The Envisat Cal/Val Data Centre

R.M. Koopman
ESA-ESRIN, Frascati, Italy, Rob.Koopman@esa.int
B.R. Bojkov°
(SSAI) NASA/GSFC, Greenbelt MD, U.S.A.; bojkov@ventus.gsfc.nasa.gov
°Formerly NILU, Kjeller, Norway
M. De Mazière
BIRA-IASB, Uccle, Belgium; martine@oma.be

Abstract - **The Envisat satellite (envisat.esa.int), launched on 1 March 2002, carries ten instruments. Three of the instruments, MIPAS, GOMOS, SCIAMACHY, are aimed at atmospheric research and two multi-spectral imaging instruments, MERIS and AATSR perform land and marine observations [1]. For geophysical validation, independent observations by a large number of in-situ, remote-sensing and satellite instruments, including those on space-borne platforms, will be used for comparison with the geophysical Envisat data products. For the five aforementioned instruments, the validation activities are performed by two dedicated teams which both use a storage and retrieval facility for correlative data. The validation activities have begun in April and will continue for the entire duration of the mission. In order to extract maximum information from the coincident measurements performed for validation, these correlative data are made accessible to all scientists and engineers performing the validation and calibration. For this purpose, a new data centre was commissioned by the European Space Agency (ESA) at the NADIR database (nadir.nilu.no/calval), hosted by the Norwegian Institute for Air Research (NILU).**

I. IMPLEMENTATION

The issue of archiving ground-based data for satellite validation has been addressed thoroughly in the EC project COSE – *Compilation of Atmospheric Observations in Support of Satellite measurements over Europe* [2] in close collaboration with the European Space Agency's Envisat project. The core of the Cal/Val data centre at NILU is a relational database system whose database index derives naturally from the adoption of a standardized data format. Fig. 1, illustrates this format which includes the necessary metadata to identify the data sets unambiguously (Table I) as well as describe in detail the reported variables (Tables II). The detailed data structure, format specification, and metadata have been documented [3].

For this project, the HDF version 4.1R3 format [4] has been implemented, because of its wide use in the satellite

Fig. 1. Standard Envisat Cal/Val data file structure.

community and the availability of numerous HDF exploitation tools. In addition, as depicted in Fig. 2, HDF facilitates the implementation of QA/QC on all incoming collocation data to the Cal/Val data centre.

Fig. 2. Envisat Cal/Val data flow.

Originator Attributes	Entry	Req
PI_NAME	Family name; Given Name	X
PI_AFFILIATION	Affiliation name, Affiliation Acronym	X
PI_ADDRESS	Address; Postal code; Country name	X
PI_EMAIL	E-mail address	X
DO_NAME	Family name; Given Name	X
DO_AFFILIATION	Affiliation name, Affiliation Acronym	X
DO_ADDRESS	Address; Postal code; Country name	X
DO_EMAIL	E-mail address	X
DS_NAME	Family name; Given Name	X
DS_AFFILIATION	Affiliation name, Affiliation Acronym	X
DS_ADDRESS	Address; Postal code; Country name	X
DS_EMAIL	E-mail address	X

Dataset Attributes	Entry	Req
DATA_DESCRIPTION	Data description	X
DATA_DISCIPLINE	Field; Class; Subclass	X
DATA_GROUP	Type; Subtype	X
DATA_LOCATION	Location code name	X
DATA_SOURCE	Concatenated:Data_SOURCE Type + Institute acronym + 3-digit identifier	X
DATA_TYPE	Concatenated:Time scale code + Data level code	X
DATA_VARIABLES	List of variables in the file	X
DATA_STARTDATE	*MJD2000*	X
DATA_VERSION	3 character numeric string	X
DATA_MODIFICATIONS	Description of the data modifications	X
DATA_CAVEATS	Description of the data caveats	O
DATA_RULES_OF_USE	Description of the data rules of use	O
DATA_ACKNOWLEDGEMENT	Data acknowledgement	O

