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NORWEGIAN FOREST AND LANDSCAPE INSTITUTE

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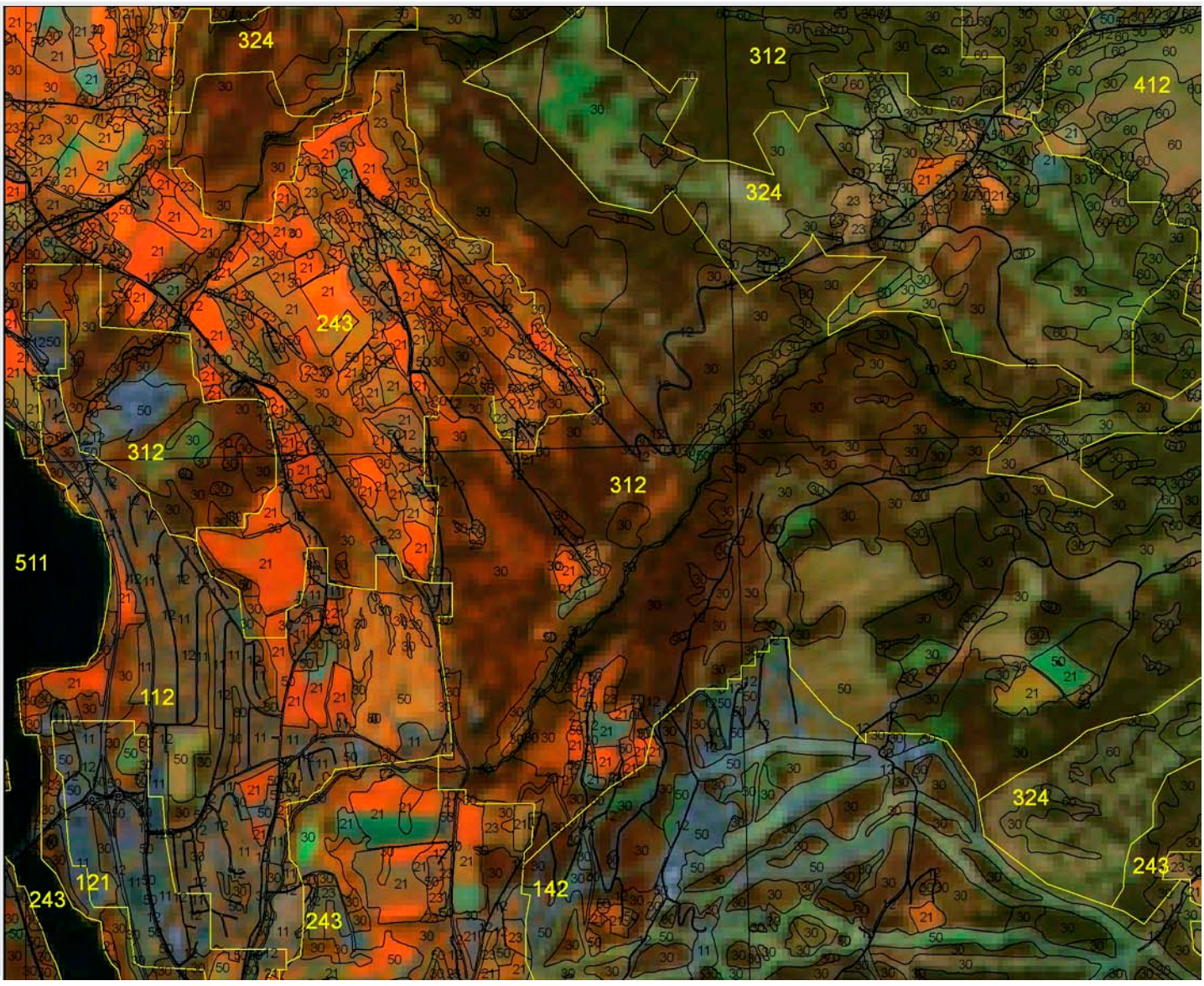
Examination of the content of CLC classes in Norway

Linda Aune-Lundberg and Geir-Harald Strand



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Øyer, Oppland County. Corine Land Cover classification (yellow) and AR5 (black) superimposed on satellite image Ir_06_1026_11jun06 (includes material © ANTRIX Corporation Limited 2007, Distribution by Euromap GmbH, Germany, all rights reserved; produced by DLR/Metria – data provided under an ESA contract for FTS LM IMAGE2006)

Norsk institutt for skog og landskap, Pb 115, NO-1431 Ås

SAMMENDRAG

Alle norske CLC2006 klasser er dokumentert gjennom beskrivende statistiske ”profiler” av det faktiske innholdet i hver klasse. Hver enkelt CLC2006 profil er utarbeidet på grunnlag av en ”overlay” operasjon mellom CLC2006 og AR5 (under tregrensa) og AR50 (over tregrensa). Ut fra dette datasettet er statistikk generert som viser prosentvis fordeling av AR5 og AR50 klasser innenfor hver CLC2006 klasse.

Undersøkelsen er gjennomført med økonomisk støtte fra Norsk Romsenter.

SUMMARY

All the Norwegian CLC2006 classes are documented through descriptive statistical “profiles” of the actual contents in each class. The CLC2006 profiles are worked through based on an overlay operation between CLC2006 and AR5 (under the timberline) and AR50 (above the timberline). Based on this dataset statistics are generated, that shows the percent distribution of AR5 and AR50 classes in each CLC2006 class.

The study was carried out with funding from the Norwegian Space Centre.

Nøkkelord: CLC2006, Norge, arealressurskart, arealstatistikk,

Key words: CLC2006, Norway, land cover maps, land resources,

:

CONTENT

1 INTRODUCTION

The CORINE (Coordination of information on the environment) program was started by the European Environment Agency (EEA) in 1985. The purpose was to establish an information system for reporting and monitoring of the environment (CLC 1994). Land cover information was introduced with the CORINE land cover (CLC) dataset for reference year 1990. The CLC database has been updated twice (CLC2000 and CLC2006) since the first edition, and CLC2000 (Büttner et al 2002) is now implemented in all EU countries, most of the Central and Eastern European countries, as well as in Norway and Iceland (EEA 2007). The same hierarchical (three levels) classification system is used throughout the whole Europe. The CORINE land cover maps are in general manually or semi automatically digitized from satellite images (IMAGE1990, IMAGE2000 and IMAGE2006) (Bossard et.al. 2000). The CORINE land cover maps are meant to reflect the land use in the years around 1990, 2000 and 2006.

Norway completed CLC2000 anno 2008 and CLC2006 by the end of 2009. CLC2000 was produced by automatic generalization of existing high-resolution national land cover datasets supplemented with input from topographic maps and various public databases. CLC2006 was compiled by interpretation of satellite images combined with CLC2000, assisted by information from the national register of buildings

CLC is not a detailed land cover dataset. The smallest mapping units are 25 hectare. The definition of the classes is not always precise. The objective of this report is to provide a more detailed documentation of the content of the CLC classes in the Norwegian CLC dataset. The approach is to provide a statistical description of each CLC class, obtained from an overlay between the CLC2006 dataset and the more detailed Norwegian land cover databases AR5 (below the tree line) and AR50 (above the tree line).

The results show good overall correspondence between the CLC2006 dataset and the actual content of the CLC classes. This is also to be expected, since the reference data sets were the primary input to the CLC2000 production, and CLC2006 is an update of CLC2000. Still, the results also show that CLC is the product of a generalization process where details are hidden and the broader trends are emphasized. As such, it does give a good general, cartographic overview of land cover distribution in Norway but it is an inadequate source for land cover statistics at the national and sub-national scale.

The advantage of CLC is that it is implementing a common nomenclature throughout Europe, thus allowing studies and analysis to be carried out on a continental level. In order to do this, it is important that the CLC classes are understood and used in a similar way in all the national CLC projects. The purpose of the present study is to present a more detailed description of the actual content of the CLC classes as they are used in the Norwegian CLC project.

The study was carried out with funding from the Norwegian Space Centre.

2 MATERIALS AND METHODS

Two different datasets were used in the study. AR5 was used for all areas covered by this dataset (mostly below the tree line) and AR50 was used for the remaining areas. The two datasets were integrated with CLC2006 through a GIS overlay and the resulting combined dataset provided the source material for a description of the actual content of each CLC class. The description of the CLC classes is therefore also limited to the information available in the reference data sets.

2.1 AR5

AR5 is the Norwegian high resolution land resource database. The details are provided for mapping in scale 1:5 000. The dataset was established by Norwegian Forest and Landscape Institute, in this report referred to as NFLI, 1964 – 2000 (Digitalt markslagskart - DMK) and is now maintained by the local municipal administrations in cooperation with NFLI. AR5 is based on a standardized national classification system with approximately 125 classes. The dataset describes land resources (mainly land cover and productivity) and special attention is given to the capability for agriculture and forest production. AR5 is a national, seamless database, but detailed information about the land resources is only available for the area below the tree line. Substantial areas above the tree line are only mapped as “not classified”.

The minimum mapping unit in AR5 is 0.05 hectare for agricultural areas, transportation network and water bodies; 0.2 hectare for forest, peat bogs and open areas; 0.5 hectare for urban areas and 2.5 hectare for perpetual snow and glaciers. The geometric accuracy for AR5 is 2 meters.

AR5 is continually updated by municipal administrations and priority is given to agricultural- and urban areas. This is an integrated part of the maintenance of the municipal geospatial database. A centralized control and editing program is carried out by NFLI with a five year turnover period.

Below is a short description of the major classes in AR5, used in the verification of CLC2006.

2.1.1 BUILD UP AREAS

Areas mainly covered with artificial surfaces as urban fabric, industrial areas etc. and their neighbouring areas (gardens, remnants of natural vegetation within the urban fabric). Holiday home areas with high density of buildings or substantial alteration of the surrounding environment also belong to this class.

2.1.2 TRANSPORTATION NETWORK

Areas mainly covered by roads and railroads. Notice that the class only is used outside built up areas. Roads (and railroads) within the built up areas are included in the class built up areas.

2.1.3 AGRICULTURAL AREAS

The agricultural area in AR5 is divided into 3 subclasses. The subclasses are used in the CLC profiles describing the CLC agriculture classes (211, 231, 242 and 243).

Table 1: Agricultural classes in AR5

Agricultural class	Definition
Fully cultivated land	Cultivated to normal ploughing depth. Can be used as field or pasture. Normally regenerated by ploughing.
Surface cultivated land	Mostly used as pasture or grass production. Can be harvested with mechanical equipment.
Pasture-land	Can be used as pasture, but can not be harvested with mechanical equipment. More than 50% of the area should be covered with grass or herbs that tolerate grazing.

2.1.4 FOREST

Forest is defined as areas with more than 60 trees per hectare, which are or can be 5 meters tall or higher. The trees should be distributed regularly throughout the area. Four different forest classes are used in the CLC profiles: *Coniferous forest*, *broad leaved forest* and *mixed forest* are represented in both AR5 and AR50. *Mountain forest* is the forest found in AR50 on the areas not covered by AR5.

Table 2: Forest classes in AR5 and AR50

Forest class	Definition
Coniferous forest	More than 50 % covered by coniferous trees
Broad leaved forest	Less than 20 % covered by coniferous trees
Mixed forest	Between 20 – 50 % covered by coniferous trees
Mountain forest	Mainly birch. Dominant three heights around 3 meters. Crown coverage above 10 %.

2.1.5 PEAT BOGS

Areas classified as peat bogs have more than 30 cm thick peat soil. The class also includes forested areas standing on peat soil.

2.1.6 OPEN AREA

The AR5 class *open area* contains areas (below the tree line) with mineral soil, which fall outside the classes' agricultural areas, forest, urban areas or transportation network. The class expands over both natural and artificial land cover, and can also contain shrub land and sparsely forested areas, not reaching the forest standard for productivity (Bjørdal and Bjørkelo 2006).

The *open area* class in AR5 is divided into four subclasses. Two of these classes (*bare rocks* and *boulder field*) describe impediment i.e. non productive areas with no significant vegetation. These two subclasses together with the *not vegetated* class from AR50 (described below) are merged together and called *bare rocks* in the present study.

The remaining two subclasses describe areas with *mineral soil* and *shallow mineral soil* cover. The first class is defined as open areas were more than 50 % of the land has a soil depth thicker than 30 cm. The second subclass consists of open areas **not** classified as *bare rocks* were more than 50 % of the land has soil depth less than 30 cm. Both subclasses can be either natural or artificial and may have vegetation cover (although not forest). Further information requires use of data about property ownership, property usage and buildings.

The two mineral soil classes from AR5 can not be linked to individual AR50 classes describing open areas (defined in table 3 below), since the AR5 classes are based on soil thickness and not the luxuriance of the vegetation. The AR5 classes contain all the gradients of vegetation from barren to vigorous.

The two mineral soil classes from AR5 and the AR50 classes' *sparse vegetation*, *lichen*, *intermediate vegetation* and *vigorous vegetation* (table 3) are therefore merged into a single class, called *vegetated open areas* in some of the CLC profiles under chapter 3.1

2.1.7 WATER

This AR5 class is unspecified and contain all kinds of water surfaces; ocean, inland bodies and inland courses. The water class in AR50 is subdivided into freshwater (including rivers and lakes) and ocean. This subdivision is not used in the CLC profiles, since AR50 only is used above the tree line in this study.

2.2 AR50

AR50 is the Norwegian land resource database for mapping in scale 1:50 000. The dataset has national coverage. The map is based on generalisation from AR5 in areas where AR5 contains information (mainly below the tree line). In areas where AR5 lacks information (mainly above the tree line) AR50 is compiled by merging data from the national topographic map (N50) and the land cover database for mountain areas (AR-FJELL).

The minimum mapping unit in AR50 is 1.5 hectare and the geometric accuracy is 20 meters.

AR-FJELL is a land resource database for the mountains made for mapping in scale 1:50 000. The dataset is based on semi automatic satellite image and contains information about the richness of vegetation in mountains and other open areas. AR-FJELL, as used in AR50, has five classes (table 3).

Table 3: AR-FJELL nomenclature used in AR50

Code	Name	Definition
1	Not vegetated	Areas with more than 75 % of bare soil and gravel, boulder fields or exposed bedrocks
2	Sparse vegetation	Areas with little green substance and low productivity.
3	Lichen	Heath dominated by light-coloured lichen species.
4	Intermediate vegetation	Areas with continuous vegetation with low to intermediate productivity.
5	Vigorous vegetation	Areas with continuous vegetation with high coverage of fresh, green plant materials as bilberry, dwarf birch, salix, grass, herbs and frondage.

The following four classes were added from the national topographic map N50 in order to complete the AR50 coverage of the mountain areas

Table 4: N50 classes used in AR50

Code	Name	Contents
	Snow/Ice	Perpetual snow and ice
	Water	Open inland water, lakes and rivers
	Peat bogs	Peat bogs
	Mountain forest	Mountainous forest omitted in AR5, mainly unproductive (More than 95 % of the area as checked by the National Forest Inventory) but pockets of productive forest can occur.

2.3 Methods

The overlay (intersect) was carried out using Python scripting with geoprocessing tools provided in ArcGIS®. The datasets were all divided into 100x100km^2 tiles (73 in total) due to the very large size of the databases. Two overlays were carried out separately for each tile. First, an overlay between CLC2006 and AR5 was carried out for areas with AR5 coverage (mainly below the tree line). For the remaining areas an overlay was done between CLC2006 and AR50. Finally, the results of all these overlays were merged together, producing a new seamless national dataset with information about CLC class and AR5/AR50 classification. Based on this dataset, statistics were compiled showing the percentage distribution of AR5 and AR50 classes for each CLC class. Table 5 shows which dataset (AR5 or AR50) that was used in order to describe each CLC class.

Table 5: AR product used in the profiles of the different CLC classes

Dataset	CLC class
AR5	111, 112, 121, 122, 123, 124, 131, 132, 133, 141, 211, 242, 243, 324, 331, 334, 411, 421, 423, 523
AR50	321, 322, 332, 333, 335
AR5 below tree line AR50 above tree line	142, 231, 311, 312, 313, 412, 511, 512

3 CLC2006 CLASSES

Corine land cover is, according to EEA, a map suited for the use in scale 1:100 000 to 1:500 000. Our inclination is that even 1:100 000 may be too detailed and that 1:500 000 and smaller scales are most appropriate for CLC. The CLC map is a relevant tool for visualization of the general land cover patterns in Norway and it completes 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.

The classification system is hierarchical with three levels. Level one has five classes, level two 15 classes and level three 44 classes. 31 of the classes on level three are present in Norway. CLC has a minimum mapping unit of 25 hectare. The minimum width of linear elements is 100 meters (except fiords and larger rivers where this minimum width rule does not apply). The nominal location accuracy is 100 meters.

