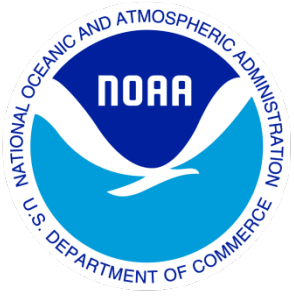
Climate Data Record Program

Transitioning CDRs from Research to Operations (R2O)



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1. CDR Research-to-Operations Overview

1.1 Introduction

These guidelines define the process used by the National Oceanic Atmospheric Administration's (NOAA) Climate Data Record Program (CDRP) to transition a Climate Data Record (CDR) from research to Initial Operational Capability (IOC) at the National Climatic Data Center (NCDC). This process is commonly called the CDR Research-to-Operations (R2O) transition process. A subsequent process will further transition these products from IOC to Full Operational Capability (FOC) but is outside the scope of this document. Figure 1 is a diagram illustrating the CDR end-to-end concept. The guidelines defined in this document only pertain to the R2O subsection of Figure 1.

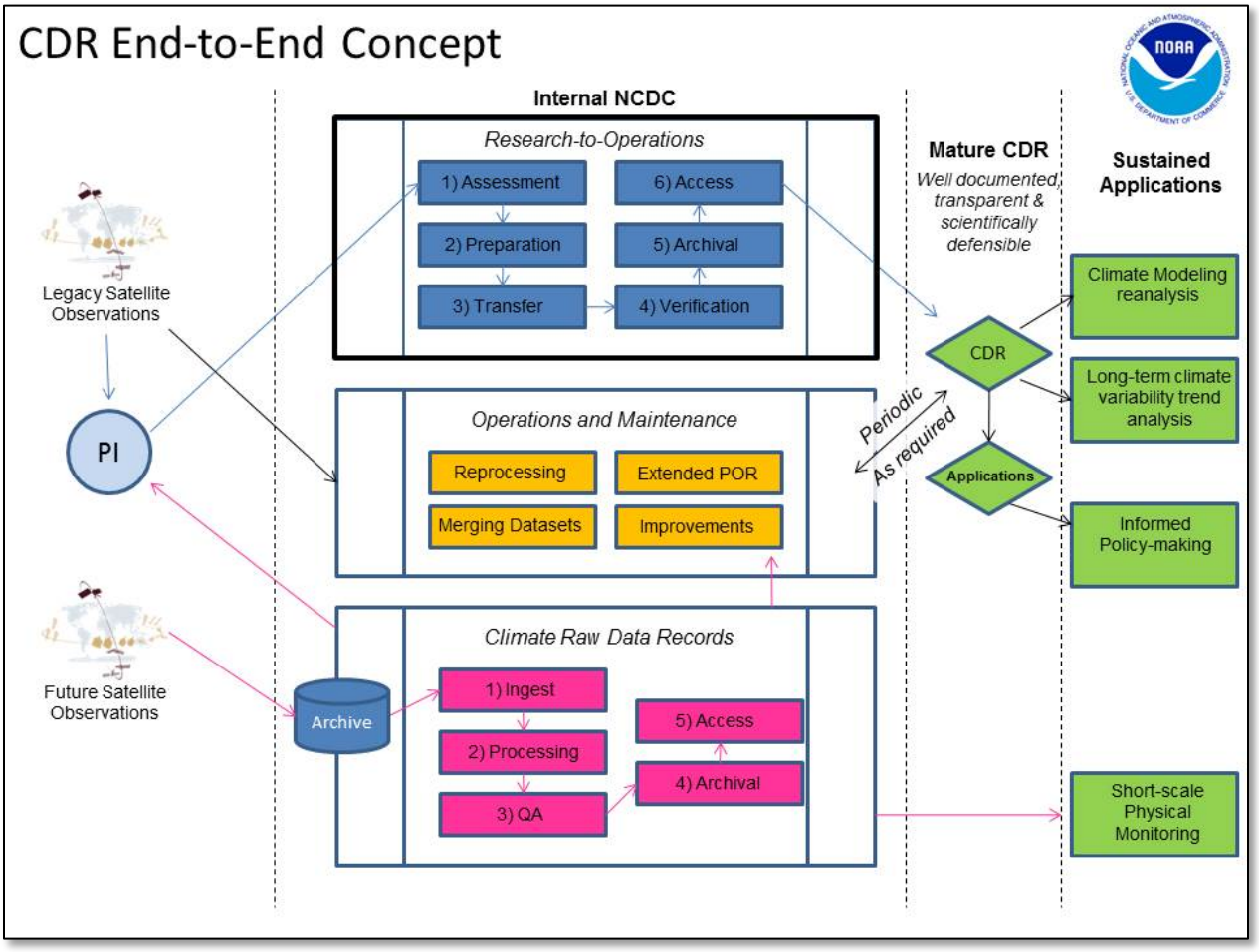


Figure 1: CDR End-to-End Concept.

For the purpose of this document, ‘external’ is defined as originating from a Principal Investigator (PI) outside of NCDC as opposed to ‘internal’ which originates from within NCDC. Regardless of origin, these guidelines ensure all CDRs meet the Global Climate Observing System (GCOS) standard of quality outlined in Appendix G. The maturity of an operational CDR can be described as either Initial Operational Capability (IOC) or Full Operational Capability (FOC). IOC processes describe the preliminary R2O requirements that need to be met before making a CDR accessible to the public. Acknowledging there is no ‘end state’ to a climate record, the Operations and Maintenance (O&M) and FOC processes describe the stewardship that maintains continuous production and cyclical improvements to a CDR. The guidelines defined in this document specifically deal only with the IOC processes.

1.2 CDR R2O Process

Figure 2 illustrates the CDR R2O process at NCDC. There are six phases toward preparing a CDR for IOC: Assessment, Preparation, Transfer, Verification, Archival, and Access. The entire process is a collaborative effort touching five separate branches spanning three divisions within NCDC, as well as the PI and the CDR program. Successful transition of CDRs requires excellent coordination and communication among all parties. Each party needs to understand and execute their roles and responsibilities for the process to be successful. These individual roles and responsibilities are defined in the Integrated Product Team (IPT) charter (CDRP-CHARTER-0177). The IPTs are formed for the purpose of efficient and effective collaboration, coordination, and execution of the tasks required to complete the IOC transition.

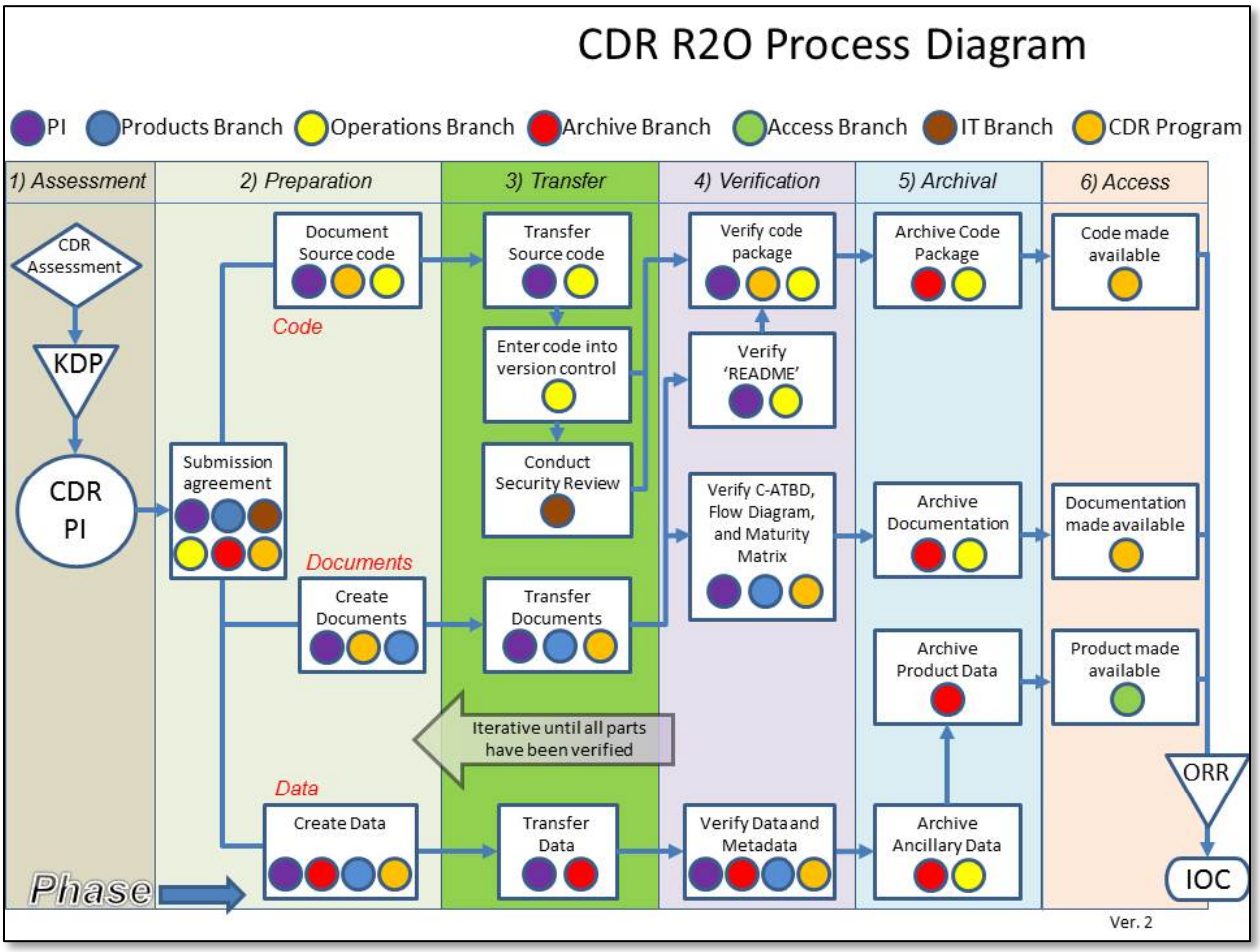


Figure 2: CDR R2O Process Diagram

1.3 Definition of IOC

A CDR is considered IOC once it has met all the source code, documentation, and data requirements; is preserved in the NCDC archive; passes an Operational Readiness Review (ORR) (Appendix F), and is made publicly accessible. The CDR is at a level of maturity such that all criteria on the Maturity Matrix (Appendix E) are at level 3 or greater. Completing the ORR ensures that the final CDR is transparent and scientifically defensible. IOC is considered the first phase of the publicly released CDR.

2. General Roles and Responsibilities

Specific roles and responsibilities are defined in the Integrated Product Team (IPT) charter (CDRP-CHARTER-0177).

2.1 CDR Program Office

The NOAA CDR Program Office, located at NCDC, serves a CDR planning and management function and is responsible for the business affairs such as performance metrics, budgets, grants and contracts management. To maintain oversight on the multiple CDRs in transition the CDR Program Manager will appoint an R2O Project Manager (PM) to monitor each CDR in the R2O transition process. The R2O PM will provide templates and program guidance to the IPT; monitor and assess risks; review source code, documents, and data against program standards; and report progress and/or issues to the CDR Program Manager.

2.2 Principal Investigator

The PI is the creator of the CDR in transition and is the primary person responsible for updating/creating the source code, documentation, and data to meet IOC requirements in a timely manner. This frequently involves several members of the PI's team. The process to achieve IOC is further detailed in Section 3.

2.3 Products Branch

The Products Branch (PB) Chief will designate a lead scientific subject matter expert (SME) for each CDR being considered for R2O transition. The SME tasks primarily consist of conducting the initial assessment, verification of PI submissions, and leading the scientific efforts needed to reach IOC.

