# Cassini / Huygens Program
# Archive Plan
# for Science Data

PD 699-068
JPL D-15976

Version 3
June 2004

**National Aeronautics and Space Administration**
**Jet Propulsion Laboratory**
**California Institute of Technology**
**Pasadena, California**

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# Change Record for 699-068

| Revision No. | Date | Changes | Sections Affected |
|---|---|---|---|
| Draft 1 | 7/15/98 | First version for review | All |
| Draft 2 | 8/1/98 | Minor updates,<br>Appendix A -- added definition of processing<br>Appendix C -- added Archive schedule | All |
| Draft 3 | 9/16/98 | Reorganization -- Updated signature page, replaced references to SO and DOI with the new "Instrument Operations Team", replaced references to MSO and Science Office with "Science Operations Office"<br>Section 2, item 2 -- states that Cassini provides volumes to PDS CN who in turn provides copies to the relevant PDS DNs. It should be noted that this is still listed as a TBD<br>Incorporated PDS comments | All |
| Draft 4 | 10/5/98 | Section 2, item 5 Added cruise archive policy & included in delivery of cruise science in Archive schedule<br>OTLs and MSOCs listed as archive contacts for each instrument | All |
| Preliminary | 4/1/99 | Changed document title<br>Revised signature page<br>Changed instances of "Cassini Project" to "Cassini Program"<br>Updated applicable document listing | All |
| Preliminary V1 | 12/27/99 | Updated Signature page<br>Major changes to Roles and Responsibility section 2.0<br>Some changes to policy section 3.0<br>Review and comment on To be Supplied list<br>Formatting changes | All |
| Preliminary V2 | 4/1/00 | Incorporated updates throughout the document as requested by reviewers. Incorporated Huygens data in the plan.<br>Updated distribution list.<br>Updated archive policies. | All |
| Initial Release, Version 0 UNSIGNED | 4/25/00 | Clarified PDS CN and PDS DN roles and responsibilities throughout document.<br>Updated table 1.5.2 data product levels to reflect CODMAC and PDS definitions. (see unresolved list)<br>Clarified the project intent to archive level 1A and level 1B data products in section 6.<br>Reorganized dataset tables in appendices.<br>Added new issues to unresolved issues list.<br>Added High-Level Catalog documents to schedule. | All |

| Revision No. | Date | Changes | Sections Affected |
|---|---|---|---|
| Initial Release, Version 1 | 8/3/00 | Higher level product archive. | 6.4 |
| Version 2 UNSIGNED | 8/12/02 | Clarified Policies<br>Clarified Roles and Responsibilities<br>Updated products list<br>Updated archive contacts<br>Added Huygens archive contacts<br>Added Huygens Products list<br>Added Mission and instrument overview<br>Moved CODMAC data level to NASA levels table to appendix.<br>Removed data level references from document in lieu of descriptions of products.<br>Added Peer Review and Validation Process<br>Clarified archive terms<br>Removed Data Flow that appeared to cause confusion.<br>Added standard values for PDS High-Level Catalog files<br>Added PDS label keyword requirements section.<br>Added coordinate system designations.<br>Clarified roles and responsibilities.<br>Added a detailed data delivery schedule. | All. |
| Version 3 | 6/04 | Incorporate many editorial changes requested by reviewers of version 2:<br>Updated Mission overview to correct tense.<br>Updated Dist list and acronym list.<br>Updated Contacts list.<br>Updated Appendices.<br>Added Huygens Archive Plan to Appendix.<br>Added Cassini data volume Section.<br>Changed policy of when pipeline production should be ready.<br>Added data distribution section.<br>Added/Clarified definitions of terms.<br>Updated Press Release products section.<br>Added Requirements section.<br>Eliminated reference to the MIFT.  The SAWG will perform the production coordination function.<br>Defined "Cassini Program" in scope.<br>Merged sections 9 and 10. | All |

# TBDs

| ITEM | Related section |
|---|---|
| Standard keywords for labels and index files. (MASTER INDEX) | 9.2.2 |

# Distribution List

| | |
|---|---|
| Achilleos, Nick | MAG |
| Acton, Charles | NAIF |
| Adams, Steven | PDS CN |
| A'Hearn, Mike | PDS |
| Alanis, Rafael | JPL/IMG |
| Anabtawi, Aseel | RSS |
| Anderson, Theresa | SE |
| Armstrong, Thomas | FTECS |
| Arvidson, Ray | PDS/GEO |
| Asmar, Sami | RSS |
| Atkinson, Dave | Huygens |
| Barbinis, Elias | RSS |
| Beebe, Reta | PDS/ATM |
| Blanc, Michel | IDS |
| Bogan, Denis | NASA |
| Bohlin, David | NASA |
| Bolton, Scott | SCI |
| Brown, Robert | VIMS |
| Brown, Tyler | PDS CN |
| Brun, Jean-Francis | ACP |
| Bunker, Anne | RADAR |
| Burton, Marcia | CIRS |
| Cabane, Michel | ACP |
| Callahan, Phil | RADAR |
| Chin, Greg | MSSO |
| Colombatti, Giacomo | HASI |
| Conner, Diane | IO |
| Cuzzi, Jeff | IDS |
| Dougherty, Michele | MAG |
| Dutta-Roy, Robin | DWE |
| Edberg, Steve | JPL |
| Elachi, Charles | RADAR |
| Eliason, Eric | USGS/IMG |
| Elson, Lee | NAIF |
| Esposito, Larry | UVIS |
| Flasar, Michael | CIRS |
| Fletcher, Greg | INMS |
| French, Dick | RSS |
| Furman, Judy | CAPS |
| Garcia, Patricia | USGS/IMG |
| Gautier, Daniel | IDS |
| Gell, David | INMS |
| Goltz, Gene | RSS |
| Gombosi, Tamas | IDS |
| Gordon, Mitch | PDS Rings |
| Gurnett, Don | RPWS |
| Haberman, John | GCMS |
| Hall, Laverne | PDS |
| Hansen, Candy | UVIS |
| Huber, Lyle | PDS/ATM |
| Ivens, John | VIMS |
| Jouchoux, Alain | UVIS |
| Joy, Steve | UCLA/PPI |
| Judd, David | UVIS |
| Kazeminejad, Bobby | Huygens |
| Kellock, Steve | MAG |
| Kempf, Sascha | CDA |
| Kirk, Randy | USGS/IMG |
| Kliore, Arv | RSS |
| Krimigis, Tom | MIMI |
| Kunde, Virgil | CIRS |
| Kurth, Bill | RPWS |
| LaVoie, Sue | JPL, Imaging |
| Lebreton, Jean-Pierre | Huygens |
| Linick, Susan | IO |
| Lorenz, Ralph | Huygens |
| Lunine, Jonathan | IDS |
| Maize, Earl | Deputy PM |
| Matson, Dennis | JPL |
| McCloskey, Rick | VIMS |
| McFarlane, Lisa | DISR |
| Mitchell, Don | MIMI |
| Mitchell, Robert | JPL |
| Nixon, Conor | CIRS |
| Owen, Tobias | IDS |
| Peterson, Joe | ISS |
| Pieri, Leslie | ISS |
| Porco, Carolyn | ISS |
| Rappaport, Nicole | RSS |
| Raulin, Francois | IDS |
| Romani, Paul | CIRS |
| Rye, Elizabeth | JPL, Imaging |
| Sawyer, Don | NSSDC |
| Sesplaukis, Tadas | SE |
| Showalter, Mark | PDS |
| Simpson, Richard | PDS Radio Science |
| Slootweg, Peter | MAG |
| Soderblom, Larry | IDS |
| Southwood, David | MAG |
| Spilker, Linda | JPL |
| Srama, Ralf | CDA |
| Stiles, Bryan | RADAR |
| Strobel, Darrell | IDS |
| Sykes, Mark | SBN/DUST |
| Tingley, Jim | CIRS |
| Waite, Hunter | INMS |
| Walker, Ray | UCLA/PPI |
| Wall, Steve | RADAR |
| Weld, Kathryn | JPL |
| West, Rich | RADAR |
| Witasse, Olivier | ESTEC |
| Young, David | CAPS |
| Zarnecki, John | SSP |
| Zinsmeyer, Charles | CAPS |
| CEL (2) | |

# 1 Introduction

## 1.1 Purpose

This document describes the Cassini / Huygens Program plan for generating, validating, and delivering data products to the Planetary Data System (PDS). Included are the policies, guidelines and requirements that will be followed by instrument teams in the generation of PDS compliant archives. It provides a high-level description of science and SPICE datasets, data size estimates, and a delivery schedule that can be used by the PDS for planning purposes.

A high-level overview of the mission and instrumentation is included to provide context to the archiving discussion.

## 1.2 Scope

This document is applicable to all science and supplementary data resulting from Cassini Program investigations. The Cassini Program includes the Cassini (orbiter) and Huygens (probe), which are referred to in this document collectively as "Cassini." Although the content of this document applies to both projects, additional details for Huygens are provided in the Appendix D of this document.

Separate agreements, established through the Cassini Program Science Group (PSG) and Huygens Science Working Team (HSWT), address data sharing policies.

Each team's data delivery methods are described in team Software Interface Specifications (SISs).

This document is subordinate to the Cassini Program Data Management Plan and Science Management Plan.

## 1.3 Applicable Documents

The Cassini / Huygens Archive Plan for Science Data (APSD) is responsive to the following program documents found on-line in the Master Controlled Document Library at https://cassini.jpl.nasa.gov/mcdl

a) Cassini Operations System Functional Requirements Document, 699-500-3-GS/R

b) Cassini Program Science Management Plan (SMP), D-9178, PD 699-006, July 1999.

c) Cassini Program Data Management Plan (PDMP), D-12560, PD 699-061, Rev.B, April 1999.

d) Cassini/Planetary Data System Interface Requirements Document (MSO - PDS IRD), PD 699-108, Rev. B, 14 April 1998.

e) Huygens Data Archive Generation, Validation and Transfer Plan, HUY-RSSD-PL-001, DRAFT, June 2004.

