GMES Land products

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DATA AND INFORMATION CENTRE
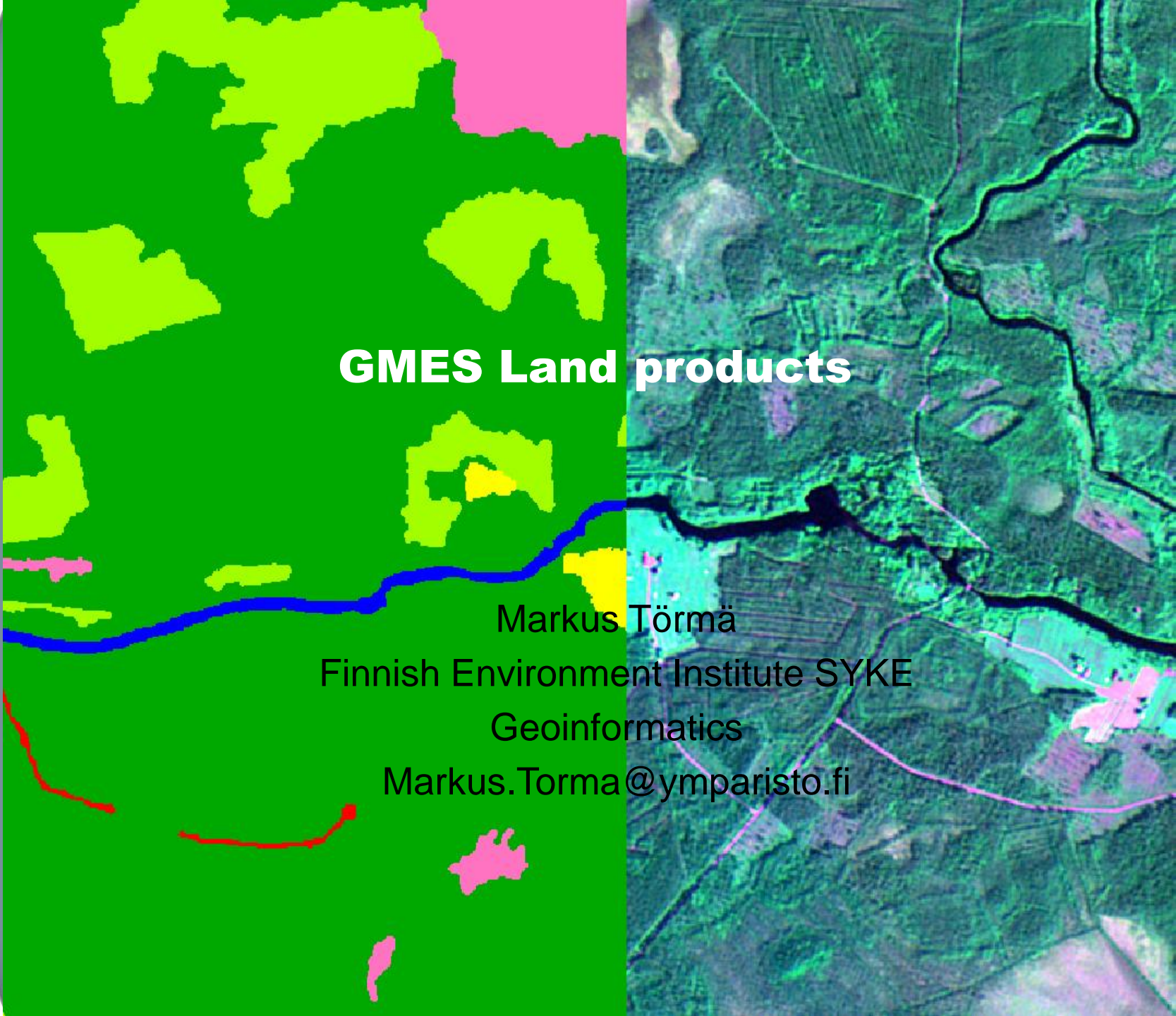
Global Monitoring for Environment and Security

- GMES: EU initiative
  - Satellites and in situ sensors to monitor our natural environment as well as keeping an eye on the security of citizens
- GIO: GMES Initial Operations
  - 2011 – 2013
- Components
  - Global
    - estimates of biophysical variables like LAI
  - Continental
    - Corine Land Cover 2012
    - High Resolution Layers (HRLs): Soil Sealing / Imperviousness, Forest, Grassland, Wetland, Water
  - Local
    - Urban Atlas
    - Hotspot monitoring: methods developed in Geoland2 Area Frame Sampling

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HRL Soil Sealing / Imperviousness

- Soil sealing: the loss of soil resources due to the covering of land for housing, roads or other construction work
- Per-pixel estimates of soil sealing based on NDVI and model
  - 2012 0-100% (20m x 20m / 100m x 100m)
- Time series 2006-2009-2012
  - degree of change over time 0-100% (100m x 100m)
- Experiences:
  - Status layers of imperviousness & built-up areas
    - partly overestimation of imperviousness at high degrees / underestimation at low degrees due to mixed pixels
  - Change layers of imperviousness changes
    - New built-up areas: good reliability
    - Densification in existing built-up areas: lower reliability
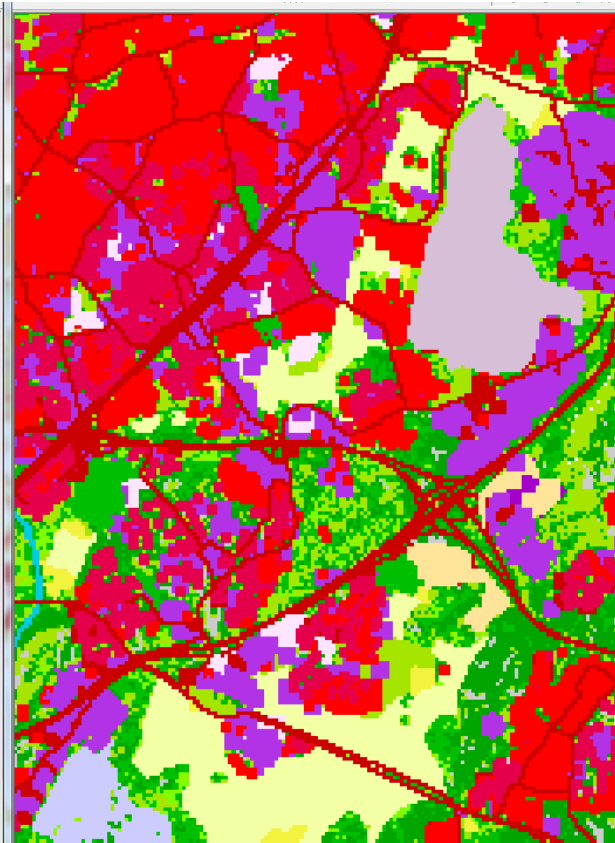
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HRL Soil Sealing / Imperviousness

