299 THE CROSS-TRACK INFRARED SOUNDER (CRIS) ON SUOMI NPP: QUALITY ASSURANCE STUDY

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1. INTRODUCTION

Post-launch evaluation of the Cross-track Infrared Sounder (CrIS) instrument has led to a number of quality assurance checks to evaluate data and ensure data quality. Imaginary radiance thresholds applied to the long-, mid- and short-wave channels have been successfully utilized to generate daily quick-looks for each channel. We can independently discern missing spectra from zero-fill radiances, and have noticed a handful of outlier cases that require further investigation.

Our methodology, applied to both direct-broadcast Interface Data Processing Segment (IDPS) and Community Satellite Processing Package (CSPP) output, is presented here. The former has shown a need to address latency issues in CrIS Raw Data Record (RDR) repair-packet granules. In fact, the vast majority of flagged data are due to missing repair-granules in the aggregated IDPS Science Data Records (SDRs). When a 24-hour latency is applied to the incoming RDRs, and processed through to SDRs via CSPP, the success rate approaches 99.99 percent.

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2. DATA AND METHODOLOGY

Our analysis evaluates SDR data processed via both the IDPS and CSPP software packages. The standard CrIS RDR granules are eight-minute aggregated products, whereas the repair-granules are 32-second data records. The size differences between the two files allow a quick and simple way to distinguish between the two file types.

Figure 1 illustrates the latency (i.e., CrIS observation time minus file creation time) for both aggregated (blue) and repair-granule (green) RDRs. It represents CrIS data received on 19 June 2012 via IDPS, CLASS and SD3E. Note that aggregated RDR packets are created about two-hours after observation, whereas repair-granules can occur in a much wider time frame, ranging from three to 24-hours. Aggregated SDR files (black) are created roughly six-hours after observation.

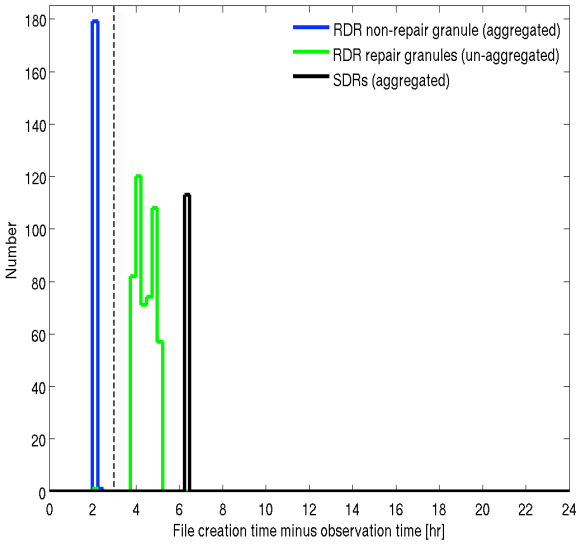

Figure 1. CrIS IDPS file latency, 19 June 2012. Creation of aggregated RDRs (blue), un-aggregated repair-granule RDRs (green) and aggregated SDRs (black) are shown relative to CrIS observation times via IDPS processing and CLASS packaging.

Given that repair-granules may arrive after aggregated SDRs have been generated via the CLASS packaging system, there stands a chance that spectral radiance data could be corrupt or missing from the final SDRs. We process all RDR data at UW-Madison within the PEATE using CSPP after a 24-hour wait, sufficient for all of the repair-granules to arrive, to circumvent this problem. A direct comparison of IDPS/CLASS packaging versus CSPP processing will be shown in Section 3.

Figure 2, similar to Fig. 1 but for data from 20 Sept. 2012, shows recent improvement in the IDPS-CLASS-SD3E packaging process as software bugs and other issues have been addressed. Though there are still a small number, roughly 20-30, of repair-granules occurring per day.

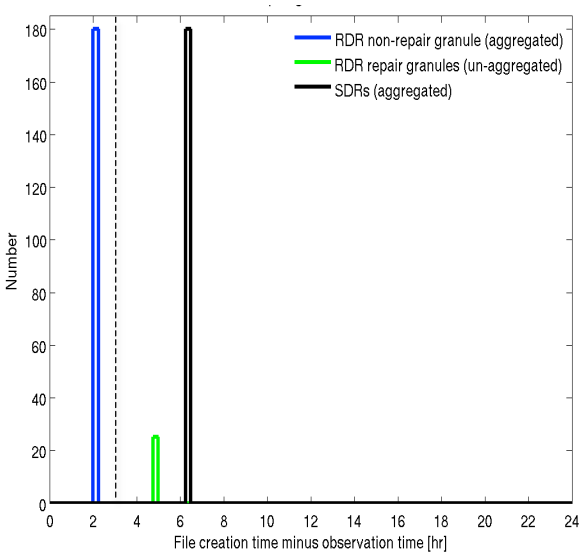

Figure 2. CrIS IDPS file latency, 20 Sept. 2012.

