

How to monitor Small Landscape Features (SLF) using Copernicus land monitoring products? State of play



Land Monitoring

Meeting DG AGRI-C4-GREXE
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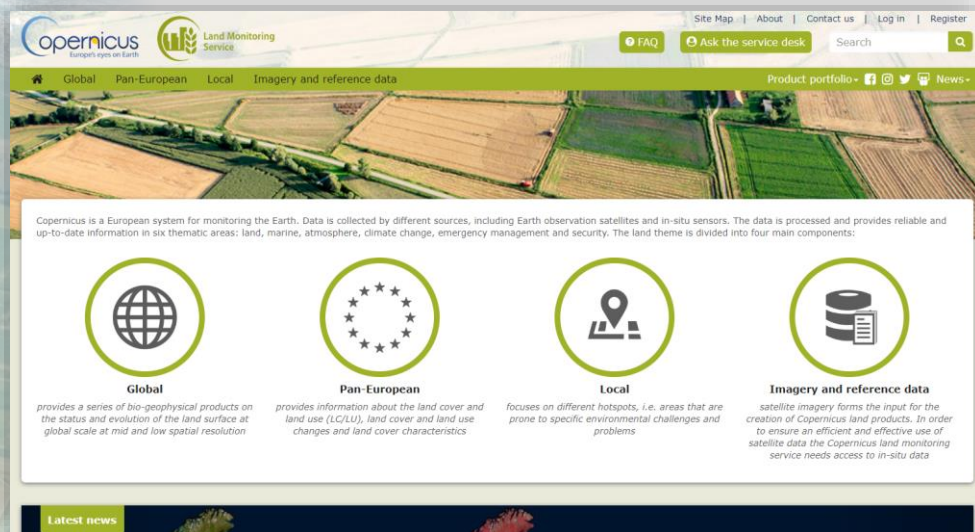
Outline of presentation

- Status of affairs with the HRL SWF (2015 results, and 2018 update CfT on-going)
- Progress in the use of AI in the detection of SLF, using XHR data for training, and then deploying on VHR
- The roadmap ahead



Copernicus Land Monitoring Service (CLMS) – context

- CLMS (Copernicus Land Monitoring Service) implemented by the European Environment Agency (EEA) and the Joint Research Centre (JRC)
- CLMS provides operational products and services, derived from satellite imagery and produced by industry
- Products and services are made available, free and open through the Copernicus land portal <https://land.copernicus.eu/> both as view service, web map services and for download.





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Example 10m HRL Tree Cover Density (TCD) 2018





CLMS: HRL Small Woody Features (SWF) - context

- **Production delay:** Small Woody Feature (SWF) product as a new product for 2015 reference year, but production challenges meant that it was only published in 2019
- For some areas in NO it was not possible to produce in sufficient quality due to input data quality and acquisition timing.
- **HRL SWF 2018** Call for Tender published May 2020. Production will start in Q4 2020. Some improvements and modifications of product as compared to 2015
- **VHR 2018 coverage also improved** as compared to 2015!



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HRL Small Woody Features (SWF)

What it is:

- Continental scale **detailed vector and raster mapping of small woody landscape elements**
- Maps linear elements and patches of woody vegetation (e.g. hedgerows and patches of trees) as a vector and raster (5m/100m) product
- Fully automated product

What it is not:

- Distinction of **trees from shrubs** and other woody vegetation
- Mapping of **height or length** of woody features
- Mapping of **plant species** or plant functional types
- Mapping of **other small landscape features** (stonewalls etc.)
- **Detailed manual delineation** of woody features





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HRL SWF2015 coverage & user documentation

<https://land.copernicus.eu/pan-european/high-resolution-layers/small-woody-features>

SWF 2015 - Availability -





HRL SWF geometric characteristics

Table 1: Geometric specifications of SWF 2015 (to be modified for the 2018 SWF)

