

**Passive Sensing Microwave Workshop Proceedings/Summary**  
**1-2 May 2007**

**Workshop Background, Objectives and Overview**

In support of Space Frequency Coordination Group (SFCG) Action Items and related International Telecommunications Union-Radio (ITU-R) efforts, this year's NOAA Passive Sensing Workshop continued the work of the two previous 2 NOAA Workshops and was held at NOAA's Silver Spring, Maryland location on 1-2 May 2007. The objective of this 3<sup>rd</sup> NOAA Workshop was to finalize the results of all three NOAA Passive Sensing Workshops. The Workshop focused on the introduction and discussion of technical papers on the identification, evaluation and utilization of particular passive sensing microwave bands, emphasizing bands above 275 GHz.

The ITU-R has established a list of passive sensing microwave, bands which are presented and described in ITU-R Recommendations RS.515, RS.1028 and RS.1029. Particular attention was given to bands above 275 GHz since these bands have not yet been firmly established in these ITU-R recommendations, and future World Radio Conferences (WRCs) are expected to consider, and possibly establish, passive microwave bands in this higher frequency domain.

The technical papers generally began with the consideration of the particular passive sensing measurement functions or objectives (e.g., water vapor measurement, temperature soundings, sea surface temperature, and rain rate) and the natural microwave emissions that support these functions and objectives. The capabilities of certain bands to support certain measurement functions also considered potential Radio Frequency Interference (RFI), RFI mitigation, required and available spectrum bandwidth, legacy instruments and associated data as well as practical mission considerations such as instrument costs and support.

Spectrum management issues related to the establishment, protection and application of radio spectrum were also addressed at this workshop including ongoing, planned and proposed efforts to support the spectrum interests of the EESS passive sensing community.

# Agenda

## Tuesday, 1 May 2007

- 9:00** Introductions, Attendees and Workshop Logistics [DM\*, NOAA]
- 9:15** Workshop Overview and Objectives [FE, NOAA]
- 9:30** Spectrum Management Overview [DM, NOAA]
- 10:15** ITU-R Passive Sensing Recommendations [FE, NOAA]
- 10:30** Coffee Break
- 10:45** Meteorology Passive Sensing Requirements [SE, UK Met Office]
- 11:15** EUMETSAT Polar System (EPS) Requirements [MD, EUMETSAT]
- 12:00** CMIS Reformulation [DK, NOAA IPO]
- 12:30** Lunch
- 1:30** Clouds and Climate [JP, NASA]
- 2:00** Frequency Band Justifications [JZ, NASA]
- 3:00** Coffee Break
- 3:15** Impact of Interference [JP, CNES]
- 3:45** Scientific and Regulatory Partnership ? [TV, NASA]
- 4:15** CORF Activities [DL, NAS]
- 4:45** Day 1 Summary and Day 2 Plans [FE, NOAA]

(\*See Table 1 for 2-letter identifiers)

**NOAA Passive Microwave Workshop**  
**1, 2 May 2007**

**Agenda (continued)**

**Wednesday, 2 May 2007**

**9:00 Overview and Review of Workshop Evaluation Methodologies [FE\*, NOAA]**

**9:30 Refinement of Assessments for “WV”, “SST”, “TP”, “RR”, etc. [Group]**

**10:15 Coffee Break**

**10:30 Review/proposal of band changes to ITU-R Recommendations (RS.515-4) [Group]**

**12:00 Lunch break**

**1:00 Discussion and final proposal of RS.515-4 Table 1 updates [Group]**

**2:15 Coffee Break**

**3:00 “Disaster Management” Presentations and Discussions [CW, NASA]**

**4:00 Workshop Conclusions, Plans and Summary [FE, NOAA]**

**(\*See Table 1 for 2-letter identifiers)**

## **Day 1; May 1, 2007**

Dave McGinnis (NOAA NESDIS) introduced the workshop and the attendees introduced themselves. Frank Eng (CSC/NOAA) provided an overview of the workshop, including the background and the objectives. The workshop was dedicated to the departed Guy Rochard (METEO France) who was the preeminent leader in the establishment and protection of radio spectrum for passive sensors employed by the Earth Exploration Satellite Service (EESS).

Dave McGinnis gave a presentation on the spectrum management process, both the United States domestic process managed by the FCC and NTIA and the international process managed by the ITU-R. There was some discussion on the process and its impact on establishing and protecting spectrum for passive sensors.

