

**SIXTH FRAMEWORK PROGRAMME**

**PRIORITY :**

**1.4.2 Space / GMES**

**PRIORITY TITLE:**

**e) Overall system integration and architecture**



**Contract for:**

**SPECIFIC SUPPORT ACTION**

***Annex I - "Description of Work"***

Project acronym: HALO

Project full title

Harmonised coordination of the Atmosphere, Land and Ocean integrated projects of the GMES backbone

Proposal/Contract no.:

502869

Related to other Contract no.:

*(to be completed by Commission)*

Date of preparation of Annex I:

25 Sept 2003

Start date of contract:

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## 1. Project summary

The work programme for the build-up of the GMES pre-operational capabilities includes

- data delivery processes of observation systems;
- interoperability and interconnection of the data processing and delivery systems; &
- organisation and system architecture.

These are vital to the Atmosphere, Ocean and Land IPs of the GMES Backbone, & there will be strong cross- dependencies between the 3 IPs.

Key elements of the Land and Ocean IPs will be dependent on the outputs of the Atmosphere IP.

The Atmosphere IP will be dependent on outputs of the Land and Ocean IPs.

Since the Land and Ocean atmospheric requirements must be addressed in a uniform way by the Atmosphere IP, the HALO SSA will prepare the architecture and system integration for the interacting part of all 3 IPs into the GMES framework, and prepare their joint transition to operational status.

HALO will optimise the interactions of these Segments of the GMES Backbone by: formulating agreed recommendations to the 3 IPs, and to the GMES Steering Group in the areas of

- scientific thematic analysis and coordination of observational, modelling and data-assimilation requirements for the interacting parts of the IPs;
- cross fertilization of scientific thematics leading to an improvement of knowledge, and definition of the overall scientific architecture;
- identification of shared issues in the areas of data policy implementation, data acquisition, data sharing and data dissemination, leading to proposed candidate solutions; analysis of the candidate solutions, and
- formulation of recommendations for a coordinated transition to operations of the interacting part of the pre-operational systems developed in the 3 IPs.

## **2. Project objectives and state of the art**

The challenging ambition of the GMES Ocean Land and Atmosphere IPs is to deliver by end 2007 a validated pre-operational system across a wide range of scientific disciplines, thus demanding a wide range of scientific and technical skills.

The Land, Ocean and Atmosphere IPs each need to generate or acquire the best possible estimates of interfacial fluxes of momentum, radiation, sensible heat, latent heat and interfacial fluxes of a number of atmospheric constituents including carbon dioxide, water vapour and aerosol. Each IP will begin its work by acquiring the necessary surface flux products (or the science to generate such products) from the best available European sources. It is expected that the best European sources will be involved in one or other of the three IPs discussed here.

In some cases the science exists, and will be implemented operationally in one of the IPs, to improve the products of all three IPs. An example is provided by the modelling and assimilation of remotely-sensed data on aerosol, which will be undertaken in the Atmosphere IP but will be of great importance for all three IPs. A further example for all three IPs is development and validation of improved methods to estimate surface fluxes of carbon dioxide and water vapour. As the GMES project develops, estimation of sources for a variety of other atmospheric constituents will become a priority.

There are important commonalities in the requirements of the three IPs for in-situ data and for space-based data. These requirements pose common issues of data-policy, as well as considerable technical and resource challenges in the management of the wide range of high-volume remotely-sensed data needed for the projects.

The objective of the HALO SSA may therefore be summarised as:

Optimising the efficiency of the interactions of the Ocean, Land, and Atmosphere Segments of the GMES Backbone by formulating agreed recommendations to the Ocean, Land and Atmosphere IPs, and to the GMES Steering group in the areas of:

- Scientific thematic analysis and coordination
- Coordinated solutions to shared problems
- Recommendation for the transition to operational status

### 3. Participants List

<b>List of Participants</b>
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Partic. Role*	Partic. No.	Participant name	Participant short name	Country	Date enter project**	Date exit project**
CO	1	European Centre for Medium-Range Weather Forecasts	ECMWF	UK	month 1	month 36
CR	2	Alcatel	ALCATEL	F	month 1	month 36
CR	3	Astrium	ASTRIUM	F	month 1	month 36
CR	4	Co-Ordinator of Atmosphere IP (TBD)	ATMOSPHERE	TBD	month 13	month 36
CR	5	Co-Ordinator of Land IP, A.Kaptein	INFOTERRA	D	month 1	month 36
CR	6	Co-Ordinator of Ocean IP Y. Desaubies	IFREMER	F	month 1	month 36