The CLC classification system is common for the whole of Europe. The nomenclature is, as a consequence, not well attuned to the Norwegian environment; witch is dominated by forest and mountain areas and where settlements and agricultural areas are both scant and scattered. As a result, 46.5 % of the land area is divided into only three CLC classes: 322 Moors and heathland; 333 Sparsely vegetated areas and 332 Bare rocks.

Artificial surfaces are described by 11 CLC classes. All these classes are present in Norway, but the total coverage of these classes is only 0.8 % of the total land surface. CLC furthermore operates with 11 classes describing agricultural areas, but only four of these classes are present in the Norwegian CLC2006. The definitions of these four agricultural classes (211 Non-irrigated land; 231 Pastures; 242 Complex cultivation pattern and 243 Land principally occupied by agriculture, with significant areas of natural vegetation) also had to be modified, since the agricultural landscape in Norway differ substantially from that found in many other parts of Europe.

Due to the low resolution of CLC2006, the land cover classes that tend to appear in small patches are often omitted from the maps and included in other dominant classes surrounding them. The result is that the small (and rare) classes are underestimated and the large classes are overestimated. Statistics based on CLC data is therefore biased due to the generalization involved in the production of the dataset.

The description of each CLC class consists of a definition and a comment concerning how the class is understood in the Norwegian context along with an illustrating map, excerpt from a satellite image and a photo of a typical occurrence of the class. The statistical composition of AR5/AR50 classes is presented as a histogram, and a small map inset shows the occurrence of the CLC class throughout Norway. This map uses occurrence in 10X10 km grid cells for the rare classes, and occurrence in 1x1 km grid cells for the more common classes. Examples (CLC.111):

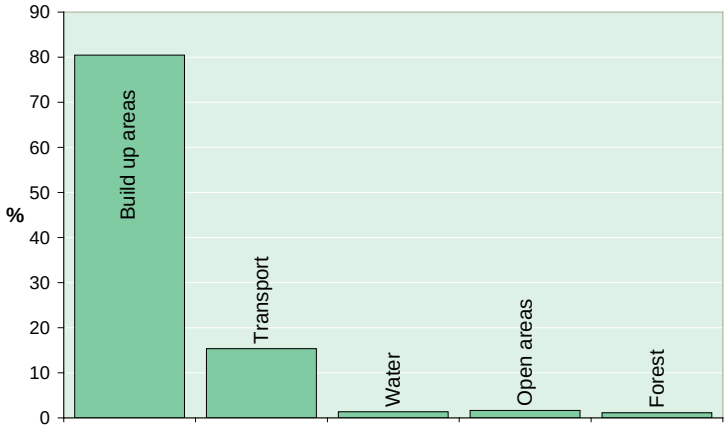


Table 6: The 31 Corine Land Cover classes found in Norway

CLC	Name	CLC	Name
100	**Artificiel surfaces**	**300**	**Forest and semi-natural areas**
110	***Urban fabric***	***310***	***Forest***
111	Continuous urban fabric	311	Broad-leaved forest
112	Discontinuous urban fabric	312	Coniferous forest
120	***Industrial, commercial and transport units***	313	Mixed forest
121	Industrial or commercial units	***320***	***Shrub and/or herbaceous vegetation assosiations***
122	Road and rail network and associated land	322	Moors and heathland
123	Port areas	324	Transitional woodland/shrub
124	Airports	***330***	***Open spaces with little or no vegetation***
130	***Mine, dump and constuctions sites***	331	Beaches, dunes, sands
131	Mineral extraction sites	332	Bare rock
132	Dump sites	333	Sparsely vegetated areas
133	Construction sites	334	Burnt areas
140	***Artificiel non-agricultural vegetaded areas***	335	Glacier and prepetual snow
141	Green urban areas	**400**	**Wetlands**
142	Sport and leisure facilities	***410***	***Inland wetlands***
200	**Agricultural areas**	411	Inland marhes
210	***Arable land***	412	Peatbogs
211	Non-irrigated land	***420***	***Coastal wetlands***
230	***Pastures***	423	Intertidal flats
231	Pastures	**500**	**Water bodies**
240	***Heterogeneous agricultural areas***	***510***	***Inland waters***
242	Complex cultivation pattern	511	Water courses
243	Land principally occupied by agriculture, with significant areas of natural vegetation	512	Water bodies
		520	***Marine waters***
		523	Sea and ocean

3.1 Description of the Norwegian CLC classes

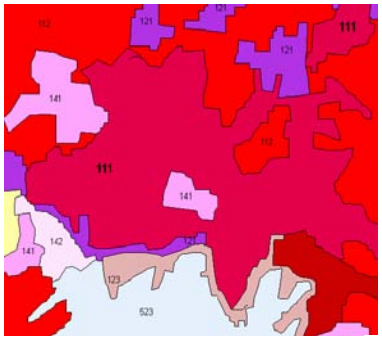
3.1.1 CLC.111 CONTINUOUS URBAN FABRIC

CLC.111 definition:

Most of the land is covered by structure. Buildings, road and artificially surfaced area cover almost all the ground. Non-linear areas of vegetation and bare soil are exceptional.

The class continuous urban fabric is rare in Norway and covers (according to CLC2006) only 0.006% of the total land area. Only small areas in the centre of some of the largest cities (as Oslo, Drammen, Bergen and Stavanger) satisfy the requirements for this CLC class. The reason is partly that Norway is less urban than many other parts of Europe, partly that urban settlements are small. The continuous urban fabric is on a limited scale found in the central part of many cities and larger towns but the extension is usually too small to satisfy the CLC minimal mapping unit of 25 hectare.

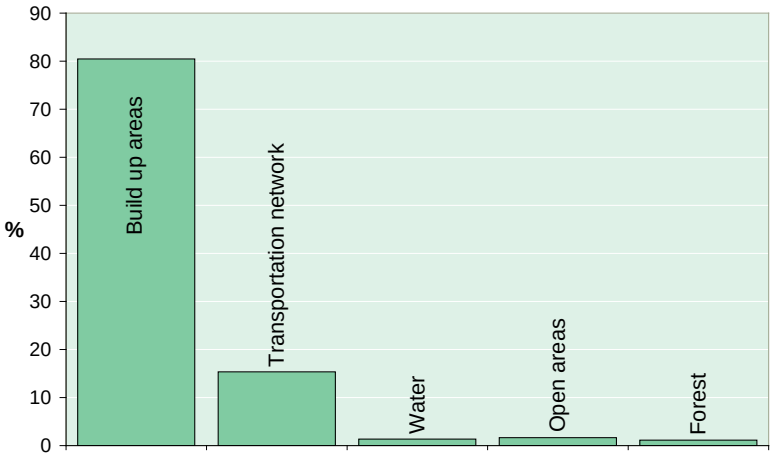
The content is 95.8% built-up land (including roads). The main additional content is open land covered with mineral soil, water and broad-leaved forest.



Figur 1. CLC 2006. Central Oslo

Figur 2. Satellite image in band combination 342. Ir06_15jul06

Figur 3. Central Oslo. Photo: GHS



Figur 4. CLC profile of class 111.

Figur 5. Occurrence of class 111 within 10km x 10km grid.

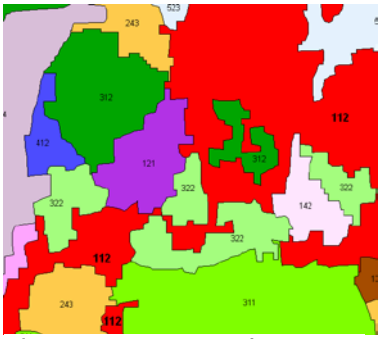
3.1.2 CLC.112 DISCONTINUOUS URBAN FABRIC

CLC.112 definition:

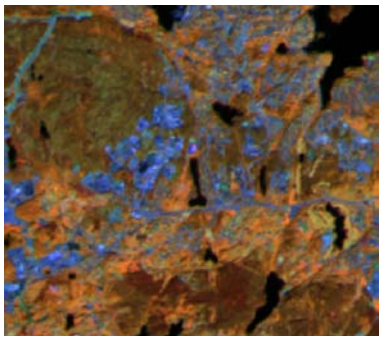
Most of the land is covered by structures. Buildings, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces.

Most of the densely built up areas, cities and larger towns in Norway would belong to this class. The class covers 0.56 % of the land area in CLC2006. The class is most common in the central eastern part of the country, corresponding to the national settlement patterns. Part of the land classified as 112 is also areas of continuous urban fabric too small to be singled out as separate polygons and therefore merged with surrounding discontinuous urban fabric.

The class consists of 65.6% built-up land (including roads). 8.4% is open land covered with mineral soil. Much of this is probably anthropogenic but not sealed. Another 17.1% is forest and 5.5% agricultural land. Norwegian urban settlements rarely have crisp boundaries and the transition into surrounding agricultural land, forest and moors is gradual.

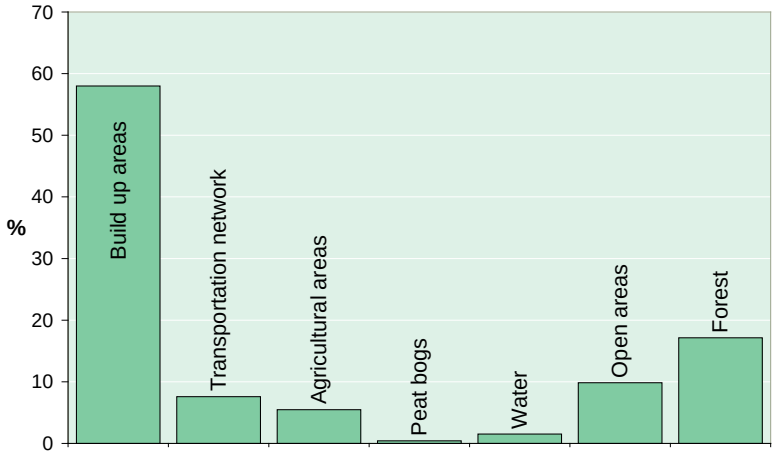


Figur 6. CLC 2006. Øvre Birkeland outside Bergen.



Figur 7. Satellite image in band combination 342. S4_19jul06

Figur 8. Subdivision in Elverum, Hedmark County. Photo: GHS.



Figur 9. CLC profile of class 112.

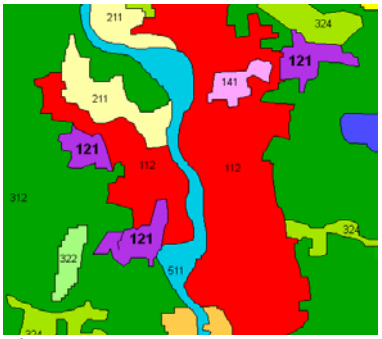
Figur 10. Occurrence of class 112 within 1km x 1km grid.

3.1.3 CLC.121 INDUSTRIAL OR COMMERCIAL UNIT

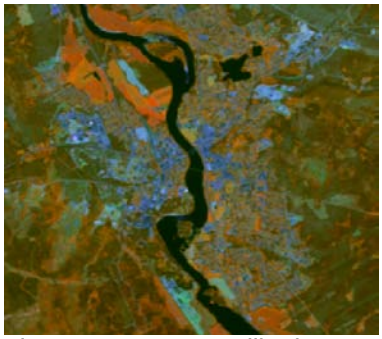
CLC.121 definition:

Artificially surfaced areas (with concrete, asphalt, tamacadam, or stabilised, e.g. beaten earth) devoid of vegetation, occupy most of the area in question, which also contains buildings and/or vegetated areas.

Industrial or commercial units cover 0.06 % of the land area in Norway according to CLC2006. The content is 64.2% built-up land (including roads), 12% forest and 8.4% open areas with mineral soil. Industry and commercial units are not described as a separate class in AR5, but are part of the built up areas. Small units of industrial and commercial land are common in Norway but often too small to be singled out in CLC and will be merged with the surrounding classes, most notably class 112. The "open land" category used in AR5 is used for areas with soil but little or no vegetation. Such areas can be both artificial and natural. Artificial "open land" is often found as storage areas around industrial sites and should in terms of land use be classified along with the industrial area. It is common in smaller towns to establish industrial and commercial development zones where factories, warehouses and shopping malls are interlaced with substantial tracts of forest or other natural land. Since class 121 is given priority over these more common classes, it also becomes overestimated.

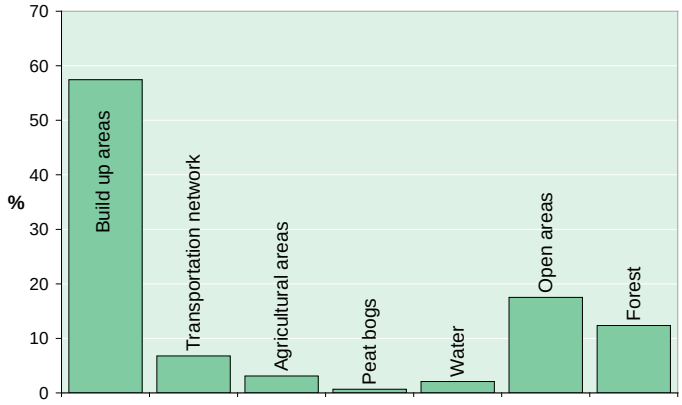


Figur 11. CLC 2006. Elverum in Hedmark County



Figur 12. Satellite image in band combination 342. Ir06_15jul06.

Figur 13. Industrial area, Skedsmo, Akershus County. Photo GHS.



Figur 14. CLC profile of class 121.

Figur 15. Occurrence of class 121 within 1km x 1km grid.

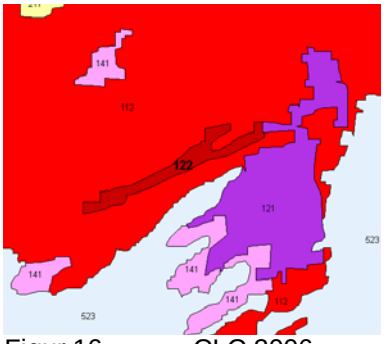
3.1.4 CLC.122 ROAD AND RAIL NETWORKS AND ASSOCIATED LAND

CLC.122 definition:

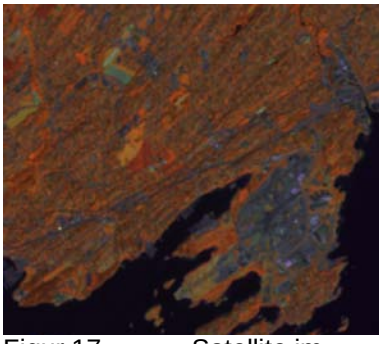
Motorways, railways, including associated installations (stations, platforms, embankments). Minimum width to include: 100 m.

This class is rare in Norway (0.003 % of the land area according to CLC2006) due to the 25 hectare minimum mapping unit and the minimum polygon width of 100 meters Most of the road and rail networks in Norway will be too narrow to be mapped according to these rules. It is possible to get a good estimate of the actual area belonging to this class by using the national road database. This exercise has been done by Statistics Norway who estimated that 2100 km^2 (0.64 % of the land area) was sealed by roads and other transportation network in Norway in 2005 (Riksrevisjonen 2007).

The land that is mapped to this class consists of 45 % built up areas, 13 % road and railroad networks, 7.8 % agricultural land, 18.8% forest and 14.5% open areas with mineral soil.

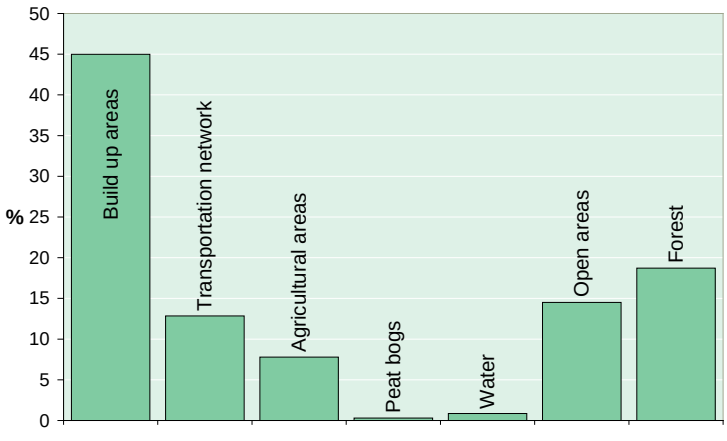


Figur 16. CLC 2006. E18 near Fornebu

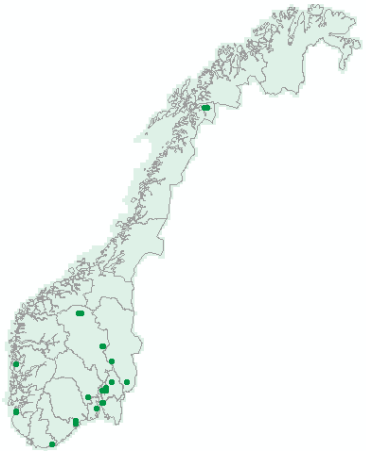


Figur 17. Satellite image in band combination 342. Ir06_15jul06.