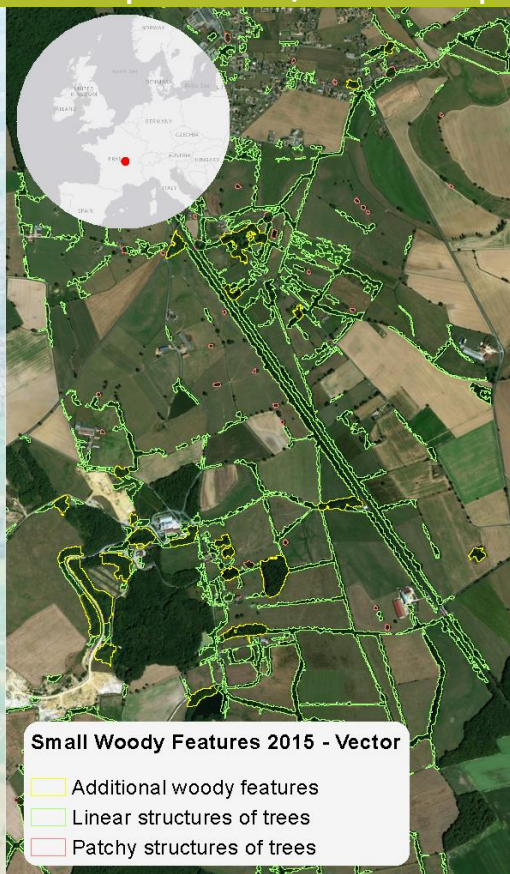
	Linear Structures	Patchy Structures
Width	$\leq 30\text{m}$	n/a
Length	$\geq 30\text{m}$ (was 50m for 2015)	n/a
Compactness	≤ 0.75	> 0.75
Area	n/a	$200\text{m}^2 \leq \text{area} \leq 5000\text{m}^2$

!!! Fine tuning of threshold values to be expected for SWF 2018



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Example LU/LC mapping: Small Woody Features (SWF)



