

The Virtual Solar Observatory - A Component of the NASA Heliophysics Data System

Frank Hill and the VSO Team

The Core Team

- Rick Bogart, *Stanford*
- Alisdair Davey, *CfA*
- Joe Gurman, *NASA GSFC*
- Keith Hughitt, *NASA GSFC*
- Joe Hourclé, *NASA GSFC*
- Piet Martens, *MSU*
- Kevin Reardon, *Arcetri*
- Jennifer Spencer, *Stanford*
- Igor Suárez-Sola, *NSO*
- *Plus many others in the past and now working on services outside the “small box”*

Outline

- History
- Design & Interface
- Current status
- Interoperability
- Lessons learned

History

- Early “local” data centers
 - NASA/GSFC SDAC – 1980s
 - NSO Digital Library – 1993
- Original idea for synthesis: The Whole Sun Catalog (1995-1997) – Fleck, Bentley & Sanchez
- Funding attempts 1999-2001, successful in 2001
- First release late 2004
- Funding level: ~\$300k/year, total so far of ~\$3M

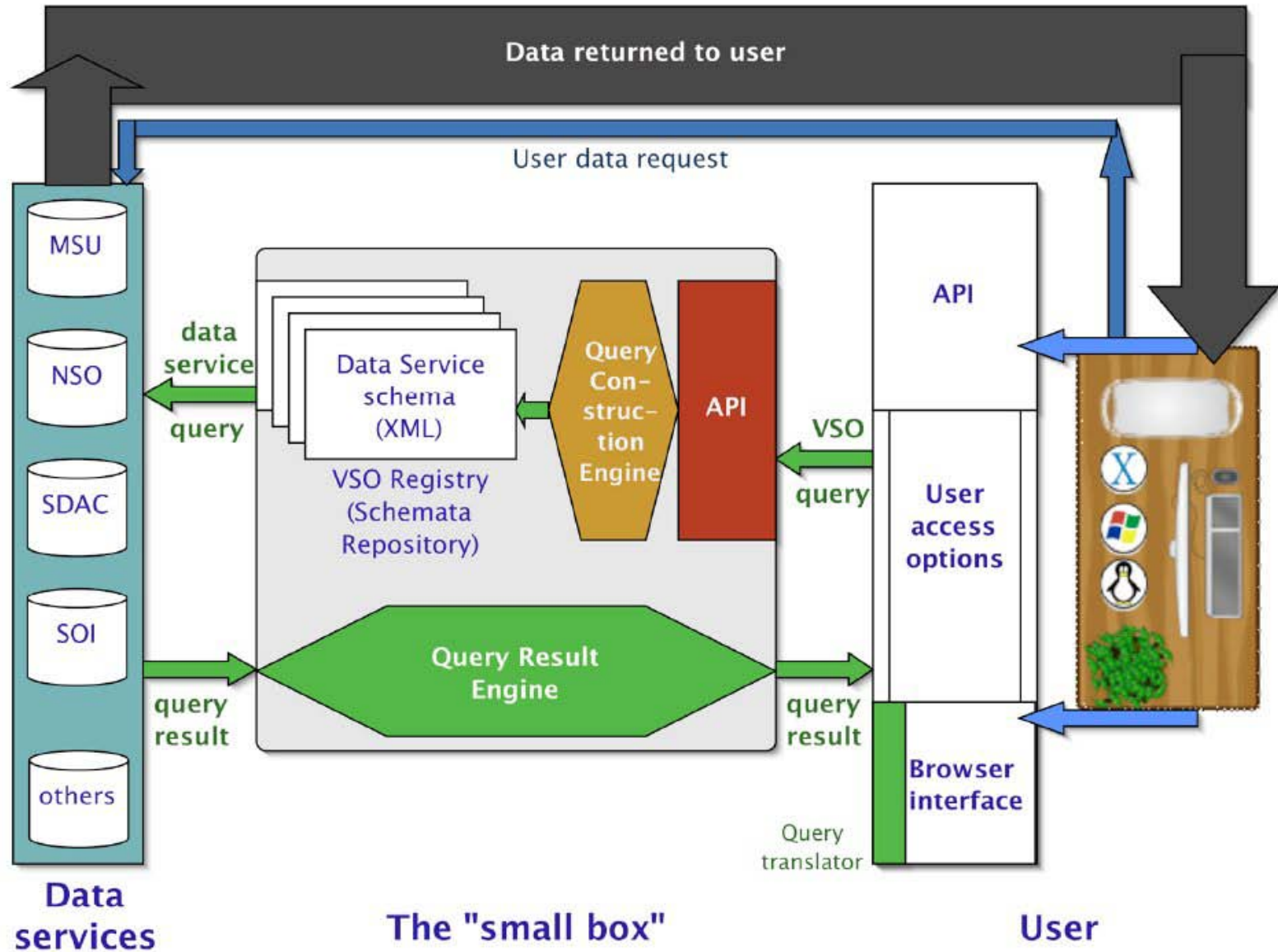
Design requirements

- Distributed
- Search for and access multiple missions, observatories, and wavelengths without intimate knowledge of the data organization (*e.g. by physical observable and/or mission/ instrument*)
- Provide access to analysis software, instrument descriptions, &c. that enable use in scientific research
- Given the funding level, had to draw a “small box” around a small set of attributes useful for doing science

What we decided we couldn't offer, at least at first

- Data mining (knowledge discovery)
- Remote processing: left for EGSO, CoSEC
- Grid computing (as opposed to data grids)
- Access control (ever)
 - We wanted only to be in the business of helping data providers to give data away, not preventing its access

Resulting Design



Multiple VSOs

- Because the VSO is a lightweight “small box”, there are several instances of the system
- “Official” instances are located at NASA/GSFC, NSO and Stanford
- Others are at CfA, MSU, ROB
- An individual user can have his/her own VSO on a local system
- URLs:
 - <http://vso.nso.edu/>
 - <http://vso.stanford.edu/>
 - <http://sdac.virtualsolar.org/cgi/search>

Search for Solar Physics Data Products:

If you're new to the VSO, see [How To Search](#), the [FAQ](#) or click the icons for online help.

