A Space and Solar Physics Data Model

from the SPASE Consortium

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Consortium Members:

Augsburg College
Mark Engebretson, <engebret@augsburg.edu>
Noel Petit, <petit@augsburg.edu>

California Institute of Technology (CalTech)
Andrew Davis, <ad@srl.caltech.edu>

Centre de Données de la Physique des Plasmas (CDPP)
Michel Gangloff, <gangloff@cesr.fr>
Christopher Harvey, <christopher.harvey@cesr.fr>
Claude Huc, <claude.huc@cnes.fr>
Thierry Levoir, <thierry.levoir@cnes.fr>

Istituto Nazionale di Astrofisica (INAF)
Kevin Reardon, <kreardon@arcetri.astro.it>

Japan Aerospace eXploration Agency (JAXA) - STP/Ehime
Yasumasa Kasaba, <kasaba@stp.isas.jaxa.jp>
Ken T. Murata, STP/Ehime, <murata@cite.ehime-u.ac.jp>

Jet Propulsion Laboratory (JPL)
Dan Crichton, <dan.crichton@jpl.nasa.gov>
Steven Hughes, <j.steven.hughes@jpl.nasa.gov>

John Hopkins University/Applied Physics Laboratory (JHU/APL)
Rose Daley, <rose.daley@jhuapl.edu>
Brand Fortner, <brand.fortner@jhuapl.edu>
Daniel Morrison, <daniel.morrison@jhuapl.edu>
Stu Nylund, <stu.nylund@jhuapl.edu>
Jon Vandergriff, <jon.vandergriff@jhuapl.edu>
Michele Weiss, <michele.weiss@jhuapl.edu>

George Mason University
Robert Weigel, <rweigel@gmu.edu>

Goddard Space Flight Center (GSFC)
Ed Bell (PSGS), <ed.bell@gsfc.nasa.gov>
Dieter Bilitza (RITSS), <bilitza@mail630.gsfc.nasa.gov>
Bobby Candey, <candey@mail630.gsfc.nasa.gov>
Carl Cornwell (Aquilent), <carl.cornwell@aquilent.com>
Joe Gurman, <gurman@grace.nascom.nasa.gov>

Joe Hourcle (EITI), <oneiros@grace.nascom.nasa.gov>
Mona Kessel, <kessel@ndadsb-f.gsfc.nasa.gov>
Joe King (PSGS), <jking@mail630.gsfc.nasa.gov>
Terry Kucera, <kucera@stars.gsfc.nasa.gov>
Bob McGuire, <rmcguire@pop600.gsfc.nasa.gov>
Jan Merka, <jan.merka@gsfc.nasa.gov>
Thomas Narock, <thomas.w.narock@nasa.gov>
Lou Reich (CSC), <lreich@pop500.gsfc.nasa.gov>
Aaron Roberts, <roberts@vayu.gsfc.nasa.gov>
Don Sawyer, <donald.sawyer@gsfc.nasa.gov>
Dave Sibeck <dsibeck@pop600.gsfc.nasa.gov>
Adam Szabo, <aszabo@pop600.gsfc.nasa.gov>
Jim Thieman, <james.r.thieman@nasa.gov>
Karen North, <Karen.C.North@nasa.gov>
Aaron Smith (Aquilent), <aaron.smith@aquilent.com>
Isaac Verghese (Aquilent), <Isaac.Verghese@aquilent.com>
Vasili Rezapkin (Aquilent), <vasili.rezapkin@aquilent.com>

National Aeronautics and Space Administration (NASA) HQ
Joe Bredekamp, <jbredeka@mail.hq.nasa.gov>
Jeffrey Hayes, <jhayes@nasa.gov>
Chuck Holmes, <cholmes@mail.hq.nasa.gov>

National Oceanic and Atmospheric Administration (NOAA)
Eric Kihn, <eric.a.kihn@noaa.gov>

Rutherford Appleton Laboratory (RAL)
Chris Perry, <chris.perry@stfc.ac.uk>
Phil Richards, <philip.richards@stfc.ac.uk>

Stanford University
Rick Bogart, <rbogart@stanford.edu>

Southwest Research Institute (SwRI)
Joey Mukherjee, <jmukherjee@swri.org>
Dave Winningham, <david@cluster.space.swri.edu>

University of California, Los Angeles (UCLA)
Lee Frost Bargatze, <lfb@igpp.ucla.edu>
Steven Joy, <sjoy@igpp.ucla.edu>
Todd King, <tking@igpp.ucla.edu>
Ray Walker, <rwalker@igpp.ucla.edu>

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1. Executive Summary

Research in Heliophysics requires information from multiple sources which includes data from and about spacecrafts, groundbased observatories, models, simulations and more. The results from research are also invaluable in building up a body of knowledge and need to be available. All the different sources and types of information are considered a "Resource". The Resources exist, are shared, exchanged and used in a framework called the "data environment". The SPASE (Space Physics Archive Search and Extract) group has defined a Data Model which is a set of terms and values along with the relationships between them that allow describing all the resources in a heliophysics data environment. It is the result of many years of effort by an international collaboration of heliophysicists and information scientists to unify and improve on existing Space and Solar Physics data models. The intent of this Data Model is to provide the means to describe resources, most importantly scientifically useful data products, in a uniform way so they may be easily registered, found, accessed, and used.

The Data Model provides enough detail to allow a scientist to understand the content of Data Products (e.g., a set of files for 3 second resolution Geotail magnetic field data for1992 to 2005), together with essential retrieval and contact information. It also allows for the incremental annotation of resources with expert assessments and the free association of resources to create bundles or networks of resources. Resource descriptions can be stored with the data or at remote locations. Sites can harvest the resource descriptions to enable services like a search engine or portal (Virtual Observatory). A typical use would be to have a collection of descriptions stored in one or more related internet-based registries of products; that can be queried with specifically designed search engines and ultimately link users to the data they need. The Data Model also provides constructs for describing components of such a data delivery system. This includes repositories, registries and services.

This document provides a specification of the SPASE Data Model. Sections 2 and 3 provide an overview of the origins and the concepts of the data model. Section 4 presents the set of elements in a hierarchy that shows the defined relationships among them. This is followed by usage suggestion and pedagogic examples in Section 5 and 6, and by the complete set of definitions of terms and enumerated lists in Section 7.

The SPASE group website is located at http://www.spase-group.org/

A PDF version of this document can be downloaded from the SPASE site.

2. Introduction

The SPASE (Space Physics Archive Search and Extract) Data Model is a set of terms and values along with the relationships between them that allow describing all the resources in a heliophysics data environment. It is the result of many years of effort by an international collaboration (see http://spase-group.org) to unify and improve on existing Space and Solar Physics data models. The intent of this Data Model is to provide the means to describe resources, most importantly scientifically useful data products, in a uniform way so they may be easily registered, found, accessed, and used.

The SPASE data model divides the heliophysics data environment into a limited set of resources types. A key resource type is Numerical Data. This type of resource typically consists of a set of files containing values of one or more physical variables and that differ from each other only by the time span. To full describe a Numerical Data resource requires other types of Resources, namely Observatory, Instrument, Person, and Repository, whose names are self-explanatory, and each of which has its own set of attributes. Often, numerical data are presented in prepared images (gif or jpeg), and such presentations are referred to as Display Data resources. The other data related resource types are Catalog which are lists of events; Annotation which enable expert comments on data products; and Granule which describe individual files within another resource (i.e., Numerical Data, Display Data or Catalog). Other types of resources include Document which can contain narratives or supporting information; Service that provide software to use data resources; Repository for storage locations; and Registry for metadata collections. Resource descriptions and the links in them are intended to make the Resource useful to scientific users.

