SNPP CrIS SDR Processing Quality Improvements Since Provisional Review

Xin Jin, Lihong Wang, Daniel DeSlover, Mark Esplin, Wael Ibrahim, Tim Gardner, and other CrIS SDR Team members

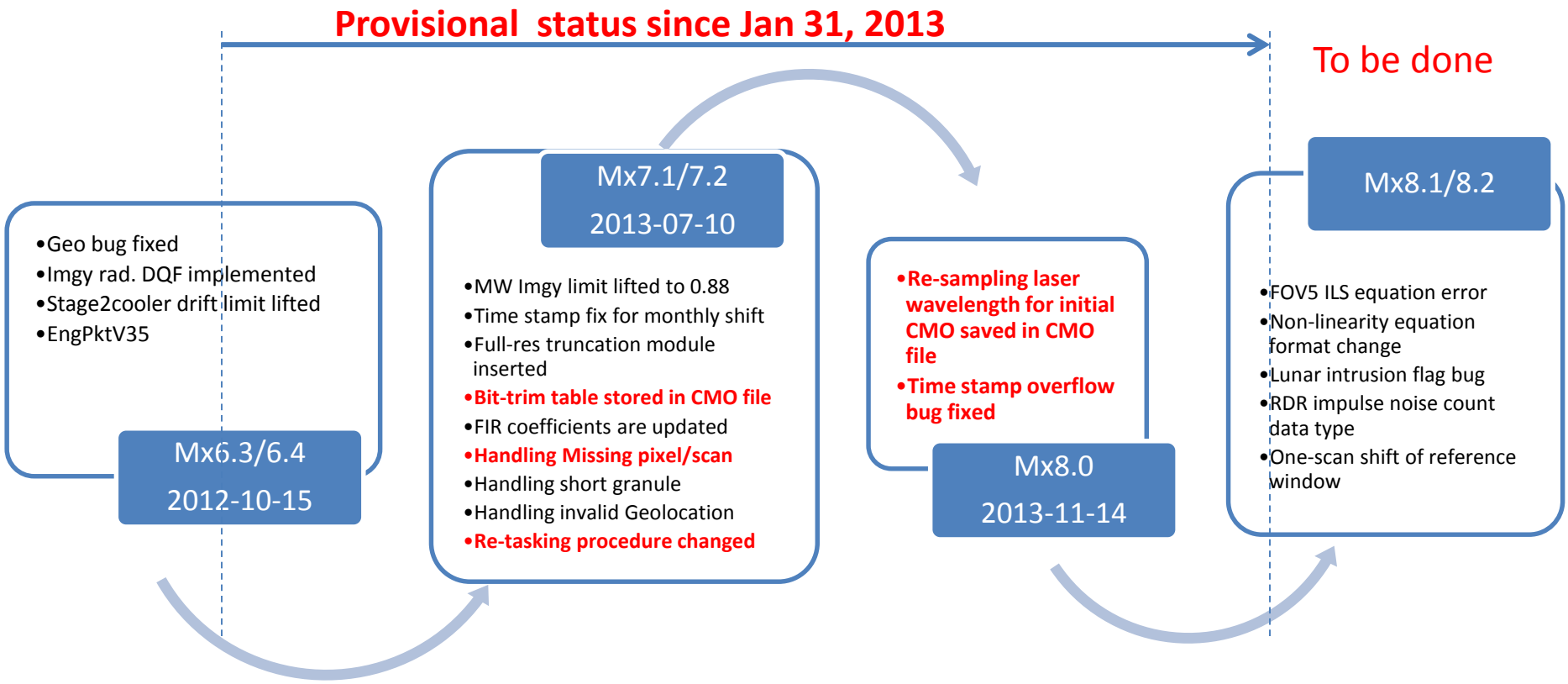
Suomi NPP SDR Product Review
NOAA Center for Weather and Climate Prediction (NCWCP)
5830 University Research Park, College Park, Maryland
December 18, 2013

Outlines

1. Updates since provisional review
2. The CrIS SDR overall data quality flag (DQF)
3. Critical fixes to improve SDR overall quality
4. Conclusion/outlook

Part 1: Updates since provisional review

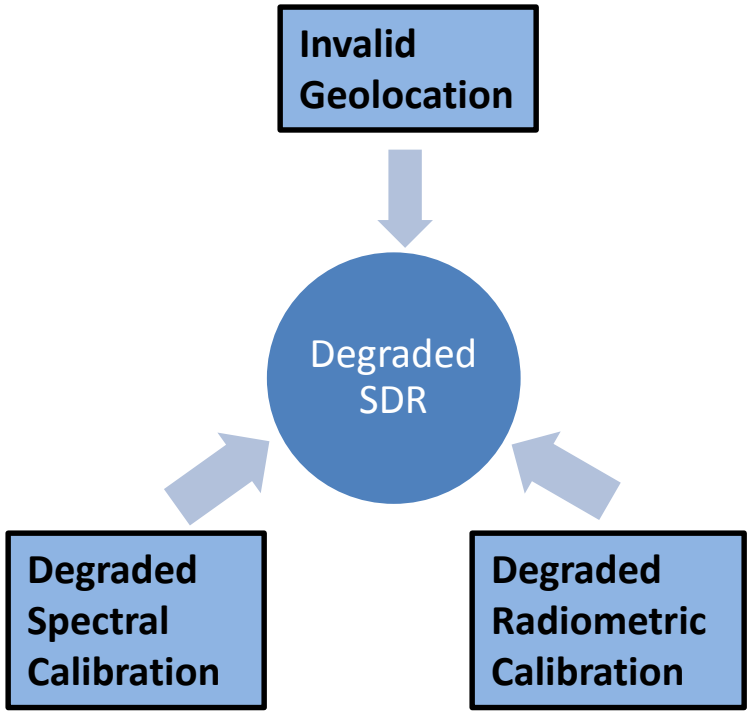
Updates since provisional product review

