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The IEEE GRSS Frequency Allocations in Remote Sensing (FARS) Technical Committee

Technical Committee Corner
by John Kerekes, Vice President of Technical Activities

One of the ways GRSS serves its members is through the organization of technical committees focused on specific areas of interest within the fields of geoscience and remote sensing. Currently, GRSS has five TCs spanning much of remote sensing technology. Among other activities, these committees organize special sessions at IGARSS, run data analysis contests, represent the society at international meetings, and write position papers on technical topics. More information on these TCs is available from the society's website at http://www.grss-ieee.org/community/technical-committees/.

Each issue of the *GRS Magazine* will include this column (continuing a tradition started with the *GRSS Newsletter*) with a contribution from one of our TCs describing recent activities or addressing current topics. We are pleased this inaugural issue of the *GRS Magazine* contains the following column by Bill Blackwell and Ian Adams on the Frequency Allocations in Remote Sensing (FARS) TC.

INTRODUCTION

The IEEE GRSS Frequency Allocations in Remote Sensing (FARS) Technical Committee (hereafter, "FARS") was created in 2000, and it is charged with facilitating the GRSS role in the frequency management process by fostering, archiving, and disseminating relevant technical information. FARS also serves as an interface for GRSS into the regulatory process by providing information to members and by organizing member efforts when appropriate. Frequency allocation and interference issues do not fall within the purview of IEEE Standards, but rather are matters of regulation by international treaty. Assessments by the FARS Technical Committee thus fill a critical gap between IEEE Standards and International Telecommunications Union (ITU) regulations. FARS currently has approximately 85 members in ten countries representing government, industrial, and academic entities.

MOTIVATION AND OBJECTIVES OF THE FARS TECHNICAL COMMITTEE

Our capacity to exploit the electromagnetic spectrum allows us to probe the universe and disseminate information. As these goals are intertwined, so are the shared resources afforded to each. Careful management of the electromagnetic spectrum results in the ability to perform precise remote measurements of the Earth and the cosmos while using the same spectrum to send high-powered communications transmissions; however, the potential for measurement contamination still exists.

Due to sharing of allocated bands, limitations in hardware, and transmissions outside of allocations, remote sensing observations experience radio-frequency interference (RFI). Corrupted measurements may be difficult to identify, especially at low levels of interference. As the need for high-precision measurements expands—principally for ocean and terrestrial sensing, but also for radio astronomy—investigators have developed new methods for sharing spectrum and for identifying and mitigating RFI. For heritage hardware, post-processing software methods have proven invaluable for identifying radio-frequency interference, with some measured success in mitigation. For future sensors, digital receivers offer