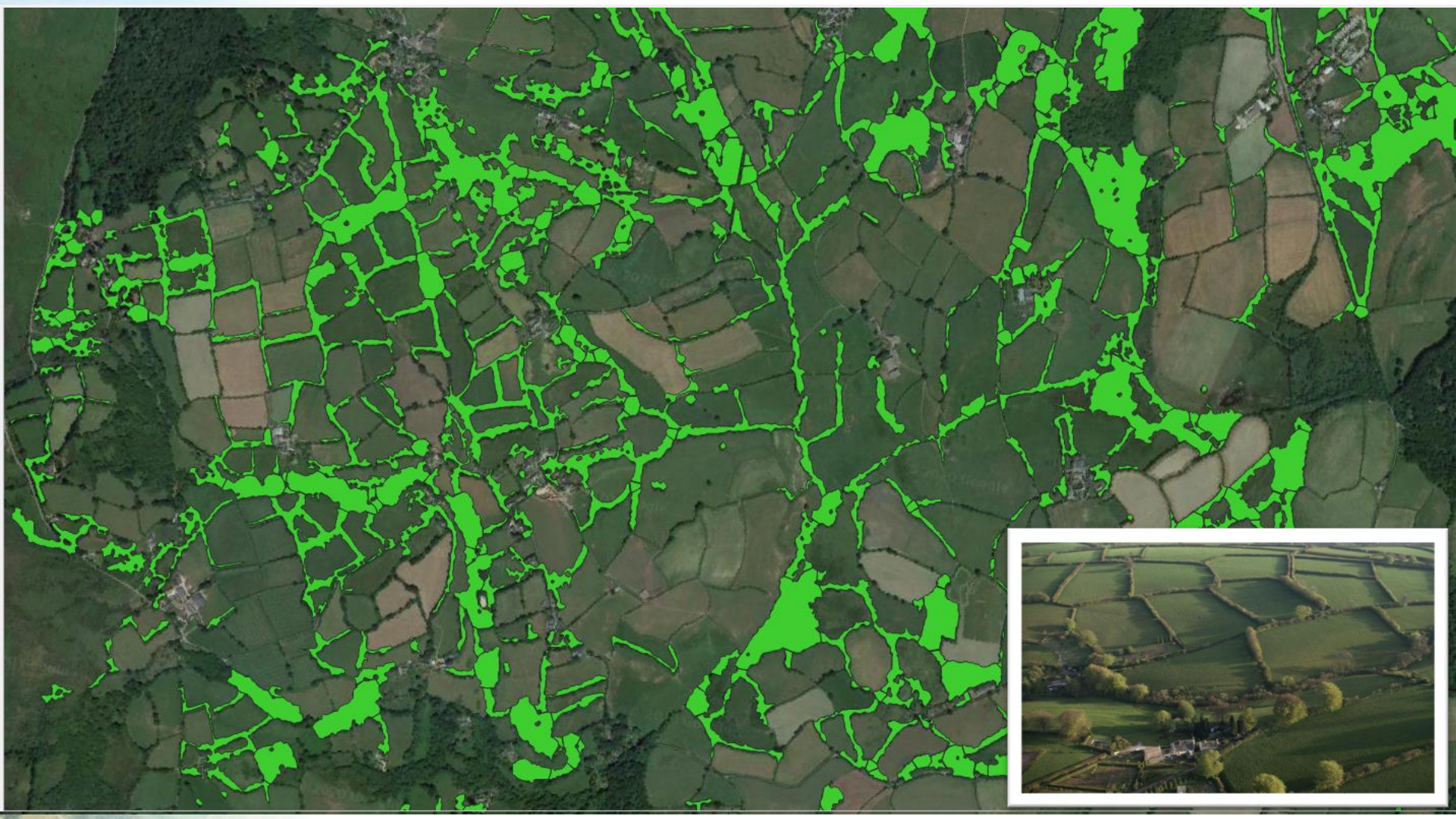


Challenge: HRL SWF – not equally meaningful everywhere!

- The SWF product provides 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



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).



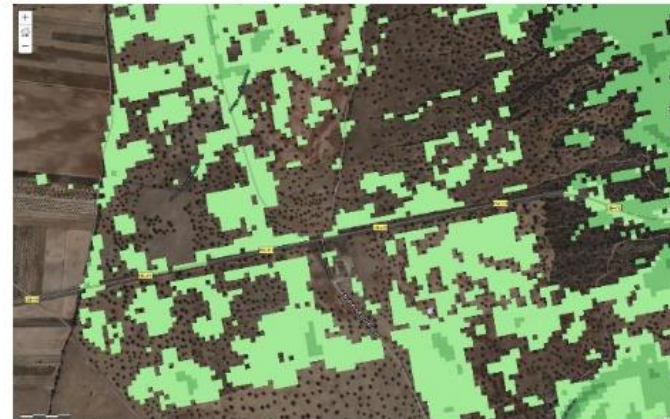
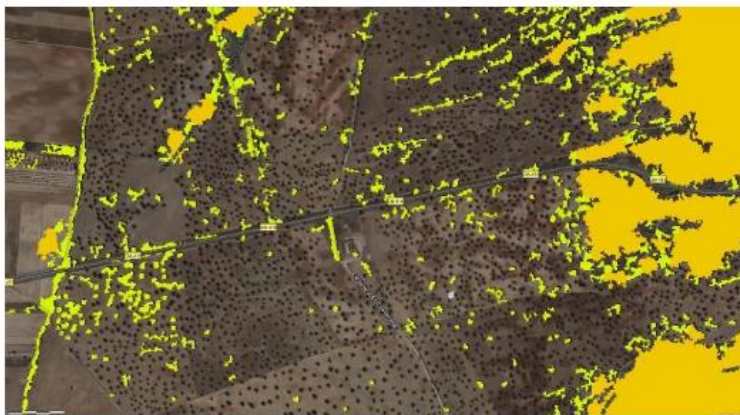


Figure 13: Example of a Dehesa landscape south of Toledo (ES), a multifunctional, agrosilvopastoral system characterized by a mix of dispersed trees or tree groups (often oak) with open grassland for grazing. Given that the individual trees can usually not be captured and/or are too small for the SWF 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).

