NOAA/STAR S-NPP CrIS Full Spectral Resolution SDR Processing

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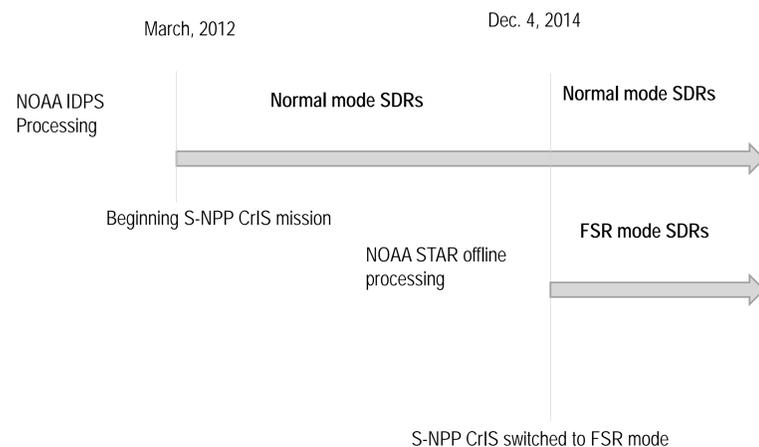
Abstract

The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP) is a Fourier transform spectrometer and provides a total of 1305 channels in normal mode for sounding the atmosphere. CrIS was switched to the full spectral resolution (FSR) mode since December 4, 2014, in which the MWIR and SWIR bands were improved to the same as in the LWIR band, with spectral resolution of 0.625 cm^{-1} for all three bands and the number of total channels is 2211. Based on CrIS Algorithm Development Library (ADL), CrIS full resolution Processing System (CRPS) has been developed to generate the near real-time FSR Sensor Data Record (SDR) at NOAA STAR. These data are delivered to all users with a latency within 12 hours. Use of these data will greatly improve the capability to observe trace gases, gases such as CO_2, CH_4, and CO, using S-NPP and J-1.

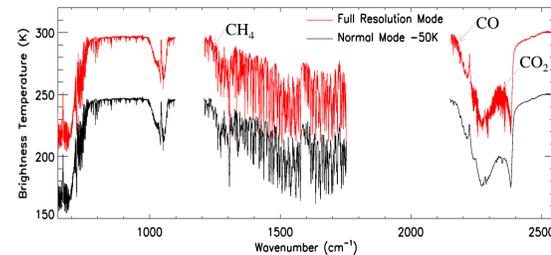## Introduction of CrIS Full Resolution SDR

CrIS instrument provides interferograms & calibration data
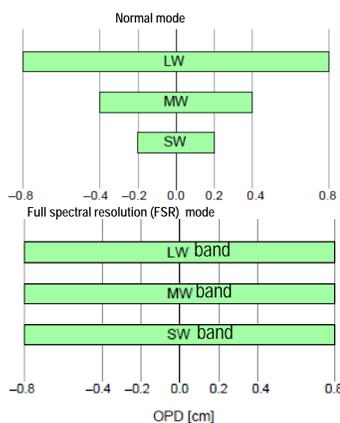
- Ground SDR processing software converts the interferograms to calibrated spectra ;
- Spectral resolution defined as 1/2Max_OPD

March, 2012   Dec. 4, 2014

NOAA IDPS Processing   Normal mode SDRs   Normal mode SDRs

Beginning S-NPP CrIS mission

NOAA STAR offline processing   FSR mode SDRs

S-NPP CrIS switched to FSR mode
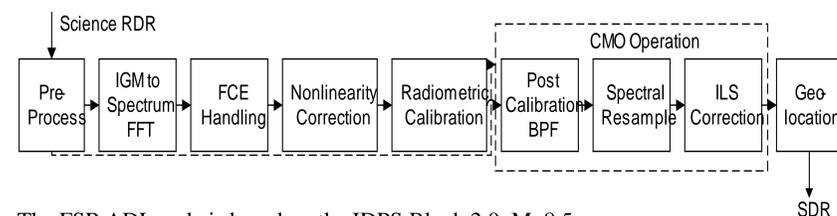
CrIS FSR Spectral Resolution

- An example of CrIS SDR LWIR, MWIR, and SWIR normal and FSR spectra produced by ADL
- CH_4 absorption band (1210 – 1400 cm^{-1}), CO absorption band (2155-2190 cm^{-1}), and CO_2 absorption band (2300-2370 cm^{-1})

