

AGU Fall 2024
SA53A-2734

Aeronomy Data Support Through NASA Space Physics Data Facility (SPDF)

Data Archives and Services

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



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Presentations at <https://spdf.gsfc.nasa.gov/pub/documents/SPDF/presentations/>



SPDF Aeronomy/ITM Support

- Ongoing ITM-related missions with data flowing to SPDF: AWE, DMSP (SSUSI, SSJ), GOES (EPEAD, EPS), GOLD, GPS, NOAA (POES), TIMED
- Data archiving in progress: AIM, ICON, ISS/FPMU
- Recently completed missions: C/NOFS, FAST
- Data from older satellites: AE, AEROS, Alouette, Ariel, C/NOFS, DE, many Explorers, Hinotori, IMAGE, ISS-b, ISIS, Polar, OGO, San Marco, SHIMMER, SNOE
- Upcoming: EZIE (Electrojet Zeeman Imaging Explorer) (launch in 2025)
- Ground-Based: CANOPUS, DARN, THEMIS-GBO
- Balloons/Sounding Rockets: PMC Turbo, RENU, SESAME

Aeronomy/ITM Missions

Recent

AIM (Aeronomy of Ice in the Mesosphere)
AWE* (Atmospheric Waves Experiment) [Not on CDAWeb yet]
DMSP (Defense Meteorological Satellite Program)
EZIE (Electrojet Zeeman Imaging Explorer) (launch in 2025)
FAST (Fast Aurora Snapshot)
GOLD (Global-scale Observations of the Limb and Disk)
GPS (Global Positioning System)
ICON (Ionospheric CONnection)
SNOE (Student Nitric Oxide Explorer)
TIMED (Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics)

Ground-Based

CANOPUS (Canadian Auroral Network Open Program Unified Study)
DARN (Dual Auroral Radar Network)
THEMIS-GBO (Time History of Events and Macroscale Interactions during Substorms Ground-based Observatory)

Balloons/Sounding Rockets

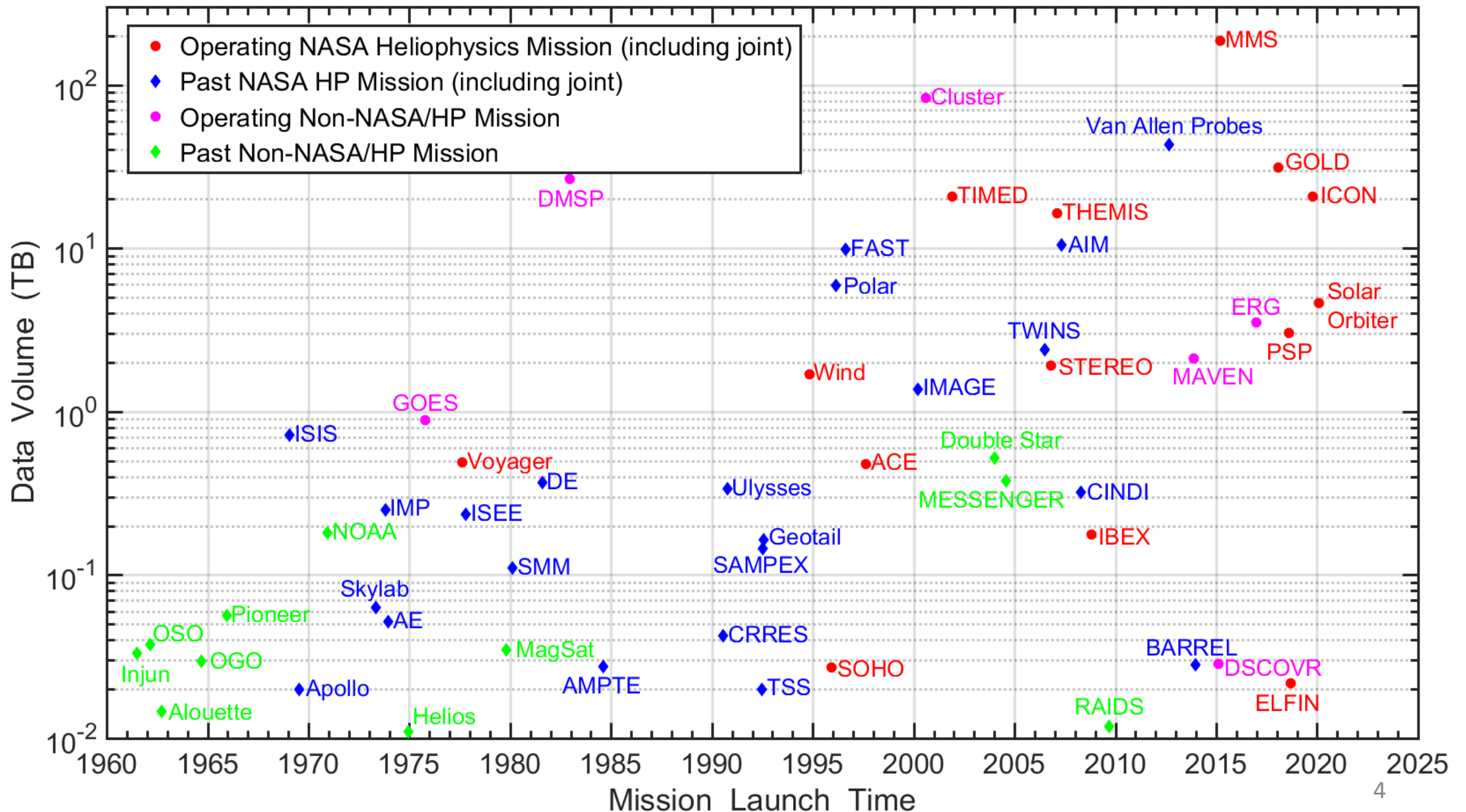
PMC Turbo (Polar Mesospheric Clouds)
RENU 2 (Rocket Experiment for Neutral Upwelling)
SESAME (Satellite Experiments Simultaneous with Antarctic Measurements)

Historical

Alouette
C/NOFS (Communications/Navigation Outage Forecasting System)
Dynamics Explorer
IMAGE (Imager for Magnetopause-to-Aurora Global Extreme)
Polar