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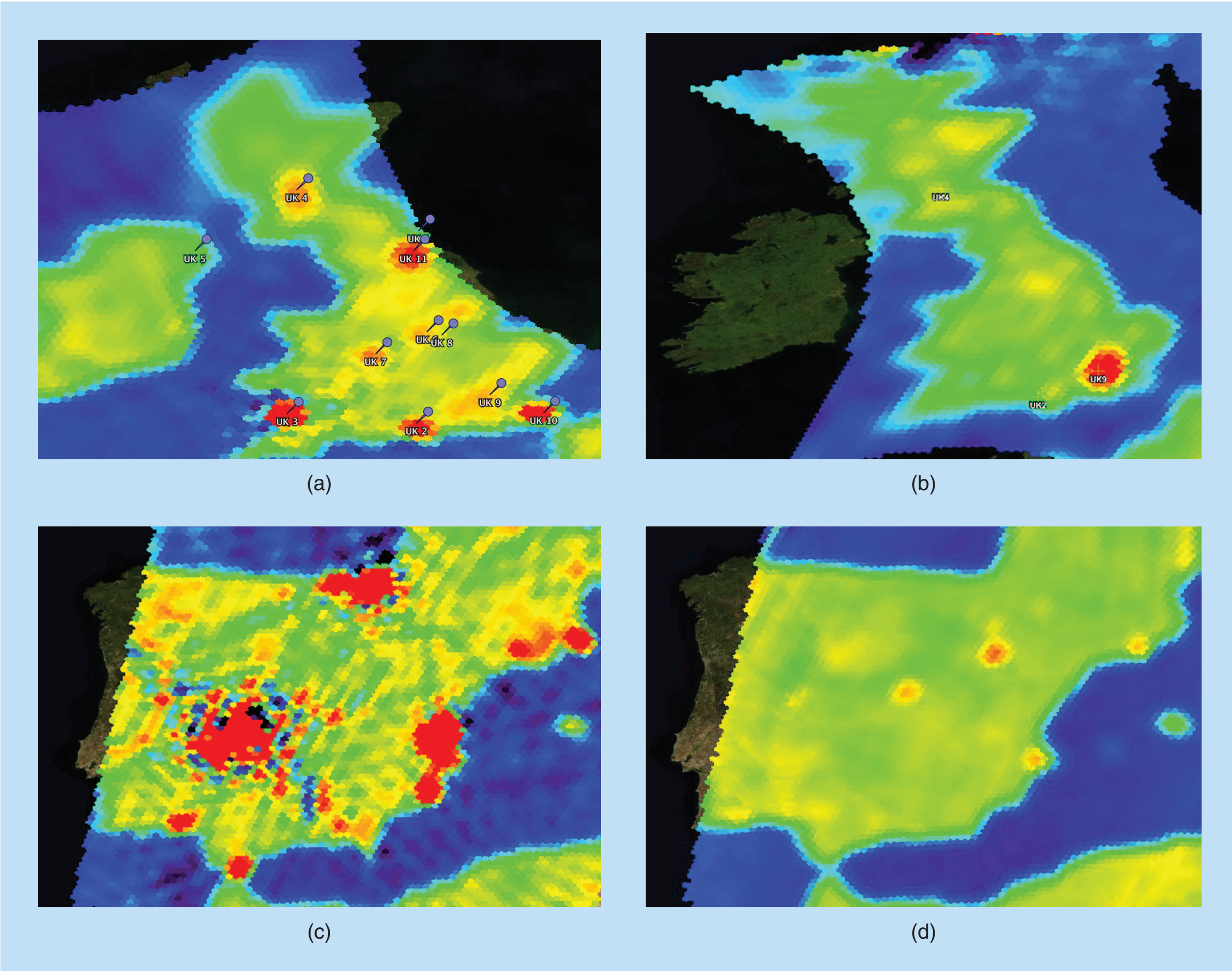

FIGURE 1. SMOS brightness temperatures observed over the U.K. [(a) and (b)] and Spain [(c) and (d)] early in the mission [(a) and (c)] and in April 2011 [(b) and (d)] after efforts to characterize and mitigate radio-frequency interference [1].

flexibility in handling RFI. Beyond the identification and mitigation of RFI, monitoring the radio-frequency environment informs scientific users of the spectrum of the expanding nature of RFI and shapes future policy. Understanding how contamination and mitigation affect measurements furthers data quality.

RFI IDENTIFICATION, MITIGATION, MONITORING, AND IMPACT ASSESSMENTS

The desire to measure an expanding list of features of the Earth and the universe results in an increasing need for high-precision measurements. Consequentially, the ability to discern radio-frequency contamination, particularly at low levels, is key to compiling long-term, consistent data records. Those who design sensors and data-processing software must work to ensure the quality of observations, while users must understand how RFI and its mitigation impact data. As society expands its use of the electromagnetic spectrum, a limited resource, the potential for interference in remote scientific observations increases.