- Degree of soil sealing from part of Helsinki
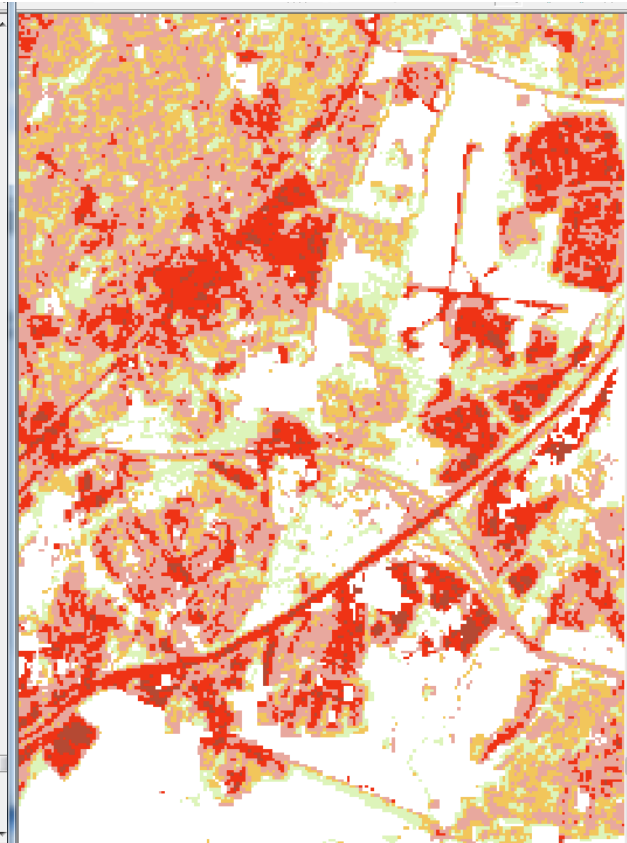 - Green: 0-29%, Orange: 30-49%, Dark pink: 50-79%, Red: 80-99%, Red brown: 100%

DSS 2006	CLC2006	DSS 2009

DATA AND INFORMATION CENTRE

HRL Forest

- Tree Density
  - Pixel-based Percentage of Tree cover within and outside Forest stands
    - Bushes and dwarf trees excluded
- Forest Type
  - 2 classes: Broadleafed Forest, Coniferous Forest
  - Versions:
    1. MMU = 0.5ha, MMW = 20m, min. Tree Density/pixel = 10%, additional information layer indicating orchards, olive groves, etc. and urban trees, 20 m pixel
    2. No MMU, min. Tree Density/pixel = 30%, 25 m pixel
- Tree cover presence/absence
  - Forest and Non-Forest class
  - No MMU applied, min. Tree Density/pixel = 30%
  - 25 m pixel

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Input Data: Image2012, Cov1

Sensor: IRS-P6 LISS-III

Spatial Resolution: 20m (25m)
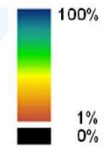
NIR-Red-Green (RGB)
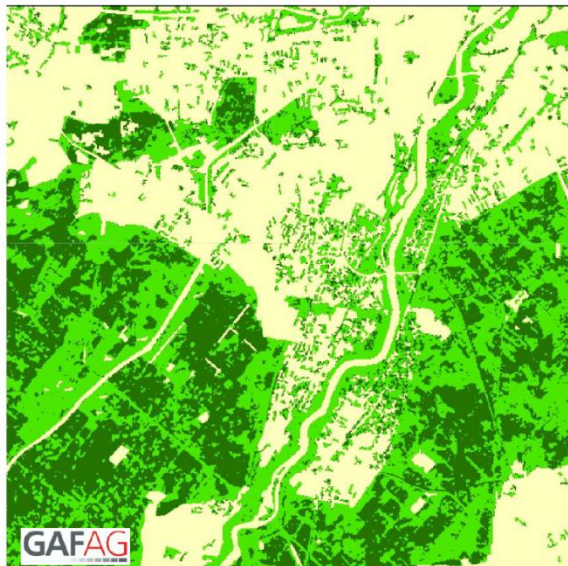
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geoland:2
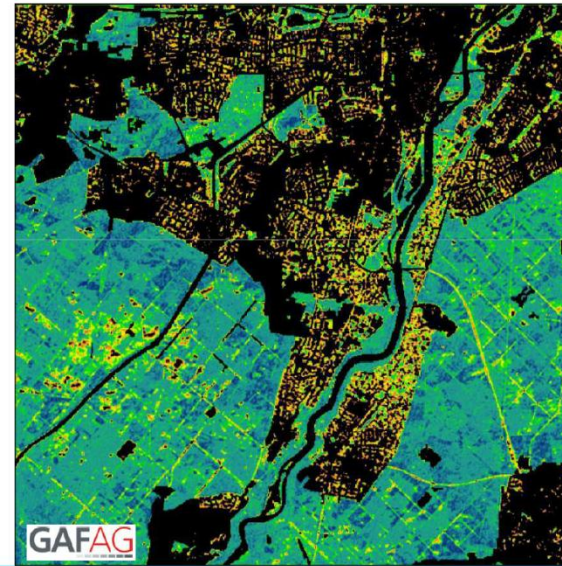
Product Example: Munich

