Heliophysics information architecture: contribution from ESDC

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ESA Heliophysics group
15 March 2022

Outline

1. Information architecture in a nutshell
2. International Heliophysics Data Environment Alliance (IHDEA)
3. COSPAR International Space Weather Action Teams (ISWAT)
4. Python for the Heliophysics Community (PyHC) consortium
5. Heliophysics Archives User Group (HAUS)

Information architecture is about Science

- Data format standards
- Metadata standards for describing observational and simulation data
- Metadata registries
- DOI
- Data access protocols
- Coordination of the development of open source data analysis software

- To ease data distribution and data analysis
- To enable data-simulation comparision
- To find distributed datasets through metadata
- For data citation, discovery and access
- To ease data distribution
- To grow data usage

IVOA – International Virtual Observatory Alliance

20 years ago, In the field of astronomy, the international virtual observatory alliance (IVOA) was setup and led to a number of advances in data model, metadata registry, data access layer, applications…

It is still highly active with

21 international members worldwide

www.ivoa.net

IPDA – International Planetary Data Alliance

In the planetary domain, the IPDA adopts standards in particular to ensure planetary data is captured in common formats (PDS4, PDS3).

Created in 2006, it is now composed of 12 space agencies https://planetarydata.org

Armenian Astronomical Society Հայերեն աստղագիտական Հասարակություն	Japan Aerospace Exploration Agency 国立研究開発法人宇宙航空研究開発機構
China National Space Administration 国家航天局	National Aeronautics and Space Administration NASA
European Space Agency ESA	National Centre for Space Studies Centre national d'études spatiales
German Aerospace Center Deutsches Zentrum für Luft- und Raumfahrt e.V.	Russian Space Research Institute Институт Космических Исследований
Indian Space Research Organisation भारतीय अंतरिक्ष अनुसंधान संगठन	United Arab Emirates Space Agency وكالةالإمارات للفضاء
Italian Space Agency Agenzia Spaziale Italiana	UK Space Agency UKSA

The main IPDA goals are

- Support construction of compatible archives.
- Support sharing of tools and software services.
- Facilitate global access to, and exchange of, high quality scientific data products managed across international boundaries.

What about Heliophysics?

In the field of heliophysics, international coordination for a common data format (CDF) mostly for plasma *in situ* data dates back to the 1980’s.

A set of compulsory metadata was defined under the International Solar Terrestrial Programme (ISTP)

All CDF files at the NASA Space Physics Data Facility (SPDF) are meant to be ISTP compliant. But apart from this data format and metadata standard, there was no organization to coordinate efforts in the heliophysics data environment. No platform to discuss evolution of this and other standards.

International Heliophysics Data Environment Alliance (IHDEA)

(Events Leading up to the IHDEA)

• 2017: a number of experts were invited at the UN/US International Space Weather Initiative Workshop, Boston College, in a special session on heliophysics data environment organised by S. Fung, NASA

• 2018: First international heliophysics data environment meeting was held at ESAC, with members from ESA, JAXA, CNES, Obs. Paris, Nagoya University and NASA inc. Space Physics Data Facility+SDAC+CCMC; main organizer: A. Masson

International Heliophysics Data Environment Alliance (IHDEA)

IHDEA

- 2019: IHDEA officially created, during a meeting near NASA GSFC
- 2020: setup of WGs, virtually hosted by Obs. Paris
- 2021: annual IHDEA meeting, GNSS experts invited, virtually hosted by ESA, 27 Sep.- 01 Oct.

https://ihdea.net

IHDEA

Goal and objectives

The goal of the IHDEA is to encourage the use of common standards and services to boost data sharing and enhance science.

Main goals are to
o Active involvement of international heliophysics and space weather data providers
o Develop Standards-based data systems with uniform and well-defined terminology
o Coordinated, user-friendly data access and analysis tools to serve diverse communities
o Adequate documentation of data products and sources
o Flexible, interoperable (ex. HAPI), and interconnected data archives, modeling centers, and virtual observatories
o Effective communication among national and international partners, data providers, data tool developers, and data users

- **The role of IHDEA is to engage the community, foster communication, and to identify the standards and services which will best serve the science needs.**

(courtesy of S. Fung)

IHDEA

Who are we?

Researchers, simulators, information technology experts, developers and data engineers dedicated to advancing heliophysics* and improving the heliophysics data environment.

• We are from many different organizations, representing the international heliophysics community.

* IHDEA Charter specifies that “the term heliophysics encompasses all studies of our Sun and its interactions with Solar System objects and beyond, their consequences for and feedback from those objects, including space weather and space climate.”

(courtesy of S. Fung)

IHDEA

How Are We Organized?

The IHDEA is governed by its Charter and Bylaws, established along with the formation of IHDEA in December 2019.

- Membership is open to all organizations and individuals who are involved in activities related to the heliophysics domain as defined in the Charter.
- Anyone may request and be granted membership by agreeing to both the IHDEA Charter and these Bylaws (join by going to https://ihdea.net/)
- The IHDEA is governed by an Executive Committee (EC)

SOCCI Confluence Spaces Glossaries

International Heliophysics Data Environment Alliance

Pages

Blog

PAGE TREE

- Meetings
- IHDEA Working Groups
  - Community Awareness
  - Community Metadata
  - Coordinate Systems Standardisation
  - DOI for Science
  - Data Access Layer
  - SPASE Information Model
  - Python Adoption
  - Standard for Computing Job Management
- Heliophysics Protocols and Standards

Pages / IHDEA Working area

IHDEA Working Groups

Created by Beatriz Martinez, last modified by Arnaud Masson on 12 Jan, 2022

- Community Awareness
- Community Metadata
- Coordinate Systems Standardisation
- DOI for Science
- Data Access Layer
- SPASE Information Model
- Python Adoption
- Standard for Computing Job Management

Steps for becoming a WG contributor

1. Self-register as IHDEA member: IHDEA registration
2. Wait confirmation via email from Arnaud Masson or Beatriz Martinez
3. Login into this Confluence space
   Enjoy working!!

