



Land Monitoring

COPERNICUS LAND MONITORING SERVICE

Pan-European and local components
European Environment Agency

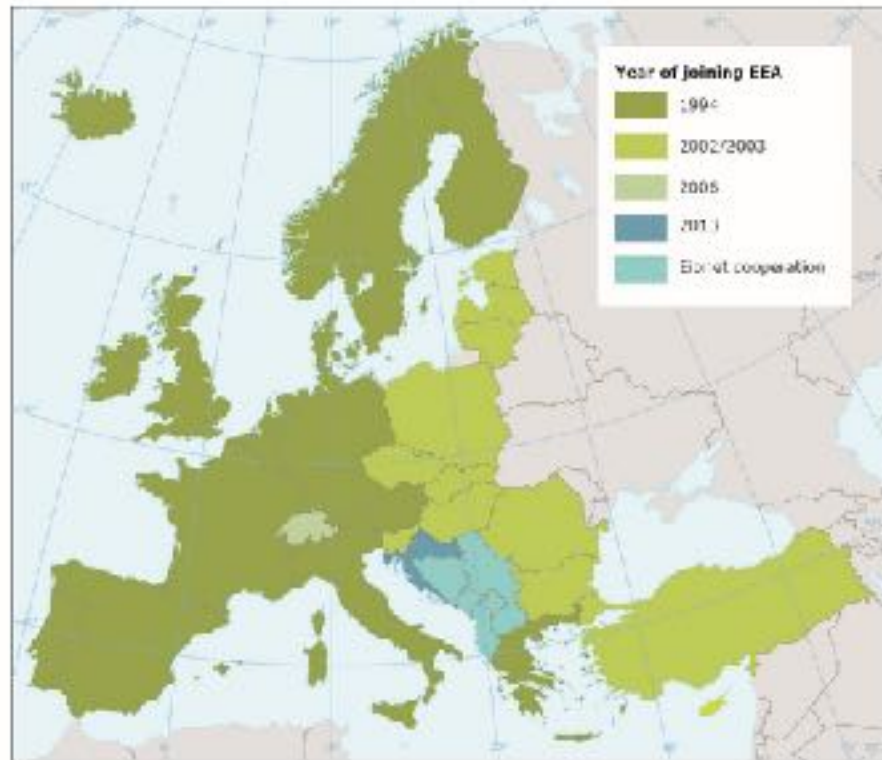
hans.dufourmont@eea.europa.eu

EuroGeographics WS LC/LU, Brussels, 15.11.2017



A network of around 1400 experts from 39 EEA member and cooperating countries in over 400 national organisations
National Reference Centres
Land Cover mostly experts from:

- EPAs
- Ministries of Environment
- NMCAs





Land
Monitoring

COPERNICUS AND THE ROLE OF EEA



Users



Air pollution,
transport and noise



Industrial
Pollution



Climate change
mitigation and
energy



Climate change
impacts, vulnerability
and adaptation



Marine and
maritime, fisheries
and coastal



Water management,
resources and
ecosystem



Biodiversity,
ecosystems,
agriculture and
forests



Urban, land use
and soil



Waste and
radiation
resources

European Environment Agency



European Commission



EEA

Core

activities

Delegation agreement
2014-2020



Land
Monitoring

COPERNICUS LAND MONITORING CORE SERVICES

wall-to-wall
coverage

HRL imperviousness

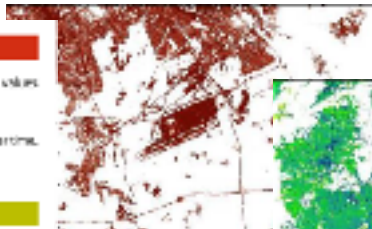
Imperviousness	
Degree of imperviousness (200 m and 1000 m)	Degree of imperviousness, values from 0-100%
Impervious density change (2000-2010) (200 m)	Mapping degree of change over time, values from -100% to 100%

Forest	
Tree cover density (200 m and 1000 m)	Tree cover density, values from 0-100%
Forest Type (200 m and 1000 m)	Mapping deciduous, leafy, coniferous and broadleaved

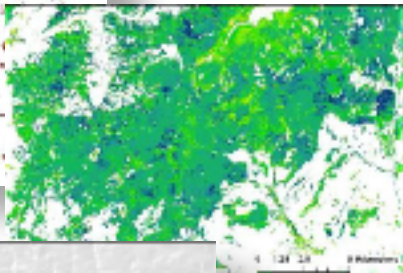
Natural and semi-natural grassland	
Natural and semi-natural grassland (200 m and 1000 m)	Mapping natural and semi-natural grasslands

Wetlands	
Wetlands (200 m and 1000 m)	Mapping wetlands

Water bodies	
Permanent water bodies (200 m and 1000 m)	Mapping permanent water bodies, including small water bodies



