

## Your response

The Met Office is the UK's National Meteorological Service, a Public Sector Research Establishment and an Executive Agency of the Department for Business, Energy and Industrial Strategy. We are responsible for monitoring and forecasting the weather, including space weather and providing the National Severe Weather Warning Service (NSWWS) which warns of the impacts caused by severe weather ranging from disruption to transportation networks to danger to life.

In addition to services provided to the UK public, the Met Office is designated by the International Civil Aviation Organisation (ICAO) as one of only two World Area Forecast Centres (WAFc). The two WAFcs share responsibility for providing essential, global, en-route weather forecasts for all civil aviation flight planning above 25,000 feet. The Met Office Hadley Centre provides climate science and services to help Government, industries and people understand and prepare for climate change, including the monitoring of global and national climate variability and change.

The Met Office represents the UK in the World Meteorological Organization (WMO) which supports the free exchange of observational data, information and derived products between WMO centres and national meteorological and hydrological services of Members around the world in real-time or near real-time. As a result of this data exchange, the Met Office benefits from weather and climate measurements made by national meteorological services around the world. The Met Office also represents the UK in EUMETSAT an intergovernmental organisation dedicated to the operation of meteorological satellites.

Satellites are hugely important to our weather forecasts and contribute significantly to our forecast accuracy. Almost all Met Office services are underpinned by both passive and active remote sensing technologies which use a range of frequencies to observe the atmosphere and wider Earth system. The frequency bands used for these measurements are determined by physical properties of the Earth system and many are used for sensitive passive measurements which are highly susceptible to interference. The use of these measurements in both operational weather forecasting and climate monitoring means that they underpin almost all Met Office services to the UK public and industry. The Met Office also make extensive use of spectrum for the wireless transmission of data, including to and from meteorological satellites.

We are happy to provide additional information related to our response to this consultation.

Question	Your response
<b>Question 1: Do you agree with the prioritisation of the agenda items, as shown in Annex 5, and if not why?</b>	<p>The highest priority items for the Met Office are those associated with new recognition of current and future measurement capabilities related to weather and climate. These are Agenda Item 1.14 and 9.1 topic A.</p> <p>Beyond these, many agenda items could impact on our ability to access measurements of the Earth system, these are noted as medium priority below. The frequency bands used for these measurements are determined by physical properties of the Earth system and many are used for sensitive passive measurements which are highly susceptible to interference. The use of these measurements in both operational weather forecasting and climate monitoring means that they underpin almost all Met Office services to the UK public and industry.</p>

	<p>Beyond these measurements, the Met Office also makes use of radiofrequency for communication with meteorological satellites and to share data with other national meteorological services. These communications provide essential data for Met Office operations, although the frequencies used are less constrained than those used for remote sensing measurements.</p> <p>Below is a note of the importance of WRC-23 Agenda Items from the Met Office perspective, as of September 2022.</p> <p>High priority Agenda Items: 1.14, 9.1 topic A</p> <p>Medium Priority Items: 1.2, 1.3, 1.4, 1.10, 1.16, 1.17, 9.1 topic C, 9.1 topic D</p> <p>Low priority items: 1.5, 1.6, 1.12, 1.18, 7</p>
<p><b>Question 2: What are your views on the continued need to protect global aeronautical and maritime services, in the 4.8 – 4.99 GHz band, under this agenda item?</b></p>	<p>No response</p>
<p><b>Question 3a: Do you agree that the UK interest in the bands 3 600-3 800 MHz and 3 300-3 400 MHz in Region 2 (North &amp; South Americas) should be limited to any impacts on UK operational use in those areas?</b></p>	<p>No response</p>
<p><b>Question 3b: Do you agree that the UK should maintain its objections to changes to the regulatory environment for the band 3300-3400 MHz (in Region 1, Europe, Africa, Middle East), noting UK has interests in use of radar for both ground and airborne operations?</b></p>	<p>No response</p>

**Question 3c: What is your view on the use of 6425-7025 & 7025-7125 MHz, and what evidence do you have to support this view? How does that inform your views on a IMT identification in these bands?**

These frequencies overlap with passive remote sensing of sea surface temperatures (SST) at 6575-7275 MHz made by the Advanced Microwave Scanning Radiometer ([AMSR-2](#)) instrument. The Met Office is concerned about the future viability of these measurements if this band is allocated to IMT.

