# *Workshop Report*

## *"In-situ monitoring and Earth observation in the framework of GMES and GEOSS"*

***Brussels, 31 May 2007***


***Organizers: G. Weets (EC DG INFSO) & P. Kamoun (EARSC)***
***Rapporteur: Y. Coene[1]***


## Executive Summary


Earth Monitoring is at a turning point world wide. The awareness of the risks inherent to an uncontrolled development of human activities has led to environmental protocols, to the setup of new partnerships, such as the Global Earth Observation System of Systems (GEOSS) and the European GMES initiative (Global Monitoring of Environment and Security), and the need to develop synergies between existing capacities internationally. These initiatives encompass in-situ, airborne and spaceborne sensors' deployment, interconnected ground infrastructures for, data sharing, processing and analysis, value added information production up to systems for decision-making.

The last decade has seen huge progress in sensor network technologies: small computers and sensors costing tens of euros, tiny operating systems running in hundreds of bytes of memory, short-range radios consuming minimal power, and multi-hop networks covering local areas.  Sensor network research has now to take advantage of the increasing trend towards more powerful computers and sensors, higher-level operating systems services, mixes of radio technologies, and wide-area networks connecting sensornets in global deployments. Another opportunity for sensor networks could come from very cheap throw away sensors (RFID and beyond). In the same time, remote sensing is becoming increasingly accurate and flexible, and these improvements are now in the process of being successfully applied to a wider range of platforms including high altitude platforms and UAV, which present new and added possibilties for civil earth observation.

It is by now well accepted that the proper monitoring of our planet will require the use of both in-situ and remote sensing techniques. While these approaches are operationally very different, they have each an essential role to play in any serious plan to monitor a site, region, country, or the Earth as a whole. Unfortunately this synergy is neither yet realised nor fully appreciated, in part because of the different technologies involved and


[1] The views expressed in this report do not necessarily represent those of the European Commission or the European Association of Remote Sensing Companies (EARSC).

skills required to operate them, in part because of the resilience of traditional working practices (resistance to change), in part also because of arguments linked to training; to the need to implement new tools and models, just to name a few…

The Workshop was held on May 31st 2007 and was jointly organised by the European Commission, Information Society and Media Directorate-General, Unit H4 "ICT for Sustainable Growth" and the European Association of Remote Sensing Companies (EARSC). This workshop was the 3rd in a series to gather stakeholders in the area of ICT for Environmental Risk Management and consult their views on how to move towards the goal of a *Single* Information *Space for the Environment in Europe* (SISE). This was also the occasion for a cluster of FP6 IST projects (including DEWS, DYVINE, InterRisk, OSIRIS, SANY, WINSOC, WARMER) to present their achievements so far in the field of sensor networks for disaster management.

The main objectives of the workshop were:

- to bring together experts in the fields of remote-sensing, in-situ monitoring and sensor networks and to increase mutual knowledge of their communities,
- to assess the potential of new trends in this domain for new applications,
- to explore the mechanisms of synergy between in-situ and remote sensing and to evaluate their impact,
- to identify technical and non-technical obstacles to the uptake of the proposed solutions..

The meeting raised a lot of interest with about 100 participants representing a wide range of stakeholders in the field. Indeed, more than 130 persons registered to this event; latest registrations had however to be refused due to space limitations.

Key strategic issues which emerged during the workshop include the following :

- Organisational interoperability versus technical interoperability
- Increased synergy between space and in-situ observations and services
- Interfacing and upgrading existing monitoring systems with new emerging technologies.
- Total cost of ownership (i.e. integration, deployment, maintenance, training, operation etc.) is too high due to lack of standards and lack of reliability.
- Sustainability of in-situ data component for GMES is a critical issue.
- Human factor remains a non-negligible (limiting) factor in the definition and deployment of a monitoring and alerting system based on in-situ data.

# INDEX

# 1. Presentations

A list of all the presentations is included as Annex B of this report. The PowerPoint presentations can be found on the Commission's website at http://cordis.europa.eu/fp7/ict/sustainable-growth/workshops_en.html.

