

**WMO OMM**

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

Secrétariat

7 bis, avenue de la Paix – Case postale 2300
CH 1211 Genève 2 – Suisse
Tél.: +41 (0) 22 730 81 11
Fax: +41 (0) 22 730 81 81
wmo@wmo.int – public.wmo.int

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Annex: 1

Subject: WMO preparation and coordination of the International Telecommunication Union (ITU) World Radiocommunication Conferences in 2023 (WRC-23)

Action required: (1) To inform your national spectrum regulator about the WMO preliminary position on the WRC-23 agenda
(2) To consider nominating a representative of your NMHS to ET-RFC

Dear Sir/Madam,

I wish to inform you that many agenda items of the forthcoming World Radiocommunication Conferences in 2023 (WRC-23) are of prime interest for meteorological and scientific communities. You will find the preliminary World Meteorological Organization (WMO) positions related to the agenda items of WRC-23, produced by the WMO Expert Team on Radio-Frequency Coordination (ET-RFC) in the annexed paper, for your consideration.

The preliminary WMO positions are aimed at facilitating your national preparations to WRC-23 to be held in Dubai, United Arab Emirates, from 20 November to 15 December 2023. Final discussions before WRC-23 will be held during the conference preparatory meeting (CPM) scheduled for March and April 2023, where the final CPM report to WRC-23 will be approved.

The final WMO position paper will be elaborated at the next ET-RFC meeting planned to take place after the CPM and I encourage you to contribute to this work.

Among the WRC-23 agenda items, I would like to point out two specific issues, one related to the impact on the sea-surface temperature measurements if a new spectrum allocation for the future development of International Mobile Telecommunications (IMT) in the frequency range 6 425–7 125 MHz is decided (see [Annex 2](#) of the document attached), and another one related to the space weather issue for which large support will be needed to obtain its recognition in the Radio Regulations.

I should be grateful if you could kindly contact your national spectrum regulator to ensure that the importance of the issues to be discussed is well understood. I also encourage you to take the opportunity of this exchange with your national regulation authority to present the WMO preliminary position for all WRC-23 agenda items of particular interest for the community.

To: Permanent Representatives of Members with WMO

cc: Mr Michel Jean, President of INFCOM
Mr Houlin Zhao, Secretary-General of ITU
Mr Mario Maniewicz, Director of the ITU Radiocommunication Bureau

Recalling [Resolution 42 \(Cg-18\)](#) - Radio Frequencies for Meteorological and related Environmental Activities, which stresses the importance of the protection of radio frequencies allocated to Earth observation services which are vital for weather forecasts and long-term climate change monitoring, I would also like to ask you to consider nominating a representative of your National Meteorological and Hydrological Service (NMHS) to ET-RFC. This should facilitate the coordination between NMHSs and national radiocommunication administrations, particularly in preparing for the ITU World Radiocommunication Conferences, by providing appropriate information and documentation.

Please submit your nomination to the WMO Secretariat (zandreeva@wmo.int).

I would like to express my appreciation for your continued support in promoting the activities of WMO.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Zhang', written in a cursive style.

Dr Wenjian Zhang
for the Secretary-General

PRELIMINARY WMO POSITION ON THE WORLD RADIOCOMMUNICATION CONFERENCE 2023 (WRC-23) AGENDA

1. Introduction

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 Reduction¹.

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 Radiocommunication Conferences (Geneva, 2012)² observes that:

- Earth observation data are essential for monitoring and predicting climate changes, 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.

¹ See <https://public.wmo.int/en/our-mandate/what-we-do/wmo-contributing-sustainable-development-goals-sdgs>.

² 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: https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020?sc_camp=DD249A18F65340498C7674FA167CAC94.

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

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

This document reflects the preliminary WMO position on the agenda of the World Radiocommunication Conference 2023 (WRC-23)³.

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 6425–7075 MHz and 7075–7250 MHz frequency bands.