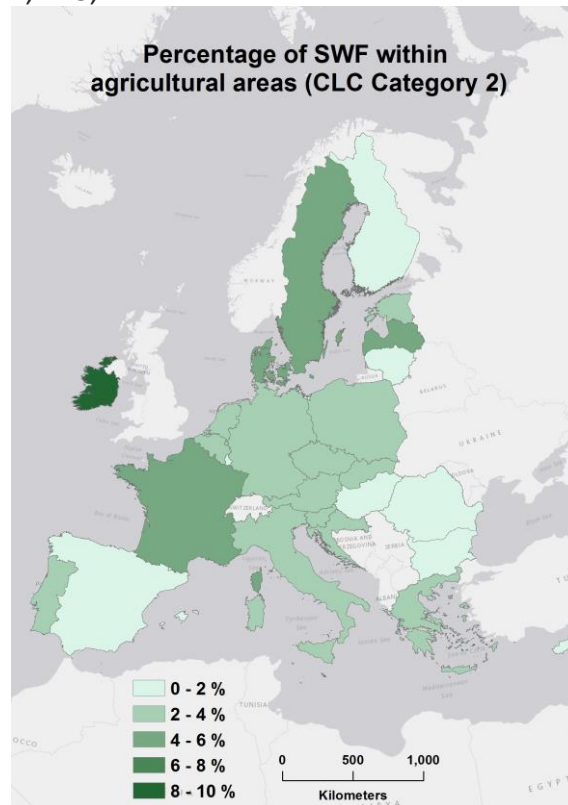
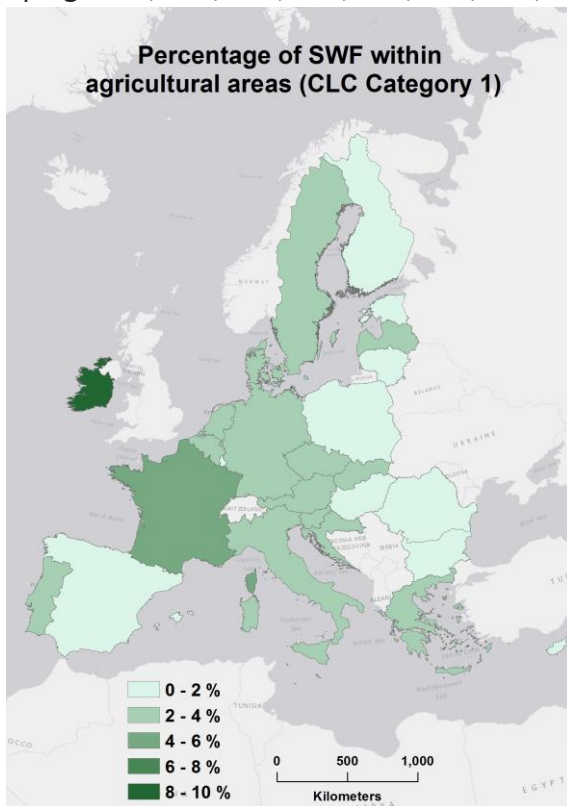


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Example indicator: % of SWF within CLC agricultural classes

CLC Category 1 grouping: 211, 212, 213, 221, 222, 223, 231, 241

CLC Category 2 grouping : 211, 212, 213, 221, 222, 223, 231, 241, 242, 243, 244





Part 2: From SWF to Small Landscape Features (SLF)

- Continued interest in additional **small landscape features** in the context of the GAECs under the new CAP.
- However, Small Landscape Features are a heterogenous mapping target.
- In EEA Copernicus exploratory use case, SLFs are understood as:
 - Stone walls
 - Small ditches
 - Small streams
 - Small tracks
 - **Hedgerows**
 - **Small tree groves**
 - Individual trees
 - Small ponds
 - Strips and patches of grass and flowers along field margins



Outlook: Small Landscape features (SLF)

- **Most** of these small landscape **features cannot be mapped operationally as part of the HRL SWF 2018 product**, using the data available (VHR2018 with 2-4 m spatial resolution)
- EEA is **exploring the potential to map those features using XHR data** (eXtreme High-Resolution satellite images around 50 cm spatial resolution)
 - **Objective:** Evaluate potential of a Deep Learning based approach to classify SLFs using submeter XHR data, going beyond the green/woody features already captured by the HRL SWF (Small Woody Features) product
 - Identify **potential/challenges** in using results from submeter data along with VHR2018 to scale up at continental level
 - Evaluation of potential for using submeter data **as training data** for coarser model
- **First results are promising**, but feasibility needs to be further tested and data availability is a limiting factor



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Small Landscape Features – pilot sites

