ESA Climate Change Initiative – Fire_cci
D3.3 Product User Guide (PUG)

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Summary

This document is the version 2.1 of the Product User Guide for the Fire_cci project. It provides practical information about the use of the Fire_cci global burned area products based on the MERIS sensor.

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Document Status Sheet

Issue	Date	Details
1.0	17/09/2013	First Issue
1.1	04/12/2013	Addressing ESA comments according to CCI-FIRE-EOPS-MM-13-0035.pdf
1.2	12/02/2014	Addressing ESA comments according to CCI-FIRE-EOPS-MM-14-0002.pdf
1.3	06/03/2014	Addressing ESA comments according to CCI-FIRE-EOPS-MM-14-0016.pdf
1.4	15/09/2014	Updating to version 3 of the algorithm and product
1.5	15/10/2014	Updating to final products of Fire_cci Phase 1
2.0	05/07/2016	First version corresponding to Phase 2 of Fire_cci.
2.1	13/07/2016	Addressing ESA comments according to CCI-GLCR-EOPS-MM-16-0071.pdf

Document Change Record

Issue	Date	Request	Location	Details
2.0	05/07/2016	UAH	Name Whole document	New naming convention for the document. New format and layout.
2.1	13/07/2016	ESA	Figures 2.3, 2.4 and 2.5	A zoom has been added to the African maps, to improve the presentation of the results.
2.1	13/07/2016	ESA	Sections 1.2, 1.3, 1.4, 2.7, 2.7.1, 2.7.3, 3.3, 3.6.1, 3.6.3, 3.6.5	Minor typographic corrections.
2.1	13/07/2016	ESA	Section 2	A new reference to section 2.7 was added.
2.1	13/07/2016	ESA	Section 2.3	The consistency between the Fire_cci and the LC_cci projection system products was stated.
2.1	13/07/2016	ESA	Sections 3.6.3 and 3.6.5	A title has been added to clarify that some information provided is to serve as recommendations on product use.
2.1	13/07/2016	ESA	Section 4	This section was reformulated, and more information added to it.

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1. General overview

The ESA CCI Programme comprises the generation and provision of different Essential Climate Variables (ECV) on global scale based on long-term satellite data time series. “Fire Disturbance” is deemed as one of these ECVs and is tackled through the Fire_cci project. Burned area (BA) is considered as the primary variable for the Fire Disturbance ECV.

This document contains practical information on how to use the Fire_cci BA v4.1 products, which are based on the Medium Resolution Imaging Spectrometer (MERIS) on board the ESA ENVISAT satellite.

1.1. Introduction

The Fire_cci version 4.1 products comprise maps of global burned area developed and tailored for use by climate, vegetation and atmospheric modellers, as well as by fire researchers or fire managers interested in historical burned patterns.

The Fire_cci project produces two burned area products available at different spatial resolutions, the PIXEL product and the GRID product, which is derived from the pixel one.

1.2. Available data and key features of the MERIS-FRS images

The input images for this BA Fire_cci product are MERIS Full Resolution Full Swath images (MERIS-FRS), acquired by the ENVISAT satellite. Images were acquired approximately every 3 days at the Equator (and more frequently at higher latitudes due to the convergence of orbits), at 0.0027778 degree resolution. The time series covers the period from November 2004 to February 2012 to produce the 2005-2011 BA final product. MERIS reflectances (MER_FSG_1P product) were downloaded at Brockman Consult (http://www.brockmann-consult.de/).

The product was based on pre-processed MERIS reflectance data generated for the Land Cover CCI (LC_cci) project with modifications to obtain daily reflectances instead of weekly composites (http://www.brockmann-consult.de). The modified pre-processing consisted of a completely automated chain performing the following operations: radiometric correction, geometric correction, pixel identification, atmospheric correction with aerosol retrieval, compositing and mosaicking. The quality of the pre-processing products was qualified by its uncertainties, which were included for each band and pixel in all 1-day surface reflectance composites.

To enhance the performance of the BA algorithm, the reflectance data were gridded into 10x10 degree tiles, i.e. 3600 x 3600 pixels at MERIS FRS spatial resolution. These tiles were the input files for all processes of the BA algorithm.

1.3. BA algorithm

The BA algorithm used for producing the final Fire_cci BA product is a hybrid approach, combining information on active fires from the MODIS sensor and temporal changes in reflectance from the MERIS time series. The algorithm is divided in two phases: in the first one the most clearly burned pixels are discriminated as “seed” pixels, while in the second one, a contextual procedure is run to improve the detection of the

whole burned patch. In both phases, 10 x 10 degree tile statistics are computed for each monthly period, to adapt the discrimination thresholds to spatial and temporal variations of burning conditions. Additional information is provided in Alonso-Canas and Chuvieco (2015). The algorithm is described in the Algorithm Theoretical Basis Document (ATBD) which is currently being updated to incorporate changes made in the algorithm since Phase 1 of the Fire_cci project..

1.4. Main improvements introduced from v3.1 to v4.1 of the product

This new version of the Fire_cci BA product (v4.1) includes several improvements with respect to the previously released version (v3.1, produced at the end of Fire_cci Phase 1). The most significant are:

- The time series of the product was expanded, and now covers the period 2005-2011.
- The new version of the algorithm includes pixels that are burned twice in the same year, as it tackles monthly burned pixels. A pixel is considered burned twice in the same year when there is at least a five-month gap between the two dates when the algorithm identified it as burned. Otherwise, it is considered the same burn.
- The spatial resolution of the grid product has been increased from 0.5 to 0.25 degree resolution.
- Changes were made in geographical subsets of the final pixel product, avoiding overlapping subsets. Tile numbers have been changed (see section 2.5).
- Layer 2 of the pixel product (input sensor) was removed, as all input data comes from MERIS in v4.1. The remaining layers were renumbered accordingly (see sections 2.6 and 2.7).
- The land cover classes are now consistent with the LC_cci product.
- Land cover is now dynamic, using two different epochs to estimate the land cover prior to the burn.
- File name conventions were changed to reflect the changes in layers.
- NetCDF-CF metadata fields were improved and clarified.

2. Pixel BA product

The pixel BA product is a GeoTIFF file with three layers indicating the date of detection (Figure 2.1), the confidence level and the land cover in the pixel detected as burned (see Section 2.7 for further detail).

