Protected Areas 2021-2024 - Nomenclature Guideline

Copernicus Land Monitoring Service

Author: **European Environment Agency (EEA)**

Date: **2026-09-18**

Version: **1.0.0**

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1. Introduction

This document provides a comprehensive Land Cover / Land Use (LC/LU) nomenclature guideline for the Copernicus local land monitoring products Protected Areas 2021-2024. It covers a detailed description of all LC/LU classes, their geographic characteristics, available input datasets and relevant methods to interpret the respective classes.

2. Protected Areas LC/LU legend

The Nomenclature for the LC/LU dataset is structured into four levels (Code level 1 – Code level 4). The LC/LU code levels were designed to correspond to the Mapping and Assessment of Ecosystems and their Services – MAES typology Level 2[1].

Table 1: Detailed Nomenclature for the LC/LU dataset overview (dated 19.12.2021)

Level 1	Level 2	Level 3	Level 4	MAES Level 2
1. Urban	1.1 Urban fabric, industrial, commercial, public, military and private units	1.1.1 Urban fabric (predominantly public and private units)		URBAN
		1.1.2 Industrial, commercial and military units		
	1.2 Transport infrastructure	1.2.1 Road networks and associated land		
		1.2.2 Railways and associated land		
		1.2.3 Port areas and associated land		
		1.2.4 Airports and associated land		
	1.3 Mineral extraction, dump and construction sites, land without current use	1.3.1 Mineral extraction sites, dump and construction sites		
		1.3.2 Land without current use		
	1.4 Green urban, sports and leisure facilities			
2. Cropland	2.1 Arable land	2.1.1 Arable irrigated and non-irrigated land		CROPLAND
		2.1.2 Greenhouses		
	2.2 Permanent crops	2.2.1 Vineyards, fruit trees and berry plantations		
		2.2.2 Olive groves		
	2.3 Heterogeneous agricultural area	2.3.1 Annual crops associated with permanent crops		
		2.3.2 Complex cultivation patterns		

[1] European Commission (2013): Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessment under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper, Final, April 2013.

		2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation		
		2.3.4 Agro-forestry		
3. Woodland and forest	3.1 Broadleaved forest	3.1.1 Natural & semi-natural broadleaved forest		WOODLAND AND FOREST
		3.1.2 Highly artificial broadleaved plantations		
	3.2 Coniferous forest	3.2.1 Natural & semi-natural coniferous forest		
		3.2.2 Highly artificial coniferous plantations		
	3.3 Mixed forest	3.3.1 Natural & semi-natural mixed forest		
		3.3.2 Highly artificial mixed plantations		
	3.4 Transitional woodland and scrub			
	3.5 Lines of trees and scrub			
	3.6 Damaged forest			
4. Grassland	4.1 Managed grassland			GRASSLAND
	4.2 Natural & semi-natural grassland	4.2.1 Semi-natural grassland	4.2.1.1 Semi-natural grassland with woody plants (C.C.D. ≥ 30 %)	
			4.2.1.2 Semi-natural grassland without woody plants (C.C.D. < 30%)	
		4.2.2 Alpine and subalpine natural grassland		
5. Heathland and scrub	5.1 Heathland and moorland			HEATHLAND AND SCRUB
	5.2 Alpine scrub land			
	5.3 Sclerophyllous scrubs			

6. Open spaces with little or no vegetation	6.1 Sparsely vegetated areas			SPARSELY VEGETATED
	6.2 Beaches, dunes, river banks	6.2.1 Beaches and dunes		
		6.2.2 River banks		
	6.3 Bare rocks, burnt areas, glaciers and perpetual snow	6.3.1 Bare rocks, outcrops, cliffs and scree	6.3.1.1 Bare rocks, outcrops, cliffs	
			6.3.1.2 Scree	
		6.3.2 Burnt areas (except burnt forest)		
		6.3.3 Glaciers and perpetual snow	6.3.3.1 Glaciers	
			6.3.3.2 Perpetual snow	
7. Wetland	7.1 Inland wetlands	7.1.1 Inland marshes		WETLAND
		7.1.2 Peat bogs	7.1.2.1 Exploited peat bogs	
			7.1.2.2 Unexploited peat bogs	
	7.2 Coastal wetlands	7.2.1 Salt marshes		MARINE INLETS AND TRANSITIONAL WATERS
		7.2.2 Salines		
		7.2.3 Intertidal flats		
8. Water	8.1 Water courses	8.1.1 Natural & semi-natural water courses		RIVERS AND LAKES
		8.1.2 Highly modified water courses and canals		
		8.1.3 Seasonally connected water courses (oxbows)		
	8.2 Lakes and reservoirs	8.2.1 Natural lakes		
		8.2.2 Reservoirs		
		8.2.3 Aquaculture ponds		
		8.2.4 Standing water bodies of extractive industrial sites		
	8.3 Transitional waters	8.3.1 Lagoons		MARINE INLETS AND TRANSITIONAL WATERS
		8.3.2 Estuaries		
		8.3.3 Marine inlets and fjords		
	8.4 Sea and ocean	8.4.1 Open sea		OPEN OCEAN

		8.4.2 Coastal waters		COASTAL

3. Mapping rules

3.1 Object delineation

Object delineation is performed on VHR EO data as primary data source. In areas, where two or more satellite scenes overlap, the most suitable scene is chosen as primary data source. In this regard a detailed prioritization system has been established considering especially acquisition year and acquisition month. In cases where clouds or cloud shadows cover the area of interest alternative image data can be used.

3.2 Delineation Rules

Object delineation should be as follows:

- Delineation shall be angular and not round.
- Avoid to digitize too many vertices: Use vertices as few as possible and only as many as necessary to define the shape of an object.
- Avoid to map sharp angles.
- Use road centers (roads < 10 m width) as border between two objects if roads separate two features. E.g. a forest and an agricultural area are separated by a road feature < 10 m width. Map the border between forest and agriculture in the middle of the road.

3.3 Minimum Mapping Unit (MMU) / Minimum Mapping Width (MMW)

The minimum mapping unit defined is ≥ 0.5 ha for all objects. A minimum width of ≥ 10 m is defined.

MMU exceptions:

- Objects located at a site border: If an object is cut at an AOI border, the feature is mapped, if the whole object (inside and outside the AOI) amounts to ≥ 0.5 ha. However, the MMU of those divided features lying inside the site shall have a MMU of at least ≥ 0.2 ha. Smaller objects will be generalized.
- Complex changes (see below).
- Linear features (roads, railways, rivers) that are split in two or more polygons by other linear elements (e.g. the road/railway network) will be mapped even if the resulting segments are smaller than the MMU in order to preserve the network. However, features < 0.2 ha will be generalized.
- Urban objects which are confined by roads or railways. Features < 0.2 ha will be generalized.

MMW exceptions:

- To maintain continuity of features with mostly linear nature (Codes 1.2.1, 1.2.2, 6.2.1, 6.2.2, 8.1.1 and 8.1.2), the MMW may fall below the limit of 10 m over a distance of up to 100 m.

3.4 Good Practice for Data Display – Mapping Scale

On-screen mapping scale is 1:5.000 – 1:10.000 depending on the landscape and feature class. Large homogeneous objects like agricultural areas or woodland are mapped at scales 1:8.000 – 1:10.000. For all other features, 1:5.000 mapping scale is applied.

3.5 Overlap Rules

- Objects may not overlap. In case of real objects overlay, the following rules apply:
- If objects overlap on different levels, the top level is mapped. Example: if a road bridge overlaps a river, the road is mapped continuously.

- If objects overlap on the same level, the visually dominant object is mapped continuously. However, if roads and railways meet on the same level, railways are mapped continuously to maintain the railway network.

3.6 Priority Rules

The priority rules applied are defined as follows:

- Objects < 0.5 ha are added to the neighboring object with the next number of the same sub-class.
- Objects < 0.5 ha are added to the neighboring object with the longest common border line. Exception: Objects surrounded by railways or roads. If an object is below the MMU size and completely surrounded by a road or railway network, it shall be aggregated with that surrounding traffic line.

3.7 Water level rules and flooding mapping

A flood event is not considered as a “Temporal fluctuation of water level”. In case of a extraordinary flood event the actual/real land cover/land use should be mapped.



Flooded areas from Danube river, Borcea (Romania), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-04-21. CNES 2011©, Distribution Airbus DS/Spot Image.

3.8 Allowed Comments

In order to clarify certain mapping delineations, there are some comments defined as product attributes.

Table 2: List of allowed comments

Order No	Description; Note	Comment
1	Polygons < 0.5 ha at outer AoI site boundary, that have an apparent continuation outside the AoI boundary, which is visible on the image data.	"Area size exception (at Protected Areas AoI boundary)"
2	Polygons < 0.5 ha inside AoI site boundary, that are allowed due to nomenclature guideline rules e.g. to represent changes, to ensure continuity of road/rail/river network at intersections of these classes, to mark urban objects confined by roads or railways ≥ 0.2 ha up to < 0.5 ha	"Area size exception (inside Protected Areas AoI boundary)"

4. Description of mapping features

1. Urban

The urban classes contain land that is covered by building structures and transport network. Urban fabrics appear in blue and darkish blue-grey colours on satellite images.

From the UA Mapping Guide:

- Surfaces with dominant human influence but without agricultural land use. These areas include all artificial structures and their associated non-sealed and vegetated surfaces.
- Artificial structures are defined as buildings, roads, all constructions of infrastructure and other artificially sealed or paved areas.
- Associated non-sealed and vegetated surfaces are areas functionally related to human activities, except agriculture.
- Also, the areas where the natural surface is replaced by extraction and / or deposition or designed landscapes (such as urban parks or leisure parks) are mapped in this class.
- The land use is dominated by permanent population.

Specific generalization/delineation rules are applied for urban classes:

- Segments of roads, rivers and railways < 0.5 ha, that are necessary to represent the “network” of each feature, will be mapped. Features < 0.2 ha will be generalized.
- Urban objects confined by roads or railways ≥ 0.2 up to < 0.5 ha, will be mapped. Smaller urban objects will be generalized.
- If an infrastructure line is crossing a river, the bridge has to be mapped if the bridge is wider than 10 meters.

This category includes:

1.1 Urban fabric, industrial, commercial, public, military and private units

- Urban fabric contains land covered by artificial structures and transport networks. Industrial or commercial units are almost completely covered by artificial surface.

1.2 Transport infrastructure

- Motorways, roads and railways with their associated land and installations are included in this class if width > 10 m. Airports and port areas with installations and associated land are included. If an infrastructure line is crossing a river, the bridge has to be mapped if the bridge is wider than 10 meters.

1.3 Mineral extraction, dump and construction sites, land without current use

- Dump sites include public, industrial or mine dump sites. Construction development, soil and bedrock excavations and earthwork are included in this class. Land without current use is land that is in a transitional phase. It is included in urban areas.

1.4 Green urban areas, sports and leisure facilities

- Green urban areas are areas with vegetation within the urban fabric and include parks. In sports and leisure facilities, camping grounds, sport grounds, leisure parks, golf courses, racecourses, etc. are included. It also comprises parks not surrounded by urban areas.

1.1 Urban fabric, industrial, commercial, public, military and private units

1.1.1 Urban fabric (predominantly public and private units)

Definition:

Buildings and their associated land together with artificial surfaced areas, regardless of the building density. Predominant residential usage contains non-sealed areas, independent of the housing scheme (single family houses or high-rise dwellings, city centre or suburb). The non-sealed areas might be private gardens or common green areas.

This category includes:

Very dense Urban:

- Built-up areas and their associated land with dominant residential use; mostly inner-city areas with central business district as long as there is partial residential use.
- Buildings, roads and sealed areas cover most of the area; non-linear areas of vegetation and bare soil.

Dense Urban:

- Predominant residential usage.

Low dense Urban:

- Residential buildings in rural areas, roads and other artificially surfaced areas. The vegetated areas are predominant, but the land is not dedicated to forestry or agriculture.
- Built-up areas on small farms.

This category excludes:

- Industrial, commercial, public (hospitals, museums, castles, university campuses, schools, government districts, cemeteries, big farms…), military → class 1.1.2 Industrial, commercial and military unit
- Nurseries with dominant areas of greenhouses (no or only small fields) → class 2.1.2 Greenhouses
- Allotment gardens → class 1.4 Green urban, sports and leisure facilities
- Holiday villages (“Club Med”) → class 1.4 Green urban, sports and leisure facilities



Continuous Urban fabric IM.D. (Tallinn, Estonia). Credit: K. Larsson.



Continuous Urban fabric IM.D. (Palermo, Spain). Credit: M. Escobar.



Dense Urban fabric : City: Stockholm. Credit: Eurostat, 2009. LUCAS.



Dense Urban fabric : City: Stockholm. Credit: Eurostat, 2009. LUCAS.



Low density urban fabric. (Täby, Sweden). Credit: K. Larsson.



Low density urban fabric (Costa del Sol, Spain). Credit: M. Palacios.

Appearance:

- Urban fabric appears in blue or dark blue /grey colours on satellite images.



Class 1.1.1, Nyköping (Sweden), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-03. CNES 2011©, Distribution Airbus DS/Spot Image.



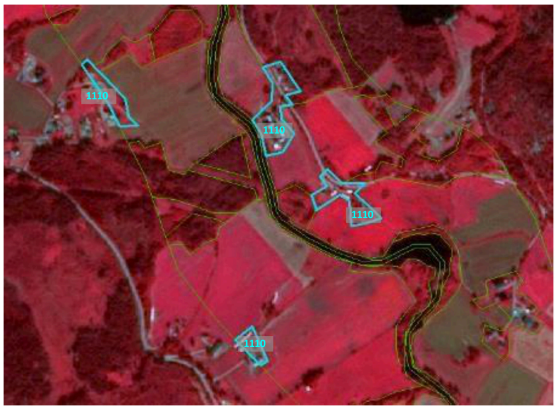
Class 1.1.1 - marked in turquoise, Skien (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



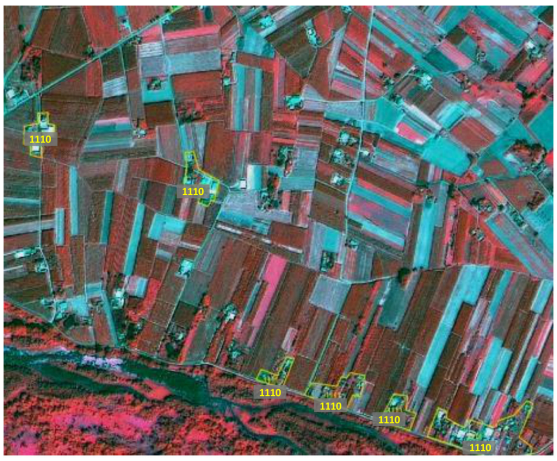
Class 1.1.1, Larvik (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



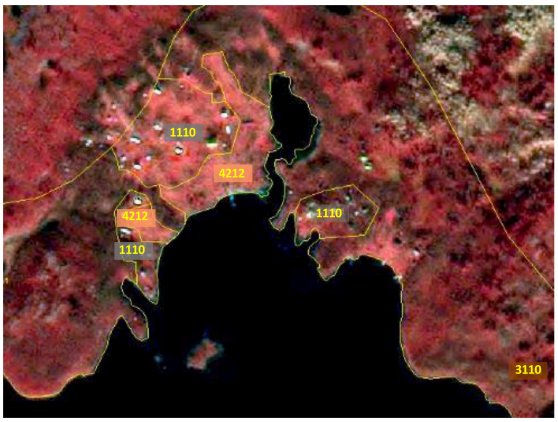
Class 1.1.1 - marked in turquoise, Lunde (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/ Spot Image.



Class 1.1.1 - low urban density marked in turquoise, Siljan (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



In an agriculture area only large accumulations of houses are mapped, Poland, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.



Example of generalized delineation of low urban density area class 1.1.1, Åre (Sweden), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.

Exceptions from MMU:

Exceptions from MMU > 0.5 ha are made for 1.2.1 Road networks and associated land and 1.2.2 Railways and associated land in order to keep the network formed by these linear features. Further exceptions are urban areas (1.1.1) or industrial/commercial units (1.1.2) being encircled by either rails, roads or rivers. In those cases urban features up to a MMU of 0.2 ha are kept and flagged with comments (Table 2).

MMW exceptions:

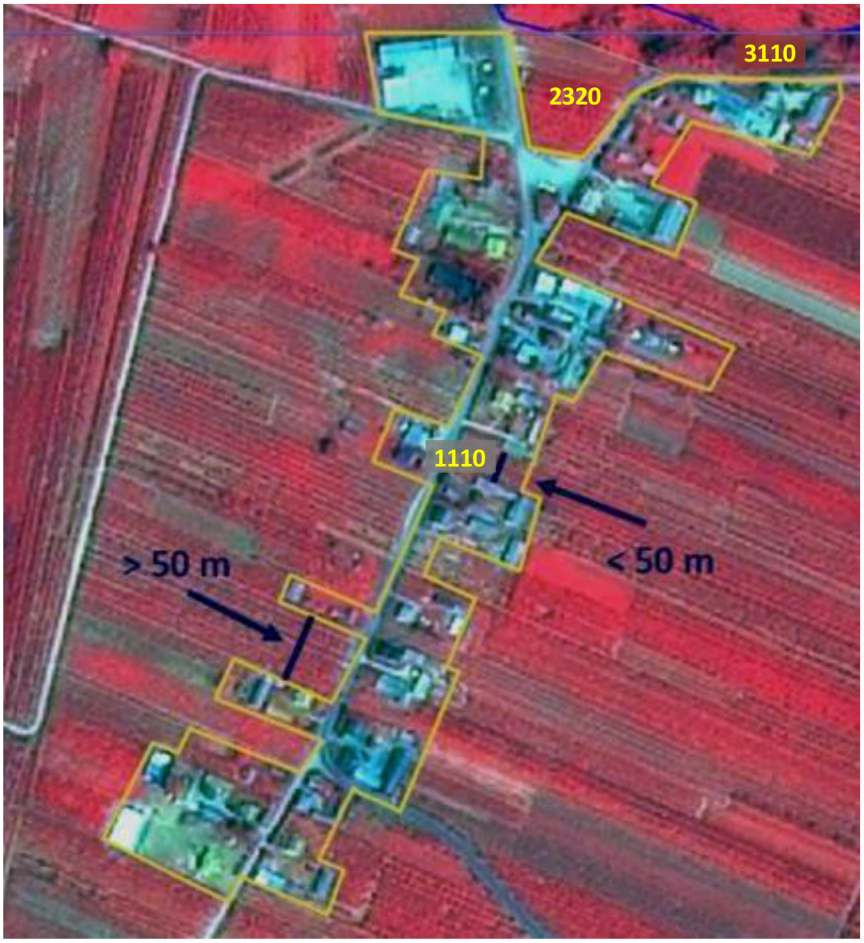
To maintain continuity of linear features, the MMW may fall below the limit of 10 m over a distance of up to 100 m.

Generalization rules for urban areas with low density:

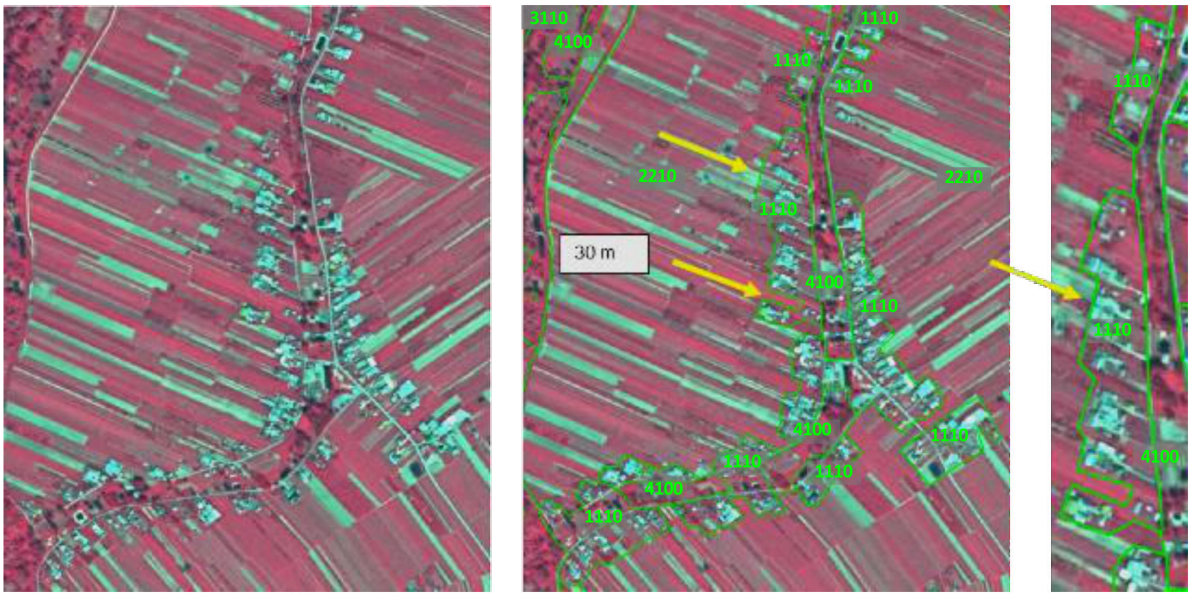
If a strict MMU > 0.5 ha mapping of urban fabric areas is applied, the low urban density areas would be underestimated. Therefore, to get a good representation of the area, the following generalisation rules will be adopted:

- Do not apply the 10 m MMW distance rule at the urban fringe but apply a < 50 m MMW to generalize outline.
- Include private gardens.
- Avoid mapping of single urban segments.
- Map the "whole structure".
- Close gaps at the urban fringe applying a maximum width of 50 m.

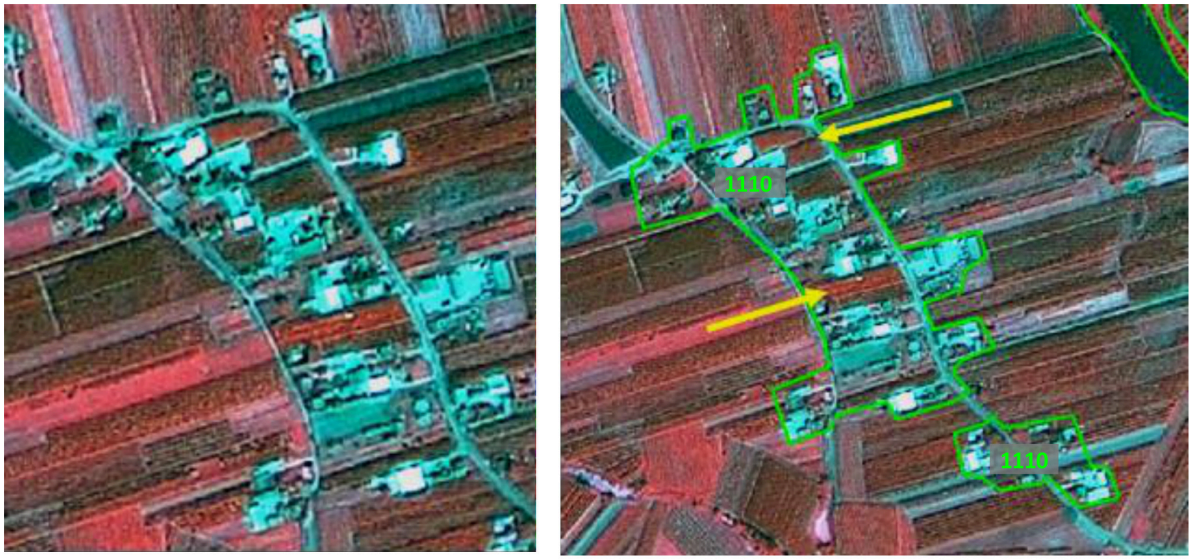
In any case, real agricultural/grassland parcel contained within urban surroundings, will be mapped as agricultural/grassland.



Example of generalized delineation of low urban density area class 1.1.1, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.



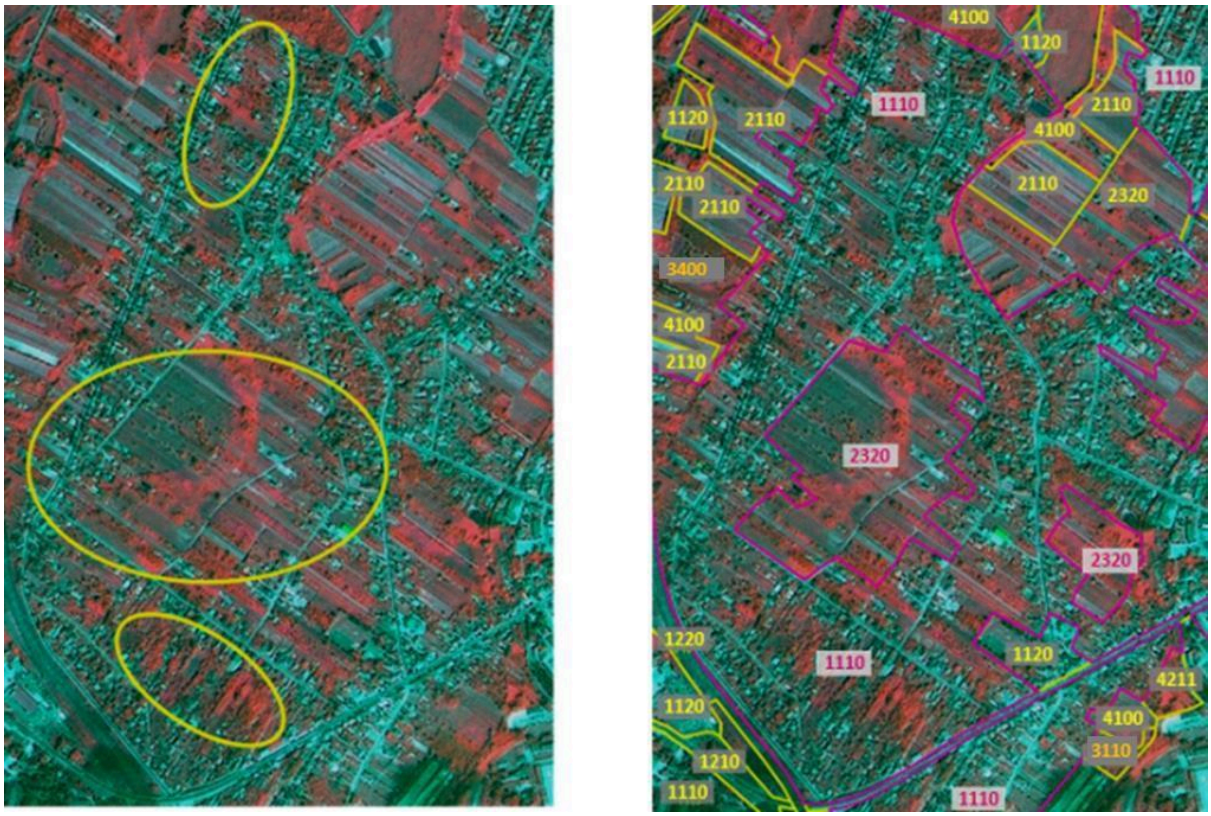
Generalized mapping of an area like the above is necessary. Gardens have to be included. Gaps of less than 50 meters are generalized and single blocks are connected. Large agricultural areas (width > 50 m) at the urban border should not be included. CNES 2011©, Distribution Airbus DS/Spot Image.



Gardens and agricultural areas are included to a certain extent to support a cartographic representation and generalized outline of scattered urban areas. Poland, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.

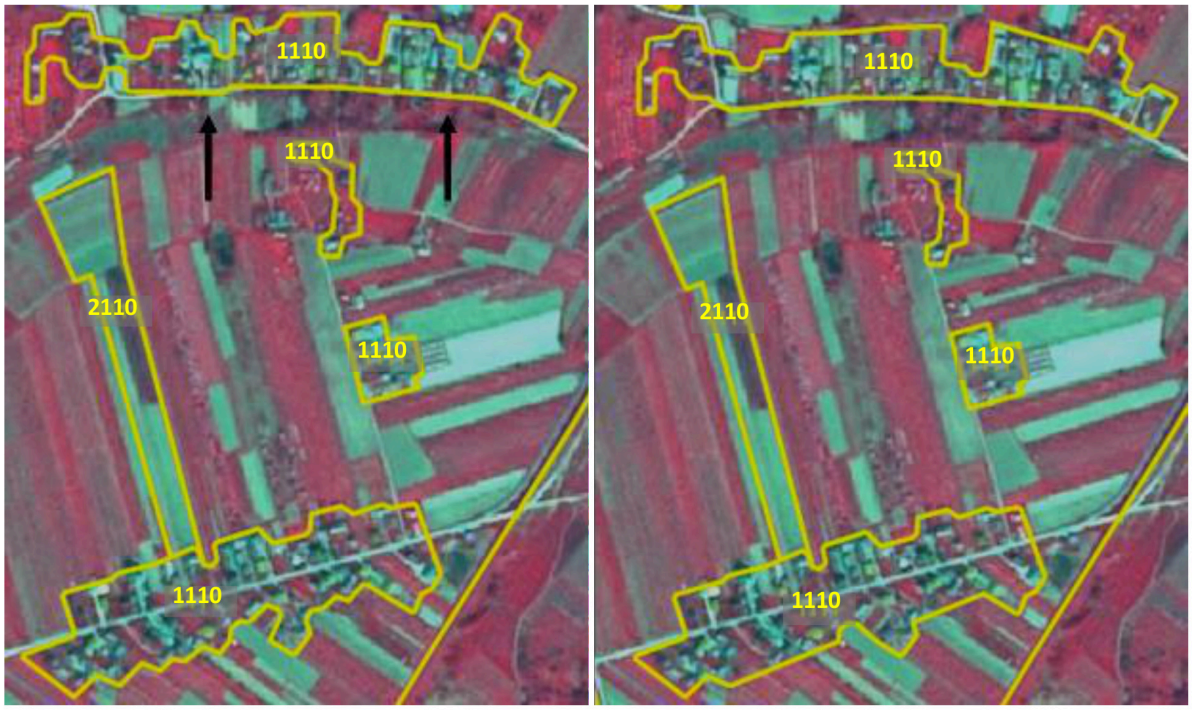


Example of generalized delineation of low urban density area class 1.1.1, Poland, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.



Generalize urban outline, include gardens and use 2.3.2 for complex areas, Poland, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.

If OSM delineation is too precise, please correct real errors and perhaps parts of the outline.



Left side: Very precise OSM delineation Keep OSM, and just correct errors. Right side: Manual delineation Map urban outline generalized. Poland, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-23. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use Urban Atlas Data, if available.

1.1.2 Industrial, commercial and military units

Definition:

This category contains industrial, commercial and military units. The administrative border and associated areas, such as roads, sealed areas and vegetated areas are included, if these areas are below the minimum mapping unit size. It also contains public, military and private services. At least 30% of the ground is covered by artificial surfaces. More than 50% of those artificial surfaces are occupied by buildings and / or artificial structures with non-residential use, i.e. industrial, commercial or transport related uses are dominant. The texture is homogenous with large buildings, car parks and sheds representing industrial or commercial complexes. Industrial or commercial units located in urban fabric are only taken into account if they are clearly distinguishable from residential areas.

This category includes:

Industrial uses and related areas:

- Sites of industrial activities, including their related areas.
- Production sites.
- Energy plants: nuclear, solar, hydroelectric, thermal, electric and wind farms.
- Farming industries (farms with large buildings and / or greenhouses below MMU, not production fields).
- Antennas, even with predominant vegetated areas. The vegetated areas may be predominant, but the land is not dedicated to forestry or agriculture.
- Water treatment plants, sewage plants and seawater desalination plants.

- Stud farms, agricultural facilities (cooperatives, state farm centers, livestock farms, living and exploitation buildings).
- Oil camps including administrative area.
- Abandoned industrial sites and by-products of industrial activities where buildings are still present.
- Water retention infrastructure (dam) and hydro-electric stations.
- Telecommunication networks (relay stations for TV, telescopes, radars) including associated land.
- Bare soil / grassland used for storage of material next to industrial sites.

Commercial uses, retail parks and related areas:

- Surfaces purely occupied by commercial activities, including their related areas (e.g. parking areas even larger than the MMU).
- High-rise office buildings.
- Petrol and service stations within built-up areas.
- Large shopping centers. Public, military and private services not related to the transport system:
- Surfaces purely occupied by general government, public or private administrations including their related areas (access ways, lawns, parking areas).
- Schools and universities research and development establishments, including associated areas like sports fields, meadows also if > 0.5 ha whenever they are inside the administrative limit.
- Hospitals and other health services or buildings.
- Places of worship (churches/ cathedrals/ religious buildings).
- Active archaeological sites and museums, near to urban areas.
- Administration buildings, ministries.
- Penitentiaries.
- Military areas excluding bases and airports.
- Military exercise areas fenced and under current use.
- Castles, etc. not primarily used for residential purposes (building management, etc.).
- Private storage areas without a residential component, such as compounds of garages.
- Company benefit schemes (old people's home, convalescent homes, orphanages, etc.).
- Exposition sites, fair sites.
- Military barracks, testing pistes, test fields, biological waste water treatment plants, water houses, transformers). The administrative boundary should be included and also associated land like storage space or managed grassland.
- Mine land areas.
- Cemeteries.
- Jetties without boats (boats belong to the water body).

Civil protection and supply infrastructure:

- Dams and dikes, if they are unvegetated.
- Irrigation and drainage canals and ponds and other technical public infrastructure, to be mapped with the roads, embankments and associated land included.
- Includes also breakwaters, piers and jetties, sea walls and flood defenses.
- (Ancient) city walls, other protecting walls, bunkers.

- Avalanche barriers.
- Security, law and order services (fire stations, penal establishments, etc.).

Water areas in industrial sites:

Water areas in industrial sites (ponds, settling basins, slurry tanks, etc.) will be mapped as industrial site even though they are larger than 0.5 ha, except water bodies related to the extractive industry (mines and gravel). These are mapped as class → 8.2.4 Standing water bodies of extractive industrial sites.

This category excludes:

- Petrol stations along fast transit and main roads with access only from these roads. They are mapped together with the road transport system → class 1.2.1 Road networks and associated land.
- Public parks → class 1.4 Green urban, sports and leisure facilities.
- Isolated holiday resorts including their hotels → class 1.4 Green urban, sports and leisure facilities.
- Sport centers or bathing centers → class 1.4 Green urban, sports and leisure facilities.
- Noise barriers → class 1.2.1 Road networks and associated land or 1.2.2 Railways and associated land.
- Lines of trees (woody barriers) for shelter or shading → class 3.5.0 Lines of trees and scrub.
- Water courses (within e.g. diked canals) if the water area is wider than 10 m → class 8.1.1 Natural & semi-natural water courses, 8.1.2 Highly modified water courses and canals.
- Artificial reservoirs not connected to industrial sites → class 8.2.2 Reservoirs.
- Dockyards and piers → 1.2.3 Port areas and associated land.
- Greenhouse surfaces → 2.1.2 Greenhouses.
- Dykes and dams, if they are vegetated → grassland or suitable LC/LU.
- Non-active archaeological sites → 1.3.2 Land without current use.
- Water bodies related to the extractive industry (mines and gravel) → 8.2.4 Standing water bodies of extractive industrial sites.
- Toxic lakes, used for disposal → 8.2.4 Standing water bodies of extractive industrial sites (if additional information is available indicating that the lake is used for industrial purposes – if no information is available: 8.2.1 Natural lakes or 8.2.4 Standing water bodies of extractive industrial sites).
- Small (usually temporal) agricultural dump sites (hay storage, manure, organic material, silage), if there is no other (permanent) storage or industrial facility in neighbourhood → 1.3.1 Mineral extraction, dump and construction sites.
- Afforestation setting, but used as transect for power line poles; power line poles visible → current LU / LC
- Open grassland, wood or other natural areas > 0.5 ha (MMU) within the boundaries of military sites → respective LC class.



Industrial or commercial units. (Riga, Latvia). Credit: K. Larsson.



Industrial site (Madrid, Spain). Credit: M. Palacios.

Appearance:



Industrial site, Skien (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Industrial site in Batman, Anatolia region (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-16. CNES 2011©, Distribution Airbus DS/Spot Image.



Active archeological site Hosap castle – Guzelsu (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-16. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use Urban Atlas data, if available.

1.2 Transport infrastructure

1.2.1 Road networks and associated land

Definition:

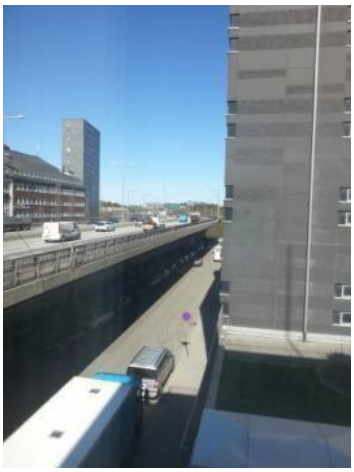
Road network and its associated land. In this sense, a road is identified as the route with a specially prepared surface that is intended for use by wheeled vehicles. Minimum mapping width for roads is $\geq$ 10 m.

This category includes:

- Roads, crossings, intersections and parking areas, including roundabouts and sealed areas with “road surface”.
- Slopes of embankments or cut sections.
- Areas enclosed by roads or railways, without direct access not representing any Urban categories and whenever below MMU.
- Fenced areas along roads (e.g. as for protection against wild animals).
- Areas enclosed by motorways, exits or service roads with no detectable access.
- Non-woody noise barriers (fences, walls, earth walls) adjacent to roads.
- Rest areas, service stations and parking areas only accessible from the fast transit roads.
- Foot- or bicycle paths parallel to the traffic line.
- Closed-down roads.
- Green strips, alleyways (with trees or bushes) if less than 10m wide.

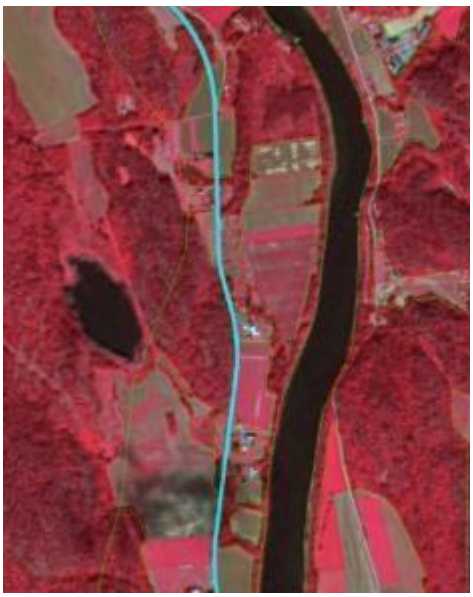
This category excludes:

- Motorways under construction $\rightarrow$ 1.3.1 Mineral extractions, dump and construction sites.
- Closed-down roads (classified under the real appropriate land cover category) if MMW less than 10 m.
- Land plots > 0.5 ha surrounded by roads and not considered as associated land. $\rightarrow$ Map current land cover category.

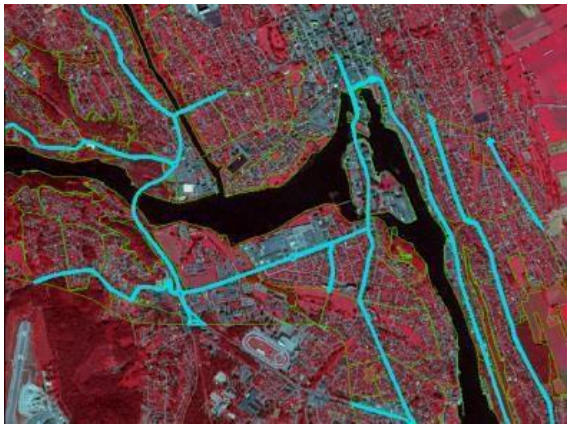


Road network and associated land, (Stockholm, Sweden) Credit: K. Larsson.

Appearance:



Delineation of class 1.2.1 marked in turquoise, Siljan (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation of class 1.2.1 marked in turquoise, Skien (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.

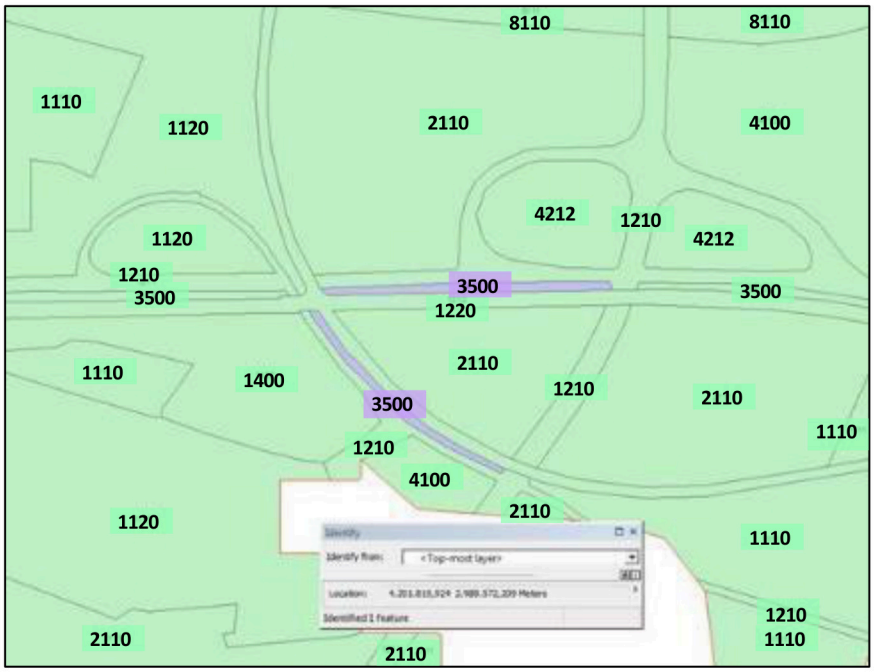


Example of 1.2.1 marked in turquoise, Bismil (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-07-13. CNES 2013©, Distribution Airbus DS/ Spot Image.

Specific aspects:

- Roads do not necessarily have to form a closed network. Isolated traffic lines are possible, but they have to be mapped with regard to the MMU criterion.
- Associated land < 0.5 ha MMU is mapped with the roads as it is visible in the EO data and topographic maps.
- If a road is covered by a tunnel, the LU/LC above the tunnel has to be mapped.

Specific generalization rule:



Class 3.5.0 (Lines of trees and shrub) surrounded by 1.2.1 (Road networks and associated land) and area < 0.5 ha: map as associated feature and generalize into road.

Methodological advice:

- Use Urban Atlas Data, if available.
- Use COTS transport infrastructure data.

1.2.2 Railways and associated land

Definition:

Railways and its associated land. In this sense, a railway is identified as one or more railway tracks comprising a network that is operated for the conveyance of passengers and/or goods. Minimum mapping width ≥ 10m.

This category includes:

- Railway facilities including stations, cargo stations and service areas.
- Closed-down rails ≥ 10m MMW and areas where infrastructure is still visible.

This category excludes:

- Rails ending in industrial sites → 1.1.2 Industrial, commercial and military units.
- Tramways → 1.2.1 Road networks and associated land.
- monorails, funiculars → 1.2.1 Road networks and associated land.
- Railways and high-speed train under construction → 1.3.1 Mineral extractions, dump and construction sites.
- Closed-down transport network: if MMW less than 10 m → generalize to surrounding LC.

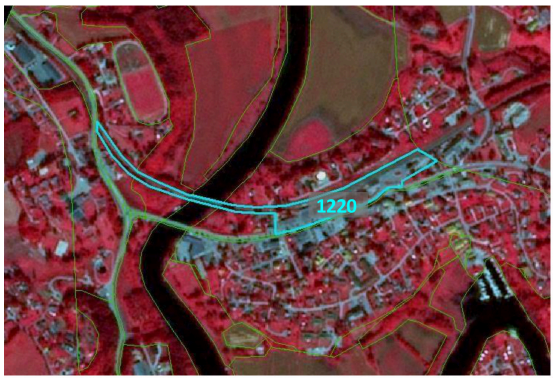


Railways and associated land (Täby, Sweden) Credit: K. Larsson.

Appearance:



Delineation in turquoise, Lunde (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



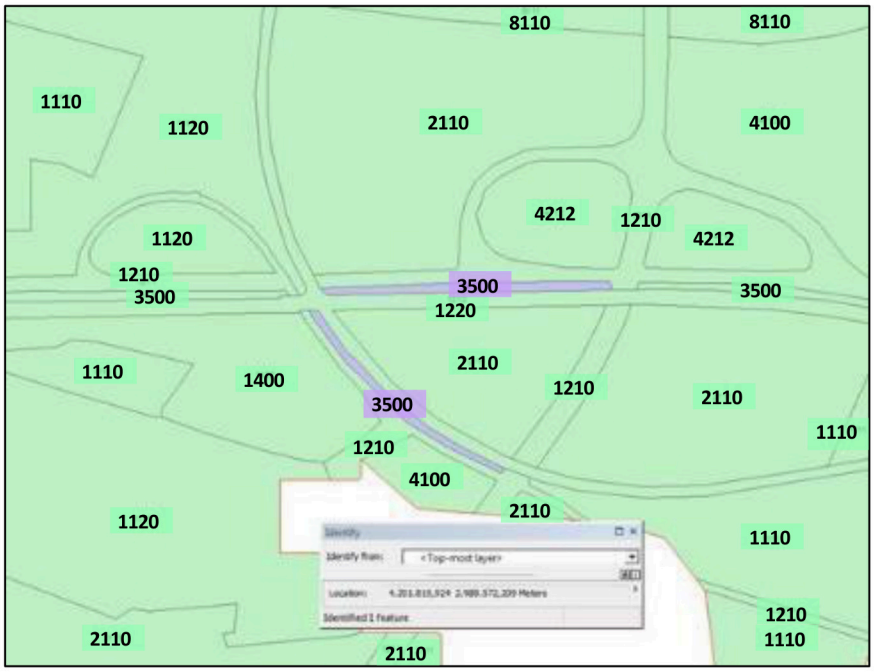
Delineation in turquoise, Gvarv (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.

Specific aspects:

- Railways do not necessarily have to form a closed network. Isolated railway lines are possible, but they have to be mapped with regard to the MMU criterion.
- Associated land < 0.5 ha is mapped with the railways as it is visible in the EO data and topographic maps, also in industrial sites.
- If railways intersect other objects on the same level, they always form the top-level. They clip all other features. If a road bridge spans above a railway line (different topological levels), the road is mapped.
- If a railway is covered by a tunnel, the LU/LC above the tunnel has to be mapped.

Generalization rules:

In industrial sites, rail networks are often complicated and hard to delineate in SPOT5/6 if no ancillary data are available. If no auxiliary data are available, map only those railroad features that can be detected with SPOT5/6 data.



Class 3.5.0 (Lines of trees and shrub) surrounded by 1.2.2 (Railways networks and associated land) and area < 0.5 ha. Map as associated feature and generalize into rail.

Methodological advice:

- Use Urban Atlas Data, if available.
- Use COTS transport infrastructure data, if available.

1.2.3 Port areas and associated land

Definition:

Port areas contain the infrastructure of the port area, quays, piers, dockyards and also the transport and storage area associated to the port. Delineation of port areas must be taken from the geographical location, near the sea or large rivers (inland ports).

