Overview of the American Meteorological Society
Committee on Radio Frequency Allocations

Jordan Gerth, AMS Committee Chair

With contributions from the committee and colleagues

@AMSspectrum
@jjgerth

NAS CORF Meeting, Washington, DC, 9 May 2025

AMS Committee on RF Allocations

- Organizes members to review and coordinate on all matters of radio frequency spectrum management pertinent to the enterprise
  - 2025 Membership: 19 members + 1 ex officio member
  - Chandra Venkatachalam, Colorado State University, incoming vice chair
- Contains academic, government, and private sector professionals with expertise in remote sensing, radar meteorology, satellite meteorology, systems engineering, telecommunications, and policy
- Reviews and revises the policy statement on radio frequency allocations for the Society

Committee Goals

- Increase membership awareness of spectrum management matters and their potential impacts on the weather, water, and climate enterprise,
- Develop coalitions with other entities to inform the public and policymakers on radio frequency interference and its consequences, and
- Provide subject-matter expertise on how changes in spectrum policy and allocations could affect the collection or delivery of meteorological, hydrological, and oceanographical data

Committee Activities

Encouraging ex parte briefings at FCC

Filings in FCC dockets

Informational meetings with legislative staff

Op-eds and media interviews

Outreach to interested groups

Planning scientific sessions at AMS meetings

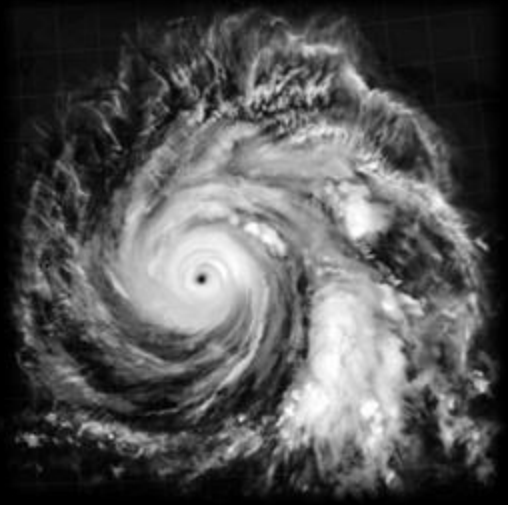
Observations	Transmissions	Inconsistency
Collection: High-power terrestrial wireless emissions in or near spectrum allocated for earth sensing will reduce consistent and reliable global weather observations	**Delivery**: Sharing of radio frequencies could threaten the timely and routine transmissions of space-to-Earth weather satellite imagery and other Earth-to-space observations (DCS)	**Impact**: The risk of spectrum sharing is not a sudden decrease in forecast skill or a complete loss of observations, but an inability to deliver consistent weather services

The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author and do not necessarily reflect the views of NOAA or the Department of Commerce.

Committee Priorities

- 1675-1680 MHz (L band) and related Ligado proceedings
  - GOES-R data relay and image rebroadcast (Delivery)
- 3.1-3.45 GHz (C), 7.125-8.4 GHz (X), 23.8/24 GHz (K band)
  - Passive rain rate and sea surface temperature sensing (Collection)
  - Direct broadcast of LEO weather satellite imagery (Delivery)
  - Passive microwave water vapor sensing (Collection)
- More passive sensing: 50+ GHz (U) and 86 – 92 GHz (W band)
- Identifying technical solutions to reduce future sharing complications in the microwave

NOAA SATELLITE L-BAND DATA DOWNLINKS



GOES Data Collection

- Flood and tsunami warning
- River and coastal gages
- Fire weather sensors
- Inland river navigation
- Drought management

Emergency Management and Reduced Data

Broadband/Proposed Share

GOES Rebroadcast (Science and Imagery)

