AIRBORNE L-BAND RFI OBSERVATIONS IN THE SMAPVEX08 CAMPAIGN WITH THE L-BAND INTERFERENCE SUPPRESSING RADIOMETER

Ninoslav Majurec, James Park, Noppasin Niamsuwan, Mark Frankford, Joel T. Johnson

The Ohio State University
Dept. of Electrical and Computer Engineering
1320 Kinnear Road
Columbus, OH 43212, USA
Phone: (614) 292-7981, Fax: (614) 292-7297
e-mail: johnson.1374@osu.edu

The impact of L-band radio frequency interference (RFI) on upcoming L-band microwave radiometry missions (including SMOS, Aquarius, and SMAP) remains an issue of concern. Previous ground-based experiments have provided some information, but these campaigns were conducted in local RFI environments only, and the instruments utilized were usually not capable of providing detailed information on observed RFI properties. Recent aircraft experiments in preparation for SMOS have expanded the dataset available, but again observations in a variety of RFI environments remain of interest. It is also of interest to quantify the performance of new radiometer technologies for improving RFI detection and mitigation.

To address these issues, three advanced RFI observing systems were deployed with the Passive Active L/S band Sensor (PALS) of NASA JPL in an airborne campaign during September-October of 2008. The campaign included observations over soil moisture ground truthing sites in Iowa and Maryland, as well as transit flights to these regions to and from Grand Junction, Colorado and additional dedicated RFI observing missions in portions of the US Northeast. One of the RFI observing systems included was the L-band Interference Suppressing Radiometer (LISR) of Ohio State University; observations from LISR will be described in this presentation.

In this campaign, LISR recorded spectrograms of the observed brightness temperature at approximately 100 kHz spectral resolution and 350 μsec time resolution. These high time and frequency resolutions allow the detection of interference that is localized either in time (i.e. "pulse" type interference) or frequency (narrowband or "CW" type interference.) LISR acquired approximately 62 hours of data (around 1.5 TB) throughout the campaign.

The presentation will describe the PALS/LISR system and campaign in more detail, as well as the "pulse" and "cross-frequency" algorithms applied to the LISR dataset to detect either pulse or CW interference. Statistics of the level of RFI detected throughout the entire campaign will also be discussed in order to provide insight into the RFI to be experienced in future satellite missions. The results show that approximately ten and three percent of the PALS footprints experience pulsed and CW RFI, respectively, of greater than 1 Kelvin. Procedures for extrapolating these results to represent the observations of a satellite radiometer will also be described.

Several examples of particular RFI sources will be presented in order to illustrate the possible mechanisms by which RFI can enter the protected portion of the L-band spectrum. Among these are sources operating at frequencies adjacent to the protected band, second harmonics of systems operating near 700 MHz, and apparent illegal sources operating within the protected band. The degree to which the RFI level is correlated with a population density database will also be examined.

The results of the data analysis show that RFI is present in the protected L-band spectrum, and that it can have a significant impact on future systems particularly for soil moisture observations (no open ocean observations were conducted in the SMAPVEX08 campaign.) The results also show that simple time and frequency-based RFI detection and mitigation methods can be effective against the majority of the sources observed. Datasets from ocean observations in a February 2009 campaign will also be presented to provide more information if these datasets are available by IGARSS 09.