

IDPS Readiness for VIIRS

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*STAR JPSS Annual Science Team
Meeting
NCWCP, College Park, MD
August 26, 2015*

RAYTHEON COMPANY
INTELLIGENCE, INFORMATION AND SERVICES (IIS)
JPSS CGS PROGRAM
AURORA, COLORADO

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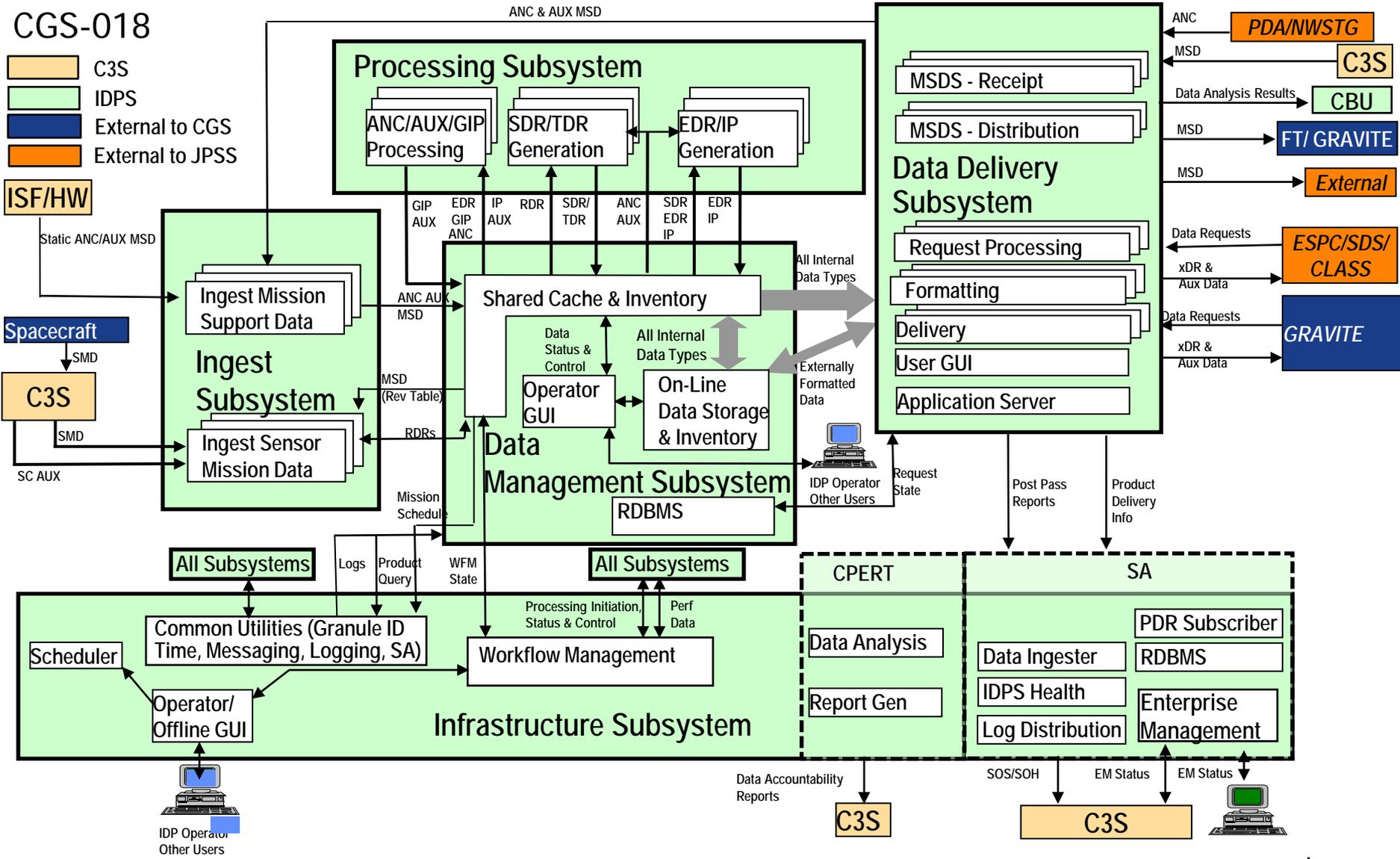
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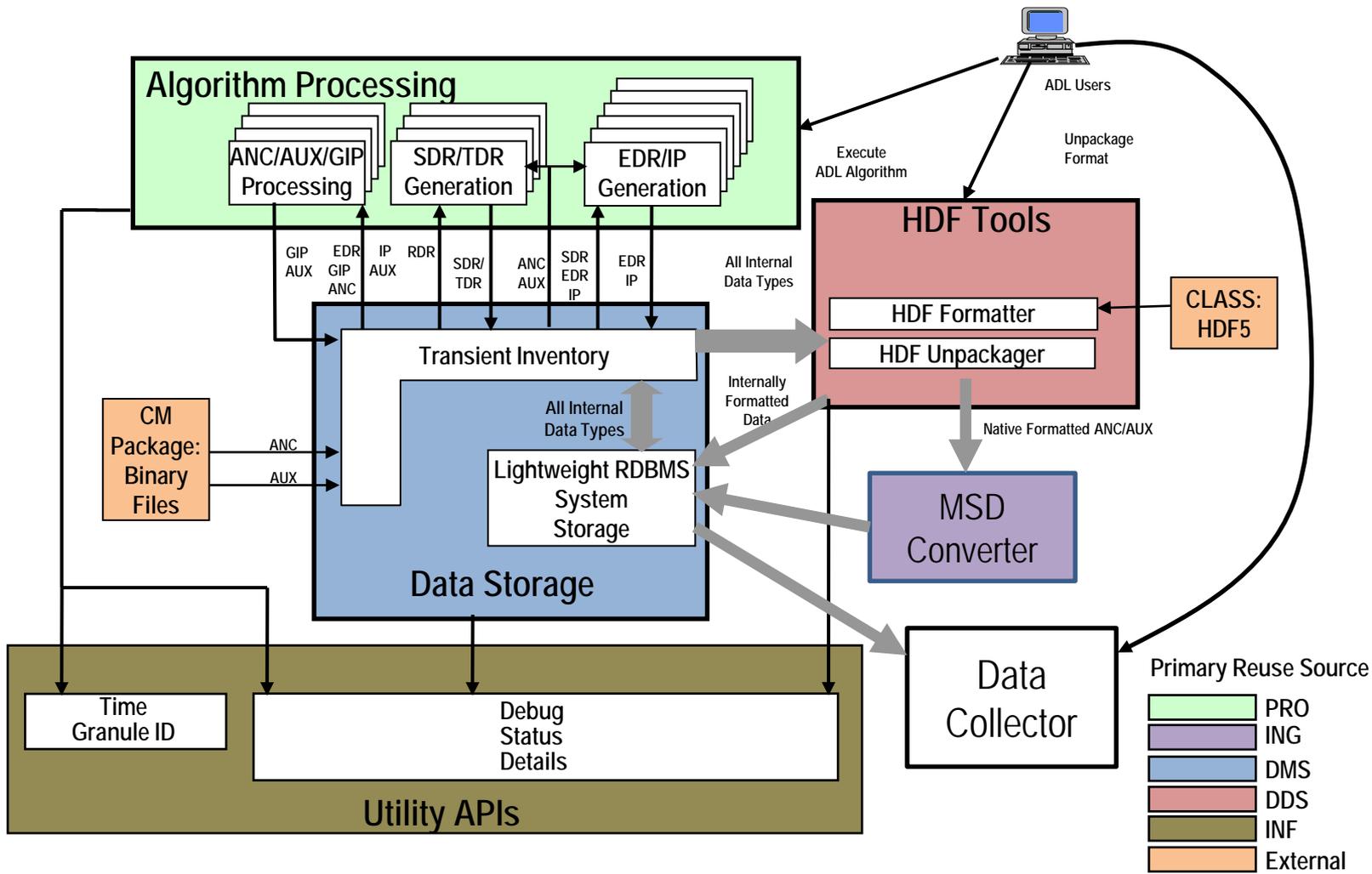
Outline