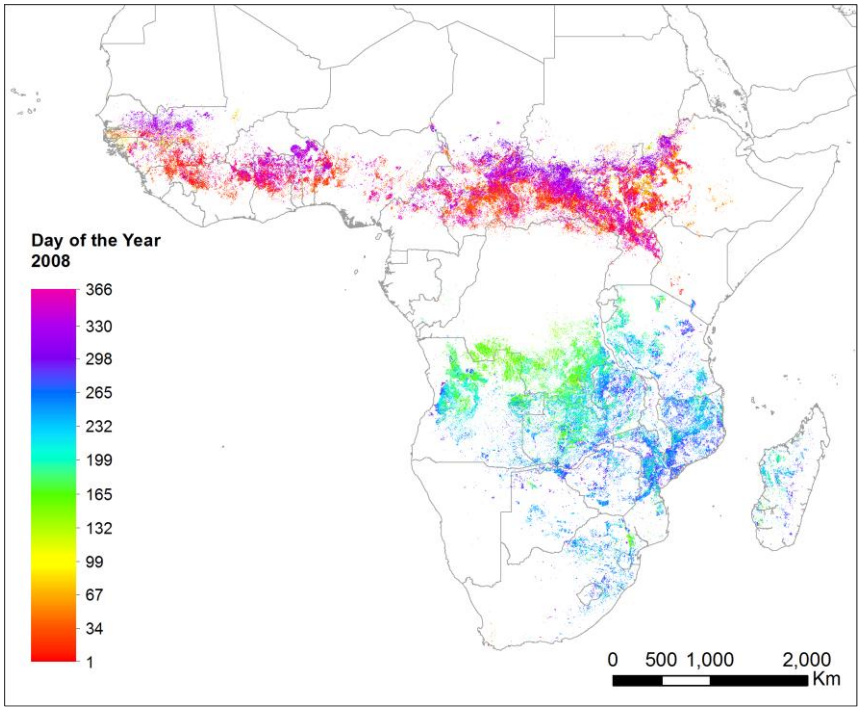

Figure 2.1: Day of detection for Area 5 (Sub-Saharan Africa) for the year 2008, derived from the pixel product.

2.1. Temporal compositing

The pixel products are released as monthly composites as they can tackle those pixels that burn more than once during a calendar year. This may occur in the North Tropical areas, where the dry season commonly occurs between December and February.

2.2. Spatial Resolution

The Spatial resolution of this BA product is 0.00277778 degrees (approximately 300 m at the Equator), the original resolution of MERIS FRS images.

2.3. Product projection system

The Coordinate Reference System (CRS) used for the global BA products is a geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid and using a Plate Carrée projection with geographical coordinates of equal pixel size. It is the same reference system used by the Land Cover CCI product. The coordinates are specified in decimal degrees. Information on product projection, ellipsoid and pixel size is included in the GeoTIFF file header, so every pixel in the file can be geographically referenced without the need of adding specific pixel indicators of geographical position.

2.4. File formats

The product is delivered in GeoTIFF format, and compressed into tar.gz files to reduce downloading file sizes.

2.5. Subsets

The BA product is distributed in continental tiles, following a similar approach to other international projects. All subsets are non-overlapping regions. They cover mostly continental tiles, excluding areas that do not burn or are very small and surrounded by large proportions of water. Figure 2.2 shows the extent of these tiles, which are referenced in Table 1.

Table 1: Geographical distribution of BA tiles for the pixel product

Areas	Name	Upper left		Lower right	
1	North America	180°W	83°N	50°W	19°N
2	South America	105°W	19°N	34°W	57°S
3	Europe –North Africa	26°W	83°N	53°E	25°N
4	Asia	53°E	83°N	180°E	0°N
5	Sub-Saharan Africa	26°W	25°N	53°E	40°S
6	Australia & New Zealand	95°E	0°N	180°E	53°S

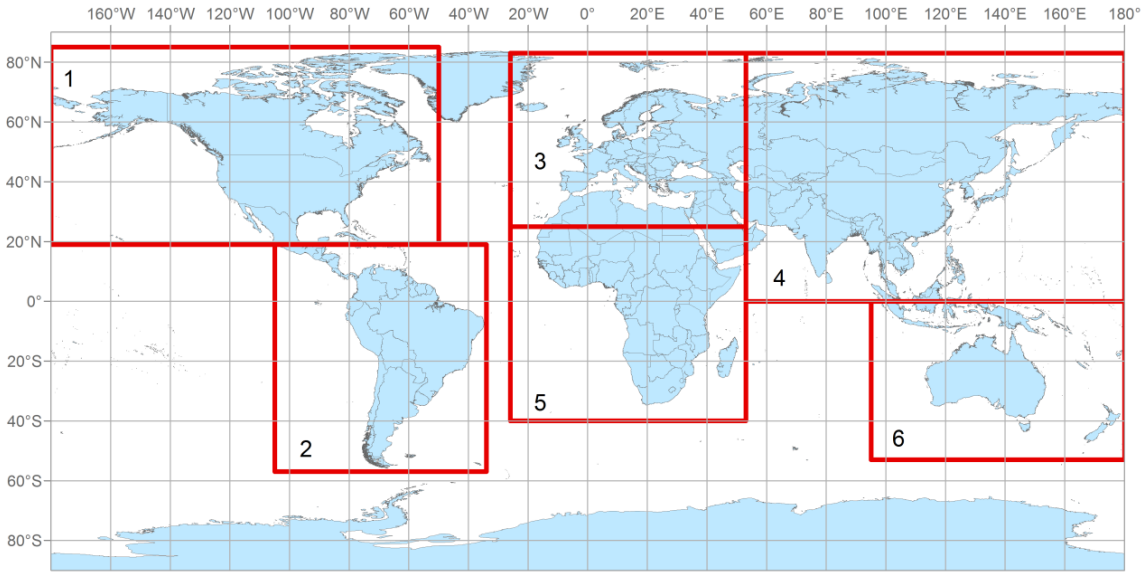

Figure 2.2: Geographical distribution of subsets for the global pixel BA product

2.6. Product file naming conventions

The files for each sensor and month are named as follows:

<Indicative_Date>-ESACCI-L3S_FIRE-BA-<Indicative_sensor>-<Additional_Segregator>-fv<xx.x>.tiff

<Indicative_Date>

The identifying date for this data set:

Format is YYYYMMDD, where YYYY is the four digit year, MM is the two digit month from 01 to 12 and DD is the two digit day of the month from 01 to 31. For monthly products DD=01.

<Indicative_sensor>

In this version of the product it is MERIS.

<Additional_Segregator>

This is AREA_<TILE_NUMBER> being the tile number the subset index described in 2.5. (see Table 1 for more information).

fv<File_Version>

File version number in the form n{1,}[.n{1,}] (That is 1 or more digits followed by optional . and another 1 or more digits). The most recent version is fv04.1.

Example:

20050301-ESACCI-L3S_FIRE-BA-MERIS-AREA_3-fv04.1.tif

20050301-ESACCI-L3S_FIRE-BA-MERIS-AREA_3-fv04.1.xml

2.7. Pixel attributes

The following sub-sections describe each of the layers of the pixel product, including the name of the attributes in the GeoTIFF file, the units of the attributes and the data type, and some information useful for the correct use of the product.

They also include examples of the pixel product layers.

2.7.1. Layer 1: Date of the first detection

Layer	Attribute	Units	Data Type	Notes
1	Date of the first detection – Julian Day	Day of the year, from 1 to 365 (or 366)	Integer	A zero (0) will be included in this field when the pixel is not burned in the month or it is not observed. A pixel value of 999 is allocated to pixels that are not taken into account in the BA processing (continuous water, ocean).

When the pixel is characterized as burned, it is assumed that the complete pixel was burned, as for all burned area products.

The date of the burned pixel may not be coincident with the actual burning date, but most probably taken from one to several days afterwards, depending on image availability and cloud coverage. For areas with low cloud coverage, the detected date of burn should be very close to the actual date of burn, while for equatorial latitudes or those with high cloud coverage the date may be from several days or even weeks after the fire is over.

