

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Satellite Spectrum	)	SB Docket No. 25-180
Abundance	)	
	)	
Use of Spectrum Bands	)	GN Docket No. 14-177
Above 24 GHz For Mobile	)	
Radio Services	)	

**REPLY COMMENTS OF THE
NATIONAL WEATHER ASSOCIATION,
AMERICAN METEOROLOGICAL SOCIETY, AMERICAN GEOPHYSICAL UNION
and UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH**

August 26, 2025

The National Weather Association (NWA), American Meteorological Society (AMS), American Geophysical Union (AGU) and University Corporation for Atmospheric Research (UCAR)¹ appreciate the opportunity to provide reply comments on these above noted Notice of Proposed Rulemaking (NPRM) seeking to make additional spectrum resources available for satellite communications in the two following areas: 1) 51.4-52.4 GHz band (52 GHz band); and 2) certain “W-band” frequencies (92.0-94.0 GHz, 94.1-100 GHz, 102.0-109.5 GHz, and 111.8-114.25 GHz).

The Lower 50 GHz Band is not Underutilized

Passive microwave observations from Earth observation satellites collected within and adjacent to the 51.4-52.4 GHz band, and in the W-Band, adjacent to the 92 GHz and 115 GHz bands, have contributed significantly to more accurate and timely weather forecasts over the past 40 years.² Such information, while collected mostly from government satellites over the Americas and worldwide (especially from the U.S., Europe, Japan and Korea), and now from emerging private-sector satellites (including Tomorrow.io (now in orbit), Spire and Weatherstream), has had significant impact on citizens, communities and businesses to both inform about and plan for weather-related hazards. Information from Earth exploration satellite service (EESS) passive bands provides critical action-

¹ The membership of NWA, AMS, AGU and UCAR include the world’s leading Earth scientists and meteorologists, oceanographers and hydrologists, including operational forecasters, emergency managers and broadcasters who work to keep U.S. communities safe. These skilled professionals depend heavily on technology that is reliant on specific passive observations only available in the above noted bands for their forecasts and models to better understand the Earth’s atmosphere, oceans and land to predict natural hazards that impact lives, property and economies in the U.S. and across the world.

² See *AGU et al* comment in SB 25-80/GN 14-177 at 1. (28 Jul 2025)
<https://www.fcc.gov/ecfs/document/10728088696934/1>

oriented weather information that is employed by diverse industries to better inform the public. These range from private-sector weather companies who adapt the data for specific weather-sensitive industries (such as agriculture, aviation and stadium event management), the general public on “weather apps” and other Internet applications, to media companies that employ broadcast meteorologists to communicate about daily forecasts and incoming hazards. While multiple commenters remarked that the 50 GHz band is underutilized,^{3 4 5 6} the undersigned organizations do not agree and call on those commenters to note the considerable economic and societal impact of the weather forecasting that relies on passive data collected from the protected use of these bands.

It is important to remember that there are diverse uses of spectrum that have both societal and commercial value and benefits. These passive meteorological measurements of the atmosphere are only available at specific frequencies which are dictated by natural emissions based on the laws of physics and chemistry. Passive EESS radio frequency use cannot be moved to other bands like other services. EESS passive operations require additional protection and power limitations on nearby transmitters, beyond the protection values generally required by typical communications systems. Clear regulation and enforcement governing spectrum use is needed to ensure required protection. Such additional space does not mean that the band is “underutilized” since there is a legitimate concern that if there were more and varied higher power transmissions, they could cause “insidious contamination” to the much quieter passive measurements, as described in our previous comment.⁷

Coexistence is Challenging and Requires Comprehensive Understanding of How Passive Data is Measured and Used by the Weather Community

Our comments and those submitted by the National Academies’ Committee on Radio Frequency (CORF) describe in detail how the very faint natural transmissions of the atmosphere are measured using microwave sounding instruments, which operate very differently from the typical communications equipment regulated by the FCC. CORF explained the complications well noting:

"In particular, new uplink transmissions authorized as a result of new Earth-to-space allocations would no longer be confined to those directed toward fixed points in the [geostationary satellite orbit] GSO equatorial plane but would include Earth stations tracking [non-geostationary satellite orbit] NGSO satellites that are constantly changing directions distributed across the sky. This significantly increases the potential for associated [out-of-band-emissions] OOBE into the EESS (passive) temperature sounding channels and could contaminate measurements made viewing toward these Earth stations with main beam or near sidelobe coupling."⁸

³ Statement of Chairman Brendan Carr at 1. (22 May 2025) <https://docs.fcc.gov/public/attachments/FCC-25-29A2.pdf>

⁴ See *Space Exploration Holdings LLC (SpaceX)* comment in SB 25-80/GN 14-177/GN 22-352/WT 23-158 at 2 and 5. (29 Jul 2025) <https://www.fcc.gov/ecfs/document/107290555708199/1>

⁵ See *Kuiper Systems LLC* comment in SB 25-80/GN 14-177/GN 22-352/WT 23-158 at 2 and 5. (28 Jul 2025) <https://www.fcc.gov/ecfs/document/10728169819980/1>

⁶ See *Logos Space Services, Inc* comment in SB 25-80/GN 14-177/GN 22-352/WT 23-158 at 2. (28 Jul 2025) <https://www.fcc.gov/ecfs/document/1072870379554/1>

⁷ *AGU et al.* at 4.

⁸ See CORF comment in SB 25-80/GN 14-177/GN 22-352/WT 23-158 at 23. (28 Jul 2025) <https://www.fcc.gov/ecfs/document/1072852368008/1>

Despite mentions of *highly efficient pencil-thin beams*⁹ ¹⁰ and *highly directional narrow beams*,¹¹ such descriptions are not useful in depicting a coexistence environment between passive microwave sensing and satellite broadband that lacks harmful interference. Those narrow beams may in fact result in more power concentrated on a passive microwave sounder instrument when coupled in the main beam or in sidelobes. In addition, multiple commenters noted how adjacent-band interference could be “mitigated.”¹² ¹³ However, none of those mitigation reassurances indicated the inherent challenges of “insidious contamination,”¹⁴ which can then also bias the overall forecast model into which the data is assimilated.¹⁵ Such “insidious contamination” realities speak to the inherent difficulty of mitigating such harmful interference.

To accurately determine how NGSO Earth-to-space operations and EESS passive can coexist without harmful interference requires clear and enforceable OOB limits. Such limits need to be derived from detailed technical studies that are informed by expertise in atmospheric science’s use of passive data and detailed, comprehensive information about the anticipated NGSO Earth-to-space operations in the band. The suggestion that harmful interference with EESS operations in the 52.6-54.25 GHz band can be mitigated with a 200 MHz guard-band¹⁶ is highly problematic. In the dialogue surrounding interference from OOB to passive measurements near 23.8 GHz leading up to the ITU’s World Radiocommunications Conference-2019 (WRC-19), it was determined that the required separation to avoid harmful interference was closer to 450 MHz. While there are some differences in spectral characteristics between the 23.8 and the 52.6 GHz bands, this example underlies the importance of the detailed technical studies noted above.¹⁷

The weather community relies on important temperature measurements from 50.2-50.4 GHz (as well as more broadly in the frequencies in the 50 – 58 GHz range), and the undersigned organizations are concerned with comments that suggest an allocation for NGSO FSS uplink could be extended to the existing 50.4-51.4 GHz uplink.¹⁸ The undersigned organizations support stringent unwanted emission limits consistent with the international mandate established in ITU

⁹ See *SpaceX* at 1.

¹⁰ See *Logos* at 4 and 7.

¹¹ See *Kuiper* at 9.

¹² See *Logos* at 4.

¹³ See *SpaceX* at 7.

¹⁴ “Insidious contamination” is when Earth-to-space transmission signals are faint enough to “look like” actual natural atmospheric emissions but are large enough to corrupt the overall passive data.

¹⁵ See *AGU et al* at 4.

¹⁶ See *Kuiper* at 9.

¹⁷ International Telecommunication Union, Radiocommunication Sector (ITU-R). (2019, February). *Report of the Conference Preparatory Meeting for WRC-19: on technical, operational and regulatory/procedural matters to be considered by the World Radiocommunication Conference 2019*. Geneva, Switzerland.