Figur 18. E18, Fillipstad in Oslo. Photo: GHS.



Figur 19. CLC profile of class 122.



Figur 20. Occurrence of class 122 within 10km x 10km grid.

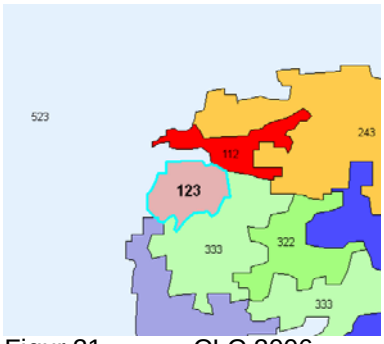
3.1.5 CLC.123 PORT AREAS

CLC.123 definition:

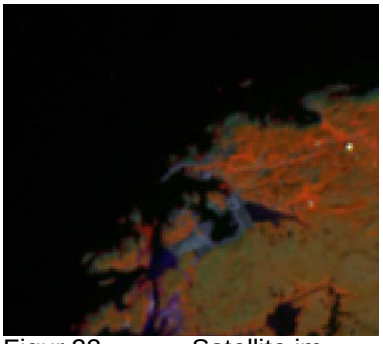
Infrastructure of port areas, including quays, dockyards and marinas.

Ports cover 0.003 % of the total land area in CLC2006. Port areas are not shown as a separate class in AR5, but will be found as a mixture of built up areas, transport network and open areas. The open areas included in CLC class 123 will partly be artificial open land, as in class 121, but partly also natural open land as found on the exposed areas along the Norwegian coast with little or no vegetation on the shoreline.

The content is 78.5% built-up land (including roads), 9.7% open areas with mineral soil and 9.5% water. The water is obviously a result of the generalization process.

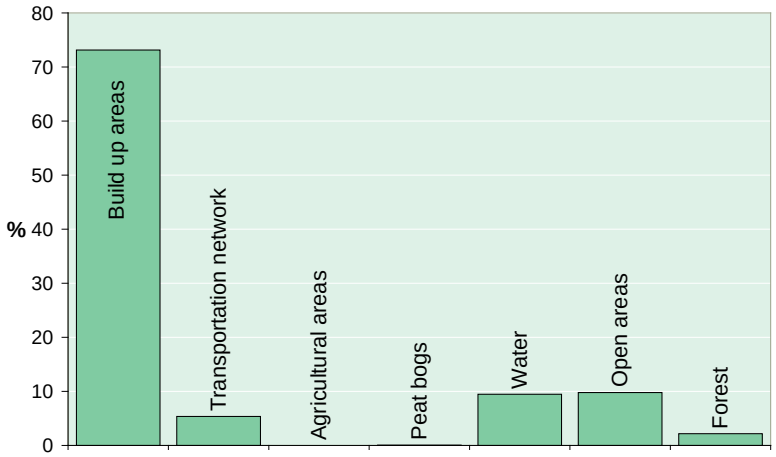


Figur 21. CLC 2006. Laukvika in Vesterålen. Nordland County.

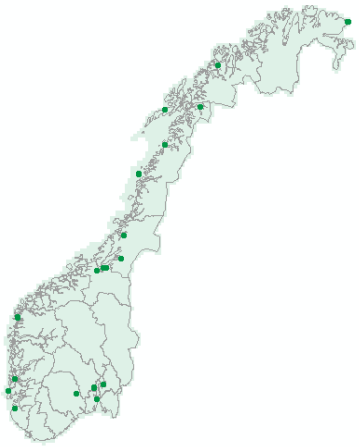


Figur 22. Satellite image in band combination 342. Ir06_30jun05.

Figur 23. Port area, Fillipstad in Oslo. Photo: GHS.



Figur 24. CLC profile of class 123.



Figur 25. Occurrence of class 123 within 10km x 10km grid.

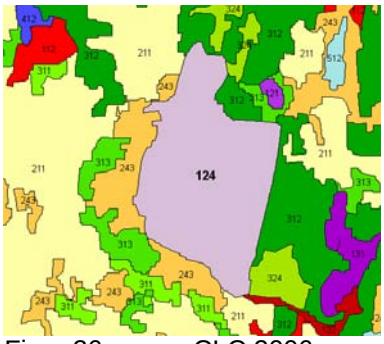
3.1.6 CLC.124 AIRPORTS

CLC.124 definition:

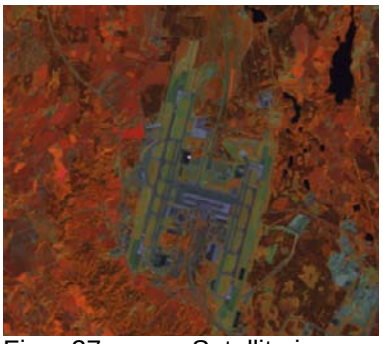
Airport installations: runways, buildings and associated land.

Airports cover 0.02 % of the land area in CLC2006. Small commercial airfields are found in many parts of Norway due to the remoteness of small communities, especially in the far north. The content is 32.7% open areas with mineral soil and 32.4% built-up land (including roads). There is also 15.1% agricultural land and 12% forest land in this class.

The high percentage of open areas probably has two different causes. Partly, grassland around runways will be mapped as open area in AR5. Furthermore, the airfields are often located close to the coast which probably adds scantly vegetated coastal land to increase the amount of open areas in this class.

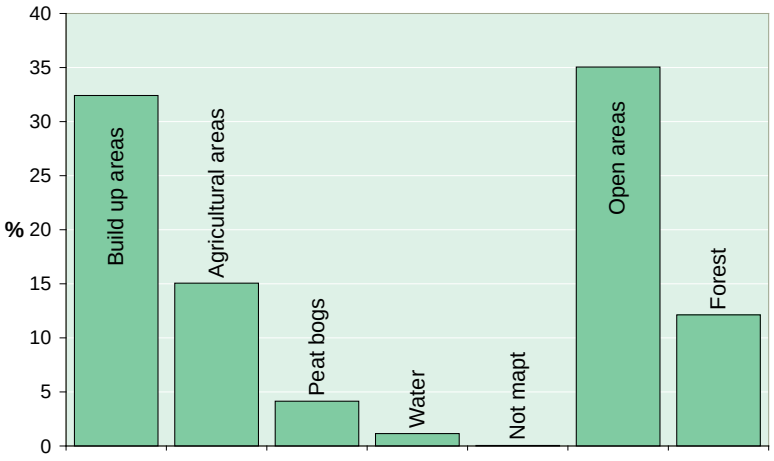


Figur 26. CLC 2006. Gardermoen



Figur 27. Satellite image in band combination 342. Ir06_15jul06.

Figur 28. Værnes airport, Nord-Trøndelag County. Photo: Norge i bilder ®



Figur 29. CLC profile of class 124.

Figur 30. Occurrence of class 124 within 1km x 1km grid.

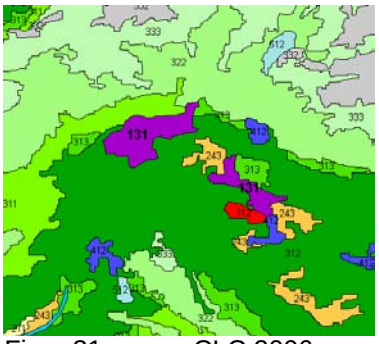
3.1.7 CLC.131 MINERAL EXTRACTION SITES

CLC.131 definition:

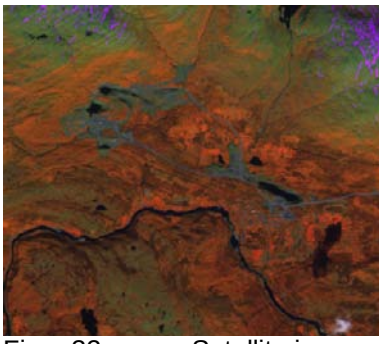
Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (opencast mines). Includes flooded gravel pits, except for river-bed extraction.

Mineral extraction sites class covers 0.02 % of the land area in CLC2006. The class is not singled out in AR5 but will be shown as built-up areas (where the ground is covered by significant constructions), open areas (where the ground is bare but vegetation can be established as in gravel pits) and bare rock (quarries and open pit mines). The fact that 66.8% of the land assigned to this class fall into these three categories shows us that the classification probably is quite correct, but we don't know to what extent sites have been omitted from the class.

The class content is 42.2% open areas with mineral soil, 22.2% forest (probably around sand pits as in the photo below, figure 33), 18.9 % bare rock and 5.7% built-up land (including roads).

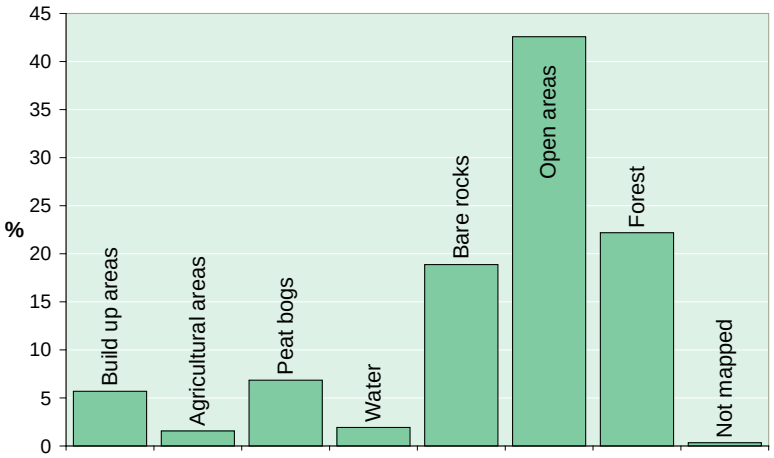


Figur 31. CLC 2006. Storforshei, Rana. Nordland County.

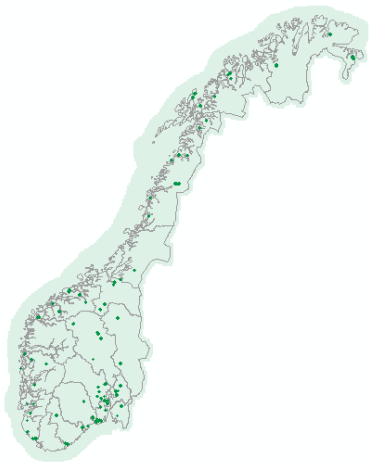


Figur 32. Satellite image in band combination 342. Ir06_30jun06.

Figur 33. Mineral extraction site in Elverum, Hedmark County. Photo: GHS.



Figur 34. CLC profile of class 131.



Figur 35. Occurrence of class 131 within 1km x 1km grid.

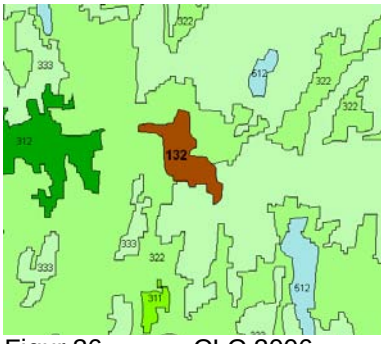
3.1.8 CLC.132 DUMP SITES

CLC.132 definition:

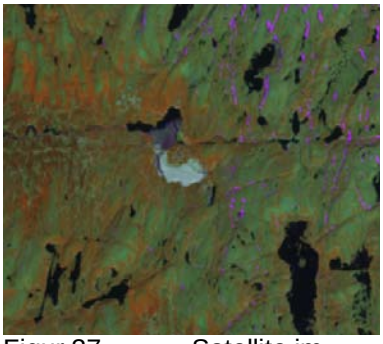
Landfill or mine dump sites, industrial or public.

Dump sites covers 0.001 % of the land area in CLC2006. The class is underestimated because most occurrences of this category will be too small to comply with the CLC minimal mapping unit of 25 haa. Since dump sites must obtain a permit from the pollution authorities, more exact statistics can be obtained from their databases. The class definition also includes “land fills”. Hydropower dams built as landfills have been included in this class. Again, most locations are too small to be included in CLC and the number of such dams not included in CLC adds to the uncertainty of the figure.

The content is 46.5% open areas with mineral soil, 26.5% forest, 15.4% built-up land (including roads) and 8.9% water.

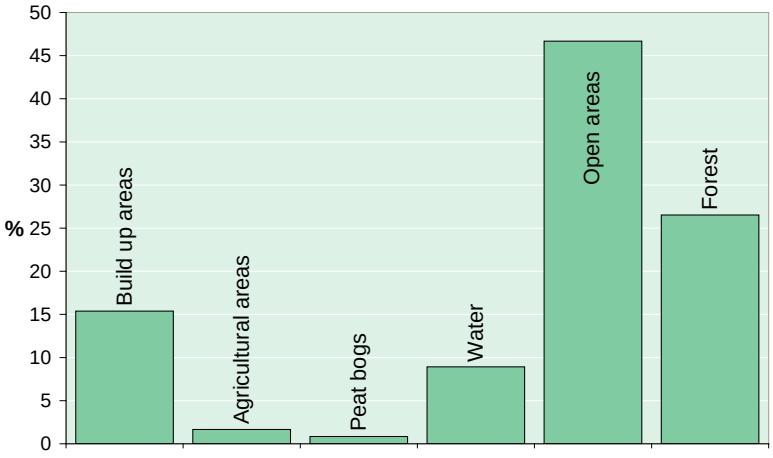


Figur 36. CLC 2006. Knaben. Dump site for sand after mining. Vest-Agder County.

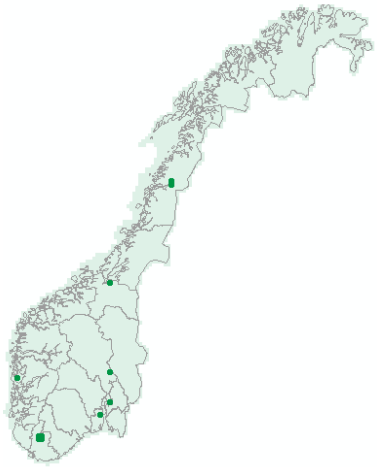


Figur 37. Satellite image in band combination 342. Ir06_11jun06.

Figur 38. Dump site at Langøya in the Oslo fjord. Photo: Norge i bilder ®



Figur 39. CLC profile of class 132.



Figur 40. Occurrence of class 132 within 10km x 10km grid.

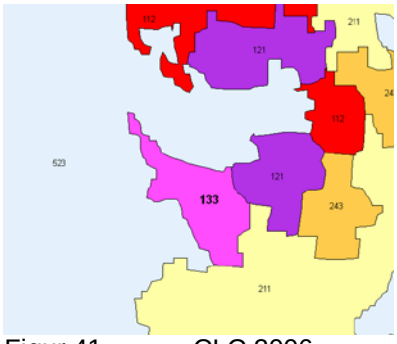
CLC.133 CONSTRUCTION SITES

CLC.133 definition:

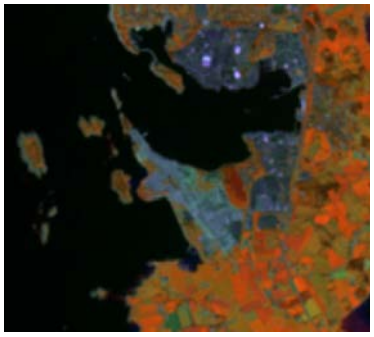
Spaces under construction development, soil or bedrock excavations, earthworks.

Construction sites cover 0.002 % of the land area in CLC2006. The profile of this CLC class is probably an effect of the current lag time in the updating of the AR5. New built up areas under construction are included in CLC because they could be identified in the database of buildings or in satellite images, but will not be included into the AR5 database until completed (this updating regime is under revision and will be changed from 2011). The statistics therefore mainly illustrate the former land cover of the areas where the construction sites are established. Most of the new establishments are in forest and open areas.

The content of the class is 40.2% forest, 21.2% open area with mineral soil, 14.5% agricultural land and 14.1% built-up land (including roads).

