The Virtual Model Repository (VMR)

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ASTRONUM

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Introduction

The Heliophysics Data Environment provides essential infrastructure supporting NASA’s Vision to understand “the Sun, the Heliosphere, and planetary environments as elements of a single interconnected system, one that contains dynamic space weather and evolves in response to solar, planetary, and interstellar conditions.”

Yes, we have a rich set of data, but it is in a wide variety of places and formats, and available through a varied collection of interfaces.

Enter the Heliophysics Data and Model Consortium (HDMC), whose mission is to facilitate Heliophysics research by providing open, easy, uniform, scientifically meaningful access to relevant resources (data, models, tools, and documentation) as quickly and easily as possible.
Some of the HDMC requirements include:

- Maintain a comprehensive inventory of data and related resources.
- Provide discipline specific portals to Heliophysics resources (VxOs) that add value by providing easy-to-use interfaces and search tools based on events, positions, etc.
- Maintain SPASE descriptions of the inventoried resources (SPASE - Space Physics Archive Search and Extract - is a data model that provides a robust description of data, facilitating discovery). The current estimate is that 25% of space-based data products have SPASE descriptions.
Virtual Observatories (VxOs)

- Discipline specific VxOs were formed by individual research proposals in response to a standard NASA Research Announcement.
- These include:
  - VHO Virtual Heliospheric Observatory
  - VMO Virtual Magnetospheric Observatory
  - ViRBO Virtual Radiation Belt Observatory
  - ViTMO Virtual Ionosphere, Thermosphere, Mesosphere Observatory
  - VEPO Virtual Energetic Particle Observatory
  - VWO Virtual Wave Observatory
  - VMR Virtual Modeling Repository
Virtual Observatories (VxOs)

- The VxOs all provide a number of functions, most importantly discipline-specific expertise.

- The VxOs provide a means of assuring that data descriptions are complete, accurate, and useful.
  - All the VxOs are committed to providing a comprehensive set of SPASE descriptions of their relevant data.
Heliophysics Data Environment

 Researchers

 Active Heliophysics Inventory

 Virtual Observatories

 Services

 Internet

 Researchers

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 Virtual Observatories

 Services

 Internet
**Virtual Space Physics Observatory – Solar Space Physics Product Finder**

<table>
<thead>
<tr>
<th>#</th>
<th>Product Name</th>
<th>Access Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ACE 27-day Survey Plots</td>
<td>- Polar-Wind-Geotail 'gif-walk' site</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ACE Science Center</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ACE/CRIS L2 data in HDF via ftp</td>
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<td>- CDAWeb</td>
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<td></td>
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<td>- In HDF via ftp from CDAWeb</td>
</tr>
<tr>
<td>2</td>
<td>ACE CRIS L2 1-day Z=3-28 flux data</td>
<td>- Pol-HLC-Geotail 'gif-walk' site</td>
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<td>- ACE Science Center</td>
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<td>- In HDF via ftp from CDAWeb</td>
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<tr>
<td>3</td>
<td>ACE CRIS L2 1-hr Z=3-28 flux data</td>
<td>- ACE Science Center</td>
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<td>- ACE/CRIS L2 data in HDF via ftp</td>
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<td>- In HDF via ftp from CDAWeb</td>
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<tr>
<td>4</td>
<td>ACE Daily Survey Plots</td>
<td>- Polar-Wind-Geotail 'gif-walk' site</td>
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<td>- ACE Science Center</td>
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<td>- ACE/CRIS L2 data in HDF via ftp</td>
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<td>- CDAWeb</td>
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<td>- In HDF via ftp from CDAWeb</td>
</tr>
<tr>
<td>5</td>
<td>ACE EPAM L2 1-hour particle flux data</td>
<td>- ACE Science Center (ASC)</td>
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<td>- In HDF via ftp from ASC</td>
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<td>- CDAWeb</td>
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<td>- In HDF via ftp from CDAWeb</td>
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<tr>
<td>6</td>
<td>ACE EPAM L2 5-min particle flux data</td>
<td>- ACE Science Center (ASC)</td>
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<td>- In HDF via ftp from ASC</td>
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<td>- CDAWeb</td>
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<tr>
<td></td>
<td></td>
<td>- In HDF via ftp from CDAWeb</td>
</tr>
</tbody>
</table>
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...
**LATEST NEWS**

- Ulysses KET and ISEE3 HECR Data Added
- Ulysses HIESALE Rates Data Added
- Neutron Monitor Data Added
- IMP 8 CPME Data Added
- Vega 1 and 2 Data Products Added

**LATEST DATA UPDATES**

- 16 Jun 2009: ISEE 3 12-min Ephemeris (7 files)
- 10 Jun 2009: ISEE3 Elemental Abundance Ratios (1 file)
- 10 Jun 2009: ISEE3 Isotopic Abundance Ratios (1 file)
- 10 Jun 2009: ISEE3 Isotopic Fractions (1 file)
- 4 Jun 2009: Daily OMNI Data Set (1 file)

**NEWSFLASH**

**Ulysses KET and ISEE3 HECR Data Added**

Written by Tom Narock

Wednesday, 10 June 2009

Ulysses COSPIN/KET Proton, Helium, and Electron Rates, Proton, Helium, and Electron PHA Count Rates, and COSPIN/High Flux Telescope, Proton and heavier nucleide fluxes have been added to VHO.