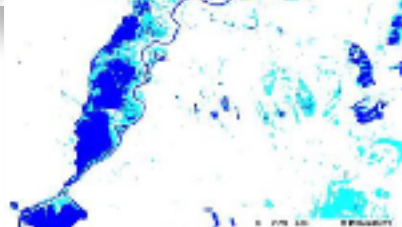
HRL forests



HRL grasslands



HRL wetness & water

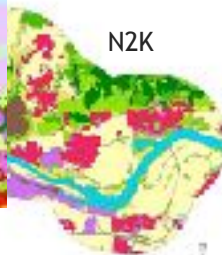


information
services at
local, national,
European level

Urban Atlas



N2K



Long-term time series
change monitoring

European Environment Agency



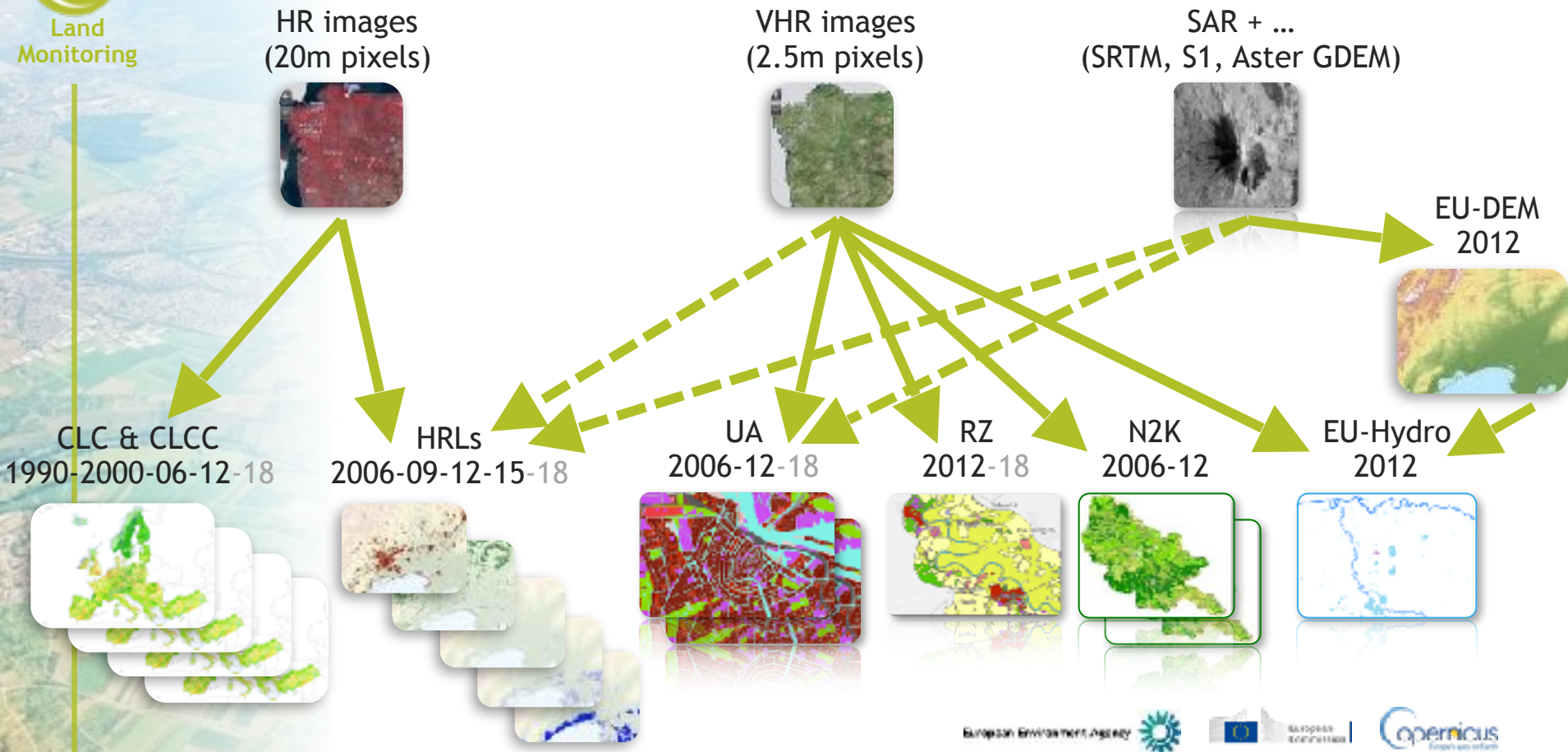
SAFARI
SCIENCE

Copernicus
Europe's satellite



Land
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PAN-EUROPEAN AND LOCAL PORTFOLIO OVERVIEW



land.copernicus.eu

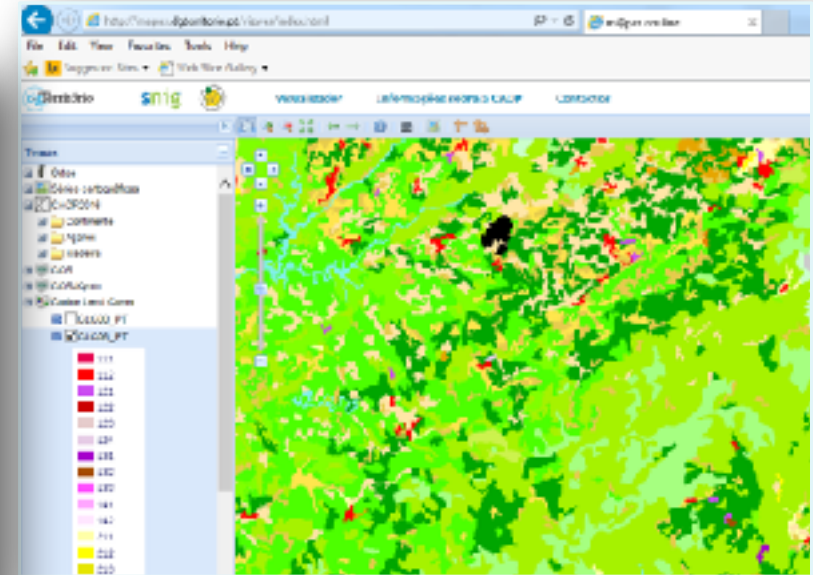
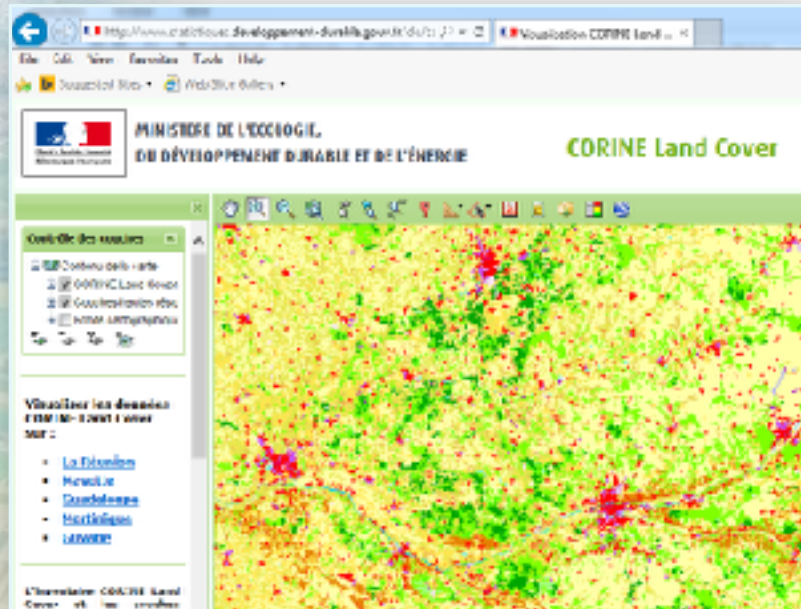
Focus on:

- Easy access to the products:
 - discover, view, WMS / download
- INSPIRE compliant metadata
- structural linkages with the open data initiatives on European and global level, in order to promote the use of the Copernicus Land products



National Copernicus dissemination platforms (Eionet)

- national subsets of the Copernicus Land products are disseminated through the national & regional portals



