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Ex-post Evaluation on the European earth monitoring programme (GMES) and its Initial Operations (2011 to 2013)

{COM(2016) 492 final}

Contents

EXECUTIVE SUMMARY

This document is based on the final evaluation of three related elements that are however different in nature: the Global Monitoring for Environment and Security GMES Initial Operations (GMES GIO) programme (2011-2013), the GMES Preparatory Actions (PAs) 2008-2010, and the FP7-funded elements of the GMES Space Component (GSC) 2007-2013 The Global Monitoring for Environment and Security (GMES) initiative has developed over two decades in response to a growing need from decision makers in Europe for access to accurate, timely and reliable data and information services relating to environment, climate change and security issues. From 1998 to 2013, GMES was co-funded by the EU and the European Space Agency (ESA). Initially, this took the form of limited support through the 6th Framework Programme for Research and Development (FP6) and ESA's Member States, focusing mostly on services and applications. However, funding was scaled up significantly on the ESA side, from 2005 and on the EU side, from 2007 with the Framework Programme for Research and Technological Development (FP7).To prepare the ground for operational services, a series of Preparatory Actions (PAs) for GMES were also launched in the years 2008 to 2010, in particular aiming at demonstrating the potential benefits and fostering the user uptake for selected GMES services. In 2011 the GMES GIO regulation was launched with a specific albeit limited budget.

The budget for the three elements were respectively: for GMES GIO: €107m; for GMES PAs: €10m; and for FP7 co-financed GMES space component: €715m.

The evaluation had two overarching objectives, which were: (i) to evaluate the relevance, effectiveness, coherence, efficiency, sustainability and European added value of the three GMES-related elements and (ii) to outline their overall societal value, in terms of the balance between the investments made in space infrastructures and services, and the value of data gathered for the selected services. The evaluation was carried out by a contractor under a specific contract under the Commission's framework contract for evaluation tasks, adopting a mixed methodology including desk research, stakeholder interview and a targeted consultation. The data collection included a desk-based review of existing documents (e.g. EU regulations, interim evaluations, GMES work programmes, administrative data, usage statistics), an online questionnaire directed to all categories of stakeholders, a small industry survey directed specifically to the contractors that 'built' the GMES space component and a programme of targeted, semi-structured interviews with relevant individuals among key stakeholder groups. More than 400 named individuals were approached for an interview or a questionnaire and 170 were consulted during the course of the study. The interview and the consultation produced rather small number of responses, reflecting the particular nature of GMES and the small population of people and organisations with knowledge of the activities. (Only 40 representatives from industry, SMEs and service providers responded to survey and interview but the space sector is composed of few high specialised industries and the respondents target had been set at 65).

The independent evaluation study concluded that five years after the publication of the GIO regulation (2010), each of the six services initially foreseen (emergency management, land, atmosphere, marine environment, security and climate change) remains important to the information needs of Europe's policy makers and public services. Indeed, concerns around climate change have escalated further and the issues of civil security and humanitarian crises have emerged as some of the most pressing challenges of our era, making earth observation needs even more crucial for the EU.

GIO, PAs and the GSC funded through FP7 were broadly effective in achieving their stated objectives, albeit they were perhaps the pragmatic (because they were the only instruments available) rather than the ideal choice of instruments (that would have required a huge, dedicated and well-funded programme) for the development of such a complex and wide-ranging set of global information services and its related space infrastructure (intended as the panoply of elements necessary to build, launch and maintain in operation the satellites, the ground structures for support and for data processing). An RTD Framework programme is not normally designed to produce the type of large-scale integrated system needed by GIO but the attempt was successful, although it created certain inefficiencies linked to the "research project" procedures to be followed as for the contracting of work or the reporting on progress made. Other inefficiencies of the Programme include the limited support for uptake and downstream applications or the lack of provision of in-situ data and its integration with other existing space-derived data from contributing missions,. However the limited budget did not allow for much choice and there was no practicable alternative, since no other programme could have sustained the costs for the

GIO implementation. Most programme participants, considered the programme results to be produced at reasonable costs, but a thorough quantitative analysis of the efficiency has not been possible due to the lack of metrics or targets for indicators associated with the operational objectives, therefore there was no baseline against which quantify and test the progress made by the programme. It should also be noted that there are no homogeneous criteria to compare services' performance, due to the totally different nature of each of them. For the space infrastructure, thanks to the use of fixed price contracts, the development of Sentinel satellites and their launch costed less than previous Earth Observation initiatives. The GIO programme had a positive influence on the phase-up of the present Copernicus Programme. On one hand, it established GMES as a programme with its own architecture and interlinked components, pre-announcing the development of the complex structure of Copernicus. On the other hand, with limited financing the programme delivered on each of its specific objectives[1] and successfully ensured: the operational provision of two of the core services (Emergency management (EMS) and Land monitoring (LMS)), the coordination of access to other space and in situ data and the contribution to developing, building, launching and operating the "Sentinels" satellites. The limited funds, however, inevitably slowed the rate of implementation of the remaining four core services, of user uptake and of the development of a downstream sector. It should be noted that the first Sentinel's data were only available after the first launch, in April 2014.

The programme had positive effects on intra-EU and international cooperation, for example contributing to the work of the international group on earth observation (GEO) where there had originally been competitive tensions and to the Global Earth Observation System of Systems. It enabled the creation of a permanent European Earth monitoring system, in line with the Commission's Communication on Europe 2020, which saw GMES as a key component of European space policy and a means by which to help address key global challenges as it has been demonstrated by the contribution of the Global Land service to the EU Development efforts and by the Emergency management Service support to the EU's emergency response and management at the international level. The series of data and information services created by the programme have the potential to deliver wider social and economic benefits in the future.

The GMES Space Component produced substantial direct benefits for Europe's space industry, with more than 230 suppliers benefitting from circa €530M in contracts, including 48 high specialized small and medium size enterprises. According to the survey held for the evaluation, all contractors considered the contractual work had improved their technological capabilities 'to a large extent,' and all respondents reported a positive benefit in terms of their competitiveness.

There are now 600 registered service users (2015), which have realised both process (productivity) and product benefits, as a result of using GMES/Copernicus services and data, estimated in annual savings ranging from €10,000 to €500,000 a year from productivity gains and reduced external purchases.

The GIO programme has worked as good example of EU policy, judging, for example, by the growing use of its Land and Emergency services by policy makers and public agencies in the agriculture, environment and climate change areas, to get information on flooding, earthquakes, fires and other environmental hazards. By using generic industrial statistics to estimate the spill over effects for the investments, while keeping the estimates in the lower bound, the total societal benefits produced by the GMES infrastructure reach up to €3 billion. Other socio-economic benefits are difficult to calculate, as for instance the extent to which the GMES initial operations had enabled savings to be made through improved early warnings or better emergency response. However, given the scale of the economic disruption, even a 1% contribution across all types of emergencies, would produce annual savings of tens of millions, which is substantially more than the annual cost of running the whole Emergency Service (4-5 million/year).

The GMES Space Component fulfilled its objectives and underpinned the launch of Copernicus, so in that sense the programme must be considered to have been 'useful.' However, the full service is still being developed and as such the issue of wider utility is only starting now. The majority of consulted stakeholders view this whole domain as a work-in-progress, so while most people are reasonably satisfied with the achievements of the GMES initiatives, there are numerous points where more needs to be done. Those challenges must fall to Copernicus now and, they comprise: (i) a very much sharper focus on (and understanding of) user needs, (ii) greater certainty around the longer-term plans / funding for the service and (iii) the development of downstream services.

[1] The objectives of GMES GIO were stated in the Annex to the REGULATION (EU) No 911/2010 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 September 2010 on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013)

The required outputs were delivered by the programme and the preparatory actions at reasonable and proportionate costs, in the opinion of the industry of the sector and the majority of people interviewed acknowledged that the programme had been properly managed although several contributors argued that the balance of priorities had been wrong (e.g. too much of the total investment had gone into the space component and insufficient attention had been paid to the development of services. The Land and Emergency Services however were both launched as planned and have run continuously since, providing all of the anticipated products and services. The space component was executed according to plan, keeping to time and budget, and was cost-effective, when judged against the cost of other Earth observation programmes. The GIO programme, including the European Space Agency funds, outside the scope of this evaluation, cost around €2.3 billion in total in 2002 prices, to develop the first seven satellites and to launch three of them. In real terms, this is lower than the equivalent cost to develop, launch and operate the Envisat satellite, which had fewer instruments and lower levels of functionality.

The different elements (FP7, PAs and GIO) were consistent in how they attempted to reach their stated objectives inasmuch as the PAs usefully helped to define the service components of three of the six core services and the GIO programme ensured the continuation and expansion of those pre-operational services and the further development of the remaining ones. The GIO programme also built on the work of the FP7 funded GMES Space Component and in particular the coordinated provision of observation data both from existing space infrastructure (Contributing Missions) and from in situ observing systems. In simple terms, GIO built on the outputs of the FP7-funded space element and prepared for the operational phase. GIO would not have been successful without the FP7 space component, and Copernicus would not be working so well without GIO. The GIO programme also complemented Member States operations, with very few examples of substantive overlaps in services; however, these can also be considered complementary, with different instruments and levels of resolution (e.g. Italy's COSMO-SkyMed programme).

The three elements evaluated provide nevertheless high levels of European Added Value. No single EU country could have created a similar system on its own, partly for reasons of cost, but also for reasons of willingness to invest. National programmes are naturally very much more limited in their scope and only fulfil a limited number of the GMES functions and typically at lower levels of functionality. GMES offers higher levels of assured continuity of service, as compared with anything available nationally (even for the US): a full-scale, permanent screen of sensors. GMES also provides substantial added value through the provision of harmonised data and technology applied across EU Member States for cross-border issues and in aggregating the harmonised data reported by Member States up to EU scale in a harmonised manner. There is real added value for a wide set of European policies in accessing a homogeneous database and derived products for the whole of the EU and beyond. For the Earth Observation industry, the added value was financial: the creation of a major space infrastructure programme that may not have been launched otherwise procured leading-edge technologies and helped ensure Europe's space industry remains globally competitive.