An example of this layer corresponding to November 2008 for Area 5 is shown in Figure 2.3.

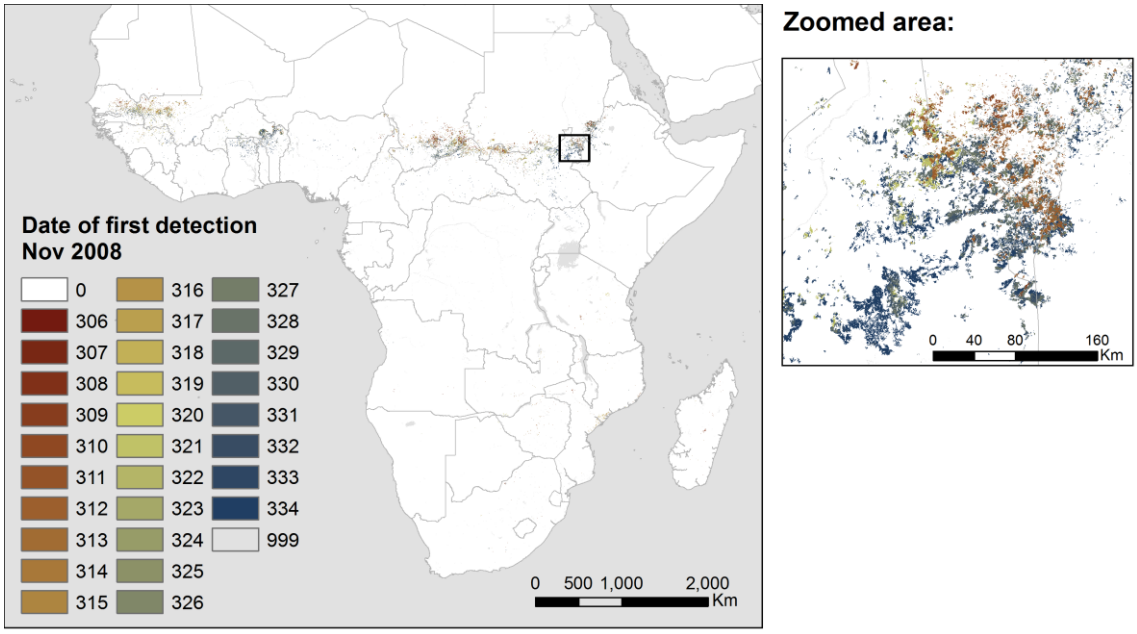

Figure 2.3: Example of the Date of the first detection layer for the 20081101-ESACCI-L3S_FIRE-BA-MERIS-AREA_5-fv04.1.tif file.

2.7.2. Layer 2: Confidence level

Layer	Attribute	Units	Data Type	Notes
2	Confidence level	0 to 100	Integer	This value is a probability value that estimates the confidence that a pixel detected as burned is actually burned, as a result of both the pre-processing and the actual BA classification. The higher the value, the higher the confidence that the pixel is actually burned. A pixel value of 999 is allocated to pixels that are not taken into account in the BA processing (continuous water, ocean).

The confidence level was modelled with a logistic regression model, This model was calibrated with reference data, using as input variables the BA algorithm likelihood and the number of pixels mapped as burned in a 9x9 window (pixels labelled as burned within a large burned patch are usually well mapped). For technical details see ATBD III v2.3 (Tansey et al. 2014).

An example of this layer corresponding to November 2008 for Area 5 is shown in Figure 2.4.

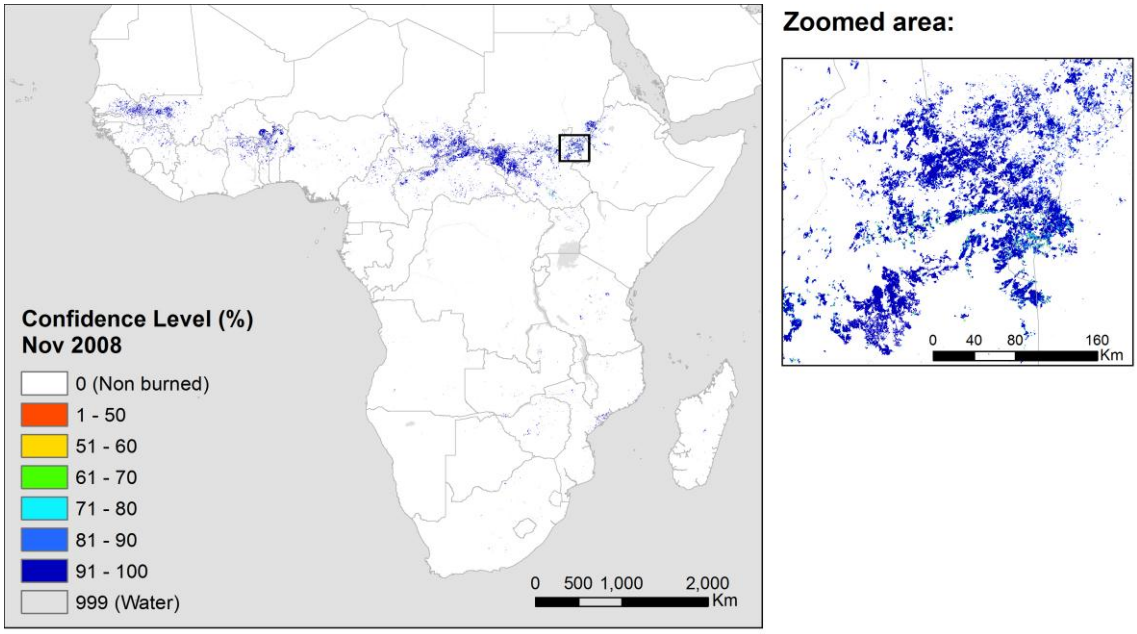

Figure 2.4: Example of the Confidence Level layer for the 20081101-ESACCI-L3S_FIRE-BA-MERIS-AREA_5-fv04.1.tif file.

2.7.3. Layer 3: Land cover of burned pixels

Layer	Attribute	Units	Data Type	Notes
3	LC: Land cover of burned pixels	0 to N	Integer	Land cover of the pixel detected as burned, extracted from the CCI Land Cover maps. N is the number of land cover categories in the reference map. It is only valid when layer 1 > 0. A pixel value of 999 is allocated to pixels that are not taken into account in the BA processing (continuous water, ocean).

It is assumed that there is only one land cover within the pixel, as in most land cover maps. This is a reasonable estimation for homogenous land cover areas, but it may imply errors for heterogeneous landscapes. The basic land cover map is the CCI Land Cover map (see Section 2.8). Obviously, errors included in this map also affect the information contained in the BA product and hence the calculation of emissions using land cover based emissions factors would be affected. The resolution of the land cover and BA products is the same.

An example of this layer corresponding to November 2008 for Area 5 is shown in Figure 2.5.