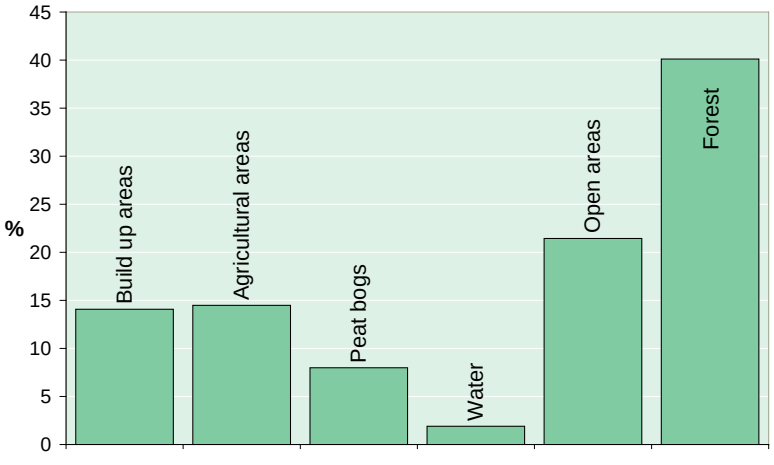


Figur 41. CLC 2006. Stavanger, Rogaland County.

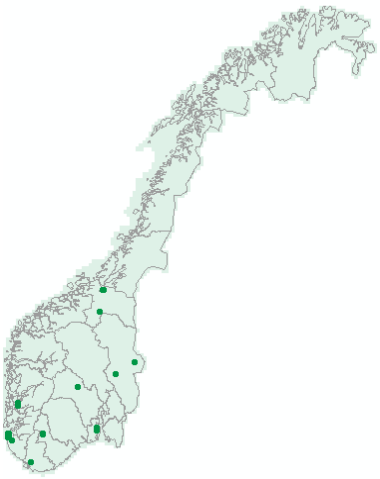


Figur 42. Satellite image in band combination 342. Ir06_19jul06.

Figur 43. Construction site at Tjuvholmen in Oslo. Photo: GHS.



Figur 44. CLC profile of class 133.



Figur 45. Occurrence of class 133 within 10km x 10km grid.

3.1.9 CLC.141 URBAN GREEN

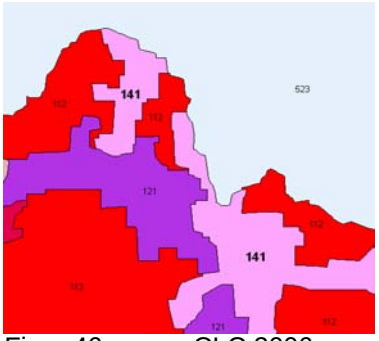
CLC.141 definition:

Areas with vegetation within urban fabric. Includes parks and cemeteries with vegetation.

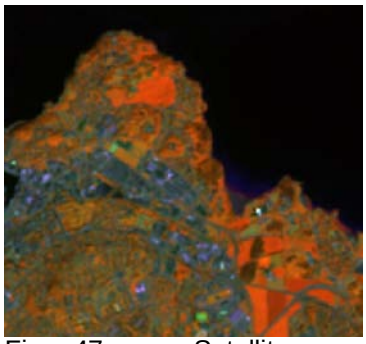
Urban green cover 0.02% of the land area in CLC2006. Interestingly, only a small proportion of this CLC class is built-up land. It is difficult to distinguish CLC.112 discontinuous urban fabric from CLC.141 urban green and the classification seems to be biased towards CLC.112.

The content is 45.5% forest. The fact that much of the urban green is covered with forest is probably correct. 20.3% is open areas with mineral soil, 13% is agricultural land and 11.4% built-up land (including roads).

Norwegian towns and settlements are small and the distance to the surrounding wilderness areas is short. The public has general access to these areas due to the "right-of-access" policy practised in the Nordic countries. The designated urban greens may therefore also be rare in many parts of Norway.

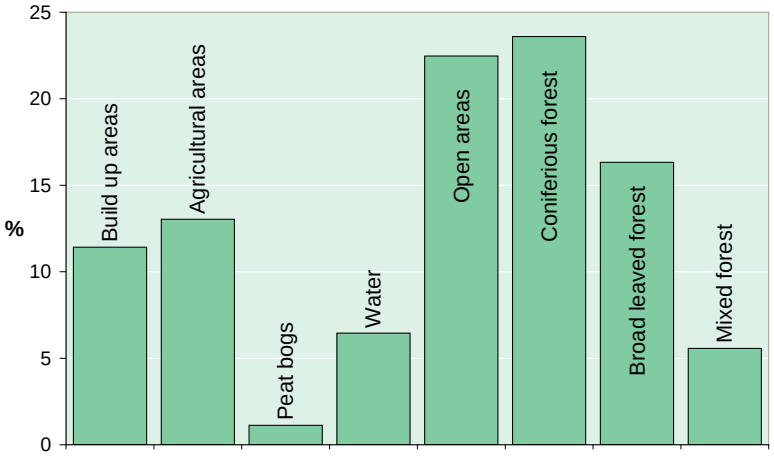


Figur 46. CLC 2006. Trondheim, Sør-Trøndelag County.

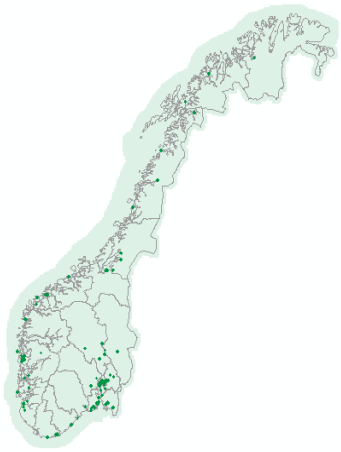


Figur 47. Satellite image in band combination 342. Ir06_30jun05.

Figur 48. The Royal Palace Park in Oslo. Photo: GHS.



Figur 49. CLC profile of class 141.



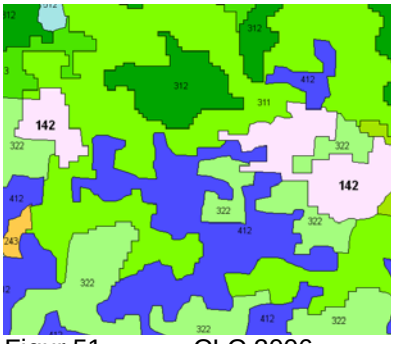
Figur 50. Occurrence of class 141 within 1km x 1km grid.

CLC.142 SPORT AND LEISURE FACILITIES

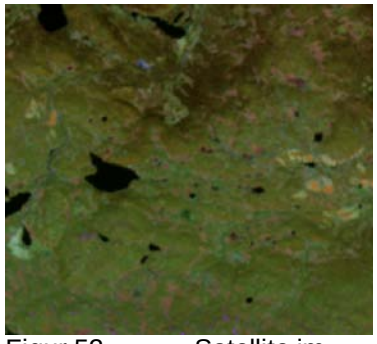
CLC.142 definition:

Camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones.

This class covers 0.13% of the land area in CLC2006. The content is 54.2% forest and 20.8% open areas with mineral soil. The large proportion of forest and open areas is due to the fact that a substantial part of this land consists of areas with vacation homes and holiday facilities along the coast and close to the tree line in the mountains (as in the photo, figure 53, below). Open areas with scant vegetation will be common in both situations. Sites in the mountain areas are usually located close to the tree line where conifer forest subsides and mountain birch forest gradually takes over. The 3.9% content of *bare rocks* and 2.2% of water is probably inherited from the coastal part of this class, where vacation homes are built along the rocky shoreline with open areas of bare rock between the cabins.

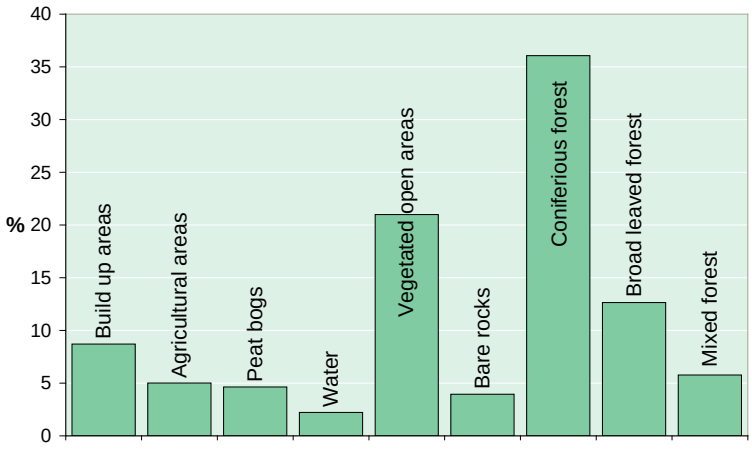


Figur 51. CLC 2006. Fjellstølen, Sør-Aurdal. Oppland County

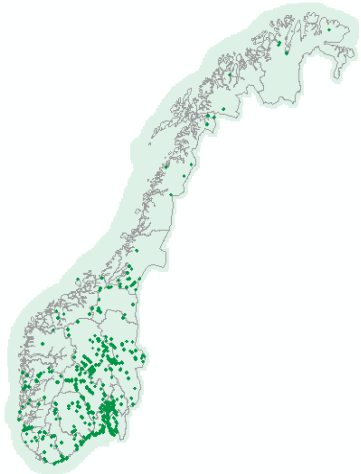


Figur 52. Satellite image in band combination 342. Ir06_11jun06.

Figur 53. Cottage area Hol, Buskerud County. Photo: MIA.



Figur 54. CLC profile of class 142.



Figur 55. Occurrence of class 142 within 1km x 1km grid.

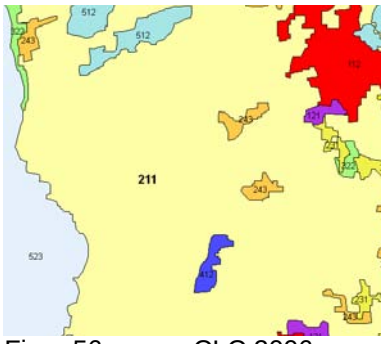
3.1.10 CLC.211 NON-IRRIGATED ARABLE LAND

CLC.211 definition:

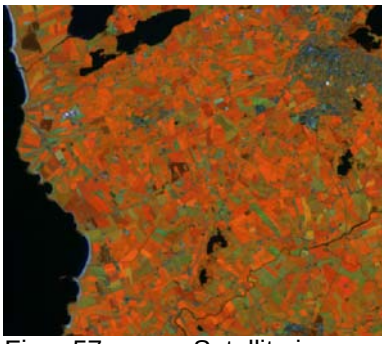
Cereals, legumes, fodder crops, root crops and fallow land. Includes flower and tree (nurseries) cultivation and vegetables, whether open field, under plastic or glass (includes market gardening). Includes aromatic, medicinal and culinary plants. Excludes permanent pastures.

Non-irrigated arable land covers 1.77% of the land area in CLC2006. The actual figure is 2.8 %. The underestimation is an effect of the topography and structure of Norwegian agriculture. Much agricultural land is distributed in small patches surrounded by forest, moors or scantly vegetated rock outcrops. It is also common to find a mixture of arable land and pasture. Due to the minimal mapping unit used in CLC, significant parts of the agricultural land therefore end up in the mixed and heterogeneous CLC agricultural land classes (below).

The content of the class is still 72.2% agricultural land. This is blended with 15.7% forest and 6.9% open areas with mineral soil. The open areas are the farmyards including houses and storage area for equipment.

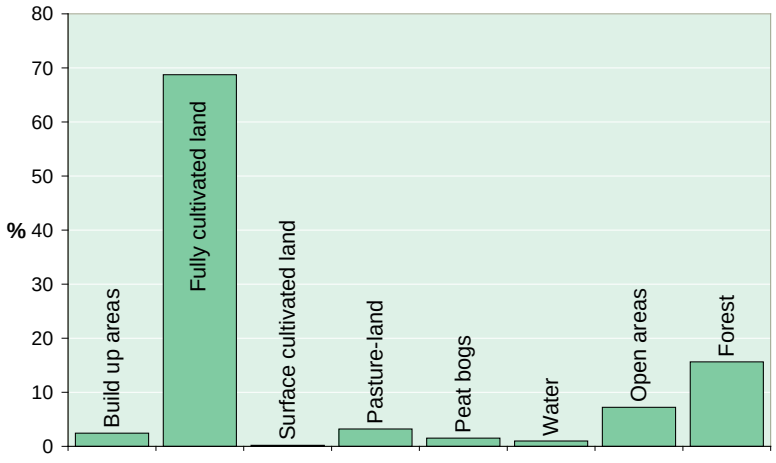


Figur 56. CLC 2006. Jæren, Rogaland County.

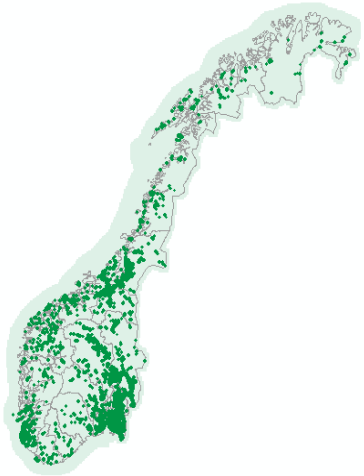


Figur 57. Satellite image in band combination 342. Ir06_19jul06.

Figur 58. Arable land on Ringeriket, Buskerud County. Photo: JYL.



Figur 59. CLC profile of class 211.



Figur 60. Occurrence of class 211 within 1km x 1km grid.

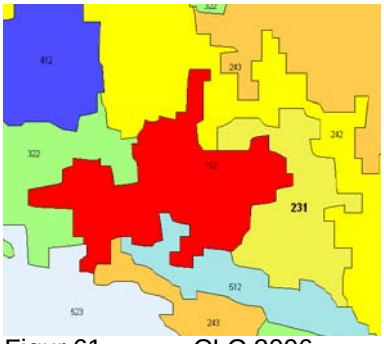
CLC.231 PASTURES

CLC231 definition:

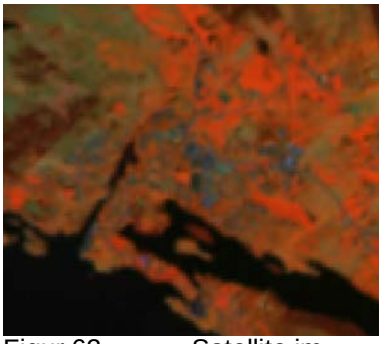
Dense, predominantly graminoid grass cover, of floral composition, not under a rotation system. Mainly used for grazing, but the fodder may be harvested mechanically. Includes areas with hedges (bocage).

Pasture covers 0.08% of the land area in CLC2006. The actual figure is 0.6 %. The underestimation is an effect of the topography and structure of Norwegian agriculture. Most of the pasture is distributed in small patches surrounded by arable land, forest, moors or scantly vegetated rock outcrops. Due to the minimal mapping unit used in CLC, significant parts of the pasture therefore end up in the mixed and heterogeneous CLC agricultural land classes (below).

The content of the class is 70.2% agricultural land, 11.9% open areas with mineral soil and 11.7% forest. The open areas are the farmyards including houses and storage area for equipment.

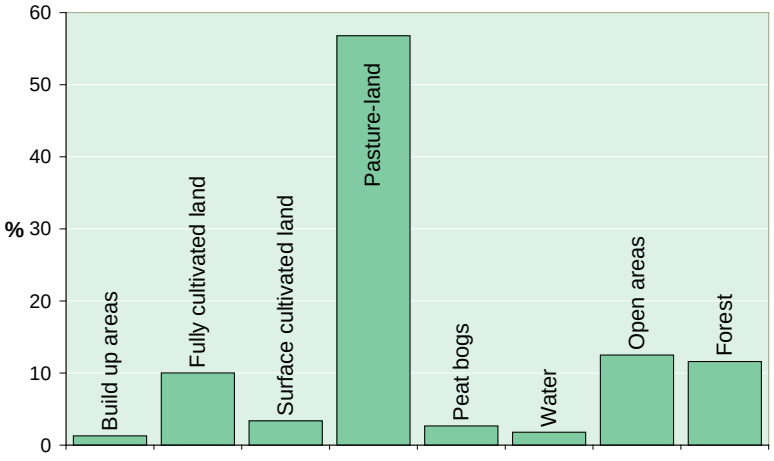


Figur 61. CLC 2006. Manger in Hordaland County.

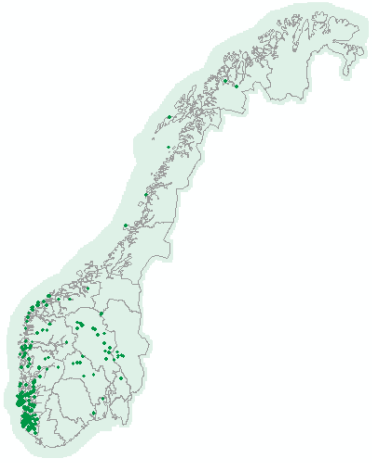


Figur 62. Satellite image in band combination 342. Ir06_10jun06.

Figur 63. Pasture in Bjarkøy, Troms County. Photo PKB.



Figur 64. CLC profile of class 231.



