

# An overview of current spectrum issues relevant to ATOVS-heritage systems



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## Why should ITWG care about Spectrum issues?

ATOVS-heritage observations are important to the accuracy of weather forecasting, climate science, nowcasting, hydrology and cryoscience. The microwave component relies on agreements on sharing spectrum with other applications, and the competition for spectrum is getting ever more intense, as discussed in [1]-[6]. This poster provides an update on issues of concern to ITWG and calls for closer collaboration.

## Current issues

### WRC-19 and 24 GHz



Table 1: Radio bands and RFI reporting

Band	L	C	X	K	Ka	V	W	G
Frequency GHz	1-2	4-8	8-12	18-27	27-40	40-75	75-110	110-300
RFI reported?	Y	Y	Y	Y	N	N	N	N

Concern has been expressed by many organisations with respect to the outcome of WRC-19 for 24 GHz where the decision fell short of the WMO position <https://www.itu.int/pub/R-ACT-WRC.14-2019/en> [2]

Need for enhanced monitoring of 24 GHz, e.g. against NWP and extension of ESA GRDS system [3].

ECMWF, EUMETSAT and ESA have discussed providing bespoke monitoring of 24 GHz based on ECMWF's operational monitoring, providing comparison to a reference "clean RFI-free" period, and focussing monitoring on geographical areas where RFI is most likely. It would be of enhanced value to do this at multiple centres, to increase confidence that RFI is detected and to share information on RFI.

An RFI screening system called GRDS (Ground RFI Detection System) has been developed, as described in [3]. This was designed for SMOS and has proven successful in flagging additional RFI. Such methods can't recover lost data, but they can reduce the impact of bad observations on operational services. The GRDS could be extended to 24 GHz, to help monitor for RFI from the future 5G rollout.

### L, C, X bands (lower frequency than ATOVS heritage instruments, but of interest)

As noted in Table 1 RFI has been widely reported in these bands. The problem is particularly severe at L-band, used by instruments such as SMOS and SMAP, and in future by CIMR, and led to the GRDS development [3] mentioned above and in-flight filtering for SMAP. Examples of RFI at C and X bands are also seen in the ECMWF RFI workshop report [4] and in [5]. Security scanners are a current concern at X-band.

### K, Ka, V, W, G bands (bands used by ATOVS heritage instruments)

The band adjacent to the 50 GHz oxygen band which provides critically important all-weather temperature information was one of bands targeted by the 5G industry, though at the World Radiocommunication Conference in 2019, this issue was dealt with satisfactorily. However, whilst 50 GHz appears safe for now, there has been new interest in sharing higher frequency bands used by meteorology, in W and G bands.

Economic and political pressure on regulatory authorities to open up new spectrum [ITU resolution 731 (f>71 GHz)].

In USA and UK bandwidth close to the 118 and 183 GHz bands was identified as suitable for sharing between meteorology and others. There are also many UltraWideBand applications above 100 GHz.

ECMWF, Met Office and UKSA provided more realistic model information about attenuation [6], to aid decision making by regulators

Figure 1 shows attenuation in intervals between 175 and 190 GHz. This shows that at the edge of the 183 GHz band the attenuation is only 3 dB for Total Column Water Vapour (TCWV) < 5mm. The ERA5 re-analysis (Figure 2) shows that a TCWV of less than 5mm occurs 3-10% of the time across much of the northern middle latitudes and in large parts of Asia and North America it occurs more than 10% of the time.

