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Joint Polar Satellite System (JPSS) Operational Algorithm Description (OAD) Document for Gridded Surface Albedo (GSA) Intermediate Product (IP)

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Joint Polar Satellite System (JPSS) Operational Algorithm Description (OAD) Document for Gridded Surface Albedo (GSA) Intermediate Product (IP)

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Preface

This document is under JPSS Ground AERB configuration control. Once this document is approved, JPSS approved changes are handled in accordance with Class I and Class II change control requirements as described in the JPSS Configuration Management Procedures, and changes to this document shall be made by complete revision.

Any questions should be addressed to:

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Change History Log

Revision	Effective Date	Description of Changes (Reference the CCR & CCB/ERB Approve Date)
Original	06/03/2011	This version incorporates **474-CCR-11-0094** which converts D39538, Operational Algorithm Description (OAD) Document for VIIRS Gridded Surface Albedo Intermediate Product (IP), Rev B, dated 06/09/2010 to a JPSS document, Rev -. This was approved by the JPSS Ground Algorithm ERB on June 3, 2011.

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Doc No: D39538
Rev B
Date: 09 Jun 2010
Subcontract No. 760002744

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)

OPERATIONAL ALGORITHM DESCRIPTION DOCUMENT FOR VIIRS GRIDDED SURFACE ALBEDO Intermediate Product (IP)

SDRL No. S141
SYSTEM SPECIFICATION SS22-0096

RAYTHEON COMPANY
INTELLIGENCE AND INFORMATION SYSTEMS (IIS)
NPOESS PROGRAM
OMAHA, NEBRASKA

IAW DFAR 252.227-7036, Raytheon hereby declares that, to the best of its knowledge and belief, the technical data delivered under Subcontract No. 7600002744 is complete, accurate, and complies with all requirements of the Subcontract.

TITLE: NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS) OPERATIONAL ALGORITHM DESCRIPTION DOCUMENT FOR VIIRS GRIDDED SURFACE ALBEDO INTERMEDIATE PRODUCT (IP)

APPROVAL SIGNATURES:

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Engineering & Manufacturing Development (EMD) Phase
Acquisition & Operations Contract

CAGE NO. 11982

Operational Algorithm Description Document for VIIRS Gridded Surface Albedo IP

Document Date: Jun 09, 2010

Document Number: D39538
Revision: B

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Under
Contract No. F04701-02-C-0502
This document has been identified per the NPOESS Common Data Format Control Book – External Volume 5 Metadata, D34862-05, Appendix B as a document to be provided to the NOAA Comprehensive Large Array-data Stewardship System (CLASS) via the delivery of NPOESS Document Release Packages to CLASS.

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Revision/Change Record

Document Number D39538

Revision	Document Date	Revision/Change Description	Pages Affected
---	9-17-04	Initial Release.	All
A1	10-12-07	Implemented Tech Memo NP-EMD.2007.510.0031 updates for B1.5, new logo, removed Unit Test section. Delivered to NGST.	All
A2	11-6-07	Corrected Table 9.	All
A3	9-19-08	Reformatted to conform to template D41851.	All
A4	10-29-08	Prepared for TIM/ACCB.	All
A	12-10-08	Addressed TIM comments. ECR A-179.	All
B1	12-01-09	Addressed RFA Nos 236 and 552 (resulting in no OAD changes), and updated subcontract number.	Title pgs
B2	5-10-10	Incorporated TM 2010.510.0038	Rev Hist. & Tables 1 & 2
B	4-28-10 6-9-10	Prepared for TIM/ARB Incorporated ECR A307 and returned to ACCB	Tables 1 & 2

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1.0 INTRODUCTION

1.1 Objective

The purpose of the Operational Algorithm Description (OAD) document is to express, in computer-science terms, the remote sensing algorithms that produce the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) end-user data products. These products are individually known as Raw Data Records (RDRs), Temperature Data Records (TDRs), Sensor Data Records (SDRs) and Environmental Data Records (EDRs). In addition, any Intermediate Products (IPs) produced in the process are also described in the OAD.

The science basis of an algorithm is described in a corresponding Algorithm Theoretical Basis Document (ATBD). The OAD provides a software description of that science as implemented in the operational ground system -- the Data Processing Element (DPE).

The purpose of an OAD is two-fold:

1. Provide initial implementation design guidance to the operational software developer.
2. Capture the “as-built” operational implementation of the algorithm reflecting any changes needed to meet operational performance/design requirements.

An individual OAD document describes one or more algorithms used in the production of one or more data products. There is a general, but not strict, one-to-one correspondence between OAD and ATBD documents.

