REV.	BY	DESCRIPTION	DATE
–	DD	First Release	Nov. 19, 2002
	DD	Revisions based on the updated launch date (and resulting trajectory) are incorporated. The addition of the AGVDP as an appendix (B) is based on a recommendation from the DAWG. Changes in text and tables are highlighted in blue. Changes in figures and/or figure captions show highlighted figure captions (in blue). The added Appendix B (the AVGDP) is NOT highlighted in its entirety, only those sections that have been changed due to updates since its initial draft.	Jan. 29, 2004
	RLM	Labeled as Rev "A," only one version has ever been released. Changes highlighted in pink and blue from changes above; entire Appendix B is updated.	Sep. 4, 2006
A	RLM	Still Rev A; incorporates RS and further changes in yellow – [all here per DCN E25228].	Sep. 26, 2006
B (Draft)	AAM/SLE/MRR/PDB	Updated for new CDR delivery requirements and schedule. Simplified on the basis of PDS examples. Changed the name of the document from "Data Management and Science Analysis Plan" to "Data Management and Archiving Plan".	Jul. 13, 2011
B (Draft)	SLE/MRR/PDB	Updated for extended mission.	Feb. 15, 2012
B	SLE	Release at Rev B in PLM	May 7, 2013
C (Draft)	SLE	Updated for second extended mission and XM2' campaign.	Feb. 3, 2015
C	SLE	Release at Rev C in PLM	Apr. 15, 2015

Revision: C

Date: April 15, 2015

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JOHNS HOPKINS APPLIED PHYSICS LABORATORY

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MESSENGER Data Management and Archiving Plan

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[2]These personnel have reviewed and approved this release, as indicated by the e-mail responses provided below.

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From: SeanSolomon <solomon@ldeo.columbia.edu>

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Cc: SeanSolomon <solomon@ldeo.columbia.edu>

Subject: Re: Your reply needed - approval of MESSENGER DMAP Rev C

I approve document 7384-9019, Revision C, MESSENGER Data Management and Archiving Plan, signed by Sean C. Solomon, Principal Investigator.

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Date: Wednesday, April 15, 2015 at 4:39 PM

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Subject: Re: Your reply needed - approval of MESSENGER DMAP Rev C

I approve document 7384-9019, Revision C, MESSENGER Data Management and Archiving Plan, signed by Thomas H. Morgan, Project Manager for PDS.

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Subject: Re: Your reply needed - approval of MESSENGER DMAP Rev C

I approve document 7384-9019, Revision C, MESSENGER Data Management and Archiving Plan, signed by Edwin J. Grayzeck, Program Scientist, Deputy Project Manager for PDS.

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Subject: Re: Your reply needed - approval of MESSENGER DMAP Rev C

I approve document 7384-9019, Revision C, MESSENGER Data Management and Archiving Plan, signed by Steven P. Joy, PDS Point of Contact.

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1 Introduction

1.1 Purpose

The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) mission's Data Management and Archiving Plan (DMAP) presents a high-level strategy for the generation, validation, and delivery of mission data and data products from the MESSENGER project's Science Operations Center (SOC) to the Planetary Data System (PDS) in complete, well-documented, and permanent archives. The plan also specifies policies for distributing data and data products within the MESSENGER project and to the science community and general public.

1.2 Scope

The plan covers the archiving of raw and reduced data sets and related information to be acquired or derived during the MESSENGER mission. Specific aspects addressed in this plan are as follows:

1. Reduction of science packet data to experiment data records (EDRs) and reduced data records (RDRs),[1] including generation of data sets expressed in physical units, with associated documentation that describes when and where the data were acquired and for what purpose
2. Generation of high-level mission, spacecraft, and instrument documentation, instrument calibration reports, and documentation of software or algorithms used to produce RDRs
3. Generation of SPICE (Spacecraft ephemeris, Planet/satellite ephemeris, Instrument information, Camera orientation, Event information) archives for use with software from the Jet Propulsion Laboratory's Navigation and Ancillary Information Facility (NAIF)
4. Generation and validation of PDS-compliant archives containing MESSENGER EDRs and RDRs, documentation, and ancillary information
5. Delivery to the community of validated MESSENGER archives through the PDS
6. Generation of deep archive volumes for permanent storage at the National Space Science Data Center (NSSDC)

1.3 Contents

The plan starts with an overview of the MESSENGER mission, including the spacecraft's payload and the Ground Data System (GDS). An overview of the archiving functions is then presented, including generation, validation, and delivery of data, and the roles and responsibilities for the major archiving functions and organizations are discussed. Policies for the release of data and other public information are described, and schedules for public release of the data are given. Additional information includes applicable documents referenced in the plan, definitions of processing levels, a synopsis of the data sets to be delivered, and a glossary of selected terms, acronyms, and abbreviations.

1.4 Applicable Documents

1. Arvidson, R., E. Guinness, and S. L. Dueck (1994). The Planetary Data System, *Remote Sensing Rev.*, **9**, 255–269.
2. Gold, R. E., *et al*. (2001). The MESSENGER mission to Mercury: Scientific payload, *Planet. Space Sci.*, **49**, 1467–1469.

[1]MESSENGER RDRs include calibrated data records (CDRs), derived data products (DDPs), and derived analysis products (DAPs).

3. McMahon, S. K. (1996). Overview of the Planetary Data System, *Planet. Space Sci.*, **44**, 3–12.

4. Santo, A. G., *et al*. (2001). The MESSENGER mission to Mercury: Spacecraft and mission design, *Planet. Space Sci.*, **49**, 1481–1500.

5. Solomon, S. C., *et al*. (2001). The MESSENGER mission to Mercury: Scientific objectives and implementation, *Planet. Space Sci.*, **49**, 1445–1465.

6. Solomon, S. C., *et al*. (2007). MESSENGER mission overview, *Space Sci. Rev.*, **131**, 3–39.

2 Overview of the MESSENGER Mission

MESSENGER is a Discovery Program mission designed to perform a global characterization of the planet Mercury. The mission's science goals are to provide the first images of the entire planet and collect detailed information on the composition and structure of Mercury's crust, its topography and geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials.