Please select which values you wish to use to search for data products:

- Time**
Search by time interval.
[Derive time intervals from event catalogs](#)
- Observable**
Search based on physical observables
- Instrument / Source / Provider**
Search based on instruments or data archives
 - Compact listing
 - Instrument / Source (not provider dependent)
 - Instrument Only (not source or provider dependent)
- Spectral Range**
Search based on a spectral range
- Nicknames**
Search based on common terms used to describe data products
Note: Nicknames generate an intersection with other search terms, so searching for a nickname, and a physical observable (or other parameter) when a nickname defines other physical observables will result in no matches.
 Show Nickname Definitions

Searching against current VSO instances

[Generate VSO Search Form](#)

VSO Documentation

Documentation for Scientists, Programmers and Data Providers, including [Changes](#), [FAQs](#), and [contact info](#).

Help us improve VSO

- Tell us what features you would like to see.
- Other suggestions / comments / criticism
- Contact information for VSO team members

[VSO @ Home](#) | [NSO](#) | [Stanford](#)



VSO Time / Catalog Search Form

Search VSO Help or enter Cart ID:

[VSO Glossary](#)
[VSO FAQ](#)
Click on the icons for online help.

Whole catalog

Catalogs

- SDHO/LASCO CME Catalog**
1996.01.11 -- 2004.05.31
 CME Type: All
 Halo
 Partial Halo
 Halo+Partial Halo
 Non-Halo
 Visibility: C2 or C3
 C2 and C3
 At least C2
 Match CME Field: Calculated CME Onset
 Free Field Match:
 Free Search Param:
- GOES X-Ray Catalog**
1996.01.03 -- 2007.07.28
 Class:
 Match GOES Field:
 Enter Active Region #:
 Match Type:
 Free Field Match:
 Free Search Param:
- RHESSI Flare List**
2002.02.12 -- 2005.02.15
 Match RHESSI Field Free Field Match:
 Free Search Param:
- KPVT Coronal Hole List**
1992.07.01 -- 1994.12.31
 Match KPVTCH Field:
 Free Field Match:
 Free Search Param:

Statistically derived data

- GONG Product Duty Cycle**
2000.02.01 -- To Date
 Product Match:
 Instrument Match:
- Current combinations**
 LOS_velocity:



Search VSO Help or enter Cart ID:

[VSO Glossary](#)
[VSO FAQ](#)
Click on the icons for online help.

Query Menu

Search Status
 No Errors; 25 Warnings
 Rows Returned

- 21 Records Found
- 21 Returned

NSO

- 1137 Records Found
- 1137 Returned

SDAC

- 515 Records Found
- 515 Returned

SHA

Select...
 All Above this box
 All Below this box
 Just this box



Search VSO Help or enter Cart ID:

[VSO Glossary](#)
[VSO FAQ](#)
Click on the icons for online help.

Query Menu

Search Status
 No Errors; No Warnings
 Rows Returned

- 218 Records Found
- 218 Returned

SDAC

VSO Search Results

Show Search Params :: [show]

total entries: 1673
 << prev - 1 - next >>

Sort Only | Rearrange only | Sort & Rearrange Applied to this page only

Views: Basic | **Thumbs** | Links | Long

<input type="checkbox"/> Thumbnail	<input type="checkbox"/> Time Start	<input type="checkbox"/> Time End	<input type="checkbox"/> Min Spectral Range	<input type="checkbox"/> Max Spectral Range	<input type="checkbox"/> Wave Type	<input type="checkbox"/> Observable	<input type="checkbox"/> Source	<input type="checkbox"/> Instrument	<input type="checkbox"/> Extent
	2001.04.01 00:00:00	2001.04.01 17:36:00	6768 A	6768 A	line	intensity	SOHO	MDI	FULLDISK
	2001.04.01 00:00:00	2001.04.01 23:59:00	6768 A	6768 A	line	intensity	SOHO	MDI	FULLDISK
	2001.04.01 00:00:30	2001.04.01 22:24:30	6768 A	6768 A	line	LOS_magnetic_field	SOHO	MDI	FULLDISK
	2001.04.01 00:01:00	2001.04.01 23:49:00	6768 A	6768 A	line	intensity	SOHO	MDI	FULLDISK
	2001.04.01 19:12:00	2001.04.01 22:24:00	6768 A	6768 A	line	intensity	SOHO	MDI	FULLDISK
	2001.04.01 21:00:30	2001.04.01 21:59:30	6768 A	6768 A	line	LOS_magnetic_field	SOHO	MDI	FULLDISK
	2001.04.01 21:36:10	2001.04.01 21:36:15	195.0 A	195.0 A	N/A	intensity	SOHO	EIT	FULLDISK

