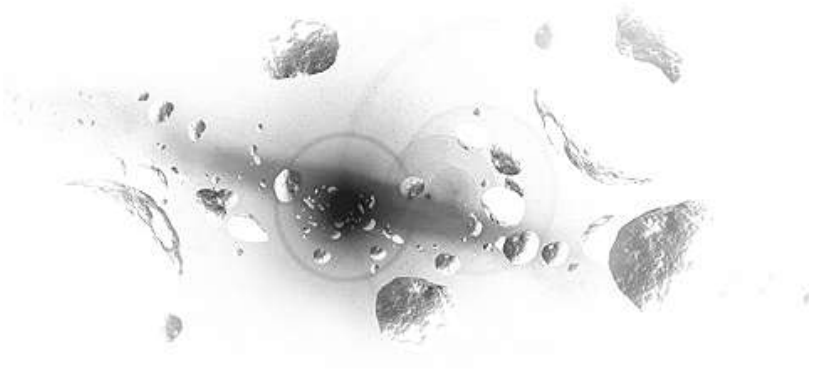

# Chapter 2

# 2. Existing Space Science Applications

The Sonification application xSonify can be used as mentioned in the introduction as an independent stand alone program as well as an additional software module for one of the following described space science applications. How to implement exactly xSonify as an additional module into one of them will be explained in one of the technical chapters later. In this chapter I would like to give an overview of the considered applications.

Before I start with the introduction of the existing space science applications I think it is necessary to familiarize the reader of this thesis a little bit with the field of research of the Earth's magnetosphere. All the tools are working with the data of this field of space science.

## 2.1 Magnetosphere Introduction

The magnetosphere is a region around an astronomical object, for instance the Earth's magnetic field. It is confined by the solar wind plasma blowing outward from the Sun. The magnetosphere can extend to distances in excess of 60,000 kilometers from the Earth.

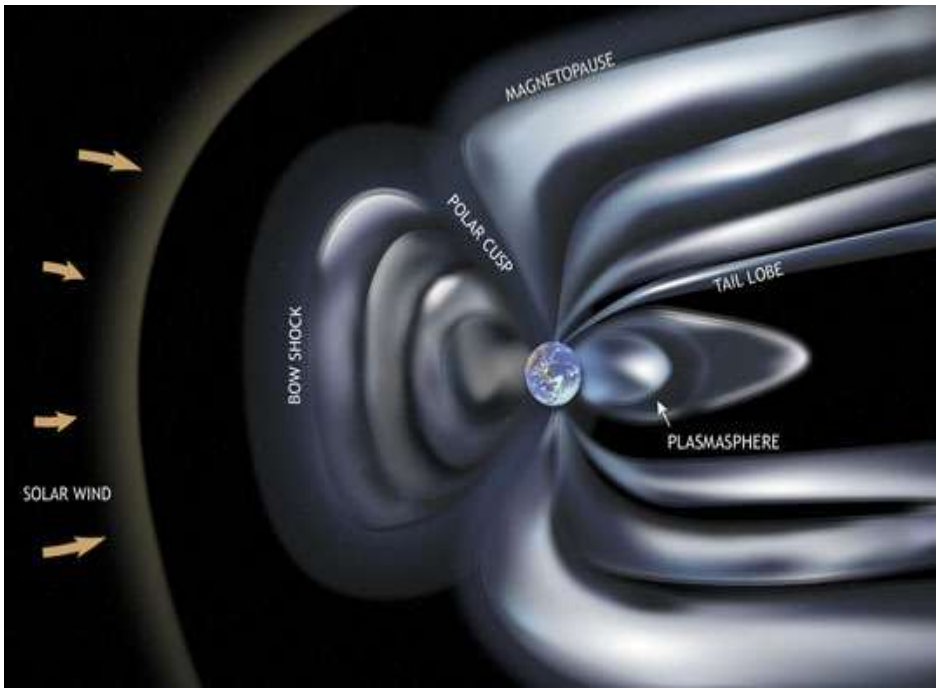


*Figure 2.1: Magnetosphere*

It is formed from two essential components. One of them is the Earth's magnetic field which is basically generated by currents flowing in the Earth's core. The form of this field outside the Earth has the same form as that of a bar magnet – a dipole field aligned approximately with the Earth's spin axis.

The other component is the solar wind which is a fully ionized hydrogen/helium plasma that streams continuously outward from the Sun into the solar system. This wind is therefore composed of protons and alpha particles, together with electrons.