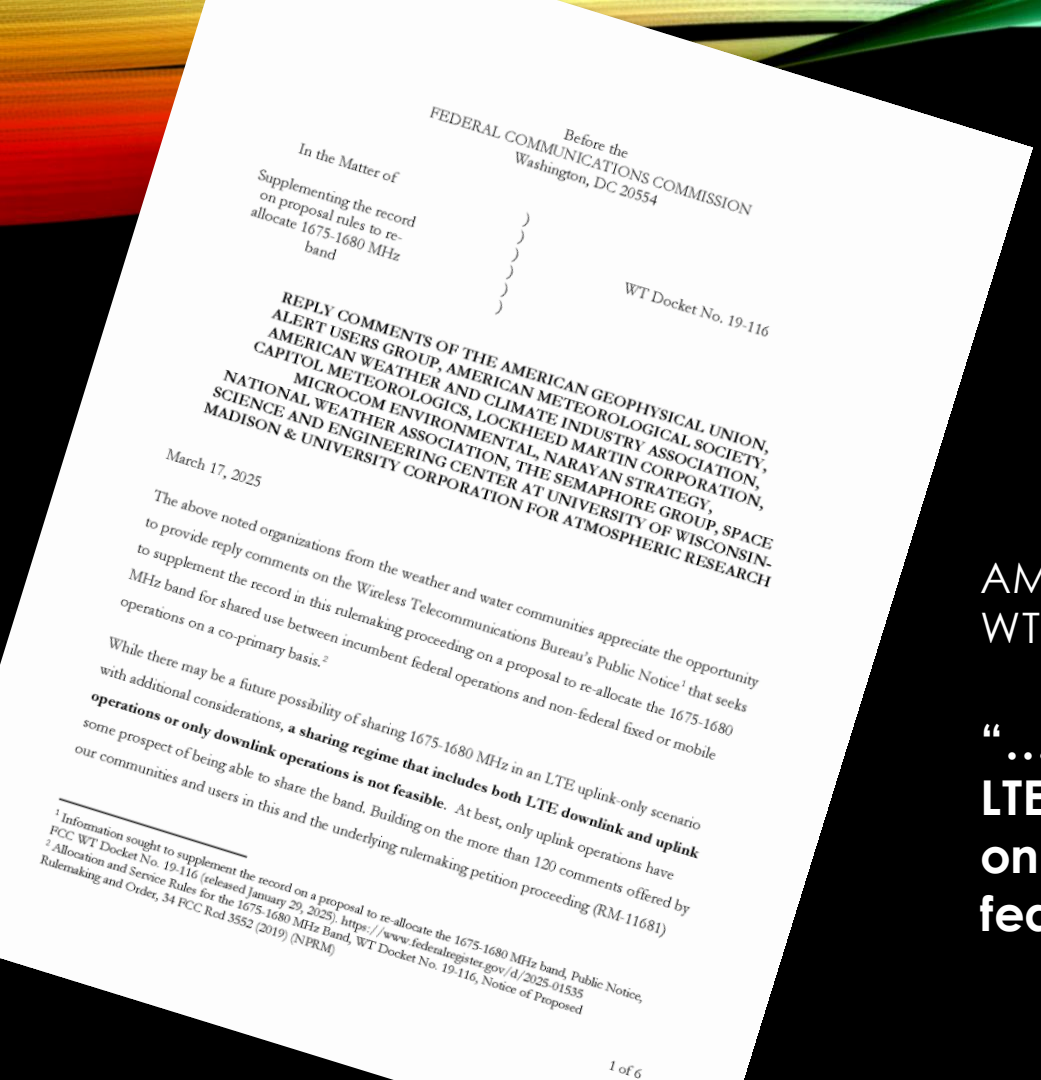
Broadband/AWS-3

1675 1680 1685 1690 1695 1700

MHz

1675-1680 MHz Proposed Auction

1695-1710 MHz NOAA Polar Satellites



Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of

Supplementing the record on proposal rules to re-allocate 1675-1680 MHz band

WT Docket No. 19-116

REPLY COMMENTS OF THE AMERICAN GEOPHYSICAL UNION, ALERT USERS GROUP, AMERICAN METEOROLOGICAL SOCIETY, AMERICAN WEATHER AND CLIMATE INDUSTRY ASSOCIATION, CAPITOL METEOROLOGICS, LOCKHEED MARTIN CORPORATION, MICROCOM ENVIRONMENTAL, NARAYAN STRATEGY, NATIONAL WEATHER ASSOCIATION, THE SEMAPHORE GROUP, SPACE SCIENCE AND ENGINEERING CENTER AT UNIVERSITY OF WISCONSIN-MADISON & UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

March 17, 2025

The above noted organizations from the weather and water communities appreciate the opportunity to provide reply comments on the Wireless Telecommunications Bureau's Public Notice[1] that seeks to supplement the record in this rulemaking proceeding on a proposal to re-allocate the 1675-1680 MHz band for shared use between incumbent federal operations and non-federal fixed or mobile operations on a co-primary basis.[2]

While there may be a future possibility of sharing 1675-1680 MHz in an LTE uplink-only scenario with additional considerations, **a sharing regime that includes both LTE downlink and uplink operations or only downlink operations is not feasible**. At best, only uplink operations have some prospect of being able to share the band. Building on the more than 120 comments offered by our communities and users in this and the underlying rulemaking petition proceeding (RM-11681)

[1] Information sought to supplement the record on a proposal to re-allocate the 1675-1680 MHz band, Public Notice, FCC WT Docket No. 19-116 (released January 29, 2025); https://www.federalregister.gov/d/2025-01535
[2] Allocation and Service Rules for the 1675-1680 MHz Band, WT Docket No. 19-116, Notice of Proposed Rulemaking and Order, 34 FCC Rcd 3552 (2019) (NPRM)

1 of 6

AMS, AGU, NWA, UCAR, and others filed in WT Docket No. 19-116 (March 2025):

"…a sharing regime that includes both LTE downlink and uplink operations or only downlink operations is not feasible."

NATIONAL SPECTRUM STRATEGY: 7125-8400 MHZ

Real-time High Rate Data (NOAA JPSS)

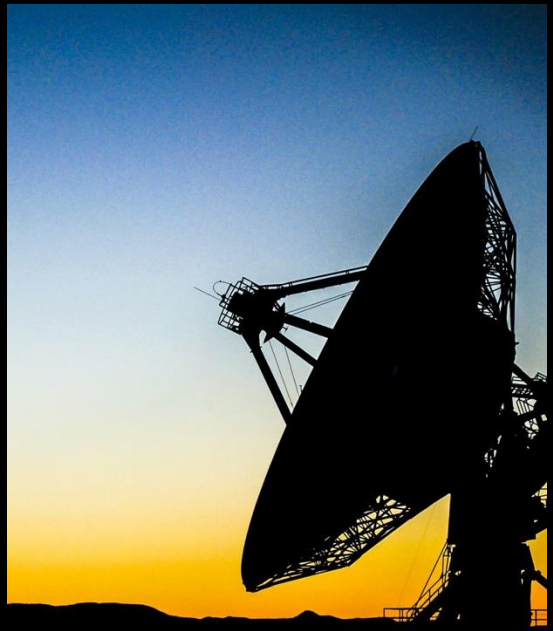
- 7.812 GHz (50 MHz Bandwidth)

Passive Sensing (JAXA GCOM-W/GW)

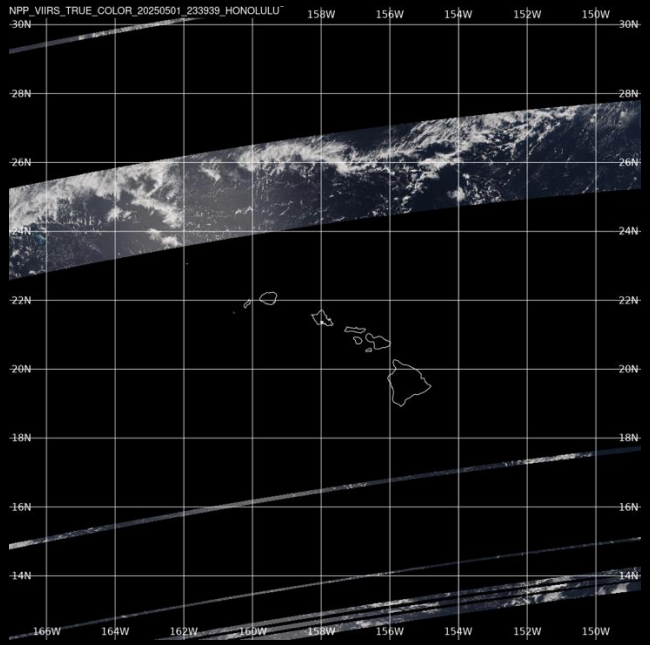
- Rainfall Rate
- Sea Surface Temperature
- 6.925 GHz (350 MHz Bandwidth)
- 7.3 GHz (350 MHz Bandwidth)
- Existing RFI evident in 6.925 GHz
- No allocation except footnote (RR FN 5.458)

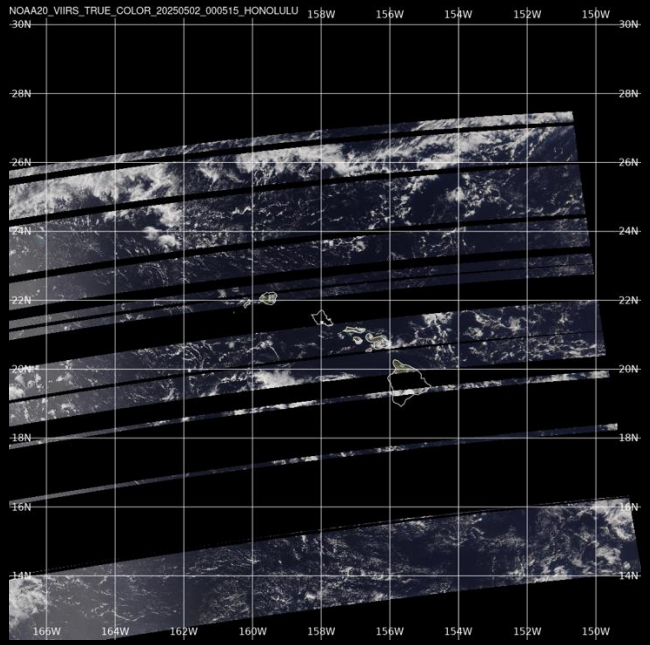
LOW-LATENCY RECEPTION

- X-band is the single most significant spectrum portion for downlinking Earth observation data acquired by satellites.
- No current alternative to X-band downlink exists at scale, especially for existing LEO satellites with a geographically-dependent direct broadcast downlink.
- Short-term challenges from a change to 7/8 GHz allocations could not be overcome without some protection.