MESSENGER's Principal Investigator (PI) is Sean C. Solomon of the Lamont-Doherty Earth Observatory of Columbia University, and the mission is managed by The Johns Hopkins University Applied Physics Laboratory (JHU/APL), which operates the spacecraft through its Mission Operations Center (MOC). The SOC resides at JHU/APL, and its responsibilities are shared among JHU/APL personnel, MESSENGER Science Team representatives, and the Applied Coherent Technology Corporation, which acts under subcontract to JHU/APL. Launched in August 2004 from the Cape Canaveral Air Force Station in Florida, the MESSENGER spacecraft completed six planetary flybys during its 6.6-year cruise phase: one of Earth (August 2005), two of Venus (October 2006 and June 2007), and three of Mercury itself (January and October 2008 and September 2009). In March 2011, the spacecraft was inserted into orbit about Mercury, becoming the first craft ever to do so and initiating the orbital phase of its primary mission. The primary mission included one Earth-year of orbital operations, until 17 March 2012, followed by one year of data analysis and archiving. In November 2011, NASA approved a first extended mission (XM1) consisting of a second Earth-year of orbital operations, to 17 March 2013, and the year of data analysis and archiving was moved one year later. A second extended mission (XM2) for MESSENGER, including just over two additional Earth-years of orbital operations, was approved by NASA in 2013, moving the final year of data analysis and archiving by an additional two years. In 2014, NASA approved the addition of a final operational campaign (XM2'), which is expected to extend orbital operations by approximately one month and adds one month to the final year of data analysis and archiving. XM2' orbital operations are expected to conclude in late April 2015 when the MESSENGER spacecraft, having exhausted its propellant reserves, impacts the planet at the end of its final ultra-low-altitude campaign. The mission is currently planned to end on 31 May 2016 at the conclusion of the final 13-months of data analysis and archiving.

2.1 Payload and Primary Mission

The MESSENGER primary mission was designed to answer the following set of focused science questions about the nature and history of the planet Mercury:

- What planetary formational processes led to the high metal/silicate ratio in Mercury?
- What is the geological history of Mercury?
- What are the nature and origin of Mercury's magnetic field?
- What are the structure and state of Mercury's core?
- What are the radar-reflective materials at Mercury's poles?
- What are the important volatile species and their sources and sinks on and near Mercury?

To answer these questions, the MESSENGER spacecraft carries a scientific payload of seven miniaturized instruments that, along with the radio science experiment, provide the data needed to conduct its mission. Descriptions of the investigations follow.

- *Mercury Dual Imaging System (MDIS)*

  The MDIS consists of a narrow-angle imager and wide-angle, multispectral imager. Pointing is assisted with a pivot platform. This instrument maps landforms, surface spectral variations, and topographic relief from stereo imaging.

- *Gamma-Ray and Neutron Spectrometer (GRNS)*

The GRNS consists of a Gamma-Ray Spectrometer (GRS) and a Neutron Spectrometer (NS). The GRS measured the emissions from radioactive elements and gamma-ray fluorescence stimulated by cosmic rays. It was used to determine elemental abundances in regions of the crust.[2] The NS measures hydrogen in ices at the poles and elements having substantial thermal-neutron absorption in surface regions, providing an average sub-spacecraft atomic weight of crustal material.

- *X-Ray Spectrometer (XRS)*

  The XRS measures Mercury surface fluorescence in low-energy X-rays that are stimulated by solar X-rays. It is used to map elemental abundances of crustal materials.

- *Mercury Laser Altimeter (MLA)*

  The MLA is an infrared laser transmitter coupled with a receiver that measures the round-trip time of a burst of laser light reflected off of Mercury's surface, yielding a distance measurement. It produces highly accurate measurements of topography and measures Mercury's physical libration.

- *Mercury Atmospheric and Surface Composition Spectrometer (MASCS)*

  The MASCS consists of the Ultraviolet and Visible Spectrometer (UVVS) and the Visible and Infrared Spectrograph (VIRS). The UVVS measures composition and spatial and temporal variations of exospheric species. The VIRS maps surface reflectance to determine mineral composition.

- *Energetic Particle and Plasma Spectrometer (EPPS)*

  The EPPS measures the composition, spatial distribution, energy, and time variability of charged particles within and surrounding Mercury's magnetosphere. It consists of the Fast Imaging Plasma Spectrometer (FIPS) and the Energetic Particle Spectrometer (EPS). Plasma is measured by the FIPS, and higher-energy particles are measured by the EPS.

- *Magnetometer (MAG)*

  The MAG maps the detailed structure and dynamics of Mercury's magnetic field and searches for regions of magnetized crustal rocks.

- *Radio Science (RS)*

  RS uses the Doppler effect (the shift in the frequency of the spacecraft's radio signal with changes in the spacecraft's velocity relative to Earth) to measure Mercury's gravitational field and to infer its corresponding mass distribution, including spatial variations in crustal thickness.

2.2 First Extended Mission (XM1)

Given the performance of the spacecraft during the first half of the primary mission orbital operations as well as the availability of the necessary resources to continue operations, NASA agreed in late 2011 to extend the period of orbital observations by one additional Earth year.

During XM1, the spacecraft spent more time close to the planet than during the primary mission, and there were a broader range of scientific objectives and the opportunity to make many more targeted observations with the imaging system and other instruments. MESSENGER was also expected to view the innermost planet as solar activity increased toward the next projected maximum in the solar cycle.

XM1 was designed to answer six scientific questions, each of which arose as a direct result of discoveries made from the flybys and primary mission orbital phase:

1. What are the sources of surface volatiles on Mercury?
2. How late into Mercury's history did volcanism persist?

[2]Nominal GRS operation concluded on June 15, 2012, with the failure of its cryogenic cooler.

3. How did Mercury's long-wavelength topography change with time?
4. What is the origin of localized regions of enhanced exospheric density near Mercury?
5. How does the solar cycle affect Mercury's exosphere and volatile transport?
6. What is the origin of Mercury's energetic electrons?

Data archive delivery to the PDS during XM1 continued at the same cadence and consistent with the deliveries planned for primary mission orbital operations. In addition, the selection of high-level products developed and delivered as part of the primary mission was expanded for XM1. The details associated with the delivery schedules and products can be found in sections 6 and 7.

2.3 Second Extended Mission (XM2)

Given the healthy state of the spacecraft and the instrument payload, ample power margin, and remaining propellant, the promise of important new measurements to complement and substantially extend those made during primary mission and XM1 operations, and the availability of necessary resources to continue operations, NASA agreed in 2013 to extend the period of orbital observations by slightly more than two additional Earth years. In 2014 NASA approved the XM2' operational campaign, increasing the duration of XM2 orbital operations by approximately one additional month.