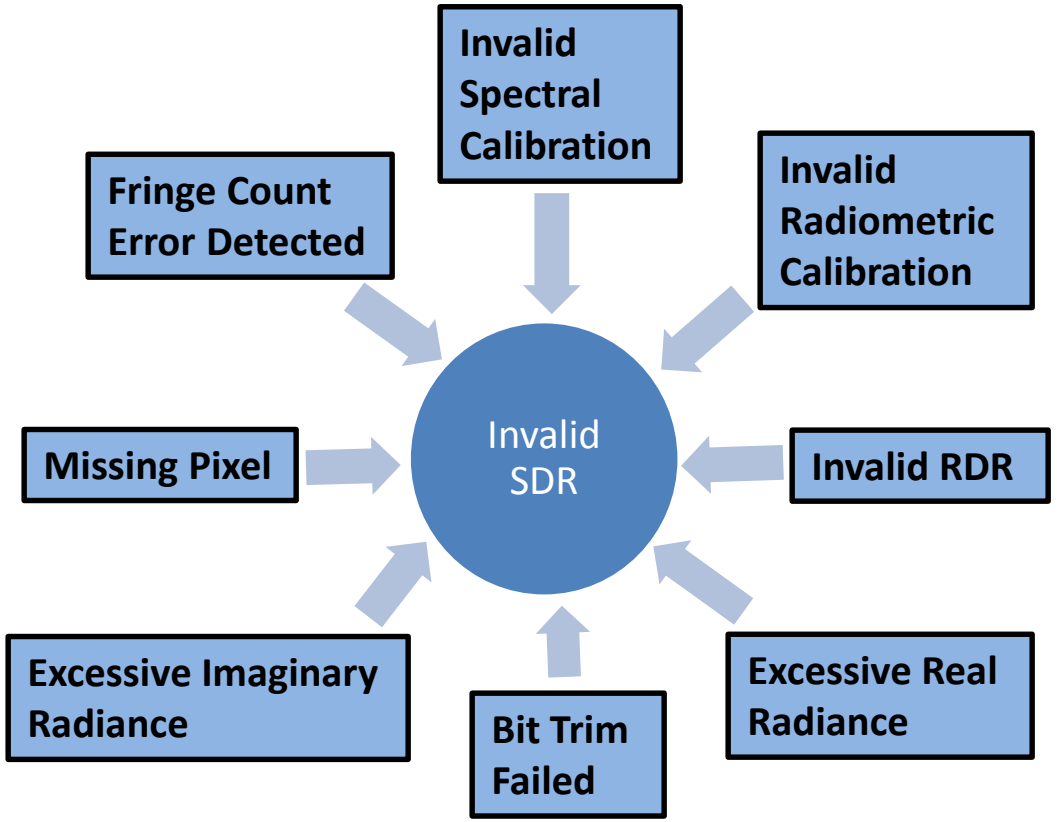


Part 2: The CrIS SDR overall data quality flag (DQF)

SDR overall quality: algorithm

The default value in the quality flag matrix is *Good*. Any of these conditions, if found, the quality flag is then marked as *Invalid* or *Degraded*. A fourth status, i.e., the *missing data*, will be added in Mx8.1.





SDR overall quality: impacting factors

Invalid RDR

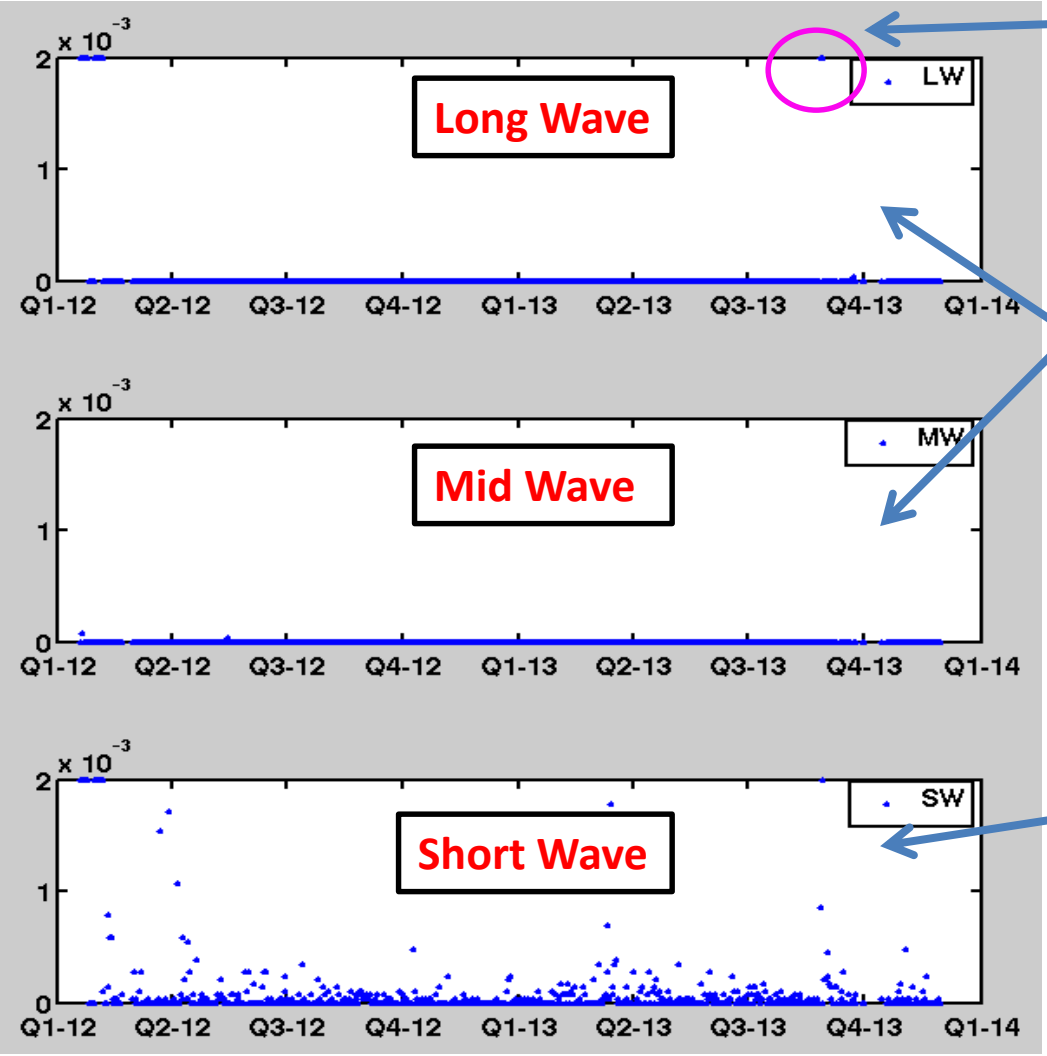
- Bad packets
  - Downlink issue
  - Short-wave sun glint
  - High-resolution test
- Missing packets
  - Any type of packet can be missing: Earth scene, cold or hot target, telemetry, engineering, spacecraft diary

