

RFI 2022

14–18 FEBRUARY 2022

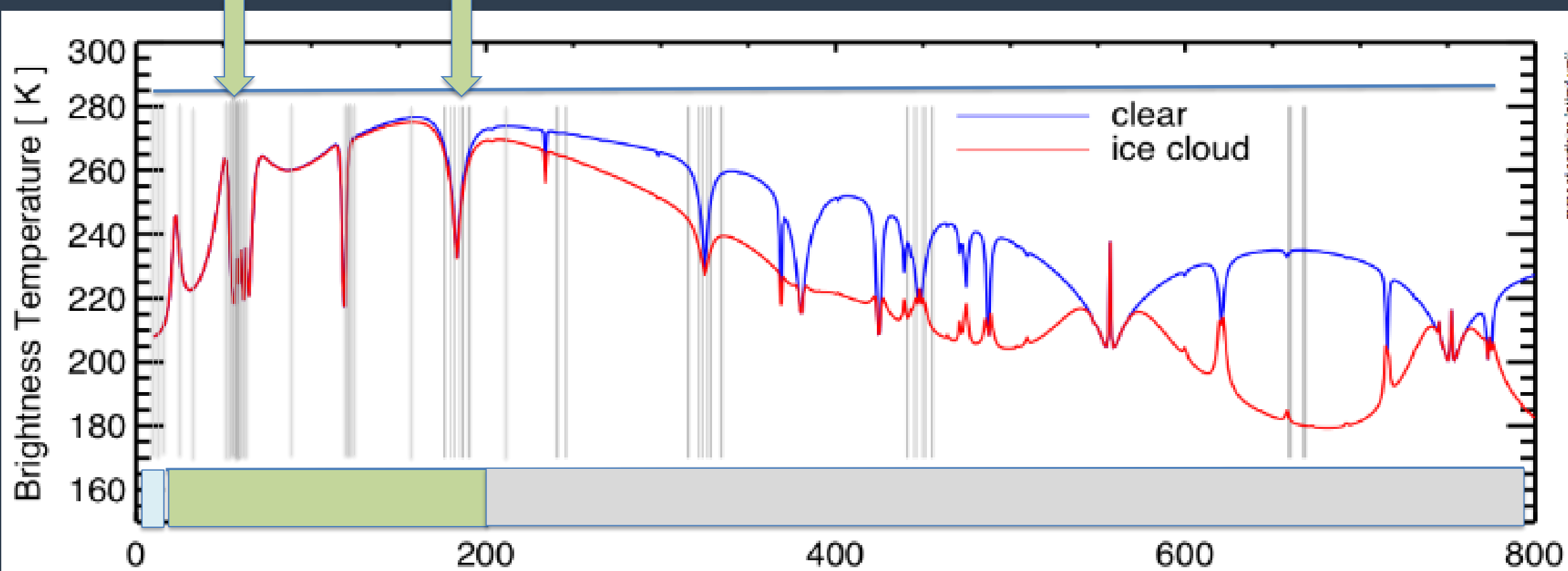
#RFI2022

An ITWG view on Spectrum

*Stephen English, Nancy Baker, Rich Kelley, Jean Pla,
Vincent Guidard, Liam Gumley*

What is ITWG (International TOVS Working Group)?

- Science Working Group with ~ 400 members reporting to the:
 - International Radiation Commission (IRC) of the International Association of Meteorology and Atmospheric Sciences (IAMAS);
 - Coordination Group for Meteorological Satellites (CGMS).
- Sister organization to the IPWG (Chris Kidd and Philippe Chambon presentation)
- Scope is research and operational use of TIROS Operational Vertical Sounder (TOVS) data from the NOAA series of polar orbiting satellites (1979-2007) and **all heritage instruments** on American, European, Chinese, Russian, Japanese and Indian satellites.
- ITWG organises International TOVS Study Conferences (ITSCs) which have met every 18-24 months since 1983.
- RFI issues are discussed at ITSCs in a Technical sub-group led by Jean Pla, Nancy Baker, Rich Kelley and Stephen English (and in the past Guy Rochard RIP).
- **Why is ITWG interested in spectrum?**



L, C, X bands


Earth surface
and
precipitation

K, Ka, V, W, G bands

Atmospheric
temperature and
humidity all-weather

Sub-millimetre bands

Ice cloud, stratosphere, trace gases
(on EPS Second Generation from mid-2020s)

