JRC Scientific and Technical Reports

Preparing CORINE Land cover Data for use

Optimalization of Land cover data using a database and a topological GIS platform

Alfred L. de Jager

EUR 25163 EN - 2012

JRC
EUROPEAN COMMISSION

ies
Institute for
Environment and
Sustainability

The mission of the JRC-IES is to provide scientific-technical support to the European Union's policies for the protection and sustainable development of the European and global environment.

Legal Notice
Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use which might be made of this publication.

Europe Direct is a service to help you find answers
to your questions about the European Union

Freephone number (*):

00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server http://europa.eu/

Picture of the Port of Alghero in Sardinia, Italy, copyright of Author.
Printed in Italy

Contents

Introduction

CORINE (Coordination of information of the Environment) Land cover is one of the most requested mapping products in Europe. Due to its continental extension and detailed comprehensive methodology it is an important contribution to quantify and locate landscape related environmental assessments.

It is made up of a satellite image interpreted classification of the European landscape using 44 classes (Table 1), subdivided in a hierarchy, classifying the land cover by human interaction. An important source for digitalization of CORINE Land cover is Landsat 7 imagery with a resolution of 25 by 25 meters, CORINE Data has been created in 2000 and 2006 for more than 30 European Countries.

Digitalization takes place by contractors varying per country. Subsequently these country organised datasets are combined into 1 large dataset.

Users can download CORINE Land cover data from a web-page maintained by the EEA. The service provides a download possibility for 44 Shape files each containing 1 CORINE Land cover class. The shape files taken together contain more than 2 million records of highly detailed vector data in the LAEA projection system.

Map 1: Mosaic of Pan Chromatic Images of Landsat 7 used to update CORINE.

Class	Description	Legend
1	**Artificial Surfaces**	
11	Urban Fabric	
111	Continuous Urban Fabric	
112	Discontinuous Urban Fabric	
12	Industrial, commercial and Transport	
121	Industrial or Commercial Units	
122	Road and Rail Networks and associations	
123	Port Areas	
124	Airport Areas	
13	Mine,dump and construction sites	
131	Mineral extraction sites	
132	Dump sites	
133	Construction sites	
14	Artificial non-agricultural vegetation	
141	Green Urban Areas	
142	Sport and Leisure facilities	
2	**Agricultural Areas**	
21	Arable Land	
211	Non-irrigated arable land	
212	Permanently irrigated land	
213	Rice fields	
22	Permanent Crops	
221	Vineyards	
222	Fruit trees and berry plantations	
223	Olive groves	
23	Pastures	
231	Pastures	
24	Heterogeneous Agricultural Areas	
241	Annual crops associated with permanent	
242	Complex cultivation patterns	
243	Land principally occupied by agriculture	
244	Agro-forestry areas	
3	**Forest and semi-natural areas**	
31	Forest	
311	Broad-leaved forest	
312	Coniferous forest	
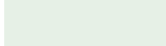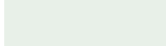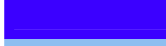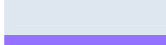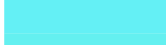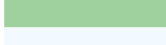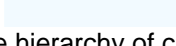
Code	Level 2	Level 3	Level 4	Colour
313			Mixed forest	
32		Shrub and/or herbaceous vegetation		
321			Natural grassland	
322			Moors and heathland	
323			Sclerophyllous vegetation	
324			Transitional woodland shrub	
33		Open spaces with little or no vegetation		
331			Beaches, dunes and sand plains	
332			Bare rock	
333			Sparsely vegetated areas	
334			Burnt areas	
335			Glaciers and perpetual snow	
4	**Wetlands**			
41		Inland Wetlands		
411			Inland marshes	
412			Peat bogs	
42		Coastal Wetlands		
421			Salt marshes	
422			Salines	
423			Intertidal flats	
5	**Water bodies**			
51		Inland Waters		
511			Water courses	
512			Lakes	
52		Marine Waters		
521			Coastal lagoons	
522			Estuaries	
523			Sea and ocean	

Table 1, CORINE Land cover classes, with the colour of the predefined legends and the hierarchy of classes.

By dividing the shape files per Land cover class users can quickly select classes of their interest and set up their own copy of the dataset.

In projects with a need to analyse or map the Land cover data for a Pan European area, the shape files are to be combined into one seamless dataset. Manipulating over 2 million records of high detailed geometric data is a problem for Geographic Information Systems. In order to deal with this size of records system specific optimalisations are to be implemented. To make a usable system adaptations are needed, which often can be realized by hiring specific consultancy, which is not so easy to access for research organisations focussing on environmental issues.

In this paper we will elaborate two methods to create pan European datasets with the 44 shape files as input. We will discuss the creation and usage of a classical method in which the data are held in so-called tiles, using the ArcINFO librarian technology. A more modern method is also used; it is to store the data in a corporate database using Oracle Spatial.

