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Interface Control Document Between the Surface Water & Ocean Topography (SWOT) Science Data System (SDS) and the Physical Oceanography Distributed Active Archive Center (PO.DAAC)

Goddard Space Flight Center
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Space Administration

Interface Control Document Between the Surface Water & Ocean Topography (SWOT) Science Data System (SDS) and the Physical Oceanography Distributed Active Archive Center (PO.DAAC)
Signature/Approval Page

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Preface

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Abstract

This document is written to formalize the interpretation and general understanding of the interfaces between the Surface Water & Ocean Topography (SWOT) Science Data System (SDS) and the Physical Oceanography Distributed Active Archive Center (PO.DAAC) for the ingest, archive and distribution of the SWOT science data.

This Interface Control Document (ICD) provides specific information about the interfaces between the SWOT SDS and the PO.DAAC. The SWOT SDS and the PO.DAAC are located at the Jet Propulsion Laboratory (JPL). The SDS provides L0 through L2 data products to the PO.DAAC for archive and distribution.

Keywords: SWOT, PO.DAAC, ICD, JPL, SDS

Change History Log

Revision	Effective Date	Description of Changes (Reference the CCR & CCB Approval Date)
Original, Rev-	01/31/2019	CCR 423-ESDIS-210; approved 12/20/2018 Pages: Baseline cover through 26
Revision A	06/27/2019	CCR 423-ESDIS-241; CCB approved 05/30/2019 Pages:Cover through 29; see DCN for detail
Revision B	09/29/2022	CCR 423-ESDIS-385; CCB approved 9/19/2022 Pages Cover thru 26; Updates to WAN diagram, data volumes, schedule

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1 INTRODUCTION

1.1 Purpose/Scope

This Interface Control Document (ICD) provides specific information about the interfaces between the Surface Water & Ocean Topography (SWOT) Science Data System (SDS) and the Physical Oceanography Distributed Active Archive Center (PO.DAAC). The SWOT SDS and the PO.DAAC are located at the Jet Propulsion Laboratory (JPL) in Pasadena, CA. The SWOT SDS Production System is deployed in AWS Commercial Cloud, US-West2, Oregon and the PO.DAAC System is deployed in the same AWS Cloud US-West2 region. The SDS provides L0 through L2 data products to the PO.DAAC for archive and distribution.

The PO.DAAC, ESDIS and the SWOT Projects have responsibility for the maintenance of this ICD. Any changes in the interfaces must be agreed to by the relevant participating parties, and then assessed at the ESDIS Project Level. This ICD will be approved under the signature of PO.DAAC, ESDIS , SWOT SDS, and SWOT Project Managers.

Included are:

a. Documentation references.
b. Context information for the DAAC-SWOT interfaces.
c. Identification of Standard Products generated by SWOT along with other products generated by SWOT that directly support Standard Products for transfer to DAAC for archive and distribution.

1.2 Mission Description

U.S. and French oceanographers and hydrologists and international partners have joined forces to develop the SWOT Mission. The SWOT Mission is designed to make the first ever global survey of Earth's surface water. The SWOT satellite will observe the fine details of the ocean's surface topography and collect detailed measurements of how water bodies on Earth change over time. The satellite will survey at least 90 percent of the globe, studying Earth's lakes, rivers, reservoirs and oceans at least twice every 21 days to improve ocean circulation models, and weather and climate predictions, and aid in freshwater management around the world.

There are two primary science rationales for the development of SWOT:

1. Make high-resolution, wide-swath altimetric measurement of the ocean surface topography to make fundamental advances in the understanding of the oceanic mesoscale and submesoscale processes.
2. Measure the elevation of water on land to make fundamental advances in the understanding of the spatial and temporal distribution of the storage and discharge of water on land.

In addition to addressing the two primary objectives in oceanography and land hydrology, SWOT measurements will have applications to a host of other topics as well. The SWOT satellite is scheduled for launch in December 2022, with a mission life of 3 years.

1.3 Related Documentation

The latest versions of all documents below should be used generally, unless the specific versions are identified that apply to this Baseline. The latest ESDIS Project documents can be obtained from URL: https://ops1-cm.ems.eosdis.nasa.gov. ESDIS documents have a document number starting with either 423 or 505. Other documents are available for reference in the ESDIS project library website at: https://doclib.eosdis.nasa.gov/ unless indicated otherwise. Documents that are located in the ESDIS library have a reference name starting with ESDIS followed by an assigned number. Documents that are located in the ESDIS library have a reference name starting with ESDIS followed by an assigned number. If you are unable to access documents please contact the EOSDIS System Manager on the signature page of this document.

1.3.1 Parent Documents

The parent document is the document from which this interface control document's scope and content are derived

420-01-01/ ESDIS02753	Earth Systematic Mission Program Plan Program-Level Requirements for the SWOT Project, Appendix S
423-IPA-003	Inter-Project Agreement (IPA) Between NASA SWOT Project and the ESDIS Project for Science Data Archive and Distribution Support.
423-SPEC-001	NASA Earth Science Data Preservation Content Specification
423-RQMT-003	Metadata Requirements – Base Reference for NASA Earth Science Data Products

1.3.2 Applicable Documents

The following documents are referenced within this interface control document, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

JPL D-56531	File Naming Convention for SWOT Data Products
423-ICD-009	ICD between Global Imagery Browse Services (GIBS) and Imagery Providers
423-ICD-015	Cloud Notification Mechanism Interface Control Document
D-109647	Operations Agreement between PO.DAAC and the SWOT SDS

2 PO.DAAC-SWOT SDS INTERFACE SPECIFICS

2.1 Interface Context

Specific details on the Cloud Notification Mechanism are provided in the Cloud Notification Mechanism Interface Control Document 423-ICD-015. From this point forward, the SWOT SDS is considered a Science Investigator-led Processing System (SIPS) when referencing Document 423-ICD-015. The interface between the SWOT SDS and the PO.DAAC are based upon the Cloud Notification Mechanism ICD.