1.2 Scope

Nominally, there is at least one Operational Algorithm Document (OAD) per EDR package. The scope of this document is limited to the description of the operational implementation of the algorithm(s) required to create the VIIRS Gridded Surface Albedo IP software.

The scope of this document is limited to the description of the core operational algorithm required to create the VIIRS Gridded Surface Albedo IP. The theoretical basis for this algorithm is described in Section 3.3 of the VIIRS Surface Albedo IP Algorithm Theoretical Description Document (ATBD), D43755.

1.3 References

1.3.1 Document References

The science and system engineering documents relevant to the algorithms described in this OAD are listed in Table 1.

Table 1. Reference Documents

Document Title	Document Number/Revision	Revision Date
Visible/Infrared/Imager/ Radiometer Suite (VIIRS) Land Module Software Architecture Document	Y2474 Ver. 5 Rev. 7	May 2002
VIIRS Surface Land Module Interface Control Document	Y3279 Ver. 5 Rev. 3	May 2002
VIIRS Surface Albedo IP Unit Level Detailed Design Document	Y2483 Ver. 5 Rev. 4	24 May 2004

Document Title	Document Number/Revision	Revision Date
VIIRS Gridding/Regridding Detailed Design Document	Y3246 Ver. 5 Rev. 6	17 Sep 2004
VIIRS Science Algorithms 4.5 Delivery to IDPS Package Version Description	D44214 Rev. ---	23 May 2007
VIIRS Surface Albedo IP Algorithm Theoretical Description Document (ref Y2398)	D43755 Rev. B	09 Jun 2010
NPP EDR Production Report	D37005 Rev. D	11 Feb 2009
EDR Interdependency Report	D36385 Rev. E	28 Jan 2009
NPP Mission Data Format Control Book (MDFCB)	D48190-01 Rev. B	03 Sep 2009
CDFCB-X Volume I - Overview	D48190-01 Rev F	08 Dec 2009
CDFCB-X Volume II – RDR Formats	D34862-01 Rev. D	03 Jun 2009
CDFCB-X Volume III – SDR/TDR Formats	D34862-02 Rev. E	09 Dec 2009
CDFCB-X Volume IV Part 1 – IP/ARP/GEO Formats	D34862-03 Rev. E	09 Dec 2009
CDFCB-X Volume IV Part 2 – Atmospheric, Clouds, and Imagery EDRs	D34862-04-01 Rev. E	09 Dec 2009
CDFCB-X Volume IV Part 3 – Land and Ocean/Water EDRs	D34862-04-02 Rev. E	09 Dec 2009
CDFCB-X Volume IV Part 4 – Earth Radiation Budget EDRs	D34862-04-03 Rev. E	09 Dec 2009
CDFCB-X Volume V - Metadata	D34862-04-04 Rev. F	09 Dec 2009
CDFCB-X Volume VI – Ancillary Data, Auxiliary Data, Reports, and Messages	D34862-05 Rev. H	09 Dec 2009
CDFCB-X Volume VII – NPOESS Downlink Formats	D34862-06 Rev. C	08 Dec 2009
CDFCB-X Volume VIII – Look Up Table Formats	D34862-07-01 Rev. C	09 Dec 2009
NPP Command and Telemetry (C&T) Handbook	D568423 Rev. C	30 Sep 2008
Data Processor Inter-Subsystem Interface Control Document (DPIS ICD)	D35850 Rev. Y	03 Feb 10
OAD Document for VIIRS Gridding and Granulation (G/G)	D39303 Rev. C2	4 Nov 2009
D35836_G_NPOESS_Glossary	D35836 Rev. G	10 Sep 2008
D35838_G_NPOESS_Acronyms	D35838 Rev. G	10 Sep 2008
Processing SI Common IO Design	DD60822-IDP-011 Rev. A	21 Jun 2007
NGST/SE technical memo – NPP_Land_Surface_Albedo_OAD_Update	NP-EMD.2007.510.0031	26 Apr 2007
NGAS/A&DP technical memo – Roujean kernel correction for the VIIRS gridded surface albedo IP	NP-EMD.2010.510.0038	05 May 2010

1.3.2 Source Code References

The science and operational code and associated documentation relevant to the algorithms described in this OAD are listed in Table 2.

