



Land Monitoring

# Copernicus Land Monitoring Service - Land and Soil

ESA Symposium: EO for Soil Protection and Restoration

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7 March 2024



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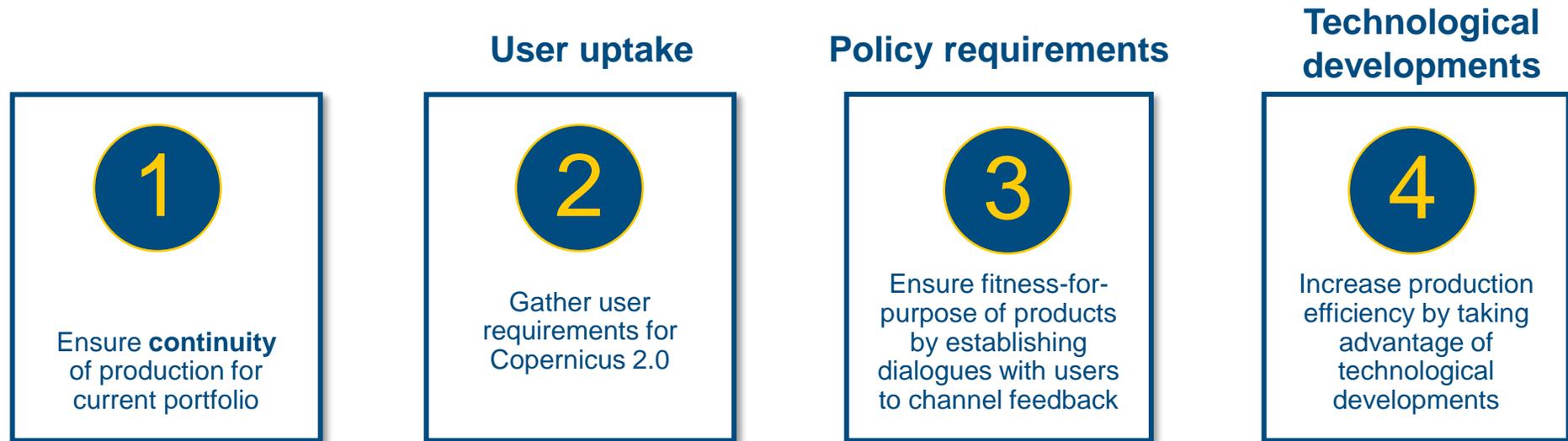
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# Copernicus Land Monitoring Service

- **>160 products on land cover and its changes, land use, vegetation state, ground motion, water cycle and Earth's surface energy variables** at European and global levels for multiple domains and applications
- **Harmonized and consistent geographical datasets**
- **Free, full and open data policy**
- **Priorities for CLMS 2.0 (2021-2027):**



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# CLMS portfolio overview

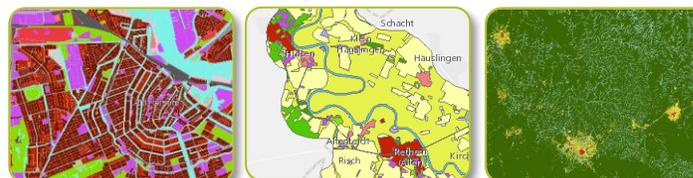
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## Land cover and land use mapping



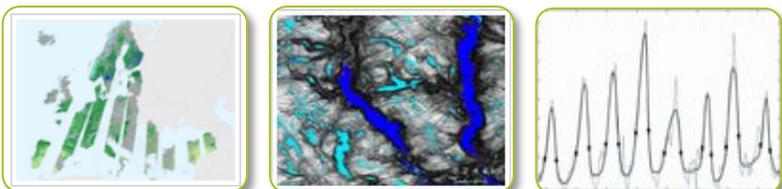
## Priority area monitoring



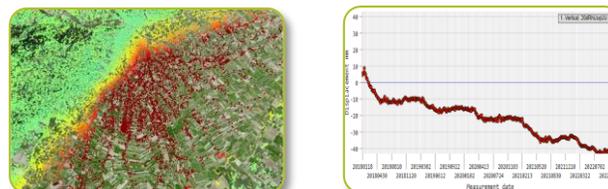
## Satellite data



## Bio-geophysical parameters



## Ground motion monitoring



## Reference and validation data



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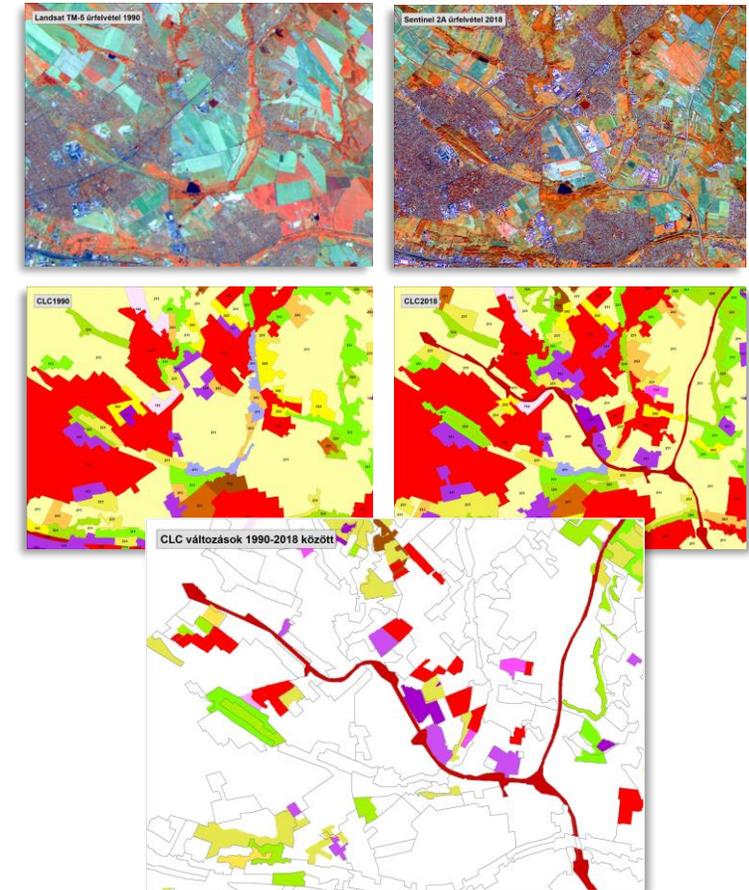
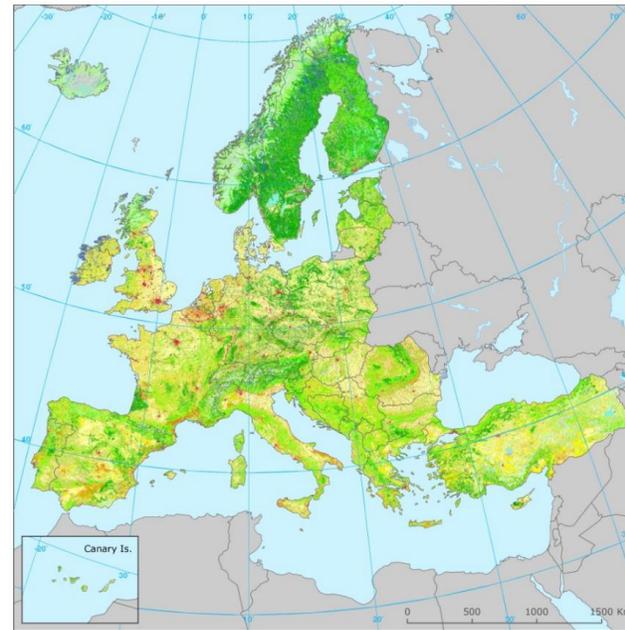




