WINDOW ON COPERNICUS

A *BRIDGES* PUBLICATION

Discover the Security dimension of Copernicus

FOCUS ON WHAT COPERNICUS CAN DO FOR THE SECURITY OF THE EU AND ITS CITIZENS

State of Play

Window on Copernicus unveils the state of play of Copernicus services for Security applications in the three main policy areas of: Border Surveillance, Maritime Surveillance and Support to EU External Action.

Opinions on Copernicus

Key stakeholders share their perspective on the Security dimension of Copernicus.

Progress Reports

The evolution of Copernicus services in the Security domain described by the main contributors to their transition into operations.

SPECIAL ISSUE

The Security dimension of Copernicus: getting ready for operational services

Every year, the world faces new challenges in the field of Security. Natural hazards, manmade disasters, international political crises and violent conflicts spur the need for coordinated actions and response mechanisms. The European Union is continuously seeking ways and means to counter both new and existing threats, and year on year the Security-related response capacities of the EU are improved, revisited or redefined. There are many tools which the EU can use to Security challenges; the Copernicus programme's services for Security applications, once operational, will significantly enhance the EU's information-gathering capabilities in the Security domain.

This special issue of *Window on Copernicus* sheds light on the fascinating and multi-faceted aspects of the Security dimension of Copernicus, reflecting the guiding principle of the *BRIDGES* FP7 project under the aegis of which this publication is being issued. *BRIDGES* (Building Relationships and Interactions to Develop GMES for European Security), an FP7 project coordinated by the European Union Satellite Centre (SatCen) which ended in early 2014, has evaluated options and scenarios for the future governance structure of Copernicus services for Security applications.

The year 2013 was pivotal in the life of the Copernicus programme as a whole, and for the services for Security applications in particular. The approval by the Council and the European Parliament of the Multiannual Financial Framework, which included a budget for Copernicus, was a major milestone of the programme. The successful delivery of results from Copernicus Maritime Surveillance projects (e.g. *DOLPHIN*, *NEREIDS*) and the commencement of two new FP7 projects aiming to deliver (*G-NEXT*) or further develop (*G-SEXTANT*) Copernicus services in Support to EU External Action, as well as the beginning of two FP7 projects (*LOBOS* and *SAGRES*) in the area of Border Surveillance, signal the entry into the final stages leading to the operationalisation of the Copernicus services for Security applications.

These elements are shaping the future of the services for Security applications which are expected to transition to operations over the next two years. The *BRIDGES* project partners have played an important role in mapping the high-level strategies required for their implementation, through in-depth consultation with key EU stakeholders. In this special issue of *Window on Copernicus*, the views of several of these authoritative representatives of European institutions and agencies, industry and national authorities are presented, shedding light on the Copernicus Security dimension and showcasing the latest developments in the field.

Our ambition is to provide you, as readers, with an easily accessible overview of the Security dimension of Copernicus, even for those without prior knowledge of the programme. We hope that you will be encouraged to follow its developments in this crucial phase of transitioning to operational services.

The team of the *BRIDGES* consortium

Copernicus demystified

THE COPERNICUS PROGRAMME (ONCE KNOWN AS GMES, FOR "GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY"), WAS CONCEIVED FIFTEEN YEARS AGO IN THE MINDS OF A FEW PIONEERS. THESE VISIONARIES, AWARE OF THE FUTURE CHALLENGES TO BE MET IN EUROPE IN ORDER TO PRESERVE ITS ENVIRONMENT AND GUARANTEE THE SECURITY OF ITS CITIZENS, WERE ALSO MINDFUL OF THE NEED TO ACT AT THE PAN-EUROPEAN LEVEL. THE GMES PROGRAMME WAS RENAMED COPERNICUS IN 2012, IN HONOUR OF THE GREAT EUROPEAN SCIENTIST AND OBSERVER NICOLAUS COPERNICUS.

Copernicus gathers, in order to share it, a vast amount of data about our environment and Security, accumulated from all over the globe, and born from years of fruitful research, that have enabled our common technological developments to reach maturity.

Born from years of fruitful research

Copernicus, previously known as GMES (Global Monitoring for Environment and Security) is the European Earth Observation (EO) programme which combines the use of satellite images and data with local, *in situ*, data sources to deliver geospatial information services and products to a wide range of end-users. It aims to achieve an autonomous and operational European capability in environmental and Security-related information services. The programme is being developed and funded by the European Commission (EC), whilst the development of the observation infrastructure is being performed under the aegis of the European Space Agency (ESA) for the Space component and of the European Environment Agency (EEA) and Member States for the *in situ* component. The information gathered and relayed by Copernicus helps to improve the management of natural resources, monitor the quality of water supplies, monitor and forecast air pollution, support urban planning and prevent urban sprawl, ease the flow of transportation, optimise agricultural activities and promote the development of renewable energy sources. Furthermore, Copernicus will improve the safety of nations and citizens in numerous ways, for example by providing early warning of natural disasters (such as floods and fires) and supporting the management of humanitarian or regional crises, thereby helping to prevent loss of life and damage to property.

One of the biggest challenges faced by the programme is to bring together a large number of very different datasets, containing data collected on the ground, at altitude by balloons or aircraft, from the depths of the sea or the surface of the ocean, by networks of probes and sensors, as well as from Space. These resources must then be made compatible with statistical data including, particularly, socio-economic information gathered for the European Union, its Member States and their Local and Regional Authorities.
The other great challenge is to be able to deliver the data and information to those decision makers and public authorities who are assigned the task of implementing policies or responding to crisis situations and who therefore need such information at the right time.

Enabling decision makers and users to access a myriad of information

The first Copernicus services have now entered into Initial Operations on the basis of the GIO regulation[1]; other services are being delivered in a pre-operational mode. They already enable decision makers and end-users – institutional as well as those from the private sector – to access a great deal of information, such as: the condition of our soils; the quality of the water we drink and the air we breathe, as well as the nature and degree of the pollution affecting them; the direction of marine currents and the level of the ocean's surface; the movement of animal populations and variations of the flora; the behaviour of airborne particles and the extent of the ozone hole; as well as the monitoring of glaciers and polar ice cover. All of this is Copernicus.

Ensuring that operators are prepared and equipped with such information will enable users to undertake urban planning for housing developments with management plans that are environmentally sustainable; control agricultural production and fish resources effectively; monitor the factors associated with pandemic disasters and their evolution more accurately, minimise the consequences of natural disasters more effectively, and even in some cases anticipate their occurrence and implement the necessary actions to mitigate them.

In the field, Copernicus services ensure that operators are better prepared and equipped to act during floods, forest fires and landslides, as well as marine pollution events and illegal dumping, and to provide more effective support for humanitarian missions responding, for example, to the impact of earthquakes, volcanic eruptions, tsunamis and famine. These services allow political decision makers and all of those responsible for safeguarding the security of citizens, to have the necessary data at their disposal during international negotiations.

At the national, regional or even local levels, these data will also be useful in enabling decision makers to fulfil their obligations more efficiently, and to improve the precision of their budgetary planning.

Other Copernicus services will be developed based on scientific or technological developments and with the provision of the necessary funding. Services at the European level respond to the collective needs of institutional agents, and address the more specific demands of end-users at the national, regional and local levels.

By giving Europe a leading role in the monitoring of our environment, Copernicus is an essential tool in the fight against the consequences of climate change. Eventually, Copernicus is also intended to give Europe a leading role on a global scale, in the monitoring of the environment.

Copernicus is a tool of international co-operation, following the example set by meteorological services, and constitutes the contribution of the European Union to the creation of a worldwide observation network, the Global Earth Observation System of Systems (GEOSS).

[1] GMES Initial Operations (GIO) refers to the period 2011-2013, during which the first GMES services became operational. The GIO Regulation provided a legal basis for the Initial Operations, and made available €107 million in EU funding.

Introducing Copernicus services for Security applications

THE CONTRIBUTION OF COPERNICUS SERVICES TO OPERATIONAL APPLICATIONS IN THE FIELD OF SECURITY HAS BECOME INCREASINGLY TANGIBLE AS A RESULT OF A DEDICATED STREAM OF RESEARCH APPLIED TO THE POLICY AREAS OF INTEREST. AS COPERNICUS SERVICES FOR SECURITY APPLICATIONS MOVE CLOSER TO OPERATIONS, THE APPLICATION DOMAINS OF THESE SERVICES ARE BECOMING MORE CLEARLY DEFINED.

The Copernicus services for Security applications aim to support the relevant European Union policies in the following priority areas[1]:

- Support to EU External Action
- Border Surveillance
- Maritime Surveillance

Support to EU External Action

As a global actor, Europe has a responsibility to promote stable conditions for human and economic development, human rights, democracy and fundamental freedoms. In this context, the key objectives are to assist non-EU countries in situations of crisis or emerging crisis, for instance by undertaking peacekeeping operations, and to address global and transregional threats leading to destabilisation, such as the proliferation of weapons of mass destruction.
Copernicus services can support EU External Action through the provision of rapid, on-demand geospatial information for the detection and monitoring of events or activities that may have implications for European Security. In addition, these services contribute to the improvement of crisis prevention, preparedness and response capacities, through the provision of more advanced geospatial intelligence and situational awareness.

One of the services developed in the framework of the Copernicus support to EU External Action is the monitoring of IDPs and refugee camps in non-EU countries (Camp Analysis). (Credits: European Commission)

[1] As defined in the Regulation on GMES and its Initial Operations. 'Regulation n. 911/2010 of the European Parliament and the Council of the 22nd of September 2010 on the European Earth Monitoring Programme (GMES) and its initial operations (2011 to 2013)'.

Maritime Surveillance

Europe has 70,000 km of coastline, belonging to twenty-two EU Member States. The safety and Security of the European Union and its citizens are thus inextricably linked to the sea and maritime surveillance is a key policy area for European institutions, agencies and bodies.
The aim of Copernicus support to Maritime Surveillance is to understand, prevent (where applicable) and manage the actions and events that can have an impact on maritime safety and Security, search and rescue, accident and disaster response, fisheries control, marine pollution, customs, border control, general law enforcement, as well as the economic interests of the EU.

One of the aims of the Copernicus services in support of Maritime Surveillance is to facilitate the implementation of countermeasures against illegal activities, such as piracy. (Credits: French Navy)

Border Surveillance

The protection of the EU's external borders is a corollary of the freedom of movement of people and goods inside the European Union and its Member States are all engaged in protecting the Security, the social and the economic interests at stake. In the area of Border Surveillance the main objectives are to participate in the reduction of the death toll of illegal immigrants at sea, in the prevention of cross-border crime and in decreasing the number of illegal entrants to the EU.

One of the aims of the Copernicus services in support of Border Surveillance is to improve the decision making and response capabilities of the authorities in charge of the control and monitoring of European maritime borders. (Credits: Frontex, 2013)

The Copernicus services in support of Border Surveillance will be contributing to the implementation of the European Border Surveillance System (EUROSUR) and are expected to enhance the effectiveness of high-time critical and low-time critical operations. The services aim to support the monitoring of border areas and to improve the decision-making and response capabilities of the authorities in charge of the control and monitoring of European maritime borders, for example by providing early detection of migrant boats.

SERVICES FOR SECURITY APPLICATIONS COPERNICUS

WINDOW ON COPERNICUS

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Interview with Philippe Brunet, Director of the 'Aerospace, Maritime, Security and Defence Industries Directorate' at the European Commission

THE DIRECTORATE G '*AEROSPACE, MARITIME, SECURITY AND DEFENCE INDUSTRIES*' IS PART OF THE DIRECTORATE-GENERAL FOR ENTERPRISE AND INDUSTRY OF THE EUROPEAN COMMISSION. WINDOW ON COPERNICUS ASKED ITS DIRECTOR, PHILIPPE BRUNET, TO REFLECT ON THE STATE OF PLAY OF THE COPERNICUS PROGRAMME AS A WHOLE AND OF THE SERVICES FOR SECURITY APPLICATIONS IN PARTICULAR.

Philippe BRUNET

The Big Picture

"Copernicus plays a very important role in the whole domain of Space policy, both as an operational programme in itself, and as part of wider European objectives."

Mr Brunet, you were appointed Director of DG Enterprise and Industry, Directorate G Aerospace, Maritime, Security and Defence Industries in January 2013. Could you please describe your daily activities and the role of your team in the context of Copernicus?

The day typically starts with a short co-ordination meeting with my team, i.e. my assistants and secretaries, organising the day's activities, planning ahead for upcoming events, and allocating tasks. My schedule continues with internal and external meetings throughout the day. In between professional obligations, I keep myself updated with the latest information on matters under my responsibility and discuss wider issues with other Commission colleagues. The Space industry, Security and Defence are areas which are constantly changing, as opposed to administrative matters, which by their nature tend to remain constant. The former areas, therefore, require continuous monitoring in order to be able to take informed decisions. My team works in close cooperation with colleagues dealing directly with Copernicus. It is a flagship industrial project for the whole of the European Union and we take a certain pride in our endeavour to make it work for the benefit of all European citizens. My Copernicus colleagues provide me with their specialised knowledge so that I can steer the deployment of Copernicus in the best possible way through an array of mainly unpredictable difficulties, whether administrative, political or institutional.

Since your appointment as Director, which have been the most important institutional developments affecting the Copernicus programme? In particular, how important is the decision to include the Copernicus programme in the 2014-2020 Multiannual Financial Framework (MFF), as opposed to adopting an intergovernmental approach?

The decision by the European Council to allocate funding for Copernicus was vital. Following the agreement for the Copernicus budget to be included in the MFF, the European Commission has had to deal with many different issues. The proposed budget of €3,786 billion is considerably lower than that originally requested by the Commission. Hence the challenge is to ensure the full development of the programme, even under these budgetary conditions. In the months following the MFF agreement, the Commission adopted two important legislative measures to better define the operational phase of Copernicus. Firstly, the new Copernicus Regulation, which will define the operational phase of Copernicus from 2014, has been submitted for consideration. In addition, a Commission Delegated Regulation on the Copernicus data and information policy was adopted by the European Commission in July 2013. The European institutions requested an extension to the deadline for discussion of this document until the 12th of November, since they recognised the importance of the subject and wished to ensure broad acceptance, taking account of diverse public and commercial interests. The Delegated Regulation entered into force on the 9th of December 2013.

Copernicus plays a very important role in the whole domain of Space policy, both as an operational programme in itself, and as part of wider European objectives. Moreover, we are dealing with a crucial phase for its implementation and we have made several steps forward in recent years. After my appointment, the Directorate also underwent a reorganisation to address the need for a better focus on Copernicus activities. This means having human resources devoted both to infrastructure issues and to the implementation of the operational services. The two units have to be well-coordinated to ensure that emerging issues are promptly dealt with and and that they deliver the complete set of services.

Could you describe the most important results and benefits of the Copernicus programme for the EU?

It is clear that the whole of the EU will enjoy benefits related to the programme's ability to closely and continuously monitor environmental conditions and their impact on everyday life. However, in addition there is an enormous potential for tangible financial benefits to EU states. The expected cumulative financial benefit to the EU's GDP has been calculated to be some €30 billion by 2030. Based on the latest envisaged Copernicus funding levels, approximately 12.000 direct jobs will be created and maintained by 2030, across the entire value chain. To this we also have to associate more than

36.000 indirect jobs, which sum up to a possible impact of some 48.000 jobs. These statistics are the result of external independent studies commissioned by the EC.

Copernicus can be seen as a driving force for creating highly skilled job opportunities, provided that long term data continuity is assured and the Earth Observation market potential is realised, with enabling factors in place (such as regulatory support, governance, federation / consolidation of user needs and industry requirements and commercially-optimised access to Earth Observation data).

To describe more specifically the unique opportunity Copernicus is giving Europe, one should focus on the new dynamic market that can be created in downstream Earth Observation services and derived applications. The estimated downstream market potential turnover attributable to Copernicus is €1.8 billion by 2030. Value-added services and applications developed from Copernicus data can improve the efficiency of specific sectors, allowing industry to offer better value for money in products and services to end-users.
Providing data for free to small innovative businesses will foster the entry into the market of new players and start-ups. A number of non-Space sectors can benefit from Copernicus, including water transport, oil and gas, non-life insurance, renewable power generation and agriculture.

The availability of new technologies and information sources can trigger additional benefits, known as R&D "spill-overs". These are related to the positive economic effects stemming from the transmission of newly-created knowledge and technical capabilities.
Security dimension

"By aggregating Space and *in situ* data observations over land and seas, Copernicus can contribute to Security intelligence needs."

What are, in your view, the major contributions of Copernicus to the Security of the EU and its citizens?
After the workshop on the Security dimension of GMES, held in 2007 at the Institute for Security Studies in Paris, we worked extensively with users and decision-makers to assess their needs and raise awareness of Space observation capacities for Security applications, in close cooperation with the European Space Agency and Member States. We are also addressing the key aspect of cooperation between stakeholders and Agencies such as Frontex, the European Maritime Safety Agency (EMSA) and the European Union Satellite Centre (SatCen). Cooperation agreements are being gradually put in place; these are vital for streamlining the provision of information related to Security needs in different areas.
In support of Border Surveillance, observations from Space are now an integral part of the monitoring capacities to be used in the frame of the recently adopted EUROSUR regulation. Two validation projects, *SAGRES* and *LOBOS* are active until end of 2014, in close cooperation with the European border agency, Frontex and Member States. This will allow the fine-tuning of service delivery in line with operational needs.
In support of actions outside the territory of the EU, we have extensively consulted with services supporting development programmes, humanitarian aid and civil protection. We have also consulted with the Common Foreign and Security Policy (CFSP) and with the Common Security and Defence Policy (CSDP) operations, working closely with the European Union External Action Service. The project *G-NEXT* just started to deliver pre-operational services to users. Timing is critical, as user uptake is a precondition to a successful operational phase. Potential operators and industry now have a unique opportunity to show that user operational needs can be matched by operational service delivery, after the demonstration exercises undertaken by a multitude of R&D projects during the past decade.

Last but not least, we are working closely with DG MOVE, DG MARE, EMSA, the European Space Agency (ESA) and Member States to identify the needs of maritime communities, contributing to the EU Common Information Sharing Environment strategy (CISE) being put in place for the maritime domain. Recommendations are expected by the end of the year, with the aim to have operational Maritime Surveillance services by 2015.

What is the added value of an EU-wide approach to Security-related geo-information?
By aggregating Space and *in situ* data observations over land and seas, Copernicus can contribute to Security intelligence needs. This has been demonstrated through a series of EU and national R&D projects, in particular in the domains of Maritime and Border Surveillance, humanitarian aid, conflict early warning and prevention, or monitoring of compliance with treaties. However, we need to bear in mind the technical limitations of observations from Space, such as satellite revisiting time, geospatial resolution or cloud coverage, which often do not match user requirements for operational needs. That makes Space-borne data a complementary source of information that has to be merged with other data and sources of intelligence, to bring added-value to the final user.

When are the Copernicus services for Security applications expected to become operational?
Operations are intrinsically related to user uptake and the maturity of the technology, but also to financing mechanisms and governance issues. EU research and development framework programmes have been a vehicle for research and pre-operational demonstrations, and operational validation is ongoing. The proposal for a regulation on Copernicus anticipates the delegation of operations of Border and Maritime Surveillance to Frontex and EMSA, so that it would be possible to move to full operations in these areas by 2015, as governance aspects are relatively clear. Services relating to CFSP/CSDP are still being analysed and governance models are being evaluated

Copernicus services for Security applications will play a crucial role in the Maritime Surveillance policy area. (Credits: Frontex)

before operations can begin. Synergies with the Emergency Management service are also being considered. We hope that options will become clearer by mid-2014, when recommendations are expected based on the experience gained through ongoing pre-operational projects and settings.

How will the operationalisation of the Copernicus services for Security applications affect the governance structure of the programme?

The overall governance of Copernicus is laid out in its regulation, which also foresees the possibility to delegate management and operations to suitable bodies. As with any other Copernicus service, the governance of Security applications will have to be compliant with the overall governance of the programme and adapted to the constituencies of the communities they will be serving. While in some cases this will be relatively straightforward, such as in Border Surveillance, where governance elements are embedded in the regulation, in other areas the task can be more challenging. However, specific adaptation is definitely necessary before any delegation of operational responsibilities.

Future steps

"The European Commission, together with all the involved partners, has to ensure that all the services become fully operational and start providing information and products for users on a routine and assured basis."

In September 2012, a survey[1] conducted by Eurobarometer reported that 61% of EU citizens were not aware of the existence of Copernicus (GMES at the time). Do you think this trend is changing, and if so, how?

Raising awareness of the Copernicus programme plays a key role in the successful implementation of the programme and that is definitely a challenge. The Flash Eurobarometer on Space activities carried out in 2012 indicates that almost four out of ten Europeans have heard of GMES (38%). This is a positive development, given that the Eurobarometer on Space activities conducted in 2009 found out that less than a quarter of Europeans (22%) were aware of the European Earth Observation satellites. Moreover, Copernicus was still in its pre-operational phase at the time. Currently two of the Copernicus services are already operational: the Copernicus Land Monitoring service and the Copernicus Emergency Management service. By the end of 2014 the Copernicus Marine Environment Monitoring service and the Copernicus Atmosphere Monitoring service will be fully operational. Copernicus evolved from being a research project to being a reality. Therefore, we can now show the benefits and opportunities that these systems can deliver for Europe. A first positive confirmation is that the number of users of the Copernicus services is rapidly increasing. Just to give you an example, in September 2012 the Copernicus pre-operational marine service had 1.475 registered users, in May 2013 it had 2.338 registrations.

Furthermore, in June 2012, the European Commission launched the European Space Expo, an exhibition that focuses on interactive and educational demonstrations of specific applications and benefits offered by the European Space Programme of which Copernicus is part. To date, the exhibition has travelled through 17 European cities. Almost 360.000 European citizens have visited the exhibition to see the benefits of Copernicus in action.

[1] http://ec.europa.eu/public_opinion/flash/fl_355_en.pdf.

In parallel to this public initiative, there will be important actions to stimulate wider research into the use of Copernicus Sentinel Data through the Horizon2020 work programme. Every opportunity will be taken to raise awareness of Copernicus and to stimulate the development of value-added services and applications.

From your point of view, what are the drivers for the success of the Copernicus programme in the coming years?

The European Commission, together with all the involved partners, has to ensure that all the services become fully operational and start providing information and products for users on a routine and assured basis. This will be the best way to demonstrate to the users the potential and the reliability of the programme. An important transition will, of course, be marked by the launch of Copernicus' own satellites, the Sentinels, starting in 2014. They will grant the European users the delivery of continuous and independent data on the state of the planet and very important information in case of emergencies or for Security issues.

Other crucial factors for the success of Copernicus are the user uptake and the development of value-added services from downstream stakeholders. I refer in particular, to SMEs which are called on to invest in services based on

The European Space Expo is the travelling exhibition showcasing the benefits of the European Space Programmes. So far the exhibition has visited 17 cities around Europe. (Credits: SpaceTec Partners)

Copernicus data, either to improve their business or to enter the downstream part of the Earth Observation market and deliver services to other final users. European citizens should also be involved in taking advantage of free Copernicus data providing information on the environment. Not only will decision-makers benefit from having access to accurate data on which to base their policies, but those directly affected by the impact of those policies will have the opportunity to verify the effectiveness of such measures by scrutinising the data themselves.

Do you believe the Copernicus programme would help in reinforcing the EU's role (and image) on the global stage? If yes, how and why?

The Copernicus programme is a revolution in the European Earth Observation domain, both technically and because it is building an autonomous European strategic capacity in monitoring the state of the planet and because it is better able to manage European natural environments and resources. The huge amount of information that will come

from Copernicus data and services will be a unique tool to support policy making and a very important stimulus to innovation in a number of different sectors, not just for those directly related to Space. The European Union's role is crucial in guiding its development and will result in an important step forward not just in the citizens' eyes but also on the global stage. The programme will of course give rise to a number of occasions for international cooperation and the Union will also play an important role in providing tools for the international community to better respond to emergencies and crises.

Worldwide it is really important for the European Union to take the role it deserves in Earth Observation, alongside all the big international players. With our monitoring capacity we will provide the scientific community and public authorities with an invaluable and reliable source of data on the state of the planet. Most importantly, this information will be accessible for the private sector and citizens as well, fostering the development of innovative downstream applications. As a result there will be plenty of benefits for European citizens, both in terms of services and in terms of turnover and jobs.

Philippe BRUNET has been the Director of Directorate G (Aerospace, Maritime Security and Defence Industries) of the European Commission's DG Enterprise and Industry since January 2013. Both a Doctor in Medicine (MD) and Iuris Doctor in Community Law (LLD), he joined the Commission in 1988 (DG V - Social Affairs). He then moved to DG III (Industry) in 1993 to help in establishing the EMEA (European Medicines Evaluation Agency, now the EMA) and to complete the legal framework of the EU authorisation scheme for medicinal products. In 2004 he became the Deputy Head and then Head of Cabinet of the European Commissioner for Health and consumer affairs, Markos Kyprianou. Following the resignation of Mr Kyprianou to become the Minister of Foreign Affairs for the Republic of Cyprus in February 2008 and his subsequent replacement by Mrs Androulla Vassiliou, Mr Brunet was appointed as Head of Cabinet as of March 2008. On the 10th of February 2010, when Mrs Vassiliou took over the position of Commissioner for Education, Culture, Multilingualism and Youth in the Barroso II Commission, she selected Mr Brunet to become the Head of her new Cabinet.

The Security dimension of Copernicus

by Arnaud Danjean

IN MATTERS RELATING TO THE COMMON SECURITY AND DEFENCE POLICY (CSDP), THE EU HAS ALWAYS STRUGGLED TO DEFINE A STRATEGY ENCOMPASSING CAPABILITY GOALS THAT ARE BOTH AMBITIOUS AND REALISTIC. WHEN CONSIDERING THE LINKS BETWEEN COPERNICUS AND THE CSDP, THE DEBATE NEEDS TO BE ENSHRINED IN THE BROADER ACKNOWLEDGMENT THAT SPACE ASSETS ARE ESSENTIAL DEFENCE AND SECURITY CAPABILITIES.

Copernicus: a relevant tool for our Security and Defence.

"The EU has only very recently engaged in formulating an EU Space Policy, whilst acknowledging the strategic importance of Space instruments and facilities for Europe."

Satellite systems can and must constitute one of those fields where the EU asserts itself as an industrial and technological actor – as it does today – but also where the EU imposes itself as a strategic actor. To that end, the Security dimension of satellites must be promoted: it is an indispensable investment if the EU wishes to play a role that lives up to the expectations of its citizens.

