Use of Data from the AVIRIS Onboard Calibrator

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ABSTRACT

The AVIRIS onboard calibrator became operational in 1992. This subsystem on the AVIRIS sensor has operated nominally throughout the 1992 and 1993 flight season. This paper describes the data measured by the onboard calibration and the two primary uses of these data.

1.0 INTRODUCTION

The AVIRIS onboard calibrator subsystem measures the intensity on a current stabilized lamp (Chrien et al., 1991) at the beginning and end of each flight line. This signal is measured through three filters and from the surface of a closed shutter. These four measurements are referred to as the high, spectral, low and dark onboard calibration data. Onboard calibrator measurements are delivered with all AVIRIS data as a four line AVIRIS image file. Each line has 614 samples and corresponds to one of the onboard calibrator positions. In this paper only the high intensity and dark data from the onboard calibrator are used.

Data from the onboard calibrator have two primary uses. First, the data may be used to optimize the tractability of the calibration of the delivered AVIRIS data to the laboratory radiometric calibration standard. Second, these data may be used to monitor and normalize the inflight radiometric performance of AVIRIS through the flight season (Green et al., 1992). These uses are described and an example presented in the following sections of the paper.

2.0 TRACTABILITY TO THE LABORATORY RADIOMETRIC CALIBRATION

A set of measurements from the onboard calibrator is acquired in conjunction with the radiometric calibration of AVIRIS in the laboratory. These data are acquired as AVIRIS data are measured from the radiometrically calibrated integrating sphere. From analysis of the AVIRIS digitized numbers (DN) and the integrating sphere radiance the radiometric calibration coefficients are calculated for AVIRIS (Chrien, et al., 1990). At the same time, a set of data is analyzed from the AVIRIS onboard calibrator. This data set consists of the average high minus dark onboard calibrator signal for the period of laboratory radiometric calibration. A plot of the high minus dark data at the time of laboratory calibration in 1992 is given in Figure 1. These data measure AVIRIS radiometric performance in terms of the onboard calibrator signal and are provided with all delivered AVIRIS data in 1992 and 1993.

With each AVIRIS, airborne flight line data from the onboard calibrator are measured. A plot of the high minus dark data for the AVIRIS inflight calibration experiment held on the 30th of May 1992 is given in Figure 2. These data measure AVIRIS inflight radiometric performance in terms of the onboard calibrator signal. If the onboard calibrator is stable, then a ratio of the laboratory signal over the inflight signal will show any change in AVIRIS performance. Some change is expected given that the operational environment inside the Q-bay of the ER-2 at 20 km altitude, 4 psi, and less than 10 degrees C differs considerably from the environment in the AVIRIS laboratory. A plot of the ratio of the laboratory signal over inflight signal for the onboard calibrator is given in Figure 3. A ratio of 1.0 indicates no onboard calibrator measured change in radiometric performance. This plot shows AVIRIS to be remarkably stable between the laboratory and flight over Rogers Dry Lake. The small disagreement at 410 nm is likely related to a quantization error due to the low signal from the onboard calibrator. At 1400, 1900, and 2500, the error may be attributed to a difference in water vapor in the AVIRIS sensor between the laboratory and the 20 km altitude. Though the agreement is quite good, multiplying this ratio by the delivered AVIRIS radiance will incrementally improve the tractability of the inflight radiance to the laboratory standard. A plot of the onboard calibrator corrected radiance for Rogers Dry Lake is given in Figure 4. Analysis of the stability of the onboard calibrator in the laboratory as well as the current supplied to the lamp indicates the onboard calibrator should be stable to better than the 3 percent level.

3.0 FLIGHT SEASON PERFORMANCE NORMALIZATION AND MONITORING

The second primary use of the onboard calibrator is for monitoring and normalizing the radiometric performance of AVIRIS from flight to flight during the flight season. When comparing AVIRIS data acquired at multiple sites in the flight season a ratio of the inflight high minus dark signal

between flights may be used to bring those AVIRIS data sets into agreement. This method is currently being used with the inversion of AVIRIS measured radiance to apparent surface reflectance (Green, 1990, and Green et al., 1993a) using an inflight calibration experiment (Conel et al., 1988, and Green et al., 1993b) as the absolute radiometric calibration.

4.0 FUTURE PLANS

As the performance of the onboard calibrator is further validated the correction described may become an option available directly from the AVIRIS data facility. In 1994, it is planned that the onboard calibrator will be improved to increase the radiometric stability to better than 3%. In addition, spectral and geometric calibration standards may be incorporated into the AVIRIS onboard calibrator.

5.0 CONCLUSION

The onboard calibrator may be used to improve the tractability of the inflight radiometric calibration of AVIRIS and to normalize the radiometric characteristics of the data set acquired at different times in the flight season. In 1992 and 1993, it is left to the science investigator to perform the simple calculations required to utilize these data.