INTERMITTENT RFI
NOAA (NPP/JPSS) DIRECT BROADCAST



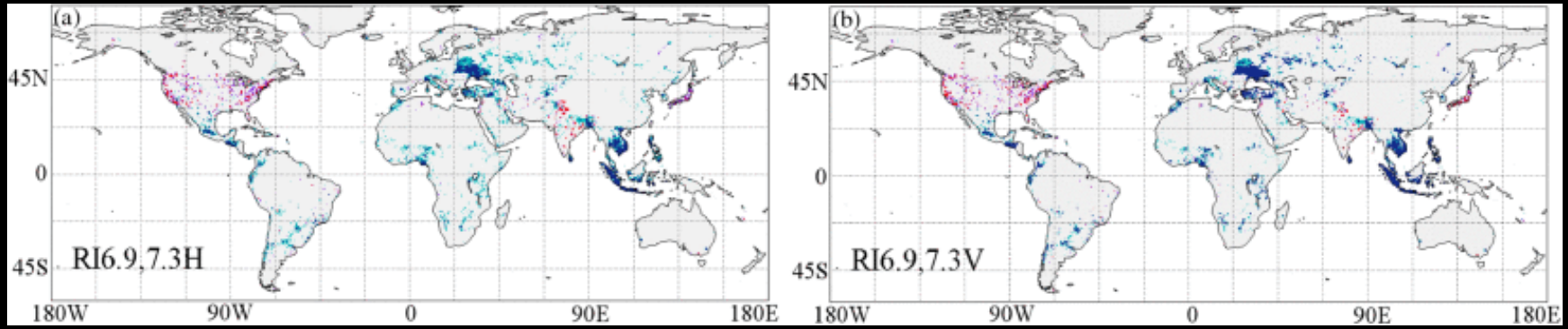


Site: Honolulu Community College (Operated by University of Wisconsin-Madison)