If you have any issue with the registration, please contact:

- Beatriz Martinez - Beatriz.Martinez@esa.int
- Arnaud Masson - Arnaud.Masson@esa.int

https://issues.cosmos.esa.int/socciwiki/display/IHDEA/IHDEA+Working+Groups

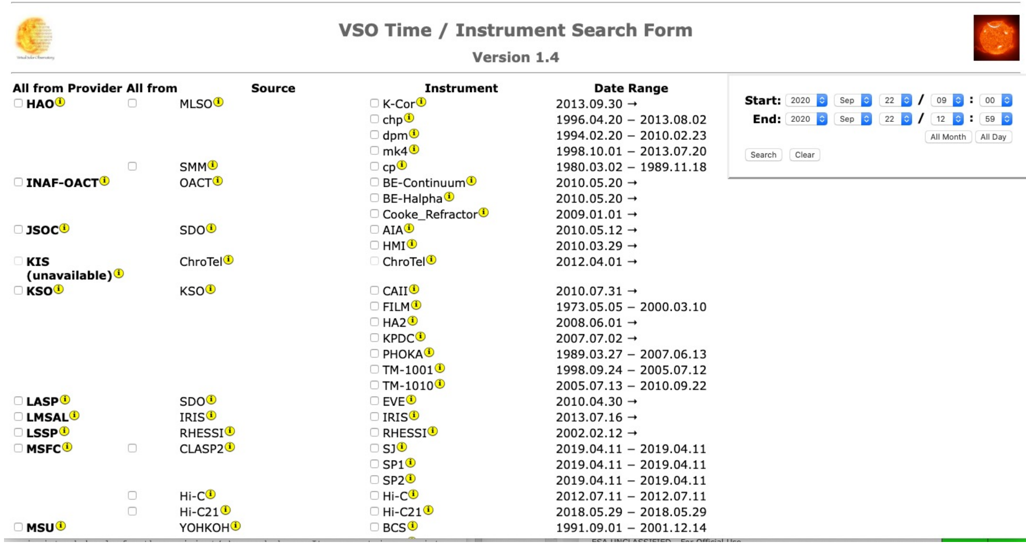
IHDEA

Some outcome of IHDEA activites

ESA SPARTA: SPace dAta foRmat TrAnslator
converts Cluster Exchange Format to CDF ISTP
converts some PDS3 products from Rosetta to CDF ISTP (IES, LAP, MAG, MIP)
Agreed by ESA Software Licensing Board to be released publicly

ESA archives accessible (soon) through VSO

- On-going activity within the VSO to request data through our Table Access Protocol servers (thanks to J.Ireland/E. Mansky)
- Proba-2 LYRA/DSLP data will be first
- Once done, Solar Orbiter should be straightforward



VSO Time / Instrument Search Form

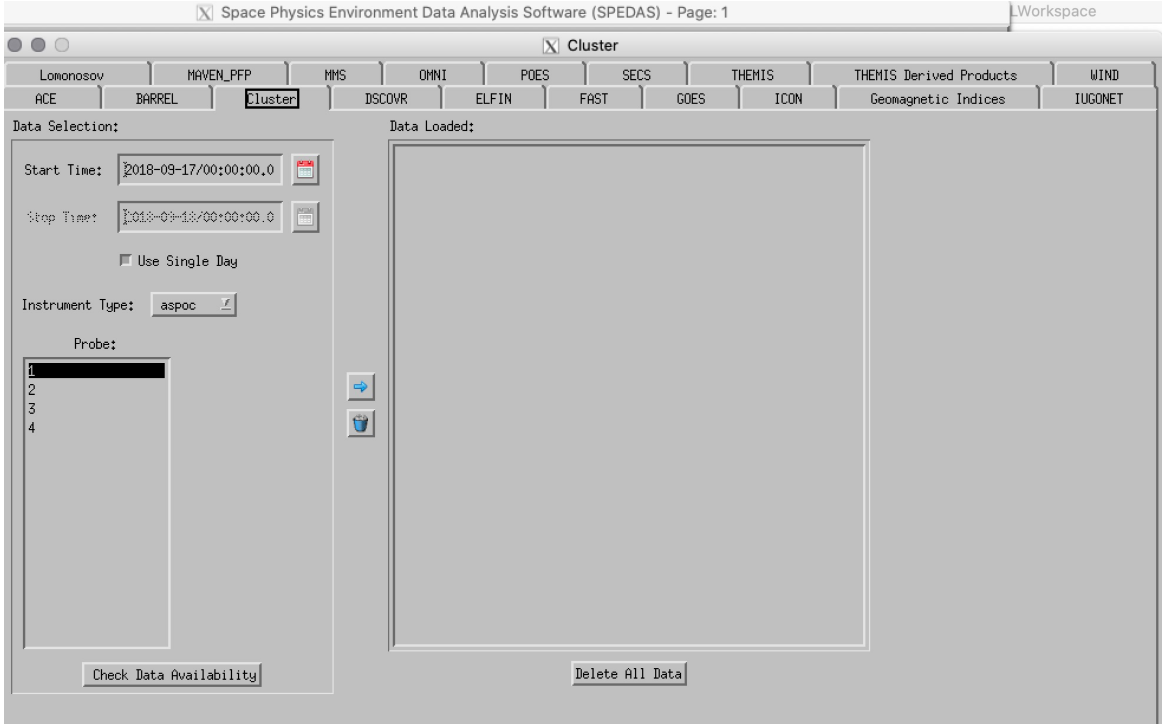
Version 1.4

All from Provider	All from	Source	Instrument	Date Range
HAO		MLSO	K-Cor	2013.09.30 →
			chp	1996.04.20 – 2013.08.02
			dpm	1994.02.20 – 2010.02.23
			mk4	1998.10.01 – 2013.07.20
		SMM	cp	1980.03.02 – 1989.11.18
INAF-OACT		OACT	BE-Continuum	2010.05.20 →
			BE-Halpha	2010.05.20 →
			Cooke_Refractor	2009.01.01 →
JSOC		SDO	AIA	2010.05.12 →
			HMI	2010.03.29 →
KIS (unavailable)		ChroTel	ChroTel	2012.04.01 →
KSO		KSO	CAII	2010.07.31 →
			FILM	1973.05.05 – 2000.03.10
			HA2	2008.06.01 →
			KPDC	2007.07.02 →
			PHOKA	1989.03.27 – 2007.06.13
			TM-1001	1998.09.24 – 2005.07.12
			TM-1010	2005.07.13 – 2010.09.22
LASP		SDO	EVE	2010.04.30 →
LMSAL		IRIS	IRIS	2013.07.16 →
LSSP		RHESSI	RHESSI	2002.02.12 →
MSFC		CLASP2	SJ	2019.04.11 – 2019.04.11
			SP1	2019.04.11 – 2019.04.11
			SP2	2019.04.11 – 2019.04.11
		Hi-C	Hi-C	2012.07.11 – 2012.07.11
		Hi-C21	Hi-C21	2018.05.29 – 2018.05.29
MSU		YOHKOH	BCS	1991.09.01 – 2001.12.14

