SAGE SERVICES & PRODUCTS AVAILABLE TODAY

INTRODUCTION

The implementation of the new European policies WFD & SPI are a challenge to most legal bodies in charge. For example, the demand for water basin management plans addressed by the WFD, and reporting schemes on GIS basis requested from the EC, will impose a real paradigm change: instead of statistical data from sampling and point measurements (today's standard approaches), spatial information on is increasingly required on national and local scales. In addition, the European Commission put strong efforts on harmonised reporting from the member states, which requires harmonisation of thematic content and data formats in order to make reports comparable at European level. Here, EO based geo-information data provided by SAGE will contribute significantly.

SAGE directly addresses the requirements of core users from 5 major European countries dealing with implementation of the WFD and SPI, and representing different environmental conditions (boreal, central European, Alpine, Mediterranean), different information levels (European, regional, national, local), and different end user-organisations (European Commission – European Environmental Agency (EEA), Ministries of Environment from member states and local end user groups; e.g. federal state ministries or regional water / soil authorities). Due to their high interest in SAGE, the core users actively participate in the project, their activities being coordinated by the European Topic Centre - Terrestrial Environment (ETC-TE).

To serve the needs of many different end user-segments, which have been identified during the preparation of the SAGE proposal and the first months of the project, SAGE reflects:

- hot spot mapping or sampling approaches at local / regional level
- complete coverage in significantly reduced scales at international level
- different end user infrastructures; e.g. an agency which has an information service already installed and which likes to improve their service will request only for better landcover information, while other customers may ask for a complete service on agri-environmental risk maps or indicators for planning, control and response actions. SAGE pre-cursor services comprise
    - o AquaSAGE with Water Quality, Water Shortage and Indicators (pressure & state indicators)
    - o SoilSAGE with pressure and state indicators.

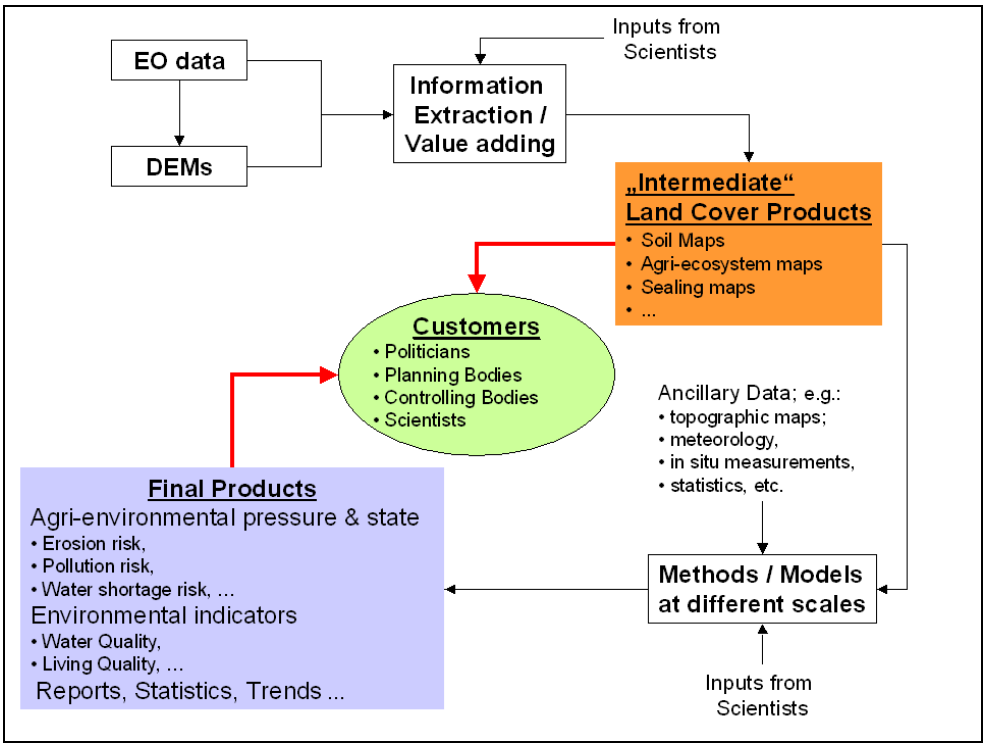
The key goal is to support the responsible authorities in establishing sustainable management of their water basins and their soils. A better understanding and the early detection of potential risks and sources of environmental degradation will contribute towards a reduction of costs for mitigation, maintenance and sustainable management of the environment as well. In addition, SAGE will be an important step towards a harmonized reporting scheme for the European Union as a whole.

The technical realisation of SAGE is based on an open concept for both the infrastructure (space, ground and services) and the partner network. As an overall principle, the design first of all reflects the user needs translated into SAGE´s product portfolio.