Processing Artifacts

- Software problems
- Improper operational procedures

SDR overall quality: Input data quality

Daily Percentage of instrument-caused bad interferogram packet



High-resolution test

For LW and MW, no bad interferogram packets have been found in operational data since March, 2012.

Most bad packets are damaged by sun glint.

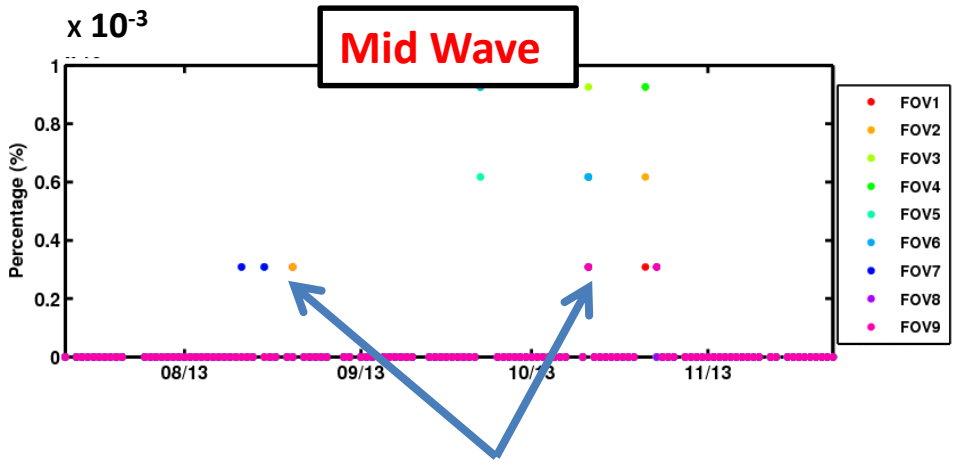
SDR overall quality: invalid

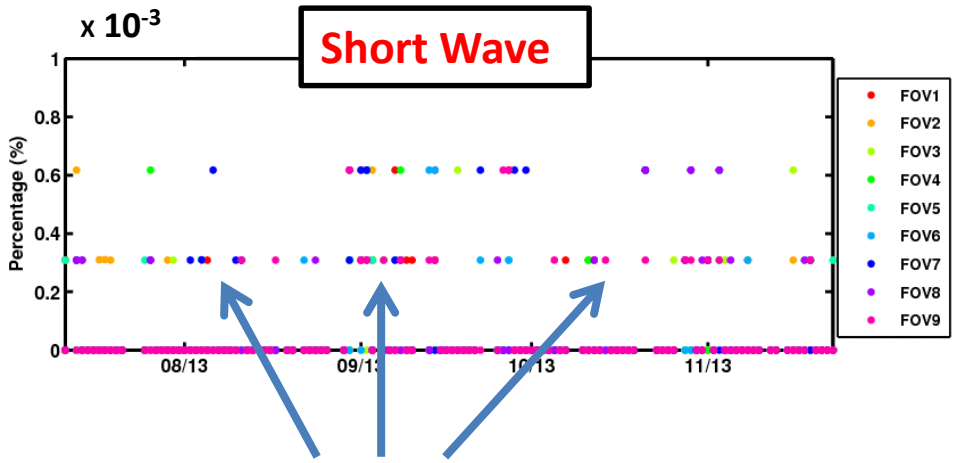
Averaged daily occurrence of invalid pixels from 2013-07-11 (Mx7.1) to 2013-11-24

	Bad/Missing RDR included		Bad/Missing RDR excluded	
	(%)	(#. of pixel)	(%)	(#. of pixel)
LW	2.8E-03	83	2.3560e-06	0.07
MW	2.8E-03	83	2.6166e-06	0.08
SW	2.9E-03	89	2.4345e-05	0.71

Total number of pixels for each band is 2916000(=10800*30*9) per day.

