

WORKING GROUP ON CALIBRATION AND VALIDATION (WGCV)

SUMMARY AND PURPOSE

WGCV report to 17th CEOS Plenary and updated 3-year work plan for the period 2003-2006

ACTION PROPOSED

The 17th CEOS Plenary participants are invited to:

- (a) Note the information contained in the WGCV report
- (b) Endorse the Work Plan 2003 – 2006 (Issue 3.2) prepared by WGCV.
- (c) Approve the proposed nomination for WGCV chair of Dr Stephen UNGAR from NASA
- (d) Endorse the appointment of new chair of the LPV subgroup
- (e) Consider the recommendations proposed to CEOS Plenary by the WGCV

**Working Group on Calibration and Validation
Report to the 17th CEOS Plenary**

Yves-Louis Desnos

European Space Agency, Via Galileo Galilei,
Casella Postale 64, 00044 Frascati, Italy

1 Executive Summary : Highlights of 2003

- Completion of Phase I of the joint WGCV / WGISS activity on CEOS core test sites and preparation of demo at CEOS plenary
- WGCV / ISPRS taskforce on radiometric and geometric standards kick-off and workshop planned for December 2003
- Atmospheric Chemistry subgroup's success in securing funds to conduct intercomparisons amongst network ozone ground stations; AC subgroup concern that arctic ground stations used for cal/val are closing
- SAR subgroup advances in calibration/validation on Polarimetric – Interferometric SARs
- Land Product Validation subgroup's preparation of a special issue in IEEE/TGARS describing state of the art research on both protocol and results for validation and accuracy assessment of global land products
- Microwave Sensors subgroup's significant progress on terminology document and advances in the calibration of interferometric radiometers
- Infrared and Visible Optical Sensors subgroup study to characterise on-board solar diffusers
- Terrain Mapping subgroup's significant progress on SRTM DEM validation
- New WGCV web site completion
- WGCV Newsletter preparation and publication
- Proposal of new chair for the WGCV Dr Stephen Ungar from NASA
- Appointment of new chair for the LPV subgroup Dr Jeffrey Morissette, NASA

2 Expanded report

2.1 WGCV plenary meetings

2.1.1 WGCV-20

The 20th meeting of the CEOS Working Group on Calibration and Validation (WGCV-20) was held in Hobart, Australia from 12-14 February 2003. The meeting was held at the CSIRO Marine Laboratory and was hosted by CSIRO Marine Research, the CSIRO Earth Observation Centre and the Australian Antarctic Division.

WGCV-20 included detailed updates from each of the six subgroups of the WGCV and also each of the agencies / countries represented at the meeting. Presentations on the progress of the joint WGCV / WGISS core site test facility (WTF), and the joint WGCV / ISPRS taskforce on radiometric and geometric standards were also given. Additional presentations were given on the ESA / Envisat calibration and validation database, hosted by the Norwegian Institute for Air Research Data Centre (NILU), and on space and aerospace development in Australia. A new chair for the LPV subgroup has been approved at WGCV plenary - Dr Jeffrey Morisette (NASA), and the nomination is put forward for endorsement at CEOS plenary.

2.1.2 WGCV-21

The 21st WGCV plenary (WGCV-21) was held from 15 – 17 October 2003 in Beijing, P.R. China. The meeting was held in the Friendship Hotel, Beijing, and was hosted by the Center for Space Science and Applied Research (CSSAR) and the Chinese Academy of Sciences (CAS).

As well as reports from the subgroups and taskforces, which form the basis for the effective working of the WGCV, the meeting included very informative presentations from the host nation and visits to the National Satellite Meteorological Center and the Center for Space Science and Applied Research in Beijing. The WGCV and its subgroups formulated a series of recommendations to put before CEOS plenary at WGCV-21, and these can be found in section 4.2 of this document. A new chair for the WGCV has been proposed and unanimously approved at WGCV plenary 21 Dr Stephen Ungar from NASA. Dr Ungar's nomination is put forward for approval at CEOS plenary.

The complete set of presentations and the minutes from the meeting are available from the WGCV website at www.wgcvceos.org.

2.2 Subgroup Activities

2.2.1 SAR

A joint venture between the Atelier ASAR workshop 2003 and the 11th CEOS WGCV SAR calibration / validation workshop 2003 was hosted by the Canadian Space Agency in St-Hubert, Montreal, Canada from 25-27 June 2003. Almost 120 participants attended and 99 presentations were given. The presentations, including keynote talks, spanned fourteen sessions ranging from new concept techniques and technologies to modelling, processing, calibration and applications of SAR. Of particular interest were dedicated presentations and results from the calibration and validation of Polarimetric-Interferometric SAR systems. One of the main conclusions from the workshop included a recommendation that the Amazon rainforest should be used as the standard reference target for C and L band SAR. The next meeting of the subgroup is scheduled for May 2004 in conjunction with the EUSAR'2004 in Ulm Germany.