Table 2. Source Code References

Reference Title	Reference Tag/Revision	Revision Date
VIIRS GSA IP Science-grade Software	ISTN_VIIRS_NGST_4.5 (ECR-A123A)	23 May 2007
VIIRS GSA IP Operational Software	B1.5 (OAD Rev A1)	12 Oct 2007

Reference Title	Reference Tag/Revision	Revision Date
ACCB	ECR A179 (OAD Rev A)	10 Dec 2008
ACCB (no code updates) (not approved, then updated by TM 2010.510.0038	OAD Rev B	28 Apr 2010
NGAS/A&DP technical memo – Roujean kernel correction for the VIIRS gridded surface albedo IP	NP-EMD.2010.510.0038 Build Sensor Characterization SC-11 (OAD Rev B2)	10 May 2010
ACCB	OAD Rev B	09 Jun 2010

2.0 ALGORITHM OVERVIEW

The purpose of the Surface Albedo IP algorithm is to determine the BRDF (Bidirectional Reflectance Distribution Function) for each 1km x 1km Earth Gridded Pixel as well as the following associated quantities:

- BRDF Coefficients Inverted from the Gridded Daily Surface Reflectance IP data,
- Nadir BRDF-Adjusted Reflectance Values (NBAR), at 1km resolution,
- Mean Solar-Zenith Angle of the Reflectance Data,
- White-Sky and Black-Sky Spectral Albedo values, and
- Surface Albedo Quality Flags.

Gridded daily surface reflectance, LUT and archetypal historical BRDF shapes are used to determine which BRDF model best explains the data. Four different criteria are used to determine the best BRDF model. These are: the minimization of the root mean square error (RMSE), the minimization of the BRDF coefficient variance, the minimization of the white-sky albedo variance, and the RMSE Heritage. The Surface Albedo IP processing chain is shown in Figure 1.

