

Mapping of Land Use and Land Cover in Europe

Project
“CORINE Land Cover 2000”

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German Aerospace Center (DLR)
Oberpfaffenhofen

„Land Cover“ versus „Land Use“

- **Land Cover:**
 - **Physical coverage of the surface**
 - **Main categories:**
 - **Vegetation areas**
 - **Bare soil**
 - **Solid surfaces (e.g. buildings)**
 - **Water**

- **Land Use:**
 - **Description related to the function of the land (socio-economic use), e.g.**
 - **Residential, industrial areas**
 - **Areas used for agriculture or forestry used areas**
 - **Leisure areas**
 - **Protected areas**

Land Cover
Biophysical control



Ecological Systems
Biogeochemistry
Biodiversity
Water
Air
Soil

Land Use
Human control



Social Systems
Population
Social/Economic structure
Political/Institution regimes
Culture
Technology



European Needs	Information users/ Policy framework	Analysis / Assessment land cover information needs
Assessing impacts of policy against regional development perspectives, spatial planning	Regional planning (ESDP, ESPON, Structural Funds)	<ul style="list-style-type: none"> territorial analysis land cover, land use and land quality assessment land cover changes landscape assessment.
Assessing impacts of agriculture policies on the environment	Agricultural and environmental policy (CAP reform, Nitrate Directive, UNCCD)	<ul style="list-style-type: none"> land cover changes landscape indicators watershed analysis for water use, fertiliser input soil cover management, conservation practices.
Strategy on integrated coastal zone management	Environmental policy (ICZM)	<ul style="list-style-type: none"> land use and land cover change along coastal zones.
Implementation of biodiversity conventions, habitats and protected sites	Environmental policy (Habitats Directive, UNCBD)	<ul style="list-style-type: none"> development NATURA2000 habitat mapping land cover and land use changes; habitat fragmentation; pressure on designated areas;
Integrated watershed analysis	Environmental policy (Water Framework Directive)	<ul style="list-style-type: none"> support to the development of watershed indicators.
Assessment of air emission and air quality measures	Environmental policy (Air quality directives, IPCC, UNFCCC)	<ul style="list-style-type: none"> estimates CO₂ sinks/sources; land cover around measurement stations re-allocation of air parameters to land cover;
Strategic environmental assessment of trans-European transport networks, Transport and Environment Reporting Mechanism	Transport and environmental policy (Common Transport Policy, SEA)	<ul style="list-style-type: none"> land take fragmentation of habitats, partitioning of land tranquil zones pressure on protected areas.



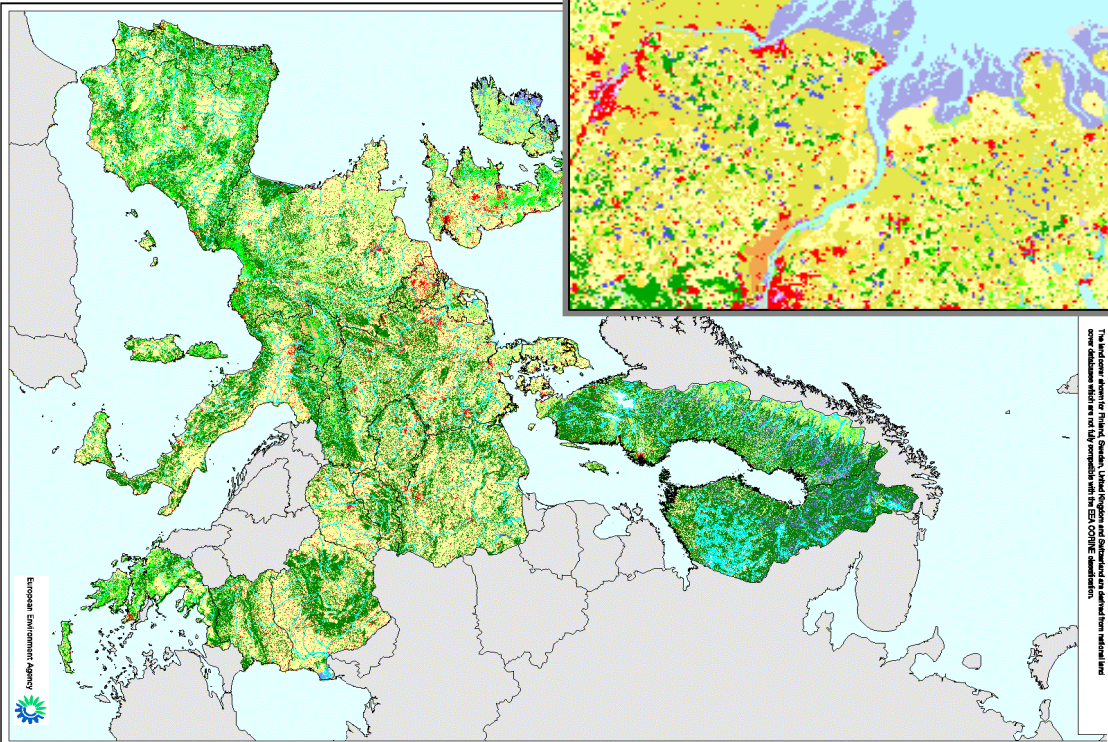
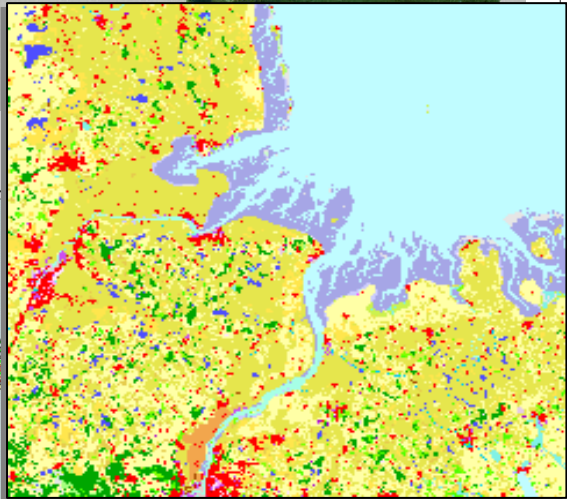
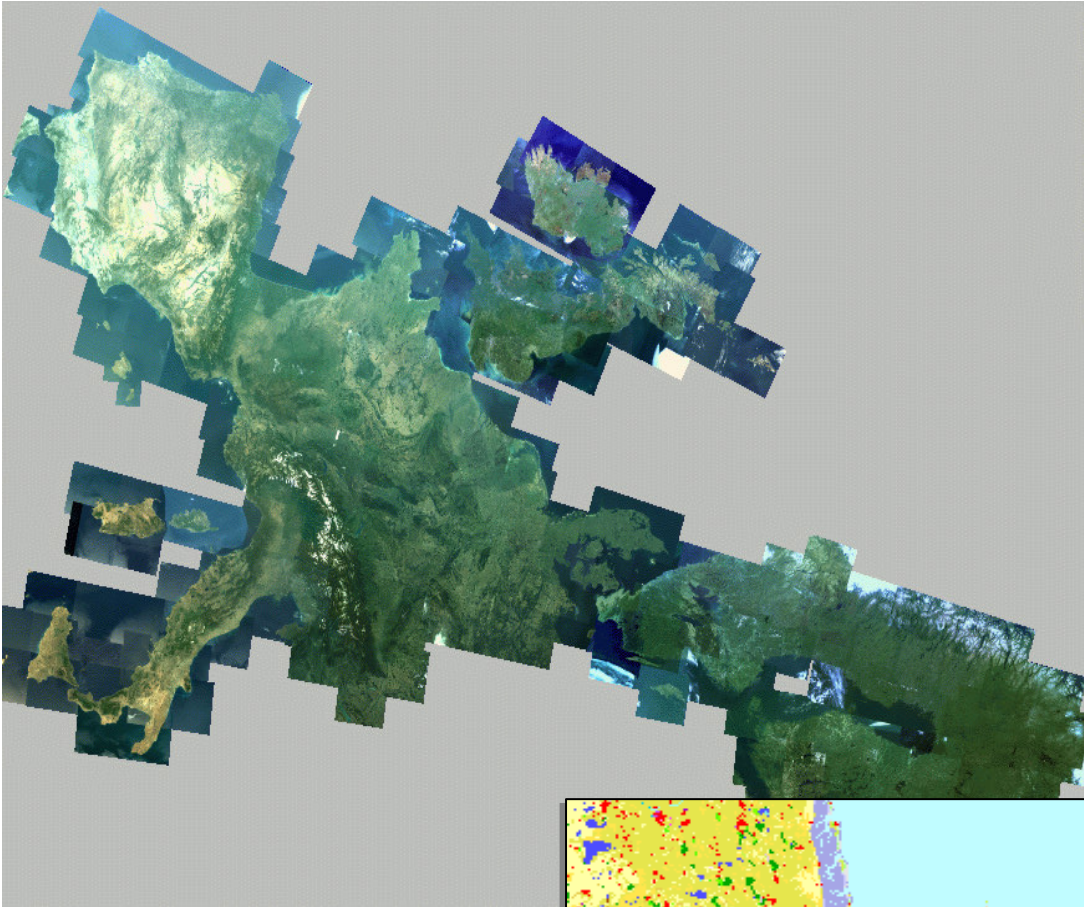
Land Use / Land Cover in support of policy implementation

