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ACTIVITIES AND OUTCOMES OF OTHER WMO TEAMS AND PROGRAMMES RELEVANT TO ET-SBO

Spectrum Management and the Work of CBS SG-RFC

(*Submitted by the Secretariat)*

SUMMARY AND PURPOSE OF DOCUMENT

To provide the session with background on the WMO and CBS approach to meteorological radio-frequency spectrum management issues and input to the international activities and bodies associated with world radio-communications.

ACTION PROPOSED

The Session in invited to note and discuss the information contained in the document.

SPECTRUM MANGEMENT AND THE WORK OF CBS SG-RFC

1. Background

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. National Meteorological and Hydrological Services (NMHS) 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 organizations, commercial interests and the general public.

Nowadays radio-based remote sensors (active and passive) are the main tools for environment and climate monitoring, disaster prediction, detection and mitigating negative effects of disasters. These sensors obtain environmental data by measuring level and parameters of natural and artificial radio waves that inherently contain information about the environment with which they have been in contact. Terrestrial and space-born remote sensing applications form the backbone of the WMO Integrated Global Observing System.

WMO information systems also make extensive use of radiocommunication systems and radio-frequency spectrum, and although they are more and more relying on commercially provided services such as communication satellites, meteorological related radiocommunication systems still form a core part of WMO's critical data collection and distribution systems (e.g. Earth-to-space and space-to-Earth transmissions). WMO Members in remote or isolated areas are most dependent on these special services and will benefit most from many of the new initiatives such as wireless broadband that are putting new stress on the demand for spectrum bandwidth.

The development of new, mass-market and added-value radio applications is putting increasing pressure on the frequency bands used for meteorological purposes. This presents the potential risk of limiting meteorological and other related applications in future.

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..

2. WIGOS

The WMO Integrated Global Observing System (WIGOS) comprises components which make use of a wide number of different radio applications and services, some of which may be affected by decisions on international Radio Regulations (RR).

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 is tending to be more and more critical with the increased density of terrestrial active devices and serious cases of interference already being reported.

In the more critical passive sensing frequency bands, Radio Regulation No. **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, scatterometers, rain and cloud radars, provides meteorological and climatology activities with important information on the state of the ocean, ice 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 systems, 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** radio-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** (3 400-4 200 MHz) and the **Ku Band** (10 700-11 700 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 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 Resolution 4 (Cg-XV) – *Radio frequencies for meteorological and related environmental activities* – 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.

The Sixteen World Meteorological Congress (Geneva, May 2011) "…agreed that the protection of frequencies used for meteorological purposes is of direct and vital interest to the international meteorological community and reiterated its full support for radio-frequency activities. It urged the pursuance of, in an organized manner, the continuous review of regulatory and technical matters related to radio-frequencies for operational and research meteorological and related environmental activities."

The WMO Integrated Global Observing System (WIGOS) comprises components which make use of a wide number of different radio applications and services, some of which may be affected by WRC-15 decisions. The dependency of observing systems on radio-frequency management has long term ramifications on the sustainability and usability of essential climate variables and other weather, water and climate related observations that contribute to the Observations and Monitoring pillar of the Global Framework for Climate Services (GFCS) as identified at the Sixteenth World Meteorological Congress in 2011, and the Extraordinary World Meteorological Congress in 2012.

3. Steering Group on Radio-Frequency Coordination (SG-RFC)

Management of radio-frequency spectrum is a national responsibility, but depending on wavelength, radio waves are not restricted to local environment and can propagate huge distances interfering with other spectrum users. Thus there is a need for an international framework for Radio Regulations and a forum for reaching and maintaining agreements on such regulations. The management of the radio-frequency spectrum on an international level is one of the main tasks of the International Telecommunication Union (ITU) (www.itu.int). The ITU at its World Radiocommunication Conferences (WRCs) (www.itu.int/ITU-R/go/wrc) establishes and maintains international treaties - Radio Regulations (RR) (www.itu.int/pub/R-REG-RR/en) related to allocation, coordination and use of the radio-frequency spectrum in the effective way to ensure maximum use of this limited resource.

Taking into consideration the identified risk management elements and the limited WMO financial resources, WMO's strategy[1] to address this important activity is divided into four areas:

1. Participation of WMO experts through and coordinated by the CBS SG-RFC in ITU processes related to the modification of the Radio Regulations. In particular, provision of the results of analyses and contributions to the ITU Radiocommunication Sector (ITU-R) (www.itu.int/ITU-R), its Study Groups (www.itu.int/ITU-R/go/rsg) and their Working Parties on the matters to be considered by the next and the following WRCs and in preparation activities;

2. SG-RFC in coordination with the Open Programme Area Group on Integrated Observing System (OPAG-IOS) leading the monitoring of emerging and critical issues affecting the needs of radio-frequency spectrum for WMO observing systems, taking necessary action including submission of documents to national and international regulatory processes;

3. Continuation of building the capacity of National Meteorological and Hydrological Services (NMHSs) to be able to effectively participate in national radio-frequency coordination issues, including representing national meteorological and related needs in regional and global radio-frequency coordination processes;

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1 "DRAFT WMO STRATEGY ON RADIO-FREQUENCY PROTECTION FOR METEOROLOGY" Information Documents EC-65-inf04-4(2)-Draft-Strategy-RFP_en.docavailable at http://ec-65.wmo.int/information-papers-e-f

4. Coordination and collaboration with other international, regional, non-government and commercial organizations involved in the Earth observations and environmental services to forward requirements and issues for a common benefit to all.

It is essential that all these areas be addressed continuously and to understand that radio-frequency coordination will be a never ending task as new issues arise or old issues re-emerge. The building of the capacity of WMO Members to understand and participate in these processes is an essential long term element of this strategy, as is the building of partnerships with likeminded organizations.[2]

Suggested actions for ET-SBO

The SG-RFC works within the ITU structure representing WMO community so it is important for Observing Systems operators to make sure they liaise closely with SG-RFC advising of changes to their needs on radio spectrum. SG-RFC has very well established interaction with space-based observations, and some surface remote sensing such as weather and ocean radars, radio sondes, lightning and so on, however, the overall surface based observation systems coordination is a long way short of that for space operations. For instance, there is little understanding about the spectrum needs of Global Atmosphere Watch.

Resolution 9 (EC-65) relates to the ITU World Radiocommunication Conference 2015 (WRC-15) to be held in November 2015 and emphasizes the importance of participation of the WMO community in the ITU WRC process. There are 18 agenda items identified in document EC-65-inf04-4(1)-RFC_en.doc which is the WMO Preliminary Position Paper on WRC-15 Agenda[3]. There are 18 agenda items identified in the preliminary position paper. ET-SBO is encouraged to review the WMO Preliminary Position Paper and future updates and to provide feedback to the SG-RFC on surface based systems components.

2 Many aspects related to the use of radio-frequency spectrum and radio-frequency coordination activities are described in the Handbook "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction" develop by the ITU (ITU-R Study Group 7) and WMO (SG-RFC). This handbook is available free-of- charge in 6 languages at: www.itu.int/ITU-R/go/R-HDB-45-2008.

3 WMO PRELIMINARY POSITION ON WRC-15 AGENDA" Information Documents EC-65-inf04-4(1)-RFC_en.doc available at http://ec-65.wmo.int/information-papers-e-f