AquaSAGE AND SoilSAGE SERVICE PORTFOLIO DESCRIPTION

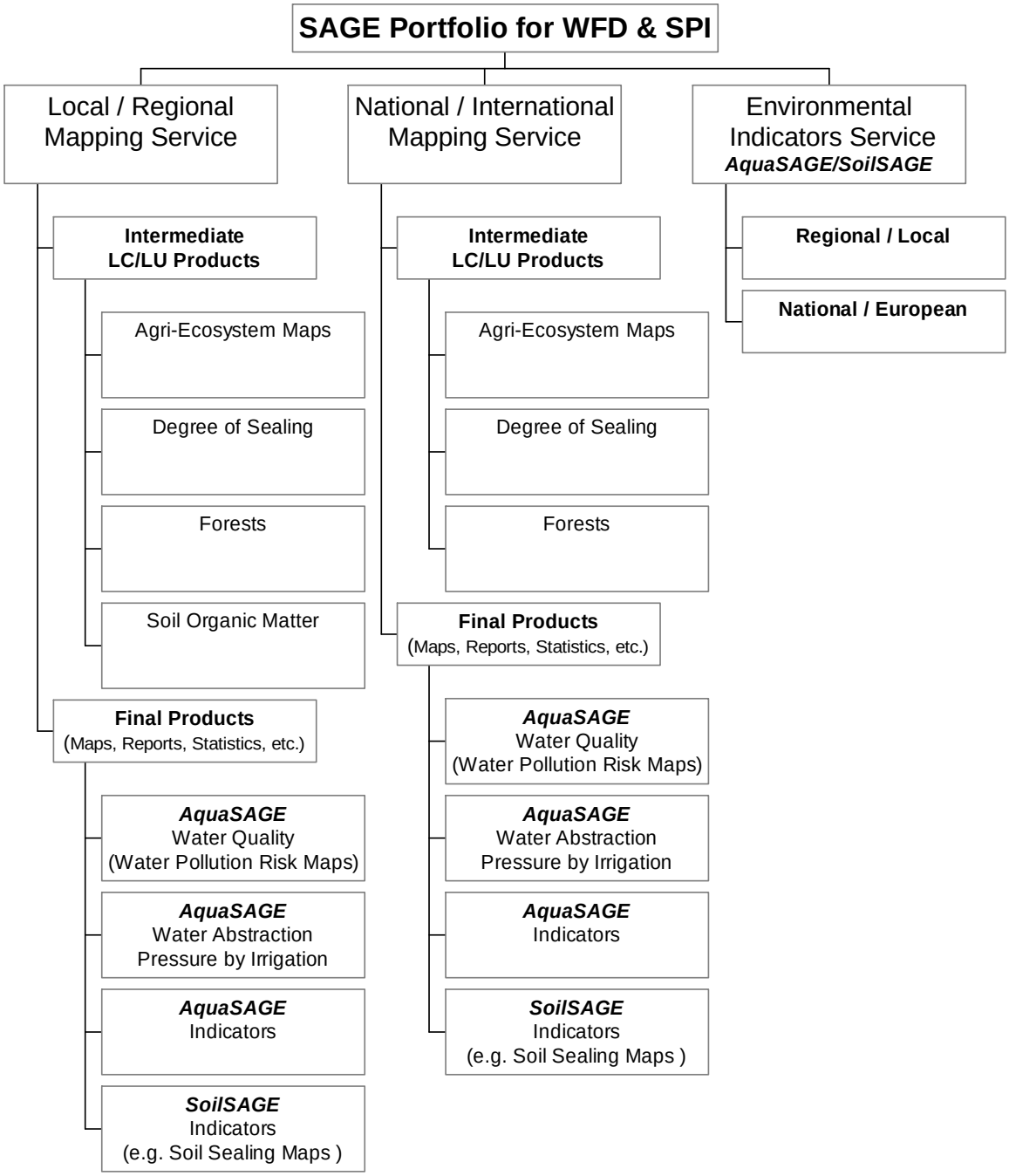
The AquaSAGE and SoilSAGE service portfolio integrates EO-based Land Cover / Land Use (LC/LU) information and data from a wide range of other sources (e.g. terrestrial measurement networks, statistics, etc.) within quantitative models on water basin level and for environmental and planning issues related to soil sealing**.** Improved geo-information is combined and analysed at various levels and scales using for instance models for risk assessment or for the creation of environmental indicators.

In the image below a generic overview of the service value chain for SAGE is presented. It considers EO data and Digital Elevation Models (DEMs) as major information sources for land cover; here specified as “basic products” resulting from a standardisable core service. In combination with data from many other sources they will have to be combined and analysed at various levels and scales using for instance models for risk assessment or for the creation of environmental indicators.



Overview of the SAGE service chain for land cover and agri-environmental information products

In the following, products and services, which are generated and delivered to users, are described in short. The description starts with the basic geo-information service to create intermediate products on LC/LU followed on top by the more specific services from the SAGE partners.



