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LAND COVER MAP 2007 DATASET DOCUMENTATION



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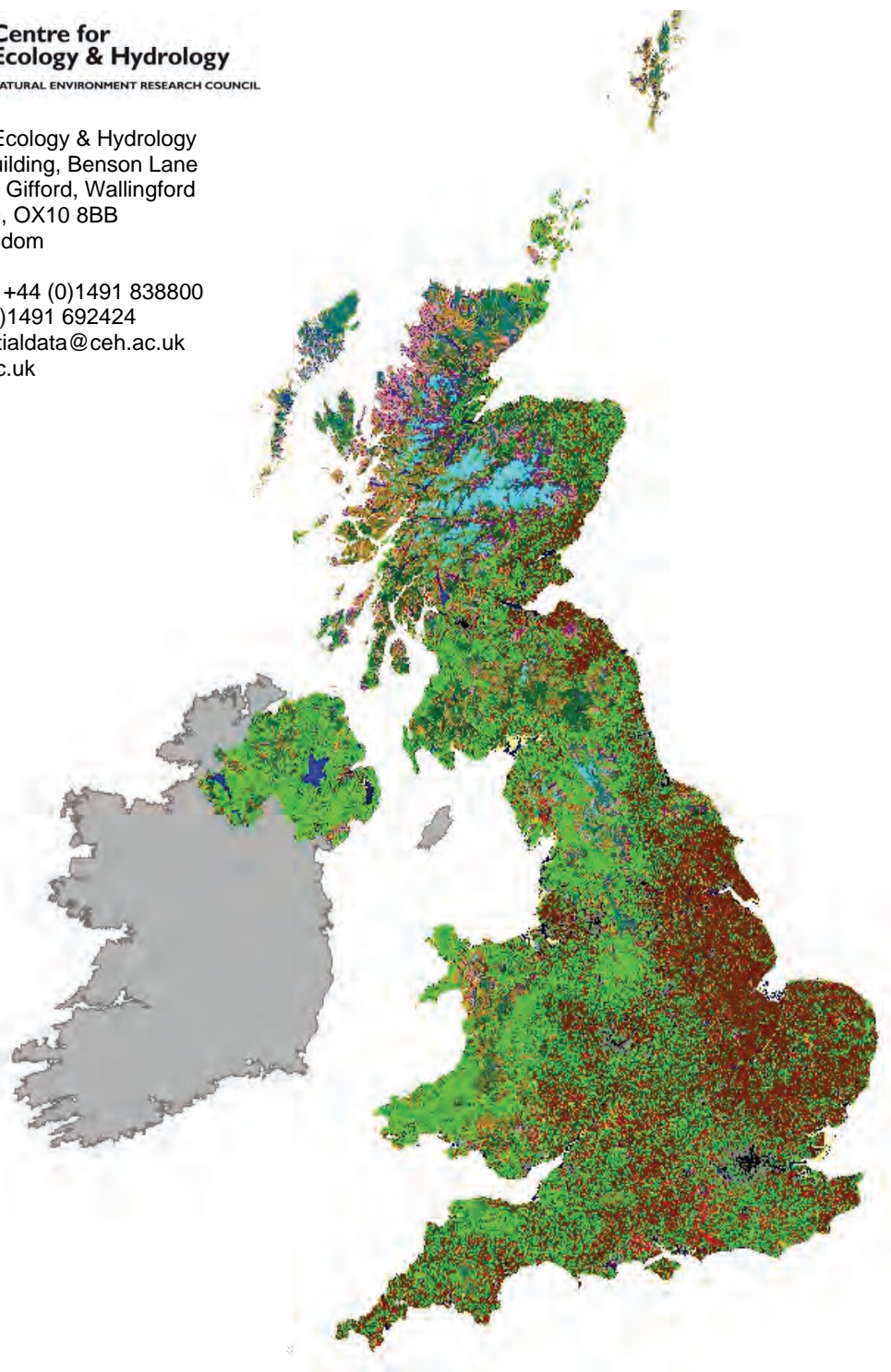
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Land Cover Map 2007 Dataset documentation

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Please note: LCM2007 is a complex data set.

To help get the most from your use of the data and guard against any inappropriate use it is important that you familiarise yourself with the production methodology, the associated metadata and the inherent limitations of the different LCM2007 data products as described in the Final Report for LCM2007.

Introduction

Land Cover Map 2007 (LCM2007) is provided as a range of data products to support the diverse requirements of the LCM user community. This report provides a brief introduction to the LCM2007 data sets for users and those considering whether LCM2007 fulfils their data needs. Although the LCM2007 data products are described here it is highly recommended that the final report should be consulted for a more comprehensive description and assessment of LCM2007 (Morton *et al.*, 2011).

Please note, this documentation only covers LCM2007 data products, for details about LCM2000 and LCM1990 products please ensure you refer to the appropriate dataset documentation.

Background

Land Cover Map 2007 is a parcel-based classification of UK land cover. It uses 23 classes to map the UK, which are based on the UK Biodiversity Action Plan (BAP) Broad Habitats. LCM2007 is created by classifying summer-winter composite images captured by satellite sensors with 20-30m pixels. LCM2007 updates and upgrades LCM2000, with the key improvement being the use of a spatial framework based on generalised digital cartography (Ordnance Survey MasterMap topographic layer (OSMM) for GB and Land & Property Services Large-scale Vector for Northern Ireland), refined with image segments (see Morton *et al.*, 2011 for details). LCM2007 is consequently constructed from polygons that clearly represent real-world objects, such as fields and blocks of woodland. This enhances its compatibility with many GIS data sets.