An excerpt of the web service of the EEA on URL http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version-1 is given below:

 Home › Data and maps › Datasets › **Corine Land Cover 2006 seamless vector data - version 15**
(08/2011)
Topics: Land use , Natural resources ,
Corine land cover 2006 is the year 2006 update of the first CLC database which was finalised in the early 1990s as part of the European Commission programme to COoRdinate INformation on the Environment (Corine)
This is the latest published version. See older versions.

111 - Continuous urban fabric

- **clc06_c111.zip** (ZIP archive)
  6.11 MB Download file

…42 other classes in between…

523 - Sea and ocean

- **clc06_c523.zip** (ZIP archive)
  37.05 MB Download file

INSPIRE compliant metadata set

- **f7d1b28c05ce9810df31852becd1c645.xml** (Extensible Markup Language (XML))
  10.04 KB Download file

Publish date:
　　24 Aug 2011
Temporal coverage:
　　2006
Last upload:
　　22 Aug 2011
Geographical coverage:

　　EFTA4, Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia the former Yugoslavian Republic of, Malta, Montenegro, Netherlands, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Turkey, United Kingdom

-- End of excerpt EEA Webservice in December 2011 --

ArcINFO librarian

ArcINFO librarian is a storage methodology of large datasets using the ArcINFO coverage data model.
Data stored in ArcINFO coverage's are stored in a topological manner. Topological storage implies that a polygon is stored by referring to lines (called Arcs). The arcs are subsequently referring to Start and End nodes.
Shape files store the line information at record level, this implies that in these 'feature oriented' methodologies the line string (coordinate pairs) of shared boundaries are stored twice.
For large datasets such as CORINE Land cover, containing detailed geometrical data, a topological storage method has as advantage that the point string information is stored only once.
CORINE Land cover information is covering the whole territory of West and Central Europe and such a data storage method should lead to a reduction of almost 50 percent of space needed to store CORINE Land cover.
Before 2003 CORINE Land cover data was distributed within the Commission Services using a librarian dataset being part of the so-called GISCO database. With the introduction of ArcGIS, the provider of ArcINFO, ESRI, abandoned further development of ArcINFO coverage's. Therefore whilst using this method we will encounter some technological limitations. We will discuss the method to work around these limitations.

Oracle Spatial

Oracle is one of the corporate databases in use in the Commission. It contains an extension called Spatial which allows for the storage and manipulation of Geographic Data.
Oracle Spatial contains various options to store geometric data.
We choose to transform the LAEA projected data to Decimal Degrees and to store the information in the normal geometry model. Contrary to the ArcINFO coverage's in this model the geometric information is stored at record level. As a consequence geometric information of adjacent polygons is stored twice.
In the Spatial model the data is stored as a list of points and for holes in the point list an additional list is stored containing the start and end point of components of the point list. The length of the lists is limited and in the conversion to Oracle Spatial with CORINE Land cover data we reached these limits.
While processing and mapping the Land cover data in Oracle Spatial we noticed performance decrease in specific areas. We found the causes of these performance leaks and we were able to solve them in a straight forward manner.

Conversion to ArcINFO coverage's

In order to prepare the 44 shape files to be inserted into the ArcINFO librarian we converted the 44 shape files to separate coverage's. This conversion is needed since ArcINFO cannot manipulate data held in Shape files.
Within ArcINFO 10.x the command SHAPEARC allows for Shape file conversion. For the resulting coverage, topology has to be created using the CLEAN command.
Before cleaning the polygons it is important to lower the ArcINFO default tolerances in order to avoid that geometry get altered with respect to the original data provided in the shape files.
Once this conversion is finished ArcINFO create so-called regions, it are references of the original non topological structured records in the shape file to the polygons in the ArcINFO coverage. These regions can be converted to topological consistent polygons using the Arc REGIONPOLY AML Macro program provided by ESRI.
The resulting ArcINFO coverage is stored in a directory (called workspace) which will be used in a later stage to combine the data in a LIBRARIAN held dataset.
ArcINFO contains a limit to the amount of Arcs that can be present in 1 dataset. We therefore had to split seven shape files into two separate datasets before we could proceed with the conversion.
Table 2 contains an overview of the classes that we broke up into two datasets. We used an arbitrary method, for example we selected the northern part of Europe and subsequently the remaining southern part.

