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Executive Summary Socio-Economic Benefits Analysis of GMES



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1 SUMMARY

A consortium led by Price Waterhouse Cooper, including ESYS and Det Norsk Veritas, has analysed the potential Socio-Economic Benefits of the GMES for the period 2006-2030.

We consulted a wide range of stakeholders to inform our analysis. Each is an authority in one or more of the policy sectors that GMES addresses. We based these consultations and our analysis on the most complete descriptions of GMES information services available during the study period.

The nature of the GMES benefits stems from its purpose. GMES is a decision support system for better formulation, implementation and assessment of Europe's policies in Environment and Security. Consequently the primary benefits of GMES will accrue in these public policy domains. GMES is inherently a public good.

The major conclusion of our study is that GMES can enable significant socio-economic benefits.

These can be realized as a result of future decisions on Environment and Security policy that are informed by better, more complete, consistent, timely, and reliable information from GMES.

We stress that GMES is an information system. The mere availability of information will not in itself, produce benefit. Benefits will materialize only when GMES information is used.

We have identified and quantified significant socio economic benefits in the following policy areas:

- Europe as a global partner (climate change adaptation, global environment protection, humanitarian response)
- Preservation and management of natural resources (air quality, marine environment, forest ecosystem management, civil protection)
- Sustainable growth (efficient delivery of public services)

We have also identified significant socio-economic benefits in the following policy areas, but are not presently in a position to monetize these:

- Europe as a global partner (climate change mitigation, development and aid)
- Preservation and management of natural resources (urban and rural policy, agriculture policy, water quality, management of wetlands)

We conclude that GMES offers significant strategic and political benefits for Europe. Although such benefits are inherently non-quantifiable they are a capital element of the GMES benefit case. They concern Europe's leadership on global policy issues that have long term consequences for the quality of life and security of its citizens.

In order to provide insight into the timescales, external dependencies and uncertainties involved in realizing these benefits we have grouped them into three categories.

- Efficiencies in implementing existing policies: These benefits could, in principle, be realized almost immediately. They represent a monetized value of order 100 M euro pa
- European policy formulation benefits: Since they depend on future policy evolution, these benefits would accrue later, typically one decade hence. We estimate the potential magnitude of these benefits to be at least ten times greater than the first category.
- **Global action benefits**. Since they depend on new international policy agreements, these benefits would accrue later again. Similarly, the external dependencies and uncertainties in their realization are greater. However, by virtue of their global scope, they hold the greatest potential benefits. These we estimate to be at least ten times greater than the previous categories.

We estimate that the potential GMES benefits accumulated over the 25 year period 2006-2030 would be comparable to 0.2% of current annual EU GDP. We caution that our monetized estimates of GMES benefits must be considered with respect to results from comparable economic analyses.



2 INTRODUCTION

2.1 Background

The Global Monitoring for Environment and Security (GMES) programme is a joint initiative of the European Commission ("EC"), the European Space Agency ("ESA") and European Member States. It is intended to provide autonomous and operational information tools required by European environment and security policies. It will also be the main European contribution to the implementation of Global Earth Observation System of Systems (GEOSS) international cooperative effort to improve the monitoring and management of our global environment.

GMES represents a significant investment. Therefore, the EC and ESA Member States recommended that a review of the resulting socio-economic impacts should be conducted. A consortium led by PricewaterhouseCoopers was awarded a contract to study GMES impacts and benefits. This team has assessed qualitative and quantitative impacts of GMES, and has characterised and - where possible – quantified the resulting benefits. The assessment of GMES implementation costs did not fall within the scope of this study.

2.2 What are socio economics benefits?

Socio-economic benefits may arise from the impact of a project, policy, or programme on a potentially wide range of variables. They can be summarised as:

- Societal benefits arise from changes in social and natural capital in a region as a result of a project, policy or programme
- Economic benefits due to impacts on economic or environmental activity as a result of changes in production and consumption, costs and the use of resources.

A socio-economic benefits framework provides a combined assessment of both these types of benefit in terms of economic resource benefits. It aims to encapsulate all social and economic benefits which might arise. It is these resource benefits that we consider in this study.

This approach is commonly applied (usually by public sector bodies) to assess the potential value of a variety of proposed new investments, projects, policies and programmes.

2.3 Study Objectives

The main objectives of this study are:

- To determine the extent of the impact resulting from GMES with respect to a reference baseline
- To characterise the benefits resulting from GMES with respect to the strategic and political dimension, and to the economic and social dimension

This study was commissioned and managed by ESA in close cooperation with EC DG Enterprise and Industry. A committee of experts nominated by the GMES Advisory Council Member States provided independent critical review and advice during the course of the study.



3 OUR APPROACH

3.1 Summary of our methodology

The basis of our approach is to estimate the impact of GMES based on consultations with key experts and stakeholders. We benchmarked stakeholder inputs against recent relevant publications, against reviews of secondary sources, and by comparison with case studies showing what is already available and possible today. This approach has been used for many similar analyses including extended impact assessments conducted by the EC and cost benefit analysis for infrastructure investments.

The benefit case reflects views stakeholders expressed to us about the projected practical application of GMES services and the effects that these services might have upon policy formulation or practice. We have, as far as possible, cross-checked and cross-validated inputs on related topics when these come from different sources.

The main component of the assessment consists of **quantitative analysis** of macro benefits and also micro economic efficiency savings. The macro economic benefits of GMES focus upon the wider societal, downstream impacts of GMES. These impacts have been assessed for each of the main policy domains impacted by GMES and cover both global impacts such as climate change, and European level impacts such as flood risk management. The process of quantifying benefits followed four steps as described below:

Step 1 Determine the policy context

Target policies were selected on the basis of EC Communications on future policy directions (eg Future Financial Perspectives, Priorities to 2010), the European Security Strategy, EC GMES Communications and EEA reports. For each target policy we characterized the key issues, the drivers and priorities and the main influences that would affect their development in the period up to 2030. By this means we established a policy context within which the potential impact of GMES services could be assessed. This initial characterization was based on published EC and national policy documents and reports. We used the stakeholder consultations to validate this and to gain deeper insights into emerging policy influences at European and national levels.

