11 Urban fabric	111 Continuous urban fabric 112 Discontinuous urban fabric
	12 Industrial, commercial and transport units	121 Industrial or commercial units 122 Road and rail networks and associated land 123 Port areas 124 Airports
	13 Mine, dump and construction sites	131 Mineral extraction sites 132 Dump sites 133 Construction sites
	14 Artificial, non-agricultural vegetated areas	141 Green urban areas 142 Sport and leisure facilities
2 Agricultural areas	21 Arable land	211 Non-irrigated arable land
	22 Permanent crops	222 Fruit trees and berry plantations
	23 Pastures	231 Pastures
	24 Heterogeneous agricultural areas	242 Complex cultivation patterns 243 Land principally occupied by agriculture with significant areas of natural vegetation
3 Forest and semi-natural areas	31 Forests	311 Broad-leaved forest 312 Coniferous forest 313 Mixed forest
	32 Shrubs and / or herbaceous associations	321 Natural grasslands 322 Moors and heathland 324 Transitional woodland / shrub
	33 Open spaces with little or no vegetation	331 Beaches, dunes, and sand plains
4 Wetlands	41 Inland wetlands	411 Inland marshes 412 Peat bogs
	42 Coastal wetland	421 Salt marshes 423 Intertidal flats
5 Water bodies	51 Inland waters	512 Water bodies
	52 Marine waters	521 Coastal lagoons 523 Sea and ocean

### 3.4 Processing methodology

The CLC2006 project was basically performed using ESRI software ArcView 3.1 supported by ArcGIS 9.2.

The main interpretation was undertaken using ArcView 3.1, allowing an efficient way of working with two image views representing the two time periods. The standard ArcView 3.1 functionality was supported by specific customizations for attribute editing, zoom and panning in fixed scales and steps and access to the many tiles of aerial photography.

The interpretation process was supported by the application of a 10 km check grid whose purpose is both to provide “orientation” support to the interpreter when zooming and panning in different scales so the entire area is checked and to allow monitoring of the interpretation progress.

The interpretation process used the existing CLC2000 product as a starting point. The three main products of the process are:

- A revised CLC2000 layer, with the “traditional” minimum mapping unit (MMU) of 25 ha.
- A CLC-Change2006 layer with an MMU of 5 ha, describing all the changes in the landscape between 2000 and 2006 at this resolution. The codes in this layer are referenced/referred to as the “real” CLC codes.
- A CLC2006 layer with an MMU of 25 ha.

As the CLC code at 5ha scale may be different from the code at 25 ha scale, three complementary attributes were added to the interpretation version of the CLC2000 layer:

- “real” CLC code for 2000
- “real” CLC code for 2006
- code for resulting CLC2006 layer

In order to reduce the risk of introducing errors during editing of geometries, all editing was either a “Cut” or “Merge” of polygons.

#### **CLC2006 training:**

No external CLC2006 specific training was performed. An internal training workshop was held with particular focus on the changes in the specifications. Two out the three persons in the team had been involved in the previous CLC2000 interpretation.

#### **Internal quality control:**

The internal quality control included:

- fulfilment of technical specifications:
  - valid CLC codes
  - valid sizes of areas and width 5 ha, 25 ha and 100m
  - topology rules – no overlaps and no gaps
- interpretation/classification of change and land cover

Quality control of technical specifications was included in the production of end products, occurring prior to the reviews and the final delivery.

The quality control of the interpretation was initially based on the internal discussions of issues arising during the interpretation phase. Following the first validation report which raised a number of issues the entire country was reviewed by photo-interpreters who had not been involved in the first interpretation of a given area.

### 3.5 Main difficulties and solutions

In the interpretation phase the Danish CLC2006 project faced difficulties in assigning the necessary staff for a single continuous period. The interpretation thus proceeded over a long period. Due to difficulties in planning the right moment for the first verification, the external validation took part only after the complete country had been interpreted. The first verification mission identified a number of issues related to:

Missing corrections to CLC2000:

- some of the interpreted changes should rather be corrections to CL2000
- some polygons were found to be too heterogeneous, e.g. 243 with forests patches larger than 25 ha and gravel pits (131) with lakes above 25 ha.

Missing interpretations of changes:

- class 133 (construction sites) not used sufficiently
- the dynamics of mineral extraction sites (131), opening of new parts and reclamation of exploited gravel pit areas
- the dynamics of forest management , from mature forest (31x) to clear-cuts (324) and from regeneration areas (324) to mature stands (31x)

As a result of the first verification report the entire CLC2006 database was reviewed with focus on both the specific identified errors and the more systematic problems. The review was performed by “fresh” eyes, i.e. interpreters not having performed the first interpretation.

#### **Christmas trees and greenery plantations**

On the interpretation side the main thematic difficulties were encountered within the largest group of land cover changes: the young immature plantations of Christmas trees and greenery.

Denmark has the second largest production of Christmas trees and the largest production of greenery in Europe. The annual production amounts to 10 million cut Christmas trees and 35,000 tonnes of greenery. The challenges of interpreting Christmas tree and greenery areas are:

- The signature for Christmas trees areas is highly variable, depending on timing in lifecycle and differences in weed management, see fig. 3.2 for examples of Christmas tree areas in different stages.
- Even the national forest inventory (Nord-Larsen et al 2008) has found problems in identifying young Christmas tree plantations from aerial photos.

- The lifecycle of Christmas trees is 7-10 years, which means that some areas may always be in the “immature state” at the time of satellite acquisitions.
- Coniferous forest areas are expected to remain as a forest type land cover, however areas with Christmas tree plantations and greenery production may look like forest and still return to other agricultural use(see e.g. fig 3.2F) as these areas are not protected under forestry legislation.

The solution was to map immature plantations as class “324 Transitional woodland-scrub” where identified in satellite imagery, supplemented with topographic maps.

During the CLC2006 project it has become clear that the identification of the immature plantations often requires a retrospective view, meaning that only after seeing the development of an area the right interpretation, also of the past, can be provided. The revised CLC2000 thus includes 84,364 ha of class 324, where the interpretation during CLC2000 project mapped 77,350 ha.

Figure 3.2. Examples of Christmas tree plantations in different managements stages



**A** Young plantation with intensive weed management



**B** Young plantation with less intensive weed management



**C** Weed or trees?



**D** Partially cut Christmas tree plantation



**E** Cut greenery plantation



**F** Former Christmas tree plantation – soon to be pasture

**Agriculture intensification degree**

Another difficult thematic area is the gradual change of the heterogeneous agricultural class "242 Complex cultivation patterns" into the more homogeneous class "211 Non-irrigated arable land." The main difficulty is that these gradual changes take place in smaller patches (< 5 ha) and are thus not mapped. The changes may also be difficult to identify as the Image2000 only covers a single date. No solutions have been found and the results show that only a few changes have been mapped. A future solution might require the analysis of agricultural registries linked to field maps in order to obtain reliable estimates on this type of changes.

## 4 Results

The main summary of results is presented in table 1. The table summarises results from both the two CLC products as well as the CLC-Change2006 product.

Table 4.1. Main summary results of CLC2006 project

<b>CORINE class code</b>	<b>CLC 2000 (rev.) [ha]</b>	<b>CLC 2006 [ha]</b>	<b>Simple CLC difference [ha]</b>	<b>Real change from class in 2000 [ha]</b>	<b>Real change to class in 2006 [ha]</b>
111	6,219	6,219	0		
112	192,549	197,925	5,376	9	5,503
121	26,053	28,157	2,105	6	2,052
122	828	910	81		243
123	4,746	4,833	87		87
124	7,183	7,361	178		178
131	5,071	4,573	-498	1,385	1,261
132	271	235	-36	36	
133	978	834	-144	1,789	1,414
141	11,290	11,291	0	29	33
142	59,350	61,521	2,172	52	2,118
211	2,792,836	2,785,875	-6,961	11,902	760
222	554	508	-45	45	
231	58,576	57,906	-669	785	152
242	108,299	103,822	-4,478	465	28
243	354,987	355,471	484	574	1,019
311	72,520	73,488	968	67	997
312	179,755	180,172	417	4,564	3,806
313	133,175	135,484	2,309	425	2,505
321	26,463	26,509	46	103	127
322	49,869	49,994	125	129	256
324	83,917	81,284	-2,633	7,488	6,030
331	9,071	9,032	-39	179	155
333	47	47	0		
411	29,703	29,364	-340	414	107
412	24,932	23,021	-1,910	1,914	
421	28,592	30,551	1,959	109	2,068
423	59,649	59,668	20	32	46
512	37,122	38,219	1,097	613	1,816
521	46,100	46,642	543	50	599

Table 4.1, column 4 (Simple CLC difference), indicates the change in land use when looking at the integrated 25 ha level (landscape level). Column 5 and 6 indicate the real changes as they are interpreted. The real changes have not necessarily taken place in a CLC polygon with same class code as the codes of the change.

The Level 1 group of agricultural areas is the only land cover group where the real changes result in a net decrease of area. The artificial surfaces are not surprisingly the group with the highest net increase of area.

