European Space Policy Institute

The Less Known, but Crucial Elements of the European Space Flagship Programmes: Public Perception and International Aspects of Galileo/EGNOS and GMES

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Executive Summary

The Context

Europe is at a stage where the successful realisation of the flagship programmes, Galileo/EGNOS and GMES, is at stake. The focus of the political debate has to now been on governance, finance and technology. Two crucial elements that are of utmost importance for the implementation of the flagships, have so far been neglected: public perception and international relations, and these are the subjects of this report. For the first time they are thoroughly analyzed and recommendations are developed in order to make these two elements an instrument for the success of the two flagships (Figure 1).

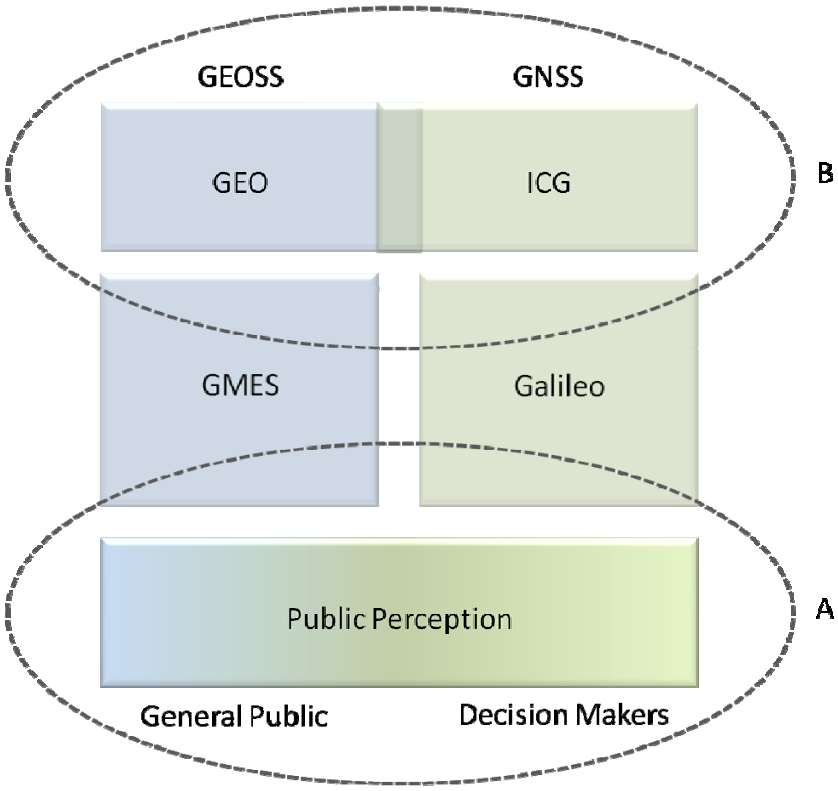

Figure 1: Conceptual schematic on public perception (A) and international aspects (B) for Galileo and GMES.

In 1998 the European Commission started its involvement in the space field with the birth of Europe's two flagship programmes: Galileo (and its augmentation system EGNOS) and GMES. These projects are essential political and economic milestones for the non-dependence and sovereignty of Europe's Member States and the Union as a whole. They will enable non-dependence on third party assets that are essential for drawing up and implementing core policy elements. In developing Galileo/EGNOS the Commission made efforts that did not go as planned and various corrective actions had to be implemented. At various times this has resulted in negative media coverage of Galileo which has diverted the public (general public and decision makers) from the fundamental questions of the need for Europe's flagship programmes. Additionally, miscalculations regarding the costs, inappropriate studies regarding the market share and speculation about the economic benefits have also been misleading. The main need for these flagship projects is not economic as is often projected, neither is it technological superiority. Europe needs to support the completion of these flagship programmes for three main reasons.

Reasoning behind the Flagship Programmes

First and foremost, it needs them for the Union's and its Member States' non-dependence on third parties for strategic infrastructure. The use of positioning and navigation and earth observation systems have become an indispensable part of everyday life and are used as an essential component in fulfilling many of our daily operations and economic development e.g. used for operations in banking, railway and aeronautics, rail and road traffic, search and rescue, etc. One often hears "Why does Europe need Galileo when one has GPS?" and the answer is that for such essential infrastructure elements, one needs to rely on European controlled systems and not foreign military controlled systems. Even though it is unlikely that the US or Russia will turn off the signals to Europe[1], the need for a system that is controlled by the Union and its Member States is essential and guaranteed interoperability with other GNSS will also secure redundancy and better quality of service.

The second reason is that due to the transverse nature of space, the two flagship programmes are important for drawing up and realizing various European policies such as agriculture, energy, environment, external, fisheries, regional development, transport, etc. These infrastructure assets can provide decision makers at European, national and regional level with the information necessary to make informed decisions. They can assist in real-time monitoring of the progress of policy implementation and allow for fast corrective measures. These assets are part of the developing market of downstream applications and can help Europe achieve its Europe 2020 goals to become a "smart, sustainable and inclusive growth economy" and contribute to the five identified objectives of innovation, employment, education, social inclusion and climate change.

The third reason is the role of Europe and its Member States vis-à-vis the international community. When Europe announced its ambition to develop Galileo back in 1998 it triggered a series of events. The United States improved the quality of the GPS signal for civilian use and sped up the development of the future generation of GPS. The Chinese also announced their intention to develop their own system, Compass, with its first MEO satellite, Compass M1, being launched in 2007 and expected to be completed between 2015 and 2020. The Indian local system IRNSS was planned to be operational by 2014. Additionally, there has been an international effort to make current and future systems interoperable and compatible. Additionally, with respect to GMES, Europe and the scientific community of its Member States are at the forefront of scientific and technological excellence. GMES is the European contribution to the international community for the Global Earth Observation Systems of Systems (GEOSS). Once the GMES system will be completed, Europe will have the most comprehensive space-based data collection system in the world. It will assist Europe by providing support to its external policies and, in particular, to development aid, disaster management in various countries including neighbouring Africa and it will contribute to Europe's humanitarian image vis-à-vis the international community. It will also assist Europe fulfil its international obligations e.g. Kyoto. Thus, Europe has been exposed to the international community with its initial ambition and has raised the expectations of its international partners. If Europe fails to live up to the expectations raised internationally this could potentially harm the integrity of the Union and its Member States in the eyes of the international community.

The European Union took an important step with its political decision to include space as part of the Union's shared competence under the Lisbon Treaty. Regulation 683/2008 put in place an autonomous satellite navigation system under EU ownership and management. The Global Monitoring for Environment and Security (GMES) is also under the Union's control. Additionally, in December 2010 it was decided to establish a User forum for GMES and the first meeting took place in January 2011 to determine the top down needs GMES can fulfil. Even though it has taken more time than expected to streamline the flagship programmes, it is now time to implement the lessons learned from the past and ensure the success of the two programmes while avoiding additional delays that result in higher costs and discontinuity of policies. European citizens support the two flagships in large numbers; in particular 91% support the importance for Europe of developing earth observation systems to monitor our environment including natural disasters, 67% support improving citizens security and 67% the importance of developing an independent "European GPS" system. This provides politicians and decision makers at European, national and regional levels the mandate to

[1] Examples of problems with GPS: 1) During the 1999 Kosovo conflict the US military 'manipulated' GPS to support military operations; 2) On 6 March 2011, in San Diego, California, there was disruption in ATM banking, traffic management etc. when the GPS signal failed. This was due to the fact that the satellites signal was of low quality. <http://www.newscientist.com/article/dn20202-gps-chaos-how-a-30-box-can-jam-your-life.html>.
3) Jamming devises can be developed with off the shelf components that can jam the signal of GPS and can create major destruction. Galileo can be used for redundancy to GPS ensuring signal integrity. In particular PRS users will be able to have an undisturbed signal.<http://www.gsa.europa.eu/go/news/prs-means-secure-satellite-navigation-for-sensitive-applications>.

safeguard the two programmes. It is important though that the right financial, governance and legal mechanism are put in place to ensure the success of the programmes. Europe is in need of a comprehensive mapping of European policies in relation to the benefits the two flagship programmes can bring to them. This study provides a list of objectives for the relevant European policies and indications of how the two flagship programmes can assist in fulfilling them. Additionally the relationship between Europe and its international strategic partners is investigated. From the information gathered a political, economic, social, technological and legal environmental factor analysis is used as a tool to develop policy recommendations.

Recommendations

Political

The development of Galileo as a core infrastructure reflects European political ambition for non-dependence on third parties and interest in boosting its competitiveness. At the time Europe made the decision to develop Galileo, only the U.S. GPS and Russian Glonass were available. European ambitions triggered the interest of other countries like China and India to also develop their own systems. Additionally, it stimulated the USA to offer a more accurate signal for the civilian use of its military system and the development of the next generation GPS which would have technical characteristics comparable to Galileo. Due to insufficient experience at the EC level and political planning, Europe made inappropriate choices with respect to a governance scheme and financing mechanisms. This resulted in failing to smoothly meet its objectives and as a result has led to political dissatisfaction and mistrust in the bodies responsible - EC and ESA. It was overlooked that ESA is a technical entity with successful stories of development, implementation, operation and exploitation initially by ESA and consequently by other bodies like EUMETSAT and EUTELSAT. The Commission was a newcomer in the space sector without sufficient experience or appropriate management structure in dealing with large-scale infrastructure programmes. Nevertheless, since 2008 the programme has resumed with encouraging progress. It is now fully financed by community money under the responsibility of the Union with ESA as the technical implementation body and GSA as the body that will take up the role of market development. The GMES flagship programme started after Galileo, with great strategic importance related to the role of the Union and its Member States as a global actor. The GMES is the European contribution to the international community is supported by the national missions and aspires to provide a complete system providing services that can assist Europe in the implementation of its policies as well as its international obligations in relation to the environment and climate change, e.g. Kyoto. A very important component in Europe's international obligations is to utilise GMES for Africa by assisting in the sustainable development of the continent and achieving the Millennium Development Goals. When GMES is completed, it will comprise the most comprehensive space-based data collection system in the world and will show internationally how Europe and its Member States can work well together. Today, full funding of the two programmes and the cost of its day-to-day operation after deployment has not been secured. The financial crisis and overall financial tightening in the European budget and its Member States is posing threats to the completion of the programmes. Additionally the negative publicity Galileo has received in the media has harmed the reputation of the programmes. The fundamental ideas represented by these programmes are backed by European citizens, as statistics show, giving sufficient "go ahead" to decision makers. The recommendations are:

- *Confirm political commitment.* Politicians and decision makers at European, national and local levels need to confirm their political commitment to the need for the flagship programmes as part of the essential infrastructure in Europe for non-dependence when it comes to strategic assets.
- *Capture adequately the policy objectives that the flagships can serve.* The flagships can serve various policy objectives in all main policy areas of the Union and those of its Member States, like agriculture, energy, environment, fisheries, foreign relations, regional development, transport, security etc. These should be thoroughly examined, beyond what has been done today. The policy objectives need to be translated to concrete applications with action plans for implementation.
- *Enhance cooperation and coordination between* the *EU and Member States.* The EU and the Member States should work together in coordinating their needs and jointly develop applications projects to utilize the potential of the flagship programmes to meet policy objectives and improve the lives of citizens.

- *Enhance user forums.* The user forum for the flagship programmes needs to be strengthened to include representatives from all stake holders.
- *Ensure successful governance.* Decision makers have to ensure and safeguard the success of the programmes and promote the need for a successful governance scheme end-to-end taking into consideration the different time frames in the development of the programmes.
- *Confirm International commitments.* The Union and its Member States should ensure the programmes are implemented to support the political commitments made to the international community e.g. Kyoto, EU and Africa with GMES for Africa and EGNOS for Africa etc.

Economic

The political backing of the two flagship programmes certainly helped save Galileo when the public-private partnership (PPP) failed and has helped GMES move forwards. Unfortunately, miscalculations and speculation regarding the market share of the two flagships on commercial revenues have damaged the image of the projects. It has to become clear that the main customers of these programmes are institutional users and although this might change in the future it should not be a basis for present calculations. The market need for navigation, positioning and earth observation data is increasing, but the return on investment of these programmes should be considered in terms of the indirect return via downstream applications and the social benefits. Unfortunately, the full financing of the two programmes from development to continuous operations is not yet guaranteed. GMES is the only programme that has funds to build the satellites, launch them and provide access and integration to Member States missions but does not have money for the operational phase. Galileo is in a similar situation where not even the full constellation of satellites is guaranteed. It is important that the financing of the programmes is guaranteed throughout their operation in order not to waste the investment already made and increase cost overruns. Failure to ensure this will have an impact on data gaps, polices, jobs, businesses as well as the image of Europe vis-à-vis the international community. The recommendations are:

- *Ensure continuation of the financial instruments.* The funding provided by the European Union, the European Space Agency and Member States should be aligned and financing should be guaranteed for the programmes' full development, deployment and basic operations.
- *Implement financial mechanisms stimulating the development of innovative downstream applications.* The market for navigation positioning and earth observation data is constantly growing. Financial mechanisms stimulating the development of novel downstream applications should be implemented. They should be based on public-private partnerships or by the involvement of investment banks. The expression of interest should be based on assessed business models. The additional risk for such development should not be borne by the Union but by private entities.
- *Investigate the implementation of alternative funding mechanisms.* The funding of such infrastructure should be fully through governmental investment and lessons learned from the failed PPP should be taken into consideration. If additional funding is required for the deployment of the full constellation, then Member States whose industries are the main developers could provide the additional budget. The operational phase requires continuous yearly funding throughout the duration of operations. As was the case with the development and operations of EUMETSAT and Eutelsat, different funding schemes can be used during the operation phase. As the largest customer is governments, a yearly contribution that covers the main costs should be planned. Furthermore, once deployment and basic operations are secured the further development stages of the programmes, in particular related to exploitation, could be implemented through different financing schemes.

Social

Space infrastructure like Galileo and GMES and their applications can assist decision makers and the European citizens in improving everyday life by providing solutions in transport, disaster management, health, working conditions, urban development, energy, environment, safety, etc. There is insufficient or misleading communication regarding these projects. Often the identification of Galileo/EGNOS and GMES as the European systems for navigation, positioning and earth observation is missing. In the case were the public does recognise e.g. Galileo it often associates it with media stories highlighting the negative aspects of the programmes. This is due to the fact that there are inconsistent and insufficient communication channels used to inform citizens about the

projects, their rationale and usefulness and the direct benefits that the citizens will be able to enjoy once they are fully functional. The recommendations are:

- *Increase awareness and enhance communication.* The European Commission and national and local governments as well as user communities and industry should develop appropriate communication strategies to provide correct and accurate information about the flagship programmes to avoid misinformation by media. The media should also be fed with correct and official information on a continuous basis. Such communication mechanisms could be seminars, workshops, and open days at industrial sites, exhibitions of successfully implemented projects like EGNOS, information days, competitions, local information centres, radio and TV advertisements.
- *Demonstrate public benefits with examples.* Successful projects that have been developed using the flagships and that provide benefits to citizens need to be showcased. It is important to demonstrate with real examples the benefits and advantages to the actors in the value chain.
- *Enhance the involvement of the user community.* European citizens should be involved in the exploitation of these flagships and the downstream applications. The free and open sources and availability of data should be emphasized. There are various volunteer organizations that could benefit from using navigation, positioning and earth observation data for their work. One area that could significantly benefit is civil protection with volunteers in fire fighters, police, boarder watchers, search and rescue, etc. This could also possibly foster innovative ways of using the information provided by the flagship programmes.

Technological

EGNOS is now operational, Galileo is one step before being launched and GMES is at the critical transition stage from technology development to operations. Technological development of downstream applications has been made using mostly community funding e.g. FP6, FP7, national funding and ESA. Industry has also made some investment in this area. In the areas of GMES research and technology development and data exchange between the communities there is excellent collaboration and utilization. EGNOS has also demonstrated successful stories with its use by 80.000 farmers[2]. Nevertheless, regarding downstream applications, the majority of these projects are still at the pilot phase. There has been little assessment of the level of maturity of projects and of their market potential. There are also various applications that can be developed using both navigation and positioning as well as earth observation data and this needs to be further exploited through integrated applications.

- *Increase development of integrated applications.* Navigation, positioning and earth observation are complementary technologies. Combined together and with other technologies, they can provide useful integrated applications. Projects that combine space and ground-based systems should be increased. They should target different potential users, including governments, business, schools, universities, public, etc. The areas where synergies between Galileo/EGNOS and GMES can be beneficial are energy, agriculture, environment, humanitarian aid, emergency response, managing oceans and seas, management of land resources, global security etc.
- *Foster inter-sectoral collaboration for innovation*. Different industries should be brought together eg. automotive, shipping, agriculture, banking, insurance in order to foster innovation for new product development.
- *Better define services.* To implement their policies, user communities e.g. European Union, Member States often have specific needs. It is important to properly capture user requirements and translate them into technological requirements for further technology development to serve their needs. This can be done though user forums with participation from industry and research and development institutions.
- *Ensure compatibility, interoperability, standardization and certification.* Efforts for compatibility, interoperability and standardization between operators and service providers should be continued, both in the area of GNSS as well as earth observation systems. Additionally, discussions with China over frequency allocation should be continued.
- *Evaluation of projects and prioritization according to potential.* Various pilot projects of technology demonstration have been developed, particularly regarding downstream applications of the flagship programmes. An in-depth evaluation should be performed and the projects that

[2] Information for the 07 Dec. Workshop at European Parliament on "Galileo-GMES Less Known Elements of the Space Flagship Programmes:Public Perception and International Aspects".

have potential should be further developed to an operational phase either through the community or through industry.

Legal

Galileo and GMES have undergone several restructuring processes. The most recent one concerning Galileo renames the 'European GNSS Supervisory Authority' as the 'European GNSS Agency'[3] and affects the mandate of the exploitation of Galileo and EGNOS. Regarding GMES the latest development was the establishment of the GMES/GEO regulation which included the establishment of a user forum. Nevertheless, there are still no clear provisions regarding the programme when it comes to operations. Changes in governance should provide continuity and sustainability in administrative, budgetary, legal responsibilities at different phases of the programmes. There are still questions regarding the Public Regulated Services (PRS) for Galileo and the data policy for GMES that should be dealt with as soon as possible. The related legislative bodies at European and Member State level should pass the provisions necessary to safeguard the success of the programmes. These provisions may include additional taxation if the European flagships are not preferred over others. Recommendations are:

- *Implement appropriate legislation.* For the exploitation of Galileo and GMES and the development of services and downstream businesses the necessary legislation needs to be passed and implemented. Appropriate legislation should be put in place to ensure the full exploitation of the two programmes in Europe including giving preference for their use over foreign systems. Additionally, appropriate data policy and intellectual property rights should be put in place.
- *Coordinate policies and regulations.* There should be an in-depth analysis of how these programmes can assist in the implementation of other policy areas and appropriate regulatory framework to make use of these assets should be adopted. Examples could be using GMES and Galileo information for identifying fishing zones, tracking agricultural production, etc.
- *Promote law enforcement through the use of the flagships.* The flagship programmes can provide data for law enforcement e.g. illegal building, false declarations, violations of laws and treaties, tax violation, etc.
- *Implement appropriate governance structures.* Appropriate governance structures should be implemented taking into consideration the different development phases. Lessons learned from Galileo should be considered in GMES and vice versa. Additionally, successful stories such as EUMETSAT and Eutelsat should be considered. The most successful structures are typically those that are close to the end customer.

[3] The European Parliament and the Council of the European Union. Regulation (EU) No 912/2010 of the European Parliament and the Council, Setting up the European GNSS Agency, repealing Council Regulation (EC) No 1321/2004 on the Establishment of structures for the management of the European satellite radio navigation programmes and amending Regulation (EC) No 683/2008 of the European Parliament and of the Council of 22 Sep. 2010.

1. Introduction

1.1 The Setting

The use of satellites and space-based technologies has become an indispensable part of our everyday life. They are used in cars, air travel, railways, ships, mobiles, ATM machines, etc. making our society critically dependent on these technologies. They ensure knowledge, information and contribute to economic development, security and defence. Thus, it is highly important for Europe and its Member States to have autonomous and comprehensive capabilities for developing and maintaining such space infrastructures.

Galileo and Global Monitoring for Environment and Security (GMES) are the EU's space flagship programmes. These programmes are of great strategic importance for Europe as they contribute to an autonomous and operational navigation, positioning and European Earth observation capability. European satellite radio navigation policy is presently implemented through Galileo and EGNOS. Galileo when operational will be the first civilian Global Navigation Satellite System (GNSS) and EGNOS is the European augmentation system currently using the GPS signal and later Galileo. GMES aims at providing accurate and timely information to policy makers (e.g., national governments, and agencies, EU institutions, intergovernmental organizations and non-governmental organizations, and other users), particularly in relation to the environment and security.

Earth observation as well as navigation and positioning from space provides homogeneous observations with unsurpassed coverage of climate, the environment, oceans, fisheries, land, vegetation, biodiversity, agriculture, transport, etc. Infrastructures like Galileo/EGNOS and GMES can assist Europe and its Member States in drawing up, implementing and monitoring their policies. Through the transverse nature of the information provide by satellites and their applications they can serve a variety of policies such as, to name a few, agriculture, fisheries, energy, environment, enterprise and industry, regional policy, external policies, etc.

Satellites and space-based technologies can also make a significant contribution to international co-operation. They not only contribute to scientific collaborations in science, technology and applications but also can be used to serve European objectives including economic and social development, environment, education, health, development aid, disaster management, security, etc. The European Union and its Member States is the number one provider of development aid in the word.

Galileo and GMES are the European contribution to the international effort in navigation and earth observation. Once completed, Galileo/EGNOS will be the only global navigation system under civilian control providing guaranteed services. GMES is the European contribution to the international effort on a Global Earth Observation System of Systems (GEOSS). Once completed it will be the world's most comprehensive system on earth observation, establishing Europe as a leader in the international community.

There have been numerous publications and discussions about the governance and financing of the two flagship programmes. There are two specific issues that have not been investigated thoroughly or in a comparative approach. These are the issues of public perception (general public and decision makers) and international cooperation. There is a need to build upon existing knowledge and to assess these issues in a comparative approach (Figure 2).

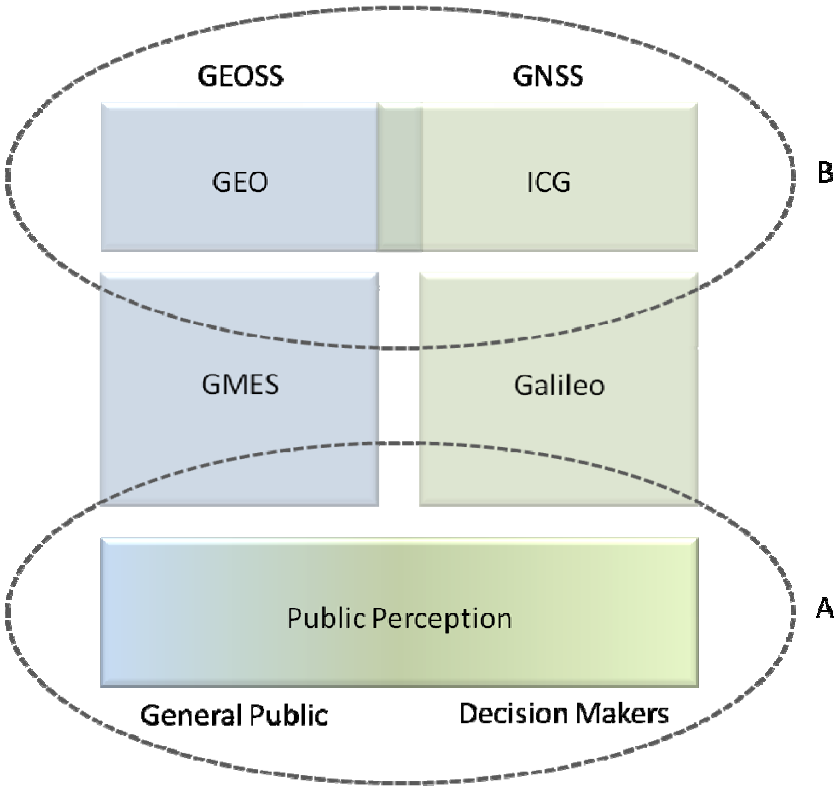

Figure 2: Conceptual schematic on public perception (A) and international aspects (B) for Galileo and GMES.

1.2 Approach of the Study

Even thought there is a lot of attention on governance and financing of the European flagship programmes, Galileo/EGNOS and GMES, there is very little on public perception (general public and decision makers) and international aspects. The European Space Policy Institute (ESPI) focuses on building on existing analysis, on governance and structure of the two flagships, and touches on two specific issues that have not been investigated thoroughly or in a comparative approach. These two areas can be seen as framing elements of the two flagships in that they look into the foundations of the programmes vis-à-vis the general public and decision makers; and relate to the interaction on the global scale with other actors conducting activities with a global approach in the two fields.

Chapter 1 of the study provides the setting. Chapter 2 gives an overview of Galileo/EGNOS and GMES. Chapter 3 gives an overview of public perception by making a comparison with the United States and examining European statistics. Chapter 4 analyses the various European policies and highlights how the two flagships can contribute to achieving policy objectives. The policies examined are: agriculture, energy, environment, enterprise and industrial, external relations, fisheries, research and technology development, transport, regional development. Chapter 5 highlights the international involvement of Europe with respect to Galileo/EGNOS and GMES in the efforts of the international community and vis-à-vis some of its strategic partners. Chapter 6 makes an analysis according to political, economic, social, technological and legal factors and draws policy recommendations addressed to the various stake holders.

The methodology used to conduct this study was based around three tools: extensive desktop study, interviews, and a workshop. In the framework of this study a workshop was organized by the European Space Policy Institute (ESPI) Institute in close cooperation with the ITRE Committee and was conducted at the European Parliament on 7 December 2010. It brought together the main stakeholders in the fields of satellite Earth observation and navigation in order to discuss aspects of relevance to political decision-makers.

2. Europe's Flagship Programmes: Galileo and GMES

The two flagship programmes - Global Monitoring for Environment and Security (GMES) and Galileo - are the EU's main space infrastructure and are important parts of European Space Policy; they are products derived from the close involvement of the European Commission and the European Space Agency (ESA).

2.1 Galileo

The Commission's Communication, in January 1998, marks the beginning of Galileo, defining the issues at stake and the objectives of the programme. It set GALILEO as the European satellite radio navigation and positioning programme. It was conceived by the European Commission and developed jointly with the European Space Agency, aiming at giving the European Union (EU) an independent system that could compete with the American GPS and Russian GLONASS systems. Already in 1994 the Council had approved the lauch of the European Geostationary Navigation Overlay Service (EGNOS) programme as the European satellite-based augmentation system to the GPS and later to Galileo. In 1996 the Inmarsat-3 F2 AOR-E a telecommunications satellite was launched carrying an EGNOS transponder.

In 2000, the European Commission prepared a communication that gave an outline of the Galileo initiative by determining the financial and economic aspects of the project, the structure of management supposed to guide the initiative as well as the envisaged international cooperation scenario. The programme was divided into 3 phases: 1) the development and validation phase; 2) the deployment phase; and, 3) the commercial operation phase. At this point, financing the initiative through a Public Private Partnership (PPP) was considered the best way to reach the expected outcome. ESA would co-fund the public expenditure; phases 1 and 2 were to be completely financed by public funds, while phase 3 would mostly be financed by private investment. An interim management body, composed of two boards representing the political control (EU) and the technical control (ESA), were entrusted to steer the endeavour until the establishment of a final structure[4].

The year after the communication, the Council adopted a resolution defining many other characteristics; Galileo was outlined as a civil programme under civil control, and led by a central administration to be established as soon as possible. Furthermore, the Council underscored the necessity for Galileo to be interoperable with other GNSS systems (i.e. GPS) and gave the Commission the mandate to establish the arrangements to assure that task. It was followed in 2002 by the creation of the Galileo joint undertaking (GJU), and subsequently, the regulation on the deployment and commercial operating phases of the programme[5]. In 2003 the Council confirmed that EGNOS in an integral part of the European satellite navigation policy. In the same year the first test signals of EGNOS were broadcasted from space.

Following a 2004 resolution by the Council, the European Commission negotiated and signed an agreement with the United States of America for the interoperability of Galileo and GPS. The agreement provides a set of rules that deal with the different understandings of GPS and Galileo. The set of rules provided deal, *inter alia*, with the compatibility of radio frequencies to avoid mutual jamming of signals; interoperability on non-military bases; and the establishment of a working group to deal with the major issues of the coexistence of both systems.

[4] Commission of the European Communities. Commission Communication to the European Parliament and the Council On Galileo. COM (2000) 750 final of 22 Nov 2000. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2000:0750:FIN:EN:PDF>

[5] The Council of the European Union. Council Resolution on Galileo. (2001/C 157/01) of 5 Apr. 2001. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2001:157:0001:0003:EN:PDF>

Council Regulation 1321/2004 established the GNSS Supervisor Authority (GSA)[6]. This authority manages the interest of the public sector in the Galileo programme, and replaces the Galileo Joint Undertaking (GJU) developed in 2002 to manage the initial phase of the project[7].

The Galileo Joint Undertaking, as the major authority that makes the tenders and receives the allocation of funds from the EU, is supposed to carry out the whole development phase. The EC, however, considered the GJU to be a duplication of the Authority and decided its services were no longer useful. To avoid double expenditure, the GSA replaced the GJU at the end of 2006.

The governance issue remained a focal point, despite the replacement of GJU with the GSA. The European Commission prepared a proposal considering three possible scenarios. The first was to continue to work on implementation through the PPP's. Here, the Commission anticipated some difficulties in reaching an agreement with the private sector, requiring mitigation of the risk sharing that would be needed. In the second scenario, the EU would pay for the deployment of the basic services of Galileo delivered by 18 satellites, and after that envisaged that private initiatives would construct the other 12 satellites required for full service. In the third scenario, public funding would finance the complete deployment of the constellation, and the private sector would be in charge of delivering the service. These scenarios were presented to the Council to support Galileo along with EGNOS. While the PPP was considered to be the most suitable way to realize these programmes, it was recognised that a reshaping needed to be considered[8].

The Commission had the role of Project Manager for Galileo; and the administrative part was delegated to GSA, which involved ensuring audits and preparing certification for the downstream market. Throughout this time, ESA was responsible for the technical matters. Under the "Delegation Agreement" with the EC, ESA would carry out the validation phase and the deployment phase. A new coordination body was established, the Galileo Interinstitutional Panel (GIP), which would coherently tackle the following issues: programming governance, marketing, and international arrangements. This Panel was composed of 7 members; 3 from the European Parliament, and 3 from the Council, plus 1 from the Commission. In 2009, the Commission presented a status report on the implementation of the infrastructures (e.g. launch of tendering, overruns, etc.), legal framework, GNSS and GIP, international activities by the Commission to assure compatibility, and interoperability. The full operational phase of Galileo is expected to start in 2013. Even though Galileo is not yet operational the European space-based augmentation system EGNOS is. It is currently used in agricuture and has been certified for use in aviation.

Regulation (EC) 1942/2004 was replaced by Regulation (EU) No. 912/2010, which entered into force on 9 November 2010. Under paragraph 5 of Regulation (EU) No. 912/2010, the GSA is renamed as the European GNSS Agency replacing its previous name European GNSS Supervisory Authority. According to Article 25 of the Regulation, the previous measures adopted on the basis of Regulation (EC) 1942/2004 remain valid[9]. The activities of the Agency include following the development of coordination and consultation procedures on security-related matters, carrying out research of benefit to the development and promotion of the programmes and providing support in the development and implementation of the Public Regulated Service (PRS) pilot project. The GSA headquarters will be moved from Brussels to Prague and new locations will be in other Member States.

[6] The Council of the European Union. Council Regulation No 1321/2004 on the Establishment of Structures for the Management of the European Satellite Radio-Navigation Programmes of 12 Jul. 2004. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:246:0001:0009:EN:PDF>

[7] The Council of the European Union. Council Regulation 876/2002 on Setting up the Galileo Joint Undertaking, of 20 May 2002. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:138:0001:0008:EN:PDF>

[8] The European Commission. Galileo at a Cross-Road: the Implementation of the European GNSS Programmes . COM (2007) 261 final of 16 May 2007. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0261:FIN:EN:PDF>

[9] The European Parliament and Council of the European Union. Regulation (EU) No 912/2010 of the European Parliament and of the Council on Setting up the European GNSS Agency, Repealing Council Regulation (EC) No 1321/2004 on the Establishment of Structures for the Management of the European Satellite Radio Navigation Programmes and Amending Regulation (EC) No 683/2008 of the European Parliament and of the Council. 22.Sep.2010 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0011:0021:EN:PDF>.

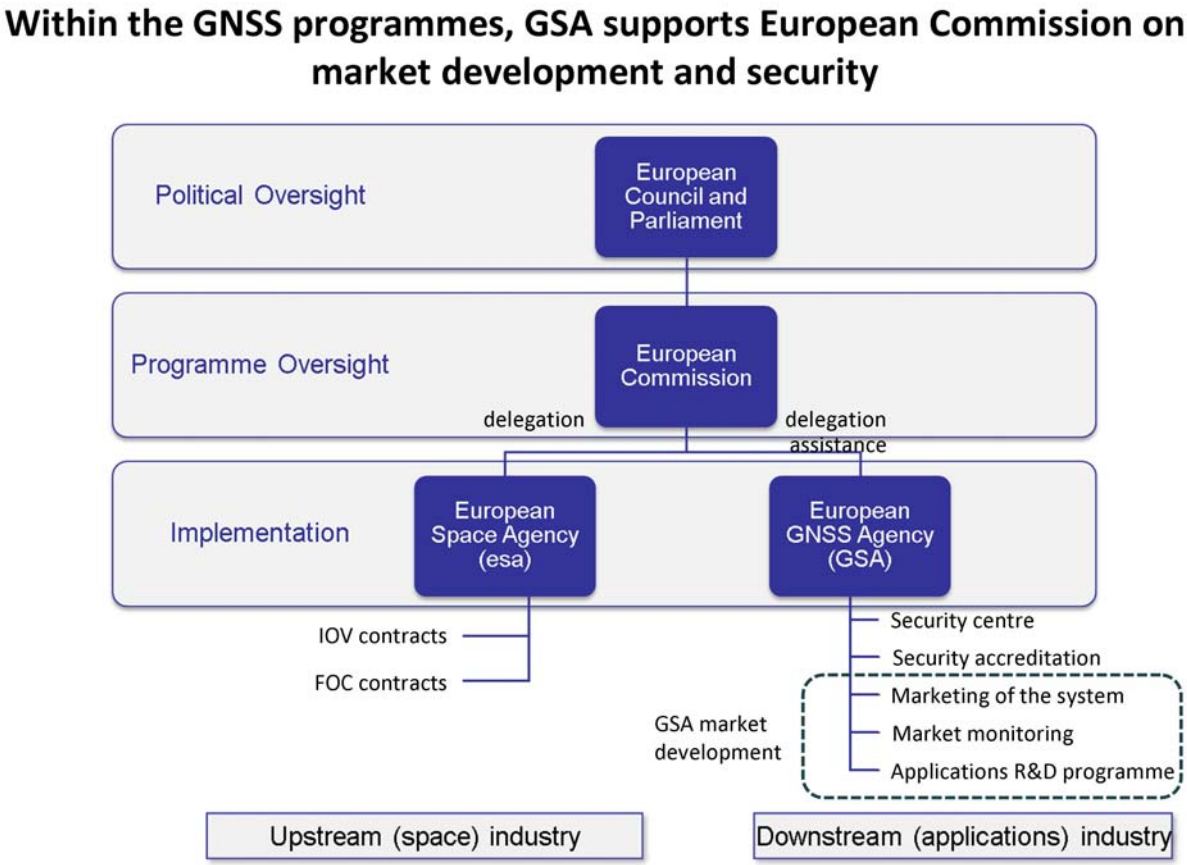

Figure 3: European GNSS Oversight

Dates	Events
21 January 1998	Neil Kinnock European Commission Transport expressed the strong need for Europe to have its own GNSS for sovereignty and security purposes. European Commission published the Communication "Towards a 'Trans-European' positioning and navigation network: A European strategy for global navigation satellite systems", COM (1998) 29
5 April 2001	The European Council approved a resolution to launch the Galileo programme with an operational phase to start in 2008
1 September 2003	The Galileo Joint Undertaking (GJU) was set up in order to manage the development phase and complete the selection of the future operating company
17 October 2003	GJU launched a tender for the Galileo Full Operational Capability (FOC)
December 2003	Four bids received for Galileo
28 June 2004	Signature of EU/US agreement on Galileo-GPS
September 2004	Two remaining bidders submitted detailed offers (Eurely and iNavSat)
2005	The two bidders were requested by GJU to make a common offer merging the two bids under three conditions: it should lead to a better offer the merged consortium should create a single entity as a sole interlocutor to the GJU it should not lead to additional delays and the signature of the concession contract should be signed by end 2005 These conditions were accepted by the consortium made up of AENA,

Dates	Events
	Alcatel Alenia Space, EADS, Finmeccanica, Hispasat, Inmarsat, TeleOp and Thales
28 December 2005	Launch of GIOVE-A
19 January 2006	Signature of the contract for the In-Orbit Validation (IOV) phase
7 June 2006	Communication from the European Commission entitled "Taking stock of the Galileo programme"
12 July 2006	ESA announced that the European Geostationary Navigation Overlay Service (EGNOS) is now operational
23 November 2006	An incomplete version of the heads of terms was signed leaving some major issues open (ex: the design risk and the market risk)
8 December 2006	European Commission's Green Paper on Satellite Navigation Applications launched
12 December 2006	European Transport Ministers failed to agree where the European GNSS Supervisory Authority (GSA) Headquarters should be located
18 December 2006	Adoption of FP7 (2007-2013) with a dedicated space theme
23 December 2006	Opinion of the European Economic and Social Committee on the GALILEO programme: successful establishment of the European supervisory authority (2006/C 318/34).
1 January 2007	European GSA officially took over the tasks of the GJU (GJU dismantled)
14 March 2007	Letter of European Commission Transport Commissaire Jacques Barrot to the German Presidency of the EU listing a series of identified problems and fixing a 10 May 2007 deadline given to the Consortium to incorporate the Galileo Operating company (GOC) and appoint its Chief Executive Officer (CEO) with a target date for signature of terms by 15 September 2007
15 March 2007	European Commission and ESA agreed to intervene more heavily in the operation and industry consortium building the four Galileo test satellites for the IOV phase since these space-hardware companies had trouble working together
26 March 2007	GOC incorporated in Toulouse (France) and CEO selected
16 May 2007	Communication from the European Commission "Galileo at a cross-road: the implementation of the European GNSS programmes" presenting six possible scenarios with their strengths and flaws
22 May 2007	4th Space Council: Adoption of the first European Space Policy
7-8 June 2007	TTE Council Resolution on Galileo ending the PPP and adopting the principle of public funding
20 June 2007	European Parliament adopted a joint resolution on the financing of Galileo considering that the programme should be entirely financed by the EU budget and that the EU budget should be raised accordingly.
6 September 2007	Cancellation of the Galileo call for tender by the European Commission
19 September 2007	Communication from the European Commission entitled "Progressing Galileo: Re-Profiling the European GNSS Programmes" "Proposal for a Decision of the European Parliament and of the Council amending the Inter-institutional Agreement of 17 May 2006 on budgetary discipline and sound financial management as regards the multiannual financial framework"
1-2 October 2007	Ministers at the Council of Transport could not agree on a public financing

Dates	Events
	scheme.
29-30 November 2007	TTE Council agrees on a fully-EU budget for Galileo giving the political go ahead for the project.
23 April 2008	Adoption by the European Parliament of a legislative resolution on the amended proposal for a regulation of the European Parliament and of the Council on the further implementation of the European satellite radio navigation programmes (EGNOS and Galileo). Creation of the Galileo Inter-institutional Panel (GIP).
27 April 2008	Launch of GIOVE-B – Second Galileo satellite.
24 June 2008	EESC and CoR host high-level debate on the economic, business and societal aspects of GALILEO.
25 June 2008	Invitation to tender for the Galileo FOC issued by the European Commission
1 July 2008	ESA and the Commission launched the procurement of the six Work Packages
1 July 2008	GALILEO: the procurement for the first constellation of the European navigation satellites starts
21-22 July 2008	Informal Space Council in Kourou
24 July 2008	Regulation (EC) n° 683/2008 of the European Parliament and of the Council of 9 July 2008 on the further implementation of the European satellite navigation programmes (EGNOS and Galileo)
August 2008	Bids and start of negotiations for all the Work Packages
19 September 2008	GALILEO: 11 candidates short-listed for the next step of the procurement procedure.
26 September 2008	5th Space Council "Council Resolution Taking Forward the European Space Policy"
10 February 2009	GALILEO: the European Commission and the European Space Agency look forward to first-rate cooperation to bring the European satellite radio navigation project to a successful conclusion.
29 June 2009	Information note of the European Court of Auditors concerning Special Report No 7/2009 on the management of the Galileo programme's development and validation phase.
June 2009	Contracts expected to be signed for all Work Packages
7 January 2010	Commission awards major contracts to make Galileo operational early 2014.
3 March 2010	Discours d'ouverture des Galileo applications days Galileo Applications Days - Antonio Tajani Vice-Président de la Commission Européenne en charge de l'industrie et de l'entrepreneuriat.
3 March 2010	Galileo offers outstanding navigation applications to spur innovation.
3 March 2010	Galileo Application Days showcase the future of satellite navigation.
22 September 2010	Regulation (EU) No 912/2010 of the European Parliament and of the Council of 22 September 2010 setting up the European GNSS Agency, repealing Council Regulation (EC) No 1321/2004 on the establishment of structures for the management of the European satellite radio navigation programmes and amending Regulation (EC) No 683/2008 of the European Parliament and of the Council
22 September 2010	Agreement with Norway on two Galileo ground stations.

Dates	Events
8 October 2010	Galileo: Secure satellite navigation for emergency and security services.
26 October 2010	Galileo: signature of major contract leading to initial services in 2014.
29 October 2010	Opinion of the European Economic and Social Committee on the 'Proposal for a Decision of the European Parliament and of the Council on the detailed rules for access to the public regulated service offered by the global navigation satellite system established under the Galileo programme'
18 January 2011	Commission presents midterm review of European satellite navigation programmes Galileo and EGNOS.
18 January 2011	The Mid-term Review of the European Satellite Radio Navigation Programmes Galileo and EGNOS: Questions and Answers.
17 March 2011	Proposal for a COUNCIL DECISION on the Conclusion of the Agreement on the Promotion, Provision and Use of GALILEO and GPS Satellite-based Navigation Systems and Related Applications between the United States of America, of the One Part, and the European Community and its Member States, of the other part – Council of the European Union.

Table 1: Chronology of the Galileo programme

2.2 GMES

The GMES concept was initiated in 1998 and later endorsed by the Gothenburg European Council and the European Space Agency in 2001. GMES is an EU led initiative carried out in partnership with the Member States and the European Space Agency (ESA) for autonomous and operational European Earth observation capacity. It aims at providing, under the Unions control, information services which give access to accurate data and information in the field of the environment and security and are tailored to the needs of the users[10]. GMES should provide decision makers with the necessary information in policy making and should foster better exploitation of the industrial potential of policies of innovation, research and technological development in the field of Earth observation.

It is a semi-space based project, tasked to collect and integrate data from different sources. It is divided into two components: the in situ component that takes information from the infrastructure located on land or on sea; as well as airborne data. It is a key tool to support biodiversity, ecosystem management, and climate change mitigation and adaptation. The space component is composed of five satellites, called "sentinels", of which each satellite performs a different mission:

- Sentinel one: a SAR satellite to monitor the sea-ice extension, or the maritime situation as well as the risks of Earth surface movements.
- Sentinel two: will carry an optical instrument that also uses infrared technology to monitor the land, agriculture and crops, and humanitarian operations.
- Sentinel three: monitors the sea surface, to observe the temperature, colour, and to support the marine environment and response to oil spills or man-made disasters.
- Sentinel four and five: both satellites will be carried by other satellites, and will use the same bus to be launched. The Sentinel four will be on board Meteosat III. These sentinels will be able to monitor the atmosphere.

The space-based data is supported by contributing missions, already in existence. The contributing missions belong to the Member States of both EU and ESA, giving a stronger role to Member States in both individual contributing missions and in the framework of the organisation. The development of GMES matches the pace of Galileo, although the programme has already delivered some data through the in situ and space component.

From the 1998 Baveno Manifesto in Earth Observation (EO), the GMES initiative has progressed forward through cooperation among many actors, including the EU, ESA and European Environ-

[10] The European Parliament and the Council of the European Union. Regulation (EU) 911/2010 of the European Parliament and of the Council on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013) of 22 Sep. 2010.

mental Association (EEA). The definition of roles began in 2000 with the "Joint ESA/ EC document on a European strategy for space"[11]. The EU included GMES in the 6th Framework Programme (FP) to finance the GMES section devoted to Research and Development. Within that period (2001), the EC highlighted 4 thematic areas for development: regional monitoring, global monitoring, environmental security, and horizontal support. Horizontal support specified that the projects must contribute to the technological development of the space infrastructure[12].

In November 2005, the EC prepared a Communication that gave a clear outline of GMES and its activities. In that same communication, the EC established a road map to achieve the "fast track" results of GMES by 2008. The Commission also provided a list of the "initial services" to be provided at the outset of GMES activity. A further defined structure of the programme was provided by the EC in a communication to the Council EESC and CoR in 2008, providing the following ideas:

- Rules for partnership were needed, since many actors are involved and the Board of partners was created according to their contribution in GMES;
- The leadership of the programme will belong to the European Union covering political coordination over the following areas: market development; budget management and implementation; international cooperation activities;
- Establish and keep a clear division of roles throughout the development of GMES;
- Compliance with the transparency rules;
- Member States were also requested to ensure the long-term availability of their assets to provide the best service to GMES[13].

A major milestone for GMES was the "Regulation on the European Earth observation programme (GMES) and its initial operations (2011–2013)"[14]. It transformed the political initiative into an actual programme"(Mantl, 2009 p. 404). According to that proposal, the European Union would only finance the infrastructure that did not exist on an ad-hoc basis in order to implement the GMES programme. The rest of the data needed for the fast track services would be provided through partnerships with the owners of the infrastructure providing that data.

Since financing the whole project in its two components was not considered sustainable for the Community, the Commission proposed a modular approach, i.e., the new activities would be decided according to the budget. The Commission planned to invest 107M Euros for the initial operations, in addition the cost of human resources and administrative expenditure were estimated in 8.5 M Euros[15]. Another 43 M Euros were devoted to GMES's initial operations from the 7th FP[16]. According to this document, public governance must be revised by giving political control over the initiative to the EC. In the meantime the European Space Agency took over management of the space component, developing the 5 "sentinels" and directing the data from the contributing missions. Besides this, ESA also provided the expertise to manage R&D resources.

Furthermore, Member State assets are meant to be part of GMES. Member States are requested to implement GMES by using national means (e.g. Terra SAR-X, Cosmo Sky MED, Pleiades) (see Appendix A2) which were developed for other purposes but will make important data available to GMES. Coordination among the partners was established by the EC this year, through decision n.2010/67/EU, creating an advisory body comprising representatives.

[11] "Joint ESA/ EC document on a European Strategy for Space". Annex II to the report: Towards a Space Agency for the European Union. ESA/ EC 2000 <http://esamultimedia.esa.int/docs/wisemen_report.pdf >. Other issues are touched in the document: the industrial standpoint, the access to space, and the project for Galileo programme. For both Galileo and GMES is pointed out the strategic importance they have in the international scenario.

[12] The European Commission. "Key elements of the GMES EC Draft Action Plan. Initial Period 2001-2003" 27 July 2001 p 3.