Outside of spectrum management, which focuses on policy-level decisions informed by scientific and societal need, the subject of radio-frequency interference may be divided into four distinct, but interconnected, topics. Identification deals with the hardware and/or software methods of determining measurements that may be corrupted with RFI. While many instances of measurement contamination may result in obvious outliers in the data, low-level RFI is much more insidious. The inability to discern small amounts of contamination can skew environmental and climate data records. Mitigation allows for the use of contaminated measurements after the removal of RFI, and is an important and evolving aspect of operating in a congested radio-frequency environment. Informing those who work with remote sensing instruments and data, both from the engineering and usage arenas, requires careful monitoring of RFI. In many instances monitoring RFI is reactive, as there may be no knowledge of an interferer until it begins to transmit. In some cases, monitoring the environment results in the removal of unsanctioned transmitters (see Figure 1, where SMOS interferers were identified and removed [1]). Finally, understanding the impact of RFI, and the mitigation of RFI, on data records ensures the integrity of research that makes use of remote sensing and radio astronomy measurements.

UPCOMING SPECIAL ISSUE IN *IEEE TGRS*

To catalog the important work being performed to identify, monitor, and mitigate RFI, and to assess the impact of interference, the Frequency Allocations in Remote Sensing Technical Committee has commissioned a special issue of *IEEE TGRS* covering this subject for publication in October 2013. Submissions will cover a combination of software and hardware solutions to the RFI problem. Moreover, the special issue will detail the challenges in monitoring radio-frequency interference, and attempt to quantify the impact that interference has on measurements. By collecting a range of papers concerning RFI, the issue will serve as a central resource to sensor designers, algorithm developers, and data users.

Although the topic of radio-frequency interference has been represented in isolated articles in previous regular issues, a dedicated special issue is highly relevant due to the expanding use of the spectrum and the demands of new spaceborne missions. The main goal of the special issue is to present the utilization of various methods to identify, mitigate, and monitor RFI. We wish to inform data users of the impact of RFI on observations as well. Though *TGRS* focuses on remote sensing of geophysical phenomena, we are also looking to the experience of the radio astronomy community in order to learn of their best practices.

UPCOMING SPECIAL SESSION AT IGARSS 2013

A half session is planned for IGARSS 2013 in Melbourne, Australia to highlight recent work on RFI as related to recent missions, including Soil Moisture Active/Passive (SMAP), Soil Moisture and Ocean Salinity (SMOS), Aquarius, and Advanced Microwave Scanning Radiometer (AMSR-2). Research efforts related to these missions will be highlighted and new techniques and results will be discussed. Furthermore, recent activities funded under the NSF Enhancing Access to the Radio Spectrum (EARS) will be presented. The focus of EARS is to identify bold new concepts with the potential to contribute significant improvements to efficient radio spectrum utilization and to greatly expand access to current and future wireless-enabled goods and services.

REFERENCES

[1] R. Oliva, E. Daganzo, Y. H. Kerr, S. Mecklenburg, S. Nieto, P. Richaume, and C. Gruhier, "SMOS radio frequency interference scenario: Status and actions taken to improve the RFI environment in the 1400–1427-MHz passive band," *IEEE Trans. Geosci. Remote Sensing*, vol. 50, no. 5, pp. 1427–1439, May 2012, doi: 10.1109/TGRS.2012.2182775.

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FROM THE EDITOR *(continued from page 3)*

The "Education" column presents an article describing remote sensing and geospatial science activities at Purdue University, Indiana, USA, from their beginning in 1966 to present. The article describes both the history of remote sensing at Purdue and the leadership role that this university has been played since the early days of optical remote sensing.

The "Women in GRS" column presents an article describing the goal of this column, which is to publish articles that explore topics such as promoting networking among women, recruiting a diverse workforce, work-life balance, and diversity. The article also reports activities in these areas accomplished by GRSS during 2012.

The "Conference Reports" section presents an article describing the results of a survey of participants of IGARSS 2012, held in Munich, Germany on July 22–27. IGARSS is the premier conference organized by the IEEE GRSS.

Finally, I would like to draw your attention to the various calls for nominations and calls for papers in this issue.

I wish you an enjoyable and productive spring season.

Sincerely,

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