Tree Cover Density

Share of trees per pixel [0-100%]
Spatial Resolution: 20m
No Minimum Mapping Unit applied
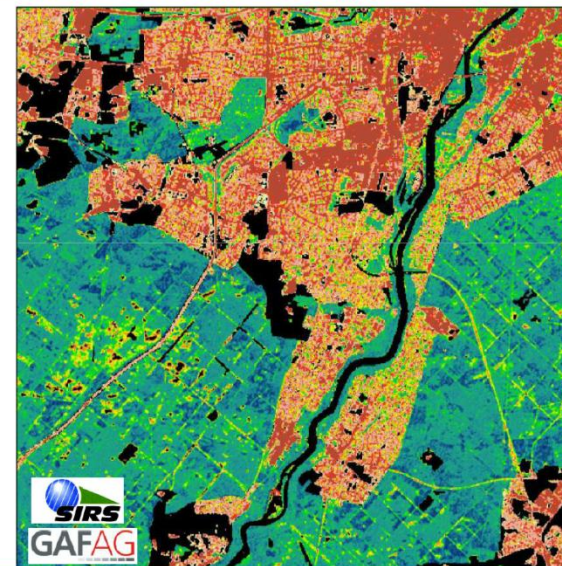
Tree Cover Density

100%

1%
0%

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Product Example: Munich

Forest Types (2 classes)

Legend

- Non-Forest
- Coniferous Forest
- Broadleaved Forest
- No thematic Data

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Overlay: Tree Cover Density / Degree of Imperviousness
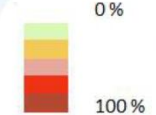
Tree Cover Density

100%

1%
0%

Degree of Imperviousness

0 %

100 %

GIO HR Grassland

Definition: permanent presence of grassland in 2006-2009-2012

Grassland includes the following landscape types:

- ✓ Pastures, grassland used for grazing or hay production (CLC classes 231, but also appears in classes 211 to 244).
- ✓ Cultivated or semi-natural grassland within forest, and grass covered surfaces within transitional woodland (appears in CLC classes 311-313, 324).
- ✓ Natural grassland in any surrounding (CLC class 321).
- ✓ Grassy areas with low fraction of scattered trees and shrubs.
- ✓ Alpine meadows with low fraction of bare rock or gravel.

Land covers not to be considered as grassland:

- ✓ Grassland in urban areas: parks, urban green in residential and industrial areas.
- ✓ Grass surfaces in sport and recreation areas, incl. golf courses.
- ✓ Clearcut areas, new forests.
- ✓ Areas of shrubs: areas dominated by moors and heathland (Atlantic) or sclerophyllous vegetation (Mediterranean).
- ✓ Surfaces covered exclusively by mosses and lichen (Subarctic).
- ✓ Peatland (either in natural condition or in excavation).

GIO HR Grassland

Differences in the GIO Grassland Methodology are:

✓ Use of an object-oriented classification approach to provide more efficient analysis of multi-sensor/multi-scale data, more flexible and efficient correction/enhancement of results by manual and automated procedures and more homogenous classification result.

✓ Use of RapidEye's automated and tested production chain it had developed for its agricultural services to generate seasonal biophysical parameters based on PSRI, NDII, NDVI, GC, etc.

✓ Use of the robust C5.0 classifier. it can handle missing values and automatically selects the relevant attributes for the classification and creates its own thresholds. No need for adjusting parameters for each eco-region.

GIO Concept - WETLANDS

Definition: Any presence of surface water during the reference year (2012)

Wetland should include:

- ✓ Wetlands associated to permanent water bodies
- ✓ Wetlands not associated to a permanent water bodies
- ✓ Wetlands with vegetation (macrophyte) cover or without vegetation
- ✓ Peatlands (having presence of surface water)
- ✓ Coastal wetlands (salt marshes, salines, intertidal flats)

Wetlands should not include areas of:

- ✓ temporary inundations by flood
- ✓ temporary water-logging because of snow melt or heavy rains
- ✓ permanent water surfaces (rivers, lakes, lagoons, estuaries)
- ✓ fishponds
- ✓ rice fields

GIO Concept

| WAM | IM | WEM | Processing ALL images – creating binary raster masks of water, wetlands and image data presence. |

| Σ | Σ | Σ | Accumulating positive values (1) from water, wetlands and image masks available in ALL the processed images within selected sampling periods. Results: layers with sums of water, wetlands and image pixels. |
| SWAM | SIM | SWEM | |

| SWAM / SIM | | SWEM / SIM | Creating Water Presence Index and Wetlands Presence Index layers for selected sampling periods.

"PSV:Proportion of Selected Values" |
| **WAPI** | PSV | **WEPI** | |

| { WAPI ≥ 0.9 } | | { WEPI ≥ 0.9 } - PWAL | Creating Permanent Water and Permanent Wetlands layers by masking and filtering WPI and VPI values. |
| **PWAL** | | **PWEL** | |

Urban Atlas

- DG REGIO initiative to complement the Urban Audit with harmonised data on land use and land cover

- Cross-boundaries neutral and independent tool to monitor effects (positive or negative) of structural investment decisions.

- One of the first operational implementation blocks of GMES Land Monitoring Core Service, led by the EC

- Cover 305 Larger Urban Zones (LUZs)
  - Cities > 100 000 inhabitants
  - At least one city per European region
  - Finland: Helsinki, Turku, Tampere, Oulu

- Earth Observation data
  - 2.5m panchromatic + 10m multispectral (bundle if > 3 months apart; else pan-sharpened)
  - Spot-5, Formosat-2, Kompsat-2, ALOS
  - Reference year 2006 ± 1 year

- Uses the specifications developed by GSE Land project
  - Geometric resolution: 1:10.000,
  - 0.25ha MMU in urban zones,
  - 1ha MMU outside
  - Positional Accuracy : ± 5 m
  - Thematic accuracy : 85% urban areas, 80% outside
  - 21 thematic classes

From satellite image...
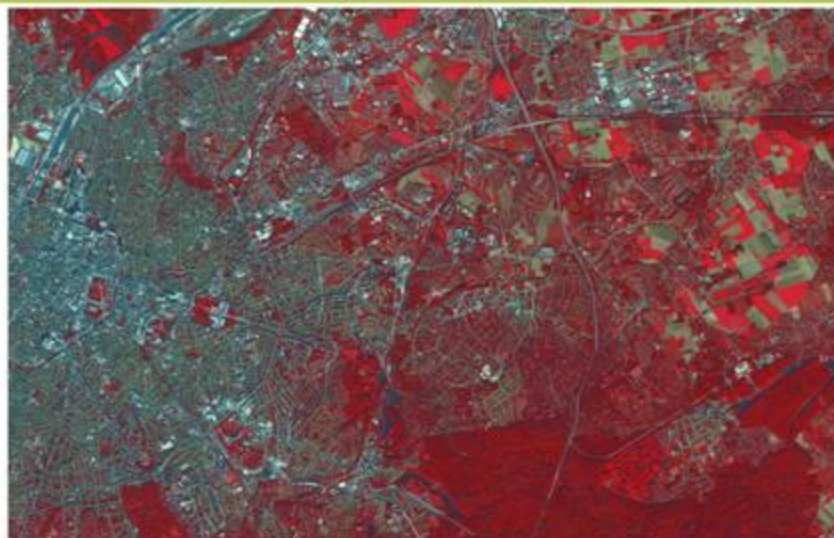
European Environment Agency