# 2. Key Achievements & Lessons Learned

## 2.1. *Technical Interoperability*

- We are in the middle of a wireless (r)evolution which enables new applications of (wireless) sensors. Examples given included:
    - Wireless controlled lightning, temperature fire in buildings
    - Car to car communications
    - "Seveso" plant monitoring
    - Monitoring of infrastructure: bridges, tunnels, dams etc…
- There are important achievements in miniaturization of sensors (e.g. RFID etc) and the resolution of the powering problems of sensors via wireless energy. This opens a perspective of massive deployment of sensors.
- On the sensor and sensor network architecture side, there are various projects defining centralized or decentralized strategies to avoid concentration. Others look at wide range of platforms and sensors: scalable, plug-in/out, self-healing networks. These approached are not yet mature, but are promising.
- There seems to be a consensus that remote sensing and in-situ data are complementary and have different intrinsic qualities. The combination of these data may serve many applications, some of which were presented during the workshop. Both the EC and ESA have on-going projects aiming to demonstrate applications from complementary remote sensing and in-situ observations. Airborne sensors provide a nice alternative to both in-situ and remote sensing with important advantages w.r.t. conventional remote sensing such as lower cost, real-time deployment, no orbital constraints, easy change of payload etc.

## 2.2. *Organisational Interoperability*

Despite technological advances, the "organisational interoperability" remains an important obstacle against deploying SISE and contributing to GMES and GEO. Beyond interoperability of environmental data, SISE implementation could drive a wide ICT agenda including electronic signature, billing services etc…

EU environmental legislation should foster standardised monitoring and sharing (not selling) of environmental data. The level of achievable standardization may depend from one community to another. For instance, EUMETSAT has a well organized, federated user community which facilitated standardization.

# 3. Key Issues

## *3.1. Synergy Remote Sensing and In-situ and Data Fusion*

Various participants perceived the concepts of "Earth observations", "remote sensing data", "in situ data" differently in the absence of well established definitions. GMES defines remote sensing data as satellite data and everything else as in-situ data. For another speaker it makes a lot of sense to call everything "remote sensing" as the operator of the sensor is in both cases (i.e. remote sensing and in-situ) remote with respect to the location of the sensor. Several speakers noted that from an IT point of view, Remote Sensing and in-situ sensors can be treated in the same way as “moving or fixed sensors” and do not require different technology. This would mean that differentiating remote from in situ data does not matter so much.

It was stated a number of times that one cannot exploit space data without in-situ data. The synergy between space and in situ data is however not yet realized. Several reasons for this lack of synergy were cited: different technologies, resilience of traditional working practices, linked to training, need to implement new tools and models.

The deployment of more sensors requires the management of the sensor data flows and multiple source data fusion. Data fusion from heterogeneous (wireless) sensor networks is a complex challenge. There is a lack of a unified and generic data fusion methodology and lack of standards for fusion.

Several project presentations referred to data synergy and data fusion:

- The JDL fusion methodology[2] is being further investigated by the SANY project (http://www.sany-ip.eu/) in order to develop a generic concept for data fusion based on four different levels ranging from data smoothing and noise removal, to pattern extraction, contextual/relational/causality aspects and spatial/temporal extrapolation.
- Two ESA projects, COPS and COPS-B presented a number of applications exploiting synergies between in-situ and space-born data.
- The WARMER project exploits Google Earth maps and correlation with/calibration of space data.
- DYVINE proposes a hierarchical approach with data fusion and processing at intermediary levels and simplified alerts at the upper level.

[2] Joint Directors of Laboratories

Participants also noted that aggregated/fused data for some (scientific) applications may be useless and cannot replace access to the original data.

## *3.2. Total Cost of Ownership*

A second issue is that procurement, deployment, configuration, operation and maintenance of a sensor network remains high. The total cost of ownership of a sensor network and usage of in-situ data is still too high because of various reasons: lack of reliability, lack of standards, education, node size, battery etc. This cost should decrease to cope with the general trend of decreasing funding in favour of operational monitoring.

### 3.2.1. Telecommunications Business Model and Reliability

Sensor networks rely more and more on (wireless) communication solutions (e.g. GPRS) and machine to machine communication. The communication system plays a central role in many applications presented during the workshop. There is a clash of cultures: Internet versus telecom. The Internet presents the advantage of offering an open environment. New business models are needed, e.g. to allow connecting to the best available network at one time whatever the telecom operator.

### 3.2.2. Lack of Standards and Interoperability

Sensors are heterogeneous: active/passive, wireless/wired, fixed/mobile. Eventually all mobile devices may become sensors. Standards are required to reduce development cost. The OGC Sensor Web Enablement (SWE) standards are being used in many of the projects presented during the workshop: OSIRIS, SANY, DEWS, InterRisk, ORCHESTRA, COPS, COPS-B etc.

Several of the FP6 projects aim to contribute to the standardization of interfaces to sensors and sensor networks, including SANY and OSIRIS. DG INFSO representatives reiterated that it is crucial that projects adopt existing standards and contribute whenever possible to the standardization process. The Integrated Projects OASIS and ORCHESTRA were cited as good examples which have contributed already.