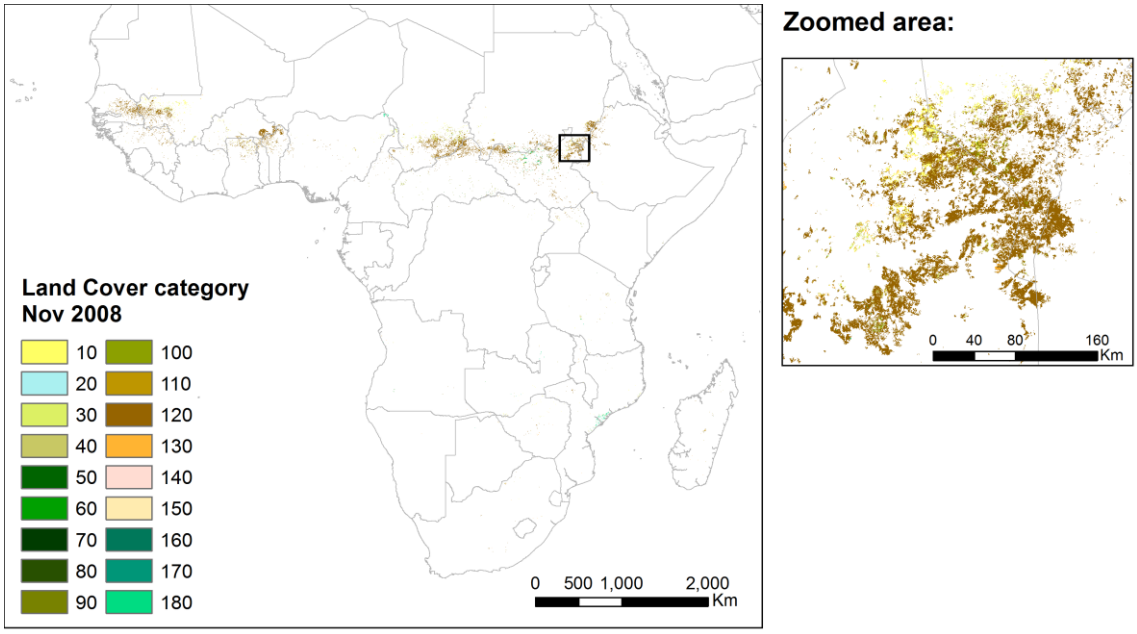

Figure 2.5: Example of the Land Cover layer for the 20081101-ESACCI-L3S_FIRE-BA-MERIS-AREA_5-fv04.1.tif file. The description of the land cover categories is in Annex 1.

2.8. Land Cover information

The land cover assigned to the pixel detected as burned was extracted from the CCI Land cover product (LC_cci, Kirches et al. 2013). As this land cover product has several epochs, different land cover maps were used according to the year of the BA product, making this variable a dynamic one.

The land cover epochs were selected to provide information about the pre-fire land cover category. For this reason, the reference land cover products are:

- LC_cci of the period 1998-2002 (designed LC_cci 2000) for the 2002-2007 BA products.
- LC_cci of the period 2002-2007 (designed LC_cci 2005) for the 2008-2012 BA products.

The land cover categories included in the BA product are listed in Annex 1.

2.9. File metadata

For each BA file product, an additional xml file with the same name is created. This file holds the metadata information following the ISO 19115 standard. The description of the populated fields is included in Annex 2.

3. Grid BA product

The grid product is the result of summing up burned area pixels within each cell of 0.25 degrees in a regular grid covering the whole Earth in biweekly composites. The attributes stored in NetCDF file format are: sum of burned area, standard error, observed area fraction, number of patches and the burned area for 18 land cover classes of LC_cci. Figure 3.1 shows the total BA from this product for 2008.

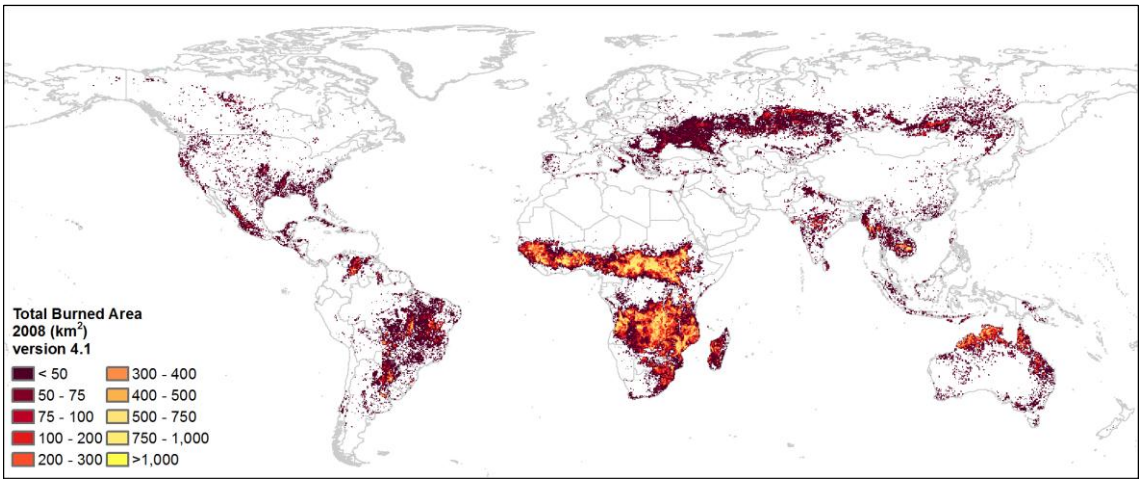

Figure 3.1: Total burned area for the year 2008.

3.1. Temporal compositing

Grid products are released at half-monthly time periods beginning at the start of each calendar month with each half being 15 days each for a 30-day month, and 15 days (the first half) and 16 days (the second half) for a 31-day month. The second half of February is either 13 days (no-leap year) or 14 days (leap year). This maintains 24 time periods with time divisions set to the convention of the calendar year.

3.2. Spatial Resolution

The spatial resolution of the grid product is 0.25 x 0.25 degrees. Grid attributes are computed from all pixels included in each cell of that size within the time period previously indicated.

3.3. Product projection system

The grid product is stored in geographical coordinates. Each cell has a latitude and longitude assignment which is tied to centre of the grid cell. For example a series of adjacent grid cells have longitude references of -67.625°, -67.375°, -67.125° and -66.875°. Similarly a series of latitude references are 0.125°, -0.125°, -0.375° and -0.625°.

3.4. File formats

The product is delivered in raster format, on a regular geographical grid. The product format is NetCDF-CF (see http://www.unidata.ucar.edu/software/netcdf/docs for detailed information about this format).

3.5. Product file naming conventions

The grid files are named as following:

<Indicative_Date>-ESACCI-L4_FIRE-BA-<Indicative_sensor>-fv<xx.x>.nc

<Indicative_Date>

The identifying date for this data set:

Format is YYYYMMDD, where YYYY is the four digit year, MM is the two digit month from 01 to 12 and DD is the two digit day of the month from 01 to 31. For 15-day products, the first half of the month has date = 07 and the second half date = 22, which are approximately the average dates of each biweekly period.

<Indicative_sensor>

In this version of the product it is MERIS.

fv<File_version>

Version number of the Fire_cci BA algorithm. It is in the form n{1,}[.n{1,}] (That is 1 or more digits followed by optional . and another 1 or more digits.). Current version is fv04.1.