LCM2007 product specification

LCM2007 maps land cover (not land use)

LCM2007 maps **land cover** and whilst this may be synonymous with **land use** it will not be in all cases. For example, an arable crop cover denotes arable land use, but often land use cannot be inferred, as, for example, grass used for recreation looks very similar to that which is grazed.

LCM2007 sets a minimum mappable area of >0.5 ha

Parcels less than 0.5ha and linear features less than 20m were dissolved into the surrounding landscape during the production process.

LCM2007 classes

LCM2007 maps 23 classes (Table 1), which are based on the UK's terrestrial Broad Habitats (Jackson *et al.*, 2000). In some cases, the Broad Habitats can be reliably divided further, based on their spectral signatures, so the:

- 'Built-up Areas and Gardens' Broad habitat is divided into 'Suburban' and 'Urban' classes.

- '*Dwarf Shrub Heath*' is divided into 'Heather' and 'Heather grassland' classes.
- '*Littoral Sediment*' Broad Habitat is divided into 'Littoral sediment' and 'Saltmarsh' (a Priority Habitat).

LCM2007 is validated at the thematic resolution of the 23 LCM2007 classes. This is the highest thematic resolution at which it is recommended the data is used.

LCM2007 has unique object labelling

During the production process each parcel is given a unique label which is stored in the Parcel_ID attribute. All users of the LCM2007 vector products will receive data containing this attribute. It is recommended that the Parcel_ID attribute is retained within the LCM2007 data set and any developments of it. This will allow unambiguous communication between LCM2007 users.

LCM2007 has rich metadata

During the production of LCM2007, like LCM2000 before it, information about processing has been retained where possible. The LCM2007 vector data set therefore has a rich set of metadata for each polygon. The polygon attributes provide a record of the data sets involved in polygon construction, the Knowledge-based enhancements (KBE) applied to the polygon and a probability list showing the top 5 spectral classes for the polygon.

LCM2007 validation using ground reference data

Ground reference data were collected to enable the validation of LCM2007 against a set of data designed to match the spatial and thematic resolution of LCM2007. This allowed LCM2007 to be compared against 9127 ground reference polygons producing an average accuracy of 83%.

Please note: The accuracy above represents the average accuracy and so represents a combination of higher and lower accuracy figures. Local discrepancies may be observed which appear to suggest higher or lower accuracy rates: this is to be expected.

LCM2007 product overview

LCM2007, like LCM1990 and LCM2000, is distributed in a range of data formats and at a range of thematic and spatial resolutions. This range of products is required to support a wide range of potential applications. Figure 1 shows a breakdown of the different products and their respective spatial and thematic resolutions.

