Testing, Troubleshooting and Integrating Changes to Joint Polar Satellite Systems (JPSS) Algorithms using Algorithm Development Library (ADL)

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Abstract

Joint Polar Satellite System 1 (J1) is the next generation spacecraft that is planned to be launched in 2017. This will carry the advanced versions of the instruments that are on board of Suomi National Polar-orbiting Partnership (S-NPP) satellite. S-NPP was launched on October 29, 2011. Currently the Raw Data Records (RDRs) from S-NPP instruments are processed in the operational system Interface Data Processing Segment (IDPS) developed by Raytheon and the same system will be used to process data from J1. ADL is the test system that mimics IDPS and is used for testing, troubleshooting and integrating algorithm updates. We, the STAR Algorithm Integration Team (AIT) members use ADL for science code transition to operations. In this poster we discuss the eight step process that we use for testing and troubleshooting the algorithms in ADL and the four-step quality check method that we use to verify the test results and check for the algorithm accuracy and product accuracy before we submit the change request package to Data Products Engineering Services (DPES). A few examples are discussed.

Algorithms and Products

The following instruments are currently on board S-NPP:
- Advanced Technology Microwave Sounder (ATMS)
- Cross-track Infrared Sounder (CrIS)
- Visible/Infrared Imager Radiometer Suite (VIIRS)
- Ozone Mapping and Profiler Suite (OMPS)
- Clouds and the Earth's Radiant Energy System (CERES)

J1 will carry the advanced versions of the above instruments and follow the same data processing flow as S-NPP. The algorithms include Sensor Data Record (SDR) algorithms, Environmental Data Record (EDR) algorithms and Intermediate Product (IP) algorithms. While CERES data is processed at NASA Langley, the data from other 4 instruments are processed in IDPS. These algorithms are used to generate various atmospheric, land and ocean products. AIT has integrated changes for sounding algorithms, ozone algorithms, cloud mask algorithm, aerosol algorithm, cryosphere algorithms and various land products algorithms. We will discuss two examples, one for CrIS SDR sounding algorithm and one for VIIRS Aerosol EDR algorithm.

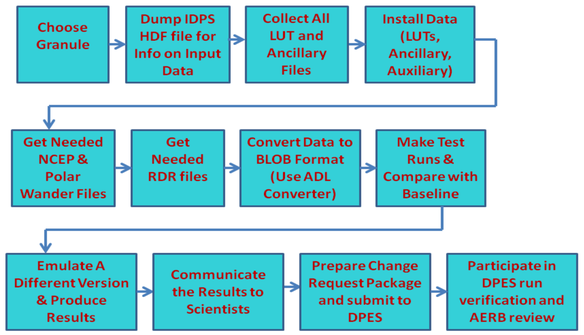
ADL Framework

- ADL is the Test System - Developed by Raytheon
- ADL mimics IDPS system
- ADL provides a Diagnostic Framework
- ADL provides one system to implement and test all the algorithms
- ADL uses an I-P-O Model (Input-Processing-Output)
- ADL provides support for HDF5 aggregation and packaging of IDPS products
- ADL provides chain running capabilities

Testing and Troubleshooting Steps

- **Step 1:** Get ADL Version from Raytheon Configuration Management (CM) system
- **Step 2:** Put these versions in STAR AIT Common CM system giving this a distinct name to differentiate from other baselines
- **Step3:** Create a Test Stream out of the above Main Integration Streams
- **Step 4:** Work with the Test Stream creating Future Emulation Scenarios
- **Step 5:** Commit these changes to CM so that other developers can use and test the algorithms in their emulation scenario.
- **Step 6:** Find out the Golden Day (special days for specific events) of interest from the science team member
- **Step 7:** Organize all the needed input files for this test date
- **Step 8:** Build ADL and Run the Executables to generate Product Data

Integration Steps



Quality Check Steps

- ADL Version Check through Configuration Management (CM)
- Science Check
- Document Check: Algorithm Theoretical Basis Document (ATBD), Operational Algorithm Description Document (OAD), Review Documents etc.
- Algorithm Package Check

References

Wang, L., D. A. Tremblay, Y. Han, M. Esplin, D. E. Hagan, J. Predina, L. Suwinski, X. Jin, and Y. Chen (2013), Geolocation assessment for CrIS sensor data records, J. Geophys. Res. Atmos.,118 , 12,690–12,704, doi:10.1002/2013JD020376.

Jackson, J. M., H. Liu, I. Laszlo, S. Kondragunta, L. A. Remer, J. Huang, and H.-C. Huang (2013), Suomi-NPP VIIRS aerosol algorithms and data products, J. Geophys. Res. Atmos.,118, 12,673–12,689, doi:10.1002/2013JD020449.