Example:

20051207-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc

3.6. Grid attributes

The following sub-sections describe each of the grid attributes, including the name of the variables (attributes) in the NetCDF file, the unit of the attributes and the data type, and some information useful for the correct use of the product.

They also include an example of the grid product attributes.

3.6.1. Attribute 1: Sum of burned area

	Attribute	Units	Data Type	Notes
1	burned_area	Square metres	Float	This value is the sum of the BA in each grid cell.

This is the sum of all pixels detected as burned. In common with other global BA products it is assumed that a pixel at the native spatial resolution of the detecting instrument was totally burned. Any burn smaller than the spatial resolution of the input sensor (for this BA product, this implies approximately 9 hectares) is unlikely to be detected. It can only be detected when the char signal is sufficiently different from the surroundings to alter the reflectance used in the BA detection system to a degree that triggers the detection.

An example of this layer corresponding to the first fortnight of October 2008 is shown in Figure 3.2.

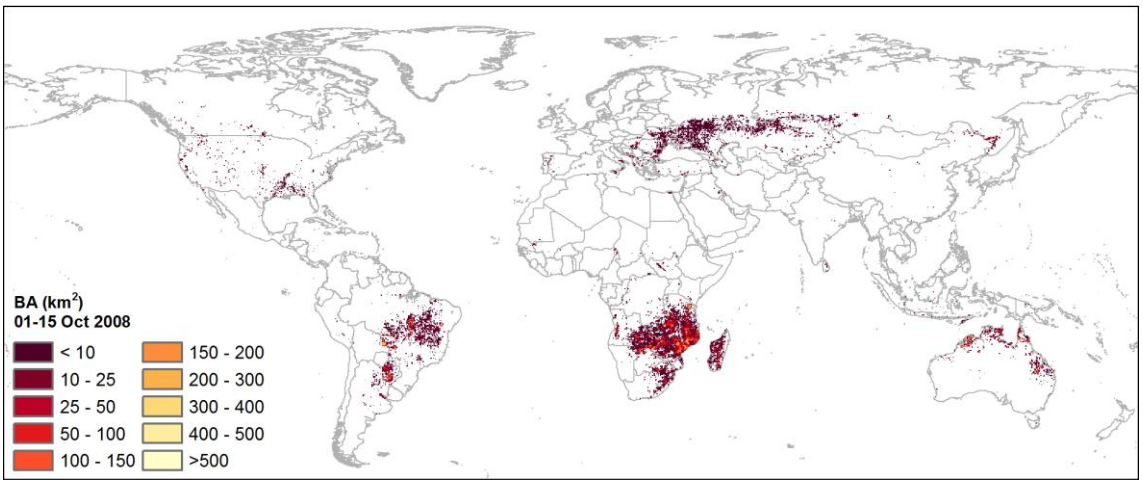

Figure 3.2: Example of the Burned Area attribute of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

3.6.2. Attribute 2: Standard error

	Attribute	Units	Data Type	Notes
2	standard_error	Square metres	Float	This value is the standard error of the estimation of BA in each grid cell.

The standard error is modelled and predicted with a regression model, calibrated with reference data. The response variable is the absolute observed error and the explicative variable is the burned area extent estimated for the grid cell. The standard error is positively related with the estimated extent of burned area in each grid cell. Even though those reference datasets were chosen to represent different fire regimes, they may be not fully representative of some regional fire conditions. More detail on the statistical models can be found in the ATBD III v2.3 (Tansey et al. 2014).

An example of this layer corresponding to the first fortnight of October 2008 is shown in Figure 3.3.

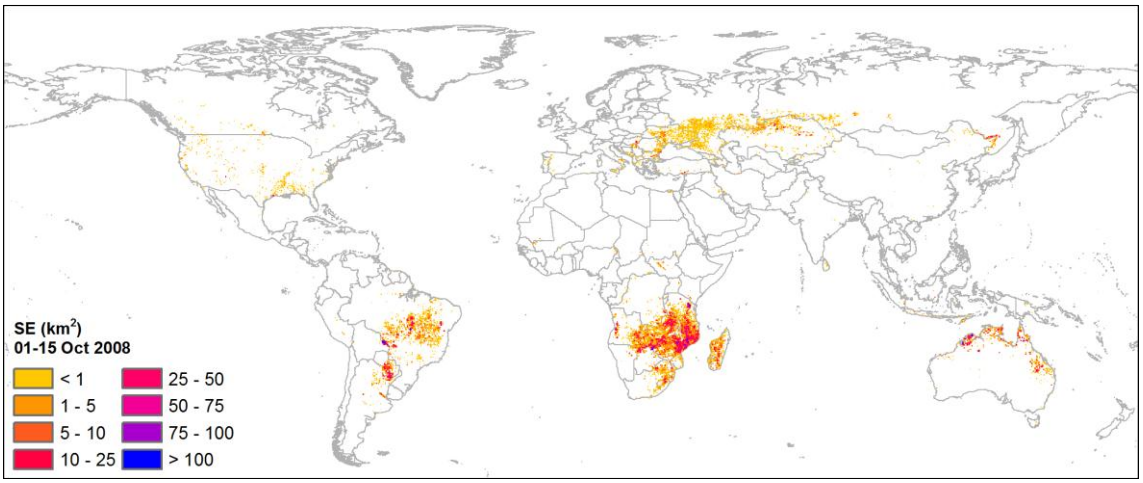

Figure 3.3: Example of the Standard Error attribute of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

3.6.3. Attribute 3: Observed area fraction

	Attribute	Units	Data Type	Notes
3	observed_area_fraction	0 to 1	Float	The fraction of area in the grid that was observed for the whole 15-day period (without cloud cover / haze or low quality pixels)

The observed area fraction is included as a layer in the grid product with the particular aim of providing information on the incomplete observation of the Earth surface by the input sensor. This may be caused by a sensor failure or by persistent cloud coverage.

Recommendation on product use: this is a very important attribute to consider, as it shows the proportion of each cell that was not observed in a particular biweekly product and therefore it identifies the regions where the product may miss burned pixels. Cells with low fraction of observed area in specific periods are therefore very uncertain in terms of using BA detections and we recommend discarding them from further analysis.

An example of this layer corresponding to the first fortnight of October 2008 is shown in Figure 3.4. Please note the absence of input data for various tiles in South America.

