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INDUSTRY, RESEARCH AND ENERGY

The EU programme for Global Monitoring for Environment and Security (GMES): governance and financing

[STUDY]

Abstract

The European Programme for Global Monitoring for Environment and Security (GMES) is an Earth observation system with the aim to provide accurate and timely information to policy makers in order to support the management of the environment and civil security. The present study introduces the GMES programme and its components. It draws lessons learned from a comparison with the Galileo Programme. The governance and financing of GMES are critically analysed and discussed. Based on the main findings policy recommendations are developed.

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LIST OF ABBREVIATIONS

AIDCO	External Cooperation Programmes/EuropeAid
CNES	French Space Agency
CORDIS	Community Research and Development Information Service
COST	European Cooperation in Science and Technology
DG	Directorate-General
DLR	German Aerospace Center
EADS	European Aeronautic Defence and Space Company
EC	European Commission
ECMWF	European Centre for Medium-range Weather Forecasting
EDA	European Defence Agency
EEA	European Environment Agency
EGNOS	European Geostationary Navigation Overlay Service
EIONET	European Environment Information and Observation Network
EMSA	European Maritime Safety Agency
EO	Earth Observation
EP	European Parliament
ESA	European Space Agency
ESP	European Space Policy
EU	European Union
EUMETNET	European National Meteorological Service
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUROSTAT	Statistical Office of the European Commission

EUSC	European Union Satellite Centre
FP	Framework Programme
FRONTEX	European Agency for the Management of Operational Cooperation at the External Borders
G-MOSAIC	GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises
GAC	GMES Advisory Council
GEOSS	Global Earth Observation System of Systems
GIP	Galileo Interinstitutional Panel
GJU	Galileo Joint Undertaking
GMES	Global Monitoring for Environment and Security
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	Global Navigation Satellite System Supervisory Authority
GSC	GMES Space Component
GSE	GMES Service Element
IG	Implementation Groups
IPR	Intellectual property rights
JRC	Joint Research Centre
LEO :	Low Earth Orbit
LUCAS	In-situ Land Use and Cover Monitoring
MACC	Monitoring Atmospheric Composition and Climate
MS	Member States
NASA	(US) National Aeronautics and Space Administration
NEREUS	Network of European Regions Using Space Technologies

NGO	Non-governmental organisation
NOAA	National Oceanic and Atmospheric Administration
PPP	Public–private partnership
R&D	Research and Development
ORFEO	Optical and Radar Federated Earth Observation
SAFER	Services and Applications For Emergency Response
SAR	Synthetic Aperture Radar
SC	Space Council
SEIS	Shared Environmental Information System
SME	Small and medium-sized enterprise
SSF	Strengthening Space Foundation
US	United States
WMA	World Meterological Association

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EXECUTIVE SUMMARY

Background

GMES is a European Union (EU)-led initiative for an autonomous and operational European Earth observation capacity and aims at providing accurate and timely information to policy makers – e.g. national governments and agencies, EU institutions, inter-governmental organisations and non-governmental organisations (NGOs), and users, particularly in relation to environment and security. The European Parliament and the EU Member States (MS) have identified different problems in the programme development, as is to be expected in unclear governance and financing structures which hinder the complete implementation of the programme.

Aims

- Provide a clear overview of the different elements of the GMES programme and the state of play of the development of GMES infrastructures and applications;
- Analyse similarities with and differences from the establishment of the Galileo Programme, with a view to learning lessons and identifying potential synergies: in particular, in the question of governance mechanisms and at the services level;
- Identify and define priority measures and actions in the field of GMES governance and financing.

GMES, its applications and strategic importance

GMES is a semi-space project: that is, it integrates Earth observation by both satellites and ground-based sensors. The purpose of GMES is to provide information in three major categories: mapping and topographical activities for short and long-term management of territories and natural resources, support for the emergency management of natural hazards, and systematic data supply for forecasting and modelling. Therefore, all conceivable applications can be classified under the topics of atmosphere, marine, land, security and emergency. Earth observation and its applications are not restricted to the European area but are available worldwide.

GMES can be the appropriate strategic tool to support Europe on geopolitical issues through unified Earth observation. GMES has a strategic importance due to the EU's role as a global actor, and will provide the EU with a tool for participating in the international efforts relating to the July 2005 G8 recommendation to strengthen the global climate system. It is a monitoring system for natural and human-made catastrophes in Europe, America, Asia and Africa, and makes an important contribution to serving the EU's civil security needs.

Components of GMES

The technical infrastructure of GMES is based on space satellites and a ground base, which includes airborne components. The latter two make up the in-situ observation infrastructure. For the space component, GMES uses both a significant number of already working earth observation satellites, and dedicated GMES missions with a minimum of five satellites called ‘sentinels’. The first, Sentinel 1, will become operational in 2012. In general terms, the role of the satellites is to generate two-dimensional (2D) images of the Earth's surface, which are complemented by height information, obtained at different optical wavelengths or by radar.

All the raw data from the various sensor measurements is processed to produce GMES services. There is a distinction between Core Services and Downstream Services. The Core Services provide standardised multi-purpose information to a broad range of EU policy-relevant applications. The Downstream Services are more targeted to European, national, regional or local information needs or specific thematic areas.

The most significant difference is that Downstream Services are processed for and financed by the private sector.

All services relate to land/marine/atmospheric monitoring as well as emergency response, security and climate change. Because of the complexity of the programme, related to the integration of space-based and in-situ data, GMES capacity can only be built up progressively, based on identified priorities and using existing elements whenever possible. Three Fast Track Services have been chosen: emergency response, land monitoring and marine services. Two additional pilot services were requested by MS, which emphasised the importance of services concerning atmospheric monitoring, external border surveillance and crisis prevention.

Comparison of Galileo and GMES

Galileo, a civil programme, is the European counterpart of the US global navigation and timing system (GPS). In its final stage, Galileo will consist of 30 satellites. It was planned to fund the Galileo programme development through a public–private partnership (PPP). However, so far all activities have been financed by public money. Neither any Galileo services nor business models of revenue generation are available.

Galileo has encountered problems in defining realistic programme aims, a lack assertiveness by government entities, and failed negotiations with industrial consortia. These have led to progress falling five years behind the initial timetable, and to cost overruns.

One reason for the delays was difficult negotiations among the EU MS concerning the use of the Public Regulated Service designed for government customers. Galileo is a civil programme, but some MS argued that it should be open to military applications. This could have brought the programme into profit sooner, but it was seen as controversial.

Another reason was the unclear management situation. The Galileo Joint Undertaking (GJU) was set up by the European Commission (EC) because of the need for a coordination platform between the EC and the European Space Agency (ESA), as well as the need to establish a single entity to run the programme. Its most important tasks were to find private investors and conclude a concession agreement along PPP lines, and to supervise ESA technical development activities. However, three years after GJU was set up it seemed that none of the main tasks had been concluded successfully.

The supervision of the ESA technical development was problematic, since ESA was both a founding member of GJU and its contractor. This led to a conflict of interest, and made it clear that the roles of the entities (ESA, EC and GJU) had not been sufficiently well defined. The GJU management underwent frequent restructuring, and this also added to the delays and difficulties. The structure now in place to support the EC's work regarding Galileo is the seventh since 1999.

Unfortunately GMES is similar to Galileo in this respect, with very slow development to date, leading to delays and cost overruns. A comparison between these two space programmes shows that the reasons for such problems are similar:

- Unclear programme tasks from the outset. In the case of GMES there was a controversial discussion about the definition of 'security';
- Insufficient political support. MS with a large space industry are more disposed than others to invest in GMES;
- Inadequately defined roles for the decision makers, leading to the programme-managing entities (in the GMES Bureau) having weak authority. Because of its limited resources and institutional setting the GMES Bureau has not been able to develop Downstream Services, involve industry, and structure future funding of operational services as expected;

- Unclear plans for revenue generation. Although the first three Fast Track Services are in operation, no revenue has yet been created. In addition, it is not yet known how GMES will be financed after 2013.

From the analysis of these problems, the following lessons can be identified:

- Common political support is indispensable for a successful programme;
- Any PPP needs to be prepared for adequately;
- It is essential to define clear roles for all the entities involved.

Governance

The development and implementation of GMES is an iterative process. GMES is partly built on already existing components which have independent functions and tasks. Additionally, there are totally new components. This results in a melange of supranational and intergovernmental networks.

GMES has a very complex governance structure. A number of shortcomings can be identified in this framework. They make it clear that it is necessary to continue efforts to improve the structure. The responsibilities of the different institutions and agencies, and their representation on the GMES management bodies, are not clearly defined. As a result, there is a lack of coordination in the reverse direction of the structure, namely from the GMES components to the GMES Authority, as well as insufficient linkage from the users to both the Downstream and the Core Services. In this context there is potential for improvement in the definition of roles and responsibilities, in overall coordination, and in developing a balance between the restructuring processes and the need to create a stable structure which provides secure working conditions.

It is clearly necessary to integrate a Security Board which deals with questions related to data security into the inner structure of GMES. It would be appropriate for institutions dealing with security issues to be tightly embedded into the Security Board, and to be directly linked to MS to fill the gaps concerning institutional management of security data and data flow.

The interlinkages between the different institutions are among the central challenges, because GMES is only meaningful if there is an intensive network linking data providers and end users, technical experts and policy makers. This is a chance for GMES to bring the different stakeholders together and become the central node in the network.

GMES is a user-driven initiative. On account of this, Downstream Services have been developed. However, there is no confirmed evidence about a potential market for those services. A market analysis for the different Downstream Services could be commissioned to assess their potential. In addition, in order to meet user requirements it would be useful to involve user forums in the development process.

Financing

GMES has been financed to date through EC, MS and European entities' contributions. During the initial period (2001–03) and implementation period (2004–08), the main task was to prepare the GMES initiative for its operational activities.

The main contributions came from EC Research Framework Programmes (FP) (FP5, FP6, FP7) and ESA (including national contributions to ESA), and were mostly dedicated to research activities. It was only after 2008 that funding was dedicated to pre-operational and operational activities.

At the current stage there is a transition from R&D and mixed (R&D and operational) funding to operational funding. The EU is increasing its expenditure on space policy and is giving more financial support through its Research Framework Programmes, resulting in an increasing budget for space research.

Questions concerning the financial relationship between the EU and ESA still remain open. A longer-term financing agreement would contribute to stable working conditions.

The MS contribute financially to GMES trough contributions to intergovernmental agencies such as ESA, EUMETSAT, etc., within the framework of own national space programmes, and to the overall budget of the EU. However, their financial amounts depend mostly on political priorities and the expectations of the outcomes for their space industries. The management of the available budgets illustrate the different motivations and approaches towards GMES as by the EC as by the MS.

The commercial space industry could also be considered as a source of financial contributions to GMES, perhaps through PPP agreements. However, space is a relatively small industrial sector, and has a limited capacity to invest in science and research, so it is expected to make only a limited contribution to GMES.

Policy recommendation

Both GMES and Galileo are based mainly on space infrastructure. In order to create added value it should be ensured that it is possible to exchange information between these programmes. Therefore, standards for the presentation of data should be developed at an early stage.

Key findings from a review of GMES governance suggest that there is still potential for improving the GMES structure. Clear governance and decision-making structures are required for its components (Space, Services, In-situ). There are unclear and overlapping responsibilities at several stages. Clear definitions of roles and responsibilities are needed.

GMES has undergone several restructuring processes. It seems to be essential to establish a balance between restructuring processes to adapt to changing framework conditions, and stable working conditions based on a stable and sustainable infrastructure.

Institutions dealing with security issues should be embedded more tightly into the Security Board and be linked to Member States to bridge the gap between the institutional management of security data and data flow.

In order to improve the visibility of GMES it seems essential to realise the fast track services as soon as possible. It is much easier to raise awareness of selected services that are already in operation.

GMES takes a user-driven approach. Therefore, it is important ensure a structured dialogue among all stakeholders. Special Downstream Services have been developed. The plan is for users to pay for the services in order to create revenue for GMES. However, there is no confirmed evidence that these services meet user requirements, or how large their potential market is. Therefore, market studies could be launched in order to assess this potential.

In addition, it is necessary to secure new and sustainable sources of finance for GMES in the long run, perhaps by bringing in private partners.

However, in the context of GMES's long-term operational capacity, a market for private end users still has to be created. As there are still no reliable market studies, it is not possible to make reliable predictions about the likely revenue from this source.

The best starting position for an operational GMES would seem to be the creation of a single budget line for GMES, with clearly defined coordination activities between ESA, EC and MS, and the involvement of the private sector.

1. INTRODUCTION

This chapter provides an introductory overview of the GMES programme and the main issues at stake, focusing on its applications and benefits, and the types of data processed.

1.1. The GMES Programme

The Global Monitoring for Environment and Security (GMES) is an EU-led initiative for an autonomous and operational Earth observation programme with a comprehensive approach. It brings together environmental and security-related data and information providers and end users, making related services available to those who need them. Although GMES might appear to be a second European space programme (the first being the European positioning and navigation system Galileo), it collects its data not only from space satellites but also from land and sea-based probes. In other words, GMES can be designated as a semi-space application.

GMES's most important infrastructure is its infrastructure in space. The data available from the large number of missions already in space (controlled by ESA, MS and third-party countries) are exploited. It is also a necessity to complete this fleet by launching new satellites, known as sentinels.

The final element of the infrastructure is what is known as in-situ observation infrastructure. This term is used slightly differently from its normal sense, to apply to the non-space infrastructure: airborne monitoring devices and ground and ocean-based sensors.

GMES will aggregate environmental data from this entire network of satellites and sensors. These devices typically **generate**:

- satellite images at high or very high optical resolution;
- multispectral imaging, used for example for data on vegetation;
- radar images with altitude values;

and **measure:**

- the surface temperature, salinity and altitude of oceans;
- the composition of the atmosphere and related pollution;
- the height of trees;
- seismic data obtained from infrasonic signals near volcanoes.

1.2. Applications of GMES

The GMES programme will provide both concrete applications and tangible contributions to decision makers and citizens in the EU. A wide variety of benefits should be derived from the completion of the space elements and an interconnected Europe-wide infrastructure. This section outlines some of the applications.

Information provided by GMES services can be classified into three major categories:

1. Mapping and topographical activities for short and long-term management of territories and natural resources, including transport, land use, forestry, and mineral and water resources. This service generally requires exhaustive coverage of the Earth's surface, archiving and periodic updating of data.
2. Support for the emergency management of natural hazards and for civil protection organisations. This service concentrates on providing the latest possible (near real-time) data prior to intervention.

3. Forecasting for marine zones, air quality or crop yields. This service systematically provides data on extended areas, permitting the prediction, modelling and evolution of short, medium or long-term events.

All applications can be mapped onto the breakdown used for GMES Core Services:

a) Atmosphere;

b) Marine;

c) Land;

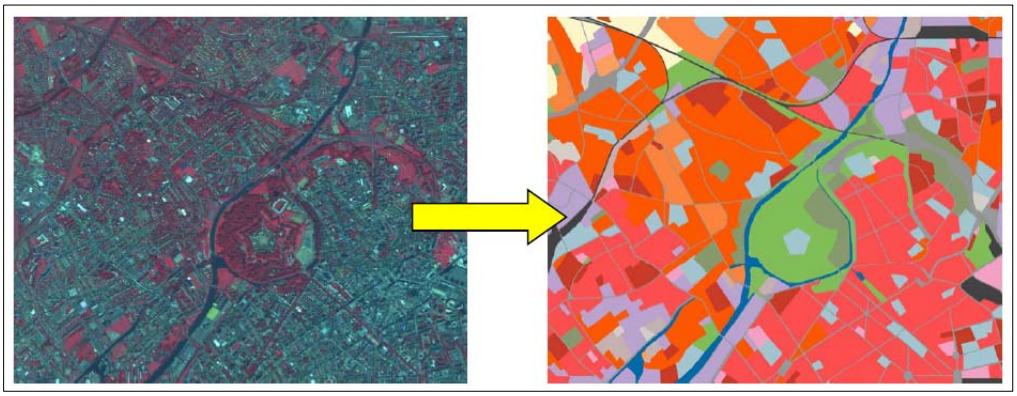
d) Security;

e) Emergency.

1.2.1. Mapping and topographical activities

A typical elementary product of GMES is a wall-to-wall pan-EU geological mapping of 38 countries, with an improved spatial resolution of 20 m and timely delivery. A subset dedicated to biodiversity aspects is the Urban Atlas, which produces a land mapping of between 300 and 500 urban agglomerations with more than 100,000 inhabitants. (Figure 1 shows an example.)

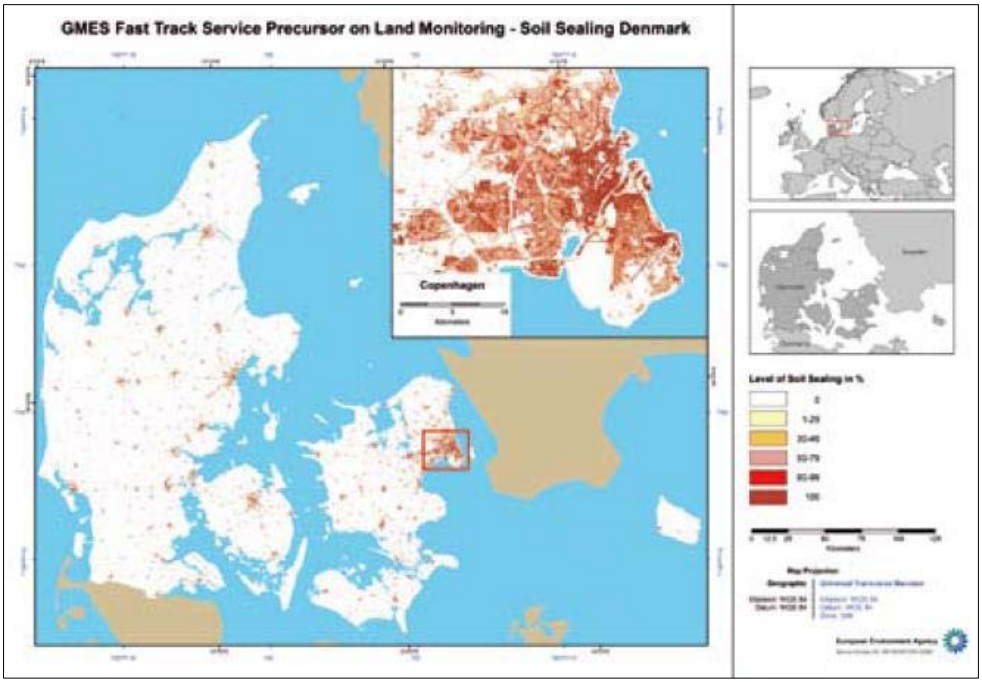
Figure 1: Urban Atlas of Lille (France), city centre



Source: Virginia Puzzolo, GMES Bureau, speech, Global monitoring for environment and security – the European Earth Observation capacity.

Related to this, GMES produces high-resolution datasets on built-up areas and soil sealing, as shown in Figure 2.

Figure 2: Soil sealing provides information on sealed areas throughout Europe. The example shows Denmark and the City of Copenhagen.



Source: EEA, published in *Window on GMES* Issue no. 2 (September 2008), p. 15.

This type of mapping is a requirement for user-oriented services. GMES is capable, for example, of supporting EU raw material policies by providing integrated data for end users from several sources. In this case it makes it possible to:

- identify and quantify areas of open pit mining and/or mining infrastructures;
- identify potential areas subject to conflicts of interest (such as protected natural sites) or requirements for compensation;
- monitor impacts on water supply and effects of pollution;
- monitor re-naturalisation processes after the closure of industrial sites;
- take urgent measures in case of accidents.

Another example in the environmental monitoring field is cross-border data gathering in relation to the Water Framework Directive, a key element of European environmental legislation. One of the major challenges of the Directive is the demand for management of and reporting on the condition of water resources for complete river basins, such as the trans-national basin of the rivers Saar and Moselle. Before this piece of legislation, management measures were confined within administrative boundaries. To provide cross-border management requires geo-information provided by GMES which does not change its character – even moderately – at administrative boundaries, and is available for the entire transboundary river catchment area.

Geo-information products and services have been developed in a GMES project called GSE Land. These services endeavour to support reporting and management by focusing on identifying nutrients and pesticides which enter surface water bodies from diffuse sources (mainly agricultural). The methods and tools used in GSE Land vary both in the application area, depending on specific differences in ecology and environment, and in the methodological approaches necessary for implementing the Water Framework Directive.

1.2.2. Emergency management

Applications related to emergency management and **support for civil protection** organisations need data in near real-time. These are also relevant to individual end users. Examples include:

- The Canadian Coast Guard uses GMES services to enhance the effectiveness of its search and rescue operations at sea, as the applications of GMES are deliberately not limited to Europe. Its Search and Rescue (SAR) coordinators use a search planning software tool that determines the most likely position of a search target. Environmental information from GMES services is fed into this system. This includes target detection of icebergs and ships, information on winds derived from satellite data, a forecast of ocean currents, and a weather forecast, as well as ice distribution information. Awareness of the marine environment and available vessel positions is crucial in planning a safe search and rescue recovery operation. SAR coordinators require easily accessible information delivered to their work stations, which can be processed by software to plan the SAR operations. Following the search planning process, assets (such as planes and boats) are assigned to search for and recover individuals in distress. All available environmental information and satellite target detection information is used.
- Satellite-based monitoring is used for the detection and surveillance of marine oil spills in European waters. The service offers to all EU coastal MS, Iceland and Norway a near real-time marine oil spill detection service using radar satellite imagery acquired by the sensors on board ENVISAT and RADARSAT satellites. The service is free of charge to all participating States and covers all European sea areas.

A 30-day experiment in 2008 demonstrated the potential of GMES **security services outside Europe** to contribute to the fight against drug trafficking in the Caribbean.[1] For the time being, some of the data-generating satellites only come into range every 48 hours. Ships less than 30 metres long are not visible on some sets of images, and the two-hour delay required for processing and transmission can be significant when the aim is to locate a ship in order to plan an immediate intervention at sea. However further progress in processing techniques is making it possible to detect ships less than ten metres in length, while processing time is being brought under half an hour. More optical and radar satellites are becoming available, allowing at least a daily coverage of the area. Thus GMES will enable better border control and aid in the fight against illegal trafficking.

Peacekeeping operations often take place in remote areas for which no up-to-date maps are available. Timely delivery of mapping and information products to enhance the situational awareness of users in the field is therefore one of the key benefits of GMES. An example is population monitoring maps for the Abdi area, a GMES product in support of EUFOR TCHAD/RCA operations in Chad. The monitoring of internally displaced persons and evaluation of resources such as water and food can support their return.