The Earth's ionosphere is the third component and plays also an important role. The upper atmosphere is partially ionized by far-ultraviolet and X-rays from the Sun above altitudes of about 100 kilometer. The resulting ionosphere forms a second source of plasma for the magnetosphere.

To enhance the perceptions in research of this and other fields of space science, NASA has send out several spacecrafts in Sun's and Earth's orbit collecting data which are processed and archived in the NSSDC[1].

1 NSSDC: National Space Science Data Center, NASA GSFC
http://nssdc.gsfc.nasa.gov/

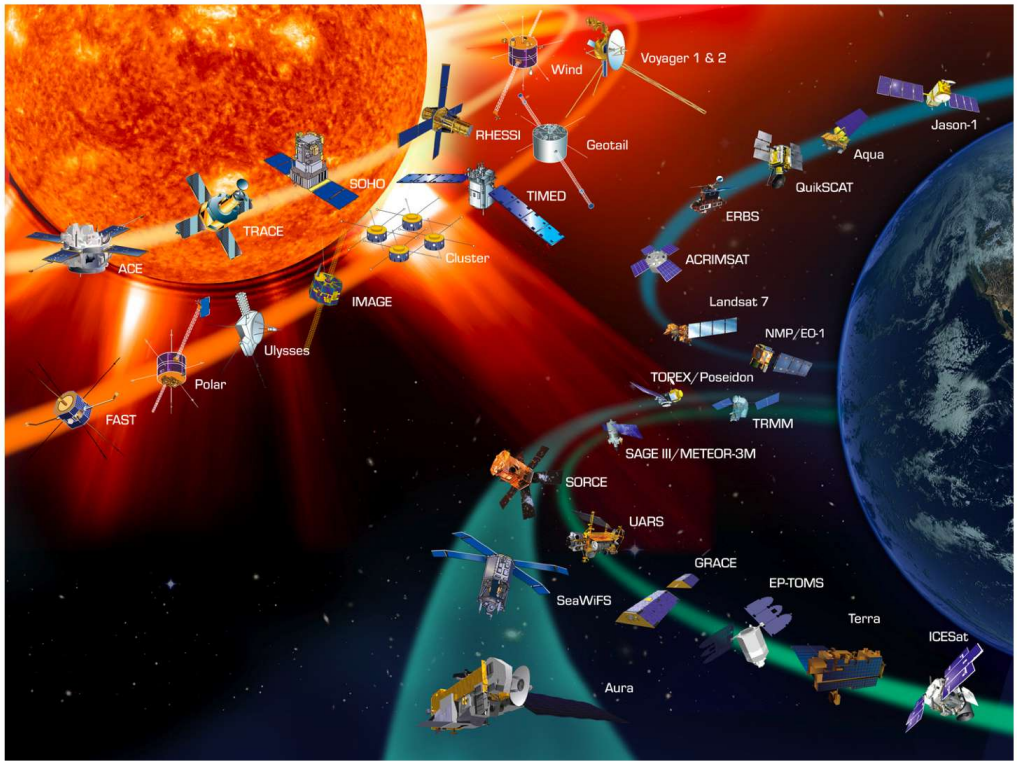


*Figure 2.2: Spacecrafts In Orbit*

These data are the base of modern research and can be accessed for example via the CDAWeb[2] which offers the scientists Java and web interfaces to access the data in a database.

2 CDAWeb: Coordinated Data Analysis Web, NASA GSFC
http://cdaweb.gsfc.nasa.gov/

## 2.2 TIPSOD

As the name TIPSOD[3] (Tool for Interactive Plotting, Sonification, and 3D Orbit Display) already describes, this software application is designed for interactive, animated, 4D (3D + time) visualization of satellite orbits.