The following PDS documentation, that is referred to in this document, is available on-line from the PDS Website at http://pds.jpl.nasa.gov/ .

f) Planetary Data System, Data Preparation Workbook, February 17, 1995, Version 3.1, JPL D-7669, Part 1

g) Planetary Data System, Standards Reference, August 1, 2003, Version 3.6, JPL D-7669, Part 2

h) Planetary Science Data Dictionary Document, August 28, 2002, JPL D-7116, Rev. E

### 1.4 Document Change Control

The APSD is under change control once all parties sign it.  All signatories must approve each published revision. The Appendix A is a living part of this document.  It will be updated periodically and made available as new products are identified.

## 2 Mission Overview

The Cassini spacecraft is a combined Saturn orbiter and ESA Huygens Titan atmospheric probe. The orbiter is a three-axis stabilized spacecraft equipped with twelve instruments. The probe has six instruments designed to study the atmosphere and surface of Titan.

Cassini was launched on 15 October 1997 using a Titan IV/Centaur launch vehicle with Solid Rocket Motor Upgrade strap-ons and a Centaur upper stage. A Venus-Venus-Earth-Jupiter Gravity Assist trajectory was used to reach Saturn in 6.7 years. Science was limited during the cruise phases due to restricted spacecraft and instrument flight software capabilities and cost constraints. Cruise periods were used to check out instrument operations and gather instrument calibration data. Magnetosphere and Plasma Science data were collected nearly continuously beginning in February 2000. Following the Jupiter flyby, the spacecraft was used to search for gravitational waves using its Ka-band and X-band radio equipment.

Science activities increased in intensity six months before arriving at Saturn. On 11 June 2004, just prior to Saturn Orbit Insertion (SOI), instruments observed the small outer moon Phoebe. During SOI on 1 July 2004 (GMT) the spacecraft will make its closest approach to the planet's surface at an altitude of only 0.3 Saturn radii (18,000 km). The approximately 90-minute SOI burn required to place Cassini in orbit around Saturn will be executed earlier than its optimal point centered around periapsis and instead will end near periapsis. This will allow science observations to be taken during this unique opportunity to gather data while passing through the ring plane.

The Huygens probe will be released from the orbiter on 24 December 2004, (11 days after the second Titan flyby). Two days after the probe is released the orbiter will perform an orbit deflection maneuver to place itself on the proper trajectory for the next Titan encounter. At the third Titan flyby, on 14 January 2005, the probe will descend through the atmosphere of Titan and relay data to the orbiter for up to 2.5 hours during its descent to the surface. The orbiter will continue to tour the Saturn system, which includes multiple close Titan flybys for gravity assists and science acquisition. Targeted and non-targeted flybys of selected icy satellites will be used to determine surface compositions and geologic histories. Cassini's orbital inclination will vary widely to facilitate investigations of the field, particle, and wave environment at high latitudes, including the hypothesized source of the unique Saturn kilometric radiation. High inclinations also permit high-latitude Saturn radio occultations, viewing of Saturn's polar regions, and more nearly vertical viewing of Saturn's rings. The baseline mission is scheduled to end mid 2008, for a total mission duration of 10.7 years.

# 3 Science Instruments Overview

## 3.1 Cassini Orbiter Science Instruments

The Cassini orbiter hosts twelve science instrument subsystems briefly described in the table below. CAPS, CDA, and the MIMI LEMMS detector are capable of some limited articulation independent of the spacecraft pointing.

| | | |
|---|---|---|
| CAPS | Cassini Plasma Spectrometer | in-situ study of plasma within and near Saturn's magnetosphere. |
| CDA | Cosmic Dust Analyzer | in-situ study of dust grains in the Saturn system. |
| CIRS | Composite Infrared Spectrometer | spectral mapping to study temperature and composition of surfaces, atmospheres, and rings within the Saturn system. |
| ISS | Imaging Science Subsystem | multispectral imaging of Saturn, Titan, rings, and icy satellites to observe their properties. |
| INMS | Ion and Neutral Mass Spectrometer | in-situ study of compositions of neutral and charged particles within the Saturn magnetosphere. |
| MAG | Magnetometer | study Saturn's magnetic field and interactions with the solar wind. |
| MIMI | Magnetospheric Imaging Instrument | global magnetospheric imaging and in-situ measurements of Saturn's magnetosphere and solar wind interactions. |
| RADAR | Radio Detection and Ranging | synthetic aperture RADAR (SAR) imaging, altimetry, and radiometry of Titan's surface. |
| RPWS | Radio and Plasma Wave Science | study plasma waves, radio emissions, and dust in the Saturn system. |
| RSS | Radio Science Subsystem | study atmospheres and ionospheres of Saturn and Titan, rings, and gravity fields of Saturn and its satellites. During cruise, RSS also made investigations into solar plasma and relativity, and searched for gravitational waves. |
| UVIS | Ultraviolet Imaging Spectrograph | investigate the chemistry, aerosols, clouds, and energy balance of the Titan and Saturn atmospheres; neutrals in the Saturn magnetosphere; the deuterium-to-hydrogen ratio for Titan and Saturn; icy satellite surface properties; and the structure and evolution of Saturn's rings. |
| VIMS | Visible and Infrared Mapping Spectrometer | spectral mapping to study the composition and structure of surfaces, atmospheres, and rings. |

### 3.2 Huygens Probe Science Instruments

There are six science instrument subsystems on the Huygens Probe.  The science instruments are listed below along with their measurement objectives.

| | | |
|---|---|---|
| ACP | Aerosol Collector and Pyrolyser | collect aerosols for GCMS to analyze their chemical compositions. |
| DISR | Descent Imager / Spectral Radiometer | multi-sensor optical instrument capable of imaging and making spectral measurements over a wide range of the optical spectrum. |
| DWE | Doppler Wind Experiment | measures wind direction and velocity using Probe-Orbiter radio link. |
| GCMS | Gas Chromatograph Mass Spectrometer | identifies and quantifies the abundances of the various atmospheric constituents. |
| HASI | Huygens Atmospheric Structure Instrument | multi-sensor instrument, intended to measure the atmosphere's physical properties, including its electrical properties. |
| SSP | Surface Science Package | a suite of simple sensors for determining the physical properties of the surface at the impact site and for providing unique information on the composition of the surface material. |

## 4 Archive Terms Defined

**Ancillary Data** – Data that are needed to generate calibrated or resampled data that may come from sources other than the science instrument.

**Archive** – An archive consists of one or more datasets along with all 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 Medium** - A physical device for storing data such as CD or DVD. For PDS archives, the medium must be approved by PDS as described in the PDS Standards Reference.

**Archive System** – The archive system comprises hardware, software, procedures, interfaces, and personnel necessary to complete the archiving of science and ancillary data with the PDS.

**Archive Volume, Archive Volume Set** – A volume is a unit of medium on which data products are stored; for example, one CD-ROM. An *archive volume* is a volume containing all or part of an archive, that is, data products plus documentation and ancillary files. When an archive spans multiple volumes, they are called an *archive volume set*.

**Data Product** – A labeled grouping of data resulting from a scientific observation. 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 accompanied by its PDS label.

**Dataset** – An accumulation of data products together with supporting documentation and ancillary files.

**Data Object** - A data object is that portion of a data product that contains the actual data. It is described in a data object definition within a PDS label; it is tangible, and can be physically accessed and manipulated. For example the data object T142836.DAT could be described in a PDS label using the following keywords. Additional keywords would fill in the "…" lines.

```
^TABLE = "T142836.DAT"
...
OBJECT = TABLE
ROWS = 1028
...
END_OBJECT = TABLE
```

**Metadata** - A label or file that describes one or more science data objects or products.

**PDS** - Planetary Data System. The primary organization within NASA responsible for the archive of planetary science data obtained from NASA sponsored missions. The PDS consists of a Central Node located at JPL and several Discipline Nodes located around the country.

**SAWG** - The Science Archive Working Group includes instrument teams, PDS Nodes, and Project representatives. The group is chartered to coordinate the archive system development and coordinate production.

**Science Data** – All data acquired that are used to accomplish primary science goals of the Cassini Orbiter and Huygens Probe science teams.

**SIS** – Software Interface Specification. Describes the volume organization, data file structures, label contents, and operational procedure for delivering data archives.

**Standard Data Product** – A data product that has been defined that is contractually required by the PI or TL as part of the investigation. Standard data products are generated in a predefined way, using well-understood procedures, and processed in "pipeline" fashion.

# 5 Cassini Data Volume Estimates

## 5.1 Cassini Orbiter

Raw Science Downlinked Data Volume:

Full Mission Success: 95% of the data transmitted from the spacecraft is received on the ground.
Calculations are rounded, and assume one 9-hour pass per day, and full mission success as described above.

**Prime Mission (1643 days):**
X-Band, 30% passes to 70-m antenna (4Gbit/pass) total 2060 Gbits
X-Band, 70% passes to 34-m antenna (1Gbit/pass) total 1045 Gbits

**Extended Mission (730 days):**
X-Band, 30% passes to 70-m antenna (4Gbit/pass) total 915 Gbits
X-Band, 70% passes to 34-m antenna (1Gbit/pass) total 465 Gbits

Dataset Volume Estimates:

**Prime Mission:**
Cassini Capability in Science Phase Prime Mission (Jan 2004 – Jul 2008)
3 Tbits of raw telemetry data based upon prime mission downlink capability
From Cassini Data Archive Plan: (26.1 Tbits + 2.1 Tbits RSS**) = 28.2 Tbits** total

TLM Expansion factor = 26/3 = 8.6

**Extended Mission:**
Cassini Capability in Science Phase Extended Mission (Jul 2008 – July 2010)
If that data were reduced as before (same expansion factor):

1.3 Tb raw telemetry data based upon extended mission downlink capability
(1.3 * 8.6) = 11.6 Tbits + 1.1 Tbits RSS = **12.7 Tbits**

Grand total for the primary and extended missions : **40.9 Tbits**

Recommend PDS size their system to accept, at a minimum, **41 Tbits** of data from the Cassini prime and extended missions.

## 5.2 Huygens Probe

The raw data volume for Huygens is approximately 173.1 Mbits. The reduced data volume has not been calculated.

# 6 Validation

This section describes the validation process for Cassini Orbiter datasets. Huygens probe dataset validation is described in appendix D.

There are pre-production and production validation activities. Pre-production validation includes a project design peer review, followed by a PDS peer review. Production validation for science usability is best achieved through science data analysis using the archive products. Production validation for format includes built in quality control to ensure archives comply with the Software Interface Specification (SIS).

