ABSOLUTE RADIOMETRIC VICARIOUS CALIBRATION OF ON ORBIT IMAGING SATELLITES

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Abstract: Due to the rigors of launch and the harsh environment of space, it becomes necessary to perform evaluations of the radiometric performance of a sensor once on orbit as well as over the course of its operational life to insure its accurate absolute radiometric calibration. While several techniques are available to calibrate a sensor on orbit, few offer the direct traceability that is obtainable by vicarious calibration. South Dakota State University (SDSU) uses a variant of the method commonly referred to as the "reflectance-based method" to perform a directly traceable radiometric calibration of on-orbit sensors. This method requires ground-based hyperspectral measurement of the ground target during an overfly of the sensor along with the monitoring of select atmospheric parameters. These ground-based measurements are then hyperspectrally propagated to top-of-atmosphere (TOA) via use of the atmospheric modeling software Modtran 5. Once these ground measurements are converted to TOA in-band radiance values, a comparison with satellite measured values is performed to evaluate the radiometric calibration of the system. The paper will describe in detail how the standard SDSU absolute radiometric field campaign is performed, outlining the data sets that are collected and processed. Then results are subsequently compared to the on-orbit satellite-based measurements to provide an evaluation of the current absolute gain of the system.

Examples of this procedure will be shown using the SDSU vegetative calibration site in Brookings, SD, for the newly launched Landsat 8, and for the decade long mission of Landsat 7. The results of the vicarious calibration campaign performed in 2013 will be presented and discussed. The paper will demonstrate that this process can achieve uncertainties in the 3% level for well characterized targets and atmospheres.

Keywords: Absolute Radiometric Calibration, Vicarious Calibration, Landsat, Modtran, Reflectance-based Method