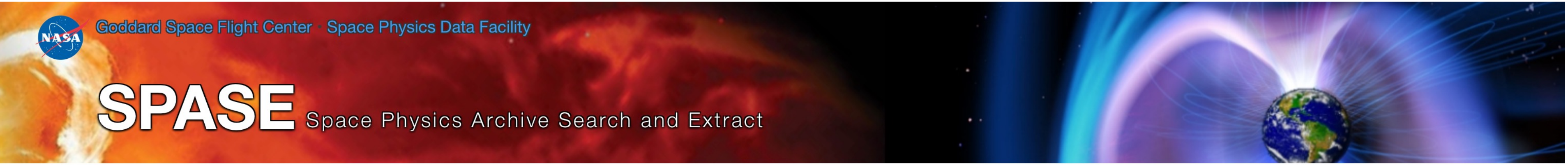
Start: 2020 Sep 22 / 09 : 00
End: 2020 Sep 22 / 12 : 59
All Month All Day
Search Clear

Cluster Science Archive (CSA) accessible through SPEDAS

- Cluster data now accessible in SPEDAS.
- Cluster is accessible through TAP as well



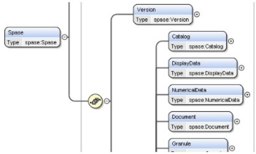
SPASE and HAPI are recommended metadata registry and API by COSPAR for heliophysics data and archives
https://www.spase-group.org/



HOME DATA MODEL DOCUMENTS TOOLS SCHOOL SERVICES ABOUT

Announcements

2021-08-12: A drag-and-drop viewer for SPASE descriptions is released.
2021-06-10: Version 2.4.0 of the SPASE Base model is released.



Data Model

Get details of the SPASE Data Model, which provides terms and syntax for uniform descriptions of Heliophysics resources, including Observatories, Instruments, People, Reposit and (most centrally) Numerical Data products, An extended set of terms deals with simulations and models. A Dictionary of the terms is provided, along with the XML schema documents used to validate SPASE descriptions.

Documents

Specifications for event lists (and catalogues) and endorsed conventions for text markup, resource ID formation, and guidelines with dealing with plain text data within SPASE descriptions.

BepiColombo/JUICE request → Evolution of the SPASE model

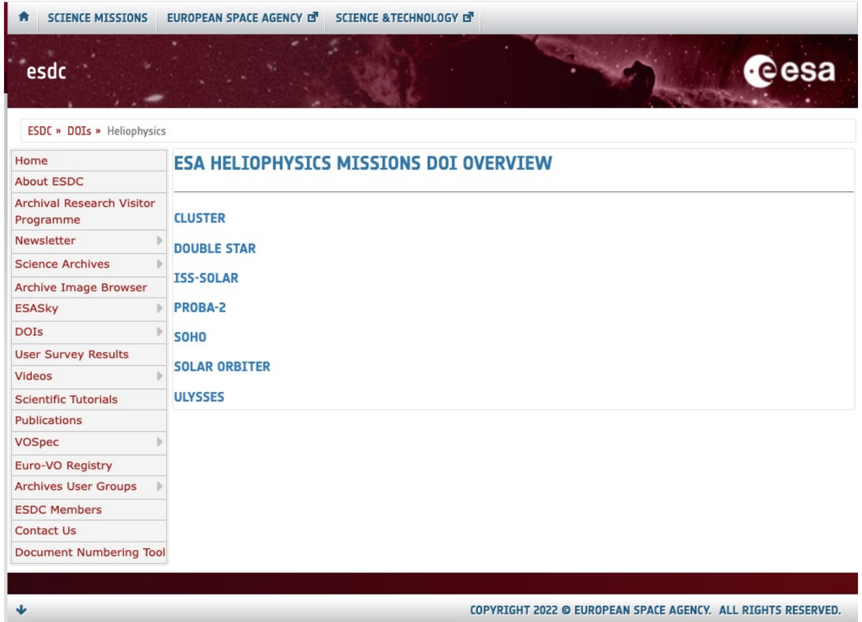
- PDS4 bundle requires SPASE ID
- What about TM and HK products? sensor Temp.
- Now with SPASE 2.3.2 those can be distinguished from Science products as support quantity
- PDS3 and PDS4 "formats" added
- Mission Manager (ESA) role added

Version: 2.3.2

Updated	Description	Notes
2020-09-10	• Add Housekeeping, Telemetry, RotationMatrix, EncodedParameter, AutoSpectrum, Coherence, ImaginaryPart, RealPart, PowerSpectralDensity, ChargeFlux, DynamicPressure, EnergyPerCharge, ParticleRigidity, MassPerCharge, LShell, MissionPrincipalInvestigator, ProgramManager, ProgramScientist, VolumeEmissionRate, SPICE, MissionManager to dictionary and to appropriate enumerations as suggested by L. Bargatze • Add PDS4 and PDS3 to dictionary and to FOrmat enumeration as suggest by A. Masson.	Decided during the telecon on 2020-08-06.
2020-09-30	• Add InstrumentGroupID and Experiment to dictionary • Add InstrumentGroupID to Instrument and Experiment to InstrumentType.	Decided during the telecon on 2020-09-24.
2020-10-08	• Add InstrumentLead to dictionary and to Role.	Decided during the telecon on 2020-10-08.
2020-10-15	• Released.	Decided during the telecon on 2020-10-15.

DOI

cosmos.esa.int/web/esdc/doi/heliophysics



25,000 DOI minted for ESA datasets,
for heliophysics experiments
Coordination with NASA SPASE for datasets

