

European Topic Centre on Land Cover

Annual Topic Update 1997

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1. THE EUROPEAN TOPIC CENTRE ON LAND COVER

1.1. Background

The mission of the European Environment Agency is to provide the European Community and Member States with timely, targeted, relevant and reliable information to policy making agents and the public, to help achieve significant and measurable improvement in Europe's environment. To achieve this, the European Environment Agency (EEA) has contracted a range of national institutions and organisations to form consortia of experts as European Topic Centres (ETC). These Topic Centres execute particular projects identified in the Agency's multi-annual work programme. For the European Topic Centre on Land Cover (ETC/LC) the project is "Land Cover - Ecological Monitoring".

The task for the ETC/LC is to make full use of and further develop the results obtained so far through the implementation of the CORINE Land Cover (CLC) programme. The CLC-programme was initiated by the European Commission in 1985 and is now under the auspices of the European Environment Agency (EEA). The CLC-programme and the work of ETC/LC are significant developments for the integration of environmental aspects, in particular those regarding the 5th European Environmental Action Programme, regional planning strategies, integrated statistical and geographical information systems.

1.2. Organisation

In 1995, the Environmental Satellite Data Centre (MDC) was appointed lead organisation for the European Topic Centre on Land Cover. ETC/LC is organised as a consortium of 16 partners as listed in table 1. The Centro Nacional de Informação Geográfica (CNIG) and the European Commission Joint Research Centre (JRC) are co-leaders.

Table 1. The ETC/LC Consortium

Organisation	Acronym	Country
Environmental Satellite Data Centre	MDC	Sweden
Centro Nacional de Informação Geográfica	CNIG	Portugal
Joint Research Centre / Space Applications Institute	JRC / SAI	based in Ispra, Italy
Centro Interregionale	CI	Italy
Centre de Recherche Publique – Henri Tudor	CRP-HT / G ² ERE	Luxembourg
National Environmental Research Institute	NERI	Denmark
Federal Statistics Office	StBA	Germany
Finnish Environment Institute	FEI	Finland
Geospace	GEOSPACE	Austria
Geographic Information Management	GIM	Belgium
Hellenic Mapping & Cadastral Organisation	HEMCO	Greece
Institut Français de l'Environnement	IFEN	France
Instituto Geográfico Nacional	IGN	Spain
Institute for Terrestrial Ecology	ITE	United Kingdom
Natural Resources Development Centre	NRDC	Ireland
Winand Staring Centre for Integrated Land, Soil and Water Research	SC-DLO	The Netherlands

1.3. Management

The ETC/LC is led by MDC. The lead organisation is supported by a Steering Committee for day-to-day issues. The Steering Committee consists of land cover experts from MDC, CNIG and JRC/SAI, and the EEA Project Manager. Main questions, such as future strategy issues, are handled by a Management Committee consisting of the Steering Committee plus the major task-leaders from IFEN, GIM, ITE, NERI and StBA, and which meets twice a year.

In July 1997, a Phare Topic Link on Land Cover (PTL/LC) extended the ETC activities towards Central and Eastern European Countries. The PTL/LC is led by GISAT (Czech Republic). The work programme of the ETC/LC and PTL/LC has been integrated to form a single extended European Topic Centre on Land Cover.

The needs of research and development of methods and other themes identified when realising the inventory work are carried out and funded separately by the Joint Research Centre, Space Application Institute.

The first Topic Centre Leader, Ulf von Sydow, left his position for other duties within MDC on 31 December 1996. The present leader, Rolf Bergström, started work for the ETC/LC on 1 April 1997.

1.4. Work Programme for 1997

The work programme for 1997 comprised nine different tasks, covering activities from management of the Topic Centre, updating of the CLC database, dissemination of land cover data, development of guidelines for CLC inventories, applications such as a strategic environmental assessment of the Trans-European Transport Network (SEA of TEN), research and development tasks on indicators for environmental impact assessments, land cover data generalisations, methods of updating and others.

The main objectives for 1997 were:

- to develop the CORINE Land Cover database by continuing the technical co-ordination of national land cover inventories;
- to distribute to EEA, European Commission and for public use, CLC data, reports and other information produced within the Topic Centre;
- to apply and use land cover inventory data for environmental and integrated applications;
- to identify needs of, and pursue applied research on, land cover.

The various tasks have been co-ordinated with other projects in the EEA work-programme, particularly projects where land cover data is a basic requirement for GIS applications (e.g. ETC on Nature Conservation).

The ETC/LC has collaborated with Eurostat in updating parts of the CORINE Land Cover data for inclusion in the Eurostat/GISCO reference database.

The ETC/LC supported EEA in its collaboration with other European Commission Directorates Generals, especially Transport (DGVII), Environment (DGXI), Research (DGXII) and Regional Planning (DGXVI).

Table 2 gives an overview of the National Reference Centres and Primary Contact Points for land cover (status December 1997). This list will be updated in 1998.

Table 2. ETC/LC National Reference Centres and Primary Contact Points

Organisation	Country
Umweltbundesamt Wien - Department for environmental planning	Austria
Institut National Géographique/Nationaal Geografisch Instituut	Belgium
Statens Planteavlsforsøg	Denmark
Suomen ympäristökeskus, akt-palveluyksikkö	Finland
Institut Français de l'Environnement	France
Statistisches Bundesamt	Germany
Institute of Terrestrial Ecology, ITE	Great Britain
Hellenic Mapping and Cadastral Organisation	Greece
Geodetic Survey	Iceland
Ordnance Survey of Ireland	Ireland
Centro Interregionale di Cartografia	Italy
SC-DLO Winand Staring Centre	The Netherlands
Norsk Institutt for Jord- og Skogkartlegging	Norway
Direktoratet for Naturforvaltning, DN	Norway
Statens kartverk, SK - Aust Agder	Norway
Centro Nacional de Informação Geográfica	Portugal
Instituto Geografico Nacional	Spain

2. PROGRESS IN 1997

2.1. Monitoring and Data Collection

One of the main objectives of the ETC/LC is to develop the CORINE Land Cover database by supporting the national CORINE Land Cover mapping projects and the integration of land cover data into the European CLC database of the European Environment Agency. It is the task of ETC/LC to ensure the consistency and coherence across Europe of the land cover data produced by the national teams.

The CORINE Land Cover database is composed of individual national land cover inventories, according to the defined methodology, described in the Technical Guidelines, Volume 1 and 2, available from EEA and ETC/LC. It is based on computer-aided interpretation of satellite imagery and a simultaneous use of ancillary data. Land units or areas have been classified by vegetation type, type of habitation (built-up areas, urban, industrial, transport areas), wetland or water bodies. 44 different classes have been defined, covering all types of land cover. They are grouped in a 3-level hierarchy, and this 3 level 44 class nomenclature is identical for all countries. The smallest mapping unit is 25 hectares and the standard mapping scale for data collection 1:100 000.

