ASIA-PACIFIC TELECOMMUNITY
The 6th Meeting of the APT Conference Preparatory Group for WRC-23 (APG23-6)
14 – 19 August 2023, Brisbane, Australia

Document No:
APG23-6/INF-xx
xx August 2023

World Meteorological Organization (WMO)

FINAL WMO POSITION ON WRC-23 AGENDA

The Report of the International Telecommunication Union of the Radio-communications sector (ITU-R) RS.2178, referred to in Resolution ITU-R **673** on "The importance of Earth observation radiocommunication applications", concluded that:

"Most of this societal value is incommensurable in financial terms, as it relates to preventing large losses of lives or threats to socio-political stability and security. Scientific use of spectrum has also a direct impact in many economic areas, which can be estimated, by producing spin-offs in technology and economic developments in energy, transportation, agriculture, communications, etc."

The enclosed document reflects the final WMO position on the agenda of the World Radiocommunication Conference 2023 (WRC-23) as given in Resolution **811 (WRC-19)** "Agenda for the 2023 World Radiocommunication Conference".

APG23-6 is invited to take into consideration the final WMO position elaborated in April 2023 when reviewing the WRC-23 Agenda.

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Enclosure:

Final WMO Position for the ITU WRC-23

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Final WMO Position on
the World Radiocommunication Conference 2023 (WRC-23) Agenda

1. Introduction

World Meteorological Organization (WMO) Members through their National Meteorological and Hydrological Services (NMHSs) and supporting agencies, including operators of space-based observing systems, make available a wide range of essential services to observe weather, water, climate and related environmental events.

The information gathered through these observations is vital for the global community and contributes to ensuring safety of life and property and in the longer term to implementing the global development agendas, such as the 2030 Agenda for Sustainable Development, the Paris Climate Agreement, and the Sendai Framework for Disaster Risk Reduction[1] and the Early Warnings for All initiative[2].

The observing networks provided by WMO Members form the backbone of the WMO Integrated Global Observing System (WIGOS) and are critically dependent on the use of radiofrequencies for the sensing and dissemination of data and information.

In this context, Resolution **673** of the International Telecommunication Union (ITU) World Radiocommunications Conference (Geneva, 2012)[3] observes that:

- Earth observation data are essential for monitoring and predicting climate change, for disaster prediction, monitoring and mitigation, for increasing the understanding, modelling and verification of all aspects of climate change, and for related policymaking;
- Many observations are performed over the entire world which require spectrum-related issues to be considered on a worldwide basis;
- Earth observations are performed for the benefit of the whole international community and the data are generally made available at no cost;

and resolves to:

- Continue to recognize that the use of spectrum by Earth observation applications has a considerable societal and economic value;
- Urge administrations to take into account Earth observation radio-frequency requirements and in particular protection of the Earth observation systems in the related frequency bands;
- Encourage administrations to consider the importance of the use and availability of spectrum for Earth observation applications prior to taking decisions that would negatively impact the operation of these applications.

The development of new, mass-market and value-added radio applications is putting increasing pressure on the frequency bands used for meteorological purposes.

This presents potential risks of limiting meteorological and other related applications, but also opportunities for enhancing observations.

[1] See: What we do | World Meteorological Organization (wmo.int)
[2] See: Executive Action Plan 2023-2027 (The UN Global Early Warning Initiative for the Implementation of Climate Adaptation): EARLY WARNINGS FOR ALL: Executive Action Plan 2023... | E-Library (wmo.int)
[3] World Radiocommunication Conference Resolutions are contained in Volume 3 of the in-force version of the Radio Regulations. The Radio Regulations can be obtained at: Radio Regulations 2020 - ITU Hub

WMO remains committed to working with ITU towards optimizing the use of the radio-frequency spectrum for the benefit of the global community.

This document reflects the final WMO position on the agenda of the World Radiocommunication Conference 2023 (WRC-23)[4].

Additionally, the two annexes of this document contain WMO concerns on the issue of:

- ITU-R Resolution **731** currently addressed in ITU-R as a follow-up of WRC-19;
- The potential impact regarding one WRC-23 agenda item on crucial satellite observations made in the 6 425-7 075 MHz and 7 075-7 250 MHz frequency bands.

2. General comments

WIGOS comprises components that make use of a wide number of different radio applications and services, some of which may be affected by WRC-23 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, water and climate-related disasters, and in the scientific understanding, monitoring and prediction of climate change and its impacts.

The impressive progress made in recent years in weather, water 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 space-borne observations and their assimilation in numerical weather and environmental prediction models.

2.1 Space-based Observations

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 radiation, usually of very low power levels, which contains 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 radiation.

For passive sensing bands shared with active services, the situation is becoming increasingly critical with an increased density of terrestrial active devices and serious cases of interference already being reported.

In the more critical passive sensing frequency bands, RR **No 5.340**[5] stating that "all emissions are prohibited" enables in principle passive services to deploy and operate their systems with the highest reliability. However, in some cases this protection appears to be insufficient due to unregulated and potentially mass-market short-range devices allowed nationally to operate in these bands or unwanted emissions from adjacent bands not properly regulated. Several geophysical parameters contribute, at varying levels, to natural emissions, which can be observed at a given frequency and presents unique properties. Therefore, measurements at several frequencies in the microwave spectrum must be made simultaneously in order to isolate and

[4] ITU-R Resolution **811 (WRC-19)** "Agenda for the 2023 World Radiocommunication Conference"
[5] Radio Regulations footnotes are found in Volume 1 of the Radio Regulations. The Radio Regulations can be obtained at: https://www.itu.int/hub/publication/r-reg-rr-2020/.

retrieve each individual contribution and to extract the parameters of interest from the given set of measurements.

Consequently, affecting a given "passive" frequency band by interference can cause disturbances in the overall measurement of a given environmental variable.

Each passive frequency band cannot hence be considered on its own but should be seen as a complementary component of a complete space-borne 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 by altimeters, rain and cloud radars, scatterometers and Synthetic Aperture Radars[6] provides meteorological and climatology activities with important information on the state of the ocean, ice and land surfaces and atmospheric phenomena.

Also, of great importance is the availability of sufficient and well-protected Earth exploration and meteorological-satellite services radio-frequency spectrum for telemetry/telecommand (2 200-2 290 MHz and 2 025-2 110 MHz) as well as for satellite downlink of the collected data (1 675-1 710 MHz, 7 450-7 550 MHz, 7 750-7 900 MHz, 8 025-8 400 MHz and 25.5-27 GHz).

2.2 Surface-based and in-situ Observations

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 and environmental 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 wind and precipitation measurements. These systems 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 sensors.

The Eighteenth World Meteorological Congress (Geneva, June 2019), attended by 193 Member countries, confirmed serious concern at the continuous threat to radio-frequency bands allocated for meteorological and related environmental systems and adopted the Resolution 42 (Cg-18)[7] – 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.

[6] Synthetic Aperture Radars (SAR) provide complementary information, which is useful for flood disaster management and many other applications.
[7] See WMO Resolution 42 (Cg-18): World Meteorological Congress: Abridged Final Report of the Eighteenth Session (wmo.int)

2.3 WMO Actions

The Eighteenth World Meteorological Congress (Geneva, June 2019) "…stresses that some radio-frequency bands are a unique natural resource due to their special characteristics and natural radiation enabling space-borne passive sensing of the atmosphere and the Earth's surface, which deserve adequate allocation to the Earth exploration satellite service (passive) and absolute protection from interference", and "…expresses its serious concern at the continuing threat to several radio-frequency bands allocated to the meteorological aids, meteorological-satellite, Earth exploration satellite and radiolocation (weather and wind profiler radars) services posed by the development of other radiocommunication services."

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 Eighteenth World Meteorological Congress (Geneva, June 2019).

