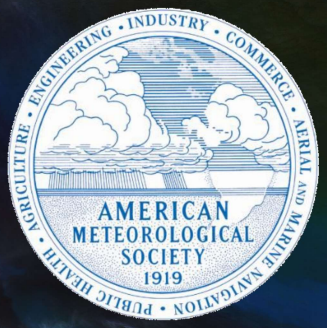
# Overview of the American Meteorological Society
# **Committee on Radio Frequency Allocations**

**Jordan Gerth**, AMS Committee Chair

*With contributions from the committee and colleagues*

@AMSspectrum
@jjgerth

NAS CORF Meeting, Washington, DC, 30 May 2024





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# AMS Committee on RF Allocations

- Organizes members to review and coordinate on all matters of radio frequency spectrum management pertinent to the enterprise
  - 2024 Membership: 20 members + 2 ex officio members
- 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

**Collection**: High-power terrestrial wireless emissions in or near spectrum allocated for earth sensing will reduce consistent and reliable global weather observations

## Transmissions

**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)

## Inconsistency

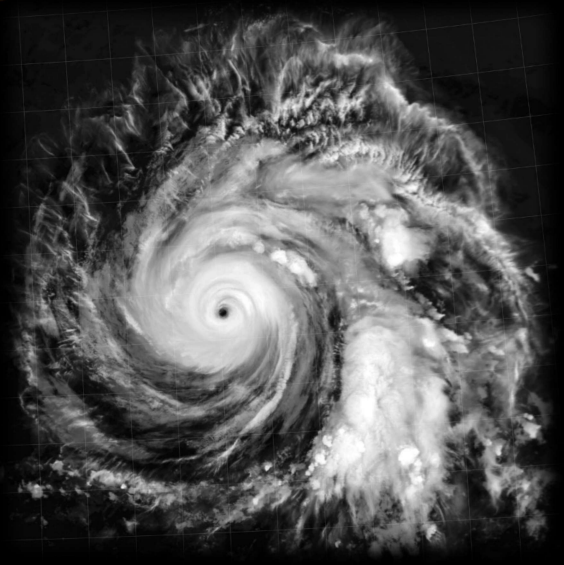
**Impact**: The risk of spectrum sharing is not a sudden decrease in forecast skill or a complete loss of observations, but an inability to deliver consistent weather services

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)
  - Ground-based weather radar (Collection)
  - 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

# THE LATEST ON LIGADO

**U.S. Government reply to Ligado lawsuit in the U.S. Court of Claims**:

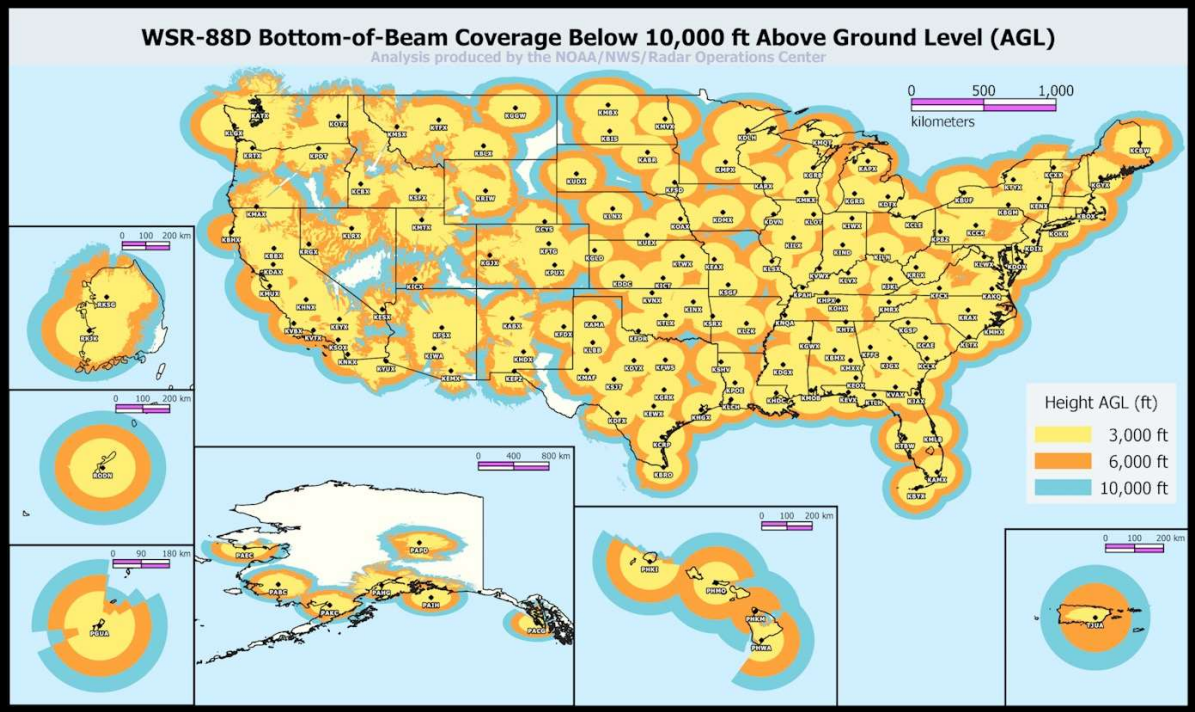
I. The Communications Act's Comprehensive Remedial Scheme Displaces This Court's Jurisdiction Under The Tucker Act

