

Copernicus Land Monitoring Service – High Resolution Layer Small Woody Features – 2015 reference year

Product Specifications & User Guidelines



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List of Acronyms

CRS	Coordinate Reference System
DWH	Data Warehouse
EPSG	European Petroleum Survey Group
ESA	European Space Agency
HR	High Resolution
HRL	High Resolution Layer
MML	Minimum Mapping Length
MMU	Minimum Mapping Unit
MMW	Minimum Mapping Width
RZ GLE	Riparian Zones Green Linear Element
SIRS	Système d'Information à Référence Spatiale, France
SP	Service Provider
SWF	Small Woody Feature
TCD	Tree Cover Density
VHR	Very High Resolution

Copernicus Land Monitoring Service – High Resolution Layer Small Woody Features – 2015 reference year. Product Specifications & User Guidelines

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1. Background

This document captures the detailed definitions and product specifications for the Small Woody Features (SWF) product for the reference year 2015. The document evolved during the production period as a specification document, and was then adopted for the final users of the datasets. The Lot 5 Small Woody Features 2015 of the Copernicus Land Monitoring Services (CLMS) - High Resolution land cover characteristics for the 2015 reference year is a new product which aims to deliver homogeneous information on small woody features across EEA39 countries. This includes linear structures such as hedgerows, but also patches of woody vegetation. The methodology for detecting these structures of small woody vegetation is based on the analysis of very-high resolution earth observation data for the reference year 2015 (+/- 1 year).

Based on very-high resolution (VHR) satellite imagery from Copernicus Contributing Missions (CCMs) made available through the ESA Data Warehouse (DWH), the consortium produced 3 SWF layers:

- SWF vector layer
- SWF 005m spatial resolution raster layer
- SWF 100m spatial resolution raster aggregate layers

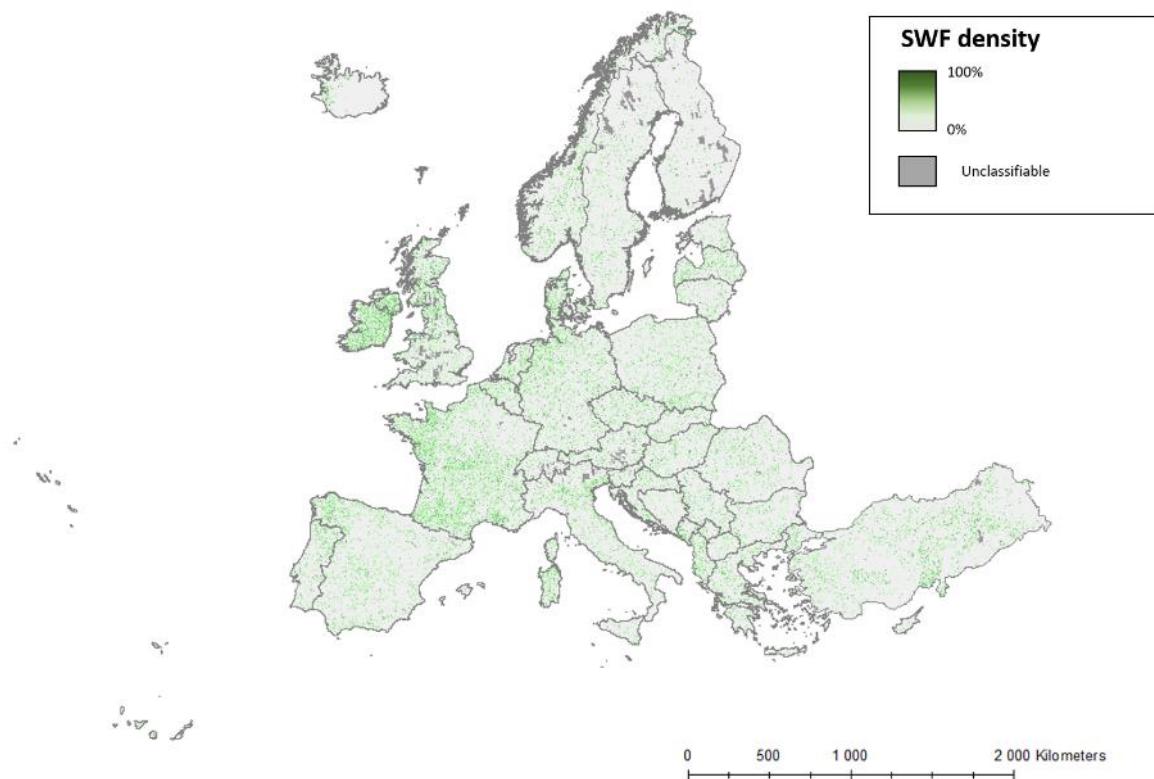


Figure 1: SWF 100m density raster product over EEA39

2. Product overview

2.1 Introduction

Small woody landscape features are important for a number of ecosystem services, among others related to biodiversity and habitat connectivity. They also improve air quality, water quality, water quantity, reduction of greenhouse gas emissions, carbon sequestration, climate change adaptation, regulation of soil erosion and soil quality, support biodiversity and pollination, and are important for cultural and recreational reasons. They are also highly relevant in terms of the green infrastructure strategy of the EU, and for monitoring of the effectiveness of the Common Agricultural Policy (CAP).

The VHR_IMAGE_2015 dataset made available in the ESA Copernicus DWH is the main data source for the detection of Small Woody Features identifiable within the given image resolution (=<1m panchromatic, 2-4m multi-spectral).

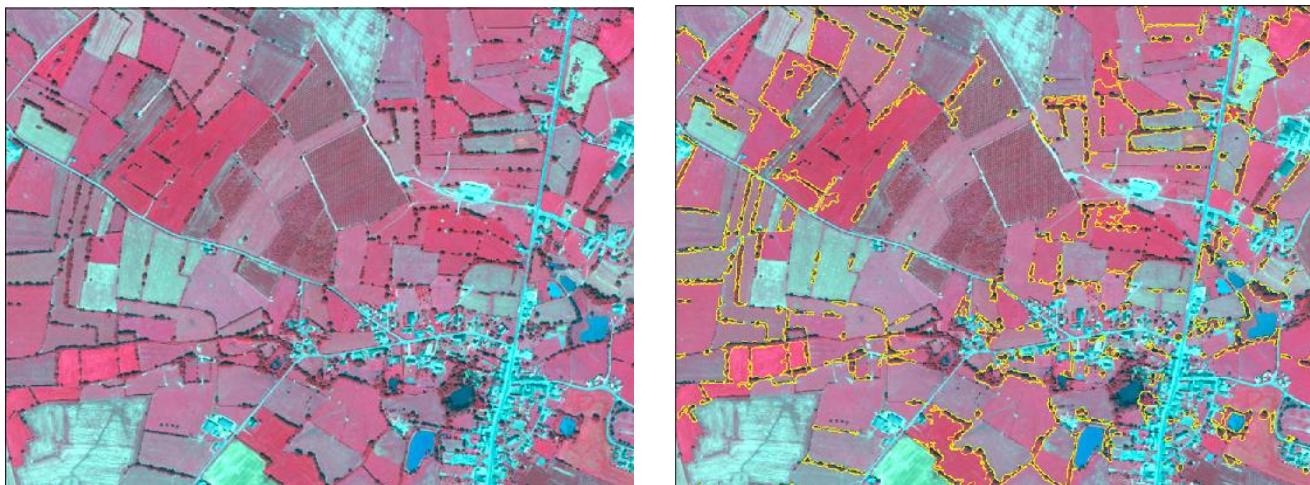


Figure 2: VHR_IMAGE_2015 input data (left) and the SWF vector product (right with yellow outlines)

2.1.1 Definition and workflow

The SWF product includes woody linear structures such as hedgerows, scrubs or tree rows along field boundaries, riparian and roadside vegetation. Also isolated patches of trees and scrub are included.

