## Virtual Observatory Concept

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 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 comprises a framework 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. 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 small 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.

Datasets alone are not sufficient to build a virtual observatory. The VSTO addresses the interface problem bringing data to the users’ tools, and to the tools within the VSTO, effectively and scalably. VSTO leverages the development of schema (e.g. CEDAR, MLSO, Earth System Grid, SPDMML) that adequately describe the syntax (name of a variable, its type, dimensions, etc.) or the efficient access (name of a variable, its type, dimensions, etc.) or the efficient access to variables, etc.)

## Solar-Terrestrial System

[Diagram of the Solar-Terrestrial System]

### CEDAR: Instrument Classes
- **Lidar**
  - Digisol (Icey/Apply, MeasuresTo, etc.)
  - Doppler Spectrometers (IR/0H)
  - Angle/Imagers (All-Sky Cameras, Lidar)
- **Photometers**
- **Spectrometers**
- **Michelson Interferometers**
- **Spectrometers**
- **Radar**
- **Interplanetary**
- **Neutral Atmosphere**
- **Earth Realm**

### Parameters and Units
- **Neutral Temperature**
- **Neutral Wind**
- **Neutral Pressure**
- **Neutral Mass Number**
- **Electron Temperature**
- **Electron Density**
- **Ion Temperature**
- **Ion Density**

### Excerpt from EarthRealm.owl

```
<!-- OWL: A knowledge representation framework (www.w3.org/2004/02/owl) -->
<owl:Class rdf:ID="Thermosphere"/>
```

### Excerpt from SunReal.owl

```
<!-- OWL: A knowledge representation framework (www.w3.org/2004/02/owl) -->
<owl:Class rdf:ID="Heliosphere"/>
```

### Excerpt from Properties.owl

```
<!-- OWL: A knowledge representation framework (www.w3.org/2004/02/owl) -->
<owl:Class rdf:ID="BuildingDensity"/>
```

### GLOSSARY

- **SPDMML**: Space Physics Data Markup Language, sd-www.jhuapl.edu/SPDMML
- **CEDAR**: Coupled Energies and Dynamics of Atmospheric Regions, cedared.ucar.edu
- **ACOS**: Advanced Coronal Observing System, acos.hao.ucar.edu
- **EISCAT**: Swedish International (Nordic) Ionosphere Radars, eiscat.usu.edu
- **ACOR**: Advanced Coronal Observing System, scnera.hao.ucar.edu

### Use-Case 1

**Excerpt from Use-Case 1**

```
1. User signs into portal application (or otherwise accesses application with or without authenticating)
2. User goes through a series of views to select (in order) the desired observatory, instrument, record-type (kind of data), parameter, start and stop dates, and the plot type (should this be inferred)? At each step, the metadata extraction determines the range of available options in the subsequent steps. If an alternate parameter is selected, the experiment, and/or instrument, etc.
3. The user request is passed to the user request (an authorized user) to access the specific kind of data. Then it verifies the logical correctness of the request, i.e. if the Millstone Hill is an observatory that operates a type of instrument that measures neutral temperatures. If so, then Millstone Hill/FPI-observatory and check that the range of the parameters properly on the Millstone Hill Fabry-Perot Interferometer subsystems neutral temperature. Also, the application must verify that no necessary information is missing from the request.
4. The application processes the user request to locate the physical storage of the data, returning for example a URL-like expression: find Millstone Hill FPI data of the correct type (operating mode, defined by CEDAR/ASIS) and the given time range (Millstone Hill Fabry-Perot Interferometer subsystems neutral temperature. Also, the application must verify that no necessary information is missing from the request.)
5. The application plots the data in the specified plot type (time series). This step involves extracting the data from records of one or more files, creating an aggregate array of data with independent variable time (at a day or day/time depending on time range selected) and passing this to a procedure to create the resulting image.
```