



Accessing and Using GOLD and ICON Data Through SPDF Services

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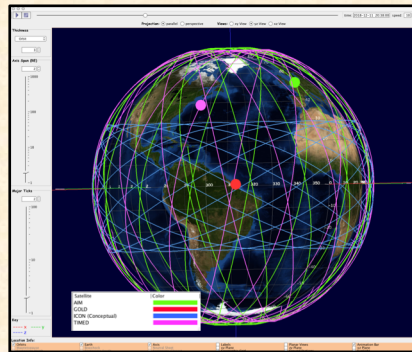
AGU 100 FALL MEETING
Washington, D.C. | 10-14 Dec 2018

Poster: SA21A-3148

First ... The Bottom Line

- The Space Physics Data Facility (SPDF), a NASA heliophysics Active Final Archive, will fully support GOLD and ICON data. This support includes existing capabilities such as
 - Direct file downloads via FTP and HTTPS
 - Orbit and ground track displays/queries via SSCWeb and 4D Orbit Viewer, with all other supported heliophysics missions
- And (working with these mission teams) structuring of their netCDF4 files and metadata to allow SPDF to extend its CDAWeb services to directly support
 - Plots and (ASCII) listings
 - Supersets-subsets by time & select variables
 - Where appropriate, time-binning of data
 - User & machine (web services) interfaces
 - Existing CDAS and SSCWeb APIs
 - Various language interfaces (including Java and Python)
 - Software interfaces for IDL and Matlab
 - New HAPI heliophysics API
- We will leverage this work to support (working with NOAA) new high-resolution GOES datasets and older missions using netCDF3 including AIM and TIMED
- SPDF services for GOLD and ICON data will complement services of the GOLD and ICON Science Data Centers (SDCs)

SSCWeb and 4-D Orbit Viewer

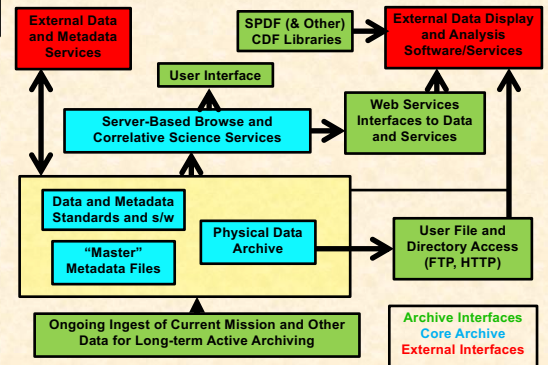


- Ongoing updates to a database of s/c orbits
- Compute radial and magnetic field line conjunctions
 - Between satellites and satellite to ground station
- Interactive graphics with rotation and zoom
 - This example geographic view as of 2018/12/11 20:38 UT

Extending CDAWeb to read netCDF4 files directly for more reliable archiving and more integrated correlative science

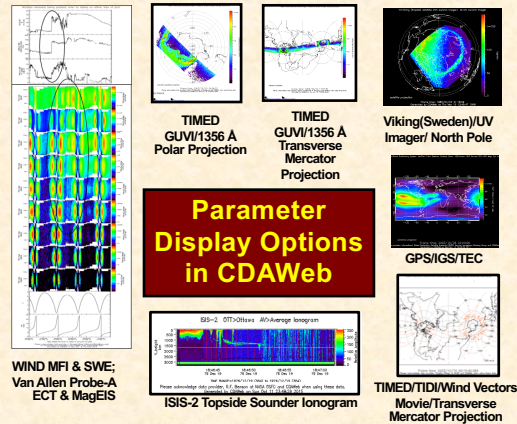
- CDF (Common Data Format)
 - Self-describing data format for storing/using scalar and multi-dimensional data in a platform- and discipline-independent fashion
 - Actual data format (block data with pointers) is transparent to the user
 - Self-documenting through use of global and variable "attributes", both to the meaning/use of data and dependencies among variables
- ISTP/ACG Guidelines (mid1990s) and subsequent extensions by SPDF define a limiting set of implementation standards for CDFs
 - Include general file naming conventions
 - Data is time-ordered and time-identified; times vary by record
 - Set of required and suggested metadata
 - Variable attributes can point to other variables by name and carry arguments
 - Attributes thus carry information about relationships among variables
 - And variables can carry metadata (e.g. labels for dimensional variables)
- Additional CDAWeb concepts: "Master" CDFs and "Virtual" Variables
 - "Master" CDF is the use of a "skeleton" CDF to insert supplemental or updated metadata for CDFs taken as a dataset (collection)
 - "Skeleton" CDF is a CDF with structure and metadata defined but no data, so it can be used as a template from which to build a data file
 - SPDF's SKTEditor Java-based tool assists users in defining ISTP/SPDF guidelines compliant skeleton CDFs
 - "Virtual" variables are computed variables, using specialized attribute conventions to link defined variables and routines within CDAWeb/CDAMiB
- CDF and netCDF come from a common heritage
 - Self-describing data formats for the storage & manipulation of scalar and multidimensional data in a platform- and discipline-independent fashion
 - Common concepts in CDF and netCDF
 - Variables generally carry data
 - Data can be scalar or multi-dimensional
 - Attributes generally carry metadata
- SPDF now has well-tested and lossless converter between CDF and netCDF
 - netCDF to CDF converter adds attributes to store version, dimensions, sizes, compression, chunking, and string (not character) information
 - CDF to netCDF converter converts time variables to binary or encoded string forms
 - netCDF4 compression requires careful block size determination
- But better approach for CDAWeb to read and serve netCDF datasets directly rather than produce/maintain/hold a second version in the archive
 - Extend read routines to load netCDF data into same internal (IDL) structure into which CDFs are loaded
 - Use the CDAWeb concept of a "master CDF" as necessary for additional metadata and add specific CDAWeb plot or other arguments
- Complexities in extending CDAWeb to read netCDF files
 - CDAWeb can only support netCDF4 so-called "classic" model
 - No groups or user-defined variable types
 - netCDF has no predefined time variable types (unlike CDF)
 - And time not always being defined as netCDF "unlimited dimension"
 - Approach: use CDAWeb master CDFs to define CDF TIME TT2000 virtual variables for netCDF datasets and add depend. 0 attribute values to time dependent variables
 - Where necessary, CDAWeb can add missing Fillval, Validmin/max, Var_type, and other attributes also using master CDFs

Standards Underpin SPDF Data, Products and Services

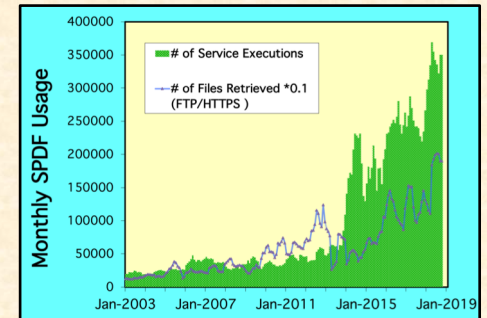


SPDF Data from ITM-Relevant Missions

- CDAWeb includes data from the following missions related to ITM science:
 - ACE, Alouette-1, -2, C/NOFS, DE-1, -2, DMSP-16, -17, -18, FAST, GPS, ISIS-1, -2, ISS, ROCSAT, SNOE, and TIMED
 - BARREL Balloons; ~170 Ground Stations
- FTP/HTTPS archive includes data from the following ITM missions:
 - ACE, AE-C, -D, -E, AEROS-A, -B, Alouette-1, -2, Ariel-1, -3, -4, CNOFS, COSMOS-1809, DE, DMSP, ESRO-4, Explorer-22, -31, -32, -33, -35, FAST, GPS, Hinotori, ISS-b, ISIS-1, -2, OGO 1-6, San Marco, SHIMMER, SNOE, and TIMED
- Future SPDF/CDAWeb missions/datasets are expected to include ICON, GOLD, and Parker Solar Probe plus new high-resolution data from GOES including GOES-16/17, other existing Geosynchronous S/C and in-situ data from Solar Orbiter



~32% of 2017 Space Physics Papers in AGU Journals Acknowledged SPDF Services and/or Data



Space Physics Data Facility (<https://spdf.gsfc.nasa.gov>)