Daily percentage of Invalid SDR from 2013-07-11 (Mx7.1) to 2013-11-24





Caused by Missing packets & code bugs

caused by sun glint, missing packet & code bugs

SDR overall quality: degraded

Averaged daily occurrence of degraded pixels from 2013-07-11 to 2013-11-24

	(%)	(#. of pixel)
LW	0.0155	451
MW	0.0155	451
SW	0.0155	451

Total number of pixels for each band is 2916000(=10800*30*9) per day.

1. Degraded SDR caused by real degraded radiometric calibration have not been found.

2. Invalid geolocation caused degrade SDR is eliminated since Mx7.1 by improving the common GEO module.

3. The remaining degraded SDR is a processing artifact. The radiance values are actually good. This bug will be fixed in Mx8.1.

SDR overall quality: good

Averaged daily occurrence of good pixels from 2013-07-11 (Mx7.1) to 2013-11-24

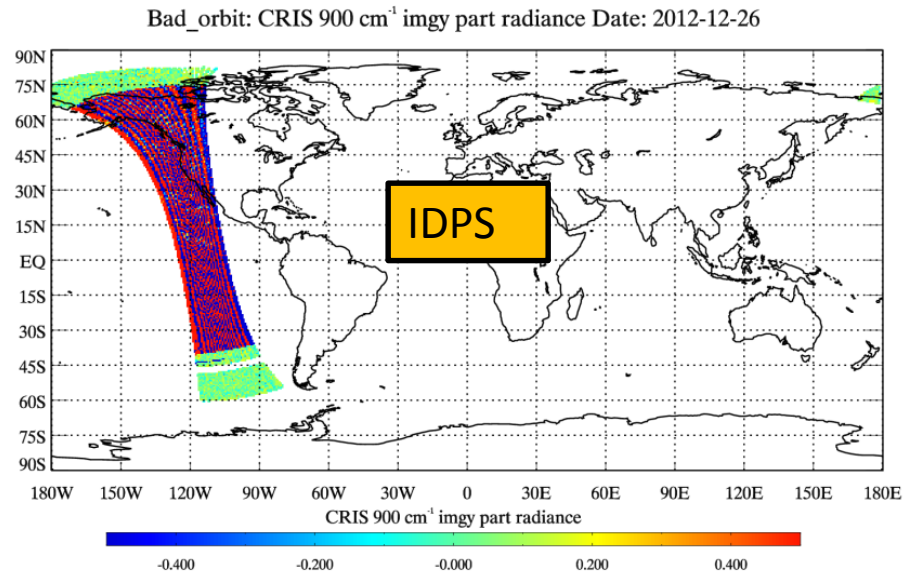
LW	99.9817%
MW	99.9817%
SW	99.9816%

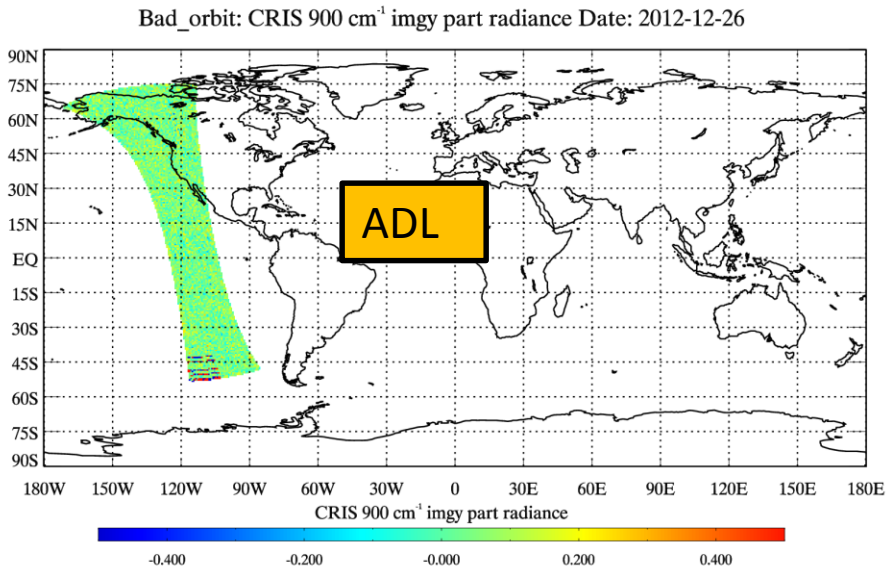
Part 3: Critical fixes to improve SDR overall quality

Critical fixes to improve SDR overall quality

DR 5043: Improper re-tasking procedure

The 900 cm^{-1} imaginary radiance anomaly caused by improper re-tasking procedure