Step 2 Develop the counterfactual baseline ("Without GMES scenario")

To establish our baseline scenario of how information services would evolve in the absence of GMES, we referred to reports from CEOS, IGOS and GCOS. We also relied heavily on the final report from the BICEPS cross-cutting study. This took account of already existing and approved systems and services. It enabled us to characterise the evolution of information collection and analysis networks that would be available to support environment and security policy over the assessment period. We also assessed other developments expected to impact over this period (eg new policies and regulations, technology development, external factors such as expansion of the EU) and investigated the consequences. This was informed and validated as part of our stakeholder consultation.



This scenario represents a reference against which the impact of GMES is assessed. Key assumptions include:

- Availability of already approved meteorological satellites, forecast models, data assimilation systems, Networks (eg EUMETNET) and Satellite Application Facilities.
- Maintenance of the EIONET analysis and reporting infrastructure and the underlying national insitu monitoring networks.
- Launch of new non European Earth Observation missions, including Landsat and MODIS continuity by the US and continued availability of Indian, Chinese and Brazilian satellites.
- **Full operational availability of already approved** national EO missions and constellations in Europe Cosmo-Skymed or Tandem-X, Pleades, Rapideye.
- Full implementation of the INSPIRE Directive

Step 3 Develop a "With-GMES" scenario

The next step was to establish the boundaries of GMES and its impact. To help stakeholders better understand what information GMES could actually deliver, we presented them the GMES Initial Services portfolio, illustrated with practical example cases drawn from the ESA GMES Services Element, the EC GMES Integrated Projects and from national pilot projects.

On the basis of this Initial Service Portfolio, we asked stakeholders to estimate the impact that such information could make in their own areas of expertise, referring specifically to the already established policy context. Each stakeholder was asked to identify mechanisms by which GMES information could impact the policy area and to estimate the extent of this improvement (if any) with respect to the baseline ("without GMES") scenario.

It is important to note that all stakeholders provided their estimates in terms of a relative impact against the baseline, i.e. based on the capacity to fulfil present and expected future responsibilities using available information systems. Each stakeholder estimated the potential relative impact of GMES on the issue for which (s)he was consulted. This was expressed this as an improvement of the order X% as compared with the baseline scenario. On the basis of the impact pathway identified, an estimate was also requested for the timescales required for these impacts to be realised.

Step 4 Quantify benefits enabled by GMES

The study team then characterized the impacts estimated by stakeholders in terms of the economic indicators selected for each policy area. The stakeholders did not participate in this process. The indicators encapsulate the underlying economic modelling through which a financial value was assigned to each estimated GMES impact. Each indicator was selected on the basis of its relevance to the policy sector, its correspondence to the GMES impact, and the availability of accepted standard practices and reference metrics for assigning economic value to changes in the indicator. Indicators were carefully chosen to be independent of each other and to avoid any double-counting of GMES impacts in different policy areas.

The resulting economic benefits were differentiated over time since benefits will start, end and accrue at different times and rates. They were then combined and discounted to reflect present value assessment of the total benefits.

To complete this quantitative approach, a higher level assessment of the strategic benefits of GMES was conducted. This asked fundamental questions of what GMES is seeking to achieve as both a strategic and political investment, and how it can support European priorities with respect to environmental protection and security.



3.2 Categories of benefit

The key issues in each policy domain for which stakeholders indicated a potential for significant GMES impact are summarised below.

GMES Policy Domain	Areas of Potential Benefit from GMES					
Global environment	Climate Adaptation/Mitigation, Desertification, Development aid, Humanitarian response and food security,					
Security	Common Foreign & Security Policy, Border surveillance					
Natural resources management	Agriculture, Biodiversity & ecosystem services, Fisheries					
European environmental protection	Air quality, water quality, land use and regional policy, urban environment and spatial planning, Marine and coastal environment protection					
Risk and civil protection	Floods, forest fires, urban subsidence, landslides, earthquakes, industrial accidents					
Sustainable growth	Competitiveness					

We have grouped all of the above areas of potential GMES benefit into three categories in order to better reflect the different timescales, policy processes, external dependencies and uncertainties involved in GMES.

- Category 1: (Efficiency benefits) relate to improved cost effectiveness of implementing, enforcing or assessing policies that are currently in place. Such benefits can be realized by use of already available or planned GMES services in existing institutional and policy channels. Consequently they could begin to accrue almost immediately. For modelling purposes, we have assumed they occur from year 3 (Dec 2008) of our analysis.
- Category 2: (European policy formulation benefits) relate to improved definition, and implementation of new European policies for which GMES information would be used from the early policy formulation stages onwards. The realization of these benefits depends upon future European policy developments and implies significant changes in institutional working practices such as, e,g widespread access to and operational use of geospatial information from GMES. Such benefits would materialize only when new policies begin to take effect. Consequently the projected benefits stream begins later in our appraisal period.
- Category 3: (Global action benefits) these relate to the use of GMES information in formulating, improving and implementing global policy agreements (e.g. for climate change, desertification, deforestation). Here again, the benefits enabled by GMES will be realized only when and if the international cooperation achieves its objectives. Such international agreements are amongst the most difficult and lengthy to formulate, negotiate, ratify and implement. They can, in principle, yield planetary-scale impacts and deliver very large global benefit. Their implementation may imply considerable effort and investment by signatory states (e.g. in transfer payments, income foregone or investing in alternative technologies). We have therefore assumed that benefits in this category would be realised from 2025 onwards.



3.3 Stakeholder engagement and consultation

The development of the baseline scenarios and the assessment of GMES benefits and impacts were based on comprehensive consultation with key stakeholders across the range of GMES sectors and geographical areas. 104 stakeholders were consulted through interviews (face-to-face and telephone) and a series of workshops covering Climate Change, Aid & Development and Civil Security & Public Health. Issues arising out of cross-validation of estimated impacts due to GMES were followed up by telephone and email.

The majority of stakeholders contacted were from European level organisations to ensure complete coverage of policy sectors addressed by GMES. Stakeholders input broke down as follows:

- 31 European level user organisations (user DGs, agencies, other European organisations), 8 international user agencies and 34 national level users or policy organisations within Europe.
- 5 stakeholders were from either DG Research or DG JRC and 3 more were from Eumetsat and ECMWF. Remaining institutional stakeholders were either general sponsors of GMES or advisory bodies (e.g. OECD).
- 10 industrial service providers and a further 3 stakeholders from industry
- Remaining stakeholders contacted were mainly policy advisors from outside Europe and DG Enterprise and Industry

Stakeholders were provided with summaries of the content of services together with a preliminary identification of the areas where the study team estimated that benefits could potentially be achieved. In addition, they were also provided with summaries of the baseline situation based on the reports listed previously. Stakeholders were then asked to provide the following contributions:

- An identification of key policy drivers and related monitoring systems for policies in their area of expertise and the types of information currently used
- An estimation of how their policy sector was expected to evolve over the appraisal period and the consequences in terms of the main issues of interest and the requirements for information
- An estimation of the additional impact of the GMES information services on their area of expertise and the issues of interest
- A confirmation that the impacts identified resulting from GMES information services would not be generated as a result of any evolution in their policy sector that would be independent of GMES



3.4 Indicators of value

Economic modelling of the value of GMES benefits has been encapsulated in the indicators used to characterise the impacts of GMES. Their use in each sector is shown in the table below.