A dataset provided by the European Space Agency

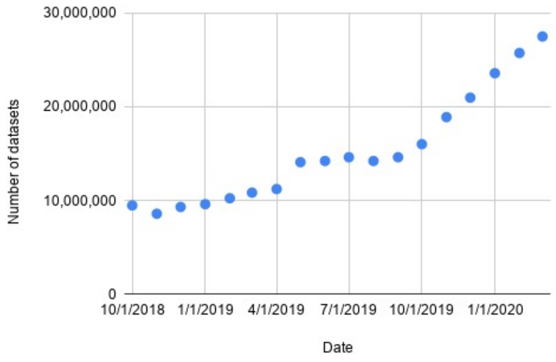
Name	MAG, MAGnetometer
Mission	Solar Orbiter
URL	http://soar.esac.esa.int/
DOI	10.5270/esa-
Abstract	The Solar Orbiter magnetometer is a conventional dual fluxgate design. Two sensors are accommodated on the spacecraft boom: MAG-IBS and MAG-OBS. A dual sensor configuration provides redundancy and, since they are at different distances from the spacecraft body (approx. 1 m for IBS and 3 m for OBS), also allows gradiometer magnetometer characterisation of spacecraft signals in flight. The instrument noise floor has been successfully tested at 10 pT Hz–1/2 at 1 Hz.
Description	Calibrated magnetic field data in RTN coordinates and in the spacecraft reference frame. Field vector components are given units of nanoteslas and in RTN coordinates, where R is the Sun-spacecraft axis, T is the cross product of the solar rotation a and R, and N is the cross product of R and T. During cruise phase, MAG is operating at 1 vector/s cadence. After the cruise phase, MAG is expected to operate continuously at 16 vectors/s cadence (normal mode) except during 1 hour per day at 128 Hz or during 2 hours at 64 Hz (Burst mode). Alternatively, burst modes will be triggered in coordination with other in-situ instruments' burst modes.
Publication	Horbury, A., et al., The Solar Orbiter magnetometer, Astron. Astrophys., 2020; DOI: doi.org/10.1051/0004-6361/201937257
Temporal Coverage	2020-05-01 - present
Mission Description	Solar Orbiter is a mission of international collaboration between ESA and NASA. It explores the Sun and the heliosphere fro close up and out of the ecliptic plane. Launched on 10 February 2020, it aims to address the overarching science question: how does the Sun create and control the Heliosphere – and why does solar activity change with time? To answer it, the Sola Orbiter spacecraft is cruising to a unique orbit around the Sun, eventually reaching a minimum perihelion of 0.28 AU, and performing measurements out of the ecliptic plane: reaching 18° heliographic latitude during its nominal mission phase, and above 30° during its extended mission phase. It carries six remote sensing instruments to observe the Sun and the solar corona, and four in-situ instruments to measure the solar wind, its thermal and energetic particles, and electromagnetic field Müller, D., O.C.St. Cyr, I. Zouganelis, et al., Astron. Astrophys., 2020; DOI: doi.org/10.1051/0004-6361/202038467 Müller, D., Marsden, R.G., St. Cyr, O.C. et al., Solar Orbiter, Sol. Phys., 285, 25–70 (2013); doi.org/10.1007/s11207-012-008
Creator Contact	Prof. T. Horbury, Principal Investigator, Imperial College, United Kingdom, t.horbury@imperial.ac.uk
Publisher And Registrant	European Space Agency

DOI at ESDC

Google Dataset Search (GDS) is a new search engine from Google, launched in January 2020.
https://datasetsearch.research.google.com

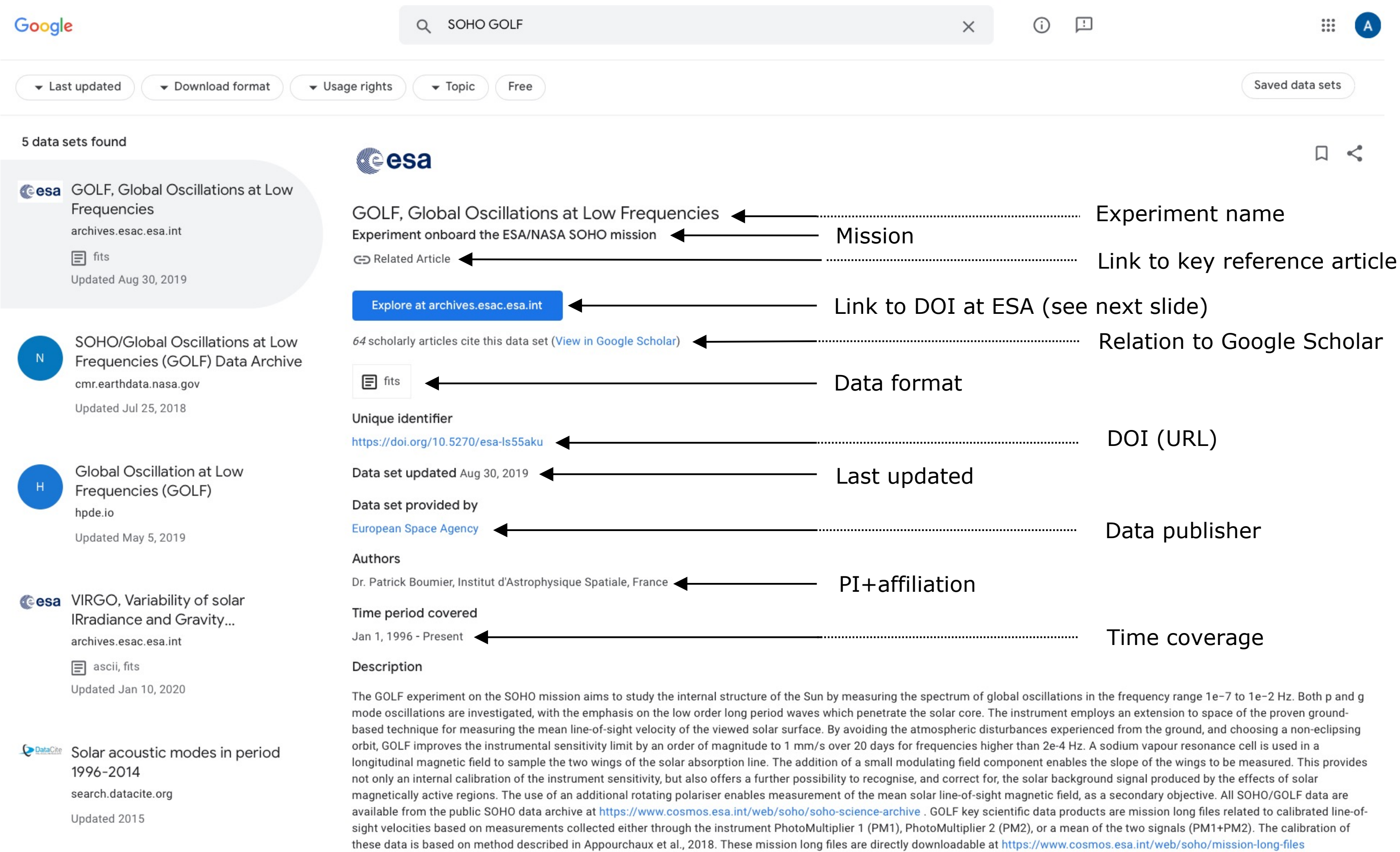
All 25,000 datasets searchable with GDS

Masson et al., Google dataset search and DOI for data in the ESA space science archives, Adv. Space Res., 67, 8, 2504-2516, 2021
https://doi.org/10.1016/j.asr.2021.01.035

