Pan-European and local components
European Environment Agency
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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 LAND MONITORING CORE SERVICES**

Wall-to-wall coverage

Long-term time series change monitoring

Information services at local, national, European level
Land Monitoring

**PAN-EUROPEAN AND LOCAL PORTFOLIO OVERVIEW**

- **HR images (20m pixels)**
  - CLC & CLCC 1990-2000-06-12-18
  - HRLs 2006-09-12-15-18

- **VHR images (2.5m pixels)**
  - UA 2006-12-18
  - RZ 2012-18

- **SAR + ... (SRTM, S1, Aster GDEM)**
  - N2K 2006-12

- **EU-DEM 2012**
- **EU-Hydro 2012**
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
Interest in the Copernicus Land products has been increasing over time.
HR (High Resolution)  20 - 25 m

VHR (Very High Resolution)  2 - 2.5m
- EEA flagship land cover and land use product (most downloaded dataset of EEA)
- 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.
Land Monitoring

**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
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

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

Partners
- ESA Data Warehouse (VHR IMAGE 2015)
- ESA, EODC Sentinel-1 Data Hub
- GAF AG (optical HR data)
- e-Geos
- TU Vienna

Pre-Processing
- Production in
  - Lot 3 – Grassland
  - Lot 4 – Water, Wetness

Pan-sharpening
- Production in
  - Lots 1, 2, 5
- Validation in
  - all lots

Input
- ~15,000 + 20,000 SAR images
- ~65,000 optical satellite images
- ~21,000 VHR data

HR optical EO-DATA (RAW)
AWS, Google, ESA, USGS

ESA, EODC Sentinel-1 Data Hub

ESA Data Warehouse (VHR IMAGE 2015)
**Products (40):**

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

**Input Data:**

- VHR images & in-situ data (via CORDA)

**Highlights:**

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 2015 (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 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)
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 Modell 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.
Coastal Zones

HR phenology

Snow & ice
LAND PORTFOLIO INTERDEPENDENCIES: RIPARIAN ZONES EXAMPLE
Urban Atlas (Region of Pamplona, Spain)
Riparian zones (region of Pamplona, Spain)
NATURA 2000 (REGION OF PAMPLONA, SPAIN)
UA + RZ + N2K (REGION OF PAMPLONA, SPAIN)
ALL + CLC (REGION OF PAMPLONA, SPAIN)
KEY USE OF COPERNICUS LAND MONITORING BY EEA
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

Source: 7th Environment Action Programme 2020
(New) Policies: Climate change, Energy Union, Urban policies

Projected change in the volume of mountain glaciers and ice caps in Europe

- Fresh water supply
- Irrigation
- River navigation
- Power generation

Climate Change

European Environment Agency
Use of Copernicus in the EEA MDIAK Framework

- In-situ monitoring, surveys, satellite observations
- Local, National, European, Global, statistics
- Indicators, environmental accounting
- Integrated assessments across scales
- Communities and academies

(M) Monitoring
(D) Data
(I) Indicators
(A) Assessments
(K) Knowledge, understanding, action

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Satellite data

Services

Applications

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European Environment Agency
Copernicus
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
### Published EEA Indicators based on Copernicus Data

<table>
<thead>
<tr>
<th>Indicator code</th>
<th>Indicator name</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>LSI 001 / CSI 014</td>
<td>Land take</td>
<td>Following CLC updates, every 6 years; last update 2006-12 published 15.06.2017</td>
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<tr>
<td>LSI 002</td>
<td>Imperviousness / soil sealing</td>
<td>Following HRL imperviousness updates, every 3 years - first published in 2016 Q1 for 2006-09. 2009-2012 update to be published mid 2017</td>
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**Planned EEA indicators:**
- land recycling indicator (CLC + UA)
- landscape fragmentation (HRL imperviousness)
- forest indicator (HRL forests)
Service evolution CLMS

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
THANK YOU FOR YOUR ATTENTION