2.4 Archive Branch

The Archive Branch (AB) Chief will appoint a team member to facilitate the archival process for long term stewardship of the CDR source code, documentation, and data. This member assures archive branch tasks are completed in a timely manner. The tasks primarily consists of reviewing metadata content and format, suggesting file naming conventions, and drafting the submission agreement (SA). The SA requires significant coordination between the PI, SME, Operations, Access, IT, and Archive branches.

2.5 Operations Branch

The Operations Branch (OB) Chief will appoint a team member to assure the operations branch tasks are completed in a timely manner. The tasks primarily consist of verifying the source code package meets standards, requesting an initial security review, and packaging the code and documents for archive.

2.6 Information Technology Branch

The IT Branch (ITB) Chief will appoint a team member to assure IT tasks are completed in a timely manner. The tasks primarily consist of reviewing the SA and performing a security review on the source code.

2.7 Access Branch

The Data Access and Analysis Branch (DAAB) Chief will appoint a team member to assure data access tasks are completed in a timely manner. The tasks primarily consist of verifying metadata against the standards and making the data available to the public.

3. CDR Transition Process

3.1 Assessment Phase

3.1.1 Initial PI Assessment Package

In order to conduct an assessment of a potential CDR, the CDR Program Office will introduce the SME and ask the PI for an initial product package. The contents of this package should include a significant portion of the source code, scientific paper or draft Climate Algorithm Theoretical Basis Document (C-ATBD), a completed Maturity Matrix, a data flow diagram, and a sample of the product data. The SME will review the package as part of the CDR assessment.

3.1.2 CDR Assessment

Prior to committing significant NCDC resources to a specific CDR, a comprehensive assessment is conducted by the SME to determine whether the CDR is mature enough for transition. This assessment will help determine the level of effort needed to meet all

the IOC requirements listed on the ORR checklist (Appendix F). The SME will make a presentation to the CDR Program Manager and also make a recommendation whether the CDR is ready for IOC transition. A sample CDR assessment is shown in Appendix A. The CDR Program Manager reviews the assessment and makes the final determination whether to proceed with the transition to IOC or not. This is the Key Decision Point (KDP) shown in Figure 2. If the CDR is chosen for transition, an estimate of the data volume and data types will be provided to the Archive and Access branches for planning purposes. A delivery schedule is then coordinated between the PI, SME, and R2O project manager to ensure that the multiple CDRs being transitioned each fiscal year are staggered. This is to prevent any potential resource conflicts that could arise from too many CDRs being in the same transition phase at the same time.

3.2 Preparation Phase

The preparation phase is typically the longest and most labor intensive. After the CDR is selected for transition to IOC, the CDR Program Office will inform the PI to start work on the CDR package. The PI will complete a request to archive using ATRAC (https://www.ncdc.noaa.gov/atrac/index.html) to ensure that all parts of the CDR package will be properly archived. The CDR package consists of well documented source code, supporting documentation, the product data, and if needed any ancillary data.

3.2.1 Source Code

The PI will ensure the source code meets the minimum standards listed in the *CDR Program General Software Coding Standards* (CDRP-STD-0007) (http://www.ncdc.noaa.gov/cdr/guidelines.html). See Appendix C for a short example. The source code will also be accompanied by a README file which provides step by step instructions on how to setup and run the source code.

3.2.2 Documents

The PI will create the following documents:

- An Implementation Plan using the template provided by the CDRP office (http://www.ncdc.noaa.gov/cdr/guidelines.html).
- Climate Algorithm Theoretical Basis Document (C-ATBD) using the template provided by the CDRP office (http://www.ncdc.noaa.gov/cdr/guidelines.html).
- Data Flow Diagram outlining the CDR production process (e.g. Appendix D)
- Maturity Matrix (http://www.ncdc.noaa.gov/cdr/guidelines.html). In order to reach IOC, all columns must be rated at a level 3 or above (e.g. Appendix E)

3.2.3 Data

The PI will ensure the CDR dataset is in NetCDF format, meets current Climate and Forecast (CF) metadata conventions (http://cf-pcmdi.llnl.gov/) and adheres to the file naming conventions documented in the SA. The PI will also identify any unique input or ancillary data sets that are required to create the CDR so they can be included in the SA and archived, if needed.

3.2.4 Submission Agreement

The Archive Branch reviews the request to archive and drafts the SA which defines in detail the CDR submission package for ingest and archive, data transfer mechanism and specific data access needs as well as identifying additional roles and responsibilities. Drafting the SA involves coordinating with several of the NCDC Branches and the PI. This agreement is a living document as long as the data reside within the NCDC archive. The PI, Operations and Archive team members will stay actively engaged during the entire submission process. An example of a CDR submission agreement is in Appendix B.

3.3 Transfer Phase

3.3.1 Send Samples

As progress is made by the PI on the source code, documents, and data, samples of each should be sent to the IPT to ensure the guidelines and standards are being met. This helps the PI by ensuring that their efforts are on track or can be refocused if needed. Subsequently the Preparation, Transfer, and Verification Phases are closely related and will be iterative until all the parts have been fully verified.

3.3.2 Data Transfer

Before the PI begins the main data transfer the ingest team member will ensure that the transfer protocols described in the SA are operational and that the NCDC ingest location has sufficient space to receive the CDR. The Archive Branch team member will complete the dataset at the Dataset Readiness Review (DSRR) before the full transfer of data takes place. After the DSRR is complete, the PI and ingest team member will monitor the transfer of the data to NCDC, and verify that it transferred correctly as described in the SA.

3.3.3 Version Controlling Source Code

The Operations Branch team member will enter the CDR source code into the NCDC version control system. Version control allows easy management of changes to documents, code and other information stored as computer files. This is also the staging area for source code requiring a security review.

3.3.4 Security Review

After the source code has been entered into the NCDC version control system, the Operations Branch team member will request an initial security review be conducted by the IT Branch. Although passing the security review is not a prerequisite for IOC it does have a twofold purpose. First, it is a way to provide feedback to the PI on any security vulnerabilities found during the initial review of their code. Second, the security review allows for future personnel resource planning when transitioning from IOC to FOC. When a CDR is selected for FOC transition, any vulnerability that was identified will need to be fixed before the code can be deployed in the production environment.

3.4 Verification Phase

The CDR source code, documentation and data need to be verified by the IPT members, to ensure the submission meets the required guidelines and standards. It is necessary for NCDC to receive sample files of source code, documents, and data before transfer of the final submission to identify any potential problems early in the process. Any items that fail verification will be returned to the PI along with recommendations for corrections.

3.5 Archival Phase

After all parts of the CDR have been verified, the Archive Branch stores the code package (source code, README, and results of the security review), documentation package (C-ATBD, Data Flow Diagram, and Maturity Matrix), and the data (CDR product and any required input/ancillary data) in the archive as outlined in the SA. Ensuring that the source code, documentation and data are all archived with a unique version identifier satisfies Global Climate Observing System (GCOS) recommendation 7, *'Version management of FCDRs and products, particularly in connection with improved algorithms and reprocessing'* (Ref. Appendix G).

3.6 Access Phase

The role of the Access Branch is to make the archived data available to the public. This can be accomplished through a variety of access methods (e.g. ftp, Thematic Real-Time Environmental Distributed Data Services (THREDDS), HDSS Access System (HAS)). The Access Branch is also in the process of making the Thematic CDRs available via a mapped based GIS application (http://www.climate.gov/data/maps-and-data). The Archive Branch team member works with the PI and IPT to create the discovery metadata for the CDR product. The CDR program office then provides full and open access to the source code, all documentation and data via the CDR web site (http://www.ncdc.noaa.gov/cdr/operationalcdrs.html). This final phase satisfies Global Climate Observing System (GCOS) recommendation 8, *'Arrangements for access to FCDR, products, and all documentation'* (Ref. Appendix G).

3.7 Operations and Maintenance

Completing R2O transition and obtaining IOC status is considered the first iteration of the publicly-released CDR. As stated in the GCOS guidance, CDRs require periodic improvements to an ever expanding climate record. CDRs have to be updated as new observational datasets are acquired or improvements to algorithms are made. These updates require the CDR go through a defined Change Request (CR) process and be approved by the Configuration Control Board. This process is beyond the scope of this document. Regardless of the complexity of the change to a CDR, the key to maintaining transparency and scientific defensibility is a well-documented history of the changes.

3.8 IOC to FOC

The full progression from IOC to FOC will be detailed in a subsequent CDR guidelines document.

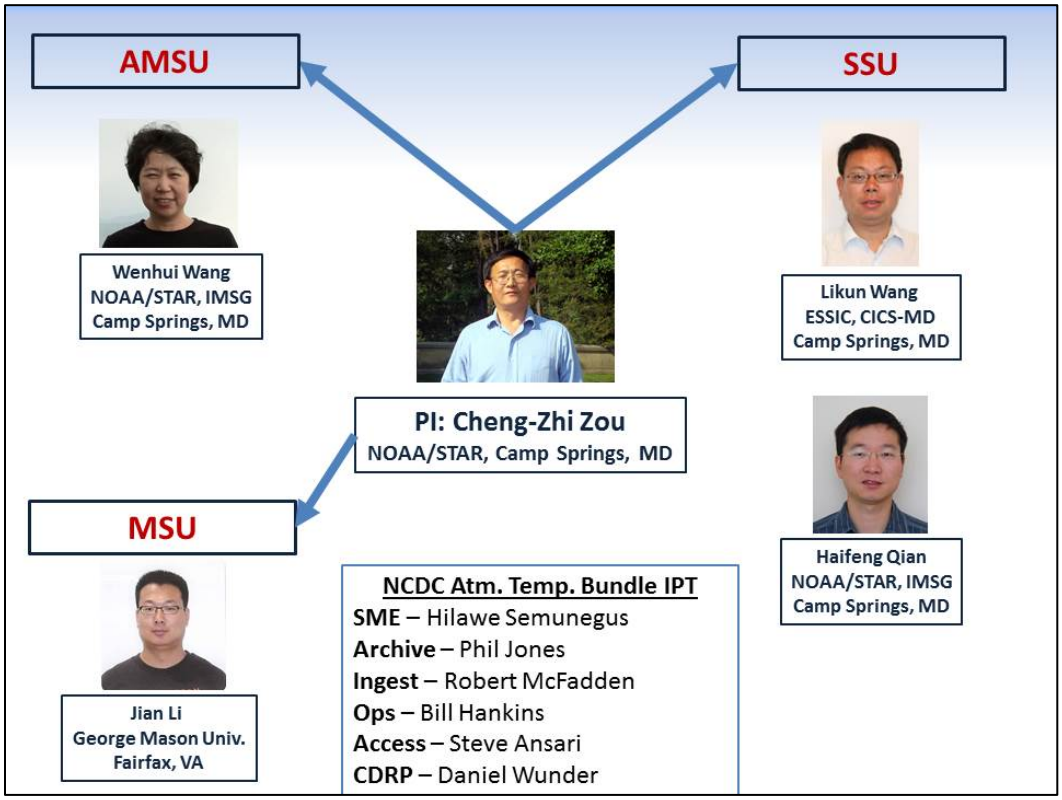
Appendix A – CDR Assessment Example

Atmospheric Temperature Bundle (MSU/AMSU/SSU CDR): Assessment of CDR Readiness

By Hilawe Semunegus, SME
NCDC Remote Sensing and Applications Division

Initial Assessment

- Describe the Atm. Temp Bundle (MSU-AMSU-SSU) CDR Project
- Overview of the assessment for the Integrated Product Team (IPT) and others who have a vested interest in the project.
- Establish the maturity of the CDR
- Identify strengths and weaknesses of the CDR



What is in the Atmospheric Temperature Bundle?

- Temperature sounding data from the Advanced Microwave Sounding Unit (AMSU/MSU) and Stratospheric Sounding Unit (SSU)
- Record extends from 1979 to 2006 (MSU/SSU) and 1998-present (AMSU)
- FCDRs or intercalibrated brightness temperatures
- TCDRs or Gridded brightness temperatures (some blended layers too)

Scientific goals for the Atm. Temp. Bundle CDR?

