

Quadrennial Report 2017-2021

IUCAF

THE SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE (IAU - URSI – COSPAR and ISC)

1. INTRODUCTION

IUCAF's Annual Reports are regularly published in the URSI Radio Science Bulletin; for 2017 see RSB #364 (March 2018); for 2018, RSB #370 (September 2019); for 2019, RSB #371 (December 2019). The Annual Report for 2020, in press, can be found at ftp://ftp.cv.nrao.edu/NRAO-staff/hliszt/URSI/IUCAF-AnnualReport2020_Final.docx.

The Annual Reports describe IUCAF member attendance at innumerable ITU-R and other spectrum regulatory and other meetings. After a brief overview of IUCAF, the focus here will be on a few major activities that came to fruition since 2017.

2. ABOUT IUCAF

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, originally the Inter-Union Committee on Allocation of Frequencies, was formed in 1960 by its adhering Unions, IAU, URSI, and COSPAR at the behest of URSI. IUCAF celebrated its 60th anniversary during the spectrum management school that was held during this period and is described below. IUCAF is online at <http://www.iucaf.org>.

IUCAF operates as an Inter-Disciplinary Body under the auspices of the International Science Council. Its 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 national/international bodies that regulate use of radio spectrum. Its terms of reference, composition and operating practices can be found at http://www.iucaf.org/IUCAF_Terms_Of_Reference.pdf.

The IUCAF membership from the three adhering Unions is:

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
Ex-officio	Dr. Vadim Nozdrin	ITU-R SG7

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) where, since May 2021, it participates in the Lunar Martian

Steering Group. IUCAF members participate in the activities of many other national and regional spectrum management bodies as noted in the Annual Reports.

3. 94 GHZ COORDINATION AGREEMENT WITH ESA

Since 2005, JPL has operated the 94.05 GHz CloudSat cloud profiling radar in the middle of a broad swath of spectrum that is allocated to and heavily used by radio astronomy. The powerful beam of this nadir-pointing radar saturates any receiver over which the satellite passes during its 16-day repeating orbital cycle, independent of the radio astronomy antenna pointing. More seriously, the radar could burn out the radio astronomy receiver in the worst case. A variety of modifications to radio astronomy operations and instruments have been made on this account, especially for moveable array antennas that are transported in a zenith-pointing orientation with their supercooled electronics operating.

To forestall this situation when ESA, with JAXA participation, launches the EarthCare mission in 2023 with an even higher-power 94.05 GHz radar, IUCAF has for many years participated in SFCG meetings where EarthCare was discussed. This 15-year effort bore fruit in April 2021 when ESA and IUCAF signed a Memorandum of Understanding under which the nadir-pointing EarthCare radar will be silenced when its beam passes close enough to a radio astronomy antenna that the radio astronomy receiver could be damaged.

IUCAF is grateful to ESA for agreeing to modify the EarthCare radar's operation, and to JAXA for designing the radar in such a way that such an accommodation was possible.

4. THE FIFTH INTERNATIONAL IUCAF SCHOOL ON SPECTRUM MANAGEMENT FOR RADIO ASTRONOMY AND OTHER OUTREACH

IUCAF maintains its World Map of Radio Astronomy Sites and Radio Quiet Zones that has been viewed 64,200 times, see <http://tinyurl.com/yrvszk>. IUCAF distributed its exceptionally popular IUCAF-logo fidget spinner, thanks to a continuing grant from an anonymous donor.



IUCAF's main outreach activities have been the international spectrum management schools it organized in 2002 (Green Bank, West Virginia, USA), 2005 (Castel San Pietro Terme, Italy), 2010 (Mitaka, Japan) and 2014 (Santiago, Chile). These events are necessary to maintaining a knowledge base for spectrum management inside radio astronomy, and

for acquainting spectrum regulators with the very particular concerns of radio astronomy.