Turning to the question of the sustainability of the changes brought about by the GIO programme, the evaluation suggests there will be a legacy in terms of better policy choices or enhanced technological capabilities. For the manufacturers and technical services companies that have built the infrastructure and delivered much of the services component, the contracts will have quite a lasting effect, conferring a competitive advantage that people anticipate to last for five years or more. The opportunities for value-added resellers and downstream businesses have yet to be crystallised in any serious scale although much is being done to promote the sector.

The lessons learned suggest further attention to the user orientation of the core services, with explicit strategies driven by the information and functional needs of key market segments. It will be necessary to continue to invest in user uptake, within both institutional and private sector client groups. Interaction with Member States and regional authorities within the governance structures (and consultative processes) of the core services must be increased. Finally, the evaluation suggests to continue to support innovation in both the core services and their platforms, looking to make greater use of data linking (and big data more generally) and to increase substantially the support available to develop downstream applications, focusing in particular on incentives for smaller businesses.

INTRODUCTION

In compliance with the Article 14 of the Regulation No 911/2010 the Commission had to conduct an ex-post evaluation of GMES Initial operations programme by 31 December 2015 and present its results in a Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. As far as the GMES Preparatory Actions are concerned, Article 21 of the Implementing Rules of the Financial Regulation[2], requires interim and/or ex-post evaluation of all programmes and activities, including pilot projects and preparatory actions, exceeding €5 million (which is the case for the Preparatory Actions). An interim evaluation for GMES and its initial operations as well as the GMES preparatory actions took place in 2012, as required by Regulation No. 911/2010. Last, but not least, for consistency reasons the final evaluation of the GIO regulation and the GMES Preparatory Actions follow an integrated approach, and include the evaluation of FP7 space actions financing the construction and launch of the GMES space component (Sentinels and data access activities).

Beyond the regulatory reporting obligations, it is significant to verify the solidity of an approach that has transformed, in very few years' time, a research and development-oriented programme into a full industry and societal endeavour, without losing its scientific character or its competitiveness edge on a global scale. Furthermore, the evaluation helps to put in perspective the past and future achievements of the Copernicus programme and the legislative initiative practices of the Commission. GIO is, in fact, one example of the successful efforts sustained by the European Union to integrate different policies and respond to big societal challenges, while respecting the political objectives of growth and modernization.

To summarize: the scope of the evaluation is the GMES Initial Operations programme (GIO) 2011-2013; the GMES Preparatory Actions (PAs) 2008-2010, and the GMES space component funded through the FP7, covering the 2007-2013 period. The focus is on the elements specifically funded by the EC through these three components (GMES GIO: €107m; GMES PAs: €10m; and FP7 co-financing of the GMES space component: €715m). Each of the elements were examined as part of an integrated evaluation, all of them were relevant to evaluating the effectiveness of GIO overall, and its impact on the phase-up of the Copernicus Programme, launched in 2014.The focus, however, is on the two fast-track services of GIO, Land and Emergency Management services, and has only considered the other four services (e.g. marine, security, etc.) as part of a contextual analysis. It should be noted that the other services were part of the ex-post FP7 space evaluation and that all elements have been part of the Commission's report on the FP7 ex-post evaluation.

For the GIO programme, it was important to assess whether its objectives were still relevant; how the adopted measures contributed to reach said objectives and their degree of effectiveness and efficiency; the performance of the organisational structure and the scope of the services deployed; the degree and the quality of the involvement of the relevant European Agencies, and, finally, the impact of data and policy on stakeholders, downstream users and investments. The evaluation exercise aimed at analysing, on one side, the GIO programme implementation, mainly the work programmes, the budget execution, delegation mechanisms (delegations to the European Environment Agency (EEA) and to the European Space Agency (ESA)), and procurement procedures (publications, evaluations, and awarding). On the other side, GMES policies and governance, from data and information policy to security policy, GMES Committees and Security Board, and user consultations (User Forum) have also been assessed. As regards to the Preparatory Actions it was important to verify the extent to which stated goals have been achieved (or were likely to be achieved), i.e. demonstrate the potential benefits and foster the user uptake for selected GMES services. Their contribution to the facilitation of the GMES regulatory work is in the background of the evaluation. Finally, for the FP7 actions dedicated to the development of the GMES space component, the final evaluation only assessed the space infrastructure and data access contribution to the build-up phase of GMES.
The evaluation had two overarching objectives, which were: (i) to evaluate the relevance, effectiveness, coherence, efficiency, sustainability and European added value (EAV) of the GMES related elements (the PAs, GIO and FP7 space component); and (ii) to outline the overall societal value of the three components of the GMES Programme, in terms of the balance between the investments made in space infrastructures and services, and the value of data gathered for the selected services. A log frame, setting out the general and specific objectives for the GMES programme was set up and is reported in the Annex.

[2] Regulation No. 1605/2002

BACKGROUND TO THE INITIATIVE

The Global Monitoring for Environment and Security (GMES) initiative was launched in 1998 with the declaration known as the "Baveno manifesto". It was, however, only in 2001 that the Council Resolution 2001/C 350/02 (13.11.2001), following the Gothenburg summit of June, adopted the strategic decision to develop before 2008 an independent observation capacity to deliver services in both the environmental and the security fields. GMES was designed on the assumption that the EU could play a more effective role than individual Member States in international cooperation through bilateral collaborations with other spacefaring nations or participation in global efforts in the field of Earth Observation (e.g. the Group on Earth Observations). Given Europe's long heritage in Earth observation, GMES was built on partnerships between the Union, the Member States and the European Space Agency (ESA) with the further participation of other entities like EUMETSAT (the European Organisation for the Exploitation of Meteorological Satellites) and the European environment agency (EEA).

In 2004, the EC Communication 'GMES: Establishing a GMES capacity by 2008'[3] introduced an Action Plan to address the Gothenburg challenge and to establish a working GMES capacity by 2008. A Framework Agreement[4] was also signed between the EC and ESA, providing the basis for future cooperation on GMES. In 2005, "GMES: From Concept to Reality"[5] set out a strategy for delivering GMES, and established priorities for rolling-out services in 2008. Initial areas of focus (Fast Track Services) included land and marine monitoring and emergency response services, while later priorities (Pilot Services) were expected to include atmosphere, security and climate change. The Communication also envisaged that GMES would be allocated a substantial majority of the funding available for Space under FP7. A GMES Bureau was also established, with the primary objective of delivering the priority services by 2008, as well as addressing issues relating to the GMES governance structure and long-term financial sustainability.

From 1998 to 2013, GMES was co-funded by the EU and the European Space Agency (ESA). Initially, this took the form of limited support through the 6th Framework Programme for Research and Development (FP6) and ESA's Member States, focusing mostly on services and applications. However, funding was scaled up significantly on the ESA side, from 2005 with the GMES Space Component Declaration at the ESA Ministerial meeting, and on the EU side, from 2007 with the Framework Programme for Research and Technological Development (FP7).

The 2005 Communication[6] expected the various GMES services to be ultimately paid for by users, but noted that the creation of this new infrastructure would be hugely costly and would take many years to develop and that, as such, it would need substantial public investment to be built and for pilot services to be developed.

The Union co-funded, through FP7, the development of the GMES Space Component for an amount of €715 million, which included the development of four dedicated missions known as the Sentinels, as well as access to data produced by other missions known as "contributing missions". The Union contribution was implemented through ESA on the basis of a delegation agreement. In addition, the Union fully funded the development of the GMES core services. Additionally, both ESA and the Union continued supporting the development of downstream services and applications. In parallel, the Union focused on establishing a programme with a dedicated budget line.

GMES FP7-funded Space Component (GSC) (as initially foreseen)

	Budget (€m)
Delegation to ESA for the development of GMES space infrastructure (Sentinels)	667
Space data access grant for procuring data from the Contributing Missions	48
Total	715

[3] COM(2004) 065

[4] Council Decision on the signing of the Framework Agreement between the European Community and the European Space Agency (12858/03 RECH 152 7 October 2003)

[5] COM(2005) 565

[6] Communication from the Commission to the Council and the European Parliament, Global Monitoring for Environment and Security (GMES): From Concept to Reality, COM(2005) 565 final.

To prepare the ground, Preparatory Actions for GMES were implemented in the years 2008 to 2010, in particular aiming at demonstrating the potential benefits and fostering the user uptake for selected GMES services. Five specific activities for a total of approximately €10 million were launched. All contracts had 36 months duration and addressed the areas of emergency management (2008), reference data for Europe, reference data for the rest of World (2009), sea ice information and air quality information (2010).

GMES Preparatory Action (PA) funding (as initially foreseen)

Launch	PA	Links with GMES	Funding (€m)
2008	LinkER	Emergency Management Uptake of the data products produced through the SAFER project (FP7)	2.823
2009	Reference Data Access (Lot 1)	Land Monitoring Reference data – Europe	2.08
2009	Reference Data Access (Lot 2)	Land Monitoring Reference data – Rest of world	0.25
2010	The ICEMAR project	Take-up of services by users Sea Ice Monitoring	2.095
2010	The ObsAIRve project	Take-up of services by users Air quality Monitoring	1.975
Total			**9.2**

The general objective of the PAs was: to facilitate the preparation and support the development of pre-operational GMES services; demonstrate the potential benefits and foster user-uptake of services, and develop user interfaces. Some of the projects supported were also intended to demonstrate the potential of GMES to spearhead the development of downstream services and applications (e.g. ICEMAR and ObsAIRve). The specific objectives of the individual PAs were set out in the annual calls for tenders. For example, the 2008 Emergency Response PA was intended to support the development of user interfaces in the emergency response field. The goals of the resulting LinkER project were to support the development of: (i) a user interface in the field of emergency response; and, (ii) the operational use of GMES EMS products across all EU countries in the Civil Protection Mechanism and in DGs RELEX and ECHO at the European Commission.

The programme developed into a Union-led flagship of European space policy with the Regulation (EU) No 911/2010 of the European Parliament and of the Council of 22 September 2010 on the European Earth monitoring Programme (GMES) and its initial operations (2011-2013) that highlighted the transformation from an initial phase of scientific demonstration projects to a fully-fledged Union programme. While the funding foreseen under this Regulation was very limited, its benefits would probably extend to a wide range of Union policies. GMES was also one of the programmes to be delivered under the Europe 2020 strategy for smart, sustainable and inclusive growth and was included in the industrial policy initiative of Europe 2020. The regulation established a Union programme based on three components: space, services (six areas: emergency response, land monitoring, marine monitoring, atmosphere, security and climate change) and in situ and entered into force in November 2010, with a budget of €107 million.