CART ID: VSO-NSO-071012-046

Show Search Params :: [show]

total entries: 218
 << prev - 1 - next >> Display Session : 12-Oct2007 20:18:42 UTC

Sort Only | Rearrange only | Sort & Rearrange

Views: Basic | **Thumbs** | Links | Long

<input type="checkbox"/> Thumbnail	<input type="checkbox"/> Time Start	<input type="checkbox"/> Time End	<input type="checkbox"/> Min Spectral Range	<input type="checkbox"/> Max Spectral Range	<input type="checkbox"/> Wave Type	<input type="checkbox"/> Observable	<input type="checkbox"/> Source	<input type="checkbox"/> Instrument	<input type="checkbox"/> Extent
	2001.04.01 21:36:10	2001.04.01 21:36:15	195.0 A	195.0 A	N/A	intensity	SOHO	EIT	FULLDISK
	2001.04.01 21:48:12	2001.04.01 21:48:17	195.0 A	195.0 A	N/A	intensity	SOHO	EIT	FULLDISK
	2001.04.01 22:00:10	2001.04.01 22:00:15	195.0 A	195.0 A	N/A	intensity	SOHO	EIT	FULLDISK
	2001.04.01 22:12:10	2001.04.01 22:12:15	195.0 A	195.0 A	N/A	intensity	SOHO	EIT	FULLDISK

VSO Time / Nickname Search Form

Version 1.4



Start Date/Time: 2007 Sep 01 / 21 : 00
 End Date/Time: 2007 Sep 02 / 00 : 59
 All Month All Day

Search Clear

Nickname

Note: Nicknames generate an intersection with other search terms, so searching for a nickname, and a physical observable (or other parameter) when a nickname defines other physical observables will result in no matches.

Dopplergram

- Full-disk dopplergram
- K-7699 dopplergram
- Na-D dopplergram
- Ni-6768 dopplergram

Image

- 10.7cm image
- Ca-K image
- Coronagraph image
- EUV image
- H-alpha image
- Hard X-ray image
- He 10830 image
- Na-D image
- Soft X-ray image
- UV image
- White-light image

Magnetogram

- Full-disk magnetogram
- LOS magnetogram
- Vector magnetogram

Spectrum

- Atlas Spectrum
- EUV Spectrum
- IR Spectrum
- UV Spectrum
- Visible Spectrum

Other

- Helioseismic Time Series
- Light Curve Time Series

Search Clear



Search VSO Help or enter Cart Id:

Go

[VSO Glossary](#)
[VSO FAQ](#)
 Click on the icons for online help.

Query Menu [\[hide\]](#)

- [New Search](#)
- [Edit Search](#)
- [Continue Adding to Cart](#)
- [Click & Bookmark](#)
- [Email This Cart](#)
- [Track Your Request](#)
- [Back to Cart](#)

Search Status [\[show\]](#)

VSO Time / Spectrum Search Form

Version 1.2



Start Date/Time: 2007 Sep 01 / 05 : 00
 End Date/Time: 2007 Sep 01 / 08 : 59
 All Month All Day

Search Clear

Spectral Range

- soft X-rays [1 - 100 Å]
- extreme UV [100 - 1000 Å]
- ultraviolet [900 - 3800 Å]
- visible [3500 - 10000 Å]
- radio [0.3 - 30 GHz]
- OR select spectral range:

min
 max
 unit [Angstrom](#)

Search Clear

Notes

- Observable classification is tentative, as some data services have not registered full information on the classes of observables available.
- Time ranges of instrumentation provide the minimum and maximum ranges of data known to be available. Lack of an end date means that the archive is still receiving new information, but some archives may be a week or more behind the present date.

VSO @ [Home](#) | [NSO](#) | [Stanford](#)

Automatically Generated at : Fri Sep 28 21:18:15 2007

CART ID: VSO-NSO-071012-046

CART Data Request

Sessions : 12-Oct-2007 20:18:42 UTC

Provider

SDAC

Select Transfer Method

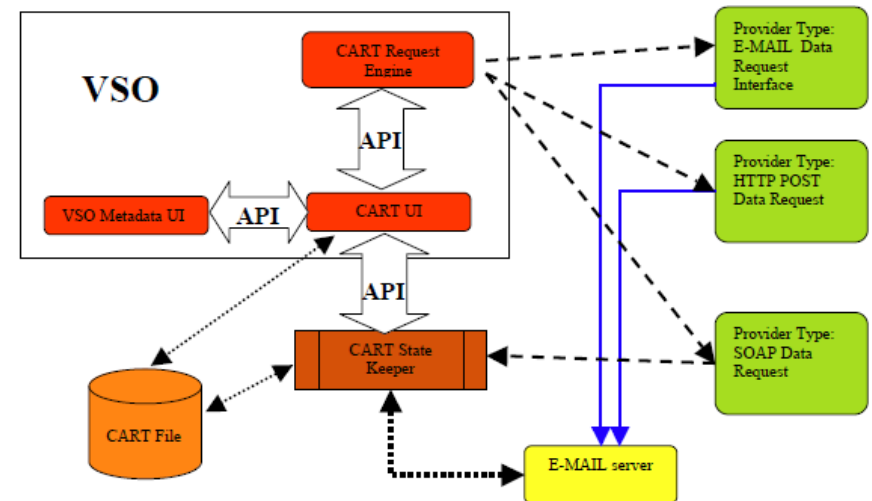
URL-FILE

STAGING-TAR_GZ

The Data Cart – A key concept

- Allows user to store and later exactly reproduce a search
- Carts are archived
- Can be cited in papers to allow others to replicate results

Shopping VSO Style!