Targeted observations continue during XM2, including imaging of regions of interest and stereo imaging as well as other observations that enhance existing data sets. Solar conditions during XM2 provide an opportunity to characterize the response of Mercury's magnetosphere and exosphere to a phase of the solar cycle not encountered earlier in the mission. During the second year of XM2 operations, periapsis altitudes will be lower than at any earlier time in the MESSENGER mission and will allow for observations of regions of Mercury at resolutions markedly superior to those yet attained, across the full suite of instruments. The final XM2' operational campaign will allow ultra-low-altitude observations. Primary objectives include acquisition of short-wavelength magnetic-field data and neutron flux measurements over permanently shadowed floors of polar impact craters. Observations beyond the primary objectives will be supported as allowed by spacecraft resources and operational constraints.

XM2 has been designed to answer seven scientific questions, each of which has arisen as a direct result of discoveries made from orbit:

1. What active and recent processes have affected Mercury's surface?
2. How has the state of stress in Mercury's crust evolved over time?
3. How have the compositions of volcanic materials on Mercury evolved over time?
4. What are the characteristics of volatile emplacement and sequestration in Mercury's north polar region?
5. What are the consequences of precipitating ions and electrons at Mercury?
6. How do Mercury's exosphere and magnetosphere respond to both extreme and stable solar wind conditions during solar maximum and the declining phase of the solar cycle?
7. What novel insights into Mercury's thermal and crustal evolution can be obtained with high-resolution measurements from low altitudes?

The cryogenic cooler for the GRS instrument germanium detector failed during XM1 at a time consistent with its expected lifetime. This failure now prevents the GRS from acquiring gamma-ray spectra. For XM2, the instrument was repurposed so that its anti-coincidence shield is now used to register energetic electrons and neutrons at high time resolution, and new GRS data products derived from data acquired in this new configuration have been incorporated into deliveries starting with release 11.

Data archive delivery to the PDS during XM2 orbital operations continues at the same cadence and consistent with the deliveries planned during primary mission and XM1 orbital operations. Two deliveries will be completed in the final 13 months of data analysis and archiving. The selection of high-level products will once again be expanded for XM2, as was done for XM1. The details associated with these delivery schedules and products can be found in sections 6 and 7.

2.4 Ground Data System

The MESSENGER GDS converts the raw spacecraft data stream to science data products. The MOC receives telemetry packets from the Deep Space Network (DSN) and processes them through Committee on Data Management and Computation (CODMAC) Level 1, providing the CODMAC Level 1 data to the SOC. (See section 8 for CODMAC data-level definitions.) Navigation data, including spacecraft and planetary ephemerides and spacecraft pointing data, are transmitted from the MOC to the SOC in SPICE format. The SOC also acquires and processes RS data, which are obtained from the DSN.

The SOC supports the MESSENGER Science Team in the processing and analysis of the science data. It provides easy access to all data required by the Science Team and the MOC. The SOC accepts and processes telemetry and navigation data through CODMAC Level 1, creating CODMAC Level 2 EDRs, calibration files, and a telemetry archive. The SOC archives the Level 2 through Level 6 data in the PDS.

The Science Team, with assistance from the SOC, is responsible for science data processing through CODMAC Levels 3 through 5 and for delivering these products to the SOC in PDS-compliant formats, including associated documentation. The SOC is responsible for negotiating all product formats with the PDS and for delivery of all data products to the PDS.

3 Overview of Archiving Functions

Standard products form the core of the archives produced by the MESSENGER SOC and released to the PDS for distribution to the science community and others. Standard products are well-defined, systematically generated data products, including EDRs and RDRs. These products and associated supporting information (e.g., documentation and index tables) are validated and delivered to the PDS at regular intervals. Additional special data products for which creation may require more subjective judgment have been incorporated starting with MESSENGER release 11, in some cases by reference to scientific publications reporting these results. The schedule for releases is provided in section 6. Standard products are listed by instrument in Table 7-1. Special products are listed by instrument in Tables 7-2 (for special products introduced in XM1) and 7-3 (for special products introduced in XM2). The processing levels defined for science data are given in Table 8-1.

The following sections discuss the processes for generation and validation of products and archives, their delivery to the PDS, and their distribution to the science community and the general public.

3.1 Generation

Responsibility for generating archive components is specified in section 4. Science data products are generated in PDS-compliant formats. Each data file (data table or image file) is in a format approved by the PDS and is accompanied by a PDS "*label*," which describes the content and structure of the accompanying data file. Navigation, geometry, and engineering data necessary to interpret the science data are provided as ancillary archive components. In addition, files documenting the archive components are prepared by the parties generating the data. In general, all information necessary to interpret and use the data is included in the archive.

The PDS "*catalog objects*" are files that document the mission, spacecraft, instruments, and data products. The catalog objects take the form of templates that must be filled out with prescribed information. The required catalog objects are the "*mission template*," describing the MESSENGER mission as a whole; the "*instrument host template*," describing the spacecraft; one "*instrument template*" for each instrument; and one "*data-set template*" for each data set. These templates contain the information needed to document the archive and enable future scientists to make correct use of the data when mission personnel are no longer available to support them.

3.2 Validation and Delivery of Archives to the Planetary Data System

There are two types of data validation: validation of the science data and validation of the compliance of the archive with PDS archiving and distribution requirements. The first type of validation is carried out by the Science Team, and the second is overseen by the PDS, in coordination with the Science Team.

When volumes are approved for release by the project, the SOC transfers the archives to the PDS. Validation and transfer take place in advance of the release dates specified in Table 6-3, allowing adequate time for the PDS review.

The formal validation of data content, adequacy of documentation, and adherence to PDS archiving and distribution requirements is scheduled and coordinated by the PDS. This review may include peer reviewers from the science community who may additionally judge the scientific usefulness of the products, at the PDS's discretion. The review process may result in "*liens*," which are actions that are recommended by the reviewers or by PDS personnel to correct the archive. All liens must be resolved by the data-set provider. PDS peer reviews for new MESSENGER products based on sample archives have generally been completed well before those products are delivered so that ample time is available to resolve any liens before release. Beyond the initial peer review and lien resolution, PDS validates delivered products before each release.

3.3 Distribution of Data Products

The MESSENGER project is responsible for making data products available to its own personnel. The PDS is responsible for making data products available to the rest of the science community and to the public.

Archives associated with specific instruments or types of data are transmitted to the PDS discipline node designated by the PDS for archiving and distribution of those data. Archives are transmitted electronically via the Internet or on physical media according to the preference of the receiving node. For electronic transmissions, unless otherwise requested by the receiving node, the MESSENGER SOC initiates and completes the transmission. That is, the data are “pushed” by the SOC rather than “pulled” by the node. Transmission is accomplished by commonly available protocols (e.g., FTP) and uses a commonly available archiving and compression format (e.g., tar or gzip) acceptable to the receiving node.

