Science tools on the Internet—access to information, data and models

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Abstract

In just a few years the Internet has become an essential element in national and international science endeavors. Transfer of data, models, and related software across the net has skyrocketed. Interactive WorldWideWeb modules let the users do everything from simply specifying time periods for data retrieval to plotting complex data sets, to computing model parameters and to finding magnetic conjunctions between points in space. This paper reviews Internet sources for solar-terrestrial data and models, with special emphasis on systems that are related to, or a result of, the Solar Terrestrial Energy Program (STEP). We also discuss on-line systems that provide specific interactive services to the research community, like data finding, viewing, and browsing capabilities, comparison with model parameters, etc. This html document provides links to a large number of WWW sites that might be of interest for STEP research. It does not attempt to be a comprehensive guide to such sites but rather to provide access to selected typical sites for the specific capabilities discussed. Throughout the paper Universal Resource Locator (URL) addresses are highlighted in italics; the links to all the services mentioned are available on the WWW at *http://nssdc.gsfc.nasa.gov/space/STEP-links.html*. © 1999 Elsevier Science Ltd. All rights reserved.

1. Information and search

The first and simplest step for finding information on the internet is through one of the powerful search engines (e.g., Infoseek, Excite, Yahoo, Lycos, AltaVista, etc.) that are accessible from any of the WWW browsers (e.g., SEARCH button in Netscape or Internet Explorer). It is important to understand that these tools do not search the WWW in real time, but rather query an index of Web pages compiled at the search engine's site. With now about 100 million Web pages and about 200,000 new ones added each day, it may take days or weeks for a search engine to traverse the whole net. There are also systems, like Yahoo, which let users search through a directory of sites that have been categorized by human reviewers (Yahoo's directory includes about 400,000 Web sites). A good explanation and brief review of some of the search tools was given by Peters and Sikorski (1997). In searching the Internet for information about a certain topic/subject, it is important to be as specific as possible in entering the search string. A search for 'Solar Terrestrial Energy Program' resulted in 77 hits (Infoseek) but a search for 'STEP' resulted in 28,363 hits including hits for the 'Sustainable Transport Emergency Program', the 'Systematic Training for Effective Parenting' and the 'STandard for the Exchange of Product data' of the International Organization for Standardization (ISO). Of the 77 sites only the first 20 had a relevance higher than 50%. Searching for STEP-related data and information in this way would, of course, be a time-consuming endeavor. Better and faster results can be obtained by using data specific query systems:

The NASA Master Directory (NMD) at *http://nssdc.gsfc.nasa.gov/nmd/nmd.html* (see Fig. 1) lets users query a large information base about space physics data sets. Queries can be done by discipline, parameter, location, etc.. The National Space Science Data Center's Master Catalog (NMC) at *http://nssdc.gsfc.nasa.gov/nmc/* provides information about the large amount of data archived at the NSSDC. It also provides brief descriptions of the spacecraft and experiments for all NASA-supported space missions. Queries are possible by spacecraft name, discipline, and launch date.

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NASA Master Directory: Data Set Information Query Form

This form can be used to submit queries to the NASA Master Directory. If you know what terms you wish to use for your query, just enter them in the appropriate boxes and submit the query with the form submit button. These values will be sent directly to the NMD server without validation at this time.

To query the database about valid values for any field, use the "Valids" button next to the field of interest.

You may also review sections of the DIF guide before proceeding with the search.

NOTE: The first 5 categories of search fields are cross-validated. Therefore, you must select the "Valids" buttons **one at a time** to ensure that you don't query the NMD server with an invalid combination of keywords.

| Submit Query | Reset |

Discipline: [＿＿＿＿＿＿＿] VALIDS

Subdiscipline: [＿＿＿＿＿＿＿] VALIDS

Parameter Group: [＿＿＿＿＿＿＿] VALIDS

Parameter: [＿＿＿＿＿＿＿] VALIDS

Location Keyword: [＿＿＿＿＿＿＿] VALIDS

Start Date (yyyy-mm-dd):   [＿＿＿＿]

Stop Date (yyyy-mm-dd):   [＿＿＿＿]

Source: [＿＿＿＿＿＿＿] VALIDS

Sensor: [＿＿＿＿＿＿＿] VALIDS

Campaign: [＿＿＿＿＿＿＿] VALIDS

Investigator Last Name: [＿＿＿＿＿＿＿] VALIDS

Data Center: [＿＿＿＿＿＿＿] VALIDS

The NASA Master Directory staff welcomes your comments and other feedback.

For questions about the NASA Master Directory, please contact:
Dr. James Thieman, thieman@nssdca.gsfc.nasa.gov, (301)286-9790
National Space Science Data Center, Code 633.2
NASA/Goddard Space Flight Center, Greenbelt, MD 20771

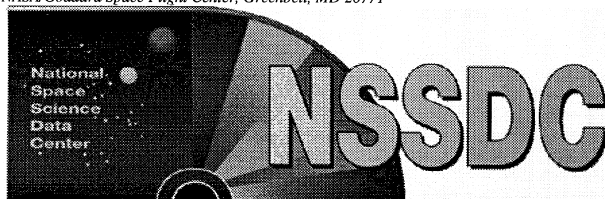National Space Science Data Center — NSSDC

Fig. 1. WWW Data Set Information Query Form of the NASA Master Directory (NMD).