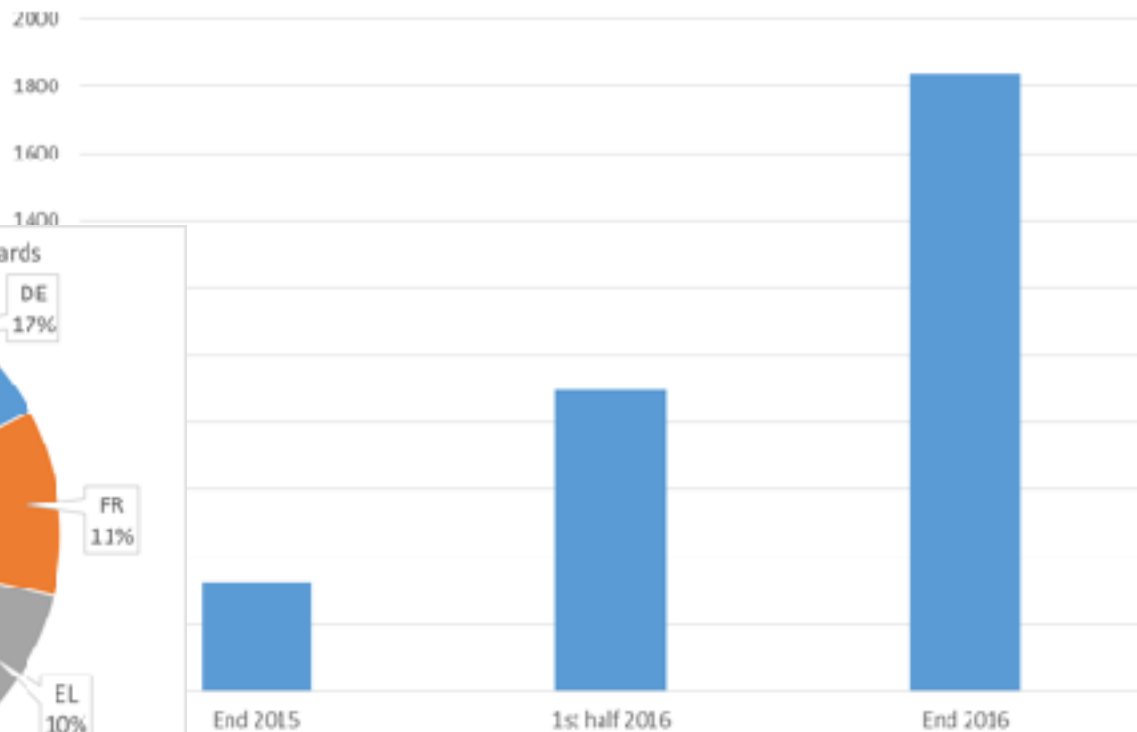


Land
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DOWNLOADS

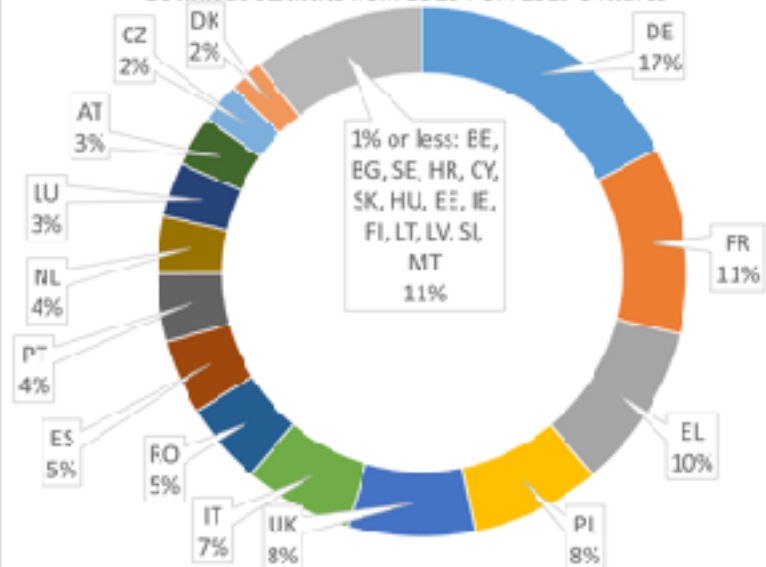
Interest in the Copernicus Land products has been increasing over time

EU-DEM downloads from 2015 onwards



Source: Copernicus land portal, accumulated

Download statistics from EU28 from 2015 onwards





Land Monitoring

LAND MONITORING PRODUCT & SERVICE PORTFOLIO

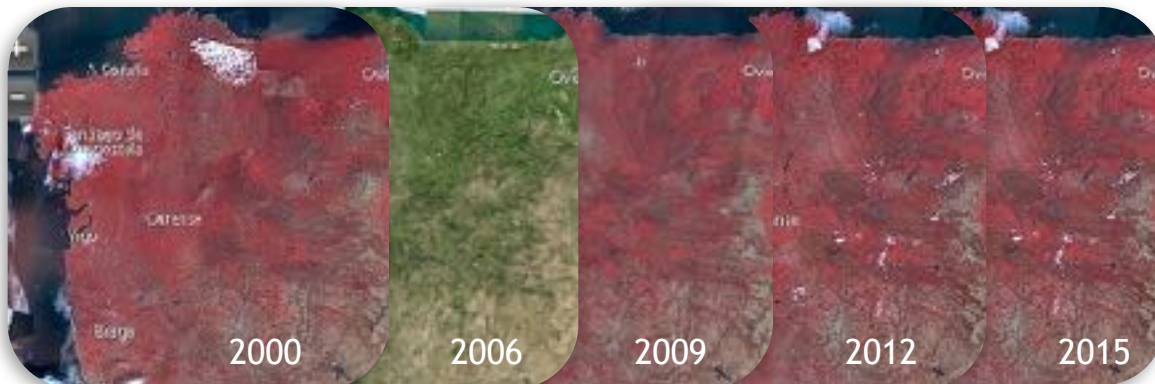




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PAN-EUROPEAN COMPONENT - IMAGE MOSAICS

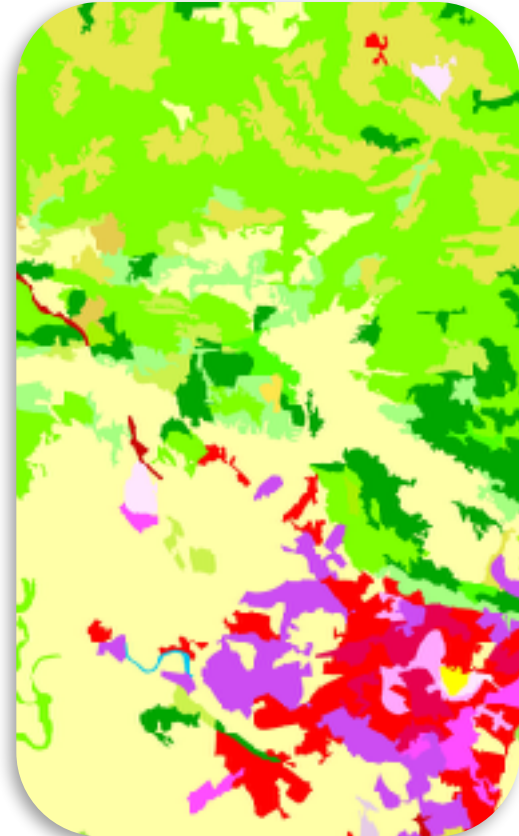
**HR (High
Resolution)**
20 - 25 m



**VHR (Very High
Resolution)**
2 - 2.5m
mosaic



- EEA flagship land cover and land use product (most downloaded dataset of EEA)
- Long time series: 1990, 2000, 2006, 2012, 2018 (>25 years!)
- Level of detail: Minimum mapping unit (MMU): 25 ha (5 ha for changes)
- Nomenclature: 5 main groups, three levels, 44 level-3 classes
- Implemented by national teams, mainly based on photointerpretation.





PAN-EUROPEAN COMPONENT - HIGH RESOLUTION LAYERS (HRL'S)

Imperviousness and imperviousness change products

- Degree of Imperviousness and Imperviousness Change (0-100%)
- 2006-2009-2012-2015
- 20 m and 100 m

