

CDAWeb and Other SPDF Services

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Space Physics Data Facility (SPDF)

<<https://spdf.gsfc.nasa.gov>>

Heliophysics Science Division (Code 670)

NASA Goddard Space Flight Center

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Infrastructure for the Heliophysics Data Environment

- **Heliophysics Data Portal (HDP)**

- HDP is a world-wide inventory of public Heliophysics-relevant data
- SPDF also uses HDP as our high-level dataset inventory

- **CDF (Common Data Format)
and SPDF Metadata Guidelines**

- **Self-describing** data format for storing/using scalar and multi-dimensional data in a platform- and discipline-independent fashion.
- **Self-documenting** through use of global and variable “attributes”, both to the meaning/use of data and dependencies among variables
- **Associated** ISTP/SPDF structuring and metadata **guidelines** are critical to Heliophysics usability and are applicable beyond data in CDF

- **APIs to SPDF system capabilities and data**

- External software and services can leverage SPDF data/services (such as AMDA, Autoplot, IDL, Python libraries)

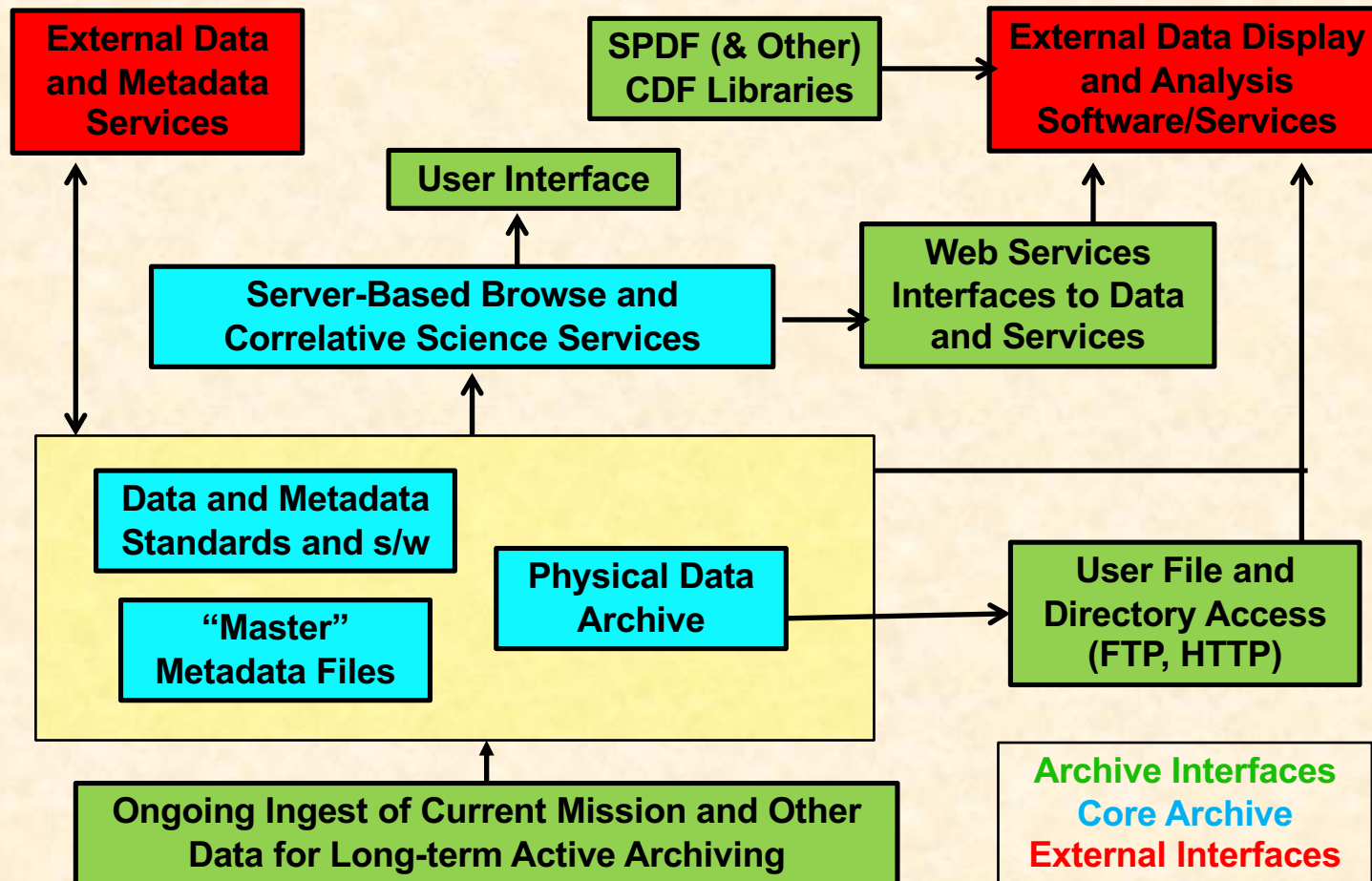
SPDF Services

- **Archive** for non-solar NASA Heliophysics science data and many other missions
- **CDAWeb** browse, correlations and display, simple interface
- **SSCWeb** orbit/ground track data/displays and conjunction queries, 4D viewer
- **OMNI Database / OMNIweb-Plus** (baseline solar wind data at Earth)
- **Heliophysics Data Portal (HDP)** SPASE-based inventory of public Heliophysics-relevant data
- **CDF** self-describing scientific data format
- **SKTeditor** for creating and testing **ISTP/SPDF Guidelines** metadata (CDF/netCDF)
- **Master** CDF/netCDF concept uses file with no data to add/over-ride metadata in datasets
- **Web services** for CDF/netCDF data in CDAWeb, SSC orbits, OMNIweb, HDP; use REST versions, many language examples
 - <https://cdaweb.sci.gsfc.nasa.gov/WebServices/REST/> (same for SSCweb)
