

# EUROPE'S CHANGING ENVIRONMENT AND OUR QUALITY OF LIFE – GMES LAND INFORMATION SERVICES FOR EUROPE'S CITIZENS AND GOVERNMENTS

S. Kuntz & A. Kaptein, Infoterra GmbH, 88039 Friedrichshafen, Germany  
W. Pagenkopf, Geodaten Integration und Analyse, Köpenickerstr. 325, 12555 Berlin, Germany  
Chr. Hoffmann, Geoville GmbH, Museumstraße 9-11, 6020 Innsbruck, Austria

## 1 INTRODUCTION

Europe's objectives are sustainable economic growth and improved quality of life. However, the pressure on land-use in Europe is increasing through growing settlements and transport infrastructure, intensive agriculture and use of water for drinking and irrigation. A number of directives have been established to better monitor and manage Europe's natural resources ranging from habitats to water quality. At the same time all stakeholders become increasingly aware that compliance of measures across policy sectors is needed to achieve both goals: economic growth and quality of life.

The European Commission (EC) together with the European Space Agency (ESA) have initialised The "Global Monitoring for Environment and Security – GMES" initiative. Projects addressing the priority theme "Land Cover & Vegetation" aim at supporting public bodies in charge of implementing European policies and directives through adequate geo-information services and tools. GMES exploits the unique capacity of Earth Observation data of providing unambiguous observations across administrative borders as regular time series. These observations are transformed into information services integrating existing in-situ and statistical data sets.

They aim to complement existing data sets - such as CORINE Land Cover - and associated analysis with operationally available information services provided to those administrative bodies that have received the mandate to monitor, report, and manage land resources. Following the subsidiary principle this ranges from decision making at international and European insti-

tutions (e.g. on foreign aid measures) to sub-national and local stakeholders in Europe and abroad (e.g. in charge of implementing the Water Framework Directive or doing spatial planning for urban agglomerations).

A common GMES Land Monitoring user and service network has been growing since 2003 to define and establish sustainable demand and associated service capacities. This paper focuses on the European land information services supporting member states and European institutions in implementing monitoring, reporting and management schemes related to environmental, agricultural and spatial development policies and directives.

## 2 GMES PROJECT ACTIVITIES ON "LAND COVER & VEGETATION"

### 2.1 One GMES Initiative - Two European Programmes

The European Commission has initiated a series of GMES activities through its Framework Programme (FP6). ESA has launched its GMES initiative within the EarthWatch programme: the first Stage of GMES Service Elements (GSEs) starting in 2003, the implementation phase (Stage 2) being launched in September 2005. The activities are loosely coordinated through the GMES Programme Office (GPO) in collaboration with the GMES Advisory Committee (GAC) representing the key user stakeholders.

The FP6 Integrated Project (IP) geoland is focussed on consolidating new and up-graded services for European and Global use. It aims

at achieving user consensus on service requirements and specifications together with service acceptance through demonstrations.

ESA's GSE State 2 project "Land Monitoring Services"<sup>1</sup> aims at large area implementation of consolidated information services. Services from ESA's Stage 1 GSEs (i.e. "SAGE", "UrbanServices", "CoastWatch"), and EC's IP geoland have been selected by EEA and European Member States for implementation on the basis of successfully scientific and technical validation, user acceptance and sustainability outlook.

## 2.2 Land Monitoring Services for Europe

Earth observation based land related geo-information services for Europe face a fragmented organisational landscape across policy sectors and administrative levels. The high resolution service scales are associated with substantial cost per km<sup>2</sup>.

Thus, it is of major importance to consolidate existing approaches towards reliable services by integrating all stakeholders in order to achieve a consensus on content and performance of the services. Such a stakeholder mechanism will build up confidence into the services in terms of quality, timeliness, and long-term continuity.

At present state the stakeholder process initialised addresses a broad range of organisations. It was already possible to achieve certain agreements on de facto service standards. This includes users beyond the projects through User Working Groups (WGs) coordinated by ETC-TE, and through introduction into official user WGs on national and European level.