3.4 Permanent Storage and Backups

The PDS is responsible for maintaining at least three copies of its science archives and for delivering one copy of the data to the NSSDC for deep archive. As archives are released, the PDS discipline nodes or their data nodes generate at least three copies on appropriate physical media for long-term storage by PDS and NSSDC.

During the period after data capture from the spacecraft, through delivery, and while the PDS is writing delivered archives to physical media, the data are backed up periodically by the SOC or copies are otherwise maintained until they are permanently stored with the PDS.

4 Roles and Responsibilities

The primary roles and responsibilities associated with MESSENGER data management and archiving are summarized in the following sections.

4.1 The MESSENGER Team

The MESSENGER team is responsible for operating the MESSENGER spacecraft, making observations, collecting the Level 1 data from the spacecraft, and providing the technical and scientific expertise to process, validate, and analyze the data in order to create the data products to be archived by the PDS. The MESSENGER team:

- plans and generates the data archives and associated documentation in accordance with PDS standards and requirements;
- participates in the formal peer reviews conducted by the PDS and corrects or resolves any issues raised; and
- transmits the data archives to the designated PDS nodes and supports the review, correction, and retransmission of the data in order to ensure timely release to the scientific community and the general public.

4.2 The Planetary Data System

The PDS Planetary Plasma Interactions (PPI) node is the designated point of contact for MESSENGER on archive-related issues. The PDS:

- consults on archive generation and advises the project Science Team on PDS standards, requirements, and documentation needs;
- conducts formal peer reviews, tracks issues raised in the reviews, and coordinates their resolution;
- maintains the MESSENGER science data collection online for access by the general public and the planetary science community;
- replicates archive volumes for distribution to the NASA-supported science community whenever physical media, as opposed to online access, are deemed appropriate; and
- provides a copy of the archive volume set to the NSSDC for long-term preservation.

4.3 The National Space Science Data Center

The NSSDC will maintain a "*deep archive*" of the data for long-term preservation and for filling large delivery orders to the science community. The PDS will serve as the interface between the MESSENGER team and the NSSDC.

5 Policies for Release of Data and Public Information

Because of the widespread interest in new results from Mercury and the strong commitment of the MESSENGER project to release data on a timely basis, the following policies guide the release of scientific data and measurements to the general public and to the scientific community:

- The principal means of releasing scientific data to the scientific community and the general public is through NASA's PDS. To ensure the quality and integrity of the data, a sufficient amount of time is required by the MESSENGER team to process and validate the data before release. The release of data generally follows major mission events and milestones (e.g., flybys of planetary bodies, orbit insertion at Mercury) by six months according to the schedule defined in Table 6-3.
- Before release by the PDS, any scientific use and analysis of the data, use of results from unpublished papers derived from such analysis, or any other public release of such information for public outreach and education purposes requires the explicit agreement of the PI.
- For the purposes of public outreach and education, selected information and data of interest to the general public or of particular scientific importance are made available through press conferences, press releases, posting on the World Wide Web, and other media, in coordination with NASA headquarters and relevant members of the Science Team, and with the concurrence of the MESSENGER PI. The MESSENGER Project Office is informed of any such release in a timely manner in order to ensure that the relevant offices and departments are properly informed.
- To facilitate the processing and validation of the data, the MESSENGER SOC provides electronic access to the data as they are downlinked from the spacecraft to the instrument and scientific discipline teams and other scientists affiliated with the project. The PI, the instrument scientists, and the science discipline group leaders are responsible for coordinating this access.

Information regarding the general status and progress of mission operations is made available to the public on a continuing basis. However, information concerning spacecraft and instrument anomalies may be released only by the MESSENGER Project Office, in coordination with NASA headquarters and the PI.

6 Archive Generation, Validation, and Release Schedules

The MESSENGER mission is divided into a series of mission phases divided by major events such as flybys of planetary bodies and orbital operations at Mercury. Distinct cruise phases are included between mission events before Mercury orbit insertion. Table 6-1 lists the major MESSENGER mission events through January 2015. Table 6-2 defines the mission phases derived from these events and through the expected conclusion of orbital operations.

The generation, validation, and release of archives to the PDS are also linked to major mission events. Table 6-3 defines the release dates and data products associated with each mission phase. Generally, archives are delivered to the PDS at least two weeks before the release date. When possible, archives are delivered sooner, to give the PDS flexibility in validating and processing the archives in order to have the data available to the public by the release date. Further details on the individual science data products are provided in section 7 of this document.

Table 6-4 shows the actual uncompressed data volumes by PDS node for each delivery completed at the time of preparation of this document (i.e., through delivery 12). Note that these delivery volumes include some reprocessed products originally included in earlier deliveries. The NAIF node delivery volumes reflect the requirement by that node that all previous kernels be redelivered with each successive delivery. Also, the MASCS data are delivered to both the Atmospheres and the Geosciences PDS nodes. MESSENGER compiles data-volume estimates for future deliveries (i.e., deliveries 13 through 15) and provides those estimates to the PDS when they are available.

Additional deliveries above and beyond those defined may be made by mutual agreement between the MESSENGER Project Office and the PDS.

Table 6-1. MESSENGER Mission Events through January 2015

Event	Event Date UTC (DOY)	Event Time UTC
Launch	03 Aug 2004 (216)	06:15:56.537
Phase E start	13 Sep 2004 (257)	00:00:00.0
Earth flyby	02 Aug 2005 (214)	19:13:08.4
Venus flyby 1	24 Oct 2006 (297)	08:31:26.3
Venus flyby 2	06 Jun 2007 (157)	00:12:36.9
Mercury flyby 1	14 Jan 2008 (014)	20:14:22.5
Mercury flyby 2	06 Oct 2008 (280)	13:39:08.2
Mercury flyby 3	30 Sep 2009 (273)	01:33:50.9
Mercury orbit insertion	18 Mar 2011 (077)	00:45:15.5
Orbit transition	20 Apr 2012 (111)	23:05:34.9

