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Wideband Radio Frequency Interference Study, Extended Abstract

Priscilla. N. Mohammed [1, 2], Matthew L. Mclinden [1], Sidharth Misra [3], Joel T. Johnson [4], Mark J. Andrews [4], Jeffrey R. Piepmeier [1]
(1) NASA Goddard Space Flight Center, Greenbelt, MD, 20771, e-mail: priscilla.n.mohammed@nasa.gov, matthew.l.mclinden@nasa.gov, jeffrey.r.piepmeier@nasa.gov
(2) Morgan State University, Baltimore, MD, 21251
(3) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91106, e-mail: sidharth.misra@jpl.nasa.gov
(4) The Ohio State University, Columbus, OH, 43210, e-mail: johnson.1374@osu.edu, andrews.250@osu.edu

Microwave radiometers provide global observations of parameters for understanding the Earth's oceans, land surfaces and atmosphere. The sensitivities of brightness temperatures for key geophysical parameters largely determine the frequency choice of measurements. It is preferable to operate within protected frequency bands allocated exclusively to passive sensing to minimize radio frequency interference (RFI). However, science enhancements are achievable with wider bandwidths (>200 MHz) and measurement frequencies in unprotected or shared spectrum. Motivations for increasing spectral coverage include reduced radiometric noise by increasing bandwidths as well as increased sensitivity and better penetration of vegetation, soil and ice at frequencies lower than 1400 MHz. Widening the measurement bandwidth allows opportunistic sensing of clean bands within a shared spectrum. It is not possible to measure brightness temperature in channels that have RFI in the same time-frequency subspace.

Understanding the global RFI environment is key to RFI risk reduction for passive sensors. A study over North America was done to determine occupied spectrum and RFI power levels from 1 to 2 GHz. The NASA spectrum office provided a comprehensive list of ~100 000 sources of licensed transmitters from North America using various FCC (Federal Communications Commission) and government databases. The list included information on transmitter location, maximum transmit power, antenna gain, frequency and bandwidth as well as transmitter type. Not surprisingly, locations of transmitters exhibit a high correlation between source location and population density (Figure 1). Mostly narrowband RFI exists over North America. In the United States, 83 % of sources have bandwidths less than 10 MHz and 99.9 % of sources have bandwidths less than 100 MHz, while 98.5 % of Canadian sources have bandwidths less than 10 MHz. Most of the Canadian sources are PCS (personal communications services) transmitting from 1.8 to 2 GHz. The US sources represent a wide range of transmitters and are distributed somewhat evenly over 1 to 2 GHz excluding the Earth Exploration Satellite Service (EESS) passive frequency allocated portion. The presentation will provide details about the study and maps of the effective isotropic radiated power (EIRP) along with the impact on wideband radiometers. Airborne data from [1] compared to the study will also be presented.

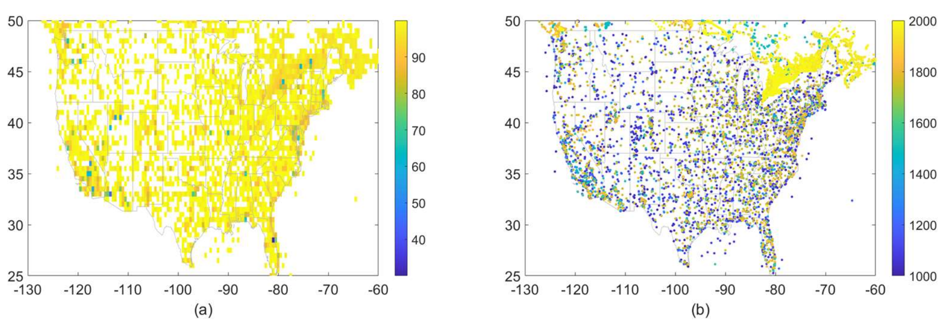

Figure 1. United States and Southern Canada showing the percentage of unoccupied spectrum by licensed sources (a) and the locations and frequencies of the sources in MHz (b).

References

[1] M. J. Andrews *et al.*, "The Ultrawideband Software-Defined Microwave Radiometer: Instrument Description and Initial Campaign Results," in *IEEE Transactions on Geoscience and Remote Sensing.*, vol. 56, no. 10, pp. 5923-5935, Oct. 2018, doi: 10.1109/TGRS.2018.2828604.