3. WMO preliminary position on WRC-23 Agenda Items

Among WRC-23 agenda items, 21 items or topics are related to frequency bands or issues of prime interest or concern for meteorology and related fields:

Agenda item 1.2: Identification of bands, including possible mobile service allocations, for International Mobile Telecommunications (IMT)

Agenda item 1.3: Primary allocation of the band 3 600-3 800 MHz to the mobile service within Region 1[8]

Agenda item 1.4: High-altitude platform stations as IMT base stations (HIBS) in frequency bands below 2.7 GHz

Agenda item 1.5: Possible regulatory actions in the frequency band 470-694 MHz in Region 1

Agenda item 1.6: Regulatory provisions to facilitate radiocommunications for sub-orbital vehicles

Agenda item 1.7: New AMS(R)S allocation in the 117.975-137 MHz

Agenda item 1.10: Possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications in 15.4-15.7 GHz and 22-22.21 GHz

Agenda item 1.12: Possible new secondary allocation to the Earth exploration-satellite service (active) around 45 MHz

Agenda item 1.13: Upgrade of the space research service allocation to primary in the frequency band 14.8-15.35 GHz

Agenda item 1.14: Possible adjustments of the existing or possible new allocation to the EESS (passive) in 231.5-252 GHz

Agenda item 1.15: Harmonization of the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by Earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally

Agenda item 1.16: Use of the frequency bands 17.7-18.6 GHz (s-E), 18.8-19.3 GHz (s-E), 19.7-20.2 GHz (s-E), 27.5-29.1 GHz (E-s) and 29.5-30 GHz (E-s) by earth stations in motion (ESIMs)

Agenda item 1.17: Regulatory actions for the provision of intersatellite links in specific

[8] It has to be noted that any reference to Regions in this document refers to ITU-R regions outlined in Article **5.2** of the Radio Regulations, Volume 1.

frequency bands

Agenda item 1.18: Potential new allocations to the MSS in the frequency bands 1 695-1 710 MHz, 2 010-2 025 MHz, 3 300-3 315 MHz and 3 385-3 400 MHz for future narrow-band MSS systems

Agenda item 4: ITU-R Resolution 731

Agenda item 7: Satellite regulatory procedures

Agenda item 9.1a): Appropriate recognition and protection in the Radio Regulations for space weather sensors, without placing additional constraints on incumbent services

Agenda item 9.1c): Study use of IMT for fixed wireless access in bands allocated to the fixed Service

Agenda item 9.1d): Protection of EESS (passive) in the frequency band 36-37 GHz from non-GSO FSS space stations

Agenda item 9 on Article 21: Applicability of Article 21.5 for IMT base stations that use an antenna that consists of an array of active elements and notification of such systems

Agenda item 10: Preliminary agenda for WRC-27

The Conference Preparatory Meeting (CPM) Report to WRC-23 can be found at: CPM Report.

3.1 Agenda item 1.2

"to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425 -7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution ***245 (WRC 19)****"*

Footnote RR **No 5.458** indicates that administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the bands 6 425-7 075 MHz and 7 075-7 250 MHz as passive microwave sensor measurements are carried out in these frequency bands. EESS (passive) measurements in or near 6 425-7 250 MHz corresponds to the peak sensitivity to sea-surface temperature (SST). Thus, the use of any portion of the 6 425-7 125 MHz band by International Mobile Telecommunications (IMT) could have an impact on current and planned SST measurements especially in coastal areas. The WMO OSCAR/Space database[9] lists some existing and planned satellite missions that include the operation of a passive sensor in these bands. Annex 2 of this document shows potential impact on these sensor measurements and provides possible way forward. This usage is noted in section 1/1.2/3.2.3 of the CPM Report, which is in alignment with WMO interests. Methods 4E and 5E in the CPM Report include a delay to the use of these bands by IMT, which could allow time for EESS (passive) users to identify complementary frequency band(s) for SST measurements in addition to the currently used 6 425–7 125 MHz band.

Similarly, the WMO OSCAR/Space database lists numerous existing and planned satellite missions that include the operation of a passive sensor in the 10.6-10.7 GHz frequency range, noting that the 10.68-10.7 GHz is a footnote RR **No 5.340** band. WMO recognizes that a 100 MHz guard-band exists between the EESS (passive) frequency band and the 10.0-10.5 GHz frequency band proposed for IMT but stresses the fact that IMT studies in other frequency bands have shown that guard-bands alone do not necessarily ensure protection of the EESS (passive). The sharing studies summarized in the CPM Report indicate that an unwanted Total Radiated Power (TRP)

[9] See http://oscar.wmo.int/space.

limit ranging from −36.3 dBW to −54.9 dBW per 100 MHz would be required to mitigate the risk of interference between these services.

Methods 6B and 6C of the CPM Report propose out-of-band emission limits of -43 dBW for IMT base stations (BS) and -41 dBW for user equipment (UE) in the 10.6-10.7 GHz EESS (passive) band. These limits are proposed to be implemented in a WRC Resolution incorporated by reference in a footnote in the Radio Regulations.

In addition, WRC-15 allocated 400 MHz to EESS (active) between 10 and 10.4 GHz, which increased up to 1 200 MHz (9.2-10.4 GHz) the bandwidth available to the EESS (active) to enable higher resolution imaging, improving the performance of satellite observation used in particular for flood and climate change monitoring. The potential identification of the 10.0-10.5 GHz band for IMT could then result in a reduction of this improved monitoring capacity due to interference to EESS (active) at 10-10.4 GHz. Based on results of sharing studies summarized in the CPM Report, there is a high risk of interference into EESS (active) operations in the frequency band 10–10.4 GHz from Region 2 IMT-2020 deployments and therefore sharing is not feasible without mitigation techniques whose efficiency to protect EESS (active) need to be demonstrated.

WMO Position on WRC-23 agenda item 1.2

WMO is not in favour of an IMT identification in the 6 425–7 025 MHz or 7 025–7 125 MHz frequency bands. However, if an identification to IMT is made in the 6 425–7 025 MHz and/or 7 025–7 125 MHz frequency bands, WMO would like to highlight that:

- Sea surface temperature (SST) measurements performed in these frequency bands are of prime importance for weather forecasting and climate monitoring. WMO understands that footnote RR **No 5.458** does not provide an EESS (passive) allocation in the 6425–7075 MHz and 7075–7250 MHz frequency bands and thus no regulatory protection for SST measurement is granted in these frequency bands,

- Due to their importance, WMO encourages Administrations to elaborate solutions in order to ensure the continuation of SST measurements. Methods 4E and 5E in the CPM Report propose a delay in the use of the 6425–7075 MHz and 7075–7250 MHz frequency bands by IMT to enable the migration of some other services, including EESS (passive),

- taking into account studies performed in WP 7C, WRC-23 could consider the possibility of new primary EESS (passive) allocations in the 4–10 GHz frequency range (4.2-4.4 GHz and 8.4-8.5 GHz bands) in which SST measurements can also be performed (see Annex 2).

WMO opposes IMT identification in 10.0-10.5 GHz. However, if an identification to IMT is made in the 10.0 – 10.5 GHz frequency band in Region 2, WMO would require:

- The application of appropriate regulatory provisions in the 10.6–10.7 GHz frequency band, with necessary limits to protect EESS (passive) operations from unwanted emissions from IMT operating within the 10.0–10.5 GHz band. WMO believes that the limits proposed in the CPM Report under Methods 6B/6C (-43 and -41 dBW/100 MHz for BS and UE, respectively) would provide adequate protection,

- The application of appropriate regulatory provisions to protect EESS (active) operations within the 10.0–10.4 GHz band,

- That the effectiveness of the mitigation techniques (e.g. suppression side lobes) to ensure the protection of EESS (active) and EESS (passive) is proven and the appropriately implemented in the RR.

3.2 Agenda item 1.3

*"to consider primary allocation of the band 3 600-3 800 MHz to mobile service within Region 1 and take appropriate regulatory actions, in accordance with Resolution **246 (WRC-19)**"*

Since an IMT identification in the 3 600-3 800 MHz could lead to a shift of current FSS usage in the band above 3 800 MHz, the possible impact on the FSS (space-to-Earth) above 3 800 MHz could be a concern as the distribution of meteorological data is facilitated by the use of commercial communication satellites in the framework of GEONETCast, which is a global network of sustained and cost-effective satellite-based dissemination systems using commercial satellites with more than 6000 user stations in 169 countries.

WMO Position on WRC-23 agenda item 1.3

Since an IMT identification in the 3 600-3 800 MHz could lead to a shift of current FSS usage in the band above 3 800 MHz, WMO is concerned regarding the possible impact on future usage of the existing FSS (space-to-Earth) allocation in the frequency band 3.8-4.2 GHz used for the distribution of meteorological data in the framework of the GEONETCast network.

3.3 Agenda item 1.4

*"to consider, in accordance with Resolution **247 (WRC 19)**, the use of high-altitude platform stations as IMT base stations (HIBS) in the mobile service in certain frequency bands below 2.7 GHz already identified for IMT, on a global or regional level"*

Operational experience of at least one WMO Member shows that ground-based broadband wireless base stations operating below 2690 MHz can cause interference to meteorological radars operating above 2 700 MHz. The interference is due to unwanted emissions falling into the radar frequency band and not due to the radar receiver selectivity extending into the frequency band of the broadband wireless base stations. Interference mitigation can only be achieved through reducing the broadband wireless base station out-of-band emissions. Report ITU-R M.2316[10] provides additional details. This WRC-23 agenda item considers the operation of broadband wireless base stations on airborne platforms, which will place a potential source of unwanted emissions in and near the radar antenna main beam, increasing the antenna gain in the interference path by as much as 35 dB relative to the above-mentioned real interference cases. In order to show a representative impact on meteorological radar operations, studies need to take into account the spatial distribution of the interference cases.