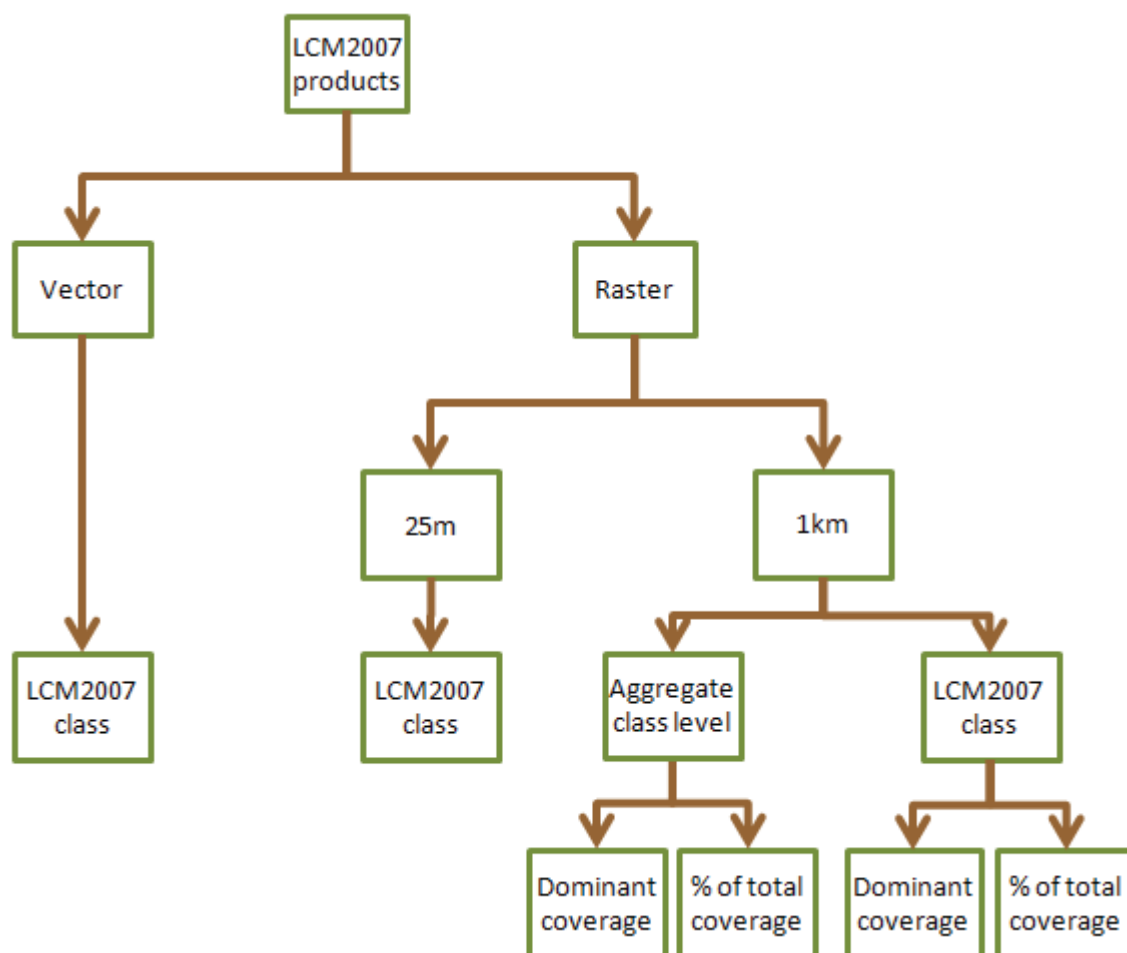


Figure 1. Diagram to show the available LCM2007 data products.

Example datasets

Figure 2 shows some examples of the data sets available for Land Cover Map 2007 and illustrates the level of detail associated with each product. Spatially the vector data set and the 25m raster data set are quite similar, however, the advantage of the vector data set is that each polygon has a set of metadata attached. The disadvantage of the vector is that this increases the file size and may make processing unwieldy for some applications/users. The 25m raster data set maybe useful in such circumstances, as it provides the same land cover detail, but without the additional metadata information and polygon boundaries; this is more appropriate for some applications. The 1km data sets are typically more appropriate for applications modelling the whole of the UK and are often combined with additional data sets, such as meteorological data set or species distribution data. By way of an example, the Broadleaved woodland percentage land cover 1km raster product is shown in Figure 3 - it shows the distribution of broadleaved woodland across the UK. It is created by calculating the percentage of the 1km square covered by Broadleaved woodland in the 25m raster data set.

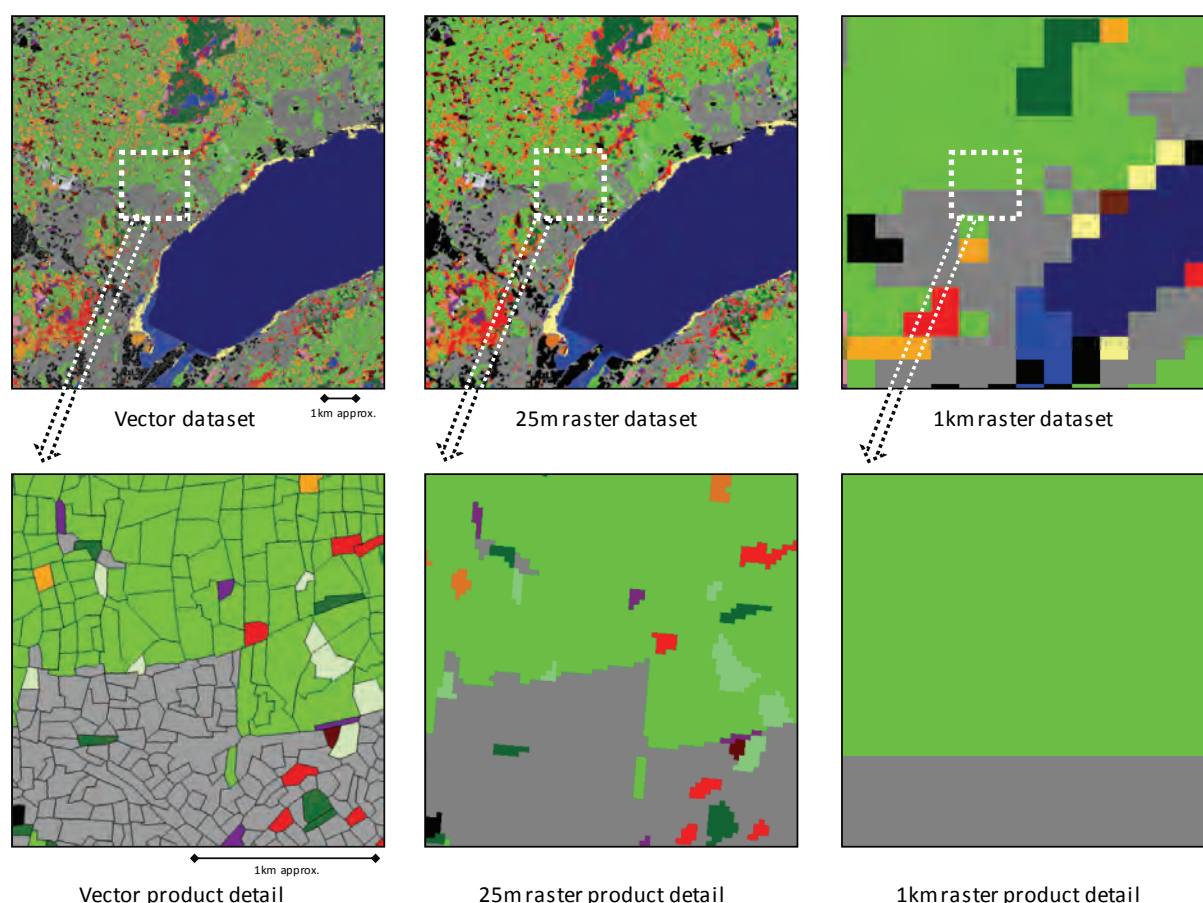


Figure 2. Comparison of level of detail in the vector data set, 25m raster data set and 1km dominant cover raster data set. © NERC (CEH) 2011. © Crown Copyright 2007. Ordnance Survey Licence number 100017572. © third-party licensors.

