NASA Heliophysics Division Project Data Management Plan Template

Project Data Management Plan Template

1. Template Instructions
   1.1. The Project Data Management Plan (PDMP) is the interface document between NASA, the mission systems, and the instrument teams that describes the science and ancillary data associated with the mission and how the data will be managed. This document describes how the mission will meet the Level-1 requirements (found within the Program Level Requirements Appendix (PLRA)) that address the preparation and distribution of processed science data for the general community.
   1.2. The science teams (instrument providers and Project Scientists) for each mission will develop a PDMP that defines the data, processing approach and implementation, data and documentation products, data availability, and storage and archival strategies. It will also define the access method(s) for the heliophysics scientific community.
   1.3. The project shall coordinate with and obtain feedback from the applicable Archive(s) on the development of and any updates to the PDMP.
      1.3.1. This template contains representative tables with example content. The project shall work with the applicable Archive(s) to ensure that the appropriate level of detail is captured.
   1.4. The PDMP shall be developed and available according to the timeline for the Science Data Management Plan within the Project Plan Control Plans Maturity Matrix in NPR 7120.5, or at the discretion of the Program Scientist. Typically, the PDMP will be available in draft form at the time of Preliminary Design Review for the mission and signed at the time of the Operational Readiness Review. The PDMP may be revised at the Flight Readiness Review/Mission Readiness Review as well as the next Senior Review or at the discretion of the Program Scientist.
   1.5. Each data provider will be expected to generate and make available metadata and other supporting material on the data products, spacecraft, and instrumentation appropriate to their investigation. The details of these will be defined during discussions with the Project and Program personnel during the drafting of the PDMP. The intent of such metadata and materials will be to make the data correctly and independently usable for science investigations.

2. Project Data Management Plan Title Page
3. Signature Page

[*Project Name*] Project Data Management Plan
[*short title or acronym*]

Project Manager	Date
Project Scientist <*for Directed missions*>	Date
Principal Investigator <*for each instrument*>	Date
Archive Project Scientist	Date
HQ Program Scientist	Date

By signing this document, signatories are certifying that the content herein is acceptable direction for managing the project's data and that they will ensure its implementation by those over whom they have authority.

Copy to: HQ Program Executive

4. Change History Log

Revision	Effective Date	Description of Changes
Baseline	mm/dd/yyyy	Original
Revision 1	mm/dd/yyyy	<<Include brief overview of any changes made from 'Original version' to this version by section.>>

5. Project Data Management Plan Content

[Project Name] PROJECT DATA MANAGEMENT PLAN
[short title or acronym]

1. Introduction

1.1 Purpose and Scope

This section provides a brief description/listing of the specific aspects of data management covered by this plan.

1.2 Plan Development, Maintenance, and Management Responsibility

This section identifies who within the project/mission is responsible for maintaining the PDMP along with who should be providing assistance in doing so. Ideally, the instrument teams provide assistance for updating information on their respective instruments within the PDMP.

1.3 Change Control

This section identifies any change control or configuration management plans and processes that apply to this document. It also identifies any key milestones or reviews that draft and/or final versions of the document are tied to.

1.4 About This Document

This section provides a brief overview of what each section of the document covers.

1.5 Relevant Documents

This section identifies (in tabular format) any other project/mission documentation with higher-level guiding requirements or that provide more detail or context. The Program Level Requirements Appendix (PLRA) version(s) and date(s) that this documentation captures data products for shall be listed. See example below:

Title	Document Number	Publication Date
SDO Mission Requirements Document	464-SYS-REQ-0004	18 Nov 2005
Interface Control Document between the SDO Data Distribution System (DDS) and the Science Operations Centers	464-GS-ICD-0010	16 Jun 2006
Interface Control Document between the SDO Mission Operations Center (MOC) and the Science Operations Centers	464-GS-ICD-0001	27 April 2006 [Baseline] 15 Jun 2007 [Revision 1]
…		

2. Mission Overview

This section briefly summarizes the mission, spacecraft, and/or instruments to provide its role and importance within the context of the SMD portfolio.

2.1 Mission Objectives

This section describes the science objective(s) of the mission. It shall also identify other mission stakeholders, partner agencies, and their science contributions.

2.2 Launch, Orbit, and Operations

This section notes the launch date for the mission. It summarizes key operational activities such as orbital maneuvers, checkout, and commissioning in order to provide checkpoints for potentially flagging initial flaws in the data as well as to provide a timeline of when primary project data collection occurs within the mission life cycle. This section also describes how the mission will operationally fulfil its science goals. It identifies the entities involved with the handling of the mission's science data.