DOY, day of year

Table 6-2. MESSENGER Mission Phase Definitions

Phase Name	Phase Start[1,2] UTC (DOY)	Phase End[1,3] UTC (DOY)
Launch	03 Aug 2004 (216)	12 Sep 2004 (256)
Earth Cruise	13 Sep 2004 (257)	18 Jul 2005 (199)
Earth Flyby	19 Jul 2005 (200)	16 Aug 2005 (228)
Venus 1 Cruise	17 Aug 2005 (229)	09 Oct 2006 (282)
Venus 1 Flyby	10 Oct 2006 (283)	07 Nov 2006 (311)
Venus 2 Cruise	08 Nov 2006 (312)	22 May 2007 (142)
Venus 2 Flyby	23 May 2007 (143)	20 Jun 2007 (171)
Mercury 1 Cruise	21 Jun 2007 (172)	30 Dec 2007 (364)
Mercury 1 Flyby	31 Dec 2007 (365)	28 Jan 2008 (028)
Mercury 2 Cruise	29 Jan 2008 (029)	21 Sep 2008 (265)
Mercury 2 Flyby	22 Sep 2008 (266)	20 Oct 2008 (294)
Mercury 3 Cruise	21 Oct 2008 (295)	15 Sep 2009 (258)
Mercury 3 Flyby	16 Sep 2009 (259)	14 Oct 2009 (287)
Mercury 4 Cruise	15 Oct 2009 (288)	03 Mar 2011 (062)
Mercury Orbit	04 Mar 2011 (063)	17 Mar 2012 (077)
Mercury Orbit Year 2	18 Mar 2012 (078)	17 Mar 2013 (076)
Mercury Orbit Year 3	18 Mar 2013 (077)	17 Mar 2014 (076)
Mercury Orbit Year 4	18 Mar 2014 (077)	17 Mar 2015 (076)
Mercury Orbit Year 5	18 Mar 2015 (077)	30 Apr 2015 (120)

DOY, day of year

[1]Data are associated with mission phases by their time of acquisition on the spacecraft.

[2]Mission phases start at the beginning of the specified UTC day.

[3]Mission phases end at the end of the specified UTC day.

Table 6-3. Schedule of Data Product Deliveries

Release	Includes Data Acquired Through	Date Released to Public*	Products
Release 1	Pre-launch	05/18/05	***On-ground calibration data***
Release 2	06/20/07	12/20/07	***EDRs for all instruments through VF2 (including EF)*** SPICE files used in processing data
Release 3	01/28/08	07/15/08	***EDRs for all instruments through MF1*** ***CDRs for MAG, MDIS, and MASCS through MF1 (including EF and VF2)*** Reprocessed EDRs (as needed) Calibration files for MAG, MDIS, and MASCS SPICE files used in processing data
Release 4	10/20/08	04/15/09	***EDRs for all instruments through MF2*** ***CDRs for MAG, MDIS, and MASCS through MF2*** Reprocessed EDRs and CDRs (as needed) Calibration files for MAG, MDIS, and MASCS SPICE files used in processing data
Release 5	10/14/09	03/15/10	***EDRs for all instruments through MF3*** ***CDRs for all instruments through MF3 (first delivery of CDRs for MLA, XRS, GRNS, and EPPS)*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 6	05/17/11	09/08/11**	***EDRs and CDRs for all instruments through first 2 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 7	09/17/11	03/08/12	***EDRs and CDRs for all instruments through first 6 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 8	03/25/12	09/07/12	***EDRs and CDRs for all instruments through first 12 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 9	09/17/12	03/08/13	***EDRs and CDRs for all instruments through first 18 months of orbital operations*** ***Primary mission DDPs and DAPs for all instruments through first 12 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 10	03/17/13	09/06/13	***EDRs and CDRs for all instruments through 24 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data

Release	Includes Data Acquired Through	Date Released to Public*	Products
Release 11	09/17/13	03/07/14	***EDRs and CDRs for all instruments through first 30 months of orbital operations*** ***Primary and extended mission (XM1 only) DDPs and DAPs for all instruments through 24 months of orbital operations*** Reprocessed EDRs, CDRs, DDPs, and DAPs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 12	03/17/14	09/05/14	***EDRs and CDRs for all instruments through first 36 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 13	09/17/14	03/06/15	***EDRs and CDRs for all instruments through first 42 months of orbital operations*** ***Primary and extended mission (XM1 and XM2) DDPs and DAPs for all instruments through first 36 months of orbital operations*** Reprocessed EDRs, CDRs, DDPs, and DAPs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 14	04/30/15 (approx.)	10/09/15	***EDRs and CDRs for all instruments through ~49 months of orbital operations*** Reprocessed EDRs and CDRs (as needed) Calibration files for all instruments SPICE files used in processing data
Release 15	04/30/15 (approx.)	05/06/16	***Primary and extended mission (XM1 and XM2) DDPs and DAPs for all instruments through ~49 months of orbital operations*** Reprocessed EDRs (as needed to incorporate corrections) Reprocessed CDRs, DDPs, and DAPs (as needed to incorporate final SPICE and corrections) Final SPICE files used in processing data Final calibration files for all instruments Engineering data (incorporated in science and SPICE products)

EF, Earth flyby; MF, Mercury flyby; VF, Venus flyby

*Release dates are dates that the PDS releases MESSENGER archives to the public. MESSENGER delivers archives to the PDS at least two weeks before the date of release to the public.

**Released to the public one week in advance of the scheduled 15 September 2011 release date

Table 6-4. Delivery Sizes through Delivery 12

PDS Node	Delivery 2 EF/VF2 EDR	Cumulative
Imaging	4.4 GB	4.4 GB
Atmospheres	1.3 GB	1.3 GB
PPI	7.8 GB	7.8 GB
Geosciences	3.7 GB	3.7 GB
NAIF	3.9 GB	3.9 GB
Total	**21.1 GB**	**21.1 GB**

PDS Node	Delivery 3 MF1 EDR, CDR	Cumulative
Imaging	44.9 GB	49.3 GB
Atmospheres	1.6 GB	2.9 GB
PPI	40.3 GB	48.1 GB
Geosciences	6.6 GB	10.3 GB
NAIF	7.9 GB	11.8 GB
Total	**101.3 GB**	**122.4 GB**
PDS Node	**Delivery 4 MF2 EDR, CDR**	**Cumulative**
Imaging	46.3 GB	95.6 GB
Atmospheres	22.4 GB	25.3 GB
PPI	49.3 GB	97.4 GB
Geosciences	59.3 GB	69.6 GB
NAIF	12.1 GB	23.8 GB
Total	**188.4 GB**	**311.8 GB**
PDS Node	**Delivery 5 MF3 EDR, CDR**	**Cumulative**
Imaging	21.0 GB	116.6 GB
Atmospheres	70.5 GB	95.8 GB
PPI	165.6 GB	263.0 GB
Geosciences	100.0 GB	169.6 GB
NAIF	12.5 GB	36.4 GB
Total	**369.6 GB**	**681.4 GB**
PDS Node	**Delivery 6 Orbital EDR, CDR**	**Cumulative**
Imaging	73.0 GB	189.6 GB
Atmospheres	130.2 GB	226.0 GB
PPI	238.2 GB	501.2 GB
Geosciences	163.4 GB	333.0 GB
NAIF	14.2 GB	50.6 GB
Total	**619.0 GB**	**1.3 TB**
PDS Node	**Delivery 7 Orbital EDR, CDR**	**Cumulative**
Imaging	188.8 GB	378.4 GB
Atmospheres	168.2 GB	394.2 GB
PPI	191.5 GB	692.7 GB
Geosciences	186.2 GB	519.2 GB
NAIF	15.2 GB	65.8 GB
Total	**749.9 GB**	**2.0 TB**

