Geoscience and Remote Sensing Society

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

Annual Meeting

Virtual
November 30, 2022

Content

- GUEST SPEAKER: J. Ciccorossi
  The need of reliable spectrum to ensure the success of your space mission

- FARS ANNUAL MEETING
  FARS Introduction
  Conferences and Outreach
  Spectrum Management
  On-going activities & initiatives

- 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

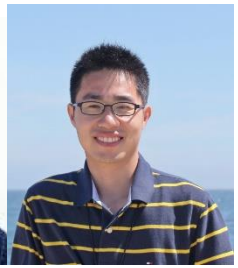
- **Chair:**

  Roger Oliva

- **Co-chairs**:

  Paolo de Matthaeis
  Ming-Liang Tao

  Tobias Bollian (stepping down)



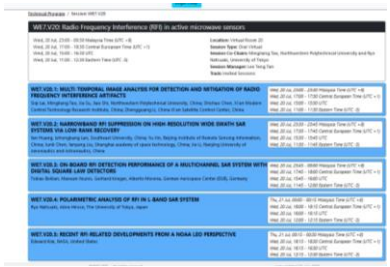
- **Secretary:**

  Priscilla Mohammed

CONFERENCES AND OUTREACH

IGARSS

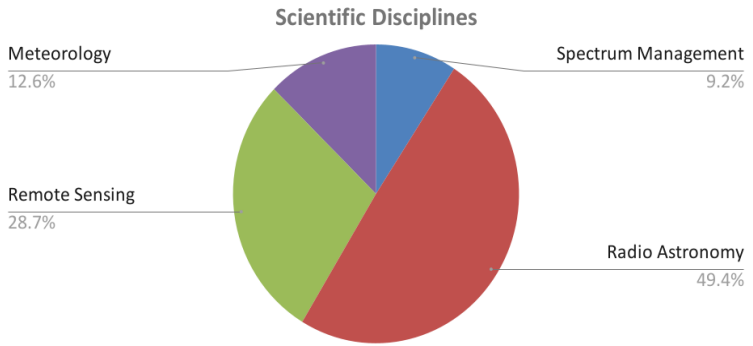
- **FARS-TC organized two Invited Sessions at IGARSS 2022**



- **FARS-TC is organizing one Community Contributed session for IGARSS 2023**
  - Associated presentations to this session not assigned yet**.**
  - **Please send us an e-mail if you would like to present at the FARS-TC session: fars_chairs@grss-ieee.org**

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

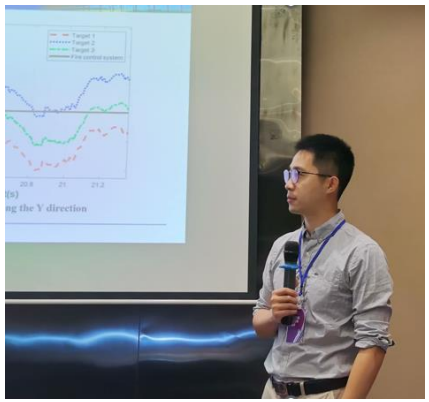
FARS-TC presence

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

- ESA Living Planet Symposium
- CORF Spring and Fall meeting
- ISRMM
- URSI General Assembly
- RWW/Sharc
- Radar 2021

FARS-TC chapter in China

Academic & Industry Presentations



- 2021.11 Huawei Company (Xi'an, China)
- 2021.12 CIE Radar Conference (Haikou, China)
- 2022.03 Shanghai Academy of Spaceflight Technology (Shanghai, China)
- 2022.08 ICEICT Conference (Hefei, China)
- 2022.08 China National Space Administration (Beijing, China)

Research

- Joint research program "Interference Compatibility Analysis for X-band SAR Satellites" lead by China National Space Administration
- Joint research program "Interference Mitigation Strategy for Radar Remote Sensing"
- Submitted an overview paper entitled "Frequency Management and Radio Frequency Interference Mitigation for Space-based Radar Remote Sensing: Opportunities and Challenges" to Aerospace Shanghai (in Chinese)

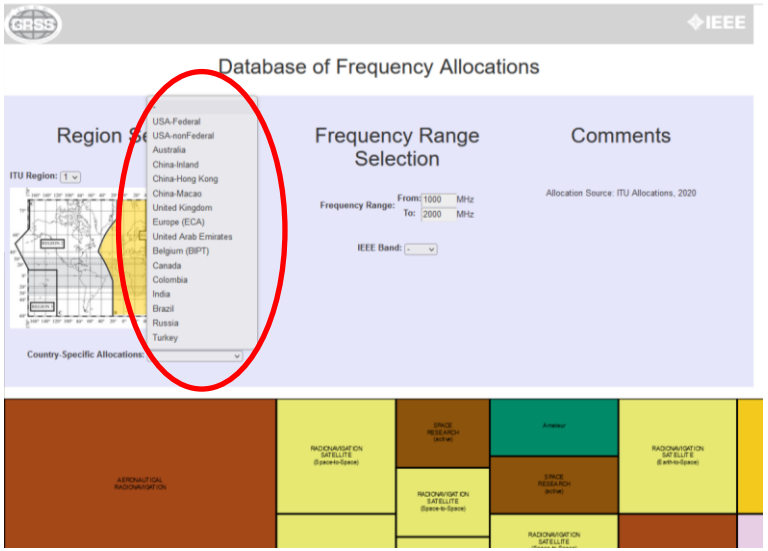
FARS Online Tools
FREQUENCY ALLOCATION TABLE

