Non-paper

EMSAs view on the GMES programme of EU and ESA;
in particular on the Marine Core Service
updated version

Introduction

GMES (Global Monitoring for Environment and Security) is the joint programme of the European Commission and ESA to provide future information services on environment and security needed for public use. GMES will be the European programme for Earth observation activities for the next decade which might provide relevant/needed imagery and services to EMSA:[1]

> *"The objective of GMES is to provide, on a sustained basis, reliable and timely services related to environmental and security issues in support of public policy makers' needs. GMES is an EU-led initiative, in which ESA implements the space component and the Commission manages actions for identifying and developing services relying both on in-situ and space-borne remote sensing data. GMES will use, to the maximum extent possible, existing capacities, be they national or European. This entails cooperation between the European Community, ESA and their Member States.* [2,3]*"*

The GMES concept is developing and certain elements are not fully defined. As a consequence GMES may be seen differently by the different stakeholders, such as EU, ESA, Member States and industry. In the light of the released call for tender for a Fast-Track-Service[4] to provide inter alia a Marine Core Service element (MCS), EMSA welcomes the report of the MCS implementation group[5] and wants to point out its view of, its contribution to, and its expectations of GMES.

---

[1] GMES bureau: Non-paper on "Sustainable GMES Governance", March 2006

[2] COM(2005)565 final "Global Monitoring for Environment and Security (GMES): From Concept to Reality" of 10.11.2005

[3] 3rd Space Council orientations of 28.11.2005

[4] FP7-SPACE -2007-1

[5] GMES Fast Track Marine Core Service Strategic Implementation Plan,
http://www.gmes.info/fileadmin/user_upload/Docs_Files/MCS_Strategic_Implementation_Plan_final.pdf

It is the aim of this paper to present EMSAs view on GMES and how further GMES services could be linked to the EMSA services for the benefit of Member States. EMSA expects that the MCS will provide important products for the EMSA CleanSeaNet service network.

The discharge of oil from ships, oil platforms and other sources causes significant damage to European coasts and to the marine environment in general. An effective response and combating mechanisms for both deliberate and accidental oil spills are necessary. A mechanism to strongly deter ship owners from releasing oil is an important part of the overall strategy. Both response and deterrence require an efficient, European monitoring system encompassing the following elements:

- Oil spill monitoring and surveillance should be performed on a wide-scale to detect potential spills with a high degree of certainty. Nowadays near real time SAR images from satellites provide the best opportunity to achieve this goal.

- Skilled interpretation of the SAR images is required to maximise the success rate of detection enabling the operational entities of the MS to be informed and take action, which may include the dispatch of aircraft to verify spills and ships to deal with them

- Forecasting and hindcasting models are activated to track the spills and to improve the response operations.

- Combination with ship traffic information will support identification of possible polluters

EMSA CleanSeaNet Service

The impact of oil pollution on the ecology of coastal and marine ecosystems and the species that inhabit them is particularly destructive following massive oil discharges caused by maritime accidents. Although oil discharges happen at regional scale the environmental damage can be of global concern.

Furthermore capacity is needed to detect any illicit spill for early and efficient oil spill response and for prosecution which will increase the deterrence. In the case of a major spill the response teams have to be supported with the best available oil location, drift and weathering information.

Directive 2005/35/EC on ship sourced pollution, and on the introduction of penalties for infringements, tasks EMSA to work with Member States to develop technical solutions and to provide technical assistance in relation to the implementation of the Directive. In line with this, the Agency provides the European operational CleanSeaNet service[6] (CSN) for oil slick detection based on satellite sourced synthetic aperture radar (SAR) images, which assimilates, harmonizes and distributes the required products to Member States. As their authorities are working differently, the data products have to be tailored according to the specific needs of Member States. The response activities require comprehensive information in an easy readable format by taking the individual coastal effects into account. It is the intention of CSN to provide all the information as a combined information package ("one-stop-shop") to support the time critical response activities. This service is aimed at supporting the response chain of Member States for locating polluters, and is offered to

---

[6] http://CleanSeaNet.emsa.europa.eu

authorities in all EU and EFTA states. CSN will be a sustainable service. It became operational in April 2007 and is under continuous development.

CleanSeaNet will supply analysed images from data provided by the European Space Agency's ENVISAT and Canada's RADARSAT satellites. The downloading, processing and analysis of the data and the supply of the resultant images is carried out by industry. Thus, there is coverage of EU waters several times per day and selected images can be ordered depending on the needs of each individual Member State. These may range from comprehensive coverage of a nation's offshore waters to the provision of selected images in perceived high risk areas. The processed and analysed information is sent simultaneously to the national authorities in the affected Member States and to EMSA. The time from data acquisition by the satellite to the receipt of processed information by pollution control authorities should not exceed 30 minutes.