### 3.2.3. Accuracy and Reliability of Data

Some issues were raised related to the required accuracy and reliability of in-situ data. As many monitoring systems react on thresholds being exceeded which are defined in regulations, it is crucial that the data is accurate and reliable to avoid false alarms etc.

## 3.3. Data Policies

Interoperability requires solutions for the current data policy issues. Remote sensing and in-situ data is often not available or cannot be shared because of too restrictive data policies. EU GMES, EEA and others gave various examples of this issue, including the lack of a European wide DEM.

Making available sensor data to the research community might create applications which cannot even be imaged for the moment. A compromise should be found allowing research institutes to access the raw data (and not only aggregated data which is useless for many models) but at the same time respecting the economic issues, causing the current restrictive data policies.

## 3.4. Sustainability

GMES could do a lot to ensure sustainability of space remote sensing systems. The Shared Environmental Information System (SEIS) announced by DG ENV and EEA could help sustaining parts of the in-situ monitoring capability in Europe. EEA stated that the sustainability in-situ component within the GMES core services is a real critical issue which should start with the funding line. There is no sustained funding available or foreseen today.

The representative of the EU GMES bureau remarked that intake of in-situ data for GMES projects is currently random. For sustainability purposes, systematic and guaranteed approaches are needed.

## 3.5. Human Factor

Technical solutions are sometimes available, but the human factor prevents their exploitation. Many examples were presented during the workshop:

- Regulations preventing use of high altitude platforms with airborne sensors,
- Last mile problem to reach the population, e.g. for tsunami alerts,
- Multi-lingual issues,
- Exact meaning of alerts generated by sensor systems. Language has to be precise,
- Alert information has to be sent to the right people at the right time.
- The final user should be involved during design and development of the system.
- Change of user behaviour hardly happens; resistance against changing modes and tools of operation.

# 4. ANNEXES

## *4.1. Annex A - Attendance List*

LIST OF PARTICIPANTS

WORKSHOP: "In-situ monitoring and Earth observation in the framework of GMES and GEOSS", Brussels, May 31st, 2007

| | | | | |
|---|---|---|---|---|
| 1 | | AETS - Apave SUDEUROPE Group | Gérard | TAREL |
| 2 | | AQUAPOLE | Vincent | TIGNY |
| 3 | | ARGOSS | Hans | WENSINK |
| 4 | | ATLAS Elektronik GmbH | Holger | KLINDT |
| 5 | | ATOS Origin | Borja | IZQUIERDO |
| 6 | | Belgium Institute for Space Aeronomy | Simon | CHABRILLAT |
| 7 | Speaker | BMTCordah (SANY Project) | Z.A. | SABEUR |
| 8 | | BNSC, British National Space Centre | Michael | ROSE |
| 9 | | BRGM - STI/DIR | Pierre | LAGARDE |
| 10 | | CEFAS, Centre for Environment, Fisheries and Envrivonmental Science | David | MILLS |
| 11 | | CEN, European Committee for Standardization | André | PIRLET |
| 12 | | Centre for Science, Society and Citizenship | Emilio | MORDINI |
| 13 | | Coastal & Marine Resources Centre | Declan | DUNNE |
| 14 | | ControlWare | Birgitte | HOLT ANDERSEN |
| 15 | | CRUE ( Conferencia de Rectores de Universidades Españolas) | Rafael | SPÍNOLA |
| 16 | | CS Communication & Systems | Anne | CHANIÉ |
| 17 | Speaker | D´Appolonia (EU-FIRE) | C.C. | TASSINI |
| 18 | | Datamat S.p.A. | Federico | ROSSI |
| 19 | | DG ENTR, GMES Bureau | Josiane | MASSON |
| 20 | | Dutch Space Agency (NIVR) | Ruud | GRIM |
| 21 | Speaker | EADS (DYVINE project) | P. | CHROBOCINSKI |
| 22 | | EADS ASTRIUM | Patrick | RUDLOFF |
| 23 | Moerator | EARSC | Paul | KAMOUN |
| 24 | | EC- JRC | Alan | STEEL |
| 25 | | EC, DG ENTR | Jan | ULRICH |
| 26 | | EEA | Markus | ERHARD |
| 27 | Speaker | EEA (Eionet) | C. | STEENMANS |
| 28 | Speaker | ENVIROMATICS (SANY project) | R. | DENZER |
| 29 | Speaker | ESA | S. | DELIA |
| 30 | Speaker | ESEAS Central Bureau | Bente Lilja | BYE |
| 31 | Speaker | EU-DG ENV (INSPIRE) | H. | de GROOF |
| 32 | Speaker | EU-DG-ENTR-H7 (GMES-Bureau) - GMES programmes | W. | STEINBORN |
| 33 | Rapporteur | EU-DG-INFSO | I. | COENE |
| 34 | Moderator | EU-DG-INFSO | J. | PEREIRA |
| 35 | Moderator | EU-DG-INFSO | K. | FABBRI |
| 36 | Moderator | EU-DG-INFSO | M. | MONTEIRO |
| 37 | Moderator | EU-DG-INFSO | M. | SCHOUPPE |
| 38 | Moderator | EU-DG-INFSO | Guy | WEETS |
| 39 | | EU-GMES BUREAU | Arno | KASCHL |
| 40 | Speaker | EUMETNET | U. | GÄRTNER |
| 41 | Speaker | EUMETSAT | Vincent | GABAGLIO |
| 42 | | EuroGeographics | Toby | WICKS |
| 43 | | EuroGOOS | Patrick | GORRINGE |
| 44 | | European Commission - Joint Research Service | Jean-Paul | MALINGREAU |
| 45 | | European Space Imaging | Rob | POSTMA |
| 46 | | Eurosense | André | JADOT |
| 47 | | Eurosense | Emile | MAES |
| 48 | | Fraunhofer-Institute IITB | Kym | WATSON |
| 49 | | FSU Jena - Earth Observation | Christiana | SCHMULLIUS |
| 50 | | GEO | Giovanni | RUM |
| 51 | Speaker | GFZ- POTDAM (DEWS project) | J. | WÄCHTER |
| 52 | Speaker | GIM nv/sa, Geographic Information Management | V. | SCHREURS |