3. Science Instrumentation

This section summarizes each instrument or investigation that this PDMP applies to (one 3.x subsection per instrument). Include a summary table that includes all of the mission's instruments and key details as shown in the example below. If the instrument has multiple operational/observation modes, those shall be described here.

Inst. Name	In situ or Remote Sensing?	Mass (kg)	Power (W)	Data Rate (Mbps)	PI	PI Organization	Inst. Status
AIA	Remote sensing	155	188	67	Alan Title	LMSAL	
EVE	Remote sensing	55	76	7	Tom Woods	LASP	
…							

Partner instruments/hosted payloads and the data they produce shall be subject to the terms of their applicable Memorandum of Understanding (MOU).

3.1 <Instrument/Investigation Name>

3.1.1 Instrument Measurement Requirements

This subsection summarizes the required measurement parameters of the instrument

Measurement Parameter	Value
Parameter Measured	Spectral irradiance covering 0.1-105 nm and 121.6 nm every 10 seconds [Baseline] Spectral irradiance covering 37-105 nm and 121.6 nm every 10 seconds [Updated 27 May 2014]
Energy/Wavelength Range	0.1 to 105 nm [Baseline] 37 to 105 nm [Updated 27 May 2014]
Energy/Wavelength Resolution	0.1 nm (5-105 nm); 1 nm (0.1-5 nm) [Baseline] 0.1 nm (37-105 nm); 1 nm (0.1-5 nm) [Updated 27 May 2014]

3.1.2 Instrument Description

This subsection describes the primary scientific objectives of the instrument, its hardware, physical configuration, etc. This subsection lists the major elements of the instrument and provides a schematic of the conceptual design. Known issues due to external factors that could impact any long-term comparison or analysis (e.g., optical distortion due to gradual radiation degradation) should be captured.

3.1.3 Instrument Observation Requirements

This subsection summarizes the required observation parameters of the instrument. Not applicable for in situ measurements.

3.1.4 Instrument Observation Capabilities

This subsection summarizes specific instrument parameters, such as number of detectors, field of view, wavelengths measured, time resolution, data rate, etc. Specify measurement capabilities for in situ instruments.

Observation Parameter	Value		
	Prime Mission	Extension 1	Extension 2
Observable	EUV	EUV	EUV
Number and Type of Detectors	2 1024 x 2048 CCDs 2 Si photodiodes in MEGS; 9 Si photodiodes in ESP	2 1024 x 2048 CCDs 2 Si photodiodes in MEGS; 8 Si photodiodes in ESP	2 1024 x 2048 CCDs 7 Si photodiodes in ESP

Observation Parameter	Value		
	Prime Mission	Extension 1	Extension 2
Sensitive Area	2048 (wavelength/spectrum) x 1024 (slit image) for each CCD	2048 (wavelength/spectrum) x 1024 (slit image) for each CCD	2048 (wavelength/spectrum) x 1024 (slit image) for each CCD
Field of View	2° ± 1°	2° ± 1°	2° ± 1°
Time Resolution	≤ 20 sec between spectra	≤ 20 sec between spectra	≤ 20 sec between spectra
Positioning	Uncertainty < 60" over 10 second intervals	Uncertainty < 60" over 10 second intervals	Uncertainty < 60" over 10 second intervals
Sensitivity			
Data Rate	Science data (Ka-band):7 Mbps HK (S-band): 2 kbps	Science data (Ka-band):7 Mbps HK (S-band): 2 kbps	Science data (Ka-band):7 Mbps HK (S-band): 2 kbps

3.1.5 Data Acquisition

This subsection describes what data is obtained by the instrument, how it's obtained, any variation in data acquisition modes, etc.

4. Data Products

A summary table of data products, mapped by data level and instrument, shall be included.

Data Level	<Inst 1>	<Inst 2>	<Inst 3>	<Inst 4>
L0	Raw CCSDS data packets, real-time Level 0 files and SSR binary files.	Time-ordered raw data, with communication artifacts removed	Raw images with header information, in instrument units	Raw CCSDS data packets, real-time Level 0 files and SSR binary files.
L1	Uncompressed and decommutated L0 + Time-tagged waveform and spectral data in telemetry and engineering units [V, dBs, nT] in spacecraft	Uncalibrated: 2-minute cadence pixel data and FFIs	Calibrated images (using best-available calibrations)	FITS files with uncompressed images. Image values are in raw counts (DN).