Class Identifier	Short Name	# Records	Limitations Oracle Conversion
211	Arable Land	180133	Too large polygon in England
231	Pastures	184484	4 polygons with 96 holes
243	Agricultural Land	242572	
311	Broad Leave Forest	195289	
312	Coniferous Forest	175634	Too large polygon in Sweden
313	Mixed Forest	182630	
324	Woodland Shrub	255631	

Table 2: Classes too large to be converted to ArcINFO coverage's

Tiling the large dataset and combining classes

When setting up the LIBRARIAN we decided to create a tiling system of 250 by 250 km based on the LAEA projection system. To cover the European Territory, including Morocco, Tunisia and the Azores we generated 327 tiles out of which 210 tiles contain Land cover data from 2006, 2000, 2002 and 1990.
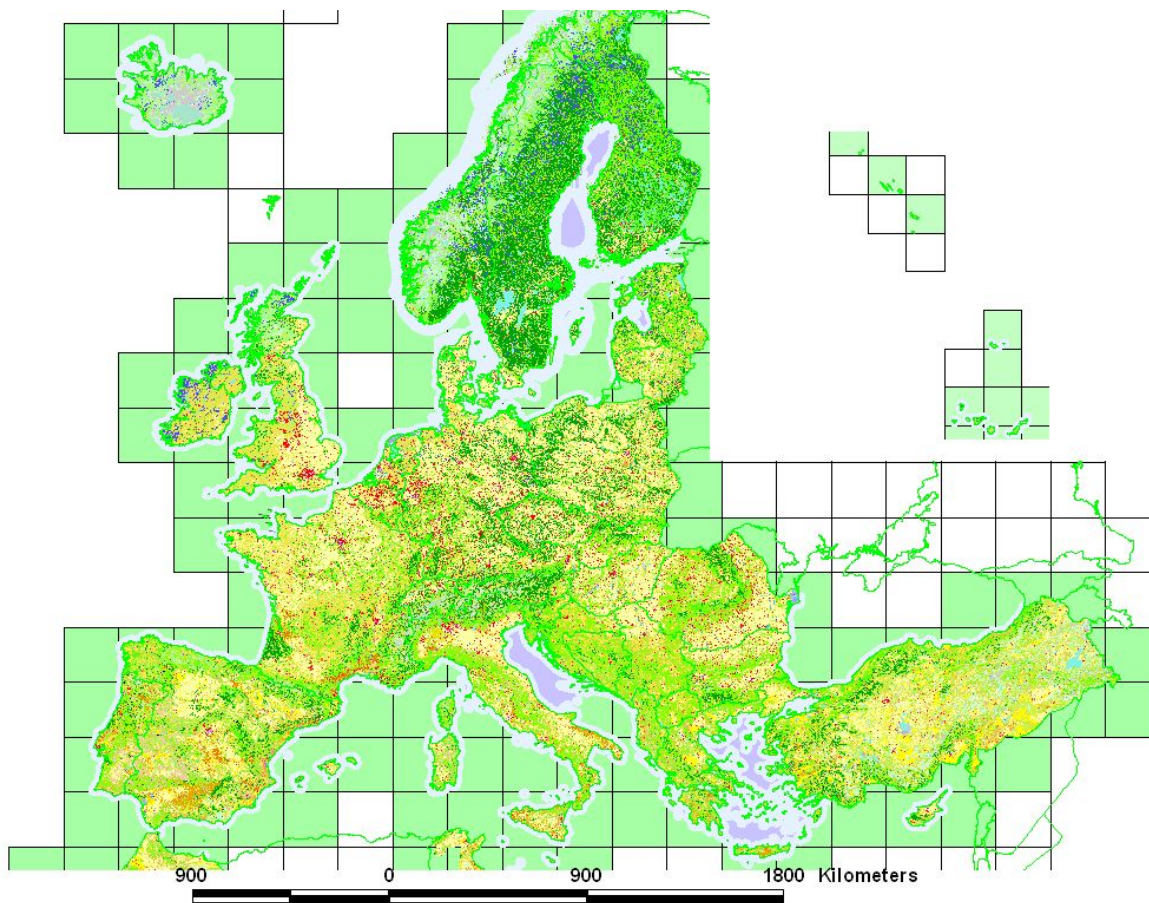
Map 2: Overview of CORINE Land cover data and the tiling system to subdivide the large dataset. In the North East corner an inset of the Azores, Madeira and the Canary Islands is placed.

Once the Coverage's were created we could combine the 44 Class Coverage's for each tile, using CLIP and subsequently the MAPJOIN command into one coverage per tile of 250 by 250 kms. The MAPJOIN command recreates the topology and removes adjacent boundaries of the neighbouring classes.
The MAPJOIN command was not sufficient to combine the 44 classes into one Coverage.
The conversion of a Shape file to a Coverage creates specific conversion artefacts. A shape file containing 1 record containing a geometry with a hole will result in a Coverage with two records. The hole will be stored in a record not containing filled attributes. When MAPJOINing these data the empty records will, depending on an arbitrary record position overwrite filled records.
We created a workaround for this limitation using an ARCEDIT session in which we 'GET' the labels of the polygons containing correct filled data from the CLIPped coverage's per CORINE Land cover class.
The resulting tiles could consequently be uploaded to the ArcINFO Library which subsequently maintains a flag whether a tile is present and contains functions to merge the tiles into more meaningful areas such as a country, a region or a catchment. Also the Library was used to generate derived products with Land cover data, such as Raster versions of the data using higher resolutions than can be downloaded from the EEA website.
In total the tiled system contained 2.400.718 polygons build up of 7.067.587 arcs in 210 tiles, the data are distributed in 4586 files using 873 folders occupying 3.723.984.896 bytes (3,46 Gigabytes).
The version that is not combined and tiled occupies 5.494.116.352 bytes (5.11 Gigabytes). The difference of 2 Gigabyte less data can be explained by the benefit of using the Topological Model in which adjacent borders are stored only once.