| | | | | |
|---|---|---|---|---|
| 53 | | GISAT s.r.o. | Tomas | SOUKUP |
| 54 | | GRICES | Ana | PONTE |
| 55 | | GTD sistemas de Información | Francisco-Javier | BUSTO |
| 56 | | IIASA, International Institute for Applied Systems Analysis | Steffen | FRITZ |
| 57 | | INASMET/TECNALIA | Jesús | MARCOS |
| 58 | | Independent Expert | Ulf | BJURMAN |
| 59 | Speaker | INDRA Space | D. | CARRASCO |
| 60 | | Infoterra Limited | Graham | DEANE |
| 61 | | INSA S.A. | Vicente | RUIZ |
| 62 | | Institute of Meteorology and Water Management, Poland | Piotr | STRUZIK |
| 63 | | International Institute for Geo-Information Science and Earth Observation | Bert | BOER |
| 64 | | LogicaCMG | Chetan | PRADHAN |
| 65 | | LSCE/IPSL, Laboratoire des Sciences du Climat et de l'Environnement | Philippe | CIAIS |
| 66 | | LSCE/IPSL, Laboratoire des Sciences du Climat et de l'Environnement | Christiane | TEXTOR |
| 67 | | LuxSpace Sàrl | Willibald | CROI |
| 68 | | NAGREF - National Agricultural Research Foundation | Leonidas | TOULIOS |
| 69 | | National Meteorological Administration, Romania | Gheorghe | STANCALIE |
| 70 | | National Research Council of Italy (CNR) - Biophysical Institute (IBF) | Stefano | VIGNUDELLI |
| 71 | | NERSC (INTERRISK project) | T. | HAMRE |
| 72 | | OHB-Technology | Stephen | HOLSTEN |
| 73 | | ORACLE | Fulvio | SANSONE |
| 74 | Speaker | ORACLE | W. | VAN DE WEGHE |
| 75 | | PLANETEK | Paolo | MANUNTA |
| 76 | | PRO DV Software AG | Lars | TUFTE |
| 77 | | QinetiQ | Wyn | CUDLIP |
| 78 | | ReSAC - Remote Sensing Application Center | Vassil | VASSILEV |
| 79 | | RIKZ - National Institute for Coastal and Marine Management | Richard | DUIN |
| 80 | | Royal Military Academy | Karin | MERTENS |
| 81 | | Saab Space AB | Hans | FRITZ |
| 82 | | SciSys UK Ltd | Adrian | GRENHAM |
| 83 | Speaker | Selex-Communications (WINSOC Project) | P. | CAPODIECI |
| 84 | | Slovak Hydrometeorological Institute | Pavol | NEJEDLIK |
| 85 | | SOST, Spanish Office of Science and Technology | Juliana | CHAVES-CHAPARRO |
| 86 | | SPMD sarl | Marc | DUFRESNE |
| 87 | | Squaris Consultants | Annie | LALÉ |
| 88 | | Starlab | Marina | MARTÍNEZ |
| 89 | Speaker | SYSTEA (WARMER Project) | L. | SANFILIPPO |
| 90 | | Tartu Observatory | Anu | REINART |
| 91 | Speaker | TELEATLAS | J. | PITTEURS |
| 92 | Speaker | Thales Communiations (OSIRIS project) | D. | TACYNIAK |
| 93 | | TNO | Chris | BREMMER |
| 94 | | TRAGSATEC | Julia | GIMÉNEZ-MORENC |
| 95 | | TÜBITAK SPACE | Hilal | YÜCE |
| 96 | | University BREMEN - Institute for Marine Environmental Sciences | Michael | DIEPENBROEK |
| 97 | Speaker | University of Münster (OSIRIS Project) | S. | JIRKA |
| 98 | Speaker | UNOSAT | Francesco | PISANO |
| 99 | | VCS Aktiengesellschaft | Peter | SCHEIDGEN |
| 100 | Speaker | VITO (OSIRIS project) | N. | LEWYCKY |
| 101 | | Yuzhnoye State Design Office (Ukraine) | Oleg | VENTSKOVSKY |