... to city maps

URBAN ATLAS
TEST AREAS

LUZ BRUXELLES BE001L
Priority 1

SIRS
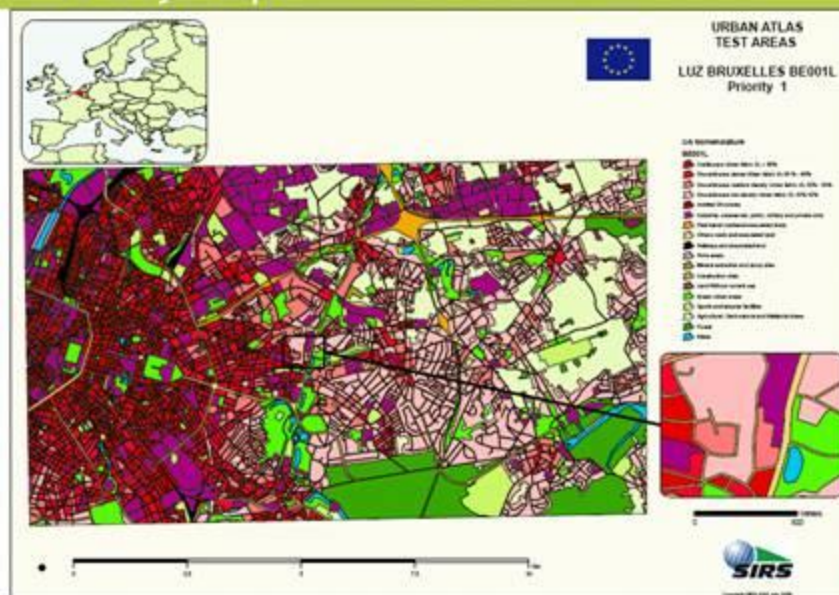
No.	Code	Nomenclature		Additional Information
1		Artificial surfaces		
1.1		Urban fabric		
1.1.1	11100	Continuous Urban fabric (S.L. > 80%)		FTS required *
1.1.2	11200	Discontinuous urban fabric (S.L. 1% - 80%)		
1.1.2.1	11210	Discontinuous Dense Urban Fabric (S.L.: 50% - 80%)		FTS required
1.1.2.2	11220	Discontinuous Medium Density Urban Fabric (S.L.: 30% - 50%)		FTS required
1.1.2.3	11230	Discontinuous Low Density Urban Fabric (S.L.: 10% - 30%)		FTS required
1.1.2.4	11240	Discontinuous Very Low Density Urban Fabric (S.L. < 10%)		FTS required
1.1.3	11300	Isolated Structures		
1.2		Industrial, commercial, public, military, private and transport units		
1.2.1	12100	Industrial, commercial, public, military and private units	zoning data / field check recommended	
1.2.2	12200	Road and rail network and associated land	COTS navigation data required	
1.2.2.1	12210	Fast transit roads and associated land	COTS navigation data required	
1.2.2.2	12220	Other roads and associated land	COTS navigation data required	
1.2.2.3	12230	Railways and associated land	COTS navigation data required	
1.2.3	12300	Port areas	zoning data / field check recommended	
1.2.4	12400	Airports	zoning data / field check recommended	

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No.	Code	Nomenclature	Additional Information
1.3		Mine, dump and construction sites	
1.3.1	13100	Mineral extraction and dump sites	
1.3.3	13300	Construction sites	
1.3.4	13400	Land without current use	
1.4		Artificial non-agricultural vegetated areas	
1.4.1	14100	Green urban areas	
1.4.2	14200	Sports and leisure facilities	
2	20000	Agricultural - + Semi-natural areas + Wetlands	1 ha MMU
3	30000	Forests	1 ha MMU
4	4000	Wetlands	1 ha MMU
5	50000	Water bodies	1 ha MMU

European Environment Agency

Urban Atlas Tampere

- Spot5 2.5m, 6.8.2007, 5.8.2006, 8.10.2005
- Overall accuracy 87.5% (321 points)