There is a large amount of project-specific information available on the Web. Nowadays almost each and every organization and project involved in research relevant to STEP has pages on the WWW. A few examples are: (1) the Mesosphere, Lower Thermosphere Coupling Study project of STEP Working Group III (A. Manson, Chair) at *http://www.usask.ca/physics/mltcs/mltcsmain.html*); (2) the International Monitor for Auroral Geomagnetic Effects (IMAGE) project at *http://www.geo.fmi.fi/ image/index.html*; IMAGE consists of 19 stations main-
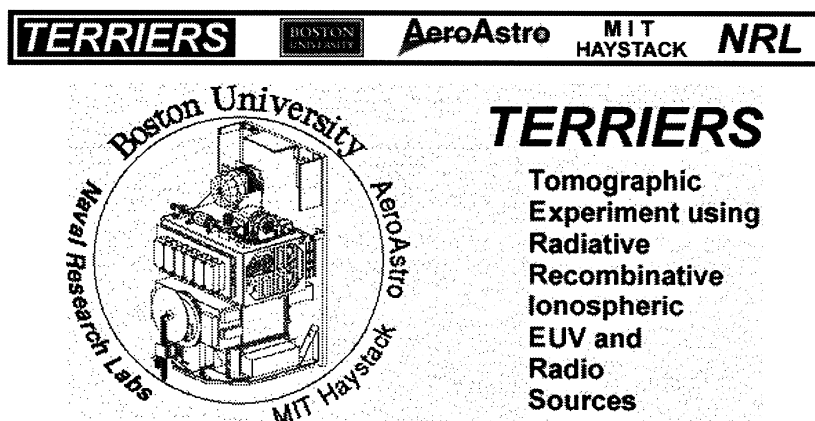
TERRIERS is a scientific research project involving a unique combination of <u>satellite</u> and <u>groundbased</u> instrumentation which will make unprecedented daily global measurements of the earth's ionosphere and thermosphere.

- <u>Mission Overview and Objectives</u>
- <u>The TERRIERS Satellite and Instruments</u>
- <u>Ground Support for Terriers</u>
- <u>Press Releases and Published Information</u>
- <u>Schedule of Events</u>
- <u>TERRIERS Photo Gallery</u>
- <u>Make your own TERRIERS satellite!</u>
- <u>The TERRIERS Team</u>
- <u>Other Small Satellite Links</u>

Your comments are important to us so that we can give you better information on what you want to know. Also if you have any questions relating to the project in any way mail them here and we will do our best to answer them.

Please Contact: <u>magjrrt@bu.edu</u>.

<u>Usage Information for This Site</u>

Fig. 2. WWW homepage of the TERRIERS satellite project.

tained by nine institutes from Finland, Germany, Norway, Poland, Russia and Sweden for the study of auroral electrojets and moving two-dimensional current systems; (3) the CANOPUS Canadian auroral network of automatic data collection stations at *http://canott.dan.sp-agency.ca/www/canopus_home.html*. CANOPUS transmits data by satellite telemetry to a central data analysis center in Ottawa; (4) the CLUSTER pages at *http://www.estec.esa.nl/spdwww/cluster/html/cluster.htm* with newest information about the redesigned mission; (5) the Danish Oersted Satellite project pages at *http://www.dmi.dk/projects/oersted/* whose goal is to provide a precise global mapping of the Earth's magnetic field; (6) the Tomographic Experiment using Radiative Recombinative Ionospheric EUV and Radio Sources (TERRIERS) pages at *http://net.bu.edu/terriers/* (see Fig. 2); TERRIERS is the first of NASA's Student Explorer satellites. A large collection of such pages related to Ionospheric/Thermospheric/Mesospheric physics can be found at the SPDS Ionosphere Thermosphere Mesosphere Home-page (*http://espsun.space.swri.edu/ITM/toc.html*). A similar page also exists for Magnetospheric physics at *http://leadbelly.lanl.gov/spds/SPDS-list-by-institution.html*. These last two pages were established as part of the NASA-sponsored Space Physics Data System (SPDS). From the SPDS home-page at *http://spds.nasa.gov/spds.html* there are also links to similar pages for Solar physics and for Cosmic and Heliospheric physics.

Searching for literature in relation to a certain science topic has become quite easy thanks to the Internet. Many libraries now let their visitors utilize Web-based searches for specific books or journal articles or for a specified topic/subject. The Library of Congress at *http://www.loc.gov* is a premier example.

The Internet is also being used for the regular dissemination of information to specific user groups. These electronic mailers have become very popular over the last few years and are now constituting a considerable part of the network e-mail traffic. Examples are the Library of Congress (to subscribe send the word 'lists' in the body of an e-mail to *listserv@loc.gov*), the Space Physics & Aeronomy (SPA) Newsletter of the American Geophysical Union (AGU) and the Geospace Environment Modelling (GEM) Messanger (contact for both: *editor@igpp.ucla.edu*), SolarNews (contact: *editor@solar.stanford.edu*). Information about publications and mailers of the American Institute of Physics can be found at *http://www.aip.org/*.

