

CEOS CAL/VAL NEWSLETTER Issue 1



Committee on Earth Observation Satellites
Working Group on Cal/Val

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This is the first issue of the Newsletter of the Working Group on Calibration and Validation of the Committee on Earth Observations Satellites. Recent years have seen an exciting increase in the number of Earth observation sensors providing data and in the types of sensors available. Data are being used for many disciplines, for operation purposes and for research, and the importance of calibration and validation is becoming increasingly understood. The aim of the Newsletter is to provide a source of information on the latest calibration and validation results. It will include contact points for calibration and validation information on sensors, notice of new calibration and validation initiatives and campaigns, and references to calibration and validation publications. It will also provide reports on meetings of the Working Group and related meetings.

COMMITTEE ON EARTH OBSERVATIONS SATELLITES

The Committee on Earth Observations Satellites (CEOS) was created in 1984, following a recommendation from a Working Group of the Economic Summit of Industrial Nations. It was recognised that Earth observations from satellites were multi-disciplinary in nature, and the Committee was established to provide a broad framework for co-ordination of spaceborne Earth observation missions. The members of CEOS are Government organisations responsible for civilian spaceborne Earth observation programs.

Recently, CEOS has been expanded to include as affiliate members other international bodies with related interests, such as the World Meteorological Organisation and the Intergovernmental Oceanographic Commission.

The CEOS members agree to co-ordinate informally current and planned systems for Earth observation from space, by :

- co-operating in mission planning and in the development of compatible data products, formats, policies etc,
- serving as a focal point for international co-ordination of space-related Earth observation activities,
- exchanging policy and technical information to encourage complementarity and compatibility among spaceborne systems in service and development.

The Committee meets once a year in plenary session, and has established two Working Groups, to investigate specific areas of interests, co-operation, and co-ordination. The Working Group on Data, has been investigating areas such as data product formats, catalogues and ground networks. The Working Group on Calibration and Validation, is investigating sensor-specific calibration and validation, and geophysical validation.

CEOS WORKING GROUP ON CALIBRATION AND VALIDATION

The Working Group on Calibration and Validation (WGCV) was re-organised in 1991 under Canadian chairmanship, and was approved as a standing Working Group by the CEOS Plenary in December, 1991. The objectives of the Working Group on Calibration and Validation (WGCV) of the Committee on Earth Observations Satellites are to enhance co-ordination and complementarity, to promote international co-operation, and to focus activities in calibration and validation. Work to meet these objectives includes, for example, co-ordination of calibration/validation campaigns, exchange of technical information, and optimising and sharing of available facilities, expertise and resources as appropriate. The Working Group meets at least once a year, to report activities, review progress, and plan initiatives.

The fourth meeting, WGCV4, was held in Ottawa, on August 27-28 1991, hosted by the Canada Centre for Remote Sensing and the Canadian Space Agency. Major outputs from the meeting were reports from the member agencies on recent and planned activities in calibration and validation, definitions of critical terms (such as calibration), and the preparation of new terms of reference for the Group. The fifth meeting was held May 6-8 1992, in Abingdon, United Kingdom, and was hosted by the British National Space Centre. Special sessions were organised on calibration and validation of recent satellite missions, specifically ERS-1 and UARS. The SAR Calibration subgroup, led by Dr A Freeman, JPL/NASA, presented their activities, and new subgroups were planned, one on infrared/visible optical sensors, led by Dr Ian Barton, CSIRO, Australia, and one on passive microwave sensors, led by NASA. In addition, activity in terrain mapping was initiated. The sixth meeting is being hosted by INPE, Brazil, in November 1992, with plans for the seventh meeting in Europe, spring 1993. Special topics are planned to include recently launched satellites, such as JERS-1 and Topex/Poseidon.

You are invited to submit contributions to the newsletter to your Working Group representative (listed at the end of this issue by country), or to the Newsletter editor Mr Mark Hutchins, (EODC.UK/OMNET). The Working Group also maintains a bulletin board on OMNET (CEOS.WGCV.NEWS/OMNET). Information for inclusion on the bulletin board should be sent to your WGCV country representative.