## 6.1 Project Design Peer Review

The project design peer review provided an assessment of instrument archive designs and allowed instruments to proceed with production software design. Ray Walker, the PDS PPI Node Manager, chaired the review. Other members included representatives from instrument teams, science teams, and PDS. Requests for action were gathered and responded to.

The review board was asked to evaluate designs to determine if:

1. List of data products identified for archive was complete.
2. Calibration methods are understood.
3. Mission consistent attributes are used in data labels. For example: time, latitude, longitude, coordinate systems, and reference frames.
4. Data labels provide the information necessary to narrow searches on data products.
5. Validation process is described and specifically assigns responsibilities.
6. Delivery mechanism is understood.
7. Liens are identified with resolution plans.

## 6.2 PDS Peer Review

The PDS Discipline Node (DN) assigned to an instrument team coordinates and leads a peer review of a sample volume. Members of the PSG will be asked to participate in peer reviews as well as members of the science community outside the PSG. The peer review is used to ensure the archive contains all the components needed to perform science analysis, and is prepared as documented in the Software Interface Specification (SIS). The PDS DN documents all liens and their closures.

Success Criteria:

1. All liens are resolved and the SIS is updated as necessary and signed.
2. The supporting documentation is comprehensive and complete to support science analysis.
3. Calibration and other data processing algorithms are provided in a way that ensures data access and algorithms can be implemented in future programming languages and computing environments.
4. If calibrated data are not provided, sample calibrated data must be provided for users to verify correct implementation of algorithm(s).

### 6.3 Production Validation

Each team in coordination with the PDS DN will develop the validation process used during production of datasets and document their validation plan in their SIS. Production validation for science usability through data use is encouraged. PDS will provide teams with tools as needed for validating products for PDS compliance. The PDS DN will hold peer reviews as necessary.

## 7 Delivery to PDS

Cassini orbiter archive datasets will be provided to PDS by the instrument teams either electronically or on physical media as negotiated between individual instrument teams, the program archive data engineer and the PDS. The agreed to delivery method and volume organization will be documented in Software Interface Specifications (SISs). The delivery schedule for all level 1A & level 1B (CODMAC 2 & 3) is defined in appendix B of this document.

Please refer to appendix D for the Huygens PDS transfer plan.

## 8 Distribution

PDS archives will be accessible to the public on-line. The PDS on-line system will provide search filters, such as time range or target name, so that a user can retrieve data that meet specific search criteria. Map coordinate based searches will be supported as appropriate for higher-level products. Data will be made available via electronic transfer or on physical media. The NSSDC will be responsible for replication and distribution of large volumes of data on appropriate physical media.

# 9 Archive Policies, Guidelines and Requirements

Archive policies, guidelines and requirements have been developed to ensure data products meet PDS standards and support collaborative studies among Cassini Orbiter and Huygens Probe data.

## 9.1 Policies

1) Cassini is committed to archiving data products as summarized in Section 9.3.1 of this document.
2) Instrument teams will produce archives that adhere to the PDS standards version specified in their SISs.
3) Each instrument team will be assigned to one primary PDS science discipline node to design and deliver its archives. Primary nodes should ensure the requirements of the secondary PDS science discipline node are met.
4) Data distribution will be done by PIs, TLs, or IDSs through their science team interfaces or the PDS after archives are released.
5) Cassini orbiter production pipelines will be complete and validated by March 2005, unless specifically approved otherwise by the project.
6) SPICE files that are used in the processing of archive products may be included on archive volumes, but are not required if they are the standard products produced and delivered to the program database. If SPICE files are used in processing that are not delivered to the program database then those files must be included on instrument archive volumes.
7) Although not required, higher-level products developed by PIs, TLs, and IDSs may be archived with the PDS, if resources are available to do so. Cassini recognizes those higher-level products are valuable and should be preserved, however funding restrictions may preclude the complete archiving of these products.
8) Cassini will provide a regular forum for discussing archive progress and issues with the PDS, PIs, and TLs.

## 9.2 Guidelines

### 9.2.1 Designation of Coordinates

A global reference system for a given body consists of several elements. These may include a) a cartographic coordinate system, b) a specified reference surface and its dimensions, and c) orientation information for the coordinate system.

The International Astronomical Union (IAU) and International Association of Geodesy (IAG) sponsor a "Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites" which sets standards in this area. The latest version of their recommendations is available as Seidelmann, et al., Celestial Mechanics and Dynamical Astronomy, 82, pp. 83-110, 2002.

For all planetary bodies, the IAU allows two possible types of coordinate systems, planetocentric and planetographic, (ibid, pp. 100-101). In both systems, the origin is the center of mass of the body in question. The rotational pole of the body which lies on the north side of the invariable plane of the solar system (the ecliptic) will be called north, and northern latitudes will be designated as positive.

The planetocentric coordinate system is a right-hand spherical coordinate system in which latitude is defined as the angle between a vector passing through the origin of the spherical coordinate system and the equator, and longitude is the angle between the vector and the plane of the prime meridian measured in an eastern direction. Although this system is consistent with right hand coordinates commonly used to formulate physical problems, historical astronomers used a system in which longitude increased with time.

The Cassini Mission will continue the tradition established through historic telescopic observations. A planetographic system will be used. The longitude in such a system is specified so that the longitude of the central meridian, as observed from a fixed direction in inertial space, will increase with time, and range from 0° to 360°. This results in longitudes being measured positively to the west when the body's rotation is prograde, and to the east when the body's rotation is retrograde. Jupiter, Saturn and all satellites rotate in the prograde sense; therefore, all longitudes will be West Longitude.

According to the IAU, a planetographic system requires a reference surface and the latitude is specified for a point on the reference surface as the angle between the equatorial plane and the normal to the reference surface at that point. Either a sphere or rotational ellipsoid is used. The WG notes that some bodies (e.g., Io, Mimas, Enceladus, and Miranda) could be well represented by a triaxial ellipsoid, but in practice a sphere will be used due to computational difficulties. Likewise for computational convenience a sphere is often used for irregularly shaped bodies.

The IAU has not defined East Longitude for the Giant Planets and traditionally either planetographic (based on the local normal) or planetocentric (a spherical coordinate system) latitude has been used with West Longitude. Thus, For Jupiter and Saturn, depending on the observational goals, either a spherical or an ellipsoidal reference surface with given equatorial and polar radii will be used and indexes will include both centric and graphic latitudes.

In order to specify the orientation of a planetary body at a given instant, the WG provides recommended equations which specify the position of the body's celestial pole (in right ascension and declination at the epoch J2000.0), and the orientation on its axis, by W, the angle along the equator to the east between the prime meridian and the equator's intersection with the celestial equator.

The prime meridian itself can be specified in several ways. Where possible it is specified by defining the longitude of the center of some small surface feature near the body's equator. If a body is tidally locked to its parent body, the prime meridian is usually that longitude passing through the average sub-planetary (parent body) point. If a body has no fixed surface features, the equation for W is chosen so as to define an arbitrary prime meridian.

The reference radius (for a spherical reference surface) or reference equatorial and polar radii (for an ellipsoidal reference surface) will be included in the labels of data from remote sensing instruments. The reference radius should be included in MAPS labels where range is expressed in radii. Currently recommended (mean) radii and reference ellipsoidal radii, and definitions for orientation are available in the latest NAIF CASSINI PCK file. These are initially the IAU/IAG WG recommended values but may be updated as the mission progresses. The location of the prime meridian for each body is defined by the equation for the value of W, unless fixed surface features have been identified in the past. For such bodies a named crater and its defined longitude are specified in the IAU/IAG WG report (Table 2, footnotes).

Ring coordinates are given in terms of radius from Saturn’s center of mass in kilometers and longitude measured in degrees from 0 to 360 in the celestial reference frame at J2000.0 (the ICRF). Radii are measured from the center of the planet along the nominal ring plane. The inertial longitude of a ring feature is measured relative to the ring prime meridian (different from Saturn’s prime meridian) where the ring prime meridian passes through the ascending node of the Saturn's invariable plane (equivalent to the equatorial plane in this case) on the celestial equator at J2000.0. Longitudes are measured in the direction of orbital motion along the Saturn's invariable plane to the ring's ascending node, and thence along the ring plane.

### 9.2.2 PDS Label and Index Keywords

PDS labels and index files provide searchable keys and describe characteristics of the products.  Index files are used to populate the PDS search catalog.   PDS requested keywords for index files are detailed in TBD.  If it is not possible for Cassini to provide values for keywords due to funding limitations, then the keywords will be included with NULL values.

### 9.2.3 Standard Designation of Time

There should be a consistent representation of time used in filenames, directory names, labels, and index files.

The time of data acquisition (written to memory or telemetry stream) should be expressed as spacecraft UTC (coordinated universal time) or Earth UTC for Radio Science data. Other representations of time may also be included in labels and index files. In the case of in-situ instrument data, if the instrument samples are filtered (digital, analog, or both) or averaged, the magnitude of the filters/average delays (may be telemetry rate dependent) should be described in the dataset documentation. Raw data that are sampled synchronously with the spacecraft clock should also contain the spacecraft clock value (SCLK). SCLK values are irrelevant if the instrument sampling is asynchronous, (as is the case for MAG), or nonexistent (as is the case for RSS).

If data files are in binary format, and the overhead of including a 21-byte time tag increases the file storage requirements beyond reason (doubles the size), then an 8-byte binary floating-point representation of the Ephemeris Time (Barycentric Dynamical Time) consistent with the output of the SPICE Toolkit UTC2ET function is an acceptable alternative. These values can be converted back to the ASCII format by using the SPICE Toolkit function ET2UTC with the appropriate string format specification.

Format descriptions:

The Cassini UTC system format formation rule is: YYYY-DDDThh:mm:ss[.fff]
Spacecraft clock count (SCLK) format is NNNNNNNNNN.NNN

## 9.3 Requirements

### 9.3.1 Minimum Science Data Archive

Cassini is committed to archiving full resolution uncalibrated data products, calibration files, algorithms for applying calibration, and sample calibrated data. See Appendix A of this document for the list of orbiter products and Appendix D for the list of probe products planned for archive.

