COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 28.10.2009
SEC(2009) 1439

COMMISSION STAFF WORKING DOCUMENT

Global Monitoring for Environment and Security (GMES): Progress Report on the GMES Space Component

Accompanying document to the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Global Monitoring for Environment and Security (GMES): Challenges and Next Steps for the Space Component

{COM(2009) 589 final}
{SEC(2009) 1440}
{SEC(2009) 1441}

COMMISSION STAFF WORKING DOCUMENT

Global Monitoring for Environment and Security (GMES):
Progress Report on the GMES Space Component

1. INTRODUCTION

As a European Space Policy flagship, GMES intends to establish and maintain an operational space Earth observation programme which will foster the links with in situ infrastructure and favour the emergence of services for a range of domains starting with land monitoring, emergency response, atmospheric composition monitoring, operational oceanography and followed by security and climate monitoring.

To date, significant resources have been allocated both through ESA and the EU budget through the 7th Framework Programme for Research and Technological Development (2007-2013) to develop GMES. Current combined investments, implemented through the ESA GMES Space Component Programme, amount to 624 M€ (28%) and 1621 M€[1] (72%) by the EU budget and ESA Participating States contributions respectively. This investment will ensure the development of the Sentinels and will also ensure data access schemes to a number of relevant public or private missions.

The 2008 GMES Communication[2] has set the scene for the architecture, governance and financing aspects of GMES including its Space Component. In its conclusions, the EU Competitiveness Council reaffirmed the need for the estimating costs and defining a sustainable funding and governance approach.

In parallel, at the ESA Council at Ministerial level in November 2008, Member States have demonstrated their active support for the further development of GMES and in particular its Space Component.

In 2009, the Commission adopted a proposal for a GMES Regulation[3] and the 6th Space Council[4] reaffirmed the need for the EU to establish a budget strategy within the framework of the next EU Multiannual Financial Framework.

This report follows those institutional milestones and provides additional technical, programmatic and financial elements for the GMES Space Component.

2. THE USE OF EARTH OBSERVATION

Space-based Earth observation systems have a unique potential to provide a wealth of information about a wide range of physical parameters over continental surfaces, oceans and the Earth's atmosphere. Such information is highly relevant to environmental, climate and security monitoring and is increasingly required to be delivered with a short re-visit time and uniform spatial distribution world-wide.

Observing from space is the only realistic means for gathering frequent information about remote locations, including under adverse meteorological conditions, thus guaranteeing timeliness of information. In addition, as the same sensors and methodology are used at global

---

1 Figures are shown in 2008 economic conditions.
2 COM(2008)748 of 12.11.2008
3 COM(2009)223 of 20.05.2009
4 6th Space Council orientations of 29.05.2009

scale, comparisons can be made between different countries or regions anywhere in the world. Moreover, spaceborne observations provide large coverage or global views thus complementing ground truth data which are acquired on a sample basis (in-situ observations).

Today, Earth observation data are primarily used by the public sector. Examples include: civil protection authorities and their networks (e.g. forest fires, floods); international emergency operators, security and defence actors, agriculture ministries (e.g. agri-environmental measures, checks); environment ministries (e.g. water, soil, forests, air quality, pollution, ozone hole, UV monitoring); urban planning; cartography and cadastre agencies; transport ministries (e.g. vessel monitoring, oil spill monitoring, ship routing, sea-ice monitoring); meteorological services (e.g. for weather forecasts and protection of life and properties) and oceanographic institutes (e.g. sea-surface temperature, ocean colour/chlorophyll concentration, sea level height).

While it is important to ensure sustainable observing systems for these needs and looking ahead towards the future, we cannot ignore the pressing need for readily available information anytime, anywhere. Spaceborne Earth observation is, in turn, close to meeting its most promising application thanks to the advent of mass geo-coded portals enabling any user with Internet access to view the whole globe. Further developments are bound to have an impact on the use of Earth observation.

Technical and programmatic options should, therefore, be examined with a view to increasing the frequency of observations worldwide. Coupled with a full and open access data policy, such an approach is expected to bring Earth observation closer to the downstream sector and open a new era for the development of mass market Earth observation applications.

3. STATE-OF-PLAY

Beyond scientific missions, European operational systems for spaceborne Earth observation have seen some rapid progress in the last decades. On the one hand, an intergovernmental process for operational meteorology is in place through EUMETSAT, leading to long-term programmatic and financial commitments on satellite series. On the other hand, some Member States have established imaging capacities targeting their defence and security needs. Between those two strands and following a gap analysis, the GMES Space Component is being developed. It comprises six Sentinel missions respectively targeting different observations. Each Sentinel mission will be implemented through a short series of identical satellites - typically four - covering a period of 15-20 years of continuous observations. Thereafter, new generations of satellites will be developed.

The Sentinel missions can be grouped in two major categories:

- Systematic observations of wide areas.

This category includes systems that monitor biogeophysical parameters over wide areas, often globally, on a routine and sustained basis, mainly addressing requirements for atmospheric composition monitoring, oceanography including altimetry, global land monitoring, and climate monitoring. Sentinels 3, 4, 5 and Jason-CS fall into this category.

- Imaging of targeted areas.

This category includes high to very-high resolution radar and multispectral imaging missions often based on satellite tasking mainly addressing requirements for land monitoring, emergency response and security. Sentinels 1 and 2 fall into this category.

4. OBSERVATION CONTINUITY FOR GMES SERVICES BEYOND 2011

4.1. Systematic Observations for Operational Oceanography and Atmospheric Monitoring

For this category, there is a need to reinforce emerging user communities starting with atmospheric composition monitoring and operational oceanography, so that they can engage into preparing shared infrastructure. Moreover, there is a need to gradually reinforce synergies between the requirements of these emerging user communities with those of operational meteorology.

Member States have already expressed their interest in exploring synergies between operational meteorology, oceanography and atmospheric composition monitoring. For the future, it seems appropriate to gradually build stronger links with the space segment of operational meteorology. In the short term, some instruments (Sentinels 4 and 5) for atmospheric composition will be hosted on board meteorological satellites of EUMETSAT. It is expected that systematic coordination will be implemented for future missions.

The GMES oceanographic and atmospheric services are designed to exploit the data flow provided by Sentinels 3, 4 and 5, to be complemented by data from EUMETSAT meteorological missions. Until the Sentinels are launched, pre-operational services will rely on data from ESA science missions (e.g. Envisat).

The EU will rely on EUMETSAT to operate Sentinels 3 (marine part), 4 and 5 missions in order to ensure the necessary flow of data in the GMES oceanographic and atmospheric services.

In the current scheme, space observation requirements for operational oceanography and atmospheric composition monitoring have been identified through an ad hoc user consultation process.

The EU needs to establish a formal process for consolidating space observation requirements and validating the response offered by the space infrastructure. Such a process already exists for operational meteorology.

The EU and ESA will hold a dialogue with EUMETSAT and its Member States in order to examine the institutional mechanisms for relying on EUMETSAT to implement a similar process, for and behalf of the EU, for GMES oceanographic and atmospheric monitoring space observations. Dedicated bodies could be created within the framework of EUMETSAT, bringing together national representatives of the relevant user communities. These bodies could be mandated to perform all necessary preparatory analysis and provide recommendations for decisions by the GMES governance bodies managed by the EU.

High-precision altimetry can be a first building block in that respect. Indeed, it is important to ensure the involvement of a user community mandated to represent national authorities in the field of operational oceanography while analysing options for international cooperation[5].

In parallel, as mentioned in the 2008 Commission Communication[6], similar options should be explored for the coordination of GMES oceanographic and atmospheric composition monitoring services, for and on behalf of the EU, by the European Centre for Medium-range Weather Forecasting (ECMWF). In this highly specialised scientific and technical field there

---

[5] To date high precision altimetry observations have been guaranteed through a co-operation scheme between France, NASA and more recently EUMETSAT and NOAA.

[6] COM(2008)745 of 12.11.2008

are no other organisations which can perform these tasks. In order to accompany the user uptake it is important to consolidate the emerging European capacity initiated under FP7. Service continuity towards the user community should be ensured following the expiry of the FP7 collaborative projects currently in place. Such an approach is expected to establish a long-term institutional scheme for GMES service operators in these thematic areas.

Building on their successful cooperation model in the field of operational meteorology, it is proposed that ESA and EUMETSAT should interact as follows for the definition and implementation of future infrastructure related to oceanography and atmospheric composition monitoring, for and on behalf of the EU:

- EUMETSAT should consolidate GMES user requirements for space observations, exploit space infrastructure and interface with the relevant user communities.
- ESA should manage the development of infrastructure corresponding to consolidated needs.

4.2. Observations for Land Monitoring, Emergency Response and Security

For imaging systems, spaceborne Earth observation is not yet a sustained information source for operational use that can stimulate the uptake by the downstream sector mainly due to lack of structured user communities ready to engage into funding of shared infrastructure; the need to improve synergies between civil and defence space programmes; lack of frequent observations; and complex and costly access conditions.

With respect to satellite imaging systems, GMES only addresses systems of civil use including civil aspects of dual-use systems. Defence imaging systems are not within the scope of the foreseeable development of GMES.

The EU will rely on ESA, ad interim, for the operations of part of the Sentinel infrastructure[7]. Options for the identification of another entity will depend on the future approach for high to very-high resolution imagery and may include: extending the mandate of existing public European organisations; using national public and private capacities; or establishing a new European entity.

The EU needs to establish an adequate process for consolidating space observation requirements in these domains. However, in the absence of a European organisation equivalent to EUMETSAT, options should be explored for the user consultation process and its associated bodies involving national representatives.

With a view to preparing a robust European capacity for land monitoring and emergency response and security based on high-and very-high resolution imagery as a means to improve the offer and stimulate the demand for such data, the EU, with the support of ESA, should develop with Member States a joint approach on how to combine national and European capacities. Options should be examined in that respect. The long-term approach for infrastructure in support of land monitoring, emergency response and security services will depend on the outcome of the consensus reached with national infrastructure owners for high to very-high resolution missions. The Commission and ESA will hold dialogues with Member States owning infrastructure, in order to achieve a shared understanding about the future terms of cooperation.

As commercial data providers in Europe are important partners in satisfying the data needs of GMES Services, there will be parallel discussions with these providers to have an exchange

[7] Currently, these are Sentinels 1, 2 and the land part of Sentinel 3.

on the advance planning for the development of Earth Observation missions and data provision.

5. PROGRAMMATIC AND FINANCIAL ASPECTS

The GMES Space Component comprises 6 series of Earth observation Sentinel missions. Some 12 missions split into six constellations are currently under development.

The Sentinel series comprise constellations of several units[8]. This is the answer to the user requirements for the implementation of GMES services, which expressed the need for observation continuity and seamless access to data, redundancy in the context of an operational system and increased frequency of observations.

In addition the GMES Space Component programme relies on some 40 missions owned by Member States, ESA, EUMETSAT and other third parties to meet the needs for GMES services. These missions are listed in the ESA GMES Space Component Programme Declaration and they are referred to as contributing missions. Data access schemes are in place to assure the availability of their data for GMES services.

The GMES Space Component is currently at its development phase. Current combined investments, implemented through the 7th Framework Programme for Research and Technological Development (2007-2013) and the ESA GMES Space Component Programme, amount to 624 M€ (28%) and 1621 M€[9] (72%) from the EU budget and ESA Participating States contributions respectively.

The Council has taken note of the ESA Long-term Scenario[10] document as the basis for the estimations of the GMES Space Component evolution and costs. According to this analysis, the financial effort would represent in total some €4 billion for the period 2014-2020 including estimated annual costs of €430 million for the operational activities and €170 million for R&D.

The costs of the operational programme include for each of the six Sentinel series, the space segment, ground segment, launchers and operations costs. A data access provision is made to ensure access to GMES contributing missions. For all elements, an R&D effort is estimated to prepare for system evolution to develop new Sentinel missions and the new generation of satellites for agreed Sentinel series.

The cost breakdown for these elements is presented in the table below.

GMES Space Component	**2014-2020 (M€)**	**Annual costs 2014-2020 (M€)**
Space Segment (including launchers)	1420	
Ground Segment and Operations	1130	
Data access	450	

8 Known as the A and B units flying simultaneously, whose operations will cover the 2013-2020 timeframe, followed by the C and D units as foreseen in the ESA Long-term Scenario (ESA/C(2009)36)

9 Figures are shown in 2008 economic conditions.

10 ESA/C(2009)36

Total - operational programme	3000	430
Total - R&D	1230	170
TOTAL	4230	600

Table 1. GMES Space Component Cost Breakdown (c.e.c)

As a comparison, it should be noted that space infrastructure investments made by Member States for operational meteorology through EUMETSAT and ESA are in the order of 400M€ annually.

A number of short-term programmatic and financial aspects need to be addressed by 2011 including:

- the operations for the Sentinel 1, 2 and 3 A units due for launch in the 2012-2013 period;
- the launch and operations of the Sentinel 1, 2 and 3 B units which could be ready for launch in the 2014-2015 period;
- the development of the Sentinel 5 and Jason-CS missions; and
- the procurement of the recurrent C units for Sentinels 1, 2 and 3.