Policy/legal needs	European user	National user	Examples of specific applications
Climate change Kyoto protocol	Priority area in 6EAP	Compliance with legal obligations	Changes of forests/ wetlands, carbon sinks. Scenarios on erosion risk due to climate change
Convention Long-range transboundary air pollution	EU is party to the convention	Compliance with legal obligations	Modelling and mapping critical loads, land-use specific deposition rates, location and description of ecosystems
New European Regional development Fund	New EC initiative	Consider and support territorial specificities	New DG Regional policy initiative
Water Framework directive	EU target for 2015 good status of water bodies	Location of driving forces, reporting based on CLC, substance input modelling	Characterisation of river catchment areas
European Soil Thematic strategy	Priority action 6EAP	Erosion risk assessment/land use, agri-env indicators, location driving forces	Soil erosion maps, soil sealing
Nature conservation Biological diversity convention	Priority 6EAP, strategy in place	EU obligation and legal compliance	Description of ecosystems, Natura2000/ EUNIS , designation of environmental sensitive areas
Agriculture	Greening CAP	National Agri-env. Programme	Yield forecast modelling, sustainable farming, preserving landscape values Land use changes related to agriculture

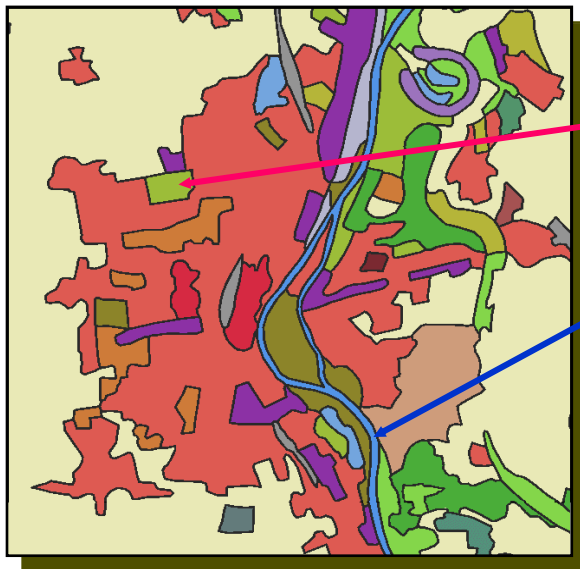
- **CORINE Program:**
 - ▶ **Co-ordination of Information on the Environment (CORINE)**
 - ▶ **Implemented by the European Commission from 1985 to 1990**
 - ▶ **Information system on the state of the European environment**
 - ▶ **Development of nomenclatures and methodologies, agreed at EU level**
 - ▶ **Responsibility for CORINE databases (and their updates): European Environment Agency (EEA)**