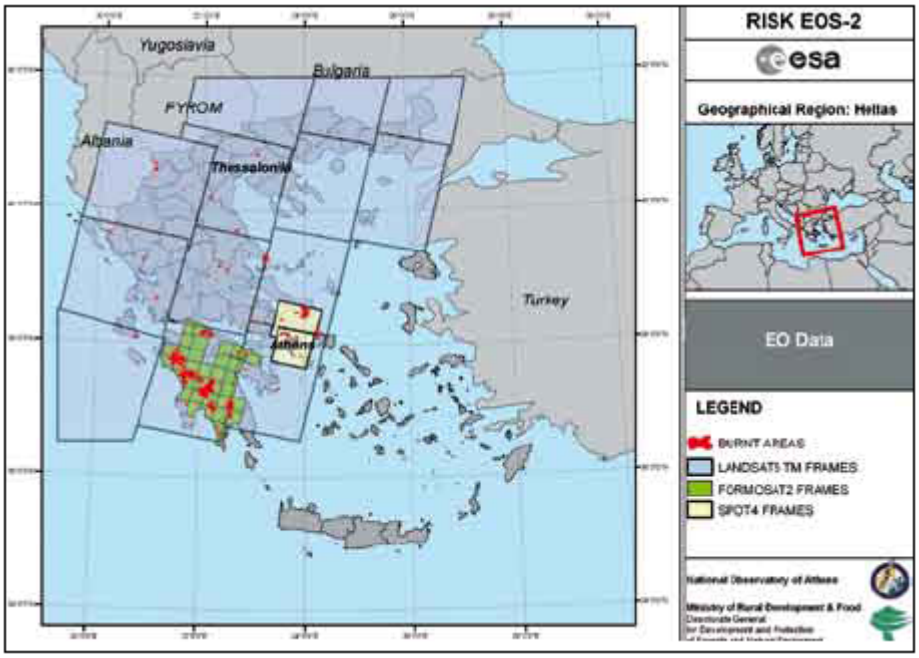
Two applications aimed at **end users** are AirTEXT and MEDSUN. AirTEXT works by sending alerts and health advice to people who are most likely to be affected on the days when air pollution levels are elevated in their area. Advance warning of higher pollution levels allows individuals to take precautionary measures such as remaining indoors, avoiding excessive exercise or carrying their relief medication with them. Under the scheme, people can sign up to receive local air pollution alerts by mobile phone text message, voicemail or e-mail.

The MEDSUN GMES service helps prevent skin cancer by delivering personalised information about UV exposure straight to users' mobile phones. MEDSUN provides near-real-time estimates of sunburn time in several regions around the Mediterranean.

[1] *Window on GMES* Issue no. 3 (March 2009), pp. 28–9.

The **emergency aspect** is represented by the Services and applications for emergency response (SAFER) project, which provides rapid mapping of disaster-prone areas and other tools to help optimise disaster response. Forest fires in Greece, Portugal and northern Spain, and massive floods in Taiwan, have highlighted the importance of responding quickly to natural disasters.

Figure 3: Image coordination is the centrepiece for delivery of operational imagery by GMES. This picture taken in 2007 shows how images of different regions of Greece were captured and delivered by different satellites, operating at different resolution levels – Landsat 5, FORMOSAT-2 and SPOT-4. Their pictures were brought together to create coherent imagery sets directly accessible by end users.



Source: National Observatory of Athens, published in Window on GMES Issue no. 3 (March 2009), p. 65.

GMES can help in crisis situations such as **meteorologically driven hazards** (such as storms, fires, floods), geophysical hazards (earthquakes, tsunamis, volcanic eruptions, landslides and subsidence), disasters caused by human actions, either deliberate or accidental (such as urban fires and chemical incidents on industrial sites), and humanitarian disasters. The instruments used are reference mapping, assessment (rapid mapping) and situation mapping, and crisis follow-up products, from data acquisition to delivery to the final users. Specific thematic products, depending on the type of event (such as a flood volcanic eruption) can provide additional specialised information. The geographical scope is not limited to Europe but extends worldwide. Reference maps can be delivered in less than six hours. The information is delivered to both decision makers (in organisational headquarters) and operatives in the field.[2]

A bird's eye view is the preferred way of assessing affected regions, so satellites bring a crucial contribution during all the stages of a crisis or emergency:

- Before crises: routine and continuous monitoring is needed to highlight the gradual change from local to global scale, with models and computer simulations to provide risk assessments and, if needed, early warning signals;

[2] Gil Denis, En route for a safer world: building operational services for emergency response, *Window on GMES* Issue no. 1 (May 2008).

- During crises or natural disasters, satellites provide information that is vital for assistance operations and for the evaluation of the impact and damage;
- After crises, satellites deliver useful indicators and maps to steer rehabilitation and reconstruction activities.

1.2.3. Forecasting for marine zones, air quality or crop yields

Ocean monitoring services, such as those planned to be developed within GMES (Marine Core Services), play an important role in supporting meteorological institutes in the development of weather prediction several months in advance (so-called seasonal forecasting). State-of-the-art seasonal forecasting is carried out by coupling global oceanic and atmospheric general circulation models with a coarse spatial resolution.

The Marine Core Services will improve the service delivered to meteorological institutes by providing a global ocean reanalysis at mesoscale. In the future this will be carried out using a high-resolution model (~25 km) into which is input all the available oceanic observations. Monitoring of ice mass loss in the Antarctic and Arctic polar regions is another application of this technology.

GMES helps countries fulfil their reporting obligations in the field of climate change. For example **forest monitoring** supplies users with accurate and timely information on the state of global forest systems. This can be used to support decision making, and lead to improved policies enabling sustainable forest management and compliance with specific protocols and binding conventions.

Other uses of GMES are in the fields of agriculture – related for example to crop production and food security – and transportation, for instance the monitoring of transport channels.

1.3. The strategic importance of GMES

As the EU-led initiative for an autonomous and operational European Earth observation capacity, GMES aims at providing relevant information to both policy makers, such as national governments and agencies, EU institutions, inter-governmental organisations and NGOs, and users, particularly in relation to environment and security. Sometimes seen as the second flagship of EU space policy after Galileo, it was initially announced during the second Space Council held in Luxembourg on 7 June 2005. The Space Council was established to coordinate and facilitate cooperative activities between the European Community and ESA through a Framework Agreement.[3]

The Baveno Manifesto of 1998 gave birth to the GMES initiative. At that time the acronym stood for Global Monitoring for Environmental Security, a name driven by the ecological concerns that had led to the signing of the Kyoto Protocol the year before. The name was changed to Global Monitoring for Environment *and* Security in 1999, in the wake of evidence that serious environmental problems might not just pose a threat to the security of individuals or nations, but even induce international conflicts.

The disputed scope of GMES and the meaning of security were clarified by a working group set up in 2002.[4] Its first results were presented at the GMES Third Forum in Athens, on 5 and 6 June 2003.[5]

A great strategic importance is attributed to GMES by the EU and its MS, since it relates to the EU's role as a global actor. GMES will become the main European contribution to the global ten-year implementation plan for the Global Earth Observation System of Systems (GEOSS).

[3] ESA press release no. 55-2005 (28 November 2005). Global Monitoring for Environment and Security is a main issue for the Third Space Council: see http://www.esa.int/esaCP/Pr_55_2005_p_EN.html.
[4] 10 Years of GMES: a chronicle, in W*indow on GMES* Issue no. 1 (May 2008).
[5] Christine Bernot, The 'S' of GMES: scope and general information requirements, speech at GMES Third Forum, Athens, 4 June 2003, http://www.gmes.info/pages-principales/library/forum-and-events/3rd-gmes-forum/parallel-session-4/?no_cache=1&download=3F_PR4_%20Bernot_ContributionPaper.pdf&did=227.

GMES will provide the EU with a tool for participating in the international efforts consistent with the July 2005 G8 recommendation to strengthen the global climate observation system.[6] It will also contribute to the EU Strategy for Africa[7] through the development of an African observatory and the implementation of the African Monitoring of the Environment for Sustainable Development initiative. GMES has been highlighted in the EU's dialogues with the USA, Russia, China and India. The USA recently published its Strategic Plan for an Integrated Earth Observation System, and Russia and Japan are about to do the same.[8]

Natural and human-caused catastrophes in Europe, America, Asia and Africa, coupled with increased security needs, have further reinforced the case for improved monitoring systems such as GMES, which will make an important contribution to the EU's civil security needs.[9] In addition, it will provide opportunities to contribute additional capabilities to the European Security and Defence Policy. All possible civil and military synergies should be pursued to ensure a better use of resources, in full complementarity with the EU Satellite Centre (EUSC), which is already operational in this area.[10] GMES will provide important support for environmental monitoring and assessment, and contribute to the implementation of the Shared Environmental Information System being developed by the Commission and MS. It will improve the quality of environmental information, while making it more accessible, and streamline and rationalise environmental reporting.[11]

MES is the autonomous information capacity to evaluate Europe's policy responses on the environment and security, areas of growing political interest where it is necessary to take political decisions and initiate follow-up actions. Earth observation-based services already exist in Europe, but they are mostly available in an uncoordinated way. They may be dispersed at a national or regional level, and often lack any guarantee of long-term availability or sustainability. The exception is weather-forecasting services.[12] GMES can be the appropriate strategic tool to support Europe on geopolitical issues by providing unified Earth observation.

6 *From Concept to Reality*, COM(2005) 565 final (10 November 2005).
7 *EU Strategy for Africa*, COM(2005) 489 Final (12 October 2005).
8 *From Concept to Reality*, COM(2005) 565 final (10 November 2005).
9 *Report from the Panel of Experts on Space and Security* (March 2005).
10 *From Concept to Reality*, COM(2005) 565 final (10 November 2005).
11 *From Concept to Reality*, COM(2005) 565 final (10 November 2005).
12 Serge Plattard, What's the problem with Europe's flagships Galileo and GMES? *The Yearbook of Space Policy 2006/2007*, Springer Vienna.

2. GMES COMPONENTS

KEY FINDINGS

- GMES works with an already existing measurement infrastructure, which will be enlarged by some satellites specially designated for the purposes of GMES, and further satellites provided by third parties.
- Further data measurement is done by non-space, in-situ infrastructure, which can be global or limited in place and time.
- Users benefit from unified information provided by the Core Services and more detailed, user-specific information provided by Downstream Services.
- The observational infrastructure depends for the most part on research funding, thus operational sustainability is not yet assured.

This chapter provides an overview of the state of play and prospects for the GMES components.

The interrelated GMES components are:

- the GMES space component (GSC) comprising observation infrastructure from space;
- the in-situ (including airborne) observation infrastructure;
- the services (Core Services and Downstream Services).

2.1. The observation infrastructure

The observation infrastructure, both in space and ground and ocean-based, is at the core of all consideration of GMES. All the sensors used, on the land, at sea, and in the air, combine to give a clear picture of the Earth's status related to environment and security.

2.1.1. The observation infrastructure from space

GMES uses both existing Earth observation satellites and dedicated technology. The intention is for satellites to be designed by the ESA to be used in the longer term.

Although the GMES network takes advantage of a significant number of satellites provided by contributing bodies, the five satellites called 'sentinels' that have been developed especially for GMES purposes, and that are therefore tailored to the specific requirements of Earth observation, add a further core element of great importance. The first of these, Sentinel 1, is scheduled to become operational in 2012.

To give an idea of the existing satellites that contribute to the GMES space component, Table 1 provides a non-exhaustive list of each project name, the type of physical sensors and the sponsor(s) responsible for maintaining the satellite.

Table 1: Non-exhaustive list of existing satellites contributing to GMES

Name of satellite project	Type of physical sensor, technical remarks	Sponsorship
SPOT 4, **SPOT 5**[13]	High-resolution visible imaging instruments with panchromatic and multispectral modes	Run by Spot Image (Toulouse, France), initiated by the CNES together with Belgium and Sweden
Jason 2 (Ocean Surface Topography Mission [OSTM])	High-precision ocean altimetry	The mission participants are: US National Aeronautics and Space Administration (NASA), providing payload instruments, launch management. French Space Agency (CNES), providing spacecraft and payload instruments, US National Oceanic and Atmospheric Administration (NOAA), responsible for operation and control, processing and distribution of operational data received by its ground station to non-European users, and generating near-real-time products to users, European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), responsible for processing and distribution of operational data received by its ground station to users in Europe, generating near-real-time products to users.
RADARSAT-2[14]	Synthetic Aperture Radar (SAR); highest resolution is 3 m.	Owned and operated by MacDonald Dettwiler and Associates by order of Canadian Space Agency. Kongsberg Spacetec of Norway provides ground station services including the provision of data.
TerraSAR-X	SAR in the X-band, highest resolution is 1 m	Joint PPP project between the German Aerospace Center (DLR) and EADS Astrium. Infoterra holds the exclusive commercial exploitation rights. Infoterra is a wholly owned subsidiary of Astrium, a European satellite system specialist.
COSMO-Skymed (Constellation of small Satellites for Mediterranean basin Observation), part of French-Italian Earth	Four satellites with SAR in the X-band, three of them in orbit, stereoscopic imaging by simultaneous use of two satellites	Funded by the Italian Ministry of Research and Ministry of Defence

[13] www.spotimage.com
[14] www.radarsat2.info

observation system ORFEO (Optical & Radar Federated Earth Observation)		
TopSat	Collaborative low-cost satellite mission, containing an optical camera. Launched in 2005 and fully operational as of 2009 – well beyond its design life of one year	Funded by the UK Ministry of Defence (MoD) and by the British National Space Centre small satellite initiative (Mosaic)
RapidEye	German programme of five satellites identical in construction. Due to the number of satellites, the RapidEye satellite system is capable of imaging any point on Earth every day in visible wavelength region plus near infra-red with a nominal resolution on the ground of 5 m.	Funding was secured for the RapidEye satellite constellation and ground segment with the help of the EU, the State of Brandenburg (Germany), and a banking consortium consisting of Commerzbank, EDC (Export Development Canada) and KfW Banking Group. RapidEye AG is a commercial service provider.[15]
UK-DMC satellites	Network of five affordable Low Earth Orbit (LEO) microsatellites. The objective is to provide a daily global imaging capability at medium resolution (30–40 m), in three or four spectral bands, for rapid-response disaster monitoring and mitigation.[16] The UK-DMC satellites will acquire satellite imagery of sub-Saharan Africa. The data will constitute an essential part of GMES and a contract between ESA and UK-based DMC International Imaging Ltd includes changes to the company's systems to interface with the ESA image catalogue as the complementary data will be made available by the ESA Sentinel missions.[17]	The Disaster Monitoring Constellation (DMC) is an international programme initially proposed in 1996 and led by SSTL (Surrey Satellite Technology Ltd), Surrey, UK

Source: Author's visualisation.

Beside the programmes listed above, some follow-ups and new missions are scheduled, as outlined in Table 2.

[15] Press release, 4 February 2009, RapidEye AG: With testing completed, RapidEye is 'open for business', www.rapideye.de/upload/documents/Press_Releases/RapidEye_Press_Release_Feb_04_2009.pdf.

[16] Mission website on http://envisat.esa.int/object/index.cfm?fobjectid=5543.

[17] Press release, 17 August 2009, DMCii wins 3.9m euro ESA contract to image sub-Saharan Africa: www.ballard.co.uk/press_releases/files/1438/DMCii%20wins%203.9m%20Euro%20ESA%20contract%20to%20image%20sub-Saharan%20Africa.pdf.

Table 2: Non-exhaustive list of scheduled satellites contributing to GMES

Name of satellite project, scheduling	Type of physical sensor, technical remarks	Sponsorship
Pleiades (part of French-Italian Earth observation system ORFEO). Launch of PLEIADES-1 is scheduled for 2010, of PLEIADES-2 for 2011; carry on the SPOT missions.[18]	Very-high-resolution remote sensing by optical imaging at visible light and infrared, stereoscopic imaging by simultaneous use of two satellites	Funded by CNES France; Spot Image, a public limited company created in 1982 by CNES and subsidiary of EADS Astrium (81%), is the official and exclusive worldwide distributor of PLEIADES products
Jason 3, Jason-2 follow-on programme	Spacecraft identical in construction to Jason-2, instruments to be defined	EUMETSAT, NOAA and CNES have confirmed a commitment to Jason-3 for 2013–14[19]; to be fully funded by the end of 2009. EUMETSAT is prepared to contribute EUR63 million to the EUR252 million programme costs of Jason-3.[20]
Radarsat Constellation Mission,[21] launched every 15 months from 2012 onwards	SAR, three satellites identical in construction	Owned and operated by MacDonald Dettwiler and Associates by order of Canadian Space Agency. Kongsberg Spacetec of Norway provides ground station services including the provision of data.
MetOp MetOp-A came into service in 2007, MetOp-B and -C are in preparation	Series of polar orbiting meteorological satellites dedicated to operational meteorology. These polar-orbiting satellites carry very different instruments in order to monitor the atmosphere, such as an infrared interferometer for measuring atmosphere temperature and relative humidity, plus the amount of trace gases such as atmospheric ozone, carbon monoxide, carbon dioxide, nitric oxide, sulphur dioxide and methane.[22]	MetOp has been developed as a joint undertaking between ESA and EUMETSAT. It is part of the European contribution to a cooperative venture with the NOAA through the Initial Joint Polar Satellite System (IJPS).

Source: Author's visualisation.

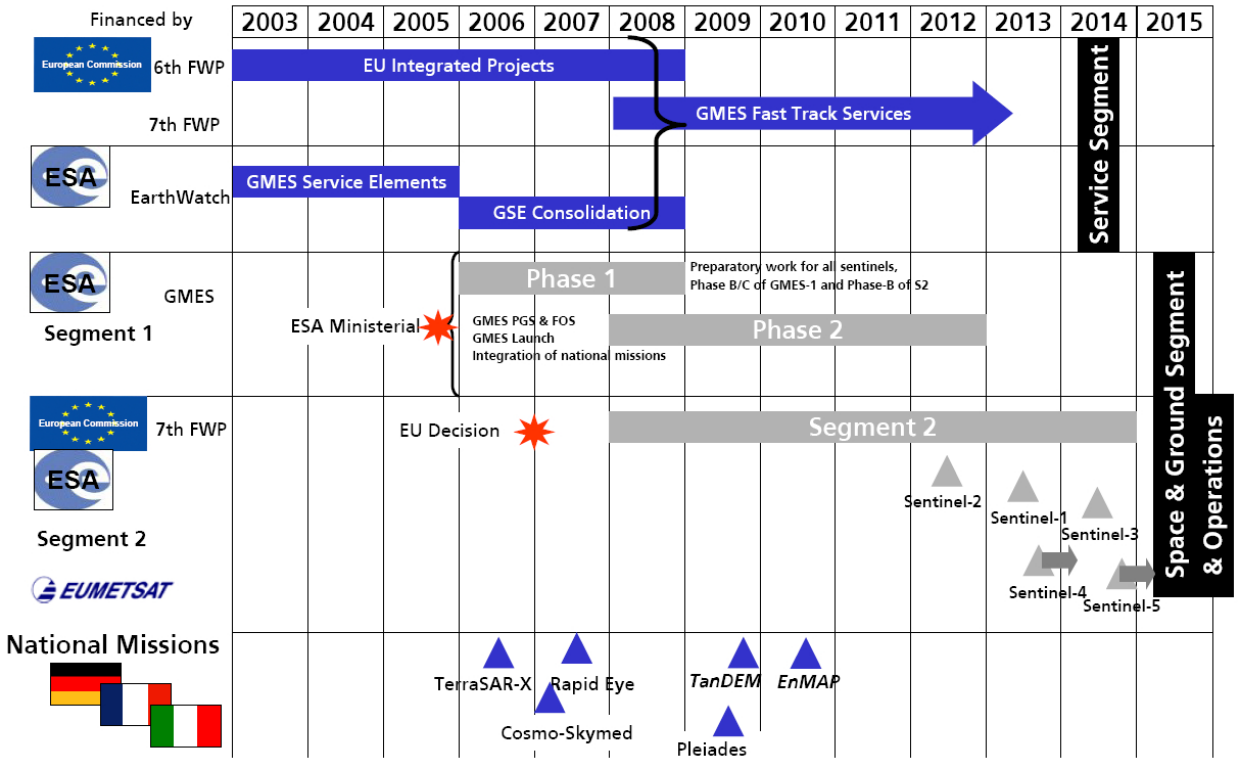
[18] http://ec.europa.eu/research/rtdinfo/44/01/article_2027_en.html.
[19] http://www.aviso.oceanobs.com/en/missions/future-missions/jason-3/index.html.
[20] EUMETSAT press release (1 July 2009): EUMETSAT 67th Council moves GMES and Jason-3 forward: www.eumetsat.int/Home/Main/Media/Press_Releases/713695?l=en.
[21] Simon Chesworth, A new era of spaceborne SAR and its contribution to disaster management and damage mitigation, presentation, www.arct.cam.ac.uk/curbe/..%5CCURBE%5CPresentations%5CChesworth.pdf.
[22] ESA news, 16 October 2006: Europe's first polar-orbiting weather satellite ready for launch: www.esa.int/esaLP/SEMAETN7BTE_LPmetop_0.html.

The ESA sentinel missions are dedicated GMES missions. The tasks they are designed to accomplish are:[23]

- Sentinel 1 – High-resolution SAR imaging
  All weather, day/night applications, interferometry planned for launch at the end of 2011;
- Sentinel 2 – High-resolution multispectral imaging
  continuity of Landsat, SPOT and vegetation-type data, especially for land services planned for launch at the end of 2012;
- Sentinel 3 – Medium-resolution ocean and global land monitoring
  Wide-swathe ocean colour and surface temperature sensors, altimeter planned for launch at the end of 2012;
- Sentinel 4 – Geostationary atmospheric
  Atmospheric composition monitoring, trans-boundary pollution planned for launch in 2017;
- Sentinel 5 – low earth orbit atmospheric
  Atmospheric composition monitoring planned for launch in 2019.

The sentinels have been en route towards realisation since the contract for building Sentinel 1 was signed on 18 June 2007. Under a EUR195 million contract signed on 17 April 2008, Astrium will provide the first Sentinel 2 satellite to ESA.[24]

Figure 4: The GMES Master Schedule



Source: speech, The German Remote Sensing Data Center - Earth observation for global monitoring of environment and security, by DLR (2006).

[23] Virginia Puzzolo, Global monitoring for environment and security: the European Earth observation capacity, presentation slides (2008): www.eurogeosurveys.org/assets/files/news/2008/February/presentations_session1/Puzzolo%20DG%20Entr%20GMES%20present.pdf.

[24] *Window on GMES* Issue no. 1 (May 2008), p 93.