Table 4.2. Changes as result of revision

<b>CORINE</b> <b>Class code</b>	<b>Original CLC2000</b> <b>ha</b>	<b>Revised CLC2000</b> <b>ha</b>	<b>Revision</b> <b>ha</b>
111	6,219	6,219	0
112	191,770	192,549	779
121	25,440	26,053	613
122	963	828	-135
123	4,692	4,746	54
124	7,012	7,183	171
131	5,217	5,071	-146
132	308	271	-37
133	283	978	695
141	11,285	11,290	5
142	58,262	59,350	1,088
211	2,797,223	2,792,836	-4,387
222	354	554	200
231	58,488	58,576	88
242	108,201	108,299	98
243	360,743	354,987	-5,756
311	72,330	72,520	190
312	179,967	179,755	-212
313	132,913	133,175	262
321	27,517	26,463	-1,054
322	49,746	49,869	123
324	77,350	83,917	6,567
331	8,916	9,071	155
333	0	47	47
411	30,983	29,703	-1,280
412	25,977	24,932	-1,045
421	25,682	28,592	2,910
423	59,176	59,649	473
512	37,034	37,122	88
521	46,083	28,592	17

The revision process has mainly led to an increase in the CLC2000 area of class 321 at the cost of e.g. arable land (211) – due to Christmas plantations now detected as part of the retrospective view. The area of the heterogeneous class 243 has been reduced - split to more homogeneous classes. Construction sites (133) have increased in area due to increased awareness of this class in the urban fabric. Finally, some of the previous freshwater wetlands (41x) were revised into salt marshes (421).

In trying to understand the main processes involved it is useful to look at each of the 1<sup>st</sup> level classes. Table 4.3 – 4.6 summarize the observed changes and group them according to whether the changes are within the 1<sup>st</sup> level group or whether they are a gain or loss from the other 1<sup>st</sup> level groups.

Table 4.3. Changes related to Artificial surfaces

	Internal Changes		Gain from other 1 <sup>st</sup> level classes		Losses to other 1 <sup>st</sup> level classes	
	Ha		Ha		Ha	
112 > 133	9.4		211 > 112	4,290.8	131 > 211	461.7
121 > 133	5.9		242 > 112	72.2	131 > 231	56.9
131 > 121	14.2		243 > 112	292.0	131 > 243	311.5
131 > 142	183.5		313 > 112	14.4	131 > 322	42.3
132 > 121	36.0		324 > 112	6.5	131 > 324	193.4
133 > 112	778.8		411 > 112	19.6	131 > 512	121.7
133 > 121	630.5		211 > 121	1,310.9	133 > 211	106.2
133 > 122	133.4		231 > 121	14.9	133 > 231	5.0
133 > 124	81.0		243 > 121	37.7	133 > 324	17.0
133 > 141	22.4		523 > 121	5.0	133 > 512	14.4
141 > 112	28.8		211 > 122	86.5		
142 > 121	3.2		243 > 122	8.2		
142 > 131	32.4		324 > 122	15.0		
142 > 133	16.2		523 > 123	87.0		
			331 > 124	96.6		
			211 > 131	1,031.2		
			231 > 131	16.8		
			243 > 131	69.1		
			312 > 131	73.1		
			313 > 131	5.4		
			324 > 131	32.9		
			211 > 133	1,301.2		
			243 > 133	36.6		
			321 > 133	30.0		
			324 > 133	15.2		
			211 > 141	11.0		
			211 > 142	1,640.5		
			231 > 142	21.1		
			242 > 142	50.8		
			243 > 142	82.0		
			312 > 142	71.2		
			313 > 142	11.8		
			324 > 142	57.6		
<b>Sum</b>	<b>1,975.8</b>			<b>10,914.7</b>		<b>1,330.1</b>

The predominant change within “Artificial surfaces” is the increase of the “urban” classes of discontinuous urban fabric and Industrial and commercial units. Mostly the change is all the way from open land to the urban class, but also partly from construction sites to the urban class. The main losses to other 1<sup>st</sup> level classes are due to either reclamation of gravel pits, or road construction sites where land occupied during construction is returned to the original land use.

Table 4.4 Changes related to Agricultural areas

Internal changes	Gain from other 1 <sup>st</sup> level classes		Losses to other 1 <sup>st</sup> level classes		
	Ha	Ha	Ha	Ha	
211 > 231	90.0	131 > 211	461.7	211 > 112	4,290.8
211 > 242	27.5	133 > 211	106.2	211 > 121	1,310.9
211 > 243	505.9	312 > 211	60.6	211 > 122	86.5
222 > 211	39.3	324 > 211	31.7	211 > 131	1,031.2
231 > 211	26.8	421 > 211	33.3	211 > 133	1,301.2
		131 > 231	56.9	211 > 141	11.0
		133 > 231	5.0	211 > 142	1,640.5
		131 > 243	311.5	211 > 312	25.8
		313 > 243	51.1	211 > 313	5.9
		324 > 243	21.5	211 > 324	1,076.0
		411 > 243	128.8	211 > 411	32.5
				211 > 421	67.2
				211 > 512	393.4
				211 > 521	5.9
				222 > 324	6.0
				231 > 121	14.9
				231 > 131	16.8
				231 > 142	21.1
				231 > 421	110.6
				231 > 512	594.9
				242 > 112	72.2
				242 > 142	50.8
				242 > 411	74.7
				242 > 512	267.3
				243 > 112	292.0
				243 > 121	37.7
				243 > 122	8.2
				243 > 131	69.1
				243 > 133	36.6
				243 > 142	82.0
				243 > 324	33.7
				243 > 512	15.1
<b>Sum</b>	<b>689.6</b>		<b>1,268.3</b>		<b>13,082.4</b>

Within the agricultural areas the predominant process is the loss of arable land to urban development and recreational use, with a significant loss also to afforestation (Christmas tree areas). Minor losses include new "nature" e.g. creation of new lakes (512) with the purpose of trapping nutrients and increasing nature value.

Table 4.5 Changes related to Forest and Semi-natural areas

Internal changes	Gain from other 1 <sup>st</sup> level classes		Losses to other 1 <sup>st</sup> level classes		
	Ha	Ha	Ha	Ha	
311 > 324	67.4	211 > 312	25.8	312 > 131	73.1
312 > 311	8.7	211 > 313	5.9	312 > 142	71.2
312 > 313	59.5	131 > 322	42.3	312 > 211	60.6
312 > 321	45.1	412 > 322	29.6	313 > 112	14.4
312 > 322	81.8	512 > 322	20.3	313 > 131	5.4
312 > 324	4,164.1	131 > 324	193.4	313 > 142	11.8
313 > 311	8.1	133 > 324	17.0	313 > 243	51.1
313 > 322	9.9	211 > 324	1,076.0	313 > 512	4.2
313 > 324	320.5	222 > 324	6.0	321 > 133	30.0
321 > 324	54.9	243 > 324	33.7	321 > 512	17.7
322 > 324	67.0	421 > 324	29.8	322 > 512	61.9
324 > 311	980.0	423 > 331	18.6	324 > 112	6.5
324 > 312	3,780.4	523 > 331	115.0	324 > 122	15.0
324 > 313	2,439.2			324 > 131	32.9
324 > 322	72.5			324 > 133	15.2
324 > 331	21.2			324 > 142	57.6
331 > 321	82.2			324 > 211	31.7
				324 > 243	21.5
				324 > 512	14.0
				331 > 124	96.6
<b>Sum</b>	<b>12,262.5</b>		<b>1,581.7</b>		<b>692.4</b>

The changes within the 1st level group of forests and semi-natural areas are mainly within the group itself and basically reflect forest management practise. The higher level of change from 324 (Transitional woodland) to 31x than vice versa was expected as a large storm fall in 1999 gave a sudden and unusual high level of 243 in CLC2000. Examples of nature management can be seen for "Natural grasslands" and "Moors and heathlands" where the areas need maintenance (cutting of trees and scrubby vegetation) to maintain their (preferred) status.

Table 4.6 Changes related to Wetlands and Water bodies

Internal changes	Gain from other 1 <sup>st</sup> level classes		Losses to other 1 <sup>st</sup> level classes		
	Ha	Ha	Ha	Ha	
411 > 512	265.9	211 > 411	32.5	411 > 112	19.6
412 > 421	1,839.5	242 > 411	74.7	411 > 243	128.8
412 > 512	45.0	211 > 421	67.2	412 > 322	29.6
421 > 423	45.8	231 > 421	110.6	421 > 211	33.3
423 > 523	13.1	131 > 512	121.7	421 > 324	29.8
512 > 521	593.0	133 > 512	14.4	423 > 331	18.6
521 > 421	50.4	211 > 512	393.4	512 > 322	20.3
		231 > 512	594.9	523 > 121	5.0
		242 > 512	267.3	523 > 123	87.0
		243 > 512	15.1	523 > 331	115.0
		313 > 512	4.2		
		321 > 512	17.7		
		322 > 512	61.9		
		324 > 512	14.0		
		211 > 521	5.9		
<b>Sum</b>	<b>2,852.8</b>		<b>1,795.5</b>		<b>487.1</b>

Within the wet nature types (“Wetlands” and “Water bodies” are merged in table 4.5), the predominant tendency is the creation of lakes, either as restored or newly “designed” lakes. The large internal change from “Peat bog” to “Salt marshes” is mainly one single very large area, where sluice management practises have been altered.