Measurements of SST are important to weather forecasting and climate science due to the important role of oceans in the climate system and such, these measurements are considered an Essential Climate Variable<sup>1</sup>. The inclusion of high quality SST measurements in weather forecast models are especially importance for predictions of hurricane formation and seasonal changes such as El Niño.

The AMSR-2 instrument provides global coverage and is used alongside in-situ data from drifting buoys, and satellite measurements made in the infrared (i.e. at much higher frequencies). Measurements from this instrument are more spatially homogeneous than infrared measurements, as observations are available in the presence of cloud and aerosols (such as Saharan dust).

AMSR-2 SST measurements have been used in Met Office operational weather forecasts since 2016 and have been shown to improve the accuracy of our sea surface temperature maps. Losing access to this data would set back the accuracy of Met Office weather forecasts and undermine the investment made to bring these data into our operational forecast system. The Met Office are also using historical AMSR-2 data within a new SST climate data record for the ESA Climate Change Initiative, which is an important resource for climate researchers.

Future missions are planned based on the continued use of the 6575-7275 MHz band, including the AMSR-3 instrument which will be launched by JAXA (the Japan Aerospace Exploration Agency) in 2023 and the Copernicus Imaging Microwave Radiometer (CIMR) which is expected to be launched by ESA in 2028. These future instruments are planning to make use of this band into the 2040s.

The use of the 6425-7025 & 7025-7125 MHz bands by IMT could have a significant impact on current and planned SST measurements. This would risk undermining investment in current and planned missions.

**In order to provide continuity in measurements of this important weather and climate variable, the Met Office encourages Ofcom to bear in mind the needs of the EESS (passive) service when considering the future planning of the bands 6425-7075 MHz and 7075-7250 MHz, and not support the identification of IMT in these bands.**

---

<sup>1</sup> <https://public.wmo.int/en/programmes/global-climate-observing-system/essential-climate-variables>

	<p><b>If these measurements cannot be suitably protected in the 6575-7275 MHz band, it may be possible to make SST measurements at a different frequency in the 4-10 GHz range.</b> Measurements made at a different frequency are more likely to be impacted by other variables (such as wind speed), so additional time may be required to undertake intercomparisons between new and existing instruments. <b>The identification of an alternative band would need to be done in a timely manner to enable instrument development and avoid gaps in the time series of SST measurements.</b></p>
--	---

<p><b>Question 3d: What are your thoughts on the current UK view that IMT should not be identified in Region 2 in the band 10-10.5 GHz in order to ensure the protection of the globally operating EESS (active) systems and airborne &amp; vessel mounted radars?</b></p>	<p>The Met Office agree with Ofcom's position on the requirement to ensure suitable protection for EESS (active) at 10.0-10.4 GHz and EESS (passive) at 10.6-10.7 GHz.</p> <p>The Met Office makes use of EESS (passive) measurements made at 10.6-10.7 GHz from multiple current satellite instruments (AMSR-2, GMI , MTVZA-GY and MWRI) for quality control of data from these instruments, which supports our weather and climate services to the UK public and beyond.</p> <p>Given the importance of these measurements to our operations, <b>the Met Office would require assurance that these sensitive passive measurements would be suitably protected from out of band emissions from any new allocation at 10.0-10.5 GHz.</b></p>
<p><b>Question 4: Do you agree that, where no additional technical limitations are placed on mobile services, the UK can support an upgrading of the mobile allocation, in 3600 - 3800 MHz, from secondary to primary?</b></p>	<p>The Met Office makes use of the fixed satellite service in the band 3600-4200 MHz for the distribution of meteorological data through the GEONETCast network (operated in Europe and Africa as EUMETCast). This allows us to exchange essential meteorological data with other national meteorological services around the world, enabling the inclusion of global data in our operational forecast systems.</p> <p>We are concerned that an IMT identification in the 3600-3800 MHz band could lead to a shift of current FSS usage and impact on this important data sharing system.</p>

