

MAPPING LOCAL SOLAR DATA TYPES

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ABSTRACT

Solar physics and heliospheric study have arrived at the era of the Virtual Solar Observatory (VSO). The VSO gathers data from observation stations and data centers geographically distributed throughout the world, providing data from multiple spectral bands. In this paper, the author briefly analyzes the existing data model and presents a description of our local data (that is produced at the Huairou Solar Observation Station) in a well-defined way. The work lays the foundation for querying our data in VSO. It forms the beginning for adding additional search elements and categories to the VSO, therefore providing an infrastructure for a web site of the solar physics domain in China.

Keywords: VSO, EGSO, Metadata, Interoperability, Solar physics

1 INTRODUCTION

The VSO (the VSO study group, 2000) provides the world with a unified query interface for more efficient identification and utilization of solar data from a world-wide range of sources. This integrated access to a wide variety of solar data sets greatly accelerates progress of many significant solar scientific problems.

A unified query of data sources needs to interpret heterogeneous data resources, and only a unified data model can guide the interpretation of these heterogeneous data sources. The data model consists of metadata. Astronomical observational data are stored as arrays of information. The access, understanding, and utilization of these arrays generally require external information called metadata to describe their contents. The metadata contain information that describes the means by which the data were acquired, the coverage that was achieved, and other details that record the motivation and applicability of the data. A definition of metadata is the identification of data of interest for a chosen research area as well as the reduction and analysis of those same data and the merging of metadata from multiple sources. Meanwhile the data model provides a reference for defining new types of data. Defining the metadata is of great importance to the VSO.

There are four types of metadata (Reardon, 2003): a) observational metadata, describing the contents of the stored datasets; b) administrative metadata, describing the organizations, resources, and means of accessing those resources; c) derived metadata, describing additional information extracted from observational data, in particular, lists of solar features and events; and d) processing metadata, describing the way in which the dataset was operated upon and modified. The Huairou Solar Observation Station collects multiple types of data, and its transverse field data, used in the study of solar magnetic fields, cannot be replicated anywhere in the world. In the following section, the author refers to the first two metadata types. The author has analyzed metadata defined in the VSO and EGSO (European Grid Solar Observations) and presents a definition of our own local metadata corresponding to them. This is for the use of international corporations, service to users, and data mining.

2 SOLAR DATA MODELS

The solar data model is used to provide an abstraction and simplification of the realities of the solar physics domain based on the VSO operations. The data model provides a common understanding of the various concepts that makes up the VSO. There are two kinds of data models present in the solar physics domain: the VSO data model and the EGSO data model. The VSO data model is based on the VSO search parameters and was constructed earlier than the EGSO. The EGSO data model involves wider contents. In this article we map our local data definitions on the VSO data model. (VSO data model, 2005; EGSO data model, 2003).

3 REGISTRY ELEMENTS, SEARCH ELEMENTS, AND LOCAL DEFINITIONS

To query the data sources, registry technology is used. The registry elements are provided by the data provider and are used for locating and identifying data resources. The corresponding values of search elements are different in different observational stations and instruments. Table 1 presents VSO registry elements and the local corresponding values. The names of registry elements are in the first line of the table. The corresponding values are in the other lines. An explanation of the abbreviations in Table 1 is listed in Table 2:

Table 1. Registry Elements and Local Corresponding Value

Provider	Source	Instrument ID	Instrument name	Physobs	Spectrum	Time Range	Data Layout	Observed Region
HSOS	HSOS	SMFT	Solar Magnetic Field Telescope	vector_magnetic_field	5324 Angstrom	1987.06.12-now	image	Local area
HSOS	HSOS	SMFT	Solar Magnetic Field Telescope	vector_magnetic_field	4861 Angstrom	1987.06.12-now	image	Local area
HSOS	HSOS	SMFT	Solar Magnetic Field Telescope	LOS_velocity	4861 Angstrom	1987.06.12-now	image	Local area
HSOS	HSOS	SMFT	Solar Magnetic Field Telescope	intensity	5324 Angstrom	1987.06.12 - now	Image	Local area
HSOS	HSOS	SMFT	Solar Magnetic Field Telescope	intensity	4861 Angstrom	1987.06.12 - now	Image	Local area
HSOS	HSOS	10Fd Halpha	10cm Full-disc & Local Halpha Telescope	intensity	6563 Angstrom	2000.01.28 - now	image	Full-disk or Local area
HSOS	HSOS	20FdVM	20cm Full-disc Vector Magnetograph	vector_magnetic_field	5324 Angstrom	1991.09.27 - now	Image	Full-disk

Table 2. Full name of Chinese solar stations and instruments used in Table 1

Abbreviated Name	Full Name
HSOS	Huairou Solar Observing Station
SMFT	Solar Magnetic Field Telescope
10FdHalpha	10cm Full-disc & Local Halpha Telescope
20FdVM	20cm Full-disc Vector Magnetograph

Additionally, a sample of combinations of common search parameters are given below:

H-alpha image:

Observable=**intensity**, Data_Layout=**image**, Wave_Type=**line**, Wave_Minimum≥**6561**,
Wave_Maximum≤**6565**

Vector magnetogram:

Observable=**vector_magnetic field**, Data_Layout=**image**, Wave_Type=**line**

Full-disk magnetogram:

Wave_Type=**line**, Data_Layout=**image**, Observable={**vector_magnetic field**|**LOS_velocity**},
|Observation_Center_West|≥**20**, |Observation_Center_North|≥**20**, Bounding Radius≤**800**

We briefly describe the corresponding relationships between the local data search system and the VSO search

system. It is common in solar physics and in the whole astronomical community to store observational data and their associated metadata together in the same physical file through a structured header that organizes metadata. The file is called FITS (Flexible Image Transport System) (The FITS Support Office, 1979). The header may vary among different observatories. The metadata elements are represented by keywords in the FITS header. Our local definitions include the FITS Keywords stored in the data file and XML file expressions. Because observational metadata are automatically recorded in a FITS file, we add corresponding FITS keywords of some VSO registry elements mentioned above to the FITS file. The keywords are listed below:

Table 3. FITS keywords

Registry elements	FITS keywords and its values
Spectral Range	wave_type='line'
Physical_Observable	phys_obs='intensity' or 'vector_magnetic_field' or 'LOC_velocity'
Data organization	data_org='image'
data source	observty='HSOS' instrumt='SMFT' or '10FdHalpha' or '20FdVM'

4 FURTHER EFFORTS

For constructing a unified data information system and providing more effective global services, we will plan to analyze our local data definition in comparison to the data model of EGSO.

5 REFERENCES

Reardon, K. European Grid of Solar Observations. Retrieved October 9, 2003, from the World Wide Web: <http://www.egso.org/>

Reardon, K. Unified Model for Solar Metadata (EGSO data model). Retrieved October 3, 2003, from the World Wide Web: <http://www.mssl.ucl.ac.uk/grid/egso/documents/DataModelv1.4.pdf>

The FITS Support Office. FITS Documentation. Retrieved March, 1997, from the World Wide Web: <http://fits.gsfc.nasa.gov>

The VSO study group. VSO White Paper. Retrieved May 25, 2000, from the World Wide Web: <http://vso.nso.edu/vsowp.pdf>

VSO data model, Retrieved May 2, 2005, from the World Wide Web: <http://vso.stanford.edu/datamodel/v18.html>