ITSC-17 WORKING GROUP ON INTERNATIONAL ISSUES AND FUTURE SYSTEMS
16 April 2010
Asilomar Conference Grounds, Monterey, California, USA

Participants

Simon Elliott, John Eyre (Co-Chair), Lars Fiedler, Louis Garand, Mitch Goldberg, Liam Gumley, Jeff Hawkins, Richard Kelley, Jerome Lafeuille (Co-Chair), Christelle Ponsard, Stephen Tjemkes, Walter Wolf.

Topics

- Frequency management issues

- Future plans for satellite sounding
  - WMO Vision for the space-based Global Observing System in 2025
  - Adequacy of current plans for satellite sounding
- Data access issues
  - Future plans for Direct Broadcast access to polar orbiter data
  - Regional ATOVS Retransmission Service (RARS) status and planned extension
  - SafetyNet
  - Data dissemination

Main Conclusions

1. Frequency Management Issues

1.1 Achievements

The WG underlined notable achievements since ITSC-16. These included the publication of two documents, which are available by contacting { HYPERLINK "mailto:dave.mcginnis@noaa.gov"}, { HYPERLINK "mailto:richard.kelley@noaa.gov"}, { HYPERLINK "mailto:jpla@cnes.fr"} .)

- Draft ITU-R Report on " Identification Of Degradation Due To Interference And Characterization Of Possible Mitigation Techniques For Passive Sensors".
- "Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz" , a document describing passive systems for use in interference analysis for future non-passive systems.

1.2 New issues

The WG also noted the following new items of concerns

- The Soil Moisture and Ocean Salinity (SMOS) mission of ESA which relies on an L-Band 1.4 GHz radiometer is affected in this band by RFI (point of contact { HYPERLINK "mailto:jpla@cnes.fr"}) as illustrated in Figure 1 below.
- The Soil Moisture Active Passive (SMAP) mission of NASA which will also operate an L-Band radiometer may be affected as well, however it is expected that this will be mitigated on board through the use of an agile digital detector for RFI (point of contact : { HYPERLINK "mailto:cruf@umich.edu"})
- The advanced scattterometer (ASCAT) of Metop is facing RFI over land (Dieter Klaes is poc: { HYPERLINK "mailto:dieter.klaes@eumetsat.int" }).

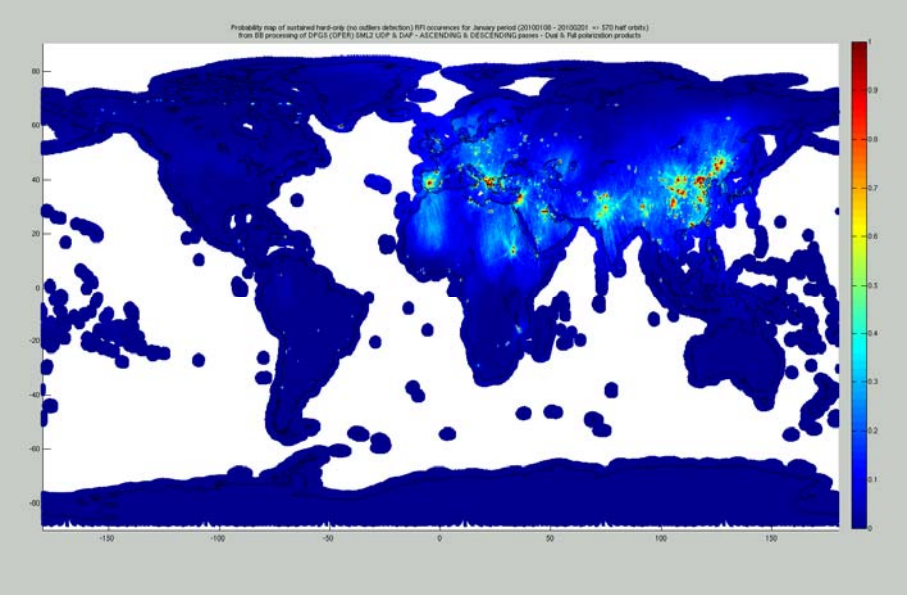

*Figure { SEQ "Illustration" *Arabic }: SMOS image of strong RFI probability*

1.3 Use of the spectrum above 275 GHz

An agenda item for the World Radiocommunications Conference in 2012 calls for a review and possible revision of the Radio Regulations (RR) No. 5.565, to address existing and projected requirements between 275 GHz and 3 000 GHz for the Earth exploration-satellite service (EESS) and space research service (SRS).

It is important for ITWG membership to review its requirements for use of the spectrum in the band between 275 and 3000 GHz and make their ideas know to the international community. Interested member can contact { HYPERLINK "mailto:dave.mcginnis@noaa.gov"}, { HYPERLINK "mailto:richard.kelley@noaa.gov"}, { HYPERLINK "mailto:jpla@cnes.fr"}.