**Question 5: What are your views on the development of regulatory conditions to facilitate deployment of high altitude IMT base stations in IMT identified bands below 2.7 GHz?**

The Met Office makes use of transmissions at 1675-1710 MHz for the sharing of meteorological data and reception of data from meteorological satellites. Given this requirement we have an interest in ensuring deployment of HIBS includes protection for these incumbent services.

In addition, other national meteorological services in Europe (Croatia, France, Greece, Romania and Serbia) with whom the UK Met Office have data sharing arrangements operate weather radars at 2.7-2.9 GHz. The Met Office benefits from access to this data through partnerships such as EUMETNET and it provides valuable information about weather which can go on to impact on the UK (e.g. the development of thunderstorms in the Bay of Biscay, which can lead to severe weather and disruption in Southern England). Given this requirement we have an interest in ensuring that HIBS does not cause interference to weather radars operating at this frequency, and that any deployment takes into account the 3D requirements of weather radar systems.

**Question 6: Do you agree that a formal modification to the Radio Regulations is not needed for fixed service applications that use IMT technologies?**

**The Met Office agree with the Ofcom position of no change.**

This is on the basis that this proposed modification is very broad in scope and could potentially affect a large number of meteorological operations and applications, including EESS (passive) services operating under RR No 5.340 which the Met Office rely on for measurement of various meteorological parameters.

**Question 7: What are your views on the proposed approach for 470-694 MHz, recognising the national decisions already in place and taken for DTT multiplex licensing in the band, and the additional and supplementary spectrum made available for UK PMSE usage?**

**The Met Office agree with Ofcom approach of no change.**

The frequency band 470-494 MHz is currently used by wind profiler radars used by various national meteorological services with whom the UK Met Office have data sharing arrangements through the WMO.

**Question 8: What are your views on the need to establish an international regulatory environment that provides adequate protection of UK fixed links from earth stations in motion, in the band 12.75 – 13.25 GHz, which is also practicable from an enforcement/implementation perspective?**

No response

**Question 9: Do you agree that the UK continues to support the maritime distance figure for ESIMs that work to nongeostationary satellites and to test the other conditions agreed at WRC-19 for ESIMs working to geostationary satellites to ascertain whether these remain appropriate for nongeostationary satellites?**

The Met Office makes use of remote sensing measurements in the band 18.6-18.8 GHz, these are used in our operational forecast system so underpin our services to the UK public and industry. We do not oppose the use of the bands under consideration in this agenda item for communications with nonGSO FSS ESIM, or the use of the maritime distance figure proposed by Ofcom, provided that an appropriate out-of-band pfd limit at the Earth's surface is applied to ensure protection of the incumbent EESS (passive) service which we rely on.

Current studies show that a value of -126.4 dBW/m<sup>2</sup>/200 MHz might be suitable.

**Question 10: What are your views on whether an allocation to inter satellite links is necessary for existing satellite allocated bands and whether this would provide benefits internationally?**

The current UK position highlights the need to ensure various incumbent services are protected but does not mention EESS – which provides a great deal of the data which underpins Met Office services.

One of the frequency bands within the scope of this agenda item (18.1-18.6 GHz) is adjacent to the frequency band 18.6-18.8 GHz which is used for the remote sensing of a range of meteorological variables used in Met Office operational systems.

In addition to the sensitivity of passive remote sensing to emissions at lower altitudes (e.g. from IMT), these services also utilise views of cold space for calibration. There is the risk that these cold space calibration views (which necessarily have very low signals) could be contaminated by such proposed intersatellite communications.