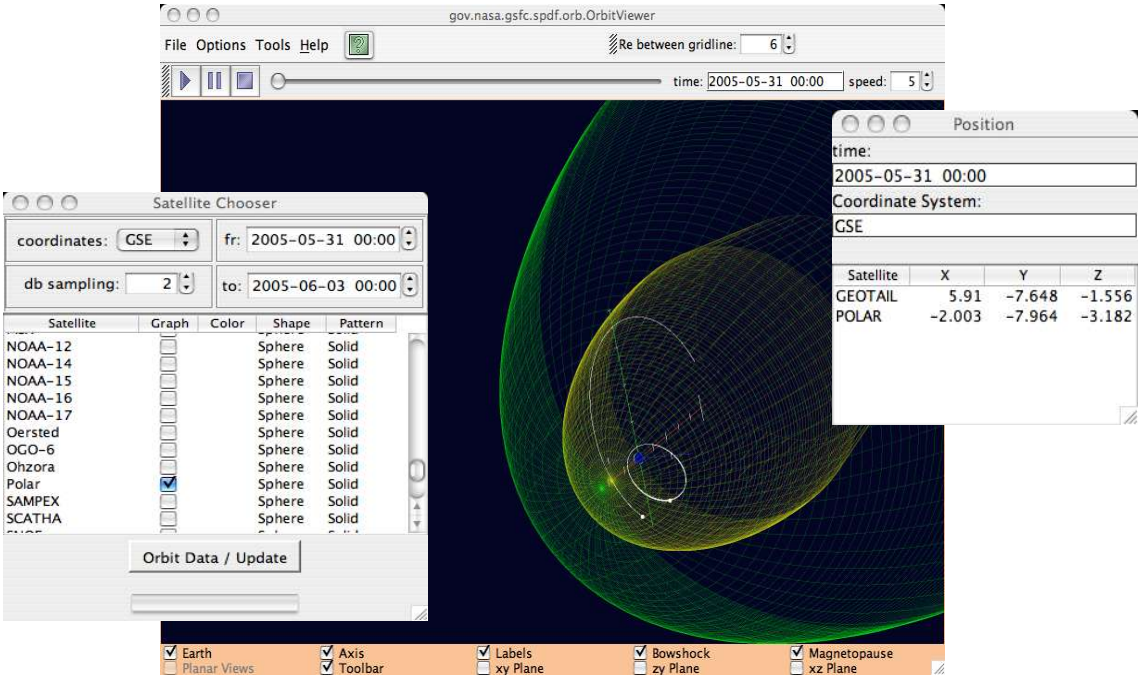


*Figure 2.3: TIPSOD*

It utilizes the SSCWeb[4] services programming interface to communicate with SSC logic and database over the open protocols of the Internet. TIPSOD is implemented in Java 3D and makes it possible to display satellite orbits. In addition to satellite orbits, the software computes and displays the Sibeck's magnetopause and Fairfield's Bow Shock surfaces. The displays are time-dependent through user activity. The program is used as a projection or interpretation tool by the scientific community.

The requested spacecraft(s) can be chosen in the “Satellite Chooser” window. Additionally to the selection of spacecraft(s) this window can also be used to specify the search by changing parameters like the time range and to change the display attributes of the satellites like the shape.

Another window called “Position” display the current position of the spacecraft dependent on the type of the selected coordinate system.

3 http://sscweb.gsfc.nasa.gov/tipsod/
4 SSC: Satellite Situation Center
http://sscweb.gsfc.nasa.gov

## 2.3 VISBARD

ViSBARD[5] displays data in three dimensions along the orbits which may be displayed either as connected lines or as points. The application provides a way of visualizing multiple vector and scalar quantities as measured by many spacecraft at once.