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# CORINE Land Cover (CLC)

- **CORINE** = Coordination of Information on the Environment
- **Oldest and most sought-after dataset** of CLMS
- **Coordination and implementation**
  - Coordination by EEA
  - Implemented by 39 countries (32 EEA member countries + UK, and 6 cooperating countries)
- **Basic parameters and methodology unchanged!**
  - MMU: 25 ha (MMW:100 m)
  - 3-level nomenclature with **44 LCLU classes**
  - **Direct mapping of changes**



1990

2000

2006

2012

2018

2024



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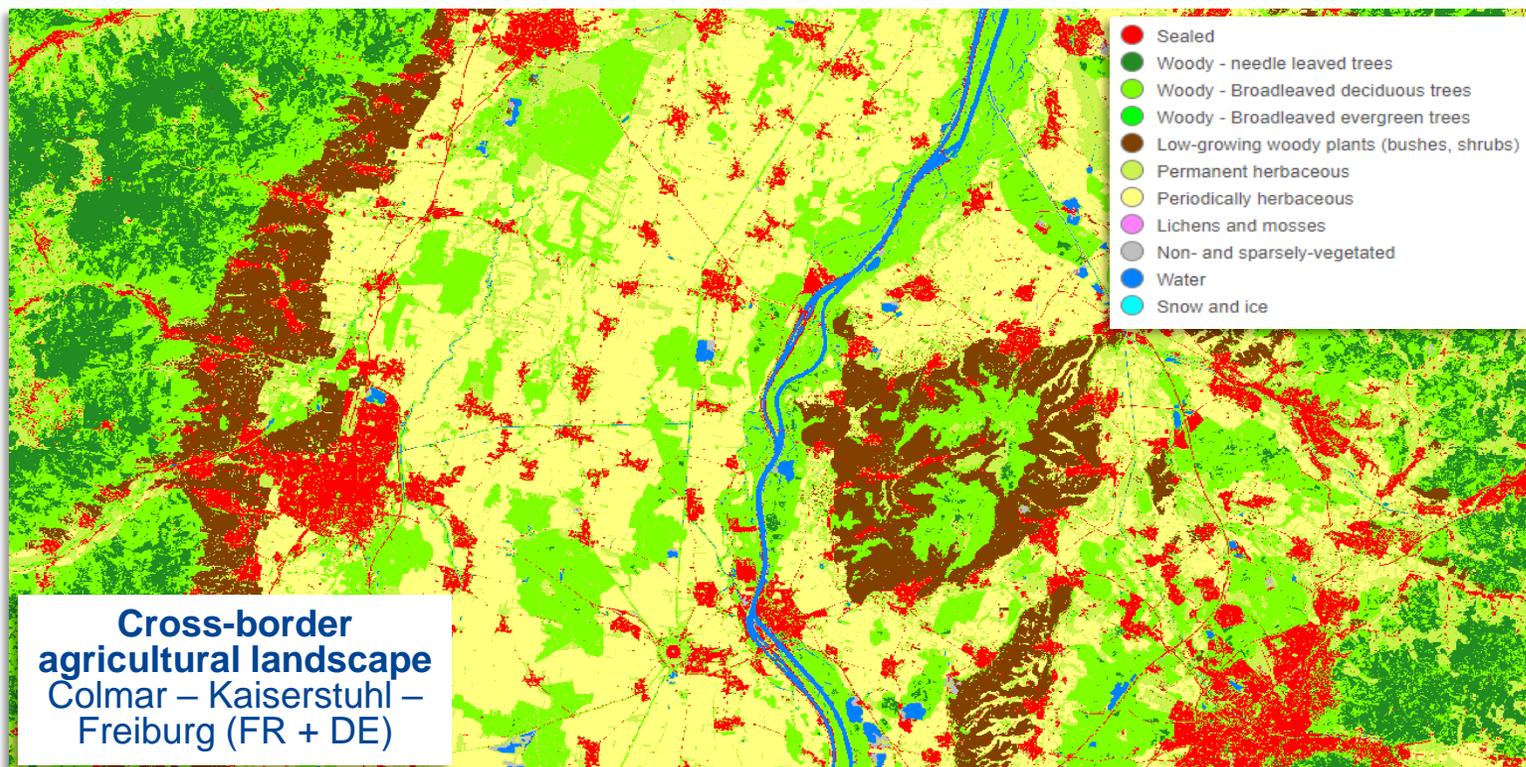


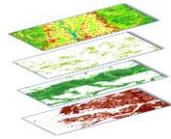


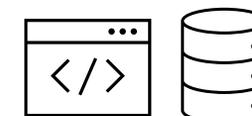
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# CLC+ Product suite

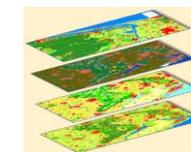
- CLC+ Backbone raster (10m)



  
**Existing LC data**  
(e.g. CLC+ BB, national)



**CLC+ Core**  
(DB + Webapp)



**CLC+ Instances**  
(downstream LC product)



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# HRL Non-Vegetated Land Cover Characteristics (NVLCC)

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## Imperviousness Density (% IMD)



Imperviousness Built-up (IBU)

2021 (publication: Q4 2024)



## Permanent Bare Surfaces

Level	Land Cover Components																					
	ABIOTIC					BIOTIC					WATER											
Lv1	Artificial					Natural					Liquid	Solid										
Lv2	Sealed		Non-Sealed		Consolidated	Un-Consolidated		Trees	Bushes	Grass-like	Forbs Ferns	Succulents	Lichen, Mosses, Algae	Liquid	Solid							
Lv3	Buildings	Specific Structures	Open Sealed	Open Non-Sealed	Waste	Bare Rock	Hard Pan	Min. Fragment	Bare Soil	Nat. Deposits	Regular	Dwarf St	Grass, C	Reeds, E	Lichens	Mosses	Algae	Inland	Marine	Snow	Ice	
Lv3																		[...]				





