CGMS

CGMS-37 WMO-WP-01
v1, 30 September 2009
Prepared by WMO
Agenda Item: I/1
Discussed in WG I

RADIO FREQUENCY MANAGEMENT ISSUES

The document provides information on related WMO activities and outcomes of the WMO CBS Steering Group on Radio-Frequency Coordination, including the draft WMO position in preparation to the World Radiocommunication Conference 2012 (WRC-12) and the revised ITU-WMO Handbook "Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction**"**.

Action/Recommendation proposed:

CGMS is invited to take note of the information and provide comments on the draft WMO position for WRC-12, as appropriate.

FREQUENCY MANAGEMENT ISSUES

DISCUSSION

1. A joint ITU-WMO Seminar on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction was held in WMO Headquarters (Geneva, September 2009) with the participation of experts from NMHSs, from national radiocommunications authorities and several international organizations. Two sessions (*Passive and active remote sensing, Meteorological satellites communications*) were specifically dedicated to spaceborne systems, with the participation of CNES, EUMETSAT, NASA, and NOAA. One session addressed frequency bands and regulatory issues, including preparation of WRC-12 agenda issues. The seminar emphasized the importance of further developing awareness of both meteorological and radiocommunication communities about the essential role of radio-frequency spectrum for activities related to climate, weather and water information, warnings and prediction services, especially in countries that are not operating space-borne systems, and only users of related data.
(see http://www.wmo.int/pages/prog/www/TEM/WMO_RFC/seminar-itu-wmo.html)

2. The agenda of the World Radiocommunication Conference 2012 (WRC-12, January 2012) includes several items of serious importance for WMO and CGMS. The CBS Steering Group on Radio-Frequency Coordination (SG-RFC), at its last session (Geneva, September 2009) consolidated the preliminary WMO position in preparation of WRC-12, which was submitted to relevant ITU-R groups; the document is included in the Appendix. The WRC-12 WMO position will be distributed by mid-October 2009 to WMO Members and relevant International Organizations, with a view to facilitating an effective preparation of national WRC-12 positions favourable for the WMO related issues. The SG-RFC is planned to meet in July 2010 (Melbourne, Australia, in coordination with SFCG-30) to finalize the WRC-12 WMO position in interaction with the ITU-R Conference Preparatory process. Among WRC-12 agenda items, the following items concern frequency bands or issues of prime interest/concern for CGMS:

- agenda item 1.6 : Passive service between 275 and 3000 GHz (see section 3.1)
- agenda item 1.8 : Fixed service between 71 and 238 GHz (see section 3.2)
- agenda item 1.22 : Effect of emissions from short-range devices (SRD) (see section 3.5)
- agenda item 1.24 : Extension of the 7 750-7 850 MHz Metsat band to the band 7 850-7 900 MHz (see section 3.6)
- agenda item 1.25 : Mobile Satellite Service (see section 3.7)
- agenda item 8.1.1 : (issue C) Resolution 673 (WRC-07) on Radiocommunications use for Earth observation

applications (see section 3.8)

There are also items of potential concern for CGMS, should identification or allocations for other radiocommunication services be considered in bands allocated to METSAT or EESS, as follows:

- agenda item 1.5 : Electronic News Gathering (ENG)
- agenda item 1.7 : Aeronautical mobile under Resolution 222 (Rev. WRC-2007)
- agenda item 8.2 : WRC-2015 Agenda (see section 3.8)

3. The revised ITU-WMO Handbook on "*Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction*", 2008 edition, is available free of charge in electronic form in six languages, through a joint WMO-ITU cooperation. The revised handbook is an important reference documentation for both meteorological/earth observation and radiocommunication communities. (see: http://www.itu.int/publ/R-HDB-45-2008/en)

4. The SG-RFC activities contribution also continues to provide the main outcome of GEO Task AR-06-11 (SG-RFC Chairman, Philippe Tristant, is the lead POC).