Generic overview of the SAGE service portfolio for agri-environmental geo-information

Basic Service – Generic and Specialised Land Cover

Products / Services Delivered Today

The basic service generates standardised land cover information as a common basis of any further environmental planning. Customers are SAGE service providers which will use it for final SAGE

products within models as described below and European and national entities in charge of monitoring environmental pressure and state.

Today the generation of such basic geo-information relies on pre-operational production chains for high-resolution (up to 1:25.000) general and specialised (urban, forest, agriculture) land cover maps. However, the technology used is sound. It was proven by independent scientific evaluators and the products, their value and their benefits have been endorsed by the SAGE core users group. The service providers have committed themselves to offer this service on regional up to national level today**.** Compatibility to CORINE Land Cover (CLC) class definitions – one of the few European standards on geo-information contents - is assured for CLC levels I-III. However, SAGE offers improved thematic content and a much better geometric accuracy. In addition, it allows more frequent large-area updates (e.g. to match with WFD demands, mapping large catchments every 5 years) and short-term hot spot monitoring at affordable costs.

Methodology

CORINE Land Cover (CLC) data and their updates constitute the first and only homogeneous EO derived European land cover data set. Consequently it has been widely used for environmental analysis and land cover related studies in the soil/water and other contexts. However, CLC data is mostly suited for spatial analysis at national scales and above and lacks detail and flexibility for regional and specialised applications. Also the CLC based MOLAND/MURBANDY products, though at higher detail, focus on selected regions and comprehensive urban/regional land cover analysis and are thus not suited for the purposes intended by SAGE. To fulfil the various information needs of end-users in water and soil policy contexts, SAGE offers as its predominant feature greater detail and flexibility through the

- Identification of smaller land cover features (e.g. 1-5 ha resolution cells) by maintaining the CLC thematic content,
- Creation of higher level of detail of the thematic content (e.g. CLC level 4 and beyond) by maintaining the CLC scale for various classes
- Generation of up-to-date, more frequent LULC information
- Improving all, scale, thematic content and topicality
- Adapting the study area to the actual area of interest, such as catchment areas in case of the WFD

Many end-users have acknowledged and incorporated the CORINE land cover nomenclature as common standard and have ascertained the importance of an accepted standard of land cover nomenclature. Thus, in the effort to improve and refine the CLC type products, it is important to maintain as far as possible the CLC nomenclature. Thus great effort within SAGE is and will be dedicated to the compatibility of SAGE derived LULC information with CLC nomenclature and to establish clear relations between CLC categories and SAGE categories, where the latter differ from the former. More over, SAGE is heading towards an increased level of automation within the production work flow. Enhanced automation is very important to achieve cost reductions of future LULC products and a big step forward towards an operational service in contrast to project-based approaches like CLC. However, automated pattern recognition processes today only allow for a limited amount of detail and thematic accuracy. Thus, it will always remain necessary to add visual interpretation work to the image classification process. However, this work can be supported very

effectively by suitable image interpretation routines, which combine human control and automated, objective approaches. Therefore it has to comprise as well improvements of the man-machine interface in image interpretation and the establishment of permanent production chains run by experienced and well-trained specialists. Such an improved and cost-efficient information production will allow more frequent updates of LULC information for environmental demands where topicality is a key issue, such as reporting in the WFD or the STS context.

The basic land cover is based on an existing production chain based on the so-called LaND25 product The data set covers the whole of Germany, in a scale of 1 : 25,000. The class definition scheme for the thematic classes is shown in the following table.

Table 1: LaND25 Classes

ARTIFICIAL	1	*Extremely Dense Urban*	Building density high with high buildings (> 4 floors little open space, > 80% built-up area.
	2	**Dense Urban**	Building density high in city centre with densely concentrated, 1-3/4 story office blocks, little vegetation. Mainly building blocks, also large single buildings, industrial buildings below minimum size.
	3	**Urban Fabric**	Building density low, including centres of small towns and residential areas. Maximum 4 storeys.
	4	**Village and Suburban**	Village and low density urban and suburban. Smaller, non-alinged buildings, high percentage of vegetation.
	5	**Urban Green**	Parks and other recreation areas e.g. playing fields, sports fields also without vegetation, golf courses, allotments.
	6	**Urban Sealed Areas**	Open spaces with artificial surfaces (e.g. runways, railway tracks, streets, squares) in urban areas.
	7	**Industrial and Commercial Buildings**	Industrial buildings (max. 4 floors), large industrial buildings, factories, power stations or public services. Mapping of single buildings, generalisation only if open space between buildings is small.
	8	**Airport Buildings**	Airport terminal buildings.
	9	**Bridges**	All major bridges (e.g. motorway fly-overs, bridges over water).
	10	**Mineral Extraction Site**	Mineral extraction site incl. open cast mining, earth deposits, area without vegetation.
	11	**Non-urban Other Sealed Area**	Open spaces with artificial surfaces (e.g. motorways, railways, runways, dump sites) outside built-up areas.
	12	**Coniferous Forest**	**Areas of dense coniferous forests**
	13	**Deciduous Forest**	Areas of dense deciduous forests.
	14	**Mixed Forest**	Areas of mixed (coniferous and deciduous) forests.
	15	**Spacious Woodland**	Areas of scattered low density woodland of any type incl. wind throw areas, fruit trees and trees along streets.