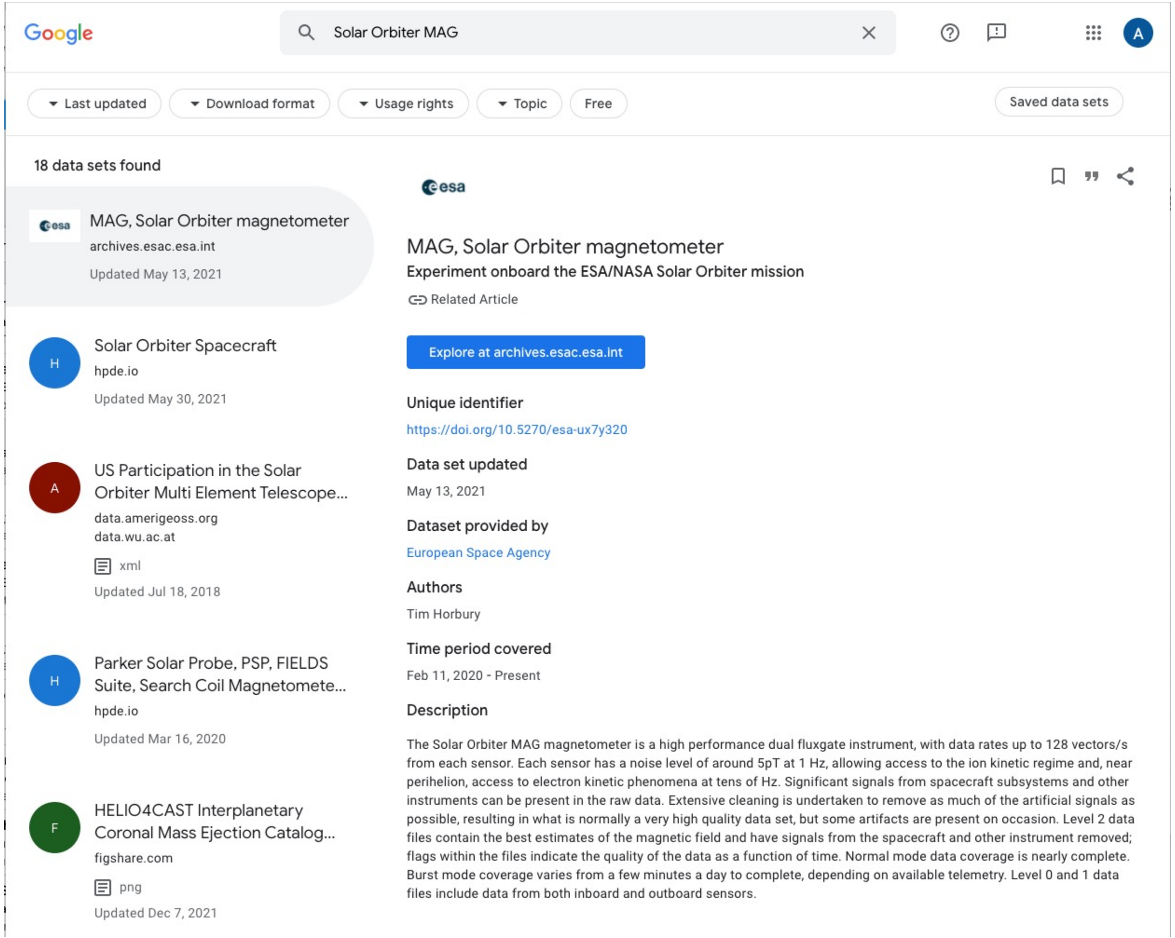


Google Dataset Search

Please search ‘SOHO GOLF’ @ https://datasetsearch.research.google.com



Please search ‘Solar Orbiter MAG’ @ https://datasetsearch.research.google.com



Google

Solar Orbiter MAG

Last updated | Download format | Usage rights | Topic | Free

Saved data sets

18 data sets found

MAG, Solar Orbiter magnetometer
archives.esac.esa.int
Updated May 13, 2021

Solar Orbiter Spacecraft
hpde.io
Updated May 30, 2021

US Participation in the Solar Orbiter Multi Element Telescope...
data.amerigeoss.org
data.wu.ac.at
xml
Updated Jul 18, 2018

Parker Solar Probe, PSP, FIELDS Suite, Search Coil Magnetomete...
hpde.io
Updated Mar 16, 2020

HELIO4CAST Interplanetary Coronal Mass Ejection Catalog...
figshare.com
png
Updated Dec 7, 2021

esa

MAG, Solar Orbiter magnetometer

Experiment onboard the ESA/NASA Solar Orbiter mission

Related Article

Explore at archives.esac.esa.int

Unique identifier

https://doi.org/10.5270/esa-ux7y320

Data set updated

May 13, 2021

Dataset provided by

European Space Agency

Authors

Tim Horbury

Time period covered

Feb 11, 2020 - Present

Description

The Solar Orbiter MAG magnetometer is a high performance dual fluxgate instrument, with data rates up to 128 vectors/s from each sensor. Each sensor has a noise level of around 5pT at 1 Hz, allowing access to the ion kinetic regime and, near perihelion, access to electron kinetic phenomena at tens of Hz. Significant signals from spacecraft subsystems and other instruments can be present in the raw data. Extensive cleaning is undertaken to remove as much of the artificial signals as possible, resulting in what is normally a very high quality data set, but some artifacts are present on occasion. Level 2 data files contain the best estimates of the magnetic field and have signals from the spacecraft and other instrument removed; flags within the files indicate the quality of the data as a function of time. Normal mode data coverage is nearly complete. Burst mode coverage varies from a few minutes a day to complete, depending on available telemetry. Level 0 and 1 data files include data from both inboard and outboard sensors.

Please google 'Cluster WBD dataset'

google.com/search?q=Cluster+WBD+dataset&sxsrf=APq-WBsjWI9T8fy5VG400LF2q1Zk2DVSsQ

Apps | Science | ESA | Cluster | International WG | Archives | Heliophysics archi... | Telespazio

Google | Cluster WBD dataset

Tous | Images | Maps | Actualités | Vidéos | Plus | Outils

Environ 29 500 résultats (0,54 secondes)

https://archives.esac.esa.int › WBD ▾ Traduire cette page

Dataset provided by the European Space Agency

The Wideband Data (**WBD**) Plasma Wave Investigation for **Cluster** provides wideband waveform measurements (up to 577 kHz) of plasma waves in the Earth's ...

Dataset ID : Dataset content | C1_CP_WBD_ELECTRON_DENSITY : Ele...

C1_CE_WBD_WAVEFORM_BM2_CDF : Ele... | C1_CP_WBD_WAVEFORM_BM2 : Electric...

Votre page n'est pas adaptée aux appareils mobiles.

https://hpde.io › ESA › NumericalData ▾ Traduire cette page

Cluster-Samba Wideband Data (WBD) Plasma Wave ...