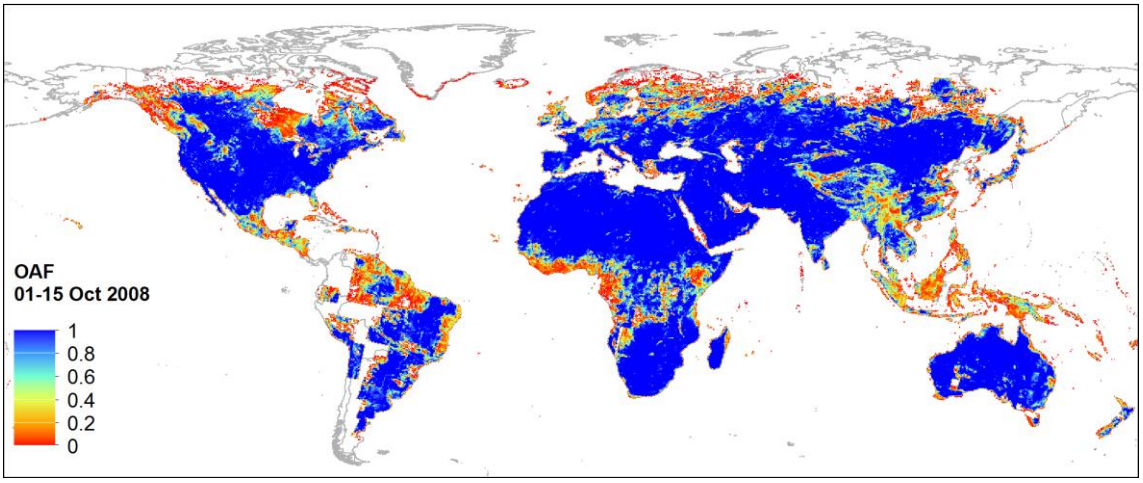

Figure 3.4: Example of the Observed Area Fraction attribute of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

3.6.4. Attribute 4: Number of patches

	Attribute	Units	Data Type	Notes
4	number_of_patches	0 to N	Float	Number of contiguous groups of burned pixels. Contiguity is defined as any burned pixel that has contact with the side of another burned pixel during the whole 15 day period.

It is assumed that individual patches only contain contiguous pixels. However, when a single burn patch is present in two grid cells it is considered as two separate burns. This should only marginally affect the analysis of burn patch sizes. On the opposite side, different burned areas may be considered as a single patch when they occurred around the same dates and form together a single-continuous patch. This temporal window has been fixed to a 15-day period following experience from previous studies (Archibald et al. 2013; Hantson et al. 2015a; Hantson et al. 2015b).

In spite of these limitations (common to most other global BA products), this information is still very useful to obtain standard indicators of fire activity. To our knowledge, this information on the number of fire patches is not currently available in other standard burned products.

An example of this layer corresponding to the first fortnight of October 2008 is shown in Figure 3.5.

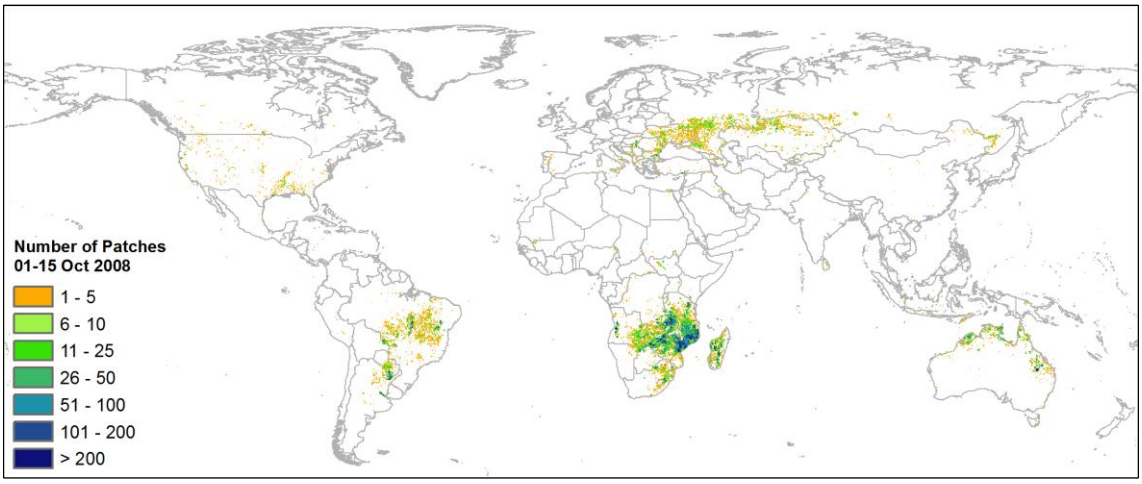

Figure 3.5: Example of the Number of Patches attribute of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

3.6.5. Attribute 5-22: Sum of burned area for each land cover category

	Attribute	Units	Data Type	Notes
5 to 22	burned_area_in_vegetation_class*	Square metres	Float	Sum of all burned pixels of each land cover as defined by the LC_cci**.

*The vegetation_class categories are those described in Annex 1.

** Reference land cover will be LC_cci 2000 for the 2002-2007 period, and LC_cci 2005 for the 2008-2012 period. See Section 2.8 for further information.

As in the case of the pixel product, it is assumed that each burned pixel that adds to the total burned area in a grid cell corresponds to only one land cover, as in most land cover maps. This is a reasonable estimation for homogenous land cover areas, but it may imply errors for heterogeneous landscapes. The basic land cover map is the Land Cover CCI (see Section 2.8). Obviously, the errors of this map affect the estimation provided by the Fire_cci pixel product.

It is assumed that the land cover source has accurately described the land cover type and is spatially consistent. We aim to provide readily available information for users on the type of vegetation that has burned. This information could be used, for example, with the vegetation type dependent fuel load data for calculation of the carbon emissions and other trace gas emissions in fires, or could be used to apply vegetation type relevant combustion completeness and emission factor information in climate modelling research.

Recommendation on product use: it is not recommended that the users select other arbitrary land cover data in order to generate similar information by themselves, because all CCI products are developed to be internally consistent across the programme.

Two examples of these types of layers corresponding to the first fortnight of October 2008 are shown in the following figures. Figure 3.6 shows the sum of the burned area of rainfed croplands (LC_cci class 10), while Figure 3.7 shows the sum of BA in shrublands (LC_cci class 120) for the same time period.

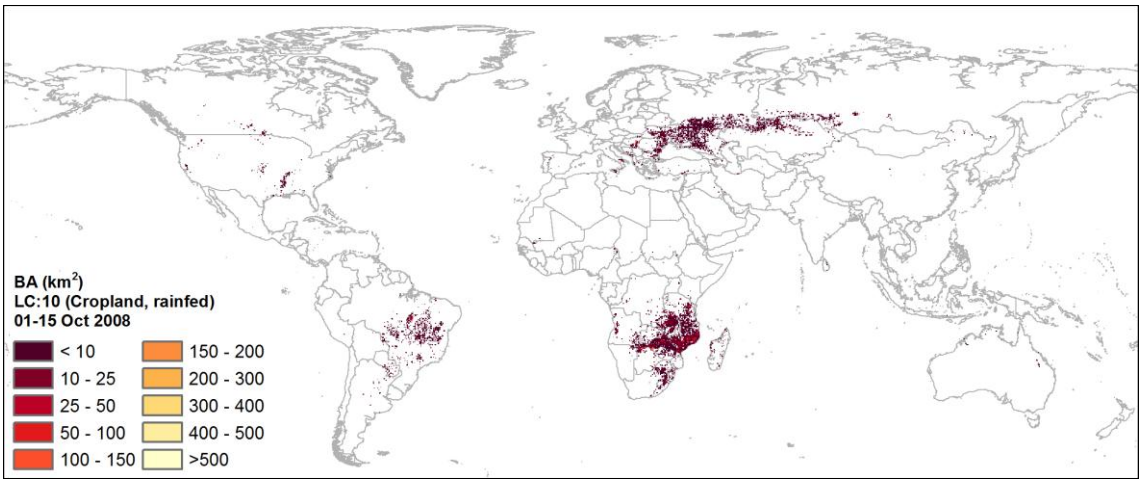

Figure 3.6: Example of the Burned Area in Vegetation Class attribute, for land cover class 10, of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