2.2 Summary of Data Flows

Figure 2-1 summarizes the data flows between the SDS and the PO.DAAC. As shown in the diagram both SDS and the PO.DAAC are in the AWS US West region of the cloud and any change to the cloud region must be approved at the IPA level since there may be a cost impact if the SDS and DAAC were in different regions of the cloud.

Table 2-1 summarizes the types of messaging and transfer mechanism between the PO.DAAC and the SDS.

The SDS provides metadata and standard product data granules via a standardized electronic polling with delivery record mechanism. The SDS will generate metadata in an Earth Science Division (ESD) approved standard format for each delivered granule, Level 0 – Level 2. In addition to the data, the SDS is also responsible for providing the algorithm packages to the PO.DAAC for archive and distribution. The NASA Earth Science Data Preservation Content Specification (Reference 423-SPEC-001) defines the contents of all items needed for preservation at the end of the mission to ensure their availability to support future investigations in long-term scientific research. The SDS will work with the PO.DAAC to ensure that the items needed for preservation are collected and archived. High Resolution Browse data will be generated by PO.DAAC for selected SWOT data products and variables and provided to the Global Imagery Browse Services (GIBS). The details of the interface between PO.DAAC and GIBS are out of scope for this ICD and will be specified in the GIBS ICD, reference 423-ICD-009.

If the SWOT data products at PODAAC are corrupted or removed by accidental or malicious means, the PODAAC may want to "regenerate" products to recover those products. The SWOT SDS will maintain the current and the previous versions of SDS software stack. The SDS makes its software stack available to PODAAC for the data regeneration.

The deployment and operation of the environment for the data recovery processing will be handled within JPL. The deployed environment will retrieve lower level data products as needed for data regeneration from the PO.DAAC archive using standard DAAC access mechanisms. The PO.DAAC will be notified of regenerated products for ingest using the same mechanisms used between the SDS and PO.DAAC.

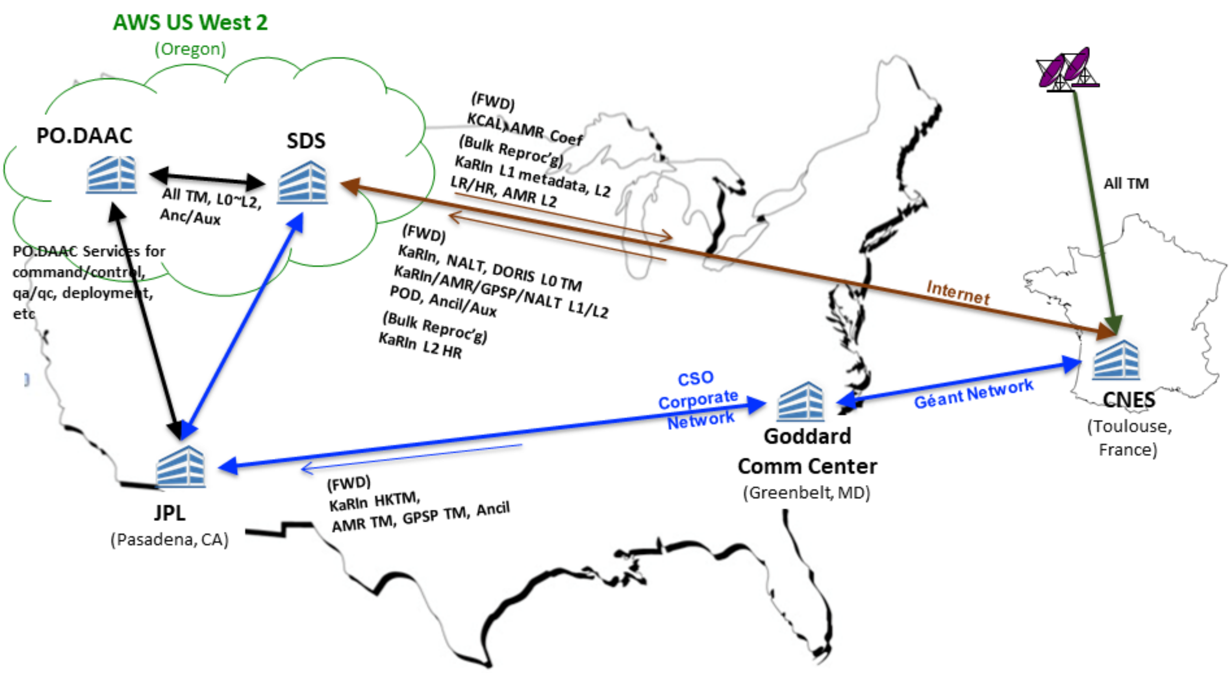

Figure 2-1. SWOT Data Flow

2.3 Interface Protocol for Transfer of Products from SDS to PO.DAAC

The SWOT SDS uses the specified Notification system of new granules for delivery of all SWOT standard products to the PO.DAAC. The PO.DAAC pulls L0 – L2 products from the JPL S3 bucket. The schema used by this transfer mechanism is referenced in the Operations Agreement (OA) between PO.DAAC and the SWOT SDS.

