

# GMES LAND MONITORING SERVICE AS DEVELOPED BY GEOLAND2 PRODUCT / SERVICE PORTFOLIO

NOVEMBER 2010

## Preamble

The GMES Services being developed by the five projects (geoland2, MyOcean, MACC, SAFER, G-MOSAIC) partly funded by the European Commission provide geo-spatial products and services. These products and services can be exploited either directly by end-users or by value-adding services providers who build on the basic services. These value-added services are generally referred to as "downstream services".

This document provides both end-users and value-added service providers with a description of the products and services developed by the geoland2 project ([www.gmes-geoland.info](http://www.gmes-geoland.info)), as well as with indicative timescales for their delivery.

The products and services described in this document may undergo revisions during the lifetime of geoland2. Hence the information provided should only be considered to be of an indicative nature.

### Contact Information

Markus Jochum

geoland2 Project Coordinator

Email: [markus.jochum@astrium.eads.net](mailto:markus.jochum@astrium.eads.net)

Web: [www.gmes-geoland.info](http://www.gmes-geoland.info)

## Table of Contents

<b>1</b>	<b>CONTRIBUTION TO GMES SERVICES .....</b>	<b>3</b>
<b>2</b>	<b>PRODUCTS AND SERVICES .....</b>	<b>4</b>
2.1	Core Mapping Services.....	5
2.2	Core Information Services.....	5
<b>3</b>	<b>INDICATIVE TIME SCALE.....</b>	<b>7</b>

## Annexes

<b>ANNEX 1</b>	<b>SUMMARY OVERVIEW OF GEOLAND2 PRODUCT/SERVICE PORTFOLIO .....</b>	<b>8</b>
<b>ANNEX 2</b>	<b>DETAILED GEOLAND2 PRODUCT PORTFOLIO .....</b>	<b>9</b>

# 1 Contribution to GMES Services

**g**eoland2 is the EU FP7 Research Project responsible for the development and pre-operational validation of the GMES Land Monitoring Service.

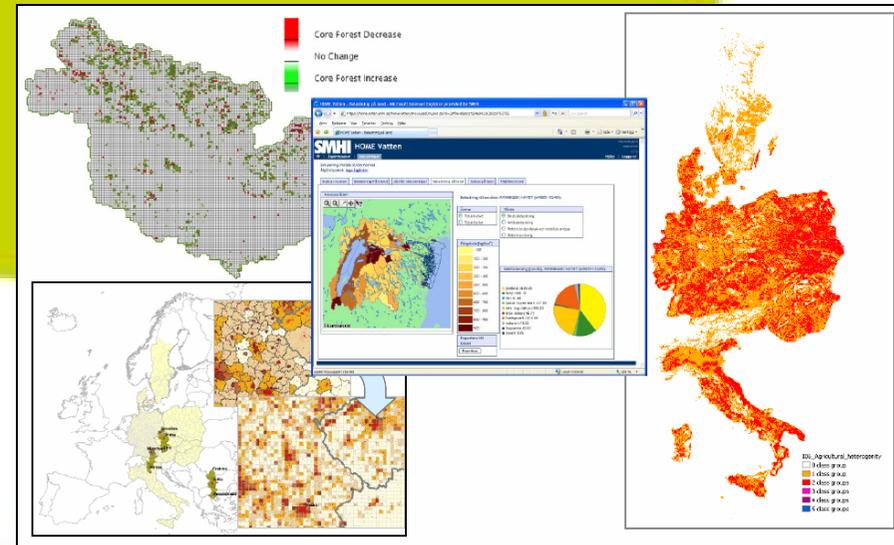
Former research projects funded by the European Commission and the European Space Agency have defined and started developing a series of land monitoring services providing harmonised geo-information at global to local scale.

Building on the results achieved by its predecessors, geoland2 is the last brick towards the implementation of a fully mature GMES Land Monitoring Service.

Based on land cover, land use or bio-physical information derived from Earth Observation satellite data, the service provides decision-makers with relevant information on the changing conditions of natural resources (e.g. water quality information across catchments basins).

**g**eoland2 aims to:

- Organise a qualified production network;
- Build, validate and demonstrate operational processing lines;
- Set-up a user driven product quality assurance process.



**Example of Information Services: Forest change indicators (upper left), Spatial planning indicators (lower left), Water quality assessment (centre), Agricultural indicator (right)**



geoland2 is a Collaborative Project partly funded under the Seventh Framework Programme of the European Union.