VHR Sample-based Mapping - Europe
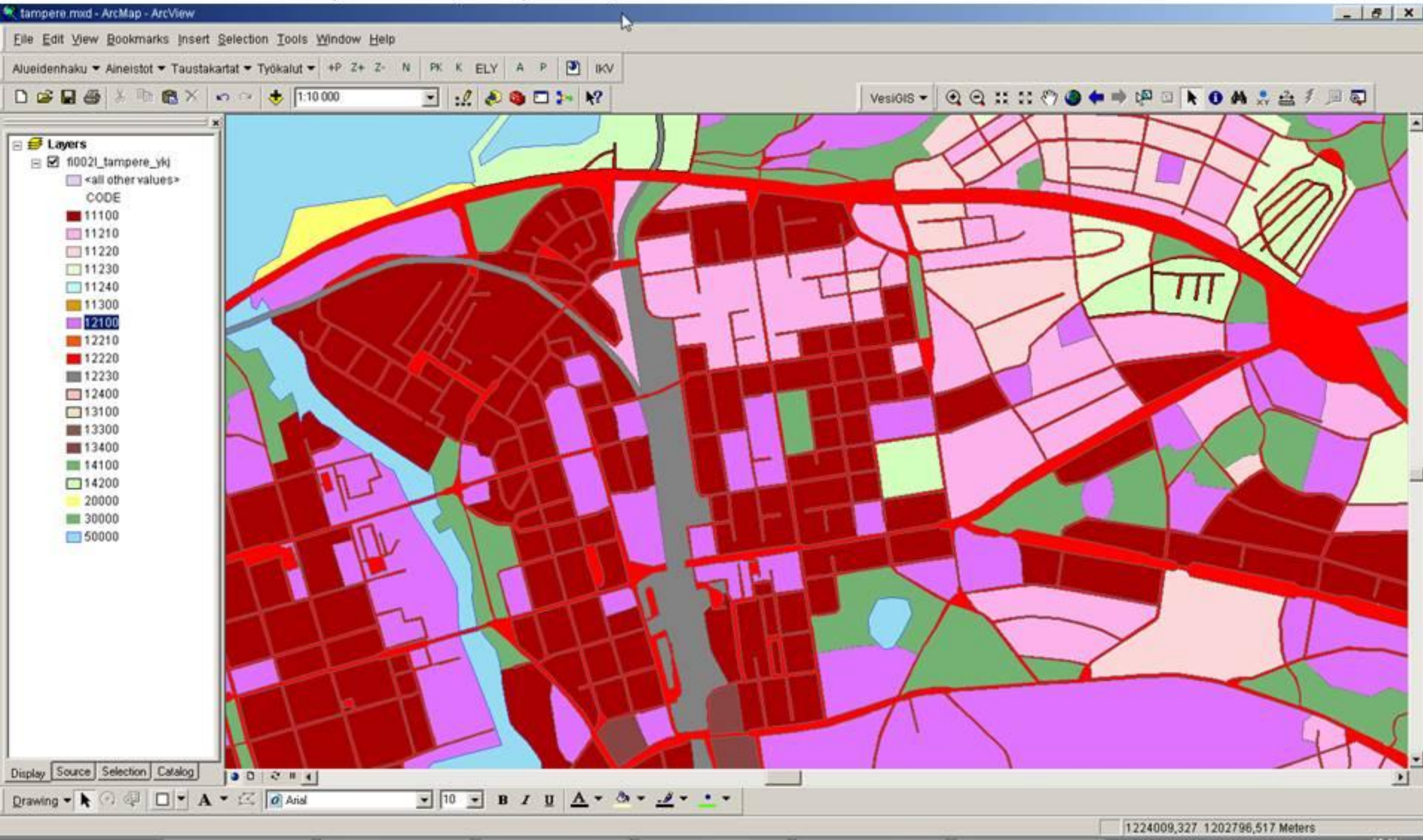
- ## Aim:
  - Provide detailed mapping of selected ('hot spots') and statistically representative sites to support a broad range of users / application types.

- ## Key components:
  - Area frame sampling (AFS) scheme.
  - VHR data.
  - Generic land cover products.

- ## User / application types:
  - Euroland validation, provision of masks aligned to HR layers.
  - Urban Atlas support, VHR data and masks.
  - LUCAS support, extend survey and add value.
  - EEA 'hot spots', Natura 2000, HNV, wetlands etc.
  - Responsive mode, purposive samples.
  - Change detection, products and contribution to tool box.

SYKE's sites

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- ## 15 sites
- ## 10 in Sweden
  - 2009: 6 sites
  - 2010: 2 sites
  - 2 sites – no images
  - Change detection in 6 sites
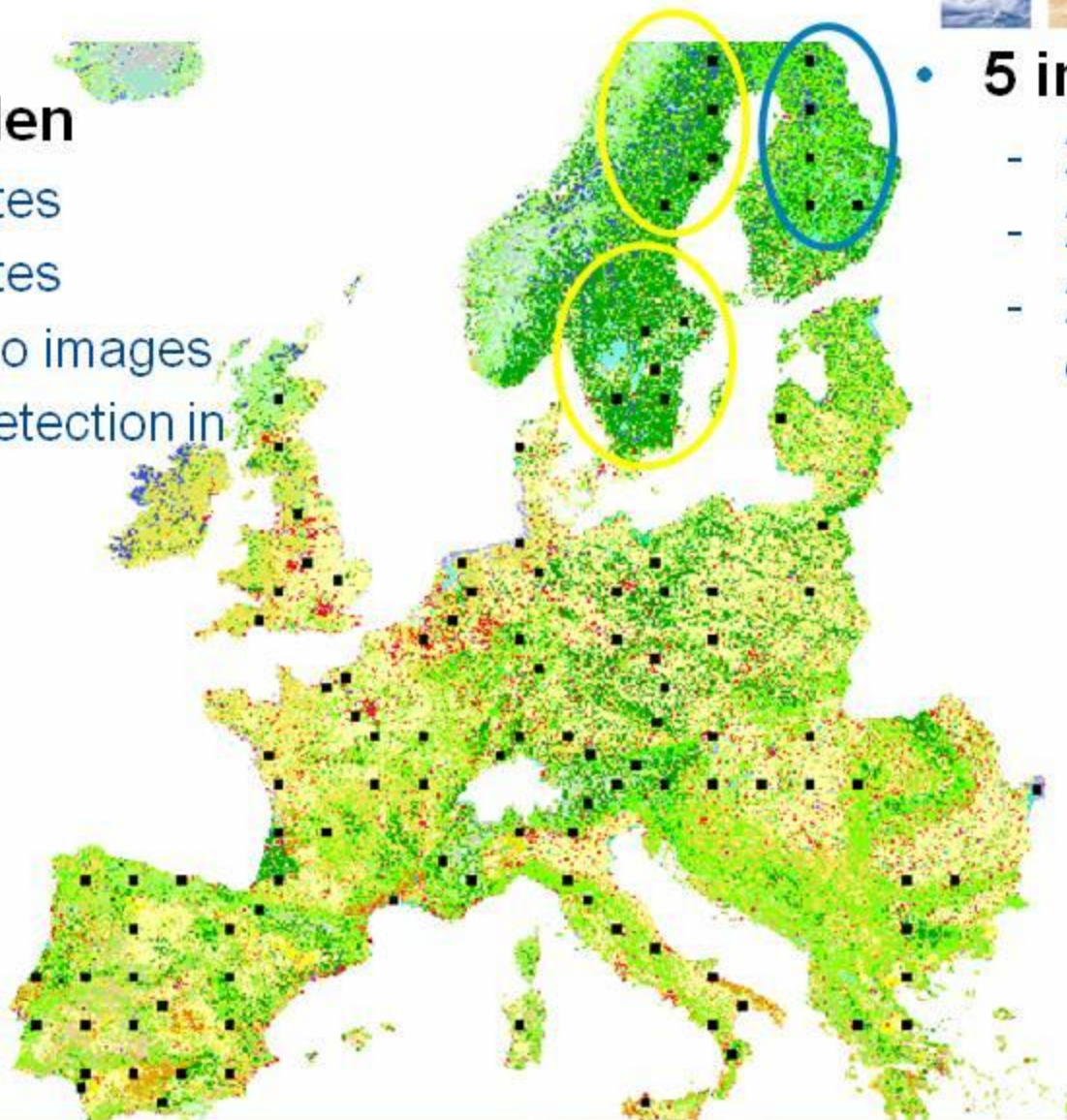
- ## 5 in Finland
  - 2009: 3 sites
  - 2010: 2 sites
  - 2011: change detection