Oracle Spatial Conversion

The conversion to Oracle spatial was done using the shape files made available on the Website of the EEA. Also here we encountered a limit of system storage that was superseded by the shape files downloaded from the website of the EEA.

The limit in this case was encountered in some specific records, for example, containing grass or forest classes with numerous holes in it, and thus making the Oracle Spatial points array very long. (see map 2) Both de Oracle Spatial Points Array as the Element Info Arrays contain physical limits to the amount of elements that can be stored in the array.

In order to upload these large records, we converted them to an ArcINFO coverage and split them in tiles of 100 by 100 km. using the GENERATE Fishnet and UNION commands.

The Sea class (identified with 523) contains a buffered coastal polygon. One polygon contains almost the whole European Atlantic coast and became therefore unmanageable to upload to the Oracle Database. We split up the whole class 523 shape file into tiled pieces using the 250 km tiles of the ArcINFO librarian, before uploading the shape file to Oracle Spatial.
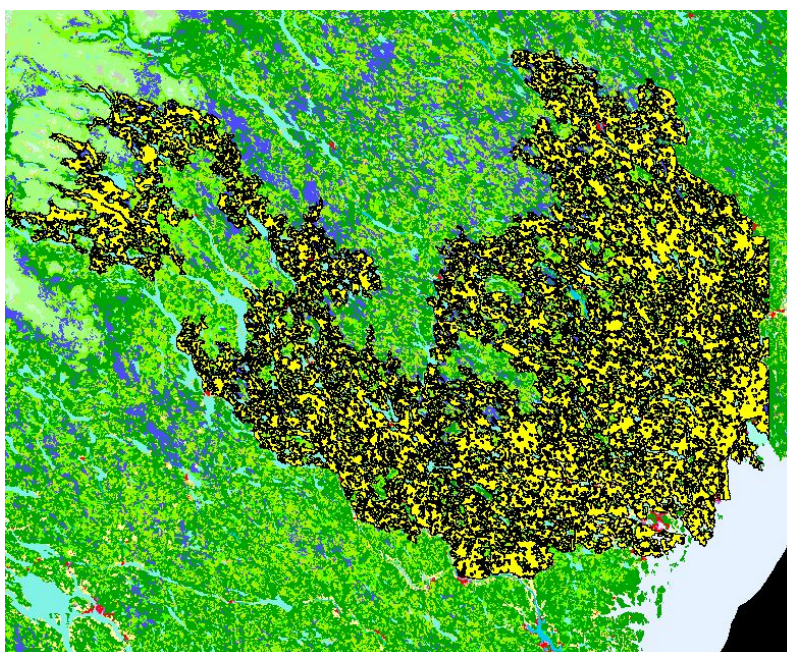
Map 3: Very big polygon in class 312 in North East Sweden. The polygon contains 547344 line strings after being split up in 172 components. Organising the data in too large polygons creates difficult to manage records in common Desk Top GIS systems. The identifier is of this polygon is EU-2227059.

Once the data were saved in Oracle Spatial we noticed that some areas were retrieved and processed slower than others. We noticed that this was especially the case in areas with remaining huge polygons. Therefore we subdivided these polygons in a post processing phase after the conversion to Oracle Spatial. As sub division criteria we used a tiling system of 1 decimal degree on polygons having a larger bounding box than 3000000 square meters.

This resulted in about 10 percent of the polygons being subdivided.

We created 23743 complex polygons and 74937 simple polygons using this subdivision algorithm. In total the Land cover data set of 2006 contains 2.297.364 records (including the Azores) covering 6970772 square kilometres. If we dump the data as an Oracle Export file than we need 5.68 GB of space.

Filling gaps

The CORINE Land cover dataset creation is organised by Country and in some federal countries even at sub country level. From Analysis and Mapmaking point of view this implies that the CORINE Dataset contains gaps within study or map -areas that are encompassing the territory of a Country or federal territory not being updated using the CORINE classification methodologies.

The CORINE version of 2006 was a large step forward with respect to the filling of gaps in the European Map, thanks to the inclusion of the West Balkan area, Norway, Iceland and Turkey. But some gaps persist which hinders straight forward analysis of the data.

In our case, for example, we wanted to analyse per 5 by 5 km cell the percentage urbanisation of Europe.

These percentages subsequently feed a simulation model, hence our model has to cater for guessing the missing areas or they are to be guessed using other, less detailed, sources.