RR5.340 + : bands of importance to the ITWG		
Frequency GHz	Instruments	Information content
18.6-18.8	AMSR-2 GMI AMR MWRI CIMR MWI	Ocean near surface wind
23.6-24	AMSR-2 AMSU-A ATMS SSMIS GMI AMR MTVZA-GY MWRI MWS+I CIMR	Total column water vapour
31.3-31.5 31.5-31.8	AMSU-A ATMS GMI MTVZA-GY MWS+I	Total column cloud liquid
37 GHz	AMSR-2 SSMIS GMI MWRI CIMR	Liquid water path and cloud detection on GMI
50.2-50.4 52.6-54.25 54.25-59.3 59.3-59.5 60.40-61.15 63-63.5	AMSU-A , ATMS SSMIS MWTS-2 MTVZA-GY MWS	Temperature profile
86-92	AMSR-2 AMSU-A ATMS SSMIS MWHS-2 MWRI MTVZA-GY MWS	Precipitation
100-102 109.5-111.8 114.25-116 116-122.25	TROPICS MWHS-2 MWI	Temperature profile, cloud
148.5-151.5 155.5-158.5 164-167	ATMS GMI MWHS-2 MTVZA-GY AMSU-B MHS MWS+I	Precipitation, water vapour
174.8-182.0 182.0-185.0 185.0-190.0 190.0-191.8	AMSU-B ATMS SSMIS MWHS-2 SAPHIR GMI TROPICS MTVZA-GY MWS+I	Water vapour
200-209 226-231.5	TROPICS MHS MWS	Ice cloud
<div>  <div> JAXA (Japan) CMA (China) NASA/NOAA/DOD (USA) ESA/EUMETSAT/CNES/UK (Europe) Roscosmos (Russia) ISRO (India) </div> </div>		

Key areas benefiting from EESS bands via ITWG activities



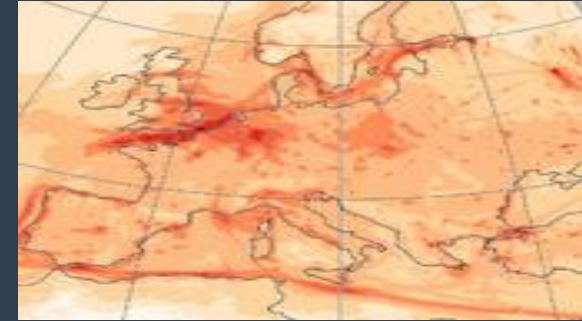
Public weather advice



Public snow, flood & fire
Warnings, public safety, protection of life and property



