SNPP VIIRS Climate Raw Data Record Production Software Development

Task Leader	Jim Biard
Task Code	NC-CDR-02-NCICS-JB
Main CICS Research Topic	Climate Data and Information Records and Scientific Data Stewardship
Percent contribution to CICS Themes	Theme 1:100%
Percent contribution to NOAA Goals	Goal 5:100%

Highlight: Development of the VIIRS Climate Raw Data Record production software entered the testing phase.

BACKGROUND

The Climate Raw Data Record (C-RDR) Project is a part of the Climate Data Record Program. The C-RDR Project is responsible for developing a system to acquire, reformat, and enhance the Suomi National Polar-orbiting Partnership (NPP) Raw Data Records (RDRs) and support data to facilitate the production of Climate Data Records (CDRs).

CDRs are fully-calibrated, long-term time series of climate variables that have the consistency and continuity required for the climate research community. The production of CDRs requires the reprocessing of extensive data sets as algorithms are improved and the sensor performance is better understood. To produce CDRs**,** the raw data are required as input for each iteration of the reprocessing.

The goal of the C-RDR system is to provide the Suomi-NPP raw data and supporting data in a format that is enhanced for utilization in research, the production of CDRs, and long term stewardship. There will be a C-RDR for each science instrument on the Suomi-NPP satellite. The C-RDRs contain the raw measurements from the RDRs, decoded and decompressed so they are easily accessible. Each C-RDR file also contains extensive provenance, discovery, and usage metadata. The C-RDR files use the established, platform-independent, community standard netCDF-4 data format.

The C-RDR system will produce C-RDRs from NPP RDRs on an operational basis for the life of the NPP mission. The C-RDR files will be archived and made available to the user community.

The C-RDR for the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument was the first one chosen for development.

ACCOMPLISHMENTS

During the last year I completed the coding of the application that produces C-RDR files from VIIRS RDR files. I also completed the coding of three applications that will be used in verifying the correctness of the VIIRS C-RDR files.

The primary application for VIIRS C-RDR production is the VIIRS C-RDR packer application. This application is built on the Joint Polar Satellite System (JPSS) Application Development Library (ADL). ADL is a port of the Interface Data Processing Segment (IDPS) software that is used for the operational processing of the data streams from the Suomi-NPP satellite. It allows an individual to run any of the applications that run in the real-time IDPS system in a standalone fashion, and to develop new applications that will run in the full IDPS environment. ADL provides me, as a developer, with all of the data structures and I/O functions that are needed to interact with the Suomi-NPP input and output data products. The VIIRS C-RDR packer differs from a standard ADL application in that it is generating a netCDF-4 file as its output, which is not a feature provided by ADL.

Figure 1 depicts the transformations to data which occur when generating a VIIRS C-RDR file using ADL and the VIIRS C-RDR packer application. The input to the process is a Hierarchical Data File 5 (HDF5) format file obtained from the NOAA Comprehensive Large Array Storage System (CLASS), which is the archive and dissemination system being used by the Suomi-NPP project for all IDPS data products. A VIIRS HDF5 RDR file contains up to four VIIRS Science RDR granules and up to nineteen Spacecraft Diary RDR granules. Each granule contains a group of CCSDS downlink data packets that contain raw measurements for that granule's type and collection period. Each HDF5 RDR file also contains metadata that specify details - such as the acquisition time range - for each granule. An ADL-provided HDF5 unpacker application is used to extract the RDR granules and metadata and store them as separate files. There is one metadata file for each RDR granule file. The RDR granule files are "binary blob" files, meaning that their internal structure does not conform to any standard file format (such as HDF5 or netCDF-4).

Once the RDR granules and associated metadata have been extracted from the HDF5 file obtained from CLASS, the VIIRS C-RDR packer application ingests these files, organizes the data into collections of individual raw measurements, and writes these raw measurements to a netCDF-4 C-RDR file as variables. Granule-level and file-level metadata is written to the C-RDR file as file-level attributes, and measurement-level metadata extracted from Suomi-NPP project documentation is written to the C-RDR file as variable-level attributes.