6.0 ACKNOWLEDGMENTS

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7.0 REFERENCES

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8.0 FIGURES

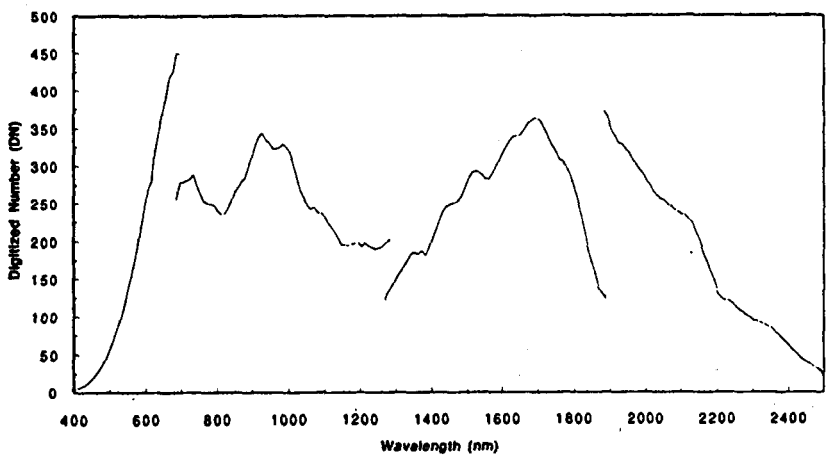

Figure 1. High minus dark shutter intensity signal measured by the onboard calibrator at the time of AVIRIS sensor calibration in the laboratory.

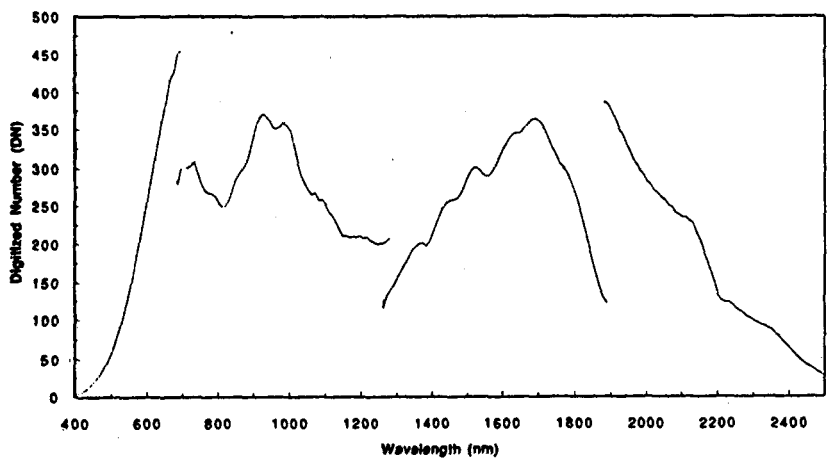

Figure 2. High minus dark signal for the AVIRIS onboard calibrator measured inflight over Rogers Dry Lake, California on the 30th of May 1992.

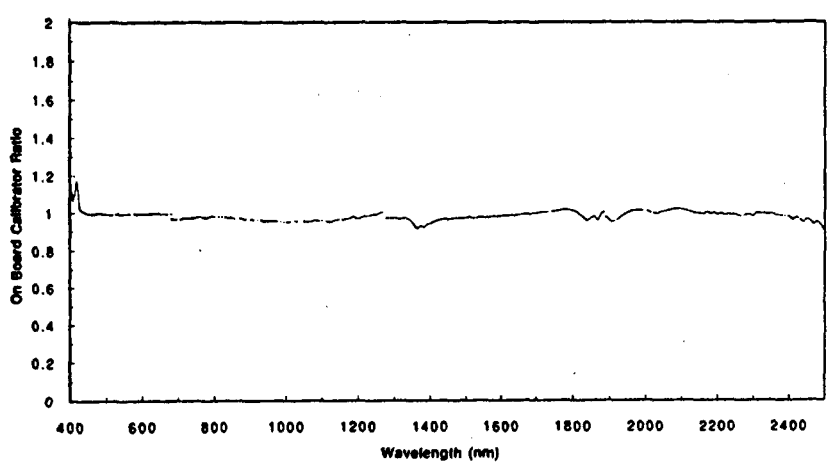

Figure 3. Ratio of the onboard calibrator signal measured in the laboratory divided by the signal inflight.

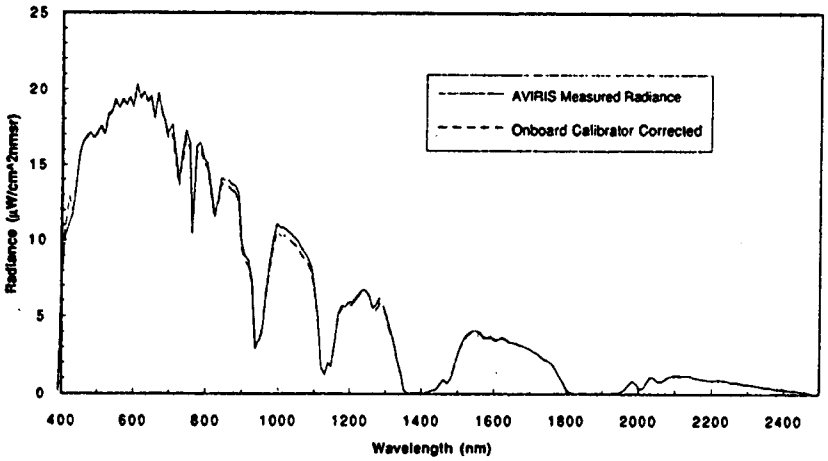

Figure 4. Comparison of the delivered spectral radiance from AVIRIS and the onboard calibrator modified radiance.