1st HALO Workshop

Report of working groups discussions

HALO
report

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Content

1 Overview

The 1. HALO-workshop was held at ECMWF in Reading on 16. - 17. November 2004. The workshop was a forum for all interested parties to discuss the thematic analysis of future and present data demands and the issues of data acquisition, sharing and dissemination between the GMES Integrated Projects (IP).

Presentations on GMES activities and data infrastructure issues were given at the first day of the workshop. The presentations can be accessed by the following link:

http://www.ecmwf.int/research/EU_projects/HALO/workshop.html#Presentations

The second workshop day was dedicated to working group discussion among the HALO Partners. The working groups were dedicated to the following topics:

- Interacting parts of Ocean - Atmosphere IPs (WG1)
- Interacting parts of Land - Atmosphere IPs (WG2)
- Future GMES demands on Ocean, Land and Atmosphere IPs (WG3)

The content of the working group discussions is provided in the following chapters of this document. The discussion of WG 1 & 2 focused mainly on the data exchange between the respective projects from a scientific point of view. WG 3 covered a broader range of issues concerning mainly future satellite, in-situ network and infra-structure demands in GMES. The outcome of the discussions will be presented to the GMES advisory committee

Scope and progress of the HALO SSA have been discussed in WG 3 and in the final plenum. It was noted that HALO should concentrate on the interacting parts of Mersea, Geoland and GEMS, which are mainly the global model and data assimilation activities in the projects. The respective demands of the risk IP could be included in the HALO work. Research efforts on the interface processes are still needed to make use of the exchanged data, and this should be fostered by HALO.

The next step in the HALO progress will be the development of candidate solutions for a shared data - infrastructure by the HALO partners Alcatel and Astrium. The prepared HALO reports on the IPs and on the carbon contribution (published at the HALO web site) are the starting point for the work of the industrial partners. Missing information will be provided by the HALO Coordinator (ECMWF). A report is being prepared, which synthesises the individual reports against the background of the workshop discussions.

2 Working Group 1: Ocean- Atmosphere

Rapporteurs: Andrew Watson (UEA), Richard Engelen (ECMWF)

The proposals of the Integrated Projects MERSEA and GEMS were written in such a way that provision of the main input data streams are covered. For example, the MERSEA project requires NWP data and the GEMS project needs in first instance climatological carbon surface fluxes. These input data will be acquired without the need for help from HALO. The existing data access and transfer arrangements can probably be upgraded to meet the operational requirements post-2008

For this reason, the discussions in the Ocean-Atmosphere working grouping focussed mainly on science issues where the various projects could interact in the longer term. Carbo-Ocean is a FP6 integrated project due to start early 2005 that will focus on the ocean carbon budget. Because of its complementarity to the greenhouse part of GEMS, the Carbo-Ocean project will probably merit as much attention from GEMS in the future as MERSEA gets at the moment.

There was also discussion about the interaction between MERSEA and the NWP community. Better knowledge of the ocean system could improve forecasts used for search and rescue, prediction of storm surges, prediction of hurricanes, etc. MERSEA could also provide high-resolution SST and sea-ice products to the NWP community. HALO could possibly play a role in promoting MERSEA products to the NWP community.

For the long term the following science interactions were identified between the MERSEA, Carbo-Ocean, and GEMS projects:

2.1.1 Greenhouse Gases:

Bottom-up ocean surface fluxes from MERSEA and Carbo-Ocean will be useful for GEMS modelling. After 2007, when hopefully more targeted CO2 satellite observations become available (e.g., OCO), GEMS could provide global constraints on ocean surface fluxes to Carbo-Ocean and MERSEA.

In-situ ship data from Carbo-Ocean will be very useful as validation or reanalysis data for GEMS. This will require extended funding after the Carbo-Ocean finishes.

2.1.2 Reactive Gases:

Depending on how well the data assimilation system in GEMS will perform, deposition rates of O3 and NOx could be provided as very useful input to MERSEA. The deposition of these gases from the atmosphere into the ocean are significant for the chemical budget in the oceanic surface layer.