\*CO = Coordinator  
CR = Contractor

\*\* Normally insert “month 1 (start of project)” and “month n (end of project)”  
These columns are needed for possible later contract revisions caused by joining/le

#### **4. Relevance to the objectives of the GMES Priority on Overall system integration and architecture.**

The overall objective of GMES is the integration and validation of the available results in order to reach a coherent and validated GMES infrastructure serving the user community.

The logic of an effective operational system begins with an implementation of the best available science, on the best available technical infrastructure, to deliver reliably a useful set of high-quality and well-validated operational products. Sustained development of the operational system requires flexibility in the basic design to facilitate exploitation of new observational opportunities, to facilitate development and implementation of scientific advances from the widest-possible science base, and to facilitate a continuous process of validation and implementation of new products meeting users' needs.

To deliver global ocean products for key economic sectors (transport, food supply, natural resources) and to support responses to environmental threats (chemical pollution, oil spills), the Ocean IP will require the highest quality atmospheric data and forecasts on marine evaporation, temperature, clouds and winds. To deliver useful global information on vegetation and forests at global scale, food security, carbon stocks in the biosphere, heat, water and gaseous exchanges, the Land IP will also require similar atmospheric and meteorological information. The Atmosphere IP will meet the meteorological requirements of the Land and Ocean IPs. It will also provide comprehensive budgets in space and time of variations in key atmospheric trace constituents including greenhouse gases, reactive gases and aerosols.

The HALO SSA partnership will use its research and operational strengths in Earth-system modelling and assimilation to provide a well-focused scientific and technical analysis of issues, and a cogent set of scientific and technical recommendations to accomplish delivery of the overall GMES goals for a successful articulation of the Atmosphere, Ocean and Land IPs in the GMES Backbone.

Verification and validation of the interfaces and the system performance will be carried out.

The expected outcome is the definition of the overall system of the interacting parts to achieve the GMES goal of a validated pre-operational demonstration of an efficient well-articulated GMES Atmosphere, Ocean and Land Backbone before 2008, and to prepare an effective transition to operations in 2008 and beyond.

## 5. Potential Impact

The ambitious goals of the Atmosphere, Ocean and Land IPs of GMES, to deliver operationally in 2008 a comprehensive set of high-quality scientific products across a broad range of environmental issues, will require the HALO partnership to provide an appropriate scientific and technical coordination between the substantial interacting elements of the Ocean and Land IPs with Atmosphere IP. The HALO Support Action will provide careful analysis of the coordination actions needed to achieve the GMES goals for these IPs together with a thorough set of recommendations for proposed solutions to achieve those goals. These activities are detailed in Tables 6.1 and 6.2 of the section on project management

The Support Action will be vital to the success of the overall GMES enterprise in many key areas; thus the Support Action will maintain and advance the standing of European science in the forefront of the environmental arena, and will provide substantial added-value from carrying out the work at European level. Our description of the impact of the Support Action is based on the expectation that the GMES pre-operational systems (2004-2007) and the GMES operational systems (post-2008) will facilitate an evolutionary development which exploits new observational opportunities, exploits scientific advances and provides an expanding range of validated products.

The potential impact of the Support Action is described under four headings:

- Achievement of Scientific and Policy Goals for the interacting elements of Atmosphere Ocean Land,
- Cost-effective achievement of interfacing relevant Operational Goals for Atmosphere Ocean Land,
- Contributions to standards
- Recommendations for post-2007 developments for interfacing parts of Atmosphere Ocean Land

### ***5.1. Achievement of Scientific and Policy Goals for the interacting elements Atmosphere Ocean Land of GMES***

One of the over-arching concerns of GMES is the development of an overarching system for treaty assessment and validation. Article 2 of the The 1992 United Nations Framework Convention on Climate Change states the objective to ‘Achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.’ The 1997 Kyoto Protocol to the UNFCCC sets out national commitments to reduce emissions by the first Commitment period in 2008-2012 . A major GMES goal is to put in place an operational system to synthesise space and in-situ data on Carbon dioxide and provide substantially improved estimates of total fluctuations of surface carbon emissions on land and ocean, on seasonal, annual and inter-annual timescales. This will be a vital first step to addressing the key verification issues which have impeded progress on the implementation of the Kyoto Protocol and of its new instruments such as Carbon credits and Emissions trading.