Table 4.7 provides a brief regional overview of the degree of changes as derived from the CLC–change layer.

Table 4.7 Regional distribution of change.

<b>Working unit</b>	<b>Total area [ha]</b>	<b>Change [ha]</b>	<b>Change [%]</b>
Nordjylland	813,883	7,614	0.94
Midtjylland	1,531,665	7,106	0.46
Syddjylland	1,564,402	10,541	0.67
Fyn	350,297	2,252	0.64
Sjælland	932,593	5,690	0.61
Bornholm	59,027	151	0.26

Table 4.8 presents the temporal change in the CORINE Land Cover distribution. This table should naturally be interpreted with some caution and only be seen as an overview in the scale of “landscapes” rather than detailed activity or economic trends. Table 4.1 clearly shows that the rate of change is highly dependent on the scale (Minimum Mapping Unit) according to which the changes are interpreted, and tables 4.3 – 4.6 show that it is necessary to look at the details of the highest resolution to understand the processes behind the changes. A few stable trends may, however, be derived from table 4.8. In the 1<sup>st</sup> level group of artificial surfaces the classes related to stable end use do expectedly remain stable or constantly increase in area. The group of more volatile land use (13x) “Mine, dump and construction sites” shows a higher degree of variation which should rather be interpreted based on the more detailed information in table 4.3 because the interpretation may be disturbed by, for example, a few large infrastructure projects

Table 4.8 Temporal change in CLC area distribution

<b>CORINE class code</b>	<b>CLC area in 1990 ha</b>	<b>CLC area in 2000 ha</b>	<b>CLC area in 2006 ha</b>	<b>CLC area change 1990 - 2000 %</b>	<b>CLC area change 2000 - 2006 %</b>
111	6220	6,219	6,219	0.0	0.0
112	187,951	192,549	197,925	2.4	2.8
121	22,398	26,053	28,157	16.3	8.1
122	812	828	910	2.0	9.8
123	4,439	4,746	4,833	6.9	1.8
124	7,012	7,183	7,361	2.4	2.5
131	3,588	5,071	4,573	41.3	-9.8
132	238	271	235	13.7	-13.3
133	108	978	834	805.2	-14.7
141	11,264	11,290	11,291	0.2	0.0
142	54,365	59,350	61,521	9.2	3.7
211	2,817,946	2,792,836	2,785,875	-0.9	-0.2
222	354	554	508	56.4	-8.2
231	57,987	58,576	57,906	1.0	-1.1
242	108,988	108,299	103,822	-0.6	-4.1
243	360,559	354,987	355,471	-1.5	0.1
311	73,098	72,520	73,488	-0.8	1.3
312	199,217	179,755	180,172	-9.8	0.2
313	138,564	133,175	135,484	-3.9	1.7
321	27,221	26,463	26,509	-2.8	0.2
322	48,441	49,869	49,994	2.9	0.3
324	46,907	83,917	81,284	78.9	-3.1
331	8,859	9,071	9,032	2.4	-0.4
333	0	47	47	-	0.0
411	29,597	29,703	29,364	0.4	-1.1
412	25,985	24,932	23,021	-4.1	-7.7
421	25,768	28,592	30,551	11.0	6.9
423	59,098	59,649	59,668	0.9	0.0
512	36,603	37,122	38,219	1.4	3.0
521	46,091	46,100	46,642	0.0	1.2

The group of agricultural areas confirms the general trend of decrease in area. The exact trends in changes of agricultural crops, pastures and set aside areas should, however, rather be examined from other agricultural databases.

Within the forested areas the observed trends are quite valid. The dramatic increase from 1990 – 2000 in class 324 and marked decrease in 312 could be explained by a major storm-fall in December 1999 and the increase in Christmas tree production, see Stjernholm (2004).

The trends within the wetlands are mainly related to nature conservation and restoration projects. The good message is that these areas seem to be generally well protected and not eroded by other domains. As the exploitation of peat bogs in the time scale of CORINE is an irreversible process the area will only decrease. However, as explained above for table 4.6 the currently observed decrease can be explained by one particular nature conservation project and not by commercial exploitation or intensified land use.

The group of water bodies also shows a stable situation with a slight increase in area due to lake "restoration" projects.

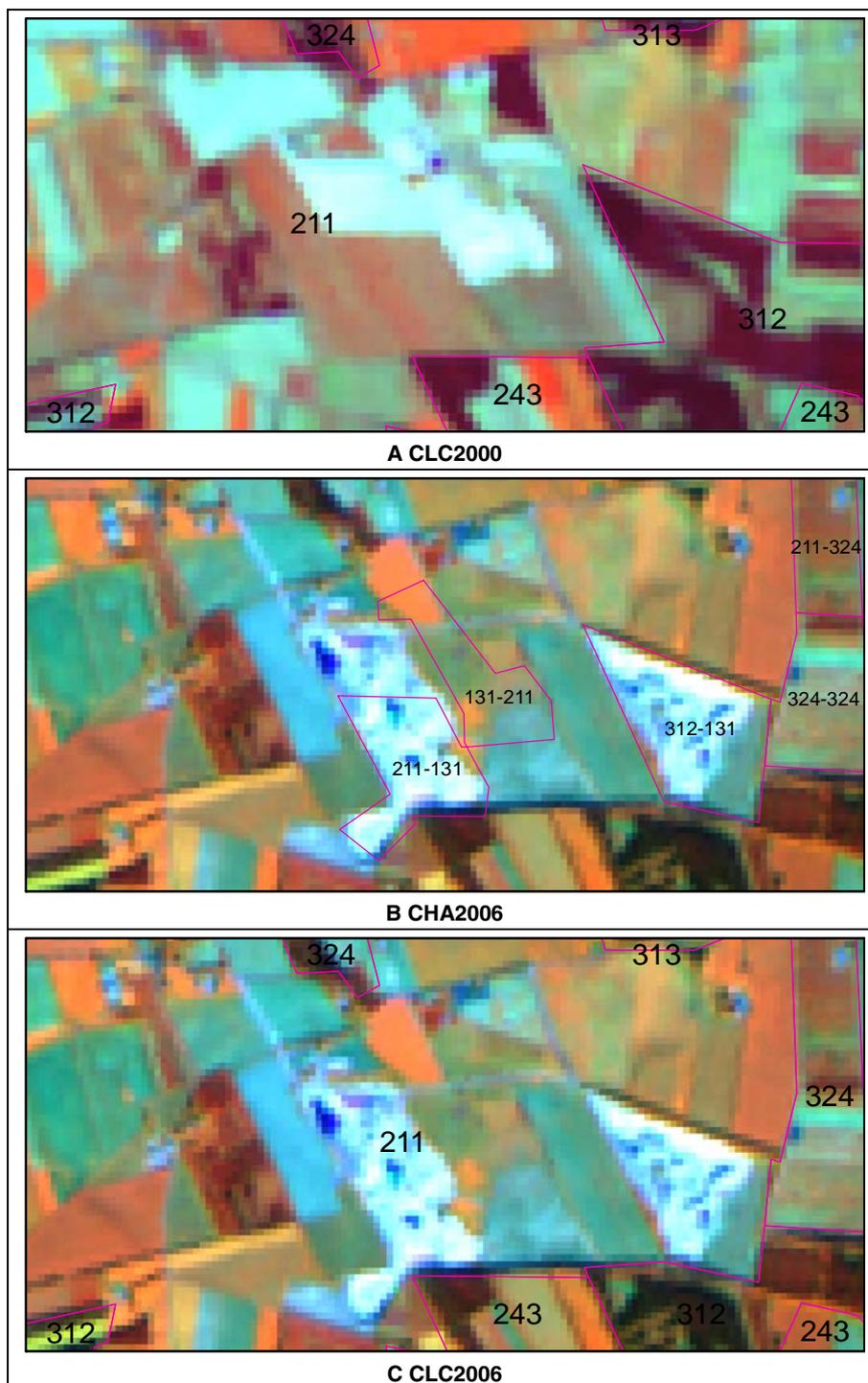


Figure 4.1. Example of gravel pits developing without impact in CLC2000 or CLC2006 as the pit in neither 2000 nor 2006 had a size above 25 ha. In the centre, part of the pit remained unchanged and thus not marked in CHA2006.