The EU has only very recently, with the implementation of the Lisbon treaty, engaged in formulating an EU Space Policy, whilst acknowledging the strategic importance of Space instruments and facilities for Europe. Accordingly, the EU has consolidated a common Space policy focusing on three main objectives: 1) coordinating Member States' civilian Space programmes, 2) supporting the industrial and technological base in terms of Space activities, and 3) developing EU level Space programmes. The European Commission has, in accordance with the third goal, launched several Space programmes, two of which are particularly noteworthy: Galileo, aiming to create an EU global satellite navigation service, and Copernicus, which is also widely known by its former name GMES – Global Monitoring for Environment and Security.

GMES, launched by the European Commission in 1998, was intended to provide reliable information concerning environmental security, thanks to satellite Earth Observation capabilities (GMES initially meant Global Monitoring *for Environmental Security)*. One year later, the programme was renamed "Global Monitoring *for Environment and Security*", and from then on included a Security element, distinct from environmental issues. Throughout the years, a Security dimension therefore progressively emerged, recognising a natural link between EU Earth Observation (EO) capabilities and Security on the ground. In 2012, the programme was renamed Copernicus, and was officially designed to develop an independent European Earth Observation capacity to deliver services in the Environmental and Security fields[1].

[1] Proposal for a regulation of the Copernicus Programme (2013), art. 2(d).

Conceptually and institutionally, there is therefore continuity between GMES and Copernicus, with the development of a clear Security dimension within the programme.

Copernicus and CSDP – State of Play

"A large number of projects have been developed and designed establishing a clear link between Space assets and the EU's Security and Defence sectors."

The mandate of Copernicus is to provide at all times, thanks to satellite Earth Observation, accurate and reliable data on environmental and Security issues to different users within the EU. It is substructured into six different services with one of them being dedicated to 'support to Security'. From the start, the Security component of this programme has been loosely defined. In 2002, 'Security' encompassed: crisis prevention and crisis management, humanitarian aid and international cooperation, compliance with international treaties, peacekeeping operations and border control activities. This broad definition did not become any clearer over time with the 2002 definition[2] being recalled in the 2013 proposal for a regulation establishing the Copernicus Programme. This resulted in the same level of inaccuracy in the wording of the proposal and the same lack of clarity for the Security actions it was designed to support.

Whether GMES or Copernicus, the programme has developed a range of projects linked to Security and Defence issues, and has done so within a three pillar structure encompassing a wide array of Security actions: support to Border Control, support to the EU External Action Service (EEAS), and finally support to Maritime Surveillance. Several projects have made services available, notably in the field of Border Surveillance where they are effectively used by the EU External Border Security Agency (Frontex). But in terms of support to the EEAS, and therefore to the Common Foreign and Security Policy (CFSP) and the Common Security and Defence Policy (CSDP), much remains to be done. Different projects within GMES and then Copernicus have indeed been designed to support the EEAS. "*G–MOSAIC*" (GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises), for instance, was a research project that worked on the development of Space technologies responding to the operational needs of Defence and Security agencies. Of great interest to the CSDP, *G-MOSAIC*'s Security and Defence dimension was based on providing the EU and its Member States with intelligence data that could be applied to "early warning and crisis prevention" as well as to "crisis management and rapid interventions" around the world. The project even researched a Contingency Plan Preparation service providing optical and radar satellite image data aimed at preparing civil and military operations.

On the lessons learned from *G-MOSAIC* (that ended in 2012), Copernicus launched two new research projects: *G-NEXT* and *G-SEXTANT*. *G–NEXT* in particular works on the supply of information and intelligence data in support to – as clearly stated in its mandate – the *operations* of the EEAS.

Hence, within Copernicus, a large number of projects have been developed and designed establishing a clear link between Space assets and the EU's Security and Defence sectors. The Copernicus services dedicated to the support of the EEAS policies are unfortunately not yet operational: they are still a work in progress. Those projects surely cannot be considered as negligible, but Copernicus needs, in order to efficiently support the EEAS and the policies it manages, to evolve to the next step: the operational phase. As a matter of fact, Copernicus information and data have so far barely been used in support of CSDP operations.

Copernicus: a very useful tool for CSDP

"Copernicus could provide at EU level the much needed geospatial intelligence and situational awareness enabling us to prepare, to respond and to manage crises more efficiently."

The relationship between Space and Defence issues is growing even closer. Recent military interventions and EU operations (notably EUTM[3] Mali and EUBAM[4] Libya), have shown how important modern Space technologies are. Space assets are crucial for conducting military and civilian operations on the ground: indeed, satellites have become indispensable for the gathering of precise intelligence providing us with the ability to observe, to listen, to communicate and to disseminate information; all of which are essential capacities to ensure the safety of our troops and guarantee the efficiency of operations. The creation of the European Union Satellite Centre (SatCen), which

Satellite-based technologies support EU missions, such as the European Union Monitoring Mission (EUMM) in Georgia. In this picture, EUMM members of staff in their daily work. (Credits: EUMM Georgia)

provides geospatial intelligence services to the CSDP through the use of national Space assets, proves that Space assets are critical for Security and Defence issues. As a matter of fact the EU SatCen plays an active role in the conduct of CSDP operations. In terms of military operations, it provides for instance, satellite services to EU NAVFOR[5], the EU naval operation aimed at fighting piracy in the Gulf of Aden. Thanks to the satellites made available by some Member States, the EU can control and detect all naval activities and efficiently deter pirates in the area. In terms of civilian missions, EUMM[6] Georgia for instance is also heavily reliant on SatCen's satellite assets (imagery, mapping, etc.). This mission is dedicated to the monitoring of the borders between Georgia and its two separatist provinces of South Abkhazia and South Ossetia (secured by Russian Border Guards). In this case, Space assets are particularly determinant since they provide unbiased information that facilitates

[2] This definition was refined in the ISS (Institute for Security Studies) Workshop 'GMES: the Security Dimension' held in Paris on the 16th of March 2007.

[3] European Union Training Mission

[4] EU Border Assistance Mission

[5] European Union Naval Force

[6] European Union Monitoring Mission in Georgia

Certain EU operations, such as EU NAVFOR, are heavily dependent on satellite data. (Credits: EU NAVFOR)

peaceful negotiations between the parties involved. I personally visited both EU NAVFOR and EUMM's Operational Headquarters (OHQ) in Northwood (UK) and in Tbilisi (Georgia), respectively. On those occasions, I had the opportunity to see with my own eyes how both operations are heavily dependent on satellite data.

Hence, since the usefulness of satellites is openly recognised in EU Defence and Security matters, why not ensure that the EU has its own satellite capabilities? Copernicus, based on the experience gained through its research projects, could serve as a complement to the national Space capabilities available through SatCen. Copernicus could provide at EU level the much needed geospatial intelligence and situational awareness enabling us to prepare, to respond and to manage crises more efficiently.

In the wider context, the formulation of a strong EU Space policy will allow the EU to act independently with autonomous Space capabilities. Copernicus is certainly the most ambitious of all EU programmes, facilitating the development of EU Space technologies. The operationalisation of Copernicus services on the basis of the EU's research projects, for instance the 'contingency Plan Preparation', the 'Event Mapping', or the 'Critical Assets' detection would for instance, represent a great step forward for the EU as an autonomous power. Having independent capabilities is particularly significant within the current international context: with growing uncertainties and multiple threats, the EU needs to be able to make decisions and to act using only its own means. We are already on the right path with the evolution of Galileo. In the future, for highly sensitive political decisions – such as the launch of military and civilian operations – the EU will be able to substitute Galileo for the American GPS (Global Positioning System) that it uses today. EU Space policy should continue to work towards the development of independent Space capabilities, and this can be achieved through the operationalisation of key projects and services that are developed within Copernicus. This is the only way to guarantee the autonomy of the EU, especially in Defence and Security matters.

Finally, the development of a strong EU Space policy represents another asset for the CSDP: it ensures, in the context of tight budgetary constraints, a better synergy between civilian and military means. Such an enhanced synergy would be particularly convenient in the context of the CSDP, which serves both civilian and military objectives. This could be ensured in two different ways: firstly, by pushing for more permanent structured cooperation between Member States (particularly because Space military capabilities remain their prerogative), and secondly, by promoting the dual use of Space technologies (guaranteeing that the tools made available can be used for both military and civilian purposes). Copernicus is a good illustration of a Space programme that relies on a civ-mil dimension. Promoting the development of Copernicus Security services and their operationalisation is without doubt, the best way to promote the dual use of Space technologies.

Promoting cooperation and the dual use of Space capabilities also avoids duplication and consolidates the European industrial and technological base. Maintaining a strong position in Space is both beneficial for Europe's Security and for its economic purposes.

Conclusion

In the wording of Article 189 of the Treaty on the Functioning of the European Union, the EU Space policy acts as a support to all other EU policies. Consequently, it is also designed to support – as fully-fledged EU policies – the CFSP and the CSDP. As discussed, an effective EU Space policy would greatly benefit the EU CSDP. The links between Defence and Space policies are yet not evident within the EU where the civilian and the military spheres are almost always mutually exclusive.

Copernicus is no exception to the contradictions in the work of the EU as a whole: it is an ambitious programme which incorporates a Security dimension, and yet its support to EU Defence and Security policies remains the exception rather than the rule.

Much remains to be done for Copernicus to effectively support EU Security and Defence policies. Furthermore, the programme will be irrelevant for the Defence of the EU if it confines itself to performing research on hypothetical services. These services need to materialise and become operational, pushing for the progressive acknowledgment that yes, EU instruments and tools are efficient and ready to be used for EU policies, even for the CSDP. What is indeed quite absurd, is that the EU finances projects, but those projects are not translated into providing concrete support to the policies they are created for. In the frame of the financial crisis and of the budgetary constraints faced by Member States, this is even more nonsensical.

All in all, Copernicus is another illustration that the EU is often willing to provide the ends but not the means, a sad EU habit when it comes to the CSDP. Member States should reconsider the links between EU Space policy, and especially Copernicus, and the CSDP. Copernicus is a promising programme for the EU Security and Defence policies, and it clearly has the capacity, and the rationale, to be used effectively as a support to the CSDP.

Arnaud DANJEAN was elected as a Member of the European Parliament (EP) in 2009, and is a Member of the EP's Foreign Affairs Committee and Chairman of the EP's Subcommittee on Security and Defence (SEDE). He graduated in political sciences and international affairs from the Paris Institute of Political Sciences (IEP) in 1993. Between 2005 and 2007 he became a personal adviser to the French Minister for Foreign Affairs for South-Eastern Europe and Afghanistan. He also served as a civil servant within the French Ministry of Defence from 1994 to 2002, with numerous postings in the Balkans (Bosnia-Herzegovina, Kosovo) and as adviser to the head of the French External Intelligence Directorate (DGSE) from 2000 to 2002. He was awarded the "Ordre National du Mérite" in 2000.

Use of geospatial services for CSDP missions and operations in the "Multilayer 2012" exercise

by Lieutenant Colonel Manuel Garcia Ortiz, Augusto Alves and Alessandra Ussorio

THE MISSION OF THE EUROPEAN UNION MILITARY STAFF (EUMS) CONCEPTS AND CAPABILITIES DIRECTORATE'S IS TO BE RESPONSIBLE FOR EUMS CONCEPTS, DOCTRINE, CAPABILITY PLANNING AND CAPABILITY DEVELOPMENT INCLUDING CRISIS MANAGEMENT EXERCISES, TRAINING, ANALYSIS AND LESSONS LEARNED, AND FOR COOPERATION WITH THE EUROPEAN DEFENCE AGENCY.

The European Union launched its seventh Crisis Management Exercise in 2012. Multilayer 2012 (ML 12) was organised by the European External Action Service (EEAS) and took place between 1st and 26th of October. The Managing Director for Crisis Response and Operational Coordination, Mr. Agostino Miozzo, was responsible for the implementation of ML 12 (Official Conducting the Exercise – OCE), acting under the authority of the High Representative of the European Union for Foreign Affairs and Security Policy and Vice President of the European Commission, Catherine Ashton. For the first time, ML 12 involved all levels of decision-making, from the political-strategic to the operational level. The aim of the exercise was:

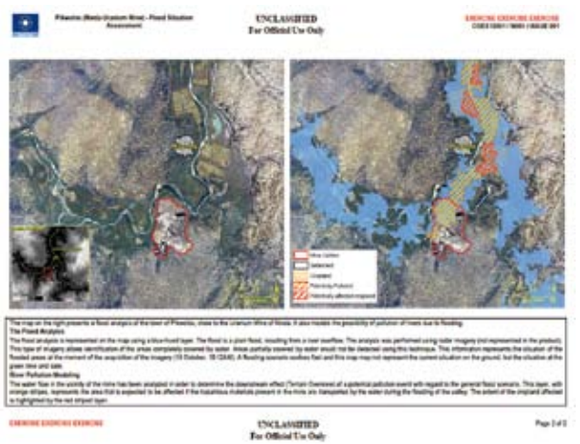
- To test and evaluate the Common Foreign and Security Policy (CFSP)/ Common Security and Defence Policy (CSDP) crisis response and management structures and their interaction with the full range of EU crisis response mechanisms. This exercise was designed to assess the institutional competence and roles and responsibilities of the respective actors, with a view to improving the EU's capacity to manage crises in a comprehensive manner, including EU decision-making and planning processes, as well as operational capabilities;
- To critically assess any new crisis response and management procedures, and the interaction and coordination within EU institutions;
- To deepen the understanding of EU crisis response amongst decision-makers and staff in the EU, including Member States.

Port Recuria – Analysis of Port; the product provides an analysis of the port of the fictitious state of "Recuria" and information on its status. (Credits: © EUSC 2012)

"It has been a complex but remarkable exercise conceived in the context of the comprehensive action that the EU is developing to manage crises in its External Action framework. It required several months of preparation for the actors involved (the training audience or "players"): EEAS – including some EU Delegations, services of the European Commission (EC), the Council, and Member States.
One of the objectives of ML 12 was to exercise the EU crisis response system in a simulated crisis situation requiring a military operation as well as a civilian mission in the framework of CSDP, deployed in the same Area of Operations (AOO). In addition, other EU crisis response and management capabilities were deployed, in order to gauge the effectiveness of the roles and responsibilities of the respective actors.

The focus of the scenario was the post-conflict situation which the fictitious states of "Nusia" and "Recuria" were faced with, in the context of a Security threat and a humanitarian crisis, in a region bordered by a high number of other neighbouring countries. Border delimitation, the security of critical assets (public infrastructure), floods, landmines and maritime piracy were among the elements addressed by the scenario.

The European Union Satellite Centre (SatCen), which supported the planning activities of the organisations involved in ML 12 (in particular Operational Headquarters (OHQs), Force Headquarters (FHQs), the Directorate General for Humanitarian Aid and Civil Protection), produced the background geospatial information for the scenario and developed a prototype geo-portal through which players were able to gain remote access to centralised information. Products were also provided in response to specific requests from users, such as information on the status of a major port in "Recuria", or on events such as a flood in the city of "Pikwolos", situated in close proximity to a uranium mine in "Nixda".



Pikwolos – Flood Situation Assessment; the product shows the impact of a flood in the fictitious city of "Pikwolos", situated close to a uranium mine in the "Nixda" state. (Credits: © EUSC 2012)

The main objectives of the exercise were to test the EEAS Crisis Platform and to review the EU Crisis Management Procedures in order to accelerate and improve the effectiveness of CSDP planning, decision-making, execution and evaluation. An initial outcome was the development of the Comprehensive Approach, with strengthened modalities and interactions between stakeholders.

ML 12 clearly contributed to a better understanding of the complex requirements necessary to maintain an adequate level of interaction and synchronisation between the various actors throughout the planning of a comprehensive response to a crisis. The exercise also provided an opportunity to further refine and shape the EU Crisis Response and Crisis Management services.

ML 12 was more than just a planning exercise since operational coordination and decision-making capacities were also exercised. This work will help to improve CSDP procedures and structures, providing a model for future exercises.

Having representatives from SatCen involved in directing the exercise and being responsible for coordinating the geo-data cell allowed us to explore the potential use of Copernicus services in Support of External Action for CSDP missions and operations. This potential seems to be very promising and the final considerations derived from this experience will be reported to the EC through the BRIDGES *(Building Relationships and Interactions to Develop GMES for European Security) project.*

The multi-layered and comprehensive approach should be extended to the EU geospatial information services available, enabling the EU to harmonise resources and maximise support to missions and operations."

Lieutenant Colonel (ES MC) Manuel Garcia Ortiz, Chief of Staff of the ML 12 Directing Staff
EXE/TRG/ANL Branch
Concepts & Capabilities Directorate, European Union Military Staff, European External Action Service

A screenshot of the geo-portal through which players had remote access to centralised information. (Credits: © EUSC 2012)

Lieutenant Colonel Manuel GARCÍA ORTIZ is a highly distinguished Spanish General Staff officer with extensive national and international experience. He was appointed to the EU Military Staff (EUMS) between August 2010 and July 2013 as the Action Officer in the Exercise, Training and Analysis Branch of the Concepts and Capabilities Directorate. He has been involved in many EU missions and Crisis Management exercises, including acting as an Advisor on Crisis Management Procedures to the Director General's Task Force on NATO Comprehensive Operations Planning Directorate and participating in the Core Planning Team for Libya. In 2008, he participated in the EU Operation ALTHEA as Deputy Commander of the Multinational Battalion based in Camp Butmir (Sarajevo). In 1999, he was appointed as the Team Monitor in the EU Monitor Mission in Kosovo.

Augusto ALVES has been the Vector Database Manager at the European Union Satellite Centre since August 2010 where, among other tasks, he develops the geo-data required for generating simulated scenarios used in EU training exercises. He joined SatCen in January 2005 as an Image Analyst, following three years of service in NATO's Joint Command unit in Lisbon (JC Lisbon). Mr Alves has a post-graduate degree in Science and GIS from the NOVA School of Statistics and Information Management from the University of Lisbon, and has also completed many other specific GIS related courses. At JC Lisbon he developed many unique skills in the field of Geographic Information Systems (GIS) specialising in simulated exercise scenarios and Environmental Fusion Capability and providing operational support for Web Mapping Services. Before joining JC Lisbon he was based at the Portuguese Army Geographic Institute.

Alessandra USSORIO has been a Project Coordinator in the Capability Development Division at SatCen since 2006 and is Deputy Head of the Copernicus Unit, currently responsible for the Support to EU External Action activities. She holds a Master's Degree in Computer Science, and in her earlier career, worked for six years as a Senior I.T. Analyst, and also as a Scientific Officer in the Nuclear Safeguards Unit at the Institute for the Protection and Security of the Citizens (IPSC) in the Joint Research Centre (JRC). She participates in the Working Group for Support to External Action driven by DG ENTR and is also involved in studies carried out by the European Defence Agency (EDA) and the European Space Agency (ESA) as an expert.

The state of play of the Security dimension of Copernicus

by Dimitrios Papadakis

COPERNICUS STANDS TO MAKE AN IMPORTANT CONTRIBUTION TO THE SECURITY NEEDS OF THE EUROPEAN UNION, ITS MEMBER STATES AND CITIZENS THROUGH THE DEVELOPMENT OF SERVICES FOR SECURITY APPLICATIONS. SERVICE DEVELOPMENT HAS TAKEN PLACE THROUGH A SERIES OF RESEARCH PROJECTS AND SERVICE DEMONSTRATION ACTIVITIES CHARACTERISED BY EXTENSIVE ENGAGEMENT WITH USER COMMUNITIES. WITH EU FUNDING SECURED FOR THE NEXT SEVEN YEARS, SERVICES ARE EXPECTED TO BECOME OPERATIONAL IN 2015.

As a flagship programme of the European Union (EU), Copernicus is designed to support European Union policies through the timely provision of geo-information products and services. Copernicus services for Security applications (the "S" in GMES[1], as the programme was formerly known) support European Union activities in the context of policies such as the Common Foreign and Security Policy (CFSP),the Common Security and Defence Policy (CSDP) and the protection of EU external borders as established by the EUROSUR regulation[2]. Three application areas have been identified in which Copernicus can play a role: **Border Surveillance, Maritime Surveillance and Support to EU External Action.** Over the last few years, a series of Copernicus research and development projects and service demonstrators have been building up capacities, engaging with user communities, and preparing for the ultimate deployment of operational services in these three areas.

"The achievement of a stable EU budget for Copernicus safeguards the investments made in both the public and private sectors".

The Copernicus programme recently passed a major milestone in its transition from a research and development phase to an operational one. Since its earliest days, the programme has been dependent on a combination of funding from the EU and the European Space Agency (ESA). The political momentum for the inclusion of an operational budget for Copernicus in the EU's Multiannual Financial Framework (MFF) has been building up for a number of years. After a difficult negotiation period, funding was eventually secured for Copernicus in the European Union's next MFF, covering the seven years from 2014 to 2020. Due to the financial constraints engendered by the current economic context, the initially proposed € 5,8 billion was cut by almost 35% to € 3,786 billion. Nonetheless, the achievement of a stable EU budget for Copernicus safeguards the investments made in both the public and private sectors over the past fifteen years, and ensures that the programme can become a genuine European asset for monitoring the environment, responding to emergencies and supporting activities related to Security.

Border Surveillance

Border Surveillance-related services are the most advanced out of the three application areas. Their primary objective is to support the European Union's external border surveillance system, EUROSUR[3], an initiative based on an EU-level approach to reinforcing Member States' control over the Schengen border.

The services are expected to support the reduction of incidents related to illegal immigration (e.g. death at sea) by improving the intelligence available to coast and border guards as well as port authorities and law enforcement agencies.

Consultations were conducted during 2008 and 2009 with a range of users in the Border Surveillance communities, including the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (Frontex), the European Defence Agency (EDA), and border control authorities and coast guards in Member States. The outcome of these consultations was a set of technical recommendations[4], which led to the development of a Concept of Operations (CONOPS) focused on the monitoring of the southern maritime and eastern land borders of Europe.

Frontex is implementing the European external border surveillance system, EUROSUR. (Credits: European Union, 2013)

"Operational Copernicus services for Border Surveillance are expected to commence in 2015."

The CONOPS envisages Frontex collaborating with relevant actors (such as the European Maritime Safety Agency (EMSA), for Maritime Surveillance and the European Union Satellite Centre (SatCen), for land borders monitoring), together with industry, to assess the risks of intrusion. The CONOPS reinforces cooperation between key players, such as Frontex, Member States' National Coordination Centres, EMSA, SatCen and the European Commission, on operational issues as well as those related to governance.

Border Surveillance services entered into a pre-operational phase in early 2013 with the launch of two FP7[5] projects: *SAGRES*[6], which focuses on validating the highly time-critical EUROSUR components (vessel tracking and monitoring third country ports and coasts), and

[1] Global Monitoring for Environment and Security.

[2] Regulation No 1052/2013 of the European Parliament and of the Council of the 22nd of October 2013 establishing the European Border Surveillance System.

[3] COM(2008) 68 final of 13/02/2008 on a European Border Surveillance System.

[4] Final report of the Working Group "GMES support to EUROSUR", 3rd of December 2009.

[5] Seventh Framework Programme for Research and Technological Development.

[6] Service Activations for GRowing EUROSUR Success. See http://www.copernicus-sagres.eu

LOBOS[7], which addresses the validation of less time-critical services (monitoring of ports, coasts and pre-frontier land areas). The projects will deliver pre-operational services for Border Surveillance up until the end of 2014 with the objective of increasing user awareness and uptake, and to corroborate the service specification for the provision of services. The provision of operational Copernicus services for Border Surveillance is expected to commence, under the aegis of Frontex, in 2015.

Support to EU External Action

As a global political actor, the European Union conducts numerous missions and operations abroad, in both civil and defence contexts. The scope of these actions includes responding to crises and providing humanitarian aid, the promotion and protection of human rights and democracy, and peacekeeping and peacebuilding operations. Copernicus provides support to the External Action of the EU through the detection and monitoring of trans-regional Security threats by improving crisis prevention, preparedness, response capacities and risk assessment, and supporting humanitarian operations in conflict zones through the timely provision of geospatial information. A dedicated working group[8], active since 2010, has been developing and refining user requirements, service specifications and applications scenarios. This process has involved the European External Action Service (EEAS) and other users and stakeholders, taking into consideration the lessons learned from previous R&D activities (e.g. *G-MOSAIC*[9]). The European Space Agency, in collaboration with industrial partners, has been developing possible evolutionary paths for the Space component (satellites and related ground infrastructure) in response to calls from Security users for improved resolution and timeliness.

"Copernicus provides support to the External Action of the EU through the timely provision of geospatial information."

The *G-NEXT*[10] and *G-SEXTANT*[11] FP7 projects have been providing or further developing services in support of EU External Action since mid-2013. Whilst *G-NEXT* services are close to being ready for operational deployment, *G-SEXTANT* focuses on research and development for the less mature services. Examples of phenomena monitored by such services include plantations of illicit crops, illegal mining activities and the spread of temporary settlements during humanitarian crises. The projects are closely coordinating their efforts, especially as regards user engagement[12], and will seek to exploit synergies with other Copernicus services (particularly the Emergency Management Service, EMS). Validation of the services by users will take place over the course of 2013 and 2014. The service specifications will be further refined based on the user feedback received during this period. Synergies with the EMS need to be set up, and governance issues resolved, before operational services are ready for deployment.

Copernicus contributes to the European Union missions and operations such as those in support of humanitarian aid. (Credits: UN – M. Bergen)

Maritime Surveillance

The EU's external maritime border presents a challenge for Security stakeholders, due not only to its extent (approximately 70.000 km) but also to the number of Member States with coastal or maritime jurisdiction (23 out of 28). The scale of this challenge is considerably increased when pre-frontier areas are also taken into account. Maritime Surveillance services are designed to support efforts to tackle piracy, drug trafficking, illegal fishing activities, and illegal immigration across Europe's blue borders. As regards piracy, improved monitoring and detection methods can improve the effectiveness and reduce the costs of counter-piracy operations by acting as a deterrent to pirates and improving the deployment of vessels, thereby reducing the economic toll of piracy activities. As with land border control, enhanced monitoring of blue borders can support in reducing the death toll of illegal immigrants at sea and illegal immigration, bringing about social, humanitarian and economic benefits.