2. General comments

The WMO Integrated Global Observing System (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 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**⁴ 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

³ Resolution 811 (WRC-19) "Agenda for the 2023 World Radiocommunication Conference"

⁴ Radio Regulations footnotes are found in Volume 1 of the Radio Regulations. The Radio Regulations can be obtained at: https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020?sc_camp=DD249A18F65340498C7674FA167CAC94 .

unregulated and potentially mass-market short-range devices allowed nationally to operate in these bands or unwanted emissions from not properly regulated adjacent bands. Several geophysical parameters contribute, at varying levels, to natural emissions, which can be observed at a given frequency and present unique properties. Therefore, measurements at several frequencies in the microwave spectrum must be made simultaneously in order to isolate and 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 atmospheric component.

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 Radars⁵ 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 (2200–2290 MHz and 2025–2110 MHz) as well as for satellite downlink of the collected data (1675–1710 MHz, 7450–7550 MHz, 7750–7900 MHz, 8025–8400 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 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 floods 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 the 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) – Radio frequencies for meteorological and related environmental activities, in which all WMO Member countries are urged to make all efforts to do their utmost

⁵ Synthetic Aperture Radars (SAR) provide complementary information, which is useful for flood disaster management and many other applications.

to ensure the availability and protection of suitable radio-frequency bands required for meteorological and related environmental operations and research.

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, 20 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 1⁶
- 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 1.10: 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

⁶ 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.

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 frequency bands
- Agenda item 1.18: Potential new allocations to the MSS in the frequency bands 1695–1710 MHz, 2010–2025 MHz, 3300–3315 MHz and 3385–3400 MHz for future narrow-band MSS systems
- Agenda item 4: ITU-R Resolution 731
- Agenda item 7: Satellite regulatory procedures
- Agenda item 9.1(a): Appropriate recognition and protection in the Radio Regulations for space weather sensors, without placing additional constraints on incumbent services
- Agenda item 9.1(c): Study use of IMT for fixed wireless access in bands allocated to the fixed Service
- Agenda item 9.1(d): 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

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 6425–7250 MHz correspond 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 database⁷ 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 possible way forward.

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

⁷ See <http://oscar.wmo.int/space>.

bands have shown that guard-bands alone do not necessarily ensure the protection of the EESS (passive).

In addition, WRC-15 allocated 400 MHz to EESS (active) between 10 and 10.4 GHz, which increased up to 1200 MHz (9.2–10.4 GHz) the bandwidth and provides a higher resolution improving the performance of satellite observation used in particular for flood and climate change monitoring. Based on current sharing studies sharing is not feasible without mitigation techniques. The potential identification of the 10.0–10.5 GHz band for IMT could then result to reduce this improved monitoring capacity due to interference to EESS (active) at 10–10.4 GHz.

The above-mentioned potential interference issues in 10.0–10.4 GHz and 10.6–10.7 GHz require completed studies, including elaboration of restrictions to ensure protection of respectively EESS (active) and EESS (passive) operations, in the ITU-R under this agenda item.

Working Party 5D is the responsible group for the studies with Working Party 7C contributing on the EESS (passive) and EESS (active).

WMO Position on WRC-23 agenda item 1.2

WMO is not in favour of an IMT identification in any of the 6425–7075 MHz, 7075–7125 MHz, or 10.0–10.5 GHz frequency bands. If an identification is made, WMO would support:

- the continued use of EESS (passive) in the 6425–7075 MHz and 7075–7250 MHz frequency bands. WMO understands that footnote RR **No 5.458** does not provide an allocation to this service. Nevertheless, due to prime importance of sea-surface temperature measurements made in these frequency bands, WMO encourages administrations to bear in mind the needs of the EESS (passive) service in their future planning of the bands 6425–7075 MHz and 7075–7250 MHz when considering identification for IMT in these frequency bands,
- 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,
- the application of appropriate regulatory provisions to protect EESS (active) operations in the 10–10.4 GHz band.

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 3600–3800 MHz could lead to a shift of current fixed-satellite service (FSS) usage in the band above 3800 MHz, the possible impact on the FSS (space-to-Earth) above 3800 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 3600–3800 MHz could lead to a shift of current FSS usage in the band above 3800 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 2700 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.2316⁸ 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 (1675–1710 MHz) if the band 1710–1855 MHz, already identified for IMT, is used in the downlink direction from an airborne platform. The 1675–1710 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 1675–1710 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 1675–1710 MHz for MetSat use.