Specifically referencing: Chapter 2, "Agenda Item 1.13: EESS (passive) bands and compatibility with active services," which details the technical studies on compatibility between IMT-2020 in the 24.25-27.5 GHz band and the EESS (passive) service in the 23.6-24 GHz band.

Persistent link: <http://handle.itu.int/11.1002/pub/8128df4c-cn> (accessed 22 Aug 2025)

¹⁸ See *SpaceX* at 6.

Resolution 750 (Rev. WRC-19),¹⁹ which may need to be revisited given changes in satellite systems hosting passive microwave sensors.

While SpaceX's efforts to coordinate with the radio astronomy community²⁰ are appreciated, such solutions developed for Radio Astronomy Service (RAS) coexistence are not directly relevant to the weather community. We appreciate the broad ranging concerns that the American Astronomical Society (AAS) and the National Radio Astronomy Observatory (NRAO) raised given the considerable challenges the operations proposed in this proceeding present to their observations. The complexity of protecting a scanning instrument on a moving satellite platform, that is measuring over an area is much more complex than the solution described by the commenters, however. The undersigned organizations would welcome open and transparent dialogue on these important topics related to OOB impacting EESS passive bands and the impacts on weather prediction and related emergency response activities.

The Critical Role of V- and W-Band Passive Measurements in Predicting Major Weather-related Emergencies

Meteorologists use remotely sensed observations of the V band, particularly 50-58 GHz, and W band, 86-92 GHz, to make and improve weather forecasts through three distinct uses: (1) as an input to numerical weather prediction (NWP) models, through a process known as (data) assimilation, (2) as an input to algorithms that combine multiple remotely sensed observations (or bands) into a physical parameter, like atmospheric temperature, moisture, or precipitation, that help meteorologists determine the state of the atmosphere absent in-situ observations from weather balloons, e.g., and (3) through direct inspection of the remotely sensed observational data (imagery) to determine the position of a storm center, such as a hurricane, or changes in its intensity. Daily weather forecasts, and special forecasts and warnings for impactful weather events, are equally and consistently improved through one or more of the aforementioned applications, and this improvement ranges from the short term (within a few hours to a few days) to the medium range (three to seven days).

Radio frequency interference would reduce or eliminate the value of V- and/or W-band observations for all three applications. In the case of interference for the NWP models and algorithms for which it is an input, the influence of the observation on the output would have to be reduced if not completely eliminated, even with the prospect or presumption of radio frequency interference (RFI). For the case in which meteorologists are evaluating the data through direct inspection of imagery, the RFI could obscure some or all of the storm structure. The outcomes of the loss of the use of this passive microwave data, which are not readily replaceable with other types of observations, or even other microwave frequencies, range from notable to stark. First, there will be a loss of confidence in medium-range weather predictions (less accuracy and more inconsistency). Second, there will be greater error in the placement of storm centers, especially at night, when visible satellite imagery is unavailable, which results in downstream consequences for expectations about storm track and intensity.

¹⁹ International Telecommunication Union. (2019). Resolution 750 (Rev. WRC-19): Compatibility between EESS (passive) and relevant active services. In Final Acts of the WRC-19. https://www.itu.int/dms_pub/itu-r/oth/0C/0A/R0C0A00000F00157PDFE.pdf (accessed on 24 Aug 2025).

²⁰ See *SpaceX* at 7.

Extreme weather events are becoming all too common - and expensive - for the U.S. Predictability is an expectation to save lives and protect property as much as possible. **Injecting uncertainty into the observations that are the source of the predictions is thus highly consequential and strong protections for EESS and existing missions must exist.**

For example, the V- and W-bands provided crucial data to weather models that informed the forecasters predicting the deadly Texas Hill Country storms and resulting floods on 4 July 2025. During that weekend there were multiple storm/flood events in that region, and in the first half of July, there were 12 flash flood warnings issued in Kerr County, TX, at the center of the flooding.²¹ This weather event started as Tropical Storm Barry over the Atlantic Ocean, the remnants of which merged with additional moisture from the Pacific Ocean. Satellites captured both as detailed in Figure 1.