1. Develop a consistent AMSU/MSU/SSU radiance period of record
2. Blend radiances from MSU/SSU (pre-2006) with the equivalent channels from AMSU (1998-present)
3. Complete the FCDR work for all AMSU/MSU/SSU channels that are not covered in Ferraro's AMSU FCDR/TCDR Hydrological Bundle

FCDR Products

CDR(s) (Validated Outputs)	Period of Record	Spatial Resolution; Projection information	Time Step	Data format	Inputs	Uncertainty Estimates (in percent or error)	Collateral Products (unofficial and/or unvalidated)
MSU FCDR (3 chs)	1979-2006	110 km	25.6 sec (scan-line)	netCDF	Raw Counts SNO Cal. Coefficients	Abs. Bias: 0.5-1 K Rel. bias 0.05-0.1 K	Limb, diurnal, corrected L1C
AMSU-A FCDR (11 chs)	1998-present	45 km	8 sec. (scan-line)	netCDF	Raw Counts SNO Cal. Coefficients	Abs. Bias: 0.5-1 K Rel. bias 0.05-0.1 K	Limb, diurnal, freq. corrected-L1C
SSU FCDR (3 chs) (Cell pres. CO2 corrected)	1979-2006	147 km	32 sec. (scanline)	netCDF	SSU L1B MERRA	~ 0.5 K	Limb, Dirunal, Atmo. CO2 corrected L1C

TCDR Products

CDR(s) (Validated Outputs)	Period of Record	Spatial Resolution; Projection information	Time Step	Data format	Inputs	Uncerainty Estimates (in percent or error)	Collateral Products (unofficial and/or unvalidated)
MSU-only TCDR (3 chs)	1979-2006	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	MSU FCDR	Inter-sat bias: 0.05-0.1 K Inter-sat σ: 0.03-0.05K	
SSU-only TCDR (3 chs)	1979-2006	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	SSU FCDR	0.5 K	
AMSU-A-only TCDR (11 chs)	1998-presen	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	AMSU-A FCDR MERRA	Inter-sat ias: 0.05-0.1 K Inter-Sat σ: 0.03-0.05K	
MSU/AMSU-A Merged TCDR (3 chs)	1979-present	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	MSU FCDR AMSU-A TCDR MERRA	0.03 - 0.05 K	
SSU/AMSU-A Merged TCDR (3 chs)	1979-present	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	SSU TCDR AMSU-A TCDR MERRA	0.5 K	

Users for FCDRs and TCDRs

1. MSU FCDR: Reanalysis development community including NCEP CFSR, NASA MERRA, ECMWF, etc. (already being used by NCEP and NASA with published papers)
2. AMSU FCDR: International community such as GSICS for satellite consistency/accuracy assessments (no published papers)
3. AMSU FCDR: Academic community for climate change, validation studies
4. AMSU/MSU/SSU TCDRs: Climate science community (e.g. WCRP and IPCC) for upper air temperature trend and anthropogenic forcing assessments (recent Nature and PNAS papers published on this TCDR)
5. AMSU/MSU TCDRs: Used in BAMS report
6. Interest from TCDR development community such as UAH, RSS, and STAR for inter-comparison of algorithm and dataset validity (do we have enough upper air related CDRs?)

Evaluation of Transition Requirements for Atm. Temp. Bundle CDR

CDR Product: TCDR – NH Snow Cover, 1966-2012 (~500 KB)
GEOSS Societal Benefit: Climate

Code

- Code is in **Fortran, Java and IDL**
- Headers not being used at all
- Sparsely commented for AMSU/MSU Fortran/Java code
- Decently commented for SSU IDL code
- No README text files found
- CDRP will request that the code developers work diligently to address coding requirements

Data

- Data provided are netCDF-4 files
- Non merged files are usually < 5 MB
- Merged files are contained in one file for an entire period of record and can be as large as 250 MB. Will probably have to negotiate with PI to break this apart if data production is still active. May be OK for a static or set period of record (1979-2006)
- Not in CF-compliant form
- Filenaming convention not being followed (e.g. delimiters have "+" in them"
- Extensive time will be spent to get investigators to follow CF standards and CDR metadata guidelines

Documentation

- AMSU/MSU CATBD almost completed
- SSU CATBD has not been started
- Flow charts available for AMSU/MSU, not for SSU yet
- OAD was not provided.

❖ Code
- ✓ Document the code (including header information) **25%**
- Create README (cookbook) – Step by step instructions to run
- Enter code in subversion
- Archive source code and README instructions
- Make source code and README package available (web)

❖ Documents
- ✓ Flow chart of process **75%**
- ✓ C-ATBD **75%**
- ✓ Maturity matrix – level 3 and above **40%**
- Source code headers (robodoc)
- Archive document package
- FGDC metadata for product
- Make docs available (web)

❖ Data
- ✓ Data in NetCDF format **25%**
- Submission agreement in place
- Archive available Input/Ancillary data
- Product archived
- Product available (THREDDS)

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What is the maturity?

Atmospheric Temperature Bundle (AMSU/MSU/SSU)

maturity level as of 12/10/2012

Climate Data Record (CDR) Maturity Matrix

Maturity	Software Readiness	Metadata	Documentation	Product Validation	Public Access	Utility
1	Conceptual development	Little or none	Draft Climate Algorithm Theoretical Basis Document (C-ATBD); paper on algorithm submitted	Little or None	Restricted to a select few	Little or none
2	Significant code changes expected	Research grade	C-ATBD Version 1+ ; paper on algorithm reviewed	Minimal	Limited data availability to develop familiarity	Limited or ongoing
3	Moderate code changes expected	Research grade; Meets int'l standards: ISO or FGDC for collection; netCDF for file	Public C-ATBD; Peer-reviewed publication on algorithm	Uncertainty estimated for select locations/times	Data and source code archived and available; caveats required for use.	Assessments have demonstrated positive value.
4	Some code changes expected	Exists at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed publication on algorithm; paper on product submitted	Uncertainty estimated over widely distributed times/location by multiple investigators; Differences understood.	Data and source code archived and publicly available; uncertainty estimates provided; Known issues public	May be used in applications; assessments demonstrating positive value.
5	Minimal code changes expected; Stable, portable and reproducible	Complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD, Review version of OAD, Peer-reviewed publications on algorithm and product	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Record is archived and publicly available with associated uncertainty estimate; Known issues public. Periodically updated	May be used in applications by other investigators; assessments demonstrating positive value
6	No code changes expected; Stable and reproducible; portable and operationally efficient	Updated and complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets current international standards for dataset	Public C-ATBD and OAD; Multiple peer-reviewed publications on algorithm and product	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation; quantified errors	Record is publicly available from Long-Term archive; Regularly updated	Used in published applications; may be used by industry; assessments demonstrating positive value

1 & 2	Research
3 & 4	IOC
5 & 6	FOC

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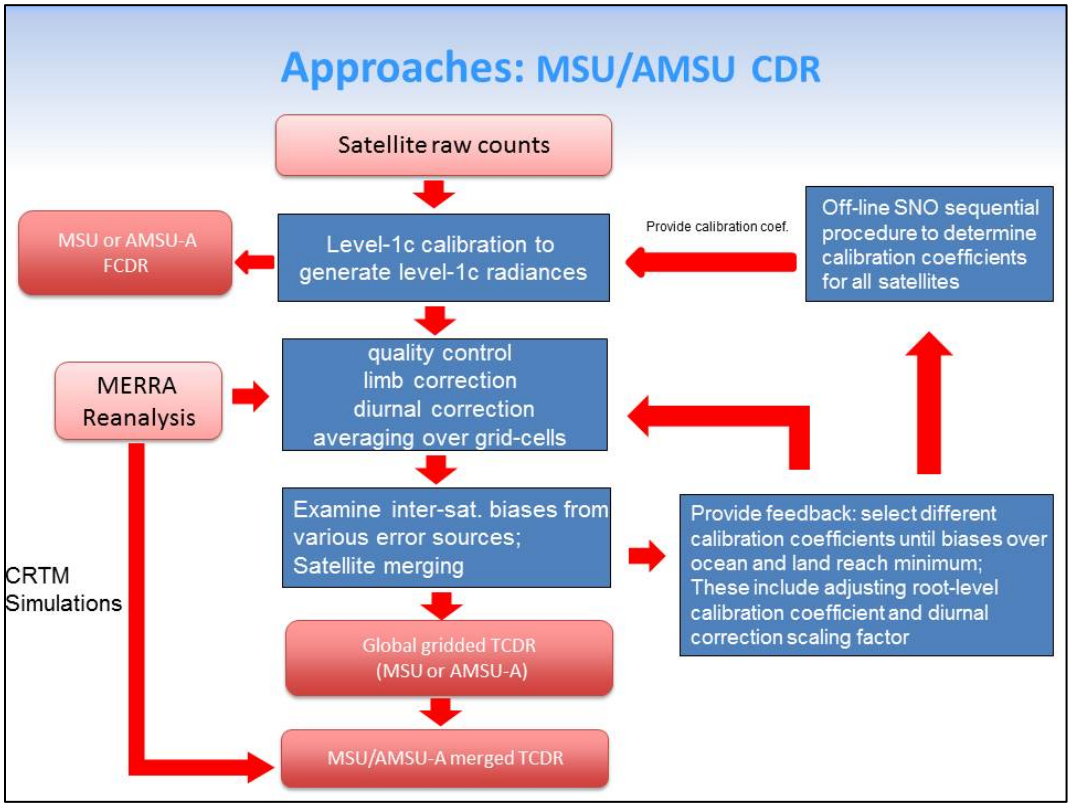
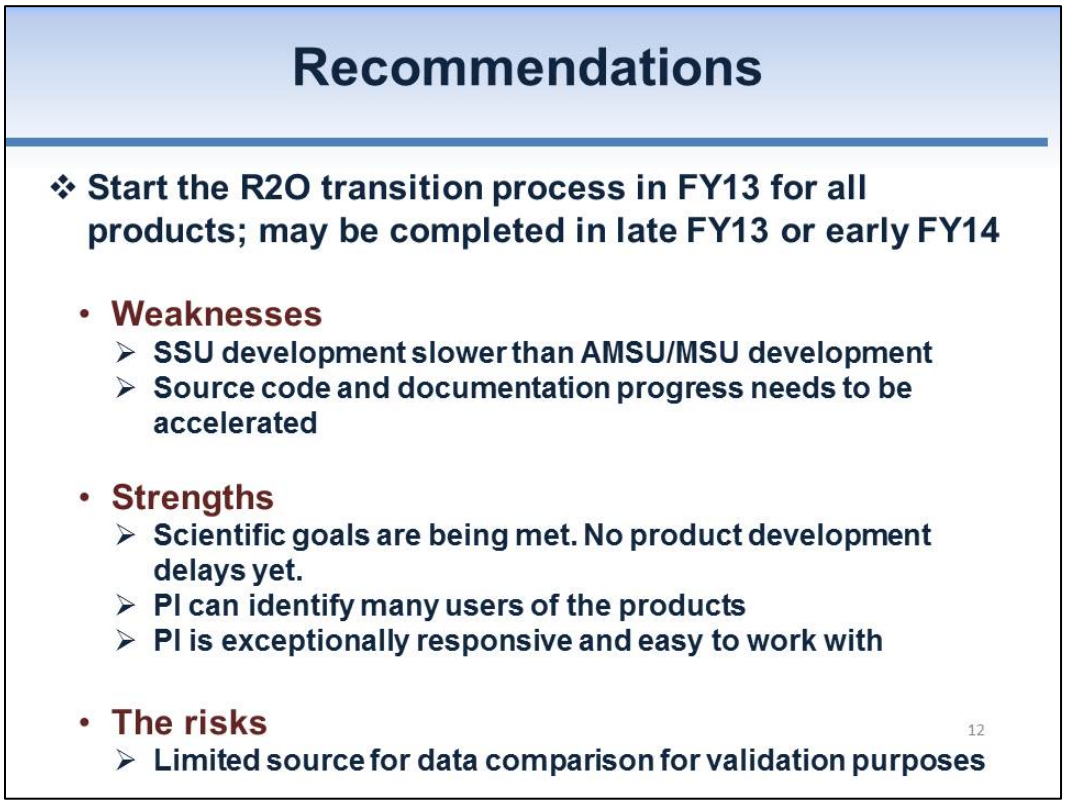