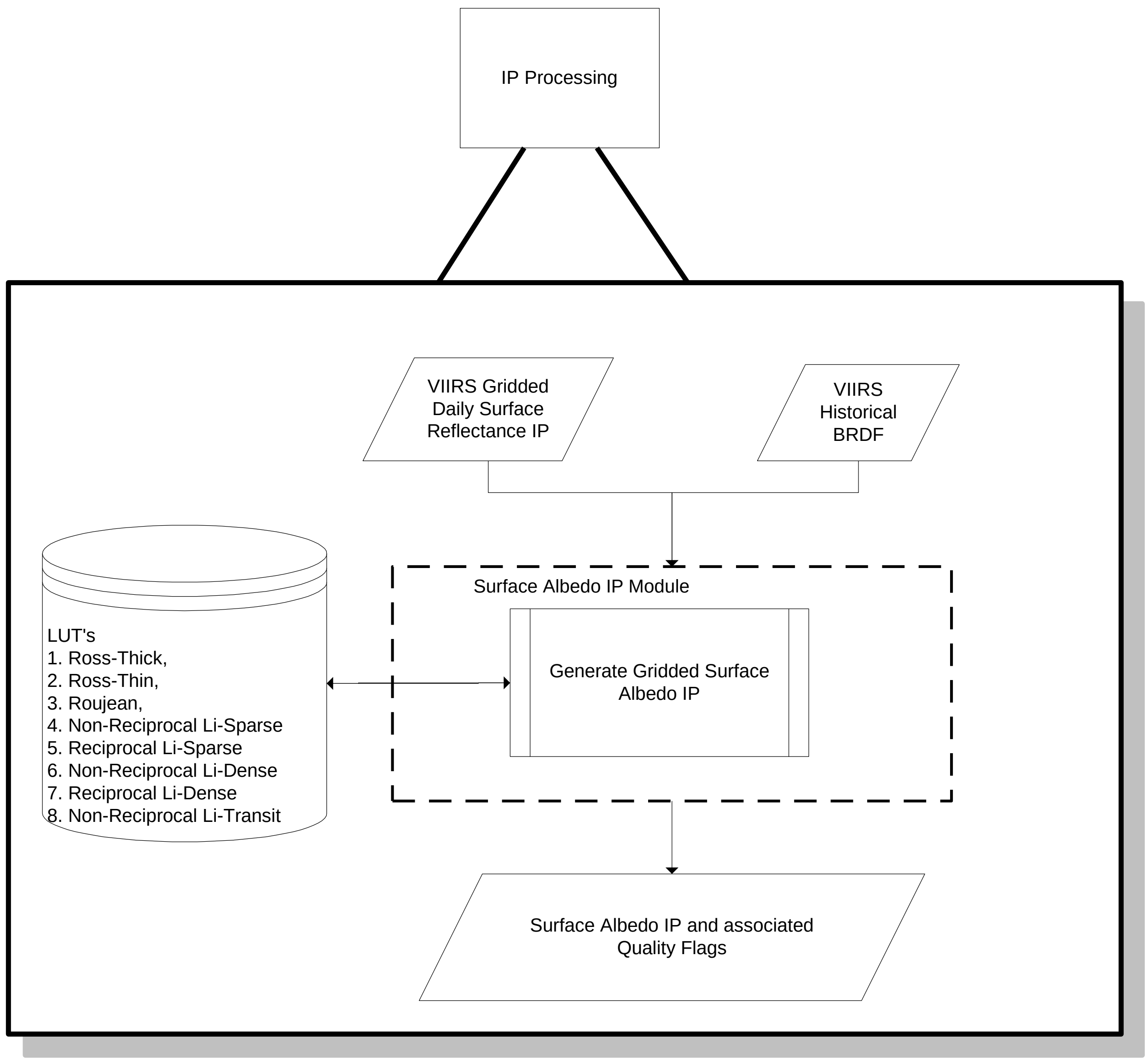

Figure 1. Surface Albedo IP Processing Chain

2.1 Gridded Surface Albedo Description

2.1.1 Interfaces

2.1.1.1 Inputs

See the Land Surface Albedo GridToGrid Inputs in the Operational Algorithm Description (OAD) Document for the VIIRS Gridding and Granulation (G/G), D39303.

2.1.1.2 Outputs

See the Land Surface Albedo GridToGrid Outputs in the Operational Algorithm Description (OAD) Document for the VIIRS Gridding and Granulation (G/G), D39303.

2.1.2 Algorithm Processing

The gridded Surface Albedo IP objective is to produce the BRDF for each 1km x 1km Earth Gridded Pixel and associated quantities; the output consists of BRDF Coefficients, Nadir BRDF-Adjusted Reflectance Values (NBAR), Mean Solar-Zenith Angle of the Reflectance Data, White-Sky, Black-Sky Spectral Albedo values at mean solar zenith angle and Surface Albedo Quality Flags. Gridded daily surface reflectance, LUT and archetypal historical BRDF shapes are used to determine which BRDF model best explains the data. Four different criteria are used to determine the best BRDF model. These are the minimization of the root mean square error (RMSE), the minimization of the BRDF coefficient variance, the minimization of the white-sky albedo variance, and the RMSE Heritage. Refer to the VIIRS Surface Albedo IP Algorithm Theoretical Description Document (ATBD), D43755 for equations used within this algorithm/OAD.