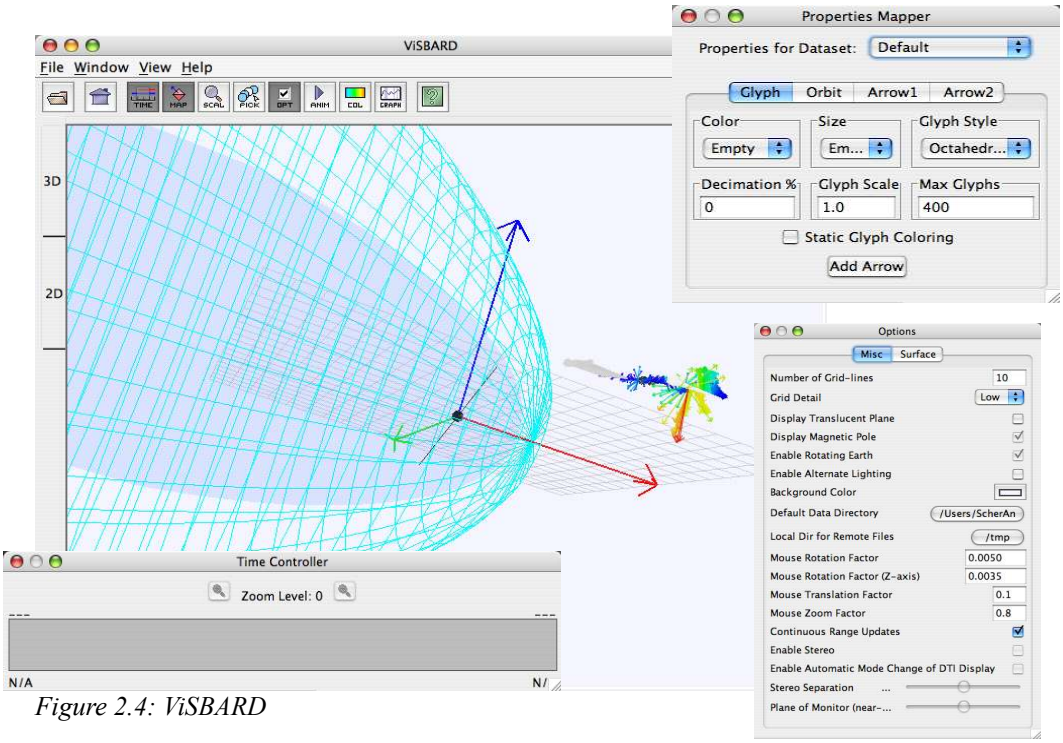


*Figure 2.4: ViSBARD*

The data display allows the rapid determination of vector configurations, correlations between many measurements at multiple points, and global relationships. Things such as vector field rotations and dozens of simultaneous variables are very difficult to see in panel plot representations. The data are displayed 3D along the orbits which may be displayed either as connected lines or as points. ViSBARD is linked to the NSSDC's CDAWeb repository via a SOAP interface for direct access to space physics data.

In future it will be linked to a Virtual Space Physics Observatory to allow direct access to a wide variety of datasets. The data may be read into ViSBARD as file formats like ASCII or CDF.

The application is platform independent since it is written in Java. It also supports stereoscopic hardware for 3D viewing.

5 ViSBARD: Visual System for Browsing, Analysis, and Retrieval of Data http://windsor.gsfc.nasa.gov/selected_software/visbard/

The dialog “Resource Toolkit” is the data import module of ViSBARD to retrieve the data from a local file or a SOAP connection via the Internet. I would like to emphasize this part of the ViSBARD application because it found its reincarnation in xSonify.

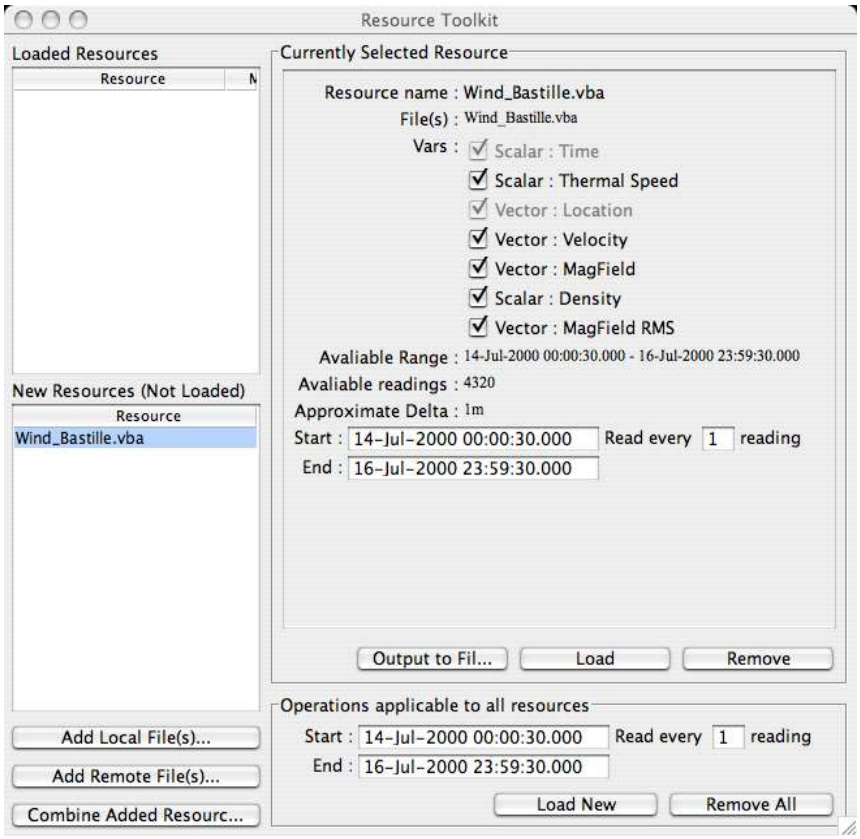


*Figure 2.5: ViSBARD's Resource Toolkit*

As soon as the file(s) are loaded either via the Internet or from a local file the header information of the file(s) is displayed in the “Currently Selected Resource” area. Further specifications of the desired spacecraft data can be made like the time range and the variables. Finally the data can be retrieved by clicking the “Load” button.