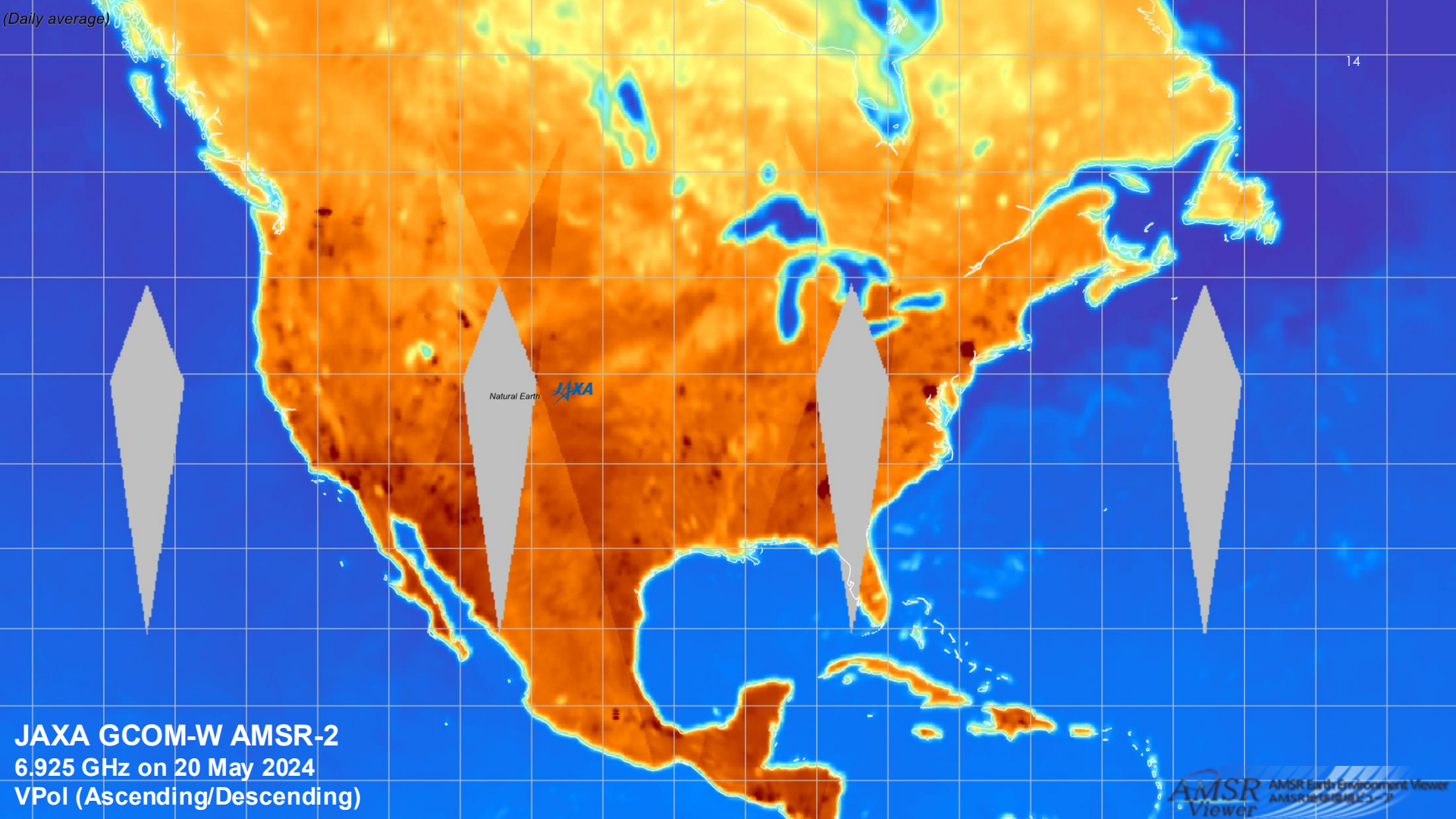
7 GHZ PASSIVE SENSING

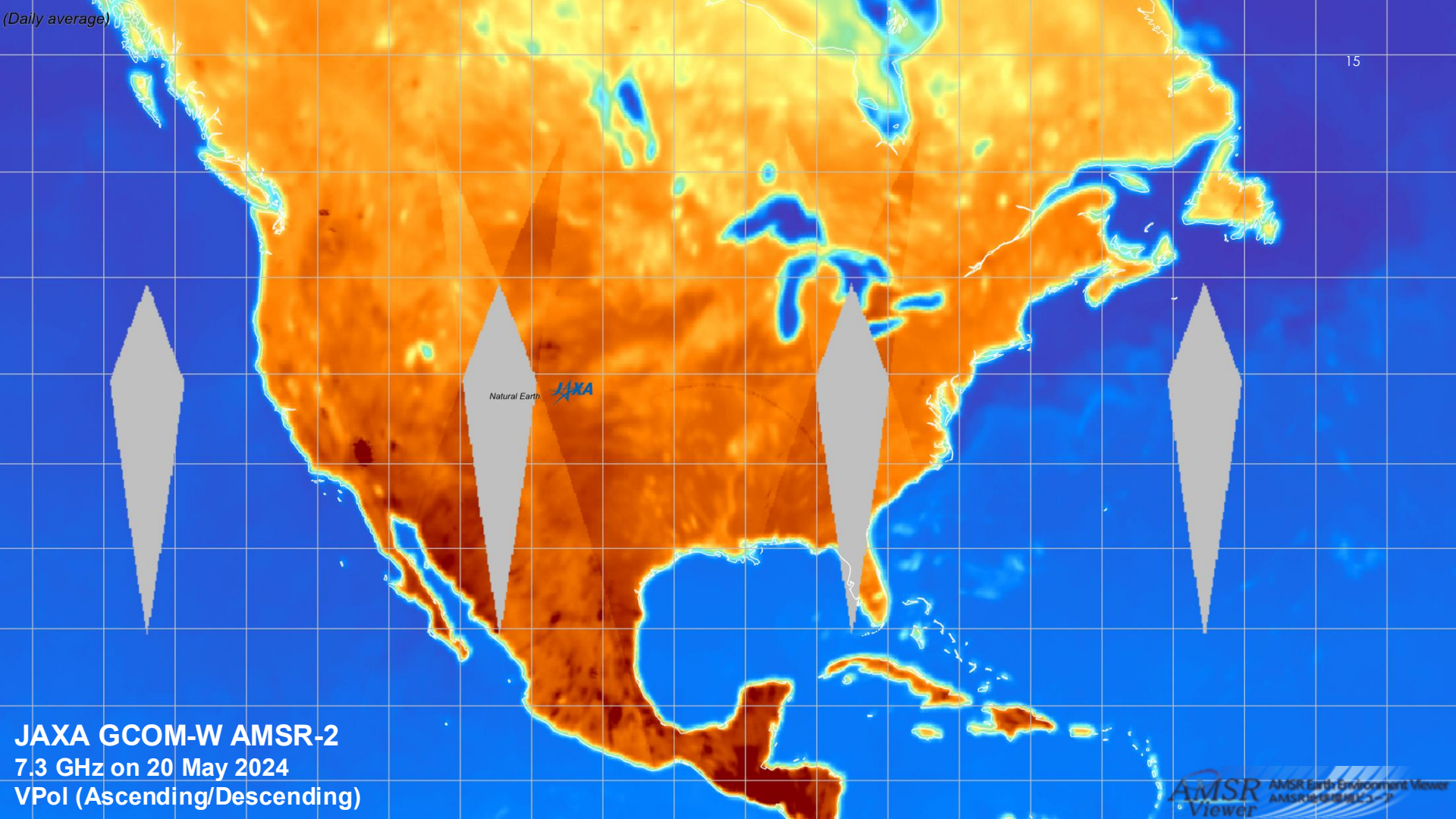
- **WMO Position**:
  - "Preliminary results of studies ongoing in ITU-R WP 7C show that interference will occur on current and planned SST measurements especially in coastal areas if IMT is deployed in any portion of the 6425-7125 MHz band."
  - "A similar conclusion can be drawn for the 7125-7250 MHz band if an IMT identification is made in that frequency band."
- **Reality**:
  - This is already interference in this band.
  - Extent depends on geographic region.
- **Challenge**:
  - We have not been able to study the role of 7 GHz on microwave (passive) SST.

6.9/7.3 GHZ RFI (9/2012-8/2013)



A. H. A. de Nijs, R. M. Parinussa, R. A. M. de Jeu, J. Schellekens and T. R. H. Holmes, "A Methodology to Determine Radio-Frequency Interference in AMSR2 Observations," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 53, no. 9, pp. 5148-5159, Sept. 2015, doi: 10.1109/TGRS.2015.2417653.


(Daily average)
14
Natural Earth
JAXA
JAXA GCOM-W AMSR-2
6.925 GHz on 20 May 2024
VPol (Ascending/Descending)
AMSR Viewer
AMSR Earth Environment Viewer


(Daily average)
15
Natural Earth
JAXA
JAXA GCOM-W AMSR-2
7.3 GHz on 20 May 2024
VPol (Ascending/Descending)
AMSR Viewer
AMSR Earth Environment Viewer

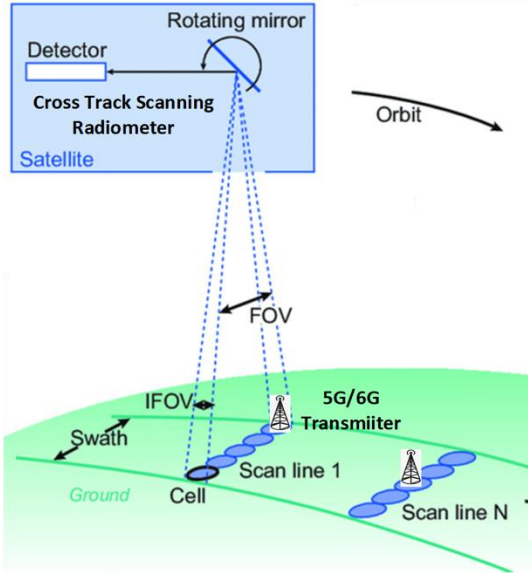
7 GHz Band Overlapping Spectrum: 5G/6G & EOS Measurements

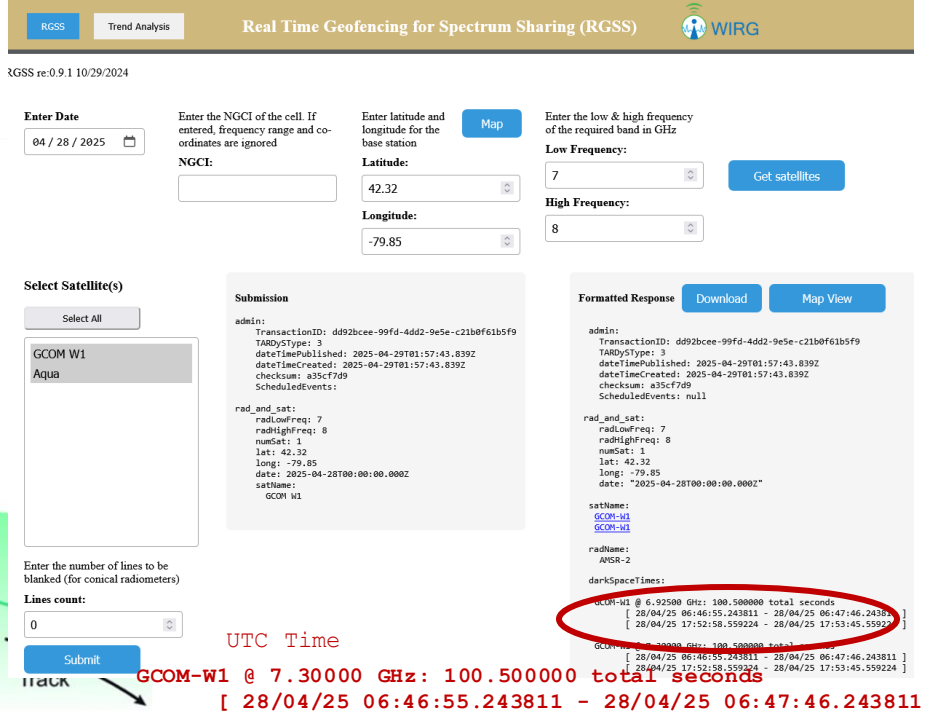
- 7.125 – 8.4 GHz: largest contiguous block of mid-band spectrum.
  - Rapid deployment: Use the existing 3.5 GHz wireless network footprint[1].
  - US National Spectrum Strategy & ITU WRC-27: Recommendations to make the 7GHz band available for wireless communications[4].