Hurricane & tornado



Air quality



Transport



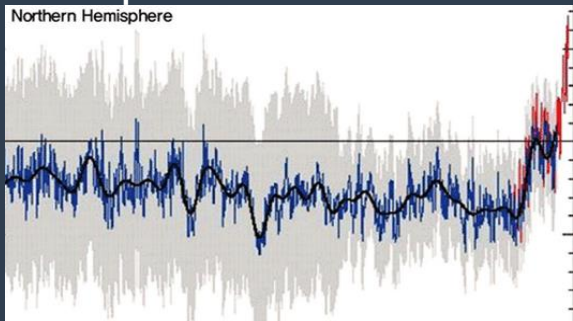
Energy



Agriculture



Tourism



Climate change Monitor



Public health and famine



Business and commerce



Defence

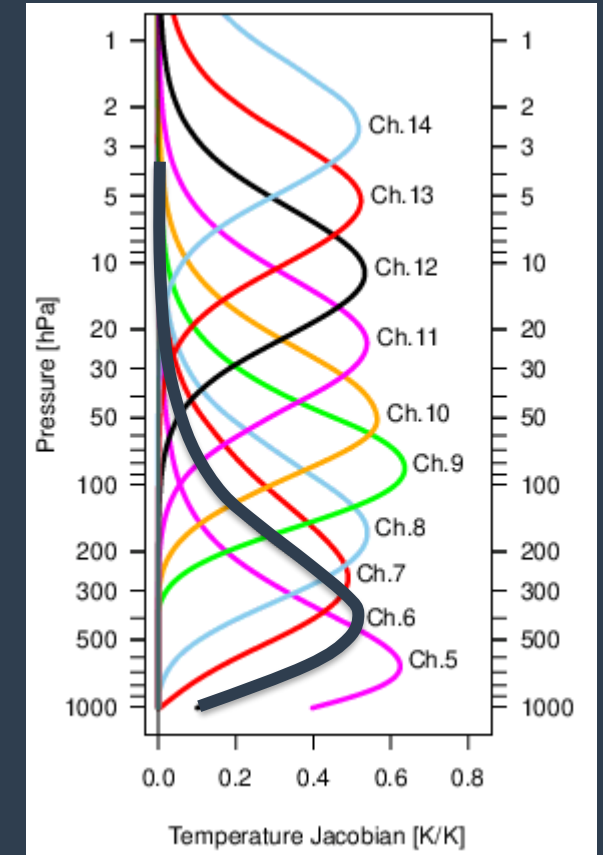
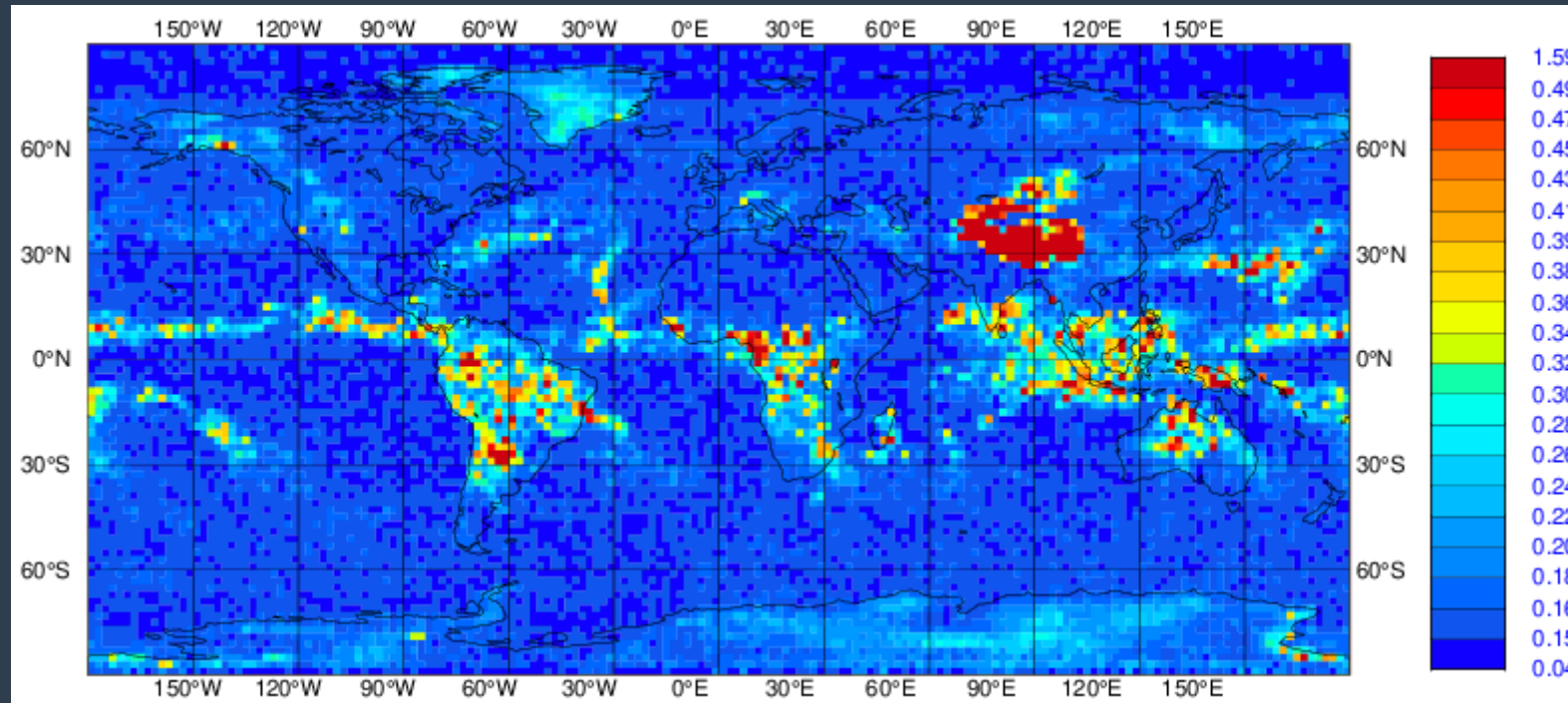
There is already RFI for “window channels” with low attenuation that constrain surface and clouds

Concerning
to ITWG

Is there a threat to atmospheric sounder frequencies that contain information about the atmosphere?