1.4 Emitter registry

There are existing international spectrum allocations which guide frequency band usage and delineate restrictions placed on such use. That being said there is recognition, among the environmental satellite community, of instances in which emitters now or in the future will destroy data of interest to this community. An international registry of emitters would provide advance notification for future environmental satellite missions. It is proposed that a discussion of such a registry be held within appropriate WMO (??) entities. Such a registry could contain information on emitter locations, RF characteristics, duty cycles, and anticipated time frame of emitter existence.

N.B. There is a much smaller scale effort called Radiofrequency Interference Survey of the Earth (RISE).

2. Vision for the space-based GOS in 2025 and adequacy of current plans

The WG was briefed on the Vision for the GOS in 2025, that was finalized and adopted by the WMO Commission for Basic Systems (CBS) in April 2009 and subsequently approved by the 61st WMO Executive Council in June 2009. It is now available online as a reference document (See: { HYPERLINK "http://www.wmo.int/pages/prog/www/OSY/WorkingStructure/documents/CBS-

2009_Vision-GOS-2025.pdf" **}**) and is attached to this report.

The Vision provides a description of both the surface and space segments of the Global Observing System as a goal to guide the evolution of this system in the coming two decades. The vision addresses general features such as the adaptation to evolving user requirements, the integration of its various components, the expanded range of observations and parameters to be handled, the need for increased standardization, interoperability, and quality control. As concerns space-based observation, the vision stresses the trend towards higher spatial, temporal and spectral resolutions, the need to improve availability and timeliness, and to ensure accurate calibration and global intercalibration. The space-based component of the GOS is anticipated to increasingly rely on partnership among operational and R&D satellite operating agencies. The vision not only foresees the continuation and enhancement of heritage missions in geostationary and in sun-synchronous orbit, but also calls for the transition to operational status of a range of missions on diversified orbit configurations that, in the past, have been only pursued with a research or demonstration purpose. These included for instance missions dedicated to the monitoring of Essential Climate Variables such as sea surface height, Earth radiation budget, or atmospheric composition.

The WG noted that planned satellites in Highly Elliptical Orbit (HEO) would have advanced imagers. A limited number of water vapour and temperature channels are suitable for assimilation at high (15 mn) temporal and spatial (2 km) resolution.

The WG highlighted and reinforced the three types of satellite sounding that are called for by the vision:

- LEO sun-synchronous MW and hyperspectral IR observation from 3 orbital planes (am, pm, early morning)
- Geostationary hyperspectral IR
- Radio-occultation (RO) sounding

The WG reviewed the adequacy of current satellite plans with respect to these sounding missions from the mid-morning, afternoon, early morning and geostationary orbits, as well as the Radio-Occultation constellation plans.

Mid-morning and afternoon orbits

The WG felt confident that the morning orbit was well covered by Metop, and complemented by FY-3 that in future would carry an IR hyperspectral sounder. It also noted the ongoing commissioning of Meteor-M1 and expected that the data from FY-3 and Meteor M satellites will be available to the community as discussed below.

As concerns the afternoon orbit, the WG noted the current redefinition of the NPOESS Programme and the plan to have an NPP-based Joint Polar Satellite System (JPSS). It anticipated that the JPSS would carry a full IR and MW sounding package. It also expected this mission to be complemented by a satellite from the FY-3 series (FY-3 B, D, F) and possibly the Meteor-M 2 satellite.

Early morning mission

As concerns the early morning mission, the WG noted that requirements for this mission were still being reviewed by the DOD, responsible for this mission that would provide a follow-on to the DMSP. As part of this review, the WG recommends that requirements be stated in terms of Satellite Data Records (SDR) rather than Environmental Data Records (EDR) in relation with the needs of the NWP and Climate communities for exploitation of radiance measurements.

When considering the MW sounder for this early morning orbit mission, particular attention should be

paid to the requirements for calibration accuracy and stability, noting the problems in these areas with current conically scanning MW radiometers.

The need for infrared sounding requirements for this early morning orbit mission was reiterated, in accordance with the Vision of the GOS.

Action 1: Mitch Goldberg, Jeff Hawkins and John Bates, to communicate these recommendations to the Joint Agency Requirements Group (JARG). a holdover from the NPOESS program that will assist in the transition to the restructured programme.

The WG was pleased to note that ROSHYDROMET had successfully launched Meteor-M1 on a morning orbit and planned to launch Meteor-M2 on a mid-afternoon orbit (15:30) with a payload including MW (MTVZA) and Hyperspectral IR (IRFS-2) sounders. It encouraged the Russian Federation to make these missions fully contributing components of the GOS by providing the global data sets from this mission in a timely manner with all necessary ancillary information.