High time resolution calibrated waveform data sampled in one of 3 frequency bands in the range 0-577 kHz along one axis using either an electric field antenna ...

https://nssdc.gsfc.nasa.gov › nmc › dataset › query.action ▾

NSSDCA - NMC - Data Collection - Query Results - NASA

6 mars 2022 — **Cluster** 2/FM7 (Samba):Wide Band Data (**WBD**) · **Cluster** 2/FM7 (Samba):Waves of HF and Sounder for Probing Electron Density by Relaxation ...

https://cdaweb.gsfc.nasa.gov › NotesC ▾ Traduire cette page

SPDF - Coordinated Data Analysis Web (CDAWeb)

High time resolution calibrated waveform data sampled in one of 3 frequency bandwidths in the range 0-577 kHz along one axis using either an electric field ...

A dataset provided by the European Space Agency

esa | cluster

Name	WBD radio receiver - passive electric and magnetic field waveforms
Mission	Cluster
URL	https://csa.esac.esa.int/csa-web/#search
DOI	https://doi.org/10.5270/esa-h8ck8ox
Abstract	The Wideband Data (WBD) Plasma Wave Investigation for Cluster provides wideband waveform measurements (up to 577 kHz) of plasma waves in the Earth's magnetosphere. The Wideband Receiver measures electric and magnetic fields over the frequency range 100 Hz to 577 kHz as part of the Wave Experiment Consortium (WEC) instrumentation. The Wideband Data Plasma Wave Receiver provides unique high time and frequency resolution measurement capabilities required for the detailed study of terrestrial plasma waves and radio emissions.
Description	WBD scientific datasets for Cluster 1 (similar for all other Cluster spacecraft)

Dataset ID	Dataset content
C1_CP_WBD_WAVEFORM	Electric and magnetic waveform data (NM mode, CEF format)
C1_CE_WBD_WAVEFORM_CDF	Electric and magnetic waveform data (NM mode, CDF format)
C1_CP_WBD_WAVEFORM_BM2	Electric and magnetic waveform data (BM2 mode, CEF format)
C1_CE_WBD_WAVEFORM_BM2_CDF	Electric and magnetic waveform data (BM2 mode, CDF format)
C1_CP_WBD_ELECTRON_DENSITY	Electron density from WBD electron plasma frequency (CEF and CDF format)

Publication	Gurnett, D.A., et al., First results from the Cluster wideband plasma wave investigation, *Ann. Geophys.*, 19, 1259, 2001; https://doi.org/10.5194/angeo-19-1259-2001 Gurnett, D.A., et al., The Wide-Band Plasma Wave Investigation, *Space Sci. Rev.*, 79, 195-208, 1997; https://doi.org/10.1007/978-94-011-5666-0_8
Temporal Coverage	2001-02-01 - current

DOI: way forward

- DOI on the fly
- On-going improvments of XMM JSON scripts to improve findability per observation proposal
- Inclusion of CHEOPS DOI
- Heliophysics datasets: through SPASE only?
- Still missing a license for all our datasets (on-going work)

Please se ... ogle.com

HPDE.io

Data Access

- FTP access to files at SPDF
- HTTP access to files at SPDF
- CDAWeb
- HAPI: CDAWeb HAPI Server
- Access to Cluster WBD CEFs

Cluster-Samba Wideband (WBD) Data Plasma Wave Receiver/High Time Resolution Electric and Magnetic Waveform Data Returned via BM2

ResourceID

spase://NASA/NumericalData/Cluster-Samba/WBD/BM2/PT0.0000046S

Description

The following description applies to the Wideband Data (WBD) Plasma Wave Receivers on all four Cluster satellites, each satellite being uniquely identified by its number (1 through 4) or its given name (Rumba, Salsa, Samba, Tango, respectively). High time resolution calibrated waveform data sampled in one of 3 frequency bands in the range 0-577 kHz along one axis using either an electric field antenna or a magnetic search coil sensor. The dataset also includes instrument mode, data quality and the angles required to orient the measurement with respect to the magnetic field and to the GSE coordinate system. The AC electric field data are obtained by using one of the two 88m spin plane electric field antennas of the EFW (Electric Fields and Waves) instrument as a sensor. The AC magnetic field data are obtained by using one of the two search coil magnetometers (one in the spin plane, the other along the spin axis) of the STAFF (Spatio-Temporal Analysis of Field Fluctuations) instrument as a sensor. The WBD data are obtained in one of three filter bandwidth modes: (1) 9.5 kHz, (2) 19 kHz, or (3) 77 kHz. The minimum frequency of each of these three frequency bands can be shifted up (converted) from the default 0 kHz base frequency by 125.454, 250.908 or 501.816 kHz. The time resolution of the data shown in the plots is determined from the WBD instrument mode. The highest time resolution data (generally the 77 kHz bandwidth mode) are sampled at 4.6 microseconds in the time domain (~4.7 milliseconds in the frequency domain using a standard 1024 point FFT). The lowest time resolution data (generally the 9.5 kHz bandwidth mode) are sampled at 36.5 microseconds in the time domain (~37.3 milliseconds in the frequency domain using a standard 1024 point FFT). The availability of these files depends on times of DSN and Panska Ves ground station telemetry downlinks. A list of the status of the WBD instrument on each spacecraft, the telemetry time spans, operating modes and other details are available under Science Data Availability on the University of Iowa Cluster WBD web site at http://www-pw.physics.uiowa.edu/cluster/ and through the documentation section of the Cluster Science Archive (CSA) (https://www.cosmos.esa.int/web/csa/documentation). Details on Cluster WBD Interpretation Issues and Caveats can be found at http://www-pw.physics.uiowa.edu/cluster/ by clicking on the links next to the Caution symbol in the listing on the left side of the web site. These documents are also available from the Documentation section of the CAA website. For further details on the Cluster WBD data products see Pickett, J.S., et al., "Cluster Wideband Data Products in the Cluster Active Archive" in The Cluster Active Archive, 2010, Springer-Verlag, pp 169-183, and the Cluster WBD User Guide archived at the CAA website in the Documentation section. ... CALIBRATION: ... The procedure used in computing the calibrated Electric Field and Magnetic Field values found in this file can be obtained from the Cluster WBD Calibration Report archived at the CSA website in the Documentation section. Because the calibration was applied in the time domain using simple equations the raw counts actually measured by the WBD instrument can be obtained by using these equations and solving for 'Raw Counts', keeping in mind that this number is an Integer ranging from 0 to 255. Since DC offset is a real number, the resultant when solving for raw counts will need to be converted to the nearest whole number. A sample IDL routine for reverse calibrating to obtain 'Raw Counts' is provided in the WBD Calibration Report archived at the CSA. ... CONVERSION TO FREQUENCY DOMAIN: ... In order to convert the WBD data to the frequency domain via an FFT, the following steps need to be carried out: 1) If Electric Field, first divide calibrated data values by 1000 to get V/m; 2) Apply window of preference, if any (such as Hann, etc.); 3) Divide data values by sqrt(2) to get back to the rms domain; 4) perform FFT (see Bandwidth variable notes for non-continuous modes and/or the WBD User Guide archived at the CAA); 5) divide by the noise bandwidth, which is equal to the sampling frequency divided by the FFT size (see table below for appropriate sampling frequency); 6) multiply by the appropriate constant for the window used, if any. These steps are more fully explained in the WBD Calibration Report archived at the CSA.... BURST MODE: ... WBD data can also be obtained in a mode called Burst Mode 2 (BM2), stored onboard, and transmitted to the ground with the data from all the other instruments. This mode has been rarely used throughout the mission only once prior to July 2010 (on March 7, 2001), but more often thereafter to obtain data at low altitude or in the high priority auroral acceleration region, because it results in decreased bandwidth or a higher degree of duty cycling for WBD. NASA's Deep Space Network terminated WBD data acquisition in February 2015 and after that date WBD operations are limited to Panska Ves real time downlink (limited to altitudes below 10 RE) and a limited number of BM2 operations. This resulted in a decreased total weekly quota of WBD operations, especially at higher altitudes where only BM2 mode is available. BM2 data are thus obtained primarily at outer boundaries (bow shock, foreshock, magnetosheath, magnetopause, plasmasheet) and during perigee crossings of the magnetic equator when Panska Ves does not have visibility. Typically, approximately 4 operations of 1-2 hours duration are obtained in these regions each month. BM_Mode (0=Duty Cycled 9.5 kHz, 1-in-3, 1 = Duty Cycled 9.5 kHz, 1-in-4, 2 = Duty Cycled 19 kHz, 1-in-3, 3 = Duty Cycled 19 kHz, 1-in-4, 4 = Duty Cycled 77 kHz, 1-in-3, 5 = Duty Cycled 77 kHz, 1-in-4, 6 = Digital Filtered 9.5 kHz, 1-in-3, roll-off at 3.2 kHz 7 = Digital Filtered 9.5 kHz, 1-in-3, optimized roll-off at 4.2 kHz 8 = Digital Filtered 9.5 kHz, 1-in-4, roll-off at 2.5 kHz 9 = Digital Filtered 9.5 kHz, 1-in-4, optimized roll-off at 3.1 kHz) +-------------------------------------+ Bandwidth Sample Rate Burst Mode ---------- ------------ ------------ 9.5 kHz 27.443 kHz 0,1 19 kHz 54.886 kHz 2,3 77 kHz 219.544 kHz 4,5 9.5 kHz 9.148 kHz 6,7 9.5 kHz 6.861 kHz 8,9 +-------------------------------------+ COORDINATE SYSTEM USED: ... One axis measurements made in the Antenna Coordinate System, i.e., if electric field measurement, it will either be Ey or Ez, both of which are in the spin plane of the spacecraft, and if magnetic field measurement, it will either be Bx, along the spin axis, or By, in spin plane. The user of WBD data should refer to the WBD User Guide, archived at the CSA, Section 5.4.1 and Figure 5.3 for a description of the three orientation angles provided in these files. Since WBD measurements are made along one axis only, these three angles provide the only means for orienting the WBD measurements with respect to a geocentric coordinate system and to the magnetic field direction ...