Should the presence of pollution be suspected, coastal authorities can decide whether they wish to deploy aircraft or surface vessels to assess the situation in greater detail before deciding if there is a need for further action. If significant pollution is confirmed, the national operational response mechanism may be activated.

CleanSeaNet also has an important role to play in the case of a major accidental oil spill in EU or adjacent waters, at which time it will respond rapidly by providing analysed satellite radar images over the affected area. The International Charter for Space and Major Disasters provides a unified system of space data acquisition and delivery to those affected by disasters, and CleanSeaNet operates within the framework of the Charter.

EMSA has established a network of links to national and international organisations. For example, EMSA has an agreement with ESA concerning the use of space based earth observation for enhancing maritime safety. In addition, it has signed Memoranda of Understanding with the European Union Satellite Centre (EUSC) and with the Joint Research Centre of the European Commission (JRC) for the development of satellite based technology to support marine pollution monitoring and detection operations.

EMSA regards its CSN service as one of the first fully operational GMES services and represents a typical example of how GMES pre-operational projects transform into sustainable and operational GMES services.

EMSAs view of GMES

GMES will be "the" programme for the next decade which will provide relevant/needed earth observation and other data to EMSA. EMSA will enhance this information (value adding) to provide products to the EC and Member States (e.g. oil spill monitoring service) according to their request and requirements. EMSA regards the GMES applications as a collection of upstream and downstream services:

- The "upstream services" which will provide crosscutting, multi purpose data products and information services to be used by a wide user community of institutional users and intermediate users (incl. value adding services/industry).
- The "downstream services" which tailors the upstream service products to the end-user needs by integrating dedicated third party information and delivering the data according to the end user working practice.

Upstream services follow the principle of "<u>producing information once to use them many times</u>" for a multiplicity of applications (public or commercial). The upstream services will be the providers of the crosscutting information which many intermediary users/downstream services will use to tailor and assimilate according to the end-user benefits and their dedicated needs. Certification of products may help to improve their acceptance by operational users and as a legal evidence in court cases e.g. for prosecuting of polluters. It is not the primary intention of upstream services to deliver products to the so called "end user". Nevertheless some of the crosscutting products will be directly of value for end users as well.

The upstream services and in particular within the marine domain,

- assimilate data from space and in-situ sensors,
- calibrate instrument measurements, convert and interpret them to form geo-located estimates of geophysical, chemical or biological variables (i.e. generate level 2 data sets)
- assemble and quality control a subset of such data,

  perform pattern recognition,

  assimilate them in near real time into numerical models to generate analytical, hindcast, forecast products, and

  derive other products by data analyses
- produce off line archives of data of the highest quality and make them available
- disseminate the results to downstream service providers

Some of the upstream services will be defined as "Core", as they represent an important/vital element of GMES. The already mentioned "fast track services" are regarded as the first Core services elements, which will be implemented by the EU under the FP7 framework program in the first instance.

The refinement/finishing of the products and the delivery to the "end user" are then the activities of the downstream services which focus on very specific operational demands. Downstream services are:

- particular applications
- combinations and fusions of information (e.g geographic, socio economic and environmental data)
- tailor made models
- interfacing with specific systems for end-user accessibility

Downstream services today might become upstream services in future, as multiple uses are found for particular types of data, as meteorological services have shown in the past. Therefore the definition of these two service streams needs to be generic to provide flexibility in the future.

The concept of core and downstream services will also be reflected in the funding model. Whereas core services are under responsibility of the EU, it is expected that downstream services will be financed by European, regional or national sources corresponding to the service coverage.

The elements of the Marine Core Service (MCS) will be "the" service infrastructure for marine applications within GMES. But only the combination of both (upstream and downstream services) will finally provide to Member States full information as requested and will allow GMES to be successful as such.

According to the above definitions EMSA enables with its CSN service on oil spill monitoring and detection the provision of a full service chain for the Member States composed of upstream MCS elements and downstream services.

The service consists of the following upstream service elements as:

- Data acquisition planning based on coordination of Member States requirements

- SAR imagery itself (downloading and processing)[7] and

- pattern recognition.

EMSA of course is an intermediate user as well as it uses these upstream products also to provide enhanced and assimilated downstream products. The tailor made downstream services for the response entities in the Member States consists of:

- Alerting the MS of any potential oil spill combined with collateral information like sea wind, sea wave, current, etc.