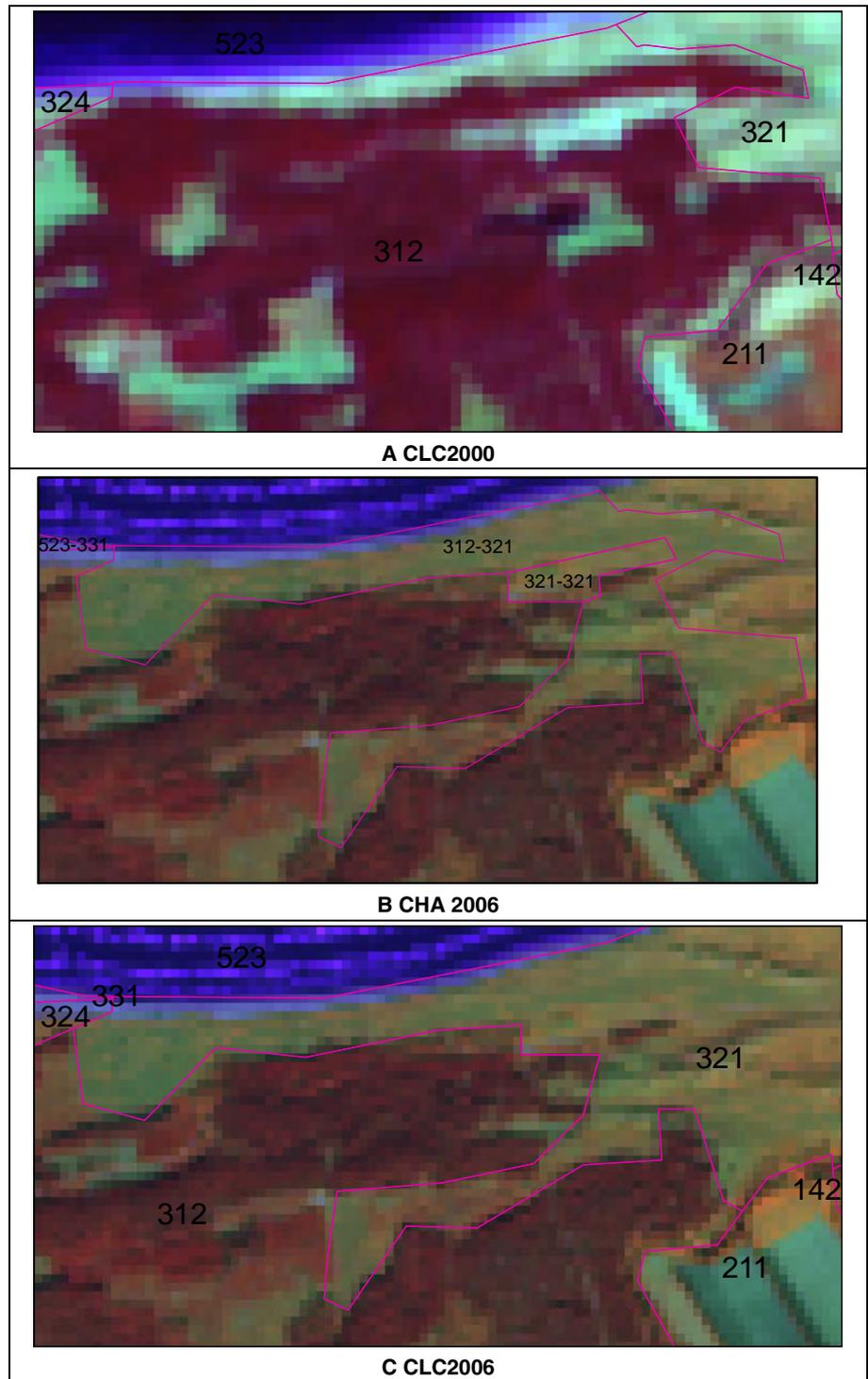
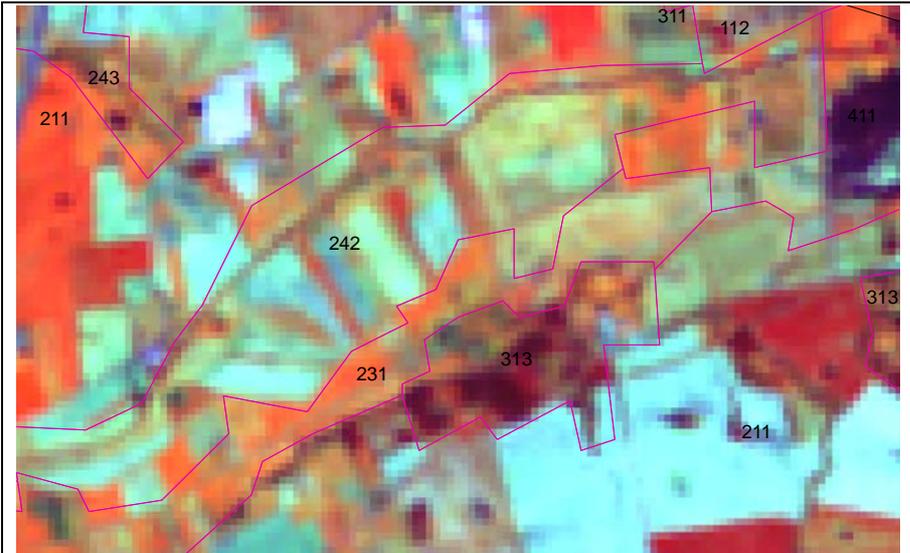
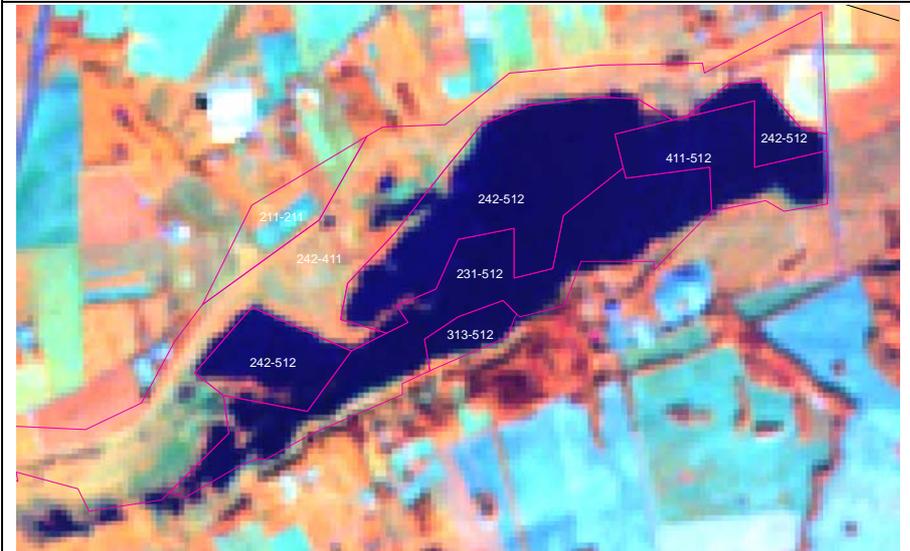


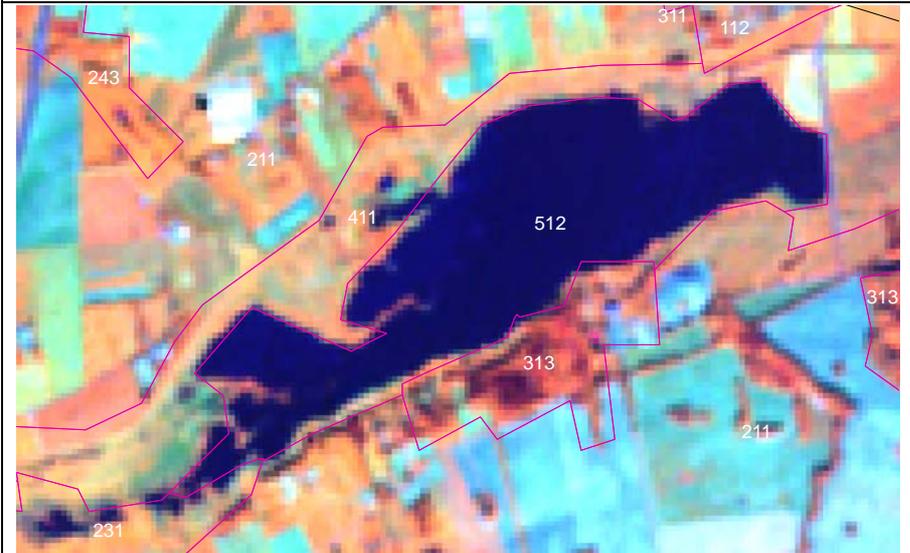
Figure 4.2. Example of nature management – fir has been cut to give room again for original heath land vegetation. In the central part of CHA2006 a heath land patch has remained unchanged – in the data set this patch is marked as “Technical change”