In the projects today the user commitment is substantial. However it is largely limited to "in kind" contributions as budgets to procure these services from external service providers are still rather limited. However, success towards

operational up-take is already visible: First "commercial" contracts have been placed with private and public service providers, and first user organisations started to discuss establishing operational service procurement lines with political decision makers.

## 2.3 From Projects to Coordinated Implementation of Services

Each GMES activity builds on a long tradition of research initiatives and operational applications. It closely collaborates with parallel projects and initiatives exchanging information, looking for common approaches and stimulating de-facto standards enabling interoperable service results and efficient service provision.

The implementation project GSE "Land Monitoring Services" now merges the efforts of SAGE, UrbanServices and the land-side activities of CoastWatch with geoland results:

- (1) **SAGE** consolidated a first set of pre-mature services related to European policies (WFD, STS) on a few sites
- (2) **Urban Services** (GUS) defined and consolidated urban services related to the Urban Environmental Thematic Strategy and the European Spatial Development Perspective, and demonstrated them on few urban functional areas
- (3) **geoland Regional Observatories** scope is to
  - a.) adapt these services to a broad range of European users and geographical conditions through customizing and optimise them for efficient production
  - b.) go beyond the selective scope of GSE Stage 1 by approaching an extended set of representative user groups and applications (Nature Protection, Water, Soil, Spatial Planning also linking to risk management requirements)
  - c.) define land cover core services serving a common set of needs across this broad range of user sectors and applications based on the de-facto standard of CORINE Land Cover but with certain

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<sup>1</sup> Proposal currently under ESA evaluation. Decision expected in September.

improvements in terms of spatial and thematic resolution in order to cope with national and regional needs of the MS.

- d.) achieve a broad user consensus on the service specifications and broadcast this message into the official user working groups of DG ENV, DG REGIO, EEA and on national level

**(4) GSE Land Information Services** (Stage 2, GSE Land) scope is to

- a.) establish a service network responding to main information needs of European institutions,
- b.) deliver validated and user accepted services (from the consolidation phase and geoland) over larger areas,
- c.) establish standards and working practices, and
- d.) demonstrate progress towards long term sustainability.

Thus, it will not develop new services, but supports service integration within user environment, technical up-grades relate to optimising production chains (integrating bits and pieces developed elsewhere, e.g. in geoland or other ESA projects) in view of an operational European service network.

### 3 USER REQUIREMENTS AND DESCRIPTION OF THE SERVICES

#### 3.1 Policy and User sectors

Policies and directives with a focus on managing Europe's landscape and environment are addressed by geoland's Regional Observatories and GSE Land. The Global Observatories aim to support international Global Change and Sustainable Development policies and conventions.

European user sectors cover environmental agencies, agricultural administration, water authorities and planning bodies addressing all administrative levels to serve the need for vertical exchange of information and respect the requirements for horizontal integration of data

and compliance of measures. The GMES services itself are dedicated to those organisations with a legal mandate to implement a policy in terms of resourcing information on the environment, to manage and to report to higher level bodies. A common need on primary information on land use / land cover and seasonal vegetation parameters that needs close coordination and a harmonised set of definitions is reflected by core services supporting the downstream applications.

**Table 1: Policies and User Sectors Addressed**

Table 2: User Organisations committed to geoland and GSE Land	Implementation Activities	Policy Addressed	Administrative Level <sup>2</sup>			
			INT'L	EUR	(Sub-) NAT	LOC
geoland Consolidation						
<b>Regional Observatories</b> <i>focus on implementation support for European directives and policies</i>						
<b>Observatory Nature Protection</b>	GSE Land Service Nature Protection (Extern-sion)	Habitats and Birds Directive (Natura2000), Ramsar Convention, Convention on Biological Diversity			•	•
<b>Observatory Water and Soil</b>	GSE Land Services Inland Water Quality & Irrigation / Agricultural Water Consumption	Thematic Strategy for Soil Protection (STS), Water Framework Directive (WFD), Common Agriculture Policy (CAP), Integrated Pollution Prevention Convention (IPPC)			•	

<sup>2</sup> Administrative level of public body mandated to implement the policy operationally, i.e. through monitoring, management and reporting to higher level bodies.