Figur 65. Occurrence of class 231 in 1km x 1km grid.

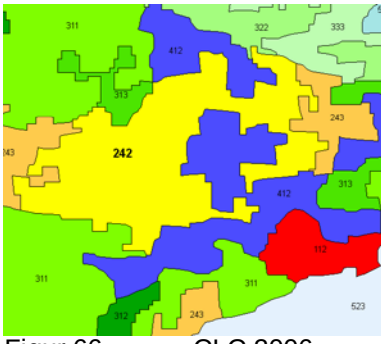
3.1.11 CLC.242 COMPLEX CULTIVATION PATTERN

CLC.242 definition:

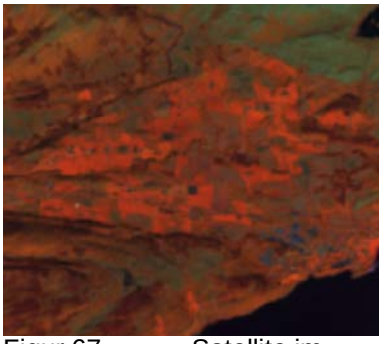
Juxtaposition of small parcels of diverse annual crops, pasture and/or permanent crops.

Complex cultivation covers 0.49 % of the land area in CLC2006. As explained under the classes' arable land and pasture above, a mixture of arable land and pasture is common in Norway – often interlaced with other land cover types. When none of the agricultural land types dominate single handed, the area has been classified as complex cultivation.

The content of the class is 64.6% agricultural land. The class also contains of 19.6% forest and 8.6% open area with mineral soil. The open areas are the farmyards including houses and storage area for equipment.

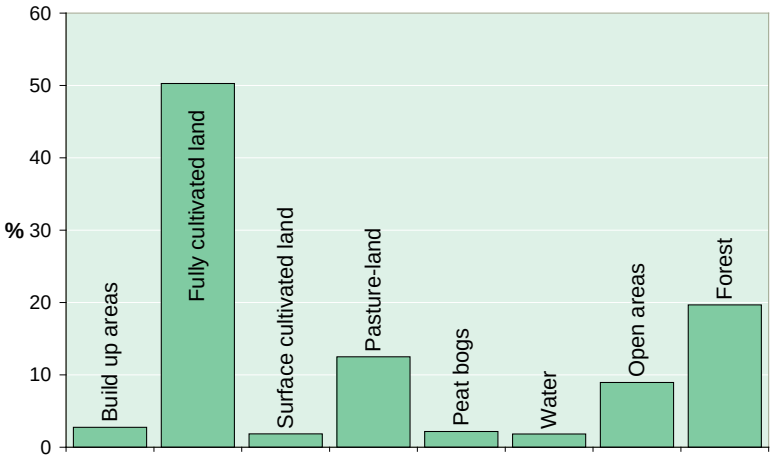


Figur 66. CLC 2006. Leirfjord, Nordland County

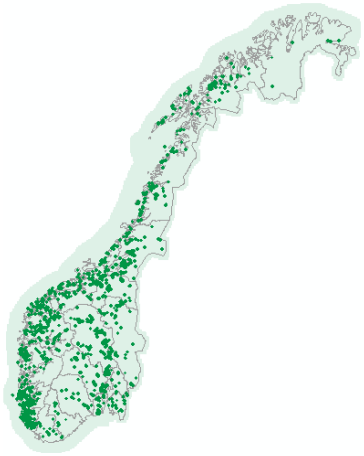


Figur 67. Satellite image in band combination 342. Ir06_30jun05.

Figur 68. Arable land and pasture at Mosterøy, Rogaland County. Photo: JOH.



Figur 69. CLC profile of class 242.



Figur 70. Occurrence of class 242 witin 1km x 1km grid.

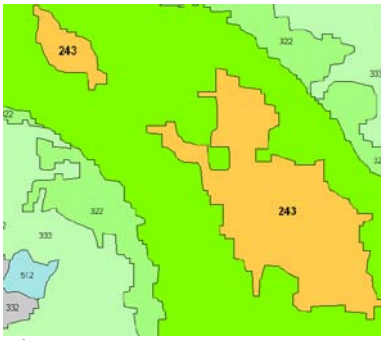
3.1.12 CLC.243 LAND PRINCIPALLY OCCUPIED BY AGRICULTURE, WITH SIGNIFICANT AREAS OF NATURAL VEGETATION

CLC.243 definition:

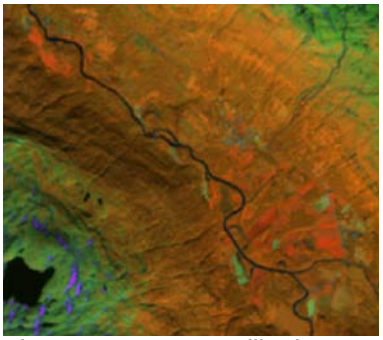
Areas principally occupied by agriculture, interspersed with significant natural areas.

This agriculture class covers 2.99 % of land area in CLC2006 and brings together a large part of the Norwegian rural areas, where the agricultural areas are small in extent and often found in a mosaic pattern with forest, semi natural areas (open areas), wetlands and water. The relative importance of this class in Norway is an effect of topography as well as the traditional structure of the agricultural system.

The content is 41.4% agriculture, 32.9% forest and 12.1% open area with mineral soil. The open areas are farmyards including houses and storage area for equipment, but will also cover natural areas with scrub vegetation - especially along the coast.

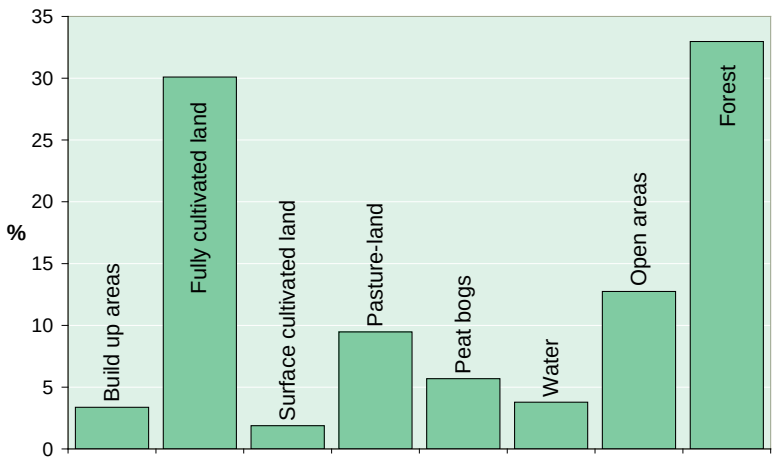


Figur 71. CLC 2006. Bones in Bardu, Troms County.



Figur 72. Satellite image in band combination 342. Ir06_29jul06.

Figur 73. Agricultural land in Lyngen, Troms County. Photo: PKB.



Figur 74. CLC profile of class 243.

Figur 75. Occurrence of class 243 within 1km x 1km grid.

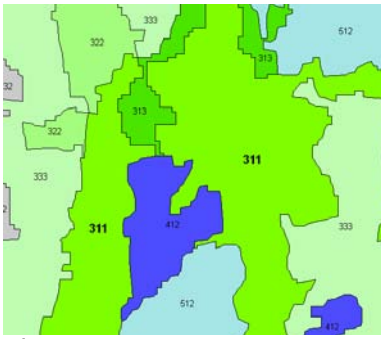
3.1.13 CLC.311 BROAD LEAVED FOREST

CLC.311 definition:

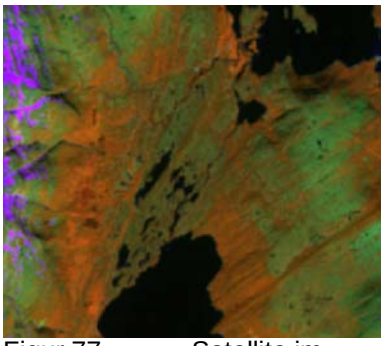
Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved species predominate.

Broad leaved forest covers 13.50 % of the land area in CLC2006. The correct figure is approximately 19 % (based on data from the National Forest Inventory outside Finnmark and topographic maps combined with data from the county forest administration in Finnmark). The content of the class is 76.1% broad leaved and mountain forest and 5.1% mixed forest.

Mountain forest mainly consists of mountain birch forest close to the tree line. Much of this mountain forest is unproductive (production is less than 0.1 m^3 per decare per year), but areas of productive mountain forest do exist – in particular in the north. More than 80 % of the area mapped as CLC.311 is either broad leaved forest, mixed forest or mountain forest and the class can therefore be thought to give a fairly correct portrait of the distribution of this broad leaved forest in Norway. The main areas of omission are probably around agricultural areas and settlements where broad leaved forest has been included in other classes.

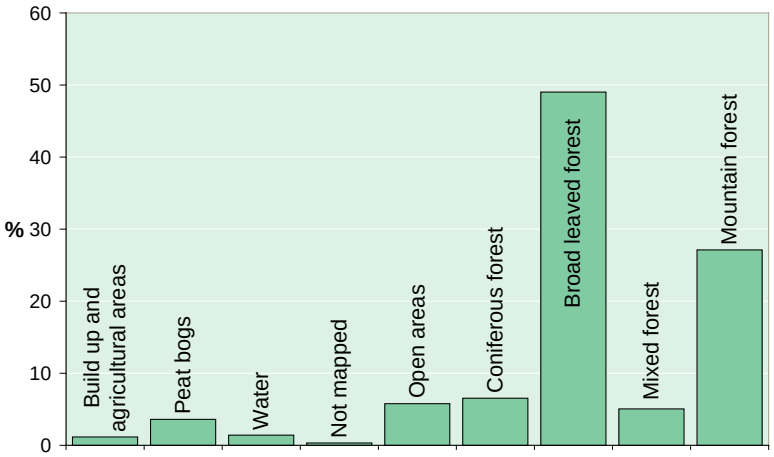


Figur 76. CLC 2006. Steigen, Nordland County.



Figur 77. Satellite image in band combination 342. Ir06_05jul05.

Figur 78. Alder forest in Lyngen, Troms County. Photo: LLA



Figur 79. CLC profile of class 311.

Figur 80. Occurrence of class 311 within 1km x 1km grid.

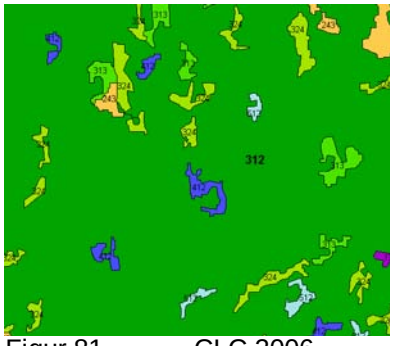
CLC.312 CONIFEROUS FOREST

CLC.312 definition:

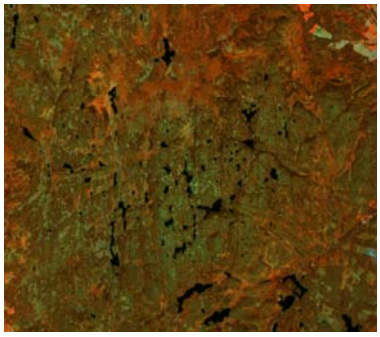
Vegetation formation composed principally of trees, including shrub and bush understories, where coniferous species predominate.

Conifer forest covers 18.33 % of the land area in CLC2006. The correct figure is approximately 17 % (based on data from the National Forest Inventory outside Finnmark and topographic maps combined with data from the county forest administration in Finnmark) when young forest classified as 324 in CLC is subtracted. 85.4% of the area mapped as CLC.312 is actually also conifer forest and the class can therefore, together with CLC.324, be thought to give a fairly correct map of the distribution of conifer forest in Norway. The class contains of 5.3% other forest types and 4.4% peat bogs.

Some areas with conifer forest have been omitted and are included in several of the other classes, but this is compensated by patches of other land cover classes included into the conifer class in CLC

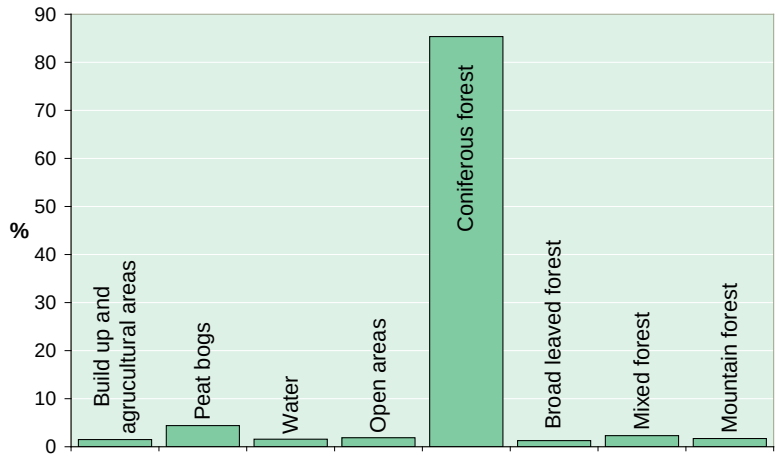


Figur 81. CLC 2006. Øvre Eiker, Buskerud County.



Figur 82. Satellite image in band combination 342. Ir06_11jun06.

Figur 83. Spruce forest in Løten, Hedmark County. Photo: LLA



Figur 84. CLC profile of class 312.

Figur 85. Occurrence of class 312 within 1km x 1km grid.

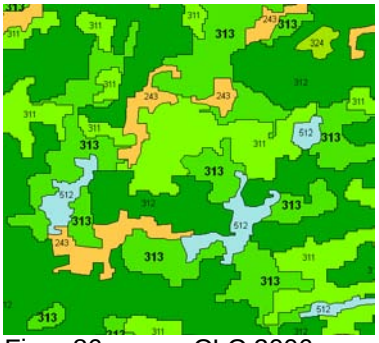
CLC.313 MIXED FOREST

CLC.313 definition:

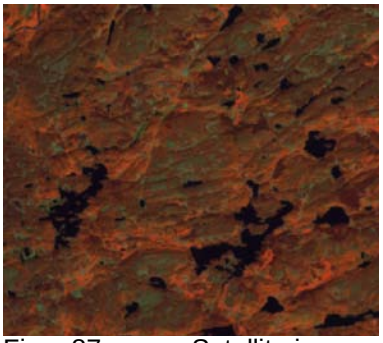
Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved and coniferous species co~dominate.

Mixed forest covers 1.50 % of the land area in CLC2006. The correct figure is approximately 6% (based on data from the National Forest Inventory outside Finnmark and topographic maps combined with data from the county forest administration in Finnmark). Only 46.8 % of the area is mixed forest in the sense that broad leaved and conifer species are growing together on the same land. 34.8% of the class is covered by other forest types. The class also includes substantial patches of other land cover types.

The poor match for mixed forest must be understood as an effect of the scale factor. Much of the mixed forest appears in patches that are too small to be mapped with minimal mapping units of 25 haa. Notice in the statistical tables (chapter 4) that mixed forest in present is a large number of the other CLC classes.

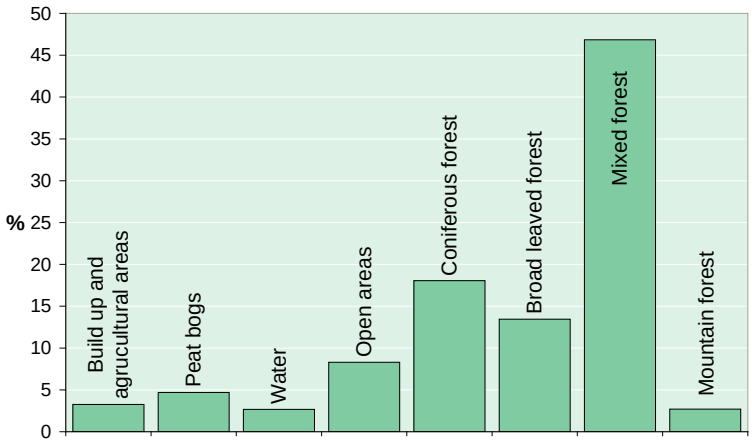


Figur 86. CLC 2006. Mandal, Vest-Agder County.



Figur 87. Satellite image in band combination 342. Ir06_05jul05.

Figur 88. Mixed forest in Sørfold, Nordland County. Photo: PKB.



Figur 89. CLC profile of class 313.

Figur 90. Occurrence of class 313 within 1km x 1km grid.