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# NVLC: Imperviousness Change

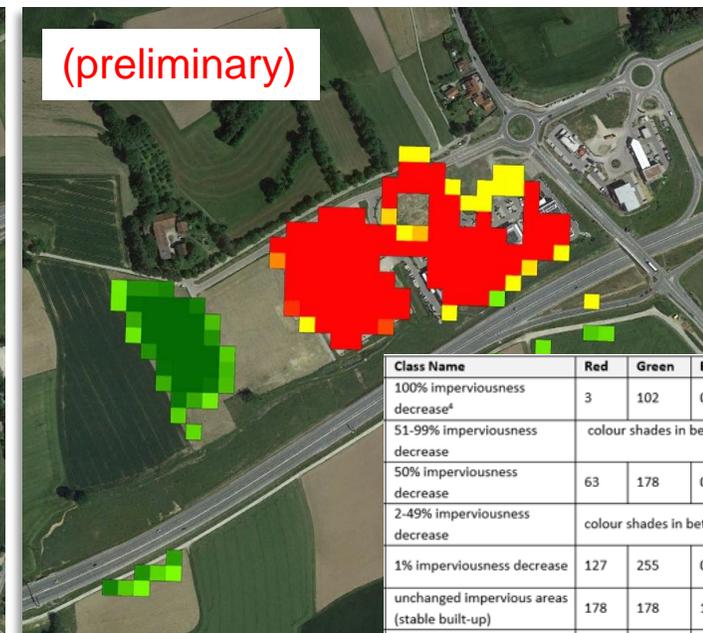
Degree of Imperviousness  
Change (IMDC) 18-21 (20m)



04/2018



06/2021



Class Name	Red	Green	Blue	
100% imperviousness decrease <sup>a</sup>	3	102	0	
51-99% imperviousness decrease	colour shades in between			
50% imperviousness decrease	63	178	0	
2-49% imperviousness decrease	colour shades in between			
1% imperviousness decrease	127	255	0	
unchanged impervious areas (stable built-up)	178	178	178	
1% imperviousness increase	255	255	0	
2-49% imperviousness increase	colour shades in between			
50% imperviousness increase	255	191	0	
51-99% imperviousness increase	colour shades in between			
100% imperviousness increase	255	0	0	
unchanged non-impervious areas (stable non-built up)	240	240	240	
outside area	0	0	0	



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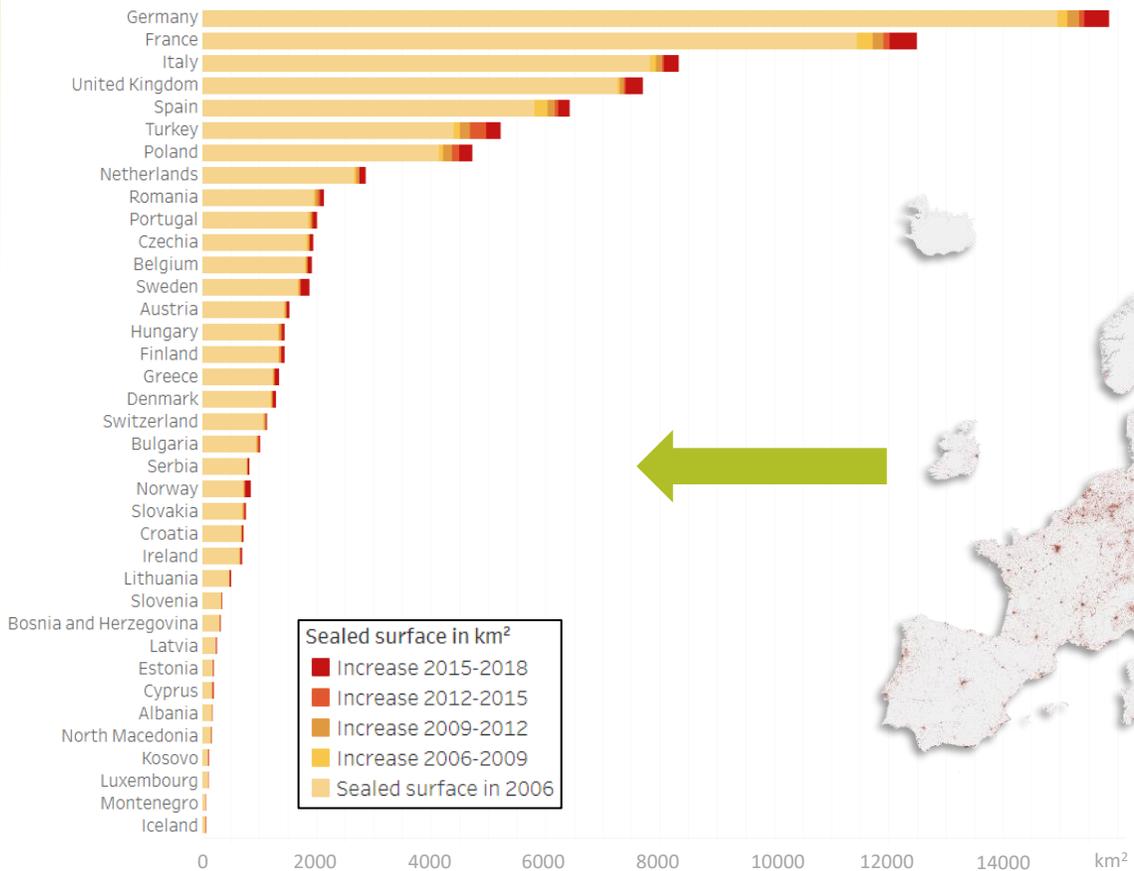
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# Imperviousness: Soil sealing in Europe