2. Access to data

The Web has done wonders in promoting the availability and accessibility of data. Because of the appeal and visibility of the WWW, projects now make it a high priority to provide data access from early on. A number of projects/missions actually provide access to data in real time, e.g., (1) Latest Solar Images obtained by SOHO, Yohkoh and ground-based telescopes at many wavelengths at *http://umbra.gsfc.nasa.gov/images/latest.html*; (2) Daily image of UV auroral activity from the POLAR spacecraft at *http://uvisun.msfc.nasa.gov/UVI/current_uvi_image.htm*; (3) Rice University's List of Real-Time Data at *http://space.rice.edu/ISTP/#RT*. NASA's Advanced Composition Explorer (ACE) satellite (*http://www.srl.caltech.edu/ACE/*, *http://www.gsfc.nasa.gov/ace/ace.html*) launched on 25 August. 1997 will provide continuous real-time solar wind information, which will give an advance warning (about 1 h) of geomagnetic storms that can affect electric power grids, Earth-orbiting spacecraft, and radio communications on Earth.

At the lowest level WWW pages may provide information about the data available at a certain site and about ways of accessing these data without actual providing access to the data. Examples are the CEDAR Data Base at *http://hao.ucar.edu/public/research/tiso/cedar/cat.textB.html#SEC1* and NGDC's Catalog of Available Ionosonde Data at *http://www.ngdc.noaa.gov/stp/IONO/ionocat.html*.

Data retrieval on the Internet is most often accomplished through ftp transfer from an anonymous account, e.g., NSSDC's ftp holdings at *nssdc.gsfc.nasa.gov/pub/* and NGDC's ionospheric ftp holdings at *ftp.ngdc.noaa.gov/STP/IONOSPHERE/*. This requires the data to reside *online* on magnetic disks. Access to larger volumes of data on cd-jukeboxes (*near-line*) is provided through automated mail retrieval systems that find the user-selected data (for the user-selected time period) and stage these data either in the host's or in the user's anonymous ftp area. One such system is the NSSDC's NDADS/Spycat system at *http://nssdc.gsfc.nasa.gov/space/ndads/spycat.html* (see Fig. 3). It provides access to a large amount of recent satellite space physics data including IMP, DE, ISEE, ISIS, Mariner, Pioneer, Phobos, Sampex, San Marco, Ulysses, Voyager high-resolution data and ISTP 1-min key parameters.

An example of a STEP-sponsored Web-accessible data source is the STEP Project 6.4 homepage (*http://www.ngdc.noaa.gov/stp/STEP/step6_4.html*) which provides access to 1-min data from approximately 100 worldwide magnetometer data. A STEP Database Catalog (*http://shnet1.stelab.nagoya-u.ac.jp/omosaic/step/step1.html*) is available at STELab Nagoya, Japan. Other data products in the international science arena may be found through the World Data Center system (*http://www.ngdc.noaa.gov/wdc/wdcmain.html*)

At an even higher level, systems provide plotting capabilities and data subsetting and format conversions. One such system is the SPDF's CDAWeb system at *http://cdaweb.gsfc.nasa.gov/cdaweb/sp_phys/*) that provides access to the ISTP 1-min Key Parameters and selected other space physics data (see Fig. 5). Other good examples are the UCB system for browsing through the FAST Summary Data (*http://sprg.ssl.berkeley.edu/htbin/fasttestcgi/sumplotsNetscape/recentplot.pl*) and the NGDC's Space Physics Interactive Data Resource (SPIDR) at *http://www.ngdc.noaa.gov:8080/index.html* for data retrieval and plotting of DMSP, GOES, and ionosonde data, and solar/magnetic indices and more.

3. Access to models

NSSDC's Model Pages at *http://nssdc.gsfc.nasa.gov/space/model/models_home.html* provide information about a large number of empirical solar-terrestrial models. This Web-based catalog of models is closely related to the STEP Project 6.7 (Directory of Solar-Terrestrial Models). Most of the models archived at NSSDC are retrievable from NSSDC anonymous ftp site at *nssdc.gsfc.nasa.gov/pub/models*. In addition several of the most frequently requested models (IRI, MSIS, IGRF, AE-8/AP-8) can be run online at *http://nssdc.gsfc.nasa.gov/space/model/models_home.html* (see Fig. 6).

The EnviroNET system (*http://envnet.gsfc.nasa.gov/*) provides access to some of the same models with run and plot capabilities but it requires user registration. EnviroNET's prime intent is to provide software tools for the development and testing of spacecraft payloads; models for the simulation of the solar-terrestrial environment are an integral part of this system.

A number of modelling groups have their own WWW pages with information about their work in progress and access to their most recent model products, e.g., the International Reference Ionosphere (IRI) Working at *http://nssdc.gsfc.nasa.gov/space/model/ionos/iri.html*, the GSFC Magnetospheric Modeling Group at *http://www-spof.gsfc.nasa.gov/Modeling/group.html*, the Rice Electro-Magnetic Field Modeling Group at *http://rigel.rice.edu/~ding/rfm.html*, and the Michigan IZMEM Electrodynamic Model Group at *http://www.sprl.umich.edu/MIST/izmem.html*.