Finally, as the EESS/MetSat satellite systems are using the band 2025–2110 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 2025–2110 MHz band. WMO acknowledges that IMT equipment are already authorized to operate in the 2 110–2 170 MHz band (downlink direction).

Working Party 5D is the responsible group for conducting the above studies, with Working Party 5B contributing on meteorological radar, and Working Party 7B contributing on MetSat service.

⁸ <https://www.itu.int/pub/R-REP-M.2316>

WMO Position on WRC-23 agenda item 1.4

WMO is not opposed to an 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 1675–1710 MHz band, HIBS operations in the 1710–1785 MHz band would have to be limited to the uplink direction (HIBS receiving from IMT UE),
- In order not to change the interference environment for EESS and SOS in the 2025–2110 MHz band, HIBS operations in the 2110–2170 MHz band would have to be limited to the downlink direction (HIBS transmitting to ground-based UE),
- Application of appropriate regulatory provisions for HIBS operations in the 2500–2690 MHz band, with necessary limits in the 2700–2900 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.
- Moreover, the application of HIBS in the 2500–2690 MHz shall not impose extra limitations over the expansion of weather radars in the band 2700–2900 MHz. This is to avoid the situation with the current terrestrial-based IMT systems, which impose limitations on meteorological radars.

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**.

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.

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) and Earth exploration-satellite services (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.

Working Party 5B is the responsible group for the studies, with Working Party 7B contributing on MetSat and EESS systems.

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 future MetSat and EESS operations. In particular, Method B, Approach A of the Draft CPM text produced by WP 5B aligns with WMO objectives.

3.6 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.

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).

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 (footnote RR **No 5.340**), however, there is no documented use of the frequency band by the EESS (passive).

Adjacent band study is required to ensure the protection of these EESS (passive) in the 22.21–22.5 GHz frequency bands.

Working Party 5B is the responsible group for the studies, with Working Party 7C contributing on the EESS (passive) systems.

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.

3.7 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 space-borne 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 the 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/climate purposes.

Working Party 7C is the responsible group for the studies, with Working Party 5B contributing on oceanographic radars and wind profiler radars.

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 5.162A.

3.8 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.

Working Party 7B is the responsible group for the studies.

WMO Position on WRC-23 agenda item 1.13

WMO is not opposed to the upgrading of the existing space research service (SRS) secondary allocation in 14.8–15.35 GHz to primary status.

3.9 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.

However, to fulfil this requirement, a rearrangement of the FS and MS allocations would be required, 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 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.

Working Party 7C is the responsible group for conducting the studies.

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.

3.10 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 issues between Earth stations on aircraft and vessels communicating with geostationary satellite orbit (GSO) space stations in the FSS, have to be studied. In addition, studies of the current and planned stations of existing services, as well as services in adjacent frequency bands, will also have to be conducted.

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.

Working Party 7C is a contributing group working on EESS (active) in 13.25–13.75 GHz.

Ref.: 25441/2022-15 VSSU

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.

3.11 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 fixed-satellite service (FSS) Earth stations in motion (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 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 currently indicate a need of an out-of-band pfd limit of $-126.4 \text{ dBW/m}^2/200 \text{ MHz}$ to ensure protection of the EESS (passive) sensors.

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. It is unclear at this stage how no additional constraints to the EESS can be ensured without contravening a basic principle of the Radio Regulations.

Working Party 4A is the responsible group for the studies, with Working Party 7B contributing on the EESS in 28.5–30 GHz, and Working Party 7C contributing on the EESS (passive) in 18.6–18.8 GHz.

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 at the Earth's surface is applied to ensure protection of the EESS (passive) in the band 18.6–18.8 GHz. Current studies show that a value of $-126.4 \text{ dBW/m}^2/200 \text{ MHz}$ might be suitable.