2.2.2 Infrared and Visible Optical Sensors

IVOS met from 13 – 14 November 2002 for its 12th meeting in ESRIN, Italy, and have been drafting a proposal to the WGCV recommending the common use of the exo-atmospheric solar spectrum by Earth Observation data providers, and the inclusion of on-board visible/NIR calibration systems in new satellite instruments

At its 13th meeting from 13 – 14 October 2003, held in conjunction with WGCV-21 in Beijing, P.R. China, IVOS expanded its action plan by preparing two future activities:

- The organisation of an international Workshop on “Inter-comparison and Cross-calibration of Large Scale Optical Imaging Sensors” to be held in 2004
- The initiation of a cross-calibration and intercomparison campaign of large scale optical imaging sensors already in orbit over (initially one) well- characterised vicarious calibration targets. This activity will include a comprehensive deployment of cross-calibrated field sensors. Cooperation with the WTF is sought for this experiment.

IVOS initiated the enhancement of an existing satellite mission planning tool. allowing users to predict overpasses for all optical imaging sensors over any vicarious calibration site. The 14th meeting of IVOS is due to be held in conjunction with the IVOS workshop, planned for October 2004.

2.2.3 Land Product Validation

The Land Product Validation (LPV) subgroup uses topical meetings to focus on specific global land products to bring together the community of users, producers, and cal/val researchers to discuss current standards and activities, and to chart a roadmap to develop validation protocols and intercomparison of similar products.

Boston University hosted an LPV workshop on Surface Albedo from 23 – 24 October 2002. This international workshop was held in association with the MODIS Radiation Products Outreach Workshop, and marked the fourth LPV topical workshop (following assemblies on Leaf Area Index, Fire/Burn Scar, and Land Cover). About 25 experts in satellite product development, field measurements, and process modelling participated. The meeting report (Privette, *et al.*, 2002) is available via the WGCV website.

LPV conducted a land cover topical workshop in Ispra, Italy, from 27 – 28 March 2003 which focused on statistical design questions. The LAI-intercomparison activity will culminate in a “results” workshop scheduled for spring 2004 in Missoula Montana. Regarding Fire and Burn scar validation, there will be a joint Global Observation of Forest Cover/Land Dynamics (GOFC/GOLD) and CEOS LPV workshop “Global Geostationary Fire Monitoring Applications”, hosted by EUMETSAT from 23 – 25 March 2004 in Darmstadt, Germany.

2.2.4 Terrain Mapping

A Terrain Mapping (TM) workshop was held with representatives from NASA, ESA, NASDA, NIMA, USGS, ISPRS and UCL on 16 June 2003 in Portland, USA, prior to the ISPRS Workshop on “Lidar and IfSAR” at which a number of delegates were able to present further results.

The latest results on the status of SRTM DEM processing and DEM product validation were presented at the meeting. JPL have completed the global processing of the C-SRTM DEMs and some unedited continental scale DEMs are available for download from <http://seamless.usgs.gov> (currently North and South America are on-line).

At the TM meeting, CEOS test sites within Europe were proposed and also potential additional sites in North America, as well as the criteria that will be used to select test sites in the future. Specific points to update in the “Best Practice” document, drafted by Dowman and Muller

(1996), were discussed and a list of missing items identified. All TM subgroup members are encouraged to submit new test sites, and members were encouraged to contact their sponsors and data suppliers to investigate how an on-line set of datasets for these test sites could be created in the future.

2.2.5 Microwave Sensors

The Microwave Sensors Subgroup (MWS) met together during the 2nd International Microwave Radiometer Calibration Workshop (μ Cal-2002) in Barcelona, Italy, from 9-11 October 2002. A second meeting of the MWS subgroup was held this year, coincident with the IGARSS symposium in Toulouse, France on 23 July 2003. The main subject of the meetings was the document on "Frequently Used Terms in Microwave Radiometry". Chapters 1 to 3 of the document on terminology (general, real aperture and polarimetric radiometry) are now complete, with most of its contents being "accepted definitions".

The next meeting of the MWS group is expected to take place in coincidence with the 8th Specialist Meeting on Microwave Radiometry and Remote Sensing Applications, 24-27 February 2004, in Rome, Italy. At this meeting, Chapter 4 on interferometric radiometers will be addressed, along with two recommendations the subgroup wish to put before CEOS.