Approaches: MSU/AMSU CDR
Satellite raw counts
MSU or AMSU-A FCDR
Level-1c calibration to generate level-1c radiances
Provide calibration coef.
Off-line SNO sequential procedure to determine calibration coefficients for all satellites
MERRA Reanalysis
quality control
limb correction
diurnal correction
averaging over grid-cells
CRTM Simulations
Examine inter-sat. biases from various error sources; Satellite merging
Provide feedback: select different calibration coefficients until biases over ocean and land reach minimum; These include adjusting root-level calibration coefficient and diurnal correction scaling factor
Global gridded TCDR (MSU or AMSU-A)
MSU/AMSU-A merged TCDR


Recommendations
❖ Start the R2O transition process in FY13 for all products; may be completed in late FY13 or early FY14
• Weaknesses
➢ SSU development slower than AMSU/MSU development
➢ Source code and documentation progress needs to be accelerated
• Strengths
➢ Scientific goals are being met. No product development delays yet.
➢ PI can identify many users of the products
➢ PI is exceptionally responsive and easy to work with
• The risks
➢ Limited source for data comparison for validation purposes
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Appendix B – Submission Agreement Example

DATA SUBMISSION AGREEMENT

BETWEEN THE

NASA GODDARD SPACE FLIGHT CENTER

AND THE

NOAA NATIONAL CLIMATIC DATA CENTER

FOR THE

VEGETATION BUNDLE CDR VERSION 4

Revised: 2013-11-26

Sections:

Introduction

This document represents the agreement that the NASA Goddard Space Flight Center (the "**Provider**") and the NOAA National Climatic Data Center (the "**NCDC**") have reached for submitting the Provider's data, the Vegetation Bundle Climate Data Record (CDR) Version 4, to the NCDC for long-term preservation and support. This document is a joint effort between the Provider and the NCDC to accurately document the agreement and the expectations between the two entities.

Purpose and Scope

This Agreement establishes a plan by which to operate the data submission, public access and long-term archival of the data. It is neither a comprehensive data management plan nor a record of the decision to archive the data. The technical data submission model defined herein has been negotiated, reviewed and tested by both parties prior to its implementation.

This Agreement is effective upon the completion of a readiness review approval involving both parties. In order to ensure the quality and integrity of the data record in the archive, the Provider and NCDC agree to maintain this Agreement with accurate and up-to-date information through the life of the specified data submission. Either party may terminate this Agreement with proper notice to the other party.

Document Change Management

Data Submission Agreements are maintained by NCDC in a configuration management (CM) system. For changes to this Agreement, either from a coordinated review or an ad hoc request, the one initiating the wanted change is responsible for submitting a change request to the respective data manager, at abdoclib.ncdc@noaa.gov. Changes must be reviewed and approved by both NCDC and the Provider in order to modify the document baseline in the NCDC CM system.

References

The cited documents are applicable to or referenced from this Agreement.

A. References

#	Reference Document
1	NASA GSFC Land Long Term Data Record (LTDR) project home page: http://ltdr.nascom.nasa.gov/cgi-bin/ltdr/ltdrPage.cgi
2	NCDC Records Retention Schedule, 2013.
3	NESDIS Policy and Procedures for Determining Minimum Documentation Requirements for

	System Interconnections, NESDIS Chief Information Division, Version 2.1, September 28, 2012.
4	NOAA Climate Data Record Program (CDRP) Development Guidelines (available at http://www.ncdc.noaa.gov/cdr/guidelines.html).
5	Statement of Work (SOW) For Climate Data Record Sustainment and Maintenance -- Vermote SOW FY13, CDRP, 2013.

Contacts

Persons listed below have mutual obligations between the parties identified in this Agreement.

A. Provider Contacts

Provider Function	Provider Contact
Principal Investigator	Eric Vermote Principal Investigator / Physical Scientist NASA / GSFC +1 301-614-5413 eric.f.vermote@nasa.gov
Subject Matter Expert Data Submission	Martin Claverie Research Scientist NASA / GSFC +1 301-614-5196 martin.claverie@nasa.gov

B. NCDC Contacts

NCDC Function	NCDC Contact
Project Management	Daniel Wunder CDRP R2O Project Manager NCDC / RSAD / CDRP +1 (828) 257-3004 daniel.wunder@noaa.gov
Subject Matter Expert	Jessica Mathews Research Associate NCDC / RSAD / PB (CICS-NC)

	+1 828-257-3055 jessica.matthews@noaa.gov
IT Security	Jennifer Urzen NCDC Information System Security Officer NCDC / SSD / ITB +1 828-271-4353 jennifer.urzen@noaa.gov
Operations	Chunying Liu IT Specialist NCDC / RSAD / OB +1 828-350-2409 chunying.liu@noaa.gov
Ingest	Robert McFadden IT Specialist NCDC / RSAD / AB +1 828-257-3010 robert.mcfadden@noaa.gov
Archival Storage	David Bowman Data Manager / IT Specialist NCDC / RSAD / AB +1 828-271-4368 david.p.bowman@noaa.gov
Metadata	Philip Jones Archive Specialist NCDC / RSAD / AB +1 828-271-4472 philip.jones@noaa.gov
Access	Steve Ansari Physical Scientist NCDC / CSMD / DAAB +1 828-271-4611 steve.ansari@noaa.gov

Data Overview

The Vegetation Bundle Climate Data Record (CDR) Version 4 contains global daily AVHRR reflectance and Normalized Difference Vegetation Index (NDVI) with quality flags at pixel resolution (0.05 degree latitude x 0.05 degree longitude). The quality flags include a cloud mask (cloud shadow under development) and several flag indicating exclusion conditions (such as water, and high solar zenith angle). The CDR was produced by NASA Goddard Space Flight Center. The dataset spans from 1981 to present and is in netCDF-4 file format with CF-1.6 compliant metadata.

Additional vegetation CDR products are planned. These include the Leaf Area Index (LAI) and fraction of Photosynthetically Active Radiation absorbed by vegetation (fPAR). This SA will be updated with information regarding these products as the new data submissions are defined.

Below is a summary of the data covered by this Submission Agreement.

A. Data Submission Summary

#	Data Description	Data Volume
1a	AVHRR NDVI daily data files, from 1981 to Present	Historical (32-year period): ~340 GB total; ~10.6 GB per year ~11,687 files total Operational (daily): ~29.7 MB per daily file
1b	AVHRR Reflectance daily data files, from 1981 to Present	Historical (32-year period): ~2,050 GB total; ~64 GB per year ~11,687 files Operational (daily): ~179.6 MB per daily file
2	Vegetation Bundle Version 4 CDR Program Documentation Package, including a Data Flow Diagram, ATBD and Maturity Matrix	<10 MB per delivery
3	Vegetation Bundle Version 4 CDR Source Code Package	<100 MB per delivery

Schedule

Schedule for the events related to this Submission Agreement.

A. Schedule

#	Event Date	Event Description
1	November 2013 (precedes the NCDC Readiness Review)	Complete testing events based on this SA, including testing FTP connections to the ingest server with sample data and companion submission manifest file (**Provider and NCDC**)
2	November 13, 2013	Brief the NCDC Readiness Review Board for the operational ingest, archive and access decision **(NCDC)**
3	December 2013 (precedes the CDRP Operational Readiness Review)	Reach full operational capability (FOC) for the data submission, ingest, archive and access **(Provider and NCDC)**
4	December 13, 2013	Present the CDR Program Operational Readiness Review (ORR) for the initial operational capability (IOC) transition **(NCDC)**

Transfer Interface

The identified host server will connect with the ingest server to transfer the data according to the specified protocol.

A. Transfer Interface for Data Files

Host Organization Name	NASA GSFC (Maryland, USA)
Host Server Name	ftp://ltdr.nascom.nasa.gov
Host Path	/orders/for_NCDC/YYYY/
Ingest Organization Name	NOAA / NESDIS / NCDC
Ingest Server Name	ftp://ftp5.ncdc.noaa.gov (borg 3)

Ingest Path	/pub/upload/Ingest/CDR/VEG/
Transfer Protocol	Anonymous FTP Pull
Data Update Frequency	**Daily**
Data Availability Period	Data will be available for a time period sufficient for NCDC to pull the data
Data Ingest Frequency	**Hourly -** will check for files staged by the Provider and ingest files as they are identified and pulled by NCDC
Additional Information	The Provider may stage the historical data (~2.5 TB) in subsetted (e.g., 10-yr) periods for NCDC to pull until the data submission is complete. The Provider will coordinate the historical data transfer with the NCDC Ingest contact.

B. Transfer Interface for Source Code Files

Host Organization Name	NOAA / NESDIS / NCDC
Host Server Name	rainband
Host Path	N/A
Ingest Organization Name	NOAA / NESDIS / NCDC
Ingest Server Name	gulp2
Ingest Path	gulp2://pub/upload/Ingest/CDR/VEG/
Transfer Protocol	FTP Push
Data Update Frequency	**One-time** - updated as needed per delivery
Data Availability Period	N/A - data pushed to ingest server
Data Ingest Frequency	N/A - files staged by the Provider will be ingested as they are identified and pulled by NCDC
Additional Information	None

SIP Files for Ingest

Details on each type of file submitted by the Provider to the NCDC ingest system are below.

A. Vegetation Bundle Daily Data Files

File Description	Vegetation Bundle Daily Data Files (by product type and satellite)
File Name Pattern	<***product-name***>_<***version***>_<***product-type***>_<***sat-id***>_<***YYYYmmdd***>_c<***processing-date***>.nc
File Name Field Definitions	<***product-name***> = static product series name with the value, "AVHRR-Land" <***version***> = static product version number with the value, "v004" <***product-type***> = NASA product type identifier with the valid domain: "AVH09C1" = AVHRR surface reflectance product "AVH13C1" = AVHRR NDVI product <***sat-id***> = Source NOAA satellite ID with the valid domain: "NOAA-07", "NOAA-09", "NOAA-11", "NOAA-14", "NOAA-16", "NOAA-17", "NOAA-18" <***YYYYmmdd***> = Date of the data in the file, formatted as year, month and day, with the valid range from "19810101" to present c<***processing-date***> = Creation or processing date of the file identified with a 'c' followed by the year, month, day, hour, minute and second
File Name Example	AVHRR-Land_v004_AVH09C1_NOAA-16_20040812_c20130920200630.nc AVHRR-Land_v004_AVH13C1_NOAA-16_20040812_c20130920200630.nc
File Format	netCDF-4 files (classic)
File Compression	None
File Size (Range)	~29.7 MB per daily file for NDVI (AVH13C1) ~179.6 MB per daily file for Reflectance (AVH09C1)
File Count (Rate)	1 netCDF file per day for each (2) product type
Data Volume (Rate)	~10.6 GB per year for NDVI (AVH13C1) ~64 GB per year for Reflectance (AVH09C1)
File Rename/Repackage Instructions	N/A - Not required
Additional Information	None

B. Vegetation Bundle Documentation Package

File Description	Vegetation Bundle Documentation Package (tar file)
File Name Pattern	<***product-name***>_<***version***>_doc_c<***processing-date***>.tar
File Name Field Definitions	<***product-name***> = static product series name with the value, "AVHRR-Land" <***version***> = static product version number with the value, "v004" doc = identifies file as documentation package (static) c<***processing-date***> = Creation or processing date of the file identified with a 'c' followed by the year, month and day
File Name Example	AVHRR-Land_v004_doc_c20130901.tar
File Format	tar file containing PDF files
File Compression	None
File Size (Range)	<10 MB
File Count (Rate)	One delivery per version, and updated as needed
Data Volume (Rate)	<10 MB per delivery
File Rename/Repackage Instructions	N/A - Not required
Additional Information	None