Table 2: User Organisations committed to geoland and GSE Land Consolidation	Implementation Activities	Policy Addressed	Administrative Level <sup>2</sup>			
			INT'L	EUR	(Sub-) NAT	LOC
Observatory Spatial Planning	GSE Land Service Urban Atlas	European Spatial Development Perspective (ESDP), European Spatial Observatory Network (ESPON), Local Agenda21, Thematic Strategy for Soil Protection (STS), Integrated Coastal Zone Management (ICZM), Urban Environmental Management and the Thematic Strategy (UTS)		•		•
	GSE Land Service Land Take Trends & Impact	EU Regional Policy on Social, Economic and Territorial Cohesion (EURP), Environmental Impact Assessment (EIA), Strategic Environmental Assessment Directive (SEA)			•	
<b>Core Services provide bio-physical parameters and land use/land cover mapping to Observatories / Services</b>						
Core Service Generic Land cover	GSE Land mapping services	Support of the regional observatories with cross-cutting land cover and land cover change products				
Core Service Bio-geophysical Parameters	Glob-Cover	Supports the global observatories with cross-cutting parameter products				
Operational Scenario	GSE Land Service Evolution	Space infrastructure requirements, service infrastructure definition and implementation			•	•
	SSA <sup>3</sup> VGT4AF R, SSA HALO		•	•	•	

### 3.2 User engagement

The growing user community currently involves more than 100 user organisations ranging from international to local; 20 organisations joined the geoland consortium as full members, all others have firmly committed their selves through formal agreements. In GSE Land users negotiate a "Service Level Agreement" that

<sup>3</sup> SSA: FP6 Specific Support Action

emulates an operational relationship with detailed definitions of rights, duties, milestones and contributions of providers and users.

**Table 3: GSE Land – services for implementation (baseline offer)**

Administrative Level	geoland		GSE Land Base-line <sup>4</sup>		Common User Base <sup>5</sup>	
	Users <sup>6</sup>	Nations	Users	Nations	Users	Nations
International	9	UN, OECD, IPCC	n.a.	n.a.	9	UN, OECD, IPCC
European	11	EUMET-SAT, EU-25, EEA-32 <sup>7</sup>	5	EU-25, EEA-32	14	EUMET-SAT, EU-25, EEA-32
(Sub-) National, Local	34	11	78	20	107	24
Totals	54		83		130	

Please note: all land cover / land use maps are based on a common nomenclature system, using dedicated performance specifications for each application (e.g. minimum mapping units from 0.25 to 5 ha) to focus on key objects and avoid unjustified cost drivers.

To federate and coordinate the GMES vision among European users an independent open **GMES User Network** has been initiated. It is coordinated by the ETC-TE in order to motivate and support self-organised ad-hoc GMES user working groups (many of them already existing). Its goal is to establish a common understanding on service needs and implementation requirements across the user organisations of

<sup>4</sup> More user organisations have already committed their selves for GSE Land extension services; the implementation of these services is optional and depends on acceptance of these proposals by ESA.

<sup>5</sup> Taking into account common users: 2 European (ETC-TE, ESPON) and 5 national/sub-national bodies (from AT, DE, FR)

<sup>6</sup> 20 consortium members, 34 user associated through letters of commitment specifying the type of engagement, in-kind contributions and services received.

<sup>7</sup> EEA discussed a possible participation in the ESA GSEs in its management board June 22. The management board recommended to its members to participate in GSEs. EEA management will discuss this in the next step with ESA.

the policy sectors and vertical administrative levels addressed.

### 3.3 Services offered

Land related services based on EO data comprise two dimensions:

1. direct assessment of land cover and it's change from space (= upstream service), and
2. integration of this information with in-situ and other data for concrete planning, management and reporting obligations from European down to local level (= downstream services; e.g. spatially explicit impact of agriculture treatment on water quality or biodiversity, including the identification of areas at risk and scenarios for trade-offs)

From findings of geoland and GSE Land table 1 shows the current status of services from the Regional Observatories (i.e. addressing directly European directives) ready for implementation and still under investigation, respectively.