Approaching a pirate vessel during the anti-piracy operation EU NAVFOR – ATALANTA (European Naval Force Somalia – Operation ATALANTA). (Credits: European Union, 2013)

Copernicus services for Maritime Surveillance have benefitted from the progress which has been made in the Border Surveillance domain, both on user requirements (since there is considerable overlap between the communities) and on governance aspects. Several R&D or demonstration activities in support of Copernicus services for Maritime Surveillance have been funded under FP7. These include the *DOLPHIN*[13], *NEREIDS*[14], and *SIMTISYS*[15] projects which have coordinated their efforts to engage with the maritime user community. ESA's *MARISS*[16] project is a component of its GSE[17] programme, providing pre-operational Maritime Security services. In addition, EMSA currently provides operational maritime safety services[18]

[7] LOw time critical BOrder Surveillance. See http://lobos.bordersurveillance.security-copernicus.eu.185-4-133-10.reseller14.grserver.gr/index.php.

[8] Working Group on Support to External Action (WG-SEA).

[9] GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises. See http://www.gmes-gmosaic.eu.

[10] Pre-operational Copernicus Services in support of EU External Action. See http://externalaction.security-copernicus.eu/projects-overview/g-next/g-next-nutshell.

[11] Geospatial intelligence in support of EU External Action. See http://externalaction.security-copernicus.eu/projects-overview/g-sextant/g-sextant-nutshell.

[12] A joint *G-NEXT/G-SEXTANT* user meeting took place in April 2013.

[13] Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/dolphin.

[14] New Service Capabilities for Integrated and Advanced Maritime Surveillance. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/nereids.

[15] Simulator for Moving Target Indicator System. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/simtisys.

[16] Maritime Security information services.

[17] GMES Service Element.

[18] See article on page 34.

(e.g. *SafeSeaNet*), and has conducted trials demonstrating the use of Space technologies in, for example, the fight against piracy, and could therefore be a good candidate for the management of operational services from 2015 onwards. It is not expected that there will be additional demonstration activities once the above projects come to an end.

"The next two years will prove crucial for the validation and user uptake of the Copernicus services for Security applications."

A dedicated working group on Maritime Surveillance has been developing recommendations for the deployment of operational services since April 2013. The identification and validation of user requirements will continue throughout 2013, along with efforts to engage additional users (i.e. outside the Border Surveillance community, with which relationships are already established).
The Maritime Surveillance domain benefits from a number of parallel initiatives, including the evolution of EMSA's *SafeSeaNet* and the progress which has been made in the definition of a Common Information Sharing Environment (CISE)[19] for the Maritime domain. The recommendations of the Working Group will form the basis for operational Copernicus services in support of Maritime Surveillance from 2015 onwards.

The way forward

The next two years will prove crucial for the validation and user uptake of the Copernicus services for Security applications; at present the services in support of Border Surveillance are more advanced than the others in their development towards operationalisation from 2015 onwards. While several challenges are still being addressed at the programmatic and operational levels, the pre-operational service development period is drawing to a close. This is an ideal opportunity for users, stakeholders and policy-makers to further shape the services by making their recommendations and constructive feedback known, as the project consortia prepare for the next and most important phase in the development of Copernicus services for Security applications: their entry into operations.

[19] See http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm.

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The Copernicus services for Security applications: the EEAS perspective

by Christophe Morand

THE OPERATIONALISATION OF THE COPERNICUS SERVICES FOR SECURITY APPLICATIONS IN SUPPORT TO EU EXTERNAL ACTIONS IS BEING UNDERTAKEN IN LINE WITH THE PRIORITIES HIGHLIGHTED BY THE HIGH REPRESENTATIVE OF THE UNION FOR FOREIGN AFFAIRS AND SECURITY POLICY, CATHERINE ASHTON, IN HER FINAL REPORT ON THE COMMON SECURITY AND DEFENCE POLICY (CSDP). THE REPORT WILL PINPOINT THE STRATEGIC INTERESTS OF THE CSDP AND THE ROLE THAT COPERNICUS COULD PLAY. THIS ARTICLE PROVIDES AN EXTRACT OF THE DOCUMENT THAT WILL BE ELABORATED UPON FURTHER IN THE SECOND PART.

Ms. Catherine ASHTON, High Representative of the EU for Foreign Affairs and Security Policy during her visit to the European Union Satellite Centre in June 2013. (Credits: SatCen)

Extracts from the High Representative's report on CSDP[1]

"The use of Copernicus in support of CSDP should be further explored."

"The debate on capabilities, military or civilian, needs to flow from an understanding of the strategic context, building on the solid basis of the 2003 European Security Strategy and its 2008 implementation report. This first part of my report sets out the strategic context, puts forward priorities, and assesses the state of play of CSDP against this overall background, in accordance with the tasking by the European Council in December 2012.
Europe's strategic environment today is marked by increased regional and global volatility, emerging Security challenges, the US rebalancing towards the Asia-Pacific and the impact of the financial crisis.
The world as a whole faces increased volatility, complexity and uncertainty. A multipolar and interconnected international system is changing the nature of power. The distinction between internal and external Security is breaking down. Complex layers of governance and new patterns of interdependence empower new players and give rise to new challenges. As a result, state power is becoming more fragile. Among the drivers for this are: changing demographics and population growth, embedded inequalities, and new technologies."

[1] Final Report by the High Representative/Head of the EDA on the Common Security and Defence Policy (October 2013).

In her report, the High Representative continues by setting out her view on the CSDP strategic priorities:

- *"The Union must be able to act decisively through CSDP as a Security provider, in partnership when possible but autonomously when necessary, in its neighbourhood, including through direct intervention. Strategic autonomy must materialise first in the EU's neighbourhood;*
- *The Union must be able to protect its interests and project its values by contributing to international Security, helping to prevent and resolve crises and including through projecting power. The EU's call for an international order based on rule of law and its support for effective multilateralism needs to be backed up by credible civilian and military capabilities of the right type, when required.*
- *The ability to engage with partners is crucial in any crisis. The EU must build regional and bilateral partnerships to be able to both cooperate in crisis management and help build the capacity of partner organisations and third states;*
- *In a context of increased volatility and new threats, there is a particular need to improve the ability to engage rapidly. Drawing as necessary on military capabilities, the EU should be able to engage all five environments (land, air, maritime, space and cyber). In addition to our traditional yet increasing dependence on Security at sea, we have become increasingly dependent on Space assets - indispensable in today's operations - and on the ability to operate in cyberspace.*
- *The comprehensive approach - the use of the various instruments at the disposal of the Union in a strategically coherent and effective manner - must also apply to capability development, to make best use of scarce resources."*

Scheme of completed EU missions and operations. (Credits: European Union, 2004-2013)

Finally, with regard to Earth Observation, the High Representative stressed that: *"Further efforts are needed to enhance access to Satellite High Resolution Imagery - a timely and precise source of information essential for the EU's effective decision-making and for supporting CSDP missions/operations. In particular, facilitating access to Member States' governmental imagery will increase the EU Satellite Centre's capacity. In parallel, taking advantage of the dual nature of Space, the use of Copernicus (a Commission- funded programme to respond to European policy makers' growing need to rapidly access geospatial information) in support of CSDP should be further explored. This could provide EU missions with the less sensitive products."*

"The transition to operations of the Copernicus services in Support to EU External Action falls perfectly along the lines proposed by the High Representative."

Final steps towards an operational service: Copernicus support to EU External Action

Between 2011 and 2012, the main actors involved in the Support to EU External Action policy area participated in a working group aimed at establishing operational scenarios with a view to developing a portfolio of the future operational Copernicus services. In 2013, the FP7 funded project *G-NEXT* (GMES pre-operational Security services for supporting external actions)[2], succeeded the *G-MOSAIC*[3] project.

The *G-NEXT* project aims to contribute to the transition of the Copernicus services for Security applications from pre-operational to operational mode. In particular, *G-NEXT* supplies geospatial services in support of EU External Action, including mapping and geo-information products ready for deployment in emergency and crisis situations, and provides a set of services suitable to be integrated in the users working environment in the field of the Common Foreign and Security Policy. The portfolio of products includes contingency plan preparation, event mapping, critical assets and crisis area monitoring, monitoring of settlements and damage assessments.

While the European Commission (EC) and its Research Executive Agency (REA) oversee the development of the *G-NEXT* project, the Coordinator of the project, the e-Geos company, is in charge of the overall management and the European Union Satellite Centre (SatCen) acts as the Service Coordinator. The role of the Crisis Management Planning Directorate (CMPD) of the EEAS in the *G-NEXT* project is to perform a sensitivity check on the activations requested by the authorised users in liaison with the relevant EC services.

The *G-NEXT* user community includes the EEAS and its bodies, the National Ministries of Defence, the United Nations (in particular the UN Department of Peacekeeping Operations, UN Department of Field Support) and DG ECHO (Humanitarian Aid and Civil Protection). Apart from requesting activations, the role of the user community is to further define and/or update their needs, provide feedback and suggestions for improvement in view of the service operationalisation and eventually contribute to defining possible new services and products.

The work carried out so far by the EC, the EEAS and the SatCen, in close cooperation with DG ECHO and DG DEVCO (Development and Cooperation), has clearly contributed to the maturity of the service and illustrated how the dual nature of Space assets could benefit the implementation of a comprehensive approach in the field of capability development, while simultaneously engaging strategic partners.

"The role of the Crisis Management Planning Directorate (CMPD) of the EEAS in the *G-NEXT* project is to perform a sensitivity check on the activations requested by authorised users in liaison with the EC services."

In addition, the close links established between the EEAS and DG ECHO have clearly benefited the coordination efforts and the exploration of potential

[2] Project website: http://externalaction.security-copernicus.eu/.

[3] GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crisis (the project launched in 2009 ended in March 2012).

The *G-NEXT* project (GMES pre-operational Security services for supporting external actions)

The *G-NEXT* project aims to support the transition of the Copernicus services for Security applications in Support to EU External Action from a pre-operational to a fully operational mode. The main attribute of the products developed by the *G-NEXT* project is the mode (rush, non-rush, monitoring) referring to the timeliness of service delivery. The products developed by the *G-NEXT* project are:

- Reference Maps
- Road Network Status Assessments
- Conflict Damage Assessments
- Critical Infrastructure Analyses
- Support to Evacuation Plans
- Crisis Situation Maps
- Border Maps
- Camp Analyses
- Camp Monitoring Analyses
- Activity Reports

The products are categorised by the three main areas of application to which they refer: Political or Armed Conflicts, Situational Awareness, and Border Survey. The *G-NEXT* project started in January 2013 and will finish in March 2015.

synergies between the Copernicus Emergency Management service and the *G-NEXT* project. Unfortunately, many humanitarian crises are located in failing state territories, therefore the provision of services based on high resolution satellite imagery is required, in order to support the delivery of humanitarian aid. However, the implementation of appropriate mechanisms for service delivery and dissemination of the products should prevent their possible misuse. On a case by case basis, specific measures have to be applied in order to deliver the relevant services on time and to the "legitimate" users with a view to mitigating the risks of the information received being mishandled. On top of sharing best practices, the sharing of information and products are important tools for the development of a common understanding of the real situation on the ground.

With regard to the engagement with strategic partners, the UN has activated the services offered on several occasions and further developments are expected in light of reinforcing cooperation in this field.

Finally, the community of users tends to expand internally within the EEAS. Beyond the traditional users involved in crisis response and crisis management, there is increasing awareness among EEAS regional desks of the benefits of the Copernicus services in support of EU External Action. The *G-NEXT* products have already supported the EEAS in the Sudan/South Sudan region by helping to define the delineation of the borders between the two countries. In addition, satellite imagery supported the EEAS working group's impact assessment on building a dam for water distribution in bordering regions.

The governance

The number of *G-NEXT* activations so far demonstrates the maturity of its product portfolio. However, at this point the main challenge is the definition of a specific governance scheme.

"In 2014 the main task will be the establishment of the legal framework for the future 'Copernicus Support to EU External Action' operational service ."

The more peculiar attribute of the provision of services based on high resolution and very high resolution satellite imagery in the field of EU External Action is the sensitivity of the products themselves. Firstly, the content of the products have the potential to compromise the Security of the Union or of the Member States; therefore in some cases sensitive information has to be protected by classifying certain products. Secondly, the "uncontrolled" dissemination of the products could present a risk to the lives of fragile populations. For example, a detailed map identifying the location of Internally Displaced Person Camps could be used by armed groups to trace and attack the people who are living there. Finally, the European Union logo being displayed on a product raises some political issues because this shows which regions are being monitored by the EU.

Taking into account the above considerations, this is not the first occasion on which the need to adopt a governance framework has arisen; when the SatCen was established a specific governance framework was developed. It should be noted in fact that the EU Political and Security Committee exercises political oversight of the use of Earth Observation capabilities.

That being said, in 2014 the main task will be to establish the legal framework for the future 'Copernicus Support to EU External Action' operational service (Copernicus SEA) which will have to be compatible with the Commission's rules and the Common Foreign and SecuPolicy's (CFSP) governance scheme.

Christophe MORAND joined the Crisis Management and Planning Directorate of the European External Action Service in October 2010. He is the Chairman of the *BRIDGES* Institutional Advisory Board (IAB) which provides support for the implementation of the project and provides political guidelines on the different governance options for the Security component of the Copernicus Programme. He is a graduate of the Paris-based *Ecole de Guerre*, the French centre of excellence in Military Training for senior officers.

EMSA's role in Maritime Surveillance

by Leendert Bal*

THE EUROPEAN MARITIME SAFETY AGENCY (EMSA) IS A REGULATORY EUROPEAN UNION (EU) AGENCY, FOUNDED IN 2002, AS PART OF A SUBSTANTIAL EU PACKAGE OF LEGISLATION RELATING TO MARITIME SAFETY IN THE WAKE OF MAJOR SHIPPING DISASTERS IN EUROPEAN WATERS, SUCH AS THOSE INVOLVING THE OIL TANKERS *ERIKA* AND *PRESTIGE*.
ONE OF EMSA'S MAIN ROLES IS TO FACILITATE TECHNICAL COOPERATION BETWEEN MEMBER STATES AND THE EUROPEAN COMMISSION (EC) FOR EU VESSEL TRAFFIC MONITORING, THE LONG RANGE IDENTIFICATION AND TRACKING (LRIT) OF VESSELS, AND SATELLITE MONITORING OF POLLUTION AND POLLUTING VESSELS. THROUGH THESE ACTIVITIES, EMSA PROVIDES A PLATFORM FOR INTEGRATED VESSEL MONITORING SERVICES, TAILORED TO USER REQUIREMENTS.

EMSA's Role in Maritime Surveillance

The latest revision of EMSA's founding regulation, published in early 2013, has confirmed its role in Maritime Surveillance activities and expanded its formal reach by tasking the Agency to support Member States and the EC in measures against the threat of piracy or any unlawful act at sea. In recent years, EMSA has built up specific surveillance expertise in terms of vessel positioning systems and Earth Observation data. The Agency has developed a unique capacity to fuse different maritime and Earth Observation datasets and distribute them according to existing access rights.

Since 2009, EMSA has been developing pilot projects to address the needs of Member State and European authorities for enhanced maritime situational awareness. It has been recognised that the information processed and managed by EMSA benefits a wide range of actors in the maritime field. These include not only Member State authorities, but also other organisations such as the European Fisheries Control Agency (EFCA), the European Union Naval Force (EU NAVFOR) and the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (Frontex).

> *"It was impressive to see the advances being developed in EMSA in fusing satellite imagery together with vessel position and voyage data to optimise positional accuracy. Data fusion and integration in developing a "common operational picture" of real utility value will be the big challenge when you consider the obstacles that need to be overcome".*
> EU NAVFOR on the *PIRASAT*[1] pilot project - 2009

1 The *PIRASAT* pilot project developed with the European Space Agency contributed to the fight against piracy by enabling stakeholders to identify possible non-cooperative targets.

*** The author would like to thank Pedro Lourenço and Machteld Price for their contributions to this article.**

These pilot projects have helped EMSA to establish a broad range of capabilities that address the needs of a wide variety of communities and allow operational end-users to exploit the full potential of EMSA systems.

Involvement in Copernicus

EMSA has been involved in Copernicus activities for a considerable period of time. EMSA's near real-time satellite-based oil spill and vessel monitoring service, *CleanSeaNet*, has been recognised by the EC as an associated[2] Copernicus Service since 2008.
EMSA has also cooperated closely with the European Space Agency (ESA) regarding the development of Earth Observation services for the maritime sector. EMSA frequently used the Copernicus Space component for a sustainable supply of Earth Observation missions in support of emergency situations. Through Copernicus, EMSA has access to a broad portfolio of radar and optical satellite data, and extensive experience in the operational use of Earth Observation data.

> **"EMSA is currently working with the EC to contribute to the development of Copernicus services for Security applications, and specifically for the further development of Maritime Surveillance services."**

EMSA is currently working with the EC to contribute to the development of Copernicus services for Security applications, and specifically for the further development of Maritime Surveillance services. These efforts, which are in an initial phase of service design, are mainly focused on improving integrated Maritime Surveillance services to address the needs of different user communities. EMSA's contribution in this area indicates that it is well-positioned to incorporate the operational outcome of research and development efforts under the Copernicus framework, and to make it available to a wide range of authorities.

2 This means that as a satellite-based service it is fully in line with the Copernicus objectives, but it has been developed outside the framework of the Research Programme (FP7) used for setting-up GMES/Copernicus.

EMSA's Maritime Surveillance capabilities

Input to maritime domain awareness

Oil spill monitoring
Since 2007, EMSA has operated *CleanSeaNet*, a satellite-based pan-European oil spill and vessel monitoring service. The *CleanSeaNet* service is based on images from synthetic aperture radar (SAR) satellites, which are analysed to indicate to the responsible authorities whether the imaged sea surface has an unusual texture, which may be attributable to an oil spill. Currently the service relies on Radarsat-2 and the COSMO-SkyMed constellation for the delivery of over 2500 images every year.
CleanSeaNet supports European coastal States in the detection of illegal discharges from vessels and oil platforms, by providing information in near real-time (less than 30 minutes after image acquisition) to operational end-users, about spill location, area and length and confidence level.

Very high resolution optical imagery
In addition, EMSA recently developed a capability based on high resolution optical services, which constitutes the newest addition to EMSA's Earth Observation portfolio. As well as the delivery of high

resolution optical images in near real-time (less than one hour from image acquisition) from several high resolution optical satellites, this service entails the delivery of value-added products that include activity detection (oil spills, beached oil, presence of skiffs on the beach, wake detection and customised activities) as well as vessel detection.

Vessel detection and correlation

By interfacing with *SafeSeaNet*, and other vessel reporting systems, and matching vessel positions with targets detected by satellites, it is possible to correlate the satellite data with vessel reporting information. This approach is used to enhance maritime domain awareness by highlighting both known (identified) and unknown vessel targets in the image.

Satellite AIS

The detection of AIS data by satellite (satellite AIS) makes it possible to monitor ship movements outside the coastal zones covered by terrestrial AIS ground stations. This ability can bridge the gaps in current maritime information provision, both by extending the reach of AIS, and by optimising other maritime information sources. As an example, this could mean correlating and/or fusing satellite AIS data with terrestrial AIS and Long Range Identification and Tracking data received via telecommunication satellites.

Satellite image and aerial photo from the Admiral Kuznetsov accidental spill (2009). (Credits: Satellite image - ESA/EMSA 2009; Photo: Irish Coast Guard)

SafeSeaNet

SafeSeaNet is a collective European platform for maritime data exchange, linking together maritime authorities from across Europe. It works by tracking Automatic Identification System (AIS) radio signals transmitted by ships. *SafeSeaNet* enables European coastal States to provide and receive information on ships, ship positions, hazardous freight and port arrivals.

EMSA has established, in partnership with ESA, the capability to process and distribute satellite AIS data to end-users either as a data stream or by combining satellite AIS data with existing vessel traffic reporting data streams.

EMSA is currently working with ESA to establish a sustainable Space-based system. With the support of the ESA ARTES[3] programme and the participation of industry, the Agency is able to provide global satellite AIS data information to EU Member States.

Integrated maritime data

EMSA systems are increasingly evolving in such a way that specific types of information can be selected, combined and integrated. The ongoing dialogue with the maritime authorities in Member States and with the EC aims to support the enhanced operational use of such information, and a more customised distribution of data services.

EMSA is currently finalising the development of the Integrated Maritime Data Environment (IMDatE), a technical framework that combines and processes data from existing EMSA maritime applications and other external sources to provide more comprehensive and configurable services to users. The new functionalities enable users to benefit from improvements to current services, such as more options for data visualisation, a single sign-on process for all EMSA applications, new machine-to-machine interfaces and automated vessel behaviour monitoring. Verification of data also improves the quality of data across the systems through the confirmation of vessel details across different vessel registries.

[3] Advanced Research in Telecommunication Systems.

LRIT

The Long Range Identification and Tracking (LRIT) of ships was established in 2006 by the International Maritime Organisation.

The LRIT regulation applies to the following types of ships engaged in international voyages:

- All passenger ships including high-speed craft;
- Cargo ships, including high-speed craft of 300 gross tonnage and above; and
- Mobile offshore drilling units.

The standard LRIT position reporting rate is one message every six hours.

"EMSA systems are increasingly evolving in such a way that specific types of information can be selected, combined and integrated."

Users who combine functions, for example vessel traffic monitoring and marine pollution control, benefit from being able to obtain an overview of maritime activities in their area of interest, integrating data which would otherwise only be available through a range of different individual applications. This integrated data can be delivered via a user-friendly web interface that is fully configurable to meet the specific visualisation requirements of users. Alternatively, information can be distributed automatically, via a system-to-system interface, to external systems, in accordance with existing access rights. These capabilities are crucial for the deployment of integrated services to different user communities.

The integration of data also means that EMSA has developed capacities for handling a wide variety of datasets, with significant data volumes and near real-time deliveries. This unique capability to handle data involves three main dimensions:

- **Volume**: EMSA currently manages high volumes of vessel position, vessel information and Earth Observation data. This means that on a daily basis, EMSA is able to process, analyse and visualise gigabytes of information
- **Variety**: EMSA receives data from a wide variety of sources, both internal and external. The IMDatE is crucial in the integration and processing of a multitude of datasets.
- **Velocity**: EMSA constantly receives data from different sources, in real time and near neal-time. The ability to monitor and provide alerts on any vessel behaviour is a key capability that the Agency has developed.

Tailor-made services and continuous validation

EMSA can deliver tailor-made maritime monitoring services for new user communities benefiting from past investments in operational ICT infrastructure, data quality, cross-checking capabilities, and validation by the dedicated EMSA 24/7 Maritime Support Services.

The experience gained and capacities developed to date in handling these datasets places EMSA at the forefront of service providers delivering accurate and clear information to decision-makers in the maritime domain.

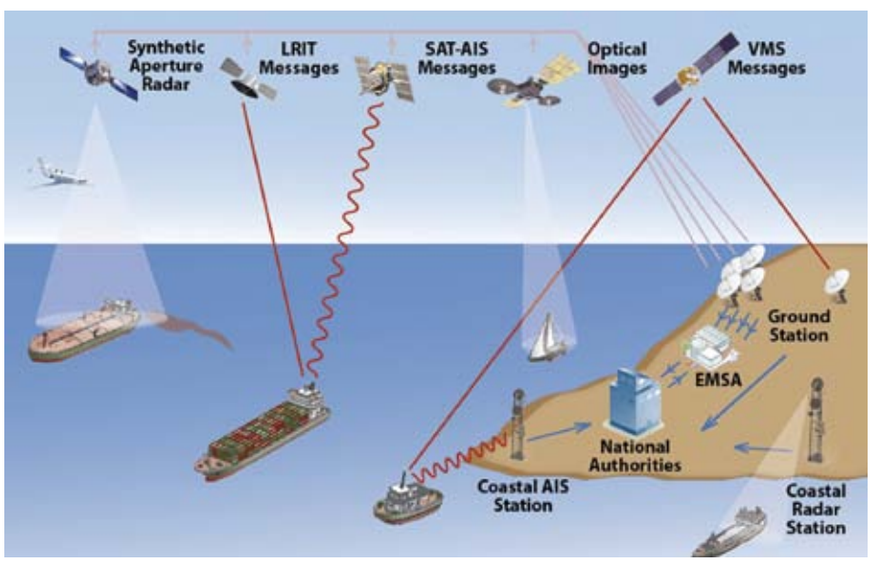
New user communities

The principal maritime applications and services that are provided by EMSA to Member States' maritime safety and environmental administrations also provide added value to actors in other maritime sectors such as fisheries, customs, law enforcement, border control and defence. As mentioned in the introduction, the revision of the Founding Regulation mandated EMSA to 'facilitate measures against threats of piracy and of intentional unlawful acts'. EMSA now supports a wide range of user communities by providing integrated services.

Fisheries

The European Fisheries Control Agency (EFCA) coordinates the monitoring and enforcement of fishery activities in EU waters. The control, inspection and surveillance of fishery activities both at sea and ashore are conducted in cooperation with Member States and the Commission. In response to a formal request from EFCA for monitoring support, EMSA set up a service that combines specific fisheries information with available maritime data in support of several joint deployment plans. The service has five main features:

- Data fusion of vessel position reports: this includes the fusion of terrestrial AIS, satellite AIS, LRIT, SAR and optical satellite vessel detection, and VMS data.
- Display of ship particulars including vessel identifiers, ship type and length, and even specific information on fishing vessels linked to different fishery control campaigns.
- Fisheries control data including visual sightings collected by means of aerial or seaborne inspection and through information resulting from inspections onboard fishing vessels, such as the detection of suspected infringements.



Integrated Maritime Services concept. (Credits: EMSA)

Vessel Monitoring System (VMS)

VMS is a satellite-based, near real-time, vessel tracking system consisting of a Global Positioning System (GPS) receiver and a satellite data transmitter. VMS is used by the fisheries authorities to monitor fishing vessel position, course, speed and behaviour.

- Automated monitoring of fishing vessel behaviour and activity near to or inside specific fishing areas.
- Option of using high resolution optical imagery to provide near real-time detection of fish farms and illegal fishery activities.