- Earth Observation Satellite sea surface temperatures at 6.925 & 7.3 GHz ($\Delta f = 0.175$ GHz) used for hurricane tracking, weather forecasting, and climate models.
  - Sea Surface Temperatures: passive microwave measurements[3] (AMRS2, AMSR3 in 2025)
  - Neither band protected. 6.9GHz data already corrupted in some places.

[1] Increased propagation loss @7GHz balanced by increased antenna gain - reduction in Tx/Rx MIMO size.
[2] ITU footnote RR No 5.458 suggests regulators should consider EESS passive services in planning the use of 6425–7075 MHz and 7075–7250 to accommodate sea-surface temperature (SST) measurements.
[3] part of the NASA/JAXA et.al. Global Precipitation Mission.
[4] Most of the world focused on 7GHz, China is planning to use the upper 6GHz

RGSS Prototype:





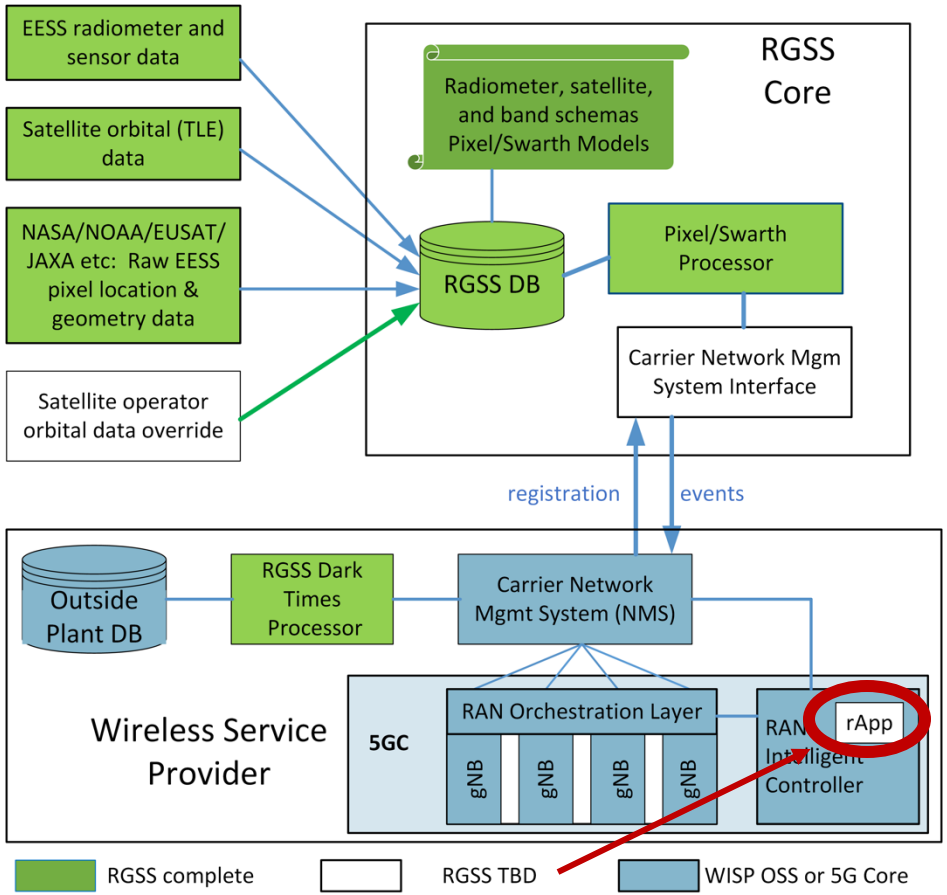
UTC Time

GCOM-W1 @ 7.30000 GHz: 100.500000 total seconds
[28/04/25 06:46:55.243811 - 28/04/25 06:47:46.243811]
[28/04/25 17:52:58.559224 - 28/04/25 17:53:45.559224]

- Currently supports ATMS (SUOMI, JPSS-1, JPSS-2), AMSU (METOP B&C), AMSR2 (GCOM). Web and programmatic (JSON) interfaces available to researchers in academia, government, & industry.
- Accurate prediction of location, size, and timing of pixels verified by comparing predicted vs actual data from satellite downloads (for ATMS, accuracy is ± a few kms and ≤ ~10 μsec)
- Enables protection of EOS measurements while allowing Wireless Service Providers access with high (>99%) network availability. In Local Time, traversals are 1-3AM and 1-3PM.

System Architecture + Feedback from the wireless community

- Minimize effort to integrate with Network Management Systems
- Maintain confidentiality of Outside Plant data (DB)
- Utilize 3GPP inter-cell band movement based on CoS as needed (DAPS and L1/L2 Triggering) => no impact to low-latency / high reliability services.
- **One remaining piece: rApp for the RIC**



Summary and Engagement:

1. Real-time Geofencing for Spectrum Sharing (RFSS) enables radiometers on Earth Observation Satellites and wireless 5G/6G to share overlapping spectrum in the 7 GHz band (6.925 and 7.3 $\pm$ 0.175 GHz) without interference. **The 7GHz band is an ideal place to test and operationalize RGSS[1] (which can be applied to all GHz & THz bands).**

2. **Positive Feedback from Government Stakeholders:**
   - Satellite/Sounder Operators: NOAA and NASA
   - Regulatory Community: FCC
   - Congress: Senate Commerce Committee (Majority & Ranking), House Science & Technology (Ranking), House Commerce (Majority)

3. **Positive Feedback from Industry:**
   - CTIA (wireless communities lobbying group)
   - US Carrier & 5G RAN Equipment Vendors

