

GMES Fast Track Service Precursor on Land Monitoring EEA Proposal 2006-2008 – Terms of Reference

1. Introduction

“The Agency is committed to support the spatial data requirements of European and global development initiatives, including key thematic strategies on marine systems and soils, with particular attention to land-use changes in ecologically sensitive areas and protection of soils “(EEA Strategy 2004-8).

With these objectives in mind, the Management Board, at the occasion of a seminar on Spatial analysis and policy evaluation (24 November 2004), debated and concluded with following recommendations:

- “Increase frequency of update of Corine land cover database to every five years from every 10 years, taking 2005 as the next update year;
- For 2006-2008, develop activities that integrate spatial analysis, ex-post policy effectiveness analysis and scenarios tools, methods and outcomes to support understanding of the environmental impacts of sectoral policies and the application of EU funding mechanisms in the 2007-2013 financial perspective.”

Recent strategic discussions amongst member countries, European Parliament and the main EU institutions responsible for environmental policy, reporting and assessment (DG ENV, EEA, ESTAT and JRC) have underlined an increasing need for factual and quantitative information on the state of the environment to be based on timely, quality assured data, in particular in land cover and land use related issues.

DG Environment addressed in June 2005 a request to EEA to include following services related to land use in its multi-annual work programme until 2008:

- Provision of high quality and reliable land cover data, delivering more regular updates and higher resolutions for vulnerable areas.
- Integration of spatial and non-spatial data, including non-environmental data into a spatial information platform to support relevant, reliable and high quality assessments.

DG Agriculture is interested to support a Corine Land Cover update which should be synchronised as much as possible with the LUCAS in-situ monitoring campaign 2006 coordinated by Eurostat to provide complementary information on land cover and land use changes between 2000 and 2006 used for updating agri-environmental indicators (hence the preference to select 2006 as reference year instead of 2005).

Based on these requirements for 2006-2008, EEA put forward a proposal to collaborate together with the European Commission (EC) and the European Space Agency (ESA) on the implementation of a fast track service precursor on land monitoring in line with the Communication from the Commission to the Council and the European Parliament “Global Monitoring for Environment and Security (GMES): From Concept to Reality” (COM(2005) 565 final).

The proposal is based on the benefits of GMES by combining the planned Corine land cover (CLC) update with the production of additional high resolution data for a selected number of land cover classes such as those concerning built-up areas. The shortcomings of standard CLC update, which is deemed insufficient to meet the wide range of user needs, can be resolved by the creation of complementary high resolution land cover data for a selected number of classes. The GMES preparatory projects¹ demonstrated that these data can be generated quickly and cost-effectively through semi-automated image processing.

This proposal is also fully in line with the ESA statement of work for scaling up consolidated services related to land information services² in stage 2 of the Earthwatch GMES Services Element (GSE) issued in 2005.

This initiative will contribute to the development and implementation of the shared European information system, of which GMES products and services as well as INSPIRE are key structuring elements. EEA and JRC are closely collaborating on the development of a European Spatial Data Infrastructure, building further on the experience from IMAGE2000 and CLC2000.

2. Consolidated user requirements

Several meetings were organised during 2005-2006 with a broad range of stakeholders to discuss the present and future user requirements for land use and land cover change data. From a long list of requirements for land cover and land use information for the next decade, EEA proposed at the GMES Advisory Council in June 2005 that the GMES fast track land monitoring service should be **“a service providing on a regular basis core land cover/land use change data that can be used by a wide range of downstream services at European, national, regional and local level”**.

The following **information requirements for framing, implementing and evaluating main policy areas at European and national level** will be addressed by this GMES land monitoring service precursor:

- Environmental thematic strategies on urban environment, soil protection and sustainable use of natural resources;
- Reporting obligations under the Water framework directive, management of Natura2000 sites, UN ECE Long Range Transboundary Air Pollution deposition and dispersion modelling,
- Reporting obligations under the UN Framework Convention on Climate Change and Kyoto Protocol;
- Environmental impact assessments and reporting;
- EU enlargement and neighbourhood policy;
- Common Agricultural Policy i.e. rural development, agri-environmental measures;

¹ ESA GSE projects SAGE, GUS, Forest monitoring, and EC FP6 Integrated project Geoland.

² ESA GSE Land and GSE Forest monitoring

- Regional policy, territorial cohesion and European spatial development perspective;
- Infrastructure for spatial information in Europe – Inspire.