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.
- Currently in (new in blue):

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



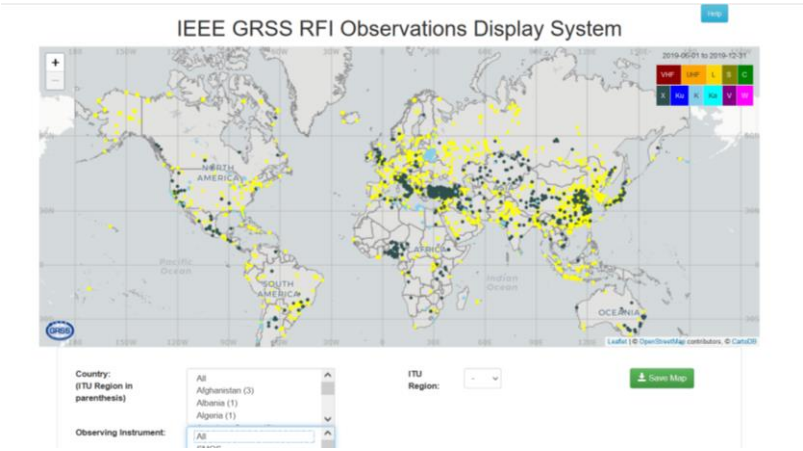
FARS Online Tools: RFI OBSERVATIONS

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



GRSM Magazine

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

- **December 2021 edition (published):** 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 (submitted and approved):** 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,

- **June 2023 edition (planned):**On the PocketQube,
  by UPC team

GRSS Newsletter

FARS-TC actively contributed to the GRSS Newsletter:

Geoscience and Remote Sensing Society IEEE

Vol. 9, No. 3 - September 2022

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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

IEEE GRSS RFI Observations Display System

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).

SPECTRUM MANAGEMENT ACTIVITIES

WRC23 Agenda Items

AI 1.16: Earth Stations in Motion (ESIM) near 18.6-18.8 GHz and Other Bands

AI 1.17: Inter-Satellite Links at 11.7-12.7, 18.1-18.6, 18.8-20.2 and 27.5-30 GHz

- Concerns for interference due to reflection off the Earth surface as well as from the direct path to the remote sensing sensor
- AMSR-2 and GMI operating at 18.6-18.8 GHz are already experiencing interference from reflections off the ocean surface of broadcast signals from geostationary satellites
- **GRSS supports studies to ensure deployment at 17.7-18.6 GHz and 18.8-19.3 GHz will not increase adjacent band interference to EESS (passive) at 18.6-18.8 GHz band, taking into account surface water reflections from satellite downlinks**

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.

- Special thanks to FARS Co-chair P. de Matthaeis, and FARS members: J. Johnson and M. Al-Khaldi

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

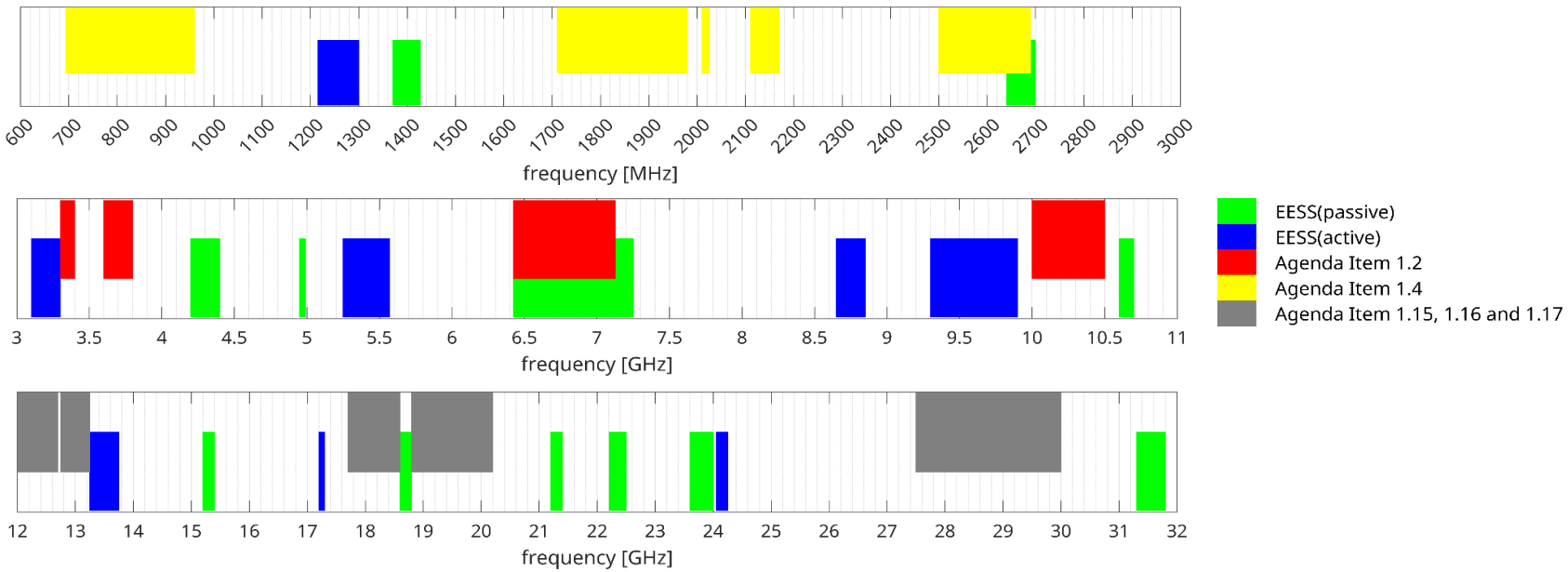
- FARS-TC contributed two documents to the 2022 Annual Meeting (SFCG-41):
  - Information document to introduce the development of a Standard to Quantify RFI in remote sensing bands.
  - Discussion document to initiate change on interference criteria for active systems with respect to coverage loss (RS. 1166).