- Links to vessel information as available

- And finally EMSA is able to support the MS in response capacities, if needed.

The "fast track services" for marine applications shall provide important products for the next EMSA service steps as they provide the basic oceanographic data which are necessary for modelling of the spill behaviour (weathering), hind-casting and forecasting[8]. EMSA regards itself to be an important user of the information and therefore it is requested that future MCS elements will adapt their portfolio so that EMSA needs can be fulfilled.

Complementarities and benefits of the EMSA CSN and the GMES marine services

To support the MS response chains and the collection of evidence a mature system of forecast, hindcast and oil weathering models tailored for the specific sea areas is necessary. This needs the integration and interaction of global, regional and local models, which are also operated nationally at different locations in Europe. EMSA would appreciate if future GMES marine services would contribute to EMSA services in such a way that the Agency is able to link the models to the EMSA CSN service products in order to provide the EC and the

---

[7] Generally speaking, SAR images are crosscutting products used by different downstream services to fulfil the dedicated end user needs. Therefore these crosscutting SAR products are classified as upstream services products. The near real time SAR images will further be used for vessel detection, fishery control, ice monitoring, sea surface wind determination, etc.

[8] Extract of the call: "The MCS will deliver regularly monitored and validated information on three-dimensional ocean state, dynamics and ecosystems, sea-ice with the spatial resolutions and timeliness of delivery chosen to meet downstream service requirements. Nowcasts, forecasts and analyses are covering a period of 20-50 years which will be produced and used to monitor and understand the changes in the state of the ocean. Indicators which summarise this knowledge will be developed."

Member States a comprehensive set of information for their activities for oil spill monitoring, surveillance and response.

The coming fast track services may provide several important service elements which would be beneficial for the existing as well as future EMSA applications:

CleanSeaNet:

> The <u>confidence level determination of derived spills</u> could be improved by using supporting visible imagery, sea state data (e.g. wind, wave), sea surface temperature and algae bloom information.

> <u>Advanced products, prosecution and response support</u> can be provided by using products for spill drift for- and hindcasting, meteorological and sea state information and weathering models of the spill. A more effective collection of evidence of potential polluters could be achieved by matching vessel tracking data with hindcasting and SAR imagery. This must be on timescales consistent with those of the SAR data processing.

Atmospheric pollution

> Dedicated remote sensing instruments allow mapping of <u>SO_x and NO_x on a regional spatial resolution</u>. The "Atmospheric Core Service", which is in the process of definition, might provide the requested data to monitor the air pollution originated by vessels. These Products are still in the development phase and need further specifications. EMSA is interested in an operational tool measuring these ship emissions in EU waters.

The existence and widespread advertising of such services will increase the likelihood of detection and prosecution and therefore act as a strong deterrent to would-be offenders.

Vice versa SAR data, which characterise the extent and structure of the spill at the sea surface could act as validation of drift and evolution predictions and provides a new source for subsequent predictions.

The existing EU-FP6 projects like MerSea, but also the ESA-GSE service elements like MarCoast can be seen as pre-cursor services as they are providing already pre-operational service elements and elements in development. EMSA would welcome a continuation of these existing service elements until they would become sustainable within GMES. E.g. the MarCoast oil spill monitoring service could be seen as a pre-cursor of the EMSA-CSN, but still MarCoast could provide with its validation exercises and service integration elements (AIS, algae detection, model integration) important services. When mature, these services should be available in the framework of GMES to EMSA for integrating them into the CSN service.

Furthermore the EMSA SafeSeaNet service might benefit from SAR based ship detection products. GMES can help to increase the safety of marine transportation by providing sea ice and sea state information, which again relies on SAR images. Therefore a synergy between the EMSA oil spill service and these data products should be capitalised.

EMSAs System Requirements

The continuous availability of SAR-satellite information is of the highest importance to EMSA to be able to provide a sustainable and mature service to Member States. Therefore the Sentinel 1 satellites (SAR) are regarded as a high priority system next to the Sentinel 3 (Ocean colour and temperature) satellite dedicated for oceanographic data[9]. To achieve the best monitoring results for oil spill monitoring C-band SAR with a resolution of 50 m and a wide swath width of 200 to 400 km is appropriate. Daily coverage of any sea area in Europe is the aim for providing an adequate European oil spill monitoring system. In order to satisfy coverage requirements of about 2 days revisit time at mid latitudes and about 1 day in the North, the Agency fully supports the ESA GMES Programme proposal assuming a sustained constellation with 2 satellites (Sentinel-1A and Sentinel-1B) operating in parallel with reliable and sufficient duty cycles. However avoiding unwanted data gaps, an extension of coverage should always be a priority.