In addition, ISEE3 Elemental Abundance Ratios, Isotopic Abundance Ratios, and Isotopic Fractions data have been added to VHO.
Virtual Magnetospheric Observatory

Latest News

★ Prognoz 6, 7, and 9 Magnetic Field Data Added
★ Four New Geotail Data Sets Added
★ OMNI Data Sets Added
★ Four New THEMIS data products added
★ Three new data products added to VMO

Latest Data Updates

★ 8 Jun 2009: THEMIS-A ESA Electron/Ion Fluxes and Moments (788 files)
★ 8 Jun 2009: THEMIS-B ESA Electron/Ion Fluxes and Moments (741 files)
★ 8 Jun 2009: THEMIS-C ESA Electron/Ion Fluxes and Moments (505 files)
★ 8 Jun 2009: THEMIS-D ESA Electron/Ion Fluxes and Moments (183 files)
★ 8 Jun 2009: THEMIS-E ESA Electron/Ion Fluxes and Moments (183 files)
1 Introduction

The Data section below has a complete list of available data. Many previously inaccessible data sets are now available and we plan to continuously add new tools, data sets, and services of interest to radiation belt scientists. If you have any suggestions, requests, or questions, email to virbo@virbo.org or look for us at GEM 2009.

ViRBO Status

This is the version 1.0 alpha release of ViRBO. The "alpha" designation means that the infrastructure of the VxO is nearly complete.

In general, many ViRBO web pages are functional. Some features are not available for all data sets. To see an example of a data set with all of the possible features enabled (except the fully enabled data subsetting and filtering server), please see the Augsburg/ULF page. The features that are not available are listed in the Development Notes section on the page associated with each data product. A more complete list of pending projects is listed in the Active Projects section.

About ViRBO

ViRBO (Virtual Radiation Belt Observatory) is one of the domain-specific virtual observatories that began operations in Fall, 2008 and is funded under the NASA Heliophysics Data Environment program. As part of this project, we have developed or extended a number of existing software codebases. These codebases have cross-VxO uses, and we are developing them to be re-usable by other virtual observatories.

- Autoplot - Visualize many space science data resources.
- VxOware - The metadata search and edit engine that ViRBO uses.
Welcome to the Virtual Ionosphere Thermosphere Mesosphere Observatory, a data discovery system that allows the user to find previously unknown data sets as well as old familiar ones through a single, easy to use interface. Click on the button below to initiate a query of space physics data sets which integrate data, services and tools across many missions, data centers, agencies and countries and suggests related models to use with your data.

VITMO now automatically supports multiple time intervals in CDaweb products - January 8, 2009 [read more]

Some unique features about VITMO include the following:

The Virtual Observatory for the Ionosphere Thermosphere Mesosphere Community (VITMO) is being implemented at JHU/APL and provides data covering the Ionosphere Thermosphere Mesosphere (ITM). The ITM region is observed by ground based remote sensing instruments, satellite based remote sensing instruments, and in-situ satellite instruments. In addition, there are external drivers in solar radiation and the solar wind and magnetospheric particle inputs. A Virtual Observatory that covers the ITM region needs to deal with the large diversity of data types in the study of this region.
INTRODUCTION

The Virtual Energetic Particle Observatory (VEPO) serves the heliophysics data user community as a focus group component operating within the domain of the Virtual Heliospheric Observatory (VHO) for improved discovery, access, understandability, and usability of energetic particle data products from selected spacecraft and sub-orbital instruments within the VEPO Data Source Environment.

NEW DATA PRODUCTS

- ISEE 3 High Energy Cosmic Ray (HECR) Elemental and Isotopic Abundance Tables
- Ulysses HISCALE count rates (32 ASCII products)
- Helios-1 Energetic Proton and Electron (E8, Kepler) Hourly Count Rates (ASCII)
The goal of the VWO is to make Heliophysics plasma wave and radiation data searchable, understandable and usable by the Heliophysics community.

VWO Services

Data Query
The methods you can use to find data.

Tutorial
A Primer on the use of wave data in Heliophysics research and examples of the VWO in action.

Education
The different kinds of waves in the Heliosphere: Where they are, what they are like, and what we can learn from them.

Annotation Service
Wave emissions don't come with labels. Here is where we add them.