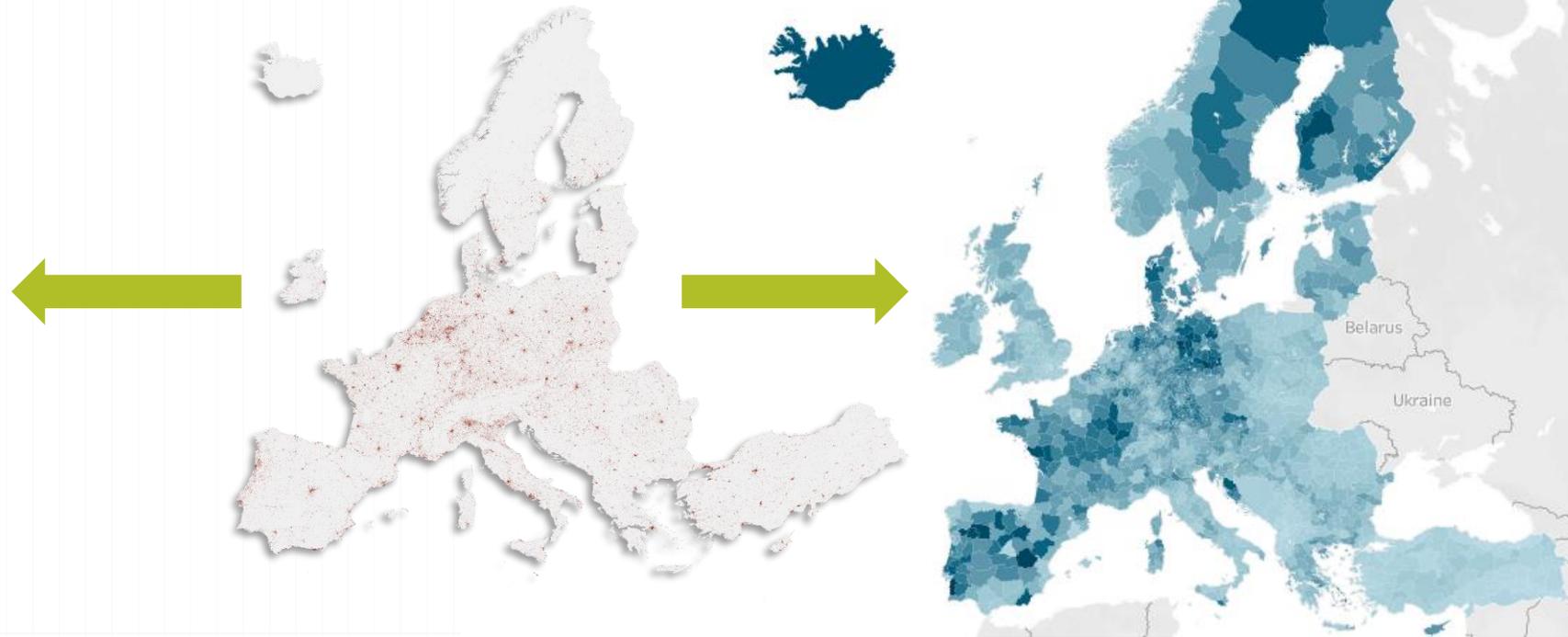
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2018: Sealed area (km²) per 1 Mio. inhabitants

576

34



<https://www.eea.europa.eu/data-and-maps/dashboards/soil-sealing-and-ecosystem-impacts>

<https://www.eea.europa.eu/data-and-maps/dashboards/imperviousness-in-europe>



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# HRL Vegetated Land Cover Characteristics (VLCC)

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**FOREST**

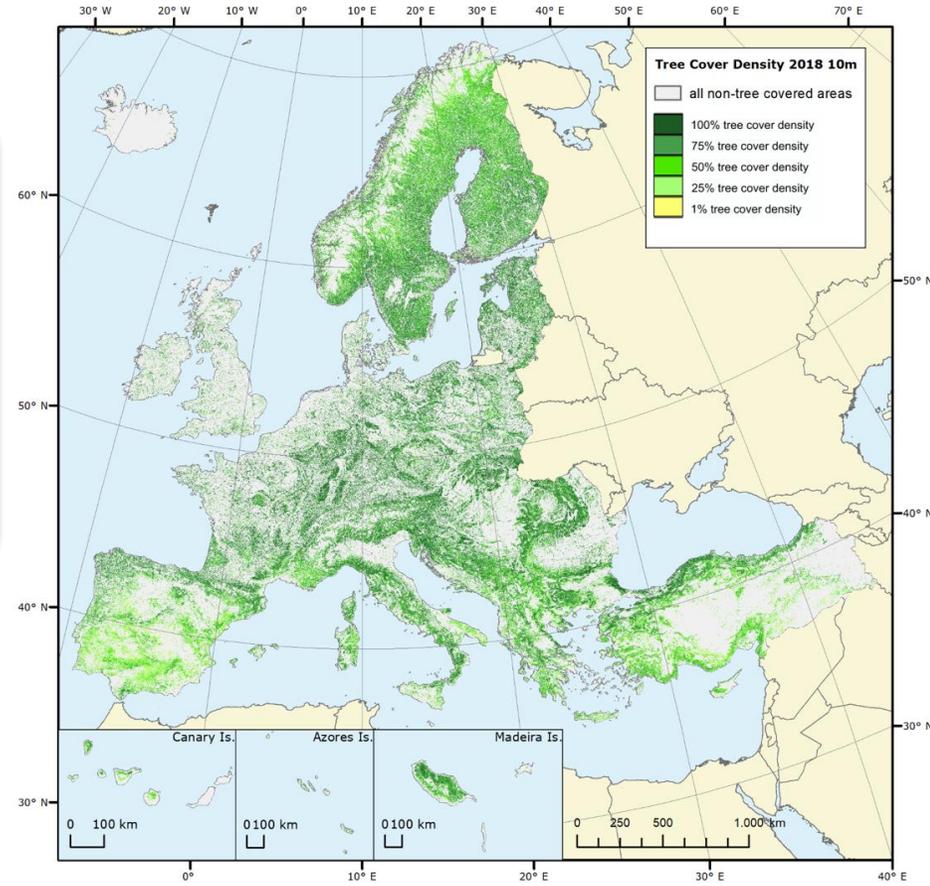
- Tree Cover Density TCD (10m)
- Dominant Leaf Type DLT (10m)
- Broadleaved Cover Density BCD(100m)
- Coniferous Cover Density CCD (100m)
- Tree Cover Presence Change TCPC (20m)
- Dominant Leaf Type Change DLTC (20m)
- Forest Type FTY (10, 100m)
- Forest Additional Support Layer FADSL (10m)