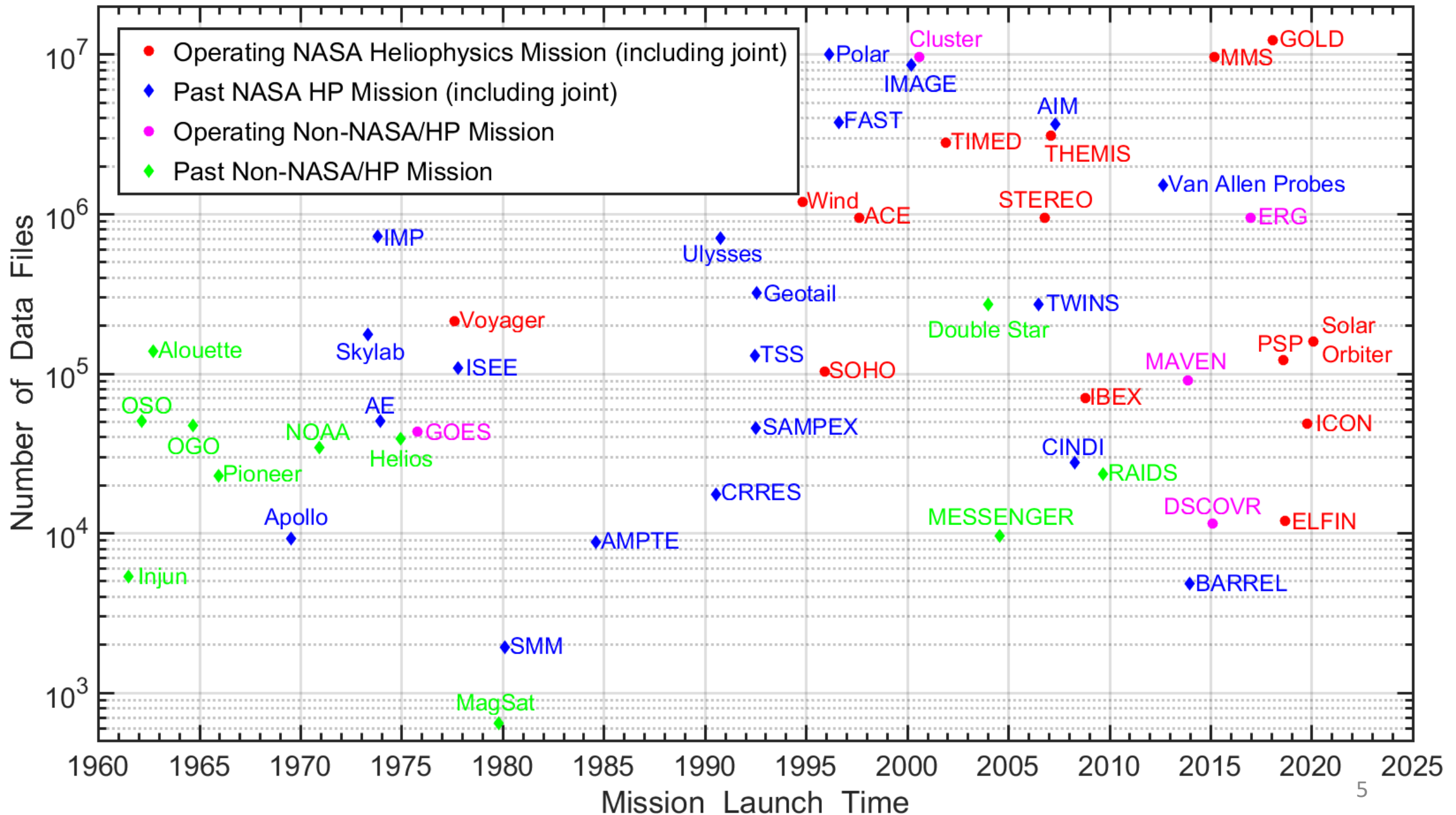
Mission Data Volume Archived at SPDF

Covering from the **Sun to the local interstellar medium** including magnetosphere – ionosphere – thermosphere – mesosphere (M-ITM) of applicable planets
~3000 CDF datasets, ~5000 non-CDF datasets, ~100M files, ~600 TB data



File Numbers of Mission Data Archived at SPDF

SPDF data holdings span 100+ missions over 65 years.
The mission never ends with SPDF.



SPDF's Science-Enabling Services

- **Coordinated Data Analysis Web (CDAWeb)**
 - Data access through web browser, API, IDL, Python
 - Interface for browsing, correlating, and displaying data (audio and movie for special cases) from 60+ missions or mission groups and multiple instruments
 - *Inventory plot and usage statistics* for mission data
- **Satellite Situation Center (SSC)**
 - Data access through web browser and API
 - 160+ missions, orbit/ground track displays and queries
 - Coordinate transformation tools
- **OMNI Web (including COHO Web)**
 - Solar wind plasma, magnetic field, and energetic particle data at the nose of Earth's bow shock and other locations of the heliosphere
 - Interface for plotting, filtering, and statistical analysis
- **Critical Infrastructures for the Heliophysics Data Environment**
 - **Common Data Format (CDF)**: self-describing science file format (cdf.gsfc.nasa.gov)
 - **International Solar-Terrestrial Physics (ISTP)** metadata standards for CDF and netCDF data including global and variable attributes
 - **Heliophysics Data Portal**: discipline-wide data inventory and access service (heliophysicsdata.gsfc.nasa.gov/)

Linking SPDF Services with Missions

https://spdf.gsfc.nasa.gov/data_orbits.html (Partial Screenshot Below)

Click an **SPDF service name** to check mark (✓) the spacecraft whose data are available.

Click a **spacecraft name** to check mark (✓) the SPDF services with its data.

See [Info for New Users](#) for more information about these data services.

160+ missions

GO =Go to Service's Home Page i =Show Source Info * = Orbit/Trajectory Data Only						
DATA SERVICES: ✓ CDAWeb GO High-resolution, current space physics data with graphics and listings from many missions. ✓ OMNIWeb Plus GO Hourly-averaged solar wind magnetic field and plasma, etc. ✓ GIFWalk GO Browse pregenerated data and orbit plots ✓ SPDF FTPS Site GO Read FTP to FTPS information. ✓ SPDF HTTPS Site GO	SOURCE SPACECRAFT: ACE i Active* i Aerocube i Aeros i AIM i Akebono* i Alouette1 i Alouette2 i AMPTE i APEX-MAIN* i Apollo i Aqua i Ariel-4 i Arase (ERG) i ARCAD i ARTEMIS i ASTRID II* i AE i Aura i Aureol2 i BARREL i BepiColombo i BioSentinel i	Explorer i FAST i FIREBIRD* i Formosat i Freja* i Galileo* i Gateway* i GCOM W1 i Genesis i Geotail i Giotto* i GOCE i GOES18 i GOES19 i GOLD i GPS i GMS 3 i GRACE* i Granat i Hawkeye i Helios i Hinode i Hinotori i IBEX i	Landsat i LANL i LRO i LUNA i Magsat i MAP i Mariner 10 i Mars i MAVEN i MESSENGER i MGS i Microlab 1 i Mir* i MMS i MRO i MSL i MSX* i Munin i Neptune i New Horizons i NOAA* i Oersted i OGO i Ohzora i	San Marco i Saturn i SCATHA* i SDO i SET-1/DSX i SMILE i SNOE i SOHO i Solar Orbiter i SORCE i Spartan-A i Spitzer i SPORT i Sputnik 1 i STEREO i Suisei i Swarm i Tatiana i THEMIS i TIMED i TRACE i TSS-1R i TWINS i UARS* i	OTHER DATA SOURCES: Planet & Comet Positions Ground-based Activity Indices	
						ORBIT/ TRAJECTORY SERVICES: ✓ SSCWeb Services GO Display and download trajectory

60+ Missions or Mission Groups

Coordinated Data Analysis Web (CDAWeb)

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

- **Special data source groups:** balloons, ground-based investigations, cubesats, sounding rockets, etc.
- **Enable Systems Science:** cross-mission, multi-instrument science
- Present dataset view rather than individual data files
- 70% of datasets in CDAWeb have SPASE records; 57% have DOIs

• **Select zero OR more Sources**
(default = All Sources if >=1 Instrument Type is selected)