Theoretical models are in general not directly accessible on the Internet since they require considerable computer resources and close collaboration with the model authors. Output from such models, however, is available for time periods of special interest in the form of graphs and movies. The Magnetospheric Specification Model (MSM: *http://rigel.rice.edu/~dmb/index.html*) developed at Rice University computes fluxes of energetic electrons and ions in real-time based on inputs from ground-based observatories and satellite data. The Assimilative

Space Physics Catalog (SPyCAT)

Welcome to SPyCAT, the space physics interface to NDADS(NSSDC's mass store system). Data retrieved from NDADS based on SPyCAT requests will be staged to NDADS mag disk for user pickup or may be FTP'd to users by NDADS.

Note that NSSDC has additional data from many of these missions - for further information click here: NSSDC Space Physics Data Index.
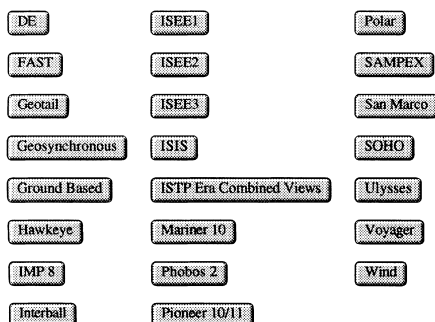
NOTICE: The system-wide year 2000 tests have been rescheduled for the week of November 9th - 13th, 1998. Access to this interface will be interrupted at that time. Please "bookmark" the URL http://ssdoo.gsfc.nasa.gov/~nancy/y2k/public.msg.html for more details and the latest continuing updates on y2k test plans and status.

NDADS Data Overview I Full NSSDC Data Catalog I What's New in SPyCAT

SPyCAT is brought to you jointly by the National Space Science Data Center (NSSDC) and the Space Physics Data Facility (SPDF) .

SPyCAT Request Buttons

Click on any of the following to access data for that mission.

|		
DE	ISEE1	Polar
FAST	ISEE2	SAMPEX
Geotail	ISEE3	San Marco
Geosynchronous	ISIS	SOHO
Ground Based	ISTP Era Combined Views	Ulysses
Hawkeye	Mariner 10	Voyager
IMP 8	Phobos 2	Wind
Interball	Pioneer 10/11	

SPyCAT Feedback
SPyCAT Help

Space Physics at the NSSDC
Catalog of all NSSDC (offline & network-accessible) Data
Space Physics Data Facility (SPDF)
National Space Science Data Center (NSSDC)

For questions about data or services of NSSDC, please contact
NSSDC Coordinated Request and User Support Office (CRUSO)
Telephone: 301-286-6695, FAX: 301-286-1771
Internet: request@ncf.gsfc.nasa.gov
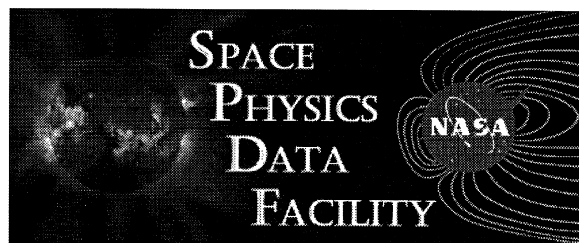
For questions or comments about SPyCAT, please contact:
Muriel Taylor, mtaylor@ndadsb.gsfc.nasa.gov , (301) 286-0191
Raytheon STX/NSSDC, Code 632, NASA/Goddard Space Flight Center, Greenbelt, MD

NASA Official: R.E. McGuire, Head, Space Physics Data Facility
(Code 632, NASA/GSFC), Robert.E.McGuire@gsfc.nasa.gov, (301)286-7794
Last Updated: March 26, 1997, CMG

Fig. 3. First Web page of the SPyCAT /NDADS interface for retrieval of space physics data.

Mapping of Ionospheric Electrodynamics (AMIE: *http://www.hao.ucar.edu/public/research/tiso/amie/AMIE_head.html*) procedure is an optimally constrained, weighted least-squares fit of electric potential distribution to diverse types of atmospheric observations. Knowledge of these distributions is important in many areas of magnetospheric, ionospheric, and thermospheric physics.

4. Space weather

With the increased presence of man in space and our increased dependence on space-based systems (Earth observations, telecommunication, etc.), improvements of space weather predictions have become an important driver for solar-terrestrial research and also an important

Data available on-line for STEP 6.4

In keeping with the STEP project goals we are pleased to make available here data the three years (90, 91, 92) of the STEP project.There are two ways to retreive the data using the Web.

You may use our STEP map to select data by region and year.
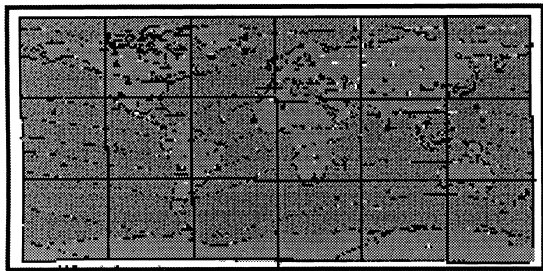
You may browse through the FTP server at your leisure.

If you wish to contibute your data to the STEP project please send e-mail to Les Morris at ldm@ngdc.noaa.gov to get details on the stations, formats and information required.