**A CLC2000**

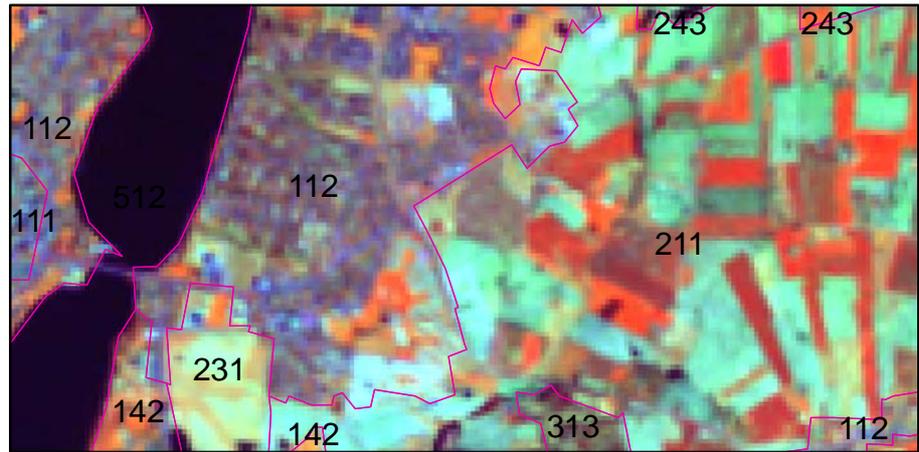


**B CHA2006**

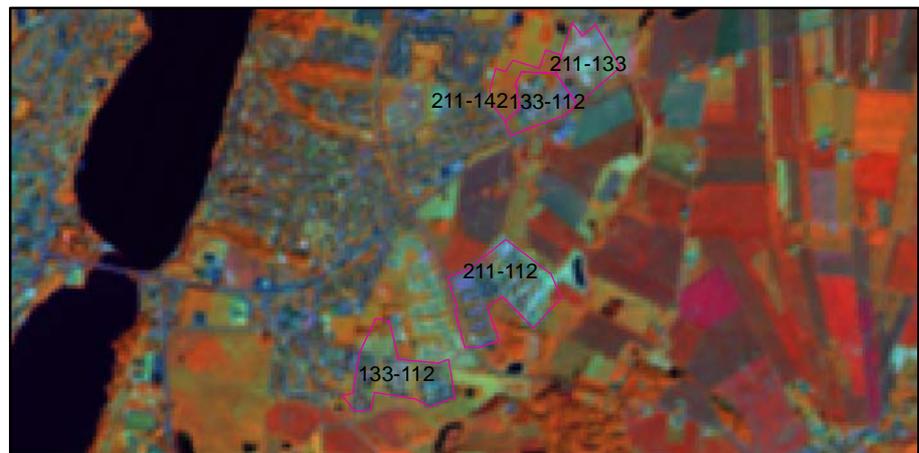


**C CLC2006**

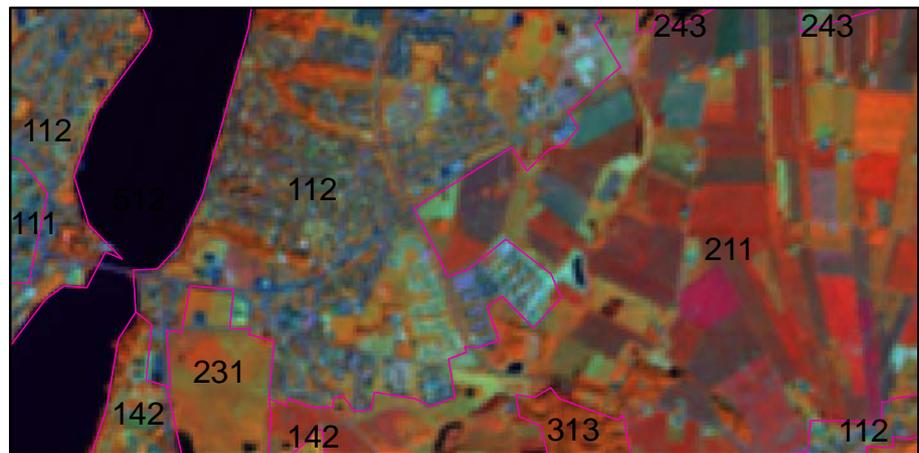
Figure 4.3. The creation of a new lake.



**A CLC2000**



**B CHA2006**

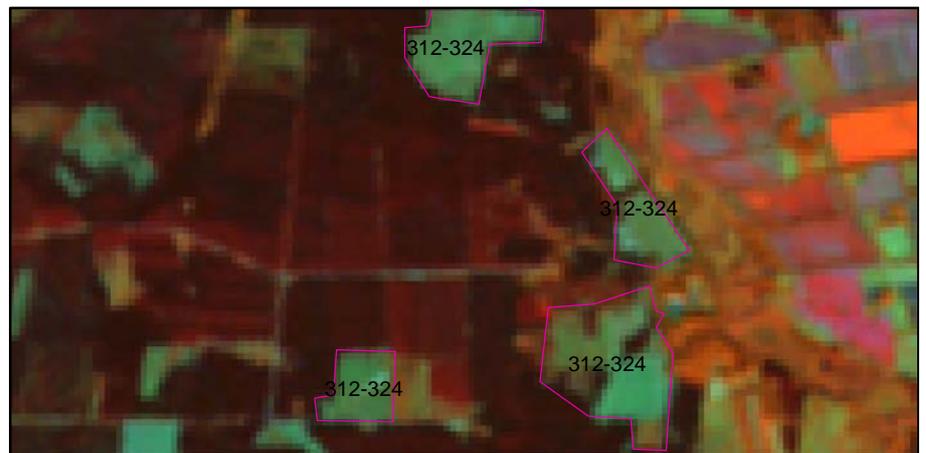


**C CLC2006**

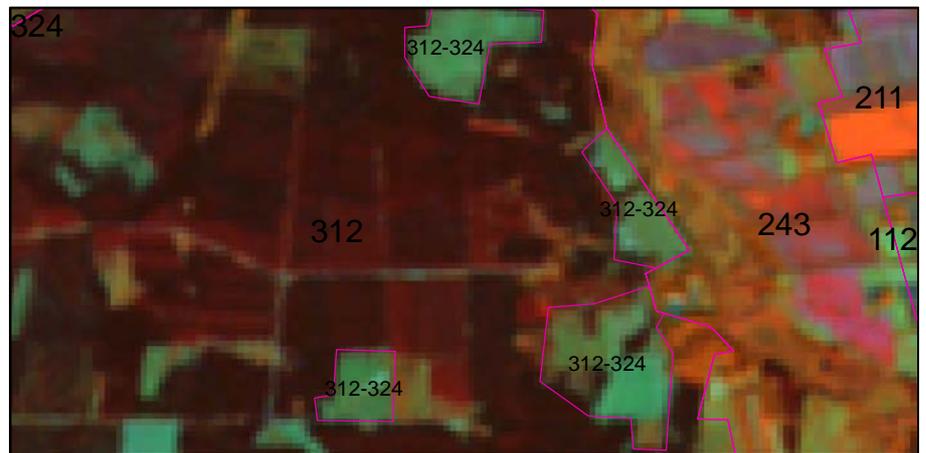
Figure 4.4. Examples of Urban change, both directly from arable land to discontinuous urban fabric and via construction sites.



**A CLC2000**



**B CHA2006**



**C CLC2006**

Figure 4.5. Example of forest clear-cutting to be found in CLC change 2006 layer.

## 5 Deliverables

The CLC2006 project has 3 main data deliverables:

- The revised CORINE land cover of Denmark for 2000 (CLC2000)
- The CORINE land cover map of Denmark for 2006 (CLC2006)
- Changes in land cover from 2000 to 2006 (CHA06)

The geodata have been provided as an ESRI personal geodatabase to EEA's [Common Data Repository](#)

The data are also available through web-map services and applications from NERI website:

[http://www.dmu.dk/Udgivelser/Kort\\_og\\_Geodata/](http://www.dmu.dk/Udgivelser/Kort_og_Geodata/)

Image2000 and Image2006 will also be made available as viewable services. Image2006 data are subject to a copyright constraint from ESA that will only allow governmental institutions direct access to the data, and only after signing an agreement with ESA.

## 6 Conclusions

CLC2006 project has added a new dimension to the analysis of change in land cover / land use according to the CORINE nomenclature. By interpreting the “real” change with a minimum mapping unit of 5 ha it is possible to deduce more information about the processes driving the change in the modern landscape.

The Danish interpretation has involved a simultaneous interpretation of not only the “real” change in the 5 to 25 ha scale but also the impact in the interpretation at landscape level (25 ha MMU). It is the impression of the team that the interpretations at the 25 ha scale should preferably be performed by the national team and not as the default option proposes in a centralized process. In this way both the change layer and the resulting land cover layer will be comparable over time.

The experience of the team is also that some of the developments taking place in the open agricultural landscapes, e.g. the heterogeneous classes 242 and 243 but also pastures, may be so subtle that statistically sound figures require the inclusion of additionally detailed analysis of data of agricultural practices in individual fields.

In parallel with the CLC 2006 change interpretation, two on-going GMES Fast track projects have provided high resolution products of “Soil sealing” and “Forest mask”. The results of these projects have only partly been available to the project and the experience with the soil sealing layer was not very satisfying. The soil sealing layer was intended to provide the percentage of soil sealing, it is, however, not limited to the detection to sealed surfaces but also includes, for instance gravel pits. It is, however, even more serious that roads and tarmac roofs were very heterogeneously detected, see also Stjernholm (2008). The detected surfaces were not classified.

If additional high resolution products derived in semi-automatic processes from satellite imagery are to be included in potential future CLC update projects, focus should probably be more on information products that can support the national teams by providing information related to vegetation dynamics (density and phenology).

## 7 References

EEA documents:

Bossard, M., Feranec, J., Otahel, J. (2000): CORINE Land Cover Technical Guide – Addendum 2000.