Coordination of the GMES Atmosphere Ocean and Land IPs for their interacting parts can achieve this ambitious goal in the carbon area.. We know of no similar effort in support of the Montreal Protocol in North America or Japan. Delivery by GMES of a credible and transparent operational system of the kind envisaged will have a major impact on the development of policy.

Related policy areas where the GMES Atmosphere Ocean Land IPs can work together is in refining the continuing scientific work of the:

- Montreal Protocol to the Vienna Convention Protection of the Ozone Layer
- Convention on Long-range Transboundary Air Pollution.

It is no longer possible to regard air pollution issues as regional issues; long-range transport, indeed global transport, of air pollutants is an established fact. Ozone, Nitrogen Dioxide Aerosols and other key pollutants are observable from space. Their sources and sinks occur in the stratosphere, in the troposphere and at the surface (through biomass burning and anthropogenic emissions). Moreover, the fields produced operationally by the global Atmosphere Ocean and Land IPs can provide boundary conditions and initial conditions for much improved regional forecasts of air quality and chemical weather.

Appropriate consolidation of the Atmosphere Land and Ocean cooperating parts can provide a comprehensive global quantification of the sources sinks and transports of key pollutants, and provide valuable operational forecasts of chemical weather, thus informing the development of policy. Delivery by GMES of a credible and transparent operational system of the kind envisaged will have a major impact on operational practice and the development of policy. We know of no similarly comprehensive effort in North America or Japan.

## ***5.2. Cost-effective achievement of Operational Goals for Atmosphere Ocean Land IPs***

The Telecommunications costs, High Performance Computing Costs, and (Terabyte scale) Data Handling and Archive costs of the GMES pre-operational and eventual operational system are enormous. It is imperative that the pre-operational system be developed in a cost effective manner.

As an example of how cost savings may be available, we note that the Atmosphere Ocean and Land IPs will use a number of the same satellite instruments for quite different purposes. Initially the three IPs will use the available basic products from the space agencies. In the scientific and technical planning of the GMES first implementation, and the planning of the GMES upgrade path, provision must be made to exploit the synergies of the three IPs to refine the agencies' products for the different applications. An example of multiple use is the MODIS, MERIS, OCTS and SeaWiFS group of instruments which provide measurements of aerosol for the Atmosphere IP, measurements of ocean colour and thus of biogeochemistry for the Ocean IP, and measurements of FAPAR (fractional absorbed photosynthetically active radiation) and of LAI (leaf area index and hence biomass) for the Land IP.

It is clear that coordination of the interacting activities of the Atmosphere, Ocean and Land may offer opportunities for cost savings at all stages of the processing chain. The Support Action will conduct a thorough analysis of opportunities of this kind, and propose approaches to exploit them.

### **5.3. Contributions to standards**

The Atmosphere Ocean and Land IPs will define the internal interfaces and data standards most appropriate for their work. HALO will seek to achieve common data standards for the traffic between the IPs; the volume of data traffic between the IPs will be dominated by meteorological information, where economics will almost require the adoption of common standards. The second type of datasets with large data volumes will be those satellite datasets required by two or more IPs, but for different purposes. Again the economics of the data acquisition and archiving will almost require the adoption of common standards between these elements of the GMES Backbone and the satellite data producers. Internationally agreed data representation standards will be adopted wherever possible.

The choice of standards will be discussed at the HALO workshops, which will have a wide participation from interested parties including representatives of data providers (including space agencies), GMES IPs and users, ESA's GMES service elements, and national EU stakeholders. In this way, the needs of interested parties will help shape the final HALO recommendations.

