THE EO CALVAL PORTAL

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ABSTRACT

The exploitation of Earth Observation data depends with increasing importance on multi-source intercalibrated 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 senor calibration, intercalibration and product validation. ESA has taken the initiative and launched the version 1.0 of the CalVal Portal in October 2006. This version is providing EO data from MERIS, AATSR, PRISM and AVNIR2 over internationally agreed diagnostic sites together with selected radiometric in-situ data. A methodology for calibration of optical and infrared sensors is described in detail and tools are made available to apply it. The supported sensors are described in SensorML language (SensorML 2004), a standard implemented in XML to technically describe measurement instruments. All elements are inter-coordinated to provide a complete and complementary set of information and tools. The upcoming version 2 of the CalVal Portal will include the functionality and data which have been provided by the WGISS Test Facility, operated by USGS until autumn 2006.

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 intercompared … Also create and maintain a fully accessible Web page containing … links to all instrument characteristics needed for intercomparisons 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 intercomparison 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 EO 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. EO CalVal Portal Project

In summer 2004 the European Space Agency took the initiative to launch the development of a Web Portal which will accomplish the CEOS-WGCV requirement. Version 1 of the Portal has been released October 2006 and is at a point where many of the CEOS requirements are implemented in software, where calibration methods are documented and a general understanding in supporting sensor calibration could be gained. The Portal includes description of methodologies for calibration, sensor intercalibration and validation. Version 2 is currently under development and will be completed by the end of 2007. It will include US sensors currently part of the WGIS test facility, address non IVOS sensors and support validation activities.

2.1. Project elements

The project includes studies to collect user requirements, to define reference methodologies for sensor calibration and intercalibration, to compile sensor technical data and to design and implement the Web Portal software. The Portal includes

- Description of methodologies for
  - Calibration
  - Sensor intercalibration
  - Validation

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- Description of instrument characteristics
    - Technical description stored in SensorML
    - Prepared for Web display and download
- Access to instrument meta data
    - Technical information for all type of GMES space sensors, namely optical, Radar, Atmospheric Chemistry instruments
    - In its first version the portal will support in detail MERIS, AATSR, ALOS AVNIR2, ALOS PRISM, Chris/Proba. As first non – IVOS sensor SMOS will be supported in version 2.
- Access to EO data
    - Data over internationally agreed diagnostic sites from various relevant sensors
    - Land EOS core sites
    - Ocean diagnostic sites
    - MERCI type data repository
    - Full usage of catalogue interoperability and Web Services for online access to third party data archives where possible
- Access to in-situ data
    - Links to existing data bases, such as SADE, Aeronet or NILU
    - Dedicated database collecting in-situ data
- Access to calibration software and other tools
    - Radiative transfer tools
    - Sensor intercalibration tools
- Access to results
    - Presentation of CalVal results
    - Collaboration tools

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 data and methods, which are made available through the portal, are linked by calibration software and other tools, such as radiative transfer programs.

In its extension, the Portal will provide description of instrument characteristics, whereby the technical description will be stored in SensorML (2004), so that it will be prepared for human reading in the Web browser and also available for download and application in software tools. These instrument data will include technical information for all type of GMES space sensors, namely optical, radar, atmospheric chemistry instruments. Finally it is planned to provide access to the results of calibration and validation experiments made by users by offering collaboration tools to publish results such as reports and data.

2.2. Web Portal

The EO CalVal Portal software is designed following the SOA architecture principles. The overall system consists of a set of coupled software services:

- The CalVal Service. This is the core software module to which all other modules communicate.
- A central database for storage of
    - satellite product meta information, file and image locations
    - satellite product statistics and quality information
    - in-situ measurements
    - product download statistics
    - user tables
    - site tables
- A web interface accessing the CalVal service for product and in-situ data retrieval, sensor specifications and calibration methodologies. The web interface is implemented as Java based web application serving as a central point of information retrieval for the external users.
- A service for satellite data pre-processing, quicklook generation, subsetting and quality checking.
- A service for in-situ data ingestion and verification.

