

**Working Group on Calibration and Validation  
Report to the 16<sup>th</sup> CEOS Plenary**

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## **1 Executive Summary**

### **1.1 Highlights of 2002**

- Successful 19<sup>th</sup> WGCV plenary meeting in Ottawa, Canada, hosted by CCRS, detailing Canadian cal /val activities, Envisat's early results, and NPOESS and NPP. Also detailed discussions concerning the workings of CEOS and the WGCV, and the CEOS review.
- Commencement of Phase 1 in the joint WGCV / WGISS activity on CEOS core test sites for land parameter validation, involving the survey of five globally distributed sites from October 2002 – October 2003.
- Establishment of the joint WGCV / ISPRS taskforce on radiometric and geometric standards, its chair and membership, and preparation for kick-off at an ISPRS meeting in Denver, USA.
- Establishment, and first meeting, of the sixth subgroup of the WGCV, the Atmospheric Chemistry subgroup.
- The focus of the Atmospheric Chemistry subgroup on ensuring sustained support for ground networks, used for product validation, both throughout the lifetime of a particular mission, and also between missions.
- The involvement of the SAR subgroup in Envisat's ASAR cal / val campaign, and the preparation of documentation detailing requirements and techniques necessary for effective calibration of polarimetric interferometric systems.
- The preparation of documentation, by the LPV subgroup, concerning the validation of Albedo measurements.
- The focus of the Microwave Sensors subgroup on general terminologies for microwave radiometry and issues of calibration for Aperture Synthesis Radiometers.
- The re-establishment of the IVOS membership and their new focus on addressing reference spectra for data processing.
- The focused dedicated effort of the TM subgroup towards SRTM validation and evaluation.
- Representation of WGCV and its subgroups at a variety of workshops and meetings
- Preparation of a stand at CEOS Plenary 2002 and a WGCV brochure update

### **1.2 Future activities**

The 20<sup>th</sup> WGCV plenary will be held in Hobart, Australia, from 12 – 14 February 2003, and will be hosted by CSIRO Marine Research, the CSIRO Earth Observation Centre, and the Antarctic Cooperative Research Centre. The 21<sup>st</sup> WGCV plenary will be held in Beijing, China, from 15 – 18 October 2003.

## **2 Expanded report**

### **2.1 WGCV plenary meeting**

The Canada Centre for Remote Sensing (CCRS) hosted the 19<sup>th</sup> meeting of the CEOS Working Group on Calibration and Validation (WGCV) in Ottawa, Canada, from 1<sup>st</sup> to 3<sup>rd</sup> May 2002. On behalf of CCRS, Dr Robert Ryerson welcomed the WGCV-19 participants to Ottawa and emphasised the links the centre has, through its new Earth sciences sector programmes, with the activities of CEOS and the WGCV. A special session on Canada and CCRS provided the WGCV-19 participants with an interesting and informative view of Earth Observation activities and operations within the host country. Presentations covered Radarsat-1 image quality and calibration, trends and uncertainties in the thermal calibration of AVHRR, hyperspectral remote sensing activities, the use of spatial products for climate change and sustainable development assessment, the validation of coarse resolution satellite products, and advanced technologies for *in situ* sensing.

The first results from ESA's Envisat mission were presented at WGCV-19, and the calibration and validation of the instruments onboard detailed. The first results are very encouraging with most instruments surpassing their predicted operational performance.

A special session on NPOESS and the NPOESS Preparatory Project (NPP) was included at WGCV-19. The NPP is scheduled for launch around 2005 and will be a precursor mission for the NPOESS constellation of satellites that will follow towards the end of the decade. The production of the NPP cal/val plan will involve interaction with the WGCV.

The WGCV brochure has been published and was distributed to those present at WGCV-19. An online request facility is in operation through the WGCV website and a number of brochures have been distributed via this mechanism.

Statistics relating to WGCV membership and attendance at plenary were presented. It was apparent that there were gaps in the membership and attendance and it was suggested that a request should be made to CEOS to nominate representatives from the various relevant organizations / agencies who would be interested in cal/val.

As a contribution to the CEOS review effort, a questionnaire was handed over to CEOS members and detailed replies collected. A dedicated session allowed WGCV members to discuss CEOS and its relationship with the WGCV. WGCV members identified that the working groups are felt to be the backbone of CEOS, and that the mechanism whereby the groups have their own meetings and then report to plenary, works well. The groups are very open to instructions from plenary although more resource commitments from plenary would be welcomed. The relationship between the WGCV and plenary should be maintained, and any links with other organisations might go through plenary, e.g. the group's current relationship with WGISS was originally instigated through plenary.