At the end of 1997 the CORINE Land Cover database was available for 12 Member States. Together with the CORINE Land Cover data sets from 6 Phare countries (Bulgaria, Czech Republic, Hungary, Poland, Romania, and the Slovak Republic) the CORINE Land Cover database currently covers 3.6 million km² or twice the area available in 1996. For the first time in Europe, a consistent detailed land cover inventory is now available for a large area of continental Europe for environmental applications at regional and European scale. The volume of this database is 1.2 Gigabyte. Table 3 gives an overview of the completed national inventories and indicates the year of satellite data acquisition for each of the countries.

Table 3. CORINE Land Cover Inventory, Data on Completed National Inventories (Status Dec. 1997)

Country	Satellite data acquisition year	Mapping completed
Austria	1985 - 1986	1996
Belgium	1989 - 1990	1995
Bulgaria	1989 - 1992	1996
Czech Republic	1990 - 1992	1996
Denmark	1986 - 1994	1994
France	1987 - 1992	1996
Germany	1989 - 1992	1996
Greece	1987 - 1995	1997
Hungary	1990 - 1992	1996
Ireland	1989 - 1990	1993
Italy	1989 - 1993	1997
Luxembourg	1989	1990
The Netherlands	1986 - 1987	1992
Poland	1989 - 1992	1996
Portugal	1985 -1987	1990
Romania	1989 - 1992	1996
Slovak Republic	1989 - 1992	1996
Spain	1985 - 1988	1991

CORINE Land Cover mapping projects are under preparation in Finland, Norway, Sweden and UK. These inventories will be prepared as high resolution land cover maps, to a large extent using existing national databases. The national data are being generalised and aggregated to the CORINE Land Cover classes. The inventories are planned to be completed between 1999 and 2002. Databases for Iceland and Liechtenstein are not yet under preparation. Within the Phare Multi-Country Programme, the CORINE Land Cover project has also been extended to Albania, Estonia, Latvia, Lithuania, Slovenia and the

Former Yugoslavian Republic of Macedonia. Table 4 summarises the area statistics for all CORINE Land Cover classes for the EEA member countries which completed the inventory (status end 1997).

Table 4. Area statistics for CORINE Land Cover classes by country (excluding sea and ocean), in km²

CORINE Land Cover class	AT	BE	DE	DK	FR	GR	IE	IT	LU	NL	PT	ES
1.1.1 Continuous urban fabric	70	51	217	64	696	223	56	*	13	*	199	*
1.1.2 Discontinuous urban fabric	1214	480 6	20425	2047	14912	1064	499	8288*	129	2534*	776	4658*
1.2.1 Industrial /commercial units	57	416	2295	147	2285	138	44	1649	18	379	86	720
1.2.2 Road/rail associated land	17	94	153	4	284	0	5	98	1	43	10	120
1.2.3 Port areas	2	54	101	23	69	6	7	62	0	54	6	41
1.2.4 Airports	30	54	472	60	401	71	22	185	5	62	31	153
1.3.1 Mineral extraction sites	60	85	1260	32	642	64	56	447	2	23	45	460
1.3.2 Dump sites	0	13	167	0	79	2	2	15	7	3	2	59
1.3.3 Construction sites	0	34	64	0	143	49	6	95	0	138	14	117
1.4.1 Green urban areas	18	44	325	100	146	10	20	115	0	80	25	24
1.4.2 Sport and leisure facilities	14	213	714	64	692	11	75	121	1	257	20	78
2.1.1 Non-irrigated arable land	11473	698 7	142883	26481	14415 3	12051	3378	68615	283	7957	14933	108966
2.1.2 Permanently irrigated land	0	0	0	0	58	6872	0	4312	0	0	283	23478
2.1.3 Rice fields	0	0	0	0	94	13	0	1272	0	0	492	899
2.2.1 Vineyards	582	0	1277	0	12138	1367	0	4022	20	0	2767	8783
2.2.2 Fruit trees, berry plantations	0	121	1257	10	1849	1221	0	4415	1	97	804	6261
2.2.3 Olive groves	0	0	0	0	82	5216	0	11589	0	0	3283	15895
2.3.1 Pastures	9254	372 4	42903	695	81490	3	39973	4322	224	11826	127	4804
2.4.1 Annual crops associated with permanent crops	0	0	0	0	256	165	0	6217	17	2	5472	1447
2.4.2 Complex cultivation	8522	534 6	20493	2998	74883	10106	1015	24998	625	5339	4262	35606
2.4.3 Agriculture with presence of natural vegetation.	671	173 5	7375	3612	25953	7798	3420	17745	265	1062	8097	29016
2.4.4 Agro-forestry areas	0	0	0	0	92	1648	0	2010	0	0	5931	22539
3.1.1 Broad-leaved forest	3091	201 8	23487	614	83907	8359	322	42734	351	476	10548	35084
3.1.2 Coniferous forest	22864	140 7	57101	2044	35473	5245	2434	11114	94	1646	7655	42844
3.1.3 Mixed forest	10925	259 1	23371	1492	20205	5703	169	8445	508	931	6602	10336
3.2.1 Natural grassland	5595	10	1915	357	13982	12506	2064	11721	5	300	2729	30070
3.2.2 Moors and heathland	1759	187	1028	447	6949	2610	2667	2274	0	451	4820	16189
3.2.3 Sclerophyllous vegetation	0	0	0	0	6527	20956	0	5303	0	0	1679	52820
3.2.4 Transitional woodland shrub	351	256	354	435	4580	10442	1318	12196	1	6	4332	34561
3.3.1 Beaches, dunes, sand plains	0	21	107	64	305	303	111	497	0	159	127	358
3.3.2 Bare rock	3771	0	150	0	4567	230	150	4380	0	0	820	4348
3.3.3 Sparsely vegetated areas	2260	0	267	22	3567	2498	193	4152	0	0	5	10957
3.3.4 Burnt areas	0	0	0	0	165	211	3	365	0	0	755	741
3.3.5 Glaciers and perpetual snow	560	0	0	0	481	0	0	302	0	0	0	25
4.1.1 Inland marshes	139	44	465	212	726	66	161	160	0	265	5	525
4.1.2 Peat-bogs	11	49	1043	194	134	22	9722	3	0	3	0	2
4.2.1 Salt marshes	0	3	83	190	458	284	19	186	0	63	92	258
4.2.2 Salines	0	0	0	0	200	15	0	250	0	0	63	148
4.2.3 Intertidal flats	0	1	371	9	524	0	108	1	0	9	2	44
5.1.1 Water courses	182	42	570	0	851	112	59	307	3	444	179	568
5.1.2 Water bodies	455	108	2785	351	1446	746	1246	1626	4	2548	281	1944
5.2.1 Coastal lagoons	0	0	310	83	622	103	8	831	0	30	9	78
5.2.2 Estuaries	0	41	173	0	134	1	45	4	0	20	210	137
Total mapped area in km ² (including water surfaces)	83947	305 55	355961	42851	54720 0	11851 0	69377	25915 5	2577	34673	88578	501503

*area statistics for discontinuous urban fabric (1.1.2) include continuous urban fabric (1.1.1). Area statistics for continuous urban fabric for Italy, The Netherlands and Spain are being validated.