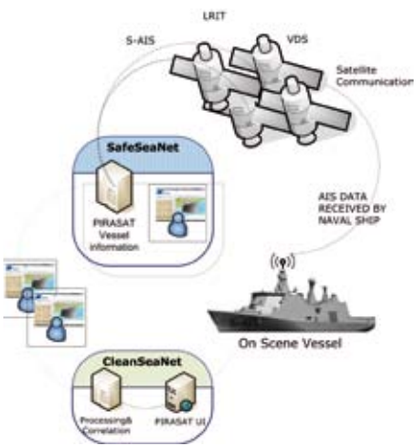
This service was considered a success in past campaigns and EFCA, the EC, and the participating Member States recognised the benefits resulting from this exchange of data and from inter-agency cooperation during the campaign. They have requested that such cooperation continues and that services are made available during other future fisheries control campaigns and operations.

> *"EMSA provides us with a service for combining different types of data from a variety of sources. Using this and combining it with our own data systems and intelligence we can get a better picture of how the vessels are fishing."*
> Pascal Savouret, Executive Director EFCA

Anti-piracy

A dedicated integrated maritime data service, based upon the operational requirements of the EU Naval Forces (EU NAVFOR), has been running since 2011. The EMSA service assists EU NAVFOR in its counter-piracy mission, Operation ATALANTA, off the coast of Somalia. Various maritime information data streams (LRIT, satellite AIS and reporting data) are combined with other vessel-related and risk information provided by EU NAVFOR intelligence sources to produce an enhanced standard traffic image, enabling EU NAVFOR to monitor the area and to protect the vessels associated with the World Food Programme (WFP).

> *"The EMSA service, called MARSURV, is certainly a key element of our day-to-day business. MARSURV provides, in addition to the complete overview of merchant shipping in the area, a direct link to the individual risk assessment of a ship. A simple layout combined with all necessary analysis tools makes MARSURV easy to use, and ensures that the information provided is precise. Protected by state-of-the-art technology, but based on available hardware, MARSURV is also ideal for implementation ashore and on board. Without MARSURV, we would not have been able to provide such an accurate service."*
> Jan Schantz, Head of J3, EU NAVFOR Operational Headquarters



PIRASAT *high level architecture. (Credits: EMSA)*

Border control

In 2011, EMSA was invited to support the Frontex-led 'Joint Operation INDALO 2011'. The principal aims of this operation were to detect and intercept illegal migration between North Africa (Morocco/Algeria) and Spain, and to detect illegal oil discharges by vessels. EMSA developed a Maritime Surveillance interface tailored to border control operations. A user-friendly interface was provided as an operational tool, presenting satellite images fused with a range of relevant data, such as AIS and nautical maps, maritime traffic information and incidents at sea.

In April 2013, EMSA and Frontex signed a Service Level Agreement to continue the surveillance cooperation and to start providing integrated EMSA services to Frontex on a more regular basis. EMSA will provide advanced surveillance tools to support the Border Surveillance concept of operations (CONOPS) within EUROSUR.

These recent Border Surveillance services show that the newly developed integrated EMSA environment provides flexibility for users, and that the system-to-system capabilities are easy to integrate.

Outlook

Based on discussions with, and feedback from, users, it is clear that there are still considerable advances to be made in the field of Maritime Surveillance. There is a growing demand for effective and intuitive tailor-made maritime interfaces to support effective operations, containing selected information for specific purposes, and delivered in real-time.

With the development of IMDatE by EMSA, an important step has been taken to respond to such demands, and it offers a strong basis for developing more integrated maritime information services in the near future. Having a "critical mass" of different maritime data sources and being engaged in intensive dialogue with users will certainly help to further develop this area and bring more benefits to users.

Efforts to enhance Maritime Surveillance at an EU level are intensifying, as demonstrated by the growing and successful activities of other EU agencies such as EFCA and Frontex. The Copernicus programme will certainly help to ensure that Earth Observation data plays a recognised and well-respected role in maritime domain awareness. EMSA will do its utmost to integrate this data into the services requested by users and to have as many authorities as possible benefiting from the enhanced capabilities at EU level.

Leendert BAL is Head of the Operations Department at EMSA. Mr. Bal started working for EMSA in 2004 as a Policy Adviser to the Executive Director, and has been involved within the Agency, as Head of Unit, in developing operational projects such as the network of stand-by Oil Recovery Vessels, the European satellite oil spill monitoring and detection service *CleanSeaNet* and the EU LRIT Data Centre since their inception.

EUROSUR and Copernicus – A positive example of how to create synergies at EU level

by Oliver Seiffarth*

ON THE 2ND OF DECEMBER 2013 THE REGULATION ESTABLISHING THE EUROPEAN BORDER SURVEILLANCE SYSTEM (EUROSUR) ENTERED INTO FORCE, MAKING EUROSUR OPERATIONAL FOR THE FIRST GROUP OF 19 SCHENGEN MEMBER STATES.[1] WHILE FOCUSING ON PROMOTING COOPERATION AND INFORMATION EXCHANGE BETWEEN DIFFERENT AUTHORITIES, THE EUROSUR REGULATION ALSO ENVISAGES THE USE OF MODERN TECHNOLOGY FOR BORDER SURVEILLANCE PURPOSES AND REFERS TO THE FUTURE COPERNICUS PROGRAMME[2] IN THIS REGARD. THIS ARTICLE DESCRIBES HOW EUROSUR AND THE COPERNICUS PROGRAMME HAVE BEEN DEVELOPED IN PARALLEL IN SUCH A WAY THAT THEY COMPLEMENT EACH OTHER, THEREBY CREATING SYNERGIES AT EU LEVEL.

EUROSUR in a nutshell

EUROSUR is a multi-purpose system, which shall prevent **irregular migration** and **cross-border crime** (e.g. drug smuggling, trafficking in human beings) at the external borders, thereby ensuring the free movement of EU citizens in the Schengen area. EUROSUR shall also **contribute to protecting and saving the lives of migrants** trying to reach European shores. In particular the practice of travelling in small, unseaworthy and often overcrowded vessels has dramatically increased the number of migrants drowning at the southern maritime external borders, as illustrated by the tragic loss of migrants' lives near Lampedusa (Italy) in October 2013.

State Police, Carabinieri, Coast Guard, Guardia di Finanza and the Navy work side-by-side in the Italian National Coordination Centre. (Credits: Italian Ministry of Interior)

For these purposes, EUROSUR provides a common framework for **information exchange** and **cooperation** between border guards, police, customs, coast guards and navies. These authorities are

[1] Regulation (EU) No 1052/2013 of the European Parliament and of the Council of the 22nd of October 2013 establishing the European Border Surveillance System (EUROSUR), OJ L295/11 of 6.11.2013.

[2] GMES was renamed Copernicus in December 2012 (see http://europa.eu/rapid/press-release_IP-12-1345_en.htm). However, the term GMES appears in several places for historical reasons.

required to cooperate via so-called **national coordination centres** for Border Surveillance, which are currently being established in each Member State and which became operational in the 19 Schengen Member States located in the eastern and southern external borders on the 2nd of December 2013, to be followed by the remaining 11 Schengen Member States on the 1st of December 2014.

These national coordination centres work closely together with the EU border agency **Frontex**[3] and other EU agencies, such as the European Maritime Safety Agency (EMSA) and the EU Satellite Centre (SatCen), as well as with relevant national authorities, such as the Maritime Rescue Coordination Centres.

EUROSUR follows an **intelligence driven approach**, allowing national authorities and European agencies to better **understand** what is happening at the external borders, and enabling them to **react** more quickly to new routes and methods used by criminal networks. Near-real time information exchange, regular intelligence sharing and a close inter-agency cooperation at national and EU level are the key elements here. But also the use of modern surveillance technology plays an essential role.

Research efforts to improve the performance of surveillance tools

In the 2008 EUROSUR roadmap[4] the Commission envisaged the development and implementation of common tools and applications for Border Surveillance at EU level. The first element was to use **the results of research** to improve the performance of surveillance tools:

"In particular two emerging tools are of interest for Border Surveillance purposes – satellites and UAVs[5]. Earth observation (EO) satellites offer the possibility of coverage for much of the earth, including the open sea and third country coasts and territories. UAVs can produce detailed images and can be placed over the target area on demand.
EO satellites are useful for monitoring and intelligence gathering with regard to predefined areas, but are currently of limited use for tracking. In wide area searches small targets cannot be found, whereas for high resolution imagery the area swept is small and therefore the position of the target has to be known, e.g. on the basis of the intelligence given.
UAVs and satellites can track a vessel in European and international waters. However, currently UAVs are not allowed to fly in civil airspace for legal and technological reasons."

Since 2008 several **research projects** have been carried out in the framework of the Seventh Framework Programme for Research and Development (FP7), aiming to improve the performance of such surveillance tools. These research projects delivered concrete results on how to better integrate different surveillance tools. They also demonstrated how to improve for instance the communication channel from a manned maritime surveillance plane to the command and control centre. But unfortunately the aforementioned limitations of UAVs and satellites could not be overcome.
Unmanned aerial vehicles (UAVs) are still not allowed to fly in civil airspace and their integration into civil airspace will not take place before 2016, at the very earliest. This means that the regular use of UAVs for Border Surveillance in the framework of EUROSUR is not an option for the next few years. Furthermore, during several test-runs carried out by national border control authorities and by Frontex since 2008, drones have not yet been proven to be more effective or cost-efficient than for instance manned surveillance planes.

"The application of new surveillance tools could provide Member States' authorities with surveillance information on their external borders and on the pre-frontier area on a more frequent, reliable and cost-efficient basis."

The use of satellite imagery also still has its limitations. Even when using all available satellites, their revisit time[6] remains poor except for during the morning and evening periods. However the main obstacle, for which there is still a significant potential for improvement, is the considerable time gap from the satellite overpass until the information derived from the satellite imagery is provided to Frontex and the national coordination centres. To give real added value to satellite imagery, results must be delivered within minutes or at least within a few hours rather than days or even weeks. Another issue is that for a civilian application like Border Surveillance, the access to high-resolution satellite imagery is limited, thereby not allowing the exploitation of existing capabilities to their full potential. Finally, only once the commercial prices for satellite imagery are considerably reduced will the growing number of satellites be used to full capacity.

Common applications of surveillance tools at EU level

Hence the logical conclusion was not to focus on surveillance technology, but on improving the information exchange and cooperation at national and European level as well as with neighbouring third countries when developing EUROSUR. This approach chosen by the Commission for EUROSUR was also confirmed by the ongoing works for improving the detection and tracking of small vessels used by migrants and for drug smuggling. In most operational scenarios, which are covering the whole Mediterranean Sea and its Atlantic approaches, the capability weaknesses are primarily linked to the need to improve coordination and communication among authorities, with the need to increase surveillance activities as the next priority.
Nevertheless the use of modern surveillance technology does provide added value. Therefore the European Commission identified in its 2008 EUROSUR roadmap the need to establish a service for the **common application of surveillance tools** at EU level:[7]
"The application of new surveillance tools could provide Member States' authorities with surveillance information on their external borders and on the pre-frontier area on a more frequent, reliable and cost-efficient basis. Consideration should be given to how the EU can support Member States in developing and using such tools, with regard to investments or by setting up mechanisms allowing for a shared use of capital intensive tools such as satellites. Frontex could act as a facilitator e.g. to liaise with service providers in order to

[3] The European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union.

[4] COM(2008)68final of 13.2.2008, page 8.

[5] Unmanned Aerial Vehicles.

[6] The satellite revisit time is the time elapsed between observations of the same point on earth by a satellite.

[7] COM(2008)68final of 13.2.2008, page 8.

procure satellite imagery on behalf of several Member States or to co-ordinate the sharing of equipment […].”

With a view to developing such a European service in the framework of EUROSUR and GMES[8], the European Commission established in 2008 the **GMES Border Surveillance group**, consisting of technical experts from the Commission (ENTR, JRC, HOME), Frontex, SatCen, EMSA, the European Space Agency (ESA), the European Defence Agency (EDA) and – on an *ad hoc* basis – from selected Member States. This expert group elaborated the GMES concept in support of EUROSUR in 2008-2009 and the GMES Concept of Operations for EUROSUR in 2010-2011. Both concepts were discussed with and approved by Member States in the framework of EUROSUR.

GMES concept in support to EUROSUR[9]

Using four operational scenarios[10], this concept defines the requested functionalities for monitoring, detection, identification and tracking as well as the geographic areas of interest. It also consolidates the user requirements for sea and land external borders and for the pre-frontier area and determines which requirements are low-time and high-time critical respectively. Another chapter summarises the lessons learned from research and development projects in each of the four operational scenarios.

In the technology outlook chapter the performance capabilities and limitations of ‘state-of-the-art’ surveillance technologies (radars, aerostats, drones, satellites, etc.) are being analysed, including technological developments up to 2020. This chapter also concludes that the best results can be achieved by following an integrated and intelligence driven approach, for instance by combining information derived from different sources, sensors and systems.

The last two chapters examine the technology readiness and the costs of existing and future surveillance technology with regard to the four operational scenarios, followed by recommendations, so as to elaborate on a concept of operations for the common application of surveillance tools in the framework of EUROSUR.

GMES Concept of Operations for EUROSUR[11]

The Concept of Operations defines the different actors, their roles and responsibilities, the different surveillance phases, tools and workflows, and also the following services and corresponding products:

1) Punctual monitoring of neighbouring third country ports;
2) Punctual monitoring of neighbouring third country beaches;
3) Determine whether a specific vessel has left the third country port;
4) Determine whether boats have left the third country beach or a mothership[12] has left the inshore zone;
5) Tracking of a vessel over the high seas (more than 40nm from Member States’ coasts);
6) Identifying any suspicious vessels based on anomalous behaviour;
7) Monitoring of a maritime area of interest;
8) Maritime environmental assessment;
9) Updated reference maps;
10) New ambient land features alert;
11) Punctual monitoring of immediate pre-frontier areas or locations in a third country;
12) Land environmental assessment.

For each of these twelve services, the required information, the objects and area of interest, the planning lead time, the delay after recapture of the data/image and the update period, the surveillance tools, products and main providers have been identified. For instance, the SatCen would support Frontex in particular with regard to sub-services 1, 2, 9, 10 and 11, while EMSA would help Frontex in providing sub-services 5, 6 and 7. Frontex would work both with SatCen and EMSA on sub-services 3 and 4.

Article 12 of the EUROSUR Regulation

The European Commission used the two aforementioned concepts as a basis for drafting Article 12 of the EUROSUR legislative proposal[13], which was presented in December 2011 and adopted by the European Parliament and the Council with modifications in October 2013. According to Article 12 Frontex shall coordinate the common application of surveillance tools[14] in order to supply the national coordination centres with surveillance information on the external borders and on the pre-frontier areas on a regular, reliable and cost-efficient basis.

This means that Frontex shall provide the national coordination centres, upon request, with information derived from the following services:

a) Selective monitoring of designated third country ports and coasts which have been identified through risk analysis and information as being embarkation or transit points for vessels or other craft used for irregular immigration or cross-border crime;
b) Tracking of vessels or other craft over high seas which are suspected of, or have been identified as, being used for irregular immigration or cross-border crime;
c) Monitoring of designated areas in the maritime domain in order to detect, identify and track vessels and other craft being used for, or suspected of being used for, irregular immigration or cross-border crime;
d) Environmental assessment of designated areas in the maritime domain and at the external land border in order to optimise monitoring and patrolling activities;
e) Selective monitoring of designated pre-frontier areas at the external borders which have been identified through risk analysis and information as being potential departure or transit areas for irregular immigration or cross-border crime.

For these purposes, Frontex shall provide this information by combining and analysing data which may be collected

[8] Global Monitoring for Environment and Security now renamed Copernicus.

[9] GMES – Security Support to EUROSUR. Version 1.0 of 3.12.2009, 95 pages. For EU government use only - no public version available.

[10] 1) Tracking of a vessel over high seas; 2) Punctual monitoring of selected neighbouring third country ports and coasts; 3) Permanent monitoring of close neighbouring third country coasts; 4) Monitoring of the EU external land borders and the pre-frontier area.

[11] GMES Concept of Operations for the common application of surveillance tools at EU level in the context of EUROSUR. Version 2.3 of 29.6.2011, 62 pages. For government use only. A shortened public version is available on http://ec.europa.eu/enterprise/policies/security/files/doc/conops_gmes_en.pdf

[12] A mothership is a vessel carrying several small boats, which are then dropped next to Member States’ coasts.

[13] COM(2011)873final of 12.12.2011.

[14] Compare also to Article 6(1)(d) of the EUROSUR Regulation.

from the following systems, sensors and platforms:

- Ship reporting systems in accordance with their respective legal bases;
- Satellite imagery;
- Sensors mounted on any vehicle, vessel or other craft.

According to the EUROSUR Regulation, Frontex may refuse a request from a national coordination centre for technical, financial or operational reasons. In the event of this taking place, Frontex needs to notify the national coordination centre in due time of the reasons for such a refusal. Frontex may also use these surveillance tools on its own initiative, for collecting information which, for instance, is relevant for establishing the common pre-frontier intelligence picture as defined in Article 11 of the EUROSUR Regulation.

According to Article 18, Frontex shall cooperate with SatCen, EMSA and the European Fisheries Control Agency (EFCA) when providing the common applications of surveillance tools to Member States. In addition, Frontex shall *'make best use of information, capabilities and systems which are already available at European level, such as the European Earth monitoring programme'*[15] – a term used as a placeholder for GMES, now known as the Copernicus programme.

[15] Compare with Recital 6 of the EUROSUR Regulation. Compare also with Article 18(1).

Frontex situation centre. (Credits: Frontex)

The way ahead

Frontex is currently implementing the common application of surveillance tools in line with the provisions of the EUROSUR Regulation and the two concepts mentioned above. Initial services have been available since 2013 and extended services shall be available as of 2015.

For this purpose Frontex signed a service level agreement with **EMSA** in April 2013 and EMSA is already providing Frontex with selected information derived from ship reporting systems. The Commission is currently preparing a revision of the VTMIS Directive[16], which would harness several technical advancements, allowing EMSA to provide additional services to Frontex and the national coordination centres, thereby improving their maritime domain awareness.

Frontex and **SatCen** are in the final stages of negotiations for a separate service level agreement, which will be signed once the mandate of SatCen has been changed later in 2014, allowing SatCen to cooperate with Frontex and other relevant actors. However, Frontex and SatCen are already cooperating in the framework of selected **FP7 projects**[17], which are being used to test and further develop selected sub-services identified in the GMES Concept of Operations of EUROSUR.

[16] Directive 2002/59/EC establishing a community Vessel Traffic Monitoring and Information System and repealing Council Directive 93/75/EEC.

[17] LOBOS (Low time critical Border Surveillance), SAGRES (Service Activations for Growing Eurosur Success) and CLOSEYE (Collaborative evaLuation Of border Surveillance technologies in maritime Environment bY pre-operational validation of innovativE solutions).

EUROSUR and Copernicus – creating synergies at EU level

In the **impact assessment** accompanying the EUROSUR legislative proposal[18] the Commission's preferred option was to establish a close working relationship between Frontex, EMSA and the SatCen, because it *'would build not only on the existing experience, know-how and capabilities of EMSA, SatCen and GMES, but existing contracts with service providers and data distributors could be used, involving cost reductions. […] The financial costs for this European service would be covered initially by Frontex and later on by GMES. […] It is envisaged for this service to be funded by the GMES programme as of 2014'*. In the impact assessment the Commission estimated the **financial costs** for establishing and maintaining the common application of surveillance would amount to 57 M€ for the period 2014-2020. Taking into account current budgetary restrictions, it is likely that the funding to be provided under the Copernicus programme will be lower than this estimate.

In July 2013 the Commission presented its proposal for a Regulation establishing the **Copernicus Programme**[19] and a revised text is expected to be adopted by the European Parliament and Council in spring 2014. The draft Regulation focuses on (1) changing the name for the European Earth monitoring programme from GMES into Copernicus, (2) establishing the governance for its operational phase, allowing the Commission to delegate activities to a number of operators, and (3) providing funding for 2014-2020. The draft Copernicus Regulation lists Border Surveillance as one of future operational services under the Copernicus services for Security applications. The same Regulation allows the Commission to entrust the implementation of the tasks described to Frontex, EMSA and SatCen as 'operators'.

This means that the Copernicus programme, once it has been established in 2014-2015, will enable Frontex, in collaboration with SatCen and EMSA, to move from the existing initial services for the common application of surveillance tools, which Frontex is currently funding from its own limited budget, to the extended services, allowing EUROSUR to be used to its full potential.

[18] SEC(2011)1536final of 12.12.2011. pages 28, 37 and 39.

[19] COM(2013)312final/2 of 12.7.2013.

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Shaping governance models for the Security dimension of Copernicus: findings of the *BRIDGES* project

by Denis Bruckert and Alessandra Ussorio

THE *BRIDGES* FP7 PROJECT[1] HAS STUDIED SEVERAL MODELS OF GOVERNANCE IN ORDER TO SUPPORT THE EUROPEAN COMMISSION (EC) IN THE IMPLEMENTATION AND OPERATIONALISATION OF SUSTAINABLE SERVICES ADDRESSING THE SECURITY DIMENSION OF COPERNICUS, IN PARTICULAR THOSE IN THE AREA OF SUPPORT TO EU EXTERNAL ACTIONS (SEA). THIS WORK WAS CARRIED OUT THROUGH AN EXTENSIVE CONSULTATION PROCESS, INVOLVING MANY STAKEHOLDERS INCLUDING REPRESENTATIVES OF THE EUROPEAN EXTERNAL ACTION SERVICE (EEAS), THE EC'S DIRECTORATE-GENERAL FOR ENTERPRISE AND INDUSTRY (DG ENTR), EU MEMBER STATES, EUROPEAN UNION SATELLITE CENTRE (SATCEN), THE EUROPEAN DEFENCE AGENCY (EDA) AND THE EUROPEAN SPACE AGENCY (ESA). THE OVERALL AIM WAS TO RECOMMEND A SUITABLE GOVERNANCE SCENARIO BY THE END OF 2013. IN THIS ARTICLE, THE AUTHORS REPORT ON THE PROJECT'S ACHIEVEMENTS, OUTCOMES AND RECOMMENDATIONS TAKING INTO ACCOUNT THE VIEWS OF STAKEHOLDERS, AND INCLUDING THE OPINIONS EXPRESSED AT THE *BRIDGES* FINAL WORKSHOP.

Copernicus Security services

The Security dimension of Copernicus encompasses three main areas: Border Surveillance, Maritime Surveillance and Support to EU External Action (SEA). The Copernicus Security services are envisaged to be deployed in 2015; therefore their governance structures and the operational services need to be in place.

The Copernicus Services in Support to EU External Action entered their pre-operational phase in the framework of the *G-NEXT*[2] and *G-SEXTANT*[3] FP7 projects. A service portfolio has been issued within the SEA Working Group under the leadership of DG ENTR following an extensive and detailed consultation with the user community[4], building on the considerable user engagement work performed by precursor projects (e.g. *G-MOSAIC)*. The experience acquired through the *G-NEXT* and *G-SEXTANT* projects clearly indicates that the users require a fully operational service as soon as possible, as the current pre-operational services do not have the capacity to fully meet their needs.

In order to support the EC in the smooth implementation of the service while ensuring the continuity and scaling-up of service provision, the *BRIDGES* consortium has studied the legal and political framework, evaluated different governance options and defined a roadmap for the future development of the services beyond the *BRIDGES* project.

State of play of the legal and political framework

In regard to the political and legal framework, there has been some debate about the framework in which the services in Support to EU External Action should operate during the legislative procedure for the adoption of the Copernicus Regulation. The field of EU External Action is mentioned in the proposed Regulation without restriction or further definitions of the field of application. It includes consequently the support to CFSP/CSDP policies.

> *(f) the security service, which shall provide information in support of the civil security challenges of Europe improving crisis prevention, preparedness and response capacities, in particular for border and maritime surveillance, but also support for the Union's external action, without prejudice to cooperation arrangements which could be concluded between the Commission and various Common Foreign and Security Policy bodies, notably the European Union Satellite Centre (EUSC)*[5].

One of the main concerns expressed during the *BRIDGES* stakeholder consultation was the issue of the protection of the Security interests of the Union and its Member States. SEA services address sensitive topics usually related to the foreign policies of Member States. Particular attention was therefore paid to this consideration during the process of defining the potential governance structures.

This situation also evolved during the legislative procedure of the Copernicus Regulation. The Regulation stipulates that specific measures be taken by the Council in order to counteract risks and threats to the Security of the Union or its Member States. This stipulation is intended to reassure Member States that any sensitivity issues that could potentially arise from the use of high-resolution imagery or Copernicus information service would be addressed appropriately.

Another central question which has been extensively discussed with the stakeholders in *BRIDGES* concerns the *modus operandi* of service implementation. The Regulation proposes two approaches: (i) a centralised approach, if the expertise required for the effective operation of the services exists within the Commission; (ii) a decentralised approach if the operation of the services would require expertise from EU stakeholders not directly employed by Commission Directorates General (DG). An example of the centralised approach is the Emergency Management Service (EMS) operated by DG ECHO and the JRC[6]. If the decentralised approach is adopted, the Commission has already selected several agencies that may become responsible for the implementation of Copernicus services, such as

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[1] Building Relationships and Interactions to Develop GMES/Copernicus for European Security, http://www.gmes-bridges.eu

[2] GMES/Copernicus pre-operational Security services in support of external actions, http://externalaction.security-copernicus.eu

[3] Service provision of geospatial intelligence in EU external actions support, http://externalaction.security-copernicus.eu

[4] The user community includes: the Crisis Management and Planning Directorate (CMPD) of the EEAS, the European Union Military Staff (EUMS), the EDA, the Joint Research Centre (JRC), the European Commission's Directorate-General for Humanitarian Aid and Civil Protection (DG ECHO), the SatCen.

[5] Art. 4, par.1(f) of the Proposal for a regulation of the European Parliament and of the Council establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010.

[6] Joint Research Centre.

the European Maritime Safety Agency (EMSA), Frontex[7] and SatCen. These three agencies are renowned for their expertise in the Security domain; the Commission has already indicated that Frontex and EMSA could have a role in the operations of the Copernicus Border Control and Maritime Surveillance services respectively. In purely logical terms, SatCen would be associated with the field of Support to EU External Action. Given, however, that the SatCen is also a Common Foreign and Security Policy (CFSP) agency, its cooperation with the Commission is a more delicate matter, seen from a legal and financial perspective. The work carried out in the context of the *BRIDGES* project provided clarity on some of these points which are reflected in the Governance Options and the Roadmap proposed by the project.

Governance options

Governance is widely understood to denote the rules and the organisational structures set up to govern a system or an entity. The governance framework adopted for the Security services should respect the rights and interests of the wide range of stakeholders involved in this area, embodying the principles of fairness and consistency.

