

ESA Earth Observation Programmes and International Cooperation in the frame of Third Party Missions

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Abstract: In Europe most Earth Observation (EO) data users rely on several EO missions, both to increase sustainability of their service and to widen the range of observation parameters. In addition to its own missions such as ERS1&2, ENVISAT and the Earth Explorers, ESA therefore offers access to the scientific and applications community to so-called 'Third Party Missions'. Third Party (TP) missions are complementing the observations of ESA missions, are used to prepare for future ESA missions including cross-calibration and create synergy to favor a wider use of EO data within ESA Member States.

Keywords: ESA, ERS, ENVISAT, Third Party Missions, International Cooperation, KARI, KOMPSAT.

- The ERS 1& 2 satellites from 1991 until today, followed by ENVISAT since more than 2 years.
- Following those big missions will be the two-fold 'Living Planet' Strategy with Earth Explorers on the one hand and Earth Watch/GMES on the other
- Earthnet with Third Party Missions since the early 1980s, to serve European Users with data from non-ESA mission

In the following, more details will be given for the different lines since ERS 1.

1. Introduction

A recent study showed that in Europe more than 80% of all Earth Observation (EO) data users rely on several EO missions, on average taking data from 2 to 3 EO sources, and only 17% of products rely on a single data source. By this European Users aim to increase the sustainability of their service and to widen the range of observation parameters. Within the study it was furthermore shown that 50% of all products exploit optical and 30% exploit SAR data, with 30% use of combined optical and SAR EO data use [1].

The European Space Agency (ESA) [2] has the mandate to provide the European and worldwide User community with EO data from ESA own missions, such as ERS1&2, ENVISAT and the Earth Explorers. On top of that, ESA shall serve the European User Community with EO data from non-ESA and non-European, so-called 'Third Party Missions'. Third Party Missions (TPM) are complementing the observations of ESA missions, are used to prepare for future ESA missions including cross-calibration and create synergy to favor a wider use of EO data within ESA Member States.

2. ESA EO Activities

The EO activities of ESA follow various lines:

- the operational Meteorological Satellites since 1977 (the Meteosat series, followed by the Meteosat Second Generation (MSG) and MetOp satellites for the Eumetsat Polar System for operational meteorological observations from polar orbit with expected launch of MetOp-1 in 2005).

1) ERS1&2, ENVISAT

The ERS-1 and ERS-2 satellites were respectively launched in 1991 and 1995. Thanks to the quality, reliability and originality of the on-board instruments, many findings related to the Earth environment have been made and many applications derived from them. The ERS instruments comprise the SAR instrument for a whole variety of applications, being continued and extended by ENVISAT ASAR. The Radar Altimeter active microwave sensor designed to measure wave height, surface wind speed, sea surface elevation and ocean currents. The Advanced Track Scanning Radiometer is used for measuring sea-surface temperatures, cloud-top temperatures and for vegetation monitoring. GOME is used for global monitoring of atmospheric Ozone and other chemically active atmospheric trace-gases as well as aerosol distribution. The Microwave Sounder is operationally devoted to the determination of the wet tropospheric Radar Altimeter path delay for ice-cover monitoring. The purpose of the Wind Scatterometer is to obtain information on wind speed and direction at the sea surface.

The ENVISAT satellite, the largest Earth Observation mission ever operated, was successfully launched on 1st March 2002 by an Ariane-5 vehicle and is since then orbiting in its assigned 35-day repeat cycle, 30 minutes ahead of the ESA ERS-2 satellite. During the first weeks of the mission, all 10 ENVISAT instruments were progressively switched on and data taking activated successfully for all of them.

The ENVISAT instruments address four major areas:
- radar imaging, with the Advanced Synthetic Aperture Radar (ASAR) instrument,

- optical imaging over oceans, coastal zones and land, with the Medium-Resolution Imaging Spectrometer (MERIS) and the Advanced Along-Track Scanning Radiometer (AATSR),
- observation of the atmosphere, with the Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument, the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) instrument and the Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) instrument,
- altimetry, with the RA-2 altimeter, supported by a Microwave Radiometer (MWR) instrument, a Laser Retro-Reflector (LRR) instrument and the high-accuracy orbit DORIS system.

After the most extensive calibration and validation activity ever performed in Europe (200 teams), the Commissioning Phase was completed in December 2002 with a Validation Workshop during which the Earth Science community confirmed its enthusiasm for the initial performances and capabilities of the data provided by the ENVISAT instruments. The validation effort continues during the mission lifetime in order to continuously improve the accuracy of the product geophysical measurements.

During 2003, the services to users were gradually open and have now reached a stable status with satisfactory data acquisition and product generation performances. A total of 77 different types of products are generated amounting to about 140 GBytes of product data per day. Most of these products have been tailored for the meteorology community and are available on Internet in Near Real Time.

About half of the ENVISAT data is transmitted to the ground via the ESA data relay satellite, Artemis, providing Europe with data acquisition capabilities for any location worldwide.

The most complete information about the ENVISAT mission, system, instruments, its products, user services can be found on the ENVISAT mission web site at [3]. The web site also includes the latest mission news, such as the problems currently experienced with the MIPAS instrument.