Below is a summary of the science data archive requirement specified in Cassini Operations System Functional Requirements Document, 699-500-3-GS/R.

Instrument teams shall produce validated PDS compliant science data archives that contain:

- Uncalibrated full resolution data
- Calibration files
- Algorithms for applying calibration and any other data processing which is critical to use the data.
- Sample calibrated data files for future users to verify their application of calibration algorithms.
- Metadata as specified by PDS Standards.
- Documentation that describes the instrument and dataset and anomalies that affect the archive data products.
- A searchable index that provides access to data products (at a minimum, this implies access through a simple set of keys, such as data source identification, data product type, time, geometry, or target).

Note: The Instrument Operations (IO) team generates data products for VIMS, ISS, RS, and RADAR Facility Instruments. IO produces data products according to TL-approved Software Interface Specifications (SISs) and Operational Interface Agreements (OIAs). TLs are encouraged to negotiate with IO to use PDS formats for these products. TLs are responsible for archive volume generation and validation. TLs will be required to reformat products to PDS standards if IO creates products that are not PDS compliant.

#### 9.3.1.1 Raw Telemetry Data

There is no plan to archive raw telemetry data with PDS other than what is required for Radio Science. Cassini Mission Science and Support Operations (MSSO) Office has a requirement to store raw telemetry data that includes engineering, science and housekeeping packets in the form of raw telemetry frames through End-of-Mission + 1 year.

#### 9.3.1.2 Higher Level Science Data Products

PI and TL teams and Interdisciplinary Scientists (IDSs) generate higher-level science products. Although not contractually required, it is expected that higher-level data products developed by PIs, TLs, and IDSs in the course of doing their data analysis will be archived with the PDS. Cassini recognizes that higher-level products are valuable and should be preserved; therefore, a joint effort between Cassini and PDS will be made to facilitate the generation of such products in PDS compliant formats, thereby minimizing any additional effort that might occur in accomplishing this objective.

#### 9.3.1.3 Public Release Data Products

Public released products will be generated in accordance with Cassini/JPL/NASA policies and procedures for public information and press releases. All press release products will be archived with the PDS by the data producers.

#### 9.3.1.4 SPICE Data Products and Toolkit

The Instrument Operations Team is responsible for generating the archive of SPICE datasets. Final versions of SPICE (SPK, PCK, IK, FK, CK, EK, SCLK, and LSK) files will be archived by the PDS NAIF node in big-endian IEEE binary and text formats, as appropriate, with accompanying documentation. The SPICE toolkit will always be available on line from the NAIF node of the PDS, for all platforms supported by NAIF, including MAC, PC/Windows, PC/Linux, and Sun/Solaris. Copies of each toolkit version are delivered to the NSSDC.

### 9.3.2 Documentation

Documentation relevant to understanding the archive will be delivered to PDS. At a minimum documentation should include:

a) Software Interface Specifications (SISs) that define the format and content of data files and volume organization.
b) Calibration and data processing algorithms necessary to use the data.
c) Instrument catalog file that describes the instrument capabilities and operations (INST.CAT).
d) Dataset description files (DATASET.CAT).
e) References to publications that are relevant to the data (REF.CAT).
f) Listing of personnel involved in the dataset generation (PERS.CAT).

### 9.3.3 Software

It is expected that standard data products delivered by the PI or TL will be in a format that is accessible by other users. If the products cannot be accessed using commonly available software tools, then the products should be accompanied by software, source code, and documentation or detailed algorithms that allow a user to access the data.

### 9.3.4 PDS High-Level Catalog Files

PDS high-level catalog files will be included in the CATALOG directory of archive volumes, as defined in JPL D-7669, Planetary Data System Standards Reference. High-level catalog files include Mission, Instrument Host, Instrument, Dataset, Reference, and Personnel catalog files.

IO provided a draft version of the Mission, Instrument Host, and Mission Reference files to PDS for catalog ingestion at SOI-1 year. Updates to these files will be provided at least every two years if new information is available. Final versions will be provided no later than two months prior to end of mission.

Archive producers will provide Instrument, Dataset, Personnel, and Reference catalog files with their archive submissions. The Cassini Archive Coordinator will generate team specific reference files with input from science teams.

The Cassini Project Archive Coordinator will maintain the mission reference catalog file that includes references found in the MISSION.CAT file.

Keyword Values defined for the mission that should be used in PDS objects include:

**MISSION_NAME** = "CASSINI-HUYGENS"

**INSTRUMENT_HOST_ID** = "CO"
**INSTRUMENT_HOST_NAME** = "CASSINI ORBITER"
**MISSION_ALIAS_NAME** = "CASSINI"

**INSTRUMENT_HOST_ID** = "HP"
**INSTRUMENT_HOST_NAME** = "HUYGENS PROBE"
**MISSION_ALIAS_NAME** = "HUYGENS"

Keyword values for INSTRUMENT_ID and INSTRUMENT_NAME are as follows:

| **INSTRUMENT_ID** | **INSTRUMENT_NAME** |
|---|---|
| CAPS | CASSINI PLASMA SPECTROMETER |
| CDA | COSMIC DUST ANALYZER |
| CIRS | COMPOSITE INFRARED SPECTROMETER |
| INMS | ION AND NEUTRAL MASS SPECTROMETER |
| ISSNA | IMAGING SCIENCE SUBSYSTEM NARROW ANGLE |
| ISSWA | IMAGING SCIENCE SUBSYSTEM WIDE ANGLE |
| MAG | MAGNETOMETER |
| MIMI | MAGNETOSPHERIC IMAGING INSTRUMENT |
| RADAR | RADAR |
| RPWS | RADIO AND PLASMA WAVE SCIENCE |
| RSS | RADIO SCIENCE SUBSYSTEM |
| UVIS | ULTRAVIOLET IMAGIN SPECTROGRAPH |
| VIMS | VISUAL AND INFRARED MAPPING SPECTROMETER |
| ACP | AEROSOL COLLECTOR PYROLYSER |
| DISR | DESCENT IMAGER / SPECTRAL RADIOMETER |
| DWE | DOPPLER WIND EXPERIMENT |
| GCMS | GAS CHROMATOGRAPH MASS SPECTROMETER |
| HASI | HUYGENS ATMOSPHERIC STRUCTURE INSTRUMENT |
| SSP | SURFACE SCIENCE PACKAGE |

### 9.3.5 Filename and Directory name Maximum Lengths

Filenames will adhere to ISO 9660 level 2 specifications that allow the total filename length of 31 characters.

### 9.3.6 Volume Naming

The following is a constant that shall be used across the Cassini mission.
VOLUME_SERIES_NAME = "MISSION TO SATURN"

Volume IDs can contain up to 11 characters and shall use the following convention:

COIIII_NNNN, for orbiter data.
HPIIII_NNNN, for probe data.

Where :

CO = Cassini Orbiter

HP = Huygens Probe

IIII = Instrument acronyms up to 4 characters in length (CAPS, CDA, CIRS, INMS, ISS, MAG, MIMI, RADR, RPWS, RSS, UVIS, VIMS, ACP, DISR, DWE, GCMS, HASI, SSP)

NNNN = volume number

# 10 Roles and Responsibilities

## 10.1 Principal Investigators (PIs), Team Leaders (TLs)

The following responsibilities apply:

a) Works directly with assigned PDS Discipline Nodes to define dataset content and format.  (Discipline Nodes have expertise in archiving specific types of data and will help define file formats, keywords and standard values for keywords in metadata such as a dataset description file and data product label files.)
b) Provides PDS with datasets that include data products (includes labels), other metadata that include Instrument, Dataset, Reference, and Personnel high-level catalog files, and ancillary data necessary to understand the data.
c) Provides PDS with archive science datasets that are validated for science content and PDS format compliance with documentation, calibration and other data processing algorithms that ensure data access. (The list of these datasets can be found in Appendix A)
d) Participates in Science Archive Working Group (SAWG) Meetings.
e) Participates in peer reviews.
f) Reports archive status to Instrument Operations (IO) by providing metadata that details submissions to PDS.

## 10.2 Interdisciplinary Scientists (IDSs)

a) Archives any significant new science data products and associated metadata and supplementary products created from the investigation.  These will likely be higher-level products and few in number.  IDSs will inform the Cassini Archive Coordinator of archive plans.
b) Participates in peer reviews.

## 10.3 Instrument Operations (IO) Program Archive Data Engineer

a) Coordinates archive dataset design and production schedule.
b) Maintains the Archive Plan for Science Data (699-068).
c) Participates in peer reviews.
d) Acts as agent between PDS, Project and PI and TL when necessary to resolve PDS format and delivery issues.
e) Leads the Science Archive Working Group (SAWG) Meetings.
f) Receives metadata describing archive submissions from instruments.
g) Tracks and reports archive status to program weekly.
h) Produces and validates SPICE data product archive as specified in Appendix A.
i) Produces Mission, Instrument Host, and reference catalog files and provide to PDS.

## 10.4 Spacecraft  Operations & Navigation

Generate and validate certain SPICE data products as specified in Appendix A.  Assist IO in identifying the files that should be included in the SPICE archive.

## 10.5 Planetary Data System (PDS)

### Central Node (CN):

a) Coordinates the definition and production of the archives and ensures they are compatible with PDS standards.
b) Maintains a database of all PDS holdings, which will be updated after Cassini archive volumes have completed the peer review process.
c) Makes archive volumes available to the science community.
d) Provides archive volume validation tools, consultation, and review of validation reports.
e) Provides PDS training and instruction to archive volume producers.
f) Participates in Science Archive Working Group (SAWG) Meetings.
g) Provides copies of archive volumes to the NSSDC.

### Lead Node(LN)

a) Coordinates interactions between instrument teams and specific discipline nodes.
b) Monitors the development of Cassini data base of PDS holdings and ensures its completion by the DNs.
c) Ensures consistency across nodes with regard to data formats, labels, indexes, documentation, and calibration practices.
d) Participates in peer reviews, monitors progress, and works with participants as needed to resolve issues.
e) Designs PDS Master index. Validates that SIS's provide data to populate.

### Primary Science Discipline Nodes (DN):

a) Works with archive producers to define archive format and content.
b) Leads peer reviews.
c) Maintain archive of released Cassini products for access by the science community.
d) Provides additional archive volume validation tools as needed.
e) Participates in Science Archive Working Group (SAWG) Meetings.
f) Produces physical volumes, if negotiated with team to do so.