The product excludes grassy elements (e.g. margins along field boundaries), wet elements (drainage ditches, water courses) or artificial elements (any kind of 'grey' infrastructure such as roads or stone walls). Also tree plantations, vineyards and orchards are not included in the SWF product.

Table 1: Thematic definition of SWF (included/excluded)

Elements to be included in SWF mapping 2015	Elements to be excluded in SWF mapping 2015 ¹
linear hedgerows and scrubs	stone walls,
tree rows (e.g. along field boundaries),	drainage ditches,
isolated/scattered patches of trees	grass margins,
	field boundaries without hedgerows or trees,
	any kind of 'grey' infrastructure such as roads
	artificial tree rows like olive tree plantations, vineyards and orchards ²

The Small Woody Features (SWF) layer contains woody linear, and small patchy elements, following the geometric specifications as indicated in Table 2. The geometric specifications contain both linear and patchy structures. The SWF product is derived by a combination of semi-automated image processing, feature extraction, classification, morphological analysis and manual editing.

¹ Small elements excluded from the SWF product, such as stone walls, drainage ditches, grass margins and field boundaries are important and relevant small landscape features. Unfortunately, the type of Earth Observation (EO) data available to produce the SWF layers does not allow to map these element reliably. They are therefore excluded from the product.

² A certain amount of commission is expected among the artificial tree rows features. These areas present the same land cover as natural woody features (same spectral or textural information) but differ in land use, which is difficult to extract in an automatic process, given the input data available for the SWF production.

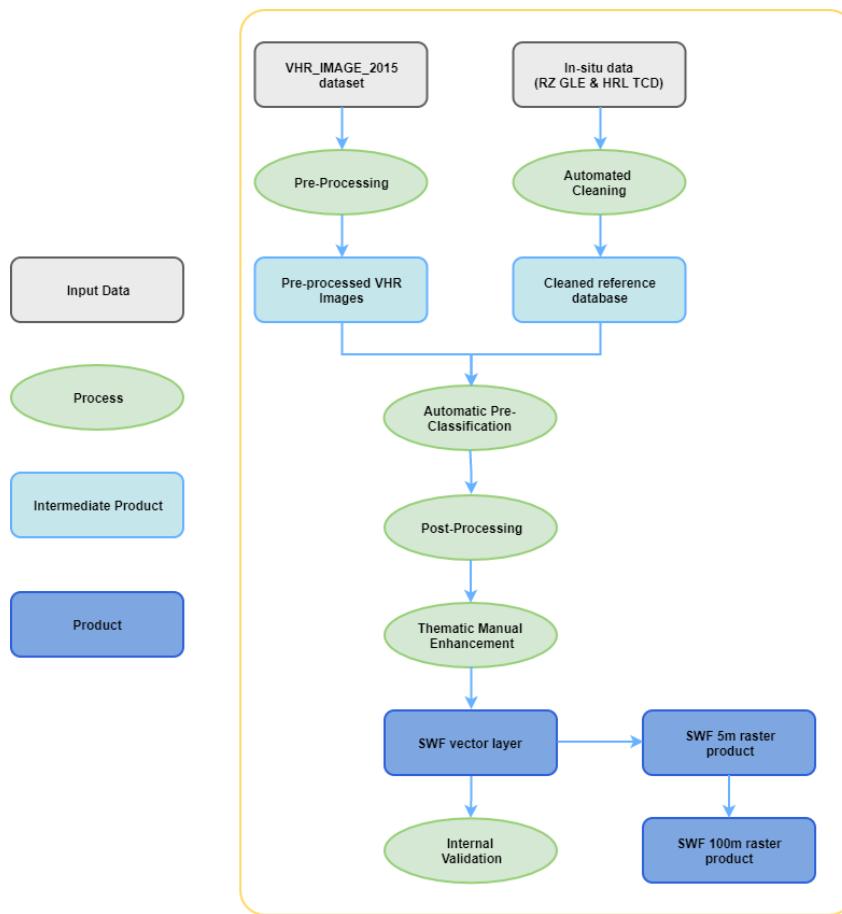


Figure 3: HRL2015 SWF production workflow

Small Woody Features (and Additional Woody Features, see below), are extracted from the VHR_IMAGE_2015 dataset, based on a specially developed classification processing chain, using an Object Based Image Analysis (OBIA) approach and cloud-Computing solutions. This methodology is based on differential attributes profiles (DAP) and classical classifiers, such as Random-Forest, using both spectral and textural signatures of each pixel (Faucqueur *et al.* 2019)³.

Post-processing and thematic manual enhancement steps aim to apply geometric specifications to detected features in order to discriminate them between linear SWF, patchy SWF or AWF (or remove them from the product if they don't fit the requested specifications), as well as correcting classification artefacts.

Figure 3 provides an overview of the SWF production workflow.

³ Loïc Faucqueur, Nathalie Morin, Antoine Masse, Pierre-Yves Remy, Justine Hugé, Clémence Kenner, Fabrice Dazin, Baudouin Desclée, Christophe Sannier, "A new Copernicus high resolution layer at pan-European scale: small woody features," Proc. SPIE 11149, Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI, 111490X (21 October 2019); doi: 10.1117/12.2532853

Specific **mapping rules** are applied to derive a homogeneous pan-European SWF database. Examples of such mapping rules are:

- Linear structures may contain feature parts wider than 30m if connecting 2 features of less than 30m width, each longer than 50m, over a distance of less than 50m – otherwise this would result in rather artificial cuts in linear structures;
- Patchy structures may have a width of less than 30m over a distance below 50m. A cut is not applied in order to keep the overall, natural characteristic of the identified patch.
- Trees are considered as green linear structure when the gaps between the trees are smaller than 5m.
- Linear and patchy features within open forest are excluded from the SWF product

Table 2: Geometric specifications of SWF

	Linear Structures	Patchy Structures
Width	$\leq 30\text{m}$	n/a
Length	$\geq 50\text{m}$	n/a
Compactness	≤ 0.75	> 0.75
Area	n/a	$200\text{m}^2 \leq \text{area} \leq 5000\text{m}^2$

2.1.2 Additional Woody Features (AWF)

During production, an additional class of feature has been implemented: **Additional Woody Features (AWF)**.

Given the limitations with any geometric rules and the need for good “green” connectivity, an additional class was added: the “Additional Woody Features” (AWF). This AWF class (thematic code = 3) includes the woody elements identified by the pre-classification but rejected by the geometric rules. This will provide to the user more relevant woody features and better ensure the link between Tree Cover Density (TCD) and SWF.

The purpose of this AWF class is to re-inject meaningful features detected by pre-classification and removed by post-processing due to the applications of SWF geometric rules.