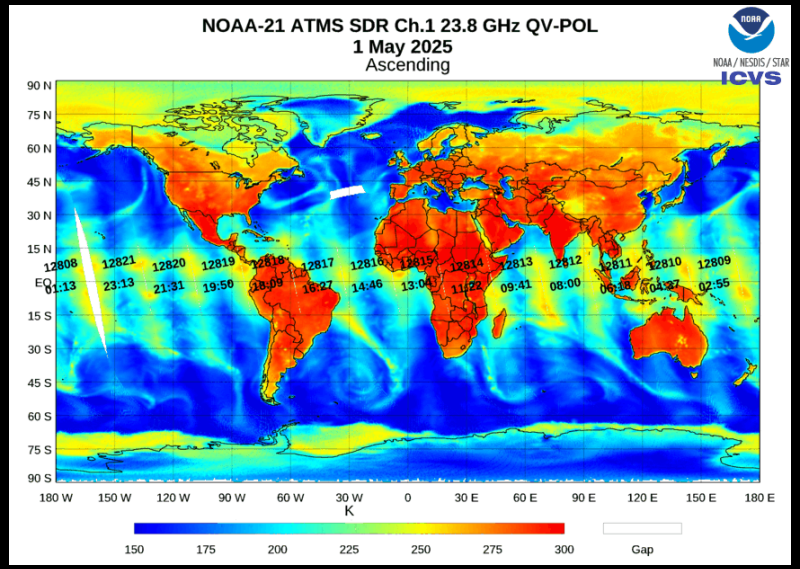
4. **Positive Feedback from the Research Community**
   - SpectrumX, NSF-NRDZCOM, & AMS Spectrum Committee participants

[1]material based upon work supported by the National Science Foundation under Grant No. 2232368

24 GHZ

Primary application:

Total column water vapor

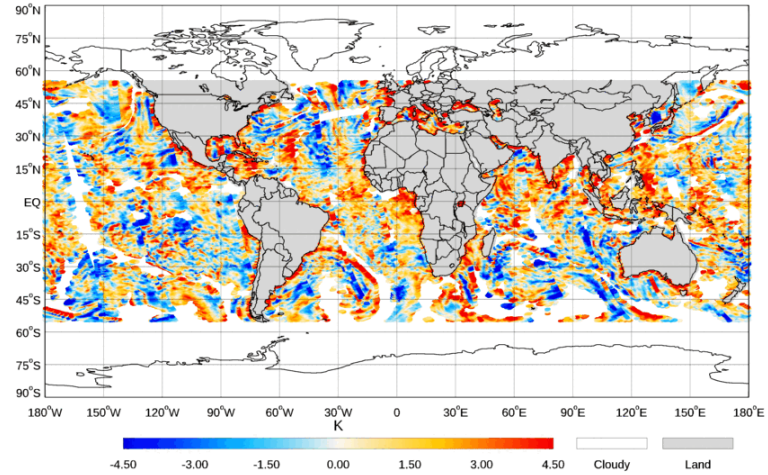


AMSU-A	ATMS	Central Frequency (GHz)	Bandwidth (MHz)	NWP Centers
1	1	23.800	270	Few
2	2	31.400	180	Few
3	3	50.300	180	Few
	4	51.760	400	Few
4	5	52.800	400	Some
5	6	53.596 ± 0.115	170	Most
6	7	54.400	400	All
7	8	54.940	400	All
8	9	55.500	330	All
9	10	f0 = 57.290344	330	All
10	11	f0 ± 0.217	78	Most
11	12	f0 ± 0.3222 ± 0.048	36	Most
12	13	f0 ± 0.3222 ± 0.022	16	Most
13	14	f0 ± 0.3222 ± 0.010	8	Most
14	15	f0 ± 0.3222 ± 0.0045	3	Most

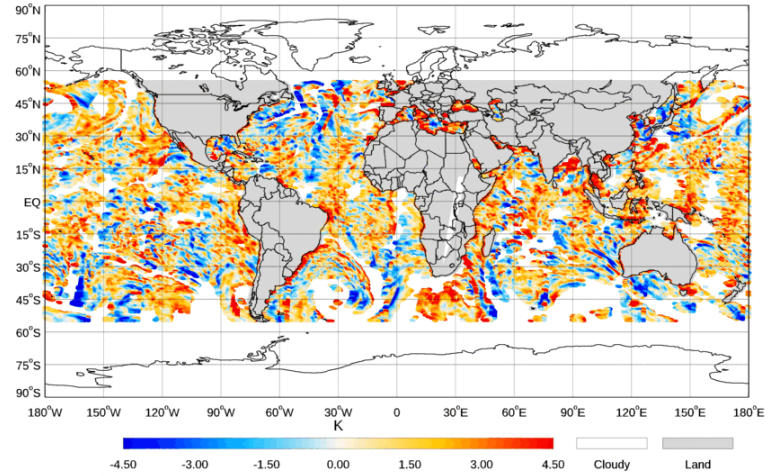
NOAA-21 ATMS (TDR - CRTM SIM) [55°S ~ 55°N] Bias Map
Ch.1 23.8 GHz QV-POL
1 May 2025

NOAA / NESDIS / STAR ICVS

Ascending Node



Descending Node



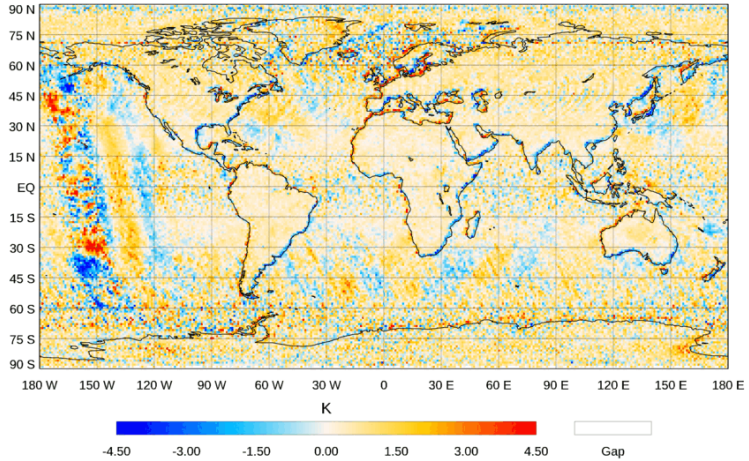
CRTM REL-2.1.3 & ECMWF

Created on May 2 11:28:14 2025 UTC

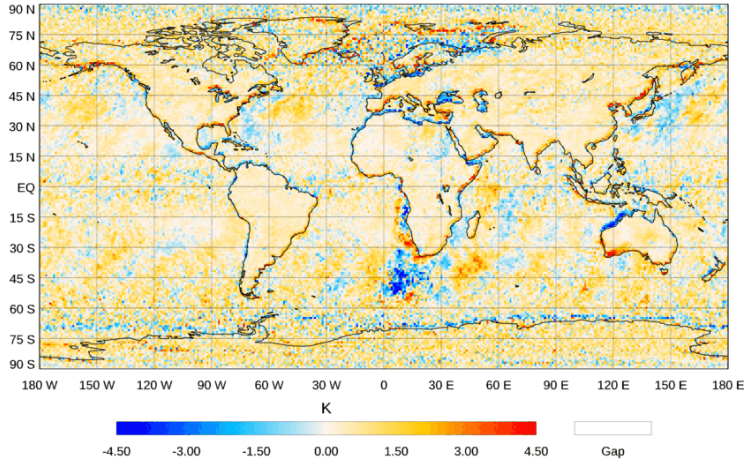
JPSS ATMS SDR 32-Day Averaged Inter-Sensor Bias Global Map
(N21 – N20)
Ch.1 23.8 GHz QV-POL
31 Mar 2025 ~ 1 May 2025