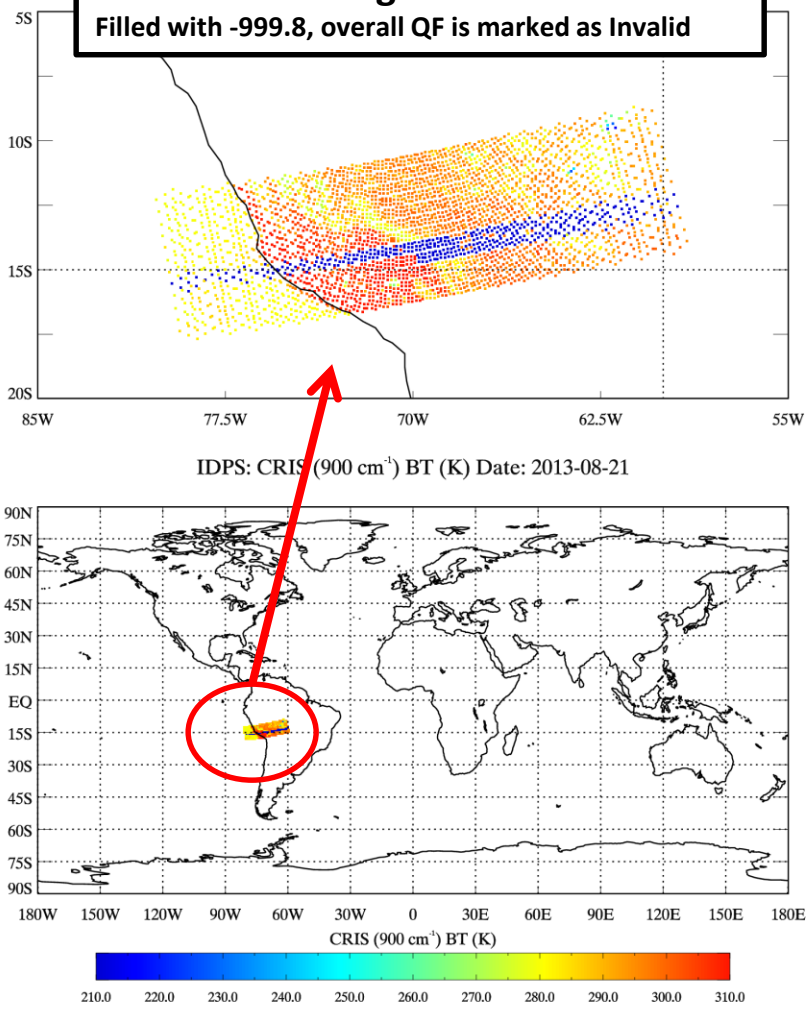


The re-tasking procedure is modified to avoid such anomalies since Mx7.1.

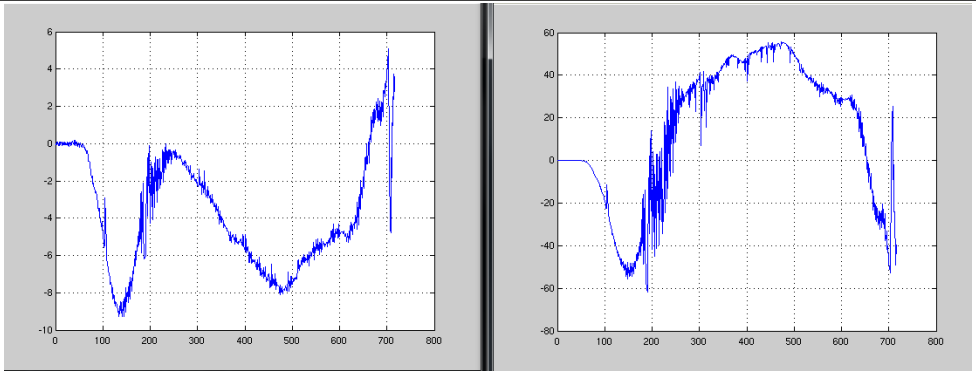
Critical fixes to improve SDR overall quality

DR 5010:Missing Earth Scene Packets

A case of missing one and half scans
Filled with -999.8, overall QF is marked as Invalid



The LW real & imaginary radiance in a pixel where the ES packet is missing and not filled with filled values



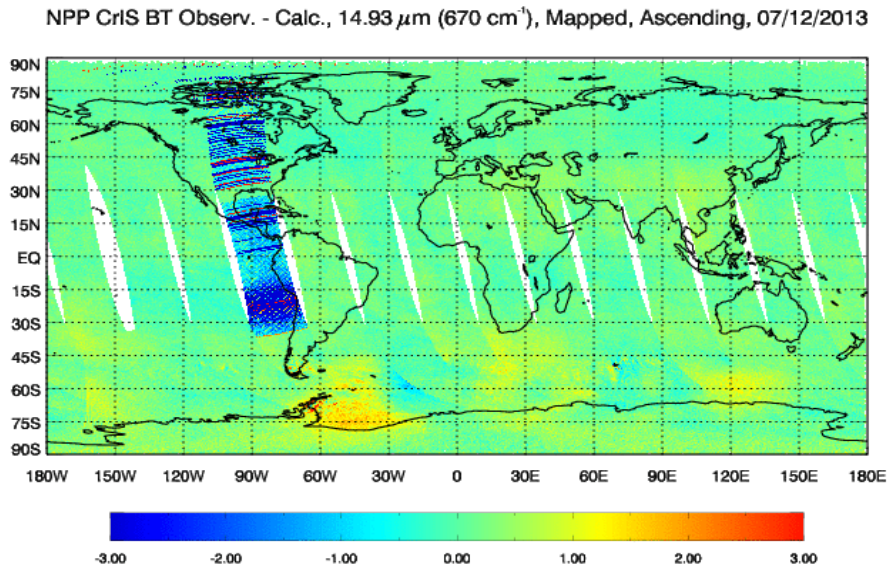
Missing ES packets could cause a number of problems, including 1) abnormal radiances, 2) missing/duplicating scans in SDR granule files, 3) incorrect time stamps on file name, 4) calibration target misalignment, and etc..

The fix is implemented since Mx7.1.