GMES policy domain	Application of GMES services	Potential GMES Impact	Indicator to characterise GMES impact	
Global environment	Climate change – reduction in uncertainty	Reduced Global damage costs imposed by climate change, through enhanced adaption & reduced deforestation	Damage costs per tonne of CO_2e Climate value of forests per Ha	
	Desertification	Reduced loss of productive land	Economic value per Ha of productive land	
Development and aid	Humanitarian aid & food security	Improved health and welfare in Africa	Value of a Disability Adjusted Life Year in Africa	
Security	Crises response in Africa	Improved health & welfare of refugees in Africa	Value of a Disability Adjusted Life Year in Africa	
	Agriculture	Efficiencies in monitoring CAP	CAP monitoring costs	
Natural	Biodiversity & ecosystem services	Reduced loss of forests	Existence value of biodiversity per Ha of forest	
	Fisheries	Reduced illegal fishing	Value of illegal fish landings (per tonne)	
	Air quality	Human health benefits	Statistical value of life in Europe	
Furopean	Water Quality	Efficiencies in delivering the WFD	WFD monitoring costs Nitrate removal costs	
environmental protection	Land use	Reduced soil quality degradation Urban planning efficiencies, energy savings	Soil Thematic Strategy monitoring costs N/A	
	Marine and Coastal environment	Reduced oil discharges	Economic cost of oil spill clean up	
	Floods	Reduced flood impact in Europe	Health, welfare & property damage costs of flooding	
Risk & civil	Forest fires	Reduced forest fire impact in Europe	Health, welfare & property damage costs of forest fires	
protection	urban subsidence & landslides	Reduced geohazard impact in Europe	Health, welfare & property damage costs	
	Industrial risk	Reduced industrial accident impact in Europe	Health, welfare & property damage costs	
Sustainable growth	Competitiveness Efficiency savings	Improved cost efficiency for primary users of GMES information	Cost savings of primary users	



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3.5 GMES Fast Track Services

The concept of the "Fast Track" services was evolving over the course of our study. In our "Fast Track" scenario, we have assumed the following four services will be operational by 2008:

- Land cover and land cover change at scales and classifications similar to CORINE 2000 for the European territory
- Physical oceanographic monitoring and forecasting at global and regional level
- Rapid mapping for crises response both at European and Global level
- Atmospheric pollution monitoring and forecasting at regional and global level
- We have assumed a layered approach for service implementation with a generic layer at European level and a downstream layer for customised services at national and regional levels.

3.6 The International Dimension of GMES

GMES is the European contribution to the Global Earth Observation System of Systems (GEOSS). We have identified GMES impacts that will contribute to key GEOSS societal benefit areas including:

- Reducing loss of life and property from natural and human-induced disasters,
- Understanding, assessing, predicting, mitigating, and adapting to climate variability & change
- Improving the management and protection of terrestrial, coastal and marine ecosystems

Some of the GEOSS societal benefit areas are not included in our policy-based analysis of GMES benefits:

- Improving weather information, forecasting and warning
- Improving management of energy resources

We note that GEOSS will provide a global framework for coordination of observation systems and observations, and that GMES will deliver information services specifically addressing European Environment and Security policies. The goals of GMES and GEOSS are highly complementary and mutually supportive.

We have assumed that data from observation systems operated by non-European GEOSS international partners would also be available to GMES. This would ensure the coverage and redundancy of observations and thereby guarantee the GMES service quality and availability levels that are implicit in our analysis.

We anticipate that, in addition to the benefits we have identified, GMES data and observations may also be used to generate benefits for Europe's international partners in relation to their own specific national and regional policy objectives. Such benefits would fall within the scope of GEOSS but are peripheral to GMES.



4 STRATEGIC & POLITICAL BENEFITS

Strategic impacts clearly carry weight in the political arena although they generally do not lend themselves to quantitative assessment. The strategic and political arguments for GMES in this context centre on (a) access to independent information to support European presence in international actions and (b) European autonomy in critical technologies and capabilities.

Politically, GMES responds to a perceived gap in the extent to which we feel informed on key environment issues¹. GMES can also support improvement in the perceived reliability of government environment² information sources. Ensuring Europe's citizens feel better informed is a significant impact given the importance we attach to our position at international level in environment and security issues.

Strategically, the importance of environmental and security issues continues to grow in key areas such as transport, industrial competitiveness, energy and ensuring Europe remains an area of freedom, security and justice. At international level, Europe is expanding its role and responsibilities. To ensure the development and implementation of effective policies at national, European and international level, guaranteed reliable access to appropriate information systems is critical.

Analogies can be helpful to place GMES in context. Europe already spends a significant level of resources collecting and validating economic data to support formulation and implementation of economic policy. Similarly, governments pay for meteorological data to support safety and security.

National and regional authorities already invest in collecting and analysing environmental data but the future of key measurement networks is not guaranteed. There are also constraints on effective integration of this information to develop European policies and support promotion of a European agenda at global level. The network effects of GMES are significant here – like the London Underground, where the value of individual lines is constrained until joined into an integrated system so GMES adds value by joining previously heterogeneous data streams into an integrated, consistent overview to support more effective interaction between different government agencies.

At global level, climate change mitigation and adaptation, development and humanitarian aid and conflict prevention are all areas where Europe has a leading position. Europe is the largest aid donor, it is one of the main proponents of coordinated action to reduce climate change impact and is continuously expanding its role in crises response and conflict prevention. These roles are critically dependent on reliable, timely access to appropriate information.

Maintaining Europe as an area of freedom security and justice requires reliable characterisation of natural and technological hazards, comprehensive action against trans-national organized crime, effective management of Europe's borders and promoting democracy, stability and economic development in our immediate sphere of influence. Successful cohesion and regional policies are also important components of the foundation on which European aspirations are built. Reliable monitoring, intelligence and analysis information is of critical importance to ensure these policies can be implemented in the most appropriate manner.