NOAA / NESDIS / STAR ICVS

Ascending Only



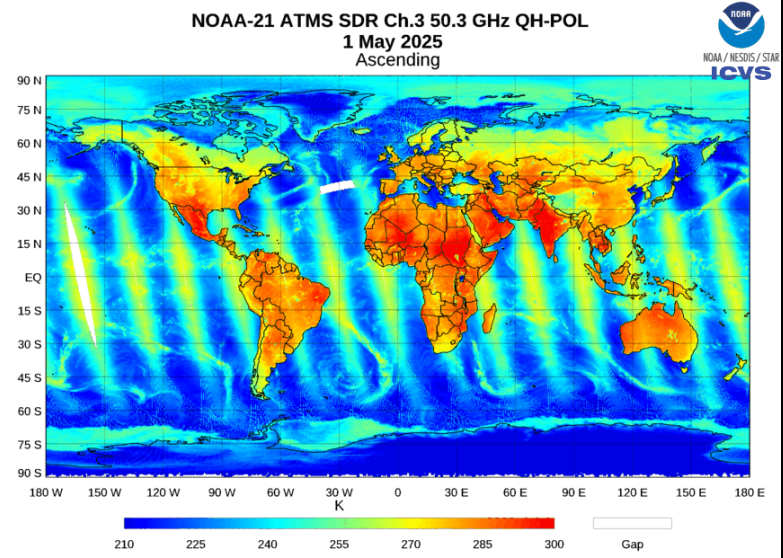
Descending Only



36-54 GHZ

Primary application:

Low-level rain water, temperature

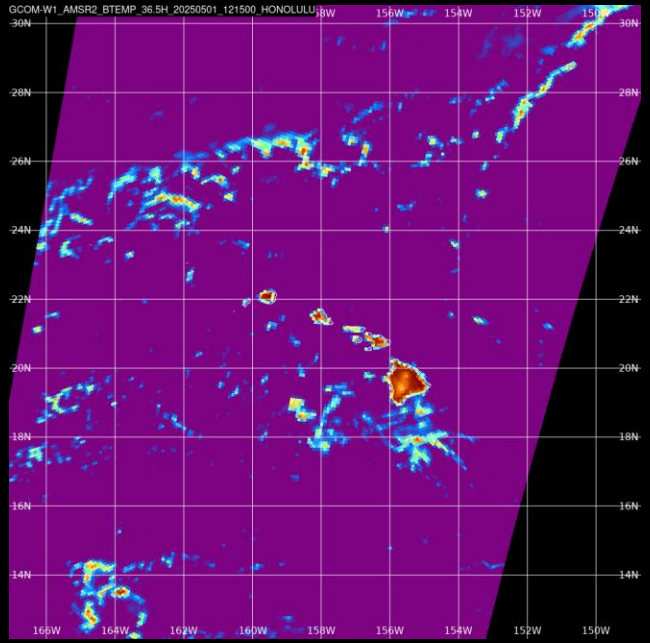


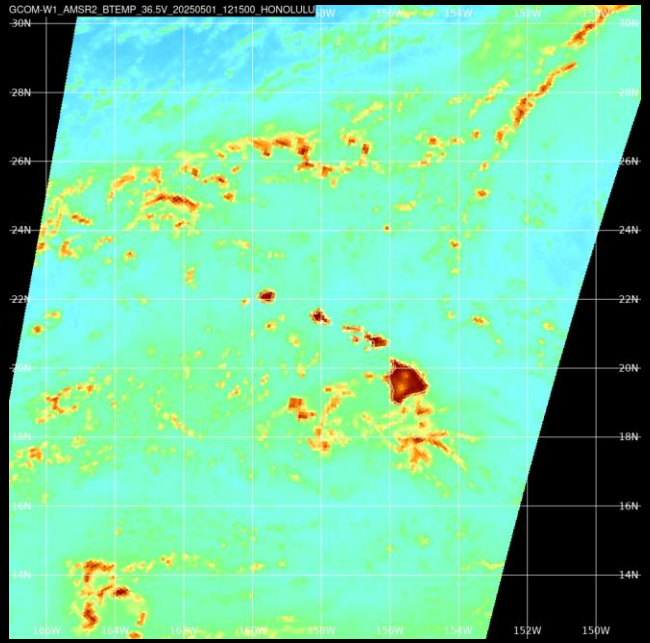
AMSU-A	ATMS	Central Frequency (GHz)	Bandwidth (MHz)	NWP Centers
1	1	23.800	270	Few
2	2	31.400	180	Few
3	3	50.300	180	Few
	4	51.760	400	Few
4	5	52.800	400	Some
5	6	53.596 ± 0.115	170	Most
6	7	54.400	400	All
7	8	54.940	400	All
8	9	55.500	330	All
9	10	f0 = 57.290344	330	All
10	11	f0 ± 0.217	78	Most
11	12	f0 ± 0.3222 ± 0.048	36	Most
12	13	f0 ± 0.3222 ± 0.022	16	Most
13	14	f0 ± 0.3222 ± 0.010	8	Most
14	15	f0 ± 0.3222 ± 0.0045	3	Most

AMS (AGU/NWA/UCAR) COMMENTS TO FCC NSS ON 37 GHZ (Docket no. 24-243)

- **[I]t is important for the Commission to implement additional measures to protect spaceborne remote passive sensors in the 36-37 GHz band.**
- To safeguard U.S. weather forecasting and climate monitoring abilities, the use of passive bands near 37 GHz must not cause harmful interference.
- Harmful interference is a growing threat to U.S. weather forecasting and climate monitoring.
- We support the CORF filing.

CHALLENGES FOR DISCERNING RFI

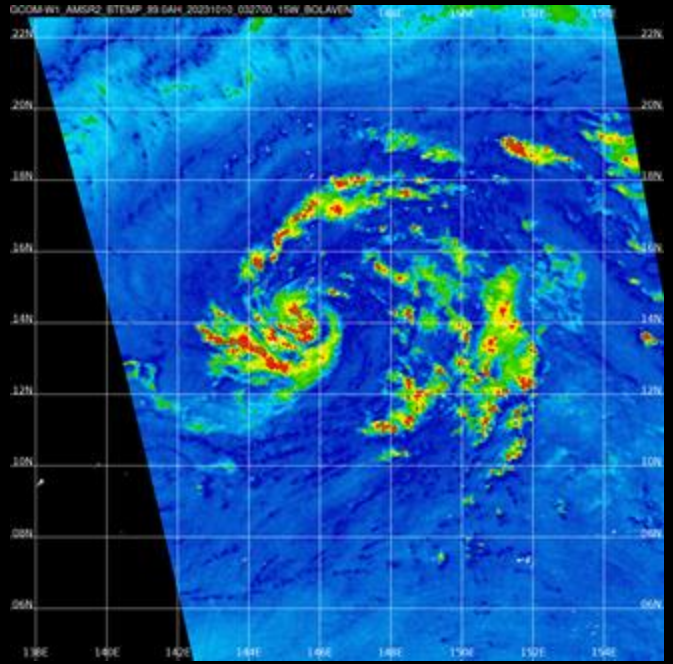




COMMUNITY ENGAGEMENT

- Impact studies of bands in 50-54 GHz range, individually and in aggregate, for both "traditional/physical" NWP models and AI-based models are in demand.
  - Land+sea vs. only sea
- The risk of significant impacts from 50-54 GHz interference is believed to be high, especially considering the potential sources (Earth-to-space).
- Increased use and impact studies of bands at 88+ GHz would also be valuable, especially considering potential for RFI in lower MW bands and the addition of new missions.