[13] The European Commission .Communication to the Parliament, the Council, Economic and Social Committee and to Committee of Regions Global Monitoring for Environment and Security (GMES): we care for a safer planet. COM (2008) 748 12 Nov 2008 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0748:FIN:EN:PDF>.

[14] The European Parliament and Council of the European Union. Regulation (EU) Nº 911/2010 of the European Parliament and the Council on the European Earth monitoringprogramme (GMES) and its initial operations (2011–2013).22 Sep 2010 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:276:0001:0010:EN:PDF>.

[15] The European Commission. 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). EC COM (2009) 223 of 20.May 2009 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0223:FIN:EN:PDF>.

[16] The European Commission. 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)" EC COM (2009) 223 of 20 May 2009 page 14 &16. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0223:FIN:EN:PDF>.

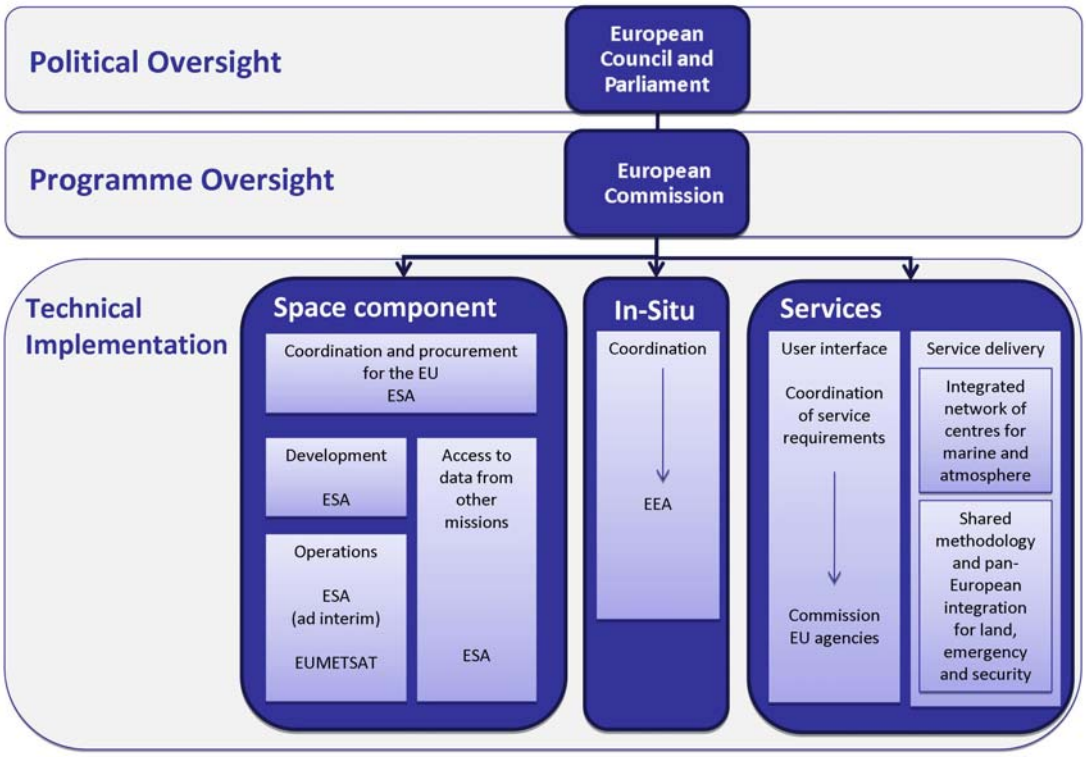

Figure 4: European GMES Oversight

Dates	Events
19 May 1998	"The Baveno Manifesto", foundation of the GMES initiative, is drawn up at a meeting of the EC, ESA and national space agencies.
16-17 October 2000	Lille Conference on GMES
16 November 2000	Joint resolution by the TTE Council and ESA Council on a European Space Strategy where GMES appears as a major policy component
2001	100 million euros committed for research and development at EU level + 100 million euros for ESA programme (GMES Service Element)
21-22 March 2001	GMES workshop on the users' perspective
02-03 May 2001	GMES - Global Monitoring for Environment and Security -A Consultation Meeting, Baveno, Italie, CP Ispra.
June 2001	Joint document by the European Commission and ESA "A European Approach to Global Monitoring for Environment and Security (GMES): Towards Meeting Users' Needs"
23 October 2001	European Commission Communication "Global Monitoring for Environment and Security (GMES) Outline GMES EC Action Plan (Initial Period: 2001-2003)"
13 November 2001	Council Resolution urging the Commission to start the initial period (2001-2003) of GMES and endorsing the establishment of a steering committee
31 July 2003	Earth Observation Summit in Washington DC established the Group on Earth Observation (GEO)

3 February 2004	European Commission Communication "Global Monitoring for Environment and Security (GMES): Establishing a GMES capacity by 2008 – (Action Plan 2004-2008))"
2005-2006	Fast-track services selected (Emergency response, Land management and Marine Services)
23 May 2005	European Commission Communication: "European Space Policy-Preliminary Elements"
28 November 2005	Third Space Council underlined that the implementation of a phased operational GMES calls for consolidation of the overall GMES architecture
10 November 2005	European Commission Communication "Global Monitoring for Environment and Security (GMES): From Concept to Reality"
18 December 2006	FP7 (2007-2013) adopted and displays a 1200 million euros budget line for GMES: 650 million as EU contribution to the ESA programme and 550 million euros for services development
8 March 2006	Co-decision of Vice-President Verheugen, Commissioners Potocnik and Dimas created the GMES Bureau to be effective on 1 June 2006
19-20 April 2006	Austrian EU Council Presidency Conference "A Market for GMES in Europe and its regions - The Graz Dialogue"
18 April 2007	Thales Alenia Space selected as prime contractor for Sentinel 1
17 April 2007	German EU Council Presidency Symposium "The way to the European Earth observation system GMES - The Munich Roadmap" .
22 May 2007	4th Space Council: Adoption of the first European Space Policy
27 September 2007	ESA Member States participating in the GMES programme approved the transition to Phase-2 of Segment 1 of the GMES Space Component Programme
6-7 December 2007	Portuguese EU Council Presidency "GMES for Africa" event organised in Lisbon (Portugal)
28 February 2008	ESA and the European Commission signed an agreement to transfer the management of 624 million euros in funds from the Commission's budget to ESA for building the GMES components. The funds will be distributed in two stages: 419 million euros for segment 1 and 295 million euros for segment 2
14 April 2008	Thales Alenia Space selected as prime contractor for Sentinel 3
17 April 2008	Astrium selected as prime contractor for Sentinel 2
21-22 July 2008	Informal Space Council in Kourou
16-17 September 2008	French EU Council Presidency event "GMES Forum"
16 September 2008	Günter Verheugen, Vice-President of the European Commission responsible for Enterprise and Industry. Caring for our Planet: Launching a New European Programme for Global Monitoring for the Environment and Security GMES Forum 2008
26 September 2008	5th Space Council "Council Resolution Taking forward the European Space Policy"
12 November 2008	European Commission Communication "Global Monitoring for Environment and Security (GMES): we care for a safer planet" and GMES Impact assessment
2 December 2008	Competitiveness Council : "Council Conclusions on Global monitoring for Environment and Security (GMES): Towards a GMES Programme"

29 May 2009	Council Resolution on "The Contribution of space to innovation and competitiveness in the context of the European Economic Recovery Plan, and further steps" – Council of the European Union.
28 October 2009	EU space missions to strengthen earth observation for Climate and Security
16 May 2010	European Commission Vice-President Antonio Tajani welcomes today's approval by the European Parliament of the Regulation on the European Earth monitoring Programme (GMES).
20 October 2010	Regulation (EC) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth observation programme (GMES) and its initial operations (2011 to 2013), OJ L276, 20.10.2010.
28 October 2010	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Integrated Industrial Policy for the Globalisation Era Putting Competitiveness and Sustainability at Centre Stage. Brussels, COM(2010) 614 – European Commission.
25 November 2010	7th Space Council resolution: "Global challenges: taking full benefit of European space systems".
25 January 2011	GMES improves iceberg forecasting and air quality monitoring.
9 March 2011	WORK PROGRAMME 2011- -European Earth monitoring programme (GMES) and its initial operations (2011 – 2013). European Commission.
6 April 2011	Communication From the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Regions towards a Space Strategy for The European Union that Benefits its Citizens. COM (2011) 152.

Table 2: Chronology of the GMES programme

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3. Public Perception

Many studies have been conducted to analyse public perceptions on space policy issues in Europe and the United States. Space technologies and applications are used constantly in everyday life. In particular, positioning and navigation technologies like GPS have a wide number of applications; in addition to the use of these signals in car navigation receivers and mobile phones, these applications are used mainly for traffic control on land (e.g. rail, road) and for air traffic control. In relation to earth observation, weather forecasting also contributes to the daily life of citizens. Early warning and satellite images are essential in the event of disasters such as the recent earthquakes in Haiti and Japan. Furthermore, public safety and security is highly reliant on the use of earth observation satellite data, and that data is often used in combination with positioning and navigation services.

Space endeavours have long captivated the interest of the general public and even the space community. Public perception remains dominated by the pioneering space endeavours that grew from the Cold War, i.e. the achievements of Russia with the shock of Sputnik, and the explosive growth of the United States' Apollo programme. Many studies have been conducted analysing public opinion polls for space programmes and in particular for space exploration[17], space and science[18], nuclear energy in space missions[19], Mars sample return[20], etc. There is a division between the Cold War influenced space activities relating to exploration, and the less obvious and less promoted emerging space programme infrastructure, which has aimed to bring space back to earth by serving a variety of government agencies, academic institutions, private corporations and the public at large.

Additionaly, the Europeans have jointely engaged in the development, deployment and operation of satellites. There are two examples where the development and deployment of satellites in the filed of meteorology and telecommunications, have been developed by one entity (ESA) and have been taken over for operations and exploitation by another (EUMETSAT and Eumetsat). These are examples which demonstrated the succesfull cooperation in Europe and are described and analysed in this Chapter.

3.1 The Americans and Space

There is a universally held belief that NASA and the US space programmes, received outstanding support from the public in the 1960s during the Apollo era. The reality is that polls in the 1960's consistently ranked space the top of the programmes to be cut under the federal budget. Americans were largely hesitant to enter the "race" against the Soviets when it came to budget spending. Figure 5 shows that the American public preferred the spending to be in other areas like air and water pollution, job training for unskilled workers, national beautification, and poverty before spending it on space.

[17]Launius, R.D, "Evolving public perceptions of spaceflight in American culture". Acta Astrnautica, 53 (2003) p. 823-831.
Arvai, J.L., "Evaluating NASA role in risk communications process surrounding space policy decisions". Space Policy, 16 (2000) p.61-69.
Launius, R.D., "Public opinion polls and perceptions of US human spaceflight". Space Policy, 19 (2003) p.163-175.
Ehrenfreund, P., Peter, N., Billings, L., "Building long-term constituencies for space exploration: The challenge of raising public awareness and engagement in the United States of Europe". Acta Astronautica, 67 (2010) p502-512.
Entradas, M., Miller, S., "Investing public space exploration support in the UK". Acta Astronautica,67 (2010) p.947-953.
[18]Sterns, P.M., Tennen, L.I., "Regulation of space activities and trans-science: public perception and policy considerations", Space Policy, 11.3, 1995, p.181-192.
[19]Maharik, M., Fischhoff, B., "Public views of using nuclear energy sources in space missions". Space Policy, 2, 1993, p. 99-103.
[20]Joyce, S., Tomkins, C.S., Weinstein, P., "Mars Sample Return: Do Australians trust NASA?" Advances in Space Research, 42 (2008) p.1096-1102.
Race, M.S., "Mars Sample Return and planetary protection in public context". Adv. Space Res., 22.3,1998 p391-399.
Lofstedr, R.E., "Public perception of the Mars Sample Return Programme." Space Policy, 19 (2003) p.283-292.

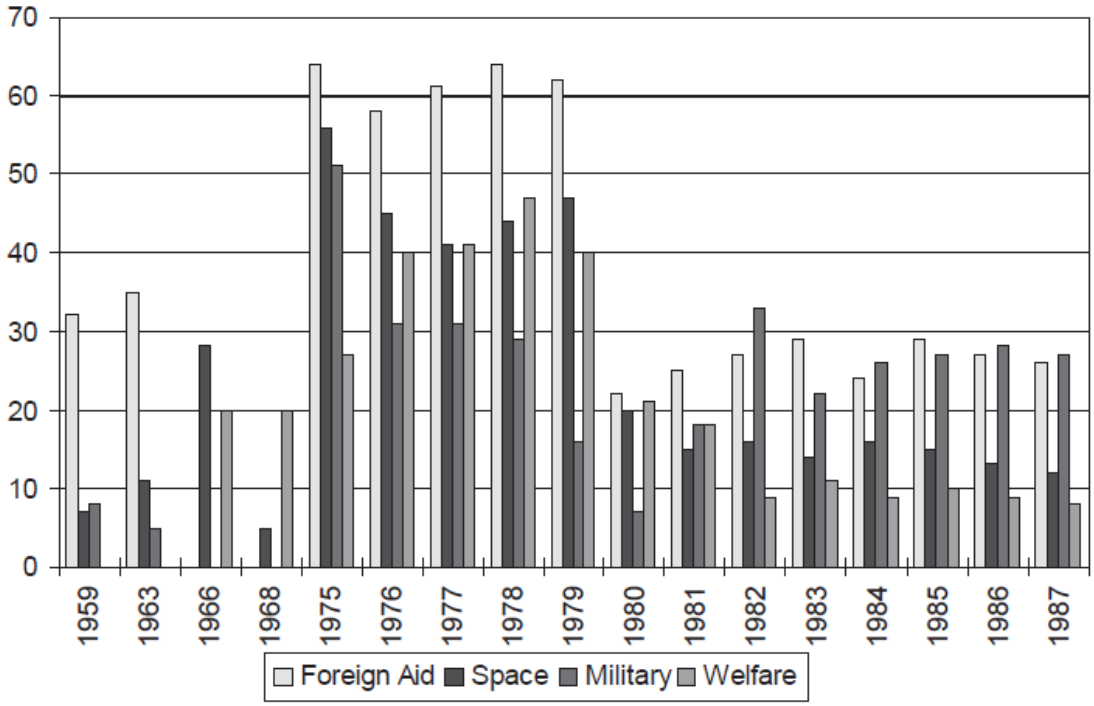

Figure 5: Percentage age who believe government funding should be decreased

While Americans may not have been familiar with the details of America's space programme, they had a largely favourable opinion (~70%) over the period from 1978 to 1999[21], in contrast with the 20% that held a less favourable opinion. Nevertheless, by the mid-nineties, there was a significant decline in public support for the US space programmes (see Figure 6).

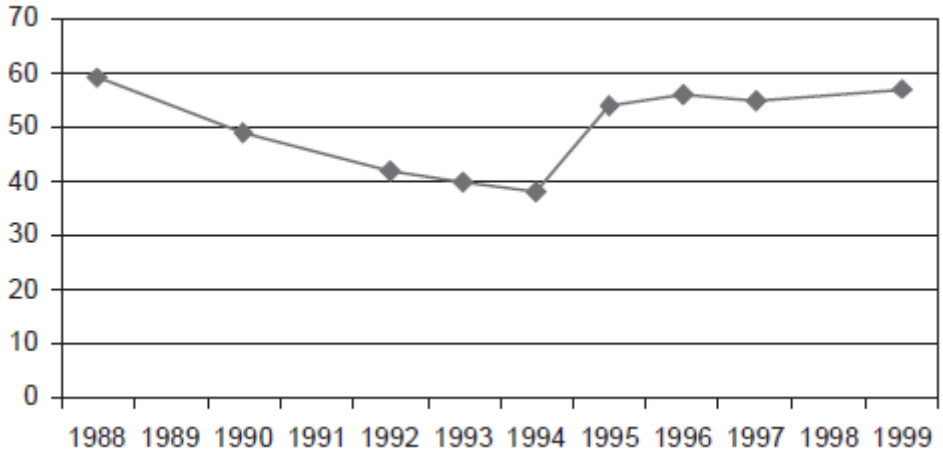

Figure 6: Population percentage considering the space programme important for America. Data from 1988 to 1999.

While the Americans approved of the work done by NASA (see Figure 7), and of NASA's "brand", Europeans considered the European Space Agency to lag behind in recognition as a brand name. Despite ESA's tremendous achievements since its creation in 1995, i.e. with Arianne, Columbus, ATV, various satellite missions, etc., it was often referred to as the "European NASA".

[21]Yankelovich polls conducted for the Boeing Company between May 1978 to December 1997. Polls available in NASA Historical Reference Collection, NASA History Office, Washington, DC.

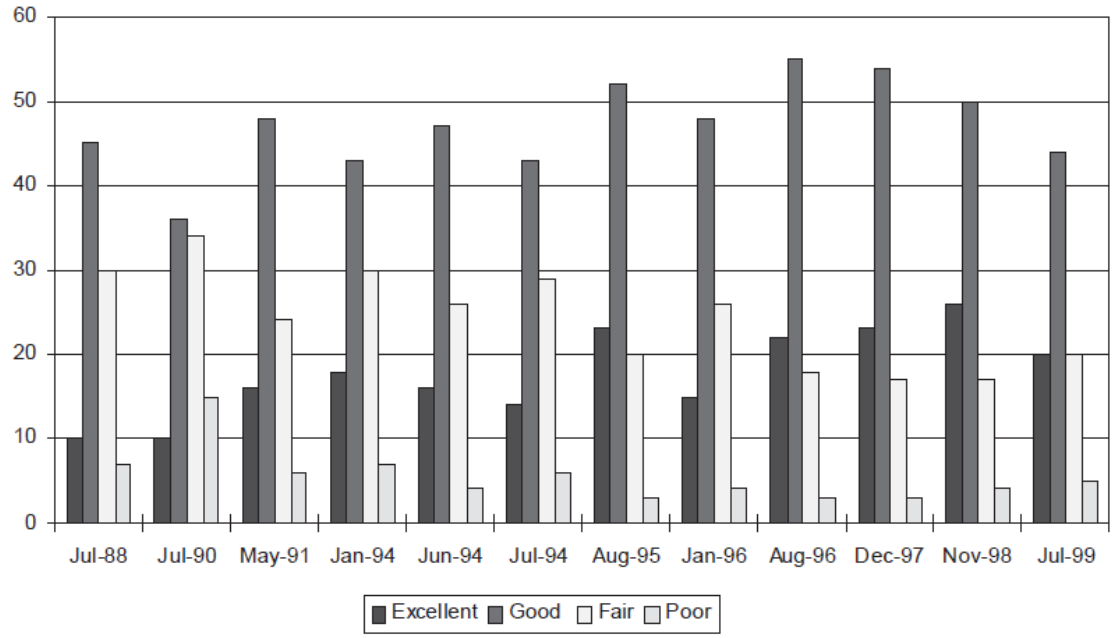

Figure 7: Quality of work done by NASA.

3.2 The Europeans and Space

A study in Europe in 2007[22], showed that the largest part of the population considered space activities as risky, expensive and not very useful. In 2006, the European Commission selected a consortium led by the Gallup Organization to run its Flash Eurobarometer opinion polls.

The study was published in October 2009 with the title "*Space activities of the European Union. Analytical Report*"[23]. According to this study, the majority of EU citizens regard European space activities as important from the perspective of the EU's future global role: one in five citizens considered such activities to be very important (20%) and a further 43% felt that space activities were important. Thus, there is a total of 63% in agreement, in contrast to the 29% that did not agree with the importance of these activities. The EU country distribution can be seen in Figure 9.

[22]Grimand, M., "Is space a luxury activity? Back to concrete figures". IAC-08-E5.2.2, Glasgow, UK, 2008.
[23]Flash Eurobarometer. "Space activities of the European Union. Analytical Report". Oct. 2009, Flash EB Series No272.

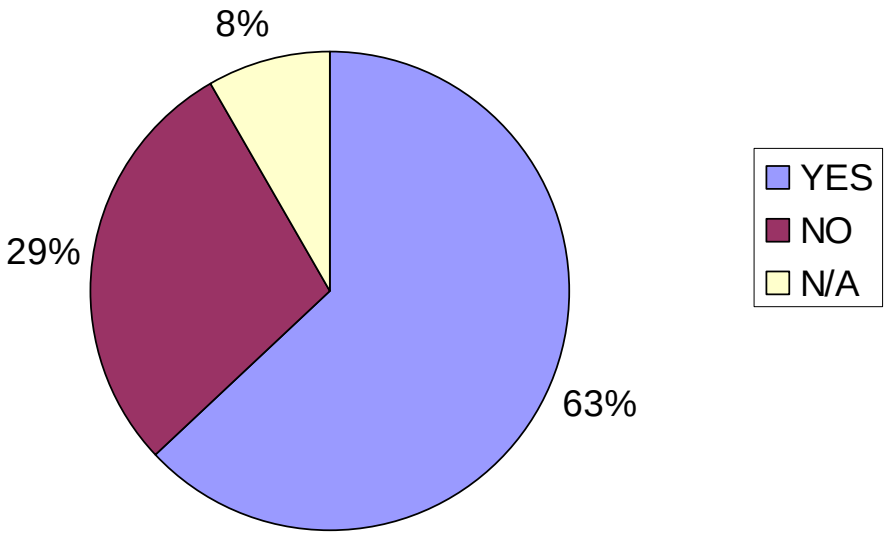

Figure 8: Importance of space activities for the future international position of the EU[24]

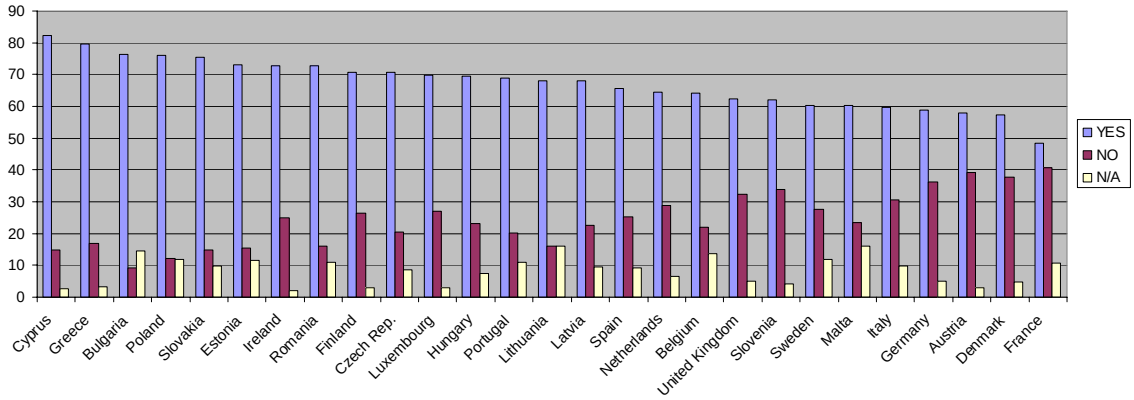

Figure 9: EU country distribution regarding the importance of space activities for the future international position of the EU[25]

When asked whether space activities contribute to industrial competitiveness, growth and job creation in the European Union, 64% replied positively in contrast to 28% who were doubtful (see Figure 10). The EU country distribution can be seen in Figure 11.

[24]The data for the figure is based on Flash Barometer No.272 with grouping together the data “very important” and important as “yes” and “no idea” and “DK/NA” as “N/A”.
[25]The data for the figure is based on Flash Barometer No.272 with grouping together the data “very important” and important as “yes” and “no idea” and “DK/NA” as “N/A”.

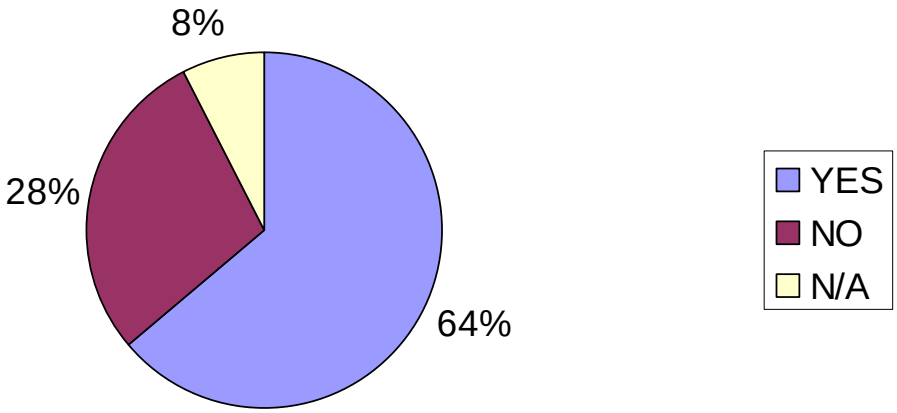

Figure 10: Space activities contribute to industrial competiveness, growth and creation of jobs in the European Union?[26]

Respondents also acknowledged that there may be various benefits related to space exploration and 26% of Europeans thought that the EU should definitely do more in the field of space exploration.

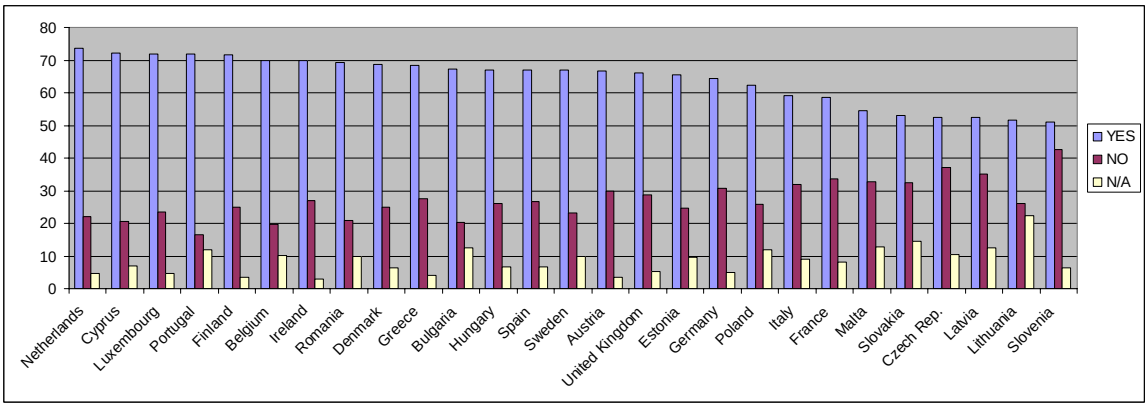

Figure 11: Space activities contribute to industrial competiveness, growth and creation of jobs in the European Union?- by country[27]

A similar analysis was also conducted in the United Kingdom.[28] It showed that the British public who come to outreach and engagement activities, support space exploration but have some reservations about considering the advancement of UK space activities to be of national interest. The greater number of supporters considered that government spending should be allocated to civil space activities.

3.3 The Europeans and Earth Observation for Environment and Security

The general opinion about the development of Earth Observations satellites can be considered overall good, since this is the application considered as the most important development priority in

[26]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[27] The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[28]Entradas, M., Miller S., "Investigating public space exploration support in the UK", Acta Astronautica, 67 (2010) p.947-953.

Europe; yet despite these results, it must be said that only 56% of Europeans (considering an average of the 27 countries) are aware of the fact that Europe is currently developing an EO system. Although the programmes are not really well known, the perception of earth observation can be considered satisfactory, even if it must be clarified that when the explanation of what can be done by an EO satellite is given, the perception of its importance rises up to 90%. The contribution to security is less supported then disaster management when the population is asked. The importance of developing satellite-based tools to improve security caused general consent to decline to 67%. This decline could probably be explained by the general lack of awareness of Earth Observation technologies.

When asked about the value of developing various space-based applications for Europe, EU respondents were most keen on (further) developing Earth observation systems to monitor our environment, including natural phenomena like forest fires or floods, effects of climate change: 58% found this to be very important. A total of 57% replied that they were aware of the European Earth Observation satellites in contrast to 42% who were not aware (See Figure 12). 22% of those aware also knew what they do. Figure 13 shows the EU country distribution.

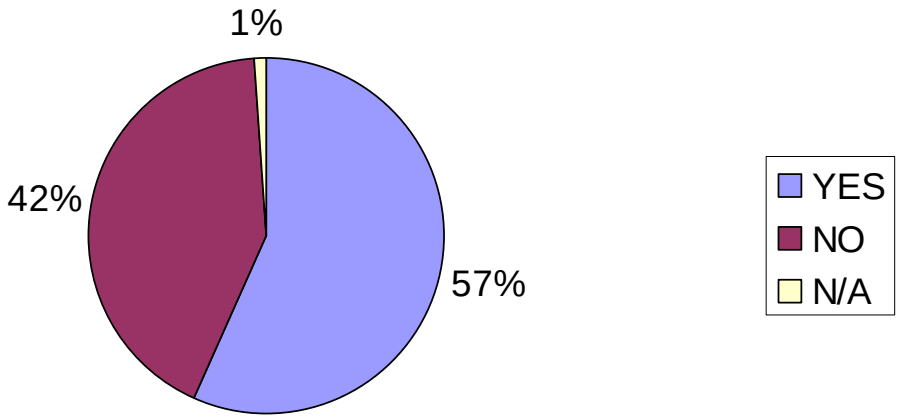

Figure 12: Awareness of the European earth observation satellites[29]

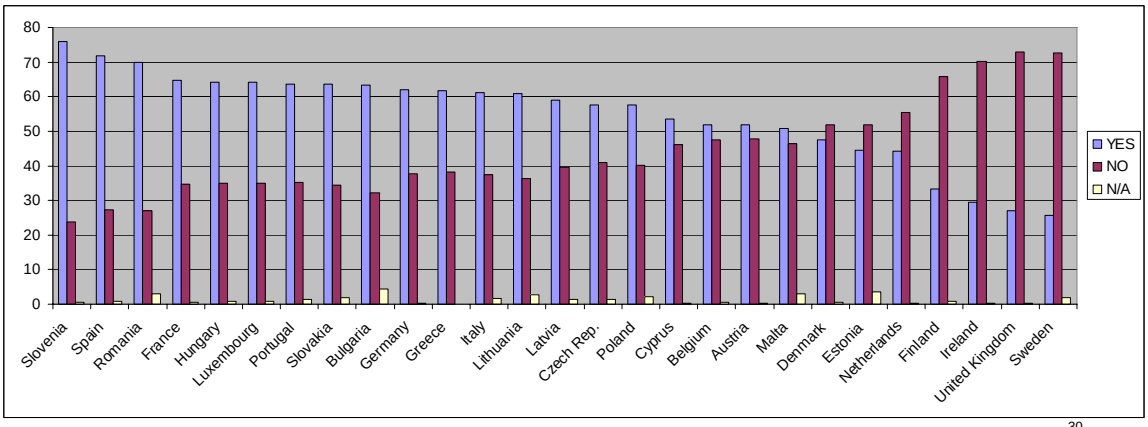

Figure 13: EU country distribution regarding awareness of the European earth observation satellites[30]

[29]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[30]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".

In particular, in response to the importance of developing earth observations systems to monitor the environment (including natural disasters), an overwhelming 91% agreed (Figure 14). Figure 14 shows the EU country distribution.

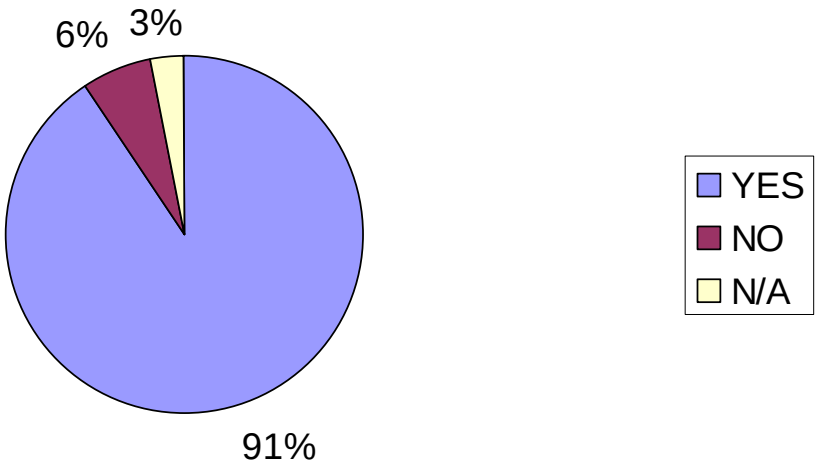

Figure 14: Importance of developing Europe earth observation systems to monitor our environment including natural disasters [31]

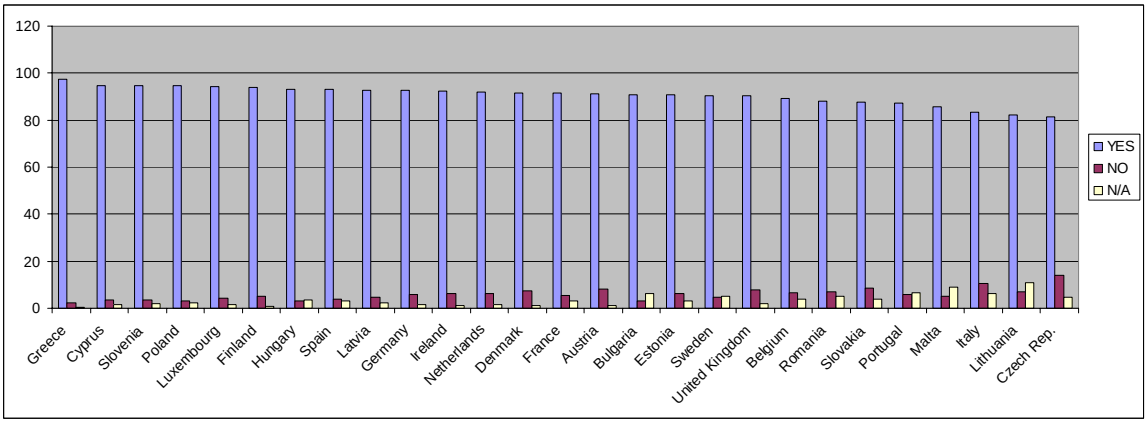

Figure 15: Importance of developing for Europe earth observation systems to monitor our environment including natural disasters –distribution by EU country [32]

Often, policy makers are puzzled as to whether the public supports the development of space applications for Europe in relation to security. 67% replied positively regarding the provision of space-based monitoring tools to improve citizen's security, in contrast to 27% who did not approve (Figure 16). The country distribution can be seen in Figure 17.

[31]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[32]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".

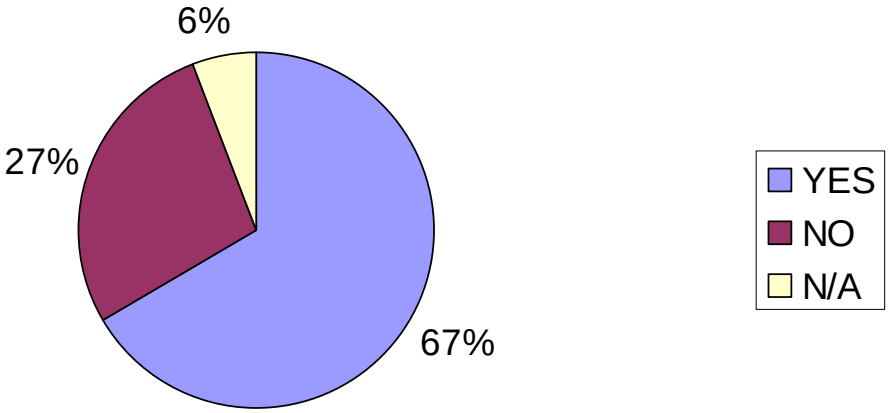

Figure 16: Importance of space-based monitoring tools to improve citizen's security[33]

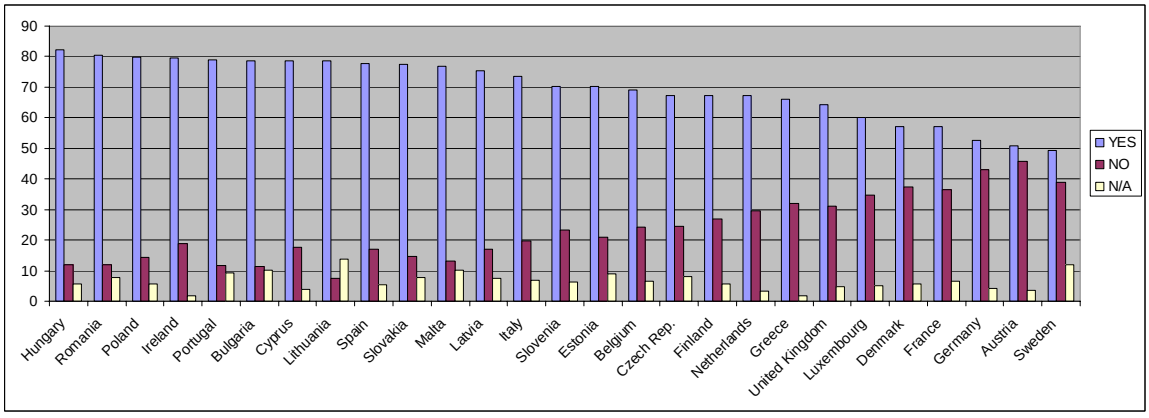

Figure 17: EU country distribution regarding the importance of space-based monitoring tools to improve citizen's security[34]

3.4 The Europeans and Positioning and Navigation

The perception of Galileo among Europeans is different from the perception of GMES. Sixty-seven percent of the population believe that is important for Europe to develop an independent system of navigation. The presence of navigation systems in everyday life, unnoticed by the public due to the fast and free service, could be the reason for this. It may be concluded that the "strategic" importance of the asset is not fully communicated, even though supported by the majority; the 67% support can be contrasted to the 91% support for European earth observation systems to monitor our environment (Figure 18) (Figure 19).

[33]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[34]The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".

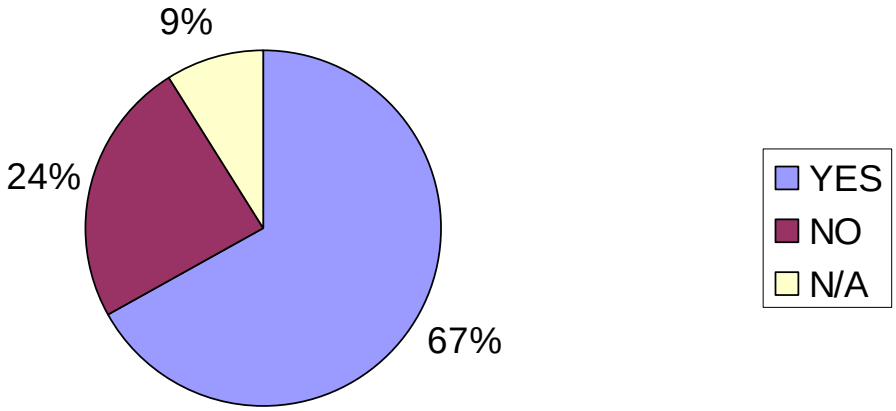

Figure 18: Importance of developing an independent "European GPS"[35]

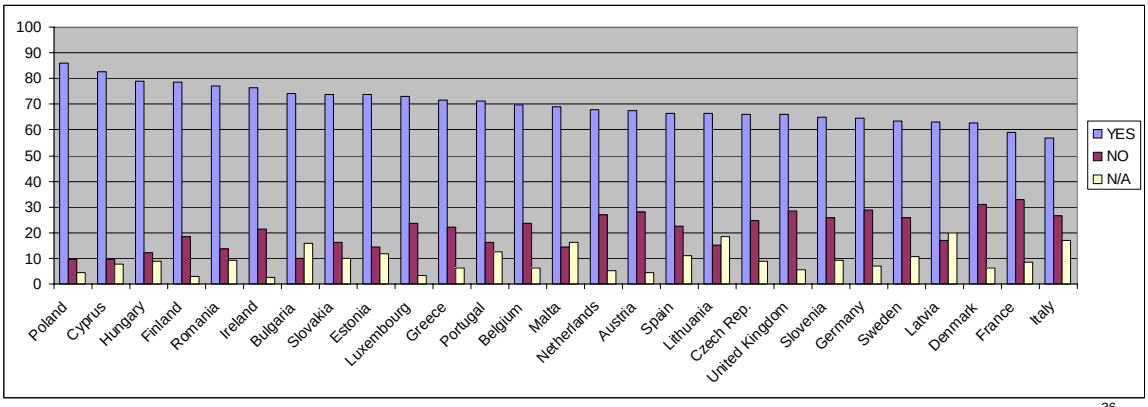

Figure 19: EU country distribution regarding the importance of developing an independent "European GPS"[36]

3.5 The Europeans and the Space Budget

Public support is a complicated issue. As in the US in the 1960's, even today the public, societies and governments consider the economy, climate change, energy, ageing population, societal benefits, etc as higher priorities. The communication of how space and space applications as integrated applications can boost these priorities remains insufficient.

The public is aware of space activities and their importance, but when it comes to the budget, they are reluctant to increase support. However, in these times of economic and financial crisis - 20% were in favour of allocating more budgetary resources to space activities; 23% favoured the reduction of such EU spending; and 43% favoured maintaining the current budget. Those who thought that spending should be increased were more likely to be male (25%) and younger than 25 (27%). Nevertheless, the importance of space and the need to invest in it is of a strategic nature. Therefore, the decision concerning the budget should be more of a political commitment. It can additionally serve the implementation of other European policies.

[35] The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[36] The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".

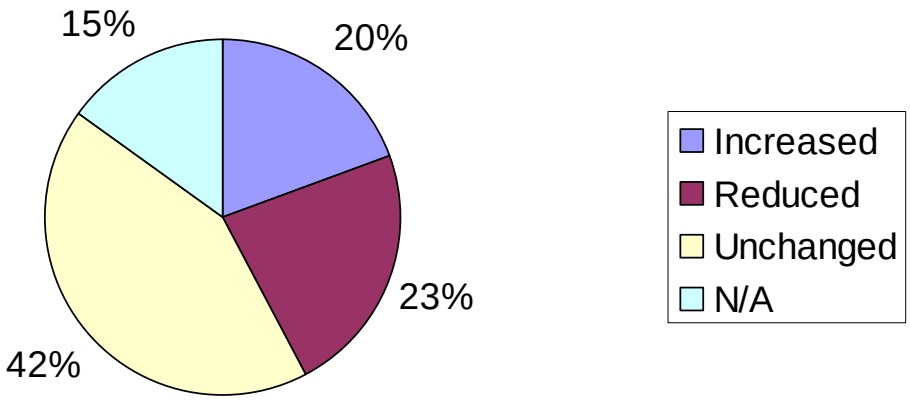

Figure 20: Expected level of future European space budgets in comparison with the current one. [37]

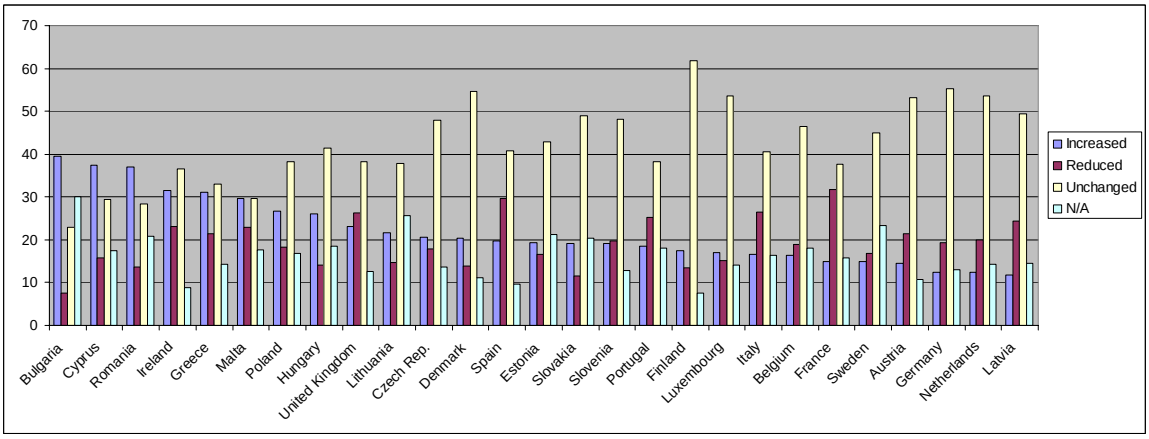

Figure 21: EU country distribution regarding the expected level of future European space budgets in comparison with the current one [38]

3.6 Success Stories of Eumetsat and Eutelsat

The European Space Agency has been involved in the past in the development and deployment of satellites that were successfully taken over by other organisations for operation and exploitation. Two successful examples are the European meteorological satellites and telecommunication satellites, which were later given to EUMETSAT and EUTELSAT. Eutelsat is particularly interesting as it started its life as an international organisation and ended up becoming a commercial entity. These could be interesting examples where lessons learned can be taken in relation to the operational phase of GMES and Galileo respectively.

3.6.1 EUMETSAT

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is an international organisation, which was founded in 1986, with the main aim to deliver weather and climate-related satellite data, images and products– 24 hours a day, 365 days a year. This informa-

[37] The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".
[38] The data for the figure is based on Flash Barometer No.272 with grouping together the data "very important" and important as "yes" and "no idea" and "DK/NA" as "N/A".

tion is supplied to the National Meteorological Services of the organisation's members and cooperating states in Europe, as well as other users world-wide.

The history[39] of satellite meteorology in Europe is closely related to EUMETSAT and the European Space Agency (ESA) and goes back to the 1970's. The creation of EUMETSAT took 10 years. Back in 1971, France proposed the Europeanization of its geostationary meteorological satellite programme Meteosat, which was developed under its French space agency, CNES. This was accepted in 1972 as part of the first "package deal" creating the Meteosat programme with the participation of Belgium, Denmark, France, Germany, Italy, Sweden, Switzerland and the United Kingdom. The objective was to develop and put in orbit a geostationary meteorological satellite, including ground stations, meeting the meteorological needs of the European community. At the same time in 1972 ESA (ESRO) agreed to participation in the worldwide meteorological observation system in cooperation with Japan, Russia and US. This global programme aimed to improve space-based weather observations and Meteosat was the European contribution to it. As it became quickly obvious to the user community that there was a need for community data for weather forecasting and climate change, ESA received the mandate in 1971 for the exploitation of Meteosat and a protocol for the pre-operational exploitation was set up. In 1978, a Conference between the heads of the national meteorological services led to the idea to create a European meteorological capacity, defined its juridical framework and relationship with ESA. In 1981 it was decided to undertake a European regional meteorological sample applications cooperation under pressure from the United States Administration which was pushing for commercialisation of weather data, thus challenging the principle of free exchange of data and other products of metrological satellites, and therefore, limiting free access to data. In particular, in 1983 the USA announced that it had agreed on this principle which, as a result, threatened Europe with being compelled to buy data. Thus, to avoid this Europe needed its own system and operating organisation.

In 1983 the creation of a new international organisation the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), was proposed. The objective was to, place into orbit, function and exploit the European systems for operational meteorological satellites. This organisation would be responsible for the financial and administrative aspects of the operational Meteosat programme. The management of the operational systems would go to ESA and would be regulated in an agreement between ESA and EUMETSAT. The EUMETSAT convention was signed in 1983 by 16 countries: Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey and the United Kingdom. It should be noted that the Member States of EUMETSAT were all ESA Member States apart from Austria, and in addition Finland Greece and Portugal joined this organisation.

EUMETSAT today remains an international organisation and has worldwide exclusive ownership of all data generated by its satellites or instruments. However, it makes available data sets to the World Meteorological Organisation. It provides meteorological services but if offers no warranty in respect to the services and products provided. All Member States of EUMETSAT contribute by means of participation in its general budget and programmes. It runs mandatory programmes in which all its Member States participate and optional programmes in which they participate if interested.

3.6.2 Eutelsat

Eutelsat S.A is a commercial company and is the leading European satellite operator and one of the top three operators in the world for the supply of fixed satellite services. It provides TV broadcast, Internet broadband, telecom and data, mobile and maritime communication services. The life of Eutelsat started as an intergovernmental organisation that was set up in 1977 to develop and operate a satellite-based communication infrastructure for Europe.