	16	**Agriculture, Grass-land**	Cultivated areas: farm land, grassland and market-gardens.
	17	**Natural Other Open Areas**	Open, non-cultivated areas (e.g. mooreland, heath, swamp, low natural vegetation)
	18	**Rocks, Snow**	Non-vegetated alpine areas (rocks, gravel), snow, firn, glaciers and other open areas.

WATER	19	**Water Bodies**	Large inland bodies of water: natural and artificial lakes.
	20	**Stream Courses**	Rivers and canals.
	21	**Sea and Ocean**	Sea and ocean including watts, tideland.

Special Feature	22	**Selected Major Traf-fic Lines**	Selected major traffic lines inside and outside urban areas.

The LULC information is provided down to CLC level 3 in a standardized but significantly improved way according to EU definitions. This will assure the capability of up-scaling the results to national and international level and the possibility of integration into European LU/LC approaches. CLC "Level 4" items will be derived w.r.t. the specific national, regional or local user needs, but fitting into the overall CLC nomenclature as required from the CORINE program [EEA, 1995 & EEA, 2000]; see Table 2.

Table 2: Comparison of specific SAGE classes with CLC

Analogue CLC Level 1	**Analogue CLC Level 2**	**Analogue CLC Level 3**	**Analogue CLC Level 4**	**Analogue CLC Level 5**
2. Agricultural areas	2.1 Arable Land	2.1.1 Non-irrigated arable land	2.1.1.1 Cereals	2.1.1.1.1 Summer Cereals
				2.1.1.1.2 Winter Cereals
			2.1.1.2 Root Crops (sum of potato, sugar beet and corn)	
			2.1.1.3 Oil Seed	
		2.3.1 Pastures		

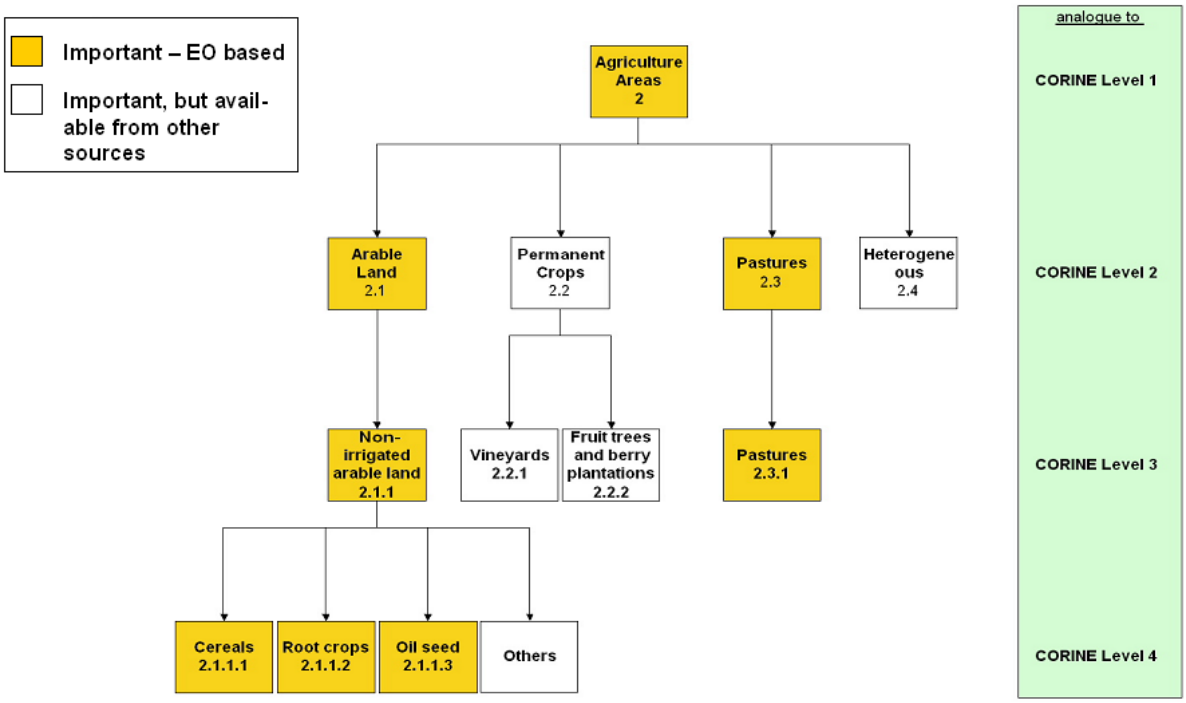


Figure 1: Subset of the hierarchical structure of SAGE LULC classes relevant to Central European conditions compared to CLC.