- IDPS Architecture Diagram – Block 2
- ADL Architecture Diagram – Block 2
- VIIRS Product Change Summary
- Data Request and Delivery
- Algorithm Documentation
- Data Endianness
- VIIRS Extended Granule
- NOVAS Library Update
- Upcoming VIIRS Algorithm Updates
- ADR/PCR Status

IDPS Architecture Diagram – Block 2



ADL Architecture Diagram – Block 2



VIIRS Product Change Summary (1/4)

- The following changes have been made to VIIRS product types in Block 2:
 - VIIRS Cloud Mask update from IP to EDR
 - VIIRS Active Fire update from ARP to EDR
- VIIRS Net Heat Flux (NHF) and corresponding GEO product are no longer produced/delivered in Block 2.
- The term “Retained IP, RIP” is retired for Block 2 and thus corresponding IPs are now deliverable IPs in Block 2
- Next slide shows a list of those deliverable IPs in Block 2

VIIRS Product Change Summary (2/4)

Product	DPID	CSN	Documentation (SRS Vol 2 document number)
VIIRS Aerosol Model Information IP	IVAMI	VIIRS-Aeros-Modl-Info-IP	474-00448-01-12; Aerosol
VIIRS Aerosol Optical Thickness IP	IVAOT	VIIRS Aerosol Optical Thickness IP	474-00448-01-12; Aerosol
VIIRS Bright Pixel IP	IVPBX	VIIRS-Bright-Pixel-Mod-IP	474-00448-01-06; VIIRS RDR SDR
VIIRS Calibrated Dual-gain Band IP	IVCDB	VIIRS Calibrated Dual-Gain Band IP	474-00448-01-06; VIIRS RDR SDR
VIIRS Cloud Base Height IP	IVCBH	VIIRS-CB-Ht-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Cloud Cover-Type IP	IVCLT	VIIRS-Cd-Cov-Type-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Cloud Layer-Type IP	IVICC	VIIRS-Cd-Layer-Type-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Cloud Optical Properties IP	IVCOP	VIIRS-Cd-Opt-Prop-IP	474-00448-01-14; Cloud Optical Properties
VIIRS Cloud Top Parameters IP	IVCTP	VIIRS-Cd-Top-Parm-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Global/Rolling 5-km NBAR NDVI Gridded IP	IVGNN	GridIP-VIIRS-Nbar-Ndvi-Rolling-Tile	474-00448-01-07; AncAuxGridGran
VIIRS Ice & Night Water Cloud Top Temperature IP	IVIWT	VIIRS-INWCTT-IP	474-00448-01-14; Cloud Optical Properties
VIIRS Ice Concentration IP	IVIIC	VIIRS-I-Conc-IP	474-00448-01-17; Cryosphere
VIIRS Ice Quality Flags IP	IVIQF	VIIRS-I-Qual-Flags-IP	474-00448-01-17; Cryosphere
VIIRS Ice Reflectance/Temperature IP	IVIRT	VIIRS-I-Refl-Temp-IP	474-00448-01-17; Cryosphere
VIIRS Ice Weights IP	IVIIW	VIIRS-I-Wts-IP	474-00448-01-17; Cryosphere
VIIRS Land Surface Albedo Gridded IP	IVGLA	GridIP-VIIRS-Land-Surf-Albedo-17Day-Tile	474-00448-01-07; AncAuxGridGran
VIIRS Monthly Brightness Temperatures, Surface Reflectance & Vegetation Index Gridded IP	IVTRF	GridIP-VIIRS-Mth-SR-BT-VI-Monthly-Final-Tile	474-00448-01-07; AncAuxGridGran
VIIRS On-board Calibrator IP	IVOBC	VIIRS-OBC-IP	474-00448-01-06; VIIRS RDR SDR
VIIRS Parallax Corrected Cloud Mask IP	IVPCM	VIIRS-Parx-Corr-CM-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Parallax Corrected Cloud Optical Properties IP	IVPCP	VIIRS-Parx-Corr-Cd-Opt-Prop-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Parallax Corrected Cloud Top Parameters IP	IVPTS	VIIRS-Parx-Corr-Cd-Top-Parm-IP	474-00448-01-16; Cloud Physical Properties
VIIRS Snow Ice Cover IP	IVSIC	VIIRS-GridIP-VIIRS-Snow-Ice-Cover-Mod-Gran	474-00448-01-07; AncAuxGridGran
VIIRS Snow/Ice Cover Gridded IP	IVGSC	GridIP-VIIRS-Snow-Ice-Cover-Rolling-Tile	474-00448-01-07; AncAuxGridGran
VIIRS RSB Autocal History AUX		VIIRS-RSB-AUTOCAL-HISTORY-AUX	474-00448-01-06; VIIRS RDR SDR
VIIRS Surface Reflectance IP	IVISR	VIIRS-Surf-Refl-IP	474-00448-01-15; Surface Reflectance
VIIRS Surface Temperature IP	IVSTS	VIIRS-Surf-Temp-IP	474-00448-01-17; Cryosphere
VIIRS Un-aggregated 750m Dual-Gain Band Geo IP	IVCDB	VIIRS-DualGain-Cal-IP	474-00448-01-06; VIIRS RDR SDR

VIIRS Product Change Summary (3/4)

- New metadata items:
 - N_IDPS_Mode
 - Defines the mode that the system was in at the time the data was produced. Value depends on domain, observation time, and transition that are defined in the Infrastructure.
 - Values are defined in CDFCB Vol 1: ops, int, dev, ada, etc.
 - Applies to RDR, SDR/TDR, EDR/IP, GEO, DQN
 - N_Primary_Label
 - Defines the labeling of JPSS Data Products as primary or non-primary. All products delivered are labeled xDR, GEO, DQN, AUX (produced by CGS), and tile products.
 - Values are 'Primary' or 'Non-Primary'

VIIRS Product Change Summary (4/4)

- The following table highlights changes to existing metadata for Block 2:

Metadata	Block 1	Block 2	Details
Document Ref	N_NPOESS_Document_Ref	N_JPSS_Document_Ref	Metadata name change for Block 2
N_Reference_ID and N_Input_Prod	<p>N_Input_Prod values are an array of strings containing N_Reference_ID (URID)</p> <p>Example: ZZZ05567890ABCD01020304VNC D25678)</p>	<p>N_Input_Prod values are an array of strings containing N_Reference_ID</p> <p>Example: VIIRS-MOD- RGEO:NPP001212022917:A1</p>	Block 2 values updated to include CSN, N_Granule_ID, N_Granule_Version

Data Request and Delivery

- Data Packaging
 - In Block 2, GEO products can be requested and delivered in separate HDF5 files, i.e., no need to request, for example, VIIRS SDR M-Band to get the MOD-Res Ellipsoid GEO (VIIRS-SDR-GEO) product.
- Data Compression
 - In Block 2, delivery of compressed HDF5 product is per DDS request.
 - Compression does not apply to RDRs, ANC, nor native format deliveries (Mission Notice nor Data Production Report).
 - The following data types may be compressed (based on request):
 - SDR/TDR
 - IP
 - GEO
 - EDR
 - AUX

Algorithm Documentation (1/2)

- In Block 2, some of the DFCB (external and internal) volumes are replaced with corresponding Software Requirement Specification (SRS) volumes. Algorithm information is documented in the SRS Volumes 1 - 4. A set of SRS Volumes is in place for each algorithm category:
 - SRS Volume 1: Requirements and Input/Output processing info
 - SRS Volume 2: Data Dictionary, product format information
 - SRS Volume 3: Reference to the applicable OAD(s)
 - SRS Volume 4: Parameter File, contains quality flag, fill value, notification logic
- CDFCB Volume 1 applies to Block 2 and includes a list of all applicable CSNs/DPIDs
- Next slide provides a more comprehensive list

Algorithm Documentation (2/2)