GIO overall budget, 2011-13 (as initially foreseen)

	Budget (€m)
Emergency management service	12
Land Monitoring Service	26
User uptake	5
Space component	64
Total	**107**

The development of GMES-dedicated satellites (the Sentinels) continued, while many of the pre-operational services projects continued to be financed with research funds. The role of the Commission was to ensure the coordination of the GMES programme with activities at national, Union and international levels and to manage the Union funding. Furthermore, as GMES was a user-driven programme, the Commission implemented actions aimed at ensuring that first service specifications matched the known user needs. Technical coordination and implementation of the GMES space component was delegated to ESA, relying on the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) where necessary. The Commission entrusted the management of the Land Service to the European Environment Agency (EEA) in Copenhagen while the Joint

Research Centre (JRC) was appointed as the technical coordinator for the Emergency Management Service and the Land Service. GMES also provided useful data to environmental networks and public authorities, for instance through the Shared Environmental Information System (SEIS) Initiative and the Infrastructure for Spatial Information in the European Community (INSPIRE). On 3 April 2014, the GMES Regulation was repealed by the new Regulation 377/2014 establishing the fully operational Copernicus Programme. The actions foreseen in the framework of the Initial Operations programme are still continuing, in particular to the Land Service and Emergency Management Service.

GMES was aimed at delivering a better understanding of how and in what way our planet is changing, and how this might influence our daily lives, through an uninterrupted provision of accurate and reliable data and information on environmental issues, climate change and security matters to decision makers in the EU. This information is needed by public authorities in the Member States and regions who are in charge of policy conception and implementation. The Commission also needs this information for evidence-based policy-making and monitoring. GMES should also have contributed to economic stability and growth by boosting commercial applications in many different sectors through full and open access to Earth observation data and information services. GMES operational objectives were listed in the Annex to the GMES Regulation and included:

- emergency services to respond to various disasters and hazards, deliberate or accidental, man-made or not, including climate change, and humanitarian disasters;
- land monitoring to the benefit of European, national, regional and international authorities;
- marine monitoring providing information on the state of physical ocean and marine ecosystems for the global ocean and the European regional areas;
- atmosphere services, monitoring of air quality on a European scale and of the chemical composition of the atmosphere on a global scale;
- security services like border control, maritime surveillance and support to EU external action;
- monitoring climate change and providing climate analysis and projections;

- implementation of technical interfaces and development of the downstream sector;
- data access from other types of observation infrastructures;
- coordination of in situ data collection;
- ensuring the operations and development of the space component.

The Copernicus Programme is not within the scope of this ex post evaluation; however, its creation is perhaps the most powerful single indication of the success of the GMES elements under review, whose principal objective was to deliver a comprehensive and permanent earth monitoring programme. In April 2014, the GMES Regulation was repealed by a new Regulation (377/2014) establishing the fully operational Copernicus Programme, essentially completing the institutionalisation and renaming of GMES.[7] Copernicus has taken forward the six core services developed by the GMES programmes under review (i.e. Land Monitoring; Marine Monitoring; Atmosphere Monitoring; Emergency Management; Security; Climate Change) and confirmed outsourcing arrangements in line with the delivery models developed by GMES.[8]

[7] http://www.copernicus.eu/

[8] The Commission entrusted the management of the Land Service to the EEA, while the JRC was appointed as the technical coordinator for the Emergency Management Service and the Land Service. Other services are being implemented through delegation agreements with Mercator Océan, ECMWF, FRONTEX and EMSA. These services have reached different degrees of maturity.

EVALUATION QUESTIONS

The evaluation follows 7 evaluation criteria which relate to the overall objectives:

Criteria	Question
Relevance	To what extent do the initial objectives of the GIO Programme (still) correspond to current needs / issues?
Effectiveness	How effective were the mechanisms and means to achieve each of the stated objectives? To what extent has GIO contributed to the Europe 2020 strategy for smart, sustainable and inclusive growth objectives, and to the implementation of other European policies (i.e. Environmental and Agricultural)? To what extent have the operations impacted the phase-up of the Copernicus Programme?
Efficiency	Have the outputs, results and impacts of GIO been achieved at reasonable and proportionate costs? Could better results have been obtained given the input and resources devoted to the activity? What aspects of GIO are the most efficient or inefficient? Are there any administrative and reporting burdens on stakeholders and / or other actors?
Coherence	Are the different elements of GIO consistent in how they attempt to reach the stated objectives? Are there overlaps or complementarities between the GIO and any other Community or Member State action in the relevant areas?
Utility	To what extent have the effects of GIO addressed the needs and problems it aimed at meeting and solving? What measures could be taken to increase this positive impact? What lessons from the implementation to date of GIO are useful for the implementation of Copernicus?
EU Added Value	What is the added value for stakeholders, citizens and administrations, and the relevant European policies?
Sustainability	To what extent are any additional positive changes (if any) brought about by GMES, or are any likely to last after the intervention end?

METHOD

The evaluation used a mixed-methods approach to collect and analyse the various primary and secondary data needed to address the evaluation objectives and to reach a conclusion on each of the evaluation questions, as well as to formulate recommendations. The data collection included a desk-based review of existing documents (e.g. EU regulations, interim evaluations, GIO work programmes and administrative data), an online questionnaire covering all three related elements and directed to all categories of stakeholders, a small industry survey directed specifically to the contractors that 'built' the GMES space component and a programme of targeted, semi-structured interviews with relevant individuals among key stakeholder groups. Wherever possible, the evaluation has sought to triangulate the information obtained through the questionnaires and interviews, with the qualitative material validated against evidence from the wider literature and more objective data (e.g. monitoring data).

The first main task of the evaluation was to obtain and undertake an initial review of key documentation, from which a log frame and key performance indicators (KPIs) for the GIO were prepared (shown in the Annexes for reference). The data collection strategy and tools were also refined and developed further during the initial phases of the evaluation, including the preparation of a single questionnaire to be used in an online survey of all stakeholders, policy makers, service providers, users and beneficiaries. A preliminary list of stakeholders and organisations for the consultation and interview programme was also established. The core documentation included delegation agreements, calls for tender and other specifications for GMES components. A thorough review of these key documents provided important contextual information and provided a narrative within which to situate the feedback collected through interviews/surveys. The documentation has also been used to inform most of the evaluation's key questions, from relevance to efficiency and European Added Value. Additional monitoring data on services during the period in scope for the evaluation has been collected; in particular, user and usage statistics for the Emergency Management (EMS) and Land Services.

In terms of consultation strategy, more than 400 named individuals have been approached with a request for an interview (semi-structured) or a completed questionnaire return. The invitations were issued to all categories of potential respondent with the exception of the lay public, on the assumption that ordinary citizens would have insufficient understanding of the technicalities to make a meaningful return. The online consultation was however advertised widely through DG GROW, ESA, EEA and the JRC, and was open to the public. The stakeholder analysis emphasised four core groups: Policy lead and other key parties involved in the governance of the initiative; GMES service operators; GMES service users, in the public and private sectors; Industrialists that helped build the infrastructure.

The consultation covered each of the three evaluation elements (GIO, PAs and FP7-funded GSC) and each broad evaluation question, from relevance to union added value. Both aspects of the consultation ran for about 12 weeks, in the period from mid-July to the end of September, in order to ensure the maximum number of responses. The first limited number of industry responses led to implement a second, targeted consultation addressed directly to ESA contractors. The task specifications required that a least 145 individuals be consulted, through interviews and surveys, and indicated the number to be consulted from different stakeholder groups. Overall, 170 individuals were consulted during the course of the study. The target number was met or exceeded for all stakeholder groups except for officials in the Joint Research Centre and industry representatives, where we had to work with a small starting population of around 50 named contacts in order to secure 21 interviews and survey responses. Additional individuals were consulted within suppliers and other organisations to increase the overall total.

The interview programme and survey-based consultation produced rather small numbers of responses overall, reflecting the rather particular nature of the GMES programme and the small population of people and organisations with knowledge of its activities. The interviews and surveys did not lend themselves to a more formal validation process, as one might do with a larger, quantitative data set. For example, it was chosen to work with the whole sample at a rather high level of disaggregation, picking out points of divergence and convergence among, for example, service deliverers and service users or between those involved with the infrastructure component or those involved with the services elements. We did not run any formal analytical tests to identify and eliminate outliers, as there were only three or four instances where this could have been applicable (e.g. willingness to pay a given price for an annual subscription) and we chose to present the full range of feedback and simply use a weighted average. The credibility of responses was tackled ex ante through the design of the questionnaire and interview checklists, and ex post through the analysts coding of feedback and pull through of clearly articulated and substantive points.

The log frame, setting out the general and specific objectives for the GMES programme provided the basis for developing a set of qualitative and quantitative indicators. Unfortunately, there were no indicators specified in the GMES GIO regulation (2010) and while the individual work programmes did include a series of indicators for two services, they focused on activities and outputs (e.g. number of downloads) and did not have any baseline or targets associated with them. The indicator analysis therefore has not been able to benefit from any concrete points of reference: the impact assessment provided no baseline or targets for the indicators, and the interim evaluations had commented on the absence of clear, SMART objectives and recommended the programme managers improve their monitoring and reporting activities. There were clearly improvements in reporting by the GIO services, however, there was no development of agreed specific, measurable and time based targets, and the ex post evaluation has therefore had to be content with estimating various outcomes and impacts in isolation and then offering judgements on their sufficiency based on feedback from the surveys and interviews and selected references to the wider literature on the impacts of public investments in space.

RESULTS

The evaluation revealed in general a solid consensus among stakeholders regarding the relevance and usefulness of the GIO, PAs and FP7 Funded space component. The GIO programme under review here worked well overall. The positives include the good level of cooperation achieved between the EC and ESA, and also the demonstration of sufficient progress within the programme to support the arguments for the creation of a budget line for Copernicus (circa €4.3 billion) within the Multiannual Financial Framework (MFF) 2014-2020. Aspects that worked less well include: the limited integration of space and non-space data within the fledgling services, cross-service coordination and user engagement.

According to the survey held for this evaluation, all contractors considered the work had improved their technological capabilities ‘to a large extent,’ and all respondents reported a positive benefit in terms of their competitiveness.