The only VSO-supplied data service




CART ID: VSO-NSO-071012-046
VSO Movie Player

Search VSO Help or enter
Cart Id:

[VSO Glossary](#)

[VSO FAQ](#)

Click on the  icons
for online help.

Query Menu [\[hide\]](#)

[New Search](#) 

[Edit Search](#) 

[Continue Adding to](#)

[Cart](#) 

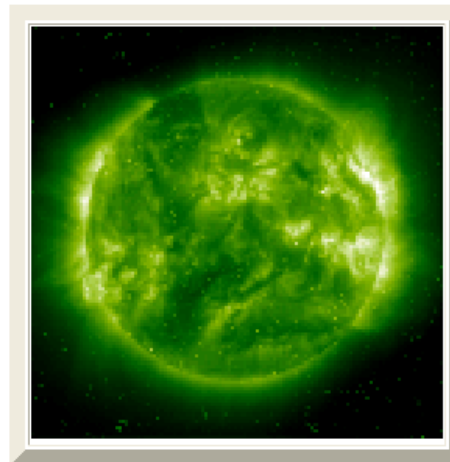
[Click & Bookmark](#)

[Email This Cart](#)


[Track Your Request](#)

Search Status [\[hide\]](#)

No Errors; No Warnings



Frame Start: Stop: Reverse: Swing:

[Comments? Help us improve VSO](#) 

Status

- Operational for more than 5 years
- More than 60 solar data sets going back to 1915
- Usage statistics
- Next steps