**Table 4: GSE Land – services for implementation (baseline offer)**

Services	Service Characteristic*	Area [km²]	Area types covered
<b>Urban Atlas</b> (based on GSE Urban Services consolidation and MOLAND heritage)	<ul style="list-style-type: none"> <li>UrbanAtlas map</li> <li>UrbanAtlas indicators supporting UrbanAudit</li> </ul>	30.393	61 cities, most of the > 100.000 inhabitants, 22 of them UrbanAudit, total pop. 32 Mio., including major European conurbations, development axis, and central cities
<b>Impervious Areas and Sealing Levels</b> (based on GSE SAGE & geoland consolidation)	<ul style="list-style-type: none"> <li>Land take maps (multi-temporal)</li> <li>Land take trend analysis (linked to socio-economic trends)</li> <li>Land take impact analysis (on designated areas/ protected sites)</li> </ul>	120.845	Sub-national administrative units in 8 European member states: SAIL region, Lake Constance, Comunidad de Madrid, Weser region, Saar-Mosel region (using synergy with impervious areas and urban atlas services)
<b>Inland Water Quality</b> (based on GSE SAGE & geoland consolidation)	<ul style="list-style-type: none"> <li>Regional land cover/use maps</li> <li>Seasonal vegetation parameters</li> <li>Diffuse pollution models for nu-</li> </ul>	201.526	6 catchments: Jucar, Kokemäenjoki, Saar-Mosel, Weser, Ljusnan, Guadalquivir (using synergy with impervious areas services)

tion)	trients and pesticides – Coupling to agri-environmental models		
<b>Irrigation</b> (based on GSE SAGE & geoland consolidation)	<ul style="list-style-type: none"> <li>Regional land cover/use maps</li> <li>Seasonal vegetation parameters</li> <li>Water Abstraction models for agricultural land use</li> </ul>	288.567	3 catchments: Adouro-Garonne, Ebro, Tejo
		<b>641.331</b>	Km² total coverage

\* Please note: all land cover / land use maps are based on a common nomenclature system, using dedicated performance specifications for each application (e.g. minimum mapping units from 0.25 to 5 ha) to focus on key objects and avoid unjustified cost drivers.

**Table 5: IP geoland – service consolidation status**

geoland Product Portfolio - Regional Observatories			
Core Service Generic Land Cover (CSL)		Operational in Year	Remarks
CSL-I-1	General land cover	2005	operational for Central European & boreal conditions
		2006	validated and operational for Mediterranean conditions
Observatory Nature Protection (ONP)			
ONP-F-1	Alpine Monitoring	2006	operational but dependent of data availability;
ONP-F-2	Protection Forests	2006	operational
ONP-F-4	Habitats & Biotopes	2006	operational; very high expectations on class accuracy (relies on SPOT 5)
ONP-F-5-1	Changes in Mountain Vegetation Cover	still immature	data availability problematic; re-search topic
ONP-F-5-2	Grazing quality of Mountainous Vegetation	still immature	data availability problematic; re-search topic

geoland Product Portfolio - Regional Observatories			
Core Service Generic Land Cover (CSL)		Operational in Year	Remarks
ONP-F-5-3	Monitoring Snow Cover Distribution Pattern	2006	operational
ONP-F-5-4	Predicting Snow Wetness and Melt-onset in the Mountains	2006	operational
ONP-F-6	Ecotone Characterisation Map	2006	operational
Observatory Water & Soil – Water (OWS-W)			
OWS-F-1	<b>Water Abstraction Pressure by Irrigation map:</b> Set of GIS compatible maps reporting on the water abstraction pressure by irrigation	2006	validated & industrialised
OWS-F-2-1	<b>High Resolution Water Pollution Map:</b> Maps and statistics qualifying and quantifying nutrient inputs into river basins for central European conditions	2005 2006	operational industrialised
OWS-F-2-2	<b>Medium Resolution Water pollution Map:</b> Set of GIS maps reporting on the nutrient (nitrogen and phosphorus) surpluses in a whole catchment basin (50,000 – 100,000 km <sup>2</sup> )	2006	validated
OWS-F-3-2	<b>Source Apportionment Map</b> based on catchment based modeling of nutrient leakage (N and P).		
OWS-F-3-1a	<b>Peatland classification</b> as input to source apportionment modelling	2005	validated
OWS-F-3-1b	<b>Change detection (forest land)</b>	2005	operational
OWS-F-3-1c	<b>Detection of spring/autumn tilling on arable land</b> , i.e. bare soil or vegetation cover during winter season	2006	operational
OWS-F-3-3	<b>Probabilistic classifiers:</b> improved quality assessment and evaluation of remote sensing products –	2006	validated
Observatory Water & Soil – Soil (OWS-S)			
OWS-F-4-1	<b>USLE based Soil Erosion Risk Map:</b> The USLE (Universal Soil Loss Equation) is a well-known model, which is designed to estimate long-term erosion rates on agricultural fields and it has been used widely at different scales in Europe USLE based Soil Erosion Risk map	2006	operational