Previous studies carried out in Europe (ECC Report 309) conclude that interference can occur in the meteorological-satellite service (MetSat) allocation in the adjacent band (1 675-1 710 MHz) if the band 1 710-1 855 MHz, already identified for IMT, is used in the downlink direction from an airborne platform. The 1 675-1 710 MHz frequency band is globally used by geostationary and non-geostationary MetSat systems for the downlink of the measured data as well as the global dissemination of the data directly to the users.

For a number of different applications, the use of the MetSat L-Band 1 675-1 710 MHz is an indispensable component in existing and currently developed GSO and non-GSO MetSat satellite systems/networks as well as in future constellations of small MetSat satellites. Therefore, it is important to preserve the long-term availability and protection of the band 1 675-1 710 MHz for MetSat use.

Finally, as the EESS/MetSat satellite systems are using the band 2 025-2 110 MHz for telecommanding and uplinking instrument data, WMO is concerned with the protection of the allocations of the EESS/Space Operation Service (SOS) in the 2 025-2 110 MHz band. WMO acknowledges that IMT equipment are already authorized to operate in the 2 110-2 170 MHz band (downlink direction).

[10] https://www.itu.int/pub/R-REP-M.2316

WMO Position on WRC-23 agenda item 1.4

WMO is not opposed to a HIBS identification if the following provisions are implemented in the Radio Regulations:

- In order not to change the interference environment for the MetSat systems in the 1 675-1 710 MHz band, HIBS operations in the 1 710-1 785 MHz band would have to be limited to the uplink direction (HIBS receiving from IMT UE). This necessary limitation is expressed in Methods B2, B3 and B4 of the CPM Report,
- In order not to change the interference environment for EESS and SOS in the 2 025-2 110 MHz band, HIBS operations in the 2 110-2 170 MHz band would have to be limited to the downlink direction (HIBS transmitting to ground-based UE). This necessary limitation is expressed in Methods C2 and C3 of the CPM Report,
- Application of appropriate regulatory provisions for HIBS operations in the 2 500-2 690 MHz band, with necessary limits in the 2 700-2 900 MHz band, to ensure protection of meteorological radar measurements. The development of these limits would have to take into account the spatial nature of meteorological radar measurements and their sensitive Minimum Detectable Signal (MDS) requiring that every scan direction (elevation and azimuth) be adequately protected. Such protection can be achieved by implementing the power flux-density (pfd) mask included in Methods D2, D3 and D4 of the CPM Report.

3.4 Agenda item 1.5

*"to review the spectrum use and spectrum needs of existing services in the frequency band 470-960 MHz in Region 1 and consider possible regulatory actions in the frequency band 470-694 MHz in Region 1 on the basis of the review in accordance with Resolution **235 (WRC 15)**"*

In some countries, the frequency band 470-494 MHz is allocated to the radiolocation service on a secondary basis, with a limited use to the operation of wind profiler radars in accordance with article footnote RR **No 5.291A**. Protection of this service is covered in Method A, Alternative A2 and Method F Alternative F1 of the CPM Report.

It has to be noted that wind profiler radars are deployed and operational in this frequency band.

WMO Position on WRC-23 agenda item 1.5

WMO would appreciate the development of a solution to ensure the effective operation of the wind profiler radars in the 470-494 MHz frequency band in accordance with RR **No 5.291A**.

3.5 Agenda item 1.6

*"to consider, in accordance with Resolution **772 (WRC 19)**, regulatory provisions to facilitate radiocommunications for sub-orbital vehicles"*

This agenda item addresses regulatory provisions to facilitate operation of sub-orbital vehicles that operate in both the aeronautical and space domains, with communications requirements spanning both aviation and satellite operations. While this agenda item does not permit changes to Article **5** of the Radio Regulations (no changes to frequency allocations), other regulatory changes permitted under this agenda item could affect regulatory provisions that are applicable to the meteorological-satellite (MetSat) service and EESS, and could increase congestion in the corresponding frequency bands.

It should be noted that sub-orbital vehicle technology may have the potential to support missions of interest to WMO in the future. The WMO would support a cautious approach to any changes which may have a negative impact on current and/or future MetSat and EESS operations as these form a vital component of the global weather and climate observing system.

WMO Position on WRC-23 agenda item 1.6

WMO supports the development of regulatory provisions to facilitate sub-orbital vehicle operations but would be opposed to provisions that have a negative impact to current and/or future MetSat, EESS and SOS operations.

The Approaches in Method B of the CPM Report include provisions to prevent sub-orbital vehicles from causing any more interference than other systems operating in the services under consideration. In particular, Approaches A and B of Method B align with WMO objectives.

Method A and Method C fail to adequately address the issue of regulatory provisions to support the operation of sub-orbital vehicles.

3.6 Agenda item 1.7

*"to consider a new aeronautical mobile-satellite (R) service allocation in accordance with Resolution **428 (WRC-19)** for both the Earth-to-space and space-to-Earth directions of aeronautical VHF communications in all or part of the frequency band 117.975-137 MHz, while preventing any undue constraints on existing VHF systems operating in the aeronautical mobile (R) service, in the aeronautical radionavigation service, and in adjacent frequency bands"*

This agenda item considers new primary aeronautical mobile-satellite (R) service (AMS(R)S) allocation in the frequency band 117.975-137 MHz adjacent to the 137-138 MHz frequency band in particular allocated to the space operations service (SOS) (space-to-Earth), the space research service (SRS) (space-to-Earth), and the MetSat (space-to-Earth). Compatibility studies were conducted and are referenced in preliminary draft new Report ITU-R M. [SPACE-VHF].

This new primary AMS(R)S allocation is planned to be in both directions (Earth-to-space and space-to-Earth). However, transmitting earth stations in the AMS(R)S (Earth-to-space) would correspond to the AM(R)S aircraft station that is already in place. Therefore, compatibility studies should only be considered with respect to:

- the transmitting space stations in the AMS(R)S (space-to-Earth), operating in the frequency band 117.975-137 MHz into the receiving earth stations of adjacent band services;
- the transmitting space stations of adjacent band services into the receiving space stations in the AMS(R)S in the frequency band 117.975-137 MHz.

WMO interest is to ensure that this proposed new primary allocation will not provide additional constraints to the incumbent service allocations in the upper adjacent frequency band (137-138 MHz) due to the safety aspect and protection criteria associated with the AMS(R)S.

In the CPM Report, protection of the space operations service (SOS) (space-to-Earth), the space research service (SRS) (space-to-Earth), and the MetSat (space-to-Earth) in the 137-138 MHz frequency band is provided through two options: a pfd mask level at the Earth's surface and a guard band of 200 kHz between 136.8 MHz and 137 MHz.

It has to be noted that only a pfd mask will ensure the protection of services in the above adjacent frequency band from out-of-band emission of the possible new primary AMS(R)S allocation in the 117.975-137 MHz but not to ensure that no additional constraints could be applied to adjacent services from this new primary allocation. The option proposing a guard band will firstly ensure that AMS(R)S protection will not constrain planned usage of satellite systems operating in adjacent band 137-138 MHz in the SOS (space-to-Earth), SRS (space-to-Earth) and MetSat (space-to-Earth), as well as the protection of these adjacent band services operating above 137 MHz from AMS(R)S stations unwanted emissions.

WMO Position on WRC-23 agenda item 1.7

WMO is not opposed to a new primary AMS(R)S allocation in the 117.975-137 MHz if the following provisions are implemented in the Radio Regulations:

- the protection of SOS (space-to-Earth), SRS (space-to-Earth) and MetSat (space-to-Earth) operated in the adjacent 137-138 MHz frequency band is ensured from unwanted emissions of this new AMS(R)S
- no additional constraint is made to the SOS (space-to-Earth), SRS (space-to-Earth) and MetSat (space-to-Earth) services to ensure the protection of this new AMS(R)S allocation.

Method B3 of the CPM Report is in line with the above WMO requests.