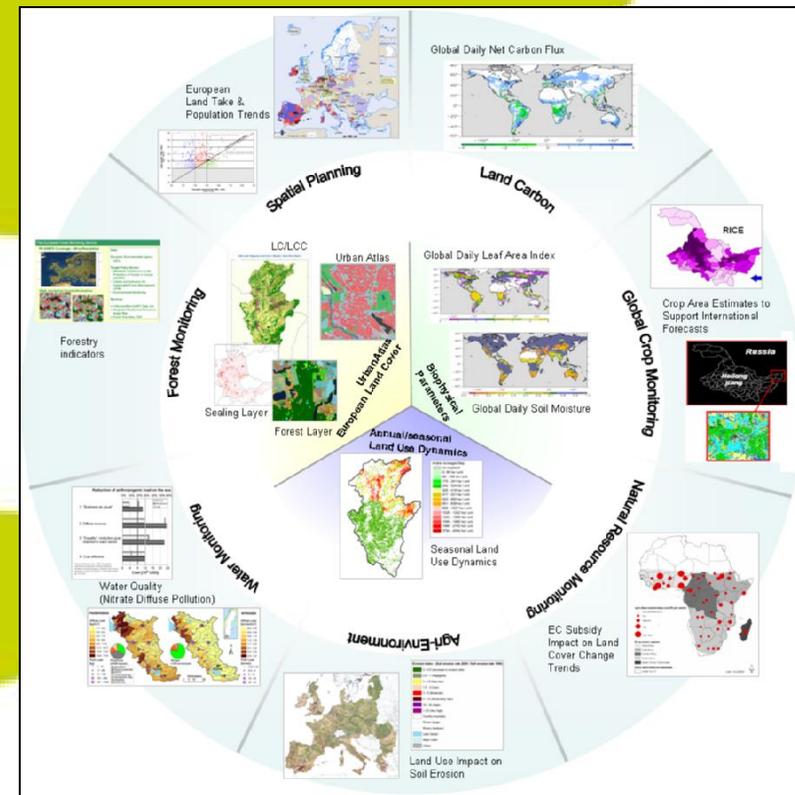
## 2 Products and Services

**G**eoland2 addresses two different service levels: Core Mapping Services (CMS) and Core Information Services (CIS).

Core Mapping Services provide land cover / land use data (Euroland), a range of bio-physical parameters (BioPar) describing the continental vegetation state, the radiation budget at the surface and the water cycle on the basis of satellite Earth observation data. Core Mapping Services also provide seasonal and annual change monitoring (SatChMo). The CMS products cover a wide variety of thematic content, spatial scales from local to global, and update frequency, from 1 day to several years.

The Core Information Services aim at demonstrating the added-value of the Core Mapping Service in various fields. They propose a set of more specific thematic products comprising forest monitoring, spatial planning, land carbon monitoring, global crop monitoring (GCM), natural resource monitoring (NARMA), agri-environmental monitoring (AgriEnv) and water monitoring applications. Core Information Services support reporting to European Environmental Policies and international treaties on Climate Change, food security and the sustainable development of Africa.

The products and services mentioned above are briefly described hereafter. More detailed specifications are provided as annexes.



**Illustration of Land Core Mapping Services (inner diagram) and Core Information Services (outer diagram)**

## 2.1 CORE MAPPING SERVICES

The mapping products are of broad generic use: besides being a valuable information source in their basic form, they are the basis for value-added geo-information services, focusing on a broad variety of thematic fields, like water quality, forest managing, spatial planning, agri-environmental issues, carbon cycle or food security.

Core Mapping Services consist of three main components:

- European Land Cover and Land Use (**EuroLand**);
- Bio-geophysical parameters (**BioPar**)
- Seasonal and Annual Change Monitoring (**SATChMo**).

**EuroLand** provides high resolution thematic land use / land cover parameters at continental scale addressing five different themes: impervious areas, forests, grassland, wetlands and small water bodies. At local scale it produces very high resolution Urban Atlas inventory and updates.

**BioPar** produces in near real time and off-line a series of bio-geophysical parameters describing the continental vegetation state (e.g. leaf area index, dry matter productivity), the energy budget (e.g. albedo, land surface temperature) and the water cycle (e.g. soil water index).

**SATChMo** operates over Europe and Sub-Saharan Africa. It provides annual statistics of land cover and land cover change based on dynamic monitoring of permanent sample areas over Europe and Africa. It also

delivers seasonal and annual vegetation parameters at continental scale enabling to address land cover change and agricultural land use.

## 2.2 CORE INFORMATION SERVICES

Core Information Services address seven different areas:

- **Spatial Planning**; the service describes, explains and forecasts urban land use change in Europe. The product portfolio consists of a selected set of policy-relevant land take trend indicators as well as urban growth scenarios to illustrate the benefit of systematic and detailed spatial analysis for spatial planning;
- **Agri-Environment (AgriEnv)**; the service contribute to the improvement of the timely and accurate monitoring of agricultural land use state and its changes at European, national and regional levels. The service addresses agricultural land use and trends, farming pressure on water and soil resources, as well as impact of agricultural land use changes on biodiversity and landscapes;
- **Water Monitoring**; the service integrates earth observation data into water discharge and quality models and contributes to water management in Europe. It provides information on water balance (e.g. flow rates & flow depths in streams & rivers, soil moisture level); nutrient (N&P) discharge/potential and

concentrations in water bodies for different scenarios (baseline and future); and decision support for defining measures to cope with water pollution resulting from nutrients. It also provides comparison between modelled and observed data, as regional statistics and for individual sites;

- **Forest Monitoring;** the service concentrates on biodiversity/ fragmentation and change indicator maps and services related to Ministerial Conference on the Protection of Forests in Europe (MCPFE) and United Nations Convention on Biological Diversity (UNCBD) reporting and indicators defined by Streamlining European Biodiversity Indicators (SEBI) 2010. The products are based on the Euroland products, additional in-situ data provided by user organisations and indicator models;
- **Land Carbon Monitoring;** the service provides global and regional variables related to the terrestrial carbon cycle, in near-real-time (NRT), for describing the continental vegetation state

(leaf area index and biomass), the surface fluxes (carbon and water), and the associated soil moisture;

- **Natural Resource Monitoring in Africa (NARMA);** the service consists of an environmental monitoring capacity over African countries for the benefits of the European Commission and its regional and continental partners in Africa. The thematic focus is on seasonal and multi-annual management of natural resources to facilitate decision making processes and medium term planning exercises;
- **Global CROP Monitoring (GCM);** the service provides factual, real-time crop assessment and yield forecasts in support of EC Policies in the field of agriculture inside and outside EU, addressing the Common Agriculture Policy (CAP), trade and food security.

