SMOS RFI in the 1400-1427 MHz passive band: ESA's Approach in RFI Detection, Monitoring and Reporting process

E. Daganzo-Eusebio*(1), R. Oliva(2), M. Castillo(2), A. Llorente(2), E. Uranga(2) , M Martin-Neira(1), S. Mecklenburg(3),
(1) European Space Agency, ESTEC, Noordwijk, The Netherlands, e-mail: elena.daganzo-eusebio@esa.int
(2) European Space Agency, ESAC, Villanueva de la Cañada, Spain
(3) European Space Agency, ESRIN, Italy

Extended Abstract

ESA's Soil Moisture and Ocean Salinity (SMOS) mission has been in orbit for over 7 years. Its Microwave Imaging Radiometer with Aperture Synthesis (MIRAS) is operating in the 1400-1427 MHz purely passive band. All emissions are prohibited in this band by the ITU Radio Regulations (footnote No. 5.340). In addition, to ensure protection of the radiometric measurements, the ITU-R Resolution 750 (WRC-15) establishes the maximum unwanted emissions levels of active systems operating in the adjacent bands, noting that EESS (passive) sensors provide worldwide measurements that benefit all countries independently of which administration is operating the sensor.

Despite the existing regulations at international level, SMOS´ objectives are being disturbed by RF Interferences (RFIs) that jeopardize part of its scientific use in certain areas of the world (1). Two types of interference sources can be distinguished:

- Illegal emissions in-band (e.g. security cameras, radio links, DECT telephone systems, malfunctioning terrestrial broadcasting systems and satellite home-TV receivers, etc…);
- Excessive unwanted emissions from active stations operating in adjacent bands, mainly due to radar systems.

To alleviate this situation, shortly after launch, ESA put several strategies in place, with the necessary resources, to improve the RFI problem. The work of SMOS RFI team is focused in the following areas:

- Increasing awareness of the RFI problem by supporting initiatives to improve and reinforce the regulatory framework to ensure protection of the passive bands. This is achieved through ESA's participation in ITU-R Study Groups, the World Radiocommunication Conference and at European level, the different CEPT working groups;
- Improvement of interference detection, data flagging and geo-location processes;
- Systematic monitoring of RFI sources world wide, including manual RFI analysis when necessary. The global RFI monitoring is updated monthly and this information is used to set the priorities for dealing with SMOS RFI;
- Regular RFI reporting of interference cases to the national spectrum management authorities and keeping the ITU informed of the contacts established. ESA asks for the cooperation of the relevant administrations to investigate, take remedial actions and eventually cancel the RFI cases reported. More than 40 administrations have been contacted so far. The RFI reporting process requires close follow-up by ESA and regular communication with the administrations to assess the results of actions initiated. The content and structure of the RFI reports was defined and consolidated over the years. This template has been used by the ITU as reference to provide guidance for passive sensors RFI reporting (2);
- Definition and maintenance of the SMOS RFI Database, containing the RFI tables per country (including RFI ID, coordinates, RFI strength, location, log dates and RFI characterization), RFI statistics per country and continent, 15 days RFI Probability Maps, Brightness Temperature Maps, RFI identification considering multiple detection methods, Google Earth files, RFI reports and logs of the communications with all administrations;

This paper describes how the overall SMOS RFI reporting process is organized, how it has evolved since the SMOS launch and the lessons learned. It will also explain how the SMOS RFI team is organised, the main challenges faced and provide some examples of how the RFI cases have been resolved.

2. References

1. E. Daganzo-Eusebio, R. Oliva et al. "SMOS Radiometer in the 1400-1427 MHz Passive band: Impact of the RFI Environment and Approach to Its Mitigation and Cancellation". IEEE Trans. Geoscience Remote Sens., vol. 51, no. 10, pp. 4999-5007, October 2013.

2. "Draft New Recommendation ITU-R RS.[RFI-SENSOR_REPORTING]: Detection and resolution of RFI interference to Earth exploration-satellite service (passive) sensors", ITU-R, pending approval at Study Group 7 meeting in April 2017.