II. Ligado Fails To State A Cognizable Takings Claim

- A. The Complaint Does Not Allege A Cognizable Property Interest
- B. Ligado Fails To Properly Plead Authorized Government Conduct
- C. Ligado Fails To State A Claim For A Physical Taking
- D. Ligado Fails To State A Claim For A Categorical Regulatory Taking
- E. Ligado Cannot State A Regulatory Taking Claim Under Penn Central
- F. Ligado Fails To State A Claim For A Legislative Taking

# NATIONAL SPECTRUM STRATEGY: LOWER 3 GHZ (3.1-3.45 GHZ)

- **NEXRAD**
  - 2700 to 3000 MHz (S Band)
- **Radar Next**
  - Not yet established



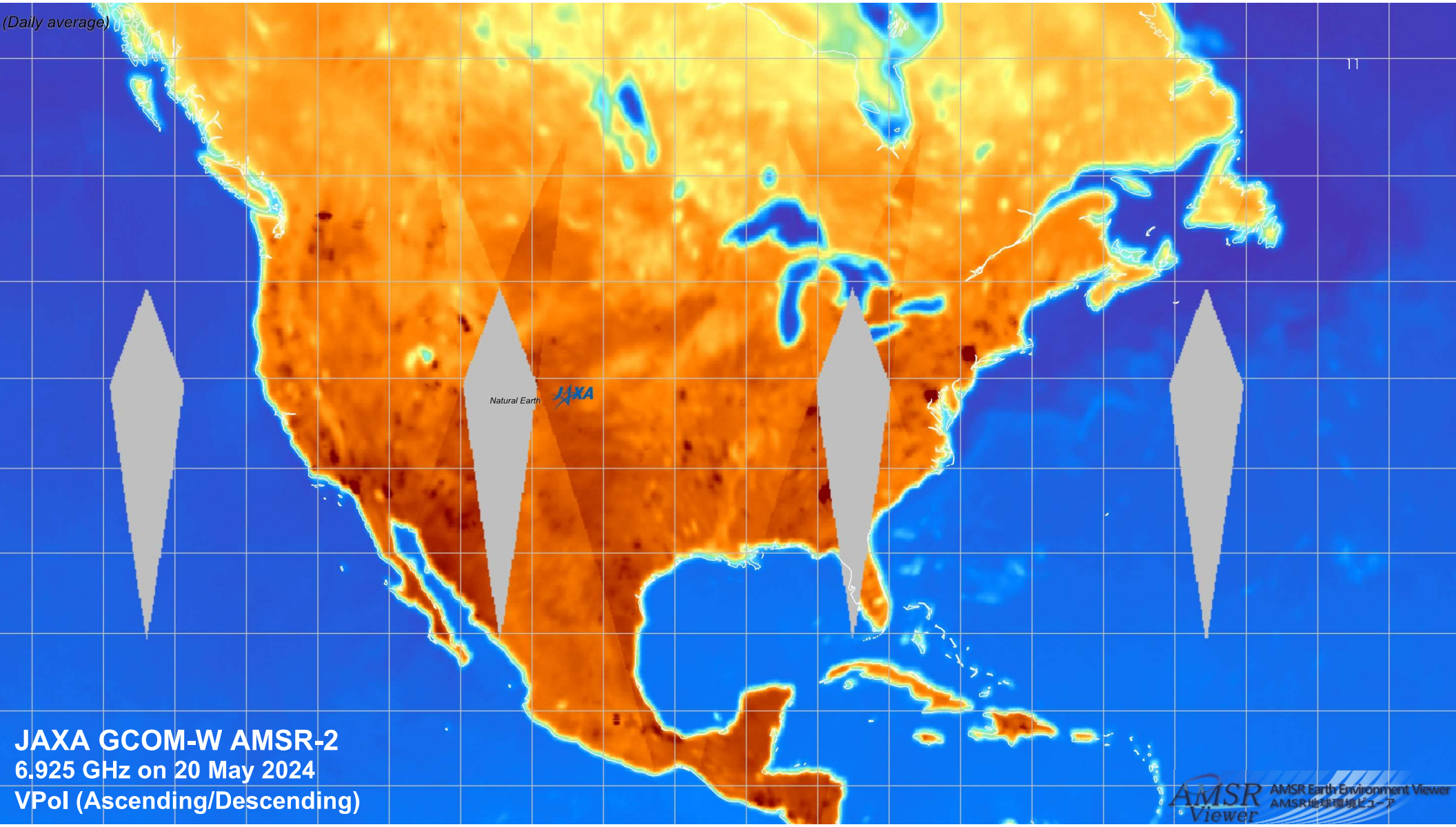
# NATIONAL SPECTRUM STRATEGY: 7125-8400 MHZ