2.1. History of Development

The data model presented here has grown from the efforts begun in 2002 that became formalized in regular teleconferences of a group of interested data providers, including scientific and technical representatives of some of the largest data holdings in the US, Europe, and Japan. As the effort to provide seamless access to distributed data proceeded, it became clear that the data model efforts were central. The SPASE Data Model was developed with an iterative process where additions were made when unaddressed needs were discovered. The original impetus occurred at an ISTP meeting in 1998 where a resolution was passed calling to make data more accessible. Interoperability test beds were constructed in 2001 and in 2002 a grassroots effort was undertaken to define the needs of community. In March of 2003 a meeting of many of the people in the Contributors list at the beginning of this document was convened to begin the data model construction in earnest. The initial effort involved collecting terms from CDPP, SWRI, NSSDC, ISTP, and other sets to form a starting point. Two years of teleconferences, e-mailed revisions, and occasional face-to-face efforts, along with the application of the terms to specific cases, led to the release of version 1.0 of the data model in November 2005. Following the release of version 1.0 many existing data products were described and lead to further improvements of the data model. Version1.1 was released in August 2006. At this time NASA established the Heliophysics VxOs and after an extended period of use and improvements version 1.2.2 was released in August of 2008. The version of the data model described in this document is an extension of this earlier release.

2.2. Intended Purpose

The design of the SPASE data model is based on a core set of principles related to the intended purpose of descriptive information (metadata), the data environment, and the operational environment. The overall goal of the Data Model is to be able to describe resources using a

taxonomy of terms familiar to the heliophysics domain. This taxonomy should provide sufficient scientific context and data content information for an individual to assess the applicability of the resource (data and metadata) to a research question. A data model is the cornerstone of an information system and one purpose for the SPASE Data Model to enable the creation of "Virtual Observatories" that will link the broad range of heliophysics resources which may be available in a loosely coupled distributed environment. Additional goals of the data model are to:

(1) Provide a way of registering products using a standard set of terms that allow the products to be found with simple searches and described so that users can determine their utility for a specific purpose;

(2) Allow searching for products containing particular physical quantities (e.g., magnetic field; spectral irradiance) that are variously represented in a diverse array of data products; and

(3) Facilitate a means of mapping comparable variables from many products onto a common set of terms so that visualization, analysis, and higher-order query tools and services can be used on all of them without regard to the origin of the data.

The content of a resource description based on the data model should enable services (either at the provider or in a VxO) to discover and access individual resources. The service layer can contain services for a variety of purposes. The basic functionality of the service layer is to provide the links necessary to connect user applications and search- and-retrieval front ends to data repositories. Ultimately, the data environment based on the data model will involve a number of software tools and services linked together as an internet-based environment. The data along with software tools and documentation associated with products will be directly accessible using standard web protocols (http, ftp). This "system" has the potential to provide capabilities that can aid even expert users of a particular dataset (e.g., on-the-fly coordinate transformations, the ability to merge datasets from different instruments, easy reference to related indices or other data), in addition to providing the broad access needed to investigate emerging questions in heliophysics.

2.3. Design Principles

The design of the SPASE data model begins with a few basic principles. These principles are:

1. Data is self-documented. Data resources have internal schema or structures for storing values. The physical structure is determined by the storage format. Each retrievable entity on the format is assigned a key or tag which can be used to retrieve the entity.

The SPASE Data Model does not attempt to describe the physical storage of the parameters, for example, the byte offsets, record format or data encoding in the data resource. Instead, the SPASE Data Model describes the scientific attributes of the parameter and links this to the parameter by a key or tag used by the storage format. Applications can use the SPASE descriptions to locate a parameter and the appropriate format-specific reader to extract parameters.

Not all data in the Heliophysics data environment is stored in self- documented formats. For example, data stored as ASCII tables. The method of assigning a key or tag name for each field in the ASCII table is external to the SPASE data model. This method must be part of an "format" specification which may be as simple as the first row of the table containing the tag

name of the field.

2. Resources are distributed. There are many providers of resources and these providers can be located anywhere in the world.

Each provider operates independently and activities are not necessarily coordinated. The SPASE data model assumes that providers have local autonomy and may operate under local rules or jurisdictions.

3. Online Resources have Universal Resource Locators (URL) If a resource is on-line it can be accessed and retrieved using Universal Resource Locators (URL).

4. The data environment is continuously evolving. New resources are actively generated either as part of an on-going experiment or as a result of analysis and assessment.

These new resources may be directly related to other resources. As new resources are generated or new associations defined the network or collections formed will expand over time.

2.4. Conceptual System Environment

The data model is intended to enable the sharing of knowledge through structured metadata (SPASE Descriptions) which can be exchanged in queries and responses between systems. The operational environment this occurs in is the current Internet where systems and users are loosely coupled and highly distributed. Special services or portals may harvest (collect) the SPASE descriptions from multiple sources to create an enriched capability for the user. For example, a search engine may provide a comprehensive search for a particular scientific discipline. The web site http:// hpde.gsfc.nasa.gov gives a guide to many currently active projects and a great deal of background information. Of particular interest there is the document entitled, "A Framework for Space and Solar Physics Virtual Observatories."

Figure 1 illustrates a conceptual architecture in a distributed environment. In this environment multiple communities have resources to share. The storage location of a resource is called a repository. Some of these repositories (boxes) have local SPASE descriptions which are available through a local registry service (balls). The contents of other repositories are described at external, possibly independent, locations which make the descriptions available through remote registries. Gateways (rings) can harvest and aggregate the resources from multiple registries or perform federated searches which provide a single access point to multiple registries. Applications access the registries to discover resources, determine their location and retrieve them from the repositories.

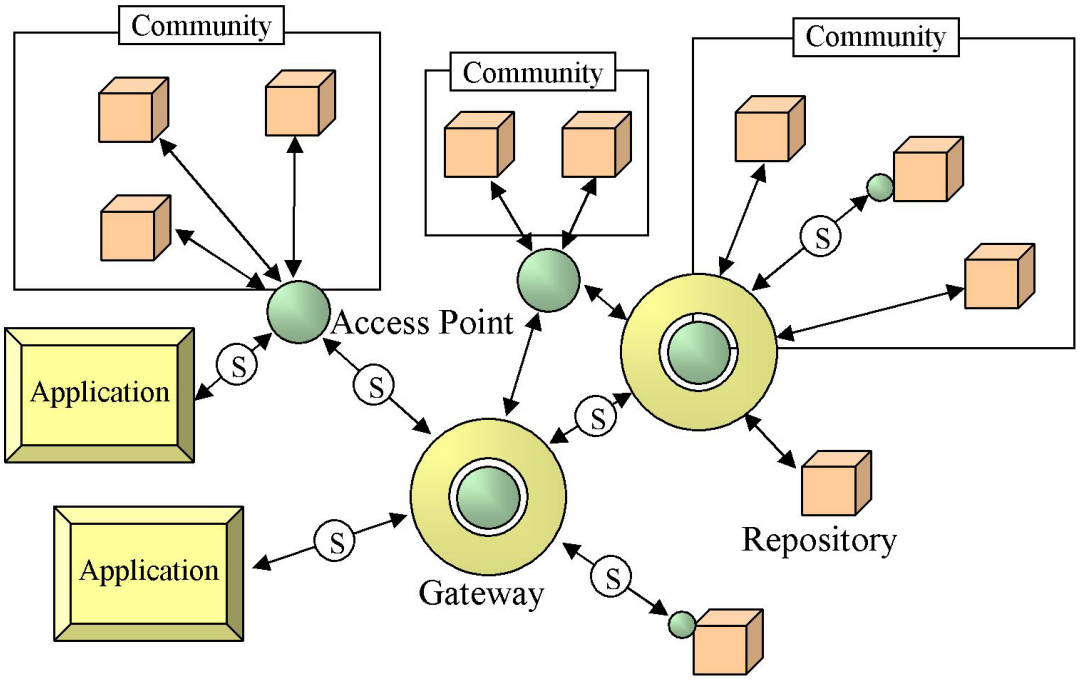


Figure 1: A possible data environment architecture. Information and data flows from Repositories to Applications through Access Points and Gateways. In this model, any Access Point or Gateway may be considered an instance of a Virtual Observatory. The portions of the system using SPASE-Data-Model-based messages are indicated with the Ⓢ.

