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Chapter 7

Rotation and Polarization Uncertainties

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Abstract

Separate experiments were conducted during SIRREX-7 to estimate the rotation and polarization uncertainties of radiometers during the calibration process. Rotational uncertainties for radiance sensors were usually less than 1%, with single and multiple aperture systems having average rotational uncertainties of 0.2–0.3% and 0.4–0.9%, respectively. Rotational uncertainties for a multiple aperture irradiance sensor was 0.7% on average, which was in close agreement with multiple aperture radiance sensors. The only significant spectral dependence was with an OCR-2000 (hyperspectral) sensor which had maximal effects in the bluest and reddest wavelengths and minimal effects in the green domain. The average polarization parameter, in percent, varied between 0.6–4.6%. The Satlantic instruments had an average polarization below 2.0%, but the OCR-200 sensors showed maximum polarization sensitivity in the blue part of the spectrum (1.4–2.4%), while the OCR-2000 instrument had maximum sensitivity in the red wavelength domain (2.1–2.6%).

7.1 INTRODUCTION

Two different experiments were designed to estimate the rotation and polarization effects on the calibration process. Although the former can be considered as a mechanical positioning problem, there are practical aspects of the problem which are more associated with the usual methods used during instrument calibration. For example, the angular positioning of the sensor during the calibration process is usually not maintained from one calibration to the next (in fact, many commercial radiometers are cylindrical and are not explicitly indexed), and the mounting hardware used is not always the best for reproducing an indexing scheme. The D-shaped collar was designed to overcome this limitation, and when used with a V-block is much easier to use for repositioning requirements than a ring carrier. In comparison, polarization is mostly an instrument design problem, with a design objective that is set by the optical protocols being used.

7.2 ROTATION EFFECTS

Two experiments were conducted to estimate the rotation sensitivity of radiance and irradiance sensors during the calibration process. Most Satlantic radiometers (e.g., the OCR-200 and OCR-1000 series of instruments) have separate apertures for each channel organized in one or more circular arrays around a central channel (Fig. 3), so changes in the orientation of the sensor in a V-block or ring mount will necessarily cause a change in what part of the plaque is viewed during the calibration process. The objective of the rotation experiments was to determine the level of uncertainty that can be associated with this part of the sensor positioning process.

Custom rotator mount adapters, which took advantage of the D-shaped collars, were built for the OCI-200 and OCR-200 series of radiometers. Separate custom adapters were also built for the SXR and the OCR-2000 instruments. The latter two also required a mechanical support (a V-block) to stabilize the large housings of these instruments during the rotation process. Although this helped maintain the stability of the large mass of these instruments during rotation, it did not ensure an axial symmetry for all trials, and some data were not used, because of unbalanced rotation.

7.2.1 Rotation of Radiance Sensors

Four types of radiance sensors were used for the rotation sensitivity experiments: R035, R064, P002, and X001.