- **CORINE Land Cover (CLC):**
 - ▶ **Largest of the CORINE databases**
 - ▶ **CLC1990 inventory, Update CLC2000, In progress CLC2006**
 - ▶ **Key reference data sets for environmental analysis and assessment**
 - ▶ **Mainly for the European level, but also at national levels**

CORINE Land Cover 2000



- **Mapping scale: 1:100 000**
- **Mapping accuracy: at least 100 m for national and European products**
- **Minimum mapping unit: 25 ha (for inventory)**
 - **Areas smaller than 25 ha are allowed in the national land cover database, but should be aggregated/generalized in the European database**
- **Minimum width of linear features: 100 m**



Areas (min. 25 ha)

Linear Structures (min. 100 m)



CORINE Land Cover - Basic Specifications

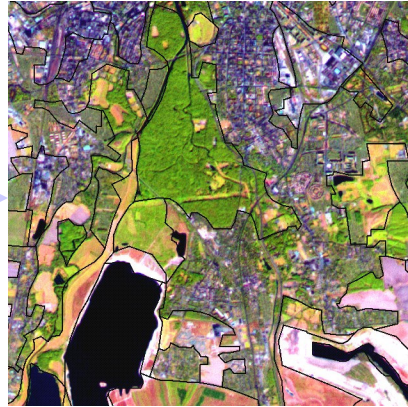
Further requirements for the updating of CLC for the year 2000:

- **Minimum mapping unit for changes: 5 ha**
- **Generate an up-to-date CLC database**
 - **for the land cover of the year 2000 and**
 - **land cover changes between the 1990s and 2000**
- **Reference year 2000, with ± 1 year**
- **Geometric accuracy:**
 - **image data: 25 m**
 - **land cover data: 100 m**
- **Thematic accuracy: at least 90 %**
- **Updating frequency: every 10 year, now becoming shorter: 5-6 years**

CORINE Land Cover - Basic Specifications

Landsat TM / 1989-1992

Landsat ETM+ / 1999-2001



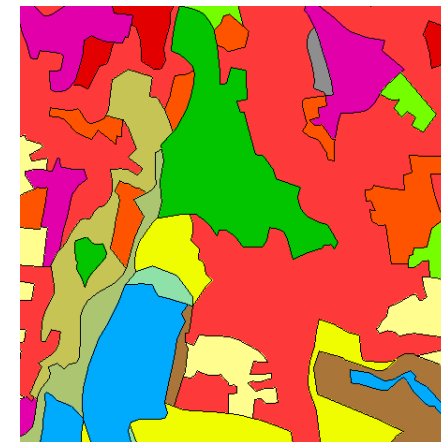
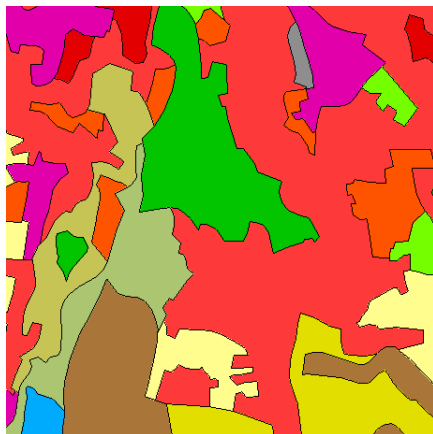
Additional reference data:

- Topographic maps
- Thematic maps
- Aerial images

CLC 1990

Change Cover

CLC 2000





CORINE Land Cover - Nomenclature

- **CLC nomenclature is hierarchical and distinguishes**
 - **5 classes at the first level,**
 - **15 classes at the second level and**
 - **44 classes at the third level**
- **CLC nomenclature has been developed in order to map the whole European countries**
- **CLC nomenclature is harmonized and agreed upon by all participating countries**
- **Use of the CLC nomenclature with 44 classes at three hierarchical levels is mandatory**
 - **Additional national levels can be mapped but should be aggregated to level 3 for the European data integration**



CORINE Land Cover – Nomenclature (classes relevant in D)

ARTIFICIAL SURFACES

URBAN FABRIC

- 111 Continuous urban fabric
- 112 Discontinuous urban fabric

INDUSTRIAL, COMMERCIAL AND TRANSPORT UNITS

- 121 Industrial, commercial and public units
- 122 Road and rail networks and associated land
- 123 Port areas
- 124 Airport

MINES, DUMPS AND CONSTRUCTION SITES

- 131 Mineral extraction sites
- 132 Dump sites
- 133 Construction sites

ARTIFICIAL NON-AGRICULTURAL VEGETATED AREAS

- 141 Green urban areas
- 142 Sport and leisure facilities

AGRICULTURAL AREAS

ARABLE LAND

- 211 Non-irrigated arable land

PERMANENT CROPS

- 221 Vineyards
- 222 Fruit trees and berries plantations

PASTURES

- 231 Pastures

HETEROGENEOUS AGRICULTURAL AREAS

- 242 Complex cultivation patterns
- 243 Land principally occupied by agriculture, with significant areas of natural vegetation

FOREST AND SEMINATURAL AREA

FORESTS

- 311 Broad-leaved forest
- 312 Coniferous forest
- 313 Mixed forest

SCRUBS AND/OR HERBACEOUS VEGETATION

- 321 Natural grassland
- 322 Moors and heathland
- 324 Transitional woodland-scrub

OPEN SPACES WITH LITTLE OR NO VEGETATION

- 331 Beaches, dunes, sand
- 332 Bare rock
- 333 Sparsely vegetated areas
- 334 Burnt areas
- 335 Glaciers and perpetual snow