The funding aspects of GMES Space Components (GSC) are divided into Segment 1 and Segment 2. Both segments consist of a build-up phase, a pre-operational and an operational programme. The build-up phase of Segment 1 (which began in 2006) comprises the development of the first generation of sentinels, data access to MS/EUMETSAT missions, the ground segment and early operations (also called pre-operational programme). Segment 2 (which started in 2008) overlaps with Segment 1 and runs through to 2018. It covers the development of the ground infrastructure and the completion of the full operational capability of the first three sentinel missions, each of which is intended to operate as a pair of satellites. The total costs amount to approximately **EUR2.4 billion**.

The core funding of Segment 1 was provided by ESA with EUR758 million (Council of Ministers 2005). In November 2008, the ESA Ministerial Council pledged over EUR830 million – some 97 per cent of the budget requested – to fund Segment 2 of the GSC. This decision was then consolidated and put into practice in January 2009 through a binding agreement between the Commission and ESA.

The moneys will thus fund the completion of the existing constellations, with the launch of the second 'twin' Sentinel satellites (1B, 2B and 3B) from 2015 to 2017, along with the necessary ground support. The reason for having two almost identical satellites of each type is a high revisit frequency. In full operational phase, the pair of Sentinel 2 satellites will deliver data taken over all land surfaces and coastal zones every five days under cloud-free conditions, and typically every 15–30 days considering the presence of clouds. Instruments for the Sentinel 4 and 5 missions will also be launched on-board other planned satellites, along with a Sentinel 5 precursor.[25]

The **next major institutional landmark for the space infrastructure of GMES is expected to be 2011**, when the satellites are in orbit and funding is needed for operating them. To put it differently, the decision reached during the Ministerial Conference ensures continuity in satellite imagery infrastructure and paves the way for the build-up of the operational space component of GMES, in a timeframe of another ten years.[26]

The Sentinel Data Policy is equated with open and free of charge access to sentinel data to all users, for both GMES use and other uses, aiming for maximum availability of data and corresponding access services. Priority management in case of conflicts will follow the High Level Operations Plan (HLOP) set up by ESA.[27]

The goals for the GMES Space Components are to guarantee the continuity of the services over decades and to handle the enormous quantity of data to be assimilated and delivered. This includes one or more meritocratic operators and careful planning of every aspect of the missions.[28]

2.1.2. The in-situ observation infrastructure

The in-situ infrastructures consist of a measurement network coordinated at national level, including the current EU contribution to international networks, such as World Meteorological Organization, in atmosphere, ocean and hydrology. The instruments are variously air, sea and ground-based (including airborne balloons, floats, ship-borne measuring stations and seismographs). The in-situ infrastructures are funded by contributions from EU MS.

The European Environment Agency (EEA) coordinates networks of data providers from MS in order to fulfil its mandate of providing environmental information and assessment.

[25] ESA's sentinel satellites, www.esa.int/esaLP/SEMM4T4KXMF_LPgmes_0.html.
[26] *Window on GMES* Issue no. 3 (March 2009), p 92.
[27] Susanne Mecklenburg, Sentinel data policy: an overview (2009): www.congrex.nl/08c33/papers/6.1_Mecklelenburg.pdf.
[28] Serge Plattard, What's the problem with Europe's flagships Galileo and GMES? *The Yearbook of Space Policy 2006/2007*, Springer Vienna.

This non-space infrastructure is very heterogeneous. Some of its systems are very complex, others much less so. It ranges from a 3,000-item network of drifting oceanic robotic probes operating worldwide day and night, to a single GPS-assisted walk to draw up a forest inventory. It is both global in nature (as is the remote sensing) and limited to place and time (as with in-situ – in the narrower sense – 'opportunity observations' and ad-hoc measurement campaigns).

The following examples should serve to indicate the **broad range of in-situ infrastructure**:

- In order to monitor sea level, GMES will include data from the Argo programme, a network of 3,000 floats measuring the temperature and salinity of the ocean down to 2,000 m. The Argo program is a collaboration of research agencies from 26 countries, with the USA contributing over half the total funding, followed by Japan, Germany, France, Australia and South Korea.
- Satellite images from space are very useful for identifying suspected oil spills, but surveillance airplanes and helicopters have to build a case and control it on site.[29]
- In-situ Land Use and Cover Monitoring (LUCAS) is part of the experimental and operational activities on land cover and land use monitoring. In 2009 more than 230,000 points will be visited in 23 EU countries. The kind of land cover and use and the height of trees will be determined, and a landscape photo will be taken. At 10 per cent of the points a soil sample will be taken and analysed in a laboratory. LUCAS is funded by Eurostat and part of the European Statistical Working Programme.[30]
- After forest fires, the data from Earth observation are compared and validated with in-situ GPS surveys, in order to produce an exact and reliable assessment of the burnt area.[31]
- The in-situ measurement network around the volcano Mount Etna indicates anomalous activities and their sources. Infrasonic signals and seismic data reveal an ongoing seismic wave.[32]
- A typical airborne campaign is In-Service Aircraft for the Global Observing System - European Research Infrastructure (IAGOS-ERI). It deploys newly developed high-tech instruments for regular in-situ measurements of atmospheric chemical compounds (O3, CO, CO2, NOy, NOx, H2O), aerosols and cloud particles. The measurement equipment is carried in planes by associated airlines. The data will be available in near real time to weather services and GMES service centres.[33]

Concerning the operational sustainability of observational infrastructure, MS often have highly developed structures for the collection and sharing of environmental data. Nevertheless, many important observation infrastructures are currently strongly dependent on research funding. The current dependence of GMES on FP7 funding would perpetuate this.

Hence, the operational sustainability of some observation systems essential for GMES Core Services is not yet assured. In the same way, financial incentives are lacking to properly maintain historical databases.

Related to **data policy**, existing networks are not yet in a position to provide standardised data to GMES services, as there is a lack of coordination and harmonisation of networks at European level.

[29] *Window on GMES* Issue no. 2 (September 2008), p. 24.
[30] Speech of Marjo Kasanko at the Geoland Forum 5, Berlin, May 2009: LUCAS 2009 – Collection of European ground data; www.gmes-geoland.info/events/download/Kasanko_LUCAS_2009_geolandforum_May_2009.pdf.
[31] *Window on GMES* Issue no. 2 (September 2008), p. 27.
[32] Bernardo De Bernardinis, Earth Observation data provides operational support to Italian Civil Protection activities during an Etna eruption, in *Window on GMES* Issue no. 3 (March 2009), p. 52.
[33] www.iagos.org.

Data access is currently limited because most of the relevant in-situ infrastructures are in the ownership of Member States, who have very different economic models for their operation and maintenance, and consequently apply very different access policy from totally free to fully commercial.[34]

In general, in-situ measurement is an essential complement to space-based Earth observation (EO). Nevertheless EO services are often regarded as competitors by decision makers because the services provided by satellites are intuitively simple to comprehend, compared with the lack of homogeneity of the non-space infrastructure.

2.2. The services provided from GMES raw information

The GMES services produce information in response to European policy priorities on the environment and security. They rely on data from the in-situ and space components we have described. In 2007, the EU German Presidency organised a symposium in Munich on 'The way to the European Earth observation system GMES – the Munich roadmap'. This roadmap, resulting from a consensus between the GMES stakeholders and the GMES Advisory Council (GAC), summarizes the architecture agreed and proposes principles for the operational implementation of the European EO services, including milestones for the way forward. More specifically, it distinguishes between the Core Services and the Downstream Services.[35]

The Core Services provide standardised multi-purpose information common to a broad range of EU policy-relevant applications. The Downstream Services are more targeted to national, regional or local information needs or specific thematic areas. Their most significant difference from the publicly funded Core Services is the participation of and partial financing by the private sector. In other words, the domain of services is the intermediate layer between the infrastructure and the users.

In general terms, the service areas are:

- land monitoring, initially European land cover and urban areas;
- marine monitoring: sea state and ecosystem characteristics over global oceans and European regional seas;
- atmospheric monitoring: atmospheric composition for air quality (European) and climate change (global), ozone monitoring (global) and solar energy.

Further horizontal components are related to:

- emergency response;
- security;
- climate change.

Due to the complexity of the programme, which is related to the need to integrate space-based and in-situ data, GMES capacity can only be built up progressively, based on identified priorities and using existing elements whenever possible. Three service areas were chosen for fast-tracking: emergency response, land monitoring and marine services.

[34] GMES Bureau 2007, *Long-term continuity of the GMES in situ Component. Governance and implementation issues,* GAC-09-02ANN1, (23 November 2007).
[35] Serge Plattard, What's the problem with Europe's flagships Galileo and GMES? *The Yearbook of Space Policy 2006/2007*, Springer Vienna.

The resulting **Fast Track Services**, funded by a first call on FP7, are:

- SAFER — Services and Applications For Emergency Response;
- Geoland2 — Towards an operational GMES Land Monitoring Core Service, funded by the EC in FP7 and the successor to Geoland in FP6;
- MyOcean — Development and pre-operational validation of upgraded GMES Marine Core Services and capabilities.

A fourth fast-track service called Supporting Awareness and Information Dissemination for GMES Fast Track Services (SWIFT) is superordinate to the other three.

The first call on FP7 space funding will make available GMES **pilot services**:

- MACC — Monitoring Atmospheric Composition and Climate;
- G-MOSAIC — GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises.

The pilot services will include, for example, services such as atmospheric monitoring, external border surveillance and crisis prevention. These services were requested by MS which have emphasised the importance they attach to them. These specific ones were selected in order to gain experience, to produce data sets for information requirements at European, national, regional and local level, and to provide the basis for the first downstream activities. Implementation Groups (IG) are responsible for the supervision and validation of the implementation of the fast track services. The processes for qualifying fast track services and defining pilot services, such as the establishment of the IG, set the basis for the 2007 FP7 call.[36]

The coordination of service requirements is made by the EC and other EU agencies. There are three stages in dealing with the financing issues for GMES services: a R&D-funded demonstration stage, a mixed R&D and operational-funded pre-operational stage, and the operational-funded operational stage. For example, 30 per cent of the budget for GMES space-based applications in FP7 is given for services development by the EC.

From the user's viewpoint the services based on GMES information are most relevant. The implementation steps for each GMES service are user workshops (as a starting point to identify users' needs), implementation groups (for the detailed specification of user requirements and the contents of the Core Services), service preparation and validation through R&D projects, and integration of the various elements (R&D, pre-operational and existing operational capacities, architecture and governance), to be established in line with operational delivery and the operational phase from 2013 onwards. It is still an open-ended question to what extent the private sector might be interested in the restriction of access to raw data, so that those who acquire it can generate market opportunities.

Land monitoring services are a good example to show the structure of a GMES Service Element (GSE). Here it is GSE Land, which aims to deliver geo-information services over large areas and for a wide spectrum of land applications. In the project Geoland2 (funded under FP7), the emphasis is on capacity building for operational production of the European Land Monitoring Core Service, to deliver information-based products to end users.

The GMES land monitoring services will consist of two general types of geo-information services addressing user needs on different geographic levels:

- the Land Monitoring Core Service (LMCS), and;

[36] Thomas Geist, Österreichische Forschungsförderungsgesellschaft (FFG), speech: GMES – Entwicklung und Status (2008).

- Downstream Services.

The **LMCS** will consist of Core Mapping Services providing basic land cover information on different spatial scales, both pan-European and globally, and Core Information Services refining the data to thematic information for various fields of application. This is relevant for all of Europe, and will support the reporting obligations arising from EU directives and international treaties as well as environmental and urban planning measures.

On the basis of the Core Services that are intended to serve general global and European interests, customised **Downstream Services** will address the specific user needs of institutional and private -sector customers on the regional and local level. These Downstream Services will be supported by the European Commission (EC) on the basis of specific funds offered under FP7. This started in mid-2008, but the details have still to be defined.

3. COMPARISONS WITH GALILEO

KEY FINDINGS

- GMES and Galileo showed similar problematic tasks during their development phases, leading to delays and cost overruns.
- Both, Galileo and GMES lacked clear programme tasks from the outset. In the case of GMES there was a controversial discussion about the definition of 'security'.
- There was an insufficient political support.
- Both programmes had inadequately defined roles for the decision makers, leading to the programme-managing entities (in the GMES Bureau) having weak authority. The GMES Bureau has not been able to develop Downstream Services, involve industry, and structure future funding of operational services as expected.
- There are unclear plans for revenue generation. Although the first three Fast Track Services are in operation, no revenue has yet been created. In addition, it is not yet known how GMES will be financed after 2013.
- Uncertainty about how the EU will deal with the IPR issues might scare applicants, service providers and equipment manufacturers, and make them reluctant to invest in the development of products and services.
- In order to ensure successful and fast programme progress, it is indispensable to have strong political support, a clear definition of the roles of different actors, and adequately prepared financing models.

3.1. The European Satellite Navigation Programme (Galileo)

In the mid-1990s the EU initiated the construction of a European-based Global Navigation Satellite System (GNSS).[37] The decision to develop this system was motivated by three factors:

- **Politics**: It was a declaration of an independent European GNSS capability;
- **Economics**: It was seen as commercially viable. The market for satellite navigation products and services was growing in 2006 by 25 per cent per annum;[38]
- **Technology**: The aim was to obtain a large piece of the very fast-growing space products market, which is dominated by the US Global Positioning System (GPS) at present. As a result it was necessary to aim to produce the best available navigation system, with outstanding performance in terms of accuracy, continuity and availability.

The GNSS programme is based on a constellation of satellites comparable to the (currently fully operational) US GPS system and the Russian GLONASS. The strategy for the development of the European GNSS consists of two phases. The first phase programme is the European Global Navigation Overlay System (EGNOS) and the second phase programme is Galileo.

EGNOS was initially intended as a demonstration system. Later it was decided to convert it into an operational programme. It was planned as a regional system for Europe that monitors and corrects the signals emitted by existing satellite navigation systems (GPS and GLONAS) by improving their accuracy and assessing their reliability.[39]

[37] *Satellite Navigation Services: A European Approach*, COM(94) 248 final (14. June 994).
[38] *Green Paper on Satellite Navigation Applications*, COM(2006) 769 final (8 December 2006).
[39] The US GPS and the Russian GLONASS were developed in the 1970/1980s and represent the first generation in satellite navigation technology.

The services offered by EGNOS should have been a precursor to future Galileo services and applications. However, EGNOS is not in operation yet.

Galileo, the second-phase programme, is the European counterpart of the US global navigation and timing system GPS and a joint initiative of the EC and the ESA. Unlike GPS, Galileo is designed as a civil system under civil control. The fully deployed system will consist of 30 satellites in three circular orbit planes at about 23,000 km altitude above the Earth. It is planed that Galileo will offer several signal enhancements, resulting in improved accuracy and more resistance against multi-path reflections and interference. Signals from at least four satellites will be receivable all over the world at all times.

The following five basic services will be offered by Galileo:

- The **Open Service** will be available free of charge and will provide competitive position and timing performance relative to other GNSS systems. It will not require any signal guarantee.
- The **Safety of Life Service** will be offered to the critical transport community for civil air-traffic control or the maritime sector. It will have an additional function, a timely warning of reduced accuracy.
- The **Commercial Service** will be encrypted and will provide an improved accuracy and higher data throughput rate for professional use.
- The **Public Regulated Service** will provide position and timing to specific users requiring a high continuity of service. The access to this encrypted service will be only for authorized users, such as emergency services, police, security forces and the military.
- The **Search and Rescue Service** will contribute to the International Satellite System for Search and Rescue. Signals from emergency beacons carried on ships or planes will be pick up by the satellites and sent to rescue centres. Thus the location of an accident can be identified easily. Additionally it will be possible to send a signal back to the person transmitting the emergency beacon, to inform them that help is on the way.

It is expected that **revenues**, for example through **IPR licences**, will be sufficient to cover the public expenses of Galileo and EGNOS. The direct revenues of Galileo (and EGNOS) during 20 years of exploitation are estimated to be EUR9.1 billion, with a lower estimate of EUR4.6 billion and a higher of EUR11.7 billion. Additional indirect revenues are estimated to total EUR50–60 billion. Revenues over the five Galileo services will mainly come from special use of the Open Service and the Public Regulated Service. More than half the revenue estimate is based on charging for manufacturing devices, such as chipsets and user terminals.[40]

[40] Policy Department Economic and Scientific Policy, *Study: EU Space Policy and its Potential for EU Industrial Sector Competitiveness* (September 2007).

3.1.1. Development of Galileo

The Galileo programme was divided at the outset into four phases. After the first, definition phase (1999–2000), the EC presented concrete proposals on the definition of the system, its economic and financial aspects and its management structure. The initial timetable for the following phases of the Galileo programme was established as follows:

- 2001–05: Development and validation phase;
- 2006–07: Deployment phase;
- from 2008: Commercial operation phase.41

At this stage the total cost for bringing the system to full operational capability was estimated at EUR3.2 billion. It was planed to fund the Galileo programme development through a **PPP**.[42]

The development and validation phase started in March 2002, 15 months later than had originally been planned. Two months later the **GJU** was set up by the EC because of the need of a coordination platform between the EC and the ESA.[43] The GJU did not however become operational until September 2003. The most important task of the GJU, founded as a private company, was to finalise the negotiations with private industry to select a concessionaire for carrying out the development and deployment phase by PPP. The GJU was unable to select a preferred consortium as a winner of the tender. Negotiations did not start in earnest until 2006, when the two remaining bidders merged into one consortium. In November 2006 an incomplete version of the heads of agreement was signed, leaving two major issues open: the transfer of the design risk to the private sector, and the transfer of the market risk to the private sector.

At the end of 2006 the GJU was closed down by the EC. Its activities were transferred to the European **GNSS Supervisory Authority (GSA)**, which had been set up two years earlier, to manage the public interest aspects of the European GNSS programmes and to act as the regulatory authority for the programmes during the Galileo deployment and operational phases.[44] This activity transfer resulted in a change in the role of the GSA, which had not been foreseen at its creation.

Internal industrial disagreements led to the negotiations coming to a halt. In early 2007 the Galileo programme had run up a **five-year delay** compared with the initial timetable, and significant **cost overruns**. After a detailed analysis of the structures for financing, management, procurement and governance, the EC decided to redirect the Galileo programme.[45] The lessons learned from this analysis flowed directly into the redirection of the programme. The organisation changed markedly, as follows:

- The European Galileo programme is for the time being fully funded from the Community budget, with an additional EUR2.3 billion being added to the original cost estimates. The total operating and maintenance costs to 2030 are estimated at another EUR5.3 billion. These new estimates seem to be reasonable and include contingencies.

[41] *On Galileo*, COM(2000) 750 final (22 November 2000).
[42] *On Galileo*, COM(2000) 750 final (22 November 2000).
[43] *Setting up the Galileo Joint Undertaking*, EC No. 876/2002 (21 May 2002).
[44] Council Regulation of 12 July 2004: The establishment of structures for the management of the European satellite radio-navigation programmes, EC No. 1321/2004.
[45] Regulation of the European Parliament and the Council of 9 July 2008: On the further implementation of the European satellite navigation programmes (EGNOS and Galileo), EC No. 683/2008.

- The GSA has lost its role as the supervisory authority. Programme management is now being carried out directly by the EC. In view of the importance and complexity of the programme, the EC, the European Parliament and the Council are supported by a Galileo Inter-institutional Panel (GIP). The implementation of GIP contributes to transparency. ESA acts as the procurement agent. A mixed industrial team will support all system design choices and decisions.
- The new procurement structure divides the Galileo system into six working packages: system support, ground mission segment, ground control segment, satellites, launch service and operations.

In 2008 the EC launched a call for the purchase of the six infrastructure packages. First proposals were received at the end of the year. The competitive dialogue process is expected to be finished in the course of 2009, so that the **full operational phase of Galileo can ultimately start in 2013** (for 30 satellites plus the ground infrastructures). The development phase, which will allow for in-orbit validation, is under way and foresees the manufacturing, testing, launching and validation of two experimental satellites (GIOVE A and B have already been launched), four operational satellites and ground control segments.

PPP or other forms of contracts with the private sector or any other form of governance will be concluded for the operation of the system after 2013.[46] Until then the whole programme will be **financed by public funds**.

For the development of applications and services based on Galileo, an action plan will be launched in 2009 according to the Green Paper.[47] Up to the present, **no Galileo services are available and no business models of revenue generation exist**.

Space experts, such as the director of the Astrium satellite division, Evert Dudok, doubt whether the aim to start the operational phase in 2013 can be achieved.[48] Today Galileo is about five years behind its initial schedule and **no operational satellites have been launched**.

3.1.2. Difficulties with Galileo

The Galileo programme was the first close collaboration between the ESA and the EC on such a large space programme. It was the first industrial programme to be managed at European level, and the first time the EC was to participate in a PPP, so in many senses the Galileo programme was the first of its kind. It is appropriate then to analyse the reasons for the delays and difficulties in detail, so lessons learned can be applied in subsequent EU programmes such as GMES.

The first sign of slowdown was the long time it took for the Council to decide on the full start of the development and validation phase (15 months later than planned). This delay was caused by difficult negotiations among the EU MS concerning **the use of the Public Regulated Service** designed for government customers. The controversial issue was that although Galileo is a civil programme, it was intended to be developed in such a way that there were no incompatibilities that would make it impossible to use the signals for military purposes.

While some EU MS declared that a civilian programme could be used for non-civilian applications under any circumstances, others felt that it was not reasonable to prohibit military use of a Public Regulated Service. In particular, from a business point of view, the widest possible range of uses would help to make Galileo profitable as fast as possible.

[46] *Annex, Work programme 2008 for the further implementation of the European satellite radio-navigation programmes (EGNOS and Galileo), including the Programme Implementation Plan*, C(2008) 8371 final (12 December 2008).
[47] *Annex, Work programme 2008 for the further implementation of the European satellite radio-navigation programmes (EGNOS and Galileo), including the Programme Implementation Plan*, C(2008) 8371 final (12 December 2008).
[48] G. Hegmann, Astrium warnt vor Wettbewerb bei Galileo, *Financial Times Deutschland*, 17 June 2009.

Most economists and industry representatives would agree that extending the customer base is one of the best ways to make any system more profitable.[49,50] In the past, civil space programmes have been used for non-civilian applications. For instance, European civil funds were used by ESA to develop military satellites such as Helios and Syracuse, Skynet and Sicral, and were launched by Arianespace.

