Using the Virtual Observatory Concept - data, models and educational materials

Goal - find the right balance of data/model holdings, portals and client software that a researchers can use without effort or interference as if all the materials were available on his/her local computer.

The prototype Virtual Solar-Terrestrial Observatory (VSTO) is proposed to be a distributed, scalable education and research environment for searching, integrating, and analyzing observational, experimental and model databases in the fields of solar, solar-terrestrial and space physics (SSTSP). VSTO would comprise a system which provides virtual access to specific SSTSP data, model, tool and material archives containing items from a variety of space- and ground-based instruments and experiments, as well as individual and community modeling and software efforts bridging research and educational use. The prototype would be a fully functional system addressing a substantial need within the SSTSP community, allowing science projects to advance more rapidly. E.g. in solar coronal physics there is a need to cohesively assemble multi-wavelength images of the dynamic solar upper atmosphere. Space weather model inter-comparisons, and Assimilative Mapping of Ionospheric Electrodynamics results need to be distributed to their communities.

In discussions with data providers and users, the needs are clear:

``Fast access to `portable' data, in a way that works with the tools we have; information must be easy to access, retrieve and work with.''

Too often users (and data providers) have to deal with the organizational structure of the data sets which varies significantly --- data may be stored at one site in a small number of large files while similar data may be stored at another site in a large number of relatively smaller files. There is an equally large problem with the range of metadata descriptions for the data. Users often only want subsets of the data and struggle with getting it efficiently. One user expresses it as:

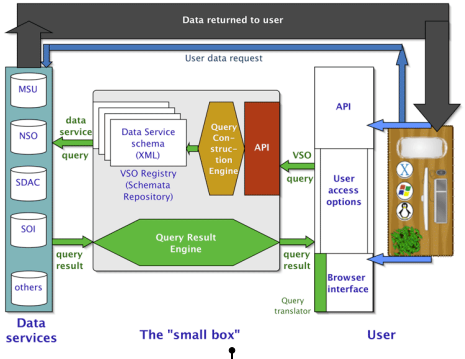
``(Please) solve the interface problem.'' VSTO will address this specific problem.

Datasets alone are not sufficient to build a virtual observatory. The VSTO must address the interface problem to bring data to the users' tools, and to the tools within the VSTO, effectively and scalably. VSTO will leverage the development of schema(e.g VSO, Earth System Grid, VHO) that adequately describe the syntax (name of a variable, its type, dimensions, etc. or the procedure name and argument list, etc.) and semantics (what the variable physically is, its units, etc. or what the procedure does and returns, etc.) of the datasets and tools.

A Grid-enabled (http://www.globus.org) virtual observatory minimizes the time to make data available and usable. Data does not have to be moved or reformatted, only registered with the catalog. It is then available from the VSTO web portal or the user's preferred application which has access to the VSTO interfaces. The Center for Integrated Space-Weather Modeling (CISM: http://www.bu.edu/cism) is an NSF STC project in community science. Its goals and mission are broad and its collaborators are geographically distributed. Its model intercomparison needs for Space Weather are clear but the capability to effectively manage and present those models is yet to be developed or implemented. Beyond that there is also the lack of a framework for building and distributing advanced data assimilation tools

Integration and coordination with Virtual Observatories, Data Centers, Data Systems

Virtual Solar Observatory - Current Architecture design



VSO development (see presentations at this meeting) has produced working implementations of this "small box". Current developments for VSTO have addressed the data services and transport and the user interface taking into account the VSO schema and query support. As a result, VSO and VSTO will interoperate.

Current Mauna Loa Solar Observatory website at HAO with images of the day.

Current Virtual Observatories and Grid Projects - a sample

Virtual Solar Observatory - http://www.virtualsolar.org/
National Virtual Observatory - http://www.us-vo.org/
International Virtual Observatory Alliance - http://www.ivoa.net/
ASTRO-GRID - http://www.astrogrid.org/
Virtual Space Physics Observatory -
SkyView Virtual Observatory - http://skyview.gsfc.nasa.gov/
Chabot's Virtual Space and Science Center - http://www.chabotspace.org/vsc/observatory/default.asp

European Grid of Solar Observations - http://www.mssl.ucl.ac.uk/grid/egso/
Astrophysical Virtual Observatory - http://www.euro-vo.org/
Australian Virtual Observatory - http://www.aus-vo.org/
GRIDs and Virtual Observatories - http://www.ict.csiro.au/Grid/virtual_observatory.htm
Virtual Heliospheric Observatory -
Open and Distance Education Virtual Observatory - http://www.odeluce.stir.ac.uk/virtual.htm

