IUCAF 2019 Annual Report

1. Introduction

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, was formed in 1960 by its adhering Scientific Unions, IAU, URSI, and COSPAR, at the behest of URSI. The IUCAF brief is to study and coordinate the requirements of radio-frequency spectrum allocations for passive radio sciences – radio astronomy, space research, and remote sensing – and to make these requirements known to the national and international bodies that regulate the use of the radio spectrum. IUCAF operates as an Inter-Disciplinary Body under the auspices of the International Science Council (ISC, formerly ICS and ICSU). IUCAF is a Sector Member of the International Telecommunication Union's Radiocommunication Sector (ITU-R), with observer status at the Space Frequency Coordination Group (SFCG). IUCAF is celebrating the 60th anniversary of its founding during 2020.

IUCAF is online at http://www.iucaf.org.

2. Membership and Member Affiliations with Other Bodies

There was no change to the composition of IUCAF during 2019. IUCAF is still seeking a replacement IAU committee member for one who resigned in 2018. At the end of 2019, the IUCAF membership from the three adhering Unions was as given in Table 1.

Additionally, the Counselor for ITU-R Study Group 7 (Science Services), Mr. Vadim Nozdrin, is an ex-officio member by virtue of his ITU-R position, as specified in IUCAF's Terms of Reference. IUCAF also has an informal group of correspondents in order to improve its global geographic representation and for consultation on specific issues, for instance, concerning astronomical observations in the optical and infrared domains.

IUCAF member van Driel recently stepped down from CRAF, the European Committee on Radio Astronomy Frequencies of the European Science Foundation (https://www.craf.eu/) whose members include Tiplady. Zhang is Secretary of the Radio Astronomy Frequency Committee in the Asia-Pacific region (RAFCAP), whose members also include Ohishi and Tzioumis (see http://www.atnf.csiro.au/rafcap/). Tzioumis is Chair of ITU-R Working Party 7D (Radio Astronomy). Ohishi, IUCAF's immediate Past Chair, is the official liaison between the IAU and the ITU, and President of IAU Commission F3 (Astrobiology). He recently was appointed Head of the newly-created Spectrum Management Office at the National Astronomical Observatory of Japan. Van Driel is Secretary of IAU Commission B4 on Radio Astronomy, and a member of its Organizing Committee. Liszt is a member of the American Astronomical Society's Committee on Light Pollution, Radio Interference, and Space Debris, and of the IAU Executive Committee on WG Dark and Quiet Sky Protection, and serves on the Steering Committee of the IAU Inter-Division Commission C.B4 on Protection of Existing and Potential Observatory Sites.

Table 1. The IUCAF membership at the end of 2019

URSI	Dr. Haiyan Zhang	China
	Dr. Steven Reising	USA
	Dr. Ingemar Häggström	Sweden
	Dr. Anastasios Tzioumis	Australia
	Dr. Wim van Driel	France
IAU	Dr. Harvey Liszt (Chair)	USA
	Dr. Masatoshi Ohishi	Japan
	Dr. Adrian Tiplady	South Africa
COSPAR	Dr. Yasuhiro Murata	Japan

3. IUCAF Terms of Reference (Revised 2015)

A revision to the statement of IUCAF's composition, operating practices, and Terms of Reference (TOR) – originally dating to 1972, when IUCAF was the Inter-Union Committee on Allocation of Frequencies – was approved by ICSU's Executive Board in 2015 (see http://www.iucaf.org/IUCAF_Terms_Of_Reference.pdf).

4. International and Regional Spectrum Management Meetings Attended by IUCAF Members During 2019

During the period January-December 2019, IUCAF members participated in the international meetings shown in Table 2.

Table 2. International meetings participated in by IUCAF members in 2019.

February	ITU-R CPM-2	Geneva
March	URSI AP-RASC	India
April-May	ITU-R WP 5C	Geneva
May	ITU-R WP 7D	Geneva
May-June	ITU-R WP 1A	Geneva
June	ITU-R WP 4C	Geneva
June	CRAF 62nd meeting	Jodrell Bank, UK
September	RFI2019	Toulouse
October-November	WRC-19	Sharm El-Sheik

Figure 1. The exceptionally-popular IUCAF-branded fidget-spinner.

Additionally, IUCAF members participated in numerous national and regional spectrum-management proceedings, working in their capacities as spectrum managers at their observatories.

