THE CEOS CAL/VAL PORTAL: A NEW INSTRUMENT FOR CAL/VAL - DATA DISTRIBUTION AND SCIENTIFIC COLLABORATION

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Abstract – The exploitation of Earth Observation data depends with increasing importance on multi-source inter-calibrated data, as demonstrated, for example, in the ESA DUE GlobColour project. The subgroup on Calibration and Validation of the Committee on Earth Observing System (CEOS) formulated a recommendation during the plenary session held in China at the end of 2004, with the goal of setting-up and operating an internet based system to provide sensor data, protocols and guidelines for the purposes of efficiently supporting sensor calibration, inter-calibration and product validation. ESA has taken the initiative and launched the version 1.0 of the CalVal Portal in October 2006 and the version 2.0 in mid 2009.

Keywords: Cal/Val Portal, CEOS, Calibration, Validation

1. INTRODUCTION

The CEOS Working Group on Calibration and Validation has recommended to "initiate an activity to document a reference methodology to predict top of atmosphere radiance for which currently flying and planned wide swath sensors can be inter-compared … Also create and maintain a fully accessible Web page containing … links to all instrument characteristics needed for inter-comparisons as specified above, ideally in a common format. In addition, create and maintain a database … of instrument data for specific vicarious calibration sites in a common format. Each agency is responsible for providing data for their instruments in this common format." [CEOS working group on Calibration and Validation, 18th plenary meeting, Beijing, November 2004. Doc No 12.1]. This recommendation fits to the importance that calibration, sensor inter-comparison and validation has in the context of GMES, which will be Europe's contribution to a better coordinated Global Earth Observing System (GEOS). GMES relies on EO data access, interoperability, long-term data preservation, and definition of standards. Applications in the GMES context are based on multi sources data and can be addressed only if the calibration and validation process is well defined and controlled through common standards. GMES requires fusion of similar sensor data to guarantee the sustainability of the services. The CEOS CalValPortal is needed to ease and strengthen the calibration process and therefore will increase the comparability of similar instrument's data, helping top match the above key GMES objectives.

2. CAL/VAL PORTAL PROJECT

The main Cal/Val Portal's components are:

- the Content Management System

- the Satellite/In-situ data Archive

- SMOS Cal/Val Facility

The logical structure of the Cal/Val Portal is reported in **Figure 1**; the user community is interfaced with the CMS, where contents, documents and other tools can be easily remotely managed.

A content management system (CMS) is a computer application used to manage work flow needed to collaboratively create, edit, review, index, search, publish and archive various kinds of digital media and electronic text. The content managed may include computer files, image media, audio files, video files, electronic documents, and Web content.[1].

The CMS is then interfaced with the Data Archive Facility, where a database manages all the archived satellite and in-situ data.

The Data Archive Facility daily accesses the ESA Rolling Archive, harvesting all new orbits over-passing a test site, sub-setting the satellite data and registering the metadata into the local database.
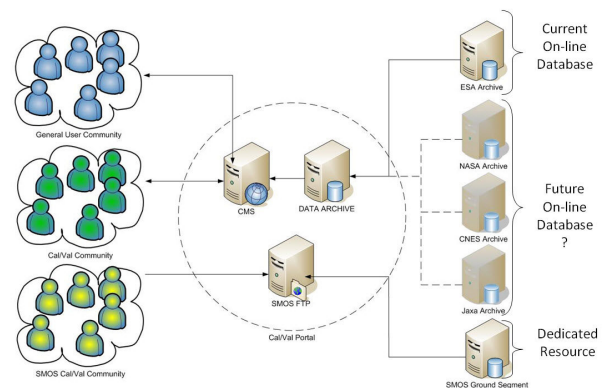

Figure 1 Cal/Val Portal Logical Structure

A dedicated resource has been set up to serve the SMOS Cal/Val Community during the Commissioning Phase. The SMOS FTP fetches SMOS orbits over-passing the calibration test sites from the ESA SMOS archive and pushes them into the Cal/Val Portal SMOS archive, where data can be downloaded by SMOS CAT.1 Registered Users.

3. THE WEB PORTAL

The Cal/Val Portal is based on Liferay®, an open source web platform that supports Content Management and other collaborative tools.
Some of the main collaborative tools are:
- eMailing
- Instant Messaging
- Application sharing
- Video Conferencing
- Collaborative workspace
- Document Management
- Task and Workflow-Management

- Wiki group or community effort to edit wiki pages (e.g. wiki pages describing concepts to enable a common understanding within a group or community
- Blogging where entries are categorised by groups or communities or other concepts supporting collaboration.

These web resources have been tailored on Cal/Val Community's needs.