PDS Node	Delivery 8 Orbital EDR, CDR	Cumulative
Imaging	166.3 GB	544.7 GB
Atmospheres	188.9 GB	583.1 GB
PPI	483.3 GB	1176.0 GB
Geosciences	219.4 GB	738.6 GB
NAIF	17.8 GB	83.6 GB
Total	**1.0 TB**	**3.0 TB**
PDS Node	**Delivery 9 Orbital EDR, CDR, DDP, DAP**	**Cumulative**
Imaging	415.8 GB	960.5 GB
Atmospheres	256.0 GB	839.1 GB
PPI	337.2 GB	1513.2 GB
Geosciences	293.5 GB	1032.1 GB
NAIF	18.0 GB	101.6 GB
Total	**1.3 TB**	**4.3 TB**
PDS Node	**Delivery 10 Orbital EDR, CDR**	**Cumulative**
Imaging	344.5 GB	1305.0 GB
Atmospheres	160.0 GB	999.1 GB
PPI	384.4 GB	1897.6 GB
Geosciences	173.5 GB	1205.6 GB
NAIF	19.6 GB	121.2 GB
Total	**1.1 TB**	**5.4 TB**
PDS Node	**Delivery 11 Orbital EDR, CDR, DDP, DAP**	**Cumulative**
Imaging	2007.4 GB	3312.4 GB
Atmospheres	233.0 GB	1232.1 GB
PPI	461.9 GB	2359.5 GB
Geosciences	292.7 GB	1498.3 GB
NAIF	21.1 GB	142.3 GB
Total	**2.9 TB**	**8.4 TB**
PDS Node	**Delivery 12 Orbital EDR, CDR**	**Cumulative**
Imaging	146.0 GB	3458.3 GB
Atmospheres	80.3 GB	1312.4 GB
PPI	1302.9 GB	3662.4 GB
Geosciences	137.8 GB	1636.1 GB
NAIF	22.7 GB	165.0 GB
Total	**1.6 TB**	**10.0 TB**

EF, Earth flyby; MF, Mercury flyby; VF, Venus flyby

7 Science Data Products

Table 7-1 provides a summary of the MESSENGER standard science data products. Details on EDRs and CDRs are found in the Software Interface Specification (SIS) documents for each instrument that are available through the PDS. DDPs and DAPs are documented in RDR SIS documents and/or other PDS documentation, as appropriate. All standard DDPs and DAPs were included in PDS delivery 9. Standard DDPs and DAPs were included in PDS delivery 11 and will be included in future DDP/DAP deliveries as appropriate. These standard DDPs and DAPs constitute the "Primary mission DDPs and DAPs" referenced in Table 6-3. Data quality indicators or figures of merit, referred to as data quality indices (DQIs), are noted for instruments for which they are, at time of preparation of this document, computed as part of product generation.

Table 7-1. Primary Mission Standard Science Data Products Summary

Instrument(s)	EDR	CDR	DDP	DAP
MDIS	Single, raw, uncompressed WAC and NAC images; associated parameters and multi-bit DQI	Single, calibrated images; units: radiance or I/F; associated parameters and multi-bit DQI		Map-projected monochrome base map (BDR) and map-projected 8-color multispectral map (MDR) [corrected to i = 30°, e = 0°]
GRNS/GRS	HPGe raw, anti-coincident, and shield spectra; microphonics time series; software rate counters; status, diagnostics, and command echo data; multi-bit DQI	HPGe raw, anti-coincident, and shield spectra and associated timing, spatial, and engineering data; multi-bit DQI	Corrected and calibrated gamma-ray spectra summed over the orbital mission to date	
GRNS/NS	Full science, galactic cosmic ray, and neutron burst spectra; gamma burst time series; sensor counters; event time series; command echo and diagnostics; no DQI	Time-normalized spectra and sensor counters, with associated timing, spatial, spacecraft attitude, and engineering data	Neutron flux (net neutron count rates)	
XRS	Science spectra and associated parameters, command echo, multi-bit DQI (only single-bit used)	Calibrated science spectra (engineering information converted to engineering units, spectral energy scales and spatial information included); multi-bit DQI (only single-bit used)		
MAG	Three-axis field samples, AC, burst, status, housekeeping in engineering units; no DQIs	Calibrated three-axis field data in physical units and coordinate systems, tagged with MET, UTC, and spacecraft location; three-digit DQI included for each CDR in label release notes	Calibrated three-axis field data averages in physical units and coordinate systems, tagged with MET, UTC, and spacecraft location; three-digit DQI included for each RDR in label release notes	

Instrument(s)	EDR	CDR	DDP	DAP
MLA	Raw ranging data, status, and diagnostics; no explicit DQIs	Ranging data converted into physical and engineering units; no explicit DQIs	Altimeter profiles with geolocation and DQIs (Science RDR), radiometry with bad data filtered (RADR)	Northern hemisphere digital elevation maps, resampled and interpolated (TOPO GDR)
MLA with RS				Derived planetary constants (libration amplitude, RA and DEC of rotational pole) provided as references to publications; coefficients for the spherical harmonic representation of the planet shape
MASCS/UVVS	Raw atmospheric and surface scan data (counts), observation geometry, housekeeping; no DQIs	Corrected/calibrated atmospheric and surface scan data in physical units (radiance) and coordinate systems with reference geometry and time; multi-bit DQIs set during CDR generation	Limb tangent height spectra	
MASCS/VIRS	Surface spectra, observation geometry, housekeeping; no DQIs	Corrected/calibrated surface data in physical units (radiance) and coordinate systems with reference geometry and time; multi-bit DQIs set during CDR generation	Surface reflectance spectra	
EPPS/EPS	PHA data, ion and electron energy spectra, rate counters, engineering and status data	PHA data, ion and electron energy spectra in physical units (differential flux), rate counters; two-state DQI covers one day's data (nominal science configuration or not set based on scientist-provided periods)	Pitch angle distributions over selected ranges of energies for selected time periods	
EPPS/FIPS	PHA and scan data, proton velocity distributions, rate counters, engineering and status data	PHA data and differential intensity spectra in physical units; two-state DQI covers one record's data (nominal science configuration or not set based on scientist-provided periods)	Spatial and temporal distribution of measured flux for major ion species; for selected time periods, energy spectra and pitch angle distributions for major ion species	
RS	TNF data (raw DSN TRK-2-34), ODF data (DSN TRK-2-18), RSR files, and ancillary information to support analysis	N/A	Occultation times and radii	Coefficients for the spherical harmonic representation of the gravity field