88+ GHZ



ATMS	GMI	Central Frequency (GHz)	Bandwidth (MHz)	NWP Centers
16		88.2	2000	Few
	8 / 9	89.0 (V / H)	6000	Few
17		165.5	3000	Few
	10 / 11	166.5 (V / H)	4000	Few
18	13	183.31 ± 7.0	2000	Most (Sounder), Few (Imager)
19		183.31 ± 4.5	2000	Most
20	12	183.31 ± 3.0	1000 / 2000	All (Sounder), Few (Imager)
21		183.31 ± 1.8	1000	Most
22		183.31 ± 1.0	500	All

EESS APPLICATION VS. ADJACENT ACTIVE SERVICE

EESS Passive Band	Application	Active Service Band	Active Service
86-92 GHz	Precipitation, Sea ice	**81-86 GHz**	Fixed satellite (E-S), mobile
		92-04 GHz	Mobile, radiolocation
114.25-116 GHz	Temperature profiling	**111.8-114.25 GHz**	Fixed, mobile
164-167 GHz	Water vapor profiling	**158.5-164 GHz**	Fixed, fixed satellite (S-E), mobile, mobile satellite
		167-174.5 GHz	Fixed, fixed satellite (S-E), inter-satellite, mobile
200-209 GHz	Water vapor	**191.8-200 GHz**	Fixed, inter-satellite, mobile, mobile satellite, radionavigation and RNSS
		209-217 GHz	Fixed, fixed satellite (E-S), mobile

229-244 GHZ

Primary application:
Ozone, cirrus clouds

Satellite	Agency	Launch	End of Life	Inst.	Frequency (GHz)	Bandwidth (MHz)	Application
Metop-SG-A1-3	EUMETSAT	≥2025	≥2037	MWS	229	2000	Window/Cirrus Clouds
Aura	NASA	2004	≥2025	MLS	230.5432	10	CO/Ozone
					230.5432	1250	CO/Ozone
					233.9515	1250	Ozone
					235.7151	10	Ozone
					235.7151	1250	Ozone
					239.66	15600	Ozone
Metop-SG-B1-3	EUMETSAT	≥2026	≥2048	ICI	243.2	8000	Window/Cirrus Clouds

WEATHER SATELLITE INTERFERENCE IMPACTS SUMMARY

The delivery of satellite weather data must always be **timely**, **consistent**, and **reliable**.

Microwave observations are **unique**, **valuable**, and **global**.

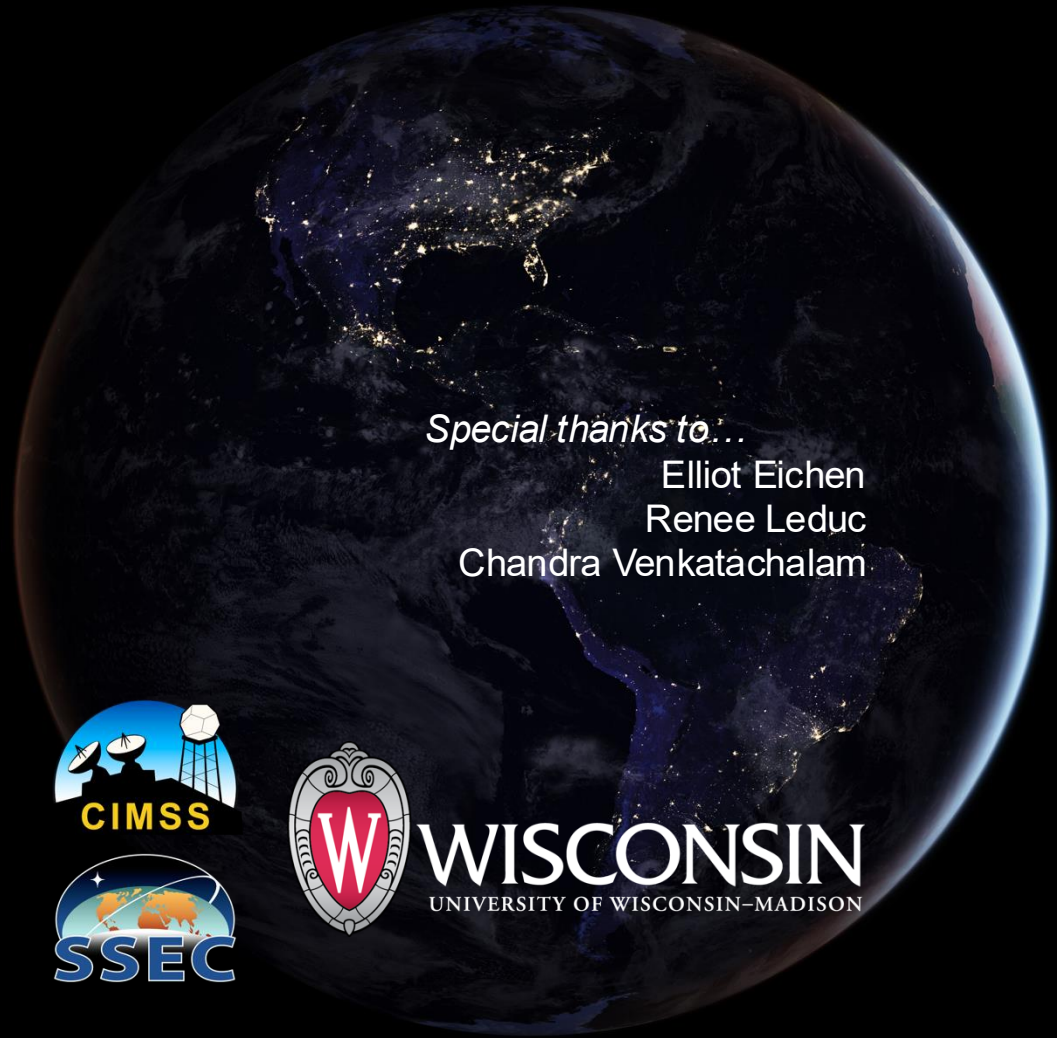
Continuing **observing capabilities** and **open data sharing policies** maintains the value of our satellite constellations and quality of **local and global** weather forecasts.

We are in search of **engineering solutions** to apply to ground networks to adapt to the **ever-changing** spectrum landscape.

Questions?

Jordan Gerth
jordan.gerth@ssec.wisc.edu
ametsoc.org/radio

@AMSspectrum
@jjgerth



Special thanks to…
Elliot Eichen
Renee Leduc
Chandra Venkatachalam

AMERICAN METEOROLOGICAL SOCIETY 1919

CIMSS

SSEC

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON