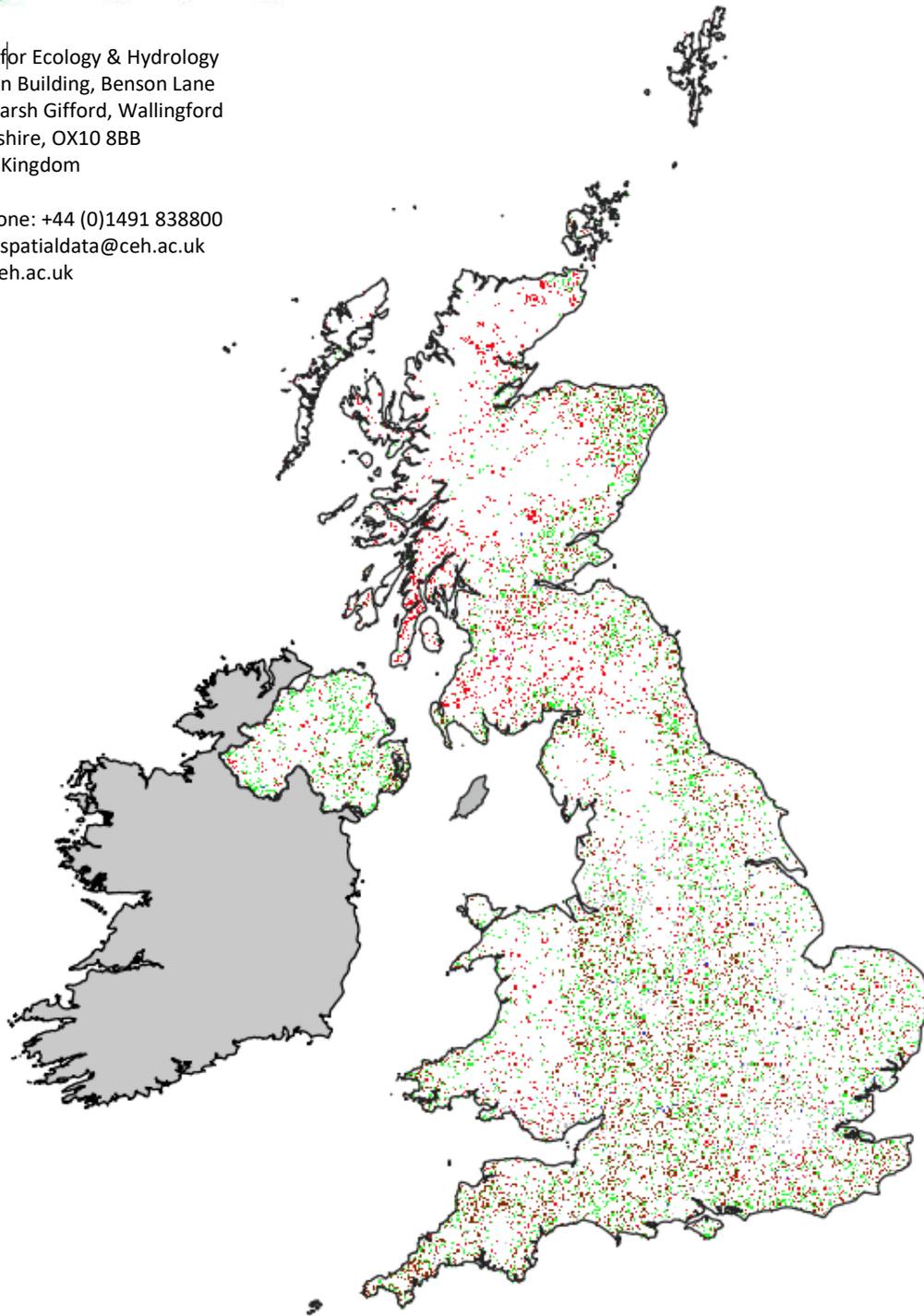UK Centre for
Ecology & Hydrology

Centre for Ecology & Hydrology
Maclean Building, Benson Lane
Crowmarsh Gifford, Wallingford
Oxfordshire, OX10 8BB
United Kingdom

Telephone: +44 (0)1491 838800
Email: spatialdata@ceh.ac.uk
www.ceh.ac.uk

Land Cover Change 1990-2015

Dataset documentation

Version 1.0, 02/07/2020

Version	Date	Updates
1.0	02/07/2020	Original release

Contents

To help get the most from this data and to guard against inappropriate use it is important that you familiarise yourself with the information in this document.

Introduction

Land Cover Change 1990 - 2015 is provided as a 5-band, 25m raster data set. This report provides a brief introduction to key aspects of the Land Cover change data set for users and potential users.