Through a magnificent stroke of good luck, the Fifth IUCAF International School on Spectrum Management (illustrated above) took place in Stellenbosch, South Africa during the period 2-6 March 2020, shortly before the world shut down. The attendance by 55 participants was far larger than usual. This meeting could not have occurred or been so successful without the strong financial and logistical support of the South African Radio Astronomy Observatory (SARAO) and a substantial financial subvention of European participation on the part of CRAF. Owing to this generosity and in respect of the venue, the meeting was held without fees for registration and meals, including the traditional banquet, and participants were provided with a spectrum management textbook written by one of the non-IUCAF lecturers. Presentations from this and the previous IUCAF schools are available on the IUCAF website at <http://www.iucaf.org>.

5. WRC-19

IUCAF's main ongoing activity since 1960 has been participation as a Sector Member at the ITU-R in Geneva. Owing to its long history, IUCAF's work protecting radio astronomy and passive radio science are accorded a high degree of recognition.

Indeed, most of IUCAF's technical work during the period covered by this report was preparation for the two-week 2019 February ITU-R 2nd Conference Preparatory Meeting (CPM-2) of WRC-19 in Geneva, and WRC-19 that was held 28 October – 22 November 2019 in Sharm El-Sheikh (Egypt) and attended by 5 IUCAF members for periods ranging from 10 days to 4 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 during the period 2015-2019 and by participating in the treaty text drafting sessions in those Groups. This effort culminated in the January 2019 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.

[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

The 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 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 in the outcome of WRC-19. Modification of footnote 5.208A eventually resulted in a direct reference in the Radio Regulations to Recommendation ITU-R RA.769 containing the basic radio astronomy service protection thresholds. An effort initiated by IUCAF and presented to WRC-19 by Japan succeeded to remove a pejorative historical remark weakening protection of radio astronomy in the English language text of Article 4.6 of the Radio Regulations.

6. NEW DIRECTIONS

Until recently, improved access to spectrum for science ran through the radio frequency spectrum regulatory regime, by procuring and protecting spectrum allocations. But allocations to science have been static while the rest of the spectrum fills in with new communication systems using broad swaths of previously-allocated but unused spectrum. Adequate regulatory limits are not always placed on unwanted emissions into bands intended for science.

One of the most impactful recent developments has been the authorization of mega-constellations of satellites in low Earth orbit (LEO) by radio spectrum regulators. Radio astronomy and LEO satellite sidelobes will make the sky uniformly quite bright in the satellite downlink bands. Even beyond this, satellite trails from reflected sunlight are increasingly affecting optical/infrared astronomy, even the Hubble Space Telescope, and distorting the appearance of the night sky. Radio spectrum regulators have no brief to consider such “negative externalities.” To counter this trend, optical and radio astronomers (strongly represented by IUCAF members) and other stakeholders convened a series of Workshops (<http://research.iac.es/congreso/quietdarksky2021/pages/home.php>) on Dark and Quiet Skies and took their concerns to the Legal and Scientific and Technical Subcommittees of the Committee on Peaceful Uses of Outer Space (COPUOS) in April 2021. The output of the first Workshop, including the Radio Astronomy Working Group’s report, is available from the IAU at <https://iau.org/news/announcements/detail/ann21002/>

Closer to home, succession planning and matters of engagement continue to be of concern. Several nations with major investments in radio astronomy and/or strong histories of participation are not currently represented by astronomers in spectrum management despite IUCAF prodding.

7. ACKNOWLEDGEMENTS

IUCAF is grateful for the organizational and financial support that has been given by ICS, IAU, URSI and COSPAR, especially the URSI Secretariat that so efficiently and helpfully manages IUCAF's finances and logistics. IUCAF also recognizes the support given to individual IUCAF members by their home institutions, allowing them to participate in the vital work of the committee. IUCAF especially appreciates the contributions of the organizations and individuals who made the spectrum management school such a resounding success in March 2020, as the world was about to shut down.

Respectfully submitted,

Harvey S. Liszt, Chair
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