

# GMES Service Element for Forest Monitoring; Achievements in the European Context and Prospects for Users in Other Nations

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**Abstract – The Forest Monitoring Service Element of the Global Monitoring for Environmental and Security initiative aims to provide improved forest monitoring (based on space technologies) for the European and global environment. The Service Portfolio provided information on yearly carbon balance, forest disturbance data as well as information for practical forest and land use management operations for both EU and developing countries. The services were well appraised by the users and results indicate a marked improvement in forest management as well as improved capacity to fulfill reporting obligations for international and national policies. Thus an expanded phase is being developed.**

**Keywords: policy relevant services, service networking, user involvement**

## 1. INTRODUCTION

The Global Monitoring for Environmental and Security (GMES) initiative is a joint initiative of the European Space Agency (ESA) and European Union (EU) with the main goal of establishing an European capacity for the provision of operational information services for global monitoring of environment and security. The first Earth Observation (EO) Summit held in Washington DC on 2003 established the ad hoc Group on EO (GEO) to develop an internationally co-ordinated EO system of systems which should also be driven and championed by governments of both developed and developing countries; the Global Earth Observations System of Systems (GEOSS) has now been approved by the members of GEO and the GMES is the EU's main contribution to this international programme.

The GMES Service Elements (GSE's) are one element of the ESA Earthwatch Programme; the main aim of the GSE's is to deliver policy-relevant, operational information services, primarily (but not exclusively) derived from EO. Several thematic priorities for the GSE's were identified and the GSE Forest Monitoring (GSE FM) was initiated in 2003. ESA contracted an international Consortium led by GAF-AG to consolidate the GSE FM for the first stage. Through a Service Portfolio of validated products and services, GSE FM supplied users with accurate, reliable, timely and effective information on the state of global forest systems in order to support decision-making and improved policies that enable sustainable forest management; compliance with specific protocols and binding conventions; and related user and/or policy-driven activities. The information provided by the monitoring service was delivered as standardised spatially referenced, quality products e.g. maps, that are cost effective, readily accessible and transparent to users, thereby promoting key applications and good governance within the forestry sector with sustainability as a paramount consideration. The first stage of the GSE Programme was considered the consolidation stage, which focused on consolidating, aggregating and improving existing pre-cursor

services in order to make them sustainable within a reasonable timeframe.

This paper will present the achievements of Stage 1 for both the European case as well as the successful introduction and follow up activities for non-EU countries. Section two will describe the core policies and services which comprised the GSE FM Service Portfolio as well as the specific case on the successful introduction of GSE FM to non-EU countries. Section 3 will then highlight the main achievements of the first stage of the programme. And finally Section 4 will outline the proposed expansion of the programme.

## 2. GSE FM STAGE ONE

The GSE FM's main objectives during Stage 1 focused on consolidating European industrial and scientific know-how for developing global operational forest monitoring services that could deliver information. The policy processes that drove the development of the GSE FM services were:

- United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP)
- European Union Forest Focus Regulation
- United Nations Forum on Forests
- Ministerial Conference on the Protection of Forests in Europe (MCPFE)
- United Nations Convention on Biological Diversity (UNCBD)
- United Nations Convention on Combating Desertification (UNCCD)
- Forest Law Enforcement, Governance and Trade processes (FLEGT)

The service portfolio offered both information services designed to help enforce policy objectives as well as practical forest management information. At the beginning of the project, the main emphasis was put on user segments within EU-countries that included:

- Governmental bodies responsible for reporting under UNFCCC and KP
- Project developers for Clean Development Mechanisms
- National and sub-national forest administrations
- Governmental bodies responsible for environmental policy and nature protection

The first stage analysed forest and environmental policies for information needs, contacted stakeholders and reviewed the current data collection infrastructure networks and sources of in-situ data, models and other necessary precursor data. Based on the policy driven user needs a Service Portfolio was constructed outlining the services and products, as well as the production, quality control and verification processes. GSE FM is thus

capable of offering a range of products and user oriented services that range from highly accurate yearly carbon balance estimates and the compilation of forest disturbance data such as forest fires and windthrow to information products for practical forest and land use management operations. In brief, GSE FM offered the following services addressing specific policy areas including:

- Forest Monitoring for Climatic Change:
  - Forest Monitoring Inputs for National Greenhouse Gas (GHG) Reporting
  - Forest Monitoring Inputs for CDM Projects
- Forest Monitoring for Sustainable Forest Management:
  - Sub-National Forest Information Updates
  - Clear Cut Mapping and Monitoring Service
- Forest Monitoring for Environmental Issues & Nature Protection:
  - Land Cover & Forest Indicators