PRELIMINARY WMO POSITION ON WRC-12 AGENDA

1 INTRODUCTION

Timely warning of impending natural and environmental disasters, accurate climate prediction and detailed understanding of the status of global water resources: these are all critically important everyday issues for the global community. The National Meteorological and Hydrological Services around the world are responsible for providing this information, which is required for the protection of the environment, economic development (transport, energy, agriculture,..) and the safety of life and property.

Radio-frequencies represent scarce and key resources used by National Meteorological and Hydrological Services to measure and collect the observation data upon which analyses and predictions, including warnings, are based or processed, and to disseminate this information to governments, policy makers, disaster management organisations, commercial interests and the general public.

On a more general basis, the utmost importance of radio-frequencies for all Earth Observation activities is also to be stressed, in particular with regard to the global warming and climate change activities.

This document reflects the position of the World Meteorological Organisation (WMO) on the agenda of the World Radiocommunication Conference 2012 *(WRC-12)* as given in Resolution **805 (WRC-07)**.

2 GENERAL COMMENTS

The Global Observing System (GOS), coordinated by WMO, comprises components which make use of a number of different radio applications and services, some of which may be affected by WRC-12 decisions.

Space-borne sensing of the Earth's surface and atmosphere has an essential and increasing importance in operational and research meteorology, in particular for mitigating the impact of weather and climate-related disasters, and in the scientific understanding, monitoring and prediction of climate change and its impacts.

The impressive progress made in the recent years in weather and climate analysis and forecasts, including warnings for dangerous weather phenomena (heavy rain, storms, cyclones) that affect all populations and economies, is to a great extent attributable to spaceborne observations and their assimilation in numerical models.

Space-borne passive sensing for meteorological applications is performed in bands allocated to the Earth exploration-satellite (passive) and meteorological satellite services. Passive sensing requires the measurement of naturally-occurring radiations, usually of very low power levels, which contain essential information on the physical process under investigation.

The relevant frequency bands are determined by fixed physical properties (molecular resonance) that cannot hence be changed or ignored, nor are these physical properties able

to be duplicated in other bands. Therefore, these frequency bands are an important natural resource. Even low levels of interference received by a passive sensor may degrade its data. In addition, in most cases these sensors are not able to discriminate between natural and man-made radiations.

For passive sensing bands shared with active services, the situation tend to be more and more critical with the increased density of terrestrial active devices and serious cases of interference are already reported.

In the more critical passive sensing frequency bands, RR N° **5.340** stating that "all emissions are prohibited" enables in principle passive services to deploy and operate their systems with the highest reliability. However this protection appears in practice insufficient with examples of unregulated and potentially mass-market short range devices allowed nationally to operate in these bands or unwanted emissions from not properly regulated adjacent bands.

It should be stressed that bands below 100 GHz are of particular importance, as they provide an "all-weather" capability since clouds are almost transparent at these frequencies.

Several geophysical parameters contribute, at varying levels, to natural emissions, which can be observed at a given frequency which presents unique properties. Therefore, measurements at several frequencies in the microwave spectrum must be made simultaneously in order to isolate and to retrieve each individual contribution, and to extract the parameters of interest from the given set of measurements.

As a consequence, interference that could impact a given "passive" frequency band could thus have an impact on the overall measurement of a given atmospheric component.

Each passive frequency band cannot hence be considered on its own but should be seen as a complementary component of a complete spaceborne passive sensing system. Current scientific and meteorological satellite payloads are not dedicated to one given band but include many different instruments performing measurements in the entire set of passive bands.

It should also be noted that full global data coverage is of particular importance for most weather, water and climate applications and services.

Space-borne active sensing, performed in particular by altimeters for ocean and ice studies, scatterometers or rain and cloud radars, provides meteorological and climatology activities with important information on the state of the ocean and land surfaces and atmospheric phenomena.

In addition, **meteorological radars** and **wind-profiler radars** are important surface-based instruments in the meteorological observation processes. Radar data are input to nowcasting, and to the Numerical Weather Prediction models for short-term and medium-term forecasting. There are currently about one hundred wind-profiler radars and several hundreds of meteorological radars worldwide that perform precipitation and wind measurements and play a crucial role in the immediate meteorological and hydrological alert processes. Meteorological radar networks represent the last line of defence in a disaster warning strategy against loss of life and property in flash flood or severe storm events, such as in several recent dramatic cases.