C. Vegetation Bundle Source Code Package

File Description	Vegetation Bundle Source Code Package (tar file)
File Name Pattern	<***product-name***>_<***version***>_src_c<***processing-date***>.tar
File Name Field Definitions	<***product-name***> = static product series name with the value, "AVHRR-Land" <***version***> = static product version number with the value, "v004" src = identifies file as source code package (static) c<***processing-date***> = Creation or processing date of the file identified with a 'c' followed by the year, month and day
File Name Example	AVHRR-Land_v004_src_c20130901.tar

File Format	tar file containing text and source code formats
File Compression	None
File Size (Range)	<100 MB
File Count (Rate)	One delivery per version, and updated as needed
Data Volume (Rate)	<100 MB per delivery
File Rename/Repackage Instructions	N/A - Not required
Additional Information	None

D. Submission Manifest Files

File Description	The Submission Manifest File is a companion file required for each data (or other) file submitted to the NCDC ingest servers in order to ensure file integrity. A Submission Manifest File contains 1) the associated file name followed by 2) the corresponding MD5 checksum value and 3) the file size in bytes. The three text values are comma delimited on one line with no spaces. Content format of the values in a submission manifest file: <***file_name***>,<***file_md5_checksum***>,<***file_size_in_bytes***> Content format example: AVHRR-Land_v004_AVH09C1_NOAA-16_20040812_c20130920200630.nc,da3e100dc9e7bebb810985e37875de38,13631488
File Name Pattern	<***file_name***>.mnf
File Name Field Definitions	<***file_name***> = name of the associated file represented by the submission manifest .mnf = submission manifest file extension
File Name Example	● AVHRR-Land_v004_AVH09C1_NOAA-16_20040812_c20130920200630.nc.mnf ● AVHRR-Land_v004_doc_c20130901.tar.mnf ● AVHRR-Land_v004_src_c20130901.tar.mnf

File Format	CSV Text
File Compression	None
File Size (Range)	<10 KB
File Count (Rate)	One submission manifest per associated data file
Data Volume (Rate)	The submission manifest file size (<10 KB) times the number of associated data files
File Rename/Repackage Instructions	Not applicable
Additional Information	Correct submission manifest files are required for a successful ingest of the associated data file.

Ingest Procedures

Procedural ingest steps at the NCDC.

A. Ingest Procedures

Receipt Verification	The NCDC Ingest contact will use the associated Submission Manifest file with file name, 32-character MD5 checksum value (as provided), and file size to verify the integrity of a received file.
Ingest Confirmation	The NCDC Archive may provide an inventory of the files ingested to the Provider via email as requested by the Provider.
Error Conditions and Actions	The Ingest contact will report any problems or errors with file integrity, file name, checksum validation or other errors that inhibit the data ingest and archival to the Provider Transfer contact via email. The Ingest contact will reconcile errors with the Data Transfer contact via email. A new corresponding submission manifest is required for files re-submitted by the Provider.
Submission Updates	The Provider may submit replacement files with unique file names by the specified creation date stamp. The Provider will notify NCDC of any wanted replacements prior to the data submission.
Additional Information	None.

Archival Storage

Archive attributes define the identification and organization of the data in the NCDC archival storage system. Administration rules apply to the management and operation of data in the archive.

A. Vegetation Bundle Daily Data Files

Archive File Description	Vegetation Bundle Daily Data Files (by satellite in netCDF)
Storage System	NCDC HDSS (includes off site location)
Archive File Path	/aab/36xx/3669_01/CDR/<***YYYY***>/<***file_name***>
Archive File Name Pattern	<***product-name***>_<***product-version***>_<***product-type***>_<***sat-id***>_<***YYYYmmdd***>_c<***processing-date***>.nc
Hierarchical Classification	SATELLITE / AVHRR
Data Family ID	VEG_CDR
Data Type ID	VEG_REFL, VEG_NDVI
Collection Metadata ID	gov.noaa.ncdc:C00811 for Reflectance (AVH09C1) gov.noaa.ncdc:C00813 for NDVI (AVH13C1)
Retention Schedule	The data will be preserved in the archive for a minimum of 20 years as a derived product, at which time the data will be reassessed for continuation of archival needs.
Data Rights/Constraints	See CDRP Use Agreement. The Provider and NCDC encourage users to properly cite the CDR when used as a source or in a publication. No other constraints on data access or use.
Additional Information	None

B. Vegetation Bundle Documentation Package

Archive File Description	Vegetation Bundle Documentation Package (tar file)

Storage System	NCDC HDSS (includes off site location)
Archive File Path	/aab/36xx/3669_01/DOC/<***file_name***>
Archive File Name Pattern	<***product-name***>_<***product-version***>_doc_c<***processing-date***>.tar
Hierarchical Classification	SATELLITE / AVHRR
Data Family ID	VEG_CDR
Data Type ID	VEG_DOC
Collection Metadata ID	n/a - for data only
Retention Schedule	The retention schedule for the documentation and software packages will be Permanent, as archived product computational methods, algorithms and documentation.
Data Rights/Constraints	See CDRP Use Agreement. The Provider and NCDC encourage users to properly cite the CDR when used as a source or in a publication. No other constraints on data access or use.
Additional Information	None

C. Vegetation Bundle Source Code Package

Archive File Description	Vegetation Bundle Source Code Package (tar file)
Storage System	NCDC HDSS (includes off site location)
Archive File Path	/aab/36xx/3669_01/SRC/<***file_name***>
Archive File Name Pattern	<***product-name***>_<***product-version***>_src_c<***processing-date***>.tar
Hierarchical Classification	SATELLITE / AVHRR
Data Family ID	VEG_CDR
Data Type ID	VEG_SRC
Collection Metadata ID	n/a - for data only
Retention Schedule	The retention schedule for the documentation and software packages will be Permanent, as archived product computational methods, algorithms and documentation.

Data Rights/Constraints	See CDRP Use Agreement. The Provider and NCDC encourage users to properly cite the CDR when used as a source or in a publication. No other constraints on data access or use.
Additional Information	None

User Access Services

The User Services function of NCDC supports data access, understanding and use.

A. User Access Services

Data Access	The current version of the CDR data will be accessible via the NCDC THREDDS Data Server (TDS) at: http://data.ncdc.noaa.gov/thredds/catalog.html and FTP at: ftp://data.ncdc.noaa.gov/cdr/
Documentation and Metadata Access	Access to supporting documentation and code will be available through the NOAA CDR web page: http://ncdc.noaa.gov/cdr/operationalcdrs.html The Provider will assist NCDC in documenting the FCDR with ISO standard metadata, which allows users to discover, access and understand the data and the supporting documents through climate.gov.
Additional Information	None

Additional Terms

No additional terms.

Appendix C – Documenting Code Headers

Code headers shall be documented according to the *CDR General Software Coding Standards* found on the CDR Development Guidelines page http://www.ncdc.noaa.gov/cdr/guidelines.html.

Code headers are extracted at NCDC using Robodoc, thus the headers must be in a specific format. There are 3 parts to a Robodoc header.

First, a start tag (lets robodoc know where to start looking for headers).

Second, individual headers (in capital letters on line by themselves).

Third, a stop tag (let's robodoc know there are no more headers).

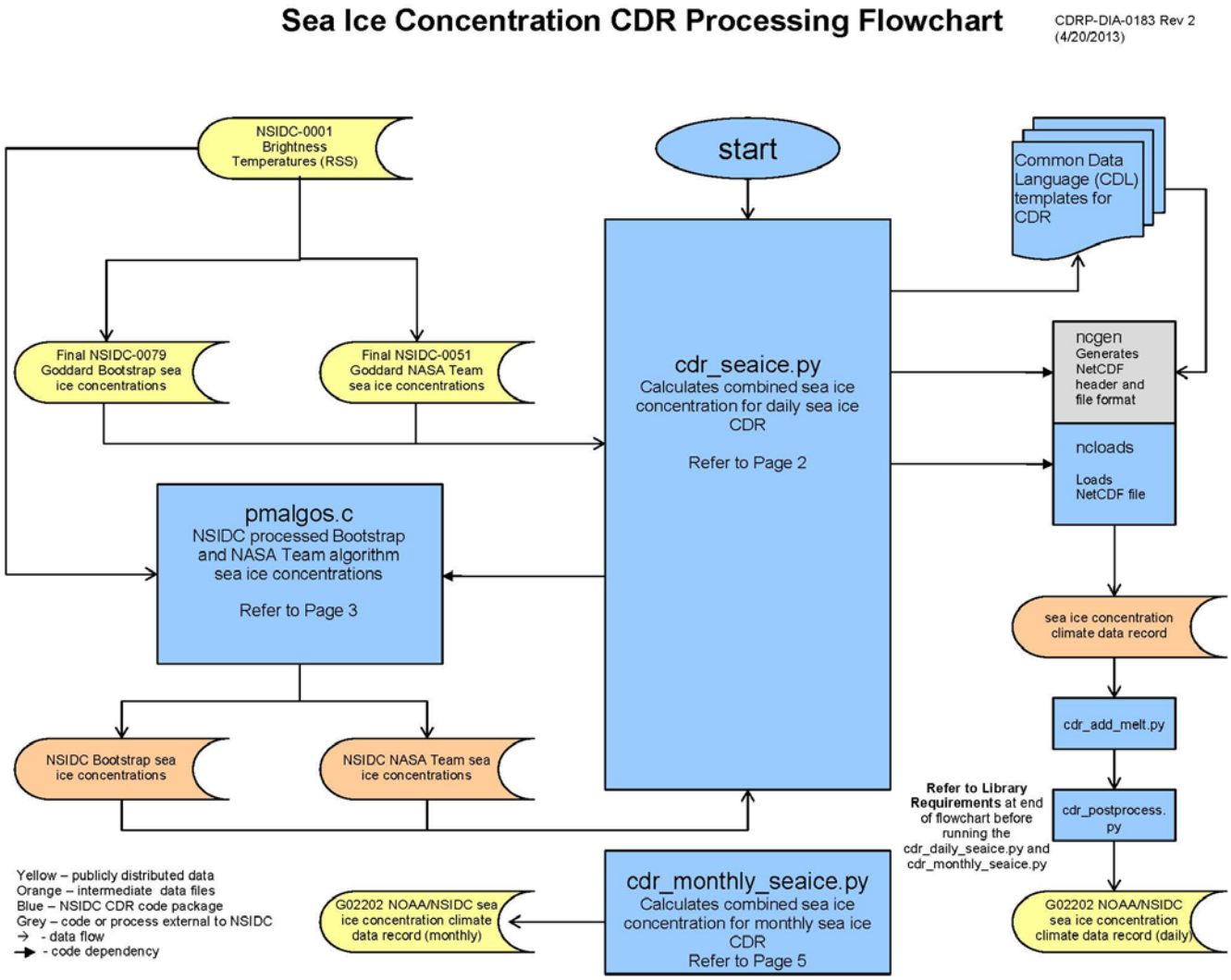
The following are the minimum standards:

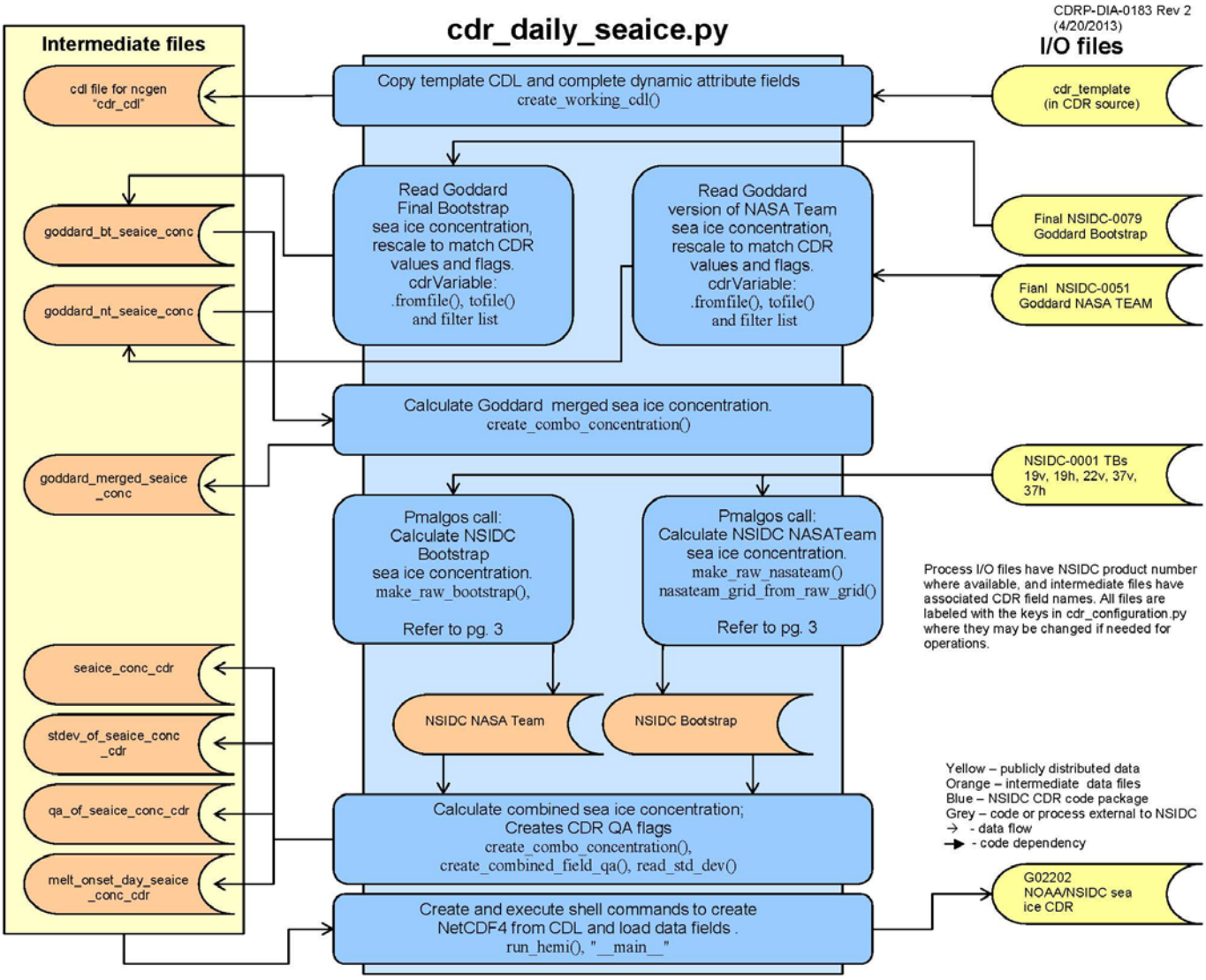
```
!@***h* CDR_Name/name_of_source_code (this is the start tag)
!
! NAME
!   The name of the source code file.
!
! PURPOSE
!   One or two sentences describing the source code file function.
!
! DESCRIPTION
!   A description of the processing performed within this source code file.
!   For published algorithms, provide a reference to the publication.
!
! AUTHOR
!   A list of those who wrote the code in the file, and their
!   organization name. This list can be easily kept up to date if each person that
!   works on the code adds his or name.
!
! COPYRIGHT (insert the following statement exactly as written)
!   THIS SOFTWARE AND ITS DOCUMENTATION ARE CONSIDERED TO BE IN THE PUBLIC
!   DOMAIN AND THUS ARE AVAILABLE FOR UNRESTRICTED PUBLIC USE. THEY ARE
!   FURNISHED "AS IS." THE AUTHORS, THE UNITED STATES GOVERNMENT, ITS
!   INSTRUMENTALITIES, OFFICERS, EMPLOYEES, AND AGENTS MAKE NO WARRANTY,
!   EXPRESS OR IMPLIED, AS TO THE USEFULNESS OF THE SOFTWARE AND
!   DOCUMENTATION FOR ANY PURPOSE. THEY ASSUME NO RESPONSIBILITY (1) FOR
!   THE USE OF THE SOFTWARE AND DOCUMENTATION; OR (2) TO PROVIDE TECHNICAL
!   SUPPORT TO USERS.
!
! REVISION HISTORY
!   The revision history of the file in forward chronological order, beginning with
!   the initial version. This section should be appended with a new entry each time
!   that a revised version of the software is submitted to the CDR Program and more
!   often if appropriate. At a minimum changes to algorithms, interfaces, and outputs
!   should be documented. For each such revision the new entry should provide version
!   identification (at a minimum the revision date), the developer's initials, a brief
!   summary of the changes made, and the reason for the changes.
!
!@***** (this is the end tag)
Note: any comment character can be used in place of the "!"
```

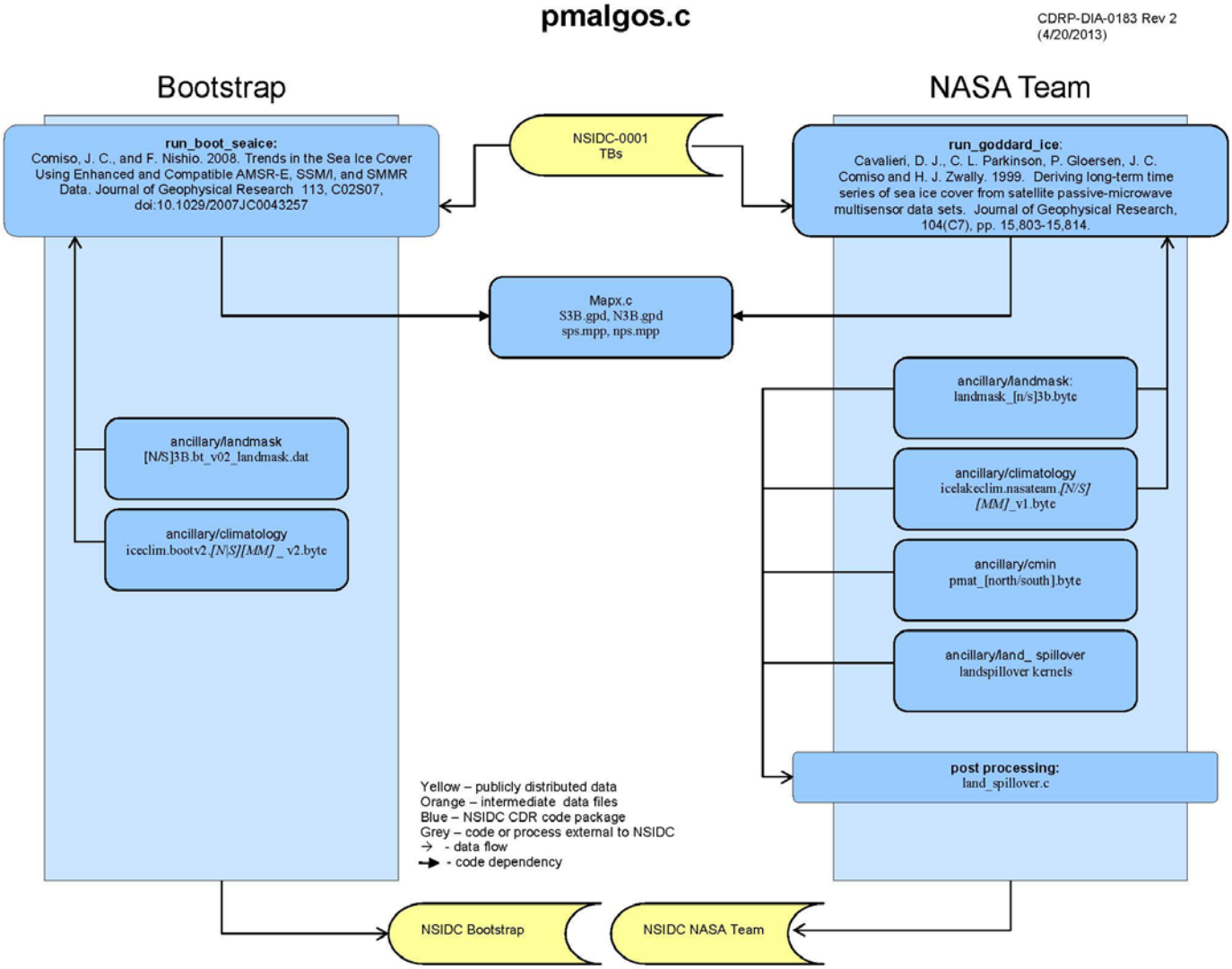
The following is a short example:

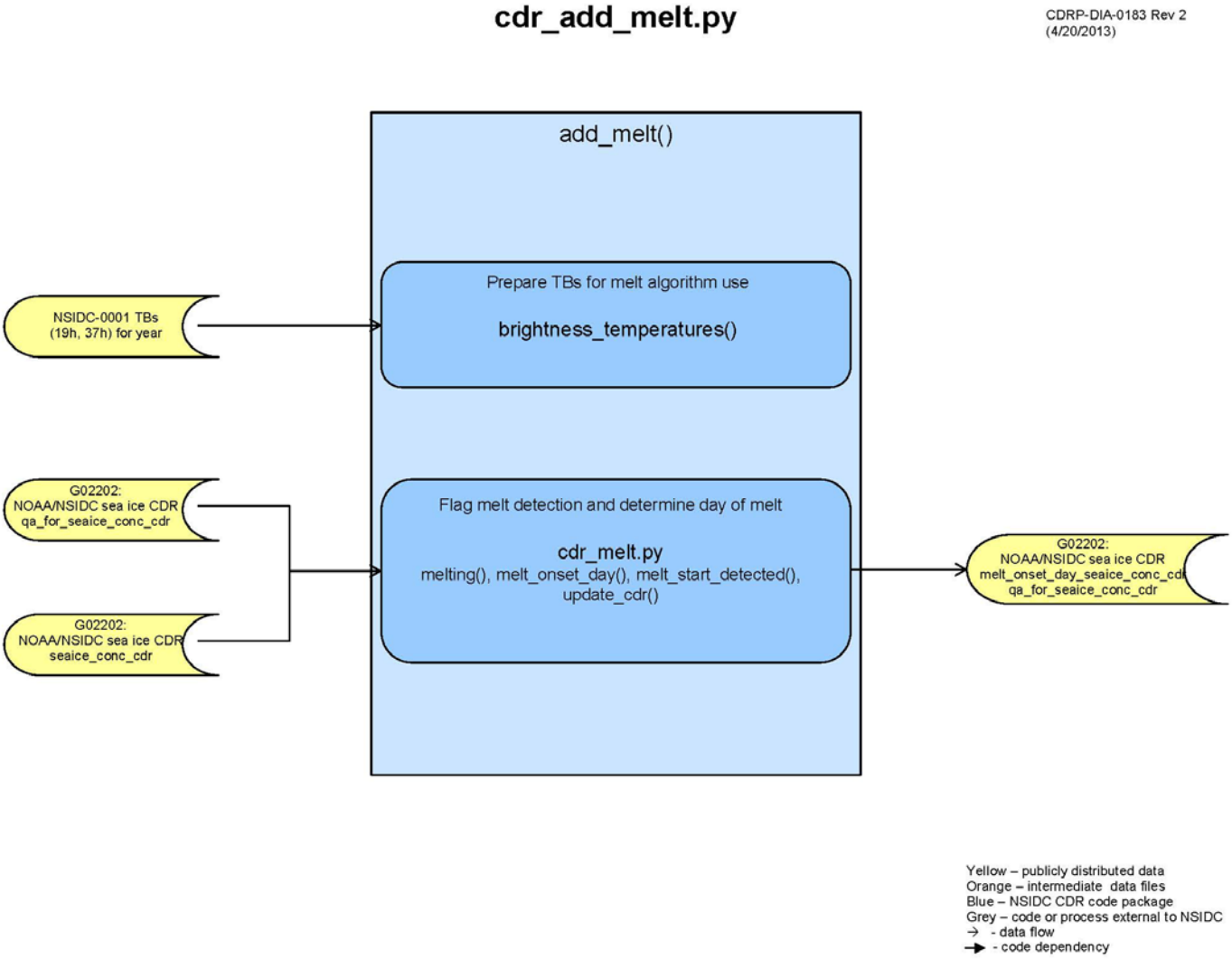
```
;@***h* MLT_RSS/check_grpt_maps_AMSU_v3_3.pro
;
; NAME
;   check_grpt_maps_AMSU_v3_3.pro
;
; PURPOSE
;   Check AMSU montly gridded data for months with too little data
;   Determines which months to use in merge and returns and array, months_to_use,
;   that is used in subsequent steps to choose which satellite months to include
;
; DESCRIPTION
;   This routine checks the AMSU GRPT data for months with too little data
;
; INPUTS
;   num_arr  (should be a (144,72,num_months,num_sats) array of number of obs per
;   grid cell sats_to_use (num_AMSUs) array of integers  0 to ignore this satellite,
;   1, to use it num_thres is the threshold for the mean number of observations to be
;   good data.
;   months_to_use_mask is a (num_months, num_sats) array of integers:
;               -1 to exclude
;                0 to use threshold to determine use (the usual case)
;                1 to use even if threshold fails
;
; OUTPUT
;   months_to_use  (num_months,num_sats) array of months to use in the merge.
;   1 means use,0 means don't use
;
; AUTHOR
;   Carl Mears, Remote Sensing Systems
;
; COPYRIGHT
;   THIS SOFTWARE AND ITS DOCUMENTATION ARE CONSIDERED TO BE IN THE PUBLIC DOMAIN AND
;   THUS ARE AVAILABLE FOR UNRESTRICTED PUBLIC USE.  THEY ARE FURNISHED "AS IS." THE
;   AUTHORS, THE UNITED STATES GOVERNMENT, ITS INSTRUMENTALITIES, OFFICERS, EMPLOYEES,
;   AND AGENTS MAKE NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE USEFULNESS OF THE
;   SOFTWARE AND DOCUMENTATION FOR ANY PURPOSE. THEY ASSUME NO RESPONSIBILITY (1) FOR
;   THE USE OF THE SOFTWARE AND DOCUMENTATION; OR (2) TO PROVIDE TECHNICAL SUPPORT
;   TO USERS.
;
; HISTORY
;   2/21/2019 Initial Version prepared for NCDC
;
; USAGE
;   check_grpt_maps_AMSU_v3_3, num_arr,sats_to_use, num_thres,
;   months_to_use_mask,months_to_use
;
;@*****
```

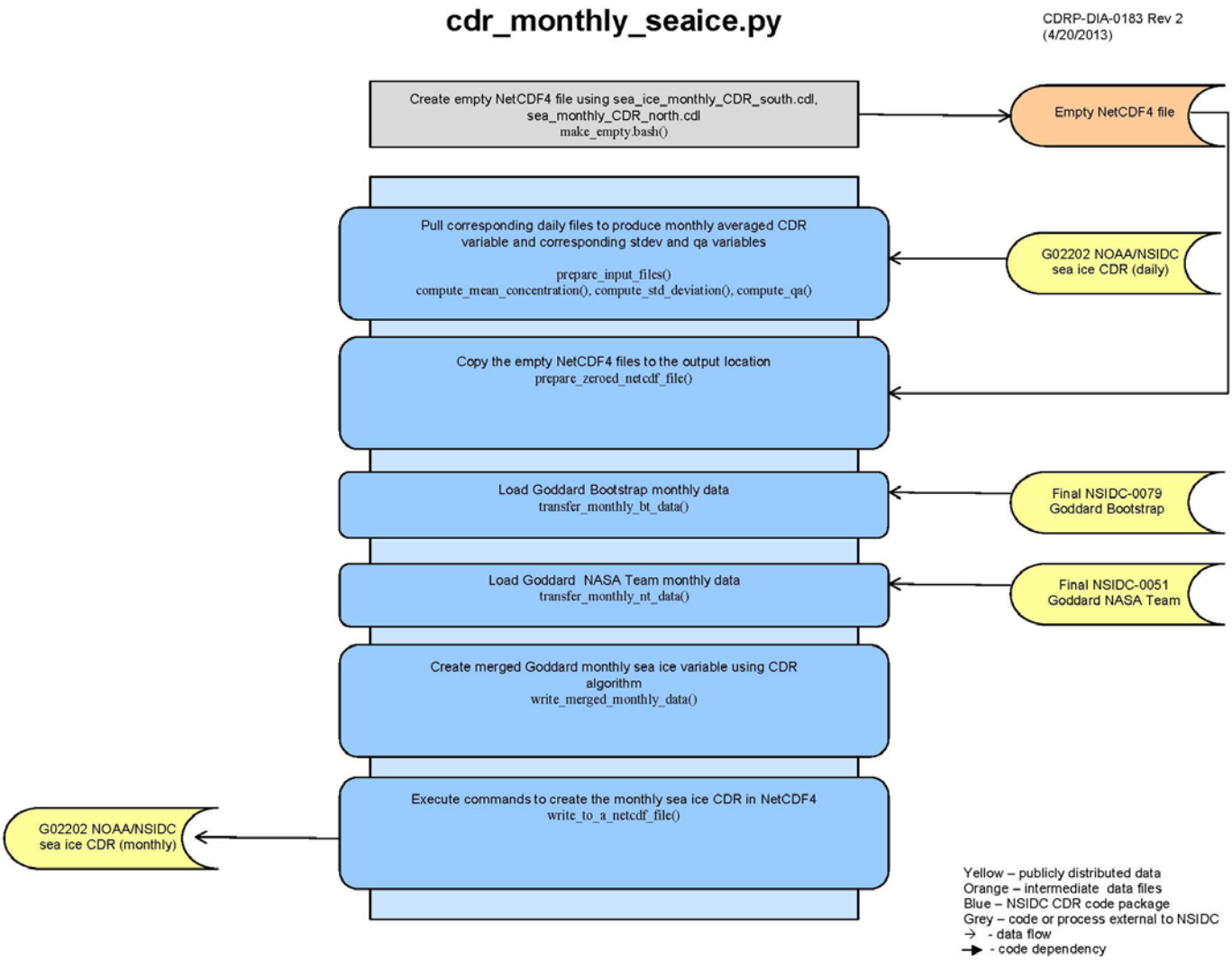
Appendix D – Data Flow Diagram Example




cdr_daily_seaice.py
CDRP-DIA-0183 Rev 2
(4/20/2013)
I/O files
Intermediate files
cdl file for ncgen "cdr_cdl"
Copy template CDL and complete dynamic attribute fields
create_working_cdl()
cdr_template (in CDR source)
goddard_bt_seaice_conc
goddard_nt_seaice_conc
Read Goddard Final Bootstrap sea ice concentration, rescale to match CDR values and flags. cdrVariable: .fromfile(), tofile() and filter list
Read Goddard version of NASA Team sea ice concentration, rescale to match CDR values and flags. cdrVariable: .fromfile(), tofile() and filter list
Final NSIDC-0079 Goddard Bootstrap
Fianl NSIDC-0051 Goddard NASA TEAM
Calculate Goddard merged sea ice concentration.
create_combo_concentration()
goddard_merged_seaice_conc
NSIDC-0001 TBs 19v, 19h, 22v, 37v, 37h
Pmalgos call: Calculate NSIDC Bootstrap sea ice concentration. make_raw_bootstrap(),
Refer to pg. 3
Pmalgos call: Calculate NSIDC NASATeam sea ice concentration. make_raw_nasateam() nasateam_grid_from_raw_grid()
Refer to pg. 3
Process I/O files have NSIDC product number where available, and intermediate files have associated CDR field names. All files are labeled with the keys in cdr_configuration.py where they may be changed if needed for operations.
seaice_conc_cdr
stdev_of_seaice_conc_cdr
qa_of_seaice_conc_cdr
melt_onset_day_seaice_conc_cdr
NSIDC NASA Team
NSIDC Bootstrap
Calculate combined sea ice concentration; Creates CDR QA flags
create_combo_concentration(), create_combined_field_qa(), read_std_dev()
Yellow – publicly distributed data
Orange – intermediate data files
Blue – NSIDC CDR code package
Grey – code or process external to NSIDC
→ - data flow
→ - code dependency
Create and execute shell commands to create NetCDF4 from CDL and load data fields .
run_hemi(), "__main__"
G02202 NOAA/NSIDC sea ice CDR


pmalgos.c
CDRP-DIA-0183 Rev 2
(4/20/2013)
Bootstrap
NASA Team
run_boot_seaice:
Comiso, J. C., and F. Nishio. 2008. Trends in the Sea Ice Cover Using Enhanced and Compatible AMSR-E, SSM/I, and SMMR Data. Journal of Geophysical Research 113, C02S07, doi:10.1029/2007JC0043257
NSIDC-0001
TBs
run_goddard_ice:
Cavalieri, D. J., C. L. Parkinson, P. Gloersen, J. C. Comiso and H. J. Zwally. 1999. Deriving long-term time series of sea ice cover from satellite passive-microwave multisensor data sets. Journal of Geophysical Research, 104(C7), pp. 15,803-15,814.
Mapx.c
S3B.gpd, N3B.gpd
sps.mpp, nps.mpp
ancillary/landmask
[N/S]3B.bt_v02_landmask.dat
ancillary/climatology
iceclim.bootv2.[N\S][MM]_v2.byte
ancillary/landmask:
landmask_[n/s]3b.byte
ancillary/climatology
icelakeclim.nasateam.[N/S]
[MM]_v1.byte
ancillary/cmin
pmat_[north/south].byte
ancillary/land_ spillover
landspillover kernels
post processing:
land_spillover.c
Yellow – publicly distributed data
Orange – intermediate data files
Blue – NSIDC CDR code package
Grey – code or process external to NSIDC
→ - data flow
→ - code dependency
NSIDC Bootstrap
NSIDC NASA Team


cdr_add_melt.py
CDRP-DIA-0183 Rev 2
(4/20/2013)
add_melt()
Prepare TBs for melt algorithm use
brightness_temperatures()
NSIDC-0001 TBs
(19h, 37h) for year
G02202:
NOAA/NSIDC sea ice CDR
qa_for_seaice_conc_cdr
G02202:
NOAA/NSIDC sea ice CDR
seaice_conc_cdr
Flag melt detection and determine day of melt
cdr_melt.py
melting(), melt_onset_day(), melt_start_detected(),
update_cdr()
G02202:
NOAA/NSIDC sea ice CDR
qa_for_seaice_conc_cdr
Yellow – publicly distributed data
Orange – intermediate data files
Blue – NSIDC CDR code package
Grey – code or process external to NSIDC
→ - data flow
→ - code dependency


cdr_monthly_seaice.py
CDRP-DIA-0183 Rev 2
(4/20/2013)
Create empty NetCDF4 file using sea_ice_monthly_CDR_south.cdl, sea_monthly_CDR_north.cdl
make_empty.bash()
Empty NetCDF4 file
Pull corresponding daily files to produce monthly averaged CDR variable and corresponding stdev and qa variables
prepare_input_files()
compute_mean_concentration(), compute_std_deviation(), compute_qa()
G02202 NOAA/NSIDC sea ice CDR (daily)
Copy the empty NetCDF4 files to the output location
prepare_zeroed_netcdf_file()
Load Goddard Bootstrap monthly data
transfer_monthly_bt_data()
Final NSIDC-0079 Goddard Bootstrap
Load Goddard NASA Team monthly data
transfer_monthly_nt_data()
Final NSIDC-0051 Goddard NASA Team
Create merged Goddard monthly sea ice variable using CDR algorithm
write_merged_monthly_data()
Execute commands to create the monthly sea ice CDR in NetCDF4
write_to_a_netcdf_file()
G02202 NOAA/NSIDC sea ice CDR (monthly)
Yellow – publicly distributed data
Orange – intermediate data files
Blue – NSIDC CDR code package
Grey – code or process external to NSIDC
→ - data flow
→ - code dependency