More specifically, GMES will contribute to the improvement of the specific EEA services related to land cover and land use change for the coming years as requested by DG Environment in June 2005. **Specific requests for land cover and land use change data** and information relate to soil and agriculture, urban environment, integrated coastal zone management, biodiversity and Natura2000 related services:

- Data and analysis regarding effect of accession in new Member States. EEA is requested to provide data and analysis regarding changes in land cover and land use, in particular in the areas of:
 - o Sealing
 - o Land use change related to agriculture and Common Agricultural Policy
 - o Land use changes resulting from the use of Community funds
- Data and analysis to support the further development and implementation of the Natura 2000 network, including coastal habitats
- Data and analysis to support the design and implementation of policy approaches and instruments for the monitoring and assessment of nature and biodiversity and the factors, pressures and responses that impact on it, in particular in relation to the achievement of the target of halting biodiversity loss within the Community by 2010
- Data and analysis in relation to High Nature Value Farmland and changes over time to assist DG Environment with policy information, particularly in its efforts to have High Nature Value Farmland areas included as a criterion for designation of Less Favoured Areas (LFAs) once the reform of LFAs begins to be discussed.
- Information on the environmental impacts of sealing. EEA is requested to collect and analyse information on sealing of land, including for the 500 or so major urban agglomerations in Europe. This must build on information derived from Corine land cover if possible on a higher frequency and with local higher resolution, and address in particular the effects on:
 - o Soil functions;
 - o Water courses, including run off;
 - o Biodiversity, including fragmentation and other effects on habitats;
 - o Temperature increase in sealed areas;
 - o Landscapes, in particular with a view of sealed greenfield sites.

Following **boundary conditions** were discussed at the GMES Land Monitoring workshop organised by DG ENTR in October 2005 and are recommended for implementation of the GMES fast track service precursor on land monitoring:

- The service should cover all EU member states and neighbouring countries providing a snapshot of a specific year in which the majority of the satellite data should be acquired;
- Continuity of Corine land cover dataflow should be guaranteed;

- Core land cover data should be available preferably within 1.5 year after the satellite data acquisition in order to ensure timely information;
- Updates with a continental coverage should be envisaged at least every 5 years; some environmental or other sensitive areas i.e. urban areas, mining sites, coastal zones or other regions with high rate of land use and land cover changes, might require more frequent updates;
- Coordination of European with national, regional, local monitoring activities should be fostered, in line with the principle of subsidiarity.
- The GMES service should build on existing land cover and land use experience and monitoring activities. Compatibility should be envisaged with Corine Land Cover (for continental monitoring), Moland (for urban monitoring) as well as FAO Land cover classification system (for global monitoring) ;
- Co-ownership of the products should be guaranteed by all actors involved in the service implementation;
- Open access and free dissemination data policy for all products as applied for IMAGE2000 and CLC2000 based services should be maintained.

3. Service and products definition

EEA proposes for the implementation of the GMES fast track service precursor on land monitoring 2006-2008 to combine a standard CLC update with the production of additional high resolution data for a selected number of classes, to provide **a first set of cost-effective operational services on core land cover and land use change data at European level**, including the provision of high quality ortho-rectified multi-temporal data.

The service should deliver following **products** during 2006-2008:

1. Ortho-rectified satellite images for the reference year 2006 (+/- 1 year), referred to as IMAGE2006;
2. Corine land cover changes 2000-2006;
3. High resolution land cover data 2006 for selected number of classes (i.e. built-up area including degree of soil sealing, forest).

4. Geographic scope

The GMES fast track service precursor on land monitoring should cover the **EU25 and neighbouring countries**, meaning at least all EEA Member countries (namely: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom) as well as the western Balkan countries (namely Albania, Bosnia-Herzegovina, Croatia, Former Yugoslavian Republic of Macedonia and Serbia-Montenegro) who are participating in the regular Corine land cover dataflow.

5. Added value of GMES

The **benefits** provided by GMES towards this approach are:

- more cost effective land monitoring by using the same input satellite data and advanced technologies for the CLC update in conjunction with the high resolution land cover mapping of specific classes;
- improved high resolution land cover information, now required for the preparation, implementation and evaluation of a range of current and upcoming European sectoral policies;
- fast implementation and delivery of products and services through a cost effective public/private partnership which presents the EEA principle of “free at the point of delivery”;
- more timely information, with a reduced processing time of 50 % from data acquisition to delivery of information compared to previous CLC2000 exercise, through a coordinated approach of pooling existing resources at national and international levels thereby avoiding duplication of work; and
- provision of a significant European contribution to the GEO implementation plan through GMES.

6. Proposed implementation steps 2006-2008

To implement this GMES fast track precursor service on land monitoring, a number of **work packages** can be defined which should be carried out as a partnership between public and private organisations:

1. satellite data acquisition
2. in-situ and ancillary data acquisition
3. ortho-correction
4. satellite image mosaicking
5. land cover change mapping 2000-2006
6. high resolution land cover data mapping 2006
7. validation
8. data dissemination

Work package 1: satellite data acquisition

What?

