VIIRS RDR to SDR Data Processing for Ocean Color EDR

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Abstract

The Visible Infrared Imaging Radiometer Suite (VIIRS) Sensor Data Record (SDR, or Level-1B) need to be reprocessed from the Raw Data Record (RDR, or Level-0) periodically when improved instrument calibration algorithm and look-up tables (LUTs) are available, primarily the F-factors LUTs (F-LUTs) [1]. NOAA ocean color team developed a new way of VIIRS SDR data reprocessing in addition to the original Algorithm Development Library (ADL)-based method. One of the two methods is chosen depending on the nature of the change:

1) Use ADL-based RDR-to-SDR data processing if the calibration update includes SDR algorithm code or other LUTs changes besides F-LUTs;
2) Use an efficient F-factor ratio approach to re-calibrate the existing VIIRS SDR granule HDF5 file for most of the SDR calibration update cases when only the F-LUTs need to be changed. This approach can be implemented into the ocean color data processing system to save computing time and disk space.

The team can reprocess VIIRS SDR data with updated SDR calibration algorithm and in-house generated F-LUTs for global scale and mission-long data efficiently to produce high quality OC Environment Data Record (EDR, or Level-2 data).

RDR-to-SDR Data Processing Based on ADL

Joint Polar Satellite System (JPSS) ADL provides an algorithms platform that can run the operational Interface Data Processing System (IDPS) (or IDPS-compatible) algorithms on Linux system. We built a ADL-based VIIRS RDR-to-SDR data processing system to perform SDR reprocessing (Fig. 1).