GMES (in partnership with EMSA) could guarantee the basic earth observation data streams to support oil spill detection, polluter identification and support for response operations. The Agency expects from the coming MCS elements and fast track services support for:

- The provision of basic oceanographic data to enable operators to improve the quality of their oil spill identification working practices

    o Current, salinity, temperature analysis and forecast profiles with spatial samplings for regional seas

    o Wind and wave analysis and forecast profiles with performance levels equivalent to current European regional products

    o Bathymetry

- The provision of state of the art combined drift, weathering and impact modelling using regional sea models with appropriate atmospheric forcing terms for the Arctic, Baltic, North Sea, North West Atlantic, Mediterranean and Black Sea and adapted to coastal zones. Forecasting models are important tools for response operations. Hindcasting and intersection with ship traffic information (AIS, LRIT) should be available for Member States prosecution purposes, etc. This shall ensure:

    o Integrated long range drift forecasting and weathering

    o accurate boundary, initial and forcing conditions on local models used for high resolution oil spill evolution forecasting

    o Forecasts of beaching and prospective contamination of other marine assets at risk enable prioritisation of efforts to collect oil at sea and the selection of clean-up resources

    o Validation data on all oceanographic products provided and advice and training on the use of these products

---

[9] MCS Implementation Group Report – Chapter A3. Adopted Report from the Working Group on Space Infrastructure for the GMES Marine

Drift forecasting services are the first stage in cueing an emergency response to a major oil slick. These require high resolution models (approximately 1km) capable of forecasting the evolution of a large oil slick in 6 hour time steps out to a forecast time of 72-96 hours in advance. Their operation is typically performed by a specialist intermediate user. The MCS should link its products with the local, high resolution models operated by local agencies, intermediate users, and downstream service providers on a sub regional scale, to allow an uniform service throughout European waters. These local models (e.g. the Sea Track web service in the Baltic) must have therefore access to boundary conditions provided by regional sea models, operated by the MCS, to ensure accurate representation of oceanic conditions and effective characterisation of their effects on the oil slick (e.g. weathering, evaporation, advection, beaching etc). Access to geographic information of sensitive ecosystems, beach types and local infrastructure is also essential.

Implementation

The following describes how the CleanSeaNet (CSN) service chain and the GMES up- and downstream service concept could complement each other.

The full oil spill detection and information service chain (including interfaces and feedback function) consists of:

1. Data acquisition and near real time SAR processing
2. Pattern recognition (detection of the spills in the images)
3. Third party data analysis to improve the confidence of the oil spill detection
4. Oil drift modelling
   - Forecasting for response operation support
   - Hindcasting (back-tracking) for collection of evidence
5. Data fusion to provide the users with a complete and mature set of information

The EMSA-CSN service comprises today the elements 1, 2 and partly 3. The ground segment must ensure that SAR imagery for all European waters are processed and analysed within 30 minutes of the satellite overpass. The Agency requests a high priority in the delivery scheme (ordering) to ensure the sustained and regular data availability. As the latter is a vital criterion for the service the Agency will take the responsibility also within GMES to provide these oil spill detection service elements.