Once a C-RDR file has been produced, the operational C-RDR processing system will then verify its correctness. Verification is accomplished by "unpacking" the contents of the C-RDR file and producing binary-blob intermediate data product files normally generated by the IDPS during VIIRS data processing. These intermediate files, known as VIIRS Verified RDR (VRDR) files, are the inputs used by the IDPS for generating all higher-

level VIIRS data products. If the VRDR files produced from a C-RDR file match the VRDR files generated by the ADL software from the same group of RDR files used to produce the C-RDR file, then the C-RDR file is considered to be verified.

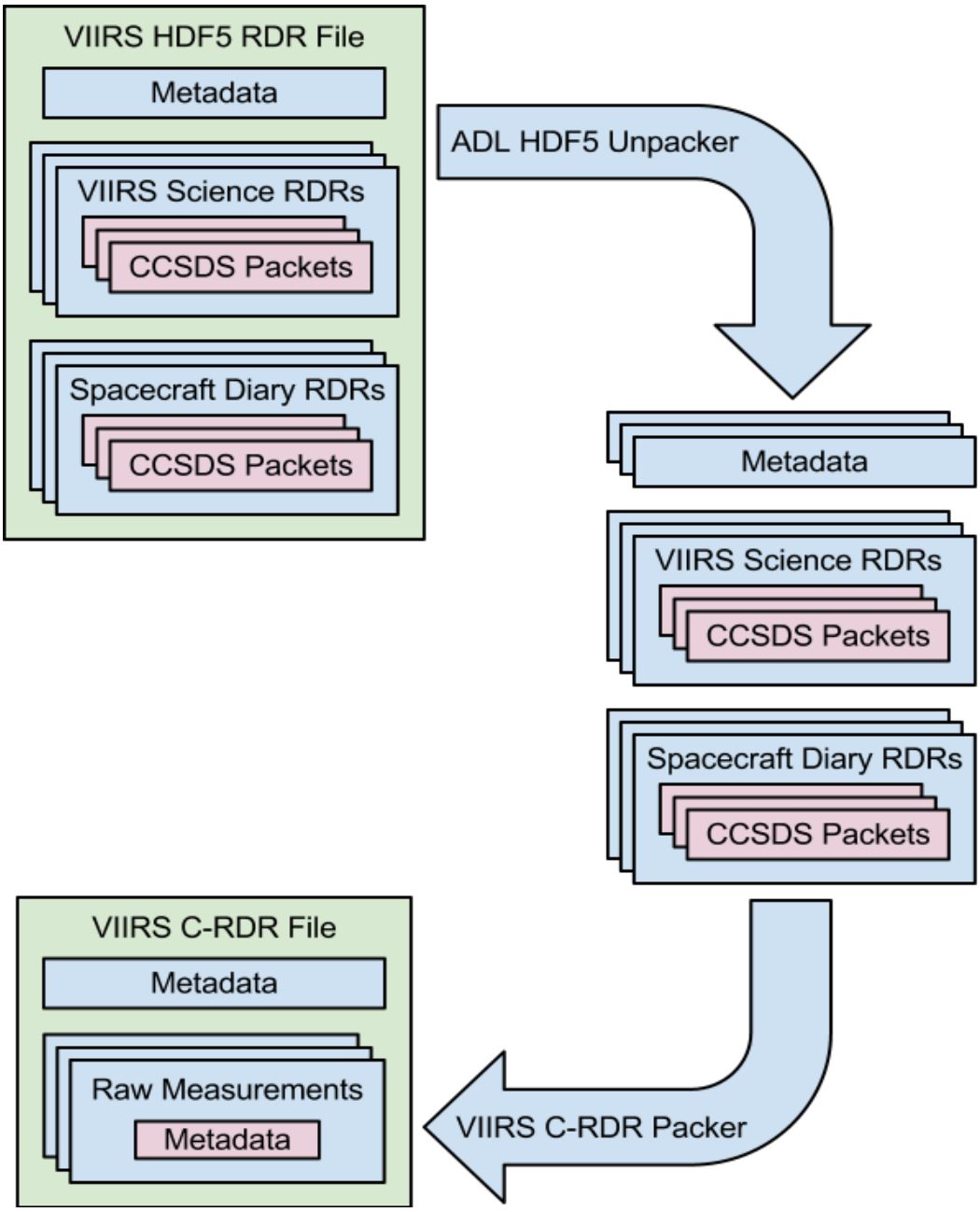

Figure 1: Flow of Data from a VIIRS HDF5 RDR file to a VIIRS C-RDR file.