2.1.3 Aerosol

There might be some overlap between GEMS and MERSEA in terms of used satellite data. Shared data streams and data storage could therefore be an option.

Aerosol distributions from GEMS are needed to estimate iron deposition from the atmosphere into the ocean in MERSEA. However, this includes knowledge of aerosol size and origin as well. Not all aerosol types contain the same amount of iron.

GEMS would benefit from good parameterizations for ocean generated aerosol.

3 Working group 2: Land - Atmosphere

Rapporteurs: Olivier Boucher (CNRS-LOA) , Johannes Flemming (ECMWF)

People from GEMS (AER and PRO) and geoland (ONC and CSP) as well as from Astrium, ESA (PROMOTE) and Eumetsat (Land SAF) attended working group 2 on land - atmosphere interaction.

During the course of the discussion the following issues were addressed:

1. Scope of HALO work
2. Data infrastructure analysis
3. Envisaged interacting parts
4. Future development and research issues
5. Unaccomplished data demands
6. Future satellite missions for GMES and their instrumentation

3.1 Scope of HALO work

HALO should predominantly focus on land, ocean and atmosphere interactions on the global scale. Coordinating the product transfer in operational or re-analysis mode between the IPs should be the main HALO task. Research efforts on the interface processes are still needed to make use of the exchanged data, and this should be fostered by HALO.

HALO should analyse and compare the architectures of the different IPs and should coordinate the setup of the operational services of GEMS and ONC at ECMWF.

HALO should address the problems of data quality and, therefore, encourage comparisons and validation of common products such as surface radiation data from satellites.

HALO is acknowledged as a forum for joint discussions and could coordinate the link to space agencies in terms of future data needs. Furthermore, HALO can help to lobby for data provision of un-accomplished data needs relevant to the IPs such as in-situ rain-gauge data.

3.2 Data infrastructure analysis

Francois Martin DuPont (Astrium) indicated that the provided data and products inventories (located at the HALO web site) are sufficient to start work of the industrial partners. Further information about gaps in services, existing services and implementation strategies is required to propose a system-architecture. The information will be provided by the HALO Coordinator.

Data exchange volumes and formats do not seem to be a major problem according to present analysis. A clear specification of the production modes of the IPs is needed. Possible categories are operational real time, near real time and delayed mode, re-analysis mode as well as research mode. Re-analysis mode means production of retrospective data for longer periods.

3.3 Envisaged interacting parts

The following issues could link Geoland and GEMS activities:

a) Radiation (SW & LW) at the surface
b) Vegetation fires
c) Wind blown aerosol emissions
d) GEOLANDs bottom-up and GEMS-GHG top-down approach for carbon flux estimation

a) Surface radiation activities at Geolands (CSP) as well as those of the Satellite Application Facility for Land Surface Analysis (Land - SAF) should be considered in the GMES context. CSP will provide global and / or continental radiation products in re-analysis mode for the 1998-2003 period. Land SAF products are based on Meteosat Second Generation (MSG) and EUMETSAT Polar System (EPS) data. Both CSP and Land SAF are expected to benefit substantially from GEMS 4D-aerosol distribution. The radiation products should be validated at different time resolutions with surface data (BSRN, ARM) from the beginning of production.

b) Vegetation fires are an important source for green house gases, reactive gases and aerosol and are needed in the risk IP (PREVIEW) too. Geoland (CSP) portfolio includes a burned-area-product (1 km resolution) for Africa and boreal Eurasia. A demand remains for a global fire product which allows inferring the amount of biomass burned in order to provide the missing emission data. ESA (Claus Zehner) should be asked to check the possibility for a NRT fire count product from AATSR by 2007. GRID technology at ESA could possibly be utilised to process and disseminate such a product. Interactions should be initiated between Geoland and the GEMS activities on aerosol emission inventories (M. Sofiev, FMI).

c) Wind blown aerosol emissions from desert areas and cultivated agrarian fields need to be accounted for by GEMS-AER. Classes of soil types and soil moisture information will be available in ECMWF model. The parameterisation of emissions and wet deposition needs further research.

d) Geolands (ONC) terrestrial carbon fluxes could be used in GEMS (GHG) atmospheric model. On the other hand, GEMS flux estimates from inverse modelling can be constrained or validated by the CO_2 fluxes from Geoland, if produced in a stand-alone mode.

