



Integrating JPSS Algorithms with Efficiency and Ease: STAR Algorithm Integration Team (AIT)



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About STAR AIT

STAR AIT provides expertise and support in effective integration of science algorithms for Sensor Data Records (SDRs), Environmental Data Records (EDRs), and Intermediate Products (IPs) into operational systems to meet JPSS Science mission goals. AIT assists in:

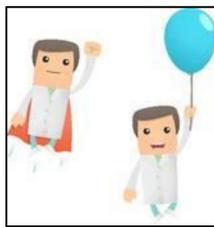
- Integration of new or updated algorithm and Look up Tables (LUTs) in ADL (Algorithm Development Library) framework.
- Emulation of various operational testing scenarios
- Development of SDR and EDR algorithms associated common software utilities and libraries
- Providing support for SDR and EDR algorithm associated documentation
- Facilitation of communication between scientists and JPSS Ground Project Data Products Engineering (DPE) Team
- Submission of algorithm change packages with regard to Discrepancy Reports (DRs)
- Analysis of test results for scientific comparison

Main Task - Science to Operations

The operational system for JPSS is the Interface Data Processing Segment (IDPS). The AIT facilitates the transition of science algorithms into operational code that is then integrated into the IDPS system and is used in processing of satellite data. This involves integration of new algorithms and updates to existing algorithms through change request process.

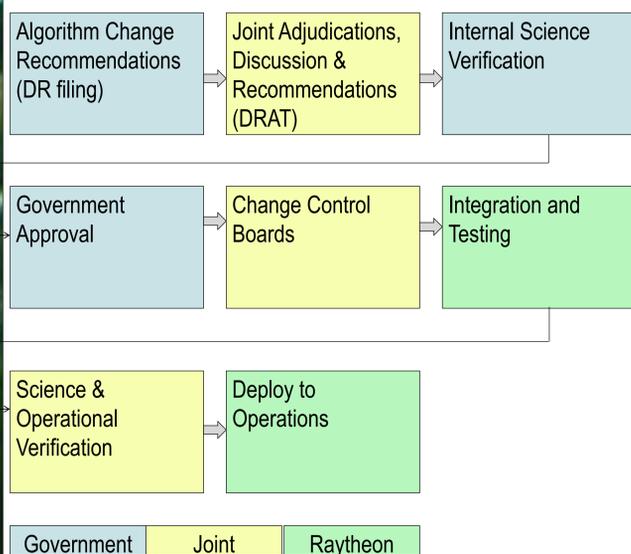
Algorithm Changes:

- When new knowledge is available
- When a mistake is found
- A new hypothesis is tested
- Cal/val process needs verification
- Algorithm changes should be smooth, flawless and timely



Algorithm Doctors

Algorithm changes are suggested by the Science Teams. The suggestions are recorded through a Discrepancy Report (DR) filing system. The DR goes through review and the recommendations are jointly discussed through Discrepancy Report Algorithm Team (DRAT). It goes through internal science verification review. A formal change request is filed and then verified through various testing. The change control board reviews the information and recommends for IDPS testing and verification. STAR AIT is involved in every step except the processes in Green that are specific for Raytheon.



Algorithm Integration using ADL Framework

The Algorithm Development Library (ADL) is a programming environment maintained by DPE. It emulates the programming interfaces available within the JPSS operational system.

Why use ADL?

- ADL mimics operational system IDPS
- ADL provides a diagnostic framework
- ADL is recommended by DPE

STAR AIT Support in Algorithm Integration Activities

Algorithm	Discrepancy Reports (DRs)	AIT Support
CrIMSS EDR	Seven Discrepancy Reports (DRs) 4922, 4926, 4942, 4943, 4945, 4946, 4958 with code updates and two LUT updates for correcting channel indexing errors and for greater yield and performance	Integrated code and LUT updates in ADL; Tested and emulated different IDPS versions; Delivered ACP; Followed up with various functional tests and reviews.
VIIRS EDR – Land Surface Albedo	DR 4704 - Update VIIRS-LSA-BPSA-LUT and corresponding code changes	Performed tests and troubleshooting in ADL; Delivered ACP; Followed up with tests and reviews.
VIIRS EDR – Active Fire Team	DR 5029 - Filter out false fire counts	Performed ADL tests and troubleshooting

Other Algorithms – Testing and Analysis Experience

JPSS instruments include:

- Visible Infrared Imager/Radiometer Suite (VIIRS)
- Cross-track Infrared Sounder (CrIS)
- Advanced Technology Microwave Sounder (ATMS)
- Ozone Mapping and Profiler Suite (OMPS)
- Cloud and Earth Radiant Energy System (CERES)