3.7 Agenda item 1.10

*"to conduct studies on spectrum needs, coexistence with radiocommunication services and regulatory measures for possible new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, in accordance with Resolution **430 (WRC-19)**;"*

This agenda item considers allocation changes to allow non-safety aeronautical mobile operations for air-to-air, air-to-ground and ground-to-air communications. The frequency band 15.4-15.7 GHz is under consideration for a new aeronautical mobile allocation whereas removal of the "except aeronautical mobile" restriction is being considered for the 22-22.21 GHz frequency band.

It has also to be noted that the 15.4-15.7 GHz frequency band is adjacent to the band 15.35-15.4 GHz (to which footnote RR **No 5.340** applies), however, there is no documented use of the frequency band by the EESS (passive).

The 22–22.21 GHz frequency band under consideration is adjacent to the 22.21–22.5 GHz frequency band allocated to the EESS (passive). Methods C, D and E in the CPM Report each provide the same two options for the protection of the EESS (passive). Option 1 proposes an out-of-band expected equivalent isotropically radiated power (e.i.r.p.) limit of −18 dBW in any 100 MHz bandwidth in the frequency band 22.21-22.5 GHz. Option 2 proposes a more suitable out-of-band e.i.r.p. limit of −23 dBW in any 100 MHz bandwidth in the frequency band 22.21-22.5 GHz.

It has to be noted that passive ground-based water-vapour radiometers operating in the frequency band 22-22.5 GHz are also used worldwide to character vertical profiles of water-vapour concentrations for applications including, but not limited to, studies of Earth's atmosphere, climatology and meteorology.

WMO Position on WRC-23 agenda item 1.10

WMO is not opposed to new allocations for the aeronautical mobile service for the use of non-safety aeronautical mobile applications, if an appropriate unwanted emission limit (-23 dBW per 100 MHz) applies in the band 22.21-22.5 GHz to ensure that EESS (passive) is protected from the AM(OR)S. Option 2 of Methods C, D and E, of the CPM Report aligns with WMO objectives.

3.8 Agenda item 1.12

"to conduct, and complete in time for WRC 23, studies for a possible new secondary allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders within the range of frequencies around 45 MHz, taking into account the protection of incumbent services, including in adjacent bands, in accordance with Resolution ***656 (Rev. WRC 19)****"*

This agenda was originally developed and placed on the WRC-23 Preliminary Agenda by WRC-15. WRC-19 reviewed the status of the work and retained the item on the final WRC-23 agenda to consider a secondary allocation to the EESS (active) around 45 MHz.

This agenda item is of interest to WMO to, on the one hand, ensure protection of oceanographic radars operating in 41.015-42 MHz and 42.5-44 MHz under footnote RR **No 5.161A** and wind profiler radars operating in 46-68 MHz under footnote RR **No 5.162A**, and, on the other hand, consider the future use of this EESS (active) allocation for meteorological and climate purposes.

With respect to wind profiler radars, all four options under Method A provide protection to the radars, though the approaches are different. Specifically, coexistence with wind profiler radars may be achieved through case-by-case coordination. WMO notes that such bilateral coordination/consultation could be achievable due to the small number of EESS (active) systems envisaged and the limited number of wind profiler radars in operation.

Based on ITU-R studies, it could be concluded that coexistence with oceanographic radars would not be an issue.

It should be noted that the pfd limit in Options 1 and 4 of Method A1 are too restrictive to provide a usable allocation for the EESS (active). Since the operation of the EESS (active) systems may support meteorological and climate purposes, a more balanced approach for providing a usable allocation while protecting the incumbent services is represented in Method A1 Options 2 and 3, or even possibly a combination of Options 2 and 3. Methods A2, B and C will not provide a usable EESS (active) allocation while also adequately protecting incumbent radio services. Method D will not provide for an EESS (active) allocation, therefore failing to meet scientific requirements.

WMO Position on WRC-23 agenda item 1.12

WMO supports a new secondary allocation to EESS (active) in the 40–50 MHz frequency band with appropriate protection being provided to wind profiler radars under **No 5.162A** and oceanographic radars under **No 5.161A**.

Method A1 of the CPM Report is in line with WMO objectives to ensure the protection of the oceanographic and wind profiler radars. However, in order to equally balance the protection of existing services operating in-band and adjacent bands and the opportunities for spaceborne radar sounder operations, WMO is of the view that an optimal solution might consist of elements included in Options 2 and 3 proposed in Method A1.

WMO also agrees with the proposal that consultation between operators of EESS (active) systems and users of wind profiler radars operating in the 40-50 MHz range may be needed on a case-by-case basis to ensure coexistence between the corresponding stations. If deemed appropriate, WMO could be proposed as a focal organisation for facilitating such consultation.

3.9 Agenda item 1.13

*"to consider a possible upgrade of the allocation of the frequency band 14.8-15.35 GHz to the space research service, in accordance with Resolution **661 (WRC 19)**"*

Agenda Item 1.13 calls for consideration of upgrading the existing space research service (SRS) secondary allocation in 14.8-15.35 GHz to primary status. A primary allocation to the EESS (passive) exists in the adjacent band 15.35-15.4 GHz, however, no use of the frequency band for passive operations has been identified.

WMO Position on WRC-23 agenda item 1.13

WMO is not opposed to the upgrading of the existing SRS secondary allocation in 14.8-15.35 GHz to primary status.

3.10 Agenda item 1.14

*"to review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5-252 GHz, to ensure alignment with more up-to-date remote-sensing observation requirements, in accordance with Resolution **662 (WRC 19)**"*

This WRC-23 Agenda item was initiated by MetSat operators with the goal of better aligning or adding possible new allocations to the EESS (passive) in the 231.5-252 GHz frequency range with passive sensor design requirements. Allocations to the EESS (passive) within the 231.5-252 GHz frequency range were created 20 years ago at a time when operational requirements were unclear. Realigning the allocations will result in better protection of future MetSat operations within the 231.5-252 GHz frequency range. With the latest scientific and technological developments for passive microwave sensors, measurements of ice clouds, which cover more than 33% of Earth's surface, will close a gap in the measurement's portfolio of the atmosphere. Ice clouds have important effects on Earth's climate and hydrological cycle by affecting precipitation, atmospheric structure, and cloud processes. Global measures of ice cloud properties including ice water path, ice particle size distribution, are therefore critically needed.

There is a requirement for two 3000 MHz bands at 239.2-242.2 GHz and 244.2-247.2 GHz for ice cloud imaging passive sensors currently under development globally.

To fulfil this requirement, Method B of the CPM Report proposes a rearrangement of the FS and MS allocations, i.e., by suppressing the existing allocations in 239.2–241 GHz (1.8 GHz) and adding new allocations to FS and MS in 235–238 GHz (3 GHz), thus ensuring that no undue constraints are placed on FS and MS as well as on other primary services currently allocated in this frequency range. This approach avoids frequency overlap between EESS (passive) conical scan sensors and the FS/MS, provides the FS/MS with a net increase of 1.2 GHz of bandwidth with a total contiguous bandwidth of 7.7 GHz, and does not provide a different active service sharing scenario than what already exists in 232–235 GHz between the FSS (space-to-Earth) and FS/MS. It has to be noted that no active existing services (in particular FS and MS) development or deployment were identified in the frequency bands under consideration.

Under Method B, three options exist for limiting the EESS (passive) usage of 235-238 GHz frequency band to limb sounding only through a new footnote **5.B114**. Of the three options, Option 1 is ideal since Options 2 and 3 place unnecessary constraints on limb sounding EESS (passive) even though it has been shown to be compatible with the active radio services.

Method A provides the necessary EESS (passive) allocations, however, constraints would also be placed on the incumbent services which would be in contradiction of the objective of Resolution **662 (WRC-19)**. Method C would not satisfy the requirements of the EESS (passive) since the necessary new allocations would not be made.

WMO Position on WRC-23 agenda item 1.14

WMO supports new primary allocations to EESS (passive) in the frequency bands 239.2-242.2 GHz and 244.2-247.2 GHz in order to accommodate the requirements for ice cloud measurements.

In order to avoid undue constraints on the FS and MS in the band 239.2-241 GHz (currently with an allocation of 1.8 GHz in bandwidth), WMO also supports the shift of the existing FS and MS allocations to the band 235-238 GHz (providing an allocation of 3 GHz in bandwidth).

In order to ensure that there would be no potential future impact to FS and MS in the band 235-238 GHz, WMO would accept limiting the existing allocation to EESS (passive) in the band 235-238 GHz for use by limb sounding passive sensors only.

Method B, Option 1 of the CPM Report aligns with these WMO objectives.

