README FOR STEREO PLASTIC PROTON VALIDATED DATA FILES

Last update: January 26, 2015 (ABG, LE, KDS)

Data Usage:

Data provided by the PLASTIC team at the University of New Hampshire is under NASA grant NNX13AP52G.

Proton data provided here is courtesy of K. Simunac, A. Galvin, and L. Ellis.

STEREO solar wind data presented are meant to provide an overview of large-scale solar wind behavior and for selection of interesting event periods.

These data are delivered to the public domain as soon as possible. Efforts are made to include the latest known calibration and background determinations, however, these are expected to undergo revision. We therefore suggest that users regularly return to this page, and check the "Modification History" at the end of this "Read_me" file.

If used in presentations or publications:

We strongly suggest that Dr. Galvin (toni.galvin@unh.edu) and Dr. Simunac (K.Simunac@unh.edu) be contacted to ensure that you are working with the latest release.

Please acknowledge STEREO PLASTIC Investigation (A.B. Galvin, PI) and NASA grant NNX13AP52G.

For reporting purposes, we request bibliography information for any publication, etc., using these data. Please send information on the use of this data to the PLASTIC PI:

Dr. A.B. Galvin
toni.galvin@unh.edu

If you have questions regarding the data and formats, please contact the PLASTIC Data System Manager:

Dr. Lorna Ellis
lorna.ellis@unh.edu

File Format:

ASCII files are tab-delimited text.
CDF files are Common Data Format.

File Naming convention:

STx_L2_PLA_1DMax_1min_YYYMMDD_Vvv.cdf
STx_L2_PLA_1DMax_1min_YYYMMDD_DOY_Vvv.txt
STx_L2_PLA_1DMax_10min_YYYYMM_Vxx.txt
STx_L2_PLA_1DMax_1hr_YYYY_Vxx.txt

Where:
"STx" is given as "STA" or "STB" for STEREO A and STEREO B, respectively.

"L2" indicates Level 2 data in the STEREO PLASTIC convention.

"PLA" indicates Plasma and Suprathermal Ion Composition (PLASTIC) Investigation.

"1DMax" indicates the proton V, Tkin, Vth, Np, and N/S angle were calculated from a 1D Maxwellian fit, as described below.

"1min", "10min", "1hr" indicates the averaging interval (instrument cadence is 1 minute). Daily files are created in both CDF and ASCII formats. In addition, the ASCII data are provided in monthly "10 min" files and yearly "1 hr" files.

"YYYY", "MM", "DD", "DOY" represent Year, Month, Day of Month, and Day of Year, respectively.

"Vxx", indicates Version number, with the processing version given by the "xx."

"txt" or "cdf" indicates ASCII file and Common Data Format, respectively.

STEREO PLASTIC PROTON PARAMETERS FROM 1D MAXWELLIAN FITS:

Proton bulk parameters provided here (except E/W angle) are derived from a 1D Maxwellian fit to a single detector rate (no coincidence required), and are corrected for background and dead time. The E/W angle is derived from a double coincidence rate using a position mapping routine. The proton velocity components are corrected for spacecraft aberration and are derived using the N/S and E/W angles.

Missing data is given as -1E+31.

Parameters provided in the 1-minute data sets:

The first set of parameters gives the time the data were acquired:

1. YEAR: Year of cycle start time

PLASTIC has a ~1 minute energy per charge (E/Q) cycle in which the electrostatic analyzer (ESA) steps through 128 logarithmically spaced E/Q steps from ~80 keV/e, down to ~0.3 keV/e.

2. DOY: Day of year of cycle start time

3. hour: Hour of cycle start time

4. min: Minute of cycle start time

5. sec: Second of cycle start time

6. millisec: Millisecond of cycle start time

7. date and time: Cycle start time (format yyyy-mm-dd/hh:mm:ss)

8. 1 keV/q time:
Time within cycle corresponding to E/Q =1 keV/e (format yyyy-mm/dd/hh:mm:ss). This parameter is only provided for the 1-minute data sets.