### 3 Indicative Time Scale

---

The indicative time scale for the availability of the products delivered by geoland2 is provided in Annex 2 (column "Status of Validation" of the table).

## Annex 1 Summary Overview of geoland2 Product/Service Portfolio

Scale	Update Frequency	Description	Spatial Resolution	Area
Local scale – specific areas of interest at EU level	3 years	Urban Atlas	Very High Resolution	318 Cities
	Yearly	Hot spot areas / Area Frame Sampling (AFS)	<ul style="list-style-type: none"> <li>Urban Atlas 0,25ha</li> <li>2,5 m Hot Spots and AFS</li> </ul>	450 sites across Europe
Continental scale – pan-EU level	3- 5 years	Continuity of Corine Land Cover (CLC)  Dynamic High Resolution Parameters <ul style="list-style-type: none"> <li>Degree of Imperviousness (0-100%)</li> <li>Forest Crown Cover Density (0-100%)</li> <li>Grassland Intensity (0-100%)</li> <li>Wetlands</li> <li>Water (Small Water Bodies)</li> </ul>	High Resolution <ul style="list-style-type: none"> <li>25 ha CLC</li> <li>1 ha HR Parameter (pixelbased)</li> </ul>	Pan-European EEA 38
Global and continental scale - Global and African level	Hourly to monthly	Biophysical Parameters	Medium Resolution / Low Resolution <ul style="list-style-type: none"> <li>300m – 25km</li> <li>&lt;50m on Pilot Areas</li> </ul>	Global, African AMESD

## Annex 2 Detailed geoland2 Product Portfolio

Main acronyms used in the tables on the next pages:

<b>AFS</b>	Area Frame Sampling	<b>IGAD</b>	Intergovernmental Authority on Development
<b>AMESD</b>	African Monitoring of the Environment for Sustainable Development	<b>LC/LCC</b>	Land Cover / Land Cover Change
<b>CEMAC</b>	Communauté Économique et Monétaire de l'Afrique Centrale	<b>LPV CEOS</b>	Land Product Validation subgroup of the Committee on Earth Observation Satellites
<b>CICOS</b>	Commission Internationale du bassin Congo-Oubangui-Sangha	<b>LU/LUC</b>	Land Use / Land Use Change
<b>DPSIR</b>	Driving Forces-Pressures-State-Impacts-Responses	<b>MCPFE</b>	Ministerial Conference on the Protection of Forests in Europe
<b>ECOWAS</b>	Economic Community Of West African States	<b>MMU</b>	Minimum Mapping Unit
<b>EEA</b>	European Environment Agency	<b>NRT</b>	NearReal Time
<b>ETC LUSI</b>	European Topic Centre on Land Use and Spatial Information	<b>NUTS</b>	Nomenclature d'Unités Territoriales Statistiques
<b>EU / EC</b>	European Union / European Commission	<b>SADC</b>	Southern African Development Community
<b>GSE</b>	GMES Services Element	<b>SEBI 2010</b>	Streamlining European Biodiversity Indicators 2010

## A2.1 Detailed Core Mapping Service Portfolio

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
<b>Pan-EU Land Cover Component</b>							
High Resolution Layer Grassland	Land Monitoring Service High Resolution Layer Grassland Intensity	Off-line	3-5yrs / 2006	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2009/2010
High Resolution Layer Wetlands	Land Monitoring Service High Resolution Layer Wetlands	Off-line	3-5yrs / 2006	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2009/2010
High Resolution Layer Water	Land Monitoring Service High Resolution Layer Small Water Bodies	Off-line	3-5yrs / 2006	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2009/2010
High Resolution Layer Grassland Change	Land Monitoring Service High Resolution Layer Grassland Intensity	Off-line	3-5yrs / 2009	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2010/2011
High Resolution Layer Wetlands Change	Land Monitoring Service High Resolution Layer Wetlands	Off-line	3-5yrs / 2009	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2010/2011

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
High Resolution Layer Water Change	Land Monitoring Service High Resolution Layer Small Water Bodies	Off-line	3-5yrs / 2009	Pixel based (20m) and 1 ha MMU	Quantitative parameters / 85% accuracy	Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by ETC-LUSI team; year 2010/2011
Automated Change of Imperviousness Layer 2006	Land Monitoring Service Automated update of Imperviousness Layer 2006	Off-line	3-5yrs / 2009	Pixel based, to be aggregated to user requirements (1 ha)	> 85% for aggregated 1 ha cells	Pan-EU EEA 38	To be validated in geoland2 by 2010
Forest Area	Land Monitoring Service Forest Area, comprising Forest - Non-Forest information-as part of the HR Forest Layer	Off-line	3 years / 2006 / 2009	Pixel-based, validated at MMU of 1 ha	2 classes / 85%	Forest Demo Sites in different EU & EEA member states representing Europes' divers ecosystems	Validated by European Commission Joint Research Centre (DG JRC)
Forest Types	Land Monitoring Service Forest Type: mapping of 4 forest type classes to the Forest Area product as part of the HR Forest Layer	Off-line	3 years / 2006,2009/	Pixel-based, validated at MMU of 1 ha	4 classes / 85%	Forest demo sites in different EU & EEA member states representing Europes' divers ecosystems	Validated in GSE FM, and projects at national level (GSE FM docs: C6, S6)