geoland Product Portfolio - Regional Observatories			
Core Service Generic Land Cover (CSL)		Operational in Year	Remarks
OWS-F-4-2	<b>PESERA ((Pan-European Soil Erosion Risk Assessment) based Soil Erosion Risk Map:</b> a physically based soil erosion model built around conceptual separation of precipitation into overland flow runoff generation and infiltration, with a runoff threshold depending primarily on soil and vegetation properties	2006	validated
OWS-F-4-3	<b>RUSLE based Soil Erosion Risk Map:</b> application of the Revised Universal Soil Loss Equation (RUSLE) approach Soil Erosion Risk Map based on the application of the Revised Universal Soil Loss Equation (RUSLE) approach RUSLE based Soil Erosion Risk Map	2006	validated
Observatory Spatial Planning (OSP)			
OSP-F-1	Spatial Indicators	2006	industrialisation
OSP-F-2	Urban Growth Scenarios	2006	validated
		2007	industrialisation
		2010	Bottleneck: data availability; only locally applicable
OSP-F-3	Landscape Transformation Scenarios	2006	validated
		2008	operational

This portfolio serves as a basis for GSE Land services. However, findings from the GUS team are included in the latter project, as well. The following figures demonstrate the roll-out from the consolidation phases in GSE Phase 1 and geoland towards the demonstration of production capabilities within GSE Land (Phase 2).

### 3.4 PRODUCTS & SERVICES DELIVERED

geoland and GSE Land aim at step-wise service growth in terms of new user organisations, ecozones served and/or geographic areas mapped.

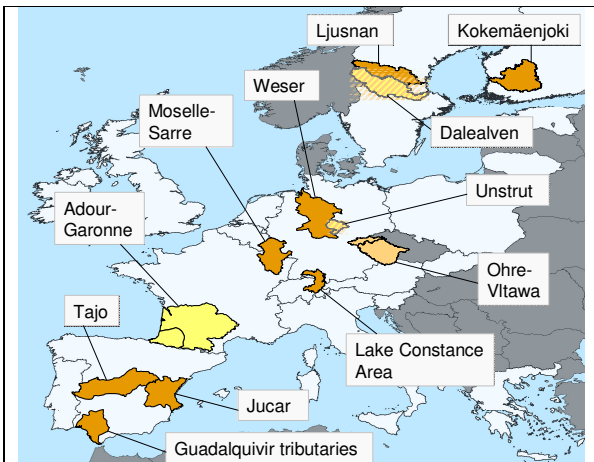
Figure 1 shows this roll-out for three key services "Land Take Monitoring", "Inland Water

Quality/Diffuse Pollution", and "Irrigation/ Agricultural Water Consumption" from 2003 until 2008 as achieved today (SAGE, geoland in 2004) and planned (GSE Land).