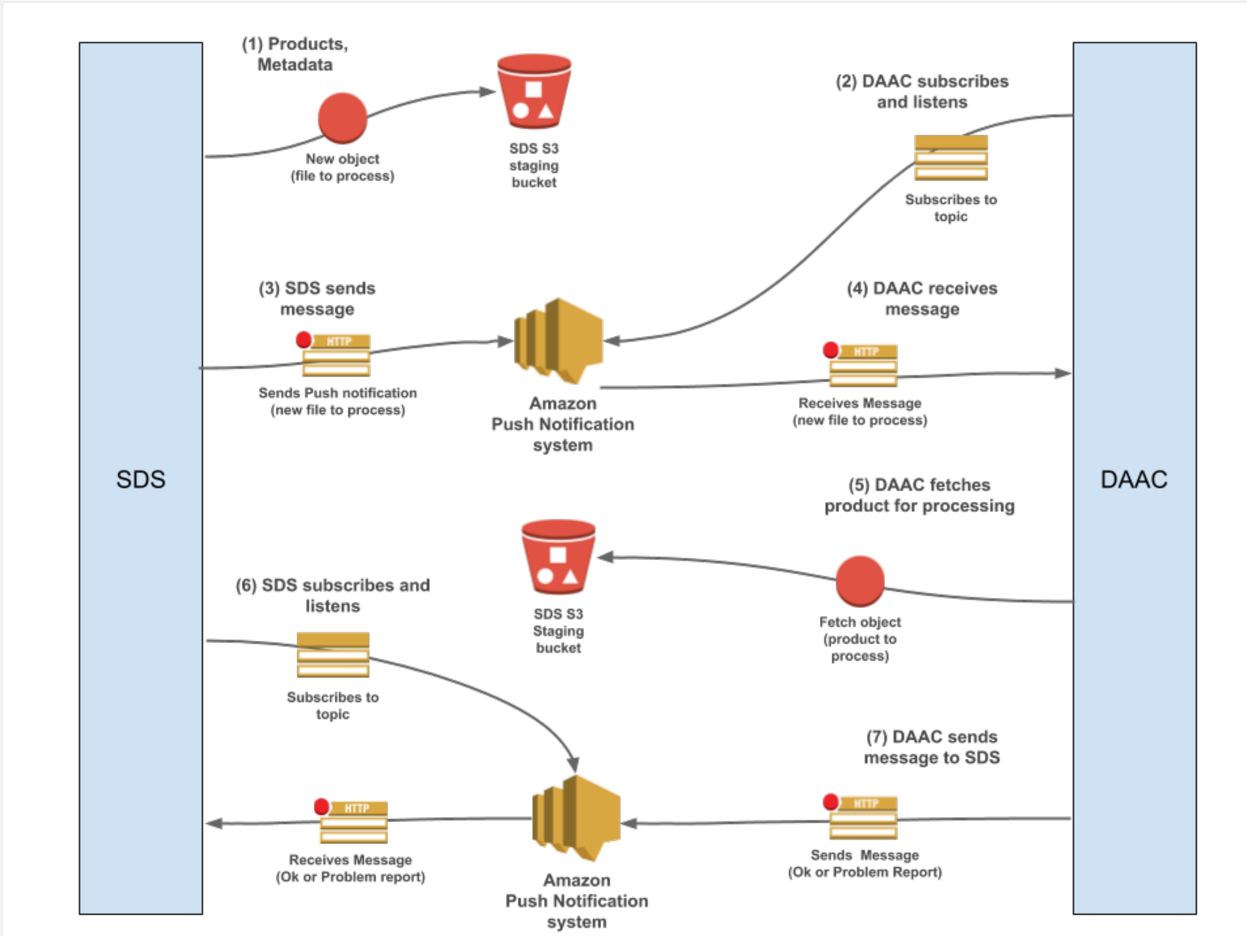

Figure 2-2. PO.DAAC – SWOT Interface for Product Delivery Data Flows

The above diagram, Figure 2-2, expresses the DAAC and SDS Interface Overview in illustration. The ingest notification system and archiving processes are described in the following steps:

(2) The SDS creates the SWOT data products and places SWOT data files designated for archive into a specified, SDS owned location (bucket) within Amazon Simple Cloud Storage Service (S3).

(2) The PO.DAAC creates and subscribes to a mutually agreed push notification service (e.g. SNS, Kinesis) and listens for CNM-formatted new granule notifications. SDS subscribes to the mutually agreed to push notification service and listens for CNM-formatted response messages from the DAAC (i.e. successes and failures during processing).

(3) The SDS generates a message with the particulars of a specific granule to be ingested by the PO.DAAC. It is expected that the SDS will send one Cloud Notification Mechanism (CNM) message per granule. (A granule may consist of one or more files, as illustrated in the Table 2-3.)

(4) The PO.DAAC receives the CNM message of a new granule to process. PO.DAAC will trigger ingest workflows based on the CNM message contents.

(5) Once a new message has been received, the PO.DAAC workflow will pull the specified granule from the SDS staging bucket. The workflow ingests the granule into the PO.DAAC archive.

(6) The SDS subscribes to the push notification mechanism and waits for CNM message indicating success or failure response from the DAAC.

(7) The PO.DAAC sends a success or failure CNM message to the agreed upon response push notification service. The SDS is responsible for deleting SWOT products and files from the SDS owned bucket after the products have been successfully ingested by the PO.DAAC and the CNM-response message received. It is expected that the DAAC will only send a CNM success message when the granule is fully ingested. Checksums may be handled by an asynchronous process by the PO.DAAC, whereby a CNM message may be sent well after the file has been ingested and archived, requiring the SDS to recreate and resend a valid file replacement. If the CNM message is invalid, then the DAAC will send a CNM message back to the SDS and processing is terminated for this granule. The SDS may get more than one failed CNM message if the DAAC retries failed responses. As the CNM messages are not persistent, the DAAC will need to keep logs of transactions or failure for later investigation of problem reports.

The following table □epressents the steps for product notification, delivery and ingestion into the DAAC system. Sample messages are included in Appendix A.