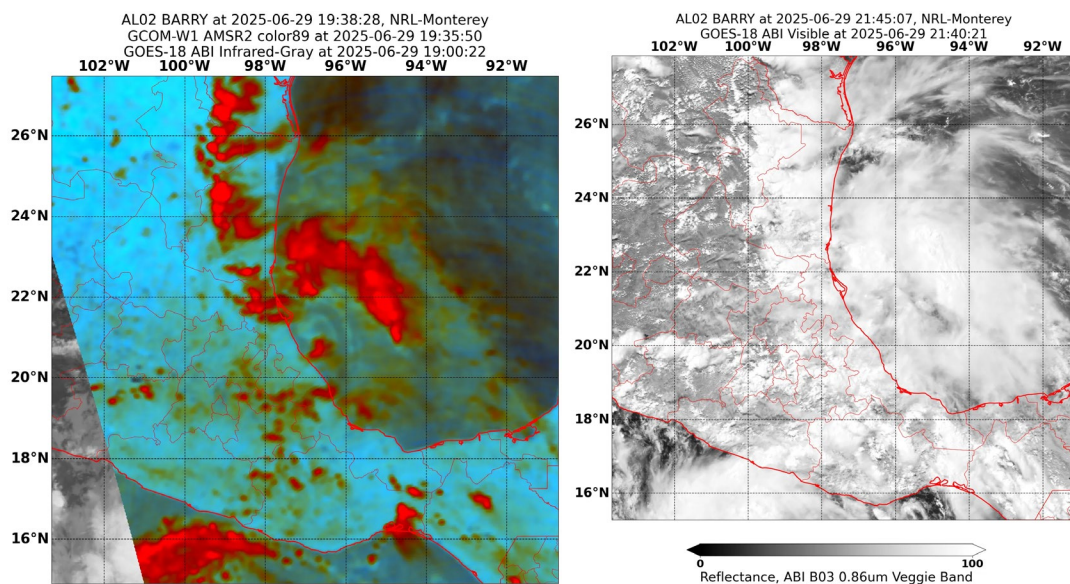


Figure 1: 89 GHz imagery of Tropical Storm Barry on the afternoon of 29 June 2025 south of Texas (left) compared to the visible/near-infrared satellite image from the Geostationary Operational Environmental Satellite (GOES-18) two hours later (right) shows the considerable advantage, and detail, that passive microwave imagery provides to meteorologists' understanding of storm dynamics. (Imagery source: U.S. Naval Research Lab)²²

As highlighted in a press release from the FCC in early August 2025,²³ the agency is seeking to re-examine the national alert and warning systems. Reliable and accurate weather forecast information is crucial to many of those alerts, and microwave measurements from passive bands are critical inputs to accurate forecasts. In addition, insidious contamination of passive observations can also lead to false alerts, which is also a concern. **As the FCC considers how to make the Emergency Alert System (EAS) and Wireless Emergency Alerts (WEA) more efficient and effective,**

²¹ Cappucci, M. "Texas is still facing more floods. When will rains finally end?" Washington Post. 14 July 2025. <https://www.washingtonpost.com/weather/2025/07/14/texas-floods-rain-ends/>. Accessed 21 Aug 2025.

²² U.S. Naval Research Lab. https://science.nrlmry.navy.mil/geoips/tcweb_nrl/. Accessed 23 Aug 2025.

²³ "FCC to Re-Examine Emergency Alert System" FCC News Release. 7 Aug 2025. <https://docs.fcc.gov/public/attachments/DOC-413552A1.pdf>

safeguarding these passive measurements from harmful interference is a key component of that effort.

The Importance of Passive Measurements to Weather Predictions and Its Array of Impacts Across Society and the Economy

While this proceeding highlights the economic value of satellite broadband, it is critical also to examine the economic and societal impacts of increasingly accurate weather forecasts fueled by satellite Earth observations from the public and private sector. While the growth of satellite broadband does have a clear economic benefit,²⁴ it is important to note that the value of weather prediction to both saving lives and mitigating economic damage is critical to the U.S.