To avoid re-introducing every feature in the product, potential AWF are selected with the following rules:

- Features that « enhance » connectivity (i.e. connected to a valid SWF)
- Isolated features with area $> 1500 \text{ m}^2$ (linear wider than 30m, and out of specs patches)

AWF and SWF classes are mutually exclusive (non-overlapping). Every detected feature is firstly compared with the SWF geometric rules. If this feature meets SWF linear or SWF patch specifications, it is labelled as SWF. If not, it is tested to be eventually labelled as AWF if it is meeting the conditions listed above.

2.2 Available products

The HRL SWF Pan-European layer represents linear and patchy SWF at a cartographic scale equivalent to 1:5,000. SWF are exclusively covered by ligneous vegetation (woody plants) and comprise linear hedges and tree rows along field boundaries, riparian and roadside vegetation, as well as scattered patches of trees and scrubs. SWF are mapped in the following categories:

- **Linear SWF:** represent landscape features such as hedgerows or tree alignments that are defined by a compactness criterion less or equal to 0.75, up to 30m width and at least 50m length. They are only distinguished as separate attributes in the vector layer.
- **Patchy SWF:** represent areas of isolated and scattered patches of trees or scrubs defined by a compactness criterion greater than 0.75, at least 10m width and with an area greater than 200m² and less than 5,000m². They are only distinguished as separate attributes in the vector layer.
- **AWF:** Woody features that are neither linear nor patchy SWF, but which are connected to linear or patchy SWF and isolated woody features that are not linear nor patchy SWF, but which present an area above 1500m² (linear features wider than 30m, and out-of-specifications patches).

2.2.1 SWF vector layer

The SWF vector layer provides presence / absence of Small Woody Features, with mapping rules as described in Table 2. This is the primary product of the Small Woody Features mapping, and thus also the one with most detail. Unlike the raster products, the Small Woody Features vector layer is also separated into two classes: Linear and Patchy (see Figure 4), containing the following attributes:

- Linear structures of trees, hedges, bushes and scrub
- Patchy structures of trees, hedges, bushes and scrub
- Additional Woody Features (AWF)



Figure 4 : SWF vector layer showing the Linear structures of trees, hedges, bushes and scrub (green), Patchy structures of trees, hedges, bushes and scrub (pink) and the additional woody features (orange).

2.2.2 SWF 5m raster layer

The SWF 5m raster layer provides information of presence / absence of Small Woody Features at 5m spatial resolution (see Figure 5). This layer is derived from the SWF vector product in order to be more in line with other HR layers, and for allowing raster processing of the results. It describes the SWF landscape according to the high resolution of the input data, but without taking into account the possible small geometric inaccuracy of the vector product (due to VHR geometric imprecision, automatic processing such as smoothing, etc.). The geometric resolution is consistent with the EEA reference grid.

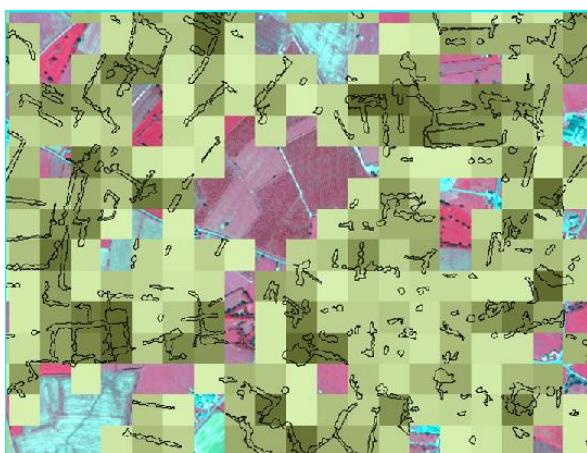


Figure 5: SWF 5m raster layer (left) and SWF 100m raster product (the darker the green, the higher the density of SWF) with the SWF vector product overlaid with black outline (right)

2.2.3 SWF 100m raster layers

The SWF 100m raster layer, consistent with the EEA 100m grid, is a 100m aggregated version of the SWF 5m raster layer. It can be used as a landscape descriptor of SWF density for large areas. Examples of each product are shown in Figure 5 above.

Following the integration of AWF in the HRL2015 SWF layer, the SWF 100m raster exists in 3 different versions:

- SWF density
- AWF density
- SWF+AWF density

3. Data used for HRL2015 SWF production

The main input data of HRL2015 SWF is the VHR_IMAGE_2015 dataset provided by ESA. This dataset comprises 37 529 scenes for the 2015 reference year (+/- 1 year) acquired by different satellites: Pleiades 1A/B, WorldView-2, WorldView-3, GeoEye-1, Deimos-2 and Spot6/7. To achieve a homogeneous product over the whole EEA39 coverage in terms of spatial resolution, the production was performed on multispectral (MS) images for Pleiades 1A/B, WorldView-2/3 and GeoEye-1 scenes, whereas pansharpened images resampled to 2m spatial resolution are used for Deimos-2 and Spot 6/7 scenes.

HRL Tree Cover Density 2015 was used to derive a forest mask (see section 5) in order to limit the overlapping between HRL2015 Forest and HRL2015 SWF products.

4. Thematic Accuracy

The general accuracy level of the HRL SWF products shall be in the order of 80 % (Overall thematic Accuracy, User's Accuracy and Producer's Accuracy). A full independent, external validation of the full European mosaic will be conducted after publication of the dataset, and will be published on the Copernicus Land Portal.

Product limitations

The HRL SWF product is based on a mostly automatic process performed over EEA39 area using as main input EO data the VHR_IMAGE_2015 dataset detailed in previous section. This dataset has several characteristics that influenced the overall quality of the SWF products:

- It consists of imagery from several sensors which have their own processing chain, and for which there is no co-registration between adjacent VHR scenes. This may lead to geometrical discrepancies on areas covered by several VHR scenes, and sometimes to an overestimation of the width/size of features. Such overestimation can lead to omission issues, as such features would be considered as out of SWF specifications.