VSO Time / Instrument Search Form



Version 1.2

Start Date/Time: 2010 Apr 20 / 06 : 00

End Date/Time: 2010 Apr 20 / 09 : 59

All Month All Day

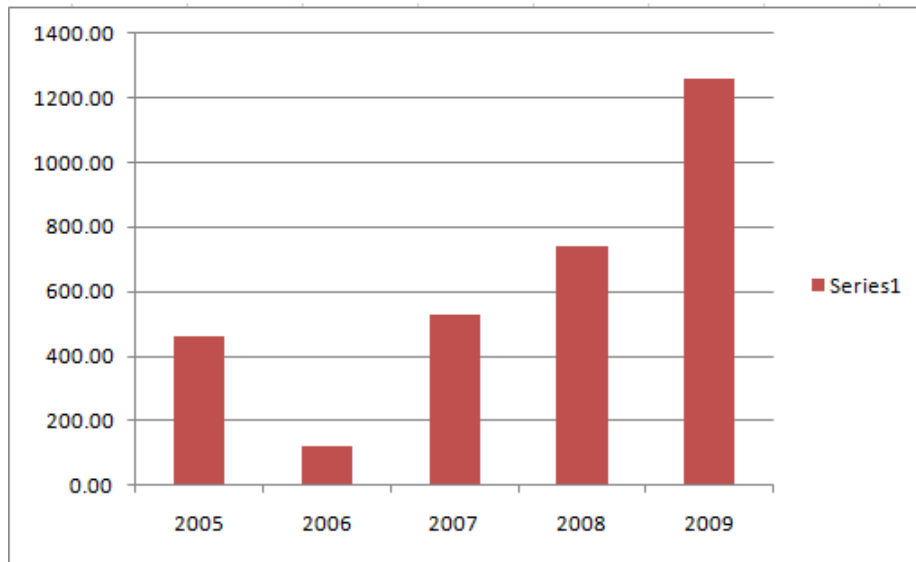
Search Clear

All from Provider	All from	Source	Instrument	Date Range
<input type="checkbox"/> HANET ⁱ	<input type="checkbox"/>	BBSO ⁱ	<input type="checkbox"/> BBSO ⁱ	2000.07.05 →
	<input type="checkbox"/>	KANZ ⁱ	<input type="checkbox"/> KANZ ⁱ	2001.02.07 →
	<input type="checkbox"/>	OACT ⁱ	<input type="checkbox"/> OACT ⁱ	2002.02.26 →
	<input type="checkbox"/>	OBSPM ⁱ	<input type="checkbox"/> OBSPM ⁱ	2004.10.22 →
	<input type="checkbox"/>	YNAO ⁱ	<input type="checkbox"/> YNAO ⁱ	2000.11.27 →
<input type="checkbox"/> HAO ⁱ		MLSO ⁱ	<input type="checkbox"/> chp ⁱ	1996.04.20 →
			<input type="checkbox"/> dpm ⁱ	1994.02.20 →
			<input type="checkbox"/> mk4 ⁱ	1998.10.01 →
<input type="checkbox"/> LSSP ⁱ		RHESSI ⁱ	<input type="checkbox"/> RHESSI ⁱ	2002.02.12 →
<input type="checkbox"/> MSU ⁱ		YOHKOH ⁱ	<input type="checkbox"/> BCS ⁱ	1991.09.01 – 2001.12.14
			<input type="checkbox"/> HXT ⁱ	1991.09.03 – 2001.12.14
			<input type="checkbox"/> SXT ⁱ	1991.09.03 – 2001.12.14
			<input type="checkbox"/> WBS ⁱ	1991.09.01 – 2001.12.14
<input type="checkbox"/> MWSPADP ⁱ		MtWilson ⁱ	<input type="checkbox"/> 60-ft SHG ⁱ	1915.08.10 – 1985.12.31
<input type="checkbox"/> NGDC ⁱ		GOES-12 ⁱ	<input type="checkbox"/> SXI-0 ⁱ	2001.09.10 →
<input type="checkbox"/> NSO ⁱ	<input type="checkbox"/>	Evans ⁱ	<input type="checkbox"/> spectroheliograph ⁱ	1996.02.05 – 1999.05.28
	<input type="checkbox"/>	GONG ⁱ	<input type="checkbox"/> Big Bear ⁱ	2005.04.11 →
			<input type="checkbox"/> Cerro Tololo ⁱ	2005.02.24 →
			<input type="checkbox"/> El Teide ⁱ	2005.02.25 →
			<input type="checkbox"/> Learmonth ⁱ	2005.02.25 →
			<input type="checkbox"/> MERGED GONG ⁱ	2001.07.22 →
			<input type="checkbox"/> Mauna Loa ⁱ	2005.04.11 →
	<input type="checkbox"/>	KPVT ⁱ	<input type="checkbox"/> 512-channel magnetograph ⁱ	1974.02.01 – 1993.04.10
			<input type="checkbox"/> spectromagnetograph ⁱ	1992.04.19 – 2003.09.21
	<input type="checkbox"/>	McMath ⁱ	<input type="checkbox"/> solar fts spectrometer ⁱ	1976.03.31 – 2003.12.31
	<input type="checkbox"/>	O-SPAN ⁱ	<input type="checkbox"/> O-SPAN ⁱ	2002.12.11 →
	<input type="checkbox"/>	SOLIS ⁱ	<input type="checkbox"/> vsm ⁱ	2004.01.02 →

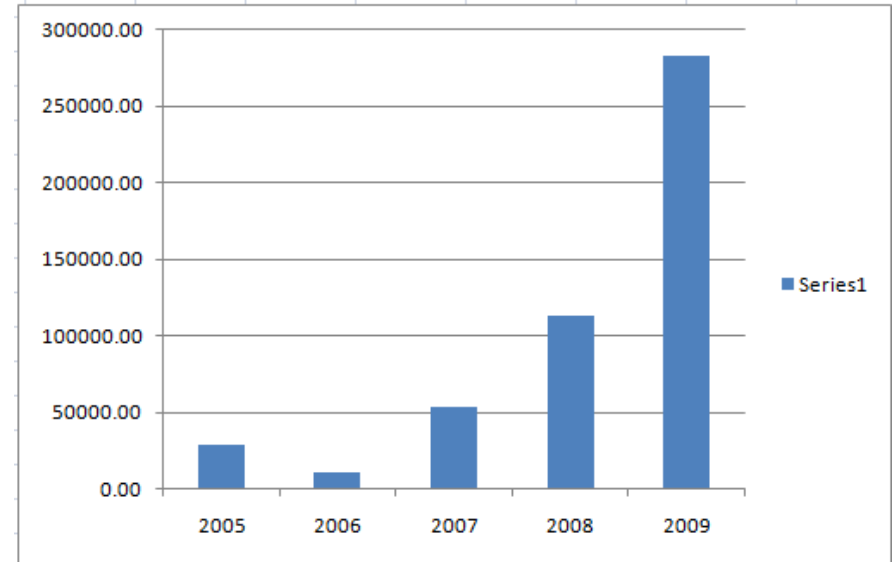
<input type="checkbox"/>	OBSPM	<input type="checkbox"/>	Nancay	<input type="checkbox"/>	Decametric Array	2003.03.10 →
		<input type="checkbox"/>		<input type="checkbox"/>	Radioheliograph	1996.10.20 →
		<input type="checkbox"/>	OBSPM	<input type="checkbox"/>	Meudon Spectroheliograph	1995.12.01 →
		<input type="checkbox"/>	Pic du Midi	<input type="checkbox"/>	Coronagraph	1995.10.20 →
<input type="checkbox"/>	OVRO		OVRO	<input type="checkbox"/>	OVSA	2000.03.16 →
<input type="checkbox"/>	SAO		Hinode	<input type="checkbox"/>	XRT	2006.10.23 →
<input type="checkbox"/>	SDAC	<input type="checkbox"/>	Hinode	<input type="checkbox"/>	EIS	2006.10.23 →
		<input type="checkbox"/>		<input type="checkbox"/>	SOT	2006.10.23 →
		<input type="checkbox"/>	SOHO	<input type="checkbox"/>	CDS	1996.01.19 →
				<input type="checkbox"/>	CELIAS	1995.12.02 →
				<input type="checkbox"/>	COSTEP	1995.12.07 – 2003.05.01
				<input type="checkbox"/>	EIT	1996.01.01 →
				<input type="checkbox"/>	ERNE	1996.05.08 – 2001.06.01
				<input type="checkbox"/>	GOLF	1996.01.01 →
				<input type="checkbox"/>	LASCO	1995.12.08 →
				<input type="checkbox"/>	MDI	1996.05.01 – 2003.04.13
				<input type="checkbox"/>	SUMER	1996.01.22 →
				<input type="checkbox"/>	SWAN	1996.01.12 – 2003.01.01
				<input type="checkbox"/>	UVCS	1996.01.20 →
				<input type="checkbox"/>	VIRGO	1995.12.06 →
		<input type="checkbox"/>	TRACE	<input type="checkbox"/>	TRACE	1998.02.16 →
<input type="checkbox"/>	SFO		SFO	<input type="checkbox"/>	CFDT1	1986.05.26 →
				<input type="checkbox"/>	CFDT2	1992.01.11 →
<input type="checkbox"/>	SHA	<input type="checkbox"/>	GONG	<input type="checkbox"/>	Big Bear	2001.03.14 →
				<input type="checkbox"/>	Cerro Tololo	2001.04.20 →
				<input type="checkbox"/>	El Teide	2001.07.30 →
				<input type="checkbox"/>	Learmonth	2001.04.30 →
				<input type="checkbox"/>	Mauna Loa	2001.06.16 →
				<input type="checkbox"/>	Udaipur	2001.10.25 →
		<input type="checkbox"/>	JSPO	<input type="checkbox"/>	MOTH	2003.01.01 – 2003.01.20
		<input type="checkbox"/>	MtWilson	<input type="checkbox"/>	MOF/60	1996.05.01 →
		<input type="checkbox"/>	SOHO	<input type="checkbox"/>	MDI	1996.01.30 →
		<input type="checkbox"/>	TON	<input type="checkbox"/>	Big Bear	1996.06.01 – 1996.08.31
				<input type="checkbox"/>	Tenerife	1996.06.03 – 1996.08.06
<input type="checkbox"/>	SSC	<input type="checkbox"/>	STEREO_A	<input type="checkbox"/>	IMPACT	2006.10.01 →
				<input type="checkbox"/>	PLASTIC	2006.10.01 →
				<input type="checkbox"/>	SECCHI	2006.11.06 →
				<input type="checkbox"/>	SWAVES	2006.10.27 →
		<input type="checkbox"/>	STEREO_B	<input type="checkbox"/>	IMPACT	2006.10.01 →
				<input type="checkbox"/>	PLASTIC	2006.10.12 →
				<input type="checkbox"/>	SECCHI	2006.11.07 →
				<input type="checkbox"/>	SWAVES	2006.10.27 →