The 2004 ENVISAT Symposium, which recently took place in Salzburg, Austria, was considered a great success. The Symposium, attended by almost 1000 participants, marks the establishment of the ENVISAT mission as one of the major tools available to the Earth Science community. The results presented during the Symposium [4] encompass many fields of Earth Science, and show that, similarly to previous symposia, the focus moves a step further from the technical issues, and more towards the applications — in particular environmental applications. It is not possible to summarize in few lines those results. However the impact of ENVISAT data to de-

scribe environmental issues such as atmospheric pollution, fires extent, sea ice motion, oceanographic current velocities monitoring or vegetation change mapping was fully recognized. Many presentations were based on ERS data, in particular those related to the exploitation of long term archive of similar measurements such than SAR interferometry, altimetry or A(A)TSR data.

2) 'Living Planet': Earth Explorers and Earth Watch/GMES

ESA's Living Planet Program implements ESA's new strategy for Earth Observation after ERS and ENVISAT. The program represents a new, flexible and user-driven approach to the whole concept of EO. Unlike the major ERS and ENVISAT Missions, 'Living Planet' will involve the use of smaller satellites on shorter, cheaper, focused missions.

Within the Program two types of EO missions have been adopted: Earth Explorers, with focus on research shall address science and technology demonstration in view of operational systems and Earth Watches, which are service driven prototype missions concerned with the operational needs of user communities and aiming to ensure long term operational monitoring.

The first 4 Earth Explorer missions will be CryoSat for ice monitoring with launch in early 2005, the Gravity Field and Steady-State Ocean Circulation Explorer (GOCE) with launch in 2006, the Soil Moisture and Ocean Salinity Mission (SMOS) with launch in early 2007 and Atmospheric Dynamics Mission ADM-Aeolus with launch in late 2007.

Central to the Earth Watch is the initiative for Global Monitoring for Environment and Security, GMES. A dedicated element is included in the Earth Watch program for the development and provision of GMES Services.

3) Earthnet: Third Party Missions

As part of the Earthnet Program ESA regularly investigates the benefits of individual Third Party Missions as part of the EO data portfolio offered to European Users. The Earthnet service offers a single point of access for the European User community by establishing international cooperation through joint Announcements of Opportunity, joint projects, contingency or data exchange agreements with Agencies and EO Mission Operators outside Europe. Furthermore ESA aims to co-ordinate and standardize the generation of products from ESA and TPMs for European use, this becoming even more important in the context of ground segment harmonization and the GEO initiative.

The list of current ESA Third Party Mission can be seen in Table 1.

Table 1. ESA Current Third Party Missions.

	Satellite	Country/Operator	Payload/Sensor
Historical	JERS-1	Japan/JAXA	SAR
	"		OPS
	Nimbus-7	USA/NASA	CZCS
	QSCAT	USA/NASA	SeaWinds
	SEASAT	USA/NASA	SAR
	MOS-1/1B	Japan/JAXA	MESS
	IRS-P3	India/ISRO	D-MOS
	Landsat	USA/NOAA, NASA, USGS	RBV
	"		MSS
	"		TM
Operational	"		ETM-
	NOAA/POES	USA/NOAA	AVHRR
	OrbView-2 (former Seastar)	USA/Orbital Sciences Corp.	SeaWiFS
	Aqua/Terra	USA/NASA	MODIS
	SPOT	France/CNES	HRV
	PROBA ¹	ESA	CHRIS

The current selection/de-selection mechanism for TPMs was established some years ago. Meanwhile, newly evolved user requirements through programs such as GMES and operational EO based services, together with technological development and altered data accessibility via ground links, demanded for a revision of this selection scheme. A new selection procedure, new International agreements and the evolution in the European Ground Segment Infrastructure shall offer the possibility to widen the data access to new missions and to establish *International Agreements for a wider use and sharing of EO data.*

Driven by technical evolution, enhanced data transfer schemes/ speed and new data distribution mechanisms, the technical range of respective set-ups with TPM Operators extends from traditional acquisition, processing, archiving and cataloguing through ESA Facilities towards the mere linking of already-existing remote TPM data catalogues, ordering systems or data holdings. This technological variety enables an enhanced co-operation possibility with the Operators of TPMs.

For the European User habits in the abovementioned study and in the view of scientific and applications/GMES, the co-operation with Operators of optical and SAR Third Party Missions such as KARI with the KOMPSAT series is an important step in finding new International Partnerships.

The range of co-operation envisaged within Earthnet ranges from the establishment of Joint Announcement of Opportunity for easy data access and joint Projects, to the common organization of workshops or symposia and to the creation of Contingency Agreements for mutual support in a fall-back system of missions providing similar data.

On the highest level, the mutual provision of data can go up to reciprocal exchange of satellite acquisition time

between partnering Agencies, allowing both Parties to acquire the respective EO data of the partnering Agencies Mission directly at their National Stations through a Data Exchange Agreement.

To this regard, close synergy with the KOMPSAT series can be established with respect to joint data use with ENVISAT, ERS or the hyperspectral PROBA mission in Europe and Korea, e.g. for Urban Planning, Disaster Management or Environmental Monitoring. Project- and Institutional-based co-operation is already established between ESA Member Countries and KARI, e.g. within the GMES Urban Services using KOMPSAT 1 data (separate papers in the ISRS2004 Proceedings).

The variety of Applications sharing the respective data sources between KARI, ESA and its Member States shall be evaluated further in the future for the benefit of the synergistic use of Earth Observation in International Co-operation.

References

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- [2] **URL:** The European Space Agency. Available at: <http://www.esa.int>
- [3] **URL:** The ENVISAT WebPage. Available at: <http://envisat.esa.int/>
- [4] **URL:** EOPI Principal Investigator Portal. Available at: <http://eopi.esa.int/esa/esa>