¹ Special Eurobarometer report 217(April 2005) – The attitudes of European citizens towards the environment

² ibid



5 BENEFITS TO EU EXTERNAL POLICIES

5.1 Europe's global agenda and GMES

GMES can support European action in the following global issues:

- Climate change adaptation and mitigation
- Land degradation and desertification
- Development and humanitarian aid
- Crises response and the Common Foreign and Security Policy

5.2 Climate Change

GMES information will contribute to many of the topics identified for the IPCC Fourth Assessment Report and also the GCOS Implementation Plan. For example, GMES can support continuity of key measurements, complementing operational meteorological measurements. GMES will also ensure availability of comprehensive global datasets (e.g. land cover change, concentration of trace gases) to support improved characterisation of climate change impacts. By guaranteeing continuity of critical time series and supporting improved modelling, GMES information will reduce the level of scientific uncertainty with respect to the extent and impacts of climate change on critical ecosystems and vulnerable geographic areas.

Stakeholders indicated that the impact of GMES information in support of climate change policy would be a reduced level of scientific uncertainty and a consequent improvement in international action to reduce climate change impact through better adaptation. This was estimated to result in a reduction in damage costs in the range 0.1 - 0.5%. This represents an economic value of between \notin 5 and 28 billion per annum starting around 2025 if we take the average of all four IPCC emissions scenarios (SRES 2000) as a representative baseline for carbon emissions and a conservative estimate of the social cost of carbon. Over the entire appraisal period, this represents a present value of \notin 14 - 70 billion.

Stakeholders also indicated potential for GMES impact in optimising climate change adaptation investment. However, estimates of the levels of investment required and the extent to which available information can already support such decisions vary considerably. As a result, it has not been possible to obtain comprehensive estimates of the appropriate GMES impact and the economic benefits are therefore not quantified.

Several stakeholders cited the potential for GMES to generate additional benefits related to climate change policy through support to international efforts in reducing tropical deforestation. Negotiations on including reduced deforestation within a post-Kyoto protocol are now starting and effective monitoring and assessment mechanisms are central considerations. Due to varying assumptions as to the outcome of these negotiations, estimates for the resulting reduction in deforestation were in the range of 5-20% of current deforestation levels.

Although there is a wide range of estimates for the impact of tropical deforestation on carbon emissions, the consensus is that this impact is significant. Using the lowest end of the range of assumptions and again applying a social cost of carbon, a 5% impact on reducing deforestation (i.e. the lowest estimated impact from stakeholders) gives economic benefits in the range of ≤ 1 -4.4 billion per annum starting around 2025, or approximately ≤ 2.7 - 11 billion in present value terms.

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The range of impacts identified is consistent with recent demonstration projects using current systems. Selected impacts are shown in the table below.

Source	Basis	impact		
Stakeholder estimates	Total deforestation impact (not just GMES)	5-20% reduction		
ISRO estimation (ISRO 2005)	Impact of ISRO on deforestation in India	Forest cover now sustained at 20%		
GEO2006/World Bank	Deforestation project in Brazilian Amazon – impact of SIVAM ³ & improved government cooperation	30% reduction in deforestation		
JRC	Illustrative assumption for an example of carbon accounting through reduced deforestation	10% reduction in deforestation		

5.3 Desertification

In the recent Millennium Ecosystem Report, gaps in both forest cover and land degradation data were repeatedly highlighted. Stakeholders identified a GMES contribution in analysis of land cover and land cover change to support monitoring and assessment tasks. The main impacts would be identification of areas at risk from degradation and determining the current extent of degradation. This will contribute to National, Regional and Sub-regional UNCCD Action Plans. GMES can also support assessment of whether and how proposed programmes have been implemented locally and in reviewing their effectiveness in combating desertification.

Specific UNCCD issues addressed by GMES services include; mapping of vegetation and agroecological zones, change detection in vegetation and agro-ecological zones, identification of risk changes and assessment of bushfires, crop yields and water supplies. Support to mapping of socioeconomic factors such as population movement, cultivation, deforestation, overgrazing can also be provided

Stakeholders suggested that with an optimal global process for managing desertification, using information provided by GMES, desertification might be better managed and global costs associated with desertification might be reduced. Estimates for this reduction were in the range 5-20% in the rate of land degradation. Assuming a global 5% reduction and using CIESIN values for the per hectare costs of degraded land, GMES could enable economic benefits of approximately €240million per annum from around 2025. This is around €0.6 billion in present value terms.

³ Brazilian Integrated System for Monitoring the Amazonian Forest



5.4 Development, Aid and Common Foreign & Security Policy

GMES already provides rapid mapping support to humanitarian aid operations and conflict resolution efforts in both emergency response and more accurate long term development planning. Improved mapping could potentially enable improved access to crisis areas and facilitate the more effective use of existing infrastructure. For example, aid agencies might be able to make decisions about means of transporting aid to crisis zones based on improved information. This could lead to more rapid response times, reduced delivery costs and more robust aid delivery logistics. In the longer term, improved mapping could also assist in the management of population pressures.

In terms of food security (crop yield forecasting), GMES could provide more accurate estimates of crop failures in local regions, or potentially identify geographical areas of humanitarian need in the context, for example, of natural disasters. These mechanisms could assist aid agencies to 'step-in' earlier. Aid agencies could also provide a more appropriate amount and type of aid; too little resulting in increased morbidity and mortality; too much damaging the local economy in the longer term, through the crowding out of local suppliers.

Representatives of humanitarian agencies estimated the potential impact of GMES to be a reduction in mortality and morbidity of between 0.3 and 0.7% for humanitarian crises. Using standard measures for the value of reduced loss of life and injury, this gives economic benefits of approximately €80 million per annum or €0.9 billion in present value terms. Stakeholders were not able to provide estimates of the impact of GMES on development and reconstruction aid.

GMES services in the common foreign and security area are in most cases at an early stage of definition. In many cases, the added value of GMES to national level users is limited by their current access to dedicated military information (e.g. the BOC, stand-off airborne surveillance etc). However, stakeholders were confident that GMES information could make an impact that would translate as a 1% reduction in mortality and morbidity in areas such as humanitarian response tasks, peacekeeping, deployment of combat forces in crisis management (including peacemaking), treaty verification, arms and proliferation control. Stakeholders indicated that GMES would make its maximum contribution over the time period of interest in activities related to Africa.