2.2. Information and Distribution of Data

2.2.1. The CLC Meta-Information

For management and use of the CORINE Land Cover data, information on the data sources is necessary. This information was initially organised in a CORINE Land Cover meta-information database, using MS Access. The ETC/LC is converting its meta-information system to the EEA Catalogue of Data Sources (EEA/CDS) for maintaining and dissemination of meta-information. The following meta-information on land cover is held by the ETC/LC:

- meta-information about the national projects currently held in the CLC directory. This includes details of the responsible organisation and contact person in each country and a general summary of how the project was carried out. This directory is available as paper copy on request to ETC/LC and also via the ETC/LC Homepage (<http://www.mdc.kiruna.se/etc>);
- meta-information of individual working units of land cover data. The data held describes the satellite images used and detailed procedures followed in order to obtain the land cover inventory for each working unit (map sheets in the national 1:100 000 topographic map series in most of the cases);
- survey of non-CORINE Land Cover and land use systems in the Member States, summarised in a MS Access database and available from ETC/LC as a printed technical report.

The ETC/CDS and the ETC/LC started co-operation with the Centre for Earth Observation (CEO) within the DGXIII/EEIS (European Environmental Information Services) project, to make land cover and earth observation catalogues accessible through CDS and the enabling services of CEO.

2.2.2. The CLC Data Storage and Distribution System

The distribution system which began to be developed in 1997 is designed to meet the EEA requirement for distributing environmental data to EEA member countries, European Commission institutions and to the public, but is also intended to promote the use of CLC data. The strategy for the data storage and distribution system is to create for the user easy access via the Internet to the meta-information and to the CLC data itself combined with functions to browse, select, clip and download the desired part or parts of the CORINE Land Cover database and other land cover data. The system is designed as an interactive Helpdesk function based on ArcView software and Oracle Relational Data Base Management System. A data storage system and a distribution function enables the user to browse the database, extract data of interest from the data sets and download the desired data sets or information, all operations performed on-line across the Internet. At the end of 1997, a prototype was demonstrated, with only restricted access for testing. A description of this prototype for data storage and distribution is given below.

The data storage system is based on a GeoINFO server containing five categories of information or data:

- meta-data, describing all characteristics of available data sets;
- geographical data, which is the CLC data and other data sets needed for the user to produce the requested maps and data sets;
- stored visualisations, which contain pre-organised data sets or base maps, allowing less advanced users (not running desk-top GIS) to produce maps by combining real CLC data and the base maps;
- user profiles, which is a mandatory user registration function without which the potential user cannot get access to the helpdesk data;
- a session log, to automatically register all helpdesk operations.

The user profile and session log functions build up an information database on the various applications for which CLC data are requested and also create a register of the users. The aim is to create a database of applications and users, from which other users can obtain information on how to use CLC data and enable contacts with expertise for different land cover applications.

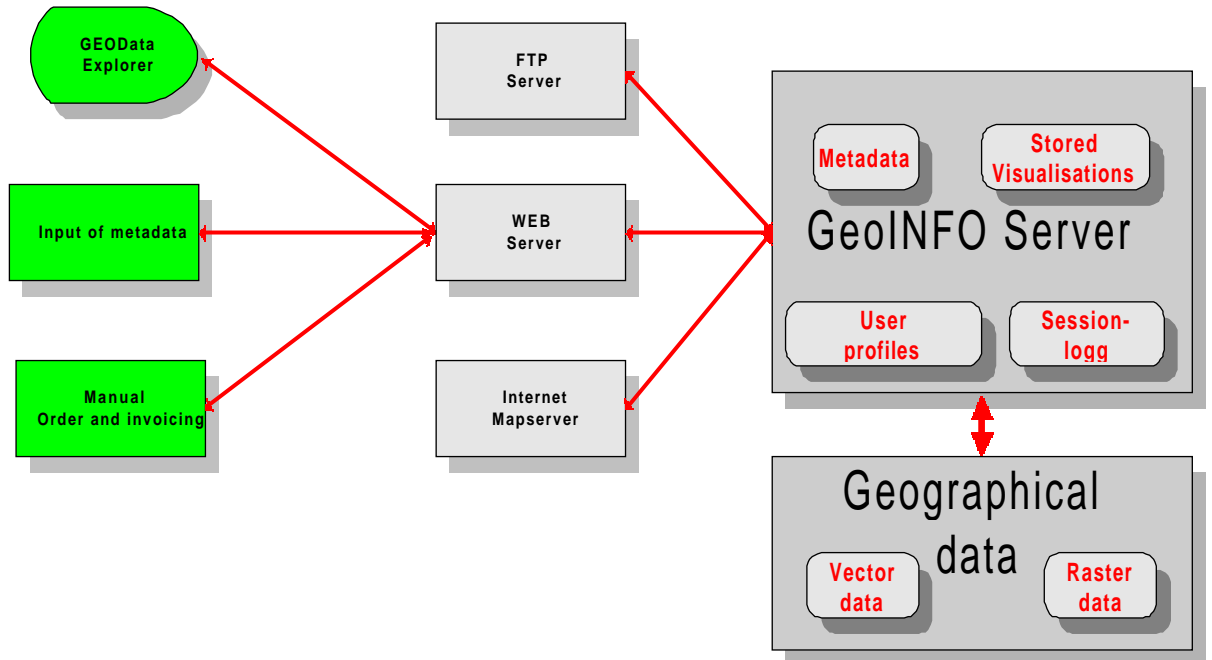


Figure 1. The structure of the GeoINFO server

The distribution function contains output functions for delivery of data either on CD-ROMs (off-line methods) or, for example, across the Internet (on-line methods). At present most deliveries of CLC data are made on CD-ROMs.