This category includes:

- Administrative area of inland harbors and sea ports.
- Infrastructure of port areas, including quays, piers, dockyards, transport and storage areas and associated areas.
- Commercial and military ports.
- Shipyards.
- Fishing ports.
- Shipping and infrastructure port facilities.
- Harbour stations, dock houses.
- Oil terminals adjacent or connected to a port site.
- Piers, if related to port.

This category excludes:

- Marinas → class 1.4 Green urban, sports and leisure facilities.
- Yachts ports, sport and recreation ports → class 1.4 Green urban, sports and leisure facilities.
- Boats will be ignored
- Port area water, connected to the sea → class 8.4.1 Coastal waters.

- Port area water, connected to river or lakes → class 8.1 Water courses or 8.2 Lakes and Reservoirs.
- Port area water situated in a transitional waters like marine inlets, estuaries or fjords → 8.3 Transitional waters
- Port area water on marina or yachting ports (small area, not complying with MMU or MMW) → 1.4 Green urban, sports and leisure facilities.

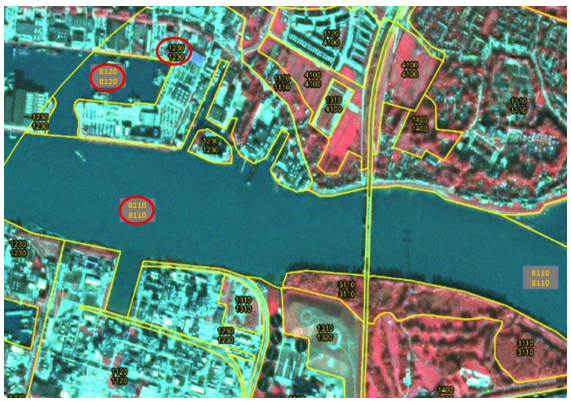


Port areas (Stockholm, Sweden) Credit: Eurostat, 2009. LUCAS.

Appearance:



Delineation of port and associated land in turquoise, Surtebogen (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Inland harbors connected to river, Dordrecht (Netherlands), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-24. CNES 2011©, Distribution Airbus DS/ Spot Image.

Methodological advice:

- Use Urban Atlas Data, if available.

1.2.4 Airports and associated land

Definition:

Everything associated with the airport (runways, buildings, hangars, associated land) is included in this class, contains also all grassland areas, even if > 0.5 ha. Artificial runways surrounded by grassy areas are easily distinguishable in satellite images. Heliports (helicopters ports) are also included in this category if they are > 0.5 ha.

This category includes:

- Administrative area of airports, mostly fenced.
- Included are all airport installations: runways, buildings and associated land (mainly grassland).
- Military airports.

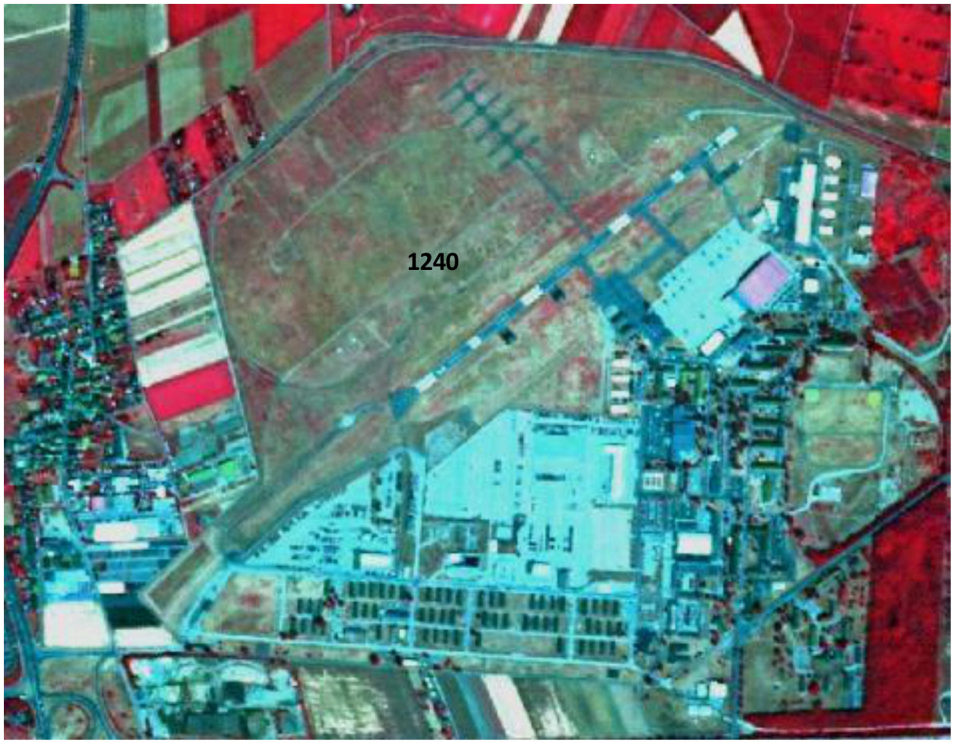
This category excludes:

- Aerodromes without sealed runway $\rightarrow$ class 1.4 Green urban, sports and leisure facilities.
- Sport airfield $\rightarrow$ 1.4 Green urban, sports and leisure facilities.



Airport, (Arlanda Stockholm, Sweden). Credit: K. Larsson.

Appearance:



Military airport, Wilhelmswöerth (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-14. CNES 2011©, Distribution Airbus DS/Spot Image.



Airport, Worms (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-14. CNES 2011©, Distribution Airbus DS/Spot Image.



Erzinkan airport, Turkey, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-16. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use Urban Atlas Data, if available.

1.3 Mineral extraction, dump and construction sites, land without current use

1.3.1 Mineral extraction sites, dump and construction sites

Definition:

This class includes public, industrial or mine dump sites, areas with open pit extraction of construction material or other minerals but also spaces under construction, soil or bedrock excavations and earthwork. Quarries and open-cast mines are easily recognizable on satellite images (white patches), because they contrast with their surroundings. The same applies to working gravel pits. Dump sites are often located near large towns or major industrial areas. Sites being exploited / in use or only recently abandoned, with no trace of vegetation, are comprised. Associated land, buildings and infrastructures are included. Construction sites are easily identifiable on satellite images. Included are construction sites for buildings, dams and motorways.

This category includes:

- Open pit extraction sites (sand, quarries) including water surface, if $< MMU$, open-cast mines, oil and gas fields; including infrastructure: buildings, roads, parking lots, etc.
- Their protecting dikes and / or vegetation belts and associated land such as service areas, storage depots.
- Public, industrial or mine dump sites, raw or liquid wastes, legal or illegal, their protecting dikes and / or vegetation belts and associated land such as service areas.
- Spaces under construction or development, soil or bedrock excavations for construction purposes or other earthworks visible in the image.
- Clear evidence of actual construction needs to be identifiable in the data, such as actual excavations and machinery on site, or ongoing construction of any stage, etc. In case of doubt → map according to their actual LC/LU.
- Active gravel pits.
- Inland salines (including water surface).
- Agricultural dump sites (hay storage, manure, organic material, silage).

This category excludes:

- Water bodies $> MMU$ → class 8 Water.
- Exploited peat bogs → class 7.1.2.1 Exploited peat bog.
- Coastal salines → class 7.2.2 Salines.
- Re-cultivated areas → mapped according to their actual land cover.
- Decanting basins of biological water treatment plants → class 8.2.2 Reservoirs or 8.2.4 Standing water bodies of extractive industrial sites.
- Non-active gravel pits → map according to their actual LC/LU, mainly 3.4.0 Transitional woodland and scrub (if bushes are visible), 6.1 Sparsely vegetated areas and 6.2.2 River banks.



Construction site (Cadiz, Spain). Credit: M. Palacios.



Construction site (Malaga, Spain). Credit: M. Palacios.



Dump site (Madrid, Spain). Credit: M. Palacios.



Dump site (Madrid, Spain). Credit: M. Palacios.

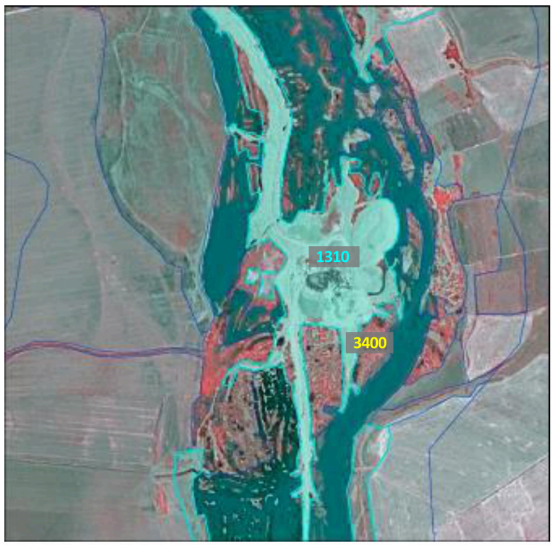
Appearance:



Delineation of mineral extraction site in turquoise, Benfeld (France), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-14. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation of construction site in turquoise, Skien (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Gravel pit, Turkey, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-08-07. CNES 2013©, Distribution Airbus DS/Spot Image.

Specific delineation rules for gravel pits:

If the gravel pit is active: map as 1.3.1 Mineral extraction, dump and construction sites. If it is not-active, map as 3.4.0 Transitional woodland and scrub (in case bushes are visible). For all areas without or with little vegetation (< 30): Map as 6.2.2 River banks.

Methodological advice:

- Use Urban Atlas Data, if available.

1.3.2 Land without current use

Definition:

Areas in the close to artificial surfaces, still waiting to be used or re-used, is obviously in a transitional position, "waiting to be used" and will be mapped as Land without current use. "Land without current use" located outside urban areas will be classified according to their land cover – mostly grassland or transitional (bushes have to be visible).

This category includes:

- Waste land, removed former industry areas, ("brown fields") gaps in between new construction areas or leftover land in the urban context ("green fields").
- No actual agricultural or recreational use.
- No construction is visible, without maintenance, but no undisturbed fully natural or semi-natural vegetation (secondary rural vegetation).
- Also areas where the street network is already finished, but actual erection of buildings is still not visible.
- Non-active archaeological sites, archaeological sites without infrastructure (like e.g. museum, parking places, access roads) if inside urban continuum.

This category excludes:

- "Leftover areas", areas too small / narrow for any construction with regard to the MMU size → map to the appropriate neighbor(u)r class as associated land.

- Active archaeological sites → 1.1.2 Industrial, commercial and military units.



Land without current use (Malaga, Spain). Credit: M. Palacios.

Appearance:



Delineation in turquoise, Urk (Netherlands), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-06-04. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation in turquoise, Porsgun (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Ruins in Caykoy, Turkey, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-30. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use Urban Atlas Data, if available.

1.4 Green urban, sports and leisure facilities

Definition:

All sports and leisure facilities including associated land, whether public or commercially managed. Public arenas for any kind of sports including associated green areas, parking places, etc. Usually near to human

settlements. Vegetation is often planted and regularly worked by humans; strongly human-influenced. Public green areas such as gardens, zoos, parks, castle parks with predominantly recreational use and sporting facilities independent of being non-sealed, sealed or built-up, are entirely included on this category.

This category includes:

- Public green areas for predominantly recreational use such as gardens, zoos, parks, castle parks.
- Suburban natural areas that have become and are managed as urban parks.
- Forests or green areas extending from the surroundings into urban areas are mapped as green urban areas when at least two sides are bordered by urban areas and structures, and traces of recreational use are visible.
- Golf courses.
- Sports fields (also outside the settlement area).
- Camp grounds.
- Leisure parks.
- Riding grounds and associated horse stables and riding halls.
- Racecourses.
- Amusement parks.
- Swimming resorts etc.
- Isolated holiday villages.
- Allotment gardens.
- Glider or sports airports, aerodromes without sealed runway.
- Marinas and associated Jetties.
- Skiing slopes.
- Buildings belonging to 1.4 areas such as riding halls next to riding grounds or tennis halls next to tennis court complexes.

This category excludes:

- Private gardens within housing areas → 1.1.1 Urban fabric.
- Cemeteries → 1.1.2 Industrial, commercial and military units.
- Buildings within parks, such as Castles or museums → 1.1.2 Industrial, commercial and military units.
- Patches of natural vegetation or agricultural areas enclosed by built-up areas without being managed as green urban areas → class 2.1.1 Arable irrigated and non- irrigated land or 4.1 Managed grassland.
- Motor racing courses within industrial zone used for test purposes → 1.1.2 Industrial, commercial and military units.
- Caravan parking used for commercial activities → 1.1.2 Industrial, commercial and military units.
- Soccer fields, etc. within e.g. military bases or within schools or university campuses → 1.1.2 Industrial, commercial and military units.
- Boats → 8 Water.



Green urban areas (Täby, Sweden). Credit: K. Larsson.



Green urban areas (Marbella, Spain). Credit: M. Palacios.



Golf course. Credit: M. Palacios.



Sports and leisure facilities (Göteborg, Sweden). Credit: Eurostat, 2009. LUCAS.



Sports and leisure facilities (playground), (Täby Sweden) Credit: K. Larsson.



Sports and leisure facilities (Artificial football field) (Täby Sweden). Credit: K. Larsson.

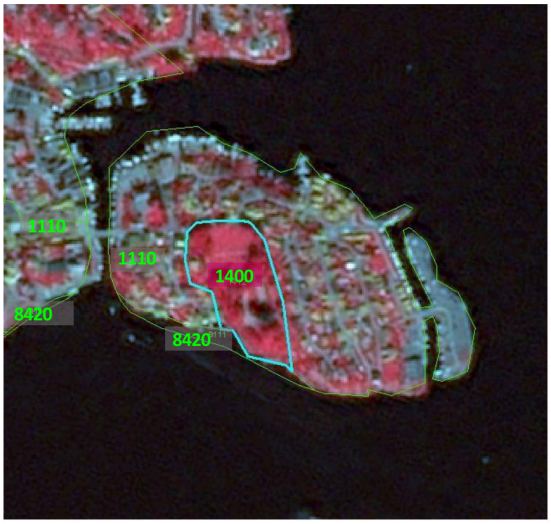
Appearance:



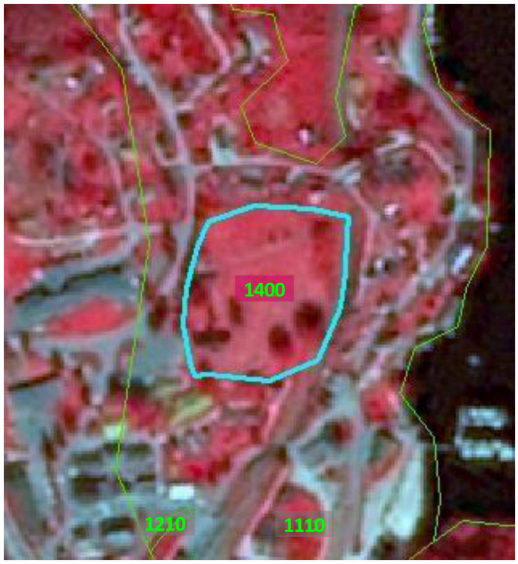
Delineation, Avezzano (Italy), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-15. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation, Uleforss (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation in turquoise, Brevik (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation in turquoise, Drangedal (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Delineation from Golf Course in turquoise, Uleforss (Norway), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.

Isolated holiday village's delineation criteria:



Übersee (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-11. CNES 2011©, Distribution Airbus DS/Spot Image.

Map only distinct “holiday and leisure infrastructure” (e. g. camping grounds) as 1.4 Green urban, sports and leisure facilities.

Methodological advice:

- Use Urban Atlas Data, if available.

2. Cropland

Cropland is the main food production area. It includes both intensively managed ecosystems and multi-functional areas supporting many semi-natural and natural species along with food production (lower intensity management). It comprises regularly or recently cultivated agricultural, horticultural and domestic habitats and agro-ecosystems with significant coverage of natural vegetation (agricultural mosaics)[2].

MAES categorizes croplands in three main groups:

Arable Land is land under a rotation system used for annually harvested plants and fallow lands. The land is permanently or not irrigated. It includes cereals, oil seed plants, vegetables, beets, fodder and flooded crops such as rice and other inundated croplands.

Permanent crops are surfaces that are not under a rotation system but last for many seasons and don´t need to be replanted after harvest. Included are ligneous crops of standard cultures for fruit production such as extensive fruit orchards, olive groves, chestnut groves, walnut groves, shrub orchards such as vineyards and some specific low-system orchard plantation, espaliers and climbers. In the case of irrigated permanent crops, the qualification of irrigation prevails over permanent, thus, all the irrigated permanent crops are classified as 2.1.1 Arable land.

Heterogeneous agricultural areas comprise surfaces where several categories are mixed. This may be either annual crops associated with permanent crops on the same parcel or annual crops cultivated under forest trees. Moreover, also combinations of annual crops, meadows and/or permanent crops mixed with natural vegetation or natural areas belong to this class.

Specific decision rules have been stabilised to distinct different types of heterogeneous agricultural areas:

- Annual crops associated or in mosaic with permanent crops (vineyards, olives groves and non-irrigated fruits trees) in parcels < 0.5 ha $\rightarrow$ 2.3.1 Annual crops associated with permanent crops.
- Mosaic or association of arable land and permanent crops in parcels < 0.5 ha. $\rightarrow$ 2.3.2 Complex cultivation patterns.
- Mix of arable land and pastures $\rightarrow$ 2.3.2 Complex cultivation patterns.
- Crops (annual/permanent/irrigated/non-irrigated) and mosaic of crops and pastures in mosaic and natural vegetation (agricultural area $> 75\%$ and presence of parcels).
- $\rightarrow$ 2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation.
- Agro-forestry landscapes in specific locations $\rightarrow$ 2.3.4 Agro-forestry.

2.1 Arable land

2.1.1 Arable irrigated and non-irrigated land

Definition:

Arable land includes irrigated and non-irrigated arable land.

[2] European Commission (2013): Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessment under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper, Final, April 2013.

Irrigated arable land	Non-irrigated arable land
Crops irrigated permanently or periodically. Most of the crops cannot be cultivated without an artificial water supply. Use of permanent irrigation infrastructure (irrigation channels, drainage network, irrigation ponds). Includes also rice fields and irrigated fruits trees and vineyards in Mediterranean region. Irrigated arable land is restricted to Mediterranean areas, except clear areas with irrigated permanent infrastructures in other regions (such as Po river valley or Danube plain in Romania). The delimitation of Mediterranean will be based on biogeographic regions cartography.	All kind of crops like cereals, legumes, fodder crops, root crops and fallow land. Includes flower and tree (nurseries) cultivation and vegetables (e.g. asparagus), whether open field or under plastic sheets. Includes market gardening and aromatic, medicinal and culinary plants.

This category includes:

Irrigated arable land	Non-irrigated arable land
• Traditional irrigated arable land with permanent irrigation infrastructure. Traditional irrigation areas located in fertile alluvial soils alongside the main Mediterranean rivers. These areas also include intensively or extensively managed fruit trees.	• All kinds of non-irrigated arable land excluding permanent crops.
• Rice fields in Italy, Spain, Portugal or France (e.g. Camargue). Rice fields can be periodically flooded.	• Hop plantations.
• Irrigated land using underground water when parcels > 0.5 ha (regardless of the irrigation system). In many cases, parcels occupied with crops under sprinkling irrigation systems are mixed with parcels occupied by non-irrigated crops. The location of irrigated parcels can vary from an agricultural year to another within the same area.	• Multi-year crops as asparagus and chicory – also if planted under plastic sheets.
• Areas predominantly irrigated using center-pivots irrigation systems. Main areas are located in Turkey (Tigris-Euphrates basins), Central Spain (La Mancha and Ebro Valley) or Portugal (Alentejo). The location of the center-pivots systems can vary from an agricultural year to another within the same area.	• Semi-permanent crops as strawberries.
• Fruit trees irrigated permanently and intensively managed. Full irrigation is needed to maintain these crops (e.g. orange trees, lemon trees, peach trees, etc.). Irrigated strawberries fields intensively managed. Intensively irrigated vineyards in Mediterranean region. In many cases associated to artificial irrigations ponds. Well represented in Southern Spain. Parcel with young tree plantations are also included (identifiable by soil removal, big parcels, presence of irrigation ponds, etc.).	• Temporary fallow land, such as land under three yearly rotation systems (no change mapping for steady rotation areas).
	• Drained arable land.
	• Non-permanent industrial crops as textile plants (e.g. cotton, flax), oleaginous plants (e.g. rapeseed, sunflower).
	• Tobacco.
	• Condiment plants.

Irrigated arable land	Non-irrigated arable land
	• Sugar cane.
	• Industrial flower crops as lavender species.
	• Flowers under rotation system.
	• Nurseries-garden (seedlings of fruit trees and shrubs)
	• Cereals burnt after harvesting (usual practice in Anatolia, Turkey).
	• Arable fields using for growing hay.
	• Abandoned irrigated arable land even the irrigation channel network is still visible in the satellite image.
	• Strawberries not irrigated.

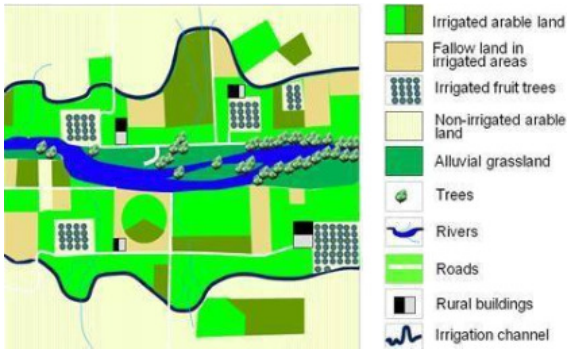
This category excludes:

Irrigated arable land	Non-irrigated arable land
• Drainage network intended to clean up wet soils → Classification according to their actual land cover.	• Permanent crops → 2.2.x Permanent crops.
• Crops under greenhouses → 2.1.2 Greenhouses.	• Managed and natural grassland → 4.x.x.x Grassland.
• In specific locations across Europe, crops could be sporadically irrigated using sprinkler systems (e.g. improvement of production of potatoes or maize in dry summers in Central and Western Europe or irrigation of winter cereals in Southern Europe). Olive-trees, other fruit trees and vineyards could be also sporadically irrigated using localization irrigation systems. These categories are not included in this class → other arable land categories.	• Allotment gardens, city gardens → 1.4 Green urban, sports and leisure facilities.
• Ancient rice fields with irrigation channels should be mapped according to their actual land cover.	• Land that lies fallow for at least three years and which looks like grassland → 4.2.1.x Semi-natural grassland.
	• Rice fields → 2.1.1 Arable irrigated and non-irrigated land.
	• Forest tree nurseries with non-commercial purposes located in forest areas → 3.4.0 Transitional woodland and scrub.
	• Fruit and berry plantation under greenhouses → 2.1.2 Greenhouses.
	• Osier trees for wicker production → 2.2.1 Vineyards, fruit trees and berry plantations.

Irrigated arable land	Non-irrigated arable land
	• Permanent plantations of roses → 2.2.1 Vineyards, fruit trees and berry plantations.
	• Wine-growing nurseries → 2.2.1 Vineyards, fruit trees and berry plantations.



Irrigation channel in Osmaniye (Turkey). Credit: "Osmaniye irrigation" by Ozgurmulazimoglu - Own work. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Osmaniye_irrigation.JPG#mediaviewer/File:Osmaniye_irrigation.JPG.



Schematic representation of a permanent irrigated area with irrigation channels.



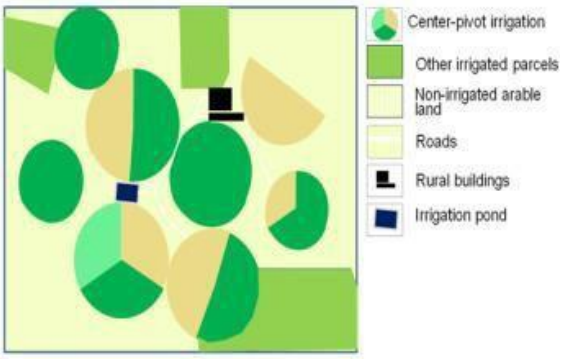
Sprinkler irrigation. Credit: M. Palacios.



Schematic representation of an area irrigated in summer time using underground water.



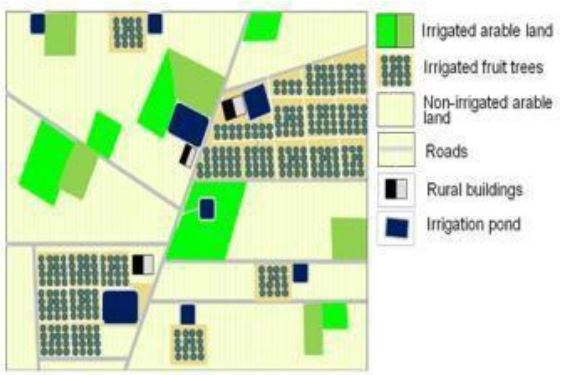
Center-pivot irrigation system. Credit: J. Pecci.



Schematic representation of an area irrigated using center pivot irrigation systems.



Irrigation pond and fruit trees in South-East Spain. Credit: M. Palacios.



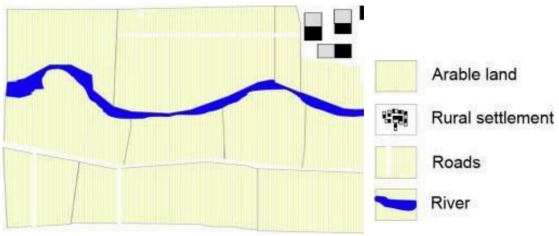
Schematic representation of irrigated fruit trees parcels with irrigation ponds.



Non-irrigated arable land: Rapeseed in Germany. Credit: M. Probeck.



Non-irrigated arable land: Parcel of cereal harvested in Central Spain. Credit: M. Palacios.



Schematic representation of managed non-irrigated arable land.

Appearance:



Traditional irrigated area in Saka, Anatolia (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-06. CNES 2011© Distribution Airbus DS/ Spot Image.

- Traditional irrigated arable land with permanent irrigation infrastructure
  - Red colours in summer-time. Regular and small-medium parcels.
  - Irrigation channels visible.
  - Villages and farms.



Rice fields at Rosayenda, Italy, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-29. CNES 2011©, Distribution Airbus DS / Spot Image.

- Rice fields
  - In specific locations as deltas or near big rivers. Other locations are also possible.
  - Red colours in summer-time. Presence of water in spring and soil in winter.
  - Regular and small-medium parcels.
  - Clear presence of irrigation channels visible.
  - Presence of buildings.



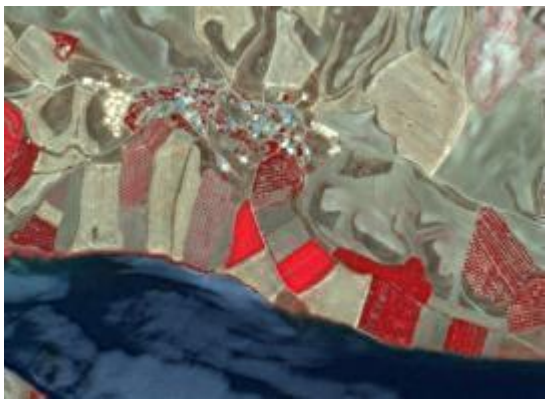
Viransehir (Turkey), Spot 5 (2.5 m; natural colour combination). Date: 2006-09-16. CNES 2006 ©, Distribution Airbus DS / Spot Image.

- Irrigated land using underground water
  - Regular medium and big parcels.
  - Red colour in infrared bands combinations in summer time. Mixed with not irrigated parcels.



Zaragoza, Ebro valley (Spain), Spot 5 (2.5 m; natural colour combination). Date: 2006-08-27.CNES 2006 ©, Distribution Airbus DS / Spot Image.

- Center-pivot irrigation landscape
  - Typical round shape of center-pivot irrigation systems.
  - Red colour in infrared bands combinations in summer time.
  - Mixed with not irrigated parcels.



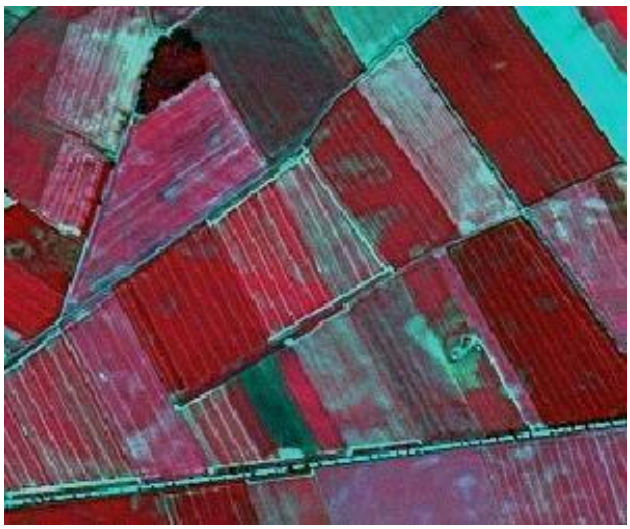
Irrigated fruit trees plantation in Morhamam, Anatolia (Turkey), Spot 5 (2.5 m; NIR/R/G band combination). Date: 2011-06-29. CNES 2011© Distribution Airbus DS/Spot Image.

- Intensively managed fruit tree plantations
  - Identification of lines of trees.
  - Red colour in infrared bands combinations in summer time.



Non-irrigated agricultural fields, Northern Germany, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-07-27. CNES 2012©, Distribution Airbus DS/ Spot Image.

- Landscape structured by fields of rectangular size.
- Mix of diverse crops resulting in a heterogeneous pattern of different image colours and image textures.
- Located on fertile grounds and in vicinity to settlements.
- Mix of red, green and blue colours. Red colours indicate vital green whereas green and light blue colours are an evidence for open soil of fields which already have been harvested.



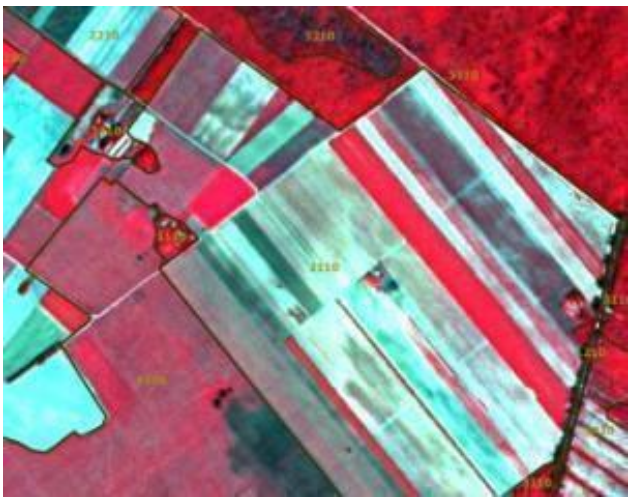
Non-irrigated arable land in central Europe, Germany, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-06-28. CNES 2010©, Distribution Airbus DS/ Spot Image.

- Plough furrows are a typical characteristic of crops.



Non-irrigated arable land in Altnkusak, Anatolia (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-05. CNES 2011© Distribution Airbus DS/Spot Image.

- Yellow/white colours in summer-time.



Non-irrigated arable land, Hungary, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-05. CNES 2013©, Distribution Airbus DS/Spot.

- Square allotments, flat surface.

Methodological advice:

- Use LPIS if available.
- EO data acquired outside the vegetation period may also support the discrimination between arable land and grassland.
- EO data with different band combinations than the normal false colours combination also support the discrimination between arable land and grassland, e.g. Landsat 8 band comination 5-6-4.

2.1.2 Greenhouses

Definition:

All types of greenhouses regardless of whether they have solid glass or plastic roofs. The greenhouses are used to breed plants, vegetables or flowers.

This category includes:

- All kinds of greenhouses used to breed trees, plants, vegetables or flowers.
- Greenhouses also with open roofs at time of EO data acquisition but with clear presence of infrastructure.

This category excludes:

- Crops grown under plastic sheets (e.g. asparagus, strawberries plantations and other vegetables) → Other types of crops.



Greenhouse in Almeria (Andalusia, Spain). Credit: Eurostat, 2009. LUCAS.



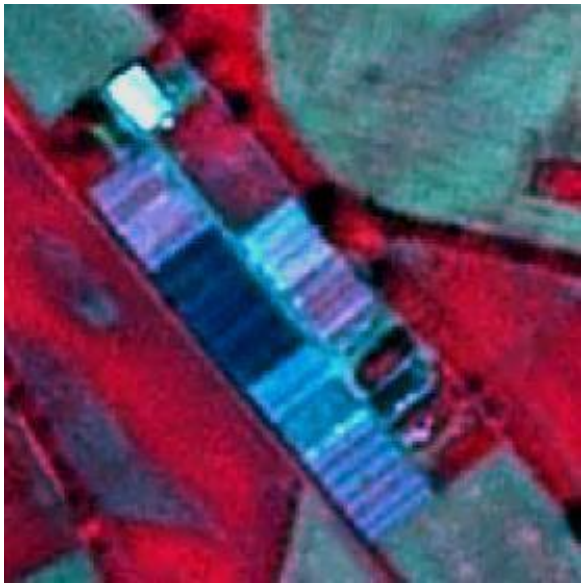
Greenhouses structure in Almeria (Andalusia, Spain). Credit: Eurostat, 2009. LUCAS.

Appearance:



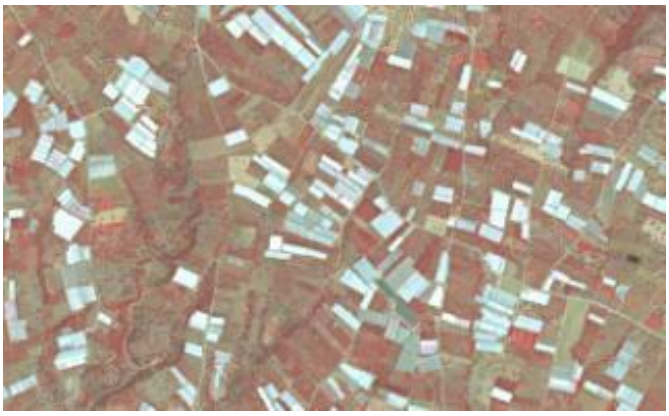
Nursery with greenhouses, Lampertheim (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-14 CNES 2010©, Distribution Airbus DS/ Spot Image.

- Mostly located in rural areas at the outer border of settlements, but near cities.
- High reflection of buildings due to the plastic or glass roofs. This may lead to confusions with industrial or commercial buildings. It is therefore recommended to check the objects with high-resolution data sources or other data sources like e.g. topographic maps.
- Oftentimes surrounded by small fields where vegetables or flowers are grown.



Nursery with greenhouses, Lampertheim (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-14 CNES 2010©, Distribution Airbus DS/ Spot Image.

- Typical characteristic: long but very narrow, parallel buildings.
- Certain types of greenhouses can open their roofs. In this case, the greenhouse may appear as a normal field.



Greenhouses in Koru (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-29. CNES 2011©, Distribution Airbus DS/Spot Image.

- In Mediterranean areas, located in very intensive agricultural areas and in many cases mixed with irrigated parcels.

2.2 Permanent crops

2.2.1 Vineyards, fruit trees and berry plantations

Definition:

Parcels planted with fruit trees, single or mixed fruit species, fruit trees associated with permanently grassed surfaces, small fruit trees or shrubs and berry plantations. Includes chestnut and walnut groves. Furthermore, it includes plantations of traditional and intensive managed grapevine grown mainly for winemaking, but also raisins, table grapes and non-alcoholic grape juice.

This category includes:

- Plantations of traditional and intensive managed grapevine including vine-growing nurseries, interspaces of vegetation and small access roads.
- Complex cultivation patterns where vineyards cover more than 50% of the area.
- Abandoned vineyards in case they still have the characteristic structure.
- Scattered high-stem and low-stem deciduous and evergreen fruit trees (e.g. apple, pear, plum, apricot, peach, cherry, citrus trees) planted in the field. The underground is mostly grassland, but can also be arable land.
- Berry plantations.
- Deciduous or evergreen fruit trees and berry plantations.
- Central Europe: “meadow orchards” which is a traditional landscape in the temperate, maritime climate.
- Mediterranean zone: non-irrigated fruit trees (almonds and others as *ceratonia siliqua* or cherries and chestnut trees in mountainous areas), in many cases mixed with vineyards and olive groves and cereals. Pistachio trees in Turkey.

- Willow plantations for wicker production.
- Abandoned orchards which still preserve characteristic alignments.
- Dwarf trees, shrubs espaliers or perennial ligneous climbers.
- Permanent florist plantation of roses.
- Permanent industrial plants like coffee, cacao, mulberry and tea.
- Plantation of vineyards associated to fruit trees within the same parcel where vines cover at least 40% of the cover.

This category excludes:

- Intensively irrigated vineyards in Mediterranean region → 2.1.1 Arable land.
- Annual crops associated with vineyards, if the single features are < 0.5 ha → 2.3.1 Annual crops associated with permanent crops.
- Intensively / permanently irrigated fruit trees and berry plantations → 2.1.1 Arable land.
- Fruit trees under greenhouses → 2.1.2 Greenhouses.
- Hop plantations → 2.1.1 Arable land.
- Fruit tree nurseries → 2.1.1 Arable land.
- Strawberries → 2.1.1 Arable land.
- Multi-year plants as asparagus → 2.1.1 Arable land.
- Olive groves → 2.2.2 Olive groves.
- Carob trees → 3.x.x Woodland and forest.
- Abandoned orchards where plantation structures have disappeared → 3.4.0 Transitional woodland and scrub.



Vineyards in Dordogne (France). Credit: C. Alonso.



Vineyards in Duero Valley (Central Spain). Credit: M. Palacios.



Apple trees in Slovakia. Credit: Eurostat, 2009. LUCAS.



Almond trees in Valencia region (Spain). Credit: Eurostat, 2009. LUCAS.



Cherry fruit trees, western Germany. Credit: Eurostat, 2012. LUCAS.



Low stem fruit trees near Rome, Italy. Credit: Eurostat, 2012. LUCAS.



Vineyard in Loutsa (Island of Evia), Greece. Credit: N. Kolpatzik.

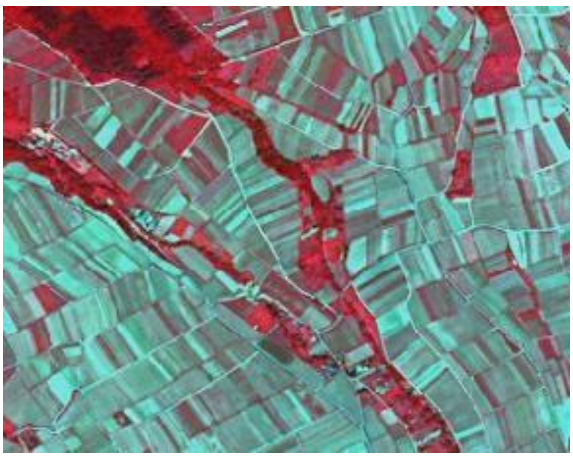
Appearance:

Vineyards:

- Characteristic structure: small parcel sizes, terraced cultivation and high reflectance of open soil when cultivated in rows.



Vineyards, Úbeda (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-12. CNES 2011©, Distribution Airbus DS/Spot Image.



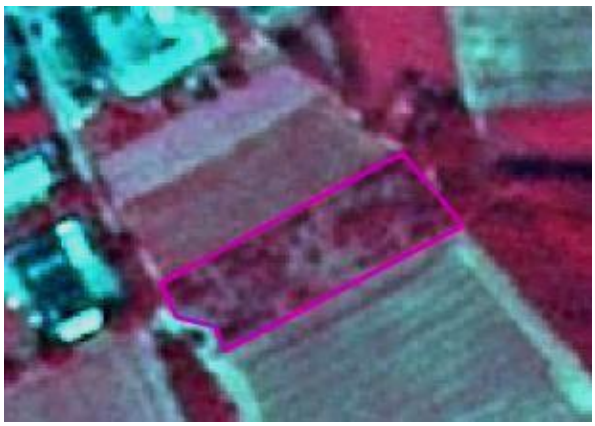
Vineyard, Oestrich-Winkel (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-06-03. CNES 2010©, Distribution Airbus DS/Spot Image.



Vineyard, Lösnich (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-06-03. CNES 2010©, Distribution Airbus DS/Spot Image.

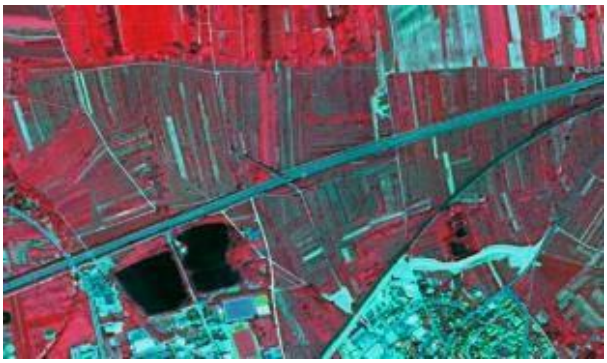
- Location in Central Europe and other Atlantic areas: very often located at steep river shores and at sun-oriented hillsides.

High stem fruit trees:



High stem fruit trees, Helmarshausen (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-06-28. CNES 2010©, Distribution Airbus DS/Spot Image.

- In vicinity to urban areas or agricultural farms; mostly private use.
- In most cases irregular planting scheme.
- In Central Europe: Understorey is normally grassland, sometimes also arable land (e.g. Luxemburg).



High stem fruit trees, Ingelheim am Rhein (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-06-03. CNES 2010©, Distribution Airbus DS/ Spot Image.

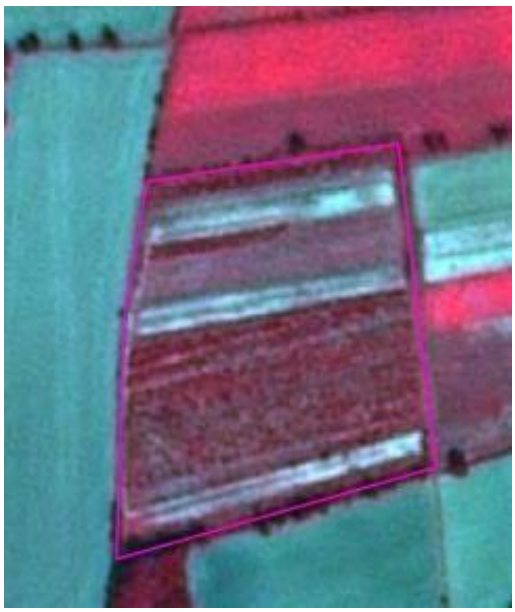
- Sometimes planted in small stripes.



Example of pistachio cultivation, Nizip (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-05-07. CNES 2011©, Distribution Airbus DS/Spot Image.

- Regular planting scheme.
- Big tree crown and red colour in infrared band combinations.
- Understorey without vegetation.
- Usually in fertile soils.

Low stem fruit trees:



Schwarmstedt (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-09-05. CNES 2013©, Distribution Airbus DS/Spot Image.

- Appearance similar to shrub, but regular planting scheme.
- Appearance similar to arable crops.
- Coarse texture.
- In many cases (e.g. tea plantations) ancillary data is needed for identification.

Special aspects:

- Where fruit trees or berry plantations are associated to olive trees on the same parcel, the following rules are applied:
  - Fruit tree cover $> 50\%$: $\rightarrow$ 2.2.1 Vineyards, fruit trees and berry plantations.
  - Fruit tree cover $< 50\%$: $\rightarrow$ 2.2.2. Olive groves
  - Fruit tree cover $= 50\%$, olive cover $= 50\% \rightarrow$ 2.2.2. Olive groves.

Generalization rules for fruit trees and berry plantations mixed with fallow land or annual agricultural crops:

- Often small, “fallow” stripes without vegetation or parcels of other annual crops inside complexes of fruit trees or berry plantations.

Approach for small, vegetationless stripes of fallow land/annual crops inside areas which are mainly covered by fruit trees or berry plantations:

- Cut out big, related blocks of areas without vegetation (see yellow arrow).
- Integrate smaller stripes without vegetation.



Apple plantation, Eger (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-18. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use of CLC class 2.2.1 as orientation.

2.2.2 Olive groves

Definition:

Areas planted with olive trees.

This category includes:

- Olive trees dedicated to production of olives and oil.
- There are some instances when olive and vineyard parcels are combined, in this case the parcels have to be delimitated individually if they are > 0.5 ha, but should be included in the same polygon when they are < 0.5 ha. Whether they are assigned to olive grove or to vineyards will depend on density.

This category excludes:

- Olive trees are considered as non-irrigated crops, except in specific sites where they are in association or mosaic with irrigated annual crops → 2.1.1 Arable land.
- Wild olive trees → 5.3 Sclerophyllous scrub.
- Abandoned olive trees → 5.3 Sclerophyllous scrub.



Olive groves in a mountainous area in South-western Spain. Credit: M. Palacios.



Young plantation of olive trees in Southern Spain. Credit: J. Pecci.



Olive groves in Kathenes (Island of Evia), Greece. Credit: N. Kolpatzik.



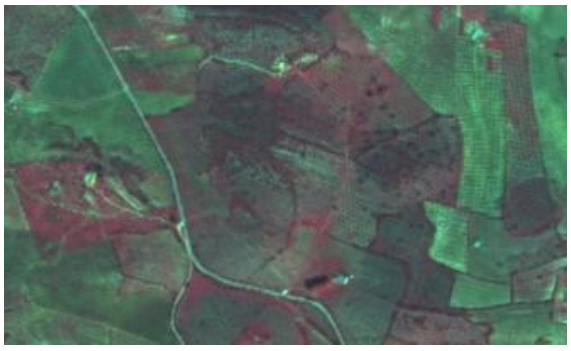
Olive groves in Kallithea (Island of Evia), Greece. Credit: N. Kolpatzik.

Appearance:

- Scattered trees on grassland or arable land.
- Regular and irregular planting scheme.
- In most cases planted schemes with characteristic Spotted structure.



Olive grove with vineyards, Úbeda (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-12. CNES 2011©, Distribution Airbus DS/Spot Image.



Olive grove, Badajoz (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-03-18. CNES 2011©, Distribution Airbus DS/Spot Image.

Special aspects:

- In case, fruit trees are associated to olive trees on the same parcel, map
  - 2.2.2 Olive groves, if olive trees cover $\geq 50\%$
  - 2.2.1 Vineyards, fruit trees and berry plantations, if olive trees cover $< 50\%$

Methodological advice:

- Use of CLC class 2.2.3 as orientation.

2.3 Heterogeneous agricultural area

2.3.1 Annual crops associated with permanent crops

Definition:

Non-permanent crops (arable land or pasture) associated with permanent crops on the same parcel. Mosaic of annual crops and permanent crops (parcels less than 0.5 ha). This class is used in Mediterranean areas, where associations olive groves/vineyards and annual crops appear frequently.

This category includes:

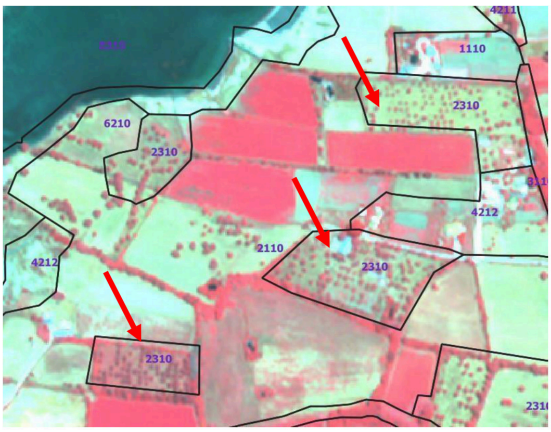
- Association of annual and permanent crops while the proportion of each crop is below the MMU of 0.5 ha.