Product Information	Block 1 Document Reference	Block 2 Document Reference
Algorithm Input/output	EDR IR	SRS Volume 1's – Table 3-1 Part 2 - 30
Product Format Info (RDR, SDR, EDR, IP, LUTs)	CDFCB Vol 2 – 4, 8	SRS Volume 2: Data Dictionaries Part 2-30
Product Format Info (IP)	IDFCB Vol 3 (Retained IP)	SRS Volume 2's (Delivered IP) Part 2 -30
Algorithm Science/Processing Descriptions	ATBDs and OADs	ATBDs SRS Volume 3 (References OADs)
Quality Flag, Data Quality Notification, and Fill information	EDR PR	SRS Volume 4's (Parameter File) SRS Volume 2 Data Dictionaries
Metadata Information	CDFCB Vol 5 IDFCB Vol 3	SRS Volume 2 for Common Algorithms (CAS Data Dictionary)
General product info, product CSN and DPIDs	CDFCB Vol 1	CDFCB Vol 1
Ancillary, Auxiliary Data, Messages, Reports	CDFCB Vol 6	CDFCB Vol 6

Data Endianness (1/3)

- In Block 1, Auxiliary binary files (e.g. Lookup Tables (LUTs), Processing Coefficient Files (PCTs) and Data Quality Threshold Tables (DQTTs)) provided to IDPS are in Big Endian (BE) file format type. In Block 2, they will come to IDPS as Little Endian (LE).
- Endianness is not currently marked on the binaries. In Block 2, binaries will be posted externally and endianness needs to be communicated to the user.
- JPSS Ground Project has requested dual LUTs (BE and LE versions) be delivered starting with OB-SAT in September 2015. STAR has determined AIT will be responsible for providing binaries in correct format.
- On-going discussions (NASA DPES, NASA SEIT, NASA IDPS, AMP, Raytheon) seem converging on agreement to place the “LE” as the first 2 digits of the 50 total allowed in the Version Field contained between PS and PE, of the binary file name.

Data Endianness (2/3)

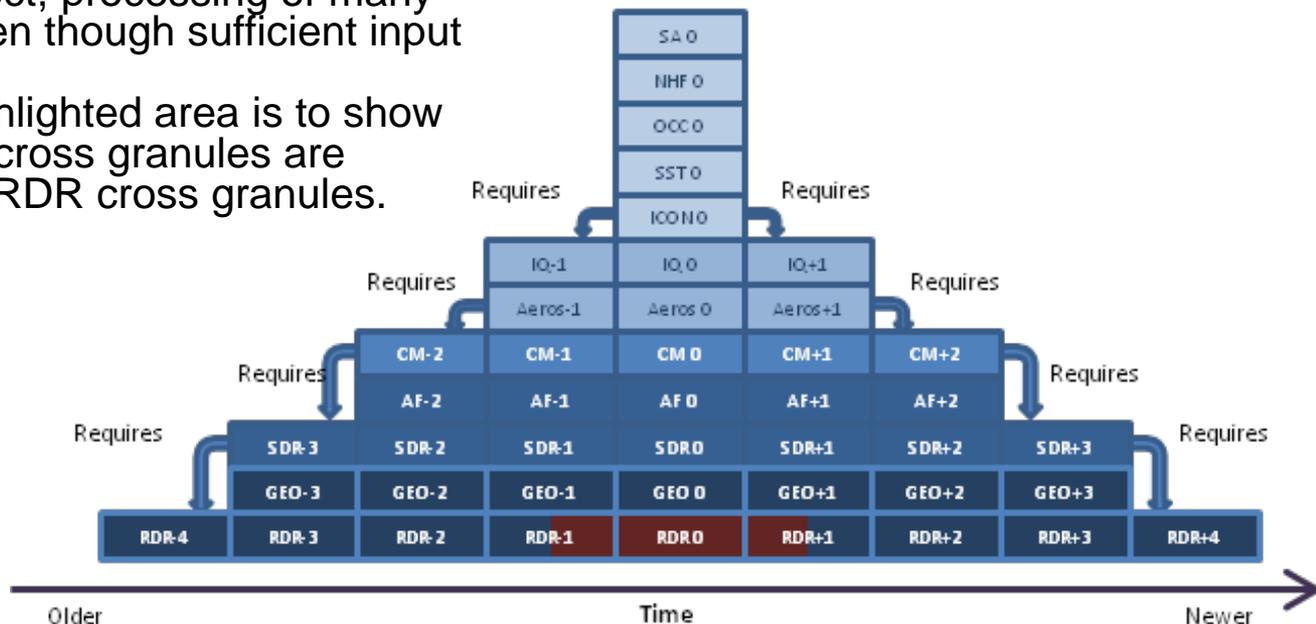
- IDPS PRO SW outputs AUX products, e.g., VIIRS-RSBAUTOCAL-HISTORY-AUX as BE. The internal-only ByteOrder metadata is set to 'BE'. PRO SW will convert it to LE before using it as an input.
- IDPS DDS SW does not perform any Endianness conversion, thus, DDS wraps the PRO output binary in the same Endianness PRO has produced it.
- Since VIIRS-RSBAUTOCAL-HISTORY-AUX is produced as BE and is HDF5-wrapped for delivery, then, no change is required in the filename.
- Next slide provides a more comprehensive list

Data Endianness (3/3)