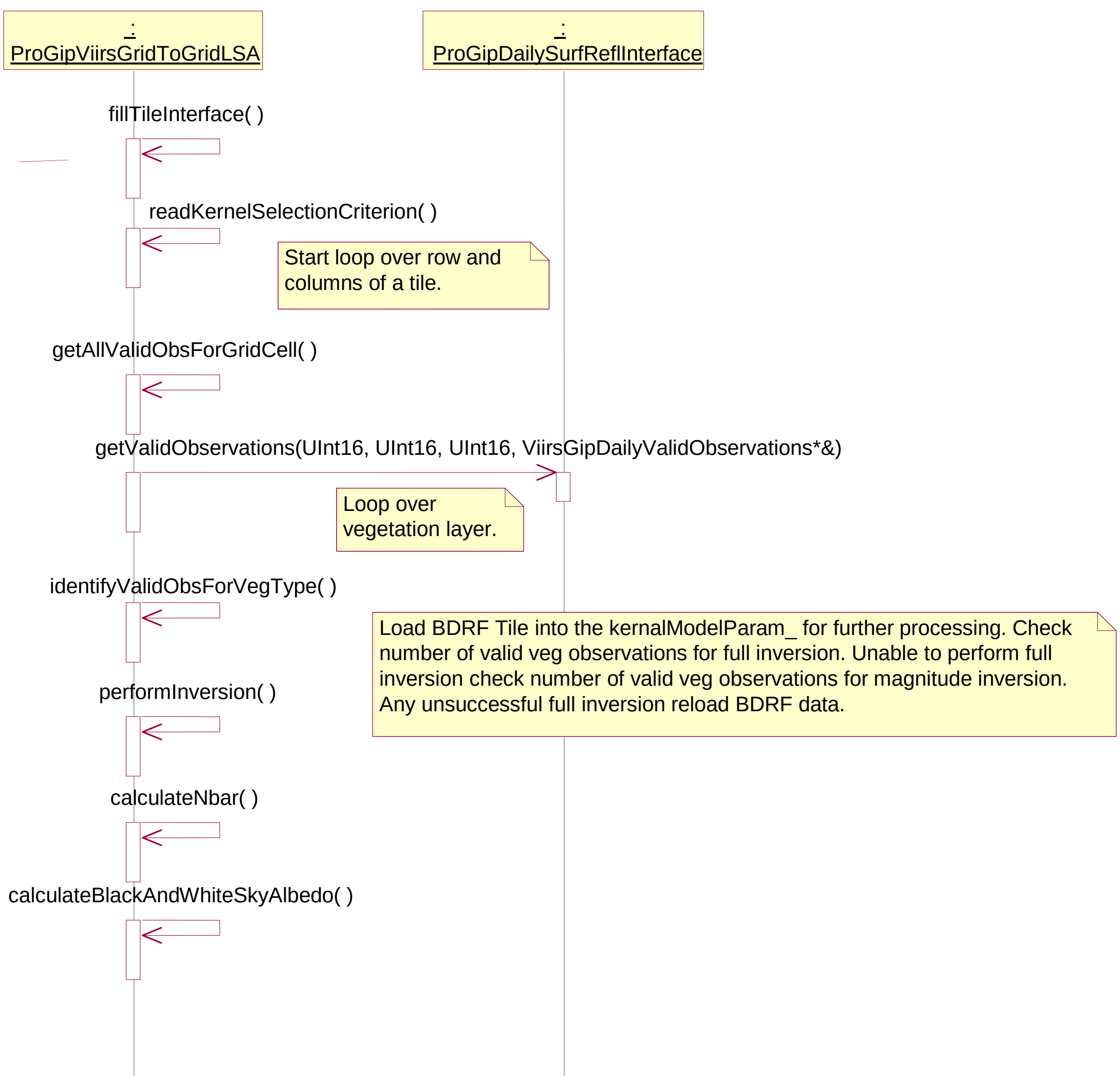

Figure 2. doProcessing Logic Flow

2.1.2.1 Main Module - ProGipViirsGridToGridLSA.cpp

The main module calls the doProcessing function for the Gridded surface albedo IP algorithm. As depicted in Figure 2, one grid cell of data is ingested at a time.

After a call to fillTileInterface() to populate the tile interfaces: the readKernelSelectionCriterion() is called to read the xml configuration file and determine which type of kernel selection criterion should be used to process these grid cells, getAllValidObsForGridCell() goes out and retrieves all the observations for a particular grid cell, getValidObservations() retrieves all the valid observations, identifyValidObsForVegType() breaks the valid observations up by vegetation type and processes each vegetation type for that grid cell, then performInversion() computes the BRDF Model according to the inversion criterion selected in the input configuration file. The four inversion criterions available are: minimization of the root mean square error (RMSE), minimization of the BRDF coefficients variance, minimization of the White-Sky albedo variance, and the RMSE Heritage. They are selected by setting the parameter KernelSelectionCriterion in the input file to: 1 (RMSE), 2 (Coefficients variance), 3 (White-Sky albedo variance), or 4 (RMSE heritage running the MODIS BRDF Kernels, Ross Thick Li Sparse Reciprocal). Then calculateNbar() and calculateBlackAndWhiteSkyAlbedo() are performed, when determined they are needed. Once the BRDF model and associated quantities are computed then the results are written in the output file.

2.1.2.2 PerformInversion()

This routine is the core of the algorithm as it performs the full inversion of the BRDF when possible; or the magnitude inversion when the full inversion is not possible, or copies the archetypal shape when possible if both inversions failed. The logic implemented is described in Figure 3.