File Attributes	Entry	Req
FILE_NAME	Concatenated and underscore separated	X
FILE_GENERATION_DATE	*MJD2000*	X
FILE_ACCESS	File project association	X
FILE_PROJECT_ID	Custom project identification related to FILE_ACCESS	X
FILE_ASSOCIATION	File "other" project association	O
FILE_META_VERSION	Meta data version used	X

The detailed information on the project data structure and format specifications is made available via a dedicated restricted-access WWW server (http://nadir.nilu.no/calval/) together with numerous supporting documents, and bespoke data format processing tools. This WWW server also provides a query interface for the interrogation of the relational database. The query interface and the metadata structure have been optimized for the purpose of validation, in particular the need to facilitate identification of datasets that are collocated in time and space with the measurements that are target of validation. In Fig. 3, an example web search for Ozone LIDAR data available at the Cal/Val data centre is

Variable Description Attributes	Entry	Req
VAR_NAME	Concatenated, underscore separated	X
VAR_DESCRIPTION	Detailed variable description	X
VAR_NOTES	Variable notes/warnings	O
VAR_DIMENSION	Number of dimensions that the dependent variables depend on	X
VAR_SIZE	Number of nodes in each dimension	X
VAR_DEPEND	List of variables that the dimensions depend on	X
VAR_TYPE	Data type (string, integer, real, …)	X
VAR_UNITS	Variable units	X
VAR_SI_CONVERSION	Offset; Factor; Base SI unit	X
VAR_VALID_MIN	Valid minimum or detection limit	X
VAR_VALID_MAX	Valid maximum or saturation limit	X
VAR_MONOTONE	Describes the monotonicity of the variable (3 options)	X
VAR_AVG_TYPE	Variable averaging technique used	X
VAR_FILL_VALUE	-990000	X

Variable Visualisation Attributes	Entry	Req
VIS_LABEL	Short string to facilitate the identification of the variable	X
VIS_FORMAT	FORTRAN like format of the data	X
VIS_PLOT_TYPE	Plot type to display the variable	X
VIS_SCALE_TYPE	Plot scale type used to display the variable: scale type code; scale order code	X
VIS_SCALE_MIN	Scale display minimum	X
VIS_SCALE_MAX	Scale display maximum	X

presented. Fig. 4 is the snap-shot of the constrained search results, while Fig. 5 is an online plot of an actual profile from the NDSC station at Lauder, New Zealand.

II. ENVISAT VALIDATION PREPARATION RESULTS

Envisat validation is an activity that will cover the lifetime of the mission, but the initial validation effort in the Commissioning Phase will be very intense. In order to ensure that the prerequisites for validation analysis are available, two validation rehearsals have been held, the first in October 2000, and the second in June 2001 [5]. This includes in particular metadata definitions, software tools and efficient data handling. Since the atmospheric chemistry instruments on Envisat generate a large variety of data products, a large number of correlative instruments (more than 300) have been included in the validation program, which further increases the complexity of the data handling activity [1,6]. The scope of the validation rehearsals was to ensure successful installation of tools, familiarization with data storage and retrieval (both Envisat data and correlative data), test performance of systems and accelerate convergence on specific metadata for similar instruments. An additional important objective was to generate corrective feedback on tools and facilities during their development phase. These
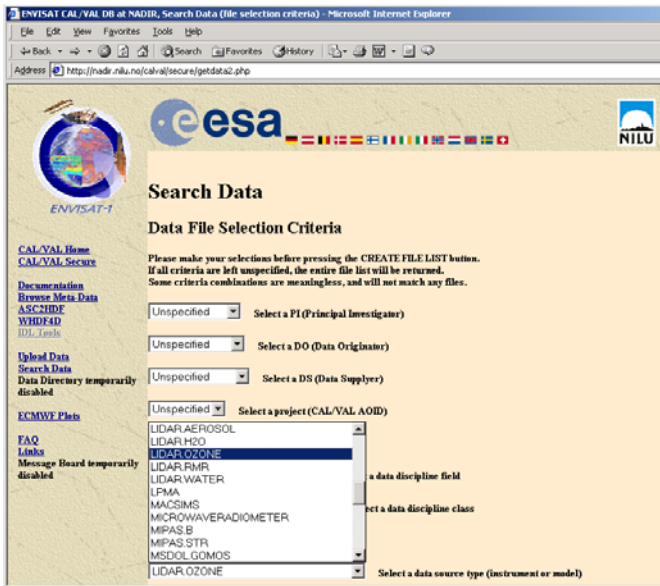
Fig. 3. Envisat Cal/Val data centre web search interface.