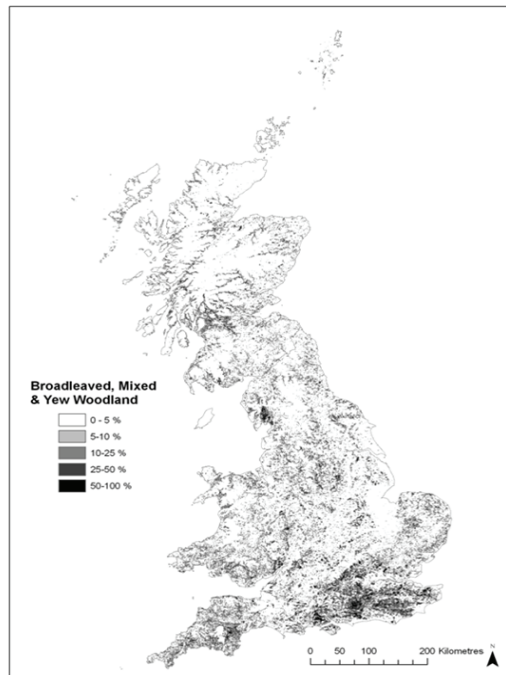


Figure 3. Map showing the 1km percentage cover raster product for LCM2007 Broadleaved woodland. © NERC (CEH) 2011. Contains Ordnance Survey data © Crown Copyright 2007, 2009. © third-party licensors.

Vector Data Set

The vector data product is provided as polygons with each one having a list of attributes attached to it. These include its area, source images, Broad Habitat, and processing details, which includes polygon construction, original spectral classification and KBE history (see Table 1). The vector data set contains 8.6 million polygons for Great Britain and 0.9 million for Northern Ireland. LCM2007 contains 10 attributes for each polygon (Table 1).

Note: Broad Habitats sub-classes (BHSub attribute in vector data set: Table 1) and Field Codes (FieldCode attribute in vector data set: Table 1) are included in the vector data set. The BHSub field gives a text description of the FieldCode. Broad Habitat sub-classes are used in the classification process and identify sub-LCM2007 class land cover types. The Broad Habitat sub-classes are aggregated to produce LCM2007 classes (see Appendix 2 for details of groupings). Broad Habitat sub-classes may give additional information, but they are not necessarily recognised with the accuracy or consistency of LCM2007 classes and Broad Habitats. They are included in the data set primarily because they are included in the ProbList attribute (described in Table 1), which gives the probability of the top five spectral classes (named at Broad Habitat sub-class level). It is recommended that users apply their own validation before using data at the Broad Habitat sub-class level if they wish to use it, as it is not covered by the LCM2007 quality assurance.

Table 1. Description of the attributes of the LCM2007 vector data set.

Attribute	Description
Parcel_ID	Unique parcel identifier for each parcel, which includes the satellite image the polygon was derived from. Follows the format: 11853977:c20 where 11853977 is the parcel id and c20 means the polygon came from composite image c20. Image numbers may also begin with an 'i', e.g. i76, which signifies a single-date image. All images are documented in Appendix 2 of Morton <i>et al.</i> , (2011).
BH	Dominant land cover at Broad Habitat level e.g. <i>Coniferous Woodland</i>
BHSub	Broad Habitat sub-class (Appendix 2). Gives a text description of the FieldCode.
FieldCode	Short text string giving field codes. Note field codes are used in the creation of LCM2007, but the accuracy of the product at this level is not assessed. The LCM2007 team recommend that these codes are used only if users perform their own validation on them.
INTCODE	RECOMMENDED FOR DISPLAY. This attribute gives the LCM2007 class as an integer code from 1-23 (see Table 2). Note this is often referred to as LCM2007 class number. It is the class recommended for display and is the class validated by the QA (Morton <i>et al.</i> , 2011). See appendix 3.
KBE	<p>Knowledge-based enhancement (KBE). Descriptor detailing the processing history of each segment including the complete list of KBE's applied and the change instigated by the KBE. The KBE notation follows a standard format of 2 or 3 letters followed by a comma followed by original class and then the new class. E.g.</p> <ul style="list-style-type: none"> SL,Gr->Bg signifies soil correction (SL) changing Rough Grassland to Bog. This would occur when the polygon was on a bog soil, with no, or only slight, slope. ALT,Sd->Gr signifies an altitude based correction (ALT) changing sand dune to Rough Grassland. The change to Rough Grassland would be based on the next spectral class is in the probability listing, as long as it was not a coastal class. <p>KBE identifiers:</p> <ul style="list-style-type: none"> MC - manual correction SL - soil correction CM - coastal mask OM - offshore mask UR - urban mask ALT - altitude correction
ProbList	The probability of the polygon belonging to a spectral variant class. The attribute lists the 5 spectral classes that closest match the spectral signature of the polygon e.g. <i>Gr_d,0.87:Gr_u,0.09:Hga_d,0.04:Gi_n,0.00:Gi_e,0.00</i> (Appendix 2).
CorePixels	Total number of pixels within the core area of the segment used to perform the maximum likelihood classification.
Construct	<p>History of the construction of the polygon,</p> <ul style="list-style-type: none"> OSMM - Polygon derived from generalised OS Master Map data OSMM:SEG - Generalised OS Master Map polygon(s) as basis with additional segmentation OSMM:AGC:SEG - Generalised OS Master Map polygon with agricultural payment boundary vectors and segmentation
TotPixels	Total number of pixels in polygon.