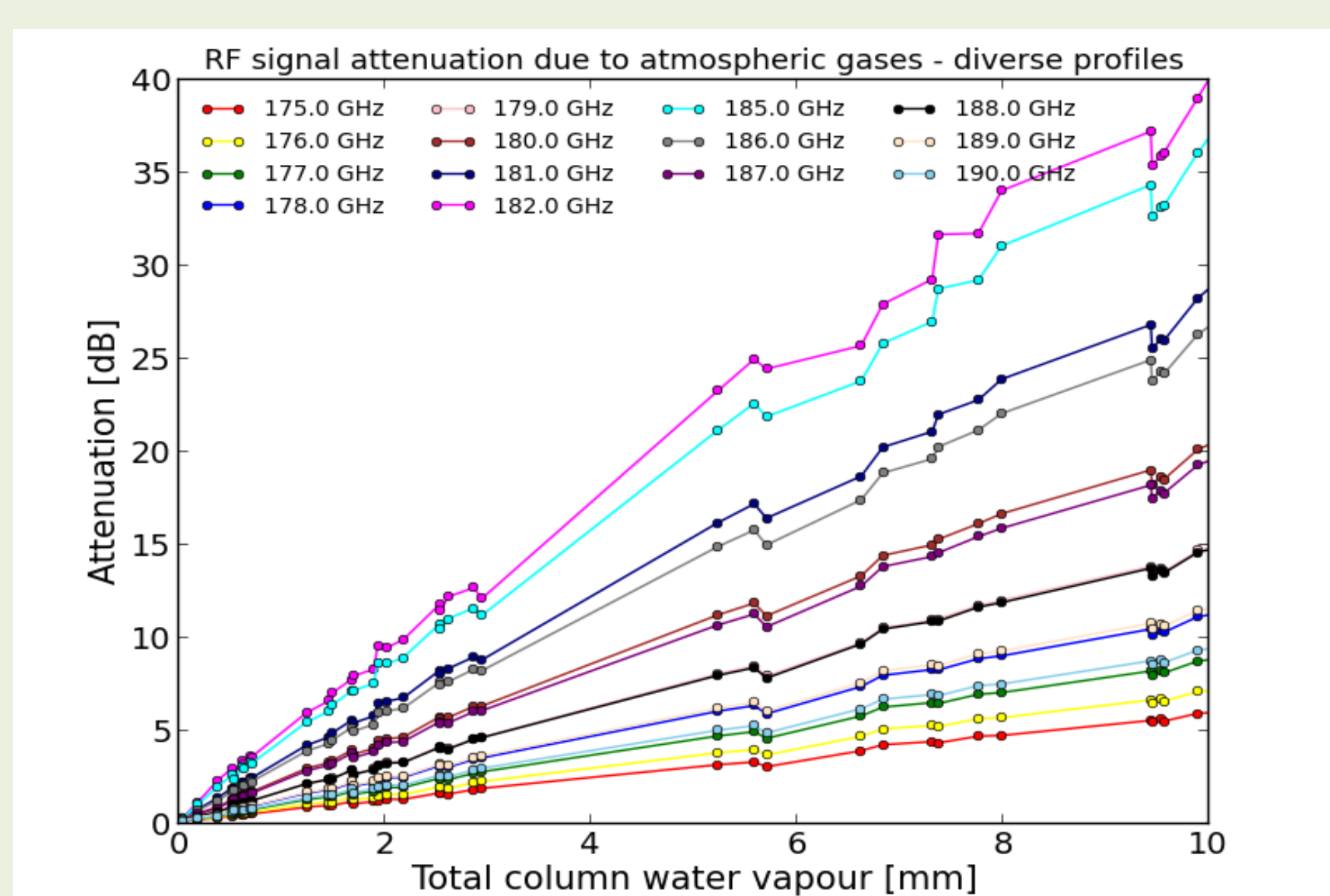
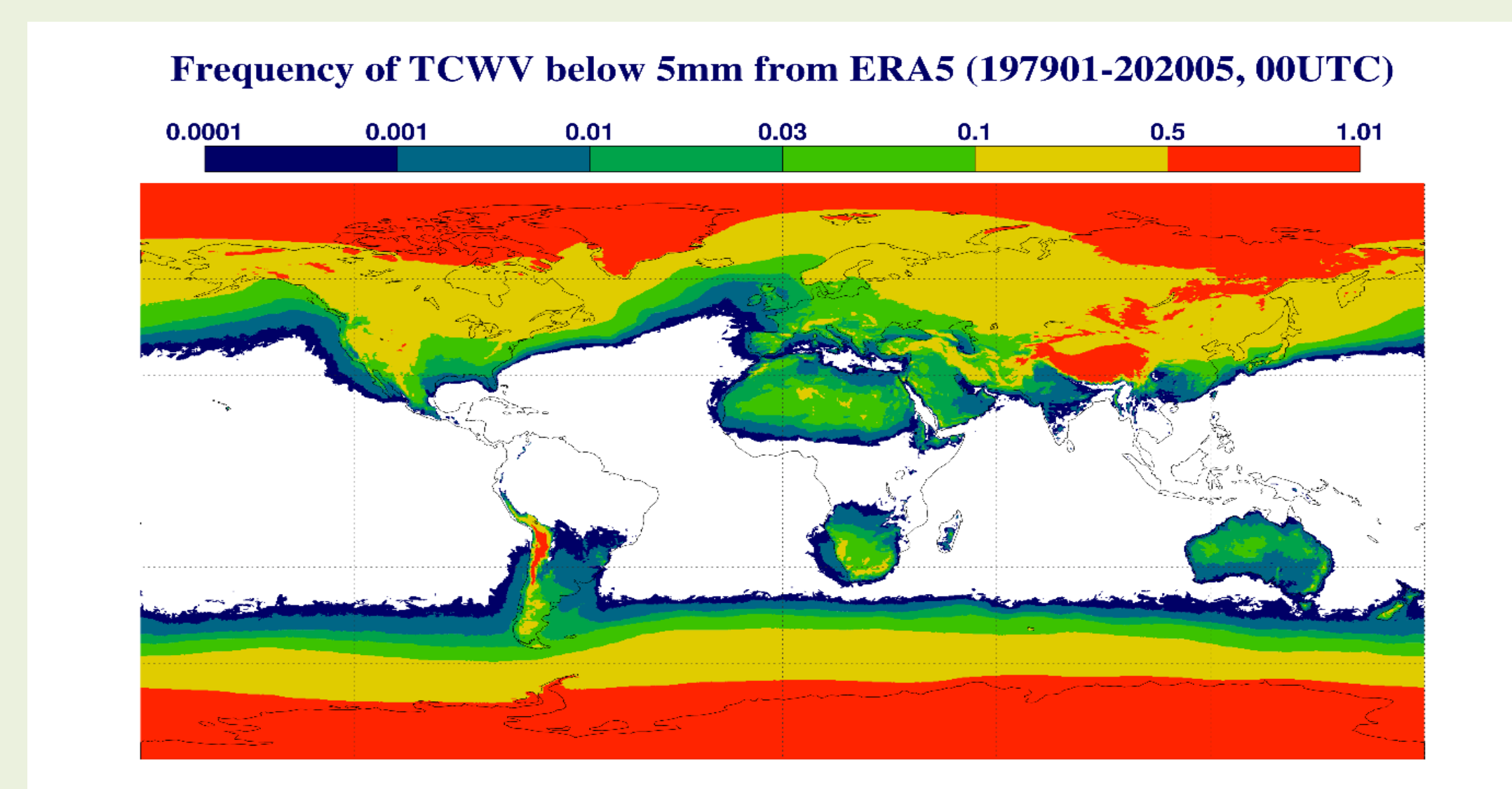