### **5.4. Recommendations for post-2007 developments for the GMES Atmosphere Ocean Land IPs**

The Support Action will provide an analysis of the issues involved in the transition of the pre-operational GMES Atmosphere Ocean and Land Interfacing parts to an efficient cost-effective operational status, and will make recommendations and proposals on how to achieve that transition so that the operational GMES system meets user needs for a growing range of well-validated product, of high scientific quality and integrity.

A key issue in the analysis and the recommendations will be how to achieve a flexible operational system which can exploit new observational resources, and new scientific advances, to meet user needs. We illustrate with two examples. As a first example of future potential, both the Land and Ocean IPs will develop improved Ocean and Land models and assimilation systems. Coordination of activities between the IPs may provide direct benefits to the European seasonal forecast capability. A second example of future potential, and the importance of a flexible system design occurs in the area of ocean surface waves. The Ocean IP will produce very high resolution ocean models and ocean current analyses. The most destructive ocean waves, 'freak waves', are a major hazard to shipping and have been implicated in the loss of many large bulk-carriers. The heaviest seas occur most often in areas where the wind opposes the ocean currents. Nowadays, ocean surface wave forecasting is an integral element advanced weather forecasting systems. As the science of 'freak waves' develops (in the interpretation of ASAR data on ENVISAT, and in wave modelling) there will be a need for flexibility within the GMES system to enforce convergence of the work of the two IPs, exploit the new scientific opportunities and deliver important benefits for the safety of marine navigation.

The Support Action will conduct a thorough analysis of opportunities of this kind, and propose sound scientific and technical approaches to exploit them in an evolutionary fashion.

## **6. Project management and exploitation/dissemination plans**

### **6.1. Project management**

The project will be run by a management committee consisting of the coordinator and the partners, which will meet twice-yearly, with the timing determined by the timing of the workshops and deliverables. As far as possible, decisions will be taken by consensus of the partners. Key members of the HALO scientific team for the interacting parts of the Atmosphere, Ocean, and Land IPs have a successful track record of working together in successive EU programmes. Where consensus is possible it will almost certainly be achieved. Where consensus is impossible on particular issues, within the HALO resources and time frame, the resources needed to achieve consensus will be reported to the EC. Decisions on purely science issues will be by consensus of the SSA Coordinator and the IPs, after consultation with the industrial partners; decisions on non-contractual matters will be made by the Coordinator, after consultation with the science and industrial partners, and where appropriate, with the GMES steering group.

The work will be organised by milestones, defined as the deliverables in the work packages, with interim progress reports to the Coordinator at the halfway point for each deliverable.

The use of official standards, or of de-facto industry standards, is of great value when proposing an architecture that must be turned into an operational system. One possible approach to ensuring that standards are observed is that HALO's work on candidate solutions and recommendations could be oriented to developing a Interface Requirement Document; this draft IRD would describe the required functionality of the GMES architecture for the interfaces between Atmosphere/Ocean/Land, and set out requirements that are mandatory, are desirable, or are requested for information.