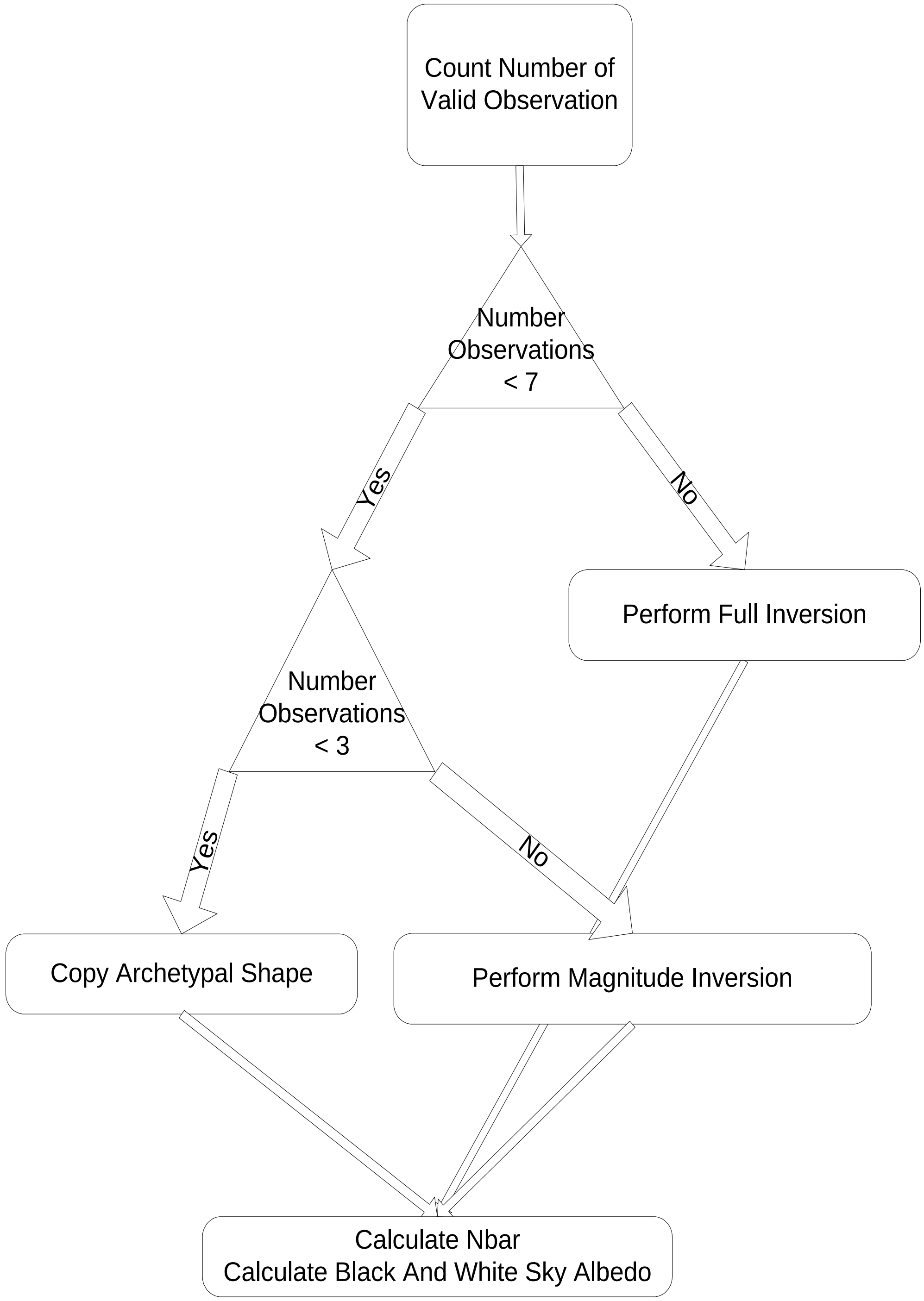

Figure 3. PerformInversion() Logic Flow

2.1.2.3 performAlbedoFullInversion()

This routine performs the full BRDF inversion if enough data is available, currently seven observations. This is a configurable parameter set up by the variable `FullInversionMinCount` given in the input configuration file. For the selected inversion criterion, the best model is the model with the smallest error (RMSE, coefficient variance, white-sky albedo variance, or RMSE Heritage).

2.1.2.4 performAlbedoMagnitudeInversion()

When a full BRDF inversion is not possible, a magnitude (one dimensional inversion) is attempted if enough data is available. The number of available data is set to three at this time, but is configurable by the parameter `MagInversionMinCount` in the input file. The unknown scaling parameter is derived from the data and the available archetypal shape previously stored for that cell.

2.1.2.5 calculateNbar()

Once the model is determined, the Nadir BRDF Adjusted Reflectance (NBAR) can easily be evaluated. It is given by the value of the BRDF model evaluated at the mean solar zenith angle, for Nadir viewing geometry, i.e. for the sensor zenith angle equal to zero and the relative azimuth also equal to zero (principal plane). The mean Solar Zenith angle is computed and stored in this routine for use in the computation of the Black-Sky albedo.

2.1.2.6 calculateBlackAndWhiteSkyAlbedo()

Once the BRDF model is obtained, for the selected criterion and by one if the available inversion (full, magnitude or look up of archetypal shape), then the Black-Sky and White-Sky Albedoes can easily be computed from stored LUT values. The White-Sky albedoes, for each of the 12 available kernels, are stored in the corresponding LUT as the first item with zenith angle equal to –9999.99. For instance, the Ross-Thick white-Sky albedo according to the LUT hk_Ross_Thick.lut is equal to 0.18918039.

The Black-Sky albedo is evaluated at the mean solar zenith angle by interpolation of the LUT values at the current mean solar zenith angle.

2.1.3 Graceful Degradation

2.1.3.1 Graceful Degradation Inputs

There is one case where input graceful degradation is indicated in the Gridded Surface Albedo IP.

1. An input retrieved for the algorithm had its N_Graceful_Degradation metadata field set to YES (propagation).

2.1.3.2 Graceful Degradation Processing

None.

2.1.3.3 Graceful Degradation Outputs

None.

2.1.4 Exception Handling

Method return values are tested for failure flags. If a method does fail, the failure is passed up the call stack and reported in the algorithm’s output log.