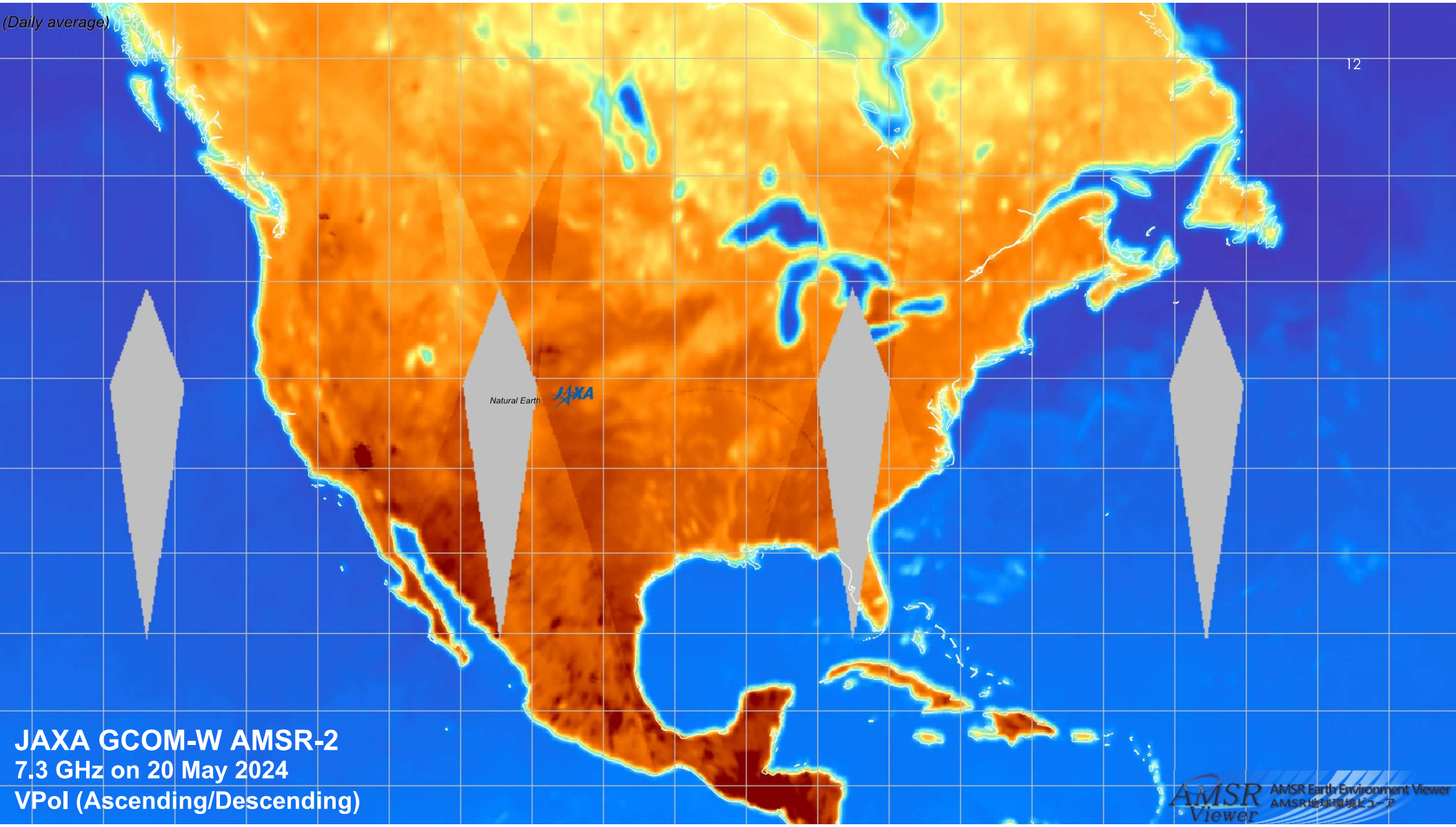
**Real-time High Rate Data (NOAA JPSS)**