Meteorological Aids, mainly radiosondes, are the main source of atmospheric *in situ* measurements with high vertical resolution (temperature, relative humidity and wind speed) to provide real time vertical atmospheric profiles that are and will remain essential for operational meteorology, including weather analysis prediction and warnings, as well as for climate monitoring. In addition, these *in situ* measurements are essential for calibrating space-borne remote sensing, in particular passive.

Also of great importance is the availability of sufficient and well-protected **Earth exploration**

and **meteorological satellite** services frequency spectrum for **telemetry/telecommand** as well as for **satellite downlink** of the collected data.

Finally, it should be noted that the **fixed-satellite service** systems, through commercial payloads in the **C-band** ((3400-4200 MHz) and the **Ku Band** (10700-11700 MHz), are used globally to disseminate weather, water and climate related information, including disaster warnings to meteorological agencies and user communities. It has to be stressed that a large part of the population, in particular in developing countries, is heavily dependent on the use of **C-Band satellites** in areas where propagation conditions (e.g. heavy rain in tropical and equatorial zones) make the use of any other telecommunication support impractical.

The Fifteenth World Meteorological Organisation Congress (Geneva, May 2007), attended by 163 Member countries, confirmed serious concern at the continuous threat to radio frequency bands allocated for meteorological and related environmental systems and adopted the Resolution 4 (Cg-XV) – *Radio frequencies for meteorological and related environmental activities* – **(see annex)** in which all WMO Member countries are urged to make all efforts to do their utmost to ensure the availability and protection of suitable radio frequency bands required for meteorological and related environmental operations and research.

3 WMO POSITION ON WRC-12 AGENDA

Among WRC-12 agenda items, 8 items concerned frequency bands or issues of prime interest/concern for Meteorology:

- **agenda item 1.6** : Passive service between 275 and 3000 GHz **(see section 3.1)**
- **agenda item 1.8** : Fixed service between 71 and 238 GHz **(see section 3.2)**
- **agenda item 1.15** : Oceanographic radars in the frequency range 3-50 MHz **(see section 3.3)**
- **agenda item 1.16** : Lightning detection below 20 kHz **(see section 3.4)**
- **agenda item 1.22** : Effect of emissions from short-range devices (SRD) **(see section 3.5)**
- **agenda item 1.24** : Extension of the 7 750-7 850 MHz Metsat band to the band 7 850-7 900 MHz **(see section 3.6)**
- **agenda item 1.25** : Mobile Satellite Service **(see section 3.7)**
- **agenda item 8.1.1** : (issue C) Resolution 673 (WRC-07) on Radiocommunications use for Earth observation applications **(see section 3.8)**

In addition, several agenda items are currently not involving specific frequency bands used for meteorological purposes but may potentially have an impact on meteorological interests, either due to their wide open scope in terms of frequency ranges under study or in relation with a potential general interest **(see section 3.9)**.

- **agenda item 1.3** : Unmanned Aircraft Systems (UAS)
- **agenda item 1.5** : Electronic News Gathering (ENG)
- **agenda item 1.7** : Aeronautical mobile under Resolution 222 (Rev. WRC-2007)
- **agenda item 8.2** : WRC-2015 Agenda **(see section 3.8)**

3.1 Agenda item 1.6 : Passive service between 275 and 3000 GHz

This agenda item will consider a review of No. **5.565** of the Radio Regulations with a view to update the spectrum use by the passive services between 275 GHz and 3 000 GHz and in particular the Earth exploration-satellite service.

Bands within this frequency range are currently or planned to be used by a number of passive sensors flying on meteorological and environmental satellites such as PREMIER, CIWSIR, MWI, MLS, MASTER, GEM, GOMAS, CLOUDS, ODIN/SMR, SOPRANO or SMILES and correspond in particular to important water vapour and oxygen spectral lines or cloud ice and cirrus measurements.