CDRP-DIA-0183 Rev 2
(4/20/2013)

Library Requirements

The following libraries are required to run the cdr_daily_seaice.py and cdr_monthly_seaice.py

Core Libraries:
netcdf-4.2 http://www.unidata.ucar.edu/blogs/news/entry/netcdf_4_2_release

hdf5 1.8.8
http://www.hdfgroup.org/ftp/HDF5/prev-releases/hdf5-1.8.8/src/

szip 2.1
http://www.hdfgroup.org/ftp/lib-external/szip/2.1/src/

Python Libraries:
argparse 1.2.1 https://pypi.python.org/pypi/argparse

mock 1.0.1 https://pypi.python.org/pypi/mock

numpy 1.6.1
http://sourceforge.net/projects/numpy/files/NumPy/

netCDF4-python 0.0.9
http://code.google.com/p/netcdf4-python/downloads/list

unittest2 0.5.1
http://pypi.python.org/pypi/unittest2

Note: Core libraries must be installed prior to the use of netcdf4-python library.

Appendix E – CDR Maturity Matrix

Maturity	Sensor Use	Code Stability	Metadata & QA	Documentation	Product Validation	Public Access	Applications
1	Conceptual development	Little or none	Draft Climate Algorithm Theoretical Basis Document (C-ATBD); paper on algorithm submitted	Little or None	Restricted to a select few	Little or none	Conceptual development
2	Significant code changes expected	Research grade	C-ATBD Version 1+ ; paper on algorithm reviewed	Minimal	Limited data availability to develop familiarity	Limited or ongoing	Significant code changes expected
3	Moderate code changes expected	Research grade; Meets int'l standards: ISO or FGDC for collection; netCDF for file	Public C-ATBD; Peer-reviewed publication on algorithm	Uncertainty estimated for select locations/times	Data and source code archived and available; caveats required for use.	Assessments have demonstrated positive value.	Moderate code changes expected
4	Some code changes expected	Exists at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed publication on algorithm; paper on product submitted	Uncertainty estimated over widely distributed times/location by multiple investigators; Differences understood.	Data and source code archived and publicly available; uncertainty estimates provided; Known issues public	May be used in applications; assessments demonstrating positive value.	Some code changes expected
5	Minimal code changes expected; Stable, portable and reproducible	Complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets international standards for dataset	Public C-ATBD, Review version of OAD, Peer-reviewed publications on algorithm and product	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Record is archived and publicly available with associated uncertainty estimate; Known issues public. Periodically updated	May be used in applications by other investigators; assessments demonstrating positive value	Minimal code changes expected; Stable, portable and reproducible
6	No code changes expected; Stable and reproducible; portable and operationally efficient	Updated and complete at file and collection level. Stable. Allows provenance tracking and reproducibility of dataset. Meets current international standards for dataset	Public C-ATBD and OAD; Multiple peer-reviewed publications on algorithm and product	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation; quantified errors	Record is publicly available from Long-Term archive; Regularly updated	Used in published applications; may be used by industry; assessments demonstrating positive value	No code changes expected; Stable and reproducible; portable and operationally efficient

1 & 2	**Research**
3 & 4	**IOC**
5 & 6	**FOC**

Appendix F – Sample ORR Checklist

CDR IOC Operational Readiness Review (ORR)
Date: 09/10/2013

MSU Brightness Temperatures - NOAA (CI# 01B-17) **PI: Cheng-Zhi Zou**

Attendees (check if present)		Integrated Product Team (IPT) Members:
CDR Program Manager - Jesse Glance		TM - Hilawe Semunegus (hs)
Program Scientist - n/a		PM - Dan Wunder (dw)
Ops Branch - Drew Saunders		AB1 - Valerie Toner (vt)
Archive Branch - Nancy Ritchey		AB2 - Robert McFadden (rm)
Products Branch - Ken Knapp		OB - Art Burden (ab)
		Access - Steve Ansari (sa)
Other Attendees:		**Other Verification Members:**
		GC - Candace Hutchins (ch)
		CM - Cheryl Preston (cp)

CDR Evaluation Item (check if complete)

Documentation:	Verified	Initials	Comments
C-ATBD created using CDRP template	PM	dw	C-ATBD is on the current template provided by CDRP
C-ATBD complete and logical	TM	hs	C-ATBD describes how the product was created in sufficient detail
C-ATBD baselined in CDRP library	CM	cp	CDRP-ATBD-0426 Rev 1
C-ATBD publicly available	PM	dw	http://www.ncdc.noaa.gov/cdr/operationalcdrs.html
Flow Chart understandable	TM	hs	Flow chart follows the production process
Flow Chart baselined in CDRP library	CM	cp	CDRP-DIA-0347 Rev 1
Flow Chart publicly available	PM	dw	http://www.ncdc.noaa.gov/cdr/operationalcdrs.html
MM rankings at level 3 or above	TM	hs	Ratings are all at level 3 or above and are consistent with product maturity
MM baselined in CDRP library	CM	cp	CDRP-MM-0349 Rev 1
MM publicly available	PM	dw	http://www.ncdc.noaa.gov/cdr/operationalcdrs.html
Documentation package archived	AB2	rm	archived on 09/04/2013

Data:	Verified	Initials	Comments
Data in netCDF format	OB	ab	Data was delivered in netCDF format
Meets "CDR NetCDF Metadata Guidelines"	AB1	vt	Data is consistent with CF 1.6 metadata conventions
Ancillary data archived, if applicable	AB2	rm	n/a
Dataset Archived	AB2	rm	Data submission approved at DSRR; CDR data has been archived
Discovery metadata active	AB1	vt	submitted 9/9/2013, will take one day to show up on climate.gov
Dataset publicly available	Access	sa	ftp and THREDDS access available http://www.ncdc.noaa.gov/cdr/operationalcdrs.html

Source Code:	Verified	Initials	Comments
Headers documented IAW "CDR General Software Coding Standards"	PM	dw	All code is documented according to the standards, Robodoc output added to source code package
README is understandable	OB	ab	Readme is simple but adequate
Security Review complete	OB	ab	Security Review complete (ref # 132); MSU_L1C.FCDR (Fortran) code analysis showed no issues
Source code package archived	AB2	rm	archived on 09/04/2013
Source code publicly available	PM	dw	http://www.ncdc.noaa.gov/cdr/operationalcdrs.html

Misc: (does not prevent IOC)	Verified	Initials	Comments
Submission Agreement allows for periodic updates to the data	AB1	vt	Completed and baselined in the Archive Branch Document Library (AB-SA-00144_R1)
License agreement has been negotiated	GC	ch	Produced by NOAA - no license agreement needed
O&M has been planned	GC	ch	n/a, this is a static dataset
CDR flyer complete	PM	dw	Overview flyer complete, in library, and on operational page
Customer support notified of new CDR	TM	hs	Gave presentation to customer service on 08/08/2013
Draft of press release completed	PM	dw	Sent draft to Susan Osborne for review - will notify her once ORR approved.

Approved for IOC:

CDR PM Signature
(see Attachment 1 for results)

CDRP-FORM-0178, Rev 3, 07/31/2013
CDRP-ORR-0423, Rev 1, 09/10/2013

Appendix G – GCOS 12 Requirements for a CDR[1]

1. Full description of all steps taken in generation of FCDRs and ECV products, including algorithms used, specific FCDRs used and characteristics and outcomes of validation activities.
2. Application of appropriate calibration/validation activities.
3. Statement of expected accuracy, stability and resolution (time, space) of the product including a comparison with the GCOS requirements.
4. Assessment of long-term stability and homogeneity of the product.
5. Information on the scientific review process related to FCDR/product construction (including algorithm selection), FCDR/product quality and applications.
6. Global coverage of FCDRs and products where possible.
7. Version management of FCDRs and products where possible.
8. Arrangements for access to the FCDRs, products and all documentation.
9. Timeliness of data release to the user community to enable monitoring activities.
10. Facility for user feedback.
11. Application of a quantitative maturity matrix if possible.
12. Publication of a summary (webpage or peer-reviewed article) documenting point-by-point the extent to which this guideline has been followed.

Table 1. GCOS 12 Requirements for CDRs[1]

[1] Guidelines for the Generation of Datasets and Products Meeting GCOS Requirements, GCOS-143 (WMO/TD No. 1530), May 2010

Appendix H – Frequently Asked Questions

Q1. What is the role and structure of the CDR Program Office?

A1. RSAD Management has implemented a matrix management approach to CDR acquisition and implementation. In short, that means RSAD branches and offices all contribute personnel to task-specific teams, since no single branch or office has all of the needed personnel or expertise to be successful. The CDR Program Office serves a CDR planning and management function for RSAD and NCDC. It is responsible for the development of definitions, requirements, guidelines, procedures and processes – including system architecture analysis and definition -- and manages the implementation and acquisitions as appropriate. This scope includes the business affairs such as performance metrics, budgets, grants and contracts management.

Q2. When there is an interim delivery, is there a defined space to put code, netCDF example, etc. This implies it will sit there to be examined by Archive, Operations, Products Branch, and/or IT security?

A2. A file system on Google Drive will be established so PIs or IPT members can stage code, documents, and data for review and verification. The proper place for source code needing a security review is in subversion on the *NCDC* server.

Q3. How is information communicated up the CDRP management chain?

A3. IPT members provide weekly updates to the CDRP R2O project manager on their specific CDR's status. The R2O project manager carries unresolved questions directly to the standing CDRP/Branch Manager meeting and then informs the team of any solutions or future actions discussed in the meeting. If needed, quarterly reviews are held with all team members and managers present for discussions of issues/concerns and to provide decisions or guidance.

Q4. Is there one location to get all the CDRP guidelines and standards?

A4. The latest versions of all guidelines, standards, and templates are available on the CDRP web site, under the *'Development Guidelines'* (http://www.ncdc.noaa.gov/cdr/guidelines.html).

Appendix I – Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
AB	Archive Branch
C-ATBD	Climate Algorithm Theoretical Basis Document
CDR	Climate Data Record
CDRP	Climate Data Record Program
CR	Change Request
DAAB	Data Access and Analysis Branch
DSRR	Dataset Readiness Review
FOC	Full Operational Capability
GCOS	Global Climate Observing System
GIS	Geographic Information System
HAS	HDSS Access System
HDSS	Hierarchical Data Storage System
IOC	Initial Operational Capability
IPT	Integrated Process Team
IT	Information Technology
ITB	Information Technology Branch
KDP	Key Decision Point
MM	Maturity Matrix
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NSIDC	National Snow and Ice Data Center
O&M	Operations and Maintenance
OB	Operations Branch
ORR	Operational Readiness Review
PI	Principal Investigator
PB	Products Branch
PM	Project/Program Manager
POR	Period of Record

Acronym or Abbreviation	Meaning
POR	Period of Record
QA	Quality Assurance
R2O	Research-to-Operations
RSAD	Remote Sensing and Applications Division
SA	Submission Agreement
SME	Subject Matter Expert
THREDDS	Thematic Realtime Environmental Distributed Data Services