The provision of Copernicus Security services presents a range of challenges that do not necessarily arise in other areas of application, or in some cases only marginally (for example, the Emergency Management Service does not address the potential security classification of products).

In some cases, a well-defined and functioning governance structure play a decisive role in the services being accessible to the users, in particular if users already have pre-existing or preferred channels for accessing or exchanging information and data. In addition, the governance model has a significant impact on the confidence the users have in the service and therefore on the extent of user uptake.

For example, if governance structures are improperly set up, the following two potential problems – representing opposite and extreme scenarios - may arise:

(i) "Overprotection" (i.e. unnecessary restrictions on distribution) of information, and
(ii) Uncontrolled dissemination of sensitive information.

The consequences of both scenarios are equally undesirable because they contradict two very important principles:

1. On the one hand, the principle of full and open access to Copernicus data;
2. On the other, the protection of sensitive information that could potentially compromise the Security of the EU, Member States and other stakeholders (e.g. a map showing of the location of an Internally Displaced Persons (IDP) camp could be used by hostile forces to plan an attack).

Both scenarios (i) and (ii) have a direct impact on the work of the users and on the Security of EU citizens in a more general sense. The model of governance selected for the Copernicus Security services must strike a balance between the two extreme situations referred by the scenarios, taking into account the importance of ensuring appropriate access to data for stakeholders while also ensuring that any sensitive information is not distributed.

These aspects have been extensively analysed in particular in the context of SEA. One of the key issues is the selection of an appropriate operator for the service. The operator will be responsible for implementing the service in line with the Commission's directives, coordinating user access through a single point of entry and organising service provision in collaboration with industry. Additionally, the operator will also have to ensure that the service activations are authorised by the relevant authorities and that during the provision and distribution of products, sensitive information is treated appropriately.

During the *BRIDGES* final workshop, held on the 30th of January 2014 on the EEAS premises in Brussels, the three governance options assessed by the project were presented to stakeholders. Following further feedback and analysis, two of these options remain under consideration for their potential implementation in the future.

Option 1

The first option is based on a decentralised approach relying on the expertise of SatCen to operate the service. This option is the option preferred by stakeholders, and the one which offers the best cost/benefit ratio, according to the cost/benefit analysis conducted within *BRIDGES*.

According to stakeholders, there are a number of advantages to this approach. The option is in line with the orientation of the Copernicus Regulation involving identifying an agency as a potential operator. This takes into account user requirements and ensures user uptake; SatCen has been involved in the development of the service for several years, and is trained as a service operator (Service Coordinator in *G-NEXT*). Such an approach generates economies of scale and facilitates synergies by using existing EU infrastructure. Information provided by SatCen image analysts could be overlaid with Copernicus data creating integrated EU information services to support EU External Action.

However, there are factors that may compromise the implementation of this option in case the necessary institutional discussions and procedures would suffer delays.

An update of the legal text which describes the functioning of SatCen (the EU SatCen Council Decision) is currently being discussed within the EU institutions and is likely to incorporate measures aimed at facilitating the participation of SatCen in Commission Space programmes; SatCen's role in Copernicus will depend to a large extent on the approval of this text. In addition, the financial rules of SatCen would have to be compatible with the delegation of funds from the Commission (although this issue was examined in *BRIDGES* and not found to create a major obstacle).

The cooperation between Commission and CFSP bodies is a complex issue; it is nevertheless possible, this being confirmed by the text of the latest draft of the Regulation, in which SatCen is mentioned as a potential operator.

Option 2

The second option is a centralised approach which would seek to use the existing operational structures of the Emergency Management Service. This approach has both advantages and disadvantages, which should be considered and compared with those of the first option, if the second is considered for implementation.

The main advantage of the second option is that it might be implemented

[7] European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union.

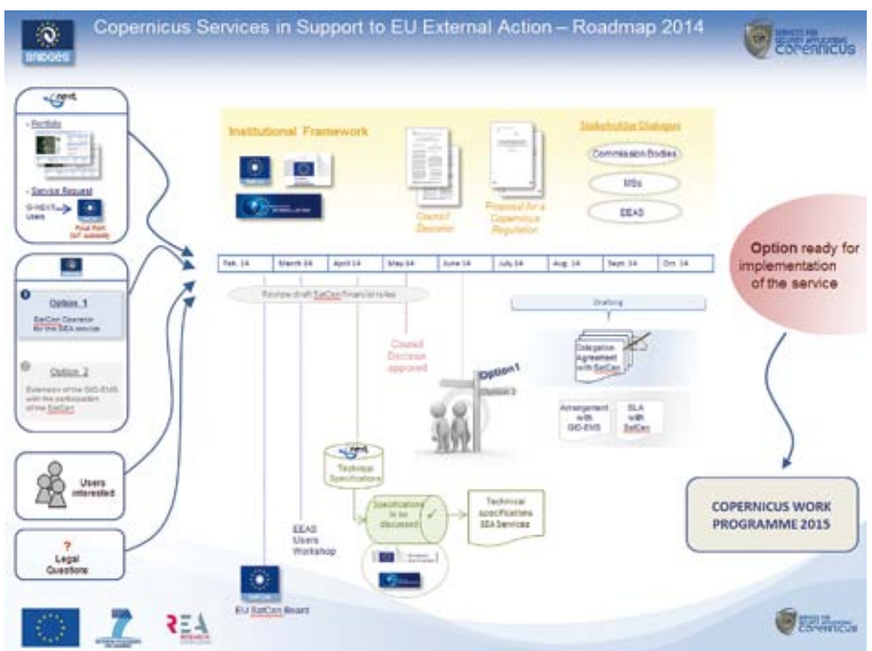
rapidly as it builds on an existing Copernicus service and the fact that there are no legal obstacles to its direct implementation by the Commission DGs.
However as with the first option, there are factors that could delay or hamper the implementation of this second approach. There are currently no mechanisms in place to fully address data sensitivity in the Emergency Management Service; EMS operators (DG ECHO and JRC) do not have existing mechanisms or channels to coordinate access for the External Action user community, and this could lead to the risk of an overlap with SatCen activities.
The full feasibility of implementing either of the two options cannot be assessed at present, since the two key legal documents are still in the process of being adopted: 1) the EU SatCen Council Decision 2) the Copernicus Regulation.
In conclusion, the work undertaken in the context of the *BRIDGES* project shall now be continued at an institutional level (SatCen, EC, EEAS, etc.) and at a technical level (*G-NEXT* and *G-SEXTANT*). A roadmap for this ongoing activity is proposed hereafter.

Roadmap

The below roadmap is proposed in order to progressively implement the Copernicus Services in support to EU External Action. This roadmap needs to fit into the more general deployment of the suite of Copernicus Security services (which also include Maritime Surveillance and Border Surveillance).
The roadmap is designed to prepare for the launch of the services in Support to EU External Action in 2015. More precisely, the roadmap proposes key actions that will be undertaken in a phased process of implementation, from February to September 2014, to deliver the following results to the Commission at the end of 2014:

- A clearly-defined governance model;
- Detailed technical specifications for the service;
- Draft legal documents for the implementation of the service (e.g. SLA, Delegation Agreement, etc.).

The governance model would be selected from the two options proposed after having clarified the legal framework and further discussed the *BRIDGES* project outputs within the SatCen Board, EEAS and the Commission. The timeframe is compatible with the ongoing legislative process including the adoption of the SatCen Council Decision and the Copernicus Regulation, and indicates that the governance option could be ready by June 2014.
The detailed technical specifications for the service could be made available by *G-NEXT* in April / May 2014. These would then need to be discussed further with stakeholders and users including EEAS, SatCen and the Commission, in order to have a comprehensive document ready by June 2014.
From June to September 2014, on the basis of the governance option and technical specifications chosen, legal documents such as administrative arrangements, service level agreements or delegation agreements could be prepared. A possible response from SatCen to a Call for Expressions of Interest in operating the service in Support to EU External Action may also have to be factored in, as well as the possible fine-tuning of SatCen's internal financial rules, if deemed necessary.
During this process it will be crucial to intensify the dialogue in the spirit of transparency amongst all the main actors, particularly between the EEAS, the Commission and SatCen, in order to reach sound decisions respecting both the interests of the stakeholders and the objectives of the programme.
This dialogue is the most effective vehicle for the implementation of the user-driven approach while also safeguarding the integrity of the Security interests of Member States.



The roadmap proposed to progressively implement the Copernicus Security services.

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The European Space Agency's technical support to the Copernicus services for Security applications and the way ahead

by Antonio Ciccolella

EARTH OBSERVATION (EO) FROM SPACE IS AN ESSENTIAL ELEMENT OF COPERNICUS SECURITY APPLICATIONS AND A DIVERSE ARRAY OF SYSTEMS RELATED TO THESE APPLICATIONS EITHER ALREADY EXIST IN EUROPE, OR WILL BE DEVELOPED AT BOTH THE NATIONAL AND INTERNATIONAL LEVELS. EUROPEAN CAPABILITIES IN SPACE CAN ADDRESS A NUMBER OF ENVIRONMENTAL, ECONOMIC AND SECURITY CHALLENGES AT GLOBAL AND/OR REGIONAL SCALES. IT IS ANTICIPATED THAT THE EU WILL NEED TO FURTHER STRENGTHEN ITS ABILITY TO RESPOND TO SUCH CHALLENGES, INCLUDING THOSE IN THE SECURITY DOMAIN, THROUGH BOTH IMPROVED COORDINATION BETWEEN EXISTING ASSETS AND THE DEVELOPMENT OF ITS OWN CAPACITIES. EACH INDIVIDUAL SPACE ASSET AND ITS ASSOCIATED GROUND SEGMENT - WHETHER DESIGNED FOR CIVIL OR DUAL-USE PURPOSES, COULD POTENTIALLY CONTRIBUTE TO A WIDER SYSTEM OF SYSTEMS - AS IN THE CASE OF THE COPERNICUS PROGRAMME.

Introduction

This article presents the results of studies carried out by the European Space Agency (ESA) related to the development of the Security dimension of Copernicus. Specifically, the studies examined the technical feasibility of an "ideal", cooperative System of Systems built on commercial and/or governmental assets owned by entities in European Member States (MS), which would be able to meet observation needs related to EU civil Security.

Background and Scope

In the last decade, the value of the Copernicus programme has been demonstrated through a series of EU and national Research and Development (R&D) projects[1] in the fields of humanitarian aid, conflict early warning and prevention, and Maritime Surveillance[2] (including Border Surveillance) among others[3].

Defining the EU's requirements for Space imagery and remote sensing for the Security dimension of the Copernicus programme is an ongoing process and it covers the three policy domains of Border Surveillance, Maritime Surveillance and Support to EU External Action[4]. The Security component of the Copernicus programme needs to be developed and to this end, a number of activities have been initiated at the institutional level, notably the formation of the Working Group on Support to External Action with the involvement of the relevant Commission services, the General Secretariat of the Council, ESA, and experts from national and EU Agencies.

The Working Group has analysed the lessons learned from research projects in the area of Security - including support to EU peace-keeping operations, intelligence for humanitarian aid operations, border monitoring outside the EU, assessment of Security risks related to urban resilience, food security, water management, and illegal exploitation of natural resources and illicit crops – which has facilitated the identification of a number of user needs related to Earth Observation.

"The value of the Copernicus programme has been demonstrated through a series of EU and national Research and Development (R&D) projects."

The requirements of Security applications in terms of image resolution and speed of delivery are difficult to fulfil with the existing Space infrastructure, which is more suitable for monitoring gradual change, rather than events which unfold rapidly, in near-real time. The limitations relate not only to the physics governing Space mechanics, but also to the financial constraints and to the political willingness to share, at an EU level, high-resolution and near-real time information acquired through national governmental assets.

Security inherently involves national policies and sovereignty issues, intellectual property and data rights, funding models, governance issues and provisions for Information Technology security. It is also crucial to consider the methods and the interfaces which enable users to access several different satellite missions, particularly where interoperability schemes are concerned.

Discussions are underway to analyse how new developments affecting Space technologies can contribute to finding effective solutions to current challenges in areas such as border monitoring, support to EU External Action, Maritime Surveillance, complex emergencies, Humanitarian Aid and Civil Protection.

ESA has actively contributed to these discussions by analysing preliminary user needs generated by institutional working groups and elaborating on them in the form of technical specifications. This activity investigated whether users' needs could be met by harnessing existing – or planned – national or commercial capabilities for improved global performance and, if not, determining how additional Space assets could complement existing Space infrastructure in Europe, for example, by providing better frequency of revisit[5] and better global availability. The underlying hypothesis was that the resulting system would work under a cooperative arrangement.

[1] For example, see http://www.gmes-gmosaic.eu and http://www.emergencyresponse.eu.

[2] GAC Security – DOC N°05 "Maritime Surveillance (MARSUR) requirements for GMES.

[3] GAC Security – DOC N° 01, "The Security Dimension of Copernicus, Status report and proposed way ahead" (background paper), 24.10.08.

[4] Council Resolution: "Global challenges: taking full benefit of European Space systems", Brussels 26/11/2010, Ref. 16864/10.

[5] Satellite Revisit Time refers to the period between two observations (i.e. image acquisitions) of the same point on earth by a satellite. The Revisit Time of a satellite for a particular area is a function of the satellite's orbit and the geographic location of the area.

Mission	Pléiades	Sentinel-2	RapidEye	RapidEye NG	SPOT 5	SPOT 6-7	Ingenio	ALL
Satellites	2	2	5	5	1	2	1	18
Mean - Max Revisit time (day)	*0.8 - 1*	*4.5 - 5*	*1 - 3*	*1 - 3*	*1.2 - 5*	*1.5 - 4*	*3- 4*	*0.3 - 1*

Table 1: Mean and maximum Revisit Times for the main existing or planned optical missions.

ESA is currently complementing this activity by assessing the options for a Ground Segment infrastructure that accounts for elements which may impact the operational availability and flexibility of the cooperative system.
Most of the user needs that have been assessed can be met by imagery with a resolution of less than 1m and a response time of less than 12 hours. These parameters, considered in a global geographic context, constitute the starting point of these studies.
The Space assets of the Copernicus programme include the dedicated Sentinel missions (financed and developed by the EU and ESA) and the "Contributing Missions"(Earth Observation missions financed and developed by MS, which provide complementary data to Copernicus).
A number of optical missions[6] could serve as contributing assets, in addition to Copernicus Sentinels (i.e. Sentinel-2), i.e. Pléiades, RapidEye, RapidEye follow-on, SPOT 5, SPOT 6-7, SEOSat/Ingenio, DMC3, EnMAP, PRISMA and VENμS.
Various numerical simulations have been performed in order to assess the Revisit Time (RT) of each existing asset as well as that of all the missions combined, as an integrated system. Due to both the flexibility and the field of view of the optical instrument, Pléiades provides the maximum possible Revisit Time for the constellation in a single orbital plane (i.e. 24 hours of "true" RT, taking into account the fact that an optical instrument cannot function at night). In addition, all the candidate missions fly in approximately the same orbital plane (Local Time Descending Node (LTDN) between 10:00 and 11:00). Therefore, even treating all of them together as a single constellation, there is no improvement to the overall Revisit Time. On the other hand, the average number of observations increases, resulting in better acquisition capacity and data availability.

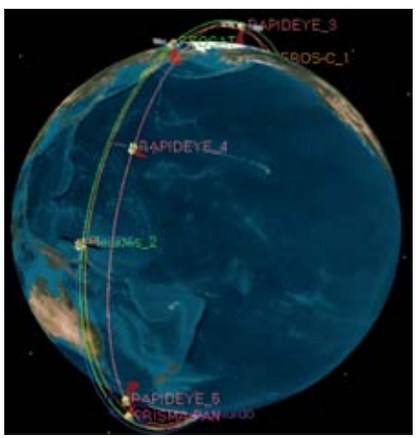

Figure 1 – Orbital configuration of current or planned optical satellites. (Credits: ESA)

[6] "Optical missions" refers to 'Copernicus Contributing Missions' and Sentinels carrying optical imagers. More information is available at: http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Optical_missions.

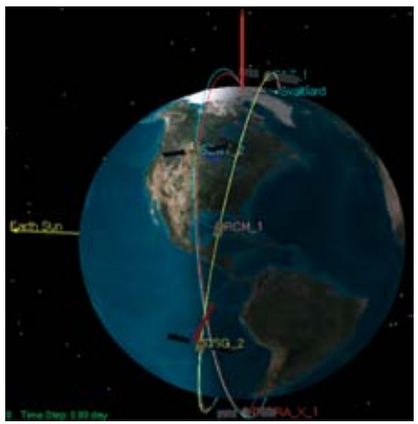

Figure 2 – Orbital configuration of current or planned satellites carrying SAR instruments. (Credits: ESA)

In quantitative terms, combining all the national and European optical missions and assuming that all of them function synergistically as a constellation, we note (in Table 1) that the overall maximum RT performance is roughly equivalent to the performance of the best contributor, i.e. the Pléiades satellites, which also have the best resolution (0.7 m).

In the same way, several Synthetic Aperture Radar (SAR) missions[7] have been considered for inclusion as assets in the Contributing Missions programme, i.e. TerraSAR-X, TanDEM-X, COSMO-SkyMed, RADARSAT, PAZ, in complement to Sentinel-1. Numerical simulations were performed to assess the Revisit Time of all the missions (treated as an integrated system), offering results similar to those of the optical missions.
All of the SAR mission candidates fly in approximately the same orbital plane (Dawn–Dusk Sun Synchronous Orbit (SSO) i.e. 06:00 local time). This means that whilst there is no improvement to the overall Revisit Time, the integrated constellation does yield better acquisition capacity and data availability.
Hence, also combining all the national and European SAR missions and assuming that they operate synergistically as a

[7] Synthetic Aperture Radar (SAR) missions refer to satellites carrying SAR instruments. More information is available at: http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/SAR_missions.

Mission	Sentinel-1	TerraSAR-X TanDEM-X	Cosmo-SkyMed	RCM	PAZ	CSK NG	ALL
Satellites	2	2	4	3	1	2	14
Mean - Max Revisit time (h)	*50 -120*	*38 - 95*	*6 - 12*	*9 - 36*	*36 - 86*	*12 - 36*	*4 - 12*

Table 2: Mean and maximum Revisit Times for the main existing or planned SAR missions.

Mission	Pléiades	Cosmo-SkyMed	Pléiades + Cosmo-SkyMed	All SAR + OPT
Satellites	2	4	6	32
Mean - Max Revisit time (h)	*20 - 24*	*6 - 12*	*5 - 12*	*3 - 12*

Table 3: Mean and maximum Revisit Times for the combined Pléiades and COSMO-SkyMed systems.

single constellation, note (Table 2) that the overall maximum RT performance is roughly equivalent to the performance of the best contributor, i.e. the COSMO-SkyMed constellation, which has also the best resolution (1 m).
If we considered a global constellation encompassing the combined system of the best contributor of SAR and Optical spacecraft in terms of Revisit Time, we would achieve a global maximum Revisit Time of 12 h, as shown in Table 3.
The responsiveness also depends heavily on the efficiency of the satellite tasking and data downlinking as well as on the performance of the dissemination network.

Figure 4: shows the main system performance parameters during systematic observation of a specific region (Ground Segment activities are shown in blue, Space Segment activities in green).
The theoretical maximum time for uploading commands using the current set-up is approximately 90 minutes, which is based on the use of near-polar ground stations. It has been noted that the existing and planned assets of Member States, assumed to operate synergistically as an integrated constellation, do not match some of the operational requirements of EU External Action users (such as the maximum response time being within 12 hours for requests made at short notice, and the capability of frequent image acquisition throughout the day and night).
It is worth highlighting once again that the above considerations assume a fully cooperative concept of operations, with no delay in the response time - which is the ideal situation.
It is logical that by complementing the existing missions with similar ones in different orbital planes, it is technically

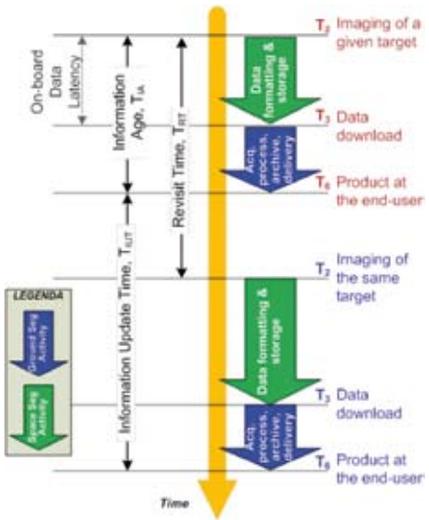

Figure 4 – Performance parameters during systematic observation of a specific region.

possible to considerably reduce the Revisit Time and, consequently, the overall response time. The extent of this reduction depends on several parameters, such as the number of orbital planes, the number of spacecraft in each orbit and the use of data relay satellites for each Space Segment.
The performance of Earth Observation systems also relies heavily on the efficiency of the network of ground stations. For best performance, it is necessary either to acquire imagery on "ascending" passes (i.e. when the satellite is moving from south to north with reference to the Earth's poles), with the data then being transmitted to a polar receiving station, or to have the possibility of transmitting data through a Data Relay Satellite[8].

[8] Through a Data Relay Satellite, users may eventually have the option of receiving raw satellite data directly, without the use of ground stations. This option remains still highly hypothetical as there are many political and technical issues to be resolved.

In order to fulfil the need for real-time responsiveness (i.e. without prior notice), the available options include the use of geostationary satellites with high resolution (in the order of a few metres), a constellation of optical Medium Earth Orbit (MEO) satellites or several Low Earth Orbit (LEO) constellations. Other means of observation (e.g. hyperspectral, thermal infrared) can also be considered to fill the gaps with the current Space systems.

Examples of potential short term solutions to improve performance

The civil and commercial assets of ESA and EU Member States are the reference constellation, assumed to form a cooperative System of Systems, the performance of which will be enhanced with additional spacecraft in optimised orbital planes. This is coherent with the spirit of Copernicus, which is based on building upon existing Space infrastructure to enhance the sustainability of the programme.

The main user requirements driving the definition of options are:

- Type of products (e.g. reference and thematic mapping, Digital Elevation Models, detection of changes, detection of moving targets);
- Quality of products (geometrical and spectral resolution, radiometric requirements, geo-location);
- Responsiveness of the system and data latency (revisit, tasking time, data downlink, processing and dissemination as the main contributors);
- Geographical coverage either at regional or global level;
- The possibility of either systematic or interactive acquisition;
- Time of observation;
- Data security, which encompasses both user requests and imagery data;
- Interoperability with other systems and other sources of data.

Various Low Earth Orbit observation options have been assessed in order to make the most appropriate choice of constellation parameters (type of orbits - SSO or inclined, altitude, planes, number of satellites) and performance requirements (swath, resolution and responsiveness).
A simple and intuitive option (which meets the responsiveness requirement of less than 12 h for metric and sub-metric resolution) consists of complementing the existing assets with:

Space Segment	2 Optical Satellites, Panchromatic, Multispectral VIS-NIR; ≤ 1 m GSD, SSO at 14:00/15:00 LTAN; 4 SAR Satellites, X-Band; ≤ 1 m GSD, SSO at 11:00/12:00 or 14:00 LTAN
Ground Segment	*Dedicated FOS and PDGS;* *Cross Mission Coordination;* *Use of Polar Stations ad/or EDRS for tasking and data link;* *Distributed Added-Value data processing*
Imaging Capability	Global Coverage; Observation night and day, combination optical and SAR; Capability ≥ 100 scenes per day per satellite
Acquisition Performances	*Systematic or interactive acquisition; Accessibility based on agility; Responsiveness ≤ 12 h; Revisit time: 6-8 h*

Table 4: The main features of a possible add-on system incorporating optical and SAR missions.

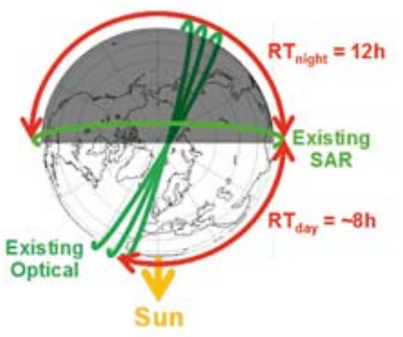

Figure 5: Current SAR/optical Revisit Times. (Credits: ESA)

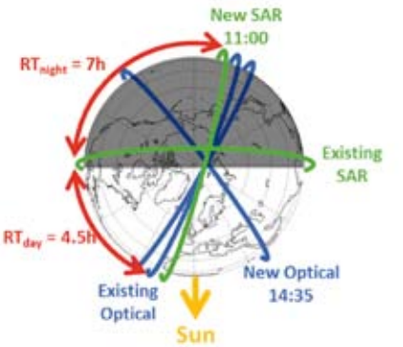

Figure 6: Improved SAR/optical Revisit Times. (Credits: ESA)

1) two or more agile[9] high resolution families of optical satellites, and
2) four radar satellites in Low Earth Orbit, on two different orbital planes.

The SAR satellites will provide initial detection capabilities in all weather conditions. The set of agile, high performance optical systems which complement the SAR satellites allow global coverage at high resolution, for the purposes of detailed feature recognition and identification. The SAR satellites will also ensure coverage during the night.
There are no technological limitations for either optical or SAR missions. The required resolution and coverage are already being achieved by existing technologies or by those planned in the short term by European industry. A summary of the features of the proposed "add-on" system is illustrated in Table 4 (p. 59).
Imagery from other, additional SAR satellites will complement optical information with high resolution modes, in order to improve responsiveness. These complementary sensors will operate in synergy with the Sentinel missions, with the national contributing missions (Pléiades, TerraSAR-X, COSMO-SkyMed, etc.) and non-Space assets when deemed necessary.
The improvement in the Revisit Times with the new proposed system is clearly depicted in Figures 5 and 6.

"Copernicus services for Security applications will depend on a variety of existing and planned assets of different types, owned by different entities."

Ground Segment System of Systems

The importance of the "System of Systems" concept has been highlighted by a Task Force examining civil/military synergies in the field of Earth Observation, which includes representatives from the European Commission (EC), the European Defence Agency, the European Space Agency (ESA) and the Secretariat of the EU Council.

[9] 'Agile' spacecraft refers to satellites equipped with a manoeuvrable platform and sensors.