Recommendation 1: the Russian Federation to make the Meteor-M mission a fully contributing component of the GOS by providing the global data sets from this mission in a timely manner with all necessary ancillary information.

Geostationary infrared hyperspectral sounding

The WG welcomed the plans of CMA and EUMETSAT to implement such IR sensors on FY-4O (by 2015) and MTG (2018) missions respectively. The WG also noted that options were being discussed by NOAA regarding a sounding capability to complement the current GOES-R,S baseline, and strongly encouraged NOAA to pursue these investigations.

Geostationary Microwave Sounding

Being aware that geostationary microwave sounding was still only envisaged as a technology and scientific demonstration mission in the WMO Vision of the GOS, the WG noted that the NASA GEOSTAR project was responding to the call for such a demonstration mission. It considered that if any trade-off needed to be made between the measurement of precipitation and the vertical temperature and moisture profile, the specific priority for microwave sounding would be on precipitation.

Radio-occultation sounding

The WG welcomed the setting up of a CGMS-sponsored International Radio-Occultation Working Group (IROWG) that will supplement the activity of ITWG, IWWG and IPWG.

It was pleased to be informed of the recent decision of the USA and Taiwan to fund a follow-on to the very successful COSMIC mission. It noted that the new constellation would include 12 satellites able to receive both GPS, GLONASS and Galileo signals. It was recalled that RO receivers are also on board of Metop and Oceansat-2, and planned for Meteor-M2 and Megha-Tropiques, and considered for other satellite missions.

3**. Data access issues**

General recommendations

The WG reiterated the need for near-real time availability of satellite sounding data and the unique role of Direct Broadcast in the case of polar-orbiting satellites in particular. It stressed the need for detailed and

comprehensive information to be made systematically available by space agencies on how to access the data in near-real time, including the description of frequencies, transmission protocols, data formats, as well as ingest and pre-processing software, and any relevant accompanying information. Information on data formats for new missions should be made available, in a draft form, in advance of the mission. Two recommendations were reaffirmed in this respect:

Recommendation 2: Satellite agencies operating environmental polar satellites to provide or continue to provide a Direct Broadcast capability on their polar environmental satellite systems, and to make available in a timely manner the Direct Broadcast data processing (L0 to L1, and/or L1 to L2) software, documentation, and related training.

Recommendation 3: Satellite agencies operating environmental polar satellites to provide expected formats of level 1b and level 2 datasets at least one year prior to launch, and to establish web sites to provide detailed information on instruments, schedule, products and formats.

Access to NPP, JPSS and DMSP follow-on missions

The WG noted that in response to an action from ITSC-16, detailed information on NPP and NPOESS Satellite Data Records (SDR) and Environmental Data Records (EDR) formats had been made available and can be found on the following page: **{** HYPERLINK "http://jointmission.gsfc.nasa.gov/project/science-documents.html" **}** , which is referred to in the WMO website (**{** HYPERLINK "http://www.wmo.int/pages/prog/sat/GOSleo.html#FutureLEO" **}**).

The WG reiterated its support to the completion and distribution of the IPOPP software and recommended including a BUFR conversion module.

The WG also noted that the former NPOESS programme included provisions for making data openly available in near-real time from both the afternoon and the early morning orbits, and expressed its strong expectation that similar provisions would apply in the new framework of JPSS and DMSP follow-on.

Recommendation 4: NOAA, NASA (or JPSS project management office) to include a BUFR conversion module in the IPOPP software package.

Recommendation 5: NOAA, NASA and DOD to confirm and implement Direct Broadcast capabilities on both the JPSS and DMSP Follow-on series ensuring that environmental data from these missions are openly and freely available in near-real time, and to make the relevant ingest and pre-processing software available to the global community.

The WG recalled the plans for the NPOESS SafetyNet that aimed at collecting at least 90% of the global data within 30 minutes from acquisition through a scheme of multiple data dumps to a network of 14 ground stations around the globe, viewed this concept as an efficient means to improve timely data availability. It was pleased to note that this SafetyNet was still envisaged as the main mechanism for data acquisition. The WG expected that it would apply to both JPSS and DMSP Follow-on data, and possibly to other missions.

Recommendation 6: NOAA and DOD to consider the use of the SafetyNet as a joint ground system ensuring timely availability of data from the JPSS and DMSP-Follow-on missions.

The WG also recalled that the SafetyNet was ensuring data concentration and had to be complemented by arrangements for onward distribution to the global community.