On-line technology will offer in the near future a simpler approach for a wider group of users. For smaller data sets, simple transfer systems (for instance FTP, File Transfer Protocol), make it possible to distribute data via a Homepage. There are, on the users side, already several cheap and simple softwares available, with varying capabilities for handling data, such as functions for clipping, zooming, panning, adding/deleting themes, identifying/locating objects etc., functions that enable the user to create maps or other presentation forms according to specific needs.

Issues on formats, standards for meta-data and for the database handling system have to be addressed before the complete data storage system and the distribution functions are fully implemented in the helpdesk function. These developments are included in the 1998 work programme and the enhanced system will be made available in late 1998.

2.2.3. CLC Data Requests

Between June and December 1997 about 50 requests for data sets or information on CLC data were received through the provisional helpdesk. The requests have mainly been for entire pan-European data sets but a number of extracts covering specific parts such as river catchment areas, specific city areas, regions or cross-border areas have also been requested.

The requests have been listed with respect to users and projects or applications fields. A database of applications and users or user organisation will be developed by merging this provisional register at MDC with an existing database at StBA and with periodical reports from France. This register or list of users will be implemented in the user profile and

session log of the Helpdesk and thus be openly accessible from the ETC/LC Website as described above. These functionalities will be fully operational in 1998.

2.3. Assessment and Reporting

2.3.1. Workshop on Land Cover Applications – Needs and Use

The ETC/LC in May 1997 organised a workshop on Land Cover Applications – Needs and Use. Invited participants were potential users of land cover data and information. The aim was primarily to demonstrate and assess the importance of land cover data in environmental and integrated applications and especially as support to EU policies. The Workshop also aimed to demonstrate the results of the first 18 months of activity of the ETC and results obtained so far.

28 applications developed in support of different European policies were presented, demonstrating current or completed studies or assessment projects from all parts of Europe, and covering applications within specific domains, see table 5.

The full account of the workshop is available on the ETC/LC Homepage under the heading "Workshop on Land Cover Applications", <http://www.mdc.kiruna.se/etc/Workshop/-contents.htm>. The dossier and results of the Workshop are also available in printed form from EEA and the ETC/LC as proceedings from the workshop.

Table 5. Application domains

Application	Coverage/scale of the examples
Nature conservation	European - Regional
Water management	Regional
Forest fragmentation	European - Regional
Coastal management	European
Transport	European - Regional
Agriculture	Regional
Urbanisation	Local comparison of European cities
Structural funds/Land planning	European - Regional
Soil degradation – desertification	Local-Regional
Hazards (forest fires, flooding)	Regional

The examples from the nature conservation domain present a range of uses, such as methods and applications for assessing area subtotals and totals and location of natural and semi-natural areas remote from artificial features, studies of landscape fragmentation and an assessment of the potential connectivity of habitats (see figure 2).

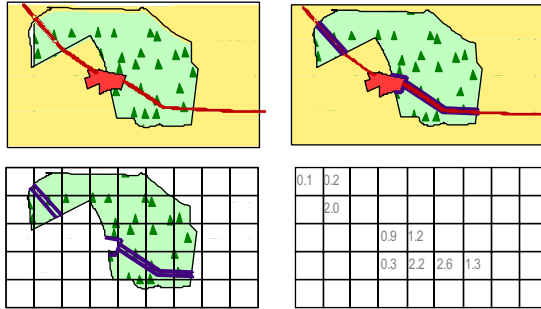
Applications within the water management domain include a regional study of pressure of water systems from non-point emissions of nutrients. Another example combines CLC data with nutrient emissions from a catchment area of the Danube tributary of Zagyva river (Hungary).

For land planning and landscape analysis, studies of land cover and land use changes describe urbanisation, intensification and extensification of agricultural land use as changing factors. A landscape analysis study of fragmentation in open spaces in a spatial context, assesses the impact on landscape patterns from different land cover classes.

Figure 2. Example of an information sheet on land cover applications
Impact of major urban areas and transport networks on natural and semi-natural countryside.

Issue

Example from Nature Conservation/Transport/Land Planning/Landscape analysis domains, illustrating Pressure (in the D-P-S-I-R framework) on natural and semi-natural areas.



$$\text{Extension} = \frac{\sum_{i=1}^n u_i}{N} = \frac{10.8}{25} = 0.4$$

$$\text{Intensity} = \frac{\sum_{i=1}^n u_i}{U} = \frac{10.8}{9} = 1.2$$

u : impact of urbanisation and roads in km/km² by cell,
 U : number of impacted cells
 N : number of natural/semi-natural cell

Methodology

Assessment of the content of a grid in terms of aggregated CLC classification. U = CLC class 1 (Artificial surfaces, urban structures). A = CLC class 2 (Agricultural areas), except 2.3 (Pastures) and 2.4 (Heterogeneous agric. areas), N = 2.3, 2.4+3 (Forests) + 4 (Wetlands) + 5 (Water bodies). Overlay with transport networks. Pressure by major urban areas and major transport networks measured in terms of length of their interface (ecotones) with natural/semi-natural land. The intensity of pressure calculated as km of artificial ecotone by km².

Data requirement

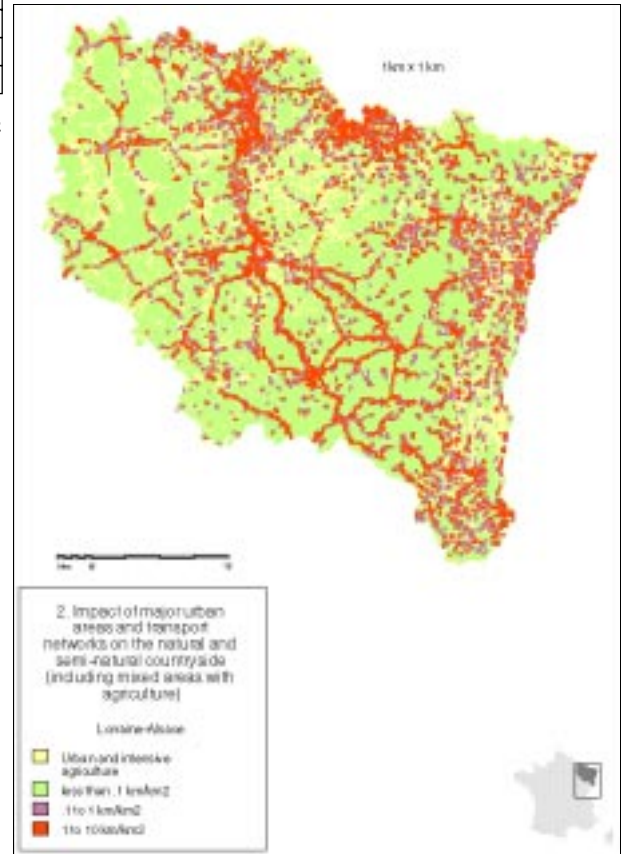
CORINE Land Cover data. Digitised map of major transport networks (roads, railways, canals).