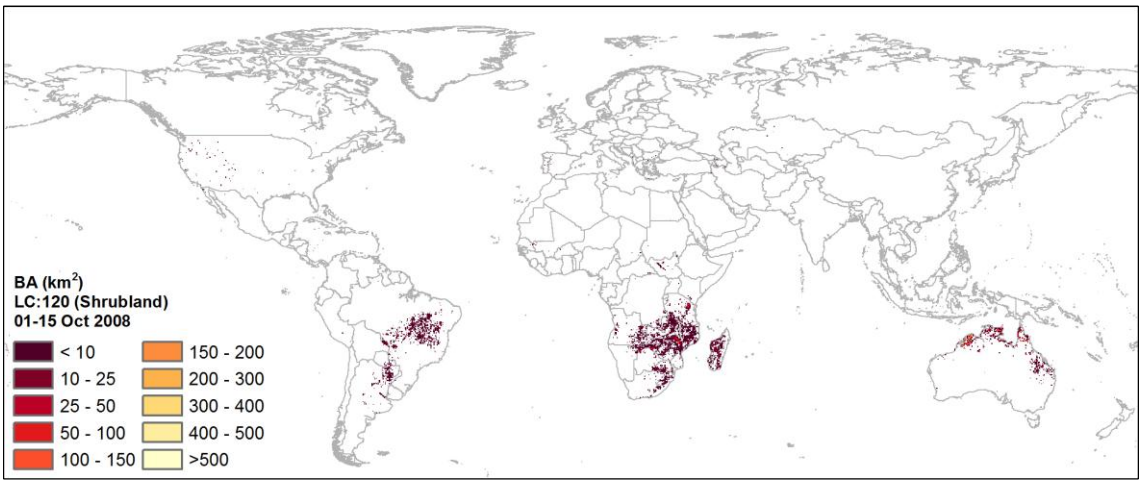

Figure 3.7: Example of the Burned Area in Vegetation Class attribute, for land cover class 120, of the 20081007-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc file.

3.7. File metadata

The grid files follow the NetCDF Climate and Forecast (CF) Metadata Convention (http://cfconventions.org/). Annex 3 describes the fields included in the .nc files.

4. Product validation

The final products generated in the Fire_cci project are being validated at global scale using a probability sampling design (Padilla et al. 2014a). The first global validation selected 2008 as target year. Stratified random sampling was used to select 105 non-overlapping Thiessen scene areas (TSA) and reference fire perimeters were determined from two multi-temporal Landsat TM/ETM+ images for each sampled TSA (Padilla et al. 2014b). The validation was based on cross tabulated error matrices, from which accuracy measures were computed to satisfy criteria specified by end-users of BA products. Accuracy differences were evaluated between each pair of products, following the theory of the stratified combined ratio estimator (Padilla et al. 2015).

From this evaluation of the 2008 BA product, the current Fire_cci v4.1 product has an estimated global accuracy of 99.6%, with higher errors for the burned area class (estimated omission 78%, commission 71%). A similar validation approach was applied to other global BA products by Padilla et al. (2015). The Fire_cci product showed similar overall accuracy, with higher commission and omission errors than the MODIS BA products, but lower errors than the Geoland BA product. Further validation will be performed including references files from other years, which are currently being produced within the validation activities of Fire_cci Phase 2.

We should point that these errors are most likely inflated, as they do not take into account reporting accuracy errors caused by the low temporal resolution of MERIS. Therefore, pixels correctly classified as burned may be labelled as omission errors when detected after the reference date of the Landsat multitemporal pairs used for generating reference files. Similarly, pixels correctly detected as burned but labelled a few days after the beginning of the Landsat multitemporal pair may be considered as commission errors.

In fact, a simple comparison of 2008 results with reference fire perimeters available for some countries showed much lower BA errors. Three large areas (around 250,000 km^2) were selected in Australia, Canada and California, who provided national fire perimeter databases (see Chuvieco et al. (2016a) Section 5.2 for further explanation on these reference datasets). The yearly BA was compared with the 2008 Fire_cci v4.1 results (thus reducing the impact of temporal reporting accuracy). The errors found for these three sites were:

- Australia: commission error (CE) = 0.22; omission error (OE) = 0.38
- Canada: CE = 0.12; OE =0.43
- California: CE = 0.22; OE = 0.28

These large differences between these values and those estimated from the Landsat validation dataset may be caused by the shorter periods covered by the Landsat multitemporal pairs (mostly less than 32 days apart) and smaller areas (< 20,000 km^2). In addition, Landsat images include small fires (<50 ha) that are not feasible to be detected by coarse resolution sensors.

The Fire_cci BA product is being currently intercompared with existing global BA products. Preliminary comparisons with the previous version of the BA algorithm showed very good agreements with the MODIS based BA products GFED and MCD45 (Chuvieco et al. 2016b).

5. Data dissemination

The Fire_cci BA products are available from the CCI Open Data Portal: http://cci.esa.int/data. We strongly recommend registering before downloading the products (or at least sending us an e-mail to mlucrecia.pettinari@uah.es with your contact information), to contact users when new versions of the products become available.

6. References

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Annex 1: Land cover categories (extracted from LC_cci)

LC number	Class name	Fire_cci number
0	No data	**0**
10	Cropland, rainfed	**10**
11	*Herbaceous cover*	***10***
12	*Tree or shrub cover*	***10***
20	Cropland, irrigated or post-flooding	**20**
30	Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)	**30**
40	Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%)	**40**
50	Tree cover, broadleaved, evergreen, closed to open (>15%)	**50**
60	Tree cover, broadleaved, deciduous, closed to open (>15%)	**60**
61	*Tree cover, broadleaved, deciduous, closed (>40%)*	**60**
62	*Tree cover, broadleaved, deciduous, open (15-40%)*	**60**
70	Tree cover, needleleaved, evergreen, closed to open (>15%)	**70**
71	*Tree cover, needleleaved, evergreen, closed (>40%)*	***70***
72	*Tree cover, needleleaved, evergreen, open (15-40%)*	***70***
80	Tree cover, needleleaved, deciduous, closed to open (>15%)	**80**
81	*Tree cover, needleleaved, deciduous, closed (>40%)*	***80***
82	*Tree cover, needleleaved, deciduous, open (15-40%)*	***80***
90	Tree cover, mixed leaf type (broadleaved and needleleaved)	**90**
100	Mosaic tree and shrub (>50%) / herbaceous cover (<50%)	**100**
110	Mosaic herbaceous cover (>50%) / tree and shrub (<50%)	**110**
120	Shrubland	**120**
121	*Shrubland evergreen*	***120***
122	*Shrubland deciduous*	***120***
130	Grassland	**130**
140	Lichens and mosses	**140**
150	Sparse vegetation (tree, shrub, herbaceous cover) (<15%)	**150**
152	*Sparse shrub (<15%)*	***150***
153	*Sparse herbaceous cover (<15%)*	***150***
160	Tree cover, flooded, fresh or brackish water	**160**
170	Tree cover, flooded, saline water	**170**
180	Shrub or herbaceous cover, flooded, fresh/saline/brackish water	**180**

Note: Only the level 1 classes are considered, so the subdivisions have the number of broader categories. Only vegetated LC classes have been considered.