3.11 Agenda item 1.15

*"to harmonize the use of the frequency band 12.75-13.25 GHz (Earth-to-space) by earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service globally, in accordance with Resolution **172 (WRC-19)**"*

This agenda item deals with the operation of Earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75–13.25 GHz (Earth-to-space). Sharing and compatibility between Earth stations on aircraft and vessels communicating with GSO space stations in the FSS were studied. In addition, studies of the current and planned stations of existing services, as well as services in adjacent frequency bands, were carried out.

Of relevance to the WMO, studies were conducted to address the potential impact from Earth stations on aircraft and vessels into the EESS (active) in the adjacent band 13.25–13.75 GHz, which is used by a number of altimeter instruments. Radar altimeters are used for a variety of applications, such as measuring sea surface heights for global sea level rise monitoring. Studies showed that no interference to the EESS (active) is expected.

WMO Position on WRC-23 agenda item 1.15

WMO supports the protection of EESS (active) in the band 13.25–13.75 GHz and concurs with the ITU-R conclusion that interference from Earth stations on aircraft and vessels in the band 12.75–13.25 GHz is not an issue and that no additional regulatory provisions are required. Any of the CPM Methods are acceptable to the WMO.

3.12 Agenda item 1.16

*"to study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 17.7-18.6 GHz and 18.8-19.3 GHz and 19.7-20.2 GHz (space-to-Earth) and 27.5-29.1 GHz and 29.5-30 GHz (Earth-to-space) by non-GSO FSS earth stations in motion, while ensuring due protection of existing services in those frequency bands, in accordance with Resolution **173 (WRC 19)**"*

This agenda item calls for the study and development of technical, operational and regulatory measures to facilitate use of several frequency bands by non-GSO FSS ESIMs. This agenda item includes consideration of frequency bands for ESIM operation adjacent to the 18.6–18.8 GHz frequency band used for passive sensing, as well as potential ESIM operation in the 28.5–30 GHz where a secondary allocation to the EESS exists for the transmission of data.

The frequency band 17.7–18.6 GHz overlaps with the GSO MetSat allocations in the frequency bands 18–18.3 GHz (ITU Region 2) and 18.1–18.4 GHz (ITU Regions 1 and 3), in accordance with footnote RR **No 5.519.**

With regard to the frequency band 18.6–18.8 GHz, it should be noted that ITU-R studies indicate a need for an out-of-band pfd limit to ensure protection of the EESS (passive) sensors.

Method B of the CPM Report identifies three options in Annex 3 to Resolution **[A116]** for the application of an out-of-band limit where each option provides some level of protection to the EESS (passive). Option 3 provides the best option for protecting EESS (passive) while not overly constraining FSS operations. Another possible solution would be to apply the agenda item 1.17 limits for the protection of the EESS (passive) in the frequency band 18.6–18.8 GHz.

With regard to ESIM operation in the 28.5–30 GHz frequency range, Resolution **173 (WRC-19)** states that no additional constraints should be imposed on the EESS. However, the EESS allocation is secondary whereas the FSS allocation is primary. No specific provision is deemed necessary to address the protection of this secondary allocation.

WMO Position on WRC-23 agenda item 1.16

WMO does not oppose the use of the bands 17.7–18.6 GHz and 18.8–19.3 GHz (space-to-Earth) for communications with non-GSO FSS ESIM provided that an appropriate out-of-band pfd limit is applied to ensure protection of the EESS (passive) in the band 18.6–18.8 GHz. Options identified in the Annex 3 to Resolution **[A116]** of the CPM Report might be suitable.

WMO believes that the unwanted emissions pfd levels derived from the studies under WRC-23 agenda item 1.17 (see below) would also provide adequate protection to EESS (passive) in 18.6-18.8 GHz under WRC-23 agenda item 1.16.

3.13 Agenda item 1.17

*"to determine and carry out, on the basis of the ITU-R studies in accordance with Resolution **773 (WRC 19)**, the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate"*

This agenda item calls for studies on provisions to allow satellite-to-satellite links to be operated in several frequency bands allocated to the FSS (e.g. 11.7–12.7 GHz, 18.1–18.6 GHz, 18.8–20.2 GHz and 27.5–30 GHz).

WMO could have some interest with these particular links as they could support the transmission of Earth observation satellite data to users in a timelier manner.

It is to be noted that the frequency band 18.1–18.6 GHz overlaps with the GSO MetSat allocations in the frequency bands 18–18.3 GHz (ITU Region 2) and 18.1–18.4 GHz (ITU Regions 1 and 3), in accordance with footnote RR **No 5.519**.

With regard to the frequency band 18.6–18.8 GHz, it should be noted that ITU-R Working Party 7C is currently addressing existing interference received by EESS (passive) sensors in the 18.6–18.8 GHz band.

The CPM Report provides two options for the protection of the EESS (passive) in Method B. While Option 2 may be adequate, Option 1 has been shown to be adequate and does not overly constrain the proposed satellite-to-satellite link operations. Option 1 imposes the following limits:

- Non-GSO space stations operating with an orbit apogee of more than 2 000 km and less than 20 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz when communicating with a non-GSO space station as described in *resolves* 1*a)* shall not exceed a power flux-density produced at the surface of the oceans across the 200 MHz of the 18.6-18.8 GHz band, of −118 dB (W/(m² · 200 MHz)).
- Non-GSO space stations operating with an orbit apogee less than 2 000 km in the frequency bands 18.3-18.6 GHz and 18.8-19.1 GHz when communicating with a non-GSO space station as described in *resolves* 1*a)* shall not exceed a power flux-density produced at the surface of the oceans across the 200 MHz of the 18.6-18.8 GHz band, of −110 dB (W/(m² · 200 MHz)).
- These provisions do not apply to non-GSO systems using orbits with an apogee less than 2 000 km that employ frequency reuse schemes of at least three colours.

The frequency band 27.5–30 GHz is partly overlapping with the secondary EESS (Earth-to-space) allocation in the 28.5–30 GHz frequency band in accordance with footnote RR **No 5.541.** No specific provision is deemed necessary to address the protection of this secondary allocation.

WMO Position on WRC-23 agenda item 1.17

WMO supports the development of technical conditions and regulatory provisions for satellite-to-satellite operations in the frequency bands 18.1–18.6 GHz, 18.8–20.2 GHz and 27.5–30 GHz, or portions thereof, as appropriate.

Specifically, WMO supports the implementation of regulatory provisions which would ensure that the operation of satellite-to-satellite links will not lead to increased interference to the EESS (passive) in the band 18.6–18.8 GHz. In particular, WMO supports the implementation of out-of-band pfd limits derived from Method B, Option 1 in Annex 3 to Resolution **[AI117]**.

3.14 Agenda item 1.18

*"to consider studies relating to spectrum needs and potential new allocations to the mobile-satellite service for future development of narrowband mobile-satellite systems, in accordance with Resolution **248 (WRC 19)**"*

This agenda item initiates studies for consideration of new allocations to the mobile-satellite service in several frequency bands, including consideration of the frequency band 1 695–1 710 MHz (in ITU Region 2 only). The frequency band 1 695–1 710 MHz is allocated to the MetSat service and is primarily used for non-GSO MetSat data downlinks to Earth stations around the world.

For a number of different applications, the use of the MetSat L-Band 1 675–1 710 MHz is an indispensable component in existing and currently developed GSO and non-GSO MetSat satellite systems/networks as well as in future constellations of small MetSat satellites. It is important, therefore, to preserve the long-term availability and protection of the band 1 675–1 710 MHz for MetSat use.

Also, as EESS/MetSat satellite systems are using the band 2 025–2 110 MHz for telecommanding and uplinking instrument data, WMO is concerned with the protection of the allocations of the EESS/SOS in the 2 025–2 110 MHz band.

WMO Position on WRC-23 agenda item 1.18

WMO does not support any RR modifications under this WRC-23 agenda item due to the absence of ITU-R studies addressing the protection of:

- a) current and future MetSat operations in the band 1 695–1 710 MHz and in the adjacent band 1670–1695 MHz from narrow-band MSS systems. It is important to ensure the protection of the downlink of the measured data as well as the global dissemination of the data directly to users

- b) EESS and SOS in the adjacent band 2 025–2 110 MHz.

WMO is in favour of Method A of the CPM Report (which proposes no change), whereas Method C does not address item b) above.

3.15 Agenda item 4

*"in accordance with Resolution **95 (Rev. WRC 19)**, to review the Resolutions and Recommendations of previous conferences with a view to their possible revision, replacement or abrogation."*

As specified in Annex 1 of this document, WMO has concerns regarding Resolution **731 (Rev. WRC-19)** as this WRC Resolution could impact a number of frequency bands above 71 GHz essential for the meteorological community.