Access to data from FY-3 and Meteor-M missions

The WG recalled previous actions and recommendations related to data access from FY-3 and Meteor-M missions. It was very pleased to note that the on-orbit commissioning of FY-3A had been successfully completed, and FY-3A sounding data were used by some NWP centres with significantly positive impact. Furthermore, Meteor-M 1 was undergoing commissioning and had provided preliminary imagery data. Both satellites are equipped with a Direct Broadcast capability as described in the table below, with comparison with the DB characteristics of other current or planned satellites:

Satellite	*Service*	Frequency	Data rate
NOAA-18, 19	*HRPT*	1698 or 1707 MHz	665.4 kbps
	APT	137.5 or 137.62 MHz	1.7 kHz
MetOp-A,B,C	*AHRPT*	1701.3 MHz (1707 MHz backup)	3.5 Mbps
	LRPT	137.1 MHz (137.9125 MHz)	72 kbps
Meteor-M-1,2	*HRPT*	1700 MHz	665 kbps
	LRPT	137.9 or 137.1 MHz	72 kbps
FY 1,D	*HRPT*	1700.4 MHz	1.33 Mbps
FY 3	*AHRPT*	1704.5 MHz	4.2 Mbps
	MPT	7775 MHz	18.7 Mbps
NPP	*HRD*	7812 MHz	15 Mbps
NPOESS-1,2,3,4	*HRD*	7834 MHz	20 Mbps
	LRD	1707 MHz	3.88 Mbps

The WG was pleased to note that transmission and data format information on FY-3A was available however no English translation was publicly available yet. The WG was also aware that Meteor-M Direct Broadcast was based on the CGMS HRPT/LRPT standard. In line with Recommendation (xxx) above, it was strongly expected that both CMA and ROSHYDROMET would pursue their efforts to provide detailed information and processing packages enabling the community to take advantage of their respective missions, and thus allowing these missions to bring a substantial contribution to the Global Observing System.

Regional ATOVS Retransmission Service

The WG noted the report provided to ITSC-17 on the implementation of the RARS, which aims at ensuring timely availability of ATOVS data to NWP centres. RARS includes three components: EUMETSAT EARS, Asia-Pacific RARS, and South-America RARS. Altogether, the 40 stations involved in RARS provide coverage for about 75% of the globe and allow availability of their sounding data worldwide over the GTS and other means within 30 minutes from acquisition. The coverage is expected to approach 80% of the globe in 2011. The WG welcomed the rapid progress of the RARS project. Considering the demonstrated benefit to NWP, WMO and the RARS contributing organizations it encouraged WMO and all RARS contributing organizations to pursue the implementation of the global RARS network.

The WG welcomed the steps taken in response to ITSC-16 to consider an extension of the RARS project towards including sounding data from new missions, starting with NPP CrIS and ATMS, pending the timely availability of this data through the SafetyNet and further redistribution worldwide. It also renewed its interest for including METOP/IASI, as well as FY-3 data in the RARS.

Harmonization of future Direct Broadcast services

The WG recalled that Direct Broadcast from current missions was ensured in L-Band along the CGMS

agreed HRPT/LRPT and HRIT/LRIT transmission standards, which are now based on CCSDS standards (Note: the CGMS standards mainly focus on the "Session" layer and the "Transport" layer in the ISO Open Systems Interconnection (OSI) reference model, while the CCSDS standards define the "Network and "Datalink" layers). As new missions are considering dissemination of much higher data rates, mainly in X-Band, it appears that satellite operators are planning new dissemination services that in some cases do not correspond to any CGMS standard. The WG wished that future services are harmonized as far as possible to facilitate their reception by the users.

Recommendation 7: CGMS to consider harmonization of the appropriate layers of the future X-Band Direct Broadcast services, for instance as concerns frequency or transmission protocols based on CCSDS standards.

Dissemination of data from geostationary services

The WG recalled that no Direct Broadcast was currently planned for the future Himawari-8 an-9 geostationary spacecraft of JMA that will follow the MTSAT series. The main dissemination mechanism for Himawari-8, 9 will be via the Internet. The WG noted that in most cases data distribution from a geostationary spacecraft is not strictly Direct Broadcast since it undergoes a prior ground processing and is then redistributed; thus there are several means to ensure near-real time distribution of geostationary data, either via a transponder on the meteorological spacecraft (e.g. for current LRIT, HRIT, or future GOES-ReBroadcast) or via telecommunication satellites (e.g. with current EUMETCAst, FengYunCast services) in the latter case, data can be integrated with other data sources.

Recommendation 8: JMA to consider a broadcast service to facilitate access to Himawari 8, 9 data in particular for users in Pacific islands that have limited Internet connectivity.

Future dissemination systems

Finally, the WG suggested that CGMS and satellite operators investigate the potential of satellite-to-satellite communication (e.g. Tracking and Data Relay Satellite System, TDRSS) as a mechanism to support timely collection and redistribution of polar-orbiting satellite data in future systems, since this mechanism potentially mitigates much of the expensive land receiving sites and communication infrastructure currently required to receive and disseminate global low earth orbiting satellite digital data sets in a timely manner.