5. IUCAF Business Meetings

IUCAF held in-person business meetings during the ITU-R sessions of Working Party 7D in Geneva listed in Table 2, at CPM-2 and WRC-19. During the year, IUCAF business was undertaken via e-mail as matters arose.

6. Finances

The IUCAF budget is held at and managed by URSI. Sustaining financial contributions of €5,000, €2,000, and €1,000 were gratefully received from IAU, URSI, and COSPAR, respectively, for calendar year 2019. Annual expenses of €6000 were incurred in support of travel to the URSI AP-RASC meeting in India in March by former IUCAF member Tomas Gergely, and attendance at WRC-19 by IUCAF member van Driel.

IUCAF continued to distribute its exceptionally-popular IUCAF-branded fidget-spinner (Figure 1).

7. The IUCAF Role in Protecting Passive Radio Science

IUCAF is a global forum where spectrum management concerns of passive radio science in all ITU-R Regions are regularly addressed in a comprehensive manner. The group is expert in the underlying science, in the spectrum-management needs of the science, and in the workings of the spectrum regulatory regime that allocates spectrum and makes the rules for spectrum use. IUCAF has been an important supporter of radio astronomy and passive radio science at the ITU-R in Geneva since its inception in 1960, when the first spectrum band was dedicated to passive research, absent any allocation to active services. The practice of reserving narrow portions of the radio-frequency spectrum for passive radio science subsequently expanded to the point where such bands now provide crucial access to spectrum used by remote sensing to improve weather prediction and quantify the effects of global warming. IUCAF also provides the spectrum-management interface between the radio-astronomy and space-science communities through its work at ITU-R and the Space Frequency Coordination Group. On these accounts IUCAF is a unique resource, with a lengthy record of contributions, the early history of which was recounted by a former IUCAF Chair in "Frequency Allocation: The First Forty Years," by Brian Robinson, *Annual Reviews of Astronomy and Astrophysics*, **37**, 1999, pp 65-96, available at https://tinyurl.com/y5vsgb6x.

IUCAF will celebrate its 60th birthday in 2020. Several IUCAF members are even older.

8. Contact with ICS, the IUCAF Sponsoring Unions IAU, URSI, and COSPAR, and Other International Organizations

IUCAF maintains regular contact with its adhering Unions and the parent body, ISC. These organizations play a strong supporting role for IUCAF, the members of which are thereby greatly encouraged.

IUCAF participated in preparation of a proposal by the IAU Inter-Division Commission C.B4 on Protection of Existing and Potential Observatory Sites for a Focus Meeting on Dark and Quiet Skies and Astronomical Site Protection at the August 2021 IAU General Assembly to be held in Busan, Korea.

9. Outreach

IUCAF's main outreach activities beyond the ITU-R are related to the international spectrum-management schools it has organized at since 2000. At the time of writing, the last such school was held in 2014 in Santiago de Chile, and the next will be held in Stellenbosch, South Africa, March 2-6, 2020. Presentations from the IUCAF schools are available on the IUCAF Web site at http://www.iucaf.org, where some basic information on the organization is reported. IUCAF maintains the World Map of Radio Astronomy Sites and Radio Quiet Zones that has been viewed 54,000 times since its inception in 2008: see http://tinyurl.com/yrvszk.

[25]	Proposed modification to the draft CPM text Chapter 5 - Agenda items 1.8 (Issue B), 1.9.1, 1.9.2	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28
[24]	Proposed modifications to the draft CPM text Chapter 4 - Agenda item 1.7	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28
[23]	Proposed modifications to the draft CPM text Chapter 3 - Agenda items 1.6 and 9.1.9	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28
[22]	Proposed modifications to the draft CPM text Chapter 2 - Agenda item 1.13	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28
[21]	Proposed modifications to the draft CPM text Chapter 1 - Agenda items 1.11, 1.14 and 1.15	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28
[20]	IUCAF views on WRC-19 agenda items of concern to Radio Astronomy	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01-28

Figure 2. The documents submitted by ICUAF at CPM-2.