Table 2 Relationship between Aggregate classes, Broad Habitat and LCM2007 classes. Green shading highlights Broad Habitats as documented by JNCC ([Jackson, 2000](#)). ^{1,2} Aggregate class number and LCM2007 class number are used for 1km and 25m raster data sets respectively.

Aggregate class	Aggregate class number ¹	Broad Habitat	LCM2007 class	LCM2007 class number ²
Broadleaf woodland	1	<i>'Broadleaved, Mixed and Yew Woodland'</i>	Broadleaved woodland	1
Coniferous woodland	2	<i>'Coniferous Woodland'</i>	<i>'Coniferous Woodland'</i>	2
Arable	3	<i>'Arable and Horticulture'</i>	<i>'Arable and Horticulture'</i>	3
Improved grassland	4	<i>'Improved Grassland'</i>	<i>'Improved Grassland'</i>	4
Semi-natural grassland	5	Rough Grassland	Rough grassland	5
		<i>'Neutral Grassland'</i>	<i>'Neutral Grassland'</i>	6
		<i>'Calcareous Grassland'</i>	<i>'Calcareous Grassland'</i>	7
		<i>'Acid Grassland'</i>	Acid grassland	8
		<i>'Fen, Marsh and Swamp'</i>	<i>'Fen, Marsh and Swamp'</i>	9
Mountain, heath, bog	6	<i>'Dwarf Shrub Heath'</i>	Heather	10
			Heather grassland	11
		<i>'Bog'</i>	<i>'Bog'</i>	12
		<i>'Montane Habitats'</i>	<i>'Montane Habitats'</i>	13
		<i>'Inland Rock'</i>	<i>'Inland Rock'</i>	14
Saltwater	7	Saltwater	Saltwater	15
Freshwater	8	Freshwater	Freshwater	16
Coastal	9	<i>'Supra-littoral Rock'</i>	<i>'Supra-littoral Rock'</i>	17
		<i>'Supra-littoral Sediment'</i>	<i>'Supra-littoral Sediment'</i>	18
		<i>'Littoral Rock'</i>	<i>'Littoral Rock'</i>	19
		<i>'Littoral Sediment'</i>	Littoral sediment	20
			Saltmarsh	21
Built-up areas and gardens	10	<i>'Built-up Areas and Gardens'</i>	Urban	22
			Suburban	23

Raster Data Sets

The raster data have been derived from the vector dataset to produce a 25m and 1km product. Great Britain and Northern Ireland are provided in separate data sets to allow for their different projections. Not all applications need the thematic resolution of the complete set of LCM2007 classes, so LCM2007 has a defined set of Aggregate classes, based on merging LCM2007 classes (Table 2). The Aggregate classes are used for the 1km raster products.

25m raster: Consisting of 23 LCM2007 Classes. The relationship between pixel value and corresponding LCM2007 class is shown in Table 2, with detail on the extent of the data set and other metadata in Table 3.

1km raster: The 1km products for LCM2007 were created by summarising the LCM2007 25m raster data set to produce percentage cover for each class and to identify the dominant (most widespread) class in each 1km pixel (Table 3). The products at 1km are:

- Dominant cover at 1km for LCM2007 classes.
- Dominant cover at 1km for LCM2007 Aggregate classes.
- Percentage cover at 1km for LCM2007 classes.
- Percentage cover at 1km for LCM2007 Aggregate classes.

Table 3. Metadata information for the LCM2007 25m and 1km raster data sets.

	Great Britain		Northern Ireland	
Pixel size	25m	1km	25m	1km
Columns / Width (pixels)	28000	700	7800	200
Rows / Height (pixels)	52000	1300	6200	220
Lower left easting (m)	0	0	180000	180000
Lower left northing (m)	0	0	280000	280000
Pixel size (m)	25	1000	25	1000
Data type	Unsigned 8-bit			
Coordinate system	British National Grid		Irish National Grid	
Projection	Transverse Mercator		Transverse Mercator	
Spheroid	Airy		Airy Modified 1849	
Datum	OSGB 1936		Ireland 1965	

Note: Different software packages define coordinates from different parts of the pixel. The values in Table 3 refer to the south-west corner of the lower left pixel.

Map projection

The LCM2007 vector and raster data sets for Great Britain and Northern Ireland data sets are in the British National Grid and Irish National Grid projections respectively (see Table 3 for details). Northern Ireland is in the process of switching over to the new Ireland Transverse Mercator (ITM) projection and GIS packages should be able to reproject the LCM2007 NI data to this projection if required.

File size

The vector data set contains almost 10 million polygons and each polygon has 10 attributes so consequently file sizes are large and this should be taken into account when using LCM2007. The following file sizes are given for guidance (as file sizes will vary with format, which in turn may vary depending on how the data is accessed). The raster file sizes are for the geotiff format.

Vector in 100km x 100km (shapefile):

- GB : 4.13GB
- NI : 433MB

Raster 25m:

- GB : 1.36GB
- NI : 46MB

The 1km products range from 21MB (percentage cover for the 23 Land Cover classes) to 49KB (dominant cover).

Data Access

The LCM2007 1km raster data sets are available via the CEH Information Gateway <https://gateway.ceh.ac.uk>

The full vector product and 25m product are available under licence on request from CEH. Please complete the online application on the CEH web site [www.ceh.ac.uk/data] or contact spatialdata@ceh.ac.uk for further details. Please note that licence fees may apply for some users and some applications.