This document only covers the Land Cover Change data set, for details about the Land Cover Maps please consult the appropriate dataset documents.

Land Cover Change product

The Land Cover Change 1990-2015 (LCC1990_2015) data set is produced from simplified versions of LCM1990 (Rowland et al., 2020a, b) and LCM2015 (Rowland et al., 2017a, b). LCM1990 and LCM2015 were produced with consistent methods to facilitate the change mapping. The revised version of LCM1990 was created especially to enable the creation of this 25 year change data set.

Data Structure

The Land Cover Change data set is distributed as a 5-band raster (Table 1), with bands 1 and 2 being versions of LCM1990 and LCM2015 in 6 simplified land cover classes (Table 2). Band 3 is a binary change layer. Bands 4 and 5 show the areas undergoing change, with band 4 showing the 'change from' class and band 5 the 'change to' class.

The format of the data is designed to support two principal modes of use:
- Bands 1 and 2 (Figure 1a, b) provide a complete spatial coverage of the UK and are designed to be used as inputs to models. The difference in the 1990 and 2015 output will then reflect the change between 1990 and 2015.
- Alternatively, bands 3-5 (Figure 1c, d, e) provide a partial spatial coverage as they map only areas where change has occurred, so are appropriate for analyses that only need to quantify the areas, locations and types of these changes.

Figures 1 provides an illustration of the five bands available in the Land Cover Change data.

Table 1: Structure of the 5-band raster data set.

Band	Details
Band 1	**Simplified classes for 1990 -** LCM1990 cast into the 6 classes used by the change product (see Table 2 for classes and Table 4 for conversion).
Band 2	**Simplified classes for 2015 –** LCM2015 cast into the 6 classes used by the change product (see Table 2 for classes and Table 4 for conversion).
Band 3	**Binary change layer** (values 0 or 1) Zero represents no change between the two dates. One shows a change has occurred between the two dates.
Band 4	**'Change from' class** – only mapped for areas undergoing change. It shows what the area was in 1990 **before the change occurred**. Values are 0-6 (see Table 2 for details of classes).
Band 5	**'Change to' class** – only mapped for areas undergoing change. It shows what the area was in 2015 **after the change had occurred**. Values are 0-6 (see Table 2 for details of classes).

Table 2: Class names and numbers for the Land Cover Change data set (see Table 4 mapping between standard LCM classes and the simplified classes). For bands 1-3 zero denotes areas not undergoing change.

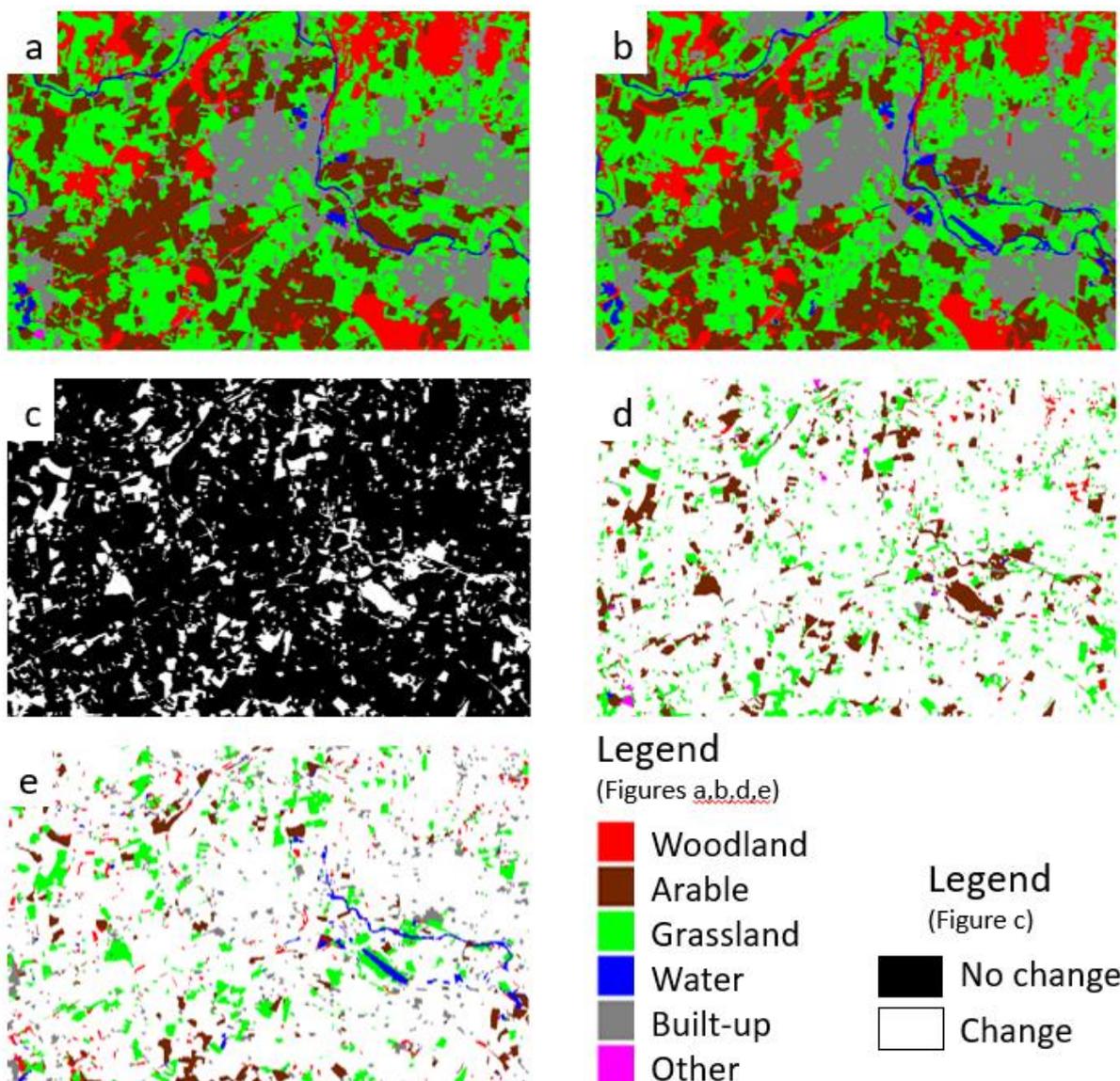| Class number	Class Name
1	Woodland
2	Arable
3	Grassland
4	Freshwater
5	Built-up areas
6	Other