<http://www.eea.europa.eu/publications/tech40add>

Büttner, G., Feranec, J., Jaffrain, G. (2002): Corine Land cover update 2000: Technical guideline. Technical report No 89. EEA. Available from:

[http://www.eea.europa.eu/publications/technical\\_report\\_2002\\_89](http://www.eea.europa.eu/publications/technical_report_2002_89)

Büttner, G., Kosztra, B. (2007): CLC2006 Technical guidelines. Technical Report No. 17 / 2007. EEA. Available from

[http://www.eea.europa.eu/publications/technical\\_report\\_2007\\_17](http://www.eea.europa.eu/publications/technical_report_2007_17)

CEC (1994): CORINE Land Cover Technical Guide.

Soukup, T. (2007): Guidelines for CLC2006 delivery.

National documents:

Nord-Larsen, Thomas et al (2008): Skove og Plantager 2006. Skov & Landskab.

[http://www.sl.life.ku.dk/publikationer/udgivelser/populaerpublikationer/skoveogplantager\\_2006.aspx](http://www.sl.life.ku.dk/publikationer/udgivelser/populaerpublikationer/skoveogplantager_2006.aspx)

Stjernholm, M. (2004): I&CLC2000 - CORINE Land Cover update in Denmark -Final report.

[http://www.dmu.dk/NR/rdonlyres/312C568C-610A-4F4D-A4B1-52354D650FB3/0/CLC2000\\_DK\\_FINAL\\_REPORT.pdf](http://www.dmu.dk/NR/rdonlyres/312C568C-610A-4F4D-A4B1-52354D650FB3/0/CLC2000_DK_FINAL_REPORT.pdf)

Stjernholm, M (2008): Quantitative verification of high resolution soil layer for Denmark.

[http://eea.eionet.europa.eu/Members/irc/eionet-circle/spatial/library?l=/clc2005\\_update/resolution\\_sealing/dkdoc\\_2/ EN\\_1.0 &a=d](http://eea.eionet.europa.eu/Members/irc/eionet-circle/spatial/library?l=/clc2005_update/resolution_sealing/dkdoc_2/ EN_1.0 &a=d)

## Annex 1 CLC-changes metadata sheet for Denmark

EEA Field name			ISO Number	EEA Description	Please fill in	M a x
Level 1	Level 2	Level 3				
Metadata on meta-data				Defines the metadata on the dataset		1
	Point of contact			Responsible organisation and individual for the metadata		1
	Organisation name		8.376	Responsible organisation name	National Environmental Research Institute, Aarhus University	1
	Individual name		8.375	Responsible individual name	Mr. Michael Stjernholm	1
	Position name		8.377	The responsible individual role or position in the organisation	Project manager	1
	Role		8.379	Function performed by the responsible organisation	Production	1
	Address: Delivery point		8.378.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
	Address: City		8.378.382	City of the location	Silkeborg	1
	Address: State, Province		8.378.383	State, province of the location		1
	Address: Postal code		8.378.384	Postal code of the location	DK-8600	1
	Address: Country		8.378.385	Country of the location	Denmark	1
	Address: E-mail		8.378.386	The electronic mail address of the responsible organisation or individual	Msh@dmu.dk	1
	Last modified		9	Date of the last modification of the metadata (YYYYMMDD)	20090611	1
	Name of standard		10	Name of metadata standard	EEA-MSGI/ISO19115 (First Edition)	1
Version of standard		11	Version of the metadata standard	EEA-MSGI 1.1	1	
Dataset identification				Basic information required to identify the dataset		1
	Title		15.24.360	Title of the dataset	CHA06_DK	1
	Alternative title		15.24.361	Alternative titles of the dataset	CORINE Land Cover change (2000 -2006) of Denmark; CLC change 2006 Denmark	N
	Brief Abstract		15.EEABriefAbstract	Brief abstract explaining in short the content of the dataset	CORINE Land Cover change (2000- 2006) of Denmark.	1

	Abstract	15.25	An abstract explaining the content of the dataset	The European Environment Agency (EEA) and the Joint Research Centre (JRC) launched the IMAGE&CLC2006 project with 30 participating countries in Europe in order to provide timely and relevant information on land cover to policy makers.  In Denmark the project is co-financed by: - The Ministry of Environment - The European Environment Agency (EEA).	1	
	Keywords	15.33.53	Keywords helping to classify the dataset	CLC2006, CORINE, geographic, land cover change, environment, vector data, Denmark	N	
	Topic category	15.41	A predefined ISO category, see <b>code list 2</b> underneath	010 (imageryBaseMapsEarthCover)	1	
	Dataset version	15.24.363	Version of the dataset	Version 1.	1	
	Reference date	15.24.362.394	Date of last modification to the dataset (YYYYMMDD)	20090610	1	
Reference system			Definition of the reference system used for the dataset		1	
	Name	13.196.207	Name of reference system	UTM/ETRS89	1	
	Datum		Identity of the datum		1	
		Name	13.192.207	Name of datum	ETRS89	1
	Ellipsoid		Identity of the ellipsoid		1	
		Name	13.191.207	Name of ellipsoid	GRS80	1
		Semi-major axis	13.193.202	Radius of the equatorial axis of the ellipsoid	6378137	1
		Axis units	13.193.203	Units of the semi-major axis	Meter	1
		Flattening ratio	13.193.204	Ratio of the difference between the equatorial and polar radii of the ellipsoid to the equatorial radius when the numerator is set to 1	1/298.2572221	1
	Projection		Identity of the projection		1	
		Name	13.190.207	Name of projection	Universal Transverse Mercator	1
		Zone	13.194.216	Unique identifier for grid zone	UTM-32	1
		Standard parallel	13.194.217	Line of constant latitude at which the surface of Earth and the plane or developable surface intersect		1

		Longitude Of Central Meridian	13.194.218	Line of longitude at the centre of a map projection generally used as the basis for constructing the projection	9° East	1
		Latitude of projection origin	13.194.219	Latitude chosen as the origin of rectangular coordinates for a map projection	0°	1
		False easting	13.194.220	Value added to all "x" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in planar coordinate units	500000	1
		False northing	13.194.221	Value added to all "y" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in planar coordinate units		1
		False easting northing units	13.194.222	Units of false northing and false easting	Meter	1
		Scale factor at equator	13.194.223	Ratio between physical distance and corresponding map distance, along the equator	0,9996	1
		Longitude of projection centre	13.194.224	Longitude of the point of projection for azimuthal projections	9° East	1
		Latitude of projection centre	13.194.225	Latitude of the point of projection for azimuthal projections		1
Distribution information				Information about the distributors of the dataset		1
	Owner 1			Information about the owner organisation		N
		Organisation name	15.29.376	Name of the owner organisation	European Environment Agency	1
		Individual name	15.29.375	Name contact person in the owner organisation	Stefan Jensen	1
		Position name	15.29.377	Position of the contact person in the owner organisation	Project manager	1
		Role	15.29.379	Always "Owner" role	owner	1
Address: Delivery point	15.29.378.389.381	Address line for the location	Kongens Nytorv 6	1		

	Address: City	15.29.378.389.382	City of the location	Copenhagen	1
	Address: State, Province	15.29.378.389.383	State, province of the location	K	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	1050	1
	Address: Country	15.29.378.389.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual	eea@eea.eu.int	1
			Information about the distributors of the dataset		
Owner 2			Information about the owner organisation		
	Organisation name	15.29.376	Name of the owner organisation	Ministry of Environment (Denmark)	
	Individual name	15.29.375	Name contact person in the owner organisation		
	Position name	15.29.377	Position of the contact person in the owner organisation		
	Role	15.29.379	Always "Owner" role	owner	
	Address: Delivery point	15.29.378.389.381	Address line for the location	Højbro Plads 4	
	Address: City	15.29.378.389.382	City of the location	Copenhagen K	
	Address: State, Province	15.29.378.389.383	State, province of the location	-	
	Address: Postal code	15.29.378.389.384	Postal code of the location	1200	
	Address: Country	15.29.378.389.385	Country of the location	Denmark	
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual		
				Information about the owner organisation	
Owner 3	Organisation name	15.29.376	Name of the owner organisation	National Environmental Research Institute, Aarhus University	1
	Individual name	15.29.375	Name contact person in the owner organisation	Michael Stjernholm	1
	Position name	15.29.377	Position of the contact person in the owner organisation	Project leader	1
	Role	15.29.379	Always "Owner" role	owner	1
	Address: Delivery point	15.29.378.389.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
	Address: City	15.29.378.389.382	City of the location	Silkeborg	1