3.1. Content

The Portal Content is organized around eight main topics:

- Spaceborne Sensors Section.
  - Technical description stored in SensorML
  - Prepared for Web display and download
- World Test Site Catalogue
- Cal/Val Documentation Library
- Cal/Val Campaigns Section
- Tools
- Cal/Val Projects
- QA4EO
- Cal/Val Data Access

3.1.1. Spaceborne Sensor Section

IVOS sensors are listed in the "Instruments" section.

Each sensor has got a dedicated web page containing useful technical information such as resolution, swath or bands; where available, information on useful processing tool, data access point or dedicated literature are reported and maintained.(**Figure 2**)

3.1.2. World Test Site Catalogue

A Google Map® based interface has been integrated into the portal, containing all the IVOS test sites organized per category, from the LANDNET CEOS endorsed sites to the USGS catalogue.

By clicking on each test site, the user can directly access to site details and its dedicated web page; sites are then organized per category and clicking the site family, it is possible to access to the related information. (**Figure 3**)
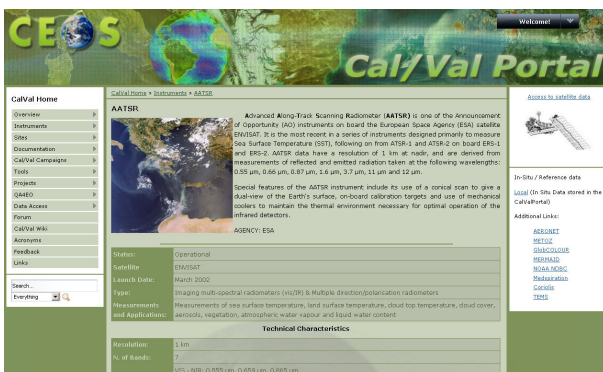

Figure 2 The Instrument Section: AATSR Page

3.1.3. Documentation Library

The Documentation Library includes a comprehensive description of a common methodology for calibration and inter-calibration of sensors working in the infrared and visible optical domain (IVOS), using ground measurements of directional surface reflectances.

Figure 3 World Test Site Catalogue

The methodology includes recommendations for in-situ measurement technique. The procedure requires the transfer of either the in-situ measurements to top-of-atmosphere, or of the satellite measurement down to the surface. A radiative transfer code is necessary for this critical step, available in the tool section, such as 6s. The methodology description includes a step-by-step description using 6S [2], and the portal is providing a web based input preparation tool, which calculated numerous parameters on the fly. Different application examples are attached to the methodology description: vicarious calibration using bright land sites, radiometric calibration in the red and near infrared, inter-comparison of imaging spectrometers. Also attached is background information such as the on-board spectral calibration of MERIS or Measurements for calibration in the solar domain: the automatic CIMEL radiometer.

3.1.4. Cal/Val Campaign Section

Ground based Campaigns are an important instrument to perform accurate sensor calibration and inter-calibration. Information on the most recent campaigns and their report and results are published in this section, as the "call for participation" for the future campaign. This section is the natural place where to collect all the information, experiences and campaign results. (**Figure 4**)

Figure 4 Tuz Golu Campaign, August 2009.

3.1.5. Tools

This section of the CalVal Portal provides the access to:

- **CalVal Software Tools**, general and specific software to support the calibration tasks. Presently, download links to the BEAM toolbox with patches

and the Radiative Transfer Code '6s' is provided. It is planned to further extend the range of tools when they become available.

- **CalVal Software Services**, services to support the calibration tasks. In its target state, the CalVal Portal shall perform typical, predefined calibration tasks on the server and supply the user with a result set consisting of calibration coefficients.

3.1.6. Cal/Val Projects

CalVal projects are a central element of the CalValPortal concept. Sites and users are associated with projects, and access to information is shared on a project basis. The portal provides support to projects by offering them a dedicated space within the portal to insert and distribute information, and to group EO data and in-situ data for easy access and exchange within the group. Collaborative tools such as a Wiki, mailing lists and forum will be added in version 2.

The portal is open to users except for data download. All textual information as well as the search for data is open, but the download of products and in-situ data is restricted to users belonging to a CalVal Project.

3.1.7. QA4EO

QA4EO has been endorsed by CEOS as a contribution to facilitate the GEO vision for a Global Earth Observation System of Systems (GEOSS). The aim of GEOSS is to deliver comprehensive and timely knowledge / information products worldwide to meet the needs of its nine "societal benefit areas". This can only be achieved through the synergistic use of data derived from a variety of sources (satellite, airborne and in situ) and the coordination of the resources and efforts of the GEO members.[3]

In this framework, the Cal/Val portal supports this activity with dedicated contents, links and documentation.
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3.1.8. Cal/Val Data Access

Access to Earth Observation data has a central role in the portal. Instrument data originating from MERIS, AATSR, ALOS AVNIR2 and ALOS PRISM is systematically acquired over internationally agreed diagnostic sites. These sites include the EOS Land core sites and the Ocean diagnostic sites as well as ALOS Calibration Team defined sites. The dataset is accessible from the internet, a powerful search interface allows dedicated data queries. Results can be directly downloaded either in the original format or as small ASCII subsets.

