THE EO CALVAL PORTAL

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ABSTRACT

The Committee on Earth Observing System (CEOS) Subgroup for Calibration and Validation has formulated a recommendation to set-up and operate an internet based system to provide sensor data, protocols and guidelines. This shall support worldwide activities on calibration and validation, and specifically ensure that sensor intercalibration is favoured in a standardised way, so that GMES can be served with information products regardless of the sensor providing the source measurements. ESA has launched a project to realise this recommendation. The objectives of this project are:

(1) to study in detail the calibration and validation requirements and methods, of all types of sensors required in the GMES context, namely active microwave imaging instruments, such as SAR, optical imaging sensors, such as AATSR and sounding instruments for atmospheric chemistry measurements (Phase 1);

(2) to design and implement a flexible internet portal to provide the required data and information to users, which follows international standards specifically for catalogue interoperability, so that easy exchange of data from and to other CalVal servers can be achieved;

(3) to operate the system for an initial period of one year.

The calibration and validation activities, which are necessary to provide best results and optimal sensor intercalibration, cannot be achieved by a single agency. The proposed CalVal Webportal will be the first of its kind, and by continuous exchange of information and consultancy with other agencies, such as Jaxa and NASA, and with those scientists performing the calibration and validation, it will be ensured that the Webportal becomes the worldwide accepted, multi-sensor information source for calibration and validation.

1. INTRODUCTION

GMES will be Europe's contribution to a better co-ordinated Global Earth Observation System of Systems (GEOSS). GMES relies on multi-source data access, interoperability, long-term data preservation and definition standards to facilitate the above objectives. In this framework, calibration and validation are two essential steps for the correct use and understanding of the Earth observation data. Applications in the GMES context are based on multi-source data and can be addressed only if the calibration and validation processes are well defined and controlled through common standards. This requires a fusion of similar sensor data to guarantee the sustainability of the services. Cross-calibration is needed to ease the calibration process and will thus increase the comparability of similar instruments data, thereby helping to achieve the above key GMES objectives.

On the basis of these requirements for sensor calibration, inter-calibration and product validation, the Committee on Earth Observing System (CEOS) Subgroup for Calibration and Validation has formulated a recommendation to set-up and operate an internet-based system to provide sensor data, protocols and guidelines. This shall support world-wide activities on calibration and validation, and specifically ensure that sensor inter-calibration is favoured in a standardised way, so that the network of Earth Observing Systems can be served with information products regardless of the sensor providing the source measurements.

2. REQUIREMENTS OF CEOS CALVAL SUBGROUP

During the CEOS plenary session held in China at the end of 2004, the subgroup on Calibration and Validation has formulated the following recommendation [1]:

"Background

Reference Datasets are required to support the understanding of climate change and quality assure operational services by Earth Observing satellites. The data from different sensors and the resulting synergistic data products require a high level of accuracy that can only be obtained through continuous traceable calibration and validation activities.

WGCV Requirement

Initiate an activity to document a reference methodology to predict Top of Atmosphere (TOA) radiance for which currently flying and planned wide swath sensors can be intercompared, i.e. define a

standard for traceability. Also create and maintain a fully accessible web page containing, on an instrument basis, links to all instrument characteristics needed for intercomparisons as specified above, ideally in a common format. In addition, create and maintain a database (e.g. SADE) of instrument data for specific vicarious calibration sites, including site characteristics, in a common format. Each agency is responsible for providing data for their instruments in this common format.

Recommendation

The required activities described above should be supported for an implementation period of two years and a maintenance period over two subsequent years. The CEOS should encourage a member agency to accept the lead role in supporting this activity. CEOS should request all member agencies to support this activity by providing appropriate information and data in a timely manner."

3. THE EO CALVAL PORTAL PROJECT

ESA has attended to this recommendation and has launched a project aiming to develop and operate a Web portal which includes elements to fulfil the above requirements. The project started in summer 2005. During the first year the portal will be developed followed by one year of initial operation. The project has two major elements: namely, studies dedicated to collect and evaluate background information on

- the influence of various parameters on vicarious calibration
- the identification of required tools
- gathering sensor characteristics

and secondly, the web portal software and its content. The portal will comprise a description of methodologies for calibration and validation in the form of scientific background knowledge as well as practical guidelines for its use. This theoretical part will be complemented by tools required to apply the methodology and by a technical description of the supported sensors, internally stored in SensorML [2] and suitable for both human readable presentation in the web page as well as for direct application in tools.

Access to data is the second corner stone of the web portal. This includes earth observation data and in-situ data, both over selected geographical areas, which have been identified by the user community as suitable calibration and sensor intercalibration sites.

Finally the portal will include a section dedicated to the presentation of the results of CalVal activities, and typical web site functions such as user management, interaction forum and online help.