- 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)


(Daily average)
Natural Earth
JAXA
JAXA GCOM-W AMSR-2
6.925 GHz on 20 May 2024
VPol (Ascending/Descending)
AMSR Viewer
AMSR Earth Environment Viewer
AMSR地球環境ビューア


(Daily average)
12
Natural Earth
JAXA
JAXA GCOM-W AMSR-2
7.3 GHz on 20 May 2024
VPol (Ascending/Descending)
AMSR Viewer
AMSR Earth Environment Viewer
AMSR地球環境ビューア

# AMS (AGU/NWA) COMMENTS TO FCC 24 GHZ NPRM (Docket no. 21-186)

- **Our organizations support the Commission's proposal to adopt the Resolution 750 unwanted emissions limits adopted at WRC-19 at a minimum.**
- It would be preferable to adopt stronger out-of-band emissions (OOBE) limits, such as those proposed in the National Academy of Sciences' Committee on Radio Frequencies (CORF) filing.
- However, we recognize the Resolution 750 unwanted emissions limits adopted at WRC-19 were a compromise, and those limits are what most countries have adopted.

# 1. ALIGNMENT

# 2. DIFFERENCES

At a minimum, the Commission should align its rules with the WRC-19 limits on emissions from active operations in the 24.25-25.25 GHz band into passive sensing in the 23.6-24.0 GHz band.

Measuring Interference to Passively Sensed Data Differs from Interference Detection in Active Measurements

# 3. IMPORTANCE

# 4. CRITICALITY

Passively Sensed Data at 23.824 GHz is Important to Weather Forecasts

Water Vapor Measurements near 24 GHz are Becoming More Crucial as Flash Flooding and Atmospheric Rivers Occur More Frequently

# 5. CLIMATE

# 6. COSTS

Authoritative U.S. climate reports point to increasing incidence of severe rain events that are predicted using satellite observations near 24 GHz

Reliable Passive Measurements Are Crucial to Accurate Forecasts as the Costs of Climate Change Impacts and Disasters Increase

# 7. ACCESSIBILITY

# 8. RESEARCH

Limits to OOBE Near 24 GHz Can Promote Equity and Accessibility of Critical Flash Flood Information to Underserved Populations

Additional Research is Needed – Especially Studies and Dialogues Bridging Atmospheric Science, Wireless Networks and Spectrum Allocation