Again using standard values for reduced loss of life, the economic benefits from GMES are approximately \in 200 million per annum assuming that the number and nature of crises in Africa remains more or less constant over the appraisal period. This is equivalent to approximately \in 2.2 billion of economic benefit through reduced health and welfare losses in present value terms.

5.5 Caveat

We have assessed the impact of GMES in supporting Europe in promoting more effective global cooperation in areas such as climate change and desertification. The benefits of GMES are inseparable from the benefits of the resulting policies and cooperative actions in effecting behavioural change. The benefits will be realised over the timescales and to the extent that these changes impact. Recognising this, we assume that the benefits from GMES in these areas will only start to be realised in the time period 2025 – 2030.



6 BENEFITS IN PRESERVATION & MANAGEMENT OF NATURAL RESOURCES

6.1 Agriculture and fisheries monitoring

GMES Services for agriculture and rural development are based mainly on land cover mapping and change detection. This includes soil monitoring, irrigation pressure mapping and crop monitoring. In agricultural monitoring, stakeholders identified a GMES contribution to ensure continuity of the MARS programme and provide monitoring information to support the rural development aspects of the Common Agricultural Policy.

GMES services can also help international partners to improve their compliance with fisheries regulations. GMES will augment existing surveillance capacity by detecting vessels that do not identify themselves using established tracking systems. This will help improve the surveillance performance and enables optimisation of interception assets such as Maritime Patrol Aircraft or Coast Guard vessels. In turn, this will improve enforcement of international agreements on fish quotas, and on fishing practices in general. Stakeholders suggested that benefits could arise for all European coastal states. Estimates are that GMES could contribute to a 10% reduction in illegal fish landings in Europe. At current market prices for typical capture species, this translates to an economic benefit of approximately €230 million per annum starting around 2012. In present value terms, this represents a total benefit in the region of €7 - 8 billion.

6.2 Urban and regional policies

GMES information services of value to urban and regional planning include inventories, assessment and monitoring of soil sealing changes, urban expansion and protected areas and the development of spatial indicators, urban growth scenarios and landscape transformation scenarios. Based on prototype services presently undergoing qualification, these services will improve current capabilities such as CORINE by providing higher resolution, higher update rates and increased thematic content. These services will enable more comprehensive and objective monitoring and assessment of change. A more consistent approach and development of key indicators will support more effective comparisons and assessments across Europe.

6.3 Ecosystems and biodiversity – deforestation

GMES can contribute to the preservation and management of biodiversity and ecosystems by detecting and monitoring changes and pressures for change on critical habitats. In addition to land and marine ecosystems, this includes Arctic ecosystems which are extremely sensitive to climate change impacts and coral reef ecosystems which are sensitive to changes in ocean temperature. By monitoring habitats it will be possible to assess some of the major pressures on biodiversity as well as improve the understanding of links between habitat changes and ecosystem response.

GMES forestry services will monitor changes in area and condition globally, thus allowing assessment of deforestation, reforestation and afforestation. This allows monitoring of compliance with project requirements, such as Clean Development Mechanisms under UNFCCC. In some areas, particularly in Europe, GMES monitoring services will be at higher resolutions allowing for improved forestry management and fire risk assessment.

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The value of GMES services in reducing deforestation goes beyond the climate benefits previously identified. The impact is expected to be localised in only some countries with tropical forests, but nevertheless, stakeholders felt that the benefit could be significant because forests provide both local and global services such as fuel-wood and watershed benefits. These services can be assigned an economic value which is additional to the value of forests in reducing or offsetting carbon emissions for climate change mitigation.

It should be noted that the range of estimated impacts for GMES on reducing deforestation (5-20%) is an average global impact – there will be strong variation in the observed impact depending on factors such as availability of alternative monitoring systems and the capacity of government agencies to enforce logging regulations.

There are a range of economic values assigned to the services provided by forest ecosystems. Taking the lowest end of the range (i.e. $105 \notin$ /ha) gives an annual impact of between \notin 75 and 150 million per annum starting around 2025 which is \notin 2.7 billion are projected, in present value terms. It is important to note that the value of reduced deforestation does not include the associated opportunity costs (e.g. the value of timber logged or the value of crops produced on cleared forest).

6.4 Air quality and public health

GMES will deliver services to assimilate and model atmospheric composition and support informed decisions on atmospheric policy issues of stratospheric ozone depletion, surface UV exposure, air quality and climate change. Specific atmospheric chemistry assessments will include O3, PM10 (and possibly PM2.5), SO2, NO2, and VOC. The services will complement existing in-situ observations by providing column integrated concentrations in the troposphere and stratosphere. Global and regional models assimilating these data can also support more detailed local / regional models and services.

New policies under the Clean Air For Europe (CAFÉ) programme are expected to make a significant impact on air quality and related health issues in Europe. As air quality monitoring is already well advanced throughout Member States, in the short term stakeholders estimated that the value of GMES in this area would not be discernable from existing tools and mechanisms. In the medium to longer-term, however, stakeholders suggested a role for GMES in advancing modelling capabilities through combining environmental and health related inputs and consequently, promoting additional health and welfare gains amongst citizens through improved modelling, public policy and ultimately, behaviours. Estimates centred around a 5% improvement over the baseline scenario. Applying standard values of life and injury gives an annual economic benefit of approximately €2 billion per annum starting in 2025. This represents around €4.1 billion in present value terms.

6.5 Land use planning and water quality

GMES will provide services to support water quality monitoring by assessing land cover and land use changes including forest and urban cover mapping. Such GMES services, including the proposed land monitoring fast track service, will provide an efficient support to fulfil some of the mandatory public tasks as laid down in the Water Framework Directive (WFD). In particular, detailed spatial information will enable authorities to comply with WFD water quality reporting requirements. To existing capabilities, GMES adds spatial information services which are harmonized over large areas, representative for varying conditions and more topical due to shorter update rates.



6.6 Marine and coastal environment

GMES will provide improvements to existing marine and coastal monitoring services as well as new services specially designed to meet the coastal water quality requirements of the Water Framework Directive. The 'added-value' of GMES will include uniform, standardised products with European scale coverage; data and models for a given area tailored to specific user requirements; integration of all relevant data sources and services in a unified access point and products responding to specific issues such as erosion, port operations or extreme events.