Product Family	File Format Type
RDR	Big Endian Binary (structure stored within HDF5)
Deliverable Indirect Indexed GridIP Tiles (LSA 17Day, Monthly SR/BT/VI Final, NBAR NDVI)	Big Endian Binary (structure stored within HDF5)
GMA SI Snow/Ice Cover Gridded IP, VIIRS Quarterly Surface Type Gridded IP Quarterly Tile, VIIRS Annual Maximum/Minimum Normalized Difference Vegetation Index (NDVI) Gridded IP Quarterly Tile	Little Endian Binary
Official Dynamic Ancillary Data (NOAA Global Multisensor Automated Snow/Ice Map - Northern Hemisphere/Southern Hemisphere)	Big Endian Binary (structure stored within HDF5)
Official Static Ancillary Data (ex. Aerosol Optical Thickness Climatology Files, NASA Code 916 Cloud Top Pressure Files, Nitrate Depletion Temperature Files, Ozone Profile: Fortuin and Kelder Climatology, Surface Pressure (TUG87) Climatology Files	Little Endian Binary IEEE 754
IPDS Terrain Database	Little Endian Binary
LUTs, PCs (Automated and Manual Processing Coefficients)	Little Endian Binary
VIIRS-RSBAUTOCAL-HISTORY-AUX	Big Endian Blob (stored within HDF5)
DQTT	Little Endian Binary

VIIRS Extended Granule (1/5)

- The following illustration displays the cross-granule requirement concept for the VIIRS processing chain, i.e.,
 - Ice Concentration (ICON) requires +1/-1 Ice Quality (IQ) cross granules
 - IQ requires +1/-1 Aerosols cross granules
 - Aerosols requires +1/-1 Cloud Mask (CM) cross granules
 - CM requires +1/-1 SDR cross granules
 - SDR requires +1/-1 RDR cross granules
- Thus, a cascading dependency is created where +4/-4 RDRs are needed for ICON to get processed .
- As an undesirable side effect, processing of many products would have to even though sufficient input data is available.
- The purpose of the red-highlighted area is to show that only parts of the RDR cross granules are needed and not the whole RDR cross granules.

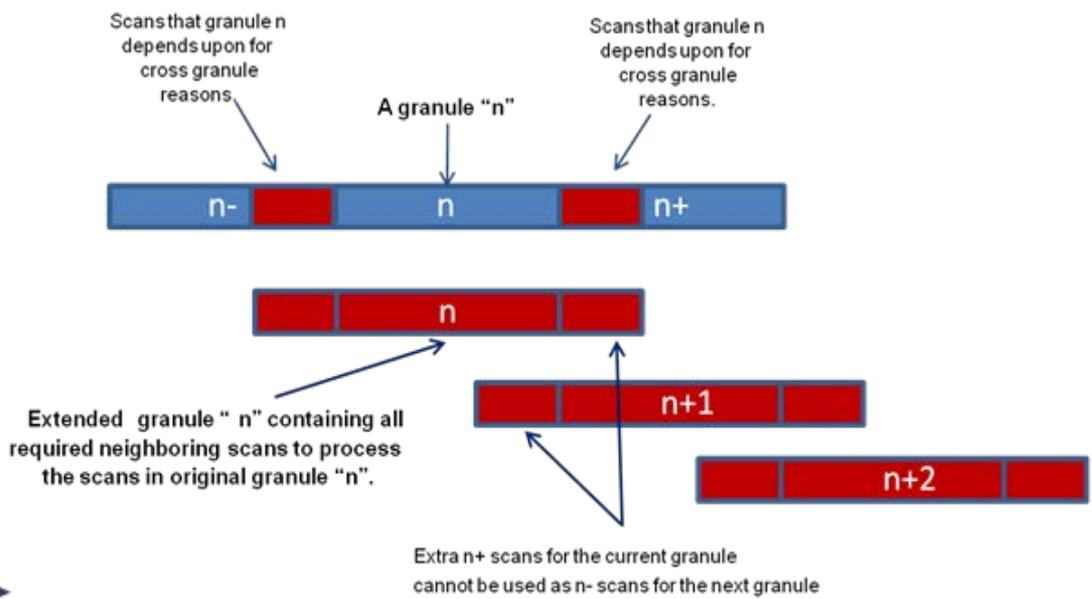
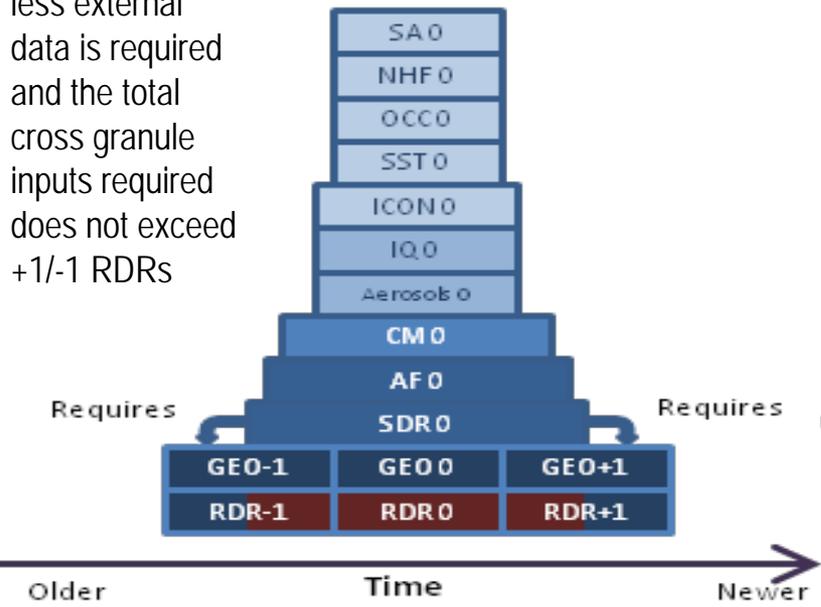