- SPOT4 HRV multi-spectral data. The year 2006 is targeted as reference year, with a deviation of maximum one year (2005 or 2007) to ensure full cloud free coverage synchronised with the 2006 in-situ monitoring campaign of LUCAS. A narrow/restricted acquisition window, corresponding to optimal acquisition dates during the vegetation growing season as well as an extended window with an enlarged period of acquisition (in most cases one month before and beyond restricted window) is determined together with the participating countries based on the IMAGE2000 experience.
- IRS P6 AWiFS multi-spectral as well as multi-temporal data (if possible 2 or 3 seasons depending on cloud coverage) for the targeted reference year required for better discrimination of agricultural classes and wetlands.

By When?

Processed satellite data should be available for interpretation and land cover mapping by end 2006. Gaps in coverage can be filled in during 2007.

How?

The ESA agreement for acquisition of third party satellite data should be considered for the satellite data acquisition of the GMES fast track service precursor on land monitoring. EC and/or ESA should coordinate data procurement.

Integration of products and services corresponding to the specifications of this proposal and which are already covered of the ongoing GSE Land and Forest monitoring projects 2005-2008 should be guaranteed to avoid duplication of work.

Work package 2: in-situ and ancillary data acquisition***What?***

- Ground control points and digital elevation model for satellite image correction;
- National topographic maps or basic geographic reference data which will be used during the image processing, interpretation, mapping and validation process;
- Existing aerial photography, thematic maps or any other ancillary data that will be used for identification or verification of land cover mapping;
- Existing thematic maps and data to facilitate the interpretation and classification process;
- LUCAS field survey data including landscape photographs from visited points that will be used for validation.
- Metadata about the ancillary and in situ data that is used should be provided.

By When?

In situ and ancillary data required for satellite data corrections should be made available during 2006. Ancillary data for interpretation and land cover mapping should be available early 2007. In-situ data for validation should be available after summer 2007.

How?

National and Regional authorities participating in the Eionet network should consider to provide access to relevant in-situ and ancillary data. Most of these data exist and are available from national or regional organisations. Access to these data should be considered as national contribution.

Eurostat and DG Agriculture should consider to grant access to LUCAS 2006/7 survey data including photographs of visited points, similar as applied for the CLC2000 validation.

Work package 3: ortho-correction***What?***

Ortho-rectification of individual scenes with geometric accuracy <30 m for Spot and <50 m for AWiFS. Image data should be resampled to a pixel size of 20 m for SPOT XS data and 50 m for IRS AWiFS data using cubic convolution³ resampling. Metadata information should be provided.

By When?

All satellite data from 2005/2006 should be processed by end 2006. Gap filling if required using 2007 data should be completed before end September 2007.

How?

This service should be provided and coordinated by the industry building on the IMAGE2000 exercise coordinated by JRC. The ortho-rectification of the satellite image should be organised as an industrialised process for fast and accurate delivery. Compatibility with IMAGE2000 should be ensured.

Integration of products and services corresponding to the specifications of this proposal and which are already covered of the ongoing GSE Land and Forest monitoring projects 2005-2008 should be guaranteed to avoid duplication of work.

Work package 4: satellite image mosaic

What?

A seamless image mosaic of the SPOT data as well as the mosaics of IRS data should be produced as a colour composite to allow further use as high quality background image reference layer within the European spatial data infrastructure. The standard European Lambert azimuthal equal area projection (52N10E) should be used. A public web service should be made available to provide access to the data. Metadata about acquisition date for each selected pixel for the mosaic should be provided.

By When?

The satellite image mosaic and web service should be made available before end 2007.

How?

The mosaicing service should be provided by industry. Based on the experience with IMAGE2000, EC together with EEA should implement the public web services. Integration of products and services corresponding to the specifications of this proposal which are already covered of the ongoing GSE Land and Forest monitoring projects 2005-2008 should be guaranteed to avoid duplication of work.

Work package 5: Corine land cover change mapping 2000-2006

What?

³To be further discussed to what extent nearest neighbourhood resampling should be to maintain radiometry for further image classification

Mapping of all land cover changes up to 5 ha for the standard 44 CLC classes based on image to image comparison carried out by local expertise using existing ancillary data when required. For the computer assisted image interpretation, SPOT, IRS data should be matched with corresponding multi-spectral Landsat TM data available from IMAGE2000.

The overall thematic accuracy should be >85 % (similar as CLC2000).

Meta data information should be provided.

By When?

Interpretation should start early 2007 and be completed by end 2007 to ensure timely delivery of the land cover change data and derived information.

How?

This service should be provided by the national and regional authorities in charge of the national Corine land cover programme supported by industry. The existing expertise from the CLC2000 exercise should be used whenever possible.