Usage statistics

Searches



Files



These statistics are for one of three “Official” VSO instances

Statistics do not include usage through the IDL API, only those through the web interface

So far in 2010: 478 searches, 87,000 files, estimate 1400 searches, 250,000 files through VSO/NSO

Next steps

- Finish SDO distributed data system
- Add spatial subset searches (currently restricted to full-disk images)
- Improve the user interface
- Continue adding data sets
- Add searches based on data computations?

Interoperability

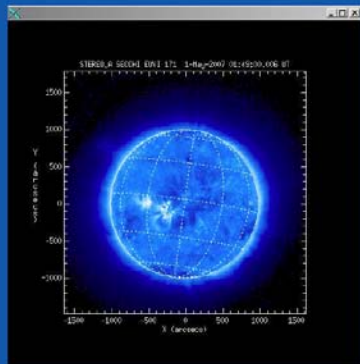
- Very important for VSO since no services are provided
- Examples:
 - IDL & SolarSoft
 - SDO/JSOC/HEK
 - Helioviewer
 - HelioScope, Aladin, TopCat
 - EGSO and successors
 - NASA Heliophysics VxOs

IDL and SolarSoft

- IDL widely used in solar physics
- SolarSoft is a large library of procedures for analysis of NASA solar physics data
- VSO IDL client is an API written in IDL
- Uses SOAP/XML & HTTP/POST/GET to query VSO registry and retrieve matching datasets from providers
- `IDL> records=vso_search (tstart, tend, inst=inst, det=det, wave=wave)`
- `IDL> vso_get, records`
- Once the data is in IDL, have full range of analysis and plotting tools available