Further development

Future development could cover the selection of urban areas according to population figures and/or type of economic activity. As for roads, actual traffic figures could be considered for defining impact levels.

Policy relevance

Major artificial features such as large urban areas or main transport networks (motorways or equivalent, railways, channels) impact strongly on natural areas and, more generally, on the countryside. The objective is to assess and locate this impact on natural and semi-natural areas (including grasslands and mixed territories with agriculture).



Impact of major urban areas and transport networks on the natural and semi-natural countryside (including mixed areas with agriculture). Example from Lorraine-Alsace, France.

The example is developed by *Institute Français de l'Environnement, IFEN, France, and GIM Geographic Information Management, Belgium, partners of the ETC/LC consortium.*

2.3.2. Map production

Pan-European land cover maps have been produced for the EEA, its Topic Centre on Nature Conservation, the European Commission Servicec and other users of land cover data on various themes. These maps have been displayed on several occasions, for instance by DGXVI at the informal meeting of Ministers responsible for spatial planning of the Member States of the EU in Noordwijk (June 97).

Figure 3. Major Land Cover types of Europe



For the report on Europe's Environment: the Second Assessment, available from OPOCE, a pan-European Land Cover database was compiled from the CORINE Land Cover database, merged with other existing national land cover maps aggregated from various sources for Finland, the United Kingdom and Sweden (see figure 3). This map with major land cover types includes artificial territories, strongly artificial vegetated areas, less artificial vegetated areas, forests, semi-natural areas, wetlands and water surfaces. For Switzerland a provisional set based on Swiss land use data was converted to CORINE standards.

These datasets of land cover maps are available as printed versions and digitally in various formats from the ETC/LC via the Helpdesk service. Deliveries of digital data are on CD-ROM, until the GeoINFO Server becomes operational during 1998.

The database with major land cover types has been developed in collaboration with the European Topic Centre on Nature Conservation to map the pressures from strongly artificialised areas and intensive agricultural land on natural and semi-natural areas.

To help support EEA in discussions about European forests with several international organisations, the ETC/LC produced a set of land cover forest maps, illustrating the spatial distribution of forest and other wooded land classified according to the definitions and mapping criteria of CORINE.

2.3.3. The pilot Strategic Environmental Assessment of the Trans-European Transport Network

In 1996 the European Parliament and Council adopted Community guidelines (Decision 1692/96/EC of the European Parliament) for the trans-European Transport Network (TEN). The objective of the TEN is the development of a transport network to strengthen the economic and social cohesion in the Union, by bringing about a sustainable mobility of persons and goods within a Europe without internal frontiers. The guidelines for the TEN should also help to achieve the environmental objectives of the Community.

To achieve the environmental objectives, the Commission recognised the necessity of developing a process of strategic environmental assessment, SEA. It was stated in the guidelines that the Commission "will develop appropriate methods of analysis for a strategic evaluation of environmental impact on the whole network" and "appropriate methods of corridor analysis covering all relevant transport modes".

The Commission, through DGVII and DGXI, requested the EEA to co-operate in the pilot SEA of TEN. A working group between DGVII, DGXI, Eurostat/GISCO and EEA was established. The EEA has on hand extensive environmental geo-referenced databases which can be used for the pilot assessment. The land cover data plays a key role in the integration of the various geographical data sets, available through other Topic Centres, which were used in the SEA of TEN.

The contribution of the ETC/LC so far has been a methodological study containing spatial-ecological assessments of a number of TEN variants or alternatives. The objectives of this work include:

- the development of an integrated GIS database on the TEN, including thematic data and maps of infrastructure, land cover, demography, geography, environment and nature;
- a selection and review of indicators for assessments of the spatial and ecological impacts of the TEN;
- development and testing of a number of GIS assessment techniques;
- compilation of the results in the form of a GIS demonstration package, allowing an interactive demonstration of indicators and methods.

A range of assessment techniques were tested, for instance:

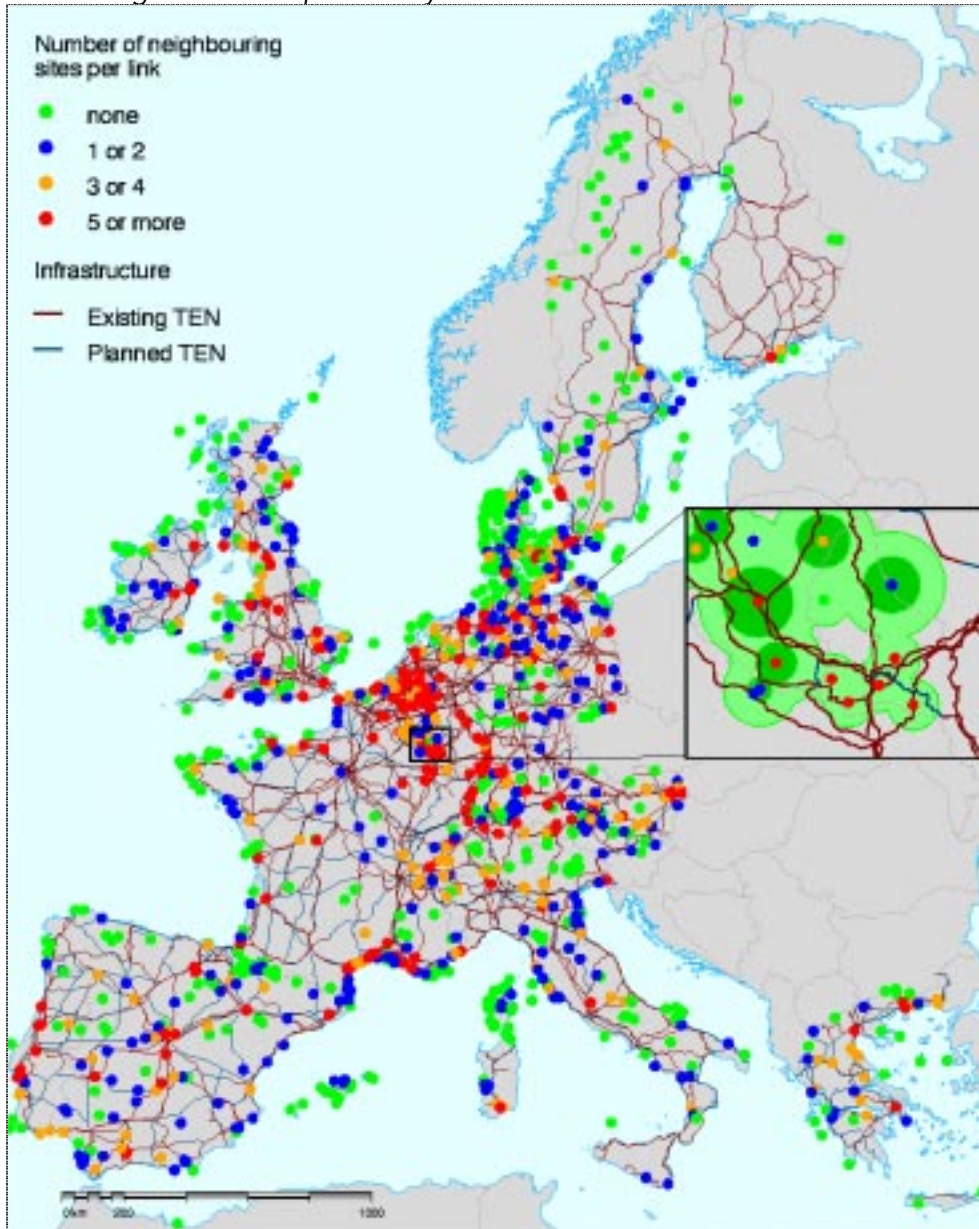
- analysis of the proximity of the planned TEN infrastructures to legally or scientifically designated sites;
- calculations of simple indicators, such as network lengths, land take, waterway crossings, etc;
- a vulnerability mapping analysis, in which the TEN alternatives are matched against sensitive zones, defined on the basis of a combination of indicators, whose sensitivity is evaluated by indices of significance.