AC, alternating current; BDR, map projected base map reduced data record; DEC, declination; HPGe, high-purity germanium; I/F, intensity divided by flux; MDR, map projected multispectral reduced data record (eight-color); MET, mission elapsed time; NAC, narrow-angle camera; ODF; orbit data files; PHA, pulse-height analysis; RA, right ascension; RADR, radiometric active data record; RSR, Radio Science Receiver; TNF, tracking and navigation files; TOPO GDR, topographic gridded data record; WAC, wide-angle camera

Table 7-2 provides a summary of the XM1 special science data products. XM1 special products were included in PDS delivery 11 and will be included in subsequent DDP/DAP deliveries as appropriate. These special DDPs and DAPs constitute the XM1 DDPs and DAPs referenced in Table 6-3.

Table 7-2. XM1 Special Science Data Products Summary

Instrument(s)	DDP	DAP
MDIS	Image backplanes including latitude/longitude and incidence, emission, and phase angles	High-resolution, three-color map with photometric correction (MD3)
GRNS/GRS		Element concentrations; accumulations by latitude–longitude, feature, and time; regional compositions
GRNS/NS		Neutron composition information
XRS		Maps of element abundances and abundance ratios
MAG		Planetary magnetic field and stationary magnetosphere models; stationary magnetosphere model provided as a reference to a publication
MASCS/UVVS	Reflectance spectra of targeted areas	Identification of volatile species and sources
MASCS/VIRS		Map projected base map with backplanes describing parameters of interest for the observation points
EPPS/FIPS	For selected time periods, arrival direction distributions for selected ion species	For selected time periods within the magnetosphere, density, temperature, and pressure for selected ion species

MD3, map projected multispectral reduced data record (three-color)

Table 7-3 provides a summary of the anticipated XM2 special science data products at the time of preparation of this document. XM2 special products are being included as of PDS deliveries 13 and 15 as indicated. The special DDPs and DAPs in this table constitute the XM2 DDPs and DAPs referenced in Table 6-3.

Table 7-3. XM2 Special Science Data Products Summary

Instrument(s)	EDR/CDR	DDP/DAP
MDIS		High-incidence east-illumination monochrome global map (HIE; release 13), high-incidence west-illumination monochrome global map (HIW; release 13), monochrome and color high-resolution regional mosaics of targeted images (RTM; releases 13 and 15), low-incidence monochrome global map (LOI; release 15), five-color low-phase color map of north-polar region (MP5; release 15), shape files (for PDS extras directory, release 15)
MDIS		Global DEM (release 15), high-resolution regional DEMs (release 15)
GRNS/GRS	Anti-coincidence shield neutron and energetic electron products (release 11 onward)	
XRS		Updated maps of element abundances and abundance ratios (release 15)
EPPS/FIPS		Viewing normalizations (releases 13 and 15)

DEM, digital elevation model; HIE, map projected high-incidence angle base map illuminated from the east reduced data record; HIW, map projected high-incidence angle base map illuminated from the west reduced data record; LOI, map projected low-incidence angle base map reduced data record; MP5, map projected multispectral reduced data record (five-color); RTM, map projected regional targeted mosaic reduced data record

8 Processing Levels of Science Data Sets

Table 8-1 provides descriptions of the CODMAC/NASA processing levels for science data sets, and Table 8-2 provides a quick reference for the common terminology of these processing levels.

Table 8-1. CODMAC/NASA Processing Levels for Science Data Sets

NASA	CODMAC	Description
Packet data	Raw – Level 1	Telemetry data stream as received at the ground station, with science and engineering data embedded. Referred to as Packetized Data Records (**PDRs**).
Level 0	Edited raw – Level 2	Instrument science data (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed. Referred to as Experiment Data Records (**EDRs**).
Level 1A	Calibrated – Level 3	NASA Level 0 data that have been located in space and may have been transformed (e.g., calibrated, rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied). Referred to as Calibrated Data Records (**CDRs**). In some cases, these also qualify as Derived Data Products (**DDPs**) or Derived Data Records (**DDRs**).
Level 1B	Resampled – Level 4	Irreversibly transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances, magnetic field strength). Referred to as either Derived Data Products (**DDPs**) or Derived Analysis Products (**DAPs**). Also termed Derived Data Records (**DDRs**) or Derived Analysis Records (**DARs**).
Level 1C	Derived – Level 5	NASA Level 1A or 1B data that have been resampled and mapped onto uniform space-time grids. The data are calibrated (i.e., radiometrically corrected) and may have additional corrections applied (e.g., terrain correction). Referred as Derived Analysis Products (**DAPs**) or Derived Analysis Records (**DARs**).
Level 2	Derived – Level 5	Geophysical parameters, generally derived from Level 1 data, and located in space and time commensurate with instrument location, pointing, and sampling. Referred to as Derived Analysis Products (**DAPs**) or Derived Analysis Records (**DARs**).
Level 3	Derived – Level 5	Geophysical parameters mapped onto uniform space-time grids. Referred to as Derived Analysis Products (**DAPs**) or Derived Analysis Records (**DARs**).
	Ancillary data – Level 6	Non-science data needed to generate calibrated or resampled data sets and consisting of such information as instrument gains and offsets, spacecraft positions, target information, and pointing information for scan platforms.

The above is based on the National Research Council CODMAC data levels.

Table 8-2. Common Terminology

Abbreviation	Description	NASA	CODMAC
PDR	Packetized Data Record	Packet data	Raw – Level 1
EDR	Experiment Data Record	Level 0	Edited raw – Level 2
CDR	Calibrated Data Record	Level 1A	Calibrated – Level 3
DDP/DDR	Derived Data Product/Record	Level 1B	Resampled – Level 4
DAP/DAR	Derived Analysis Product/Record	Levels 1C, 2, 3	Derived – Level 5
RDR	Reduced Data Record	Levels 1–3	Levels 3–5

9 Glossary of Selected Terms, Acronyms, and Abbreviations

Ancillary Data – Non-science data needed to generate calibrated or resampled data. Any information needed to create any of the data products, such as CDRs, DDPs, and DAPs.

Archive –One or more data sets along with all of the documentation and ancillary information needed to understand and use the data. An archive is a logical construct independent of the medium on which it is stored.