4

Generic land cover

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- ## Geometry
 - 0.25 ha MMU, 12 m MFW

- ## Classes
  - 1 Urban/artificial
  - 2 Bare non-cultivated ground
  - 3 Water
  - 4 Snow and ice
  - 5 Agricultural areas ('cropland')
  - 6 Forest/woodland/trees
  - 7 Shrubland (shrubs, bushes)
  - 8 Grassland
  - 9 Other vegetation (e.g. moorland, reed beds, saltmarsh)
  - 10 Unclassified

- ## Production
  - Object-based
  - Semi-automated
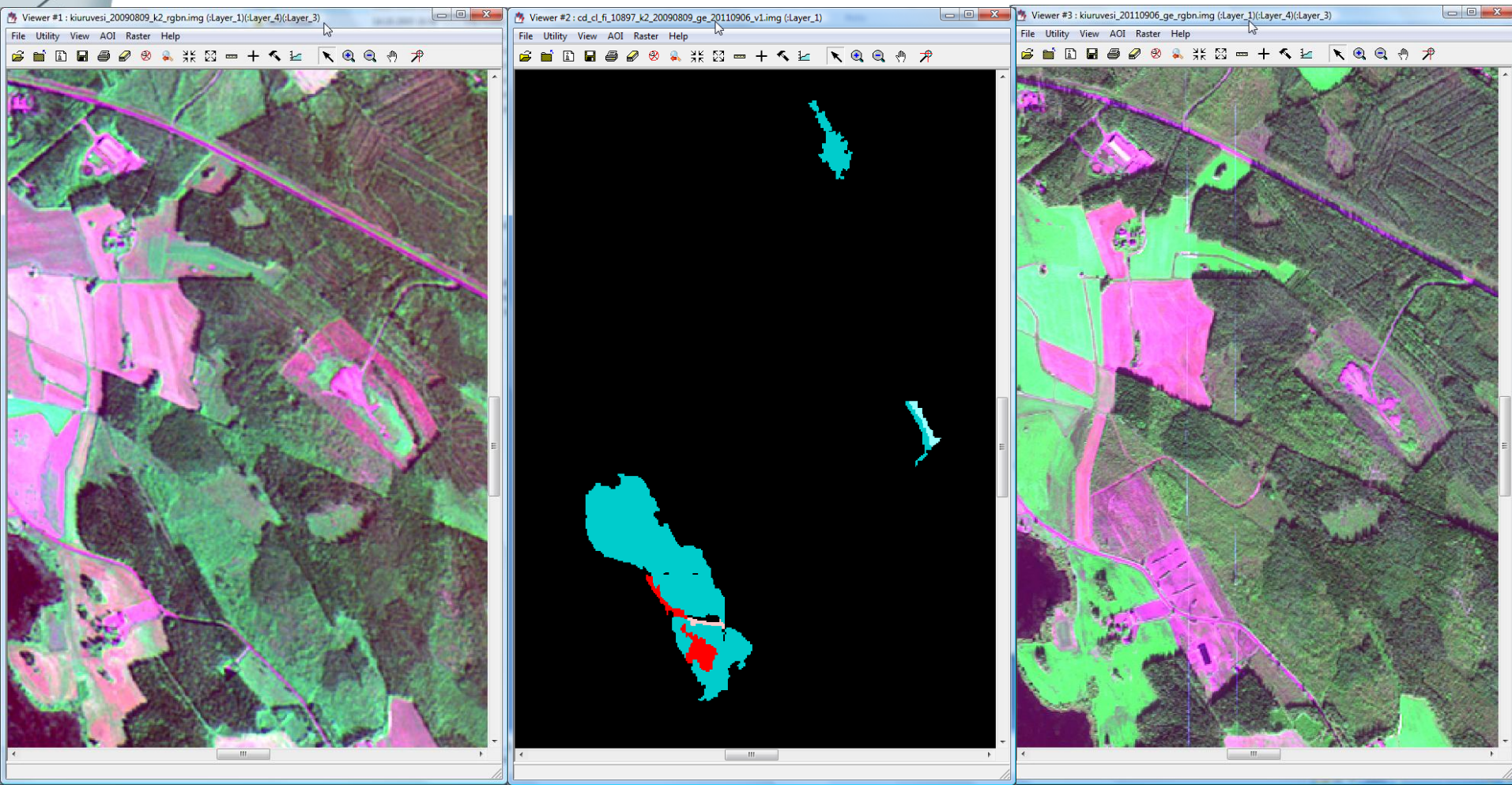 - Rule-based plus manual correction
  - Operational