Balloons
 Geosynchronous Investigations
 Ground-Based Investigations
 Helio Ephemeris
 OMNI (Combined 1AU IP Data; Magnetic and Solar Indices)
 Smallsats/Cubesats
 Sounding Rockets

 ACE
 AIM
 AMPTE
 ARTEMIS
 Alouette
 Apollo
 Arase (ERG)
 CNOFS
 CRRES
 Cassini
 Cluster
 DMSP
 DSCOVR
 Dynamics Explorer
 Equator-S
 FAST
 Formosat

• **Select zero OR more Instrument Types**
(default = All Instrument Types if >=1 Source is selected)

 Activity Indices
 Electric Fields (space)
 Electron Precipitation Bremsstrahlung
 Energetic Particle Detector
 Engineering
 Ephemeris/Attitude/Ancillary
 Gamma and X-Rays
 Ground-Based HF-Radars
 Ground-Based Imagers
 Ground-Based Magnetometers, Riometers, Sounders
 Ground-Based VLF/ELF/ULF, Photometers
 Housekeeping
 Imaging and Remote Sensing (ITM/Earth)
 Imaging and Remote Sensing (Magnetosphere/Earth)
 Imaging and Remote Sensing (Sun)
 Magnetic Fields (Balloon)
 Magnetic Fields (space)
 Particles (space)
 Plasma and Solar Wind
 Pressure gauge (space)
 Radio and Plasma Waves (space)
 Spacecraft Potential Control
 ... Imaging Spectrograph (Space)

- AEROCUBE-6-B_DOSIMETER_L2:** Aerocube 6/Dosimeter Level 2 - J. B. Blake (The Aerospace Corporation)
[Available Time Range: 2014/06/21 14:49:56 - 2017/06/30 15:24:08] [Info](#) [Metadata](#)
- CSSWE_REPTILE_6SEC-COUNTS-L1:** CSSWE REPTile level1 6sec Counts and Position - Xinlin Li (University of Colorado at Boulder)
[Available Time Range: 2012/09/14 00:28:03 - 2014/08/20 20:27:56] [Info](#) [Metadata](#)
- CSSWE_REPTILE_6SEC-FLUX-L2:** CSSWE REPTile level2 6sec flux and Position - Xinlin Li (University of Colorado at Boulder)
[Available Time Range: 2012/09/14 00:28:03 - 2014/08/20 20:27:56] [Info](#) [Metadata](#)
- ELA_L1_STATE_PRED:** ELFIN-A state file, contains predictive position, velocity, and attitude - V. Angelopoulos (UCLA, IGPP/EPSS)
[Available Time Range: 2018/09/17 00:00:00 - 2022/09/17 23:59:59] [Info](#) [Metadata](#)

CDAWeb Data Explorer

- Time interval is automatically set by the last available day of the selected dataset(s)
- Remove spikes or filter coarse noise
- **Plot data availability**
- Adjust X and Y lengths for plotting
- **Auto scale time axis for finding discrete bursts or events**
- Overlay vector components of selected variables, or selected variables that are identical among multiple datasets
- Output a subset or a superset of datasets in CDF, ASCII/CSV, JSON
- Create **audio** and **movie** files for selected variables

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

Start time (YYYY/MM/DD HH:MM:SS.mmm):

Stop time (YYYY/MM/DD HH:MM:SS.mmm):

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

Use spike removal to filter data without binning (not available with noise filtering)(Warning: Experimental !!).

Select an activity:

Data Availability Chart : Generate a chart showing when data is available for the selected data set(s) and time range (Select > 1day).

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.

Change the X-axis width for time-series and spectrogram PNG plots (NEW default=3). **NEW**

Change the Y-axis height for time-series and spectrogram plots (NEW default=2). **NEW**

Autoscale time axis (useful for finding discrete bursts/events). **NEW**

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

Plot overlay options.

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)

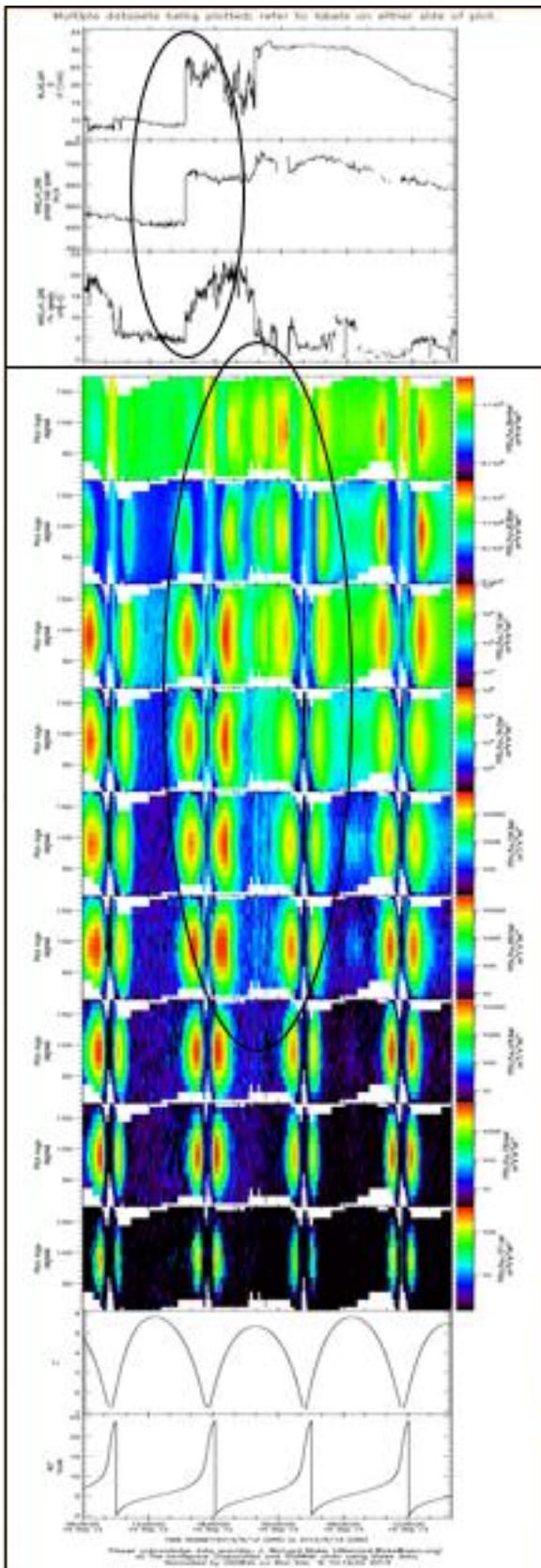
Download original files : press submit button to retrieve list of files. (Max. 200 days - use [HTTPS site](#) for larger requests)

Create V3.9 CDFs for download: select one or more variables from the list below and press submit. **NEW**

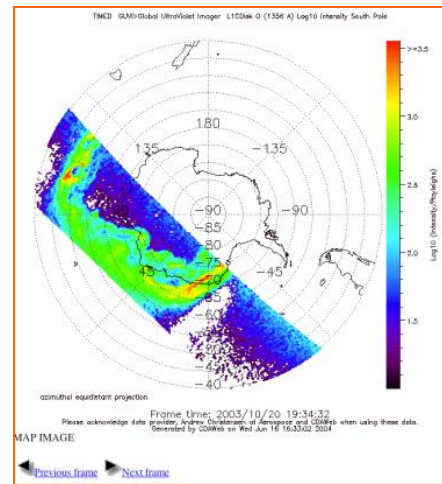
Create audio files based on data from selected variables. [More information about audification.](#)

Note: [CDF patch](#) required for reading Version 3.9 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.