WETLANDS

INLAND WETLANDS

- 411 Inland marshes
- 412 Peat bogs

COASTAL WETLANDS

- 421 Salt marshes
- 423 Intertidal flats

WATER BODIES

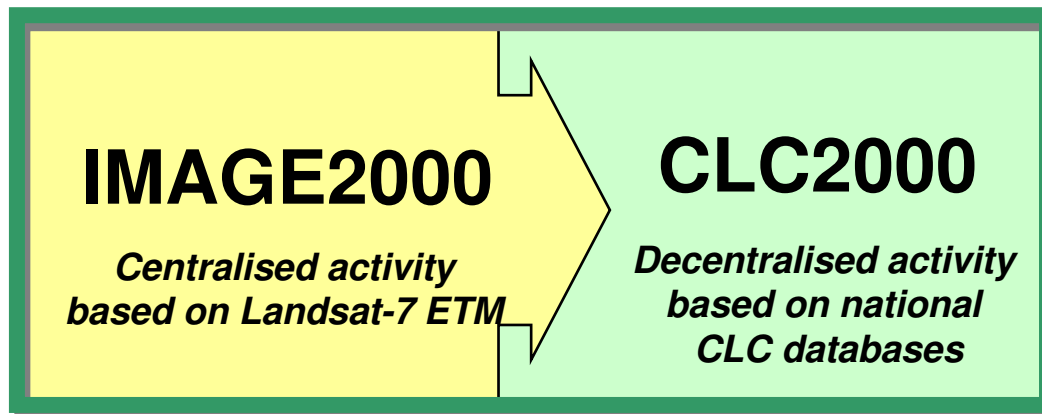
INLAND WATERS

- 511 Water courses
- 512 Water bodies

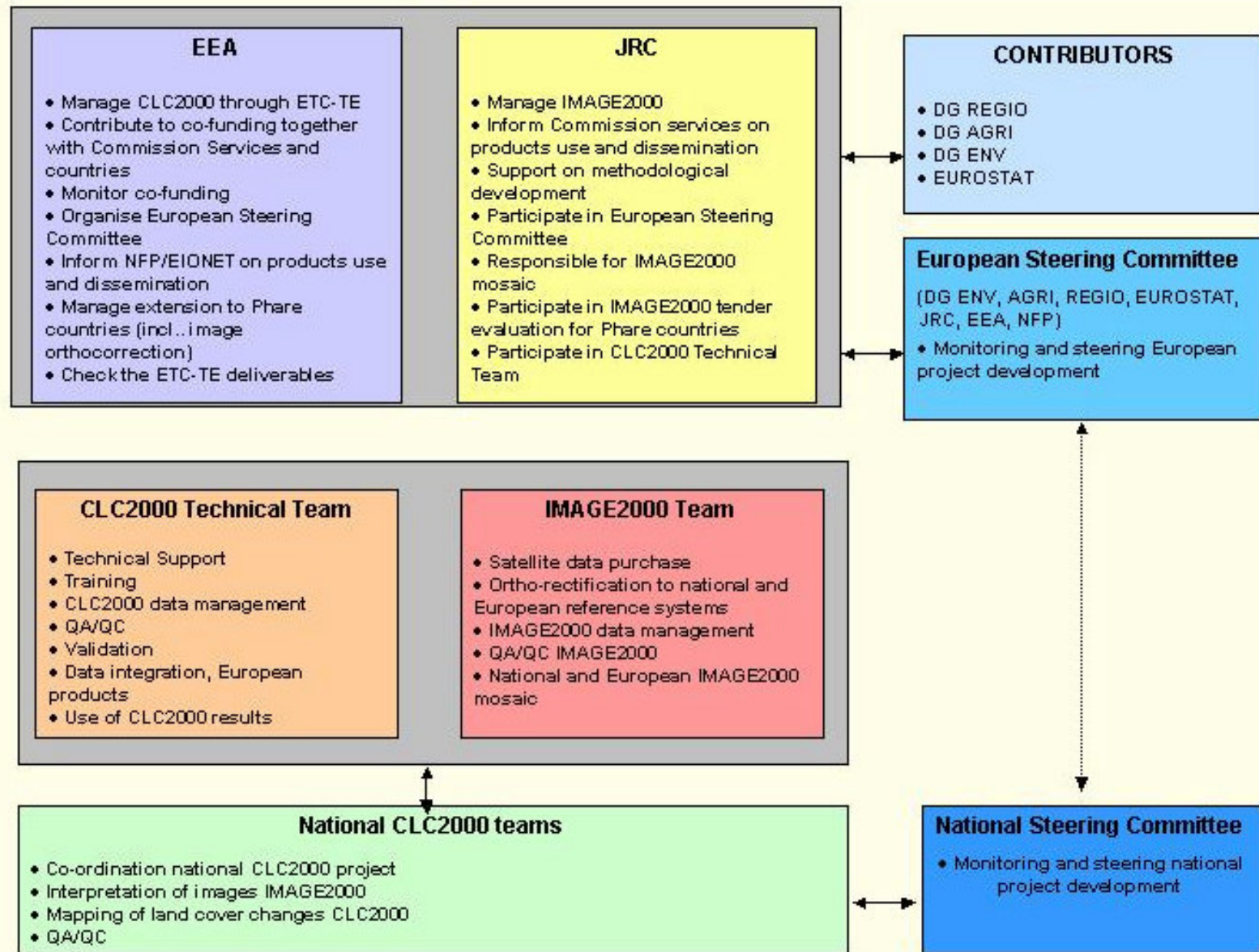
MARINE WATERS

- 521 Coastal lagoons
- 522 Estuaries
- 523 Sea and ocean

- **CLC2000 project consist of 2 main components:**
 - **IMAGE2000: covering all activities related to satellite image acquisition, ortho-rectification and production of European and national image mosaics**
 - **CLC2000: covering all activities related to detection and interpretation of land cover changes, including training and correction of CLC90**