The Task Force has expressed the view that in the short term, priority should be given to analysing the Ground Segments (ground infrastructure required for the operation of satellites and the reception of data). This analysis will pave the way for assessing the application of the "System of Systems" concept in the civil domain, and will allow ESA to identify the potential civil/military synergies of such concepts at a European level, together with the other relevant organisations, in particular EDA. While ESA will address the technical aspects of the civil domain, EDA will focus on both the governance and data policy elements and the use of military assets, which could also be combined with civilian assets. The study will investigate the technical feasibility of the Ground Segments of future civil or dual use Earth Observation systems, to deliver services for Security applications on an *ad hoc* basis.

Copernicus services for Security applications will depend on a variety of existing and planned assets of different types, owned by different entities. These assets include ESA, EU and MS systems, European commercial systems and even commercial systems from outside Europe. Access and usage of data from these assets are limited by various constraints, which have to be taken into account during the development and implementation of the services, and of the associated infrastructure.

As the Ground Segments contain the necessary interfaces for requesting and accessing data from national and commercial assets of different types, a comprehensive Earth Observation approach for EU civil Security could be obtained by connecting them in a network, and therefore enhancing efficiency and sustainability through the coordination of existing or planned systems.
The individual Ground Segments can be regarded as potential components of a wider System of Systems, participating on a voluntary basis and under specific conditions. The coordination of civil national or commercial Space infrastructure may be constrained by:

1. The governance scheme, which may include provisions on shutter control (the prerogative of the owners and legal restrictions for data distribution);
2. The business cases of commercial providers, which may involve exclusivity arrangements;
3. The control, identification and clearance of the users.

The points listed above could affect the operational availability and flexibility of the cooperative system. They imply the need for a detailed analysis of the required levels of interoperability between the various constituent Ground Segments and their associated assets, which is an essential part of any joint undertaking.

Data security aspects are intrinsic to the definition of these applications and involve, *inter alia*, functions such as:

- Assessment of the sensitivity of the original data;
- The restriction of data quality;
- Evaluation of user type (e.g. international or European institution) and background information;
- Data integrity;
- Confidentiality of data requests.

The expected outcome of the study is the definition of options for the feasibility of a civil infrastructure which enables users to access data from a constellation of EO missions, which takes into

account the associated programmatic conditions derived from the relevant technical specifications.

Conclusions

This article has described the results of the active contribution of ESA to the institutional discussions on the use of Space for Security-related issues in Europe, within a coherent institutional framework, reaffirming the role of ESA as the technical focal point for Copernicus and, specifically, for the Security-related Space infrastructure. This contribution exists because the cooperation among all actors (EU, ESA, EDA, and industry) has proven fruitful and efficient.

It has presented the results of a study assessing the options for a Space and ground infrastructure that can fulfil the observation needs stemming from potential EU Security requirements.

In addition, the study has highlighted some of the work now in progress on the feasibility of an infrastructure that enables users to access data from a constellation of EO missions, accounting for constraints imposed by programmatic conditions, including issues of national Security.

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Perspective of Industry on the Copernicus services for Security applications

by Geoff Sawyer

THE EARTH OBSERVATION (EO) SERVICES INDUSTRY IN EUROPE IS COMPRISED OF A YOUNG, VIBRANT AND DYNAMIC SET OF COMPANIES WHICH SUPPLY EO GEO-INFORMATION SERVICES TO A LARGE NUMBER OF CUSTOMERS, OFFERING A WIDE RANGE OF APPLICATIONS. IN THE NEXT FEW YEARS, THE EUROPEAN UNION'S (EU) COPERNICUS PROGRAMME PROMISES TO DRIVE FORWARD MANY CHANGES IN THE SECTOR.

As the first truly operational civilian programme gathering EO data in order to deliver services, Copernicus will ensure that large volumes of satellite data are readily accessible and that new products and services are available and operational for European policy makers and other decision-makers. Copernicus[1] has the explicit goal of delivering economic growth in the downstream sector[2].
As one of the six Copernicus services, the products delivered by the services for Security applications will serve European institutions such as Frontex[3] and the European External Action Service (EEAS) as well as national authorities responsible for Security (such as coast and border guards, law enforcement agencies and port authorities). European industry has many capabilities (such as skills, resources and technical expertise) which can support the delivery of these services.

Security and Copernicus

The Security element of Copernicus (i.e. the "S" in GMES) has a particular dimension not seen in the other Copernicus services. Sometimes perceived as being closely linked to the needs of defence, Security is mainly concerned with the awareness and prevention of danger and risk to European citizens. These dangers or risks can lead to the deployment of peacekeeping and crisis management operations in territories outside of Europe, as they pose a threat to the EU due to economic or political interests as well as the more direct need to safeguard the integrity of European borders.
Hence, Copernicus is expected to support a number of different policy areas under the banner of the services for

[1] Formerly known as GMES, Global Monitoring for Environment and Security.

[2] Here the downstream sector means both value added service providers and satellite data providers (who are often also satellite operators). The latter is sometimes referred to as the "midstream"; for the purposes of this article, the term "downstream" will be used to refer to both sectors, as distinct from the "upstream" sector which is concerned with the manufacture and launch of satellites.

[3] The European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union.

Security applications, including those linked to crisis prevention, border control, Maritime Security as well as the detection and monitoring of Security threats. The provision of these services can benefit from a partnership between the public and private sectors.

G-MOSAIC, one of the earlier Copernicus projects which aimed to develop services for Security applications, identified five areas of application:

- **Crisis management**: Supporting peacekeeping and conflict-related crisis management operations abroad through rapid geospatial intelligence; post-crisis reconstruction, rehabilitation and resilience monitoring.
- **Critical assets**: Monitoring and assessment of manmade structures or natural elements, the disruption, destruction or alteration of which may cause problems for the Security of EU Member States and citizens.
- **Migration and borders**: Monitoring of borders, migration routes and temporary settlements, improving the intelligence available and informing the allocation of Security resources along borders.
- **Natural resources**: Monitoring the exploitation and/or degradation of natural resources and other potential indicators of regional conflict, in order to facilitate the preparedness and effectiveness of EU intervention.
- **Non-proliferation**: Monitoring nuclear decommissioning sites in support of the monitoring of compliance with non-proliferation treaties, both as a deterrent to treaty non-compliance and as an aid to enforcement operations.

These rely on a mix of different types of satellite data: optical and radar, very high resolution and low resolution, large scale (wide area) and local. This mix can be supplied from a combination of publicly and privately owned systems.

"The private sector has both the assets and the competencies to make a valuable contribution to public sector customers in the field of Security."

EO Industry

The European EO services industry comprises over 300 companies spread over most of the EU Member States. Whilst the greatest numbers can be found in those countries which have traditionally built capacity based on Space technologies, in the area of Space-related applications the same limitations do not apply and the need for local services has encouraged companies to become established in countries that have little or no Space heritage.

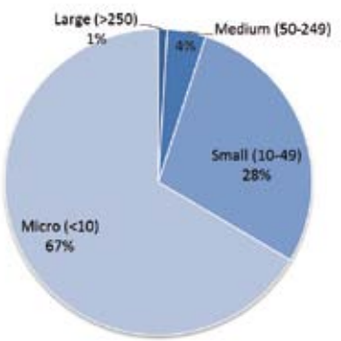
The great majority[4] of these companies are Small and Medium Enterprises (SMEs) and indeed, only 16 of them (5%) have more than 50 employees. This seems to indicate a sector undergoing significant development as new micro-enterprises have been created with the potential to grow into larger ones. The last few years have seen a growth rate in the number of companies of around 8% per annum.

The sector embraces both companies that supply satellite data and those that supply geo-information. The satellite operators offer commercial data from their own satellites and this is complemented by data coming from other Third Party Missions (TPMs) and distributed by European resellers, some of which receive the data directly from their ground stations. The majority of these resellers are also value-adding companies.

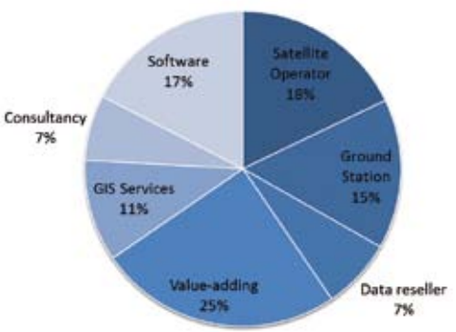
The value-adding companies take the satellite data and use this to generate geo-information products. Many more of these companies have been created as the entry barriers and the level of investment are significantly lower, when compared with those associated with the operation of satellites. Whilst it is estimated that there are 15 companies which are either satellite operators or ground station operators, the remaining 285 are generally value-added service providers. Despite the difference between the number of companies operating satellites and value-adding companies, the total sales of data compared with those of value-added products in Europe are about the same.

The market served by EO geo-information products and services is very wide. EARSC (European Association of Remote Sensing Companies) has split this into 23 market segments, the largest of which addresses Security needs.

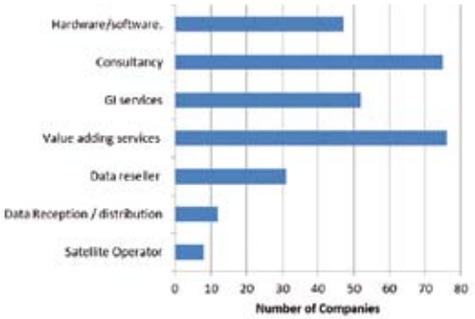
[4] The figures and data reported hereafter are drawn from the study 'A Survey into the State and Health of the European EO Services Industry' prepared by EARSC under assignment from ESA in September 2013.



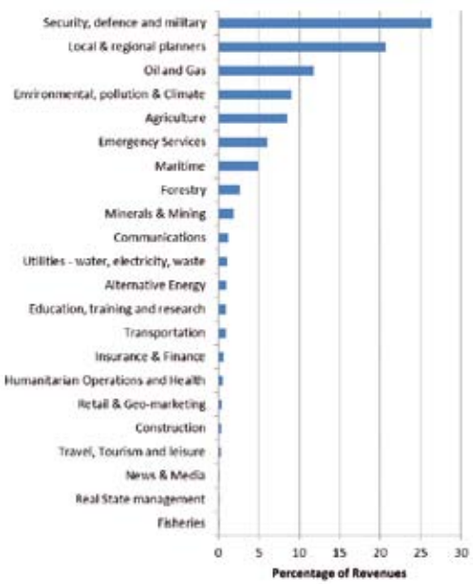
Percentage breakdown of EO service companies by size (number of employees). (Credits: EARSC, 2013)



Percentage breakdown of sector revenues by activity. (Credits: EARSC, 2013)



Number of companies in each activity. (Credits: EARSC, 2013)



Percentage revenues by market category. (Credits: EARSC, 2013)

Whilst the figures shown cover both data and information, there are over 50 companies (representing some 50% of those interviewed) involved in selling to the Security market. These cover many different thematic applications including maritime surveillance, land cover and population movements, which are not uniquely applicable to Security and which are supplied to other customers as well. This high proportion confirms that there is a demand for information products as well as for data (although the survey results do not make a distinction between the two markets).

What can the EO services industry offer?

The private sector has both the assets and the competencies to make a valuable contribution to public sector customers in the field of Security, and can offer both satellite data and geo-information products.

High resolution data is the bedrock of many products for Security applications. Several companies in Europe and North America have taken the step of investing in their own satellite systems in order to supply data. Uniquely, European satellite operators can offer both radar and optical data at very high resolutions, which can complement the public systems such as the Sentinels. Copernicus enables this through the Contributing Missions programme, which is the source of high and very high resolution imagery for use by European decision-makers.

This mixed approach provides a means of ensuring the most effective combination of resources. Whilst satellite data of low or moderate resolution has a relatively low value, this rises rapidly as the resolution drops below the 10m limit of the Sentinel satellites. Whilst low resolution data can best be served through public missions, the value of the market for high resolution data is sufficient to attract and justify private sector funding. As the use of satellite data and geo-information increases, stimulated by the Copernicus programme, it is anticipated that there will be further discussion on using private investments to meet public needs.

If privately-sourced data is used for Security purposes, what does this mean for the security of the data and the system itself? Policy regimes exist in Member States in which companies offering data are based. These regimes place a clear responsibility on the satellite operator to ensure that imagery which covers sensitive areas is not released. These regimes are not always the same and the European Commission has recently started to discuss the idea of introducing European legislation to control the distribution of sensitive satellite data. Whilst in general, these national regimes are fully protective of the data, they differ in terms of application between countries (in particular, regarding the resolution at which they should take effect) - some harmonisation in this respect could therefore be useful.

Regarding geo-information products, the full range of capabilities exists in the private sector and industryis willing and able to supply authorities in the field of Security. Many services developed under *G-MOSAIC*[5], *DOLPHIN*[6], *LIMES*[7], G-NEXT[8], LOBOS[9], and other FP[10] and GSE[11] projects are ready to be deployed operationally for Copernicus.

"Significant pressure on public budgets means that a partnership approach may offer a mutually beneficial outcome."

Role of Industry

The role of industry in the Copernicus programme has two aspects. Firstly, as a supplier of products and services that meet the needs of the European public sector and secondly, based on the competencies developed to supply these public sector customers in Europe, companies can expand by exploring new business opportunities with other customers in the private sector, or in public administrations outside of Europe.

As noted previously, whilst the private sector can offer both EO data and geo-information products, some public sector organisations (particularly in the Security domain) would prefer to buy only the satellite data and then to use internal resources to create their own geo-information products. This approach is well-understood, and the rationale may stem from reasons of efficiency, security concerns or simply because the capability already exists. Nevertheless, the loss of this part of the market may make it harder for industry to develop and maintain similar competencies to supply other customers. The ultimate cost to the public organisation may be higher and the public-private balance should be carefully examined in the context of real public needs and economic policy objectives.

As a supplier of Copernicus products in the field of Security, industry should be encouraged to remain competitive through appropriate procurement mechanisms, with rules which recognise the national or European dimension of Copernicus and which place an emphasis on quality as well as on price.

Industry will then be well-placed to develop the second aspect of its role in the programme, by taking products which are designed for one customer and selling them to other customers engaged in different activities. Indeed, this can be seen as a fundamental strength of industry. It also means that customers benefit – whether they are in the public or private sectors – as the cost of developing specific products is spread (amortised) over many customers, and the price is consequently reduced. Conversely, if there is insufficient demand for a specific type of product then the customer will pay a higher price, which may lead to the product becoming economically unviable.

A further role of industry will be to bring private capital to future investments in new data sources, including satellite systems, and in developing new products and services. Significant pressure on public budgets means that a partnership approach may offer a mutually beneficial outcome. Industry is able to bring private investment when the business conditions are appropriate. A clear understanding of the relevant roles of the public and private sectors is crucial, as is the confidence that boundaries, once established, do not change.

[5] GMES Services for Management of Operations, Situation Awareness and Intelligence for regional Crises.

[6] Development of Pre-Operational Services for Highly Innovative Maritime Surveillance Capabilities.

[7] Land and sea Integrated Monitoring for European Security.

[8] GMES pre-operational Security services for supporting external actions.

[9] LOW time critical BOrder Surveillance.

[10] Framework Programme, referring to the Framework Programmes for Research and Technological Development of the European Union (mostly FP6 and FP7).

[11] GMES Service Element, referring to the programme funded by ESA.

"Putting the user in control of the operational services is a fundamental priority."

Governance

The governance of Copernicus is an important element of its implementation. The services for Security applications have certain domain-specific elements but other than those, and in common with all the Copernicus services, they should be led and determined by users. Putting the user in control of the operational services is a fundamental priority. As the overall programme manager of a system designed to deliver public information, the European Commission has the responsibility to ensure that the products developed under each service are done so in an efficient way which minimises duplication. This will necessitate close interaction between the Emergency Management Service and the services for Security applications. The governance structure must allow for, and indeed, facilitate, this interaction.

Although the public sector user must drive the evolution of the services, the involvement of the private sector is also important; for two reasons:

- Industry will bring private investment to the development of new products and services. For this to be supported by an adequate business case, the conditions and actions of the public sector customer must be well-understood. A stable investment environment is extremely important and the roles of the public and private actors must be clear. Hence, in any discussion that involves new products and services, an industrial perspective should be considered.
- Industry's role in leveraging the public investment in Copernicus and, through this, generating more business, employment and taxes also requires an industrial perspective. Giving industry access to the data, and ensuring that the necessary competencies are maintained are prerequisites for taking the European Copernicus products and services into new markets.

With regard to identifying the most suitable public body to take responsibility for the overall management of the services for Security applications, industry has no particular perspective on this matter other than that it should be an organisation with an operational role as a customer or user of Security-related geo-information products.

Sensitive Information

The Security of citizens is a core public responsibility, and the role of the public sector is central in the Copernicus programme. Concerns over confidentiality and the security of data and information mean that control over the use, dissemination and transparency of products becomes critical. Nevertheless, if industry is to sell similar products to other customers, the extent of this form of control must be reasonable. Hence, a close relationship between the public and private sectors is essential to finding the optimum approach.

The process by which sensitive information is controlled must be kept as simple as possible. Governance structures for the Copernicus services for Security applications have not yet been formalised, and the opportunity to develop a streamlined approach is available. At present, companies are responsible for ensuring that data sales respect national security requirements. A similar approach should be used for Copernicus. In other words, the conditions under which there could be security concerns regarding the sale of a particular product should be clearly defined. It would then be the responsibility of the company to ensure that these rules are respected, and – if there is any doubt – to make the necessary checks with the appropriate authority.

Which authority? In the case of Copernicus there are likely to be both national and European constraints to meet. What is acceptable in one EU Member State may not be acceptable in another. The use of EU resources will dictate that a common set of rules is applied. It is not currently clear how this aspect of the governance will be implemented and which organisation will be responsible for clearing requests. The industry requirement would be that such requests are processed quickly and without ambiguity.

The FP7 project, *BRIDGES*[12], being conducted under the leadership of the European Union Satellite Centre, is examining the possible governance structures for the Copernicus services for Security applications.

Conclusion

Industry anticipates that it will play an essential role in the supply of products for the Copernicus services for Security applications. This will comprise the supply of both data (from privately owned, high resolution satellites) and geo-information products. Industry also anticipates that it will be able to exploit these assets and competencies in developing additional business opportunities in both the commercial and export markets. Industry views will need to be incorporated into the design and evolution of Copernicus and the governance model selected should minimise the impact on industry serving these new markets (specifically in terms of delays). A stable operating environment and a well-developed relationship between public and private actors will enable private sector investments to support the fulfilment of future public needs.

[12] Building Relationships and Interactions to Develop GMES for European Security.

Geoff SAWYER is an independent consultant in Brussels and Secretary General of EARSC (European Association of Remote Sensing Companies). Geoff has followed a long and varied career, holding senior management positions in the Space industry as well as numerous representative positions in the UK and Europe. These include three years as the chairman of EARSC (from 1991 to 1995) and as a member of several EU consultative bodies such as Spassec (for Space and Security) and the SecAG (Security Advisory Group). Geoff began his career as a radar systems engineer responsible for the ERS-1 synthetic aperture radar (SAR) and continued until recently as EADS Vice President Corporate Strategist for Space. In addition to his extensive industrial experience, Geoff spent three years working for the European Commission where he was responsible for supporting Space policy and, in particular, the creation of the GMES initiative. Geoff is well-known to many in the Space and Earth Observation sectors and brings his wealth of experience and knowledge to support the ambitions of the geo-information industry that EARSC represents.

Towards the sound management of fisheries: what *DOLPHIN* brings to Fisheries Control

FISHERIES CONTROL TACKLES THE ISSUES RELATED TO THE CONTROL AND MONITORING OF FISHERIES ACTIVITIES, AND TO COMBATING ILLEGAL, UNREPORTED AND UNREGULATED (IUU) FISHING. IUU FISHING IS A WORLDWIDE PHENOMENON: ITS IMPACT AND ITS ENVIRONMENTAL, ECONOMIC AND SOCIAL CONSEQUENCES ARE SUCH THAT IT HAS BECOME A HIGH PRIORITY ISSUE AT INTERNATIONAL LEVEL. THEREFORE, IN ORDER TO MANAGE FISHING ACTIVITIES EFFECTIVELY AND FAIRLY, IT IS NECESSARY TO "MONITOR" THE ACTIVITIES OF THE ENTIRE SUPPLY CHAIN USING THE MOST SUITABLE AND TECHNOLOGICALLY ADVANCED MEANS.

Lieutenant Luigia CALAZZO
(Italian Coast Guard- ITCG)

"The Remote Sensing-based services, integrated with cooperative systems like the Vessel Monitoring System (VMS), represent a valid support mechanism to detect, with a higher level of accuracy, fishing activities in areas where these are banned. In addition, higher resolution images allow the detection of other kinds of features like fishing cages, and contribute to improving Situation Awareness in the Fisheries Control domain."

Lieutenant (ITCG) Luigia CALAZZO
Italian Fisheries Monitoring Center (FMC), Satellite Monitoring Section.

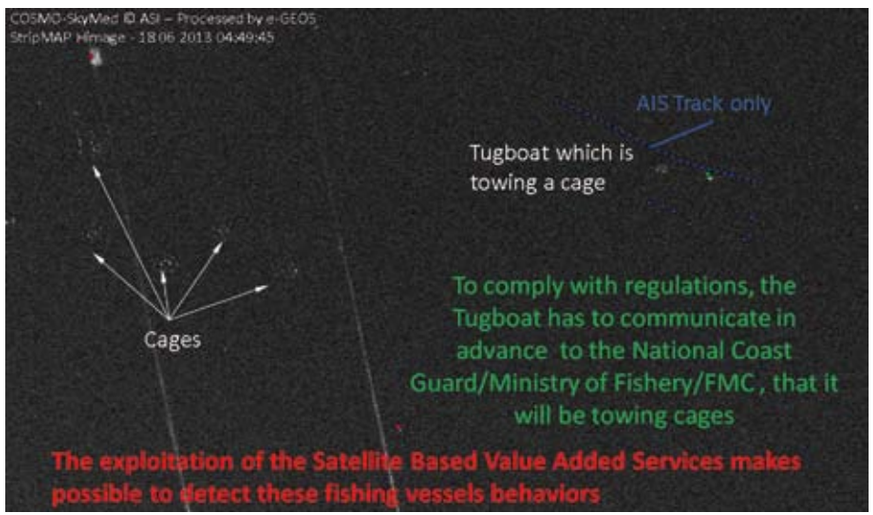
The Italian Coast Guard experience with the Copernicus programme is related to several projects, including the DOLPHIN *FP7 project and ESA's* MARISS *project (Maritime Security Services). (Credits: Italian Coast Guard)*

The *DOLPHIN* (Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities) project

Drawing on the benefits from the past and on-going efforts in the context of the Copernicus programme (previously GMES), the *DOLPHIN* project (http://www.gmes-dolphin.eu), co-ordinated by e-GEOS, has developed key technological and operational gap-filling innovations, that pave the way to the full and sustainable operational exploitation of Earth Observation (EO) Satellite capabilities in the EU and Member States' maritime policies.
DOLPHIN aimed to develop new tools to provide effective improvements to the state-of-the-art capabilities in Maritime Surveillance in three main policy areas: Fisheries Control, Border Surveillance and Traffic Safety.

Operational scenario in collaboration with the Italian Coast Guard

Within *DOLPHIN* a validation exercise was performed between the 17th and the 20th of June 2013 during the 'Blue Fin Tuna campaign'. Its purpose was to assess the added-value of satellite data exploitation in suppporting the Fisheries Control activities of the European Fisheries Control Agency (EFCA) and the Italian Coast Guard (ICG). Satellite-based value-added services made it possible to detect the anomalous behaviour of fishing vessels.

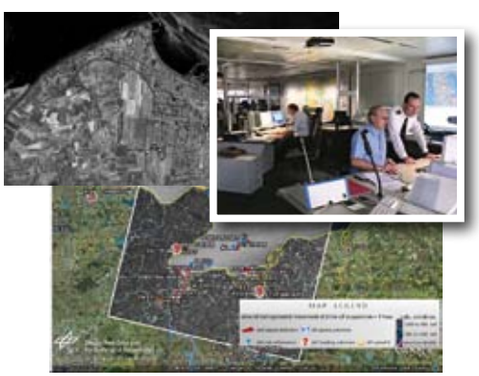


Product developed in the framework of the DOLPHIN*'s 'Blue Fin Tuna Campaign'. (Credits: COSMO-SkyMed © ASI – Processed by e-GEOS)*

Copernicus support to German Federal Police in the Surveillance of the external Schengen border in the North and Baltic Seas

THE GERMAN FEDERAL POLICE FALL UNDER THE AUTHORITY OF THE FEDERAL MINISTRY OF THE INTERIOR. WITHIN THE SECURITY FRAMEWORK OF THE FEDERAL REPUBLIC OF GERMANY. THE FEDERAL POLICE UNDERTAKE EXTENSIVE AND VARIED POLICE DUTIES GOVERNED BY THE *FEDERAL POLICE ACT*, AS WELL AS NUMEROUS OTHER PIECES OF LEGISLATION INCLUDING THE *RESIDENCE ACT*, THE *ASYLUM PROCEDURE ACT* AND THE *AVIATION SECURITY ACT*.

Offshore vessels in action.
(Credits: German Federal Police)



Use of satellite data in a control centre. (Credits: German Federal Police)

MARISS and *DOLPHIN*: Federal Police cooperation with the German Aeronautics and Space Research Centre (DLR)

"Since 2008, the Federal Police have been cooperating closely with the German Aeronautics and Space Research Center (DLR) in conducting research into improving Maritime Security. This cooperation includes both national and international projects, such as MARISS[1] *and* DOLPHIN[2]. *The Federal Police are particularly keen to further develop their own capabilities in respect to Maritime Surveillance. One focus of research has therefore been the detection of smaller boats and larger ships at sea using radar satellites.*
In a number of joint campaigns, the radar data collected from satellites and ground stations were combined with in situ *data and transmitted to the Federal Police in Near Real-Time (NRT) for analysis and operational use."*

Police Chief Inspector Olaf JUHL
German Federal Police

[1] *MARISS*: Maritime Security Services project

[2] *DOLPHIN*: Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities

Organisation and duties of the German Federal Police Naval Division

The maritime arm of the Federal Police is responsible for border protection of Germany's 700 km maritime border in the North and Baltic Sea, which is also an external border of the Schengen Area. It is therefore subject to the provisions of the Schengen Borders Code in its surveillance of cross-border traffic. For this purpose, the Federal Police Naval division monitors and controls cross-border traffic at sea and in ports in order to avert dangers and to prevent illegal entry into the Country.