The WGCV current work plan expires at the end of 2002. Changes to the work plan have already been made to update it for the new Atmospheric Chemistry subgroup, and it will be further updated to version 2.7, covering 2002 to 2004.

The CSIRO Marine Research, the CSIRO Earth Observation Centre, and the Antarctic Cooperative Research Centre have kindly offered to host the next WGCV Plenary meeting (WGCV-20) from 12 – 14 February 2003.

Full minutes are available from the WGCV web site.

## **2.2 Subgroup Activities**

### **2.2.1 SAR**

The 2002 SAR subgroup workshop, hosted by the British National Space Centre (BNSC), was held at the DTI Conference Centre, London, from 24 – 26 September 2002. The meeting involved approximately 40 participants from Europe, Japan and Canada. There were three technical sessions and an invited paper from the WGCV chair on the objectives and programme of the WGCV and the activities of its subgroups. The three technical sessions comprised presentations and round-table discussions covering SAR calibration techniques, Envisat ASAR calibration and SAR polarimetry. Resulting from the discussions, a series of recommendations to the WGCV were identified:

1. The WGCV SAR subgroup should set up calibration and validation reference sites (to include both natural and man made targets) for the following purposes:
  - to provide an easily accessible source of reference calibration data to data providers,
  - to show the mutual compatibility between different SAR systems,
  - to demonstrate the total quantitative and qualitative quality of SAR data.
2. Space Agencies should continue to improve the quality of single and full polarization SAR data by technical exchange of information on the development of SAR calibration and imaging algorithms and techniques.
3. The next meeting of the SAR subgroup should focus on the problem of full polarimetric SAR calibration, both establishing requirements and techniques.
4. Space agencies should ensure that calibration processes for SAR are traceable to the primary standards.

The next SAR subgroup meeting will have as its main theme the identification of SAR polarimetric calibration requirements. These are needed to enable the effective the extraction of geophysical parameters from SAR data. The next meeting is provisionally planned for June 2003 in Canada, hosted by the CSA.

### **2.2.2 Infrared and Visible Optical Sensors**

Michael Rast (ESA) took over the role of IVOS chair at the 11<sup>th</sup> IVOS meeting, which was held in conjunction with a MERIS calibration meeting from 6 – 7 February 2002 in ESA-ESTEC, and was the first time the subgroup had met for three years. Participants to the meeting included representatives from NASDA, ONERA, NPL, CNES, USGS, NASDA, RAL, CCRS, EC-JRC, ESA. The objectives of the meeting included a review of the ongoing cal/val activities at the CEOS member agencies and institutions and the identification of areas for future coordination and/or cooperation. The subgroup agreed on the importance of documentation in the derivation of the exo-atmospheric solar spectrum used in data processing. An accepted reference spectrum should be used as a standard. An in-depth study was proposed to characterize on-board solar diffusers, including their stability in the space environment. The 12<sup>th</sup> IVOS subgroup meeting will be held at ESA-ESRIN, Frascati, 14 – 15 November 2002.

### **2.2.3 Land Product Validation**

The initial programmatic focus of the LPV subgroup was on the GOFD priorities of fire, land cover and biophysical products, and the support of the IGOS-P terrestrial carbon theme. Topical workshops, chaired by community experts, have identified best practises and made recommendations for action. A workshop on LAI was held from 7 – 8 June 2001 in ESA-ESRIN, and a workshop on fire / burn scars was held in collaboration with GOFD from 9 – 11 July 2001 in Lisbon, Portugal. Also, the LPV subgroup contributed to the GOFD Forest cover characteristics and changes implementation meeting, which was held from 11 – 13 February

2002 in Toulouse, and to the Global land cover 2000 (GLC2000) project meeting, whose participants met in Ispra, Italy, from 18 – 22 March 2002.

The LPV subgroup have produced a report on the best practise strategies for validating satellite-derived LAI products . Protocols for active fire burned area validation and reporting have been developed, and a network of long-term monitoring sites for fire product validation have been established. A ‘best practises’ special issue or report on land cover is also planned.

The subgroup’s new activities include the planning of a new topical workshop on Albedo validation from 22 – 24 October 2002 in Boston, USA. Also, the importance of working with industry, and NPOESS, is recognised.