VIIRS Extended Granule (2/5)

Extended Granule Characteristics

- Allows for greater availability of products.
- Extends the contents of a granule to include the needed data, e.g., scans, from the input cross granules.
- The core granule and the extended scans "slivers" are created as separate products to allow for use of the core granule in the event that the extended scans are not needed as input to a product.

less external data is required and the total cross granule inputs required does not exceed +1/-1 RDRs

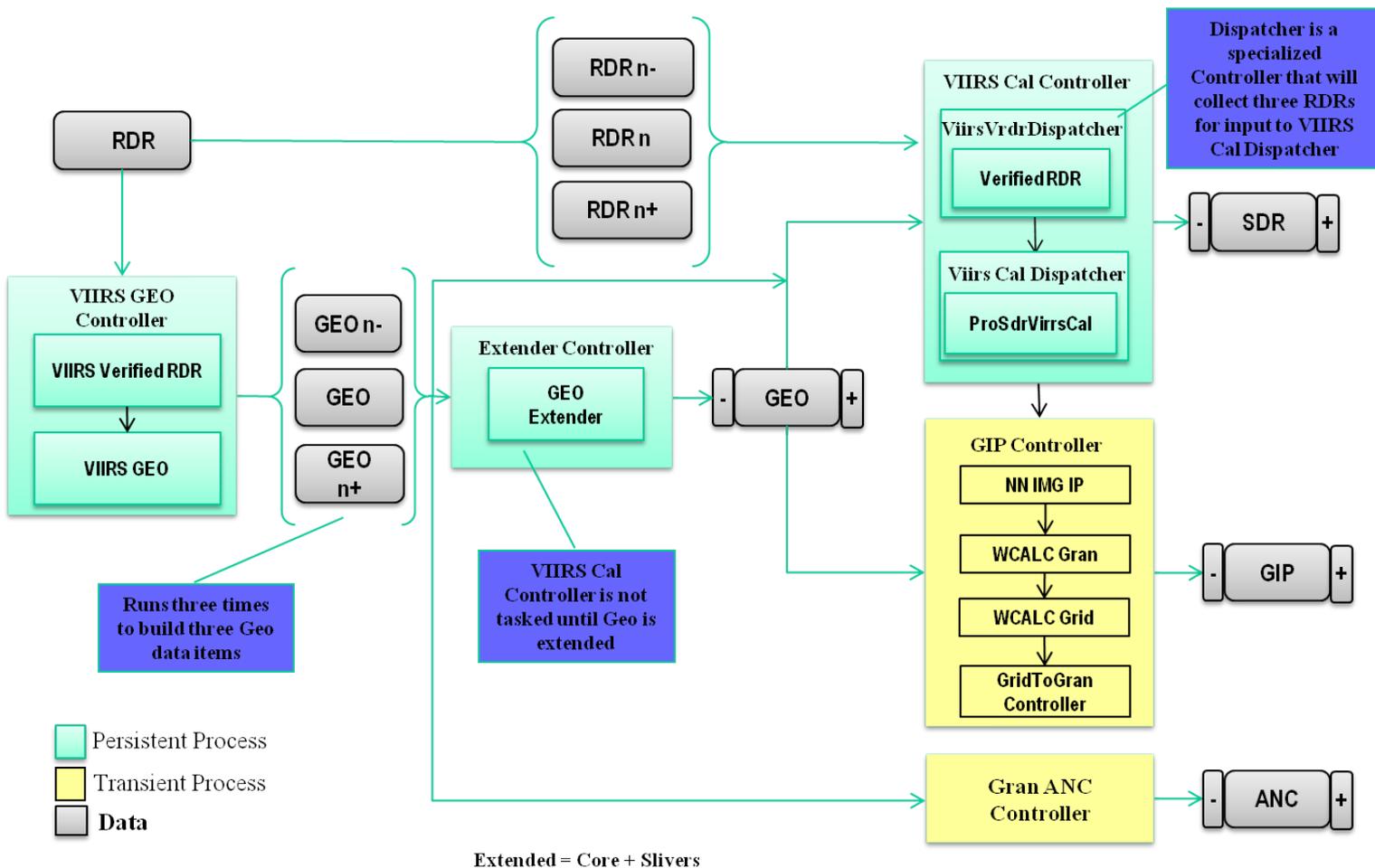


VIIRS Extended Granule (3/5)

- The sliver binary files are not included in the HDF5 packages generated when running the VIIRS chain.
- Per implementation of the “Extended Granule,” the VIIRS SDR Controller, in Block 2, is split into multiple executables.
 - Algorithms requiring only geolocation do not need to wait for other algorithms that were formerly in the VIIRS SDR Controller.
 - Next slide illustrates the splitting for the SDR Controller.

VIIRS Extended Granule (4/5)

Data Item Diagram Splitting of the VIIRS SDR Controller



VIIRS Extended Granule (5/5)

- Block 2 ADL provides a tool, i.e., Gran Extender, that creates an extended granule from a core granule and its cross granule data items “slivers.”
 - If the granule has already been extended, the tool will not re-extend it.
- The Extender Tool provides a simple command-line-based user interface. There are several ways to run the tool.
 - Accepts a single granule ID (or list of granule IDs) and produces the extended granule for the single granule (or each of the listed IDs).
 - Accepts a time range and extends all available granules within that time range.

