



Geoscience and Remote Sensing Society

Frequency Allocations in Remote Sensing Technical Committee (FARS-TC)



Annual Meeting

IGARSS 2023

Pasadena

July 18, 2023



Content

- GUEST SPEAKER: Yan Soldo
The need of reliable spectrum to ensure the success of your space mission
- FARS ANNUAL MEETING
 - FARS Introduction & New Chairs
 - PocketQube initiative
 - GRSS Views on WRC23 initiative
 - IEEE Standard on RFI quantification initiative
 - Spectrum Management
 - Conferences and Outreach

DISCUSSION



Introduction

The Frequency allocations in Remote Sensing Technical Committee goal is to *interface between GRSS and the radio-frequency regulatory world* by

- ❑ educating the remote sensing community on spectrum management processes and issues
- ❑ promoting the development of radio frequency interference detection and mitigation technology
- ❑ organizing technical sessions at conferences, workshops, etc. on the above processes, issues and technologies
- ❑ providing spectrum managers and regulators with technical input and perspective from remote sensing scientists and engineers
- ❑ fostering the exchange of information between researchers in different fields, such as remote sensing, radio astronomy, telecommunications, etc. with the common scope of minimizing harmful interference between systems

FARS-TC Chairs

- **Outgoing:**

- **Chair:**

Roger Oliva

- **Co-chairs:**

Paolo de Matthaeis

Ming-Liang Tao

Incoming:

Chair:

Paolo de Matthaeis

Co-chairs:

Ming-Liang Tao

Beau Backus



ONGOING INITIATIVES



PocketQube

- Following the outcome of WRC19 and the discussions at the 2019 and 2020 FARS-TC Annual Meetings regarding the concerns for the 5G deployment, FARS launched an initiative to develop a PocketQube with RF monitoring capabilities at 24 GHz to follow the deployment of 5G and its impact on this remote sensing frequency band.
- The PocketQube was added to the list that UPC through a GRSS educational initiative was developing that included two PocketQubes (5cm x 5cm x 5cm):
 - Optical Payload.
 - RF Payload at L-band
 - **RF Payload at 24.5 GHz**

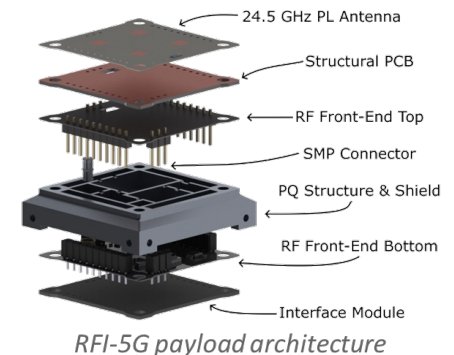
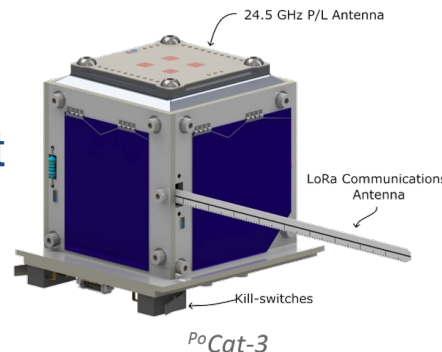


PocketQube

Focus on assessing presence of 5G out-of-band signals reaching the 23.6-24 GHz protected band



- Measure RF power with a RSSI in the band from 24 to 25 GHz in 10 MHz channels, +30 dB INR interferences.
- To be used in Drone Campaigns for assessing sites with 5G deployment at 24 GHz.
- Possibility for PocketQubes to be launched with the UPC NanoSat Lab custom CubeSat integrated deployer within the future ³Cat-8 mission (TBC).



PocketQube Test Campaigns

Attach PocketQube to a drone to perform flight campaigns in Spain.