2.2.6 Atmospheric Chemistry subgroup

Since its establishment in 2002 the Atmospheric Chemistry Subgroup (ACSG)'s main objective is to ensure accurate and traceable calibration of remotely-sensed atmospheric chemistry radiance data and the validation of higher level products, for application to atmospheric chemistry and climate research. The ACSG is also in the process of recommending calibration sites for the ozone ground station network and is encouraging the uniform quality control of validation data.

An intercomparison series has been approved for several groups of network Dobson stations. A cross mission Envisat-Aura Data Validation Centre has been approved and builds on architecture developed by NILU in Norway. Discussions are now underway between ESA, the EC and NASA to collaborate on Envisat and Aura validation.

Planning collaboration for validating data products from the upcoming operational chemistry instruments on the NPOES and Metop satellites is the ACSG's next challenge. In the meantime the ACSG provides a forum and an access through agreements for chemistry satellite missions such as the Canadian ACE and the Japanese ILAS-II, which do not fund validation campaigns of their own. Of particular interest to these missions is the establishment and the availability of validation data centres, which all missions sponsored by CEOS members will have free access to.

The ACSG's continued action item is to seek assurance from the space faring nations and the supporting national agencies that funding will be sustained for the ground-based network to continue to collect quality and timely validation data.

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. A lot of effort is currently being channelled into developing a prototype, together with WGISS, that aims to provide a web-based data access and delivery service to support validation and inter-comparison of remotely-sensed land data products. This activity is being conducted under the aegis of a WGISS Test Facility (WTF) and it builds upon the infrastructure developed for the EOS Land Product Validation program. The WTF is a web portal that enables

investigators to select a particular site of interest, to determine what data are available for that site, and to select datasets for ftp download. Requests to apply certain services to the data prior to download are possible. These could include spatial and parameter subsetting, projection transformation and file format conversion.

It is anticipated that the types of services available through the WTF will enhance the ease of use of data products, i.e. data will be more easily assimilated into commonly-used software analysis tools. By offering diverse data products that can be retrieved in a more usable form, calibration/validation investigators will spend less time on data preparation and more time on data analysis and product inter-comparison.

In phase I, which is now complete, the LPV selected five 'core sites' representing different biomes and including locations at which *in situ* measurements are routinely acquired. The types of remotely-sensed data that are acquired and analysed over these sites include Landsat 7 ETM+, ASTER, MODIS, and SPOT VEGETATION. During phase I, MERIS and AATSR data over the five sites were acquired and should be available soon. In Phase II the plan is to expand the number of sites to include those of interest to all the subgroups. The number of remotely-sensed datasets will also be increased, as well as access to *in situ* measurements collected by core site principal investigators.

3.2 Collaboration with WGEdu

At the request of the WGEdu, a single presentation, detailing the activities of the WGCV and its subgroups, was prepared. This, together with other relevant and accessible educational material, have been placed online on the WGCV website (www.wgcvceos.org), and a link from the WGEdu's site to these is proposed.

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

The joint activity between the International Society for Photogrammetry and Remote Sensing (ISPRS) and the WGCV, to formulate a plan for standardisation of radiometric and geometric parameters of sensors, was kicked-off in Denver in November 2002. Bruce Davis (NASA) was confirmed as the chair of the taskforce, and Veljko Jovanovic (JPL) as co-chair. NASA has agreed to host an International Workshop on Radiometric and Geometric Calibration from 2-5 December 2003, and this will form a springboard for the task force's deliberations. The current plan calls for 2 days of invited technical presentations focusing on state-of-the-art techniques and best practices for calibrating infrared and visible optical sensors, both orbital and sub-orbital. On 5 December 2003 the Joint WGCV/ISPRS task force will conclude the workshop with a one-day meeting to discuss recommendations for standardising "best practices" of radiometric and geometric calibration.

4 Conclusions and recommendations

4.1 Conclusions

The Working Group on Calibration and Validation (WGCV) and its six technical subgroups provide a forum for sustained debate, international co-operation and common actions. Since the last CEOS plenary, the WGCV has met twice in plenary in order to work proactively on the priority actions defined at the 16th CEOS plenary. This is reflected in the revised WGCV work plan for 2003 – 2006 and the associated subgroup activities.

4.2 Recommendations to CEOS Plenary

4.2.1 Recommendation 1

Since satellite operators and data providers globally use varying solar irradiance profiles for the derivation of radiances and reflectances, WGCV recommends for consistency, to converge to the recently refined solar reference spectrum by G. Thuillier and encourages its use at the highest possible spectral resolution.