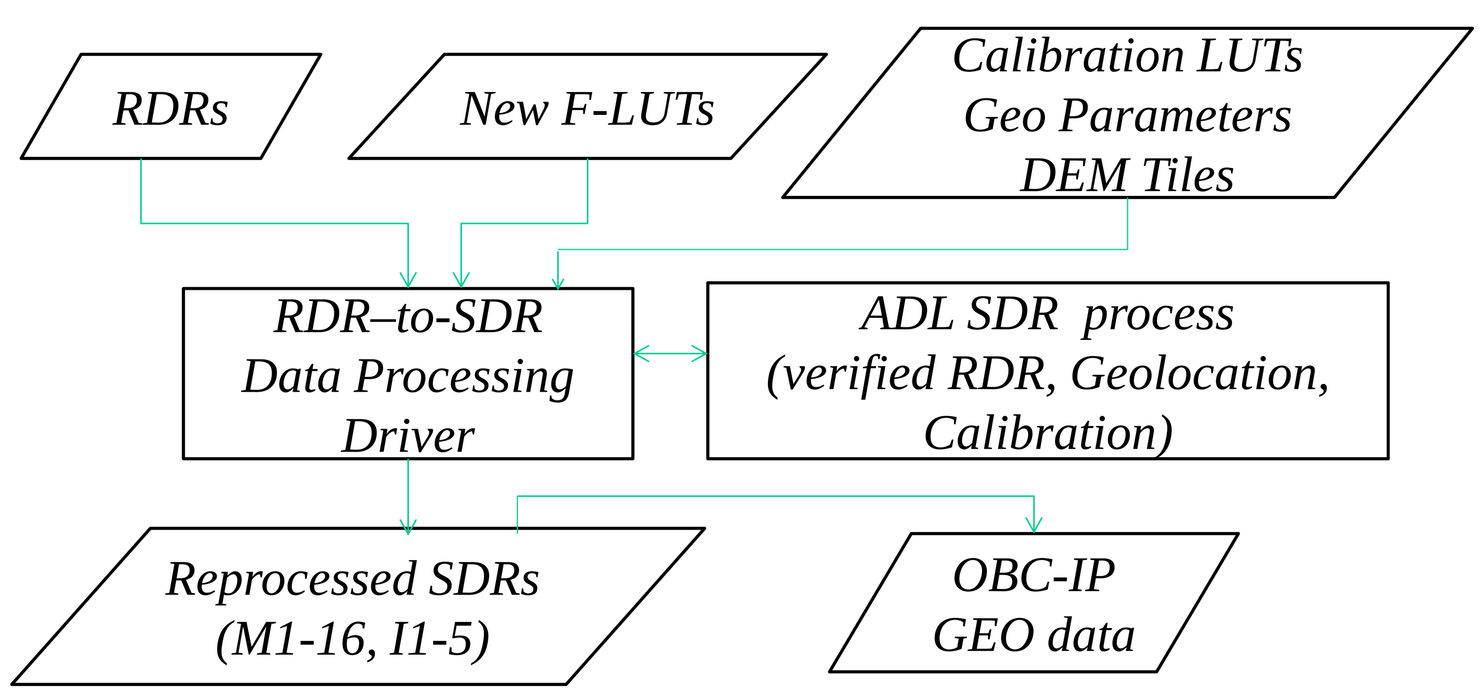

Figure 1. SDR reprocess using ADL-based data processing.

- ➢Designed for producing VIIRS SDR from the raw RDR.
- ➢Driver to search/stage/unpack required input data (such as RDR granule and the adjacent, appropriate USNO-PolarWander ANC, LUT files), allocate computing resource, submit the processing jobs, and run ADL to produce SDR.
- ➢F-LUTs compiling and LUTs metadata generation.
- ➢Allow batch jobs parallel-executions on multi-processors, and automatically allocating available servers and distributing daily processing tasks to multiple server nodes in the cluster, to achieve high performance.
- ➢Currently configured to run ADL4.1_Mx7.2 (or prior-versions. Will adapt to ADL4.2_Mx8.x).
- ➢Support in-house VIIRS SDR calibration algorithms code change and LUTs update testing runs at different scales for VIIRS OCC EDR.

VIIRS SDR Data Processing Using F-factor Ratio

However, the disadvantage of the ADL-based SDR data processing is that it requires tremendous computational power and storage space. To bypass the resource-intensive RDR to SDR data processing, we can use the new developed "F-factor ratio approach", which is based on the linear relationship between the SDR radiance/reflectance and the F-factors, to apply for the most common SDR calibration update cases, e.g., F-LUT changes [2]. Figure 2 shows the VIIRS SDR data processing using F-factor approach.