GMES oil pollution surveillance services were estimated to improve monitoring effectiveness and contribute to a 10% reduction in the level of illegal discharges, over and above the decrease in discharges expected as a result of improved port waste handling practices. Services for emergency notification and drift forecasts could also act to limit the environmental and economic cost of oil spills from major accidents. Based on the clean up costs per tonne of oil, this represents an economic value of approximately €120 million per year for European waters or approximately €2 billion in present value terms. GMES will also improve existing algal bloom alert services which will in turn help aquaculture operators and reduce any health impacts of harmful blooms. However, as the water framework directive is intended to reduce the occurrence of algal blooms, the extent of this impact is difficult to estimate reliably.

6.7 Risk and Civil Protection

Europe suffers regularly from major natural and technological disasters which affect its citizens directly through loss of life, by causing injury and property damage. GMES services can provide an important input to support reduced losses from flooding, wildfire, subsidence, landslides, seismic events, and possibly industrial incidents also.

There are two types of GMES service:

- Base maps and rapid mapping to assess forest fire and flood risk, damage extent and support planning of response actions and post crises activities
- Land motion measurements to detect subsidence, earthquake motion and land slide extent

GMES flood and fire services will support national and regional civil protection organisations responsible for floods and fires within Europe, in addition to the extensive monitoring infrastructure such organisations have in place today. Stakeholders estimated that the impact of GMES would be a reduction in flood costs of approximately 1.5% (this would vary between pre-event and post event impacts) for forest fires, improved risk assessment based on GMES would contribute to a 1% reduction in damage and loss of life. Using standard values for loss of life, injury and property gives an economic benefit of approximately €145 million Euro per annum over the appraisal period which is €2.6 billion in present value terms.

Stakeholders estimated that GMES would contribute to a 0.75% reduction in damage and injury due to land slides and a 1% reduction in the impact of earthquakes as a result of wider area systematic land motion monitoring. The impact is limited due to the extent of in-situ monitoring networks already deployed over areas with the greatest risk exposure. Using standard values for the value of life and property in Europe, this translates to an economic benefit of €25 million per annum or approximately €0.5 billion in present value terms over a 25 year period. Benefits in urban subsidence are considered as efficiency savings in the following section.



7 BENEFITS TO SUSTAINABLE GROWTH

Improved competitiveness leading to sustainable economic growth and a resulting increase in high quality employment is at the heart of the Lisbon Strategy, agreed by European Union leaders in March 2000. Though there is often a tension between the environmental protection and economic growth objectives, GMES can contribute to both because it supports the following key benefit areas.

7.1 Improved long term environmental regulation

Environmental regulation within Europe is increasingly developed on a Europe wide basis and key areas such as climate and ozone issues are negotiated at global level. GMES can contribute to the assessment underpinning possible regulation as well extending the options for monitoring and enforcement. The potential for impact is significant – according to DG Enterprise⁴, the cost of protecting Europe's environment is 2% of GDP and rising. There are also major industrial competitiveness implications – OECD and Eurostat estimate⁵ European industry spends approximately €28 billion per annum on environmental protection measures. In the current globalised economy, ensuring European environmental regulations address the target issues effectively but without placing undue burden on industry is vital for sustained economic growth.

7.2 Improved monitoring efficiency

A key GMES objective is to improve the efficiency with which environmental information is collected across Europe. GMES projects are already contributing to this objective by developing and delivering GMES services based on existing satellite and in situ observations. Services developed under the ESA GMES Services Element have included a Cost Benefit Analysis (CBA) assessing the specific benefits of each service; identifying benefits in terms of cost savings in addition to wider benefits. These savings accrue to the primary users of GMES information – ie, GMES is projected to deliver cost savings (efficiencies) by providing qualitatively or quantitatively different information to users. We have reviewed the benefits within these CBAs (being careful to avoid any 'double-counting' of benefits summarised in this study), aggregated them together and expressed them in present value terms. These analyses suggest that on average, €312 million per annum (by 2030) of efficiency could be generated by the "full service" GMES, or €2.8 billion in present value terms.

7.3 Industrial development

The availability of environmental information through GMES represents a significant opportunity to exploit and develop innovative new products, services and markets. A study carried out for the EC estimated that the commercial potential in exploiting European public sector information (mainly environmental information) represents more than €50 billion per year. According to the EEA⁶, properly developed environmental policies stimulate innovation in environmental technologies and services and the global market for such products is already in the region of €425 billion per annum. Already, EEA estimate that total commercial revenues from exploiting the current version of CORINE are more than € 250 million.



⁴ Speech by Erkki Liikanen http://europa.eu.int/comm/environment/news/efe/17bis/print_article_1478_en.htm

⁵ Environmental protection expenditure by industry in the European Union, Eurostat 2005

⁶ State of the Environment Report 2005



8 SUMMARY OF BENEFITS

8.1 Expression of benefits as present values

It is standard practice in socio-economic benefits assessments to analyse benefits in present value terms. This requires assumptions on the period over which benefits accrue, the points in time at which different GMES impacts create benefits and the appropriate discount rate to apply in order to derive the present values. In this study, the following assumptions are made:

- The appraisal is conducted over 25 years, from 2006 through 2030;
- All benefits are presented in net additional terms, that is they are presented relative to a counterfactual assessment of the status quo (i.e. the 'Without GMES' scenario);
- Benefits are presented in present value terms; discounted to 1/1/2006. In line with EC standard practice for this type of study, a discount rate of 4.0% real is applied. Terminal Values are also used to capture additional perpetual benefits where appropriate;
- The first year for which GMES benefits start to accrue is assumed to be 2008. However, many of the benefits identified start to be realised later. Benefits associated with new European policies (category 2 benefits) are assumed to start in 2013, with the exception of projected air quality improvement benefits which stakeholders consulted in the course of this study thought would take longer to arise – these are assumed to commence in 2025. Benefits associated with global action (category 3 benefits such as climate change, deforestation and desertification) are assumed to start accruing in 2025.