Please note: The files are large, please use the load to local hard disk option and not attempt to display them to screen.
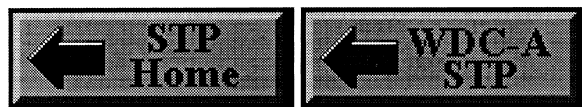
Fig. 4. STEP Project 6.4 Web page for access to ground magnetometer data.

driver for funding issues in the political arena. It is not surprising then that 'Space Weather' is a hot item on the Internet with many excellent WWW pages, e.g., the Space Weather Resources pages (*http://space.rice.edu/ISTP*) compiled at Rice University. They include links to real-time data sources, to models, to educational pages and many more.

Information about the current space weather conditions can be found at Space Weather Today (*http://www.windows.umich.edu/spaceweather/*) WWW pages setup jointly by the University of Michigan, Rice University and NBC's Channel 4 and at NOAA's Space Environment Center (*http://www.sel.noaa.gov/today.html*). One can also setup one's own monitoring station with the help of the Solar Warning and Real-time Monitor (SWARM: *http://solar.uleth.ca/solar/www/swarm.html*) software tool. It automatically fetches net-accessible data and indices to provide uptodate information about solar-terrestrial conditions.

Solar indices are an essential input for most atmospheric and ionospheric models. Predictions of future atmospheric conditions therefore depend critically on predictions of solar indices during the time period. Predictions concerning the next solar cycle can be found in the Solar Cycle 23 Project: Summary of Panel Findings (*http://www.sel.bldrdoc.gov/info/Cycle23.html*). For ionospheric models special ionospheric-effective solar indices have been proposed based on actual ionosonde measurements (e.g., Secan's SSNe index: *http://www. nwra.com/nwra/spawx/fof2/fof2.html*). Magnetic indices and real-time magnetometer data are available from the WDC in Kyoto, at *http://swdcdb.kugi.kyoto-u.ac.jp/*. NOAA's Space Environment Laboratory (SEL) provides real-time Planetary K-Index Plots (*http://www.sel.noaa. gov/planetary_k.html*) and NOAA/TIROS Hemispheric Power Input Plots (*http://www.sel.noaa.gov/hempower/ index.html*)

Recently an inter-agency initiative was started in the

CDAWeb Data Explorer

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

Start time (YYYY/MM/DD HH:MM:SS): | 1978/02/01 14:10:45
Stop time (YYYY/MM/DD HH:MM:SS): | 1978/02/01 14:11:30

❋ **Select an activity:**

○ Download CDFs : *press submit button to retrieve list of files.*
○ List Data (ASCII): *select one or more variables from list below and press submit. (Max. 31 days)*
◉ Plot Data : *select one or more variables from list below and press submit.*

❋ **Plotting Options**

☐ Use noise reduction to filter out values outside 3 deviations from mean.

[Submit] [Reset]

❋ **Variable parameters (required for Listing and Plotting data only)**

I2_AV_QUI

ISIS Topside Sounder Ionogram - R.F. Benson (NASA GSFC)

Available dates: 1973/09/19 04:08:06 - 1978/06/16 14:53:52
(Continuous coverage not guaranteed - check the inventory graph for coverage)

☒ Sounder amplitude at 223 virtual heights for fixed & swept frequency
☐ interpolated fixed & sweep frequencies

[Submit] [Reset]

❋ Notices/Warnings
❋ Data Inventory Graph
❋ ISTP Principal Investigators

HOME   **ABOUT**   **HELP**   **FEEDBACK**

Output Generated: November 3, 1998, TJK.

Fig. 5(a). NSSDC/SPDF's CDAWeb interface for plotting and listing of key space physics data.

I2_AV_QUI

ISIS–2   QUI>Quito   AV>Average Ionogram

TIME RANGE–1978/2/1 (32) to 1978/2/1 (32)
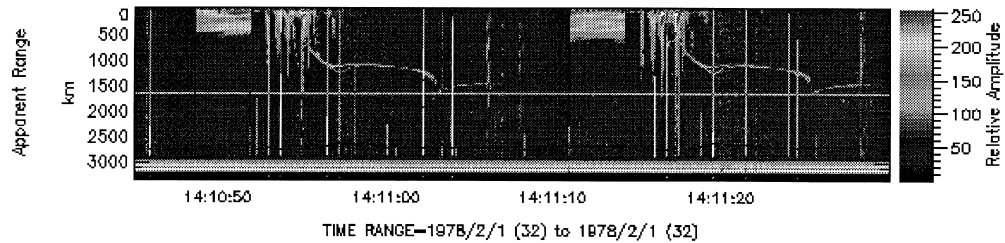
Please acknowledge data provider, R.F. Benson at NASA GSFC and CDAWeb when using this data.
Generated by CDAWeb on Tue Nov 3 11:54:05 1998

Notes on ISTP Key Parameters

HOME   ABOUT   HELP   FEEDBACK

For questions or comments about CDAWeb, please contact:
Tami Kovalick,   kovalick@nssdca.gsfc.nasa.gov , (301) 286-9422
Raytheon STX/NSSDC, NASA/Goddard Space Flight Center,
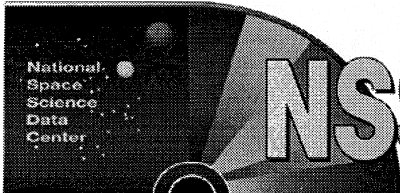*Greenbelt, MD 20771, USA*

National Aeronautics and
Space Administration

Goddard Space Flight Center

Responsible NASA Official:
Dr. Robert E. McGuire,   Robert.E.Mcguire@gsfc.nasa.gov , (301) 286-7794
Chief, Space Physics Data Facility, NASA/Goddard Space Flight Center,
Greenbelt, MD 20771, USA

Output Generated: November 3, 1998, TJK.

