# INTERSATELLITE CALIBRATION OF MICROWAVE RADIOMETERS FOR THE GLOBAL PRECIPITATION MEASURING MISSION

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The aim of the Global Precipitation Measuring (GPM) mission is to measure precipitation globally with high temporal resolution by using a constellation of satellites logically united by the GPM Core Satellite which will be in a non-sunsynchronous, medium inclination orbit. The usefulness of the combined product depends on the consistency of precipitation retrievals from the various microwave radiometers. The calibration requirements for this consistency are quite daunting requiring a multi-layered approach. The radiometers can vary considerably in their frequencies, view angles, polarizations and spatial resolutions depending on their primary application and other constraints. *Prima facie*, the planned parametric algorithms [1] will correct for the varying viewing parameters, but they are still vulnerable to calibration errors, both relative and absolute.

The first layer is that we assume that each radiometer will have been calibrated to the state-of-the-art by its provider. The GPM Intersatellite Calibration Working Group (aka X-CAL) will adjust the calibration of all the radiometers to a common consensus standard for the GPM Level 1C product to be used in precipitation retrievals. Finally, each Precipitation Algorithm Working Group must have its own strategy for removing the residual errors. If the final adjustments are small, the credibility of the precipitation retrievals will be enhanced.

Before intercomparing, the radiometers must individually be self consistent on a scan-wise and orbit-wise basis. Pre-screening for this consistency (and adjusting to make it so) constitutes the first step in the intercomparison. An early success in the pre-screening has been reported by Gopalan *et al*.,[2]. The radiometers are then compared pair-wise with the microwave radiometer (GMI) on the GPM Core Satellite. Two distinct approaches are used for sake of cross-checking the results. On the one hand, nearly simultaneous observations are collected at the cross-over points of the orbits and the observations of one are converted to virtual observations of the other using a radiative transfer model to permit comparisons[3]. The complementary approach collects histograms of brightness temperature from each instrument. In each case a model is needed to translate the observations from one set of viewing parameters to those of the GMI. For the conically scanning window channel radiometers, the models are reasonably complete.

Water vapor and temperature sounders will use a different scenario. Some of the precipitation retrieval algorithms will use sounding channels. The GMI will include typical water vapor sounding channels (near 183 GHz). Temperature sounding channels (50-60 GHz) from the operational sounders will also be used by some algorithms. The calibration requirements for precipitation retrievals are less stringent than the sounding applications. We will exploit this to intercalibrate the various sensors. The radiances are ingested directly via 3DVAR and 4DVAR techniques into forecast models by many operational weather forecast agencies. The residuals and calibration adjustments of this process will provide a measure of the relative calibration errors throughout the constellation. In effect, the forecast models will serve as transfer standards in much the same sense as the GMI on the GPM Core Satellite will serve as a transfer standard for the window channels. Having multiple forecast agencies involved will permit cross checking of the results. The use of the ARM Southern Great Plains site as a benchmark for calibrating the more opaque channels is also being investigated and will help understand differences in the results from different forecast agencies.

The purview of the X-CAL working group has recently been expanded to include the development of traps and corrections for Radio Frequency Interference (RFI), instrument malfunctions and other phenomena not reasonably modeled in the parametric algorithms.

## BIBLIOGRAPHY

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