Access to in-situ data is provided by a dedicated database of in-situ data. This collection contains measurements of the characteristic geophysical properties, spanning over 6 years of historical and up-to date measures. Additional links to existing data bases, such as Aeronet, complete the ground measurements support.

The WGISS Test Facility (WTF), in the past operated by USGS, has been completely integrated and it is accessible from the Dara Access section. This project gathers and distributes data of US instruments over selected calibration sites.

The Data Access section provides also data for Geometric Calibration of High Resolution Sensor.

Geometric calibration is an important issue for spatial high resolution sensors. With the launch of new instruments of this type, such as ALOS and KOMPSAT, the geometric calibration of IVOS becomes more and more important, and it has been decided to support this work in the portal. Geometric calibration methods has been documented in collaboration with ETH Zürich, supporting tools has been identified and supplied; the in-situ database has been upgraded to support ground control points.

4. SMOS CAL/VAL FACILITY

ESA's Soil Moisture and Ocean Salinity (SMOS) mission has been designed to observe soil moisture over the Earth's landmasses and salinity over the oceans. Soil moisture data are urgently required for hydrological studies and data on ocean salinity are vital for improving our understanding of ocean circulation patterns.

Launched on 2 November 2009, SMOS is the second Earth Explorer Opportunity mission to be developed as part of ESA's Living Planet Programme. As well as demonstrating the use of the new radiometer, the data acquired from this mission will contribute to furthering our knowledge of the Earth's water cycle. The data acquired from the SMOS mission will lead to better weather and extreme-event forecasting, and contribute to seasonal-climate forecasting. As a secondary objective, SMOS will also provide observations over regions of snow and ice, contributing to studies of the cryosphere.[4].

During the Commission Phase it is important to give a rapid access to calibration data to the Principal Investigators, in order to control and tune the PDGS processing algorithms and to control data quality. To give proper access to data, a dedicated facility has been set up: user can access, subset or download SMOS data over test sites.

The SMOS Facility quickly detects data uploads by ESA, analyses the input and handles it. The handling of the data consists of file identification, moving the file into the archive, storing acquisition information into the database. Finally, the tool implements the dispatching policies of the appropriate data into the user ftp-homes. Mail notification are then sent to users.

5. CONCLUSION AND EVOLUTIONS

Sensor calibration, inter-calibration and validation are essential contributions to the process of acquiring long term datasets of environmental parameters, as required by GMES and GEO. The CEOS CalVal group has expressed at high level the requirements for successful interoperability of various EO sensors. ESA has taken the initiative to implement a web based system to fulfil these requirements: the EO CalVal Portal.

Version 2 of the portal has been released end of 2009 with the major upgrade of migrating the portal from a classical HTML based system to the new collaborative environment and content management system based on Liferay®.

Different calibration projects and ground campaigns have already acknowledged the CalVal Portal as useful platform for gathering information and sharing results. With the foreseen evolution, the portal will become significantly more attractive and has the potential to become a reference place for information and data to be used for calibration and validation activities for all EO sensors providing information to GMES and GEO.

The evolution of the portal currently under development is addressing additional sensors, expanding the scope of the

portal, as well as attracting new calibration and validation teams to the portal.

A major upgrade has been the integration of the WGISS Test Facility (WTF) web site, operated in the past by USGS. This project gathers and distributes data of US instruments over selected calibration sites. The WTF project has been discontinued and consequently, the access to satellite and in-situ data has been integrated into the CalValPortal.

Geometric calibration is an important issue for spatial high resolution sensors. With the launch of new instruments of this type, such as ALOS and KOMPSAT, the geometric calibration of IVOS becomes more and more important, and it has been decided to support this work in the portal. Geometric calibration methods has been documented in collaboration with ETH Zürich, supporting tools has been identified and supplied and the in-situ database has been upgraded to support ground control points.

Non-optical sensors (Microwave Passive and Active Sensors) will be supported in the next future A study on the calibration process of such sensors will be performed. The results of this study will give conclusions on the sensors to be implemented into the CalValPortal.

SMOS Cal/Val Facility has been developed and it is fully operational.

The next portal challenge will be the hardware migration to a Cloud Computing System. This new modular and distributed system will allow to easily add new cal/val tools to the portal and to use the portal also as computing power for Cla/Val Data Processing.

6. REFERENCES

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