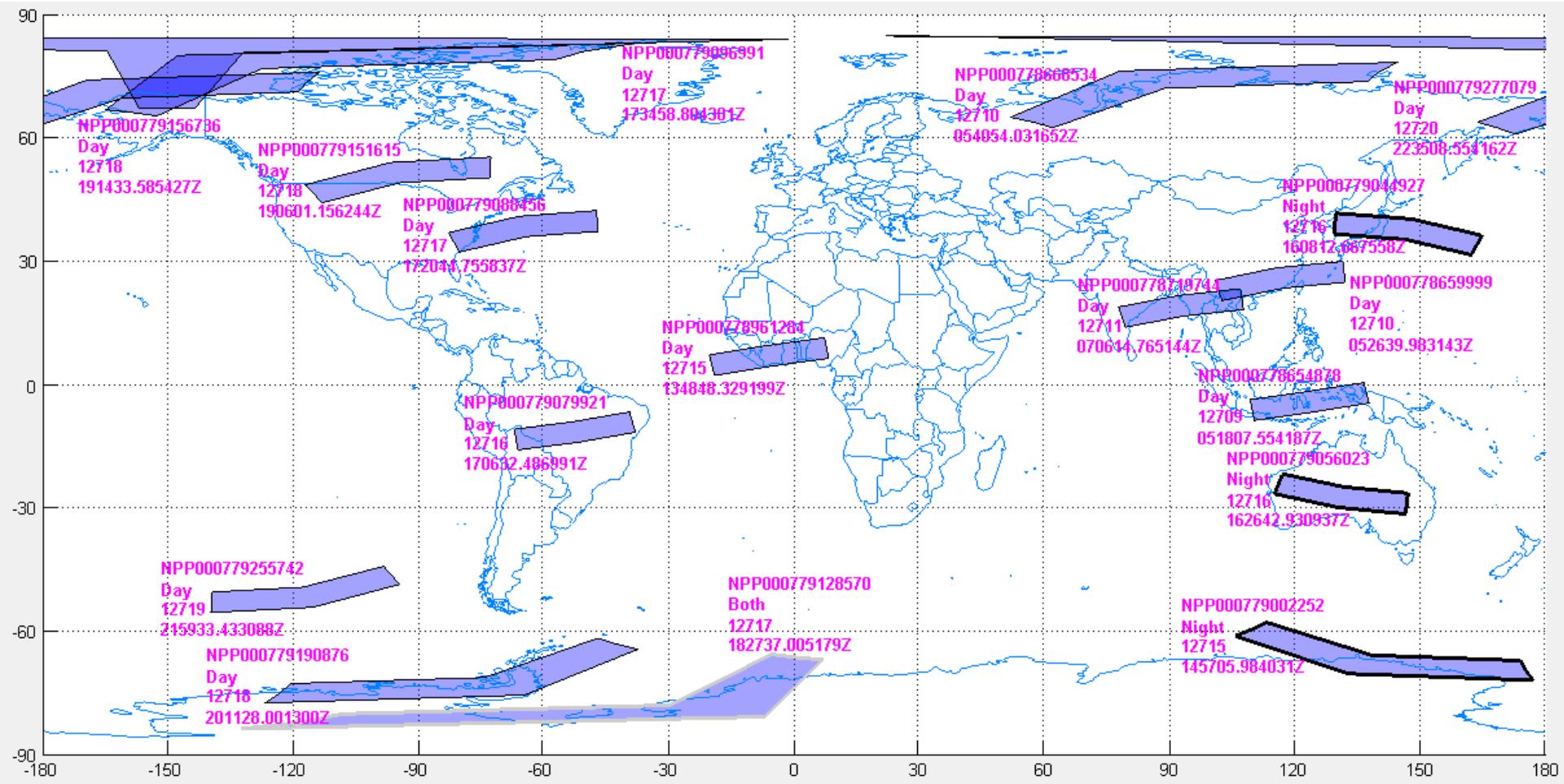
NOVAS Library Update (1/6)

- The following is an excerpt from the weekly Cal/Val Lead meeting notes provided by the meeting chair, Janna Feeley:
 - “ *Naval Observatory Vector Astronomy Software (NOVAS):*
 - Current IDPS version is NOVAS-C 2.0.1 (outdated and unsupported by U.S. Naval Observatory).
 - IDPS will upgrade to the current available version, NOVAS-C 3.1, with Block 2.0. Raytheon OAA Team will generate test data products to compare the same set of granules produced with the current version, NOVAS-C 2.0.1, and the updated version, NOVAS-C 3.1. These data will be provided to the Cal/Val teams for analysis of impacts to data products in September 2015 (exact date TBD).”

NOVAS Library Update (2/6)

- Raytheon OAA performed analyses related to the impact of the NOVAS-C library upgrade in IDPS Block 2.
- OAA utilized the VIIRS Science and S/C Diary RDRs from the April 11th, 2014 Focus Day dataset. This FD dataset is used by OAA for various Block 1.0 / Block 2.0 Build-to-Build "B2B" verification and regression analysis.
- The VIIRS test dataset consists of 17 granules that cover a wide variety of scene conditions & geographical locations.
- Next slide illustrates the locations of the selected 17 granules

NOVAS Library Update (3/6)



NOVAS Library Update (4/6)

- Two IDPS Block 2.0 builds are used for analysis:
 1. SAT07 (Base) build with the original (outdated) NOVAS-C 2.0.1 library suite is used as the baseline for the analysis*
 2. SAT07 (NOVAS) build which is a SAT07 (Base) build with the NOVAS-C library suite being upgraded to the NOVAS-C 3.1 version, i.e., the NOVAS upgrade is the only change that could affect the IDPS algorithms/products.
- *Notes:
 - The Block 2 SAT07 (Base) build is equivalent to the operational Mx8.10 build
 - A parallel activity is in progress to ensure both build contents (PCRs, LUTs, PCTs, etc.) are fully synched together.
- The IDPS Block 2 Factory Segment Integration Linux-based (Little Endian) hardware is used to generate the VIIRS chain runs for both SAT07 (Base) and SAT07 (NOVAS) builds, e.g., various SDR and GEO products.
- The OAA Linux-based hardware is used to execute the OAA analysis MATLAB-based tool suite (QCV/VOID), perform the comparison analysis and generate the B2B analysis artifacts.