Data Level	<Inst 1>	<Inst 2>	<Inst 3>	<Inst 4>
	coordinate system. Daily CDF files. Quick Look and daily/orbital summary plots.			
L2	L1 + Time-tagged waveform and spectral data in fully calibrated physical units [V, mV/m, nT, (V/m)2/Hz, nT2/Hz] in spacecraft and heliophysical coordinate systems. Daily CDF files. Quick Look and daily/orbital summary plots.	Calibrated: 2-minute cadence pixel data and FFIs	Irradiance curves, reconstructed temperature maps, etc.	FITS files with calibrations applied. Image values are in units of brightness. FITS files of the background image computed for each calibrated image
L3	…	Simple Aperture Photometry Light Curves and Centroids		
L4				

4.1 <Instrument or element name> Science Data Products

This section includes a summary list of the mission's instruments

Inst. Name	Parameters Measured [Baseline performance]	Instrument Type	Instrument Status
AIA	Images of the Sun in seven EUV wavelengths every 10 seconds, with 3 UV and visible channels every 30 seconds	Camera	OK
EVE	Spectral irradiance covering 0.1-105 nm and 121.6 nm every 10 seconds	Spectrometer	MEGS-A and SAM powered down due to anomaly. No measurements from 6-37 nm after 26 May 2014.
HMI	Line-of-sight velocity and magnetic field (vector and longitudinal)	Imager: Optical	OK
…			

4.1.1 <Instrument or element name> Data Products Functional Description

This subsection details the science data products produced by a particular mission instrument or ground system element (e.g., SOC). The mission-specific data levels should be defined, and the steps needed to process each level of data shall be described. A reference to the general data level definitions located in the Heliophysics Science Data Management Policy should be included.

Data Level Definitions

Data Level	Data Format	Brief Description	Source
Level 0	Google Protocol Buffer	Time-ordered raw data, with communication artifacts removed	POC
Level 1	FITS	Uncalibrated: 2-minute cadence pixel data and FFIs	SPOC
Level 2	FITS	Calibrated: 2-minute cadence pixel data and FFIs	SPOC
…			

Any associated metadata products to be generated and maintained shall also be described. Details should also include the cadence (e.g., hourly, daily, etc.) for processing of data products.

Data Product	Brief Description	Source	Host
Uncalibrated Full-Frame Images (FFIs)	FITS data files containing the uncalibrated pixels on a single CCD per 30 minute cadence observations. FFIs are provided for each camera individually and are contained in a single FITS file.	POC	MAST
Light Curves (LCs)	FITS binary table files for science targets observed as 2-minute cadence in a single observing sector that contains a primary header, a light curve extension containing the simple aperture time-series photometry (SAP), systematic-corrected aperture time-series photometry (PDC_SAP), and additional data like associated uncertainties, centroid values, and an aperture extension.	SPOC	MAST
…			

4.1.2 <Instrument or element name> Science Data Distribution

This subsection summarizes the data products and key parameters (possibly in tabular format, see example below).

Level	Components	Time Resolution	Time Span	Processing Cadence	Daily Volume (MB)	Public release of day N data	Date Modified
L2	~~MEGS-A, B~~ MEGS-B	10 sec	1 hour	After L1	~~1200~~ 600	Hour 23-24 on day N+1	15 Dec 2009 [Baseline]

Level	Components	Time Resolution	Time Span	Processing Cadence	Daily Volume (MB)	Public release of day N data	Date Modified
							26 May 2014 [MEGS-A failure]
L3	ESP~~, SAM, MEGS-A~~, MEGS-B, MEGS-P	1 day	1 day	1/day	~~0.026~~ 0.015	Hour 0-1 on day N+2	15 Dec 2009 [Baseline] 26 May 2014 [MEGS-A/SAM failure]

This subsection also provides details on data storage, including storage medium and available space/volume, file format(s), backup and archival strategy, and data catalogues

5. Ground System

This section provides details on each element on the ground that project data is routed through.

5.1 Ground System Architecture

This section lists the elements (e.g., DSN, MOC, SOC) that make up the mission's ground system.

5.2 <Ground system element name>

This section provides additional details for the ground system element, such as its primary function and responsibilities. Develop a separate section for each element.

6. Data Flow

This section provides details on the transfer of data between [flight and ground] mission elements.

6.1 Overview of End-to-End Data Flow

6.1.1 Data Flow to Spacecraft

This subsection describes the transfer (e.g., Guest Observer Office-to-Science Office, Science Office-to-POC, POC-to-MOC, MOC-to-Network) of information as it evolves from a desired observation to a spacecraft command, including the development of intermediate products (e.g., objects of interest, candidate target lists, pixel masks, target tables, instrument and spacecraft commands).

6.1.2 Data Flow from Spacecraft

This subsection describes the transfer (e.g., Network-to-FDF, Network-to-POC, POC-to-SOC, etc.) of return data and the development of products along each step (e.g., raw telemetry, Level 0 data, light curves, calibrated images, etc.) as well as transfer timeframe and expected processing time.