- SPDF cited in a third of JGR Blue articles

SPDF Services

- **Multi-instrument, multi-mission Heliophysics science**
 - (1) Specific mission/instrument data in context of other missions/data
 - (2) Specific mission/instrument data as enriching context for other data
 - (3) Ancillary services & software (orbits, data standards, special products)
- **CDAWeb** (browse, correlations and display, simple interface)
 - Plot, list, subset, and download data in CDF or ASCII format
 - Primary SPDF data service for currently active mission data
 - Presents dataset view rather than individual data files
- **SSCWeb** (orbit/ground track displays and queries)
 - Plot, list orbits of multiple spacecraft in a variety of coordinate systems; query for satellite-satellite and satellite-ground station conjunction. Includes most heliospheric satellites and many ground stations.
 - **4D Orbit Viewer:** Interactive 4D animation of orbits
- **OMNI Database / OMNIweb-Plus** (baseline solar wind data at Earth)
 - Solar wind magnetic field & plasma parameters mapped to Earth's bowshock
 - Based on a large volume of quality-controlled satellite measurements (November 1963 ->) plus interface for plotting, filtering, downloading the data

Standards Underpinning SPDF Data, Products and Services



SPDF Data Access

All data files (not just CDFs and netCDFs)

- Through FTP and HTTP spdf.gsfc.nasa.gov/pub/

For data in CDFs or netCDFs with sufficient metadata:

- CDAWeb data browser for plots, lists (text, CSV, JSON), CDFs
- CDAS Web Services (REST/SOAP) cdaweb.gsfc.nasa.gov/WebServices/
- In IDL cdaweb.gsfc.nasa.gov/WebServices/REST/CdasIdlLibrary.html using CDAWlib IDL library routines spdf.gsfc.nasa.gov/CDAWlib.html
- Within Autoplot autoplot.org/help#CDAWeb
- HAPI interface to CDAWeb holdings cdaweb.gsfc.nasa.gov/hapi
 - Not all data can be sent via HAPI

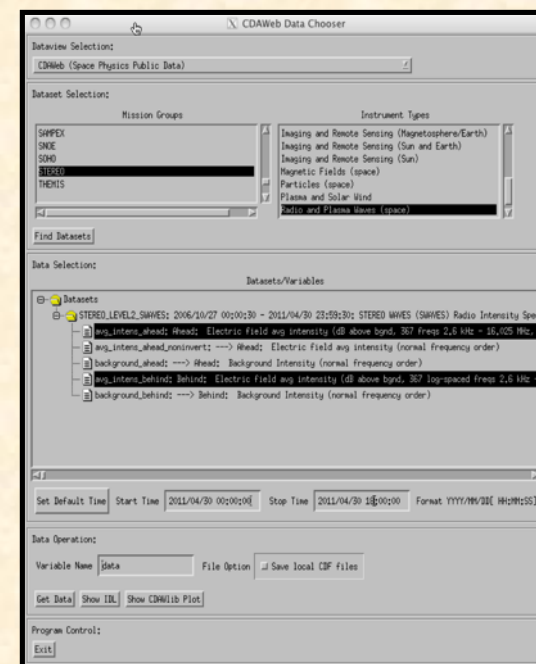
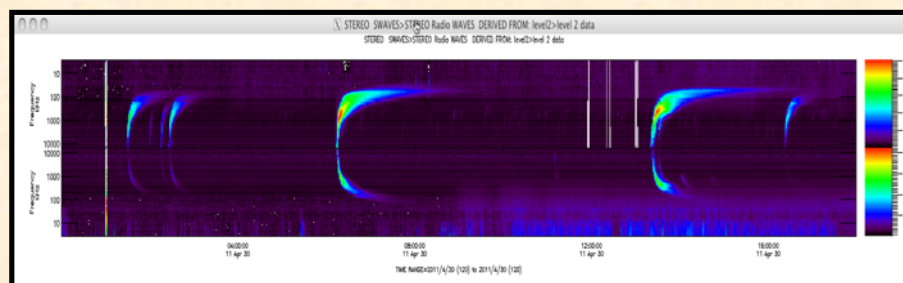
CDAS REST example (CDF fastest but other formats also)