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 the WRC-23 Agenda Items is nearing completion.
- We would like to have some volunteers to review it and provide their feedback. Please contact us directly. Another call will also be sent in a few days.

ON-GOING ACTIVITIES & OTHER INITIATIVES

POCKETQUBE (1/3)

- GRSS educational initiative proposed the development of an Open PocketQube Kit. It includes two PocketQubes (5cm x 5cm x 5cm):
  - Optical Payload.
  - RF Payload at L-band

- FARS discussed with Adriano and the IFT-TC and proposed the development of a 3rd PocketQube with RF monitoring capabilities at 24 GHz to follow the deployment of 5G and its impact on this remote sensing frequency band.

POCKETQUBE (2/3)

- **PocketQube:**

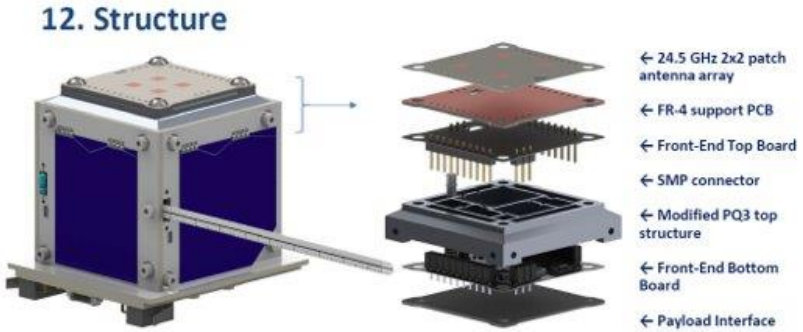
- PocketQubes are well advanced, despite severe challenges: lack of components and/or rocketed prices have forced hardware revisions, delays, and budget overruns.

- Expected delivery by March 2023

POCKETQUBE (3/3)

- **Initial Drone Campaign to assess performance to take place in Spain:**
- Goal is to have 5 flights in different areas and assess presence of RF signal at L-band and 24 GHz

- **Preparation of a Second Drone campaign** centered in areas where 5G transmissions at 24 GHz might have been deployed.
- Discussion started among FARS-TC chairs, A. Camps, and VPTA
- Investigating collaboration/interest with space agencies and/or international agencies



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:

Step 1 - RFI Detection
Acquisition-Reference-Frame

Step 2 – RFI Maps (per Sensor)
Sensor-Reference-Frame

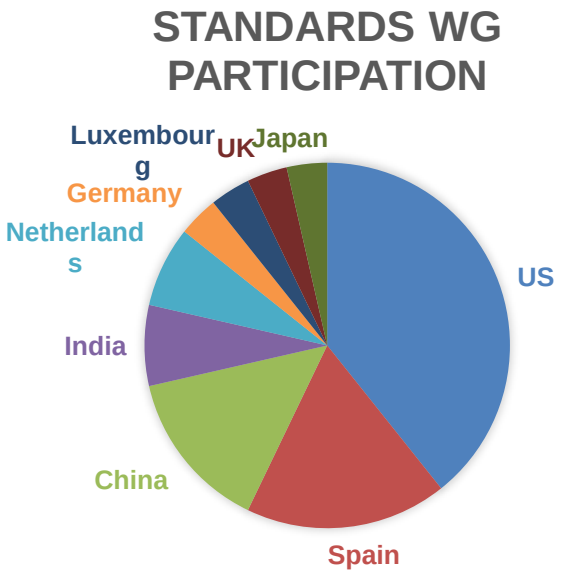
Step 3 – RFI Maps
Global-Reference-Frame

Step 4 – Output products
RFI characterization

The RFI in Remote Sensing Working Group,

- 28 Participants from different countries
- 20 Voting Members

We've hold 7 Working Group Meetings,
and many sub-group meetings



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.