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Forest Crown Cover Density	Land Monitoring Service crown cover density map with pixel-based continuous crown cover density in percent as component of the High Resolution Forest Layer	Off-line	3 years / 2006, 2009 / +	Pixel based, to be aggregated to user requirements	Continuous % values; can be aggregated / 85%	Forest demo sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by 2009+
Forest Area Change	Land Monitoring Service historic Forest Area Change Map, showing the gain, loss and stable areas of Forest and Non-Forest over defined time periods (e.g. 1990-2006) as component of the High Resolution Forest Layer	Off-line	3 years / 2006, 2009	Pixel based, to be aggregated to user requirements	4 classes / 85%	Forest demo sites in different EU & EEA member states representing Europes' divers ecosystems	To be validated in geoland2 by 2009+ (precursors validated in GSE FM; GSE FM docs: C6, S6)
Urban Atlas automated update	Land Monitoring Service Urban Atlas automated indicator of increase of artificial area in respect to the Imperviousness Layer 2006	Off-line	3 years / 2010	tbd in geoland2	tbd in geoland2	46 European urban areas	To be validated in geoland2 in year 2

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Urban Atlas full update	Land Monitoring Service Urban Atlas Full Update	Off-line	3 years / 2011	MMU 0,25ha	26 classes, > 85% urban, > 80% non-urban	8 European urban areas	To be validated in geoland2 by ETC-LUSI team; year 4
<b>Biophysical Parameters</b>							
Vegetation Variables	Normalized Difference Vegetation Index, Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation, Fraction of Vegetation Cover, Phenological Variables, Dry matter Productivity	NRT	10-day / 2009	1 km	Units: LAI m <sup>2</sup> /m <sup>2</sup> ; FAPAR: %; Fcover: %; Phenology: decade; DMP: kgDM/ha/day; Accuracy: 0.3m <sup>2</sup> /m <sup>2</sup> for LAI; 10-15% for Fcover according to users requirements	Global	V0: validated and user accepted in geoland; v1: upgraded products which will be validated in geoland2 following the approach of LPV CEOS
Burnt Areas + Seasonality	Pixelwise mapping of occurrence of fires and estimation of start-end time of fire season	NRT	daily / 2009	1 km	Unit: day for Seasonality	Global	V0: validated in GLOBCARBON and L3JRC projects; v1: products adapted to new sensors
LST, DSR, DLR	Surface level temperature, Short & Longwave radiation available at surface level	NRT	Hourly / 2011	~5 km	Units: LST: °Kelvin; DSSF and DSLF: W/m <sup>2</sup>	Global	Global products which will be validated in geoland2

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Surface Albedo (1)	Indication of the capacity of the continental surface to reflect the sun radiation.	NRT	10-day / 2009	1 km	Unit: %, Accuracy: 5% relative	Global	V0: validated and user accepted in geoland; v1: upgraded products which will be validated in geoland2
Surface Albedo (2)	Indication of the capacity of the continental surface to reflect the sun radiation.	NRT	10-day / 2011	~5 km	Unit: %, Accuracy: 5% relative	Global	Products which will be validated in geoland2
Water Bodies + Seasonality	Detection of water bodies and variation of surface pond along the season.	NRT	10-day / 2010	1 km – 250 m	Unit: decade for Seasonality; Accuracy: 10% for the detection of ponds	Africa	V0: validated and user accepted in geoland; v1: upgraded products which will be validated in geoland2 ; v2: adapted to MODIS will be validated in geoland2
Soil Moisture + Freeze/thaw	Estimation of the water content for the 0-100cm layer of soil (soil water index), Mapping of pixels which are in freeze or thaw conditions.	NRT	daily / 2010	0.1°	Unit: % for soil water index	Global	V0: soil moisture validated and user accepted in geoland; v1: upgraded soil moisture + new freeze/thaw product which will be validated in geoland2

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
MERIS FR biophysical products	The set of parameters includes an estimate of the green, brown, & soil cover fractions, the Leaf Area Index, the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), the chlorophyll content, a shadow factor, the water & snow cover fractions, and the water height for MERIS FR pixel.	NRT	10-day / 2010	300 m	Units: % for various "fractions"; m <sup>2</sup> /m <sup>2</sup> for LAI, µg/cm <sup>2</sup> for chlorophyll content; m for water height	Strymonas-Struma and Guadalquivir catchments, Seine-Normandie and Rhine catchments Europe	Original products (available in Overland) validated and user accepted in geoland and in GSE Land. New validation will be made in geoland2 to validate the technical upgrades
High Resolution biophysical products	Same as BP-10 derived from High Resolution data	Off-line	Every 2-3 months / 2009	< 50 m	Same as BP-10	High risk areas in Strymonas-Struma, Guadalquivir, Seine-Normandie and Rhine catchments	Validated and user accepted in GSE SAGE and within the FARMSTAR operational service. New validation approach in geoland2
Climatology vegetation products	Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Fraction of Vegetation Cover	Off-line	yearly / 2011	1 km	Same as BP-01	Global	Validated in geoland2 following the approach of LPV CEOS,