CORINE Land Cover 2000 – Project Structure

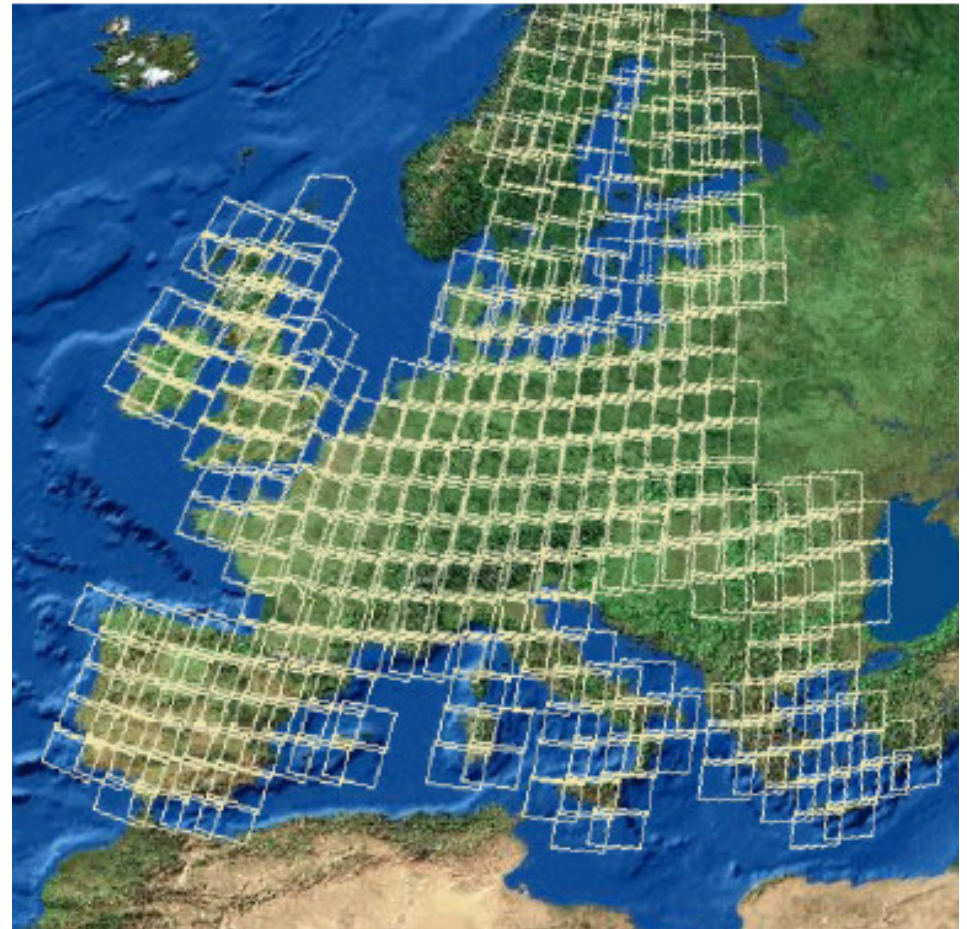
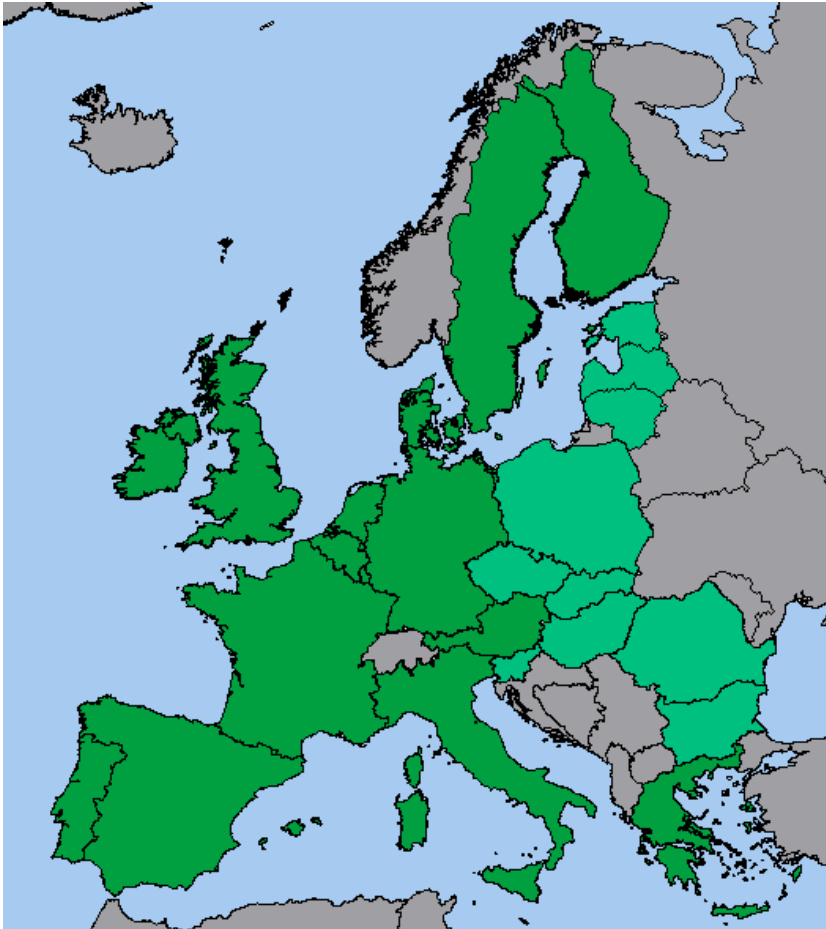