Fig. 5(b). CDAWeb plot of ISIS-2 topside sounder data.

Ionosphere - IRI-95

available IRI parameters are electron, ion and neutral (CIRA-86) temperatures, electron and 2+, NO+) densities.

Go to the IRI description

Use Form 1 to get parameters for one time/space point, or Form 2 to get profiles

Form 1.

Year(1958 - 2000, Dec): ▢
Note: User can enter sunspot number(Rz12) instead of year.
Month: | January ▾ | **Day(1 - 31):** ▢
Time | Universal ▾ | **Hour of day** (e.g. 1.5): ▢
Coordinates | Geographic ▾ |
Latitude(deg.,from -90. to 90.): ▢   **Longitude**(deg.,from 0. to 360.): ▢
Height above Earth's surface (km, from 60. to 2000.): ▢

User Input (optional):
NmF2/cm-3 (1000.-100000000.) or **foF2/MHz**(2.-14.): ▢
Note: Enter "1." to choose CCIR maps for NmF2/foF2, by default ("0.") the URSI maps are used.

hmF2/km (100. - 1000.) or **M(3000)F2**(1.5 - 4.): ▢

| Submit Query | | Reset |

Form 2

Choose the independent variable, e.g HEIGHT if you want IRI parameter profiles versus height:
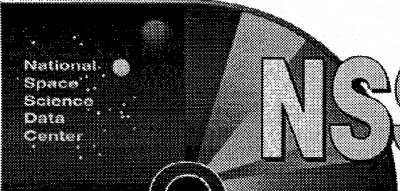
HEIGHT   LATITUDE   LONGITUDE   YEAR

MONTH   DAY OF MONTH   DAY OF YEAR   HOUR OF DAY

Go to the Models page
Go to the NSSDC Space Physics page

If you have any questions/comments about this model available from NSSDC, contact:
Dr. Dieter Bilitza, bilitza@nssdca.gsfc.nasa.gov , National Space Science Data Center, Mail Code 632, NASA/Goddard Space Flight Center, Greenbelt, MD 20771

ional Space Science Data Center, Mail Code 633, NASA/Goddard Space Flight Center,

Version 1.0, 20 October 1995
Last Updated: 20 February 1996, NEP

7050

Fig. 6. IRIWeb: Interactive Webpage for Computing International Reference Ionosphere (IRI) model parameters.

USA with the goal to improve space weather predictions (National Space Weather Program—The Implementation Plan: *http://www.ofcm.gov/nswp-ip/text/cover.htm*). An excellent summary of the science aspects of space weather can be found in a report of the Space Studies Board of the Commission on Physical Sciences, Mathematics, and Applications of the National Research Council (Space Weather: A Research Perspective: *http://www.nas.edu/ssb/elements.html*). Another interesting link in the space weather context is to a Chart that Links Solar, Geophysical Events With Impacts on Space Technologies (*http://www.agu.org/eos_elec/95183e.html*).

5. Project/campaign coordination and planning

International and national campaigns and projects have greatly benefited from their access to the Internet; e-mail, electronic mailers, WWW pages are essential tools in setting up collaborative research efforts and global multi-instrument campaigns. An example of an international coordination effort is the Inter-Agency Consultative Group (IACG: *http://iacg.org/*) that coordinates space missions undertaken by its four member agencies: the European Space Agency (ESA: *http://www.esrin.esa.it/*), the Japanese Institute of Space and Astronautical Science (ISAS: *http://www.isas.ac.jp/*), Russian Space Agency (IKI: *http://arc.iki.rssi.ru/Welcome.html*), and the National Aeronautics and Space Administration (NASA: *http://www.nasa.gov/*).

Several STEP campaigns have taken advantage of the WWW (e.g., see the SCOSTEP homepage at *http://www.ngdc.noaa.gov/stp/SCOSTEP/scostep.html*). One example is the International Auroral Study (IAS: *http://bolero.gsfc.nasa.gov/ias/ias.html*; see Fig. 7), which is STEP Project 2.6. Other STEP-related projects with many campaign-style pages include the NSF projects Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR: *http://hao.ucar.edu/public/research/tiso/cedar/cedar.html*) and Geospace Environment Modelling (GEM: *http://igpp.ucla.edu/gem/Welcome.html*), and the multi-satellite International Solar-Terrestrial Physics program (ISTP: *http://www-istp.gsfc.nasa.gov/*).

The WWW also provides access to a number of interactive systems that assist and support campaign and mission planning. The SPDF's SSCWeb (*http://sscweb.gsfc.nasa.gov/*) provides important tools for determining potential campaign periods (see Fig. 8). It lets users plot and tabulate the orbits of most satellites of interest for space physics, indicating also specific magnetospheric regions. It finds times of magnetic conjunctions between satellites and between satellites and ground stations and supports many more (even quite complex) queries for conjunctions between satellites, stations and regions. Another SPDF system computes helio-

centric coordinates for 12 spacecraft, two planets, and three comets in Solar Ecliptic (SE) and Heliographic (HG) (rotating and inertial) coordinates *http://nssdc/space/helios/heli.html*.