The two main reasons for setting up the GJU were first, the need for a coordination platform between the EC and the ESA, and second, the need for a single entity to run the Galileo programme. The two most important tasks of the GJU were **to find private investors and conclude a concession agreement** within a PPP framework, and to supervise the ESA technical development activities during the development and validation phase.[51] Three years after GJU had come into existence, it seemed that none of the main tasks had successfully been concluded,[52] quite contrary to a GJU press release issued in 2006.[53]

Most experts regard the negotiations for a PPP as a failure. According to the report of the European Court of Auditors, the reasons were that the PPP had been inadequately prepared for, and the GJU has **underestimated the complexity** of the European Galileo Space Programme. Realistic studies were not conducted into what is marketable and whether the case for a PPP really existed.[54] As a result, the GJU was required to negotiate an unrealistic PPP. In addition, the tight timetable led to industry bids containing **no firm pricing or commitments**, so that a comparison of the bids was difficult. Because the GJU was not able to select a preferred bidder, it agreed to the merging of the last two bidders into one consortium, putting aside the competitive nature of the offer. Finally, only an incomplete heads of agreement document could be signed.

The supervision of the ESA technical development was seen by experts as problematic for two main reasons.[5] First, the ESA was both a founding member of the GJU and its contractor. This led to a **conflict of interest**. Second, the closing down of the GJU before the end of the validation phase and the early setting-up of its successor, the GSA, degraded the GJU's authority. For these reasons the GJU was not able to supervise the ESA adequately. Experts have pointed to the lack of clarity in defining the roles of the entities involved in the programme (ESA, EC and GJU), which led to unclear lines of accountability. Therefore, many decisions related to Galileo were affected by the fact that **no single actor could assume full responsibility**. This unclear management situation resulted in enormous delays. For instance, the second Galileo In-Orbit Validation Element (the GIOVE-B satellite) was launched 30 months later than planned.

The recently founded Galileo Inter-institutional entity (GIP) is the seventh structure since 1999 to support the EC's work regarding the Galileo programme. Experts consider this **discontinuity** as a major problem.

Although public sector governance arrangements seem to have been defined in this new structure, the role of the European Parliament has still to be clarified. The management of the whole programme is carried out by the EC, and it has little experience in this field,[55] according to experts.

Therefore, there remain a number of difficult issues which add to the risks of the programme. For example:

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[49] *Green Paper on Satellite Navigation Applications*, COM(2006) 769 final (8 December 2006).
[50] Consulting project PACIFIC: PRS Application Concept Involving Future Interested Customers, www.gsa.europa.eu/projects/pacific/www.prs-pacific.eu/index0c51.html?option=com_frontpage&Itemid=1 (18 August 2009).
[51] As established in the statues of the GJU.
[52] European Court of Auditors, *The Management of the Galileo Programme's development and validation phase,* special report No. 7, 2009.
[53] GJU press release, Next step in the Galileo Program: Handover of the management from the Galileo Joint Undertaking to the European GNSS Supervisory Authority, 30 November 2006.
[54] European Court of Auditors, *The Management of the Galileo Programme's development and validation phase*, special report No. 7, 2009.
[55] European Court of Auditors, *The Management of the Galileo Programme's development and validation phase*, special report No. 7, 2009.

- The development of applications and services based on Galileo will start at the earliest in 2009, with the publication of the action plan by the EC. However, the development of services and revenue models needs to be speeded up, to turn the Galileo programme into an economically profitable one as soon as possible;
- Galileo is based on expected revenues from offering satellite navigation signals. There is conflict between this requirement to generate income and the original intention that at least the Open Service should be free of charge. The EC might charge equipment manufacturers and service providers to use the Galileo signals, so even the Open Service will not be entirely free of charge;
- Intellectual property rights (IPR) licences for the certification of receivers, user terminals and other devices should guarantee the expected income. But uncertainty about how the EU will deal with the IPR issues might scare applicants, service providers and equipment manufacturers, and make them reluctant to invest in the development of products and services. Experts fear that the unknown size of IPR royalties could make Galileo devices more costly and less competitive than proven GPS devices;
- A definite pricing policy for Galileo services is not yet known. The only pricing statement available is that customers should receive high-quality services at fair prices;[56]
- Another unsolved problem related to IPR is that services developed for Galileo might enter into foreign hands, for instance through cooperation with countries outside Europe;
- Finally, experts regard the high costs to obtain patents and the unclear global patent situation as reasons that many SMEs do not use the available systems to protect their IPR.

3.2. Difficulties with GMES and comparison with Galileo

The development of such big space programmes as GMES and Galileo is not an easy task. Comparing two programmes that are at a different phase of realisation is also quite difficult. Therefore, the findings outlined here should be considered with care.

Galileo and GMES, two complementary European satellite programmes, aim to provide services for end users, ranging from ordinary citizens to public and private bodies. Both programmes underwent difficult development phases.

The nature of GMES, which can be seen as the second European space flagship programme, is different from that of Galileo. First of all, **GMES is a semi-space programme**. It collects its data not only from space satellites, but also from land, sea, air and space-based probes. **Galileo is a classical space programme**, which is mainly based on 30 similar satellites and the corresponding ground structures.

The main difference is that while the Galileo programme is still in the development phase, GMES has now entered its pre-operational phase. It has been claimed that in 2011 it will be technically feasible to move into the operational phase. Most of the GMES infrastructure already exists and the main part of the components is currently in operation. Therefore the first (pre-operational) GMES services can already be offered (that is, the Fast Track Services: emergency response, land monitoring and marine services).

The **progress** of GMES is similar to Galileo – **very slow**.

Considering that most GMES infrastructure components already existed when the programme started in 1998, it is difficult to understand why only **three Fast Track Services** are available after ten years of programme development.

[56] Regulation of the European Parliament and the Council of 9 July 2008: On the further implementation of the European satellite navigation programmes (EGNOS and Galileo), EC No. 683/2008.

Other GMES services, such as the Downstream Services, are still under development. They are not yet fully and permanently globally available, and their sustainability cannot be yet fully guaranteed. Further investment will be necessary to fill in the gaps in GMES services: for example, in the space infrastructure.[57]

One reason for the **delay may be the extreme complexity** of the programme, related to the integration of an enormous amount of different data from space-based and in-situ Earth observation capabilities into user-driven operational application services. Both the space-based and the in-situ Earth data need to be processed and synchronised before they can be incorporated in services.

Another reason is associated with the large number of actors involved in the GMES programme. When an international programme is based on existing elements and compelled to incorporate new ones, and this involves a large variety of actors, it is very difficult to solve problems fast and to move ahead in a coherent way, because it is tremendously hard to mediate between so many different stakeholder positions.

This was seen for example in the debate about GMES's name change in early 2002. Not every MS was comfortable with the 'S'. A working group has to be set up to **define 'Security', and this caused in a delay** in the programme.

To avoid such situations and to create a coordination platform for the GMES programme, the **GMES Bureau** was set up in March 2006. This is comparable to the Galileo structures, the GJU, GSA and GIP. The most important tasks of the GMES Bureau were to move GMES gradually from R&D towards a more user-driven approach and to be the centre for coordination of the EC's GMES services. The Bureau should also identify priorities for future services, and will eventually manage services in addition to the EC's, including those for EU institutions and bodies, MS, and intergovernmental organisations such as ESA, EUMETSAT and EUSC.

A Technopolis Group evaluation report on the activities of the EC's GMES Bureau concluded that the overall working of the Bureau had been good.[58] The Bureau has helped to promote the implementation of the three pre-operational Fast Track Services in 2008 and secure funding for preparatory action for the emergency services.

The authors also concluded that the Bureau had had less success with some other key issues, for example the development of the Downstream Services, because of the focus on Core Services like the Fast Track Services. The report mentioned too that the Bureau had had also less success in engaging institutional users and in directing links with industrial users. It discussed the problem that the stakeholders have **no clear idea of the benefits GMES might ultimately deliver**.

The Technopolis Group identified these reasons for the limited work of the Bureau:

- the low current level of development of GMES, where pre-operational services cannot cover the operational needs of individual Directorates-General, which rely instead on established information services and providers;
- the generally insufficient political support for GMES within the European Community;
- the limited control the Bureau has over the Research and Technological Development Framework Programme priorities and actions.

Big international programmes such as GMES or Galileo often show delays in their development. Although the programmes are not fully comparable, it seems that both went through development phase difficulties caused by similar problems (see Table 3).

[57] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008).
[58] E*valuation of the Activities of the European Commission's GMES Bureau, Final report* (February 2009).

Table 3: Comparison of the programme difficulties of GMES and Galileo

	GMES	Galileo
Programme terms	Argument between the EU MS about the definition of 'security' in the GMES programme. A working group had to be set up to define the term.	Difficult negotiations among the EU MS concerning the use of the Public Regulated Service designed for government customers for military purposes.
Controlling	Limits in its mandate, resources and institutional settings hindered the GMES Bureau from achieving tasks such as the development of Downstream Services, involving industrial users and structuring the future funding of GMES operational services.	Insufficiently clearly defined roles for the EC, ESA and GJU led to unclear lines of accountability. The GJU was not able to achieve its aims because of conflicts of interest between the actors, and its weak authority.
Financing	GMES is mostly publicly funded. It is planed to involve the private sector. The first three Fast Track Services are available but no revenue has yet been received. It is not known yet how the programme will be financed after 2013. A single budget line within the EU financial framework is being considered.	It was planned to fund bringing the Galileo system to full operational capability through a PPP, but negotiations failed. After a redirection the programme is now funded fully from the Community budget. No services are yet available and no business models of revenue generation exist.
Political support	The MS support is partly expressed by their financial commitments. MS with a large space industry are more disposed to invest in GMES.	Arguably the slow progress of Galileo, with as yet no concrete results, will lead to less and less political support, so that money that could have been used for Galileo projects will be diverted to other programmes.

Source: Author's visualisation.

The GMES governance and financing structures are discussed in more detail in Chapter 4.

3.3. Lessons learned

Different studies analysing the mistakes in the development of the two programmes have identified the following issues.[59,60,61]

Common political support is indispensable for successful programme continuation

If no clear, realistic and acceptable programme aims are formulated from the outset, the MS may have different expectations of such big international programmes.

[59] Policy Department Economic and Scientific Policy, *Study: EU Space Policy and its Potential for EU Industrial Sector Competitiveness* (September 2007).
[60] European Court of Auditors, *The Management of the Galileo Programme's Development and Validation Phase*, special report No. 7, 2009.
[61] Serge Plattard: What's the problem with Europe's flagships Galileo and GMES? *The Yearbook of Space Policy 2006/2007*, Springer Vienna.

There is a visible tendency for MS to try to 're-nationalise' international programmes, to maximise the national return in the interest of their national industries. Often they try to hold up or block important decisions which are needed for the continuation of the programme. The resulting compromises affect the direction of the programme and lead to unrealistic aims.

Therefore insufficient political drive from the top is a main reason for the failure to make critical decisions, leading to programme hold-ups. Strong programme management and a common will within the Programme MS and the European Community are indispensable for a successful programme.

A PPP agreement has to be prepared for adequately

PPP is an important form of cooperation in European programmes. Some EC countries have considerable experience of PPP projects, for instance in successful exploitation models for international satellite projects like Inmarsat, Intelsat, Eutelsat or Eumetsat. This experience indicates that the best practice for PPP includes the following elements:

- Adequate preparation and regular review: The public sector should clearly define the project aims, assess private sector capabilities, evaluate potential benefits, examine alternative ways of meeting needs, investigate appropriate risk management, consider affordability and likely value for money, and outline a business case. The choice of a particular type of PPP should be preceded by an appropriate risk assessment. During the ongoing project there should be regular review of the chosen PPP model, to ensure that it continues to offer value for money. Experiences with successful international satellite projects financed by PPP models should be considered in more detail in the planning of new satellite programmes such as GMES and Galileo. It can be argued that public funding is more appropriate for projects with incalculable risks, for example those using new and untested technology. In this way the programme development and the costs will stay under control, and the public sector partners will not try to negotiate a PPP with unrealistic aims, leading to delays.
- Maintain effective competition: PPP structures which lead to monopolistic structures, either through mergers of consortia or because of the procurement rules, should be avoided because any competitive element will be lost. It is not then possible to choose the most cost-effective bid.
- Sufficient time: The experience of other organisations suggests that defining a robust PPP approach and public-sector positions takes more than a year, even with PPP projects that are less complex than the European satellite programmes.

Appropriate management resources: Managing a PPP project requires a team with appropriate skills, assembled in good time.

A clear definition of the division of roles between the entities involved in the programme development is essential

When a programme incorporates a large variety of entities or actors, such as public and private partners, end users and suppliers, it is very difficult to move ahead in a coherent way if the actors' roles are not clearly defined. Therefore, it is necessary to establish rules of governance which clearly define the roles and responsibilities of all the actors or entities involved. Every delay in decision making or decision execution leads to high additional costs.

The development of such big programmes as the European programme for GMES and EGNOS/Galileo is not easy. It is not possible to avoid every risk in the programme (there is risk in every space programme), but if these points are noted and acted on, Europe will be well positioned to offer a broader range of satellite-based services in several application fields. It remains to be seen whether the programmes will turn into economically profitable ones.

4. GOVERNANCE

KEY FINDINGS

- The development and implementation of GMES is an iterative process. GMES partly builds on already existing components, which have independent functions and tasks. Additionally there are totally new components. This results in a melange of supranational and intergovernmental networks.
- Multiple stakeholders contribute together to the overall structure of GMES. There is a division of responsibilities between the political leadership (EC) and the technical knowledge and responsibility (ESA).
- The interim structure is quite fragmented and as a result it lacks efficiency and effectiveness. There arises the need for a GMES authority with a functional interim management structure. This role is intended for the EC and its management bodies.
- There are missing links between the users and the Downstream Services providers, on the one hand, and the actors involved in the technical implementation of GMES components, on the other hand.
- In order to ensure the main aim of GMES, to unite all the European, national and regional initiatives under one roof, the roles and responsibilities of the main stakeholders (particularly EEA and ESA) in the development and operation of GMES should be clearly defined. It is recommendable to give EEA an outstanding role and to fully engage it in the development and coordination of user-driven services.

4.1. GMES key stakeholder groups

The first subsection of this chapter offers a preliminary categorisation of the key stakeholder groups and describes their current and future roles in developing GMES. GMES is characterised by a **high variety of different actors with different roles which interact on and between different levels**. The most important stakeholders, those that play a fundamental role in the development of GMES, are categorised here by institutional level (European, national, regional and local, and intergovernmental) and their involvement in GMES. Since there will be more and more stakeholders in the future, this structure cannot be taken for granted.

The following categories have been selected:

1. Supranational institutions/European agencies;
2. Intergovernmental agencies;
3. Intergovernmental institutions;
4. MS/space agencies of the MS;
5. Regions;
6. End users.

4.1.1. Supranational institutions and EU agencies

Supranational institutions and EU agencies are important stakeholders in the development of GMES. Their institutional settings and different approaches on the initiative call for a detailed analysis.

Supranational institutions such as the EC and the European Parliament (EP) do not have any history of decision making in the space field, but they are in charge of the establishment of common rules and the elaboration of proposals on the European Space Policy (ESP). The new Lisbon Treaty (Article 4.3, 24, 172a) contains the regulations concerning the construction of the ESP. According to the Treaty the EC and the MS share competences for the space policy. In order to manage the relations between the ESA and the EC, 'the Union shall establish any appropriate relations with the European Space Agency'.

In institutional matters including mandate and governance, the **EC** (in cooperation with the Council of the EU and the MS) has a **leading position in the development of the GMES** initiative. The EC has primarily the objectives of defining the institutional setting, determining the responsibility of the different actors within GMES, and clarifying the future links between the different institutions and stakeholders. Furthermore, the EC is responsible for the development of the common institutional framework for the implementation of the GMES programme and its future development.

EU agencies, such as the European Defence Agency (EDA), the European Agency for the Management of Operational Cooperation at the External Borders (FRONTEX), EUSC, the European Maritime Safety Agency (EMSA), EEA, and Joint Research Centre (JRC) will be data providers and end users of the GMES services. A major challenge lies in cooperation between the agencies and their interaction with the EC. The main purpose is to create synergies with the EC for better coordination and communication on the GMES development and for efficient employment of funding. Table 4 gives some examples of cooperation projects that have started.

Table 4: Initial undertakings of EU agencies on GMES

Agency	Cooperative projects with GMES background
EDA	Multinational Space-based Imaging System (MUSIS) ad-hoc project related to the second generation of military earth observation satellites. EDA Project Team dedicated to Space Situational Awareness (SSA: European space civil-military platform/forum, under the chairmanship of ESA to understand the Earth's orbital population, the space environment, and possible threats based on data sharing policy).[62] Development of civil and defence-related space technologies: EC/ESA/EDA task force, involving European industry and Research & Technology (R&T) actors.
FRONTEX	Communication network for use and monitoring of common data (refugees and demonstration). To be linked with GMES for rapid access to all civil observation satellites.
EUSC	Implementation of Web Map Services within the GMES initiative (EUSC Annual Work Programme 2008). To be linked with GMES for rapid access to all civil observation satellites. Observation of the West African coast.
EMSA	Technical and scientific assistance to the EC and MS in the proper development and implementation of EU legislation on maritime safety, pollution by ships and security on board ships. EMSA CleanSeaNet Service to be linked with GMES Marine Core Services.
JRC	Potential contribution from existing and planned Earth observation satellites. Telecommunication integration within GMES services. Future cooperation with EUMETSAT in contributing to the extension of the GMES to Africa, Caribbean and Pacific (ACP) countries.

Source: Author's visualisation.

[62] Council conclusions on European Security and Defence Policy, 2943rd External Relations Council meeting, Brussels, 18 May 2009, p. 10.

The EEA already manages networks of data providers from MS to fulfil its mandate of providing environmental information and assessment to the EU.[63] Once the in-situ component becomes operational, the EEA will coordinate the different non-space components in GMES, which are often run by MS institutions.[64] A question arises about the role of the EEA. Should it be the first among equals, or does it act in behalf of GMES in all non-space data?[65] In order to ensure the main aim of GMES, to unite all the national initiatives under one roof, it is recommended to give the **EEA an outstanding role** and to fully engage it in the development and coordination of user-driven services.

4.1.2. Intergovernmental agencies

Intergovernmental agencies (ESA, EUMETSAT, European Centre for Medium-range Weather Forecasting (ECMWF)) are not part of the EU institutional framework. As independent agencies dealing with space missions, they have already strong links to the space industry. Compared with the involvement of EU agencies in GMES, the intergovernmental agencies are significantly more deeply involved in the processes of designing (construction), introducing and applying new technologies, which are important for the further development of GMES.

ESA develops space technologies and systems and coordinates the space component of the GMES. Its decision-making body is the ESA Council, where each MS has its own representative. Furthermore, the ESA convenes and prepares the Space Council meetings. The ESA has been a key player in the development of GMES, being in permanent discussion and information exchange with the EC.

The work of ESA is supported by **EUMETSAT** and ECMWF with scientific background and technical responsibilities. EUMETSAT (2009) and ECMWF (2005) signed Agreements with ESA on the GMES programme, and exchange information and expertise on weather data. EUMETSAT contributes to GMES Core Services with data from its satellites. It will also contribute with data and products from its future missions. In addition, it will operate some elements of the sentinel satellites, such as Sentinel 3, serving the marine user community with near-real-time and off-line products.

ECMWF is the coordinator of the atmospheric services and is a partner in the three Fast Track Services (ocean, land and risks). Existing ECMWF infrastructure includes telecommunication, high-performance computing and archive facilities. Further cooperation with the EU foresees the development and implementation of projects on GMES with an atmospheric background (such as MACC)[66]. This reflects the further ECMWF involvement in EU-funded projects concerning its mission on weather forecasting and data distribution. A future priority of ECMWF will be to establish a functioning link of cooperation to European institutions, for instance with DG Environment, DG Development, EEA, European Parliament, and the Council of the EU.[67]

4.1.3. Intergovernmental institutions

At the political level, the Council of the EU and the ESA Council of Ministers are the two important executive institutions involved in the current and future implementation of the ESP. The Framework Agreement signed in 2003 sets the basis of cooperation between the two players. As provided in Article 8 of the Agreement, both organisations created common institutions on the observation and implementation of the aims laid down in the Agreement. They serve as communication platforms for the cooperation between the EU and ESA.

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[63] GMES Bureau 2007, *GMES In-Situ Observation Working Group*, GAC-09-03 (23 November 2007).
[64] Josef Aschbacher, GMES Space Component, Paper presented at Towards e-ENVIRONMENT, Prague, 25–27 March 2009, www.e-envi2009.org/?presentations.
[65] Zofia Stot, GMES organisational models: pros and cons of different approaches for the public and private sectors. Paper presented at the Impact of GMES Governance Models on Industry Workshop, 11 May 2009, Brussels, www.eomag.eu/articles/834/the-impact-of-gmes-governance-models-on-industry.
[66] Monitoring Atmospheric Composition and Climate, which will deliver pre-operational services from 2009–11.
[67] ECMWF, *Four-Year Programme of Activities 2009–2012*, p. 24, www.ecmwf.int/about/programmatic/4yp-2009-2012.pdf.

- Space Council (SC): consists of representatives from the concerned ministers of the EU MS and the ESA MS. It endorses orientations, actions and recommendations, and acts as a control body over ESA/EC cooperation. However, the Space Council takes decisions which are not binding for the contract parties;
- High Level Space Policy Group: supports the SC; ensures cooperation between EC and ESA on a regular basis;
- Joint Secretariat: supports the SC.

4.1.4. MS/space agencies of the MS

The MS level remains the most important level in the decision-making process in the field of the ESP and its leading initiative, GMES.

All MS (of ESA and EU) are part of the governance bodies that have been created around the GMES initiative. On the national level all MS are requested to further develop and implement the ESP. Furthermore, each of the 27 MS of the EU uses the operational level of the Presidency of the Council of the EU (EU Presidency) for setting its own impulses and political inputs on the future direction and development of the GMES initiative.

Below, only selected EU Presidencies that had significant outcomes for the GMES process are mentioned (for example the Austrian in 2006, the German in 2007, the French in 2008, the Czech in 2009 and the Swedish in 2009). These set their priorities for the solution of the governance and funding problems of the GMES initiative:

- a strategic, economic and regional action plan;
- expansion of the GMES market involving the regions (NEREUS);
- political and governance issues;
- long-term funding under the EU;[68]
- synergies between the Shared Environmental Information System (SEIS), Single Information Space for Environment in Europe (SISE), Infrastructure for Spatial Information in Europe (INSPIRE) and GMES;
- involvement of the new MS;
- development of integrated maritime governance structures and maritime and land-based spatial planning.[69]

The space agencies of the MS are designed to serve national objectives. They have their own technical capacity and conduct their own scientific research. This enables the space agencies to propose space programmes to decision makers on the national level, to aggregate and define service requirements, and to develop new technology. For the national space agencies it is a major challenge to prepare their own programmes in the future to make capacities and data available for and compatible with GMES.