Major Benefits

EO based information on Land Cover / Land Use (LC/LU) is a cross-cutting issue because such information is mandatory for describing a multitude of environmental conditions. Hence, it's cost effective and sustainable provision to end user segments will improve significantly management and planning activities at all levels from European customers down to regional applications, by preserving time and money for the users and by improving output results from subsequent modelling approaches.

Today's Constraints

Besides data availability over long periods and large areas a critical issue is the lack of harmonised reporting schemes for geo-information data at European level. However, as far as the European Reporting Directive and INSPIRE are not in place it has to be assured by a "late customising approach" that national and regional special requirements from users can be met.

For a coherent production of LC/LU the European community of service providers includes an important number of institutions, but the community is fragmented and has not been organized to bridge the gap. It is fragmented in its applications and geographical scopes (often national), resulting in a disorganized duplication of activities.

Improvements in the next 2-5 years

The basic service will be produced in a standardised and automated way as far as possible. Here for instance, the SAGE service providers will benefit from results of on-going development activities, such as the European Research Framework 6 project "geoland", which aims on developing

European-wide standards for thematic contents and improved production of GMES related services. This will lead not only to a reduction of costs for both, producers and customers but to a faster and more reliable delivery. New sensors, (e.g. TerraSAR, which will be available from 2006 on) will reduce the risk of weather dependency and will allow improved monitoring of regions at risk. In addition, it is expected that the portfolio of specific land cover classes will permanently grow. Here, features which take care for specific land cover classes such as Mediterranean fruits (e.g. olives, citrus) or boreal forestry together with local national demands will be added.

Improvements in the next 5-10 years

It is expected that within this time frame new sensors will not only assure the data availability to serve on a permanent basis European geo-information demands but also an extension of the service portfolio. For instance it is expected that super or hyper spectral sensors or advanced SAR sensors with longer frequencies (e.g. TerraSAR L) will allow new products such as more agriculture classes, better identification of vegetation stress, biomass, information on soils (e.g. soil moisture, C-content, pollutants).

It also means that according to WFD demands (to report every 5 years on status and progress of catchments) every year at least 20 % of Europe's surface has to be mapped in the framework of a permanent inventory scheme in large scale (i.e. 1 : 25,000). Such a framework will significantly reduce production costs for all parties. In addition SAGE will provide means to map / monitor specific regions of interest (endangered or indicative areas) in high accuracy (e.g. permanent sampling plots) annually or on demand. The complete production process and product generation will be transparent for customers due to external auditing of production chain and products, Thus, the SAGE team will commit itself completely to rigorous quality assurance means, following GMES quality guidelines and European standards developed so far.

AquaSAGE: Surface and ground water quality

AquaSAGE – boreal forests

Products / Services Delivered Today

The SAGE service “AquaSAGE – boreal forests” focuses on nitrogen leakage in the boreal zone. The forest indicators biomass, productivity and clear cuttings and the aquatic indicator nitrogen leakage are addressed. The service has been successfully applied to the river Dalälven drainage basin (29 000 km2) in central Sweden

The products provided by the service Aqua-SAGE for boreal forests are

1. Wall-to-wall datasets of forest indicators productivity, biomass and clear cuttings covering the river Dalälven drainage basin, as input to an
2. Improved source apportionment for nitrogen in the river basin, using specific models with the possibility of scenario studies.

The intermediate products (forest indicators) are primarily used as improved input to a refined source apportionment model for nitrogen in the drainage basin, i.e. the final product, but they may also be used for other purposes (e.g. terrestrial monitoring).

The final products from the service are the source apportionment for the river basin based on the source apportionment model (FYRIS model) and water quality maps.

Methodology

The catchment characteristics will be based on official maps and the intermediate products, i.e. the improved spatial information on forest indicators. Ancillary data used in the modelling will be data on e.g. point sources, nitrogen deposition, runoff and land use (other than forest).

For clear cut mapping, a methodology for change detection is used, developed and implemented in a software tool within the ENFORMA project (EC FP4 project ENV-CT97-0423).

For mapping of forest biomass and productivity a classification of tree species composition and age is applied which was specifically adapted for handling a mixture of reference data from different sources. The approach is non-parametric and the images are de-noised using wavelet-transformations. Estimation of biomass and productivity (growth) are then derived from the tree species classification.

Today’s Constraints

The areas to be covered in Scandinavia are large and the time period needed to cover a specific area, e.g. an entire drainage basin, varies depending on the availability of individual cloud free satellite scenes. The cloud coverage also affects the possible up-dating frequency which for monitoring purposes probably will have to be defined as an interval, e.g. target on every year for some purposes but allowing an interval 2 – 6 years.