Also interesting in this context is a NSSDC/SPDF page that lets users convert from geographic coordinates to Corrected GeoMagnetic (CGM) coordinates and vice versa (*http://nssdc/space/cgm/cgm.html*). The NASA ISTP/SPOF facility supports campaigns and collaborative efforts by letting users browse through orbit plots and data for ISTP and collaborating spacecraft (*http://www-spof.gsfc.nasa.gov/cgi-bin/gif_walk*).

6. Public outreach and education

The WWW is the perfect tool for reaching out to the public and for helping educators in schools. A large number of links to space physics pages related to this effort can be found on NSSDC's General Public Page (*http://nssdc.gsfc.nasa.gov/nssdc/gen_public.html*) and on the Space Weather page of Rice University with Educational Links (*http://space.rice.edu/ISTP/#Education*).

Web-based educational materials and information for all grades can be found at the Space Science Institute in Boulder, Colorado *http://www-ssi.colorado.edu/1.html*. An Exploration of the Magnetosphere is provided by David Stern and Mauricio Peredo (*http://www-spof.gsfc.nasa.gov/Education/Intro.html*). Interesting facts and educational material about the ionosphere can be found at a site (*http://www.ips.gov.au/papers/*) of the Australian Ionospheric Prediction Service (IPS).

The Sodankyla Geophysical Observatory in Finland has compiled pages with beautiful auroral images (*http://space.sgo.fi/htmls/jpics.html*) and the mysterious sounds associated with the aurora can be heard at an IPS site (*http://www.ips.gov.au/papers/richard/auroral_sound_explan.html*). Of general interest and appeal are also the Web site with pictures and information about newly discovered phenomena like the Red Sprites and Blue Jets—upward lightning discharges (*http://elf.gi.alaska.edu/*; see Fig. 9) or Lou Frank's Small Comets (*http://smallcomets.physics.uiowa.edu/*).

The Solar and Heliospheric Observatory (SOHO) satellite has produced an impressive gallery of solar pictures (*http://sohowww.nascom.nasa.gov/gallery*) and some fun-filled educational activities (*http://solar-center.stanford.edu*). NASA has just begun the KidSat program (*http://www.jpl.nasa.gov/kidsat/*) that will bring space exploration into the classrooms via the Internet. Students are involved in planning observations and using images from Shuttle-based cameras to study the Earth's dynamic, and fragile, environment.

The real front runners in terms of network hits (public interest) have been JPL's Hale-Bopp Comet page at

THE INTERNATIONAL AURORAL STUDY
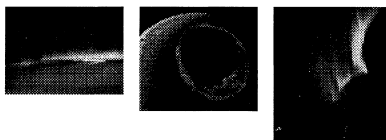
Welcome to the IAS Homepage

You are our visitor since March 1, 1996

The International Auroral Study (IAS) is a coordinated international program for studying the Northern and Southern aurora using multiple and simultaneous space-based and ground-based observations. The IAS is Project 2.6 of the Solar Terrestrial Energy Program (STEP) and the Project Leader is Dr Cindy Cattell of the University of Minnesota. The general time period for the study is 1996-1998 and a series of specific campaign intervals will be selected based upon the predicted positions of a series of spacecraft and ground observation sites which will include opportunities for intense study of both the Northern and Southern aurora. The first broad campaign period was the Northern winter of 1996/97 (December 1996 through March 1997).

If you are interested in being part of the IAS please complete the
Participant's Contact Information Form

What's New?

- New conjunction lists for FAST, EISCAT and Polar are now availble for:
  January 1998
  February 1998

Announcements and Bulletins

- IAS Status Bulletin -
  January 1997
- IAS Status Bulletin -
  November 1995

Rules of the Road

- Rules for accessing the IAS databases and distributing data.

IAS Meetings

- Comming Soon...

Educational Programs

- Coming Soon...

TABLE OF CONTENTS

- **Project Description and Science Objectives**

- **Data Management Plans**
  Identifies plans for establishing databases to support the coordinated IAS data analysis effort.

- **Campaign Timeline and Criteria**
  Approximate schedule for determining campaign products through December 1996 and criteria to be used for determining the IAS intervals.

- **Project Leaders and Campaign Coordinators**
  E-mail addresses, postal addresses, FAX numbers, and telephone numbers for campaign personnel.

- **Project and Campaign Participants**
  Names, affiliations and e-mail addresses of campaign participants. If the included information is incorrect or you wish to be added to this list, please contact Cindy Cattell

- **Participant's Interest Areas**
  Identifies the theory programs, observation programs, etc., in which individual participants are involved.

- **Preliminary Conjunctions and Campaign Intervals**

- **Spacecraft Support**
  Links to information on primary and secondary IAS spacecraft and information on rocket flights.

- **Aircraft Flights**
  Poker Flat aircraft flights.

- **Ground-Based Observation Sites**
  Instrument descriptions, site locations, and contact points for all world-wide ground-based observations. Potentially, many of these will be important during the IAS campaign. A number of the ground-based observers have declared their interst in the IAS and appear in the participants list

Related WWW Pages

- Michigan Technological University - General Auroral Information
- See an example of the damage to power systems on Earth that can be caused by geomagnetic storms.
- University of Minnesota Space Physics Homepage

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Fig. 7. Homepage of the STEP Project 2.6 International Auroral Study (IAS).