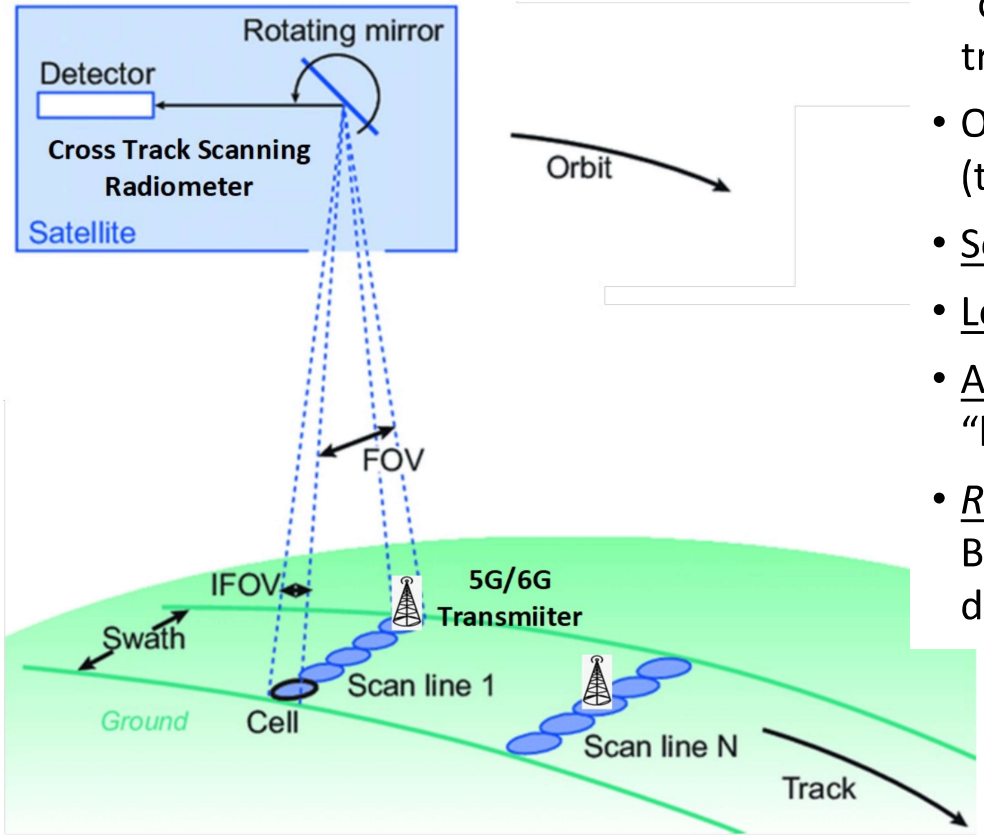
# MORE EMISSIONS NEAR PASSIVE BANDS

- Multiple commercial licensing actions and proposed international recommendations all contribute to emissions in adjacent passive bands
  - 50.2 – 50.4 GHz (closest to surface):
    - Multiple fixed satellite satellite uplink services directly adjacent above and below temperature (oxygen) band (profile created from multiple 50+ GHz bands)
  - 86 – 92 GHz (cloud features):
    - Hundreds to thousands of uplink gateways in 81 – 86 GHz requested to support 7,500 NGSO satellites
    - No currently funded means to detect space-based radiometer interference
    - Other maritime and in-flight aircraft broadband uplinks also in 81 – 86 GHz