The source spectrum will be provided also through the WGCV website, with pointers to different instrument (resampled) spectra (Reference: The Solar Spectral Irradiance from 200 to 2400 nm as Measured by the SOLSPEC Spectrometer from the Atlas and Eureka Missions, Solar Physics 214(1): 1-22; May 2003, by: G. Thuillier; M. Hersé; D. Labs; T. Foujols; W. Peetermans; D. Gillotay; P.C. Simon; H. Mandel).

WGCV further recommends that instrument teams should post the exo-atmospheric solar irradiances they use, together with processing/resampling information, in a band-integrated form on the www (single spectrum recommended).

4.2.2 Recommendation 2

Considering the experience with current satellite sensors and the preliminary study carried out by a Standard Laboratory for the WGCV, the need for testing on board diffusers under hard radiation, UV radiation and contamination environments is recognised.

WGCV recommends to further support the in-depth study of the behaviour of satellite onboard calibration diffusers and their stability in the space environment.

4.2.3 Recommendation 3

The polar regions are most sensitive to, and are early indicators of, climate change. Atmospheric chemistry observation in these regions are needed by the IGOS and satellite cal/val.

The WGCV recommend that CEOS strongly encourages that full use of high latitude ground stations be maintained or restored to full operation. This recommendation should be considered by CEOS member agencies and passed on to their partner national agencies who have the interest and resources to implement this recommendation.

4.2.4 Recommendation 4

Noting that the Amazon rainforest has been well studied and is currently the best natural target for SAR calibration.

Statistical evaluation of the Amazon rainforest SAR data sets acquired for more than five years shows that C and L band SAR data (ERS-2 Scatterometer data for AMI, Radarsat SAR, JERS-1 SAR) are ultimately stable with the absolute backscattering coefficients (sigma-naught or gamma-naught), which vary with frequency, polarization, and incidence angle (for sigma-naught and not for gamma-naught), and standard deviation of less than 0.3 dB, which includes diurnal and seasonal variation (WGCV SAR subgroup's 11th workshop report to be published Dec 2003).

The WGCV recommends that the Amazon rainforest area be used as one of the calibration transfer standards. The Amazon rainforest must be regularly measured to maintain its traceability to the internationally agreed standards.

4.2.5 Recommendation 5

The WTF has received significant interest among both LPV subgroup members and other WGCV subgroups in support of their cal/val activities.

WGCV recommends that the joint WGCV/WGISS Test Facility be continued through 2006.

The primary roles for the two subgroups within this activity are:

- WGISS – web based interface, distributed storage infrastructure and simple processing functionality (e.g. reformatting/reprojection)*
- WGCV – data set and site selection, case studies to demonstrate the effectiveness of the system*

4.2.6 Recommendation 6

WGCV recognises the significant improvements in spaceborne DEM quality over pre-existing DEM products currently used in satellite data processing systems.

WGCV recommends use of newly available spaceborne DEMs, where available and suitably validated, to replace existing coarse data-sets for processing land and atmospheric data-sets at the earliest opportunity.



**COMMITTEE ON EARTH OBSERVATION SATELLITES
WORKING GROUP ON CALIBRATION AND VALIDATION**

Work Plan 2003 - 2006

Issue 3.2

Amendment Record

ISSUE	DATE	UPDATES	AUTHOR
3.0	22/10/02	Updated for period 2002 - 2005	M-C R
3.1	27/03/03	Updated during WGCV-20 <ul style="list-style-type: none"> • Section 4.3 WGCV Mailing list • Section 5.2 WGCV / WGISS Test Facility Timeline & Ownership • Section 6.2 ISPRS / WGCV Taskforce Actions • Section 7.3 IVOS Subgroup Objectives and Action Plan • Section 7.5 LPV Mission and Objectives 	M-C R
3.2	17/10/03	Updated during WGCV 21 <ul style="list-style-type: none"> • Section 1.1 priority actions from plenary • Section 2 collaboration with other WGs • Section 4.1 best practice documentation • Section 7.5 LPV objectives • Section 6 ISPRS / WGCV Taskforce Activity 	Y-LD

For comments or corrections, please contact:

Yves-Louis Desnos, WGCV Chair

ESA ESRIN
 EOP-SER
 Via Galileo Galilei
 Casella Postale 64
 00044 Frascati, ITALY

Tel: +39 06 94180 606 Fax: +39 06 94180 552

Email: Yves-Louis.Desnos@esa.int

5 Introduction

5.1 Basis of the work plan

In order to focus the activities of the CEOS Working Group on Calibration and Validation (WGCV) the third issue of the three-year work plan, for the years 2002 - 2005, has been developed by members of the WGCV. The activities outlined in the work plan follow from the actions, guiding principles, and recommendations outlined in the Strategic Plan of the WGCV as well as recommendations from CEOS Plenary.

The third issue of the work plan was discussed and amended at the 18th and 19th meetings of the WGCV. All actions are in support of the fundamental objectives of the WGCV, specifically:

1. ***Sensor-specific calibration and validation***: document and establish forums for the assessment and recommendation of current techniques and standards for pre- and post-launch characterisation and calibration and assessment of homogeneity issues associated with long term data continuity.
2. ***Geophysical validation***: document and establish forums for the assessment and recommendation of techniques for validation of geophysical parameters derived from Earth observation satellite systems and in the light of CEOS involvement in the developing IGOS.

In addition, actions identified in the work plan should:

- Improve co-ordination of space missions and ensure they meet user needs.
- Benefit Members and Associates.
- Assist, rather than direct, Member and Associate agencies.
- Respond to the priority actions defined by CEOS plenary in the CEOS 5 years plan

It is expected that additional tasks will be incorporated in future releases of the Work Plan. The WGCV members have agreed to an annual review of the Work Plan, to be conducted during WGCV plenary meetings, to ensure that the critical needs of the international community are being met by the CEOS activity.

The plan will be achieved through WGCV Plenary meetings and the meetings and technical work of the WGCV Subgroups.

The objectives of the WGCV are to enhance coordination and complementarity, to promote international cooperation and to focus activities in the calibration and validation of Earth observations¹ for the benefit of CEOS Members and the international user community. Meeting these objectives will include the promotion of:

- Exchange of technical information and documentation;
- Investigation of possibilities for technical coordination and cooperation for space and ground segments;
- Coordination of calibration and validation campaigns and programs; and
- Optimization and sharing of available facilities, expertise, and resources as appropriate.

5.2 Summary of Tasks and Activities

The work of the WGCV for the next three years has been organised into the following activities:

Activity 1 - WGCV Plenary

Activity 2 - WGCV Subgroups meetings and technical work

Activity 3 - Communication with the Community

¹ Includes cryosphere, hydrosphere, lithosphere, biosphere, and atmosphere.

Activity 4 - Joint activity between WGCV and WGISS for the establishment of a network of “CEOS Calibration and Validation Core Sites”

Activity 5 - Joint WGCV / ISPRS taskforce on Radiometric and Geometric Standards

6 Activity 1 - WGCV Plenary

WGCV meet in Plenary at least once per year. The meeting provides an opportunity for Members and Associates to review and compare their plans for calibration and validation activities and to identify opportunities and requirements for collaboration.

The WGCV provides a forum for debate and discussion of key cal/val topics and issues.

The WGCV provides a conduit for the flow of information and recommendations between the CEOS Plenary and the Earth Observation data users’ community.

The WGCV Plenary provides a forum for discussing recommendations received from the CEOS Plenary and identifying appropriate responses from the calibration and validation community.

The subgroups make formal presentation at the WGCV’s meetings. These may include recommendations to the WGCV for action at the working group level, or may include recommendations that the WGCV considers should go forward to the CEOS Plenary for action at the community level. The WGCV itself may also formulate recommendations to the CEOS Plenary.

The WGCV will collaborate and communicate regularly with the other CEOS Working Groups. Particularly, with the Working Group on Information Systems and Services (WGISS) and the ad hoc Working Group on Education and Training (WGEdu) .

7 Activity 2 - WGCV Subgroups

The technical work of the WGCV is carried out by its Subgroups, which are:

- Atmospheric Chemistry Subgroup
- Infrared and Visible Optical Sensors Subgroup
- Land Product Validation Subgroup
- Microwave Sensors Subgroup
- SAR Subgroup
- Terrain Mapping Subgroup

Each Subgroup has its own mandate and action plan, and these are set out in Section 7. Further information on the activities of a particular Subgroup can be obtained from the Subgroup Chair.

8 Activity 3 - Communication with the Community

8.1 Overview

As part of WGCV’s role in providing leadership and co-ordination to ensure data quality and continuity, it is critical that the WGCV maintain an active role in communicating with the entire community of Earth Observation data users and data providers. In this role, communication with researchers and experts, both within CEOS agencies and the worldwide user and research community, is critical. In addition to communication on general calibration and validation related topics, the WGCV has an obligation to communicate specific information to CEOS members and associates.

This will be done through:

- The active maintenance of a WWW site (www.wgcvceos.org) for calibration and validation information and an email distribution list for general cal/val information
- Attendance at, and sponsorship of, conferences and specialist sessions related to calibration and validation topics
- The posting on the WWW of key bibliographies and best practice documentation from the WGCV Subgroup chairs
- The inclusion of external experts and representatives of non-CEOS agencies as needed for WGCV-sponsored activities
- Involvement, as appropriate and within the context of IGOS, experts from developing countries
- The encouragement of the dissemination of pre- and post- launch calibration following the launch of a new satellite
- The coordination of information and actions with the other CEOS Working Groups, particularly the Working Group on Information Systems and Services (WGISS) and the ad hoc Working Group on Education (WGEdu)

8.2 Timeline and Ownership

The WGCV Secretariat has committed to coordinating the communications task, in particular supporting the active maintenance of a WWW site. This activity will continue throughout the period covered by this work plan. Attendance at, and sponsorship of, conferences and specialist sessions will be supported and encouraged by CEOS Member and Associate agencies and WGCV Subgroups and participants as needed.

8.2.1 Actions

- The CEOS WGCV website will be regularly maintained to provide an up-to-date and complete information source.
- WGCV participants have agreed to keep the secretariat informed of any news, calendar events, or new websites that should be advertised on the CEOS WGCV web pages.
- Key bibliographic references selected by the subgroup chairs will be posted on the website
- The WGCV Newsletter will be issued via the website.
- Case studies illustrating the work of WGCV and its subgroups will be developed, and posted on the website.
- Each WGCV plenary meeting will include a special session on a technical aspect of calibration or validation to serve as a focus for information exchange.
- Regular information about WGCV activities will be provided to all CEOS working group representatives.
- As needed, the CEOS WGCV chair will contact CEOS members to request greater availability of pre- and post- launch calibration information and data to the community.

8.3 Details

The WGCV's terms of reference and strategic plan outline several activities that ultimately relate to improved, proactive communication with the global community of EO data users and providers.

8.3.1 WWW Site

A WGCV site on the WWW provides focus for communicating information related to data and instrument quality and consistency for both CEOS Members and the global community. The WGCV web pages are located at www.wgcvceos.org.

8.3.2 Newsletter

Newsletters providing information on contributions of the WGCV and its subgroups to cal/val issues will be produced and disseminated via the WGCV website. The frequency of publication depends on contributions from WGCV members.

8.3.3 Case studies

Case studies illustrating the activities of WGCV and its subgroups will be developed and updated.

8.3.4 Build Key Bibliographic References

Chairs from the six subgroups have agreed to request inputs from their members and compile a bibliographic reference set. The references should be categorised by topic based on categories deemed appropriate by the subgroup Chairs. These bibliographic references will then be hosted on the web site by the Secretariat and will be reviewed and updated annually as needed by the subgroup chairs.

8.3.5 WGCV Mailing List

An email distribution list of WGCV members, affiliate representatives and observers will be maintained by the Secretariat for use in working group administrative activities and is available on request.

8.3.6 Identify Key Conferences

As part of leading the exchange of information on calibration and validation it is critical that the WGCV and its subgroups attend key conferences and encourage and sponsor sessions on special topics in calibration and validation. All such conferences and sessions will be noted in the WGCV website calendar.

8.3.7 Linkages to External Groups and Experts

Participation by specialists in many areas of data and instrument calibration and validation is important for WGCV success. Rather than expand the membership of CEOS and/or the WGCV and its subgroups, it was agreed that experts should be invited to participate in WGCV activities as needed, particularly for special sessions and conferences. WGCV representatives in many cases only represent their own interests within an agency and all participants are asked to pass on information about WGCV activities to others within their institution.

Invited experts should include EO research scientists, specialists in data applications and specific geographic regions. In addition the WGCV may specifically call upon appropriate CEOS associates to assist. The need to involve experts from developing countries that do not have CEOS representation is particularly important where validation activities are concerned. Funding and travel restrictions may make it difficult for regional experts to participate, but efforts should be made to involve them in subgroup meetings and special sessions.

Invited expert participants will be chosen based on speciality regardless of whether they represent commercial or governmental organisations.

8.3.8 Pre-launch Information

Though it is the responsibility of CEOS Members to provide standardised calibration information following the launch of a new satellite, the WGCV has agreed to provide a forum for raising concerns from the community. Any issues related to insufficient availability of pre- and post- launch calibration information should be raised with the WGCV, and the WGCV chair will contact the appropriate CEOS Member. In addition, the CEOS secretariat will, upon request, seek to identify the official contacts for calibration information for newly launched satellites.

8.3.9 Co-ordinate with WGISS and WGEdu

The WGCV is not responsible for submitting specific user requirements or datasets to WGISS or WGEdu. However, the WGCV should provide information on WGCV activities to WGISS and WGEdu members for their information. In addition, any specific requests for review or help from WGISS and WGEdu will be welcomed by the WGCV secretariat and forwarded to the appropriate individuals.

9 Activity 4 – Joint activity between WGCV and WGISS for the establishment of a network of “CEOS Land Validation Core Sites”

9.1 Overview

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.

9.2 Timeline and Ownership

The scope of this project, is to utilise, 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 IGOS, GTOS and the GOFB 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.

9.3 Details

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.

10 Activity 5 – Joint activity between WGCV and ISPRS on radiometric and geometric standards

10.1 Overview

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

10.2 Timeline and Ownership

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 was held on 11 November in Denver, USA, and was chaired by Manfred Schroeder, DLR, chair of ISPRS WG I/2.

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. The Taskforce is chaired by Bruce Davis of NASA Stennis Space Center, USA.

10.2.1 Actions

- Collect terms and standard procedures used to describe the radiometric and geometric performance of Earth observing sensors,
- Identify ambiguity and confusion within these terms and standard procedures, and recommend solutions,
- Recommend a list of terms and standard procedures,
- Prepare a document which sets out terms and radiometric and geometric standard procedures for describing EO sensors,
- Communicate and consult widely with the user community.
- Hold an International Workshop on Radiometric and Geometric Calibration in USA from 2 – 5 December 2003.

11 Subgroups

11.1 SAR Subgroup

11.1.1 Mission

To foster high-quality synthetic aperture radar imagery from airborne and spaceborne systems through precision calibration in radiometry, phase, and geometry, and validation of higher level products.

11.1.2 Objectives

- (a) To act as a forum for international technical interchange on the evolving methodologies, techniques, and equipment of SAR calibration and validation.
- (b) To determine standard definitions and calibration-validation requirements for synthetic aperture radar imaging systems.
- (c) To support changes in CEOS formats and user products as appropriate.
- (d) To facilitate international cooperative programs in the calibration and validation of SAR systems.
- (e) To educate the SAR community.

11.1.3 Action Plan

The major activity of the SAR subgroup in recent years has centred on the annual meetings. This is expected to continue. In the 2002 meeting, it was agreed to set up calibration and validation reference sites (to include both natural and man made targets) for the purposes of providing an easily accessible source of reference calibration data to data providers, showing the mutual compatibility between different SAR systems, and demonstrating the total quantitative and qualitative quality of SAR data. The 2003 meeting of the SAR subgroup should focus on the problem of full polarimetric SAR calibration, both establishing requirements and techniques.

11.2 Microwave Sensors Subgroup

11.2.1 Mission

To foster high quality calibration and validation of microwave sensors for remote sensing purposes. These include both active and passive types, airborne and spaceborne sensors.

11.2.2 Objectives

- (a) To facilitate international cooperation and co-ordination in microwave sensor Cal/val activities by sharing information on sensor development and field campaigns.
- (b) To promote accurate calibration and validation of microwave sensors, through standardization of terminology and measurement practices.
- (c) To provide a forum for discussion of current issues and for exchange of technical information on evolving technologies related to microwave sensor cal/val.

11.2.3 Action Plan

The plan of action for the Subgroup is based on spaceborne microwave sensors. The Subgroup is concerned mainly with passive sensors at the present; however, it is envisioned that there will be a gradual increase of attention to active sensors, especially towards the end of the three-year period of this plan. The Subgroup will approach its objectives by starting from currently operating sensors, such as those flying aboard the DMSP and NOAA platforms, and extending to the next generation of sensors. A focal point will be sensors aboard the EOS platforms of ESA, Japan, and the United States, as there will be both active and passive sensors covering a large part of the microwave spectrum.

11.3 Infrared and Visible Optical Sensors Subgroup**11.3.1 Mission**

To ensure high quality calibration and validation of infrared and visible optical data from Earth observation satellites and validation of higher level products.

11.3.2 Objectives

- (a) To promote international and national collaboration in the calibration and validation of all IVOS and, thus, to assist in the improved application of data from satellite sensors.
- (b) To address all sensors (ground based, airborne, and satellite) for which there is a direct link to the calibration and validation of satellite sensors.
- (c) To identify and agree on calibration and validation requirements and standard specifications for IVOS.
- (d) To identify test sites and encourage continuing observations and intercomparison of data from these sites.
- (e) To encourage the timely and unencumbered release of data relating to calibration and validation activities including details of pre-launch and in flight parameters.

11.3.3 Action Plan

After a period of inactivity, the IVOS subgroup is revitalised, and improving, its membership. The subgroup plan to review the ongoing activities of CEOS member agencies and institutions. Opportunities for coordination / cooperation will be actively sought. Recommendations with respect to solar irradiance, radiative transfer codes, and protocols for calibration and validation will be devised and put forward. The subgroup will meet at least once each year.

11.4 Terrain Mapping Subgroup

11.4.1 Mission

To ensure that characteristics of digital terrain models produced from Earth Observation sensors at global and regional scale are well understood and that products are validated and used for appropriate applications.

11.4.2 Objectives

- (a) To develop specifications for the generation of ‘standardised terrain surface products with known accuracy’ from similar sensing systems in the context of data continuity.
- (b) To specify evaluation methods and statistics which give transparent information about the quality and heritage of terrain models.
- (c) To update the current dossier of test sites and identify new sites, particularly to satisfy the cal/val requirements of future missions and generally improve access to validation data sets.
- (d) To prepare recommendations for the establishment of a global ground control point network.
- (e) To consider how orbit validation could be developed.
- (f) To keep an up to date record of the current status of sensors which produce data for terrain mapping and of the DEMs available.
- (g) To produce a DEM requirements document with a science rationale, taking into account the output from SRTM.

11.4.3 Action Plan

The objectives will be achieved through the following activities:

- (a) Liaise with CEOS Members and Associates activities, especially the IGOS in order to determine the DEM requirements of the user community to ensure that cal/val procedures are in place to satisfy that need.
- (b) Collaborate with other groups to ensure that common activities are co-ordinated and enhanced by collaboration.
- (c) Hold one meeting a year to review progress, plan future action and discuss results.

11.5 Land Product Validation Subgroup

11.5.1 Mission

To foster quantitative validation of higher-level global land products derived from remote sensing data and relay results so they are relevant to users

11.5.2 Objectives

- (a) To work with users to define uncertainty objectives**
- (b) To Identify opportunities for coordination and collaboration – through product Inter-comparisons and global test sites for systematic measurements**
- (c) To develop consensus “best practice” protocols for data collection and description – through workshops, case studies, and publications**
- (d) To develop procedures for validation, data exchange and management (done in conjunction with WGISS)**
- (e) To serve as a clearinghouse for accuracy statements of CEOS members’ higher level global land products**

11.5.3 Action Plan

The objectives will be achieved through a series of topical workshops focussing on specific land product validation issues, co-chaired by community experts. Initial programmatic focus will be on the GOFD priorities of Fire validation, Fine resolution land cover change products, and Biophysical products (such as LAI and Albedo). Support to the IGOS-P Terrestrial Carbon theme will also be a focus. Collaboration between other CEOS working groups and their subgroups will also be sought. A joint WGCV / WGISS test facility on CEOS core test sites for land parameter validation is already in its first phase. This phase involves the survey of five globally distributed sites from October 2002–October 2003. Collaboration with industry is also very much a focus for the subgroup. As land product maturity allows for producers to establish accuracy statements, LPV will work within CEOS to post this information in a uniform way (in conjunction with the CEOS/WMO database). LPV will be available as a mechanism for producers to agree upon the format and supporting information appropriate for such accuracy statements.

11.6 Atmospheric Chemistry Subgroup**11.6.1 Mission**

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.

11.6.2 Objectives

- (a) To promote international collaboration and technical exchange to ensure the efficient use and maintenance of calibration/validation resources required for atmospheric chemistry missions
- (b) To verify accurate scientific products by encouraging an end-to-end approach to the calibration and validation of Level 1 and Level 2 data products, and any subsequent re-calibration and reprocessing
- (c) To ensure that validation sensors are calibrated to traceable national standards, with documented statements of accuracy and repeatability
- (d) To encourage interaction between calibration scientists and data users to enable a better understanding of data uncertainties and user requirements
- (e) To recommend a network of validation sites and to encourage continuous observation and quality control of data through the use of standard procedures and inter-comparison
- (f) To develop comprehensive data validation methods that employ ground, aircraft, balloon, and satellite measurements and data assimilation with chemical transport models
- (g) To specify a comprehensive, consistent and quality-controlled multi-mission validation database in an accepted format and employing user-friendly tools

11.6.3 Action Plan

The membership of the subgroup will be completed by including relevant agencies and organisations who are not yet represented. The subgroup will initiate and support the process of approaching agencies, through CEOS, for partial sustained support for ground validation networks and the maintenance of these networks between missions. Data validation archival and retrieval for the long term and across present and future mission applications is seen as very important and this will be actively pursued. The subgroup will meet regularly to review and coordinate upcoming validation activities, discuss results and pursue its main objectives. These objectives will be reviewed and updated as required.