This category excludes:

- Permanent crops (vineyards and olive groves) non cultivated in mosaic or association with annual crops → 2.2.1 Vineyards, fruit trees and berry plantations / 2.2.2 Olive groves.



Typical landscape of annual crops in association and mosaic with olive groves and vineyards in Spain. Credit: Eurostat, 2009. LUCAS.



Annual crops associated with permanent crops in Greece. (1/2/3 band combination). Date: 2018-06-11. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

Appearance:

- The same appearance as annual crops, olive groves and vineyards.

2.3.2 Complex cultivation patterns

Definition:

Mosaic of small parcels of diverse annual crops, pastures and/or permanent crops. Small irrigated parcels mixed with non-irrigated arable land parcels. Includes irrigated fruits trees.

This class includes mixed parcels (< 0.5 ha) of permanent crops (fruits trees as almonds and others, berry plantations, vineyards and olive groves.

In difference to 2.3.1 Annual crops associated with permanent crops the class 2.3.2 Complex cultivation patterns includes mixed parcels which are too small to be mapped as a single feature with an area of > 0.5 ha.)

The distinction between 2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation and 2.3.2 is, unlike in 2.3.2, the presence of natural vegetation (patches of trees, small forests, scrub) or natural objects like little lakes or ponds.)

In 2.3.2 Complex cultivation patterns we only have a mixture of annual crops, grassland and/or permanent crops, but no natural vegetation.

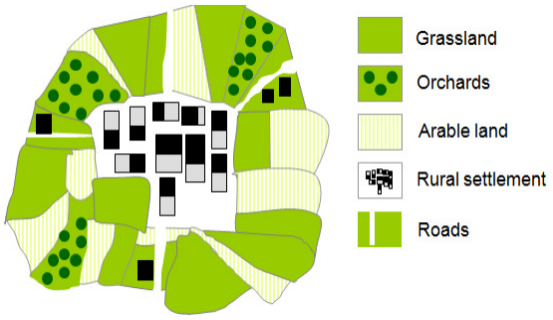
This category includes:

- Diverse annual crops (irrigated and non-irrigated), pastures and/or all kinds of permanent crops (vineyard, fruit trees, berry plantation, olives groves, etc.).
- Mixed parcels of permanent crops (fruit trees as almonds and others, berry plantations, vineyards and olive groves. Each category covers less than < 0.5 ha.

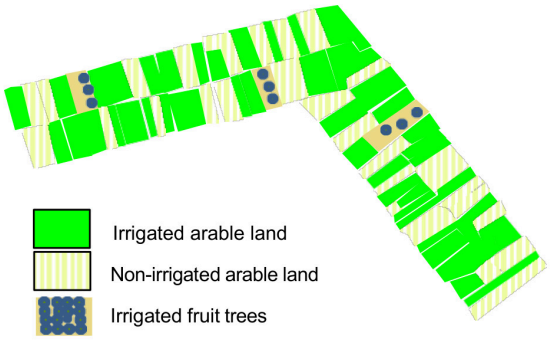
This category excludes:

- Hobby gardens / city gardens / allotment gardens → 1.4 Green urban, sports and leisure facilities.
- Market gardening → 2.1.1 Arable land.
- Nursery cultivation → 2.1.1 Arable land.
- Irrigated or non-irrigated arable land parcels larger than 0.5 ha. → 2.1.1 Arable land.
- Grassland parcels larger than 0.5 ha → 4.x.x.x Grassland.

- Complex patterns of irrigated and non-irrigated arable land with significant presence of natural vegetation → 2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation.



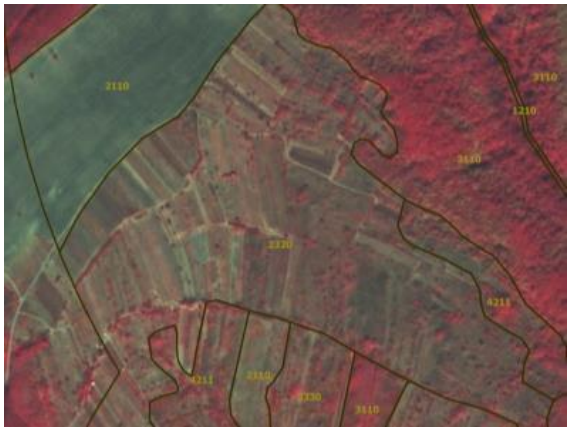
Schematic representation of complex cultivation patterns.



Schematic representation of complex patterns of irrigated and non-irrigated arable land.

Appearance:

- Coarse texture.
- Mix of diverse colours.
- Small parcels separated or mixed with rows of trees or vine.
- Characteristic pattern caused by small parcels of diverse annual crops, pasture and/or annual crops.



Mix of annual and permanent crops, Hungar, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-18. CNES 2010©, Distribution Airbus DS/Spot Image.



Mix of annual and permanent crops, Kallithiro (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-02. CNES 2011©, Distribution Airbus DS/ Spot Image.



Mix of annual and permanent crops, Megala Kalivia (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-02. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use of CLC class 2.4.3 as orientation.

2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation

Definition:

Areas principally occupied by agriculture (mix of crops/grassland), interspersed with significant natural areas.

This category includes:

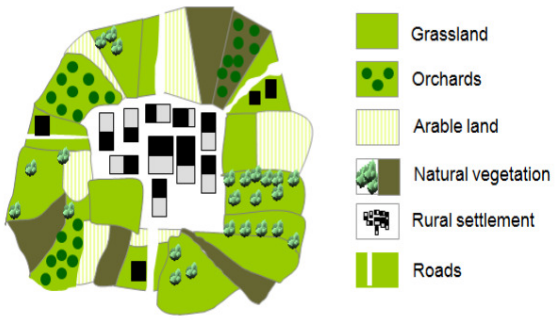
- Parcels of annual cropland in mosaic/association with natural vegetation < 0.5 ha.
- Parcels of permanent crops in mosaic/association with natural vegetation < 0.5 ha.
- Parcels of natural/semi-natural vegetation (forest, groups of trees, shrub, small water bodies) < 0.5 ha mixed with arable land.
- Hortillonage (vegetable crops and canals) in France.
- Agriculture and scattered heaps of stones.

This category excludes:

- Mixture of arable land and permanent crops without parcels of natural vegetation → 2.3.2 Complex cultivation patterns.
- Areas, where agricultural area (2.1.x, 2.2.x, 2.3.x) is $> 75\%$ → 2.x.x Croplands.
- Areas, where natural/semi-natural area is $> 75\%$ → 3.x.x Woodland and forest.
- Hedged areas.
- Areas with grassland and natural vegetation → 4.1 Managed grassland or 4.2.x.x Natural & semi natural grassland.



Agricultural parcel included in an area with vegetation natural (spontaneous grasses, trees, scrub, etc.). Credit: M. Rodriguez.



Schematic representation of 2.3.3 Land principally occupied by agriculture with significant areas of natural vegetation.

Appearance:

- Heterogeneous areas with predominant land parcels structure but presence of natural vegetation.



Agricultural area with vegetation natural, Inandik (Anatolia, Turkey), Spot 5 (2.5 m, NIR/R/G band combination). Date: 2011-07-16. CNES 2011© Distribution Airbus DS/Spot Image.

2.3.4 Agro-forestry

Definition:

Agro-forestry is a land use management system in which trees or shrubs are grown around or among crops or pastures. It combines agricultural and forestry techniques to achieve a more sustainable land use system. An example of this landscape is the *dehesa* (located in southern and central Spain and southern Portugal where it is called *montado*).

This category is limited to Mediterranean area. In this landscape the understory is regularly cleared of scrubs to improve grasslands or trees. In agroforestry areas with T.C.D. $< 30\%$ it is frequent the presence of arable land. Agro-forestry areas with more than 50% of scrub understory are considered as forest. Agroforestry areas (grassland understory) with less than 10% T.C.D. are considered as grassland.

This category includes:

- Trees (several species of *quercus*) with an understory of grasses (predominant) or arable land.
- Areas of forest trees imbricated with fruit trees/ olive trees but neither of them dominates.
- Trees (predominantly *quercus* species) planted in agricultural land.
- Pastures mixed with agricultural land, or parcels that vary their use (between agriculture or pasture) depending on the year, mixed with trees.

This category excludes:

- Scandinavian forest meadows → 4.2.x.x Natural and semi-natural grassland / 3.x.x. Woodland (with low density).
- Fruit trees including meadow orchards of Central Europe → 2.2.1 Vineyards, fruit trees and berry plantations.
- Complex cultivation patterns → 2.3.2 Complex cultivation patterns.
- Annual crops associated with permanent crops → 2.3.1 Annual crops associated with permanent crops.
- Olive groves → 2.2.2 Olive groves.

- Grasslands with trees in other locations; Atlantic parkland (EUNIS Code E7.1) and sub-continental parkland (EUNIS Code E7.2) → 4.x.x.x. Grassland.
- Agro-forestry areas with more than 50% of scrub understory → 3.x.x Woodland and forest.
- Agro-forestry areas (grassland understory) with less than 10% T.C.D. → 4.x.x.x Grassland.



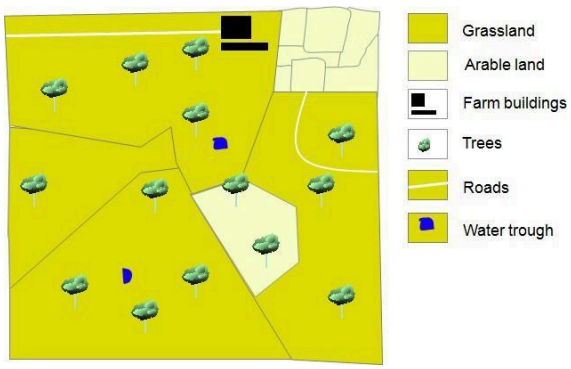
Dehesa of cork oaks with very high T.C.D. in South-western Spain. Credit: M. Palacios.



Dehesa invaded by scrubs. Credit: M. Palacios.



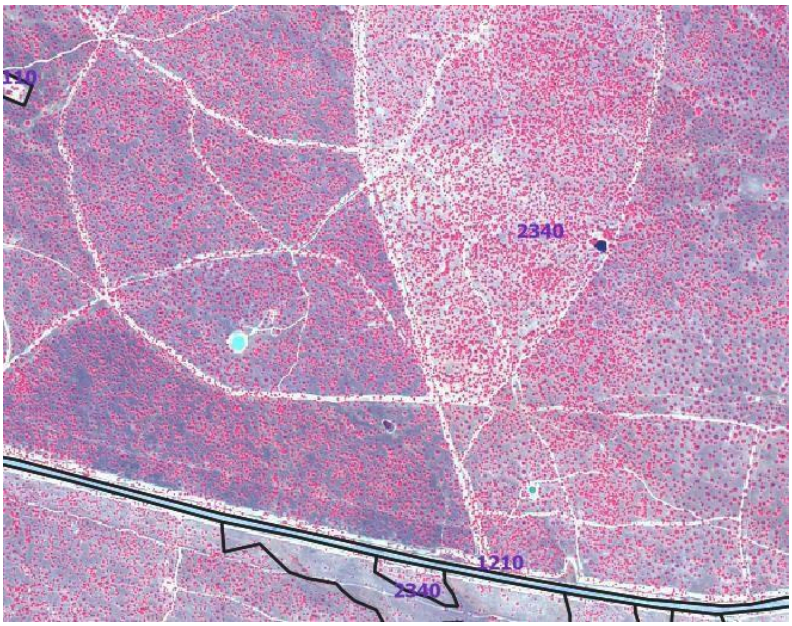
Dehesa in Spain in springtime. Credit: C. Alonso.



Schematic representation of Agro-forestry T.C.D. < 30%.

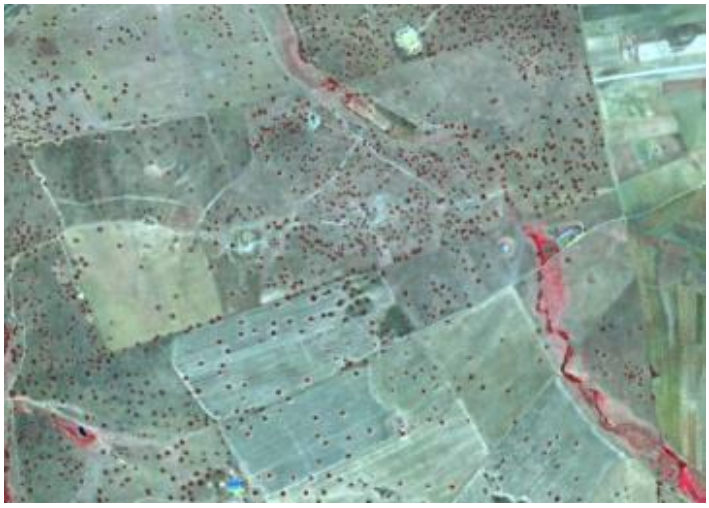
Appearance:

- Land with scattered trees.
- Big parcels with different management and appearance: grasses (dry in summertime), arable land and scrubs.



Los Zamores (Spain), (1/2/3 band combination). Date: 2018-07-28. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

- Land with very disperse trees.
- Big parcels with different management and appearance: grasses (dry in summertime), arable land and scrubs.
- Distinction to forest with low density (3.x.x Woodland and forest) and 4.x.x.x Grassland is based in the use of in situ data (e.g. specific national databases as SIOSE in Spain).



Example of Agro-forestry (T.C.D. < 30%) with grassland and arable land understory, Extremadura (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-03-18. CNES 2011©, Distribution Airbus DS/Spot Image.

3. Woodland and forest

The woodland and forest classes are mainly dominated by woody vegetation of various age or by succession of climax vegetation types[3]. The interpretation is done according to FAO (2000) with tree cover > 10 %, MMU of 0.5 ha and trees able to reach 5 m height in-situ at maturity. Young natural stands and all plantations established for forestry purposes, which have yet reached a crown density of 10 % or tree height of 5 m, are also included as forest. These areas are normally part of the forest area although temporarily unstocked because of human intervention or natural reasons but which are expected to revert to forest.

Forest further comprises:

- nurseries and seed orchards that constitute an integral part of the forest;
- forest roads,
- cleared tracts < 0.5 ha,
- firebreaks and other small open areas < 0.5 ha;
- forest in national parks, nature reserves and other protected areas with an area of more than 0.5 ha and width of more than 10 m (which goes beyond the FAO Forest definition of 20 m);
- plantations primarily used for forestry purposes, including rubber wood plantations and cork oak stands.

Land predominantly used for agricultural practices is excluded. Excluded is also land with

- either a crown cover (or equivalent stocking level) of 5-10% of trees able to reach a height of 5 m at maturity in situ;
- or a crown cover (or equivalent stocking level) of more than 10% of trees not able to reach a height of 5 m at maturity in situ (e.g. dwarf or stunted trees);
- or shrub or bush cover of more than 10% are not accounted as forest.

The differentiation between broadleaved, coniferous and mixed forest is in accordance with CLC interpretation guideline and HR Forest definition.

Broadleaved forest: Vegetation formation composed principally of trees, including shrub and bush understoreys, where broadleaved species predominate and represent more than 75% of the pattern.

[3] European Commission (2013): Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessment under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper, Final, April 2013.

Coniferous forest: Vegetation formation composed principally of trees, including shrub and bush understoreys, where coniferous species predominate and represent more than 75% of the pattern.

Mixed forest: Vegetation formation composed principally of trees, including shrub and bush understoreys, where neither broadleaved nor coniferous species predominate. The share of coniferous or broadleaved species does not exceed 75% in the canopy closure.

The definition of Woodland and Forest is mainly oriented along aggregated EUNIS habitat classes. Forest type interpretation might be problematic in locations with sunny slopes or in hilly regions with shady slopes.

Fire breaks will be classified according to their current land covers.

3.1 Broadleaved forest

3.1.1 Natural & semi-natural broadleaved forest

Definition:

This class is comprised of the tree species *Fagus* (EUNIS G1.6), deciduous or semi-deciduous thermophilous types like *Quercus* species and *Carpinus orientalis*, *Castanea sativa* or *Ostrya carpinifolia* (EUNIS G1.7). Moreover, *Quercus robur* or *Quercus petraea* on acid soils (G1.8), forest composed of *Betula*, *Populus tremula* or *Sorbus aucuparia* (G1.9) species; *Quercus robur*, *Ulmus* spp., *Fraxinus excelsior*, *Tilia cordata* or *Acer platanoides* (G1.A) and woods dominated by *Alnus* (G1.B).

Also forest growing on wet ground (e.g. moors, swamps, marshes, fens or peat bogs) is included in this class. On non-acid peat the class is comprised of the tree species *Alnus*, *Populus*, *Quercus* swamp woods (EUNIS G1.4). On wet acid peat *Betula pubescens* predominates, or rarely *Alnus glutinosa* (EUNIS G1.5).

In addition, this class comprises broadleaved sclerophyllous or lauriphyllous evergreen trees and palms, which are characteristic for the Mediterranean and warm-temperate humid zones (EUNIS class G2). In these regions broadleaved evergreen forest is predominant and represents more than 75% of the pattern.

This category includes:

- Vegetation formation composed of trees, including shrub and bush understoreys, where broadleaved species (EUNIS classes G1.6, G1.7, G1.8, G1.9, G1.A and G1.B) predominate and represent more than 75% of the pattern.
- Broadleaved swamp forest: Vegetation formation composed principally of trees, including shrub and bush understorey, where broadleaved species (EUNIS classes G1.4, G1.5) predominate on acidic peat/not on acidic peat but wet soil and represent more than 75% of the pattern.
- Broadleaved evergreen forest of the Mediterranean and warm-temperate humid zones. Includes all extensively managed, but sometimes regularly planted semi-natural broadleaved forests in Southern, Central and Northern Europe composed of regional forest types.
- Includes all extensively managed, but sometimes regularly planted semi-natural broadleaved forests in Southern, Central and Northern Europe composed of regional forest types.
- Linear broadleaved forest stripes at river sides.

This category excludes:

- Clear-cut or regrowth of other natural and semi-natural broadleaved forest → 3.4.0 Transitional woodland and scrub.
- Clear cutting or regrowth of broadleaved swamp forest → 3.4.0 Transitional woodland and scrub.
- All intensively managed highly artificial broadleaved forest plantations, composed of exotic types → 3.1.2 Highly artificial broadleaved plantations.

- Heathland and Moorland where vegetation cover is composed of heather, scrub and transitional woodland (e.g. birch, alder, pine) → 5.1.0 Heathland and Moorland.
- Scrub and reeds in rivers or at river shores → 3.4.0 Transitional woodland and scrub.
- (repetition, see two points above) Heathland and Moorland where vegetation cover is composed of heather, scrub and transitional woodland (e.g. birch, alder, pine) → 5.1.0 Heathland and Moorland.
- Broadleaved evergreen Eucalyptus plantations → 3.1.2 Highly artificial broadleaved plantations.



Broadleaved forest (beech), Bavaria, Germany. Credit: M. Probeck.



Broadleaved forest (beech and maple), Stockholm, Sweden. Credit: E. Alkrona.



Broadleaved forest in La Rioja region (Spain). Credit: C. Alonso.



Poplar (*Populus* sp.) plantation. Credit: M. Palacios.

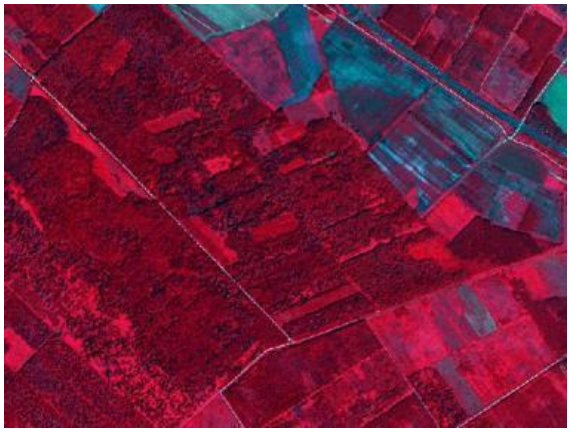


Broadleaved swamp forest, Island of Rügen, Germany. Credit: U. Weingart.

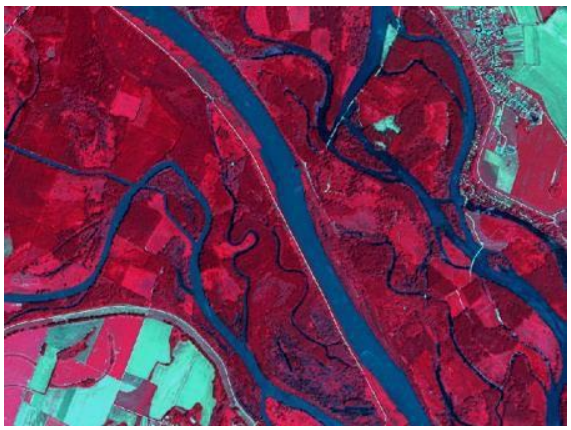


Broadleaved evergreen forest (*Quercus ilex*, *Quercus coccifera*, *Juniperus* spec.) in Ano Vathia (Island of Evia), Greece. Credit: N. Kolpatzik.

Appearance:

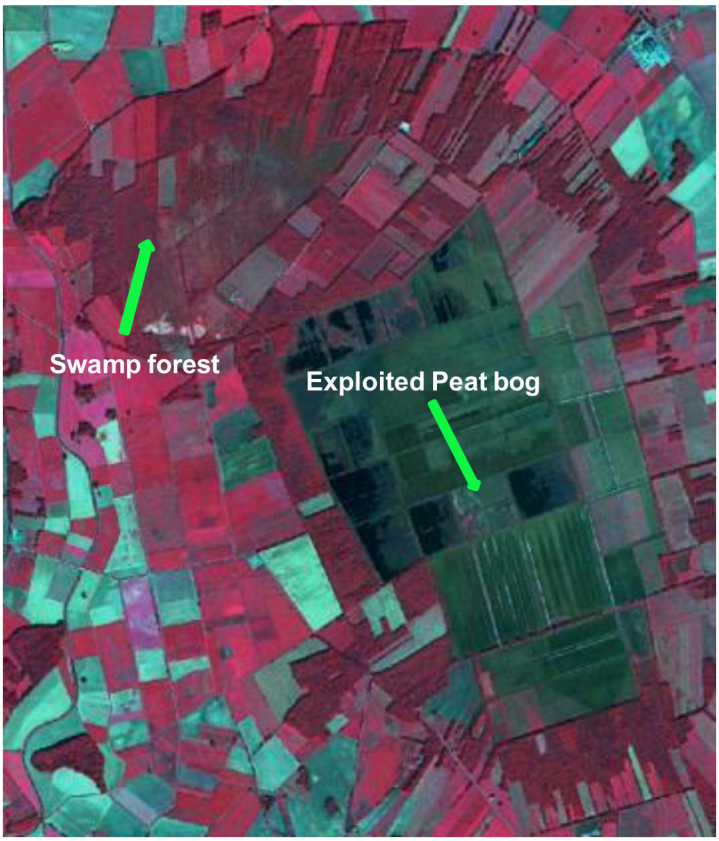


Natural and semi-natural broadleaved forest near the Danube river, Károlyháza (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.



Broadleaved forest at the Danube river, Kisbodak (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.

Broadleaved swamp forest:



"Borsteler Moor", Borstel (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-09-05. CNES 2013©, Distribution Airbus DS/Spot Image.

- Located on wet grounds.
- Near or in vicinity to exploited/unexploited peat bogs, moors, swamps or marshes. Therefore, swamp forest often shows regular, streaky shape.
- Not flown through by rivers.

3.1.2 Highly artificial broadleaved plantations

Definition:

Cultivated deciduous broadleaved tree formations planted for the production of wood, composed of exotic species or native species out of their natural range, planted in clearly unnatural stand or as monocultures (e.g. row plantation).

This category includes:

- Exotic species (e.g. *Eucalyptus* sp.) planted in clearly unnatural stand (basically row plantation).
- Monoculture stands out of their natural range with clearly artificial planting pattern.
- Visible clear cutting in *Eucalyptus* sp. plantations. Many of these plantations have a management based on harvesting (felling, chipping and hauling) and short-term regeneration. In this case the clear cutting between harvesting and regeneration are considered as fallow land and will be included in this category.

This category excludes:

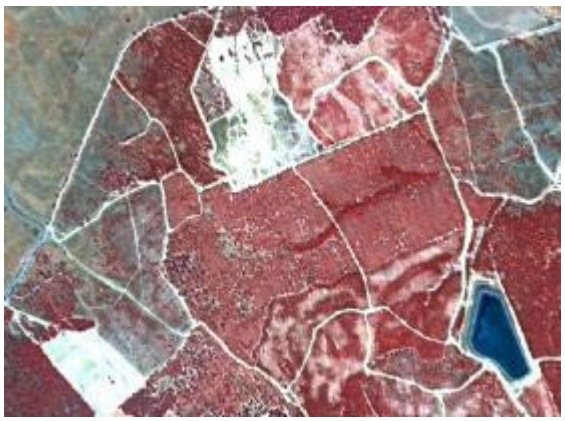
- Small, linear forest stands > 25 m width, planted for wind shield purposes → 3.1.1 Natural and semi natural broadleaved forest.
- Small, linear forest stands < 25 m width, planted for wind shield purposes → 3.5.0 Lines of trees and scrub.
- Natural stands but planted in monocultures and structured by regular road network → 3.1.1 Natural and semi-natural broadleaved forest.
- Semi-natural broadleaved forest planted in the natural stands for timber production → 3.1.1 Natural & semi-natural broadleaved forest.
- Naturalized plantations (basically not visible rows or plantations integrated in the landscape) of exotic trees (mainly *Eucalyptus* sp.) → 3.1.1 Natural & semi-natural broadleaved forest.

Appearance:

Eucalyptus sp. monocultures:



Eucalyptus sp. plantation in Southern Spain. Credit: 2009 Ministerio de Fomento IGN.



Eucalyptus sp. plantation in Southern Spain, Lepe (Huelva, Spain), Spot 5 (2.5 m; NIR band combination). Date: 2011-08-06. CNES 2011© Distribution Airbus DS/Spot Image.

- Red colours in infrared bands combinations.
- Plantation in stands.
- Visible rows.
- Presence of forest tracks and forest and firebreaks.
- Presence of clear cutting.

Harvesting, clear cutting in *Eucalyptus* sp. plantations delineation rules:

- Included in *Eucalyptus* sp. plantations (class 3.1.2 Highly artificial broadleaved plantation).
- Bare soil visible.
- Plantations rows visible.



Clear cutting between harvesting and restoration in an eucalyptus plantation, Cortegana (Huelva, Spain), Spot 5 (2.5 m; NIR band combination). Date: 2011-08-06. CNES 2011© Distribution Airbus DS/Spot Image.

3.2 Coniferous forest

3.2.1 Natural & semi-natural coniferous forest

Definition:

Vegetation formation composed principally of coniferous trees, including shrub and bush understoreys and where coniferous species predominate and represent more than 75% of the pattern.

Class is comprised of coniferous tree species mainly evergreen (*Abies*, *Cedrus*, *Picea*, *Pinus*, *Taxus*, *Cupressaceae*) but also deciduous *Larix decidua* (EUNIS G3) or *Juniperus sabina* (but with low TCD).

This class is also comprised of coniferous tree and stunted growth species (EUNIS G3.D) like e.g. *Pinus sylvestris*, *Pinus rotundata* and *Picea abies*, growing on a humid to wet peaty substrate, with an permanent high water level and even higher than the surrounding water table.

This category includes:

- Vegetation formation composed principally of coniferous trees, including shrub and bush understoreys, where coniferous species predominate and represent more than 75% of the pattern.
- Coniferous swamp forest: Vegetation formation composed principally of trees, including shrub and bush understoreys, where coniferous species predominate on acidic peat/not on acidic peat but wet soil and represent more than 75% of the pattern.
- Includes all extensively managed, but sometimes regularly planted semi-natural coniferous forests in Southern, Central and Northern Europe composed of regional forest types.
- Linear coniferous forest stripes at river sides.

This category excludes:

- Heathland and Moorland where vegetation cover is composed of heather, scrub and transitional coniferous woodland (e.g. pine) → 5.1.0 Heathland and Moorland.
- Clear-cut or regrowth of coniferous forest → 3.4.0 Transitional woodland and scrub.
- Artificial coniferous plantation of exotic species → 3.2.2 Highly artificial coniferous plantations.



Other natural coniferous (spruce) forest in Attali (Island of Evia), Greece. Credit: N. Kolpatzik.



Coniferous forest (*Pinus canariensis*). Credit: M. Palacios.

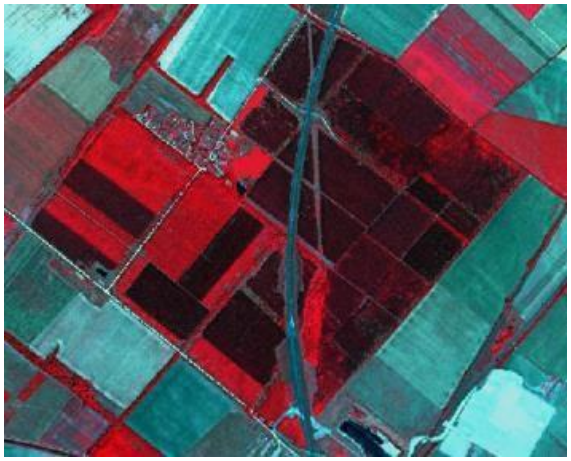


Coniferous forest (*Pinus*) in Sweden. Credit: Eurostat, 2012. LUCAS.

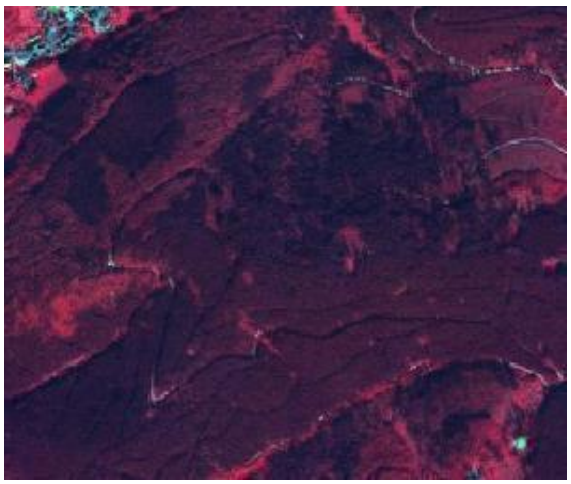


Dwarf pine on swampland, Bavaria, Germany. Credit: M. Probeck.

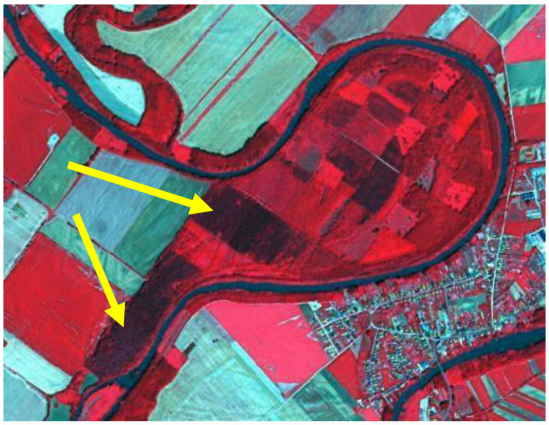
Appearance:



Other natural or semi-natural coniferous forest located, Bezenye (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.



Other natural or semi-natural coniferous forest, Harz (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-03. CNES 2011©, Distribution Airbus DS/Spot Image.



Coniferous forest located at the Monsini Danube River, Magyarkimle (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.

3.2.2 Highly artificial coniferous plantations

Definition:

Cultivated coniferous tree formations planted for the production of wood, composed of exotic species or native species out of their natural range, planted in clearly unnatural stands or as monocultures (e.g. clearly visible row plantation).

This category includes:

- Highly artificial coniferous tree formations planted in monocultures and out of their natural range.
- Christmas tree plantations.

This category excludes:

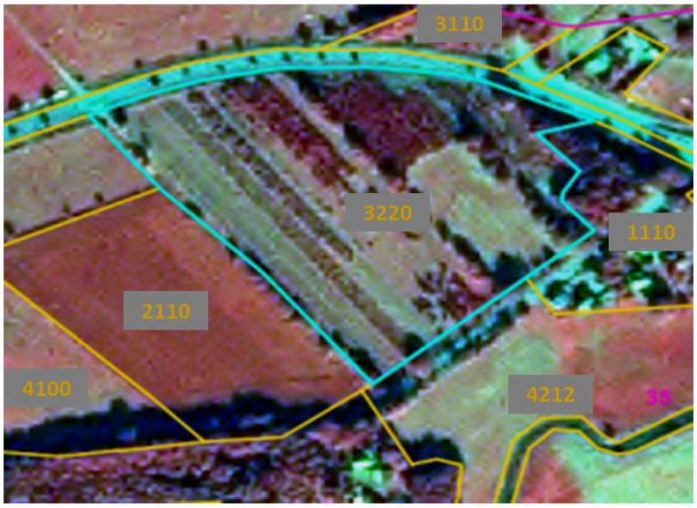
- Small, linear forest stands, probably planted as wind shield – No plantation → 3.5.0 Lines of trees and scrub.

- Clearly detectable monoculture coniferous stands (e.g. row plantation) not composed of exotic species and planted not out of their natural range will be classified as class 3.2.1 Natural and semi-natural coniferous forest.
- Semi-natural coniferous forest planted in the natural environments for timber production → 3.2.1 Natural and semi-natural coniferous forest.



Highly artificial coniferous plantations (Pine) in the north west of Spain. Credit: Eurostat, 2012. LUCAS.

Appearance:

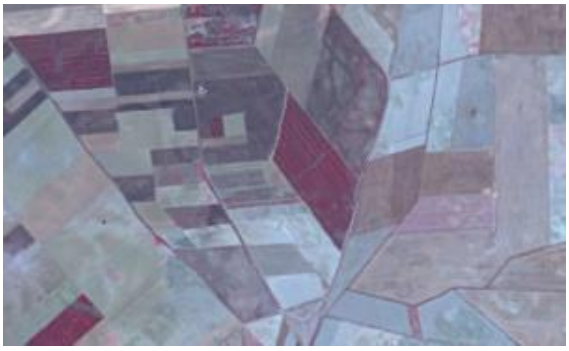


Highly artificial coniferous plantation (christmas trees) near Gifhorn (Germany), Spot 6 (1.5 m; 4/1/3 band combination). Date: 2013-09-28. CNES 2011©, Distribution Airbus DS/Spot Image.

- Regular planting scheme.
- Coniferous plantations in arable land (in many cases related to set-aside obligations). Only clear highly artificial coniferous plantation are included here.



Highly artificial coniferous plantation in Central Spain. Credit: 2009 Ministerio de Fomento IGN.



Coniferous plantation, Spain, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-07-04. CNES 2011© Distribution Airbus DS/Spot Image.

3.3 Mixed forest

3.3.1 Natural & semi-natural mixed forest

Definition:

Vegetation formation composed of coniferous and deciduous trees, including shrub and bush understoreys. Neither broadleaved nor coniferous species predominate. The share of coniferous or broadleaved species does not exceed 75% in the canopy closure.

Furthermore, the class includes mixed forest on wet ground (e.g. moors, swamps, marshes, fens or peat bogs) and forest which consists of a mix of broadleaved deciduous or evergreen and coniferous trees.

This category includes:

- Vegetation formation composed principally of trees, including shrub and bush understoreys, where neither broad-leaved nor coniferous species predominate and the share of coniferous or broad-leaved species does not exceed 75% in the canopy closure.
- Mixed swamp forest: Vegetation formation composed principally of trees, including shrub and bush understoreys, where neither broadleaved nor coniferous species predominate on acidic peat/not on acidic peat but wet soil and the share of coniferous or broadleaved species does not exceed 25% in the canopy closure.

- Includes all extensively managed, semi-natural mixed forests in Southern, Central and Northern Europe composed of regional forest types.

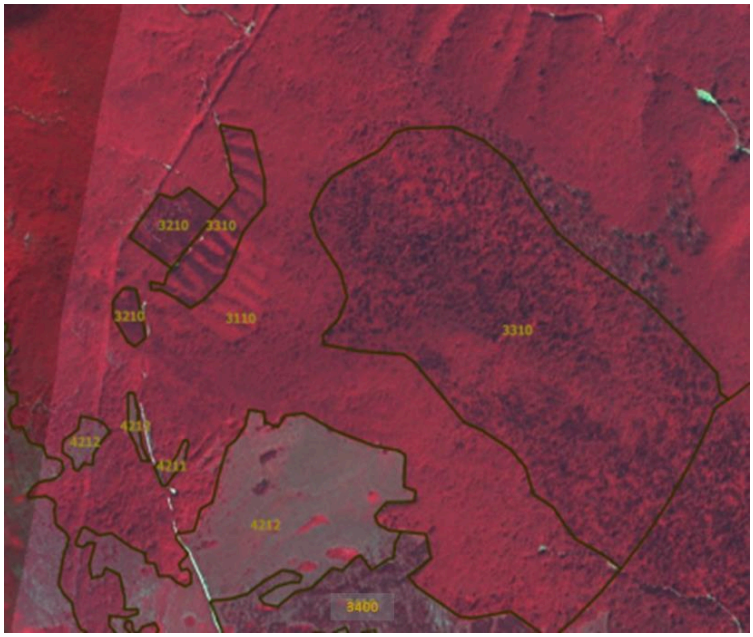
This category excludes:

- Clear-cut or regrowth of other natural and semi-natural mixed forest → 3.4.0 Transitional woodland and scrub.
- Heathland and Moorland where the vegetation cover is composed of heather, scrub and transitional woodland (e.g. birch, alder, pine) → 5.1.0 Heathland and Moorland.



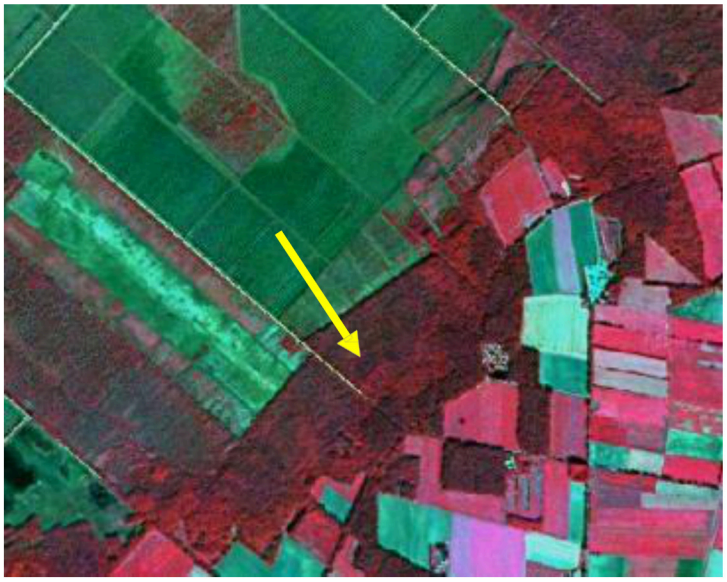
Mixed forest (*Pinus sylvestris*, *Quercus petraea*), Germany. Credit: Eurostat, 2012. LUCAS.

Appearance:



Other mixed forest, Mazin (Croatia), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-15. CNES 2010©, Distribution Airbus DS/Spot Image.

Mixed swamp forest:



Mixed swamp forest, "Großes Moor", Uchte (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-09-05. CNES 2013©, Distribution Airbus DS/ Spot Image.

- Located on wet grounds.
- Near or in vicinity to exploited/unexploited peat bogs, moors, swamps or marshes. Therefore, swamp forest often shows regular, streaky shape.
- Not flown through by rivers/located at the riverside.

3.3.2 Highly artificial mixed plantations

Definition:

Mixed plantations (EUNIS G4.F) of coniferous and deciduous species where at least one constituent is exotic or outside its natural range, or if composed of native species planted in clearly unnatural stands.

This category includes:

- Cultivated mixed tree formations planted for the production of wood, composed of exotic species, of native species out of their natural range, or of native species planted in clearly unnatural stands, often as monocultures.

This category excludes:

- Small, linear forest stands (MMW > 25 m) of mixed forest, planted for wind shield purposes → 3.3.1 Natural and semi-natural mixed forest.
- Small, linear forest stands (MMW < 25 m) of mixed forest, planted for wind shield purposes → 3.5.0 Lines of trees and scrub.
- Semi-natural mixed forest planted in the natural stands for timber production → 3.3.1 Natural and semi-natural mixed forest.

3.4 Transitional woodland and scrub

Definition:

Bushy or herbaceous vegetation with scattered trees that represent either woodland degradation or forest regeneration/ recolonization. The class is comprised of EUNIS G5.6 which defines early stages of woodland regrowth or newly-colonizing woodland composed predominantly of young individuals of high-forest species that are still less than 5 m in height as transitional woodland.

This category includes:

- Pre- or post-formation of broadleaved evergreen forest with usually thick evergreen shrub stratum composed of evergreen oaks, olive trees, pines etc. Crown cover $< 30\%$.
- Abandoned agricultural land under recolonization of trees and shrub. Scattered trees or shrub cover more than 30%.
- Abandoned peat bogs covered by scrubs and trees in recovering process.
- Abandoned fruit tree plantations and orchards.
- Abandoned vineyards, where original structure is not visible any more.
- Shrub along river sides and on river banks (may include small patches of reeds with area < 0.5 Ha) where neither climax tree-like forest formations nor grassland is detected (mainly located in areas of Mediterranean and continental climates with a summer season with warm-temperate & low precipitation).
- Abandoned military training areas in regeneration process.
- Clear-cuts in forest areas.
- Forest regrowth areas, that haven't reached the climax vegetation.
- Young forest plantations of young trees that are still less than 5 m in height.
- Forest nurseries inside forest areas.
- Short-rotation *Salix* beds for biomass production.

This category excludes:

- Forest stands with canopy cover of at least 50% → 3.1.x/ 3.2.x/3.3.x. Broadleaved forest/ Coniferous forest/ Mixed forest.
- Climax vegetation → 3.x.x Woodland and forest.
- Stable/climax tree-like forest formations on wet land with a tree height of less than 4 m → 5.1.0 Heathland and Moorland or 5.2.0 Alpine scrub land.
- Reed coverd wetland along river sides → 7.1.1 Inland Marshes.
- Abandoned olive groves → 5.3.0 Sclerophyllous scrub.

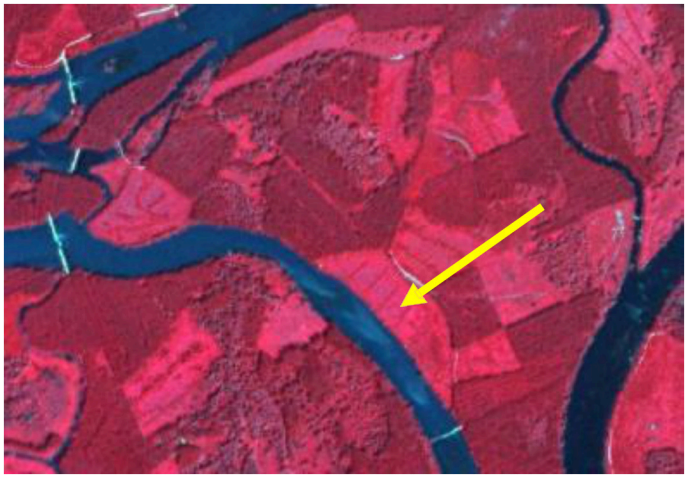


Transitional woodland, Scotland Credit: M. Rosengren.

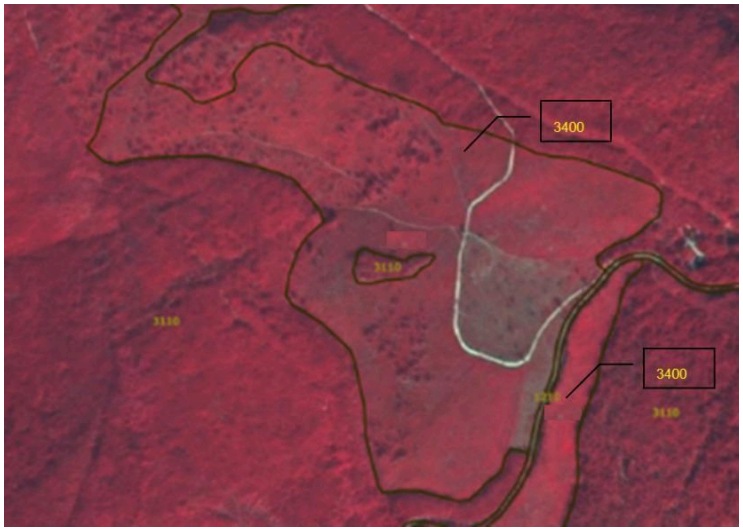


Reeds alongside a Mediterranean River: Credit: M. Palacios.

Appearance:



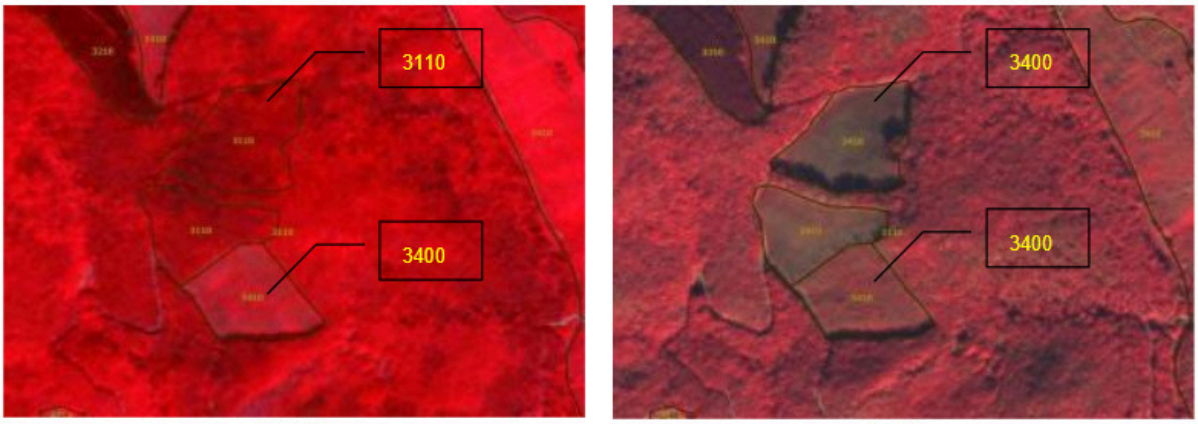
Forest clear-cuts at the Danube river side, Hungary, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.



Transitional forest, Eger (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-109-18. Source: CNES 2011©, Distribution Airbus DS/Spot Image.

- Colour and texture of young clear-cuts is very similar to natural or managed grassland.
- Forest clear-cuts often show rectangular shapes.
- Often scattered single trees or tree patches.
- Sometimes coarse texture and mix with open areas.

- Multi-temporal information is helpful to clarify whether the area was forest before.



Transitional forest, Oger (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date:2006-07-28 and 2011-10-18. Source: CNES 2012©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use of CLC class 3.2.4 as orientation.