3. Guide to the SPASE Data Model

3.1. Resource Types

The top level entity in the SPASE data model is a Resource. There are 12 different types of resources. Each resource type consists of a set of attributes that characterize the resource. The resource types can be divided into three categories: Data Resources, Origination Resources and Infrastructure Resources.

This section provides an overview of the resource types. Complete details for each resource can be found in Section 4.

3.1.1. Data Resources

Data Resources describe one or more data products. A "data product" is a set of data that is uniformly processed and formatted, from one or more instruments, typically spanning the full duration of the observations of the relevant instrument(s). A data product may consist of a collection of granules of successive time spans, but may be high-level entities such as event catalogs. Data products can be images (Display Data), sample or observation values (Numerical Data), event lists (Catalog). Included in the Data Resource category are the resources used to describe individual files (Granule) which are part of data product sets and assessments of a resource (Annotations). The complete list of Data Resources is:

Numerical Data,
Display Data,
Catalog,
Granule, and
Annotation

3.1.2. Origination Resources

Origination Resources describe the generators or sources of data. Included in a Data Resource description is information about the origination of the data. A Data Resource will refer to one or more Origination Resource. The complete list of Origination Resources is:

Observatory,
Instrument,
Person, and
Document

3.1.3. Infrastructure Resources

Infrastructure Resources describe system components that are part of the exchange and use of data. This includes storage locations for data (Repository), metadata (Registry) and functions (Service). The complete list of Infrastructure Resources is:

Registry,
Repository, and
Service

3.1.4. Ontology

In the SPASE data model there can be associations between pairs of resources. Some associations are specific and are required in order to fully describe a resource. For example, an Instrument resource is always associated with an Observatory resource. The specific associations form an ontology which is illustrated in Figure 2. The SPASE data model also allows associations of resources which are not explicitly defined in the ontology. These associations are described and assigned a relationship type using generic association attributes.

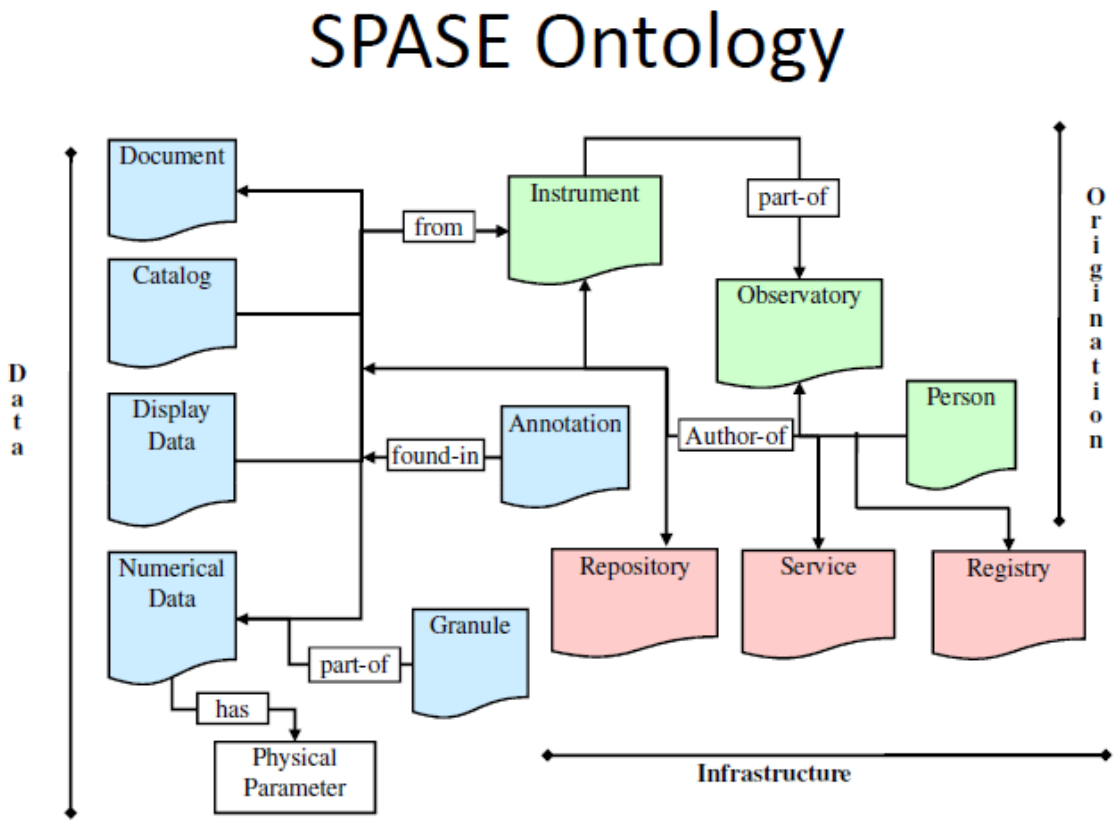


Figure 2: The association map between resources in the SPASE model. Arrows point in the direction of association.

3.2. Resource Identifiers

Every resource has a unique identifier so that it can be tracked and referenced within a system. This identifier is defined by the naming authority for the resource. The entity which acts as the naming authority is determined by the agency or group who provides the resource. Each resource identifier is a URI that has the form

scheme://authority/path

where "scheme" is "spase" for those resources administered through the SPASE framework, "authority" is the unique identifier for the naming authority within the data environment and "path" is the unique local identifier of the resource within the context of the "authority". The resource ID must be unique within the data environment.

To illustrate the definition of a resource identifier consider that there is a registered "authority" called "SMWG" which maintains information for spacecraft (Observatory) resources. One such spacecraft is GOES8. Now "SMWG" decides that the "path" to the GOES8 resource description should include the Resource Type as part of the path and that the observatory "name" will be "GOES8". So, the resource identifier would be:

spase://SMWG/Observatory/GOES8

The Resource ID is used to formally or informally associate one resource with another. For example an Instrument resource must be formally associated with an Observatory. A Numerical Data resource may be formally associated with an Instrument resource and informally associated with other Numerical Data resources. The free association of resources allows networks or collections to be formed from distributed resources and allows for new associations to be formed as needed without affecting existing associations.

3.3. Core Attributes

With the exception of Granule and Person, every resource has a common set of core attributes. The core attributes provide textual descriptions of the resource and the capability to reference external sources of information (Information URL). It also describes the context of the resource in the larger data environment. This context consists of associations with other resources (Association) and with previous versions (Prior ID). These attributes are grouped in a Resource Header and consists of:

Resource Name
Alternate Name
Release Date
Expiration Date
Description
Acknowledgement
Contact
Information URL
Association
Prior ID

3.4. Extensions

The SPASE Data Model allows for additional metadata to be embedded within a SPASE description. Every Resource Type has an "Extension" element which can contain metadata compliant with other data models. The "Extension" element has a SPASE data model type of "Text", but is not limited to alphanumeric characters and may contain tagged information.

3.5. Element Data Types

Each element in the SPASE Data Model has a data type. One design feature of the SPASE data model is that an element can contain either a value or other elements. Mixed content (elements and values) are not allowed. This allows the data model to be implemented in a wider range of metadata languages. The following data types are supported:

Container A container of other elements.

Count A whole number.

DateTime A value is given in the ISO 8601 recommended primary standard notation: YYYY-MM-DD. where YYYY is the year in the usual Gregorian calendar, MM is the month of the year between 01 (January) and 12 (December), and DD is the day of the month between 01 and 31. It may also have an optional time portion given in the ISO 8601 recommended primary standard notation: HH:MM:SS.sss where HH is the number of complete hours that have passed since midnight (00-24), MM is the number of complete minutes that have passed since the start of the hour (00-59), and SS is the number of complete seconds since the start of the minute (00-60), and sss are milliseconds that have passed since the start of the second (000-999). Time zones are not allowed so all times are in Universal Time. The time portion must follow the date portion with both portions separated by a "T". For example, "2004-07-29" is July 29, 2004 and "2004-07-29T12:30:00" is precisely 12:30 on July 29, 2004.