The above instruments are currently aboard S-NPP. STAR AIT has tested several SDR and EDR algorithms currently in use for data products involving these instruments. STAR AIT has developed software using Fortran, IDL, Perl, Shell Scripts etc. to read LUTs, analyze outputs and compare results between various IDPS emulations. Examples of these activities include:

- Developing the geolocation file converter for the land surface team
- Integrating VIIRS Cloud Mask Algorithm in ADL
- Exploring different pathways of OMPS Total Column EDR production and the effects
- Troubleshooting, testing and verifying VIIRS Imagery Algorithms
- Integrating capabilities to include GMASI Ancillary Data in Cryosphere Algorithm
- Troubleshooting and testing VIIRS Sea Surface Temperature (SST) Algorithm

Main Integration Steps in ADL Framework

- ADL Version Calibration
- Testing
- Analysis

Detailed Procedure

- Install and Build ADL
- Gather Input: Ancillary, LUTs, RDRs
- Emulate different IDPS versions
- Analyze the effect of new IDPS versions
- Compare with IDPS results
- Communicate with scientists to verify the results
- Create change submission documents
- Follow change submission procedure to deliver change request package
- Verify regression tests, functional tests, spot checking, integration tests

CrIMSS Algorithm Integration – An Example

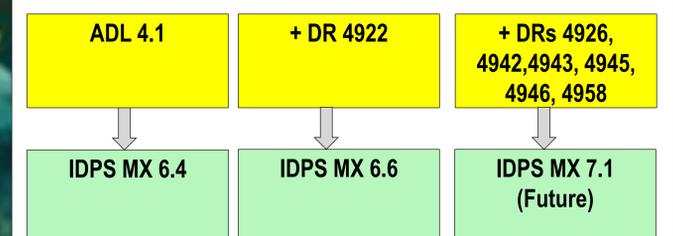
CrIMSS - The Cross-track Infrared and Microwave Sounder Suite
CrIMSS = Advanced Technology Microwave Sounder (ATMS) + Cross-track Infrared Sounder (CrIS) instruments

EDR Products:

- Global atmospheric vertical temperature (AVTP)
- Global atmospheric moisture profile (AVMP)
- Global vertical pressure profiles (AVPP)
- Intermediate Product from CrIS Radiances

Issues Resolved in 7 DRs

- DR 4922:** Incorrect Channel Indexing for Ozone and Non-LTE Channels
- DR 4926:** Fix handling of forward model errors
- DR4942:** Code modification for tighter clear scene detection
- DR 4943:** Upgrade to sensor and forward model noise LUTs
- DR4945:** Modify surface air temperature constraint over daytime land
- DR4946:** Optimize the climatology LUT
- DR4958:** Optimize CrIMSS EDR Quality Control (QC) thresholds



Results: Increase in Yield and Performance

IDPS MX 6.4 Yield

Categories	QC(1)	QC(4)	QC(5)	QC(1) & QC(4)
All Profiles	54.15	28.71	81.70	19.16
Clear	55.60	18.52	77.55	11.37
Partly Cloudy	51.13	37.57	84.97	25.12
Cloudy	58.40	30.41	83.27	22.59
Day	30.94	30.79	82.13	11.86
Night	75.73	26.78	81.30	25.95

IDPS MX 6.6 Yield

Categories	QC(1)	QC(4)	QC(5)	QC(1) & QC(4)
All Profiles	75.17	28.67	81.68	27.65
Clear	73.44	17.76	76.40	17.36
Partly Cloudy	73.38	37.34	84.96	35.57
Cloudy	82.59	30.69	84.70	30.15
Day	74.68	30.70	82.19	29.47
Night	75.62	26.78	81.89	25.95

In the above tables 47400 profiles are analyzed for February 5th, 2013

CrIMSS EDR Team has compared the results with ECMWF and has reported enhancement in performance in all the products, temperature, moisture and surface pressure.

Risk Reduction

The STAR AIT is by nature designed to mitigate risk in transitioning algorithms from research to operations.

Abbreviations

ACP: Algorithm Change Package
 CLASS: Comprehensive Large Array-data Stewardship System
 GMASI: NOAA Global Multisensor Automated Snow/Ice Map
 GRAVITE: Government Resource for Algorithm Verification, Independent Testing, and Evaluation
 NCEP: National Centers for Environmental Prediction
 RDR: Raw Data Record
 S-NPP: Suomi National Polar-orbiting Partnership