The next set of parameters give the solar wind proton data:

9. Np [1/cc]: Solar wind proton number density (protons per cubic centimeter)

10. Bulk speed [km/s]: Proton bulk speed (s/c frame)

11. Tkin [deg K]: Proton kinetic temperature

12. v_th [km/s]: Proton thermal speed, defined here as sqrt(2kT/m)

13. N/S Inst. [deg]:
Proton North-South flow angle in the INSTRUMENT COORDINATE SYSTEM. This coordinate system does not compensate for aberration (spacecraft movement) nor for spacecraft attitude. This parameter is included for verification purposes, only.

14. E/W Inst. [deg]:
Proton East-West flow angle in the INSTRUMENT COORDINATE SYSTEM. This coordinate system does not compensate for aberration (spacecraft movement) nor for spacecraft attitude. This parameter is included for verification purposes, only. To decrease "jitter" a three-period (7-period) moving average is used for STA (STB). This running average is also incorporated into the HERTN and RTN components.

15. Vr HERTN [km/s]:
    Proton radial velocity component in the HERTN system. The effects of aberration and spacecraft attitude have been removed.

16. Vt HERTN [km/s]:
    Proton tangential velocity component in the HERTN system. The effects of aberration and spacecraft attitude have been removed.

17. Vn HERTN [km/s]:
    Proton normal velocity component in the HERTN system. The effects of aberration and spacecraft attitude have been removed.

18. N/S HERTN [deg]:
    Proton North-South flow direction in the HERTN system. The effects of aberration and spacecraft attitude have been removed.

19. E/W HERTN [deg]:
    Proton East-West flow direction in the HERTN system. The effects of aberration and spacecraft attitude have been removed.

20. Vr RTN [km/s]:
    Proton radial velocity component in the RTN system. The effects of aberration and spacecraft attitude have been removed.

21. Vt RTN [km/s]:
    Proton tangential velocity component in the RTN system. The effects of aberration and spacecraft attitude have been removed.

22. Vn RTN [km/s]:
    Proton normal velocity component in the RTN system. The effects of aberration and spacecraft attitude have been removed.

23. N/S RTN [deg]:
    Proton North-South flow direction in the RTN system. The effects of aberration and spacecraft attitude have been removed.

24. E/W RTN [deg]:
    Proton East-West flow direction in the RTN system. The effects of aberration and spacecraft attitude have been removed.

The next set of parameters is included in the "10min" and "1hr" files:

25. Num Cycles (Np, v_therm, temp):

Number of 1-minute cycles used in average of Np, v_th, Tkin.

26. Num Cycles (Speed): Number of 1-minute cycles used in average of Bulk Speed.

27. Num Cycles (NS_inst):
    Number of 1-minute cycles used in average of instrument coordinate system N/S flow angle.

28. Num Cycles (Vel. Com., Other Angles):
    Number of 1-minute cycles used in average of velocity components, and other N/S, E/W flow angles.

The next set of parameters is for data quality control:

29. Error Code:
    0 = no known issues
    1 = Processing error, data removed
    2 = Data Level 1 error
    3 = Data overflow (rate compression code saturated)
    4 = Data outside 3-sigma limit (1 hr window)
    5 = Data gap (usually due to operations), data removed
    6 = Jump in thermal speed, use caution on all parameters
    7 = Suspicious thermal speed. Density, temperature, and thermal speed removed
    8 = Removed through manual check

Note: Starting with August 2014 data, for the 10-min and 1-hr data, error codes of 5 and 8 are ignored. Rather, the num_cycles data products show how many cycles during the time period are included.

30. Caution Code:
    The caution code is an indication of how sensitive the density value is to the method used for determining the background correction. The caution code can also indicate periods when the solar wind speed falls outside the range of the usual 1-minute data product and a 5-minute cadence product is substituted to minimize data gaps.
    - 0 = no issues (<5% effect on density calculation)
    - 1 = minor issues (5-10% effect on density calculation)
    - 2 = use with caution (>10% effect on density calculation)
    - 5 = 5 minute cadence data, use with caution

31. Attitude Flag (roll):
    This flag indicates the s/c roll angle is not nominal, possibly due to a spacecraft maneuver. Although efforts are made to correct the data, use all data with caution, particularly component and density values.