4.1.5. Regions

The Graz Declaration submitted under the Austrian EU Presidency in 2006[70] acknowledged the Regions as pertinent territories to express needs related to space technologies, exchange experiences and experiment services.[3] European Regions are engaged in both parts of the chain: as potential data providers (development of infrastructure) and potential end users of GMES services (for crisis management after natural catastrophes, local impact on climate change, urban management and so on). The involvement of the regions is organised through a network of Regions using space technologies (NEREUS) which will

[68] Graz Declaration 2006; Munich Roadmap 2007, Der Weg zu Europäischen Erdbeobachtungsdiensten – GMES.
[69] *European Union Strategy for the Baltic Sea Region*, COM(2009) 248 final (10 June 2009).
[70] The Graz Declaration was submitted during the Expert Conference, A market for GMES in Europe and its regions – the Graz Dialogue, 19–20 April 2006.

manage its relations with the EU Institutions, the MS, the ESA (through the Group of Regional Authorities), and regroup industries, training institutions, research laboratories, administrations and so on (through Group of Associate Members). The idea was to proceed from a network of space industry regions (such as the Midi-Pyrénées Region, Bavaria – bavAIRia GMES initiative) to a network of regions using space technologies (such as the Bretagne Region using the GMES data for the purpose of oceanographic research). There are other initiatives that have direct links to the Graz Dialogue, such as the GMES Office Bremen initiative. This initiative in itself represents a PPP approach that can serve as a model, as a regional endeavour concerning European partnership networking and focusing existing regional GMES capacity. The objective is to integrate all relevant regional competencies to a common effort in order to act as one region. The GMES Office Bremen is the instrument to enable Bremen to develop a consistent GMES and security concept together with DLR on national level, the EC on European level and public organisations, industry and the scientific sector.[71]

4.1.6. Private sector/industry

The roles of the private sector and the end users still have to be defined. The creation of a functional market for GMES services includes the supply and demand side of GMES. The space industry takes an active part in the co-financing of EC projects, development of related services and contribution to GMES definition. However, its full involvement in GMES has yet to be defined. The role of small and medium-sized enterprises (SMEs) is not really clear in the GMES framework and especially in the EU Communication on GMES. However, without tighter engagement of the private sector there will be not enough investment for the further development and operation of GMES.[72]

4.1.7. End users

The description above of potential stakeholders shows their current and future role in the GMES initiative. However, they do not only contribute substantially to the governance and funding system of GMES. At the same time they are potential end users of GMES services, and together they define the potential market situation for GMES services. In order to address and involve various stakeholders, the European Space Policy Institute (ESPI) organised a series of high-level workshops with national and other organisations. The first one took place in Warsaw (12–14 December 2005), and discussed the 'Integration of New Member Countries into the GMES Programme'. Further workshops followed, for instance in Toulouse (9 March 2006), Budapest (24 March 2006), and Graz (19–20 April 2006). In addition, the European Association of Remote Sensing Companies organised a workshop in Paris (21 March 2006) which was dedicated to the role of industry in GMES.

The outcome of this workshop was fed into the Budapest workshop which addressed 'GMES Socio-Economic Benefits' and into the Graz workshop which looked at 'A Market for GMES in Europe and its Regions'.

Table 5 outlines the potential categories of European, national, regional and local, and global end users, such as the private sector, the industry, and private citizens, according to their demand for GMES services.

[71] http://www.gmes-bremen.eu/.
[72] EASRC Statement on GMES, For the workshop on GMES governance, 11 May 2009.

Table 5: Categories of end users

GMES services	Demand
Emergency response	Forecasting; prevention; active prevention; post crisis; information; command and control.
Land	Estimation of influence of weather and climate variability; raising agricultural productivity; providing timely food aid; ensuring sustainable development; evaluation, monitoring, management of forest resources and of water shortages; reporting, localisation and assessment of the impact of diffuse pollution sources; identifying major threats to European environment; conserving Europe's natural heritage.
Marine	Monitoring and policing busy sea lines; control of illegal trafficking; fighting oil spills; control of illegal discharges; detection of ships; monitoring the evolution of atmospheric and oceanic parameters; real-time ocean analysis and forecasting data; monitoring long-term meteorological trends; providing accurate data.
Atmosphere	Monitoring and forecasting of air quality; providing information services on UV conditions and forecasts.
Security	Supporting vital infrastructure; contributing to the security of important events; up-to-date mapping for peacekeeping operations; fight against piracy; radar.

Categories of end user	
European users	EU Commission (Management and Information, ECHO, DG FISH, ENV, AGRI, REGIO, RELEX, High Representative for CFSP, etc.) EU agencies (EEA, FRONTEX, EDA, EMCWF. OSPAR, EUSC, EUMS, EMSA, EUMETSAT, etc.), research institutes (environment, marine, food and agriculture, medicine), NGOs, ESA, peacekeeping missions.
MS level	MS, national organisations, research institutes (environment, marine, food and agriculture, medicine), agencies (national space agencies), environment centres, national institutions, NGOs, peacekeeping missions.
Regional and local authorities	Regions, cities, local environmental centres, regional organisations, research centres (environment, marine, food and agriculture, medicine), NGOs.
Global	UN, global organisations (GEO, GEOSS, WMA), agencies (IPCC, WMA), research centres (environment, marine, food and agriculture, medicine), NGOs.
Private sector/industry/ private citizens/SMEs	Agriculture, shipping, fisheries, energy, transport, telecommunication, media, insurance, forestry, medicine, food, construction.

Source: http://boss4gmes.customers.arjuna.eu/, author's visualisation.

To summarise the results, it can be noted that there are multiple stakeholders in key political, productivity and intermediary activities which will contribute together to the development of the governance of GMES. This interrelation highlights the overall complexity and the inherent challenges for the current and future governance structure. However, no matter how the formal relations between the different stakeholders are organised, a well-coordinated network has to emerge as an end result of the involvement of the potential stakeholders in the decision-making process. The identified heterogeneity and diversity of stakeholder groups continues to require clearly defined mechanisms for user and data provider engagement at the different levels (local, national and European).

4.2. Current governance structure

Before starting with the description of the current governance structure, it should be stated that GMES is proceeding through an Initial period (2001–03), Implementation period (2004–08), Pre-operational phase I (2008–11), Pre-operational phase II (2011–13), and Period of fully pledged GMES operations (2014–).

The development and implementation of GMES is an iterative process. GMES mainly builds on already existing components, with independent functioning and tasks, which have to be brought together. Additionally there are totally new components. This results in a melange of supranational and intergovernmental networks. In order to bring GMES into its implementation phase, there are different governance structures foreseen for different phases of the project. However, there are no exact lines of separation between the different periods.

4.2.1. Initial period (2001–03)

In the initial period (2001–03) of the GMES initiative, a GMES Steering Committee, a GMES Support Team, a GMES Forum, National Coordination Groups, and Thematic projects and cross-cutting assessment groups were established in order to perform the initial tasks.[73] The aim of the initial period was to deliver information and services on climate change, threats to public health, management of natural resources and improved land-use management, make assessments and recommendations for establishing a European capacity for GMES, and prepare proposals on infrastructures, data services and so on.[74]

[73] GMES Support Team, *GMES Vision and targets 2008 and Work Progress of the Initial Period of the GMES Action Plan (2002–2003)*, Information Document for the participants of the Third GMES Forum, 23 May 2003.
[74] EC DG Research, *Key elements of the GMES EC Draft Action Plan, Initial Period 2001–2003*, Brussels (27 July 2001).

Table 6: Management bodies in the initial period of GMES (2001–03)

Tasks	Composition
GMES Steering Committee: established in Brussels on 19 March 2002	
- informal coordination body to assist in the implementation of the EU's Action Plan on GMES; - advise the GMES Bureau in the Implementation stage.	Unites users and suppliers of GMES services and technologies; consists of senior representatives from ESA, the Directors-General of Directorates-General of the EU Commission (AGRI, FISH, RELEX, DEV, ECHO, AIDCO, TREN, JLS, TAXUD, OLAF, REGIO, ESTAT, RTD, INFSO, ENV, JRC), the EUCOM, EC Council, MS, EEA, EUMETSAT, the High Representative for CFSP.
GMES Support Team: subordinated to the Steering Committee	
- animates and interact activities in the initial period; - will ensure the coherence of the activities undertaken in the delivering of information and services, establishing/ improving operational systems for GMES, incl. organisational aspects; - political, technological and scientific development for production and delivery of information for environment and security.	- Members of DG Research and Environment and representatives of ESA; - works together with national coordination groups on proposals and reports for the establishment of a European capacity for GMES.
GMES Forum	
- gives the possibility for active involvement in the development of the GMES initiative; - involvement of end-users and interface to user community, media, and citizens; - communication platform for the stakeholders; - feeds back views on GMES to the Steering Committee.	Representatives of EEA EIONET, European institutions, GMES Steering Committee, GMES GSC Working Groups, ESA, EUMETSAT, industry, NGOs, national and regional administrations from EU and Accession Countries, European Associations of cities and regions.
Working groups at the national level:	
- coordination of technology and national activities; - identification of user requirements; - mobilizing the country's stakeholders; - consulting body to the Advisory Council.	Representatives of different pilot projects

Source: Author's visualisation.

4.2.2. Implementation period (2004–08)

In connection with the demand for further development of the GMES it was decided to introduce new management bodies and prepare the GMES governance structure. The aim was to establish by 2008 a European capacity for GMES. In this period the following institutions were created in order to pave the way to the establishment of a functioning organisational structure for GMES: the GMES Bureau, GMES Advisory Council, GMES Programme Office, GMES In-Situ Observation Working Group, Implementation Group for Fast-Track-Services.

Table 7 takes a detailed look on the tasks and the composition of the institutions within GMES during the Implementation period.

Table 7: Management bodies in the implementation period of GMES (2004–08)

Tasks	Composition
GMES Bureau: became functional on 1 June 2006 for three years; within Directorate-General for Enterprise and Industry (Unit H/5)	
• Pave the way towards the establishment of a permanent organisational structure for GMES; • Ensure efficient management; • Develop a funding framework and an implementation strategy; • Promote structured dialogue with potential GMES stakeholders; • Contribute to long-term sustainability of GMES; • Perform its tasks through an annual work programme; studies on the legal basis of GMES; evaluations; regular meetings with stakeholders from industry, regions; • Act as a supportive secretariat for the Implementation Groups.	Gathers staff from the Commission's Directorates-General for Enterprise and Industry, Research, Environment, Information Society, Agriculture, Rural Development, Fisheries and Maritime Affairs, as well as the Joint Research Centre.
GMES Advisory Council: meetings will be held two to four times a year	
- Becomes an overall responsibility within the internal structure of GMES; - Preparation of long-term steering structures; - Control of EU Commission; - Consults national GMES coordinators.	Includes representatives from all relevant GMES stakeholders, including EU and ESA MS, the EU Commission, ESA and other relevant European organisations.
GMES Programme Office	
- Acts as a permanent secretariat; - Fosters the coordination of European and national activities; - Technical meetings with ESA.	Seconded experts from MS and other related institutions, e.g. EEA, EUMETSAT, EU Satellite Centre.
Implementation Group (IG) for Fast-Track Service: Emergency Response, Land Monitoring and Marine Services, Atmosphere, and potential capability for 11 different GMES initial services	
- Responsible for the supervision and validation of the implementation of the services by 1. identifying the potential users and 2. drawing up cost-benefit studies for services; - Deliver information which will be collected on different workshops organised by each IG on progress to the GMES management structure; - Output of the work: Strategic Implementation Plan[75,76,77] which includes recommendations regarding the main fast-track service implementation issues and evaluation.	*The internal structure of the IGs differs from IG to IG; example Land Monitoring*: two representatives from MS, representatives from EC DG ENV, AGRI, REGIO and ESTAT, one representative from EEA (end of its mandate: May 2009).

[75] Detailed overview of the Implementation Plans: Peter Ryder, *GMES Fast Track Marine Core Service - Strategic Implementation Plan, Final Version* (24 April 2007).
[76] Dietmar Grünreich, *GMES Fast Track Land Monitoring Core Service - Strategic Implementation Plan, Final Version* (24 April 2007).
[77] Bernardo De Bernardinis, *GMES Fast Track Emergency Response Core Service - Strategic Implementation Plan, Final Version* (24 April 2007).

GMES In-Situ Observation Working Group: proposed on the informal meeting of the GMES Advisory Council on 13 September 2007	
- Consolidate the inputs from in-situ data and external service products; - Advise on further development of the in-situ segment; - Supervise the in-situ requirements of the Fast Track Services; - Analyse the MS capacities to meet the requirements of GMES services.	- MS representatives (each sends one or two delegates); - Support Group: includes representatives from GMES Bureau, JRC, DG ENV, EUROSTAT, IG, EEA, EUMETNET; - Chaired by EEA.
Impact Assessment Board: work on IA started in 2006, became functional on 1 October 2008; **central quality control** and support function working under the authority of the Commission President	
GMES relevance: - Meetings with and opinions (not binding) to DG (ENTR); - Impact assessments on political (governance) and budgetary commitments of EC and MS.	DG Economic and Financial Affairs, DG Employment, Social Affairs and Equal Opportunities, DG Enterprise and Industry, DG Environment.

Source: Author's visualisation.

4.3. Outcome of the EC impact assessment

This third subsection will discuss the impact assessment of the Commission Communication 'Global Monitoring for Environment and Security – we care for a safer planet'[78] issued by the EU in 2008, and of the proposed regulation on the European Earth Observation Programme and its initial operations (2009). The documents contain plans for the future governance and funding structure of GMES.

4.3.1. Pre-operational Phases I and II (2008–11/13)

The temporary character of the GMES structure has already been described (see 4.1.2). It was a necessary step for the preparation of the implementation of the GMES programme. Now the GMES programme has entered the pre-operational stage.

The remaining open issues include sustainable funding, operational service delivery mechanisms, an approach for the overall governance of the system and all its components, and a comprehensive data policy.

Political coordination

In the Pre-operational phase, the EU Commission takes the overall responsibility and coordination of GMES, and will be assisted in the implementation of the EU programme by a Partners Board, Programme Committee, Security Board and User Forum.[79]

[78] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008).
[79] *Global Monitoring for Environment and Security (GMES): we care for a safer plane*t, COM(2008) 748 final (12 November 2008)

Table 8: Management structure of GMES for the pre-operational phase

Tasks	Composition
Partners Board	
- Instrumental in the implementation and future evaluation of the programme; - Coordinate activities that are financed by EU, national and intergovernmental funds.	Representatives of MS, which contribute to GMES with infrastructure.
Programme Committee	
- Provides assistance to the Commission to manage the implementation of the GMES programme and to the budget implementation.	Stakeholders contributing in-situ or space infrastructure.
Security Board	
- Corresponding work to provide guidance and input through expertise for data security, which meets MS security requirements.	Not defined yet.
User Forum	
- Safeguard the user-driven objective of GMES; - Address technical and scientific issues.	Different representatives depending on the services.

Source: [80], author's visualisation.

International cooperation

In the framework of GMES, international cooperation is performed by European national and intergovernmental actors with international counterparts, such as the World Meteorological Organisation, and will be developed and integrated for new areas through the Group on Earth Observation (GEO) that is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS).[81] The participation of other countries and organizations is only possible through international agreements[82] or through participation on the basis of the EEA Agreement.[83] Furthermore, GMES and research results from the European Research Framework Programmes will be of enormous assistance in the performance of key global tasks, such as compliance with the Kyoto Protocol[84] and the Intergovernmental Panel on Climate Change (IPCC).

Security policy

Civil and defence applications increasingly draw from the same technological base, and there is an increasing overlap of functions and capabilities required for military and non-military security purposes (such as is found between border police, coast guard and emergency response teams) which often allows the use of the same technology for the development of both security and defence applications. Space technologies are a perfect illustration of this: the decision whether global positioning or earth observation systems, for example, are to be used for security or defence purposes is primarily political in character, not technological.

[80] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008)
[81] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008)
[82] *On the European earth observation programme (GMES) and its initial operations (2011–2013)*, COM(2009) 223 final (20 May 2009).
[83] *On the European earth observation programme (GMES) and its initial operations (2011–2013)*, COM(2009) 223 final (20 May 2009).
[84] Niklas Rinke, *The History of German Space Policy: Ideas, influences, and interdependence 1923–2002*, Beauchesue Editeur Paris, 2007, p. 441.

Security issues are very controversial among the European Community and the MS. In this context the GMES programme raises security-oriented issues, which also have strong infrastructure and technology interdependencies to the European Security Research Programme (ESRP).

4.3.2. Assessment of the plans for the initial operations (2011–13)

The impact assessment[85] done by the EU Commission in 2008 proposes four different scenarios that describe different options for the establishment of an efficient governance and funding framework for GMES for the 2011–13 period:

1. Scenario 1: strong role of the Commission in the management structure, until 2013: research funds, propose programme in the next financial framework; gap between the preparatory action (2008–10) and 2014;
2. Scenario 2: Commission externalises the management; programme prepared in the context of the next financial framework;
3. Scenario 3: Commission manages GMES directly; Community programme is proposed in due time to bridge the gap between 2011 and 2014;
4. Scenario 4: Commission externalises the management; Community programme is proposed in due time to bridge the gap between 2011 and 2014.

The Commission assessment opted for Scenario 3, because the **Commission would directly manage a GMES programme** that would already be launched before 2013. The internal management of the Commission could be based on the GMES Bureau or another specific internal management structure as presented in Table 8. The development of a special GMES programme was proposed, which still has to be adopted by the EU Council and the EP.[86] The programme is to bridge the gap between 2011 and 2014, giving continuity to the preparatory actions and defining the role of the actors in the implementation of GMES.

The impact assessment was supplemented and the respective commitments enhanced by a Proposal for a Regulation on the GMES in 2009.[87] The assessment was elaborated in consultation with a Steering Group consisting of representatives of the DG ENV, BUDG, RTD, AGRI, ESTAT, JRC, TAXUD, DEV, AIDCO, ECHO, INFSO, TREN, RELEX, MARE, REGIO and JLS and outlined three possible options for the implementation of the GMES initial operations:

- Open method of coordination;
- Regulatory intervention;
- Community financing.

Community financing (Option 3) accompanied by coordination activities is considered to be the preferred option for the period 2011–13 by the European Commission. (More detailed information about the Commission's decision is given in Chapter 5.9 Assessment of the financing of GMES).

4.4. Key findings on GMES governance

The governance framework proposed by the European Commission (EC) introduced a structure that should ensure the interests of all the stakeholders involved, and recognised the participation of the main stakeholders in the GMES decision-making processes.

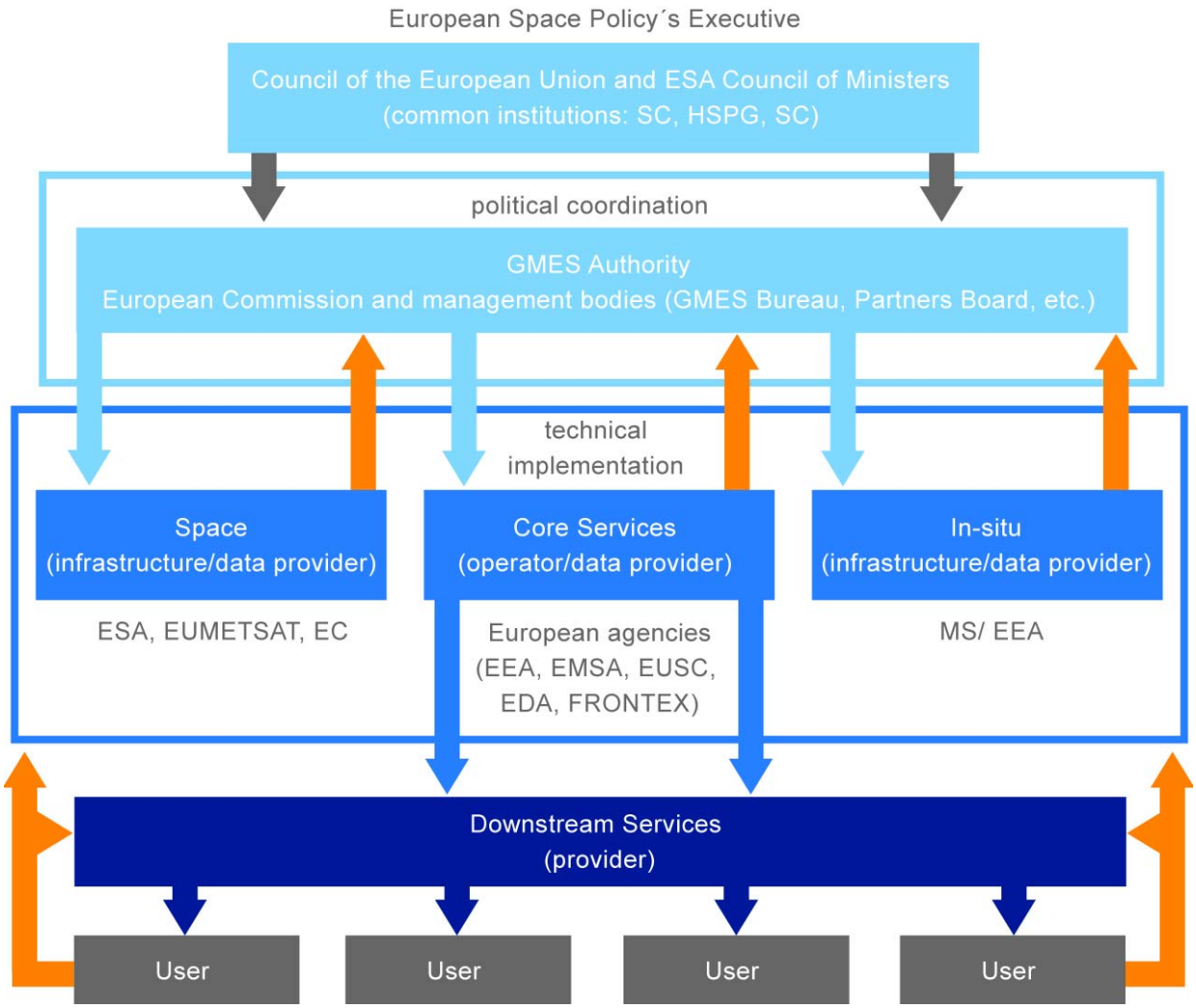
[85] *Global Monitoring for Environment and Security (GMES): we care for a safer planet,* Impact Assessment, COM(2008) 748 final, SEC(2008) 2809 (12 November 2008).
[86] The proposed regulation has not yet appeared in the *Official Journal of the European Union*.
[87] *Commission Staff Working Document accompanying the proposal for a Regulation of the European Parliament and of the Council on the European earth observation programme (GMES) and its initial operations (2011–2013),* SEC(2009) 639, (20 May 2009).

However, different shortcomings in the governance framework make clear the need to continue the path to reform GMES governance.