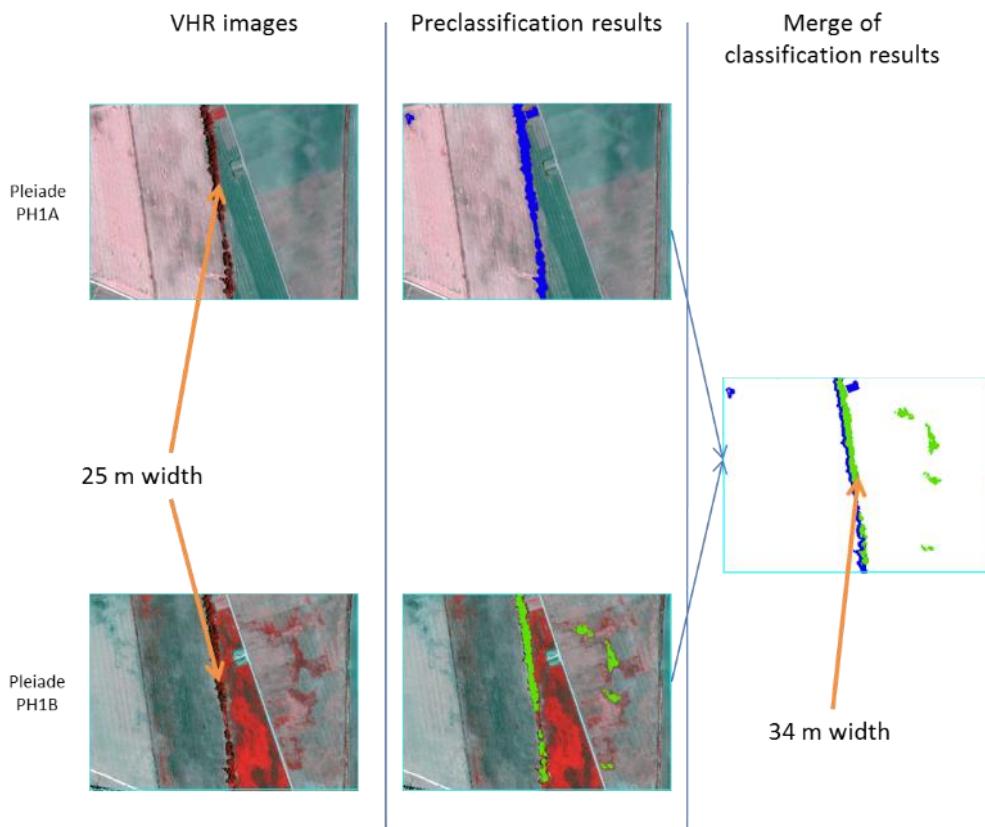


Figure 6: Case of two overlapping VHR scenes from the VHR_IMAGE_2015 dataset. Absence of precise co-registration between the 2 scenes will induce a slight overestimation of the detected feature in the final product. In this case, the feature will be removed from the product as its measured width is above maximum width of linear SWF (30m).

- The different spatial resolution between sensors may cause heterogeneity in the SWF product.
- Acquisition time of the VHR scenes is mostly in summer (from late May to early September), which is the peak period of chlorophyllous activity of grassy/cropland areas. This causes high levels of spectral confusion between woody and non woody vegetation. Adjacent VHR scenes with different acquisition time (ex: before and after harvest of cropland) can cause artefacts on image boundaries in the final product.
- The absence of a cloud mask for the VHR_2015 input satellite data, caused a certain level of omission errors, in particular for areas where no multiple overlapping images exist.

Additional confidence/PSIL products

- To help users evaluate the spatial variation in product quality, additional quality/confidence layer and Parent Scene Identification Layer (PSIL) were produced. These additional layers give users a comprehensive overview of the data used to produce SWF layers, including sensor, acquisition date, resolution and cloud coverage over the images processed over a given area.
- **PSIL** contains the footprints of all VHR scenes processed to produce the SWF 2015 layers. This is a vector file which contains information, for each footprint, concerning sensor, acquisition time and cloud coverage. The cloud coverage for each VHR scene was derived from cloud masks provided to the Consortium by the Joint Research Centre (JRC) in the frame of HRL 2018. These cloud masks were automatically generated for each scene of the VHR_IMAGE_2015 dataset.
- The **confidence/quality layer** aims to provide to the final user a comprehensive overview of where the VHR_IMAGE_2015 dataset characteristics would potentially impact the accuracy of the SWF products. Each SWF 100x100m pixel is assigned a confidence value between 0 and 10 to reflect the accuracy of the

products for a given pixel, 10 being the maximum confidence value. This confidence value is the result of a combination of several parameters:

- **Acquisition time:** the best acquisition period to detect woody vegetation such as SWF has been empirically determined to be mid spring (April/May) or at the start of fall (late September/ October) depending on location within Europe. VHR acquisitions in June/July/August occur during the peak of chlorophyllous activity of grassy / cropland areas and may cause high level of spectral confusion between woody and non woody vegetation.
- **Spatial resolution:** VHR_IMAGE_2015 dataset is composed of several sensors which have different spatial resolution. A lower spatial resolution will decrease the ability to correctly identify small landscapes elements.
- **Cloud coverage:** as described above, presence of clouds could imply omission errors.
- **Number of observations:** VHR_IMAGE_2015 dataset shows a significant overlap between adjacent VHR scenes. The SWF 2015 production workflow has been adjusted to take advantage of this overlap when processing VHR scenes. High number of observations for given area allow to decrease commissions errors, and mitigate impact of cloud coverage.

Internal Validation

The HRL SWF is a complex product combining linear and patches elements. These two kinds of elements require different accuracy assessment approaches and a reliable procedure is necessary. After several iterations during production, a validation concept appropriate for the assessment of the HRL SWF 2015 was designed.

The internal validation procedure has been developed and implemented on the 100m raster product, based on a scientifically sound validation concept adequate for evaluating the quantitative accuracy of the HRL SWF layer. It takes in account the HRL SWF product specifications while being consistent with the validation approach used in other HRL products. More detailed information on the SWF internal validation concept can be found on document [clms_hrl_swf_validation_concept_sc03_1_1-2.pdf](#) available on the land.copernicus.eu portal.

The validation exercise includes three parts, (1) the stratification and sampling design, (2) the response design and (3) the analysis procedures.

The stratification and the sampling design consist primarily in selecting an appropriate sampling frame and sampling unit. The selected sample design for thematic accuracy assessment for HRL SWF combines systematic and stratified approaches. It is based on the LUCAS (Land Use/Cover Area frame statistical Survey) sampling approach. LUCAS corresponds to a grid of approximately 1,100,000 points throughout the European Union where land cover or land use type is observed. Using LUCAS points ensures traceability and coherence between the different layers. For the SWF layer, a stratification is applied for the whole analysed area based on a series of omission/commission strata.

The response design is the photointerpretation of each sample unit and is based on the independent assessment (SWF or non-SWF) at the unit level. The reference data are the images used in the production, the VHR_IMAGE_2015 dataset.

The last step, the analysis procedure, consists in analysing the samples in order to draw conclusions for the thematic accuracy of the product. Thematic accuracy is presented in the form of an error matrix resulting from

samples interpretation. The different accuracies (Overall thematic, Producer's and User's Accuracy) are provided as well as 95% confidence interval.

	Producer accuracy	CI 95%	User Accuracy	CI 95%
HRL 2015 SWF Full EE39 coverage	80.34%	0.63%	80.48%	0.41%