3.5 Lines of trees and scrub

Definition:

More or less continuous lines of trees forming strips within a matrix of grassy or cultivated land or along roads, typically used for shelter or shading. The predominant width of these tree lines is between 10 m and 25 m (sporadically transgressions are allowed, if the linear character is retained).

This category includes:

- Lines of trees and shrub ≥ 10 m and predominantly ≤ 25 m in width and ≥ 0.5 ha MMU inside urban or agricultural areas.
- Lines of trees along rivers $<$ Strahler Level 3 (except clear and relevant Mediterranean gallery forests– narrow stretches or strips of forests along the banks of a water body).

This category excludes:

- Lines of trees and shrub < 10 m or predominantly > 25 m MMW or < 0.5 ha MMU.
- Lines of trees at the border of forest clear-cuts $\rightarrow$ 3.4.0 Transitional woodland and scrub.
- Lines of trees along rivers with Strahler Level $\geq 3-6 \rightarrow$ 3.x.x Forest.
- Shore area of rivers, which is already digitalized by Riparian Zone data $\rightarrow$ 8.1.1 Natural & semi-natural water courses.

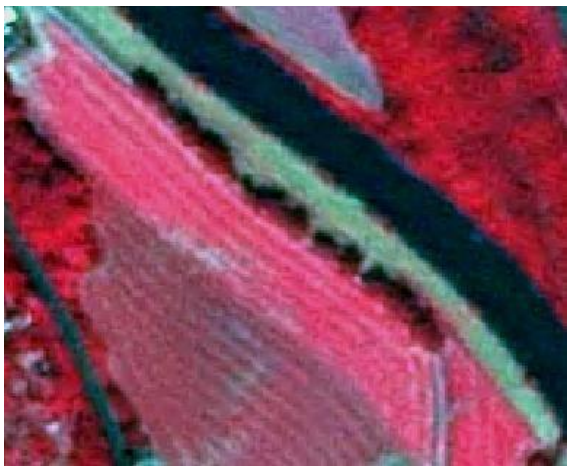


Lines of trees and scrub, eastern Germany. Credit: Eurostat, 2012. LUCAS.

Appearance:



Lines of trees and scrub, Novákpuszta (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-10. CNES 2011©, Distribution Airbus DS/Spot Image.



Lines of trees and scrub, Guntershausen (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-07-10. CNES 2010©, Distribution Airbus DS/ Spot Image.

- Mostly deciduous or mixed forest.
- Includes bushes.
- In case of very small rivers, lines of trees and scrub will cover the creek.
- Lines of trees and scrub may adjoin to forest features.



Example: Lines of trees along river → 3.5.0, Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-10-18. CNES 2011©, Distribution Airbus DS/Spot Image.



Example: Lines of forest along river → 3.5.0, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-22. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Do not include forest shadow areas.
- Map lines of trees and scrub a bit smaller and map the “general” tree outline.

3.6 Damaged forest

Definition:

Damaged forest includes areas still visible on the satellite image e.g. spectrally due to discolouration of needles and leaves or trees lying on the ground.

Either pests, storm or tornado events or snow and ice damage or fires may have caused the forest damage.

In most cases, the damage affects monocultures, as these are more vulnerable than mixed forests. Severe bark-beetle attacks, however, are most evident in National Parks, as the park regulations do not allow counteractions that may confine the damage.

Forest damaged by fire will mainly occur in southern Europe where wildfires are a common phenomenon. In Central Europe forest fires are rare and occur only sometimes during very hot and dry summers on south-facing slopes.

This category includes:

- Forest damaged by fire.
- Forest damaged by storm, tornado or snow events as long as trees are lying on the ground.
- Forest damaged by pests like e.g. bark-beetle as long as the damage is visible due to discolouration.

- This class also includes temporary forest damages caused by e.g. the oak processionary moth, even if the affected forests seem to recover quite fast in the following years.

This category excludes:

- Areas already cleared after a storm event → 3.4.0 Transitional woodland and scrub.
- Areas already cleared and prepared or ready for afforestation → 3.4.0 Transitional woodland and scrub.
- Forest clear-cuts → 3.4.0 Transitional woodland and scrub.
- Afforestation → 3.4.0 Transitional woodland and scrub.
- Other natural features damaged by fire → 6.3.2 Burnt areas.



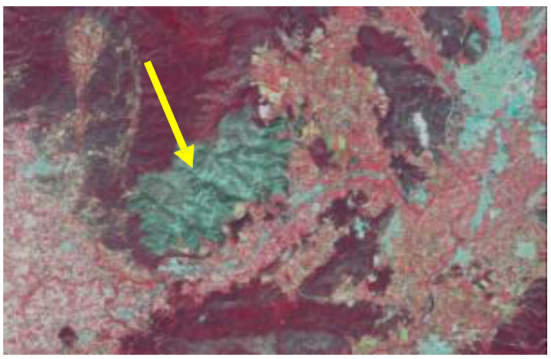
Other damaged forest: Bark-beetle damage, Bavarian Forest, Germany. Credit: M. Probeck.



Other damaged forest: Bark-beetle damage, Bavarian Forest, Germany. Credit: M. Probeck.

Appearance:

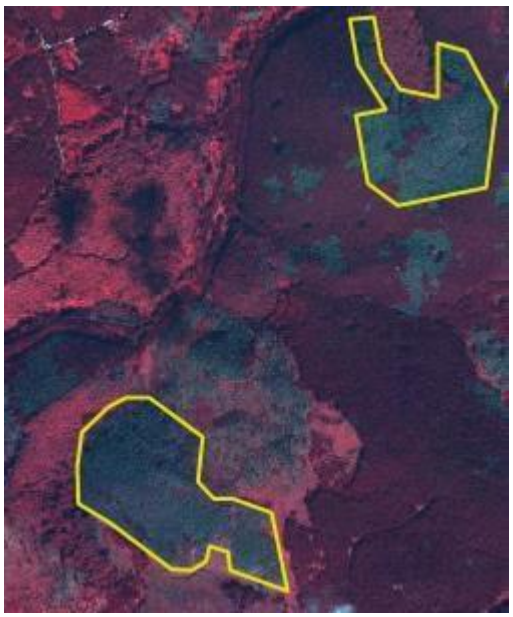
- Clearly visible in EO data due to different colour scheme: greenish to bluish colours instead of red/brown colours for forest areas.
- Located inside or at the border of forests.
- Located primarily in Southern Europe.
- Compact area.
- May have only short-term effects and forest fully recover within 1-2 years (e.g. oak processionary moth)



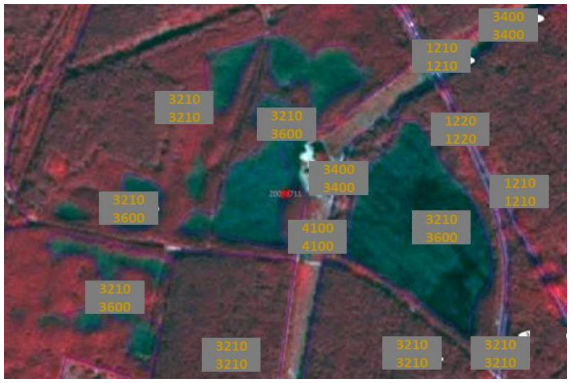
Forest damaged by fire in Benicolet (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-22. CNES 2011©, Distribution Airbus DS/Spot Image.



Almost 1.500 ha of forest affected by fire in San Joan de Labritja (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-17. CNES 2011©, Distribution Airbus DS/Spot Image.

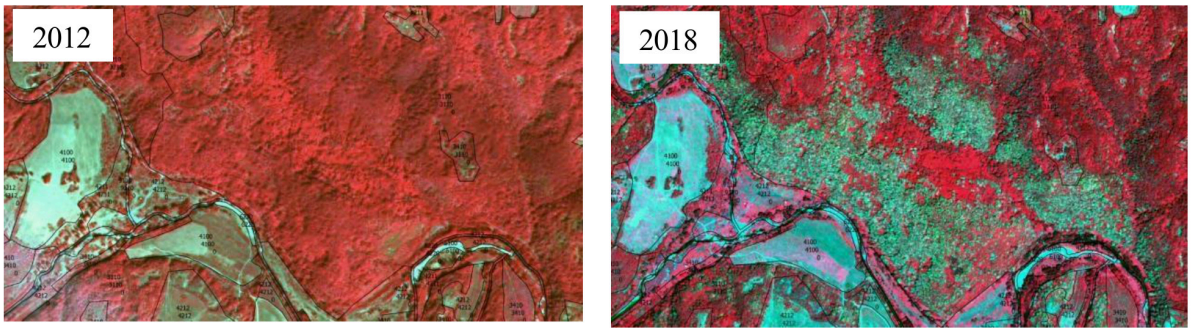


Bark-beetle damage, Harz National Park (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-03. CNES 2011©, Distribution Airbus DS/ Spot Image.

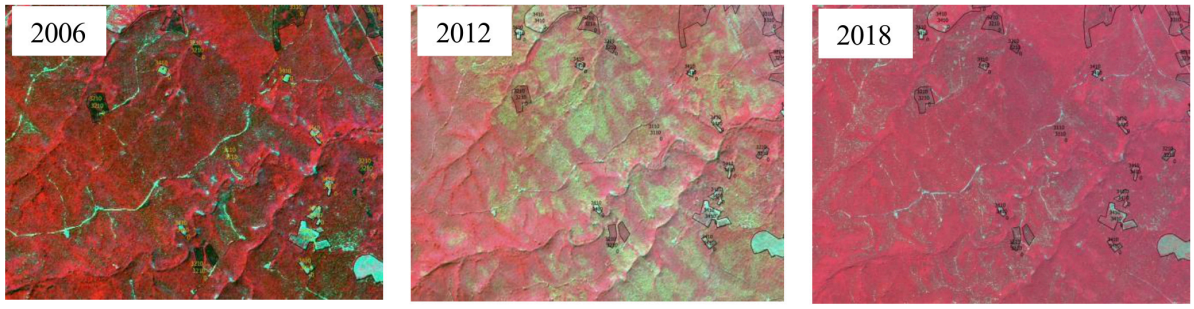


Damaged forest due to increasing soil moisture (codes:N2K 2006/ N2K2012), Magdeburg (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-18. CNES 2011 ©, Distribution Airbus DS/ Spot Image.

- In case of bark-beetle clearly visible due to greenish appearance of deadwood inside vital forest stands.
- Sometimes mix of deadwood and natural regrowth - mix of green and light red spectral signatures.



In 2012, no damage is visible. Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-09-26. CNES 2013 ©, Distribution Airbus DS/Spot Image. Forest damaged in 2018 by the oak processionary moth (*Thaumetopoea processionea*) on the whole Turkish-Bulgarian border (here Stoilovo) causing disruptions the leaf formation of the tree and a limited chlorophyll content resulting in discolorations in the images. Pleiades 1B (4 m; 1/2/3 band combination). Date: 2018-08-06. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA.



In 2006, no damage is visible. Spot 5 (2.5 m; 1/2/3 band combination). Date: 2006-07-24. CNES 2006 ©, Distribution Airbus DS/Spot Image. Forest damaged in 2012 by the oak processionary moth (*Thaumetopoea processionea*) on the Turkish-Bulgarian border. Disruptions in the leaf formation of the tree and a limited chlorophyll content causing discoloration in the images. Spot 5 (2.5 m; 1/2/3 band combination). Date: 2013-09-26. CNES 2013 ©, Distribution Airbus DS/Spot Image. In 2018, the forest looks healthy again. Pleiades 1B (4 m; 1/2/3 band combination). Date: 2018-08-06. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA.

Methodological advice:

- Recent fire events show blackish shades. When several months have passed, forest damaged by fire may resemble other causes such as pests.

4. Grassland

The grassland classes are areas dominated by grassy vegetation of two kinds –managed pastures and (semi-) natural (extensively managed) grasslands[4]. Generally grasses (basically *graminacea* plants but can include tall forbs, rushes and sedges, mosses and lichens) cover more than 30% of the soils (EUNIS description), called below Crown Cover Density (C.C.D.).

According to Annex I of the EU Habitats Directive, European natural grasslands are limited to alpine meadows (as Alpine, Pyrenean and Oro-Iberian grasslands) and other located grasslands.

In this sense, level 2 natural grasslands are considered as natural and semi-natural grasslands and managed grasslands are agricultural grasslands. The main characteristic of agricultural grassland is the high human influence, mainly cultivation and visible parcel structure in EO data.

[4]European Commission (2013): Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessment under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper, Final, April 2013.

Semi-natural grasslands are frequently associated with trees and scrubs. These grasslands should be managed to maintain their grass coverage, basically by cutting out scrubs manually or mechanically. The combination of trees and grasslands is also present in many locations in Europe (in alluvial areas; in wooded hay meadows; due forest clearing, etc.). *Dehesas* and other wooded pastures, as Fennoscandinavian wooded pastures, are included in the cropland class (agroforestry systems located in South Western Europe) or woodland and forest (in the case of forest pastures).

4.1 Managed grassland

Definition:

Managed grasslands are considered intensively managed areas for the production of grass. From a land use point of view, in the case of these agricultural grasslands, grass is a crop in the same way as cereals or others. Managed grasslands could be divided into improved and semi-improved grasslands according to their management.

Agricultural grasslands occupy huge areas in the lowlands of the European plain and in United Kingdom and Ireland, where they have a longer growing season due to climatic conditions, leaving dryer areas for arable crops. In many areas, arable land and agricultural grasslands are mixed.

This category corresponds to 2.3.1 CORINE class (Pastures). According to the statistical analysis of CORINE Land Cover 2006 data, pastures (231 class) occupied 66% of more than 60.000.000 ha considered as grasslands (classes 231-pastures and 321-natural grasslands).

The main characteristics of an ideally improved agricultural grassland farmland are:[5]

- The grass farmland is dominated by selected grasses, especially perennial, and the crop is very dense. In early spring, the grassland is often fertilized by the farmer. These grass farmland areas are chlorophyll rich almost all year long and do not contain or contain very little dead biomass.
- Intensive cutting and grazing is done during the grass growing season (usually from April to September).
- The grass could be cut and preserved for winter feeding. The grass for silage must be harvested in an optimal moment.
- Some farmers spread the grass by mower to achieve a better wilt, with the objective to remove excessive moisture for silage. This process could generate rows in the land due to accumulation of grasses. In many cases, this makes grasses undistinguishable from arable land using remote sensing techniques.
- Fertilizers are applied.
- Agricultural grassland could be reseeded.
- Usually there are farm buildings (silages; covered yards; stables, etc.) around.
- Often/mainly used for grazing.
- Improved grassland must be included in rotation. In many countries and in European regulations (as EC Regulation 796/2004 related to EU agricultural policy) an area is considered as “permanent grassland” if the land is covered by grasses during at least five years.

Per definition, there is no tree or scrub presence in improved grasslands.

In between the intensively used grass farmland or in specific regions (as the *bocage* landscape in France), there can be plots of less intensive or extensive grassland, e.g. mowed only once a year. This type of grasslands (lowland and mountain hay meadows) could be considered as semi-improved grasslands (*prairie* in France; *prado* in Spain). Like in mountain alpine meadows, the percentage of wild floral species can increase. These grasslands can content trees and scrubs, especially tree walls around the parcels.

[5] Intensive British Agricultural Grasslands. An Introduction to Production & Biodiversity. http://www.countrysideinfo.co.uk/ag_grasslnd/index.htm

Managed grasslands are discriminated from arable land using Landsat and VHR images, specific colour and structure patterns (arable land parcels are generally more angular in shape than pastures and the texture is smooth) and the identification of cultivation tracks, but a certain grade of confusion between two classes is expected. Arable land, in Continental, Mediterranean and Nordic environments, typically appears on flat lowland soils with clay / fine sediment and few blocks. They are therefore generally more angular in shape than pastures and the texture is smooth.

This category includes:

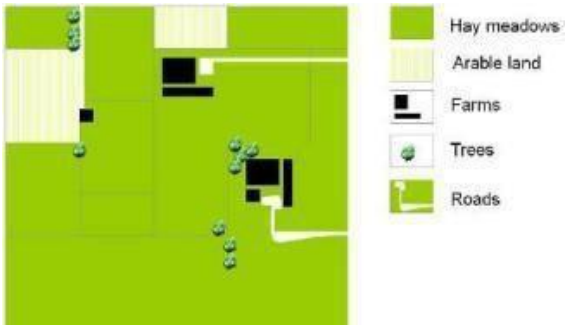
- Agricultural grasslands fenced by lines of trees (including hedges and/or scrub).
- Abandoned arable land used as pastures or without use (set aside) within agricultural areas.
- Managed grasslands may content patches of arable land (less than 25% according CORINE rules; 30% according EUNIS general rules).
- Managed grasslands with scrub and trees (basically due to process of land abandonment in mountain but also in lowland environment) where grasses are dominant.
- Improved and semi-improved grasslands without trees.

This category excludes:

- Agro-forestry systems (dehesas). → 2.3.4 Agro-forestry.
- Urban grasslands (Urban lawns and sport turfs like golf, cricket, tennis, football or polo courses, plots without use in non-urban dense environments colonized by herbaceous plants and grasses of aerodromes and airports, grassland belonging to industrial areas). → 1.4 Green urban, sports and leisure facilities.
- Land plot clearly dominated by scrubs and trees and where grasses are not dominant → 3.4 Transitional woodland and scrub.
- Meadows of dump sites → 4.2.1.2 Semi-natural grassland without woody plants



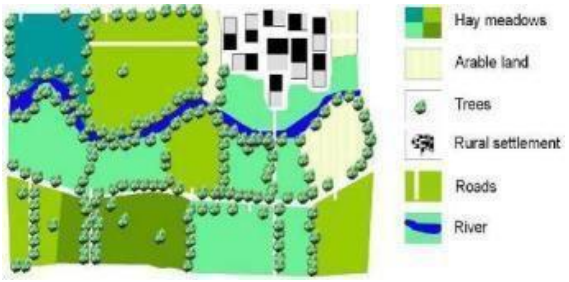
Managed (improved) grasslands in Friesland (The Netherlands). Credit: Eurostat, 2012. LUCAS.



Schematic representation of managed (improved) grasslands.



Managed (semi-improved) grasslands. Prairies in Auvergne, France. Credit: C. Alonso.

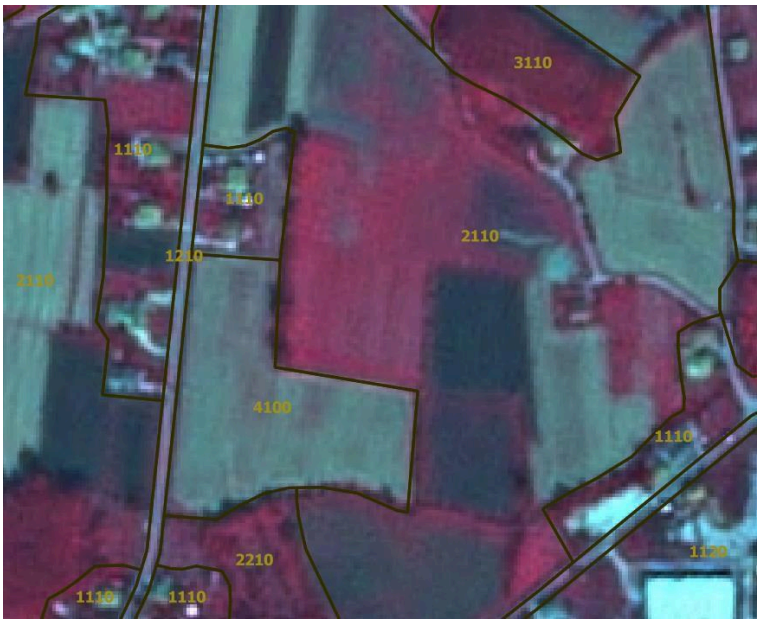


Schematic representation of managed (semi-improved) grasslands.



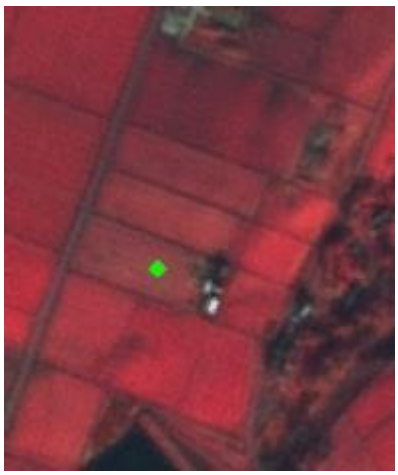
Managed grasslands plot containing scrubs and trees (right), in this case due to a process of land abandonment (Central Spain). Credit: M. Palacios.

Appearance:



Managed grassland with borders to arable land, Badoere (Italy), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-20. CNES 2011©, Distribution Airbus DS/Spot Image.

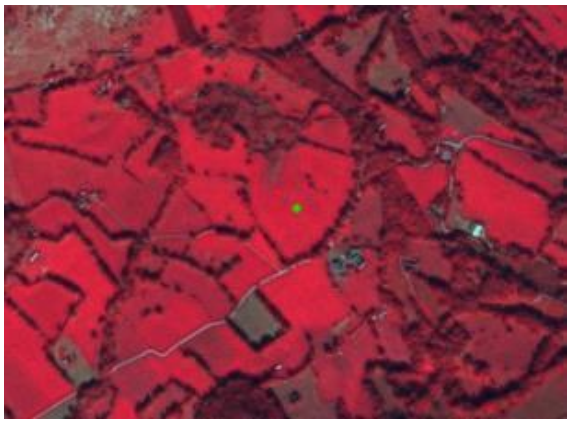
Managed (improved) grasslands:



Hade edge, United Kingdom, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-01-31. CNES 2012©, Distribution Airbus DS/Spot Image

- Located in fertile soils, preferably in Atlantic and Continental regions in flat or low slope sites.
- In many cases, presence of agricultural buildings and infrastructure.
- Land plot structure present.
- Homogenous texture based on high permanent grass density.
- Red colours present in band combinations based on infrared during the entire year. Decrease of greenness due to summertime mowing.

Managed (semi-improved) grasslands:



Example of managed grassland, Omex (France), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-04. CNES 2011©, Distribution Airbus DS/Spot Image.

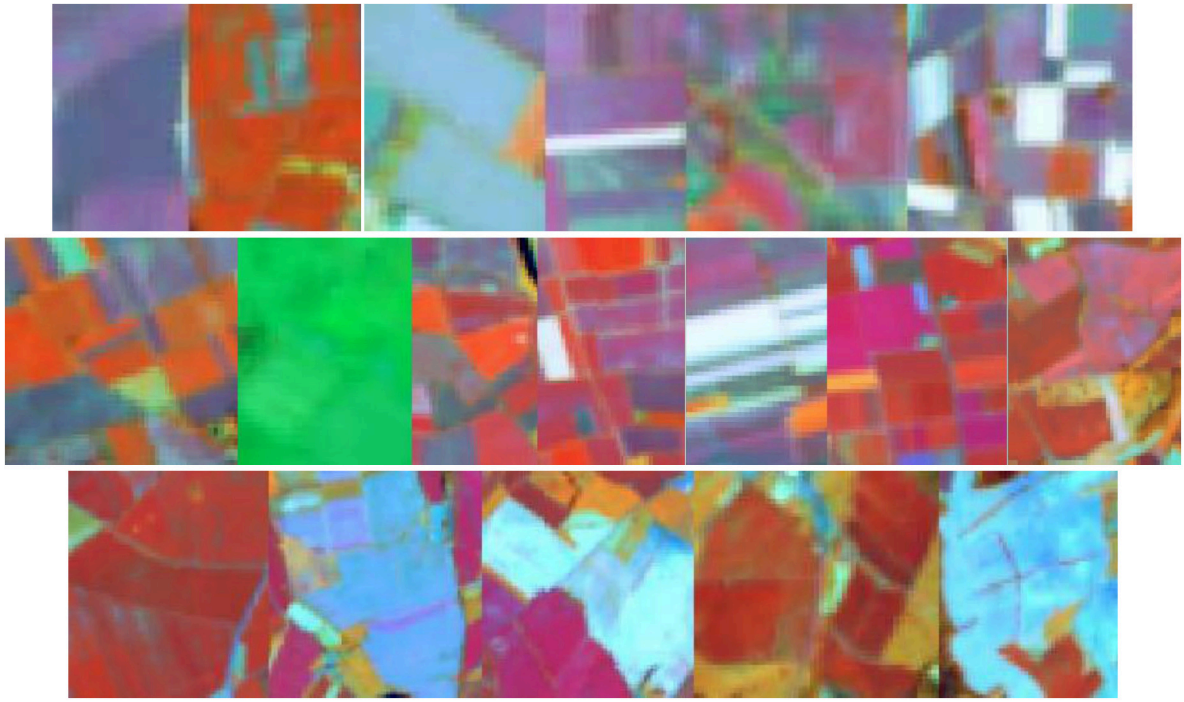
- Located in lowland areas in humid regions around Europe.
- Located in mountainous areas in Mediterranean region.
- Managed (semi-improved) grasslands fenced by lines of trees (including hedges and/or scrub).
- These trees in walls/fences are not considered as 3.5.0 Lines of trees and scrub.
- Presence of buildings (villages and agricultural facilities).
- Frequently mixed with agricultural grasslands. Lowland hay meadows are placed in less productive locations. In many cases related to forests.
- Land plot structure present (in many cases bigger than surrounded agricultural grasslands).
- Homogenous texture based on high permanent grass density, but in any cases covered by scrubs and trees.
- Red colours present in band combinations based on infrared during the entire year.

Difference between managed (semi-improved) and semi-natural grasslands:

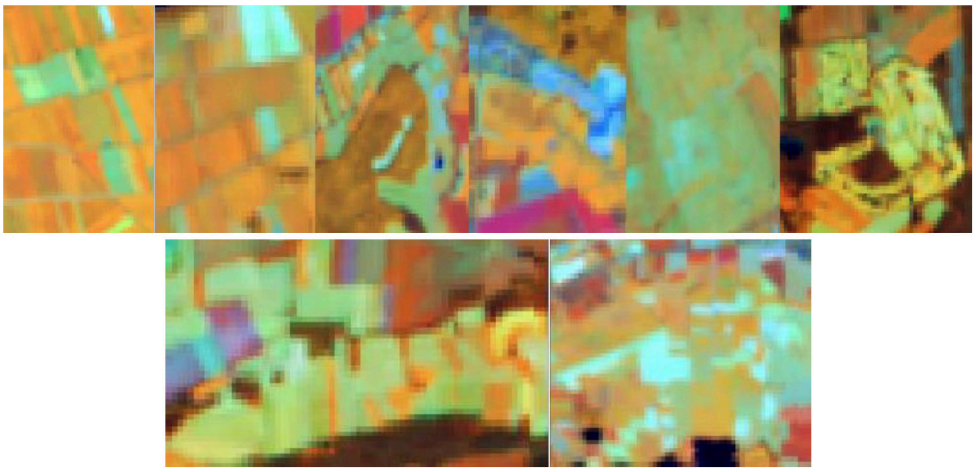
	Managed (semi-improved) grassland	Semi-natural grassland
Land use	Managed land parcel normally used for hay production	Normally used for grazing either because it cannot be mowed or because it is located on poor soils (calcareous soils, etc). Normally never used for hay production
Environmental conditions	Normally located in more humid environments (except humid semi-natural tall herb meadows) and more fertile soils (as at bottoms of river valleys).	Normally located in poor soils areas (calcareous soils, sands, etc.) In many cases (Mediterranean areas) conditioned by a period of water scarcity (usually summertime).
Degree of management	Grassland that is more or less frequently mowed and/or managed in other ways. More homogeneous grass coverage. In specific conditions can be irrigated. In the case of grassland with trees they can be also managed (e.g. cut for forage).	The herbaceous plants are natural but are created and maintained as permanent grasslands by non-intensive activities, such as grazing. Less homogenous grass coverage.
Landscape	Normally artificially limited by fences, tree lines, small stone walls and other types of structures in order to facilitate its management. Normally small regular parcels.	Normally larger areas, and normally with no parcel structure. In many cases presence of trees and shrubs due to process on natural vegetation invasion or land abandonment
Location	Near villages, fertile soils of valleys and accessible areas	Normally located on slopes or poor soils which limit the production. Located in less accessible areas.

Methodological advice:

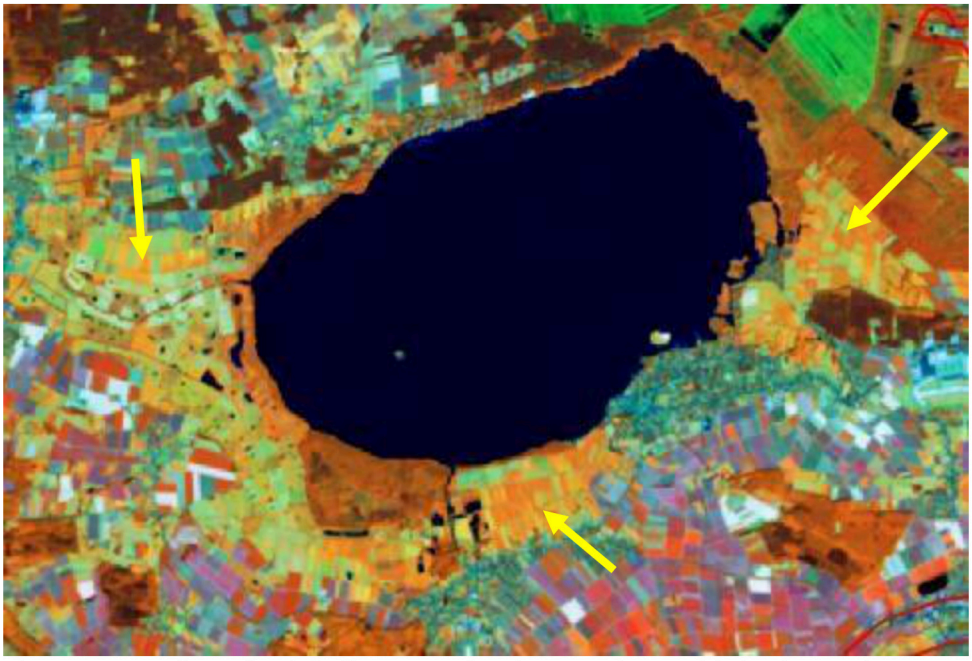
- Use of CLC class 2.3.1 as orientation.
- Arable land/managed grasslands (= permanent) discrimination: use of Landsat imagery or other EO datasets acquired outside the vegetation period (August-October, March/April) and application of specific colour patterns.



Typical arable land colour patterns in Landsat images (band combination 5-6-4).

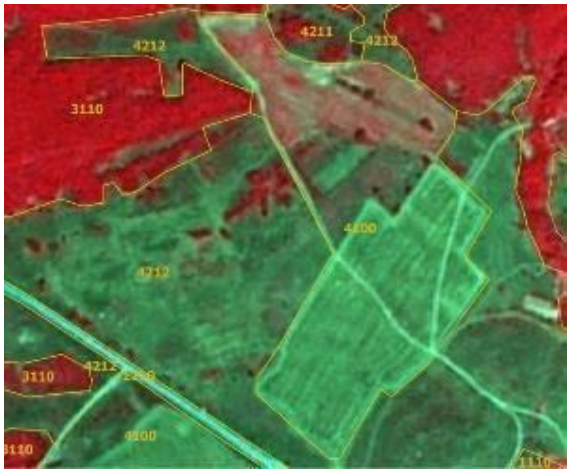


Typical grasslands colour patterns in Landsat images (band combination 5-6-4).

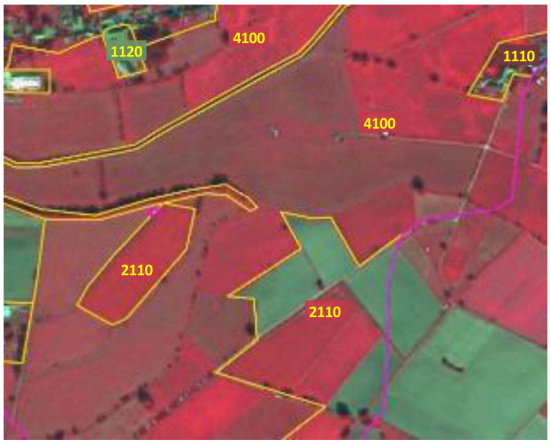


Typical colour patterns of grasslands (yellow arrows) and surrounding arable land in Landsat images (band combination 5-6-4). Credit: USGS

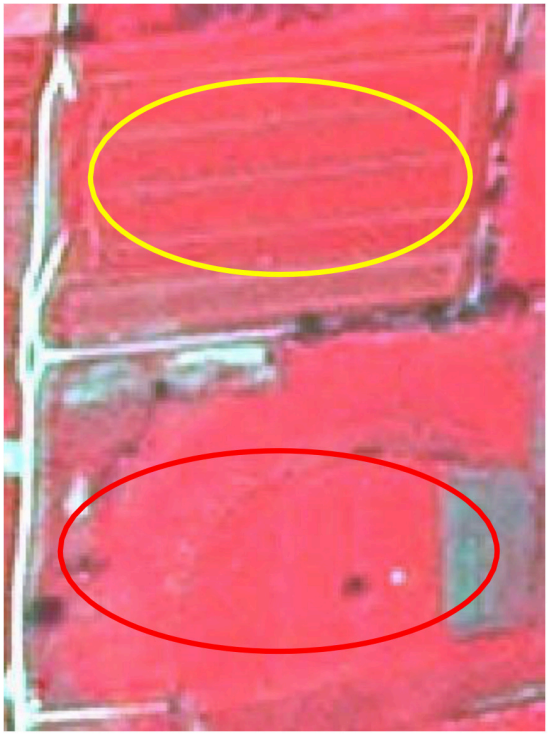
- Use of VHR images to detect cultivation tracks. In many cases, mowing management of grassland produces tracks similar to those in arable land but with different pattern and row distance.



Visible cultivation tracks, Varna (Bulgaria), Spot 5 (2.5 m; 1/2/3 band combination). Date 2011-08-03. CNES ©, Distribution Airbus DS/Spot Image.



Homogenous parcels of grassland without visible mowing tracks, Spot 5 (2.5 m; 1/2/3 band combination). CNES ©, Distribution Airbus DS/Spot Image.



Tracks in cropland (yellow circle) and tracks in grassland (red circle), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-05-06. CNES 2012©, Distribution Airbus DS/Spot Image.




Examples of rows in a grassland parcel due to mowing management. Credit: Eurostat, 2009. LUCAS.

- Use of specific in-situ data (as Land Parcel identification System in the case of Sweden).
- Grassland is often situated in specific locations, e.g. along rivers and lakes.

Difference between arable land and managed grassland:

	Arable land (2.1.1)	Managed grassland (4.1)
Parcel shape	Parcel generally more angular	Often angular, but also more irregular shapes
Appearance	• Smooth texture • Different colours → different crops, different growth stages; after harvest soil appears blue	• Smooth texture • due to summertime mowing
Cultivation marks	• Cultivation tracks (plough marks, rows) • Bales of straw • Access road	• Rows of mowed grass possible • Hay bales • Access road
Landscape	Very large connected areas lying in lowlands	Appears also in more hilly areas, near forests

4.2 Natural & semi-natural grassland

4.2.1 Semi-natural grassland

4.2.1.1 Semi-natural grassland with woody plants (C.C.D. $\geq 30\%$)

4.2.1.2 Semi-natural grassland without woody plants (C.C.D. $< 30\%$)

Definition:

By semi-natural grasslands we mean areas where the herbaceous plants are natural but are created and maintained as permanent grasslands by less intensive agricultural activities[6]. Here are also included marginal grasslands: abandoned crops invaded by grasses; areas near roads and other infrastructures; abandoned dumping sites, etc. Semi-natural grasslands are divided into two categories, according to the presence of woody plants (Crown Cover Density, C.C.D $< 30\%$ or $\geq 30\%$).

Specific habitats are considered as semi-natural grasslands in EU Habitats Directive like dry grasslands (as calcareous/limestone dry grasslands; Mediterranean dry grasslands or pseudo-steppes; pannonian/subpannonian substeppes; Anatolian steppes or machair and alvar in Nordic countries), mesophilic grasslands and tall herb humid meadows or alluvial meadows in Mediterranean areas.

[6] FAO, http://www.fao.org/agriculture/crops/core-themes/theme/spi/gcwg/definitions/en/

Class 4211 includes semi-natural grassland with some isolated trees and woody plants. If there is no change, the assignment of 4211 is considered correct. However, if the proportion of shrubs increases and the of grassland decreases, this is seen as a sign of progressive tree invation and should therefore be considered an important pressure in the grassland analysis. In cases of continuing increase of bushes the assignment of 3400 Transitional woodland and scrub should be mapped.

This category includes:

- Natural grasslands, according CORINE 3.2.1 classification.
- Hydrophilous tall herb areas.
- Wet grasslands alongside river in dry environments (including former gravels covered by grasses and grass-like plants).
- Grasslands which are open because of topographic or climatic reasons (such as grasslands periodically planed by ice).
- Mesic and dry grasses of military training areas.
- Marginal grasses located near infrastructures (as intersections of railroads).
- Grassland covering abandoned arable land.
- Mediterranean dry grasslands ploughed to remove scrubs.
- Meadows of dump sites.
- Typical afforestation setting, but used as transect for power line poles, no regeneration or re-planting of trees visible, power line poles visible.

This category excludes:

- Wet grasslands, which are wet most time of the year, should be considered to be included in the wetland layer (in the case of sedge communities and tall rush swamps). → 7.x.x Wetland.
- Habitats of bogs and boreal mires (including herbaceous plants such as sphagnum and others) → 7.x.x Wetland.
- All grasslands with more than 30% C.C.D could be considered as scrub (CORINE consider 25%). → 5.x.x Heathland and scrub.
- Clear cutting areas, new forests → 3.4.0 Transitional woodland and scrub.
- Reeds covering former gravels → 3.4.0 Transitional woodland and scrub.
- (In Nordic conditions) Grazed/mowed humid pastures → 4.1 Managed grassland.
- Managed grasslands → 4.1 Managed grassland.
- Agro-forestry systems → 2.3.4 Agro-forestry.
- Broadleaved evergreen forests, which may appear with a low tree crown coverage and may be misinterpreted as semi-natural grassland (4.2.1.1). → 3.1.1 Natural and semi-natural broadleaved forest.
- Grasslands growing in temporary wet areas.



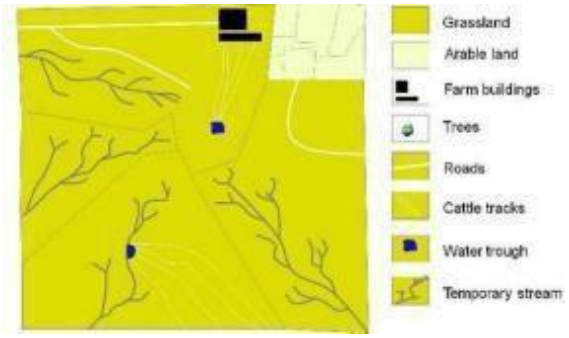
Dry grassland on the Franconian Alb (juniper heath-land), Germany. Credit: M. Probeck.



Schematic representation of calcareous dry grass-lands.



Dry Mediterranean grasslands in Extremadura region, South Western Spain. Credit: M. Palacios.



Schematic representation of Mediterranean pseudo steppes in summertime.



Pannonian dry grasslands in Northwestern Hungary. Credit: Eurostat, 2012. LUCAS.



Nordic alvar (Oländ, Sweden). Credit: Eurostat, 2012. LUCAS.



Grasses covering an abandoned arable land. Credit: M. Palacios.



Grasses in a military camp. Credit: M. Palacios.



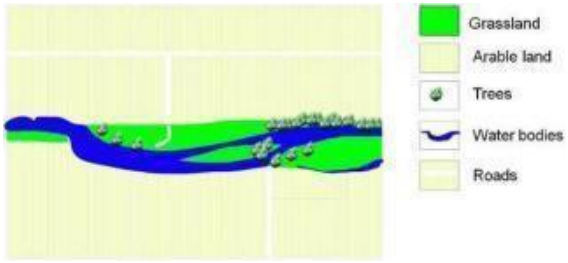
Spontaneous grassland in Bieszczday district (Poland). Credit: Eurostat, 2009. LUCAS.



Wet grassland in Donegal (Ireland): Credit: Eurostat, 2009. LUCAS.



Wet grassland alongside river humid soils in Spain. Credit: M. Palacios.



Schematic representation of Mediterranean alluvial meadows.



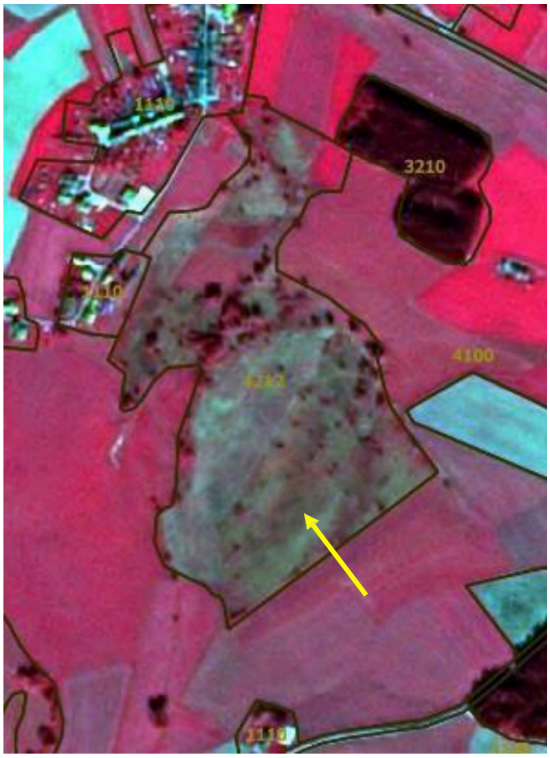
Examples of Mediterranean grasslands ploughed 3-5 years to remove scrubs invading the parcel. Example in Extremadura, Spain. Credit: Eurostat, 2012. LUCAS.



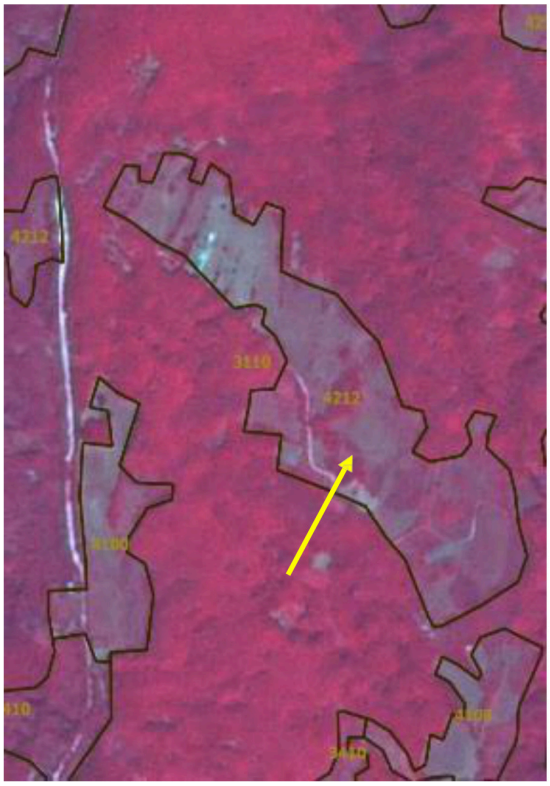
Examples of Mediterranean grasslands ploughed 3-5 years to remove scrubs invading the parcel. Example in Extremadura, Spain. Credit: Eurostat, 2012. LUCAS.

Appearance:

- Inhomogeneous appearance.
- Presence of scrub and trees inside grassland area.
- Irregular shape – no or hardly any rectangle structures.
- Often remote area with no infrastructure.
- Often in vicinity to forest areas/ other natural areas.
- May have 1-2 cuts per year.



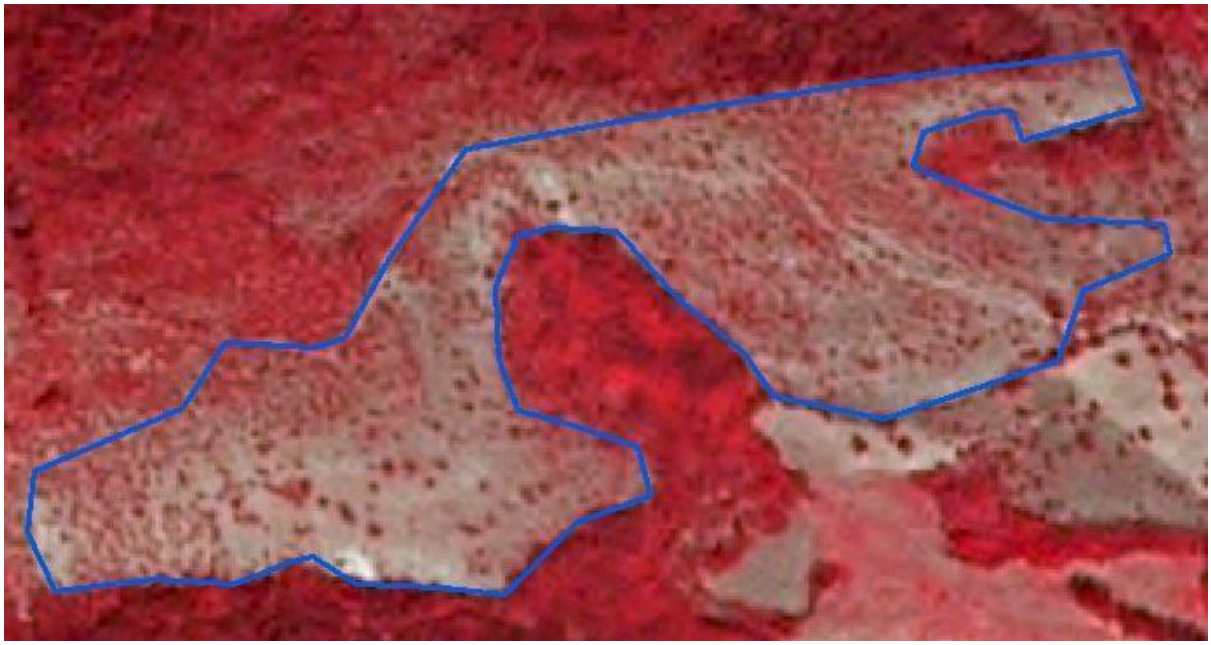
Semi-natural grassland without woody plants, Germany, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-10-01. CNES 2012©, Distribution Airbus DS/ Spot Image.



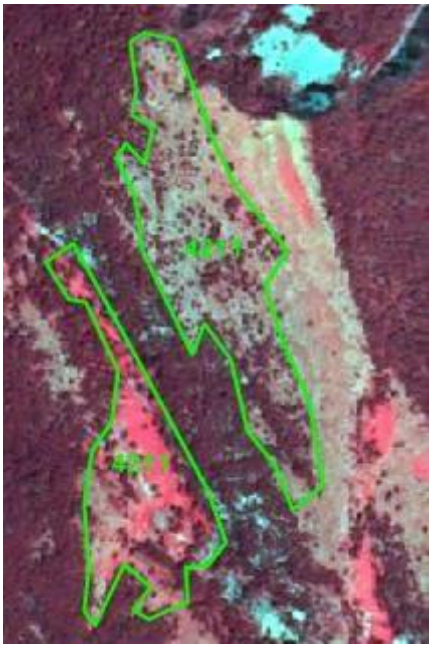
Semi-natural grassland without woody plants, Croatia, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-06. CNES 2012©, Distribution Airbus DS/ Spot Image.