## 10.6 National Space Science Data Center (NSSDC)

NSSDC ensures the long-term preservation of data. The NSSDC is also be responsible for filling large delivery orders to the science community, and making data available to foreign investigators, educators, and the general public.

## 11 PDS Discipline Nodes Contacts

| PDS Node | Contact | Email | Phone Number |
|---|---|---|---|
| Central Node (CN)<br>JPL, Pasadena, CA | Steven Adams | Steven.Adams@jpl.nasa.gov | (818) 354-2624 |
| Atmospheres Node (ATM)<br>New Mexico State University, Las Cruces, NM | Lyle Huber<br>Reta Beebe | Lhuber@NMSU.edu<br>Rbeebe@nmsu.edu | (505) 646-1862<br>(505) 646-1938 |
| Geosciences Node (GEO)<br>Washington University, St. Louis, MO | Ray Arvidson | arvidson@wunder.wustl.edu | (314) 935-5609 |
| USGS Imaging Subnode (IMG/USGS)<br>Flagstaff, AZ | Lisa Gaddis<br>Patty Garcia | lgaddis@usgs.gov<br>pgarcia@usgs.gov | (928) 556-7053<br>(928) 556-7246 |
| JPL Imaging Subnode (IMG/JPL)<br>JPL, Pasadena, CA | Sue Lavoie<br>Rafael Alanis | Susan.K.LaVoie@jpl.nasa.gov<br>Rafael.Alanis@jpl.nasa.gov | (818) 354-5677<br>(818) 354-8959 |
| Planetary Plasma Interactions Node (PPI)<br>University of California, Los Angeles, CA | Ray Walker<br>Steve Joy | rwalker@igpp.ucla.edu<br>sjoy@igpp.ucla.edu | (310) 825-7685<br>(310) 825-3506 |
| Rings Node (RINGS)<br>Ames Research Center, Moffet Field, CA | Mark Showalter<br>Mitch Gordon | showalter@ringside.arc.nasa.gov<br>mgordon@mail.arc.nasa.gov | (650) 604-3382<br>(650) 604-2529 |
| Small Bodies Node (SBN), Dust Subnode<br>University of Arizona,<br>Tucson, AZ | Mark Sykes | sykes@as.arizona.edu | (520) 621-5381 |
| Navigation and Ancillary Information Facility (NAIF)<br>JPL, Pasadena, CA | Lee Elson | Lee.Elson@jpl.nasa.gov | (818) 354-4223 |
| Radio Science Subnode (RS) *<br>Stanford University, Stanford, CA | Dick Simpson | rsimpson@magellan.stanford.edu | (650) 723-3525 |

* through September 2004

## 12 Cassini Principal Investigators and Team Leaders (PIs/TLs) Archive Contacts

| Instrument | Instrument Team Archive Representative(s) | Email | Phone Number | PI or TL |
|---|---|---|---|---|
| CAPS<br>Cassini Plasma Spectrometer | Charles Zinsmeyer<br>Judy Furman | CZinsmeyer@swri.edu<br>jfurman@swri.edu | (210) 522-5018<br>(210) 522-6040 | David Young, PI |
| CDA<br>Cosmic Dust Analyzer | Sascha Kempf | Sascha.Kempf@mpi-hd.mpg.de | 49 6221 51 6247 | Ralf Srama, PI |
| CIRS<br>Composite Infrared Spectrometer | Conor Nixon<br>Jim Tingley | nixon@cirsrss.gsfc.nasa.gov<br>James.S.Tingley@gsfc.nasa.gov | (301) 286-6757<br>(301) 286-4980 | Michael Flasar, PI |
| INMS<br>Ion and Neutral Mass Spectrometer | Greg Fletcher<br>Dave Gell | gfletch@umich.edu<br>gellda@umich.edu | (734) 763-8182<br>(734) 763-6221 | Hunter Waite, TL |
| ISS<br>Imaging Science Subsystem | Leslie Pieri<br>Ben Knowles<br>Josh Riley | Leslie@ciclops.org<br>knowles@ciclops.org<br>josh@ ciclops.org | (830) 693-8955<br>(720) 974-5852<br>(720) 974-5856 | Carolyn Porco, TL |
| MAG<br>Magnetometer | Nick Achilleos<br>Steve Kellock | n.achilleos@imperial.ac.uk<br>s.kellock@imperial.ac.uk | 44 207 594 7759<br>44 207 594 7760 | Michele Dougherty, PI |
| MIMI<br>Magnetospheric Imaging Instrument | Don Mitchell<br>Thomas Armstrong | Don.Mitchell@jhuapl.edu<br>Armstrong@FTECS.com | (240) 228-5981<br>(785) 840-0800 | Tom Krimigis, PI |
| RADAR | Bryan Stiles<br>Rich West<br>Randy Kirk | Bryan.Stiles@jpl.nasa.gov<br>Richard.D.West@jpl.nasa.gov<br>rkirk@usgs.gov | (818) 354-5329<br>(818) 354-6025<br>(520) 556-7020 | Charles Elachi, TL |
| RPWS<br>Radio and Plasma Wave Spectrometer | Bill Kurth | william-kurth@uiowa.edu | (319) 335-1926 | Don Gurnett, PI |

| Instrument | Instrument Team Archive Representative(s) | Email | Phone Number | PI or TL |
|---|---|---|---|---|
| RSS<br>Radio Science Subsystem | Operations:<br>Elias Barbinis<br>Gene Goltz<br>Science:<br>Dick French | <br>Elias.Barbinis@jpl.nasa.gov<br>Gene.Goltz@jpl.nasa.gov<br><br>rfrench@wellesley.edu | <br>(818) 393-0661<br>(818) 393-1142<br><br>(781) 283-3747 | Arv Kliore, TL |
| UVIS<br>Ultraviolet Imaging Spectrograph | David Judd | David.Judd@lasp.colorado.edu | (303) 492-8582 | Larry Esposito, PI |
| VIMS<br>Visual and Infrared Mapping Spectrometer | Rick McCloskey<br>John Ivens | rickm@lpl.arizona.edu<br>jivens@lpl.arizona.edu | (520) 626-3255<br>(520) 621-7301 | Robert Brown, TL |

## 13 Cassini Interdisciplinary Scientists

| Discipline | Name | Email | Phone Number |
|---|---|---|---|
| Solar Wind | Darrell F. Strobel | strobel@jhu.edu | (410) 516-7829 |
| Atmospheres | Tobias C. Owen | owen@ifa.hawaii.edu | (808) 956-8007 |
| Magnetospheres/Plasma Physics | Michel Blanc | blanc@obs-mip.fr | 33 561 33 2948 |
| Rings | Jeffrey N. Cuzzi | jcuzzi@mail.arc.nasa.gov | 650 604-6343/5524 |
| Magnetospheres/Plasma Physics | Tamas I. Gombosi | tamas@umich.edu | (734) 764-7222 |
| Satellites | Laurence A. Soderblom | lsoderblom@usgs.gov | (928) 556-7018 |

## 14 SPICE Archive Contact

| Dataset | Team | Archive Representative |
|---|---|---|
| SPICE | SAUL/IO<br>Science and Uplink Office / Instrument Operations Element | Diane Conner<br>Diane.Conner@jpl.nasa.gov<br>(818) 354-8586 |

## PDS Discipline Nodes Responsible for Archiving Data by Instrument

Instrument teams submit archives to the primary nodes for distribution within the PDS and to NSSDC.

| Instrument | Primary Node | Secondary Node |
|---|---|---|
| CAPS | PPI | N/A |
| CDA | Small Bodies | Rings, PPI |
| CIRS | Atmospheres | Rings |
| INMS | PPI | Atmospheres |
| ISS | Imaging / JPL | Rings, Geosciences, Atmospheres |
| MAG | PPI | N/A |
| MIMI | PPI | Atmospheres |
| RADAR | Imaging/ USGS | Geosciences, Rings |
| RPWS | PPI | N/A |
| RSS | Radio Science subnode | All |
| UVIS | Atmospheres | Rings |
| VIMS | Imaging / JPL | Rings, Atmospheres |
| SPICE | NAIF | |
| Huygens<br>ACP<br>DISR<br>DWE<br>GCMS<br>HASI<br>SSP | Atmospheres | Geosciences |

## 16 Data Product Levels

There is no official reference for the NASA product level descriptions. The source for the NASA product level descriptions found below was taken from a Mars project archive plan. CODMAC descriptions were taken from the "Issues and Recommendations Associated with Distributed Computation and Data Management Systems for Space Sciences", Committee on Data Management and Computation Space Science Board Commission on Physical Sciences, Mathematics, and Resources National Research Council, PB88-1884466, 1986.

| NASA Levels | Product Description | CODMAC Equivalent |
|---|---|---|
| Raw | Telemetry data stream as received at the ground station, with science and engineering data embedded. | Level 1 – Raw Data |
| Level 0 | Instrument science data (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed. | Level 2 – Edited Data |
| Level 1A | Level 0 data that have been located in space and may have been **reversibly** 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).  No resampling. | Level 3 – Calibrated |
| Level 1B | **Irreversibly** transformed (e.g., resampled, remapped, calibrated) values of the instrument measurements (e.g., radiances magnetic field strength). | Level 3 – Calibrated<br>Level 4 – Resampled data |
| Higher levels | Geophysical parameters mapped into uniform space time grids. | Level 5 – Derived data |
| | | Level 6 – Ancillary Data |

| CODMAC Equivalent | CODMAC Description |
|---|---|
| Level 1 – Raw Data | Telemetry data with data embedded. |
| Level 2 – Edited Data | Corrected for telemetry errors and split or decommutated into a dataset for a given instrument. Sometimes called Experimental Data Record. Data are also tagged with time and location of acquisition. |
| Level 3 – Calibrated | Edited data that are still in units produced by instrument, but that have been corrected so that values are expressed in or are proportional to some physical unit such as radiance. No resampling, so edited data can be reconstructed. |
| Level 4 – Resampled data | Data that have been resampled in the time or space domains in such a way that the original edited data cannot be reconstructed. Could be calibrated in addition to being resampled. |
| Level 5 – Derived data | Derived results, as maps, reports, graphics, etc. NASA Levels 2 through 5. |
| Level 6 – Ancillary Data | Non-science data needed to generate calibrated or resampled datasets. Consists of instrument gains, offsets; pointing information for scan platforms, etc |

# Appendix A: Cassini Science and Ancillary Datasets to be archived with PDS by Instrument Teams

The Appendix A will be periodically updated to add or modify products as needed then posted for electronic access on the Cassini archive web site.