The history[40] of space telecommunications is closely related to Eumetsat and the European Space Agency (ESA) and goes back to the 1960's when European countries realised the significance of the satellite communications. In 1962 the United States made a proposal to create a World Wide telecommunication system and Europe was addressed to undertake such an initiative at a regional level as opposed to doing it through bilateral agreements with the US. In 1963 the European Conference for Satellite Telecommunications (CEPT) was established in order to prepare European countries for further negotiations with the US on Intelsat. At that time in Europe, even though the predecessors of ESA (ELDO and ESRO) were created neither of them was in charge of building and operating application satellites. Nevertheless, when the US satellite "Early Bird" (renamed Intelsat

[39] The history of EUMETSAT is based on earlier unpublished work of Nicolas Peter, European Space Policy Institute.
[40] The history of Eutelsat is deducted from earlier unpublished work of Nicolas Peter, European Space Policy Institute.

I) demonstrated the technical feasibility and economic importance of geostationary telecommunications satellites, ESRO was asked in 1966 to design a joint European programme for the development of experimental satellites for telephony and television. In 1971 it was agreed to broaden the satellite programme including telecommunications and in 1973 it was decided to initiate a European telecommunications satellite programme that started as a preoperational programme called Orbital Test Satellite (OST)[41]. OTS was succeeded by the European Communications Satellite (ECS) programme undertaken by ESA. It became evident that there was a need to create an organisation that would represent the interests of the members of CEPT. Thus in 1977 an ESA council resolution called for the creation of s separate organization to operate the ECS system on a commercial basis. Thus, the provisional European Telecommunications Satellite Organisation or "Interim Eutelsat" was formed with the objective of ensuring the establishment, operation and maintenance of the space segment of satellite telecommunications systems. Seventeen administrators or authorised private operating entities (members of CEPT) became parties to the Interim Eutelsat Agreement, which was signed in 1977. The countries involved were Austria, Belgium, Denmark, Finland, France, Germany Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and Yugoslavia.

Together with the establishment of Interim Eutelsat, two space agreements were placed under the control and authority of ESA: ECS for fixed satellite services (FSS) and MAROTS/MARECS for mobile satellite services (MSS). In 1978 an additional agreement was signed between ESA and Interim Eutelsat covering the operation of ECS, stating the provision by ESA of five satellites over a ten-year period. Interim Eutelsat would become the owner of the satellites as soon as they were in orbit and would assume exclusive responsibility for the terrestrial segments of the ECS system. In 1982 an intergovernmental conference was organised with the participation of the 20 Member States of Interim Eutelsat and Lichtenstein, Monaco, San Marino and the Vatican State. Two international agreements were concluded. One was between the "State Parties" and the other between the "Signatories" which were the relevant governments themselves or their authorised telecommunications entities. Furthermore, the Eutelsat convention entered into force in 1985 and the membership of the organisation and span of services grew significantly.

In the 1990's there was a Community action plan for the progressive achievement for a competition oriented community wide satellite communications market and the strengthening of European competitiveness in this field. At the same time there was a prevailing policy of privatisation of the communications sector that led in the late 1990's to the transformation of Eutelsat into a limited liability private company. Thus, in 2001 Eutelsat was privatised and Eutelsat S.A was created under French law, the convention was revised and the activities of the intergovernmental organisation (IGO) were revised. In April 2005 Eutelsat Communications was created as a private company under French Law while Eutelsat IGO maintained the right to the frequencies and orbital positions assigned by the ITU prior to 2001.

Eutelsat demonstrates the development of communications systems for commercial purposes to both develop the industrial base of Europe as well as serving the purpose of having its own communication satellite system covering Europe.

[41] OST 1 failed during launch in 1997 and OST2 was successfully launched in 1978.

4. The Flagship Programmes and European Policies

Space policy by its transverse nature and in particular through its infrastructure instruments, the flagship programmes (Galileo/EGNOS and GMES), can help in developing, implementing and monitoring various European and national policies. In particular with respect to European policies the following were identified without excluding the contribution of others: agriculture, energy, environment, enterprise and industrial, fisheries, transport, regional development, research and technology development, external relations. Figure 22 shows an overview of the indicative policies, the responsible entity in the European Commission and the activities involved. In the following subsections the policies are analysed, the main objectives are deduced and indicative information is given on how the two flagships can contribute to achieving those objectives. The list is not exhaustive but it is aimed at making links for decision makers on how they can potentially benefit from the development of the Union's space infrastructure.

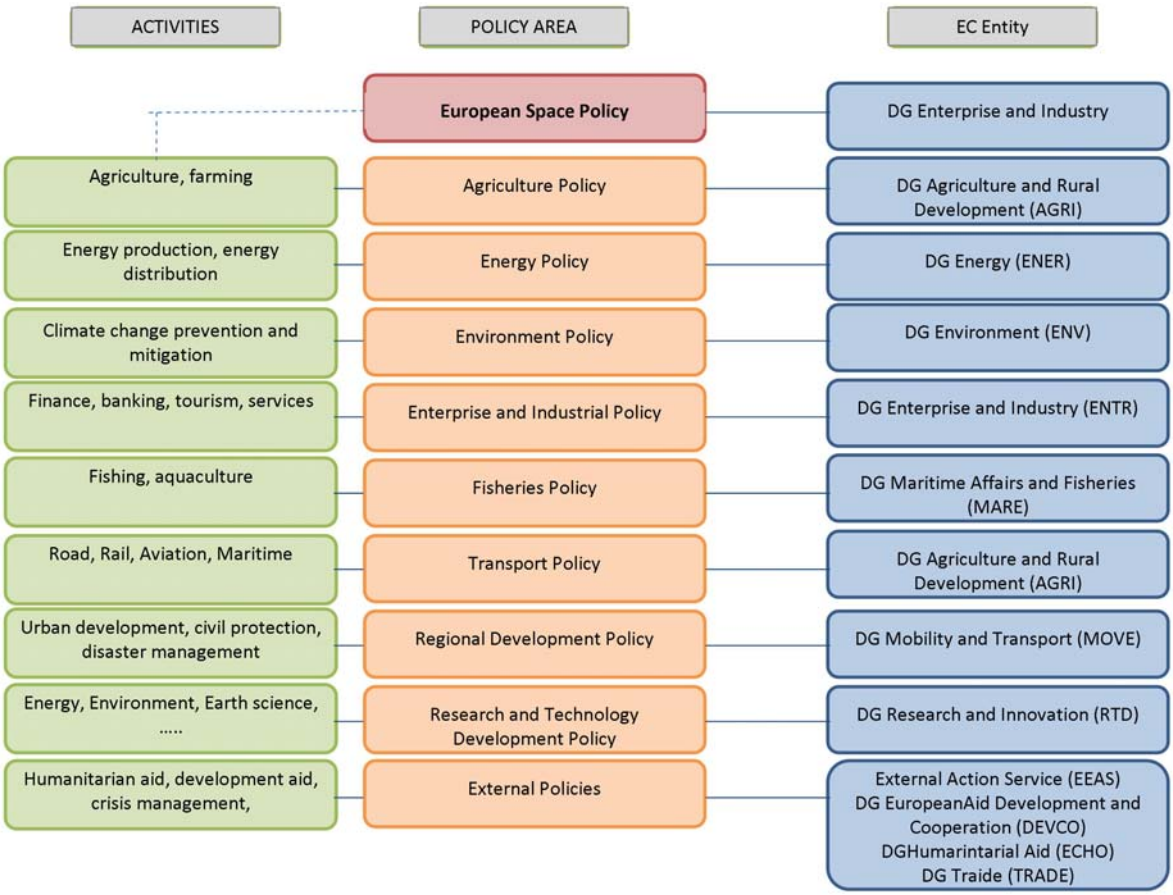

Figure 22: Indicative activities and policies to which the flagship programmes can contribute.

4.1 Environment Policy

4.1.1 Policy Overview

The path to the implementation of a common policy for the environment in Europe was opened in 1972 by the Summit Conference of the Head of State and Government held in Paris. Common environmental problems required common solutions.

The legal basis for the environment policy was given by the Single Act of 1987, and firmly established by the Maastricht Treaty. Today, the basis for EU environmental policy is the Lisbon Revision under Arts. 191-193 TFEU. It is a shared competence and should contribute to pursuit of the following objectives:

- preserving, protecting and improving the quality of the environment; protecting human health,
- prudent and rational utilisation of natural resources,
- promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.

The Göteborg European Council (15-16 June 2001) approved a European Union Strategy for sustainable development[42], based on: coordinated development of common policies, addressing the economic, environmental, and social dimensions of sustainability; a set of headline objectives to limit climate change and increase use of clean energy; and steps to implement the strategy and review its process at every Spring meeting of the European Council.

In 2002, the Union established the Sixth Community Environment Action Programme (6 EAP)[43] in order to address its key environmental objectives and priorities. The programme is intended to promote the integration of environmental concerns in all Union policies and represents the environmental dimensions of the Union's sustainable development strategy[44]. The programme covers a ten year period from July 2002 to July 2012 with a particular focus on four key environmental priorities; and for each of the priority areas, it sets specific objectives and actions:

- *Climate change*. "an outstanding challenge for the next 10 years and beyond", it aims to contribute to the long-term objective of "stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"[45]. This includes reducing greenhouse gasses according to the objectives of the Kyoto Protocol, i.e. at least 20% by 2020, and 20% for renewable energy production and 10% of consumption for bio fuels; increase energy efficiency in the Union; and set the objective of reducing the Union's energy consumption by 20% compared to projections for 2020[46].
- *Nature and biodiversity*. Protecting and restoring the structure and functioning of natural systems, and halting the loss of biodiversity through the implementation of environmental legislation; protection, conservation and restoration of landscapes; completion of the Natura 2000 network to aid the survival of many species and their habitats in Europe; new initiatives for protecting the marine environment; and a thematic strategy for protecting soils[47].
- *Environment, health and quality of life*. Providing an environment where the level of pollution does not give rise to harmful effects on human health and the environment"[48], i.e. achieving the quality of environment that does not endanger health, necessitating, *inter alia*: a fundamental overhaul of the Union's risk-management system for chemicals[49], a strategy for reducing risks from pesticides, protection of water quality in the Union, noise abatement and thematic strategy for air quality

[42]Commission of the European Communities. A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development. Communication.COM (2001) 264 final of 15 May 2001. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0264:FIN:EN:PDF >

[43]The European Parliament and The Council of the European Union.Decision Nº 1600/2002 EC of the European Parliament and the Council. Laying down the Sixth Community Environment Action Programme of , 10 Sep.2002. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:242:0001:0015:EN:PDF >

[44]Sustainable development is a key objective set out in the Treaty. It aims at the continuous improvement of the quality of life on Earth of both current and future generations, by combating the abusive exploitation of natural resources and of human beings. It seeks to promote a dynamic economy respecting the environment, human values, cultural diversity, full employment, a high level of education, health protection, social and territorial cohesion in a peaceful and secure world.

[45]The European Parliament and The Council of the European Union, Decision No 1600/2002 EC of the European Parliament and the Council, Laying Down the Community Environment Programme of 10 Sep. 2002. Article 2(2). < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:242:0001:0015:EN:PDF

[46] Commission of the European Communities. Communication from the Commission to the European Parliament, the Council, the European Economical and Social Committee and the Committee of the Regions on the Mid-term Review of the Sixth Community Environment Action Programme.COM (2007) 225 final of 30 Apr.2007. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0225:FIN:EN:PDF>.

[47]Commisison of the European Communities. Communication from the Council and to the European Parliament on Biodiversity Action Plan for Economic and Development Co-operation. COM (2001) 162 final of 27 Mar.2001 < http://www.epbrs.org/PDF/EPBRS-IR2004-BAP%20Economic%20and%20Development%20Co-operation.pdf >.

[48]The European Parliament and The Council of the European Union, Decision Nº 1600/2002 EC of the European Parliament and the Council, Laying Down the Community Environment Programme of 10 Sep. 2002. Article 2(2).< http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:242:0001:0015:EN:PDF >

[49]Commision of the European Communities. White Paper, Strategy for a future Chemicals Policy.COM (2001) 88 final of27Feb.2001. < http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0088en01.pdf >

- *Natural resources and wastes*. The 6 EAP aims at The 6th EAP aims at "better resource efficiency and improved resource and waste management, to help bring about more sustainable patterns of production and consumption"[50]. Focusing on decoupling resources from economic growth, in particular through: improved resource efficiency, taxation of resource use, increase recycling, and waste prevention with the aid of an integrated production policy.

The international dimension of environment policy increases in importance due to a number of interconnected aspects. Environmental problems such as climate change are global. This means that it is increasingly part of the Union's External Policy. This focuses on[51]:

- Promoting sustainable development worldwide and further mainstreaming environmental considerations into all EU external policies – not only our development assistance but also trade and the Common Foreign and Security Policy.
- Effective "environmental diplomacy" will mean linking environmental objectives with other international negotiations. It will be necessary to use the full potential of trade and cooperation agreements at regional or bilateral levels.
- The negotiations for Free Trade Agreements with partners in Asia and Latin America will be an opportunity to boost trade in sustainable goods and services.
- Promoting the Union's environmental policies and requirements.
- Promoting the transfer of technology and/or resources with developing countries as an incentive for them to address global problems such as climate change.
- Working with Member Sates in order to develop regional/country support strategies that adequately address environment and natural resource management issues.
- Intensifying, together with Member States, the dialogue with key emerging economies such as China, India, Brazil, Ukraine and South Africa.
- Improving international environmental governance where a priority is to upgrade the United Nations Environment Programme (UNEP) by establishing a UN Environment Organisation (UNEO) with a strengthened mandate and adequate, predictable financing.
- Setting up an International Panel on the Sustainable Use of Natural Resources and supporting a global system to monitor the levels of biodiversity (in particular as regards forests).
- Making sure that European environmental policy concerns are also taken forward in coordination with Member States in specialised organisations such as the International Maritime Organisation and the International Civil Aviation Organisation.

Environmental policy is a cross cutting policy that is meant to ensure that environmental requirements are complied with in the planning and performance of economic and social activities. Therefore, sustainable development of the environment depends upon other policies in the field of energy, transport, agriculture and tourism. The Commission has further set out a long term community strategy to integrate environmental issues with economic policy. In the field of civil protection, in 2001 the European Civil Protection Mechanism was established to support the mobilisation of emergency assistance in the occurrence of major disasters. This mechanism can be activated in response to a natural or man-made disaster, e.g. earthquakes, floods, forest fires, industrial accidents, marine pollution or terrorist attacks. Directive 2007/2/EC[52] of the European Parliament and of the Council of 14 March 2007 established an Infrastructure for Spatial Information in the European Community (INSPIRE) to support Community environmental policies, and other activities that may have an impact on the environment. It addresses 34 spatial data themes needed for environmental applications.

4.1.2 Space Flagship Programmes Contribution

The Community environmental programme focuses efforts to combat pollution and nuisances. The objectives are the protection of European waters, the control of discharges into the aquatic envi-

[50]The European Parliament and The Council of the European Union, Decision Nº 1600/2002 EC of the European Parliament and the Council, Laying Down the Community Environment Programme of 10 Sep. 2002. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:242:0001:0015:EN:PDF >
[51]Commission of the European Communities. Communication from the Commission to the European Parliament, the Council, the European Economical and Social Committee and the Committee of the Regions on the Mid-term Review of the Sixth Community Environment Action Programme.COM (2007) 225 final of 30 Apr. 2007.
[52]European Parliament and the Council. Establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). 108, Volume 50, 25 Apr. 2007 < http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML>.

ronment, monitoring maritime pollution, air pollution and prevention of industrial and chemical hazards. Apart from the effort to combat pollution and nuisance, it also seeks to improve the environment and quality of life through the rational management of space, the environment and natural resources. These measures can be grouped under protection of flora and fauna; and management of waste. Space based services can be a major tool in implementing the policies and taking the appropriate steps to improve environmental protection.

Galileo

The importance of navigation technologies on environmental policy has been recognised by European Commission: many results have been achieved using the satellite navigation systems provided by United States (GPS) and its regional augmentation, the European Geostationary Navigation Overlay System (EGNOS)[53]. The European Union is developing an independent navigation system, which will facilitate the mapping and better management of land and resources.

One of the most important fields of application for a navigation system is in the transport system; the impact of this sector on the pollution of air and land is evident. The use of navigation systems will help the efficiency of transportation, reducing resource waste and improving the safety of citizens[54].

Recently, precision agriculture has become a widely used farming strategy because of its capacity to increase productivity and avoid waste[55]. The precision measurement of the fields and calculation of their extension can easily avoid the inefficient use of herbicides and pesticides; increasing the quality of the products as well as their quantity, with a clear benefit for human health and environmental security.

GMES

Global Monitoring for environment and security (GMES), with its five sentinels, can be considered a unique opportunity to monitor the environmental situation, forecast natural and man-made disasters and improve the quality of European flora and fauna.

The land monitoring systems such as the satellites, both optical and radar, will give a well rounded picture of the extension of forests, the intensity of desertification, and the evolution of these processes. This dataset will improve the accuracy of the results, facilitating the protection and restoration of biodiversity in the European continent. Moreover the possibility to control the colour and the extension of fields and crops will ameliorate cultivation techniques and lead to more effective space management[56].

As previously noted, the quality of water and its resources is a major concern of the European Union: the marine monitoring service of GMES is designed to control on a continuous basis the coastal environment and the marine resources. Furthermore, the exploitation of fisheries and consequently biodiversity will constantly be monitored and easily protected[57].

Implementation of environmental policy concerning the quality of air and the pollution created by greenhouse gasses, is addressed by the Atmosphere Monitoring service of GMES. This service, using satellites that can measure the presence of gasses in the atmosphere and forecast weather conditions, will ensure a constant awareness of the quantity of reactive gasses facilitating measures to reduce it. The capacity to provide a series of data on a constant basis, moreover, will foster the study of the trends related to climate change, facilitating the decision making process[58].

In the mean time, civil protection can benefit from the potential of space-based assets, forecasting catastrophes such as tornados and storms to provide the information needed for a prompt response. The combined use of the space-based assets of GMES will be an efficient tool to be used in such a complex and cross-cutting issue as environmental policy.

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[53]European Commission. Communication from the Commission to the Council , the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Action Plan on Global Navigation Satellite System (GNSS) Applications.COM (2010)308 final of 14 Jun.2010. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0308:FIN:EN:PDF>.

[54] "EGNOS for Road Users Charging High Flexibility,Low Investment." European Commission. http://ec.europa.eu/enterprise/policies/satnav/egnos/files/egnos-road-leaflet-gsa_en.pdf

[55] "EGNOS Applications." European GNSS Agency 18 Jan.2010. <http://www.gsa.europa.eu/go/home/egnos/applications/>. and A"EGNOS for Agriculture: High precision, Low cost." 18 Jan.2010. <http://www.gsa.europa.eu/go/egnos/applications/egnos-for-agriculture-high-precision-low-cost>, <http://ec.europa.eu/enterprise/policies/satnav/egnos/files/egnos_agriculture.pdf>.

[56]GMES Office, Land Service. 20.Jan.2011. < http://www.gmes.info/pages-principales/services/land-monitoring/>.

[57]GMES Office Marine Service 20.Jan.2011. <http://www.gmes.info/pages-principales/services/marine-monitoring/ >.

[58]European Space Agency. Contributing Mission. 21 Jan.2011. <http://www.esa.int/esaLP/SEMB585KXMF_LPgmes_0.html >.

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES -CONTRIBUTION
Environment policy Preserving, protecting and improving the quality of the environment; Protecting human health; Prudent and rational utilisation of natural resources; Promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change; Implementation of measures for the maintenance of ecosystems;	**Galileo** - track pollutants, dangerous goods and icebergs; - map the oceans; - study tides, currents and sea levels; - monitoring the atmosphere, water vapour for weather forecasting and climate studies; - monitoring the ionosphere for radio communications, space science and earthquake prediction; - track movements of wild animals to help preserve their habitats; - contribution to the implementation of the Shared Environmental Information System(SEIS)[59]; - detecting illegal waste sites and criminal trades of toxic waste; *Examples* - **monitoring climate change.** By collecting data and images of Earth, freeze cycles, vegetation structure changes, climate change can be monitored with precision. - **monitoring currents and sea levels.** Using satellites to monitor the sea level can develop a deeper understanding of the reasons for sea level rise and monitor possible future changes. - **land use mapping.** Positioning information combined with high-quality images can provide three dimensional information about the entire planet, and with that a more accurate land use mapping is possible. - **measuring and monitoring biodiversity**. The use of high-resolution satellites with tracking systems allows tracking the movement of thousands of individual animals. There have been significant advances in land-cover classifications by combining data from multi-passive and active sensors, and new classification techniques. Remote sensing of nature reserves can provide natural resources managers with near real-time data within and around reserves that can be used to support conservation efforts anywhere in the world[60]; **GMES** - protecting and restoring nature and biodiversity; - monitoring the level of pollution; - monitoring green house gas concentrations; - monitoring natural resources and waste; - monitoring man-made and natural disasters (earthquakes, floods, forest fires, industrial accidents, marine pollution, terrorist attacks); - monitoring and forecasting of Ultraviolet Radiation; - monitoring and forecasting of Total Ozone;

[59] Shared Environmental Information System – SEIS- is collaborative initiative of the European Commission and the European Environment Agency (EEA). The system intends to establish, together with the Member States, an integrated and shared EU-wide environmental information system, to better tie in all existing data gathering and information flows related to EU environmental policies and legislation. Based on technologies such as the internet and satellite systems it will thus make environmental information more readily available and easier to understand to policy makers and the public.<http://ec.europa.eu/environment/seis/>.

[60] Gillespie, T.W., Foody, G.M., Rocchini, D., Giorgi, A.P., Saatchi, Sassan, "Measuring and modelling biodiversity from space",Progress in Physical Geography April 2008 vol. 32 no. 2 203-221. <http://ppg.sagepub.com/content/32/2/203.short>.

	- total ozone record; - improve water storage (surface waters, aquifers) to address water shortages and desertification; *Examples* - **Arctic ice monitoring.** An application to monitor the decrease of the Arctic ice surface and its movements, in order to understand climate change.[61] - **monitoring oil spills at sea**. Availability of satellite data in near-real time, particularly from radar such as the Advance Synthetic Aperture Radar on Envisat and in the future from the GMES Sentinel-1, is an essential way of monitoring oil spills at sea. They provide wide area coverage and have the capability to detect oil slicks on the sea surface both in daylight and darkness, and through clouds[62]; - **real-time monitoring the composition of the atmosphere.** The atmosphere's composition can be monitored in real-time by assimilating observations of various meteorological variables as well as reactive gases and aerosols.[63] - **monitoring and forecasting the marine environment, w**ith a combination of space and in situ observations and data assimilation, the system could provide information on the ocean for large scale (worldwide coverage) and regional scale (main European basins and seas) temperature, salinity, currents, ice extent, sea level, primary ecosystems; - **land monitoring,** to close the gap between low-resolution global coverage and high-resolution by providing seasonal to annual Europe -wide coverage of physical properties describing bio-geophysical information parameters; - **ecosystems management.** With real-time data provided by satellites it is easier to conserve major ecological services and restore natural resources while meeting the socioeconomic, political and cultural needs of current and future generations.[64]

Table 3: Galileo and GMES contributions to implement environment policy

[61] Changes in sea ice extent, concentration and volume are signals used to detect global warming.
As an example, the MyOcean project aims at providing a sustainable service for Ocean Monitoring and Forecasting validated and commissioned by users. MyOcean information includes observations, analysis, reanalysis and forecasts describing the physical state of the ocean and its primary biogeochemical parameters. It also contributes to research on climate by providing long time-series of reanalysed parameters. <http://www.myocean.eu>.
[62] The Agreement between ESA and EMSA furthers Maritime Safety <http://www.esa.int/esaEO/SEMKNJRZ5BG_index_0.html>.
[63] Project for Monitoring and Forecasting of Global Atmospheric Composition (MACC) <http://www.gmes-atmosphere.eu/services/gac/nrt/>.
[64] One example of the utilization of earth observation satellites capacity and data has been developed by ESA's program - Earth Observation for Development. ESA and the World Bank have a joint venture to use earth observation for the Bank's operations. <http://www.esa.int/esaCP/SEMV5HZ57NG_index_0.html>.

4.2 Transport Policy

4.2.1 Transport Policy Overview

In the EU, 44% of goods are transported by road, whereas 39% are transported by short-sea shipping routes, 10% by rail and 3% by inland waterways. The transport industry at large accounts for about 7% of GDP, and for over 5% of total employment[65].

European transport policy begins with the treaty of Rome, entering into force in 1958, which sought a common policy for inland transport, namely roads, rail, and inland waters, but not for maritime and air transport (Art 84 EEC, Art. 80 TEC). It focuses on removing borders between Member States, and contributing to the free movement of individuals and of goods. In 1991, the Treaty of Maastricht reinforced the political, institutional and budgetary foundations of the transport policy, *inter alia*, by introducing the concept of the trans-European Transport Network (TEN-T)[66]. The network on transportation is aimed at organizing a single multimodal way to connect EU countries, using the traditional structures as well as innovative technologies[67]. Today, the basis of the Common Transport Policy (CTP) is found in the Lisbon Revision under Arts. 90-100 TFEU. The Union's common transport policy lays down:

1. Common rules applicable to international transport to or from the territory of a Member State or passing one or more Member States;
2. The conditions under which non-resident carriers may operate transport services within a Member State;
3. Measures to improve transport safety.

The Union seeks to organise the various means of transport in accordance with the "Community Rules". A communication from the Commission entitled "The common transport policy - Sustainable mobility: perspectives for the future", provides an updated framework for the future development of transport policy[68]. Three priority areas are identified: a) improving efficiency and competitiveness by liberalising market access, establishing integrated transport systems and developing the Trans-European Transport Network (TEN-T); b) improving quality through targeted safety, primary on air, maritime and road transport and protection of the environment; c) improving external effectiveness by appropriate negotiations with third countries including the United States on aviation, and India and China on maritime and on global environmental and safety challenges by initiatives with appropriate international organisations. In particular under the integrated transport systems, priority was given to promoting intelligent transport systems, mainly through the implementation of the Action plan for global navigation by satellite (GNSS)[69].

In the area of transport, the TEN-t aims to organize a single multimodal way to connect EU countries, using traditional structures as well as innovative technologies. These innovative technologies are then applied to transport in order to create Intelligent Transport Systems (ITS). ITS will increase the efficiency of services and at the same time their safety and security; moreover, these technologies can be used for transporting both passengers and freight.

These systems are also useful in alternative forms of transport: road, rail, water and air. Therefore, the action of the EU will smooth the process of integration of such systems and eventually give a trans-border dimension to the initiatives.

[65] Commission of the European Communities. Communication from the Commission on A sustainable Future for Transport: Towards an Integrated, Technology-led and User Friendly System COM (2009) 279 final of 17 Jun..2009. <http://www.eu-oplysningen.dk/upload/application/pdf/e752d81a/20090279.pdf >.

[66] The Trans European Network (TEN) are initiatives created in the domain of energy, transport and telecommunication to better connect and integrate the common development of these domains within EU borders. The development of TEN is crucial for policies on growth and jobs.
TEN will also offer a major opportunity to boost industrial policy namely in sectors considered strategic for EU competitiveness in the global scenario (e.g. Galileo) .Furthermore other areas of EU policy will be boosted by the TEN such as information sharing, security of supply and sustainable development.

[67] "The TEN-T Components". European Commission 24 Feb.2011 <http://ec.europa.eu/transport/infrastructure/networks_eu/networks_eu_en.htm>. The traditional components are the ground infrastructure (e.g. road, rail); the ITS are the management systems that could be water borne, airborne or space based (i.e. GNSS).

[68] Commission of the European Communities. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on The Common Transport Policy Sustainable Mobility: Perspectives for the Future. Follow-up to the Green Paper. COM (1998) 716 final/2 of 21 Dec.1998.Brussels.

[69] European Commission. COM (1998) 29 final.

Areas such as: traffic management, emergency response, and environment can also benefit from the deployment of these technologies.

The deployment of TEN-t will follow the EC guidelines that identify 6 priority areas:

1. Optimal use of travel data: real time wide traffic information data, i.e. how to collect and how to distribute them
2. Continuity of traffic and freight management ITS services on European transport corridors and conurbations: the need to take in consideration the increasing number of vehicles in EU corridors and in conurbations in particular, has to be satisfied by modern means.
3. Road safety and security: to improve the safety of the roads, the number of ITS must increase the number of machines as well as the devices.
4. Integration of vehicles into the transport infrastructure: improve the use of "nomadic devices" such as pocket computers, mobile phones, GNSS receivers that could be integrated in the ITS system. This should start in commercial vehicles and later be used by private cars.
5. Data security protection and liability: the ITS and other groups, e.g. European Fee Collection, deal with the personal data of each user/citizen; therefore the security of the service needs to be improved.
6. European ITS coordination and cooperation: the installation and putting in place of the ITS is necessary to avoid gaps and different levels of integration mostly within cities and regions. There is a need for an adequate structure of governance for these tools[70].

In 2001, the Gothenburg European Council invited the Community institutions to adopt revised guidelines for the trans-European transport network. Today it comprises infrastructure (roads, railways, waterways, ports, airports, navigation aids, intermodal freight terminals and product pipelines), together with the services necessary for the operation of this infrastructure. The objectives of the trans-European transport network (TEN-T) are to:

1. ensure the mobility of persons and goods;
2. offer users high-quality infrastructure;
3. include all modes of transport;
4. allow the optimal use of existing capacities;
5. be interoperable in all its components;
6. be economically viable;
7. cover the whole territory of the European Union (EU);
8. allow for its extension to the Member States of the European Free Trade Association (EFTA), the countries of central and eastern Europe and the Mediterranean countries.

There are currently 30 infrastructure projects[71], and Galileo is one currently in development.

Since the 2001 White Paper[72], which was revised in 2006[73], this policy area has been oriented towards harmoniously and simultaneously developing the different modes of transport, in particular with co-modality, which is a way of making use of each means of transport (ground, waterborne or aerial) to its best effect. It should be noted that the White Paper of 2001 did not refer to security; over the last ten years, the need for security has increased and this might be addressed in a subsequent White Paper covering the period over the next ten years.

[70] Commission of the European Communities. Communication from the Commission on Action Plan for the Deployment of Intelligent Transport Systems in Europe.COM (2008) 886 final of 16 Dec.2008. Brussels. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0886:FIN:EN:PDF >.

[71]The European Parliament and the Council of the European Union. Decision Nº 884/2004/EC of the European Parliament and the European Council an Amending Decision No 1692/96/EC on Community Guidelines for the Development of the Trans-European Transport Network.29 Apr.2004 < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:167:0001:0038:EN:PDF >.

[72]Commission of the European Communities. White Paper, European Transport Policy for 2010: Time to Decide. COM (2001) 370 final of12 Sep.2001. <http://ec.europa.eu/transport/strategies/doc/2001_white_paper/lb_com_2001_0370_en.pdf>.

[73]Commisison of the European Communities. Communication from the Commission to the Council and to the European Parliament on Keep Europe Moving -Sustainable Mobility for our Continent Mid-term Review of the European Commission's 2001 Transport White Paper.COM (2006) 314 final of 22 Jun. 2006. <http://ec.europa.eu/transport/transport_policy_review/doc/2006_transport_policy_review_en.pdf >.

In other words, today the principal aims of the Common Transport Policy are to complete the internal market, ensure sustainable development, extend transport networks throughout Europe, maximise the use of space, enhance safety and promote international cooperation. The Union's CTP also tackles the sector-by-sector organisation of the various modes of transport, namely road, rail, maritime and air.

The Commission's communication entitled "A sustainable future for transport: towards an integrated technology-led and user friendly system"[74] looks further ahead and prepares the ground for later policy developments. It analyses how challenges, e.g. aging, migration and internal mobility, environmental challenges, increasing scarcity of fossil fuels, urbanisation, and other global trends affecting European Transport Policy, are going to shape the future of the transport sector and consequently the policy. The communication identifies the policy objectives for sustainable transport as:

- Quality transport that is safe and secure
- A well maintained and fully integrated network
- More environmentally sustainable transport
- Keeping the EU at the forefront of transport services and technologies.
- Protecting and developing the human capital
- Smart prices and traffic signals
- Planning with an eye to transport: improving accessibility

Technological innovation will be a major contributor in solving transport challenges. New technologies will provide innovative and more comfortable services to passengers, increase safety and security, and reduce the environmental impacts. "Soft infrastructures", like intelligent transport systems for road (ITS[75]), traffic management systems for rail (ERTMS[76]), and aviation (Single European Sky's SESAR[77]), all backed by Galileo, can optimise the use of the network and improve safety. Innovative vehicle technology can lower emissions, reduce oil dependency and increase comfort. In addition, well focused infrastructure expansion will help to avoid congestion and time loss. Infrastructure projects include the European global navigation satellite systems (Galileo and EGNOS), which will complement 'traditional' networks and improve their exploitation.

The "White Paper on Transport: A Single Transport Area: Smart Mobility for People and Businesses", released in the first quarter of 2011, was expected to contain the following objectives for the next decade:

- Eliminating bottlenecks. This will include TEN-T and funding
- Placing users at the heart of the transport policy, focusing on transport safety (road, maritime, rail, air), transport security, passenger rights and social dialogue and working conditions;
- Urban transport. Focusing on transport beyond country borders, or city to city, and promotion of green public procurement,
- Promotion of research and technological development in transport.
- External dimension of transport. It will provide links in agreements with other neighbouring countries, agreements with third countries (e.g. USA) and the role of the EU in the international transport forums.

European Union transport policy is not limited to the Union's borders. It is the subject of a number of agreements with third countries aimed at converging technical standards and transferring technologies within the framework of cooperation agreements, specifically the Euro-Mediterranean Agreement. In addition, candidate countries for accession to the Union must adopt and apply European transport legislation. The progress of reforms in each country is regularly monitored and assessed as part of the accession process. The Union also negotiates agreements with third countries on market access for transport companies, particularly airlines.

[74]Commission of the European Communities.Communication from the Council on A sustainable Future for Transport: Towards an Integrated, Technology-led and User Friendly System. COM (2009) 279 final of 17 Jun..2009. <http://www.eu-oplysningen.dk/upload/application/pdf/e752d81a/20090279.pdf >.
[75]Commission of the European Communities. Communication from the Communities onAction Plan for the Deployment of Intelligent Transport Systems in Europe. COM (2008) 886 and COM (2008) 886/2 final of 16 Dec.2008. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52008DC0886R(01):EN:HTML>.
[76]Commission of the European Communities. Commission Decision on Amending Decision 2005/263/EC on Authorising Member States to Adopt Certain Derogations Pursuant to Directive 94/55/EC with Regard to the Transport of Dangerous Goods by Road. COM(2005) 903 final of 15 Dec. 2005. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:328:0062:0067:EN:PDF>.
[77] Council Decision 2009/820/EC.

The high standards of security offered by Galileo services is one of the strengths of this system so that the sensitive data collected via ITS can also be protected using the features of a European GNSS. Cooperation to realise Galileo is indeed very broad and the example of Galileo as a model of cooperation for ITS can be considered as a benchmark for integration of other services. The situation of congestion can be controlled in a specific area using the imagery produced by these satellites, and the operation of rescue in certain cases can be addressed using the data of GMES service thus improving the security of EU transport routes. Management of traffic depends also on the operators providing their vehicles with a better management of their resources, i.e. the fleets can help the mitigation of congestion and the waste of energy thus reducing pollution.

Space based navigation and earth observation systems like Galileo and GMES can assist in realising the policy objectives of transport. The space based navigation system is, indeed, one of the most important tools to reach the goal of intelligent mobility. Nowadays navigation systems are widespread but many other services deriving from that signal can be exploited. Therefore Galileo is mentioned in many documents as an ITS asset. Most of the objectives stated by the Commission can be achieved using a GNSS system. Using GNSS receivers, travel data can be received and sent in near real time to the authorities (who could also use the PRS in order to have high precision) and to the users.

Furthermore the management of freight and vehicles from one country to another can be monitored using the track of their GNSS devices, and eventually if integrated with the system the same can also show different alternatives to the driver.

4.2.2 Road Transport and Contributions from the Flagship Programmes

Within the EU, the percentage of total freight transport on roads increased from 50% in 1970 to 70% in 1990; this was partially related to the Member States' choice not to charge the cost of infrastructure to the price of road transport.

One of the aims of the Transport policy is to stimulate technological innovation. European Space Policy, through the introduction of satellite navigation with Galileo and EGNOS, aims at optimising road, rail, air and maritime traffic management. Such systems will also assist in safety, including improved emergency services (e.g. fire, road accidents, mountain rescue, etc) and reduced pollution.

Due to increasing road traffic congestion in the Union, and the high number of road accidents, in addition to high CO2 emissions, there was a need to reduce gridlock, road accidents, and emissions; keeping in line with the Union's strategy for growth and employment. A communication from the Commission first proposed an action plan for the deployment of intelligent transport systems in Europe[78], and later a directive was adopted[79]. "*Intelligent Transport Systems*" (ITS) involves applying Information and Communication Technologies (ICT) to transport. These applications are being developed for different transport modes, and for interaction between them (including interchange hubs).

In air transport, Single European Sky Air Traffic Management Research (SESAR) is the framework for the implementation of a new generation of air traffic management. Inland waterways are introducing River Information Services (RIS) to manage waterway utilisation and the transport of freight. The railway network is gradually introducing the European Rail Traffic Management System (ERTMS) and Telematics Applications for Freight (TAF-TSI). Shipping has introduced SafeSeaNet and the Vessel Traffic Monitoring and Information Systems (VTMIS) and is progressing towards an Automatic Identification System (AIS) and Long-Range Identification and Tracking (LRIT). Examples of Intelligent Transport Systems applications in road transport include urban and motorway traffic management and control systems, electronic toll collection and route navigation.

Similar activities have taken place in Europe since 1990, but in a fragmented way. Thus there is a need to for a more coherent European action for applications and services regarding: geographical continuity, interoperability of services and systems and standardisation. A pan-European approach

[78] Commission of the European Communities. Communication from the Commission onthe Action Plan for the Deployment of Intelligent Transport Systems in Europe. COM (2008) 886 final of 16 Dec. 2008. <http://www.eie.gov.tr/duyurular/EV/dankur/2010/%C3%9Clkelerin%20Ula%C5%9F%C4%B1mda%20Enerji%20Verimlili%C4%9Fi%20Hususundaki%20Eylem%20Planlar%C4%B1/Intelligent%20Transport%20Systems%20Action%20Plan%20(2009%20%E2%80%93%202014).pdf >.

[79] Commission of the European Communnities. Proposal for a Directive of the European Parliament and of the Council Laying down the Framework for the Deployment of Intelligent Transport Systems in the Field of Road Transport and for Interfaces with other Transport Modes.COM (2008) 887 finalof16 Dec..2008.< http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0887:FIN:EN:PDF >.

would secure accurate and reliable real-time data, and adequate coverage of all travelling modes. Thus the following targets were brought forward:

- *Greening of transport.* ITS technology is essential for achieving green transport corridors[80] to enable more environmentally friendly alternatives for long-distance transport between logistics hubs.
- *Improving transport efficiency.* ITS tools are key for logistic chains and maintaining paperless management (eFreight); Real-time Traffic and Travel Information (RTTI) services, combined with satellite navigation; inter-urban and urban traffic management, fostering modal interchange at major hubs and transfer points; cooperative systems based on vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I) and infrastructure-to-infrastructure (I2I) communication and information with GNSS positioning time.
- *Improving road safety and security.* Improving road safety of Driver Assistance Systems such as Electronic Stability Control (ESC), Adaptive Cruise Control (ACC), Lateral Support (lane departure warning and lane change assistant), Collision Warning and Emergency Braking Systems and other applications such as eCall (emergency call), driver hypo-vigilance systems, "speed alert" and "alcohol-lock"; use of active e-safe systems, and advanced driver assistance and human machine interfaces (HMI), extended to allow for proliferation of nomadic devices; remote monitoring of vehicles and cargo, e.g. dangerous goods or livestock through navigation and tracking systems.

Six areas were suggested as priority areas needing input from public and private stakeholders:

- *Area 1: Optimal use of road, traffic and travel data.* This includes activities in defining procedures for the provision of EU-wide real-time traffic and travel information services; optimising the collection and provision of road data and traffic circulation plans, traffic regulations and recommended routes (in particular for heavy goods vehicles); defining specifications for data and procedures for the free provision of minimum universal traffic information services (including the definition of the repository of messages to be provided); promoting the development of national multimodal door-to-door journey planners, taking due account of public transport alternatives, and their interconnection across Europe.
- *Action Area 2: Continuity of traffic and freight management ITS services on European transport corridors and in conurbations.* This includes: defining a set of common procedures and specifications to ensure the continuity of ITS services for passenger and freight in transport corridors and in urban/interurban regions including emergency planning; identification of ITS services to be deployed in support of freight transport (eFreight) and development of appropriate measures to progress from concept to realisation with particular attention to applications for goods tracking and tracing using state-of-the-art technologies such as RFID and EGNOS/Galileo-based location devices; support for the wider deployment of an updated multimodal European ITS Framework architecture for intelligent transport systems and definition of an ITS framework architecture for urban transport mobility, including an integrated approach for travel planning, transport demand, traffic management, emergency management, road pricing, and the use of parking and public transport facilities; and implementation of the interoperability of electronic road toll systems.
- *Action Area 3: Road safety and security.* Includes the promotion of deployment of advanced driver assistance systems and safety and security-related ITS systems, together with their installation in new vehicles (via type approval) and, if relevant, their retrofitting in used ones; support in the Implementation Platform for the harmonised introduction of pan-European eCall, including awareness campaigns, upgrading Public Service Access Points' infrastructure and an assessment of the need for regulation; the development of a regulatory framework for a safe on-board Human-Machine-Interface and the integration of nomadic devices, building on the European Statement of Principle[81] on safe and efficient in-vehicle information and communication systems; the development of appropriate measures including best practice guidelines concerning the impact of ITS applications and services on the safety and comfort of vulnerable road users; the development of appropriate measures including best practice guidelines on se-

[80]Commission of the European Communities. Communication From the Commission to the European Parliament and the Council on Greening Transport.COM (2008) 433 final of 8 Jul..2008. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0433:FIN:EN:PDF >

[81] The Council of the European Union. Council Regulation (EC) Nº 2135/98 amending Regulation (EEC) No 3821/85 on Recording Equipment in Road Transport and Directive 88/599/EEC Concerning the Application of Regulations (EEC) No 3820/84 and (EEC) No 3821/85 of 24 Sep.1998. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1998:274:0001:0021:EN:PDF >.

cure parking places for trucks and commercial vehicles and on telematics-controlled parking and reservation systems.

- *Action Area 4: Integration of the vehicle into the transport infrastructure.* The adoption of an open in-vehicle platform architecture for the provision of ITS services, applications and standard interfaces. The outcome of this activity would then be submitted to the relevant standardisation bodies; development and evaluation of cooperative systems in view of the definition of a harmonised approach; assessment of deployment strategies, including investments in intelligent infrastructure; defining the specifications for infrastructure-to-infrastructure (I2I), vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication in co-operative systems; defining a mandate for the European Standardisation Organisation to develop harmonised standards for ITS implementation, in particular regarding cooperative systems.
- *Action Area 5: Data security and protection, and liability issues*. Including assessing the security and personal data protection aspects related to the handling of data in ITS applications and services and proposing measures in full compliance with Community legislation; addressing the liability issues pertaining to the use of ITS applications and notably in-vehicle safety systems.
- *Action Area 6: European ITS cooperation and coordination.* This includes the proposal for a legal framework for European coordination in the Europe-wide deployment of ITS; development of a decision-support toolkit for investment decisions in ITS applications and services; development of guidelines for public funding from both EU (e.g. TEN-T and Structural Funds) and national sources of ITS facilities and services based on an assessment of their economic, social and operational value; the set-up of a specific ITS collaboration platform between Member States and regional/local governments to promote ITS initiatives in the area of urban mobility.

The Commission is expected to report on this action plan in 2012. In Europe, transport of both passengers and freight is typically performed using roads and inland means across the EU Member States. The Commission, in response to the main aims of this policy, is to achieve efficient, safe, secure and environmentally friendly mobility on European roads[82], *and* take up different initiatives. The Intelligent Transport System (ITS) has been operational for many years now and most of the products that permit use of this system, such as the eCall (automatically calls the emergency), are already wide spread. Unfortunately, due to fragmentation and the different systems present within the Union's borders, it is not possible to exploit fully the potential benefits of this initiative. Further harmonization is required to implement coordinated and effective plans. The Commission acts as a coordinator in this, and space based applications such as Galileo and GMES can assist in achieving these goals. This would make mobility in Europe more comfortable and safe. The use of real time information systems enable "dynamic traffic management" using a mixture of simulations and real-time data in order to also ameliorate the mitigation of congestion[83].

Galileo

Navigation based on satellites is a very important tool in road transport. Many of the possibilities offered by these systems are already well known to the public because of the broad use of the Global Positioning System (GPS) operated by the US. The European Augmentation system EGNOS provides Europe with an even more accurate GPS signal, though often disrupted for technical reasons.

The new ongoing project, known as Galileo, will give Europe the possibility to rely on an independent system under civilian control and for civilian purposes[84]. Galileo can provide a driver with different services:

Navigation: using the position system, the receiver can offer alternative routes to the driver to decrease the duration of the trip. The use of this service would decrease the consumption of fuel and the emission of CO2, simultaneously mitigating the probability of traffic congestion and developing "greener" mobility.

Furthermore, the positioning system can activate an e-call service in case of emergency; determining the location of the vehicle in real time. Many possibilities also exist for private businesses that work in the transport industry, such as truck and bus companies. Through the use of Galileo, con-

[82] These target are stated in< http://ec.europa.eu/transport/road/index_en.htm>.
[83] "Intelligent Transport Systems. Road." < http://ec.europa.eu/transport/its/road/road_en.htm>.
[84] European Parliament and Council. on the further implementation of the European satellite navigation programmes (EGNOS-Galileo) Regulation n. 683/2008, 9 Jul. 2008.

trolling a fleet of vehicles will be easier and faster, allowing the companies to better organize the possibilities of their logistic resources[85].

GMES

Global monitoring for environment and security (GMES) is the second space-based flagship of Europe; in monitoring the Earth's surface, it can provide a number of services in the domain of road transportation:

The land monitoring system, with an accurate optical system, can provide institutions with a series of useful images to direct traffic. From its high vantage point, this service reduces the need for helicopter or other airborne solutions, decreasing the costs of the operation and the emission of gases into the atmosphere.

Relevant data on air pollution and the concentration of certain gases, normally released by land transport sources, can be determined by the atmospheric monitoring service. Once identified, where the concentrations of these gases exceed limits, more effective decisions can be taken on the basis of that data.

GMES provides security services, including search and rescue and monitoring of the borders. These services can increase the safety of the journey over the border of one nation, allowing prompt response beyond the borders of the State of departure.

4.2.3 Railway Policy and Contributions from the Flagship Programmes

Since 1996, the European Union has been working to revitalize the railway sector. The means used for this have been through financial investment, the introduction of market forces in the railway industry, citizen oriented service, and the integration of the railways of different Member States.

In order to put these concepts into practice, the European Commission released three sets of legislation, called railway packages.

- The first package increases the effectiveness of existing regulations in this area[86].
- The second package creates an integrated railroad area and creates a European Railway Agency (Agency Regulation)[87].
- The third work package assesses the work of the second package, and improves the measures to benefit the EU packages[88].

An integrated railway in Europe is needed to facilitate the free movement of people and freight. Furthermore, a service oriented (public service) railway will improve welfare in Europe. Nevertheless, railroad safety requires ever-increasing supervision and improvement.

Galileo

The European GNSS system benefits integration, public service and safety.