Discussions were initiated in WPs 7C and 7D in ITU-R which show some different interpretations of activities requested by *invites 1* and *2* of Resolution **731 (Rev. WRC-19)**.

WMO Position on WRC-19 agenda item 4

With regards to Resolution **731 (Rev. WRC-19)**, WMO supports a revision of this WRC Resolution under agenda item 4 to clarify that in-band sharing studies cannot be performed in bands covered by RR No. **5.340**.

3.16 Agenda item 7

*"to consider possible changes, and other options, in response to Resolution **86 (Rev. Marrakesh, 2002)** of the Plenipotentiary Conference, an advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks, in accordance with Resolution **86 (Rev. WRC 07)**, in order to facilitate rational, efficient and economical use of radio frequencies and any associated orbits, including the GSO."*

This standing agenda item deals with any possible changes to the Radio Regulations affecting the advance publication, coordination, notification and recording of satellite networks and requires WMO consideration. None of the Agenda Item 7 topics contained in the CPM present a risk to WMO at this time, however WMO will continue to monitor the progress of this agenda item at WRC-23.

WMO Position on WRC-19 agenda item 7

WMO supports the current CPM Report for Agenda Item 7. No changes are suggested to the Radio Regulations that would impose unnecessary constraints on MetSat and EESS systems or that would overcomplicate the regulatory procedures for the corresponding ITU filings for the frequency bands that are used by these systems.

WMO will continue to monitor the development of Agenda Item 7 issues.

3.17 Agenda item 9.1 Topic a)

*"In accordance with Resolution **657 (Rev. WRC-19)**, review the results of studies relating to the technical and operational characteristics, spectrum requirements and appropriate radio service designations for space weather sensors with a view to describing appropriate recognition and protection in the Radio Regulations without placing additional constraints on incumbent services"*

Work began in the ITU-R and WMO in 2014 to determine the radio spectrum requirements for space weather sensors that use the radio spectrum for acquiring data. WRC-2015 placed an item on the Preliminary Agenda of WRC-23 calling for regulatory changes to provide protection to space weather sensors that use radio spectrum. WRC-19 reviewed the work on the topic and included the issue on the WRC-23 agenda as a Topic under Agenda Item 9.1, and placed a subsequent item on the Preliminary Agenda for WRC-27 to resolve any remaining regulatory issues.

Space weather sensors that use the radio spectrum currently do not have any regulatory protection in the Radio Regulations. Based on analysis done in Working Party 7C it was considered that, due to the nature of the space weather application (active or receive-only), specific provisions in the RR are needed. It is of vital importance to WMO Members that this effort be completed to ensure protection of space weather sensor operations in the future.

Under WRC-23 Agenda item 9.1 Topic a), the following two step proposal is made for consideration by WRC-23:

- to insert in Articles **1** and **4**, and/or as a WRC resolution, a suitable definition and provision respectively. The following examples of these are reflected in the CPM report:

    - 1.XXX Space weather: *natural phenomena, mainly originating from solar activity and occurring beyond the major portion of the Earth's atmosphere, that impact Earth's environment and human activities*.

    - 4.XXX Space weather sensors systems may operate under the meteorological aids service (space weather) allocations.

- to elaborate on a new WRC-27 agenda item (based on preliminary agenda item 2.6 of Resolution **812 (WRC-19)**). WMO believes that, with actions taken at WRC-23 with respect to the above definition and provision, this new WRC-27 agenda item would complete the establishment of regulatory provisions in the RR.

WMO also considers the need to reflect the importance of space weather applications. The new WRC Resolution proposed in the CPM report on this issue is therefore supported.

WMO Position on WRC-23 agenda item 9.1 Topic a)

WMO supports the proposed definition in the CPM Report for space weather and the approach regarding its recognition in the RR, through a subset of the MetAids service, called the MetAids (space weather).

WMO also supports the following actions:

- The recognition, at WRC-23, of space weather by modifications to RR Articles **1** and **4**, using the definition and provision provided in the CPM Report.
- The recognition of the importance of space weather applications by means of a new WRC Resolution as contained in the CPM report.
- The development of a new WRC-27 agenda item on space weather to define regulatory provisions while not placing undue constraints on incumbent services.

3.18 Agenda item 9.1 Topic c)

*"Study the use of International Mobile Telecommunication systems for fixed wireless broadband in the frequency bands allocated to the fixed services on primary basis, in accordance with Resolution **175 (WRC-19)**"*

Topic c) under Agenda Item 9.1 calls for studies on the use of existing frequency bands allocated to the fixed service. This item is of concern since any frequency band allocated to the fixed service is open for consideration and hence has the potential to change coexistence conditions for services allocated in-band or adjacent to frequency bands allocated to the fixed service.

This topic could affect a number of meteorological applications including EESS, MetSat and MetAids frequency bands either in-band or in adjacent frequency bands. It needs to be stressed that this also includes a number of adjacent EESS (passive) bands in which footnote RR No **5.340** applies.

WMO Position on WRC-23 agenda item 9.1 Topic c)

WMO is concerned about Topic c) under agenda item 9.1 as it is very broad in scope and could hence potentially affect many meteorological operations and applications, including EESS (passive) under footnote RR No **5.340.** Protection of the corresponding radio services needs to be ensured.

Consequently, WMO supports no change to the Radio Regulations, other than the suppression of Resolution **175 (WRC-19)**, under agenda item 9.1 Topic c).

3.19 Agenda item 9.1 Topic d)

"Protection of EESS (passive) in the frequency band 36–37 GHz from non-GSO FSS space stations"

Under studies considered for WRC-19 agenda item 1.6, a preliminary study on the protection of EESS (passive) sensors operating in the band 36–37 GHz from non-GSO FSS space stations

in the band 37.5–38 GHz was submitted to the ITU-R. This preliminary study indicated that it may be necessary to apply to FSS non-GSO space stations an unwanted e.i.r.p. limit of −34 dBW/100 MHz, for all angles greater than 71.4 degrees from nadir. In addition, interference into the cold calibration channel of the EESS (passive) sensor operating in the frequency band 36–37 GHz was not studied.

On this basis, WRC-19 invited ITU-R to conduct further studies of this topic and develop recommendations and/or reports, as appropriate, and report back to WRC-23 to take action, if necessary. Furthermore, WRC-19 agreed that modifications to Resolution **750 (Rev. WRC-19)** should not be considered under these studies since the frequency band 36–37 GHz is not referenced in footnote RR No **5.340**.

Two study topics are under consideration:

- Impact on the EESS sensing channel from constellations operating at altitudes lower than the EESS satellites altitude.

- Impact on the EESS calibration channel from constellations operating at altitudes higher than the EESS satellites altitude.

The CPM Report notes that for the first scenario, for non-GSO FSS constellations operating at altitudes below 970 km, no specific unwanted emission limit would be needed when the attenuation provided by the FSS satellite body is taken into account.

For the second scenario, studies concluded that an unwanted emission power density limit of −31 dBW/100 MHz in the frequency band 36-37 GHz would be needed to ensure the protection of EESS (passive) from non GSO FSS constellations operating at altitudes between 407 and 2000 km.

WMO Position on WRC-23 agenda item 9.1 Topic d)

WMO supports the protection of EESS (passive) sensors (including for the cold-sky calibration channel) in the band 36–37 GHz from non-GSO FSS operations in the band 37.5–38 GHz.

To achieve this, WMO supports the implementation of an unwanted emission power density limit of −31 dBW/100 MHz in the frequency band 36-37 GHz as regulatory provisions in the RR (such as in a new specific RR Article **5** footnote) to protect EESS (passive) sensors. This limit would be applicable to non-GSO FSS constellations operating at altitudes above 407 km (minimum altitude of EESS (passive) sensors in this frequency band) and below 2 000 km (limited to LEO constellations).

3.20 Agenda item 9 on Article 21

*"ITU-R is invited to study, as a matter of urgency, the applicability of the limit specified in **No. 21.5** of the Radio Regulations to IMT stations, that use an antenna that consists of an array of active elements, with a view to recommend ways for its possible replacement or revision for such stations, as well as any necessary updates to Table 21-2 related to terrestrial and space services sharing frequency bands. Furthermore, the ITU-R is invited to study, as a matter of urgency, verification of **No. 21.5** regarding the notification of IMT stations that use an antenna that consists of an array of active elements, as appropriate."*

In line with the decision taken for WRC-19 agenda item 1.13, WRC-19 Document 550 invited ITU to study the applicability of the limit specified in **No. 21.5** of the RR to IMT stations in the 26 GHz band that use an antenna that consists of an array of active elements.