At this moment CORINE 2006 does not contain Greece. But also small gaps in the territory provoke analysis results of limited use.
For example Andorra (Map 4) is missing in all versions and also the Channel Islands are omitted.
One can expect the omission of the Kaliningrad Oblast, a Russian ex-clave in the EU 27 Territory.
The omission of minor territories such as Andorra or the Channel Islands can cause problems with users expecting an area like 'the Pyrenees' or the 'coast of Normandy' to be complete.
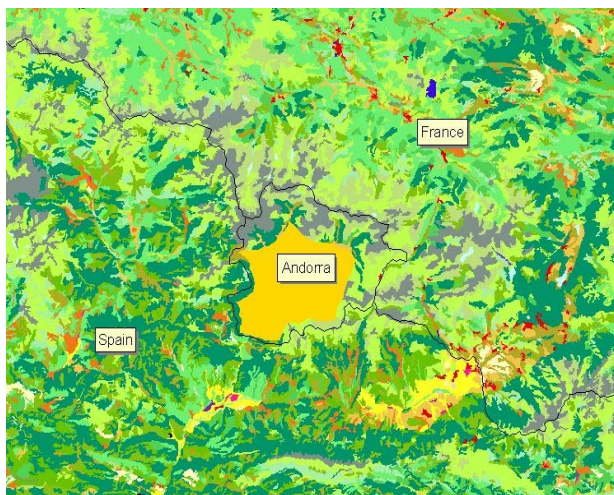
Map 4: Andorra is not digitized in CORINE Land cover

Map 5: Southern Channel omission of the Channel Islands.
Alderney and parts of Jersey are covered with a Sea Buffer.

Other Omissions

Between Estonia and Finland, Russian islands, such as Gogland, are omitted, making the latter area more complex to use in mapping applications. Annoying with these omissions is that the Sea Buffer generated along the Finish (and also along the French coast, for the Channel Islands) suggests that these islands are water.
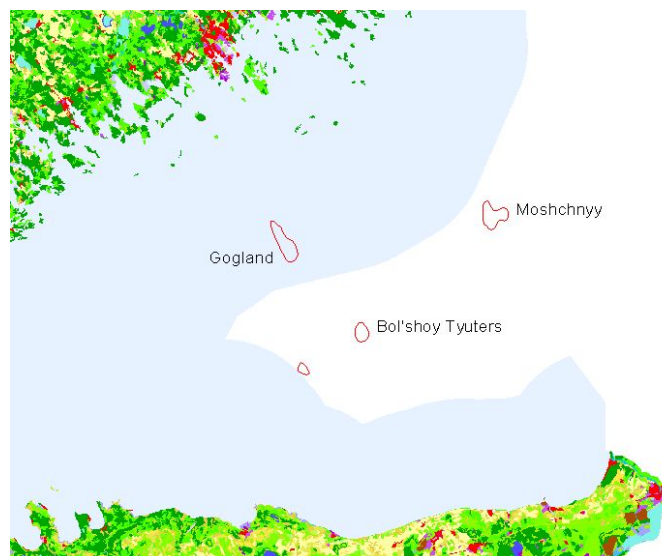
Map 6: Finnish Gulf omission, the Island of Gogland is covered by the Sea Buffer. These islands between Estonia and Finland belong to Russia.

In order to provide our models and maps with as best as available Land cover data we decided to complete the gaps with data from previous CORINE versions. The filled 'gap' records are marked as coming from another source. Table 2 displays the missing areas and the resource we used in order to complete the dataset.
On a whole we still miss areas such as Kaliningrad- and Leningrad Oblast hindering seamless mapping and analysis of the Baltic Sea area. But also the North Sea area is to be mapped and analysed with care due to the omission of the Faeroe Islands.

Area with Gap	Country	Filing Method	Remark
Faroe Islands	Denmark	Not Available	Limiting North Sea area
Finish Gulf Islands	Russia	Not Available	Limiting Finish Gulf area
Azores	Portugal	Filled with data from 2000 and 2002	Slightly different method
Pyrenees	Andorra	Not Available	Limiting Pyrenees
Kaliningrad Oblast	Russia	Not Available	Limiting Border Poland, Lithuania
Channel Islands	United Kingdom	Not Available	Limiting North West France
Greece	Greece	Data from 2000	Unclear on 2006

Table 3: Gap areas in CORINE Land cover of 2006, The Gaps provoke limitations on use of the dataset for analysis and mapping of areas encompassing a country. Smaller gaps of not inhabited islands like Jan Mayen, Rockal, Alboran, Columbretes and Selvagem are not listed here.