#### **2.2.4 Terrain Mapping**

The TM subgroup met during the ISPRS WG II/2 symposium on 3D mapping from IfSAR and Lidar in Banff, Canada, from 11 – 13 July 2001. There, several private sector companies agreed to provide ‘ground truth’ DEMs, subject to licence agreements, for validation activities. SRTM / C-SAR DEM data has been released by NASA / JPL over the USA, and quality assessment activities on the data have started. The test site dossier is being updated to include more European validation sites. A best practice document is also being updated in the light of interest in linking SRTM and Lidar data into WGCV / WGISS activities that aim to provide easy web access to test data sets.

The next technical workshop of the subgroup will take place at JPL, USA, on 10 December 2002. The subgroup will also be represented at the X-SRTM project meeting in Munich, Germany from 17 – 18 October 2002.

#### **2.2.5 Microwave Sensors**

The microwave subgroup met in conjunction with a specialist Meeting on Microwave Remote Sensing in Boulder, USA, on 6 November 2001. The near term action plan of the WGCV Microwave Sensors Subgroup is very much focused on spaceborne microwave radiometry. The advent of polarimetric and interferometric radiometers, such as the US Windsat and the European SMOS, pose new challenges in the calibration and validation. The MSSG work plan currently remains focused the compilation of a document on frequently used terms in microwave radiometry and multi-mission cal/val site identification.

The group recommend that all future missions carrying a microwave radiometer are designed to allow the view of the cold sky of its primary reflector at least twice a year (around one equinox and one solstice), and preferably four times a year (every equinox and solstice). It is also recommended that an analysis of available microwave radiometer records over different potential cal/val areas of the World is performed, in particular Dome-C in Antarctica and the oceans.

The MSSG met at the Polytechnic University of Barcelona, Spain, from 9 – 11 October 2002, in conjunction with the 2<sup>nd</sup> International Microwave Radiometer Calibration Workshop ( $\mu$ Cal-2002). The MSSG meeting focused on general terminologies for microwave radiometry, terminology for Aperture Synthesis Radiometers and terminology for Polarimetric Radiometers. The next meeting is provisionally planned in conjunction with the IGARSS symposium in July 2003, Toulouse, France.

#### **2.2.6 Atmospheric Chemistry subgroup**

The first Atmospheric Chemistry subgroup meeting, chaired by Ernest Hilsenrath (NASA) was held from 29 - 30 April 2002, in Ottawa, Canada. The charter for the subgroup is based on the WMO-GAW No 140 document, which details goals and a set of recommendations. The IGOS

theme relating to atmospheric chemistry is also an influence. The subgroup will address atmospheric chemistry and also dynamics, and will be particularly interested in long-term changes and the sensitivity of instruments over time. An holistic approach and consistent procedures for calibration will be sought, as will international collaboration and cooperation.

The mission of the subgroup is to ensure accurate and traceable calibration of remotely sensed atmospheric chemistry radiance data, and validation of higher-level products, for application to atmospheric chemistry and climate research, from Earth Observing satellite missions. This is important as 28 instruments, on 14 missions, for observing atmospheric chemistry will be flown by 2015.

At their first meeting, the subgroup identified the need for sustained support for the ground networks in order to complement the space observing systems for climate change. Observations of climate change due to changing composition of the atmosphere demand accuracy and continuity that are currently at the brink of our capabilities. To this end, the subgroup recommend that the ground network station's homeland institutions, and the interested space agencies, commit to sustained financial support of both existing network stations and for new stations in under-sampled regions of the globe. In addition the network station should commit to established guidelines for data accuracy and timely archival.

The next meeting of the subgroup is scheduled in conjunction with an Envisat cal/val workshop in December 2002 at ESA/ESRIN.

### **3 Liaisons with other CEOS Working Groups**

#### **3.1 Joint activity between WGCV and WGISS for the establishment of a network of "CEOS Land Validation Core Sites"**

Collaboration with the Working Group on Information Systems and Services (WGISS) has been ongoing. This joint WGCV / WGISS activity aims to provide web-based access and value-added formatting / geo-registration of Earth Observation remote sensing (and other) data over a set of "core" validation sites in support of global land product inter-comparison activities. This activity was initially proposed at CEOS plenary in 2001, and to WGISS-13 and WGCV-18.