Further Information

For further information on LCM2007:

Morton, D., Rowland, C., Wood, C., Meek, L., Marston, C., Smith, G., Wadsworth, R., Simpson, I.C., (2011) *Final Report for LCM2007 - the new UK Land Cover Map*. Countryside Survey Technical Report No. 11/07 NERC/Centre for Ecology & Hydrology 112pp. (CEH Project Number: C03259).

For a detailed description of the Broad Habitat Classification:

Jackson D.L., (2000), *Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other classifications*, JNCC Report 307, 73 pages, ISSN 0963 8091 (available online at: <http://www.jncc.gov.uk/page-2433>).

Appendix 1. LCM2007 Classes

LCM2007 class	Brief Review
Broadleaved woodland	<p>Broadleaved woodlands are characterised by stands >5 m high with tree cover >20%; scrub (<5 m) requires cover >30% for inclusion in this BH. Such fine distinctions cannot be made through remote sensing. Open-canopy woodland (stands with trees <50%) is a particular problem, albeit occurring relatively rarely, and may not often be mapped consistently, due to the dominance of the non-woodland plants. Stands with near-closed canopies can be interpreted easily in the field and pure examples can normally be found for training the classifier. Broadleaved evergreen trees (part of this BH) rarely occur in stands >1ha (an area large enough to create suitable training areas appropriate for classification). Mixed woodland (with >20% broadleaved trees) was trained separately. Where individual stands of broad-leaved or evergreen trees exceeded the minimum mappable unit, they were treated as separate blocks within the woodland; in many parts of the UK, truly 'mixed woodlands' as opposed to those with mosaic-blocks of broadleaved and coniferous trees, are unusual.</p>
'Coniferous Woodland'	<p>'Coniferous Woodland' includes semi-natural stands and plantations, with cover >20%. The recognition of coniferous woodland is generally straightforward. Rare examples of open canopy semi-natural pinewoods may have been classified according to the dominant understorey class. The BH includes new plantation and recently felled areas (this is a class where the BH definition is based on land use, i.e. forestry, rather than cover). New plantations, predominantly heather and/or grass, for example, are recorded as such by the spectral classification of image data. New plantations are only consistently recorded as conifers when tree cover is sufficient to strongly influence the reflectance. LCM2007 includes newly felled areas. Once they are fully recolonised by rough grass, heath or scrub, they are recorded according to that cover. Deciduous larch is discernible from other deciduous trees and is generally correctly included with other conifers.</p>
'Arable and Horticulture'	<p>This Broad Habitat includes annual crops, perennial crops such as berries and orchards and freshly ploughed land. Orchards with a ground flora are hard to distinguish.</p>
'Improved Grassland'	<p>Improved grassland is distinguished from semi-natural grasslands based on its higher productivity, lack of winter senescence and location and/or context. In some cases heavy grazing can cause misclassification with semi-natural grassland, or even arable land.</p> <p>Some confusion occurs between 'Improved Grassland' and 'Calcareous Grassland' and 'Neutral Grassland', as 'Calcareous Grassland' and 'Neutral Grassland' are often very productive grassland and so spectrally very similar to 'Improved Grassland'.</p>

'Neutral Grassland'	<p>In the production of LCM2007 grassland is mapped by classifying images into '<i>Improved Grassland</i>' and Rough grassland. The knowledge-based enhancement rules determine whether Rough grassland should be reclassified as '<i>Neutral Grassland</i>', '<i>Calcareous Grassland</i>' or '<i>Acid Grassland</i>', or whether it should remain as Rough grassland.</p> <p>In the field '<i>Neutral Grassland</i>' is determined based on botanical composition and it also includes semi-improved grasslands managed for silage, hay or pasture (Jackson, 2000), which in LCM2007 will often be classified as '<i>Improved Grassland</i>'.</p>
'Calcareous Grassland'	<i>The same methods apply as for 'Neutral Grassland' (see above).</i>
'Acid Grassland'	<p><i>The same methods apply as for 'Neutral Grassland' (see above).</i></p> <p>Bracken can be mapped using LCM2007 methods, but it depends on image timing and suitable training areas (bracken often fails to offer stands sufficiently extensive for classification and training), so for consistency it is assigned to '<i>Acid Grassland</i>'. However, some stands of bracken can be identified at the subclass level.</p>
Rough grassland	<p>The knowledge-based enhancement rules determine whether Rough grassland should be reclassified as '<i>Neutral Grassland</i>', '<i>Calcareous Grassland</i>' or '<i>Acid Grassland</i>', or whether it should remain as Rough grassland. The grass that remains as Rough grassland is therefore a mix of areas of managed, low productivity grassland, plus some areas of semi-natural grassland, which could not be assigned Neutral, Calcareous or Acid grassland with confidence by the knowledge-based enhancements.</p>
Note about grassland classes	<p>The comparisons between LCM2007 and other data sets (the ground reference polygons and Countryside Survey in 2007 Broad Habitat maps) (Morton <i>et al.</i>, 2011), showed that '<i>Neutral Grassland</i>' and '<i>Calcareous Grassland</i>' were often mis-classified as '<i>Improved Grassland</i>'. Users requiring '<i>Neutral Grassland</i>' and '<i>Calcareous Grassland</i>' should read Section 3.9 and Chapter 4 of the LCM2007 final report (Morton <i>et al.</i>, 2011). Other users may wish to aggregate the grassland classes together, if appropriate to their needs.</p>
<p>'Heather' and 'Heather grassland'</p> <p>(together form the '<i>Dwarf Shrub Heath</i>' Broad Habitat)</p>	<p><i>'Dwarf Shrub Heath'</i> is divided into two classes, depending on the density of Heather, producing 'Heather' and 'Heather grassland' classes respectively. This is similar to LCM1990's and LCM2000s Open and Dense Shrub Heath classes.</p> <p>Note: comparing LCM2007 to other data sets (ground reference data set (Section 3.9 of Morton <i>et al.</i>, 2011) and Countryside Survey in 2007 (Chapter 4 of Morton <i>et al.</i>, 2011)) shows confusion over the separation of '<i>Bog</i>' and '<i>Dwarf Shrub Heath</i>', however, this only affects the separation of these two BHs and they are often difficult to separate in the field.</p> <p>Note, the Broad Habitat classification treats ericaceous vegetation on peat > 0.5 m depth as '<i>Bog</i>'. A soil map showing peat-soils is used to distinguish heaths from ericaceous bogs.</p>