3.4 Future Developments

There are many interacting process in the areas covered by GEMS and Geoland, which should be pursued further. At the current stage, the following topics seemed to be research issues with no prospect of operational implementation in their near future.

- Parameterisation for emissions from vegetation (biogenic VOC and DMS, pollens)
- Impact of air pollution on plant growth (ozone, NO2, aerosols)
- Impact of vegetation on dry deposition parameters
- Need to homogenise cloud / snow / ice masks

- Coupled surface correction for atmospheric inversion & atmospheric correction for surface inversion
- Couple land / atmosphere retrievals from satellite data (assuming it is to early to assimilate radiances in land surface models)

3.5 Common needs of data

HALO will prepare agreed recommendation to the IPs and the GMES advisory committee. Supporting the request for unaccomplished data needs in operational, re-analysis and research mode could become an important part of the recommendations. Geoland (ONC and CSP) requires in-situ and satellite data of importance for the GEMS activities as well.

HALO should lobby for an easy access to data from the hydrological and climatological in-situ precipitation network and European radar network as well as for the operational provision of satellite vegetation products from satellite agencies beyond 2008.

Precipitation data is need to model soil moisture in geoland and to determine wet deposition in GEMS. Geoland would benefit from snow depth and snow mass observations. Both IPs need snow mask information since snow also alters the dry deposition of ozone. Direct soil moisture probes would help Geoland during the validation purposes. The meteorological-hydrological data would also create a link to the risk IP (PREVIEW) since they are a prerequisite for flood forecasting.

Geoland (ONC) requires in its operational phase a near real-time (1-2 weeks delay) vegetation parameter products (LAI, FAPAR, FVC) since, according to the current product portfolio, CSP will only supply data for the 1998 -2003 period in re-analysis mode. Snow cover, snow mass and soil moisture products from microwave instruments would be appreciated by Geoland (ONC and CSP). Reprocessing of satellite data, e.g. AVHRR, for both Geolands and GEMS purposes would benefit from a consistent snow, cloud and ice mask.

3.6 Long term satellite and other data needs

Geoland and GEMS operational commitment beyond 2007/8 requires continuity of satellite mission. ESA and Eumetsat representatives communicated the following information to the working group:

IASI and AVHRR-3 instruments, being needed by GEMS and Geoland, will be onboard all three METOPs. EUMETSAT plans delta-user consultation for the post-EPS program planned for 2018 onwards. ESA sentinel satellites (launch from 2008) will provide European earth observation in the post Envisat-epoch. User consultations are taking place and funding will be decided in 2006. The sentinels will rely on proven instruments and technology, which allows a quick transition from planning state to launch.

Sentinel-2 may carry an instrument that can be seen as a MERIS and ATSR combination, which would be very useful to GEMS.

There are concerns that an atmospheric chemistry mission will be missing for the post-ENVISAT epoch.

These issues are discussed further in the report of Working Group 3.

4 Working Group 3: Future Issues for the GMES Atmosphere, Land and Ocean Integrated Projects.

Rapporteurs: A. Hollingsworth, J-N. Thepaut (ECMWF)

Working Group 3 considered the following issues involved in the GMES transition to operational status.

4.1 In-Situ Observations

HALO noted that

- Observation networks are in place, some field campaigns data are accessible.
- It is crucial for GMES that many networks be put on an assured sustainable basis.
- There is a need for agreement on essential in situ observational networks.
- Data tabulations in the HALO documents prepared for the workshop could be used to start identifying priorities
- The Atmosphere, Land and Ocean IPs all need long records of in situ data for validation.
- As GEMS becomes operational, there will be a constant need for a reference network for continuous validation of different products

HALO recommends to GAC the sustained provision of in-situ data from an agreed reference network of in-situ observations.