4. METHODOLOGIES FOR CALIBRATION

The physical interpretation of satellite data needs an accurate sensor calibration. This is valid for infrared and optical sensors (IVOS) as well as for atmospheric chemistry instruments, SAR sensors and other microwave instruments. Initially the CalVal portal will concentrate on IVOS sensors. An accuracy of a few percent is required for the radiometric calibration of ocean colour missions. The calibration protocol usually includes a pre-launch radiometric activity as well as an onboard checking [3]. In this purpose, some of the ocean colour sensors are equipped with diffuser panels [4] supposed to measure the solar irradiance on a daily basis (MERIS, SeaWiFS). Nevertheless, it is difficult to separate the degradation of the sensor calibration from a change in a panel reflectance. The lunar calibration [5] has been used as well for the SeaWiFS sensor in order to indicate variations in the panel characteristics. This technique consists of assuming the moon is a diffuse reflector whose surface remains unchanged. The sensor points at the moon each month in order to evaluate the temporal degradation of its sensitivity for each channel [6]. The cross-calibration between sensors is also often used to check the validity of the sensors sensitivity. For example, MOS was recalibrated using the SeaWiFS data [7] and POLDER was cross-calibrated with OCTS. Specific activities are also conducted for the spectral calibration [7].

The EO CalVal Portal includes a synthesis of currently applied vicarious calibration and sensor intercalibration methodology. The method is centred on radiative transfer modelling. The objective is either to transfer ground measurements to top of atmosphere (vicarious calibration) or to relate the measurements of one instrument to those of a second one (sensor intercalibration).

5. WEB PORTAL ELEMENTS

The EO CalVal Portal comes with an interface as shown in figure 1. The main navigation area is on the left side. The "Access to data" entry expands to the subjects "Satellite data" and "in-situ data". The "Instruments" entry includes a technical description of each sensor grouped into optical instruments (MERIS, AATSR, ALOS AVNIR and PRISM, Chris/Proba, Bird, Vegetation), and the technical details can be viewed as html or downloaded as SensorML files. The "Methods" section comprises documentation of methods (pdf) for optical, microwave and atmospheric chemistry instruments. The tools entry offers a list of tools required to implement the methods described. The tools are offered either directly for download or as a link to the originator of the tool. Since the first version of the portal concentrates primarily on IVOS instruments, the tools section includes radiative transfer codes (6S, SOS

radiative transfer code), a Web based input generator for 6S tailored to the application of sensor intercalibration, BEAM [8] and other necessary tools. Finally, a section is dedicated to the uploading and sharing of results from the calibration and validation activities.

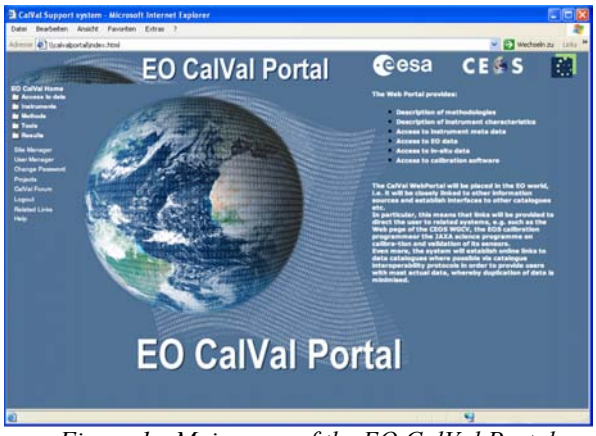

Figure 1: Main page of the EO CalVal Portal

5.1. Access to satellite data

One of the primary functions of the CalVal Portal is the provision of earth observation measurement data over selected sites. These sites are defined by the scientific community as sensor intercalibration sites, or sites with regular in-situ measurements which can be used for sensor calibration and product validation, called diagnostic sites,. Examples are La Crau (France) [9], Railroad Valley (USA), Moby (Pacific Ocean) or Boussole (Medditerranean). Data of the supported instruments will be systematically obtained over these sites and will be made available through a graphical search and download interface. The interface will provide functions for a geographical search, both by site name or co-ordinates, a temporal search or a criteria search based on specific meta data including cloud coverage and other quality information. Selected data can be downloaded via http stream directly through the interface. Ftp access for systematic download will also be available.

The CalVal Portal will gather information on the EO data available either from its internal catalogue or by query of remote catalogues which offer suitable interfaces, e.g. access to the ESRIN catalogue via EOLI-XML, which is a partial implementation of the OGC Web Catalogue Service. Accordingly, the data products will be extracted from an internal data repository or will be retrieved from remote archives via appropriate protocols.

5.2. Access to in-situ data

In-situ data are important reference data for vicarious calibration, sensor intercomparison and the validation of products. In the case of IVOS, in-situ data include, amongst other, ground reflectances, atmospheric properties (especially aerosol data) and other meteorological data. These data will be provided either by linking to existing databases, such as Aeronet [10], Sade or NILU, or from an internal database. The CalVal Portal internally links the EO data which have been selected with matching in-situ data from its database to ease the collection of data sets to be used according to the proposed methodology.

6. SUMMARY

The EO CalVal Portal is a project presently being undertaken by the European Space Agency with the aim of implementing the CEOS requirement of creating a common platform which will support calibration, sensor inter-comparison and product validation. As a first step, a methodology for vicarious calibration and sensor inter-calibration for IVOS sensors has been elaborated as a common standard. A Web Portal is under development to make this reference methodology widely available, and to provide systematic data from various instruments over selected diagnostic sites. In subsequent phases the portal will be extended to microwave and atmospheric chemistry instruments. This initiative is an important step forward in supporting calibration and validation activities in a standardised way, as well as providing quality checked EO data and corresponding instrument data in an easy and uniform way for the users.

7. REFERENCES

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