**GRASSLAND**

- Grassland GRA (10m)
- Herbaceous cover HER (10m)
- Plough PLOUGH (10m)
- Grassland Probability Index GRAVPI (10m)
- Mowing events GRAM (10m)
- Grassland Change GRAC (20m)

**CROP TYPES**

- Crop Types CT (10m)
- Crop Diversity and Diversification CDD (10m)
- Harvest and Bare Soil HBS (10m)
- Fallow Land FL (10m)
- Cover Crops CC (10m)



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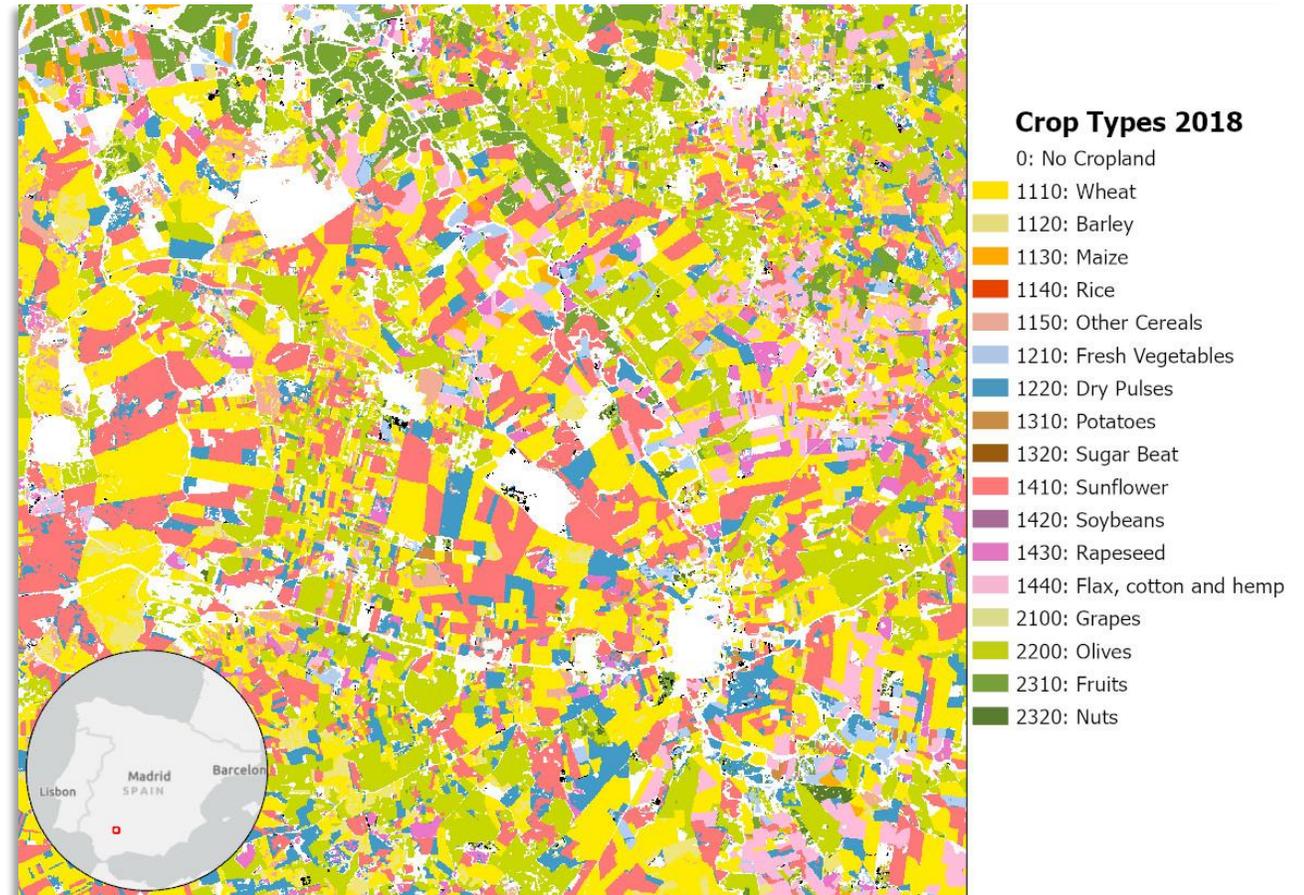
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# VLCC: Crop Types

- Spatial resolution: 10 m
- Update frequency: Annual
- 2017-2021 to be published in Q2 2024
- Cropping patterns (Expert):
  - Main/Secondary crop emergence - harvest dates, duration;
  - Harvest and Bare soil;
  - Fallow land presence and duration;
  - Cover crops





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# VLCC: Grassland mowing events



No. of  
events  
(2021)

Events	Colour
0	Light blue
1	Light cyan
2	Light green
3	Medium green
4+	Dark green

1<sup>st</sup>

Mowing  
Dates (2021)

2<sup>nd</sup>

Date	Colour
1 Jan	Light orange
↓	
31 Dec	Dark red

3<sup>rd</sup>

4<sup>th</sup>



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# High-Resolution Vegetation & Phenology (HR-VPP)

## Vegetation Indices



### Daily (NRT)

- ✓ PPI
- ✓ FAPAR
- ✓ LAI
- ✓ NDVI
- ✓ Quality Flag

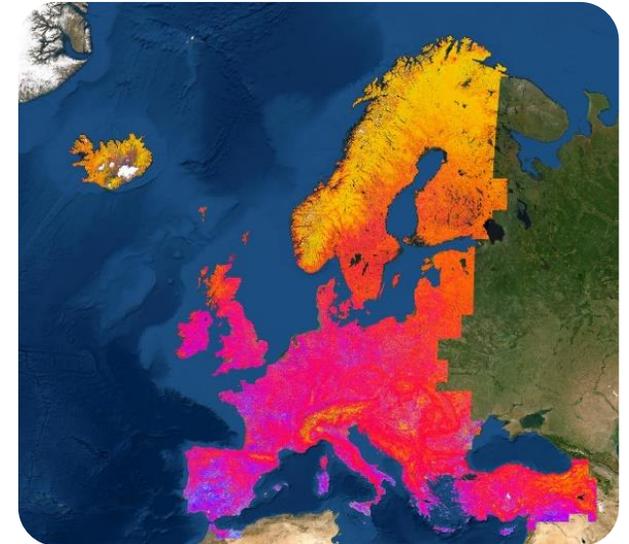
## Seasonal Trajectories



### 10 Days

(Plant Phenology Index, PPI)