- ## Validation
  - Version of approach used by ETC-SIA, Urban Atlas etc.
  - 500 points, random sampling
  - Operational
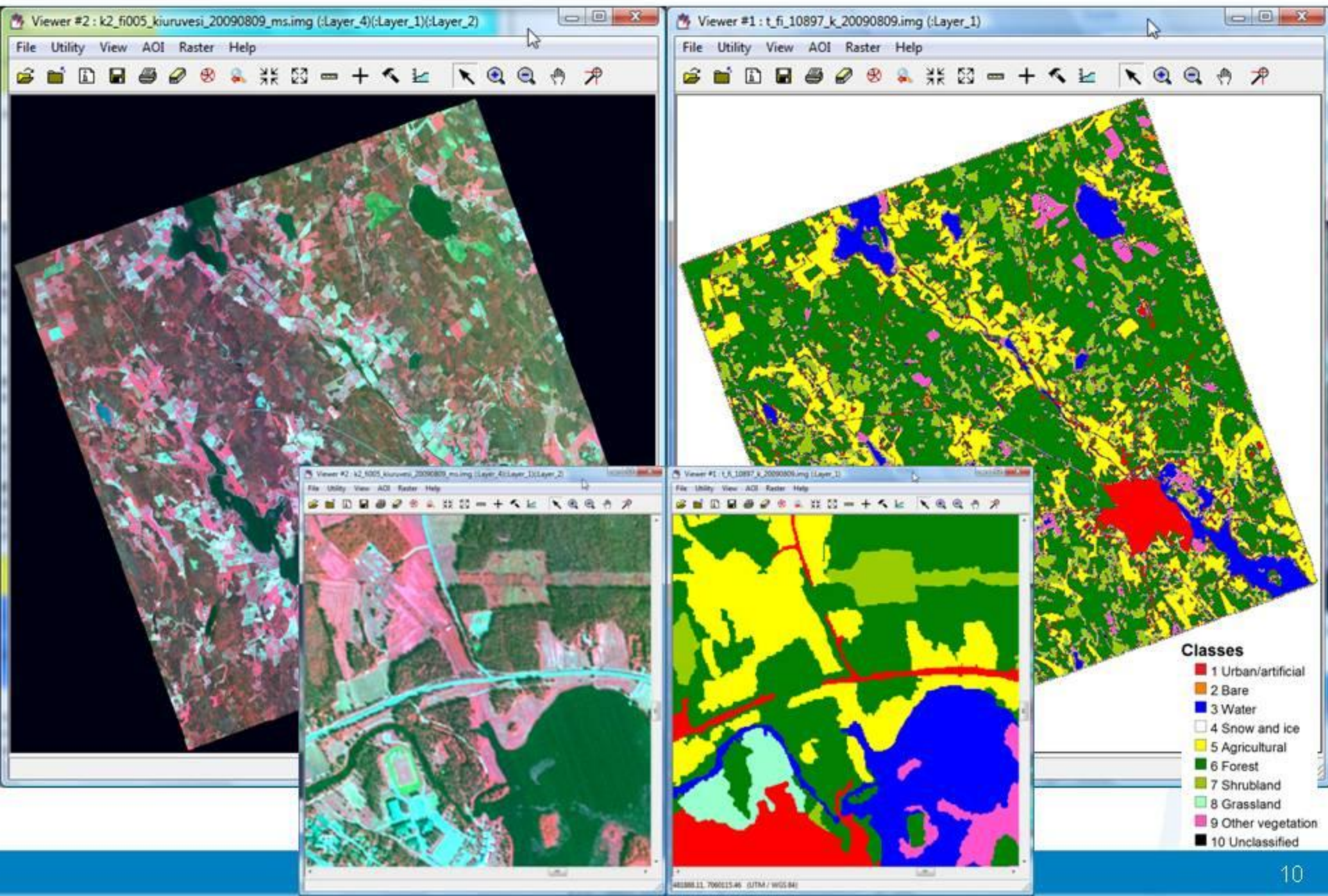
AFS Change Detection

- Example from Kiuruvesi
- Kompsat-2 9.8.2009 – Detected changes – GeoEye1 6.9.2011

- **Phenology**

  - Study of periodic plant and animal life cycle events and how these are influenced by seasonal and interannual variations in climate
  - Relevance to wide variety of climate and ecosystem research

- **Phenological information using remote sensing**

  - Time series: daily or composition vegetation index images
  - Processing: filter in order to decrease noise and fill gaps due to cloud cover
  - Study time series and extract phenological dates and other information

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- **Product features:**
  - Stratified according to land cover type
  1. Start of growing season A: Day of start of rapid increase in NDVI.
  2. Start of growing season B: Day when NDVI goes over defined threshold.
  3. Day of maximum NDVI.
  4. End of growing season: Day when NDVI decreases below threshold.
  5. Length of growing season A: feature 4 - feature 1.
  6. Length of growing season B: feature 4 - feature 2.
  7. Quality estimate for feature 1.
  8. Quality estimate for feature 2.
  9. Quality estimate for feature 4.

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- **Terra MODIS daily images**
  - 250 m
  - Years 2001 – 2008
  - Early March – late October
- **TOA reflectance**
  - NO atmospheric correction
- **Daily NDVI-images**
- **Average NDVI-curves for different land cover types**
  - Agricultural areas
  - Broadleaf forest
 - Coniferous forest
  - Mixed forest
  - Open bogs

27 drainage (sub)basins In Finland

Mutusjärvi
Pallastunturi
Pallasjärvi
Saariselkä
Sodankylä
Parkano
Hyytiälä
Aulanko

Example

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- ## Interpolated MODIS NDVI-timeseries of drainage basin VA35.9 and extracted phenological features with their quality indicators
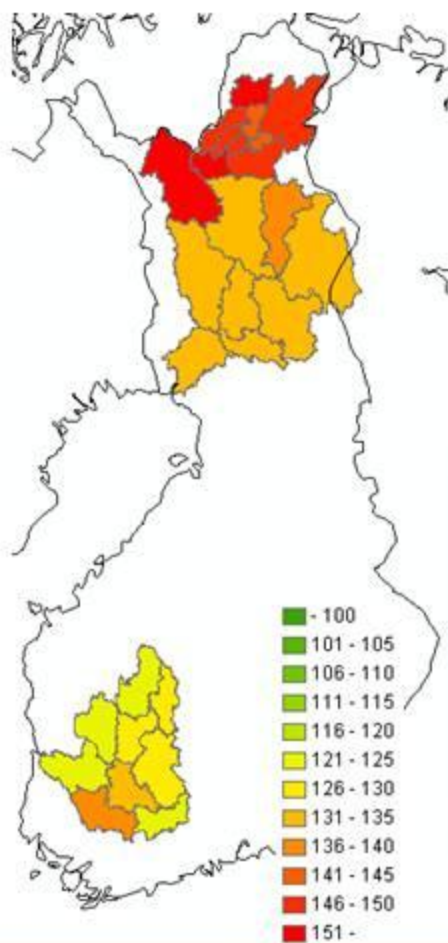 - height of extracted feature, higher means better quality