The governance structure foresees a division of responsibilities between the political leadership (European Community) and the technical knowledge and capability (ESA). In order to ensure an efficient approach, EC and ESA need to start the discussion about political requirements and technical feasibility at an early stage.

According to the state of discussion on GMES governance, Figure 5 gives an overview on the main problems arising during the current and future development of GMES, and summarises the above description.

Figure 5: Current and future state of discussion on GMES governance structure



Source: Author's visualisation.

On the top of policymaking, the Council of the EU and the ESA Council of Ministers are the two important executive institutions involved in the current and future implementation of the ESP. They are connected through common institutions. However, there are first attempts to strengthen the internal communication platform to coordinate the space policy.

In order to meet the challenge for an overall responsibility in the leading project of the ESP, namely GMES, there arises the **need for a GMES authority with a functional interim management structure**. This role is intended for the EC and its management bodies such as the GMES Bureau and the Partners Board. The EC's prime objectives are to define the institutional setting, to determine the responsibility of the different GMES actors, and to clarify the future links between the different institutions and stakeholders.

The technical implementation of GMES is organised in three main components, namely Space, In-situ (the non-space infrastructure) and Core Services, and different agencies and institutions take up position as the main coordinators of each. However, the responsibilities of the different institutions and agencies and their representation in the GMES management bodies are not clearly defined. As a result, there is a lack of coordination in the reverse direction, as shown by the orange arrows in Figure 5.

The Downstream Services will be provided by the data providers of the Core Services directly to the users. This is illustrated in Figure 5 through the dark blue arrows. However, there are **missing links between the users and the Downstream Services providers**, on the one hand, **and the actors involved in the technical implementation of GMES components**, on the other hand, as shown by the orange arrows.

During the first years of the development of GMES, several problems concerning the governance remain open:

- Continuity and stability of the GMES structure;
- Inner structure;
- Involvement of stakeholders:
    - Inter-institutional setting;
    - Private industry;
- Data policy.

4.4.1. Continuity and stability of the GMES structure

There is still potential for action at Community level to ensure the continuity and stability of the management structures for the different periods, and to ensure the permanent involvement of the main stakeholders.

Although it is important to adapt the governance structures to the respective stage of the development of GMES it is essential to create sustainable institutions with well-defined functions. This is a consequence learned from the Galileo programme. The frequent changes bear the risk to be more involved in the restructuring of working groups than in the work on the content. It takes much time until a (international) working group is ready to work on the content. This is even more the case when there is no clear mandate and when the responsibilities are not clearly defined. Therefore, it is desirable to avoid situations in which once the working groups' members are familiar with the group and the work, a new structure is about to be established. In this context there is still potential for improvement regarding the **definition of roles and responsibilities as well as a balance between restructuring processes and stable working conditions**.

4.4.2. Inner structure

The identified heterogeneity and diversity of the stakeholders' calls for clearly defined mechanisms for the engagement of providers and users at the different levels.

In the past governance structures it was almost impossible to define clearly the relationships between the different internal bodies because of unclear and partially overlapping responsibilities. This problem persists in all the stages described.

For example, in the initial stage there are six different organs. It is not obvious why there is a GMES Bureau and a GMES Programme Office, which is also to act as a permanent secretariat and attend the meetings with ESA. Here, it could be useful to check whether these tasks could be allocated to only one entity, or whether the profile and tasks of the organs could be defined more clearly.

The same situation seems to exist within the pre-operational phase. There is a Partners Board which is to ensure the implementation of the programme and which has coordinating activities. The Programme Committee is to give assistance to the EC to manage the implementation of the programme and of the budget. The problem seems to be that two organs are responsible for the implementation without a clear definition of the tasks and responsibilities related to the implementation.

The integration of a Security Board which dealt with questions concerning data security was a positive step. However, it would be appropriate for institutions dealing with security issues to be more tightly embedded into the Security Board and linked directly to MS bodies, to fill the gaps concerning institutional management of security data and data flow.

The integration of a User Forum to safeguard the user-driven approach was a good starting point for the inclusion of users. However, to meet user requirements it would be useful to involve user forums in the development process.

The role of some main stakeholders needs to be defined more clearly. The roles of ESA and EEA are crucial for the whole governance of GMES. EEA needs an outstanding role in the In-situ area if the EC really wants the agency to execute this coordinating role. As EEA already has a great deal of experience in managing huge data flows, it seems to be experienced to fulfil this role. In order to ensure the main aim of GMES, to unite all the national initiatives under one roof, it is recommended to **give EEA an outstanding role and to fully engage it in the development and coordination of user-driven services**.

4.4.3. Inter-institutional setting

There is still a missing link to the European institutions that are expected to be potential end users. The fact that ECMWF includes the aim of 'establishing links to European institutions such as DG Environment, DG Development and Relations with African, Caribbean and Pacific States, EEA, Council of the EU' shows that the current level of interlinkage is so low that this issue has to be included explicitly into the working plan; but it also shows that this shortage is about to be addressed. The interlinkage between the different institutions is one of the central challenges, because GMES is only meaningful in an intensive network, between data providers and end users, and between technical experts and policy makers. This is the chance for GMES to bring the different stakeholders together and to be the central node in the network. There are so many actors that it does not seem unusual for one institution to be aware of special tasks or even the existence of another actor.

In order to make GMES more visible, it seems essential to push the fast track services into operation, because it is more difficult to inform EU institutions about an idea that is still in the planning phase. Awareness-raising would be much more successful if the services were already working.

4.4.4. Private industry

Last but not least, there seems to be still the problem of harmonising the roles of the EC, ESA and the space industry. Although some steps have been taken, there is still a lack of involvement of the industry, and particularly SMEs, in the political process. The space industry, which has a direct link to the end users, could foster this involvement and express and specify their needs.

GMES is called a user-driven initiative. A huge amount of resources has been invested in order to develop Downstream Services, although there is no confirmed evidence of the potential market for those services. A market analysis for the different Downstream Services could be commissioned to assess this potential before calculating likely revenues.

4.4.5. Data policy

There still seems to be a lack of a common European data policy regarding security data flow and management in the GMES initiative. As a consequence all the data providers only provide data following their own data restrictions. In order to ensure **real open access and availability of the existing data, there is a need to address this urgent issue**.

A question that has to be clarified is who will take the responsibility on GMES security data and management. According to the Commission Communications, data services will be fully and openly accessible as long as stakeholders' security interests (at both the EU and MS levels) do not suggest otherwise. However, in order to make the data infrastructures of the MS compatible and usable in a Community and transboundary context, links between GMES and the information infrastructures of SEIS, INSPIRE and SISE need to be established and strengthened.

5. FINANCING

KEY FINDINGS

- In its origins, the GMES programme is a publicly driven programme. Its funding is provided at European, intergovernmental and national levels, based on partnerships between the different players in the sector.
- The development of the Core and Downstream Services is funded mainly by FP7 research grants and formerly by previous FPs. However, the GMES downstream sector lacks an EU-wide financing system because of the absence of an established market for commercial financing of private space activities. Currently, the industry is too fragmented to enable it to develop and drive the market for GMES services. But which entity will secure the long-term operational capacity of GMES?
- There is a temporary gap between the funding proportions provided by the EU and ESA. The repeated negotiations on financial contributions do not encourage the sustainable commitment of the key stakeholders, particularly the MS.
- It seems realistic to state that the major proportion of end users will again be public-sector bodies and therefore the financing will remain mostly publicly driven. A market for private end users still has to be created. As there are still no reliable market studies, it is not possible to calculate the likely revenue from private end users.
- The most sustainable solution lies in a single budget line of GMES within the European Financial Framework, as proposed by the EC. Particularly, it will become more essential to create a central funding management body within the EC with clearly identified and binding responsibilities.

5.1. Overview of financing at the different stages of GMES

This section provides an overview of the funding of GMES, including EC, MS' and European entities' contribution for the five periods of development of GMES that have been described.

The funding procedure is a very complicated network, as indeed are the governance structure of GMES and the overall interaction between the stakeholders. As a consequence, the funding procedures are not transparent enough for either the involved stakeholders or the general public. The management of the funding grants is still not clearly defined. There is no central structure that can provide current data on funding.

In its origins, GMES is a **publicly driven programme**, and its funding is provided at European, intergovernmental and national level, based on partnerships between the different players in the sector. This is the case because space programmes concern all European states. They are too expensive to be funded by separate national budgets, so there has been cooperation at an early stage.

The financing is composed of contributions from the EC, MS and intergovernmental agencies (such as ESA). The financing procedure differs from stage to stage.

During the first two periods of GMES (the **Initial period, 2001–03**, and **Implementation period, 2004–08**), the main task was **to prepare the GMES initiative for its operational activities**.

According to this, the main contributions, mainly made by EC and ESA, were mostly dedicated to research activities and came from the Research Framework Programmes (FP5, FP6) and ESA (including national contributions to ESA).

Only for the period after 2008 was the funding dedicated to pre-operational and operational activities. **At the current stage there is a transition from R&D and mixed (R&D and operational) funding to operational funding.** As the transition phase and the operational phase require more detailed analysis, their financing structure is described more extensively below.

Table 9 shows the financing in the different periods, and indicates the main financing sources. The data is selective, not exhaustive.

Table 9: GMES development and funding

Initial period (2001–03)		
R&D funding		
EU	-	FP5:
	-	First activity, Theme 4 'Energy' (EUR16 million – Section 'Research and Technological Development Activities of a Generic Nature'), 'Environment and Sustainable Development' (EUR119 million – Section 'Research and Technological Development Activities of a Generic Nature'): support the implementation of the GMES Action Plan Initial Period (2001–03).[88]
ESA	-	Earth Observation Envelope Programme (EOEP);
	-	EUR83 million (global forest monitoring in the context of Kyoto Protocol reporting requirements, information to prevent or reduce the occurrence of floods and forest fires, sea ice monitoring for ship routing, or the monitoring of agricultural resources for food security at global level).
Implementation period (2004–08)		
Mixed R&D and operational funding; ESA and EU (FP6); users/providers dialogue		
EU	-	FP6: EUR100 million dedicated to the ESA GMES service element[89] (such as Information Society Technologies – for Environmental Risk Management)
	-	FP7 Space: for development and consolidation of GMES Services (2007 – EUR35 million; 2008 – EUR70 million).
ESA	-	EUR100 million in GMES service elements projects;[90]
	-	Earth Observation Envelope Programme (EOEP).

[88] *Work Programme for Part A: Environment and Sustainable Development,* C(2001) 4307 (18 December 2001).
[89] *Commission Staff Working Document accompanying the proposal for a Regulation of the European Parliament and of the Council on the European Earth observation programme (GMES) and its initial operations (2011–2013)*, SEC(2009)639, (20 May 2009).
[90] *Commission Staff Working Document accompanying the proposal for a Regulation of the European Parliament and of the Council on the European Earth observation programme (GMES) and its initial operations (2011–2013)*, SEC(2009)639, (20 May 2009).

Pre-operational Phase I (2008 –11) (establishing a capacity close to operational conditions)	Pre-operational Phase II (2011 –13) (first operational activities); sentinels start (2012)
Initial operations under FP7, from R&D to operations;[91] ESA and EUMETSAT[92] budgets.	First operational activities; sentinels start (2012)/2011–13 Financial envelope for the implementation of the GMES programme shall be EUR107 million + EUR43 million for research activities.[93]
EU (FP7),[94] - Space: EUR1.43 billion (consisting of projects on Core and Downstream Services development, space infrastructure, and coordinated access to space borne data). ESA (incl. ESA MS contribution) - EUR1.8 billion (trough the ESA Optional Programme): EUR1.65 billion for GMES space component + EUR130 million for GMES service element.	
Period of fully pledged GMES operations[95] (2014–)	
Proposal[96]: GMES operational budget line (part of the EC multiannual financial framework).	

Source: Author's visualisation.

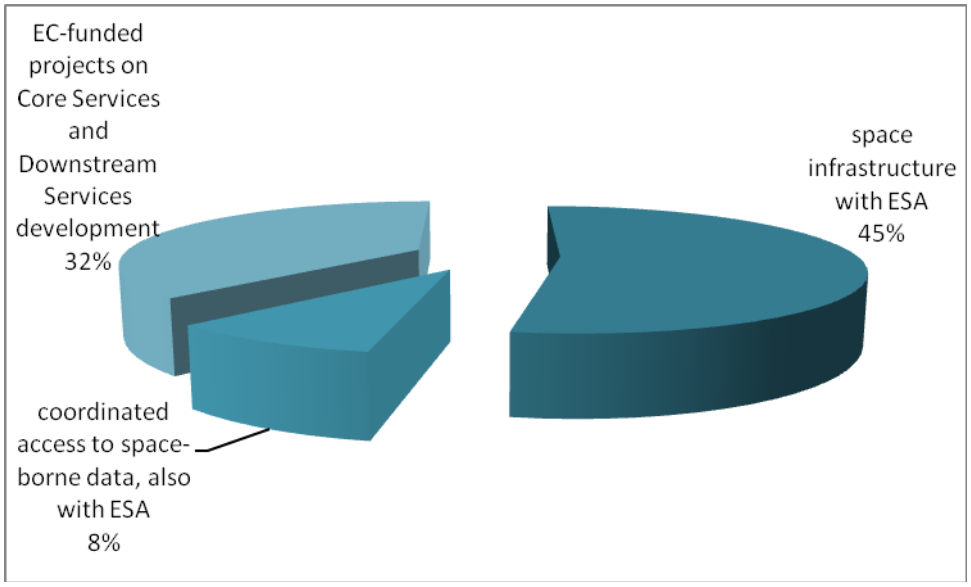
In the last decade, the EU has been increasing its expenditure on space policy. The space component of ESP found more financial support through the **Research Framework Programmes of the EU**, namely FP5 (1998–2002), FP6 (2002–06), and FP7 (2007–13), resulting in an increasing budget for space and security research.[97] Through the research programmes the EC defines the topics and format of the funded projects.

A substantial part of the **Pre-operational phase** is still funded through **research projects in FP7**, Cooperation (2007–13). The projects are published in three of ten thematic priorities: Theme 9 (Space), Theme 10 (Security) and Theme 6 (Environment). This outlines the different aspects of and interests in GMES. The biggest part comes from Theme 9 (Space), where 85 per cent of the total budget of EUR1.43 billion is dedicated to GMES and the space infrastructures.

The budget line for GMES in Theme 9 (Space) is divided into three main components as Figure 6 shows.

[91] *On the European Earth observation programme (GMES) and its initial operations (2011–2013)*, COM(2009) 223 final (20 May 2009).
[92] The EUMETSAT User Service stated that 'there is no direct financial support of EUMETSAT to GMES. But some internal work is being done towards GMES.' Nevertheless, there are differing informations about the financing of GMES services, stating: 'Funding activities will be through third parties activities (e.g. Sentinel 3 - as third party programme) and/or optional programmes.' EUMETSAT, Strategy: 2030, October 2006, http://www.eumetsat.int/Home/Main/AboutEUMETSAT/Strategy/index.htm?l=en.
[93] *On the European Earth observation programme (GMES) and its initial operations (2011–2013)*, COM(2009) 223 final (20 May 2009), p. 17/detailed financial resources, pp. 32–3. Appropriations shall be authorised annually by the budgetary authority within the limits laid down in the multi-annual financial framework. Third countries may also provide additional funding, p. 18.
[94] http://cordis.europa.eu/fp7/budget_en.html.
[95] *On the European Earth observation programme (GMES) and its initial operations (2011–2013)*, COM(2009) 223 final (20 May 2009).
[96] *Commission Staff Working Document Accompanying the proposal for a Regulation of the European Parliament and of the Council on the European Earth observation programme (GMES) and its initial operations (2011–2013)*, SEC(2009)639 (20 May 2009), p. 6.
[97] *Proposal for a Decision of the European Parliament and of the Council Concerning the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (2007 to 2013)*, COM(2005) 119 final (6 April 2005).

Figure 6: EC funding of GMES for Space available through FP7 for the period 2007 to 2013



Source: Frank Fell, Bronwyn Cahill, Birgit Mohaupt-Jahr, GMES Network of Users, Project no. 30956, 2007, author`s visualisation.

Figure 6 outlines the funding allocation for two of the three main components of GMES, the Space and Services components. It should be pointed out here that the large part of the In-situ Component (the third main component of GMES) is not funded by the EC. In order to give a detailed overview on the financing of the three components, the financing procedure will be explained in relation to the technical implementation of the three components.

5.2. Technical implementation and financing

Table 10: Technical implementation

Component	Entity
Space	ESA - coordination and procurement for the EC; - coordinates access to data from other satellites; - development of Sentinels 1, 2, 3 (land); - develop and procure an **Agency for dedicated space infrastructure.**[98] EUMETSAT - development of Sentinels 3 (marine), 4, 5. EU Commission - produces information services in response to European policy priorities in environment and security; - relies on data from the In-situ and Space components.[99]
In-situ	Member States - operation, development and maintenance of In-Situ infrastructure. EEA - supervision of services; - coordination with user communities under SEIS.
Services	User interface

[98] Josef Aschbacher, GMES Space Component, Paper presented at 'Towards e-ENVIRONMENT', Prague, 25–27 March 2009, www.e-envi2009.org/?presentations.
[99] Josef Aschbacher, GMES Space Component, Paper presented at 'Towards e-ENVIRONMENT', Prague, 25–27 March 2009, www.e-envi2009.org/?presentations.

	- EEA, EMSA, EUSC, EDA, FRONTEX contribution to service requirements Service delivery - Network of technical centres for marine and atmosphere services; - Land, emergency and security under control of national and regional authorities, integrated and aggregated at European level.

Source: [100], author's visualisation.

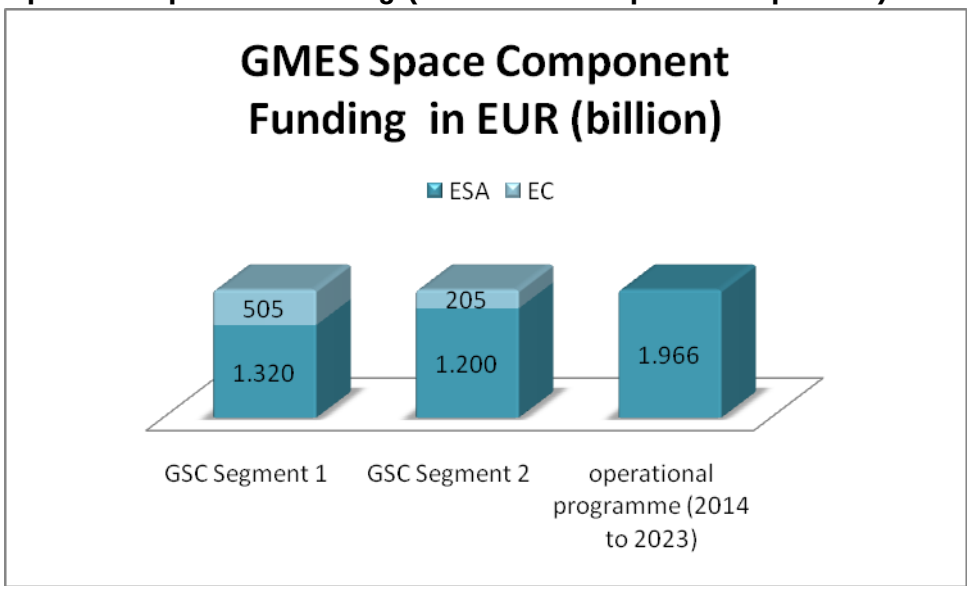
5.2.1. Space component

The Space component includes co-financed efforts by the EU and ESA. On the one side, the EU is responsible for the development of services such as for the coordination and procurement of national logistic assistance (national space missions). On the other side, the ESA assumes the leadership on the construction of the space infrastructure (satellites).

Sentinel operations, which also belong to the space component, are jointly organised by ESA and EUMETSAT. The EUMETSAT annual budget (total) fluctuates between EUR170 million and EUR300 million depending on the undertakings.[101]

Figure 7 shows the total funding made available by the EC and ESA for the period 2008–13.

Figure 7: Space component funding (GSC – GMES Space component)



Source: Frank Fell, Bronwyn Cahill, Birgit Mohaupt-Jahr, GMES Network of Users, Project no. 30956, 2007, author's visualisation.

ESA estimated that the space component would cost **EUR2.3 billion for the period 2006–13**. This sum would be funded 50 per cent by ESA MS subscriptions, and the other 50 per cent by the EU (FP7). However, two problems arise.

First, the EU will fund the space component through FP7, Cooperation, Theme 9 (Space), and is planning to invest just EUR780 million. A short look at the allocation of funding shows that there is a **temporary gap between the funding proportions of the EU and ESA**. This shows that a wider spread in potential funding sources would diminish the risk of a funding shortfall. EUMETSAT and EUSC could also be involved as funding bodies.

[100] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008), pp. 7–9.
[101] Paul Counet, EUMETSAT: Monitoring weather and climate change from space, Eurisy Conference, Budapest (26 January 2009).

The EC proposed to proceed from research and development to the infrastructure budget line within a single GMES budget line within the financial framework of the EU within the next years. For its part, ESA should focus on technological evolution and upgrades as well as on the overall coordination of the GMES space component.[102]

Second, the rules for industrial return (*juste retour*) differ between ESA and EU programmes. ESA operates a system of *juste retour* which states that members of programmes can expect to receive back in industrial contracts an amount roughly equivalent to its contributions. The EU's attitude of *juste retour*[103] is that each EU MS focuses on securing its best possible individual net financial position in relation to the community budget.

The Council Regulation applicable to the general budget of the European Communities on Financial Regulation[104] declares that the funds of the Research and Framework Programme, and in particular GMES, **may not be spent according the principle of juste retour** (Article 109/1). It leaves open some alternatives (Articles 53 and 54) for a common ESA-EU structure for GMES (either joint management with ESA or ESA as a subordinate body).

The GMES Agreement between the EC and ESA on the GSC recognised the EU and ESA as equal partners in the GSC. Therefore, there will be a need for an annual financial agreement between the EU and ESA. However, this will imply **high administrative costs for implementation of the GSC.**[105] If the ESA became an EU agency, it would be integrated into EU structures, including the budget. Nevertheless, this seems quite impossible because some EU MS, and also non-EU MS of ESA, prefer intergovernmental structures in the space field. Longer-term commitments between EU and ESA would at least attenuate the problem.

5.2.2. In-situ component

The in-situ component[106] is operated, developed and maintained by the MS.[107] Therefore, the infrastructures follow national rules in economic and data policy matters. Furthermore, MS already have a large number of national and sub-national observation networks in place[108] which are partly funded by national budgets, partly under FP7, Capacities (when there are several infrastructures from different European countries linked)[109]. However, MS have **not made enough commitment to open the access to their infrastructures** or to prepare them for European coordination. Probably, DG Research and future calls in FP7[110] will need to take in-situ needs into account.