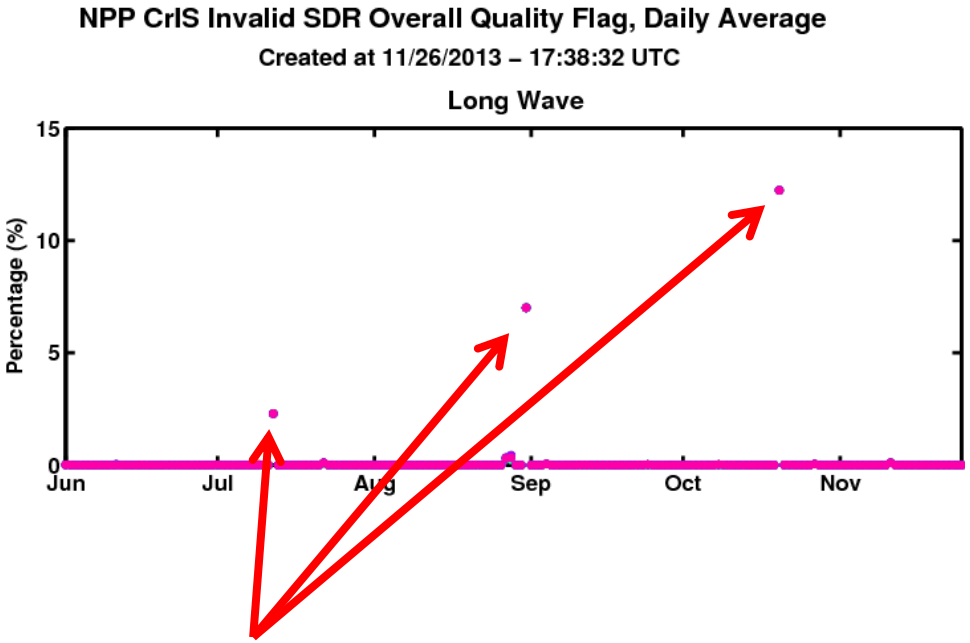
Critical fixes to improve SDR overall quality

DR 7295: Time stamp bug corrupted the radiance calculation

BT: Observation minus Calculation



Actual daily percent of invalid SDR DQF

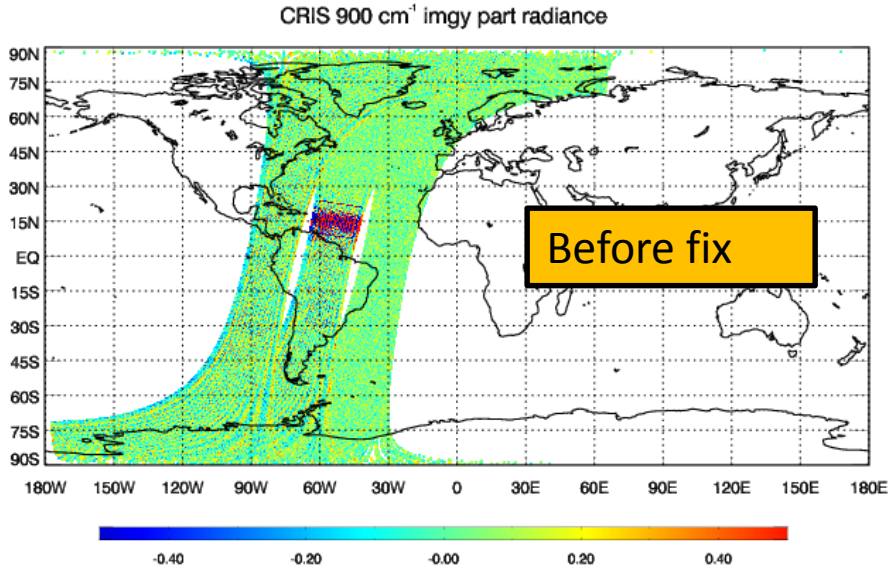


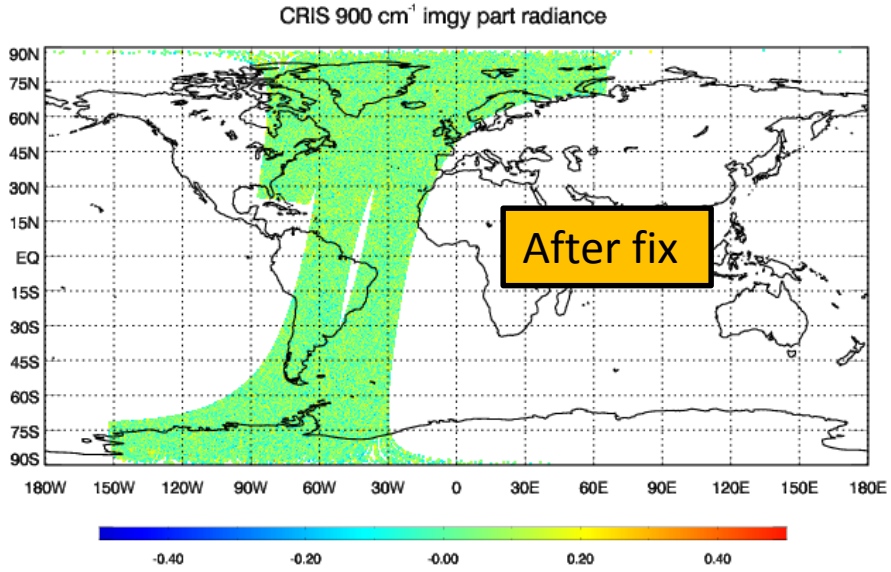
This bug has triggered three major radiance anomaly events. Bad radiance occurred every 49.7 days.