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CAPS_ACT | Actuator Data Files | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 132MB/Year = 528 MB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 2 | CAPS_ELS | Electron sensor data | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 9.3GB/Year = 37.1 GB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 3 | CAPS_ANC | Ancillary information | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 138MB/Year = 550 MB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 4 | CAPS_IBS | Ion Beam sensor data | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 32GB/Year = | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 5 | CAPS_IMS_EVN | IMS event data | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | ?? | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 6 | CAPS_IMS_LOG | Ion Mass logicals | IO-AR-017 | 27 | BINARY | PPI | J. Furman | J. Furman | 4.2GB/Year = 16.7 GB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 7 | CAPS_IMS_SNG | Ion Mass singles | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 5GB/Year= 20 GB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 8 | CAPS_IMS_ION | Ion Mass Ion data | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 137GB/Year= 548 GB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 9 | CAPS_IMS_TOF | Ion Mass Time of Flight data | IO-AR-017 | 2 | BINARY | PPI | J. Furman | J. Furman | 485MB/Year = 2 GB | CO-E/J/S/SW-CAPS-2-UNCALIBRATED-V1.0 |
| 10 | CDA_PNT | J2000 Pointing vector of instrument as a function of time when CDA is on | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 4 GB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 11 | CDA_CAL_AREA | The sensitive area of the CDA impact detector (IID) and chemical analyser (CAT) is tabulated as a function of the incident angle with respect to the instrument axis. | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 10 KB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 12 | CDA_STAT | Cassini mission and CDA configuration, tests and other events. Records are triggered by change in status affecting the sensitivity of the different CDA instruments and mission events that may affect the interpretation of the data. | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 300 MB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 13 | CDA_DA_IMP | Detector responses and derived quantities from the Cassini dust detector as well as spacecraft geometry information for reliable impacts. | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 10 GB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 14 | CDA_MS_PEAKS | Time-of-flight mass spectra peaks for individual impact events. | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 1 GB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 15 | CDA_MS_SPECTRA | Time-of-flight mass spectra for individual impacts, identified by their unique identifier number xxxxxx | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | 1 GB | CO-D-CDA-3/4/5-DUST-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | CDA_CAL_SET | Table of voltages corresponding to voltage level codes and Coulomb threshold settings. | IO-AR-012 | 3 | tables | SBN | S. Kempf | S. Kempf | 20 KB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 17 | CDA_DA_CTR | CDA impact counter time history file. | IO-AR-012 | 6 | table | SBN | S. Kempf | S. Kempf | 1 GB | CO-D-CDA-3/4/5-DUST-V1.0 |
| 18 | CDA_HRD | HRD data and ancillary files - HRD takes data only during Saturn ring plane crossings | IO-AR-012 | 3 | table | SBN | S. Kempf | S. Kempf | TBD | CO-D-CDA-3/4/5-DUST-V1.0 |
| 19 | CIRS_IHSK | Resampled (interpolated) housekeeping data | IO-AR-002, IO-AR-003 | 3 | table | Atmos | CIRS | CIRS PI | 3.5 MB/mon= 168 MB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 20 | CIRS_GEO | spacecraft orientation w.r.t. target, sun | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 41 MB/mon = 2.0 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 21 | CIRS_HSK | Housekeeping Data | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 18.5 MB/mon = 890 MB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 22 | CIRS_IFGM | uncompressed, raw interferogram data | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 682 MB/mon= 32.7 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 23 | CIRS_OBS | observation parameters | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 1 MB/mon = 48 MB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 24 | CIRS_POI | pointing information for detectors on target | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 236 MB/mon=11.3 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 25 | CIRS_RIN | pointing information for detectors on rings | IO-AR-002, IO-AR-003 | 2 | table | Atmos | CIRS | CIRS PI | 200 MB/mon= 9.6 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 26 | CIRS_AIFM | averaged reference interferograms (deep space, warm shutter) | IO-AR-002, IO-AR-003 | 4 | table | Atmos | CIRS | CIRS PI | 42.5 MB/mon = 2.0 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 27 | CIRS_ISPM | Calibrated individual spectra | IO-AR-002, IO-AR-003 | 4 | table | Atmos | CIRS | CIRS PI | 500 MB/mon = 24 GB | CO-S-CIRS-2/4-TSDR-V1.0 |
| 28 | INMS_SCI | Science data, counts/sec | IO-AR-016 | 2 | table | PPI | INMS | INMS | 1600 MB | CO-EJS-INMS-2-SCI-U-V1.0 |
| 29 | INMS_HKG | Housekeeping in engineering units | IO-AR-016 | 2 | table | PPI | INMS | INMS | 90 MB | CO-EJS-INMS-2-HKG-U-V1.0 |
| 30 | INMS_OSI | Operations tables | IO-AR-016 | 2 | table | PPI | INMS | INMS | 10 MB | CO-EJS-INMS-2-OSI-U-V1.0 |
| 31 | INMS_EVT | Event times | IO-AR-016 | 2 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-2-EVT-U-V1.0 |
| 32 | INMS_SMD | Science memory dump | IO-AR-016 | 2 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-2-SMD-U-V1.0 |
| 33 | INMS_HMD | Housekeeping memory dump | IO-AR-016 | 2 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-2-HMD-U-V1.0 |
| 34 | INMS_CNT | Science data, spectra with ancillary data | IO-AR-016 | 3 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-3-CNT-C-V1.0 |
| 35 | INMS_SPC | Science data, species | IO-AR-016 | 5 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-5-SPC-C-V1.0 |
| 36 | INMS_MSS | Science data, mass spectra | IO-AR-016 | 5 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-5-MSS-C-V1.0 |
| 37 | INMS_TTN | Science data, titan atmospheric profiles | IO-AR-016 | 5 | table | PPI | INMS | INMS | TBD | CO-EJS-INMS-5-TTN-C-V1.0 |
| 38 | ISS_EDR | Raw, uncalibrated images | DOIS-002, IO-AR-005 | 2 | IMG | Imaging (JPL) | IO/MIPL | ISS TL | 650 GB | CO-S-ISSNA/ISSWA-2-EDR-V1.0, CO-J-ISSNA/ISSWA-2-EDR-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 39 | ISS_CAL | Calibration files, sample calibrated images | IO-AR-005 | 3 | IMG, algorithms, software | Imaging (JPL) | ISS/CICLOPS | ISS TL | TBD | CO-X-ISSNA/ISSWA-2-CAL-V1.0 |
| 40 | MAG_FGM | L1A fluxgate magnetometer data (duplicates removed, gaps filled, idiosyncrasies of onboard data processing unit fixed, data separated into files by type) 75 GB (combined size of FGM, VHM, SHM, CON, ANA, ERR, CMD, CHATT, CHUSR data) | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | 75 GB (combined size of FGM, VHM, SHM, CON, ANA, ERR, CMD, CHATT, CHUSR data) | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 41 | MAG_VHM | L1A vector helium magnetometer data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 42 | MAG_SHM | L1A scalar helium magnetometer data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 43 | MAG_CON | L1A configuration image data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 44 | MAG_ANA | L1A analog housekeeping data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 45 | MAG_ERR | L1A error counter data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 46 | MAG_CMD | L1A command validation data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 47 | MAG_CHATT | L1A Cassini attitude data | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 48 | MAG_CHUSR | L1A engineering data from a user-selected set of channels | IO-AR-020 | 2 | Time series binary TABLE | PPI | MAG | MAG PI | | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 49 | MAG_CAL | Calibration files | IO-AR-020 | 2 | binary TABLE | PPI | MAG | MAG PI | 500 MB | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 50 | MAG_SW | software to convert L1A to L1B | IO-AR-020 | 6 | TEXT, binary FILE | PPI | MAG | MAG PI | 500 MB | CO-E/SW/J/S-MAG-2-REDR-RAW-DATA-V1.0 |
| 51 | MAPS_KEY_PARAMETERS | MAPS instruments key parameters dataset - may contain plots and model data | IO-AR-004 | 4 | ascii | PPI | MAPS Instrument teams | Univ of Michigan | 28 GB | CO-V/E/J/S/SS-RPWS-4-SUMM-KEY60S-V1.0<br>CO-V/E/J/S/SS-MAG-4-SUMM-KEY60S-V1.0<br>CO-V/E/J/S/SS-MIMI-4-SUMM-KEY-5MIN-V1.0<br>CO-V/E/J/S/SS-CAPS-5-DDR-KEY-5MIN-V1.0<br>CO-S-INMS-5-DDR-KEY-5MIN-V1.0 |
| 52 | MIMI_CHEMS_PHA | CHEMS Pulse Height Analysis data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 450 MB / Day Maximum = 722 GB | CO-E/J/S-MIMI-2-CHEMS-UNCALIBRATED-V1.0 |
| 53 | MIMI_CHEMS_ACC | CHEMS accumulation rate data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 7 MB / Day Maximum = 12 GB | CO-E/J/S-MIMI-2-CHEMS-UNCALIBRATED-V1.0 |
| 54 | MIMI_CHEMS_SCI | CHEMS science rate data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | | CO-E/J/S-MIMI-2-CHEMS-UNCALIBRATED-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 55 | MIMI_INCA_PHA | INCA Pulse Height Analysis data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 300 MB / Day Maximum = 482 GB | CO-E/J/S-MIMI-2-INCA-UNCALIBRATED-V1.0 |
| 56 | MIMI_INCA_RAT | INCA accumulation rate data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 4 MB / Day Maximum = 6.5 GB | CO-E/J/S-MIMI-2-INCA-UNCALIBRATED-V1.0 |
| 57 | MIMI_INCA_IMG | INCA image data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 110 MB / Day Maximum = 177 GB | CO-E/J/S-MIMI-2-INCA-UNCALIBRATED-V1.0 |
| 58 | MIMI_LEMMS_PHA | LEMMS Pulse Height Analysis data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 30 MB / Day Maximum = 49 GB | CO-E/J/S-MIMI-2-LEMMS-UNCALIBRATED-V1.0 |
| 59 | MIMI_LEMMS_ACC | LEMMS accumulation rate data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | 35 MB / Day Maximum = 57 GB | CO-E/J/S-MIMI-2-LEMMS-UNCALIBRATED-V1.0 |
| 60 | MIMI_LEMMS_FRT | LEMMS fine accumulation rate data | IO-AR-006 | 2 | ASCII | PPI | MIMI | MIMI PI | | CO-E/J/S-MIMI-2-LEMMS-UNCALIBRATED-V1.0 |
| 61 | RADAR_SBDR | Short Burst Data Record. Time ordered tabular data records including engineering telemetry, spacecraft geometry, calibrated science data (radiometry, scatterometry, and altimetry) and associated meta data. Also includes time-ordered SAR metadata. | DORA-001 DORA-002 | 3 | table | Imaging | IO/RADAR | Radar TL | 1100 MB | CO-V/E/J/S-RADAR-3-SBDR-V1.0 |
| 62 | RADAR_LBDR | Same as RADAR_SBDR with addition of sample radar echo data for each burst. | DORA-001 DORA-002 | 3 | table | Imaging | IO/RADAR | Radar TL | 44000 MB | CO-V/E/J/S-RADAR-3-LBDR-V1.0 |
| 63 | RADAR_ABDR | Same as RADAR_SBDR with addition of altimeter profile vector (range compressed echo data) for each burst. | DORA-001 DORA-002 | 3 | table | Imaging | IO/RADAR | Radar TL | 4800 MB | CO-SSA-3-ABDR-V1.0 |
| 64 | RADAR_BIDR | Basic Image Data Record. SAR data correlated, resampled to oblique cylindrical grid (different projection for each swath), looks summed. Includes latitude, longitude, incidence angle, and beam mask back-planes. | DORA-002 DORA-003 | 5 | IMG | Imaging | IO/RADAR | Radar TL | 5600 MB | CO-SSA-RADAR-5-BIDR-V1.0 |
| 65 | RADAR_PRDR | Calibrated & gridded radiometer data | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 300 MB | CO-SSA-RADAR-5-PRDR-V1.0 |
| 66 | RADAR_PSDR | Calibrated & gridded scatterometer data | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 300 MB | CO-SSA-RADAR-5-PSDR-V1.0 |
| 67 | RADAR_GRDR | Mosaicked radiometer data | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 100 MB | CO-SSA-RADAR-5-GRDR-V1.0 |
| 68 | RADAR_MIDR | Mosaicked SAR image data | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 6500 MB | CO-SSA-RADAR-5-MIDR-V1.0 |
| 69 | RADAR_RIDR | Multilook SAR "cubes" | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 50 MB | CO-SSA-RADAR-5-RIDR-V1.0 |
| 70 | RADAR_DTM | Digital Topographic Models (DTMs) | IO-AR-012 IO-AR-018 | 5 | IMG | Imaging | USGS | Radar TL | 10 MB | CO-SSA-RADAR-5-DTM-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 71 | RPWS_KEY_PARAMETERS | spectral information as a function of time | IO-AR-019 | 4 | ascii | PPI | RPWS | RPWS | 4 GB | CO-V/E/J/S/SS-RPWS-4-SUMM-KEY60S-V1.0 |
| 72 | RPWS_ANCIL | Description of RPWS IEBs | IO-AR-019 | 6 | ascii | PPI | RPWS | RPWS | <1 MB | CO-V/E/J/S/SS-RPWS-4-SUMM-KEY60S-V1.0, CO-V/E/J/S/SS-RPWS-2-REFDR-ALL-V1.0, CO-V/E/J/S/SS-RPWS-3-RDR-LRFULL-V1.0, CO-V/E/J/S/SS-RPWS-2-REFDR-WBRFULL-V1.0, CO-V/E/J/S/SS-RPWS-2-REFDR-WFRFULL-V1.0 |
| 73 | RPWS_RAW_COMPLETE | Raw telemetry data, edited | IO-AR-019 | 2 | BINARY | PPI | RPWS | RPWS | 65 GB | CO-V/E/J/S/SS-RPWS-2-REFDR-ALL-V1.0 |
| 74 | RPWS_WIDEBAND_FULL | Wideband Full Resolution Uncalibrated | IO-AR-019 | 2 | Time Series | PPI | RPWS | RPWS | 10 GB | CO-V/E/J/S/SS-RPWS-2-REFDR-WBRFULL-V1.0 |
| 75 | RPWS_WAVEFORM_FULL | Waveform Full Resolution Uncalibrated | IO-AR-019 | 2 | Time Series | PPI | RPWS | RPWS | 10 GB | CO-V/E/J/S/SS-RPWS-2-REFDR-WFRFULL-V1.0 |
| 76 | RPWS_LOW_RATE_FULL | Low Rate Full Resolution Calibrated | IO-AR-019 | 3 | Time Series | PPI | RPWS | RPWS | 65 GB | CO-V/E/J/S/SS-RPWS-3-RDR-LRFULL-V1.0 |
| 77 | RPWS_LOW_RATE_BROWSE | Low Rate Browse | IO-AR-019 | 3 | PNG | PPI | RPWS | RPWS | 6.5 GB | CO-V/E/J/S/SS-RPWS-3-RDR-LRFULL-V1.0 |
| 78 | RPWS_WIDEBAND_BROWSE | Wideband Browse | IO-AR-019 | 2 | PNG | PPI | RPWS | RPWS | 1 GB | CO-V/E/J/S/SS-RPWS-2-REFDR-WBRFULL-V1.0 |
| 79 | RPWS_WAVEFORM_BROWSE | Waveform Browse | IO-AR-019 | 2 | PNG | PPI | RPWS | RPWS | 1 GB | CO-V/E/J/S/SS-RPWS-2-REFDR-WFRFULL-V1.0 |
| 80 | RPWS_SP | Special Data Sets | IO-AR-019 | 4+ | | PPI | RPWS | RPWS | 1 GB | CO-V/E/J/S/SS-RPWS-4-SP-V1.0 |
| 81 | RSS_ATMOS_OCCULT | complex signal amplitude A(f,r,lambda,t) for frequency f at ring plane (model-independent quantity)radius r, longitude lambda, and time t (direct ray) (model-independent quantity)Fresnel scale Fr(f,r,lambda,t) (model-independent quantity)range to ring intercept pt of center of beam R(t) (model-independent quantity)transverse and radial velocity components of direct ray (model-independent quantity)normal and slant path optical depth tau(f,r,lambda,t) at multiple resolutions (derived quantities)Spectrograms of scattered signal as function of time (derived quantities) | IO-AR-022 | 5 | | RS Subnode | Radio Science Team (RST) | RST | N/A | CO-X-RSS-5-EXP-V1.0 |
| 82 | RSS_GRAV_FIELDS | frequency residuals vs time (model-independent quantity)<br><br>covariance matrix (derived)<br><br>reconstructed trajectory vs time (derived) | IO-AR-022 | 5 | | RS Subnode | Radio Science Team (RST) | RST | N/A | CO-X-RSS-5-EXP-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 83 | RSS_RING_OCCULT | complex signal amplitude A(f,r,lambda,t) for frequency f at ring plane radius r, longitude lambda, and time t (direct ray)(model-independent quantity)Fresnel scale Fr(f,r,lambda,t)(model-independent quantity)range to ring intercept pt of center of beam R(t)(model-independent quantity)transverse and radial velocity components of direct ray(model-independent quantity)normal and slant path optical depth tau(f,r,lambda,t) at multiple resolutions (derived quantities)Spectrograms of scattered signal as function of time(derived quantities) | IO-AR-022 | 5 | | RS Subnode | Radio Science Team (RST) | RST | N/A | CO-X-RSS-5-EXP-V1.0 |
| 84 | RSS_SC_GWE | sky frequency at 1 sec interval (90% level of completeness) for each observed frequency [1GB ascii file for 40 days of obs] | IO-AR-022 | 5 | | RS Subnode | Radio Science Team (RST) | RST | N/A | CO-X-RSS-5-EXP-V1.0 |
| 85 | RSS_ODF | Closed-loop Orbit Data File (ODF); Doppler, range, and ramps | DSN-001 IO-AR-021 | 4 | Binary | RS Subnode | RMDCT | RST | 2 GB | CO-X-RSS-1-EXP-V1.0 |
| 86 | RSS_EOP | EOP - Earth Orientation Parameters File | DSN-004 IO-AR-021 | 6 | ASCII | RS Subnode | TSAC | RST | 250 MB | CO-X-RSS-1-EXP-V1.0 |
| 87 | RSS_MCF | MCF - Media Calibration Files | DSN-005 IO-AR-021 | 6 | ASCII | RS Subnode | TSAC | RST | 2 MB | CO-X-RSS-1-EXP-V1.0 |
| 88 | RSS_PDD | [Advanced Media Calibration System] Path Delay Data (PDD) | DSN-005 IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | 1 GB | CO-X-RSS-1-EXP-V1.0 |
| 89 | RSS_ATDF | Closed-loop Archival Tracking Data File (ATDF); Doppler, range, and ramps | DSN-023 IO-AR-021 | 2 | Binary | RS Subnode | Radio Metric Data Conditioning Team (RMDCT) | RST | 10 GB | CO-X-RSS-1-EXP-V1.0 |
| 90 | RSS_TDAF | Closed Tracking Data Archival File (TDAF); up-link and downlink carrier and range phase | DSN-025 IO-AR-021 | 1 ,2,3,4 | Binary | RS Subnode | Tracking Data Delivery Subsystem (TDDS) | RST | 3 GB | CO-X-RSS-1-EXP-V1.0 |
| 91 | RSS_RSR | Open-loop Radio Science Data (ODS), from RSR; digitized signal | DSN-026 IO-AR-021 | 1 | Binary | RS Subnode | IO-RS * | RST | 200 GB | CO-X-RSS-1-EXP-V1.0 |
| 92 | RSS_MON | Mission Monitor Data | DSN-027 IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | 13 GB | CO-X-RSS-1-EXP-V1.0 |
| 93 | RSS_HGA_CAL | High Gain Antenna (HGA) Boresight Alignment reports | IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | N/A | CO-X-RSS-1-EXP-V1.0 |
| 94 | RSS_HGA_PAT | High Gain Antenna (HGA) Pattern reports | IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | N/A | CO-X-RSS-1-EXP-V1.0 |
| 95 | RSS_USO_CAL | Ultrastable Oscillator Characterization reports | IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | N/A | CO-X-RSS-1-EXP-V1.0 |