**Given the importance of these measurements to our operations, the Met Office would require assurance that these sensitive passive measurements – including cold space calibration views – would be suitably protected from out of band emissions from satellite-to-satellite links. ITU-R studies indicate that this would require an out of band emissions limit of -126.4 dBW/m<sup>2</sup>/200 MHz.**

<p><b>Question 11: What are your views on the need for additional satellite allocations in support of narrowband IoT “M2M” type applications, noting that there remains the continued use of PMSE for wireless cameras in the band 2010 – 2025 MHz?</b></p>	<p>Across the frequencies noted in the consultation document, two of these are currently used for meteorological satellite transmissions.</p> <ul style="list-style-type: none"> <li>• <b>1695-1710 MHz</b> is used for the data reception, command and control of NOAA and EUMETSAT satellites.</li> <li>• <b>2025-2110 MHz</b> is used for the data reception, command and control of EUMETSAT satellites.</li> </ul> <p>These satellites provide data vital to the provision of Met Office services to the UK public and industry. Any new allocation in these bands would need to ensure suitable protection for these incumbent services.</p>
<p><b>Question 12: What are your views on the proposed approach to this agenda item concerning the fixed satellite service in 17.3-17.7 GHz in Region 2?</b></p>	<p>No response</p>
<p><b>Question 13a: On Topic B, what are your views on the post milestone procedures for non-geostationary satellite systems?</b></p>	<p>No response</p>
<p><b>Question 13b: On Topic L, what are your views on regulatory conditions for Telemetry, Tracking and Command (TT&amp;C) for NGSO in-orbit servicing?</b></p>	<p>No response</p>
<p><b>Question 13c: What are your views on the remaining topics currently listed for Agenda Item 7?</b></p>	<p>As a member of the World Meteorological Organization and EUMETSAT, <b>the Met Office does not support changes to the RR that would impose unnecessary constraints on MetSat and EESS systems or over-complicate the regulatory procedures for the corresponding ITU filings for the frequency bands that are used by these systems.</b></p>

<p><b>Question 14: Noting that any UK position will be developed only after the ITU Plenipotentiary Conference, do you have any comments relating to the use of Article 48 that may be addressed at WRC-23?</b></p>	<p>No response</p>
<p><b>Question 15: What are your views on the need to establish an international regulatory environment for sub-orbital vehicles, which at the same time does not limit flexibility of spectrum options, and retains international safety considerations?</b></p>	<p>The Met Office supports studies on the development of regulatory provisions to meet the requirements of sub-orbital vehicle operations but would be opposed to provisions that have a negative impact to current and future MetSat and EESS operations.</p>
<p><b>Question 16: Do agree that where the adjacent band compatibility issues are addressed and ICAO coordination processes are not compromised, that the addition of an aeronautical satellite (AMS(R)S) allocation to the band can be supported?</b></p>	<p>No response</p>
<p><b>Question 17: Do agree that functions related to international aviation safety are a matter for ICAO? On this basis, and absent any contrary information from ICAO, should the UK support the development of an international spectrum regulatory framework for UA use of FSS that would support efficient use of spectrum?</b></p>	<p>No response</p>



<p><b>Question 18: Recognising the recent diminishing industry interest in this item relating to possible modification of the aeronautical HF assignment plan, and the general lack of global interest, do you agree that UK move towards a No Change proposal under this agenda item?</b></p>	<p>No response</p>
<p><b>Question 19: What are your views on the need for additional spectrum, specifically in the 15 [15.415.7] and 22 [22-22.21] GHz bands, for non-safety aeronautical use?</b></p>	<p>The Met Office does not currently have any plans to make use of additional spectrum in either of these bands.</p> <p>The Met Office makes use of passive remote sensing measurements in the 21.1-22.5 GHz band for the measurement of atmospheric water content. These data are used in our operation weather forecast system so underpin our services to the UK public and industry.</p> <p>The Met Office would require assurances that more widespread use of aeronautical mobile in the 22 GHz band would not create interference with these sensitive measurements. Method C or D in the current (Sept 2022) draft CPM text would allow this as long as the proposed footnote contains appropriate unwanted emission limits. Studies indicate a value of -23dBm / 100 MHz will be required to protect EESS passive in the adjacent band.</p>
<p><b>Question 20: What are your views on Agenda Item 1.11 and the proposed UK position to support modernisation of GMDSS?</b></p>	<p>No response</p>
<p><b>Question 21: What are your views on the approach to the review of 1240-1300 MHz, recognising that discussions concerning future satellite navigational needs for the UK are a matter for Government?</b></p>	<p>No response</p>