Red: Full resolution

Frequency Band	Spectral Range (cm^{-1})	Number of Channel (unapodized channel)	Spectral Resolution (cm^{-1})	Effective MPD (cm)
LWIR	650 to 1095	713* (717)	0.625	0.8
MWIR	1210 to 1750	433* (437)	1.25	0.4
		865* (869)	0.625	0.8
SWIR	2155 to 2550	159* (163)	2.5	0.2
		633* (637)	0.625	0.8

CrIS FSR Processing System (CRPS) Update

Science RDR

Pre Process → IGM to Spectrum FFT → FCE Handling → Nonlinearity Correction → Radiometric Calibration → **CMO Operation** [Post Calibration BPF → Spectral Resample → ILS Correction] → Geo location → SDR

The FSR ADL code is based on the IDPS Block 2.0, Mx8.5

Spectral calibration algorithm changes:
- The resampling matrices now always follow the laser metrology wavelength λ measurements, rather than updated when λ varies by more than 2 ppm;
- The resampling and self-apodization matrix calculation algorithms are modified to reduce spectral ringing artifacts.

NEdN algorithm change:
Spectral calibration (CMO operation) is applied to radiance noise (NEdN) calculation

References

- Han, Y., et al. (2013), Suomi-NPP CrIS measurements, sensor data record algorithm, calibration and validation activities, and record data quality, *J. Geophys. Res. Atmos.,* 118, doi:10.1002/2013JD020344

- Han, Y., Y. Chen, X. Xiong, X. Jin, (2015), S-NPP CRIS Full Spectral Resolution SDR Processing and Data Quality Assessment, AMS 2015 Proceedings

FSR Data Latency and Delivery

- CrIS SDR Algorithm product comprises the radiance, NEdN (noise), geolocation, and data quality flags (Han et al 2013). The FSR SDRs data are available to the public with a data latency of 12 hours on two sites:
  (1) STAR FTP site (refresh in 7 days):
  ftp://ftp2.star.nesdis.noaa.gov/smcd/xxiong/
  (2) GRAVITE (refresh in 34 days): https://gravite.jpss.noaa.gov/ (need a GRAVITE account) (see below to download data)

- File name and data formats are the same as normal resolution data
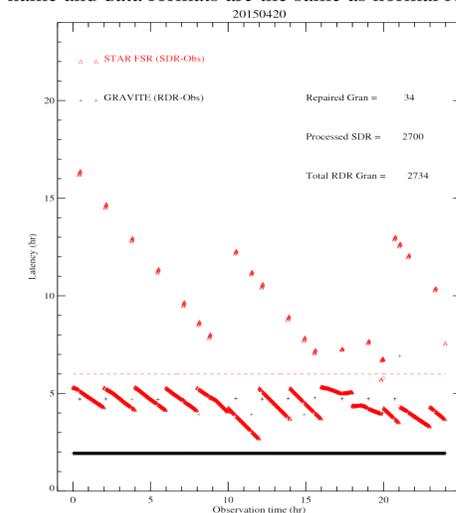
- Black is the latency of the GRAVITE RDR hdf5 files
- Red is the latency including STAR processing time;
- "+ " is the repaired granules from GRAVITE (Black) and STAR FSR (Red);
- The time of data transferred from GRAVITE to STAR is not counted here;
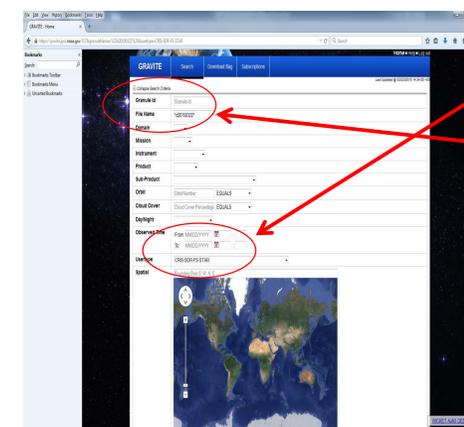
1. Select the user type : "CRIS-SDR-FS-STAR"

2. Input the date in file name, e.g. *d20150321* → for data on March 21, 2015

3. Click "Search", then you can get the list of all granules

Conclusion

- CrIS full resolution Processing System has been developed to process the full resolution SDRs at NOAA STAR in near real time with a latency of 12 hours;
- CrIS FSR data was available since December 4, 2014, and the data is kept the same name and format as normal mode SDR;
- Data is delivered to users via STAR ftp and GRAVITE web sites.

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