## Phenology & Productivity



### Yearly (2 seasons)

- ✓ Start-of-Season
- ✓ End-of-Season
- ✓ Season length
- ✓ Season Max
- ✓ Season Min
- ✓ Amplitude
- ✓ Slope of green up/down
- ✓ Seasonal Productivity
- ✓ Total Productivity



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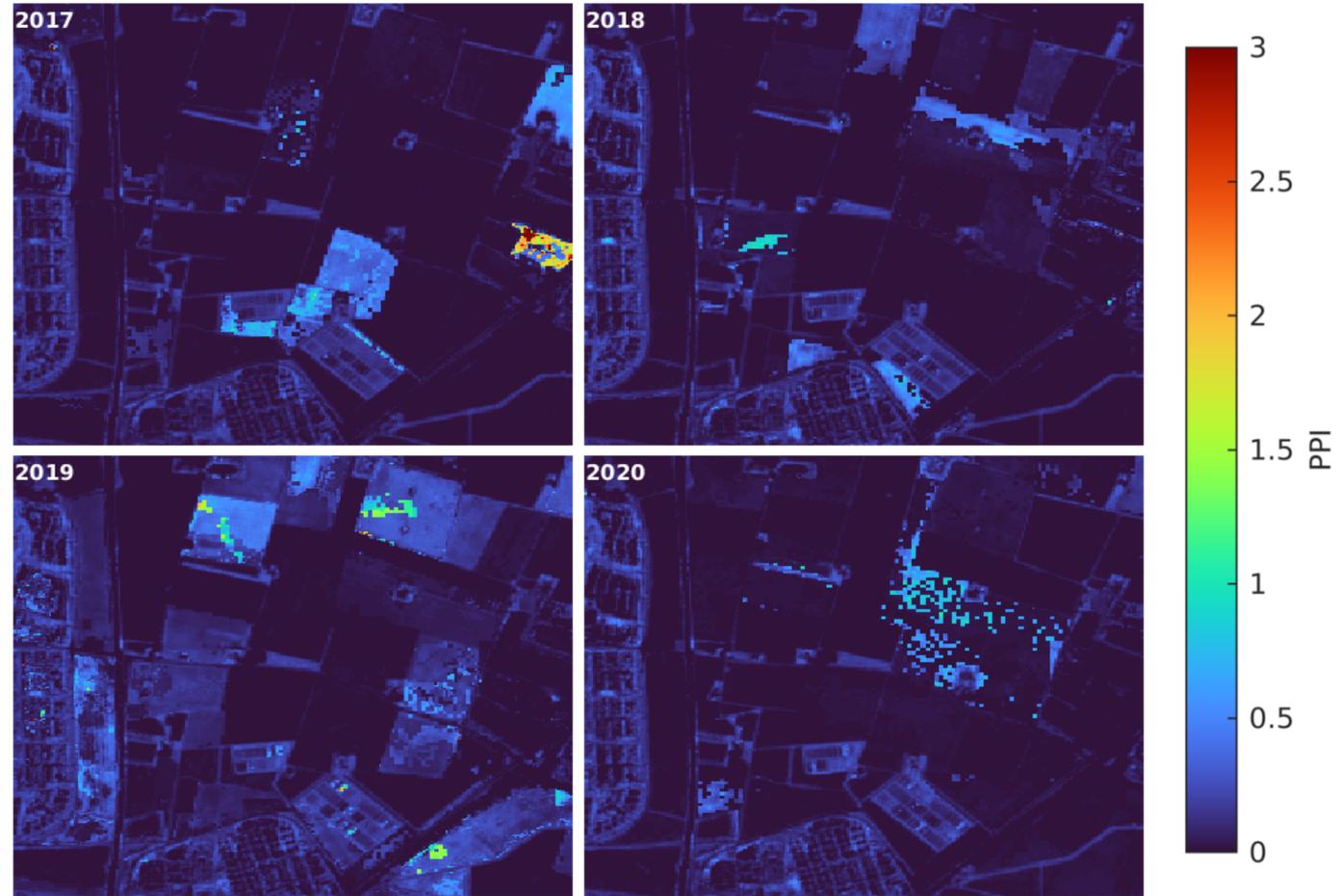
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# HR-VPP: Seasonal Trajectories