EGNOS has already paved the way for Galileo, offering services that will allow for less financial expenditure while also improving the safety of rail infrastructure.

GNSS services could replace 50% of the track-side equipment used today to manage the traffic of trains; the GSA determined that this switch would result in €72.5 million in savings[89].

The ability to continuously track all trains, even beyond national borders, will boost the process of integration. Moreover, the use of Galileo will assure the same standard of navigation and speed and improve safety in the European integrated network.

[85]"Egnos Applications-" European GNSS Agency.2010. <http://www.gsa.europa.eu/go/home/egnos/applications/>.
[86]The European Parlaiment and the Council of the European Union. Directive 2001/12/EC of the European Parliament and the Council Amending Council Directive 91/440/EEC on the Development of the Community's Railways of 26 Jan.2001. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:075:0001:0025:EN:PDF>.
[87]The European Parliament and the Council of the European Union. Regulation (EC) No 881/2004 of the European Parliament and the European Council Establishing a European Railway of 29 Apr. 2004- <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:164:0001:0043:EN:PDF >.
[88] Commission of the European Communities. Communication from the Commission on Further Integration of the European Rail System: Third Railway Package.COM (2004) 140 final of 3 Mar.2004. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2004:0140:FIN:EN:PDF >.
[89]"EGNOS-Benefits." European GNSS Agency. 19 Dec.2010 <http://www.gsa.europa.eu/go/home/egnos/benefits/>.

The ability to anticipate and give timely information to passengers about transportation delays could make the railway system more efficient.

Furthermore, by monitoring trains, operators can sned repair crews to defined locations, increasing work efficiency and reducing factors that contribute to delay[90].

Galileo's commercial applications will present another opportunity for the European economy: many consultations have been conducted in the United States, analyzing the performance of GPS to foster accurate services that can be used in the rail sector.

GMES

This system can also play an important role in railway evolution. With the ability to monitor a large part of the European tracks, in real-time via optical satellites, the standard of safety will improve and allow for the fast and precise recovery of breakdowns.

Safety can be improved even further via radar satellites, since they can notice minute faults in the infrastructure and predict the possibility of harmful consequences. And the general benefit provided by an accurate metro-service will affect rail transportation in addition to other transportation sectors.

4.2.4 Air Transport and Contributions from the Flagship Programmes

The aviation policy[91] of the European Union began in early 2000 with a Communication by the Commission, initiating a series of bilateral agreements with neighbouring countries in the "east" and with Mediterranean States. The Commission stated that: "It is obvious that transport in general, and aviation in particular is a key factor in promoting productive co-operation between countries The establishment of navigation policy towards all of the neighbours of the Community should thus be considered to be an important policy objective"[92]

The driver for the development of this policy has been:

- Economic: neighbouring countries are important trading partners, and this collaboration has to be increased. Economic growth related to the aviation sector is remarkable.
- Political: all the countries considered are involved in close co-operation with the EU through bilateral agreements as well as through participation in different international organizations. Nevertheless the EU hosts a large number of immigrants coming originally from the countries considered, so that an efficient link has to be established.

Moreover with globalization, air connections are increasingly important when considering the European Commission's assessment that in 2007, over 120 million people travelled via air transport and this trend continues to increase[93].

The European Union is developing a series of measures to use when it is established as the main regulator of air traffic between Member States. These measures provide the Union with an adequate tool in order to perform its role at the optimum level.

Galileo

The aviation sector relies completely on GPS and its Augmentation Systems such as EGNOS. The GPS signal for civil use needs improvement in certain aspects, e.g. vertical precision as well as the integrity of the signal (the signal must be guaranteed or the disruption has to be notified to the user). Galileo was designed to overcome these obstacles and offer continuous service with better accuracy. These improvements in technology are directly connected with the safety and the security of passengers. Safety (including aircraft safety) can be improved by installing an on-board receiver that provides a navigation signal on a continuous basis and in the best scenario that could be interoperable with the other GNSS signals around the globe. Security is assured during critical moments of the flight (i.e. take off and landing), due to the vertical precision that allows manoeu-

[90]"EGNOS Applications." European GNSS Agency. 19 Dec.2010 <http://www.gsa.europa.eu/go/home/egnos/applications/>.
[91] aviation (Single European Sky's SESAR),
[92]European Commission: "A Community aviation policy towards its neighbours" Communication COM(2004) 74 final Brussels, 09.02.2004
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2004:0074:FIN:EN:PDF
[93]EuropeanCommission- DG Mobility and Transport- External Aviation Policy - A Common Aviation Area with the EU's neighbours. 17.1.2011
<http://ec.europa.eu/transport/air/international_aviation/external_aviation_policy/neighbourhood_en.htm>

vrability in adverse climate conditions[94]. Galileo's and EGNOS's potential benefit is that they "will assist air traffic control to cope with increased traffic as well as improving safety and reducing the infrastructure needed on the ground". An additional use offered by the Galileo service "en route" is the ability to plan the route to be followed and to avoid fuel waste, while also helping to make aviation more environmentally friendly[95]. Furthermore, Unmanned Aerial Systems (UAS) is an outstanding sector in aviation that makes great use of space-based navigation systems, using the integrated Applications to perform services normally executed by manned aircraft (e.g. coastal patrol, security control of borders)[96]. UAS is increasing the number of civil applications that may be exploited. The civil use of UAS is in line with the civil purpose of Galileo in improving sustainable development[97].

GMES

The aviation domain requires significant investment and a high level of security. The operator of this economic sector must be vigilant to avoid the loss of human life and significant economic loss. To reduce these risks, many GMES services could be exploited by airlines and the organizations devoted to the air traffic control.

Firstly the meteo-services of this programme can be used by experts for a complete and coherent set of data that can be used to plan the flight and assure the security of passengers; together with the prevention of delays due to lack of information about the weather over the destination airport.

As natural events are often the main reason for air traffic related problems, the possibilities offered by GMES to monitor and deal with such critical situations will affect operational efficiency in this domain. A recent example is the volcanic eruption that took place in Iceland. This event distrupted the operations of the aviation sector due to safety related issues posed by the volcanic ash. The GMES atmospheric service could have provided institutions with valuable data that could avoid future problems[98].

4.2.5 Flagship Programmes' Contribution

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES –CONTRIBUTION
Transport policy • Common rules applicable to international transport to or from the territory of a Member State or passing one or more Member States; • The conditions under which non-resident carriers may operate transport services within a Member State; • Measures to improve transport safely; • Development of a modern and sustainable transport system from an economic, social and environmental point of view; • Optimum and more sustainable use of transport infrastructure;	**Galileo** - assist in ensuring mobility of persons and goods; - cover the whole territory of the EU with high quality signal quality of transport safe and secure; - assist in a well maintained and fully integrated network keeping the EU at the forefront of transport services and technologies; - facilitate use of smart prices and traffic signals; - eliminate traffic bottle necks; - enhance transport safety and security; - increase transport efficiency; - support fleet management, detailed maps or voice notifications to alleviate problems in the transport domain: road, aviation, maritime, rail and pedestrian traffic; - generate new commercial services in areas such as road vehicle navigation and air traffic control;

[94]"EGNOS in Aviation: Vertical Precision for Improved Approaches." European GSA Agency.- - 17 Jan2011 < http://www.gsa.europa.eu/index.cfm?objectid=E0BEB1A2-E4A8-A2B8-9396853731AC442A>.
[95]"EGNOS Navigation- Feature-Who benefits from EGNOS?". European Space Agency.- 17 Jan.2011<http://www.esa.int/esaNA/ESAG130VMOC_egnos_0.html>.
[96]GINATI A. Space, the essential component for UAS-The case of Integrated Applications –"Space 4 UAS" . Workshop "Opening Airspace for UAS. A Regulatory Framework to introduce Unmanned Aircraft Systems in the Civilian Airspace." 4 Nov. 2010 European Space Policy Institute. Vienna. <http://www.espi.or.at/index.php?option=com_content&view=category&layout=blog&id=2&Itemid=18>
[97]"4 November 2010. ESPI hosts Workshop on Integration of Unmanned Aircraft Systems in the Airspace." European Space Policy Institute(ESPI). 4 Nov. 2010. <http://www.espi.or.at/index.php?option=com_content&view=article&id=589:espi-hosts-workshop-on-integration-of-unmanned-aircraft-systems-in-the-airspace&catid=39&Itemid=37>.
[98]"Satellites tracking Mt Merapi Volcanic Ash Clouds." 15 Oct. 2010. European Space Agency (ESA) 12 Dec. 2010 < http://asimov.esrin.esa.it/esaCP/SEMY0Y46JGG_Improving_2.html >.

	Examples - **safe transport of dangerous good**. EGNOS/Galileo capabilities can be used to ensure improved safety of transport of dangerous goods[99]. - **freight and fleet management**. Tracking and tracing of goods, vehicle scheduling and control and improved "just-in-time" delivery processes; - **traveller information systems**. To provide accurate and real-time traffic information; - **electronic pricing systems**. To allow the introduction of more flexible pricing policies and reduce the need for roadside infrastructure; - **position and timing information**. Provide positioning and timing information to specific users requiring a high continuity of service, with controlled access, using real-time data and 3D mapping capabilities provided by satellites. - **Command and Control, Sense and Avoid, and Air Traffic Control of Unmanned Air traffic Systems (UAS)**. UAS can be integrated into non-segregated airspace using satellite communications and satellite navigation[100]. **GMES** - enhance safe and secure quality of transport; - support environmentally sustainable transport; - monitor ship detection for maritime security; - provide early disaster detection to provide warning and guidance services for civil protection; *Examples* - **ships routing for transportation and efficient use of fuel**. Using a radar satellite and high-resolution images, this measure could improve maritime transportation by reducing prices and ensuring efficient management of fuel and natural resources;

Table 4:Galileo and GMES contributions to implement transport policy

4.3 Regional Development Policy

4.3.1 Policy Overview

The main objective of regional policy is to reduce economic, social and territorial discrepancies across the EU, particularly in countries or regions whose development is lagging behind. They are often in connection with economic, social restructuring and aging population; restructure declining industrial areas; and diversify rural areas declining in agriculture and are achieved by transferring Community resources to problem regions using the Union's financial instruments know as Structural Funds. The action is grounded in the Lisbon Treaty under Art. 174 TFEU. The European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund contribute towards the following objectives[101]:

- *Convergence.* This is aimed at speeding up convergence of the least-developed Member States and regions by improving conditions for growth and employment through increasing and improving the quality of investment in physical and human capital, the development of innovation and of the knowledge society, adapting to economic and social changes, protecting and improving the environment, and improving administrative efficiency.

[99] SCUTUM (SeCUring the EU GNSS adopTion in the dangeroUs Material transport) <http://www.scutumgnss.eu/>.
[100] European Defence Agency. Signature of First Coordinated EDA/ESA Studies on "Satellite Services for UAS Missions". 9 Feb. 2010. Brussels.
< http://www.eda.europa.eu/WebUtils/downloadfile.aspx?fileid=849>
[101] Regulation 1083/2006, OJ L 210, 31.07.2006 and Regulation 1989/2006, OJ L 411, 30.12.2006.

- *Regional competitiveness and employment.* This is aimed at strengthening regions' competitiveness and attractiveness as well as employment by anticipating economic and social changes, including those linked to the opening of trade, through increasing and improving the quality of investment in human capital, innovation and the promotion of the knowledge society, entrepreneurship, the protection and improvement of the environment, and the improvement of accessibility, adaptability of workers and businesses as well as the development of inclusive job markets.
- *European territorial cooperation.* This is aimed at strengthening cross-border cooperation through joint local and regional initiatives, strengthening transnational cooperation by means of actions conducive to integrated territorial development linked to the Community's priorities, and strengthening interregional cooperation and exchange of experience at the appropriate territorial level.

4.3.2 Space Flagship Programmes Contribution

Space based technology and application, particularly in navigation Galileo/EGNOS and earth observation GMES, can assist in achieving the Community's objectives. In combination with other technologies they can assist in providing information to remote areas and enhance safety. Monitoring changes in the regions using satellite imaging can assist in shaping policy roadmaps and monitoring the implementation of projects and programmes. A particular example is the role of satellite images in the regional policy supporting urban development. Since 2003, the Urban Audit provides a solid evidence base to assess the state of European cities and now offers comparative data for 321 cities across the EU. In 2010, this was complemented by the publication of the Urban Atlas, which offers detailed digital maps for more than 300 Urban Audit areas based on satellite imagery[102].

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES –CONTRIBUTION
Regional Policy Reduce economic, social, and territorial discrepancies across the EU; Restructure declining industrial areas; Diversify declining rural areas in agriculture; Improvement of population security; Natural resources management to respond to specific needs and demands;	**Galileo** - stimulate development and innovation, knowledge based society; - enhance regional competiveness and employment; - support urbanization; - enhance safety; *Examples* - **telemedicine**. Using real-time data to improve health care. It could be used to provide health assistance to rural and less populated areas, as well as for managing medical resources efficiently. - **epidemiology**. Combining satellite navigation real-time data with in situ measurements it is possible to create a surveillance and early warning system capable of identifying risk factors for disease and determining optimal treatment approaches to clinical practice.[103] - **periodical surveillance of rail tracks**. This allows to look for changes in shape and loads. A civil engineering application that could reduce territorial discrepancies. - **monitoring the use of territory**, for example to identify increasing desertification areas and migratory movements,; - **supporting the construction industry**. Using the near pinpoint accuracy provided by GNSS with group augmentation, highly accurate surveying and mapping produces results thatcan be rapidly obtained and, thus, it is now being adopted by professional surveyors and

[102] European Union Regional Policy, Panorama inforegio, "Regional policy, an Integrated Approach." 34, Summer 2010.
103 The study of patterns of illness and health and associated factors at the population level can be developed and improved by the use of satellite data. Several examples can be presented: monitoring of water quality, disease mapping and the creation of special prediction maps for detection of specific ecosystems favourable to the development of diseases.

	mapping personnel throughout the world. Such technology was also used during the construction of the Eurotunnel. - **monitoring natural disasters**. GNSS positioning applications permit, inter alia, the delivery of disaster relief to areas in a more timely and accurate manner, saving lives, restoring critical infrastructure and providing position information for the mapping of disaster regions where little or no mapping information is available; the enhancement of capabilities for flood prediction and the monitoring of seismic precursors and events; providing positioning of individuals with mobile phones and vehicles in case of emergency[104]. - **recreational activities (biking, trekking, fishing, etc.)**. Use of navigation and positioning makes many recreational activities easier and safer, such as biking, trekking, climbing, skiing etc. **GMES** - strengthen interregional cooperation; - support protection and improvement of the environment; - support improvement of the quality of life; *Examples* - disaster management. Support technological and natural disaster management on a worldwide basis by fostering improved utilization of existing and planned Earth observation satellite data. - land surveillance. Crossing high-resolution images with data provided by Earth observation satellites enables monitoring of security measures and control of borders;

Table 5:Galileo and GMES contributions to implement regional policy.

4.4 Agriculture Policy

4.4.1 Policy Overview

In the agriculture sector around 21.7 million people were employed across EU-27 in 2010, according to DG Agriculture and Rural Development. The primary sector (agriculture, hunting and forestry) represents 6% of employment for the EU-27 and accounted for 1.7% of GDP in 2006 ranging from 0.4% in Luxembourg to 8.8% in Romania. However, the sector's importance has declined over the years; between 2000 and 2006, it decreased by 1.2% in terms of employment and 0.6% in terms of added value[105]. In order to assess the changes in the sector and the need for new policies, in April 2010 the European Commission launched a public debate[106] on the Common Agriculture Policy's future, regarding its objective, principles, and contribution to Europe 2020 strategy.

The Union's agriculture policy was encapsulated in the creation of the Common Agriculture Policy (CAP). Today the basis of CAP is contained in the Lisbon Treaty, Art. 38-44 TFEU. The first paragraph of Art. 38 states that the internal market includes agriculture and trade in agriculture products, while Art. 44 specifies that the operation and development of the common market for agricultural products must be accompanied by the establishment of a common agricultural policy. In Art. 39 the objectives of the CAP are:

[104] <http://www.unidroit.org/english/documents/2010/study79/s-79-preliminarystudy-e.pdf>.
[105] ECORYS. "Study on Employment, Growth and Innovation in Rural Areas (SEGIRA)", 8. Dec. 2010. <http://ec.europa.eu/agriculture/analysis/external/employment/full-text_en.pdf >,
[106] The European Commission. "Agriculture and Rural development: The Common Agriculture Policy After 2013". Public debate Summary Report.
1 Mar.2011<http://ec.europa.eu/agriculture/cap-post-2013/debate/report/summary-report_en.pdf >.

- to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour;
- thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;
- to stabilise markets;
- to assure the availability of supplies;
- to ensure that supplies reach consumers at reasonable prices.

The founding fathers of the European Economic Community were aware of the need to include agriculture in the common market. They also were aware that due to the very nature of agriculture there was need to take into consideration the fact that it is volatile to weather conditions, crops, and livestock diseases which are often beyond human control and make it difficult to balance agricultural output with market demand which has socio-political characteristics and to provide food security and price stability.

The CAP is structured around two pillars focusing on market orientation production support and rural development. There have been various CAP reforms and the CAP of the 80's and the 90's is very different from the CAP of today. The successive changes have made the CAP more market-oriented. The fourth reform in 2000 brought in market organisation regulations concerning arable crops, beef, milk and the wine sector, the new rural development policy and financial framework[107]. The aim of this CAP reform was to deepen and widen the 1992 reform by replacing price support measures with direct aid payments and joining this process with a consistent rural policy, thus, bringing European prices closer to world market prices and helping the competitiveness of agricultural products on domestic and world markets. The fifth CAP reform in 2003 established common rules for direct support schemes for certain crops[108]. This reform takes into consideration the increased consumer concerns over food quality and safety and environmental protection. Payment aid to farmers is linked to compliance with the rules for agricultural land, agricultural production and activity, with the aim of incorporating in large organisations basic standards for environment, food safety, animal health and welfare, and food agricultural and environmental conditions. This would result in receiving additional payment aid when particular environment policies are followed. The 2003 reform was based upon an agreement to maintain EU spending on agricultural support until 2013. The CAP is due to be reformed again in 2013.

In November 2010, the European Commission published the first proposals that will eventually result in a framework for the CAP after 2013 - The Commission Communication on the CAP towards 2020, November 2010[109]. There are no figures and the ideas are expressed in very general terms. The challenges to be faced are the future of farming and farmers in Europe; the future of the rural landscape and countryside; and global food security[110]. The policy needs to be reshaped to be market sensitive and respond to the changes and new challenges. In particular, the policy needs to be able to address the challenges of food security, climate change, preserve natural resources and maintain territorial balance across Europe.

There are currently three options regarding the CAP after 2013. The first option is to introduce further gradual changes to the current policy framework, mainly on adjustments and improvements in the area of equality in the distribution of direct payments between Member States. The second option would be to make major overhauls of the policy in order to ensure that it becomes more sustainable, and that the balance between different policy objectives, farmers and Member States is better met. This implies that the focus would be on added value and it would allow the EU to address economic, environmental and social challenges and strengthen the contribution of agriculture and rural areas to the objectives of Europe 2020 i.e. smart, sustainable and inclusive growth.

[107]The Council of European Union. Council Regulation No 1251/1999 to 1259/1999 on Establishing a Support System for Producers of certain Arable Cropsof 26 Jun.1999.. Brussels: European Union.
The Council of European Union Regulation. Council Regulation on Establishing Common Rules for Direct Support Schemes under the Common Agricultural Policy and Establishing certain Support Schemes for Farmers and Amending Regulations (EEC) No 2019/93,(EC) No 1452/2001, (EC) No 1453/2001, (EC) No 1454/2001, (EC) 1868/94, (EC) No 1251/1999, (EC)No 1254/1999, (EC) No 1673/2000, (EEC) No 2358/71 and (EC) No 2529/2001. No. 1782/2003 of 29 Sep.. 2003. Brussels: European Union.

[108] Regulation 1782/2003 to 1788/2003, OJ L 270, 21.10.2003 and Regulation 674/2008, OJ L 189, 17.07.2008.

[109] The European Commission. Communication from the Commission to the European Parliament , The Council, the Economic and Social Committee and the Committee of the Regions on The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. COM (2010) 672 final of 18 Nov. 2010 Brussels: European Union.

[110] Dacian, Cioloș. "The CAP beyond 2013 – challenges and opportunities for European agriculture."SPEECH/11/3, Oxford Farming Conference, Oxford, United Kingdom. 6 Jan. 2011.

The third option would be to reform with a strong focus on environmental and climate change objectives, while moving gradually away from income support and most market measures.

In the Commission Communication three main objectives have been identified for the future CAP:

- *Viable food production.* Contribute to farm incomes and limit farm income variability due to the nature of the sector being prone to income volatility and natural risks. Additionally, improve the competitiveness of the sector and enhance its value share in the food chain covering the current fragmentations and increase its bargaining power while facing strong world competition in combination with the need to respect high standards relating to environmental, food safety, quality and animal welfare objectives requested by European citizens. Furthermore, compensate for production difficulties in areas with specific natural constraints because such regions are at increased risk of land abandonment.
- *Sustainable management of natural resources and climate action.* Guarantee sustainable production practices and secure the enhanced provision of environmental public goods and foster green growth through innovation which requires adopting new technologies, developing new products, changing production processes, and supporting new patterns of demand, notably in the context of the emerging bio-economy. Additionally, pursue climate change mitigation and adaptation since agriculture is particularly sensitive and needs to better adapt to extreme weather fluctuations.
- *Balance territorial development.* Support rural employment and promote diversification and allow structural diversity in farming systems.

4.4.2 Space Flagship Programmes Contribution

Regardless of which of the three options will be adopted in the next reform of CAP policy, space based applications and in particular Galileo and GMES can be at the heart of achieving the overarching objectives and would help face the changes in the sector and the new challenges. Implementation of Galileo and GMES in agriculture can contribute to the development of a new way of farming, facilitating the implementation of EU policies in this domain. Additionally, these assets will increase the life quality and welfare of the agricultural community on the one hand; while assuring the availability of food supplies and food security with due consideration to sustainable development, on the other.

Galileo

The services provided by EGNOS are currently available to improve precision farming. Precision farming is a strategy that increases productivity of agriculture and lowers the costs and the impact on the environment. The obstacles to the adoption of this method of production, up to now have been: the high costs of the infrastructure and the equipment, and the price for subscription to receive the necessary information. Today the GNSS signal provided by EGNOS is free of charge and the receiving devices are not expensive anymore. An increasing number of services is already accessible.

To decrease the impact of agriculture on the environment EGNOS can support the activities of ploughing, seeding and spraying as well as the guidance of tractors. Assistance in these activities prevents the waste or the inappropriate use of materials especially chemical fertiliser or herbicides. Also, the usage of equipment will be reduced thanks to the more efficient use. Furthermore GNSS services can be also used for the positioning of herds and their tracking during a period of time. The mapping service of EGNOS can also be applied to agriculture, in order to obtain a precise map of fields and facilitate their partition using the technique of virtual fencing.

The use of space based services will, indeed, help the implementation of CAP while increasing the profit margins for the single farmer. Most of the political objectives of CAP, inter alia, increasing productivity, stabilisation of the market and preservation of the environment can be achieved using EGNOS now and Galileo later on.

Besides this general benefit, the standard of living and the earnings of the agricultural community will increase due to the reduction of fatigue caused by manual work and the fruitful maintenance of equipment[111]. At the moment all these services of EGNOS are easily available and perfectly inte-

[111]" EGNOS for Agriculture: High precision, Low cost." European GNSS Agency <http://www.gsa.europa.eu/go/news/egnos-for-agriculture-providing-high-precision-at-a-low-cost>.

grated with other receivers; in this regards the project Fieldsfacts is on its way to provide European farmers with a database that allows better sharing of information[112].

GMES

The agricultural sector is typically prone to income volatility due to its connection with natural events. The use of GMES in this sector will help to ameliorate this aspect, fostering the meteorological and natural sciences while improving the sustainable use of scarce natural resources. Precise information about meteorological conditions and detailed forecasts will help the agricultural community to plan its work (e.g. day for ploughing, seeding). Moreover the possibility of monitoring the moisture and the composition of the soil will make easier the selection of seed and type of crop in order to increase the quantity and the quality of the production.

In certain areas the constant monitoring of water supply can be helpful for the local administration to realize the efficient and equal distribution of such a resource. The optic and radar component of GMES will assure the monitoring of specific areas and fields for efficient land management. The same facility can also provide farmers with datasets to foresee livestock diseases and changes in pasture land.

POLICY AREAS AND MAIN OBJECTIVES	**GALILEO AND GMES –CONTRIBUTION**
Agriculture policy • Increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour; • Ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture; • Stabilise markets; • Assure the availability of supplies; • Ensure that supplies reach consumers at reasonable prices.	Galileo - crop acreage and livestock tracking; - chemical spraying; - crop yield monitoring; - monitoring the distribution and dilution of chemicals; - improved parcel yield from customised treatment; - more efficient property management; - tracing food enhancement; Examples - precision farming. Farming management concept based on observing and responding to intra-field variations that can significantly reduce the amount of nutrient and other crop inputs used while boosting yields; - tracking products. Knowing end-to-end where the product comes from; GMES - rational use of fertile lands; - monitoring of variables such as the vegetation state or the water cycle; - exploitation of natural resources; - monitor weather and soil moisture for agriculture to improve irrigation system; Examples - food security. Using satellite images and data to identify areas of food shortages; - crop monitoring. Provide objective, near real-time assessments of crop conditions and yield forecasts in support of European policies in the fields of agriculture, trade and food security; - monitoring of agricultural land use, its state and any changes. To register agricultural land use and trends, farming pressure on water and soil resources, and to measure the impact of agricultural land use changes on biodiversity and landscapes[113]; - monitoring seasonal and annual changes for geographical information on land cover.

Table 6: Galileo and GMES contributions to implement agriculture policy

[112] Source: Field Fact, GNSS in Agriculte. 18 Feb. 2001 <http://www.fieldfact.com/>
[113] GeoLand 2. Agri Environmental Monitoring <http://www.gmes-geoland.info/project-background/project-tasks/core-information-services/agri-environmental-monitoring.html>.

4.5 Fisheries Policies

4.5.1 Policy Overview

The Union is the fourth largest producer in the world representing about 4.6% of global fisheries and aquaculture production. The largest producers in terms of volume are Spain, France and the United Kingdom. Employment in the salt-water fishing sector is not as high as in agriculture but in countries like Spain alone accounts for a quarter of employment in this sector in the EU. In Spain, Greece and Italy employment account for 60%. Over the last 17 years, EU fishing fleet capacity has declined at a fairly steady annual average rate, a little below 2%, in terms of both tonnage and engine power. Despite the EU enlargements in 2004 and 2007, there were 84,909 vessels in September 2009, 21,000 fewer than in 1995. [114]

The Union's fisheries policy originated in Article 38 of the Treaty of Rome (1957) which made it part of the Common Agriculture Policy (CAP) by placing fishery products, products of the soil and livestock products in the same category. There is however a basic difference between products of the soil and livestock on the one hand, and fisheries products on the other. The former remain within the boundaries set around them whereas the latter move freely. There is also a distinct difference between this sector and the agriculture sector. Between 1956-1967 world fish production increased by 50% due to higher investments, vessel modernisation and higher productivity which led to over-fishing that threatened various species. It became necessary to monitor and regulate fish levels in times of shortage and surplus. Production depends on several factors that cannot be controlled by producers such as weather, pollution, delimitation of fishing areas. It also has a highly specific social structure and is more important in areas were there are no other sources of income. Additionally, the implementation of the UN law of the sea and the 200 mile fishery conservation zone and the concept of a Total Allowable Catch (TAC)[115], needed implementation at community level. Thus, it was soon realised that there was a need for a specific common policy for fisheries products, due to the two main problems as described above. The first reason was related to fisheries resources and the second was due to the sector's specificities. Fisheries policy became a full common policy in 1983. It has been structured around two pillars: resources policy and structural policy, since 1970.

Today the basis of the Common Fisheries Policy (CFP) is the Lisbon Treaty, Art.38-44 TFEU, together with the CAP, which no longer has much in common with it. Current policy, consisting of four main sections dealing with resource management, markets, structural policy and external aspects, did not materialise until 1983. In the basic regulation in 1983 a ten-year reform cycle was created. Previous reforms took place in 2002 and 1992; currently the process of the third reform is taking place. The objectives of the CFP can be summarised as to 'ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions[116].

Regarding resource policy the sustainable exploitation of resources covers internal and external aspects. The internal aspects of the Council Framework Regulation on the Conservation and Sustainable Exploitation of Fisheries Resources lay down the basis for ensuring long term viability of the fisheries sector[117]. Additionally, it is aimed at ensuring the effective implementation of the CFP by providing measures for Community fishing licences[118], special permits[119], and detailed rules and objectives for achieving balance between resources and exploitation[120]. The external aspects are assured through the Community Agreements in order for the Union's fishing industry to be granted or to keep rights in waters of third countries. The common organisation market (CMO) for fisheries and aquaculture products was born with the aim of ensuring that the rules assist in better management of resources. Some of the measures are the common standards for marketing, conformity check, guide price and withdrawal price.

Regarding structural policy, the European Fisheries Fund (EFF) is used as an instrument to overcome structural problems in the sector. It aims to[121]: (a) support the common fisheries policy so as

[114] European Commission,Maritime Affairs and Fisheries. "Facts and figures on the Common Fisheries Policy", 2010, ISSN 1830-9119.
[115] Decision 98/392,OJ C 155, 23.05.1997
[116] The Council of the European Union. Council Regulation (EC) No 2371/2002 on the Conservation and Sustainable Exploitation of FisheriesResources under the Common Fisheries Policy of 20 Dec. 2002. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002R2371:EN:NOT>.
[117] Regulation 237/2002 OJ L 358, 31.12.2002 and Regulation 1242/2004, OJ L 236, 07.07.2004.
[118] Regulation 1281/2005, OJ L 203, 04.08.2005.
[119] Regulation 1627/94, OJ L 171,06.07.1994.
[120] Decision 2002/70, OJ L 31, 01.02.2002.
[121] Regulation 1198/2006, OJ L 223, 15.08.2006.

to ensure exploitation of living aquatic resources and support aquaculture in order to provide sustainability in economic, environmental and social terms; (b) promote a sustainable balance between resources and the fishing capacity of the Community fishing fleet; (c) promote sustainable development of inland fishing; (d) strengthen the competitiveness of the operating structures and the development of economically viable enterprises in the fisheries sector; (e) foster the protection and the enhancement of the environment and natural resources where related to the fisheries sector; (f) encourage sustainable development and the improvement of the quality of life in areas with activities in the fisheries sector; (g) promote equality between men and women in the development of the fisheries sector and fisheries areas.

The current reform is due to take place some time in 2012 with the adoption of the new legislation by the Parliament and the Council. The process of the reform already started in April 2009 when the Commission published its Green Paper[122] which followed a public consultation that ended in December 2009 and resulted in a Commission working paper consolidating the consultation[123]. The challenges to be faced are the future of European fish stocks and fishermen; access to the maritime space and healthy marine ecosystems; and food security. The policy needs to be reshaped to respond to the current reality of over-fishing, fleet overcapacity, heavy subsidies, low economic resilience and decline in the volume of fish. In particular it needs to be able to address the fact that the sector can no longer be seen in isolation from the broader maritime environment and from other policies dealing with marine activities - fisheries are dependent on access to maritime space and to healthy ecosystems; climate change is having an impact on the seas, triggering changes of fish stocks; and food security requires better management and exploitation of natural resources. Additionally, some of the most fuel-intensive fishing practices contribute to greenhouse gas emissions. In the Green Paper the Commission identifies five key structural failings of the CFP that need to be overcome: deep-rooted problem of fleet overcapacity; imprecise policy objectives resulting in insufficient guidance for decisions and implementation; a decision-making system that encourages a short-term focus; a framework that does not give sufficient responsibility to the industry; and lack of political will to ensure compliance and poor compliance by the industry. However the Commission in the Green Paper does not take a policy position or present an action plan.

4.5.2 Space Flagship Programmes Contribution

Space based information and applications through systems like Galileo/EGNOS and GMES can assist in implementing the fisheries policy objectives and respond to the specificities of the sector. In particular they can assist in carrying out conformity control checks on products and provide the necessary information to apply sanctions for any infringements. The underlying space technologies for navigation and earth observation can assist to restructure, modernise and develop the fishery sector, to develop aquaculture, encourage experimental fishing and tailor the Union's fishing capabilities to realistic possibilities. Furthermore, this space information can assist in providing desirable results in surveillance systems, inspection and surveillance activities, fleet control and application of penalties. Currently, Member States' activities in this respect are mostly operated at a national level and are not fully coordinated. Thus systems like GMES and Galileo/EGNOS can provide the necessary tools at the European level for coordination. At the international level, space assets can facilitate reflecting environmental and socioeconomic factors promoting sustainable and responsible fisheries in fisheries policy.

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES –CONTRIBUTION
Fisheries policy • Ensure exploitation of living aquatic resources covering internal and external aspects; • Provide sustainable environmental conditions; • Provide sustainable social conditions; • Provide measures for Community	Galileo - monitoring independent access to maritime space; - monitoring overfishing and overcapacity; - navigation and monitoring of fishing vessels; - monitoring fishing applications; Examples - tracking fishing vessels. Track location of vessels to avoid overfishing. - monitoring currents. Analysis of the navigation meas-

[122] Commission of the European Communities. Green Paper, Reform of the Common Fisheries Policy. COM(2009)163 final of 22 Apr.2009. < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0163:FIN:EN:PDF>.
[123] European Commission. Commission Staff Working Document. Synthesis of the Consultation on the Reform of the Common Fisheries Policy. SEC (2010) 428 final of 16 Apr. 2010. < http://ec.europa.eu/fisheries/reform/sec(2010)0428_en.pdf>. "

fishing licences, special permits; • Provide detailed rules for a balance between resources and exploitation; • Provide common standards for marketing, conformity check, guide price and withdrawal price	urements, with respect to reference frames, allows following the shoals movements yields time series of daily site positions, containing both secular and seasonal variations.[124] - tracking fishing locations. GNSS helps fishermen to return to the spots where fish are located. GMES - monitoring the broader maritime environment; - monitoring the health of the eco-systems; - monitoring climate change impact on the sea; - monitoring changes in fish stock; - monitoring fuel-intensive fishing practices contributing to greenhouse gas emissions; - monitoring fishing applications; - counter illegal fishing as well as control marine resource preservation; Examples - fish stock management. Acquire precise information about the conservation and management of straddling fish stocks and highly migratory fish stocks; - satellite fishing maps. Map the location of fishing grounds;

Table 7: Galileo and GMES contributions to implement fisheries policy.

4.6 Energy Policy

4.6.1 Policy Overview

The European Union is the world's largest regional energy market and the world's second largest energy market. Energy is a core element to industry, economy and the citizens and it is essential to ensure safe, secure, sustainable and affordable access to energy. The Union's import dependency in all fuels is 53.1%[125]. The EU-27 energy gross inland consumption is 36.4% dependent on oil, 23.9% on gas, 18.3% on solid fuels, 13.4% on nuclear and 7.8% on renewable sources[125]. The Union's energy consumption per sector is 37.1% on household and services, 27.9 % on industry, 32.6% on transport and 2.4% on agriculture. Europe's import dependency for crude oil and gas is mainly from Russia (34% for oil and 40.8% for gas), Norway.(5% for oil and 26.7% for gas). Other sources for oil are Libya (10.2%) and Saudi Arabia (7.2%) and for gas Algeria (16.9%) and Nigeria (5.1%).

Europe perceived the risk of its dependence on energy supply during the 1973 Arab oil embargo. This highlighted three main issues[126]. First, the need for energy policy collaboration between the European countries and the producing world became evident. Second, necessary institutional mechanisms were needed to increase coordination for supply distribution. Third, Europe needed to prepare mechanisms to prevent becoming a possible victim of exporting countries who use energy supply as a political and economic weapon. This geared up the development of a common energy policy in Europe which had developed at a very slow pace. Europe also felt the energy disputes between the Ukraine and Russia in 2005-2006, when four-day energy cuts aimed at the Ukraine affected Europe. Since then, a variety of efforts have been made in Europe to enhance and speed up a European Energy policy. This energy insecurity was recently repeated in 2008-2009 when gas supplies to Ukraine were suspended and fifteen Member States were affected. This reminded the Union of its energy dependency and the need for a common voice and approach vis-à-vis the international communities and in particular when dealing with countries that are suppliers of energy

[124] http://www.soi.gov.il/pap/geodesy/Wdowinski-et-al-2004.pdf
[125] The European Commission.EU Energy and Transport in Figures. Statistical Pocketbook. Belgium.2010 < http://ec.europa.eu/energy/publications/statistics/doc/2010_energy_transport_figures.pdf>.
[126] Yergin, Daniel. "Ensuring Energy Security," Foreign Affairs, March/April 2006.

products. The EU's key energy partners are Russia, Norway, U.S., India, China, Central-Eastern European Countries and OPEC countries[127].

Thus, Europe has been facing problems related to energy supply. In particular, it faces strong dependency on imports from third countries, instabilities in oil and gas supply, and volatile energy prices. Additionally, the energy market faces a number of challenges in relation to the interconnection of national and international markets and the need for more transparency and European integration as well as the large investments related to energy infrastructure, transport issues, slow development of improved efficiency and renewable energy resources and the increased challenges posed by the global increase of energy demand and by climate change.

Energy policy is based on shared competences between the EU and its Member States (Art.4.2 TEU) and has it roots back in the first two EU Treaties. The first was the European Treaty establishing the European Coal and Steel Community (ECSC) in 1951 aiming to create a common market for steel and coal. The second was the Treaty of Rome establishing the European Atomic Energy Community (EAEC), known as Euratom, in 1957 aimed at creating a common market for equitable supply of ores and nuclear fuels (source materials and special fissile materials), coordinating Member States research programmes and drawing up of safety standards for the peaceful uses of nuclear energy.

Since 2006 Europe has been calling for a more comprehensive energy policy based on solidarity between the Member States. The 2006 Green Paper of the Commission defined a European energy policy with three main objectives aimed at attaining sustainable development. These are: competitiveness -to give consumers competitive energy prices by increasing competition in energy markets; security of supply -to ensure security of energy supplies within an international context; and sustainability -to reduce the energy system's environmental impact to acceptable levels and combat climate change[128][129]. Six key areas were identified where action is necessary to address the challenges of the need to develop a new, common European strategy for energy, with sustainability, competitiveness and security underpinning the strategy. These are: competitiveness and the internal energy market; diversification of the energy mix; solidarity; sustainable development; innovation and technology; and external policy. The COM (2007) 1 "An Energy Policy for Europe"[130], sets out an Action Plan revolving around the two axes of the energy policy, the functioning of the internal energy market and the security of energy resources. In March 2007 during the EU Summit, European Commission adopted the Energy Policy for Europe (EPE) whivh will pursue the following three objectives, fully respecting Member States' choice of energy mix and sovereignty over primary energy sources and underpinned by a spirit of solidarity amongst Member States: increasing security of supply; ensuring the competitiveness of European economies and the availability of affordable energy; promoting environmental sustainability and combating climate change. In September 2007 there was an urgent call for the establishment of a common foreign energy policy and in 2008 an action plan[131] highlighting that security and solidarity are essential factors for energy efficiency identified six priority areas: connecting the remaining isolated energy markets in Europe; developing a southern gas corridor for the supply of gas from the Caspian region and Middle Eastern sources; making use of liquefied natural gas to ensure the liquidity and diversity of the European Union markets; linking Europe with the Southern Mediterranean area through electricity and gas interconnections; developing gas and electricity interconnections crossing Central and South-East Europe along a north-south axis; developing interconnections between the electric networks of the North-West of Europe so as to optimise wind energy in the North Sea.

Today, the legal basis for common energy policy is in the Lisbon Treaty in Art. 194 TFEU according to which the Union's policy objectives on energy should be to:

- ensure the functioning of the energy market;
- ensure security of energy supply in the Union;

[127] The Organization of the Petroleum Exporting Countries (OPEC) includes the following countries: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Soudi Arabia, United Arab Emirates and Venezuela.
[128] Commission of the European Communities. Green Paper – A Strategy for Sustainable, Competitive and Secure Energy. COM (2006) 105 final of 8 Mar. 2006.
[129] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on External Action: Thematic Programme For Environment and Sustainable Management of Natural Resources Including Energy COM(2006) 20 final of 25 Jan. 2006. ""
[130] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on An Energy Policy for Europe COM(2007) 1 final of 10 Jan. 2007. ""
[131] Commission of the European Communities. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Second Strategic Energy Review: an EU Energy Security and Solidarity Action Plan. COM (2008) 781 final of 13 Nov. 2008.

- promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
- promote the interconnection of energy networks.

A coherent energy policy framework is necessary as energy is closely linked also to other policy areas such as economic policy, trans-European networks, environment, transport, and industry and enterprise. The Lisbon Treaty in its economic policy under Art. 122 TFEU mentions that, based on the proposal from the Commission, the Council may decide upon appropriate measures on the economic situation if severe difficulties arise in the supply of certain products, notably in the area of energy. Under Art.170 TFEU the Union should contribute to the establishment and development of trans-European networks also in the area of energy infrastructure. Regarding the environment, Art.192 TFEU refers to a special legislative procedure affecting the Member States choice regarding different energy sources and the general structure of the energy supply.

The recent Commission communication on the Union's "Europe 2020 strategy for a competitive, sustainable and secure energy"[132] is structured around five priorities: limiting energy use in Europe; building a pan-European integrated energy market; empowering consumers and achieving the highest level of safety and security; extending Europe's leadership in the development of energy technology and innovation; strengthening the external dimension of the EU energy market. The Commission also intends to launch new large-scale European projects concerning: smart grids linking the whole electricity grid system; electricity storage; large-scale sustainable biofuel production; energy savings both in cities and in rural areas.

As mentioned above, the energy policy is developed around two axes. The first axis of the energy policy is the internal energy market[133,134] which aims both at giving European consumers a choice between different companies supplying gas and electricity at reasonable prices, and of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy. It provides the common rules for the internal market for solid fuel, oil, electricity[135, 136] and gas[137,138,139,140]. The internal market also depends on the development of trans-European networks that allow interconnection and interoperability for transporting electricity and gas. The second axis of the energy policy is the security of the energy supply which aims to ensure that Europe's energy needs are satisfied by internal and external exportation of resources under affordable competitive prices and providing an accessible, stable and diversified energy mix. It covers the supply of coal, nuclear fuels, oil, gas, and new technologies and new energy sources. In particular new technologies and new energy sources provide an alternative option for energy security. Additionally, new and renewable energies such as wind, solar power, hydroelectric, geothermal, biomass can contribute to Europe's economic growth providing job creation.

The Union's research and innovation policy promotes the development of such technologies with a focus on: energy savings and energy efficiency; efficiency of combined production of electricity, heating and cooling services, through the use of new technologies, such as bioenergy, hydrogen. Energy objectives are also coupled with environmental objectives requiring energy efficiency and low emissions[141]. In particular, the European Strategic Energy Technology Plan (SET-Plan) is the technology pillar of the EU's energy and climate policy. It is the EU's response to the challenge of accelerating the development of low carbon technologies. Technology Roadmaps 2010-2020 for the implementation of the SET-Plan have been drawn up and include the European industrial initiative for wind; solar; electricity grid; CO2 capture, transport and storage; sustainable nuclear fission;

[132] COM(2010) 639 final
[133] Commission of the European Communities. Communication from the Commission to the Europe Council and the European Parliament on An Energy Policy for Europe. COM (2007) 1 final of 10 Jan. 2010.
[134] "Internal Energy Market." <http://europa.eu/legislation_summaries/energy/internal_energy_market/index_en.htm>.
[135] The European Parliament and the Council of the European Union. Directive 2003/54/EC of the European Parliament and the Council Concerning Common Rules for the Internal Market in Electricity and repealing Directive 96/92/EC of 26 Jun. 2003. Brussels.
[136] The European Parliament and the Council of the European Union. Directive 2009/72/EC of the European Parliament and the Council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC of 13 Jul. 2003. Brussels.
[137] The European Parliament and the Council of the European Union. Directive 98/30/EC of the European Parliament and the Council concerning common rules for the internal market in natural gas of 22 Jun. 1998.
[138] The European Parliament and the Council of the European Union. Directive 2003/55/EC of the European Parliament and the Council concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC of 26 Jun. 2003.
[139] The European Parliament and the Council of the European Union. Directive 2003/55/EC of the European Parliament and the Council concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC of 26 Jun. 2003.
[140] The European Parliament and the Council of the European Union. Directive 2009/73/EC of the European Parliament and the Council concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC of 13 Jul. 2009.
[141] The European Parliament and the Council of the European Union. Directive 2006/32 EC of the European Parliament and the Council on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC of 5 Apr. 2006.

fuel cells and hydrogen and the energy efficiency-smart cities initiative; and complementary initiatives for other technologies and breakthrough science. An important element also is international cooperation where Europe has already been working closely with the USA and Japan. Over the past years emerging countries like China, India, South Africa and Brazil have formulated their national climate change strategies and Europe is supporting them in low carbon emission development plans. The EU-China Near Zero Emissions Coal (NZEC) project is a concrete example of technology cooperation, in this case demonstrating carbon capture and storage. The Global Energy Efficiency and Renewable Energy Fund (GEEREF) will invest in renewable energy and sustainable energy infrastructure funds and similar investment structures tailored to regional needs and conditions. Other initiatives include the Mediterranean Solar Plan and the Africa-EU Energy Partnership[142]. The financial instruments used for the financing of such activities are the Competitiveness and Innovation Framework Program for 2007-2013 and the Seventh Framework Programme.

In conclusion, Europe has made significant steps toward its energy policy but there is still a need to focus more on the external action to guarantee the security of energy supply. On 4^{t} February, at the first European Council explicitly devoted to energy it was concluded that "there is a need for better coordination of EU and Member States' activities with a view to ensuring consistency and coherence in the EU's external relations with key producer, transit, and consumer countries and the High Representative is invited to take full account of the energy security dimension in her work. Energy security should also be fully reflected in the EU's neighbourhood policy.[143]" In June 2011, the Commission is expected to submit a communication on security of supply and international cooperation aimed at further improving the consistency and coherence of the EU's external action in the field of energy.

4.6.2 Space Flagship Programmes Contribution

In the energy field, Galileo and GMES can bring a high range of additional information and new applications, contributing to improving and raising the efficiency of the services currently provided.

The Galileo system can contribute mainly in two areas: power generation and increased control and safety.

Galileo can be used as a tool to control energy generation infrastructure more efficiently, for example with the establishment of a synchronization network dedicated to large distance electricity distribution, which would be able to monitor the distribution of electricity in real-time and avoid or reduce power outage time by about 20%. Galileo can also provide a valuable service to increase control and safety, mainly by improving the control of drilling facilities and tracking oil and gas transport in order to enhance safety and security.

GMES can be useful in the monitoring of pipelines, surveillance and in the improvement of knowledge concerning mineral deposits. This precise and accurate earth observation system could also bolster efficiency in natural resources management. Concrete applications for GMES in the energy field are easy to see: it can provide UV and solar energy services based on the ozone and aerosol global data assimilation results. Another application is that it can monitor the wind energy used to supply wind farms and, consequently reduce the costs of installation and maintenance, by calculating the wind speed and direction and advising on the best areas to install such farms. The same capabilities can be used for the selection of the optimal location to build dams, taking into account the possible harmful effects of building a dam.

Over all, Galileo and GMES will help to ensure the availability of affordable energy and the competitiveness of European economies.