The services were based on combinations of products including: land use and land use change maps; land cover and land cover change maps; forest cover and forest cover change maps; clear cut/disturbance maps and related databases; stand-type maps that support sub-national forest Geographic Information Systems (GIS); forest fragmentation and structural diversity maps; stem volumes, biomass and carbon statistics and corresponding change data, as well as user-customised versions and/or combinations of the above. The GSE FM Service Portfolio was designed to include quality control and validation processes. The complex issue of standards (for example for the production, quality control, verification and documentation processes) was also addressed in the service production and delivery chain and was central to the sustainability of GSE FM services. These factors assisted in obtaining viable results and the assessment of these results and achievements will be presented in the next Section.

An important aspect of the GSE FM which aimed at addressing the global component of the GMES was the attempt to assess the requirements of non-EU countries. Specifically this included Russia and countries in the southern African region. These countries were introduced to the GSE FM Service Portfolio and a series of preliminary activities were undertaken in order to develop the institutional and technical frameworks for establishing the GSE FM programme.

For example the successful introduction of the GSE FM services to southern Africa was based on a chronological series of steps that introduced the user community to the GSE FM Service Portfolio and assessed the user needs as well. In the case of the southern African region an Awareness Raising Workshop was held in S.Africa to introduce the user community to GSE FM, and this was followed by an User Needs Analysis for Namibia, Botswana, Zimbabwe and S.Africa. Based on the results of this survey a pilot programme was designed for the user community in S.Africa. The pilot programme intended to demonstrate the use and validity of the selected GSE FM service in S.Africa so that end-users, decision makers and relevant stakeholders in both public and private sector in the country could better understand the role of GSE FM for policy implementation; additionally the pilot was to provide a platform for the South African region to engage more fully with the GMES initiative and begin to implement nation and region wide GSE FM services that meet specific user requirements during the period 2005-2008. The specific service for the pilot focussed on the provision of information for the forest sector as required for S. Africa for

national reporting on Land Use Land Cover Change (LULCC) in the framework of UNFCCC and its Kyoto Protocol which includes statistics for forest area, forest area changes and for volume, biomass and carbon stock and their respective changes for the service area. It should be noted that the GSE FM received endorsement and support for implementation in southern Africa from the New Partnership for Africa's Development (NEPAD), which provides the framework for development programmes on the continent.

In Russia a complete service delivery mechanism was established by the Remote Sensing Centre of the Institute of Solar Physics SB RAS (RSC ISTP SB RAS). Products and services from the GSE FM Portfolio were generated and delivered to the Forest Service of Irkutsk (General Survey of Natural Resources (FS of GSNR) of the Russian Ministry of Natural Resources (MNR)). Aim of this service is the provision of a powerful tool for effective forest monitoring and inventory at regional scale using both EO-data and ground based observations. The combination of high and low resolution EO-data is the most promising and cost-efficient approach, especially for regions covered by vast forest areas. In a two-level strategy forest changes over large areas caused by fires, cutting, and other natural and human induced disturbances are monitored operationally by using low and medium resolution satellite data. Territories where significant changes occurred are subject of further inventories by using high-resolution satellite data and aerial photos. In addition, ground-truth data like inventory maps and topographic data are integrated where available.

To monitor and upgrade the efficiency of the provision of products/services and meeting the user requirements, the GSE FM project has adopted a third party validation approach agreed by all members of the service supply partnership. The validation was performed for all service cases across Europe as well as for the S.African and Russian ones. The results were adequately documented in Validation Reports and have shown conformances with the user requirements and the quality standards of the GSE FM Service Portfolio in all the cases.

### 3. ACHIEVEMENTS FROM STAGE ONE

The major achievements from Stage 1 for the EU countries are divided into 4 main areas, which relate to the user assessments of the Service Portfolio, the value of the services provided, a cost-benefit analysis, and the development of an effective service supply chain. A fundamental aspect to the successful implementation of the GSE FM relates to the effective institutional arrangements both in the EU and non-EU countries with the various partners, and the establishment of a Service Network. Even with quite modest promotion and incrementally growing (user) awareness, a significant number of parties including national-level users and service providers have stepped forward and expressed an interest in joining the GSE FM partnership under the implementation phase. Thus, the GSE FM identified new committed users both in Europe and in Africa and thereby also demonstrated the potential for increased geographic coverage which is a key indicator of the sustainability and viability of the GSE FM.