- Get a CDF file containing the variables Magnitude and BGSEc data from the AC_H2_MFI dataset in the time range of 2009-06-01T00:00:00 to 2009-06-03T00:00:00
- https://cdaweb.gsfc.nasa.gov/WS/cdasr/1/dataviews/sp_phys/datasets/AC_H2_MFI/data/20090601T000000Z,20090603T000000Z/Magnitude,BGSEc?format=cdf

“Fill My (IDL) Array” with Data from CDAWeb

- Load specific CDAWeb data into an IDL structure using
 - @compile_cdaweb
 - spdfgetdata
- GUI to select/load/display data from CDAWeb in IDL
 - spdfcdawebchoosers

```
IDL>  
data  
= spdfgetdata('STEREO_LEVEL2_SWAVES',  
['avg_intens Ahead', 'avg_intens Behind'],  
['2011-04-30T00:00:00.000Z', '2011-04-30T18:00:00.000Z'])
```



Directly Read Data from CDAWeb into IDL

```
timename='jul_day' ;name of time variable -- Julian days  
start_time = '1998-06-10T00:00:00.0Z' ;start time  
stop_time = '1998-06-10T23:59:59.0Z' ;stop time  
dt_sec=10.0 ;sec -- bin size in seconds
```

```
dataset_id='WI_H0_MFI' ; CDAWeb dataset ID  
vars=[ 'B3F1=Bmag3', 'B3GSE=Bx3,By3,Bz3' ] ; CDAWeb variable names with locally assigned names
```

```
cdaweb_get_bin, dataset_id,vars,start_time,  
stop_time,dt_sec,time_name=timename
```

```
dataset_id='WI_PM_3DP'  
vars=[ 'P_DENS=np3', 'P_VELS=Vxp3,Vyp3,Vzp3', 'P_TEMP=Tp3', 'A_DENS=na3', $  
      'A_VELS=Vxa3,Vya3,Vza3', 'A_TEMP=Ta3']
```

```
cdaweb_get_bin, dataset_id,vars,start_time,  
stop_time,dt_sec,time_name=timename,/autobad
```

No more writing code for every dataset.
The Internet functions as a local, easy to use hard drive.
“HAPI” will generalize this to accessing “everything.”
VSO does the same for Solar Data

SPDF FTP/HTTPS Directories

Name
000_readme.htm
000_readme.txt
▶ catalogs
▼ data
000_readme.txt
▶ 1963-038C
▶ aaa_special-purpose-datasets
▶ ace
▶ ae
▶ aeros
▶ aim
▶ alouette
▶ ampte
▶ apollo
▶ arcad
▶ ariel
▶ astp
▶ ats
▶ aureol
▶ azur
▶ barrel
▶ canopus
▶ cassini
▶ cdaw9
▶ cluster
▼ cnofs
▶ cindi
▶ plp
▼ vefi
▶ bfield_1sec
▶ efield_1sec
▶ ld_500msec
▶ cosmos
...

CDAWeb Interface: Simplicity and Multiple Missions

• Select one OR more Sources (default = All unless no Instrument Types selected)

• AND Select one OR more Instrument Types (default = All unless no Sources selected)

☐ ACE

☐ ARTEMIS

☐ CNORP

☐ CRRES

☐ Cluster

☐ DMSP (selected links only)

☐ Equator-S

☐ FAST

☐ GOES

☐ GPS

☐ Genesis

☐ Geotail

☐ Helios

☐ IMAGE

☐ IMP (All)

☐ ISS

☐ Interball

☐ LANL

☐ MESSENGER

☐ NOAA

☐ OMNI (Combined 1AU IP Data; Magnetic and Solar Indices)

☐ Pioneer

☐ Polar

☐ ROCSAT-1 (FORMOSAT-1) (SPE)

☐ SAMPEX

☐ SNOE

☐ SOHO

☐ STEREO

☐ THEMIS

☐ TIMED

☐ TWINS

☐ Ulysses

☐ Voyager

☐ Wind

☐ Ground-Based Investigations

☐ Activity Indices

☐ Electric Fields (space)

☐ Engineering

☐ Ephemeris

☐ Gamma and X-Rays

☐ Imaging and Remote Sensing (ITM/Earth)

☐ Imaging and Remote Sensing (Magnetosphere/Earth)

☐ Imaging and Remote Sensing (Sun and Earth)

☐ Imaging and Remote Sensing (Space)

☐ Particles (space)

☐ Plasma and Solar Wind

☐ Radio and Plasma Waves (space)

☐ Ground Based Magnetometers

☐ Ground-Based HF-Radars

☐ Ground-Based Imagers

☐ Ground-Based Magnetometers, Riometers, Sounders

☐ Ground-Based VLF/ELF/ULF, Photometers

Submit Reset

Missions and
Instrument Types

Variables

CDAWeb Data Explorer

Select start and stop times from which to GET or PLOT data:

☐ Use pre-defined start/stop times

September 2005 Events 2005/09/07 00:00:00 2005/09/20 00:00:00

☒ Use custom start/stop times

Start: 2012/10/02 00:00:00 (YYYYMMDD HHMMSS.mmm)

Stop: 2012/10/03 00:00:00 (YYYYMMDD HHMMSS.mmm)

Select an activity:

☒ Plot Data: select one or more variables from list below and press submit.

☐ Also create PS and PDF outputs (all plot types except images and spectrograms).

Many panels per dataset are allowed but <=4 panels optimal for standard Y-axis height and single page display.

☐ List Data (ASCII): select one or more variables from list below and press submit. (Works best for <31 days)

☐ Download original CDFs: press submit button to review list of files. (Max. 200 days - use [CDF API](#) for larger requests)

☐ Create V3.4 CDFs for download or VBRIO Astropoint demonstration: select one or more variables from the list below and press submit.

☐ Create Version 2.7.2 compatible CDFs (Default is Version 3.4)

Note: CDF patch required for reading Version 3.4 CDFs in IDL or MATLAB.

Get [CDF-X](#) - IDL CDF plotting/testing toolkit software. To be used with either the daily or "crouded" CDF files available above.

Plotting Options

☐ Use coarse noise filtering to remove values outside 3 deviations from mean of all values in the plotted time interval.

☐ Double the Y-axis height for time-series and spectrogram plots.

☐ Combine all time-series and spectrogram plots, for all requested datasets, into one plot file.

Pressing the "Submit" button will spawn a new window/tab in order to support the new "Previous" and "Next" functions.

Submit Reset

Variable parameters (required for Listing, Creating and Plotting data only)

G10_L2_MAG

GOES-10 High Resolution Magnetometer data vectors (at 512 ms, uphem at 60 sec) - Howard J. Singer (NOAA Space Weather Prediction Center)

Available dates: 20070101 00:00:00 - 20081231 23:59:59

(Continuous coverage not guaranteed - check the inventory graph for coverage)

☐ Satellite geographic west longitude at noon UTC

☐ Magnetic local time at satellite position

☐ Satellite position (GSE)

☐ Satellite position (GSM)

☐ Satellite velocity (GSE)

☐ Satellite velocity (GSM)

☐ Unit vector in GSE perp to orbit plane (parallel to Earth's spin axis for 0 inclination orbit)

☐ Magnetic field in L2 ENP (P=northward Perp to orbit plane, B=Earthward perp to P and Earth center, N=normal to P and B)

☐ Magnetic field in GSE

☐ Magnetic field in GSM

☐ Total magnetic field strength

☐ T1 magnetometer filtered counts

☐ T2 magnetometer filtered counts

☐ Data quality flag (0=good)

GOES-10 L2 drift magnetometer README file [\[PDF\]](#)

GOES magnetometer data [\[PDF\]](#)

GOES general information [\[PDF\]](#)

GOES-10 L2 data magnetometer data [\[PDF\]](#)

G11_L2_MAG

GOES-11 High Resolution Magnetometer data vectors (at 512 ms, uphem at 60 sec) - Howard J. Singer (NOAA Space Weather Prediction Center)

Available dates: 20070101 00:00:00 - 20081231 23:59:59

(Continuous coverage not guaranteed - check the inventory graph for coverage)

☐ Satellite geographic west longitude at noon UTC

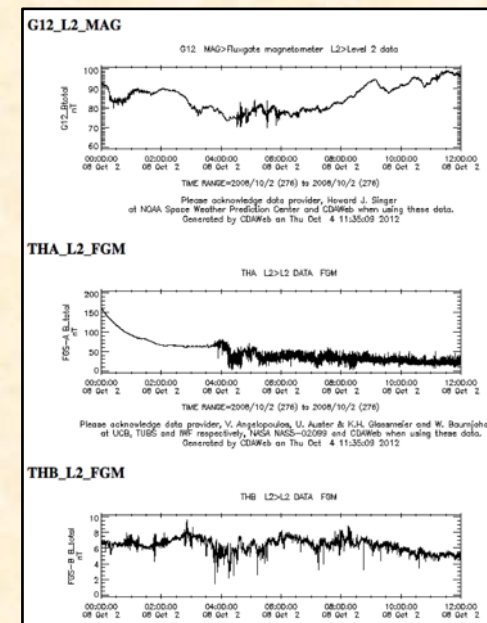
☐ Magnetic local time at satellite position

☐ Satellite position (GSE)

☐ Satellite position (GSM)

☐ Satellite velocity (GSE)

☐ Satellite velocity (GSM)



Sample Plots: also can
produce ASCII listings
and CDF downloads

CDAWeb Data Explorer

Automatically set by
the last available day
of the selected data

Options:
noise filtering,
spike removal,
overlay plotting

Select start and stop times from which to GET or PLOT data:

Start time (YYYY/MM/DD HH:MM:SS.mmm): 2019/12/16 00:00:00.000

Stop time (YYYY/MM/DD HH:MM:SS.mmm): 2019/12/17 00:00:00.000

☐ Compute uniformly spaced binned data for scalar/vector/spectrogram data (not available with noise filtering) **NEW**

Select an activity:

☒ Plot Data : select one or more variables from list below and press submit.

☐ Also create PS and PDF best quality outputs (all plot types except images and plasmagrams).
Many panels per dataset are allowed but <=4 panels optimal for standard Y-axis height and single page display.

☐ Use coarse noise filtering to remove values outside 3 deviations from mean of all values in the plotted time interval.

☒ Use spike removal to filter data without binning (not available with noise filtering)(Warning: Experimental !!).
Spike removal method: removal of extreme outliers only

☒ Increase the Y-axis height for time-series and spectrogram plots. **NEW**
multiply by: 1

☐ Combine all time-series and spectrogram plots, for all requested datasets, into one plot file.

☒ Plot overlay options. **NEW**

☒ Overlay vector components of selected variables.

☐ Overlay selected variables or variable components that are identical among the datasets chosen
(Supported constellations: MMS, Van Allen Probes (RBSP), THEMIS, Cluster, and GOES).

☐ List Data (ASCII/CSV): select one or more variables from list below and press submit. (Works best for < 31 days)

☐ Download original files : press submit button to retrieve list of files. (Max. 200 days - use [HTTPS site](https://cda.cern.ch/) for larger requests)

☐ Create V3.7 CDFs for download or Autoplot demonstration: select one or more variables from the list below and press submit.

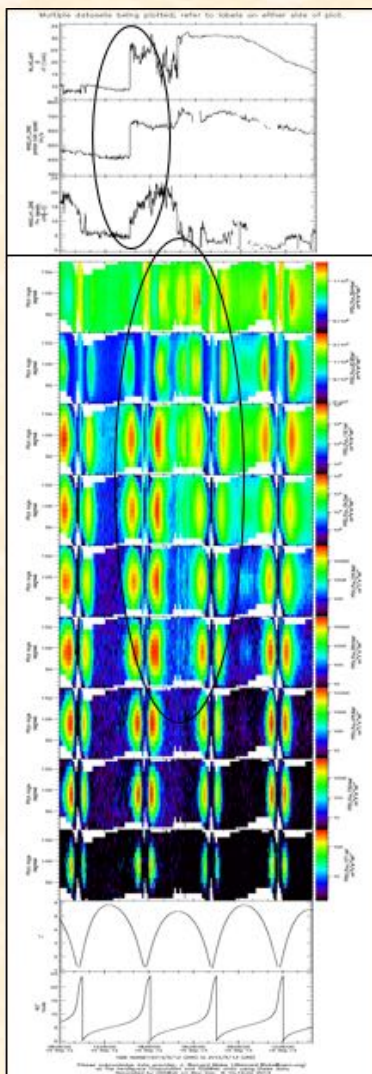
☐ Create audio files based on data from selected variables.

More information about audification is available here.

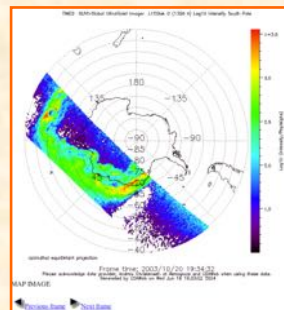
Note: [CDF patch](#) required for reading Version 3.7 CDFs in IDL or MATLAB.
Get [CDFX](#) - IDL GUI plotting/listing toolkit software. To be used with either the daily or "created" CDF files available above.

NEW Pressing the "Submit" button will spawn a new window/tab in order to support the new "Previous" and "Next" functions.

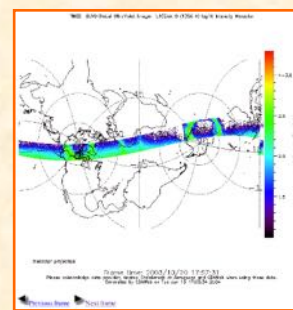
Submit Reset



**WIND MFI & SWE and Van
Allen Probe A ECT & MagEIS**

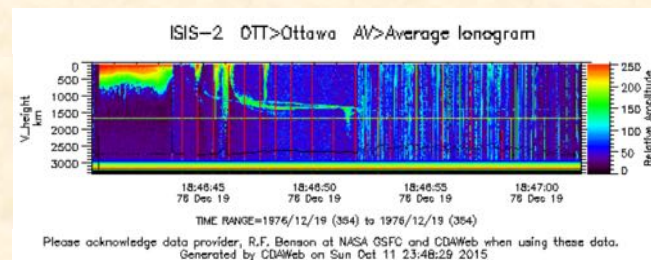


**TIMED/GUVI/1356
Å
Polar Projection**

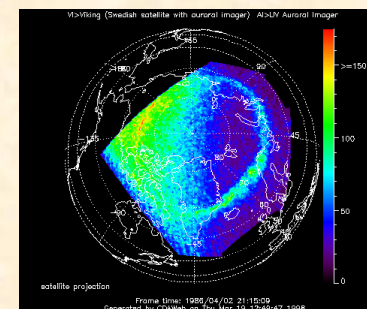


**TIMED GUVI/1356 Å
Transverse
Mercator Projection**

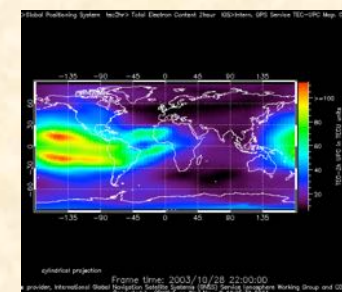
Parameter Display Options in CDAWeb



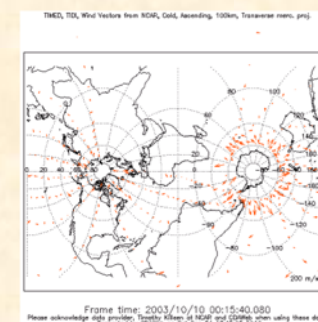
ISIS-2 Topside Sounder Ionogram



**Viking(Sweden)/UV
Imager/ North Pole**



GPS/IGS/TEC



**TIMED/TIDI/Wind Vectors
Movie/Transverse Mercator Projection**



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SSCWeb

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+ [FEEDBACK](#)

+ [LOCATOR GRAPHICS](#)

+ [4-D ORBIT VIEWER](#)

+ [LOCATOR TABULAR](#)

+ [QUERY](#)

+ [COORD. CALCULATOR](#)

+ [ABOUT SSCWEB](#)

Important Cluster Ephemeris Changes

+ [Download pdf](#)

Guides and Tutorials

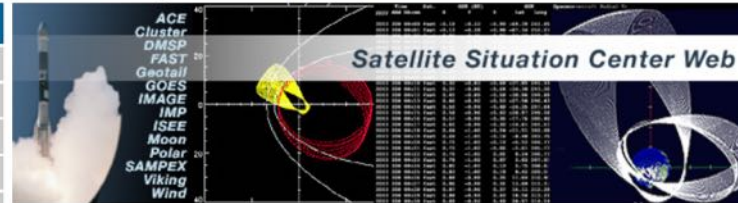
- + [Users Guide](#)
- + [Navigation Tips](#)
- + [Models and Regions of Geospace](#)
- + [Query Tutorial](#)
- + [Locator Tutorial](#)

Additional Services

- + [Web Service Access to SSCWeb](#)
- + [Heliospheric spacecraft, planet and comet trajectories](#)
- + [Space Physics models at CCMC](#)
- + [IGRF/DGRF and CGM coordinate transformations](#)
- + [Products and information](#)
- + [Data Format Translations](#)

Additional Resources

- + [Usage Statistics](#)
- + [NEW! Key parameter and orbit plots produced by the THEMIS & PWG projects](#)



SATELLITE SITUATION CENTER (SSCWeb) SYSTEM AND SERVICES

[SPDF News & Announcements](#)

MMS Definitive and Predictive data available in the system.

Graphics

+ [Locator Graphics](#)

The Locator graphics component provides the ability to plot the orbits of multiple spacecraft. In addition to orbit plots, mapped and time series plots can also be generated. [\(THEMIS Saved Examples\) NEW!](#)

+ [4-D Orbit Viewer](#)

This application provides the user with the capability to select spacecraft(s) and time ranges of interest, and see their orbits represented as an interactive 4-D animation.

Listings

+ [Locator Tabular](#)

The Locator component provides tabular information. As tabular output, the spacecraft's coordinate location can be listed in a variety of coordinate systems, as well as other location related items. [\(THEMIS Saved Examples\) NEW!](#)

+ [Query](#)

The Query component provides two query matching options: magnetospheric region occupancy and magnetic field line tracing. The region query lists the entry and exit times during which specified satellite(s) were in particular magnetospheric regions. The trace query identifies periods when one or more spacecraft are on the same magnetic flux tube of force, or periods when one or more spacecraft occupy a field line which traces down to a specified ground station. [\(THEMIS Saved Examples\) NEW!](#)

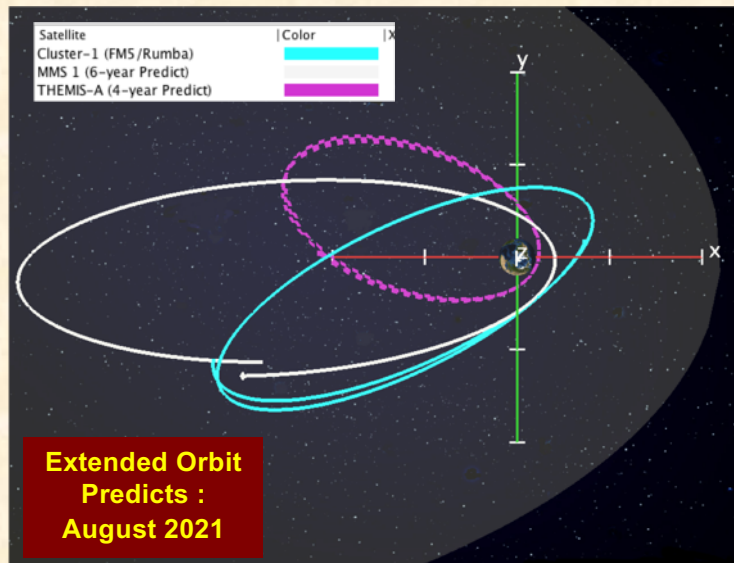
+ [Coordinate Calculator](#)

+ [USA.gov](#)
+ [Privacy Policy and Important Notices](#)



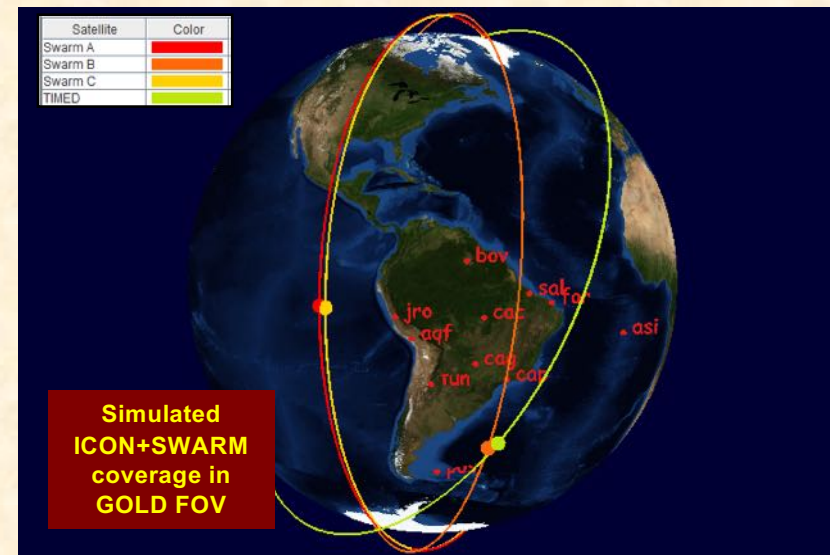
Curator: Tami Kovalick
NASA Official: Robert McGuire
(301)286-7794, Robert.E.McGuire@nasa.gov
Last Modified: 10/24/2016

SSCWeb and the 4-D Orbit Viewer



SSCweb also computes radial and magnetic field line conjunctions between satellites and satellite to ground station

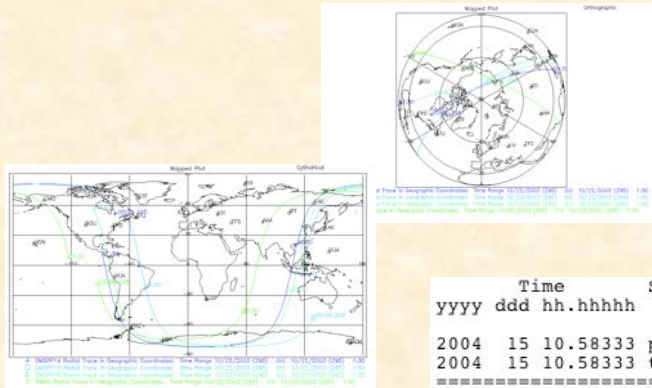
4D Orbit Viewer uses SSCWeb webservice API to access S/C database (CDF)



SSCWeb

Multi-satellite and/or satellite - ground station magnetic conjunctions

Orbit plots for TIMED and DMSP 14, 15, 16 in a Polar or Cylindrical Projection. Ground station 3-letter codes included.



Listing of times when the magnetic footprints of TIMED, DMSP 13, 14, 15 or 16 crossed the Arecibo ground station.