# COMMITTEE MEMBER CONTRIBUTIONS

Items of interest to the NAS CORF

# Real-Time Geofencing of EESS Radiometers



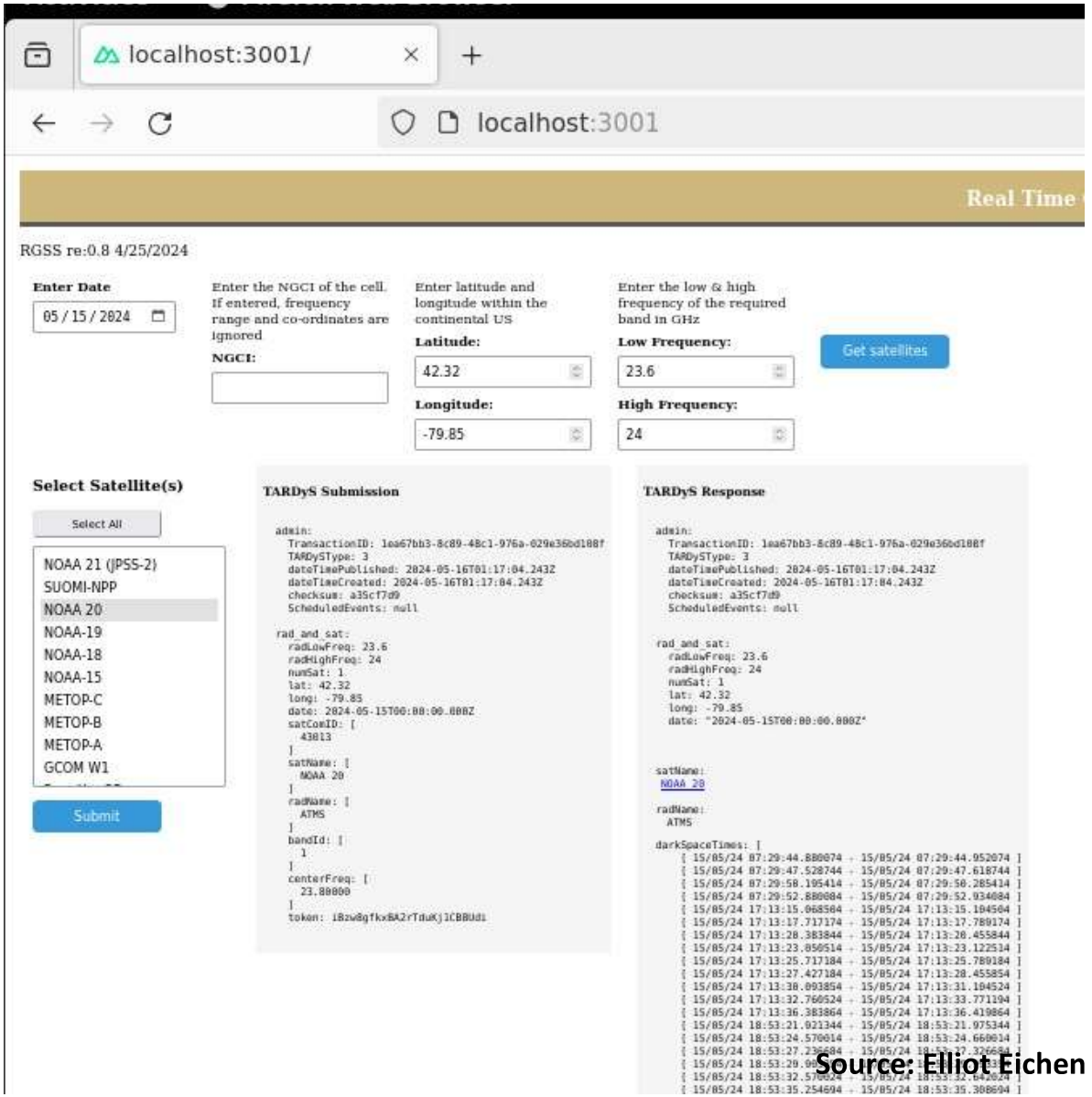

- Software-based geofencing of passive EESS measurements from RF interference by geofencing 5G/6G transmitters in "dark-spaces" (when the measurement pixel overlaps a 5G transmitter).
- Overlap time/radiometer + buffer ~100s msec => worst case (turn off transmitters) network availability of ~ 99%.
- Software vs. ITU hardware. Flexible, fast, multi-band, cheap.
- Less interference to EESS than ITU recommendations.
- Actual network infrastructure. Enables 5G networks to run "hotter" in rural/suburban areas. Solves $$ last mile problem.
- *Requires accurate and precise prediction of dark spaces.* UC-Boulder system is accurate to < 1 pixel compared to data downloaded from NOAA cross-track radiometers.



**Source: Elliot Eichen**

Programmatic interface to RGSS “dark-space” data publicly available 3Q24[1].

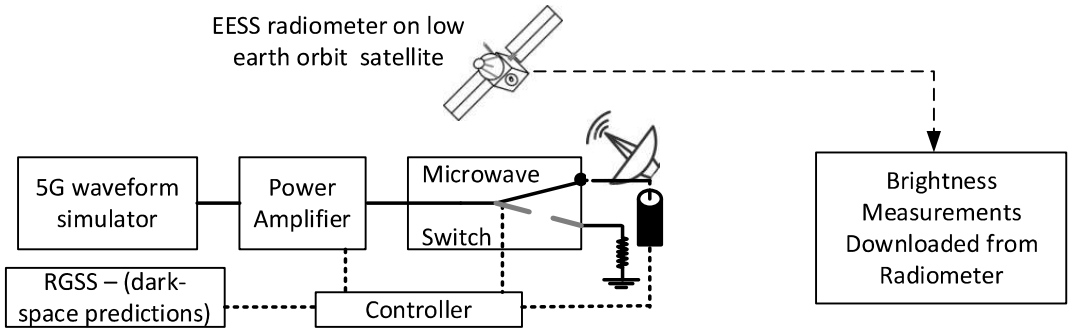
(for all EESS satellites provided that data is available from the satellite operator to confirm accuracy)