The lack of suitable, cloud-free, scenes implies that in the future a stabilized service (the whole chain of satellite data processing, source apportionment, validation etc.) with up-dated deliverables will have to be able to handle data from different years in different parts of the drainage basin.

Major Benefits

EO-based information will provide wall-to-wall data on forest indicators covering drainage basins. This will make it possible to incorporate homogeneous data with higher spatial and thematic resolution than presently available for use in source apportionment for example for the river Dalälven. It will also allow for a refined definition of element loss (nitrogen) from forest land. The data will be implemented together with ancillary data (GIS layers on sub catchments, monitoring data etc.) into the FYRIS source apportionment model, which in turn will provide an improved estimate of nitrogen leakage from boreal forests.

AquaSAGE Central Europe

Products / Services Delivered Today

The AquaSage service for Central Europe consists of maps and statistics qualifying and quantifying nutrient inputs into river basins. Today the basis of the service is the model MONERIS (MOdelling Nutrient Emissions in River Systems) which was recommended by our core users. The catchment based analysis allows either summary or differentiated catchment quantification of the main nutrient pathways. This analysis serves for identifying of regional focal points of nutrient pollution, which are prominently to be considered for the installation of measures for reducing inputs.

The service is delivered to the German Environmental Agency (UBA) and the Thuringian Institute for Environment and Geology (TLUG). Both organisations are in charge for the reporting on water status and the installation of measures to conserve good water quality.

Examples of spatial and statistic results are shown in the following example.

Methodology

Whereas point emissions from waste water treatment plants and industrial sources are directly discharged into the rivers, diffuse emissions into surface waters are caused by the sum of different pathways, which are realised by separate flow components of the MONERIS model. This separation of the components of diffuse sources is necessary, because nutrient concentrations and relevant processes for the pathways are mostly very different. Most important input parameters are especially LC/LU information detailed to agricultural crop types as already mentioned in SAGE´s basic service.

Today’s Constraints

Besides availability of EO data in terms of large scale mapping of important LC/LU classes in reasonable time periods, another critical issue is the availability of harmonized additional data sets like statistics and thematic maps. A lot of work has to be done in preparation of input data while the modelling approach itself is settled. This is especially true for international approaches.

Major Benefits

The MONERIS model approach is scientifically sound and can easily be transferred to other regions and river catchments. It delivers standardized outputs of catchments at risk, which are important for national and regional WFD reporting. The integration of all important pathways into the modelling approach guarantees a holistic consideration of all possible nutrient inputs into river systems. As catchments are the basis for MONERIS instead of legislative borders this leads to easy integration into WFD reporting schemes required from the European Commission..

Improvements in the next 2-5 years

Currently there exist a multitude of different model approaches for pollution estimation from diffuse sources. However, most of them are not well adapted to very high resolution input data on agriculture intensity, as such data was simply not available for large areas before. This is true for the MONERIS model as well. It is expected that in the next years efforts in research and harmonisation on European level will lead to internationally accepted and proven recommendations for a certain set of models to be applied in the framework of the WFD. The SAGE team will extensively make

use of these developments to offer standardised and accepted water pollution services. Here, it should be mentioned that European research projects such as “EUROHARP” are working in the direction towards European wide standards on water pollution modelling. Within geoland a thematic observatory on water and soil will work in the same direction, e.g. including pesticide pollution models.

Improvements in the next 5-10 years

In a middle term aspect the developments in EO data interpretation and environmental modelling will lead to a thematic expansion of land cover towards land use. However, these new possibilities will require again the adaptation of water pollution models as well as water management tools. Therefore the SAGE team has already assured close co-operation with leading scientific European entities to permanently extent the services based on state-of-the-art developments. Here, as an example, based on long-term monitoring facilities for land cover features (which are expected from GMES) it will be feasible to estimate certain land use management practices and their trends. For instance there is a strong demand from core users to identify and monitor crop rotation cycles in intensive agriculture areas and within catchments. This information can be used to improve water catchment management plans by changing and controlling agriculture practices and by identifying positive or negative developments.

AquaSAGE: Water Abstraction Pressure by Irrigation

Products / Services Delivered Today

The service consists in the provision of GIS based information reporting on the water abstraction pressure by irrigation in homogeneous hydrographical units of a catchment. It is made up of two products:

- A land cover map displaying irrigated crops. The first version of this product is presently available. It has a high-resolution and covers sub-catchment sectors. The second version will be a low-resolution product covering the complete catchment. It will be appropriate for most application cases of AquaSAGE. It will be available in France by the completion of SAGE (2004),
- A map of the irrigated surfaces combined with a map of the irrigation volumes per hydrographical unit. The irrigation volumes are computed for the year of the land cover and for a quinquennial and a decennial dry year.