To assess the potential impacts and conflicts of the TEN alternatives on environmentally sensitive areas thematic GIS-based analysis were carried out regarding biodiversity, water resources, noise and land resources and various indicators tested.

The proximity indicator proposed in this study is based on the distance between the site and neighbouring TEN infrastructure links. The sites are represented symbolically by a

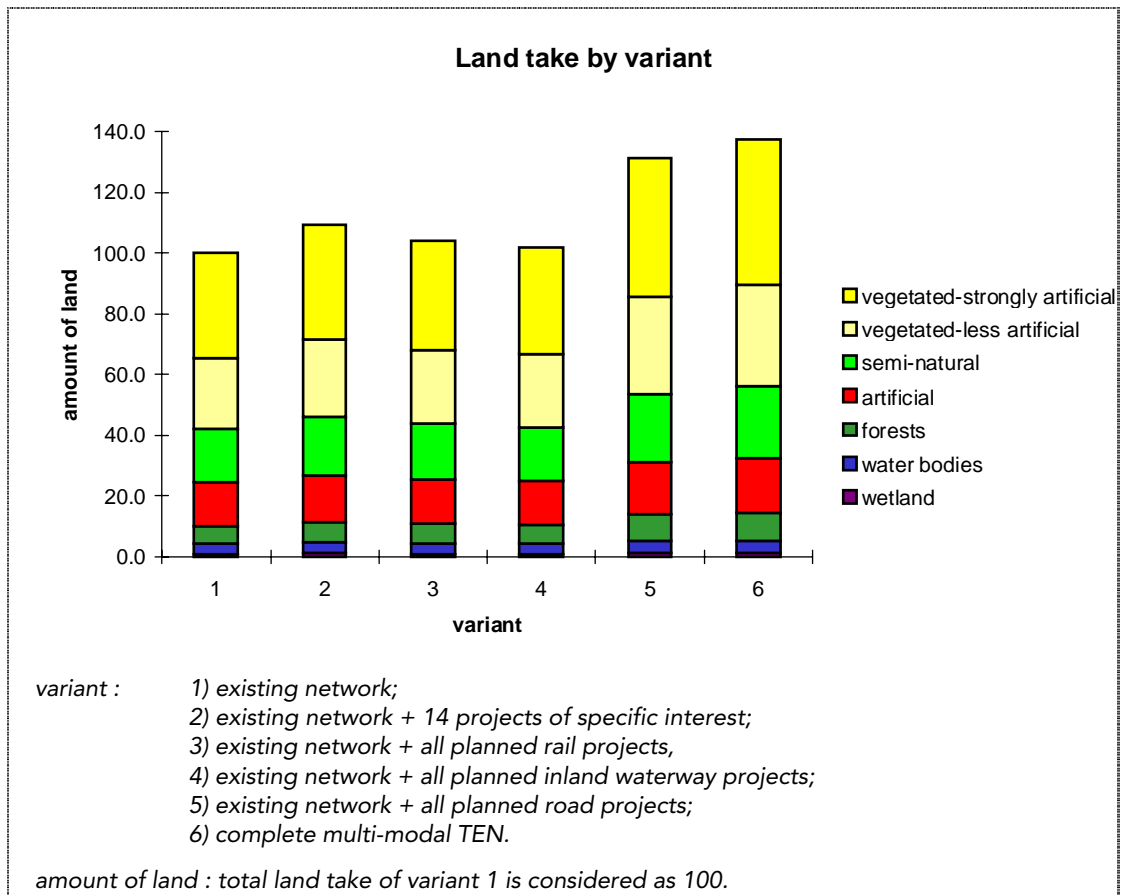
circle with a radius proportional to the site surface. The influence zone of the TEN is represented by a 10 km buffer zone along the infrastructure centre lines. A site is considered at risk of disturbances if it falls within the buffer zone. The map in figure 4 demonstrates the location and number of designated sites per link of the TEN that are exposed to disturbances or even running a risk to be damaged by the present and planned links of the TEN.

Figure 4. Analysis of the proximity of planned TEN infrastructures to legally or scientifically designated sites - preliminary results



In the study, the land take is illustrated by an indicator, based on the length of development of infrastructure, differentiated per major land cover types, underlying the present or planned links. The major land cover types were obtained from the CORINE Land Cover database, by aggregating the CLC classes to seven major land types (see figure 5).

