Towards the Development of a Unified Distributed Date System for L1 Spacecraft

Year One Progress Report

MIT PI: Alan J Lazarus
MIT CO-I: Justin C Kasper
NASA-Goddard, NNG04GH11G
MIT Account #6896169

## 1. Summary and review of objectives

The purpose of this grant, "Towards the Development of a Unified Distributed Data System for L1 Spacecraft", is to take the initial steps towards the development of a data distribution mechanism for making in-situ measurements more easily accessible to the scientific community. Our obligations as subcontractors to this grant are to add our Faraday Cup plasma data to this initial study and to contribute to the design of a general data distribution system.

The year 1 objectives of the overall project as stated in the GSFC proposal are:

1. Both the *rsync* and *Perl* based data exchange tools will be fully developed and tested in our mixed, Unix, VMS, Windows and Mac OS X data service environment. Based on the performance comparisons, one will be selected and fully deployed. Continuous data exchange between all L1 solar wind monitors initiated.
2. Data version metadata will be agreed upon, fully documented, and deployed on our data sites.
3. The first version of the data description rules, encoded in a XML Schema, will be finalized.
4. Preliminary set of library routines will be collected, documentation standards and formats agreed on, and desirable routines that have not been implemented identified and assigned.
5. ViSBARD test site implemented to independently validate data mirroring procedures.

The specific MIT tasks over the duration of this project are the following:

a) Implement mirroring service for WIND plasma data
b) Participate in XML Schema development
c) Contribute toward routine library

## 2. Description of year 1 work at MIT

Work at MIT in the first year of this project centered on overall project goals 1-3 through work on MIT tasks (a) and (b). The two main components of this work are the creation of an ASCII format text data file for the processed Wind SWE Faraday Cup hydrogen and helium datasets and the installation of the rsync data exchange software on the CSR computer network.

### 2.1 Generation of ASCII data files

Wind/SWE Faraday Cup ion data are converted from raw binary data into structured IDL save files with calibrated measured currents and spacecraft ephemeris. The key parameter "KP"

analysis code (which analyzes the data using a non-linear least-squares fit to an isotropic Maxwellian velocity distribution) run by both MIT and NASA is applied within hours of receiving data from Wind and the resulting KP data products (hydrogen bulk speed, number density, temperature) are available within one day on the web. MIT also produces a more detailed analysis of the same raw data, currently with a delay of several months, in which hydrogen and helium are characterized through non-linear fitting of *bi*-Maxwellian velocity distribution functions. Since 2001 the bi-Maxwellian data have been made available through the NSSDC in yearly increments with delays of at least one year from the arrival of the raw data at MIT.

The data prepared for the NSSDC are in 20-day ASCII files generated by the IDL program *prepare_bimax_nssdc.pro* at the end of each year and in the event of a re-processing of archival data. Under the grant from GSFC, a new program was created, based on the NSSDC data product, called *gen_bimax_ascii_interval.pro*, to generate ASCII data files for individual days. This program has been run on the available data from the start of the Wind mission through summer 2004 and text data files have been generated. In the future we may consider generating smaller, more clearly documented data files using the CDF format, for example. In the mean time we're sticking with the ASCII files and including a header in each file to explain the contents (see Appendix A for an example).

## 2.2 Installation of *rsync* server

We have installed the rsync software as requested by Dr. Szabo on a computer on the CSR network, birkeland.mit.edu, with access to the Wind data files. A file system was created "/nfs/faraday/d9/wind/vho/" to house data related to the VHO project. Currently the sole subdirectory of this system is "wind_swe_fc_apbimax", which holds the Wind SWE data.

We have tested synchronizing data using rsync over the local network, and we have just learned at the Fall 2004 AGU meeting that GSFC was able to connect to MIT and view the available files. Currently access to the data is limited to MIT and the GSFC computers lepszel.gsfc.nasa.gov and zathras.gsfc.nasa.gov.