In figure 1 the different elements of the GMES concept and of CSN are visualised. The near real time SAR acquisition, processing and pattern analyses are due to its multi-use core service elements.
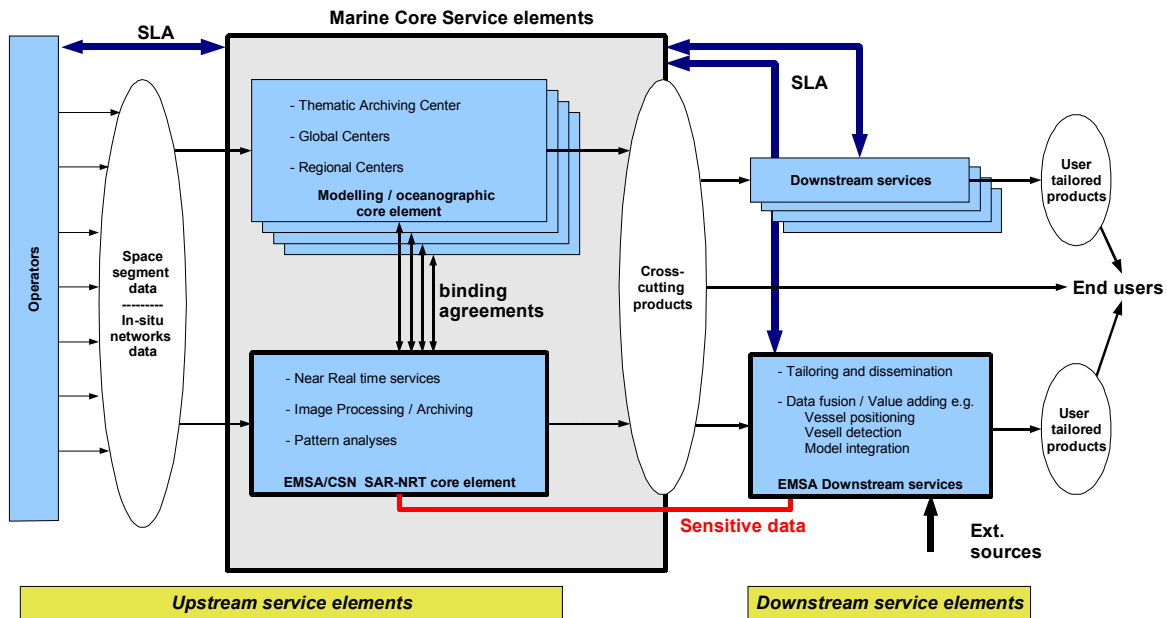

Figure 1 The MCS service elements. The circles identify the generic products and do not represent any institution handling them. The handling will be done by the processing service elements.

Whereas the imagery and feature extraction is a European core service, the tailoring and merging with other information (e.g. sea state and algae information) and models are typically downstream activities. The wide area coverage of space borne SAR imagery is unique and can not be obtained by classical aerial surveillance, which remains necessary for verification and response support. The sum of these complementary systems will contribute to a much improved surveillance capability.

EMSA will be an intermediate user as it will combine the core data products and will enhance this information (value adding) to provide products to the EC and Member States according to their requirements. A key role of EMSA will be fostering collaboration with the Member States in terms of collecting user needs, providing tailored information and, most important, to guarantee service quality, availability and sustainability of the oil spill detection and information service chain.

Standardization of GMES services and Harmonization of Data policy

The general situation regarding spatial information in Europe is one of fragmentation of datasets and sources, gaps in availability, lack of harmonisation between datasets at different geographical scales and duplication of information collection. These problems make it difficult to identify, to access and to use data that are already available. Therefore standardisation is a key issue to enable the cost efficient exploitation of data and information and is a prime indicator for a successful GMES service implementation.

It is desirable that GMES services comply with the directive on "Infrastructure for Spatial Information in the European Community" (INSPIRE)[10] to be able to provide the users with integrated spatial information services. Standardisation should cover elements like data format, resolution of the products (in time and space), quality but also the SLAs (Service Level Agreement: data policies regulating the access, pricing and term of use, penalties in case at non-performance) between the services themselves.

Based on former experiences and best practice an open data policy should be achieved for GMES recognised users, to make best use of the service products to the benefit of Member States users. Any data policy has to be established based on the "end-user" perspective. The data policies of the upstream services should be harmonized and should enable the downstream service providers to grant the rights to the "end-users".

Based on the experiences of the EMSA CSN service the following "end-user" rights (the rights shall apply to the original Data/Images/Products with associated metadata and on Derivative Works) might be duly considered:

- to make a copy of the "Products" for internal databases and archives or for backup purposes;

- to use the "Products" for further analysis and/or processing and/or to create higher level products;

- to modify/process the "Products" through manipulation/processing techniques and/or the addition of other data.

- to distribute the "Products" in uncompressed or compressed digital formats, on a non-commercial basis to the EU Organisations and EU Member States authorities or to International Organisations, involved in the same topic as the product receiving "end-user". It is acceptable, that any third party receiving the "Products" from end-users shall not be granted any right (in particular the right to reproduce and/or to distribute) on such "Products";

- "Further Processed Data" have been derived from the original data and have been produced by significantly and irreversibly modifying the original data. They are considered as "Further Processed Data" if they can, by no means, lead back to the original data. Any "Further Processed Data" should not be subject to any copyright and other intellectual or industrial property rights.

- Further processing and analyses activities of 'products' might be performed by a third party on behalf of the "end-user". The third party might be consultants, contractors or other non commercial public organisations. No rights, including copyright and other intellectual or industrial property rights, shall be passed on to these third parties.

- The "end-user" should have the right to publish all relevant data without any limitations by the service providers or MCS.

---

[10] Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), http://www.ec-gis.org/inspire/