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Historic vegetation products	Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), Fraction of Vegetation Cover	Off-line	10-day / 2011	4 km	Same as BP-01	Global	Validated in geoland2 following the approach of LPV CEOS
Historic water products	Estimation of the water content for the 0-100cm layer of soil (soil water index), Mapping of pixels which are in freeze or thaw conditions.	Off-line	daily / 2011	25 km	Same as BP-08	Global	Products will be validated in geoland2
<b>Seasonal Annual Change Monitoring</b>							
European AFS sampling scheme	1500 to 2000 sample sites will be chosen according to the agreed sampling procedure.	Off-line	yearly / 2007-2010	< 2,5 m	10 x 10 km sites	1% of 1/3 of EEA 38 territory	AFS design, i.e. distribution of sampling sites will be validated successively in geoland2 from year 2 to 4

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
High Resolution generic land cover maps on European AFS samples	High Resolution generic landcover maps on 75% of samples of the European AFS sampling scheme	Off-line	yearly / 2007-2010	2,5 m	Classes to be defined according to users' needs. Accuracy 80%	Sampled 30 % of Europe, incl. Guadalquivir, Rhine, Seine-Normandie and Strymunas-Struma catchments	High Resolution maps will be validated in geoland2 on a number of sampling sites in the southern, central and northern Europe, starting from year 3
High Resolution agricultural land use maps on European AFS samples	High Resolution generic landcover maps on 75% of samples of the European AFS sampling scheme	Off-line / NRT	monthly & yearly / 2007-2010	2,5 m	Main crops, grasslands and possibly hedges, weeded bands according to the users' needs	Sampled 30 % of Europe, incl. Guadalquivir, Rhine, Seine-Normandie and Strymunas-Struma catchments	High Resolution maps will be validated in geoland2 on a number of sampling sites in the southern, central and northern Europe, starting from year 1+
Statistics on generic LC / LCC and on agricultural LU/LUC in Europe based on AFS	High Resolution land cover maps and agricultural LU/LUC maps obtained on AFS sites will be used to get statistical estimates on EUROLAND for the whole Europe	Off-line	yearly / 2007-2010	Statistical parameters valid on NUTS1 scale, coefficient of variation 5-30% depending on LC type and size of region	Same as SM-02	30 % of Europe, incl. Guadalquivir, Rhine, Seine-Normandie and Strymunas-Struma catchments	Statistical estimates will be validated in geoland2 against other sampling schemes (e.g. LUCAS) and on a set of independent sites

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
African AFS sampling scheme	About 2000 sample sites will be chosen according to the agreed sampling procedure (1 deg grid + denser coverage in smaller countries).	Off-line	Every 5 years / 2010	1 degree grid	10 x 10 km sites	Sub-Saharan Africa	AFS design, i.e. distribution of sampling sites will be validated successively in geoland2 starting from year 2
High Resolution generic land cover maps on African AFS samples	Sites from AFS scheme will be used to produce land cover maps; SATChMo will cover at least 50% the whole sub-Saharan Africa	Off-line	Every 5 years / 2010	30 m	statistical parameters valid on NUTS1 scale, coefficient of variation 5-30% depending on LC type and size of region	Sampled Sub-Saharan Africa	High Resolution maps will be validated in geoland2 on a number of sampling sites in Africa, starting from year 3
Statistics on generic LC / LCC and on agricultural LU/LUC in Africa based on AFS	HR land cover and agricultural LU/LUC maps obtained on AFS sites will be used to get statistical estimates on EUROLAND for the whole sub-Saharan Africa	Off-line	Every 5 years / 2010	1 degree grid	as in SM-07	Sub-Saharan Africa	Statistical estimates will be validated in geoland2 against other sampling schemes (e.g. FAO) and on a set of independent sites
Medium Resolution vegetation phenological trends	Multitemporal vegetation maps will be used to derive phenological trends from MERIS data	NRT	every 10 days in average / 2009	300 m	N.A.	EEA-38	To be validated in geoland2 in year 4 as the result of a 4-year long time series analysis

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in geoland2	Spatial resolution of output	Themes/Classes & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Medium Resolution dynamic LCC indicator maps	Continental maps indicating dynamic change (and global land cover map) obtained from a sequence of yearly data	Off-line	yearly / 2009	300 m	21 classes, 75%	EEA-38 & Sub-Saharan Africa	To be validated in geoland2 in year 4 as the result of a 4-year long time series analysis
Medium Resolution monitoring of crop growing conditions	Two level product, with higher level comprising MR maps of crop area estimates on several test sites (possibly to be extended to a wider area), and with lower level providing green cover fraction as indicator of crop development + meteo data	Off-line / NRT	monthly & yearly / 2010	300 m	N.A.	30 % of Europe, incl. Guadalquivir, Rhine, Seine-Normandie and Strymunas-Struma catchments	To be validated in geoland2 in year 4 as the result of a 4-year long time series analysis