No studies have been conducted with respect to the MetSat service, however additional provisions may be required to ensure non-GSO FSS ESIM deployment will protect the co-frequency band MetSat allocation in the bands 18–18.3 GHz (ITU Region 2) and 18.1–18.4 GHz (ITU Regions 1 and 3).

3.12 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).

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**.

WMO could have some interest with these particular links.

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. In this context, it is to be studied if the operation of satellite-to-satellite links in the adjacent bands would result in changes to the interference environment to EESS (passive).

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**. It is unclear at this stage whether protecting this secondary allocation needs to be addressed.

Working Party 4A is the responsible group for the studies, with Working Party 7B contributing on the MetSat service in 18–18.4 GHz and Working Party 7C contributing on the EESS (passive) in 18.6–18.8 GHz.

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 link transmissions will not lead to an increase interference to MetSat in the bands 18–18.3 GHz (ITU Region 2) or 18.1–18.4 GHz (ITU Regions 1 and 3), or to EESS (passive) in the band 18.6–18.8 GHz. In particular, WMO supports that an appropriate out-of-band pfd limit at the Earth’s surface is applied to ensure protection of the EESS (passive) in the band 18.6–18.8 GHz. Current studies show that a value of $-126.4 \text{ dBW/m}^2/200 \text{ MHz}$ might be suitable.

3.13 Agenda item 1.18

“to consider studies relating to spectrum needs and potential new allocations to the mobile-satellite service for future development of narrow-band 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 1695–1710 MHz (in Region 2 only). The frequency band 1695–1710 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 1675–1710 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 1675–1710 MHz for MetSat use.

Also, as EESS/MetSat satellite systems are using the band 2025–2110 MHz for telecommanding and uplinking instrument data, WMO is concerned with the protection of the allocations of the EESS/SOS in the 2025–2110 MHz band.

Working Party 4C is the responsible group for the studies, with Working Party 7B contributing on the EESS/MetSat services, while Working Party 7C is a contributing group with regard to the MetAids service in the band 1668.4–1700 MHz.

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 :

- current and future MetSat operations in the band 1695–1710 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
- EESS and SOS in the adjacent band 2025–2110 MHz.

3.14 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 the activities requested by *invites 1* and *2* of Resolution **731** (Rev. WRC-19).

WMO Position on WRC-19 Agenda item 4

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

3.15 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 geostationary satellite orbit.”*

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. The full list of Agenda Item 7 topics are as follows:

Topic A: Tolerances for non-GSO orbital characteristics in the FSS, BSS, and MSS

Topic B: Non-GSO BIU post-milestone procedure

Topic C: Protection of GSO MSS from non-GSO emissions in 7/8 and 20/30 GHz

Topic D1: Modifications to Appendix 1 to Annex 4 of AP 30B

Topic D2: New AP4 parameters for Rec. S.1503 updates

Topic D3: BR reminders for Bringing into Use and Bringing Back into Use

Topic E: Improved procedures under AP 30B for new ITU member States

Topic F: Impact of excluding feeder-link/Uplink service and coverage areas in the bands subject to RR Appendix 30A and RR Appendix 30B

Topic G: Amendments to Resolution 770 (WRC-19)

Topic H: Implicit agreement in Radio Regulations AP30/30A/30B

Topic I: Special agreements under Radio Regulations Appendix 30B

Topic J: Modifications to Resolution 76 (Rev.WRC-15)

Topic K: Modifications to Resolution 553 (Rev.WRC-15)

Topic L: TT&C for In-Orbit-Service non-GSO

Working Party 4A is the responsible group for conducting the above studies.

WMO Position on WRC-19 Agenda item 7

WMO does not support changes 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 follow and monitor the development of Agenda Item 7 issues as they are identified and studied.

3.16 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 of 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. It is of vital importance to WMO Members that this effort be completed to ensure protection of sensor operations in the future.