Mapping and modelling is done, most of the time, using rectangular areas, described by 4 coordinates in the coordinate system of use. CORINE is not addressing this 'geographers' working method, the CORINE updating approach is characterized by an administrative territory based method. Since satellite imagery is the main and also a costly input for CORINE database creation, we advice to create and maintain the CORINE database at the level of 'Acquired Image' rather than units as countries or territories.
One can also argue that completeness of the Dataset should be considered with regard to the Policy support objectives of the CORINE project.
It would therefore be advisable to map and digitize new CORINE versions rather on 'Mapping areas' encompassing parts of countries. For example for policy support on the development of the Baltic Sea area it would be advisable to digitize the Leningrad Oblast at the expense of for example updating 'Northern Finland'

Methodology for inserting data in Land cover 2006

Once we generated 'manageable' units, the 250 by 250 km tiles, we could at the level of these tiles, insert omissions using data from CORINE 2000 and CORINE 1990.
The insertion had to be done with care since the three datasets are not consistent geometrically with each other. We developed a methodology to include earlier land cover data in tiles containing partially land cover data of 2006. The method consists of the usage of the ArcINFO command 'UNION' with as input the geometries of both datasets. The command intersects the geometries of both datasets. For areas that overlap small new

geometries are generated containing both the class of 2006 and the previous class. Subsequently the land cover class attribute is updated with the value of the 'old' dataset if the current dataset polygon class is empty. In some cases were the new land cover class of 523 (Sea) was overlapping existing territories (for example in Spain covering Morocco) the old class was retained and the 523 class was removed. The 'year valid' record was set back to the period the old class was digitized.

Optimizing the Spatial table

The Oracle spatial held dataset was divided into tables per CORINE version. A table containing all classes of 2000 and a table containing all classes of 2006 was defined. The tables contain the following columns:

Column Name	Data Type	Mandatory	Remark
ID	String		Could be used for updates
LCE_ID	Number	Yes	Converted to number
POLYGONS	Geometry	Yes	Split to maximum 100 by 100 kms
UPDATED_WHEN	Date	Yes	Set to delivery data EEA website
UPDATED_BY	String	Yes	Set to version number, altered if split

Table 4: Spatial Database table representation of the data. The LCE_ID, contains the classification of 3 digits, listed in table 1.

Apart from problems converting certain very large polygons of the grassland, tree and sea class, al data could be read into the database using the SHP2SDO conversion program combined with Oracle Loader.
Mapping the data versions of 1990, 2000 and 2006 was done by mapping the latest version of top of the older versions, thus one can in three steps we can create a consistent map.
Analyse programs function country based, countries like Greece, are processed using the data of 2000. The Azores were copied into the version of both 2000 and 2006 and marked using the UPDATED_WHEN field for the different update source and year.
The Sea buffer covers some specific islands, as in the case of Normandy (France) covering Guernsey, Alderney and Jersey. Also the sea buffer of Finland covers the Russian Island of Gogland.
The issue of the sea buffer we solved by displaying a coastline boundary on top of the Land cover mosaic of three layers. The sea class was set to 'transparent' in order to avoid that the buffer of 2006 covering for example, Jersey, cover the island.
In total the dataset of 2006 contains 25.234.489.121 meters of length of line strings distributed over 294263915 coordinate pairs. The average line in the 2006 dataset is therefore 86 meters long.

Version control

In august 2011 the EEA website made a new version of CORINE 2006 available, also versions of CORINE 2000 were updated. It was unclear which records were changed so we decided to replace the whole archive and its derived products again.
For the Oracle Spatial version this update work took 4 days of operator work. Mainly because we could not automate the full chain since some records were too large to be loaded in Oracle. Also we choose to 'update' each class in the production table rather than replacing the whole table in one moment. This method allowed our mapping systems to continue to function without major interruption. To replace the whole table our Oracle Spatial configuration needed 1 hour. For the web mapping applications, serving world wide services, such a downtime would be too long.
The regeneration of the ArcINFO Librarian model took 2 weeks of processing time; operator time was in the order of 2 days, it is the time to verify the new product, the time to split too large shape files and the time to intersect old data with the new version.
When comparing the previous version 2006 and the version released in August 2006 we noted various small changes. For example data from Turkey were move around 12 meters to the west. Such a change can be due to use of other projection system conversion software.
Automatic change detection becomes impossible if the software platform or minor parameters are changed in between the delivery of two versions.
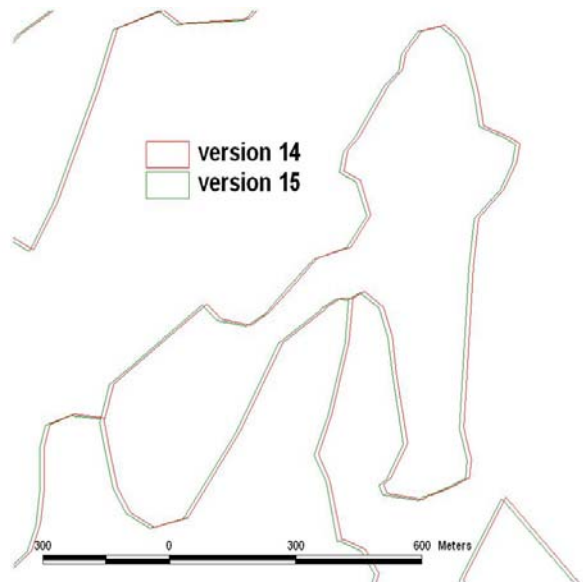
Map 6: Minor shifts in Turkey.