HALO further noted that

- HALO activity will benefit from free exchange of air quality data and hydrology measurements.
- The predictive capability of the HALO Partners would be improved by free and open access to in situ data (hydrology).
- GMES should make use of existing capabilities from world data centres, GRDC on hydrology, PREV'AIR on air quality, GCOS data centres,...

4.2 Satellite Observations

Noting the inevitable loss of ENVISAT and EOS data provision in 2008-2010, HALO has substantial concerns about satellite data availability for a GMES transition to operational status, Beyond that time-frame the only committed missions are the operational EUMETSAT and NOAA satellites.

<u>Atmosphere Land and Ocean Common Requirement</u>

The Atmosphere, global part of Land and Ocean Integrated projects expressed as their first priority a common need for continued provision of a well calibrated moderate resolution multi-spectral instrument to provide land products (land cover, LAI, FAPAR,), ocean colour and aerosol products from space. At present the only commitment to supply such observations is NOAA's set of NPP / NPOESS missions.

Ocean Requirement

In addition to the ocean colour requirement, the Ocean IP has an operational requirement for four altimeters in orbit.

The Ocean IP has a requirement for a second scatterometer in orbit, in addition to the ASCAT instrument on the operational METOP series.

Land Requirement

The Land IP needs sustained data provision from instruments in the SPOT/LANDSAT class.

Atmosphere / Reactive Gas Requirements -Troposphere

Beyond 2008-2010 (i.e. post EOS_AURA, ENVISAT) there is a clear requirement for operational measurements of tropospheric chemical composition. The requirement is only partly satisfied by the GOME-2 instrument which will fly on METOP until 2020. GOME-2 may provide information on NO2 variability in the lower troposphere but will have difficulty with SO2, since its capabilities are limited to large volcanic emissions. A tropospheric profiling capability is needed for these and other important reactive gases such as ozone.

Atmosphere / Reactive Gas Requirements - Stratosphere

Beyond 2008-2010 (i.e. post EOS_AURA, ENVISAT) there is a clear requirement for operational measurements of stratospheric chemical composition, icluding both profiles and column amounts. The operational sounders will provide broad information on Ozone. However there is no committed provision for detailed stratospheric profiles of many important gases.

Atmosphere / Greenhouse Gas (GHG) Requirements

The GHG component of the Atmosphere IP will have access to the operational advanced sounders on METOP and NPP/NPOESS. These instruments will provide operational capabilities for upper tropospheric and stratospheric column measurements of CO2, CH4, N2O, (and CO which is usful for the reactive gas element).

The Atmosphere IP has a requirement for access to data from NOAA's OCO mission, and to data from JAXA's GOSAT mission. Both missions will make measurements of column CO2 for the lower troposphere. In addition, GOSAT will make measurements of column CH4 for the lower troposphere. These research missions will complement the operational missions in the time frame 2006-2011.

HALO informs GMES Advisory Council (GAC) of the potential value for verification of the Kyoto protocol of a combination of observations (active CO2 mission and SPOT/Vegetation) used in a high-resolution (5-10km) assimilation system with downscaling capabilities.

HALO suggests that GAC and/or the space agencies initiate studies of this issue.

Requirements for Risk Integrated Project

Although the RISK IP is not part of the HALO charge, it was noted that the GPM mission and the E_GPM component is very important for forecasting rain including heavy rain.

HALO takes note of ESA's plans for sentinel missions, which may offer a way forward before 2020.

- Sentinel 1: SAR family
- Sentinel 2: Superspectral imaging family
- Sentinel 3: Ocean monitoring family embarking a wide swath multispectral sensor as well as an altimeter
- Sentinel 4: A geostationary family for atmospheric composition and transboundary pollution detection
- Sentinel 5: An atmospheric composition monitoring family in low Earth orbit.