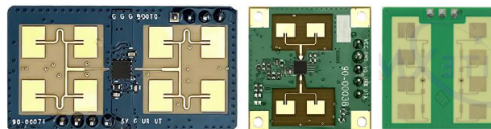
Drone Campaign

NANOSAT LAB

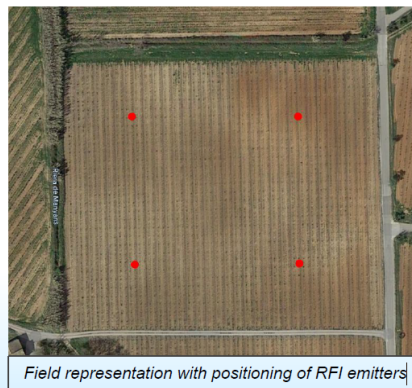
- Drone test campaign to validate payload operability
- 5-6 flights over crops field
- **Objective:** Detect hidden RFI emitters

24 GHz COTS radar modules

- Detections based on time and frequency pulse thresholding, as well as statistical analyses



Commercial-Off-The-Shelf 24 GHz radar modules



Field representation with positioning of RFI emitters



Drone + PocketQube

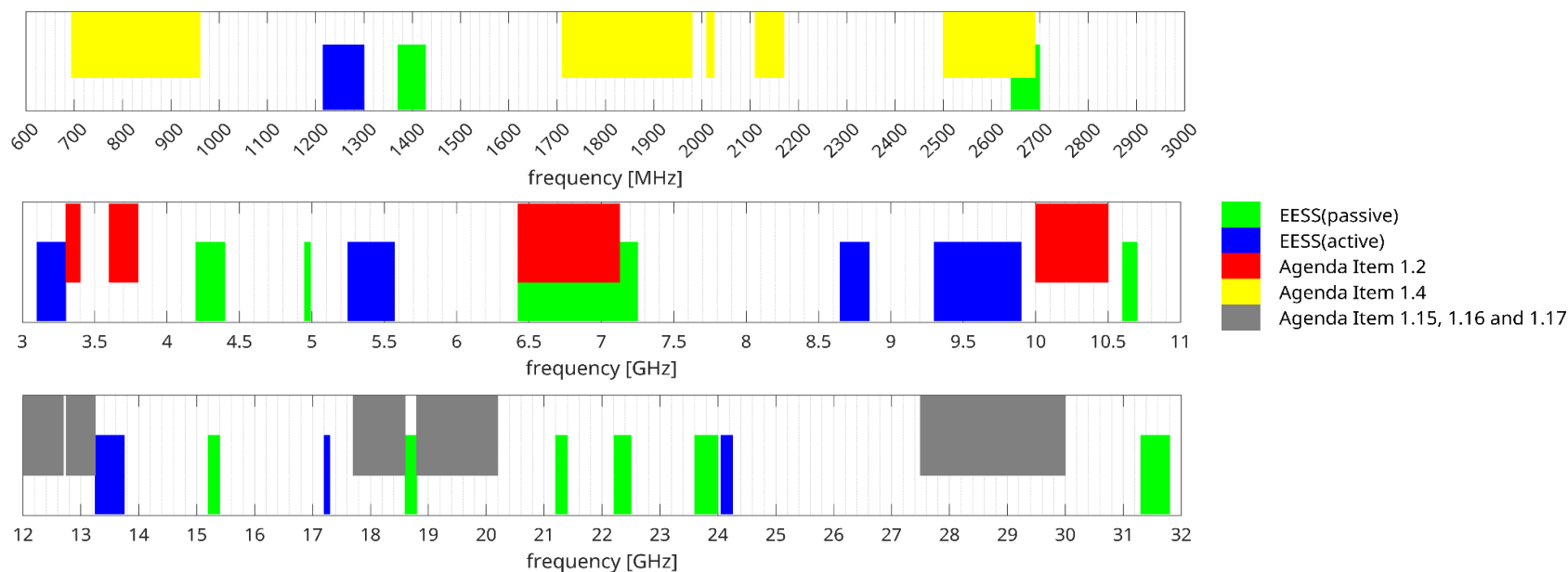
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GRSS Views on WRC-23 Agenda Items