Under WRC-23 Agenda item 9.1 Topic (a), the following issues need to be completed for consideration by WRC-23:

- Determine the appropriate radiocommunication service or services that these sensors should fall under. It is proposed at this stage to include the receive-only and the active usage of space weather sensors in a subset of the MetAids, called the MetAids (space weather).
- *Resolves 2 and 4 of Resolution 657 (Rev. WRC 19), ask respectively to conduct sharing studies with incumbent systems operating in frequency bands used by receive-only operational space weather sensors and active space weather sensors with the objective of determining potential regulatory provisions that can be provided for their appropriate recognition in the Radio Regulations, while not placing additional constraints on incumbent services. Analysis done in WP 7C considers that due to the nature of the space weather application (active or receive-only) specific provisions in the RR are needed. But it is also recognized that it would be difficult at this stage to modify Article 5 through this topic of agenda item 9.1 as, in particular due to the fact that space weather is not recognized in the RR. It will be then necessary to elaborate on a new WRC-27 Agenda item (based on the view 2.6 of Resolution 812 (WRC-19)) to provide opportunity to conduct all necessary studies mentioned above. WMO notices that such new WRC-27 Agenda item will only be appropriate if WRC-23 decides to recognize space weather in the RR.*
- Develop potential solutions to describe in the Radio Regulations, Articles 1 and 4, and/or as a WRC resolution, if deemed appropriate space weather sensor systems and their corresponding usage, as well as protection requirements for receive-only space weather sensors. The following definitions were elaborated in WP7C for inclusion in RR Articles 1 and 4, at the appropriate time:
 - 1.XXX space weather: *information relating to the characteristics of natural phenomena occurring in space and in high atmosphere that impact Earth's environment and human activities;*
 - 4.XXX Space weather sensors intended to observe phenomena in space or high atmosphere may use the meteorological aids service (space weather) allocations.

Working Party 7C is the responsible group for conducting the studies.

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

WMO supports the definition proposed by WP7C 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,
- the development of a new WRC-27 Agenda item on space weather to define regulatory provisions while not placing constraints on incumbent services.

3.17 Agenda item 9.1 Topic (c)

“Study the use of International Mobile Telecommunication system 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 has hence the potential to change coexistence conditions for services allocated in-band or adjacent to frequency bands allocated to the fixed service.

This agenda item could affect a number of meteorological applications including EESS, MetSat and MetAids frequency bands either in-band or 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.

Working Parties 5A and 5C are jointly responsible for conducting studies with Working Parties 7B and 7C contributing.

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

WMO is concerned about this Topic (c) under Agenda item 9.1 that 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 space science services needs to be ensured. Consequently, WMO supports no change to the Radio Regulations, other than the suppression of Resolution 175 (WRC-19), under this agenda item 9.1 topic.

3.18 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. 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.

Working Party 7C is the responsible group for conducting the studies.

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) in the band 36–37 GHz from non-GSO FSS operations in the band 37.5–38 GHz. To achieve this, WMO supports the relevant conditions identified in the results of the ITU-R studies performed under this agenda item and their appropriate implementation as regulatory provisions in the RR to protect EESS (passive) sensors.

3.19 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.

Working Party 5D is the responsible group for conducting the studies.

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 for IMT stations with AAS with respect to RR **No 21.5** in the frequency band 25.5–27 GHz before an appropriate competent WRC decision is taken.

3.20 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: 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 the 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: 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: 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: 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 while not placing 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: 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 narrow-band 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: 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 AI 1.18. WMO is also of the view that given the results of studies completed under WRC-23 AI 1.18, the band 1675–1710 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 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-R on topics outside of WRC-23 preparatory activities that concern 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 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.

WMO concerns on the potential risk regarding the future usages in the 6425–7125 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 6425–7125 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 6425–7075 and 7075–7250 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 6425–7075 and 7075–7250 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

In order to avoid that the critical SST measurements not be usable if such high density deployments occur, the following approach should be taken into account:

- administrations bear in mind the needs of the Earth exploration-satellite (passive) service in their future planning of the bands 6 425–7 075 MHz and 7 075–7 250 MHz, as per footnote RR **No 5.458**,
- to consider new EESS (passive) allocations in the 4–10 GHz frequency range in which SST measurements may also be performed, although at the cost of reduced SST sensitivity relative to 6 425–7 075 MHz and 7 075–7 250 MHz frequency range. This should be done in a timely manner to ensure continuity of SST measurements.