2.1 THRESHOLDS

Application of a spectral imaginary radiance threshold check can be utilized to flag faulty data. This is performed for every spectrum in each of the three CrIS bands. If the following condition is satisfied,

$$\text{abs}(\max(\text{imag. rad}(\nu))) > \text{threshold};$$

where the threshold values are provided in Table 1 for each band-dependent spectral range, respectively, then the spectrum in the given band is flagged.

Table 1. Imag. radiance threshold values

Spectral Range (cm^{-1})	Threshold Value
800 – 980	1.5
1500 – 1700	0.5
2250 – 2350	0.05

The number of flagged spectra can be correlated to the incidence of repair granules.

3. RESULTS

A series of CrIS quality assurance (QA) images are generated each day. These include global images of flagged data for each of the three bands and simple day/night observations of 900 cm^{-1} brightness temperatures (T_b) for both real and imaginary spectra as a quick-look indicator for instrument status.

Figure 3 corresponds to the case shown in Fig. 1 on 19 June 2012. It shows all flagged LW spectra, processed via IDPS, though the majority are spectra with fill values (i.e., -999) that do not appear. The fill values also apply to latitude and longitude fields and, therefore, cannot be projected on the global map image.

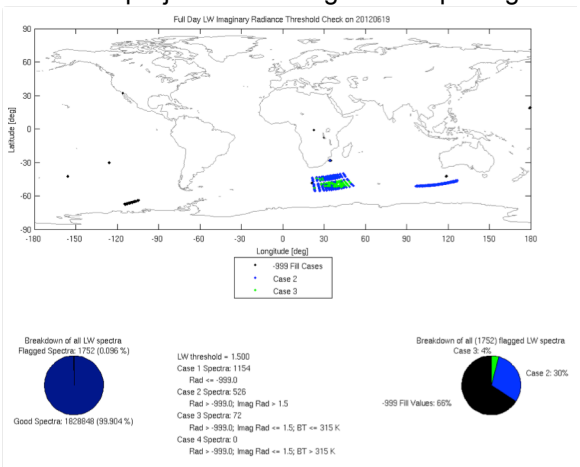

Figure 3. CrIS LW QA image for analysis on 19 June 2012. Image shows spectra that have been flagged using the imaginary radiance threshold check.

Note that all the repair-granules are collected before the SDRs are generated (Fig. 1). However, IDPS processing does not always incorporate repair-granules into the final aggregated SDRs. Figure 4 shows the nighttime 900 cm^{-1} T_b for this day, where more than 33% of the SDRs were not generated. Missing data cannot be flagged, therefore using Fig. 3 and 4 together is necessary to fully gauge the data quality.

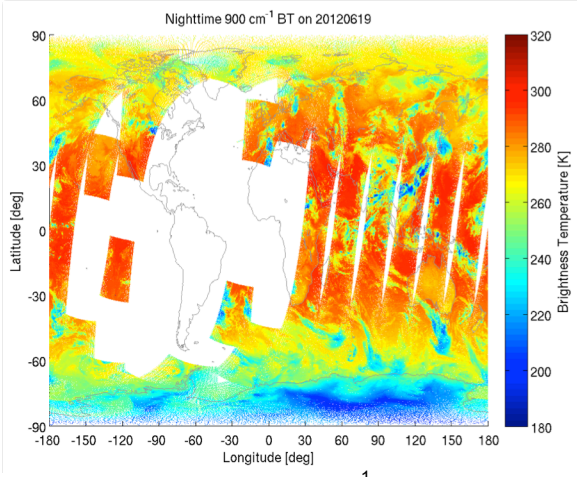

Figure 4. Nighttime 900 cm^{-1} T_b on 19 June 2012. Gaps in the data are due to missing data from repair-granules that have not been packaged into the final CrIS SDRs.

We processed the same case illustrated by the QA images in Figs. 3 and 4 via CSPP. The processing occurs after all repair-granules have been received and results in 99.99% of good spectra. Figures 5 and 6 are the CSPP analogs of the IDPS QA images shown in Figs. 3 and 4.