[102] Pierre Potin and Josef Aschbacher, The contribution of earth observation to environmental monitoring and the GMES, p.90, in K.-U. Schroge, C. Mathieu, A. Lukaszczyk, *Threats, Risks and Sustainability – Answers by Space*, Springer-Verlag Wien, 2009, pp. 76–91.
[103] Sándor Richter, Facing the monster 'Juste Retour' on the net financial position of Member states vis-á-vis the EU budget and proposal for reform., EU-Consent EU-Budget Working Paper No. 7, August 2008.
[104] *On the Financial Regulation applicable to the general budget of the European Communities* (EC, Euroatom) No. 1605/2002 (25 June 2002).
[105] Stephan Hobe et al., Entwicklung der Europäischen Weltraumagentur als ‚implementing agency' der Europäischen Union: *Rechtsrahmen und Anpassungserfordernisse*, LIT Verlag Berlin, 2009, p. 386.
[106] In-situ observation involves, first, all the networks of sensors used on land, at sea, in other bodies of water and in the atmosphere to measure and provide a comprehensive description of the Earth system, and second, all the studies aimed at collecting socio-economic data, land-use data (including aerial photographs), geology, the state of the soil, biodiversity and other geographical data such as altitude, administrative borders, transport and public service networks, and so on.
[107] *Global Monitoring for Environment and Security (GMES): we care for a safer planet*, COM(2008) 748 final (12 November 2008).
[108] GMES Bureau 2007, *Long-term continuity of the GMES in situ Component. Governance and implementation issues,* GAC-09-02ANN1 (23 November 2007), p. 2.
[109] http://cordis.europa.eu/fp7/capacities/research-infrastructures_en.html
[110] GMES Bureau 2007, *Long-term continuity of the GMES in situ Component. Governance and implementation issues,* GAC-09-02ANN1 (23 November 2007), p. 2.

The EEA will evaluate the in-situ need and coordinate the provision of in-situ data for individual Core Services. The EEA already manages networks of data providers from MS to fulfil its mandate of providing environmental information and assessment.[111]

The role of EEA for the in-situ component has been already discussed in the Governance part of this study. Nevertheless, the financing of the EEA coordinating activities is not defined yet.

5.2.3. Services

The third component consists of the services: Core Services and Downstream Services. About 32 per cent of space-based applications from FP7 Space (about EUR670 million) is foreseen for the development of Core and Downstream Services for 2007–13, and about EUR100 million has been contributed by ESA MS for 2001–08.

Table 11 shows projects funded under FP7 for the development of Core and Downstream Services. In the last line of the table indicative priorities for future calls are presented. The first call for proposals concentrated on Core Services. The second and third calls were dedicated to the development of Downstream Services.

Table 11: Priorities of the first, second, third and future calls for proposals under FP7

	Collaborative projects	Funding
First call 2007–08	GMES Core Services: Emergency Response (SAFER); Atmosphere (MACC); Land (Geoland2); Marine (MyOcean); Security (G-MOSAIC) Strengthening Space Foundations (SSF): research in space science (space technology, space transportation).	EUR103 million from 2009 to 2011/12 EUR35 million
Second call 2009	GMES (Downstream Services, Climate, Integration SATCOM/GALILEO); GMES (International Cooperation); SSF (Critical Technology); SSF (Exploration/ New MS); ESP Studies.	EUR51.5 million (total grant requested: EUR253 million)
Third call 2010	GMES (stimulating the development and fostering downstream services); SSF; Cross-cutting activities (International cooperation; EU Space Policy).	EUR114 million
Indicative priorities for future calls (2011 or 2012)		
1. Pre-operational validation of GMES services and products; Integration of SatCom with GMES for prevention and management of emergencies; 2. Research to support space science and exploration; Research to support space transportation and key technologies; Reducing the vulnerability of space assets; 3. International cooperation (Africa, GEOSS).		

Source: COOPERATION, THEME 9 (SPACE), Work Programme 2010: EC C(2009) 5893 of 29 July 2009, author's visualisation.

[111] GMES Bureau 2007, *GMES In-Situ Observation Working Group*, GAC-09-03 (23 November 2007).

5.3. Funding of the operation of Core and Downstream Services

As described above, the **development** of the Core and Downstream Services is funded mainly by FP7 research grants (and formerly by previous FPs). The question arises who or which entity will pay once the services enter into operation. Because of the character of Core Services, which means that they deliver multifunctional information, the European Community will be involved in governance and funding issues (as an European Public Good). The Downstream Services which are developed on the basis of the data from the Core Services will be paid for by the end users.

But which entity will **secure the long-term operational capacity** of GMES?

The most sustainable solution lies in a single budget line of GMES within the European Financial Framework, as proposed by the EC. The other option (a mixed financing via MS contributions and contributions from intergovernmental and European institutions) would imply repeated negotiations. Nevertheless a project of the dimensions foreseen for GMES needs a financial framework on which future plans can securely be based.

The Downstream Services are to be paid by the end users. The Commission has allowed for a small downstream sector, which seems quite rational. As was described in Chapter 4.1, subsection 4.1.7. (Table 5), the range of potential end users is wide. It seems realistic to state that the **major proportion of end users will again be public-sector bodies**. A market for private end users still has to be created. As there are still no reliable market studies, it is not possible to calculate the likely revenue from private end users. The benefits of the downstream data services from private industry could be used for the further development of new services.

The public end users would have to pay for the Downstream Services although they had already contributed to the financing of primary data. Here two different perceptions are likely. On the one hand, those end users who are not directly involved in the running costs of the services operations might be more willing to pay for the special Downstream Services than those already involved in financing the Core Services. However, on the other hand it could be argued that users that have already contributed to the Core Services will also be prepared to pay for Downstream Services because they actively support GMES and do value its services. A market study could contribute to finding out the prevailing position (in order to elaborate an accepted pricing mechanism).

5.4. Private industry of the GMES downstream sector

The GMES downstream sector includes those organisations that offer value added services based on EO data. EO is the smallest of the three value-adding space segments (the others being telecommunication and navigation). On average, the sector employs 20 persons per company and generates a turnover of around EUR2 million per company. **Currently the industry is too fragmented to enable it to develop and drive the market for GMES services**.

Commercial revenues generated by European space industry are approximately EUR175 million. **If the core services became operational**, it is expected that the value of the commercial Downstream Services industry which will potentially be impacted by the GMES Core Services is EUR117 million per annum (based on 2006 turnover out of the overall EUR175 million).

Most of the SMEs producing EO data provide them to customers within the country in which they are located. This implies that intra-European exports are limited and exports to non-European customers are poor, and almost entirely carried out by a few large companies. Therefore, there is limited scope for financing from this sector.

The EO sector's average investment in R&D is comparable to other sectors, with the average **R&D expenditure accounting for 27.5 per cent of EO revenue**. It is important to note that technical development activities in the EO sector are mostly funded by clients or public funds and not directly by internal investment.

Furthermore, **investment intensity is negatively correlated with company size**. Large companies spend 10 per cent or less, compared with the SME spend of 25 per cent. A significant number of SMEs devote more than half of their staff to R&D.

The public sector has an important influence on the downstream sector, not only because it sets the legal and regulatory framework for the sector, but also because it has a large influence as a client, by funding the development of the sector and by shaping policies that influence market demand for EO services.

The Core Services are intended to improve the efficiency of the downstream sector by providing access to basic processed and modelled products more cheaply than would be the case if each company had to undertake the basic processing and modelling. The business case for GMES is that these core services will therefore improve the efficiency of the downstream sector, allowing it to offer better value for money in products and services to end users.

The GMES downstream sector lacks an EU-wide financing system. This is because of the absence of an established market for commercial financing of private space activities. The markets are heavily dependent on public money, and have limited growth perspectives.

Private investors and insurers are showing limited acceptance and understanding of EO products. The development of PPPs, particularly in Europe, would increase the access to private finance.[112]

5.5. International cooperation

The European Research Framework Programmes, namely FP6 and FP7, funded selected projects which pave the way for a significant contribution from the EU to the GEOSS in form of communication, data and information exchange, monitoring, forecasting systems and so on. The projects[113] launched in 2007, and the subsequent calls for proposals in 2007, 2008 and onwards will strengthen the science and technology component of GEOSS, and will contribute to the development and implementation of GEOSS with a significant European character.

In accordance with the Commission's proposals of 2008 and 2009, the intergovernmental level (international organisations and non-EU states) can/should be more tightly involved through appropriate agreements for contribution and cooperation after the implementation period. Countries like Russia[114] and India are interested in investing in GMES. However, it is very difficult to allow data flow with security applications to countries which do not belong to West-European alliances.

Third country cooperation would reduce the financial pressure on the European Community and GMES. Nevertheless such a solution requires a very **careful and critical dialogue on the data policy**. Some of the data collected in GMES are very sensitive. Careful consideration should be given to whether third countries should have easy access to them.

5.6. EC programmes with a common GMES approach

The European Community also provides financing in different EC programmes beyond FP7. However, it was not possible within the scope of this study to discover the whole contribution of these programmes to GMES. In addition, the funding possibilities are small compared to the contribution of the Research Framework Programmes, and especially FP7.

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[112] *Study on the Competitiveness of the GMES Downstream Sector*, ECORYS Research and Consulting, Rotterdam, 4 November 2008.

[113] A detailed register of the launched projects can be found at: http://ec.europa.eu/research/environment/index_en.cfm?section=geo&pg=fp6-fp7-projects.

[114] Vladimir Putin, Vladimir Putin in dialogue with Handelsblatt: ‚Europa bastelt am Bild des russischen Bären', *Handelsblatt* No. 176 (14 September 2009).

They are mostly concerned with funding SME capacities, local infrastructure projects, and the organisation of conferences related to GMES.

The EC provides smaller grants for investment in local research infrastructure and Downstream Services under the **Structural Funds**. One aim is to promote European network development in the regions' efforts to integrate space-based technologies into their current coastal management systems. The project started with two pilot regions (Ventspils in Latvia and Bremen in Germany) in order to achieve a cross-linking of the regions which corresponds to GMES and Galileo policy aims. The transfer of existing regional good practices into mainstream EU Structural Funds Programmes is funded with sums between EUR300,000 and EUR3 million. Structural Funds also provide grants for increasing EU-wide civil protection from natural catastrophes (EUROBALTIC CP programme).

Although the Commission recommended funding through the **Competitiveness and Innovation Programme (CIP)**[115] which addresses specific SME measures, critical technologies, technology transfer and so on, there has not as yet appeared a dedicated call for GMES-related issues. As a result, there is no specific earmarking for a specific activity such as GMES. However, if an entrepreneur had innovative ideas based on GMES or Earth observation they might fall within the scope of GMES and be eligible for funding. The programme runs from 2007 to 2013 with a budget of EUR3.621 billion, and the main beneficiaries are SMEs.

There are other funding opportunities for GMES-relevant projects from the Community at regional and local levels, which fund projects related to matters addressed in GMES (biodiversity, climate change, coastal zone management and so on) although they do not have a specific relation to GMES:

- DG Environment (LIFE+) for small to medium-sized projects;
- DG Regional Policies (Interreg IV C) for collaboration of European regions.

Table 12: New GMES funding opportunities

Opportunity	Budget	Projects favoured
LIFE+ (2007-2013) http://ec.europa.eu/environment/life/	Budget: EUR2.143 billion/average project budget: EUR1 million	Trans-national, large and ambitious projects dealing with climate change (information and communication)
Interreg IV C http://www.interreg4c.net/	EUR500,000–EUR5 million	Innovation and knowledge economy; environment and risk prevention

Source: Author's visualisation.

5.7. Joint European research activities

Besides EC funding on GMES, there is an intergovernmental framework allowing the coordination of nationally funded research at European level. The funding possibilities are small compared with the contribution of the Research Framework Programmes and especially FP7. This mostly involves scientific and technical research.

[115] *European Space Policy - Preliminary Elements*, COM(2005) 208 final (23 May 2005).

COST (European Cooperation in Science and Technology) anticipates and complements the activities of the EU Framework Programmes. COST programme activities concerning GMES are ENCWF (Towards a European Network on Chemical Forecasting and Information Systems) and EG-CLIMET (European Ground-Based Observations of Essential Variables for Climate and Operational Meteorology), which were both granted EUR100,000 per year (for a four-year period).[116]

5.8. MS contributions

The MS contribute financially to GMES as follows:

- to intergovernmental agencies such as ESA and EUMETSAT;[117]
- within the framework of their national space programmes;
- to the overall budget of the EU.

While the sizes of national space programmes differ between MS and depend on their political priorities and the expectations of the outcomes for their space industries, MS contributions to the overall EU budget are a fixed percentage (the equivalent of only 1 per cent) of combined gross national income.

The ESA financing is a mixed mode. There are mandatory activities[118] funded by all the MS agencies, calculated in accordance with each country's gross national product (GNP). In addition ESA conducts a number of optional programmes.[119] GMES is part of ESA's optional activities. Each MS decides in which optional programmes it wishes to participate and the amount it wishes to contribute.

As an example of the different approaches to GMES, Table 13 analyses the financial contributions and the motivation behind their support for GMES of Germany and the United Kingdom (UK).

Table 13: The UK's and Germany's space contributions

Contribution	UK	Germany
Contribution to intergovernmental agencies	- ESA (2006–09) EUR11.04 million - EUMETSAT – 15.84%[120]	- ESA (2008) EUR603 million - EUMETSAT – 19.47%[121]
Net contribution to the overall EU budget	ESA Space Component Programme (2007–13) - EUR102.5 million (5% of total)	ESA Space Component Programme – EUR317 million (37% of total)
National Space Programme	EUR11.1 million on Earth observation	EUR175 million
Industry expectation	EUR7.7 million	EUR49.9 million

Source: [122,123,124,125,126] Author's visualisation.

[116] COST Office 2009, *About COST 2009*, http://www.cost.esf.org/library/newsroom/About-COST-2009.
[117] Contributions are calculated as pro-rata to the Gross National Income (GNI).
[118] The Mandatory Activities at ESA consist of the Scientific Programme and the Basic Activities (General Studies, Technology Research, Technology Transfer Programme and Earthnet, Education and Corporate/Administrative activities). They are implemented in five-year funding slices.
[119] The Optional Programmes cover areas such as Earth observation, telecommunications, satellite navigation, space transportation systems (launchers), human spaceflight, microgravity and exploration.
[120] Reference period 2004–06, applicable for the period 2009–11.
[121] Reference period 2004–06, applicable for the period 2009–11.
[122] House of Commons 2007, *Science and Technology – Seventh Report*, http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/66/6602.htm.
[123] BMBF, Pressemitteilung No. 213/03, 19 November 2003, p. 2, http://www.bmbf.de/_search/searchresult.php?URL=http%3A%2F%2Fwww.bmbf.de%2Fpress%2F998.php&QUERY=gmes

The numbers in the table illustrate the countries' different motivations and approaches. In the UK, there is concern in the British National Space Centre that the GMES programme does not meet user objectives and policy requirements, and therefore does not warrant additional funding. Whereas the German industry can expect higher revenue from the contracts in the field of GMES due to *juste retour,* UK industry expects lower revenue from the contracts.[127]

Other major contributors to space activities/GMES are France and Italy, followed by Spain, Belgium and the Netherlands. However, France and Italy have **decided to focus more on national efforts than on ESA programmes**. France has a strong national budget and has established a very strong national industry. Italy followed the French example and decided to reduce ESA funding and to increase national programme funding.[128]

The comparison underlines once more the **necessity of common EC-ESA action to focus on a functioning financing structure for GMES.**

5.9. Assessment of the financing of GMES

As described in section 4.3.2, the Impact Assessment outlined three possible options for the implementation of the GMES initial operations:

- open method of coordination;
- regulatory intervention;
- Community financing.

Community financing (Option 3) accompanied by coordination activities was considered to be the preferred option for the period 2011–13 by the European Commission.

As stated in the Impact Assessment 2009, the EC will continue to analyse whether regulatory intervention is necessary. This would entail an EU financial contribution to the provision of operational emergency and land monitoring services. The technical management of GMES Initial Operations shall be delegated to entities with a proven expertise, including ESA for the GSC and EEA for in-situ infrastructure coordination. The areas where the Community co-finances activities shall be closely coordinated with GMES partners in the framework of the GMES Partners Board. The exact scope and content of the activities that will be financed or co-financed shall be determined in a way that avoids crowding out of private investments, based on an intensive consultation of all relevant players, including users and downstream service providers, and interaction with MS through a comitology procedure. The beneficiaries of the EC contribution on services would be mostly public sector users. Regarding data procurement, the long-standing experience of ESA and JRC will be fundamental in assessing cost estimates. Regarding the initial operations of the sentinels, there shall be continuity with the current budget implementation approach through ESA.[129]

In the development of GMES, several problems concerning the financing remain open:

- one single funding management body;

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[124] BMBF, *Die Hightech-Strategie für Deutschland, BMBF* (Bonn/Berlin), 2006, p. 72, http://www.hightech-strategie.de/de/350.php.
[125] DLR 2008, *Research and Economic Development 2007/2008*, Druckerei Thierbach GmbH, Mühlheim/Ruhr, p. 81.
[126] EUMETSAT official page: http://www.eumetsat.int/Home/Main/AboutEUMETSAT/WhoWeAre/MemberandCooperatingStates/index.htm?l=en
[127] House of Commons 2007, *Science and Technology – Seventh Report*, http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/66/6602.htm.
[128] Johann-Dietrich Woerner, Chairman of the German Aerospace Center, DLR, in interview for *Space News*, posted 19 November 2008, http://www.spacenews.com/archive/archive08/profile_1117.html.
[129] *Commission Staff Working Document Accompanying the Proposal for a Regulation of the European Parliament and of the Council on the European Earth Observation Programme (GMES) and its Initial Operation (2011–2013),* SEC(2009) 639, (20 May 2009).

- financial relationship between EU and ESA;
- role of the space industry;
- long-term operational capacity of GMES.

5.9.1. One single funding management body

Particularly during the transition from the GMES pre-operational to its operational phase, independently of the contributions amount, it will **become more essential to create a central funding management body within the EC**.

While the Partners Board should coordinate activities that are financed by EU, national and intergovernmental funds, there is a need to provide this body with **clearly identified and binding responsibilities**.

In addition, **central contact points** for EC and non-EC funding programmes would be desirable (comparable to the National Contact Points in FP7 but for all available grants relevant to GMES).

5.9.2. Financial relationship between EU and ESA

The question about the financial relationship between the EU and ESA still remains open. This deserves further consideration on the principle of *juste retour* within the EU and the ESA framework. If the financial relationship remains undefined, the consequence would be repeated negotiations on financial contributions with high administrative costs. Uncertainties regarding the process and the outcome of the negotiations could discourage MS from investing in GMES. Therefore, there is a need for a successive approach to create an attractive GMES funding framework and to get the MS more tightly involved in GMES financing.

5.9.3. Role of the space industry

The space industry could also be considered for a financial contribution to GMES, for example through PPP. As was learned from Galileo, such PPP agreements have to be adequately prepared for. The space industry could be interested in these cooperations in order to gain information and knowledge. There is significant growth in the demand for geospatial information, and the importance of climate change for private stakeholders, and the opportunity for operational information provision add new possibilities for space industry participation.

However, the space industry is relatively small compared with other industries. As a result of its limited capacity to invest in science and research it is expected that the space industry will only make a limited contribution to GMES.

5.9.4. Long-term operational capacity of GMES

Another open question is which entity will secure the long-term operational capacity of GMES in the operational phase.

The most sustainable solution lies in a single budget line for GMES within the European Financial Framework as proposed by the EC. The other option (mixed financing via MS contributions and contributions from intergovernmental and European institutions) would imply repeated negotiations. Nevertheless a project of the dimensions foreseen for GMES needs a financial framework on which to make secure future plans.

It is foreseen that the Downstream Services will be paid for by the end users. The EC has assumed a small downstream sector, which seems quite rational. However, the range of end users is wide. Most likely, the majority of end users will again be from the public sector. A market for private end users still has to be created.

As there are still no reliable market studies, it is not possible to calculate the likely revenue from private end users. However, the revenues from downstream data services for private industry could be used for the further development of new services. Public end users would have to pay for the Downstream Services although they have already contributed to the collection of primary data. It could be that these end users (like DGs of the EC or MS) will be willing to pay for special services if they are not directly involved in the running costs of the service operations. This is another argument in favour of a single GMES budget line to cover the Core Service operations.

All GMES services are new to users, therefore in the first years during the build-up phase there will be a supply-driven market. After a long-term development, the focus should be customer-focused, additionally backed by reasonable pricing, considering the added value from Core Services to Downstream Services.

The Core Services might be free at any time, because of their importance, their characteristic as raw data and their funding through FPs. It is recommended that the value of Downstream Services should be market-driven, with the customers themselves determining it. This approach is comparable with Galileo's situation in European satellite navigation: basic services are freely available for everyone, but newly created services with high accuracy or additional benefit have to be paid for.

From the next financial perspective, a single budget line for GMES will certainly impact and probably be the main driver for the development of a European space infrastructure. The proposed scenario in the previous chapter on governance for Community funding of GMES is considered to be the preferred option for the period 2011–13. However, it should be noted that involvement of public and private funding for the short term is a new way of harnessing the initiative and competency of the industry, and also of mobilising new financial resources for further development.

In conclusion, the creation of a single budget line for GMES with clearly defined coordination activities between ESA, EC and MS and the involvement of the private sector will be the best starting position for an operational GMES.

6. POLICY RECOMMENDATIONS

This chapter summarises the key findings and outlines policy recommendations based on following findings.

6.1. Recommendation from comparison of Galileo and GMES

GMES, like Galileo, is based mainly on space infrastructures. Both programmes will give Europe the appropriate tools to ensure it has an impact on geological, economic, security and navigation issues. In order to create added value, it should be ensured that it is possible to exchange information between both programmes. Therefore, standards for the presentation of data should be developed at an early stage.

6.2. Recommendations on GMES governance

Key findings on GMES governance suggest that there is still potential for improving the GMES structure. Clear governance and decision-making structures are required for the main components: Space, Services and In-situ. At several stages there are unclear and overlapping responsibilities. Therefore, clear definitions of roles and responsibilities are needed.

There is still potential for action at Community level to ensure the continuity and stability of the management structures for the different periods.

The analysis of the inner structure of GMES identified heterogeneity and diversity among the stakeholders. This requires clearly defined mechanisms for the engagement of providers and users at the different levels.