Figure 1. Illustration of each of the 5 bands of the Land Cover Change product, a) band 1: simplified LCM1990; b) band 2: simplified LCM2015 data; c) binary change or no change layer; d) band 4: 'change from' layer; e) band 5: 'change to' layer. © UKCEH 2020.

Corrections applied to the change data set

A preliminary assessment of the difference between LCM1990 and LCM2015 in the simplified classes showed a number of systematic issues. Corrections have been applied for the following issues:

- **Inter-tidal areas** - Due to the structure of the simplified classes, water and inter-tidal zones were classified in different classes, so to avoid wrongly detecting change, changes between these classes were excluded from the change bands (bands 3-5). This correction also addressed the issue of confusion between freshwater and saltwater.

- **Rock/non-rock confusion over 600m** - Similarly, changes from non-rock to rock above 600m were also excluded, using the NextMAP DEM for altitude. This area (mainly in Scotland) was susceptable to errors, because the areas are highly cloudy, suffer from high spectral variability due to topography and also experience high levels of snow cover. This means that the satellite data available to classify them is often limited and of lower quality.

- **River fragments and water bodies**– LCM2015 classified fragments of wider sections of rivers as freshwater. The LCM1990 classifications were less likely to capture these fragments of rivers. Consequently, false positives were detected in band 4 in the 'change to' water data. Because the locations of rivers is known data for GB and NI, river networks were used to identify and then remove these false changes. A number of other water bodies, falsely appearing as 'change to' water, were also manually identified at this stage and masked out.

These corrections were applied to bands 3-5. They were also applied to band 1, to allow bands 1 and 2 to be used as inputs to models, whilst retaining consistency with the change mapped in bands 3-5.

Derivation of the Land Cover Change data set

The LCM data for 1990 and 2015 was cast from their original 21 classes into 6 simplified classes (Table 3). This was done to increase the accuracy with which classes were mapped, increasing the likelihood that the differences mapped are real changes. The aggregation for this first iteration of the change data set uses the six classes in Table 3, where high accuracy can be achieved. These classes are also suitable for the Land-Use and Land Cover Change and Forestry (LULUCF) tracking required for Greenhouse Gas Inventory reporting.

LCM1990 (Rowland et al., 2020a, b) and LCM2015 (Rowland et al., 2017a,b) are both parcel-based land cover maps for the UK, created by classifying satellite data into 21 land cover classes. They have been created with consistent methods to enable change mapping. The standard 21 LCM classes are based on the UK Biodiversity Action Plan Broad Habitat definitions (Jackson, 2000). Further details about LCM1990 and LCM2015 are given in the data set documents for those products.

Table 3: Class names and numbers for aggregate classes for the change product (based on 21 class LCM data).