Related Sites

SPASE - Space Physics Archive Search and Extract
Heliophysics Data Environment

Wave Research Resources

Research Groups
+ Iowa Radio and Plasma Wave Group
+ U. Maryland/IPST Space & Upper Atmospheric Physics Group
VMR: Virtual Modeling Repository
http://vmr.engin.umich.edu/

- Make model results available to the general community in a consistent format
  - Allow visualization of any model results
  - Allow independent interpretation of published model results
- Seamless data-model comparisons
  - Get data from other VxOs
  - Get model results from Virtual Model Repository and CCMC
    - Can request a model run if no model results exist
VMR: ModelWeb Interface

VMR - Virtual Modeling Repository

Run IRI

Select date for all run types: Year: 2000 Month: January Day: 31

1st location selected.
Latitude = 40.5 Longitude = 239.5

Clear all values
Run IRI for single vehicle profile

2nd location selected.
Latitude = 9 Longitude = 278

Clear all values
Run IRI 2D sweep with 20 steps.

The original IRI ModelWeb site can be found here.

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University of Michigan
VMR: ModelWeb Interface

- Web page is at UM
- Runs ModelWeb at NASA
- Gathers data at UM
- Create plots at UM

IRI plot results for January 1, 2000 at lat/lon = 40.5/239.5

UMS1 maps are used for the F2 peak density (NmF2)
CIT1 maps are used for the F2 peak height (hF2)
D-0 Table option is used for the bottomside thickness parameter D0
Danilov- option is used for the ion composition
The f0F2 ITPRM model is turned on
IRI-91 option is used for the electron temperature
IRI-95 option is used for the D-region No
Gorina-97 no L option is used for the F1 occurrence probability
Peak densities/cm-3: NmF2= 907817.7 NmF1= 0.0 NmE= 6898.4
Peak heights/km: hF2= 285.75 hF1= 6.00 hE= 110.00
Solar Zenith Angle/degree 98.3
Dip (Magnetic Inclination)/degree 64.67
DMSP Data is available from University of Texas at Dallas.

Want to make the web page a little more intuitive, for people who don’t think in terms of orbit.

Also want to compare data to ModelWeb IRI results.

Created web page at UM to gather metadata at UTD about orbits, satellites, dates, etc.

Choose date you want.

Data downloaded from UTD (on the fly)
Once data is downloaded from UTD, can do many things:
- Choose portion of data to examine.
- Plot different variables available within the data files.
- Compare to ModelWeb IRI run.
VMR: Data Comparison

- Plot of data downloaded from UTD (ANY TIME!)
- IRI run at ModelWeb site utilizing location and time of data.
- None of this is pre-loaded
  - Data is downloaded on the fly (and cached)
  - IRI is run when you select compare to IRI
  - Matches variables between IRI and DMSP
Multiple days can be combined together to create new plots types that enable further science insight.
We have coupled to other VxOs, here to capture satellite data, with availability lists.
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We have coupled to other VxOs, here to capture satellite data, with availability lists.
Similarly, we can show availability of events run at the CCMC.

Test of satellite data access through JHUAPL site

Select satellite: Geotail ACE WIND IMP-8 CCMC

2001 CCMC Data Availability [Green=YES, Red=NO]

Select date: 2001

You can also enter the date/time by hand to get multi-day or custom date/time ranges
(plot may be slightly different)
We can search by event date and run type and plot comparisons with data, even if not created at runtime.
VMR Data-Model Plot

- Black is satellite data & trajectory
- Red is model run at CCMC
- Positions are taken from satellite cdf for model plot times, data at those positions are extracted, and comparison plot is made.
### SWMF GUI: Visualization

#### SWMF GUI: Create Plots for "default-tec-long"

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>GM</th>
<th>IE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Select desired plot options and 'Update Plot'.

**Pltfile:** T=Hour:Min:Sec N=Iterations (183 files found)

- X: not selected
- Y: not selected
- Z: T=0001.00:00 N=6238254

**Contour:**
- Variable: V4: n/M (amu/cm^3) $\text{ }$
- Range: Min/Max Custom 0.0 1.0

**Grid:**
- Plot grid? No $\text{ }$ Yes

**View:**
- Center at: X: 8.0, Y: 0.0, with view width 48

**Vector Traces:**
- Plot fieldlines? No $\text{ }$ Yes $\text{ }$ Line Color: Black $\text{ }$ White

**Body:**
- Plot circle at origin? No $\text{ }$ Yes with radius 2.7

**Text Label:**
- Label: '\&AUXZONE[II]/TIMESIM'

*Update Plot* (wait ~ 1 minute unless fieldlines plotted)

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![Diagram]
SWMF Component Visualization

View movie
We are currently working on a web portal that will organize our internal UM run library, help with setup and filing of new runs at the CCMC, pull visualization tools from the SWMF GUI and other visualization work, and interact with the VMR for public viewing.

- Enhanced data/model comparison will be provided.
- It will have public, authenticated, and admin sections.
- It is under development now, with a working prototype expected soon.