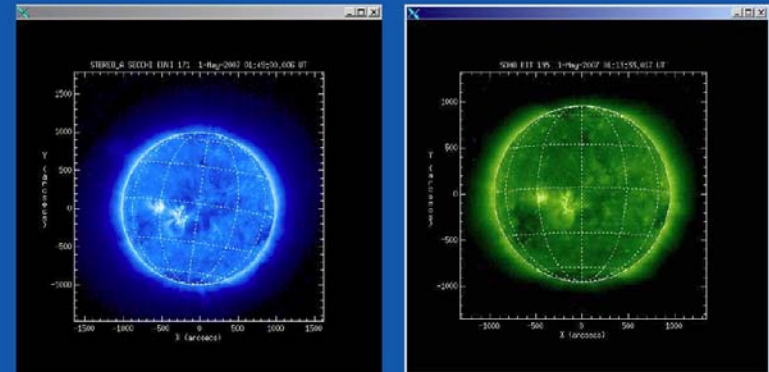
An example using RHESSI Plotman

Access STEREO Data



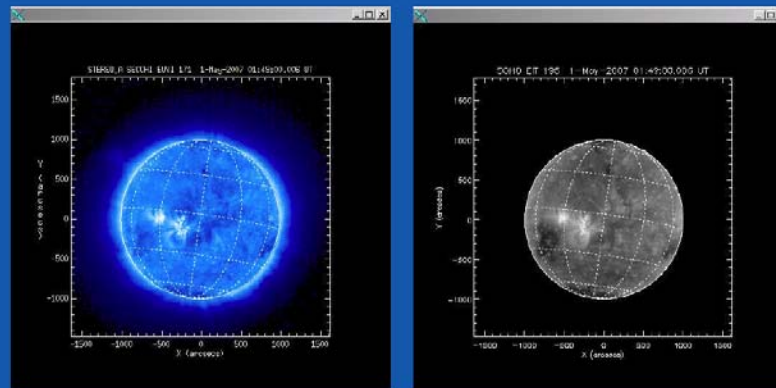
16

Compare SOHO and STEREO



17

Project SOHO to STEREO View



18

SDO and VSO

- SDO (Solar Dynamics Observatory) is the new major NASA solar mission
- Largest data set in solar physics history (so far)
- Sustained 150 Mbs, 1.5 TB per day, expected total of 5 PB mission data set
- VSO is constructing a system of satellite sites to mirror part or the whole SDO archives
- Uses the Data Record Management System (NetDRMS) and Storage Unit Management System (SUMS) frameworks as the backbone
- Developed both by the SDO Joint Science Operations Center (JSOC) composed of Stanford University and Lockheed Martin
- Sites in Germany, Massachusetts, Arizona

JSOC interface



jsoc.stanford.edu gives access to export series only, use jsoc2 for access to internal series

Series Select | Series Content | RecordSet Select | Values Display | Export Data | Test

Information about selected series

Current Series is: aia_test.lev1

PrimeKeys: T_OBS, FSN

DBindex: T_OBS_index, FSN

Data NOT archived, online retention 60 days

Unit size: 1 record

Series Description AIA level 1 test

Release Notes [for aia_test](#)

This series contains no records

3. Select Records and Get Record Count

Enter RecordSet Specification here for keyword listings and for export.

Check box to show the QueryBuilder.

Request may take a while if the recordset is large (more than a few thousand records).

Record Limit Optional, + for from start, - for from end.

Record Count:

- Check to Get Record Query.
- Check to Allow Huge Record Queries.
- Check to show full segment info
- Check to make local file links (only at JSOC).
- Prepare value table in 'show_info' format in new window. (No *psuedo* keywords yet please) Segments fail

Select Keywords, Segments, and Links for table of values.

4. Select Keywords

cparams_sg000
image_lev1_bzero
image_lev1_bscale
cparams_sg001
bad_pixel_bzero
bad_pixel_bscale

5. Select Segments

image_lev1
bad_pixel
spikes

6. Select Links

Heliophysics Event Knowledgebase (HEK)

The Sun 2010-5-17

- 1 Day +

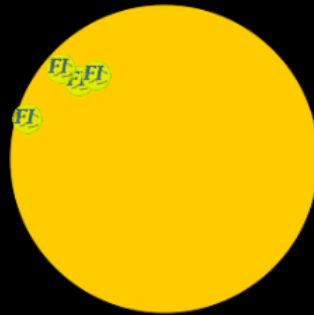
Last Updated 17-May-10 13:14:11.130 UT

"What's this?"

Events



Disk Carrington Map



<< 2010-05-17T00:00:00, >>
2010-05-18T00:00:00



[about / contacts](#)

Search results ([export](#))

- 1.FI: Filament
- 2.FI: Filament
- 3.FI: Filament
- 4.FI: Filament

iSolSearch (v1.1)

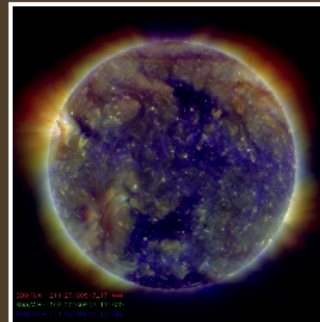
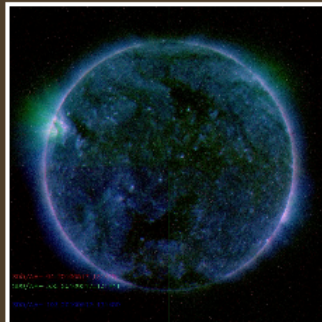
Welcome to iSolSearch – a window into the Heliophysics Events Knowledgebase (HEK). iSolSearch and HEK are designed to guide heliophysics researchers to relevant solar data, and primarily to that acquired by the Solar Dynamics Observatory (SDO) with the Atmospheric Imaging Assembly (AIA) and the Helioseismic and Magnetic Imager (HMI).

- [Users Guide](#)
- [QuickTime User Video](#)
- [SolarSoft IDL](#)
- [API Documentation](#)

other links...


- [Heliophysics Events Knowledge Base](#)

e Channels



Not yet available

Helioviewer

 Helioviewer.org

Time

Date:

Time:

Time-step:

Images [Add]

▸ EIT 304 2010/01/01 01:19:34 |

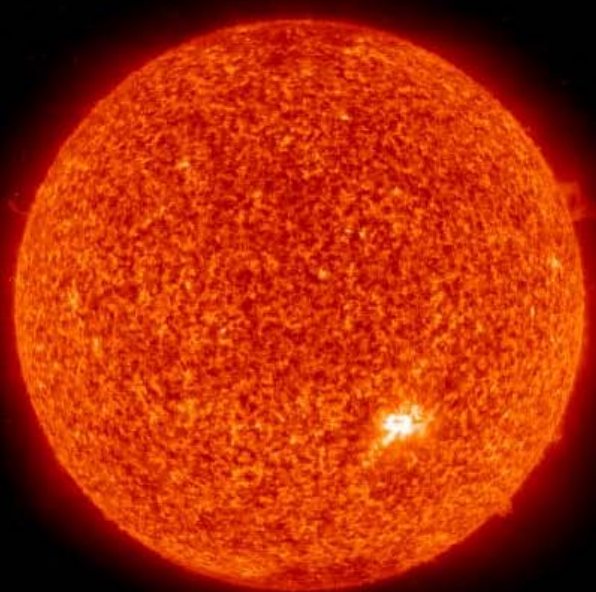
Features/Events [Add]

▸ LASCO CME List C |

▸ GOES X-Ray G |

▸ NOAA Active Regions AR |

center Link JHelioviewer



Help About Usage Tips Wiki API Contact Report Bug

HeliScope, Aladin, TopCat via Plastic

The image displays two overlapping software windows from the AstroGrid Workbench. The background window is HeliScope, and the foreground window is Aladin v3.7 multiview.