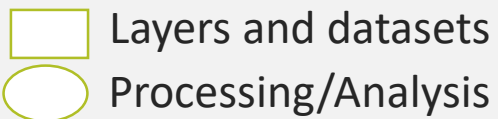
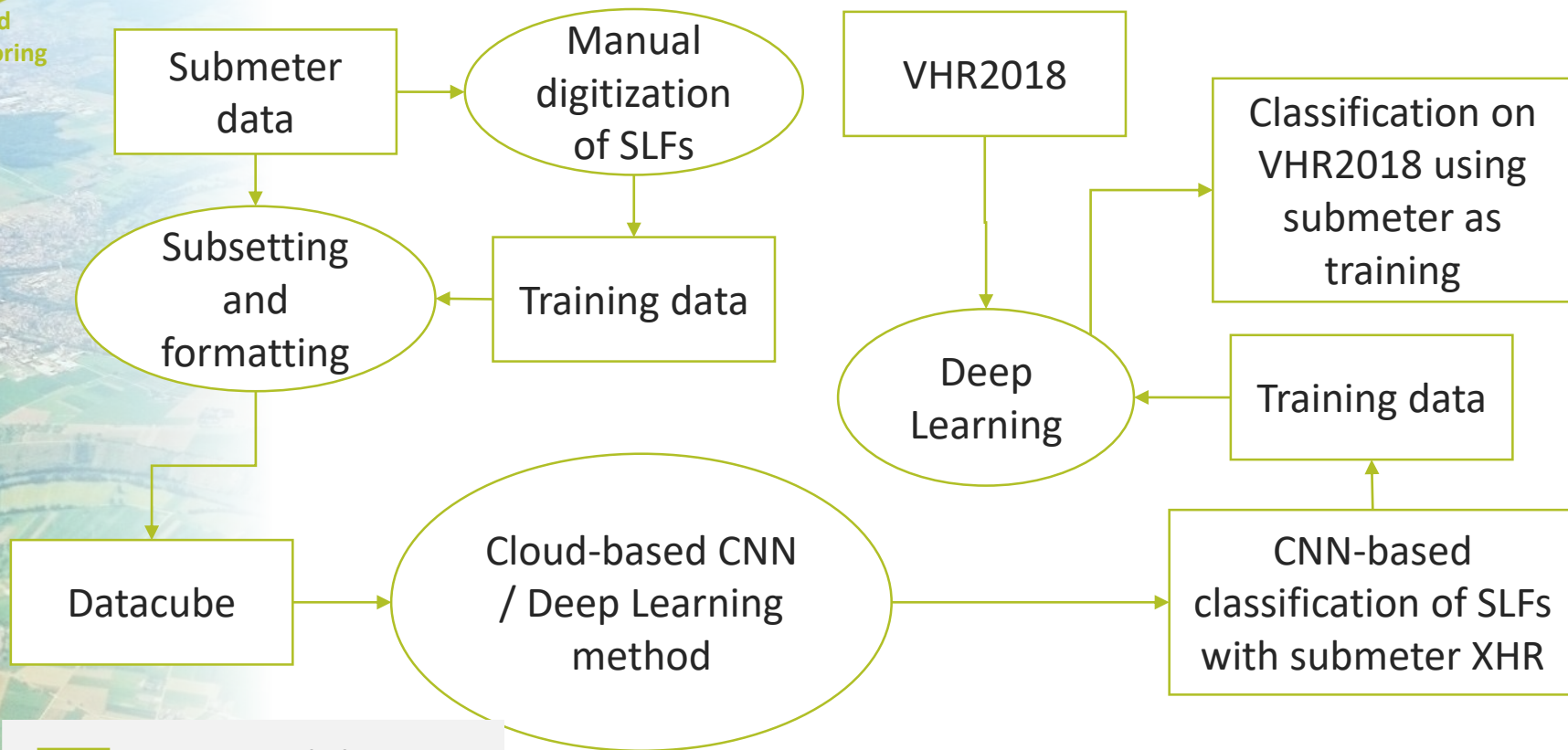
- Status
 - 10 test sites (1 km² each) throughout pan Europe
 - All sites have been mapped.
- Data sources:
 - Pleiades:
UK, PL, BG, IE
 - WorldView2:
DK, ES, FR, FI
 - WorldView3:
CY, NL





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Small Landscape Features - Workflow





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Small Landscape Features- Preliminary results

SLFs in the United Kingdom. Irregularly shaped hedges and shrubbery. A few isolated trees and bushes, along with a few tracks characterise this landscape.