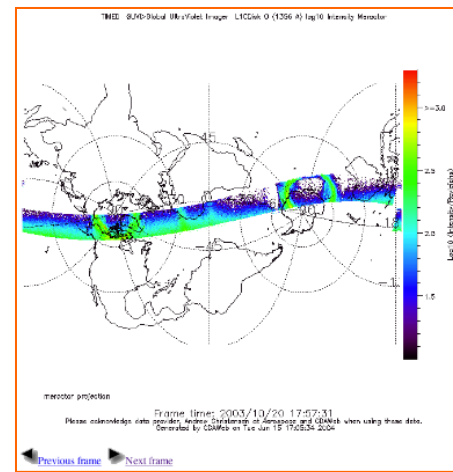
Pressing the "Submit" button will spawn a new window/tab in order to support the new "Previous" and "Next" functions.



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

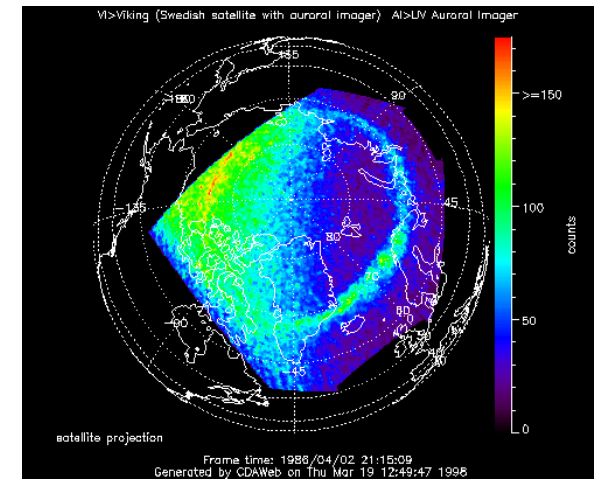


TIMED/GUVI/1356 Å Polar Projection

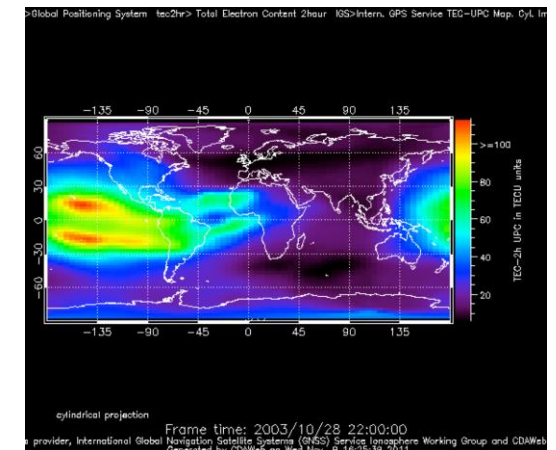


TIMED GUVI/1356 Å Transverse Mercator Projection

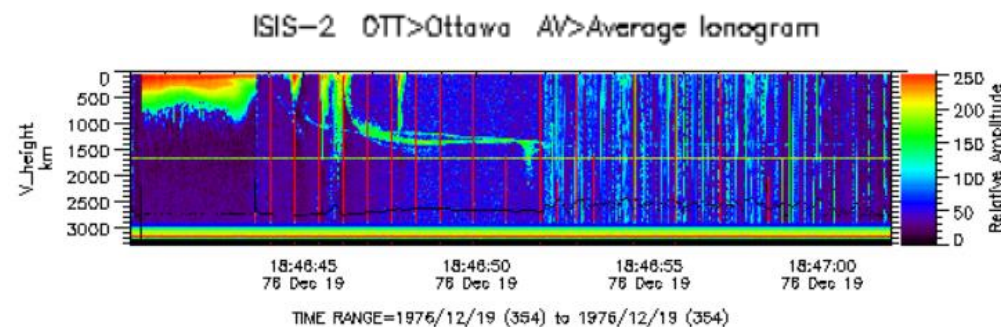
Example Parameter Displays in CDAWeb



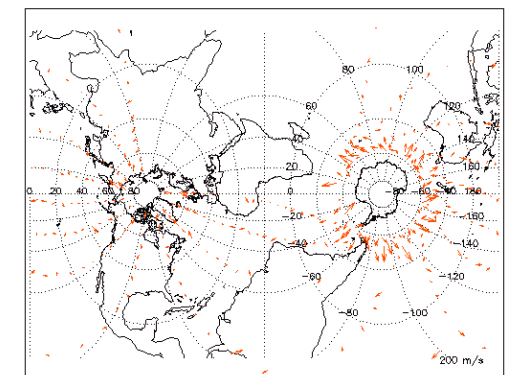
Viking(Sweden)/UV Imager/ North Pole



GPS International GNSS Service Total Electron Content



ISIS-2 Topside Sounder Ionogram



TIMED/TIDI/Wind Vectors Movie/Transverse Mercator Projection



Get Dataset Information

The following code demonstrates how to get information about a dataset.

```
In [3]: #print(dataset)
datasets = cdas.get_datasets(idPattern=dataset)
ds_info = datasets[0]
#print(ds_info)
print(ds_info['Id'], ':', ds_info['Label'])
ds_time_interval = ds_info['TimeInterval']
print('Time range:', ds_time_interval['Start'], 'to',
      ds_time_interval['End'])
print('Principle Investigator:', ds_info['PiName'], ':',
      ds_info['PiAffiliation'])
print('Notes:', ds_info['Notes'])
if 'Doi' in ds_info and ds_info['Doi']:
    print('DOI:', ds_info['Doi'])
    print('DOI landing page:',
          cdas.get_doi_landing_page_url(ds_info['Doi']))
```

Jupyter notebook calling
CDAWeb web services

```
AEROCUBE-6-B_DOSIMETER_L2 : Aerocube 6/Dosimeter Level 2 - J. B. Blake (The Aerospace Corporation)
Time range: 2014-06-21T14:49:56.000Z to 2017-06-30T15:24:08.000Z
Principle Investigator: J. B. Blake : The Aerospace Corporation
Notes: https://cdaweb.gsfc.nasa.gov/misc/NotesA.html#AEROCUBE-6-B\_DOSIMETER\_L2
DOI: 10.48322/49dd-na02
DOI landing page: https://doi.org/10.48322/49dd-na02
```

Get An Example Time Interval

The following code gets a small example time interval.

```
In [4]: example_interval = cdas.get_example_time_interval(dataset)
print('Example time interval:', example_interval)
```

```
Example time interval: 2017-06-30T13:24:08+00:00 2017-06-30T15:24:08+00:00
```

Get Dataset Variable Names

The following code demonstrates how to get a dataset's variable names.

```
In [5]: var_names = cdas.get_variable_names(dataset)
print('Variable names:', var_names)
```

```
Variable names: ['alt', 'lat', 'lon', 'XYZ_GEO', 'dos1l', 'dos1m', 'dos1rate', 'dos2l', 'dos2m', 'dos2rate', 'dos3l', 'dos3m', 'dos3rate', 'flag', 'Sample_Rate', 'Lm_IGRF', 'Bmag_IGRF', 'MLT_IGRF', 'InvLat_IGRF', 'Lm_OPQ', 'Bmag_OPQ', 'MLT_OPQ', 'InvLat_OPQ', 'Loss_Cone_Type', 'Rxyz_GEO', 'Rmag', 'IT', 'K1', 'K2', 'K3', 'Ustar', 'Ustar_Z', 'Umin', 'Umax']
```


Each supported dataset also provides links to IDL and Python code examples for downloading and working with the data files independently (outside of the CDASWeb system)

CDAS Web Service Client Code Examples

The following web service client code examples demonstrates how to access data from the [AEROCUBE-6-B DOSIMETER L2](#) dataset from particular programming environments.