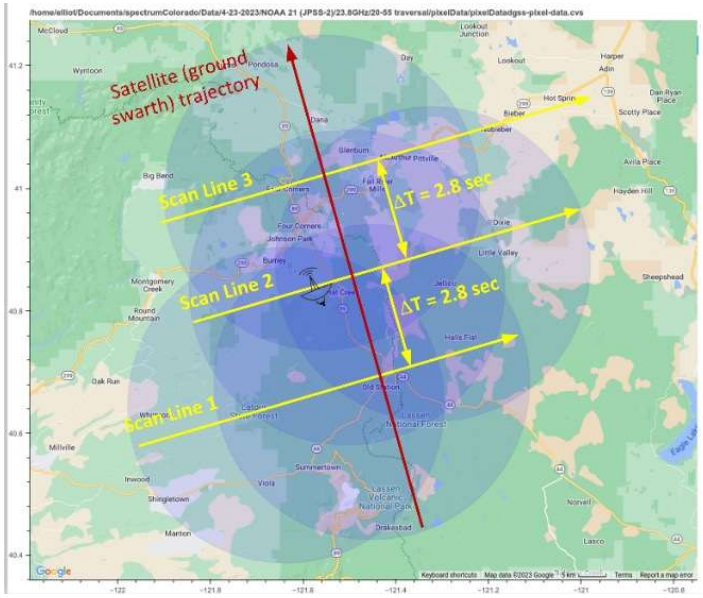



Source: Elliot Eichen

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

# RF Flashlight Testbed Proposal (NSF):



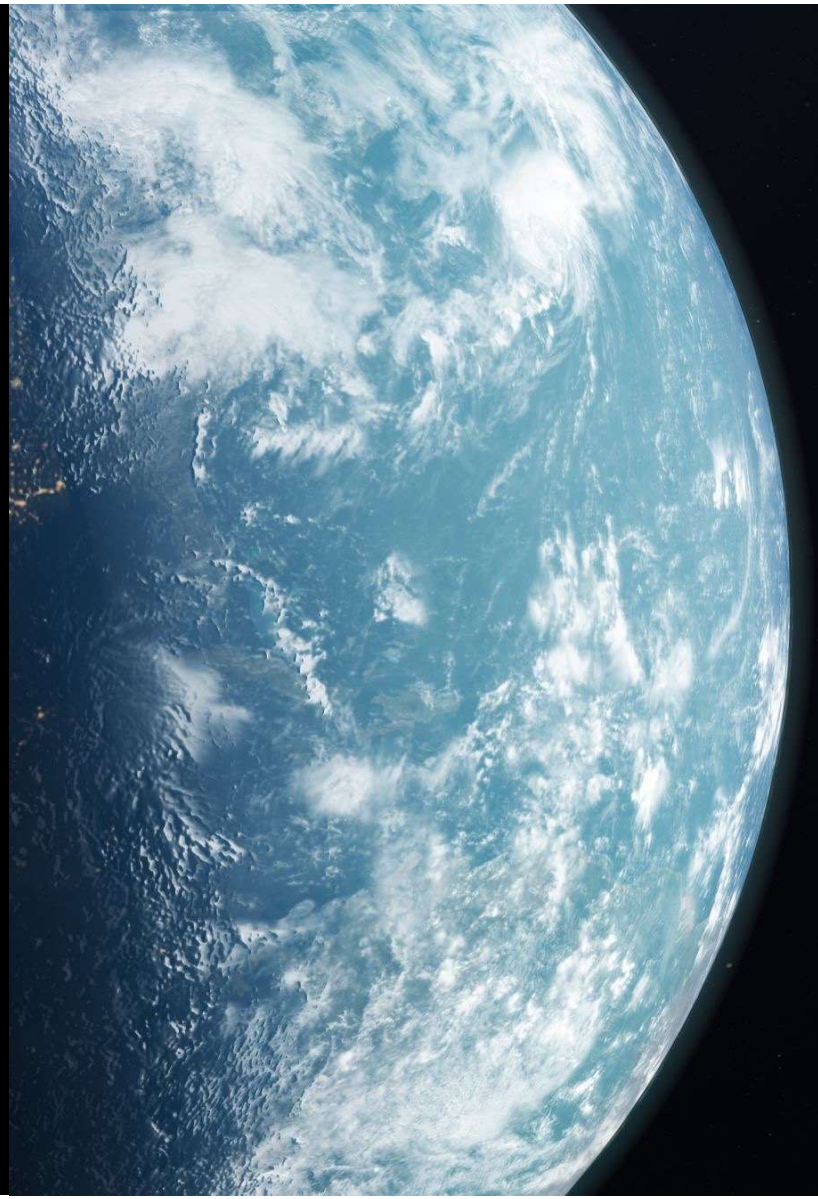

- Experimental verification of the accuracy and precision of predicted “dark-spaces.”
- Turning the transmitter (ON/OFF) for measured pixels in subsequent scan lines enables brightness changes due only to the “flashlight”, rather than atmospheric changes or changes in the satellite-to-ground geometry.
- Potential to use this experiment (not covered in the grant proposal) to test more accurate (multi-path,non-line-of-sight) propagation models than the ITU’s simple (line-of-sight) model – reinforces the sensitivity of EESS passive measurements.