Forest

- Tree Cover Density (0-100%)
- Dominant Leaf Type
- 2012-2015
- 20 m and 100 m

Grassland

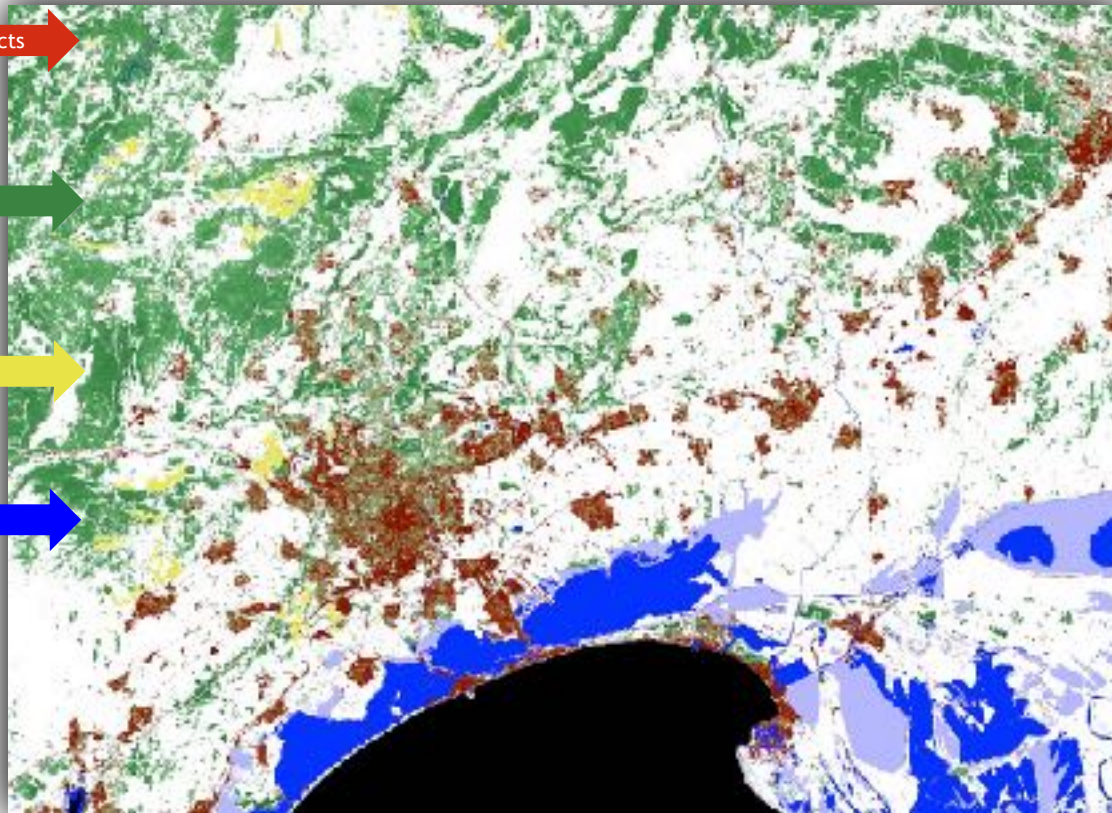
- Grassland (binary)
- 2012
- 20 m and 100 m

Water and Wetness

- Permanent/Temporary Water
- Permanent/Temporary Wetness
- Based on 2009-2016 time series

Small Woody Features

- Linear and patchy structures (binary)
- 2015





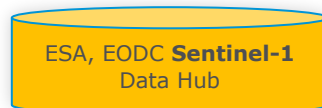
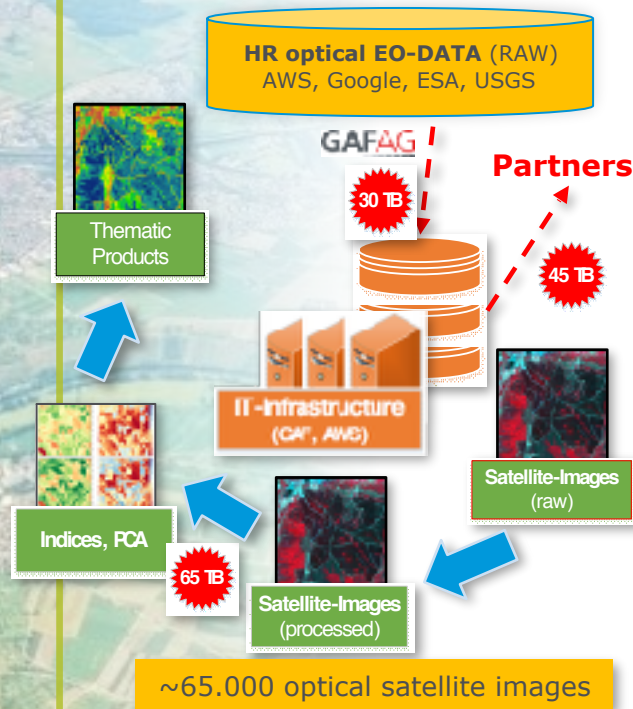
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PRE-PROCESSING

Automated pre-processing chains developed by

GAF AG (optical HR data), e-Geos and TU Vienna

(Sentinel-1), SIRS (VHR IMAGE 2015 pan-sharpening) as basis for production of the **five HRLs**



input

Production in

- Lot 3 - Grassland
- Lot 4 - Water, Wetness

~15.000 + 20.000
SAR images



input

Production in

- Lots 1, 2, 5
- Validation in all lots

~21.000 VHR data

Highlights

Different automated pre-processing chains: e.g. for HR optical satellite data from various sensors (Sentinel-2, Landsat-5, -7, -8, SPOT-4, -5, Resourcesat-2, IRS-P6) incl. download, import, cloud/ shadow masking, ToA, geometric validation and correction, topographic normalization, image transformations, indices), parallelised and scalable processing in hybrid cloud environment





Products (40):

- Built-up area & Imperviousness Degrees 2015 (20m)
- Reprocessing of 2012-2009-2006 (20m)
- Imperviousness (classified) change
- Imperviousness reference database

Input Data:

- Multi-temporal optical HR composites (Sentinel-2, Landsat, SPOT-4 & -5, IRS-P6, ResourceSat-2) for 2015 +/-1 year plus HR IMAGE 2012/2009/2006
- VHR images & in-situ data (via CORDA)

Highlights:

High-quality information on imperviousness change in Europe (2006/2009/2012/2015).





Products (17):

- Dominant Leaf Type (DLT) (20m)
- Tree Cover Density (TCD) (20m)
- DLT Change (20m)
- TCD Change (100m)
- Forest reference database

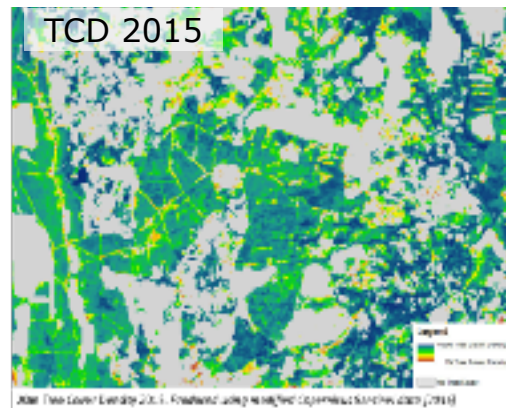
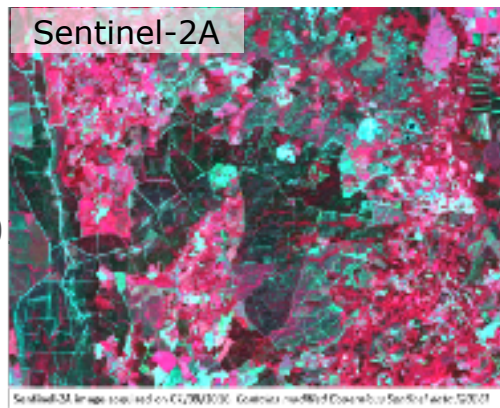
Input Data:

- Sentinel-2, Landsat 8, HR Image 20 (2015+/-1)
- HR IMAGE 2012, Landsat-8
- VHR IMAGE 2012 & 2015

Highlights:

Very high thematic accuracy, including change products (OA > 90%).

Change products 2012-2015 with up to 14 thematic classes.