One problem of the inner structure is the number of different bodies. For instance, six different bodies (including the GMES Bureau and the GMES Programme Office) are involved in the initial stage, and have overlapping tasks and responsibilities. This could be simplified. It could be useful to check whether tasks can be allocated to only one entity. If this is not possible clearer definitions of the profiles and specific tasks of the organs are required.

GMES has undergone several restructuring processes. It is essential that there is a balance between restructuring processes to adapt to changing conditions and creating a stable working environment based on a secure and sustainable infrastructure.

A division of responsibilities between the political leadership (EC) and the provider of technical knowledge and capability (ESA) is foreseen in the governance structure. In order to ensure an efficient approach, EC and ESA need to start a discussion about political requirements and technical feasibility at an early stage.

The roles of ESA and EEA are crucial for the whole governance of GMES. In order to ensure the main aim of GMES, to unite all the national initiatives under one roof, it is recommended that EEA be given an outstanding role, and is fully engaged in the development and coordination of user-driven services.

There seems to be a problem of harmonising the roles of the EC, ESA and the space industry. Although some steps have been taken, the industry, particularly its SMEs, is not sufficiently involved in the political process. The space industry, with its direct links to the end users, could foster their involvement and express and specify their needs.

A strategic dialogue with all main stakeholders is needed to ensure their permanent involvement. Missing links have been identified between the users and the Downstream Services providers as well as the actors involved in the technical implementation of GMES components. These require appropriate actions.

A good starting point for the inclusion of users is the early integration of a User Forum which safeguards the user-driven approach.

GMES needs more visibility. Therefore, it seems essential to push the fast track services into operation, because it is more difficult to inform EU institutions about ideas that are still in the planning phase than about functioning services. Awareness raising would be much more successful if the services were already working.

GMES as a user-driven initiative has invested a significant amount of resources in the development of Downstream Services, although there is no confirmed evidence of a potential market for them. It is recommended that detailed market analysis is carried out to assess the potential for the different Downstream Services.

There is a need to embed institutions dealing with security issues more tightly into the Security Board, and to link them directly to MS to fill the gaps concerning institutional management of security data and data flow.

There is still a lack of a common European data policy regarding security data flow and management in the GMES initiative. As a consequence all the data providers only provide data following their own data policy. In order to ensure real open access and availability of the existing data, there is a need to address this urgent issue.

6.3. Recommendations on GMES financing

The creation of a central funding management body within the EC is becoming more essential, and will be particularly so during the transition from GMES's pre-operational to operational phase. The Partners Board should coordinate activities that are financed by EU, national and intergovernmental funds. However, there is a need to provide this body with clearly identified and binding responsibilities.

The financial relationship between the EU and ESA still remains unclear. There should be further consideration of the principle of *juste retour* within the EU and the ESA frameworks. On the one hand, repeated negotiations on financial contributions should be avoided because they result in higher administrative costs. On the other hand, uncertainties regarding the process and the outcome of the negotiations are likely to discourage MS from investing in GMES. Therefore, there is a need for an approach that creates an attractive GMES funding framework, and gets the MS more tightly involved in GMES financing.

The GMES concept foresees that end users will pay for Downstream Services. The EC has calculated that there will be only a small downstream sector, which seems quite rational. It is expected that most end users will be in the public sector, while a market for private end users still has to be created. Until there are reliable market studies, it will not be possible to calculate the likely financial contribution from this source. However, the revenues for downstream data services from private industry could be used for further development of new services.

All GMES services are new to the users. In the first years during the build-up phase the market will be supply-driven. In the long-term development, the focus should be on customers, additionally backed by reasonable pricing which takes into account the value added from Core Services to Downstream Services.

In a conclusion, the creation of a single budget line for GMES, with clearly defined coordination between ESA, EC and MS and the involvement of the private sector, could be the best starting position for an operational GMES.

7. REFERENCES

Aschbacher, J., GMES Space Component, presentation prepared for Towards e-ENVIRONMENT, Prague, 25-27 March 2009. Available form: www.e-envi2009.org/?presentations.

Ballard Communications Management, DMCii wins 3.9m euro ESA contract to image sub-Saharan Africa, Press release, 17 August 2009. Available from: www.ballard.co.uk/press_releases/files/1438/DMCii%20wins%203.9m%20Euro%20ESA%20contract%20to%20image%20sub-Saharan%20Africa.pdf. (Ballard Communications Management, 2009)

Bernot, C., The 'S' of GMES: scope and general information requirements, speech at the GMES 3rd Forum, Athens, 4 June 2003. Available from: http://www.gmes.info/pages-principales/library/forum-and-events/3rd-gmes-forum/parallel-session-4/?no_cache=1&download=3F_PR4_%20Bernot_ContributionPaper.pdf&did=227.

BMBF, Pressemitteilung No 213/03, 19 November 2003. Available from: http://www.bmbf.de/_search/searchresult.php?URL=http%3A%2F%2Fwww.bmbf.de%2Fpress%2F998.php&QUERY=gmes. (BMBF, 2003)

BMBF, Die Hightech-Strategie für Deutschland, Bonn/Berlin, 2006. Available from: http://www.hightech-strategie.de/de/350.php. (BMBF, 2006)

CEC, 'Satellite Navigation Services: A European Approach', Communication from the Commission, COM(94) 248 final, Brussels, 14 June 1994. (CEC, 1994)

CEC, 'On Galileo', Commission Communication to the European Parliament and the Council, COM(2000) 750 final, Brussels, 22 November 2000. (CEC, 2000)

CEC, 'Work Programme for Part A: Environment and Sustainable Development', Programme for Research, Technological Development and Demonstration under the Fifth Framework Programme, C(2001) 4307, 18 December 2001. Available from: http://cordis.europa.eu/eesd/calls/a_200104.htm. (CEC, 2001)

CEC, 'Building the Europe of Knowledge', Proposal for a Decision of the European Parliament and the Council concerning the seventh frame work programme of the European Community for research, technological development and demonstration activities (2007 to 2013) and Proposal for a Council Decision concerning the seventh frame work programme of the European Atomic Energy Community (Euratom) for nuclear research and training activities (2007 to 2011), COM(2005) 119 final, Brussels, 6 April 2005. (CEC, 2005a)

CEC, 'European Space Policy - Preliminary Elements', Communication from the Commission to the Council and the European Parliament, COM(2005) 208 final, Brussels, 23 May 2005. (CEC, 2005b)

CEC, 'EU Strategy for Africa: Towards a Euro-African pact to accelerate Africa's development', Communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee, COM(2005) 489 final, Brussels, 12 October 2005. (CEC, 2005c)

CEC, 'Global Monitoring for Environment and Security (GMES): From Concept to Reality', Communication from the Commission to the Council and the European Parliament, COM(2005) 565 final, Brussels, 10 November 2005. (CEC, 2005d)

CEC, 'Green Paper on Satellite Navigation Applications', COM(2006) 769 final, Brussels, 8 December 2006. (CEC, 2006)

CEC, 'Global Monitoring for Environment and Security (GMES): we care for a safer planet', Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2008) 748 final, Brussels, 12 November 2008. (CEC, 2008a)

CEC, 'Global Monitoring for Environment and Security (GMES): we care for a safer planet', Impact Assessment, Commission Staff Working Document, accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, SEC(2008) 2809, Brussels, 12 November 2008. (CEC, 2008b)

CEC, 'Annex, Work programme 2008 for the further implementation of the European satellite radio-navigation programmes (EGNOS and Galileo), including the Programme Implementation Plan', Commission Decision, C(2008) 8371 final, Brussels, 12 December 2008. (CEC, 2008c)

CEC, 'On the European Earth observation programme (GMES) and its initial operations (2011-2013)', Proposal for a Regulation of the European Parliament and of the Council, COM(2009) 223 final, Brussels, 20 May 2009. (CEC, 2009a)

CEC, 'On the European Earth observation programme (GMES) and its initial operations (2011-2013)', Impact Assessment, Commission Staff Working Document accompanying the proposal for a Regulation of the European Parliament and of the Council, SEC(2009) 639, Brussels, 20 May 2009. (CEC, 2009b)

CEC, 'European Union Strategy for the Baltic Sea Region', Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2009) 248 final, Brussels, 10 June 2009. (CEC, 2009c)

CEC, 'Work Programme 2010: Cooperation, Theme 9 - Space', C(2009) 5893, 29 July 2009. Available from: ftp://ftp.cordis.europa.eu/pub/fp7/docs/wp/cooperation/space/j_wp_201001_en.pdf. (CEC, 2009d)

Chesworth, S., A new era of spaceborne SAR and its contribution to disaster management and damage mitigation, presentation prepared for the 4th International Workshop on Remote Sensing for Post-Disaster Response, Cambridge, 25-26 September 2006. Available from: www.arct.cam.ac.uk/curbe/..%5CCURBE%5CPresentations%5CChesworth.pdf.

COST Office, About COST 2009, 2009. Available from: http://www.cost.esf.org/library/newsroom/About-COST-2009. (COST Office, 2009)

Counet, P., EUMETSAT: Monitoring weather and climate change from space, presentation prepared for the Eurisy Conference, Budapest, 26 January 2009. Available from: http://www.eurisy.org/DocEurisy/20090126_Budapest/Presentations/1.4_P_Counet_Eumetsat.pdf.

De Bernadinis, B., GMES Fast Track Emergency Response Core Service - Strategic Implementation Plan, Final Version, 24 April 2007. Available from: http://www.gmes.info/pages-principales/library/implementation-groups/emergency-response-core-service-ercs/?no_cache=1&download=ERCS_Strategic_Implementation_Plan_Final.pdf&did=42.

De Bernadinis, B., 'Earth Observation data provides operational support to Italian Civil Protection activities during an Etna eruption', Window on GMES, Issue no. 3, March 2009, pp. 52-55.

Denis, G., 'En route for a safer world: building operational services for emergency response', Window on GMES, Issue no. 1, May 2008, pp. 32-40.

DLR, Research and Economic Development 2007/2008, Druckerei Thierbach GmbH, Mühlheim/Ruhr, December 2008. Available from: http://www.dlr.de/en/desktopdefault.aspx/tabid-621/1041_read-1420/. (DLR, 2008)

Deutsche EU-Ratspräsidentschaft, Der Weg zu Europäischen Erdbeobachtungsdiensten – GMES: Munich Roadmap, 17 April 2007. Available from: http://www.bmvbs.de/Anlage/original_1004403/Der-Weg-zu-Europaeischen-Erdbeobachtungs-diensten-GMES-Munich-Roadmap-barrierefrei.pdf.

EARSC (European Association of Remote Sensing Companies), EARSC Statement on GMES, statement prepared for the Workshop 'The impact of GMES Governance Models on Industry', Brussels, 11 May 2009. Available from: http://www.earsc.eu/file_download/67/EARSC+Statement+on+GMES+Governance+11May 2009.pdf. (EARSC, 2009)

EC (Council of the European Union), 'A Market for GMES in Europe and its Regions - the Graz Dialogue', Conference Report 9182/06 on the 19-20 April 2006, Graz Conference, Brussels, 15 May 2006. (EC, 2006)

EC (Council of the European Union), 'Council conclusions on European Security and Defence Policy', 2943rd External Relations Council meeting, Brussels, 18 May 2009. Available from: http://www.consilium.europa.eu/App/NewsRoom/loadDocument.aspx?id=985&lang=EN&directory=en/esdp/&fileName=107909.pdf. (EC, 2009)

EC DG Research, Key elements of the GMES, EC Draft Action Plan, Initial Period 2001–2003, Brussels, 27 July 2001. Available from: http://www.gmes.info/pages-principales/library/reference-documents/?no_cache=1&download=GMES_EC_Action%20plan_Brief.pdf&did=71. (EC DG Research, 2001)

ECMWF, Four-Year Programme of Activities 2009–2012, December 2008. Available from: www.ecmwf.int/about/programmatic/4yp-2009-2012.pdf. (ECMWF, 2008)

ECORYS Research and Consulting, 'Study on the Competitiveness of GMES Downstream Sector', Final Report, Rotterdam, 4 November 2008. (ECORYS Research and Consulting, 2008)

EC Regulation (EC) No 876/2002 of 21 May 2002 setting up the Galileo Joint Undertaking, Official Journal of the European Communities, L138, 2002. (EC Regulation 876/2002a)

EC Regulation (EC) No 1605/2002 of 25 June 2002 on the Financial Regulation applicable to the general budget of the European Communities, Official Journal of the European Communities, L248, 2002. (EC Regulation 1605/2002b)

EC Regulation (EC) No 1321/2004 of 12 July 2004 on the establishment of structures for the management of the European satellite radio-navigation programmes, Official Journal of the European Union, L246, 2004. (EC Regulation 1321/2004)

EC Regulation (EC) No 683/2008 of the European Parliament and the Council of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and Galileo), Official Journal of the European Union, L196, 2008. (EC Regulation 683/2008)

ESA, Global Monitoring for Environment and Security is a main issue for the Third Space Council, ESA press release No 55-2005, 28 November 2005. Available from: http://www.esa.int/esaCP/Pr_55_2005_p_EN.html. (ESA, 2005)

ESA, Europe's first polar-orbiting weather satellite ready for launch, ESA news, 16 October 2006. Available from: www.esa.int/esaLP/SEMAETN7BTE_LPmetop_0.html. (ESA, 2006)

European Court of Auditors, The Management of the Galileo Programme's development and validation phase, Special Report No 7/2009, Office for Official Publications of the European Communities, Luxembourg, 2009. (European Court of Auditors, 2009)

European Parliament, EU Space Policy and its Potential for EU Industrial Sector Competitiveness, Study of the Policy Department Economic and Scientific Policy of the European Parliament, IP/A/ITRE/ST/2007-09 PE 408.555, September 2007.

EUMETSAT, EUMETSAT Strategy: 2030, October 2006. Available from: http://www.eumetsat.int/Home/Main/AboutEUMETSAT/Strategy/index.htm?l=en. (EUMETSAT, 2006)

EUMETSAT, EUMETSAT 67th Council moves GMES and Jason-3 forward, EUMETSAT press release, 1 July 2009. Available from: http://www.eumetsat.int/Home/Main/News/Press_Releases/713695. (EUMETSAT, 2009)

Fell, F., Cahill, B. and Mohaupt-Jahr, B., The European initiative Global Monitoring for Environment and Security – A users' approach, Project no. 30956, Project Title: GMES Network of Users, German Federal Environment Agency and INFORMUS GmbH, Germany, October 2007. Available from: http://www.gmes-network-of-users.eu/fileadmin/inhalte/gnu/pdf_files/Deliverables/GNU_GMES_Users_Appr.zip.

Galileo Joint Undertaking (GJU), Next step in the Galileo Programme: Handover of the management from the Galileo Joint Undertaking to the European GNSS Supervisory Authority, GJU press release, 30 November 2006. (GJU, 2006)

Geist, T., GMES - Entwicklung und Status, speech prepared for the Geoconvent 2009, Niederösterreich, 28-29 January 2009. Available from: http://www.3dgeo.at/download/09_geist.pdf.

GMES Bureau, Long-term continuity of the GMES in situ Component. Governance and implementation issues, GAC-09-02ANN1, 23 November 2007. (GMES Bureau, 2007a)

GMES Bureau, GMES In-Situ Observation Working Group, GAC-09-03, 23 November 2007. (GMES Bureau, 2007b)

GMES Support Team, GMES Vision and targets 2008 and Work progress of the Initial Period of the GMES Action Plan (2002-2003), Information Document for the participants of the 3rd GMES Forum, 23 May 2003. (GMES Support Team, 2003)

Grünreich, D., GMES Fast Track Land Monitoring Core Service - Strategic Implementation Plan, Final Version, 24 April 2007. Available from: http://www.gmes.info/pages-principales/library/implementation-groups/land-monitoring-core-service-lmcs/?no_cache=1&download=LMCS_Strategic_Implementation_Plan_Final.pdf&did=49.

Hegmann, G., 'Astrium warnt vor Wettbewerb bei Galileo', Financial Times Deutschland, 17 June 2009. Available from: http://www.ftd.de/wissen/:paris-air-show-astrium-warnt-vor-wettbewerb-bei-galileo/527809.html.

Hobe, S., et al., Entwicklung der Europäischen Weltraumagentur als ‚implementing agency' der Europäischen Union: Rechtsrahmen und Anpassungserfordernisse, LIT Verlag, Berlin, 2009.

House of Commons, Science and Technology – Seventh Report, 2007. Available from: http://www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/66/6602.htm. (House of Commons, 2007)

Kasanko M., LUCAS 2009 – Collection of European ground data, presentation prepared for the Geoland Forum_5, Berlin, 12-14 May 2009. Available from: www.gmes-geoland.info/events/download/Kasanko_LUCAS_2009_geolandforum_May_2009.pdf.

Kontoes, H., Sifakis, N. and Keramitsoglou, 'GMES Burn Scar Mapping kicks into full gear after 2007 wildfires in Greece', Window on GMES, Issue no. 3, March 2009, pp. 64-69.

Mecklenburg, S., Sentinel data Policy: An overview, presentation prepared for the Ground Segment Coordination Body Workshop 2009, Frascaty (Italy), 18-19 June 2009. Available from: http://www.congrex.nl/08c33/papers/6.1_Mecklelenburg.pdf.

N.N., 'ESA orders the first SENTINEL 2 Earth Observation satellite', Window on GMES, Issue no. 1, May 2008, p. 93. (N.N., 2008a)

N.N., 'More efficient surveillance increases the number of detected oil spills in Finland', Window on GMES, Issue no. 2, September 2008, pp. 24-25. (N.N., 2008b)

N.N., 'GMES services help local authorities to prevent forest fires in Haute-Corse', Window on GMES, Issue no. 2, September 2008, pp. 26-27. (N.N., 2008c)

N.N., 'Experiment demonstrates the potential of GMES security services to contribute to the fight against drug trafficking in the Caribbean', Window on GMES, Issue no. 3, March 2009, pp. 28-29. (N.N., 2009a)

N.N., 'European ministers provide further funding for the GMES Space infrastructure', Window on GMES, Issue no. 3, March 2009, pp. 92-93. (N.N., 2009b)

Plattard, S., 'What's the problem with Europe's flagships Galileo and GMES?', published in: The Yearbook of Space Policy 2006/2007, ed. by Schrogl, K-U., Mathieu, C., Peter, N., Springer, Vienna, 2008, pp. 153-166.

Potin, P. and Aschbacher, J., 'The contribution of earth observation to environmental monitoring and the GMES', published in: Threats, Risks and Sustainability – Answers by Space, ed. by Schrogl, K-U., Mathieu, C. and Lukaszczyk, A., Springer-Verlag, Vienna, 2009, pp. 76-91.

Putin, V., 'Europa bastelt am Bild des russischen Bären', Vladimir Putin in dialogue with Handelsblatt, Handelsblatt No 176, p. 2, 14 September 2009.

Puzzolo, V., Global monitoring for environment and security: the European Earth observation capacity, presentation from GMES Bureau, 2008. Available from: www.eurogeosurveys.org/assets/files/news/2008/February/presentations_session1/Puzzolo%20DG%20Entr%20GMES%20present.pdf.

RapidEye AG, With testing completed, RapidEye is open for business, RapidEye press release, 4 February 2009. Available from: www.rapideye.de/upload/documents/Press_Releases/RapidEye_Press_Release_Feb_04_2009.pdf. (RapidEye AG, 2009)

Rheticus, '10 Years of GMES: a chronicle', Window on GMES, Issue no. 1, May 2008, pp. 48-51.

Richter, S., Facing the monster 'Juste Retour' on the net financial position of Member states vis-à-vis the EU budget and proposal for reform, EU-Consent EU-Budget Working Paper No. 7, August 2008.

Rinke, N., The History of German Space Policy: Ideas, influences, and interdependence 1923–2002, Beauchesue Editeur, Paris, 2007.

Ryder, P., GMES Fast Track Marine Core Service - Strategic Implementation Plan, Final Version, 24 April 2007. Available from: http://eea.eionet.europa.eu/Public/irc/eionet-circle/water/library?l=/environment_copenhagen/background_documents_1/implementation_2007pdf/_EN_1.0_&a=d.

Space and Security Panel of Experts (SPASEC), Report of the Panel of Experts on Space and Security, March 2005. Available from: http://ec.europa.eu/enterprise/newsroom/cf/document.cfm?action=display&doc_id=2408&userservice_id=1. (SPASEC, 2005)

Stot, Z., GMES organisational models: pros and cons of different approaches for the public and private sectors, presentation prepared for the Workshop on Impact of GMES Governance Models on Industry, Brussels, 11 May 2009. Available from: www.eomag.eu/articles/834/the-impact-of-gmes-governance-models-on-industry.

Technopolis Group, Evaluation of the Activities of the European Commission's GMES Bureau, Final report, February 2009. Available from: http://ec.europa.eu/gmes/pdf/studies/gmes_bureau_evaluation_main_report.pdf. (Technopolis Group, 2009)

Woerner, J.-D., Interview for Space News, 19 November 2008. Available from: http://www.spacenews.com/archive/archive08/profile_1117.html.

Websites

AVISO, Jason-3, http://www.aviso.oceanobs.com/en/missions/future-missions/jason-3/index.html.

Boss4GMES, http://boss4gmes.customers.arjuna.eu/.

CEC, Research, Environment, FP6-FP7 GEO related projects, http://ec.europa.eu/research/environment/index_en.cfm?section=geo&pg=fp6-fp7-projects.

CEC, Research, Europe sets its sights on GMES, http://ec.europa.eu/research/rtdinfo/44/01/article_2027_en.html.

CEC, Seventh Framework Programme, Budget breakdown of the Seventh Framework Programme of the European Community (EC) (2007-2013) and Euratom (2007-2011), http://cordis.europa.eu/fp7/budget_en.html.

CEC, Seventh Framework Programme, Research Infrastructures, http://cordis.europa.eu/fp7/capacities/research-infrastructures_en.html.

Consulting project PACIFIC, PRS Application Concept Involving Future Interested Customers, www.gsa.europa.eu/projects/pacific/www.prs-pacific.eu/index0c51.html?option=com_frontpage&Itemid=1. (18 August 2009)

ESA, Earthnet Online, http://envisat.esa.int/object/index.cfm?fobjectid=5543.

ESA, ESA's sentinel satellites, www.esa.int/esaLP/SEMM4T4KXMF_LPgmes_0.html.

EUMETSAT, EUMETSAT official page, http://www.eumetsat.int/Home/Main/AboutEUMETSAT/WhoWeAre/MemberandCooperatingStates/index.htm?l=en.

GMES Office Bremen, http://www.gmes-bremen.eu/.

IAGOS, www.iagos.org.

Interreg IV C, http://www.interreg4c.net/.

LIFE+, http://ec.europa.eu/environment/life/.

RADARSAT 2, www.radarsat2.info.

Spot Image, www.spotimage.com.

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