Turning to the question of social impacts, desk research has estimated lower bound in the final assessment of the benefits to the GMES space component and suggests that the GMES infrastructure has produced total societal benefits of up to €3 billion. There have been wider socio-economic benefits (impacts) too, which are presented in more detail in the following sections.. The space component itself looks to have been cost-effective, when judged against the cost of the earlier EO space programmes. The GMES programme cost around €2.3 billion in total (in 2002 prices), to develop the first seven satellites and to launch three of them. In real terms, this is lower than the equivalent cost to develop, launch and operate the Envisat satellite, which has fewer instruments and lower levels of functionality.

The stakeholder interviews found a clear majority on the production side (e.g. DG GROW, ESA, Industry Bodies) taking the view that the programme had been sufficiently resourced and had delivered value for money. The survey was rather positive, with over 80% of respondents rating the investments as medium to good value for money. The GIO / GSC fulfilled their objectives and underpinned the launch of Copernicus, so in that sense they must be considered to have been 'useful.' However, the full service is still being developed and as such the issue of wider utility is only starting now.

The programme under review here provides high levels of European Added Value. No single EU country could have created a similar system on its own, partly for reasons of cost, but also for reasons of willingness to invest. National programmes are naturally very much more limited in their scope and only fulfil a limited number of the GMES functions and typically at lower levels of functionality.

In terms of financial sustainability and the extent to which the GIO services could have been developed without dedicated EU funding or could become self-financing in future, the conclusion is 'no' on both counts, based on the costs involved in the creation of the infrastructure and service operations and the EU (and global) scope of those products and services.

Turning to the question of the sustainability of the changes brought about by the GIO programme, the evaluation suggest there will be a legacy in terms of better policy choices or enhanced technological capabilities. For the manufacturers and technical services companies that have built the infrastructure and delivered much of the services component, the contracts will have quite a lasting effect, conferring a competitive advantage that people anticipate may last for five years or more. The opportunities for value-added resellers and downstream businesses have yet to be crystallised in any serious scale.

The results are also based on interim reports and other independent studies mentioned in the contractor report in the appendix B, (OP n. ET0116321ENN).

ANSWERS TO THE EVALUATION QUESTIONS

RELEVANCE

There is a solid consensus regarding the relevance of the GIO, which corresponded exactly with Europe's needs as regards the creation of a European Earth Monitoring system. This view is held broadly across stakeholder groups, including Member States and industry. The growing pressures of climate change, natural disasters and migration have crystallised these views about the focus of the programme in the minds of many. The programmes' objectives clearly correspond to Europe's defined needs for the establishment of a comprehensive, permanent and global earth monitoring system. Five years after the publication of the GMES GIO regulation (2010), each of the six services foreseen remains important to the information needs of Europe's policy makers and public services. Indeed, concerns around climate change have escalated further and the issues of civil security and humanitarian crises have leapfrogged over many political priorities to emerge as some of the most pressing challenges of our era.

There was also a clear need for an interim programme to bridge the limited scope of the Preparatory Actions and the anticipated launch of the full GIO service in 2014, at the earliest, ensuring continuity of service from the PAs, further developing the other four prototypical services, ensuring access to space-derived and other EO data and supporting ESA with the creation of the Sentinels infrastructure. EU action was necessary (in the period 2011-2013) to ensure continuity with the Preparatory Actions and to establish GIO operational services on a more permanent basis in areas of sufficient maturity and with potential for the development of downstream services.

EFFECTIVENESS

The three elements under review were broadly effective as a means by which to achieve their stated objectives, albeit they were perhaps the pragmatic rather than the ideal choice of instruments for the development of such a complex and wide-ranging set of global information services and its related space infrastructure. However, the use of FP7 as a means by which to co-finance the development of the new infrastructure can be criticised, as the EU RTD Framework Programme is not designed to produce this type of large-scale integrated system. This created certain inefficiencies, however, there was nonetheless recognition that this was a practical solution and that any such difficulties were simply a cost that had to be coped with. The GMES GIO Regulation (2010) and the related work programmes specify the mechanisms but do not rationalise their choice of recommended funding instruments , nor do they explain the thinking behind the level of financial investment allocated to the programmes. This final evaluation confirms that the work programmes had been completed successfully and on time, with contracts having been put in place in line with the calls and project work completed as per the specifications.

Around one third of the total GIO programme budget was invested in the further development and operation of the two core services, EMS (€12M) and LMS (€26M). The programme's limited budget meant it was able to spend very much less on its objectives relating to user uptake and the development of downstream applications (c. 10%). The analysis shows that very little funding was provided to support the required level of data harmonisation and gap filling, for ex. between European dataset and National mapping, Land registries and cadastral agencies,, which had been flagged already as an issue by the Interim Evaluation. In this framework it was difficult to progress with the implementation of the core services beyond the EMS and LMS operations. Due to the limited resources, the GIO programme had not made neither as much progress as it ought to have done also in the provision of in situ data and its integration with other existing space-derived data from the Contributing Missions.

There have clearly been some contributions to European businesses, in terms of jobs and growth. The €530M the GSC spent with industry has helped to maintain high value jobs and technological capabilities across more than 230 suppliers. Moreover, around 20% of the contractors were SMEs, with a significant number working on new value added services.[9] Downstream applications are expected to become more of a priority going forwards, as Horizon 2020 begins to focus on these issues, and assuming the Sentinels deliver the required data continuity, having the potential for far more dramatic expansion than the classic upstream sector[10]. Contractors are universally positive about the impacts of the GIO contracts on their competitiveness, a benefit that is expected to produce a legacy over the following 5-10 years.

As for the wider socio-economic impact, it is clear that the cost of natural disasters to society amounts to hundreds of billions in any decade, and a meaningful if small fraction of Europe's total economic output (before we consider the human cost). As an example, the benefits from satellite-based landslide monitoring suggest the GMES could save 10% of the €1 billion a year estimated annual cost from landslides. Floods and fires cause far more extensive damage, and taken together, even if we assume the Emergency services have enabled Europe to reduce the economic impact of those crises by just 1%,by enabling early warning that one service will have

[9] These data are taken from a PowerPoint presentation entitled, FP7 Implementation: ESA Quarterly Status Reports; Final Status Report, which the Copernicus Office presented to the 3rd meeting of the H2020 "Space" Programme Committee on the 2nd October 2014. This 'wrap-up' presentation shows the final industrial commitment for FP7 space was €535.2M, by 31 December 2013. The presentation also shows there were 45 individual SME suppliers out of a total of 236 organisations (c. 19%), with around €68M in industrial contracts as at 30 September 2013. This is around 13% of the €530M in total industrial commitments that had been agreed at this time, with a further €5M or so in total industrial commitments (all organisations, all firm sizes) between the end of September 2013 and the end of December 2013.

[10] The space sector has tended to be thought of in terms of an upstream and downstream sector. The upstream sector comprises three main components, launchers, satellites and spacecraft and ground systems, mostly manufacturing and technical services. The downstream sector relates to the services provided using space systems, whether that is satellite telecommunications (e.g. services provided by satellite operators) or consumer / business services based on space-derived data or functionality but provided by companies located outside the classic space sector (e.g. navigation, banking, data handling). The OECD annual report, The Space Economy at a Glance, estimates the split between the upstream and downstream sectors was around 30:70, in 2013. The annual report, Size and Health of the UK Space Industry, shows that for the UK economy, that ratio has changed from around 1:2 in 1999 to around 1:4 in 2013, with the upstream (manufacturing) sector broadly tracking growth rates in the wider economy, while the downstream sector has shown annual growth rates of 5-8%. The UK Space Innovation and Growth Strategy 2014-2030 (Action Plan) anticipates the global downstream sector will continue to grow strongly and will be the main driver of the expanding space economy, possibly worth £400 billion by 2030, which is around four times its estimated value in 2013.

saved many millions of Euros in the period 2011-2013 and far more than the €10M or so cost of running the service over the period.[11]

The programmes had had a positive effect on the level of cooperation and interaction within the EO community, in Europe and internationally; increased and improved cooperation occurred among EU member states and between the EU and third countries.

GMES GIO/Copernicus is expected to have a positive impact on Europe's industrial competitiveness and growth but, as already noted in the Interim evaluation, it is too early for such wider economic effects to have materialized.

EFFICIENCY

The evaluation sought to understand the extent to which the programme had delivered on its objectives at a reasonable cost. It proved difficult to compare the efficiency of the two main services, emergency management and land monitoring because of their wholly different service offers: The EMS service offers a bespoke and often labour intensive information service to a relatively small number of end users, where the land service emphasises multiple data products, and is closer to an international data centre, addressed by thousands of users. The GIO work programmes did include lists of indicators for the larger work packages, which were service specific. For example, the pan-European land cover monitoring service had seven indicators, which included the 'total area covered by high resolution data,' the 'number of downloads and page views' and the 'results of validation of products.' In just one or two cases, the work programmes included indicators linked with some quality or quantum of output. The very great majority of indicators were not linked with any specific target.

In the case of EMS, there was an expectation that the service should be ready to deal with at least 50 activations a year. The number of activations was lower than the expected target in both 2012 and 2013 and was exactly 50 in 2014. The number of activations is contingent upon the number of emergencies that occur, as well as the awareness of the service among prospective users and their perception that it is relevant and helpful.[12] In terms of efficiency, the EMS mapping services benefited from around €10M in service contracts, which produced response to around 65 activations, and the preparation of more than 500 maps, across the period 2012-2013, which is judged to be reasonable value for money.

Although no data are available on the extent to which the GIO had enabled savings to be made through improved early warnings or better emergency response, for example, given the scale of the economic disruption, even a 1% contribution across all types of emergencies, would produce annual savings of tens of millions, which is substantially more than the annual cost of running the whole Emergency Service.

The work programmes similarly listed various outputs and indicators for the Land Monitoring Service; however, they provide no specific targets and the LMS monitoring reports focus heavily on page-views. The LMS had a total budget of €26M for the period 2011-2013, and has created a service that combines satellite and in-situ data to provide data sets on around 40 variables, from vegetation dynamics to tree cover and land-use. The data sets vary quite dramatically in terms of their extent and thematic content, with the more generic type of maps, such as the Corine Land Cover maps and Urban Atlas attracting the largest number of page views (9,000+ and 3,00+ page views respectively in 2012; 13,300+ and 14,500+ in 2014), where more specialised maps on for example groundwater or emissions were attracting page views in the high hundreds. The top 20 maps recorded around 33,000 page views in total, in 2012. The EEA advises that downloads run at around 60% of page views, which would be around 20,000 downloads. The global element of the LMS also maintains a count of registered uses, which had reached around 375 (service continuity) and 416 (data production), as at the end of 2013, and with download volumes on the order of 54GBs and 130GBs respectively.