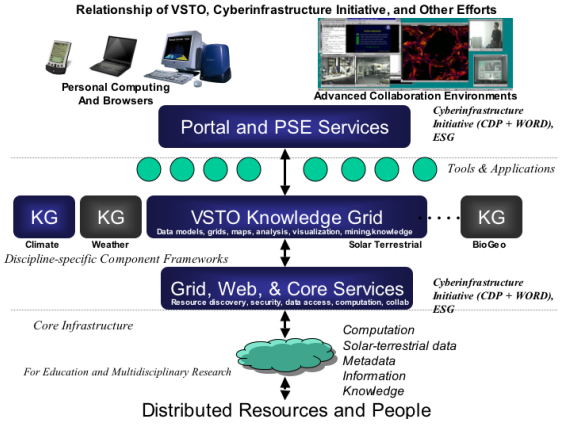
HAO contribution to data holdings for the VSTO

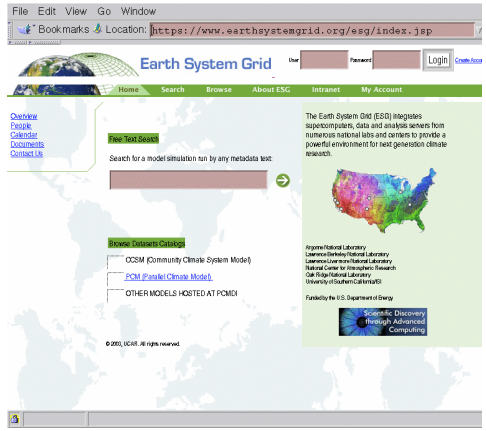
Initial HAO holdings: Advanced Coronal Observing System (ACOS, also in VSO), the Advanced Stokes Polarimeter (ASP), and the accompanying Community Inversion Codes (CIC), the Precision Solar Photometric Telescope (PSPT), Experiment for Coordinate Helioseismological Observations (ECHO), STellar Astrophysics and Research on Exoplanets (STARE), CISM models}, TIME-GCM models, Assimilative Mapping of Ionospheric Electrodynamics models (AMIE), the entire CEDAR database, some collaboration elements of SPARC and HAO's education/outreach materials} based on existing web materials, and many others.

ACKNOWLEDGEMENTS: Don Middleton (NCAR/SCD), Stan Solomon (NCAR/HAO)

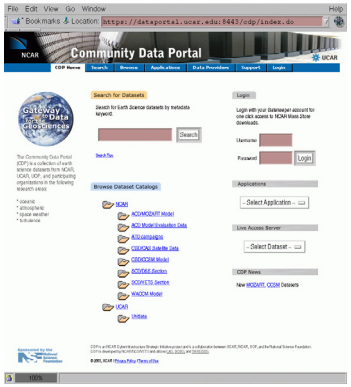
FURTHER READING: http://vsto.hao.ucar.edu/

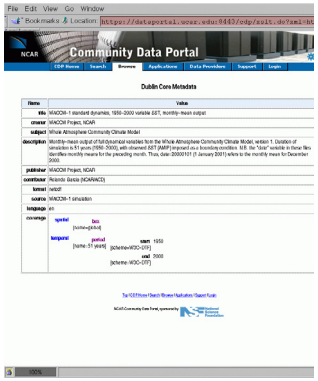
Functionality





Technology

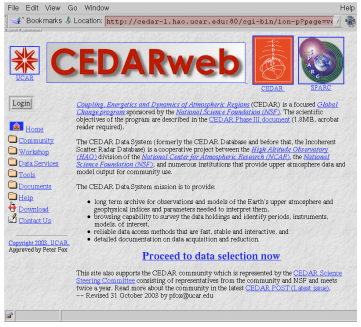




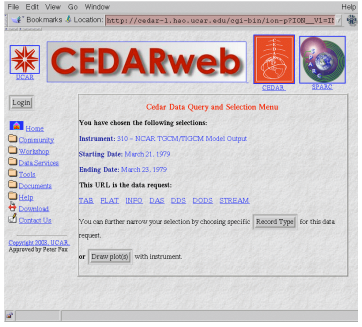
Building on experience

The CEDAR (Coupled Energetics and Dynamics of Atmospheric Regions) is an NSF focused global change program. NCAR hosts the CEDAR database, a collection of data from a variety of ground instruments, models and indices.

The CEDAR Data System mission is to provide:
• long term archive for observations and models of the Earth's upper atmosphere and geophysical indices and parameters needed to interpret them,
• browsing capability to survey the data holdings and identify periods, instruments, models, of interest,
• reliable data access methods that are fast, stable and interactive, and
• detailed documentation on data acquisition and reduction.



CEDARWEB main page



CEDARWEB main data selection page

CEDARWEB has been dev eloped and improved over more than 10 years of interaction with users, data providers, and a community steering committee. Each of these elements has directly contributed to changes in what services are provided, what information and materials are made available via the web site and what levels of authorization and authentication are required.

Biggest lesson: *we have plenty of technology, so get close to the people and listen to them to build something that is useful and*