Forest cover mapping over Europe at three dates: 1990, 2000, 2006

Lucia Reithmaier
Anssi Pekkarinen
Peter Strobl

Institute of Environment and Sustainability
Joint Research Centre
European Commission
To develop harmonized pan-European Forest Maps on the basis of high resolution satellite imagery

- **Consistent** over Europe
- independent of **national boundaries**
- higher level of **spatial detail** than currently available
  (e.g. small patches or non-forest openings and corridors)
- with high level of **geometric** (<25m) and **thematic accuracy**
- compatible with **INSPIRE** standards*)

(ETRS-LAEA, consistent with European Grid Coding System of Quad-tree subdivision)

Forest/Non-Forest Maps for

**Year 2000** - based on ca. 400 Landsat ETM scenes (GLCF+Image2000)

**Years 1990s** - based on ca. 400 Landsat TM scenes (GLCF)

**Year 2006** – based on more than 3500 scenes (SPOT/LISS) (Image2006)

**Technical Specifications**

**Minimum Mapping Unit** 25 m pixel resolution

**Map Classes**
- forest
- non-forest
- clouds/snow
- no data

**Coverage** EU27 + CH, Balkan States, (NO+TR)
Input data

Satellite Input data:

TARGET YEAR 2000

415 Scenes
LANDSAT ETM+
30% Image2000
70% GLCF

GLCF:
Global Land Cover Facility

TARGET YEAR 1990

Global Land Cover Facility (GLCF)
Landsat TM (25m resolution)

Sources: http://www.landcover.org/data/landsat/
Joint Research Centre 2008

– **Harmonised and consistent**
  → Independent of national borders, vegetation zones

– **Efficient**
  → high number of scenes to be processed

– **Automated processing**
  → Minimal interactive input in order to assure efficient processing
Land Cover information:

CORINE Land Cover 2000

(44 Land use/cover classes)

2000

1990

References:

Source: http://dataservice.eea.europa.eu/dataservice/
1. **Spatial resolution**: Minimum Mapping Unit (MMU) of 25 hectares
   Land cover patches smaller than 25 ha are not mapped!

**Example:**

- **CORINE 2000**
  Green colours: Forest, Yellow: Agricultural land

- **Landsat ETM**
  false colour
2. Properties of CORINE classes

- Highly spectrally heterogeneous:
  e. g. Artificial surfaces class 1.1.1 – 1.4.2

- Heterogeneous land covers, mixture of forest, natural and agricultural land:
  e.g. Land principally occupied by agriculture, with significant areas of natural vegetation (2.4.3)

For training extraction: ‘REFINEMENT’ of CORINE
Methodology applied

Preparation Steps

Landsat scene

Edge-preserving Image Segmentation

Adaptive CLUSTERING
Preparation Steps – Cloud masking

2000

Automatic Cloud Cover Assessment (ACCA)

(Irish, Barker et al 2006)

Methodology applied

1990

Step 1:
cloud AND shadow prospective areas

Step 2:
Simplifying clouds by morphological post-processing
Classification Steps

Original Image
Segmented Image
Clustered Image

Training Extraction

Adaptive Spectral Representativity Analysis

CORINE land cover

Nearest Neighbour Classification

Methodology applied

GOFC-GOLD boreal and temperate forest monitoring workshop, 13.10.2008 Jena
Reference Sources for year 2000

Comparison with Land Use/Cover Area frame statistical Survey (LUCAS) 2001

- Coverage EU15
- regular grid of 18 x 18 km for PSU (ca. 10 000 PSU)
- 10 SSU

Source: EC – EUROSTAT 2003
Results: Year 2000 & 1990s

False colour  Forest/Non-Forest Map  CORINE Land Cover

1990s

2000

Example: Ireland
### Results: Point-level Validation FMAP2000

Comparison to LUCAS 2001 data

**Overall agreement (OA):**

Using all points (96388):  
**84%**

Using homogeneous points: (73985)  
**91%**

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<th>COUNTRY</th>
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<th>δ %</th>
<th>HOMOGENEOUS OA %</th>
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**ALL:** all LUCAS points used for validation  
**HOMOGENEOUS:** points that fell into a 3x3 pixel spatial support region consisting of either only forest or non-forest  
δ: **upper and lower** bounds of a 95% confidence interval
Current available Image 2006 data set

Pan-European Data Set

Projection:
ETRS - LAEA
25m resolution

Sensor type
- IRS-P6
- SPOT4
- SPOT5

Reference Data Set of the Image2006 (1st + 2nd coverage)

SP4: ~1453
SP5: ~ 871
IRS: ~ 1209
Joint Research Centre 2008

Preliminary Results: Year 2006

GOFC-GOLD boreal and temperate forest monitoring workshop, 13.10.2008 Jena
Conclusions

✔ Fully automated algorithm
  o applicable for all Europe 2000 & 1990
  o independent of bio-geographic regions

✔ High level of spatial detail

✔ Sufficient thematic accuracy of at least 85% (for FMAP2000)
Consistency of input image
  - Acquisition year and season (1990)
  - Differences in the spectral properties of the imagery (1990 & 2006)

Validation
  - Lack of consistent and timely reference data

Comparisons between data sets
  - Change estimation at which level possible?
Forest/Non-Forest Maps

Available Products

Period 2000

Data

Forest Map

Tiles

Forest Proportion

Poster

download from
http://forest.jrc.it/ForestResources/

NEW!
Google Earth layer
A detailed description of the methodology is published in:


THANK YOU FOR YOUR ATTENTION!