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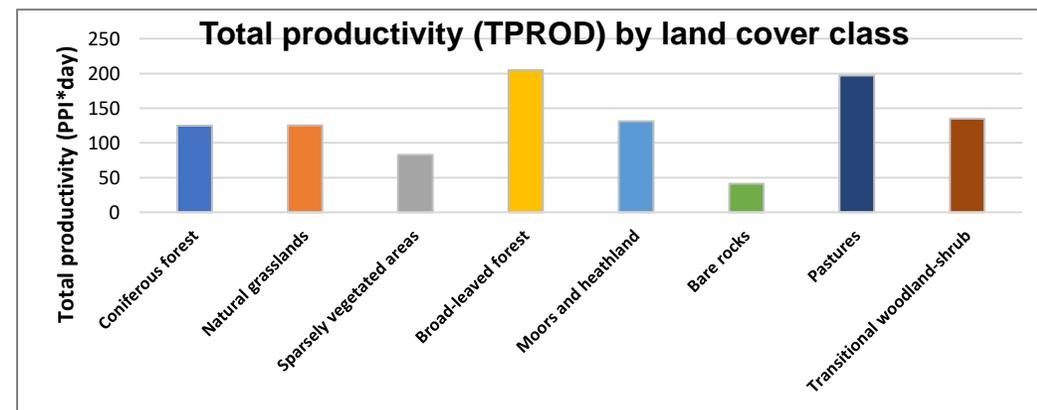
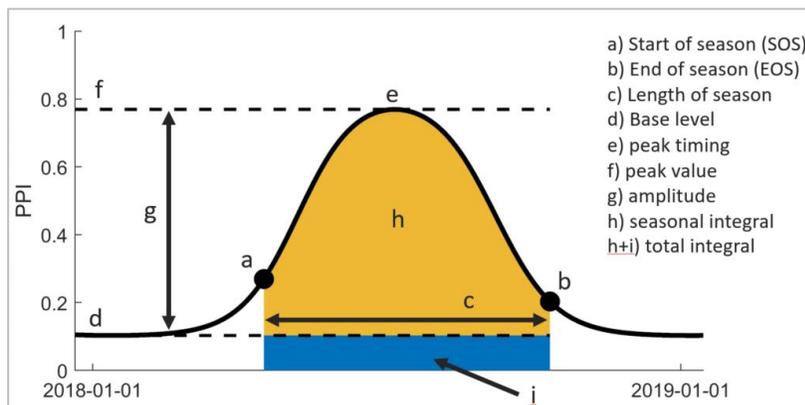
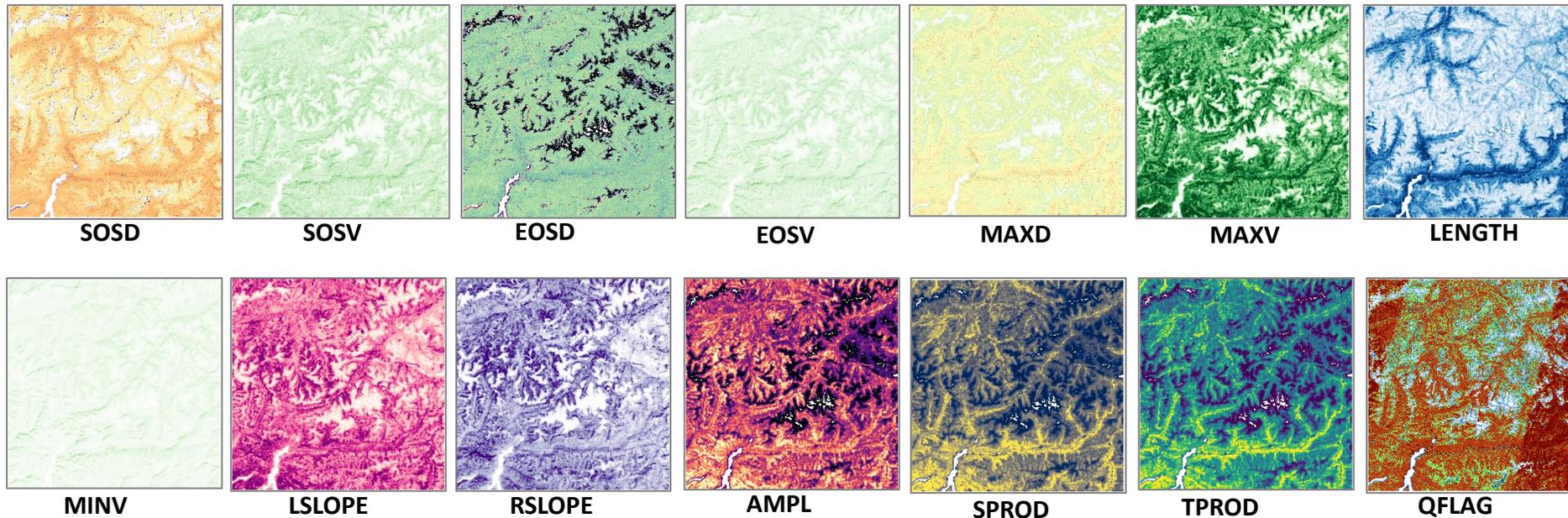
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# HR-VPP: Phenological metrics (e.g. tile T32TNS 2019)



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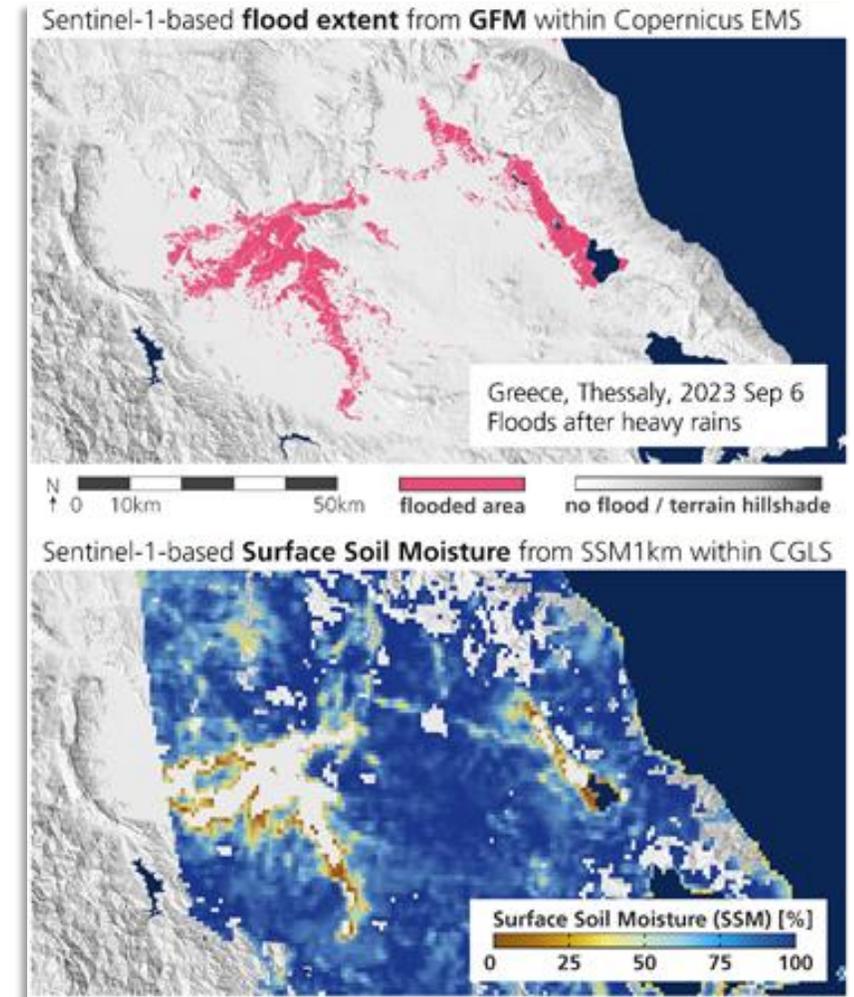
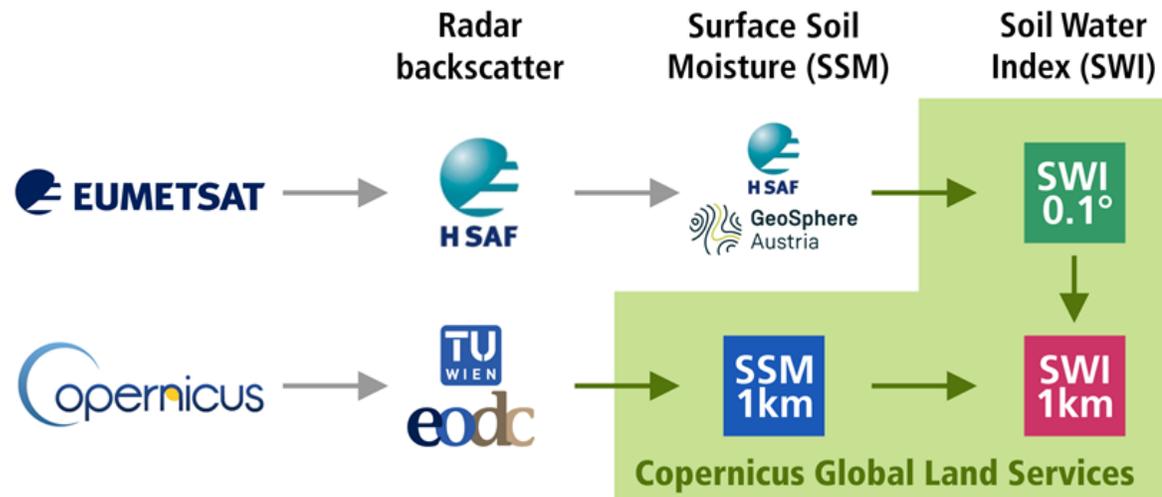
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# Soil moisture suite