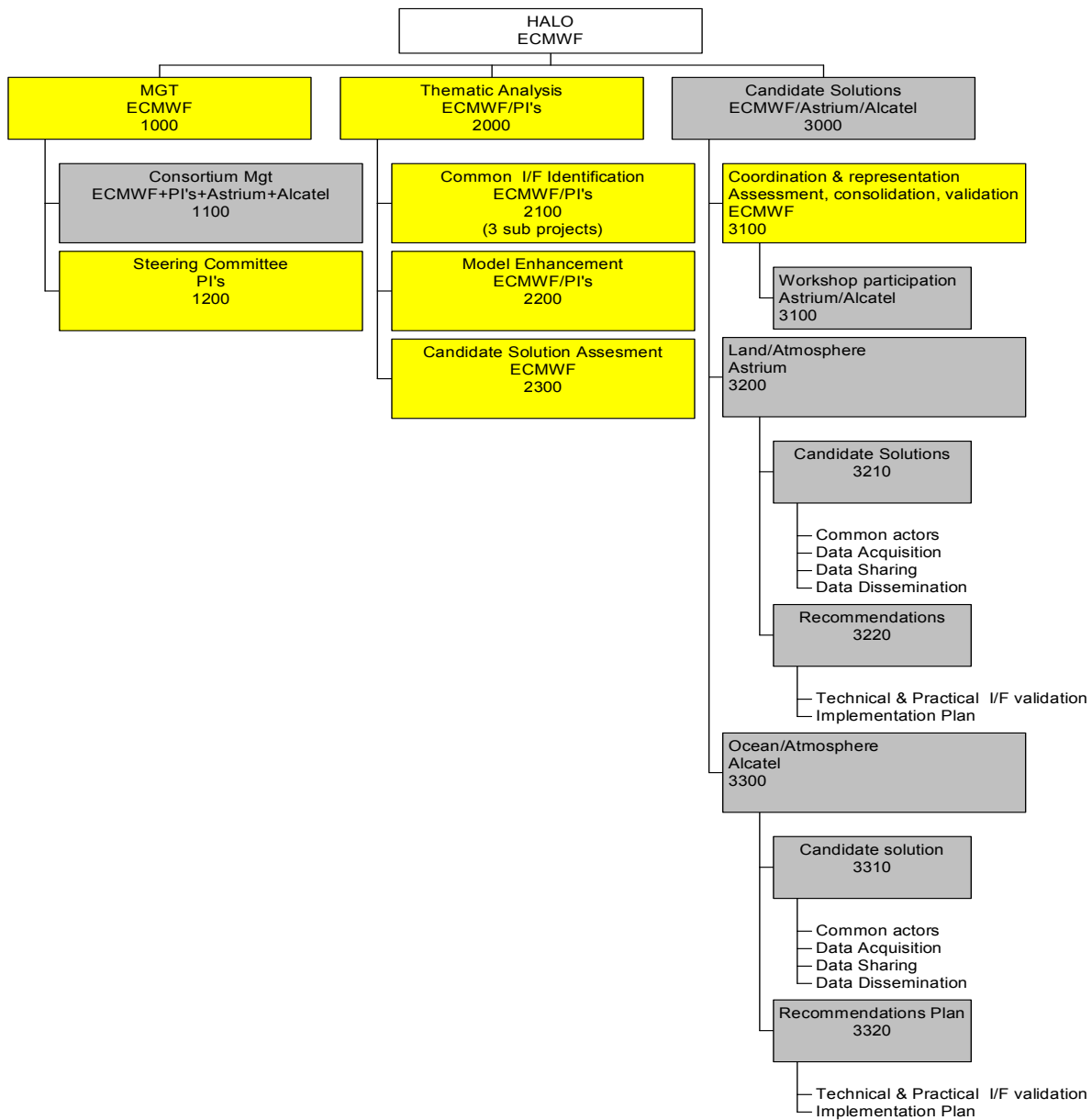
Apart from the kick-off meeting, the main management meetings will be scheduled in conjunction with the three HALO workshops. The business of the intermediate management meetings will be conducted by telecon, where possible

### **6.2. Advice from the Community**

The three HALO workshops will constitute a vital means of for consulting the stakeholders in the GMES enterprise on the range of issues to be addressed in the industrial work, on the candidate solutions, and on the final recommendations. The Coordinator will ensure that the workshops are publicised effectively among the GMES stakeholders - GMES Integrated projects, Space agencies, ESA GMES service elements, and interested national entities, and that the views of the community are reflected in the work of the HALO project. The set of three workshops will constitute a key input of scientific and technical advice, and comment, to HALO. As such the three successive workshops, fulfil the role that would undertaken by an advisory group in other SSAs.

### **6.3. Work breakdown structure**

The work breakdown structure is shown below in Figure 6.1.



*Figure 6.1 HALO Work Breakdown Structure*

**6.4. The general scope of the Scientific Thematic Analysis tasks**

The general scope of the Scientific Thematic Analysis tasks of the Support Action are listed in Table 6.1.