## A2.2 Detailed Core Information Service Portfolio

Product	Description	NRT or Off-line	Frequency , temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
<b>Spatial Panning</b>							
Regional land take trend indicators	Regional indicators in the DPSIR Framework describing land take trends	Off-line	3- 6 years / 2000 & 2006, 2009	Output is indicator based on regional/national reference grid 100-250m; MMU of underlying LC/LU data according to LMCS requirements	Thematic of population modelling >80%; concept of thematic accuracy not applicable for other indicators	3 European transects	Validated in geoland (OSP-F-1) and GSE Land (PR1 & PR2)
Land take scenario	Scenarios of land take trends	Off-line	3- 6 years / 2000 & 2006, 2009	100m raster	5-8 classes; thematic accuracy >80%	3 European transects	Validated in geoland (OSP-F-2)
European land take trend indicators	European indicators in the DPSIR Framework describing land take trends	Off-line	1990, 2000 and 2006	Output is indicator based on European reference grid 500m; MMU of underlying LC/LU data according to	Thematic of population modelling >80%; concept of thematic accuracy not applicable for other indicators	European transect North-South	Validated in geoland (OSP-F-1)

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
				LMCS requirements			
<b>Agri-Environmental Monitoring</b>							
Agriculture state	Agricultural Land Use Changes - Cropping Patterns - Crop Rotation Patterns	Off-line	Every 2 to 3 years / – 2009-2011	10m to 20m hydr. /admin. Units	N/A	Whole Strymonas-Struma and Guadalquivir catchments, AFS samples in Seine-Normandie and Rhine catchments	Will be validated in geoland2 by year 2011
Agriculture trends	Extensification - Agri-Environmental Measures Effectiveness	Off-line	Every 3 years / 2007 - 2010	10m - 20m to hydr. /admin. Units	N/A	Strymonas-Struma and Guadalquivir catchments	Will be validated in geoland2 by year 2011
Pressure of farm management on water resources	Water Abstraction by Irrigation (regional & local scale) – Intermediate Crop Coverage Rate (regional & local scale)	NRT	Annual, Monthly / 2011	10m to hydr. /admin. Units	N/A	Strymonas-Struma, Guadalquivir, Seine-Normandie catchments	Validated in GSE Land (WA1.1) / GSE SAGE / AGRIMOD
Pressure of farm management on soil resources	Bare Soil Rate (regional & local scale) - Soil Erosion (regional & local)	NRT	Annual, Quarterly, 10 days / 2011	5m to hydr. /admin. Units	N/A	Strymonas-Struma, Guadalquivir, Seine-Normandie catchments	Validated in AGRIMOD / FARMSTAR / will be validated partly in geoland2 by year 2011
Agricultural land use changes as driving force for sustainability - Biodiversity	Percentage of High Nature Value (HNV) Farmland – HNV Farmland Land Use Changes – Landscape Coherence between Intensive Agricultural Areas	Off-line	Every 2 years / 2008 - 2010	hydro. / admin. / landscape (LANMAP2) units	N/A	30 SRRF cluster regions and AFS samples in Seine-Normandie, Rhine, Strymonas-Struma and Guadalquivir catchments	Will be validated in geoland2 by year 2011

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Agricultural land use changes as driving force for sustainability - Landscapes	Landscape changes w.r.t. Closedness / Openness, Diversity, Heritage functions,	Off-line	Every 2 years / 2008 - 2010	hydro. / admin. / landscape (LANMAP2) units	N/A	AFS samples in Seine-Normandie, Rhine, Struma and Guadalquivir catchments	Will be validated in geoland2 by year 2011
<b>Water Monitoring</b>							
Hydrological predictions	Prediction of discharge and likelihood of floods and droughts based on variable LC/LU at present and in a changed climate	Off-line	Daily / last 20 - 140 years	Sub-catchment size: 100-1000 km <sup>2</sup>	Discharge at outlet (m <sup>3</sup> /s)	Moselle-Sarre river basin, Nemunas	Model validated in different project since the 70ies (including EU-project TELFLOOD). Operational forecasts for ca 1000 catchments in Sweden of which ca 60 are evaluated every week. For example is it used for operational forecasts in Rhein, Norway and Sweden
Long-term water resources	Simulation of soil moisture and local runoff at subcatchment level for estimation of long-term water balance based on variable LC/LU at present and in a changed climate	Off-line	Seasonal / last 20 - 140 years	subcatchment size: 1000-100000 km <sup>2</sup> (Europe); 100-1000 km <sup>2</sup> (national)	mm (water balance)	Europe, Moselle-Sarre river basin, Nemunas	Model validated in different project since the 70ies. Validated for climate change situation in several project since the 90ies (e.g. in EU-projects PRUDENCE, ENSEMBLES, and several national projects).

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Nutrient loads to enclosed seas & source apportionment (CISW partner: SMHI)	Estimation of the gross and net nutrient load to receiving seas and source apportionment of the load based on variable LC/LU	Off-line	Yearly or mean over simulation time period / 10 years	subcatchment size: ca 40 km <sup>2</sup>	Organic & inorganic nitrogen, soluble reactive & particulate phosphorus (kg/year & mg/l)	Motala Ström, Sventoji	Nitrogen model validated in several projects since the 80ies (e.g. in EU-project EUROHARP and national projects TRK), while phosphorus validated recently (national project VASTRA). Recent model changes to be validated 2007 (NHMG). Variable landuse to be validated in geoland2 by T36
Nonpoint Pollution Potential Service (CISW partner: ITD & GIA)	Nonpoint Pollution Potential Service based on MONERIS algorithms - Nitrogen & Phosphorus Leakage & Loads	Off-line	Yearly or mean over simulation time period / 10 years	SWB > 10km <sup>2</sup> , up to whole catchments	kg/year/unit & mg/l/unit	Moselle-Sarre, Sventoje, Motala, Ström, Rhine river basin	Validated in AquaSAGE (OWS-S-1), GSE Land (WQ1.7) & geoland OWS-F-2-1) & Europharp
Agri-economical assessment of Nutrient Surplus (CISW partner: WUR-LEI)	CAPRI - modelling of Nitrogen & Phosphorus surplus based on actual agricultural management practises and changes due to European and national policies as input to Nutrient Leakage & Load modelling	Off-line	Yearly or mean over simulation time period / 10 years	SWB, up to whole catchments, NUTS 2 regions (EU27)	kg/year/ha	Moselle-Sarre, Sventoje, Motala, Ström, Rhine river basin	CAPRI is continuously used in several projects and applied analyses, for example: Validated in GSE Land (national component); Seamless project; SENSOR project;