Thus the user's commendation on the service provision as well as their involvement in the definition of a service portfolio was noted via the Service Appraisals which were undertaken as independent

assessments by users and were intended to cover the next few years. The users were requested to assess various criteria such as credibility, competitive value, overall utility, availability of Earth Observation (EO) data, availability of value-addition, reliability and access conditions. These criteria were all well evaluated for the current services and projected evaluation of these criteria was foreseen as very good into the next decade

This user assessment demonstrated how routine reporting commitments within the forest sector could be more readily and cost effectively fulfilled at various administrative levels and geographic scales. Thus, all stakeholders including those in the non-EU countries, have indicated confidence that GSE FM will fulfil its objectives for improved implementation of environmental policies and conventions (regionally and internationally) and furthermore will support the next stage of the programme.

A Cost Benefit Analysis (CBA) for the services/products showed a net present value (NPV) of Euro 570 million in the next 20 years. For example, the average annual cost saving attained using GSE FM services as inputs for National Greenhouse Gas (GHG) reporting was noted to be an estimated Euro 13.1 per km<sup>2</sup> and for Mapping and Monitoring Disturbances to be an estimated Euro 5.5 per km<sup>2</sup>. The additional non-quantified benefits were noted to be improved policy planning and management for various key environmental policies.

An effective Portfolio Supply Chain was developed which comprised 5 main elements: the products/service packages of known and validated quality with clear policy relevance; vertically organised value chains delivering products and services to users; pre-qualified service providers delivering services in a timely and cost effective manner; support to the supply chain by multiple service providers to complement competencies and to ensure back-up systems; and finally the use of a Global User and Open Service Partnership (OSP) network with distributed regional competences and a global presence.

These achievements highlight the main successes of the consolidation stage for GSE FM and reflect the improved information available to decision makers for forest management and environmental policy implementation; these factors also provide the basic fundamentals for a successful next stage.

#### 4. PROPOSED EXPANSION STAGE

Due to the successful consolidation stage and achievements as described in Section 3, the next major stage of the GSE FM is the progress towards operationalising the services in a sustainable and viable manner with further user engagement (to include an expanded user community and geographical area). A list of the committed end-users for GSE FM Stage 2, grouped according to policy related services is presented in Table A. This stage would be the opportunity for the GMES to fulfill its overall policy and vision. For the GSE FM the policy sectors that the expanded phase will focus on remain the same as those that were targeted in Stage 1; that is "climate change, biodiversity and sustainable forest management." It should be noted that the Kyoto Protocol has now entered into force, which means that for the signatory countries, included in Annex I to the UNFCCC, the formalities of fulfilling the requirements are more legally binding, with punitive fines for non-compliance with the agreed emission limitations. For this reason there will be continued emphasis on services related to the

KP reporting in Stage 2. Finally there is a special effort in Stage 2 to provide a **Pan European Case** which will address the needs expressed by the European Environmental Agency (EEA) in terms of Sustainable Forest Management (SFM).

Table A: Committed End-users for GSE FM Stage 2

<b>PAN European Forest Monitoring Service</b>	
Europe	European Environment Agency; EEA
<b>Support to National UNFCCC and Kyoto Protocol Reporting on LULUCF Activities</b>	
Germany	Ministry of Consumer Protection, Food and Agriculture (BMVEL)
Greece	National Observatory of Athens (NOA)
France, French Guiana	Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) Ministry of Agriculture, Food, Fishery and Rural Affairs (MAAPAR)
Italy	Ministry of Environment and Territory Protection (MATT)
Indonesia	BADAN PENGKAJIAN dan PENERAPAN TEKNOLOGI (BPPT)
Switzerland	Swiss Agency for Environment, Forests and Landscape (SAEFL)
Spain	Ministerio de Medio Ambiente (MMA)
The Netherlands	National Reference Centre for Agriculture, Nature and Food Quality (LNV)
Poland	Ministry of Environment of Poland (ME)
Republic of South Africa	Council for Scientific and Industrial Research; Institute for Environmental Technologies (CSIR-ENV)
<b>Forest Information Up-date at National and Sub-national Scales</b>	
Germany	Thuringian State Institute for Forest, Game and Fishery (TLWJF)
Germany	Landesamt für Forsten und Großschutzgebiete in Mecklenburg-Vorpommern (LFG)
<b>Supporting to Environmental Monitoring at National and Sub-national Scales</b>	
Austria	Federal Environmental Agency Ltd. (UBA-A)
Germany	Umwelt Bundesamt; Federal Environmental Agency (UBA-G)
Germany	Landesamt für Natur und Umwelt Schleswig Holstein (LANU)
Italy	Ministry for the Environment and Territory (MATT)
Spain	Ministry of Environment, State Biodiversity Office (SBO-ME)
<b>Detection and Post-monitoring of Natural and Human induced Forest Disturbances</b>	
Sweden	National Board of Forestry (NBF)
Latvia	State Forest Service (SFS)
France	Association Forêt Cellulose (AFOCEL)
France	Coopérative Agricole et Forestière Sud Atlantique (CAFSA)
France	Coopérative Forestière Bourgogne Limousin (CFBL)
Russia	Forest Service of Irkutsk (FS-I)
<b>Supporting Management and Reporting Obligations of LULUCF CDM Projects</b>	
Germany	Global Woods AG