Jupyter Notebook on Binder

The following link launches a Python Jupyter Notebook that demonstrates using the `cdasws` library to access [AEROCUBE-6-B DOSIMETER L2](#) data in a Jupyter Notebook. It is merely an example and does not show all the capabilities of the library. You should edit the code to suit your needs.

 [launch binder](#)

cdasws Python Library

The following code demonstrates using the `cdasws` library to access [AEROCUBE-6-B DOSIMETER L2](#) data in Python. You should edit the code to suit your needs.

```
# Install these prerequisites once before executing the example
# Option 1.
#   Install CDF from https://cdf.gsfc.nasa.gov/
#   pip install -U spacepy
#   pip install -U cdasws
# Option 2.
#   pip install -U xarray
#   pip install -U cdflib
#   pip install -U cdasws

from cdasws import CdasWs
cdas = CdasWs()

# Edit the following vars, time variables, and printing to
environment
# (spacepy or cdflib) and needs.
vars =
['alt', 'lat', 'lon', 'XYZ_GEO', 'dos11', 'dos1m', 'dos1rate', 'dos21', 'dos2m', 'dos2rate', 'dos31', 'dos3m', 'dos3rate', 'flag', 'Sample_Rate', 'Lm_IGRF', 'Bmag_IGRF', 'MLT_IGRF', 'InvLat_IGRF', 'Lm_OPQ', 'Bmag_OPQ', 'MLT_OPQ', 'InvLat_OPQ', 'Loss_Cone_Type', 'Bxyz_GEO', 'Beq', 'I', 'K', 'K_Z', 'Lstar', 'Lstar_Z', 'Hmin', 'Hmin_Z', 'Loss_Cone_Near', 'Loss_Cone_Far', 'B100N', 'LAT100N', 'LON100N', 'B100S', 'LAT100S', 'LON100S', 'Alpha', 'Alpha_X', 'Alpha_Y', 'Alpha_Eq', 'Beta', 'Beta_X', 'Beta_Y', 'Phi_B', 'OmegaXYZ_GEO', 'B_spin', 'Spin_Sun', 'Dist_In_Track', 'Lag_In_Track', 'Dist_Cross_Track_Horiz', 'Dist_Cross_Track_Vert', 'Dist_Total', 'alt_10Hz', 'lat_10Hz', 'lon_10Hz', 'dos11_10Hz', 'dos1m_10Hz', 'dos1rate_10Hz', 'dos21_10Hz', 'dos2m_10Hz', 'dos2rate_10Hz', 'dos31_10Hz', 'dos3m_10Hz', 'dos3rate_10Hz', 'flag_10Hz', 'Subcom_10Hz', 'Lm_OPQ_10Hz', 'Bmag_OPQ_10Hz', 'MLT_OPQ_10Hz', 'InvLat_OPQ_10Hz', 'Loss_Cone_Type_10Hz', 'K_Z_10Hz', 'Lstar_Z_10Hz', 'Hmin_Z_10Hz', 'Alpha_10Hz', 'Beta_10Hz', 'Dist_In_Track_10Hz', 'Lag_In_Trac
```

cdasws IDL Library

The following code demonstrates using the `cdasws` library to access [AEROCUBE-6-B DOSIMETER L2](#) data in IDL. It is merely an example and does not show all the capabilities of the library. You should edit the code to suit your needs.

```
compile_opt idl2
savfilename = filepath('spdfcdas.sav', /tmp)
oUrl = obj_new('IDLnetUrl')
; For IDL installations with old root certificates
oUrl->setProperty, SSL_VERIFY_PEER=0
savfilename = oUrl->get(filename=savfilename,
url='https://cdaweb.gsfc.nasa.gov/WebServices/REST/spdfcdas.sav')
restore, savfilename

; Edit the following vars and time variables to suit your needs.
vars =
['alt', 'lat', 'lon', 'XYZ_GEO', 'dos11', 'dos1m', 'dos1rate', 'dos21', 'dos2m', 'dos2rate', 'dos31', 'dos3m', 'dos3rate', 'flag', 'Sample_Rate', 'Lm_IGRF', 'Bmag_IGRF', 'MLT_IGRF', 'InvLat_IGRF', 'Lm_OPQ', 'Bmag_OPQ', 'MLT_OPQ', 'InvLat_OPQ', 'Loss_Cone_Type', 'Bxyz_GEO', 'Beq', 'I', 'K', 'K_Z', 'Lstar', 'Lstar_Z', 'Hmin', 'Hmin_Z', 'Loss_Cone_Near', 'Loss_Cone_Far', 'B100N', 'LAT100N', 'LON100N', 'B100S', 'LAT100S', 'LON100S', 'Alpha', 'Alpha_X', 'Alpha_Y', 'Alpha_Eq', 'Beta', 'Beta_X', 'Beta_Y', 'Phi_B', 'OmegaXYZ_GEO', 'B_spin', 'Spin_Sun', 'Dist_In_Track', 'Lag_In_Track', 'Dist_Cross_Track_Horiz', 'Dist_Cross_Track_Vert', 'Dist_Total', 'alt_10Hz', 'lat_10Hz', 'lon_10Hz', 'dos11_10Hz', 'dos1m_10Hz', 'dos1rate_10Hz', 'dos21_10Hz', 'dos2m_10Hz', 'dos2rate_10Hz', 'dos31_10Hz', 'dos3m_10Hz', 'dos3rate_10Hz', 'flag_10Hz', 'Subcom_10Hz', 'Lm_OPQ_10Hz', 'Bmag_OPQ_10Hz', 'MLT_OPQ_10Hz', 'InvLat_OPQ_10Hz', 'Loss_Cone_Type_10Hz', 'K_Z_10Hz', 'Lstar_Z_10Hz', 'Hmin_Z_10Hz', 'Alpha_10Hz', 'Beta_10Hz', 'Dist_In_Track_10Hz', 'Lag_In_Trac
```

[Copy code to clipboard](#) [Download code](#)

More information about using this library is available from the following:

- IDL library description [cdasws](#)
- Jupyter IDL [notebook example](#)
- Application Programming Interface description [API](#)

Alternative data access methods

https://cdaweb.gsfc.nasa.gov/alternative_access_methods.html

4-D Orbit Viewer (160+ Spacecraft)

<https://sscweb.gsfc.nasa.gov/4dorbit/>

Select coordinates

Coordinates centered at the Earth, Moon, Sun, Mercury, Venus, Mars, Lagrange Point 1

Earth

Cluster-1 (FM5/Rumba)