Table 2-1. PO.DAAC and SDS Interface Overview

Item No.	Source	Destination	Message	Data	Transfer Mechanism	Frequency
1	SDS	DAAC	CNM	Granule Identifier, Collection, and file names and locations	Push initiated by SDS	In sync with Standard Products
2	SDS	DAAC	N/A	Metadata File for each granule transferred	Pull initiated by DAAC	In sync with Standard Products
3	SDS	DAAC	N/A	Standard Products	Pull initiated by DAAC	Daily/Continuously
4	DAAC	SDS	CNM-Response	Success or Error Status and Cause if applicable, Granule Identifier, Cause	Push initiated by DAAC	In sync with Standard Products (when needed)

2.4 File Naming Convention

The system only requires unique filenames. The SWOT file naming convention will be used (see document: JPL D-56531).

Table 2-2. FILE_TYPEs Used by SWOT

FILE_TYPE	Description
netCDF	File is a science data granule that conforms to Climate Forecast (CF) conventions and metadata such as in HDF5 and/or netCDF file format(s).
Shapefile	File is a science data granule that conforms to Shapefile format(s).
SCIENCE	File contains science data in an unspecified format, e.g., raw science telemetry data
METADATA	1) File is ISO-MENDS metadata (conformant with the data model), which accompanies all L1~L2 science data granules at the collection level. 2) File is XML metadata (conforming with achive.xml data model), which accompanies all L0 science data granules and other archive-only data granules 3) Not Applicable to Legacy products (e.g. Nadir Altimeter products, POD products, Radiometer products)
Quick Look	Low resolution browse/thumbnail image.

2.4.1 Delivery Packaging

Products and data files SDS prepares for PO.DAAC are packaged in a diverse format.

Products SDS generates are composed of several individual files as listed in Section 3.3. Ancillary/auxiliary data files SDS uses are composed of one or more files and there is no standardized categorization of their components.

The delivery packaging can be summarized as in the following table 2-3.

Table 2-3. Delivery Packaging

	Originates from JPL SDS	Originates from CNES
SWOT Products	One tar-ed file per granule	One tar-ed file per granule
Ancillary/Auxiliary data files	Individual files or One tar-ed file per granule	Various forms – individual, tar-ed, gzip, zip, etc

The data packaging details, including list/name/volume of individual ancil/auxiliary data, are specified in the SDS-PO.DAAC OA.

2.5 Data Accountability

The interface between SDS and DAAC typically allows for the accountability of the data travelling through the Granule/Product Notification and Response Messages. Any further reconciliation needed will be described in the OA.

2.5.1 CNM Notification and Response Messages

The Cloud Notification Mechanism (CNM) will be used to assert clear determination for each granule. For the SWOT interface, the heretofore optional CNM success response shall now be required. See Appendix A for example CNM Notification and Response messages.

2.5.2 Granule Reports

The original purpose of a longer-latency granule report was to catch gaps in data where the DAAC never received notification of a new granule in the first place. With the adoption of CNM, the accounting will be managed per granule, obviating a direct need for such a longer-latency report. As the SDS plans to track both the initiation of granule notification along with the DAAC response, such gaps can be automatically discerned.

2.5.3 Monitoring

Both the SDS and the DAAC will monitor data flows and alert operators to possible issues. Details of events to be monitored and responsible parties and actions to be taken will be documented in the Operations Agreement.

2.6 Metadata

2.6.1 Metadata Format

NetCDF files will follow NetCDF Climate and Forecast (CF) Metadata Conventions Version 1.7. http://cfconventions.org/Data/cf-conventions/cf-conventions-1.7/cf-conventions.html.

The best practice recommendations for consideration are available in the Attribute Convention for Data Discovery (ACDD) Version 1.3
http://wiki.esipfed.org/index.php/Attribute_Convention_for_Data_Discovery_1-3.

The metadata for shapefile is not subject to the CF convention.

The SDS provides the variable metadata for NetCDF file in the form of local attributes of individual variables according to CF convention. For non-NetCDF file, such as the shapefile, the provision of the variable metadata is accompanied with the product file such as .shp.xml file.

The SDS will provide the ISO metadata for the Standard Data Products (see **Error! Reference source not found.**), based on the SMAP ISO Model.

For the Standard Data Products, SDS will generate ISO MENDS XML metadata per agreed upon XML template, for products intended for archive and distribution. PO.DAAC will extract the salient metadata and transform it to convey to Common Metadata Respository (CMR) using UMM/JSON.

- SDS will generate ISO MENDS XML Metadata as per their requirements
- PO.DAAC will retrieve the XML file as a metadata file described in the CNM
- PO.DAAC will extract metadata from the ISO metadata files and convert them to UMM JSON files
- PO.DAAC will send the UMM JSON files to CMR
- PO.DAAC will save the SDS provided ISO-XML files, along with data products, to the archive.

More information on ISO in EOSDIS can be found at:
https://wiki.earthdata.nasa.gov/display/NASAISO/NASA+ISO+for+EOSDIS. The schema for ISO MENDS can be found at: https://cdn.earthdata.nasa.gov/iso/

For products (e.g., INT_LR_XoverCal) and data (e.g., Ancil/Aux) collections intended for archive only, SDS will generate XML metadata according to the metadata model and template as defined in the above table.

2.6.2 Metadata Dictionary

The SDS will supply metadata as defined in the Section 2.6.1. The PO.DAAC will use the SDS supplied products and metadata to extract collection, granule and variable level metadata according to PO.DAAC's metadata dictionary. The PO.DAAC is responsible for meeting the requirements for CMR and enough information so that the data can be searchable and discoverable via PO.DAAC tools and services. The metadata dictionary is in the Appendix B. The Algorithm Development Team may change some of the variable level metadata and these changes will be provided as updates to the ICD.