Products (3):

- Permanent Grassland Mask (20m)
- Grass Vegetation Probability Index
(additional product for expert users, 20 m)
- Ploughing Indicator
(additional product for expert users, 20m)

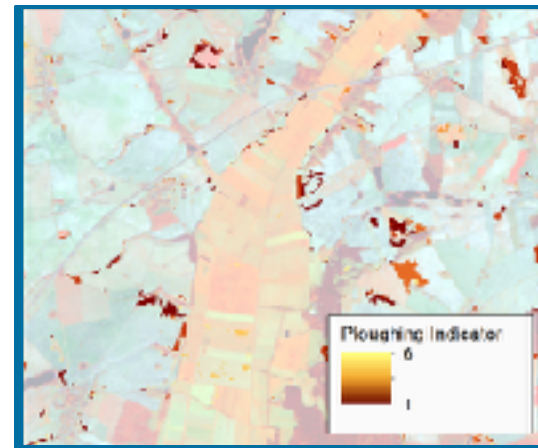
Input Data:

- Sentinel-1: (2015+/-1: 30 amplitude & short-term coherence images)
- Sentinel-2/Landsat8 (2015+/-1)
- Landsat 5-8/HR IMAGE 2012 (2008-2013)

Highlights:

First high-resolution retrieval of both managed and (semi-)natural grasslands on continental scale.
Optical-SAR multi-temp/multi-seasonal evaluation.
New multi-year product (ploughing indicator).

First Results:





Products (2):

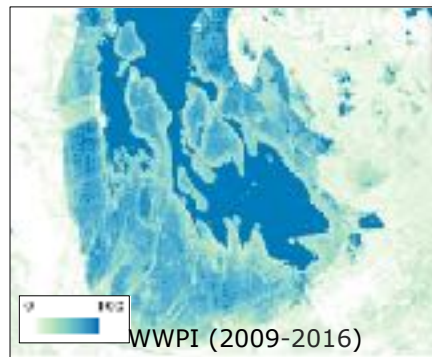
- Classified Water & Wetness product (20m)
- Water Wetness Probability Index from...
...2009 to 2015 (20m)
(additional product for expert users, 20m)

Input Data:

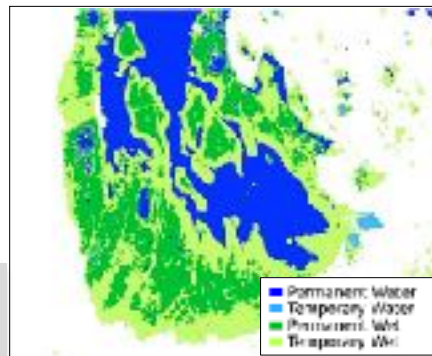
- Multi-temporal optical HR composites: SPOT, ResourceSat, Sentinel-2, Landsat (2009-15)
- Multi-temporal SAR data: Sentinel-1 (since 2014), ENVISAT-ASAR, METOP-Ascat (since 2004)
- Soil moisture calibration database
- VHR images & in-situ data (via CORDA)

Highlights:

New high-quality information on water & wetness presence in Europe on HR scale (2009-2016 multi-year products)



Water Wetness
Probability Index



Water & Wetness
(classified product)



Products (1):

- SWF 2015 including :
 - Linear hedgerows and scrubs
 - Tree rows
 - Isolated patches of trees

Input Data:

- VHR IMAGE 2015 (Pleiades 1A/1B, WorldView-2/3, GeoEye-1, Deimos-2 and Dubaisat-2)
- Riparian Zones GLE & In-situ data

Highlights:

High quality information on small woody linear & patchy structures at continental level.

Detailed detection of small landscape elements.

Big data: Computation of very high volume
(> 100 TB).





REFERENCE DATA: EU-DEM & EU-HYDRO

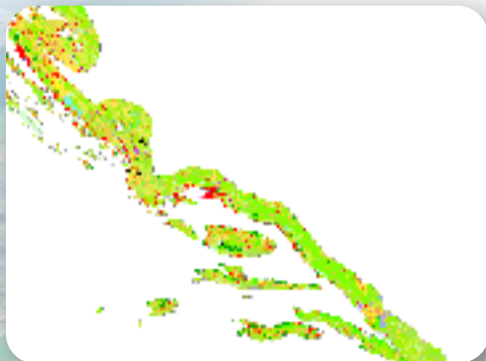
- EU-DEM: Digital Elevation Model with 30 metre spatial resolution. It is a hybrid product based on SRTM and ASTER GDEM data. Upgrade on-going
- EU-Hydro: river network and a drainage model with catchments and drainage lines derived from EU-DEM



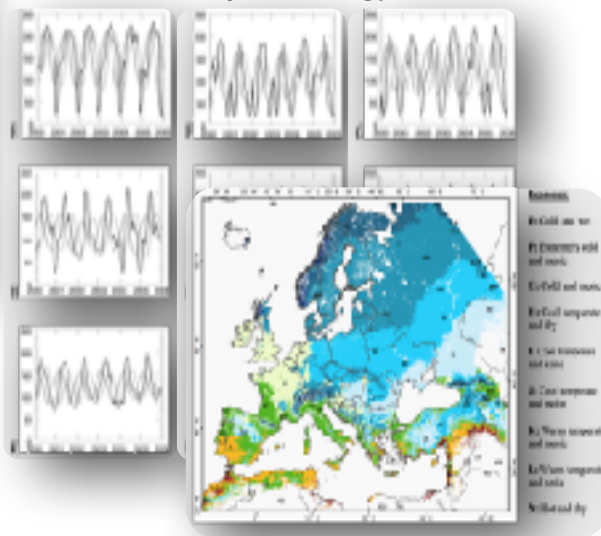


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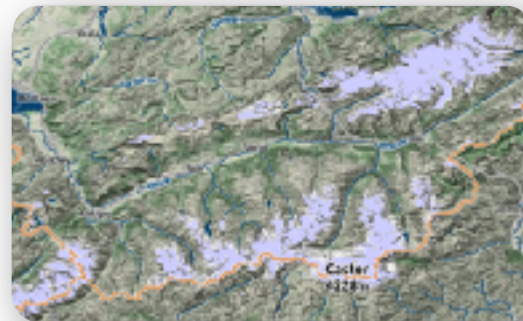
Coastal Zones