Work package 6. High resolution land cover data 2006

What?

Following high resolution land cover data will be produced by semi-automatic image classification:

- Pixel based classification of all built-up areas with a minimum mapping unit of 0.1-1 ha, corresponding to soil sealing, to be provided as a dataset of percentage imperviousness⁴;
- Pixel based classification of all forested areas (differentiating deciduous and coniferous forest) with a minimum mapping unit 0.5-1 ha.

The overall thematic accuracy for built-up and forest classes should be >85 %

Note: Additional land cover classes (i.e. wetlands, grassland, arable land, water) are expected to be produced as an extension of the service, depending on availability of additional funding.

Meta data information should be provided.

By When?

High resolution land cover data should be available by end 2007.

How?

Classification procedures should be based on proven methods applied by the relevant service portfolios of the GMES pilot projects GSE SAGE, Urban services, Land and Forest Monitoring which provided successful results. Integration of products and services corresponding to the specifications of this proposal which are already covered of the ongoing GSE Land and Forest monitoring projects 2005-2008 should be guaranteed to avoid duplication of work.

Work package 7: validation

⁴ Imperviousness or impervious surfaces refers to impenetrable surfaces such as rooftops, roads, or parking lots.

What?

Assessment of accuracy of the land cover and land use products using the LUCAS survey data 2006-7, similar to the validation carried out within the frame of the CLC2000 update exercise. This include examination and interpretation of the photographs collected during field survey and statistical analysis of omission/commission, as well as a comparison of LUCAS classification results with collected CLC and high resolution land cover and land use data. A report should be produced summarizing the statistical results.

By When?

Validation should be completed early 2008 before dissemination to the public of the products

How?

LUCAS 2006/7 data will be used to validate the land cover data. Access to the data should be discussed with Eurostat and DG Agriculture. EEA will coordinate together with the participating countries the validation.

Work package 8: data dissemination service***What?***

All the products of the precursor service should be made available on line through a web portal, including free services for viewing and download of the data, including relevant meta data.

By When?

The data service should be online early 2008.

How?

Land cover and land use data will be distributed by EEA (as part of its data centre on land use) and participating member countries. Satellite imagery should be available through web services which should be further discussed with EC and ESA in line with the other GMES services .

All data should be available free of charge for further use downstream for commercial and non-commercial applications. Similar to the IMAGE2000 and CLC2000 exercise, the widest possible use of all products should be guaranteed. This data dissemination service will be in line with the Inspire initiative.

7. Budget and proposed timeframe

The **total cost** of the combined approach is estimated to be approximately €14 million. EEA is requesting the Commission (i.e. DGs Agriculture, Regional Planning, Environment) and ESA to consider to cover the cost for satellite data acquisition and pre-processing (approx. 5.5 M€), processing of the high resolution land cover data (approx. 4 M€ depending on the number of classes) and co-funding of verification and validation by participating countries. Participating countries are requested to consider covering the interpretation costs for the CLC update (approx. 4 M€) and to

make existing ancillary and in-situ data available. EEA is expected to play a leading role in quality assurance, data dissemination and coordination (approx. 0.5 M€).

WP	Project phases	2006				2007				2008		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1	Satellite data acquisition		■	■			■	■				
2	In-situ data acquisition		■	■			■	■				
3	Ortho-correction			■	■		■	■				
4	Satellite mosaicking				■	■		■	■			
5	Corine land cover change mapping 2000-2006					■	■	■	■			
6	High resolution land cover data mapping 2006					■	■	■	■			
7	Validation							■	■	■		
8	Data dissemination									■	■	■

8. Management and organisation of work

A project board should be set up with representatives from all contributing organisations, namely The Commission, ESA, EEA and participating member countries. EEA proposes that the new established GMES implementation group for land monitoring responsible for implementation of the GMES fast track service could take this responsibility (to be confirmed).

Before kick-off of the activities, a technical workshop will be organised by EEA to discuss and agree on the technical details of each of the proposed work packages with all interested partners. One of the main discussion items will be the quality assurance and quality control procedures to be implemented for each of the services.

To achieve an early start, EEA is proposing to the Commission and ESA to consider the implementation of this GMES service precursor under EEA technical lead, where the different work packages could be contractually handled by the Commission, EEA or ESA, the latter as an extension to the existing GSE projects, where an extension of the proposed services to all Europe has been included in the Statement of Work of the competitive tendering in 2005.

A final decision from EEA/Eionet, EC and ESA on a common approach within the framework of GMES together with funding in place is needed at the latest by June 2006 if EEA is to meet stakeholders expectations on the delivery of quality assured data and analysis at the European level similar to and in some cases at a higher resolution that produced in the State and Outlook report of Europe's Environment (EEA, 2005).