One can also note that these bands are of interest for ground-based passive sensing (aeronomy), although not a specific radio service, focusing on terrestrial atmosphere studies from the ground and making use of different types of instruments.

WMO confirms the high interest and importance of such bands above 275 GHz for meteorology, climatology and environmental activities and supports such review and update of spectrum use by EESS or aeronomy to allow early assessment of meteorological next generation equipments.

3.2 Agenda item 1.8 : Fixed service between 71 and 238 GHz

This agenda item will mainly consider technical and regulatory issues related to the fixed service between 71 and 238 GHz, including sharing and adjacent compatibility with passive services under Resolution 731 (WRC-2000).

This frequency range covers a number of important EESS (passive) frequency bands, such as 86-92 GHz, 100-102 GHz, 114.25-122.25 GHz, 148.5-151.5 GHz, 174.8-191.8 GHz, 226-231.5 GHz and 235-238 GHz, covered or not by RR N°**5.340** and already in use by a number of instruments.

WMO supports the protection of passive frequency bands in the 71-238 GHz range and strongly urges that any technical and regulatory conditions set up for the Fixed Service should be associated with appropriate in-band or adjacent-band conditions to ensure protection of the EESS (passive).

3.3 Agenda item 1.15 : Oceanographic radars in the frequency range 3-50 MHz

This agenda item will consider possible allocations in the range 3-50 MHz to the radiolocation service for oceanographic radar applications.

The experience gained from operating experimental or pre-operational HF oceanographic radars in a number of countries around the world has provided an understanding of spectrum needs and spectrum sharing considerations, as well as an understanding and confirmation of the benefits provided by these systems through measurement of coastal sea surface conditions to support environmental, oceanographic, meteorological, climatological, maritime and disaster mitigation activities.

WMO confirms the importance of oceanographic radars for meteorology, climatology and environmental activities and supports relevant radiolocation service allocations within the 3-50 MHz band to enable the implementation and operation of such radars.

3.4 Agenda item 1.16 : Lightning detection below 20 kHz

This agenda item will consider recognition of systems in the meteorological aids service (passive) in the frequency range below 20 kHz for lightning detection applications and a corresponding service allocation.

One such system is currently deployed and operated by the UK Met Office to the benefit of meteorological organizations worldwide. This system contributes towards safety of life, both in terms of forecasting for public safety and safety of aviation operations, especially over the oceans and large areas of land where national lightning detection systems do not exist. As well as the dangers of the lightning strike itself, thunderstorms can result in intense precipitation with consequent flooding, severe icing, wind shear, turbulence and gusting winds.

This system, which does not yet provide the required global coverage, is currently operated below 20 kHz without RR allocation. This system allows for long distance (several thousands kms) strike detection but is currently experiencing interference that is impacting its quality of service. An allocation to the meteorological aids service (passive) in a given frequency band below 20 kHz would provide necessary recognition and long-term protection to this application.

WMO supports an allocation to the meteorological aids service (passive) below 20 kHz that is the only solution to ensure long-term availability of long range and global lightning detection applications of importance for a number of meteorological services and the whole meteorological community.

3.5 Agenda item 1.22 : Effect of emissions from short-range devices (SRD)

This agenda item will examine the effects of emissions from Short Range Devices (SRDs) in order to ensure that radiocommunication services are adequately protected.

Even though a particular focus is made on RFIDs, this agenda item could consider all types of SRDs, including Ultra Wide Bands (UWB) applications, and, to this respect, could hence lead to a global consideration of all frequency bands of interest for the meteorological community.

Should any provision relating to SRDs be included in the Radio Regulations, WMO urges that compatibility with and protection of meteorological applications and services be ensured.

3.6 Agenda item 1.24 : Extension of the 7 750-7 850 MHz Meteorological-satellite service allocation to the band 7 850-7 900 MHz

This agenda item will consider the extension of the existing primary allocation to the meteorological-satellite service in the band 7750-7850 MHz to the band 7850–7900 MHz, for non-geostationary meteorological satellites in the space-to-Earth direction.