	Address: State, Province	15.29.378.389.383	State, province of the location	-	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	8600	1
	Address: Country	15.29.378.389.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual	msh@dmu.dk	1
			The technical producer or processor of the data		1
Processor	Organisation name	15.29.376	Name of the processor organisation	National Environmental Research Institute, Aarhus University	N
	Individual name	15.29.375	Name contact person in the processor organisation	Michael Stjernholm	1
	Position name	15.29.377	Position of the contact person in the processor organisation	Project leader	1
	Role	15.29.379	Always "Processor" role	processor	1
	Address: Delivery point	15.29.378.389.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
	Address: City	15.29.378.389.382	City of the location	Silkeborg	1
	Address: State, Province	15.29.378.389.383	State, province of the location	-	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	8600	1
	Address: Country	15.29.378.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the processor organisation or individual	msh@dmu.dk	1
				The organisation distributing the data	1
Distributor	Organisation name	15.29.376	Name of the distributor organisation	European Environment Agency	N
	Individual name	15.29.375	Name contact person in the distribution organisation		1
	Position name	15.29.377	Position of the contact person in the distributor organisation		1
	Role	15.29.379	Always "Distributor" role		1
	Address: Delivery point	15.29.378.389.382	Address line for the location	<a href="http://dataservice.eea.europa.eu/dataservice">http://dataservice.eea.europa.eu/dataservice</a>	1
	Address: City	15.29.378.389.383	City of the location		1
	Address: State, Province	15.29.378.389.384	State, province of the location		1

		Address: Postal code	15.29.378.385	Postal code of the location		1
		Address: Country	15.29.378.389.386	Country of the location		1
		Address: E-mail	15.29.378.389.382	The electronic mail address of the distributor organisation or individual	eea@eea.europa.eu	1
				Defines access rights for the dataset		1
	Access rights	Type of constraint	20.70	The type of access right applied to assure the protection of privacy or intellectual property, and any special restriction or limitations on obtaining the resource. See <b>code list 1</b> .	005 (licence)	N
		Restriction	20.72	Description of the restriction of the access right.	Described in the Agreement between EEA and Member State on a common policy for the use and the dissemination of I&CLC2006 products: "Use and dissemination of I&CLC2006 products"	1
			Other aspects explaining the dataset		1	1
Other dataset information		15.39	Language used within the dataset	EN	1	
	Language	15.32.285	Name of the used exchange format for the dataset	ESRI Personal Geodatabase	1	
	Format name	15.32.286	Version of the used exchange format for the dataset	-	1	
	Format version	18.81.83	General explanation of the data producer's knowledge about how the geometry was constructed/derived and how the attribute information being part of the dataset was generated.	CLC2006 for Denmark has been produced by a process slightly deviating from the standard CORINE methodology. The CLC2000 product of CORINE Land Cover 2000 has been used as the starting point. On the basis of Image2000 and Image 2006 changes between image material and vector representation has been interpreted. Where interpreted differences were due to mistakes in original CLC_00 revisions have been made. Where real changes in land cover had taken place both the "true" change" in 5 ha perspective (CHA-06) and change in 25 ha perspective (CLC-06) was interpreted.  Reference to standard guidelines: George Büttner and Barbara Kosztra., 2007. CLC2006, Technical Guidelines, EEA Technical Report No. 17 / 2007 <a href="http://www.eea.europa.eu/publications/technical_report_2007_17">http://www.eea.europa.eu/publications/technical_report_2007_17</a> ,	1	

Methodology description		18.EEACHanges	Description of the changes since last version of the dataset	-	1
Changes				Information about the event in the creation process of the dataset	
Process steps	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step1: Visual interpretation of CLC2000 database displayed on IMAGE2000 and Image2006. Direct delineation of changes. Software used: ArcView 3.1	N
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	IMAGE2000 data: Ortho-corrected Landsat ETM imagery. Pixelsize: 25 m; Date range: 11/7-1999 – 9/5-2001.	1
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		N
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	IMAGE2006 data: A composite of IRS, Spot-4 and SPOT-5 data with minimum two different acquisitions. Pixelsize 20 m Date range: 25/4-2005 – 26/9 2006 (spring and autumn data)	N
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	Rasterized topographic maps in scale 1:25.000 Revised in 5 year cycles. Versions used 1999 and 2007	
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step2: Internal verification (Technical&thematic)	
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step3: External verification by the CLC2006 Technical Team	
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step4: Merging of adjacent map sheets	

		15.38.60.57	Gives a rough value of accuracy of the dataset; e.g. 2500000 means dataset has an accuracy suitable for use at scale 1:2.5 million at best	100.000		1	
Scale		15.38.61	Geographic accuracy of location, ground distance as an value in meters		100		1
Geographic accuracy					Geographic position bounding box of the dataset		
Geographic box	West bound longitude	15.42.336.344	Western-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)		7,79		1
	East bound longitude	15.42.336.345	Eastern-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)		57,86		1
	South bound latitude	15.42.336.346	Southern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)		54,46		1
	North bound latitude	15.42.336.347	Northern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)		15,38		1
							1

## Annex 2 CLC2006 metadata sheet for Denmark

EEA Field name			ISO Number	EEA Description	Please fill in	M a x
Level 1	Level 2	Level 3				
Metadata on meta-data				Defines the metadata on the dataset		1
	Point of contact			Responsible organisation and individual for the metadata		1
		Organisation name	8.376	Responsible organisation name	National Environmental Research Institute, Aarhus University	1
		Individual name	8.375	Responsible individual name	Mr. Michael Stjernholm	1
		Position name	8.377	The responsible individual role or position in the organisation	Project manager	1
		Role	8.379	Function performed by the responsible organisation	Production	1
		Address: Delivery point	8.378.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
		Address: City	8.378.382	City of the location	Silkeborg	1
		Address: State, Province	8.378.383	State, province of the location		1
		Address: Postal code	8.378.384	Postal code of the location	DK-8600	1
		Address: Country	8.378.385	Country of the location	Denmark	1
		Address: E-mail	8.378.386	The electronic mail address of the responsible organisation or individual	Msh@dmu.dk	1
		Last modified	9	Date of the last modification of the metadata (YYYYMMDD)	20090611	1
		Name of standard	10	Name of metadata standard	EEA-MSGI/ISO19115 (First Edition)	1
	Version of standard	11	Version of the metadata standard	EEA-MSGI 1.1	1	
Dataset identification				Basic information required to identify the dataset		1
		Title	15.24.360	Title of the dataset	CLC06_DK	1
		Alternative title	15.24.361	Alternative titles of the dataset	CORINE Land Cover 2006 of Denmark; CLC 2006 Denmark	N
		Brief Abstract	15.EEABriefAbstract	Brief abstract explaining in short the content of the dataset	CORINE Land Cover 2006 of Denmark.	1

	Abstract	15.25	An abstract explaining the content of the dataset	The European Environment Agency (EEA) and the Joint Research Centre (JRC) launched the IMAGE&CLC2006 project with 30 participating countries in Europe in order to provide timely and relevant information on land cover to policy makers.  In Denmark the project is co-financed by: - The Ministry of Environment - The European Environment Agency (EEA).	1
	Keywords	15.33.53	Keywords helping to classify the dataset	CLC2006 CORINE, geographic, land cover, environment, vector data, Denmark	N
	Topic category	15.41	A predefined ISO category, see <b>code list 2</b> underneath	010 (imageryBaseMapsEarthCover)	1
	Dataset version	15.24.363	Version of the dataset	Version 1.	1
	Reference date	15.24.362.394	Date of last modification to the dataset (YYYYMMDD)	20090610	1
Refer- ence system			Definition of the reference system used for the dataset		1
	Name	13.196.207	Name of reference system	UTM/ETRS89	1
	Datum		Identity of the datum		1
	Name	13.192.207	Name of datum	ETRS89	1
	Ellipsoid		Identity of the ellipsoid		1
	Name	13.191.207	Name of ellipsoid	GRS80	1
	Semi-major axis	13.193.202	Radius of the equatorial axis of the ellipsoid	6378137	1
	Axis units	13.193.203	Units of the semi-major axis	Meter	1
	Flattening ratio	13.193.204	Ratio of the difference between the equatorial and polar radii of the ellipsoid to the equatorial radius when the numerator is set to 1	1/298.2572221	1
	Projection		Identity of the projection		1
	Name	13.190.207	Name of projection	Universal Transverse Mercator	1
	Zone	13.194.216	Unique identifier for grid zone	UTM-32	1
Standard parallel	13.194.217	Line of constant latitude at which the surface of Earth and the plane or developable surface intersect		1	

		Longitude Of Central Meridian	13.194.218	Line of longitude at the centre of a map projection generally used as the basis for constructing the projection	9° East	1
		Latitude of projection origin	13.194.219	Latitude chosen as the origin of rectangular coordinates for a map projection	0°	1
		False easting	13.194.220	Value added to all "x" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in planar coordinate units	500000	1
		False northing	13.194.221	Value added to all "y" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in planar coordinate units		1
		False easting northing units	13.194.222	Units of false northing and false easting	Meter	1
		Scale factor at equator	13.194.223	Ratio between physical distance and corresponding map distance, along the equator	0,9996	1
		Longitude of projection centre	13.194.224	Longitude of the point of projection for azimuthal projections	9° East	1
		Latitude of projection centre	13.194.225	Latitude of the point of projection for azimuthal projections		1
Distribution information				Information about the distributors of the dataset		1
	Owner 1			Information about the owner organisation		N
		Organisation name	15.29.376	Name of the owner organisation	European Environment Agency	1
		Individual name	15.29.375	Name contact person in the owner organisation	Stefan Jensen	1
		Position name	15.29.377	Position of the contact person in the owner organisation	Project manager	1
		Role	15.29.379	Always "Owner" role	owner	1
Address: Delivery point	15.29.378.389.381	Address line for the location	Kongens Nytorv 6	1		