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
End User scenario tool (based on WA-03 & WA-04)	Adoption of web application to improved dynamic nutrient model	Off-line	Yearly or mean over simulation time period / 10 years	subcatchment size: ca 40 km <sup>2</sup> up to whole catchments, Surface water bodies > 10 km <sup>2</sup> , up to whole catchments	N/A	Motala Ström, Sventoji, Moselle-Sarre	Present version of web application (WA-06) for WA-03 modelling previously validated in cooperation with end users (Swedish water authorities). New version to be validated in geoland2 by T36. WA-06 based on WA-04 modelling validated in GSE Land (WQ1.7) & geoland (OWS-F-2-1) & Europharp
<b>Forest Monitoring</b>							
Forest Area-based indicators + statistics	Supporting reporting according to MCPFE, SEBI2010: Forest Area Based Indicator Information and Data (selected areas)	Off-line	3 years / 2006, 2009	pixel-based, aggregated to user-requested MMU on demand	1-4 thematic layers (continuous values) / 85%	Forest demo sites in different EU & EEA member states representing Europes' diverse ecosystems	Validated by GSE-Forest Monitoring (documents C6, S6) e.g. for pan-European Service Case to EEA
Forest fragmentation and connectivity indicators	Supporting reporting according to MCPFE, SEBI2010: Forest Indicators Information / Data for Fragmentation/Connectivity (selected areas)	Off-line	3 years / 2006, 2009	pixel-based, aggregated to user needs levels	1-2 thematic layer (continuous values) / 85%	Forest demo sites in different EU & EEA member states representing Europes' diverse ecosystems	Validated by GSE-Forest Monitoring (documents C6, S6) e.g. for pan-European Service Case to EEA, and DG JRC

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Forest Type-based indicators	Supporting reporting according to MCPFE, SEBI2010: Forest Type-based Indicators Information (selected areas)	Off-line	3 years / 2006, 2009	pixel-based, aggregated to user needs levels	1-4 thematic layer (continuous values) / 85%	Forest demo sites in different EU & EEA member states representing Europe's diverse ecosystems	Validated by GSE-Forest Monitoring (documents €5, C6, S6) and DG JRC
Analysed LAI	Leaf Area Index - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	NRT	daily / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Prototype product validated in geoland (ONC-0350-RP-0058-5-UserAcceptanceTest-12.01.pdf)
Root-zone soil moisture	Root-zone soil moisture - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	NRT	daily / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Prototype product validated in geoland (ONC-0350-RP-0058-5-UserAcceptanceTest-12.01.pdf)
Carbon flux	Carbon flux - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	NRT	daily / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Prototype product validated in geoland (ONC-0350-RP-0058-5-UserAcceptanceTest-12.01.pdf)
Water flux	Water flux - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	NRT	daily / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Prototype product validated in geoland (ONC-0350-RP-0058-5-UserAcceptanceTest-12.01.pdf)

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Biomass	Above & below ground biomass - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	NRT	daily, monthly / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Not finalised in geoland, will be validate in geoland2 by 2011 (ONC-F-3)
Carbon storage	Carbon storage - Produced by assimilating CMS data into a land surface model - Fully consistent with the other LC products	Off-line	monthly / 2008 - 2011 + last 40 years	25 km (global), 1-10 km (EU focus)	tbd in geoland2	Global	Not finalised in geoland. Will be validated in geoland2.
<b>Natural Resource Monitoring in Africa</b>							
Land surface indicators for CICOS (Central Africa)	Indicators according to EC "Country environmental Profile user manual" 01 e-station based production procedures for environmental indicators on Management of water resources focusing on environmental aspects of watersheds (CEMAC – CICOS)	Off-line / NRT / T+7 days	every 10 days / 2009 + yearly analysis of historical data	Full input res, reduced res (0.5° * 0.5°, watersheds and /or level 2 admin units)	Dimensionless continuous indicators	Central Africa, extention to the whole continent foreseen as part of AMESD Objective	(1) analysis methods reviewed and accepted via geoland 1 OLF user review. (OLF-I-1, OLF-I-2, OLF-I-3, OLF-I-4, OLF-I-7, OLF-F-1, OLF-F-2, OLF-F-3, OLF-F-4, OLF-F-5, OLF-F-6, OLF-F-7) (2) To be updated with AMESD users, tested and reviewed