Estimates of how potential degradation to weather forecast models would impact model forecast accuracy require operational simulations using supercomputers to rerun weather models over a time duration without using a subset of the input data (e.g., passive sounding measurements in the lower 50 GHz band). We understand that SpectrumX, the NSF Spectrum Innovation Center, is conducting an initial analysis of this type in partnership with the University of Wisconsin-Madison Space Science and Engineering Center. However, a few Federal science agencies, as well as other academic and federally funded research and development centers (FFRDCs), may also have the capacity to conduct such simulations, which can be costly, time-consuming and specialized. The undersigned recommend that Spectrum Relocation Funds be considered for such important analyses for this proceeding.

Earlier this year in the journal *Remote Sensing*,²⁵ a review of the uses of passive microwave instruments noted that their data were essential for advancing the understanding of Earth's atmosphere and surface processes. These advancements of understanding, especially in the lower 50 GHz bands are crucial to improve weather forecast accuracy, which save lives and sustain economic activities through natural disasters, especially hurricanes, severe rain and snow, wildfires and drought.

It is difficult to place a precise valuation on weather disasters and the contribution of accurate forecasts, but the above noted study indicated weather disasters in 2020 cost \$258 billion, including \$63 billion in damages, with more than 80 percent of these damages occurring in the U.S. A study from the *Bulletin of the American Meteorological Society* reported that the effect of weather variability on the U.S. economy can amount to 3.36% (\$485 billion) of the Gross Domestic Product (GDP) in 2008 dollars. (The World Bank estimates US GDP in 2024 at \$29.18 trillion.) Applying the 3.36% variation in GDP in the study would yield more than \$980 billion in 2024 USD.²⁶ Some of the most sensitive economic sectors to weather hazards include agriculture, communications, construction, finance/insurance/real estate, manufacturing, mining, retail trade, services, transportation, utilities, and wholesale trade, with mining (oil, coal and gas exploration and extraction) being the most sensitive sector.²⁷

²⁴ See *SpaceX* at 2.

²⁵ Rouzegari, N., Bolboli Zadeh, M., Jimenez Arellano, C., Afzali Gorooh, V., Nguyen, P., Meng, H., Ferraro, R. R., Kalluri, S., Sorooshian, S., & Hsu, K. (2025). Passive Microwave Imagers, Their Applications, and Benefits: A Review. *Remote Sensing*, 17(9), 1654. 2025. <https://doi.org/10.3390/rs17091654> (accessed 24 Aug 2025)

²⁶ Lazo, J.K.; Lawson, M.; Larsen, P.H.; Waldman, D.M. U.S. Economic Sensitivity to Weather Variability. *Bull. Am. Meteorol. Soc.* 2011, 92, 709–720.

²⁷ See Rouzegari et al.

Additional life, property and economic facts related to the prediction of weather-related hazards include:

- Specific to hurricanes, from 1980 to August 2023, such storms resulted in a death toll of nearly 7000 people and caused substantial financial damage, with an average cost of \$22.8 billion per event in the U.S. alone.²⁸
- Due to the high concentration of costly infrastructure and equipment on U.S. military bases, hurricanes have caused costly damages at such facilities. For example, in 2018, Hurricane Florence and Hurricane Michael struck Camp Lejeune and Tyndall Air Force Base, respectively, costing the U.S. military billions of dollars in rebuilding costs and resulting in the loss of an F-23 fighter jet.²⁹
- The aviation industry is highly sensitive to weather. Conditions such as lightning, turbulence, icing, strong winds, tornados, hail, heavy rain, freezing rain, and snow affect airport ground and airborne operations leading to flight delays and cancellations. In another *Bulletin of the American Meteorological Society* article, the estimate of the impact of a single storm affecting New York City in 2016 resulted in 2,420 weather-related flight cancellations, costing airlines \$13.2 million and passengers/businesses \$30.1 million in lost productivity.³⁰ Accurate weather forecasts play an essential role in minimizing and mitigating those losses.
- Passive microwave instruments provide data that is valuable for forecasting intense winter storms. These weather extremes have a short but significant effect on the economy, with utilities, construction, hospitality, and retail being the most heavily affected. Between 1980 and 2017, fourteen winter storms in the U.S. caused damages worth \$43.9 billion, resulting in 1013 deaths, emphasizing the need for continued reliable access to such passive data.³¹
- Wildfires are dangerous to life and property, with the National Interagency Fire Center (NIFC) reporting³² that as of Friday, 22 August 2025 in the U.S. there were 49 large fires currently being suppressed, with 1,182,174 acres burned in large fires, with 7 new large fires. So far in 2025, there have been 44,808 incidents that have burned 4,025,601 acres year to date with 16,559 personnel assigned to them. Suppression alone in 2022 cost \$35 billion (not including insurance and landowner costs). NIFC indicates the five-year average statistics for Federal firefighting suppression costs show a total expenditure of nearly \$3 billion,³³ plus losses.