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES –CONTRIBUTION
Energy policy • Ensure the functioning of the energy market; • Ensure security of energy supply in the Union;	Galileo - improved control of energy infrastructures; - improved power flow; - improved time-synchronisation of power-related instruments;

[142] Commission of the European Communities. The Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Investing in the Development of Low Carbon Technologies. COM(2009) 519 final of 7 Oct. 2009.
[143] European Council. Conclusions on Energy. EUCO 2/1/11 REV 14 Feb. 2011. "

Promote energy efficiency and energy saving; Development of new and renewable forms of energy; Promote the interconnection of energy networks; Ensure the competitiveness of European economies; Ensure the availability of affordable energy; Promote environmental sustainability; Combat climate change;	- increased safety and efficiency in oil exploration; - improved control of drilling facilities; - timely decision-making thanks to faster positioning information, even in remote areas; - enhancing safety and security of oil and gas transport; - synchronising European electricity distribution networks. Examples - network synchronisation for power generation and distribution, a network dedicated to large distance electricity distribution with continuous monitoring to detect any line break. This monitoring could reduce power outage time by about 20 % and can lead to more efficient operation of electrical facilities; - electronic mapping systems: this application could benefit an electrical facility that needs to store the accurate location of utility poles, transformers and even customers. Accurate information could be provided by Galileo. - design, construction and operation of large networks for the development of energy applications; GMES - surveying; - providing electrical grid; - power supply; - pipeline monitoring; - improve knowledge concerning mineral deposits; - bolster the efficient use of natural resources. Examples - production of solar energy services: providing UV and solar energy services based on ozone and aerosol global data assimilation results; - monitoring wind energy to supply wind farms. Using high-resolution data on the wind field, the calculation of wind speed and direction. This is useful information to help assess installation and maintenance costs; - identify the best areas to install dams to generate hydropower energy. Dams for hydropower energy are expensive and can be harmful to the natural environment. The selection of the optimal location is, therefore, of utmost importance.

Table 8: Galileo and GMES contributions to implement space policies

4.7 Enterprise and Industrial Policy

4.7.1 Policy Overview

Businesses are essential for Europe's prosperity, competitiveness, and job creation. In the Union there are almost 20 million enterprises active in the non-financial business economy. The majority of these (99.8 %) are Small Medium Size Enterprises (SMEs)[144] and they employ 67.1 % of the non-financial business economy workforce, while 57.6 % of the non-financial business economy's value added is generated by them[145]. Over the last decade the global business environment has been transformed due to the rapid development of emerging economies like China, India and Brazil, thus posing opportunities and challenges for Europe. Additionally, issues related to the environment and climate change affect the way business needs to be conducted today.

[144] ' The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million euro.' Extract of Article 2 of the Annex of Recommendation 2003/361/EC.
[145] Schemiemann, Manfred. "Enterprises by size class - overview of SMEs in the EU." Eurostat 31/2008, < http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-031/EN/KS-SF-08-031-EN.PDF>.

The Lisbon strategy in 2005 placed enterprise and industry policy at the top of European priorities. This policy comprises all government interventions that are directed towards the supply side of the economy (enterprises, industries, sectors) and aim to influence the industrial structure of the economy and/or its industrial development. This policy comprises framework, horizontal and sectoral aspects. An important part of the Union's industrial policy is related to the harmonisation of legislation, standardisation and public procurement as part of the Union's common internal market. It focuses on providing the foundations for competitiveness of European industry by setting up an industrial policy for a single market, fostering the role of SMEs and responding to the challenges Europe faces. Enterprise policy sets the legal environment for European business, promotes an enabling environment, provides funding for businesses and fosters cooperation between businesses. It stimulates research and technology development to ensure European competitiveness in the market in the future. Enterprise policy not only covers industries but also other sectors such as tourism, crafts, healthcare. The sectoral policy approach recognises the peculiarities of various sectors and the need to respond individually to them, such as aeronautics, automotive, pharmaceutical, telecommunications, textile, tourism, etc.

The foundations of industrial policy go back to 1993 with the Treaty of Maastricht calling for industrial competitiveness as part of the European integration objectives. Today the legal basis for the Union's Industrial policy is Art. 173 of the TFEU. The aims shall be

- speeding up the adjustment of industry to structural changes;
- encouraging an environment favourable to initiative and to the development of undertakings throughout the Union, particularly small and medium-sized undertakings;
- encouraging an environment favourable to cooperation between undertakings;
- fostering better exploitation of the industrial potential of policies of innovation, research and technological development.

Nevertheless, as described by Art. 6 TFEU, the Union shall have competencies to carry out actions to support, coordinate and supplement the actions of the Member States. This means that most of the industrial policy is still carried out at the Member State level.

Enterprise and industry policy also interact with other policy areas namely, competition, trade, internal market, research and technology, environment and energy, sustainable development, education, etc. In particular, the research and technology development policy under Art.179.1, states that it should serve European industry to become more competitive. Policies for the environment and sustainable development focus on integrating environmental issues into enterprise policy and implementing measures to limit the impact of businesses and SMEs[146] on the environment[147]. In energy policy the SET-Plan focuses on technologies with low carbon emission.

Europe's recently adopted 2020 strategy aims at smart, sustainable and inclusive growth. One of the seven flagships in the strategy is "An industrial policy for the globalisation era" aiming to improve the business environment, notably for SMEs, and to support the development of a strong and sustainable industrial base able to compete globally 2020[148]. It recognises that European industry is faced with two major challenges. The first is that European enterprises are facing increased competition from emerging markets such as China, Brazil and India not only for raw materials and energy but also market share. The second is issues related to the environment and climate change that raise the need to shift to a low-carbon, resource efficient economy. The Commission recognises that due to cost-cutting measures across the Union industrial policy "cannot be built on major spending programmes", instead it focuses on improving the framework conditions for industry, promoting innovative activities, and establishing sector specific measures.

The Commission, intends to take into consideration global aspects in the implementation of its new industrial policy and aims at[149]:

[146] Commission of the European Communities. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on Small, clean and competitive , A programme to help Small and Medium-sized Enterprises Comply with Environmental Legislation. COM(2007) 379 final of 8 Oct. 2007."

[147] COM(2004) 394 final - Official Journal C 49 of 26.02.2006

[148] European Commission. Communication from the Commission on Europe 2020, A strategy for smart, sustainable and inclusive growth. COM (2010) 2020 of 3 Mar. 2010.

[149] The European Commission. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on An Integrated Industrial Policy for the Globalisation Era Putting Competitiveness and Sustainability at Centre Stage COM(2010) 614. Brussels.

- Improving the framework conditions. This includes strengthening the internal market regarding intellectual property rights and standardisation; improving infrastructure in relation to energy, transport and communication; implementing "smart regulations" and performing "fitness checks" on existing legislation; and improving access to finance for business and finding "new innovative" financing mechanisms.
- Increasing industrial innovation. Europe has difficulties in turning new ideas into market products. The "innovation union" flagship is also intended to find ways to bridge this gap. Additionally, the so-called "key enabling technologies" such as biotechnology, nanotechnology, advanced materials, photonics, micro- and nano- electronics can provide the basis for new processes and goods and services[150]. The knowledge base and skill base should be strengthened, as well as the uses of ICT for industrial competitiveness, and resource optimisation.
- Promoting industrial modernisation. It is focused around environment and climate change where Europe must speed up its transition to a low-carbon and energy efficient economy; and on the financial and economic crisis imposing restructuring on the industry.
- Capitalising on globalisation. It will increase efforts to fight protectionism, so that European industry, especially small businesses, can fully benefit from globalisation and at the same time implement "trade defence instruments" when necessary. It is important to ensure access to raw materials and critical products; this should be secured thought international agreements with, for example, Africa countries. Additionally, in 2008 the raw material initiative was launched, with a three pillar strategy: (i) ensure a level playing field in access to resources in third countries; (ii) foster sustainable supply of raw materials from European sources, and (iii) reduce consumption of primary raw materials by increasing resource efficiency and promoting recycling.
- Implementing sector specific measures. All sectors are important. Nevertheless, a targeted approach is needed in some sectors like space, transport, energy, chemicals, engineering, agro-food, business services, and sectors which address the social challenges of climate change, health, and security.

This policy is expected to start taking effect by implementing some of the elements in 2011 and others will take effect gradually. The Commission published its 2011 Management plan[151] where five general objectives for its work were set out:

- to strengthen the competitiveness of Europe's industrial base and promote the transition to a low carbon economy;
- to promote innovation as a means to generate new sources of growth and meet societal needs;
- to encourage the creation and growth of SMEs and promote a new entrepreneurial culture;
- to ensure an open internal market for goods;
- to support the European presence in space.

Looking ahead the Commission is expected in 2011 to present its proposal for the next Multi-annual Financial Framework where it will aim at supporting its 2020 goals in areas of competitiveness, innovation, support space and security research, and put into operation large scale infrastructure like Galileo and GMES[152].

The objectives of the policy are undertaken under the competitive and innovation framework programme (CIP) for the period 2007-2013. The aim is to contribute to the enhancement of competitiveness and innovation capacity in the Community, the advancement of the knowledge society, and sustainable development based on balanced economic growth[153]. It has the following objectives: to foster the competitiveness, of enterprises, in particular SMEs; to promote innovation activities (including eco-innovation); to accelerate the development of a sustainable, competitive, innovative and inclusive information society; to promote energy efficiency and energy sources in all sectors, in particular the transport and building sectors. The CIP is divided into three operations programmes contributing to the specific objectives. These are: the entrepreneurship and innova-

[150] Giannopapa, Christina. "Key Enabling Technologies and Open Innovation. New Impulse for the Space Sector." ESPI Report24.<http://www.espi.or.at/images/stories/dokumente/studies/espi%20report%2024%20online_1.pdf>-
[151] European Commission. "Enterprise and Industry Directorate General, Management Plan 2011." <http://ec.europa.eu/enterprise/dg/files/entr_2011_mp_public_en.pdf>.
[152] Enterprise and Industry Directorate General, Management Plan 2011 http://ec.europa.eu/enterprise/dg/files/entr_2011_mp_public_en.pdf
[153] Decision No. 1639/2006/EC, L 310/15

tion programme (EIP); the information communication technologies policy support programme (ICT-PSP); and the intelligent energy Europe programme (IEE).

4.7.2 Space Flagship Programmes Contribution

In the Enterprise and Industry field the contributions of Galileo and GMES are important to strengthen competitiveness, develop the market, promote innovation and increase industrial innovation. These could be achieved by the creation of a long-term profitable GNSS civilian market, by providing opportunities for upstream and downstream European enterprises and public sectors and, crucially, by protecting information in the electronic exchange of documents and computer files. Galileo is able to develop these capabilities and many examples are already taking place. Among them a mechanism created to build electronic map models for a free traffic-toll collection system, is a clear and practicable example of how to use Galileo positioning information. Moreover, with the development of the system, several new space technologies will be developed, as well as services and applications for daily life uses (software, real time information to people on the move, road transportation and transport management, etc). GMES will also assist economic development, mainly by providing data free of charge. It is predicted that this will create new business opportunities in the services market and, consequently, development of the labour market to meet the demand for new services and technologies.

POLICY AREAS AND MAIN OBJECTIVES	**GALILEO AND GMES –CONTRIBUTION**
Enterprise and Industry Policy • Speeding up the adjustment of industry to structural changes; • Encouraging an environment favourable to initiative in the Union; • Development of undertakings throughout the Union, particularly small and medium-sized undertakings; • Encouraging an environment favourable to cooperation between undertakings; • Fostering better exploitation of the industrial potential of policies of innovation, research and technological development. • Effective investments to support smart, sustainable and inclusive growth;	Galileo - reduction of Europe's vulnerability to external suppliers; - creation of a long-term profitable GNSS civilian market; - provide a wealth of opportunities for upstream and downstream European enterprises and public sectors; - protection of information in the electronic exchange of documents and computer files related information society, security, data integrity, authenticity and confidentiality; Examples - development of new space technologies, services and applications for daily life utilization, such as software, hardware, social services to all kinds of citizens, real time information to people on the move, road transportation, public transport management, aviation, agriculture, energy. - free Traffic-Toll Collection system with protection of personal data[154]. This mechanism will work using the Galileo positioning information that will allow building electronic map models, representing a set of all toll stations with coordinates for the entire tolling region. Each vehicle will be equipped with an onboard unit (OBU). This OBU is capable of identifying the associated account number, the category of the vehicle, the ID of the tolling station, the exact date/time of detection and (in the case of commercial vehicles) the number of passengers. The OBUs do not send data which compromises privacy, such as current or previous positions of the vehicle, the driving direction, etc. - Europe's regional augmentation system for GPS signals. EGNOS. Unprecedented positioning precision by improving the accuracy of GPS can be provided by satellites with high-resolution capabilities (European Geostationary Navigation Overlay Service);

[154]The project was established to develop an innovative toll collection system using EGNOS-based Global Navigation Satellite System and Cellular Networks (GNSS/CN) using intelligent vehicle device and program modules that will ensure greater personal data protection, guarantee fair charging of the distance travelled and prevent avoidance of toll payments at the open toll collection systems.
<http://www.gsa.europa.eu/index.cfm?objectid=6D3CCC27-D604-0456-3ED46B7518C83208>.

	- design and trial deployment of a set of new innovative social location-aware mobile user-generated services using GNSS-based "Intelligent Tagging". This system will contribute to Galileo by demonstrating that there is great mass market potential for LBS in Europe and that the technology is mature enough to deliver real benefits to users, such as a set of new innovative social location-aware. Ex. MUGGES; - develop a GNSS-based mobility service dedicated to visually disabled pedestrians in urban environments. PERNASVIP [155] - protecting personal data. Using an encryption system used for authentication and electronic-signing could be based on its trusted time signal that offers the additional value of traceability and liability for the time information. GMES - provides use of data free of charge; - new business opportunities in the services market; - development of the labour market to meet the demand for new services and technologies; - improvement of Europe's competitiveness; Examples - development of new space technologies and applications. With the increasing development of the space sector, new technologies and applications will be created, for example components, nanotechnology and know-how, among others; - development of new European capabilities. An entrepreneurship environment with no barriers to the acquisition and circulation of knowledge and with the availability of data free of charge, would exponentially increase European enterprise and industrial capabilities;

Table 9:Galileo and GMES contributions to implement Enterprise and Industry Policy

4.8 Research and Technology Development Policy

4.8.1 Policy Overview

Research and technology development contributes to economic growth, prosperity and quality of life and is essential to be able to face increasing challenges from global competitors and emerging economies. The aim of the research and technology development policy is to coordinate and bridge the fragmentation of national research policies and define and implement research programmes of European interest which Member States could not put together individually. Common research and technology development policy is closely linked to other policies such as industrial, energy, environment, transport, information society, new technologies, space, etc. At the international level with a common research and technology policy the Union would be able to play a leading role in a number of international programmes.

The legal basis for a common research and technological development is in Arts. 179 to 190 TFEU. Contrary to the Euratom treaty that focused on nuclear research, the EEC and now TFEU treaty gives powers to finance and coordinate Member States' research. The objective of the Union is to strengthen its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encourage it to become more competitive, including in its industry, while promoting all the research activities deemed necessary by virtue of other Union policies[156]. In order to achieve this the Union encourages undertakings,

[155] For more examples of applications developed by the public and private sector see <http://ec.europa.eu/enterprise/policies/satnav/galileo/applications/index_en.htm>.
[156] Art 179. TFEU.

including small and medium-sized undertakings, research centres and universities in their research and technological development activities of high quality; it shall support their efforts to cooperate with one another, aiming, notably, at permitting researchers to cooperate freely across borders and at enabling undertakings to exploit the internal market potential to the full, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal obstacles to that cooperation. In pursuing these objectives the Union will complement the activities carried out by the Member States and carry out the following activities[157]:

- implementation of research, technological development and demonstration programmes, by promoting cooperation with and between undertakings, research centres and universities;
- promotion of cooperation in the field of Union research, technological development and demonstration with third countries and international organisations;
- dissemination and optimisation of the results of activities in Union research, technological development and demonstration;
- stimulation of the training and mobility of researchers in the Union.

The common research and technology development policy provides a common approach to common research problems. The common policy focuses at defining the economic, social, political and even security and defence objectives in research. Furthermore, it aims to keep an inventory of the Union's resources including, human, infrastructure and funding and set the priorities and adoption of the work programme of the Union. The Union over the period has realised that there have been significant changes in the economy and society on a global scale. Traditional industrial production lines e.g. textiles, shipbuilding, steel, etc. have been moved outside the Union. In order for Europe to remain competitive an amount has been to invest in a knowledge-based society and innovation. Additionally new technologies and information and communication technologies have changed the way business and society are structured. Thus, Europe's industrial competitiveness, quality of life and sustainable growth depend largely on information society technologies. Research and technology development in areas such as the environment, energy and sustainable development are important for the implementation of community policies and to deliver on Europe's international obligations e.g. implementation of the Kyoto Protocol. Furthermore, Europe has been making efforts to provide access to community R&D infrastructure for its citizens and allow free movements of scientists within the Community.

Research at the Union level is undertaken under two programs, the Framework Programme and the Euratom Framework Programme. The Framework programme is a five year multiannual programme adopted by the Council and the European Parliament. The Union is currently implementing the Seventh Framework Programme (FP7) for research, technology and demonstration activities for the period 2007-2013. The programme has four main objectives: "Cooperation"[158], which focuses on collaborative projects at transnational and international level; "Ideas" [159], with the European Research Council supporting investigator-driven frontier research, "People"[160], aiming to reinforce the training and career development activities of researchers and "Capacities"[161] focussing on supporting research and innovation capacities including research infrastructure, research for the benefit of SMEs and regional research driven clusters. The Cooperation programme of FP7, under transnational cooperation supports various areas: health; food, agriculture, and fisheries, biotechnology; information and communication technologies; nano-sciences, nano-technologies, material and new production technologies; energy; environment (including climate change); transport (including aeronautics); socio-economic sciences and humanities; space; and security. The Euratom framework programme has two specific programmes: the fusion energy programme for technologies for a safe, sustainable, environmentally responsible and economically viable energy source and the second programme covering the activities of the Joint Research Centre (JRC) in nuclear energy.

4.8.2 Space Flagship Programmes Contribution

Research and technology development can greatly benefit from Galileo and GMES services. Accurate and real-time data will be an important element for the implementation of research, technological development and demonstration programmes. Galileo can provide navigation and positioning assistance to researchers in several fields, where the use of high precision geometry processing

[157] Art 180. TFEU
[158] Decision, 2006/971, OJ L 400, 30.12.2006.
[159] Decision 2006/972, OJ L 400, 30.12.2006.
[160] Decision 2006/973, OJ L 400, 30.12.2006.
[161] Decision 2006/974, OJ L 400, 30.12.2006.

and navigation positioning for images is required, for example for environmental sciences, earth dynamics and polar studies. This means that a geographic information system can be deployed, able to capture, analyze, store and present data, collected by high-resolution satellites. On the other hand, the contributions from GMES are also valuable in this field. It can be a starting point for the development of new instruments and systems to analyze satellite data for concrete purposes. Furthermore, it provides users with data free of charge among the twenty-seven nations of the European Union. This generates the right conditions for knowledge-intensive production and efficient data management and information sharing among them. Both projects are able to optimize the results of various research activities in the Union as well as to promote cooperation with third countries and international organizations. The Union's involvement in GEOSS is an essential part of this international collaboration.

POLICY AREAS AND MAIN OBJECTIVES	**GALILEO AND GMES –CONTRIBUTION**
Research and technology development policy • Implementation of research, technological development and demonstration programmes; • Promoting cooperation with and between undertakings, research centres and universities; • Promotion of cooperation in the field of Union research, technological development and demonstration with third countries and international organisations; • Dissemination and optimisation of the results of activities in Union research, technological development and demonstration; • Stimulation of training in the Union; • Mobility stimulus for researchers in the Union.	Galileo - support building and managing networks gathering private and public institutions around the technologies for, or the applications of, and the services offered by, satellite navigation - developing pan-European cooperation between research centres and universities of different regions in the EU and associated countries; Examples - navigation and positioning assisting researchers. Navigation and positioning can assist researchers in various fields, where the application of high precision geometry processing, used in navigation positioning of images, is required. It can be used in many fields connected with geography, environmental sciences, earth dynamics, polar studies and glaciology, volcano studies and monitoring, etc - developing a geographic information system which captures, analyzes, stores and present data, collected by high-resolution satellites, with reference to geographic location data; - deployment of a spatial decision support system to assist spatial planners with guidance in making land use decisions. With accurate data the spatial decision support system could initiate a better land management process; - creation of a digital earth and circular economy. Accurate information, data and analyses can boost the energy economy corridor for sustainable development; GMES - generating new knowledge on interface and size dependent phenomena; - generating new knowledge on high-performance materials for new products and processes; - international agreement verification; - creating conditions and assets for knowledge-intensive production; - efficient data management and information sharing; - harmonisation of geospatial information at pan-European level; - provides use of data free of charge among the 27-nation European Union; Examples - development of instruments and systems to analyse satellite data for concrete purposes. Analysing high-resolution images and data provided by Earth observa-

	tion satellites can be a starting point for many scientific studies and researches; - development of new evaluation programs. Programmes to evaluate several different subjects supported by satellite provided information. Human activity impact on ecosystems, strategic planning for the provision of safe drinking water, improving the understanding of actual and specific problems, among other examples.

Table 10: Galileo and GMES contributions to implement Research and technology development policy

4.9 Space Policy

4.9.1 Policy Overview

The Member States of the European Union have a long history of cooperation in the field of space which dates back to the early sixties with the creation of the European Launcher Development Organization (ELDO) and the European Space Research Organization (ESRO), the predecessors of the European Space Agency (ESA). Through ESA the Members States have successfully collaborated and obtained experience in launch, satellites, space science, communications, earth observation, applications and user services. Several Member States have pursued their national goals and objectives while benefiting from the European dimension within the framework of ESA.

The active involvement of the European Union in space dates back to 1998 with the birth of the European Flagship Programmes, Galileo[162] and GMES. Although, as early as 1988, the Commission Communication "The community and space: A coherent approach"[163] expressed the need for a more active role of the community while acknowledging the increasing importance of space and the achievements of ESA and Member States.

In 1999, European Ministers called on the European Commission and the Executive of the European Space Agency to elaborate a coherent European Strategy for Space. In 2000 the Commission's communication entitled "Europe and Space: Turning to a new chapter"[164] was issued. It was followed by a resolution by the European Parliament in 2002. This recognised that society has become critically dependent on the use of satellites and space-based technologies, thus highlighting the importance of an autonomous and comprehensive capability to develop and manage space infrastructure. The following objectives were defined: strengthening the foundation for space activities so that Europe preserves independent and affordable access to space; enhancing scientific knowledge; and reaping the benefits for markets and society through demand-driven exploitation of the technical capabilities of the space community. This strategy was aimed at strengthening the European Commission with an active role in the implementation of the strategy by: establishing the right political and regulatory conditions for space activities, in line with and in support of Community policies; acting as an animator to catalyse joint research and development efforts of all actors in line with the objectives of a European Research Area; bringing together all actors and competencies around common political objectives in projects of European-wide interest and, in particular, Galileo and GMES.

In 2003 the Commission published a Green paper on "European Space Policy"[165], which was prepared in cooperation with ESA. This document addressed the global challenges and how space can serve Europe and it citizens, heading towards a European space policy. The areas where space can serve Europe are through: contributing to the emerging knowledge society and the competitiveness of European industry; supporting sustainable development; and improving the security of the citizens. The Commission held a wide consultation concerning this paper which resulted in the issuing of the first white paper on space in 2003 with the title "A New Frontier for an Expanding Union" The White Paper describes itself as "an Action Plan for Implementing the European Space Policy"166.

[162] Galileo: involving Europe in a new generation of satellite navigation services. COM (1999) 54 final of 10 Feb. 1999.
[163] Commission of the European Communities. The Community and space: A Coherent Approach. COM (1988) 417 Final of 16 Jul.1988.
[164] Commission of the European Communities. Europe and Space: Turning to a new chapter COM (2000) 597 final of 27 Sep. 2000.
[165] COM (2003)17 final. 21.1.2003 "Green Paper: European Space Policy"
[166] European Commission. "White Paper: Space: A New Frontier for an Expanding Union. An Action Plan for Implementing the European Space Policy". COM (2003) 673.

The White Paper seeks to build on past successes and existing competencies at all levels in order to achieve more cost-effective support for European Union policies and objectives from space technologies, infrastructure and services than is currently being delivered. It made a strong case for the ability of shared, coordinated space programmes to provide important tools for the benefit of five core political challenges:

- *sustainable development.* Earth observation from space supports sound environmental management and protection by providing basic homogeneous observations with unsurpassed coverage of climate and weather, oceans, fisheries, land and vegetation. Space has enabled weather predictions for 5 days. A sustainable agricultural model could, as well, benefit from the use of Earth observation tools. Likewise, monitoring the application of the Kyoto protocol will require European independent space capabilities.
- *stronger foreign, security and defence for all.* To be able to have autonomous access to reliable global information so as to foster informed decision-making. Space technologies and infrastructures ensure access to knowledge, information and military capabilities on the ground that can only be available through the capacity to launch, develop and operate satellites providing global communications, positioning and observation systems. At the same time, space-based systems can provide a higher level of security for citizens allowing, for example, better enforcement of border and coastal control and identification of humanitarian crises in their early stages. And space endeavours can contribute to international partnerships since they are an instrument for developing such partnerships. This should not only include cooperation in technology and applications but also economic and social development, protection of the environment, education, health, science, technology and security. It should include the following areas human space flight, solar system exploration, space and Earth science, telecommunications, earth observation and navigation.
- *economic growth, job creation and industrial competitiveness.* Strengthen industrial performance by stepping up R&D and technological innovation, while defining Trans-European Transport Network (TEN - T) priorities. Space R&D and TEN-T development are also part of a larger value chain that stimulates R&D in other sectors and leads to commercial applications, such as GALILEO, with potentially very large revenues and job creation possibilities.
- *fighting poverty and aiding development.* The Union is the largest provider of development aid in the world. Space technologies can strengthen development efforts, and help other countries to develop access to information, raise skills levels and better manage their resources. In addition to supporting the creation of commercial communication infrastructures, space technologies such as Earth observation and global positioning systems can be employed in a variety of tasks including: protecting soils and managing water resources; monitoring crop development and forecasting food production; providing early warning for flood and fire risk; monitoring the tropical forest; preventing ground-motion hazards; ensuring coastal and maritime monitoring; forecasting, preventing and managing natural disasters.
- *a successful enlargement of the Union.* To ensure a globally competitive, independent satellite-based European capability for navigation, timing and positioning –Galileo- that will be financially viable in the long term. To maximise the use of space data in support of sustainable development policies with particular regard to the protection of the environment, the management of resources and the quality of life and security of citizens though GMES. Priority areas are: land management, ocean monitoring, atmosphere monitoring, management of water resources, risk management, humanitarian aid and security policies. Additionally, space can contribute in bridging the digital divide through all available broadband technologies (including satellite communications).

This was a call for the EU to develop a European space policy and many of the recommendations began to be implemented.

An important milestone was in 2004 when the European Commission and ESA signed a Framework Agreement considering that closer cooperation between them will strengthen the peaceful use of space as an important tool to contribute to European cohesion and economic growth which would allow space-related activities to be brought under a wider political, economic, scientific, environmental and social framework that was more directly at the service of European citizens[167]. The agreement aimed to advance the coherent and progressive development of overall European Space Policy[168]. The specific fields of cooperation were identified as: science, technology, earth observation, navigation, communication by satellite, human space flight and micro-gravity, launchers, and

[167] Framework Agreement and Decision 2004/578, OJ L 261, 06.08.2004
[168] Framework Agreement and Decision 2004/578, OJ L 261, 06.08.2004

spectrum policy related to space. This agreement was extended in 2008 until 2012. In accordance with the Framework Agreement, the European Space Council was established comprising the relevant Ministers from 27 States (all members of the EU plus the two additional non-EU Member States, Norway and Switzerland). A series of Space Councils took place, which played an important role in identifying the priorities for European Space Policy. The first took place in 2004 setting the first orientations. The third Space Council in 2005 focused on the orientations for GMES.

In 2005 the Commission issued a communication setting out the preliminary elements of the European Space Policy[169]. The actual space policy Communication was issued and adopted in 2007 under the title "European Space Policy" [170] . This communication set out the strategic mission where the development of a European Space Policy is seen as a strategic choice for Europe. It recognised that "space systems are strategic assets demonstrating independence and the readiness to assume global responsibilities. Initially developed as defence or scientific projects, they now also provide commercial infrastructures on which important sectors of the economy depend and which are relevant in the daily life of citizens. However the space sector is confronted with high technological and financial risks and requires strategic investment decisions. Europe needs an effective space policy to enable it to exert global leadership in selected policy areas in accordance with European interests and values."[171] The policy seeks to[172]:

- develop and exploit space applications that serve Europe's public policy objectives and the needs of Europe's citizens and enterprises;
- meet Europe's space-based security and defence needs;
- ensure Europe retains a strong and competitive space industry that is innovative and provides sustainable, high-quality and cost-effective services;
- contribute to the knowledge-based society by investing significantly in space-based science and playing a strong role in international space exploration;
- secure Europe's unrestricted access to the best technologies, systems and capabilities to ensure the availability of independent European space applications.

According to this communication, the European Space Policy should enable the European Union, the European Space Agency (ESA) and their Member States to increase coordination of their activities and programmes, and organise their respective roles relating to space, providing a more flexible framework to facilitate Community investment in space activities. This is equally true in the areas of security and defence space programmes and in the integration of space policy into a range of the EU's external relationships. The key stated applications were: satellite navigation and in particular Galileo and EGNOS; earth observation with GMES; satellite communications; security and defence. Additionally it highlighted the importance of science and technology, the international space station and exploration of the solar system, access to space, and a competitive European space industry.

On 22 May 2007 during the fifth Space Council, the communication for a European Space Policy was widely supported. Additionally, the Space Council identified four new priorities of European Space Policy: space and climate change, the contribution of space to the Lisbon strategy, space and security and space exploration[173]. In 2008 the economic crises also affected the discussions in the space sector. This resulted in 2009 at the sixth Space Council in the adoption of a resolution on the contribution of space to innovation and competitiveness in the context of the European Plan for Innovation and the European Economic and Recovery Plan[174]. Until the end of 2009 even though the European Union had been making steps towards a European Space Policy, including the adoption of the 2007 European Space policy, it did not directly have the responsibility for space policy. The legal basis was given to the Union when the Lisbon Treaty entered into force in December 2009.

[169] Commission of the European Communities. Communication from the Commission to the Council ant the European Parliament on European Space Policy - Preliminary Elements COM (2005) 208 final of 23 May 2005.
[170] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on European Space Policy. COM (2007) 212 final of 26 Apr. 2007. Brussels.
[171] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on European Space Policy. COM (2007) 212 final. of 26 Apr. 2007. Brussels.
[172] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on European Space Policy. COM (2007) 212 final of 26 Apr. 2007. Brussels.
[173] Council of the European Union. 5th Space Council "Council Resolution Taking forward the European Space Policy", 2008.
[174] 6th Space Council "Resolution on the contribution of space to innovation and competitiveness in the context of the European Plan for Innovation and the European Economic and Recovery Plan". Jun. 2009.

In the Lisbon Treaty in relation to previous Art. 167-173 TEC there is an additional Art. 189 that sets the basis for the Union for a European space policy. The article states: *"To promote scientific and technical progress, industrial competitiveness and the implementation of its policies, the Union shall draw up a European space policy. To this end, it may promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space"*[175]. To contribute to these objectives, "*the European Parliament and the Council, acting in accordance with the ordinary legislative procedure, shall establish the necessary measures, which may take the form of a European space programme, excluding any harmonisation of the laws and regulations of the Member States*" [176]. The provisions of the treaty clearly state that the Union "*shall have competence to carry out activities, in particular to define and implement programmes; however, the exercise of that competence shall not result in Member States being prevented from exercising theirs*"[177]. Additionally the Union is called upon to establish appropriate relations with the European Space Agency.

In April 2011, the European Commission published a communication regarding the European space strategy. In this communication, it is highlighted that space policy can be used as an instrument serving the internal and external policies of the Union in response to three types of needs:

- social: citizens' well-being depends on space policy in areas such as the environment, combating climate change, public and civil security, humanitarian and development aid, transport and the information society;
- economic: space generates knowledge, new products and new forms of industrial cooperation, it is therefore a driving force for innovation and contributes to competitiveness, growth and job creation; and
- strategic: space serves to cement the EU's position as a major player on the international stage and contributes to the Union's economic and political independence.

Europe's space policy is aimed at achieving the following objectives: promoting technological and scientific progress, stimulating industrial innovation and competitiveness, enabling European citizens to reap the benefits of space applications and raising Europe's profile on the international stage in the area of space.

According to this communication the priority actions for European space policy are satellite navigation with the Galileo and EGNOS programmes; using space for the benefit of the environment and climate change with the GMES programme; secure space to achieve security and defence; space exploration. Satellite navigation with Galileo as one of the Union's flagship programmes which will enable the Union to be independent in a strategically important field. This also includes EGNOS with the goal to improve the GNSS signals transmitted in Europe before Galileo is fully operational. These systems represent the first major space facilities exclusively belonging to and being managed by the Union. The second priority is the Union's other flagship programme, GMES, that provides information services on the environment and security and will be used to support policies on climate change adaptation and security, and to contribute to crisis prevention and management, with emphasis on humanitarian aid, development assistance and civil protection. The third priority regarding security and defence, space infrastructure, is both an instrument and asset that can serve the Union's interests and at the same time needs protection. To this end it is important to develop the "S" component of GMES in areas such as monitoring borders, support to the Union's external action, maritime surveillance, complex emergencies, humanitarian aid, civil protection. Additionally, space infrastructure needs protection as it risks damage or destruction by natural phenomena, such as solar radiation and asteroids, and by other spacecraft and debris as well as electromagnetic interference. In order for Europe to develop capabilities in this field the Space Situation Awareness (SSA) preparatory programme started after the fifth Space Council in 2008. The Union needs to play an active role in the development of this programme. The Commission is planning to define organisation and governance for such a system to ensure sustainable exploitation. The fourth priority is space exploration were four priorities have been identified: critical technologies, the International Space Station (ISS), access to space and setting up a high-level international forum. In particular the Union seeks to identify and support the development of technologies in energy, health and recycling.

Additionally, the communication seeks to set out the contribution of European space policy for the benefit of competitiveness as an integral part of the Europe 2020 strategy. The space industry is a driving force for innovation. In particular, satellite communications generate the largest revenues

[175] Art 189. TFEU
[176] Art 189. TFEU
[177] Art. 4. TFEU

in the space industry in Europe and internationally. In the area of research and innovation, it is vital to develop key enabling technologies e.g. advance materials and nanotechnology. Space research and technology development can contribute to the 'Innovation Union'. This can be stimulated by boosting market applications and services utilising the flagship programmes Galileo/EGNOS and GMES.

The international dimension of European space policy was also highlighted in the communication, as international cooperation in the field of space is essential. Space should be used also to support the promotion of European values through projects focused on environmental protection, climate change, sustainable development and humanitarian action. The countries mentioned for collaboration are the United States, Africa and China. The contributions of GMES and EGNOS in Africa are essential to the Africa-EU strategic partnership. The Union's competence in the field of space is highlighted in various forums and in particular in its involvement in the Global Earth Observation System of Systems (GEOSS). Additionally, reference is made to the EU Code of Conduct for Outer Space Activities[178]. Overall, the Union must ensure that space-related matters are better integrated into the Union's external policy.

The European space programme currently in Europe is a civilian programme. Public financing mostly comes from European space agencies such as the British UK Space Agency, the French Centre National d'Etudes Spaciales (CNES), the German Aerospace Research Centre and Space Agency (DLR), the Italian Space Agency (ASI). Member States have a separate budget for the European Space Agency (ESA). Also countries with no space agency can contribute to the ESA budget to develop their space programme, such as Belgium. The European Commission has been contributing to the space budget mainly through the Framework Programme for Research and Development, where there is a dedicated part for space, and through the Trans-European Network. There have also been contributions through Structural Funds and the Competitiveness and Innovation Programme (CIP).

Dates	Events
July 1988	Commission of the European Communities. Communication from the Commission to the Council and the European Parliament. "The Community and Space: A Coherent Approach". COM(88) 417 final
September 1992	Commission of the European Communities. Communication from the Commission to the Council and the European Parliament. "The European Community and Space: Challenges, opportunities and new actions". COM(92)360 final.
December 1996	Commission of the European Communities. Communication from the Commission to the Council and the European Parliament . "The European Union and Space: Fostering Applications, Markets and Industrial Competitiveness". COM(96) 617 final
June 1999	Commission of the European Communities. Commission Working Document. "Towards a Coherent European Approach for Space". SEC(1999)789 final .
September 2000	European Commission. Communication of the European Commission to the Council and European Parliament. "Europe and Space: Turning to a New Chapter". COM (2000) 597 final.
December 2001	Communication from the Commission to the Council and the European Parliament. "Towards a European Space Policy". COM(2001) 718 final
January 2003	European Commission Communication. "Green Paper: European Space Policy". COM (2003) 17 final
November 2003	European Commission. "White Paper: Space: A New Frontier for an Expanding Union. An Action Plan for Implementing the European Space Policy". COM (2003) 673.
April 2004	Council Decision. Framework Agreement between the European Com-

[178] The EU Code of Conduct is a proposal that aims at overcoming the deadlock in international negotiations on space weaponisation, based on Transparency and Confidence Building Measures (TCBM).

Dates	Events
	munity and the European Space Agency. (2004/578/EC) OJ L 261, 06.08.2004.
November 2004	1st Space Council "Orientations on the European Space Policy"
May 2005	European Commission. Communication from the Commission to the Council and European Parliament. "European Space Policy: Preliminary Elements." SEC (2005) 664, COM(2005) 208 final.
June 2005	2nd Space Council: Orientations concerning the preparation of the future European Space Programme
November 2005	3rd Space Council: "Orientations on Global Monitoring for Environment and Security –GMES"
April 2007	Commission of the European Communities. Communication from the Commission to the Council and the European Parliament: European Space Policy. COM(2007) 212 final.
May 2007	4th Space Council "Resolution on the European Space Policy"
July 2008	European Parliament Resolution "Space and Security". 2008/2030 (INI).
September 2008	5th Space Council "Council Resolution Taking forward the European Space Policy"
November 2008	European Parliament Resolution "European space policy: how to bring space down to earth"
June 2009	6th Space Council "Resolution on the contribution of space to innovation and competitiveness in the context of the European Plan for Innovation and the European Economic and Recovery Plan"
December 2009	Lisbon Treaty. Art 189.
November 2010	7th Space Council. "Global challenges: taking full benefit of European space systems".
April 2011	Communication From the Commission to the Council, the European Parliament, the European economic and social committee and the regions towards a Space Strategy for The European Union that Benefits its Citizens. COM(2011) 152.

Table 11: Chronology of the main documents leading to the European Space Policy.

4.10 External Policies

4.10.1 Policy Overview

The European Union has 495 million inhabitants making it the world's third largest population after China and India. In comparison with the US it is less than half the size but over 50% larger in terms of population. The Union is the world's largest trading entity and the world's largest provider of development aid. Thus, its impact commercially, economically and financially in the global arena is of great importance.

The external policy endeavours of the Union go back to the time after its creation when the first members were establishing trade agreements with their neighbours giving rise to a common commercial policy. At the same time the Union's members decided to share part of the cost of development aid to their former colonies, in particular in Africa. Thus, the Union has been present in the global arena under three roles: common commercial policy, development aid and external relations. The role of the Union in external relations is often mixed with the developing role of the Union in the Common Foreign and Security Policy (CFSP) which was introduced by the Treaty of Maastricht in 1991 so that the Union could take action when its interests as a whole are at stake, and reinforced by the Lisbon Treaty in 2009. Even though there are obvious overlaps between the various aspects of the external policies of the Union there is also a distinct difference in their conduct. The commercial policy, development aid and the external relations of the Union depend on

the its decision making process whereas the CFSP has a special decision making process. It has been common only in name and functions through intergovernmental cooperation.

Today the legal basis of the Unions external policies are in Title V of the Lisbon Treaty setting forth general provisions for the Union's external action and specific provisions for the Unions CFSP. Under Art. 21 TFEU, the Union shall define and pursue common policies and actions in all fields of international relations to:

- safeguard its values, fundamental interests, security, independence and integrity;
- consolidate and support democracy, the rule of law, human rights and the principles of international law;
- preserve peace, prevent conflicts and strengthen international security, in accordance with the purposes and principles of the United Nations Charter, with the principles of the Helsinki Final Act and with the aims of the Charter of Paris, including those relating to external borders;
- foster the sustainable economic, social and environmental development of developing countries, with the primary aim of eradicating poverty;
- encourage the integration of all countries into the world economy, including through the progressive abolition of restrictions on international trade;
- help develop international measures to preserve and improve the quality of the environment and the sustainable management of global natural resources, in order to ensure sustainable development;
- assist populations, countries and regions confronting natural or man-made disasters; and
- promote an international system based on stronger multilateral cooperation and good global governance.

This should also encompass the external aspects of its other policies and ensure that there is consistency. Regarding the Common Foreign and Security Policy (CSFP) of the Union, the European Council should decide on the strategic interests and objectives of the Union and relate them to the common foreign and security policy and to other areas of the external action of the Union. Under Art. 24 TFEU, the Union's competencies in CFSP shall cover all areas of foreign policy and all questions relating to the Union's security, including the progressive framing of a common defence policy that might lead to a common defence.

With the entry into force of the Lisbon treaty, Ms. Ashton is the High Representative of the Union for Foreign Affairs and Security with the duties to conduct the Union's common foreign and security policy and has authority over the European External Action Service (EEAS), also set up by the Treaty of Lisbon, and over some 130 Union delegations in third countries and international organisations. Furthermore she is the Council's representative for Common Foreign and Security policy, the President of the Foreign Affairs Council and the Vice-President of the Commission.

4.10.2 Space Flagship Programmes Contribution

Space assets and applications can contribute to the Union's external policy through meteorological forecasting, terrain mapping, positioning (cargo, personnel, populations, etc), navigation, observation, communications, intelligence, etc. These cap abilities already exist to a certain extent and will be under further development mainly through Galileo and GMES. Galileo will be important for better management of critical transport and emergency services, better law enforcement (police), improved internal security (border control) and safer peace-keeping missions. GMES applications in the security dimension will include aspects such as emergency response, global stability and homeland security by contributing from e.g. maritime surveillance and border control to food security worldwide.

POLICY AREAS AND MAIN OBJECTIVES	GALILEO AND GMES -CONTRIBUTION
External Policies • Safeguard its values, fundamental interests, security, independence and integrity; • Consolidate and support democ-	Galileo - critical transport management ; - emergency services management; - support law enforcement (police); - support internal security (border control);

racy, the rule of law, human rights and the principles of international law; • Preserve peace, prevent conflicts and strengthen international security; • Foster the sustainable economic, social and environmental development of developing countries, with the primary aim of eradicating poverty; • Encourage the integration of all countries into the world economy, including through the progressive abolition of restrictions on international trade; • Help develop international measures to preserve and improve the quality of the environment; • Help develop international measures to preserve and improve the sustainable management of global natural resources, in order to ensure sustainable development; • Assist populations, countries and regions confronting natural or man-made disasters; • Promote an international system based on stronger multilateral cooperation and good global governance; • Cover questions relating to the Union's security; • Help to develop the progressive framing of a common defence policy that might lead to a common defence.	- proide information on positioning and navigation (cargo, personnel, populations, etc); - safer peace-keeping missions; Examples - management of emergency situations. To improve response time when the crisis occurs, particularly through the provision of rapid mapping capacities[179] - forest fire fighting. Through satellite real-time information, it is possible to identify single situations, advising competent authorities when the situation moves to hazard risks.[180] - earthquake prediction. Determination of place and time of earthquake occurrence by using the data observed by satellite and on the earth surface. GMES - meteorological forecasting; - humanitarian disasters and natural disasters e.g. fires, earthquakes; - terrain mapping ; - monitoring issue of proliferation of weapons of mass destruction - assist in maritime surveillance and border control; - emergency response; - global stability and homeland security by contributing to e.g. maritime surveillance and border control; - food security worldwide; Examples - maritime surveillance. As part of the security aspect of GMES, the use of Earth Observation (EO) data together with integrated telecommunication services together with state of the art sensors and the Automatic Identification System (AIS) can assist in maritime surveillance and evacuation scenarios (project TANGO, EUSC); - humanitarian disasters and natural disasters e.g. earthquakes, proliferation of weapons of mass destruction. As part of the security aspect of GMES, the focus is on providing the geospatial infrastructure needed for a rapid humanitarian response (project GMOSS, EUSC); - respond to emergency situations such as fires, floods, earthquakes, volcanic eruptions, landslides or humanitarian crisis, providing environment recovery maps and determining safe zones.[181]

Table 12: Galileo and GMES contributions to implement External Policies

Space Relevant Actors

The High Representative has under its authority the oversight of the European Union's Satellite Centre, the European Defence Agency and the European Union Institute for Security Studies. These entities have been involved in space related activates.

[179] The Mature Applications of Galileo for Emergency Services – MAGES project- was conceived to provide position and positioning assets for emergency management scenarios, such as floods, fires and earthquakes. This system improves the effectiveness and response time of alerting and disaster management. <http://mages-project.eu/>.

[180] The HARMLESS project conducted several tests that demonstrated the capabilities of EGNOS and Galileo to improve the surveillance and management of fighting forest fires and improve safety. The project demonstrates the use of Galileo and EGNOS for managing fire fighters and vehicles during a forest fire <http://egnos-portal.gsa.europa.eu/index.cfm?objectid=F7160B60-C531-11DE-825D0013D3D65949>.

[181] SAFER is the EU FP7 Research Project that aims at reinforcing the European capacity to respond to natural or man-made disasters.
03 May 2011 <http://www.emergencyresponse.eu/gmes/en/ref/home.html>.
<http://www.gmes.info/fileadmin/files/4.%20GMES%20Services/GMES_Emergency_Management_Service_Portfolio_19Nov10.pdf>.

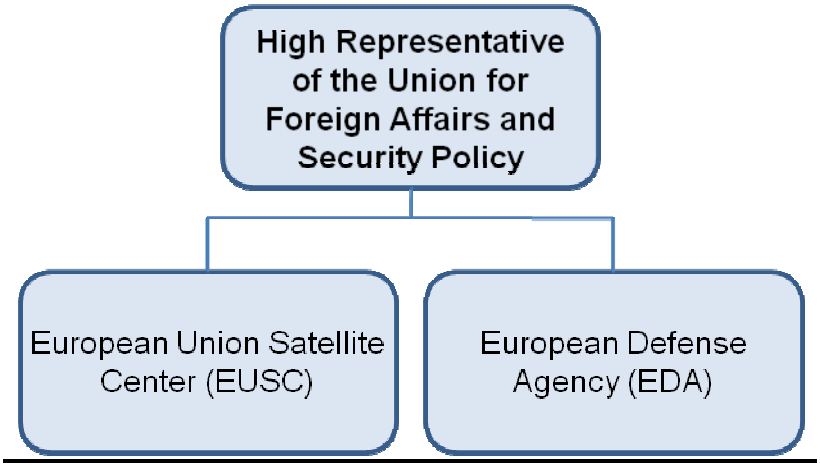

Figure 23: Agencies serving the CFSP under the leadership of the High Representative of the Union for Foreign Affairs and Security Policy.

European Union Satellite Centre (EUSC)

The European Union Satellite Centre (EUSC) is an agency of the Council of the European Union. It was founded in 1992 as the Western Union Satellite Centre. The EUSC was set up in 2002 to replace the Western Union Satellite Centre representing the transfer of functions from the Western European Union (WEU) to the EU in relation to the CFSP. Its mission is to support the decision-making of the European Union in the field of CFSP by providing analysis of satellite imagery and collateral data, including aerial imagery, and related services. It is one of the key institutions for the Union's Common Security and Defence Policy (CSDP), and the only one exclusively in the field of space. The High Representative of the Union for Foreign Affairs and Security Policy is responsible for its operational direction. In 2009 in line with the EP call for the EUSC to be fully developed it was used to support the operations of the EU in NAVFOR Atalanta, EUFOR Chad/RCA and EU Monitor Mission in Georgia[182].