HR phenology



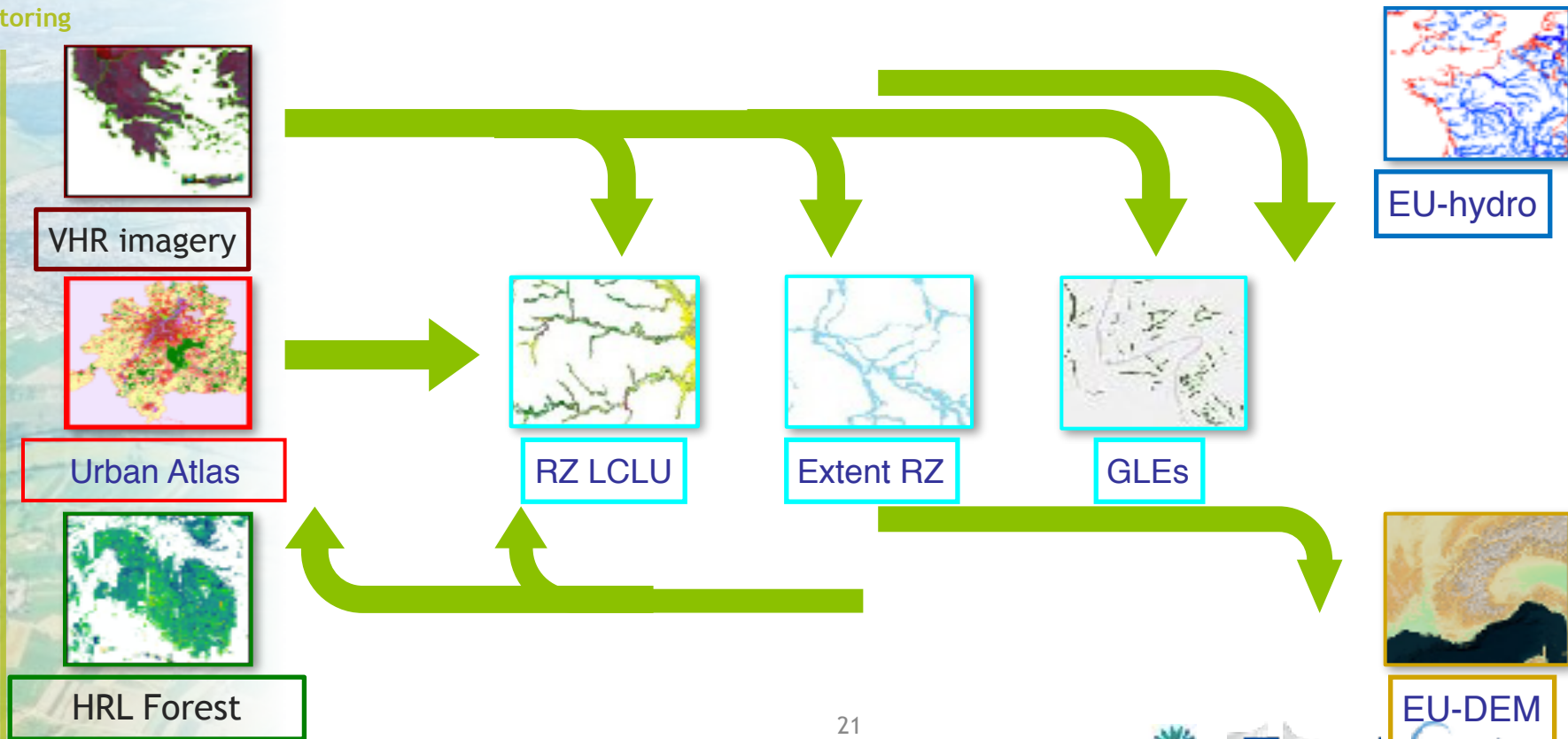
Snow & ice





Land
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LAND PORTFOLIO INTERDEPENDENCIES: RIPARIAN ZONES EXAMPLE

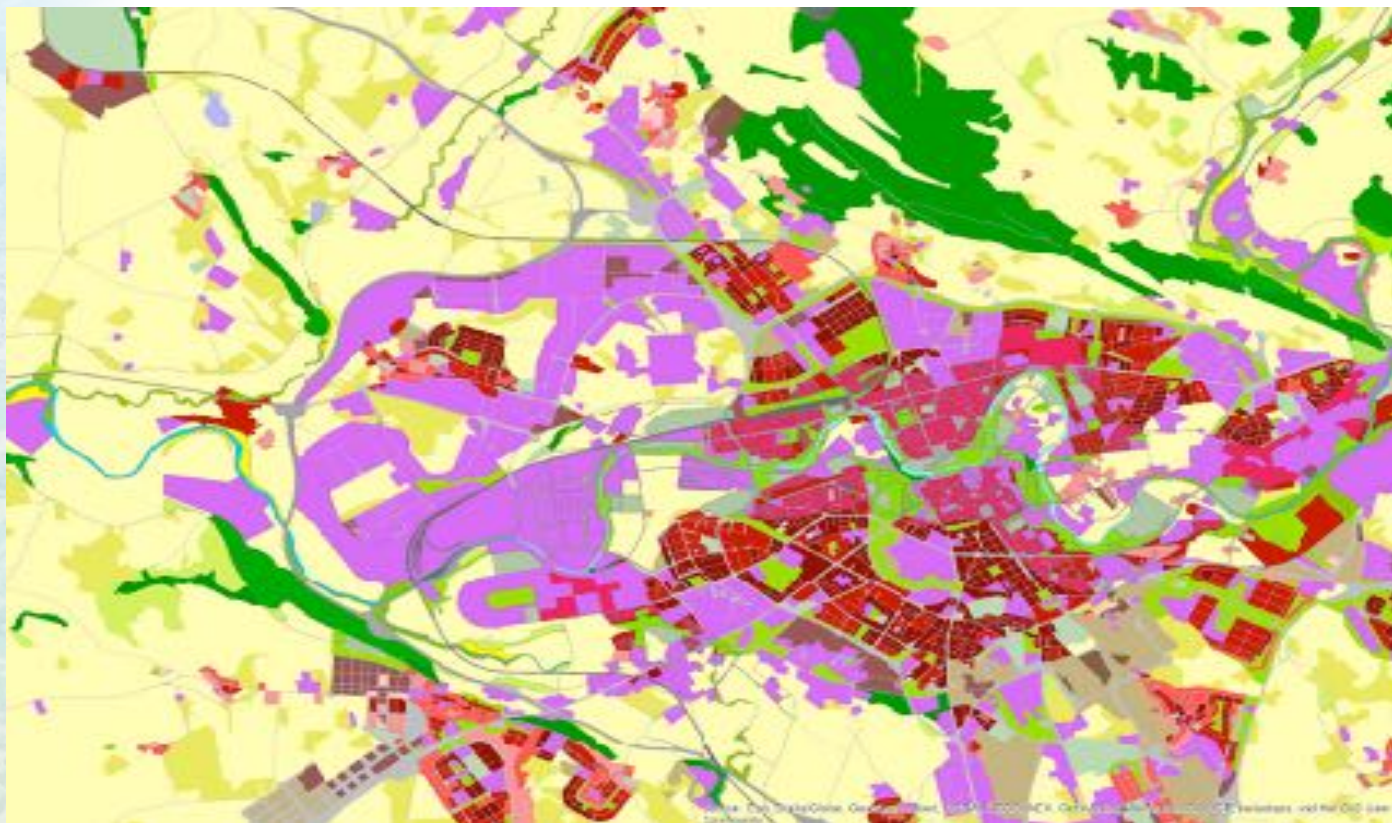




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URBAN ATLAS (REGION OF PAMPLONA, SPAIN)





Land
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RIPARIAN ZONES (REGION OF PAMPLONA, SPAIN)





Land
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NATURA 2000 (REGION OF PAMPLONA, SPAIN)