With the potential for contamination of key lower 50 GHz passive bands, it is possible that forecast accuracy of NWP models could be compromised. Since human forecasters develop their watches, warnings and forecasts using the numerical weather models, any compromise of the model outputs

²⁸ NOAA Office of Coastal Management. NOAA Hurricane Costs. <https://coast.noaa.gov/states/fast-facts/hurricane-costs.html> (accessed 22 Aug 2025)

²⁹ Gulati, S.; Sampson, C.R. Economic Value of Tropical Cyclone Conditions of Readiness. *Nat. Hazards* 2021, 108, 1687–1700.

³⁰ Lazo, J.K.; Hosterman, H.R.; Sprague-Hilderbrand, J.M.; Adkins, J.E. Impact-Based Decision Support Services and the Socioeconomic Impacts of Winter Storms. *Bull. Am. Meteorol. Soc.* 2020, 101, E626–E639.

³¹ See Lazo *et al.* 2020.

³² NIFC. Fire information statistics. <https://www.nifc.gov/fire-information/statistics> (accessed 22 Aug 2025)

³³ NIFC. Suppression Costs. <https://www.nifc.gov/fire-information/statistics/suppression-costs> (accessed 22 Aug 2025)

would yield degraded forecast products. As a result, the economic costs associated with the weather disasters noted above would increase at a rate higher than inflation, leading to problematic impacts on the U.S. economy. **We ask the Commission to consider these economic factors in determining the public benefit of this proposed rulemaking.**

Summary

The use of passive microwave spectrum allocations for Earth exploration-satellite services is an essential component to the development of weather forecasts. Characteristics of Earth-to-space emissions, such as power levels, deployment schedule, and direction of emissions, will determine if contamination of adjacent passive bands alters the accuracy of weather forecasts, which are a result of the output from complex numerical weather prediction models. Improvements in weather model performance over the past 20 years can be attributed to passive microwave satellite observations.³⁴

The potential for additional economic impacts and decreases in the safety of life and property during severe weather events further reinforces the recommendation for further study made in our organizations' earlier comment.³⁵ To accurately determine how Earth-to-space operations and EESS passive can coexist without harmful interference requires clear and enforceable OOBE limits. Such limits need to be derived from detailed technical studies that are informed by expertise in atmospheric science's use of passive data and detailed, comprehensive information about the anticipated Earth-to-space operations in the band.

It is critical for comprehensive studies to be conducted that consider the modeling and weather forecasting impacts to any such adjacent or shared band operations before further regulatory actions are taken to change allocations in these spectral areas.

We appreciate the opportunity to provide additional input into this proceeding.

Respectfully Submitted by:

Janice Bunting
Chief Executive Officer
National Weather Association

Lexi Shultz
VP, Science Policy & Government Relations
American Geophysical Union

Brian Papa
Acting Executive Director
American Meteorological Society

Antonio J. Busalacchi
President
University Corporation for Atmospheric
Research

³⁴ Geer, A. J., F. Baordo, N. Bormann, P. Chambon, S. J. English, M. Kazumori, H. Lawrence, P. Lean, K. Lonitz, and C. Lupu. "The Growing Impact of Satellite Observations Sensitive to Humidity, Cloud and Precipitation." *Quarterly Journal of the Royal Meteorological Society* 143, no. 709 (October 2017): 3189–3206. <https://doi.org/10.1002/qj.3172>. (Accessed 24 Aug 2025.)

³⁵ See *AGU et al* at 11.