These products have been generated for two pilot areas (System Neste, France and Flumen Irrigation Unit, Spain). They are to be delivered to national (e.g. National Environmental Institute) and regional (e.g. District Environmental Agencies, Water Catchment Agencies and Water Suppliers) every one or two years.

Methodology

The high-resolution land cover results from a supervised classification based on the NDVI (Normalised Difference Vegetation Index) or on spectral bands (red, near infrared and middle infrared) (Landsat, SPOT). The images are acquired at key dates of the crops development. Inserting the land cover into a GIS software allows to generate the map of irrigated surfaces per hydrographical unit. A low-resolution version of this map will be produced from MERIS images. It is destined to replace the high-resolution product due to the lower cost and higher availability of MERIS images.

The irrigation heights per hydrographical unit are computed from a model taking into account the plant water demand according to the FAO (Food and Agriculture Organisation of UNO) method, the precipitations and the soil water content (for France) or irrigation efficiency (for Spain). The soil characteristics and the irrigation efficiency are measured from ground surveys or calibrated from the water volumes invoiced by the water suppliers. Multiplying the map of irrigated surfaces by the irrigation heights provides the map of irrigation volumes per hydrographical unit.

Today´s Constraints

The main constraint on this service is the availability of complete and accurate databases on the soil properties. It also depends on the availability of satellite images. The use of the low-resolution sensor MERIS will restrict this constraint.

Major Benefits

This service gives access to an accurate and reliable spatial distribution of the water abstraction pressure due to irrigation at the local and regional scale. It benefits to the water catchment authorities and water suppliers (irrigation, hydro-electricity) who have thereby a monitoring tool which provides the means for a more rationale and efficient management of the water resources. This better management will then benefit to various water users, including farmers, industry (secured access to water) and to the public (better water quality and quantity).

Agri-environmental indicators

Products / Services Delivered Today

To understand the development of environmental problems Environmental indicators are a key element. They can be useful to describe environmental changes and pressure. Communication is the main function of these indicators.

SAGE´s environmental indicator are fitting into the core set of policy-relevant indicators EEA is just developing for six environmental issues (air pollution, climate change, water, waste and material flows, biodiversity and terrestrial environment) and five sectors (transport, energy, agriculture, tourism and fisheries). Within the GSE SAGE project environmental indicators primary the following environmental issues are addressed:

- Water
- Biodiversity
- Terrestrial environment
- Agriculture

Finally the service provides a set of indicators providing indicator maps and statistical data over catchments, NUTS 3 areas as well as 1 x 1 km grid cells. Additionally the technique of “moving windows” allows the production of results without delineation of raster cells or administrative units. It addresses primarily EU- and national environmental agencies, agriculture and landscape planning authorities, non-governmental environmental groups, planners, etc.

Methodology

The products follow as far as applicable and reasonable the guide-lines and proposals of EEA and EUROSTAT and relevance is commonly assessed with reference to the Pressure/State/Response model (PSR) developed by OECD.

The basis for derivation of the selected environmental indicators are the CLC compatible generic land cover product (CSL-S-1) delivered from Infoterra and multi-temporal EO data. Using common of the shelf software (COTS) the indicators are derived via object-based image segmentation algorithms and GIS operations.

Today’s Constraints

Most spatial environmental indicators are based on CORINE Landcover (CLC) data. However, CLC is not the universal tool and, on many occasions, CLC data needs to be improved regarding

accuracy and to be supplemented with other data on land cover and land use to provide a sound and relevant source for the production of useful information. The scale of CLC (1:100 000) and the size of the smallest mapping unit (25 ha) restrict the sensitivity of the tool. The updating over an average period of 10 years is also a limitation. Particularly in areas changing at a high pace or in areas under stress (e.g. coastal zones, urban zones, protected zones) it is necessary to have a more detailed inventory in order to capture changes of a smaller magnitude and, as well, to have more frequent updating.

Major Benefits

Environmental indicators over large areas in a comprehensive and standardised way allow comparison between regions (i.e. catchments) with lower bias to detect non-natural changes. Because of this a quick reaction by policy makers and authorities on actual trends in the state of the environment (e.g. improvement versus degradation) is possible. The geometric resolution and the repeat rate of CORINE land cover (10 years) is to low for accuracy and actual indicators. Therefore, the benefit of SAGE indicators are to give information about changes of smaller magnitudes and to have more frequent updating. Additionally the indicators are designed as follows that they fit to the core set of policy-relevant indicators EEA is just developing for six environmental issues.