The mission requirements for next generation non-GSO (Geostationary-Satellite Orbit) meteorological satellites in terms of observations, instruments and user-services clearly show a need to transmit higher data rates compared to current systems.

The required extension of the MetSat allocation into the band 7850–7900 MHz concerned the same radiocommunication services, namely the FIXED (FS) and MOBILE (except aeronautical mobile) (MS) services as in the current band 7750–7850 MHz.

Compatibility between MetSat and FS and MS was already demonstrated in the current band and it is hence more than likely that the same services can share the extended bands under similar conditions.

WMO would like to stress that similar services are allocated in the 7750-7850 MHz and 7850-7900 MHz bands hence justifying similar sharing conditions with METSAT service. WMO supports the METSAT allocation extension in the 7850-7900 MHz under similar conditions to the current 7750-7850 MHz band.

3.7 Agenda item 1.25 : Mobile Satellite Service

This agenda item considers studies of possible bands for new allocations to the mobile-satellite service in the Earth-to-space and space-to-Earth directions, with particular focus on the range 4 GHz to 16 GHz in which a number of bands are allocated and used by various meteorological applications (METSAT, radars, EESS).

Current ITU-R studies are focusing on the following frequency bands for which detailed technical compatibility or sharing analysis are yet to be made:

Frequency band	**MSS direction** (DL = downlink, UL = uplink)	**Meteorological applications concerned**
4 400-4 500 MHz	DL or UL	
4 800-4 990 MHz	UL	
5 150-5 250 MHz	DL	
7 055-7 250 MHz	DL	Passive sensing
7 750-7 900 MHz	UL	METSAT
8 400-8 500 MHz	UL	
10.5-10.6 GHz	DL, but UL might also be considered	Passive sensing (adjacent band)
13.25-13.4 GHz	DL	Active sensing
14.8-15.35 GHz	DL or UL	

WMO will involve itself in these studies but already stresses the difficulty of coexistence with MSS, in particular on the uplink. Indeed, MSS Earth stations are mobile and unlicensed by nature and as such, make the necessary separation distances with fixed stations (e.g. METSAT receiving stations) difficult to control.

Should identification or allocations for mobile satellite service be considered in bands allocated to meteorological or EESS services, WMO urges that adequate protection be ensured with related applications.

3.8 Agenda item 8.1.1 (Issue C): Resolution 673 (WRC-07) on Radiocommunications use for Earth observation applications

Last WRC-07 adopted **Resolution 673** (WRC-07) on Radiocommunications use for Earth observation applications, highlighting and recognising the importance of the essential role and global importance of Earth observation radiocommunications applications and calling on studies on possible means of improving this recognition and of increasing the knowledge and understanding of administrations regarding the utilization and benefits of these applications.

This **Resolution 673** (WRC-07) instructs the Director of the Radiocommunication Bureau to report to WRC-12 on these studies and will, to this respect, be considered under WRC-12 agenda item 8.1.1 (Issue C).

WMO would like to emphasise the importance of **Resolution 673** (WRC-07) that has already been referred to and welcomed in the Earth Observation Summit Ministerial declaration (Cape Town, Nov 07).

To this respect, it is worth emphasising the intergovernmental Group on Earth Observations (GEO) worldwide effort over the next 10 years to build a *Global Earth Observation System of Systems* (GEOSS) that will work with and build upon existing national, regional, and international systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide, transforming the data they collect into vital information for society.

Indeed, the GEOSS will, to a large extent, rely on radio frequencies to yield a broad range of societal benefits, including:

- Reducing loss of life and property from natural and human-induced **disasters**.
- Understanding environmental factors affecting human **health** and well-being.
- Improving management of **energy** resources.
- Understanding, assessing, predicting, mitigating, and adapting to **climate** variability and change.
- Improving **water** resource management through better understanding of the water cycle.
- Improving **weather** information, forecasting and warning.
- Improving the management and protection of terrestrial, coastal and marine **ecosystems**.
- Supporting sustainable **agriculture** and combating desertification.
- Understanding, monitoring and conserving **biodiversity**.