50cm data



Small Landscape Elements



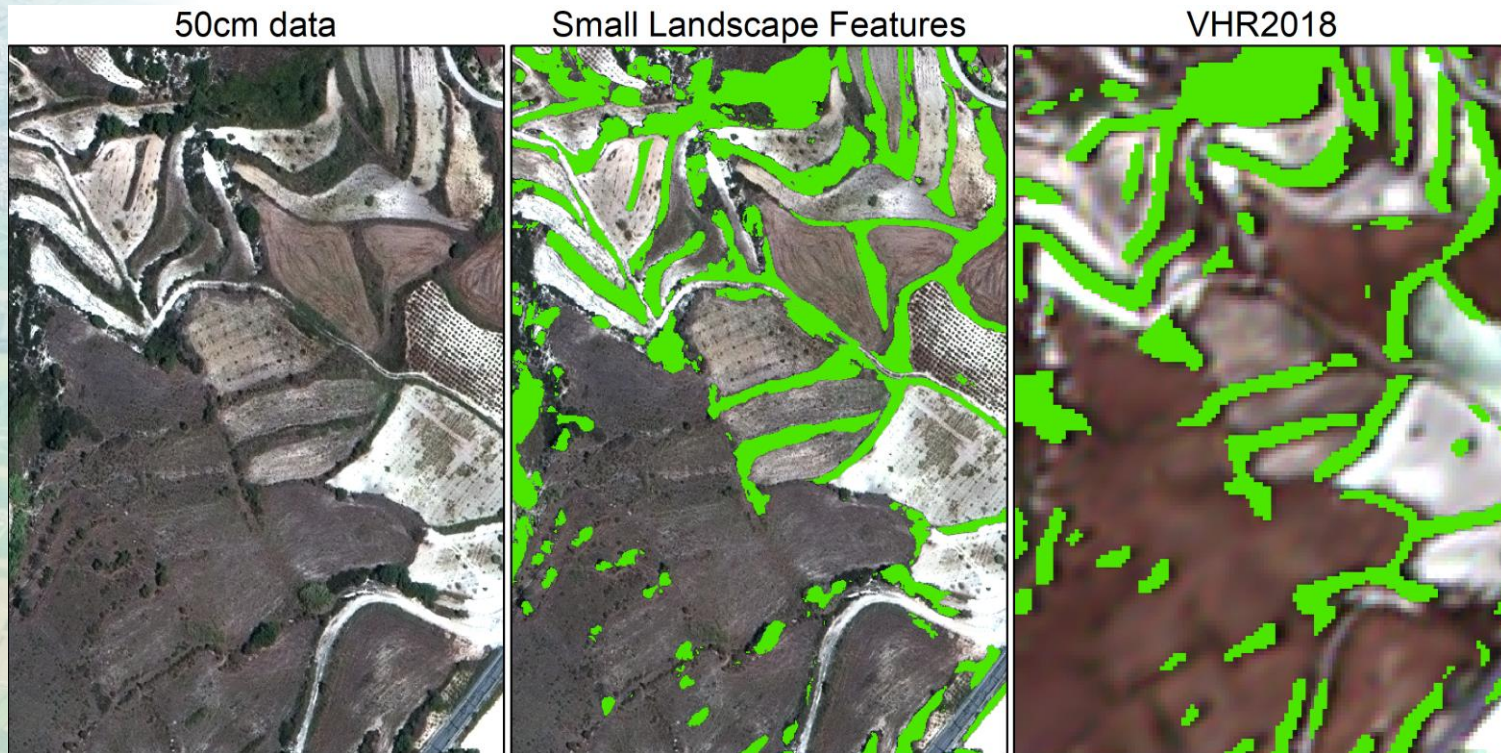
VHR2018





Small Landscape Features – Preliminary results

SLFs in Cyprus. Irregularly shaped hedges, terraces, and groves as well as a few isolated trees characterise this landscape





Small Landscape Features – Results and way forward

Preliminary results indicate significant potential of improved SLF mapping potential using submeter XHR data:

Feature	Feasibility with VHR2018		Feasibility with submeter VHR	
Stone walls	Doable	😊	Doable	😊
Small ditches	Partly feasible	😐	Doable	😊
Small streams	Partly feasible	😐	Doable	😊
Hedgerows	Doable	😊	Doable	😊
Small tree groves	Partly feasible	😐	Doable	😊
Individual trees	Challenging	😞	Doable	😊
Small ponds	Partly feasible	😐	Doable	😊
Small tracks	Challenging	😞	Challenging	😞
Strips and patches of grass and flowers in fields	Challenging	😞	Challenging	😞



Small Landscape Features - Challenges

Main challenges:

- Many SLFs are **too small** to be reliably identified in the coarser ranges of VHR2018
- **Consistent identification** of SLFs;
- **Clear definition** and delineation of SLF features to be included in the SLF product going forward

Submeter data



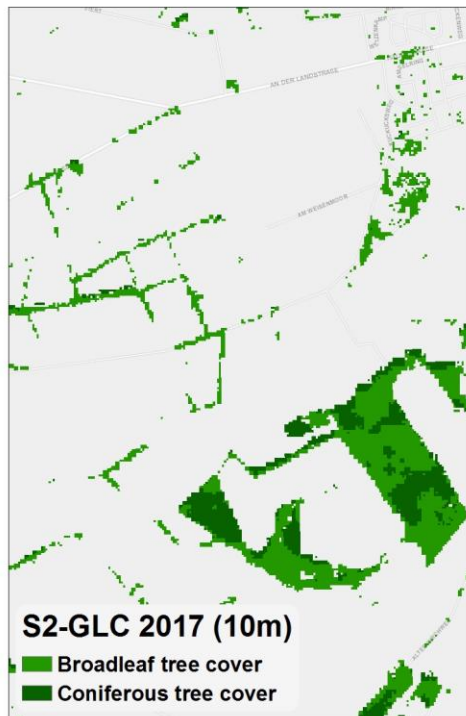
VHR2018





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Combining HRL Forest Type (FTY) with HRL SWF



Hamburg (50 km west)



53.5767642 N, 9.2291013 E



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HRLs for monitoring ecological corridors



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Roadmap part 1: Methodological development (August 2020 to December 2020)

Task	Steps	Deadline / status
1) Defining and producing a spatial layer for agricultural area (AA)	Selection of CLC classes	Done
	Overlay with HRL layers	Ongoing
	Visual validation / country level tests	Sept 2020
2) Review of landscape features (LF)	Review existing lists of LF	Sept 2020
	Classify into important / nice to have	
3) Identifying LF that can be monitored by Copernicus data from 2021 onwards	Compare priority LF from step 2) to available Copernicus products	Oct / Nov 2020
	Identify which LF can be reliably monitored from 2021 onwards	
4) Producing a calculation method that combines the elements above	Considering outcomes of steps 1) and 3) decide on formula for the calculation of area of LF per country / NUTS region in relation to AA; encode within EEA's geo-spatial accounting system	Nov 2020
5) Interaction points with DG AGRI	To enable feedback on draft outputs and direction of work	Early Oct 2020
		Dec 2020





Roadmap part 2: Implementation + Delivery (January 2021 to June 2021)

Task	Steps	Deadline / status
1) Acquiring time series data for LF to be measured	Put together available Copernicus HRL data sets (e.g. SWF 2015 and 2018) as foundation for calculation of LF area	March 2021
2) Calculation of LF area per country / NUTS regions	Using data from step 1 above utilise outcome of step a) 4) to calculate LF area of LF per country / NUTS region in relation to AA	April - May 2021
3) Integration of LF data as spatial data set in EEA's geo-spatial accounting system	To facilitate an efficient (future) production and to make LF data available for additional spatial analysis integrate data products from steps 1) and 2) above in EEA IDP	Q2 2021
4) Delivery of LF area calculation per AA to DG AGRI	Building on steps 1) and 2) above, carry out final validation of approach and deliver resulting data sets to DG AGRI (data format to be specified)	June 2021
5) Interaction points with DG AGRI	To enable feedback on draft outputs and direction of work	March 2021 May 2021



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Thank you


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