| | Standard_data_product_id | Science Data Product Description | Product Specification ID (SIS) | CODMAC Level | PDS Format IMG, etc.. | Prime PDS Node interface | Producer | Supplier to PDS | Estimated Data Set Size | Data Set ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 96 | RSS_CK | C-Kernel | NAV-005<br>IO-AR-021 | 6 | Binary | RS Subnode | SCO | RST | 1 GB | CO-X-RSS-1-EXP-V1.0 |
| 97 | RSS_SPK | SP-Kernel; spacecraft and planetary ephemeredes | NAV-009<br>IO-AR-021 | 6 | Binary | RS Subnode | SCO | RST | 400 MB | CO-X-RSS-1-EXP-V1.0 |
| 98 | RSS_TLM | RFS/RFIS engineering telemetry | TLM-007<br>IO-AR-021 | 6 | ASCII | RS Subnode | IO-RS | RST | 31 GB | CO-X-RSS-1-EXP-V1.0 |
| 99 | UVIS_1WAV | Image at one wavelength | IO-AR-023<br>IO-AR-024 | 2 | Image | Atmos | UVIS | UVIS PI | 34 MB | CO-S-UVIS-2-WAV-V1.0 |
| 100 | UVIS_QUBE | Spatial and spectral qubes | IO-AR-023<br>IO-AR-024 | 2 | Qube | Atmos | UVIS | UVIS PI | 34 GB | CO-S-UVIS-2-CUBE-V1.0 |
| 101 | UVIS_SPEC | Spectra | IO-AR-023<br>IO-AR-024 | 2 | Spectrum | Atmos | UVIS | UVIS PI | 136 MB | CO-S-UVIS-2-SPEC-V1.0 |
| 102 | UVIS_SSB | Solar and Stellar brightness time history | IO-AR-023<br>IO-AR-024 | 2 | Time Series | Atmos | UVIS | UVIS PI | 2 MB | CO-S-UVIS-2-SSB-V1.0 |
| 103 | UVIS_CAL | Calibration files, algorithms and calibrated data examples | IO-AR-023<br>IO-AR-024 | 6 | Qube, algorithms , etc.. | Atmos | | UVIS | 2 GB | CO-S-UVIS-2-CAL-V1.0 |
| 104 | VIMS_EDR | Image cube of visible bands | DOVI-002, IO-AR-009 | 3 | PDS Spectral Cube | Imaging (JPL) | IO/MIPS | VIMS Team | 125 GB | CO-S-VIMS-3-QUBE-V1.0<br>CO-J/JSA-VIMS-3-QUBE-V1.0<br>CO-X-VIMS-3-QUBE-V1.0 |
| 105 | SPICE_HUYSPK | Spacecraft, Planet, satellite, and rock ephemeredes | NAV-009 | 6 | SPICE | NAIF | NAVT & ISS | Instrument Ops | 5 GB in ascii | HP-SSA-SPICE-6-V1.0 |
| 106 | SPICE_SPK | Spacecraft, Planet, satellite, and rock ephemeredes | NAV-009 | 6 | SPICE | NAIF | NAVT & ISS | Instrument Ops | 5 GB in ascii | CO-S/J/E/V-SPICE-6-V1.0 |
| 107 | SPICE_PCK | Planetary Constants and basic models | NAV-010 | 6 | SPICE | NAIF | MP | Instrument Ops | 2 MB | CO-S/J/E/V-SPICE-6-V1.0 |
| 108 | SPICE_IK | Instrument description and frame definitions | DOI-002 | 6 | SPICE | NAIF | NAIF | Instrument Ops | 2 MB | CO-S/J/E/V-SPICE-6-V1.0 |
| 109 | SPICE_CK | Pointing | MSAS-005 | 6 | SPICE | NAIF | SCO/AACS | Instrument Ops | 3.3 MB/Day = 6 GB in ascii | CO-S/J/E/V-SPICE-6-V1.0 |
| 110 | SPICE_EK | Events | DOI-001 | 6 | SPICE | NAIF | Instrument Ops | Instrument Ops | 500 MB | CO-S/J/E/V-SPICE-6-V1.0 |
| 111 | SPICE_LSK | Leapseconds | MSAS-019 | 6 | SPICE | NAIF | IO/NAIF | Instrument Ops | 5 KB | CO-S/J/E/V-SPICE-6-V1.0 |
| 112 | SPICE_SCLK | spacecraft clock offset | MSAS-017 | 6 | SPICE | NAIF | SCO | Instrument Ops | 3 MB | CO-S/J/E/V-SPICE-6-V1.0 |
| 113 | SPICE_FK | Frames | DOI-035 | 6 | SPICE | NAIF | Instrument Ops | Instrument Ops | 500 MB | CO-S/J/E/V-SPICE-6-V1.0 |