WRC-23 Agenda Item	Service	Frequency Bands under consideration	EESS Bands Potentially Affected
1.2	International Mobile Telecommunications (IMT)	3300-3400 MHz 3600-3800 MHz 6425-7025 MHz 7025-7125 MHz 10.0-10.5 GHz	3100-3300 MHz (active) 10.0-10.4 GHz (active) 6425-7075 MHz (passive) 7075-7250 MHz (passive) 10.6-10.7 GHz (passive)
1.4	High-altitude platform stations as IMT base stations (HIBS)	various bands between 694 and 2690 MHz	2690-2700 MHz (passive)
1.12	Earth Exploration Satellite Service (EESS) active	40-50 MHz	40-50 MHz (active)
1.10	Non-safety aeronautical mobile service	15.4-15.7 GHz 22-22.21 GHz	22.21-22 GHz (passive)
1.14	Earth Exploration Satellite Service (EESS) passive	231.5-252 GHz	235-238 GHz (passive) 250-252 GHz (passive)
1.15	Earth Station in Motion (ESIM) services	10.7-10.95 GHz 13.25-13.75 GHz 17.2-17.3 GHz	10.6-10.7 GHz (passive) 13.25-13.75 GHz (active) 17.2-17.3 GHz (active)
1.16	Earth Station in Motion (ESIM) services for Non GSO Fixed-Satellite Service (FSS)	17.7-18.6 GHz (space-to-Earth) 18.8-19.3 GHz (space-to-Earth) 19.7-20.2 GHz (space-to-Earth) 27.5-29.1 GHz (Earth-to-space) 29.5-30 GHz (Earth-to-space)	18.6-18.8 GHz (passive)
1.17	Satellite-to-satellite links	11.7-12.7 GHz 18.1-18.6 GHz	18.6-18.8 GHz (passive)
1.18	Mobile-Satellite Service (MSS)	1695-1710 MHz, 2010-2025 MHz, 3300-3315 MHz, 3385-3400 MHz;	3100-3300 MHz (active)
1.19	Fixed-Satellite Service (FSS) space-to-Earth	17.3-17.7 GHz	17.2-17.3 GHz (active)
9.1 (b)	Amateur and Amateur-satellite services	1240-1300 MHz	1215-1240 MHz (active) 1240-1300 MHz (RNSS)
9.1 (d)	Non GSO FSS space stations	37.5-38 GHz	36-37 GHz (passive)

GRSS Views on WRC-23 Agenda Items

- WRC Agenda items with potential impact on the remote sensing Frequency bands.



GRSS Views on WRC-23 Agenda Items

- FARS WRC WG has produced, for the first time, a document summarizing the IEEE-GRSS Views on the WRC Agenda Items related to remote sensing.
- Concerns and opportunities from the GRSS perspective on the proposed modifications to the Radio Regulations are discussed
- We would like to share this document with volunteer members from FARS-TC for a final consolidated version to be released in the coming months.

Potential Impact of Agenda Items of the World Radiocommunication Conference 2023 on Remote Sensing and Views of the IEEE GRSS

EXECUTIVE SUMMARY

The World Radiocommunication Conference 2023 (WRC-23) will be held from 20 November to 15 December 2023 in Dubai, United Arab Emirates. WRC-23 will consider several modifications to the ITU Radio Regulations in its agenda. The following document presents and discusses the agenda items that could potentially affect microwave remote sensing and provide the IEEE GRSS position on them.

These agenda items affecting passive and active remote sensing instruments are summarised in the two separate tables for passive and active instruments below, with the frequency bands under consideration, the frequency bands relevant to remote sensing.