We advise therefore to exchange CORINE data always in Decimal Degrees based on a WGS84 spheroid. In this manner one can limit the projection algorithm artefacts to being introduced from the projection in which the dataset was digitized to Decimal Degrees only. It is simpler to identify errors due to projection system artefacts, than by introducing also a secondary transformation such as a projection to the LAEA system. Note also that the LAEA projection system is merely intended for mapping data in a window or paper map covering whole Europe. It is not mend to store and exchange the data, since distortions of a Lambert Equal Area projection become relevant further than 500 kilometres from the projection centre.

Model input

We use CORINE Land cover data to generate input for Climate Models needing percentage of vegetation types or urban land use for a given pixel size. In our case we determined percentages of urban land cover by intersecting the vectors in classes 111 to 124 with pixels of 5 by 5 kilometres. Map 7 gives an example of this for Europe. Note that before running the model we will have to guess data for the missing area's or break up the model and make them work for areas smaller than Central and Western Europe. Apart from the Faroe Islands al the 'missing' areas were available on the acquired satellite imagery bought to create CORINE Land cover data. for the surrounding areas.
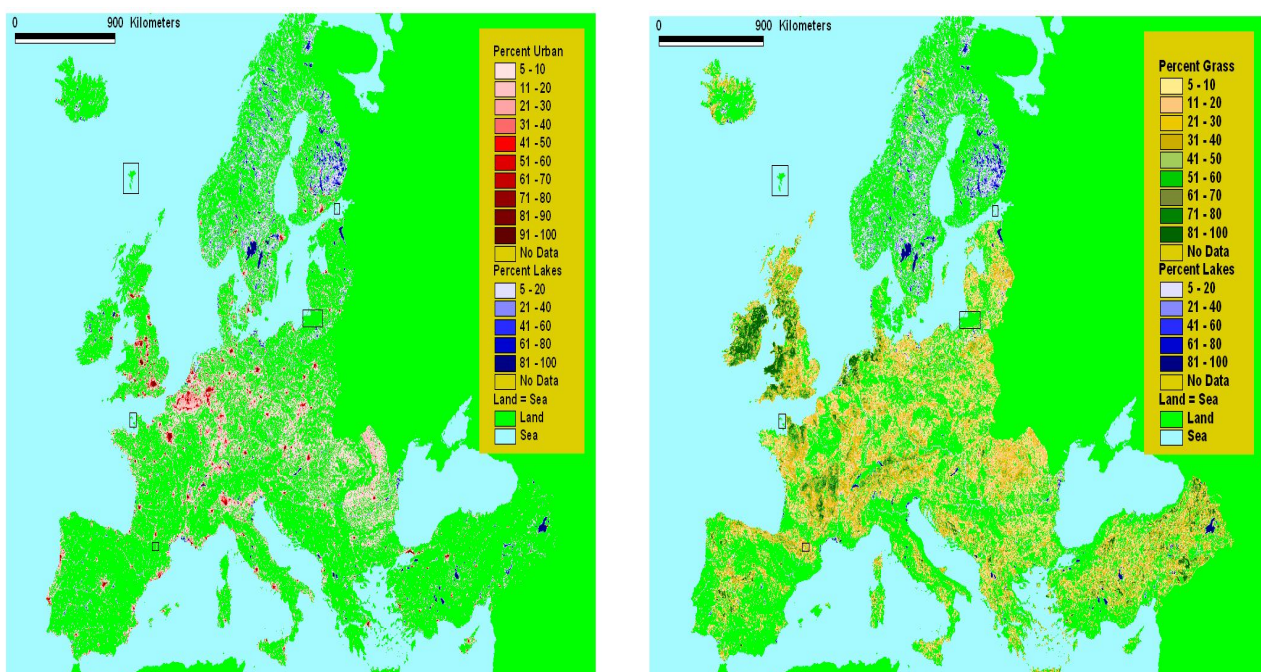
Map 7 and 8: Percent urban classes and percent Grass per 5 by 5 km cell using CORINE 2006 with addition of Greece of 2000, the black squares are area's that have to be guessed before running a model, provided the model is based on computing for example climate phenomena in an area delimited by a rectangle.

Recommendations and Conclusions

In order to make of the 44 shape files a usable product, allowing to provide computer models with statistical data related to Land cover regarding the territory of Europe we processed 4 versions of CORINE Land cover vector data to 1 seamless dataset.
Our main conclusion is that in both the ArcINFO as the Oracle computing environment care must be taken on the maximum size of the polygons to be stored by the system. The current versions provided by the EEA contain 10 percent too large elements limiting full automation of updating and analysis software.
CORINE 2006 -2000 covers whole Central and Western Europe and as such can contribute as valuable input for various climate and environmental models with data of known and high quality. With minor effort CORINE can be completed for Andorra, Azores, Guernsey, Jersey and the Faeroe Islands making the product more ready to use as input for enhanced models as well as for base mapping. Beside those also bordering areas such as Russia, Moldova and Ukraine are valuable to understand and compare the dynamics of the European Land cover.