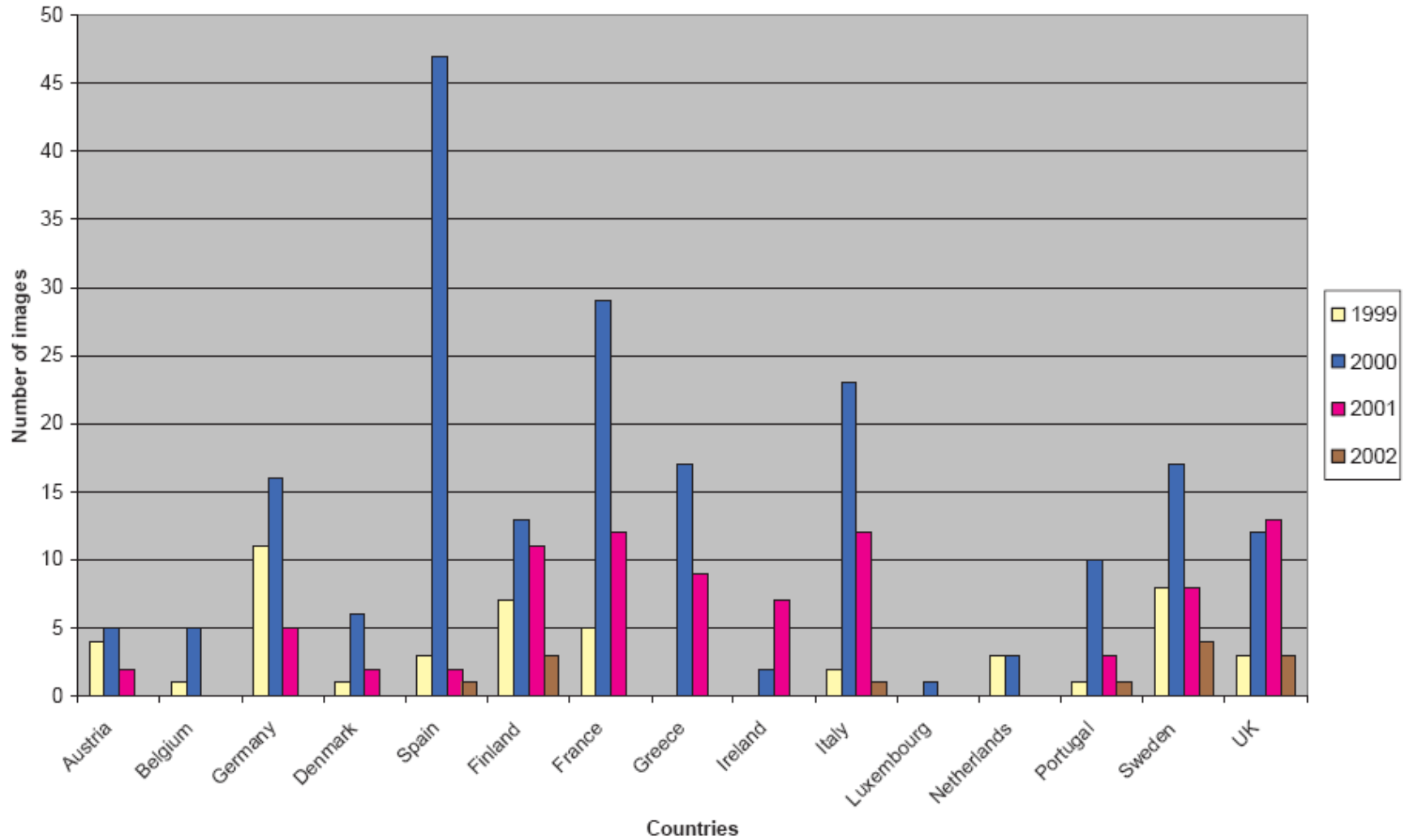
CORINE Land Cover 2000 – Participating Countries

- **Co-funding mechanism between European Commission and each participating country (50% / 50%)**
- **29 countries of Europe participated CLC2000**
 - **EU25**
 - **Bulgaria, Croatia, Liechtenstein and Romania**
- **plus**
 - **Serbia-Montenegro, Turkey, Norway, Iceland, Switzerland, ..**

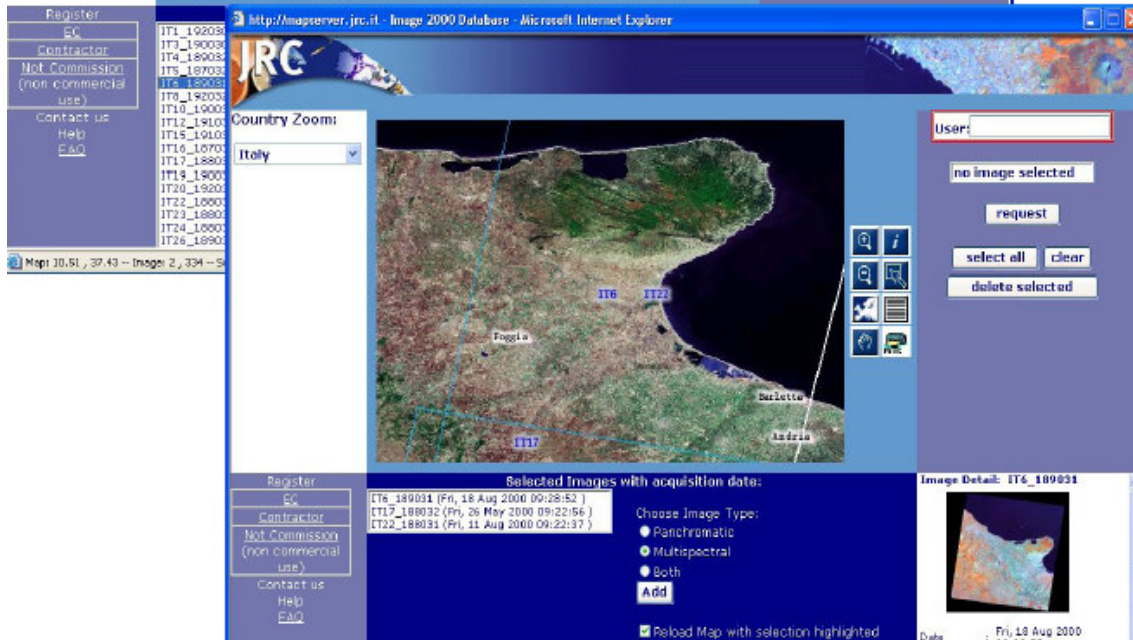
CLC1990	23 countries	3.86 M km ²
CLC2000 in 2004/05	29 countries	4.38 M km ²
CLC2000 in 2006/07	37 countries	5.74 M km ²



Overview of images by year



<http://image2000.jrc.it>



Product 1- individual scenes

- Free access for non-commercial uses
- Disseminated by JRC and MS
- Dissemination for commercial purposes by Metria and Eurimage