Duration A duration of time. A time value given in the ISO 8601 recommended primary standard notation: PTHH:MM:SS.sss where PT are tokens to indicate that the time value is a duration, HH is the number of complete hours that have passed since midnight (00-24), MM is the number of complete minutes that have passed since the start of the hour (00-59), and SS is the number of complete seconds since the start of the minute (00-60), and sss are milliseconds that have passed since the start of the second (000-999).

Enumeration Value is selected from a list of allowed values. The name of list is an additional attribute of the element. Lists may be externally controlled in which case the location of the list is indicated in the textual definition of the element.

Item An element which is a value for an enumerated list.

Numeric A fractional number which can be expressed in scientific notation. The string "NaN" represents not-a-number (flag) values and the string "INF" represents an infinitely large value. The value "-INF" represents an infinitely small value.

Sequence A list of whole number values where the order of the values is fixed. A space separates each value. For example, "1 2 3".

Text A string of alphanumeric characters. A text based "markup" is supported. See Text Mark-up section (3.4.1) for details.

URL Universal Resource Locator

3.5.1. Text Mark-up

While descriptive text may be brief, some formatting of the text may be necessary to convey the necessary information, for example, multiple paragraphs or nested lists. To ensure system portability text values in SPASE are sequences of alphanumeric one byte UTF-8 (US_ASCII)

characters with white space preserved. When text is displayed in some applications (a web browser is the best example) a strict preservation of white space may not result in a desirable presentation. Also, to make the metadata more human readable (for example in XML) additional white space may be introduced in the form of indentation. If strictly preserved, this could result in an undesirable presentation. To allow an author to express a preferred layout for the text, a special set of text "mark-up" rules are defined. The layout can then be determined by normalizing the text and applying a simple set of interpretation rules.

3.5.1.1. Text Normalization Rules

To aid in determining the layout or structural intent of the author the following rules are to be applied to text to create a normalized form:

1. All lines are to end with a newline character.
2. All text is left justified. No line has leading whitespace.

3.5.1.2. Text Interpretation Rules

After normalization of text the following rules can be used to interpret the layout intent of the author.

1. Blank lines indicate paragraph breaks.
2. Lists
    a. Must be preceded by a blank line.
    b. Items are indicated by a line beginning with a reserved character followed by a space. Three levels of lists are supported. The reserved characters are:
        * : First level list
        - : Second level list (must appear within a first level context)
        . : Third level list (must appear within a second level context)
    c. End with a blank line.
3. Tables
    a. Begin and end with a line that starts with "+--".
    b. The first "row" of a table is the field headings.
    c. Fields in a table are separated with a vertical bar ("|").
    d. Visual row separators are lines which begin with "|--".

4. The Data Model Presented Hierarchically

The taxonomy tree shows the inter-relationship of elements in the data model. This provides a "big picture" view of the SPASE data model. This taxonomy is implementation neutral. Details for each element are contained in the data dictionary.

Notes: Occurence specifications are enclosed in parenthesis: 0 = optional, 1 = required, * = zero or more, + = 1 or more

+ Spase (1)

5. Guidelines for Metadata Descriptions of Products

The following sections describe the details of the SPASE Data Model, especially the metadata used to describe data. There is a richness in the available metadata that allows very detailed descriptions of products. Many of the types of metadata may not apply in your case or you may not need much detail to adequately describe your data holdings. But it must be remembered that the better data are described, the easier they will be to use.

To determine what level of detail is needed, we recommend considering not only what the user needs to find the correct data, but also what is necessary to know if the data will be useful for the requestor’s purpose. The user might get this information by contacting you, but if the data were moved somewhere else and only the data description were available to determine the utility of the data, consider if the user would have sufficient information to know if this is the right data set and what problems might be associated with the use of these data. Also consider if additional documentation is neccesary and if so create an Document resource and associate it with the data resource. An "Information URL" may also be used to provide links to more detailed information.

In summary, products need not be described in minute detail, but users will need, at minimum, information for assessing what the data products represent and where to find them. Of course it is also useful to include information on how the data can be applied and common pitfalls in their use, but the first need is to make the products usefully visible.

6. Examples

As an example let us describe a person using SPASE metadata. This person is "John Smith" from Smith Foundation. While the SPASE data model is implementation neutral, XML representation is preferred. This example uses the SPASE XML form.

```
<?xml version="1.0" encoding="UTF-8" ?>
<Spase>
  <Version>2.0.0</Version>
   <Person>
     <ResourceID>spase://person/jsmith@smith.org</ResourceID>
     <PersonName>John Smith</PersonName>
     <OrganizationName>Smith Foundation</OrganizationName>
     <Address>1 Main St., Smithville, MA</Address>
     <Email>jsmith@smith.org</Email>
     <PhoneNumber>1-800-555-1212</PhoneNumber>
  </Person>
</Spase>
```

For a more extensive example let us consider a collection of numerical data from the magnetometer on the ACE spacecraft. This data set has been averaged to 1 minute intervals (cadence) and spans the beginning of the mission to the end of 2004 (1997-09-01 through 2004-12-31). The ACE spacecraft orbits the L1 point between the Earth and the Sun. While the SPASE data model is implementation neutral, XML representation is preferred. This example uses the SPASE XML form. The presented URLs are fictitious and will not direct you to the actual data.

```
<?xml version="1.0" encoding="UTF-8" ?>
<Spase>
  <Version>2.0.0</Version>
  <NumericalData>
     <ResourceID>spase://VMO/NumericalData/ACE/MAG/200301</ResourceID>
     <ResourceHeader>
        <ResourceName>ACEMAG200301</ResourceName>
        <ReleaseDate>2006-07-26T00:00:00.000</ReleaseDate>
        <Acknowledgement>
           User will acknowledge the data producer and instrument P.I. in any

           publication resulting from the use of these data.
        </Acknowledgement>
      <Description>
         ACE MFI 1-minute averaged magnetic-field data in GSE coordinates
         from Jan 2003. These data have been derived from the 16 second
         resolution ACE MFI which were linearly interpolated to a 1-minute
         time grid with time stamps at second zero of each minute.
      </Description>

      <Contact>
         <Role>PrincipalInvestigator</Role>
         <PersonID>spase://SMWG/Person/Norman.F.Ness</PersonID>
      </Contact>

      <Contact>
         <Role>Co-Investigator</Role>
         <PersonID>spase://SMWG/Person/Charles.Smith</PersonID>
      </Contact>

      <Contact>
         <Role>DataProducer</Role>
```

```
            <PresonID>spase://SMWG/Person/James.M.Weygand</PresonID>
         </Contact>
      </ResourceHeader>

      <AccessInformation>
         <AccessRights>Open</AccessRights>
         <AccessURL>

<URL>http://www.igpp.ucla.edu/getResource?format=text&id=spase://UCLA/ACEMAG200
301</URL>
         </AccessURL>
         <Format>Text</Format>
         <Encoding>GZIP</Encoding>
      </AccessInformation>

      <InstrumentID>spase://SMWG/ACE/MAG</InstrumentID>
      <MeasurementType>MagneticField</MeasurementType>

      <TemporalDescription>
         <TimeSpan>
           <StartDate>1997-01-01T00:00</StartDate>
           <StopDate>2004-01-31T23:59</StopDate>
         </TimeSpan>
         <Cadence>PT1M</Cadence>
      </TemporalDescription>

      <InstrumentRegion>Heliosphere.NearEarth</InstrumentRegion>
      <ObservedRegion>Heliosphere.NearEarth</ObservedRegion>

      <Parameter>
         <Name>SAMPLE_TIME_UTC</Name>
         <ParameterKey>time</ParameterKey>
         <Description>
          Sample UTC in the form DD MM YYYY hh mm ss where
            DD   = day of month (01-31)
            MM   = month of year (01-12)
            YYYY = Gregorian Year AD
            hh   = hour of day     (00:23)
            mm   = minute of hour  (00-59)
            ss   = second of minute (00-60).
         </Description>
         <Support>
           <SuportQuantity>Temporal</SuportQuantity>
         </Support>
      </Parameter>

      <Parameter>
         <Name>MAGNETIC_FIELD_VECTOR</Name>
         <Units>nT</Units>
         <CoordinateSystem>
            <CoordinateRepresentation>Cartesian</CoordinateRepresentation>
            <CoordinateSystemName>GSE</CoordinateSystemName>
         </CoordinateSystem>
         <Description>
             Magnetic field vector in GSE Coordinates (Bx, By, Bz).
         </Description>
         <Field>
            <Qualifier>Vector</Qualifier>
            <FieldQuantity>Magnetic</FieldQuantity>
        </Field>
      </Parameter>

      <Parameter>
         <Name>SPACECRAFT_POSITION_VECTOR</Name>
```

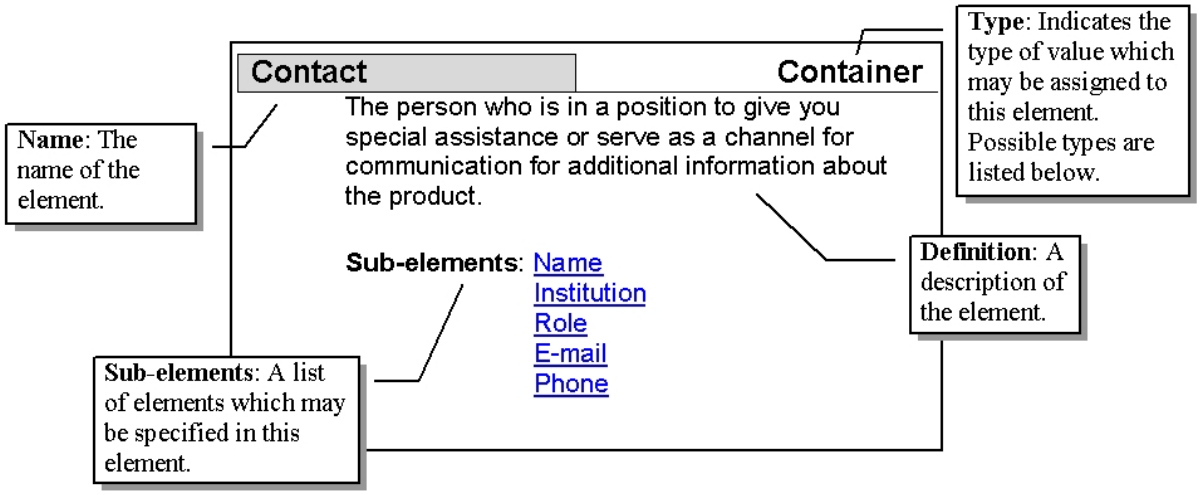
```
      <CoordinateSystem>
         <CoordinateRepresentation>Cartesian</CoordinateRepresentation>
         <CoordinateSystemName>GSE</CoordinateSystemName>
      </CoordinateSystem>
      <Units>EARTH RADII</Units>
      <UnitsConversion>6378.16 km</UnitsConversion>
      <Description>
         ACE spacecraft location in GSE coordinates (X,Y,Z)."
      </Description>
      <Support>
        <SuportQuantity>Positional</SupportQuantity>
      </Support>
   </Parameter>

  </NumericalData>
</Spase>
```

7. Definitions of the Data Model Terms

How to Read a Definition

Each element has certain attributes and context for use. The details for each element are presented in the following form:



8. Enumeration of Selected Quantities

Lists are either "open" or "closed". The items in a "closed" list are determined by the SPASE model and definitions of each item is in the SPASE data dictionary. The items in an "open" list are determined by an external control authority. The URL for the control authority is indicated in the definition of each "open" list.

9. Appendix A - Comparison of Spectrum Domains

Electromagnetic Spectrum Domains

(all wavelengths given in nanometers)

Band	Wavelength [ISO 21348]		Wavelength [EGSO]		Wavelength [VSO]	
	min	max	min	max	min	max
Gamma	0.00001	0.001	-	0.025		
X	0.001	10	0.025	10	0.02	15
HXR	0.001	0.1	0.025	0.25	0.02	1
SXR[1]	0.1	10	0.25	10	1	10
EUV	10	121	10	90	10	100
UV	100	400	90	320	90	380
Visible	380	760	320	700	350	1000
IR	760	10^6	700	10^6	700	$3.5*10^5$
Near IR	760	1400	700	$25*10^2$	700	
Mid IR	1400	3000	$25 \cdot 10^2$	$5 \cdot 10^4$		
Far IR	3000	10^6	$5 \cdot 10^4$	10^6	$3.5*10^5$	
Microwaves	10^6	$1.5*10^7$	10^6	10^9		
Radio	10^5	10^{11}	10^9	-	10^7	10^9

1 Also called “XUV” in ISO 21348

10. Bibliography

National Solar Observatory Sacramento Peak
http://www.sunspot.noao.edu/sunspot/pr/glossary.html

Terms and Definitions
http://www.pgd.hawaii.edu/eschool/glossary.htm

International System of Units (SI)
http://www.bipm.fr/en/si
Base units: http://www.bipm.fr/en/si/si_brochure/chapter2/2-1/#symbols
and those for Common derived units: http://www.bipm.fr/en/si/derived_units/2-2-2.html

ISO 8601:2004 - Date Format
http://en.wikipedia.org/wiki/ISO_8601
- or -
http://www.iso.ch/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=40874
- or -
http://www.iso.org/iso/en/prods-services/popstds/datesandtime.html

RFC 3339 - Date and Time on the Internet
The basis for the ISO 8601 standard. http://www.ietf.org/rfc/rfc3339.txt

RFC 1014 - XDR: External Data Representation standard
http://www.faqs.org/rfcs/rfc1014.html

11. Index

12. Change History

0.99.1	
2005-06-23	Removed duplicate entries.
2005-06-23	Added Chris Harvey's definitions for Electron Drift.
2005-06-23	Particle Correlator and Spacecraft Potential Control.
2005-06-23	Released.

0.99.2	
2005-07-07	Corrected "Numerical Data" entry under Product
2005-07-07	Released.

0.99.3	
2005-08-03	Added definitions supplied by J. Thieman, C. Harvey and T.King; Significant revision of document as suggested by Joe Hourcle

0.99.4	
2005-08-08	Restructured the taxonomy of elements to match the one suggested by A. Roberts.
2005-08-08	Added definitions for new elements introduced in the new taxonomy.
2005-08-08	Released.

0.99.5	
2005-08-26	Clarified some definitions and corrected typographical errors based on comments from J. Thieman and J. Hourcle.
2005-08-26	Changed data types of "Integer" to "Count" and "Double" to "Numeric".
2005-08-26	Added document elements to product resources.
2005-08-26	Added catalog, display data to top list.
2005-08-26	Included region descriptions from J. King with additions suggested by K. Reardon.
2005-08-26	Add parameters loosely based on a model proposed by A.Roberts.
2005-08-26	Released.

0.99.6	
2005-09-07	Corrected the inclusion of Atmosphere-Ionosphere regions into the Magnetosphere.
2005-09-07	Changed Surface to Ground.
2005-09-07	Removed Body and references to it.
2005-09-07	Added Spherical and Cartesian under Position.
2005-09-07	Remove Ratio (Numerator and Denominator).
2005-09-07	Change Upper Latitude to High Latitude, Lower to Low.
2005-09-07	Introduced "Photon Context" and "Particle Context" as replacements for "Independent Variable".
2005-09-07	Removed "Provider" and "Manufacture" resources and replaced with ID pointers.

0.99.7	
2005-09-08	Under Parameter add Description, Tensor Order.
2005-09-08	Change Photon Context and Particle Context to Independent Variable.
2005-09-08	Move Wavelength and Wave Number under Photon Independent Variable.
2005-09-08	Drop Speed from Particle Independent Variable.
2005-09-08	Move Polar Angle under Particle Independent Variable.
2005-09-08	Add Analysis Method under Field/Electric and

	Field/Magnetic.
2005-09-08	Add Wave Form, Spectra etc. under Analysis Method.
2005-09-08	Add Near 1AU under Heliosphere; Add Body under Atmosphere-Ionosphere, Magnetosphere and Ground.
2005-09-08	Add all planets + Moon under Body.
2005-09-08	Update definition of Magnetotail, etc. to be generic, add Earth examples.
2005-09-08	Change "Acceptable abbreviation" to "Conventional abbreviation" since abbreviations are not supported in the model.
2005-09-08	Released.

0.99.8

2005-11-03	General clean-up and alignment with the schema agreed upon at the APL meeting (Nov 2-4, 2005)
2005-11-03	Released.

0.99.9

2005-11-18	Incorporate comments from consortium members on the "final" draft before the release of version 1.0
2005-11-18	Released.

1.0.0

2005-11-22	Incorporate comments from consortium members on the "final" draft before the release of version 1.0.
2005-11-22	Added Phenomenon Type list and defined terms in the list.
2005-11-22	Released.

1.0.1

2006-01-03	Changes in value type for elements: Exposure, InputResourceID, RepositoryName, Size.
2006-01-03	Added elements: Pressure.
2006-01-03	Released.

1.0.2

2006-03-07	Added "Project Scientist" to dictionary and "Role".
2006-03-07	Added "Caveats" under "Instrument".
2006-03-07	Added "Repository" resource class.
2006-03-07	Added "Registry" resource class.
2006-03-07	Released.

1.0.3

2006-04-27	Added "Earth" as a enumeration with "Magnetosphere" as a member.
2006-04-27	Changed "Observed Region" and "Instrument Region" to enumerations.
2006-04-27	Changed definition of "Item" to indicate it is a value of an enumeration.
2006-04-27	Move "Access Rights" under "Access Information".
2006-04-27	Made "Acknowledgement optional.
2006-04-27	Change "HF Radar" to "Radar".
2006-04-27	Added "NCAR" as a "Format".
2006-04-27	Dropped N, Z, Q from dictionary.
2006-04-27	Moved Mass and Size under "Particle Physical Quantity" and changed to type item.
2006-04-27	Added "Near Earth" under "Heliosphere" and added "Outside Bowshock" and "Orbital" under "Near Earth".
2006-04-27	Changed "Spectral Range Name" to "Spectral Range" for consistency.
2006-04-27	Correct links to "Stoke's Parameters".
2006-04-27	Released.

1.1.0	
2006-08-31	Removed "Orbital".
2006-08-31	Modified definition of "Near Earth".
2006-08-31	Changed "Instrument type" to allow multiple occurrences.
2006-08-31	Made data type of "Mixed" text.
2006-08-31	Added "Service" resource class.
2006-08-31	Updated description of "Resource ID".
2006-08-31	Added MAT_4, MAT_6, MAT_7 and VOTable as a Format.
2006-08-31	Added J2000 as a coordinate system.
2006-08-31	Added Base64 as an Encoding.
2006-08-31	Added Parent ID, Energy Range, Frequency Range, Azimuthal Angle Range, Polar Angle Range, Atomic Number Range, Integral, Differential, Low and High.
2006-08-31	Remove Coordinate System from Particle Physical Parameter.
2006-08-31	Updated Pressure definition.
2006-08-31	Add ObservatoryID under Instrument.
2006-08-31	Remove Observatory ID from Numerical Data and Display Data.
2006-08-31	Changed definition of Investigation Name.
2006-08-31	Remove Access Right from Display Data.
2006-08-31	Change Repository Name to Repository ID under Access Information.
2006-08-31	Added Granule.
2006-08-31	Added Parameter Key under Physical Parameter.
2006-08-31	Add Release Date to Resource Header, Person, and Granule.
2006-08-31	Changed "alias" to "alternate name".
2006-08-31	Removed "Instrument Name" and "Observatory Name".
2006-08-31	Added ChargeState to Particle Quantity.
2006-08-31	Add Field Component container.
2006-08-31	Add Statistics to Phenomenon Type.
2006-08-31	Released.

1.1.1	
	Changed InstrumentID and Bin to multiple occurrence. Removed enumeration of Component. Modified definition of Units. Changed AccessURL to type container.

1.2.0	
2007-05-22	Added Aurora and Substorm under Phenomenon Type.
2007-05-22	Added Checksum, Hash Value, Hash Function, MD5 and SHA1, SHA256.
2007-05-22	Added Note as a term and added Note under Timespan.
2007-05-22	Added all planets, Comet and Asteroid as regions.
2007-05-22	Added Data Extent, Bytes and Per to describe the size of a resource.
2007-05-22	Added Data Extent to Access URL and Granule.
2007-05-22	Added the ValidMin, ValidMax and FillValue to Physical Parameter.
2007-05-22	Added Uncertainty and Standard Deviation to qualifiers.
2007-05-22	Added Expiration Date to Resource Header and Granule.
2007-05-22	Added Longitude and Latitude to Orientation.
2007-05-22	Updated Phi and Theta definitions.
2007-05-22	Added Ephemeris as an Instrument Type.
2007-05-22	Added Sequence as a element type and changes Size to a Sequence.
2007-05-22	Defined PriorID and added PriorID to ResourceHeader and Granule.
2007-05-22	Changed InstrumentID in DisplayData and

	NumericalData to one or more occurrences.
2007-05-22	Added Metadata Contact to Role.
2007-05-22	Modified definitions of H, Flux, Integral and Differential.
2007-05-22	Cardinality of Access Information changed from 1 to + (1 or more).
2007-05-22	Added Deputy-PI to Roles;Changed cardinality of Caveats under Instrument to optional.
2007-05-22	Added Element with members of Name, Index, ParameterKey and Component.
2007-05-22	Added Element under Dimension.
2007-05-22	Removed Orientation.
2007-05-22	Made Component and enumeration with the values from Orientation.
2007-05-22	Added InstrumentStatus to MeasurementType.
2007-05-22	Converted Support to an enumeration with Other, Positional and Temporal as members.
2007-05-22	Added ProcessingLevel, Removed Theta and Phi.
2007-05-22	Added Postscript as a Format.
2007-05-22	Added "Extension" as a container.
2007-05-22	Made "URL" in "Granule" multi-valued.
2007-05-22	Changed name of "Date" data type to "DateTime" and "Time" data type to "Duration" to be consistent with conventional terminology.
2007-05-22	Under "Physical Parameter" made "Parameter Key" optional and "Name" required.
2007-05-22	Removed "Dynamic Spectra" from "Measurement Type".
2007-05-22	Added "Spectrum" to "Measurement Type".
2007-05-22	Removed D, H, T, N, Latitude, Longitude from the dictionary.
2007-05-22	Added "Theta" and "Phi" to "Component".
2007-05-22	Added Location container under Observatory and added the elements Latitude, Longitude, Elevation, ObservatoryGroup.
2007-05-22	Added ITM regions under Near Surface.
2007-05-22	Remove Instrument Region from NumericalData.
2007-05-22	Added WGS84 as a Coordinate System Name.
2007-05-22	Released.

1.2.1

2008-03-20	Added SpacecraftOrbitPlane to CoordinateSystemName.
2008-03-20	Added Parallel and PhaseAngle to FieldQualifier.
2008-03-20	Added Current, GyroFrequency, Energy, PlasmaFrequency to the appropriate ParticleQuantity, FieldQuantity, or PhotonQuantity.
2008-03-20	Added Characteristic to ParticleQualifier.
2008-03-20	Add EnergyRange and WavelengthRange to PhotonQuantity.
2008-03-20	Added White-light, H-alpha, He-10830, Ca-K, Na-D, Extreme Ultraviolet, Ni-6768, K-7699 to dictionary and to SpectralRange.
2008-03-20	Added Time Of Flight Interferometer, Photometer, Radiometer, Coronograph, ProportionalCounter, ScintillationDetector, Photopolarimeter, Geiger-MuellerTube, NeutralParticleDetector, Sounder, NeutralAtomImager, RetardingPotentialAnalyser, MultispectralImager, ImagingSpectrometer, Riometer, Unspecified to Instrument Type.
2008-03-20	Added Archive Specialist to Role.
2008-03-20	Added Flow Speed, Number Flux to Particle Quantity.
2008-03-20	Added Energy Flux to Particle Quantity and Photon Quantity.
2008-03-20	Added Anisotropy to Particle Qualifier.
2008-03-20	Added Carrington and HCI to Coordinate System.

2008-03-20	Updated definitions of Vector and Size.
2008-03-20	Removed Flux and Intensity.
2008-03-20	Released.

1.2.2

2008-07-31	Change "Plasmafrequency" to "Plasma Frequency".
2008-07-31	Change "Plasmafrequency" to "Plasma Frequency".
2008-07-31	Change "Retarding Potential Analyser" to "Retarding Potential Analyzer"
2008-07-31	Change "Time-of-flight" to "Time of flight".
2008-07-31	Change "Observatory Group" to "Observatory Name".
2008-07-31	Removed "Offline" from "Medium".
2008-07-31	Remove "Field Component" from lists.
2008-07-31	Remove "Near Earth" as a list.
2008-07-31	Added "Ionosphere" as a list.
2008-07-31	Azimuthal Angle,Dayside,Electric Field Instrument,Frequency,High Latitude,Low Latitude,Nightside,Polar Angle,Provider ID,Provider Release Date,RTF,SGI,Soft X-rays,Spatial Range,TeX,Wavelength,Wavenumber,XDR
2008-07-31	Added Repository ID and Stop Date
2008-08-14	Released.

1.3.0

2007	Add WavelengthRange to dictionary; Add BandName to Bin.
2007	Added SupportQuantity to Support.
2007	Moved Extension into each resource class.
2007	Add SpectralRange to EnergyRange, FrequencyRange and WavelengthRange.
2007	Added Units, UnitsConversion, ValidMin, ValidMax, FillValue to Element
2007	Added Fax Number to Person.
2007	Added Contributor and Publisher to dictionary and Role.
2007	Added Language to dictionary.
2008	Introduced Document resource.
2008	Added Document Type enumeration and Paper as an item.
2008	Added Number Flux to Particle Quantity.
2008	Moved CrossSpectrum from FieldQuantity to FieldQualifier.
2008	Added Electromagnetic to FieldQuantity.
2008	Added PhysicalParameter to Catalog and DisplayData.
2008-04-24	Removed "Structure Type" from dictionary and Structure.
2008-04-24	Removed "Observatory Group" from dictionary and Observatory.
2008-04-25	Removed "Provider Release Date" from dictionary.
2008-05-20	Added "Magnetic Cloud" to dictionary and "Phenomenon Type"
2008-05-20	Changed cardinality of "Phenomenon Type" to + in Catalog.
2008-04-24	Restored "Observatory Group" and made it multiple occurrence.
2008-05-22	Added "TAR" to the dictionary and to "Encoding Type".
2008-05-22	Made "Encoding Type" multiple occurrence (*) in "Access Information".
2008-05-22	Changed "End Date" to "Stop Date" and "Relative End Date" to "Relative Stop Date".
2008-05-22	Added "Active Region" to dictionary and "Phenomenon Type".
2008-05-22	Added "Coronal Hole" to dictionary and "Phenomenon Type".

2008-05-22	Added "Radio Burst" to dictionary and "Phenomenon Type".
2008-05-22	Added "EIT Waves" to dictionary and "Phenomenon Type".
2008-05-22	Fixed spelling of "Plasma Frequency" in the "Photon Qualifier" list.
2008-05-22	Removed "Array" from the Field, Photon and Particle qualifier lists.

1.3.1

2008-07-21	Updated description of duration type.
2008-07-31	Added "Set" to "Physical Parameter"
2008-07-31	Added "Source" dictionary and to "Granule", Removed URL, Checksum and Data Extent from Granule (now in Source)
2008-07-31	Added "Source Type" as a list with possible values of Data, Layout, Ancillary, Browse and Thumbnail.
2008-07-31	Added "Qualifier" as a unified list of all qualifiers. Removed "Field Qualifier", "Photon Qualifier" and "Particle Qualifier" from the dictionary. Replaced each with "Qualifier" in the ontology. Added "Qualifier" to "Support"
2008-07-31	Added "Trace" to the dictionary and to the "Qualifier" list.
2008-07-31	Added "Ion Drift" and "Dust Detector" to the dictionary and to the "Instrument Type" list.
2008-07-31	Added "Platform" to the dictionary and to the "Instrument Type" list, remove "Ephemeris" from the "Instrument Type" list.
2008-09-04	Added "Rendering Hints" with elements Format, AxisLabel, DisplayType, ScaleMin, ScaleMax, ScaleType and related enumerated values.
2008-09-04	Added "Symmetric" to the dictionary and to Qualifier.
2008-09-04	Changed "Physical Parameter" to "Parameter".
2008-09-04	Removed "Measured" and shifted containers under "Measured" up one level.
2008-09-04	Added "Velocity" to "Support Quantity".
2008-09-04	Added "Count Rate" to the dictionary and to "Particle Quantity".

1.3.2

2008-10-07	Removed "Charged Particle Flux" from Measurement Type and the dictionary.
2008-10-07	Added "Interstellar" to dictionary and Region.
2008-10-15	Changed "Format" under "Rendering Hints" to "Value Format" to eliminate name conflict with "Format".

1.3.3

2008-10-16	Added the "Association" container and "Association Type" enumeration to the dictionary. Modified the ontology to replace "Association Type" with the new "Association" container.

1.3.4

2009-01-14	Added "Wave", "Passive" and "Active" to the dictionary. Added "Wave" as an enumeration. Remove "Radio and Plasma Waves" and "Radio Soundings" from the "Measurement Type" enumeration and added "Wave" to the enumeration.
2009-01-14	Added "Linear Scale" and "Log Scale" to the dictionary. Removed "Log" from the dictionary. Modified the definition of "Linear" to remove reference scaled related usage. Updated the "Scale" enumeration with the name

	changes.
2009-01-14	Added "Language" under "Information URL".
2009-01-14	Changed the definition of "Text" and converted "Text" to an enumeration with possible encoding types.
2009-01-14	Modified "Component" to consist of "I", "J", "K". Added "Direction Angle", and "Projection" to "Qualifier". Removed "R", "Theta", "Phi", "X", "Y", and "Z". Added "Direction Angle" as an enumeration with values of "Azimuth Angle", "Polar Angle" and "Elevation Angle". Added "Projection" as an enumeration with value of "IJ", "IK", and "JK".
2009-01-22	Modified definition of "Mixed"
2009-01-22	Changed occurrence of "Particle" to one or more.
2009-01-23	Added "Ion Chamber" to dictionary and "Instrument Type" list.
2009-02-05	Added (restored) "Intensity" to dictionary and "Photon Quantity" list.
2009-02-05	Changed "Line-of-sight" to "Line Of Sight".
2009-02-05	Added "Psuedo" and "Column" to the dictionary and to "Qualifier" list.
2009-02-26	Added "Annotation" resource and "Annotation Type" and "Confidence Rating" enumerations. The terms "Anomaly", "Event", "Feature", "Probable", "Good", "High" were added to support the new enumerations.
2009-02-27	Change "Wave" to "Waves".