2.7 Data Access Interface

It is foreseen that the SDS and the other project approved users want access SWOT data and products archived at PO.DAAC.

PO.DAAC Responsibility	**SDS/Project Responsibility**
Support the user account and profile creation for data discovery & access	Obtain the EarthData User account(s) to access SWOT products in PO.DAAC Maintain the validity of the project approved user list
Control the access according to the user profile defined by the SDS	Define the access level of the project approved user(s) and user group(s)
PO.DAAC makes user-requested products available by providing the access points of individual products via AWS Cloud Front	Search/order products according to the method provided by DAAC
Provide the technical support for the data transfer	Copy or Download the products of interest to the location of their choice, and are not charged for the cost of egress or data transfer

PO.DAAC provides the following method for the data discovery:

Types of Access Interface	**Reference**
Earth Data Search Client (GUI)	[URL] – TBD by PO.DAAC
API	[Specification document] – TBD by PO.DAAC

PO.DAAC provides the following data access performance depending on the location of user access:

Category	Data Access Quantity	Data Transfer Bandwidth
Access from the same AWS region	Unlimited	AWS S3 access native bandwidth
Access from another AWS region	Limited 40 TB / day [TBD by PO.DAAC] aggregated for all DAAC users (1)	Variable, not to exceed 40TB/day/month on average
Access from outside of AWS	Limited 40 TB / day [TBD by PO.DAAC] aggregated for all DAAC users (1)	Variable, not to exceed 40TB/day/month on average

(1) During the data access, PO.DAAC does not limit the access (data quantity & bandwidth) to the project users unless the average daily maximum support level has been reached for a given month, then egress throttling measures activate to prevent out of bound egress distribution

2.8 Delivery of Document, Software, and other Data

- Scientific algorithm software source code: Requests for Algorithm Specification Documents or computer software source code for the purpose of validation of the data products generated by the software shall be addressed in conformance with the existing JPL Prime Contract. The SDS will deliver the source code to the PO.DAAC at the end of the Mission
- Other ancillary files needed for preservation are delivered to PO.DAAC by the Project System Engineer

3 SWOT PRODUCTS FOR DELIVERY TO THE PO.DAAC

3.1 SWOT Standard Products

The SWOT SDS is charged with the production and delivery of the Raw data and the Standard Data Products, listed in Table 3-1, to the PO.DAAC. The individual volume and daily number of products are provided as a context. The data volume in Table 3-1 does not include any margin.

Table 3-1. Standard Data Products archived at the PO.DAAC

Short Name	Data Level	Collection Description	Granule Size (GiB)	Granules/ Day	Average Vol/Day (GiB) Uncompressed
L0A_LR_Packet	L0A	Level 0A KaRIn low rate instrument data packets	2	92	184
L0B_LR_Frame	L0B	Level 0B KaRIn low rate instrument data frames	6.9	28	194
LlB_LR_INTF	LlB	Level 1B KaRIn low rate nine beam interferogram product	52.7	28	1476
INT_LR_XOverCal [(1)]	N/A	KaRIn crossover calibration product	0.004	1	0.004
L2_LR_SSH [(2)] (sub-types: L2_LR_SSH_Basic / L2_LR_SSH_WindWave / L2_LR_SSH_Expert / L2_LR_SSH_Unsmoothed)	L2	Level 2 KaRIn low rate sea surface height, wind waves, and sigma0 product on a 2 km geographically fixed grid or on a ~250 m native grid	1.8 (0.03 / 0.04 / 0.12 / 1.59)	28 (28 / 28 / 28 / 28)	50 (0.9 / 1.0 / 3.3 / 44.4)
L0A_HR_Packet	L0A	Level 0A KaRIn high rate instrument data packets	2	420	840
L0B_HR_Frame	L0B	Level 0B KaRIn high rate instrument data frames	0.2	1942	882
LIB_HR_SLC	LIB	Level 1B KaRIn high rate single look complex data product	2.8	3883	10834

Short Name	Data Level	Collection Description	Granule Size (GiB)	Granules/ Day	Average Vol/Day (GiB) Uncompressed
L2_HR_PIXC	L2	Level 2 KaRIn high rate water mask pixel cloud product	0.3	3883	1188
L2_HR_RiverSP	L2	Level 2 KaRIn high rate river single pass vector product	0.04	56	2
L2_HR_RiverAvg	L2	Level 2 KaRIn high rate river average vector Iproduct	0.03	3	0.08
L2_HR_LakeSP	L2	Level 2 KaRIn high rate lake single pass vector product	0.16	28	4
L2_HR_PIXCVec	L2	Level 2 KaRIn high rate pixel cloud vector attribute product	0.1	3883	400
L2_HR_LakeAvg	L2	Level 2 KaRIn high rate lake average vector Iproduct	0.56	3	2
L2_HR_Raster (3) (sub-types: L2_HR_Raster_100m / L2_HR_Raster_250m)	L2	Level 2 KaRIn high rate raster product at 100 m, 250 m resolution	0.24 (0.21 / 0.03)	971 (971 / 971)	234 (202 / 32)
L2_HR_FPDEM (sub-types: L2_HR_FPDEM_Gridded / L2_HR_FPDEM_Ungridded)	L2	Level 2 KaRIn high rate floodplain DEM product, gridded / ungridded	0.26 (0.001 / 0.26)	n/a	14,800 (per campaign (4)) (58 / 14,770)
L0A_KCAL_Packet	L0A	Level 0A KaRIn instrument calibration data packets	0.09	20	2
L0B_KCAL_Frame	L0B	Level 0B KaRIn instrument calibration data frames	0.07	28	2
INT_KCAL_Dyn (1)	N/A	Dynamic KaRIn calibration product	1.95	28	54