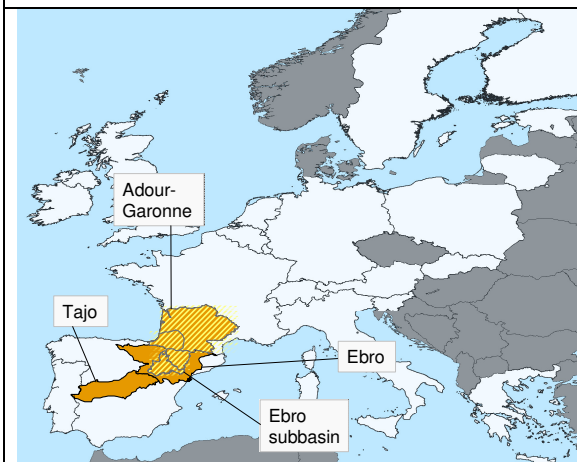
The geoland service development will continue for the next two years until the end of 2006 encompassing

- New product and services to address key user requirements that were identified during the first year, but could not yet be covered;
- Downstream integration of products into scenario and management tools;
- Geographic expansion and validation of services including necessary adaptations of models used and customisation of results to fit into local user processes, also in support of GSE Land

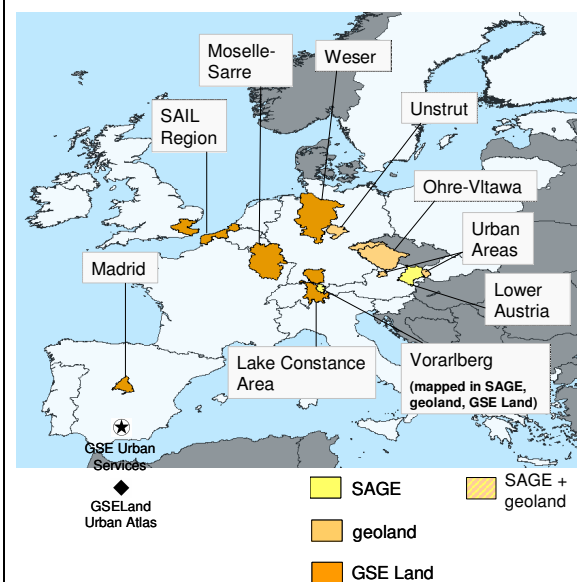
With the final delivery of baseline products, more than 11% of Europe's 10.5 million km<sup>2</sup> area will be covered. This impressive result of service roll-out builds on the history of GSE Stage 1 and geoland. As examples for the combination of upstream land cover monitoring and downstream end-to-end service solutions in the following two figures two services are shown: 1. Land Take Monitoring to derive indicators on trends and land consumption impacts, and 2. Water Quality risk assessment based on the identification of diffuse pollution sources.



Water Quality



Irrigation



Impervious Areas

### 3.4.1 Steps towards operational implementations

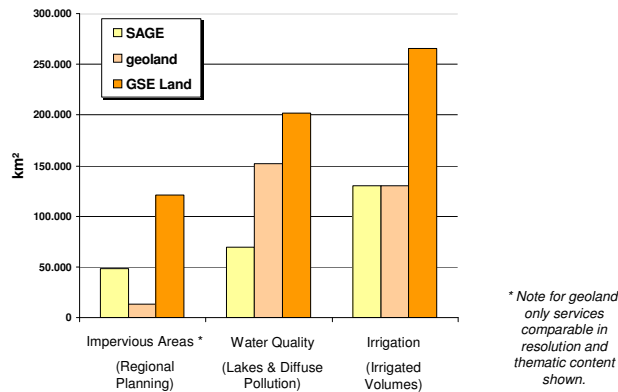
The geoland and GSE Land teams successfully managed to move beyond the project into first steps towards operational implementation of the services.

The GMES projects can only build the bottom-up user acceptance and awareness. Impact on agency decision making and policy making level needs top down GMES policy support. However, key European DGs and member state institutions have not really become full supporters of GMES on this level.