## 18 Appendix B: Archive Delivery Schedule

The below delivery schedule applies to data products identified in the Appendix A that are classified as CODMAC levels 4 and below.  Higher level products are archived with the PDS on a best efforts basis on a schedule developed by the producing team.

| Data Collection Interval | | Delivery to the PDS Required by the First Day of: |
|---|---|---|
| From First Day of: | Through Last Day of: | |
| Oct 1997 | Jun 2004 | Jul 2005 |
| Jul 2004 | Sep 2004 | Jul 2005 |
| Oct 2004 | Dec 2004 | Oct 2005 |
| Jan 2005 | Mar 2005 | Jan 2006 |
| Apr 2005 | Jun 2005 | Apr 2006 |
| Jul 2005 | Sep 2005 | Jul 2006 |
| Oct 2005 | Dec 2005 | Oct 2006 |
| Jan 2006 | Mar 2006 | Jan 2007 |
| Apr 2006 | Jun 2006 | Apr 2007 |
| Jul 2006 | Sep 2006 | Jul 2007 |
| Oct 2006 | Dec 2006 | Oct 2007 |
| Jan 2007 | Mar 2007 | Jan 2008 |
| Apr 2007 | Jun 2007 | Apr 2008 |
| Jul 2007 | Sep 2007 | Jul 2008 |
| Oct 2007 | Jul 2008 | Sep 2008 |

# 19 Appendix C: Acronyms

| | |
|---|---|
| ACP | Aerosol Collector and Pyrolyser |
| APSD | Archive Plan for Science Data (formerly known as the Archive Policy and Data Transfer Plan, APDTP) |
| ASCII | American Standard Code for Information Interchange |
| ATM | Atmospheres |
| CAPS | Cassini Plasma Spectrometer |
| CD | Compact Disc |
| CDA | Cosmic Dust Analyzer |
| CD-ROM | Compact Disc – Read Only Memory |
| CEL | Cassini Electronic Library |
| CIRS | Composite Infrared Spectrometer |
| CK | SPICE spacecraft orientation data |
| CN | Central Node |
| CO | Cassini Orbiter |
| CODMAC | Committee on Data Management and Computation |
| Co-I | Co-Investigator |
| DISR | Descent Imager / Spectral Radiometer |
| DN | Discipline Node |
| DVD | Digital Versatile Disc the next generation of optical disc storage technology |
| DWE | Doppler Wind Experiment |
| EK | SPICE events information |
| ESA | European Space Agency |
| FK | SPICE Frames Kernel |
| GCMS | Gas Chromatograph Mass Spectrometer |
| GMT | Greenwich mean time |
| GWE | Gravity Wave Experiment |
| HASI | Huygens Atmospheric Structure Instrument |
| HP | Huygens Probe |
| HSWT | Huygens Science Working Team |
| IAG | International Association of Geodesy |
| IAU | International Astronomical Union |
| IAU | International Astronomical Union |
| IDS | Interdisciplinary Scientist |
| IEEE | Institute of Electrical and Electronics Engineers |
| IK | SPICE instrument Kernel |
| INMS | Ion and Neutral Mass Spectrometer |
| IO | Instrument Operations Team |
| IRD | Interface Requirements Document |
| ISS | Imaging Science Subsystem |
| JPL | Jet Propulsion Laboratory |
| LEMMS | Low Energy Magnetospheric Measurement System |
| LSK | SPICE leapseconds data |
| MAG | Magnetometer |
| MAPS | Magnetosphere and Plasma Science |
| Mb | Megabits |
| MIMI | Magnetospheric Imaging Instrument |
| MIPS | Multimission Image Processing System |
| MSSO | Mission Science and Support Operations |
| NAIF | Navigation and Ancillary Information Facility |
| NASA | National Aeronautics and Space Administration |
| NSSDC | National Space Science Data Center |
| OIA | Operational Interface Agreement |

| | |
|---|---|
| OTL | Operations Team Leader |
| PCK | SPICE Planetary Constants Kernel |
| PDMP | Project Data Management Plan |
| PDS | Planetary Data System |
| PI | Principal Investigator |
| PPI | Planetary Plasma Interactions |
| PSG | Program Science Group |
| RPIF | Regional Planetary Image Facility |
| RPWS | Radio and Plasma Wave Spectrometer |
| RSS | Radio Science Subsystem |
| SAUL | Science and Uplink Office |
| SAWG | Science Archive Working Group |
| SCLK | SPICE spacecraft clock coefficients |
| SCLK | Spacecraft Clock |
| SIS | Software Interface Specification |
| SMP | Science Management Plan |
| SOI | Saturn Orbit Insertion |
| SPICE | Spacecraft, Planet, Instrument, C-matrix, Events (NAIF PDS Node) |
| SPK | SPICE Spacecraft and Planetary Kernel ephemeredes |
| SSP | Surface Science Package |
| TBD | To Be Determined |
| Tbits | TerraBytesTerrabits |
| TL | Team Leader |
| UTC | Coordinated Universal Time |
| UVIS | Ultraviolet Imaging Spectrograph |
| VIMS | Visual and Infrared Mapping Spectrometer |
| WG | Working Group |

# 20 Appendix D: Huygens Data Archive Generation, Validation and Transfer Plan