TABLE 1: Passive Instruments

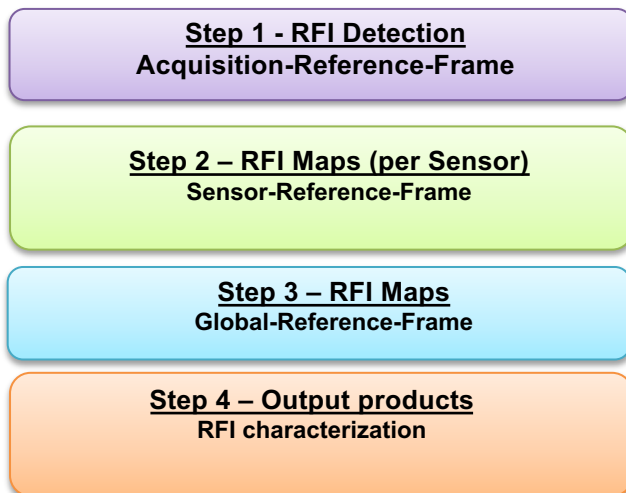
WRC-23 Agenda Item	Proposed use	Frequency Bands under consideration	Relevant EESS (passive) Frequency Bands	Relevant Passive Instruments
1.2	International Mobile Telecommunication (IMT)	6425-7025 MHz (region 1)	C-band (non allocated)	<p>Current:</p> <ul style="list-style-type: none"> Aqua (6.925\pm0.175) Coriolis (6.8\pm0.0625) GCOM-W (6.925\pm0.175) HY-2A (6.6\pm0.175) COWR <p>Future:</p> <ul style="list-style-type: none"> CMR (6.925\pm0.200)

Special thanks to: G. De Amici, R. Natsuaki, T. Bollian, J. Johnson, A. Bringer, D. Le Vine, A. Camps, D. Lubar, L. Carrer, P. Mohammed

FARS-TC and Standards Committee

- FARS-TC triggered the development of an IEEE Standard to define a methodology to quantitatively evaluate the amount of man-made Radio Frequency Interference (RFI) in any given frequency band allocated to space-based remote sensing.
- Useful in understanding the situation of all the bands allocated to remote sensing, follow their trends and in defining priorities for our spectrum managers.
- After several meeting and discussions, the activity entered the stage of writing down the first draft
- We welcome all our members to join.

Initial Flowchart:

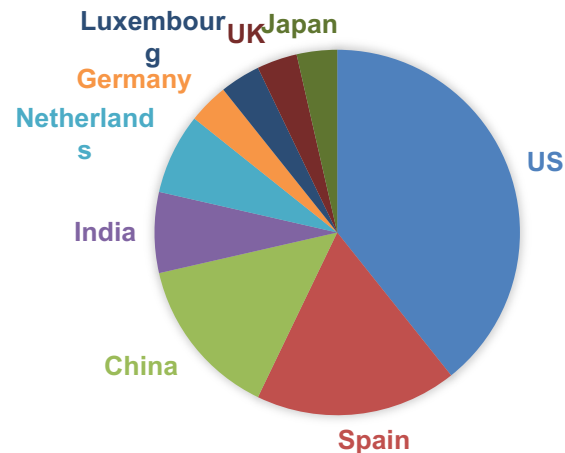


The RFI in Remote Sensing Working Group,

- 28 Participants from different countries
- 20 Voting Members

We've hold 11 Working Group Meetings,
and many sub-group meetings

STANDARDS WG PARTICIPATION





SPECTRUM MANAGEMENT ACTIVITIES



Spectrum Management Meetings (1/4)

- IEEE-GRSS continues to be recognized as an important independent player in spectrum management discussions. FARS participated at the following Meetings
- ITU-R Study Groups:
 - **Working Party 7C** (Remote Sensing Systems)
 - **Working Party 3J** (Radiowave Propagation)
- Space Frequency Coordination Group (SFCG)



Spectrum Management Meetings (2/4)

Accomplishments at Working Party 3J

- FARS-TC co-lead the development of two new ITU-R Recommendations:
 - [ITU-R P.2146 Sea surface bistatic scattering](#)
 - [ITU-R P.2148 Digital maps related to surface wind speed statistics](#)
- This new recommendations are already being used for sharing and compatibility studies in the latest meetings, notably WP 7C and WP 4A.