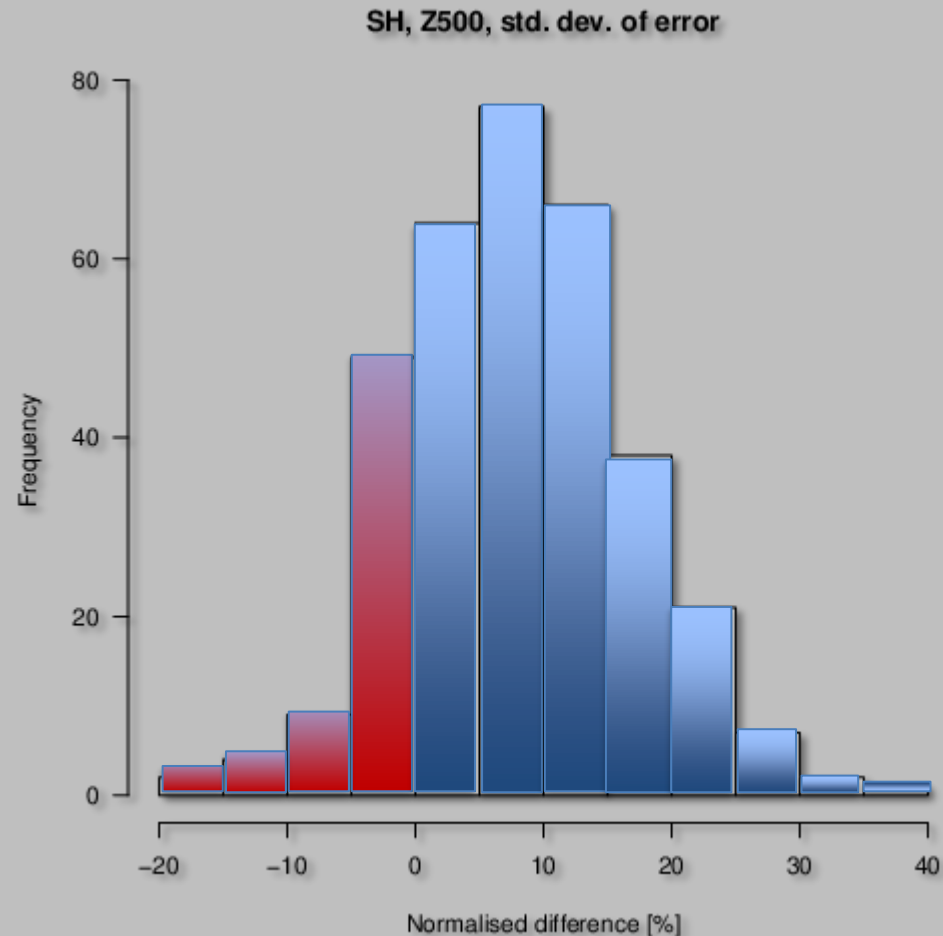
Critical to
ITWG

Example: 54 GHz St. Dev. Of Obs - NWP model



0.005 K: not an issue; 0.05 K: a problem; 0.5 K: easily spotted and flagged

Variability of impact illustrated for MW radiances (50 and 183 GHz)



Histogram of several months of forecast impact: +ve means obs improve forecasts, -ve means forecasts degraded by observations

Can we tell if a bad forecast is due to RFI?

“normal” good observations on average improve forecasts but locally can degrade

e.g. is short range forecast always worse than long range?

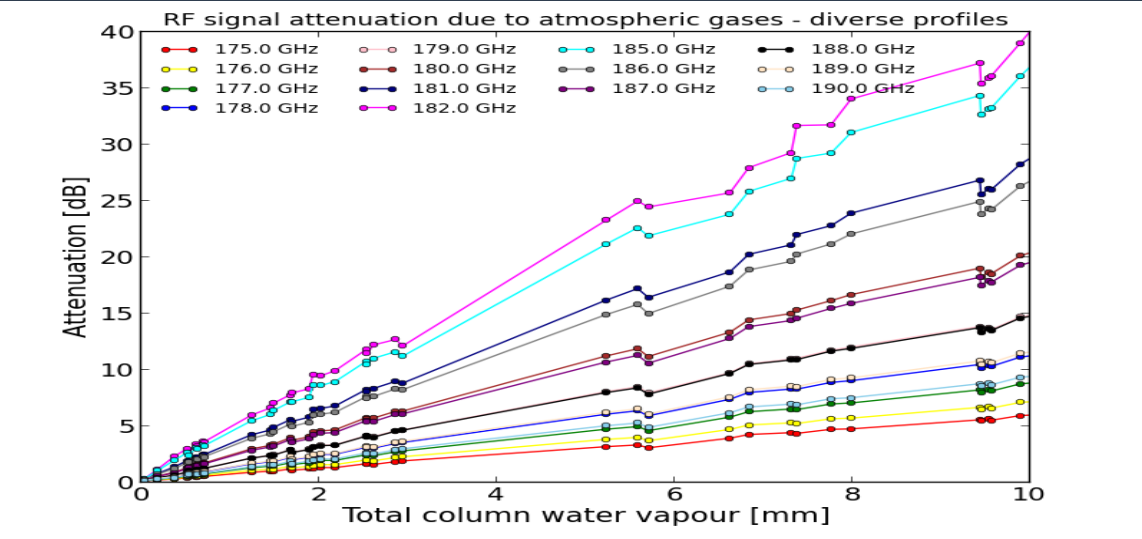
Regulatory authorities want proof RFI impacts forecasts but good observations can degrade forecasts