**Question 22: What are your views on a new spectrum allocation in the 40-50 MHz range to support and enhance climate monitoring, such as, environmental shifts in ice sheets?**

**The Met Office is supportive of studies to ensure compatibility of existing services with a new allocation for EESS (active).**

The spaceborne radar sounders which this new allocation is seeking to support could provide additional observations of ice thickness. This additional information could be hugely relevant for climate studies, as the impact of Antarctic ice sheet melt on future sea level rise remains a major uncertainty in climate science, as highlighted in the IPCC 6<sup>th</sup> Assessment Report<sup>2</sup>.

A wind profiler radar is operated in this frequency band by the Natural Environmental Research Council at Aberystwyth. The Met Office have considered relevant compatibility studies and are satisfied that the new applications described in this agenda item will not require additional constraints to avoid interference with ground-based wind profiler radars.

**Question 23: What are your views on upgrading the Space Research Service allocation, from secondary to primary, in the 14.8-15.35 GHz band?**

No response

<sup>2</sup> IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896.

**Question 24: What are your views on the potential for defragmentation in this band to facilitate both EESS (passive) use and provide for larger contiguous blocks for fixed & mobile allocations?**

**The Met Office are supportive of new primary allocations proposed under this agenda item, to support the provision of new weather and climate measurements.**

The Met Office – as the UK’s representative in EUMETSAT – are keen to ensure that suitable allocations are in place for the operation of the Ice Cloud Imager instrument. This instrument will provide valuable information regarding ice clouds, which play a significant role in the global hydrological cycle. The impact of clouds on the climate system is still a significant area of uncertainty in climate science, so the additional measurements made by this instrument will improve our understand of the Earth system and our ability to predict, mitigate and plan for future climate change.

**Question 25: Do you agree that formal international recognition for Space Weather Sensors should be implemented in the Radio Regulations?**

**The Met Office are very supportive of the recognition of Space Weather sensors in the Radio Regulations, as this would support current and future space weather frequency requirements. The Met Office will continue to work with Ofcom to ensure that they have the information needed about these requirements.**

As noted in the consultation document, the Met Office operates the UK's Space Weather Operation Centre, which is one of a small number globally with specialist 24/7 capability. As such we play a key role in supporting the global space weather enterprise and are a member of the WMO's Expert Team on Space Weather<sup>2</sup>, which is working to support the ITU-R studies regarding the Space Weather recognition and protection in the international radio regulation at ITU-R level.

In addition to the three space weather prediction centres noted in the consultation document, South Africa and China also operate 24/7 space weather centres and are likely to have an interest in this agenda item. More nations are developing similar centres, so the number of space weather prediction centres is likely to increase between now and WRC-23.

**Question 26: What are your views on the limits proposed to protect EESS (passive) under Agenda Item 9.1 topic d) and do you have any views on which of these limits might be accommodated in the Radio Regulations and how?**

The Met Office makes use of EESS (passive) measurements at 3637 GHz to provide information on a variety of meteorological parameters including cloud liquid water content. These measurements are incorporated into our operational systems which underpin services to the UK public and industry.