5. Complementarity and possible overlaps of the SWF product with the HRL Tree Cover Density (TCD)

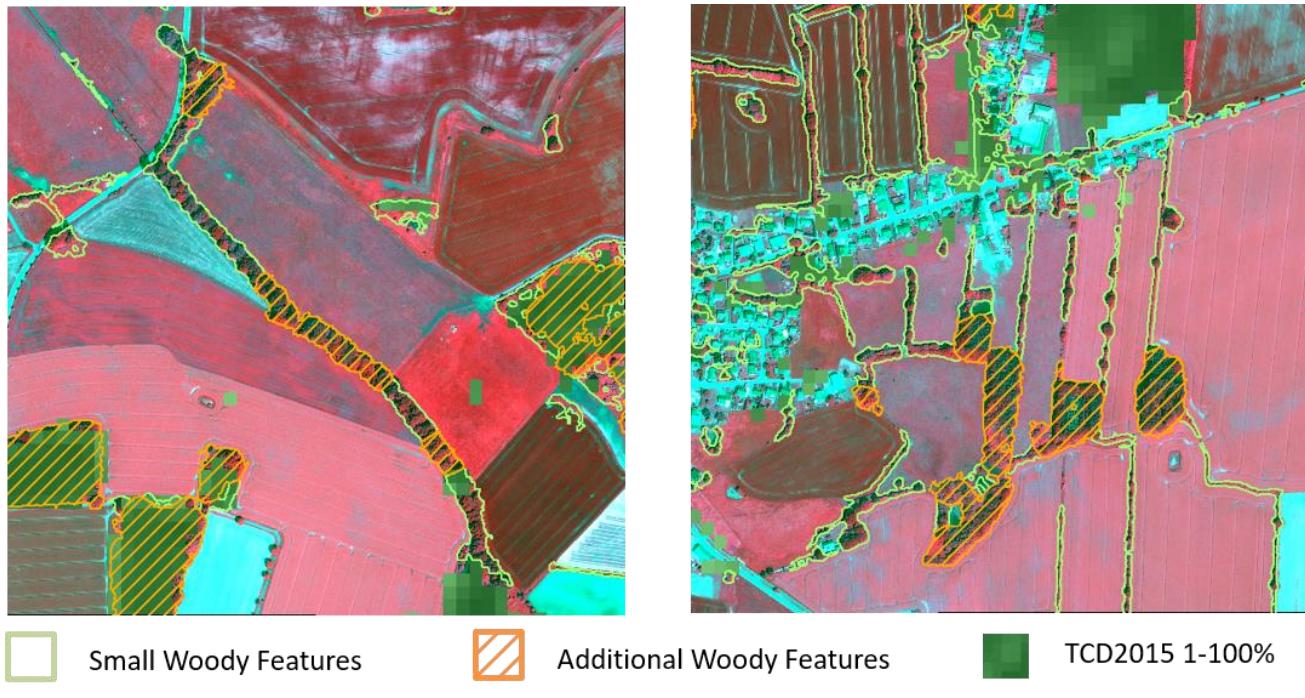


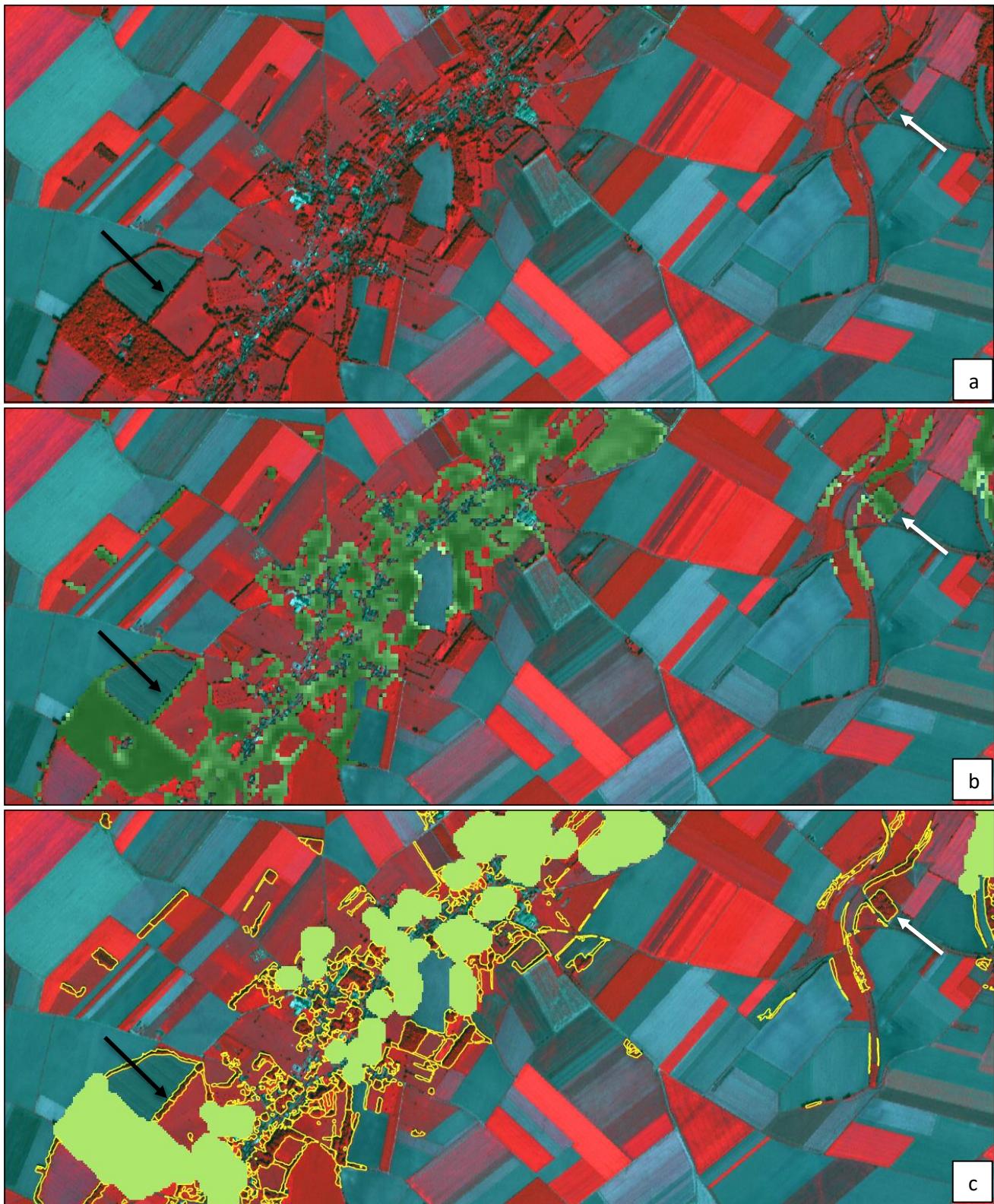
Figure 7: AWF (dashed orange features) enhancing connectivity between SWF (light green), while partially overlapping TCD2015 (green 20m pixels; left), or being complementary with TCD 2015 (right). For more information on the mapping rules with regards to the TCD (Tree Cover Density) product, please see below.

In order to exclude SWF from large areas with dense tree cover, which are well covered by the TCD HRL, the production workflow considers a mask based on HRL TCD 2015. To obtain the tree cover mask used in production,

- a 30% threshold is applied to HRL TCD 2015.
- In a second step, a morphological filter (erosion + dilatation) is applied to the tree cover mask. This allows to exclude from the tree cover mask linear elements connected to larger forest area (see Figure 8)
- In a third step, a minimal mapping unit (MMU) of 5 ha is applied. Due to the coarser spatial resolution of HRL TCD2015 compared to SWF product, this allows to identify relevant small woody features over areas which are covered by HRL TCD 2015, especially in areas of lower tree cover density and urban areas. (see Figure 8)
- To avoid boundary effects at forest edges due to difference in spatial resolution between HRL TCD2015 and SWF products, a 10m buffer zone is applied to the resulting mask (see Figure 9).

SWFs located inside this TCD based forest mask are systematically removed from the SWF layer. Figure 8 shows the difference between the HRL TCD 2015 and tree cover mask used during production, as well as why SWF and TCD layer can overlap while being complementary. (For complementary between SWF and TCD, see also Figure 7). SWFs located outside this mask (including low density forest areas with TCD values lower than 30%) are treated in a separate step in order to ensure the inclusion of SWF in fragmented areas

representing isolated groups of trees and avoid SWF located in continuous forest (even of low density). These detected features are removed during the manual enhancement step.