So only large time-space averages are possible, and impact varies from season to season and year to year.

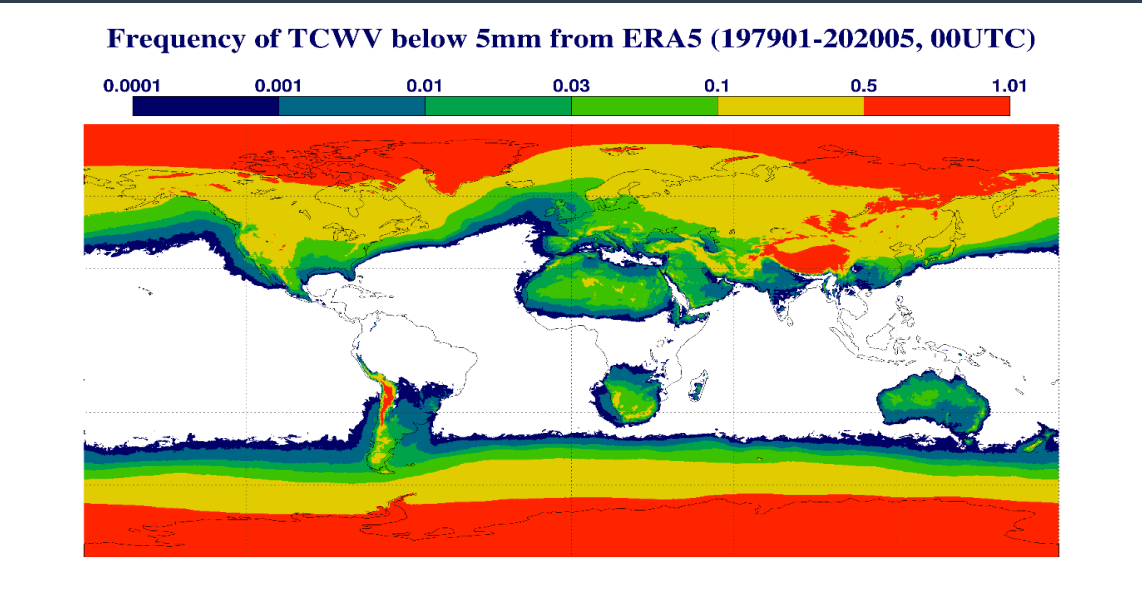
Out of band emissions

- Measurements need to be very clean
- Example: the 24 GHz 5G discussion
 - Defining what 5G power levels would be a problem from an allocation in a neighbouring band e.g. source at 25 GHz impact at 24 GHz
 - Language difficulty:
 - -39 dB/200 MHz for sources means what for our measurements?
 - Not well understood by user communities like ITWG – how to enable communities like this to engage properly in the debate?
 - IEEE Standards Agency activity (Roger Oliva)?

Challenging assumptions made by studies eg 183 GHz in UK



Attenuation as a function of TCWV close to 183 GHz



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

Summary

- We can monitor for RFI and we can measure impact...but proving a given forecast is worse because of RFI will be challenging;
- On-going concerns at 24 GHz following WRC-19, looser regulation above 100 GHz.
- At the 23rd ITSC, the ITWG community recognised the need for:
 - Improved RFI monitoring, especially at 24 GHz, to report suspected RFI, whilst recognising the most dangerous RFI won't be detected;
 - Improved communication between groups e.g. in metrics used to define RFI (link to IEEE Standards Association efforts led by Roger Oliva);
 - Recognition of issue in CGMS High Level Priority Plan (HLPP)
 - Provision of very strong evidence to governments / decision makers on the high socioeconomic benefit of the sounding bands, notably at 50-60 and 176-190 GHz;
 - New technology solutions and improved RFI screening, where possible, whilst also recognising some RFI will always evade detection.