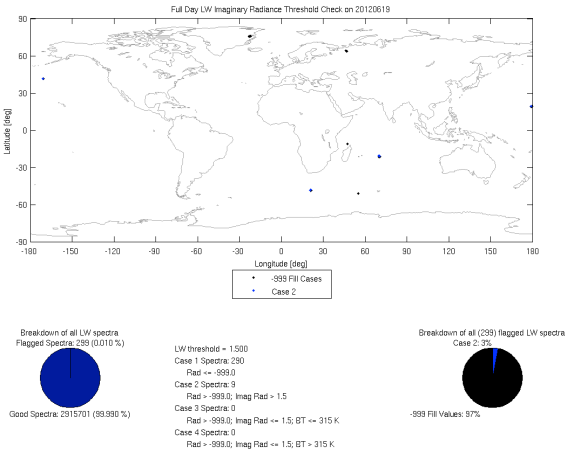

Figure 5. Same as Fig. 3 but for data processed using CSPP at UW-Madison's PEATE.

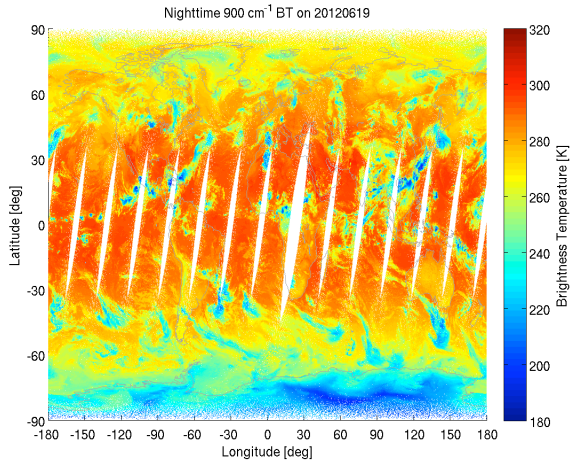

Figure 6. Same as Fig. 4 but for data processed using CSPP at UW-Madison's PEATE.

We have broken down the flagged spectra into "cases." Case 1 are simple fill values (-999), Case 2 occur when the imaginary spectra wildly fluctuate about a zero mean, and Case 3 occurs when the imaginary spectra are close to a zero mean.

Figure 7 shows Case 2 LW spectra, both real and imaginary (top and bottom panels, respectively) for the example on 19 June 2012. These radiances are clearly non-physical and/or very noisy.

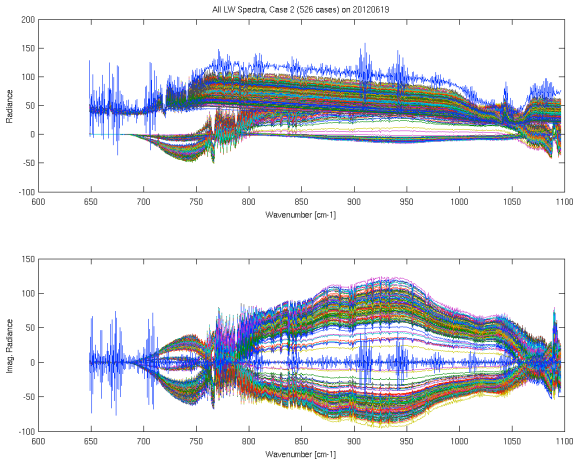

Figure 7. Case 2 flagged LW CrIS spectra on 19 Jun 2012. Real and imaginary radiances are provided (top and bottom panels, respectively).

The Case 3 examples for the same day, Figure 8, are a bigger issue because they could appear to be okay upon quick examination, especially if one ignores the imaginary component of the spectrum.

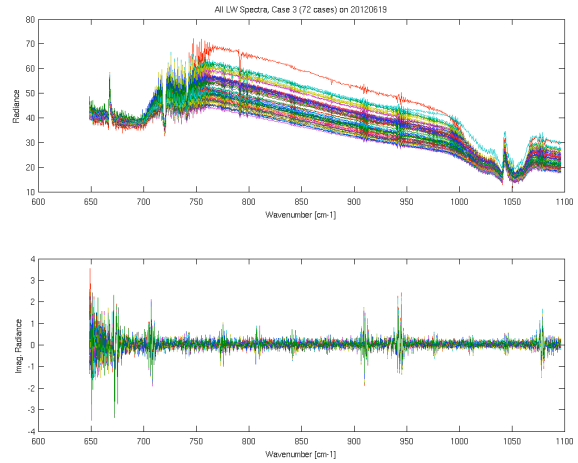

Figure 8. Same as Fig. 7, but for Case 3 flagged LW spectra.

4. CONCLUSIONS

CrIS RDR repair-granules are a necessary component of the SDR processing. IDPS packaging via CLASS has a tendency to produce SDR files that contain either missing or corrupt spectra. Users that can wait 24-hours for science data can use CSPP processed data that has a 99.99% yield. Those who require the IDPS output should be using the data quality flags or applying a similar imaginary radiance threshold check outlined here.