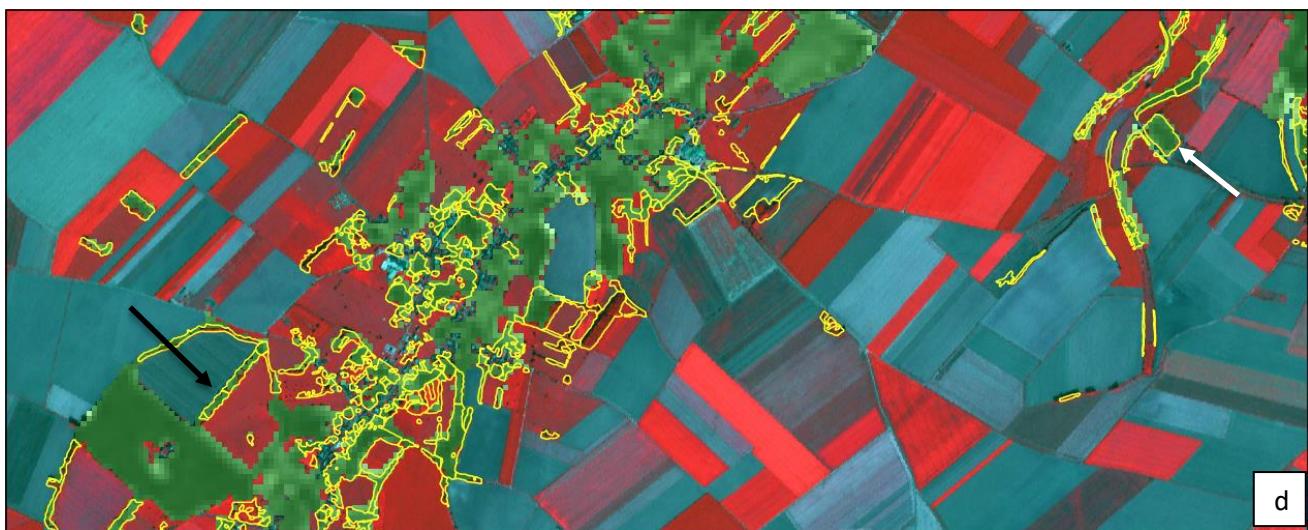


Figure 8: Application of forest mask based on HRL TCD 2015. a: VHR2015 ; b: HRL TCD 2015 ; c: small and additional woody feature (yellow outline) and forest mask (light green) ; d: Small and additional woody features (yellow outline) and HRL TCD2015 : the 2 products are partially overlapping, but also complementary for features too small to be included in HRL TCD 2015. Black arrow: relevant linear SWF captured also in HRL TCD 2015. Morphological filters applied to derive the Tree Cover mask allow to include this element in the SWF product. White arrow: relevant patchy SWF included in HRL TCD 2015. Application of a MMU in the Tree Cover mask allows to include this element in the SWF product.



Figure 9: Due to difference of spatial resolution between VHR_IMAGE_2015 imagery used for the SWF production (left) and the 20m pixels of the HRL TCD 2015 product and HR imagery used for TCD production (20m TCD superimposed on VHR_2015 centre), some woody vegetation at the edges of forest area may not be included in HRL TCD 2015. To avoid having these elements wrongly included in the SWF product, they are masked through the application of a 10m buffer to the Tree Cover Mask (right).

6. Variability of small woody features across Europe

Please note that the pattern, type, size and frequency of small woody landscape elements differs greatly across Europe. The SWF product provides the most useful results for landscapes with a clear spatial separation of distinct linear and patchy woody vegetation from open areas with agricultural (or other) use (see 10 for a landscape dominated by linear elements of woody vegetation, and Figure 11 for a landscape with more patchy woody vegetation elements). At the same time, many landscapes, in particular in northern and southern Europe are characterized by a low-density mix and mosaic of open areas and woody vegetation elements, often individual trees or bushes. While the density of woody elements gradually changes, there is often no clear spatial separation of linear and patchy woody elements (see Figures 12 and 13). In such landscapes it is often not possible to map meaningful linear or patchy SWF fully corresponding to the geometric specifications, and it might be more appropriate to use the HRL TCD (Tree Cover Density) to characterize and monitor such landscapes.



Figure 10: Example of landscape dominated by small parcels of crop/grassland, and large number of linear woody elements. South of England, village of Coolham and surroundings. Please note that the background imagery is NOT the same as used in production (and likely of higher spatial resolution).



Figure 11: Agricultural area around the village of Gislinge (DK), dominated by small patchy woody features. Please note that the background imagery is NOT the same as used in production (and likely of higher spatial resolution).

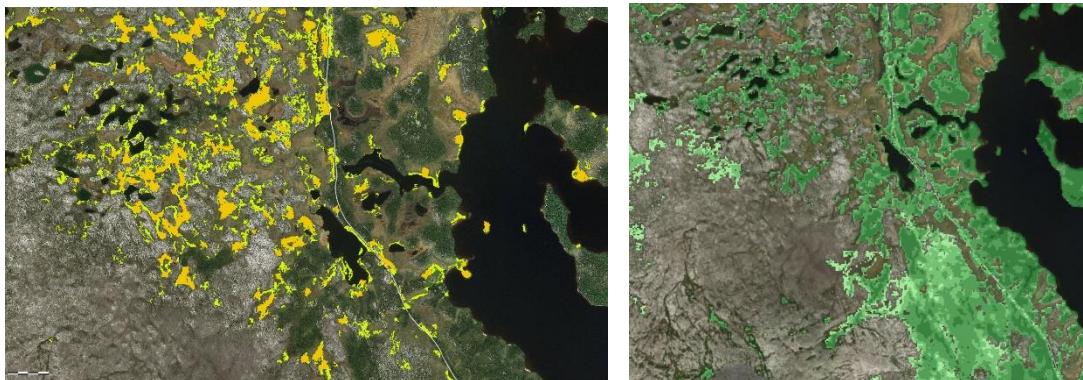


Figure 12: Periglacial landscape in NO (around Isteren lake), characterized by discontinuous tree cover of variable density, no agricultural use. Denser areas of tree cover are mapped as SWF and AWF (yellow and orange, left image), but it is very difficult to make a meaningful distinction (of SWF) towards the more open tree covered areas. It might be more useful to characterize woody vegetation in this area using the TCD product (right). Please note that the background imagery is NOT the same as used in production (and likely of higher spatial resolution).