8.2 The nature of GMES benefits

Before presenting our summary of the different benefits, it is worthwhile to consider some aspects of the impacts and the benefits that stakeholders have contributed during the course of this study:

- The GMES Added Value The impacts and benefits identified are additional to those of ongoing and planned developments in the policy sectors discussed. In other words, if GMES is not implemented, the stakeholders we consulted believe that the benefits and impacts they identified will not be realised.
- The value of information The value of information in support of public policy decisions depends on the extent to which alternative information is available, the capacity to react to the information provided, the cost implications of an incorrect decision and the level of uncertainty inherent in a decision. This indicates that the major value of GMES information is where there is greatest uncertainty, significant cost implications and a lack of alternative information i.e. global action benefits. This also implies that much of the benefit case will accrue outside Europe.
- **Public goods** the benefits identified are very much public goods. Any benefits accruing to industry as commercial benefits are based on the expectation that a public funded basic capability is put in place. This has implications for how GMES should be financed.
- **Cost savings** the benefits identified are mainly cost savings e.g., more cost effective monitoring, reduction in negative impacts from incorrectly structured policies. This has implications for preparatory work to ensure that appropriate mechanisms are put in place to support the realisation of the benefits identified. It also has implications for GMES financing.



8.3 Benefits evolution

The table illustrates the relative magnitude of the three benefit categories and their evolution in time. It should be noted that we have analysed the response of the total benefits case to variations in the rate at which each of the three categories generate benefit (ie how fast each "ramps up"). In all realistic cases, the total benefits case is relatively insensitive to the ramp up rate.



The estimated break down in evolution of benefits in each category is as follows:

Category 1 benefits (Efficiency benefits)

Benefits comprise of efficiency savings delivered by GMES. These are projected to extend to around €312 million per annum by the year 2030, or over 25 years, €2.79 billion in present value terms.

Time evolution is dominated by how fast service coverage and performance capability can be rolled out and the rate at which integration with user agency information systems occurs.





Category 2 benefits (European policy formulation benefits)

Benefits comprise of GMES applications in the areas of humanitarian aid, conflict resolution, air quality, flooding, seismic applications, and several other applications which fall within the Risk and Civil Security policy domain. These are projected to amount to €2.9 billion per annum by the year 2030 (projected to rise incrementally over the appraisal period), or €14.6 billion in aggregate present value terms (over 25 years).



Category 3 benefits (Global action benefits)

Benefits comprise of GMES applications in the fields of climate change, desertification and deforestation. These are projected to total €7 billion per annum by the year 2030 (these benefits are expected to accrue only in the longer term), or €17.3 billion in present value terms. However, with the inclusion of Terminal Values, this present value benefit rises to €119.7 billion.





8.4 Benefits Comparison

In addition to cross validation of impacts and benefits within the study, we have compared our findings with analogous studies already completed. Although there are variations in the underlying assumptions and the scope of the benefits considered, our findings are broadly consistent.

Appropriate comparisons for this study included:

- The GSES cross-cutting study (ESYS 2004) in the benefit areas we have identified, the nature of the impact and the order of magnitude of the benefits is broadly consistent with our findings
- EC Extended Impact Assessments several impact assessments have considered similar issues and impacts to those considered within our analysis. These include the assessments for Inspire, a Marine Environment thematic strategy, an urban environment thematic strategy, a directive on the reuse of public sector information, an integrated coastal zone management policy and a directive on ambient air quality. Our findings are consistent in areas common to the impact assessments and our study. For example:
 - Ambient Air Quality Extended Impact Assessment (2005) A cost benefit analysis formed part of this overall EC regulatory assessment. It look at costs and benefits of reductions in levels of PM, O₃, SO₂, NOx, VOC and NH₃ and forecast that total health benefits from maximum technically feasible reduction estimated at €180bn per annum addressing less than 30% of the total problem
 - The Inspire extended impact assessment (2004) identified impacts of a similar type and extent to those identified in category 1 and category 2 of our analysis. The Inspire analysis is complementary to that performed here in that it assumed the availability of the information to which standards were to be applied. We assume that Inspire will be implemented and have assessed similar benefits from the perspective of availability of the underlying information.
- Association of British Insurers The study examined the financial implications of climate change through its effects on extreme weather events (US hurricanes, Japanese typhoons and European windstorms). It includes valuing the impact of improved climate change information on flood defences and subsidence investment, is based on insurance catastrophe model and assumes flood risk would only increase 2-4 fold compared to 10-20 fold under a high emissions scenario. It valued the benefits at some €20bn per annum in Europe.
- We have also conducted other benefits analysis for major investment programmes. Like GMES some have a significant space component and the order of magnitude of the resulting benefits and the timescales involved are consistent with the findings from this study. In particular:
 - Digital Divide Cost Benefit Analysis (PwC,2004) This study was undertaken on behalf of the European Space Agency to assist in building a case for public sector investment in European-wide broadband coverage, particularly for those (rural) areas with limited or no existing access. The projected present value of benefits for the period 2004-13 were €84bn with a nominal discount rate 7.07%. If consideration of a terminal value is included, the total benefit rises to €297billion.
 - Galileo Cost Benefit Analysis (PwC, 2001) Prepared as part of the approval process for Europe's partially publicly funded €4bn satellite navigation system, this study demonstrated that the present value of the incremental benefits to Europe of having the system in place would be €17.8bn for the period 2008-20, in 2000 prices and using a discount rate of 5.67%.



The analysis was built up using benefits derived from only those activities with the largest impact.

Our findings are compatible with the identification and valuation of impacts conducted in many other studies. For example, the EEA values the socio-economic impact of harmful algal blooms in the Mediterranean⁷ at €320 million per annum while industrial analysis of the issues to which GMES is responding are also consistent with the magnitude of the benefits identified in this study. For example, Swiss Re estimates the cost of climate change impacts at many billions of Euro per annum while NOAA conduct regular assessments of the value of different areas of economic activity to which their services contribute, and the order of magnitude of the issues being considered are again an appreciable fraction of GDP (although no impact assessment has been conducted).

Finally, the Macro Economic Assessment of Candidate Earthwatch Missions, prepared by KPMG for ESA in 1997 assumes that many of the basic GMES observation capabilities are independently available and yet estimates benefits analogous to our category 3 benefits from additional Sentinel type satellites as being higher than the figures from the Cost Benefit Analyses.

8.5 Summary of the total benefits

We have brought together the benefits streams from each of the impacts identified by stakeholders and discounted them to present values. These are illustrated in the following graph.



Summary of Projected Economic Benefits by Impact Category

⁷ "Priority Issues in the Mediterranean Environment", EEA report 2006/4



Note that a sensitivity analysis has been conducted with respect to the major assumptions and critical dependencies (e.g. variation in impact of GMES, variation in economic value of indicator, variation in time period over which benefits will accrue). Due to the conservative assumptions made in our analyses, the benefits presented below are at the lower end of the range of possible values. In particular, given the range of impacts for climate change mitigation, economic benefits can be as high as €28 billion per annum based on the same conservative social cost of carbon.