Figure 1: SOA architecture of the Portal software

These services are implemented in such way that the system can be run on a distributed system – it is not mandatory to use a closed (one computer) hardware environment.

The user interface of the portal reflects the main structure of the CEOS recommendation into access to EO and in-situ data, instrument data and methodology. As an example, Figure 2 shows the user interface for querying EO data. On the left of the interface the main navigation bar can be seen. It is accessible for each interface and directs the user "access to data", "Instruments", "Tools", "Methods", "Projects", "Information" and "Feedback". The query page, which uses the main space of the screen, permits multiple selections of sensors, which is important for sensors intercalibration studies, the selection of pre-defined sites and the temporal range. The result set includes one or many products, which can be downloaded on the fly. The data are available in sensors specific, native format as well as an ASCII subset of values around the exact location of the site. The ASCII output is unique for all sensors which enables easy ingestion into further evaluation procedures.

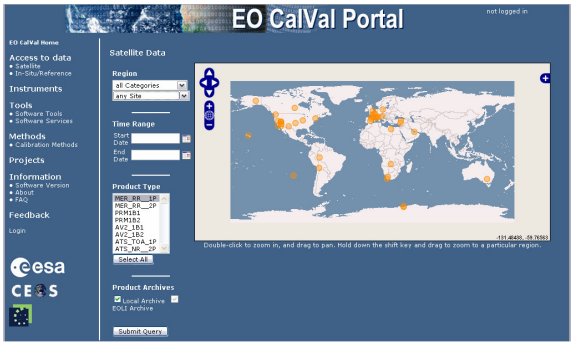

Figure 2: User Interface of the query page for EO data.

2.3. IVOS methodology

Version 1 of the EO CalVal Portal includes a comprehensive description of a common methodology for calibration and intercalibration of sensors working in the infrared and visible optical domain (IVOS), using ground measurements of directional surface reflectances. 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. A commonly accepted and publicly availably radiative transfer tool is 6S (Vermote 1995). The methodology description includes a step-by-step description using 6S, and the portal is providing a web based input preparation tool, which calculated numerous parameters on the fly (Figure 3). Different application examples are attached to the methodology description: vicarious calibration using bright land sites, radiometric calibration in the red

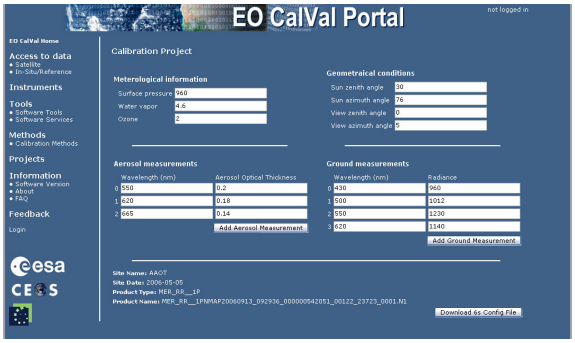

Figure 3: 6S input preparation interface

and near infrared, intercomparison 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.

2.4. Project support

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. Evolution

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 will be the integration of the WGISS Test Facility (WTF) web site, operated currently by USGS. This project gathers and distributes data of US instruments over selected calibration sites. The WTF project will be discontinued and consequently, the access to satellite and in-situ data will be 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 will be documented in collaboration with ETH Zürich, supporting tools will be identified and supplied and the in-situ database will be upgraded to support ground control points.

Non-optical sensors will be supported in version 2 of the portal. 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 will be a first candidate to be supported.
Validation of EO sensors is very specific for each class of sensors. A study is currently being performed to identify methods and to generalise them. The results of this study will be documented in the portal and used to defined future support of validation activities.
The schedule of the evolution foresees to complete the migration of the WTF in summer 2007. The geometry calibration support and the inclusion of non optical sensors will be implemented by the end of 2007. An initial operation phase will be take place in the first half of 2008.

4. Conclusion

Sensor calibration, intercalibration 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 1 of the portal has been released end of 2006 and a major upgrade, including the functionality of WTF, support to non IVOS sensors (SMOS) and support for validation activities, is scheduled for the end of 2007.
Different calibration projects 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.

5. References

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