Spectrum Management Meetings (3/4)

Accomplishments at Working Party 7C

- Further advancement of the report on interference at 18 Ghz caused by reflection of broadcast signals over the ocean surface;
- Involvement in the process of developing the conditions for the new secondary allocations to radar sounders at 40-50 MHz under WRC-23 Agenda Item 1.12;
- Advancement in the update of Recommendation ITU-R RS.1166 on active sensors, that had not been revised since 2009.

Spectrum Management Meetings (4/4)

- Space Frequency Coordination Group (SFCG)
- FARS-TC succeeded to have the IEEE-GRSS RFI database linked at the SFCG website
- FARS-TC contributed two documents to the 2022 Annual Meeting (SFCG-41) and two documents to 2023 (SFCG-42), and responsible for several action items



The Space Frequency Coordination Group (SFCG), an organization comprised of space agencies and related national and international entities concerned with the use of the radio-frequency spectrum for space-related application for the benefit of humanity, has recently included a link on its website to the **Database of Radio Frequency Interference (RFI)** observed by some remote sensing instruments on its section "RFI to EESS (passive) sensors". SFCG has the objective of coordinating the regulatory efforts of all main space agencies and related organizations to achieve an effective use and management of those radio frequency bands that are allocated by the ITU Radio Regulations to the Space Research, Space Operations, Earth Exploration Satellite, and Meteorological Satellite services.

By listing this database along with other important RFI repositories, SFCG is recognising the quality of the work being done by the IEEE-GRSS Frequency Allocations in Remote Sensing-Technical Committee (FARS-TC).

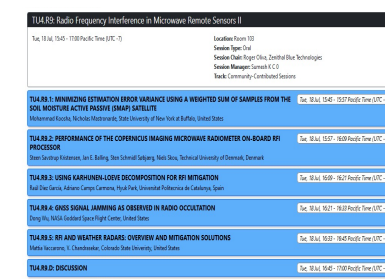
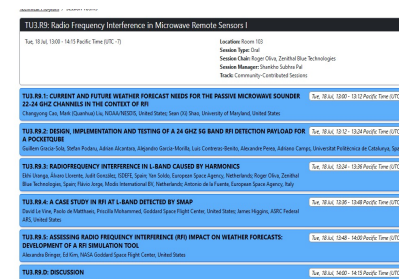
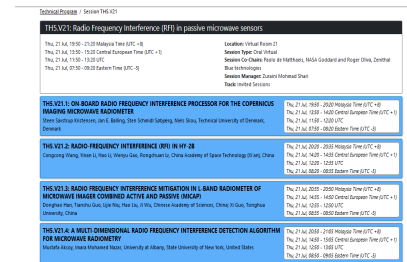
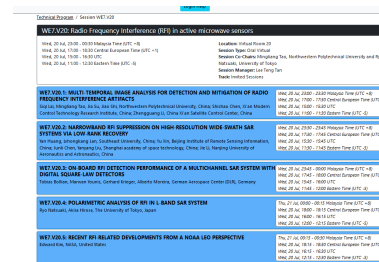