Figure 5. Example of indicator: land take by TEN variants - preliminary results

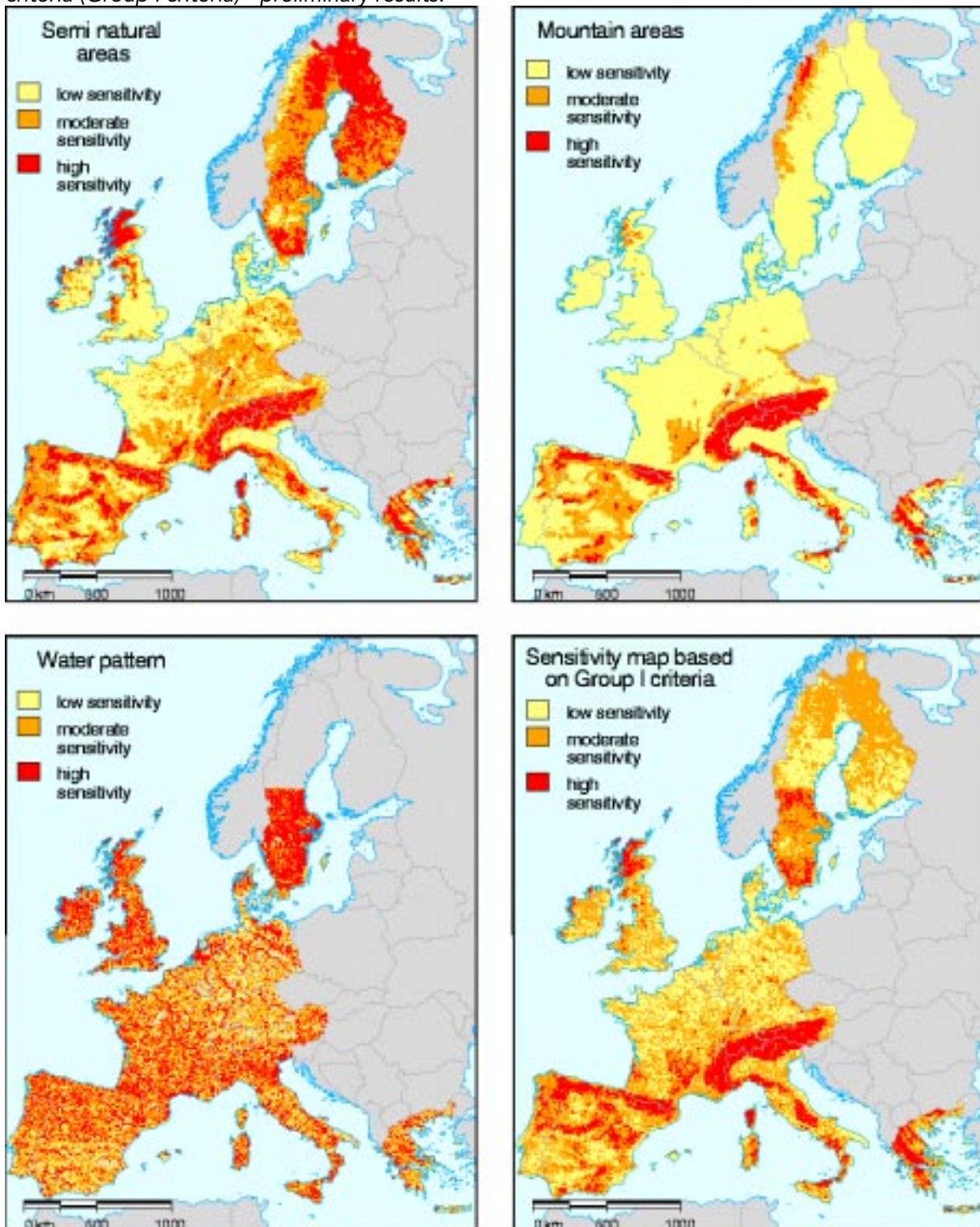


Vulnerability analysis is a tool for impact assessment used in several countries. In the pilot study, the feasibility of mapping environmentally sensitive zones was studied. The identification of sensitive areas is based on an approach that combines the use of GIS and various indices which integrate the existing thematic environmental and other data. These are presented in maps indicating the different degrees of vulnerability of the specific environmental systems to impacts of the alternative TEN infrastructures. The analysis was done as an aggregation of spatial-ecological indicators and of geographical, demographic and environmental characteristics of the system in question, in the perspective of "impact groups" based on:

- physical-environmental criteria: e.g. mountainous areas, semi-natural habitats etc. (group I);
- social criteria: e.g. population density, degree of urbanisation (group II);
- legal criteria: e.g. legally designated areas (group III).

The expected sensitivity was appraised by indices such as low, moderately or highly sensitive areas (see figure 6). An overlay of the TEN infrastructure on the mapped sensitive areas identifies areas where conflicts might arise.

Figure 6. Example of sensitivity map analysis based on some physical-environmental criteria (Group I criteria) - preliminary results.



*Note : surface water data for Finland and N-Sweden is missing

The pilot study on SEA of TEN has achieved most of its original objectives. The study also identified issues which require additional research and consultations. The proposed work programme for 1998 includes optimisation of indicators and methods of analysis, a filling of the major data gaps on TEN and the environment and a full spatial and ecological assessment of TEN. A technical report on indicators and GIS methods for spatial and ecological assessment was produced and will be published by EEA in 1998.

3. RESEARCH AND DEVELOPMENT OF NEW APPLICATIONS

The main R&D activities, co-ordinated by JRC, concerned implementation of updating methods for CLC data through the COPILOT software, development of new applications on indicators, an assessment of the use of more detailed CLC inventories and the LACOAST (Land Cover Changes in Coastal Zones) Project.

A final assessment of the methodology developed by JRC for updating the CORINE Land Cover database resulted in a software, the COPILOT, on updating and change detection. It was distributed to the national CLC teams involved in the LACOAST project and the necessary training was organised. More information about LACOAST can be found on the Internet: <http://aisws6.jrc.it:2001/LACOAST>.

The methodology for updating using COPILOT is described in "Technical and Methodological Guide to Update CORINE Land Cover data base", a co-publication of JRC and EEA and available from JRC and EEA. The dedicated software is available from JRC for national teams that wish to use it for updating the database.

The LACOAST project was launched in 1996. The objective is to provide quantitative estimates of land cover and/or land use changes in the European coastal zones, in particular those due to human activities. The coastal zone was defined as a strip 10 km wide inland from the shoreline. The CLC database is taken as reference and satellite data and aerial photographs are used to identify the changes on a certain date (1975-1990). When changes are observed, the factors responsible for these changes are identified and interpreted. The pan-European analysis assesses the changes that have occurred over a period of about 15 years (1975-1990) along the entire European coastal zone. Three case studies with detailed analysis are being carried out, taking as observation dates 1955, 1975, 1985 and 1995. These case studies are located on the Belgian coast, Spanish and Portuguese southern coast and Charente coast (France). Results on land cover changes in coastal zones are expected to be available in 1998.

