CROSS-TRACK INFRARED SOUNDER (CrIS) PRE-LAUNCH PERFORMANCE

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ABSTRACT

This paper discusses the development, test, and performance of the first Cross-track Infrared Sounder (CrIS) flight instrument and its data product performance based on the latest test results. CrIS sensor measures upwelling infrared radiance at very high spectral resolution. The science heritage for CrIS was derived from the Atmospheric Infrared Radiation Sounder (AIRS) on the NASA EOS Aqua satellite. Together with the Advanced Technology Microwave Sounder (ATMS), the CrIS sensor is a critical payload for National Polar-orbiting Operational Environmental Satellite System (NPOESS) providing two key Performance Parameters (KPP) namely, the Atmospheric Vertical Temperature Profiles (AVTP) and Atmospheric Vertical Moisture Profiles (AVMP) as well as the vertical pressure profile. The combination of ATMS and CrIS is called CrIMSS (Cross-track Infrared Microwave Sounder Suite). CrIS has been extensively tested and has demonstrated excellent performance, meeting or exceeding most of its important performance parameters. It will first fly on the NPOESS Preparatory Project (NPP) mission, the risk reduction flight for NPOESS. NPOESS is a tri-agency (DOC, DOD, and NASA) United States program for the Next-generation Polar-Orbiting, Operational, Environmental, Satellite System. The presentation describes instrument development and progression process from the engineering demonstration units through the first flight model. The CrIS sensor development has included three engineering unit builds, as well as the design, development, and testing of the flight sensor unit. The run-for-record flight sensor and algorithm performance compare favorably against the specification requirements.

The CrIS instrument has a number of design features which allow it to achieve high performance in a relatively small volume. A compact optical design provides a large 8-cm aperture for superior sensitivity. An innovative 4-stage passive cooler provides low-temperature detector operation without the complexities of an active cooler. Photovoltaic detectors are used in all three spectral bands for maximum sensitivity and linearity. A 3x3 array of detectors (each with a 14km diameter at nadir) is used in each spectral band for improved spatial coverage. The interferometer uses a proven plane-mirror Michelson design with dynamic alignment to maintain precise alignments between the two arms of the interferometer. A deep-cavity internal calibration target is used for improved calibration accuracy performance. Spectral resolution is as fine as 0.625 cm^{-1} in the long wave band providing 1305 total spectral channels covering the spectral range of 650-2550 cm^{-1}. Finally, a passive vibration-isolation system enables CrIS to operate on spacecraft with relatively high levels of disturbances. The modules that make up the CrIS instrument and their function will be discussed.

The radiometric performance is at the heart of the environmental mission performance, since it represents the quality of the calibrated sensor response. The latest radiometric performance such as noise susceptibility, calibrated spectral response shape, Instrument Line Shape (ILS), error residuals and absolute spectral calibration of the CrIS Flight Model 1 (FM1) sensor will be presented. Additional important performance parameters based on the latest TVAC data will be presented, including: sensor noise, short-term repeatability, long-term repeatability. The SDR algorithm flow is given along with examples of the algorithm's ability for linearity correction to limit radiometric uncertainty and produce accurate spectral response functions in all sensor Fields Of Views (FOV) and spectral channels.

The testing so far has included ambient, electrical magnetic interference testing, vibration, as well as thermal vacuum testing to simulate the environmental conditions on-orbit. By the time of the presentation, the sensor sell-off and the final TVAC testing will have been completed and the presentation will summarize the results. The CrIS sensor calibration plan is being developed in order to ensure high quality SDR and EDR environmental products on-orbit. In order to get accurate results, the sensor data must be well calibrated both radiometrically and spectrally. In this presentation, sensor performance testing results will be summarized and both SDR and EDR performances will be discussed for the as-delivered CrIS sensor.

References

[1] Performance of the As-delivered NPOESS Preparatory Project (NPP) CrIS Sensor
Sabet-Peyman, et al AGU Annual Meeting Dec 2008

[2] Development and Testing Status of the NPOESS Cross-track Infrared Sounder (CrIS) Flight Model

Hookman, et al, MSS Conference, February, 2009

[3] Performance of the NPOESS CrIS Sensor and Environmental Data Records

Andreas, el al, IGARSS July 2009