WRC-19 identified the frequency band 24.25–27.5 GHz for IMT. WMO's concern is in relation with the existing EESS (space-to-Earth) allocation in the 25.5–27 GHz frequency band. It has to be noted that other allocations could be concerned where such array of active elements are deployed or plan to be deployed.

WMO considers there is a need:

- to update Table 21-2 related to terrestrial and space services sharing frequency bands,
- to study the impact of the existing limits specified in RR **No 21.5** to IMT base stations using an array of active elements, and
- to ensure that deployment, under the provision of RR (2020 Edition), of such IMT base stations will not impact EESS (space-to-Earth) operations in the 25.5-27 GHz frequency band.

WMO Position on WRC-23 agenda item 9 on Article 21

WMO supports the approach to ensure that no impact will occur in the band 25.5–27 GHz on EESS (space-to-Earth) operations due to the future deployment of co-frequency IMT systems that use an antenna that consists of an array of active elements. Regarding the notification of such IMT systems, WMO supports that a temporary approach be developed for the notification and verification of IMT stations with an array of active elements with respect to RR **No 21.5** in the frequency band 25.5–27 GHz before an appropriate competent WRC decision is taken.

3.21 Agenda item 10

*"to recommend to the Council items for inclusion in the Agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, in accordance with Article 7 of the Convention, (Resolution **810 (WRC-15)**)."*

WRC-19 established the Preliminary Agenda for WRC-27. The preliminary agenda will be reconsidered at WRC-23 where each preliminary agenda item will be evaluated for inclusion in the final WRC-27 agenda.

The current WRC-27 preliminary agenda has a number of items of interest and/or concern to WMO:

- ***Preliminary Agenda item 2.1*** *- to consider, in accordance with Resolution **663 (WRC-19)**, additional spectrum allocations to the radiolocation service on a co-primary basis in the frequency band 231.5-275 GHz and identification for radiolocation applications in frequency bands in the range 275-700 GHz for millimetre and sub-millimetre wave imaging systems;*

  The frequency ranges specified in this agenda item overlap some frequency bands allocated to, or identify for use by, the EESS (passive). Protection of the EESS (passive) must be ensured.

WMO Position on Preliminary agenda item 2.1

WMO supports the protection of passive remote sensing systems and applications in the frequency range 231.5–700 GHz. If this preliminary agenda item is placed on the Agenda for WRC-27, any changes in support of radiolocation applications should take into account the protection of existing allocations and systems operating under RR **No 5.565** and the results of WRC-23 AI 1.14. Also note is given to the fact that this range covers and is adjacent to footnote **RR 5.340** frequency bands that need to be protected.

- ***Preliminary Agenda item 2.2*** *- study and develop technical, operational and regulatory measures, as appropriate, to facilitate the use of the frequency bands 37.5-39.5 GHz (space-to-Earth), 40.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by aeronautical and maritime earth stations in motion communicating with geostationary space stations in the fixed-satellite service, in accordance with Resolution* ***176 (WRC 19)****;*

  This preliminary agenda item considers regulatory provisions to facilitate deployment of earth stations in motion (ESIMs) operating in the fixed satellite service. This preliminary agenda item introduces a potential for increased interference to the EESS (passive) in the 50.2-50.4 GHz frequency band.

WMO Position on Preliminary agenda item 2.2

WMO is of the view that any WRC-27 Agenda item dealing with ESIM in the bands 37.5-39.5 GHz (space-to-Earth), 40.5–42.5 GHz (space-to-Earth), 47.2–50.2 GHz (Earth-to-space) and 50.4–51.4 GHz (Earth-to-space) should take due account of the need to protect space science services allocations (SRS, EESS, EESS (passive)) in the considered bands and the adjacent bands.

- ***Preliminary Agenda Items 2.4, 2.5 and 2.7***

  2.4 *- the introduction of pfd and e.i.r.p. limits in Article 21 for the frequency bands 71–76 GHz and 81–86 GHz in accordance with Resolution* ***775 (WRC 19)****;*

  2.5 *- the conditions for the use of the 71-76 GHz and 81-86 GHz frequency bands by stations in the satellite services to ensure compatibility with passive services in accordance with Resolution* ***776 (WRC 19)****;*

  2.7 *- to consider the development of regulatory provisions for non-geostationary fixed-satellite system feeder links in the frequency bands 71-76 GHz (space-to-Earth) and proposed new Earth-to-space) and 81–86 GHz (Earth to-space), in accordance with Resolution* ***178 (WRC-19)****.*

  Preliminary WRC-27 Agenda item 2.5 calls for studies and regulatory provisions that could be implemented to ensure protection of passive services including the EESS (passive) in the frequency band 86–92 GHz, from satellite operations in 71–76 GHz and 81–86 GHz. The protection of the EESS (passive) in 86–92 GHz through implementation of mandatory limits in Resolution **750 (WRC-19)** is a priority for WMO. *This preliminary agenda item is inter-related with preliminary agenda items 2.4 and 2.7 and they need to be considered together.*

WMO Position on Preliminary agenda item 2.4, 2.5 and 2.7

WRC-27 Preliminary Agenda Items 2.4, 2.5 and 2.7 address the frequency bands 71–76 GHz and 81–86 GHz. If WRC-23 agrees to the inclusion of agenda items 2.4 or 2.7 on the WRC-27 Agenda, then agenda item 2.5 would consequentially need to be included.

Any of these preliminary agenda items, if placed on the WRC-27 Agenda, would need to take into account the protection of the EESS (passive) allocation in the frequency band 86–92 GHz.

WMO supports the inclusion of agenda item 2.5 in the Agenda for WRC-27.

- ***Preliminary Agenda item 2.6*** *- to consider regulatory provisions for appropriate recognition of space weather sensors and their protection in the Radio Regulations, taking into account the results of ITU R studies reported to WRC 23 under agenda item 9.1 and its corresponding Resolution* ***657 (Rev. WRC 19)****;*

  This preliminary agenda item is intended as a follow-on to WRC-23 Agenda Item 9.1, Topic A. This follow-on preliminary agenda item for WRC-27 will address any required further actions.

WMO Position on Preliminary agenda item 2.6

WMO supports the continuation of ITU-R studies under WRC-23 AI 9.1 (Topic A) through a new agenda item for WRC-27, in order to define regulatory provisions in the RR for space weather, in particular including a definition and designation of corresponding radiocommunication service, and possible new allocations to the radiocommunication service designated for their use (e.g., MetAids (*space weather*)), while not placing undue constraints on incumbent services.

- ***Preliminary Agenda item 2.11*** *- to consider a new EESS (Earth-to-space) allocation in the frequency band 22.55-23.15 GHz, in accordance with Resolution* ***664 (WRC 19)****;*

  This preliminary agenda item calls for consideration of creating a new EESS (Earth-to-space) allocation in the frequency band 22.55–23.15 GHz frequency band to be paired with the existing 25.5–27 GHz (space-to-Earth) EESS frequency allocation. The creation of the new allocation to the EESS would benefit WMO interests.

WMO Position on Preliminary agenda item 2.11

WMO supports inclusion of this preliminary agenda item on the Agenda for WRC-27 taking into account existing space research and inter-satellite allocations.

- ***Preliminary Agenda item 2.13*** *- to consider a possible worldwide allocation to the mobile satellite service for the future development of narrowband mobile-satellite systems in frequency bands between the range 1.5-5 GHz, in accordance with Resolution* ***248 (WRC-19)****,*

  This preliminary agenda item appears to be a duplicate of Agenda item 1.18 on the WRC-23 agenda. The reason for inclusion on the WRC-27 preliminary agenda is unclear.

See WRC-23 Agenda item 1.18 for discussion and WMO position.

WMO Position on Preliminary agenda item 2.13

WMO is of the view that this preliminary agenda item requires further refinement and a narrower scope to avoid difficulties encountered similar to those under WRC-23 Agenda Item 1.18. WMO is also of the view that given the results of studies completed under WRC-23 Agenda Item 1.18, the band 1 675–1 710 MHz should not be reconsidered.

- ***Possible new WRC-27 Agenda items suggested by WMO***

WMO supports the inclusion of the following item on the WRC-27 Agenda

Agenda Item 1.xx: *to consider, based on the results of ITU-R studies, possible regulatory measures regarding the protection of the Earth exploration-satellite service (passive) in frequency bands above 86 GHz from unwanted emissions of active services.*

Frequency bands allocated to EESS (passive) are of prime interest for WMO. Resolution **750** was approved at WRC-07, to ensure compatibility between the EESS (passive) and relevant active services, in the frequency bands covered by RR **No 5.340**.