Short Name	Data Level	Collection Description	Granule Size (GiB)	Granules/ Day	Average Vol/Day (GiB) Uncompressed
L0A_RAD_Packet	L0A	Level 0A Radiometer instrument data packets	0.001	20	0.02
L2_RAD_OGDR	L2	Level 2 Radiometer Operational Geophysical Data Record	0.01	20	0.28
L2_RAD_IGDR	L2	Level 2 Radiometer Interim Geophysical Data Record	0.01	28	0.28
L2_RAD_GDR	L2	Level 2 Radiometer Geophysical Data Record	0.01	28	0.28
L0A_NALT_RAW	L0A	Level 0A Nadir Altimeter instrument data packets	0.04	20	0.8
L2_NALT_OGDR	L2	Level 2 Nadir Altimeter Operational Geophysical Data Record	0.07	20	1
L2_NALT_IGDR	L2	Level 2 Nadir Altimeter Interim Geophysical Data Record	0.05	28	1
L2_NALT_GDR	L2	Level 2 Nadir Altimeter Geophysical Data Record	0.05	28	1
L0A_DORIS_RAW	L0A	Level 0A DORIS instrument data packets	0.001	20	0.02
L0A_DORIS_NAV_T	L0A	Level 0A DIODE Navigator ITRF Telemetry Packets	0.001	20	0.02
L1_DORIS_RINEX	L1	Level l DORIS tracking data product in RINEX format	0.001	2	0.002
L0A_GPSP_Packet	L0A	Level 0A GPSP instrument data packets	0.001	20	0.02

Short Name	Data Level	Collection Description	Granule Size (GiB)	Granules/ Day	Average Vol/Day (GiB) Uncompressed
L1_GPSP_RINEX	L1	Level 1 GPS Payload tracking data product in RINEX format	0.001	20	0.02
MOE	N/A	Medium- accuracy Orbit Ephemeris data product	0.001	1	0.001
POE	N/A	Precision Orbit Ephemeris data product	0.001	1	0.001
ATTD_RECONST	N/A	Reconstructed attitude product	0.02	1	0.02
SAT_COM	N/A	Satellite Center of Mass	0.5	1	0.5
TOTALS				**15,603** (5)	**16,353** (5)

(1) date granules for archive only
(2) L2_LR_SSH product type consists of 4 sub-type products that may be distributed individually; metrics represents
(3) L2_HR_Raster product type consists of 2 sub-type products that may be distributed individually
(4) Total data volume per campaign; the baseline is 1 campaign; additional campaigns are possible. Total volume per campaign depends on it scope
(5) Daily Total does not include L2_HR_FPDEM

3.2 SWOT Product Volume Requirements including Reprocessing

In this table, the Daily Volume does not include the bulk reprocessing data volume. The End of Mission Total Volume assumes a 3 year mission (3-mo Calibration phase plus 36-mo Science Operations phase) and includes the product volume from the bulk reprocessing campaigns. Currently up to three bulk reprocessing campaigns are planned (Sec **Error! Reference source not found.**). The data volume includes about 20% margin. The volume in this table does not include the ancillary / auxiliary data volume. Static/Dynamic Aux data volume may potentially reach up to 100 TB Life of mission.

Table 3-2. Data Products and Volumes

Data Products/Description	Daily Volume (GiB/day)	Post-Calibration ReProc'g Volume (PiB)	Post-Validation ReProc'g volume (PiB)	Post-Validation ReProc'g volume (PiB)	End of Mission ReProc'g volume (PiB)	Mission Total Volume (PiB)
KaRIn Raw (downlink)	1,231	1.5	n/a	n/a	n/a	1.5
KaRIn L0B	1,294	1.6	0.3	0.8	n/a	2.7
KaRIn L1	14,837	18.1	3.5	9.1	n/a	30.6
KaRIn L2 (1)	2,217	2.7	0.5	1.4	0.8	5.4
Radiometer L0	0.02	0.00003	n/a	n/a	n/a	0.00003
Radiometer L2	0.9	0.001	0.0002	0.0006	n/a	0.002
Nadir Altimeter Raw	1.0	0.001	n/a	n/a	n/a	0.001
Nadir Altimeter L2	4.1	0.005	n/a	n/a	n/a	0.005
POD Raw	0.1	0.0001	n/a	n/a	n/a	0.0001
POD Products	7.0	0.009	0.0016	0.0043	n/a	0.014
TOTAL	**19,592**	**23.9**	**4.3**	**11.2**	**0.8**	**40.2**

(1) The volume includes the systematically generated raster products. The volume does not include Floodplain DEM that can be up to 14.4 TiB per campaign

3.3 Dataset Composition and Distribution Constraints

The following table defines the components of a dataset by product types. The Processing Control and Data Management System (PCM) catalog metadata, ISO metadata file, and RunConfig File are archive only and are not intended for public distribution to avoid any confusion to end users

- The CheckSum information may be included in the Archive & Distribution metadata or in the CNM message.
- "-" means not applicable
- Filenaming convention for individual file is defined in the OA