Semi-natural grasslands with woody plants:

- Semi-natural grassland with woody plants (C.C.D. $\geq 30\%$).
- Understory clearly dominated by grasses ($> 30\%$), except
  - climax forest with low tree density and grasses understory $\rightarrow$ 3.x.x Woodland and forest.
  - 2.3.4 Agro-forestry in specific locations, as Southwestern Spain.



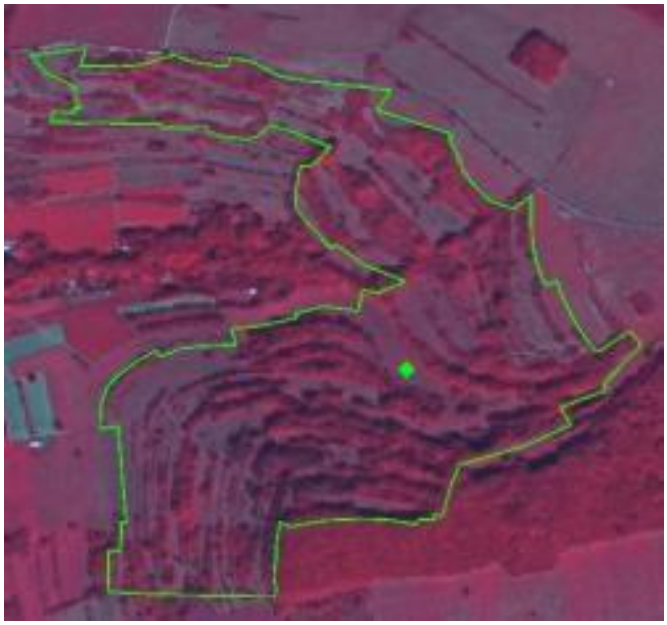
Semi-natural grasland with woody plants, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-27. CNES 2011©, Distribution Airbus DS/Spot Image.



Semi-natural grassland with woody plants, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-08. CNES 2011©, Distribution Airbus DS/Spot Image.

Calcareous/limestone dry grasslands:

- Located in less fertile soils (such as limestone) in Atlantic and Continental regions.
- Frequently mixed with rocks and scrubs/trees.
- Land plot structure present (big plots surrounded by smaller agricultural grassland plots).
- Medium texture.
- Predominant green/orange colours present in band combinations based on infrared throughout the year. Less greenness than agricultural grasslands in the same area.



Calcareous dry grasslands example, Himsklamm Natura 2000 site (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-08-27. CNES 2012©, Distribution Airbus DS/Spot Image.

Mediterranean dry grasslands:

- Located in the Mediterranean regions in areas affected by dry summers.
- Frequently mixed with scrubs. In some areas mixed with wooded grasslands.
- Generally land plot structure present (big plots).
- Non-homogenous texture.
- Green/Red colours in springtime band combinations based on infrared. Brown colours in summer-time (annual grasses). In some cases white colours due to over-grazing.



Mediterranean dry grasslands example, Contrada Giammaiano Natura 2000 site (Sicily, Italy), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-16. CNES 2012©, Distribution Airbus DS/Spot Image.

Pannonian steppes:

- Located in flat areas in Pannonian region (Hungary; Romania; Slovak Republic; Czech Republic; Austria; Serbia and Croatia), but centered in the Hungarian plaine (puszta).
- Mixed with agricultural land areas located in areas less productive.
- Usually big plots with presence of drainage channels in specific locations (Duna-Tizsa plaine).
- Non-homogenous texture based on a medium grass density and bare soil patches.

- Green-brown colours in spring and autumn respectively.



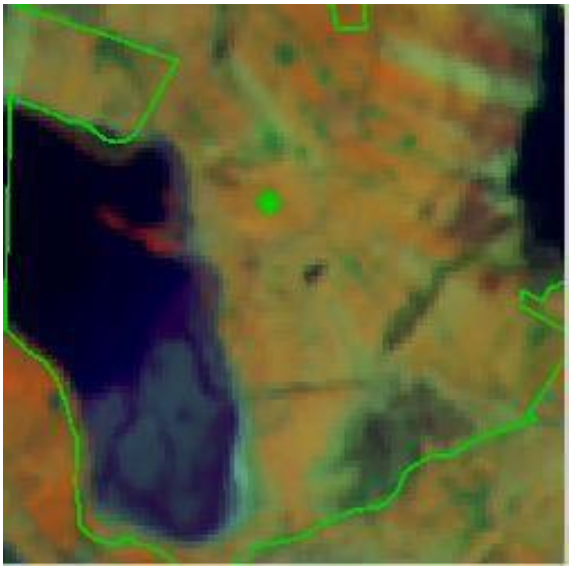
Pannonic steppe grasslands example, Hortobágy Natura 2000 site (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-22. CNES 2012©, Distribution Airbus DS/Spot Image.

Anatolian steppes:

- Located in Centre and Eastern Anatolian (montane steppes) and Black Sea region.
- Frequently mixed with scrubs. No tree presence.
- No land plot structure present, but surrounded by arable land plots.
- Non-homogenous texture.
- Green-Brown colour throughout the year in dry locations. Green colours in montane steppes during less dry periods.

Coastal meadows (machair):

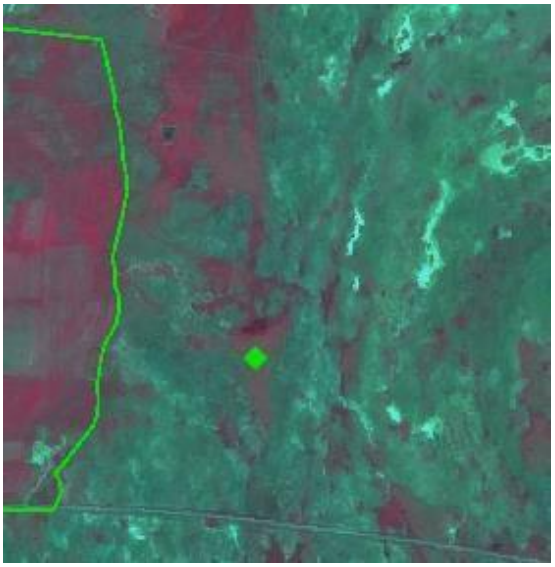
- Located at sand dunes in Scotland and Ireland.
- Can be mixed with scrubs and agricultural plots.
- No land plot structure present.
- Homogenous texture based on a medium grasses coverage and the presence of sand.
- Red colours present in band combinations based on infrared throughout the year. Also brown due to the sand.



Machair example in green marked Nature 2000 site, Termoncarragh Lake and Annagh Machair SPA (Ireland), IRS (20 m; 3/4/2 band combination). Date: 2011-03-31. CNES 2011©, Distribution Airbus DS/Spot Image

Nordic alvar:

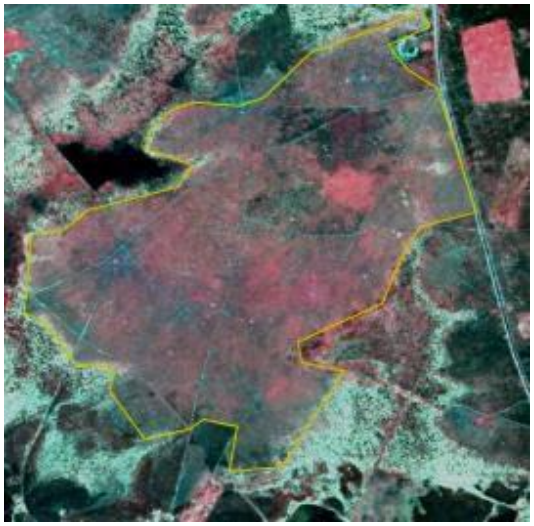
- Located in Boreal region (basically Sweden and Baltic countries).
- Grasses occupying areas with rocks and scrubs.
- Without land plot structure.
- Non-homogenous texture (grasses, rocks and scrubs)
- Grasses appearsin red to green colours.



Nordic Alvar example with grasslands in red colour, Stora Alvaret Natura 2000 site (Sweden), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-29. CNES 2012©, Distribution Airbus DS/Spot Image.

Grasslands in military camps:

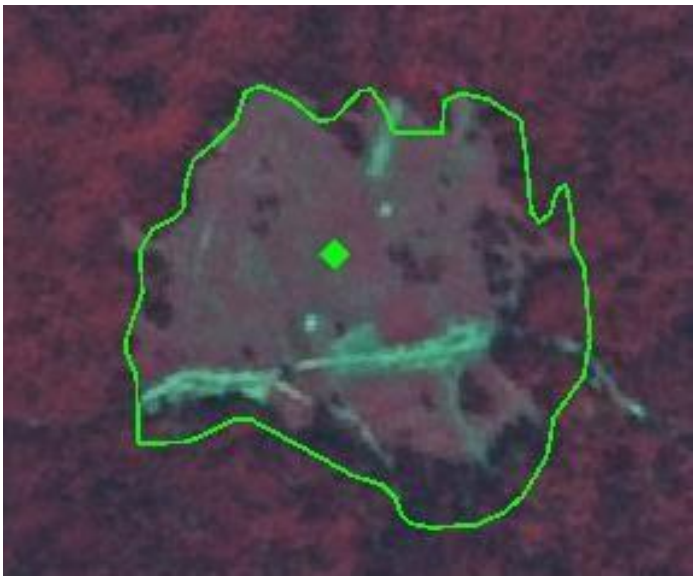
- Non-homogenous texture (grasses, sandy areas, low bushes, heath).
- Xeric grassland appears in green colours.



Dry natural grassland without woody plants (4.2.1.2) on a former military training site, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-05-06. CNES 2012©, Distribution Airbus DS/Spot Image.

Semi-natural mesophilic grassland:

- Located in Atlantic and Continental biogeographic regions or in mountains in other areas.
- Can be mixed with scrubs, trees and agricultural plots.
- No land plot structure present.
- Homogenous texture based on medium grass coverage.
- Red colours present in band combinations based on infrared throughout the year. Also brown due to the sand.
- The texture is often more rough than arable land and flamed with alternating dryer and more humid parts.



Hydrophilous tall herb example, Rečice Natura 2000 site (Croatia), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-25. CNES 2012©, Distribution Airbus DS/Spot Image.

Alluvial meadows:

- Associated to humid soils/valleys alongside rivers and humid soils.
- Frequently flooded. In big alluvial grassland mixed with agricultural plots.

- Shape related to river valleys. In big rivers presence of abandoned meander.
- No land plot structure present.
- Homogenous-medium texture based on high permanent grass density (temporarily flooded).
- Red colours present in band combinations based on infrared throughout the year. In many locations affected by a loss of greenness in summertime (green colours).



Alluvial meadow example, Umurca (Turkey), Spot 5 (2.5 m, NIR/R/G band combination). Date: 2011-07-05. CNES 2011© Distribution Airbus DS/Spot Image.

Methodological advice:

- Use of CLC class 3.2.1 as orientation.
- Subtract alpine-subalpine grasslands using digital elevation model as reference.
- Soil identification as a proxy: calcareous, sand, chalk, gypsum.
- Tree encroachment should be mapped 4212 to 3400 and shrub encroachment (42xx to 5xxx).

4.2.2 Alpine and sub-alpine natural grassland

Definition:

According EUNIS definition "primary and secondary grass- or sedge-dominated formations of the alpine and subalpine levels of boreal, nemoral, mediterranean, warm-temperate humid and Anatolian mountains"[7].

This category includes following natural grasslands identified in Annex I Habitat Directive:

- 6140 *Siliceous Pyrenean Festuca eskia grasslands*[8] (in the Pyrenees and Cantabrian mountains in Spain);
- 6150 *Siliceous alpine and boreal grasslands*[9] (acidic grasslands of mountains in the Alps, Carpathians and Scandinavia together with higher mountains elsewhere in northern Europe such as in the north of the British Isles);

[7] http://eunis.eea.europa.eu/habitats/146
[8] http://eunis.eea.europa.eu/habitats/10114
[9] http://forum.eionet.europa.eu/x_habitat-art17report/library/datasheets/habitats/grasslands/grasslands/6150-siliceous_grassland

- 6160 *Oro-Iberian Festuca indigesta grasslands*[10] (located in the high Mediterranean mountains of the Iberian Peninsula) and
- 6170 *Alpine and subalpine calcareous grasslands* (present in the Alps, Pyrenees, Carpathian and Scandinavian mountains, highest mountains of Corsica, Apennines, Cantabrian, Betic and Iberic mountains in Spain, Dinaric Alps, the mountains of Greece and Turkey and the Scottish Highlands[11]).

These natural grasslands are known commonly as alpine meadows. In all the cases, these alpine meadows involve grasses growing above the limits of the mountain hay meadows and forests (in many cases in areas with mountain scrublands and bare rocks or barren landscapes).

The majority of these alpine grasslands are grazed traditionally in summertime under traditional transhumance regimes.

Per definition, there are no trees in alpine grasslands or their presence is rare.

Related EUNIS Habitat Classification: E4.

Alpine and subalpine grassland can be located in alpine valley bottom, slopes or mountain tops.

This category includes:

- Natural grasslands (occasionally grazed) above the tree line[12] with low fraction of bare rock or gravel, shrubs and sporadic trees. Grasslands cover at least 30% of the surface. Low managed grassland close to the tree line with high grass density and no land plot structure present are also included here.
- In the case of Nordic countries this class includes natural grasslands and extensive/former grazed grasslands above the tree line.

This category excludes:

- Alpine heaths, usually located between the tree line and the grasslands formations
- → 5.x.x Heathland and scrub.
- Surfaces covered by mosses and lichen → 6.1 Sparsely vegetated areas.
- Grasslands with less than 50 % field cover (in climax stage), such as snow bed grassland
- → 6.1 Sparsely vegetated areas.
- Mountain hay meadows (managed grasslands) below tree line → 4.1 Managed grassland.

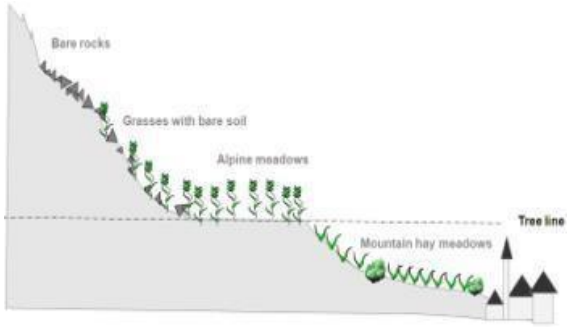


Oro-Iberian festuca indigesta grasslands at altitude above 2,000 m in Madrid region (Spanish Central Mountains range) Credit: M. Palacios.

[10] http://eunis.eea.europa.eu/habitats/10116

[11] http://ec.europa.eu/environment/nature/natura2000/management/habitats/pdf/6170_Alpine_calcareous_grasslands.pdf

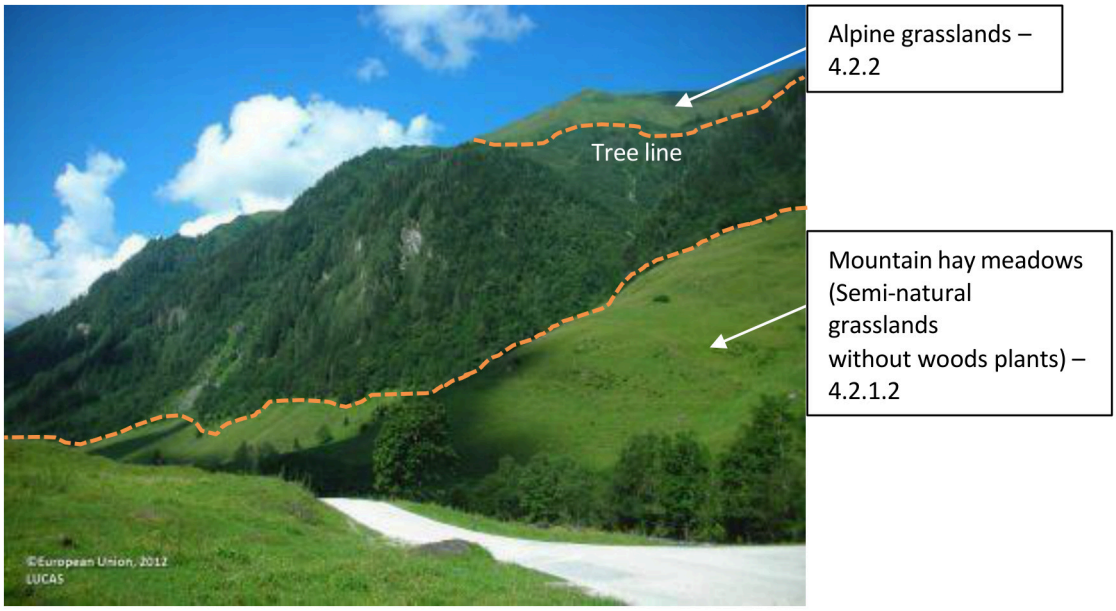
[12] Berdanier, A. B. (2010) Global Treeline Position. Nature Education Knowledge 3(10):11. http://www.nature.com/scitable/knowledge/library/global-treeline-position-15897370



Schematic representation of alpine grasslands.



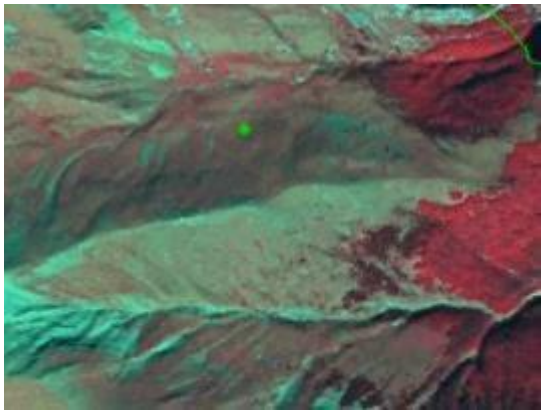
Location of alpine and subalpine grasslands. Credit: M. Rodriguez.



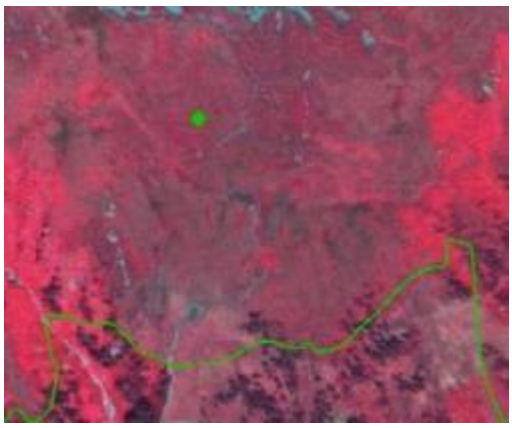
Alpine meadows/mountain hay meadows discrimination using a theoretical tree line (dotted line in yellow). Alps in Austria. Credit: Eurostat, 2012. LUCAS.

Appearance:

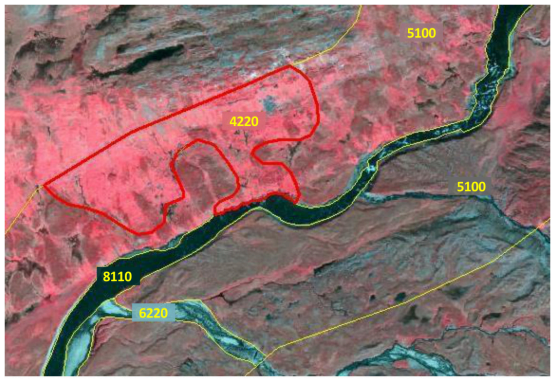
- Located over the tree limit in high mountains in Alpine region (valleys and slopes).
- Frequently mixed with rocks; non-permanent water and peat bog.
- Discrimination affected by mountain shadows.
- No land plot structure present.
- Homogenous-medium texture based on high permanent gras density (rocks)
- Red colours present in band combinations based on infrared throughout the year (frequently covered by snow during wintertime). Grasslands in valleys present more greenness than slope grasses.
- In Nordic countries this category is normally a heterogeneous vegetation type where grass dominates in a mosaic of heath vegetation, mire vegetation, alpine willow bushes and rocky ground.



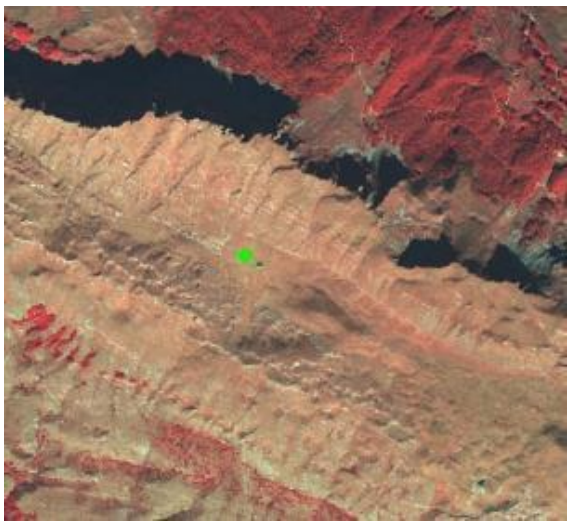
Siliceous Pyrenean *Festuca eskia* grassland example, Tendeñera Natura 2000 site (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-08.



Alpine calcareous grassland example, Verwall Natura 2000 site (Austria), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2012-09-28. CNES 2012©, Distribution Airbus DS/Spot Image.



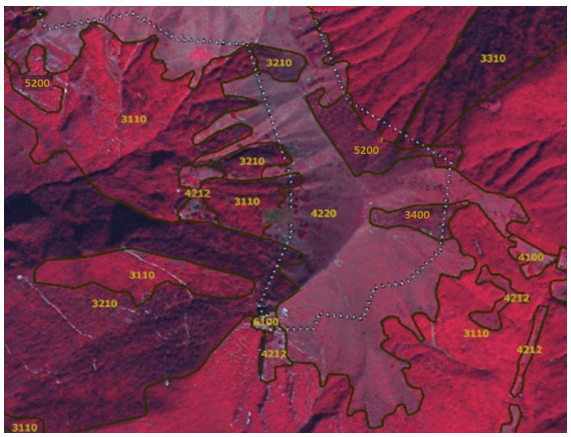
Example from mountainous parts, Scandinavia, Spot 6 (1.5 m; 1/2/3 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.



Alpine grassland example. Border between Bosnia and Herzegovina and Montenegro, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-18. CNES 2012©, Distribution Airbus DS/Spot Image.



Alpine grassland example, Durness Natura 2000 site (Scotland, UK), IRS (20 m) Date: 2013-06-05. CNES 2012©, Distribution Airbus DS/Spot Image.



Alpine grassland example with subalpine belt (dashed line), Lake Garda (Italy), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2010-08-31. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Extraction of potential subalpine (this zone also includes forests) and alpine zones (above the tree line) included in LC/LU buffer area using EU-DEM according regional altitudinal zonification:

Mountainous area (associated AOI)	Subalpine altitudinal zone (above m)
Alps	1,600 m[13]
Black Forest, Harz, Vosgues	1,200 m[14]
Pyrenees	1,600 m[15]
Cantabrian Mountains and Mountains of Central Spain	1,700 m[16]
Carpathians mountains	1,390 m[17]
Tatra Mountains	1,550 m[18]
Uplands of Scotland	900 m[19]
Turkey mountains	1,500 m[20]
Corsica mountains	1,600 m[21]

- Analysis of the extraction of tree line from HRL Forest.
- The tree line can be used as interpretation aid, but the boundary between alpine grassland and other classes can also run below or above the tree line.
- In the case of Nordic countries, and considering the heterogeneous nature of this class, a polygon may include up to 30% of the classes 3.1.1 Other natural and semi-natural broadleaved forest,

[13] Huetz de Lemps, A. (1970): La Végétation de la Terre, Masson et Cie, Paris.
[14] Huetz de Lemps, A. (1970): La Végétation de la Terre, Masson et Cie, Paris.
[15] Rivas-Martínez, S. (1990): Los pisos subalpino y alpino de los pirineos y de la Cordillera Cantábrica; relaciones y diferencias, Botánica pirenaico-cantábrica, 577-595, Jaca y Huesca.
[16] Rivas-Martínez, S. (1990): Los pisos subalpino y alpino de los Pirineos y de la Cordillera Cantábrica; relaciones y diferencias, Botánica pirenaico-cantábrica, 577-595, Jaca y Huesca.
[17] http://retro.seals.ch/cntmng?pid=gbi-002:1992:107::136
[18] http://geoinfo.amu.edu.pl/sgp/LA/LA11/LA11_06.pdf
[19] http://www.snh.org.uk/publications/on-line/advisorynotes/26/26.htm
[20] http://www.ukeconet.org/wp-content/uploads/2009/10/Colak_Rotherham_International_Foresty_Review.pdf
[21] http://www.oec.fr/modules.php?name=Sections&sop=viewarticle&artid=114

5.1.0 Heathland and Moorland, 5.2.0 Alpine scrub land , 7.1.2.2 Unexploited peat bog, 7.1.1 Inland marshes, 6.1 Sparsely vegetated areas and 6.3.1.1 Bare rocks, outcrops, cliffs if these surfaces are too small to map separately. The specified class should therefore cover at least 70% of the surface. The minimum mapping unit for these heterogeneous classes will be around 1 ha.

5. Heathland and scrub

Heathland and scrub is divided into two classes depending on whether the shrubby vegetation is evergreen and adapted to water loss (Sclerophyllous vegetation) or not (Moors and heathland).

Moors and heathland appears in both temperate and frigid zones. Areas with heath and dwarf scrub vegetation adheres to the class 5.1.0 Heathland and Moorland. Areas dominated by brush woods and bush-like forest adheres to the class 5.2.0 Alpine scrub land.

Sclerophyllous vegetation appears in Mediterranean region.

5.1 Heathland and moorland

Definition:

Areas with low and closed cover, dominated by brush, bushes and herbaceous vegetation or dwarf shrubs. They are mostly secondary ecosystems with unfavourable natural conditions. The field layer has a cover > 50 % and tree cover < 10 %.

This category includes:

- Areas where the field layer has a cover of more than 50% at the phenological mature stage. (The date of the satellite data is crucial, especially in the northern countries where the vegetation period is short. An area may change from 0% to 100% green field cover within weeks).
- Heath and scrub formation in Atlantic, sub-Atlantic and sub-Continental areas with *Ulex* spp., *Calluna vulgaris*, *Vaccinium* spp., *Erica* spp, *Genista* spp., *Vaccinium myrtillus* and *Rubus* spp.
- Moors in supra-Mediterranean area (400 m-1100 m of elevation) with box trees and gorse, *Buxus* spp., *Astragalus* spp., *Bupleurum* spp., etc.
- Sub Alpine tall herbs with dominating bushy facies, *Calluna* spp., *Vaccinium* spp., *Rubus* spp., *Juniperus nana*, etc.
- Arctic moors areas with moss, lichen, gramineous coverage and small dwarf or prostrate shrub formations (*Betula nana*, *Salix lapponum*, *Salix glauca*, *Juniperus alpina*, *Dryas* spp.);
- Heathland of Mediterranean mountains (apart from alpine and subalpine areas), including *Juniperus* sp. and *Erica* sp. rich heaths.
- Grey dunes with heathland vegetation.
- Mosaics of complex distribution between the classes 5.1, 3.1.1, 4.2.1.x, 5.2, 7.1.2.2, 7.1, 6.1 and 6.2.1, where the class 5.1 cover at least 70% of the surface.

This category excludes:

- Low maquis/mattoral vegetation (CLC class 323) and heathland under recolonizing process where tree-like species cover more than 30% of the surface (CLC class 324) are excluded.
- Non-sclerophyllous scrub, such as dwarf pine (*Pinus mugo*) and green alder (*Alnus ciridis*) in mountainous regions → class 5.2.0 Alpine scrub land.
- Leafy bush, bushy fens and *Salix* spp. Thickets → 5.2.0 Alpine scrub land.
- *Juniper* bush → 5.2.0 Alpine scrub land or in Mediterranean areas → Class 5.3 Sclerophyllus scrubs.
- Areas with $> 50\%$ field coverage with predominance of grass vegetation → Class 4.x.x.x Grassland.
- Areas with field coverage between 10-50 % field cover → Class 6 Open spaces with little or no vegetation.
- Areas with peat producing vegetation → Class 7.x.x Wetland.

- Areas with > 10 % tree coverage $\rightarrow$ Class 3.x.x Woodland and forest.



Ungrassed lichen area of Rödfjället, Dalarana, Sweden. Credit: C. Cristvall.



Stornärfjället, Dalarna (Sweden). Credit: S. Kirppu.



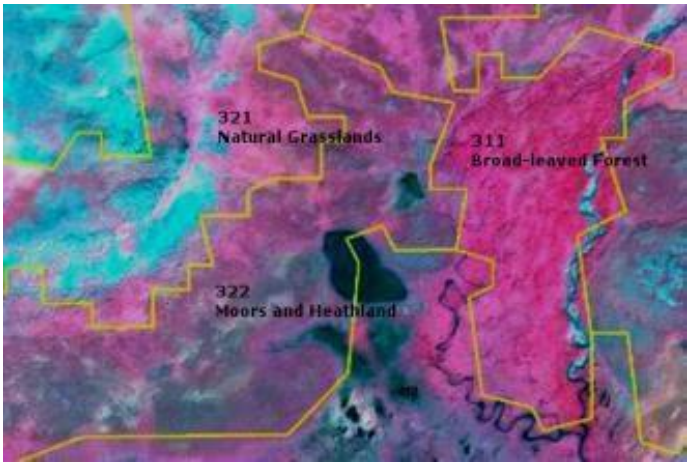
Juniperus communis subsp. *nana* in Mediterranean Alpine-subalpine mountains. Credit: M. Palacios.



Heathland invading grasslands in Ireland. Credit: A. Utanda.

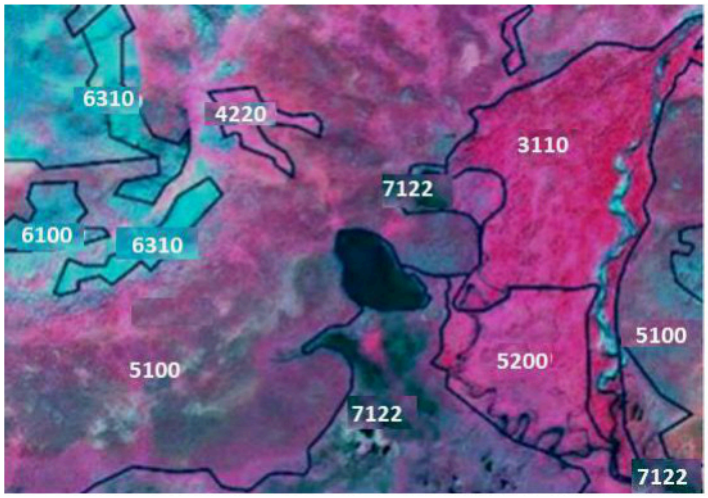
Appearance:

- In Scandinavian condition this vegetation type occurs in a mosaic with mire vegetation, alpine grasslands, alpine willow bushes and rocky ground. This requires generalization where 5.1.0 should cover at least 70 % of the delineated area.
- Delineation between grass heath (4.2.2) and herbaceous heath (5.1.0) is associated with low accuracy when validated in field. A recommendation in the interpretation is also to use additional supporting data consequently.



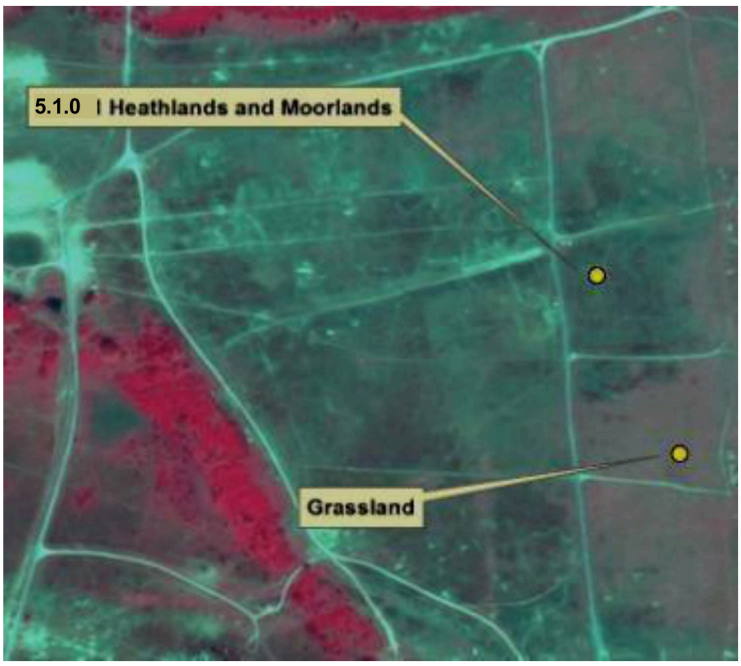
LC CLC classes, Kebnekaise (Sweden), Spot 6 (1.5 m; 1/2/3 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.

Example from alpine and subalpine areas wi *Juniperus nana*, *Loiseleuria procumbens*, *Empetru hermaphroditum*, *Arctostaphylos uva-ursi*, *A tostaphylos alpina* and elements of Alpine flora



5.1.0 Heathland and Moorland, SPOT 6 (1.5 m; 1/2/3 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.

Examples from Scandinavian alpine area. Heathland and Moorland vary with areas of predominantly dwarf shrubs (brown to gray in IR) and more herbaceous (appears more red). Areas with predominance of grass in alpine areas belong to class 4.2.2 Alpine and subalpine grassland.



Heathland and Moorland, Scandinavia, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-06-28. CNES 2011©, Distribution Airbus DS/Spot Image.

Example of delineation between grassland ($> 30\%$ grass coverage) and Heathland and Moorland. The area is used as gunnery range.



Heathland on a military training site, Munster (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-05-06. CNES 2011©, Distribution Airbus DS/Spot Image.

5.2 Alpine scrub land

Definition:

Thickets, brush woods and bush-like forest with a total crown cover of $> 30\%$.

This category includes:

- Brush woods and bush-like forest in mountainous area with dwarf mountain pine scrub or green alder scrub (*Pinus mugo* ssp. *mughus* and *Alnus* spp.) Alpine willow brush, etc., accompanied by *Rhododendron* spp.

This category excludes:

- Typical heath and dwarf scrub vegetation → 5.1.0 Heathland and Moorland.
- Areas with vegetation > 5 meter, and a tree coverage $> 10\%$ → 3.x.x Woodland and forest.
- Sclerophyllous bushes of arid zones, *Maquis* and *garrigue* in France and Spain, *Phrygana* in Greece, *Matorral* and *tomillares* in Spain, *Junipers*. → Class 5.3 Sclerophyllous scrub.
- Shrub- or tall forb-dominated vegetation aside from northern or mountainous locations → 5.1 Heathland and Moorland/4.2.1.x Semi-natural grassland.



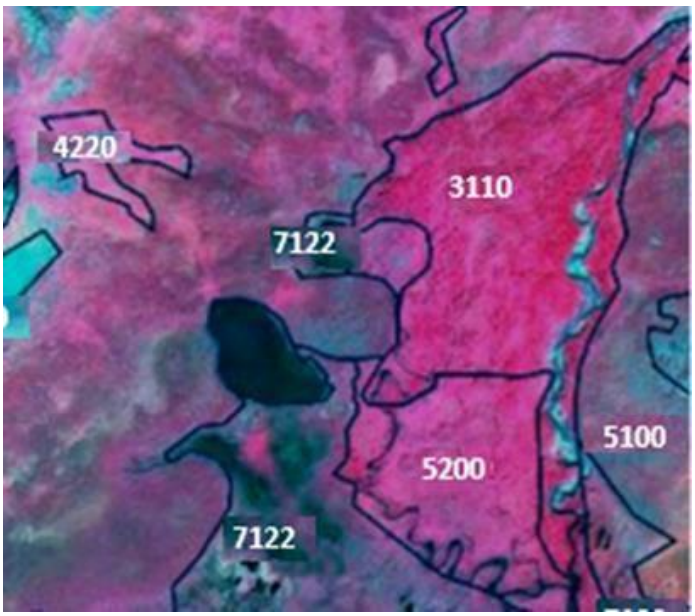
5.2.0 Alpine scrub land: Mountain dwarf pine in the Bavarian Alps, Germany. Credit: M. Probeck.



5.2.0 Alpine scrub land, the phytocoenoses typical for this habitat type are dominated by the oligothermal willows *Salix*, that grow in peat-bogs, marshes and along streams and rivers. These willows have limited distribution in the Bulgarian mountains and occur separately or together. Credit: V. Roussakova.

Appearance:

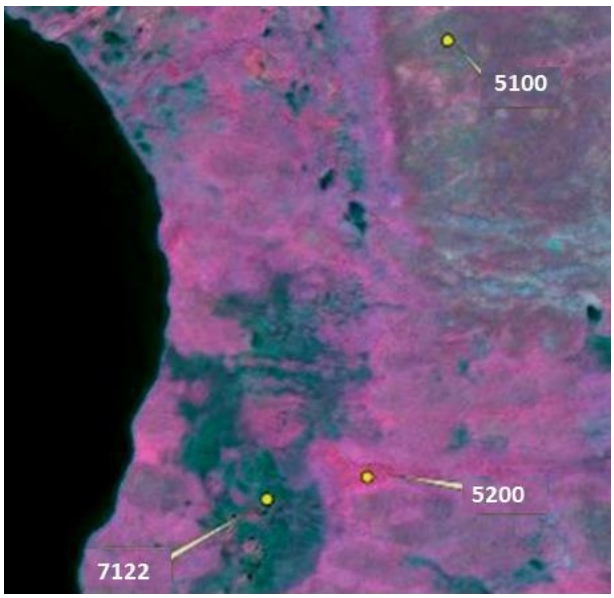
Example from mountainous area near Kebnekaise, Sweden.



5.2 *Salix* scrub in slightly more grey relative to the Nordic subalpine/subarctic forests with *Betula pubescens* ssp. *Czerepanovii*, Spot 6 (1.5 m; 1/2/3 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.

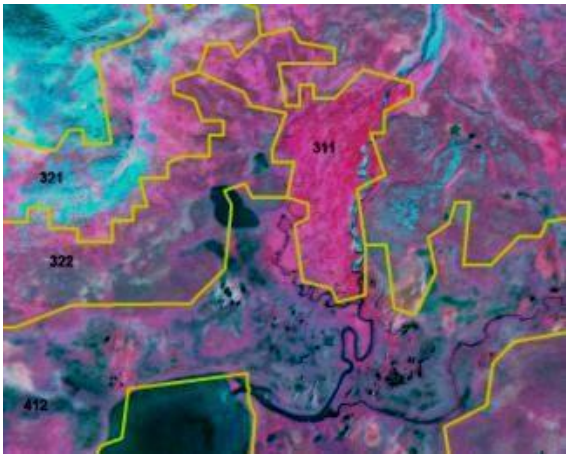
- *Salix* scrub, class 5.2.0 Alpine scrub land.
- Dwarf scrubs, class 5.1.0 Heathland and moorland.
- Peat producing areas, class 7.1.2.2 Unexploited peat bog.
- Nordic subalpine/subarctic forests, class 3.1 Broadleaved forest.

Example from mountainous area south of Kebnekaise, Sweden.

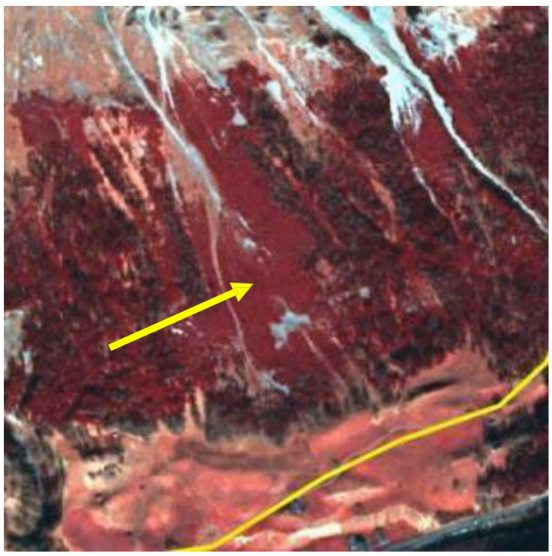


5.2. *Salix* scrub appears in intense red colour in low laying parts of mountainous areas relative to dwarf scrubs (5.1), Spot 6 (1.5 m; 3/4/2 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.

- *Salix* scrub, class 5.2.
- Dwarf scrubs, class 5.1
- Peat producing areas, class 7.1.2.2.
- According to CLC the whole area is 322 - Moors and Heathland.



Salix scrubs in alpine areas appears close to streams may be included in CLC classes 311, 322 and 412 (yellow lines), Spot 6 (1.5 m; 1/2/3 band combination). Date: 2013-07-24. CNES 2013©, Distribution Airbus DS/Spot Image.



Dwarf pine region in the Alps, where difference in height and texture to neighbouring coniferous forest is clearly visible, Spot 5 (2.5 m; 1/2/3 band combination). CNES 2011©, Distribution Airbus DS/Spot Image.

5.3 Sclerophyllous scrubs

Definition:

This class includes evergreen sclerophyllous bushes and scrubs, also includes *maquis*, *garrigue* and *phrygana*. It corresponds to CLC class 3.2.3 and is characterized by hard, leathery, evergreen foliage that is adapted to prevent moisture loss.

This category includes:

- Bushes of arid zones.
- *Maquis* and *garrigue* in France, Italy and Spain.
- *Phrygana* in Greece.
- *Matorral*, *tomillares* and *espartales* in Spain.
- Either type must occupy more than 50% of the area.
- Areas covered with junipers in Mediterranean areas > 0.5 ha.

This category excludes:

- Arborescent shrubs which are in the limits of forest formations with more or less dense arborescent cover. These arborescent shrubs have usually a thick high evergreen shrub stratum organized around several types of trees. If the crown cover of these trees is more than 30%, they will be included in the forest class. If the crown cover is less than 30%, it is assigned to class → 3.4.0 Transitional woodland and scrub.
- If bushes of scrub occupy less than 50% of coverage → 6.1 Sparsely vegetated areas.



"Garriga" in Catalonia (Spain). Credit: Eurostat, 2012. LUCAS.



Sclerophillous vegetation (*Stipa tenaccissima*) in Central Spain. Credit: Eurostat, 2012. LUCAS.

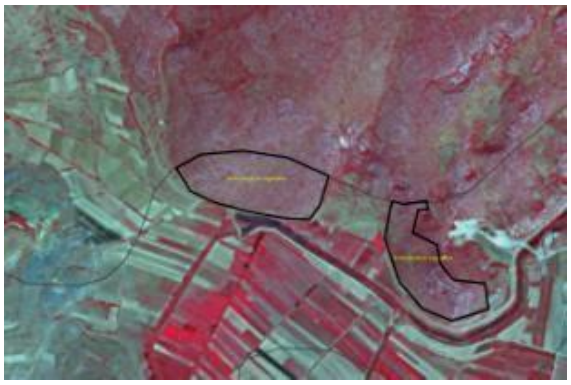


Sclerophyllous vegetation (*Asparagus* sp., *Euphorbia* sp., *Cistus* sp., *Olea europaea* var. *sylvestris*) in Loutsa (Island of Evia), Greece. Credit: N. Kolpatzik.



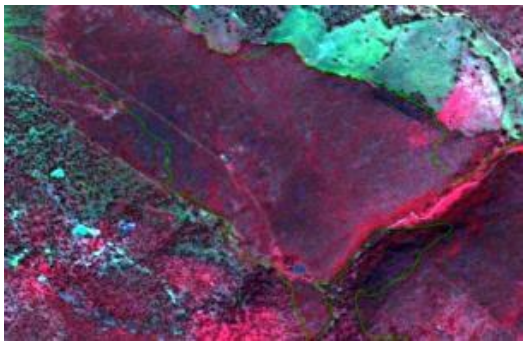
Scrubs (*Retama sphaerocarpa*) invading a grassland area in south-western Spain. Credit: M. Palacios.

Appearance:



Tren (Albania), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-22. CNES 2011©, Distribution Airbus DS/Spot Image.

Mediterranean scrubs in Albania in summertime.



Badajoz (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-03-18. CNES 2011© Distribution Airbus DS/Spot Image.

Matorral in South-Western Spain. In Mediterranean areas, rain is concentrated in spring and autumn and red colours in scrubs are not rare as is the case.

6. Open spaces with little or no vegetation

Natural areas covered with little or no vegetation, including open thermophile formations of sandy or rocky grounds distributed on calcareous or siliceous soils frequently disturbed by erosion, sparsely vegetated areas of stones on steep slopes, screes, cliffs, rock fares, limestone pavements with plant communities colonizing their tracks, beaches, sand dunes and plains, riverbanks, perpetual snow and ice, and burnt areas (other than forest areas).

Sparsely vegetated areas have less than 50 % field cover (herb, grass and/or scrub) at the phenological mature stage and less than 10 % tree cover.

6.1 Sparsely vegetated areas

Definition:

Sparsely vegetated areas. The field layer has a cover between 10% and 50% at the phenological mature stage.

This category includes:

- Sparsely vegetated areas with a field cover between 10% and 50% at the phenological mature stage.
- Snowbed vegetation and transitions.
- Sparsely vegetated heath.
- Sparsely vegetated and unstable areas of stones, boulders or rubble on steep slopes.
- Sparsely vegetation of 'lapie' areas, limestone paving and karstic areas.
- Mosaics of complex distribution between the classes 6.1 (Sparsely vegetated areas), 3.1.1 (Natural and semi-natural broadleaved forest), 4.2.2 (Alpine and sub-alpine natural grassland), 5.1.0 (Heathland and moorland), 7.1.2.2 (Unexploited peat bog), 7.1.1 (Inland marshes) and 6.2.1 (Beaches and dunes) where the class 6.1 (Sparsely vegetated areas) cover at least 70% of the surface.

This category excludes:

- Non-natural sparsely vegetated areas in Urban and Croplands → 1.x.x Urban / 2.x.x Croplands.
- Areas with > 10 % tree cover → 3.x.x Woodland and forest.
- Areas with > 50 % field cover → 4.x.x.x Grassland / 5.x.x Heathland and scrub.
- Areas with < 10 % field cover → 6.2.x Beaches, dunes, river banks / 6.3.x Bare soil, rock, perennial snow & glaciers.
- Areas with dunes or sand plains with or without a grass cove → 6.2.1 Beaches and dunes.
- Burnt areas → 6.3.2 Burnt areas.
- Wetland → 7.x.x Wetland.
- Bare rock, debris without vegetation → 6.2.x Beaches, dunes, river banks / 6.3.x Bare soil, rock, perennial snow & glaciers.



Sparsely vegetated areas in the foreground Nipfjället, Sweden. Credit: S. Kirppu.