Details

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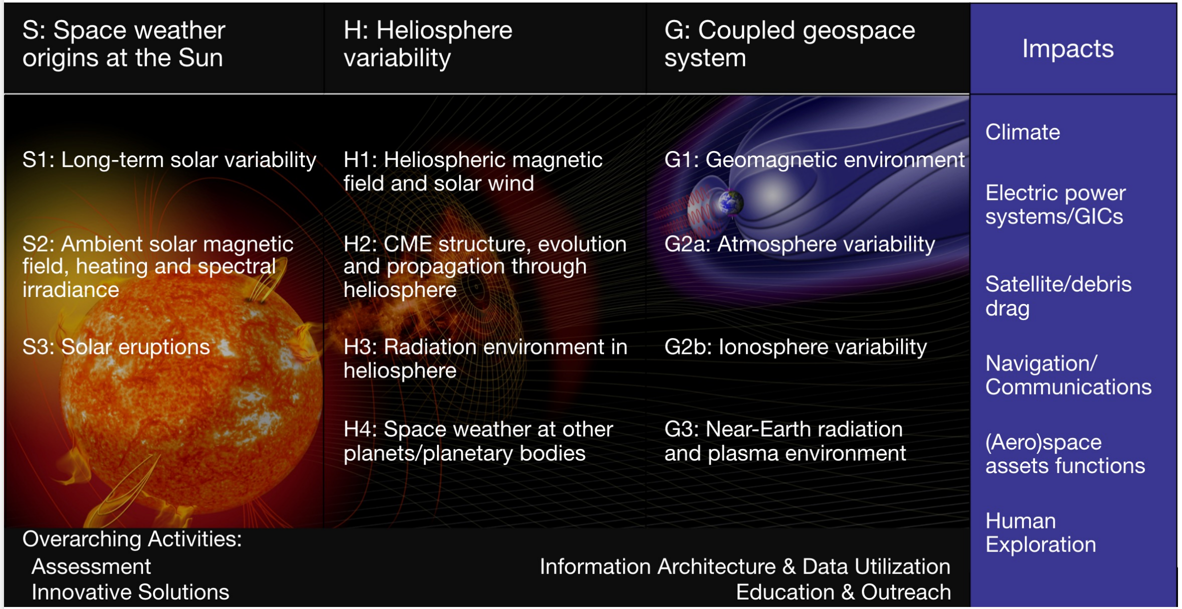
Version:2.3.2

NumericalData

ISWAT - International Space Weather Action Teams

Goal is to **define the new international space weather roadmap** in a number of articles as a follow up of the 2015 roadmap published by Schrijver et al. (Understanding space weather to shield society: A global road map for 2015-2025 commissioned by COSPAR and ILWS, Adv. Space Res., 2015). This activity is planned to be completed by the end of 2022.



ISWAT - International Space Weather Action Teams

https://www.iswat-cospar.org/

O2: Information Architecture and Data Utilization

Action Teams

O2-01: Kamodo Python Visualization (Lead: Darren De Zeeuw darrens@umich.edu Asher Pembroke apembroke@gmail.com)
O2-02: Using SPASE metadata to facilate data science (Lead: Shing Fung shing.f.fung@nasa.gov)
O2-03: Data archive preparation and implementation to advance Machine Learning activities for space weather forecasting in support of human exploration. (Lead: Viacheslav Sadykov vsadykov@gsu.edu Yaireska (Yari) Collado-Vega yaireska.m.colladovega@nasa.gov)
O2-04: Digital Object Identifiers to support Space Weather (Lead: Guido De Marchi gdemarchi@esa.int Aaron Roberts aaron.roberts@nasa.gov)
O2-05: HAPI Standard Development and Promulgation (Lead: Jon Vandegriff jon.vandegriff@jhuapl.edu Robert Weigel rweigel@gmu.edu)
O2-06: Coordination and collaborations of Python libraries and tools for ISWAT (Lead: Arnaud Masson Arnaud.Masson@esa.int)

O2

PyHC

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Python in Heliophysics Community (PyHC)

Promoting and facilitating the use and development of Python for Heliophysics.