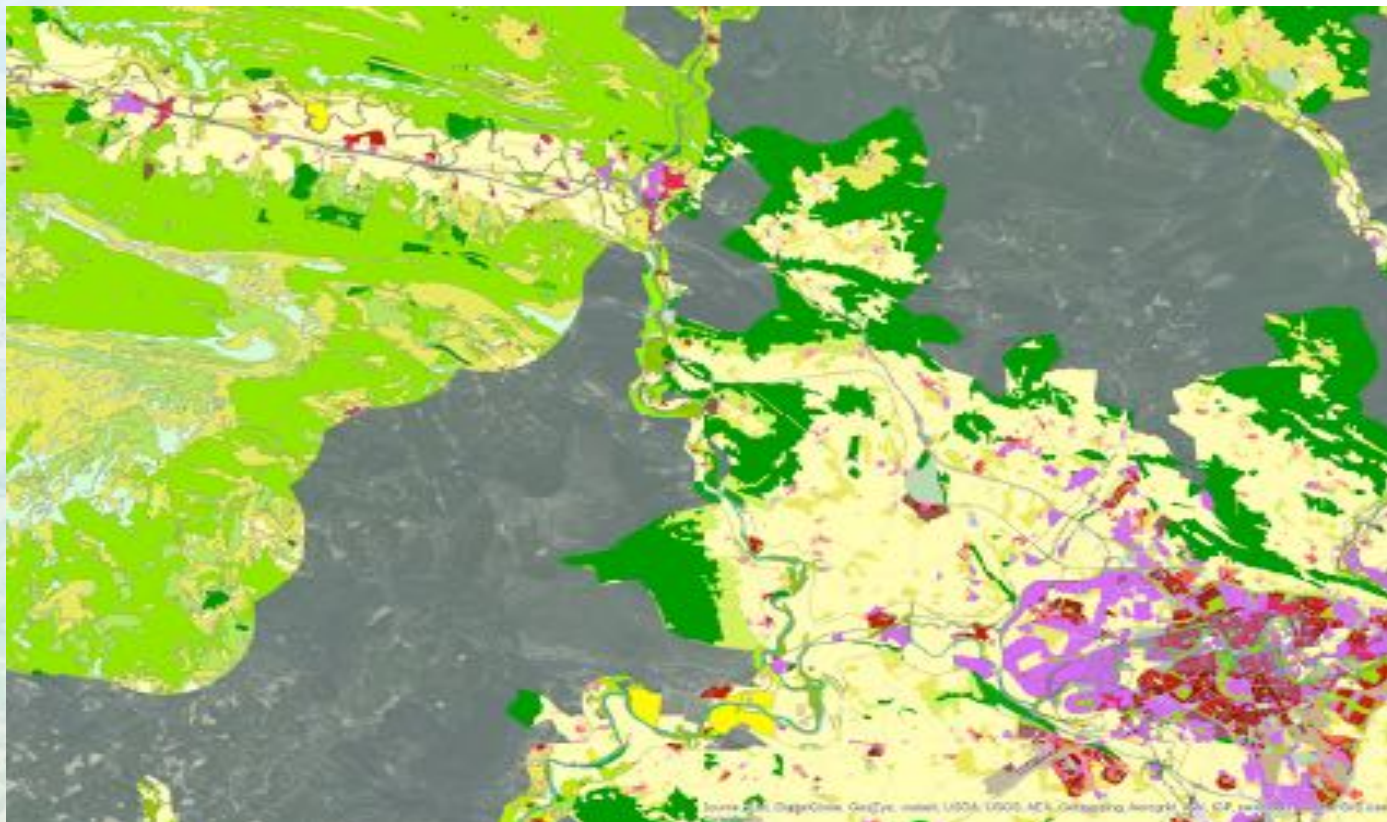




Land

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UA + RZ + N2K (REGION OF PAMPLONA, SPAIN)





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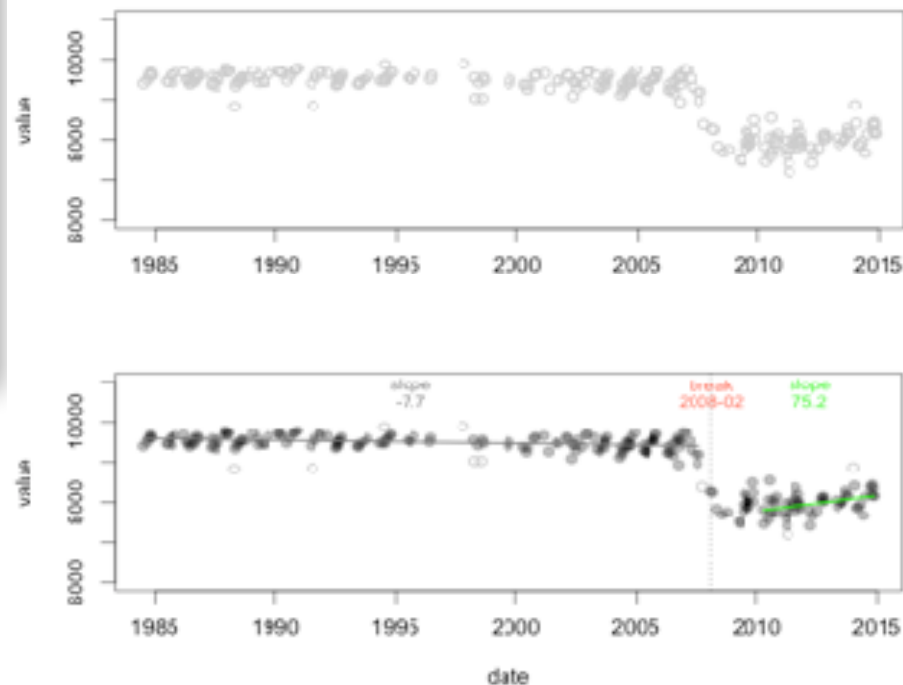
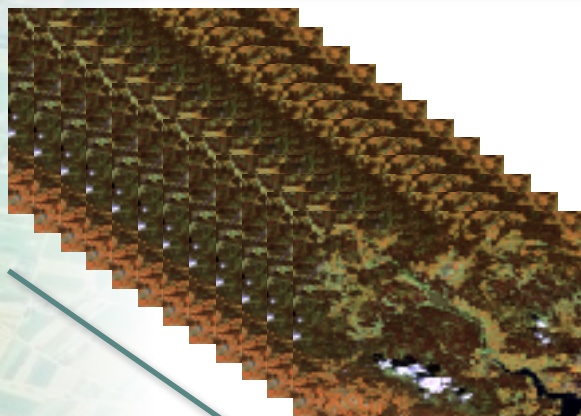
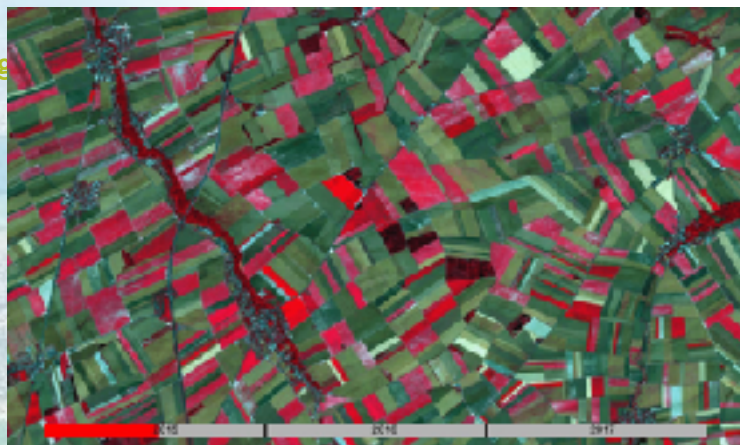
ALL + CLC (REGION OF PAMPLONA, SPAIN)