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
Land surface indicators for ECOWAS (W; Africa)	e-station based production procedures for environmental indicators on Water management for cropland and rangeland management (ECOWAS – AGRHYMET)	Off-line / NRT / T+7 days	every 10 days / 2009 + yearly analysis of historical data	Full input res, reduced res (0.5° * 0.5°, watersheds and /or level 2 admin units)	Dimensionless continuous indicator,	W Africa, extension to the whole continent foreseen as part of AMESD Objective	(1) analysis methods reviewed and accepted via geoland 1 OLF user review. (OLF-I-1, OLF-I-2, OLF-I-3, OLF-I-4, OLF-I-7, OLF-F-1, OLF-F-2, OLF-F-3, OLF-F-4, OLF-F-5, OLF-F-6, OLF-F-7) (2) To be updated with AMESD users, tested and reviewed
Land surface indicators for IGAD (E Africa)	e-station based production procedures for environmental indicators on Land degradation, mitigation and natural habitat (IGAD – ICPAC & RCMRD)"	Off-line / NRT / T+7 days	every 10 days / 2009 + yearly analysis of historical data	Full input res, reduced res (0.5° * 0.5°, watersheds and /or level 2 admin units)	Dimensionless continuous indicator,	E Africa, extension to the whole continent foreseen as part of AMESD Objective	(1) analysis methods reviewed and accepted via geoland 1 OLF user review. (OLF-I-1, OLF-I-2, OLF-I-3, OLF-I-4, OLF-I-7, OLF-F-1, OLF-F-2, OLF-F-3, OLF-F-4, OLF-F-5, OLF-F-6, OLF-F-7) (2) To be updated with AMESD users, tested and reviewed
Land surface indicators for SADC (Southern Africa)	e-station based production procedures for environmental indicators on Agricultural and environmental resource management (SADC – BMS)	Off-line / NRT / T+7 days	every 10 days / 2009 + yearly analysis of historical data	Full input res, reduced res (0.5° * 0.5°, watersheds and /or level 2 admin units)	Dimensionless continuous indicators	E Southern Africa, extension to the whole continent foreseen as part of AMESD Objective	(1) analysis methods reviewed and accepted via geoland 1 OLF user review. (OLF-I-1, OLF-I-2, OLF-I-3, OLF-I-4, OLF-I-7, OLF-F-1, OLF-F-2, OLF-F-3,

Product	Description	NRT or Off-line	Frequency , temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
							OLF-F-4, OLF-F-5, OLF-F-6, OLF-F-7) (2) To be updated with AMESD users, tested and reviewed
Land-cover change assessment at national level with special reference to forest, agricultural and pastureland domains	national level statistics on the amount of land cover conversion (surface and percentage) in particular of forest, agricultural and pastureland domains	Off-line	yearly update based on MR and 5 yr update based on AFS & HR	Per country	Per site: % of surface assigned to land cover classes, with focus on: forest, rainfed agriculture, irrigated agriculture, build out areas; at country level: surfaces expressed in 000 ha	Sub-Saharan Africa	Analysis methods reviewed and accepted via geoland 1 OLF user review. To be updated with EC-user review and African users in WP 9400 (OLF-I-5 + OLF-I-6)
Seasonal synthetic bulletin (sub-continental scale)	Seasonal synthetic bulletin (sub-continental scale) of environmental conditions, describing most salient events	Off-line	1-2 per year & per region / 2010 +	per country and sub-country, identification of areas of interest	Binary information: identification of areas with anomalies, with text report	Key sub-continental region (typically 3 for the whole Sub-Saharan Africa, TBC)	End product under definition with EC services
Multi-annual per-country synthesis (contribution to the "Country Environment Profiles")	Description of environmental conditions for international aid programming, as described in the EC "country env. Profile user manual"	Off-line	every 5 years, following the CEP planning of EC	Per country	Text report	European Development Fund eligible countries	End product under definition with EC services according to CEP official guidelines

Product	Description	NRT or Off-line	Frequency, temporal resolution of output / reference years in g2	Spatial resolution of output	Thematic resolution & accuracy	Spatial coverage of output / Demonstration Site	Status of Validation
<b>Global Crop Monitoring</b>							
Area estimates outside Europe	2 campaigns in China (huabej region) and 2 campaigns in a region of Black sea	Off-line	Annual / 2009, 2010, 2011, 2012	Country and sub regions	tbd in geoland2	Regions of circa 200- 500 km2 outside Europe (China, Kazakhtan, Ukraine)	Validation in geoland2 by 2011
Area estimate in Sub-Saharan Africa	2 campaigns in 1 or 2 regions of Sub Saharan Africa	Off-line	Annual / 2009, 2010, 2011, 2012	Country and sub regions	tbd in geoland2	Regions of circa 200-km2 in Sub-Saharan Africa	Validation in geoland2 by 2011
Agriculture land use change indicators in Sub-Saharan Africa	2 campaigns in one or 2 regions of Sub Saharan Africa , based on NARMA Area Frame sampling	Off-line	pluri annual / 2010, 2011	Regional	tbd in geoland2	Regions of circa 200-km2 in Sub-Saharan Africa	Validation in geoland2 by 2012
Rainfall estimates and ensemble approach in crop monitoring	State of the art in the MSG rainfall estimates, development and testing of ensemble approach to take into account timely and spatial uncertainty on rainfall in crop development models	Off-line	daily to 10-daily / 2009, 2010, 2011	5 km, 50km, admin. regions	tbd in geoland2	Selected regions in Africa	Validation in geoland2 by 2010