DUAL WAVELENGTH, DUAL POLARIZED RADAR SYSTEM FOR GPM GROUND VALIDATION EXPERIMENTS

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1. INTRODUCTION

Precipitation affects the daily lives and economic wealth of the citizens of United States and elsewhere. Obtaining quantitative measurements of precipitation on a global scale has been identified by NASA, the USWRP and other government organizations as essential to improving our ability to forecast and understand weather events [1]. Launched in 1997, the Precipitation Radar (PR) aboard the Tropical Rain Measuring Mission (TRMM) satellite was the first precipitation radar flown in space [2]. This single frequency radar operating at 13.8 GHz has been highly reliable and has generated a wealth of information on the spatial distribution, variability and intensity of rainfall. However, its ability to accurately estimate rainfall is limited because it measures only a single parameter, reflectivity factor (Z).

The follow-on mission to TRMM, the Global Precipitation Mission (GPM), includes a dual-wavelength precipitation radar (DPR) system that can measure an effective drop size. This information can significantly improve the accuracy of rainfall estimates. Dual-wavelength systems have been shown to provide additional information about the drop size distribution (DSD) and the phase of hydrometeors [3]-[6]. Assuming a gamma distribution to describe the DSD and a shape factor, then two parameters (N_o, D_o) are required to characterize the DSD [7]. The proposed GPM DPR system will operate at Ku (~13.6 GHz) and Ka-band (~35.6 GHz) to take advantage of these dual-wavelength techniques. “Super sites” are planned for calibration and validation of the GPM DPR precipitation retrieval algorithms. Each site will require at least A working group has been established to define the requirements for this radar system. Besides acquiring dual wavelength measurements, this system must also acquire polarimetric measurements at the two wavelengths. Measuring quantities such as differential reflectivity, linear depolarization ratio and differential phase will further aide in quantifying the drop size distribution of the observed precipitation event and validate the retrieval algorithms that will be used to interpret the GPM DPR measurements.

Through a NASA SBIR Phase I and Phase II effort, Remote Sensing Solutions (RSS) developed a compact, solid-state dual wavelength, dual polarized transceiver and antenna feed. These innovative subsystems were to form a low-cost precipitation radar system capable of obtaining very stable and accurate measurements over multiple deployments to serve as a test bed for radar precipitation algorithm development and validation. Although the intended system would meet most of the requirements, the sensitivity and beam resolution requirements set forth by the working group were beyond its capabilities.

Currently an effort is underway further improve the RSS SBIR radar system by incorporating recent advancements in microwave and millimeter-wave solid-state amplifier technology and on going research in large scale dual wavelength, dual polarizaed antennas to realize a calibration/validation radar system that meets the GPM Mission level 3 requirements for the Ku/Ka-band ground validation radar system. This paper will describe the level 3 requirements, the ground validation experiments and the new ground validation, dual wavelength, dual polarized radar system that will be used to validate and improved the retrieval algorithms for the GPM DPR mission and future follow-on spaceborne precipitation missions.

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2. REFERENCES

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