VA35.9 Loimijoki, Agricultural areas, year 2001
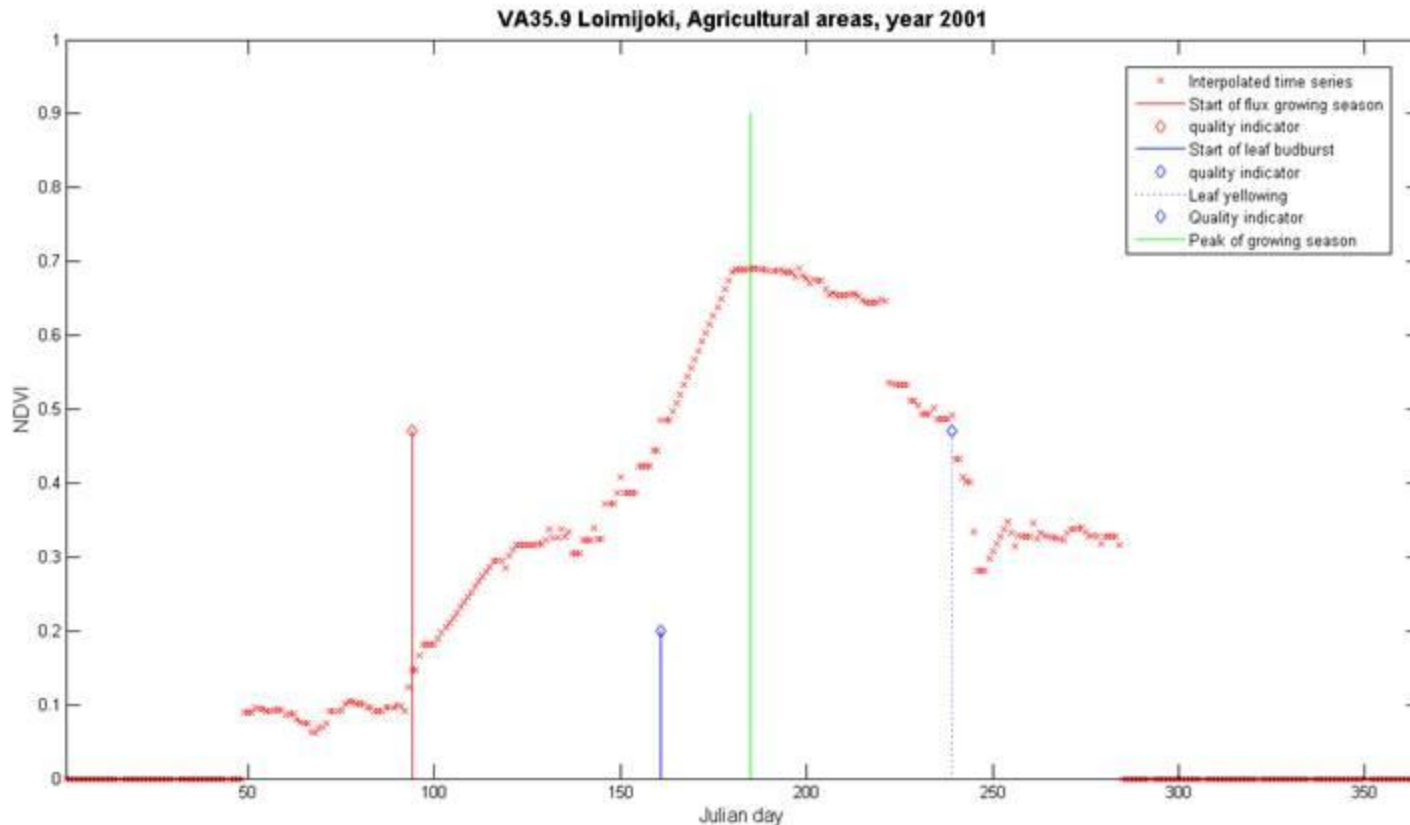
Example: Deciduous forest, Year 2006

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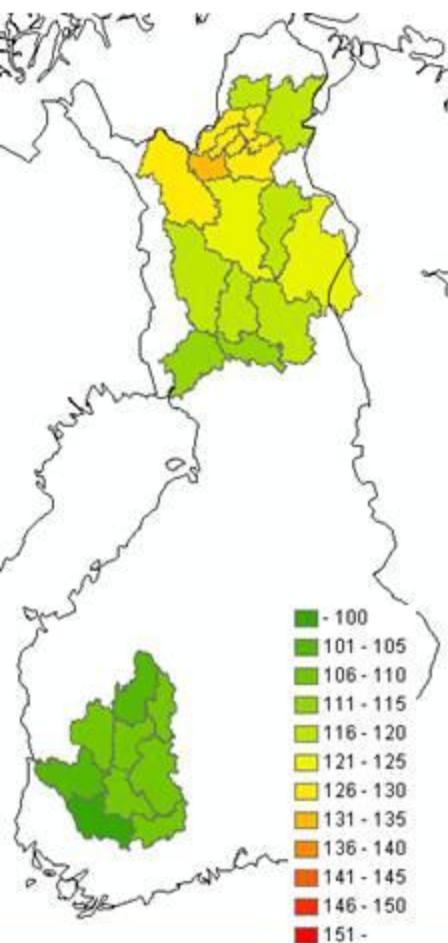
Start of growing season A | **Start of growing season B** | **Day of maximum NDVI** | **End of growing season**

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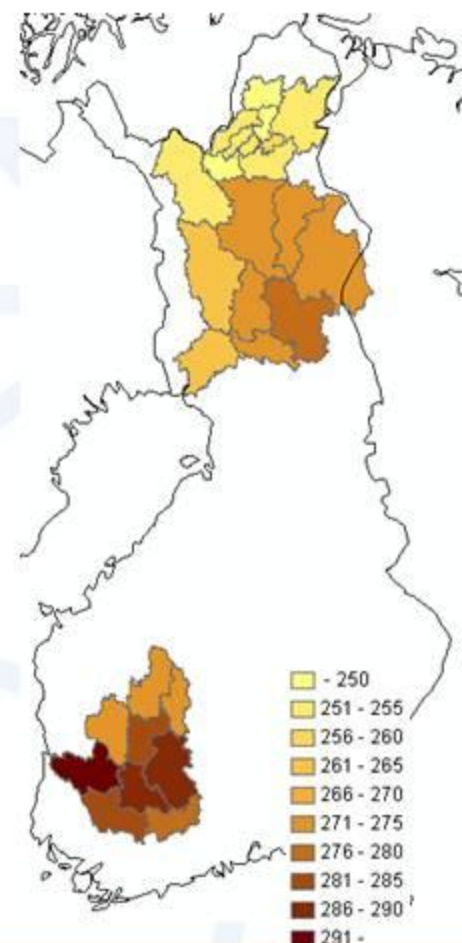
THANK YOU FOR YOUR ATTENTION!

Got interested?

Need data?

Contact: Markus.Torma@ymparisto.fi

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