**The two proposed limits outlined in the document seek to provide protection for two elements of EESS (passive) operations: measurement and cold calibration. As both of these are important to the operation of EESS (passive) measurement systems which the Met Office rely on, we support the requirement of limits to provide suitable protection for EESS measurement and cold calibration.**

**Question 27: Do you agree that the formalised time reference in common global use, is not a matter of spectrum regulation?**

No response

<sup>2</sup> WMO Expert Team on Space Weather (ET-SWx):

<https://community.wmo.int/governance/commissionmembership/commission-observation-infrastructure-and-information-systems-infcom/commissioninfrastructure-officers/infcom-management-group/standing-committee-data-processing-applied-earthssystem-modelling-and-prediction-sc-esmp>

<p><b>Question 28: Do you have any comments concerning the Standing Agenda Items, where not covered elsewhere in this document?</b></p>	<p>No response</p>
<p><b>Question 29: Do you have a view on any of the footnotes to which UK is a party?</b></p>	<p>No response</p>
<p><b>Question 30: Are you aware of any specific issues, not covered elsewhere in this document, which are likely to be raised in this part of the Director's Report and of which you think Ofcom should be aware?</b></p>	<p>No response</p>
<p><b>Question 31: Do you have any comments on Agenda Item 9.3 considering Resolution 80?</b></p>	<p>No response</p>
<p><b>Question 32: What changes to the Radio Regulations have you identified that would benefit from action at a WRC and why? Do you have any proposals regarding UK positions for future WRC agenda items or suggestions for other agenda items, needing changes to the Radio Regulations, that you would wish to see addressed by a future WRC?</b></p>	<p><b>A new allocation for EESS (passive) measurements</b></p> <p>Depending on how Agenda Item 1.2 develops, there may be additional work required to establish a suitable allocation for Sea Surface Temperature measurements in the microwave range. Early identification of a suitable channel would enable satellite manufacturers to incorporate a new channel alongside existing measurements; allowing intercomparisons to ensure the integrity of the climate monitoring record.</p> <p>The following potential Future Agenda items listed within WRC23 Agenda Item 10 are of interest to the Met Office:</p> <p><b>Preliminary Agenda Item 2.1: Radiolocation Service in 230700 GHz</b></p> <p>The frequency ranges identified in this agenda item overlap various frequencies used for passive remote sensing. The needs of these incumbent users would need to be protected against interference from a potential new allocation.</p> <p><b>Preliminary Agenda Item 2.2: Aeronautical and Maritime Earth Stations in Motion</b></p>

	<p>This preliminary agenda item introduces the potential for increased interference to measurements in the 50.2-50.4 GHz frequency band, which the Met Office make extensive use of. The needs of these incumbent users would need to be protected against interference from a potential new allocation.</p> <p><b>Preliminary Agenda Items 2.4, 2.5 and 2.7: frequency bands 7176 GHz and 81-86 GHz</b></p> <p>The Met Office makes use of measurements made in the 81-86 GHz band, so any agenda item related to that frequency band would need to consider the needs of these incumbent users and ensure that they are suitably protected.</p> <p>We have grouped these possible Agenda Items together because if either Agenda Item 2.4 or 2.7 is included on the WRC-27 agenda, then item 2.5 would also need to be included to consider the protection of these incumbent EESS (passive) measurements.</p> <p>Given the increased interest in the use of bands about 71 GHz by active services, the Met Office supports extending the scope of this agenda item to consider additional unwanted emission limits above 71 GHz.</p> <p><b>Preliminary Agenda Item 2.6: Space weather sensors</b></p> <p>The work which the Met Office have undertaken to date with Ofcom and others on the recognition of space weather sensors in the Radio Regulations has highlighted the benefit which these sensors provide to the UK and beyond. We support further work to capture both current and future space weather spectrum requirements in the Radio Regulations, including expanding the scope from passive to active measurement systems.</p>
<p><b>Question 33: What are your views on the use of IMT stations that use antennas that consists of an array of active elements, in bands shared with satellite services?</b></p>	<p>No response</p>