CLC.322 MOORS AND HEATHLAND

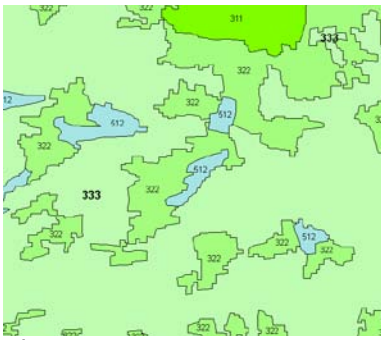
CLC.322 definition:

Vegetation with low and closed cover, dominated by bushes, shrubs and herbaceous plants (heath, briars, broom, gorse, laburnum, etc.).

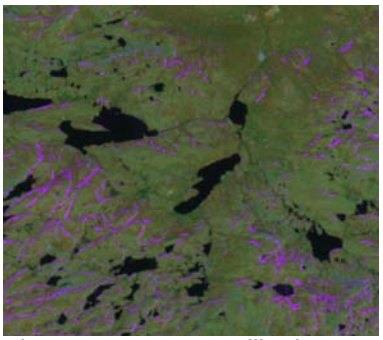
Moors and heathland class covers 14.65 % of the land area in CLC2006.

The class content is dominated by open areas with vigorous vegetation (41.7%), mainly alpine heath and meadow communities, witch fits well with the definition. The AR5 classes' *mineral soil* and *shallow mineral soil* also cover a substantial part of the CLC.322 area below the tree line (36.6%). Mineral soil is in this case manly coastal heath and is correctly placed in CLC.322 The class includes 7.2% forest and 2.6% water. In general, it seems that the richer or more vegetated open areas are present in this CLC class.

See also CLC.333 (sparsely vegetated areas)

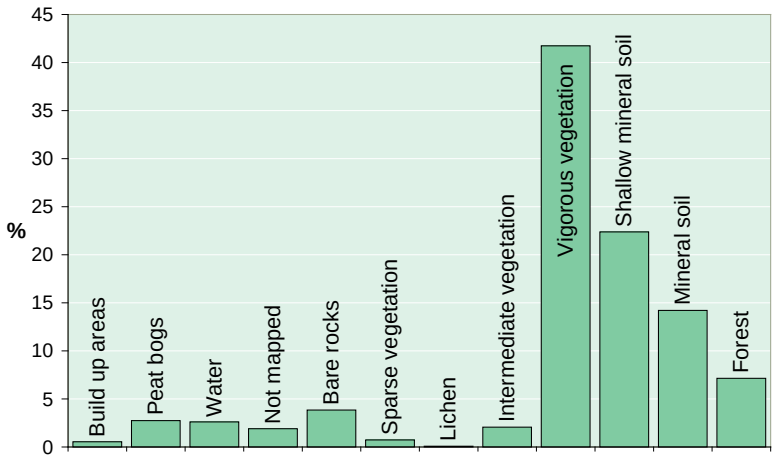


Figur 91. CLC 2006. Nore and Uvdal in Buskerud County.

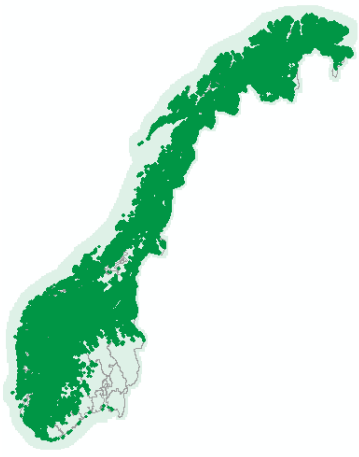


Figur 92. Satellite image in band combination 342. Ir06_11jun06.

Figur 93. Moors and heathland in Tolga, Hedmark County. Photo: GHS



Figur 94. CLC profile of class 322.



Figur 95. Occurrence of class 322 within 1km x 1km grid.

3.1.14 CLC.324 TRANSITIONAL WOODLAND/SHRUB

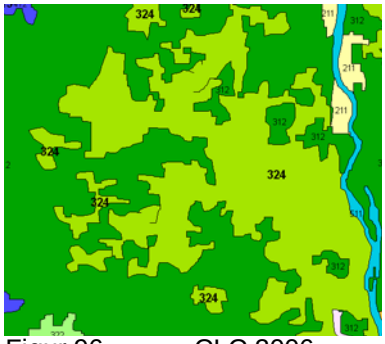
CLC.324 definition:

Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration/colonisation.

Transitional woodland/shrub covers 1.95 % of the land area in CLC2006.

The content is 92.8% coniferous forest, 1.3% other forest types and 3.4% peat bogs.

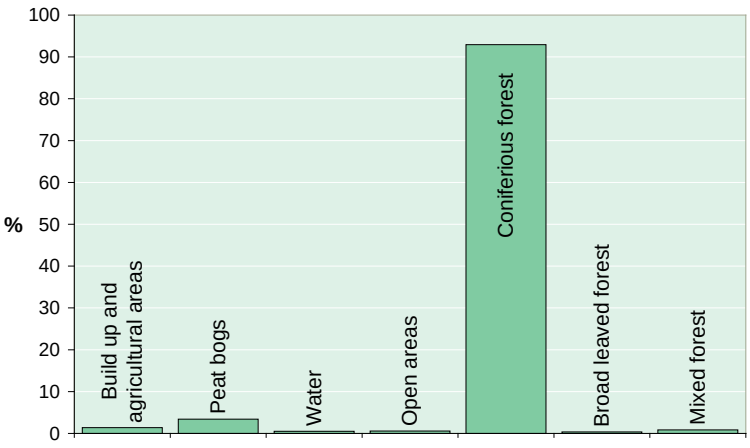
Transitional woodlands and scrubs can either be clear cuttings where new forest is being established or previously open areas under forest encroachment. The AR datasets do not provide information about forest management, only about the main forest classes. The CLC profile for this class shows that most of the area is clear cuttings under regeneration and reflects where forestry in Norway is concentrated, mostly in coniferous forest.



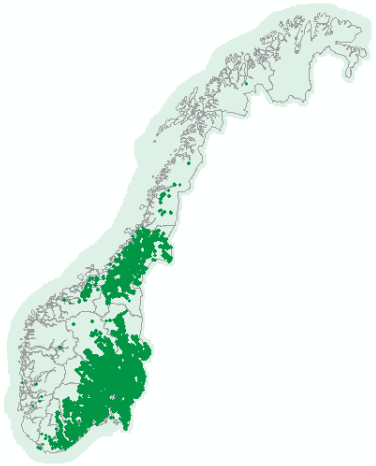
Figur 96. CLC 2006. Åmot, Hedmark County.

Figur 97. Satellite image in band combination 342. Ir06_15jul06.

Figur 98. Clearcut in Løten, Hedmark County. Photo: LLA.



Figur 99. CLC profile of class 324.



Figur 100. Occurrence of class 324 within 1km x 1km grid.

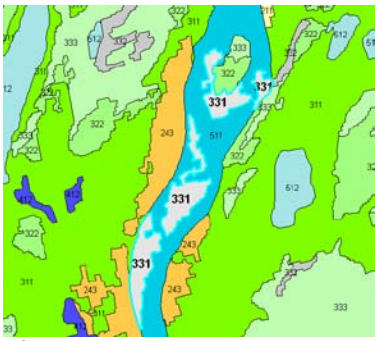
3.1.15 CLC.331 BEACHES, DUNES AND SAND PLAINS

CLC.331 definition:

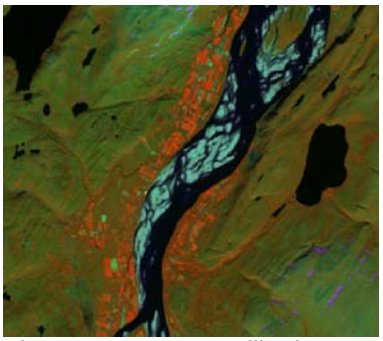
Beaches, dunes and expanses of sand or pebbles in coastal or continental, including beds of stream channels with torrential regime.

Beaches, dunes and sand plains cover a minute 0.005 % of the land area in CLC2006.

The content is 74.6% water. This is an effect of mapping units being enlarged in order to allow at least some areas of class 331 in the final map. It is 18.6% open areas inside these polygons that probably constitute the actual sand dunes. Beaches, dunes and sand plains are small, usually narrow areas mainly found in sheltered bays along the coast and much more detailed scale is needed to represent these land cover types with any accuracy.

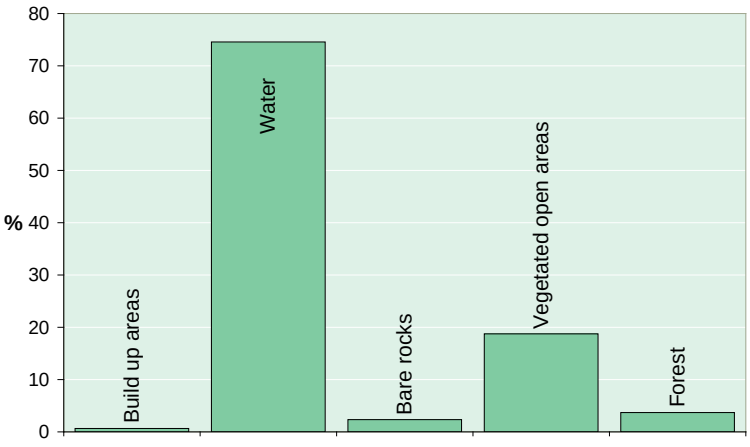


Figur 101. CLC 2006. Tana river, Finnmark County.

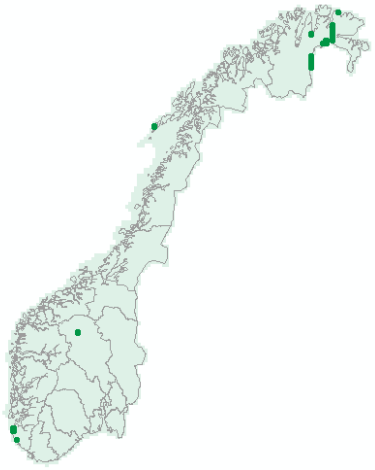


Figur 102. Satellite image in band combination 342. Ir06_02jul05.

Figur 103. Beach in Steigen, Nordland County. Photo: PKB.



Figur 104. CLC profile of class 331.



Figur 105. Occurrence of class 331 within 10km x 10km grid.

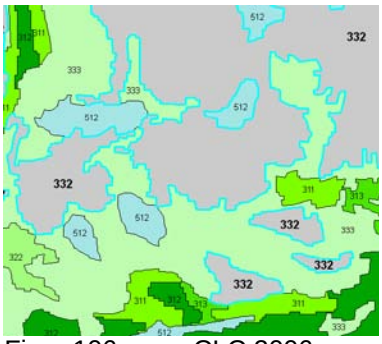
3.1.16 CLC.332 BARE ROCKS

CLC332 definition:

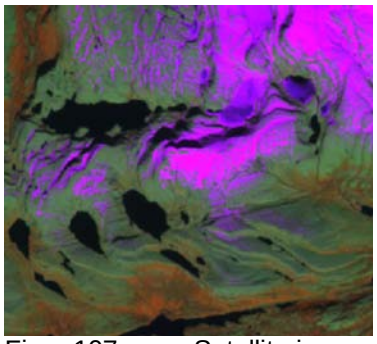
Scree, cliffs, rocks and outcrops.

Bare rocks cover 6.83 % of the land area in CLC2006.

The content is 89.4% bare rocks, interspaced with smaller patches of other land cover types mostly open areas with no or sparse vegetation due to the generalization effect.

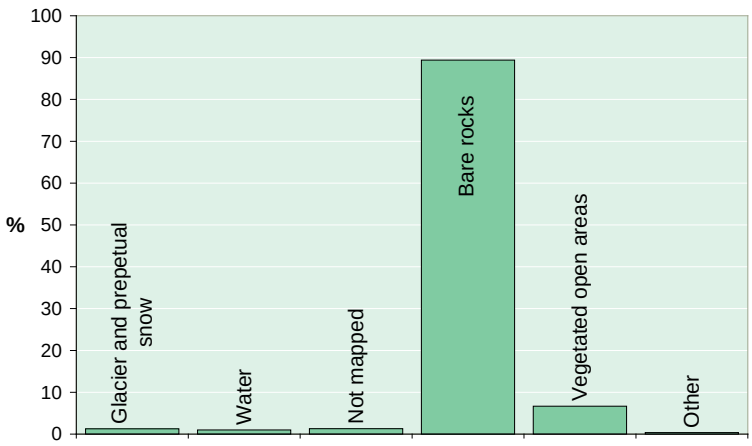


Figur 106. CLC 2006. Flora, Sogn og Fjordane County.

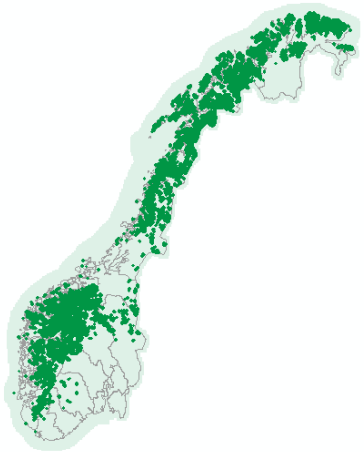


Figur 107. Satellite image in band combination 342. Ir06_10jun06.

Figur 108. Bare rocks in Nordreisa, Troms County. Photo: FAH



Figur 109. CLC profile of class 332.



Figur 110. Occurrence of class 332 within 1km x 1km grid.

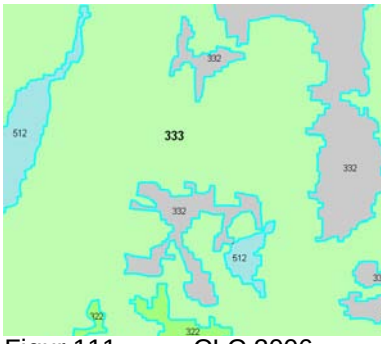
3.1.17 CLC.333 SPARSELY VEGETATED AREAS

CLC333 definition:

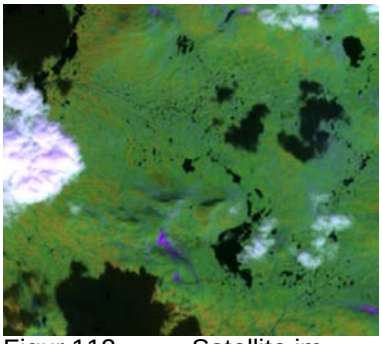
Includes steppes, tundra and badlands. Scattered high-attitude vegetation.

Sparsely vegetated areas covers 25.20 % of the land area in CLC2006. This is the main land cover class above the tree line but the class also encompasses some open areas below the tree line, shown as *shallow mineral soil* and *mineral soil*.

The main content is sparse (33.8%) and intermediate (30.5%) open vegetation. The 17.7% open area with mineral soil, 6.5% patches of bare rock and 2.9% lichen strengthen the description of this class as the covering the poorer part of the mountain and coastal areas in Norway. Around 85% of the area is land correctly allocated to this class.

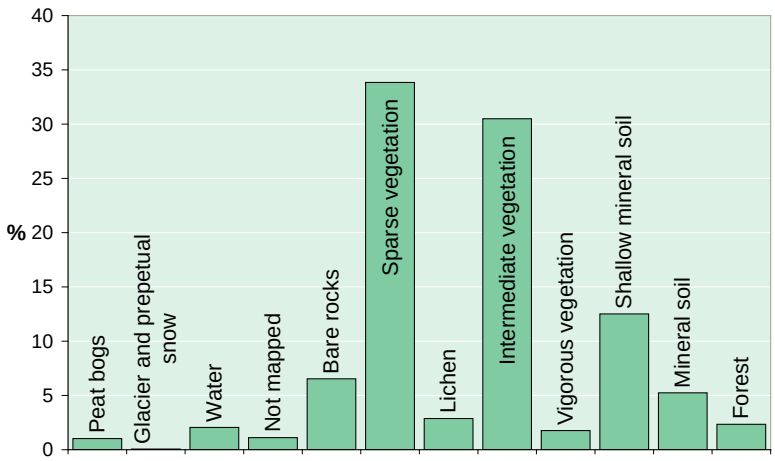


Figur 111. CLC 2006. Børgefjell national park, Nordland County.

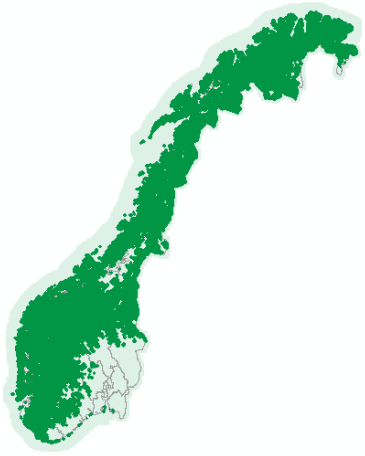


Figur 112. Satellite image in band combination 342. Ir06_03aug06.

Figur 113. Sparsely vegetated areas in Forsand, Rogaland County. Photo: YNR.