HeliScope Window:

- File Edit Help** menu bar.
- Buttons for **Data Discovery**, **Workflows**, and **Advanced**.
- Icons for **AstroScope**, **HeliScope**, **Aladin**, **TopCat**, **VisIVO**, and **VOSpec**.
- 1. Search** section: Start Date&Time: 2006-01-19T12:00:00, End Date&Time: 2006-01-19T18:00:00. Includes checkboxes for **Time Series** and **Graphic**, and a **Halt** button.
- 2. Navigate** section: **To To Top** and **Clear selection** buttons.
- 3. Process** section: **View tables in Aladin** and **View images in Aladin** buttons.
- Main area: A radial tree diagram showing search results for **Time Series/Images**. The tree branches into various datasets including: **Cluster spacecraft dataset**, **Polar spacecraft dataset**, **Ulysses spacecraft dataset**, **RHESSI (Reuven Ramaty High)**, **SOHO Coronal Diagnostic**, **SOHO LASCO (Large Angle)**, **LASCO**, **SOHO EIT (Extreme ultraviolet)**, **EIT**, **TRACE (Transition Region And)**, **TRACE**, and **ACE spacecraft dataset**. Each dataset has associated time ranges.

Aladin v3.7 multiview Window:

- *** PROTOTYPE VERSION (based on v3.702) ***
- Buttons: **Load...**, **Save...**, **Tools...**, **Interop...**, **Print...**, **Help...**, **Quit**.
- Position: J2000, No proj => use XY coord, Pixel: 8 bits, 015 / 255.
- Two main image panes: **PLASTIC-1** (left) and **PLASTIC** (right). The **PLASTIC** pane shows a grayscale image of the Sun with a red arrow and a pink crosshair.
- Right sidebar: Tools for **select**, **isamp**, **dist**, **cont**, **draw**, **zoom**, **tag**, **mois**, **text**, **prop**, **filter**, **rgb**, **del**, **assoc**.
- Bottom right: **Zoom 1/4x** and **out** button.
- Footer: (c)1999-2006 ULP/CNRS - Centre de Données astronomiques de Strasbourg, 2 planes, 2 views, 2Mb.

EGSO interface



European Grid of Solar Observations

[Introduction](#) | [Help](#) | [Tools](#)

EGSO GUI - BUILD QUERY

New query **Build query** **List of observations** **List of files**

QUERY TYPE

Standard Query

SEARCH PARAMETERS

Remote Observable Entity

Insitu Observable Entity

RESULT PARAMETERS

Select Plots

DATE/TIME

Start Date: 2002-07-15 00:00:00 ...

Format: 2003-12-31 23:59:59

End Date: 2002-07-16 00:00:00 ...

Format: 2003-12-31 23:59:59

EVENT

None

GEV GOES Event List

NOAA Proton Events

REMOTE OBSERVABLE ENTITY

Select all Photons

Photons: Gamma Rays

XRays: SXR HXR

Ultra Violet: EUV UV

Visible (inc. H alpha and 10830A)

Infrared

Microwaves

Radio Waves

INSITU OBSERVABLE ENTITY

Select all Particles

Particles: Energetic

Charged

Neutral

Select all Fields

Fields: Electrical

Magnetic

Gravitational

SELECT PLOTS

none

GOES XRay Plot

GOES Proton Plot

New query **Build query** **List of observations** **List of files**

NASA Heliophysics VxOs

- Next talk by Aaron Roberts
- Several different flavors of virtual observatories for specific disciplines in heliophysics
- A central data model and framework to glue them all together

Lessons learned

- Basic design also used by NVO, PDS, so probably the optimal solution
- Best Decisions
- What had to be revised
- User uptake

Best decisions (in hindsight)

- Chose SOAP over various competing methodologies
- Were forced to KISS (“small box”) because of very constrained budget
- Few non-data services, no public outreach features
- Supported by SolarSoft for a good fraction of community’s needs
- Continually went to community for input
 - AAS, SPD, AGU meetings/BoF’s
 - Beta testing and feedback

What we had to change or add

- Registry
- Replication of registry
- Data model (still being expanded)
- Writing SOAP servers for some data providers
- Providing proxies for database-less providers
- Even some hardware for one data provider

User uptake

- Resistance by elders (“I don’t like it”) is hard to overcome
 - Keep the old access methods, i.e. direct FTP
- Younger researchers adopt quickly
- Interfaces are hard to do well
 - Too much box clicking is bad (VSO is still guilty)
 - More graphical systems highly dependent on browsers

Conclusion

- The simple design has resulted in a robust system that can be maintained with limited funding
- Many other groups are developing data services for the VSO
- VSO is increasingly being used by the heliophysics community