

## **CEOS CVWG Microwave Sensors Subgroup**

June 2002 – January 2003

### **PROGRESS REPORT**

*by M. Martin-Neira*

*(Subgroup Chair)*

#### **1.- Introduction**

This is the progress report of our Microwave Sensors Subgroup (MSSG) of CEOS Calibration and Validation Working Group. The reporting period spans from the CEOS WGCV-19 Plenary meeting that took place in Ottawa on May 1-3, 2002, till the present CEOS WGCV-20 Plenary meeting in Tasmania.

As main event within this period we have the Second International Microwave Radiometer Calibration Workshop and the CEOS WGCV Microwave Sensor meeting, that took place during the past October 9-11, 2002 at the Polytechnic University of Catalonia (UPC), Barcelona, Spain.

#### **2.- Objectives**

This progress report is to be presented at the CEOS WGCV-20 plenary meeting, to report on the activities of the Microwave Sensors SubGroup.

#### **3.- Meeting Calendar**

Last meeting of MSSG took place in Barcelona (Spain) in October 2002, in combination with the Micro-Cal Workshop.

Next meeting of some of the MSSG experts will happen in combination with IGARSS-2003, at Toulouse, France.

#### **4.- Actions from WGCV-19 Plenary**

During the WGCV-19 Plenary Meeting (May 1-3, 2002, Ottawa, Canada), the following actions on our group were closed:

- WGCV17-6: *Martin-Neira to rework mission statement of Microwave Sensors subgroup and send to Desnos asap.*

A page with the mission statement of the subgroup and themes we would make emphasis on was sent to Y.L. Desnos.

- WGCV18-10: *Privette / Martin-Neira / Mutlow (now Rast) to appoint a representative from the LPV, Microwave & IVOS subgroups to join an ISPRS-WGCV joint taskforce.*

During the meeting it was clarified that the job of our MSSG subgroup representative consisted in assisting WGCV-ISPRS (International Society for Photogrammetry and Remote Sensing) joint taskforce in defining geometric and radiometric standards. Finally the chairman of MSSG volunteered himself for this task.

During the WGCV-19 Plenary Meeting new actions opened for MSSG as well. The status of these actions is reported next:

- WGCV19-A: *To provide Christine Hutton (Working Group on Training and Education WGTE) with web-sites from your institute-university-research group where general descriptions and explanations of instruments can be found at graduate level.*

A note was distributed to the MSSG members in this respect. Very few replies were received. We should consider this action still as open.

- WGCV19-B: *To provide recommendations to the next WGCV plenary.*

Two recommendations were discussed during the Barcelona meeting of MSSG. The final form of these two recommendations is put forward to the WGCV members, for further addressing at CEOS level. These recommendations are given below, within the working plan review.

- WGCV19-C: *To provide inputs from the MSSG subgroup to the WGCV brochure.*

Some inputs were provided as requested.

## **5.- Micro-Cal 2002 / CEOS MSSG Meeting Report**

Sponsored by ESA, NASA, EADS-CASA Space Division, NIST, the IEEE Spanish Chapter, the IEEE GRS Society, the Barcelona City Hall and UPC, this workshop joined fifty scientists and engineers from the US, Europe and Japan in a three-day meeting. The workshop was inaugurated by Dr. Juan Jesús Pérez, Vice-UPC Chancellor of Research.

A total of twenty seven oral and three interactive presentations were organized as a single forum of serial sessions, organized by thematic areas:

- real aperture radiometers,
- synthetic aperture and polarimetric radiometers, and
- technology and theoretical issues.

In addition, two lectures on topics of general interest for the community were given:

- “Ultra Stable Radiometers”, by Bill Wilson, Alan Tanner and Fernando Pellerano, and
- “Calibration of Synthetic Aperture Radiometers”, by David LeVine.

During the CEOS WGCV Microwave Sensors Subgroup sessions, terminology for real aperture, synthetic and polarimetric radiometers was discussed. Our subgroup has already drafted three out of the four chapters on commonly used terms in Microwave Radiometry. This has been done in consultation with experts in the different fields of general, real aperture, polarimetric and interferometric microwave radiometry.

The Friday afternoon joint session of CEOS MSSG with  $\mu$ Cal-2002 dealt with the elaboration of recommendations to the WGCV Plenary. The formulation of the recommendations presented below was established at this meeting.



$\mu$ Cal 2002 and CEOS WGCV Microwave Sensors inaugural session.