4.3 HALO Priorities for Satellite Missions

HALO draws GAC attention to the following HALO priorities

- Sentinel 3 will meet the common requirement of the Atmosphere, then global part of the Land and Ocean IPs, and will go some way towards meeting the ocean requirement for improved altimeter coverage beyond JASON.
- Sentinels 4 and 5 will go some way to meet the Atmosphere /Reactive gas requirements, with a strong preference for Sentinel 5, because of the global coverage. HALO regrets the apparently low ESA priority for these missions.
- Sentinel 2 will help meet key requirements of the Land IP.
- None of the proposed sentinels meets the requirement for an EGPM mission.

4.4 Data infrastructure/architecture, Data-Volumes, Formats, Interfaces

The main drivers of the data architecture for GEMS & MERSEA (and for GMES incl. Risk) infrastructure are:

- Near Real Time (NRT) activities including
- Observation acquisition (international exchange of 2-20 GB daily)
- Feedback to producers on data quality
- Data assimilation
- Forecasting,
- Product dissemination (hundreds of GB are disseminated/ exchanged daily)
- Off-line data and product quality assurance activities which normally include accessing datasets not used in the real-time production activities

An infrastructure is already in place in the meteorological community, and to somewhat lesser extent for the ocean community. The main technical challenges are associated more with the variety and number of observations (i.e. the granularity of the information in terms of spatial resolution, spectral resolution) than with the data volume per se. High data granularity (requiring routine access to small volumes of information) has resource and effort implications in terms of software development , disk capacity , CPU capacity, etc...

HALO recognises that the Atmosphere, Land Ocean IPs will have to deal with

- a lot of granularity in various products and
- NRT constraints

The expertise of the meteorological community will be very valuable as GMES develops. In particular HALO notes the benefits for the meteorological activity of a dedicated telecommunications network.

HALO informs GAC that the annual cost of the existing managed network to handle WMO traffic within Europe, plus ECMWF traffic within Europe is about 1.5 M EURO

HALO notes that in 2005 the industrial partners will propose a data architecture for the HALO partners.

4.5 Inter-Agency Collaboration and Exchanges of Data & Products.

INSPIRE

The meteorological community has only recently become aware of the INSPIRE initiative. EUMETNET and the INSPIRE project have begun discussions, which are likely to be dominated by political issues (incl. data policy issues) rather than technical issues.

HALO looks forward to a satisfactory outcome of discussions between EUMETNET and INSPIRE.

Inter-Agency Collaborations and the GMES transition to Operations

The Atmosphere land and Ocean Integrated projects involve inter-disciplinary and inter-agency collaborations at regional, national and European level. Transition of the GMES Integrated Projects to an operational status will require effective scientific / technical agreements, and effective interagency collaboration agreements at all three levels.

The Integrated Projects will develop the scientific and technical bases for the transition to operations. However HALO feels that the negotiation of the necessary Collaboration Agreements is a matter for the GAC.

HALO recommends that the GAC begin work soon on preparing the necessary collaboration agreements at European level, and facilitating the necessary agreements at national and regional level. In this respect a recent US study may be enlightening (

From Research to Operations in Weather Satellites and Numerical Weather Prediction: Crossing the Valley of Death, http://books.nap.edu/catalog/9948.html)

4.6 HALO Activity in the Coming Year

The HALO team will guide the work of the industrial partners on developing a HALO architecture in the coming year.
Furthermore, there is a lack of information (even climatology) about many boundary exchanges between the three media (land, ocean, atmosphere). Products are generated too much in isolation (example: GEMS requirements for aerosol source terms from biomass burning may not correspond to what JRC currently produces) The HALO team will act as a catalyst to undertake the following priority activities in the coming year:

- Circulate information and documentation about products between the different communities and produce inventories
- Test the products already available from the Land and Ocean IPs through atmospheric modelling activities,
- Identify mismatches between requirements and provisions,
- Identify gaps in the planned products
- Provide feedback back to the IPs to improve the products.
- Assess data reception rates and volumes for different data streams
- Identify gaps in Satellite data availability