Frank Eng (CSC/NOAA) gave a presentation on the 3 primary ITU-R passive sensing Recommendations, RS.515, RS.1028 and RS.1029, with the focus on RS.515 since it contains the passive sensing spectrum requirements and their association with specific “measurement functions”. RS.515 was emphasized and discussed as the primary mechanism or vehicle for establishing and documenting international spectrum requirements for EESS passive.

Stephen English (UK Met Office) gave a presentation on the spectrum requirements for meteorology, focusing on the sensitivity of the measurements in specific bands and the potential for error when the integrity or accuracy of these measurements is compromised.

Markus Dreis (EUMETSAT) gave a presentation on the spectrum requirements of the EUMETSAT Polar System (EPS), focusing on 3 EPS instruments, Microwave Sounder (MWS), Microwave Imager (MWI) and Milli-metre Wave Mission (MMW). The requirements addressed existing and follow-on (i.e., post-EPS) requirements. His paper included a table summary of the four measurement functions (i.e., WV, SST, TP, and RR) evaluated by the previous 2 workshops, presenting a comparative assessment of different bands for each of the four functions.

Jeff Piepmeier (NASA/GSFC) gave a presentation of NASA developed spectrum requirements for their cloud sensing mission.

John Zuzek (NASA/Lewis) gave a presentation summarizing and generally reviewing the key spectrum requirements included in the associated NASA paper. This NASA paper contains comprehensive application and assessment data for almost all bands of interest to the passive sensing community and could serve as the basis for the planned EESS Passive Sensing Handbook being considered by ITU-R WP 7C.

Jean Pla (CNES) gave a presentation on the impact of Radio Frequency Interference (RFI) on passive sensing meteorological products and services.

David Lang (NA/CORF) gave a presentation on the spectrum management activities of the National Academies with a focus on the CORF Handbook and upcoming activities to promote the establishment and protection of spectrum for passive sensing.

Tom VonDeak (NASA/Lewis) gave a presentation on the working relationship between the “regulatory” and “science” community, focusing on improving the relationship.

Charles Wende (ASRC/NASA) gave a presentation on “disaster management” and its relationship or dependency on the EESS sensing missions.

## **Day 2; 2 May 2007**

Day 2 began with a introduction and discussion of the primary workshop objective of evaluating and updating the passive sensing spectrum requirements, beginning with the baseline requirements presented in ITU-R RS.515-4. The evaluation methodologies and their associated application of the previous 2 workshop were reviewed as a basis for continuing and perhaps “finalizing” (i.e., draft) the results of the three workshop.

The review of the methodology focused on specific evaluation criteria and processes employed in the previous workshops. These were discussed and generally accepted with out change.

The actual results of the previous two workshops establishing and evaluating the bands employed for the 4 measurement functions of “water vapor”(WV),”sea surface temperature”(SST), “temperature profiling” (TP) and “rain rate” (RR) were briefly reviewed but it was decided to postpone any further review or refinement of these previous evaluations.

The workshop conducted a “work session” with the objective of updating ITU-R Recommendation RS.515-4, with a focus on modifying and adding additional bands, especially above 275 GHz. The session produced a “Change Table” that contained specific changes to the RS.515-4 Table 1 characterized in the second column of the table as either a “modification” (M) or “new” (N) change. It was agreed that this Change Table would be distributed to the attendees along with the Workshop Record so they could review and comment on both. After a brief review period (i.e., one month) all comments would be considered and a final version of the Change Table and Workshop Record would be prepared and distributed to the attendees.

At the end of the workshop, the results of the workshop were summarized for review and comment. Potential plans for future similar workshops were discussed and it was generally agreed that the workshop was quite productive and useful in understanding and establishing spectrum requirements for the EESS passive community. It was also agreed that future similar workshops would continue to be useful although they would not necessarily be conducted on a regular or annual basis.