The scope of this project, is to utilize, or develop, WGISS tools such that the Science Team's needs are met for information systems and services. The WGCV has identified a need for a GIS/web based interface to access "CEOS Core Sites" data, starting with sites where LAI inter-comparison work will be done, thus supporting the LPV inter-comparison, which can feed into the GOCF biophysical component. It is proposed that the first phase of this activity addresses the requirements of five test sites and provides a common user interface to the multi-agency data sets that exist for each site. These data will be made available on-line in a common, user-specified, file format and projection.

Instigated by the WGCV, the project will initially focus on establishing an access prototype for distributed EO data, *in situ* data, and test site validation databases. This first phase will last from October 2002 until October 2003. The initial objective during Phase 1 is to represent sites and data associated with the EOS core sites and VALERI, i.e. Barton Bendish (UK), Mongu (Zambia), Harvard Forest (USA), BOREAS Northern study area (Canada), and Uardy (Australia). Satellite data acquired thus far includes MODIS, Landsat ETM+, SPOT HRV and VEGETATION. This has been achieved with support from the USGS, NASA, NASDA and ESA.

#### **3.2 Collaboration with WGTE**

An update on the activities of the Working Group on Training and Education (WGTE) was presented at WGCV-19. Opportunities for the two working groups to collaborate were identified. The WGTE are to host a web-based forum to provide links to already existing

informative Earth Observation material, but which would not be a duplication of existing sites / databases. It was agreed that a single presentation from the WGCV could be prepared that details the activities of the subgroups. This presentation would be hosted on the WGCV website, along with any other relevant and accessible existing material, and a link to the site be provided from the WGTE's site.

### **3.3 Joint activity between WGCV and ISPRS on radiometric and geometric standards**

A further joint activity is the ISPRS / WGCV joint taskforce on radiometric and geometric standards. This was established after it was noted that Earth observing sensor parameters are specified and quoted in a disparate way, whilst the extraterrestrial community a standard format. Proper use, understanding and intercomparison of sensor parameters depends on clear and unambiguous definition.

A special session on this joint WGCV / ISPRS activity was held at both WGCV-18 and WGCV-19. The WGCV chair also gave a presentation at the ISPRS meeting in Hanover, Germany, in September 2001. The joint taskforce kick-off meeting is planned for 11 November in Denver, USA, and will be chaired by Manfred Schroeder, DLR.

The detailed aims of the taskforce are to:

- collect and collate lists of parameters used to describe Earth observing sensors.
- make an analysis of these and recommend a standard list of parameters for presenting descriptions of EO satellites,
- identify ambiguity and confusion within these terms and recommend methods of clarifying these issues,
- prepare a document which sets out standard methods of describing EO sensors
- communicate and consult widely with the user community.

The initial membership to the taskforce comprises the ISPRS WG (Chair ISPRS WG I/2, Co-Chair ISPRS WG I/2, Chair ISPRS WG I/1, Co-Chair ISPRS WG I/1, ISPRS TCP) and WGCV representatives from the standard laboratories (NIST,NPL) and from the WGCV subgroups.

## **4. Conclusions and recommendations**

### **4.1 Conclusions**

The Working Group and its six technical subgroups provide a forum for sustained debate, international co-operation and common actions. The addition of a further subgroup concerned with atmospheric chemistry issues has provided an important additional input to the WGCV's work, and filled a recognised gap within the atmospheric chemistry community.

The recent success of the establishment of joint activities between the WGCV and other groups and organisations has been apparent and these relationships will be nurtured and improved. The subgroup members and the user community in general remain the main determining force behind the activities of the WGCV.

## **4.2 Recommendations to CEOS Plenary**

Recommendation 1 on the need for sustained support for the ground networks in order to complement the space observing systems for climate change.

- Noting the ground networks are complementary and necessary components for surveying the Earth's atmosphere and detecting global climate change.
- Noting that they provide observations that cannot be made from space and correlative data for space missions to validate their observations.
- Noting that Observations of climate change due to changing composition of the atmosphere demand accuracy and continuity that are at the brink of our capabilities.

The CEOS WGCV recommends that:

- the station's homeland institutions and the interested space agencies, commit to sustained financial support of existing network stations and to locate stations in under-sampled regions of the globe.
- the network station shall commit to established guidelines for data accuracy (e.g. WMO, ESA-Envisat) and timely archival.

### **Recommendation 2**

CEOS agencies should ensure that calibration processes for SAR are traceable to the primary standards.

### **Recommendation 3**

CEOS agencies should encourage and enable their representatives to attend and make effective contributions to Working Group activities

### **Recommendation 4**

CEOS members should propose a suitable candidate to chair the WGCV after the current chairmanship runs out in November 2003