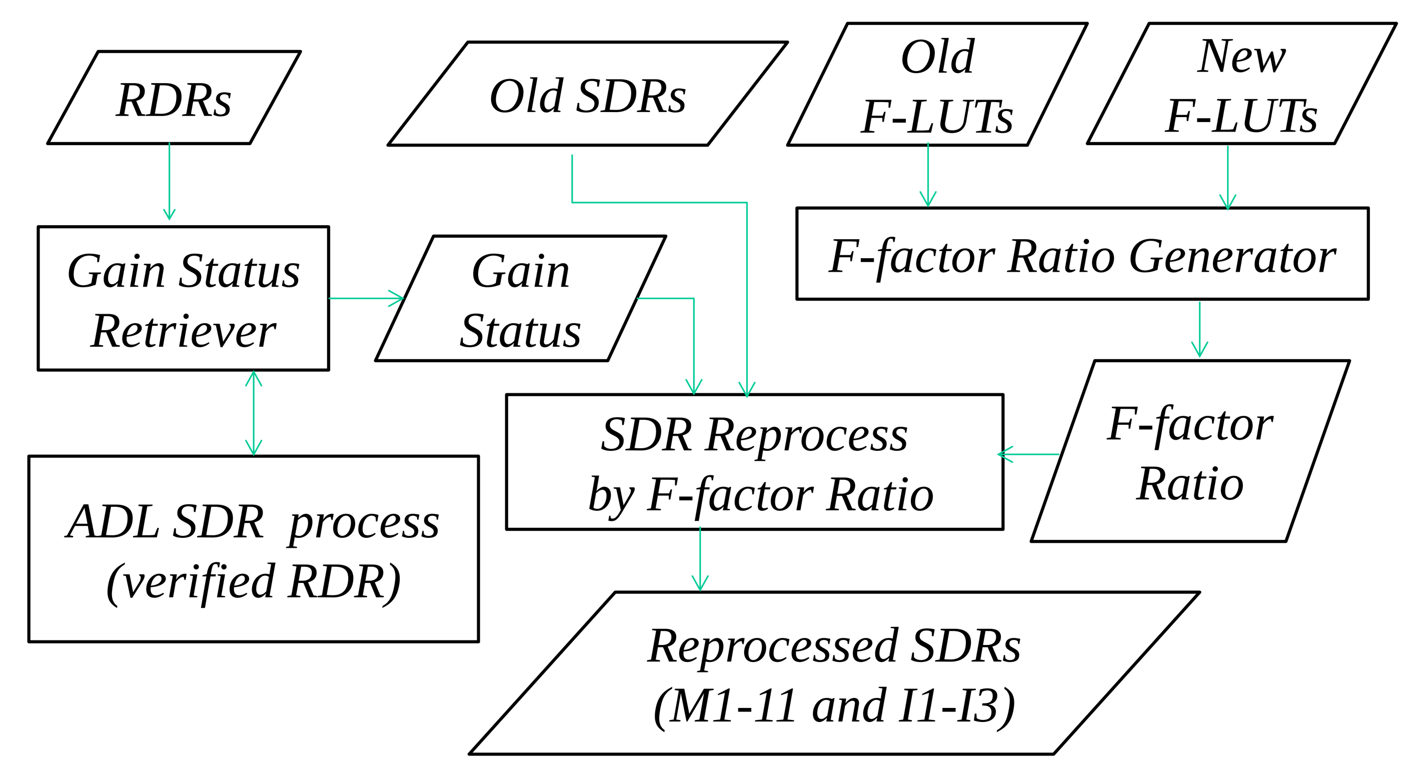

Figure 2. SDR reprocess using the F-factor ratio approach.

- ➢Calculate the F-factor ratio from the old and new F-factor LUTs for the old SDR to be re-calibrated and the new F-LUTs.
- ➢Generate the new SDR (M1-M7) by replacing the values of the EV radiance and reflectance inside the old SDR HDF5 file with the new values modified by the F-factor ratio. Change the input F-LUT file name in the metadata to the new F-LUT file name.
- ➢All other data (e.g., GEO, etc.) do not need to be regenerated.
- ➢The F-factor ratio approach provides the same accuracy and quality of the SDR data as from the ADL-based RDR to SDR process (Fig. 3) [2].
- ➢The F-factor ratio approach requires much less computation time (~100 times less than that using the ADL approach. See Table 3) and storage .
- ➢The F-factor ratio approach can also be directly implemented into the ocean color EDR data processing system to bypass the production of the new SDR files.