2.1.5 Data Quality Monitoring

No data quality monitoring is performed for this algorithm's outputs.

2.1.6 Computational Precision Requirements

Calculations are performed using a mix of 32 and 64 bit floating point values.

2.1.7 Algorithm Support Considerations

The kernel selection parameter within the /vobs/PRO/cfg/ProGipViirsGridToGridLSA_CFG.xml needs to be monitored. Also, the Ingest Coefficients may need to be adjusted over the course of the mission.

2.1.8 Assumptions and Limitations

2.1.8.1 Assumptions

Daily gridded surface reflectance IP files are required as inputs as well as archetypal BRDF shapes.

2.1.8.2 Limitations

None.

3.0 GLOSSARY/ACRONYM LIST

3.1 Glossary

The current glossary for the NPOESS program, D35836_G_NPOESS_Glossary, can be found on eRooms. Table 3 contains those terms most applicable for this OAD.

Table 3. Glossary

TERM	DESCRIPTION
Algorithm	A formula or set of steps for solving a particular problem. Algorithms can be expressed in any language, from natural languages like English to mathematical expressions to programming languages like FORTRAN. On NPOESS, an algorithm consists of: 1. A theoretical description (i.e., science/mathematical basis) 2. A computer implementation description (i.e., method of solution) 3. A computer implementation (i.e., code)
Algorithm Configuration Control Board (ACCB)	Interdisciplinary team of scientific and engineering personnel responsible for the approval and disposition of algorithm acceptance, verification, development and testing transitions. Chaired by the Algorithm Implementation Process Lead, members include representatives from IWPTB, Systems Engineering & Integration IPT, System Test IPT, and IDPS IPT.
Algorithm Verification	Science-grade software delivered by an algorithm provider is verified for compliance with data quality and timeliness requirements by Algorithm Team science personnel. This activity is nominally performed at the IWPTB facility. Delivered code is executed on compatible IWPTB computing platforms. Minor hosting modifications may be made to allow code execution. Optionally, verification may be performed at the Algorithm Provider's facility if warranted due to technical, schedule or cost considerations.
Ancillary Data	Any data which is not produced by the NPOESS System, but which is acquired from external providers and used by the NPOESS system in the production of NPOESS data products.
Auxiliary Data	Auxiliary Data is defined as data, other than data included in the sensor application packets, which is produced internally by the NPOESS system, and used to produce the NPOESS deliverable data products.
EDR Algorithm	Scientific description and corresponding software and test data necessary to produce one or more environmental data records. The scientific computational basis for the production of each data record is described in an ATBD. At a minimum, implemented software is science-grade and includes test data demonstrating data quality compliance.
Environmental Data Record (EDR)	*[IORD Definition]* Data record produced when an algorithm is used to convert Raw Data Records (RDRs) to geophysical parameters (including ancillary parameters, e.g., cloud clear radiation, etc.). *[Supplementary Definition]* An Environmental Data Record (EDR) represents the state of the environment, and the related information needed to access and understand the record. Specifically, it is a set of related data items that describe one or more related estimated environmental parameters over a limited time-space range. The parameters are located by time and Earth coordinates. EDRs may have been resampled if they are created from multiple data sources with different sampling patterns. An EDR is created from one or more NPOESS SDRs or EDRs, plus ancillary environmental data provided by others. EDR metadata contains references to its processing history, spatial and temporal coverage, and quality.
Model Validation	The process of determining the degree to which a model is an accurate representation of the real-world from the perspective of the intended uses of the model. [Ref.: DoDD 5000.59-DoD Modeling and Simulation Management]
Model Verification	The process of determining that a model implementation accurately represents the developer's conceptual description and specifications. [Ref.: DoDD 5000.59-DoD Modeling and Simulation Management]
Operational Code	Verified science-grade software, delivered by an algorithm provider and verified by IWPTB, is developed into operational-grade code by the IDPS IPT.