The EUSC participates in various GMES projects with the role of supporting the CSDP policy of the Union. It is involved in GMES projects that contribute to the development of new pilot services at the Centre facilitating links with EU industry in space security projects, particularly Global Monitoring for Security and Stability (GMOSS), the Telecommunications Advanced Network for GMES Operations (TANGO) and ASTRO+. The GMOSS project concentrates its efforts on monitoring issues of proliferation of weapons of mass destruction, humanitarian disasters and natural disasters e.g. earthquakes. The focus is to provide the geospatial infrastructure needed for a rapid humanitarian response. The TANGO project uses Earth Observation (EO) data together with integrated telecommunication services. The project is focused on maritime surveillance and evacuation scenarios. It makes use of state of the art sensors such as the Automatic Identification System (AIS) for maritime surveillance tasks. ASTRO+ aims to use space-based assets to support security operations to demonstrate the advantage of space based information. This type of information is non-instructive and legal, available anytime and anywhere, robust and non-vulnerable to local threats.

The European Defence Agency

The European Defence Agency (EDA) was created in 2004 to develop projects and programmes aimed at supporting the development of the CSDP. It aims at developing defence capabilities in the field of crisis management, promoting and enhancing European armaments cooperation, strengthening the European defence industrial and technological base (DTIB) and creating a competitive European defence equipment market, as well as promoting, in liaison with the Community's research activities where appropriate, research aimed at leadership in strategic technologies for future defence and security capabilities, thereby strengthening Europe's industrial potential in this domain[183]. The EDA is subject to the direction and authorities of the Council, which issues guidelines to and receives reports from the High Representative of the Union for Foreign Affairs and Security Policy.,

[182] Council of the European Union. Annual Report from the High Representative of the Union for Foreign Affairs and Security Policy to the European Parliament on the Main Aspects and Basic Choices of the CFSP. 2009.
[183] COUNCIL JOINT ACTION 2004/551/CFSP, OJ L 245/17, 17.7.2004. Amended by Joint Action 2008/299, OJ L102, 12.04.2008

The European Defence Agency and ESA in 2010 signed contracts with two consortia regarding feasibility studies on "Satellite Services for the integration of Unmanned Aircraft Systems (UAS) into European Airspace"[184] which investigated the feasibility and the overall planning for a UAS mission, demonstrating that UAS can be integrated into non-segregated airspace using satellite communications and satellite navigation for Command and Control, Sense and Avoid, and Air Traffic Control, and the added value of satellite communications for high data rate payload links. Additionally, space based imaging and earth observation systems like GMES are of essential importance in the work of EDA and have already been used for maritime surveillance.

4.10.3 Strategic Partnerships

The Union has established partnerships with key actors in the global scene with which it shares common values or common interests. The Union has partnerships with various countries particularly in relation to its European Security Strategy. It has nine strategic partners[185] in this area: the United States, Russian Federation, China, India, Mexico, Brazil, Japan, Canada, and South Africa. The United States and the EU transatlantic relationship remains a cornerstone for CFSP. The Russian Federation and the EU have interests in working together on global issues such as climate change, terrorism, organised crime and energy security. Apart from issues related to trade and economic matters, the China-EU relations also include issues like climate change. With India it covers issues including terrorism, climate change, energy security, cyber security, non-proliferation, etc. With South Africa it includes close co-operation in research, environment, energy, space, transport, migration, health. There is also close collaboration through the GMES for Africa initiative and the extension of the European Geostationary Navigation Overlay System (EGNOS) over Southern Africa, and installation of elements of the Galileo ground infrastructure in South Africa. These countries are also involved in space activities and therefore will be discussed in detail in the following section in particular in relation to their activities in research and technology development through the Union's international cooperation agreement and in the field of earth observation and navigation.

[184] European Defence Agency. Signature of First Coordinated EDA/ESA Studies on Satellite Studies for UAS Missions. 9 Feb. 2010. Brussels. <http://www.eda.europa.eu/WebUtils/downloadfile.aspx?fileid=849>.
[185] Council of the European Union, 2009, Annual report from the High Representative of the Union for Foreign Affairs and Security Policy to the European Parliament on the main aspects and basic choices of the CFSP, June 2009.

5. International Aspects

5.1 International Efforts in Navigation

5.1.1 Global Navigation Satellite Systems (GNSS)

Global Navigation Satellite Systems (GNSS) can be defined as "space-based positioning and navigation systems designed to provide worldwide, all weather, passive, three-dimensional position, velocity and timing data"[186]. GNSS comprise three parts: satellites in orbit; control and monitoring stations on the ground; and receivers by users. Currently GNSS in space consist of two constellations: the NAVSTAR Global Positioning System (GPS) of the United States and the Global Navigation Satellite System (GLONASS) of the Russian Federation.

The first satellite navigation system was "Transit" the US Navy Satellite System that was operated from 1964-1996 and provided navigation data to navy submarines and ships. In 1997 it started providing data around the world to commercial shipping and aircraft and by 1970 its civil use had exceeded its military uses. The GPS was developed in 1973 and became fully operational in 1994. It was funded, operated and maintained by the U.S. Air Force and is managed by the National Space-based PNT Executive Committee, which is chaired jointly by the deputy Secretaries of Defence and Transport and the committee members include equivalent-level officials from the Departments of State, Homeland Security, Interior, Agriculture, Commerce, Joint Chiefs of Staff and NASA. The system was designed to be accurate to within a couple of metres and in 2007 it was the only available system for civilian use. U.S. policy promotes the use of GPS technology through no direct user fees for civil GPS services. They provide open, public signal structures and encourage open market driven competition in GPS related goods and services.

The first satellite based radio navigation system in the Russian Federation was Tsiklon, which was launched between 1967 and 1978. It was intended to provide accurate positioning for ballistic missile submarines. The Global Navigation Satellite System (GLONASS) was developed in 1976, with first launch in 1982 and it was completed in 1995. In 2001 only eight satellites were still operational. The GLONASS system went into full restoration undertaken under a special-purpose federal programme named "Global Navigation System" restoring it to full deployed status with 24 Satellites by 2011. This system was restricted to military use until 2007. After the restrictions were lifted GLONASS became the second global positioning and navigation system available for civilian use after GPS.

In the future there will be other operational systems that will have global coverage. Galileo will be the European system and COMPASS-Beidou 2 Navigation the system of China. There will be also other regional GNSS systems like the Indian Regional Navigation Satellite System (IRNSS) of India under civilian control and the Quasi-Zenith Satellite System (QZSS) of Japan. Table 13 shows an overview of the different GNSS systems.

The accuracy of global navigation systems can be augmented either to a wide area or regionally in order to increase the accuracy of the signal. These system use space-based and ground based infrastructure to correct for errors related to the positioning signal of the satellite and the signal delays due to atmospheric distortions, discrepancies in transmission, etc. The first space-based augmentation system was developed by the U.S. to augment the GPS signal. This system is the Wide Area Augmentation System (WAAS), which was developed by the Federal Aviation Administration for air navigation. There are also other augmentations systems like the European Geostationary Navigation Overlay Service (EGNOS) which has been operational since 2009 and is used in Agriculture and, since March 2011, has been available for aviation; Japans Multi-functional Transport Satellite-based Augmentation System (MSAS) with tests in aviation accomplished in 2007; and India's Global Positioning System-aided GEO-Augmented Navigation System (GAGAN) started in 2008 and expected to complete its operational phase in 2013.

[186] F. LYALL, P.B. LARSEN, Space Law. A Treatise, 2009, Farnham/Burlington, p. 389 (quoting: E. D. KAPLAN, C. HEGARTY, Understanding GPS: Principles and Applications, 2nd ed., Boston, 2005).

Country	United States	Russian Federation	European Union	China	India	Japan
GNSS space system	Global Positioning System (GPS)	Global Navigation Satellite System (GLONAS)	Galileo	COMPASS	Indian Regional Satellite System (IRNSS)	Quasi-Zenith Satellite System (QZSS)
Number of Satellites	30	21+3	27+3	30+5	7	3
Frequency	L1:1575.42 MHz L2: 122.76 MHz	L1:1598.06-1604.40MHz L2:1242.94-1248.63MHz	E1: 1559-1594MHz E6:1260-1300MHz E5a:1164-1188MHz E5b:1195-1219MHz E6:1215-1300 MHz	B1: 1559.052-1591.788 MHz B2: 1166.22-1207.37MHz B3: 1250.618-1286.423 MHz	L1: 1576.42 MHz L5:1176.45 MHz	L1:1575.42 MHz L2:1227.6MHz L5:1176.45MHz LEX:1278.75MHz
Accuracy	Horizontal 3m (95%) Vertical 6m (95%)	6.2m (95%)	Dual frequency user Horizontal 4m (99.5%) Vertical 8m (99.5%) Single frequency user Horizontal 15m (99.9%) Vertical 35m (99.5%)	10m (95%)	7.6 m	Dual-frequency user 6.11m (95%) Single frequency user 7.02m (95%)
Augmentation system	Wide-Area Augmentation System (WASS) Accuracy 1-2 m		European Geostationary Navigation Overlay Service (EGNOS) Accuracy 1-2 m (99%)		Global Positioning System-aided GEO-Augmented Navigation System (GAGAN)	Multi-functional Transport Satellite-based Augmentation System (MSAS) Accuracy 1-2 m
Coverage	Global	Global	Global	Global	Regional India	Regional East Asia
Status	Operational with restrictions Next Generation GPS III launches in 2014 to have 24 satellites by 2021.	Operational with restrictions Next Generation Glonass-K demonstration phase from 2010	In preparation Two pre-operational satellites (Giove-A and Giove-B)	5 satellites operational In 2007 first satellite launched Compass M1 Asia-Pacific coverage by 2011 and full system completed by 2020	In preparation First satellite to be launched in 2011 Expected to be fully operational by 2014	In preparation First satellite launched in September 2010 Expected to be fully operational by 2013
Services	C/A code for civil use in L1 Band P(Y) code for military purposes	Using band L1 and L2 with differences in accuracy:	Open services. Safety of life Commercial services Publicly regu-	Open service: for navigation Authorised	Standard position service; Authorised service	Using three different frequency bands it

	used by armed forces or government and some allies.	one for normal use the second one for „special" use.	lated services Search and rescue	service: Wide area differential service (1m acc.) short message service within China	(restricted) encrypted for certain users.	also uses a band to work as a GPS augmentation (L1 saif)
Compatibility and interoperability	Agreement in 2004: with EU Coordination on regular meetings with QZSS after a joint declaration of USA and Japan Joint statement with Russia working groups going on Joint statement with India held in Washington in 2007	Cooperation completed with GPS for compatibility; ESA for compatibility and interoperability with Galileo.	Coordination completed with GPS and QZSS; Ongoing procedures with GLONASS	Coordination is needed with other operators in the ITU framework, a multilateral level is also considered, so far coordination meetings have been held with GPS, Galileo, GLONASS and QZSS.	Coordination at inter-agency and planning to have bilateral agreement with others providers. To achieve the interoperability talks between the providers are needed.	Coordination with all the other providers, at bilateral level is fostered. Compatibility has been achieved by using working groups and interoperability is on his way to come.

Table 13: Overview of Global Navigation Satellite Systems (GNSS)[187]

5.1.2 International Committee on GNSS (ICG)

The International Committee on GNSS (ICG) was established in 2005 under the umbrella of the United Nations. The ultimate goal of ICG is to achieve compatibility and interoperability of GNSS systems thereby saving costs through international cooperation and making positioning, navigation, and timing available globally for societal benefits, including monitoring all aspects of environment and security[188]. It is an informal, voluntary forum where governments and interested nongovernmental entities can discuss all matters regarding GNSS on a worldwide basis[189]. The ICG promotes international cooperation on issues of mutual interest related to civil satellite-based positioning, navigation, timing, and value-added services.

To achieve this ICG has created working groups on issues such as the compatibility of the GNSS systems, and interoperability. Until now, five ICG meetings have been held between the Member States and international organizations participating in this initiative. The Member States are: China, European Commission on behalf of EU, India, Japan, Nigeria, Russian Federation, United States of America, and Italy. Apart from Member States many international organization are present in the plenary meeting and in the working groups. These are: Bureau international des poids et mesures (BIPM); Civil GPS Service Interface Committee (CGSIC); Committee on Space Research (COSPAR); European Space Agency (ESA); IAG Reference Frame Sub-Commission for Europe (EUREF); Fédération internationale des géomètres (FIG); International Association of Geodesy (IAG); International Association of Institutes of Navigation (IAIN); International Cartographic Association (ICA); International GNSS Service (IGS); International Telecommunication Union (ITU); Office for Outer Space Affairs; Union radio-scientifique internationale (URSI); International EUPOS Steering Committee (EUPOS). The ICG meets on an annual basis, and OOSA acts as the secretariat for their meetings.

[187] "Current and planned global and regional navigation satellite systems and satellite-based augmentation systems." United Nations, Office for Outer Space Affairs.2010. New York. < http://www.oosa.unvienna.org/pdf/publications/icg_ebook.pdf>.
[188] United Nations, General Assembly. Committee on the Peaceful Uses of Outer Space. Second Meeting of the International Committee on Global
Navigation Satellite Systems. A/AC.105/879, 2006. < http://www.oosa.unvienna.org/pdf/reports/ac105/AC105_901E.pdf>.
[189]International Committee on Global Navigation Satellite Systems. <http://www.unoosa.org/oosa/SAP/gnss/icg.html>.

In the first meeting the ICG adopted a work plan encompassing the issues of compatibility, interoperability, implementation of GNSS services and information sharing regarding non-military navigation systems. As far as compatibility and interoperability are concerned, the ICG approved two common definitions. Compatibility is considered as the possibility to use separately, two different navigation systems, without the possibility of receiving a corrupted signal. Interoperability refers to the possibility of using two or more GNSS signals with the same receiver. The notion of compatibility is related mostly to frequencies and concerns the use of certain bands by providers; whereas interoperability is also related to the downstream market, since the production of specific receivers is up to the industry, national sellers and re-sellers of services. The working groups produced technical results to facilitate the compatibility of the GNSS systems, in particular in relation to frequencies.

One of the most important results was the establishment of the GNSS Providers Forum, composed of GNSS service providers. Currently all actors running navigation systems are represented in that forum. Normally the Providers forum meets once a year during the plenary meeting of ICG. The main focus of the meeting is to achieve the maximum compatibility between the providers, and find all the possible ways to achieve global interoperability that will enable customers to use only one receiver and get data from all the systems. This is not an easy task since the differences in the accuracy of the free service can change according to the need of the provider.

The latest publication of the Provider Forum is the "Report on Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentation Systems". This is based on the declarations of all providers who furnished the data of their systems according to four parameters: description of the system time of deployment services and policies for international cooperation interoperability and compatibility. Table 3 summarises the results of the Providers Forum study. The importance of this study is that it allows the provider to share information by using the same template and achieve better knowledge of other GNSS systems, in order to avoid difficulties once the systems are fully operational. Europe is one of the providers that are using GNSS for non-military purposes, although a PRS is expected to be operational. The USA is the provider that has more ongoing activities to facilitate the interoperability and compatibility of the signals. Europe and the USA are already planning cooperation and activities to facilitate the coexistence of more than one GNSS. It should be noted that in the chart the regional augmentation systems built by the providers to get better performance from existing navigation systems are not considered.

5.1.3 The European Involvement

The European contribution to the GNSS is though Galileo, which will be a global system under civilian control offering free services and additionally having Public Regulated Services. Europe also contributes with the EGNOS augmentation system. Regarding compatibility and interoperability, Galileo and EGNOS have had complete coordination with GPS and WAAS and the first Satellite of QZSS. The U.S and the European Union signed an agreement in 2004 establishing cooperation between GPS and Galileo on radio frequency compatibility and interoperability; trade and civil applications; design and development of the next generation of systems; and security issues related to GPS and Galileo. In June 2010 the U.S. and EU made a GPS and Galileo combined performance. The combination of GPS and Galileo services provided noteworthy performance improvements particularly in partially obscured environments, where buildings, trees or terrain block large portions of the sky. Dual-frequency receivers provide additional improvements in most environments.[190] As regards COMPASS and Galileo, there have been series of meetings between China and Europe. In 2007 the first meeting took place in Beijing regarding frequency compatibility coordination. In September 2008 there was the first Technical Working Group meeting on compatibility and interoperability in Beijing followed by the second meeting in December 2008 and the third in January 2009 in Brussels. Interoperability and compatibility issues are of concern between the two systems and there discussions are ongoing. Another high level meeting is expected to take place in 20011. The EU and the Russian Federation have regular meetings to address the compatibility and interoperability of GLONASS and Galileo/EGNOS and there is a draft agreement under discussion. There are regular technical meetings to address compatibility and interoperability of IRNSS and GAGAN with Galileo and EGNOS. An agreement between the European Union and India for GNSS is currently under negotiation.

[190] Government of the United States of America and the European Union. Joint Statement. 30 Jul. 2010.<http://www.pnt.gov/public/docs/2010/wgc.shtml>.

5.2 International Efforts on Earth Observation

5.2.1 Global Earth Observation System of Systems (GEOSS)

The Global Earth Observation System of Systems (GEOSS) is an effort to integrate existing and future Earth observation systems in a "system of systems" in order to provide information for the benefits of society. In particular the purpose is "to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behaviour of the Earth system" [191]. The origin of GEOSS goes back to the First Earth Observation Summit convened in Washington, D.C., in July 2003. The EO summit adopted a Declaration establishing the ad hoc intergovernmental Group on Earth Observations (ad hoc GEO) to draft a 10-Year Implementation Plan of GEOSS for the period 2005-2015.

GEOSS aims to build upon existing initiatives capturing the success of the Earth observation research programmes, and facilitate their transition to sustained operational use. It will provide institutional mechanisms for ensuring the necessary level of coordination, strengthening and supplementation of existing global Earth observation systems[192] and later incorporate future ones. Apart from space based observations GEOSS aims also to incorporate in-situ and airborne observations.

Figure 24: The Global Earth Observation System of Systems (GEOSS) societal benefits areas

The building block of GEOSS would be established earth observation systems with networks like MARBEF, ALTER-Net, GTOS, GOOS, through countries cooperating as members of United Nations Specialized Agencies and Programmes and contributors to the international scientific community.

The GEOSS principle of cooperation enables the share of observations and products within the system and ensures that data is accessible, compatible and understandable by adopting common standards and adapting to user needs. Initially nine societal benefits areas have been identified where GEOSS will contribute[193]:

- Reducing loss of life and property from natural and human-induced disasters;
- Understanding environmental factors affecting human health and well-being;
- Improving management of energy resources;
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- Improving water resource management through better understanding of the water cycle;
- Improving weather information, forecasting, and warning;

[191] The Global Earth Observation System of Systems (GEOSS) 10-year Implementation plan (As adopted 16 Feb. 2005).
[192] The Global Earth Observation System of Systems (GEOSS) 10-year Implementation plan (As adopted 16 Feb. 2005).
[193] The Global Earth Observation System of Systems (GEOSS) 10-year Implementation plan (As adopted on 16 Feb. 2005).

- Improving the management and protection of terrestrial, coastal, and marine ecosystems;
- Supporting sustainable agriculture and combating desertification;
- Understanding, monitoring, and conserving biodiversity.

The contribution of GEOSS in these areas will also be a step toward the challenges posed in the 2002 World Summit on Sustainable Development, including the Millennium Development Goals (MDG). Additionally, it responds to the 2008 G8 Summit in Toyako (Hokkaido, Japan) and the 2009 G8 Summit in L'Aquila (Italy) to accelerate GEOSS efforts to meet the growing demand for Earth observations. The Group on Earth Observation (GEO) implements the GEOSS.

5.2.2 Group on Earth Observation (GEO)

The Group on Earth Observation (GEO) is a coordination group that aims to achieve comprehensive, coordinated and sustained Earth Observation. The group is composed of four committees dealing with different aspects of Earth Observation: architecture data, user interface; capacity building, and science and technologies. The major project carried out by this organization is the Global Earth Observation System of Systems (GEOSS): using the different data coming from the individual missions of Member States through an efficient data management system and through sharing the observation data of our planet, could be considered completed and reliable information. The Strategic Goals of GEO in Support of GEOSS are[194]:

- Sustain operation of comprehensive and coordinated Earth observation networks that meet user requirements in support of informed decision making;
- Sustain operations of the shared architectural GEOSS components and related information infrastructure;
- Address the need for timely, global and open data sharing across borders and disciplines, within the framework of national policies and international obligations, to maximize the value and benefit of Earth observation investments;
- Implement interoperability amongst observational, modelling, data assimilation and prediction systems;
- Foster research and development activities and coherent planning for future observation and information systems;
- Catalyze national, regional and global investments in scientific and technological advances and innovative approaches for upgrading and expanding Earth observations;
- Build the capacity of individuals, institutions and infrastructures to benefit from and contribute to GEOSS, particularly in developing countries.

To complete this programme and create a system formed by different systems, data policy and the sharing of information and knowledge are essential. The Group has a plenary assembly composed of all the Member States and international organizations that are part of the coordination group. The plenary meets once a year and is in charge of approving the work of the working group and giving the general direction to GEO. It has a permanent secretariat that supports all the activities of GEO as well as those of the working groups. The agreements decided by consensus during the plenary meeting are carried out by the Executive Co mmittee, which is composed of the representatives of the five GEO regions present at the plenary session. The total members of this committee are thirteen: three for the Americas, three for Europe, four for Asia, two representatives from Africa and a representative of the Community of Independent States. The Plenary session normally appoints by consensus four Co-chairs that have to prepare the work of both the plenary and the Executive Committee, and report to the Assembly about the work of other bodies. Normally the five co-chairs are appointed using a rotation system among the geo-regions, to facilitate procedures and avoid useless challenges. Funds are gathered by GEO through the international mechanism or by the national contribution of Member States or Organizations; specific project or initiatives can be funded also by other entities not directly involved in the group.

The basic document of the group is the "10 Year Implementation Plan" adopted in February 2005, which sums up the essential steps that must be taken to create an efficient system of systems in EO, in a coordinated comprehensive and sustained endeavour. The effective actions that the GEO wants to put in place are in the areas of reducing the effect of man-made disasters, managing the resources of the planet including water, improving the capacity of weather forecasting, protecting

[194]GEO-VI.. GEOSS Strategic Targets Document 12(Rev1). As accepted at GEO-VI. 17-18 Nov. 2009.

the different ecosystems, combating desertification through new agriculture and eventually conserving biodiversity. All these areas of competence are compatible with European environmental policy. The EU has to play an active role in this coordination group to contribute to global sustainable development through an adequate environmental set of measures and enabling technologies. GMES has been identified as the European contribution to GEOSS. GMES is a good example of a system of systems since it combines in situ with space-based data to obtain a comprehensive outcome. The contribution of GMES can be summarised by mentioning that it can be used as an example for integration and can be considered as a major contributing system to GEOSS. Furthermore coordinated action of EU Member States from inside GEO (where many of them are members) can contribute to the way forward for Europe as one of the major players in environmental space-based policy.

5.2.3 European Involvement

The GEOSS with its objective of providing information for societal benefit in areas such as disasters, health, energy, water, weather, agriculture, biodiversity is at the core of the European interest in being able to make informed decisions for the benefit of its citizens. The involvement of the EU in GEOSS is via its Framework Programme for research, technological development and demonstration activities (2007-2013)[195]. There are currently various regional and national European contributions to GEOSS[196] (e.g. GOS, COSMO-skyMed), and the future European GMES will be the contribution at the EU level. A table with GMES contributing missions can be found in Appendix 2 The various GMES services will represent a significant contribution from the EU to the GEOSS and will put Europe at the forefront of international cooperation. GMES has already adopted an open access data policy. There are a variety of research projects that have been funded under the FP7 program in support of the GEOSS and GMES development of applications in the nine areas.

There are already various missions from ESA that are contributing to GEOSS, such as GOCE, SMOS and Crysat. Additionally, the ESA and FAO developed together the ESA-FAP GEOportal as the gateway to the Global Earth Observation data, information and services. This GEOportal was one of the three candidates developed in response to the set of requirements from the GEO Secretariat aiming at the implementation of a GEO Web Portal serving the GEO User community. The GEOportal is now operational and is based on the GEO data sharing principle for full and open exchange of data.

[195] The European Parliament and the Council of the European Union. Decision No 1982/2006/EC of the European Parliament Concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) of 18 Dec. 2006.
[196]“ Earth Observation.” European Commission.
<http://ec.europa.eu/research/environment/index_en.cfm?section=geo&pg=geoss>.

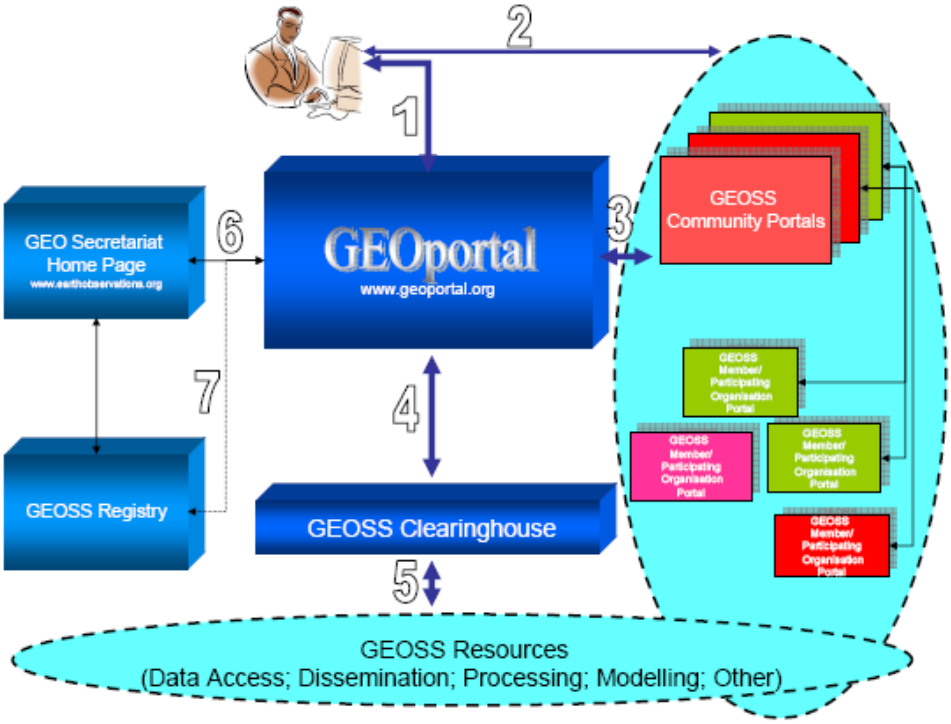

Figure 25: GEOportal and interaction with other GEOSS components[197]

5.3 Europe's International Cooperation and Bilateral Agreements

5.3.1 EU and Africa

The EU-Africa summit, held in December 2007 in Lisbon, concluded a new Africa-EU strategic partnership, marking a qualitative leap in relations between the two continents. The Joint Africa-EU Strategy provides an overarching long-term framework for Africa-EU relations, while its first action plan specifies concrete proposals for 2008-2010, structured along eight (8) Africa-EU strategic partnerships. Priority 8 explicitly includes space, but space also covers other priority such as area 6, environment. Rather than creating new instruments, the existing ones will have to be streamlined to finance the new partnerships. The second action plan covering 2011-2013 maintains the 8 priority areas. In both action plans in use, there are two initiatives relating to GMES and Galileo and its extension and provisions in Africa.

Africa is the continent where the scientific and digital divides are the widest. The Millennium Development Goals (MDGs) identify the essential role of science and technology for socio-economic transformation. Investments in African scientific capacities have not been prioritized and the continent is losing some of its best scientific and technical expertise to other regions. It is in this context that the Africa's Science and Technology Consolidated Plan of Action was developed, consolidating the African Union (AU) Commission and New Partnership for Africa's Development (NEPAD) programmes related to science and technology capacity building, knowledge production and technological innovation.

5.3.2 EU and Brazil

Diplomatic relationships were established between the EU and Brazil in 1960. Several initiatives have sought to formalize the close links between Brazil and European countries beginning with the Framework Agreement for Cooperation between the European Economic Community and Brazil in 1992 . This Framework agreement governs the present relationship between them in addition to the EU-Mercosul Framework Co-operation Agreement (1995) and the Agreement for Scientific and Technological cooperation (2004).

[197] Mirko Albani, Hermann Ludwig Moeller, Jolyon Martin. "Position Paper The ESA-FAO GEOportal – Operational Gateway to GEOSS". European Space Agency.

In order to further deepen its ties with Brazil, based on their close historical, cultural and economic issues, the EU recommended in May 2007 to launch a strategic partnership which was accomplished in June 2007 with the EU-Brazil: Strategic Partnership.

The 1992 Agreement for Cooperation is a short agreement. Under this agreement cooperation between Brazil and the European Community is based on respect for democratic principles and human rights. As concerns economic cooperation, the focus of attention went to industry, the use of natural resources (against a background of sustainable development), data processing, electronics, telecommunications, the use of space technology, environment and energy, among others. Concretely, in the field of information technology and telecommunications and the use of space technology, the parties recognized that information technology and telecommunications are vital to the development of the economy and society.

The strategic partnership between EU and Brazil is in both their interests. Several areas and sectors at the global, regional and bilateral levels were considered by the European Commission for closer cooperation. The following are highlighted: strengthen co-operation in all international fora, by consulting systematically ahead of important UN and other meetings; EU and Brazil should co-operate closely to support and further develop the global non-proliferation regime; raising human rights standards, fostering democracy and governance; achieving the Millennium Development Goals and promoting regional and social development; dialogues on social, employment and regional policy issues; protecting the environment; strengthening energy cooperation; reinforcing trade and economic relations; science, technology and innovation: co-operation on the European Satellite Navigation Programme, Galileo, should be further intensified through a new co-operation agreement.

The Agreement for Scientific and Technological Cooperation between the European Community and the Federative Republic of Brazil was signed in 2004 and entered into force in 2007. This agreement is based on the principles of mutual benefit based on an overall balance of advantages, reciprocal access to the activities of research and technological development undertaken by each Party and the appropriate protection of intellectual property rights.

Regarding cooperation in the field of space, Brazil was invited to participate in the European satellite navigation system, Galileo. Several expressions of interest on various occasions at different levels were demonstrated but no official position was transmitted to the European Commission. On May 2005 GEONSAT was created, which is an inter-ministerial group headed by the Brazilian Space Agency, with the task of preparing the decision on Brazilian's participation in the Galileo programme. On 25-26 November 2009, the Galileo Networking Meeting for Industry for Latin America took place. On 4 April 2011, the European Commission met with the Brazilian Minister of Science and Technology, to revive cooperation in the space field.

5.3.3 EU and Canada

Canada is one of the oldest partners of the Union. Their cooperation dates back to the 1950's. It started as an economic relationship and soon became strategic. The EU and Canada work together on global challenges such as the environment, climate change, energy security, non-proliferation of nuclear weapons, crisis management, and regional stability[198]. In 1976 the EEC and Canada signed a framework agreement on Economic Cooperation. Later, in 1990, the Declaration on Transatlantic Relations was adopted. The main achievement of this document was the establishment of regular periodic meetings at Summit level. This was renewed in 1996 by the Political Declaration on EU-Canada relations. In 2004, at the Ottawa Summit the EU-Canada Partnership Agenda was adopted. The items highlighted by the 2004 Agenda are: security and effective multilateralism; advancing global economic prosperity; justice and home affaires; cooperating in global and regional challenges. In order to advance these, a Dialogue at political level is envisaged by the Agenda. Canada also takes part in crisis management and international missions along with the EU. The latest EU-Canada Summit took place in May 2010 in Brussels. At this meeting the leaders of both parties confirmed their commitment to the points listed on the Agenda. Inter alia, they stressed the will to continue to tackle climate change through high level measures; for this the leaders stated that cooperation should focus on a financing mechanism to support "greener" development in third countries.

After several years of Canada's collaboration with Europe in space activities, Canada established a formal relationship with ESA in 1976; only one year after the creation of the agency. Canada joined ESA with an associate membership in a unique status: it was allowed to participate in optional pro-

[198] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/er/114195.pdf

grammes and its contribution to the General Budget was considerably lower. This meant that it would have voting rights when its financial interests were involved. The first agreement between ESA and Canada was signed in 1979 and was to be in force between 1979 and 1983. In this cooperation agreement the parties established Canada's financial contribution for general studies concerning future projects. It was also agreed that its general budget contribution would be 1% of ESA's global budget. The second cooperation agreement appeared in 1984, which ran until 1988. In this agreement the general budget contribution rose to 3% and all the previous agreements were reaffirmed. The third agreement came in 1989, until 1999. Of the three agreements reached between the ESA and Canada, the last one was always excluded from the basic Technology Research Programme. In 2000, the cooperation agreement was renewed and came into force for ten years[199]. Recently Canada has reinforced its relations with Europe in the space sector. In December 2010 Canada renewed the association agreement with ESA. The cooperation is now extended until 2020.

In the field of scientific and technological cooperation, Canada and the EU signed a Treaty in 1996[200] and amended it in 1999[201]. It refers to the 1976 Framework agreement and the 1990 Declaration and aims at encouraging and facilitating cooperation in fields of common interest. The main areas of cooperation identified are: agriculture, including fisheries; medical and health research; non-nuclear energy; environment, including earth observation; forestry; information technologies; communication technologies; telematics for economic and social development; mineral processing. The forms of cooperation and the implementation of the treaty are under the control of the Joint Science and Technologies Cooperation Committee

In the 2009 road map for the EC-Canada scientific and technological cooperation agreement in the field of space, the following co-operation areas were identified: GMES/Earth observation (particular interest in ice and coastal monitoring and forest management), noting that Canada is already participating in the Sentinels programme via ESA; integration of SatCom/SatNav with GMES; GMES and Climate Change; Space Science and Exploration; Space Situational Awareness and reducing the vulnerability of Space Assets – Space Weather, Space Debris[202]. In the area of global navigation Canada does not have its own navigation system but in the past had already expressed interest in cooperating with Europe in the development of Galileo. This interest was reaffirmed in the 2009 road map where Canada expressed its interest to pursue discussions with the Commission to secure a continuing role in the development and operationalization of Galileo. Canada can take part in projects funded by the European Union via the Framework Programmes. Therefore Canada has taken part in more then 80 projects, some of which are related to GMES. In particular it participates though FP7 in projects aiming to develop services for GMES (e.g My Ocean[203]). Moreover Canada has offered the data from certain national missions as contribution to the dataset of GMES. In particular Canada is providing data from Radarsat1 and Radarsat2. This data is an all time imagery of the earth surface produced by synthetic aperture radar.

5.3.4 The EU and China

China and the EU are the second largest trading partners after the US. China is the EU's biggest trading partner and the EU's largest source of imports. The relationship between China and the EU was initiated in 1975, which led to the entering into of the 1985 EU-China Trade Cooperation Agreement (TCA). The comprehensive EU-China strategic partnership was launched in 2003, and was followed by the communication "EU-China: Closer Partners, Growing Responsibilities". In 2003, China released a White Paper on relations with the EU which was the first ever released paper with a foreign partner. The new EU-China Partnership and Cooperation Agreement (PCA) was launched in 2007, reflecting upon the EU-China Comprehensive Strategic Partnership. In 2009, global issues were discussed at the 12th EU-China Summit in Nanjing; these issues included energy and climate change, energy, resource security, food security, and environment. In 2010, China and the EU furthered their bilateral relations in foreign affairs, security matters and global challenges, including climate change. The latest EU-China Summit took place in Brussels on 6 October 2010. Regarding climate change, the partnership was established in 2005 at the EU-China Summit, focusing on clean energy technology of "zero emissions". In science and technology, in 1998 they signed a

[199] Dotto, Lydia. Canada and the European Space Agency. Three Decades of Cooperation. European Space Agency. 09 May 2011. < http://www.esa.int/esapub/hsr/HSR_25.pdf>.
[200] Council of the European Union.Council Decision considering the Conclusions of the Agreemetn for Scientific and Technological Cooperation between the European Community and Canada.26 Feb. 1996
[201] Amended by the Agreement amending the Agreement for Scientific and Technological Cooperation between the European Community and Canada. OJ L156 of 23/06/1999, p.24.
[202] EC-Canada Scientific and Technological Cooperation Agreement Road Map Document. Jul. 2009 23 Apr.2011.
[203] Aimed at creating the infrastructure to deliver the data for the marine fast track of GMES.

cooperation agreement that was renewed at the Nanjing Summit, and concerns research under FP7 (2007-2013). China has also participated in the flagship Galileo project as part of the sectoral agreement and dialogue under the S&T Cooperation.

5.3.5 EU and India

The relationship between the EU and India dates back to the 1960's. In 1993, a joint political statement was issued and a Cooperation Agreement was signed in 1994, which gave the legislative framework for mutual cooperation. In 2004, India became EU's strategic partner, and in 2005, they adopted a Joint Action Plan that was revised in 2008. It included the implementation of the joint work programme on climate change adopted during the last summit in 2008. The joint Country Strategy Paper for India 2007-2013 considers issues such as: the environment considering environmental resources, establishing environmental standards, and promoting environmental certification and indicators; and developing institutional capacity and technical responses for climate change, waste, water issues, etc. In implementation, the action plan earmarked funding for economic policy dialogue and cooperation in sectors including transport, environment, science and technology, and space technology.

5.3.6 The EU and Israel

The EU and Israel have a long history of successful scientific and technological cooperation[204]. The main programme in which Israel participates is the EU Research and Technological Development Framework Programme (FP).

Since 1996, Israel has been the only non-European country associated with the Framework Programmes. The most recent of the agreements that govern Israel's participation in the programmes was signed in July 2007, and provides Israeli researchers, universities and companies with full access to the 7th RTD Framework Programme (FP7). In addition, Israeli representatives participate as observers in the FP7 implementing committees and bodies. Israel is set to contribute over €440 million to the €50 billion budget of the FP7. There are a number of other EU and European programmes and instruments for scientific cooperation in which Israeli entities may participate.

The EU's relations with Israel are governed by the EU-Israel Association Agreement, which has been in force since 2000. The Agreement includes a section on environmental cooperation and provides for regular formal meetings. The European Neighbourhood Policy came into force in 2004, and provided a framework for the deepening of the EU's relations with its Mediterranean and Eastern European neighbours.

The central element of the European Neighbourhood Policy (ENP)[205][206] is the bilateral ENP Action Plan agreed between the EU and each partner. The action plan includes the following priorities:

- Promote co-operation in transport, energy and telecom networks: in the transport field, co-operation in the Galileo initiative in particular and in the areas of air, maritime and road safety; in the energy sector, exploring gradual convergence towards the principles of the EU internal electricity and gas markets, development of energy networks and regional co-operation; in the science and technology area, promote the information society through the use of new technologies and electronic means of communications by businesses, government and citizens, as well as strengthening scientific and business links
- Strengthen the environmental dimension of public policy and EU-Israel co-operation: promotion of sustainable development policies and actions, including on climate change and water pollution

The strong cooperation of Israel with Europe for the environment and in particular in relation to GMES is achieved through its participation in the Framework Programme of the EU.

[204]European Union-Delegation of EU to Israel- 9 Jan..2011 <http://ec.europa.eu/delegations/israel/eu_israel/scientific_cooperation/scientific_cooperation/index_en.htm>.
[205]Commission of the European Communities. Communication from the Commission to the Council and the European Parliament on Wider Europe — Neighbourhood: A New Framework for Relations with our Eastern and Southern Neighbours.COM (2003) 104 final 11Mar.2003 < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2003:0104:FIN:EN:PDF>.
[206]Commission of the European Communities. Communication from the Commission to the Council Communication from the Commission to the Council on the Commission proposals for Action Plans under the European Neighbourhood Policy (ENP).COM (2004) 795 final of 9 Dec.2004 < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2004:0795:FIN:EN:PDF>

In 2005, Israel became a member of the Galileo Joint Undertaking. Israel committed to contribute EUR 18 million to the Galileo Joint Undertaking for activities in the development phase of the Galileo Programme. This agreement provides for co-operative activities on satellite navigation and timing in a wide range of sectors, notably science and technology, industrial manufacturing, service and market development, as well as standardisation, frequencies and certification.

5.3.7 The EU and Japan

The European Union and Japan are committed to building a cooperative global partnership, in order to move forward on their positions as leading world economic powers and to shape developments in a mutually beneficial way. The first step that led to this cooperation dates back to 1991, with the signing of the Joint Declaration between Japan and the European Community and its Member States[207]. This Joint Declaration constituted an agreement between both parties, setting the principles and the objectives of integrated dialogue and cooperation and it also provided a framework for meetings between the President of the European Council, the President of the European Commission and the Japanese Prime Minister, at high or ministerial level. Furthermore, the Declaration initiated a political dialogue and the strengthening of trade, economic, and cooperation on common and global challenges.

The second step towards intensive cooperation, due to a steady bilateral political dialogue, is anchored in the Action Plan of 2001[208]. This Action Plan, a result-oriented partnership over a ten-year period, has many objectives including: promoting peace and security: arms control, disarmament, democracy, peace building and human rights; strengthening the economic and trade partnership: encouraging the bilateral trade and Investment partnership, strengthening cooperation on information and communication technology; coping with global and societal challenges; bringing people and cultures together.

Along with this Action Plan, the EU and Japan recognized that Science and Technology were key elements for enhancing competitiveness as well as for sustainable economic and social development. EU-Japan cooperation can help address major scientific, industrial and societal issues and be of mutual benefit to our societies. Since then, the scientific and technological relations between the parties have been improved. The European Union and its partners became aware that Japan has high-level scientists and research institutions, as well as innovative companies of huge potential. For this reason, Japan was invited to participate in the EU 6th Framework Programme for Research (FP6)[209] as well as the EU 7th Framework Programme for Research (FP7)[210]. For the FP7, the European Commission proposed a seven years duration project (2007 to 2013), and a structure based on four specific programmes: Cooperation, Ideas, People and Capacities.

From an economic point of view, the EU and Japan continue to work bilaterally on market-access restrictions. However, the main focus has changed to investment-related issues and regulatory matters. The Regulatory Reform Dialogue (RRD)[211] has taken place, annually, since 1994, in which both parties present specific proposals for deregulation. From the EU side these include issues such as telecommunications, air and sea transport, foreign direct investment, etc. Japan raises issues such as environmental legislation, accounting standards, work and residence permits.

More recently, at the EU-Japan summit in 2004, the Cooperation Framework for Two-Way Investment Promotion[212] was signed. All of the values hitherto outlined were reaffirmed in the last annual EU-Japan Summit Joint Statement[213], in June 2010.

Along with Galileo, Japan is developing the Multi-functional Transport Satellite (MTSAT) Satellite-based Augmentation System (MSAS), which also complies with ICAO standards and recommended practices. MSAS was created to provide navigation service for aircraft within Japanese airspace. On the other hand, Japan also owns a regional space-based, all-weather, continuous positioning, navigation and timing system that provides signals for GPS - Quasi-Zenith Satellite System[214]. This

[207] "Joint Declaration on Relations between the European Community and its Member States and Japan." 18 Jul. 1998. The Hague. <http://www.eeas.europa.eu/japan/docs/joint_pol_decl_en.pdf>.
[208] European Union. Shaping our Common Future an Action Plan for EU-Japan Cooperation.2001. Brussels. <http://eeas.europa.eu/japan/docs/actionplan2001_en.pdf>.
[209] The EU 6th Framework Programme for Research (FP6). <http://www.deljpn.ec.europa.eu/modules/programme/fp6/index.html>.
210The EU 7th Framework Programme for Research (FP7) <http://ec.europa.eu/research/future/documents_en.cfm>.
[211] The EU-Japan Regulatory Reform Dialogue (RRD) <http://eeas.europa.eu/japan/regulatory_reform_en.htm>.
[212] Cooperation Framework for Promotion of Japan-EU Two-Way Investment. <http://eeas.europa.eu/japan/docs/2004_invest_en.pdf>.
[213] EU-Japan Summit Joint Statement. EU News 12/2010. <http://www.deljpn.ec.europa.eu/modules/media/2010/100429.html>.
[214] Pagkratis, Spyros. "Space Policies, Issues and Trends in 2009/2010." European Space Policy Institute, Report 23. Jun 2010.

system is a three-satellite regional time transfer system and enhancement for the Global Positioning System[215]. The QZSS was designed to reach compatibility and interoperability with other systems. For example, QZSS signals were successfully designed as GPS common signals and they are fully interoperable and compatible. Concerning Galileo, JAXA and the European Union have met six times to assure compatibility between Galileo and QZSS but the process is not yet complete.

The European Space Agency has established cooperative relations with Japan. One of the most important agreements dates from 1998 and was signed in Washington: The Inter-Governmental Agreement (ICA) concerning cooperation on the civil international space station. Japan was the first partner to deposit its instrument of ratification[216].

5.3.8 The EU and Mexico

Mexico was the first Latin American Country to enter into cooperation with the European Union. In 1997 the "Economic Partnership, Political Coordination and Cooperation Agreement" was signed, however it only entered into force in 2000. This instrument was the basis for cooperation in certain areas inter alia: social cohesion, justice and human rights, sustainable development, science and technology, education and culture[217] In 2008 the Commission proposed a Communication in order to begin a strategic cooperation with Mexico[218]. This document set up the framework to strengthen relations between the Parties at both bilateral and multilateral levels. The Commission defined Mexico as a "Like-minded Country"[219] and on this basis proposed the adoption of a strategic Cooperation. Cooperation is designed with a two level approach in order to take into consideration the former relations established under the Agreement of 1997 and to integrate the latter with the new institution of a Partnership. In order to implement the Cooperation between the actors, the Council prepared the Mexico – European Union Strategic Partnership Joint Executive Plan[220.]

In the area of research, in 2004 the EU and Mexico signed an agreement to establish cooperation on the principles of mutual benefit and exchange of information. A steering Committee for the implementation of this agreement was established. This agreement envisages also the participation of Mexican researchers and institutions in the Framework Programmes[221]. Mexico is taking part in FP7 under the provision of the treaty of 2004. About forty projects have been founded via the FP7 in different areas of research, two of which were devoted to the application of GMES technologies.

Mexico does not have a GNSS system; however relations with the EU have been carried out in the framework of the EU Latin America Summit. During the Summit held in Guadalajara (2004), the political support of the regional group to Galileo was confirmed. Also information days about Galileo have been held in Mexico[222]. The cooperation is also more concrete using the Galileo Information Centre for Latin America. This Centre aims to support the use of Galileo in this region and to strengthen the links between the stakeholders in GNSS activity[223].

The GMES programme can be useful in many areas of the Mexico-EU agreement; in particular GMES can help face the issues of the environment and sustainable development, and human security. Mexico is currently taking part in two projects related to the development of GMES and fi-

[215] United Nations, Office for Outer Space Affairs, International Committee on GNSS "Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentation Systems United Nations - Office for Outer Space Affairs, 2010 < http://www.oosa.unvienna.org/pdf/publications/icg_ebook.pdf>.

[216] Farand, A. The Space Station Cooperation Framework. European Space Agency. <http://www.esa.int/esapub/bulletin/bullet94/FARAND.pdf>.

[217] Economic Partnership, Political Coordination and Cooperation Agreement between the European Community and its Member States, of the one part, and the United Mexican States of the other Part. 3 Feb. 2004. OJ L 290/20 < http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:276:0045:0061:EN:PDF>.

[218] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament: Towards an EU-Mexico Strategic Partnership. COM(2008) 447 final of 15 Jul. 2008 Brussels. <http://eeas.europa.eu/mexico/docs/com08_447_en.pdf >.

[219] Commission of the European Communities. Communication from the Commission to the Council and the European Parliament: Towards an EU-Mexico Strategic Partnership. COM (2008) 447 final of 15 Jul. 2008 Brussels.p5<http://eeas.europa.eu/mexico/docs/com08_447_en.pdf>.