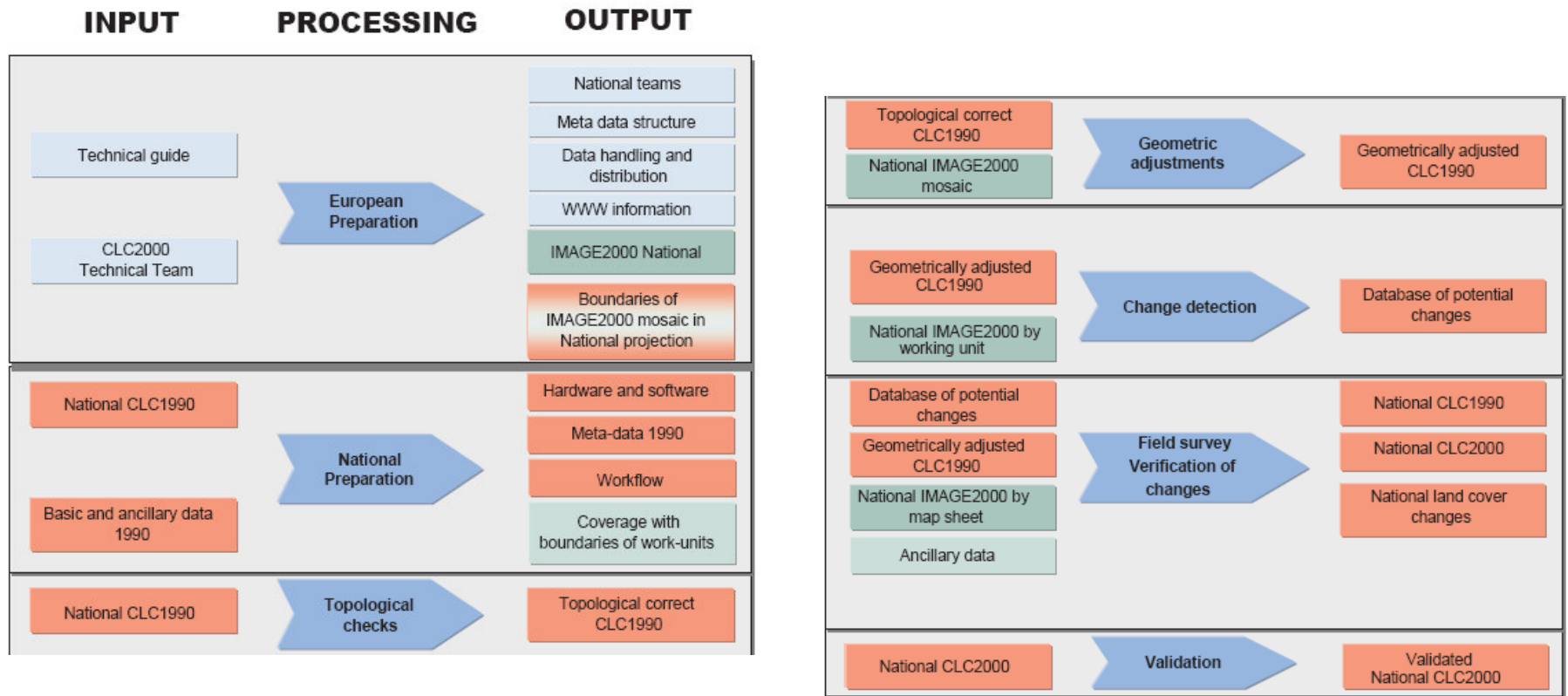
Product 2 – national mosaics

- Free access for non-commercial uses
- Disseminated by MS

Products 5 – European mosaic

- Free access for non-commercial uses
- Disseminated by JRC

CORINE Land Cover 2000 – Production Flow

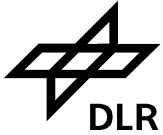


- **Geometric adaptation of satellite images from 1990s**
 - Transformation and Resampling (Image processing)
- **Geometric correction of CLC1990**
 - Rubber sheeting (GIS)
- **Mapping of land cover changes**



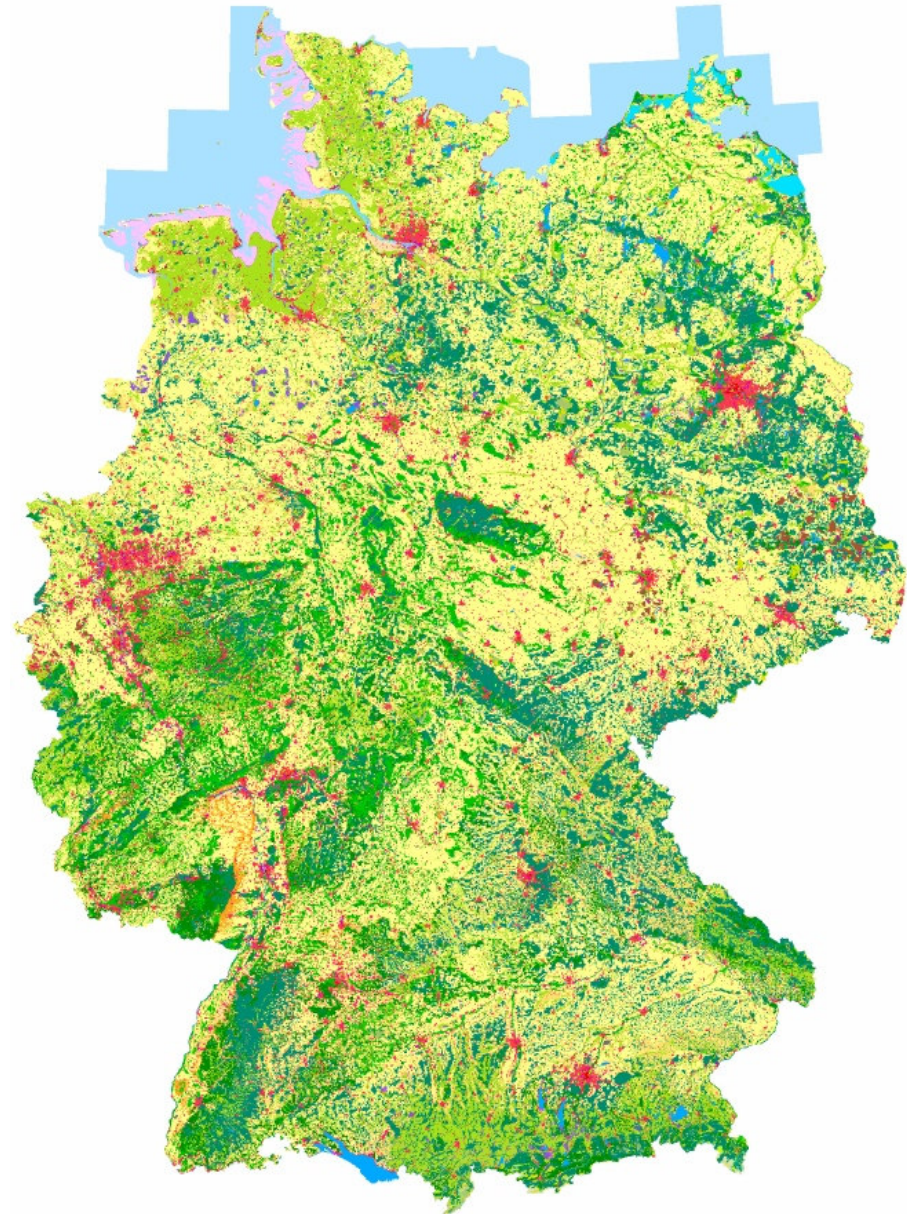
CORINE Land Cover 2000 – Quality control