Cluster-2 (FM6/Salsa)

DMSP-18

Earth

GOLD

MMS 2

4D Orbit Viewer

NASA

SPDF

bow shock

magnetopause

Switch to perspective camera

Spacecraft	X	Y	Z
Cluster-1 (FM5/Rumba)	-2.22	-6.29	8.38
Cluster-2 (FM6/Salsa)	-1.42	-5.68	7.71
DMSP-18	0.45	0.15	1.03
GOLD	6.22	0.51	-2.19
MMS 2	7.23	-26.13	-9.18

spacecraft positions in Earth Radii (Re) in GSE coordinates

Start Loop Speed: 1 x

2024 May 09 00:00:00

2024 May 09 15:36:52

2024 May 16 00:00:00

Spacecraft Situation Center (SSC) Conjunction Query

Spacecraft/Time Range Selection

[Spacecraft Availability & Time Ranges](#)

Satellites	Time Range
<ul style="list-style-type: none"> ACE Active AE-C AE-D AE-E AEROCUBE-6A AEROCUBE-6B AIM Akebono Alouette1 Alouette2 APEX-MAIN Aqua Arase (ERG) ARIEL-4 ARTEMIS_P1 ARTEMIS_P1 (6-year Predict) ARTEMIS_P2 ARTEMIS_P2 (6-year Predict) ASTRID II 	<p>Valid Date/Time Formats:</p> <p>Date yyyy ddd yyyy/mm/dd yyyy-mmm-dd</p> <p>Time (Optional) hh.hhhh hh:mm:ss hh:mm</p> <p>Start Time (inclusive) <input type="text" value="2023 200"/></p> <p>Stop Time (inclusive) <input type="text" value="2023 202"/></p> <p>Query Conjunction Condition Type</p> <p><input checked="" type="radio"/> Ground Station <input type="radio"/> Lead Satellite <input type="radio"/> Region</p>

Satellite Combination

All satellites At least satellite(s)

Example Using THEMIS Mission

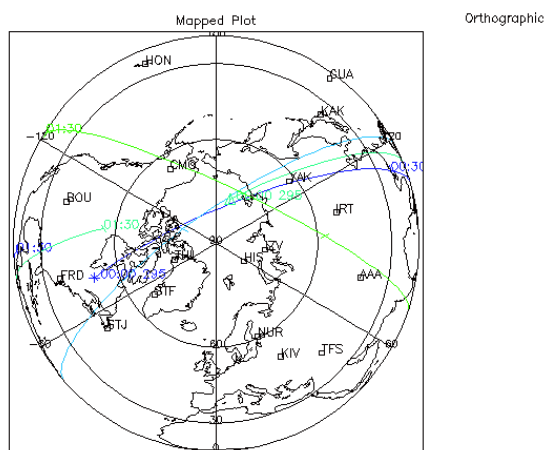
https://sscweb.gsfc.nasa.gov/examples/THEMIS_queries

- [themis_conjunction2](#) Magnetic conjunction of THEMIS-5 (lead satellite) with at least 3 other THEMIS
- [themis_fast2](#) Magnetic conjunction of at least 2 THEMIS satellites with FAST (lead satellite)
- [themis_goes11a](#) Magnetic conjunction of at least two satellites (THEMIS 1-5, GOES 13) with GOES 11
- [themis_goes13a](#) Magnetic conjunction of at least two satellites (THEMIS 1-5, GOES 11) with GOES 13
- [themis_ground_stations1](#) Magnetic conjunction of at least 2 THEMIS satellites with one of 4 THEMIS ground stations during 2008 doy=1-5

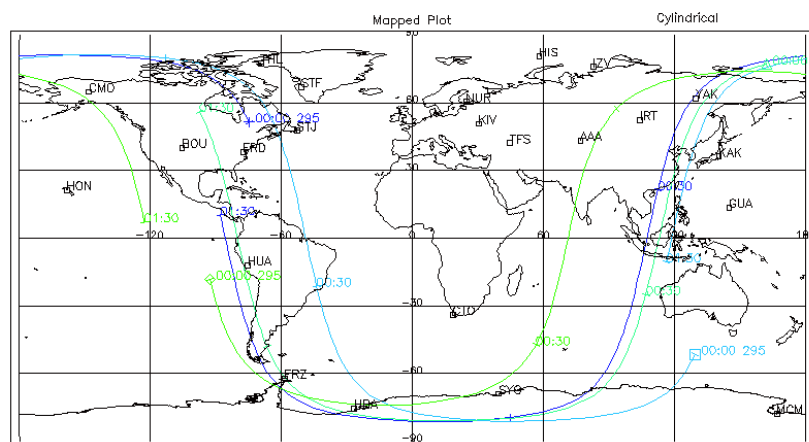
SSCWeb

Multi-satellite or satellite to 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.



+ DMSPF14 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 □ DMSPF15 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 △ DMSPF16 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 ◇ TIMED Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30



+ DMSPF14 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 □ DMSPF15 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 △ DMSPF16 Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30
 ◇ TIMED Radial Trace in Geographic Coordinates: Time Range 10/22/2003 (295) 0:0 10/22/2003 (295) 1:30

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

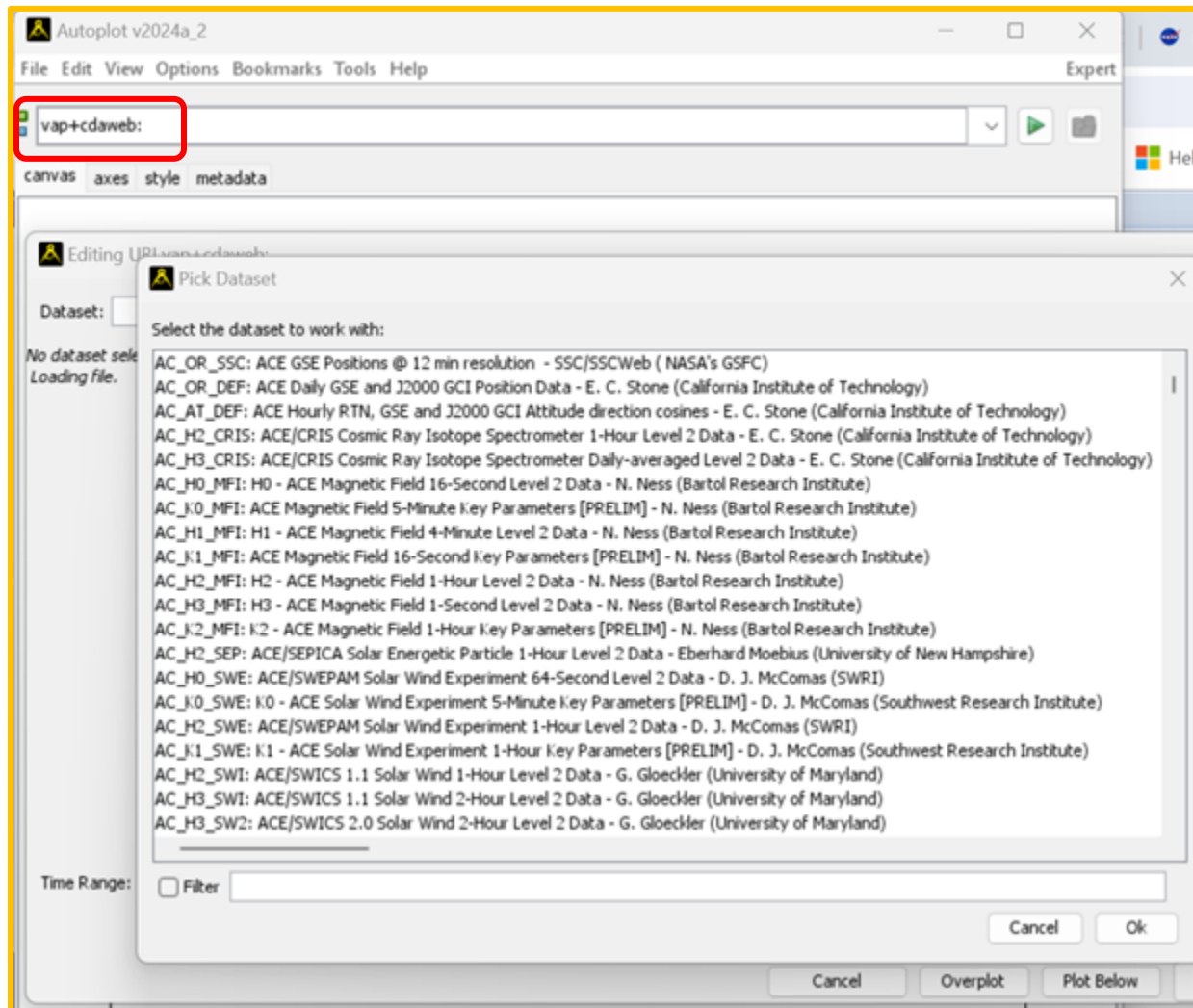
Time		Sat.	GEO		Radius (km)	Trace GEO		ArcLen (km)	Ground Stations:
yyyy	ddd hh.hhhhh		Lat	Long		Lat	Long		
2003	292 0.01667	dmspf16	-32.78	304.10	7230	19.60	294.66	8199	Arecibo
2003	292 0.03333		-29.31	303.11	7230	17.01	294.61	6898	Arecibo
2003	292 0.23333	dmspf16	12.51	293.05	7229	19.05	291.77	1097	Arecibo
2003	292 0.31667	dmspf14	-32.87	297.28	7221	17.44	290.81	7650	Arecibo
2003	292 1.23333	dmspf15	-28.26	306.59	7219	17.71	296.86	6875	Arecibo
2003	292 1.41667	dmspf15	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	dmspf13	-28.67	306.75	7233	18.11	296.85	7045	Arecibo
2003	292 11.13333	dmspf13	12.61	291.12	7228	19.03	289.98	1084	Arecibo
2003	292 11.36667	dmspf16	-31.39	302.55	7229	18.10	293.97	7538	Arecibo
2003	292 11.66667	dmspf14	-33.90	295.55	7227	17.79	289.73	7937	Arecibo
2003	292 12.53333	dmspf15	-29.56	307.38	7221	18.82	297.08	7377	Arecibo
2003	292 14.03333	dmspf15	11.53	291.65	7221	18.18	290.46	1101	Arecibo
2003	292 22.28333	dmspf13	11.54	300.06	7217	18.76	298.24	1160	Arecibo
2003	292 23.81667	dmspf16	-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.

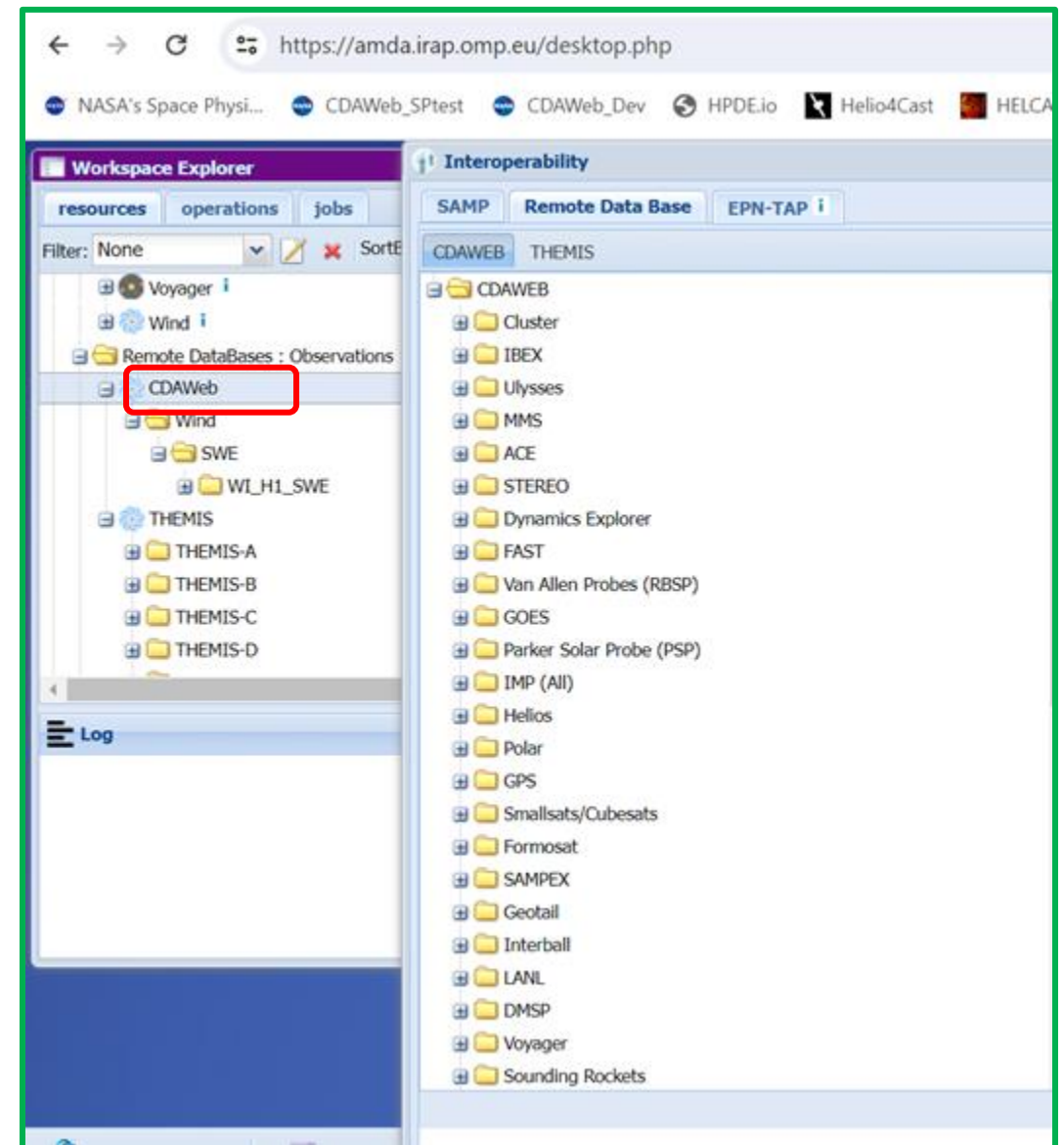
Time		Satellite	GEO		Radius (km)	Trace GEO		ArcLen (km)	Lead Sat.	
yyyy	ddd hh.hhhhh		Lat	Long		Lat	Long		Dist.	Name
2004	15 10.58333	polar	13.96	76.64	38152	69.34	73.69	41635	34567	timed
2004	15 10.58333	timed	68.49	76.85	6992	69.13	77.44	539		
2004	16 0.53333	doublestar1	-28.18	165.25	38715	-58.65	151.85	34985	32959	timed
2004	16 0.53333	timed	-58.42	151.78	7003	-58.85	151.19	544		
2004	16 6.08333	dmspf15	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	dmspf16	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		

CDAWeb Datasets Are Available at HelioCloud, Autoplot, AMDA, etc.