Figure 1: Attenuation as a function of TCWV close to 183 GHz

Figure 2: Normalised frequency of occurrence (1=100%) of TCWV < 5mm in ERA5



## WRC-23 issues

Issues tabled for **WRC-23** relevant to ITWG are being presented at ITSC-23 by Dr. Richard Kelley. Items of interest to ITWG include agenda items: **1.2** (includes 6.425-7.250 GHz and 10-10.5 GHz), **1.10** (includes 22-22.1 GHz), **1.14** (231.5-252 GHz), **1.16/1.17** (bands 17.7-30 GHz), **9.1d** (36-37 GHz). The agenda for **WRC-27** may include issues around 50 GHz, close to 89 GHz and above 230 GHz.

## References

[1] Palmer R. et al. 2021, doi: [BAMS-D-21-0009](https://doi.org/10.1016/j.bams.2021.01.009)

[2] WRC-23 Final Acts, 2019: <https://www.itu.int/pub/R-ACT-WRC.14-2019/en>

[3] Olive R et al. 2020, doi: [10.1109/IGARSS39084.2020.9324403](https://doi.org/10.1109/IGARSS39084.2020.9324403)

[4] ECMWF, 2019: <https://www.ecmwf.int/sites/default/files/elibrary/2019/19026-radio-frequency-interference-rfi-workshop-final-report.pdf>

[5] Draper D., 2018, doi: [10.1109/JSTARS.2018.2801019](https://doi.org/10.1109/JSTARS.2018.2801019)

[6] Memo, 2020: [https://www.ofcom.gov.uk/data/assets/pdf\\_file/0013/201091/ecmwf-metoffice-uksa.pdf](https://www.ofcom.gov.uk/data/assets/pdf_file/0013/201091/ecmwf-metoffice-uksa.pdf)