[220] Council of the European Union. Mexico – European Union Strategic Partnership Joint Executive Plan. 9820/10 PRESSE 126 Comillas, 16 May. 2010 <http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/er/114467.pdf >.

[221] Agreement for Scientific and Technological Cooperation between the European Community and the United Mexican States. Brussels 3 Feb. 2004 . OJ of 4.11.2005 L 290/17 <http://eur-lex.europa.eu/LexUriServ/site/en/oj/2005/l_290/l_29020051104en00170024.pdf>.

[222] Francisco Salabert: European Union cooperation activities with Latin America on GNSS. Galileo Joint Undertaking December 2005 .http://www.galileoic.org/la/files/GIC%20Inaguration%20-%20Cooperation%20activities%20with%20%20Latin%20America.pdf page 2

[223] GNSS Supervisory Authority GALILEO Information Centre for Latin America 20Apr. 2011 http://www.gsa.europa.eu/go/galileo/international-co-operation/galileo-information-centre-for-latin-america/galileo-information-centre-for-latin-america

nanced via the EU FP7. The first project, called SIRIUS, aims to create efficient water resource management in water-scarce environments. In particular this project focus on the use of water for food production to develop a sustainable agricultural system[224]. Mexico is also involved in RECOVER. This project aims to manage and control deforestation and the degradation of forests all over the world using the integrated data of an EO system[225].

5.3.9 The EU and Russia

Russia is the EU's third biggest trade partner after the United States and China. Cooperation between the Union and Russia currently revolves around specific areas including: economic issues and environment; freedom, security and justice; external security; research and education. Their cooperation deals with a number of issues dealing with climate change, drugs and human trafficking, organised crime, counter terrorism, non-proliferation, the Middle East peace process and Iran. The Partnership and Cooperation Agreement (PCA) between the EU and Russia was signed in 1994, and was amended in 2007[226]. There is a financial cooperation programme to support the common activities. New negotiations for an updated agreement between Russia and the EU were initiated in June 2008, at the Khanty-Mansyisk summit.

After the EU-Russia summit in Moscow on 10 May 2005, a roadmap for the creation of the EU-Russia Common Spaces was adopted which resulted in an agreement for EU-Russia dialogue on space cooperation. This was later signed on 10 March 2006, in Brussels between the European Commission, the European Space Agency and the Russian Federal Space Agency. The areas of the strategic dialogue focus on space applications; in particular they focus on: earth observation, Global Navigation Satellite Systems (GNSS), satellite communications; access to space and space transport systems; space exploration and the use of the International Space Station (ISS); and space technologies development.

Regarding GMES, GEOSS, and GNSS, the following objectives were specified:

- Provide an appropriate environment for fruitful cooperation in satellite communication and Earth Observation, in particular in relation to the Global Monitoring for Environment and Security (GMES) programme and for joint projects in satellite communication
- Enhance and strengthen cooperation on GNSS on compatibility and interoperability, in particular between the Galileo and GLONASS system, and create favourable conditions for industrial and technical cooperation for this purpose.
- Coordinate the EU and Russian positions towards the implementations of the space component of the Global Earth Observation System of the Systems (GEOSS)

5.3.10 The EU and the United States

The United States of America and the European Union have the largest bilateral trade agreement in the world. Diplomatic relations between the U.S. and the EU date back to 1953, but the formal cooperation was establsihed in the Transatlantic Declaration in 1990. The New Agenda of 1995 provides the foundations of this relationship. The principles of the partnership are economic cooperation; education, scientific and cultural cooperation; and transnational challenges including terrorism, crime, proliferation, environment.

The European Commission came forward with the Strategy Framework for International Science & Technology Cooperation to strengthen the international dimension of the European Research area. Major scientific challenges are increasingly global which argues for an increased emphasis on international science and technology cooperation. In 1997 the parties signed, an Agreement for scientific and technological cooperation between the European Community and the Government of the United States of America - Intellectual property, which would enter into force in 1998. This agreement encouraged the parties to develop and facilitate cooperative activities in fields of common interest where they pursued research and development activities in science and technology. It remained in force until 2008.

[224]Sustainable Irrigation water management and River-basin governance: Implementing User-driven Services (SIRIUS) 20 Apr. 2011
http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&QUERY=012f975c4bea:d2e1:4b4c8d1e&RCN=96852
[225]Science based remote sensing services to support REDD and sustainable forest management in tropical region (RECOVER)
http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&QUERY=012f975dae75:239a:4ecb7040&RCN=96835
[226]OJ L 119, 9.5.2007

U.S.-EU. space cooperation is based on the Agreement signed on 26 June 2004 between the Government of the United States of America and the European Community on the promotion, provision and use of Galileo and GPS satellite-based navigation systems and related applications. Following the US-EU Summit in 2005, the US and EU initiated a "Dialogue on Civil Space Cooperation", whereby both parties agreed to promote cooperation in space applications in key areas, including: earth observation (GMES), satellite navigation (Galileo, GPS), and to provide support to developing countries for space related activities. In 2008 the first US-EU Plenary meeting on satellite navigation was held in Washington. Additionally, the 2009 'roadmap' document sets the basis for scientific and technological cooperation between them, which also includes issues regarding space, earth observation, security and Galileo. A EU-US Joint Statement on Galileo/GPS continuing cooperation to ensure interoperability was signed in October 2008. An initial phase of consultations between the EU and US affirming user interoperability and enhanced performance of combined GPS and Galileo receivers was concluded in July 2010. The result of these consultations in the Working Group meeting was the release of two papers, the Combined Performances for SBAS Receivers Using WAAS and EGNOS and the Combined Performances for Open GPS/Galileo Receivers.

In April 2010, transatlantic cooperation in Earth Observation was discussed, specifically the need to promote full and open exchange of civil Earth Observation data and geospatial dialogue. At the end of this meeting, it was agreed to organize an EU-US workshop in order to identify areas for cooperation in the use of space infrastructures and applications to fight climate change. Additionally, transatlantic cooperation was extended to space situational awareness, to protect critical space infrastructure through tracking of space debris and monitoring of space weather, where the main actors were: The European Space Agency and EUMESTSAT (European Organisation for the Exploitation of Meteorological Satellites) on the European side, and NASA (National Aeronautics and Space Administration), NOAA (National Ocean and Atmospheric Administration) and USGS (U.S. Geological Survey) on the U.S. side. Four working groups and an annual plenary meeting were set up on satellite navigation to address trade and civil applications, radio frequency compatibility and interoperability, cooperation on the next generation of civil satellite-based navigation and timing systems, security issues relating to GPS and Galileo.

ESA plays a role in all the areas that form the six programmatic pillars for transatlantic cooperation, which are Space science, human spaceflight, satellite navigation, meteorology, Earth science and Earth observation and Space exploration. Currently, ESA has the National Aeronautics and Space Administration (NASA), the National Oceanic Atmospheric Administration (NOAA) and the US Geological Survey (USGS) as main partners, although it maintains contact with the US government. In March 2007, an agreement was signed by ESA and NASA to extend their cooperation in the areas of satellite tracking, spacecraft navigation and mission operations. In May 2008, ESA used Mars Express to monitor and record the entry and descent of NASA's Phoenix mission to Mars. Another example of cooperation is Europe's regular use of orbital object data supplied by the US Space Surveillance Network.

6. Conclusions and Recommendations

6.1 The Setting

The Member States of the European Union have longstanding cooperation in the field of space that dates back to the early sixties with the creation of the European Launcher Development Organization (ELDO) and the European Space Research Organization (ESRO), the predecessors of the European Space Agency (ESA). Through ESA the Members States have achieved more than thirty-five years of successful collaboration and obtained experience in developing and launching satellites for their common objectives. In their space endeavours they have succeeded amongst others in the development of Europe's capabilities and independence in the field of weather forecasting and satellite communications with EUMETSAT and EUTELSAT, placing Europe at the forefront of the international community.

In 1998 the European Commission started its involvement in the space field with the birth of Europe's two flagship programmes: Galileo (and its augmentation system EGNOS) and GMES. These projects are essential political and economic milestones for the non-dependence and sovereignty of Europe's Member States and the Union as a whole. They will enable non-dependence on third party assets that are essential for drawing up and implementing core policy elements. In developing Galileo/EGNOS the Commission made efforts that did not go as planned and various corrective actions had to be implemented. At various times this has resulted in negative media coverage of Galileo which has diverted the public (general public and decision makers) from the fundamental questions of the need for Europe's flagship programmes. Additionally, miscalculations regarding the costs, inappropriate studies regarding the market share and speculation about the economic benefits have also been misleading. The main need for these flagship projects is not economic as is often projected, neither is it technological superiority. Europe needs to support the completion of these flagship programmes for three main reasons.

First and foremost, it needs them for the Union's and its Member States non-dependence on third parties for strategic infrastructure. The use of positioning and navigation and earth observation systems have become today an indispensable part of everyday life and are used as an essential component to perform many of our routine daily and economic activities e.g. banking, railways and aeronautics, rail and road traffic, search and rescue, etc. One often hears "Why does Europe need Galileo when there is GPS?" and the answer is that for such an essential infrastructure element, one needs to rely on European controlled systems and not foreign military controlled systems. Even though it is unlikely that the US or Russia will turn off the signals to Europe[227], the need for a system that is controlled by the Union and its Member States is essential and the guaranteed interoperability with other GNSS will also achieve redundancy and better quality of service.

The second reason is that due to the transverse nature of space, the two flagship programmes are important for drawing up and realizing various European policies such as agriculture, energy, environment, external, fisheries, regional development, transport, etc. These infrastructure assets can provide the decision makers at European, national and regional level with the necessary information to make informed decisions. They can assist in real-time monitoring of the progress of the policy implementation and enable fast corrective measures. These assets are part of the developing market of downstream applications and can support Europe in achieving its Europe 2020 goals to become a "smart, sustainable and inclusive growth economy" and contribute to the five identified objectives on innovation, employment, education, social inclusion and climate change.

The third reason is the role of Europe and its Member States vis-à-vis the international community. When Europe announced its intention to develop Galileo back in 1998 it triggered a series of

[227] Examples of problems with GPS: 1) During the 1999 Kosovo conflict the US military 'manipulated' GPS to support military operations; 2) On 6 Mar. 2011, in San Diego, California, there was disruption in ATM banking, traffic management etc. when the GPS signal failed. This was due to the fact that the satellite signal was of low quality. <http://www.newscientist.com/article/dn20202-gps-chaos-how-a-30-box-can-jam-your-life.html>.
3) Jamming devices can be developed with off the shelf components that can jam the signal of GPS and cause major disruptions. Galileo can be used for redundancy to GPS ensuring signal integrity. In particular PRS users will be able to have an undisturbed signal.<http://www.gsa.europa.eu/go/news/prs-means-secure-satellite-navigation-for-sensitive-applications>.

events. The United States improved the quality of the GPS signal for civilian use and sped up the development of the future generation of GPS. The Chinese also announced their intention of developing their own system, Compass, with its first MEO satellite Compass M1 being launched in 2007 and expected to be completed between 2015 and 2020. The Indian local system IRNSS is planned to be operational by 2014. Additionally, there has been an international effort to make current and future systems interoperable and compatible. Furthermore, GMES Europe and the scientific community of its Member States are at the forefront of scientific and technological excellence. GMES is the European contribution to the international community for the Global Earth Observation Systems of Systems (GEOSS). Once the GMES system will be completed, Europe will have the most comprehensive space-based data collection system in the world. It will assist Europe in supporting its external policies particularly in development aid, disaster management in various countries including neighbouring Africa and will contribute to Europe's humanitarian image vis-à-vis the international community. It will also assist Europe fulfil its international obligations e.g. Kyoto. Thus, Europe has been exposed towards the international community with its initial ambitions and has raised the expectations of international partners. If Europe fails to live up to the expectations raised internationally this could potentially harm the integrity of the Union and its Member States in the international community.

The European Union has taken an important step with its political decision to include space as part of the Union's shared competence in the Lisbon Treaty. Already, Regulation 683/2008 put in place an autonomous satellite navigation system under EU ownership and management. The Global Monitoring for Environment and Security (GMES) is also under the Union's control. Additionally, in December 2010 it was decided to establish a User Forum for GMES and the first meeting took place in January 2011 to identify the top down needs GMES can fulfil. Even though it has taken more time than expected for streamlining the flagship programmes, it is now time to implement the lessons learned and ensure the success of the two programmes while avoiding additional delays that would result in higher costs and discontinuity of policies. European citizens support the two flagships in large numbers; in particular, 91% support the importance of Europe developing earth observation systems to monitor our environment including natural disasters, 67% to improve citizen's security and 67% the importance of developing an independent "European GPS" system. This gives politicians and decision makers at European, national and regional level the mandate to safeguard the two programmes. It is important though that the right financial, governance and legal mechanisms are put in place to ensure the success of the programmes. Europe is in need of a comprehensive mapping of European policies in relation to the benefits the two flagship programmes can bring. This study provided a list of objectives for the relevant European policies and indications of how the two flagship programmes can assist in fulfilling them. Additionally the relationship between Europe and its international strategic partners was investigated. From the information gathered a political, economic, social, technological and legal environmental factor analysis is used as a tool to draw policy recommendations.

6.2 Analysis and Recommendations by External Factor

Political

The Galileo development as a core infrastructure reflects Europe's political ambitions for non-dependence on third parties and its interest in boosting competitiveness. At the time when the decision was made to develop Galileo, only USA GPS and Russian Glonas were available. European ambitions stimulated other countries like China and India to also develop their own system. Additionally, it encouraged the USA to offer a more accurate signal for civilian use of its military system and the development of the next generation GPS which would have comparable technical characteristics to Galileo. Insufficient experience at the EC level and in political planning resulted in an inappropriate choice of governance scheme and financing mechanisms. This resulted in failing to smoothly meet objectives and this in turn has resulted in much political dissatisfaction and mistrust in the bodies responsible - EC and ESA. It was overlooked that ESA is a technical entity with successful stories of development, implementation, operation and exploitation initially for ESA and consequently for other established bodies like EUMETSAT and EUTELSAT. The Commission was a newcomer in the space sector without sufficient experience or appropriate management structure for dealing with large-scale infrastructure programmes. Nevertheless, since 2008 the programme has resumed with encouraging progress. It is now fully financed by community money under the responsibility of the Union with ESA as the technical implementation body and GSA as the body that will handle market development. The GMES flagship programme started after Galileo, with great strategic importance related to the role of the Union and its Member States as a global actor.

The GMES is the European contribution to the international community is supported by the national missions and aspires to provide a complete system providing services that can assist Europe in the implementation of its policies as well as its international obligations in relation to the environment and climate change, e.g. Kyoto. A very important component in Europe's international obligations is contributing GMES for Africa and assisting in the sustainable development of the continent to achieve the Millennium Development Goals. When GMES is completed it will comprise the most comprehensive space-based data collection system in the world and will show internationally how well Europe and its Member States can work together. Today, the full funding of the two programmes and the cost of its day-to-day operations after deployment has not been secured. The financial crisis and overall financial tightening in the European budget and its member states is posing threats to the completion of the programmes. Additionally the negative publicity Galileo has received in the media has harmed the reputation of the programmes. The fundamental ideas represented by these programmes are backed by the European citizens as statistics show giving sufficient "go ahead" to decision makers. The recommendations are:

- *Confirm political commitment.* Politicians and decision makers at European, national and local level need to confirm their political commitment to the need for the flagship programmes as part of essential infrastructure in Europe for non-dependence when it comes to strategic assets.
- *Capture adequately the policy objectives that the flagships can serve.* The flagships can serve various policy objectives in all main policy areas of the Union and those of its Member States, like agriculture, energy, environment, fisheries, foreign, regional development, transport, security, etc. These should be thoroughly examined, beyond what has been done today. The policy objectives need to be translated into concrete applications with action plans for implementation.
- *Enhance cooperation and coordination between the EU and Member States.* The EU and the Member States should work together in coordinating their needs and jointly developing applications projects to utilize the potential of the flagship applications to meet policy objectives and improve the life of citizens.
- *Enhance uptake by the users. The users need to become more informed of the benefits of the flagship programmes and to be supported to use them. User forums can be used as a tool and need to be strengthened to include representatives of all stake holders.*
- *Ensure successful governance.* Decision makers must ensure and safeguard the success of the programmes and promote the need for a successful governance scheme end-to-end taking into consideration the different time frames in the development of the programmes.
- *Confirm International commitments.* The Union and its Member States should ensure the programmes are fulfilled to support the political commitments made to the international community e.g. Kyoto, EU and Africa with GMES for Africa and EGNOS for Africa etc.

Economic

Political backing to the two flagship programmes certainly helped save Galileo when the public-private partnership (PPP) failed and has helped GMES move forwards. Unfortunately, miscalculations and speculation regarding the market share of the two flagships and commercial revenues have damaged the image of the projects. It has to be recognised that the main customers of these programmes are mainly institutitional users - this may change in the future but should not be a basis for calculations. The market need for navigation, positioning and earth observation data is increasing, but the return on investment for these programmes should be considered as the indirect return via downstream applications and social benefits. Unfortunately, the full financing of the two programmes today is not guaranteed from development to continuous operations. GMES is the only programme that has funds to build the satellites, launch, access and integrate to Member States missions but does not have money for the operational phase. Galileo is in a similar situation where not even the full constellation of satellites is guaranteed. It is important that the financing of the programmes is guaranteed throughout their operation in order not to waste the investment already made and increase cost overruns. Failure to ensure this will have an impact on data gaps, polices, jobs, businesses as well as the image of Europe vis-à-vis the international community. The recommendations are:

- *Ensure continuation of the financial instruments.* The funding provided by the European Union, the European Space Agency and Member States should be aligned and the financing should be guaranteed for the programmes' full development, deployment and basic operations.

- *Implement financial mechanisms stimulating the development of innovative downstream applications.* The market for navigation positioning and earth observation data is growing constantly. Financial mechanisms stimulating the development of novel downstream applications should be implemented. They should be based on public-private partnerships or by the involvement of investment banks. The expression of interest should be based on assessed business models. The additional risk of such development should not be borne by the Union but by private entities.
- *Investigate the implementation of alternative funding mechanisms.* The funding of such infrastructure should be fully through governmental investment and lessons learned from the failed PPP should be taken into consideration. If additional funding is required for the deployment of the full constellation, then the Member States whose industries are the main developers could contribute the additional budget. The operational phase requires continuous yearly funding throughout the duration of operations. As was the casewith the development and operations of EUMETSAT and Eutelsat, different funding schemes can be used during the operation phase. As the largest customer is the government a yearly contribution should be made to cover the main costs. Furthermore, once deployment and basic operations are secured, the further development stages of the programmes, in particular related to exploitation, could be implemented through different financing schemes.

Social

Space infrastructure like Galileo and GMES and their applications can assist decision makers and European citizens in improving everyday life by providing solutions in transport, disaster management, health, working conditions, urban development, energy, environment, safety, etc. There is mostly insufficient or misleading communication regarding these projects. Often the identification of Galileo/EGNOS and GMES as the European systems for navigation, positioning and earth observation is lacking. Where the public does identify e.g. Galileo they often associate it with media stories expressing negative views about the programmes. This is due to the fact that there are inconsistent and insufficient communication channels used to inform citizens about the projects, their rationale, usefulness and the direct benefits that citizens will be able to enjoy once fully functional. The recommendations are:

- *Increase awareness and enhance communication.* The European Commission, national and local governments as well as user communities and industry should develop appropriate communication strategies to provide correct and accurate information about the flagship programmes to avoid misinformation by media. The media should also be fed with correct and official information on a continuous basis. Such communication mechanisms could be seminars, workshops, open days to industrial sites, exhibitions of successfully implemented projects like EGNOS, information days, competitions, local information centres, radio and TV advertisements.
- *Demonstrate public benefits with examples.* Successful projects that have been developed using the flagships and provide benefits to citizens need to be showcased. It is important to demonstrate with real examples the benefits and advantage to the actors in the value chain.
- *Enhance the involvement of the user community.* European citizens should be involved in the exploitation of these flagships and the downstream applications. The free and open availability of data should be emphasized. There are various volunteer organizations that could benefit from use navigation, positioning and earth observation data for their work. One area that can benefit is civil protection with volunteers in fire fighters, police, border watchers, search and rescue, etc. This could also possibly foster innovative ways of using the information from the flagship programmes.

Technological

EGNOS is now operational, Galileo is one step before being launched and GMES is at the critical transition stage from technology development to operations. The technology development of downstream applications has been made using mostly community funding e.g. FP6, FP7, national funding and ESA. The industry has also made some investment in this area. In the areas of GMES research and technology development and data exchange between the communities there is excellent collaboration and utilization. EGNOS has also demonstrated successful stories with its use by

80.000 farmers[228]. Nevertheless, regarding downstream applications, the majority of these projects are still at the pilot phase. There has been little assessment of the level of maturity of projects and of their market potential. There are also various applications that could be developed using both navigation, positioning as well as earth observation data and this needs to be further exploited through integrated applications.

- *Increase development of integrated applications.* Navigation, positioning and earth observation are complementary technologies. Combined together and with other technologies they can provide useful integrated applications. Projects which combine space and ground-based systems should be increased. They should target different potential users, including governments, businessmen, schools, universities, public, etc. The areas where synergies between Galileo/EGNOS and GMES can be beneficial are energy, agriculture, environment, humanitarian aid, emergency response, managing oceans and seas, management of land resources, global security etc.
- *Foster inter-sectoral collaboration for innovation*. Different industries should be brought together eg. automotive, shipping, agriculture, banking, insurance in order to foster innovation for new product development.
- *Better define services.* The user community e.g. European Union, Member States in order to implement their policies often have specific needs. It is important to properly capture user requirements and translate them into technological requirements for further development to serve their needs. This can be done though user forums with participation from industry and research and development institutions.
- *Ensure compatibility, interoperability, standardization and certification.* Efforts for compatibility, interoperability and standardization between operators and service providers should be continued both in the area of GNSS as well as earth observation systems. Additionally, discussions with China over frequency allocation should be continued.
- *Evaluation of projects and prioritization according to potential.* Various pilot projects of technology demonstration have been developed in particular regarding downstream applications of the flagship programmes. An in-depth evaluation should be performed and the projects that have potential should be further developed to an operational phase either through the community or industry.

Legal

Galileo and GMES have undergone several restructuring processes. The latest one concerns Galileo with the renaming of the 'European GNSS Supervisory Authority' as the 'European GNSS Agency'[229] with the mandate for exploitation of Galileo and EGNOS. Regarding GMES the latest development was the establishment of the GMES/GEO regulation which included the establishment of a user forum. Nevertheless, there are still no clear provisions regarding the programme when it comes into operation. Changes in governance should provide continuity and sustainability in administrative, budgetary, legal responsibilities at different phases of the programmes. There are still questions regarding the Public Regulated Services (PRS) for Galileo and the data policy for GMES that should be dealt with as soon as possible. The related legislative bodies at European and Member State level should provide the necessary regulations that will safeguard the success of the programmes. These provisions may include additional taxation. Recommendations are:

- *Implement appropriate legislation.* For the exploitation of Galileo and GMES and the development of services and downstream businesses the necessary legislation needs to be implemented. Appropriate legislation should be put in place to ensure the full exploitation of the two programmes in Europe including giving preference to their use over foreign systems. Additionally, appropriate data policy and intellectual property rights should be put in place.
- *Coordinate policies and regulations.* There should be an in-depth analysis of how these programmes can assist in the implementation of other policy areas and appropriate regulatory frameworks established to make use of these assets. Examples could be using GMES and Galileo information for identifying fishing zones, tracking agriculture products, etc.

[228] Information for the 07 Dec. Workshop at European Parliament on "Galileo-GMES Less Known Elements of the Space Flagship Programmes: Public Perception and International Aspects".
[229] The European Parliament and the Council of the European Union. Regulation (EU) No 912/2010 of the European Parliament and the Council, Setting up the European GNSS Agency, repealing Council Regulation (EC) No 1321/2004 on the Establishment of structures for the management of the European satellite radio navigation programmes and amending Regulation (EC) No 683/2008 of the European Parliament and of the Council of 22 Sep. 2010.

- *Promote law enforcement though the use of the flagships.* The flagship programmes can provide data of legal violations e.g. illegal building, false declarations, violations of laws and treaties, tax violation, etc.
- *Implement appropriate governance structures.* Appropriate governance structures should be implemented taking into consideration the different development phases. Lessons learned from Galileo should be considered in GMES and vice versa. Additionally, successful stories such as EUMETSAT and Eutelsat should be considered. The most successful structures are typically those that are close to the end customer.

6.3 SWOT – Strengths – Weaknesses – Opportunities – Threats

STRENGTHS	**WEAKNESSES**
Political - European decision makers are committed to European non-dependence and the prosperity of the Union's citizens - Member States are also giving political back up to such programmes as repeatedly seen in the conclusions of the European Interparliamentary Space Conference (EISC). *Economic* - The financing and procurement instruments of ESA (e.g continuous funding when programme approved) are suitable for additional technology development programmes if needed (e.g. GSTP[230]). *Social* - European Citizens support developing a "European GPS" and satellites for monitoring the environment and security. *Technology* - GMES will be the most comprehensive space-based data collection system in the world. - Galileo will be the only system providing Public Regulated Services (PRS) *Legal* - The ESA has strong technical performance and long experience. In particular two successful stories that can be used as examples for the deployment, operation, maintenance and exploitation phase	*Political* - There is not enough coordination between the European Union, Member States, regional governments to support the programmes in a unified manner - The catalogue of objectives of polices the flagship programmes can fulfil at European, national and regional level is incomplete. *Economic* - The financing and procurement instruments of the EU (e.g. 7 year cycles) are not suitable for the peculiarities of the space sector (e.g. concentrated space industry). - GMES is the only programme that has funds for building the satellites, launch, access and integration to Member States missions but does not have funding for the operational phase. *Social* - There is no sense in Europe of European space identity, unlike in the USA, and there is lack of recognition and identification of Galileo and GMES. *Technology* - Spectrum is a scarce resource and the success of Galileo depends on it. *Legal* - The governance structure in the operational phase is still not clear especially for GMES.
OPPORTUNITIES	**THREATS**
Political - By making Galileo and GMES a success Europe can show to the outside that it can work well together - These projects will help the positive image of the EU and its Member States with respect to itsinternational partners and its obligations toward them. - Enhancing European non-dependence in critical infrastructure. - Serve European Policies (eg. agriculture,	*Political* - Currently there is heavy dependence on non-EU systems and if the systems do not succeed this will remain - Europe and its Member States will lose credit in the international community for raising expectations and not being able to fulfil them, including failure to meet international obligations (e.g Kyoto, GMES and Africa, EGNOS and Africa) - The failure of these programmes will create

[230] eneral Support Technology Programme (GSTP) is one of the ESA technology development programmes. Ist aim is to convert promising engineering concepts into a broad spectrum of mature products.
<http://www.esa.int/SPECIALS/Technology/SEMEU4WPXPF_0.html>

environment, energy, fisheries, transport, regional development, external) with European means *Economic* - Growing demand for Earth Observation and Navigation systems - Provide new infrastructure that will spin off downstream applications and market developments. - The sooner these programmes are up and running the faster European industry can develop downstream applications in an expanding market to gain its market share. *Social* - To enhance European identity without compromising national interests. *Technology* - To provide state of the art technologies available to citizens with a variety of applications. *Legal* - Prepare Europe for appropriate governance schemes and legislation for future large-scale programmes.	doubts about the choices of the political leaders at European, national and regional levels. - Failure or delays will result in discontinuities in European, national and regional policies. *Economic* - Delays will result in increased costs in satellite and services and loss of market share for downstream applications. - Enhanced competition from the Chinese system and American next generation of GPS *Social* - The difficulties with the programmes have disoriented public opinion about Galileo in particular. *Technology* - The more there are delays the more the technological superiority will erode. *Legal* - Insufficient government regulations and legislation to assist market opportunities can hinder the success of the programmes.

6.4 Specific Recommendation by Actor

Actor	Proposed Action
European Union (European Commission, European Council, European Parliament and other European institutions)	• ensure political commitment for the full realization and utilization of the flagship programmes. Main argument on the commitment should be European non-dependence (e.g. banking, transport, security). • raise awareness about the flagship programmes in the European Parliament in other Committees outside ITRE. • identify the objectives and strategic goals in other policies where the flagships could help achieving them. • promote the benefits the flagship programmes can bring in other policy areas (e.g. agriculture, energy, environment, external, fisheries, regional development, research, transport, etc.) • promote the development of applications through use of the flagships in various components of the new Frameworks Programme. They should be included as a core element in innovation. • facilitate cross-sectoral exchange in developing novel integrated applications between ground and space assets. • implement appropriate legal frameworks for ensuring the success of the flagship programmes • ensure adequate financing for the entire cycle of the programmes • ensure continuous dialogue with the user communities • establish appropriate communication channels for promoting the flagship programmes and protecting their reputation in Europe and internationally. Set up a coherent communication strategy to promote the importance of the flagships to citizens (e.g. seminars, workshops) • perform assessment of public funding activities in relation to the flagship programmes, catalogue the successful ones and ensure their transition to the operational phase. • improve coordination between Union, Member States and indus-

Actor	Proposed Action
	trial development projects. • promote contribution of the flagship projects in the international community through the External Action Service, especially their contribution to humanitarian aid, disaster management, etc. • ensure political backing for compatibility, interoperability and standardization • implement an appropriate regulatory framework for Public Regulated Services (PRS). • ensure that frequency allocation of other systems does not compromise the signal for PRS.
Member States	• ensure the political commitment of Member States through their parliamentary groups and committees as well as the European interparliamentary platform EISC[231]. Main argument should be European non-dependence (e.g banking, transport, security) • ensure success of the flagships vis-à-vis the international community • identify objectives and strategic goals of national policies where the flagships could assist implementation • promote the use of Galileo/EGNOS and GMES in day to day operations and include them in future planning • implement appropriate legislation • ensure political backing for compatibility, interoperability and standardization
European Space Agency	• focus on the technological development of the flagships and ensure the timely implementation of the programmes with minimum cost and time overruns. • provide technical advice to decision and policy makers on how these programmes can be used for the implementation of policies. • ensure technical compatibility, interoperability and standardization
National Space Agencies	• provide technical advice to decision and policy makers on how these programmes can be used for the implementation of policies. • support the development of additional technologies and applications that could be useful for the programmes' full exploitation. • ensure technical compatibility, interoperability and standardization
User communities	• promote an integrated approach for different technologies and space and ground systems • promote synergies between Galileo/EGNOS and GMES. • user communities should expand representation to include all relevant stake holders. Networks such as Nereus could assist in this task. • Enhance communication of the benefits to society. Example associations such as Eurisy could network with other associations to highlight the benefits.
European industry	• ensure that no further time and cost overruns take place • inform the technical implementation body and programme oversight body if they envisage problems in time for appropriate mitigation • develop appropriate communication material that can assist in promoting the flagships. In particular develop jointly a case for space book with particular focus on how the technical capabili-

[231] The EISC was created in 1999 to act as a permanent platform for inter-parliamentary co-operation amongst European National Parliaments interested in space policy, and it aims at facilitating the exchange of information on space activities and at promoting mutual understanding of national policies through the provision of a forum for analysing the major issues at stake in the European space sector. More information about EISC at < http://www.eisc-europa.eu/>.

Actor	Proposed Action
	ties of the flagships can have applications that can serve governments and citizens.

List of Acronyms

Acronym	Explanation
ACC	Adaptive Cruise Control
AIS	Automatic Identification System
AP	Action Plan
ASAR	Advanced Synthetic Aperture Radar
ASEAN	Association of Southeast Asian Nations
ATV	Automated Transfert Vehicle
AU	African Union
AVNIR	Advanced Visible and Near Infrared Radiometer
A-VTMIS	Active Vessel Traffic Management and Information System
BIPM	Bureau international des poids et mesures
CGPSIC	Civil GPS Service Interface Committee
CNES	Centre National d´ Etudes Spatiales
CoR	Committee of Regions
CORE	Collection of Open Resources for Everyone
COSPAR	Committee on Space Research
CTP	Common Transport Policy
DG	Directorate General
DLR	Deutsche Zentrum für Luft- und Raumfahrt e.V.
DMCs	Disaster Management Monitoring
DSP	Digital Signal Processor
EAP	Environment Action Programme
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EDAS	EGNOS Data Access Service
EEA	European Environmental Organization
EEC	European Economic Community
EESC	European Economic Social Council
EFTA	European Free Trade Association
EGNOS	European Geostationary Navigation Overlay System
EMSO	European Multidisciplinary Seafloor Observatory
ENP	European Neighbourhood Policy
ENTR(DG)	Directorate General for Enterprise and industry
EO	Earth Observation
EP	European Parliament

Acronym	Explanation
ERMTS	European Railway Traffic Management System
ESA	European Space Agency
ESC	Electronic Stability Control
ESPI	European Space Policy Institute
EU	European Union
EUFAR	European Facility For Airborne Research
EUPOS	European Position Determination System
EUREF	Reference Frame Sub-Commission for Europe
FIG	Fédération Internationale des Géométres
FP	Framework Programme
GAGAN	Global Positioning System-aided Geo-Augmented
GCI	GEOSS Common Infrastructure
GDP	Grosse Domestic Product
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GEPW	GEO European Projects Workshop
GIP	Galielo Inter-institutional Panel
GJU	Galileo Joint Undertaken
GLONASS	Russian Federation´s Global Navigation Satellite System
GMES	Global Monitoring Environmental and Security
GNSS	Global Navigation Satellite System
GOCE	Gravity field and steady-state Ocean Circulation Explorer
GPS	Global Positioning System
GSA	Galileo Supervisor Agency
GSC	GMES Space Component
HMI	Human machine interfaces
I2I	Infrastructure to Infrastructure
IAG	International Association of Geodesy
IAGOS	In-service Aircraftfor a Global Observing System
IAIN	nternational Association of Institutes of Navigation
ICA	International Cartographic Association
ICG	International Committee on GNSS
IGS	International GNSS Service
ILS	Instrument Landing System
IMO	International Maritime Organization
INSPIRE	Infrastructure for Spatial Information in the European Community
IPPC	Integrated Pollution Prevention and Control
IRNSS	Indian Regional Navigation Satellite System
ISS	International Space Station
ITS	Intelligent Transport System

Acronym	Explanation
ITU	International Telecommunication Union
JAXA	Japan Aerospace Exploration Agency
JRC	Joint Research Centre
LRIT	Long-Range Identification and Tracking
MACC	Monitoring Atmospheric Composition and Climate
MDGs	Millennium Development Goals
MetOp	Meteorological Operational satellite
MEP	Member of European Parliament
MSG	Meteosat Second Generation
MTG-S	Meteosat Third Generation–Sounder
NASA	National Aeronautics and Space Administration
NEPAD	New Partnership for Africa's Development
OLCI	Ocean and Land Color Instrument
OOSA	Office for Outer Space Affaires
PCA	Partnership and Cooperation Agreement
PPP	Public Private Partnership
PRS	Public Regulated Services
QZSS	Quasi Zenit Satellite System
R&D	research and Development
RFID	Radio Frequency Identification
RTD	Research Technology and Development
RTTI	Real-time Traffic and Travel Information
S&T	Science and Technologies
SAR	Synthetic Aperture Radar
SBAS	Space Based Augmentation System
SDCM	System of Differential Correction and Monitoring
SESAR	Single European Sky ATM Research
SMEs	Small Medium Enterprises
SMOS	Soil Moisture and Ocean Salinity
SPOT	Satellite Pour L'Observation de la Terre
TAEIX	technical assistance and information exchange
TAF-TSI	Telematics Applications for Freight
TCA	Trade Cooperation Agreement
TEN	Trans European Network
TEN-T	Trans European Network for Transport
TFEU	Treaty on the Functioning of the European Union
UAS	Unmanned Aerial System
UK	United Kingdom of Great Britain
UNEO	United Nations Environment Organisation
UNEP	United Nations Environment Programme

Acronym	Explanation
URSI	Union radio-scientifique internationale
US	United States of America
V2I	Vehicle to infrastructures
V2V	Vehicle to Vehicle
VTMIS	Vessel Traffic Monitoring and Information Systems
WG	Working Group
WTO	World Trade Organisation

Appendix

A1 Galileo Frequency Bands[232]

The navigation signals of Galileo are transmitted in four frequency bands, which are E5a, E5b, E6 and E1 bands and they provide a wide band width for transmission for Galileo. The frequency bans have been selected in the allocated spectrum for Radio Navigation Satellite Services (RNSS) and in addition to the E5a, E5b and E1 bands are included in the collocated spectrum for Aeronautical Radio Navigation Service (ARNS) employed by Civil-Aviation users, and allowing dedicated safety-critical applications.

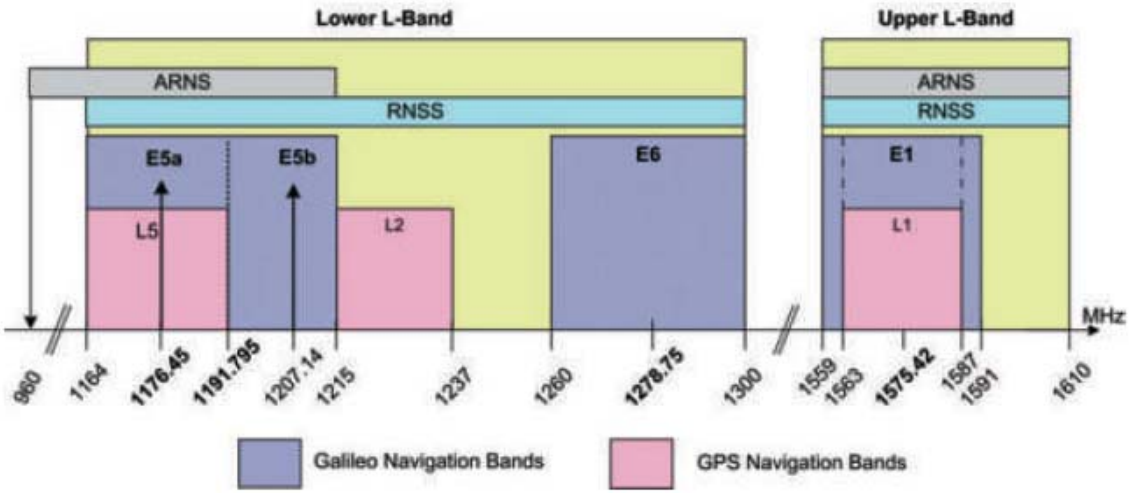

Figure 26: Galileo Frequency Plan

A2 GMES, Current and Potential Contributing Missions

Name	Mission Type	Principal Owner	Status	Description
ALOS	Synthetic Aperture Radar (SAR)	JAXA/ JAROS	2006-2011 In orbit	Phased Array type L-band Synthetic Aperture Radar (PALSAR) for day-and-night and all-weather land observation for disaster monitoring
ALOS-2	Synthetic Aperture Radar (SAR)	JAXA	2012-2017 Planned	L-Band, capable of observing day and night, and in all weather conditions. Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM), Visible and Near Infrared Radiometer type 2 (AVNIR-2) for precise land and coastal zones observation. Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) for digital elevation

[232] European Union, 2010, "European GNSS (Galileo) Open Service. Signal in space interface control document", September 2010, Fef OS SIS ICD, Issue 1.1.

Name	Mission Type	Principal Owner	Status	Description
				mapping. Advanced land-observing technology used for cartography, regional observation, disaster monitoring, and resource surveying.
ALOS-3	Optical Earth Observation	JAXA	2014-2019 Planned	Panchromatic - 0.8m resolution in 50km swath; multi - 5m in 90km swath; and hyper-spectral 30m in 30km swath, complementing ALOS-2 for disaster monitoring and resources management.
Aqua MODIS	Optical Earth Observation	NASA	2002-2008 In orbit	AMSR-E — Advanced Microwave Scanning Radiometer-EOS to measure cloud properties, sea surface temperature, MODIS (Moderate Resolution Imaging Spectroradiometer) measuring visible and infrared radiation, AMSU-A — Advanced Microwave Sounding Unit — measures atmospheric temperature and humidity, AIRS — Atmospheric Infrared Sounder — measures atmospheric temperature and humidity, land and sea surface temperatures, HSB — Humidity Sounder for Brazil — VHF band equipment measuring atmospheric humidity. Furnished by Instituto Nacional de Pesquisas Espaciais of Brazil and CERES — Clouds and the Earth's Radiant Energy System to measure broadband radiative energy flux.
AstroTerra (SPOT-6, -7)	Optical Medium/High Resolution	InfoTerra/Astrium	2012-2022 Approved	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities, optical measurements in the 2-5 m range
CALIPSO		CNES/NASA	2008-2010 In orbit	Atmosphere Monitoring Mission, monitoring of aerosols.
CARTOSAT-2	Opticsl Earth Observation	ISRO	2007-2012 In orbit	Panchromatic Camera
Cosmo-Skymed 2nd gen	Synthetic Aperture Radar (SAR)	ASI	2012-2023 Planned	X-Band, SAR sensors, for all weather day/night observations of land, ocean and ice surfaces
Cosmo-Skymed -S/C 1,2,3	Synthetic Aperture Radar (SAR)	ASI	2008-2012 In orbit	X-Band, SAR sensors, for all weather day/night observations of land, ocean and ice surfaces
Cosmo-Skymed -S/C 4	Synthetic Aperture Radar (SAR)	ASI	2010-2014 Approved	X-Band, SAR sensors, for all weather day/night observations of land, ocean and ice surfaces
Cryosat-2	Earth Observation satellite	ESA	2010-2013 Approved	Altimetry Mission for precise monitoring of the changes in the thickness of marine ice floating in the polar oceans and variations in the thickness of the vast ice sheets that overlie Greenland and Antarctica.

Name	Mission Type	Principal Owner	Status	Description
				DORIS-NG (Doppler Orbitography and Radiopositioning Integrated by Satellite- NG for precise orbit determination, , SIRAL (SAR Interferometer Radar Altimeter) for marine ice and terrestrial ice sheet thickness measurement, Laser Reflectors to measure the distance between the satellite and the laser tracking stations.
DMC UK2	Low Earth Orbit microsatellites	SSTL	2009-2014 In orbit	Disaster Monitoring Constellation (DMC) made of five LEO microsatellites providing daily global imaging capability at medium resolution (30-40 m), in 3-4 spectral bands, for rapid-response disaster monitoring and mitigation.
DMCIIDeimos-1 DMC	Optical High Resolution	Deimos	2009-2013 In orbit	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities
EnMap	Optical Medium/High Resolution	DLR	2013-2017 Approved	hyperspectral/superspectral missions with both scientific and application development objectives. High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities. The mission will offer data on a wide range of ecosystem parameters encompassing agriculture, forestry, soil and geological environments, coastal zones and inland waters.
Envisat	Optical Low Resolution	ESA	2002-2013 In orbit	AATSR (Advanced Along Track Scanning Radiometer) for precise datas concerning the sea surface temperature. MERIS (programmable, medium-spectral resolution, imaging spectrometer operating in the solar reflective spectral range) to acquire data over the Earth whenever illumination conditions are suitable. Used for Oceans and land colour monitoring, as well as land and atmosphere control. RA-2 (Radar Altimeter 2) for determining the two-way delay of the radar echo from the Earth's surface to a very high precision. GOMOS (Global Ozone Monitoring by Occultation of Stars) for long-term monitoring of the global vertical ozone distribution. MIPAS (Michelson Interferometer for Passive Atmospheric Sounding) to detect and spectrally resolve a large number of emission features of atmospheric minor constituents play-

Name	Mission Type	Principal Owner	Status	Description
				ing a major role in atmospheric chemistry. SCIAMACHY is an imaging spectrometer performing global measurements of trace gases in the troposphere and in the stratosphere. Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems, monitoring of aerosols.
EROS A	Optical Earth Observation	ImageSat Int.	2000-2011 In orbit	equipped with a camera whose focal plane of CCD (Charge Coupled Device) detectors produces a standard image resolution of 1.9 meters with a swath of 14 km at Nadir (perpendicular to the surface) at an altitude of ~500 km, and sub-meter resolution using hypersampling techniques.
EROS B	Optical Earth Observation	ImageSat Int.	2006-2016 In orbit	larger camera of CCD/TDI type (Charge Coupled Device/Time Delay Integration), with standard panchromatic resolution of 0.70 m at an altitude of about 500 km. Larger onboard recorder, improved pointing accuracy and a faster data communication link.
ERS-2	Synthetic Aperture Radar (SAR) Optical Low Resolution	ESA	2008-2010 In orbit	C-Band, SAR sensors, for all weather day/night observations of land, ocean and ice surfaces Sea Surface Temperature Mission. ATSR-2 (Along Track Scanning Radiometer) made up of an infrared radiometer and a microwave sounder, is used for measuring sea-surface temperatures, cloud-top temperatures and vegetation monitoring with a swath of 500 km and 1×1 km spatial resolution. Global Land Monitoring Mission, Altimetry mission, High accuracy Radar Altimeter systems for sea level measurements and climate applications, RA, GOME,Atmosphere Monitoring Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems
ESAEnvisat ASAR	Synthetic Aperture Radar (SAR)	ESA	2008-2013 In orbit	C-Band, ASAR ensures continuity with the image mode (SAR) and the wave mode of the ERS-1/2 AMI. Full active array antenna equipped with distributed transmit/receive mod-

Name	Mission Type	Principal Owner	Status	Description
				ules which provides distinct transmit and receive beams, a digital waveform generation for pulse "chirp" generation, a block adaptive quantisation scheme, and a ScanSAR mode of operation by beam scanning in elevation. Applications include Ocean and Coast (Ocean Currents and Topography) Land (Landscape Topography) Snow and Ice (Snow and Ice).
Formosat 2	Optical Earth Observation	NSPO of Taiwan	2004-2014 In orbit	high-resolution panchromatic (2 m) and multispectral (8 m) imagery for a great variety of applications such as in land use, agriculture and forestry, environmental monitoring, natural disaster evaluation, and in support of research interests, in particular with the ISUAL (Imager of Sprites and Upper Atmospheric Lightning) instrument. Frequently used to deliver high-resolution imagery for event monitoring.
Geo Eye 1	Earth Observation Satellite	GEOeye	2008-2015 In orbit	Sub half-meter Earth-imaging satellite, can collect images with a ground resolution of 0.41-meters or 16 inches in the panchromatic or black and white mode. The agile camera allows for side-to-side extensions of the camera's 15.2 kilometre (9.44 miles)-wide swath width or multiple images of the same target during a single pass to create a stereo picture.
HiROS	Optical Very High Resolution	DLR	2014-2018 Planned	TBC, Very High Resolution (VHR) optical sensors, panchromatic and multi-spectral, specifically for urban mapping or security applications. High revisit time.
IKONOS 2	High resolution Earth Observation	GEOeye	1999-2008 In orbit	High-resolution panchromatic imagery with 82-centimeter resolution and multispectral imagery with 4-meter resolution on a commercial basis. Imagery from both sensors can be merged to create 1-meter colour imagery (pan-sharpened).
JASON-1	Earth Observation satellite	EC-BSPO-CNES-SNSB-ASI	2008-2011 In orbit	Altimetry Mission with altimeter flying in low-inclination orbit. Carries a radiometer instrument to measure water vapour, a Global Positioning System receiver and a laser retroreflector array. Designed to directly measure climate change through very precise millimeter-per-year measurements of global sea-level changes.