Out of this work we would recommend the following:

1. Adjacent areas such as islands are to be excluded from the Sea class also if the islands do not belong to a country.
2. Small states and territories like Andorra and the Channel Islands can be incorporated in CORINE Land cover at the same expense. Excluding them cost more effort on quality control aspects than just digitizing them during the preparation of a map sheet.
3. Geometric objects in CORINE Land cover should not encompass a certain size and complexity, irrespective of the change of class. If such rules are established the data become more usable for all users, also for users limited to use the data using desktop GIS systems.
4. Rules for the size of objects could use the visible structures of the landscape itself, for example a large forest polygon can be split along the little river flowing through it.
5. CORINE Land cover records should contain a logical unique identifier. An ideal identifier identifies the 'operator' that created the record and the source that was used (the satellite image) to define the boundaries and class. Within that subset a sequence number could be given out by a system. Identifiers should be unique in time in the whole system. Updates also due to errors should lead to new identifiers. The logic of the current provided identifier is unclear and not documented.
6. An updated version, valid for a year already published should contain a list of records that are to be deleted and added rather than the replacement of files containing thousands of records. For this the identifier mentioned before could be used.
7. In addition to the 44 classes shape files, we would recommend to make a download per tile (as shape file) also available. Also a list of tiles that contain updates would be recommended. Using tiles containing topology would reduce the download size with 40 percent. The lack of a commonly used standard for exchanging topological data would hinder such an optimisation at this moment. A recommendation to the (Inspire) committees setting standards is to put forward a topological data exchange standard. The tile size we used in this study, of 250 by 250 km is a size that approximates the maximum physical ArcINFO coverage size of some areas in Central Europe. Therefore is the largest tile size possible will be in the range of 200 to 300 km. Eventually some tiles containing very few features can be amalgamated with a larger neighbour. A website containing a service for downloading tiles will have to allow for the download of approximately 200 entries.

Programs to repeat the work described

One can expect that the exercise of recreating a new version of the Tiled version or an Oracle Spatial version is to be repeated with the provision of a new version or an update of CORINE Land cover.
In order to facilitate such work, computer programs that run for a certain time on a dedicated computer are programmed.
In table 5 the programs are presented that we used to (re-)generate the tiled datasets and the Oracle Spatial table. The programs can be requested by sending an email to the author.

Program	Purpose	Time to process
makecov.aml	Conversion of a shape file to a coverage	51 times on average 3 hours
split.aml	Splitting of coverage's and combining them per tile	240 times on average 5 hours
make_grid.aml	Visiting the librarian tiles and creation of a grid for a certain cell size	1 day for a grid of 100 meter cell size
integrate.aml	Integration of 'old' version with new version	Done for 8 tiles in Greece, 3 tiles in Morocco and 2 tiles in Tunisia. (30 minutes per tile)
upgrade.sql	Converting loaded data to decimal degrees and minor conversion issues	44 times 1 hour.
tileit.sql	Tiling large polygons to small polygons of maximum 1 decimal degrees	1 day
inserttiles.sql	Inserting the tiled polygons and replacing the large polygons	6 hours
intersect_grid_5km.sql	Intersecting the classes with a 5*5 km grid and storing percentages	1 day

Table 5: Programs used to make the 2 datasets. Programs with extension .aml are run on the ArcINFO v10 platform and require an ArcINFO license. Programs with extension .sql are run on the Oracle Spatial platform and require Oracle 11 installation.

The conversion of a shape file to an Oracle Loader file can be done with the free software package shp2sdo which is provided by Oracle.
The times to process mentioned in table 5 are valid for 1 version of CORINE. We reduced the marked processing times by running programs in parallel on a computer network.
Both ArcINFO and Oracle processing is CPU intensive and processing time can be optimised by providing more CPU.
Writeable disk requirement is in the order of 4 times the final storage space required for the dataset.
During the project we had to process the year 2000 version for Greece (14 tiles) and subsequently the year 2006 version for whole Europe. Morocco, Tunisia and the Azores were prepared as separate datasets and placed in the database with 1 insert command.

References

CLC 2006 Technical Guidelines, 2007, European Environment Agency, 66 pp. DOI 10.2800/12134
Bossard, M; Feranec,J; Otahel,J. 2000, Corine land cover technical guide – Addendum 2000, EEA Technical Report No 40. Copenhagen (EEA).
Annoni, A; Luzet,C; Gubler,E; Ihde,J, 2003, Map Projections for Europe, Institute for Environment and Sustainability, 132 pp. Technical Report EUR 20120 EN.

Abstract
CORINE Landcover Data are distributed in 44 Shapefiles. In this report the author displays two methodologies to combine the 44 shape files in order to make a usable product. ArcINFO librarian and Oracle Spatial are being exploited.

How to obtain EU publications

Our priced publications are available from EU Bookshop (http://bookshop.europa.eu), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

Publications Office