From left to right:

M. Martín-Neira (CEOS/WGCV/MSSG chairman), J.M. Lecue (BAiE), A. Camps (UPC), J.J. Pérez (UPC) and P. Racette (NASA Goddard)

## **6.- Work Plan Review**

The MSSG work plan remains focused at this moment on the following main topics:

- document on frequently used terms in microwave radiometry
- multi-mission CAL/VAL sites
- following up feedback from proposed recommendations to WGCV plenary

These areas are detailed next. They will be reviewed during next meeting of MSSG at IGARSS 2003.

## 6.1.- Definitions Document

The definitions document is an effort that started some time ago within our MSSG group. Jim Schiue provided Martin-Neira with what was available of this document by November 2001, titled:

*"Definition of Frequently Used Terms in Microwave Radiometry for Remote*

During the MSSG Boulder (Nov 2001) meeting Martin-Neira made the point that such document could be expanded beyond real-aperture radiometers, to include polarimetric as well as interferometric radiometers. It was agreed to split the work of the expanded document into a few well-differentiated subjects.

The chapter captains and major contributors are:

- Chapter 1: general terminology:  
J. Randa (NIST) and J. Schiue (NASA-GSFC)
- Chapter 2: real-apertures radiometers:  
J. Randa (NIST) and J. Schiue (NASA-GSFC)
- Chapter 3: polarimetric radiometers:  
J. Lahtinen (ESA/ESTEC), A. Camps (UPC)
- Chapter 4: interferometric radiometers:  
M. Martin-Neira (ESA/ESTEC), A. Camps (UPC)

During WGCV-19 meeting C. Johnson from NIST (US National Institute of Standards and Technology) provided Martin-Neira some useful references of documents and web-sites on standards (listed in Annex 2) which have been used wherever possible to avoid duplicating definitions already available elsewhere.

A draft version of Chapters 1 through 3 is already available. They have been sent to Y.L. Desnos by e-mail. Chapters 1 and 2 are posted for wider review on the NIST Standard Terminology website:

<http://www.boulder.nist.gov/div813/stdterms/Links.htm>

Chapter 3 has been distributed among polarimetric radiometry experts for further review too.

A draft of Chapter 4 is expected for IGARSS 2003.

## 6.2.- Multi-Mission CAL/VAL Sites

CAL/VAL sites for in-orbit deployed microwave radiometers are difficult to set-up mainly because the spatial resolution of microwave radiometers is coarse, in the order of 100 km<sup>2</sup> at least and typically much larger. Therefore our search is constrained to large regions, as homogeneous and stable as possible which can be modelled accurately enough or better, characterised by measurements (in-situ, aircraft and satellite).

So far there have been discussions on three sites in our MSSG subgroup:

- the cold sky

The cold sky is perhaps the most accurate and extensive target of all, available to every mission (if designed properly) and indeed cheap to maintain. Further, the cold sky can be characterised quite accurately from ground microwave measurements after atmospheric corrections.

- the poles

M. Drinkwater's (ESA/ESTEC) has proposed to use Antarctica Dome-C as a multi-mission CAL/VAL site. This proposal was based on the fact that several missions will likely use this part of the World for such purpose: ICESAT, AMSR-E, AMSR, CRYOSAT, SMOS.

However the high cost required for the characterisation of such remote sites has to be considered. Short-term aircraft campaigns will not solve questions regarding seasonal stability. Long-term in-situ observations require expensive maintenance and rugged hardware. The installation of some radiometers in a tower that is available has been studied.

Perhaps the first step should be to analyse the available radiometer data. There are time series of SMMR and SSM/I brightness temperatures from the late 70's already (M.J. Brodzik initiated this work, at the US National Snow and Ice Data Center).

It is worth mentioning that, for the time being, some campaigns are planned in Greenland, a more accessible place by comparison to Dome-C.

- the oceans

At Boulder K. Imaoka (NASDA) mentioned that observations over an adequate portion of ocean (essentially stable enough) could allow solving for possible AMSR drifts.

The poster mentioned above from M.J. Brodzik also showed brightness temperature time series over the Indian Ocean portion that SSM/I uses for cross calibration between different platforms. This is one potential area for cross calibration with AMSR.