Name	Mission Type	Principal Owner	Status	Description
JASON-2	Earth Observation satellite	CNES-EUM-NASA-NOAA	2008-2013 In orbit	Altimetry Mission with altimeter flying in low-inclination orbit. Ocean Surface Topography Mission (OSTM) providing co-located measurements of significant wave height, wind speed and sea surface topography.
JASON-3	Earth Observation satellite	EUM-NOAA-CNES	2013-2017 Approved	Altimetry Mission (expected to continue the low-inclination measurements)
JASON-CS	Earth Observation satellite		2017-2018 Planned	Altimetry Mission (expected to continue the low-inclination measurements)
KOMPSAT-2	Earth Observation satellite	KARI	2006-2011 In orbit	MSC (Multi-Spectral Camera) able to acquire optical 1 m resolution panchromatic images and 4 m resolution color images or various applications such as surveillance of massive natural disasters, utilization of mineral resources, construction of Geographic Information System (GIS), and cartography.
Meteosat	Earth Observation satellite	EUMETSAT	2008-2009 In orbit	MVIRI, Atmosphere Monitoring Mission
METOP- 3 S/C	Optical Low Resolution	EUMETSAT	2008-2020 In orbit	AVHRR-3, Sea Surface Temperature Mission, Global Land Monitoring Mission, GOME-2/IASI, Atmosphere Monitoring Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems, monitoring of aerosols
MSG 4 S/C	Optical Low Resolution	EUMETSAT	2008-2019 In orbit	SEVIRI/GERB, Sea Surface Temperature Mission, Global Land Monitoring Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems
MTG	Optical Low Resolution	EUMETSAT	2015-2023 Approved	Sea Surface Temperature Mission, , Global Land Monitoring Mission, Atmosphere Monitoring Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems
NigeriaSAT-1	Earth Observation microsatellite	NASRDA	2003-2008 In orbit	The spacecraft is equipped with two 0.5Gbyte Solid State Data Recorder (SSDR) for data storage during imaging and a main Receiver Frequency (RF) downlink at S band Frequencies with data rate of 8Mbps

Name	Mission Type	Principal Owner	Status	Description
				using store and forward communications.
NigeriaSAT-2	Earth Observation satellite	NASRDA	2011-2018 Approved	high resolution of 2.5m panchromatic and 5m multispectral, broad area coverage inclusive of cadastral mapping, land use mapping, geospatial analysis and environmental change monitoring.
Oceansat-2	Earth Observation satellite	ISRO	2009-2014 In orbit	Ocean Colour Monitor (OCM), Ku-band Pencil Beam scatterometer (SCAT) developed by ISRO, Radio Occultation Sounder for Atmosphere (ROSA) developed by the Italian Space Agency.
Oceansat-3/AltiKa	Earth Observation satellite	ISRO/CNES	2011-2015 Approved	Altimetry Mission with high-inclination altimetry (polar orbit).
Orbview 2	Earth Observation satellite	GEOeye	1997-2011 In orbit	Sea-viewing Wide Field-of-view Sensor (SeaWiFS), acquires data critical for the study of the role of oceans, and the exchange of critical elements and gases between the atmosphere and ocean, and how these exchanges affect production of phytoplankton.
PARASOL	Earth Observation satellite	CNES	2008-2010 In orbit	Atmosphere Monitoring Mission, monitoring of aerosols
Pléiades 1 & 2	Optical Very High Resolution	CNES	2010-2016 Approved	VHR sub-metric domain (panchromatic), Very High Resolution (VHR) optical sensors, panchromatic and multi-spectral, specifically for urban mapping or security applications, high relevance for GMES emergency and security related applications as well as specific areas of land monitoring services (in particular with the 0.7 m Panchromatic and the 2.8 m VIS/NIR channels), swath width in the 20-30 km range with different spatial resolution performances.
Post-EPS	Optical Low Resolution	EUMETSAT	2018-2023 Approved	Sea Surface Temperature Mission, , Global Land Monitoring Mission, Atmosphere Monitoring Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems, monitoring of aerosols
Prisma	Optical High Resolution	ASI	2011-2015 Planned	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities
Quickbird 2	Optical Earth	Digitalglobe	2001-2014	high quality multi-spectral and pan-

Name	Mission Type	Principal Owner	Status	Description
	Observation		In orbit	chromatic satellite imagery for map creation, change detection, and image analysis.
Radarsat-1	Synthetic Aperture Radar (SAR)	CSA	1995-2000 In orbit	C-band. Wide variety of beam widths, to capture swaths of 45 to 500 kilometres, with a range of 8 to 100 metres in resolution and incidence angles of 10 to 60 degrees.
Radarsat-2	Synthetic Aperture Radar (SAR)	CSA	2008-2014 In orbit	C-Band, serves national dual-use requirements and could offer some additional capacity for GMES.
RapidEye - 5 S/C	Optical Medium/High Resolution	RapidEye	2008-2014 In orbit	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities, optical measurements in the 2-5 m range, swath width in the 60-70 km range. Designed to provide insurance and food companies, farmers, governments, other agencies and institutions throughout the world with up-to-date customised information products and services.
RapidEye Follow-on	Optical Medium/High Resolution	RapidEye	2014-2019 Planned	TBC, High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities
RCM	Synthetic Aperture Radar (SAR)	CSA	2014-2020 Approved	C-Band
Resourcesat 1 (IRS P6)	Earth Observation	ISRO	2003-2008 In orbit	Carries a high resolution Linear Imaging Self Scanner (LISS-4) operating in three spectral bands in the visible and Near Infrared Region (VNIR) with 5.8 metre spatial resolution, a medium resolution LISS-3 operating in three spectral bands in VNIR and one in Short Wave Infrared (SWIR) band with 23.5 metre spatial resolution; and an Advanced Wide Field Sensor (AWiFS) operating in three spectral bands in VNIR and one band in SWIR with 56 metre spatial resolution. For integrated land and water resources management.
Resourcesat 2	Earth Observation	ISRO	2011-2016 In orbit	Enhanced multispectral and spatial coverage, carries an additional payload known as AIS (Automatic Identification System) from COMDEV Canada as an experimental payload for ship surveillance in VHF band to derive position, speed and other information about ships.
Sentinel-1 A	Synthetic Aperture	ESA	2012-2018 Approved	wide-swath, medium to high resolution C-band observations, high re-

Name	Mission Type	Principal Owner	Status	Description
	Radar (SAR)			visit time and continuation of interferometry capabilities
Sentinel-1 B	Synthetic Aperture Radar (SAR)	ESA	2016-2029 Approved	wide-swath, medium to high resolution C-band observations, high revisit time and continuation of interferometry capabilities
Sentinel-1 C, ..	Synthetic Aperture Radar (SAR)	ESA	2018-2023 Planned	wide-swath, medium to high resolution C-band observations, high revisit time and continuation of interferometry capabilities
Sentinel-2 A	Optical Medium/High Resolution	ESA	2013-2019 Approved	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities in the 10-20 m resolution range
Sentinel-2 B	Optical Medium/High Resolution	ESA	2017-2023 Approved	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities in the 10-20 m resolution range
Sentinel-2 C, ..	Optical Medium/High Resolution	ESA	2019-2023 Planned	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities in the 10-20 m resolution range
Sentinel-3 A	Optical Low Resolution	ESA	2013-2019 Approved	SLSTR/ OLCI will provide continuity of MERIS, AATSR and VEGETATION in terms of spectral and revisiting requirements. Sea Surface Temperature Mission, Ocean Colour Mission, Global Land Monitoring Mission, RA, Altimetry Mission, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems, monitoring of aerosols
Sentinel-3 B	Optical Low Resolution	ESA	2017-2023 Approved	SLSTR/ OLCI will provide continuity of MERIS, AATSR and VEGETATION in terms of spectral and revisiting requirements. Sea Surface Temperature Mission, Global Land Monitoring Mission, RA, Altimetry Mission, High accuracy Radar Altimeter systems for sea level measurements and climate applications, Medium-low resolution optical sensors for wide area information on land cover, for example agriculture indicators, ocean monitoring, coastal dynamics and ecosystems, monitoring of aerosols
Sentinel-3 C		ESA	2019-2023 Planned	SLSTR/OLCI will provide continuity of MERIS, AATSR and VEGETATION

Name	Mission Type	Principal Owner	Status	Description
				in terms of spectral and revisiting requirements. Global Land Monitoring Mission, RA, Altimetry Mission, High accuracy Radar Altimeter systems for sea level measurements and climate applications, monitoring of aerosols
Sentinel-4	Earth Observation	ESA	2018-2025 Approved	Atmosphere Monitoring Mission. Comprises an Ultraviolet Visible Near-infrared (UVN) spectrometer and data from Eumetsat's thermal InfraRed Sounder (IRS), both embarked on the MTG-Sounder (MTG-S) satellite. After the MTG-S satellite is in orbit, the Sentinel-4 mission also includes data from Eumetsat's Flexible Combined Imager (FCI) embarked on the MTG-Imager (MTG-I) satellite. It will cover the needs for continuous monitoring of the atmospheric chemistry at high temporal and spatial resolution from the geostationary orbit.
Sentinel-5	Earth Observation	ESA	2025-2032 Planned	Atmosphere Monitoring Mission. Comprises an Ultraviolet Visible Near-infrared Shortwave (UVNS) spectrometer and data from Eumetsat's IRS, the Visible Infrared Imager (VII) and the Multi-viewing Multi-channel Multi-polarization Imager (3MI).
SeoSAR/PAZ	Synthetic Aperture Radar (SAR)	CDTI	2012-2017 Approved	X-Band
Seosat / Ingenio	Optical Medium/High Resolution	CDTI	2014-2018 Approved	Global Land Monitoring Mission, High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities, optical measurements in the 2-5 m range, swath width in the 60-70 km range
SPOT 4	Optical Medium/High Resolution	EC-BSPO-CNES-SNSB-ASI	2008-2011 In orbit	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities. The HRVIR (High Resolution Visible Infrared) is complemented by VEGETATION, an independent instrument which uses 4 cameras, one for each spectral band, with each one covering a wide field of view of 101° producing a swath width of 2 250 km.
SPOT 5	Optical Medium/High Resolution	CNES	2008-2012 In orbit	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities, swath width in the 60-70 km range

Name	Mission Type	Principal Owner	Status	Description
VEGETATION Continuity Mission		EC-BSPO-CNES-SNSB-ASI	2012-2017 Planned	Global Land Monitoring Mission agriculture, land-cover mapping, damage assessment associated with natural hazards and urban planning.
TanDEM-X	Synthetic Aperture Radar (SAR)	DLR	2010-2015 Approved	X-Band
Terra MODIS	Optical Earth Observation	NASA	1999-2005 In orbit	MODIS (Moderate Resolution Imaging Spectroradiometer) a 36-band spectroradiometer measuring visible and infrared radiation. Medium-resolution, multi-spectral, cross-track scanning radiometer.The datas obtained are used to derive products ranging from vegetation, land surface cover, and ocean chlorophyll fluorescence to cloud and aerosol properties, fire occurrence, snow cover on the land, and sea ice cover on the oceans. Advanced Very High Resolution Radiometer (AVHRR), High Resolution Infrared Radiation Sounder (HIRS), Landsat Thematic Mapper (TM), and Nimbus-7 Coastal Zone Color Scanner (CZCS)
TerraSAR-X	Synthetic Aperture Radar (SAR)	DLR	2008-2013 In orbit	X-Band
TerraSAR-X-2	Synthetic Aperture Radar (SAR)	DLR	2014-2018 Planned	X-Band
THEOS	Optical Earth Observation	Geo-Informatics and Space Technology Development Agency Thailand (GISTDA)	2008-2013 In orbit	Its payload features both high resolution in panchromatic mode (two metres) and wide field of view in multi-spectral mode (90km). Worldwide geo-referenced image products and image processing capabilities for applications in cartography, land use, agricultural monitoring, forestry management, coastal zone monitoring and flood risk management.
UK-DMC & UK-DMCII	Optical Medium/High Resolution	DMCII	2008-2013 In orbit	High Resolution (HR) or Medium Resolution optical sensors for regional and national land monitoring activities
Venμs	Optical Medium/High Resolution	CNES-ISA	2012-2015 Approved	Hyperspectral/superspectral missions have both scientific and application development objectives. Dedicated to monitoring vegetation. It will acquire high resolution and superspectral images of predefined sites of interest all around the world.
Worldview-1	Very High Resolution	Digital Globe	2007-2014 In	High-capacity, panchromatic imaging system featuring half-meter

Name	Mission Type	Principal Owner	Status	Description
	Earth Observation		orbit	resolution imagery.
Worldview-2	Very High Resolution Earth Observation	Digital Globe	2009-2016 In orbit	high-resolution 8-band multispectral commercial satellite providing 46 cm panchromatic resolution and 1.85 meter multispectral resolution for precise map creation, change detection and in-depth image analysis.

A3 International Committee on Global Navigation Satellite Systems (ICG)

Dates	Events
1-2 December 2005	United Nations International Meeting for the Establishment of the International Committee on Global Navigation Satellite Systems (ICG), Vienna, Austria.
1-2 November 2006	First Meeting of the International Committee on Global Navigation Satellite Systems (ICG) organized by the United Nations Office for Outer Space Affairs, Vienna, Austria.
5-7 September 2007	Second Meeting of the International Committee on Global Navigation Satellite Systems (ICG) organized by the International Space Research Organization, Bangalore, India , 5 - 7 September 2007
8-12 December 2008	Third Meeting of the International Committee on Global Navigation Satellite Systems (ICG) organized jointly by the US State Department and the Jet Propulsion Laboratory, Pasadena, USA.
2-3 March 2009	ICG Workshop on GNSS Interoperability. Residenz München, Munich, Germany.
30-31 July 2009	ICG Workshop on GNSS Interoperability. United Nations Office at Vienna, Vienna, Austria.
14-18 September 2009	Fourth Meeting of the International Committee on Global Navigation Satellite Systems (ICG) organized by the Federal Space Agency (ROSCOSMOS), Saint-Petersburg, Russian Federation.
30 November 2009	ICG Workshop on GNSS Interoperability - Global and Regional Navigation Satellite Systems and Satellite-based Augmentations. Gold Coast, Queensland, Australia.
8 March 2010	ICG Working Group B Special Meeting on GNSS User Positioning Integrity. Residenz München, Munich, Germany.
9-11 March 2010	Munich Satellite Navigation Summit 2010. GNSS - Quo vadis ? Munich, Germany.
6-24 April 2010	Satellite Navigation and Science for Africa, Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy. (Promoting the Use of GNSS Technologies).
1-2 June 2010	Fourth International Satellite Navigation Forum, Moscow, Russian Federation.
21-24 June 2010	Asia Pacific Economic Cooperation (APEC) Fourteenth Meeting of the GNSS Implementation Team (GIT/14), Seattle, Washington, USA.
5-8 September 2010	Third GNSS Vulnerabilities and Solutions 2010 Conference, Baska, Krk Is-

	land, Croatia.
4-6 October 2010	Workshop on Global Navigation Satellite Systems: Basic Principles, Applications and Legal Aspects, Vienna, Austria.
4-29 October 2010	Training Course on Global Navigation Satellite Systems and Location Based Services, African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E), Ile-Ife, Nigeria.
18-22 October 2010	Fifth Meeting of the International Committee on Global Navigation Satellite Systems (ICG) jointly organized by Italy and the European Commission, Turin, Italy.
21-22 November 2010	Second Asia Oceania Regional Workshop on Global Navigation Satellite Systems (GNSS. Melbourne, Australia.
23-26 November 2010	Seventieth Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-17), Melbourne, Australia.
29-30 November 2010	International Symposium on Global Navigation Satellite Systems, Space-Based and Ground-Based Augmentation Systems and Applications 2010, Brussels, Belgium
1-3 March 2011	Munich Satellite Navigation Summit 2011, Munich, Germany.
23-25 May 2011	Fifth GNSS Vulnerabilities and Solutions Conference, Baška, Krk Island, Croatia (Announced).
1-2 June 2011	Fifth International Satellite Navigation Forum, Moscow, Russian Federation. (Announced).
5-9 September 2011	Sixth Meeting of the International Committee on Global Navigation Satellite Systems (ICG), organized by the Government of Japan, Tokyo, Japan. (Announced).
20-23 September 2011	ION GNSS 2011, Portland, United States of America.
5-16 December 2011	School on Space Weather, African Regional Centre for Space Science and Technology Education - in French Language (CRASTE-LF), Rabat, Morocco. (Scheduled).

Table: International Committee on Global Navigation Satellite System (ICG)

A4 Group on Earth Observation (GEO)

Dates	Events
27-29 March 2007	GEO Inland and Nearshore Coastal Water Quality Remote Sensing Workshop. Geneva, Switzerland.
6-27 September 2007	Meningitis Environmental Risk Consultative Meeting. Geneva, Switzerland.
1-2 November 2007	Recognition of Cross-border Capacity Building in Earth Observation. Enschede, The Netherlands.
27 November 2007	11th GEO Executive Committee Meeting. Cape Town, South Africa.
28-29 November 2007	2007 GEO-IV Plenary Session. Cape Town, South Africa.
30 November 2007	2007 GEO Cape Town Ministerial Summit. Cape Town, South Africa.
10-11 December 2007	The Role of Remote Sensing in Disaster Management. Meeting. Geneva, Switzerland.
12 January 2008	GEOSS Users & Architecture Workshop IXX: Communications for Disaster Management. Honolulu, Hawaii.
4-5 February 2008	GEOSS Architecture Workshop. Ispra, Italy.

Dates	Events
5 February 2008	9th ADC Co-Chairs Meeting. Ispra, Italy.
6-7 February 2008	6th Architecture & Data Committee Meeting. Ispra, Italy.
8 February 2008	9th ADC Co-Chairs Meeting. Ispra, Italy.
11-12 February 2008	6th Science and Technology Committee Meeting. Hannover, Germany.
13-14 February 2008	6th Capacity Building Committee Meeting. Hannover, Germany.
15 February 2008	CBC Co-Chairs Meeting. Hannover, Germany.
26-27 March 2008	12th GEO Executive Committee Meeting. Geneva, Switzerland.
7 April 2008	GEOSS Users & Architecture Workshop XX: Oceans and Water (in conjunction with Oceans 2008 conference). Kobe, Japan.
8-10 April 2008	GEO Biodiversity Observation Network Meeting. Berlin, Germany.
15 April 2008	Session on Mapping Forest and Tracking Carbon in the 2nd GEOSS AP. Tokyo, Japan.
14-16 April 2008	The Second GEOSS Asia-Pacific Symposium (The role of Earth Observations in tackling climate change). Tokyo, Japan.
6-8 May 2008	7th User Interface Committee Meeting. Toronto, Canada.
15-16 May 2008	GEOSS Sensor Web Workshop. Geneva, Switzerland.
19-23 May 2008	Effects of Climate Change in the World's Oceans. Gijón, Spain.
19 May 2008	10th ADC Co-Chairs Meeting. Geneva, Switzerland.
20-21 May 2008	7th Architecture & Data Committee Meeting. Geneva, Switzerland.
22 May 2008	10th ADC Co-Chairs Meeting. Geneva, Switzerland.
22-23 May 2008	7th Science and Technology Committee Meeting. Geneva, Switzerland.
3-5 June 2008	7th Capacity Building Committee Meeting. Tashkent, Uzbekistan.
5-6 June 2008	GEOSS Best Practices for Crop Area Estimation / Forecasting and Future Needs Workshop. Ispra, Italy.
9-13 June 2008	Observing System Requirements for Managing and Mitigating the Impacts of Human Activities and Coastal Inundation in the Mediterranean Region. Athens, Greece.
16 June 2008	Meeting on GEO forest carbon tracking action. Geneva, Switzerland.
26-27 June 2008	Target Task Team (T3) - 1st meeting. Geneva, Switzerland.
2-3 July 2008	GEOSS Users & Architecture Workshop XXI: Air Quality & Health. Beijing, China.
6 July 2008	GEOSS Users & Architecture Workshop XXII: Air Quality & Coastal Ecosystems. Boston, USA.
15-16 July 2008	13th GEO Executive Committee Meeting. Geneva, Switzerland.
8-9 September 2008	8th Science & Technology Committee Meeting. Paris, France.
10-12 September 2008	GEO Performance Indicator Workshop. Paris, France.
15 September 2008	GEOSS Users & Architecture Workshop XXIII: Science Modeling and Data Policy. Quebec City, Canada.
16-18 September 2008	CEOS SIT-22. Tokyo, Japan.
21 September 2008	11th ADC Co-Chairs Meeting. Boulder, Colorado, USA.
22-23 September	8th Architecture & Data Committee Meeting. Boulder, Colorado, USA.

Dates	Events
2008	
22-24 September 2008	8th User Interface Committee Meeting. Boulder, Colorado, USA.
22-24 September 2008	8th Capacity Building Committee Meeting. Boulder, Colorado, USA.
24 September 2008	11th ADC Co-Chairs Meeting. Boulder, Colorado, USA.
22-26 September 2008	CEOS WGISS-26. Boulder, Colorado, USA.
25-26 September 2008	Committee Co-Chairs Coordination (C4) meeting. Boulder, Colorado, USA.
30 September – 3 October	CEOS WGCV-29. Avignon, France.
30 September – 3 October 2008	2008 GEOSS in the Americas Symposium. Panama City, Panama.
13-15 October 2008	2nd United Nations International UN-SPIDER Workshop: "Disaster Management and Space Technology - Bridging the Gap". Bonn, Germany.
13-17 October 2008	4th IPWG Workshop Chinese Meteorological Administration. Beijing, China.
15-16 October 2008	CEOS ACC Workshop. New York, USA.
22-24 October 2008	Workshop on Rainfall Estimates for Crop Monitoring and Food Security. Ispra, Italy.
24-26 October 2008	GEOSS Users & Architecture Workshop XXIV: Water Security & Governance. Accra, Ghana.
27-31 October 2008	7th AARSE conference: Application of Earth Observation and Geoinformation for Governance in Africa. Accra, Ghana.
4-7 November 2008	GEO Forest Monitoring Symposium. Foz do Iguacu, Brazil.
11-12 November 2008	22nd CEOS Plenary. CSIR/George, South Africa.
17-18 November 2008	12th ADC Co-Chairs Meeting. Bucharest, Romania.
17-18 November 2008	9th User Interface Committee Meeting. Bucharest, Romania.
18 November 2008	14th GEO Executive Committee Meeting. Bucharest, Romania.
19-20 November 2008	2008 GEO-V Plenary Session. Bucharest, Romania.
21 November 2008	12th ADC Co-Chairs Meeting. Bucharest, Romania.
3-4 December 2008	GEOSS Users & Architecture Workshop XXV: Architecture of GEOSS. Valencia, Spain.
3-4 December 2008	GEO/CEOS Work Plan Review Workshop. Geneva, Switzerland.
12 December 2008	C4 Meeting (teleconference - 13h00 GMT). Geneva, Switzerland.
16-17 December 2008	9th Science & Technology Committee meeting. San Francisco, USA.
6-9 January 2009	GEOSS African Water Cycle Symposium. Gammarth, Tunisia.
22-23 January 2009	GEO BON Interim Steering Committee meeting. Washington, DC USA.
26-28 January 2009	CEOS-SIT Workshop and associated side meetings. Silver Spring, Maryland, USA.
2-3 February 2009	IGWCO 5th Annual Planning Meeting. Kyoto, Japan.
4-6 February 2009	CEOS WGEdu Workshop. Bangkok, Thailand.
4-6 February 2009	3rd GEOSS Asia-Pacific Symposium. Kyoto, Japan.

Dates	Events
5 February 2009	Session on WG6. Necessity and possibility of observation, forecast, and data sharing through the interdisciplinary collaboration of "Ecosystem - Climate Change - Disaster" in the 3rd GEOSS AP. Kyoto, Japan.
5-6 February 2009	Meeting of GEO Tasks ST-09-01 and ST-09-02. Brussels, Belgium.
6-7 February 2009	4th GEOSS Asia Water Cycle Initiative International Coordination Group meeting. Kyoto, Japan.
9-10 February 2009	9th Architecture & Data Committee Meeting. Kyoto, Japan.
11-13 February 2009	Developing an Agricultural Monitoring System of Systems. Beijing, China.
26-27 February 2009	10th User Interface Committee Meeting. Sophia Antipolis, France.
3-5 March 2009	CEOS SIT-23. NOOA/Florida, USA.
26-27 March 2009	1st GEOSS Monitoring and Evaluation Working Group Meeting. Geneva, Switzerland.
2 April 2009	C4 Meeting. Geneva, Switzerland.
30 March – 1 April 2009	Reconciliation Meeting Targets / Work Plan / Monitoring & Evaluation. Geneva, Switzerland.
27-28 April 2009	9th Capacity Building Committee Meeting. Athens, Greece.
2 &8 May 2009	11th User Interface Committee Meeting. Stresa, Italy.
3 May 2009	GEOSS Workshop XXVI: Towards a Global Forest Carbon Monitoring System. Stresa, Italy.
3 May 2009	UIC Co-Chairs Meeting. Stresa, Italy.
4-8 May 2009	33rd International Symposium on Remote Sensing of Environment. Stresa, Italy.
4 May 2009	13th ADC Co-Chairs Meeting. Stresa, Italy.
5 May 2009	STC Co-Chairs Meeting. Stresa, Italy.
6-7 May 2009	10th Science & Technology Committee meeting. Stresa, Italy.
7 May 2009	10th Architecture & Data Committee Meeting. Stresa, Italy.
8 May 2009	C4 Meeting. Stresa, Italy.
8 May 2009	Joint UIC / ADC Meeting. Stresa, Italy.
9 May 2009	13th ADC Co-Chairs Meeting. Stresa, Italy.
10 May 2009	GEOSS Workshop XXVII: Understanding the Oceans Integrated Observation Systems including subsurface sensors. Bremen, Germany.
11-15 May 2009	CEOS WGISS. France.
18-20 May 2009	CEOS WGEdu meeting. Oslo, Norway.
19-21 May 2009	GEO Inland and Coastal Water Quality Remote Sensing Algorithm Workshop. Washington, DC USA.
21-22 May 2009	GEOSS Sensor Web Workshop. Ibaraki, Japan.
26-29 May 2009	CEOS WGCV. Ilhabela, Brazil.
27-28 May 2009	1st Data Sharing Task Force Meeting. Geneva, Switzerland.
1-2 June 2009	15th GEO Executive Committee Meeting. Geneva, Switzerland.
8-10 June 2009	GEO South – Eastern Europe and Eastern Mediterranean Symposium. Athens, Greece.
22-23 June 2009	GEO BON Steering Committee meeting. Geneva, Switzerland.

Dates	Events
1-3 July 2009	2nd GEO Forest Monitoring Symposium. Chang Rai, Thailand.
7-9 July 2009	GEOSS Workshop XXVIII: Health and the Environment. Geneva, Switzerland.
13-17 July 2009	International Geoscience & Remote Sensing Symposium, IGARSS 09. Cape Town, South Africa.
27-28 July 2009	GEO Task ST-09-02 Kick-off Meeting. Frascati, Italy.
29-30 July 2009	GEO Task ST-09-01 Kick-off Meeting. Brussels, Belgium.
31 August- 2 September 2009	International Workshop on Innovative Data Mining Techniques in Support of GEOSS. Sinaia, Romania.
3-5 September 2009	GEOSS Summer School: Advancing Earth Observation Data Understanding. Sinaia, Romania.
9-11 September 2009	CEOS SIT-24. Darmstadt, Germany.
14-18 September 2009	Co-located GEO Committee Meetings. BoM, Melbourne, Australia.
21-22 September 2009	16th GEO Executive Committee Meeting. Geneva, Switzerland.
21-25 September 2009	2009 OceanObs Conference. Venice, Italy.
23-24 September 2009	First Task Team meeting in preparation of the Second GEOSS African Water Cycle Symposium. Geneva, Switzerland.
24-25 September 2009	Workshop on Soil Data for GEOSS. Prague, Czech Republic.
29 September-11 October 2009	QA4EO workshop on Facilitating Implementation. Antalya, Turkey.
30 September-2 October 2009	Future Satellite Gravity Missions Workshop. TU Graz, Austria.
5-8 October 2009	Workshop on High-Impact Weather Predictability & Information System for Africa. Trieste, Italy.
8-9 October 2009	3rd GEO European Projects Workshop. Istanbul, Turkey.
23-25 October 2009	GEOSS Workshop XXX: Disasters management and humanitarian assistance for GEOSS. Kampala, Uganda.
26-30 October 2009	AfricaGIS 2009. Kampala, Uganda.
2-4 November 2009	International GEO Workshop on Synthetic Aperture Radar (SAR) to Support Agricultural Monitoring. Kananaskis Alberta, Canada.
3-5 November 2009	23rd CEOS Plenary. Phuket, Thailand.
12-13 November 2009	GEOSS Workshop XXXI: Using Earth Observations for Health - a workshop of the GEO Health and the Environment Community of Practice. Washington DC, USA.
14 November 2009	12th Science & Technology Committee Meeting. Washington DC, USA.
15-16 November 2009	13th User Interface Committee Meeting. Washington DC, USA.
16 November 2009	17th GEO Executive Committee Meeting. Washington DC, USA.
17-18 November 2009	GEO-VI Plenary Session. Washington DC, USA.
19 November 2009	GEO-IGOS Symposium. Washington DC, USA.
30 November 2009	GEOSS Workshop XXXII: Disasters with emphasis on Communication. Honolulu, Hawaii, USA.

Dates	Events
30 November- 4 December 2009	GEO Water Cycle Capacity Building Workshop. Lima, Peru.
7-9 December 2009	Global Space Technology Forum 2009. Abu Dhabi, UAE.
18 December 2009	GEOSS Workshop XXXIII: using Earth Observation for Water Management. San Francisco, CA, USA.
17- 18 December 2009	Impact of climate change on agriculture. Ahmedabad, India.
18-21 January 2010	GEONetCab kick-off meeting. Enschede, Netherlands.
18-21 January 2010	Workshop of the GEO Geohazards Community of Practice (GHCP). Paris, France.
20 January 2010	GEONetCab presentations & discussions. Enschede, Netherlands.
21-22 January 2010	11th Capacity Building Committee meeting. Enschede, Netherlands.
25-27 January 2010	GEO-CEOS Work Plan Workshop. Washington DC, USA.
25-27 January 2010	CEOS Climate SBA Action Meeting. Washington DC, USA.
2-3 February 2010	GEO 2010 Ministerial Task Force meeting. Geneva, Switzerland.
2-4 February 2010	Data Sharing Task Force Action Plan Workshop. Reading,UK.
15-17 February 2010	Joint Regional Workshop of GEO Coastal Zone Community of Practice (CZCP), UNESCO Water Division, UNESCO-IOC/GOOS, and the Integrated Global Observing System (IGOS) Coastal Theme. Cotonou, Benin.
15-17 February 2010	SAFARI Symposium. Kochi, India.
22-25 February 2010	GEO BON Detailed Implementation Plan meeting. Asilomar, CA USA.
22-23 February 2010	1st GEO-Africa Core Team Meeting. Geneva, Switzerland.
23-24 February 2010	IGWCO Community of Practice Workshop on Water Resource Assessment and Applications. New York, USA.
23-24 February 2010	GCI Coordination Team meeting. Geneva, Switzerland.
24-25 February 2010	IGWCO Community of Practice 6th Annual Planning meeting. New York, USA.
2-4 March 2010	14th User Interface Committee Meeting. Reading,UK.
3-4 March 2010	12th Architecture and Data Committee meeting. Buenos Aires, Argentina.
10-12 March 2010	4th GEOSS Asia-Pacific Symposium. Bali, Indonesia.
11-12 March 2010	AIP-3 kickoff workshop. Frascati, Italy.
13 March 2010	6th GEOSS Asia Water Cycle Initiative International Coordination Group meeting. Bali, Indonesia.
22-23 March 2010	18th GEO Executive Committee Meeting. Geneva, Switzerland.
24-26 March 2010	13th Science & Technology Committee Meeting. Ankara, Turkey.
29-31 March 2010	4th Session of the WCRP Observation and Assimilation Panel, WOAP-IV. Hamburg, Germany.
12-14 April 2010	25th Session of the CEOS-Strategic Implementation Team, SIT-25. Tokyo, Japan.
19-23 April 2010	Global Drought Assessment Workshop. Ashville, USA.
26-30 April 2010	GCOS/WCRP Atmospheric Observation Panel for Climate, AOPC-XV. Geneva, Switzerland.
3 May 2010	GEOSS Workshop XXXIVa: Bringing GEOSS Services to Practice, a hands-on workshop of the EnviroGRIDS Project. Bucharest, Romania.

Dates	Events
4 May 2010	GEOSS Workshop XXXIVb: GEOSS for Decision Makers in the Black Sea area, a workshop of the EnviroGRIDS Project. Bucharest, Romania.
10-21 May 2010	What are the remote sensing data needs of the population-environment research community.
17-19 May 2010	GEO Work Plan Symposium. Pretoria, South Africa.
20 May 2010	15th User Interface Committee Meeting. Pretoria, South Africa.
20 May 2010	14th Science & Technology Committee Meeting. Pretoria, South Africa.
20 May 2010	12th Capacity Building Committee meeting. Pretoria, South Africa.
20 May 2010	13th Architecture and Data Committee meeting. Pretoria, South Africa.
1 June 2010	GEO Forest Carbon Tracking (FCT) Task Information meeting. Geneva, Switzerland.
7-9 June 2010	Fourth meeting of the GEOSS Monitoring and Evaluation Working Group. Geneva, Switzerland.
13-14 June 2010	GEOSS Workshop XXXV – Arctic Climate and Data Management: Recommendations for GEOSS. Oslo, Norway.
23-24 June 2010	GEO UN-REDD "Measurement reporting and verification joint Workshop". Zapopan, Jalisco, Mexico.
23-25 June 2010	GEOSS Workshop XXXVI - has become "INSPIRE in the Global dimension", a track organized on behalf of the EuroGEOSS project for the INSPIRE 2010 conference. Krakow, Poland.
7-8 July 2010	Geosciences observations and observing systems. London, United Kingdom.
15-16 July 2010	19th GEO Executive Committee Meeting. Geneva, Switzerland.
20-21 July 2010	GEO BON Steering Committee meeting. Cambridge, United Kingdom.
25 July 2010	GEOSS Workshop XXXVII – Radio spectrum allocation impact on earth observation and Data Quality. Honolulu, Hawaii, USA.
25-29 July 2010	GEO Health and Environment Community of Practice Workshop. CNES, Paris, France.
9-12 August 2010	ISPRS Commission VIII Symposium. Kyoto, Japan.
31 August – 2 September 2010	16th User Interface Committee Meeting. Oslo, Norway.
1-3 September 2010	14th Architecture and Data Committee meeting. Ankara, Turkey.
19 September 2010	GEOSS Workshop XXXVIII – Evolution of Ocean Observing Systems, building on infrastructure for science. Seattle, WA, USA.
28 September 2010	GEO JECAM workshop. Hong Kong, China.
28-29 September 2010	15th Science & Technology Committee Meeting. Rome, Italy.
29-30 September 2010	International Workshop on Global Agricultural Monitoring. Hong Kong, China.
3 October 2010	GEOSS Workshop XXXIX – Forest and Bio-energy. Santiago, Chile.
	International Symposium: Benefiting from Earth Observation – Bridging the Data Gap for Adaptation to Climate Change in the Hindu Kush-Himalayan Region. Kathmandu, Nepal.
11-13 October 2010	IGCP 565 Workshop 3: Separating Hydrological and Tectonic Signals in Geodetic Observations. Reno, Nevada, USA.
13-15 October 2010	EO system achievements and requirements for worldwide operational agriculture monitoring. Brussels, Belgium.

Dates	Events
22-23 October 2010	Towards a Bioenergy Atlas of Africa. Addis Ababa, Ethiopia.
25-29 October 2010	8th AARSE conference. Addis Ababa, Ethiopia.
1-2 November 2010	User Engagement Session. Beijing, China.
2 November 2010	20th GEO Executive Committee Meeting. Beijing, China.
3-4 November 2010	GEO-VII Plenary Session. Beijing, China.
5 November 2010	2010 GEO Beijing Ministerial Summit. Beijing, China.
17-18 November 2010	GEOSS Monitoring and Evaluation Meeting. Geneva, Switzerland.
18-20 November 2010	4th International Meningitis Environmental Risk Information Technologies 'MERIT' Technical Meeting. Addis Ababa, Ethiopia.
30 November 2010	Earth Observation and Life Conference. Budapest, Hungary.
19-21 January 2011	3rd Data Sharing Task Force "Scoping" Meeting. Washington DC, USA.
25-28 January 2011	17th User Interface Committee Meeting. Vienna, Austria.
1-4 February 2011	GEOSS support for IPCC assessments. A workshop on the data needs of the climate impacts, adaptation and vulnerability research community. Geneva, Switzerland.
8-9 February 2011	GEO European Projects Workshop (GEPW-5). ZSL, London, UK.
18 February 2011	GeoViQua 1st workshop: Making GEOSS a quality immersed system of systems. Barcelona, Spain.
23-25 February 2011	2nd GEOSS African Water Cycle Symposium. UNCC, Addis Ababa, Ethiopia.
28 February – 2 March 2011	13th Capacity Building Committee meeting. Sao Paolo, Brazil.
28 February – 3 March 2011	15th Architecture and Data Committee meeting. Sao Paolo, Brazil.
9-11 March 2011	GEOSS Support for Decision-Making in the Coastal Zone: Americas Workshop - Earth Observation Support for Sustainable Tourism in Small Island States. San Juan, Puerto Rico.
14-15 March 2011	7th IGWCO Planning Meeting. Tokyo, Japan.
22-23 March 2011	21st GEO Executive Committee Meeting. Geneva, Switzerland.
29-31 March 2011	3rd GEO Health and Environment Community of Practice Workshop. Geneva, Switzerland.
6-8 April 2011	18th User Interface Committee Meeting. Sidney, Australia.
10 April 2011	Building a User-Driven GEOSS: Methods to Capture, Analyze, and Prioritize User Needs. Sidney, Australia.
10 April 2011	GEOSS Workshop XL – Managing Drought through Earth Observation. Sidney, Australia.
14-15 April 2011	16th Science & Technology Committee Meeting. Sidney, Australia.
10-15 April 2011	34th International Symposium on Remote Sensing of Environment. Sidney, Australia.
18-19 April 2011	World Forest consultation meeting. Geneva, Switzerland.

Table: Group On Earth Observations (GEO)

A5 Overview of EU Agreements with Third Countries in the Framework of GMES and GNSS

The table below summarises the main elements of the agreements made between deferent countries and the EU.

Country	Date	Agreement and Content
AFRICA	Dec.2007	**The Africa-EU strategic partnership, a Joint Africa-EU Strategy**[233] *- Environmental Sustainability and Climate Change* *- Science, Information Society and Space* Work together in the global arena and international fora to effectively respond and adapt to climate change and other global environmental challenges. Support Africa's capacity building efforts in the sustainable management of natural resources bridging the digital and scientific divide within African countries and between Africa andother regions. Tackle illegal logging and associated trade. Support peace and security facilitating humanitarian aid operations and improving security of populations through integrated space applications.
	Nov. 2010	**Joint Africa EU Strategy** **Action Plan 2011-2013**[234] *- Regional integration, Trade and infrastructure* *- Science, Information Society and Space* Support effective environment and resource management, tackle climate change, achieve peace and security. Strengthen Africa's participation in the Information Revolution. Leverage faster inclusive economic growth and social development in Africa. Compete more effectively in rapidly evolving world markets.
CHINA	Oct. 2003	**Co-operation Agreement on a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States, and the Peoples Republic of China**[235] *-Scientific research* *- Industrial manufacturing* *-Service and market development* *-Trade* *-Radio spectrum issues* *-standardisation and certification and security*. Promote joint research activities in the field of GNSS. Encourage and support the cooperation between the industries. Protect intellectual property in accordance with the relevant international standards. Identify and respond effectively to user needs. Cooperate on building a regional augmentation system in China.
	2005	**Memorandum of understanding, EU-China dialogue on Energy and Transport Strategies**[236] *- Energy and Transport Strategies* Promote cooperation on new transport technologies, such as Galileo

[233] The Africa-EU strategic partnership a Joint Africa-EU Strategy Lisbon. 9 Dec.2007. <http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/er/97496.pdf>.
[234] Joint Africa EU Strategy Action Plan 2011-2013 Introductory Part <http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/er/118211.pdf>
[235] Co-operation Agreement on a Civil Global Navigation Satellite System (GNSS) between the European Community and its MemberStates, and the People´s Republic of China <http://www.fco.gov.uk/resources/en/pdf/pdf19/fco_ref_cm7202_chinagnss>

Country	Date	Agreement and Content
		applications, rail technologies and air traffic management
INDIA	Sept. 2005	**The India-EU Joint Action Plan**[237] *-Transport* *-Space Technology* Support further collaboration in areas such as earth observation and remote sensing for monitoring of natural resources and environment. Develop efficient transport systems Strengthen civil air safety
	Dec 2010	**EU-India Joint Statement**[238] *-Security and Defence* *- Energy security, energy efficiency and promoting the development of renewable energy* *- Maritime transport* Active cooperation pursued by space agencies and industries for developing, launching and operating Earth Observation and Communication Satellites through appropriate bilateral relations. Formation of ISO-ESA Joint Working Group on Earth Observation to concretize the cooperation areas.
ISRAEL	Jun 2004	**Cooperation Agreement on a Civil Global Navigation Satellite System (GNSS)between the European Community and its Member States and the State of Israel**[239] *- Scientific research* *- Industrial manufacturing, - Service and market development,* *- Radio Spectrum issues* *- Standardisation and certification and security* Promote joint GNSS research activities. Encourage and support cooperation between the industries. Identify and respond effectively to user needs. Grant and ensure adequate and effective protection of intellectual, industrial and commercial property rights in the fields and sectors relevant to the development and operation of GALILEO/EGNOS
MOROCCO	Dec 2006	**Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and the Kingdom of Morocco**[240] *- Scientific research* *- Industrial manufacturing,* *- Service and market development,* *- Radio Spectrum issues* *- Standardisation and certification and security* Ensure the accessibility of GNSS services to users in Morocco. Promote joint GNSS research activities.

[236] EU-China dialogue on Energy and Transport Strategies, memorandum of Understanding <http://ec.europa.eu/energy/international/bilateral_cooperation/china/doc/dialogue/2005_mou_eu_china_energy_transport_strategies.pdf>
[237] India-EU Strategic Partnership Joint Action Plan <http://www.europa-eu-un.org/articles/en/article_5018_en.htm>.
[238] EU-India Joint Statement, Brussels, 10 December 2010 <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/670>
[239] Cooperation Agreement on a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and the State of Israel, Brussels. 2 Jun. 2004 <http://ec.europa.eu/enterprise/policies/satnav/galileo/files/2004_09_01_accord_eu_israel_en.pdf>

Country	Date	Agreement and Content
		Encourage and support cooperation between the industries. Identify and respond effectively to user needs. Grant and ensure adequate and effective protection of intellectual, industrial and commercial property rights in the fields and sectors relevant to the development and operation of GALILEO/EGNOS
NORWAY	Oct. 2010	**Co-operation Agreement on Satellite Navigation between the European Union and its Member States and the Kingdom of Norway**[241] *- Radio spectrum issues* *-Ground facilities of European GNSS* *- Security* Further strengthen the cooperation between the Parties by complementing the provisions of the EEA Agreement applicable to satellite navigation. Adoption and enforcement of equivalent GNSS security measures. Ensure the protection and the continuous and undisturbed operation of ground facilities in Norway. Support the development of Galileo standards and promote their application worldwide, emphasising interoperability with other GNSS.
RUSSIA	May 2005	**Roadmap for the Common Economic Space**[242] *- Networks: telecommunications and transport* *-Space* Provide appropriate environment for fruitful cooperation on Global Monitoring for Environment and Security (GMES) programme Co-operation of the EU Satellite Centre with Russia on specific areas like logistical aspects of crisis management operations. Implement the space component of the Global Earth Observation System of Systems (GEOSS) Enhance and strengthen cooperation on Galileo and GLONASS GNSS including on compatibility and interoperability between the two systems and the creation of the conditions for industrial and technical cooperation.
	Mar. 2006	**EU- Russia Dialogue on Space Cooperation**[243] *- Satellite communication and Earth Observation* *- Space Transportation* Exchange Earth Observation (EO) service methodologies in arctic ice, forest inventories, earthquake precursors and crop monitoring. Investigate further areas for cooperation in early warning and risk management as well as global issues like greenhouse gases[244].
SOUTH KOREA	Sept. 2006	**Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its**

[240] Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and the Kingdom of Morocco Brussels. 12 Dec.2006 <http://www.fco.gov.uk/resources/en/pdf/pdf19/fco_ref_cm7201_moroccognss>
[241] Cooperation Agreementon Satellite Navigation between the European Union and its Member States and the Kingdom of Norway.29 Oct.2010 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:283:0012:0020:EN:PDF>.
[242] Road map for the common economic space- Building blocks for sustained economic growth , 15th EU-RUSSIA SUMMIT Moscow, 10 May 2005 <http://ec.europa.eu/environment/enlarg/pdf/road_map_ces.pdf>
[243] EU- Russia Dialoque On Space Cooperation. <http://ec.europa.eu/enterprise/policies/international/files/eu_russia_space_dialogue_en.pdf>.
[244] "EU-Russia Dialogue on Space Cooperation – 5th meeting of the Steering Board" 10 Jun. 2010, http://ec.europa.eu/enterprise/policies/space/files/policy/conferences_page/5th_meeting_of_the_eu-russia_space_dialogue_v3_en.doc

Country	Date	Agreement and Content
		Member States and the Republic of Korea, on the other part[245] *- Scientific research* *- Industrial cooperation* *- Trade and market development,* *- Standards, certification and certification and regulatory measures* *- Augmentations* *-Security* *-Liability and cost recovery* Promote joint GNSS research activities. Encourage and support co-operation between the industries. Identify and respond effectively to user needs. Grant and ensure adequate and effective protection of intellectual, industrial and commercial property rights in the fields and sectors relevant to the development and operation of GALILEO/EGNOS
UKRAINE	Dec.2005	**Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and Ukraine**[246] *- Radio Spectrum* *-Scientific research* *- Industrial cooperation* *- Trade and Market development* *- standards, certification and regulatory measures* *-developing of global and regional GNSS ground augmentation systems* *-Security* *-Liability and cost recovery* Promote joint GNSS research activities. Encourage and support the cooperation between the industries. Ensure adequate and effective protection and enforcement of intellectual, industrial and commercial property rights at the fields and sectors relevant to the development and operation of Galileo/EGNOS. Promote broad and innovative use of the GALILEO services for open, commercial and safety of life purposes. Implement a ground regional augmentations system in Ukraine based on the GALILEO system.
USA	Jun 2004	**Agreement on the promotion, provision and use of Galileo and Gps satellite-based navigation systems and related applications**[247] *-Interoperability between GPS and Galileo navigation systems* Promote and facilitate the use of positioning signals, services, and equipment for peaceful civil, commercial, and scientific uses, consistent with and in furtherance of mutual security interests.

[245]Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and the Republic of Korea, on the other part http://www.fco.gov.uk/resources/en/pdf/pdf19/fco_ref_cm7203_repkoreagnss>.

[246] Co-operation Agreement On a Civil Global Navigation Satellite System (GNSS) between the European Community and its Member States and Ukraine, Kiev, 1.12.2005 <http://www.fco.gov.uk/resources/en/pdf/pdf19/fco_ref_cm7199_ukrainegnss>.

Country	Date	Agreement and Content
	Jul. 2009	**EC-US Scientific and Technological Cooperation Agreement**[248] - *Space and Earth* - *Crisis management* Cooperate on land imaging activities relating to the US Landsat satellites and the European GMES activities on Sentinel 2. Address growing concerns over climate change, other natural disasters and sustainable development issues.

[247] Agreement on the promotion, provision and use of Galileo and Gps satellite-based navigation systems and related applications, Dromoland Castle, Co.Clare, 26 Jun. 2004.
<http://www.official-documents.gov.uk/document/cm73/7384/7384.pdf>.
[248] EC-US Scientific and Technological Cooperation Agreement Road Map Document. Jul. 2009
<http://ec.europa.eu/research/iscp/pdf/usa_roadmap_2009.pdf>.

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Mission Statement of ESPI

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