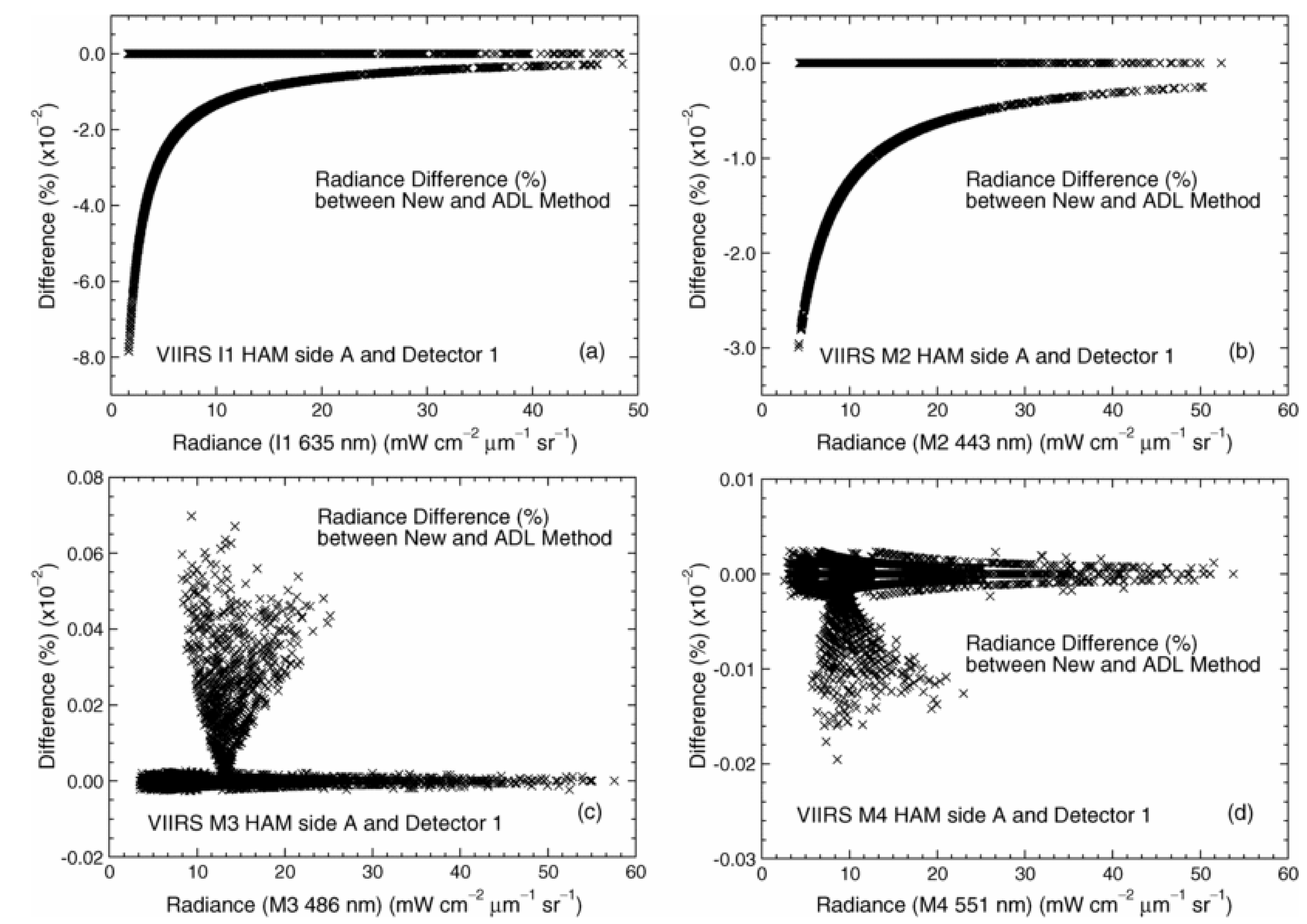

Figure 3. Radiance difference (%) as a function of radiance value between using the new F-factor ratio approach and the ADL-based data processing for producing VIIRS SDR data for (a) band I1 (635 nm), (b) band M2 (443 nm), (c) band M3 (486 nm), and (d) band M4 (551 nm). Results were derived from a VIIRS granule acquired on January 30, 2012.

Table 3. Comparison of CPU usage (in seconds) for SDR data processing using the ADL and F-factor ratio approaches.

Method	RDR to SDR using ADL			F-factor Ratio Approach			Ratio of two approaches		
# Gran.	1	10	100	1	10	100	1	10	10
System	27.66	282.18	2852.78	0.70	8.79	75.60	39.51	32.10	37.74
User	338.09	3222.75	32030.60	2.66	29.17	279.35	127.10	110.48	114.66
Total	365.75	3504.93	34883.38	3.36	37.96	354.95	108.85	92.33	98.28

Summery

The VIIRS solar reflective bands SDR performance relies on-orbit radiometric calibrations which is maintained by F-factor LUTs. They need to be reprocessed periodically with calibration updates, primarily due to F-factor LUTs changes. This presentation has described the NOAA VIIRS Ocean Color team's capability of reprocessing the VIIRS SDR in two different ways, the VIIRS RDR-to-SDR data processing tool and the newly developed F-factor ratio approach [2]. We discussed these two approaches in detail, including their suited conditions of SDR calibration update, inputs and outputs, and their computational efficiency.

References

[1] M. Wang, X. Liu, L. Tan, L. Jiang, S. Son, W. Shi, K. Rausch, and K. Voss, "Impact of VIIRS SDR performance on ocean color products," *J. Geophys. Res. Atmos.*, vol. 118, pp. 10347–10360, doi:10.1002/jgrd.50793, 2013.

[2] J. Sun, M. Wang, L. Tan, and L. Jiang, "An efficient approach for VIIRS RDR to SDR data processing," *IEEE Geosci. Remote Sens. Lett.*, vol. 11, pp. 2037–2041, 2014.