Critical fixes to improve SDR overall quality

DR 7295: Time stamp bug corrupted the radiance calculation

The 900 cm^{-1} imaginary radiance of Oct 20, 2013

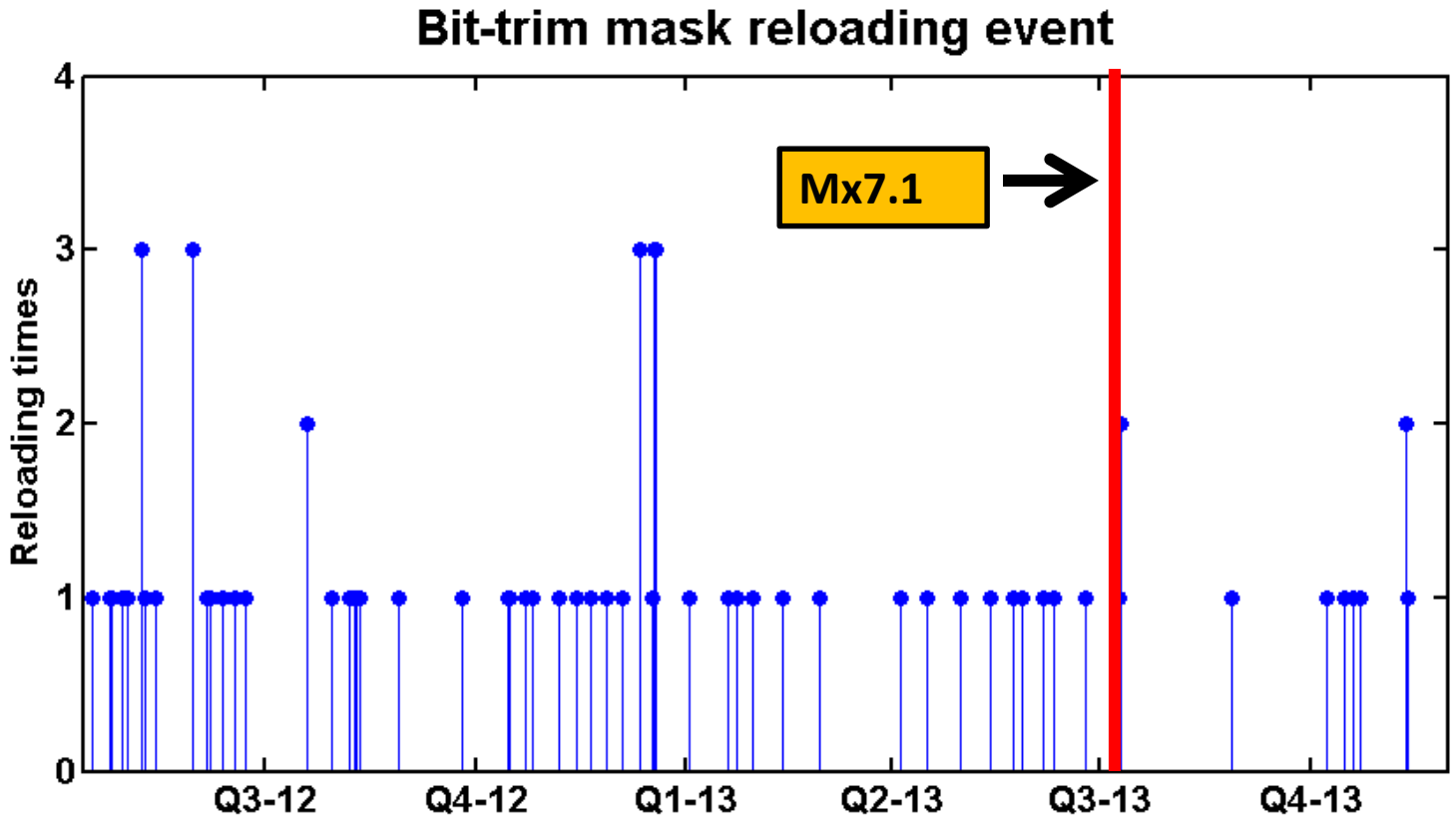




The fix is implemented since Mx8.0 (2013-11-14).

Critical fixes to improve SDR overall quality

DR 4878: Incorrect initial BTM table



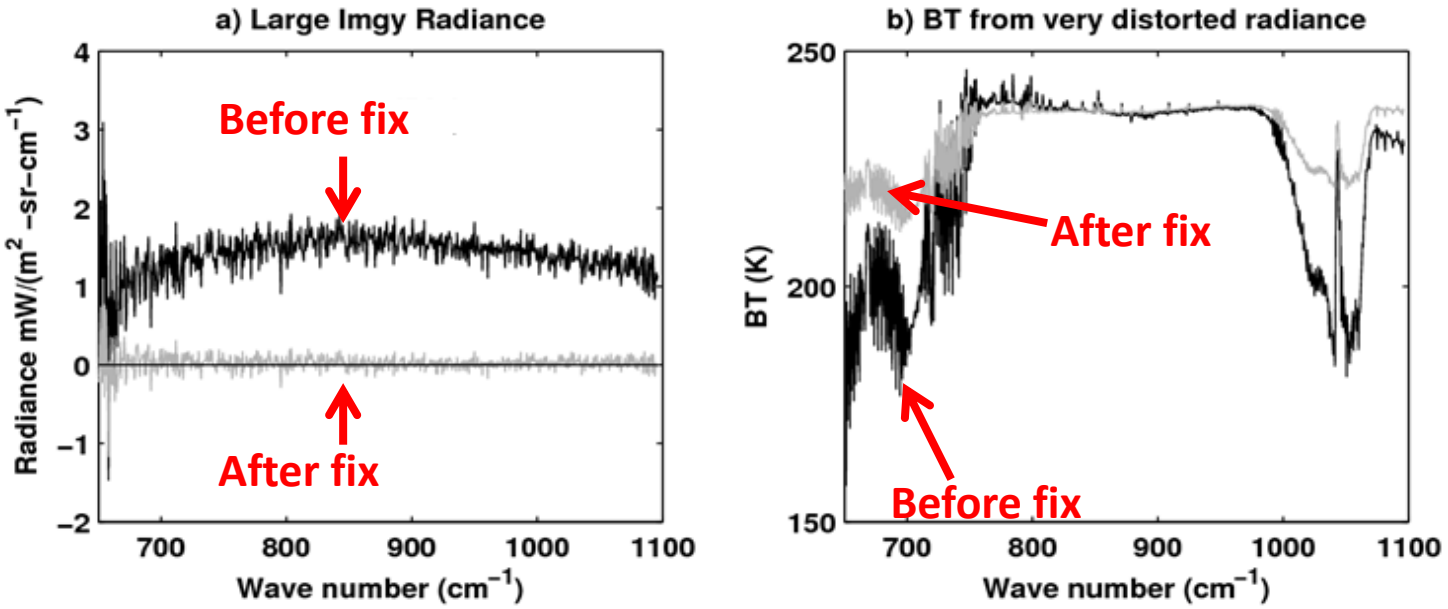
This anomaly is caused by loading an incorrect BTM table every time when the program restarts. It could corrupt up to 8 granules in the initial moving window.