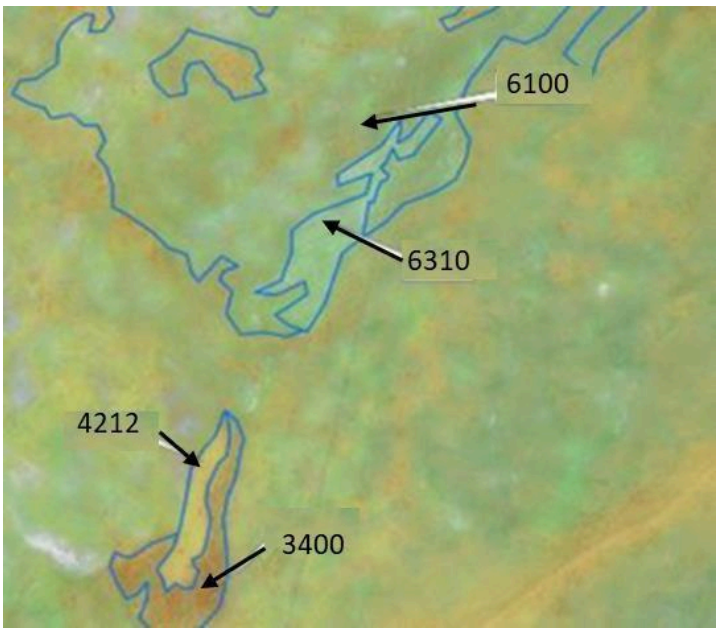
Sparsely vegetated areas in the background. South of Spain. Credit: M. Palacios.

Appearance:

Challenges with the class 6.1 Sparsely vegetated land:

- It is natural scattered and occurs in a mosaic with heath vegetation, mire vegetation, alpine grassland and willow bushes. This requires generalization where 6.1 Sparsely vegetated land should cover at least 70 % of the delineated area.
- The date of the satellite data is thus crucial, especially in the northern countries where the vegetation period is narrow. An area may change from 0 % field cover to 100 % field cover within weeks. A recommendation in the interpretation is also to use additional supporting data consequently.

In dry environments sparsely vegetated areas may be covered by grasses in spring.



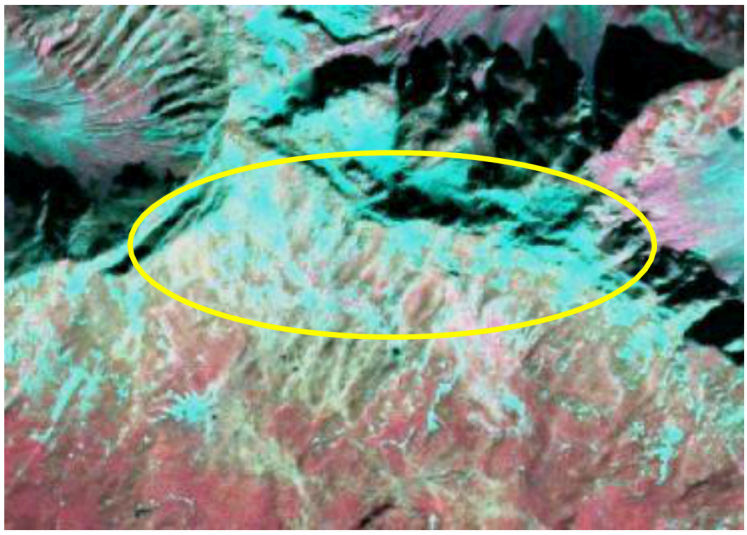
Sparsely vegetated areas, Ölands alvar, Sweden. SPOT-5 data. CNES 2011© Distribution Airbus DS/ Spot Image

Example from Ölands alvar (a limestone barr
plain): 6.1 Sparsely vegetated land; 6.3.1.1 Ba
rocks, outcrops, cliffs (previously 6.3.1.0); 4.2.1
Semi-natural grassland; 3.4.0 Transitional woo
land and scrub



Sparsely vegetated areas (6.1) in Agalar (Turkey), Spot 5 (2.5 m; NIR/R/G band combination). Date: 2011-06-29. Source: CNES 2011© Distribution Airbus DS/Spot Image.

Example from Turkey. The semi-arid condition of these areas (cold-steppe) give as a result a type of vegetation composed of very low density of xeric scrubland.



Sparsely vegetated areas (6.1) in the Alps, Spot 5 (2.5 m; NIR/R/G band combination). Date: 2012-09-07. Source: CNES 2011© Distribution Airbus DS/Spot Image.

Example in the Alps.

6.2 Beaches, dunes, river banks

6.2.1 Beaches and dunes

Definition:

This class includes dunes (above the drift line, that means above the high point of material deposited by water) as well as beaches (up to the drift line, that means up to the high point of material deposited by water) with sand, gravel, shingle, pebbles or cobblestones along lakes, rivers or sea and also artificial "beaches" in urban areas.

Trees or shrub should cover $< 10\%$. The dunes and sand plains can be partly vegetated with grass.

This category includes:

- Beaches with sand, gravel, shingle, pebbles or cobblestones along lakes, rivers or sea.
- Artificial "beaches" in urban areas (if > 0.5 ha.), if not included in 1.4 Green urban, sports and leisure facilities.
- Dunes and sand plains close to the drift line along rivers, lakes and sea.
- Inland dunes and sand plains, i.e. not only just above the drift line.
- Shifting dunes with mobile, unvegetated or open grasslands (white dune).
- Grey dunes fixed, 164olonized164 or 164olonized by more or less closed perennial grasslands.
- Machair (natural coastal sandplain) formations if $< 50\%$ of field vegetation not covered by grass vegetation.

This category excludes:

- Areas with > 10 % tree cover → 3.x.x Woodland and forest.
- Areas with > 50 % field cover → 4.x.x.x Grassland / 5.x.x Heathland and scrub.
- River banks with sand and gravel, accumulation of material at bars and floodplain → 6.2.2 River banks.

- Bare rocks → 6.3.1.1 Bare rocks, outcrops, cliffs.
- Wet areas → 7.x.x Wetlands.
- Inland dune heaths (crowberry and heather brown dunes) → 5.1.x Moors and heathland.
- Inland dunes thickets occupied by dense formations of shrubs including sea buckthorn privet, elder, willow, gorse or broom often festooned with creepers → 5.1.x Moors and heathland.
- Dune sclerophyllous scrubs → 5.3 Sclerophyllus scrub.
- Machair (natural coastal sandplain) formations if $> 50\%$ of grass vegetation → 4.x.x.x Grassland.



Beach at Lanzarote (Canary Islands, Spain). Credit: K. Larsson.



Maspalomas dune, (Canary Islands, Spain). Credit: M. Palacios.

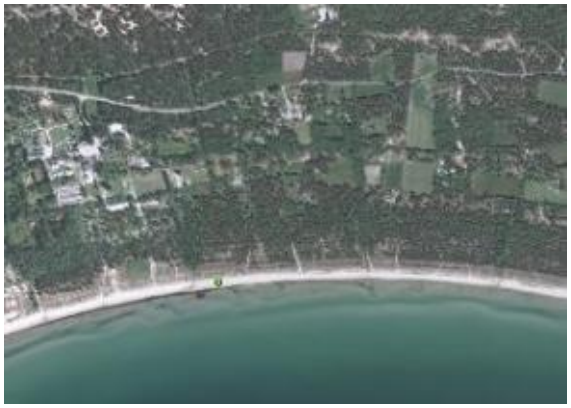


Beach at Doñana Natura 2000 site (Southern Spain). Credit: M. Palacios.

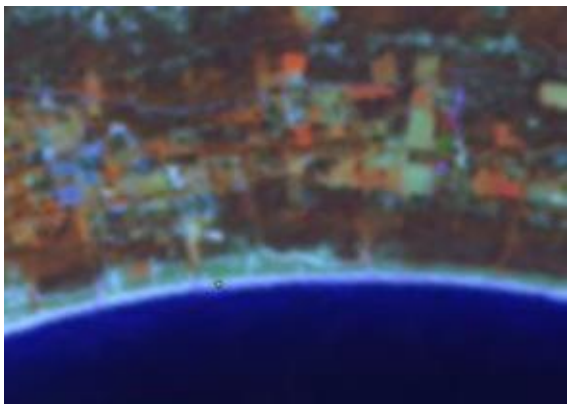


Dune in Doñana Natura 2000 site (Southern Spain) Credit: M. Palacios.

Appearance:



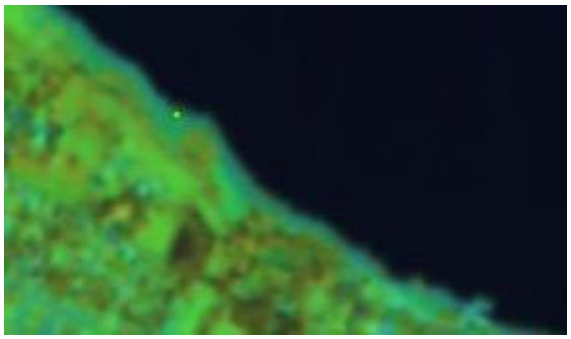
Example of sand beach, 20-30 m wide. Sudersand, Sweden. Aerial orthophoto. Credit: Lantmäteriet, Sweden.



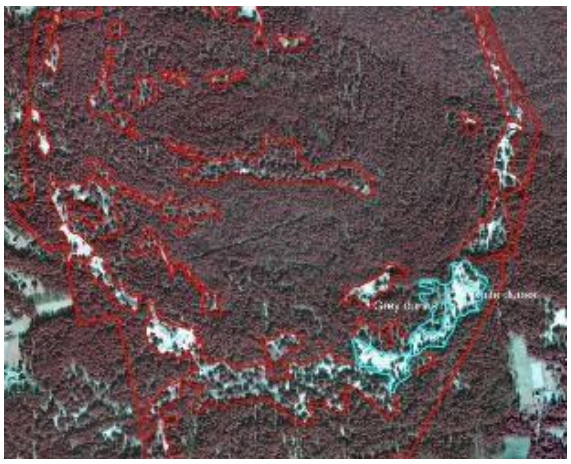
Example of sand beach, Sudersand (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2012-08-22. CNES 2011©, Distribution Airbus DS/Spot Image.



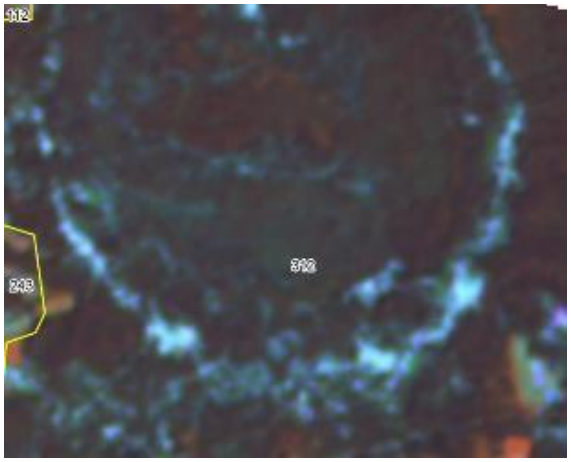
Example of beach (cobblestones), Skäre (Sweden), Aerial orthophoto. Credit: Lantmäteriet, Sweden.



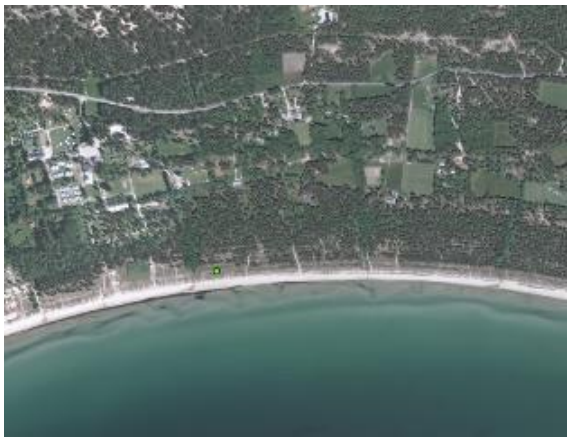
Example of beach (cobblestones), Skäret (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-07-04. CNES 2011©, Distribution Airbus DS/Spot Image.



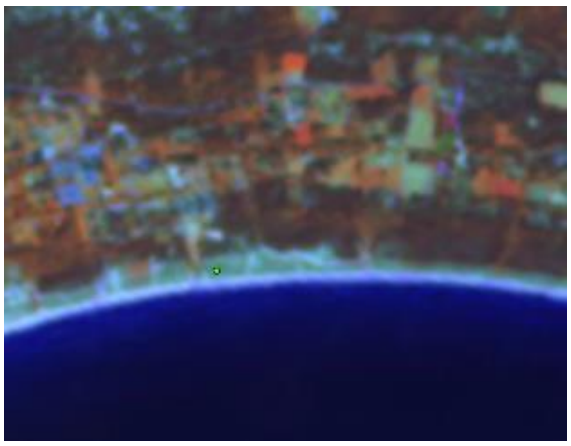
Example white and grey dunes marked (based on Natura 2000 habitats), Ulla Hau (Sweden), Infrared orthophoto. Credit: Lantmäteriet, Sweden.



Coniferous forest (CLC). The dunes are too small to be mapped, Ulla Hau (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2012-08-22. CNES 2011©, Distribution Airbus DS/Spot Image.



Example of grey dunes, Sudersand (Sweden), Aerial orthophoto. Credit: Lantmäteriet, Sweden.



Example of grey dunes, Sudersand (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2012-08-22. CNES 2011©, Distribution Airbus DS/Spot Image.

6.2.2 River banks

Definition:

Sand and gravel of river banks including accumulation of material at bars and floodplain. Little or no vegetation ($< 10\%$).

This category includes:

- Sand and gravel of natural river banks (at the time of the image).
- Deposit material at bars and floodplain may also consist of silt and clay.
- Alluvial fans with little or no vegetation or crops.
- Completely or partly dry river beds with a width of > 10 m
- Dry river bed-sections < 10 m in width and max. 100 m in length, which are parts of a > 10 m river system

This category excludes:

- Beaches along sea and lakes $\rightarrow$ 6.2.1 Beaches and dunes.
- River banks/River beds with a width < 10 m along a water course with a width > 10 m $\rightarrow$ generalized as 8.1.1 Natural & semi-natural water courses.

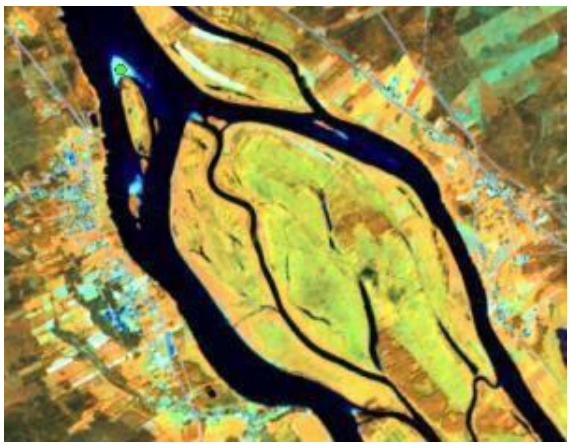


River bank in Var River (Alps Maritimes, France). Credit: Eurostat, LUCAS.

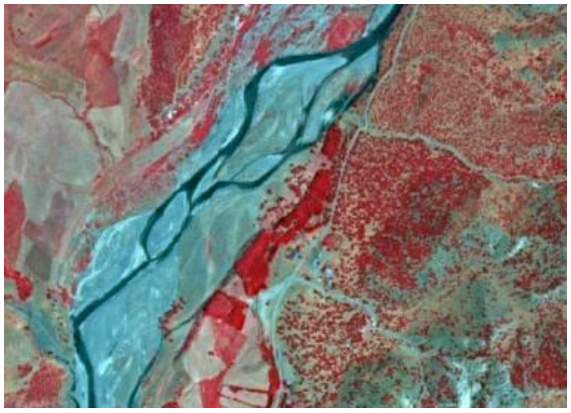
Appearance:



River banks, Torneträsk (Sweden), Aerial orthophoto. Credit: Lantmäteriet, Sweden.



River banks, Torneträsk (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-07-22. CNES 2011©, Distribution Airbus DS/Spot Image.



River bank, Anatolia (Turkey), Spot 5 (2.5 m; NIR/R/G band combination). Date:2011-06-30. CNES 2011© Distribution Airbus DS/Spot Image.

Exceptions from MMU:

Exceptions from MMU > 0.5 ha are made for "6.2.2 River banks" in order to keep the network formed by these linear features.

MMW exceptions:

To maintain continuity of linear features, the MMW may fall below the limit of 10 m over a distance of up to 100 m.

6.3 Bare rocks, burnt areas, glaciers and perpetual snow

6.3.1 Bare rocks, outcrops, cliffs and scree

6.3.1.1 Bare rocks, outcrops, cliffs

Definition:

Bedrock outcrops with little or no high vegetation ($< 10\%$) but can be moss or lichen covered.

This category includes:

- Cliffs, rock outcrops, rocks and reef flats.

- Unvegetated lapiaz.
- Sites and products of recent volcanic activities, volcanic ash and lapilli fields, barren lava fields.
- Unvegetated supra-littoral rocky zones.
- Eroded areas with little or no high vegetation ($< 10\%$).
- Bare areas in dams, barrages and lakes of hydropower stations.

This category excludes:

- Beaches with sand, gravel, shingle, pebbles or cobblestones along lakes or sea → 6.2.1 Beaches and dunes.
- Areas with more than 10% field, bush or tree cover.
- Rivers banks (sand and gravel) → 6.2.2 River banks.
- Dry river beds → 6.2.2 River banks.



Bare rocks and rock debris (Sweden). Credit: K. Larsson.



Bare rocks and rock debris in the background. Nipfjället, Sweden. Credit: S. Kirppu.



Etna's volcanic landscape. (Italy) Credit: A. Utanda.

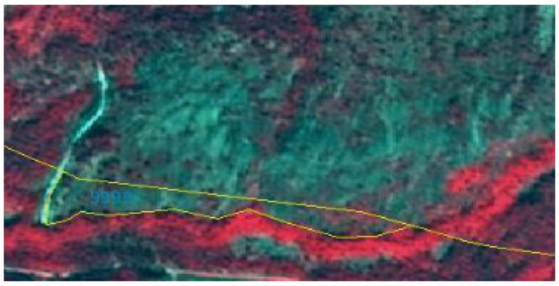


Volcanic bare rocks in (Canary Islands, Spain). Credit: M. Palacios.

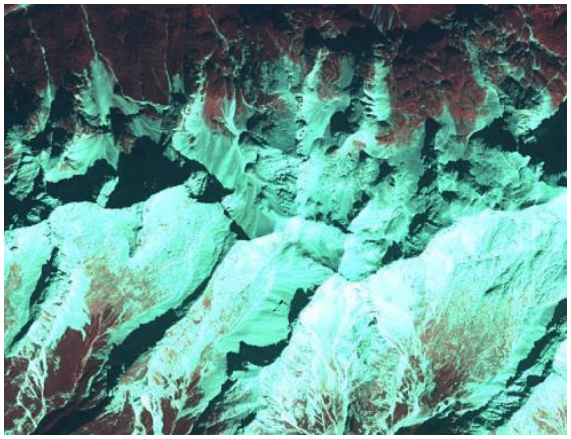
Appearance:



Bare rocks formations (6.3.1.1), Anatolia (Turkey), Spot 5 (2.5 m; NIR/R/G band combination). Date: 2011-06-30. Source: CNES 2011© Distribution Airbus DS/Spot Image.



Examples of bare rock with < 10% vegetation (steep hillside dotted with birch), Norway, Spot 5 (2.5m; 1/2/3 band combination). Date: 2012-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.



Examples of bare rock with <10% vegetation in the Alps, Austria), Spot 5 (2.5m; 1/2/3 band combination). Date: 2012-09-07. CNES 2011©, Distribution Airbus DS/Spot Image.

6.3.1.2 Scree

Definition:

Blocky areas with little or no high vegetation ($< 10\%$) but can be moss or lichen covered.

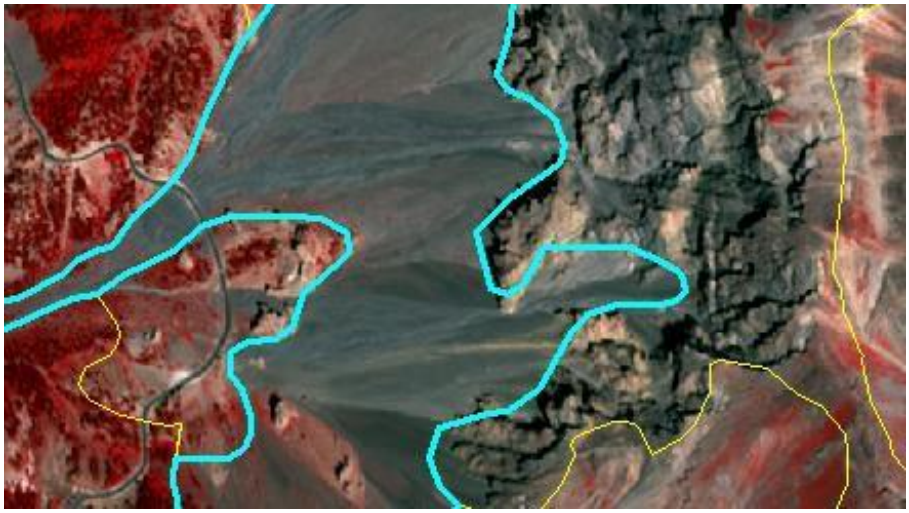
This category includes:

- Scree.
- Block litter and mountaintop debris.

This category excludes:

- Beaches with sand, gravel, shingle, pebbles or cobblestones along lakes or sea → 6.2.1 Beaches and dunes.
- Areas with more than 10% field, bush or tree cover.
- Rivers banks (sand and gravel) → 6.2.2 River banks.
- Dry river beds → 6.2.2 River banks.

Appearance:



Examples of Scree (highlighted) with <10% vegetation in the Alps, France), PH1A (2.m). Date: 2020- 07-09

6.3.2 Burnt areas (except burnt forest)

Definition:

Areas affected by recent fires, still mainly black, not in forest.

This category includes:

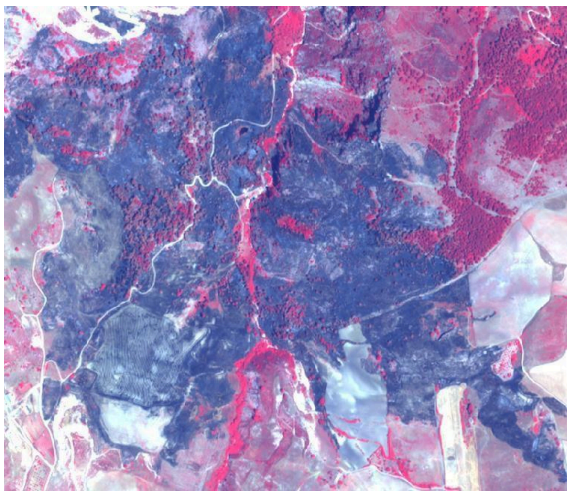
- All vegetation classes except forest (class 3) which recently have been affected by fires and do not show any new vegetation cover.

This category excludes:

- Human farming management by burning arable lands → 2.x.x Cropland.
- Burnt forest area → 3.6 Damaged forest.
- Fires in urban areas → 1.x.x Urban.



Scrubland affected by fire (North Western Spain).
Credit: Eurostat, LUCAS.



Burnt scrubland (South Italy). Date: 2018-07-29. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

Appearance:

- Black areas in the image.

6.3.3 Glaciers and perpetual snow

6.3.3.1 Glaciers

Definition:

Land covered by glaciers.

This category includes:

- Glaciers.

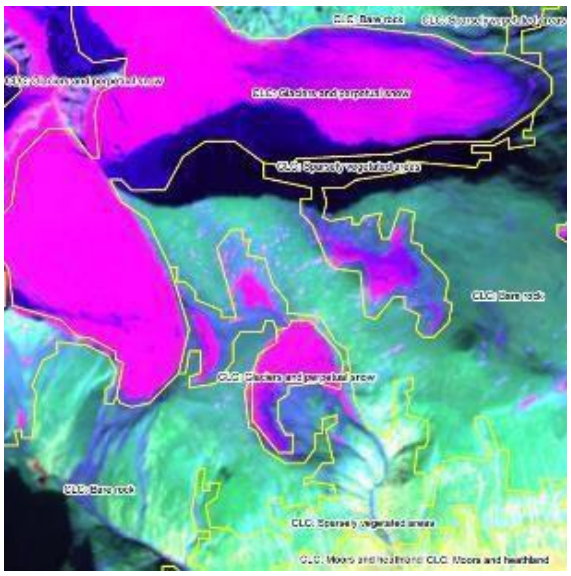
This category excludes:

- Temporary snow or ice covered areas → map according to the dominant LC/LU (e.g. bare rocks 6.3.1.1).

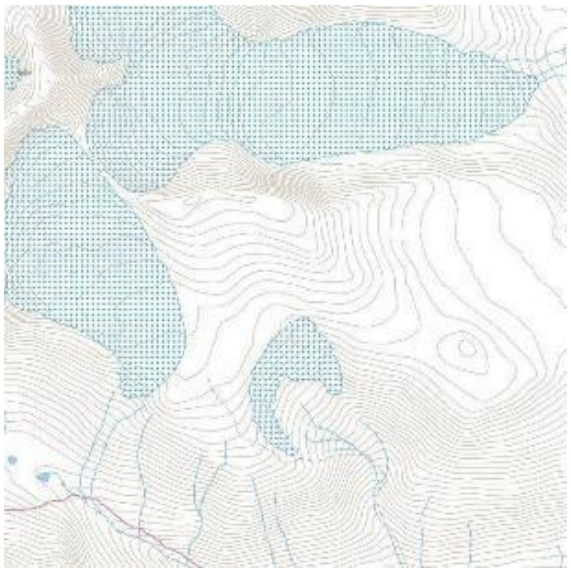


Glacier (6.3.3.1) de Bossons (French Alps). Credit: K. Larsson.

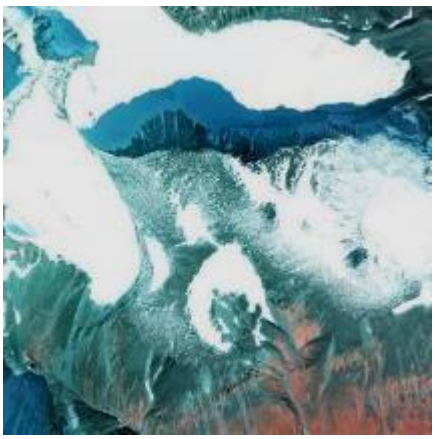
Appearance:



Glacier and perpetual snow (yellow delineation of the class is from CORINE Land Cover and corresponds well to a PA delineation), Kebnekaise (Sweden), Spot 5 (2.5 m; 3/4/2 band combination). Date: 2010-09-07. CNES 2011©, Distribution Airbus DS/Spot Image.



Glacier and perpetual snow according to topographical map. (Kebnekaise, Sweden). Credit: Lantmäteriet, Sweden.



Infrared orthophoto over glacier and perpetual snow, Kebnekaise (Sweden). Credit: Lantmäteriet, Sweden.

Methodological advice:

- Use CLC class 3.3.5 as orientation.
- The identification of glaciers and permanent snow fields depends on an appropriate date of the image with a low cloud coverage since clouds can be lead to misinterpretations due to very similar appearance in the satellite images.

6.3.3.2 Perpetual snow

Definition:

Permanent snowfields.

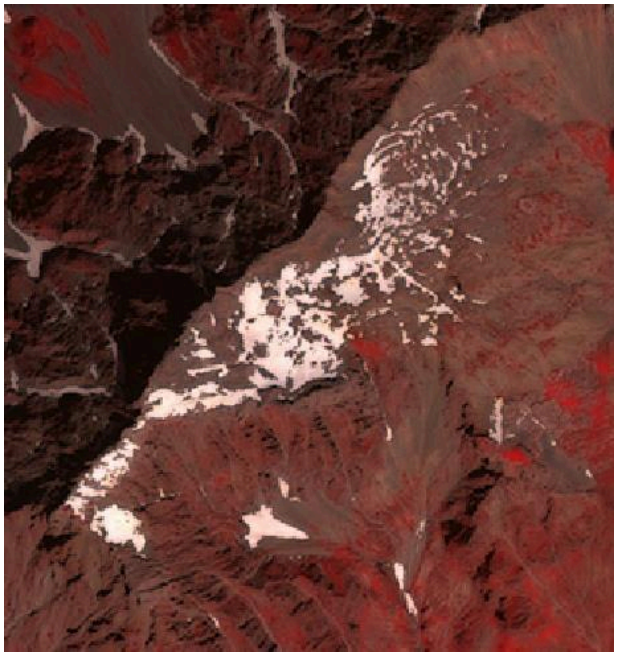
This category includes:

- Perpetual snow.

This category excludes:

- Temporary snow or ice covered areas → map according to the dominant LC/LU (e.g. bare rocks 6.3.1.1).

Appearance:



Perpetual snow, Vallouise (France), Spot 7 (4 m; 3/4/2 band combination). Date: 2020-09-07. Distribution Airbus DS/Spot Image.

Methodological advice:

- Use CLC class 3.3.5 as orientation.
- The identification of glaciers and permanent snow fields depends on an appropriate date of the image with a low cloud coverage since clouds can be lead to misinterpretations due to very similar appearance in the satellite images.

7. Wetland

According to Article 1.1 of the Ramsar Convention[22] (1971), wetlands are: "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". This class refers only to inland freshwater/saline wetlands.

Inland wetlands are predominantly water-logged specific plant and animal communities supporting water regulation and peat-related processes. This class includes natural or modified mires, bogs and fens, as well as peat extraction sites[23]. Surfaces of temporary water are included in wetlands. According EUNIS guidelines (see table below), water-logged means the presence of the water table at or above ground level for at least half of the year.

Adaptation of water interpretation in EUNIS[24] and related PA classes

PRESENCE OF WATER	PA CLASSIFICATION
Always dry (except extraordinary floods)	1 Urban (except ponds related to industrial units); 2 Croplands (except rice fields); 3 Woodland and forest (except swamp forests; 4 Grassland, 5 Heathland and scrub; 6.1 Sparsely veg-

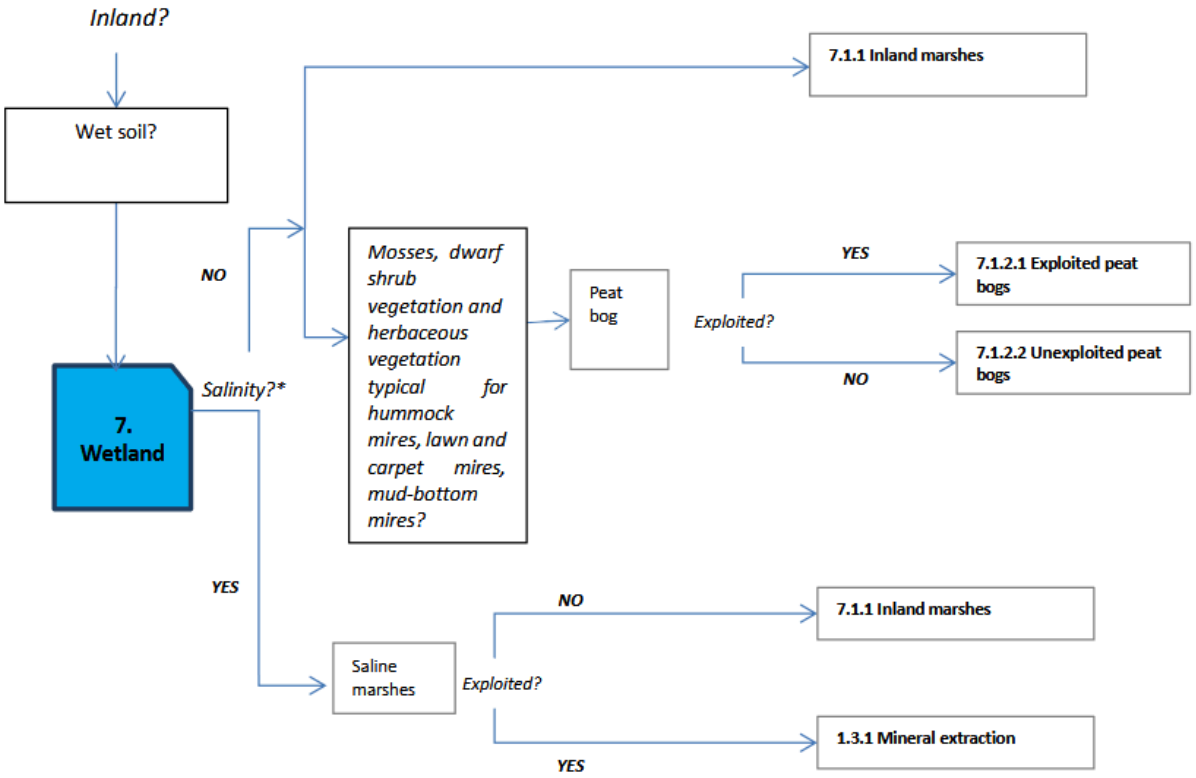
[22] http://www.ramsar.org/

[23] European Commission (2013): Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessment under Action 5 of the EU Biodiversity Strategy to 2020. Discussion Paper, Final, April 2013.

[24] Davies, C.E., Moss, D. and Hill, M.O. (2004): EUNIS Habitat Classification Revised, 2004, report to European Environment Agency/European Topic Centre on Nature Protection and Biodiversity.

PRESENCE OF WATER	PA CLASSIFICATION
	etated areas; 6.3.1.1 Bare rocks, outcrops, cliffs; 6.3.2 Burnt areas
Permafrost	N/A
Ice	6.3.3.1 Glaciers
Permanent snow	6.3.3.2 Perpetual snow
Mesic, moist, or humid	3 Woodland and forest 4.2.x Natural and semi-natural grass-lands
Water-logged (the water table at or above ground level for at least half of the year). Wet soil (including periods with presence of dry soils in dry regions).	3 Woodland and forest 7. Wetland
Permanently covered by water table, but water level variations occurs (including occasionally periods with presence of wet soils)	8.1.1 Natural & semi-natural water courses; 8.1.3 Seasonally connected water courses (oxbows); 8.2 Lakes and reservoirs (except temporary water bodies); 8.3.3 Marine inlets and fjords; 7.2.3 Intertidal flats; 8.3.1 Lagoons; 8.3.2. Estuaries
Permanently covered by water with tidal move-ments	8.4.1 Open sea 8.4.2 Coastal waters

A decision criteria tree is established to clarify guideline distinctions between the sub-classes as follows:



*To determinate the salinity of wetlands it is necessary to use ancillary data.

7.1 Inland wetlands

7.1.1 Inland marshes

Definition:

Inland wetlands without a direct connection to the open ocean with significant content of water, which is influenced by a certain seasonal fluctuation.

This category corresponds to 4.1.1 CORINE Land Cover class (Inland marshes). Both inland freshwater marshes and inland salt marshes are included in this class. They are created where saline ground water rises to the surface, or in endorheic basins.

Inland marshes appear with or without a vegetation coverage. The coverage usually consists of reeds. Reed is the common name for several tall, grass-like plants of wetlands and rivers. They are all members of the order Poales: *Poaceae*, *Cyperaceae*, *Sparganiaceae*, *Typhacea* or *Restionaceae*.

Reed in marshes groups basically two types of plants:

- Sedges (*Cyperaceae* family) are monocotyledon plants with solid and triangular stems; 3-ranked leaves; with flowers, and lenticular or triangular fruits. Sedges are common in wet habitats, including marshes, and in tundra habitats.
- Rushes (*Juncaceae* family) are monocotyledon plants with solid and mostly round stems; few leaves, only basal or reduced to sheaths; with flowers and fruits in capsules. Rushes are common in wet habitats.

If not covered by vegetation: basically mud areas and/or waterlogged grasses and grass-like plants will be mapped.

Inland salt marshes without vegetation are located predominantly in Pannonic region (Pannonic salt steppes), Turkey, in Mediterranean specific locations and in endorheic basins across Europe.

This category includes:

- Marshes (freshwater or salt) with or without vegetation (reeds) coverage.
- Areas, where reeds are harvested.
- Reed covered wetland along river sides
- In Nordic conditions: includes non-grazed/mowed and non-peat producing wetlands. These areas normally have a vegetation of tall grasses and sedges.
- Areas flooded at least six months a year with low or no vegetation.
- Grasslands highly wet or flooded at least six months a year.
- Bare soils as results of previous presence of water will be also included within this category.
- It will be taken into account that the Baltic Sea has only brackish coastal waters, which qualify for inland freshwater marshes.
- Limestone mires.
- Floating vegetation.
- Reed beds in saline marsh with coverage less than 30%.

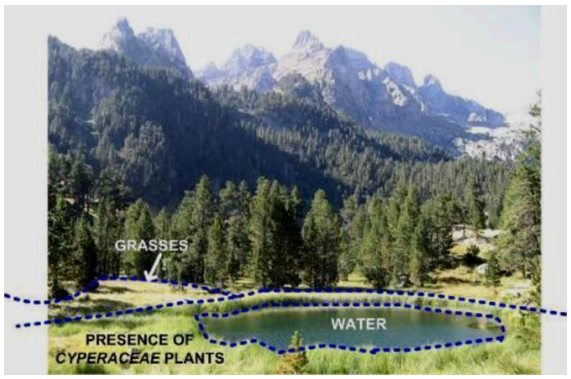
This category excludes:

- Floating aquatic vegetation (species such as *Nuphar* spp., *Nymphaea* spp., *Potamageton* spp. And *Lemna* spp.) is not considered as reeds and is included in 8.2 Lakes and reservoirs or 8.4 Sea and ocean.
- Grassland highly wet or flooded less than six months a year → 4.1 Managed grassland / 4.2.1.x Semi natural grassland.
- Rice fields → 2.1.1 Arable land.
- Reeds mixed with trees (> 5m) in rivers banks → 3.x.x Woodland and forest.

- Open water ≥ 0.5 ha in wetland areas (class 8.2.1 Natural lakes).
- Mesic/moist grasslands → 4.1 Managed grassland / 4.2.1.x Semi-natural grassland.
- Marine wetlands such as salt marshes or salines → 8.1.x Coastal wetlands.
- Mires with more than 30% of tree cover density are considered as 3.x.x Woodland and forest.
- Inland exploited salines and extraction of sodium minerals in salt marshes, salt lakes or other locations → 1.3.1 Mineral extraction, dump and construction sites.
- Shrub along river sides and on river banks (may include small patches of reeds with area < 0.5 Ha) where neither climax tree-like forest formations nor grassland is detected (mainly located in areas of Mediterranean and continental climates with a summer season with warm-temperate & low precipitation) → 3.4.0 Transitional woodland and scrub.



Inland freshwater with reeds in Tablas de Daimiel Natura 2000 Site (Central Spain). Credit: M. Palacios.



Interpretation of *Cyperaceae* plants in a wetland. Credit: M. Rodriguez.



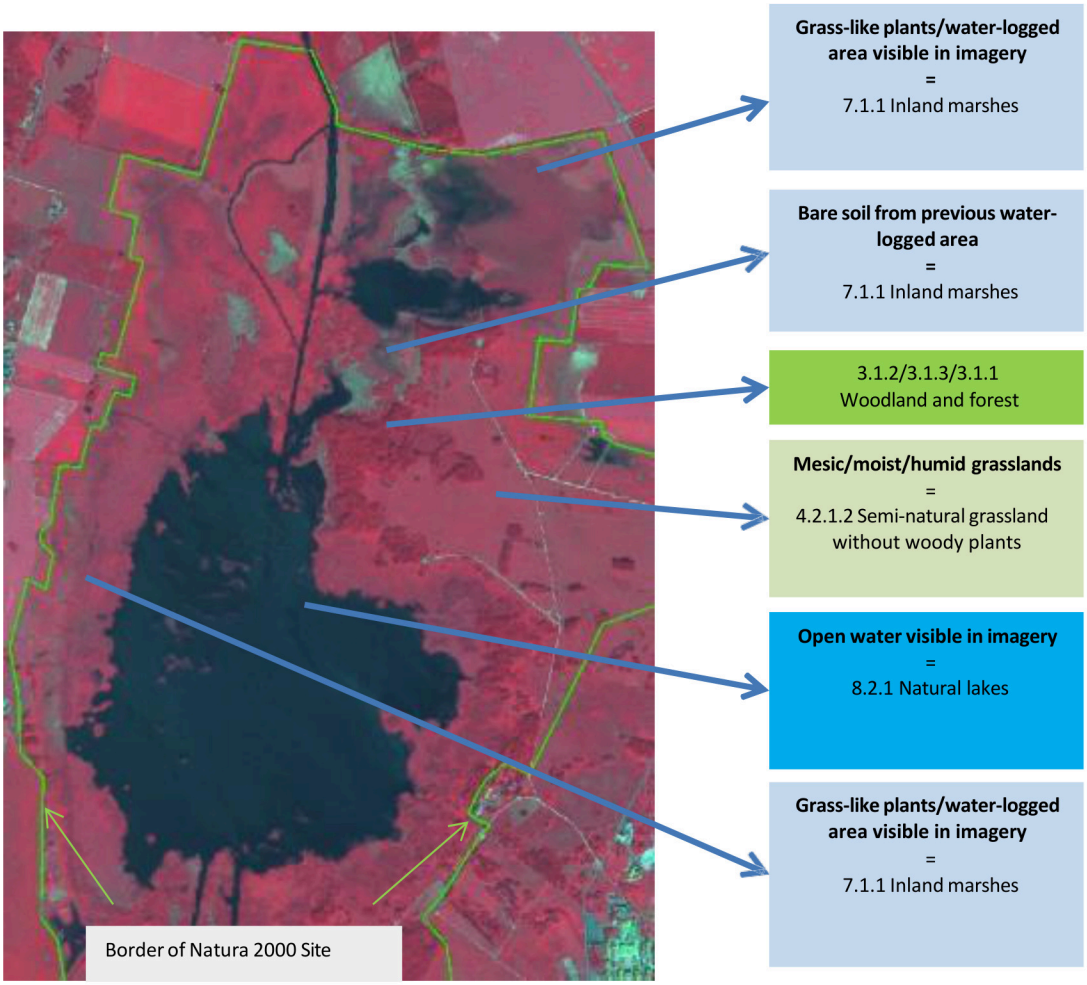
Juncaceae plants. Credit: M. Palacios.



Inland saline marsh in Central Spain. Credit: Eurostat, 2012. LUCAS.

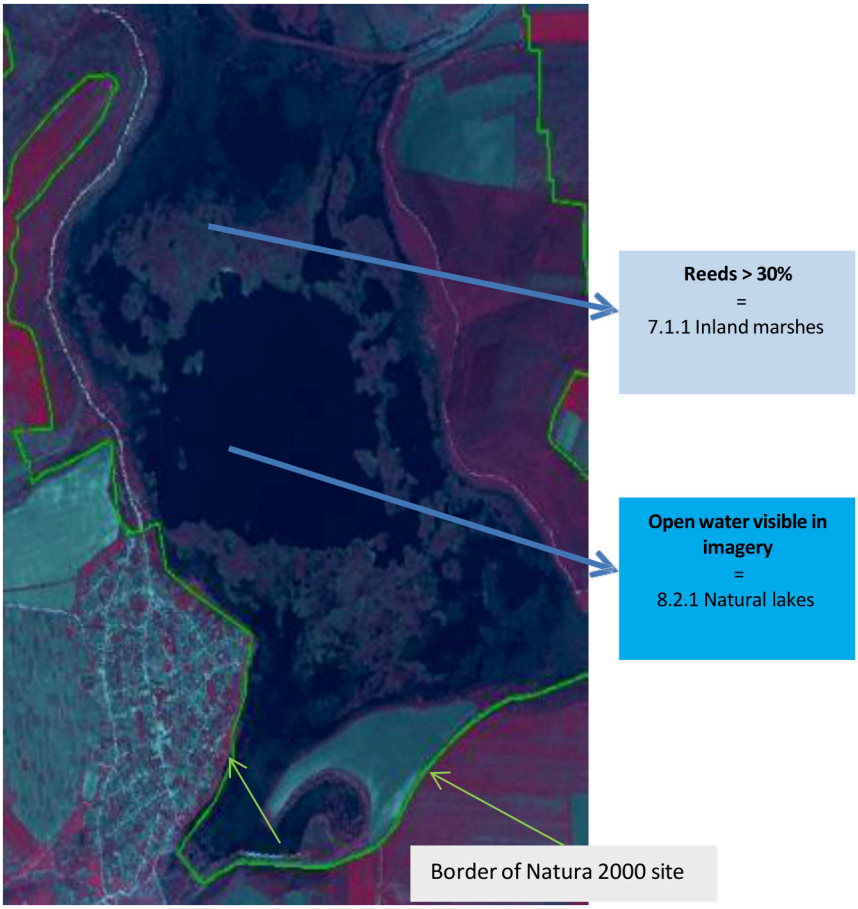
Appearance:

Example of inland wetland interpretation rules:



Araslövssjöområdet Natura 2000 site (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-06-28. CNES 2011©, Distribution Airbus DS/Spot Image.

Waterlogged areas covered by vegetation:

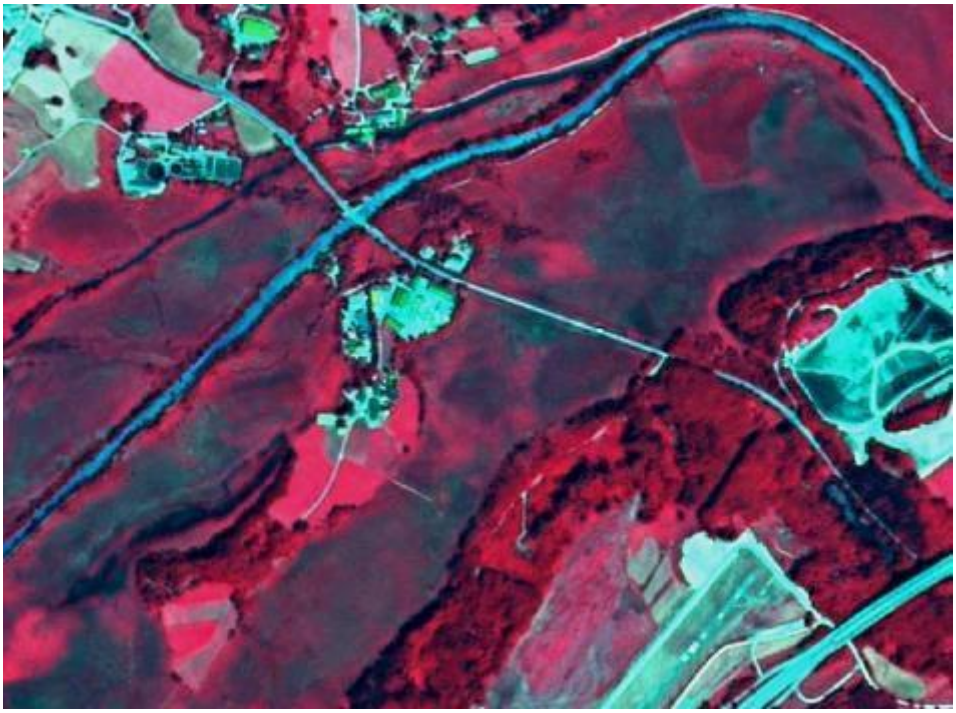


Srebarna Natura 2000 site (Bulgaria), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-04-26. CNES 2011©, Distribution Airbus DS/Spot Image.