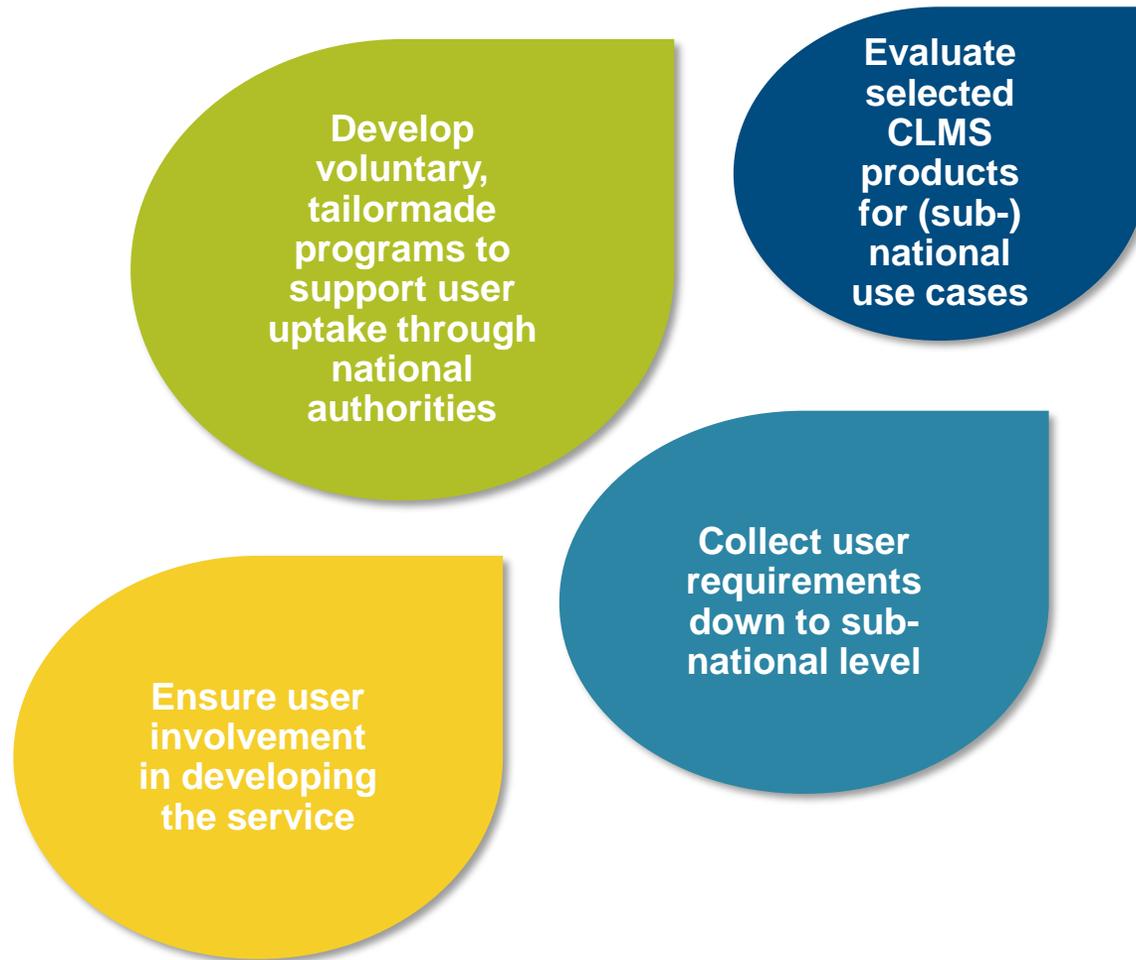
- Soil moisture is a **key environmental variable** for e.g. agriculture, meteorology, disaster management
- **Daily updates** on the moisture conditions:
  - Europe: SSM and SWI, 1km (2015-present)
  - Global: SWI, 0.1° (2007-present)





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# CLMS National Collaboration Programme (NCP)



- Module-based framework for collaboration and MS relations
  1. Organisation of national-level meeting
  2. Supporting progress monitoring
  3. Development of two use cases
  4. Final report

(+optional: trainings, focus teams,..)
- Funding for activities
- Implementation via MoU
  - currently: 5 MS pilots (+15 MS interested)



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# Conclusions

- CLMS 2.0: new products, more frequent updates, higher resolution
- CLMS products support the soil domain
  - Direct metrics
  - Indirect parameters
- Community inputs and collaboration are key to service evolution

2024 edition

**Copernicus Land Monitoring Service**  
**General Assembly**

**3 - 5 June 2024**

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# Thank you!

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