CEOS WORKING GROUP ON CALIBRATION AND VALIDATION TERMS OF REFERENCE

MEMBERSHIP

Membership in the CEOS WGCV is open to all members of CEOS as defined in the CEOS Terms of Reference, including observers and affiliates. Members may include in their delegations to WGCV meetings any participants who have relevant expertise to contribute to the objectives of the WGCV.

OBJECTIVES

The objectives of the WGCV are to enhance co-ordination and complementarity, to promote international co-operation and to focus activities in the calibration and validation of Earth observations for the benefit of the CEOS members and the international user community.

Work to meet these objectives will include the promotion of:

- exchange of technical information and documentation
- investigation of possibilities for technical co-ordination and cooperation for space and ground segments
- co-ordination of calibration and validation campaigns and programs
- optimising and sharing of available facilities, expertise and resources as appropriate

Specific objectives are

1.Sensor-specific calibration and validation:

To document, and establish forums for the assessment and recommendation of, current techniques and standards for pre and post launch characterisation and calibration.

2.Geophysical validation:

To document, and establish forums for the assessment and recommendation of, techniques for validation of geophysical parameters derived from Earth observation satellite systems.

PROCEDURES

The WGCV meet when appropriate but at least once per year, rotating venue among members. The chairman and secretariat for the WGCV, designated by the plenary, shall prepare and

distribute minutes for each meeting. At each meeting of the WGCV, the time, place, and host for the next meeting shall be established. For each meeting of the WGCV, each member shall prepare a report on the member's current and planned calibration and validation activities.

The CEOS WGCV shall co-ordinate its work with other international groups involved in related activities as described in the CEOS Terms of Reference.

Each member shall designate a point of contact for WGCV correspondence.

The WGCV may propose modifications to these Terms of Reference and such modifications will be submitted to the plenary for approval at the next plenary meeting.

Subgroups may be established to perform technical work in specific areas. Subgroups shall be established by the consensus of the WGCV. The WGCV shall develop Terms of Reference for each subgroup. The chairman of each subgroup shall report at each WGCV meeting on the group's progress and plans.

The WGCV Library shall serve as the repository for documents, such as meeting minutes and documents produced by the WGCV, and other material as may be agreed by the WGCV.

The WGCV shall work towards developing agreement on common terminology.

The WGCV shall develop additional procedures as may be required.

PRELIMINARY DEFINITION OF CRITICAL TERMS.

CALIBRATION is the process of quantitatively defining the system response to known controlled signal inputs.

VALIDATION is the process of assessing by independent means the quality of the data products derived from the system inputs.

The WGCV is aiming to produce definitions for the following cal/val terms: characterisation, conversion, verification, standard, accuracy, and precision.

AVHRR PATHFINDER ACTIVITY: THE CALIBRATION WORKING GROUP

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THE PATHFINDER PROCESS

Since the NOAA-NASA Pathfinder agreement was signed by NOAA and NASA on October 15, 1990, considerable progress has been made in defining, organising and initiating Pathfinder activities. Data management and science involvement have been the key components of these activities. Together, they define the Pathfinder process, which is summarised in the following four steps:

Step 1: Identification of data sets is the first step in developing Pathfinder products. NASA and NOAA have identified three NOAA operational satellite data sets as Pathfinder data sets: the Advanced Very High Resolution Radiometer (AVHRR--4 km 5-channel data only), the TIROS Operational Vertical Sounder (TOVS), and the Geostationary Operational Environmental Satellite (GOES). A fourth data set, Special Sensor Microwave Imager (SSM/I), from the Defense Meteorological Satellite Program (DMSP), has recently been added to the Pathfinder project.

Step 2: Transfer Level 1 archive data to a readily accessible working storage medium. This step is necessary to provide online access to multi-year, terabyte, satellite data.

Step 3: Involve scientists from academia and the agencies in the definition of community-consensus derived products, and in the development plans to generate and, with user participation, to quality control and validate these Pathfinder products.

Step 4: Generate and validate the Pathfinder derived products, and make them readily accessible, with supporting metadata and an efficient means for browsing.