	Address: City	15.29.378.389.382	City of the location	Copenhagen	1
	Address: State, Province	15.29.378.389.383	State, province of the location	K	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	1050	1
	Address: Country	15.29.378.389.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual	eea@eea.eu.int	1
			Information about the distributors of the dataset		
Owner 2			Information about the owner organisation		
	Organisation name	15.29.376	Name of the owner organisation	Ministry of Environment (Denmark)	
	Individual name	15.29.375	Name contact person in the owner organisation		
	Position name	15.29.377	Position of the contact person in the owner organisation		
	Role	15.29.379	Always "Owner" role	owner	
	Address: Delivery point	15.29.378.389.381	Address line for the location	Højbro Plads 4	
	Address: City	15.29.378.389.382	City of the location	Copenhagen K	
	Address: State, Province	15.29.378.389.383	State, province of the location	-	
	Address: Postal code	15.29.378.389.384	Postal code of the location	1200	
	Address: Country	15.29.378.389.385	Country of the location	Denmark	
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual		
			Information about the owner organisation		
Owner 3	Organisation name	15.29.376	Name of the owner organisation	National Environmental Research Institute, Aarhus University	1
	Individual name	15.29.375	Name contact person in the owner organisation	Michael Stjernholm	1
	Position name	15.29.377	Position of the contact person in the owner organisation	Academic associate	1
	Role	15.29.379	Always "Owner" role	owner	1
	Address: Delivery point	15.29.378.389.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
	Address: City	15.29.378.389.382	City of the location	Silkeborg	1

	Address: State, Province	15.29.378.389.383	State, province of the location	-	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	8600	1
	Address: Country	15.29.378.389.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the owner organisation or individual	msh@dmu.dk	1
			The technical producer or processor of the data		1
Processor	Organisation name	15.29.376	Name of the processor organisation	National Environmental Research Institute, Aarhus University	N
	Individual name	15.29.375	Name contact person in the processor organisation	Michael Stjernholm	1
	Position name	15.29.377	Position of the contact person in the processor organisation	Projectleader	1
	Role	15.29.379	Always "Processor" role	processor	1
	Address: Delivery point	15.29.378.389.381	Address line for the location	Vejlsøvej 25, Postbox 314	1
	Address: City	15.29.378.389.382	City of the location	Silkeborg	1
	Address: State, Province	15.29.378.389.383	State, province of the location	-	1
	Address: Postal code	15.29.378.389.384	Postal code of the location	8600	1
	Address: Country	15.29.378.385	Country of the location	Denmark	1
	Address: E-mail	15.29.378.389.386	The electronic mail address of the processor organisation or individual	msh@dmu.dk	1
				The organisation distributing the data	1
Distributor	Organisation name	15.29.376	Name of the distributor organisation	European Environment Agency	N
	Individual name	15.29.375	Name contact person in the distribution organisation		1
	Position name	15.29.377	Position of the contact person in the distributor organisation		1
	Role	15.29.379	Always "Distributor" role		1
	Address: Delivery point	15.29.378.389.382	Address line for the location	<a href="http://dataservice.eea.europa.eu/dataservice">http://dataservice.eea.europa.eu/dataservice</a>	1
	Address: City	15.29.378.389.383	City of the location		1
	Address: State, Province	15.29.378.389.384	State, province of the location		1

		Address: Postal code	15.29.378.385	Postal code of the location		1
		Address: Country	15.29.378.389.386	Country of the location		1
		Address: E-mail	15.29.378.389.382	The electronic mail address of the distributor organisation or individual	eea@eea.europa.eu	1
				Defines access rights for the dataset		1
	Access rights	Type of constraint	20.70	The type of access right applied to assure the protection of privacy or intellectual property, and any special restriction or limitations on obtaining the resource. See <b>code list 1</b> .	005 (licence)	N
		Restriction	20.72	Description of the restriction of the access right.	Described in the Agreement between EEA and Member State on a common policy for the use and the dissemination of I&CLC2006 products: "Use and dissemination of I&CLC2006 products"	1
			Other aspects explaining the dataset		1	1
Other dataset information		15.39	Language used within the dataset	EN	1	
	Language	15.32.285	Name of the used exchange format for the dataset	ESRI Personal Geodatabase	1	
	Format name	15.32.286	Version of the used exchange format for the dataset	-	1	
	Format version	18.81.83	General explanation of the data producer's knowledge about how the geometry was constructed/derived and how the attribute information being part of the dataset was generated.	CLC2006 for Denmark has been produced by a process slightly deviating from the standard CORINE methodology. The CLC2000 product of CORINE Land Cover 2000 has been used as the starting point. On the basis of Image2000 and Image 2006 changes between image material and vector representation has been interpreted. Where interpreted differences were due to mistakes in CLC_00 revisions have been made. Where real changes in land cover had taken place both the "true" change" in 5 ha perspective (CHA-06) and change in 25 ha perspective (CLC-06) was interpreted.  Reference to standard guidelines: George Büttner and Barbara Kosztra., 2007. CLC2006, Technical Guidelines, EEA Technical Report No. 17 / 2007 <a href="http://www.eea.europa.eu/publications/technical_report_2007_17">http://www.eea.europa.eu/publications/technical_report_2007_17</a> ,	1	

Methodology description		18.EEACHanges	Description of the changes since last version of the dataset	-	1
Changes				Information about the event in the creation process of the dataset	
Process steps	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step1: Visual interpretation of CLC2000 database displayed on IMAGE2000 and Image2006. Direct delineation of changes. Software used: ArcView 3.1	N
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	IMAGE2000 data: Ortho-corrected Landsat ETM imagery. Pixelsize: 25 m; Date range: 11/7-1999 – 9/5-2001.	1
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		N
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	IMAGE2006 data: A composite of IRS, Spot-4 and SPOT-5 data with minimum two different acquisitions. Pixelsize 20 m Date range: 25/4-2005 – 26/9 2006 (spring and autumn data)	N
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		
	Source data reference title	18.81.84.91.360	Name of the resource used in process step	Rasterized topographic maps in scale 1:25.000 Revised in 5 year cycles. Versions used 1999 and 2007	
	Source data reference date	18.81.84.91.362	Date of the resource used in process step		
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step2: Internal verification (Technical&thematic)	
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step3: External verification by the CLC2006 Technical Team	
	Description	18.81.84.87	Description of the process step including related parameters or tolerance	Step4: Merging of adjacent map sheets	

		15.38.60.57	Gives a rough value of accuracy of the dataset; e.g. 2500000 means dataset has an accuracy suitable for use at scale 1:2.5 million at best	100.000		1	
Scale		15.38.61	Geographic accuracy of location, ground distance as an value in meters	100			1
Geographic accuracy				Geographic position bounding box of the dataset			
Geographic box	West bound longitude	15.42.336.344	Western-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	7,79			1
	East bound longitude	15.42.336.345	Eastern-most coordinate of the limit of the dataset extent, expressed in longitude in decimal degrees (positive east)	57,86			1
	South bound latitude	15.42.336.346	Southern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)	54,46			1
	North bound latitude	15.42.336.347	Northern-most coordinate of the limit of the dataset extent, expressed in latitude in decimal degrees (positive north)	15,38			1
							1

## **NERI National Environmental Research Institute**

DMU Danmarks Miljøundersøgelser

National Environmental Research Institute, NERI, is a part of Aarhus University.

NERI undertakes research, monitoring and consultancy within environment and nature.

At NERI's website [www.neri.dk](http://www.neri.dk) you'll find information regarding ongoing research and development projects.

Furthermore the website contains a database of publications including scientific articles, reports, conference contributions etc. produced by NERI staff members.

Further information: [www.neri.dk](http://www.neri.dk)

National Environmental Research Institute  
Frederiksborgvej 399  
PO Box 358  
DK-4000 Roskilde  
Denmark  
Tel: +45 4630 1200  
Fax: +45 4630 1114

Management  
Department of Arctic Environment  
Department of Atmospheric Environment\*  
Department of Environmental Chemistry and Microbiology  
Department of Marine Ecology\*  
Department of Policy Analysis

National Environmental Research Institute  
Vejlsovej 25  
PO Box 314  
DK-8600 Silkeborg  
Denmark  
Tel: +45 8920 1400  
Fax: +45 8920 1414

Department of Freshwater Ecology  
Department of Marine Ecology  
Department of Terrestrial Ecology

National Environmental Research Institute  
Grenåvej 14, Kalø  
DK-8410 Rønne  
Denmark  
Tel: +45 8920 1700  
Fax: +45 8920 1514

Department of Policy Analysis  
Department of Wildlife Ecology and Biodiversity

\* Department's main address

## CORINE LAND COVER 2006

Final report on interpretation of CLC2006 in Denmark

CLC2006 is a joint European project aimed at mapping the Changes in Land Cover (CLC) from 2000 to 2006 according to the CORINE land cover nomenclature and methodology. The report describes the process and results of the interpretation of Denmark.