rehearsal objectives have been met, thanks to the intense participation of 50 validation groups. Performance testing has shown that the Envisat Cal/Val database can handle the load foreseen during the intense Commissioning Phase. Convergence on metadata standards, including the preparation of instrument metadata templates, has progressed rapidly and has since been finalised.

III. VALIDATION-PHASE OPERATIONS OF THE DATA CENTRE

Validation results will be made public at the Envisat Validation Workshop in December 2002. The IGARSS presentation included an overview of the Commissioning-

Fig. 4. Cal/Val "ozone" LIDAR search results.
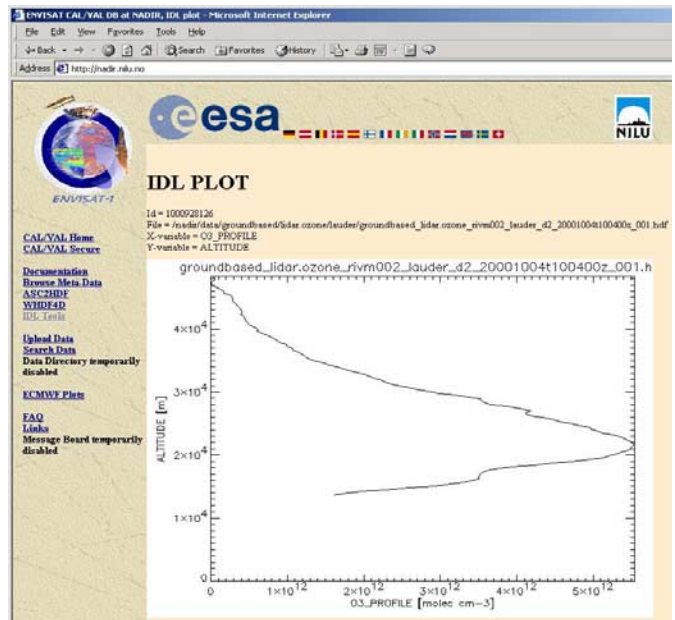
Fig. 5. Online visualization of a LIDAR ozoneprofile from Lauder.

Phase operations" for some instruments the validation phase will not have started, but already during calibration some use will be made of the data center.

REFERENCES

[1] ESA, "Envisat - Caring for the Earth", European Space Agency, Paris, France, (2001).
[2] M. De Mazière, "Final Report of the EC-COSE Project (contract ENV4-CT98-0750)", BIRA-IASB, Brussels, Belgium, (2001).
[3] B.R. Bojkov, *et al.*, "Generic metadata guidelines for atmospheric and oceanographic sciences for the Envisat Calibration and Validation Project", ESA, (2002).
[4] NCSA, HDF4 Documentation. The National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign. http://hdf.ncsa.uiuc.edu/doc.html
[5] ESA, "Second Envisat Rehearsal Campaign Guidelines – Version 1.1", European Space Agency, Noordwijk, The Netherlands, (2002).
[6] P. Snoeij, *et al.*, "Validation of the Products derived from the Envisat Atmospheric Chemistry Sensors", IEEE 2001 International Geoscience and Remote Sensing Symposium, 9-13 July 2001, Sydney Australia, (2001).