**Source: Elliot Eichen**

# DRAFT TENETS OF UPDATED AMS POLICY STATEMENT

1. Meteorological uses of spectrum are not interchangeable with other spectrum resources.
2. The global Earth observations architecture is vulnerable to interference from other services.
3. Spectrum resources enable the weather, water, and climate enterprise to sense and communicate information critical to the Nation's economy, security, and public safety.

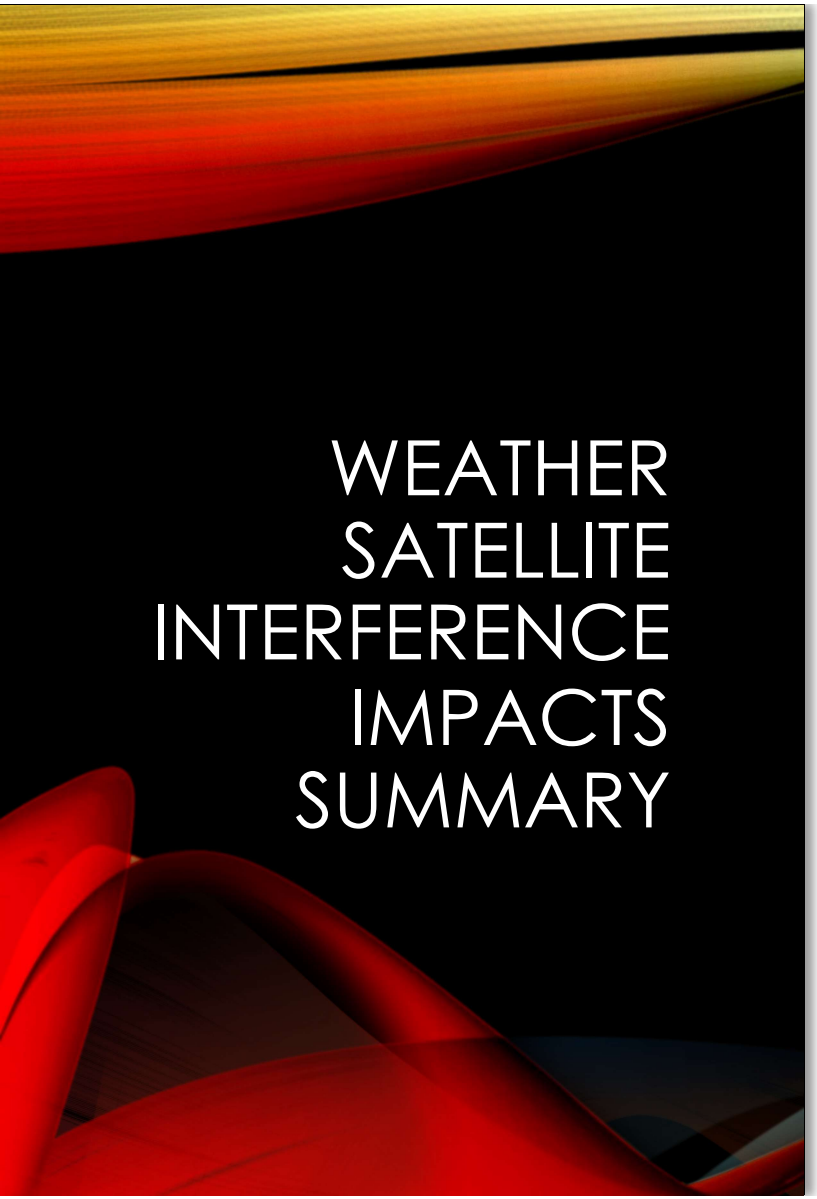


# CONFERENCE PRESENCE

- May: MicroRAD 2024 and NSF Spectrum Week
- Session at the International Microwave Symposium in Washington, DC, June 20

  Speakers will include:
  - Umair Javed (CTIA)
  - Andy Clegg (Google and WinnForum)
  - Jennifer Warren (Lockheed)
  - Dave Kunkee (Aerospace)
  - Renee Leduc (Narayan Strategy)

- October: RFI 2024 in Argentina?



# 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?

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*Special thanks to…*
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