People acknowledge the programmes had been properly managed, however, some argue the balance of priorities had been wrong (e.g. too much of the total investment had gone into the space component and insufficient attention had been paid to the development of the services), which had slowed the rate of progress overall and

[11] Source: Booz & Company, Cost Benefit Analysis for GMES, Final, 19th September 2011, section 4.3.1, including EM-DAT statistics.

[12] The data on the timeliness of the service shows that only around 15% of requests were dealt with within the target response time of 24 hours, for rush mode, although we understand this has improved post GMES with the expansion of capacity.

effectively reduced the GIO programme's outputs. From the evaluation perspective, this reflects the under-resourcing of GIO rather than an over-commitment by the EU to the space component. Maybe better results could have been attained given the input and resources devoted to the activity, had the focus been different (e.g. tackling specific, data related obstacles to launching extended EO services for particular user groups) and the procurement strategy more innovative (e.g. public private partnerships). A closer coordination with member states and other Commission Services could have produced a more 'efficient' series of service specifications and architectures, for example for climate change, where member states have already made substantial investments. This additional complexity, however, (e.g. increased coordination and harmonisation) may have slowed progress further still and to a degree that the whole project may have been at risk. The efficiency with which the GIO programme was created and service continuity assured is counterbalanced by the less positive support to take-up, access to data from contributing missions, support for downstream applications and coordination of data. The relevance and quality of the data holdings are the aspects that were most widely judged to be highly satisfactory, while ease of navigation and updates were the aspects least widely regarded as satisfactory. Several people however noted the efficiency of the 'common data programme,' which maximised reuse and delivered various economies of scale.

As for administrative burden that could have an impact on efficiency, the great majority of the expenditure under review here was committed through the GMES space component, and coordinated by ESA. This expenditure split roughly 80:20 between external procurement through contracts with industry and ESA internal costs. The €500M+ of industrial procurement was managed by ESA, following their purchasing processes and rules. The €50M in GIO contracts were implemented by the European Commission, and as such these contractors did have a view of the Commission's reporting requirements and any attendant administrative burden on their organisations. Several contributors noted the additional time delays that had arisen as a result of headcount constraints within the implementing agencies.

According to ESA and its member states, the GMES space component (GSC) was delivered on time and within budget. Less robust seems to be ESA's financial controls. The monitoring of technical and financial progress relied upon high-level roadmaps that were not sufficiently detailed to allow the Commission to follow closely the programme's implementation. This limitation in the Commission's control was defined in the delegation agreement with ESA and reflected a decision to allow the Agency to manage the programme, in acknowledgement of its competence and for the avoidance of duplication. ESA's approach to financial reporting did not allow a clear comparison between actual versus budgeted expenditure at a detailed level. The Commission's concerns about transparency were echoed by an Independent Auditor's decision to qualify ESA's overall financial accounts for 2011 (not just the GMES space component). Following this 'qualified opinion,' the Commission and ESA set up a task force to work on actions to improve financial reporting, with a view to avoiding a similar situation for the coming years. This was achieved, and the Independent Auditors report for 2012 stated that the financial statements gave a true and fair account. In the annual report of DG GROW on internal audits to the European Parliament and Council (October 2014), it is recommended to improve the governance arrangements for the space component and in particular enhanced monitoring.[13] These particular audits took place in the transition period between the GIO programme 2011-2013 and the operational phase, renamed Copernicus. The concerns were expressed more fully in a Commission working document,[14] which was prepared in 2013, and made several recommendations regarding necessary improvements in ESA's financial reporting arrangements when moving to the new Delegation agreement (2014-2020 MFF funds), where the co-funding rates were inverted with the EU carrying 70% of the costs and possibly any programme overruns.

COHERENCE

The log frame analysis and supporting interviews revealed a clear logic connecting the elements and the evolution from the Preparatory Actions through to two GMES fast-track services and the GIO programme's inputs to the space component and oversight of access to other space data (contributing missions). The GIO programme also built on the work of the FP7 funded GMES Space Component and in particular the coordinated provision of observation data both from existing space infrastructure (Contributing Missions) and from in situ observing systems. In simple terms, GIO built on the outputs of GSC and prepared for the operational phase.

[13] COM(2014) 615 Final. Brussels 3.10.2014. REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL. Annual report to the Discharge Authority on internal audits carried out in 2013 (Article 99(5) of the Financial Regulation)

[14] SWD (2014) 0276. COMMISSION STAFF WORKING DOCUMENT Roadmaps for international cooperation Accompanying the document REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Report on the implementation of the strategy for international cooperation in research and innovation.

GIO would not have been successful without the FP7 space component, and Copernicus would not be working so well without GIO.

For several commentators, the move from FP7 research projects to GIO was problematic, with for example the requirement to launch new calls for proposals for GIO that made no commitment to take forward the work of the research projects or even to involve those established consortia in the further development of services. There were exceptions; apparently there was a smooth transition from the Myocean research projects to the Marine Service. Paradoxically, where several interviewees criticised the poor connections between the SAFER research projects and EMS, two interviewees criticised the marine service for overly tight links between Myocean and the Marine service, which was felt to have disadvantaged or even excluded new entrants. The link between the PAs and GIO is considered to have worked better, albeit on a narrower basis. There were also concerns raised about the balance of funding priorities within the various elements, and the extent to which that was coherent with the programmes' objectives: specifically that GIO was too small and that the balance between the expenditures on the space and non-space components was misjudged in light of the overall objectives. There should have been greater support for the in-situ component and for the work on user uptake. ESA also judged that a larger GIO programme would have allowed the agency to buy four satellites, rather than two and then a second two, which would have improved unit costs and reduced the overall costs for EU taxpayers.

As for complementarities between GIO and other EU or MS actions, for land cover inventories, for instance, there are 28 national inventories, which are leveraged by GIO within Corine. There are some overlaps in services including for example, flood alerts (2013) in Germany and Hungary or the Spanish National Plan for Land Observations (PNOT).A possible duplication is between GIO and France's SPOT satellites in their respective coverage over Africa. Complementarities needed to be developed further and there remain substantial opportunities / needs for the follow-on Copernicus Programme to contribute more to the global efforts in key EO areas (e.g. environment). Member State programmes typically cover only the national territory, or have at best a regional focus, whereas only GIO was capable of providing EU-wide (or wider) and harmonised data and a useful benchmark to solve the "patchwork" issue arising when data from different national systems needed to be combined. At the same time, value from MS instruments was recognised to support local needs of "zooming in" thanks to its higher resolution. The overlaps might also be considered as complementarities, with different instruments and levels of resolution (e.g. Italy's COSMO-SkyMed programme) available through EU and national EO missions.

The overlaps do not need to be eliminated, but rather need to be managed in order to maximise the potential of existing assets and instruments. As an example, considering the partial overlap between EMS and the International Charter on Space and Major Disasters, it can be useful to have different schemes running in parallel to support emergency management and relief operations during major disasters. The very high levels of transparency required by the Commission around the GIO had helped avoid EU / MS overlaps. The regular and detailed 3-monthly reports to the FP7 space committee provided MS with the opportunity to question EC / ESA plans on the one hand and to make adjustments to their own programmes on the other. The GIO largely complemented MS EO operations, with just a small number of examples of substantive overlaps with member state programmes, which in practical terms, tended to provide users with access to additional instruments and data sources and did not result in substantial duplication of effort / public investment.

UTILITY

There is a clear consensus among the stakeholders on the utility of GIO and on the fact that the programme had enabled substantial progress to be made as regards the operation of the two core services and the further development and creation of the related space infrastructure. Several people noted the importance of the move from the research budget to the MFF and the launch of the Sentinels, all of which had been facilitated by the GIO programme. The majority of stakeholders, however, view this whole domain as a work-in-progress, so while most people are satisfied with the achievements of the GMES programmes, there are numerous points where they feel more needs to be done. The resolution of those challenges must fall to Copernicus, but for completeness, they comprise: (i) a very much sharper focus on (and understanding of) user needs, (ii) greater certainty around the longer-term plans / funding for the service and (iii) the development of downstream services. Others recognised that GIO addressed ambitious goals, and to some extent it already addressed the problems it aimed at solving.

GIO demonstrated its usefulness through its support to Member States during various extreme flood events (e.g. in Poland). In the field of agriculture, GIO data were used for crop yield forecasting. Stakeholders also commented that GIO has been successful in setting the ground for the coming activities, although there is still a long way to go, also in the light that at the end of the Programme, in 2013, the first Sentinel satellite had yet to

be launched out of the seven planned. Some progresses have been too slow but it is not clear this is the result of flaws in the system, but rather a reflection of the intrinsic challenges. The security service for example is still not completely operational, and that will be highly important but this is perhaps not a failure of the GIO programme. These services intersect with some rather tricky / delicate political issues, around MS sovereignty and in particular the overlap with defence-related security. Copernicus will also support EU external actions, for example, which immediately raises issues of sovereignty; no MS will relinquish control over its own defence. These issues therefore take a very long time to work through. On balance, the longer than anticipated timeframe required to address these social needs should not been considered a failure of the GIO, in the light of the high ambitions, the significance of existing challenges and the political context.

Overall, we conclude that the programme successfully addressed its key objectives and in that sense it must be considered to have been 'useful.' However, certain elements were left unfinished (e.g. the further development of four services) and the full European earth monitoring service offer is still being developed by GMES' successor, the Copernicus Programme, and as such the issue of wider utility is only starting now.

The GIO programmes underestimated the extent to which we might need to explain and market the service to end-users. User take-up and communications were only allocated a small fraction of the total GIO budget, and effectively nothing from the space component; on balance, not enough funding was allocated to promotion and explanation.

EU ADDED VALUE

Stakeholders were unanimous in the opinion that there was additional value from GIO. While several Member States have their own earth observation structures, the European programme provided data in a standardised format and of good quality which covered the whole of Europe and in some cases even had global coverage. GIO offered higher levels of assured continuity of service, as compared with anything available nationally (even for the US): a full-scale, permanent screen of sensors. It was just the logical way forward, which was apparent to MS and was the basis for the Baveno agreement and the decision to move forward with a pan-EU programme. It also means that Europe has met its geopolitical ambitions of creating an independent EO infrastructure for Europe. Furthermore, there is substantial added value for a wide set of European policies in accessing a homogeneous database and derived-products for the whole of the EU, and in some cases beyond. The necessity to be able to access data of a comparable format across European borders is especially apparent for issues, which are, by their very nature, not limited to a single Member State such as environmental and land issues as well as disasters or climate change that need to be addressed on a global level. Earth observation on such a level could not have been run or financed by any single Member State, and national programmes are naturally very much more limited in their scope and only fulfil a limited number of the GIO functions and typically at lower levels of functionality

For Europe's EO industry, the added value of the GIO programme and the space component in particular was financial, on the assumption that the Sentinel programme would have been very much smaller or delayed without the Commission's co-funding. Those additional EU funds as a minimum increased the volume of investment by a third and arguably ensured the infrastructure programme went ahead at all, thus ensuring that Europe's space industry remains globally competitive and maintains its cutting-edge technological capabilities. The added value for ESA is that it was able to achieve its goal of ensuring that Europe's space industry remains globally competitive and maintains its cutting-edge technological capabilities. It is part of the ESA mandate to support EU industry. The GIO satellites and sensors are very powerful and much better than any other systems that are flying currently, whether they have for the US, Japan or Israel.

The added value for citizens was less easy for stakeholders to determine, however, the desk research identified numerous examples of service activations that had contributed to crisis management and flood warnings, which undoubtedly reduced the economic and social dislocation of those emergencies for Europe's citizens and possibly also saved lives.

SUSTAINABILITY

Considering the costs involved in the creation of the infrastructure and service operations and the EU (and global) scope of GIO products and services these would have not been developed without dedicated EU funding nor could become self-financing in future and it is clear that the Copernicus Programme will continue to need substantial public funding to go forward.

For the sustainability of the programme, the continued support of the EC, including financing, was seen as necessary. In turn, the Member States would need to see their needs addressed through the programme in order

to continue to support it through the EU. ESA stated that it is working on the next generation of satellites: the first four sentinels are what one might call first generation; the next two satellites will be a new generation. The intention is that ESA / EU should have a clear view as to what the next generation of satellites will look like, by 2017. This will have the same kind of effect as the first development programme, helping EU industry develop its capabilities and stay at the cutting edge of technology in the field.

Turning to the question of the sustainability of the changes brought about by the GIO programme, ther desk research and stakeholder interviews suggest there will be a legacy in terms of better policy choices or enhanced technological capabilities. However, the various services are akin to any utility, which is to say they are valuable while they are running; turn them off and the decision making and operational processes they supported will quickly need to revert to alternative inputs or be degraded.

For the manufacturers and technical services companies that have built the infrastructure and delivered much of the services component, the termination of the GIO programme without the progression to the new Copernicus Programme would have seen much of their competitive advantage (knowledge) competed away over a period of several years. The supplier survey suggests the GIO contracts will have quite a lasting effect however, conferring a competitive advantage that people anticipate may last for five years or more. The opportunities for value-added resellers and downstream businesses, however, have yet to be crystallised in any serious scale.

CONCLUSIONS

In conclusion, five years after the entry into force of the GIO programme, the initial objectives of the programme remain relevant to the current needs of users among policy makers, public institutions and commercial businesses. The three elements under review were effective as a means by which to achieve their stated objectives, albeit they were perhaps the pragmatic rather than the ideal choice of instruments for the development of such a complex and wide-ranging set of global information services. GIO made wide-ranging and important contributions to the phase-up of a fully-operational programme. However, the limited funding available for the programme had constrained progress, in an absolute sense, and at the time of the programme's conclusion, there remained substantial work to be done before users would have access to the full range of effective, operational services that had been planned.

The GIO and its FP7-funded space component had a positive impact on the phase-up of the Copernicus programme, but there remains substantial work to be done even within the four most advanced services. While the opinion is strongly positive overall, there are some reservations about the programme's effectiveness and its impact on the phase-up of Copernicus, mainly related to the rate of progress with the implementation of the full set of anticipated services, the provision of in situ data and integration with other existing space-derived data from the Contributing Missions. The GIO programme has largely delivered on each of its specific objectives (intended effects), perhaps with the exception of promotion to users and the development of the downstream sector. It enabled the creation of a permanent European earth monitoring system, in line with the Commission's Communication on Europe 2020, which saw GIO as a key component of European space policy and a means by which to help address key global challenges. Moreover, the programme made possible the creation of a series of data and information services that have the potential to deliver substantial wider social and economic benefits in the future. The GMES Space Component produced substantial direct benefits for Europe's space industry, with more than 230 suppliers benefitting from €530M in ESA contracts, including 48 SMEs.

There have been many concrete operational successes as regards the GIO programme's contributions to EU policy, with the growing use of the LMS and EMS services by policy makers and public agencies in the agriculture, environment and climate change areas. The EMS services have been used to support the information requirements of various government agencies around for example flooding, earthquakes, fires and other environmental hazards. Turning to the question of social impacts, generic industrial statistics can be used to estimate the benefits of investments in the space infrastructure, working with economic multipliers for EO capital investment to estimate the wider private returns (the literature suggests these fall in the range 2-4) and more general estimates of spill overs to investments in research. Based on those parameters, lower and upper bound effects for the programme can be estimated, with the direct effect of the €530M (2006 prices) of FP7 funding that ESA committed through its 200+ industrial contracts falling in the range €1 billion to €2 billion, while the related spill over effects, using standard multipliers, falls in the range €2 billion to €6 billion, giving a total benefit falling in the range of €3 billion to €8 billion. These are broad estimates that rely on the use of

general multipliers and the spill over effects are subject to substantial time lags: using the lower bound estimates the GIO infrastructure has produced total societal benefits of up to €3 billion.

There have been wider socio-economic benefits (impacts) too.To estimate the scale of the economic costs of disasters in Europe, like floods or fires or landslides, which run into the many hundreds of millions of Euros each year and compare it with potential savings through the use of the GIO emergency service, for instance, is difficult, although some estimates exist (for ex. ELDAT, Munich Re). However, given the scale of the economic disruption, even a 1% contribution across all types of emergencies, would produce annual savings of tens of millions, which is substantially more than the annual cost of running the whole EMS service. There were also a number of additional and unexpected positive outcomes. In particular, the programme had a positive effect on cooperation. Increased and improved cooperation is reported as occurring among Member States and between the EU and third countries..

The GIO and its FP7-funded element for 2007-2013 had limited direct impact on the Europe 2020 strategy, however, the programme enabled further progress to be made with the GIO project and made possible the creation of a series of data and information services that have the potential to deliver substantial wider social and economic benefits in the future. As such, the contribution of GMES GIO, now Copernicus, to the EU 2020 strategy remains an important work in progress. The services component has produced useful benefits too, in terms of improved operations and improved sales. The effect on employment was less strong. There has been only limited progress with respect to the development of downstream applications; however, some services users' organisations are providing value-added services, thanks to GIO products and data, to downstream users. Stakeholders expect downstream applications and value-added resellers to become more of a priority in the next future.The transition from a research programme to an operational budget is an important development for GIO, and was made possible in part by the success of the programme. Two issues, however, emerge as negative: the limited integration of space and non-space data within the fledgling services; and user engagement. There was a need for further consolidation and integration of existing national and regional systems into the European systems.

It is difficult to compare the efficiency of the service because of their wholly different offers, however users seem willing to pay an annual subscription, which suggests the GIO created a service that offers reasonable value for money. The space component itself looks to have been cost-effective, when judged against the cost of earlier EO space programmes. The programme and actions are perceived as properly managed, although the balance of priorities has been wrong (e.g. too much space and insufficient attention to services), which had increased the absolute costs for the programme overall and slowed the rate of progress (again, effectively increasing costs). .

The great majority of the expenditure under review here was committed through the space component, and coordinated by ESA, following its purchasing processes and rules and not those of the European Commission. As a result, these contracts provide no view of the Commission's reporting requirements or any associated administrative burden. Industry contributors stated that the programme' reporting requirements were quite demanding. Financial and technical reporting was judged to be unnecessarily complex and overly protracted, however, there was a sense that FP7 contracts would tend to require even higher levels of technical reporting and review and as such bring a higher burden than was the case for contract funding. The small number of specialist SMEs interviewed argued that the Commission's standard reporting requirements were off-putting and that invoicing was rather complex and meant securing payment was sometimes difficult and always rather slow, which in turn had created problems with their cash flow.

The GIO programme also built on the work of the FP7 funded GMES Space Component and in particular the coordinated provision of observation data both from existing space infrastructure (Contributing Missions) and from in situ observing systems. In simple terms, GIO built on the outputs of GSC and prepared for the operational phase. GIO would not have been successful without the FP7 space component, and Copernicus would not be working so well without GIO.

The GIO / GSC fulfilled their objectives and underpinned the launch of Copernicus, so in that sense the programmes must be considered to have been 'useful.' However, the full service is still being developed and as such the issue of wider utility is only starting now. As noted above, the majority of stakeholders view this whole domain as a work-in-progress, so while most people are reasonably satisfied with the achievements of the programmes, there are numerous points where more needs to be done. Those challenges must fall to Copernicus now, but for completeness, they comprise: (i) a very much sharper focus on (and understanding of) user needs, (ii) greater certainty around the longer-term plans / funding for the service and (iii) the development of downstream services.

The GMES initiative and the GIO programme under review here provide high levels of European Added Value. No single EU country could have created a similar system on its own, partly for reasons of cost, but also for reasons of willingness to invest. National programmes are naturally very much more limited in their scope and only fulfil a limited number of the GMES GIO functions and typically at lower levels of functionality. GMES offers higher levels of assured continuity of service, as compared with anything available nationally (even for the US): a full-scale, permanent screen of sensors. The satellites and sensors are very powerful and much better than any other systems that are flying currently, whether they have for the US, Japan or Israel. For the Earth Observation industry, the added value was seen in the support from the programme in terms of financial resources, thus ensuring that Europe's space industry remains globally competitive and maintains its cutting-edge technological capabilities.

Turning to the question of the sustainability of the changes brought about by the programme, there will be a legacy in terms of better policy choices or enhanced technological capabilities. However, the various services are akin to any utility, which is to say they are valuable while they are running; turn them off and the decision making and operational processes they supported will quickly need to revert to alternative inputs or be degraded. For the manufacturers and technical services companies that have built the infrastructure and delivered much of the services component, the termination of the GIO programme without the progression to the new Copernicus Programme would have seen much of their competitive advantage (knowledge) competed away over a period of several years. The supplier survey suggests the GIO contracts will have quite a lasting effect, conferring a competitive advantage that people anticipate may last for five years or more. The opportunities for value-added resellers and downstream businesses, however, have yet to be crystallised in any serious scale.

Some lessons could be learned from the implementation of GIO and be useful to accelerate or otherwise increase the social and economic benefits derived from this programme.

- Closer involvement of users in the governance of the overall EO system and in particular in the definition of the individual service requirements to ensure they offer the right products and services that are based on the full array of available data (on this last point, there is a keen interest to see better treatment of in situ data)
- Related to this issue of user orientation, closer cooperation between European, national and regional bodies, to improve data access / data interoperability,and to optimise public investment levels overall
- The individual services need to be more business-like, with clear strategies and measurable goals and performance metrics, which they can work towards and be judged against
- More effort should be made to strengthen links between Copernicus and GEOSS, to arrive at a truly global system
- Improving the delineation between upstream and downstream services, and substantially increasing the level of support / types of incentives available to encourage the development of novel applications. It is necessary to check that the measures taken are actually supporting the involvement of smaller businesses, and the kinds of start-ups that can launch new industries and generate substantial numbers of jobs in Europe
- Maintain support for developing new technologies, like micro-satellites (e.g. Skybox Imaging) to allow very many more satellites to be included within the system, providing more frequent imaging and much better coverage than is possible currently
- Revisiting the ground segment, to ensure appropriate levels of integration of satellite and in situ data and our access to those data, leveraging the INSPIRE process. This is a critical piece in the jigsaw that has been overlooked to some degree

ANNEXES

Table 1. Logframe for GMES Initial Operations programme, 2011-2013

Level	Objective	Type	Description	KPIs
Global	Europe 2020	Impact	Contribute to the realisation of the Europe 2020 strategy	€530M in GSC supplier contracts supported €630M in direct and indirect economic activity and

Level	Objective	Type	Description	KPIs
				employment within Europe 100% suppliers stated that the GMES space component had improved their global competitiveness 20% of GMES services users are re-packaging / adding value to GMES data for use in downstream applications 25% of GMES service user report downstream users
Global	Other EU policy needs	Impact	Contribute to the successful implementation of other EU policies (e.g. environment and agricultural policies)	78% of the respondents to the GMES consultation judged that GMES services had made a 'significant' or 'very significant' contribution to environment policy 43% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to agricultural policy 30% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to security policy 16% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to transport policy
General	Establish permanent operations	Outcome	Establish GMES operations on a more permanent basis	A new regulation establishing the Copernicus European Earth monitoring system was implemented (2013), with its own budget line within the MFF 2014-2020
Specific	Operate EMS	Output	Operate EMS	EMS Rapid Mapping Products: 57 activations and 632 maps produced in the 2-year period to the end of 2013 (the number of activations increased year on year, and increased further by around 25% in 2014, reaching 50 activations (in line with the target in GMES work programme) EMS Risk and Recovery: 7 activations and 71 maps produced in the 2-year period to the end of 2013 Service was provided continuously, 24/7/365
Specific	Operate LMS	Output	Operate LMS	LMS pan European and local datasets: 32,337 page views, 19,400 downloads, 2.1TB data for the 12 month period to end 2012, with a

Level	Objective	Type	Description	KPIs
				fourfold increase in usage by 2014 LMS global: 416 registered users as at the end of 2013Service was provided continuously, 24/7/365
Specific	Ensure access to EO data	Output	Ensure GMES services have access to necessary EO data from other EU missions and EO infrastructure	44% of the respondents to the GMES consultation judged that the GMES programme had ensured, fully or in large part, the GMES services had access to all necessary EO data
Specific	Support take-up by users	Output	Launch measures to support take-up of services by users (e.g. Creation of bespoke interfaces for different user groups, Training, Communications, Develop downstream sector)	37% of the respondents to the GMES consultation judged that the GMES programme had launched sufficient measures, fully or in large part, to ensure the take up of services by users
Specific	Coordinate space and non-space	Output	Ensure coordination of GMES services access to in-situ data (collected by third parties)	33% of the respondents to the GMES consultation judged that the GMES programme had effectively coordination access to in situ data
Specific	Support downstream	Output	Support the development of the downstream sector in Europe	28% of the respondents to the GMES consultation judged that the GMES programme had effectively supported the development of downstream services / business

Table 2- Ventilation of interviews and survey participants

Category	Interviews	Surveys	Total	Target
EU officials in DG GROW	5	-	5	5
EU officials in JRC	6	1	7	10
GMES Committee, Security Board, User Forum, GAC	10	4	14	10
The European Environment Agency	7	-	7	5
The European Space Agency	5	-	5	5
Relevant national and local officials[15]	24	31	55	50
Representatives from Industry and SMEs	5	16	21	45
GMES Users (including other relevant DGs)	19	5	24	20
Service providers	8	11	19	
Other stakeholders (including MEPs)	5	8	13	
Total	94	76	170	150

Table 3 - The overall results of the survey

Objective	Achievements
Creation of a permanent GMES	The GMES space component completed the design of the sentinels architecture and developed the seven missions ahead of the launch of Sentinel 1 in 2014

[15] Including government departments, public agencies (e.g. regulator, coastguard, emergency services) and national space agencies

Objective	Achievements
	Access to necessary EO data was assured, from contributing missions (e.g. ESA's European Remote Sensing satellites and ENVISAT; EUMETSAT's MetOp meteorological satellites; France's SPOT satellites; Germany's TerraSAR-X; the UK's Disaster Monitoring Constellation; etc.)
Industrial competitiveness	Space industry: 230 suppliers benefited from €530M in contracts through the GMES space component, including 48 SMEs Space industry: 50% of respondents to our supplier survey stated that the GMES contracts had improved their competitiveness 'to a large extent,' with the balance (50%) suggesting it had improved their competitiveness 'to some extent' Space industry: 75% of respondents stated that the GMES contracts had improved their technological capability 'to a large extent,' with the balance noting it had improved innovation-related capabilities 'to some extent' 20% of GMES users indicated they were using GMES data for the provision downstream applications and services, around half of which are being charged
Service provision	Continuation of the EMS and LMS, both of which provided a continuous service throughout the period 2012-2013 Further enhancement of the EMS and LMS services, and in particular the land service, for example, with the geographical extension of the Corine Land Cover mapping activities, the further development of the Urban Atlas and the production of high-resolution layers that allow the visualisation of different land cover characteristics (e.g. artificial surfaces or agricultural areas) The development of the other four GMES core services was not progressed to the same extent, with only very limited advancement around the climate change and security services reflecting the smallness of the GIO budget and the very real challenges for pan-European action on security
Service users and use	EMS Rapid Mapping Products: 57 activations and 632 maps produced in the period to the end of 2013 (the number of activations increased year on year, and increased further by around 25% in 2014) EMS Risk and Recovery: 7 activations and 71 maps produced in the period to the end of 2013 LMS pan European and local datasets: 32,337 page views, 19,400 downloads, 2.1TB data for the 12 month period to end 2012, with a fourfold increase in usage by 2014 LMS global: 416 registered users as at the end of 2013
More effective user operations	LMS users: feedback from our GMES consultation suggests services users would consider an annual subscription of €25,000 (weighted average) as a fair price, in recognition of the efficiency gains and improvements delivered by access to LMS products and data LMS users: From our GMES consultation, around 30% of users were able to provide an estimate of the annual savings their organisations had made as a result of using the LMS services, these ranged from €10,000 to €500,000 a year from productivity gains and reduced external purchases, with a median of around €100,000. That suggests a benefit of c. €12M a year LMS Services: From our GMES consultation, around 13% of users were able to provide an estimate of the additional annual income their organisations had made as a result of using the LMS services, these ranged from €50,000 to €700,000, with a median of around €500,000. That suggests a benefit of c. €26M a year
Improved policy	78% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to environment policy 43% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to agricultural policy 40% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to emergency management

Objective	Achievements
	30% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to security policy 16% of survey respondents judged that GMES had made a 'significant' or 'very significant' contribution to transport policy
Socio-economic impacts	The large investment in space infrastructure is estimated to have produced around €1 billion in private (industrial) returns and can be expected to yield a further €2 billion in social benefits through spill overs 50% of our respondents to the GMES consultation believe the provision of better and more timely data has reduced the social dislocation and environmental damage of various natural disasters (e.g. floods in Europe, which cost €5bn - €10bn a year)

Overview of the GMES Emergency Management (EMS) and Land Monitoring Services (LMS)

EMS – Rapid Mapping products

- This service consists of the on-demand and fast provision (hours-days) of geospatial information. This information supports emergency management activities immediately following an emergency event. The service is based on the acquisition, processing and analysis, in rapid mode, of satellite imagery and other geospatial raster and vector data sources. The products are standardised following a set of parameters the user can choose when requesting the service.
- Reference maps

  Provide quick updated knowledge on territory and assets before the disaster
  Normally based on image captured as close as possible prior to the event
  Show selected topographical features of affected area
- Delineation maps

  Provide assessment of event extent and evolution
  Based on post-disaster satellite images
  Examples: burnt area map, flooded area map, earthquake impact area map
- Grading maps

  Provide assessment of damage grade and evolution
  Based on post-event satellite images
  Show extent, magnitude or damage grades specific to each disaster type

Examples: earthquake grading map with the count of the number of destroyed/ damaged buildings in each cell of a regular grid (population, roads, hospitals, shelters, gathering areas, etc. may be included).