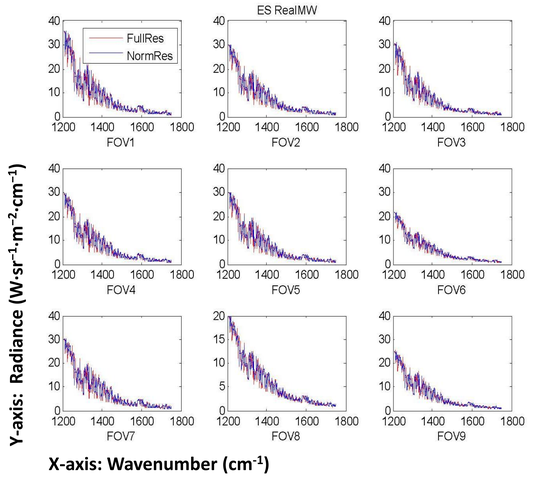
Results and Discussion: CrIS SDR Example

ADL is an effective tool for analyzing changes in the science algorithms, whether we're improving the algorithm science or correcting and tweaking the existing software. The CrIS SDR algorithm is currently being enhanced to support the reading of full resolution J1 RDR data and produce a full resolution SDR. Both the short-wave infrared (SWIIR) and mid-wave infrared (MWIR) bands will have additional channels whereas the long-wave infrared channels will be unchanged and the new algorithm will read and process the data. The STAR Algorithm Integration Team (AIT) conducted tests in the ADL framework and provided results to the science team for evaluation.

S-NPP and J1 Spectral Characteristics

Band	Instrument	IFGM number of bins	User Grid Range (cm^{-1})	Spectral Resolution (cm^{-1})	Maximum Optical Path Difference (cm)	Number of SDR Channels
LWIR	S-NPP	866	650-1095	0.625	0.8	713
	J1	866		0.625	0.8	713
MWIR	S-NPP	530	1210 - 1750	1.25	0.4	433
	J1	1052		0.625	0.8	865
SWIR	S-NPP	202	2155-2550	2.5	0.2	159
	J1	799		0.625	0.8	633

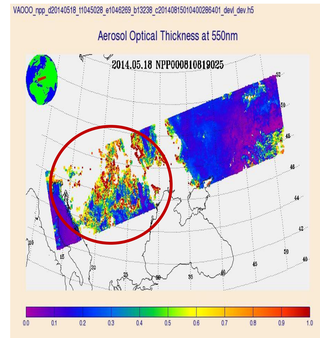
CrIS SDR Evaluation: Full Resolution versus Normal Resolution

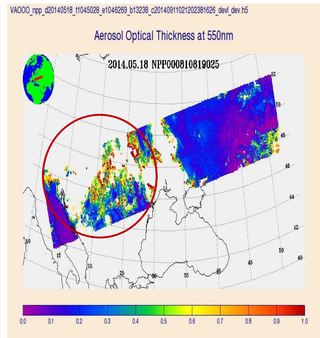


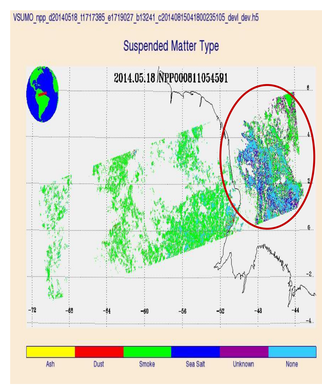
Results and Discussion: Aerosol EDR Example

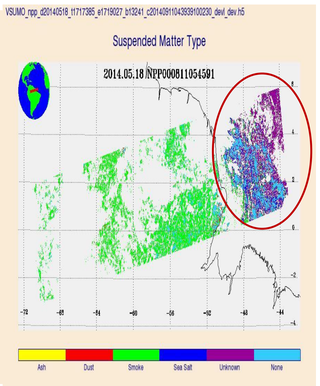
We conducted tests for Aerosol EDR using a new internal snow test and spatial filter homogeneity test. In addition to code changes, new processing coefficients (threshold values used in the new snow and homogeneity tests) are added to the Processing Coefficient Table. Also, a new Quality Flag (Homogeneity Test Quality Flag) was added to the aerosol products.

Below are examples of Aerosol Optical Thickness (AOT) at 550 nm and Suspended Matter Type with and without this test for May 18, 2014.









MX8.4 Baseline

MX8.4 Baseline with Code & LUT Updates

Conclusions

- ADL can be used as an effective tool in algorithm testing and integration for J1 algorithms.
- Following a step by step testing and integration process minimizes the risks associated with the science transition to operations.
- Quality check methods help in catching oversights and better understanding of the algorithms and products.

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