The VIIRS C-RDR Unpacker application, which is built on ADL just as the VIIRS C-RDR Packer application is, reads in the contents of a VIIRS C-RDR file and writes out binary-

blob VIIRS VRDR files, binary-blob Spacecraft Diary RDR files, and the ASCII metadata files that accompany each VIIRS VRDR and Spacecraft Diary RDR file.

There are three parts to the verification process. The VRDR files produced by the VIIRS C-RDR Unpacker must be compared with VRDR files that were produced as a byproduct when the VIIRS C-RDR Packer was run, the Spacecraft Diary RDR files produced by the VIIRS C-RDR Packer must be compared with the Spacecraft Diary RDR files that were used as inputs when the VIIRS C-RDR Packer was run, and the ASCII metadata files produced by the VIIRS C-RDR Unpacker must be compared with the those associated with the corresponding "original" RDR files.

Comparing the different types of files is handled by three different applications. The VIIRS VRDR Comparator application (developed by Linda Copley), the Spacecraft Diary RDR Comparator application, and the ASCII Metadata Comparator application. Once a VIIRS C-RDR file has been produced, it will be used as input to the VIIRS C-RDR Unpacker. These three applications will then be run, and the results of the comparisons will used to determine whether or not the VIIRS C-RDR file is considered verified.

Coding of all of the applications described above was completed during this fiscal year. Operational testing has begun using several previous months of VIIRS RDR files. There are currently only two open issues, neither of which should prevent a transition to operations in the first quarter of FY 2013.

Performance Metrics	FY12
# of new or improved products developed	1
# of products or techniques transitioned from research to ops	0
# of peer reviewed papers	0
# of non-peered reviewed papers	0
# of invited presentations	0
# of graduate students supported by a CICS task	0
# of undergraduate students supported by a CICS task	0

PLANNED WORK

* Complete the operational testing of VIIRS C-RDR production applications.
* Transition to VIIRS C-RDR operational production.

* Automate the handling of support data files for VIIRS C-RDRs. This is currently a manual process.

PUBLICATIONS
N/A

PRESENTATIONS
- Biard J. (2012). Using ADL for NPP Climate Raw Data Record Production. Oral presentation at the JPSS Data Products Engineering (DPE) Algorithm Development Library (ADL) 4.0/4.1 User Workshop. Lanham, MD. 14-15 November 2012.
- Biard J., Copley L., Baldwin D., Saunders D., and Privette J.L. (2013). The VIIRS Climate Raw Data Record: An Easy-to-use Raw Data Set (Level 1b) for the Suomi-NPP Visible Infrared Imaging Radiometer Suite. Oral presentation at the *American Meteorological Society* (AMS) annual meeting. Austin, TX. 6-10 January 2013.
- Biard, J., Dissen, J. (2013), Climate Science and Climate Change Overview, Presentation to the 8th Grade Academically and Intellectually Gifted (AIG) class at Asheville Middle School, Asheville, NC, 7 February 2013.

OTHER ACTIVITIES
- Provided support for the development and verification of Climate Data Record (CDR) metadata for the NCDC CDR Program Office.
- Provided support for the development of NCDC metadata standards with the NCDC Metadata Working Group (NMWG).
- Provided support for the design of the NOAA Comprehensive Large Array Storage System (CLASS) common ingest interface that is currently under development.
- Supporting Pierre Guillevic in the VIIRS LST Cal/Val work.
- Supporting Jenny Dissen's K-12 outreach efforts.