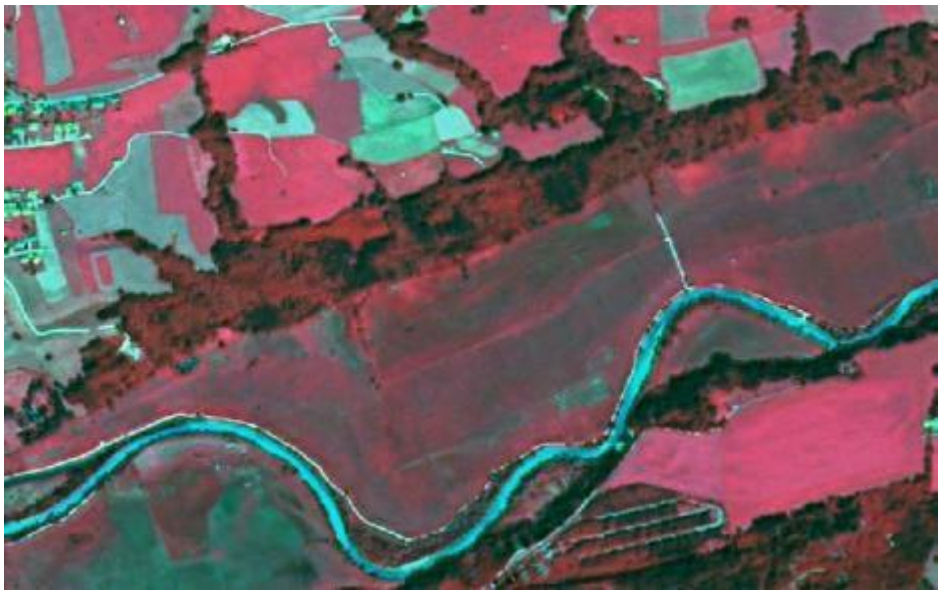
Wetlands with reeds examples:



Example of 7.1, Umeå (Sweden), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-07-08. CNES 2011©, Distribution Airbus DS/Spot Image.

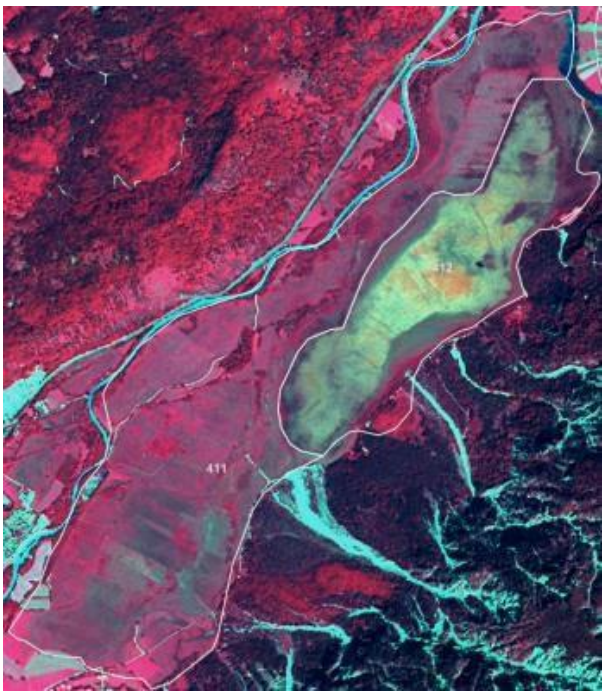


Inland freshwater marsh with reeds, Murnau (Germany), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-06-28. CNES 2011©, Distribution Airbus DS/Spot Image.



Inland freshwater marsh with reeds – but mowed and mixed with grassland. Murnau (Germany), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-06-28. CNES 2011©, Distribution Airbus DS/Spot Image.

Wetland and semi-natural grassland distinction example:



Inland freshwater marsh with CLC class 411 overlay. A neighboring moorland shows yello-green-spectral signatures, Murnau (Germany), Spot 5 (2.5m; 1/2/3 band combination). Date: 2011-06-28. CNES 2011©, Distribution Airbus DS/Spot Image.

- Map orange-brown-green/red-blue/blue-grey areas as wetland (7.1). Map other neighboring grassland areas as 4.2.1.2 Semi natural grassland without woody plants

Special case in Nordic conditions:

In the case of Nordic countries, when typical mire/peat structures cannot be seen in the satellite image/ orthographic photo, it is difficult to determine if an area is peat producing or not. Therefore the position in the terrain is used for guidance. Areas directly adjacent to bigger rivers or lakes are included in 7.1 when visual interpretation is insufficient. This is because of lower chances of peat production when oxygen from flowing water is supplied to the ecosystem as opposed to ecosystems adjacent to standing water.

Non-peat producing wetlands normally have a vegetation of grasses and sedges, either grazed/mowed or not. These areas are included in 7.1.1 Inland marshes. Temporarily flooded areas with low grasses and sedges are included in 4.2.1.2 Semi-natural grassland without woody plants.

Methodological advice:

- Use of Corine Land Cover for first location of main sites.
- Freshwater status of the water bodies will be determined by location, assuming that considerable distance (up-stream) from the sea, restrains the salty water from mixing into the water bodies.

7.1.2 Peat bogs

7.1.2.1 Exploited peat bogs

Definition:

Open exploited peat producing wetlands that are not greatly affected by lakes, sea water or water from water courses. Exploited peat bogs are characterized by linear trench and parcel structure.

This category includes:

- Extraction of peat in mires.

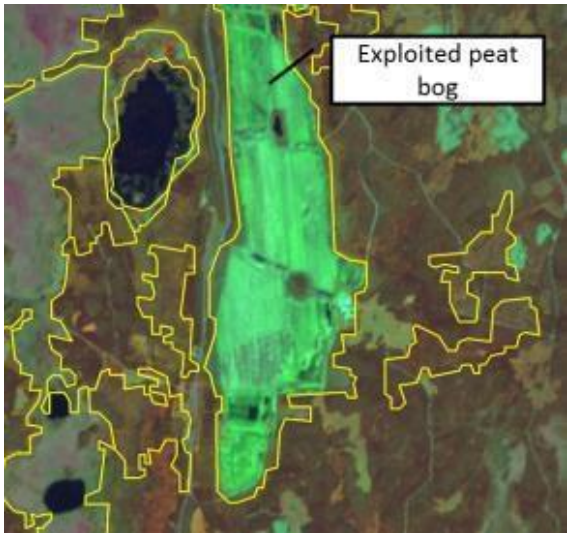
This category excludes:

- Abandoned peat extraction site with regrowth → Class 3.x.x Woodland and forest.
- Unexploited peat bogs → 7.1.2.2 Unexploited peat bog.
- Exploited peat bogs which are covered by trees, waterbodies or managed grassland on an area > 0.5 ha → 3.x.x Woodland and forest/8.x.x Water/4.1 Managed grassland.



Exploited peat bog in Roscommon (Ireland). Credit: Eurostat, 2012. LUCAS.

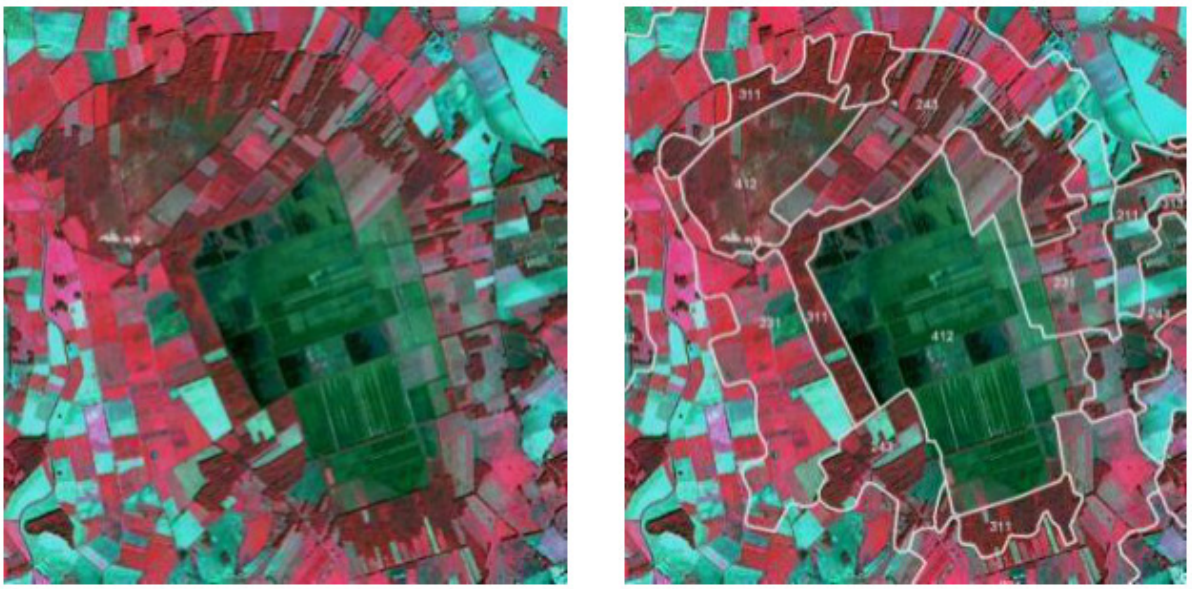
Appearance:



The delineation of the exploited peat bog (yellow polygons) is from CORINE Land Cover and corresponds fairly to a PA image situation, Sweden, Spot 5. Credit: ESA.



The same area as left but infrared orthophotos as image background. Credit: Lantmäteriet.



Exploited peat bog in northern Germany – right side: CLC overlay), Spot 5 (2.5m; 1/2/3 band combination). CNES 2011©, Distribution Airbus DS/Spot Image.

7.1.2.2 Unexploited peat bogs

Definition:

Open unexploited peat producing wetlands that are not greatly affected by lakes, sea water or water from water courses. In Nordic conditions this class is normally a heterogeneous vegetation type where mire vegetation dominates in a mosaic of heath vegetation, alpine grassland, alpine willow bushes and a rocky ground. Alternative names are proposed for this class as ”Peat producing land” or “Peat bog and other peat producing land”.

This category includes:

- The mire types hummock, lawn, carpet mires and mud bottom mires.
- Peat bogs in Alpine / Sub-Alpine environment across Europe.

- Mosaics of complex distribution between the classes 7.1.2.2 Unexploited peat bog and 8.2.1 Natural lakes, where the class 7.1.2.2 covers at least 70% of the surface.

This category excludes:

- Areas with > 10 % tree cover $\rightarrow$ Class 3.x.x Woodland and forest.
- Peat extraction site $\rightarrow$ 7.1.2.1 Exploited peat bog.

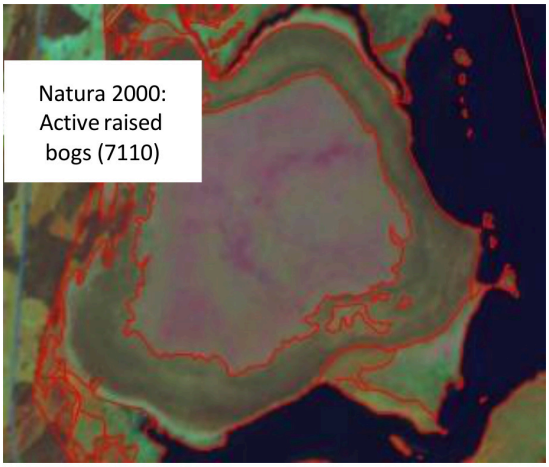


Unexploited peat bog near Benderloch (Western Scotland, United Kingdom). Credit: Eurostat, 2012. LUCAS.

Appearance:



Typical raised, unexploited peat bog (yellow delineation is from CORINE Land Cover and corresponds well to the PA image situation), Jordbärsmuren-Albo Natura 2000 site (Sweden), Spot 5. Credit: ESA.



Same area as left. The delineation of the peat bog (red polygons) is from a Nature 2000 habitat map, also corresponding well to the PA image data. Credit: ESA.

In low lying areas or local depressions complex mire types include areas of open peat, small ponds and streaks of mosses/heath vegetation.

Methodological advice:

- Use of CLC class 4.1.2 as orientation.

7.2 Coastal wetlands

7.2.1 Salt marshes

Definition:

Coastal salt marshes, according to the EUNIS habitat description, are dominated by sediments and salt-tolerant stands of vegetation, occurring on the extreme upper shore of sheltered coasts and periodically covered by high tides. According to the definition of CLC class 5.2, Marine waters are oceanic and continental shelf waters, bays and narrow channels including sea lochs, fiords and straits.

The class salt marshes includes according to EUNIS following habitat types: salt marsh drift lines, upper salt marshes, mid-upper salt marshes and saline brackish reed, rush and sedge beds and littoral sediments not included in 7.2.3 Intertidal flats or 6.2.1 Beaches and dunes.

The Estuaries class (8.3.2) includes marine waters not included in class 8.4.0 Sea and ocean or other lagoons and coastal wetlands classes.

Vegetated low-lying areas, above the high-tide line, susceptible to flooding by seawater. Often in the process of filling in, gradually being colonized by salt tolerant plants (saline reed beds). Salt marshes also appear without or less vegetation coverage.

On the date of the EO data of reference these areas may be covered or not by water. In this category, the entire marsh area will be considered as class 7.2.1, regardless if it is covered by water or not on the date of the image.

This category includes:

- Vegetated beds in salt marshes (basically salt-tolerant plants but also sedges and rushes).
- Salt marshes in estuaries and delta areas with or without vegetation coverage.
- Floating aquatic vegetation in coastal zones.

- Muddy areas covered by water in coastal salt marshes.

This category excludes:

- Inland salt marshes → 7.1.1 Inland marshes.
- Coastal lagoons → 8.3.1 Lagoons.
- Salines → 7.2.2 Salines.
- Intertidal flats → 7.2.3 Intertidal flats.
- Estuaries → 8.3.2 Estuaries.



Salt marsh in Foz do Rio Miñor Natura 2000 site during low tide (Galicia, Spain). Credit: M. Palacios.



Salt marsh in Foz do Rio Miñor Natura 2000 site during high tide (Galicia, Spain). Credit: M. Palacios.



Salt marshes with salt tolerant plants in Camargue (Southern France). Credit: Eurostat, 2012. LUCAS.



Reeds (foreground) and salt tolerant plants (background) in marshes of Foz do Rio Miñor Natura 2000 site (Galicia, Spain). Credit: M. Palacios.

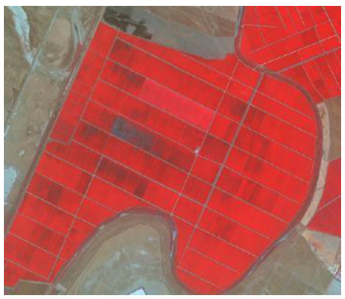
Appearance:



Marshes and estuary of the Guadalquivir river, Doñana Natura 2000 site (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-01. CNES 2011©, Distribution Airbus DS/Spot Image.

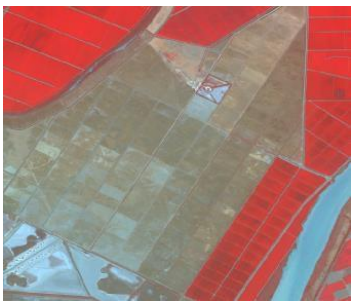
- Flat areas covered by water or mud or moist soil in/near the coastline or in estuaries and other coastal landscapes and with low vegetation coverage.

In the case of salt marshes transformed to agriculture, classification rules are applied as follows:



Rice fields, Doñana National Park (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.

- Agricultural activity is evident → 2.1.1 Arable irrigated and non- irrigated.



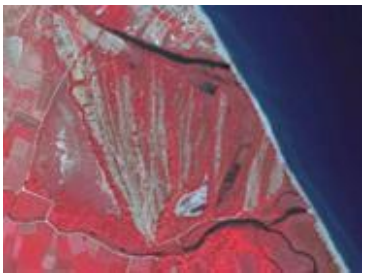
Transformed salt marsh without agricultural use, Doñana National Park (Spain), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-11. CNES 2011©, Distribution Airbus DS/Spot Image.

- Parcels and drainage channels are visible but agricultural activity is abandoned → 6.1 Sparsely vegetated areas. If the area is water- logged → 7.2.1 Salt marshes.



Pineiou Delta, Natura 2000 site (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-23. CNES 2011©, Distribution Airbus DS/Spot Image.

- Parcels and drainage channels are visible but the area is covered by grassland or scrubland → 4.2.x.x Natural & semi-natural grassland / 5.x.x Heathland and scrub.



Pineiou Delta, Natura 2000 site (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-23. CNES 2011©, Distribution Airbus DS/Spot Image.

- The area is invaded by scrubs and trees → 3.4.0 Transitional woodland and scrub.

These rules for transformed salt marshes also apply to 8.3.1 Lagoons.

The treatment of water inside salt marshes is based on the following rules:

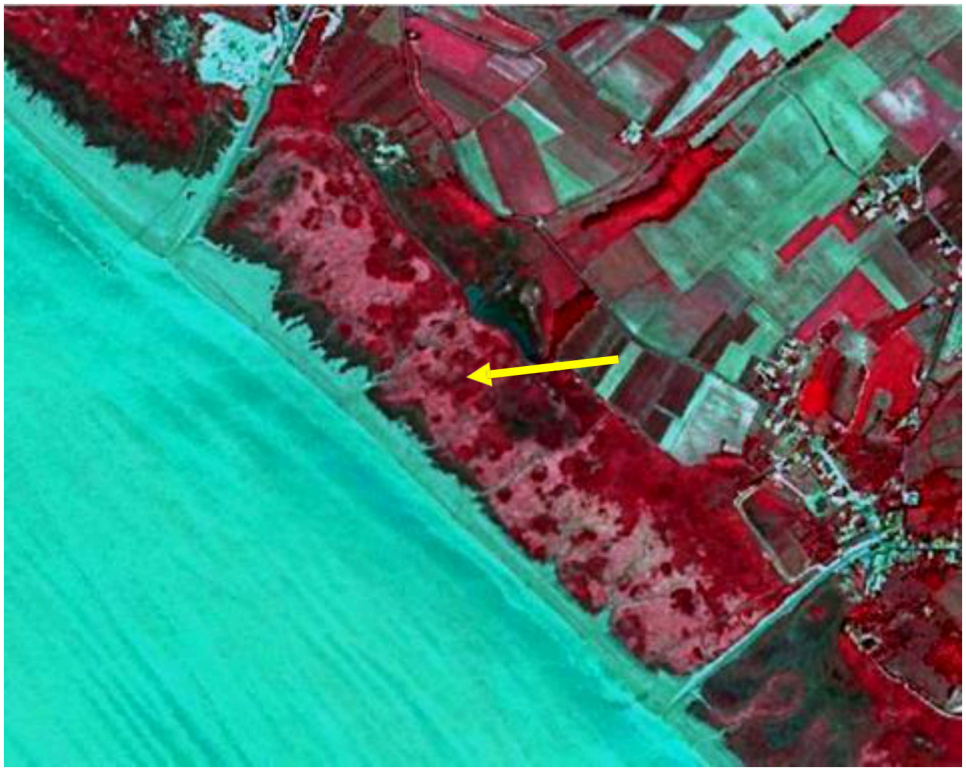
- Water-logged areas (having water or not at the date of the image) are classified as 7.2.1 Salt marshes.

- Relevant ponds and channels visible in the image (containing water or clear surface depressions) will be classified as 8.3.1 Lagoons.



Relevant and clear ponds and channels in salt marshes are classified as 8.3.1 Lagoons, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-01. CNES 2011©, Distribution Airbus DS/Spot Image.

Vegetated flat areas in/near the coastline or in estuaries and other coastal landscapes:



Marais at Gironde estuary, France, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-01. CNES 2011©, Distribution Airbus DS/Spot Image.

Methodological advice:

- Use of CLC class 4.2.1 as orientation.

7.2.2 Salines

Definition:

CORINE Land Cover 422 Salines class definition is adopted: "Salt-pans, active or in process of abandonment. Sections of salt marsh exploited for the production of salt by evaporation. They are clearly distinguishable from the rest of the marsh by their parcellation and embankment systems"[25].

Salines (active ones and in process of abandonment) will be based on CORINE land cover and computer assisted visual interpretation.

This category includes:

- Exploited coastal salines.
- Salines organized to breed fish in coastal areas and any type of fish farms in maritime environments (including inland oyster fish farms).

This category excludes:

- Saline coastal lagoons → 7.2.1 Salt marshes.
- Salines not exploited (irregular forms, presence of vegetation in ponds, barriers covered by vegetation) will be classified in other classes as 8.3.1 Lagoons or 7.2.1 Salt marshes.
- Freshwater fish ponds → 8.2.3 Aquaculture ponds.

[25] Bossard, M., Feranec, and J. Otahel, J. (2000): CORINE land cover technical guide – Addendum 2000, Technical report No 40, European Environment Agency.

- Inland salines → 1.3.1 Mineral extraction, dump and construction sites. Floating fish farms → 8.4.0 Sea and ocean.



Salines des Pesquieres (Southern France). Credit: Eurostat, 2012. LUCAS.



Salt marshes in Lanzarote (Canary island, Spain). Credit: C. Alonso.

Appearance:

- Water ponds with regular shape, close quarters and many small ponds in or near the coastline. Different colours of ponds according to their level of water. Without vegetation. In many cases, associated to buildings.



Santa Pola salines, Spain, Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-12. CNES 2011©, Distribution Airbus DS/Spot Image.

7.2.3 Intertidal flats

Definition:

CORINE Land Cover 423 Intertidal flats class definition is adopted: "Generally vegetationless expanses of mud, sand or rock lying between high and low water marks"[26].

This category includes:

- Area between tide marks, basically composed by mud, rocks or boulders.

This category excludes:

- Coastal lagoons and marshes → 8.3.1 Lagoons / 7.2.1 Salt marshes.
- Estuaries (rivers meet the sea and salt water is diluted by fresh river water) → 8.3.2 Estuaries.
- Beaches and dunes → 6.2.x Beaches, dunes, sands.
- Transformed intertidal flats → Current land cover.

[26] Bossard, M., Feranec, and J. Otahel, J. (2000): CORINE land cover technical guide – Addendum 2000, Technical report No 40, European Environment Agency.



Intertidal flat in Étel (Bretagne, France). Credit: Eurostat, 2012. LUCAS.



Intertidal flat (Nissum Bredning, Denmark). Credit: Eurostat, 2012. LUCAS.

Appearance:

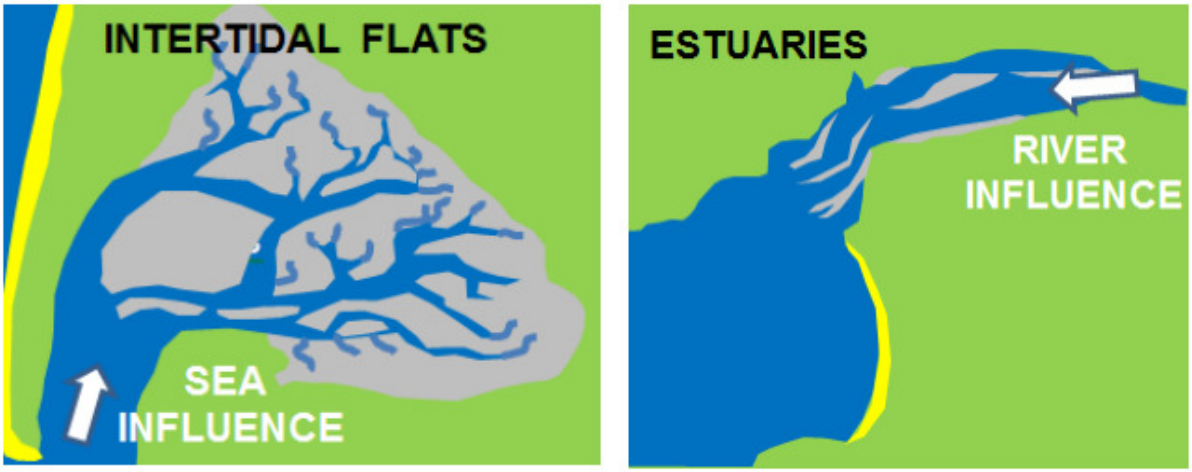
- Generally, mud flats and water channels in the coastline.



Waddenzee (Netherlands), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-24. CNES 2011©, Distribution Airbus DS/Spot Image.

Difference between intertidal flats and estuaries:

Intertidal flats are characterized by the influence of the sea and the presence of tidal channels. 8.3.2 Estuaries are characterized by the influence of the river.



Schematic differentiation 7.2.3 Intertidal flats/ 8.3.2 Estuaries.

Methodological advice:

- Use of CLC class 4.2.3 as orientation.
- Use of EU-DEM (0 m altitude line) to identify the exterior border of intertidal flat.
- The outer border will be defined by the supratidal zone (zone regularly splashed, but not submerged by sea water).
- Use of Transitional Water layer (European Framework Directive) to identify general limits of coastal waters.

8. Water

This level comprises all water courses and water bodies, which are permanent, visible at the surface, containing freshwater and located in the inland as well as coastal water bodies influenced by saline sea water like lagoons, marine inlets and estuaries. Open sea is also included in this parent class.

As general for this category, the water level visible in the EO data used for interpretation will be mapped. Where the water is missing, the current land cover seen in the image will be mapped. This general principle is valid for lakes (especially dams, barrages and lakes of hydropower stations), rivers, oxbows, fishponds, etc.

8.1 Water courses

8.1.1 Natural & semi-natural water courses

Definition:

Natural stream of water that empties into another body of water or into the sea. Also watercourses that cease to flow for part of the year, leaving a partially dry bed or water pools (EUNIS definition class C2.5) are included here. Different classes of temporary rivers are considered[27]: snowmelt and glacial meltwater; perched and semi-perched alluvial and karstic non-permanent streams.

This category includes:

- Natural streams of water with more than 10 m width.
- Un- or less vegetated river beds with a width < 10 m along water courses with a width > 10 m.

This category excludes:

- Highly modified natural water courses and canals → 8.1.2 Highly modified water courses and canals.
- Dams, barrages, lakes of hydropower stations and other water bodies → 8.2.1 Natural lakes.
- Water bodies belonging to the river system → 8.1.3 Seasonally connected water courses (oxbows).
- Small rivers completely covered by vegetation (trees, scrub, hedges) → map current land cover.
- Bank within a river that is covered by scrub is not considered as inland wetlands will be classified as 3.4.0 Transitional woodland and scrub.
- Lakes that are connected to the river systems are mapped as 8.2.1 Natural lakes.
- Small marinas in rivers: Marina water surface: 8.2.1 Natural lakes / Sports facilities around water 1.4 Green urban, sports and leisure facilities.
- Completely or partly dry river beds with a width of > 10 m → map whole riverbed as 6.2.2 River banks.
- Dry river bed-sections < 10 m in width and max. 100 m in length, which are parts of a > 10 m river system → 6.2.2 River banks.

[27] Larned, S.T., Daltry, T., Arscott, D.B. and. Tockner, K. (2010). Emerging concepts in temporary-river ecology. Freshwater Biology 55, 717–738



Natural & semi-natural water course in Antalya Province (Southern Turkey). Credit: M. Escobar.



River in Northern Wales (United Kingdom). Credit: Eurostat, 2012. LUCAS.

Appearance:



River Weser, Bodenwerder (Germany), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-02-05. CNES 2011©, Distribution Airbus DS/Spot Image.

Exceptions from MMU:

Exceptions from MMU > 0.5 ha are made for "8.1.1" in order to keep the network formed by these linear features.

MMW exceptions:

To maintain continuity of linear features, the MMW may fall below the limit of 10 m over a distance of up to 100 m.

8.1.2 Highly modified water courses and canals

Definition:

Natural water courses highly modified due to man-made interventions (usually concrete bedding and or straightened river shores).

Artificial water courses according to Water Framework Directive[28] definition: "water bodies which have been created in a location where no water body existed before and which have not been created by the direct physical alteration, movement or realignment of an existing water body".

This category includes:

- Highly modified natural water courses and artificial water courses > 10 m width.
- Inner harbour areas.

This category excludes:

- Natural courses partially modified (e.g. flood control structures as bank modification). → Other river classes



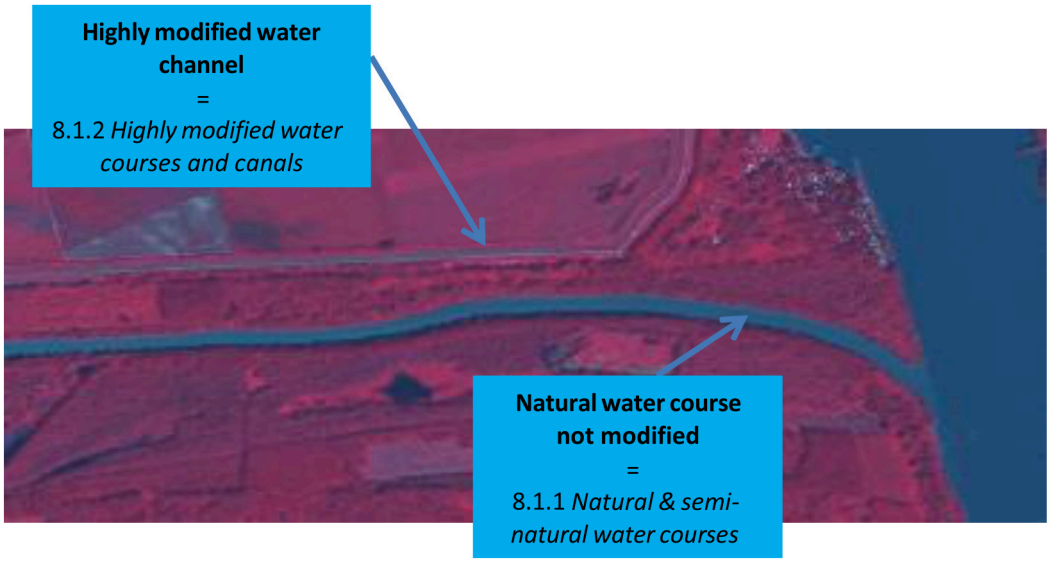
Highly modified natural water course (Río Manzanares crossing Madrid city). Credit: M. Palacios.

[28] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy



Canal in Lingen (Lower Saxony, Germany). Credit: Eurostat, 2012. LUCAS.

Appearance:



Danube river, Gemenc Ramsar Site (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-02-24. CNES 2011©, Distribution Airbus DS/Spot Image.



Inland harbors, Stellendam (Netherlands), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-10-24. CNES 2011©, Distribution Airbus DS/Spot Image.

Exceptions from MMU:

Exceptions from MMU > 0.5 ha are made for "8.1.2" in order to keep the network formed by these linear features.

MMW exceptions:

To maintain continuity of linear features, the MMW may fall below the limit of 10 m over a distance of up to 100m.

8.1.3 Seasonally connected water courses (oxbows)

Definition:

Lentic backwaters as oxbow lakes, dead side arms, abandoned braid, etc. separated from the main river channels.

This category includes:

- Permanent and temporarily separated water bodies belonging to the river system.

This category excludes:

- Oxbow lakes, dead side arms, meander scar, abandoned braid, etc. not water-bearing at the date of the image. → map according to current land cover.
- Secondary river channels. → 8.1.1 Natural & semi-natural water courses.



Intermittent oxbow lake in Scandinavia. Credit: B. O. Finseth. http://es.wikipedia.org/wiki/Brazo_muerto#mediaviewer/File:Finna2.JPG Creative Commons BY 2.5

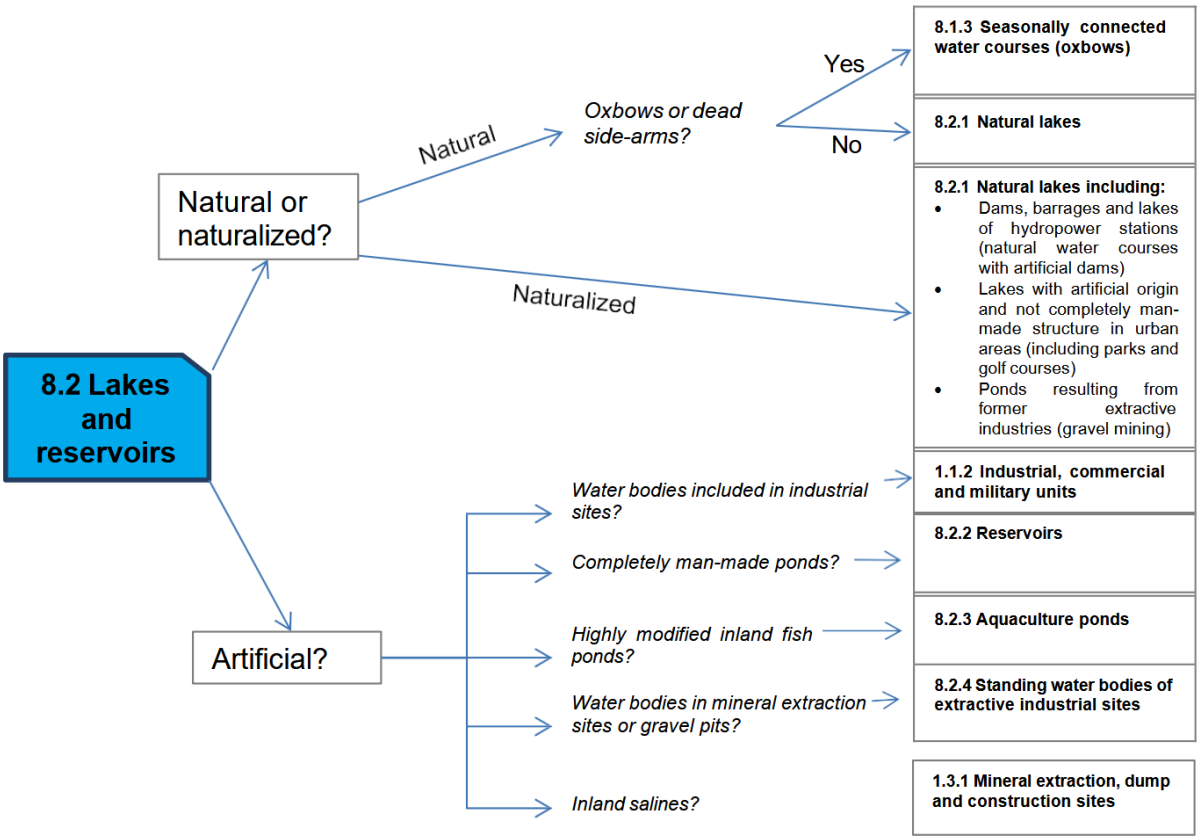
Appearance:



Dead side-arms of Danube river, Tolna (Hungary), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-02-24. CNES 2011©, Distribution Airbus DS/Spot Image.

8.2 Lakes and reservoirs

A specific decision tree has been elaborated to distinguish the 8.2 Lakes and reservoirs classes from other water classes.



8.2.1 Natural lakes

Definition:

Natural permanent lakes, including dams, barrages and lakes of hydropower stations. Includes lakes with artificial origin in urban environments and lakes resulting from former extraction industries (gravel mining, open cast pit) after restoration.

This category includes:

- Lakes, ponds and pools of natural origin containing fresh water.
- Lakes, ponds and pools of artificial origin but with natural structure.
- Dams, barrages and lakes of hydropower stations (including their tails).
- Lake with artificial origin in urban environments.
- Lakes resulting from former extractive industries (gravel mining, open cast pit) after restoration.
- Water surface of temporary ponds visible at time of satellite acquisition date.
- Floating aquatic vegetation.

This category excludes:

- Fish ponds → 8.2.3 Aquaculture ponds.
- Ponds and lakes with completely man-made structure → 8.2.2 Reservoirs.
- Concrete structure and related areas in dams, barrages and lakes of hydropower stations will be classified as 1.1.2 Industrial, commercial and military units. Soil removed in these sites will be classified as 1.3.1 Mineral extraction, dump and construction sites. Watercourses passing power stations and dams will be classified as 8.1.2 Highly modified water courses and canals.
- Flooded areas e.g. due to heavy rain conditions etc. → map according to current land cover.



Natural water body in the Bavarian Alps (S-Germany). Credit: M. Probeck.



Lake in a green area in Madrid city (Spain). Credit: M. Palacios.

Appearance:



Tail of a reservoir in Euphrates river, Kasaba (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-05-07. CNES 2011©, Distribution Airbus DS/Spot Image.

Delimitation of water level in dams, barrages and lakes of hydropower stations:



Delimitation of water bodies using the maximum water lever. This is the wrong interpretation. Reservoir in Canary Island (Spain). Credit: M. Palacios.



Delimitation of water bodies using the current water level. This is the correct interpretation. Reservoir in Canary Island (Spain). Credit: M. Palacios.

8.2.2 Reservoirs

Definition:

Pond with completely man-made structure. Water reservoirs, especially in Mediterranean countries, used for irrigation and located in agricultural surroundings. This category includes ponds and water basins for industrial use/sewage not connected to buildings and other facilities like storage tanks.

Main characteristic are rectangular or circular shape, concrete border, sometimes fenced.

This category includes:

- Completely artificial ponds used for irrigation or industrial deposits (sedimentation ponds, sewage ponds, storm water ponds or water ponds near ski areas as a source for artificial snow).
- Other man-made liquid pools not connected with buildings or tanks.

This category excludes:

- Natural or naturalized ponds. → 8.2.1 Natural lakes.
- Lakes in urban areas (parks, recreational and sport lakes) with artificial origin → 8.2.1 Natural lakes.
- Water ponds/lakes in industrial sites → 1.1.2 Industrial, commercial and military units.

- Lakes that originate from former extractive industries → 8.2.4 Standing water bodies of extractive industrial sites.
- Fish ponds → 8.2.3 Aquaculture ponds.

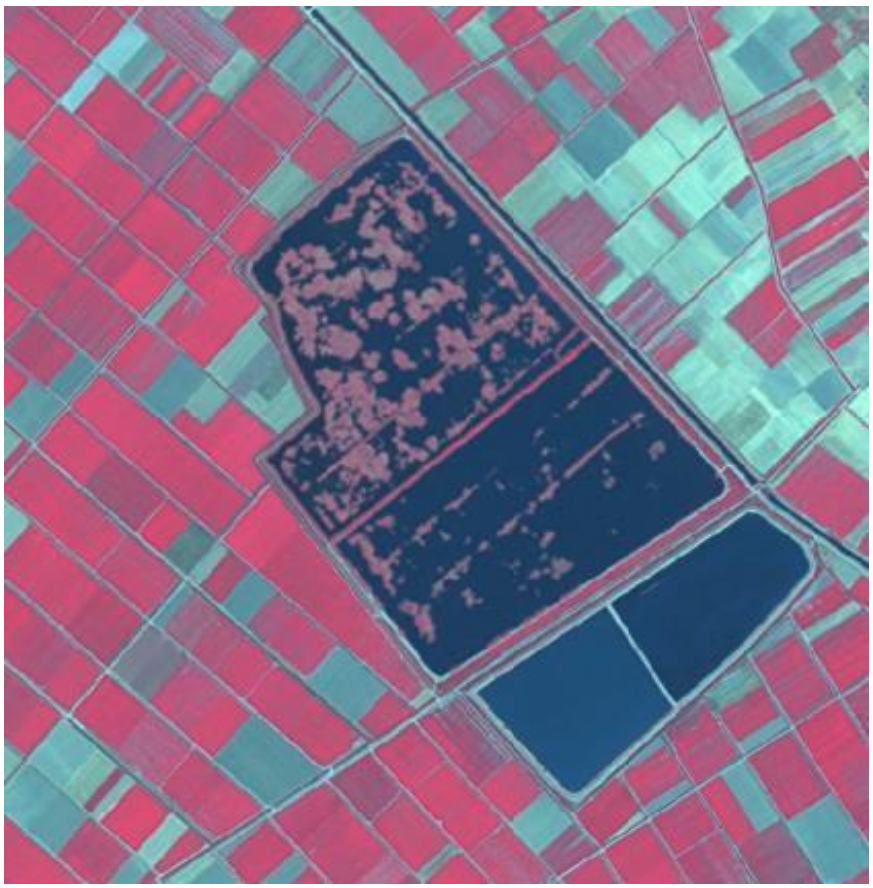


Irrigation pond with completely man-made structure (Canary Islands, Spain). Credit: M. Palacios.



Irrigation pond in Sicily, Italy. Credit: Eurostat, 2012. LUCAS.

Appearance:



Irrigation water pond, Thessaly (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-23. CNES 2011©, Distribution Airbus DS/Spot Image.

- Artificial ponds/lakes with regular shape.

8.2.3 Aquaculture ponds

Definition:

Highly transformed and controlled freshwater ponds, artificial lakes or reservoirs that are stocked with fish and are used in aquaculture and fish farming.

This category includes:

- Highly transformed ponds used as fish farms / for fish farming.

This category excludes:

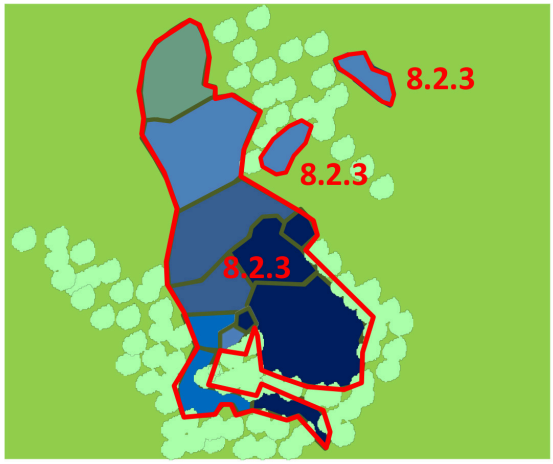
- Natural water bodies used as fish farms / for fish farming. → 8.2.1 Natural lakes.
- Highly transformed coastal waters used mainly for fish-breeding activities → 7.2.2 Salines or 8.3.1 Lagoons if fish farms are located in coastal lagoons.
- Completely man-made ponds with concrete structure → Class 8.2.2 Reservoirs.
- Silted basins that are not used any more → map current land cover.
- Fish cage systems in lakes, reservoirs or in the sea.



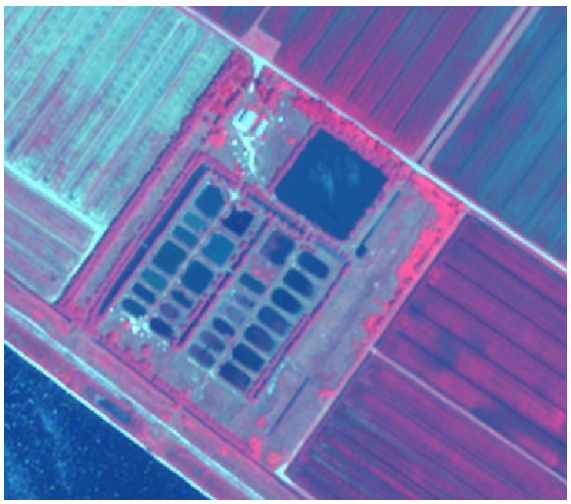
Fish ponds in Lubusz (Poland). Credit: Eurostat, 2009. LUCAS.

Appearance:

- Water ponds with regular shape, close quarters (rectangular structure) and many small ponds. Fresh water fish ponds differ from saline ponds in water colour and algae on their water surface.



Typical pattern of fish ponds in the region of Třeboňsko (Czech Republic).



Aquaculture ponds, Goro (Italy),(1/2/3 band combination). Date: 2018-07-02. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

8.2.4 Standing water bodies of extractive industrial sites

Definition:

Water bodies related to active quarry created from ground water or rainwater accumulation.

This category includes:

- Water bodies in active gravel pits.
- Water bodies associated with open pit extraction of gravel.
- Decanting pools associated with mining activities.
- Toxic lakes used for disposal (only if additional information indicates industrial purposes – if no information is available: 8.2.1 Natural lakes or 8.2.2 Reservoirs).

This category excludes:

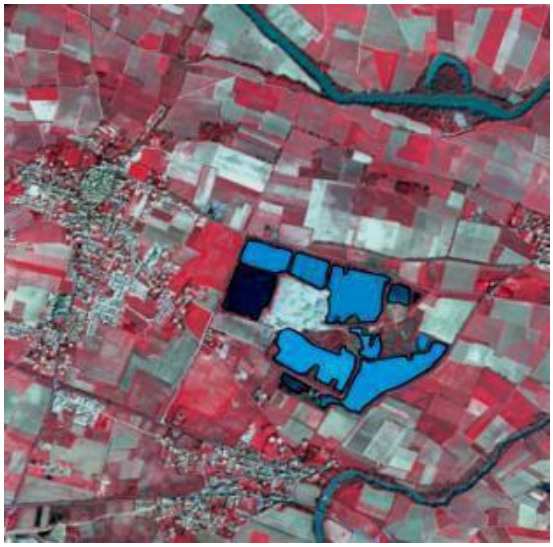
- Mineral treatment pools in mine facilities with industrial liquids and mud. → 8.2.2 Reservoirs.
- Water bodies associated to waste treatment plants. → 8.2.2 Reservoirs.
- Liquid pools in industrial facilities → 1.1.2 Industrial, commercial and military units.



Mining pond near Tornitz (Saxony-Anhalt, Germany). Eurostat, 2012. LUCAS.

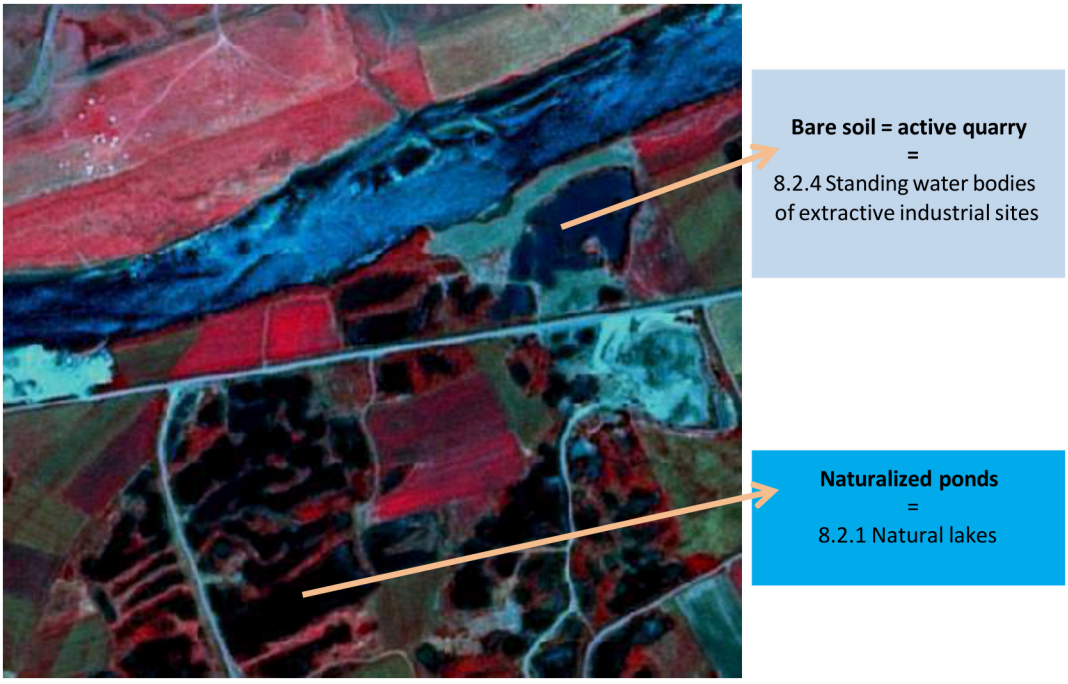
Appearance:

Ponds with regular shape and related to soil removal.



Water bodies in extraction area, Villedaigne (France), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-03-20. CNES 2011©, Distribution Airbus DS/Spot Image.