Time yyyy ddd hh.mmmmm	Sat.	GEO Lat Long	Radius (km)	Trace GEO Lat Long	ArcLen (km)	Ground Stations:
2003 292 0.01667	dmospf16	-32.78 304.10	7230	19.60 294.66	8199	Arecibo
2003 292 0.03333		-29.31 303.11	7230	17.01 294.61	6898	Arecibo
2003 292 0.23333	dmospf16	12.51 293.05	7229	19.05 291.77	1097	Arecibo
2003 292 0.31667	dmospf14	-32.87 297.28	7221	17.44 290.81	7650	Arecibo
2003 292 1.23333	dmospf15	-28.26 306.59	7219	17.71 296.86	6875	Arecibo
2003 292 1.41667	dmospf15	10.19 297.54	7219	17.57 295.85	1173	Arecibo
2003 292 9.41667	timed	-35.35 296.89	7004	17.40 290.50	8028	Arecibo
2003 292 9.63333	dmospf13	-28.67 306.75	7233	18.11 296.85	7045	Arecibo
2003 292 11.13333	dmospf13	12.61 291.12	7228	19.03 289.98	1084	Arecibo
2003 292 11.36667	dmospf16	-31.39 302.55	7229	18.10 293.97	7538	Arecibo
2003 292 11.66667	dmospf14	-33.90 295.55	7227	17.79 289.73	7937	Arecibo
2003 292 12.53333	dmospf15	-29.56 307.38	7221	18.82 297.08	7377	Arecibo
2003 292 14.03333	dmospf15	11.53 291.65	7221	18.18 290.46	1101	Arecibo
2003 292 22.28333	dmospf13	11.54 300.06	7217	18.76 298.24	1160	Arecibo
2003 292 23.81667	dmospf16	-29.87 306.48	7231	18.70 296.49	7409	Arecibo

Listing of times of magnetic conjunction between TIMED and Doublestar 1, or DMSP 15 or 16.

Time yyyy ddd hh.mmmmm	Satellite	GEO Lat Long	Radius (km)	Trace GEO Lat Long	ArcLen (km)	Lead Sat. Dist. Name
2004 15 10.58333	polar	13.96 76.64	38152	69.34 73.69	41635	34567 timed
2004 15 10.58333	timed	68.49 76.85	6992	69.13 77.44	539	
2004 16 0.53333	doublestar1	-28.18 165.25	38715	-58.65 151.85	34985	32959 timed
2004 16 0.53333	timed	-58.42 151.78	7003	-58.85 151.19	544	
2004 16 6.08333	dmospf15	74.37 195.14	7205	75.16 196.12	754	239 timed
2004 16 6.08333	timed	73.96 192.34	6992	74.57 192.98	539	
2004 16 22.25000	dmospf16	74.43 291.52	7215	74.79 290.13	759	239 timed
2004 16 22.25000	timed	73.81 290.53	6992	74.07 289.54	535	

- OMNIWeb Plus, Home
- + ABOUT THE DATA
- + ABOUT THE INTERFACE
- + Data from command line
- + SPDF/FTP
- + Citing OMNI data usage
- DATA via FTPBrowser
- Energetic Particle fluxes
- ATMOWeb main page
- CGM transformation

OMNIWeb Plus

SPDF • Goddard Space Flight Center

Paths to Magnetic field, Plasma, Energetic particle data relevant to heliospheric studies and resident at Goddard's Space Physics Data Facility.

- OMNI data (spacecraft-interspersed, near-Earth solar wind data)
 - Low resolution OMNIWeb (1-hour, 1 and 27 days, 1963 - current)
 - High resolution OMNIWeb (1-min, 5-min, 1981 - current)
- Spacecraft-specific data sets (near 1 AU, including near-Earth)
 - + ACE
 - + Geotail
 - + IMP-8, IMP6&7
 - + Wind
 - + Explorer 33&35, Genesis, ISEE 3, Prognoz, SOHO, GOES
 - + Moon Related Spacecraft
 - + DSCOVR
- Deep space data
 - + COHOWeb-formatted hourly solar wind field, plasma and proton fluxes
 - + Pioneer
 - + Ulysses
 - + Voyager
 - + Cassini, Helios, Mariner, STEREO
- Interfaces for comparing multi-source data
 - + Merged Magnetic field and Plasma 1-min
 - + Magnetic field
 - + Plasma
 - Energetic particle fluxes
 - + Multi-source spectra of energetic particle fluxes (MSSP)
 - + IMP8/CPME, GOES and ACE/SIS proton fluxes, 1-hour

[Heliocentric Trajectories for Selected Spacecraft, Planets, and Comets](#)

OMNIWeb Plus

- OMNI Data: Database of solar wind magnetic field and plasma parameters mapped to the nose of the Earth's bow shock
- Based on a large volume of quality-controlled satellite measurements (since Nov. 1963)
- **COHOWeb**: Solar wind field, plasma, and proton fluxes in other locations of heliosphere, especially useful for planetary studies and heliospheric model validation
- Interface for plotting, filtering, and downloading the data

<https://spdf.sci.gsfc.nasa.gov/pub/catalogs/all.xml>

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