As waterway police, the Federal Police monitor and control maritime traffic outside German territorial waters. Their work includes identifying violations of environmental protection regulations.
Fisheries surveillance and the surveillance of underwater operations, marine mining and research activities in the area of the German continental shelf also fall within the scope of responsibility of the Naval Division.
The Federal Police Naval Division has a Maritime Detection and Investigation Unit. This unit is responsible for investigating incidents such as accidents at sea, piracy and other issues involving German ships outside the country's territorial waters.

The Federal Police's Piracy Prevention Centre produces risk analyses and provides advice and training to German shipping companies on issues such as attacks by pirates.
The Federal Police Naval Division has six offshore vessels, five coastal patrol boats and seven seaworthy helicopters at its disposal to fulfil the above operational duties.
These vessels are deployed at the following three locations: Neustadt in Holstein (Baltic Sea), Warnemünde (Baltic Sea) and Cuxhaven (North Sea).

Area of responsibility of the German Federal Police Naval Division in the Baltic Sea.

Area of responsibility of the German Federal Police Naval Division in the North Sea.

The Copernicus contribution to Integrated Maritime Surveillance

by Gerard Margarit Martin*

THE INTEREST THAT EUROPEAN AUTHORITIES AND AGENCIES ARE SHOWING TOWARDS THE MARITIME APPLICATION DOMAIN IS CONSTANTLY GROWING DUE TO THE EVIDENT SOCIETAL AND ECONOMIC IMPACT OF ACTIVITIES AT SEA (E.G. IMMIGRATION, GOODS DEALING). DEVELOPMENTS IN THE FIELD OF EARTH OBSERVATION TECHNOLOGY HAVE ALLOWED MARITIME SURVEILLANCE ACTORS TO BE MORE AMBITIOUS IN TERMS OF WHAT THE SURVEILLANCE OF TARGETS, AREAS AND ACTIVITIES OF INTEREST CAN ACHIEVE.

Recent Maritime Surveillance test campaigns in the framework of Copernicus projects have produced tangible results. Central to these successes is the integration of diverse data sources through algorithms that enable the extraction of complex patterns from Earth Observation (EO) data. This facilitates the creation of an 'integrated maritime picture', in which all the information needed by authorities to support their decision-making would be made available in the most suitable format, and through the most appropriate mode and channel. Several key European agencies, such as the European Maritime Safety Agency (EMSA)[1], the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (Frontex)[2] and the European Union Satellite Centre (SatCen)[3] share the common goal of identifying an approach that responds to the needs of both agencies and users, thanks to the flexibility of developing a long-term operational inter-domain system[4]. This article presents the progress achieved so far thanks to the research carried out in the framework of the Copernicus projects in support of Maritime Surveillance in general, and the *NEREIDS*[5] project in particular.

[1] http://www.emsa.europa.eu

[2] http://www.frontex.europa.eu

[3] http://www.satcen.europa.eu

[4] This system is the *Common Information Sharing Environment (CISE)* currently being developed by the European Commission. It will integrate the existing surveillance systems and networks and give all concerned authorities access to information necessary for their missions at sea. A further aim of *CISE* is to allow a smooth and easy exchange of data and information thanks to modern technologies (http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm).

[5] NEREIDS (New Service Capabilities for Integrated and Advanced Maritime Surveillance) is a 36-month FP7 Copernicus research and development project in the field of Support to Maritime Surveillance.

*** Stakeholder testimony kindly provided by Torkild Eriksen and Harm Greidanus, European Commission – Joint Research Centre.**

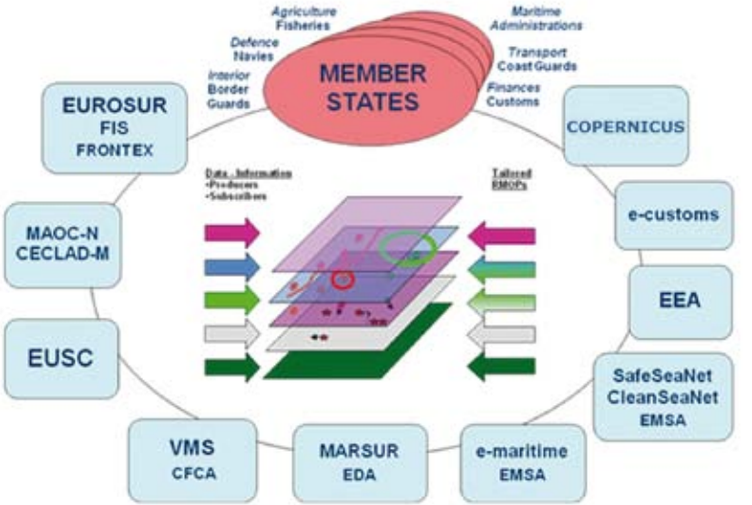


Figure 1: Copernicus in a maritime surveillance context.

Copernicus support to Maritime Surveillance

The Integrated Maritime Policy (IMP) is one of the most prominent policies of the European Union (EU) and the implementation of an integrated Maritime Surveillance system is one of its key goals. This aim is reflected in the Communication on an Integrated Maritime Policy, in which it is stated that the IMP aims "to *take steps towards a more interoperable surveillance system to bring together existing monitoring and tracking systems used for Maritime Safety and Security, protection of the marine environment, fisheries control, control of external borders and other law enforcement activities*"[6]. Through the analysis of different sectors connected to the maritime economy[7], various studies have highlighted the enormous potential that the sea holds for the European economy. The studies have also outlined the challenges faced by Member States (MS) in ensuring a sustainable use of the seas. For this purpose, effective cooperation between all the actors involved in the maritime domain is crucial.

In this context, Copernicus can play an important role. The main asset is the satellites which allow Earth Observation (EO) optical and radar data to be exploited. The satellite provides continuous surveillance that is independent of the targets that are being monitored, which is vital for support in the maritime domain. Key services that can be delivered are: sea border control, Maritime Safety and Security, Search and Rescue, and monitoring of illegal fishing, piracy and smuggling. From a technological point of view, Copernicus can address the key issue of integrating EO data with communication and positioning technologies, such as: coastal surveillance radar, airborne patrol, Vessel Traffic Management Systems (VTS) and cooperative tracking feeds (Automatic Identification Systems – AIS – and similar).

[6] COM (2007) 575 final of 10.10.2007.

[7] ECORYS et al., *Blue Growth – Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts*, Final Report (13th of August 2012), European Commission, *Study on the Economic Effects of Maritime Spatial Planning*, Final Report (April 2010).

Several Research and Development (R&D) projects have been funded by the European Commission to fuel progress in the field of Maritime Surveillance in the framework of Copernicus. The focus of these projects is to overcome the current operational limitations, in line with the user requirements expressed by Member States and European agencies. The projects originated in three main calls for proposals:

- The 2010 FP7 Space call, under the topic "*2010-1.1.5: Contributing to the – S in GMES – Developing preoperational service capabilities for Maritime Surveillance*". The three main projects funded are *DOLPHIN*[8], *NEREIDS*[9] and *SIMTISYS*[10], which aim to improve the performance of EO in the field of Maritime Surveillance;
- The 2010 FP7 Security call, under the topic "*10.3 Intelligent surveillance and enhancing border security*". The three main projects funded are *SEABILLA*[11], *PERSEUS*[12] and *I2C*[13], which aim to improve the cooperation and operational capabilities of Member States;
- The 2012 FP7 Space call, under the topic "*2012.1.1-01: Testing and validating the intelligence-driven and high time-critical scenarios of the CONOPS*[14]". The two main projects are *SAGRES*[15] and *LOBOS*[16], which aim to pre-operationally test the Concept of Operations (CONOPS) services defined by relevant European services and agencies in the field of Border Surveillance.

The link between the three FP7 calls is evident and there is fruitful and ongoing collaboration between the various projects. The projects can be mutually beneficial as they are running in parallel, *SAGRES* and *LOBOS* being the last to conclude. A number of different platforms are now available to support their activities, such as the EUROSUR network promoted by Frontex to exchange information about Border Surveillance incidents and the operational Maritime Surveillance systems managed by EMSA[17].

In the *NEREIDS* project, one of the main users is the Spanish Guardia Civil (GCIV), which is also one of the project's partners. One of its key tasks is the surveillance of all maritime domains within the Spanish Exclusive Economic Zone. As such, GCIV is involved in border control, traffic safety and monitoring of illegal activities such as drug smuggling. Even though GCIV has numerous coastal-based means of surveillance at its disposal, the detection of small

[8] Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/dolphin.

[9] New Service Capabilities for Integrated and Advanced Maritime Surveillance. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/nereids.

[10] Simulator for Moving Target Indicator System. See http://maritimesurveillance.security-copernicus.eu/fp7-supporting-projects/simtisys.

[11] Sea Border Surveillance, http://www.seabilla.eu/cms/seabilla.

[12] Protecting EuRopean SEas and borders through the intelligent USe of surveillance, http://www.perseus-fp7.eu/.

[13] Integrated System for Interoperable sensors & Information sources for Common abnormal vessel behaviour detection & Collaborative identification of threats, http://www.i2c.eu/.

[14] *Application of surveillance tools to Border Surveillance 'Concept of Operations' (7th of July 2011).*

[15] Service Activations for GRowing EUROSUR Success. See http://www.copernicus-sagres.eu/.

[16] LOw time critical BOrder Surveillance. See http://lobos.bordersurveillance.security-copernicus.eu.185-4-133-10.reseller14.grserver.gr/index.php.

[17] CleanSeaNet and SafeSeaNet. See https://csndc.emsa.europa.eu/homepublic and http://www.emsa.europa.eu/operations/safeseanet.html.

Figure 2: Spanish Guardia Civil support border control and immigration activities. (Credits: Spanish Guardia Civil)

and fast boats remains a challenge. The Copernicus projects offer an ideal framework within which the relevant actors can work collaboratively towards finding a solution to this, and other, problems.

Copernicus services provided by *NEREIDS*

NEREIDS aims to provide an integrated maritime picture corresponding to policy and surveillance requirements. The underlying idea is to develop a 'system of systems' where different elements of the service in practice support the different maritime domains (fisheries, traffic monitoring, etc.). This objective is aligned with the goals of the EUROSUR programme. The main aims are:

- Identifying new areas in which EO data can efficiently contribute to surveillance;
- Investigating new EO data processing capabilities for small ship detection, target categorisation, wake detection and back-propagation for finding the origin of oil spills;
- Enhancing data fusion techniques for combining EO data with cooperative data sources (where ships automatically report their positions using technologies such as AIS, VTS or LRIT[18]);
- Motivating users to adopt new technologies;
- Defining an open toolbox that simplifies the integration of new capabilities / features;
- Contributing to the definition of the future Copernicus Maritime Surveillance services and the Space component;
- Ensuring that key EU and national policy areas are addressed, such as Border Surveillance, Search & Rescue, traffic safety and fisheries control.

Regarding software design, *NEREIDS* has adopted a Service Oriented Architecture (SOA) philosophy, in which a system kernel (the core component of an operating system) will manage and interconnect a set of modules with specific processing capabilities (target detection, data fusion, etc. – see Figure 3). From a logical point of view, the architecture can be represented by "operational nodes", situated at different locations that are interconnected, which allow the actors and systems to process and exchange information. The *NEREIDS* graphical interface is based on a WebGL website similar to the user interface adopted by EMSA in the Integrated Maritime Data system[19]. The tool has sufficient flexibility to manage large volumes of data without compromising performance. Only the elements that need to be updated (for instance, ship icons with updated attributes such as speed or heading) are refreshed, and on-the-fly ship track generation is available. A snapshot is shown in Figure 4.

[18] Long-Range Identification and Tracking.

[19] The EMSA system is developed by Advanced Computing Systems.

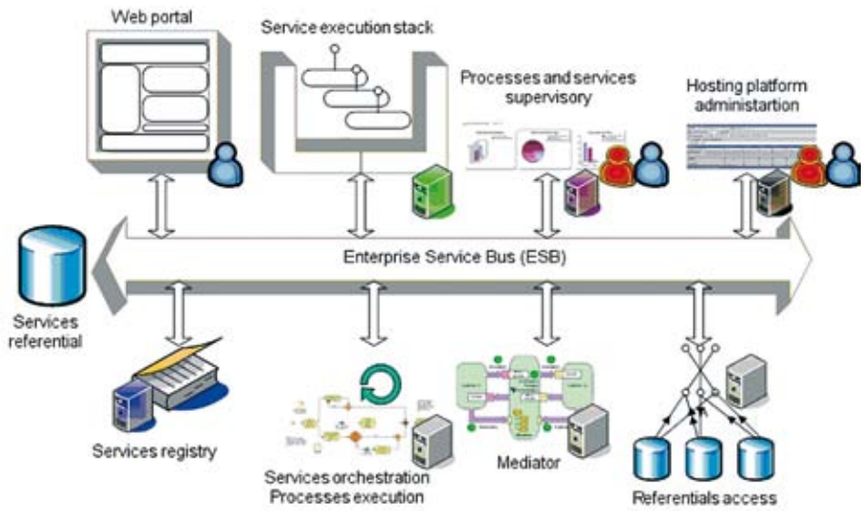


Figure 3: The NEREIDS *system manages and interconnects a set of modules with specific processing capabilities (such as target detection and data fusion). (Credits: GMV)*

Progress Report

Several test campaigns have been conducted in the framework of Copernicus Maritime Surveillance projects. Some of them have worked collaboratively, leading to notable improvements in the outcomes of the projects. Ship monitoring services have been brought to a more advanced level through new technological developments. Two test campaigns have been conducted in the framework of the *NEREIDS* project; one in March 2013 over the Gulf of Guinea and another in June 2013 over the Lampedusa and Libya area, supporting the Blue Fin Tuna campaign[20]. The success of the campaigns increased the degree of interaction between the actors involved, which included GCIV, the Italian Coast Guard (ITCG), the Portuguese Guarda Nacional Republicana (GNR) and the European Fisheries Control Agency (EFCA). The campaigns focused on traffic monitoring, fisheries and piracy; more test campaigns have been conducted during the summer with a focus on border control and smuggling. The results are being consolidated.

The test campaign in the Gulf of Guinea faced several challenges in fusing data sources from different sensors, each with their own limitations. Issues with timestamps[21] inherently associated with Satellite AIS (S-AIS) (due to the collision of signals emitted by ships in crowded areas) proved significant for that area. This necessitated the development of improved track processing algorithms in order to avoid the resulting inaccuracies. The campaign was considered a resounding success regarding the detection of small targets using EO data. Targets as small as five to ten metres were detected, as confirmed by the available ground truth[22] data. For example, the upper part of Figure 5 shows the result of vessel detection in one of the SAR[23] images acquired during the campaign. By examining archive optical imagery of the same area (Figure 5, lower part), it was suspected that the detected targets were likely to be wooden canoes, although it was not possible to find an exact match between the targets in both images, as they were acquired at different times. Track processing has also been very successful. Data acquired via the transponder-based LRIT, Terrestrial AIS (T-AIS) and S-AIS systems have been fused into single and independent track elements (see Figure 6).

The focus of the campaign in the Lampedusa and Libya area was on tracking fishing boats and evaluating complex patterns related to their cruising manoeuvres. Figure 6 shows an example of a fishing ship monitored by T-AIS streams and the successful detection of the ship after processing a COSMO-SkyMed SAR image with a horizontal resolution of 5 metres. Correlation of the data confirmed the identity of the detected ship. Another example is provided in Figure 7, where a fishing ship track built with T-AIS and S-AIS streams is complemented by two detections retrieved after processing two consecutive SAR images (acquired 25 minutes apart). This opens the door to EO correlation, i.e. the generation of vessel tracks based on information extracted from EO images. This is very important in specific domains, such as piracy and border control where the availability of cooperative transponder-based data is not always assured.

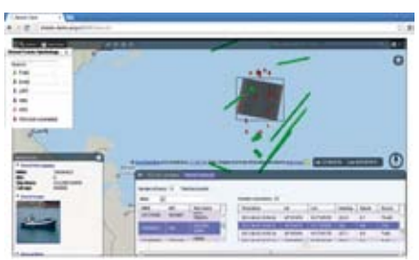


Figure 4: The NEREIDS *graphical interface is based on a WebGL website. (Credits: GMV)*

[20] The campaign was conducted under the aegis of the European Fisheries Control agency (EFCA).

[21] Encoded information about the time at which the signal was sent.

[22] Ground truth refers to *in situ* data – observations collected on the site of the area of interest which allow satellite measurements to be validated.

[23] Synthetic Aperture Radar.

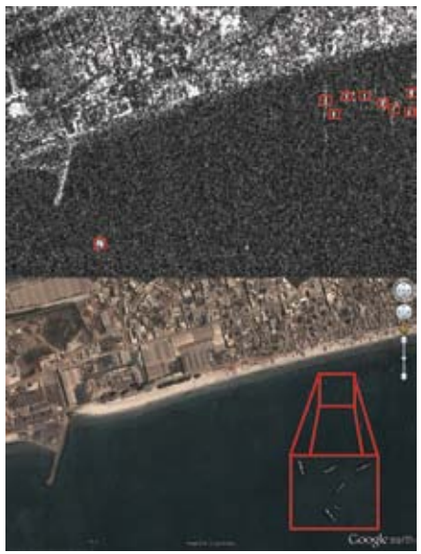


Figure 5: Example of the detection of a small ship in a SAR image created by the Joint Research Centre of the European Commission in the framework of the NEREIDS *project (top), and archive optical image of the same area (Dakar, Senegal) (bottom). (Credits: JRC)*

Figure 6: Example of track reconstruction performed by GMV in the framework of the NEREIDS *project. (Credits: GMV)*

Figure 7: Example of track reconstruction performed by GMV in the framework of the NEREIDS *project, with two detections derived after processing two consecutive SAR images. (Credits: GMV)*

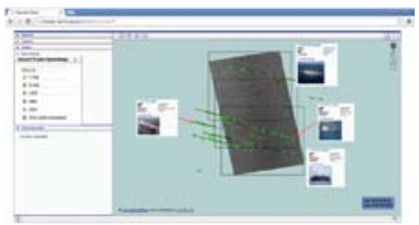


Figure 8: Example of traffic monitoring with T-AIS, S-AIS and EO-derived ship detections. (Credits: GMV)

Figure 9: Example of anomalous cruising behaviour in a fishery. (Credits: GMV)

Figure 8 shows an example of traffic monitoring carried out by combining different data sources. The availability of EO images provides a more complete maritime picture. Ships with lengths below 40 metres are detected in the surrounding areas of ships larger than 200 metres, which are cruising over the corridor lane connecting the Strait of Gibraltar and the Suez Canal. This could indicate the possibility of a *rendezvous* in progress. Figure 9 shows an example of a possible anomaly (two ships sailing in parallel) in a fishery. However, interaction with EFCA confirmed that this pattern is normal, as nets are deployed between the two ships for a period of two hours. This example has enabled the exploration of more complex definitions of anomalies by highlighting the peculiarities of each maritime domain.

The examples provided showcase the technologies that have been tested in the context of Copernicus projects. The current state-of-the-art has been surpassed in the field of the detection of small non-metallic boats, EO-based ship categorisation, data fusion and correlation, track processing and anomaly detection. This is important as it paves the way for Maritime Surveillance and monitoring services based on Space assets to support operational missions involving patrolling ships and ground-based assets (coastal radar).

Figure 10: Example of the GNR campaign conducted in NEREIDS*; detecting a 4 metre long rubber boat. (Credits: GMV)*

Success story

An important aim of Maritime Surveillance projects is to collaboratively engage as many users as possible. One good example is the fruitful collaboration between the Spanish Guardia Civil (GCIV) and the Portuguese Guardia Nacional Republicana (GNR) and the GNR that took place in the context of the *NEREIDS* project. Several test campaigns involving the deployment of patrols were enacted. The latest campaign, conducted with GNR, provided evidence about the capability of Very High Resolution (VHR) EO images to detect rubber boats. The campaign took place in June 2013 along the Algarve coastline and lasted ten days. A GNR patrolling ship was deployed within a specific Area of Interest (AoI), timed to coincide with the overhead passage of the satellites. Two sets of images were

COPERNICUS CONTRIBUTIONS TO MARITIME SURVEILLANCE

Stakeholder testimony by the European Commission's Joint Research Centre (JRC)

The European Copernicus initiative (formerly known as GMES) is a user-driven programme exploiting the potential of Earth Observation (EO) from Space for the development and operation of services designed to match user needs in different application domains.

The CONOPS for Border Surveillance has already been defined in the framework of EUROSUR[1] and other relevant similar exercises have been performed to identify user requirements. The development of Copernicus services for Security applications – in the domain of Maritime Surveillance – that will make EO data available to the services of user communities is now underway.

Several ongoing FP7 and European Space Agency (ESA)-funded projects are working towards improvements in both ship detection and data fusion to develop an integrated maritime picture, combining data from several sources. The European Commission's Joint Research Centre (JRC) cooperates as an R&D partner in some of them – including *NEREIDS*. Broadly speaking, this follows on from previous work by JRC that demonstrated the utility of using EO satellites for fisheries control[2]. Since then, Space-based assets, processing capabilities and IT infrastructures have steadily grown to bring operational services for Maritime Surveillance based on EO closer to reality.

The correlation of cooperative data (AIS, LRIT, VMS) and vessel detection in satellite imagery (VDS) makes it possible to detect ships that are not reporting to the relevant authorities. However, this is still one of the most challenging surveillance tasks, because the ocean areas are very large, and the boats involved in illegal activities are often small.

Copernicus and FP7 provide industry with the opportunity to make technological developments and present the results of these to the user community through demonstrations. The outcome of the FP7 projects will serve as a basis for making decisions on upgrades or renewals of Maritime Surveillance systems as well as highlighting potential technologies that may become the subject of future research in this area.

[1] COM (2008) 68 final.

[2] Kourti et al., "Integrating Remote Sensing in Fisheries Control", Fisheries Management and Ecology 2005.

selected: VHR images with resolutions below 1 metre and VHR images with resolutions between 1 and 4 metres. In the first set, the patrolling ship was easily detected, along with the ancillary 4 metre long rubber boat deployed close by. In the second set, the rubber boat was not visible. In both cases, ships in motion were more easily detected than static vessels. The results were validated using the GPS[24] track and ship-based radar snapshots provided by GNR. More test campaigns will follow, but the feedback on this one confirms that EO imagery is useful for detecting small rubber boats, provided that there is *a priori* information about the possible area of interest.

[24] Global Positioning System.

Conclusions

This article has showcased the successful results from the efforts invested in the Copernicus programme in the field of Maritime Surveillance. Relevant stakeholders in different maritime domains benefit from the added value of integrated and consolidated data. Collaboration with users, especially in the context of recent test campaigns, has contributed to successful outcomes. Users are becoming increasingly aware of the benefits that EO assets can provide when combined with traditional methods of surveillance. It is anticipated that the Copernicus programme will achieve the following two objectives: provide support to resolve the fundamental problems caused by both crime and emergencies at sea, and provide opportunities for the development of maritime EO services in new markets.

Gerard MARGARIT MARTIN has been a Remote Sensing Specialist and Project Manager at the Payload Data Processing and Applications (PDPA) business unit of GMV Aerospace and Defence (a Spanish private company) since 2008. He has been involved in numerous projects (such as *SAGRES, MARISS, INTEGRA, NEREIDS, EMSADFM, G-MOSAIC, LIMES, IMPAST, DECLIMS*) addressing ship detection and classification, operational Maritime Surveillance and monitoring, data fusion, critical infrastructure monitoring, forest mapping, waste management, precision agriculture and interferometric applications. His current research interests are in the fields of radar image processing techniques, SAR simulation in multiple scenarios, wind and ocean current mapping and SAR applications in forestry and agriculture. He obtained a PhD with European Mention in 2007 at the Universitat Politècnica de Catalunya (UPC) (Barcelona). Dr. Margarit was the recipient of the outstanding UPC award for the best PhD in the field of Communication and Information Technologies.

Support to Security and stability in Africa: the development of Copernicus services in the framework of the *G-SEXTANT* project

by Peter Zeil*

G-SEXTANT[1] , ONE OF THE COPERNICUS PROJECTS IN THE AREA OF SERVICES FOR SECURITY APPLICATIONS IN SUPPORT OF EU EXTERNAL ACTIONS, AIMS TO DEVELOP A PORTFOLIO OF EARTH OBSERVATION (EO)-BASED PRODUCTS AND SERVICES, ADDRESSING THE GEOSPATIAL INFORMATION NEEDS OF EU EXTERNAL ACTION USERS AND STAKEHOLDERS.

At the height of the conflict in Northern Uganda (2004) the number of IDPs (Internally Displaced Persons) reached 1.8 million. At present, at least 30.000 people are still unable to return to their areas of origin. (Credits T. Koene/ MSF)

On the 14th of August 2013, the humanitarian NGO, Médecins Sans Frontières (MSF)[2], was forced to take the most difficult and painful decision in its history: to cease operations in Somalia, after 22 years of working in the country. Since then, many of MSF's patients in Somalia have struggled to find the care that they need. For an organisation providing essential medical services, this decision was not taken lightly. Large parts of the

[1] Service Provision of Geospatial Intelligence in support to EU external actions, for more information visit: http://externalaction.security-copernicus.eu.

[2] Médecins Sans Frontières (MSF) is an international, independent, medical humanitarian organisation that delivers emergency aid to people affected by armed conflict, epidemics, natural disasters and exclusion from healthcare. MSF offers assistance to people based on need, irrespective of race, religion, gender or political affiliation (http://www.msf.org/).

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Somali population are malnourished, or suffering from diseases or injuries. They now have little chance of finding good quality health care when they most need it. In addition, there is no other country in the world where threats to Security are so high. However, neither concerns over Security, nor the high crime rates precipitated MSF's decision to withdraw humanitarian operations from Somalia. Their last hopes were dashed when it emerged that the very parties with whom MSF had been negotiating the minimum acceptable levels of Security had, in fact, been tolerating attacks against humanitarian workers. The failure of the Somali government to guarantee even basic Security measures for these workers has prevented them from administering healthcare services to its citizens.