32. Attitude Flag (yaw):
    This flag indicates the s/c roll angle is not nominal, possibly due to a spacecraft maneuver. Although efforts are made to correct the data, use with caution.

33. Attitude Flag (pitch):
    This flag indicates the s/c roll angle is not nominal, possibly due to a spacecraft maneuver. Although efforts are made to correct the data, use with caution.

34. E/W Source Flag:
    Indicates which solar wind sector channel (Main or S-chan) was used in the analysis.

35. E/W Missed Peak Flag:
    0 indicates no issues.
    > 0 use with caution, as the peak of the speed distribution may not be represented.

36. Reduced Chi^2: Reduced Chi-square of the 1D Maxwellian fit.

37. E/W Rel Stat Uncertainty (%):
    An indication of the relative uncertainty from the number of counts available in determining the E/W flow direction (sqrt(n)/n), where n is the number of counts in the peak of the position array. Higher % indicates higher statistical uncertainty.

The next set of parameters provide Carrington Rotation and spacecraft trajectory information:

38. Carr. Rot.: Carrington Rotation Number relative to the given spacecraft.

39. Spcrft. Long. [Carr, degrees]: Carrington Longitude relative to the given spacecraft.

40. Heliocentric Distance [km]: Distance of the spacecraft from the center of the Sun.

41. Spcrft. Long. [HEE, degrees]: Spacecraft longitude in the HEE coordinate system.

42. Spcrft. Lat. [HEE, degrees]: Spacecraft latitude in the HEE coordinate system.

43. Spcrft. Long. [HEEQ, degrees]: Spacecraft longitude in the HEEQ coordinate system.

44. Spcrft. Lat. [HEEQ, degrees]: Spacecraft latitude in the HEEQ coordinate system.

45. Spcrft. Long. [HCI, degrees]: Spacecraft longitude in the HCI coordinate system.

46. Spcrft. Lat. [HCI, degrees]: Spacecraft latitude in the HCI coordinate system.
Coordinate Systems used here:

HCI Heliocentric Inertial

HEE Heliocentric Earth Ecliptic

HEEQ Heliocentric Earth Equatorial (or HEQ)

Carrington

RTN Radial-Tangential-Normal

R is the Sun to SC vector, T = (Omega x R)/|(Omega x R)|, where omega is the Sun's spin axis (in J2000 GCI), i.e., roughly the orbital direction; N is the right-handed normal to complete the triad, essentially "north". The RN plane contains the solar rotation axis.

HERTN Heliocentric Ecliptic RTN

The RT plane is parallel to the ecliptic plane.

STEREO PLASTIC SENSOR INFLIGHT PERFORMANCE

PLASTIC is a novel sensor in that each flight unit functions like three separate instruments: a solar wind proton/alpha monitor, a solar wind composition (m, m/q) experiment, and a low energy m/q sensor for observing ions from opposite the Sun-spacecraft direction. Multi-functionality gives rise to a need for multiple geometric factors and fields-of-view within the same instrument. The first major subdivision within the instrument is based upon the in-ecliptic (azimuth) field-of-view. The region that covers the Sun-spacecraft line +/- 22.5 degrees is the Solar Wind Sector (SWS). The remaining portion is called the Wide Angle Partition (WAP). The SWS can be further subdivided into two entrance apertures (Main Channel and Small Channel) with different geometric factors. The Main channel geometric factor allows for sufficient counting statistics of heavy solar wind ions. The switch to the smaller geometric factor S-channel prevents the saturation of the electronics and controls the lifetime fluence on the MCP and SSD detectors. The S-channel is the primary channel for solar wind protons and often alphas. The PLASTIC Entrance System’s electro-static analyzer (ESA) steps through 128 logarithmically spaced energy per charge (E/Q) steps from about 80 keV/e, down to about 0.3 keV/e in a one-minute cadence. At the start of each 1-minute ESA sweep the Small channel is off, and the Main channel is open. Upon reaching a set (but commandable) count threshold, the Main channel is electrostatically closed and the S channel is enabled. Extended analysis of in-flight data indicates a major variance in the performance of the Schannel instrumental response (geometrical factor, E/Q, and polar and azimuth angular response) from expectations based upon the pre-flight testing and calibrations. The effect is attributed to insufficient fringe-field control within the aperture section of the Entrance System. The results provided here are based upon an extensive in-flight calibration of the S-channel response which has been performed by the PLASTIC team utilizing Main channel data (which is unaffected) and confirming results through cross-calibrations of early mission data with Wind SWE (courtesy K. Ogilvie and A. Lazarus) and SOHO PM