TERM	DESCRIPTION
Operational-Grade Software	Code that produces data records compliant with the System Specification requirements for data quality and IDPS timeliness and operational infrastructure. The software is modular relative to the IDPS infrastructure and compliant with IDPS application programming interfaces (APIs) as specified for TDR/SDR or EDR code.
Raw Data Record (RDR)	*[IORD Definition]* Full resolution digital sensor data, time referenced and earth located, with absolute radiometric and geometric calibration coefficients appended, but not applied, to the data. Aggregates (sums or weighted averages) of detector samples are considered to be full resolution data if the aggregation is normally performed to meet resolution and other requirements. Sensor data shall be unprocessed with the following exceptions: time delay and integration (TDI), detector array non-uniformity correction (i.e., offset and responsivity equalization), and data compression are allowed. Lossy data compression is allowed only if the total measurement error is dominated by error sources other than the data compression algorithm. All calibration data will be retained and communicated to the ground without lossy compression. *[Supplementary Definition]* A Raw Data Record (RDR) is a logical grouping of raw data output by a sensor, and related information needed to process the record into an SDR or TDR. Specifically, it is a set of unmodified raw data (mission and housekeeping) produced by a sensor suite, one sensor, or a reasonable subset of a sensor (e.g., channel or channel group), over a specified, limited time range. Along with the sensor data, the RDR includes auxiliary data from other portions of NPOESS (space or ground) needed to recreate the sensor measurement, to correct the measurement for known distortions, and to locate the measurement in time and space, through subsequent processing. Metadata is associated with the sensor and auxiliary data to permit its effective use.
Retrieval Algorithm	A science-based algorithm used to 'retrieve' a set of environmental/geophysical parameters (EDR) from calibrated and geolocated sensor data (SDR). Synonym for EDR processing.
Science Algorithm	The theoretical description and a corresponding software implementation needed to produce an NPP/NPOESS data product (TDR, SDR or EDR). The former is described in an ATBD. The latter is typically developed for a research setting and characterized as "science-grade".
Science Algorithm Provider	Organization responsible for development and/or delivery of TDR/SDR or EDR algorithms associated with a given sensor.
Science-Grade Software	Code that produces data records in accordance with the science algorithm data quality requirements. This code, typically, has no software requirements for implementation language, targeted operating system, modularity, input and output data format or any other design discipline or assumed infrastructure.
SDR/TDR Algorithm	Scientific description and corresponding software and test data necessary to produce a Temperature Data Record and/or Sensor Data Record given a sensor's Raw Data Record. The scientific computational basis for the production of each data record is described in an Algorithm Theoretical Basis Document (ATBD). At a minimum, implemented software is science-grade and includes test data demonstrating data quality compliance.
Sensor Data Record (SDR)	*[IORD Definition]* Data record produced when an algorithm is used to convert Raw Data Records (RDRs) to calibrated brightness temperatures with associated ephemeris data. The existence of the SDRs provides reversible data tracking back from the EDRs to the Raw data. *[Supplementary Definition]* A Sensor Data Record (SDR) is the recreated input to a sensor, and the related information needed to access and understand the record. Specifically, it is a set of incident flux estimates made by a sensor, over a limited time interval, with annotations that permit its effective use. The environmental flux estimates at the sensor aperture are corrected for sensor effects. The estimates are reported in physically meaningful units, usually in terms of an angular or spatial and temporal distribution at the sensor location, as a function of spectrum, polarization, or delay, and always at full resolution. When meaningful, the flux is also associated with the point on the Earth geoid from which it apparently originated. Also, when meaningful, the sensor flux is converted to an equivalent top-of-atmosphere (TOA) brightness. The associated metadata includes a record of the processing and sources from which the SDR was created, and other information needed to understand the data.

TERM	DESCRIPTION
Temperature Data Record (TDR)	*[IORD Definition]* Temperature Data Records (TDRs) are geolocated, antenna temperatures with all relevant calibration data counts and ephemeris data to revert from T-sub-a into counts. *[Supplementary Definition]* A Temperature Data Record (TDR) is the brightness temperature value measured by a microwave sensor, and the related information needed to access and understand the record. Specifically, it is a set of the corrected radiometric measurements made by an imaging microwave sensor, over a limited time range, with annotation that permits its effective use. A TDR is a partially-processed variant of an SDR. Instead of reporting the estimated microwave flux from a specified direction, it reports the observed antenna brightness temperature in that direction.

3.2 Acronyms

The current acronym list for the NPOESS program, D35838_G_NPOESS_Acronyms, can be found on eRooms. Table 4 contains those terms most applicable for this OAD.

Table 4. Acronyms

TERM	DESCRIPTION
AM&S	Algorithms, Models & Simulations
API	Application Programming Interfaces
ARP	Application Related Product
CDFCB-X	Common Data Format Control Book - External
DMS	Data Management Subsystem
DPIS ICD	Data Processor Inter-subsystem Interface Control Document
DQTT	Data Quality Test Table
INF	Infrastructure
ING	Ingest
IP	Intermediate Product
LUT	Look-Up Table
MDFCB	Mission Data Format Control Book
QF	Quality Flag
SDR	Sensor Data Record
SI	International System of Units
TBD	To Be Determined
TBR	To Be Resolved
TOA	Top of the Atmosphere

4.0 OPEN ISSUES

Table 5. TBXs

TBX ID	Title/Description	Resolution Date
None		