The nexus between Security and development

If any more proof is needed of the interdependence of Security and development, the situation in Somalia in August 2013 represents a key turning point. Both the Security of citizens and the development of the country are essential elements of stability, as important as the process of achieving and securing peace, prosperity and dignity. As the European Security Strategy[3] and the 2005 European Consensus on Development[4] have acknowledged, sustainable development cannot take place without Security and stability, and without development and the eradication of poverty there will be no sustainable peace. Conflict is often linked to the fragility of a state. Countries like Somalia are caught in a vicious cycle of weak governance and recurring conflict. External Action by the European Union have sought to break this cycle, both through providing assistance for development and by implementing measures to improve Security. Security sector reform and disarmament, demobilisation and reintegration are all key elements of post-conflict stabilisation and reconstruction which have been at the heart of European missions in Africa (e.g. in Guinea-Bissau or in the Democratic Republic of the Congo - DRC). This process is most successful when implemented in partnership with the international community and particularly with local stakeholders.

'Often specific drivers need to be considered. The ruthless exploitation of natural resources is often an underlying cause of conflict. There are increasing tensions over water and raw materials which require multilateral solutions. The Kimberley Process and the Extractive Industries Transparency Initiative offer an innovative model to address this problem'[5].

The aim of preserving peace, preventing tensions from escalating into violence and strengthening international Security is an important element of the External Action of the European Union, as laid down in the Lisbon Treaty. Violent conflicts cost lives, lead to violations of human rights, displace people from their homelands, disrupt livelihoods, set back economic development, exacerbate state fragility, weaken governance and undermine national and regional Security. Preventing conflicts and relapses into conflict, in accordance with international law, is therefore a primary objective of the EU's External Action, in which it could take a leading role, acting in conjunction with its global, regional, national and local partners[6].

Copernicus Services for Security applications – the *G-SEXTANT* project

One of the Copernicus projects in the area of services for Security applications, *G-SEXTANT*, aims to develop a portfolio of EO-based products and services, addressing the geospatial information needs of EU External Action users and stakeholders, such as the European External Action Service (EEAS) and potentially the African Union Commission (AUC). The main goals of the *G-SEXTANT* project are:

a) The preparation and delivery of pre-operational services, developed in the context of user-driven Support to External Action (SEA) scenarios;
b) The enhancement of mature products and services, as requested by users;
c) The development of a standardised portfolio of products and services.

With a specific focus on Africa, the *G-SEXTANT* project addresses the following proposed scenarios in the context of support to the Peace and Security Facility at the AUC:

- Humanitarian Crises;
- Natural Resource Exploitation;
- Land Conflict Situation Awareness.

The *G-SEXTANT* project takes into account the skills and experience of the various stakeholders involved: industry (in terms of production and implementation capacity), academic and research organisations (in terms of scientific expertise), and EU bodies and institutions (in terms of coherence with existing policies and operations, and access to ancillary data). Finally, the feedback of the users will be taken into due consideration during the design and production phases in order to enhance the final products, so that the impact of the project on the Security user community can be analysed.

The areas of interest have been selected on the basis of existing user engagement and on analyses performed by conflict and peace research organisations. According to the various conflict databases maintained by European think tanks, some of the case study areas are situated in post-conflict countries and regions where Security and stability are fragile. Moreover, some areas can be characterised by a high level of militarisation or disproportionately high military expenditure and militarisation of the society, which may have negative effects upon both human and economic development. Economic stagnation, power struggles and weak governance are jeopardising efforts to overcome barriers to growth and peace.

The countries in question have a long record of violent conflicts (either interstate or intrastate) and are still conflict-prone. Affected societies have to cope with the subsequent impact of these conflicts, which include the formation of refugee camps and informal settlements as well as land degradation. In some cases, the exploitation of natural resources and large-scale land investments play a significant role, whether during or in the aftermath of civil unrest.

In this context, the proposed study sites of the *G-SEXTANT* project in

[3] 'A Secure Europe in a better world – European Security Strategy', Brussels 12th of December 2003, http://www.consilium.europa.eu/uedocs/cmsUpload/78367.pdf.

[4] Joint statement by the Council and the Member States' government representatives meeting within the Council, the European Parliament and the Commission on European Union Development Policy: 'The European Consensus', http://ec.europa.eu/development/icenter/repository/european_consensus_2005_en.pdf.

[5] Report on the Implementation of the European Security Strategy - Providing Security in a Changing World – 2008 EEAS/Council.

[6] Council of the European Union, 11820/11 2011.

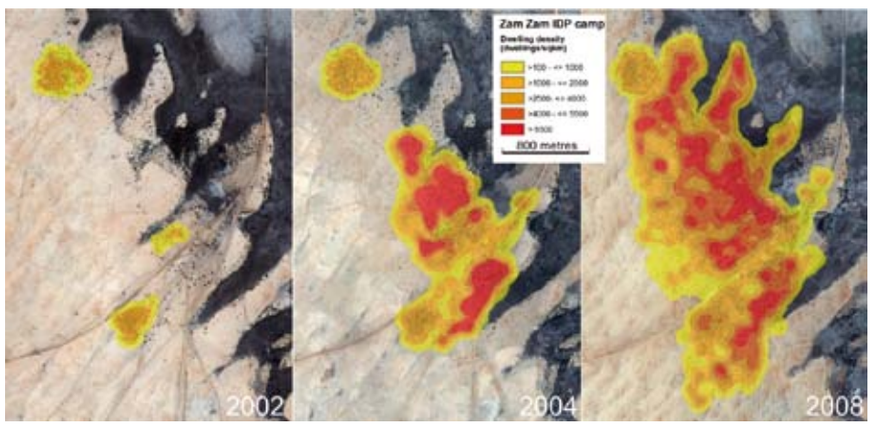
Africa represent test sites for specific products and services that will be developed to respond to a range of selected scenarios. These proposed test sites have been selected as a result of user requests or based on the expertise of project partners. It is possible that the location of some of the proposed study sites may change over the course of the project either for methodological / technological reasons or on the basis of additional user requests. Even if such changes are subject to the availability of both personnel and data, the project aims to satisfy new user requests in terms of new test sites and product development. These activities also should be understood in the wider context of the Africa-EU Partnership. Information services for conflict monitoring and humanitarian action address the specific partnerships on Peace and Security, and Science, Technology and Space[7]. "GMES and Africa" (see box) provides the most relevant platform for cooperation between *G-SEXTANT* and stakeholders in Africa.

Scenarios and Services related to Africa

Humanitarian crises

The overall objective of this scenario is the provision of information products related to humanitarian crises through the analysis of temporary (e.g. refugee/Internally Displaced Persons (IDP) camps) and informal settlements in fast-growing cities. Satellite imagery-based information products, which can, for example, allow users to estimate the number of dwellings (as a proxy for the camp population), provide important information to support humanitarian aid and conflict prevention. In urban areas, EO products allow the monitoring of formal and informal agglomerations as well as the identification of potential hot spots that compromise urban resilience.

[7] For more information on the Africa-EU partnership, visit: www.africa-eu-partnership.org.



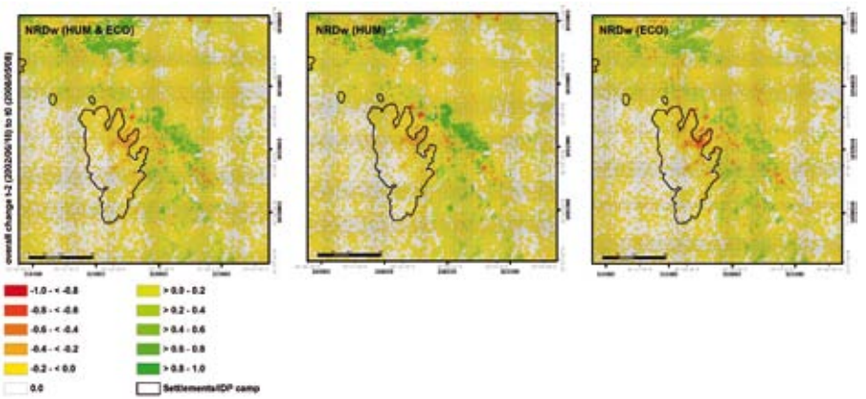
An example of how IDP camps can be monitored during a crisis. This image shows the density of dwellings in the Zam Zam IDP camp (Sudan). Source: Lang, S., Tiede, D., Hölbling, D., Füreder, P. & Zeil, P., 2010: EO-based ex post assessment of internally displaced person (IDP) camp evolution and population dynamics in Zam Zam, Darfur. (Credits: International Journal of Remote Sensing, vol.31, pp. 5709-5731)

Four subscenarios have been identified:

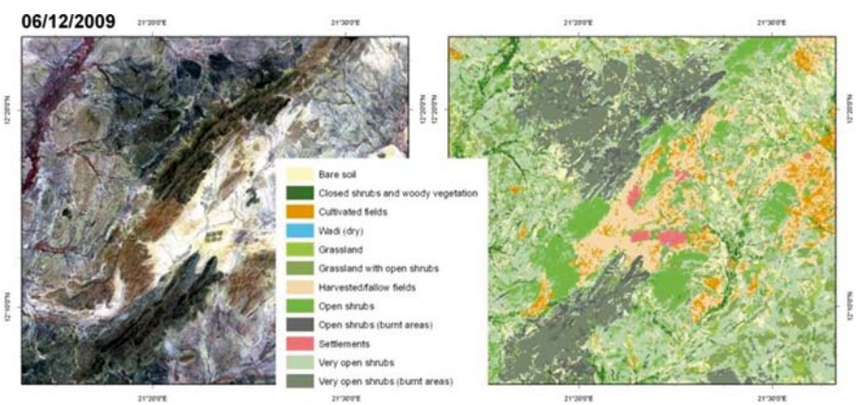
- Subscenario 1: Situation analysis for one refugee camp in East Africa and one in Jordan;
- Subscenario 2: Monitoring of refugee camps during a crisis in East Africa;
- Subscenario 3: Support to the repatriation process after a crisis in Tanzania and Chad;
- Subscenario 4: Identification and monitoring of informal settlements in Southern and Eastern Africa.

Natural resource exploitation

Natural resources are often exploited beyond a sustainable level, endangering natural habitats, affecting people's livelihoods and potentially fuelling armed conflict. Vast areas of land must be observed within a narrow timeframe, since exploitation activities can easily move from one area to another. These areas are generally difficult and costly to access because they are widely dispersed, too remote or too dangerous for field



Integrated assessment of the environmental impact of the Zam Zam IDP camp in Sudan based on very high resolution multi-temporal satellite imagery. Natural resource depletion (NRD) index showing implications of observed environmental changes for human security (HUM), ecosystem integrity (ECO) or a combination of both (HUM & ECO), based on multi-temporal LULC (land use/ land cover) analyses and expert weightings. Shades of red indicate regions of tremendous impact of observed environmental changes on human security and/or ecosystem integrity, while areas where environmental changes have resulted in improved conditions concerning human security and/or ecosystem integrity are displayed in shades of green. (from Hagenlocher, M., Lang, S., Tiede, D., 2012). (Credits: Remote Sensing of Environment 126, 27-38)



Land use map around the Djabal refugee camp, Chad. (Credits: G-MOSAIC *© PLUS)*

GMES[8] and Africa

The "GMES and Africa" initiative - according to the Lisbon Declaration[9] - establishes a long-term partnership between Europe and Africa, working together on the development and implementation of Earth Observation (EO) applications tailored to African requirements. This process is an element of the wider context of the Africa-EU Partnership aiming at sustainable development and scientific cooperation. "GMES and Africa" strengthens Africa's capacity and ownership of EO activities and acknowledges the importance of past and present African programmes, recognising the need to coordinate actions to avoid duplication, increase synergies and enhance complementarities.

"GMES and Africa" derives from the consensus reached as a result of the Lisbon Summit, in December 2007, on the need to define a common programmatic view for EO activities in Africa, acknowledging the Maputo Declaration (2006), and calling on the EU to extend its GMES initiative in Europe to Africa and other ACP countries. The Lisbon Declaration on "GMES and Africa" and the Lisbon Process on "GMES and Africa" put forward guidelines to launch the partnership and described the necessary actions that need to be undertaken to formulate a "GMES and Africa" Action Plan. The initiative forms part of the 8th Joint Africa-EU Strategic Partnership (Science, Information Society and Space), with clear synergies with other partnerships, and is included in the ARAPKE Book of Lighthouse Projects (2008-2010).

The Space application dialogue between Africa and Europe is supported on a political level by the Joint Expert Group JEG8 facilitating the 8th Partnership with representation from the African Union Commission (AUC) and the European Commission (EC). A Coordination Team for GMES Africa involves the participation of experts from Member States (South Africa, Kenya, Nigeria, Tunisia, Egypt, Portugal, France, Belgium, Austria) and stakeholder organisations in addition to the Commissions.

The FP7-funded *BRAGMA*[10] (Bridging Action for GMES and Africa) Support Action was consolidating this dialogue and three thematic workshops on Marine and Coastal Environment, Water Resources, and Sustainable use of Natural Resources[11] were organised in 2012 and 2013. Furthermore, a Validation Workshop to assess the progress so far also took place in South Africa in October 2013. The objective of this event was to propose the way forward and to draft a high-level policy document to be tabled at the forthcoming Africa-EU Summit in April 2014.

[8] The official name of the European programme for Earth Observation was changed to Copernicus in December 2012. Nevertheless the name of this initiative remains GMES and Africa, referring to the previous name of the European Earth Observation programme, GMES (Global Monitoring for Environment and Security).

[9] http://www.mundiconvenius.pt/eventos/2007/gmes/programme_final_conclusions.htm

[10] Bridging Action for GMES & Africa, for more information visit: www.bragma.eu.

[11] For more information, visit: capacity4dev.ec.europa.eu/africa-eu-part.gmes/.

missions, as conflict situations often prevent research teams from travelling freely and/or safely. Remote sensing is therefore complementary to more traditional means of monitoring, and can often yield valuable information on the presence and dynamics of exploitation activities.

Two subscenarios have been identified:
- Subscenario 1: Mining of minerals in Central Africa;
- Subscenario 2: Oil exploitation in Central and East Africa.

Land conflict situation awareness

The overall aim of this scenario is to provide geospatial information on land use changes in relation to conflict-prone situations, such as the transition of a political or societal system, the impact of refugee/IDP camps or large-scale land investments. The rationale is to effectively link empirically observable changes in natural habitats or societal systems, in order to make predictions about changes occurring in either one, based on developments in the other. Such interdependencies will be captured and showcased by the development of integrated indicators based on EO data, *in situ* data, expert-knowledge and ancillary data (e.g. socio-economic data).

This scenario is divided into three subscenarios:
- Subscenario 1: Systems in transition in East Africa;
- Subscenario 2: Land degradation in Eastern Africa;
- Subscenario 3: Land use change caused by large-scale land investments in East Africa.

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Governance options for the Security dimension of Copernicus: a legal perspective

by Ingo Baumann

Copernicus Emergency Management and Security Services

The Copernicus programme aims to ensure the uninterrupted, independent and reliable provision of data and information on environmental and Security matters to users in charge of policy making, implementation and monitoring both in the EU and in Member States. Copernicus is divided into six types of services: Atmosphere Monitoring, Climate Change Monitoring, Marine Monitoring, Land Monitoring as well as Emergency Management and Security services.

The Copernicus Emergency Management service provides information relating to different types of disasters, including meteorological hazards, geophysical hazards, deliberate and accidental man-made disasters and other humanitarian disasters, as well as the necessary prevention, preparedness, response and recovery activities.

The Copernicus Security service will provide information in support of the civil security challenges of Europe improving crisis prevention, preparedness and response capacities, in particular for Border and Maritime Surveillance, but also support for the Union´s External Action.

New legislative framework

As Copernicus enters into its operational phase from 2014 onwards, a new legislative framework and a new governance structure will be required. The European Commission published its proposal for a new Copernicus Regulation[1] on the 12th of July 2013. The new Copernicus regulation will, once it enters into force in 2014, replace the current GMES Regulation[2]. On the same day, the Commission also published its proposal for a Delegated Regulation for the Copernicus Data and Information Policy[3]. The Copernicus Regulation is currently under final review by the European Parliament; its entry into force is expected in April 2014. The Delegated Regulation for the Copernicus Data and Information Policy was published in November and entered into force on the 9th of December 2013[4]. The two Regulations propose new governance structures addressing among other matters the use of Copernicus data for Security applications, and establish rules on how access to Copernicus data and services may be restricted, primarily for reasons pertaining to Security.

[1] COM(2013)312 final/2 of the 12th of July 2013, Proposal for a Regulation of the European Parliament and of the Council establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010 (the "Copernicus Regulation").

[2] Regulation (EU) No 911/2010 of the European Parliament and of the Council of the 22nd of September 2010 on the European Earth monitoring programme (GMES) and its initial operations (2011 to 2013) Text with EEA relevance, Official Journal L 276 , 20/10/2010 P. 0001 - 0010 (the "GMES Regulation").

[3] COM(2013)4311 final of the 12th of July 2013, draft Commission Delegated Regulation supplementing Regulation (EU) No 911/2010 of the European Parliament and of the Council on the European Earth monitoring programme (GMES) by establishing registration and licensing conditions for GMES users and defining criteria for restricting access to GMES dedicated data and GMES service information (in the following: "Copernicus Data and Information Policy" or "Delegated Regulation").

[4] Commission Delegated Regulation 1159/2013, OJ L 309/1 of the 19th of November 2013.

New Governance Scheme

Under the new governance structure, the Commission will have overall responsibility for Copernicus. It will define the priorities and objectives of the programme and ensure the overarching coordination and supervision. However, due to the complex nature of Copernicus, the provision of different types of services addressing a diverse array of user groups, and the existing internal structures and competencies within the EU, the programme requires a dedicated governance scheme that reflects its complexity. The needs of a considerable number of stakeholders must be taken into account in different roles, including for service provision, definition and validation of user requirements, and for the implementation of security measures.

Delegation of tasks

For the design, deployment and initial operations of the Copernicus Space Segment, the European Commission largely draws on the competencies of the European Space Agency (ESA)[5]. A new Delegation Agreement for the operational phase 2014-2020 is currently being prepared. For the operations relating to the Sentinel 4 and 5 instruments, the Commission is considering partially delegating operational tasks to the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)[6]. Emergency Management and Security services will use data from the Sentinels, but will remain primarily dependent on higher resolution data from Contributing Missions[7]. *In situ* data provided by Member States is likely to be less relevant for these service areas. Responsibility for the provision of the different Copernicus services may be delegated by the Commission to different specialised EU bodies with the appropriate technical and professional capacities[8]. In the case of the Security service, responsibilities could be delegated to the European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union (Frontex), to the European Maritime Safety Agency (EMSA), and to the European Union Satellite Centre (SatCen). The allocation of such responsibilities to these entities would require dedicated Delegation Agreements or broader types of cooperation arrangements.

Frontex was set up in 2004 to reinforce and streamline cooperation between national border authorities. In pursuit of this goal, Frontex has several operational tasks defined in the Frontex Regulation[9]. Since 2008, these tasks also include the development and operation of the European Border Surveillance System (EUROSUR). EUROSUR provides

[5] Art. 12 Section 4 of the Copernicus Regulation.

[6] Art. 12 Section 5 of the Copernicus Regulation.

[7] These are satellite missions operated by national, European, or international organisations. There around thirty existing or planned Contributing Missions that make data available for Copernicus.

[8] Article 12 Section 1 of the Copernicus Regulation. On the 21st of January 2014, the Commission published a Request for Expression of Interest in relation to the Copernicus Marine, Climate Change and Atmosphere Services, more information are available at www.copernicus.eu.

[9] Regulation (EU) No 1168/2011 of the European Parliament and of the Council of the 25th of October 2011 amending Council Regulation (EC) No 2007/2004 establishing a European Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union.

Member States with a common technical and operational framework in order to increase situational awareness at their external borders and to improve the reaction capabilities of their competent national authorities. One of the objectives is to harmonise the application of surveillance tools, including data and services from satellites. Therefore, the Commission is currently considering the delegation of responsibility for services related to Border Control to Frontex.

For Copernicus services in support to Maritime Surveillance, the Commission envisages delegating the implementation to the European Maritime Safety Agency (EMSA). EMSA has recognised expertise in the implementation of *CleanSeaNet* an operational Maritime Safety programme relying on Earth Observation data. It is also actively involved in several R&D projects preparing for the Copernicus Security service.

The SatCen supports the decision-making of the European Union in the context of the Common Foreign and Security Policy (CFSP), and in particular of the Common Security and Defence Policy (CSDP), including European Union crisis management operations. It does so by providing products resulting from the analysis of satellite imagery and ancillary data, including aerial imagery, and related services. SatCen participates in numerous Copernicus R&D projects and is involved in studies on the Security domain of Copernicus as a key European-level stakeholder. The final role of SatCen within the provision of the Security service is currently still being defined, taking into accounts *inter alia* the valuable inputs from the *BRIDGES* project[10].

[10] The objective of the *BRIDGES* project was the development of several potential models of governance for future Copernicus services for Security applications, information can be found at www.gmes-bridges.eu.

User involvement

The provision of Copernicus data and services requires the involvement of users, particularly in regard to the definition and validation of service requirements. The Commission is currently considering options for appropriate governance structures in order to ensure that the involvement of users is properly formalised. Under the GMES Regulation, a User Forum was set up with representatives from the relevant EU bodies, Member States including national agencies, industrial users and independent experts. As regards the Security service, the creation of a dedicated coordination body ("Security Board") is envisaged. Such body is required in view of the potential need for exchanging classified or otherwise sensitive information.

Security Management

The two new Regulations adopt the principle already laid down in Article 9 (1) of the current GMES Regulation that access to Copernicus data and information will be provided on a full, free and open basis. However, this rule is subject to exceptions arising from technical limitations[11], conflicting rights[12], or from the protection of Security interests. The main provisions on Security restrictions are contained in Article 16 of the Copernicus Regulation[13], then further detailed in Articles 12-16 of the Delegated Regulation[14]. The access restrictions laid down in these provisions will ensure the protection of the Security interests of the Union as well as those of the Member States. They also respect the obligations of Member States participating in systems of collective defence under international treaties.

As a first step, the Commission will conduct an *ex ante* assessment of sensitive Copernicus data and information with regard to Security. This assessment will be made against the criteria laid down in Articles 13-16 of the Delegated Regulation. The sensitivity criteria refer to various factors that are likely to pose a risk to the Security of the Union or its Member States, including critical infrastructure such as nuclear power stations. Article 13 provides the criteria for assessing the sensitivity of Copernicus data from Space-based observation systems that have certain technical specifications stipulated in an Annex to the Delegated Regulation.[15] Article 14 provides the criteria for assessing the sensitivity of Copernicus services.[16]

According to Article 15, Member States may request that the Commission reassesses the sensitivity of certain data or services with a view to restricting, suspending or allowing their acquisition or dissemination.[17] This reassessment aims to reassure Member States of the protection of their Security interests. By examining requests from Member States, or acting on its own initiative, the Commission shall ensure an efficient and effective response to protect the Security interests of the Union or the Member States, *while striving for the least possible interruption of data and information flows to users.*[18]

Article 16 sets out the general rule that Security interests are to be balanced against the interests of users and the environmental, societal and economic benefits arising from the continuous provision of Copernicus data and information to users.[19] The data policies of countries outside of the EU will be considered, namely with regard to legal limitations for the commercial provision of very high resolution (VHR) images.[20]

The procedures described above fall under the responsibility of the Commission. The Regulations are not explicit on the underlying governance and the roles and competencies of other EU bodies, Member States, international organisations or third countries involved in the Copernicus programme with regard to access restrictions for Security reasons. According to Section 3, Chapter 3 of the Explanatory Memorandum to the Delegated Regulation, the Security Board referred to in Article 16 (2) of the current Regulation (EU) 911/2010 may be involved in the decision-making procedure. The Security Board is currently a specific configuration of the GMES Committee, which itself is composed of representatives from Member States and the international organisations involved in the programme. For the continuation of the Security Board, it must still be decided how the different EU entities mentioned above (EMSA, Frontex, SatCen) and the EU External Action Service (EEAS) can be properly involved. Whilst Article 16 of the Copernicus Regulation envisages that Member States *and third countries participating in the Copernicus programme* may ask the Commission to perform a new Security assessment, Article 15 of the Delegated

[11] Article.17 of the Delegated Regulation.

[12] Article 11 of the Delegated Regulation.

[13] Article 16 of the Copernicus Regulation

[14] Article 12 of the Delegated Regulation still refers to the GMES Regulation, as the Copernicus Regulation is currently in the legislative process. The text therefore is likely to be amended once the Copernicus Regulation has entered into force.

[15] Article 13 of the Delegated Regulation.

[16] Article 14 of the Delegated Regulation.

[17] Article 15 of the Delegated Regulation.

[18] See Preamble No. 15 of the Delegated Regulation.

[19] Article 16 of the Delegated Regulation.

[20] See Spacenews Vol. 24, Issue 36, of the 16th of September, 2013: "U.S., European Rivals pushing for permission to sell sharper imagery", reporting that commercial companies are urging governments to ease restrictions on the commercial sale of optical satellite data with a resolution of less than 50 cm.

Regulation currently stipulates that this right is only applicable to Member States. Another consideration is whether and to what extent the relevant international organisations and the different EU bodies, namely the EEAS, should be involved in such potential reassessment process. Under Article 16 of the Copernicus Regulation, a reassessment may be requested '*when Security developments warrant such a new assessment*', while Article 15 of the Delegated Regulation allows such a request to be made '*where the conditions under which the assessment made according to Article 13 or 14 have changed*'.

Conclusions

The Emergency Management and Security services of Copernicus require a dedicated governance structure. While the Commission´s proposal for a new Copernicus Regulation and the already enacted Delegated Regulation on the Copernicus Data and Information Policy form the basis of such future governance, details regarding the roles and responsibilities of the numerous stakeholders involved are currently still under evaluation. The final governance structure must take into account the diverse roles of stakeholders in the programme, including as service providers and users. Specific issues must be addressed concerning the cooperation of EU bodies and institutions across the former "pillars" and namely the role of the Council within the Copernicus governance and the potential delegation of tasks from the Commission to SatCen as an CFSP agency. The latest Council version of the Copernicus Regulation dated 20th of December 2013, anticipates broadening the scope of the Council's role, including in particular the autonomy to adopt measures whenever the Security of the EU or its Member States requires them. This will now be reviewed by the Parliament and is likely to be the subject of further discussions before the Regulation is adopted. With regard to the role of SatCen, much will depend on the approval by the Council of the High Representative's proposal for a revised Council Decision establishing Satcen. This proposal explicitly allows SatCen to receive financial contributions from the general budget of the European Union, including for operational tasks in relation to Copernicus Security services. If adopted, it would enable SatCen to conclude a corresponding Delegation Agreement or broader cooperation arrangement with the European Commission.

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