### 6.3.- Recommendations to WGCV Plenary

Based on the discussions of the three main areas above during the Micro-Cal 2002 – CEOS WGCV meeting in Barcelona, the following recommendations are submitted to the WGCV Plenary:

1. *“The Microwave Sensors Subgroup of the CEOS Calibration and Validation Working Group recommends 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 in the whole mission taking into account its value against its cost.*

*A survey of ground sites where the sky is observed at different microwave frequencies of interest in Earth remote sensing should be done (useful at lower frequencies).*

2. *“The Microwave Sensors Subgroup of the CEOS Calibration and Validation Working Group recommends 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 (for radiometers in its view), deserts, tropical rain forest and the oceans.*

*Presently flying should continue gathering data on these areas of interest to continue the research on their suitability as cal/val sites for long term applications. Study on stable areas on the Earth surface suitable for radiometer inter-calibration purposes should be pursued..*

The MSSG Subgroup looks forward to receiving comments back from the WGCV-20 Plenary meeting. These comments will be taken into account during next MSSG meeting in Toulouse (IGARSS-2003).

## **7.- Actions and Near Future Work**

Our MSSG subgroup should aim at:

1. having a draft of Chapter 4 of the definitions document and
2. considering the feedback on the recommendations from the WGCV-20 Plenary

by next meeting (July 2003, Toulouse).

A table with a summary of the actions can be found in Annex 1.

## **8.- Reporting**

Reporting is currently taking place through e-mail exchange among MSSG members.

## **9.- Updating MSSG Member List**

The MSSG Member List has been updated following last MSSG meeting in Barcelona.

### **Annex 1: Action Items**

No.	Description	on	due date	status
Boulder-1	Distribution of document on calibration methods, as available, to all members of the subgroup	E. Lobl	June'02	Closed
Boulder-2	Contact active sensor expert and provide name to Martin-Neira	J. Schiue	June'02	Closed
Boulder-3	To approach S. Yueh at JPL working on radars as potential active sensor expert	S. Gasster	June'02	Closed
Boulder-4	To check the status of the MSSG cal/val site compilation web page	J. Schiue	September '02	Closed
Boulder-5	To ask S. Yueh if he volunteers to lead the chapter on terminology for polarimetric radiometers	S. Gasster	June'02	Closed
Boulder-6	To provide information on Dome-C in Antarctica to J. Schiue for NPOESS.	M. Martin-Neira	June'02	Closed
Boulder-7	To find calm-sea areas to be used potentially for microwave radiometer drift correction	J. Boutin K. Imaoka	October'02	OPEN
Ottawa-A	To provide Martin-Neira with web-sites from your institute, university, research group with descriptions of instruments at graduate level (this is for the Training and Education WG).	ALL	October'02	OPEN
Ottawa-B	To provide recommendations for the next CVWG plenary to Martin-Neira.	ALL	October'02	Closed
Barcelona-1	To provide comments on draft definitions document	ALL	July'03	OPEN



## **Annex 2: References on Standard Definitions**

The following references have been provided by C. Johnson (NIST, US):

### a) International Standards

- *The International System of Units (SI)*, 7<sup>th</sup> Edition, Bur. Intl. Poids et Mesures, Sevres, France (<http://www.bipm.fr/>).
- *International Vocabulary of Basic and General Terms in Metrology, Quantities and Units (ISO 31)*, and *Guide to the Expression of Uncertainty in Measurement*, International Organisation for Standardization, Geneva, Switzerland (<http://www.iso.ch/>).
- *International Commission on Illumination (CIE): CIE 17.4/IEC 50(854) International Lighting Vocabulary*, 1987 (<http://www.cie.co.at/cie/>).
- *Mutual Recognition Arrangement, the Joint Committee of the Regional Metrology Organizations, the Key Comparison Database, and the Calibration and Measurement Capabilities of National Metrology Institutes* (<http://www.bipm.fr/>).

### b) Standards in Applications

- *US Guide to the Expression of Uncertainty in Measurement*, ANSI/NCSL Z540-2-1997, National Conference of Standards Laboratories, Boulder, Colorado (<http://ncsli.org/>).
- B.N. Taylor, *Guide for the Use of the International System of Units (SI)*, NIST Special Publication 811, 1995 Edition, US Department of Commerce, Gaithersburg, Maryland (<http://physics.nist.gov>).

### c) Standards in Radiometry

- C.L. Wyatt, V. Privalsky, R. Datla, *Recommended Practice: Symbols, Terms, Units and Uncertainty Analysis for Radiometric Sensor Calibration*, NIST Handbook 152, US Department of Commerce, Gaithersburg, Maryland.
- C.J. Bruegge, E. Miller, R. Martin, H.H. Kieffer, J.M. Palmer, *Definitions in Use by the Visible and Near-Infrared, and Thermal Working Groups*, Earth Observing System Calibration Advisory Panel (1991).
- EOS Data Products Hadnook, EOS Project Science office (<http://eospsso.gsfc.nasa.gov/>).