10. IUCAF Activities and Concerns in 2019

Most of IUCAF's work during the previous triennium, 2015-2018, was preparation for the 2019 February ITU-R 2nd Conference Preparatory Meeting (CPM-2) of WRC-19, and WRC-19. WRC-19 was held October 28 - November 22 in Sharm El-Sheikh, and was attended by five IUCAF members for periods ranging from 10 days to four weeks. IUCAF strove to acquire a thorough knowledge of the WRC-19 agenda by participating in the spectrum-sharing and compatibility studies conducted in ITU-R Study Groups 1, 4, 5, and 7, and by participating in the treaty text drafting sessions in those Groups. This effort culminated in the January 2020 submission of five CPM-2 input documents, describing suggested modifications of the draft WRC-19 treaty text, and another document summarizing IUCAF's views of methods proposed to satisfy relevant items on the WRC-19 agenda (Figure 2).

The most consequential items in this work package were adopted into the final report of the CPM to WRC-19, especially for Agenda Item 1.14 concerning High Altitude Platform Systems (HAPS), where the unmodified CPM text would not have protected radio-astronomy sites registered after May 2020. Radio-astronomy bands at 153 MHz and 322 MHz received additional protection, including in the latter case from the harmonics of emissions around 160 MHz, an unusual recognition of this kind of spurious emission. These IUCAF positions were incorporated at WRC-19, and a sly modification of footnote 5.208A eventually resulted in a direct reference in the Radio Regulations to ITU-R Recommendation RA.769 containing the basic radio-astronomy service protection thresholds. WRC-19 also saw an acceptable outcome for Agenda Item 1.15 concerning Land Mobile and Fixed Service use of the spectrum at 275 GHz to 450 GHz.

Other Agenda Items did not have such felicitous outcomes. The Iridium satellite system's downlink was granted a primary Maritime Mobile Satellite Service allocation status at 1621 MHz to 1626.5 MHz, which, along with other rule changes, allowed Iridium's entrance as a safety-of-life service in the Global Maritime Disaster and Safety System (GMDSS). Immediately following WRC-19, the Iridium operator renounced its halting attempts to protect the radio astronomy band at 1610.6 MHz to 1613.8 MHz in its new constellation, thereby ensuring a new round of radio-astronomy complaints against this system.

Agenda Item 1.13 saw the adoption of overly-permissive limits on the unwanted emissions of 5G equipment into the passive service band at 23.6 GHz to 24.0 GHz that is used for weather forecasting and other remote-sensing observations of climate change. AI 1.6 allowed non-GSO use of V-band (37 GHz to 42 GHz) spectrum formerly used only by GSO systems, without adequate consideration of the possible harmful effects of modern non-GSO systems on radio-astronomy operations in the frequency band 42.5 GHz to 43.5 GHz.

Much of the work for the WRC-19 cycle actually continued well into 2019, as evidenced by the roster of ITU-R Working Party meetings attended by IUCAF last year. Although interference is usually regarded as a failure of spectrum management, it does occur, and IUCAF was much in evidence at the RFI2019 meeting in Toulouse in September.

Scientific access to radio spectrum was eroded in 2019 in several ways. The potential for harmful interference to allocated spectrum increased when overly-permissive levels of unwanted emissions were allowed for 5G and other devices operating in adjacent and nearby spectrum bands. Frequencies that were formerly used only by fixed point-point links on the ground were increasingly projected to find use by mobile and airborne transmitters, making their signals difficult to avoid even inside radio-quiet and coordination zones. Non-GSO FSS constellations began launching constellations of thousands of satellites, where previously the largest system operated only 66. Broad swaths of clean spectrum for leading-edge research became increasingly hard to find and were increasingly likely to exist in proximity to radio communication signals at levels 60 dB to 100 dB higher than those needed for research. New modes of observing, data-handling, and RFI mitigation will have to be developed if radio astronomy and remote sensing are to operate in such a spectrum environment.

Closer to home, succession planning and matters of engagement were of concern. Nations with major

investments in radio astronomy and strong histories of participation are not currently represented by astronomers in national and international spectrum management. IUCAF reached out to astronomers in Thailand, where radio astronomy is newly developing, and encouraged astronomers in some other administrations to re-engage given the occasionally aggressive and unhelpful tactics of their administrations in ITU-R deliberations.

11. Acknowledgements

IUCAF is grateful for the organizational and financial support that has been given by ICS, IAU, URSI, and COSPAR over the past 60 years, especially the URSI Secretariat. IUCAF also recognizes the support given by radio-astronomy observatories, universities, and national funding agencies to individual members, allowing them to participate in the vital work of this committee.

Respectfully submitted,

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