(courtesy F. Ipavich). We extend special thanks to our Wind and SOHO colleagues for the use of their data.

Modification History

Feb 2008

First issue of 1 Min data sets - BETA runs.

Aug 2008

Some changes in processing s/w. Additional Error/Caution codes added. Flow angles provided in instrument coordinates only.

Dec 2008

Issues identified for efficiencies used in low speed (< 300 km/s) conditions.

May 2009 Version 4

Flow angle and velocity components have been incorporated in both RTN and HERTN coordinate systems for STEREO A. These include compensations for s/c aberration and s/c attitude. QA flags expanded. S/C trajectory information included. Standardization of file naming convention for use by NSSDC. Identified outliers have been removed. Suspect data have been manually removed.

Jun 2009 Version 6

Contains extreme verification criteria and revised error code responses.

Dec 2009 Version 7

Updates to conversion and efficiency curves. Revisions to Maxwellian fitting procedure (using a "first guess" and changes in array of uncertainties); revisions in verification criteria (rchi^2 and "caution flag"). Purpose of changes is to reduce "data loss" in the automatic verification algorithms. Data retrieval now up to 98%.

Apr 2010 Version 8 (for B 2007)

STB EW calculations improved and incorporated into Level 2.

Oct 2010 Version 8

Updates made to conversion tables and efficiency curves. Removed initial guess from Maxwellian fitting routine (see version 7) as it seemed to introduce more problems than it solved. Error flag 8 (data removed by manual inspection) successfully implemented. Reduced chi^2 values calculated for 10-min and 1-hour averaged data sets.

Jan 2011

Algorithm for E/W angle for STA is truncating the highest positive angle beginning mid 2010. This issue is being investigated.

September 2011 Version 9 (for B)

Updates made to efficiency curves. Processing modified to include bulk solar wind protons sampled through the main channel aperture.

November 2011

Algorithm for E/W angle for STA is truncating the highest positive angle beginning mid 2010. This issue is being investigated and a new algorithm is under development. There is some additional offset in the second half of April 2011 that was not incorporated into the data. This data will be revised when the new E/W algorithm is employed.

December 2011

Files for STA for Nov. 9, Nov. 19, and Dec. 16, 2010 (doy: 313, 323, 350) and Feb. 1, 2011 (doy: 32) were replaced, without changing version number, to fix a problem with out-dated ephemeris files.

October 2012

New efficiency curves used in determination of E/W angle, to address problem in modification note November 2011.

April 2013

E/W angles for STB after 2007 now included.

August 2014

Starting on August 19, 2014, STA went into "Sidelobe 1" operations which require limited telemetry. Although we continue to get proton data, we only receive it during real-time passes, generally a few hours a day.

September 2014

From 01 Sept. 2014 14:30 UT through 08 Sept. 2014 16:00 UT the post-acceleration (PAC) and MCP voltages on STB were reduced from their nominal settings. As a result, the reported proton densities during this period are diminished and have been replaced with fill values.

September 2014

On September 26, 2014, STB was turned off for a solar conjunction test. It has not yet been recovered; so data stops at this point.

January 2015

Starting January 5, 2015, STA went into "Sidelobe 2" operations. During this time, we only receive the proton data for one collection cycle out of every three, and still only during real-time passes, generally a few hours a day.