Table 3-3. Data Product Types

ShortName	Product (1 or more files) (1)	Shapefile metadata	Archive & Distrib'n metadata	PCM catalog metadata	Quick look image (4)	Run Config File	Log	Check-sum (2)
L0A_LR_Packet	binary	-	Archive.xml	Yes (3)	-	-	-	Yes
L0B_LR_Frame	netCDF	-	Archive.xml	Yes	-	Yes	Yes	Yes
L1B_LR_INTF	netCDF	-	ISO.xml	Yes	-	Yes	Yes	Yes
INT_LR_XOverCal	netCDF	-	Archive.xml	Yes	-	Yes	Yes	Yes
L2_LR_SSH	netCDF	-	ISO.xml	Yes	-	Yes	Yes	Yes
L0A_HR_Packet	binary	-	Archive.xml	Yes (3)	-	-	-	Yes
L0B_HR_Frame	netCDF	-	Archive.xml	Yes	-	Yes	Yes	Yes
L1B_HR_SLC	netCDF	-	ISO.xml	Yes	Yes	Yes	Yes	Yes
L2_HR_PIXC	netCDF	-	ISO.xml	Yes	Yes	Yes	Yes	Yes
L2_HR_RiverSP	shapefile	Yes	zip.ISO.xml	Yes	Yes	Yes	Yes	Yes
L2_HR_RiverAvg	shapefile	Yes	zip.ISO.xml	-	Yes	Yes	Yes	Yes
L2_HR_LakeSP	shapefile	Yes	zip.ISO.xml	Yes	-	Yes	Yes	Yes
L2_HR_PIXCVec	netCDF	-	ISO.xml	Yes	-	Yes	-	Yes
L2_HR_LakeAvg	shapefile	Yes	zip.ISO.xml	-	-	Yes	Yes	Yes
L2_HR_Raster	netCDF	-	ISO.xml	Yes	Yes	Yes	Yes	Yes
L2_HR_FPDEM	netCDF	-	ISO.xml	Yes	Yes	Yes	Yes	Yes
L0A_KCAL_Packet	binary	-	Archive.xml	Yes (3)	-	-		Yes
L0B_KCAL_Frame	netCDF	-	Archive.xml	Yes	-	Yes	Yes	Yes
INT_KCAL_Dyn	netCDF	-	Archive.xml	Yes	-	Yes	Yes	Yes
L0A_RAD_Packet	binary	-	Archive.xml	Yes (3)	-	-		Yes
L2_RAD_OGDR	netCDF	-	-	Yes	-	Yes	Yes	Yes
L2_RAD_IGDR	netCDF	-	-	Yes	-	Yes	Yes	Yes
L2_RAD_GDR	netCDF	-	-	Yes	-	Yes	Yes	Yes
L0A_NALT_RAW	binary	-	-	-	-	-	-	Yes
L2_NALT_OGDR	netCDF	-	-	-	-	-	-	Yes
L2_NALT_IGDR	netCDF	-	-	-	-	-	-	Yes
L2_NALT_GDR	netCDF	-	-	-	-	-	-	Yes
L0A_DORIS_RAW	binary	-	-	-	-	-	-	Yes
L0A_DORIS_NAV_T	binary	-	-	-	-	-	-	Yes
L1_DORIS_RINEX	netCDF	-	-	-	-	-	-	Yes
L0A_GPSP_Packet	binary	-	Archive.xml	Yes (3)	-	-	-	Yes
L1_GPSP_RINEX	netCDF	-	-	Yes	-	Yes	Yes	Yes
MOE	netCDF	-	Archive.xml	-	-	-	-	Yes
POE	netCDF	-	Archive.xml	-	-	-	-	Yes

ShortName	Product (1 or more files) (1)	Shapefile metadata	Archive & Distrib'n metadata	PCM catalog metadata	Quick look image (4)	Run Config File	Log	Check-sum (2)
ATTD_RECONST	netCDF	-	Archive.xml (3)	-	-	Yes	Yes	Yes
SAT_COM	netCDF	-	Archive.xml(3)	-	-	Yes	Yes	Yes

(1) Shapefile dataset is packaged into a .zip file that includes .dbf, .prj, .shp, .shp.xml, and .shx
(2) If a tar package is delivered, individual files in the tar file accompany respective .md5 files
(3) Files are created by JPL SDS even if the product may originate from CNES: archive.xml file, .met.json
(4) Quicklook image is optional

3.4 Ancillary/Auxiliary Data

JPL SDS routinely delivers ancillary/auxiliary data to PO.DAAC. The following information is for a reference only.

- Delivery frequencies: 2/day ~ once/yr
- Average number of datasets per day: ~ 20 datasets / day
- Average Daily Volume: ~ 5 GB / day
  (note: Static auxiliary data such as DEM is not included

The detailed information is available in SWOT-PO.DAAC OA document.

Appendix A: CNM Message Examples

A.1 CNM Notification message:

```
{
  "identifier": "SWOT_L1B_HR_SLC_001_504_255L_20160918T235931_20160918T235943_PG33_01",
  "collection": "SWOT_L1B_HR_SLC_1.0",
  "version": "1.5",
  "submissionTime": "2022-09-07T21:13:34.803262Z",
  "product": {
    "name": "SWOT_L1B_HR_SLC_001_504_255L_20160918T235931_20160918T235943_PG33_01",
    "files": [
      {
        "name": "SWOT_L1B_HR_SLC_001_504_255L_20160918T235931_20160918T235943_PG33_01.tar",
        "type": "data",
        "uri": "s3://swot-ops-osl-
reproc/jpl/staging/SWOT_L1B_HR_SLC_001_504_255L_20160918T235931_20160918T235943_PG33_01.tar",
        "size": 2011586560,
        "checksum": "b32a5d02d764cb0439f2c51e417f06b9",
        "checksumType": "md5"
      }
    ],
    "dataVersion": "1.0",
    "dataProcessingType": "reprocessing"
  },
  "provider": "JPL-SWOT",
  "trace": "reproc-jpl-staging"
}
```