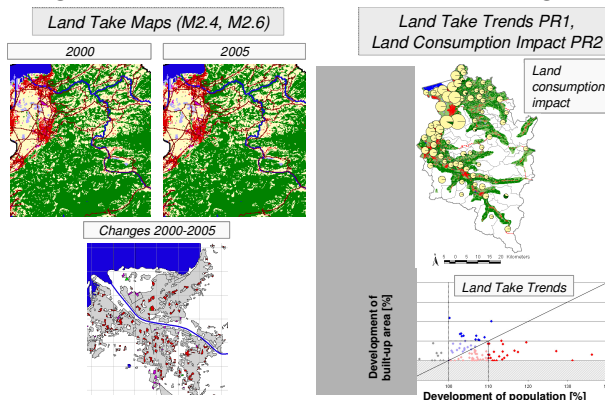
This remains a key concern for the regional observatories that do usually depend on public tenders issued by national or European agencies - but those cannot build on sufficient operational budgets today to procure the geo-information they do need to fulfil the recent directives.

### 3.4.2 Consolidation and implementation roadmap 2003 - 2007

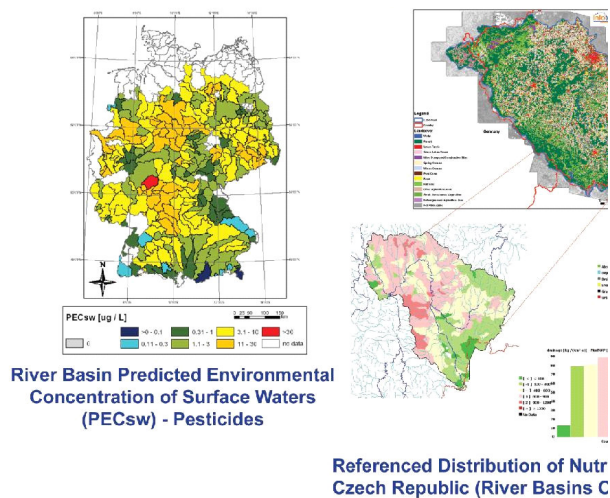
With respect to the ongoing discussion the following table provides an overview of terminated and currently running projects and projects under negotiation.



**Figure 1: GSE Land Service Roll-out Heritage**



**Figure 2: Land Take Monitoring to derive indicators on trends and land consumption impacts.**



**Figure 3: Water quality risk assessment for nutrients and pesticides (the latter by courtesy of the Institute of Landscape Ecology and Resources Management, Univ. Gießen).**

Period	R&D and Demonstration Projects	Description of milestones and achievements
2003 – 2005	GSE Stage 1 SAGE & GUS projects	<ul style="list-style-type: none"> <li>building on previous research (from previous framework programs and national activities) and de-facto standards such as CORINE, MOLAND, etc.</li> <li>Goals and achievements: consolidation and implementation of selected mature service concepts for few customers and user sectors</li> </ul>
2004 – 2006	IP geoland	<ul style="list-style-type: none"> <li>consolidation of land cover &amp; vegetation services for a broad range of policy sectors</li> <li>achieving European consensus,</li> <li>exploiting common core services</li> <li>and federating downstream applications / best practice</li> </ul>



Period	R&D and Demonstration Projects	Description of milestones and achievements
		results into the MS
2005 – 2008	GSE Land Information Services	<ul style="list-style-type: none"> <li>Large area roll-out for most mature downstream applications in Europe: <ul style="list-style-type: none"> <li>UrbanAtlas (60 out of 500 cities),</li> <li>Water Quality (Diffuse Pollution) (387.161 km<sup>2</sup>),</li> <li>Irrigation (252.432 km<sup>2</sup>),</li> <li>Land Take Trends and Impact (178,967 km<sup>2</sup>)</li> </ul> </li> <li>Production based on common mapping standards,</li> <li>interoperable results fit for integrated land management, and efficient qualification / QA concept</li> </ul>
2006 – 2007	IP Sustainability	<ul style="list-style-type: none"> <li>From the land perspective preparing consolidated service standards across environmental, agriculture, spatial planning and risk management sectors (cross compliance) enabling integrated management and planning.</li> <li>Consolidating service and space infrastructure needs</li> </ul>