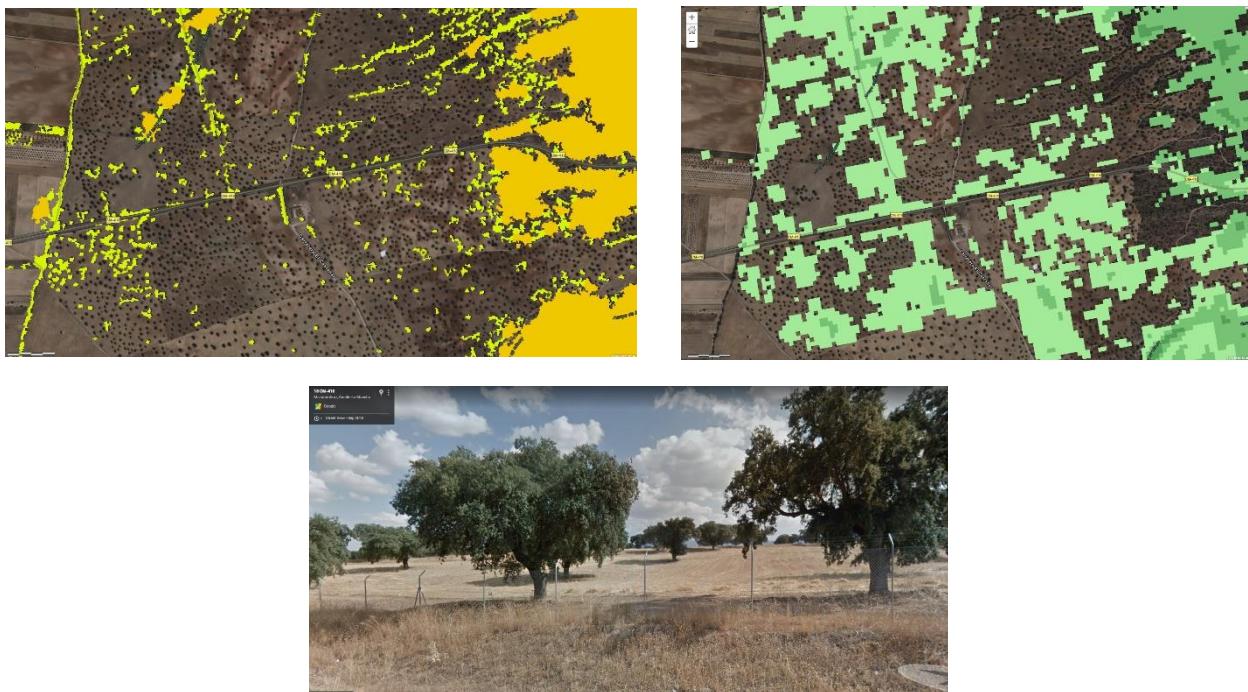


Figure 13: Example of a Dehesa landscape south of Toledo (ES), a multifunctional, agrosylvopastoral system characterized by a mix of dispersed trees or tree groups (often oak) with open grassland for grazing. Given that the individual trees can usually not be captured and/or are too small for the SWF MMU, the results of the SWF mapping (upper left) are only partially meaningful. The TCD product (upper right) captures low density tree cover. Please note that the background imagery is NOT the same as used in production (and likely of higher spatial resolution).

Annex I: File naming convention

For the products, the naming convention is based on the following HRL descriptors:

THEME	YEAR	RESOLUTION	EXTENT	EPSG	VERSION
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THEME:

- 3 letter abbreviation for main products SWF

REFERENCE YEAR

- 2015 in four digits

RESOLUTION

- 3 letter abbreviation “vec” for vector layer
- Four-digit (005m and 100m) for raster layer

EXTENT

- 2-digit country code + 3-digit delivery number for VHR_large_region deliveries, from 001 to 141. E.g. AL065
- “EU” for all deliveries in European Projection (100m raster mosaics)

EPSG

- 4-digit EPSG code (geodetic parameter dataset code by the European Petroleum Survey Group)
- “3035” for the European LAEA projection

VERSION (only for final deliveries)

- 4-digit qualifier of the version number, starting with “V1_1” for a first full final version, and allowing to capture re-processing/calculation of small changes as (“V1_2”, “V1_3” etc.). In case of major changes, a second version should be used (“V2_1”)

Annex II: File format specification

Raster layers:

GeoTIFF or TIFF

Vector layer:

Vector layer will be made available in both ESRI File Geodatabase and the OGC GeoPackage format.

Annex III: Detailed product tables

Table 3: Detailed specifications for small woody features (SWF), 2015 reference year, vector layer

Product Small woody features (SWF) 2015 vector layer "SWF_2015_vec"
Geometric resolution /Scale equivalent 1: 5,000
Coordinate Reference System Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale) According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %) N/A
Data type GIS compatible vector format; too complex polygons shall be split into GI-technical manageable units.
Minimum mapping Unit (MMU) No MMU for the linear elements. MMU for Patchy structures of trees and scrub: 200m ² (size limit of 5000m ²)
Minimum Mapping Length (MML) Linear structures/elements: >= 50 m length. No MML for Patchy structures.
Minimum Mapping Width (MMW) Linear structures/elements: <= 30m (only linear elements > 3m will be validated).
Necessary attributes Area, class names and code
Thematic coding 1 Linear structures of trees, hedges, bushes and scrub 2 Patchy structures of trees, hedges, bushes and scrub 3 Additional woody features
Metadata XML metadata files are to be produced according to INSPIRE metadata standards INSPIRE compliant meta data profile. Specifications available online at http://taskman.eionet.europa.eu/projects/sdi/wiki/Cataloguemetadata_guidelines . Always refer to the online version as these guidelines are periodically updated.
Delivery format Geospatial data shall be provided either in shapefile or personal geodatabase for the vector files; Opendoc shall be used for the documentation and XML for the metadata.

Table 4: Detailed specifications for small woody features (SWF), 2015 reference year, 5m raster layer

Product
Small woody features (SWF) 2015 5m raster layer "SWF_2015_005m"
Geometric resolution /Scale
Pixel resolution 5m x 5m
Coordinate Reference System
Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)
According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)
> 80% user's / producer's accuracy taking into account the relative occurrence of the thematic classes to be identified.
Data type
8bit unsigned raster with LZW compression
Minimum mapping Unit (MMU)
No MMU (The MMU > 200 m ² for the patchy structures is applied on the vector product).
Minimum Mapping Length (MML)
No MML (The MML >= 50 m for the linear structures is applied on the vector product).
Minimum Mapping Width (MMW)
No MMW (The MMW <= 30 m for the linear structures is applied on the vector product).
Thematic coding
0: Non SWF area 1: SWF area (Linear or patchy structures of trees, hedges, bushes and scrub) 3: Additional woody features 254: Unclassifiable (no satellite image available, or clouds, shadows) 255: Outside area
Metadata
XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format
GeoTIFF

Table 5: Detailed specifications for small woody features (SWF), 2015 reference year, 100m raster layer

Product
Small woody features (SWF) 2015 100m raster layer "SWF_2015_100m"
Geometric resolution /Scale
Pixel resolution 100m x 100m
Coordinate Reference System
Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)
According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)
N/A
Data type
8bit unsigned raster with LZW compression
Minimum mapping Unit (MMU)
No MMU
Minimum Mapping Length (MML)
No MML
Minimum Mapping Width (MMW)
No MMW
Thematic coding
0: Non SWF area 1-100: increased SWF density (from 1 to 100%) 254: Unclassifiable (no satellite image available, or clouds, shadows) 255: Outside area
Metadata
XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format
GeoTIFF

Table 6: Detailed specifications for additional woody features (AWF), 2015 reference year, 100m raster layer

Product
Additional woody features (AWF) 2015 100m raster layer "AWF_2015_100m"
Geometric resolution /Scale
Pixel resolution 100m x 100m
Coordinate Reference System
Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)
According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)
N/A
Data type
8bit unsigned raster with LZW compression
Minimum mapping Unit (MMU)
No MMU
Minimum Mapping Length (MML)
No MML
Minimum Mapping Width (MMW)
No MMW
Thematic coding
0: Non SWF area 1-100: increased AWF density (from 1 to 100%) 254: Unclassifiable (no satellite image available, or clouds, shadows) 255: Outside area
Metadata
XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format
GeoTIFF

Table 7: Detailed specifications for small and additional woody features (SWFAWF), 2015 reference year, 100m raster layer