The fix is implemented in Mx7.1 by saving the correct BTM table in CMO file

Critical fixes to improve SDR overall quality

DR 4878: Incorrect initial BTM table

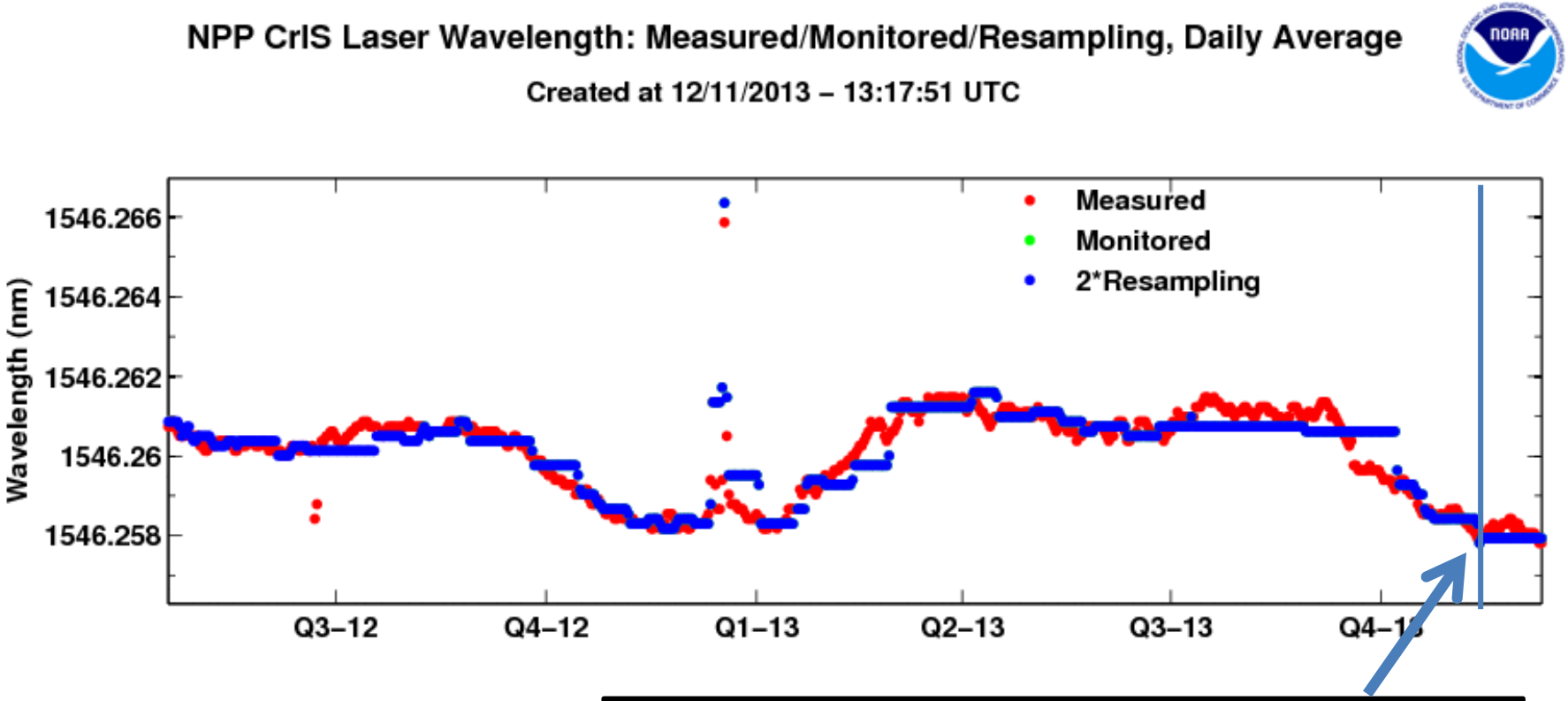
The LW imaginary radiance (left) and brightness temperature (right)



Critical fixes to improve SDR overall quality

DR 7073: missing resampling laser wavelength

The resampling laser wavelength for CMO calculation was missing before Mx8.0



Nov-14-2013 (Mx8.0):
1546.25793 nm is the new reference, saved in CMO file

Conclusions/outlook

1. Reducing processing errors is critical for weather forecast and is very helpful in avoiding artifacts in climate studies.

2. SNPP CrIS SDR product processing quality is significantly improved in the past year by detecting and fixing many code bugs. By implementing the latest version, if the invalid RDR is removed from statistics, more than 99.98% pixels are in good quality, on average.

3. We have fixed all known bugs and verified them with ADL. Most of them are implemented in the operational program and the rest will be implemented in the near future.

4. We have learned a lot of lessons during the debugging. All of these anomaly cases are archived. They will be very useful in developing a comprehensive proxy dataset to test J1 algorithm.