NOVAS Library Update (5/6)

- The comparison results between SAT07 (Base) vs. SAT07 (NOVAS) builds revealed the following:
 - GEO Products:
 - The 5 Geo products (VIIRS-MOD-GEO, VIIRS-MOD-GEO-TC, VIIRS-IMG-GEO, VIIRS-IMG-GEO-TC, and VIIRS-DNB-GEO) showed no differences in QFs. The differences were observed in the following GEO fields:
 - S/C Attitude (RPY)
 - S/C Solar Zenith Angle
 - S/C Solar Azimuth Angle
 - Latitude
 - Longitude
 - Height
 - Satellite Zenith Angle
 - Satellite Azimuth Angle
 - Satellite Range
 - Solar Zenith Angle
 - Solar Azimuth Angle
 - Lunar Zenith Angle (DNB)
 - Lunar Azimuth Angle (DNB)
 - The maximum absolute difference in S/C attitude RPY components was on the order of $\sim e-02$ arcsec.
 - The differences observed in the remaining Geo fields were, in general, several orders of magnitude less than the retrieved values.
 - Complete analysis spreadsheet is sent out to the SDR team for their review.

NOVAS Library Update (6/6)

- VIIRS-OBC-IP Product:
 - This product showed differences in the following fields:
 - Solar and Lunar Vectors
 - Sun Zenith
 - Earth-Sun Distance
 - The magnitudes of the differences observed were several orders of magnitude less than retrieved physical values
- SDR Products:
 - For the SDR (M-bands, I-Bands, and DNB) products, differences were only observed in the reflectance fields in RSB bands M1-M11 and I1-I3. The differences observed were relatively small in magnitude and on the order of $\sim e-05$. No differences were observed in QFs.

Complete analysis spreadsheet is sent out to the SDR team for their review.

Upcoming VIIRS Algorithm Updates

Change	Description	Delivery Date	Receiver Unit	Mission	Block	Build(s)	NASA Version	Reference Information
New DNB APIDs	Adds new APIDs to RDR in support of Cal/Val	NA	NA	J1	2	SAT_09	OB-SAT	Ground 474-CCR-15-2427 - IDPS process two new APIDs for VIIRS DNB for JPSS-1 PCR49336: Allocated to SAT and is Path C.
VIIRS M11 at Night	Collect M11 at night and associated data processing updates	ATP TBD	NA	NPP/J1	2	PSAT_11 (TBD)	JCT-3A Dry Run	Ground CCR pending for MDFCB updates AERB 474-CCR-15-2510 - SRS Parameter File Updates for VIIRS M11 at Night Ground 474-CCR-15-2434 - IDPS Updates for VIIRS M11 at Night AERB 474-CCR-14-2020 - VIIRS SDR to Include Band M11 in Nighttime Operations - DR 7755 OPS ERB ECR-OPS-0319 S-NPP VIIRS FSW Load V.0x4017
VIIRS Sensor/Table updates	Updates based on sensor characterization	9/23/15 9/23/15	SEI:21218 SEI:21219	J1	2	PSAT_14	JCT-3B Dry Run	Need B2.0 G-ADA ready for use, for DPES testing
VIIRS Sensor Mounting Coefficients	Updates based on sensor mounting	5/23/2016	SEI:21216	J1	2	MxI2.0.X (TBD)	JCT-3B Dry Run	May get pre-environmental in time for JCT-3B (Launch - 11 months delivery to science teams). Final updates during LEO&A.

ADR/PCR Status

- There are currently no Block 1 DR/PCRs planned for VIIRS SDR
 - With exception of FastTrack tables
- Block 2 Sat 09 build will contain DR 7032
 - This will be the first Block divergence introduced

PCR049986	Subsystem >> PRO	Severity >> 3-Moderate	State >> Fixed	AssignedTo >> sjoo
Title1	DR7032-VIIRS SDR DNB GEO Percent Out of Bounds QF is not calculated properly			
ProblemDescription	<p>In VIIRS Maneuver PROXY Dataset 4, Granule NPP001212117655 (Short Granule with DNE fill), the "Percent Out of Bounds" quality flag is not calculated properly. When determining the value for percent out of bounds, the denominator should be the total number of pixels that are not DNE fill. The code for this is in ProSdrViirsGeo.cpp geolocate().</p> <p>*Note in the code how the variables imgSize and modSize have the number of DNE subtracted from the total number of pixels where as the variable dnbSize does not.</p>			
FixDescription	<p>Added code that will stop counting the values that are Vdne for dnb logic. Reference the htmdiff folder for differences in code.</p>			

And The Thank Yous Goto..

- JPSS IDPS PRO SE – Cristi Owen
- CGS Block Leadership Team – Paula Smit
- OAA – Khalil Ahmad