Archive Volume, Archive Volume Set – A *volume* is a unit of medium on which data products are stored (e.g., one CD-ROM). An *archive volume* is a volume containing all or part of an archive (i.e., data products plus documentation and ancillary files). When an archive spans multiple volumes, they are called an *archive volume set*. Usually the documentation and some ancillary files are repeated on each volume of the set so that a single volume can be used alone.

Calibrated Data Records – CODMAC Level 2 data that have been located in space and may have been transformed (e.g., calibrated, decompressed, and rearranged) in a reversible manner and packaged with needed ancillary and auxiliary data (e.g., radiances with the calibration equations applied).

CODMAC – National Research Council Committee on Data Management and Computation. CODMAC defined processing levels for science data sets, described in Table 8-1.

Data Product – A labeled grouping of data resulting from a scientific observation, usually stored in one file. A product label identifies, describes, and defines the structure of the data. An example of a data product is a planetary image, a spectrum table, or a time series table.

Data Set – An accumulation of data products. A data set together with supporting documentation and ancillary files is an archive.

Derived Analysis Products/Records – CODMAC Level 3 through 5 data products for which the values of the instrument measurements (e.g., radiances, magnetic field strength) have been irreversibly transformed (e.g., resampled, remapped, and calibrated). Data that have been resampled and mapped onto uniform space-time grids. The data are calibrated and may have additional corrections applied.

Derived Data Products/Records – CODMAC Level 3 or 4 data products for which the values of the instrument measurements (e.g., radiances, magnetic field strength) have been irreversibly transformed (e.g., resampled, remapped, and calibrated).

Engineering Products – A subset of ancillary data, often in the form of instrument settings (such as voltages, current, and temperature), and spacecraft health status.

Experiment Data Records – NASA Level 0/CODMAC Level 2 data for a given instrument; raw data.

Navigation Data – A subset of ancillary data, often in the form of SPICE files, that aid in the interpretation and processing of data products and are needed in order to produce the higher-level data products, such as the DDPs and DAPs.

Packetized Data Records – Telemetry data stream as received at the ground station, with science and engineering data embedded (CODMAC Level 1).

Processed Data – CODMAC Level 3 or higher data products.

Project Data – Any data products produced by the MESSENGER project for archiving to the PDS.

Raw Data – Same as Packetized Data Records.

Raw Science Data – Same as Raw Data and Packetized Data Records.

Reduced Data Records – Science data that have been processed from raw data to NASA Level 1 or higher (CODMAC Level 3 or higher). See Table 8-1 for definitions of processing levels.

Science Data – PDRs, EDRs, and RDRs that have scientific value.

Special Product – A data product of special interest that may require subjective judgment to produce and may not be produced in a pipeline fashion. Special products are produced as resources permit.

SPICE Data – A suite of elemental ancillary data sets, often called kernels. They include spacecraft ephemeris, planet/satellite ephemerides, instrument information, camera orientation, and event information.

Standard Product – A data product that has been defined during the proposal and selection process and that is contractually promised by the PI as part of the investigation. Standard data products are generated in a predefined way, using well-understood procedures, and processed in "pipeline" fashion.

Table 9-1. Definitions of Acronyms and Abbreviations

Acronym	Definition
AC	Alternating Current
BDR	Map Projected Base Map Reduced Data Record
CDR	Calibrated Data Record
CODMAC	Committee on Data Management and Computation
DAP	Derived Analysis Product
DAR	Derived Analysis Record
DDP	Derived Data Product
DDR	Derived Data Record
DEC	Declination
DEM	Digital Elevation Model
DMAP	Data Management and Archiving Plan
DOY	Day of Year
DQI	Data Quality Index
DSN	Deep Space Network
e	Emission Angle
EDR	Experiment Data Record
EF	Earth Flyby
EPPS	Energetic Particle and Plasma Spectrometer
EPS	Energetic Particle Spectrometer
FIPS	Fast Imaging Plasma Spectrometer
GDR	Gridded Data Record
GDS	Ground Data System
GRNS	Gamma-Ray and Neutron Spectrometer
GRS	Gamma-Ray Spectrometer
HIE	Map Projected High-Incidence Angle Base Map Illuminated from the East Reduced Data Record
HIW	Map Projected High-Incidence Angle Base Map Illuminated from the West Reduced Data Record
HPGe	High-Purity Germanium
i	Incidence Angle
I/F	Intensity Divided by Flux, or the Ratio of Radiance to Incident Solar Irradiance
JHU/APL	The Johns Hopkins University Applied Physics Laboratory
LOI	Map Projected Low-Incidence Angle Base Map Reduced Data Record
MAG	Magnetometer
MASCS	Mercury Atmospheric and Surface Composition Spectrometer
MD3	Map Projected Multispectral Reduced Data Record (Three-Color)
MDIS	Mercury Dual Imaging System
MDR	Map Projected Multispectral Reduced Data Record (Eight-Color)
MESSENGER	MErcury Surface, Space ENvironment, GEochemistry, and Ranging
MET	Mission Elapsed Time

Acronym	Definition
MF1/MF2/MF3	Mercury Flyby 1, 2, 3
MLA	Mercury Laser Altimeter
MOC	Mission Operations Center
MP5	Map Projected Multispectral Reduced Data Record (Five-Color)
NAC	Narrow-Angle Camera
NAIF	Navigation and Ancillary Information Facility
NASA	National Aeronautics and Space Administration
NS	Neutron Spectrometer
NSSDC	National Space Science Data Center
ODF	Orbit Data File (edited raw RS Doppler data or TRK-2-18 data)
PDR	Packetized Data Record
PDS	Planetary Data System
PHA	Pulse-Height Analysis
PI	Principal Investigator
PPI	Planetary Plasma Interactions
RA	Right Ascension
RADR	Radiometric Active Data Record
RDR	Reduced Data Record
RS	Radio Science
RSR	Radio Science Receiver
RTM	Map Projected Regional Targeted Mosaic Reduced Data Record
SIS	Software Interface Specification
SOC	Science Operations Center
SPICE	Spacecraft ephemeris, Planet/satellite ephemeris, Instrument information, Camera orientation, Event information
TNF	Tracking and Navigation File (raw RS Doppler data from closed-loop receiver, TRK-2-34 data)
TOPO GDR	Topographic Gridded Data Record
UTC	Coordinated Universal Time
UVVS	Ultraviolet and Visible Spectrometer
VF1/VF2	Venus Flyby 1, 2
VIRS	Visible and Infrared Spectrograph
WAC	Wide-Angle Camera
XM1	First Extended Mission
XM2	Second Extended Mission
XRS	X-Ray Spectrometer