Figur 114. CLC profile of class 333.



Figur 115. Occurrence of class 333 within 1km x 1km grid.

3.1.18 CLC.334 BURNT AREAS

CLC.334 definition:

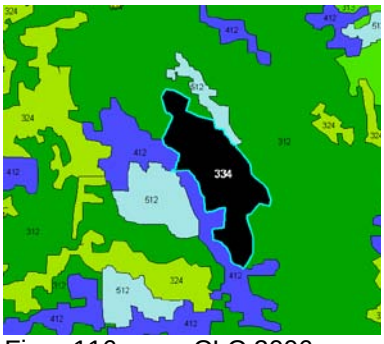
Areas affected by recent fires, still mainly black.

This class covers 0.002 % of the land area in CLC2006.

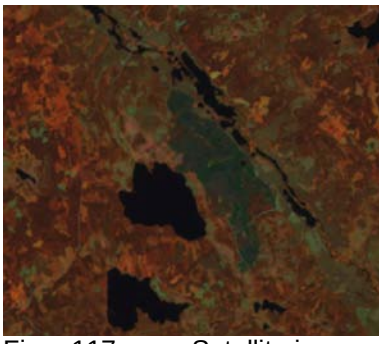
The content is 51.6% coniferous forest, 43.8% open area with mineral soil.

Only three places have burnt areas larger than 25 ha in Norway. All three locations are found in Hedmark county. Two of the areas are localized in coniferous forest. The last area is a dry alpine heather heath above the three line. The three areas are confirmed. A number of smaller wildfires, especially along the southern part of the west coast have left burnt areas too small to be included in the CLC map.

The southwestermost of the three areas depicted in CLC2006 was hit by a wildfire in june 2006. The photo below (figure 118) is taken in the same area two years later.

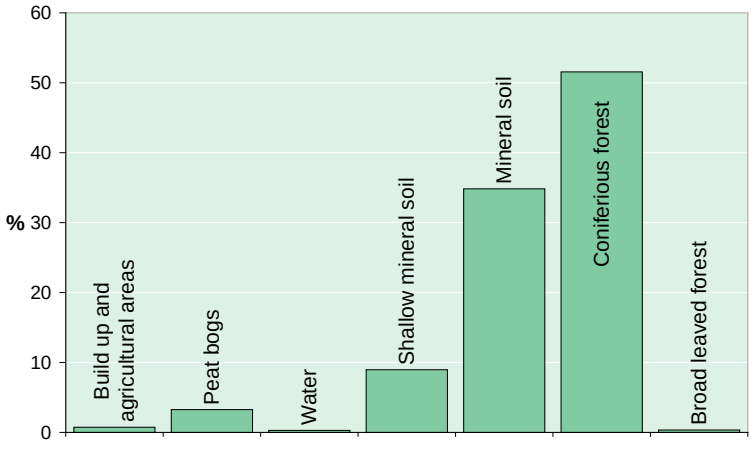


Figur 116. CLC 2006. Nordre Fløgen, Våler, Hedmark County

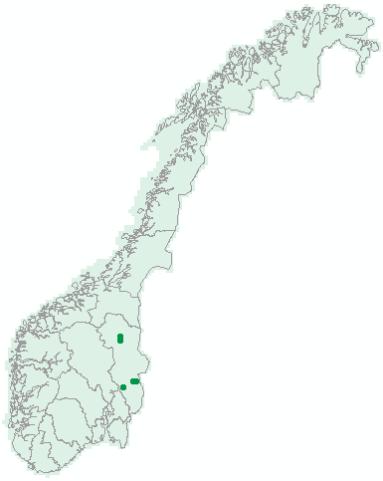


Figur 117. Satellite image in band combination 342. Ir06_15jul06.

Figur 118. Burnt area in Stange, Hedmark County. Photo: GHS.



Figur 119. CLC profile of class 334.



Figur 120. Occurrence of class 334 within 10km x 10km grid.

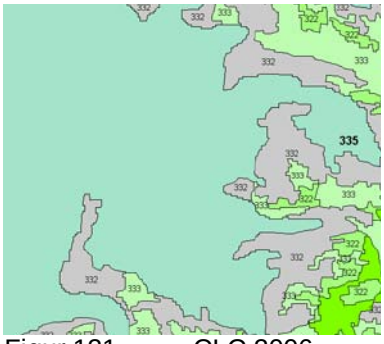
CLC.335 GLACIERS AND PERPETUAL SNOW

CLC.335 definition:

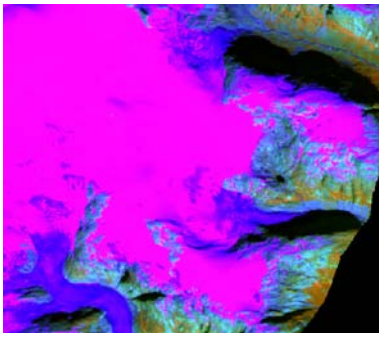
Land covered by glaciers or permanent snowfields.

Glaciers and perpetual snow covers 0.92 % of the land area in CLC2006.

The content is 89.8% glacier and perpetual snow and 4.2% bare rock.

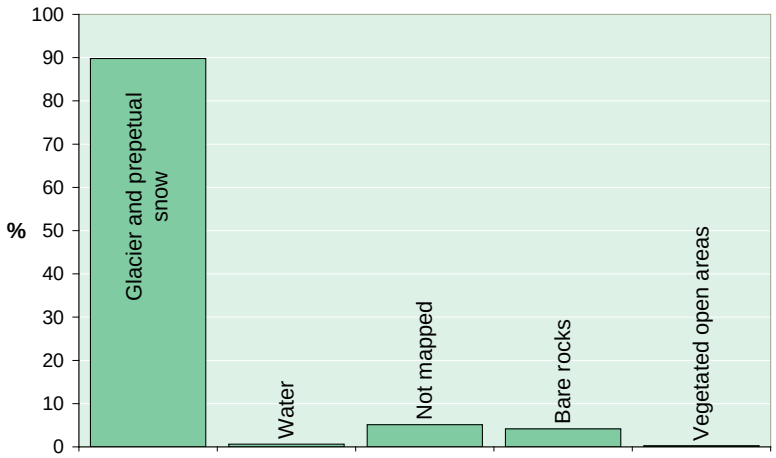


Figur 121. CLC 2006. Jostedalsbreen, Sogn og Fjordane County

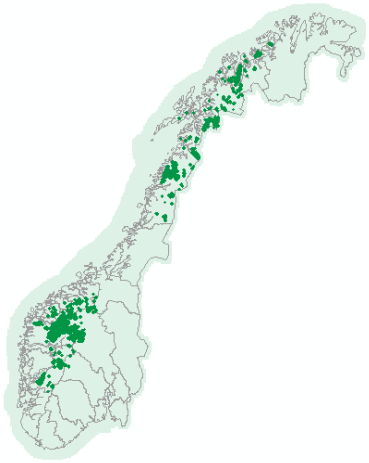


Figur 122. Satellite image in band combination 342. S4_22aug07.

Figur 123. Glacier in Lyngen, Troms County. Photo: FAH.



Figur 124. CLC profile of class 335.



Figur 125. Occurrence of class 335 within 1km x 1km grid.

3.1.19 CLC.411 INLAND MARSHES

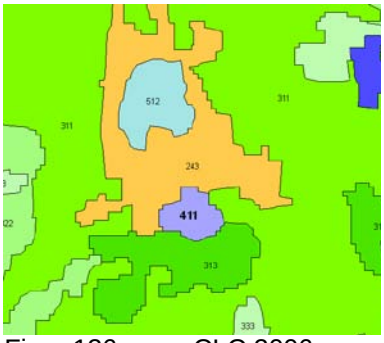
CLC.411 definition:

Low-lying land usually flooded in winter, and more or less saturated by water all year round.

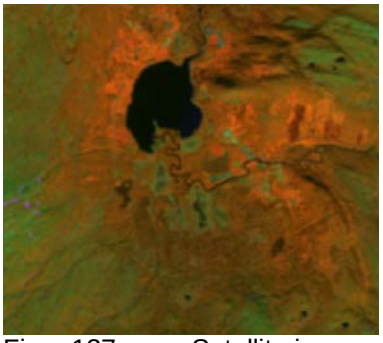
Inland marshes cover 0.001 % of the land area in CLC2006. Inland marshes have been mapped by Geodatasenteret AS for the Norwegian Directorate for Nature Management (Elvedelta 2008). The total area of this land cover type is 26 km^2 (0.008%) but only a few locations are large enough to satisfy the MMU in CLC.

The content is 34.5% peat bogs, 27.4% open land with vigorous or intermediate vegetation, 18.9% water and 11.1% forest. The class also includes 8.5% agricultural land.

The class only a small number of the larger inland marshes in Norway. The results show how these locations are characterized by a mixture of land cover types. This will also be characteristic for the many locations with smaller marshes that are excluded by the generalization process.

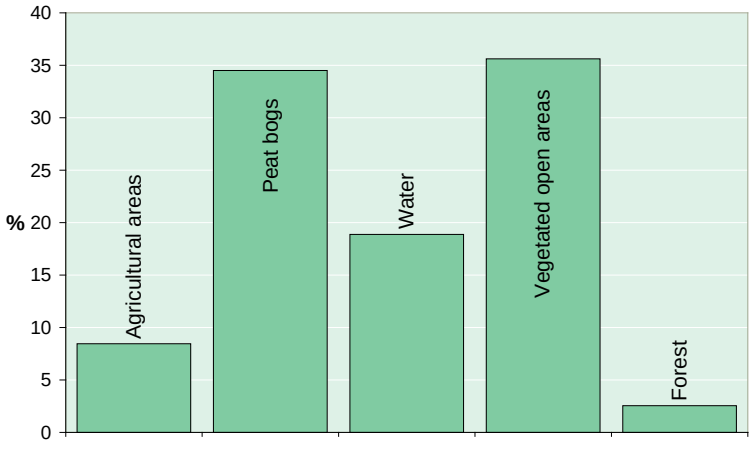


Figur 126. CLC 2006. Saltdalen, Nordland County.

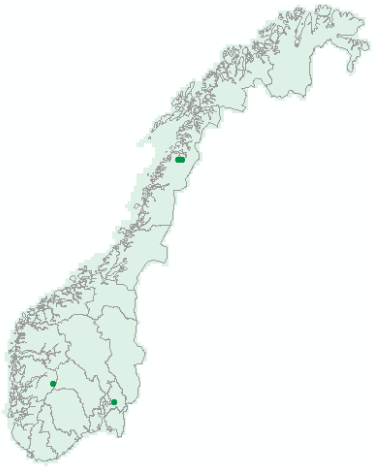


Figur 127. Satellite image in band combination 342. Ir06_30jun06.

Figur 128. Inland marches in Karlsøy, Troms County. Photo: PKB.



Figur 129. CLC profile of class 411.



Figur 130. Occurrence of class 411 within 10km x 10km grid.

3.1.20 CLC.412 PEAT BOGS

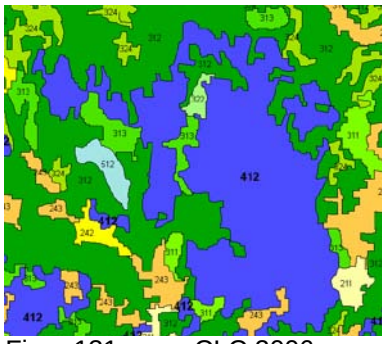
CLC.412 definition:

Peat land consisting mainly of decomposed moss and vegetable matter. May or may not be exploited.

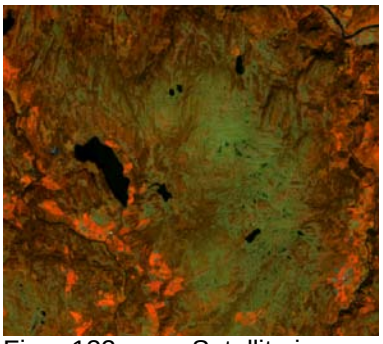
This class covers 6.57 % of the land area.

The content is 56.4% peat bogs, 28% forest and 4.6% water.

Since peat bogs generally are many in numbers but relatively small, this were taken into account in the generalization process, and can be seen as a relative high amount of forest in the CLC profile of this class.

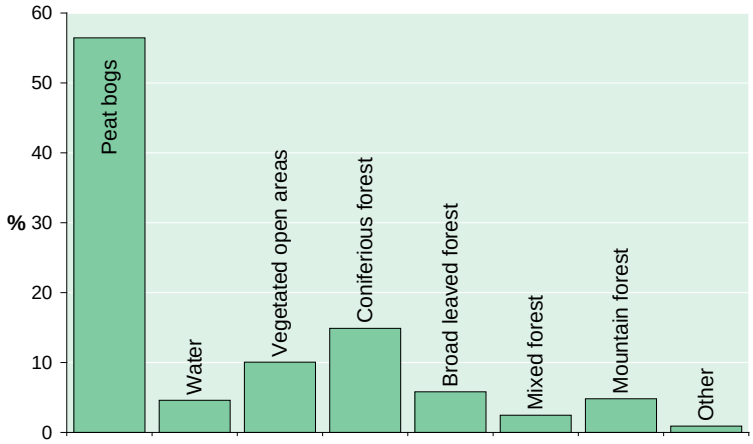


Figur 131. CLC 2006. Midtre Gauldal, Sør-Trøndelag County.



Figur 132. Satellite image in band combination 342. Ir06_05jul05.

Figur 133. Peat bog in Tranøy, Troms County. Photo: PKB.



Figur 134. CLC profile of class 412.

Figur 135. Occurrence of class 412 within 1km x 1km grid.

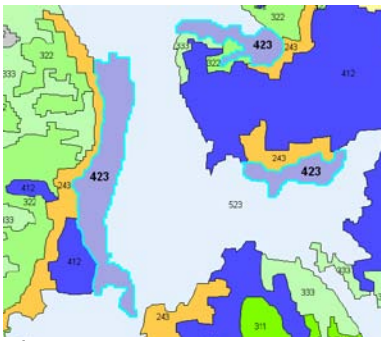
3.1.21 CLC.423 INTERTIDAL FLATS

CLC.423 definition:

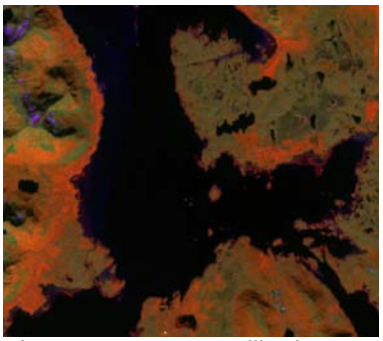
Generally unvegetated expanses of mud, sand or rock lying between high and low water-marks. On contour on maps.

Intertidal flats cover 0.14% of the land area in CLC2006.

The content is dominated by water (91.5%), showing that the mapping units have been enlarged in order to allow at least some areas of class 423 in the final map. It is probably only the 6.2% *open areas* inside these polygons that actually are intertidal flats. These flats are small, usually narrow areas mainly found in bays and around river outlets along the coast. A much more detailed scale is needed to represent this land cover type with any accuracy.

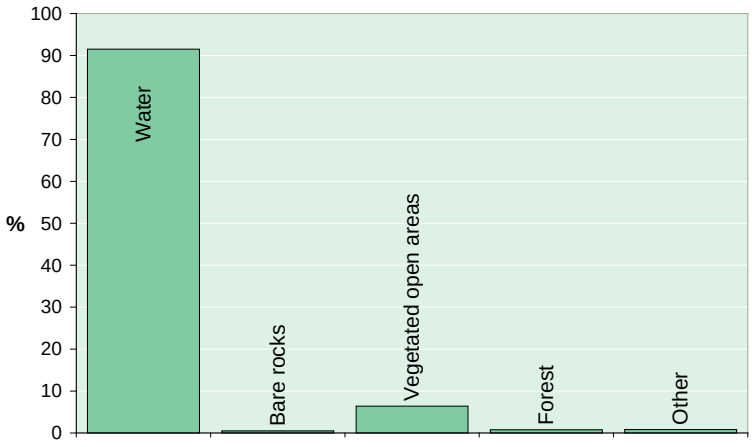


Figur 136. CLC 2006. Sundklakkstraumen, Nordland County

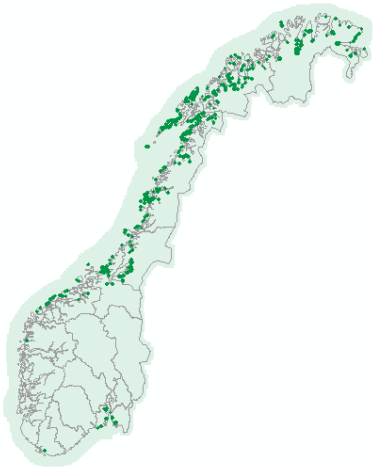


Figur 137. Satellite image in band combination 342. Ir06_30jun05.