Class Number	Class Name	Equivalent LCM classes	LCM class numbers
1	Woodland (Forestland)	Broadleaved woodland Coniferous woodland	1,2
2	Arable (Cropland)	Arable and horticulture	3
3	Grassland	Improved Grassland Neutral grassland Calcareous grassland Acid grassland Fen, Marsh and Swamp Heather Heather grassland Bog Supra-littoral sediment Saltmarsh Littoral sediment	4,5,6,7,8,9,10,11,16,18,19
4	Water (Wetlands)	Freshwater	14
5	Built-up areas	Urban Suburban	20,21
6	Other	Inland rock Saltwater Supra-littoral rock Littoral rock	12,13,15,17

Citing Land Cover Change (DOI's)

The Land Cover Change data sets have corresponding DOI's, so the data can be cited in the same way as a journal article (Table 4). Citing the DOI's enables methods to be clear and repeatable as well as enabling better understanding of the level of use of the data and the range of applications supported by the data. DOI's are also increasingly required by scientific journals.

When using the DOI in publications, please include the author(s) and date within the text and the full DOI citation in the references section.

For more information about data citation and DOIs, see http://eidc.ceh.ac.uk/citing-data

Table 4. Digital Object Identifier (DOI) for Land Cover Change products.

Product	DOI
GB 25m raster	Rowland, C.S.; Marston, C.G.; Morton, R.D.; O'Neil, A.W. (2020). Land Cover Change 1990-2015 (25m raster, GB). NERC Environmental Information Data Centre. https://doi.org/10.5285/07b6e5e9-b766-48e5-a28c-5b3e35abecc0
NI 25m raster	Rowland, C.S.; Marston, C.G.; Morton, R.D.; O'Neil, A.W. (2020). Land Cover Change 1990-2015 (25m raster, N. Ireland). NERC Environmental Information Data Centre. https://doi.org/10.5285/a747aa7a-c875-42e1-ac31-984f6571f446

Quality Assurance

The UK CEH Land Cover data sets are created using defined scripts and methods and are created by trained and experienced staff.

A series of QA checks are run against the data sets to ensure that they meet the product specification as described in this document. These include the following: checks that the projections are correct, checks to ensure the products are spatially complete, checks that the five bands are correct, a check that pixel sizes are correct and that the product meets the specification in Table 3.

The Land Cover Map parcel framework, which underpins LCM1990 and LCM2015, is based on 2007 Ordnance Survey Mastermap® data. Field boundary changes are relatively infrequent and so the effect on overall mapping accuracy is quite limited.

A full validation exercise has been carried out in order to assess the accuracy of the maps in comparison to other available datasets (for example the UK CEH Countryside Survey, National Forest Inventory data). The results of this will form a separate publication.

Data Access and Further Information

The data sets are available via the CEH Environmental Information Platform https://eip.ceh.ac.uk/

Great Britain and Northern Ireland are provided in separate data sets to allow for their different projections (see Table 5 for details).

Table 5. Metadata information for the Land Cover Change data set.

	Great Britain	Northern Ireland
Pixel size	**25m**	**25m**
Columns / Width (pixels)	28000	7600
Rows / Height (pixels)	52000	6400
Lower left easting (m)[1]	0	180000
Lower left northing (m)[1]	0	300000
Pixel size (m)	25	25
Data type	Unsigned, uncompressed 8-bit GeoTiff[2]	
Coordinate system	British National Grid	TM75 Irish Grid
EPSG	27700 (https://epsg.io/27700)	29903 (https://epsg.io/29903)

[1]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. [2] The data are distributed as uncompressed GeoTiffs, so file sizes may be reduced considerably by saving them as a format that allows compression.

Queries should be addressed to: spatialdata@ceh.ac.uk

A journal paper is currently in preparation and will contain additional information.

Acknowledgement

References

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, 73pp. ISSN 0963 8091
(available online at: http://www.jncc.gov.uk/page-2433).

Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017a) Land Cover Map 2015 (25m raster, GB). NERC Environmental Information Data Centre. https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7

Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017b). Land Cover Map 2015 (25m raster, N. Ireland). NERC Environmental Information Data Centre. https://doi.org/10.5285/47f053a0-e34f-4534-a843-76f0a0998a2f

Rowland, C.S.; Marston, C.G.; Morton, R.D.; O'Neil, A.W. (2020a). Land Cover Map 1990 (25m raster, GB) v2. NERC Environmental Information Data Centre. https://doi.org/10.5285/1be1912a-916e-42c0-98cc-16460fac00e8

Rowland, C.S.; Marston, C.G.; Morton, R.D.; O'Neil, A.W. (2020b). Land Cover Map 1990 (25m raster, N. Ireland). NERC Environmental Information Data Centre. https://doi.org/10.5285/d446589e-478f-4206-80ed-38a5ff4a7dc0