<i>'Fen, Marsh and Swamp'</i>	<i>'Fen, Marsh and Swamp'</i> includes fen, fen meadows, rush pasture, swamp, flushes and springs. From a remote sensing perspective <i>'Fen, Marsh and Swamp'</i> is problematic as it can be comprised of a wide range of land cover types and many patches of Fen are below the LCM2007 MMU. The small size of <i>'Fen, Marsh and Swamp'</i> patches, plus their typically mosaic nature make it difficult to find representative areas of sufficient size to conduct a spectral classification. Soil data is of limited use in assisting as it shows the historical land cover, so large swathes of East Anglia have a peaty, fen soil, but subsequent drainage and management have changed them to arable.
<i>'Bog'</i>	<i>'Bog'</i> includes ericaceous, herbaceous and mossy swards in areas with a peat depth > 0.5 m. <i>'Bog'</i> forms part of an ecological continuum covering <i>'Acid Grassland'</i> , <i>'Dwarf Shrub Heath'</i> and some types of <i>'Fen, Marsh and Swamp'</i> and the separation of these habitats can be difficult, as the surface vegetation (i.e. land cover) maybe very similar and the division rests on the depth of peat. The division in the field can account for species presence, plus peat depth, but for LCM2007 the division is based on soil data sets.
Saltwater	Saltwater is mapped to a limited extent around the coastline of the UK.
Freshwater	This is based on merging two freshwater BHs (<i>'Standing Open Water and Canals'</i> and <i>'Rivers and Streams'</i>), as they cannot be reliably separated from each other using the methods and data used for LCM2007. In many cases small and/or narrow water bodies fall below the MMU. Water bodies > 0.5 ha are readily mapped, as are very wide rivers (>50 m).
<i>'Montane Habitats'</i>	The montane distribution for LCM2007 is assigned based on altitude (see Section 3.7 of Morton <i>et al.</i> , 2011), whereas the Broad Habitat definition is based on vegetation type. The Broad Habitat definitions produced by JNCC note (Jackson, 2000) that if other habitats, such as <i>'Calcareous Grassland'</i> and <i>'Bog'</i> , occur within the <i>'Montane Habitats'</i> zone they should not be recorded as <i>'Montane Habitats'</i> . In the production of LCM2007 it was not possible to determine whether a <i>'Montane Habitats'</i> reclassification based on altitude has greater validity than the original spectral classification. This should be taken into account by users interested specifically in the <i>'Montane Habitats'</i> class. LCM2007 above the montane altitude LCM2007 maps three Broad habitats: <i>'Montane Habitats'</i> , Freshwater and <i>'Inland Rock'</i> .
<i>'Inland Rock'</i>	This Broad Habitat type covers both natural and artificial exposed rock surfaces which are >0.25ha, such as inland cliffs, caves, screes and limestone pavements, as well as various forms of excavations and waste tips such as quarries and quarry waste. To be classified as <i>'Inland Rock'</i> the rock has to be the dominant spectral signature.
<i>'Urban' and 'Suburban'</i> (together form the <i>'Built-up</i>	Within the <i>'Built-up Areas and Gardens'</i> Broad Habitat LCM2007 recognises two categories that can be determined reliably: <i>'Urban'</i> and <i>'Suburban'</i> . <i>'Urban'</i> includes dense urban, such as town and city centres, where there is typically little vegetation. <i>'Urban'</i> also includes areas such as dock sides, car parks and industrial estates.

Areas and Gardens' Broad Habitat)	'Suburban' includes suburban areas where the spectral signature is a mix of urban and vegetation signatures.
'Supra-littoral Rock'	Features that may be present in this coastal class include vertical rock, boulders, gullies, ledges and pools. Very limited areas are mappable using satellite remote sensing.
'Supra-littoral Sediment'	This class includes sand-dunes, which are reliably mapped in this class. Areas of coastal sand may be confused between this class and the 'Littoral sediment' class.
'Littoral Rock'	These classes are those in the maritime mask zone on a rocky coastline. They are generally more extensive than supra-littoral rock and thus more readily mappable from satellite images.
'Littoral sediment' and 'Saltmarsh' (together form the 'Littoral Sediment' Broad Habitat)	Littoral sediment is mapped as two classes: 'Saltmarsh' and 'Littoral sediment'. Saltmarsh is a Priority Habitat and of sufficient extent and spectral distinction to be mapped consistently. The remaining 'Littoral Sediment' is mapped spectrally, although there maybe some confusion with the 'Supra-littoral sediment' class.

Appendix 2: Relationship between Broad Habitats, LCM2007 classes and Broad Habitat sub-classes for LCM2007.