The table below presents an overview of EMS Rapid Mapping and Risk and Recovery Mapping Activations. It shows there were some 64 EMS activations in the period under review (2012 and 2013), and that service use increased during the life of the GMES programmes (2012-2013) and has continued to increase subsequently.[16] The statistics show widespread use by the EC and EU member states. Italy is revealed as the single most active user among member states. The types of emergencies are also somewhat skewed, with floods dominating (41%). We also obtained a list of the 50 EMS European Flood Alert Service (EFAS) partners (of which 33 were partners in 2013), who are sent flood alert, flood watch and flash flood watch notifications.

EMS activations (2012 to date)

Activation date:	2012	2013	2014	2015	To date

[16] The number of activations is only a proxy for the extent of service usage. Each EMS activation will differ in scope, ranging from the provision of a small number of maps provided a few hours after the request has been issued and on to very much larger service requests that comprise many tens of delineation (extent of problem), reference (situation before incident) and grading maps (e.g. for appraisal of damage levels) and will be delivered over several days and with interaction to allow refinement and adaptation to user needs.

EMS Rapid Mapping Activations	21	36	44	18	119
EMS Risk and Recovery (R&R) Mapping Activations	1	6	6	0	13

EMS activations by location of user (2012 to date)

User Location	Activations		User Location	Activations	
EC	40	30%	Luxembourg	3	2%
Italy	17	13%	Romania	3	2%
Germany	9	7%	Sweden	3	2%
Spain	9	7%	Bulgaria	2	2%
Portugal	6	5%	Netherlands	2	2%
United Kingdom	6	5%	Poland	2	2%
France	5	4%	Austria	1	1%
Slovenia	5	4%	FYR Macedonia	1	1%
Croatia	4	3%	Iceland	1	1%
Greece	4	3%	International	1	1%
Czech Republic	3	2%	Ireland	1	1%
Hungary	3	2%	Norway	1	1%
			Grand Total	**132**	

EMS activations by event type (2012 to date)

Event Type	Activations	
Flood	54	41%
Forest fire, wild fire	18	14%
Wind storm	12	9%
Industrial accident	4	3%
Earthquake	3	2%
Other	*41*	31%
Grand Total	**132**	

Number of EMS rapid map activations and maps produced

	2012	2013	Total
Number of activations	21	36	57
Number of maps produced	248	384	632

EMS Risk and Recovery mapping activations and maps produced

	2012	2013	Total
Number of activations	1	6	7
Number of maps produced	0	71	71

Source: Technopolis analysis of activation information on EMS website

EMS risk and recovery mapping activations for EU civil protection exercises

Code	Event	Activation date	Countries covered	Request from	Activation reason	Type and number of maps
EMSN 004	EU Civil Protection Exercise: TRIPLEX 2013	17/06/13	Germany, Denmark	German Federal Agency for Technical Relief (THW), Germany	The service was activated to support the Civil Protection Exercise "TRIPLEX" (from 30.9.2013 to 3.10.2013). The exercise scenario simulates the flash floods in border region between Denmark and	Delineation maps (6 detail maps, 1 overview map)

Code	Event	Activation date	Countries covered	Request from	Activation reason	Type and number of maps
					Germany. The floods generated a refugee flow into neighbouring countries and set up of temporary camps. The products will be available after the exercise is completed.	
EMSN 005	EU Civil Protection Exercise: EU TARANIS 2013	21/06/13	Austria, Germany	Federal Ministry of the Interior, Austria	An EU civil protection exercise, EU TARANIS 2013, held in Salzburg, Austria, was completed on Saturday 29 June. The cooperation within and among the civil protection teams from Austria, Bulgaria, Romania, Croatia, the Czech Republic, the Netherlands and Germany was tested during this three day drill. According to the scenario, Austria was hit by heavy rains and the consequent flooding greatly damaged the infrastructure. This triggered road, train and plane accidents, some of which involved chemical spills.	Delineation maps (3 detail map, 1 overview map) Reference maps (3 detail map, 1 overview map)
EMSN 006	Civil Protection Exercise: RESTART 2013	21/06/13	Czech Republic, Poland	Ministry of Interior - General Directorate of the Fire Rescue Service of the Czech Republic	The map products were used in the framework of RESTART 2013 national exercise, simulating a power failure associated to a severe windstorm. The products served decision makers involved in coordination activities, providing support to orientation.	Delineation maps (4 detail maps, 2 overview maps) Reference maps (5 detail maps, 4 overview maps)
EMSN 008	EU Civil Protection Exercise: TWIST 2013	19/07/13	Italy	Italian Presidency of the Council of Ministries - Civil Protection Department	The map products were used in the framework of TWIST 2013 EU co-funded exercise, whose reference scenario is a landslide detaching from the submerged "Palinuro" volcano in southern Thyrrenian Sea and the consequent tidal wave (tsunami) on the coastal areas of southern Campania, Basilicata and northern Calabria regions.	Delineation maps (6 detail maps, 2 overview maps) Reference maps (6 detail maps, 2 overview maps)

EFAS services

- Daily overview reports
- Flood alerts
- Flood watches - for forecasted floods up to 10 days in advance (real-time info: not public, for national authorities and ERCC only)

- European overview of ongoing floods (public)

Number of flood alerts and watches sent by EFAS

Month Year	Number of flood watches	Number of flood alerts
Oct 2012	1	3
Nov 2012	2	1
Dec 2012	9	2
Jan 2013	6	1
Feb 2013	6	0
Mar 2013	4	14
Apr 2013	4	8
Jun 2013	22	6
Jul 2013	0	0
Aug 2013	0	0
Sep 2013	2	1
Oct 2013	6	0
Nov 2013	1	0
Dec 2013	15	4
Total	78	40

Cost-benefit of Emergency applications

Types of crises	Cost of crises / disasters	Benefits of GMES
Global cost of humanitarian crisis[17]	In 2010, the global economic cost of humanitarian crises was estimated at approximately €100 billion and is expected to double by 2030[18] By 2015, the number of people worldwide, affected by disasters related to climate, will be £375 million per year" (UK Humanitarian Emergency Response Review, 2011)[19]	Provide up-to-date, accurate geographic information for logistics, water supply infrastructures, demography, health facilities and the environment Help to identify priority areas for receiving humanitarian and financial aid Provide essential geographic information for remote areas where this is absent or not current
Land slides[20]	Economic losses resulting from landslides in Europe: Spain: €170 million/year Sweden: €8 to 15 million/year Norway: €6.5 million/year Italy: €1,000 million/year (incl. rehabilitation)	Satellite-based landslide monitoring can save up to 10% of costs up to 2020 by: reducing damage from landslides by better and routine monitoring of vulnerable areas minimising harm to the population.

[17] www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue37_HumanitarianCrises_Sep2013.pdf and Booz & Company, Cost Benefit Analysis for GMES, Final, 19th September 2011

[18] sustainabledevelopment.un.org/content/documents/2301TST%20Issue%20Brief_CC&DRR_FINAL.pdf

[19] www.gov.uk/government/uploads/system/uploads/attachment_data/file/67579/HERR.pdf

[20] www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue13_Landslides_Sep2013.pdf

Types of crises	Cost of crises / disasters	Benefits of GMES
Floods[21]	Affected people, damage and economic losses in the EU in the period 1998 to 2009 More than 1,100 fatalities More than 3 million people affected Cost of €60 billion in total In 2002, damage in the Elbe basin cost €20 billion alone During the 2013 central European flood, the Copernicus Emergency Management Service (GIO-EMS) provided 53 reference maps and 65 flood delineation maps of areas in Germany, Hungary and the Czech Republic In May and June 2013, floods in Germany and neighbouring countries led to a loss of more than €12 billion	Preparation for floods, their mitigation and analysis Input to flood forecast modelling, risk assessment and damage evaluation Direct integration into existing disaster management systems Rapid support to crisis management teams
Wildfires[22]	Wildfires cost up to 1% of GDP in most European countries, not to mention the loss of human life Every year, fires in the European Union reduce around 500,000 hectares of forest to ash Europe suffers over 50,000 forest fires every summer	EO satellites have proven to be a vital tool in responding to wildfires and in the recovery period following an event. Fires and their extent can be detected in near-real time with satellite instruments that sense heat. Changes can be monitored over short periods of time and fire maps can be generated within few hours to provide an overview
Typhoons[23]	Globally, 80 to 100 tropical typhoons develop each year. The Philippines gets struck by around 20 storms and typhoons annually Typhoon Haiyan affected around 14 million people and claimed over 5200 lives. The typhoon had wind speeds up to 235 km/h, causing waves heights up to 15 metres Early estimates of the economic cost are about €11 billion	Rapid support for crisis management teams Tracking and forecasting storm strength and landfall location Improving early warning of storms Preparation for storms, their mitigation and analysis

Source: Technopolis desk research

Land monitoring service

Top 20 downloaded datasets for pan European, local and in situ component of LMS in 2012 and 2014

Type of map	**2012**	**2014**
CLC 2006 seamless vector	9249	13322
CLC 2000 seamless vector	5916	5130

[21] www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue22_Flood_Sep2013.pdf
[22] www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue15_Fires_Sep2013.pdf and www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue39_Flood_Oct2013.pdf
[23] www.copernicus.eu/fileadmin/user_upload/Copernicus_Briefs/Copernicus_Brief_Issue42_TyphoonHaiyan_Dec2013.pdf

Type of map	2012	2014
Urban Atlas	3487	14580
Natura 2000	1658	13708
AirBase – the European air quality database	1312	10121
CLC 2000 – 2006 changes	1230	
CLC 2006 raster data	1121	16167
MS reporting (Art 7) under the (E--PRTR) Regulation	850	
National emission – UNFCCC and EU GHG Mon.Mech.	821	1984
CLC 2000 raster data	813	4240
EEA reference grids	782	2358
Digital elevation model of Europe	771	13443
Waterbase - Rivers	733	
Nationally designated areas (National – CDDA)	631	2886
Population density (disaggregated with CLC 2000)	617	
EU ETS data from CITL	511	2671
National emissions - LRTAP	505	
Waterbase – Groundwater	473	
Waterbase – Water Quantity	465	
Waterbase – Lakes	392	
Elevation map of Europe		9635
The European pollutant release and transfer register		5129
Monitoring of CO2 emissions from passenger cars		2513
World digital elevation model (ETOPO5)		2404
European catchments and Rivers network system		2355
Waterbase – uwwtd: urban waste water treatment		1976
Wise wfd database		1898

Source: data provided by EEA