Autoplot



Automated Multi-Dataset Analysis (AMDA)



OMNIweb

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

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, yearly, 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

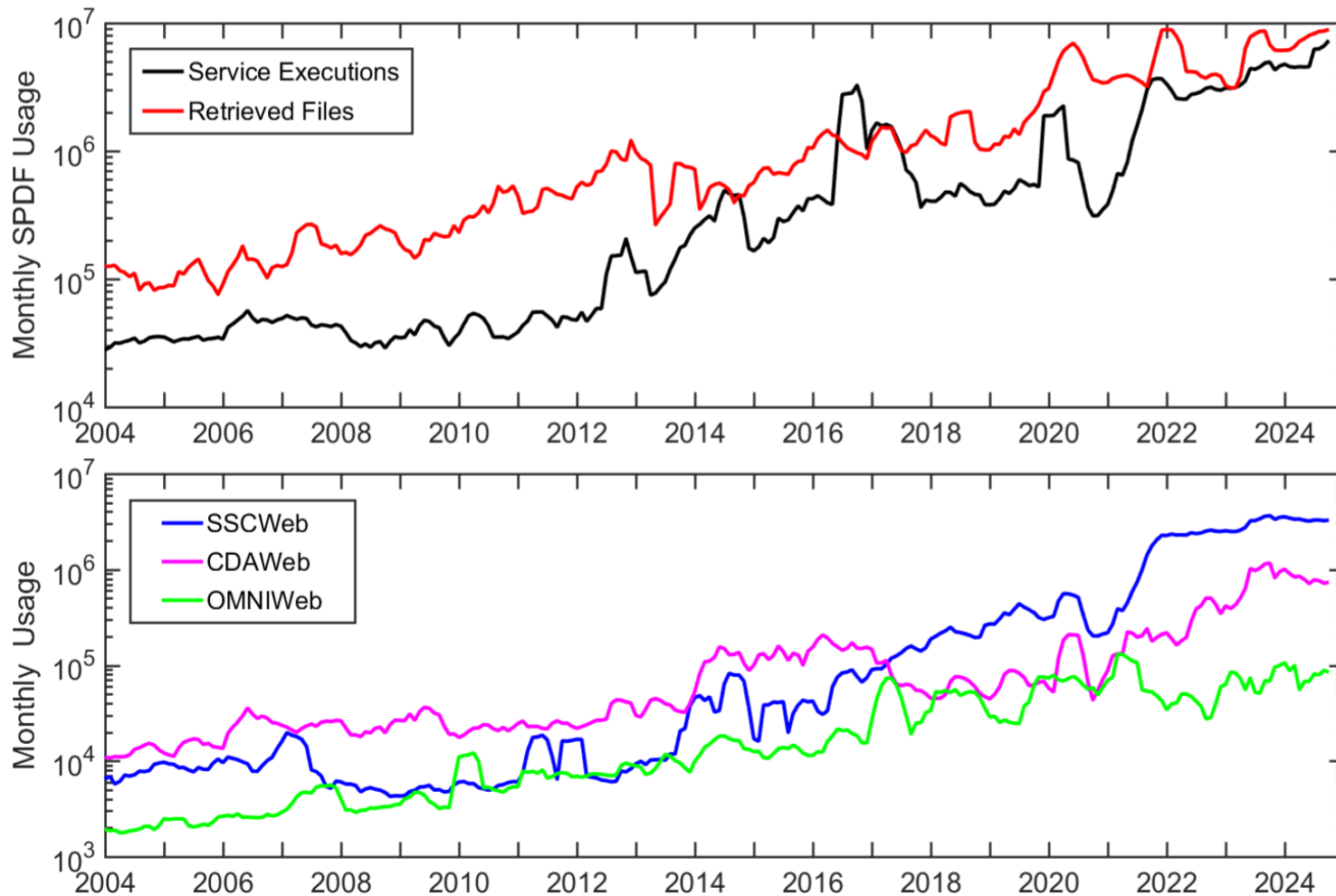
[Heliocentric Trajectories for Selected Spacecraft, Planets, and Comets](#)

- 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 energetic particle fluxes in other locations of the heliosphere, especially useful for planetary studies and heliospheric model validation
- Interface for plotting, filtering, and downloading the data

SPDF Provides Multiple Services and Access Methods

- Direct file downloads via FTPS and HTTPS <https://spdf.gsfc.nasa.gov/pub/data/>
- Orbit and ground track displays/queries via SSCWeb and 4D Orbit Viewer
- CDAWeb services:
 - Data files, plots and listings with supersets or subsets by time & selected variables, time-binning
 - Web service interfaces (REST, SOAP, IDL, Matlab, Java, Python)
<https://cdaweb.gsfc.nasa.gov/WebServices/>
 - HAPI (Heliophysics API) <https://cdaweb.gsfc.nasa.gov/hapi>
 - Autoplot autoplot.org/help#CDAWeb
 - Other methods such as IDL
https://cdaweb.gsfc.nasa.gov/alternative_access_methods.html
- The **SPASE** (Space Physics Archive Search and Extract <http://www.spase-group.org/>) team use the master CDFs to generate SPASE IDs and descriptions for all datasets, to add entries to the **Heliophysics Data Portal** <https://heliophysicsdata.gsfc.nasa.gov> and mint DOIs for each dataset

Summary



About 50% of *JGR-Space Physics* and *Space Weather* papers in 2023 acknowledged SPDF services and data

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

- SPDF archives and serves observational space physics data to promote correlative and collaborative research across discipline and mission boundaries
- SPDF provides three main science-enabling services: CDAWeb, SSCweb, and OMNIweb
- CDAWeb database (quality-controlled, ~3000 datasets) is also widely used outside of SPDF (e.g., Autoplot, HelioCloud, AMDA)
- SPDF has regularly meetings with NSF and NOAA to coordinate the data archiving and service
- The mission never ends with SPDF

Abstract

The non-solar NASA Heliophysics archive, the Space Physics Data Facility (SPDF <https://spdf.gsfc.nasa.gov>), works with current operating missions and the heliophysics community to ingest, preserve and serve a wide range of science-quality data from the mesosphere into the furthest reach of deep-space exploration. In particular, SPDF archives data from many aeronomy missions, such as GOLD, ICON, AIM, and TIMED, with data access via multiple web services. SPDF provides CDAWeb data browsing system, SSCweb orbit services and the 4D Orbit Viewer, OMNIweb, Plot Walk for pre-generated plots, and the Common Data Format (CDF) self-describing science format. Recent updates include newly revised web sites, new browser-based 4-D orbit viewer, improved user interfaces, and a revised pre-generated plot browsing tool.