- **Quality assurance and quality control:**
 - **Geometric and thematic quality checks**
- **Verification:**
 - **Verification sessions by the European Technical team**
 - **To assist the national teams in producing CLC2000 database and to assure a homogenous implementation across Europe.**
 - **Discussing specific problems occurring during the production, correcting databases if necessary and thereby assuring a harmonized European CLC database**
 - **Provide the EEA with information on overall quality of work performed by the countries**



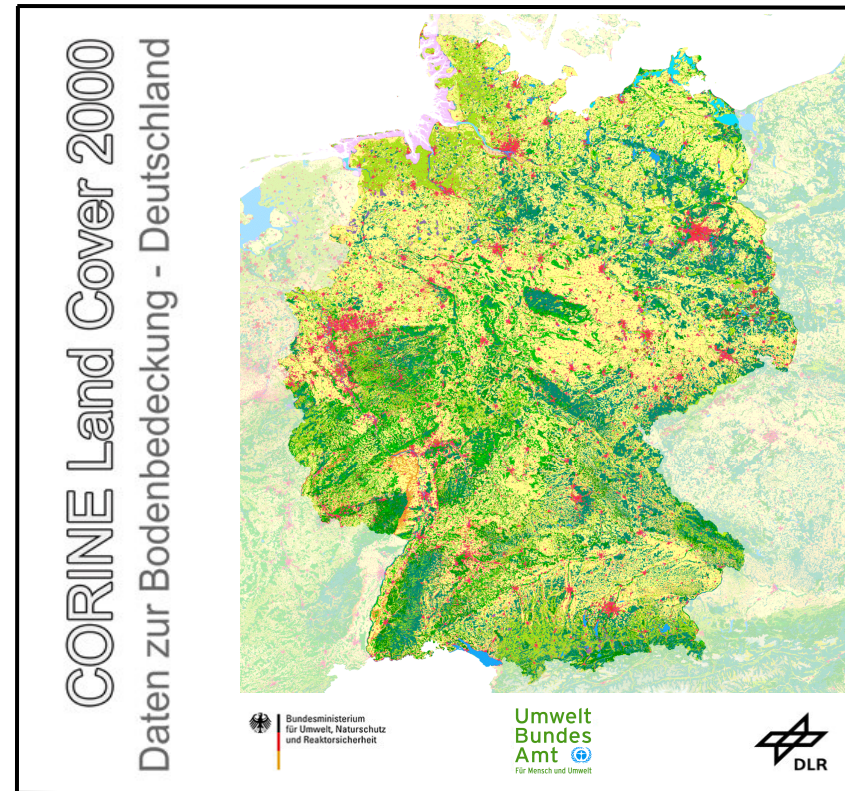
- **Data integration:**
 - ▶ **Delivered national data were produced in national systems of all participating countries**
 - ▶ **Each national Coordinate Reference System (CRS) definition must be known precisely, together with its geometric relationship to a standard system**
 - ▶ **Transformation from the national reference system into the European reference system ETRS89**
- **Validation of the European CLC2000**
 - ▶ **LUCAS data (Land Use and land Cover Area frame Sampling) was used for the validation of CLC2000**
 - ▶ **Field surveys and landscape photos**

- **Lead of the national project in Germany: Federal Environmental Agency (UBA)**
- **DLR-DFD was contracted for the implementation of CLC2000 in Germany**
- **DLR-DFD's role: management, coordination, quality control and overall responsibility for CLC2000 in Germany**
- **Subcontracting of companies for the CLC interpretation**
- **Project duration: 2001 - 2004**



CLC 2000: Data availability via Internet

- **Since December 2004 CLC2000 for Germany is available**
- **Data ordering on Internet**
- **Data delivery via DVD or FTP transfer**
- **Complete data set for Germany (vector and raster data)**



www.corine.dfd.dlr.de



CORINE Land Cover 2000 – References

- **Websites:**

- ▶ **European CLC2000 Webpage and data portal (EEA)**
 - <http://terrestrial.eionet.eu.int/CLC2000>
 - <http://dataservice.eea.eu.int/dataservice>
- ▶ **European IMAGE2000 Webpage and data portal (JRC)**
 - <http://www.ec-gis.org/clc>
 - <http://image2000.jrc.it>
- ▶ **CLC2000 in Germany (UBA, DLR)**
 - <http://corine.dfd.dlr.de>

- **Publications:**

- ▶ Bossard, M., J. Feranec, J. Otahel, 2000: CORINE Land Cover Technical Guide – Addendum 2000, Technical report No 40. Copenhagen, EEA, May 2000, <http://terrestrial.eionet.eea.int>
- ▶ Büttner G, J. Feranec, G. Jaffrain, L. Mari, G. Maucha, T. Soukup, 2004: The European CORINE Land Cover 2000 Project, ISPRS Symposium, Istanbul, Turkey, July 12-23, 2004
- ▶ EEA-ETC/TE, JRC, 2002: CORINE Land Cover update: I&CLC2000 Project Technical Guidelines
- ▶ Nunes de Lima, M.V. (Ed.), 2005: IMAGE 2000 and CLC 2000 Products and Methods