## *Annex B - Presentations List*

**Welcome (09h00-09h30) -** *G. Weets (EU-DG INFSO) & P. Kamoun (EARSC)*

**Discussion1: Sensors network architecture: (09h30-10h30)**

Moderator: *J. Pereira (EU-DG-INFSO)*

- Current trends in sensor networks, *J. Pereira (EU-DG-INFSO)*
- Sensor networks interoperability, *R. Denzer (ENVIROMATICS, SANY Project)*
- Open architecture for smart and in-situ sensor networks, *D. Tacyniak, S. Jirka (THALES COMMUNICATIONS, OSIRIS Project)*
- Self-organized wireless sensor networks, *P. Capodieci (SELEX- COMMUNICATIONS, WINSOC Project)*
- Data base integration of multiple sensors, *J. Jackson (ORACLE)*

**Discussion 2: Pilot implementations: (10h45-12h30)**

Moderator*: K Fabbri (EU-DG-INFSO)*

- Sensors for forest fire detection: *C.C. Tassini (D´APPOLONIA, EU-FIRE Project)*
- Sensor networks for tsunami monitoring: *J. Wächter (GFZ-POTDAM, DEWS Project)*
- High Altitude Platforms for environmental monitoring and risk management: *N. Lewyckyj (VITO, OSIRIS Project)*
- Multi-parametric approach to water quality: *L. Sanfilippo (SYSTEA, WARMER Project)*
- Visual sensor integration: *P. Chrobocinski (EADS, DYVINE Project)*

**Discussion 3: Integration of in-situ and EO sensors: (14h00-15h00)**

Moderator: *P. Kamoun (EARSC)*

- Combining EO and in-situ: *T. Hamre (NERSC, INTERRISK Project)*
- Sensor Fusion Services: *Z.A. Sabeur (BMT Cordah, SANY Project)*
- COPS project: Cooperating EO sensors: *D. Carrasco (INDRA)*
- Demonstrate innovative ways to exploit EO and in-situ data synergies: *V. Schreurs (GIM)*

**Round Table 1: Integration of in-situ and EO sensors: (15h00-16h00)**
Moderator: *P. Kamoun (EARSC)*

- Mapping of in-situ communities: *C. Steenmans (EEA)*
- GEO/GEOSS introduction/ Meteorology and air pollution: *U. Gartner (GEO Executive Council)*
- Integration in mapping: *J. Pitteurs (TELEATLAS)*
- GMES fast track applications: *W. Steinborn (GMES Bureau)*

**Round table 2: Infrastructure and Policies: (16h15-17h00)**
Moderator: *M. Monteiro (EU-DG-INFSO)*

- The Community Environmental Policy Context: *H. De Groof, (EU-DG-ENV)*
- Infrastructure and Support for Research and Services (SSE, HMA, Keops, ): *S. D'Elia, (ESA)*

**Final Round table: "Technology and Systems Roadmap: what's next" (17h00-17h30)**
Moderator: *M. Schouppe (EU-DG-INFSO)*

- Participants: B.L. Bye *(ESE),* Markus Erhard *(EEA)*, V. Gabaglio *(EUMETSAT)*, G. Rum *(GEO secretariat)*, W. Steinborn *(EU-DG-ENTR)*, G. Weets *(EU-DG-INFSO)*.