WMO stresses the recognised importance of Resolution 673 (WRC-07) in relation to Earth observation activities and the need to secure it as a long-term ITU Resolution.

WMO supports on-going ITU-R studies toward an ITU-R Report on "*The essential role and global importance of radio spectrum use for Earth observations and for related applications*". Also, WMO encourages the use of such study results to identify frequency bands for use in Earth observation activities, which could require consideration at future WRCs.

3.9 Other agenda items

Agenda item 1.3 : Unmanned Aircraft Systems (UAS)
Although no specific frequency bands are mentioned, this agenda item will probably consider spectrum in the range between 2 and 10 GHz in which a number of bands are allocated and used by various meteorological applications.

WMO notes that UAS applications are currently not considered in frequency bands used for meteorological applications.

WMO recognises that UAS have already been operated in the past by some meteorological services and that such vehicles are of interest for future climatological, meteorological and environmental activities, either for research or operational use. It is assumed that these UAS requirements would fit in the current general requirements made for other purposes.

WMO supports this agenda item. However, should identification or allocations for Unmanned Aircraft Systems (UAS) be considered in bands allocated to meteorological services, WMO urges that compatibility with related applications be assessed and adequate protection be ensured.

Agenda item 1.5 : Electronic News Gathering (ENG)
Some frequency bands used or under consideration for ENG are also allocated to meteorological services (e.g. 2700 – 2900 MHz and 10.6 – 10.68 GHz) in which concentration of rather powerful ENG operations could adversely impact corresponding meteorological applications.

Should identification or allocations for Electronic News Gathering (ENG) be considered in bands allocated to meteorological services, WMO urges that compatibility with related applications be assessed and adequate protection be ensured.

Agenda item 1.7 : Aeronautical mobile under Resolution 222 (Rev. WRC-2007)
Although no specific frequency bands are mentioned, this agenda item will probably consider spectrum above 1.6 GHz in which a number of bands are allocated and used by various meteorological applications (METSAT, radars, EESS).

Should identification or allocations for Aeronautical mobile service be considered in bands allocated to meteorological services, WMO urges that compatibility with related applications be assessed and adequate protection be ensured.

Agenda item 8.2 : WRC-2015 agenda item

There are no proposals at this stage.

4 CONCLUSION

Radio-frequencies represent scarce and key resources used for measurement, collection and dissemination of information, for provision of meteorological services to the global community. All these frequency applications are inter-related and help to comprise a global meteorological system.

WMO hence stresses the fact that a lack of any radio component of this system, whether associated with measurement, collection or dissemination, is able to put at risk the whole meteorological process and, as expressed in the attached WMO Resolution 4 (Cg-XV), **appeals to the International Telecommunication Union and its Member Administrations:**

(1) To ensure the availability and absolute protection of the radio-frequency bands which, due to their special physical characteristics, are a unique natural resource for spaceborne passive sensing of the atmosphere and the Earth surface; In this regard, the exclusive 23.6 - 24 GHz passive band that is associated with a water vapour absorption line is of crucial importance for weather, water and climate research and operations;

(2) To give due consideration to the WMO requirements for radio frequency allocations and regulatory provisions for meteorological and related environmental operations and research;

It is emphasized that observing systems using these frequencies have a crucial role in detecting, warning and forecasting weather, water and climate related disasters. Since these disasters represent more than 90% of natural disasters, these systems are essential components of all-hazards emergency and disasters early-warning and mitigation systems promoted in particular by Resolution 136 (Antalya, 2006) of the Plenipotentiary Conference under its *resolves* 1 and 2.

WMO would also like to stress the importance of radio-frequencies for all Earth Observation activities, in particular with regard to global warming and climate change related activities, coordinated within the GEO group and, in this respect, highlight the declaration of the Cape Town Ministerial Summit on “Earth Observations for sustainable growth and development” (30 Nov 2007) that specifically addresses radio-frequency issues in stating:

“We welcome the resolution of the World Radio Conference-07 on radiocommunication use for Earth observation applications and the support it provides for the international protection and long-term availability of frequencies for terrestrial, oceanic, air-borne and space-based observations, including passive measurement”