At present, 12 Member States are involved and it is envisaged that LACOAST will be extended to cover the remaining coastal zones in Europe.

During 1997, a study was carried out targeted on short term operational use of CLC database for indicators that can be produced on a European level linked to issues such as:

- land cover of protected areas;
- impact of major urban areas and transport networks on the natural and semi-natural countryside;
- natural and semi-natural countryside remote from artificial features;
- potential connectivity of habitats;
- pressure on protected areas from land use;
- fragmentation of forests by road networks;
- pressure on water systems from non-point emissions of nutrients.

Future developments on spatial indicators based on CORINE Land Cover data were identified for development during 1998 within the following fields:

- landscape analysis based on descriptors identified in collaboration with ETC/NC;
- assessment of non-point emissions through combination with statistics;
- pressure indicators on nature sites.

4. ETC/LC PRODUCTS 1997

The following reports, databases and software were produced and are available on request (by E-mail, fax or phone) from MDC or EEA.

Table 6. Reports and products prepared by ETC/LC

Title	Available from	Content
<i>Topic report:</i>		
Annual Summary Report 1996	EEA	Summary description of the progress and results 1996
<i>Technical reports:</i>		
Workshop on Land Cover Applications - needs and use	EEA, ETC/LC Website	Workshop 6-7 May; Workshop dossier with Applications examples
Contributions to Dobris +3 report	EEA	Land cover map of Europe, land cover forest map of Europe, map of Europe with pressure of urbanisation, agriculture and transport infrastructure on natural and semi-natural areas
CORINE Land Cover Directory 1997	EEA, ETC/LC Website	Information of National Teams, inventories, status and progress
Technical Guide, Volume 2	EEA, ETC/LC Website	Methodology handbook for CLC inventory. Addendum to of Technical Guide Vol , 1993
Data storage and dissemination	EEA, ETC/LC Website	Report on the system and softwares for dissemination of land cover data over the Internet; Description of Helpdesk functions
<i>Databases:</i>		
CORINE Land Cover vector reference data	EEA, GISCO	Delivered to GISCO for use by the Commission services
CORINE 100 m and 250 m grid data	EEA, ETC/LC	CORINE Land Cover Database; the 250 m grid data is input to EEA's second Natural Resources CD-ROM
Database on users and use of CLC database	EEA, ETC/LC Website	Provisional database of Helpdesk registrations of requests and deliveries of CLC datasets
<i>Software</i>		
Correspondence to other themes as a basis for integrated approaches	EEA, ETC/LC Website	Beta test software for inter-comparisons of land cover and land use data
Homepage and Helpdesk functions	EEA, ETC/LC Website	Maintaining and development of Homepage, Helpdesk and Extranet Functions

Table 7. Research and development reports, produced by and available from JRC

Title	Content
Indicators by domains/sectors derived from CLC database. Proposal	Internal report, proposal to further development
CoPilot	Software, for updating of CLC mapping
Technical and methodological Guide for Updating CORINE Land Cover database	Topic Report on methodology for CLC updating (EUR 17288 EN)

5. PLANS FOR 1998

1998 is the third and final year of activity under the current agreement with EEA. In the first part of the period, emphasis was on developing the CORINE Land Cover database. This database is now completed for a large part of continental Europe and a unique consistent land cover database is available.

The emphasis of the Topic Centre work has therefore gradually been shifted towards information and demonstration of the usefulness of the database by carrying out GIS applications with CLC data as basic input for integrated environmental assessment and the development of spatial indicators.

This trend is further emphasised in the plans for 1998. Table 8 summarises the main planned activities and schedule for 1998. The work plan of the ETC/LC for 1998 is focused on the following issues:

- indicator development for policy relevant European environmental applications (nature conservation, planning, transport, coastal zones): habitat fragmentation, pressure from urbanisation, transport and agriculture;
- update of the European Land Cover database: analysis of national and European user requirements;
- dissemination of CLC data: further development of homepage and helpdesk functions to make the CLC database easily accessible;
- development of new applications with support from JRC: land cover/land use changes and spatial indicators for landscape analysis.

Table 8. Workplan 1998. Overview table for main ETC/LC events and products.

<u>Event/Activity</u>	<u>Event date</u>	<u>NFP response date</u>	<u>Expected output/Content</u>	<u>EEA output date</u>
Workshops Land Cover Workshop	6 Oct 98		Workshop Proceedings	15 Dec 98
Country visit to: UK Sweden	To be defined 25 Mar 98		Quality control conversion Land Cover Map Great Britain to CORINE Kick-off CORINE Land Cover Sweden	1999
Questionnaire send out Update of national land cover inventories	15 Jun 98	31 Aug 98	National plans for update	7 Oct 98
Data Update Request Meta-information land cover	31 May 98	15 Sep 98	Integration of land cover meta-information in CDS	15 Dec 98
Draft reports send out for review by NFP/EIONET Users Guide on European land cover data Environmental indicators from land cover	30 Jun 98 30 Sep 98	15 Sep 98 30 Oct 98	A manual on data storage, search and retrieve engines and accessing on and downloading procedures of LC data Assessment of environmental indicators to serve as input to future EEA reporting	15 Dec 98 15 Dec 98

Other main events			
Annual Topic Update 1997	15 Jan 98	Activity report 1997	Jul 98
Annual Topic Update 1998	15 Dec 98	Activity report 1998	Mar 99
Support to DGVII on Pilot Strategic Environmental Assessment of the TEN	30 Apr 98	Report on indicators and GIS methods for spatial and ecological assessment; contribution to the DGVII-DGXI-Eurostat-EEA Working Group on SEA of TEN	Sep 98
Technical Guide, Vol. 2	Dec 97	Addendum to the CLC Technical Guide, to be included on CD-ROM Natural Resources	Jul 98
Natural Resources CD-ROM V2	30 Apr 98	European land cover database	Jul 98
Inter-comparison of land classifications	31 May 98	Technical report and software for correspondence between CLC and other existing classifications	30 Jun 98
Support to DGXVI on ESDP	31 May 98	Use of CLC within ESDP	31 May 98
EU98 SoE report	30 Jun 98	Contribution: chapter 2.4 on land cover and land use changes in Europe	15 Dec 98
Support to ETC/IW	30 Nov 98	Land cover info by river catchment areas	30 Nov 98
Support to NATLAN info CD-ROM	15 Dec 98	Information on land cover/nature related topics, In collaboration with ETC/NC	Early 1999
R&D in collaboration with JRC/SAI	15 Dec 98	ETC/LC R&D activity report 1998	15 Dec 98