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TIME SERIES AND BIG DATA: TOWARDS TIME PROFILE ANALYSIS



gisat

European Environment Agency





Land Monitoring

KEY USE OF COPERNICUS LAND MONITORING BY EEA





Land
Monitoring

COMMUNITY POLICY NEEDS FOR LAND MONITORING

1. Protect, conserve and enhance the EU's natural capital

2. Turn the EU into a resource-efficient, green and competitive low-carbon economy

3. Safeguard EU citizens from environment-related pressures and risks to health and wellbeing

© Keith Arkins, Environment & Me /EEA

Source: 7th Environment Action Programme 2020

EUROPEAN GOALS



Living well, within
the limits of our planet

REPORT OF THE GROUP OF
EUROPEAN ECONOMISTS

European Environment Agency



European
Commission

Copernicus
Imaging and Monitoring



Land

Monitoring



Climate
Change

(NEW) POLICIES: CLIMATE CHANGE, ENERGY UNION, URBAN POLICIES

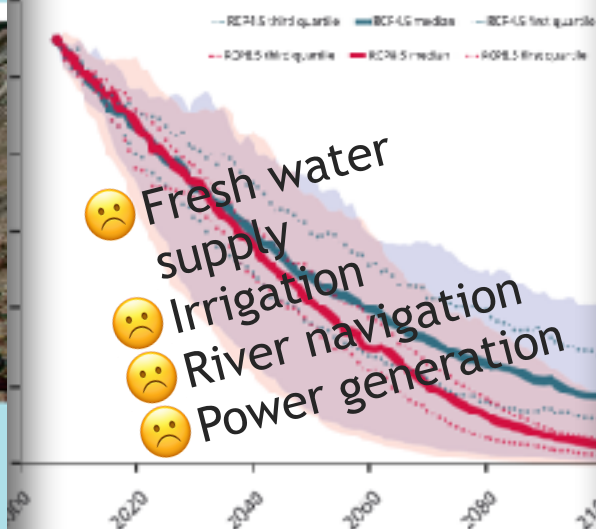
Climate change, impacts and vulnerability in Europe 2016 An indicators-based report



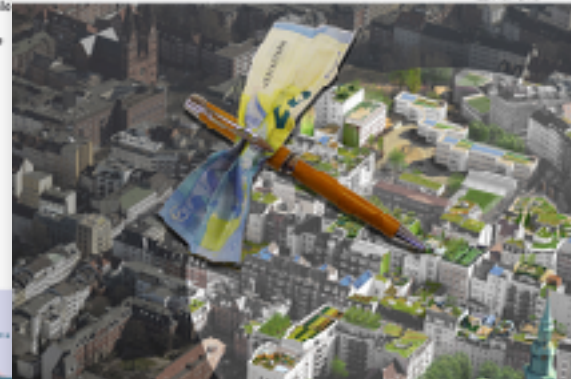
European Environment Agency



Projected change in the volume of mountain glaciers and ice caps



Financing urban adaptation to climate change



European Environment Agency



European Environment Agency



SAFOPOLIS
EUROPEAN POLICE

Copernicus
Europe's eye in the sky



Land
Monitoring

USE OF COPERNICUS IN THE EEA MDIAK FRAMEWORK

In-situ monitoring, surveys,
satellite observations

(M)

Monitoring



Structure

Local, National, European,
Global, statistics

(D)

Data



Interpret

Indicators, environmental
accounting

(I)

Indicators

in-situ



Integrate

Integrated assessments
across scales

(A)

Assessments

Communities and
academies

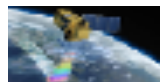
(K)

Knowledge, understanding, action

Reflect & act



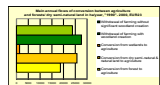
← satellite data



← services



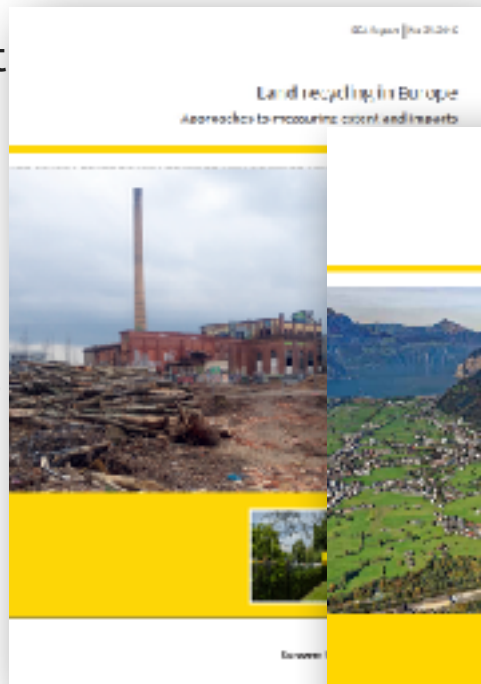
← applications





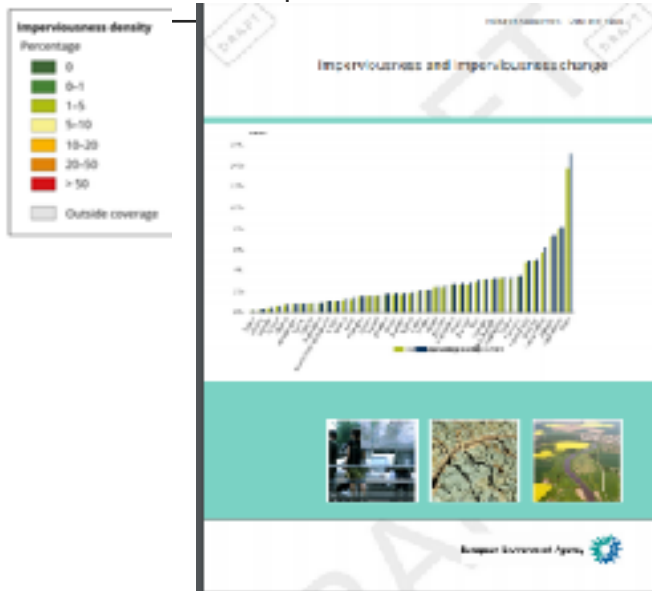
EEA REPORTS BASED ON COPERNICUS LAND MONITORING DATA

- **Land recycling, EEA report 31/2016 - w. ETC ULS**
- **Urban sprawl in Europe EEA/FOEN joint report, 11/2016 - w. ETC ULS**
- **Recent land cover trends, EEA report (Q2 2017) - CLC re-analysis 1990-2012 - w. ETC ULS**
- **Land resource efficiency, EEA report (Q3 2017) - w. ETC ULS**
- **Environmental performance of cities, EEA report (Q4 2017) - w. ETC ULS**





Indicator code	Indicator name	Comments
LSI 001 / CSI 014	Land take	Following CLC updates, every 6 years; last update 2006-12 published 15.06.2017
LSI 002	Imperviousness / soil sealing	Following HRL imperviousness updates, every 3 years - first published in 2016 Q1 for 2006-09. 2009-2012 update to be published mid 2017



Planned EEA indicators:

- land recycling indicator (CLC + UA)
- landscape fragmentation (HRL imperviousness)
- forest indicator (HRL forests)





Basic requirements:

- Full coverage EU28 / EEA39
- Copernicus data policy: full, open and free access
- Harmonised specifications
- Fitness for purpose
- Timeliness

Major challenges:

- Annual update frequency of selected products
- Countries involvement (national, regional, local)
- Merging 10-20 m Global/European product portfolio
- Automation and machine/deep learning
- Copernicus Data and Information Access Service
- Synergies with other Copernicus core services



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THANK YOU FOR YOUR ATTENTION