Figur 138. Low water. Lenvik, Troms County. Photo: PKB.



Figur 139. CLC profile of class 423.



Figur 140. Occurrence of class 423 within 1km x 1km grid.

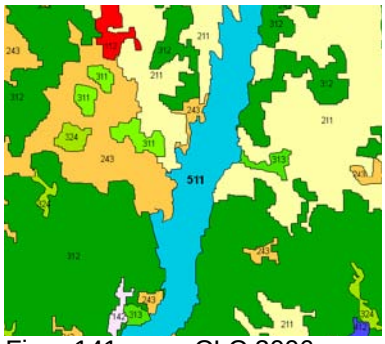
3.1.22 CLC511 WATER COURSES

CLC511 definition:

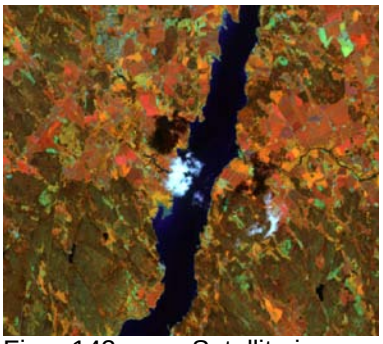
Natural or artificial water-courses serving as water drainage channels. Includes canals. Minimum width to include: 100 m.

Water courses cover 0.14 % of the land area in CLC2006. Water (the Norwegian AR data sets do not distinguish between water courses and water bodies) is the dominating land cover in these polygons (90.1%), but tracts of *open areas* (2.6%) and *forest* (6.3%) is also present.

Few Norwegian rivers are actually wide enough to be mapped as CLC polygons (minimum width 100 meters). Still, rivers are distinct features important for reading maps. Quite a few rivers were therefore included in CLC2006 in spite of not reaching the minimum width. Some of these were cartographically widened, at least along part of the watercourse, in order to be mapped. The result is that the class includes tracts of other land cover types.

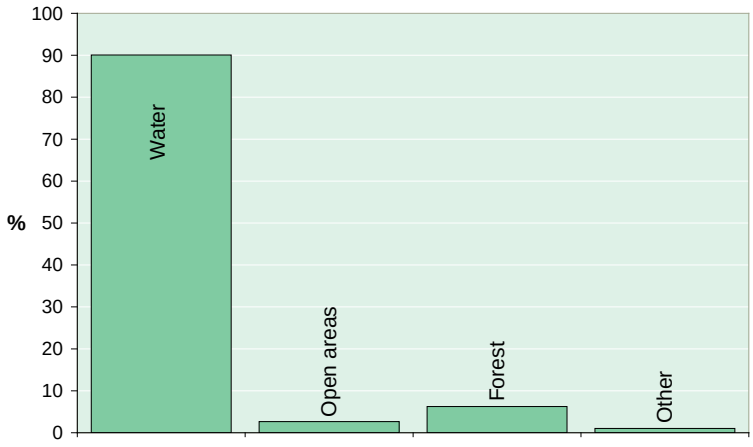


Figur 141. CLC 2006. Glomma river. Skiptvedt, Østfold County.



Figur 142. Satellite image in band combination 342. Ir06_15jul06.

Figur 143. Neiden river in Sør-Varanger, Finnmark County. Photo: PKB.



Figur 144. CLC profile of class 511.

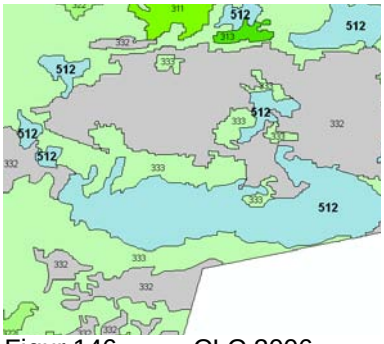
Figur 145. Occurrence of class 511 within 1km x 1km grid.

3.1.23 CLC512 WATER BODIES

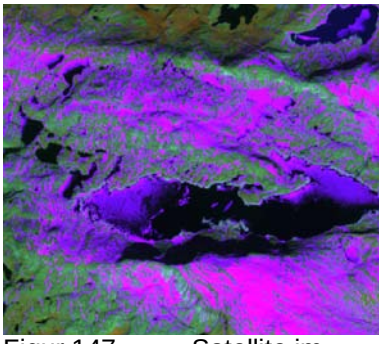
CLC512 definition:

Natural or artificial stretches of water.

Water bodies cover 4.11 % of the land area in CLC2006. The class consists almost entirely of water (96.5%) and the class is probably a fairly good rendition of Norwegian lakes above 25 haa. The inclusion of small patches of *open areas, peat bogs* and *forest* will include many small islands merged into the lakes, but can also include land separating smaller ponds that may have been grouped together in order to form a water body polygon.

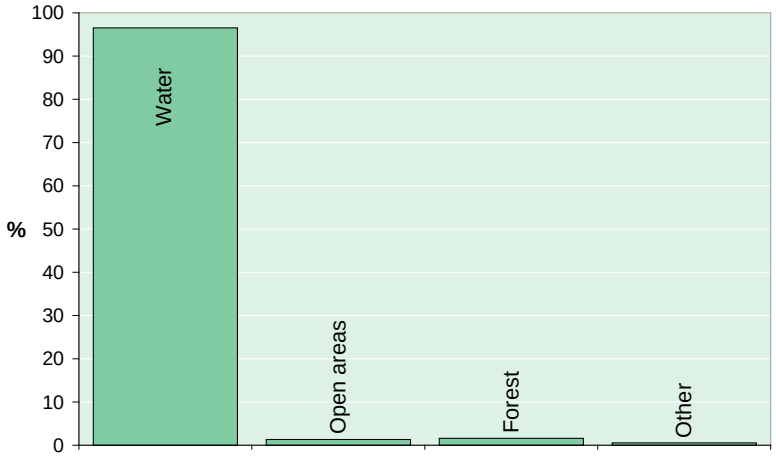


Figur 146. CLC 2006. Langvatnet in Sørfold, Nordland County.



Figur 147. Satellite image in band combination 342. Ir06_05jul05.

Figur 148. Storsteinvatnet in Bykle, Aust-Agder County. Photo: YNR.



Figur 149. CLC profile of class 512.

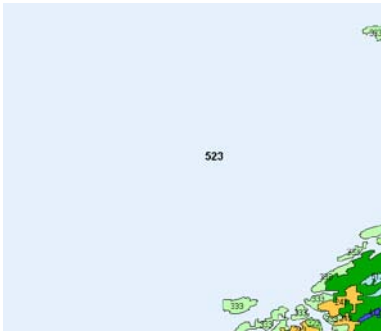
Figur 150. Occurrence of class 512 within 1km x 1km grid.

3.1.24 CLC523 SEA AND OCEAN

CLC523 definition:

Zone seaward of the lowest tide limit.

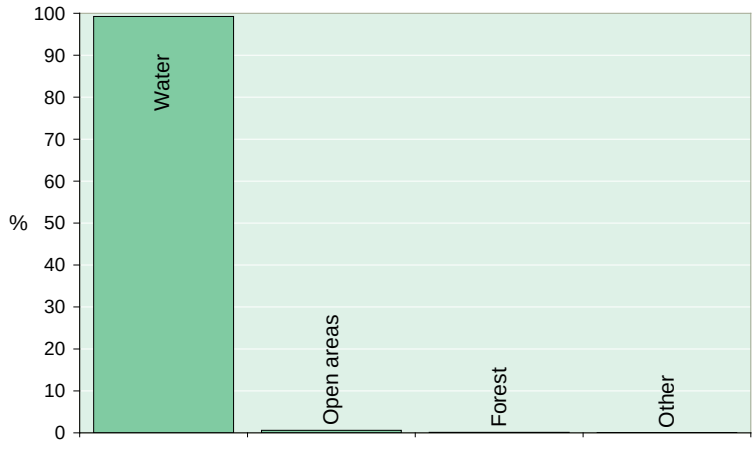
Sea and ocean covers 24.70 % of the total Norwegian CLC area. The class consists almost entirely of water (9.2%) and is thought to be fairly correct. The occurrence of *open areas* is mainly small islands, usually with little or no vegetation, that through generalization have been merged with the larger sea polygon.



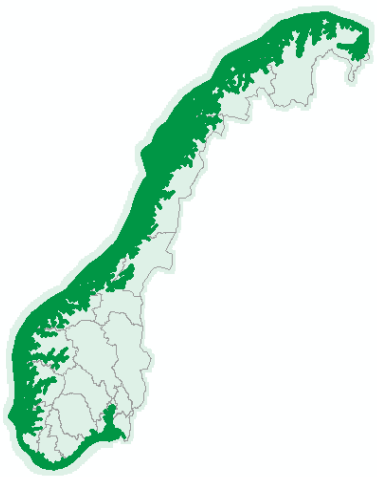
Figur 151. CLC 2006. Osean outside Møre og Romsdal County.

Figur 152. Satellite image in band combination 342. Ir06_05jul05.

Figur 153. Ocean outside Rødøy, Nordland County. Photo: PKB.



Figur 154. CLC profile of class 523.



Figur 155. Occurrence ofclass 523 within 1km x 1km grid.

4 STATISTICS

Table 7 – 11 shows the statistical profile of AR5 and AR50 classes in each CLC class. The figures are percent (%) and summarize to 100 for each CLC class.

Table 7: The AR distribution of each CLC artificial surface class in percent

Artificial surfaces	***Corine Land Cover Class***										
	111	**112**	**121**	**122**	**123**	**124**	**131**	**132**	**133**	**141**	**142**
Build up areas	95.8	65.6	64.2	57.8	78.5	32.4	5.7	15.4	14.1	11.4	8.7
Agricultural areas	0.0	5.5	3.1	7.8	0.0	15.1	1.6	1.7	14.5	13.0	5.0
Coniferous forest	0.0	7.8	7.3	14.0	0.8	8.0	14.5	20.6	34.9	23.6	35.8
Broad leaved forest	1.1	7.0	3.8	3.1	1.0	3.1	4.9	3.6	4.2	16.3	12.6
Mixed forest	0.1	2.3	1.2	1.7	0.4	0.9	2.8	2.3	1.1	5.6	5.8
Mountain forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Peat bogs	0.0	0.4	0.7	0.3	0.1	4.1	6.8	0.8	8.0	1.1	4.6
Bare rocks	0.0	0.3	0.4	0.0	0.0	0.2	18.9	0.3	0.2	2.2	3.9
Shallow mineral soil	0.1	1.1	1.8	0.0	2.4	1.5	3.7	11.4	4.6	3.0	3.2
Mineral soil	1.6	8.4	15.3	14.5	7.3	31.2	38.5	35.1	16.6	17.3	17.6
Sparse vegetation	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Lichen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intermediate vegetation	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1
Vigorous vegetation	0.0	0.0	0.0	0.0	0.0	1.7	0.2	0.0	0.0	0.0	0.2
Glacier & perpetual snow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water	1.4	1.5	2.1	0.9	9.5	1.1	1.9	8.9	1.9	6.5	2.2
Not mapped	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 8: The AR distribution of each CLC agricultural area class in percent

Agricultural areas	***CLC class***			
	211	**231**	**242**	**243**
Build up areas	2.4	1.3	2.7	3.4
Agricultural areas	72.2	70.2	64.6	41.4
Coniferous forest	8.9	5.2	8.3	14.3
Broad leaved forest	5.1	6.0	9.3	15.2
Mixed forest	1.7	0.5	2.0	3.4
Mountain forest	0.0	0.0	0.0	0.1
Peat bogs	1.5	2.7	2.2	5.7
Bare rocks	0.1	0.6	0.3	0.6
Shallow mineral soil	0.3	3.8	1.1	3.5
Mineral soil	6.9	8.1	7.5	8.6
Sparse vegetation	0.0	0.0	0.0	0.0
Lichen	0.0	0.0	0.0	0.0
Intermediate vegetation	0.0	0.0	0.0	0.0
Vigorous vegetation	0.0	0.0	0.0	0.0
Glacier and perpetual snow	0.0	0.0	0.0	0.0
Water	1.0	1.8	1.8	3.8
Not mapped	0.0	0.0	0.0	0.0
Total	**100**	**100**	**100**	**100**

Table 9: The AR distribution of each CLC forest and semi-natural area class in percent

Forest and semi-natural areas	***Corine Land Cover Class***									
	311	**312**	**313**	**322**	**324**	**331**	**332**	**333**	**334**	**335**
Build up areas	0.3	0.5	0.6	0.1	0.6	0.1	0.0	0.0	0.5	0.0
Agricultural areas	0.9	1.0	2.6	0.5	0.8	0.6	0.0	0.1	0.3	0.0
Coniferous forest	6.5	85.4	18.1	1.1	92.8	0.1	0.0	0.7	51.6	0.0
Broad leaved forest	49.0	1.3	13.4	3.9	0.4	3.6	0.3	0.8	0.3	0.0
Mixed forest	5.1	2.3	46.8	0.5	0.8	0.0	0.0	0.2	0.0	0.0
Mountain forest	27.1	1.7	2.7	1.7	0.1	0.0	0.1	0.6	0.0	0.0
Peat bogs	3.6	4.4	4.7	2.7	3.4	0.0	0.0	1.0	3.3	0.0
Bare rocks	1.0	0.6	1.9	3.8	0.1	2.3	89.4	6.5	0.0	4.2
Shallow mineral soil	1.9	0.6	3.4	22.4	0.1	0.3	2.7	12.5	9.0	0.1
Mineral soil	2.2	0.6	2.9	14.2	0.4	18.3	0.7	5.2	34.8	0.0
Sparse vegetation	0.1	0.0	0.0	0.7	0.0	0.0	2.9	33.8	0.0	0.2
Lichen	0.0	0.0	0.0	0.1	0.0	0.0	0.0	2.9	0.0	0.0
Intermediate vegetation	0.3	0.0	0.0	2.1	0.0	0.2	0.2	30.5	0.0	0.0
Vigorous vegetation	0.3	0.0	0.1	41.7	0.0	0.0	0.1	1.8	0.0	0.0
Glacier and perpetual snow	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.1	0.0	89.8
Water	1.4	1.6	2.7	2.6	0.5	74.6	1.0	2.1	0.3	0.6
Not mapped	0.3	0.0	0.0	1.9	0.0	0.0	1.3	1.1	0.0	5.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 10: The AR distribution of each CLC wetland class in percent

Wetlands	***CLC class***		
	411	**412**	**423**
Build up areas	0.0	0.1	0.2
Agricultural areas	8.5	0.3	0.6
Coniferous forest	0.6	14.9	0.1
Broad leaved forest	0.3	5.8	0.6
Mixed forest	1.7	2.5	0.0
Mountain forest	0.0	4.8	0.0
Peat bogs	34.5	56.4	0.1
Bare rocks	0.0	0.1	0.5
Shallow mineral soil	0.0	2.0	2.3
Mineral soil	7.8	3.7	3.9
Sparse vegetation	0.4	0.3	0.1
Lichen	0.0	0.4	0.0
Intermediate vegetation	15.3	1.9	0.1
Vigorous vegetation	12.1	1.8	0.1
Glacier and perpetual snow	0.0	0.0	0.0
Water	18.9	4.6	91.5
Not mapped	0.0	0.4	0.0
Total	**100**	**100**	**100**

Table 11: The AR distribution of each CLC water body class in percent

Water bodies	***CLC class***		
	511	512	523
Build up areas	0.3	0.0	0.0
Agricultural areas	0.6	0.0	0.0
Coniferous forest	1.6	0.9	0.1
Broad leaved forest	3.9	0.4	0.0
Mixed forest	0.6	0.1	0.0
Mountain forest	0.2	0.2	0.0
Peat bogs	0.1	0.4	0.0
Bare rocks	0.1	0.1	0.2
Shallow mineral soil	0.1	0.3	0.3
Mineral soil	2.5	0.3	0.1
Sparse vegetation	0.0	0.2	0.0
Lichen	0.0	0.0	0.0
Intermediate vegetation	0.0	0.3	0.0
Vigorous vegetation	0.0	0.1	0.0
Glacier and perpetual snow	0.0	0.0	0.0
Water	90.1	96.5	99.2
Not mapped	0.1	0.0	0.0
Total	**100**	**100**	**100**

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6 PHOTO CREDITS

The photographs in this report are labelled with acronyms identifying the photographers. The photographers are

FAH Finn-Arne Haugen

GHS Geir-Harald Strand

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JYL John Y. Larsson

LLA Linda Aune-Lundberg

MIA Michael Angeloff

PKB Per K. Bjørklund

YNG Yngve Rekdal