Water bodies from restored or naturalized or nonactive quarries are not included in this category. The main differentiation between active/non-active is based on the presence of recently removed soil around the water bodies.



Water bodies in a gravel pit, Bozbulut (Turkey), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-07-05. CNES 2011©, Distribution Airbus DS/Spot.

8.3 Transitional waters

8.3.1 Lagoons

Definition:

Lagoons (8.3.1) are, according to the EUNIS habitat classification, characterized by their chemical composition (presence of salt water) and their morphology (partially separated from the sea by sand banks or shingle, or, less frequently, by rocks). Coastal lagoons are vegetated (reed bed and salt marsh plants) or unvegetated.

CORINE Land Cover 521 Coastal lagoons is adopted: “Stretches of salt or brackish water in coastal areas which are separated from the sea by a tongue of land or other similar topography. These water bodies can be connected to the sea at limited points, either permanently or for parts of the year only”[29].

Coastal lagoons are considered as a water ecosystem composed by water and specific adapted vegetation (reed beds and marsh plants). Coastal lagoons also appear without or less vegetation coverage.

This category is relevant in Mediterranean coastal areas. This class is also present in Baltic sea and is a scarce habitat at the Atlantic coast.

This category includes:

- Open water of coastal lagoons.
- Reed beds in coastal lagoons
- Floating aquatic vegetation in coastal lagoons.
- Tidal mud flats and muddy areas in coastal lagoons.
- Tidal channels.
- Areas separated by barriers in coastal lagoons and not included in salines or fish farms.

[29] Bossard, M., Feranec, and J. Otahel, J. (2000): CORINE land cover technical guide – Addendum 2000, Technical report No 40, European Environment Agency.

- Coastal lagoons separated from the sea by rocks if they are distinguishable from fjords and other related features. This type is common for the coasts of Scotland, Wales and Ireland (silted or chocked coastal lagoons).
- Percolation lagoons if they are clearly separated from sea by sand banks or shingle.
- Coastal lagoons separated from the sea by artificial structures, as roads.

This category excludes:

- Estuarine lagoon (a lagoon interconnected to a major river) → 8.3.2 Estuaries.
- Inland salt marshes → 7.1.1 Inland marshes.
- Coastal salt marshes → 7.2.1. Salt marshes
- Water courses → 8.1.x Water courses.
- Beaches and dunes → 6.2.x Beaches, dunes, sands.
- Fjords and other coastal lagoons not separated from the sea by a visible tongue of land, are not included → 8.4.0 Sea and ocean.



Coastal lagoon at Golfo di Signo (Sardinia, Italy). Credit: Eurostat, 2012. LUCAS.



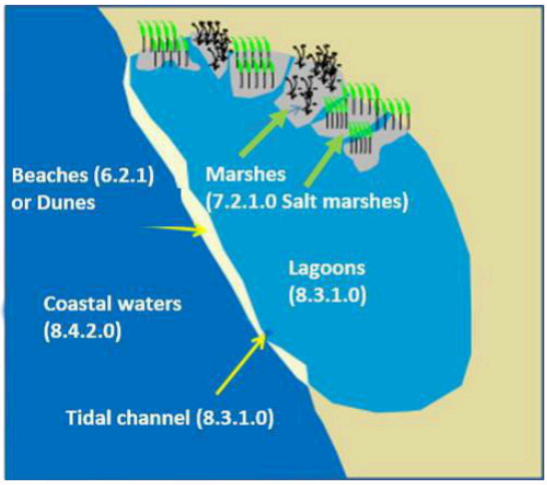
Orbetello Lake (Grosseto, Italy). Credit: Eurostat, 2012. LUCAS.

Appearance:

- Vegetationless (water coverage) bodies of water generally separated from the sea by a land barrier (usually sand).



Limnes Voulkaria Kai Saltini Natura 2000 site (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-02-05. CNES 2011©, Distribution Airbus DS/ Spot Image. In green, limits of Natura 2000 site.



Schematic representation of typical coastal lagoon landscape.

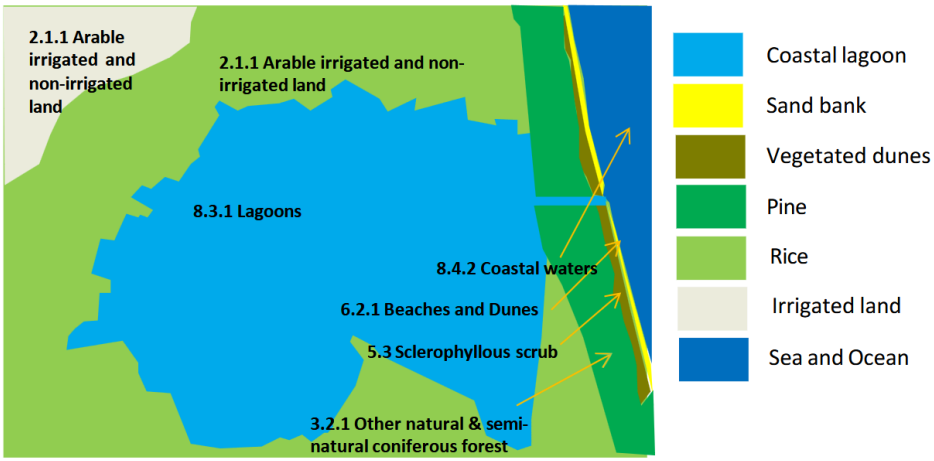


Schematic view of the treatment of bare soils in coastal lagoons. Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

- Muddy areas in coastal lagoons will be also considered as 8.3.1 Lagoons (including muddy areas separated from the main lagoons by barrier and not included in salines or fish farms).

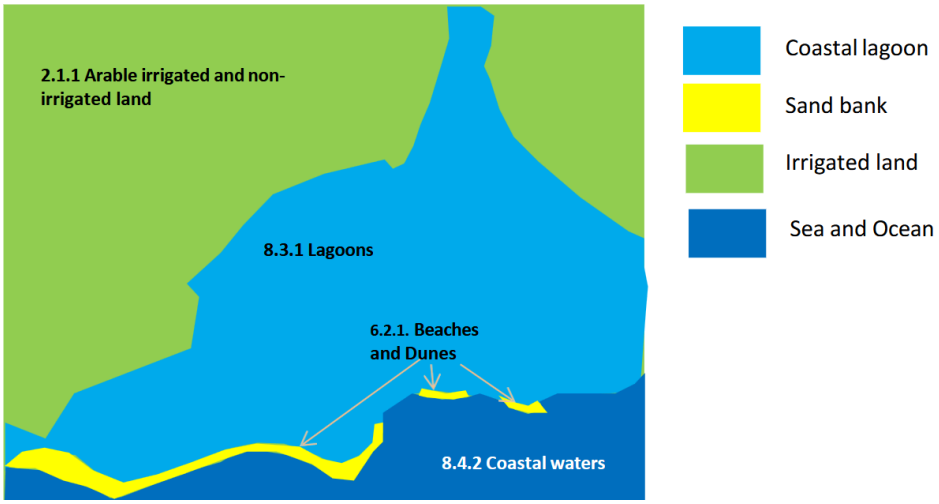
The following types of coastal lagoons are considered according to their main morphological characteristics:

- Isolated lagoons: These are shallow bodies of water separated from the sea by a sand barrier (dunes and beaches). These lagoons are connected to the sea at limited points. Typical for Mediterranean coastal areas. In Spain called *Albuferas*.

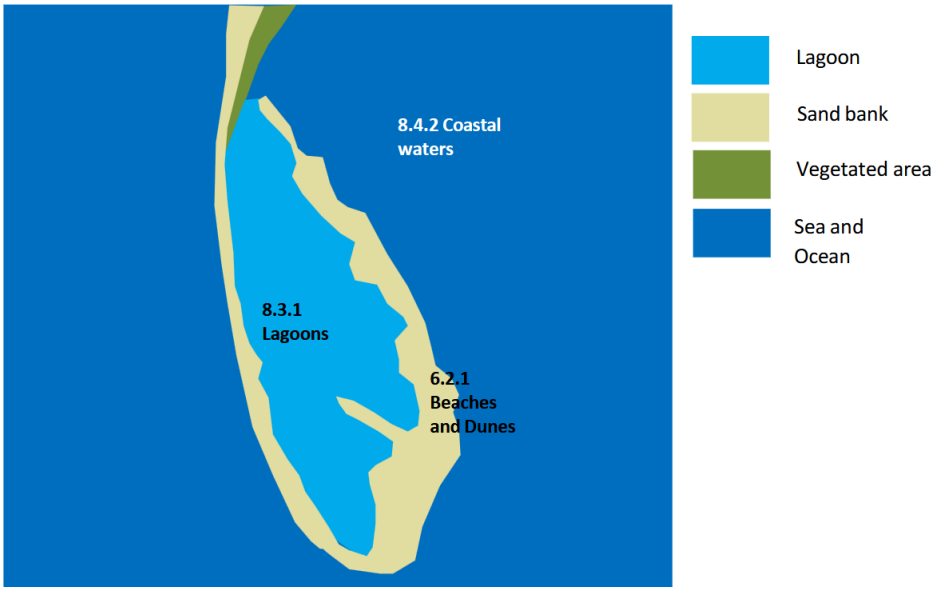


Schematic view of La Albufera coastal lagoon (Valencia, Spain).

In many cases, these coastal lagoons which are separated by sand barriers are open to the sea due to sea erosion or other processes (leaky, restricted or open type lagoons). In other cases they are entirely surrounded by sand banks.

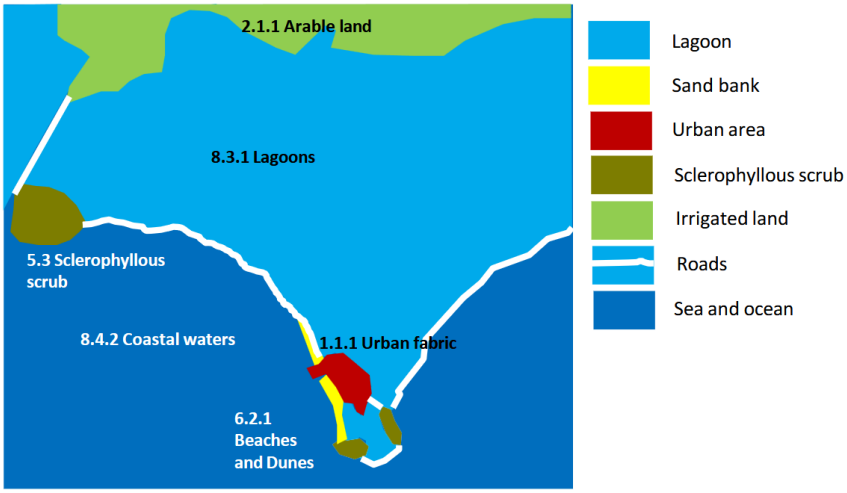


Schematic view of open coastal lagoon. Limni Kiknolakka (Greece).



Schematic view of Falsterbo coastal lagoons complex (Scania Province, Sweden).

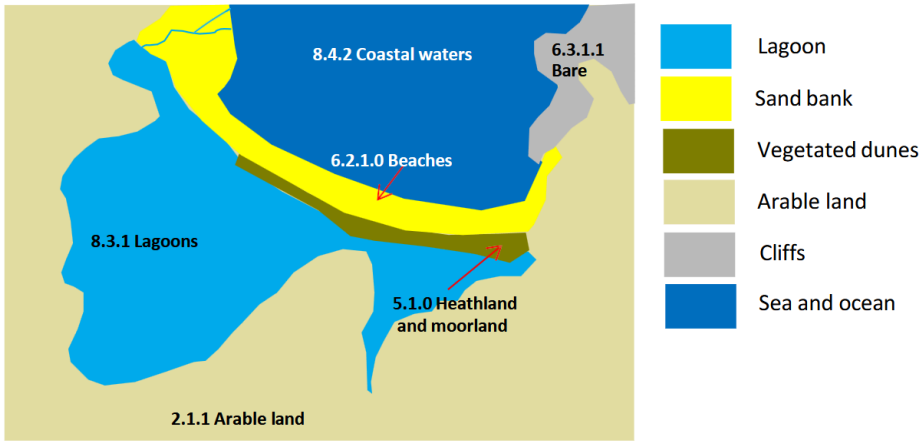
Many of these lagoons are either man-made OR artificially transformed (especially by the construction of roads on the sand barriers).



Schematic view of a transformed coastal lagoon. Logarou lake (Greece).

Percolation lagoons[30]:

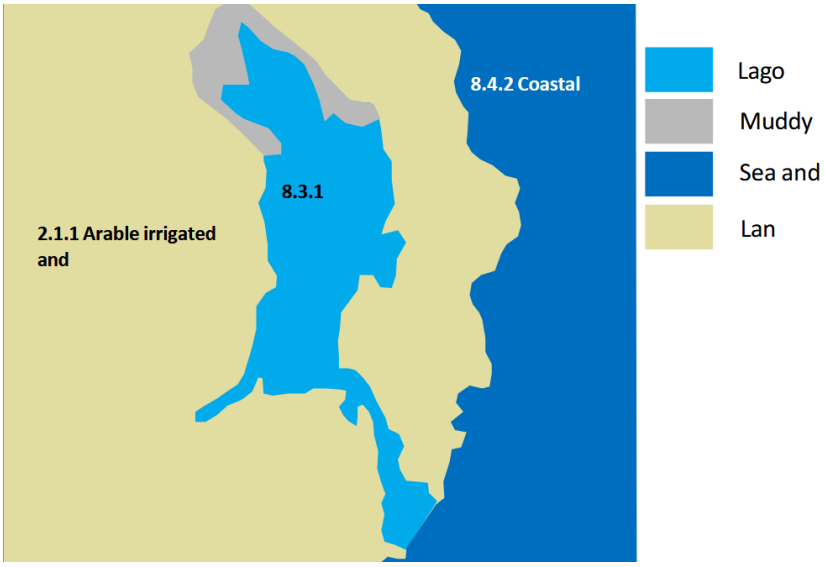
These are normally separated from the sea by sand or shingle banks. Seawater enters by percolating through the bank.



Schematic view of percolation Cemlyn lagoon (north Wales, United Kindgdom)

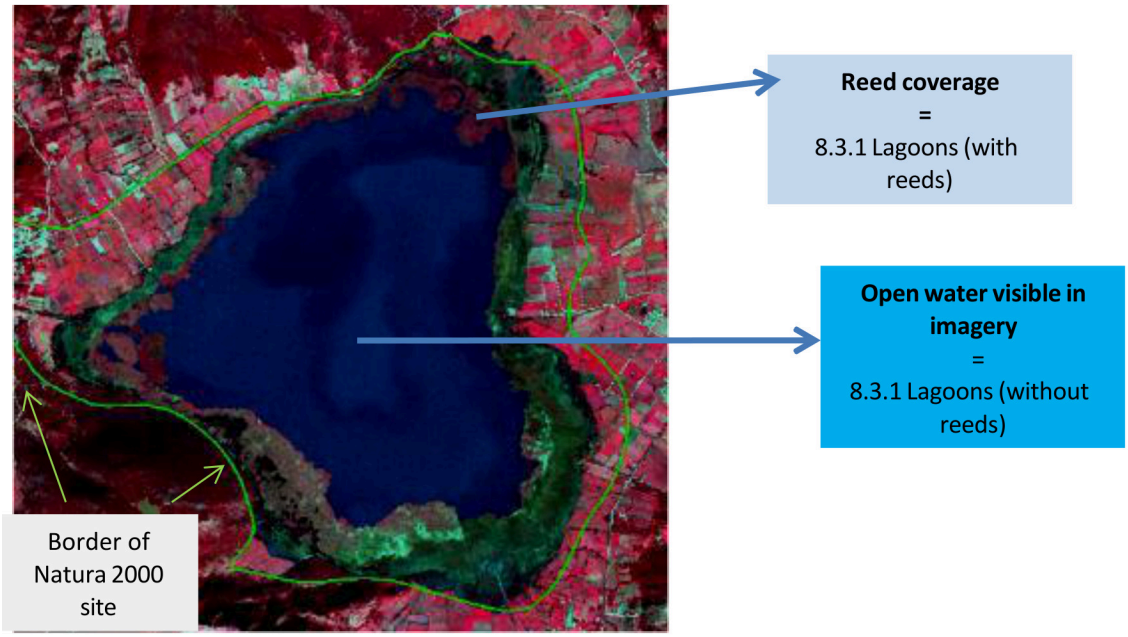
A specific case of coastal lagoons are silted or choked lagoons. These coastal lagoons are open to the sea, but the water is retained by a rock barrier (in many cases not visible in the satellite images) or by a long narrow entrance channel. Fjords are the same landforms that only differ from lagoons in their water depth.

[30] http://jncc.defra.gov.uk/protectedsites/sacselection/habitat.asp?FeatureIntCode=H1150



Schematic view of silled lagoon of Strangford Lough (Northern Ireland, United Kindgdom).

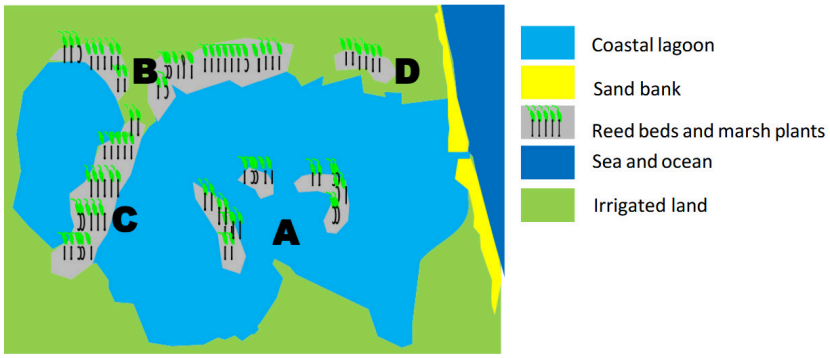
Vegetated (water coverage) bodies of water generally separated from the sea by a land barrier (usually sand).



Limnes Voulkaria Kai Saltini Natura 2000 site (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-02-05. CNES 2011©, Distribution Airbus DS/Spot Image.

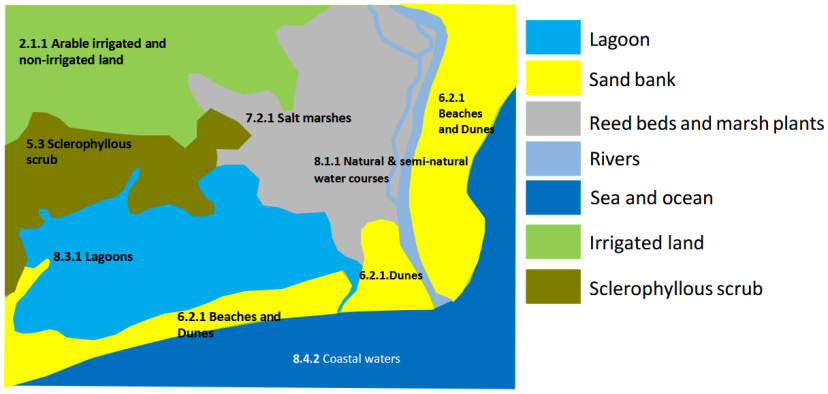
This class only applies to following situations in coastal lagoons not related with estuaries or coastal wetlands:

- A. Reed beds and marsh plants inside coastal lagoons.
- B. Reed beds and marsh plants located in the shoreline of coastal lagoons.
- C. Reed beds and marsh plants dividing two coastal lagoons.
- D. Reed beds and marsh plants separated from coastal lagoons not related with estuaries or coastal lagoons.



Concept of coastal marshes with reeds: A, B, C and D situations are considered as 8.3.1 Lagoons.

In the case of complex coastal lagoons (costal lagoons related to coastal wetlands and estuaries) they will be classified as 7.2.1 Salt marshes, prevailing the concept of coastal wetlands over coastal lagoons. In these cases, only reed beds and marsh plants inside the waterbody or/ and separating two coastal lagoons will be classified as 8.3.1 Lagoons.



Schematic concept for differentiation between 8.3.1 class.

Special cases are coastal lagoons covered by reed beds and marsh plants and the presence of tidal channel. In these cases the tidal channels will be as well classified as 8.3.1 Lagoons.



Schematic concept of coastal lagoons (with reed beds) and tide channels (Leaky coastal lagoon of Ria Formosa in Portugal).

Methodological advice:

- Use of CLC class 5.2.13 as orientation.

8.3.2 Estuaries

Definition:

CORINE Land Cover 522 Estuaries class is adopted: "The mouth of a river within which the tide ebbs and flows, either permanently or for parts of the year only"[31].

In many cases, estuaries are associated with marshes.

This category includes:

- Estuaries.
- Deltas.

This category excludes:

- Marshes in estuaries → 7.2.1 Salt marshes
- Coastal waters → 8.4.2 Coastal waters.
- Coastal lagoons → 8.3.1 Lagoons.
- Rivers ending in highly artificial harbors will not be categorized as 8.3.2 Estuaries.
- Fjords, *rias* (in Northwestern Spain) and straits → 8.3.3 Marine inlets and fjords.

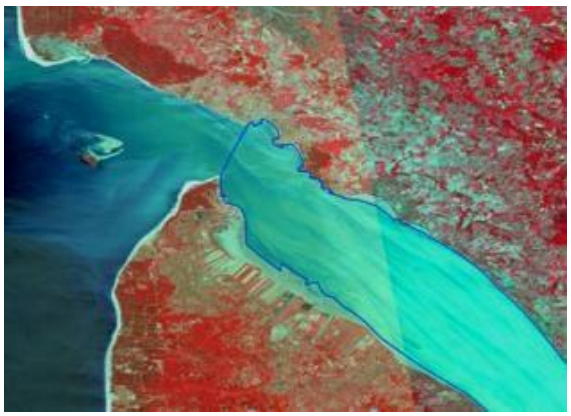


Estuary of Guadalquivir River (Southern Spain). Credit: E. Mazón.

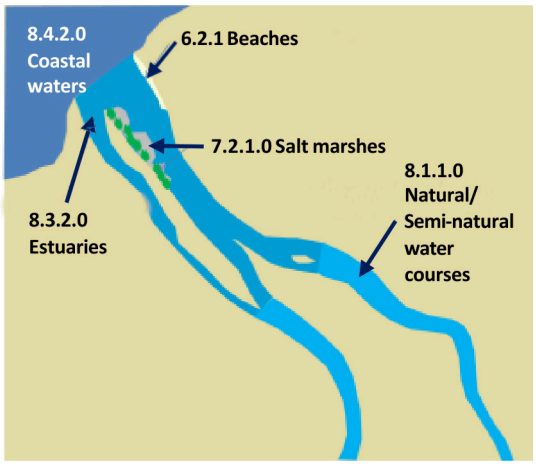
Appearance:

- Ending of rivers which flow into the sea.
- Estuaries are influenced by tides and in small rivers sand/mud appears when low tide occurs.
- The limit between 8.2.2 Estuaries and 8.4.1 Coastal waters is based on the intended continuation of the coastline.

[31] Bossard, M., Feranec, and J. Otahel, J. (2000): CORINE land cover technical guide – Addendum 2000, Technical report No 40, European Environment Agency.



Gironde Estuary delineated (France), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-08-01. CNES 2011©, Distribution Airbus DS/Spot Image.

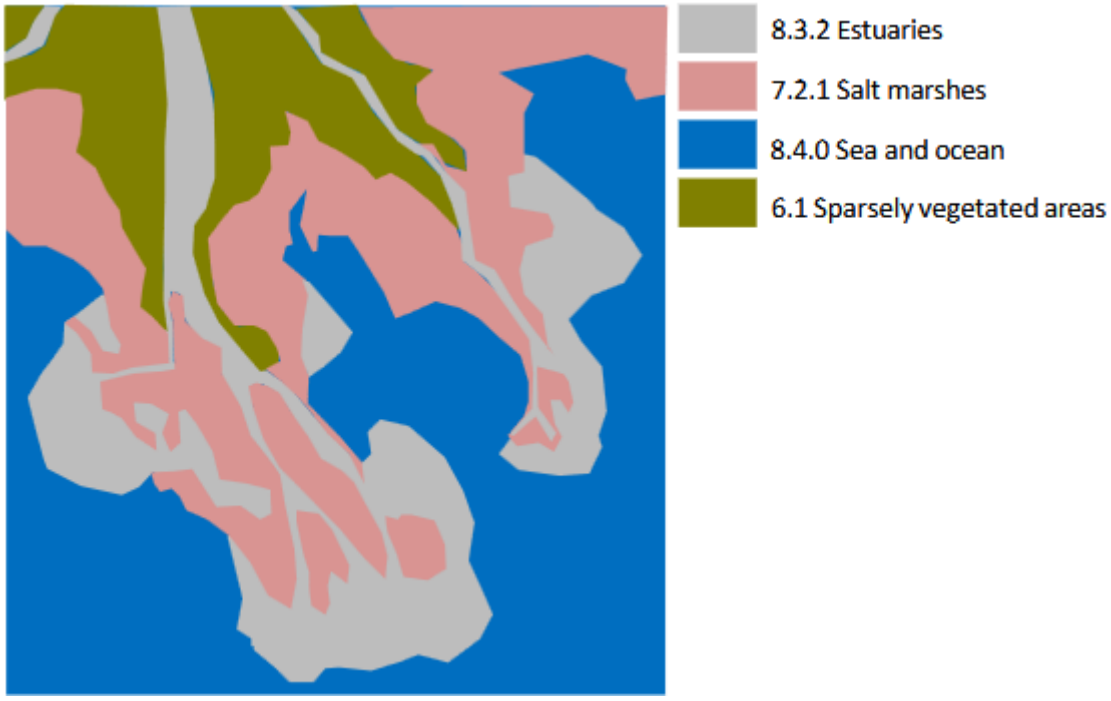


Schematic representation of typical estuary morphology.

In delta rivers, the area where the river meets the sea is classified as 8.3.2 Estuaries. The area affected by tides (presence of mud in the image) inside the deltaic system which is not covered by vegetation is also classified as 8.3.2 Estuaries.

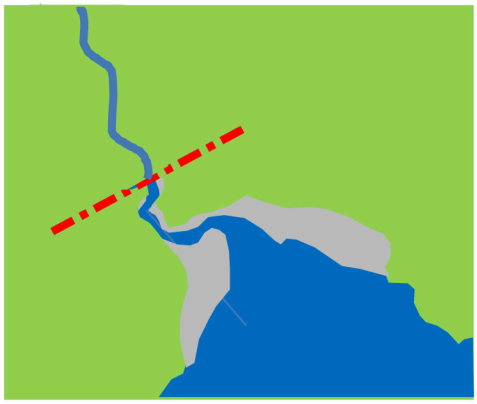


Axios Delta (Greece), Spot 5 (2.5 m; 1/2/3 band combination). Date: 2011-09-17. CNES 2011©, Distribution Airbus DS/Spot Image.

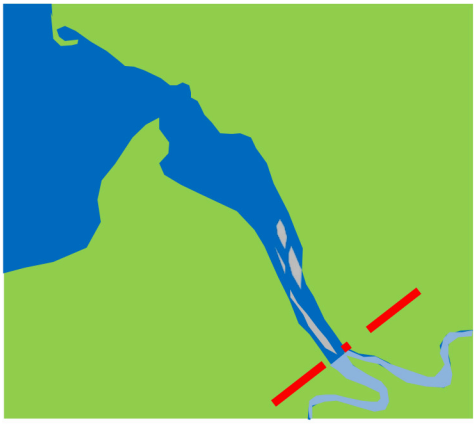


8.3.2 Estuaries 7.2.1 Salt marshes 8.4.0 Sea and ocean 6.1 Sparsely vegetated areas Schematic representation of PA level 4 classification of Axios Delta (Greece).

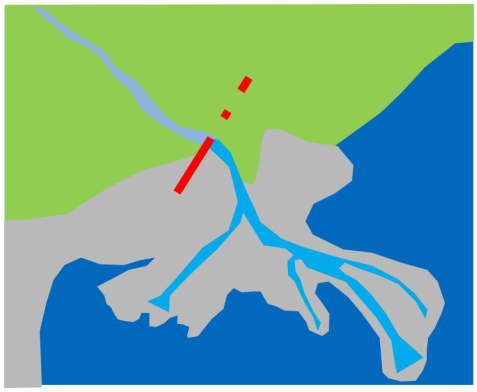
The limits between 8.1.1 Natural & semi-natural water courses and 8.3.2 Estuaries is based in the following practical visual rules:



- There is a clear narrowing of the river channel → the limits are established where the river begins to be wider. Usually, there are muddy areas from this point on.



- The estuary is formed by a river and a major tributary and the river begins to be wider → the limit is the confluent of two rivers.



- In deltas and at big rivers where no difference in the width of the channel is apparent and salt marshes or complex coastal systems are present → the limit is the point where wet mud banks forming salt marshes or old wetlands transformed by agriculture appear.

Methodological advice:

- Use of CORINE LC class 5.2.2 as orientation.
- Computer assisted visual interpretation complemented by ancillary information. The delimitation of CLC 8.3.2 Estuaries / 8.1 Water courses will be determined by the photo interpreter according to morphological characteristics as e.g. river junctions or other geographic elements as bare or sandy capes.
- Use of Transitional Water layer (European Framework Directive) to identify general limits of coastal waters.
- Use of ancillary information:
  - GIO-Land HR Water/Wetland Layers.
  - Natura 2000 database.
  - Wetland Ramsar Sites.
  - Any available ancillary or in-situ data sources.

8.3.3 Marine inlets and fjords

Definition:

Marine inlets and fjords are valley-shaped openings in the coastline stretching inland. Fjords are created through glacier activity where a valley is carved out and later submerged because of rising sea level. Marine inlets, e.g. ria coast in north-western Spain, originate from rivers forming a valley which is flooded due to a rise of sea level. Both can have a complex structure of branches, which may unite to one before entering the sea. Water inside marine inlets and fjords are influenced by the sea and its tide and are therefore saline. Delineation on the water surface is a straight line between the two points of entry into the sea on each side of the inlet. In contrast to the often long and linear shaped fjords, marine inlets can have a very broad funnel shaped opening to the sea. To differentiate between a marine inlet and a bay (8.4.2 Coastal waters) a river terminating in the marine inlet or a dry valley formerly shaped by a river can be used as indicator.



Ria coast near Vigo (Spain). Credit: Harpagornis - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=18 115391



Lysefjord (Norway). Credit: Andreas Tille - Eigenes Werk, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=9249 46

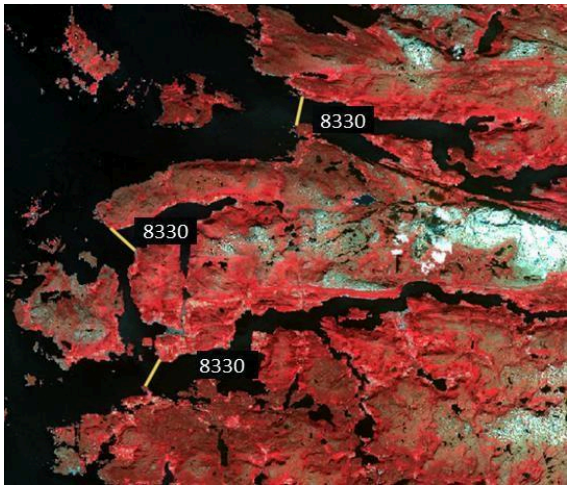
This category includes:

- Coastal fjords of northern Europe (Scandinavia, Ireland, Scotland, Faroe Islands).
- Ria coast in Northern Spain and Andalusia, north-western France, Ireland, England and Wales, Croatia, Montenegro and Malta.
- Some kind of lochs in Scotland, if they were carved by rivers or glaciers and open into the sea.

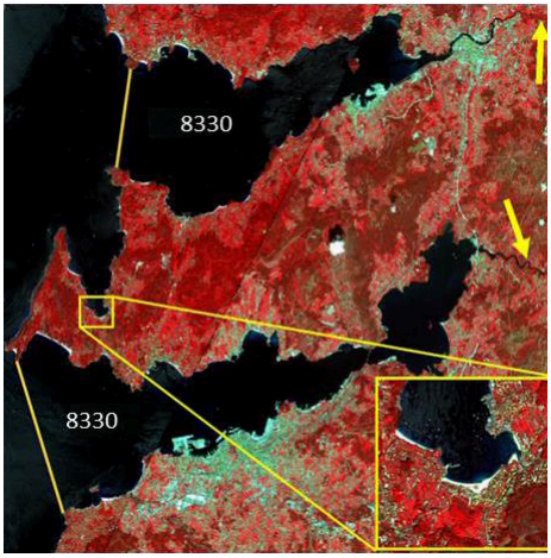
This category excludes:

- Mouths of rivers → 8.1.1 Natural & semi-natural water courses.
- Deltas → 8.3.2 Estuaries.
- Bays and coastal enclosures by spits → 8.4.2 Coastal waters.
- Lagoons connected to the sea → 8.3.1 Lagoons.
- Tidal inlets and channels → depending on size and location 7.2.1 Salt marshes, 7.2.3 Intertidal flats or 8.4.2 Coastal waters.

Appearance:



Delineation of fjords near Stongfjorden (Norway). SPOT-5 (2.5 m) (1/2/3 band combination). Date: 2012-06-28. Credit: CCME 2012 provided under COPERNICUS by the European Union and ESA.



Delineation of ria coast near Vigo (Spain). Yellow arrows indicate the river tributaries necessary for this class. The mini map shows a bay situation since there is no river source. SPOT-5 (2.5 m) (1/2/3 band combination). Date: 2011-04-29 and 2011-08-10 Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA.

Methodological advice:

- Computer assisted visual interpretation complemented by ancillary information.

8.4 Sea and ocean

8.4.1 Open sea

Definition:

Open water of seas and oceans outside coastal waters.

The coastal waters are defined as all water areas extending from the landside up to one nautical mile into the sea (see detailed description in 8.4.2 Coastal waters).

This category includes:

- Open water outside the coastline, including the Baltic Sea, the Bothnia Sea and the Gulf of Bothnia

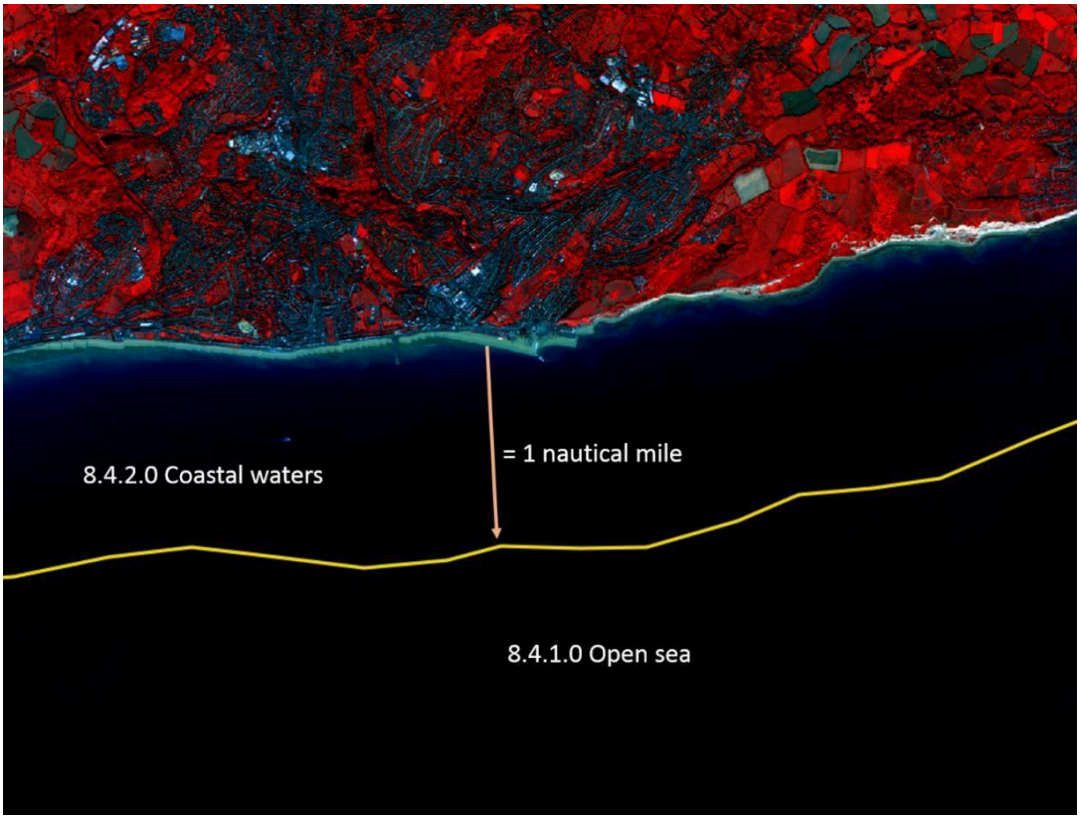
This category excludes:

- Sea area that is within the coastline and one nautical mile seawards → 8.4.2 Coastal waters



Open sea in the Bay of Biscay Credit: By STHLM, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=54638112

Appearance:



Delineation of coastal waters and open sea at the British coastline near Fairlight (UK). SuperView-1 (2m) (1/2/3). Date: 2018-09-02. Source: Airbus DS Geo SA (2018). Credit: CCME 2018 provided under COPERNICUS by the European Union and ESA

Methodological advice:

- The mapping of open sea will be an automated GIS operation.

8.4.2 Coastal waters

Definition:

Water area between the coastline (or the theoretical coastline in case of estuaries, inlets, fjords, etc.) and the open sea.

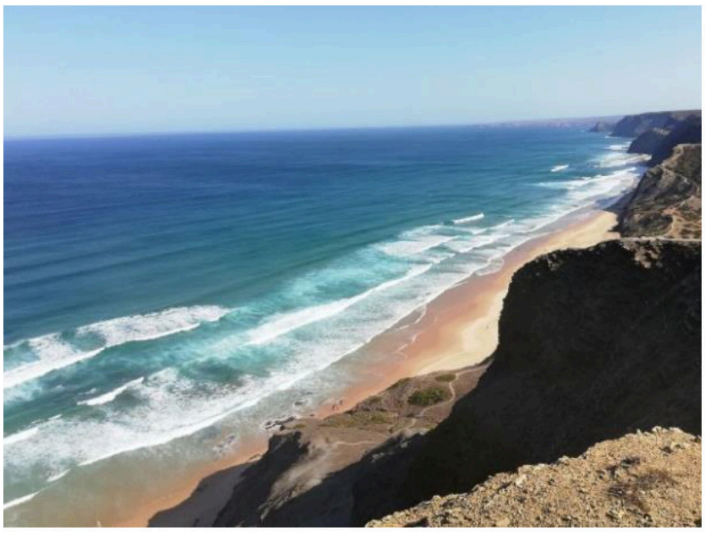
The European water framework directive defines coastal waters as "surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters"[32]. Hence the coastal waters extend from the landward extent of either the coastal or transitional waters out to one nautical mile from the baseline. According to the United Nations Convention on the on the Law of the Sea (UNCLOS) the baseline is measured as the low-water line except along the mouths of estuaries and heads of bays where it cuts across open water.[33]

This category includes:

- Open water outside the coastline up to one nautical mile seawards, including harbour waters.

This category excludes:

- Estuaries. Estuaries are areas greatly affected by freshwater influence (> 20 m^3/s) and variate in water level → 8.3.2 Estuaries.
- Intertidal flats → 7.2.3 Intertidal flats.
- Coastal lagoons are areas separated from the sea. These water bodies can be connected to the sea at limited points, either permanently or for parts of the year only → 8.3.1 Lagoons.
- Inlets evolved from valleys created by former glaciers or rivers which later submerged, e.g. ria coasts, fjords and some kind of lochs in Scotland → 8.3.3 Marine inlets and fjords.
- All water outside of one nautical mile → 8.4.1 Open sea.



Atlantic Ocean near Sagres (Portugal). Credit: C. Gruber

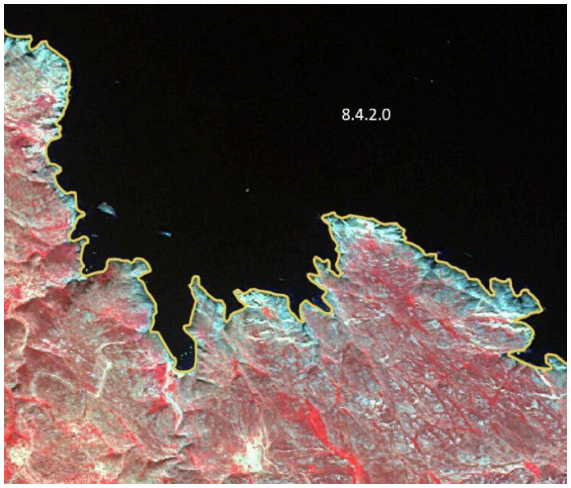
[32] http://inspire.ec.europa.eu/featureconcept/WFDCoastalWater

[33] Common Implementation Strategy for the Water Framework Directive (2000/60/EC) https://circabc.europa.eu/sd/a/85912f96-4dca-432e-84d6-a4dded785da5/Guidance%20No%205%20-%20characterisation%20of%20coastal%20waters%20-%20COAST%20(WG%202.4).pdf

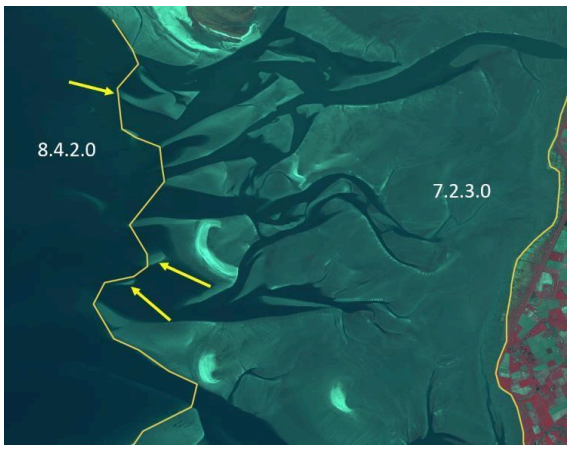


Strait of Gibraltar seen from Tarifa (Spain). Credit: CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=58051

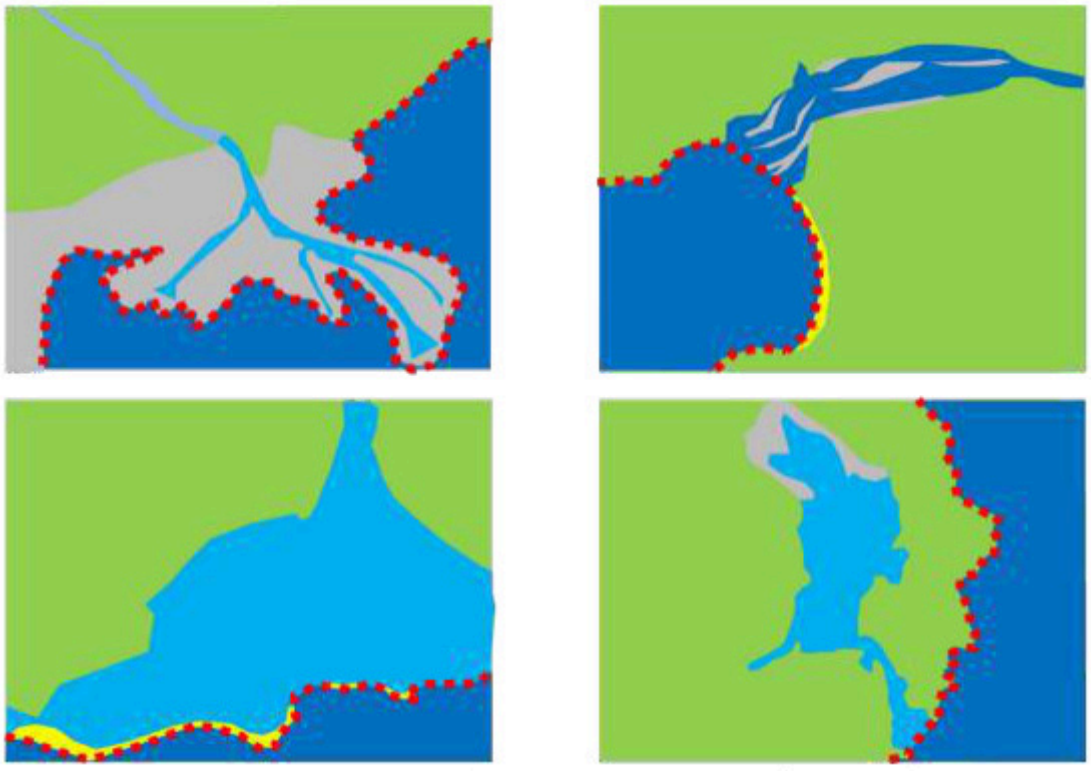
Appearance:



Delineation of a coastline in Catalonia (Spain). (1/2/3 Band Combination). Date: 2012-09-07. Credit: CCME 2012 provided under COPERNICUS by the European Union and ESA.



8.4.2 Coastal waters separated from the other marine classes by the presence of fine sediment deposition of Intertidal flats (7.2.3) that are in between high and low water marks. (Wadden Sea, Germany). (1/2/3 Band Combination). Date: 2011-04-25. Credit: CCME 2011 provided under COPERNICUS by the European Union and ESA.



Schematic representation of classes 8.4.2 Coastal waters (red dot line).

Methodological advice:

- CORINE LC class 5.2.3 as indication.
- The delineation between 8.4.1 Open sea and 8.4.2 Coastal waters will be made by semi-automated GIS operations.
- Use of Transitional Waters layer (European Framework Directive) as indication of limits between open sea and coastal wetlands/coastal lagoons/intertidal flats.

- National data (coastal line from national supporting data such as topographical maps is used as a support to define the borderline between water courses and coastal sea).
- Supporting remote sensing data and depth data to delineate from 8.2 Lakes and reservoirs.
- Computer assisted visual interpretation of SPOT-5 data.

5. List of abbreviations & acronyms

Abbreviation	Definition
AOI	Area of Interest
CAPI	Computer Assisted Photo Interpretation
CCD	Crown Cover Density
CCME	Copernicus Contributing Mission Entity
CLC	CORINE Land Cover
CSW	Catalogue Service for the Web
DEM	Digital Elevation Model
DWH	Data Warehouse of the European Space Agency
EC	European Commission
EEA	European Environment Agency
EO	Earth Observation
ESA	European Space Agency
EU-DEM	European Digital Elevation Model
EU-HYDRO	European Hydrography Layer
EUNIS	European Natural Information System
GIO	GMES Initial Operations
HR	High Resolution
HRL	High Resolution Layer
IM.D	Imperviousness Density
JRC	Joint Research Centre of the European Commission
LCC	Land Cover Change
LC/LU	Land Cover/Land Use
LUCAS	Land Use/Cover area Frame Statistical Survey
LUZ	Large Urban Zone
MAES	Mapping and Assessment of Ecosystems and their Services
MMU	Minimum Mapping Unit
MMW	Minimum Mapping Width(s)
N/A	not applicable
NDVI	Normalised Difference Vegetation Index
OSM	Open Street Map
PA	Protected Areas
RZ	Riparian Zones
SPOT	Satellite Pour l'Observation de la Terre

Abbreviation	Definition
T.C.D./TCD	Tree Cover Density
UA	Urban Atlas
USGS	United States Geological Survey
VHR	Very High Resolution
WMS	Web Map Service