Science Thematic Analysis & Coordination of Requirements		Partners Contributing
	<p>Identification of common requirements for</p> <ul style="list-style-type: none"> <li>• in-situ data</li> <li>• remotely-sensed data</li> </ul> <p>Identification, and coordination of the IP's approaches to scientific interfaces and common requirements</p> <p>Exchange of scientific information, software, on improved methods for</p> <ul style="list-style-type: none"> <li>- assimilation of remotely sensed and in-situ data</li> <li>- modelling</li> <li>- validation</li> </ul> <p>Coordinated assessment / validation (where necessary) of new GMES products emerging from the IPs</p> <p>Identification / communication of common concerns to GMES Steering Group</p>	<p>ECMWF ATMOSPHERE INFOTERRA IFREMER</p>

*Table 6.1 Science Thematic Analysis & Coordination of Requirements*

## 6.5. The general scope of the Recommendations on Candidate Solutions

The general scope of the Recommendations on Candidate Solutions are listed in Table 6.2.

Recommendations on Candidate Solutions		Partners Contributing
Data Acquisition	<p>Common approach between the Ocean, Land and Atmosphere IPs to Data Acquisition, addressing (inter alia) the following issues</p> <ul style="list-style-type: none"> <li>• Common response to, of, the data policy of Data Providers</li> <li>• Interfaces, Methods and means for validation of input data</li> <li>• Interfaces, Methods and means for Data Archiving and Retrieval</li> </ul>	<p>ECMWF ATMOSPHERE</p> <p>INFOTERRA ASTRIUM</p> <p>IFREMER ALCATEL</p>
Data Sharing	<p>Common approach between the Ocean, Land and Atmosphere IPs to Data Sharing within and between IPs, addressing (inter alia) the following issues</p> <ul style="list-style-type: none"> <li>• Common response to, of, the data policies of IP partners for data sharing within and between the Ocean, land and Atmosphere IPs</li> <li>• Common approach to methods and means for telecommunications and data circulation between the Ips</li> </ul>	<p>ECMWF ATMOSPHERE</p> <p>INFOTERRA ASTRIUM</p> <p>IFREMER ALCATEL</p>
Data Dissemination	<p>Common approach between the Ocean, Land and Atmosphere IPs to Data Dissemination of GMES results outside the IPs, addressing (inter alia) the following issues</p> <ul style="list-style-type: none"> <li>• Common formulation of the GMES Data Policy in relation to the provision of information and services to the EU Commission and its specialised Agencies</li> <li>• Common formulation and implementation of the GMES Data Policy in relation to the provision of information and services to the EU National Governments and their specialised Agencies</li> <li>• Common formulation of the GMES Data Policy in relation to the provision of information and services to commercial bodies</li> <li>• Common formulation of the GMES Data Policy in relation to the provision of information and services to European citizen</li> </ul>	<p>ECMWF ATMOSPHERE</p> <p>INFOTERRA ASTRIUM</p> <p>IFREMER ALCATEL</p>
Communication and Representation	<p>Communication within and outside the Ocean, Land and Atmosphere IPs, including</p> <ul style="list-style-type: none"> <li>• workshops needed to advance discussions amongst the three IPs</li> <li>• Workshops and presentations to present the shared results of the IPs to EU, National Governments, industry, the commercial world, the scientific world and the citizen.</li> </ul>	<p>ECMWF</p> <p>with support from ALCATEL &amp; ASTRIUM</p>
Assessment of Adequacy of interfaces; Planning for the transition to operational status	<p>In the second half of its lifetime, the SSA will assess the adequacy of the interfaces of the Atmosphere/Ocean IP's, and Atmosphere/Land IPs and prepare recommendations for the further steps needed to transition the common parts of the three IPs from validation status to an operational status</p>	<p>ECMWF ATMOSPHERE</p> <p>INFOTERRA ASTRIUM</p> <p>IFREMER ALCATEL</p>

*Table 6.2 Recommendations on Candidate Solution*

### ***6.6. Plan for using and disseminating knowledge***

The management of knowledge and dissemination of results will follow EU guidelines and will be detailed in the consortium agreement. The HALO workshops will be an important mechanism for collecting the views of relevant stakeholders, and for disseminating the results of the HALO work to those stakeholders. Representatives of the other GMES IPs and of ESA's GMES service elements will be invited to the HALO workshops, so that there will be a dialogue with these interested parties. In addition HALO will consult with the commission on interested national users.

### ***6.7. Raising public participation and awareness***

HALO workshop summaries and reports will be published on a public website, and will be presented in appropriate scientific fora.