A.2 CNM Response Message (Success)

```
{
    "identifier": "SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01",
    "collection": "SWOT_L0B_HR_Frame_1.0",
    "version": "1.5",
    "submissionTime": "2022-09-07T21:16:28.817188Z",
    "product": {
      "dataVersion": "1.0",
      "dataProcessingType": "reprocessing",
      "files": [
        {
          "type": "metadata",
          "name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.archive.xml",
          "uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-
public/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T20
0435_PG33_01.archive.xml",
          "checksumType": "md5",
          "checksum": "c9824034f51205f9e085d9d4d95d6366",
          "size": 5240
        },
        {
          "type": "metadata",
```

"name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.log",
"uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-protected/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.log",
"checksumType": "md5",
"checksum": "12c4710f0854b222b597daf5d0b5fbfc",
"size": 1099
},
{
"type": "metadata",
"name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.met.json",
"uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-protected/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.met.json",
"checksumType": "md5",
"checksum": "e0bb4c9e8ae788c4bb9c4ce945f483af",
"size": 255
},
{
"type": "data",
"name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.nc",
"uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-protected/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.nc",
"checksumType": "md5",
"checksum": "66e7084d3b04ff46d6563aeb5fbac2b4",
"size": 446481081
},
{
"type": "metadata",
"name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.qa.xml",
"uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-protected/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.qa.xml",
"checksumType": "md5",
"checksum": "3c30a533bb9a398ab3cf3fe3ed19fc66",
"size": 1539
},
{
"type": "metadata",
"name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.rc.xml",
"uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-protected/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.rc.xml",
"checksumType": "md5",
"checksum": "97b8ce1598de3717a86b24ab2ce504df",
"size": 2895
},

```
        {
          "type": "metadata",
          "name":
"SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.cmr.json",
          "uri": "https://archive.swot.podaac.earthdata.nasa.gov/podaac-swot-ops-cumulus-private/SWOT_L0B_HR_Frame_1.0/SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01.cmr.json",
          "size": 2244
        }
      ],
      "name": "SWOT_L0B_HR_Frame_001_528_076F_20160919T200423_20160919T200435_PG33_01"
    },
    "provider": "JPL-SWOT",
    "trace": "reproc-jpl-staging",
    "receivedTime": "2022-09-07T21:17:25.090Z",
    "response": {
      "status": "SUCCESS",
      "ingestionMetadata": {
        "catalogId": "G2442407894-POCLOUD",
        "catalogUrl": "https://cmr.earthdata.nasa.gov/search/concepts/G2442407894-POCLOUD.umm_json"
      }
    },
    "processCompleteTime": "2022-09-07T21:18:41.522Z"
  }
}
```

A.3 CNM Response Message (Failure)

```
{
    "identifier": "SWOT_L1B_HR_SLC_001_484_289L_20160918T065617_20160918T065629_PG33_01",
    "collection": "SWOT_L1B_HR_SLC_1.0",
    "version": "1.5",
    "submissionTime": "2022-09-07T21:13:38.088719Z",
    "provider": "JPL-SWOT",
    "trace": "reproc-jpl-staging",
    "receivedTime": "2022-09-07T21:17:27.816Z",
    "response": {
      "status": "FAILURE",
      "errorCode": "PROCESSING_ERROR",
      "errorMessage": "Validation was not successful, CMR error message:
[{\"path\":[\"SpatialCoverage\",\"Geometries\"],\"errors\":[\"[Geometries] cannot be set when the parent collection's GranuleSpatialRepresentation is NO_SPATIAL\"]}]"
    },
    "processCompleteTime": "2022-09-07T21:19:01.090Z"
  }
}
```

Appendix B: Abbreviations and Acronyms

ACDD	Attribute Convention for Data Discovery
AMR	Advanced Microwave Radiometer
ANC/AUX	Ancillary/Auxiliary
API	Application programming interface
ASCII	American Standard Code for Information Interchange
ATBD	Algorithm Theoretical Basis Document
AVISO	CNES Server for Altimetry Data
AWS	Amazon Web Services
CA	California
CF	Climate Forecast
CMR	Common Metadata Respository
CNES	Centre National D'études Spatiales
CNM	Cloud Notification Mechanism
CSO	Communications Services Organization
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
DEM	Digital Elevation Model
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ESD	Earth Science Division
GB	10^9 bytes
GCMD	Global Change Master Directory
GDS	Ground Data System
GiB	Gibibyte (2^{30} or 1024^3 bytes)
GIBS	Global Imagery Browse Services
GPSP	Global Positioning System, Payload
GSFC	Goddard Space Flight Center
GUI	Graphical User Interface
HDF	Hierarchical Data Format
HTTP	Hypertext Transfer Protocol
ICD	Interface Control Document
IPA	Inter-Project Agreement
ISO	International Standards Organization
JPL	Jet Propulsion Laboratory
JSON	JavaScript Object Notation
KaRIn	Ka-band Radar Interferometer
L0 – L2	Level 0 through Level 2
MB	10^6 bytes
Mbps	Megabits per second
MENDS	Metadata Evolution for NASA Data Systems
NASA	National Aeronautics and Space Administration

NetCDF	Network Common Data Form
NGAP	NASA-compliant General Application Platform
OA	Operations Agreement
PAN	Production Acceptance Notification
PB	Petabytes
PCM	Photography ContractProcessing Control and Data Management System
PiB	Pebibyte (2^{50} or 1024^5 bytes)
POD	Precise Orbit Determination
PO.DAAC	Physical Oceanography Distributed Active Archive Center
S3	Simple Storage Service
SDS	Science Data System
SIPS	Science Investigator-led Processing System
SNS	Simple Notification Service
SWOT	Surface Water & Ocean Topography
SQS	Simple Queue Service
TB	Terabytes
TBD	To Be Determined
UMM	Unified Metadata Model
URL	Uniform Resource Locator
UUID	Universally Unique Identifier
XML	Extensible Markup Language