However, some frequency bands, covered by RR **No 5.340**, are not yet included in this Resolution. The objective of this proposed WRC-27 Agenda item is to elaborate regulatory provisions in order to ensure the long-term EESS (passive) usage in bands not yet covered by Resolution **750**.

- **WMO comment on possible new WRC-27 Agenda items presented by other entities**

WMO also considered the various proposals made during the CPM-23-2 meeting for WRC-27 agenda items. WMO understands that these proposals were only noted but proposes comments and views below for some of these proposals:

a) Doc CPM/14, CPM/103 and CPM/182: Spectrum allocation and associated regulatory provisions to support use of the 51.4-52.4 GHz FSS (Earth-to-space) frequency band for gateway earth stations operating with non-GSO FSS systems on a primary basis

   WMO Position: WMO is of the view that any consideration of the 51.4-52.4 GHz frequency band for gateway earth stations operating with non-GSO FSS systems should include studies on the protection of EESS (passive) in adjacent bands 50.2-50.4 GHz and 52.6-59.3 GHz.

b) Doc CPM/84 and CPM/103: Review the use of the frequency band 13.75-14 GHz (Earth-to-space) by the geostationary fixed-satellite service (GSO FSS), to enable efficient use of the band by uplink GSO and NGSO FSS earth stations.

   WMO Position: WMO does not oppose this possible new agenda item, provided that the protection of the EESS (active) in the adjacent frequency band 13.25-13.75 GHz is taken into account.

c) Doc CPM/84 and CPM/103: Technical and regulatory measures to ensure coexistence between spaceborne synthetic aperture radars (SAR) in the Earth exploration-satellite service (active) and radiodetermination service in 9 200-10 400 MHz frequency bands.

WMO Position: The meteorological community has interests in both the Earth exploration-satellite service (active) and the radiodetermination service. WMO will monitor the development of this possible new agenda item.

d) Doc CPM/84, CPM/94, CPM/103 CPM/213 and CPM/221: Studies on frequency-related matters for IMT identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between AA-BB GHz and CC-DD GHz for the future development of IMT for 2030 and beyond

WMO Position: WMO does not support this possible new agenda item. This Agenda Item presumably proposes broad frequency ranges (i.e. 7-24 GHz and above 92 GHz) which will be difficult to address. WMO also stresses in particular the possible impact to the EESS (passive) including frequency bands covered by footnote RR No **5.340** such as 23.6-24 GHz, 10.68-10.7 GHz and multiple bands above 92 GHz.

ANNEX 1

WMO concerns on the issue of Resolution 731 (Rev. WRC-19) currently addressed in ITU-R as a follow-up of WRC-19

WMO is observing and following discussions in the ITU on topics outside of WRC-23 preparatory activities that concerns frequency bands essential for the meteorological community. Those issues are identified in this section and a WMO position is expressed.

Resolution 731 (Rev. WRC-19)

Resolution **731 (Rev. WRC-19)** deals with the consideration of sharing and adjacent band compatibility between passive and active services above 71 GHz.

In this context the ITU-R is invited:

(1) to continue its studies to determine if and under what conditions sharing is possible between active and passive services in the frequency bands above 71 GHz, such as, but not limited to, 100-102 GHz, 116-122.25 GHz, 148.5-151.5 GHz, 174.8-191.8 GHz, 226-231.5 GHz and 235-238 GHz;

(2) to conduct studies to determine the specific conditions to be applied to the land-mobile and fixed-service applications to ensure the protection of EESS (passive) applications in the frequency bands 296-306 GHz, 313-318 GHz and 333-356 GHz.

WMO recognizes the recent trend for broadband applications with growing bandwidth requirements expressed by industry and the migration of those applications into higher frequency bands intensively exploited by passive microwave sensors. Triggered by regulatory consideration in individual countries, this resulted in the first considerations of studying the sharing conditions in bands above 71 GHz at the level of the ITU-R under *invites 1* of this Resolution **731 (Rev. WRC-19)**, including in bands covered by footnote RR **No 5.340** (where all emissions are prohibited).

WMO recognizes further that *invites 2* is a continuation of the discussion under WRC-19 Agenda item 1.15 on sharing conditions for some bands for which sharing conditions could not be identified at WRC-19 that would render sharing with passive sensors feasible. Although no new elements are available for possibly reassessing the situation that led to the conclusions of WRC-19, it is realized that the discussion is immediately going on in the relevant ITU-R Working Parties, which is of concern to WMO.

WMO Position on ITU-R Resolution 731 (Rev. WRC-19)

WMO highlights that bands above 71 GHz used by passive sensors are unique resources for atmospheric measurements. These passive bands are indispensable for meteorological forecasting and climate monitoring.

WMO is concerned that in the process of establishing the sharing conditions in bands above 71 GHz under *invites 1* of Resolution **731 (Rev. WRC-19)**, some frequency bands are included which are subject to footnote RR **No 5.340.** Studies carried out under Resolution **731 (Rev. WRC-19)** can only be performed for active services potentially operating in frequency bands not covered by footnote RR **No 5.340**.

WMO supports the revision of Resolution 731 (Rev. WRC-19) under WRC-23 agenda item 4, in order to clarify that in-band sharing studies cannot be performed in frequency bands subject to footnote RR **No 5.340**.

In addition, WMO is also of the view that any new studies under Resolution **731 (Rev. WRC-19**), related to the impact from active services into passive services, should only be undertaken when duly justified active services spectrum requirements are assessed.

ANNEX 2

WMO concerns on the potential risk regarding the future usages in the 6 425−7 125 MHz frequency bands on the EESS (passive)

WMO is observing the discussions in ITU-R regarding WRC-23 agenda item 1.2 but also the possible future usages of the 6 425–7 125 MHz under the mobile service allocation to the EESS (passive). Those issues are identified in this section and a WMO position is expressed.

Regulatory status

During discussions under WRC-23 Agenda Item 1.2, different views were expressed regarding the status of the EESS (passive) usage in the 6 425–7 075 MHz and 7 075–7 250 MHz.

It is recognized that there is no formal EESS (passive) allocation in the RR but footnote RR **No 5.458** indicates that administrations should bear in mind the needs of the Earth exploration-satellite (passive) and space research (passive) services in their future planning of the bands 6 425–7 075 MHz and 7 075–7 250 MHz as passive microwave sensor measurements are carried out in these frequency bands.

During the discussions it was agreed that studies in relation with WRC-23 AI 1.2 don't take into account EESS (passive) operation under footnote RR **No 5.458**.

Operational use of EESS (passive) in these frequency bands

The frequency ranges 6 425–7 075 and 7 075–7 250 MHz are unique for Earth exploration-satellite service (EESS) (passive) sensor measurements, since they correspond to the peak sensitivity to sea-surface temperature (SST). Thus, these measurements of sea-surface temperature (SST) are currently predominantly performed in the 6 425–7 075 and 7 075–7 250 MHz ranges.

SST, together with ocean salinity, is one of the drivers of the ocean circulation, which is key for any numerical weather prediction or numerical ocean prediction model. SST is also a critical variable for climatological studies and for the assessment of global temperature trends, and it is fundamental to understand the exchanges of heat, gas and momentum between the atmosphere and the ocean, and in calculations of carbon uptake by the ocean from the atmosphere.

Potential interference risks

Taking into account the preliminary results of studies provided in the working document towards a preliminary Report RS. [EESS (passive) 6–7 GHz], SST measurements would be severely constrained by high density deployment of communication systems (e.g. RLAN or IMT) in this range.

Approach proposed

Based on the elements developed above, WMO will stresses the need to ensure the continuity of SST measurements on a long-term basis as SST is a critical variable for climatological studies and for the assessment of global temperature trends as well as to ensure numerical weather prediction or numerical ocean prediction, in particular to support "Early Warnings for All" initiative.

Knowing that the development of scientific satellites takes multiple years, and that the selection of frequencies needs to be done several years before the launch, in addition to existing regulations, an early as possible WRC decision related to the use of EESS (passive) sensors in the 4-9 GHz frequency range will ensure SST measurements on a continuous and long-term basis.

As a consequence, WMO believes that the action has to be taken at WRC-23 as follows:

- To consider new primary EESS (passive) allocations in the 4.2-4.4 GHz and 8.4-8.5 GHz frequency bands in which SST measurements can also be performed.

- These possible new primary EESS (passive) allocations will not require protection from existing services but will be able to require protection from potential future new services/applications in these frequency bands.

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