The next stage will be implemented over a period from June 2005 to 2007. This Stage has as its overall objectives to:

- Demonstrate progress towards long-term sustainability for a set of GMES services.
- Deliver services and benefits to users on progressively larger scales.
- Establish a durable, open, distributed GMES Service Provision Network.
- Establish standards and working practices for GMES Services.

Additionally several new and innovative approaches towards streamlining the process and improving data access to users have already been constructed for testing in Stage 2; for example a cost reduction for EO data that has already been offered by SPOT, EUROMAP and European Space Imaging for all GSE's will also assist in the feasibility of increasing the geographical coverage that is expected.

In the case of the non-EU countries the pilot programme in S.Africa produced useful and first-time results in terms of a thorough User Needs Analysis in the context of implementation of national and international environmental Conventions and assessment of existing national databases that could be potentially used for the GSE FM services as well as the existing infrastructural capacity. There is thus a more comprehensive and improved knowledge of what the requirements are for an expanded stage of implementation for GSE FM in both S.Africa and the southern African region. It has been noted for example that the current lack of in-situ forest resources data is a major constraint in any policy implementation and thus the pilot programme proposed options for Conceptual Programmes to develop frameworks for a national forest inventory as well as biomass estimates. These concepts have to be examined by the user community and a proposed implementation plan has to be designed in the short-term. This aspect of the GSE FM will constitute a major advance towards improving the environmental management (using EO) in the southern African countries.

The GSE FM has made major strides in the new ESA/EU programme with investigating the various institutional and infrastructural as well as technical needs for supplying services on a sustainable basis to users and getting the user community involved in the service provision process. The public sector agencies in the forest and environment related services of both EU and non-EU countries do not have much experience in being actively engaged in this type of programme and processes and therefore the consolidation stage uncovered new technical and processing issues for the service providers to manage effectively; these findings will have to be incorporated into the implementation stage for improved service delivery. The success of the GSE FM programme hinges on various factors such as the effective and transparent management systems, the inclusion of partners in the various stages of programme development (that is the service network), and having a quality assurance programme that involves the user or client. It is anticipated that these factors will continue to be the main strengths of the programme which will facilitate in the improved services especially for forest management and UNFCCC/KP reporting in the future.

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## 6. REFERENCES

GMES Special Session, October 2004, Global Monitoring for Environment and Security - Europe's Contribution to a Global Earth Observation System of Systems (GEOSS), ESA/EU Session, International Astronautical Congress in Vancouver, Canada, on 5th October 2004.

Häusler, T.; Dees, M.; Fockelmann, R.; Pryjomko, R., Strunz, G. (2004): „Land Use, Land Use Change and Forestry Information for Kyoto Protocol Reporting and Sustainable Forest Management”. In: Umweltbundesamt, Mohaupt-Jahr, B.; (Hrsg.): Proceedings of the CORINE Land Cover 2000 Workshop in Berlin, 20.-21. January 2004, S.123-134.

Van Brusselen J., Schuck A., 2003. GMES Service Element Forest Monitoring - Policy Sector and Global User Needs Analysis. Presented at the 3rd Forum for Global Monitoring for Environment and Security, 5-6 June 2003, Athens, Greece.

Van Brusselen J., Schuck A., 2004. Policy Foundations Review. GSE FM project report. European Forest Institute, Joensuu, Finland. Document number: GAF-GSE-FM-A-T1-C1-Ph2-04-011.