CONFERENCES AND OUTREACH



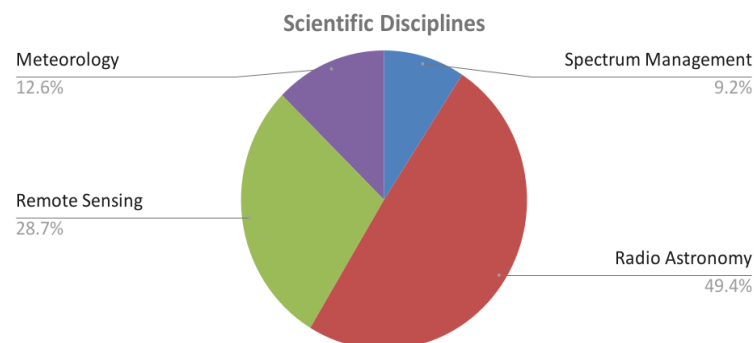


- **FARS-TC organized two Invited Sessions at IGARSS 2022 and two Community Contributed Sessions at IGARSS 2023**



RFI 2022 Workshop

- **FARS participated in the organization of a new edition of the RFI Workshop**, held virtually on February 14-18, 2022, and hosted by ECMWF.
- The goal of the workshop was to promote the exchange of information and techniques on RFI.
- Remote sensing, astronomy and meteorological communities will share their strategies to mitigate RFI in their respective fields.
- **70 presentations and 9 posters: almost doubled last edition in 2019**



<http://www.rfi2022.org>

FARS-TC presence

FARS participated at the following conferences to discuss our activities or some of the FARS initiatives:

- ESA Living Planet Symposium
- CORF meetings
- ISRMM
- RWW/Sharco
- Radar 2021

FARS will also have a presence in the:

- URSI General Assembly 2023



FARS Online Tools

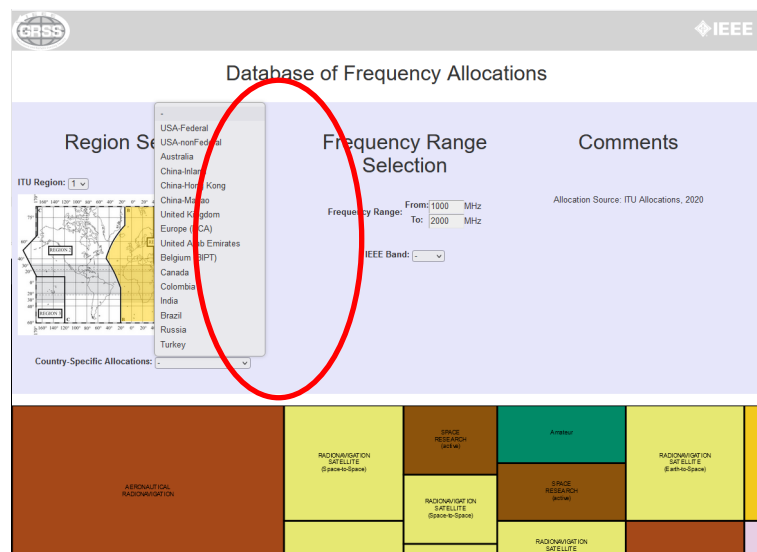
FREQUENCY ALLOCATION TABLE

GRSS FARS-TC tool available on the GRSS website at:

http://www.classic.grss-ieee.org/frequency_allocations.html

- Added new country-specific allocations in the Frequency Allocations tool:

USA Federal use	Europe (ECA)
USA non-Federal	United Arab Emirates
Australia	Belgium (BIPT)
China –Inland	Canada
China – Hong Kong	Colombia
China- Macao	India
United Kingdom	Brazil
Russia	Turkey
Egypt	



FARS Online Tools: RFI OBSERVATIONS

GRSS FARS-TC tool available on the GRSS website at:
http://www.classic.grss-ieee.org/rfi_observations.html

- The Space Frequency Coordination Group (SFCG) added a link to our FARS-TC RFI Observation tool on their website.
- It represents a recognition of the quality of the work performed by our Technical Committee
- Currently including:

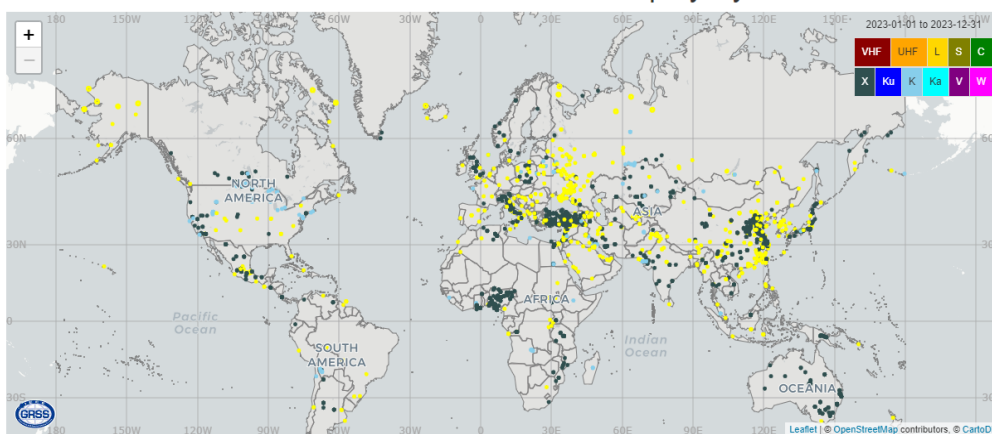
SMOS

SMAP

Aquarius

GMI

IEEE GRSS RFI Observations Display System



GRSM Magazine

The following articles were promoted by FARS in the Geoscience Remote Sensing Magazine:

- **December 2021 edition:** Agenda Items of the World Radiocommunication Conference 2023 With a Potential Impact on Microwave Remote Sensing,
by FARS-TC co-chair P. de Matthaeis
- **December 2022 edition:** Protection of Earth Observation Satellites from Radio Frequency Interference: Policies and Practices, portraying the efforts to protect the spectrum,
by the Portuguese Autoridade Nacional de Comunicações
- **December 2023 edition (planned):** On the Chinese Lutan-1 Mission and RFI
by FARS-TC co-chair M. Tao.
- **March 2024 edition (planned):** On the PocketQube campaigns,
by UPC team

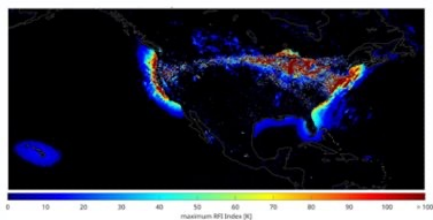
GRSS Newsletter

FARS-TC actively contributed to the GRSS Newsletter:



GRSS Community

GRSS contributes to new ITU recommendations

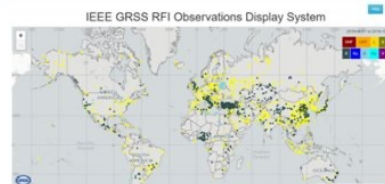


Use of the radio-frequency spectrum by scientific and commercial services is managed by the International Telecommunication Union (ITU). IEEE GRSS has been participating in the ITU meetings to support the interests of the remote sensing community for several years.

In this framework, the FARS Technical Committee co-lead the development of two new recommendations on scattering from the sea surface to be used to predict interference from satellite transmissions potentially reflected on the ocean into remote sensing instruments, such as that observed by GPM/GMI at 18 GHz:

- ITU-R P.2146: Sea surface bistatic scattering
- ITU-R P.2148: Digital maps related to surface wind speed statistics

An IEEE-GRSS product at the SFCG Website



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By listing this database along with other important RFI repositories, SFCG is recognising the quality of the work being done by the IEEE-GRSS Frequency Allocations in Remote Sensing-Technical Committee (FARS-TC).

Thank you for your attention!

For more information on the FARS Technical Committee visit:

<https://www.grss-ieee.org/>

For any questions, please write to

fars_chairs@grss-ieee.org.