A community knowledge base for performing heliophysics research in Python, aiming to provide a variety of tutorials, resources, a list of useful packages, general discussion, and advice.

Our Mission Statement

Facilitate scientific discovery by promoting the use and development of sustainable open-source Python software across the solar and space physics community; improving communication and collaboration between disciplines, developers, and users; establishing and maintaining development standards; and fostering interoperability and reproducibility.

Our Strategic Goals

- Coordinate development across projects to minimize duplication of effort and share lessons learned
- Promote best practices for software development, documentation, testing, and dissemination
- Increase community awareness of and participation in projects

ISWAT - Interna

O2: Informati

PyHC

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Projects

To add a project to this page, please refer yourself to the project addition instructions.

Core packages

These packages each offer a wide range of functionality in their area, and conform to the PyHC community standards.

Table Cards

Search: Show Keyword Filters

Name	Description	Code	Docs	Site	Contact	Community	Documentation	Testing	Software Maturity	Python 3	License
PlasmaPy	A Python package for plasma physics				Nick Murphy	Good	Good	Good	Partially met	Good	Good
pysat	Management and analysis tool for satellite and radar data.				Russell Stoneback	Good	Good	Good	Good	Good	Good
pySPEDAS	Tools for loading, analysis and plotting of data from various heliophysics missions and ground magnetometers				Nick Hatzigeorgiu, Eric Grimes	Good	Good	Good	Good	Good	Good
SpacePy	Space science library for Python. Includes file I/O, time and coordinate conversions, common analysis techniques.				Steve Morley	Good	Good	Partially met	Good	Good	Good
SunPy	Python for Solar Physics				Stuart Mumford	Good	Good	Good	Good	Good	Good

Other packages

Table Cards

Search: Show Keyword Filters

Name	Description	Code	Docs	Site	Contact	Community	Documentation	Testing	Software Maturity	Python 3	License

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PyHC Integration Strategy Workshop Report

We present a report on the 2021 PyHC (Python in Heliophysics Community) virtual workshop held August 30-31st, 2021. This workshop pulled together leading developers in PyHC to discuss how the community could improve integration between PyHC projects by uncovering high-value shared (or "key") challenges and suggested possible solutions to these challenges. The results of the workshop show that there are many potential concrete actions which could be taken to improve PyHC software and their associated projects. Key challenges may be grouped into items which involve sustaining/improving/expanding the community, improving information dissemination and undertaking technical goals to better integrate and coalesce projects. Suggested solutions to challenges ranged from smaller and/or straight forward efforts to more detailed, long-term solutions.

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Document Type	Technical Memorandum (TM)
Authors	Brian A Thomas *(Goddard Space Flight Center Greenbelt, Maryland, United States)* Arnaud Masson *(European Space Astronomy Centre Madrid, Spain)* Julie I Barnum *(Colorado State University Fort Collins, Colorado, United States)* Aaron Roberts *(Goddard Space Flight Center Greenbelt, Maryland, United States)* Reinhard Hans Walter Friedel *(Los Alamos National Laboratory Los Alamos, New Mexico, United States)*
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Keywords	Heliophysics; Python; Software Development; Strategy

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NASA/TM–20210023307

PyHC Integration Strategy Workshop Report

Brian A. Thomas, Arnaud Masson, Julie I. Barnum, Aaron Roberts and Reinhard Hans Walter Friedel

October 2021

https://ntrs.nasa.gov/citations/20210023307 international heliophysics data environment alliance (ihdea)

esa

2022 PYTHON IN HELIOPHYSICS COMMUNITY SUMMER SCHOOL (30 MAY - 03 JUNE 2022)

Want to know more about SunPy, pySPEDAS, PlasmaPy, pysat, SpacePy or Speasy?
Meet their developers?

The ESAC science data center is proud to announce the venue of the 2022 Python in Heliophysics Community (PyHC) summer school at the European Space Agency ESAC center (Madrid, Spain) from 30 May to 03 June 2022. This summer school will also be hybrid and online participation will be offered. This summer school is held in the framework of the International Space Weather Action Teams (ISWAT) Information Architecture cluster (https://www.iswat-cospar.org/information). Detailed program: click here and follow the PyHC blog here .

Registration is open until 31 March 2022. if you do not see a registration form below please click here

ISWAT - International Space Weather Action Teams

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6 papers under review
Session at COSPAR 2022+TESS session on open science

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  - **2021-02 -- 5th HAUS group meeting**
  - 2019-10 -- 4th HAUS group meeting
  - 2019-01 -- 3rd HAUS group meeting
  - 2018-06 -- 2nd HAUS group meeting

TITLE TREE

Agenda

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2021-02 -- 5th HAUS group meeting

Created by Arnaud Masson, last modified on 24 Feb, 2021

Meeting Date	2021-02-15 and 2021-02-24	**Ref**	HELIO-MOM-0004
Meeting Place	Virtual	**Chairman**	Harra, L., PMOD/WRC and ETH Zurich, Switzerland
Minute's Date	2021-02-24	**Participants**	Graham, C., IRFU, Uppsala, Sweden De Marchi, G., ESTEC/ESA Dresing, N., Turku University, Finland Fleck, B., GSFC/ESA Cecconi, B., Observatoire de Paris, France Martinez, B., ESAC/ESA Masson, A., ESAC/ESA (secretary) Osuna, P., ESAC/ESA (excused on the 24th) Roth, M., Freiburg University, Germany Salgado, J., ESAC/ESA Taylor, M., ESTEC/ESA Veronig, A., Graz University, Austria
Subject	Minutes of the 5th Heliophysics Archives USer (HAUS) group meeting	**Copy**	

Agenda

February 15
14:00-15:00 ESDC archives: 2020 progress report (A. Masson)
15:00-15:45 DOI for ESA science datasets and Google Dataset Search
15:45-17:00 Presentation and Open discussion on Solar MACH (N. Dresing/All), for the minutes, see below

February 24
14:00-15:00 New SOHO archive at ESAC: live demo (A. Masson) + TAP presentation + discussion (minutes below)

https://issues.cosmos.esa.int/socciwiki/display/HELIOPHYSICSEXT1/Heliophysics+Archives+Public+Area+Home