## 2.4 CDA Web +

CDAWeb Plus is a Java based interface for integrated access to all existing SPDF[6] services and public data including CDAWeb itself, SSCWeb, OMNIWeb, COHOWEB, ATMOWeb, ModelWeb as well as the file-level holdings on the NSSDC and selected other FTP sites.

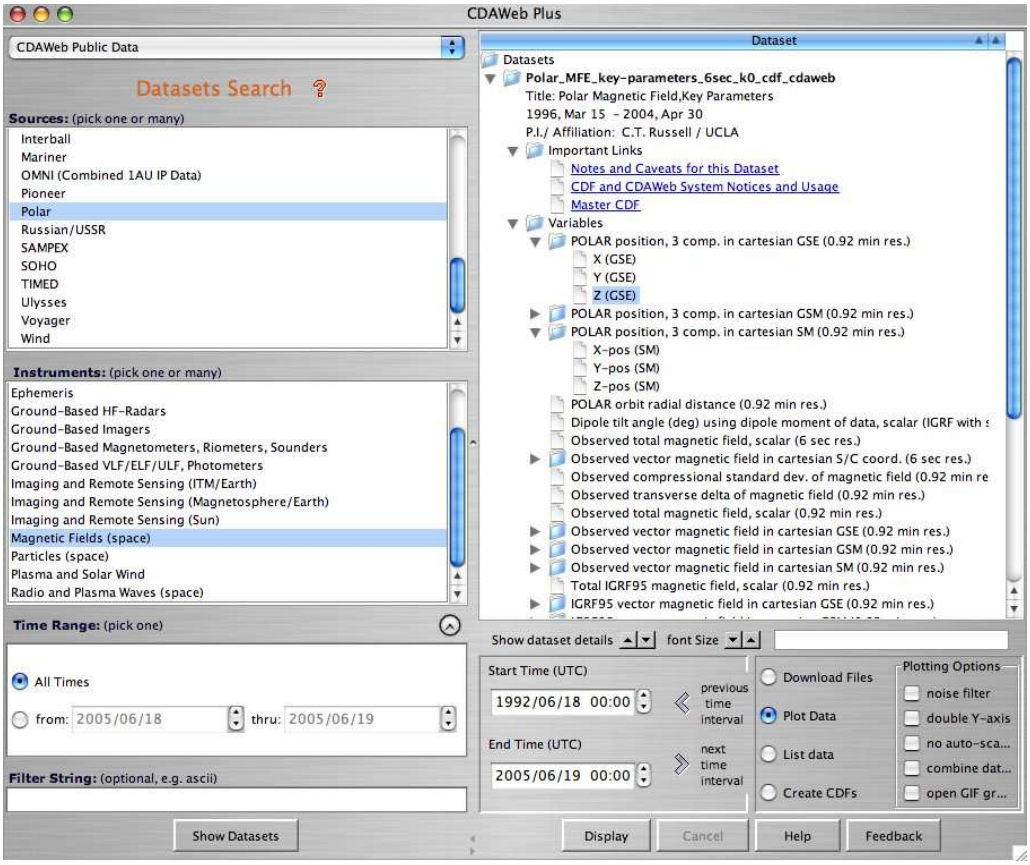

*Figure 2.6: CDAWeb Plus*

In the “Sources” area the spacecrafts of interest can be selected. As second step every spacecraft has a variety of instruments which can be chosen in the “Instruments” area. After the time range is specified and the button “Show Datasets” was clicked the “Dataset” panel lists the results for the previous selections. The results are a list of datasets, beginning with the name and additional information like the “Date” and “Author” and furthermore “Important Links”. It also lists the “Variables” for each result dataset if they are available. This depends on the previous selection of spacecraft, instrument and time range. The “Variables” can be selected and the four options in the lower right panel can be applied on it. They can be downloaded as files if the option “Download Files” was selected and appear after the download as CDF files. The option “Plot Data” opens after the selection an additional window or

6 SPDF: Space Physics Data Facility, NASA GSFC
http://spdf.gsfc.nasa.gov/

dependent on the chosen option a HTML browser window instead and displays the data as a plot within the created window. “List Data” creates a list of the chosen variables within a new created window with all the detailed header information at top. The last option “Create CDFs” out of the variables opens a dialog box with the request for downloading the created CDF file.