Soil Sealing

Products / Services Delivered Today

The SoilSAGE products/services are maps and statistics related to land consumption and soil sealing and its change during the 1990ies. SoilSAGE is about to deliver this information to a national (e.g. Federal Environment Agencies) and several regional users (e.g. Landesregierung Vorarlberg). This has been done already for 1 pilot provinces in Austria at two scales (1:100.000 and 1:25.000), and two others will follow. The products are based on spaceborne EO data, aerial photography, maps, and other ancillary data, such as demographic and zoning data, etc. The EO component serves to derive land cover and soil sealing data, where the land cover component applies the CORINE LC nomenclature (level 1 and partly level 2/3).

A significantly improved LC (compared to CORINE in terms of minimum mapping unit 1ha and 0.25 ha, respectively) delivers a thematic accuracy of at least 95% for the artificial areas. The GIS component (including modelling approaches) of SoilSAGE co-analyses the EO derived results with ancillary data. The results describe and quantify the amount of land consumption in relation to demographic data, and assess the ecological and geophysical impact of soil sealing.

Methodology

Besides standard geometrical pre-processing steps the EO methodology is composed of a sequence of methods of information extraction from the satellite data (SPOT, ERS, Landsat), i.e. automated image classification techniques, visual refinement of the classification results for correction and class refinement, and vegetation index based derivation of the degree of soil sealing. An intrinsic component of the methodology is the validation of the thematic results via aerial photography. Subsequently the LC products serve to generate secondary products via GIS analysis and models along with demographic and geo-spatial data, such as land use zoning data.

Today’s Constraints

Today's major constraints are EO data availability, missing thematic and geometric standards of the products, and the new characteristics of the provided information. Many users are not familiar with satellite derived products or may not accept them due to their lower geometric precision than that of aerial photography and cadastral or land use zoning based information (with lower thematic accuracy) they are currently using.

Major Benefits

Major benefits arise from the consistency, timeliness, the spatial coverage, and from the localised nature of EO derived information on land consumption as opposed to the aggregated nature of the existent information. The latter allows for a spatial co-analysis of EO data and other geospatial data, which in turn enables localised impact assessment of land consumption and soil sealing as needed in many applications of spatial planning.

AquaSAGE AND SoilSAGE SERVICES in the next future

From 2004 until 2008

SAGE will be based on existing European service networks to assure harmonised reporting to European bodies (e.g. EEA, DG ENV) and to support in addition national up to regional requirements from member states. The fragmented and money strapped service provider scene (represented here by the SAGE team and comparable partnerships established by Infoterra) is ready to build a strong Open Service Partnership within the GMES service implementation process driven by EC, ESA and member states.

The schedule for the service roll-out permits flexible up-scaling from single projects via partner networks (allowing the specialisation of partners) up to centralised core services linked to specialised value adders in a maturing market.

The pre-condition of approved and sustainable GMES services for land applications will be assured via open data access to multi-mission EO data. Of similar importance is the open market access which allows all stake holders to step in or out at any time under commercial conditions.

Based on these assumptions it is expected that the partnership will evolve while the core services on general and specific land cover are first to start. The migration will lead from separate processing line concepts towards joint implementation service infrastructure (e.g. standardised process chains) which in turn will allow auditable production set up. The services developed together with the core users are applied on national level (e.g. for the second reporting period of WFD) and will be accepted by several additional European member states as state-of-practice. This process is strongly supported by international projects, such as geoland, which emphasises European-wide roll-out of advanced EO technologies based on the development of standards to be approved by most stakeholders.

From 2008 on

From 2008 on it is expected that the European Commission, together with the member states will assure operational budgets for WFD and STS reporting schemes. This will imply that the service industry will be able to create an improved monitoring scheme where the first substantial European GI market addressing “land cover & vegetation”, and an efficient commercial service infrastructure can be established.

Today’s fragmented and money strapped service provider scene (represented here by the SAGE team and comparable partnerships established by Infoterra) is ready to build a strong Open Service Partnership within the GMES service implementation process driven by EC, ESA and member states.

The Open Service Concept envisaged will assure that the key issues for SAGE´s success can be addressed; i.e.:

- Reliability: by establishing user-accepted standards for thematic content and accuracy and service providers committed to a GMES approved quality production process. This implies regulatory frameworks, like the Reporting Directive and accepted EO based products.
- Affordability: by emphasising centralisation where necessary and appropriate in order to achieve a standardized approach and by establishing flexible, modular production and delivery chains. This way, a lot of image processing and interpretation work can be carried out more effectively (i.e. faster, cheaper and much more standardised) and harmonised than with current project based approaches. However, it is recognised as well that any centralised data analysis approach has to stop at a certain stage, in order to address specific national, regional, ecological, or socio-economical conditions effectively. This is reflected in SAGE by late customising along the processing chain (i.e. from core services towards final products).
- Availability: by integrated value chains with open interfaces (w.r.t. INSPIRE, OGC, Reporting Directive) and multi-mission / multi-sensor approaches to allow for continuous data streams and maximal flexibility.
- Sustainability: by networking and production at European level to assure continuous work load and economic feasibility through serving several markets and market segments.