**Table 1  
Summary of Presentations and Papers**

<b>#</b>	<b>Title</b>	<b>Presenter</b>	<b>Description and Comments</b>	<b>Paper</b>
<b>1</b>	<b>Management of Radio Frequency Spectrum</b>	<b>Dave McGinnis (DM)</b>	<b>Management of Radio Frequency Spectrum</b>	
<b>2</b>	<b>ITU-R Recommendations</b>	<b>Frank Eng (FE)</b>	<b>ITU-R Recommendations RS. 515, RS.1028, RS.1029 and their role in PMRS spectrum management</b>	
<b>3</b>	<b>The requirement for PM RS in meteorology</b>	<b>Stephen English (SE)</b>	<b>Requirement(s) for PMRS (UK Met Office)</b>	
<b>4</b>	<b>Frequency Bands for PM sensing for EPS &amp; post-EPS</b>	<b>Markus Dreis (MD)</b>	<b>EUMETSAT requirements for PMRS</b>	<b>X</b>
<b>5</b>	<b>Usage of frequencies &gt;275 GHz for PRS of Cirrus Clouds</b>	<b>Jeff Piepmeier (JP)</b>	<b>NASA use of bands above 275 GHz for ice-cloud sensing</b>	
<b>6</b>	<b>Frequency Band Justifications for PMS- Historical Perspective</b>	<b>John Zuzek (JZ)</b>	<b>NASA comprehensive and traditional basis for spectrum requirements considering interdependencies</b>	<b>X</b>
<b>7</b>	<b>PM Frequency Bands: Impact of RFI &amp; Lost Data on Passive Observations</b>	<b>Jean Pla (JP)</b>	<b>Impact of RFI and lost data, considering reliance on multiple bands and interdependencies</b>	<b>X</b>
<b>8</b>	<b>Update on CORF Activities</b>	<b>David Lang (DL)</b>	<b>CORF objectives and activities with focus on CORF Handbook and spectrum management for science</b>	
<b>9</b>	<b>The Scientific and Regulatory Community Partnership</b>	<b>Tom VonDeak (TV)</b>	<b>Improving the relationship between the regulatory and scientific communities; Disaster Management plans</b>	
<b>10</b>	<b>Summary of Space Based Sensor Applications for Disaster Support</b>	<b>Charles Wende (CW)</b>	<b>Disaster Management scenarios and applicable passive bands</b>	<b>X</b>
		<b>David Kunkee</b>	<b>CMIS Reformulation/Revision [Canceled]</b>	

**Table 2**  
**“Change Table” Updating RS.515, RS.1028, RS.1029**

Band (Upper and Lower bound)	Change Status (e.g., New, Modified, etc)	Measurement and Comments (Measurement function, priority, dependencies, alternatives/comparisons, etc.)	Performance		Scan Mode (N,L)	Source (1)
			Sensitivity (K)	Data Availability		
1.37-1.4 1.4-1.427	M	Vegetation <del>index</del> <u>biomass</u> (replace)			N	JP
2.64-2.655 2.655-2.69 2.69-2.7	M	Vegetation <del>index</del> <u>biomass</u> (replace)			N	JP
4.2-4.4 4.95-4.99	M	Soil moisture Soil moisture			N	JP
6.425-7.25	M	Soil moisture			N	JP
52.6-59.3	M	Cloud liquid water			N	MD
50.2-50.4	M	Cloud liquid water			N	MD
86-92	M	Cloud liquid water			N	MD
100-102	M	Precip. over sea and land			N	MD
115.25-122.25	M	Cloud liquid water, precip. over sea and land, incl. light precip. and snowfall, ht. and depth of melting layer			N	MD
164-167	M	Water vapor profile, precip. over land and snowfall			N	MD
174.8-191.8	M	Snowfall, cloud ice water path retrieval			N	MD
239-247 241.7-244.7	N	Quasi window for cirrus clouds and cloud ice (Can the window, currently in Rec. 515-4, at 226-231.5 GHz be used? Avoid spectral lines)			N	JP MD
316-334	M	Cloud ice			N	JP
334-336	N	Cloud ice, Cirrus, quasi-window			N	JP
371-389	M	Cloud ice			N	JP
446.5-449.5 439.3-456.7	N	Cloud ice water path (integrated ice in clouds) and cirrus			N	MD JP
634.8-637.6	M	Cloud ice			N	JP
648.2-651.0	M	Cloud ice, paired with 634.8-637.6 GHz, note Rec. 515-4 already has 634-654 GHz			N	JP

Band (Upper and Lower bound)	Change Status (e.g., New, Modified, etc)	Measurement and Comments (Measurement function, priority, dependencies, alternatives/comparisons, etc.)	Performance		Scan Mode (N,L)	Source (1)
			Sensitivity (K)	Data Availability		
<b>662.5-666.5</b>	<b>N</b>	<b>Cirrus clouds and cloud ice water path</b>			<b>N</b>	<b>MD</b>
<b>866-882</b>	<b>N</b>	<b>Cloud ice</b>			<b>N</b>	<b>JP</b>

**Notes**

**JP: Jeff Piepmeier**

**MD: Markus Dreis**

**Table 3**  
**Workshop Attendees**

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