SSC Query Form

Standard Interface

Go to the command menu

Spacecraft/Time Range Selection

Satellites	Time Range

ACE
Active
Akebono
APEX-MAIN
CCE (AMPTE/CCE)
Cluster-1
CRRES
DE-1
DE-2
DMSP-10
DMSP-11
DMSP-12
DMSP-13
DMSP-14
DMSP-8
DMSP-9
Equator-S
FAST
Freja
Geotail
	Valid Date/Time Formats:
	
	Date yyyy ddd
	   yyyy/mm/dd
	   yyyy-mmm-dd
	
	   hh.hhhh
	Time (Optional) hh:mm:ss
	   hh:mm

Start Time (inclusive) [ ]

Stop Time (inclusive) [ ]

Query Conjuction Condition Type

○ Ground Station ○ Lead Satellite ● Region

Satellite Combination

● All Satellites ○ At Least [ ] Satellites

Command Menu			
1	*REQUIRED INPUT*	**2**	*INPUT SUMMARY*
	OPTIONAL INPUT	**3**	*EXECUTION OPTIONS*
Interface Style:			

 SSCWeb Home Page

Known bugs for SSCWeb

Comments or Questions?

Please send your comments or questions to ssc@sscweb.gsfc.nasa.gov.

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Greenbelt, MD 20771
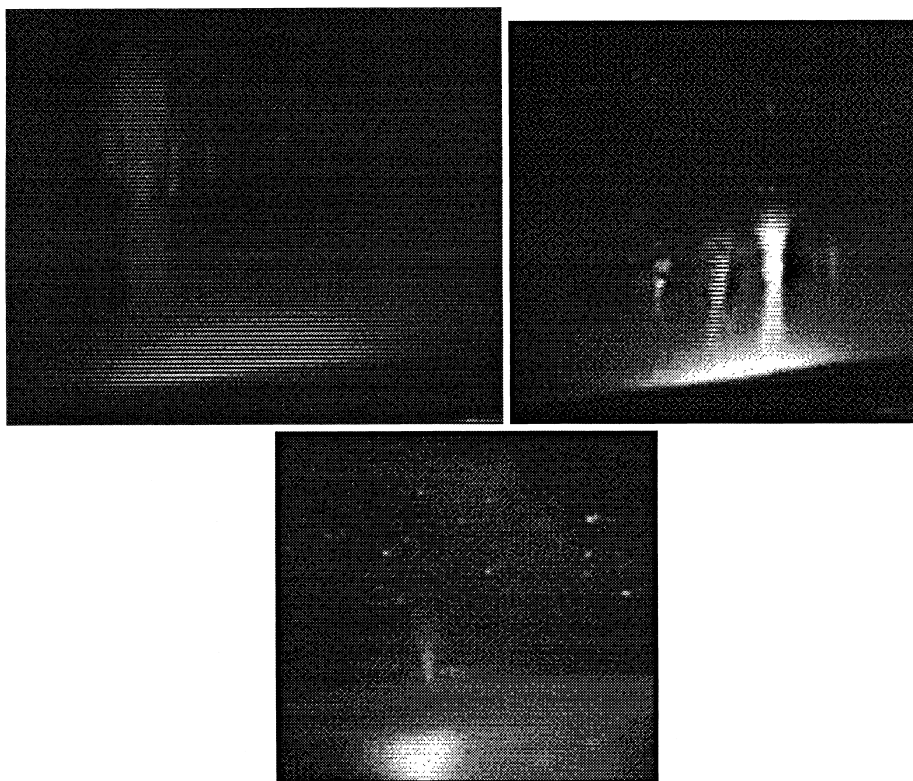
Developers

Gregory C. Galiardi

Tamara Kovalick

Richard T. Baldwin

Page generated on: 3 Nov 98 at 11:52

Fig. 8. SSCWeb interface to list and plot satellite orbit information and to explore conjunctions between spacecrafts and/or regions and/or ground sites.

Red Sprites and Blue Jets

For a more recently updated page, see <u>Sprites</u> Current field research is <u>underway</u> in the High Plains of the United States. We have imaged sprites from the aircraft and hope to have quick look results up this afternoon. Also, Stanford University has some <u>incredible images</u> showing high spatial resolution from a Dobsonian telescope. Please email <u>me</u> with any more links for this summers research.

- Introduction
- Characteristics of Red Sprites
- Characteristics of Blue Jets
- Why Haven't Sprites and Jets Been Reported Before?
- How to Look For Sprites and Jets
- Current Research Focus
- Speculations
- References
- Related Topics
- Report Observations

Fig. 9. New phenomena page: Red Sprites and Blue Jets.

http://www.jpl.nasa.gov/comet/index.html with 16.7 million hits in April 1997 and now a total *36 million* hits, and the Mars Pathfinder (*http://mpfwww.jpl.nasa.gov*), which showed a steady stream of *45 million* hits per day following Sojourner's landing on 4 July 1997; the Pathfinder site has 17 reflector sites around the world. The Mars 1998 Surveyor lander will carry a microphone, thus giving Internet users not only eyes but also ears on Mars; surely this will give NASA a new WWW hits record!

Reference

Peters, R., Sikorski, R., 1997. Smarter Searching—Search Engines. Science 277, 976–977.