6.2 Data Handling and Timeline

This section summarizes the flow of data from the spacecraft as well as the transfer method (e.g., TCP/IP over Restricted IONet, FTP, etc.) along with the timeline for delivery to/from each element (see sample below).

Flow	Data Product	Timeline	Transfer Method
DSN to MOC	Ka-band data *Primary Science* *Ancillary Data* *Inst. HK*	1 day of downlink	VPN
DSN to POC	S-band data *Playback spacecraft HK* *Playback Inst HK* *Realtime TLM*	<10 seconds of downlink	TCP/IP via RIONet
…			

If available, a more detailed breakdown of the release schedule for calibrated data by campaign (e.g., Launch + xx, by orbit, by perihelion passage, etc.) may be provided

Campaign	Observation Start	Observation Stop	Timeframe for Calibrated Data Availability
C001	Launch + 2 months	Launch + 3 months	6 months after start of C001
…			

7. Archiving and Data Access

This section describes the process for archiving data and how those archives may be accessed. An estimate of instrument data storage requirements over the nominal life of the mission should be provided. Revised estimates for extended mission phases shall be provided at the Senior Review.

Prime Mission (Prime mission start date – Prime mission end date)				
Instrument/Data Set	**Annual (Uncompressed)**	**5-Year Total (Uncompressed)**	**Annual (Compressed)**	**5-Year Total (Compressed)**
<Instrument 1>				
Level 0 Data	54 TB	270 TB	27 TB	135 TB
Level 1 Data	0.5 TB	2.5 T	0.25 TB	1.25 TB
Space Weather Data	0.028 TB	0.14 TB	0.028 TB	0.14 TB
Higher level Products	0.5 TB	2.5 TB	0.25 TB	1.25 TB
<Inst 1> Total	55 TB	275 TB	27.5 TB	137.5 TB
<Instrument 2>				
Level 0 Data				
…				

Extended Mission (Extension start date – Extension end date)				
Instrument/Data Set	**Annual (Uncompressed)**	**5-Year Total (Uncompressed)**	**Annual (Compressed)**	**5-Year Total (Compressed)**
<Instrument 1>				
Level 0 Data	54 TB	270 TB	27 TB	135 TB
Level 1 Data	0.5 TB	2.5 T	0.25 TB	1.25 TB
Space Weather Data	0.028 TB	0.14 TB	0.028 TB	0.14 TB
Higher level Products	0.5 TB	2.5 TB	0.25 TB	1.25 TB
<Inst 1> Total	55 TB	275 TB	27.5 TB	137.5 TB
<Instrument 2>				
Level 0 Data				
…				

7.1 Current Archive Locations

This section describes each of the locations/repositories for science data products, any mirroring locations, and archival roles and responsibilities. The implementation of any archive-specific

naming conventions and file verification processes shall be explained (see https://spdf.gsfc.nasa.gov/guidelines/archive_newdata_reqt.html for requirements). Any requirements or restrictions for accessing the archives (e.g., accounts) are identified.

7.2 Data Access and Processing Tools

This section identifies any software available to help users search the archive catalog, access data, and further process the data. Minimum system requirements needed to install (if needed) and use the software shall be provided. This section identifies the capabilities of the software (e.g., browsing, generating light curves, performing analyses, etc.), the language it was developed in, and the file types it can be used with.

7.3 Documentation and Metadata

This section describes how the project will make documentation of data products and format available. Listings of any software documentation or user guides shall indicate when they were last updated as well as the version of the software they are applicable to. This section also identifies any metadata schemes to be employed (e.g., SPASE).

7.4 Final Archive/Mission Archive Plan

This section describes the tasks needed to adapt products/data sets in order to maintain their long-term utility with minimal (or no) support from the mission or instrument team. The details of this section will be updated at each Senior Review in preparation for extended mission phases and to leverage advances in Information Technology.

7.4.1 Data Products

This subsection describes the classes of data products to be contained within the Final Archive including, but not limited to catalog data, calibrated data, and ancillary products. A summary list or table of final products and their formats shall be included. This subsection also includes details on each instrument team's archiving plan.

7.4.2 Analysis Tools

This subsection describes the set of analysis tools (i.e., software/code) to be archived for the research community.

7.4.3 Documentation

This subsection describes the process of reviewing existing mission documentation and downselecting to a core set that has been scrubbed to remove obsolete and/or conflicting material.

7.4.4 Final Archive Access and Distribution

This subsection describes how data, tools, and documentation are to be served and maintained for the long term.

Appendix A. Acronyms