1.3.5

2009-03-25	Updated definitions for "Numeric" and "Text" data types.
2009-03-26	Changed "Mixed" to a container with "Qualifier" and "Mixed Quantity" as attributes. Added "Mixed Quantity" enumeration with allowed values of "Alfven Mach Number", "Other", "Plasma Beta", "Thermal Pressure", "Alfven Velocity", "Magnetosonic Mach Number", "Plasma Beta", and "Plasma Frequency-To-Gyrofrequency Ratio".
2009-03-26	Added "Access URL" to "Repository" and "Registry".
2009-03-26	Added "Image URL" to "Annotation" and dictionary
2009-03-26	Various editorial updates to definitions, spelling and typos
2009-03-26	Added "Plasmagram", "Spectrogram" and "Wave Form" to the dictionary and to the "Display Type" list.
2009-03-26	Changed the name of "Photon" to "Waves" and "PhotonQuantity" to "WaveQuantity". Added "Wave Type" with values of "Electromagnetic", "Electrostatic", "Photon", "Plasma Waves", "Hydrodynamic", and "MHD".
2009-03-26	Updated definitions of "Emissivity", "Equivalent Width", "Gyrofrequency", "Intensity", "Line Depth", "Plasma Frequency", "Poynting Flux". Added "Wave Type" with values of "Electromagnetic", "Electrostatic", "Photon", "Plasma Waves", "Hydrodynamic", and "MHD".
2009-03-26	Added "Absorption", "AC-Electric Field", "AC-Magnetic Field", "Doppler Frequency", "Frequency", "Propagation Time", and "Wavelength" to dictionary and "Wave Quantity". Added "Wave Type" with values of "Electromagnetic", "Electrostatic", "Photon", "Plasma Waves", "Hydrodynamic", and "MHD".
2009-03-26	Added "Far Ultraviolet", "HE-304", "LBH Band" and "Soft X-Rays" to dictionary and "Spectral Range".
2009-04-06	Removed "Spectral Range" from under "Energy Range".

1.3.6

2009-04-09	Added "Atom" and "Neutron" to "Particle Type".

2009-04-09	Added "Array" and "Total" to "Qualifier".
2009-04-09	Added "Particle Type" to "Mixed".
2009-04-09	Added "Unlikely" and "Weak" to the dictionary and modified "Confidence Rating" to have values "Unlikely", "Weak", "Probable", and "Strong".
2009-04-09	Added "Classification Method" as a enumeration with allowed values of "Automatic", "Inspection", and "Inferred". Added "Classification Method" to "Annotation".
2009-04-09	Added "Observation Extent" with attributes of "Observed Region", "Start Location", "Stop Location" and "Note". Added "Observation Extent" to "Annotation".
2009-04-09	Added "Child Event Of" and "Observed By" to "Association Type".
2009-04-09	Added "Area", "Bandwidth" and "Solid Angle" to "Integral", added "Field-Aligned", "Group", "Perturbation", "Phase" and "Spectral" to "Qualifier".

2.0.0

2009-04-15	Released.

2.0.1

2009-07-12	Changed "Rendering Hints" to 0-to-many occurrence.
2009-07-12	Under "Element" replaced "Component" with "Qualifier" and allow multiple occurrences.
2009-07-12	Update the description of "Index" data type to explain wild cards.
2009-07-12	Added "Sound Speed" to dictionary and to "Particle Quantity".
2009-07-12	Updates to the definition "Access URL", "Data Extent", "Polar" and "Sonic Mach Number".

2.0.2

2009-09-24	Added "Atomic Number Detected", "Mass Number" and "Charge State" to dictionary and to "Particle Quantity" enumeration. Also added "Direction Angle" to "Particle Quantity".
2009-10-08	Added "Arrival Direction" to dictionary and to "Particle Quantity" enumeration. Added "Instrument Mode" to dictionary and "Support Quantity". Updated definitions of "Charge State" and "Atomic Number Detected".
2009-11-05	Added "Stream Interaction Region" to dictionary and to "Phenomenon Type" enumeration. Updated definition of "Coronal Mass Ejection".
2009-11-18	Modified definitions for "Observatory" and "Instrument".

2.0.3

2010-02-04	Added "Former-PI" to dictionary and to "Role" enumeration; Added "Note" to "Person".
2010-03-19	Updated definitions for "Number Flux", "Energy Flux", "Differential", and "Integral"; Added "Dust" to "Measurement Type" enumeration;

2.1.0

2010-03-19	Released.

2.2.0

2010-04-15	Added "Hardcopy" as an enumeration to dictionary and to "Format"; Added "Film", "Photographic Plate", "Photograph", "Microfiche", "Microfilm", "Print" to dictionary and to "Hardcopy" enumeration; Changed "Observatory Group" to "Observatory Group ID";

	Updated definition of "Observatory" to make it more suitable for creation of conceptual Observatories.; Added "Operating Span" to dictionary with elements "Start Date", "Stop Date" and "Note"; Added "Operating Span" to "Instrument" and "Observatory".;
2010-05-21	Added "Heliosheath" to dictionary and to "Heliosphere" enumeration;
2010-06-25	Added "Fluence" to dictionary and "Particle Quantity"; Updated definitions for "Number Flux", "Coordinate System" and "Counts"; Added "HCC" (Heliocentric Cartesian), "HCR" (Heliocentric Radial), HPC (Helioprojective Cartesian) and "HPR" (Helioprojective Radial) to dictionary and "Coordinate System Name"
2010-08-17	Added "S3_BUCKET" to dictionary and "Encoding"; Add "Directional" to dictionary and to "Qualifier"; updated definition for "Energy Flux" and "Differential"
2010-08-20	Updated definitions of "Outer", "Inner", "Heliosheath" and "Remote 1AU"
2010-09-15	Added "Excel" to dictionary and to "Format" list; Added "Rendering Axis", and "Index" to dictionary and under "Rendering Hints"; Add "Vertical", "Horizontal", and "Color Bar" to dictionary and to the "Rendering Hints" enumeration; Changed cardinality of "Investigation Name" from 1 to +; Add "Median, " Maximum" and "Minimum" to dictionary and to "Qualifer" list.;
2010-09-17	Added "SSE_L" to dictionary and to "Coordinate System Name" list;
2011-01-06	Updated definition for "irradence".
2011-01-06	Released.

2.2.1

2011-05-12	Strike "product" from the definition of "Numerical Data".;
2011-06-16	Added "core", "halo", "strahl" and "superhalo" to the dictionary and to "Qualifier";
2011-08-18	Released.

2.2.2

2011-09-26	Add "Rendering Hints" under "Element"; Set occurrence for "Coordinate Representation" and "Coordinate System Name" under "Coordinate Sytem" to required (1); Set "Size" under "Structure" to required (1); Set "Association ID" and "Association Type" under "Association" to required (1).
2011-10-27	Update definition of "Document"; Add "MIME Type" to dictionary and "Document" structure; Add "Presentation", "Poster", "White Paper", "Technical Note", "Specification" and "Report" to dictionary and to "Document Type" enumeration; Remove "Paper" from dictionary.
2012-02-02	Add "Sector Boundary Crossing" to the dictionary and the "Phenomenon Type" list.; Add "Product Key" to the dictionary and under "Access Information";
2012-02-27	Add "Albedo" to the dictionary and to "Wave Quantity" list.; Add "Partical Radius" to the dictionary and to the "Particle Quantity" list;
2012-02-27	Released.

2.2.3

2012-03-15	Modified definition of "Numerical Data" as suggested by R. Weigel and D.A. Roberts; Modified definition of "Potential" as suggested by F. Mozer, D.A. Roberts and S. Fung; Add "Magnetograph" to dictionary and

	"Instrument Type" as suggested by J. King
2012-05-10	Modified definitions of "GEI", "Azimuth Angle", "Elevation Angle" and "Polar Angle" as suggested by J.Merka; Add definition for "ENP and add to "Coordinate System Name" enumeration as suggested by J. Merka; Add definitions of "Photomultiplier Tube" and "Solid State Detector" to dictionary and "Intrument Type" as suggested by B. Weigel.
2012-05-24	Add definition of "Moon" and add to "Earth" enumeration as suggested by T. Narock.
2014-05-22	Released.

2.2.4	
2015-05-28	Add coordinate systems MSO, VSO, KSO, KSM, JSO, JSM to dictionary and CoordinateSystemName, Add SolarUVFlux and IMFClockAngle to dictionary and MixedQuantity.
2015-05-31	Released.

2.2.5	
2015-06-12	Add moons and magnetosphere to planets. Only the larger moons which are typically encountered or simulated were added.
2015-06-12	Add coordinate systems to enumeration.

2.2.6	
2015-09-09	Released.

2.2.7	
2016-07-21	Change occurrence of Particle->ParticalType from + to * and Wave->WaveType from 1 to 0.
2016-07-21	Add JSON and CSV to the dictionary and to Format enumeration.

2.2.8	
2016-07-21	Release