The table below summarises the temporal evolution of the benefits accruing in each category and the associated present value. In addition, where GMES enables a process to begin which will continue to impact beyond the appraisal period considered in our analysis, we have calculated the resulting terminal values. The results are shown in the last column. These are limited to category 3 benefits.

Benefit category	Projected benefit Areas	Out- turn 2012	Out- turn 2020	Out- turn 2025	Out- turn 2030	PV Benefit	PV Benefit including Terminal Value
One	Efficiency savings	162	232	272	312	2,786	N/A
Sub-total		162	232	272	312	2,786	2,786
	Humanitarian aid	80	80	80	80	892	N/A
	Conflict Resolution	197	197	197	197	2,202	N/A
	Forest ecosystems (EU)	6	6	6	6	63	N/A
	Air Quality	-	-	1,675	1,675	4,167	N/A
Two	Marine	351	319	304	291	3,622	N/A
TWO	Flooding	135	227	314	435	2,584	N/A
	Forest Fires	9	21	39	73	278	N/A
	Seismic applications	22	44	68	103	520	N/A
	'Other' Civil Security (landslides, infrastructure stability, industrial risk)	6	18	37	75	254	N/A
Sub-total	807	913	2,719	2,935	14,582	14,582	
	Desertification			145	247	615	1,472
	Deforestation – climate			631	1,074	2,488	6,146
Three	Deforestation -ecosystem			65	75	185	258
	Climate change - adaptation			3,309	5,631	14,010	111,779
Sub-total				4,085	6,952	17,298	119,655
TOTAL	969	1,145	7,076	10,199	34,666	137,024	

Summary of projected economic benefits: GMES 'Full Service' Scenario (€m, 2005 prices)

Source: PwC analysis



9 DISCUSSION AND CONCLUSIONS

9.1 Limitations of the Analysis

In undertaking the economic benefit assessment of GMES we are critically aware of the limitations of our analysis. These include:

- We consider that it is not feasible to isolate the portion of the total benefits case uniquely dependent on the availability of GMES information given the current level of understanding of the impact of information on public sector decision making. Therefore, we have presented the total benefits case enabled by GMES.
- Our analysis identifies and measures economic benefits that expert stakeholders have suggested could be realised through GMES information. However, realisation of these benefits is critically dependent on a range of additional factors inherent in the policy implementation process such as setting up appropriate international agreement and effecting changes in behaviour. The benefits resulting from GMES will depend on these policies successfully achieving their objectives. If GMES information is not used or cannot be used, the resulting benefits are worth nothing. It is critical to note therefore that the benefits we have forecast are not guaranteed by GMES, they are enabled by GMES;
- Our analysis of the impact of GMES has been determined through an extensive stakeholder engagement process and the views of experts about the 'with' and 'without' GMES scenarios. Whilst we have considered the development of alternative policies, programmes and projects which might influence our assessment of the incremental nature of GMES benefits, we have necessarily assumed that no alternative (or complementary) developments arise which could displace GMES impacts. Again, this is a standard assumption which is typically employed in economic impact studies of this nature;
- The main part of our consultation focussed on European level stakeholders to ensure broad coverage of the target policy areas. This means that national and regional level benefits and priorities are not adequately addressed in our analysis. In addition, stakeholders were not willing to provide estimates of the social benefits resulting from GMES – the benefits we have assessed relate to changes in natural capital and economic wealth and security. We do not have an adequate basis to characterise the impact of GMES on changes in social capital.
- Our analysis has explicitly excluded a number of potential benefit areas. This is a reflection of limitations on the scope of our work, the potentially numerous applications through which GMES might generate economic benefits and the extent to which stakeholders were comfortable in identifying impacts due to GMES. Consequently, there are additional benefits that have not been factored into our findings.



9.2 Next Steps

Our analysis provides a first step towards an assessment of the economic benefits that could arise from GMES, and consequently it lends itself to being followed up by a series of supporting tasks. We suggest two priorities:

- Our analysis has identified a series of potential benefits arising from GMES and high level options for how the impacts can be generated. If the benefits are to be realised, preparations must begin in the near future to ensure the appropriate mechanisms are in place to effectively exploit GMES in the appropriate manner. A more detailed characterisation of how the impacts can be ensured is necessary.
- GMES investments are already beginning. One of the major problems we encountered was the lack of measured data to demonstrate the impact of capabilities such as GMES. Measurement systems should be devised to monitor progress in realising the identified benefits from GMES as the investments are made and the services and infrastructure progressively deployed. Here we point to the recent initiative under the Millennium Ecosystem Assessment to review the impact that initial reports have made on a range of organisations responsible for definition and implementation of public policy related to global environment and development issues. This could be a useful case study in helping define how the progressive impact of GMES can be monitored.

9.3 Conclusions

Our analysis of the inputs we obtained from an extensive stakeholder consultation indicates that GMES will enable benefits significantly in excess of the levels of investment currently being discussed. These benefits are of a public good nature and relate to the opportunity to make significant cost savings over the next 25 years and beyond.

The three different categories of benefit have important implications for rolling out GMES. The most significant economic benefits are associated with the use of GMES information in achieving international cooperation in areas such as climate change adaptation, reduced deforestation and improved management of land degradation. However, these benefits will not be realised until 2025 due to the timescales implicit in setting up such policies. At the other end of the spectrum, some relatively modest (but still worthwhile) economic benefits can be achieved almost immediately with very little additional requirements on the capacity to deliver new information services.

This indicates elements of an implementation strategy that should look to provide a short term response to support the potential efficiency gains related to monitoring and reporting for current policies while progressively expanding the service portfolio to ensure that the information required by Europe to support its global role is available at the appropriate time. This gives time to ensure appropriate mechanisms are put in place to ensure that the benefits of these new European and international policies can deliver the expected benefits and impacts.

Finally, many of the benefits cited are dependent on the capacity that GMES brings to improve forecast information integrating diverse models and data streams. This is a significant added value that GMES brings over systems currently in place or under development today. It is clear that to ensure that the benefits in these areas (e.g. climate change, air quality, risk and civil protection, humanitarian aid), it is essential that GMES progresses as a truly integrated evolution of the four components. Many of the investments underpinning the developments of these components (in particular in-situ data sets, models and data assimilation, databases and decision support systems) are presently financed at national level. Continued coordination of these investments with the GMES components financed at European level must therefore be ensured.