Broad habitat	LCM2007 class	LCM2007 class number	Broad Habitat sub-class	Broad habitat sub-class code (called FieldCode in LCM2007 vector)
'Broadleaved, Mixed and Yew Woodland'	Broadleaved woodland	1	Deciduous	D
			Recent (<10yrs)	Dn
			Mixed	M
			Scrub	Sc
'Coniferous Woodland'	'Coniferous Woodland'	2	Conifer	C
			Larch	Cl
			Recent (<10yrs)	Cn
			Evergreen	E
			Felled	Fd
'Arable and Horticulture'	'Arable and Horticulture'	3	Arable bare	Aba
			Arable Unknown	Aun
			Unknown non-cereal	Aun
			Orchard	O
			Arable barley	Aba
			Arable wheat	Aw
'Improved Grassland'	'Improved Grassland'	4	Arable stubble	Ast
			Improved grassland	Gi
			Ley	Gl
			Hay	Gh
	Rough Grassland	5	Rough / unmanaged grassland	Gr
'Neutral Grassland'	'Neutral Grassland'	6	Neutral	Gn
'Calcareous Grassland'	'Calcareous Grassland'	7	Calcareous	Gc
'Acid Grassland'	Acid Grassland	8	Acid	Ga
			Bracken	Br
'Fen, Marsh and Swamp'	'Fen, Marsh and Swamp'	9	Fen / swamp	F
'Dwarf Shrub Heath'	Heather	10	Heather & dwarf shrub	H
			Burnt heather	Hb
			Gorse	Hg
			Dry heath	Hd
	Heather grassland	11	Heather grass	Hga
'Bog'	'Bog'	12	Bog	Bo
			Blanket bog	Bb
			Bog (Grass dom.)	Bg
			Bog (Heather dom.)	Bh
'Montane Habitats'	'Montane Habitats'	13	Montane habitats	Z
'Inland Rock'	'Inland Rock'	14	Inland rock	Ib
			Despoiled land	Ud
Salt water	Salt water	15	Water sea	Ws
			Water estuary	We
Freshwater	Freshwater	16	Water flooded	Wf
			Water lake	Wl
			Water River	Wr
'Supra-littoral Rock'	'Supra-littoral Rock'	17	Supra littoral rocks	Sr
'Supra-littoral Sediment'	'Supra-littoral Sediment'	18	Sand dune	Sd
			Sand dune with shrubs	Sds
			Shingle	Sh
			Shingle vegetated	Shv
'Littoral Rock'	'Littoral Rock'	19	Littoral rock	Lr
			Littoral rock / algae	Lra
'Littoral Sediment'	Littoral sediment	20	Littoral mud	Lm
			Littoral mud / algae	Lma
			Littoral sand	Ls
			Saltmarsh	Sm
	Saltmarsh	21	Saltmarsh grazing	Smg
'Built-up Areas and Gardens'	Urban	22	Bare	Ba
			Urban	U
			Urban industrial	Ui
	Suburban	23	Urban suburban	Us

Appendix 3: Recipe for standard LCM2007 colour mapping (as used in the LCM2007 Final Report (Morton *et al.*, 2011)).

LCM2007 class	LCM2007class number	Red	Green	Blue
Broadleaved woodland	1	255	0	0
<i>'Coniferous Woodland'</i>	2	0	102	0
<i>'Arable and Horticulture'</i>	3	115	38	0
<i>'Improved Grassland'</i>	4	0	255	0
Rough grassland	5	250	170	0
<i>'Neutral Grassland'</i>	6	127	229	127
<i>'Calcareous Grassland'</i>	7	112	168	0
Acid grassland	8	153	129	0
<i>'Fen, Marsh and Swamp'</i>	9	255	255	0
Heather	10	128	26	128
Heather grassland	11	230	140	166
<i>'Bog'</i>	12	0	128	115
<i>'Montane Habitats'</i>	13	0	255	255
<i>'Inland Rock'</i>	14	210	210	255
Saltwater	15	0	0	128
Freshwater	16	0	0	255
<i>'Supra-littoral Rock'</i>	17	204	179	0
<i>'Supra-littoral Sediment'</i>	18	204	179	0
<i>'Littoral Rock'</i>	19	255	255	128
Littoral sediment	20	255	255	128
Saltmarsh	21	128	128	255
Urban	22	0	0	0
Suburban	23	128	128	128

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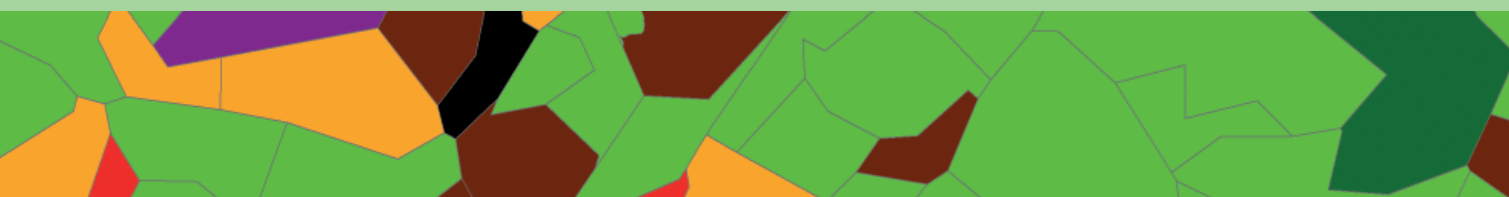
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