## 3. Plans for future work

We will progress with our future assignments as described in the original grant. In particular we will continue working on an xml description of the SWE plasma data (and plasma data in general). In addition to the xml we have identified the following path to making full use of the rsync system:

1. Implement regular downloading of 3-second MFI data from GSFC.
2. Run bi-Maxwellian analysis of SWE Faraday Cup data as soon as they are available from GSFC as determined by rsync
3. Immediately make processed SWE data available through rsync.

## Appendix A: Sample data file header

```
; Project: WIND/SWE Faraday Cup (Proton-Alpha Anisotropy Analysis)
; Description: Solar wind proton and alpha parameters, including anisotropic
;  temperatures, derived by non-linear fitting of the measurements
;  and with moment techniques.
; Filename:
/nfs/faraday/d9/wind/vho/wind_swe_fc_apbimax/wi_swe_fc_apbimax.2000363.txt
; Author: J. Kasper (jck@mit.edu) 1 (617) 253-7611
```

; 12        One sigma uncertainty in trace thermal speed
; 13        Proton thermal speed Wperpendicular (km/s) from non-linear analysis
; 14        One sigma uncertainty in Wperpendicular [km/s]
; 15        Proton thermal speed Wparallel (km/s) from non-linear analysis
; 16        One sigma uncertainty in Wparallel [km/s]
; 17        East-West flow angle (degrees)
; 18        One sigma uncertainty in EW flow angle
; 19        North-South flow angle (degrees)
; 20        One sigma uncertainty in NS flow angle
; 21        Proton number density Np (n/cc) from non-linear analysis
; 22        One sigma uncertainty in Np [n/cc]
; 23        Alpha bulk speed V (km/s) from non-linear analysis
; 24        One sigma uncertainty in V [km/s]
; 25        Alpha velocity component Vx (GSE, km/s) from non-linear analysis
; 26        One sigma uncertainty in Vx [km/s]
; 27        Alpha velocity component Vy (GSE, km/s) from non-linear analysis
; 28        One sigma uncertainty in Vy [km/s]
; 29        Alpha velocity component Vz (GSE, km/s) from non-linear analysis
; 30        One sigma uncertainty in Vz [km/s]
; 31        Scalar alpha thermal speed (km/s) trace of anisotropic temperatures
; 32        One sigma uncertainty in trace thermal speed
; 33        Alpha number density Na (n/cc) from non-linear analysis
; 34        One sigma uncertainty in Na [n/cc]
; 35        CHISQ/DOF for this fit
; 36        Proton bulk speed (km/s) from moment analysis
; 37        Proton velocity component Vx (GSE, km/s) from moment analysis
; 38        Proton velocity component Vy (GSE, km/s) from moment analysis
; 39        Proton velocity component Vz (GSE, km/s) from moment analysis
; 40        Proton thermal speed W (km/s) from isotropic moment analysis
; 41        Proton thermal speed Wperpendicular (km/s) from bimax moment analysis
; 42        Proton thermal speed Wparallel (km/s) from bimax moment analysis
; 43        Proton number density Np (n/cc) from moment analysis
; 44        Magnetic field component Bx (GSE, nT) averaged over plasma measurement
; 45        Magnetic field component By (GSE, nT) averaged over plasma measurement
; 46        Magnetic field component Bz (GSE, nT) averaged over plasma measurement
; 47        Angluar deviation of magnetic field over plasma measurement [degrees]
; 48        Deviation in magnitude of field over plasma measurement [nT]
; 49        X (GSE) Position of Wind S/C at start of spectrum [Re]
; 50        Y (GSE) Position of Wind S/C at start of spectrum [Re]
; 51        Z (GSE) Position of Wind S/C at start of spectrum [Re]
; 52        Y (GSM) Position of Wind S/C at start of spectrum [Re]
; 53        Z (GSM) Position of Wind S/C at start of spectrum [Re]
;
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