To help define Step 3 of the Pathfinder program, NOAA and NASA have formed Pathfinder Science Working Groups (SWGs) to review the AVHRR, GOES, TOVS and SSM/I data sets and to recommend community-consensus algorithms, product generation, and browse requirements. To help make the initial generation of Pathfinder products manageable, the SWGs have agreed to focus on a subset of the total archive period. The subset is from April 1987 to November 1988--a 20-month period covered by maximum satellite coverage and a period that spans two full growing seasons, two in the Northern Hemisphere and one in the Southern.

Five interagency and extramural SWGs were formed. Three SWGs were formed for the AVHRR Pathfinder: Oceanic, Land and Atmospheric, and one each for TOVS, GOES and SSM/I. Each group has met at least once and status reports are being prepared that will provide recommendations to NOAA and NASA for generating Pathfinder products.

AVHRR CALIBRATION FOR PATHFINDER

An important result of SWG deliberations has been the formation of an AVHRR Calibration Working Group, which has representatives from each AVHRR SWG and is chaired by C R Nagaraja Rao of NOAA's Satellite Research Laboratory. The membership of the working group is drawn from NOAA, NASA and academia. The working group has met twice over the past year.

The Working Group has been entrusted with the task of establishing a long-term record of trends in the calibration and in-orbit performance of the visible (channel 1; approx. 0.63 micrometers) and near-infrared (channel 2; approx. 0.83 micrometers) channels; and with the development of appropriate corrections for the non-linearity of thermal infrared sensors (channel 4; approx. 10.8 micrometers; channel 5; approx. 12 micrometers) of the AVHRR onboard the NOAA afternoon polar orbiters. The findings of the working group will be an integral part of the Pathfinder atmosphere, land, and ocean product library, and are considered vital to the cross calibration of the various AVHRRs in operation over the total Pathfinder period, 1981 to present.

Three different techniques have been identified to study relative trends in calibration and in-orbit performance of AVHRR channels 1 and 2. They are: (a) the Staylor technique to determine relative trends in the degradation of channels 1 and 2, utilising clear-sky radiance measurements over the southeastern part of the Libyan desert; (b) the Rossow-Brest statistical trending method using the International Satellite Cloud Climatology Project (ISCCP) data sets and (c) the Kaufman-Holben technique using radiance measurements over oceans in the sun-glint region to obtain "absolute" calibrations.

In addition, the relative efficacies of two different methods to account for the non-linearities in the thermal infrared sensors, one developed at the Satellite Research Laboratory, NOAA/NESDIS, and the other at the University of Miami in Florida, are being examined. Researchers at the Satellite Research Laboratory, NOAA/NESDIS; NASA Goddard Space Flight Centre, Greenbelt,

Maryland; NASA Langley Research Centre, Hampton, Virginia; NASA Goddard Institute for Space Studies, New York; and the University of Miami are involved in this activity, with the efforts at the NASA centres and at the University of Miami being partly supported by NOAA.

It is expected that the findings of the working group, and the results of the various investigations mentioned above, will be documented and appropriate recommendations drafted for the user community at the working group meeting tentatively scheduled for late August/early September 1992 and that a technical report will be issued by the end of 1992. All calibration-related information will be available both in print and electronic media.

The Satellite Research Laboratory, NOAA/NESDIS, plans to continue to serve as a focal point for the study of calibration-related issues and for the acquisition and dissemination of calibration-related information for the NOAA operational satellites.

CALIBRATION OF THE ERS-1 SAR PRODUCT ERS-1.SAR.PRI

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This note summarises the status of the calibration of the ERS-1 SAR product (ERS-1.SAR.PRI) generated by ESA using the off-line Processing and Archive Facilities (PAFs) located in the United Kingdom at Farnborough (UK-PAF) and in Germany at Oberpfaffenhofen (D-PAF) and also by the ESA ERS-1 Central Facility (EECF).

Since 1 September 1992 the SAR.PRI products generated by ESA from the UK and D PAFs have been corrected for the effects of the antenna range pattern and for the range spreading loss and in addition a calibration constant, K, with upper and lower bounds is written into the header of each product (see Table 1). SAR.PRI products generated prior to this date were uncorrected for the antenna range pattern, K values were not included in the product headers and only the UK-PAF generated products were corrected for the range spreading loss.

The in-flight SAR range antenna pattern (see Figure 1) has been determined by ESA from an analysis of SAR images of the Amazonian tropical rain forest from which the radar backscatter observed appears independent of incidence angle.