Annex 2: Metadata of the pixel product (XML file)

In each XML file corresponding to the pixel product, the following fields are populated:

- Universal Unique Identifier
- Language
- Contact
- Date stamp
- Metadata Standard Name
- Reference System
- Citation
  - Title
  - Creation date
  - Publication date
  - DOI
  - Abstract (contains information about each layer)
- Point of Contact
  - Resource provider
  - Distributor
  - Principal investigator
  - Processor
- Keywords
- Resource constraints
- Spatial resolution
- Extent:
  - Geographical extent
  - Temporal extent

Annex 3: Dimensions, variables and metadata of the gridded BA product (NetCDF file)

Here is an example of the dimensions and variables of the gridded product for the 2005-11-22 12:00:00 file:

Global Attributes:

title = 'Fire_cci Gridded MERIS Burned Area product'
institution = 'University of Alcala'
source = 'MERIS_FSG_1P, MODIS MCD14ML Collection 5, ESA CCI Land Cover dataset v1.6.1'
history = 'Created on 2016-06-29 15:07:31'
references = 'See www.esa-fire-cci.org'
tracking_id = 'b2c006a9-2a92-44b7-bfcc-b798c72fc032'
Conventions = 'CF-1.6'
product_version = '4.1'
summary = The grid product is the result of summing up burned area pixels within each cell of 0.25 degrees in a regular grid covering the whole Earth in biweekly composites. The attributes stored are sum of burned area, standard error, observed area fraction, number of patches and the burned area for 18 land cover classes of CCI_LC.'
keywords = 'Burned Area, Fire Disturbance, Climate Change, ESA, GCOS'
id = '20051122-ESACCI-L4_FIRE-BA-MERIS-fv04.1.nc
doi = 'doi:10.5285/D80636D4-7DAF-407E-912D-F5BB61C142FA'
naming authority= 'org.esa-fire-cci'
keywords_vocabulary = 'none'
cdm_data_type = 'Grid'
comment = 'These data were produced as part of the ESA Fire_cci programme. '
date_created = '20160629T150731Z'
creator_name = 'University of Alcala'
creator_url = 'www.esa-fire-cci.org'
creator_email = 'emilio.chuvieco@uah.es'
project = 'Climate Change Initiative – European Space Agency'
geospatial_lat_min = '-90'
geospatial_lat_max = '90'
geospatial_lon_min = '-180'
geospatial_lon_max = '180'
geospatial_vertical_min = '0'
geospatial_ vertical _max = '0'
time_coverage_start = '20051116T000000Z'
time_coverage_end = '20051130T235959Z'
time_coverage_duration = 'P14D'
time_coverage_resolution = 'P01D'
standard_name_vocabulary = 'NetCDF Climate and Forecast (CF) Metadata Convention
licence = ESA CCI Data Policy: free and open access'
platform = 'Envisat, Terra, Aqua'
sensor = 'MERIS, MODIS'
spatial_resolution = '0.25 degrees'
geospatial_lat_units = 'degrees_north'
geospatial_lon_units = 'degrees_east'

geospatial_lon_resolution = '0.25'
geospatial_lat_resolution = '0.25'

Dimensions:
vegetation_class = 18
lat = 720
lon = 1440
nv = 2
strlen = 150
time = 1 (UNLIMITED)

Variables:
lat
Size: 720x1
Dimensions: lat
Datatype: single
Attributes:
units = 'degree_north'
standard_name = 'latitude'
long_name = 'latitude'
bounds = 'lat_bnds'
lat_bnds
Size: 2x720
Dimensions: nv,lat
Datatype: single
lon
Size: 1440x1
Dimensions: lon
Datatype: single
Attributes:
units = 'degree_east'
standard_name = 'longitude'
long_name = 'longitude'
bounds = 'lon_bnds'
lon_bnds
Size: 2x1440
Dimensions: nv,lon
Datatype: single
time
Size: 1x1
Dimensions: time
Datatype: double
Attributes:
units = 'days since 1970-01-01 00:00:00'
standard_name = 'time'
long_name = 'time'
bounds = 'time_bnds'
calendar = 'standard'
time_bnds
Size: 2x1

Dimensions: nv,time
Datatype: single
vegetation_class
Size: 18x1
Dimensions: vegetation_class
Datatype: int32
Attributes:
units = '1'
long_name = 'vegetation class number'
vegetation_class_name
Size: 150x18
Dimensions: strlen,vegetation_class
Datatype: char
Attributes:
units = '1'
long_name = 'vegetation class name'
burned_area
Size: 1440x720x1
Dimensions: lon,lat,time
Datatype: single
Attributes:
units = 'm2'
standard_name = 'burned_area'
long_name = 'total burned_area'
cell_methods = 'time: sum'
standard_error
Size: 1440x720x1
Dimensions: lon,lat,time
Datatype: single
Attributes:
units = 'm2'
long_name = 'standard error of the estimation of burned area'
observed_area_fraction
Size: 1440x720x1
Dimensions: lon,lat,time
Datatype: single
Attributes:
units = '1'
long_name = 'fraction of observed area'
comment = 'The fraction of observed area is 1 minus the area fraction of unsuitable/not observable pixels in a given grid. The latter refers to the area where it was not possible to obtain observational burned area information for the whole time interval because of lack of input data (non-existing images for that location and period), cloud cover, haze or pixels that fell below the quality thresholds of the algorithm.'
number_of_patches
Size: 1440x720x1
Dimensions: lon,lat,time
Datatype: single
Attributes:

units = '1'
long_name = 'number of burn patches'
comment = 'Number of contiguous groups of burned pixels.'

burned_area_in_vegetation_class
Size: 1440x720x18x1
Dimensions: lon,lat,vegetation_class,time
Datatype: single
Attributes:
units = 'm2'
long_name = 'burned area in vegetation class'
cell_methods = 'time: sum'
comment = 'Burned area by land cover classes; land cover classes are from CCI Land Cover, http://www.esa-landcover-cci.org/'

Annex 4: Acronyms and abbreviations

ATBD	Algorithm Theoretical Basis Document
BA	Burned Area
CCI	Climate Change Initiative
LC_cci	CCI Land Cover project
CE	Commission Error
CF	Climate and Forecast Metadata Convention
CRS	Coordinate Reference System
ECV	Essential Climate Variables
ENVISAT	ENVIronmental SATellite
ESA	European Space Agency
FRS	Full Resolution Full Swath
GCS	Geographic Coordinate System
GFED4	Global Fire Emission Database version 4
LC	Land Cover
MCD45	MODIS Collection 5.1 Burned Area product
MCD64	MODIS Burned Area product used for GFED
MER_FSG_1P	MERIS geo-corrected full-resolution Level-1
MERIS	Medium Resolution Imaging Spectrometer
MODIS	MODerate Resolution Imaging Spectrometer
NetCDF	NETwork Common Data Format
OE	Omission Error
TSA	Thiessen scene areas