### 3.4.3 Implementation steps 2006 – 2008+ beyond the projects

Period	Milestones	Description of milestones and achievements envisaged
2006 – 2008	GMES fast track services "land"	<ul style="list-style-type: none"> <li>building on geoland core services specifications and GSE Land service organisation</li> <li>involving users agencies, public and private service providers</li> <li>achieving pan-European coverage with land use / land use change information providing key land use classes at higher geometric resolution as required for internal Commission and MS services</li> </ul>
2008 – 2013	Step-wise expanding downstream services	<ul style="list-style-type: none"> <li>end-to-end services serving for instance directly reporting and management obligations (e.g. WFD management plans, cohesion planning and control, etc.),</li> <li>addressing European Member States (MS) and/or natural units (e.g. river basins, ecozones)</li> <li>using existing households, pooling user-DG, MS, and FP7 resources.</li> <li>Mechanisms still to be discussed</li> </ul>
2014+	European-wide Service operations	<ul style="list-style-type: none"> <li>based on operational household budget lines on DG and MS level</li> <li>using consolidated procurements mechanisms</li> </ul>

## 4 KEY ISSUES FOR EFFECTIVENESS AND SUSTAINABILITY OF THE SERVICE

### 4.1 Demand & Supply Side

In order to enable the European service industry to create a cost-efficient market offer through economics of scale it is recommended to establish a "coordinated procurement" (pooling of demand). This should include considering mid/long-term framework contracts to provide supply-side incentives for necessary investments into service infrastructure (leading ageing to stability, quality of production while reducing costs)

Of same importance is the establishment of common European minimum standards on service content and performance to enable

- production efficiency (supply side) and
- cross-compliance for integrated management and transboundary coordinated reporting (user side)

Here, the consensus found within geoland on the proposed standard needs to be consolidated on user side either by accepting the de facto standard (e.g. via MS Working Groups) or formal standards (e.g. through INSPIRE mechanism)

With respect to the mandatory user engagement based on their mandates and obligations to act upon national and European laws mechanism already exist but need to be upgraded to become "spatial", cost efficient and timeliness. Here, many users already today heavily invest into spatial data infrastructure for data sharing and dissemination (e.g. "WasserBlick", a WEB based on-line GIS supporting German federal states on WFD reporting). Nevertheless, it is important to note that such data are owned by the users and it is their issue to agree on a data access policy!

## 4.2 EO Data

### Gaps in EO Data availability:

Considering the existing and planned missions for land applications the following priority ranking was derived from GSE projects policy analysis and FP 6 IPs findings addressing key application areas and respective services selected, tested and validated within the above mentioned projects by independent user organisations.

- 1) High Resolution Optical VNIR-SWIR  
→ Landsat type background mission for regional environmental monitoring
- 2) Medium Resolution Optical VNIR-SWIR  
→ MERIS/MODIS type background mission for continental environmental monitoring and food security, also closes VEGETATION gap
- 3) L-Band SAR → to complement existing X / C-Band missions for environmental monitoring coping with cloud coverage

### EO data procurement

For European-wide coverage of EO data we propose to tender out the type of data required in order to negotiate bulk rates. This would allow suppliers to join efforts to assure timely delivery of large data amounts<sup>8</sup>. It might be considered as well to establish framework contracts allowing coordinated tasking (ground segment). However, when data from public missions are available the costs will need to be covered completely from public budgets (e.g. according to ESA missions following the Oxygen approach proposed.).

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<sup>8</sup> ) Having in mind the failure of Landsat 7 and the respective gap of a background mission until Europe has established own EO data acquisition capabilities (approx. in 2011; Sentinel 2)

## 5 CONTACT & FURTHER INFORMATION

Each project provides further information on its web-site and publicly available progress reports and documents.

Please check the web-sites and feel free to contact the coordinators for further information:

### **Project web-sites**

[www.gmes-geoland.info](http://www.gmes-geoland.info)  
[www.gmes-sage.info](http://www.gmes-sage.info); <http://www.gmes-urbanservices.com/>

### **Communications**

Mareike Döpke  
Infoterra GmbH, Phone: +49 (0)7545 8 3924, Fax:  
+49 (0)7545 8 1337,  
E-mail: [Mareike.Doecke@infoterra-global.com](mailto:Mareike.Doecke@infoterra-global.com)

### **Coordinators:**