Product	Small and Additional woody features (SWFAWF) 2015 100m raster layer "SWFAWF_2015_100m"
Geometric resolution /Scale	Pixel resolution 100m x 100m
Coordinate Reference System	Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)	According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)	N/A
Data type	8bit unsigned raster with LZW compression
Minimum mapping Unit (MMU)	No MMU
Minimum Mapping Length (MML)	No MML
Minimum Mapping Width (MMW)	No MMW
Thematic coding	<p>0: Non SWF area</p> <p>1-100: increased SWF+AWF density (from 1 to 100%)</p> <p>254: Unclassifiable (no satellite image available, or clouds, shadows)</p> <p>255: Outside area</p>
Metadata	XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format	GeoTIFF

Table 8: Detailed specifications for the additional confidence layer

Product
HRL_SWF_QualityLayer_final.tif
Geometric resolution /Scale
Pixel resolution 100m x 100m
Coordinate Reference System
Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)
According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)
N/A
Data type
8bit unsigned raster with LZW compression
Minimum mapping Unit (MMU)
No MMU
Minimum Mapping Length (MML)
No MML
Minimum Mapping Width (MMW)
No MMW
Thematic coding
0-10: Increased SWF layer product confidence
Metadata
XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format
GeoTIFF

Table 9: Detailed specifications for the PSIL layer (Parent Scene Identification Layer)

Product
HRL2015_SWF_PSIL
Geometric resolution /Scale
equivalent 1: 5,000
Coordinate Reference System
Production in European ETRS89 LAEA projection (EPSG 3035) / national projections to be provided after production
Geometric accuracy (positioning scale)
According to ortho-rectified satellite image base delivered by ESA.
Thematic accuracy (in %)
N/A
Data type
GIS compatible vector format; too complex polygons shall be split into GI-technical manageable units.
Minimum mapping Unit (MMU)
No MMU
Minimum Mapping Length (MML)
No MML
Minimum Mapping Width (MMW)
No MMW
Attributes
TAR: Archive name in the VHR_IMAGE_2015 dataset
IDENTIFIER: Scene identifier
PRODTYPE: Sensor
PARENT: Path in VHR_IMAGE_2015 dataset
BEGIN: Acquisition time start
END: Acquisition time end
DATASETS: DWH dataset
COUNTRY: Country
PROJ: Coordinate System (EPSG:3035)
LR: Large region
CLOUD_COV: Cloud Coverage estimated from cloud masks provided by JRC
Metadata
XML metadata files are to be produced according to INSPIRE metadata standards
Delivery format
ESRI Shapefile

Annex IV: Colour palette & attribute fields

For each product, both the GIS files specifying the colour palettes, and a table listing the RGB values for possible non-GIS products and material are provided.

Formats:

- *.clr for GIS colour palettes
- *.txt for other purpose

The colour palettes are as follow:

SWF 5m raster product

Classcode	Classname	Red	Green	Blue	Render
0	Non SWF area	240	240	240	
1	SWF area	60	250	50	
3	AWF	240	200	0	
254	Unclassified	153	153	153	
255	Outside Area	0	0	0	

SWF 100m raster product (SWF density / AWF density / SWF+AWF density)

Classcode	Classname	Red	Green	Blue	Render
0	Non SWF area	240	240	240	
1	1% SWF/AWF/SWF+AWF density	186	255	172	
50	50% SWF/AWF/SWF+AWF density	85	160	89	
100	100% SWF/AWF/SWF+AWF density	28	92	36	
254	Unclassified	153	153	153	
255	Outside Area	0	0	0	



Annex V: Delivery Units

The VHR_IMAGE_2015 dataset covers the EEA39 national territories to a total of ~6 Mio. km² and is divided into 140 “Large Regions” (LR), shown in Figure 14. The production follows that division and products are produced and delivered by LR, with the exception of 100m raster products that only exists as full EEA39 mosaics.

Please note that the timing and quality of the VHR input imagery was not sufficient to allow a satisfactory SWF product quality for two delivery units in Norway (116 and 119). We were not able to improve the quality for those areas significantly, and therefore exclude these areas from the delivery. Results for these 2 regions can be made available on request in particular cases.

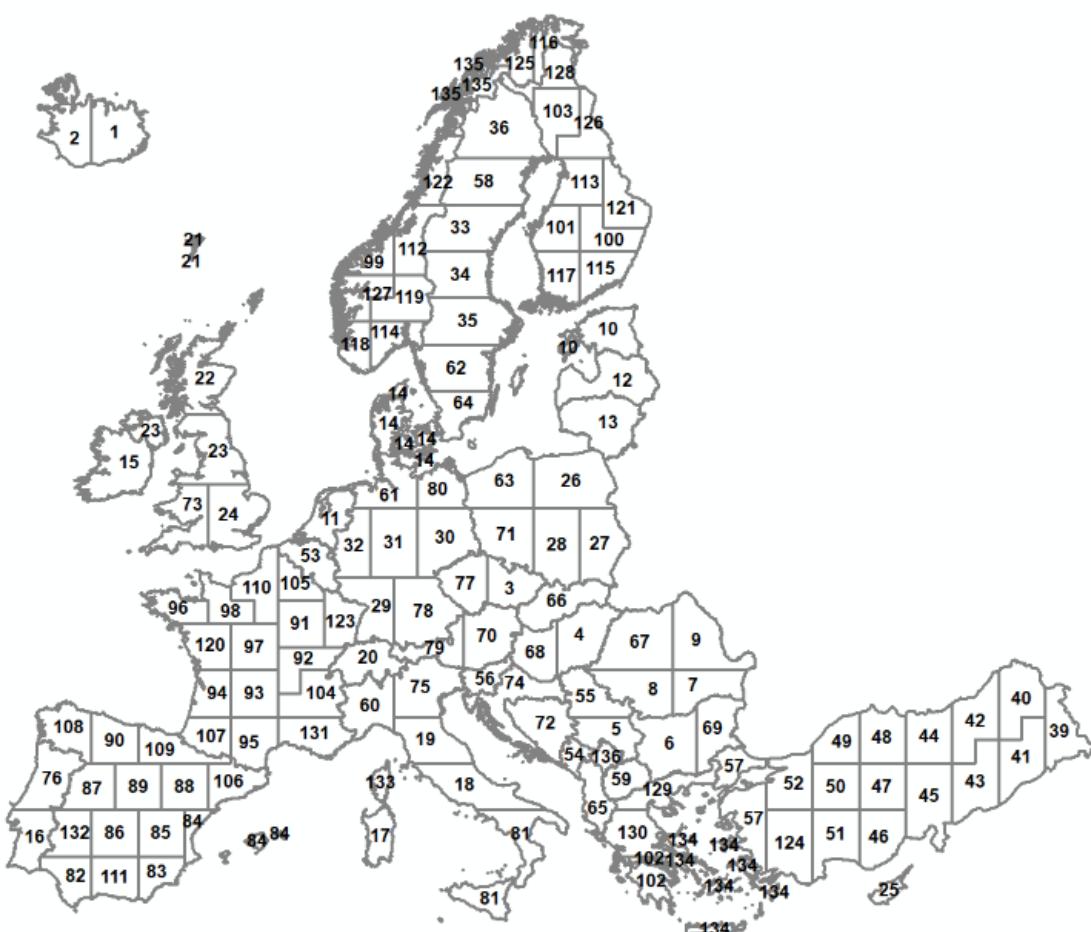


Figure 14: Divisions of the Large Regions for the VHR_IMAGE_2015 dataset